

Excerpt of "Earth: Our Changing Planet. Proceedings of IUGG XXIV General Assembly Perugia, Italy 2007" Compiled by Lucio Ubertini, Piergiorgio Manciola, Stefano Casadei, Salvatore Grimaldi

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Organized by Perugia, Italy July 2-13, 2007 IRPI IUGGG XXIV2007 PERUGIA ITALY FRANCING PLANET OUR CHANGING PLANET

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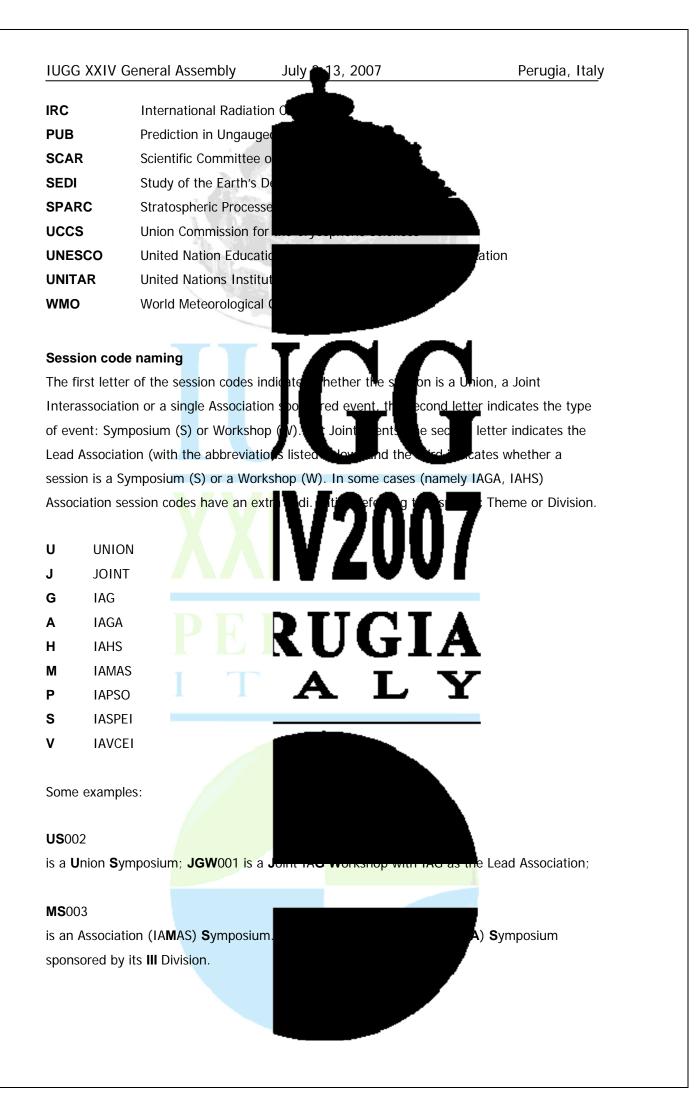
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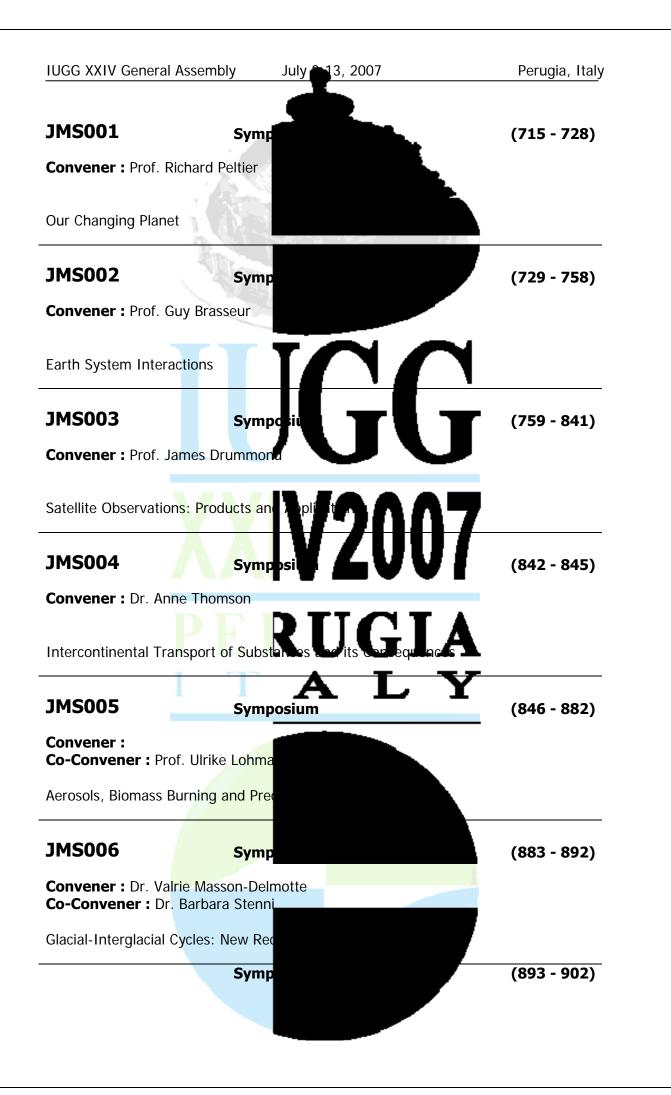
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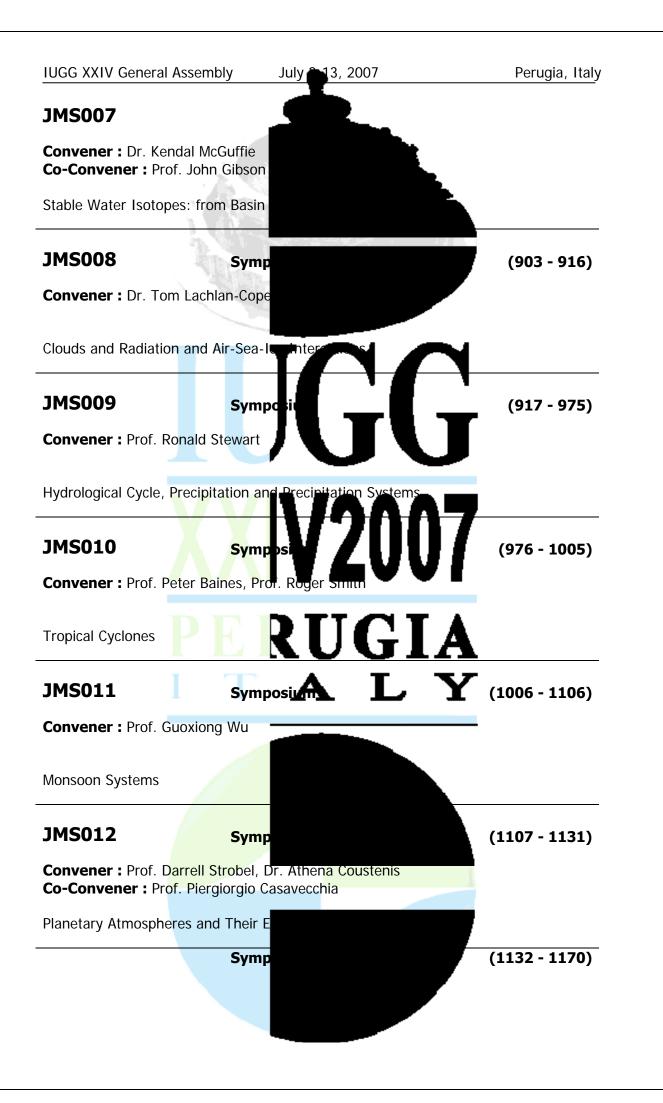
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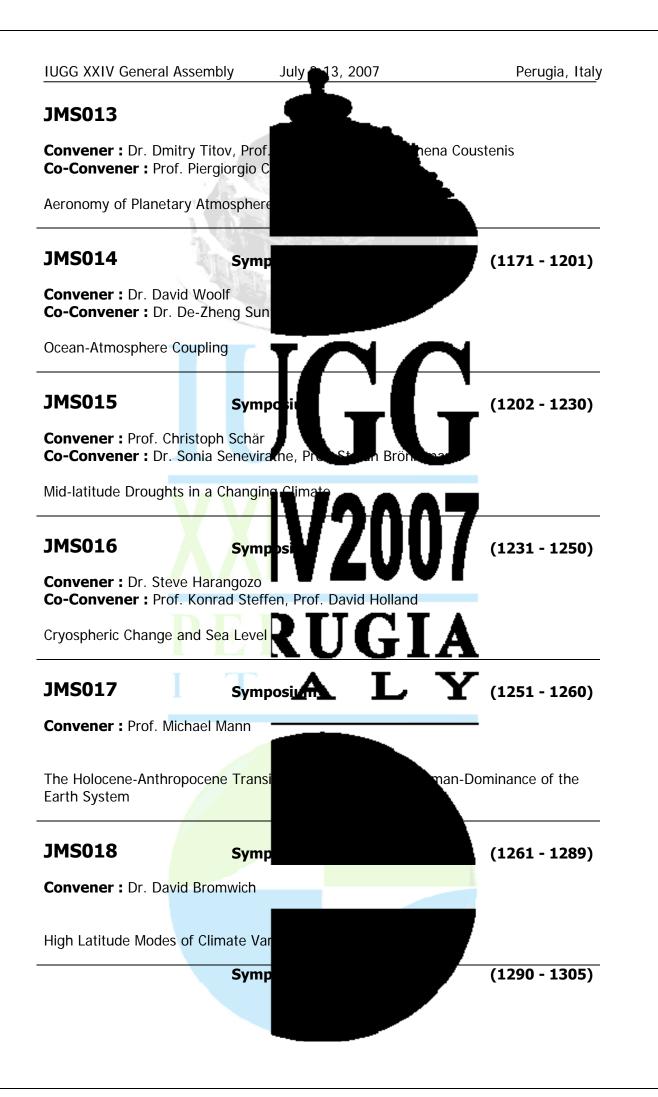
IUGG XXIV General Assembly	July 13, 2007	Perugia, I	taly
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Paola Rizzoli	Ch Pri	Committee	Usa
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Jo Ann Joselyn	Se ona Ge os, TUGG	al Union of	Usa
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Peter Suhadolc	Securiary General (ASTET Intern Association of Seismology and Pl Earth's Interior	hin pal hysics of the	Italy
Steve McNutt	Secretary-General IAVCEI Interna Association of Volcanology and C Earth's Interior		Usa
		<b>/</b>	

	neral Assembly July 13, 2007	Perugia, Italy
Abbreviations		
AG	International Association	
AGA	International Association	ronomy
AHS	International Association	
AMAS	International Association	Sciences
APSO	International Association	Oceans
ASPEI	International Association	the Earth's Interior
AVCEI	International Associati	stry of the Earth's Interior
CliC	Climate and Cryospher	
Ev-K2-CNR	Everest-K2 CNR Commune	$\sim$
GEWEX	Global Energy and Wate Experiment	
HKH-FRIEND	Hindu Kush-Himalayan Foveregimes from	ernational Experimental
	and Network Data	
ABO	International Association for the logic	ean raph
ACS	International Association of Cryospheric So	ciences
CACGP	International Commission All nemberic	Shemintry Global Pollution
CASVR	International Commiss on an amospheric	Sill equitation Relations
CCE	International Commission explorition tails	
CCL	International Commission & Clining	/VI
CCLAS	International Commission on the Coupled	Land-Atmosphere System
ССР	International Commission on yours and	ecipitation
CDM	International Commission on synamic Me	orongy 🗛
CGW	International Commission on Groundwater	
CIMOD	International Center for International Center for	ain Develop tent
СМА	International Commission on the Middle A	tmosphere
CRS	International Celestial Performance	
CSIH	International Commiss	drology
CSW	International Commiss	
СТ	International Commiss	
CWQ	International Commiss	
CWRS	International Commiss	
GAC	International Global Atmospheric Chemistr	у
GS	International Glaciological Society	
LP	International Lithosphe	
NQUA	International Union for	
	International Ocean Ne	

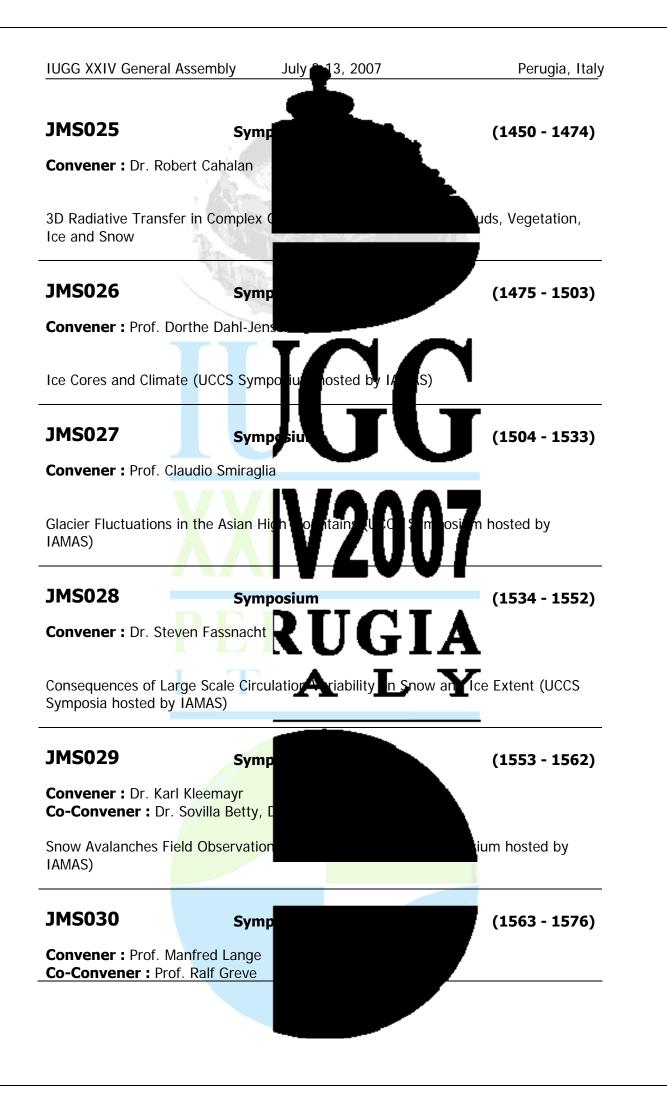
















# 13, 2007

Perugia, Italy

(M) - IAMAS - International Associa

**JMS001** 

Symposium **Our Changing Planet** 

Convener: Prof. Richard Peltier

This is a continuation of Union Symposium is dedicated to fluids and addresses gl magnetosphere), the oceans, and the hy induced global warming, the role of the o

cryospheric, etc. The second Monday afternoon is dedicated to solid Earth processes and the Earths deep interior. Topics in this area may include the anguar source mechanism, the geodetic monitoring of tectonic deformation he of the Earths core, including the dynamo pro

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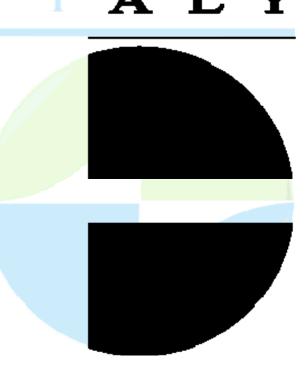
UGIA

atmosphere (including the e). Topics will include trace gas nability and change, the stability of the

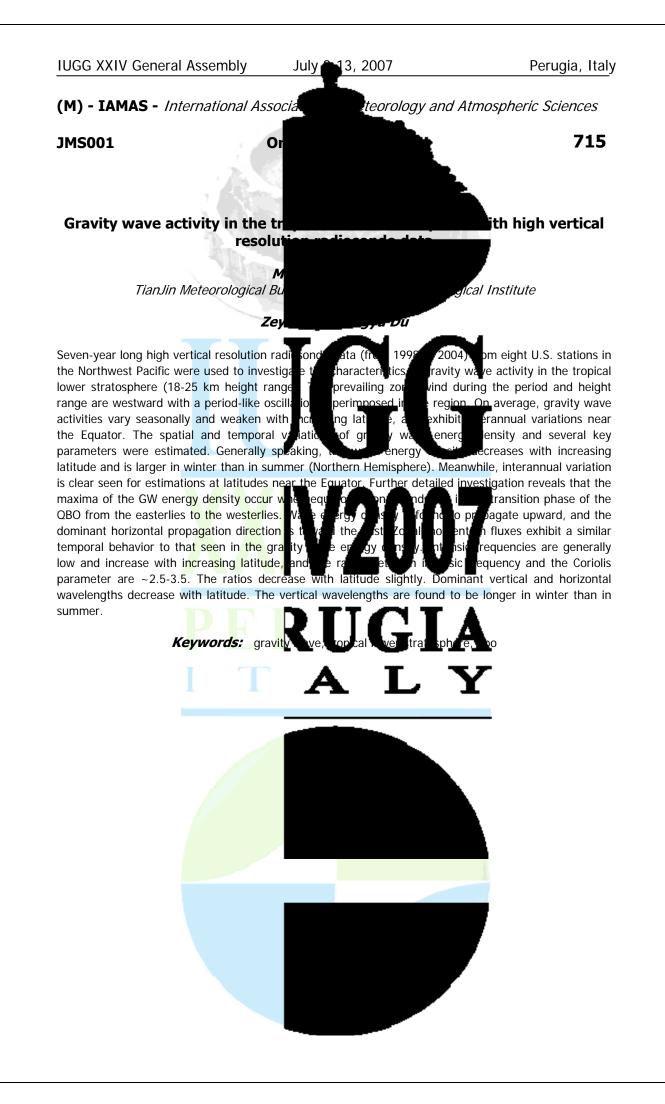
. First Monday afternoon

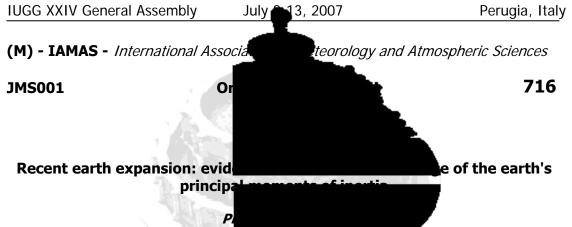
teorology and Atmospheric Sciences

process and the physics onvectio s) of field reversal



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Dept of Physics, School of Geodesy a

ly, Wuhan, China IAMAS

nce. The information of

e Earth is expanding in

spherical harmonic series outside

by a truncated series, e.g., EGM96

Whether the Earth is expanding or contraction the secular change of the Earth's gravity find s recent 10 years. The gravitational potential out the Earth. In practical applications, it could t (the Earth Gravity Model 96), EIGEN-GL04C the second order coeficients of the spherical the principal moments of inertia and espec principal moments of inertia are gradually increasi

expansion could not be attributed to the rise of the sea water, which has too week influence on the observed variation of the moments of iner process in the interior of the Earth or at le Earth is expanding at the rate 0.3 to 0.6 r large number postulate, it could be concl de continuously in a long geological history.

∎is ap ng probl oncl irts e expres ed ximately real ne Ea<u>rth's pri</u>r nic seri Šas lly tem va st the

Keywords: earth, expansion

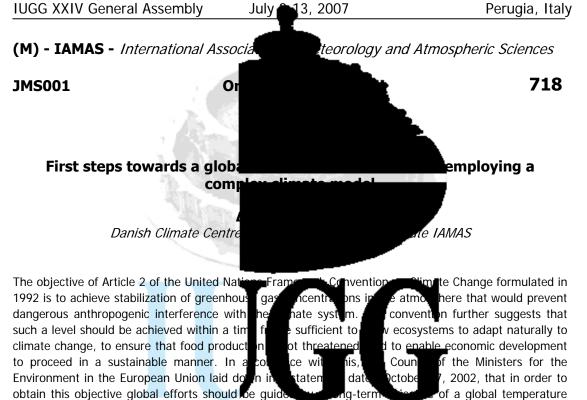
moments of inertia are related to s well as EIGEN-GL04C, n EGN ons ar etermined. All the three clearly demonstrates that the Earth is expanding at least in recent 10 years. Calculations show that the

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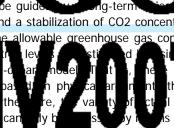
and will have happened

in recent 10 years. This e expansion is a whole culations show that the king into account Dirac's





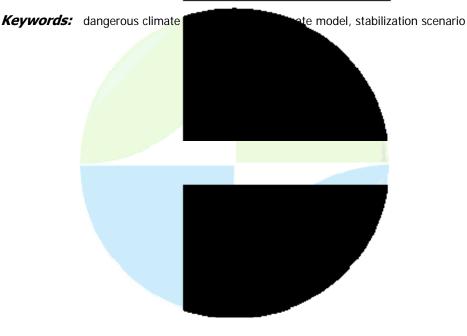
increase of 2 C over pre-industrial levels and a stabilization of CO2 concentrations below 550 ppm.. In this study, which is the first of its kind, the allowable greenhouse gas concentrations for keeping the future warming at 2 C relative to pre-indu the ECHAM5/MPI-OM coupled atmospher greenhouse gas concentrations are more from simplified energy balance models. Fu with this so-called 2 C-stabilization scenaric This is, however, necessary in order to evaluate how strongly the EU-target affects various aspects of

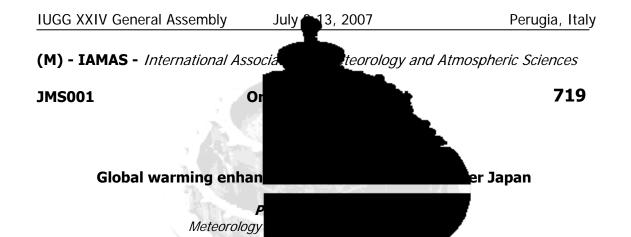


of a global temperature

omplex climate model, hates of the allowable the estimated obtained natic changes associated a complex climate model. climate and how big an improvement this means relative to stronger emission scenarios. In addition to

the allowable greenhouse gas concentra bgenia aerosol load and ozone levels are considered. In this study also the with the 2 C- stabilization ociat scenario are assessed in further detail, con mg and oceanic variables oro ogi var such as temperature, precipitation, sea-ice conditions, sea-level pressure, winds etc. These changes are compared to the respective changes in a marker ire climate Wut 3.5 C with respect to warmer fu pre-industrial times), following the SRES A1B propo the IP Also, the impact of the anthropogenic aerosol load and ozone levels on the climatic changes is investigated.





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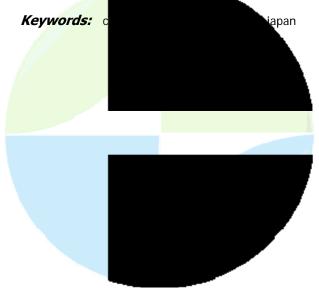
When the low temperature anomaly app temperature anomalies were frequently se noticed by the longrange weather forecas Cooler North Warmer West. We analyzed the part and the northern part of Japan islands islands is increasing in spite of cold and hot part of Japan has a tendency to be cooler th in monthly mean surface temperature in ev The summer 2004 was a hot summer; however the

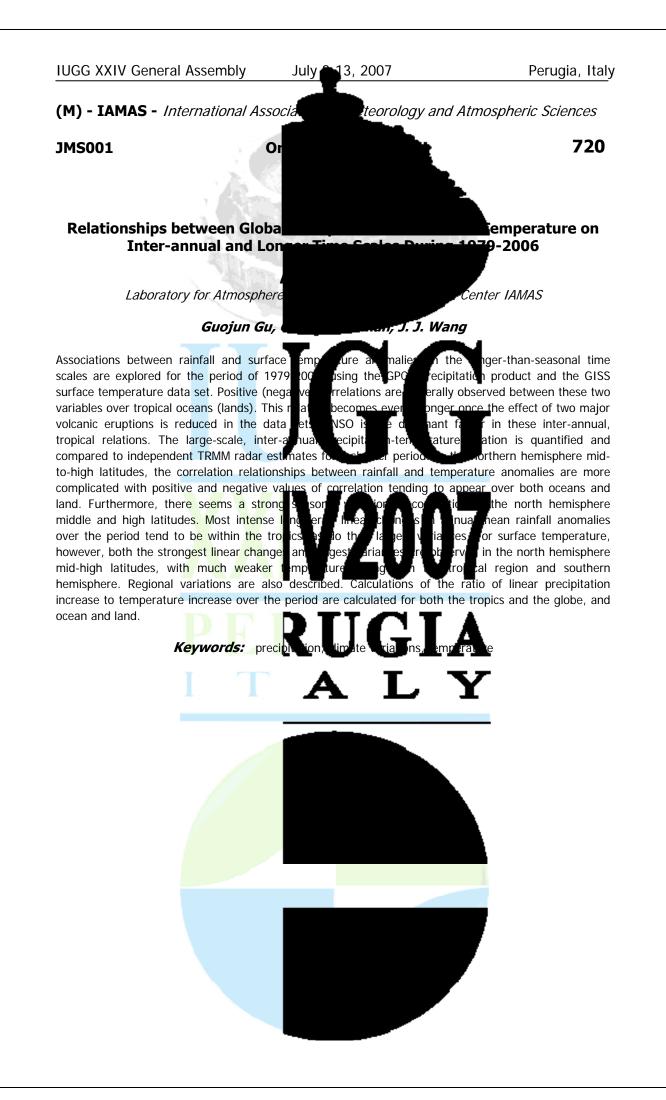
parts of Japan in mid August, which brought Cooler North Warmer West. The anomalous cool summer took place in July and August 2003, and the large negative temperature anomalies are seen. The distribution of anomalies are not uniform than in the western part of Japan; as a res normals. In this way the temperature grad than normals in the twenty-first century. over Japan (LTGJ). Such a feature can b in August from 1990 to 1999 by ERA40 data made by ECMWF. We calculated the anomaly of monthly

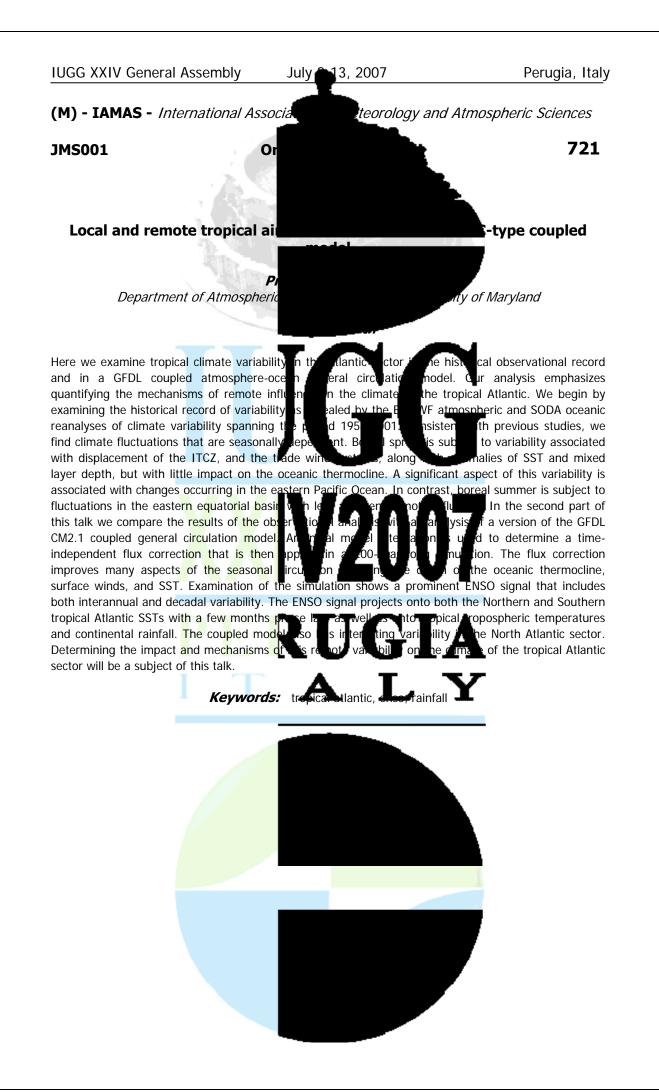
ver the northern part of Japan, warm stern part an This phenomenon was n Me Agency) and named as A (Ja blogið temperature between the western nce of surface nd that the r temperature gradient over Japan rs. T<u>hat is to</u> the temperature over the northern an. St ohenomena can be seen err y and just from 2001 to 2004. Ce to northern and eastern ass W

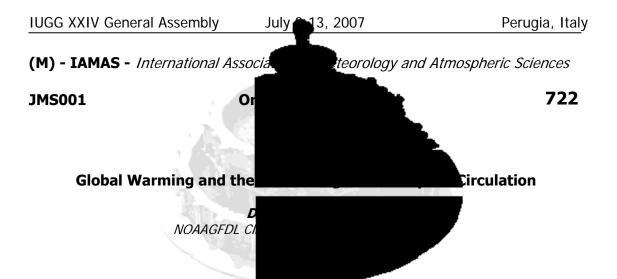
r in the northern part an islands is larger than ugust tends to be larger e Temperature Gradient air temperature anomaly

mean index of LTGJ and compare with the global mean surface air temperature over land in July analyzed by JMA. The IPCC report (2001) bal warming started from 1976 when the recent cool summers in the northe . The rrelation coefficients are calculated ; the value is 0.26 for the last om 1976 to 2006 when οQ ŧ٦ vea hsee the effect of global warming increased. The value of the correlation coefficients from 1894 to 1975 was ip twenty-first century negative (-0.07) when the effect of global ward ng was no clear. Then, all. This indicates that the (2001-2006), the value reached to 0.67, althour a the samplin rod was s recent increase of LTGJ is associated with global warming, and therefore LTGJ in July and August becomes to be highly correlated with the global mean temperature over land. Conversely, Japan islands are said to be located in the place where the Luences strongly.









We explore the impact of CO2-induced reduction in ; resulting from global energetic constraints, circulation. We examine the projected 21st ( climate model experiments performed for th strength of the atmospheric overturning c weakens in a manner consistent with s preferentially in the zonally-asymmetric (i.e of the tropical circulation, and results in a weakening

These wind changes induce substantial changes to the thermal structure and circulation of the tropical oceans. Although many aspects of the model changes in both the atmospheric and ocean circulation resemble El Nio-like conditions, the mecha reproduced in both mixed-layer and full mechanisms and structure differ from E strengthening of tropical Atlantic vertical seen in the consensus of models presente the tropical circulation since the 19th Century.

ensity of la the fic at Sical response of th hnt AR4. In all m n de<u>creases</u> nermo mi ) rath nan equat

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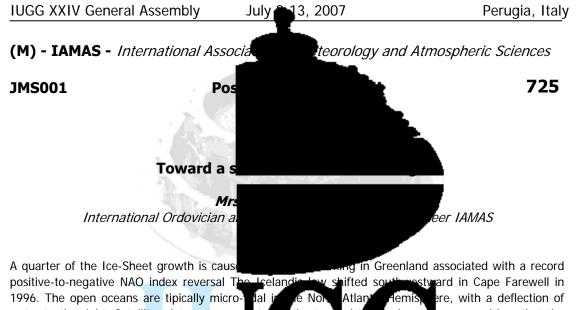
ale atmospheric circulation, nd oceanic structure and pheri opical circulation using a set of 22 s there is a robust decrease in the he climate warms; the circulation The weakening occurs i.e., Hadley) component ies in the Pacific Ocean.

> hose of El Nio and are dels. Even though the ections (in particular a ed with El Nio. Changes ntly detected changes in









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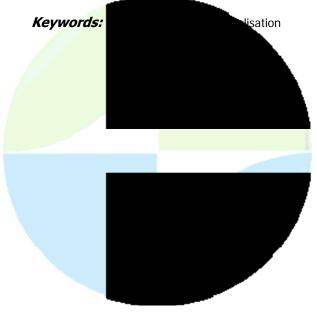
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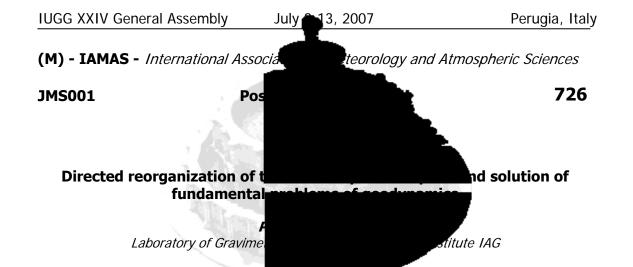
water to the right. Satellites data sets suge the tropcal surface which would correspond to an incre apse rate. Th by internal variability mode, the gyre index i ated <u>with th</u>e to a hurricanes growth over the last decad effed since 1900 (32 seconds since 1958) in ato s acc rotation of the Earth may be significant at high lath last decadal increase of the hurricanes observed in the Northern Hemisphere. Some centimeters per year, only 3.82 cm per year but the days length have slightly changed over the Cambrian, is the rate at which the Moon is currently retreating slov minus UTC Time was 12 seconds. The curr enough to detect rotational changes caus femtosecond accuracy. The preliminary st die Sumatra Earthquake show a bilateral ruptu function of 210 sec duration and a total s calar rotation, decreased the lenght of day by 2.68 microseconds, slightly changed the shape of the planet bulging the equator and shifted the north longitude. The magnetic crustal thickness h the subduction zone, the Earth inner core ota

sphere has warmed less that the nate system is strongly influenced ing Sea Surface high mode related acceleration introduced seco e cor acceleration due to the lection of water and the

ar 1996, the GPS time hiques are not sensitive hitude 8 at present GPS magnitude 9 ,Northern th a complex source time eismic moment of 7.25x10 21 Nm. It affected Earth's

e direction of 145 degrees East nd n east, in the direction of he d crust at about 0.3 to 'nā Tthe naŋ 0.5 per year increasing or decreasing the earth magnetic field when each leap second is added and increasing the continental drift, the ephemeris seconds introd 67 for the irregularities in ed before the spin rate of the earth of about 60 millisecords ( er the ve required or year averages The Moon which is rotating with the Earth would evolved at a standard distance, the present one, with even a quarter of the uncertainty introduce in the Time set to Universal Time and Earth Time.





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Problems of secular changes of rotation of before last century (approximately 150 year repeatedly and caused rough scientific dis coefficients has arisen rather recently - about interpretations, at times rather inconsistent. purpose to understand possible mechanism times improbable. In the report the solution geodynamics is offered. The problems about secula

of axial rotation of the Earth, about secular variations of coefficients of the basic zonal harmonics of geopotential have been studied from general positions and on the basis of one general mechanism of planetary redistribution of masses of the the Earth (oceanic, atmospheric and fluid dynamic basis is the translational drift of with velocity of 12.7 mm/yr in the direct directed slow redistribution of atmospheri from a southern hemisphere in northern hemisphere. For an explanation of the mentioned secular

variations here it is used the point asymmetric inversion model of secular redistribution of masses of the Earth, set by geocentric axis OP (Barkin, Z with masses m2 and m1, located on the Ea in southern hemispheres. Masses are change and 0.043x10 (15) kg /yr. On our geodynamical model to secular drift of a geocenter there corresponds the identical drift of the Earth core relatively to the elastic mentle in same of thern direction (Barkin, 1995, 2001, 2002). The gravitational attraction of secular (asymmetric) redistribution of atmospheric and oceanic masses from the southern hemisphere

displacement of the centre of mass of the with velocity about 6 mm/yr (Gayazov, 20 secular variations of coefficients of the s velocities of their changes have been cald dS21=1.155, dC22 =-0.095, dS22 =-0.052 the basic zonal harmonics of geopotential 0.4), dJ3 = -1.51 (-1.3 + /-0.5), dJ4 = -1.70.8). The values obtained on the data of

isen for astrometrists in have been undertaken solu secular changes of geopotential ve already caused many different efforts of various experts with the rth were undertaken at of the n of t undamental problems of out non-tidal acceleration

> tribution of masses of mental phenomena. Its y to deformable mantle P) 70 N, 104.3 E and a in the specified direction

m of two material points

prdingly, in northern and s: 0.179x10 (15) kg/yr

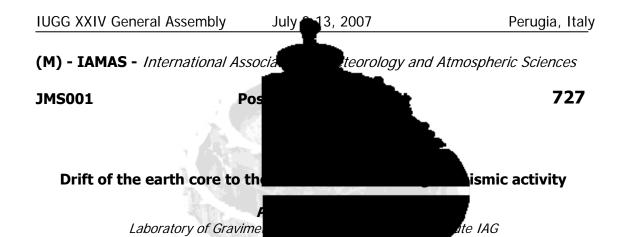
asses of dis aced core results to slow to the northern. Data of the space geodesy studies confirm the predicted direction of secular point with coordinates 72.7 N, 115.4 E iven model analytical formulas for ntial have been obtained and dJ2 = -3.06, dC21 = -0.294, changes of coefficients of ): dJ2 = -3.06 (-3.07 +/-)0.7), dJ8=0.94 (1.1 +/ed in brackets (Cheng,

Shum, Tapley, 1997). At last settlement values of non-tidal acceleration of diurnal rotation of the Earth and the components of velocity of the pole drift (divided on the value of angular velocity of the Earth) have been determined on the base of analytical solution of equations of rotational motion of the weakly

deformable body (Barkin, 2000). In units Morrison, 1995) and for a component of s (1548). Observable values of components Stephenson, F.R. and Morrison, L.V. (1995 1990", Phil. Trans. R. Soc. Lond., A, 351,

9 +/-1.7, Stephenson, 888 (395), dq/w =-1505 hdrak, 1999). Referenses th's rotation: 700 BC to AD ak J. (1999) Astrometric and

IUGG XXIV General Assembly	July 13, 2007	Perugia, Italy
space-geodetic observations of polar wand 2085. Barkin, Yu.V. (2001) Explanation a geopotential, force of gravity and geocent 2001". Astronomy and geodesy in new r Publisher "DAS", pp. 73-79. Cheng M.R., periodic changes in the Earth's gravity Geophysical research, V. 102, No. B10. p geopotential coefficients from SLR data of "Astrometry, Geodynamics and Solar Sy Journees 2003 (September 22-25, 2003, S	stem Dynamics: from milliarcse	L900422, Vol. 26, No. 14, p. ations of the Earth rotation, anal Conference "AstroKazan- 01), Kazan State University: 997) Determination of long- g observations. Journal of Nariations of C21, S21 atternational conference conds to microarcseconds". pp. 193-202.
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Gravitational influence of the Moon, the S Earth forces them to make small translational oscillation Barkin, Vilke, 2004). The basic interacting st

of geodetic, gravimetry and geophysical obs outer core and its translational oscillations mantle of the Earth (Barkin, 1995; Barkin phenomena were predicted on the basis of Pole, the slow expansion of southern and q hpi a gravity etc.). Displacements of the core are acc

variations of its tension states contrast in opposite hemispheres. They in turn find reflection in variations of seismic, volcanic and, generally speaking, in variations of all\_planetary processes. The displacement of the core in northern direction results hemisphere and to reduction of their ad relatively to elastic mantle should result in mantle. The specified phenomenon is show their temporal variations (in annual, dec earthquakes are mainly located at subduction zones (in northern hemisphere) and much more poorly are shown in spreading zones and other areas. It means, that at displacement of the core in northern direction the seismicity in northern hemisp

confirm the seismic data. This tendency w relatively to elastic mantle. Unfortunately, is concerns thall at a ophic menomena on the Earth, including heavy climatic changes which the nearest decades will accrue. The data of observations relatively to elastic mantle. Unfortunately should confirm the phenomenon of slow increase of seismic activity in a decrease (but with smaller rate) in southern he isphere. bis phenom essence of developed geodynamic model. The phenomenon of cyclic inversion of displays of seismicity

Earth with interannual, decadal and other seismic activity of the Pacific belt and of Observed phenomenon of mirror - symmet earthquakes for northern and southern h catalogue of National information centre considered geodynamical model. Last phe northern hemisphere, when in a souther 1994). The developed geodynamical mo

Earth. The modern data nd m e of t y of the henomena of drift of the s testify to a wide spectry of frequencies relatively to elastic 2004: Barkir uanggen, 2006). Some observed odel ( of the core to the North , non-tidal variations of misph her tions of the mantle and v elas

nal bodies on non-spherical shells of the

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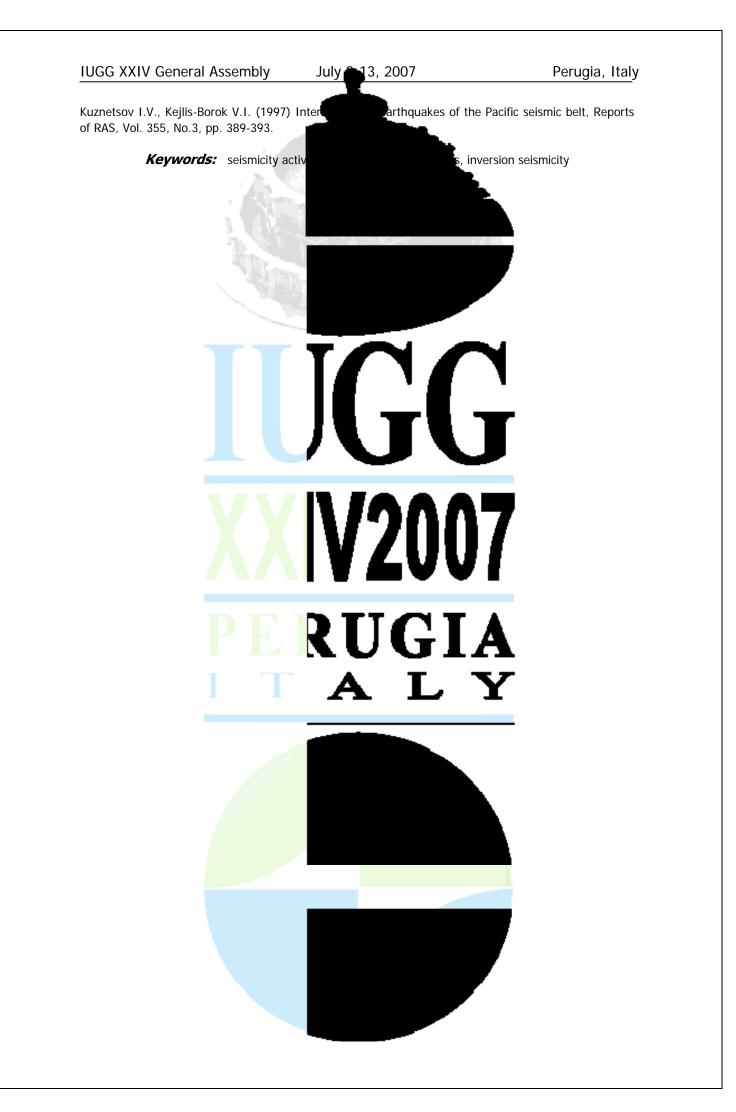
phenome on directly follows from in opposite hemispheres should be observed at oscillations of system "the core- elastic mantle" of the non of inversion of decade variations of ity (Kusnezov, Keilis-Borok, 1997). ent) of variations of number of sult of data processing the explained on the base of recession of activity in ntrary (Gorkavyj et al., mena of migration of

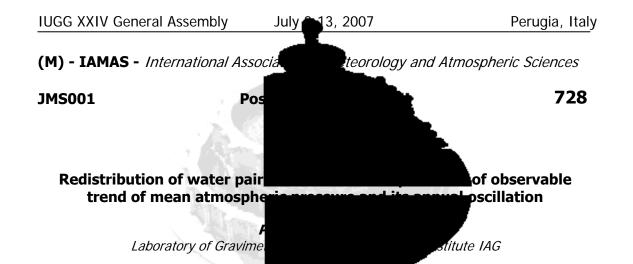
male of all planet increases, that

seismicity, the periods of recession of planetary seismicity, the existence and location of global planetary seismic belts and other regularities. References Barkin, Yu.V. (2002) Explanation of endogenous activity of planets and satellites and its cyclicity. Izvestia cekzii nauk o Zemle. Rus. Acad. of

Nat. Sciences, Issue 9, December 2002 Shuanggen, J. (2006) Kinematics and dy (Vienna, Austria, 2-7 April 2006). Geoph 01680. Gorkavyj N.N., Levitskii L.S., Tajd revealing three component in seismic a

an. Barkin, Yu.V. and EGU General Assembly 8, abstract # EGU06-Aidman A.M. (1994) About the Earth, No.10, p. 23.





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The graph of change of mean atmospheric decrease, its annual variation, and also in gran period with 1979 on 2005 the mean pressu of its annual variation in the specified perio decrease of amplitude of annual fluctuation our geodynamic model in northern and so mean pressure of atmosphere should be ob should accrue, and in a southern hemisphere on th

of atmosphere in N-S hemispheres vary in an antiphase with annual, semi-annual and others periods which were predicted by the theory (Barkin, 2002), atmosphere (and in their canhges) in the dynamic reason of the mentioned redistrib the forced relative swing of system of the external celestial bodies causes secular an The gravitational attraction of superfluou atmosphere and causes the observable redistribution of air masses between N-S hemispheres. On

preliminary estimations the velocity of slow changes of mean pressure of atmosphere in N and S hemispheres can make 0.17-0.22 mb/yr data over the period April 2002 - Apri atmospheric pressure in hemispheres make variations and inversion redistributed masses have been predicted on the base of geodynamic model (Barkin, 2002). Also similar variations of atmospheric masses, for example, with the periods have been predicted (in days): 2403; 592; 515; 365; 172; 22 27.4; 19.4. According to the developed model in variations of mean atmospheric pressure of

hours): 24.00; 12.00; 8.00; 6.00; 4.80; 4.0 remark that variations of the atmospheric every from meteorological stations. Burluz both hemispheres remains practically cons inversion and asymmetric style. The data pair in atmosphere with velocity about ( Approximately with the same velocity 0 specified period was varied (Salstein, 2005

water pair. References Barkin Yu.V. (2002 and its cyclicity. Izvestia cekzii nauk o Zem VINITI, pp. 45-97. In Russian. Burluzkii R.I the ground pressure. Materials of Sagito (www.sai.msu.ru).

rather clear trend in its alstein, 2005). For the ation 0.021 h a/yr, and the amplitude 0.25 hPa. And rather monotonous hPa/vr is observed. According to hon of inversion of the phend press in northern hemisphere sides the mean pressure

Thus the certain asymmetry in masses of e observed. The basic action of mechanism of ravitational attraction of latively to elastic mantle. netary inversion tides in

variation of the mean

ntiphase. The specified

4; 50.4; 40.4; 38.1; 30.5;

y (Barluzkii, 2007; observation

hemispheres and all the Earth will be revealed also short-periodic variations with the hour periods (in 41 (Barkin, 2002; 2005). It is worth to hour periods will be observed on lump of a dry atmosphere in n these hemispheres vary in ease of full mass of water ne data for 1979-2005). pheric pressure for the nt of experimental data

about variations of mass of water pair in atmosphere and the mean atmospheric pressure again is observed. Thus, we come to a conclusion: observable variations of mean atmospheric pressure of the Earth (trend and various cyclic variations) are caused by processes of condensation and evaporation of

> of planets and satellites 9, December 2002, M.: concentration of pair on uary 2007). GAISH, MSU



### **IUGG XXIV General Assembly**

#### July 13, 2007

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Perugia, Italy

(M) - IAMAS - International Associa

### **JMS002**

## Symposium **Earth System Interactions**

Convener: Prof. Guy Brasseur

This symposium is a continuation of U Contributions are expected on cutting ed system and the interactions among its cor future. Situations of particular interest in

led to glacial cycling, and that prevailed present

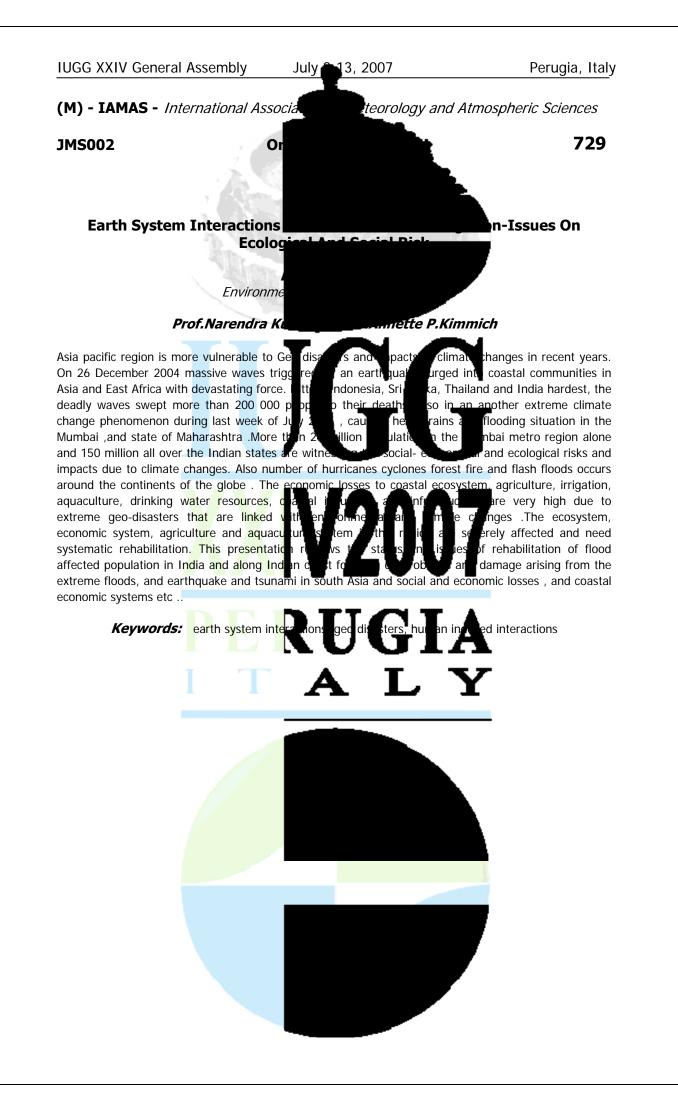
teorology and Atmospheric Sciences

729 - 758

ses contributed papers. observations of the Earth if, and projected to occur in the nd processes affecting the interactions among the atmosphere, oceans, ice and land. Also welcome are contributions addressing human-induced changes that alter climate, contributed to the apparent stability of the pre-industrial climate and ast clim were warmer than at ic tions th

**V2007** 

UGIA



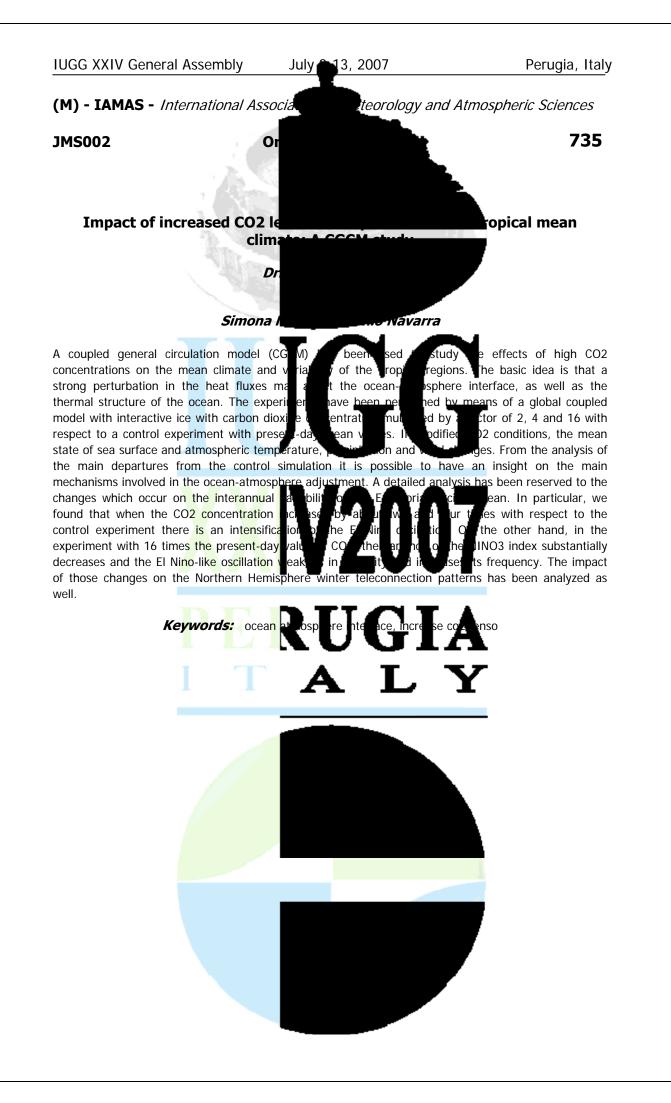


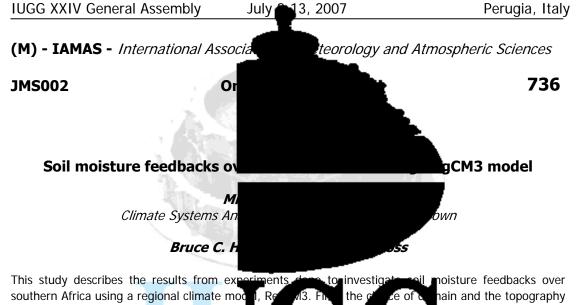












southern Africa using a regional climate moc I, Re overlaid with the landuse classification is pre modeling follows. Changes to the parameeric highlighted. Caveats regarding the observations response of the model to changes in soil mostu which show how the surface energy and mostul feedbacks is explained as part of a general dis

ents done to investigat equals. Find the conc red. A discrimination ins and fine-toning analysis data m s descrimination was udget inget he discussion and pan

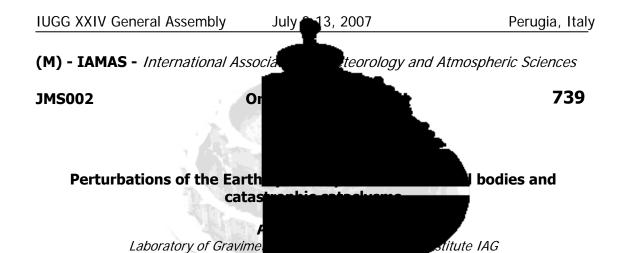
ato for hain and the topography of the experimental set-up for g of the convection scheme are model physics are discussed. The various odel surface parameters, he base heory of the highlighted plan atoms of southern Africa

especially in Zimbabwe are highlighted where these feedbacks are potentially important to the local climate.









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processes: the large earthquakes, eruptions of volcano's and other ecological catastrophes, the large

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The Earth shells are subject to intensive celestial bodies. As individual celestial bo physical properties) they are exposed to external influences on "system the Earth" of Sun and planets and have cyclic characte actions of the shells against each other res mantle and lithosphere, the outer core of oceanic and, in general, fluid masses between the

resulting in cyclic variations of all planetary geodynamic and geophysical processes, including seismic processes. In the report the possible correlations of geodynamic and geophysical processes with particularities of orbital motions of the Mo certain relations between variations in displacements of a geocenter with activiza are revealed. By analytical and numerical me characteristics: the elastic energy dW of relative displacements and the swing of the Earth shells (its core and mantle) under an attraction of the

Moon and the Sun; a tidal component of variation of angular velocity of the Earth dw/w; variations of coordinates of the Earth pole dp/w and d forces of inertia for lithosphere as a whole the Earth) have been studied. The spectral and L is fulfilled, dates of their extreme values (local minima and maxima) Tm for the various periods of time, including the last and current centuries hav been determined. In resource important correlations of dates Tm with dates of natural cataclysms and

(revolutionary) shocks in biosphere and in <u>a society</u> (demography processes). In many resulted examples of dates Tm and Tc are situat earthquakes with M> 8 the dates of the corresponding to them dates Tm (for elast one-two years. On this basis, dates Tm o (Barkin et al., 2006) with M>8 have been their exact description also are correlated shown, that positions of the seismic belts global rotation of the lithosphere. Even de

the part of all external ous and with different omog turns and deformations. These ns and motions of the Moon, the ous <u>time scales</u>. Naturally forced s of all layers of elastic ision 3 al red butions of atmospheric, d it will be inevitable for

> och are discussed. The notion of its pole, in eir catastrophic displays of the following dynamic function dU, determining

ed by diurnal rotation of

istics dW, dU, dw/w, Q

ave been established for

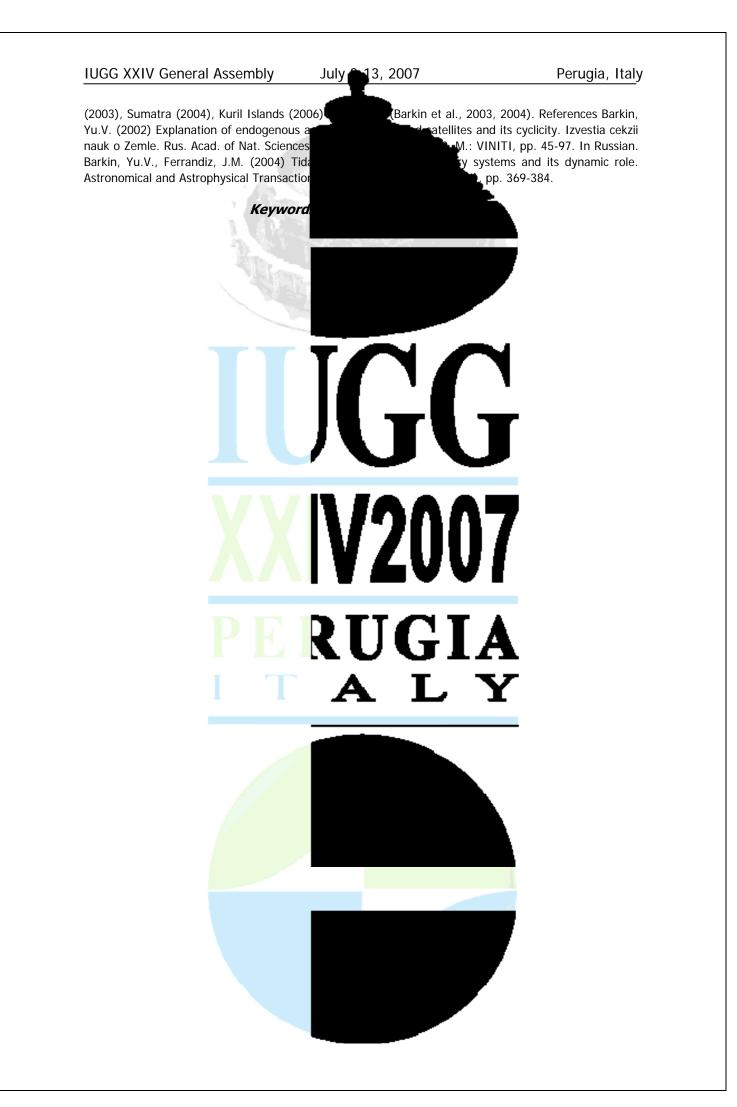
ector **D** and main moment L of

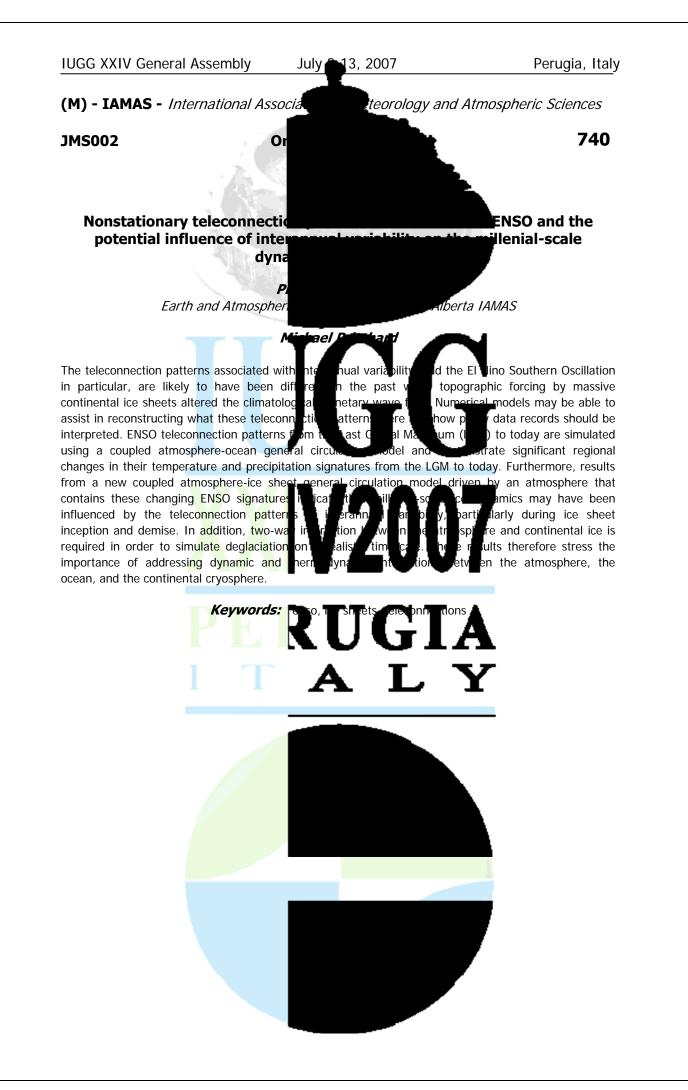
to each other. So practically for all entury (their number is 23) and ated in intervals of time about eismic events in 21 century tories of the Earth pole at V, dU and dw/w. It was ted with parameters of Russia of 20th century)

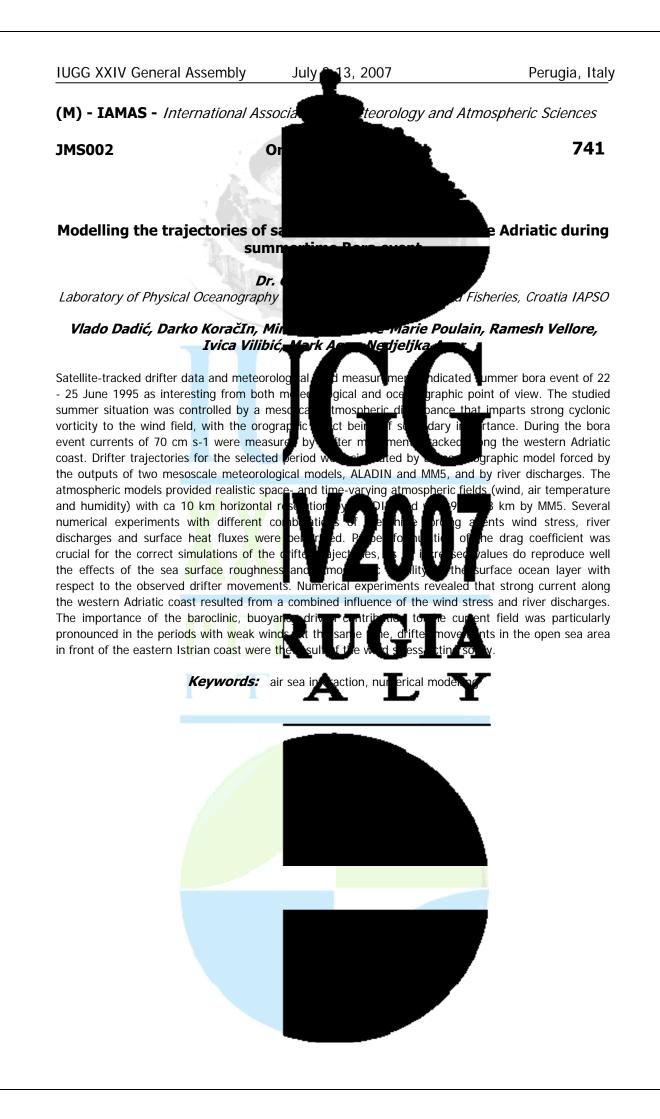
observe precise correlations with extreme states of the tension states of the Earth (dW). Thus, despite of the complex structure of a planet the Earth and "concealing and covering" dynamic reorganization of terrestrial masses (for example, motion of plates, climatic changes), in all planetary processes occurring

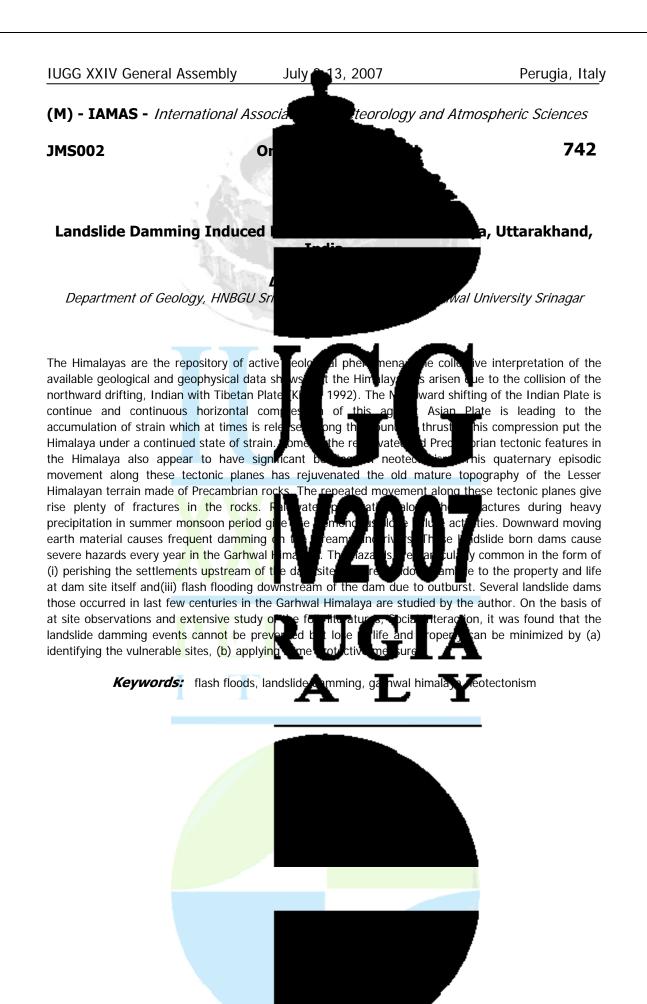
in its shells, including an atmosphere an shown cyclic gravitational influences of ext relations of discussed processes are mech the forced swing and deformations of sh developed approach the dates of largest e

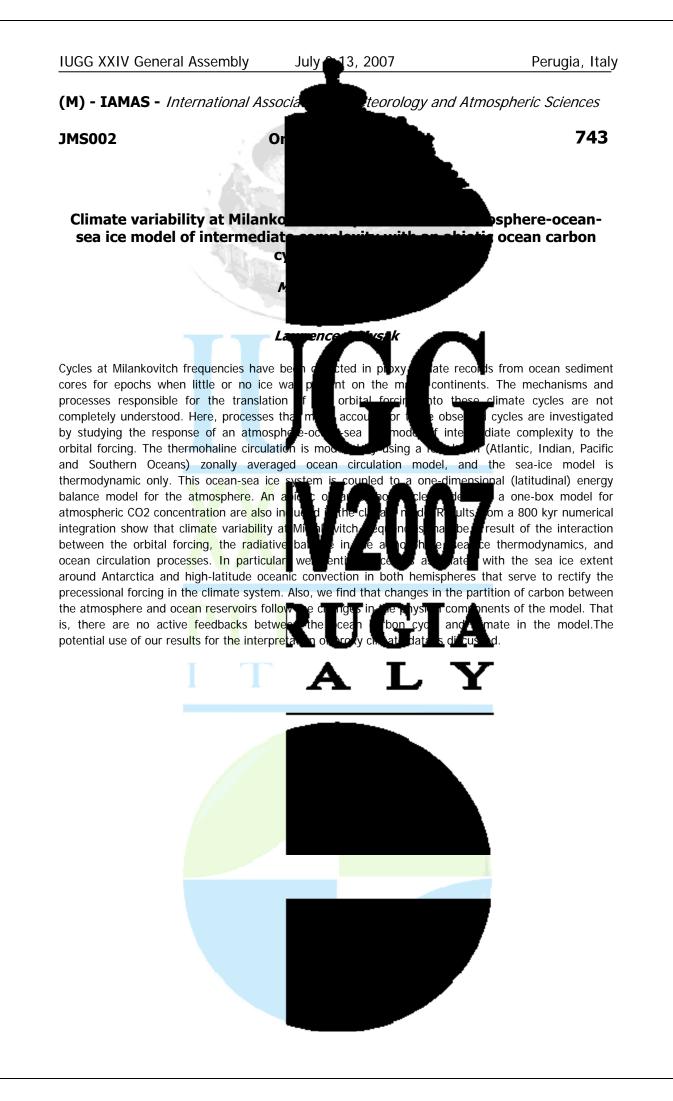
ated and are precisely mechanisms of dynamic system from outside of: des. On the basis of the ve been predicted: Hokkaido

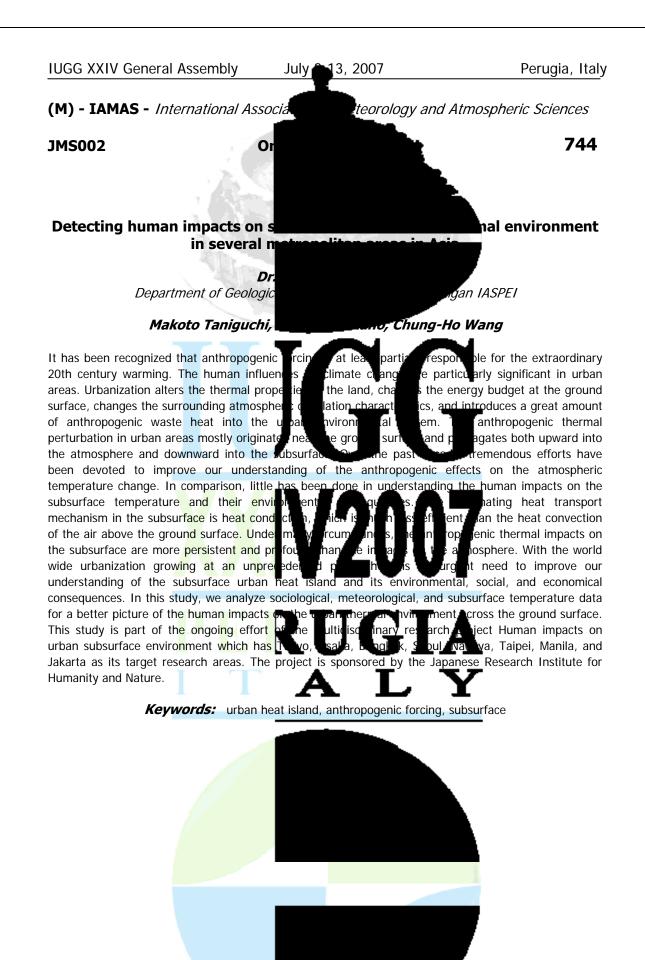


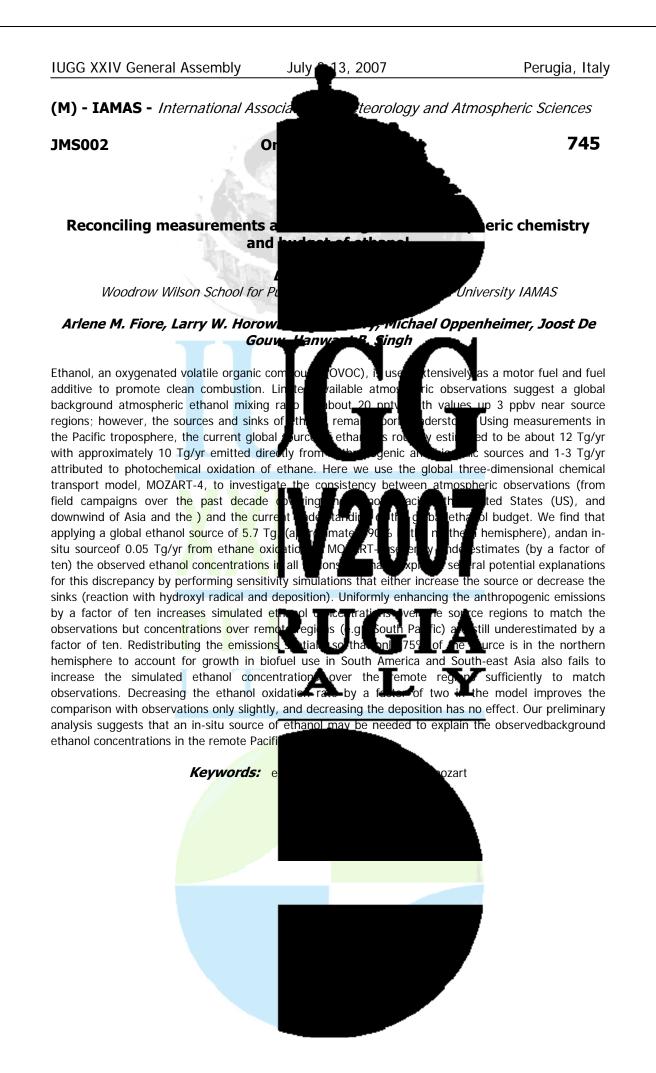


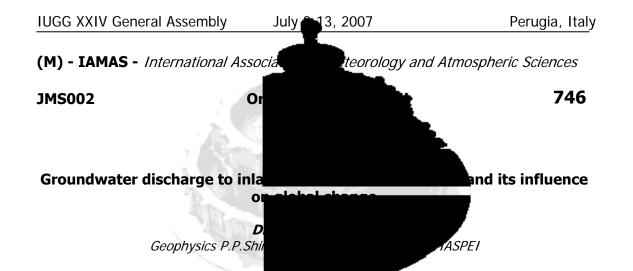












Globally, submarine groundwater dischare freshwater flux but, regionally, for some inland a estimated to be much higher. In the Med estimated to contribute 75 % of the fr groundwater discharge (SGD) includes not recirculated through the sediments by the c of freshwater to the coastal zone and it Because it is also responsible for limiting faltwate

the reliability and extent of potable water supplies. SGD often makes a disproportionately large contribution to the flux of dissolved pollutants. In addition, the SGD drives the recirculation of seawater, which can influence coastal water quality resting grounds. Its influence in the coast limits on development. SGD in some regi conventions on pollution source controls. problems arise where SGD is carrying pollitan waters. Pollutant input via SGD has been the cause of eutrophication of, for example, in the Aral Sea (Kontar et al, 2003). The effect of SGD in supplying dissolved constituents or, perhaps, in merely

as be ated to hor hn, karst er input. It fro eshwater. ater di rq sub ial into th

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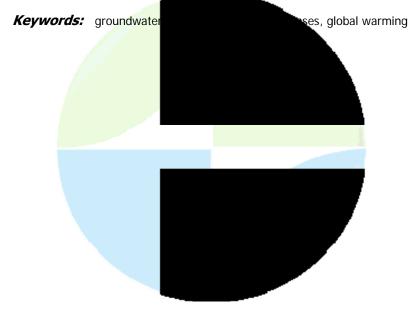
spall percent of the total undwater flux has been s the es 60 % of the shoreline and is be recognized that submarine e land but also seawater that is the principal component D can of fre vater from arid regions. ts nature can determine

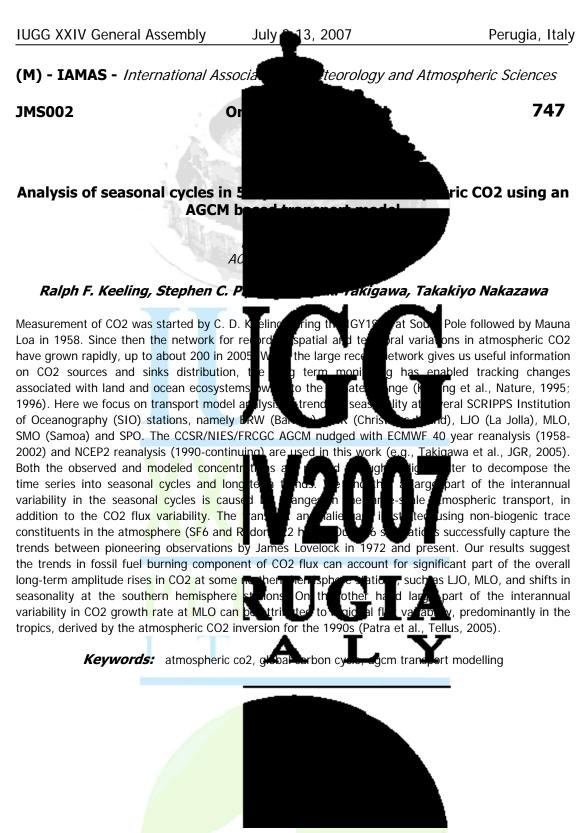
> ds, and breeding and e planning and present international or regional ome of the most serious nd into restricted coastal

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angal booms. The distribution of reducing salinity has been implicated in t SGD can also affect benthic habitats. Eelc and opportunistic growth of reduce micro alga increased. In some places, low s abitats on the sea floor pity s co oviq sp∉tiai especially for fishery stock. Or the seepage of groundwater may actually produce changes in morphology or substrates that serve as microhabets. Very rand seepage destabilize sediments on the sea floor or at the coastline by sapping. rough se ts with high organic content can accelerate the release of methane into the overlying water. Locally, SGD could lead to hypoxia in the open water and, globally, it would contribute to the greenhouse gases causing global warming.

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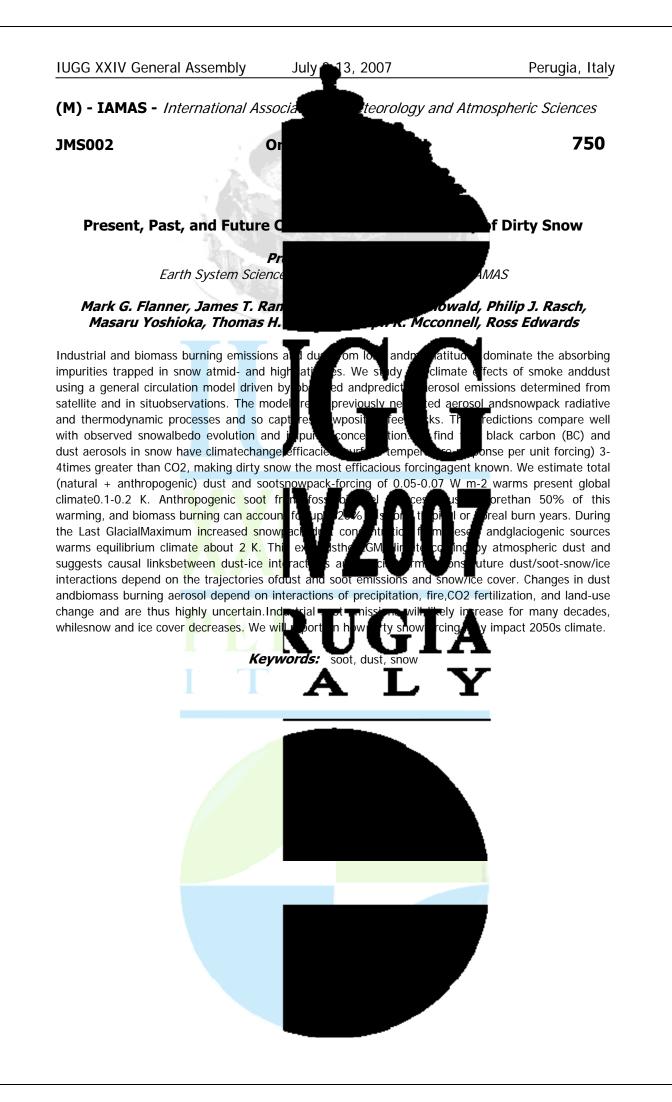


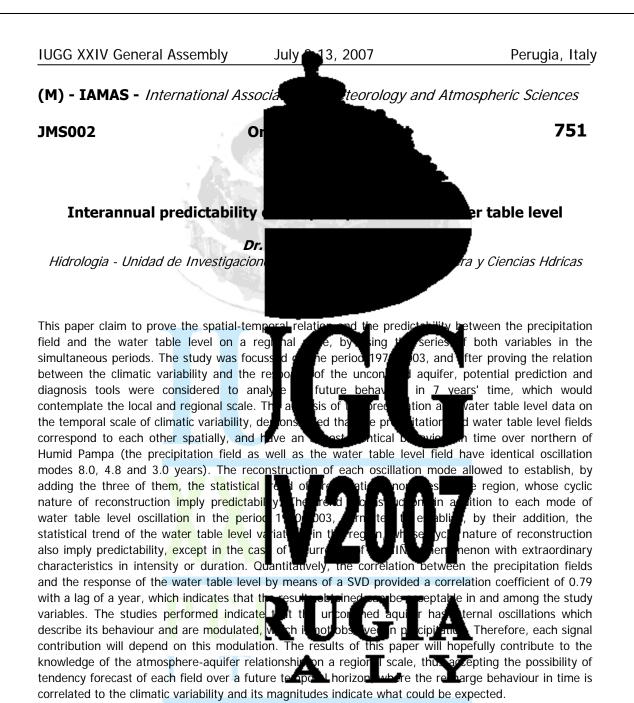


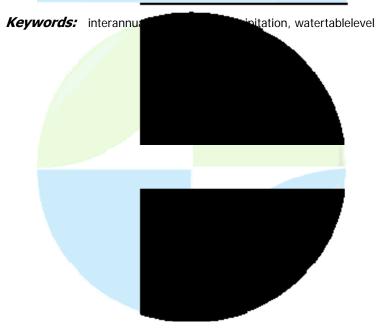


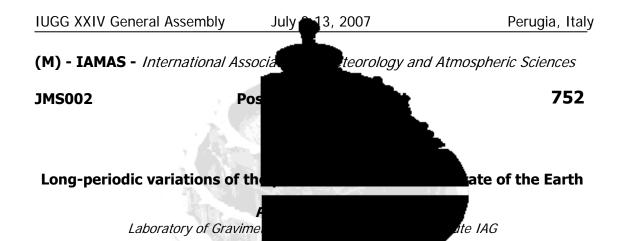












period (Tch) and phase (PHch) of Chandler perturbed tion of the p (Barkin, 2000). The mechanism of the forced reof t ie sw bodies was put in a basis of study. The actic mechanism simple model of eccentric core of the Earth d in direction of equations of the rotation of a weakly de le b<u>ody in A</u>r study. It was shown, that amplitudes of ns of an Chandler (for concrete epoch) are connected certai alyt carried out for observable values of parameters ( iO .(0 appropriate variations of products of inertia of the Earth with the period about 425 days (close to period of free pole motion of deformable Earth) were determined. Thus the basic observable 40 years variation of amplitude and period of Chandler ha variations of movement of the pole (Barki the Moon, the Sun and planets on the sys state of the Earth and to deformations of he inertia and to perturbations of the pole. The mechanism of the swing of shells is real we have the right to expect, that a variations of the tension state of the Earth, for example, of elastic energy of the mantle, should correlate with variations of Chandler motion. The executed analysis has rotation of the Earth and in many others of dyn are discussed in report. In the report the ph om on bf d cu ence envelope of elastic energy caused as, in mechanism of luni-solar tides (Barkin et al., 200 envelope of elastic energy caused by action of the specified mechanism, and also by the classical and enverppes of variant **0**-2000 correlations are shown in the early period of observation of motion of pole in period 1840-1900 that gives additional arguments for the benefit of them enough to high accuracy. We shall notice also, that the forced motion of the pole causes addi full elastic energy. References Nastula J.A Variations of the Chandler and annual w Manua Geodetica, 18, pp. 131-135. Vondra from combination of astrometric and space

One of the first attempts of a dynamic e

periodic behavior of amplitude (Ach), the undertaken by the author ells by external celestial arth been illus rated on the base of the outhern America. The special form er variables has been used in this value of amplitude of pertu xpres which is approximately Ach, Tch and PHch the

iods of other decade avitational influence of variations of the tension variations of products of y interconnected. If the endercy we observe actually in society processes, which of drates f extreme values of the tions of coordinates of the discussed. Lather precisely specified

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th and gives the certain contribution to Kosek W., Horakowski W. (1993) 46-1988 and their prediction. odic polar motion as derived 01. Kolaczek B., Kosek W. 220. Barkin, Yu.V. (2000) r Motion: Historical and / Proceedings of IAU

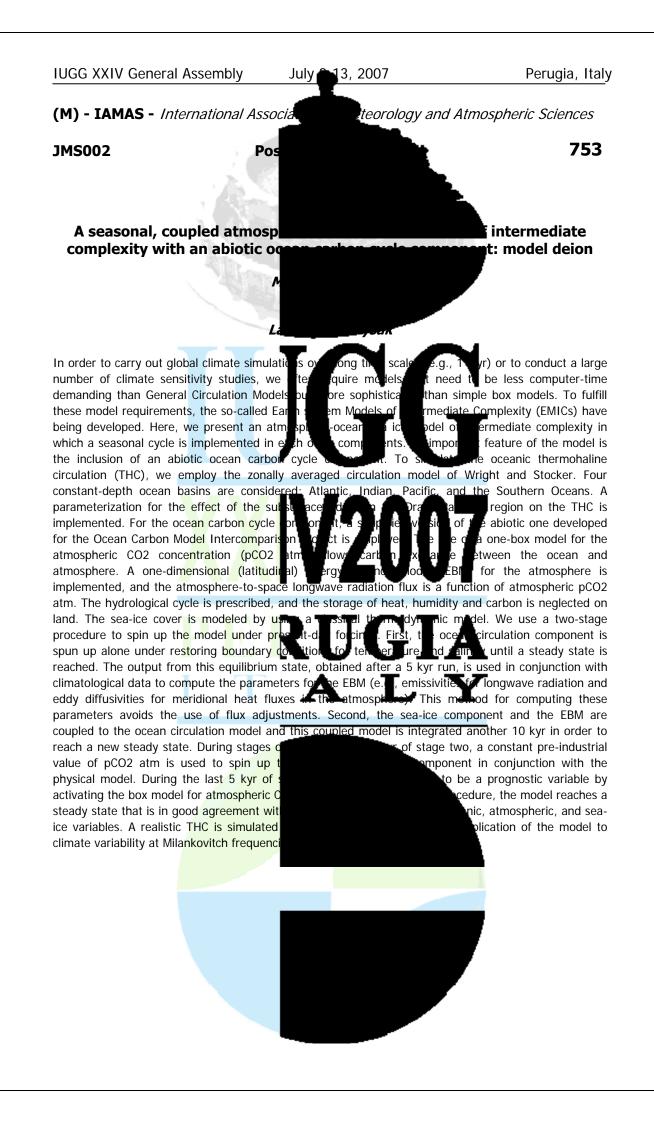
Colloquium 178 (Cagliari, Sardinia, Italy, 27-30 September 1999). Astronomical Society of the Pacific conference series, V. 208. Sheridan Books, Chelsia, Michigan. pp. 373-379.

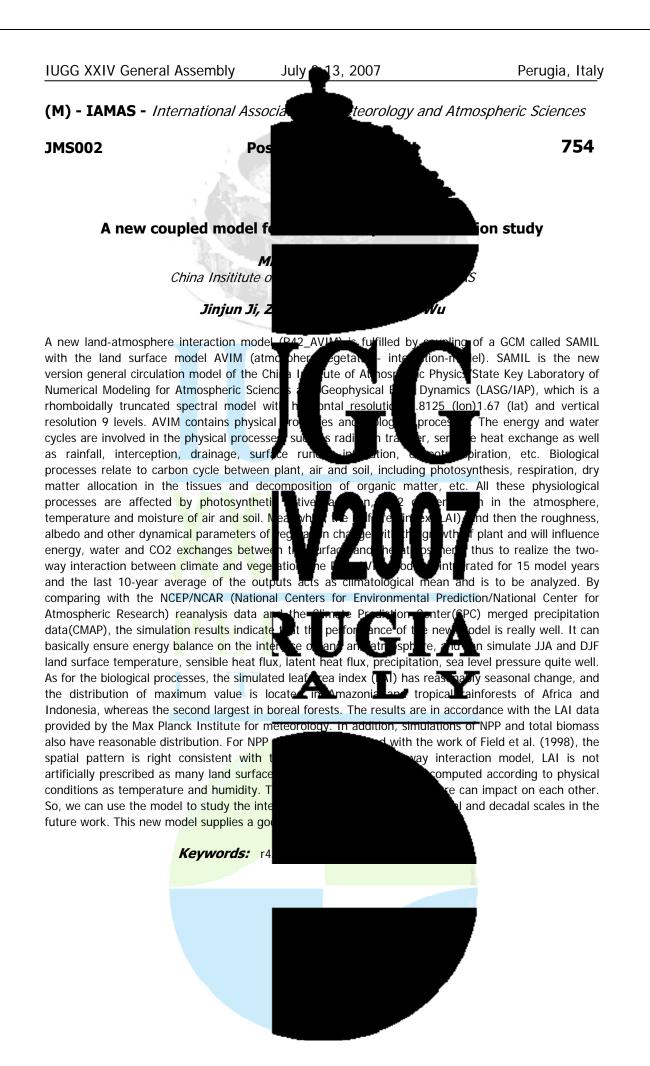
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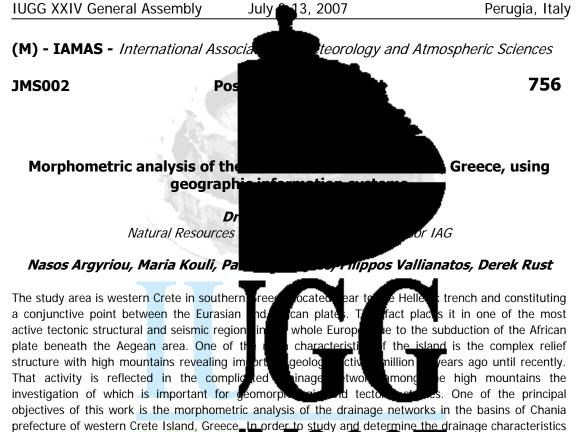
A mechanism of variations of the Earth ro

Scientific Problems (Eds. Steven Dick,









of the basins, Aster (Advanced Spacebo imagery linked with topographical maps Service) and DEMs (digital elevation model was an essential tool in order to map and networks and drainage basins. Stream network updated from Aster satellite imagery by applying the abstraction of band 3N to band 1 (band 3N-band

area. The calculated morphometric parar perimeter of basins, total stream length, ba

(bifurcation ratio, stream frequency, drainat

anomalies, relief elements and active s

neotectonic study of western Crete. The p

Resources in the framework of the proje

"Methodology integration of EO technique

and the aspect were derived from the DEMs.

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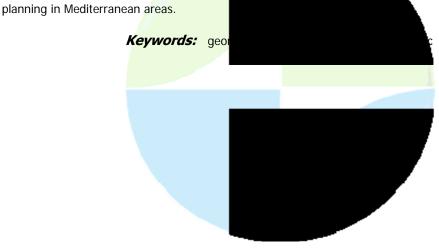
advance. The use of GIS cterization of the stream raphical maps and were 1) while drainage basins were digitized using as source the 1:50000 hydrolithological maps of the study

the derived parameters

channel maintenance,

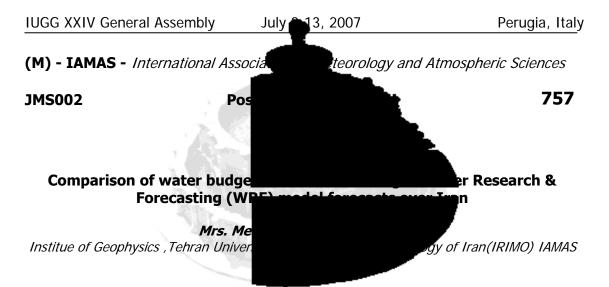
rameers (number of streams,

factor, basin circularity) and were extracted in a S environment. Moreover Farameters as the slope, of morph metric parameters in the study area, which is characterized by recent terrain movements such as the occurrence of AD 365 earthquake, reveals important data as far as the erosion status, the presence of drainage network constitute useful information in the uropean Social Fund and National 2, sub-project A1.020 entitled gradation management and



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average stream-length ratio, length of overland flow), and the shape parameters (elongation ratio, form



This article discusses the simulation of wet Surface parameterization Schemes(LSMs) is an and momentum between the atmosphere known to be of importance for atmospheric model is a next -generationmesoscale mod LSMs to represent land-surface processes version2.The three LSM are :a) A5-layer th is a 4-layer soil tempreature andmoisture model

c)Themodel Rapid Update Cycle (RUC)with 6-sublayer soil and up two snow layers. This case is being studied over Iran from 27 December 2006 to 1 January 2007. During this period, A heavy rainfall caused by passing cold front and then a s the passage of cold front. The high pres period ARW is being executed by different Runoff and soil moisture are being comp rec comparisions expresses how WRFs Land Su

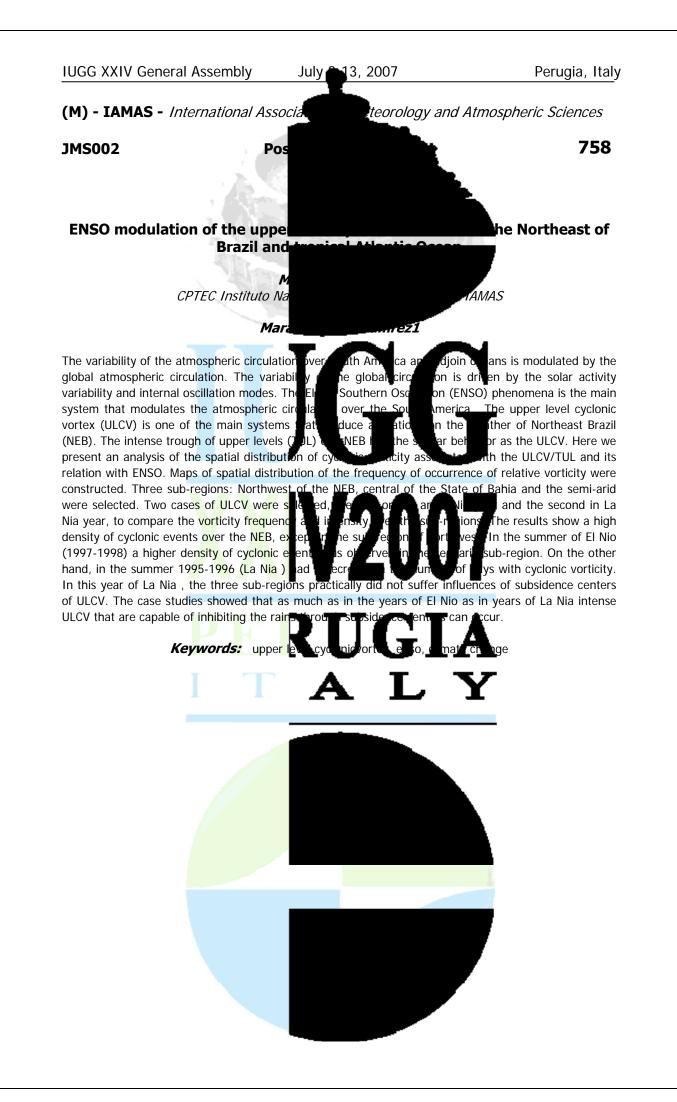
buda an usin dete "ithm" d surface Re hd hg system. N stem<u>Curre</u>r Adva ussior ma h n opy mo

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nodel forecasts. A Land hanges of energy, mass hing è c of land surface process is well er Research & Forecasting (WRF) is possible to choose from three ch W ARW) modeling system plicit tation b)Noah LSM that snow cover prediction

> west of Iran following mpreature. During this that is involved Rainfall, used to run WRF. These of water budget.





**IUGG XXIV General Assembly** 

July 13, 2007 Perugia, Italy

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## **JMS003**

## Symposium Satellite Observations: Product

Convener: Prof. James Drummond

Starting with the launch of Tiros-N in 197 Earth and other planets. Observational te being used in unanticipated ways. Sate industrial and social activities affecting n

uses for these data. It will consist of both hvi covering all aspects of space-based observat

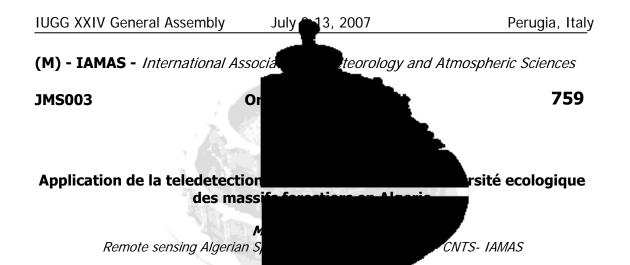
teorology and Atmospheric Sciences



ationized our view of the d into many activities, often a vital part of many scientific, and have had a significant impact in studies of many issues, both societal and scientific. This symposium will bring together practitioners from a number of fields to celebrate the success of the provide constraints and exciting ibut a wide range of topics and co apers

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Les forts en Algrie prsentent une diversit c allant du aride vers lhumide. Ces tages conditionne la composition floristique de ces for forts de part sa constitution elle joue un rle conservation de la diversit biologique et la n plus en plus dimportance. Car les cosystme des eaux intrieures, des terres agricoles et ont fait progresser la connaissance sur le fonction

activits humaines (Feux, coup de bois). Lhomme mesure ainsi mieux limportance des modifications quil apporte son environnement. Non seulement il peut amliorer en consquence ses pratiques, mais il prend galement conscience de la ncessit - et, d dgrads. Dans cette tude, lutilisation des im et qui ont subit diffrents traitements ont p rgion semi arides et humides et identifier a compostes du milieu forestier a t rendu po sibl de classification multispectrale au models forestier

ique rtante influ e dir insi que lur nt dans la rgr /aleu<u>r\_durab</u>l partici d arid : su cosys

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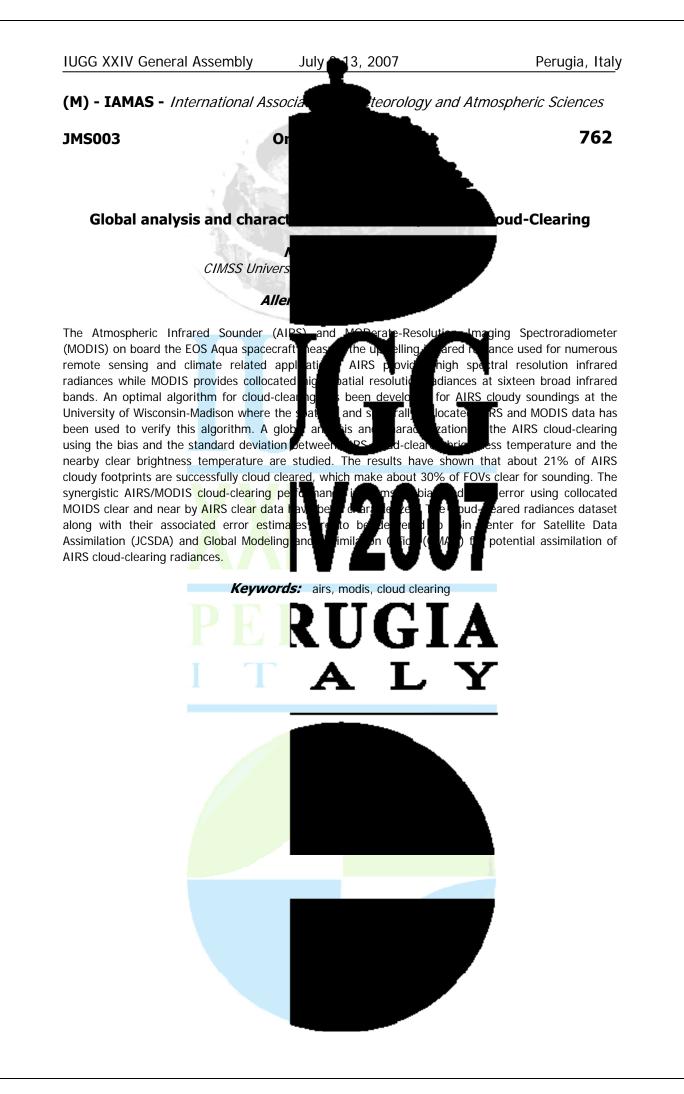
nt tage bioclimatique en cosystmes forestier et ation. Ce le diversit cologique des n naturelle suite a un incendie. La cosystmes. Forestiers prennent de ir la rÌ se biologique des forts, s recherches en cologie mide tiers et sur l'impact des

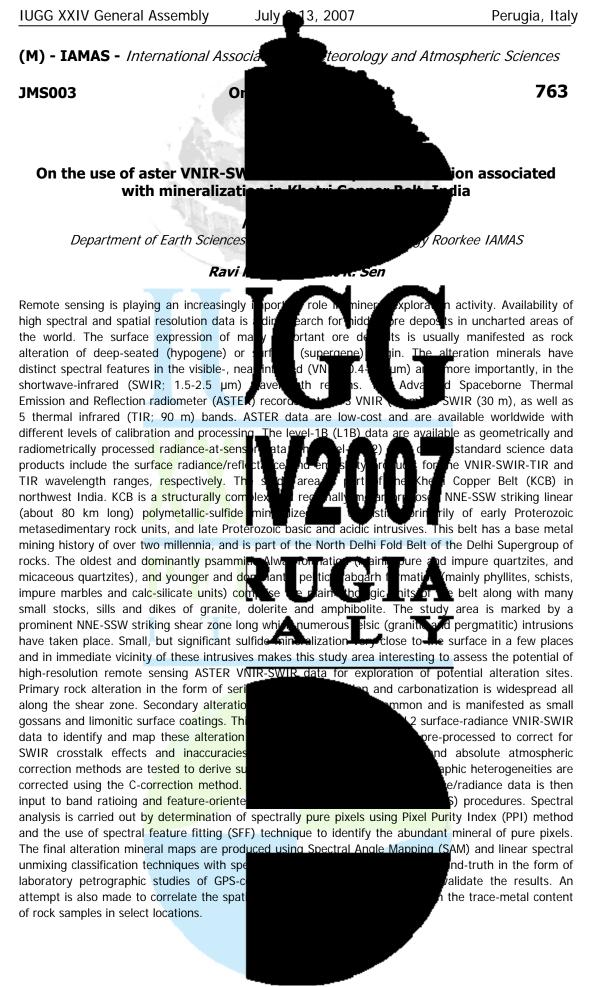
> tit - rparer les milieux 1 du mois de Mai 2006 des forts naturelles des ndie 2006. Lanalyse des dindice de vgtation et



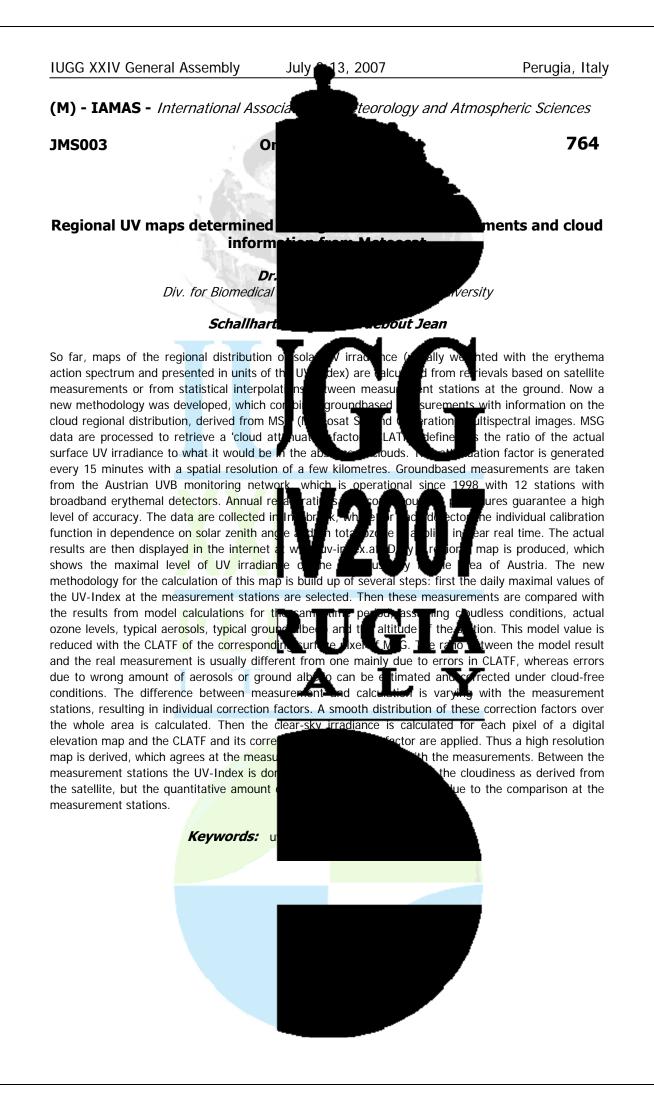


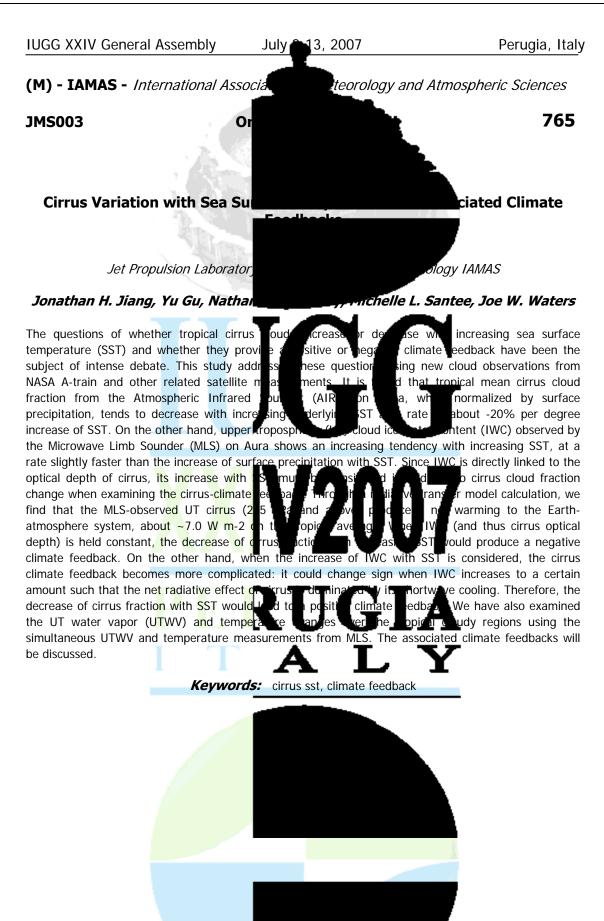




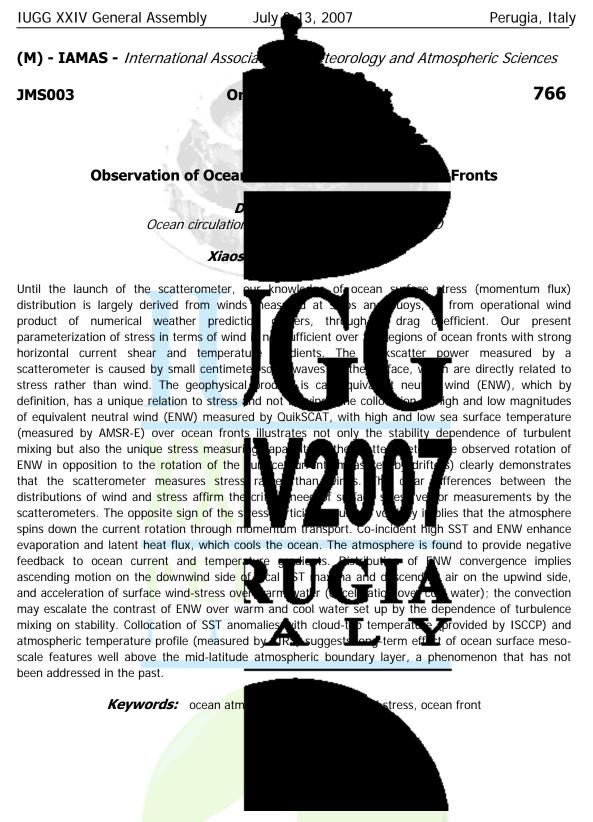


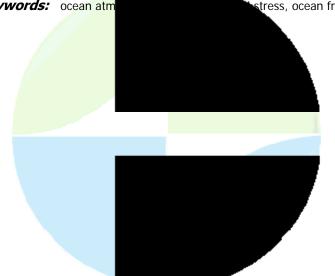




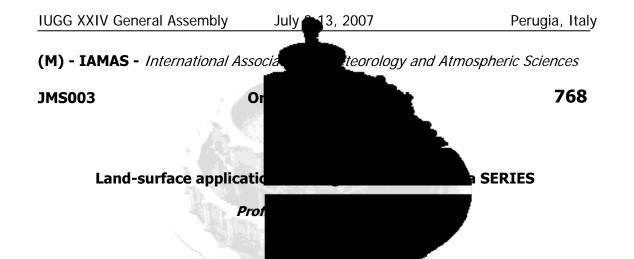


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The AVHRR data set is one of the longest available from change research. For land-surface applicatio obtained with different instruments is nec world-wide for ecological research. Because European area is ideally suited to test the a data. For this purpose the MEDOKADS arch long-term, re-calibrated, homogenized, full covering the area of 27 - 55 N, 10 W

Mediterranean it has a range of other applications as well of which examples are presented. Basic or primary products are spectral reflectances averaged over a decade to remove cloud effects and radiometric temperatures. The long term regional synergies of surface temperature reflectances leads to broad band reflectance density, vegetation period, and changes of inclusion of higher (Landsat, SPOT) and lov supplemental ground observations leads to higher order data products. The combination of shortwave and longwave infrared data allows to determine the extent of droughts, heat waves, and fires. More elaborate evaluation of the data leads to al latent heat flux from the surface, a comp finally allows to study changes of ecosystem nd dust outbreaks, industrial pollution and burning and volcar atmospheric turbidity. The local time difference channels and a normalization of the radi problems. Notwithstanding a careful re- an probably caused by variations of the sense with other satellite data from shorter term are necessary. Validation studies have be

tellites and 6, ha node ier, a Methodshav opographic c and applicab gene set aily 42 E. levelo

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for predestinated for global calibration of the series fion en developed to use these data ity the Mediterranean and central of the products derived from these Free versity of Berlin. It is a tarting January 1, 1989, RR da by desertification in the

> variability, trends and ombination of spectral are related to vegetation gation eventually under llite data as well as of

ombination with models

at the surface. Part of this is the

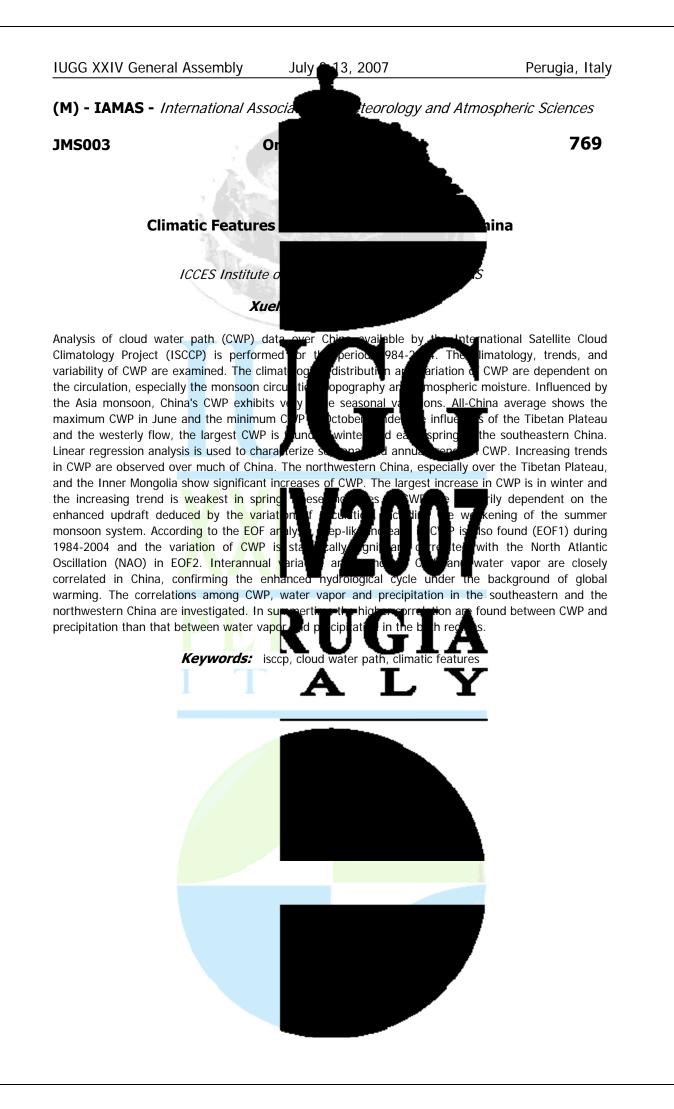
sed are also limitations **S**ces llod es. for the application of the data. Aerosol effects play a major role in the Mediterranean: Frequent desert eruptions are a high variability of een the ern and stern edge of the swath results in different illumination geometries and surface temperatures. This requires an in principle pixelwise correction according to the bidirectional reflection function of the surface in the shortwave AVHRR erature. Orbital drifts cause additional main irregularities in the data base uch effects, inter-comparisons urements at anchor stations ices in the Mediterranean

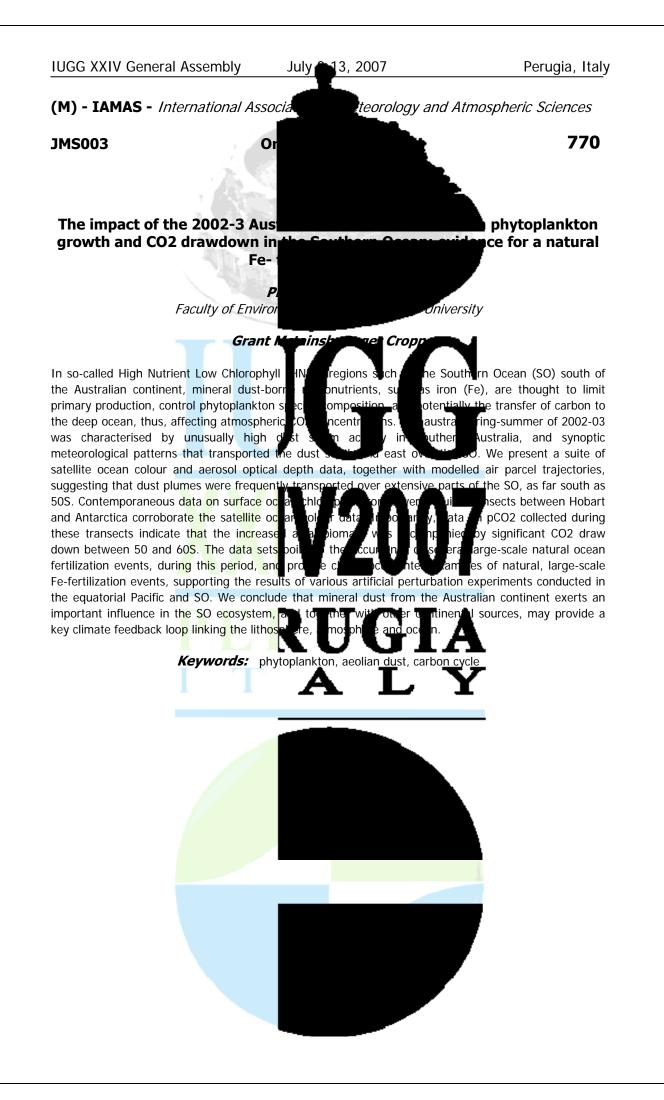
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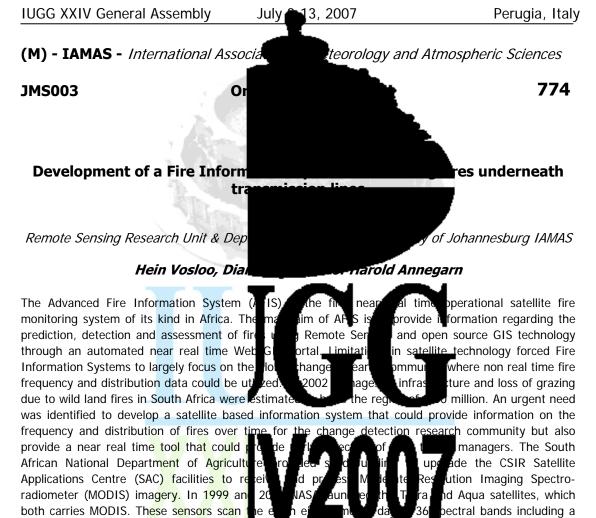












mid infra red band dedicated to fire detection. Coupled with MODIS data, Meteosat Second Generation (MSG) geostationary satellite data are providing fire location information every 15 minutes feeding AFIS to with continuous fire detections day are

University of Maryland and NASAs Earth Ob ing for the development he bin fi and implementation of AFIS came from Sou ESKOM. Wild land fires Afr omr iny igg underneath power lines can cause flashovers (arcing between the line and the ground) which severely affect industries electricity supply. ESKOM and he CSIR Farch to investigate the mmenced affectivity of the MODIS and MSG satellite sensers detect f that could use flashovers on the 28 000 km of transmission lines of South Africa. ESKOM implemented AFIS in June 2004, scanning a buffer of 5 km along all transmission lines searching for any fire hot spots at 15 minute time intervals. With the nd send to relevant authorities in near

detection of a fire, email and SMS text m real time. The effectiveness of the system detect fires before a flashover occurs. By c actual MODIS fire detections for the same flashover fires. For MSG statistics shows combining the 2 satellite sensors the detection period. The higher spatial resolution from limited temporal frequency, it missed a lot

the smaller fires due to its coarser spatial resolution, but its ability to update every 15 minutes enables the detection of fires that the polar arbiters can not see. Additional to the detection of active fires, the MODIS and MSG sensors are also used to derive a near real time Fire Weather and Fire Danger Index.

Air temperature and relative humidity are burning index. A regression tree was used MSG and MODIS. The burning index is con Weather Index. The Fire Weather Index Danger Index.

hal data to generate a on multiple inputs from which generated the Fire ndex to generate the Fire

loped in collaboration with the

the MODIS and MSG sensors to

statistics from 2003 2006 with

s in the region of 40% of all

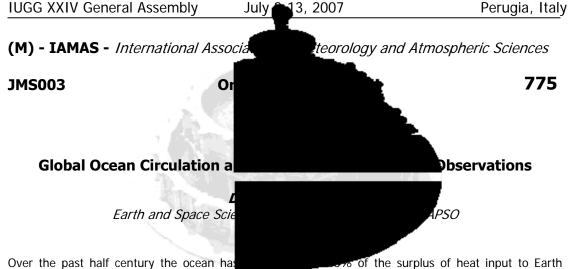
er fires are detected. By

60% for the 2003 2006

aller fires but due to its

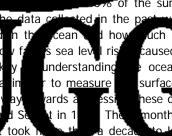
sensor misses a lot of





resulting from global warming. However, the data c questions like: How is the heat distributed maintain its current rate of heat uptake? He important questions whose answers are I Observations from satellites using a radar a called satellite altimetry, have gone a long for studying the ocean was launched onbog the potential of the technique. However,

TOPEX/Poseidon Mission (T/P) in 1992, which marked the beginning of precision altimetry with sufficient accuracy for studying the large-scale patterns of ocean circulation and global sea level change. The data record established by T/P was c This combined 14 plus year record of SSI circulation and sea level on decadal scale climate variability such as the Pacific Deca determined in all ocean basins. Such varia taken into account in the determination of longer-term trends in global sea level change. The combination of the observations from Jason and GRACE, a satellite measuring Earths gravity field,



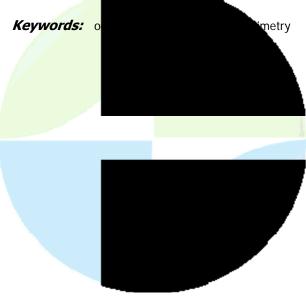
renot sufficient to answer er is the ocean able to uch T caused b the heating? These are oceans role in climate change. surface height (SSH), a technique tions. The first altimeter g mission demonstrated the Joint U.S./French

> ason Mission in 2002. f the change of ocean tied to major modes of of decadal variability are wn right; it must also be

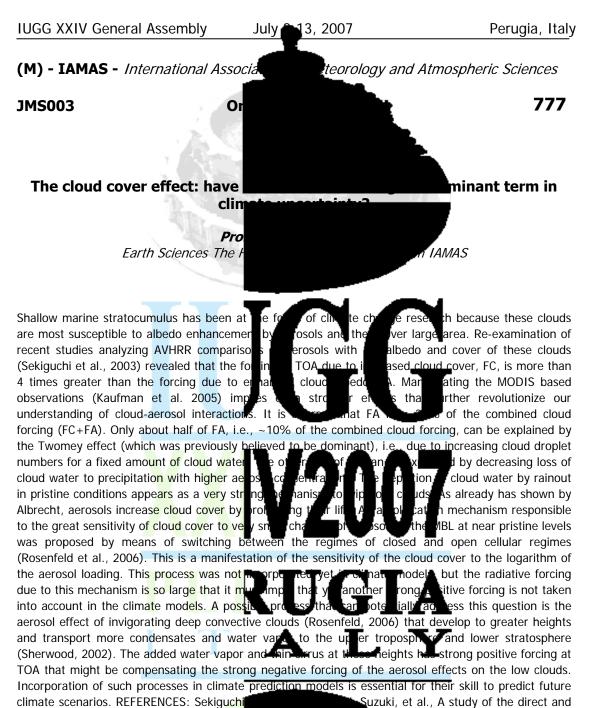
allows the separation of sea level change im nd density change of the ocean. The density change of the ocean from heating cod es inforr tion the oceans heat storage. With the approach of modeling and data ass buti the heat storage can be ilati dist e v determined. In addition to T/P and Jason, the European Remote Sensing (ERS) Satellites and their replacement, ENVISAT, have provided complementary data a resolution of SSH observations. Significant advance have also iding to en pred spatial and temporal the understanding of the bogh made i mesoscale variability of the ocean that contains most of the kinetic energy of the ocean. The continuation of the SSH data record using conventional and advanced attimetry techniques will also be discussed.

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Suzuki, et al., A study of the direct and L and cloud parameters J. Geophys. Y.J., I. Koren, L. A. Remer, D. ng the Atlantic Atmosphere. Id D., 2006: Aerosol-Cloud Reviews. Springer, 9p. 6 n, and I. Koren, 2006: in response to aerosols

suppressing precipitation. Atmos. Chem. Phys., 6, 2503-2511. Sherwood, S.C. A microphysical connection among biomass burning, cumulus clouds, and stratospheric moisture. Science, Vol. 295, No. 5558, 2002, pp. 1272-1275.

indirect effects of aero-sols using global sa

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Rosenfeld, Y. Rudich, 2005: Smoke, Dus

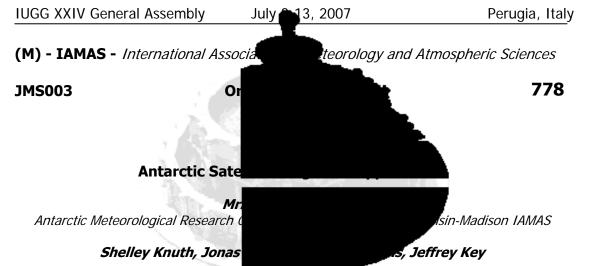
Proceedings of the National Academy of Sc

Interactions Control of Earth Radiation and

December 2006. DOI: 10.1007/s11214-00

Switching cloud cover and dynamical regin

Keywords:



Satellite observations over the Antarctic forecasting in support of logistic operations behavior of the Antarctic atmosphere. Po observing platform providing critical operati inspiration for new developments. The statu McMurdo Station, Antarctica such as clou automated motion vectors (AMV) from the Spectroradiometer (MODIS) will be reviewed. Ap

nd adi Southern we tool a ma ing satel tes pport as well odern<u>satellit</u>e ucts . and benef

re critical for weather and learning about the obser e been and remain the primary bng-term monitoring, and offering duct generation and processing at op pressure, etc.) and clou rate-resolution Imaging of these modern and

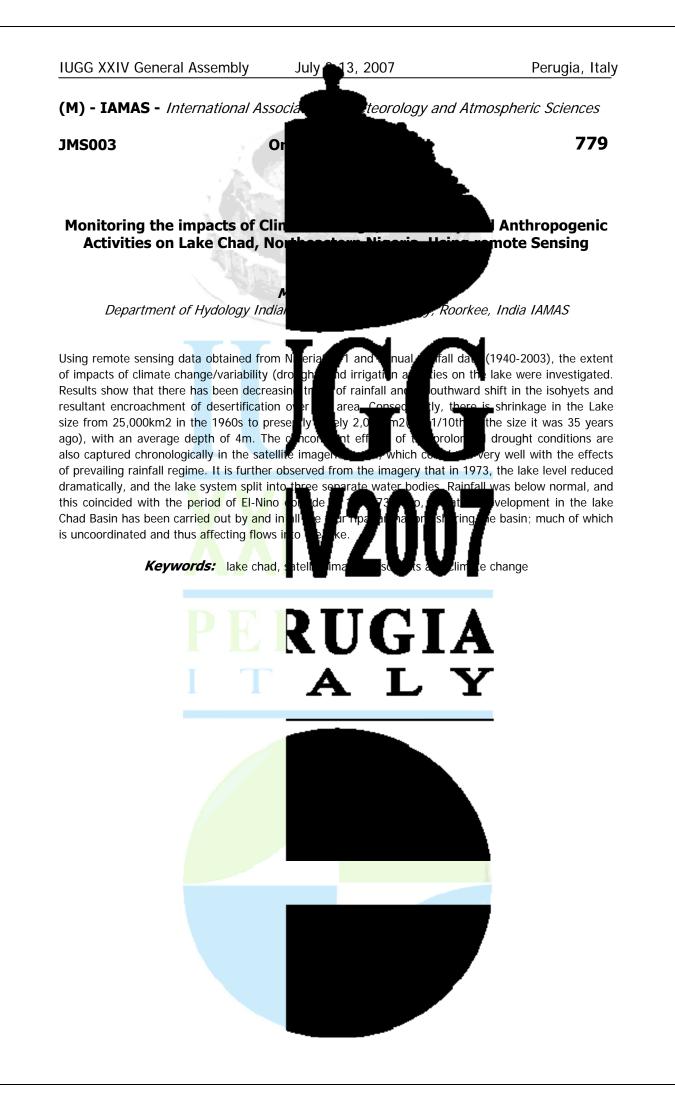
traditional polar orbiting satellite observational datasets will be outlined along with current and future data distribution plans. This year marks the 15th year the University of Wisconsin-Madison has been

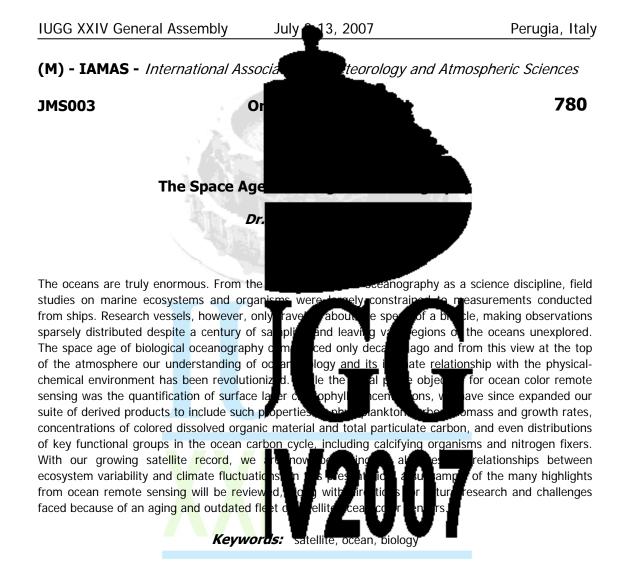
tes N

generating Antarctic composite imagery us observations. The latest updates to the col of new satellites, increased temporal fre planned. The archival, distribution, and sa this presentation. Additional spectral chann

d polar satellite source ussion on the inclusion efforts underway and will also be reviewed in ions to the effort.

Keywords: satellite, antarctica, observations

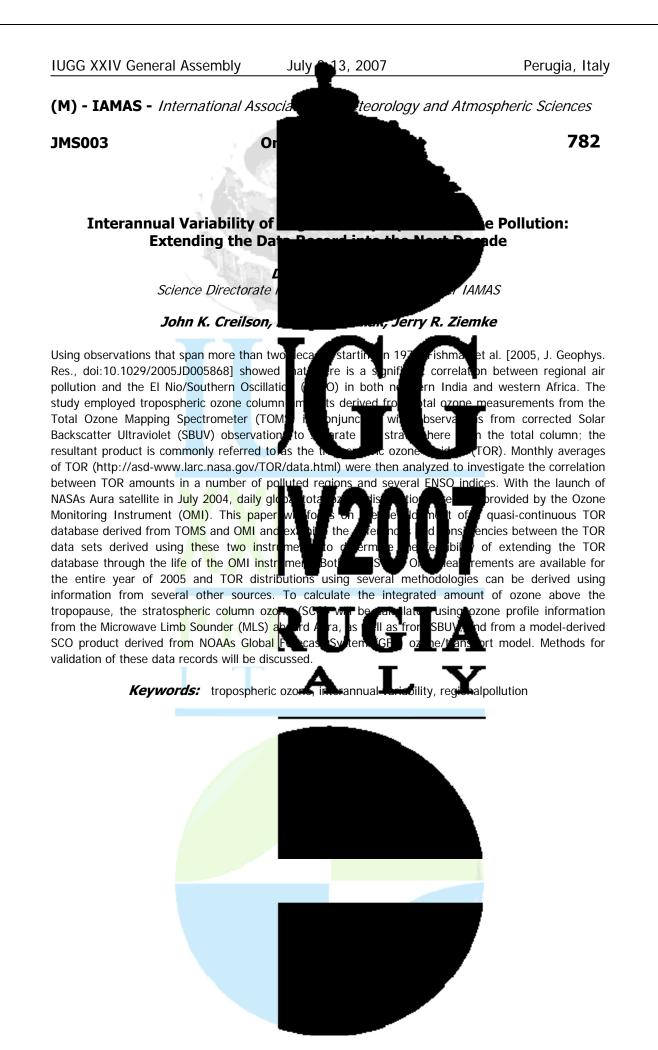


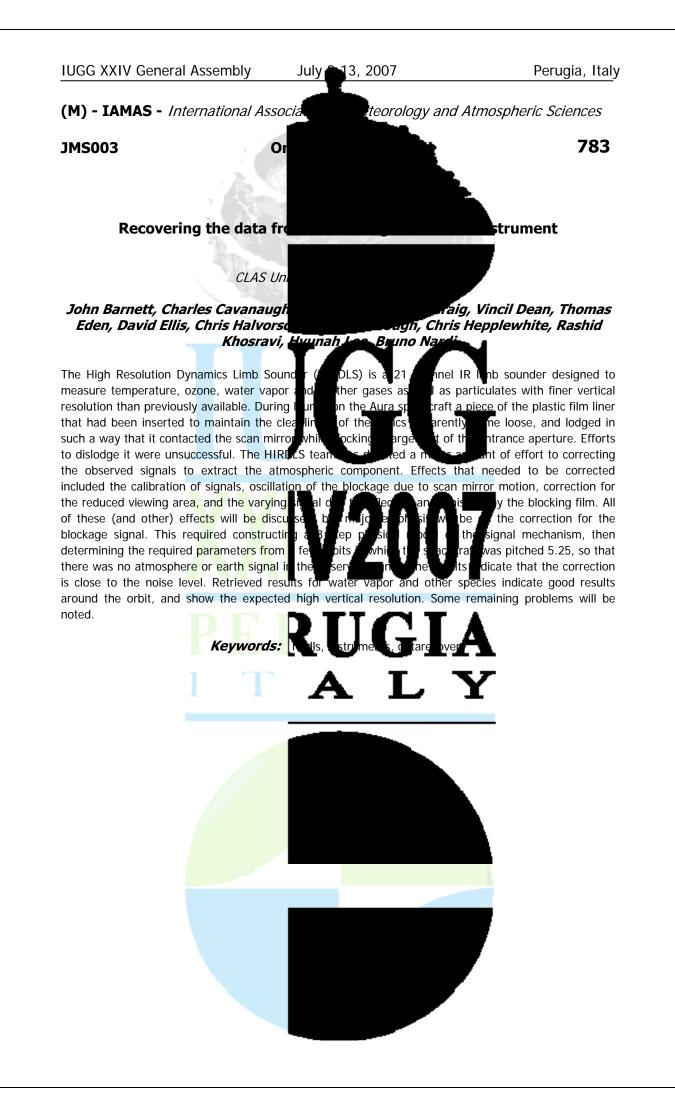


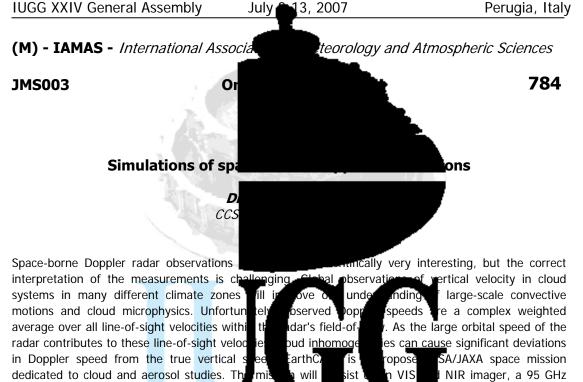












synergetic cloud & aerosol studies. EarthCARE will be the first space mission with a cloud profiling Doppler radar on-board. To assess the accuracy of EarthCARE's Doppler observations, we have developed a new Doppler radar simulation inhomogeneity. The technique is faster that more versatile than the traditional inverse scenes derived from ground-based Dopple proposed for the EarthCARE space-mission accuracy of the Doppler observations is not anways

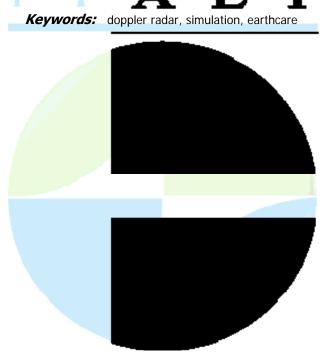
Doppler radar, a 355 nm lidar and a broadband ra l on t ra

tform and optimized for

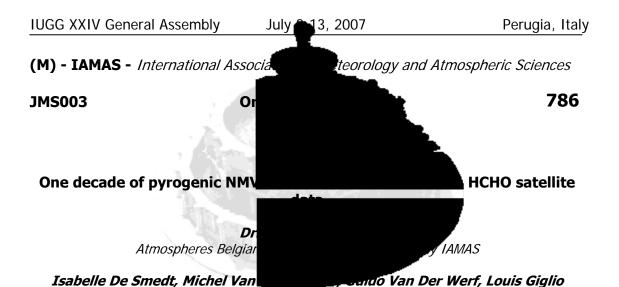
effectively with cloud hulation) technique and ue. Using realistic cloud e 95 GHz Doppler radar thin clouds, the required met. For ground-tracks of 1 km, 10 % of the observations with Z > -20 dBZ has a deviation > 1 m/s from the truth, and for ground-tracks of 10 km

30 % has a deviation > 0.2 m/s from the lateral cloud boundaries, errors can easily amount to several m/s. A correcti ased the horizontal gradients in observed reflectivity. For the cases con capable of sufficiently jori m ş ere en correcting for the biases caused by cloud inhomogeneity. Based on this finding, the required along-track m to 500 m. sampling distance of the EarthCARE radar was reg atly decreas d from 100

wa







ME

Formaldehyde columns retrieved from the G are used together with the IMAGES global c biomass burning and biogenic NMVOC emis the differential optical absorption spectro consistently applied to formaldehyde profile diversity of NMVOCs involved in the produc

quasi-explicit chemical mechanisms (mostly from determine the formaldehyde yields in the oxidation of the most prominent NMVOCs (> 20 compounds). These results have been used to optimize the chemical mechanism of the CTM with respect to formaldehyde production. Pyrogenic emi estimates of monthly burnt biomass betw GFEDv2 database of van der Werf et al. (2 in the afternoon, and little emissions at lgh derived by extrapolating the estimated diamal impact on the modeled HCHO columns at 10:30 AM

techn<u>ique</u> d fron HO, elim Chem

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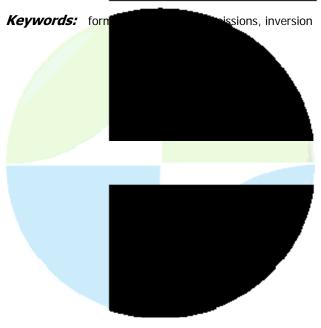
the global

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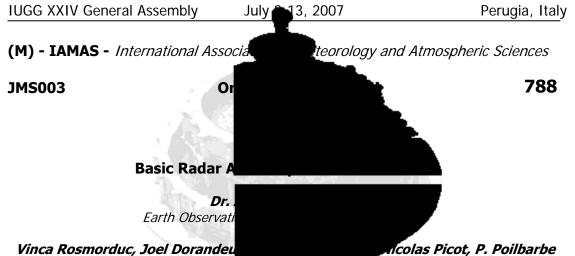
between 1997 and 2006 to provide top-down estimates for The formaldehyde retrievals use e-resolved air mass factors are the large number and In viè stud s been conducted using hism, MCM) in order to

ndreae (2007). Prior either the GFEDv1 or iurnal cycle, with a peak dded diurnal profiles are ly of Giglio (2007). Their local time (the satellite overpass time) will be discussed. Total pyrogenic NMVOC emissions and total biogenic emissions are optimized using the grid-

y Staurakou and Muller (2006). based approach, previously applied to the In this framework, the emissions are optimised he ( (5 degrees). Given the fic spatial and temporal large number of emission parameters to be rce spe correlations among errors on the prior emissions are essential in order to reduce the number of effective unknowns. We found a good agreement etween ou model and Surements in most sites. In several regions however, the model results dev ed from Suremente highlighting the potential of satellite data for further constraining biogenic and pyrogenic emissions.







## Vinca Rosmorduc, Joel Dorandeu

The field of satellite radar altimetry has matured. multimission approach (between various all netr tutorial. Such an integrated approach and v offers altimeter products but also to show Altimetry Toolbox (BRAT) is a collection of of radar altimetry data for altimetry users, of the upcoming CryoSat mission. It is able & 2, Topex/Poseidon, Geosat Follow-on, Jason-1,

some processing, data editing and statistic, - and to visualise the results. As part of the Toolbox, a Radar Altimetry Tutorial gives general information about altimetry, the technique involved and its applications, as well as an overview of pas access data and additional software and covering all uses of altimetry over ocean, the most frequent manners of using altime

and CNES. It is available at http://earth.es

t where nd stem al not or V em and consi toria<u>ls and d</u>o ced as ginner l mos trib the ft

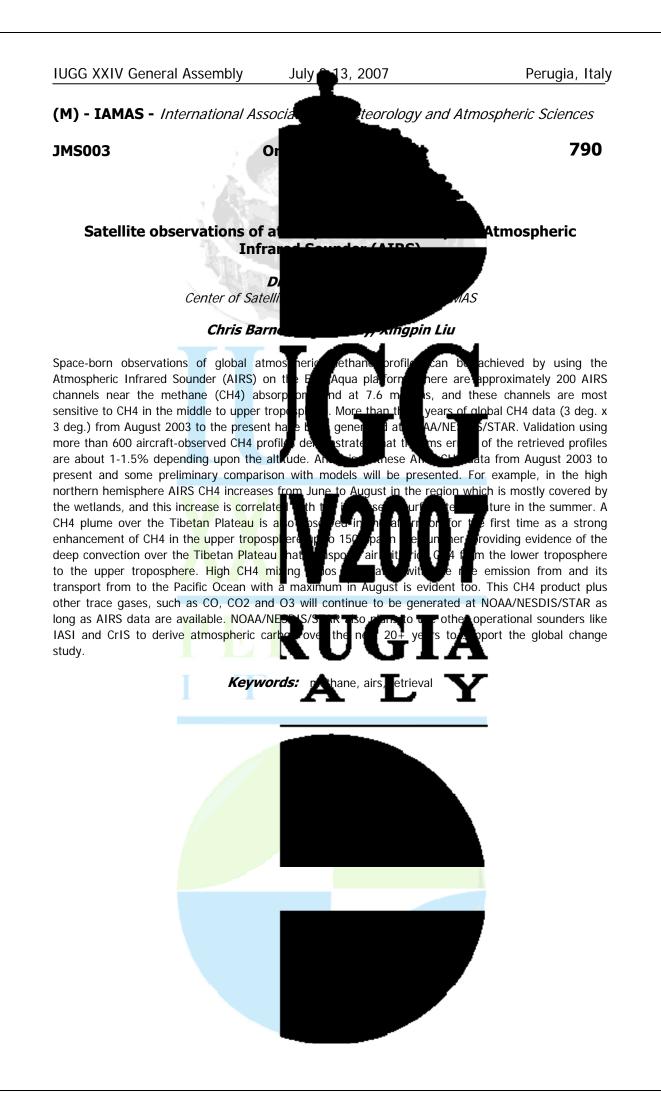
new time to encourage a II-altimeter toolbox and Sive 2 sessing the current status of what cy with the past. The Basic Radar ents designed to facilitate the use nd particularly the users metry data, from ERS-1 t missions, - to perform

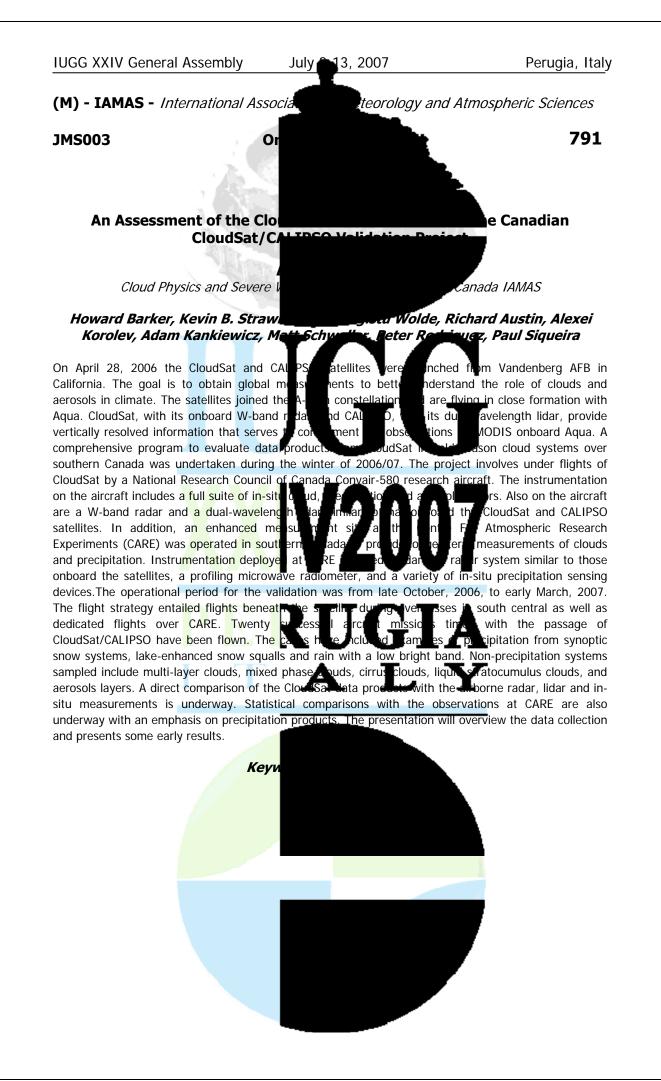
radar

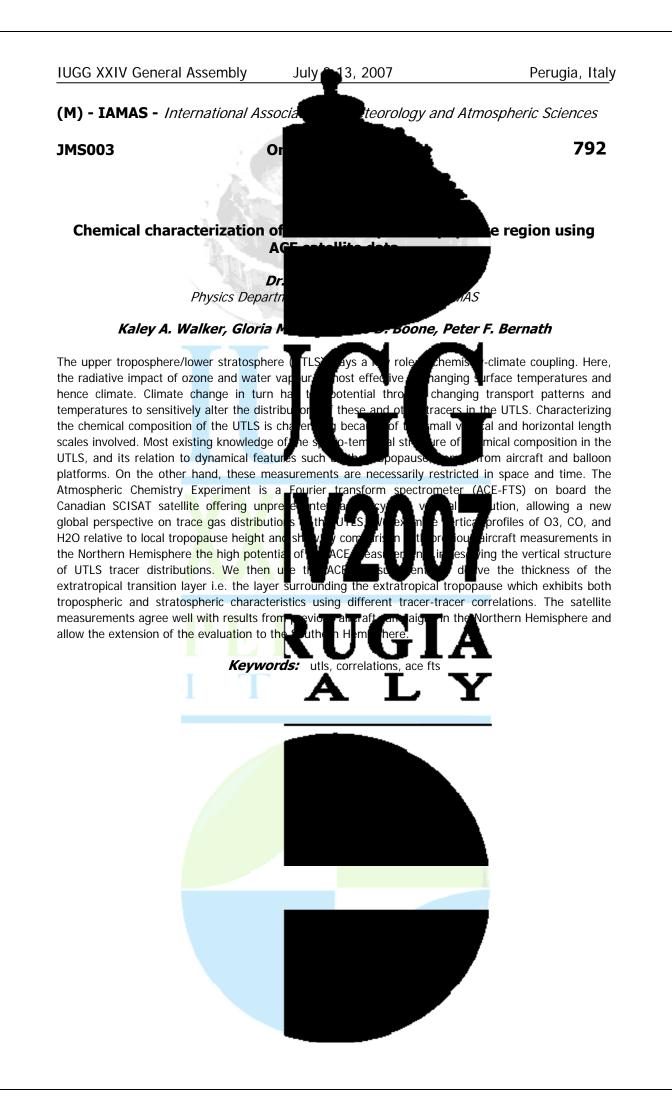
information on how to ies of data use cases, sic methods for some of under contract with ESA

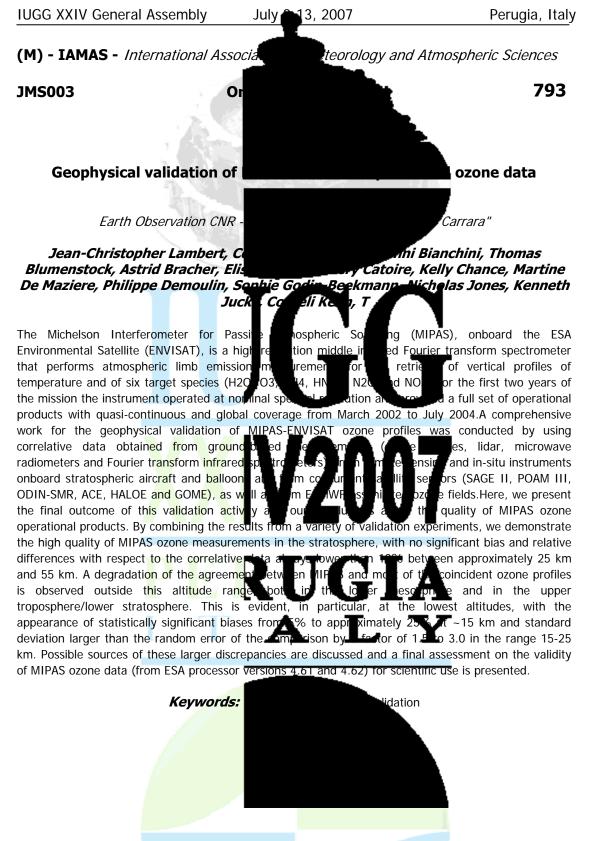




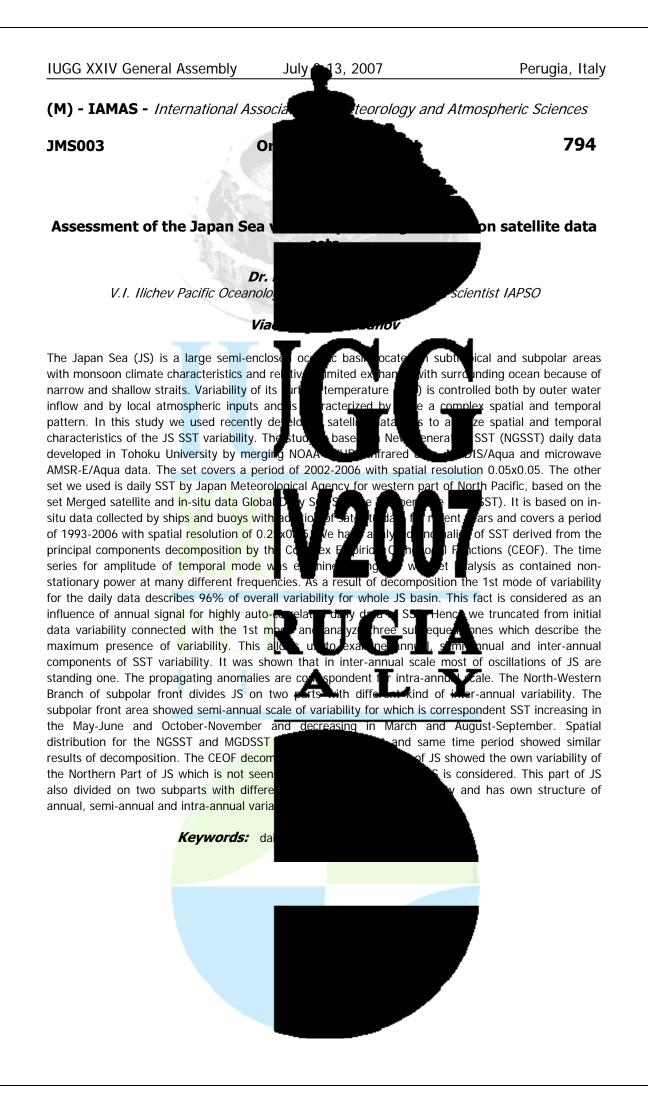










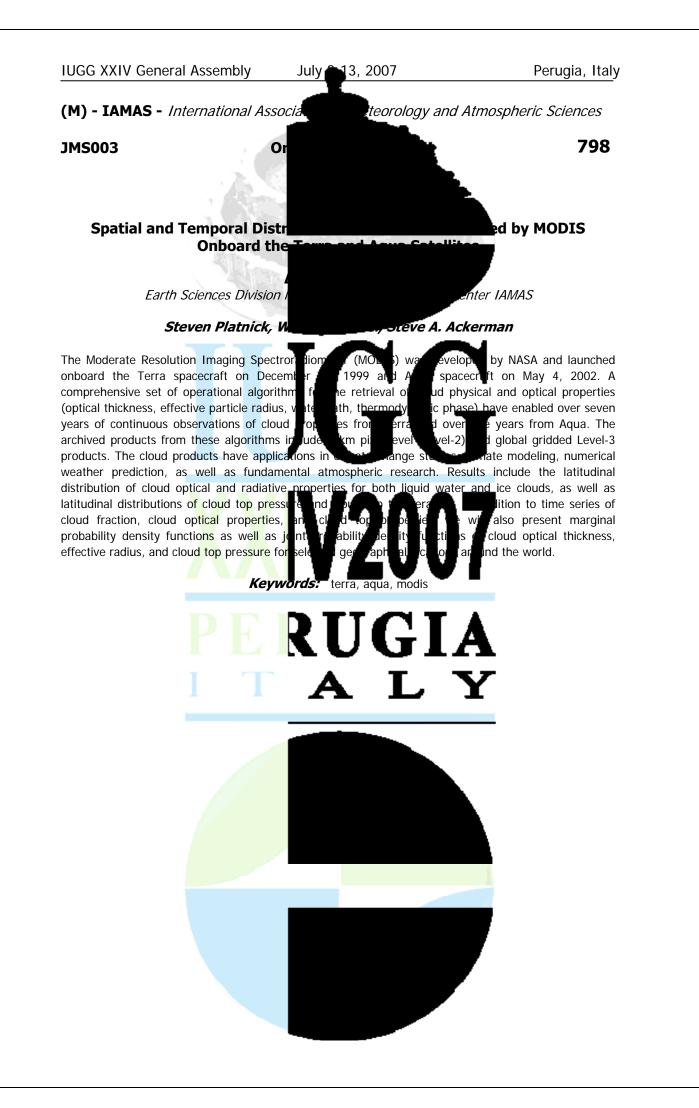




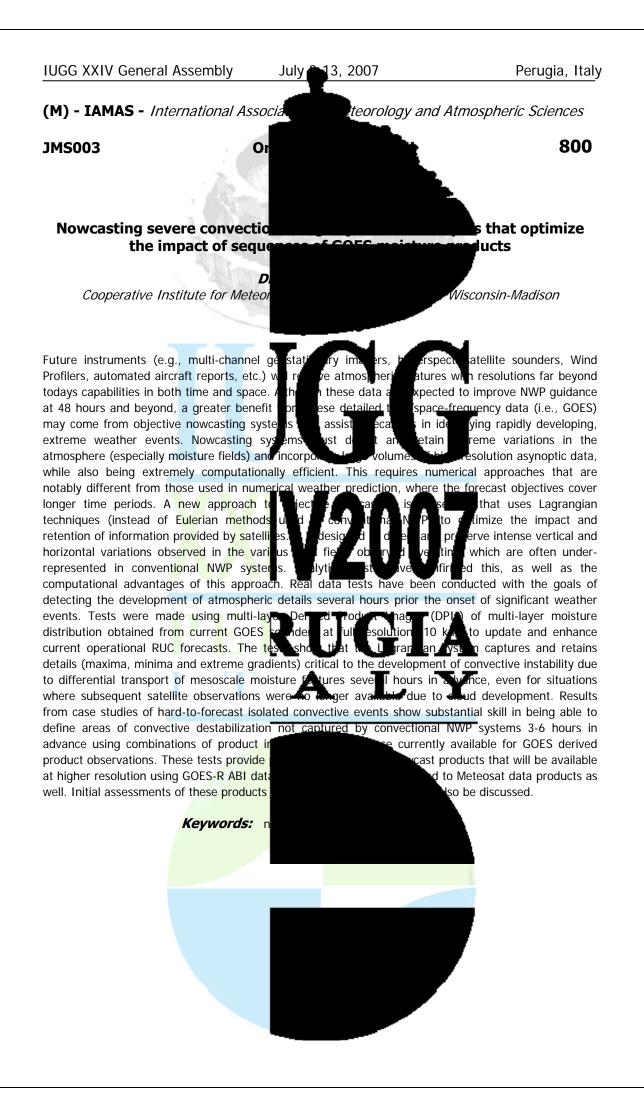


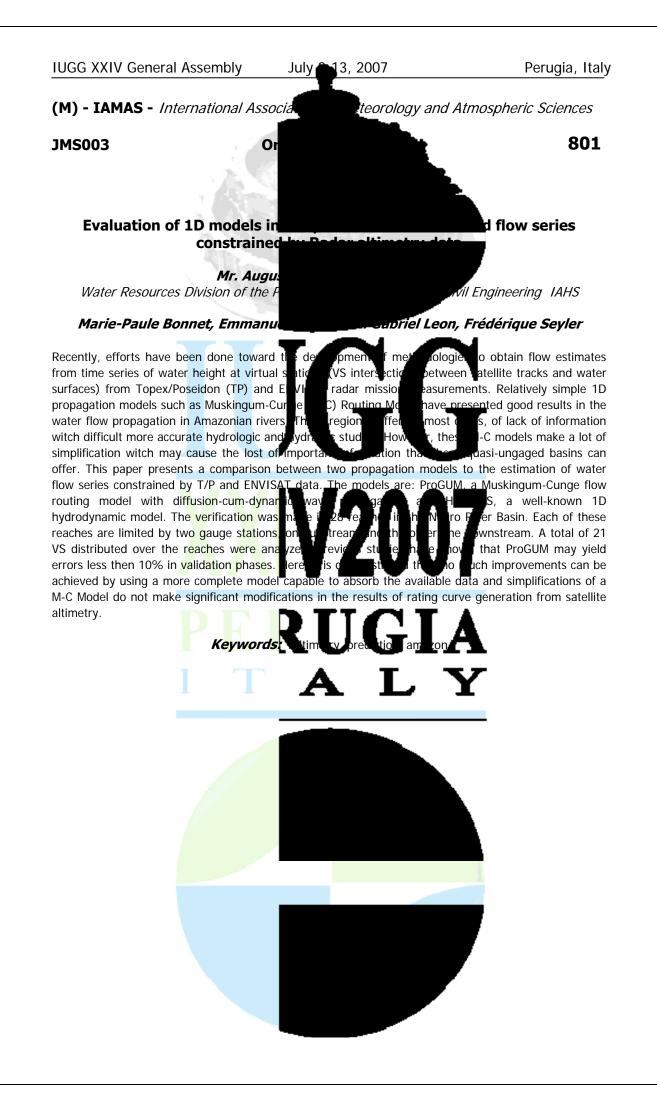


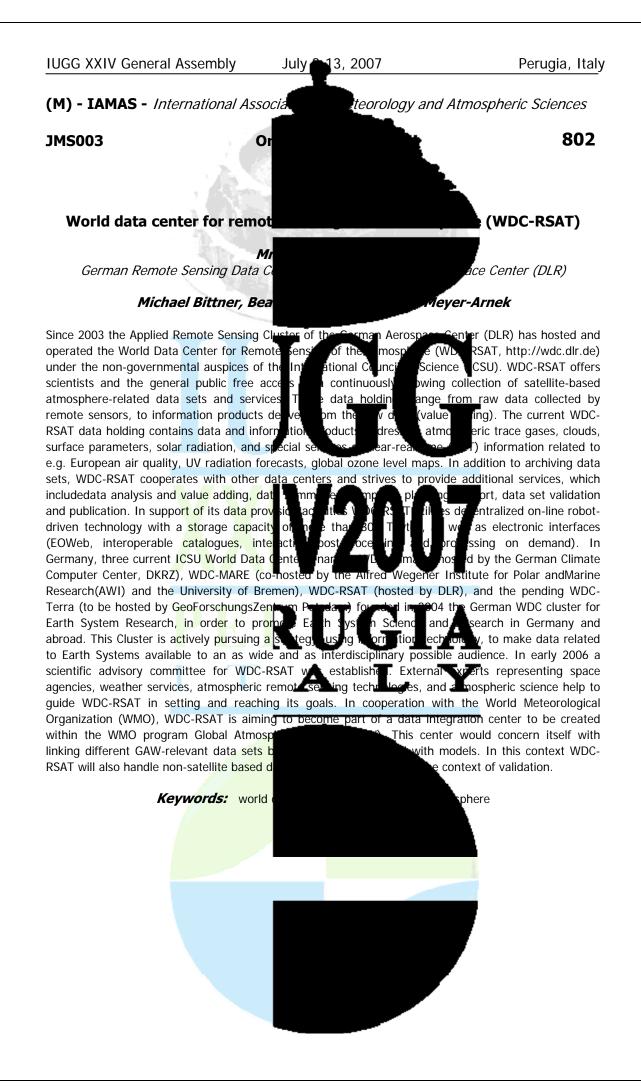


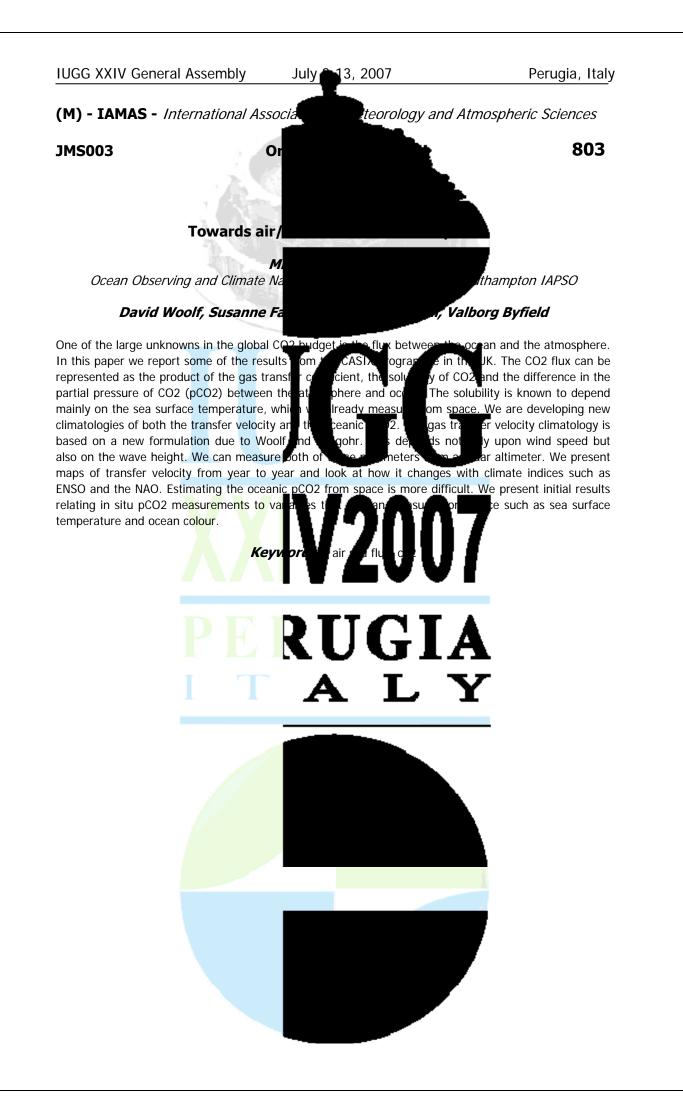




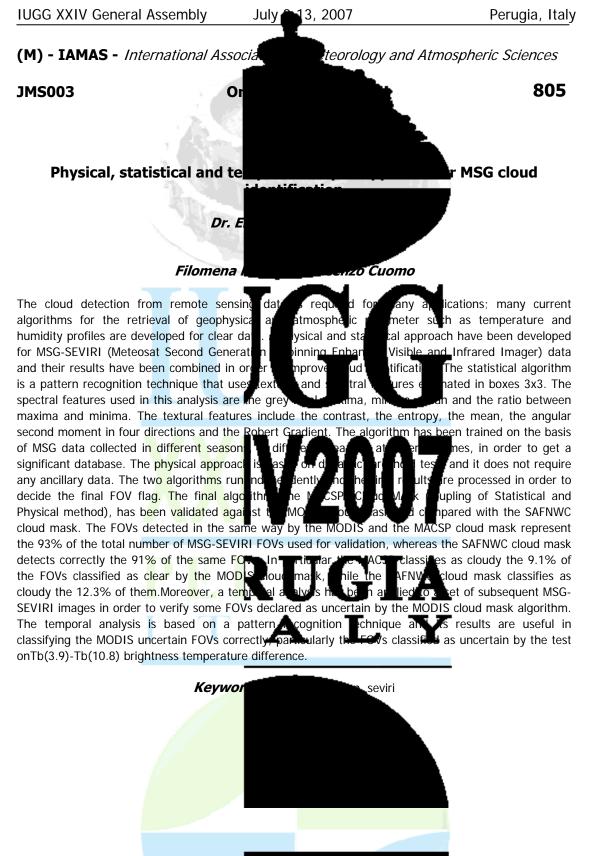




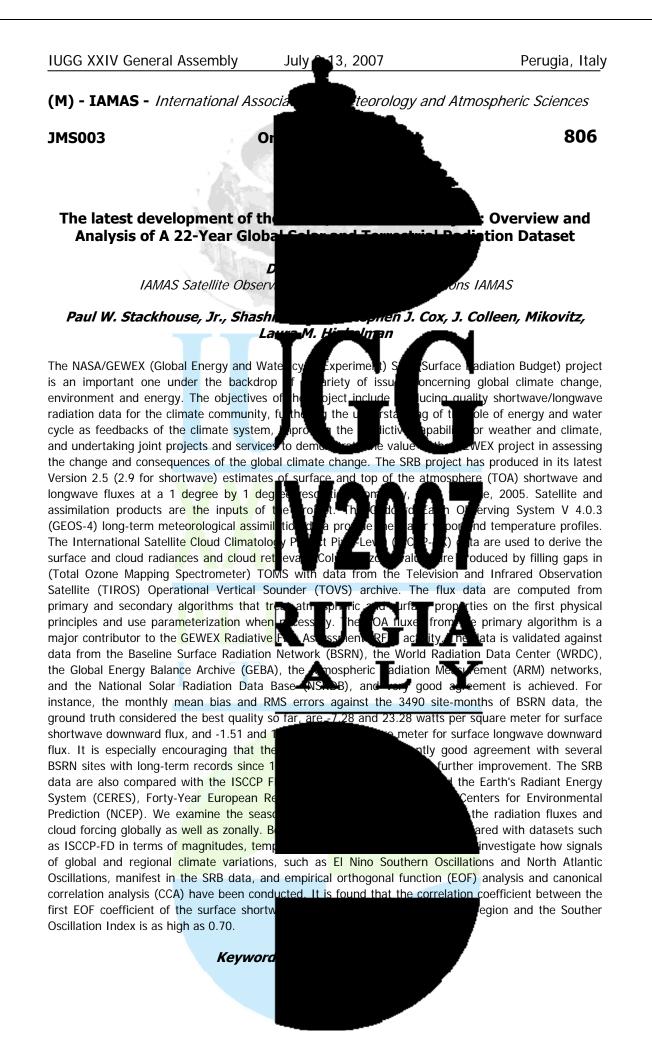


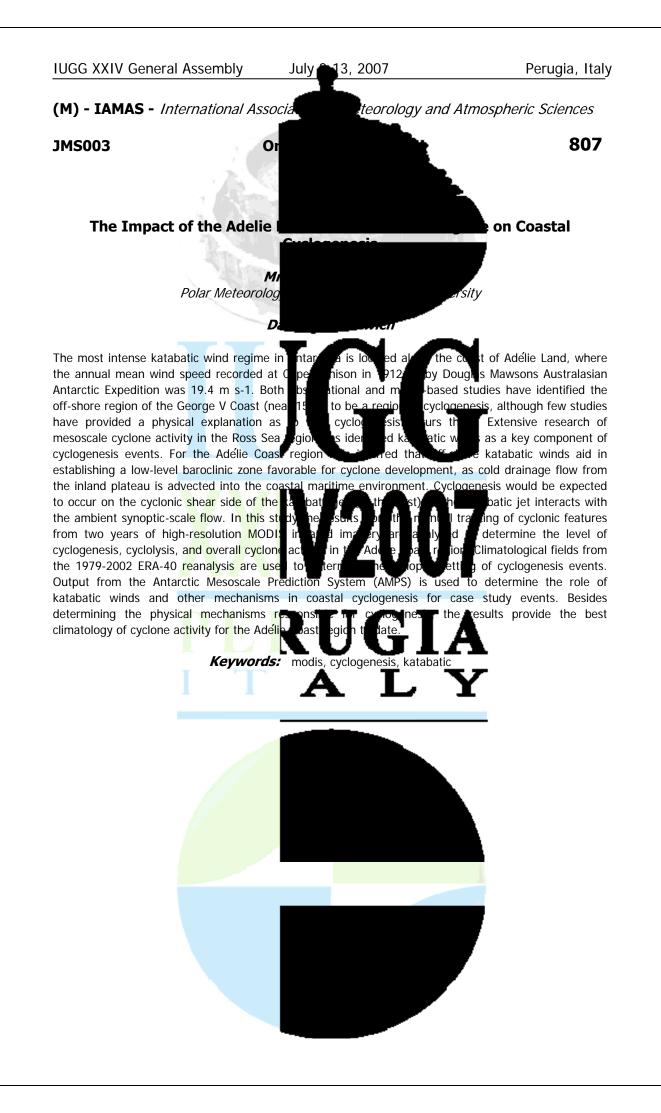


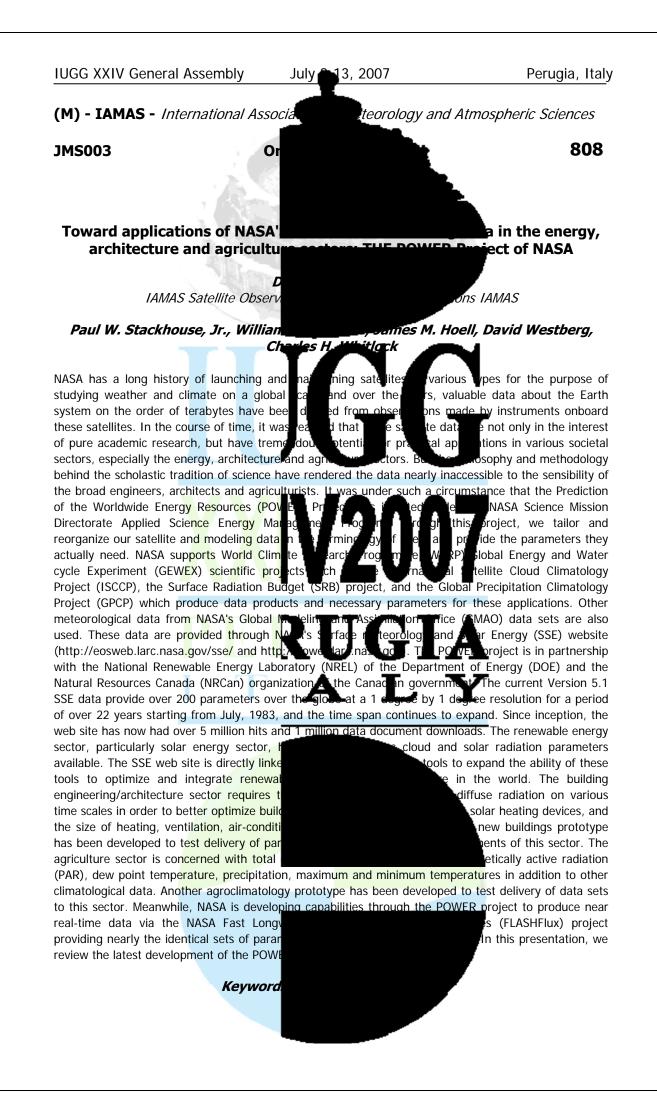




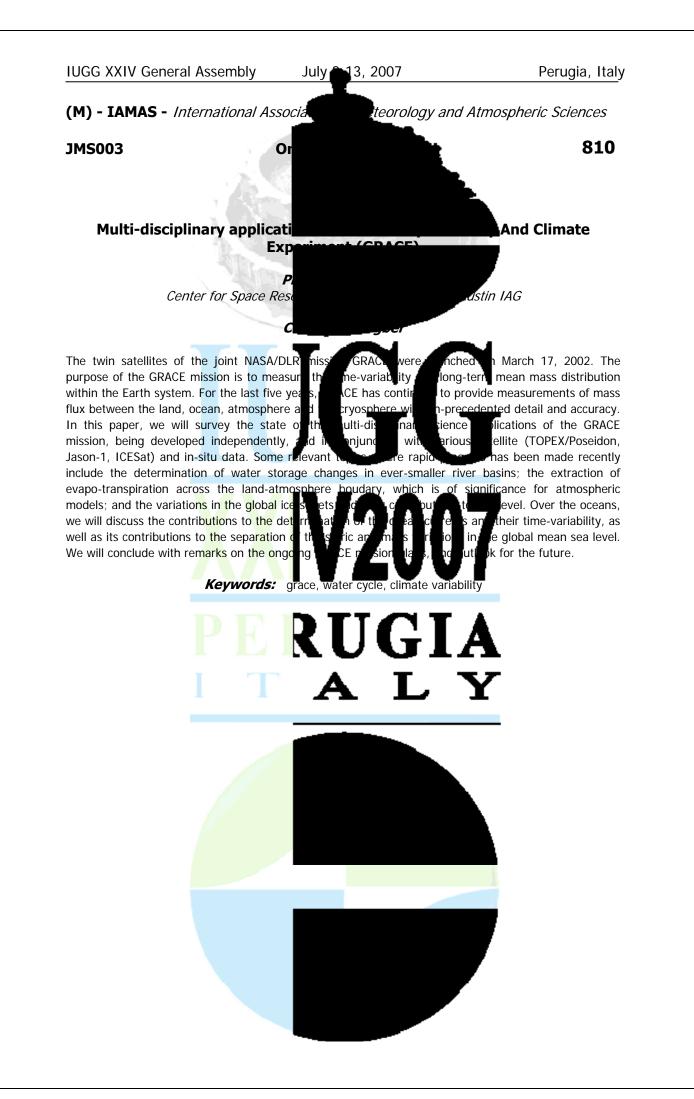


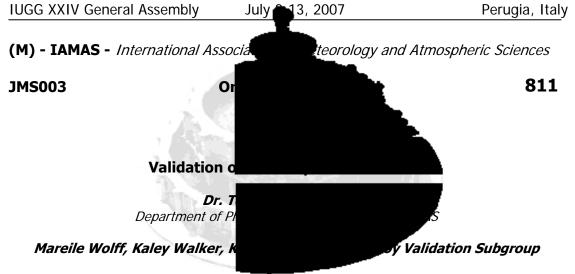












The accuracy and reliability of the measurements fr satellite mission are validated by comparing balloon- and ground-based instruments. Lau ch an 74o orbit at 650 km altitude. ACE scient board the satellite provide measurements Transform Spectrometer (ACE-FTS) and a d aľ (Measurements of Aerosol Extinction in the Str The primary goal of the ACE mission is to provide

vertical profile and column measurements are being used as part of the validation of NO, NO2, CIONO2, HNO3, N2O5 and N2O from ACE-FTS \ presentation, Ace vertical profiles will be satellite instruments. In addition, ACE measurements by Fourier transform spectr CIONO2, HNO3 and N2O) and with UV-visil e q in some cases, low-resolution NO2 profiles

Keywa

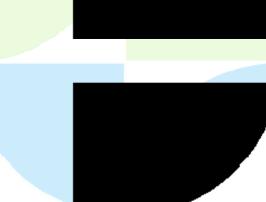
e Atmosph the es of lo a n 12 Aug st I tions began emic<u>al spec</u>ie /isible phere

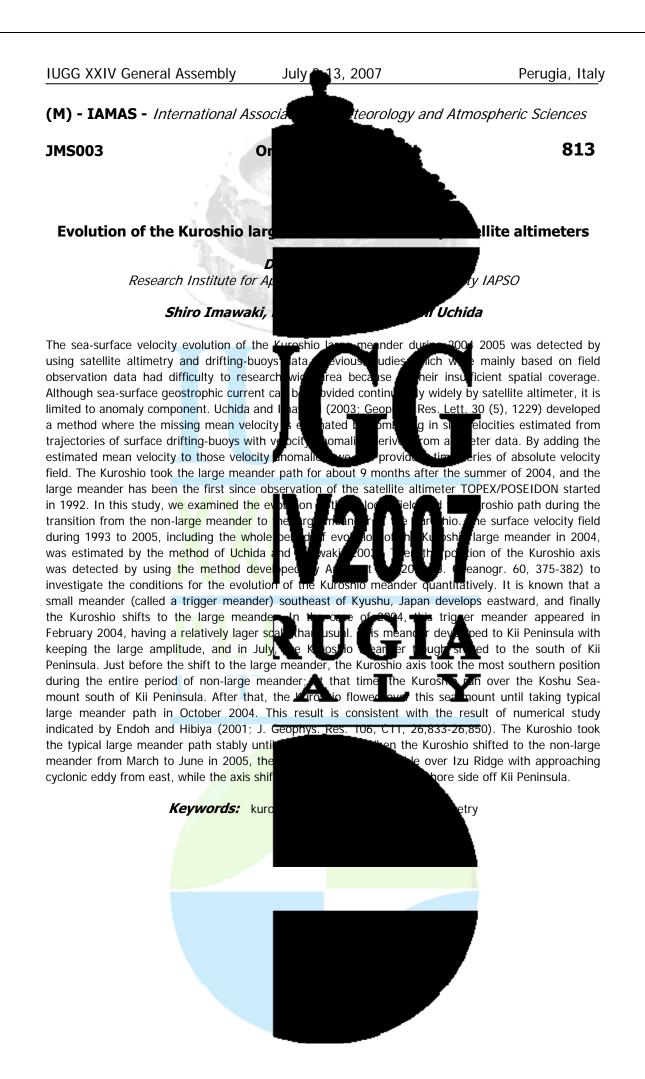
hemistry Experiment (ACE) ents made by satellite-, asur the ACE satellite (SCISAT-1) is in bruary 2004. Two instruments on high-resolution infrared Fourier photo er called ACE-MAESTRO trieved by Occultation). phere ur understanding of the

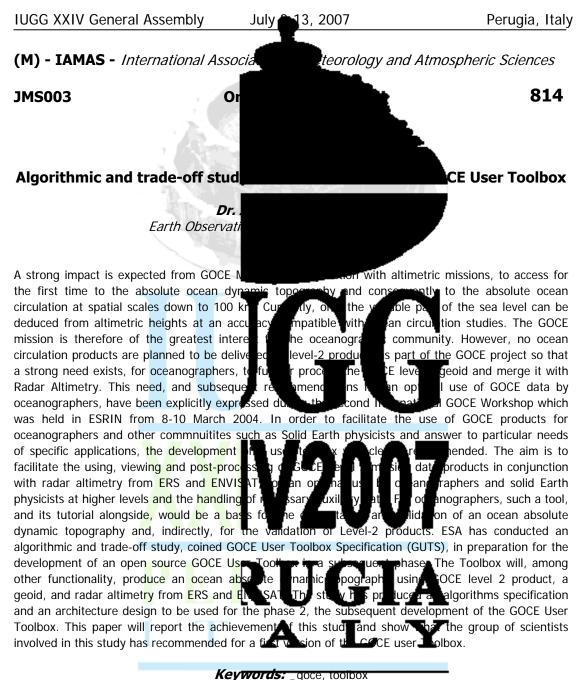
ozone distribution in the upper troposphere and the stratosphere, especially over the Arctic. Both

version 1.2. In this alloon-borne and other with ground-based éd i ial columns of NO, NO2, NO2 total columns, and



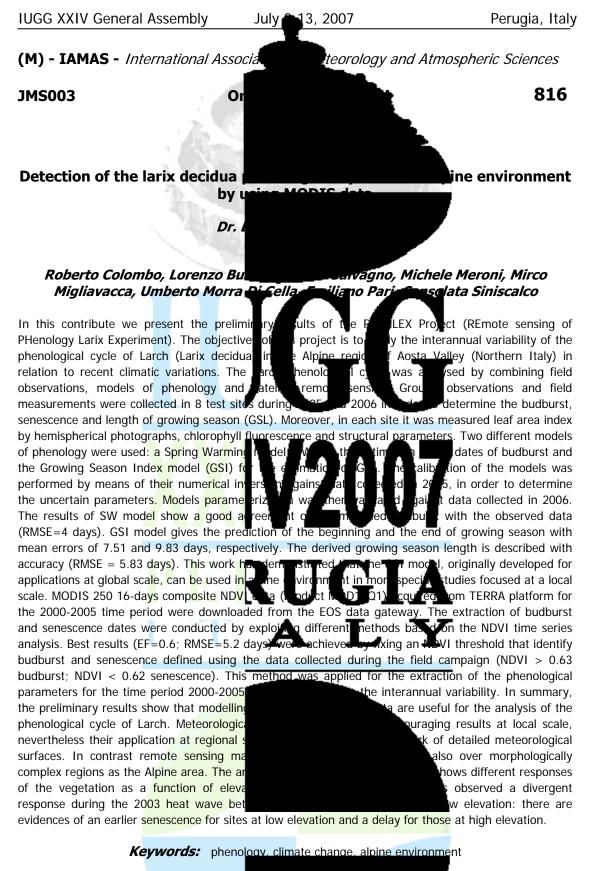




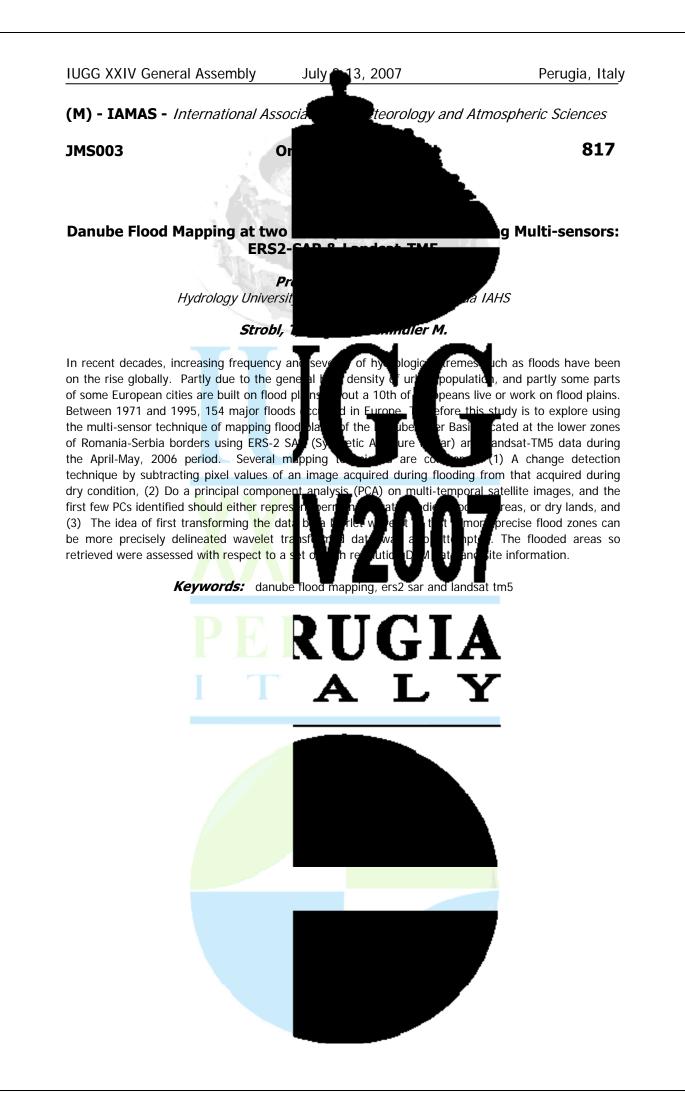




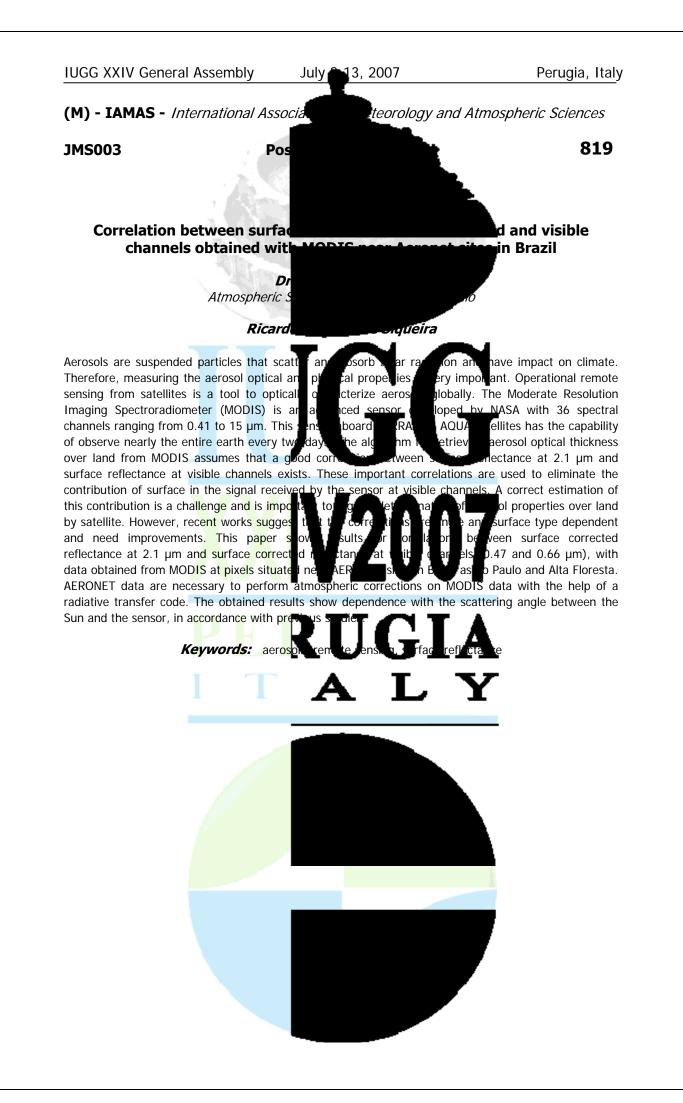


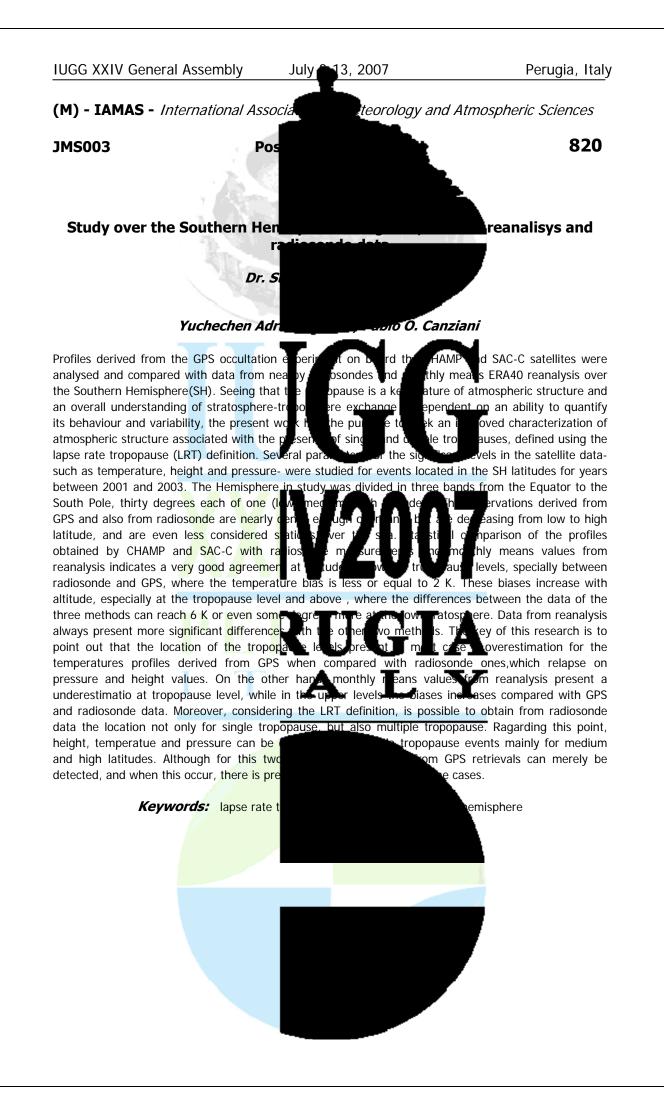


eywords: phenology, climate change, alpine environmen

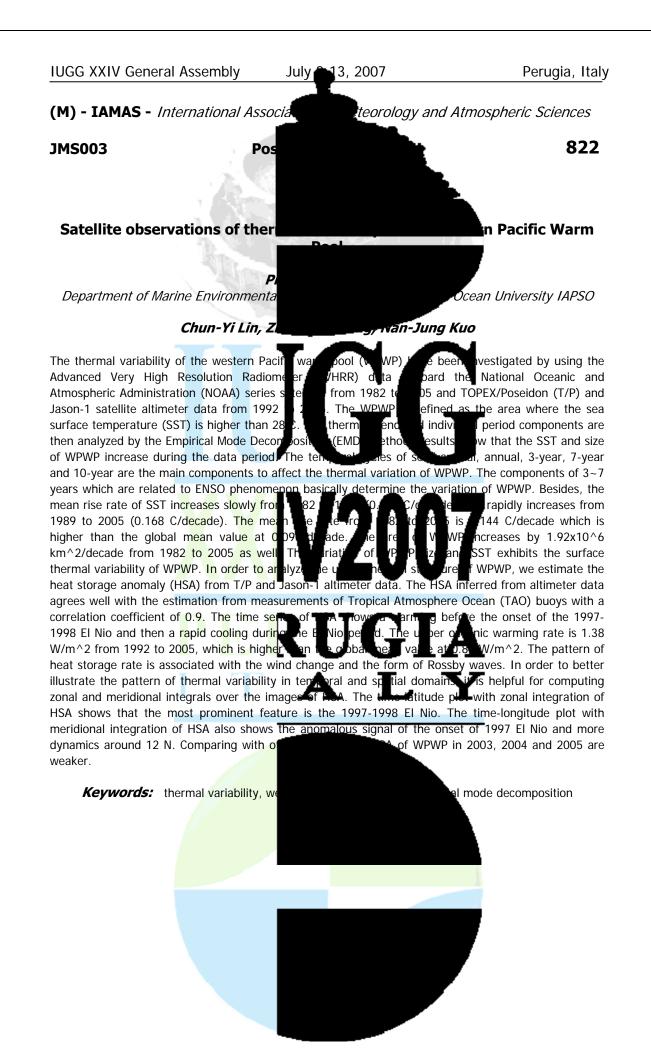


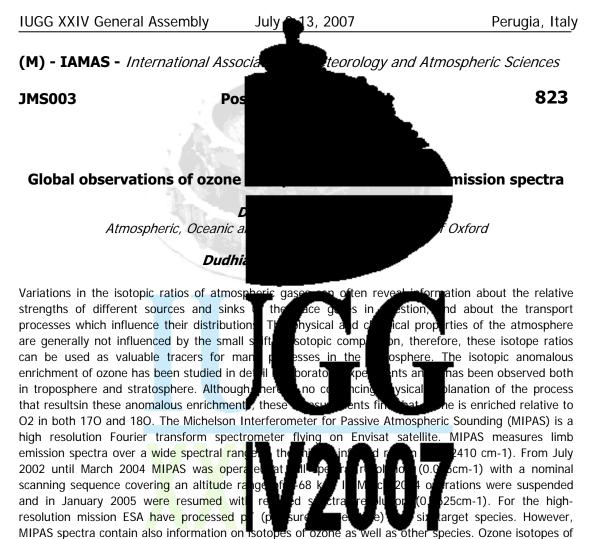




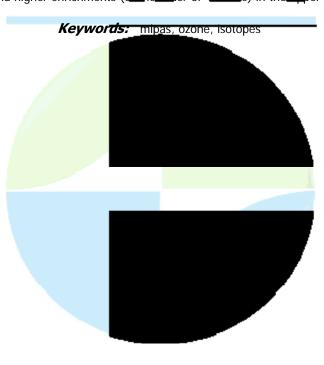


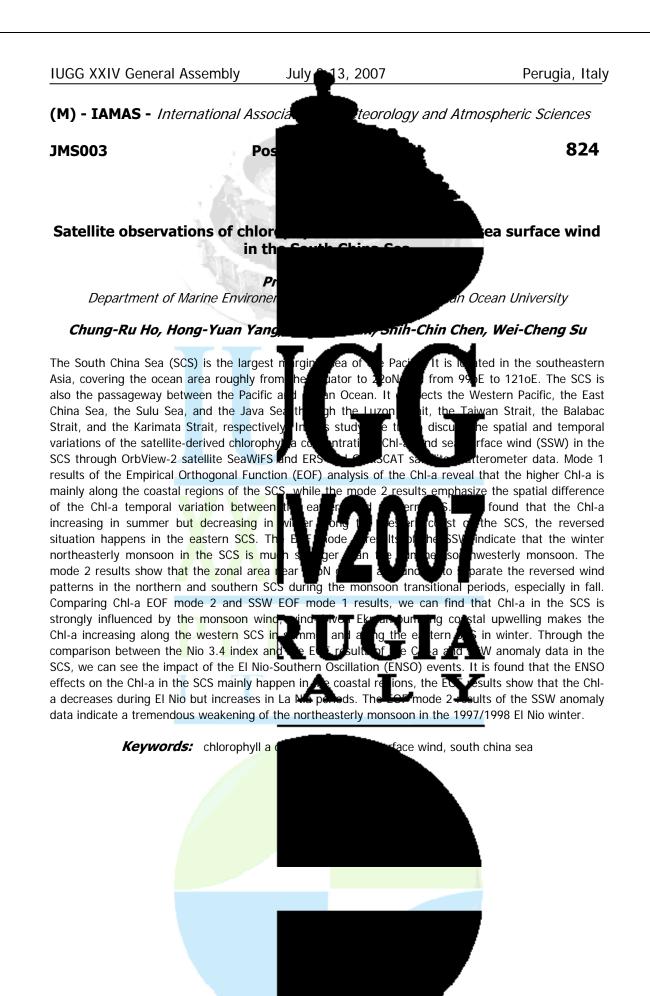


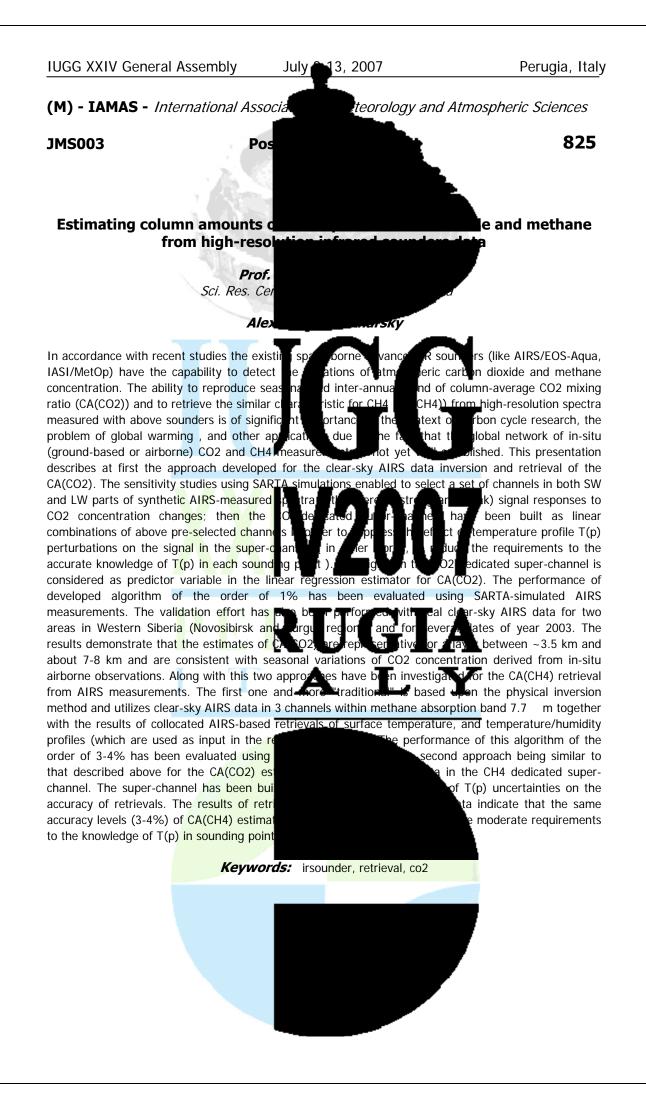




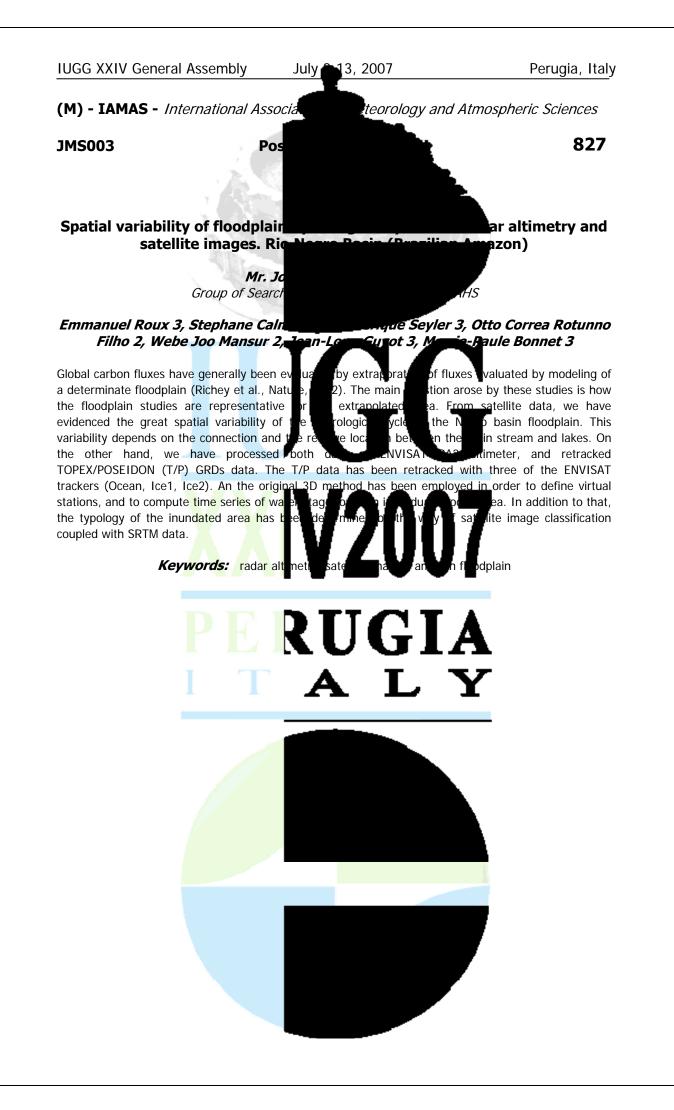
molecular mass 49 and 50 are difficult to measure in atmosphere because they are present in the parts trieving the different isotopes of per billion range and below. In this study v ozone and their global distributions and en h laboratory studies and stratospheric balloon samples show consist % through the middle bel re 200 stratosphere for both ozone isotopes of molecular mass 49 and 50. On the contrary, global distributions of ozone isotopes observed by MIPAS and ODU SMR show middle stratosphere and higher enrichments (of new der of 40 t70-20% in the low and enrichments ber stratosphere. 50%) in the

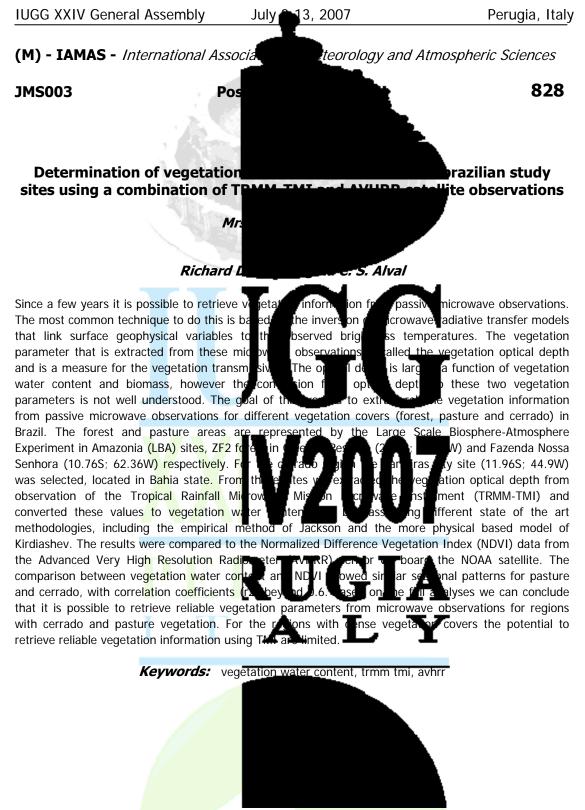




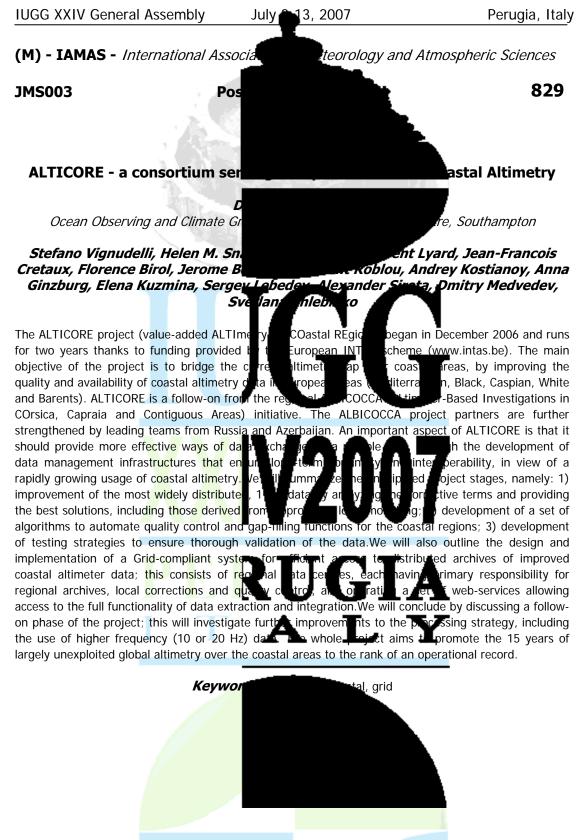




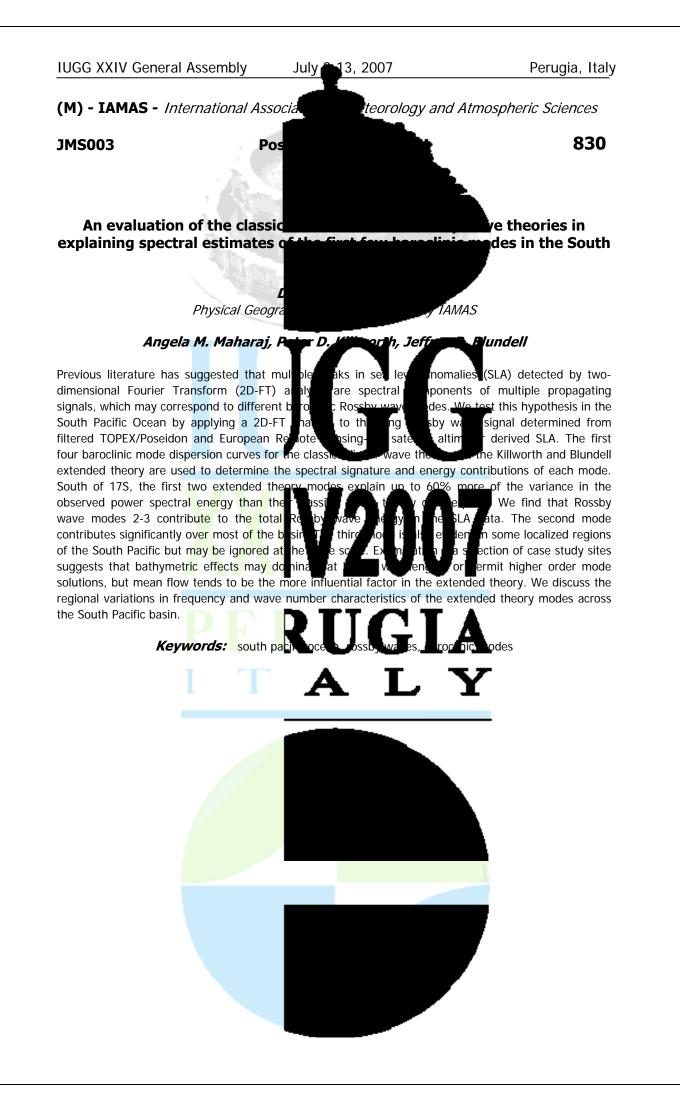








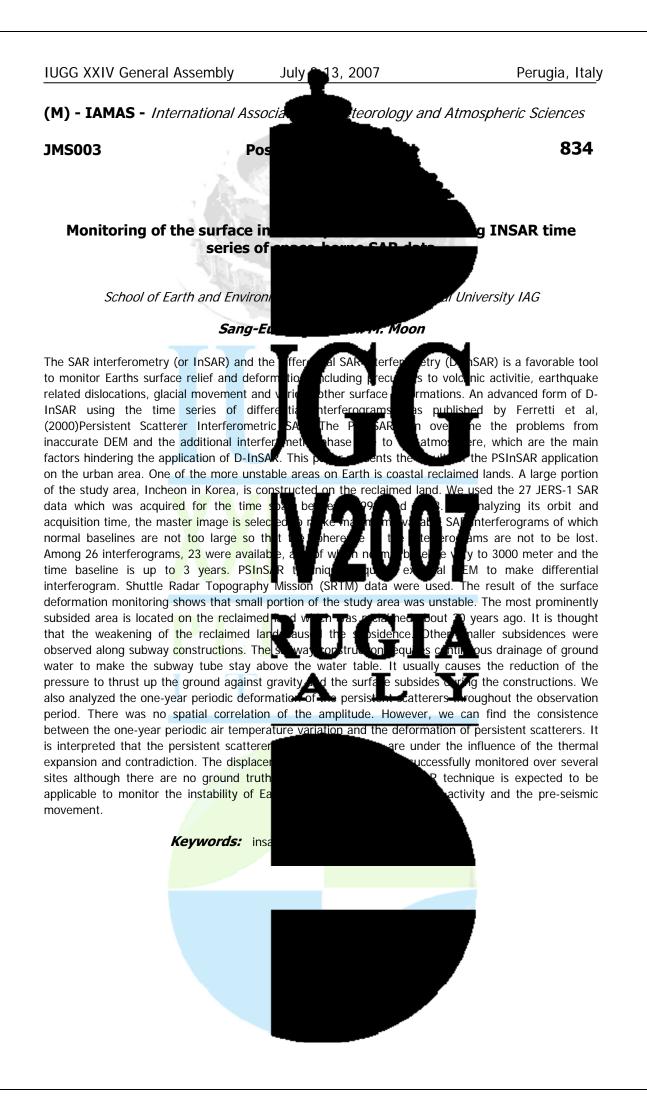


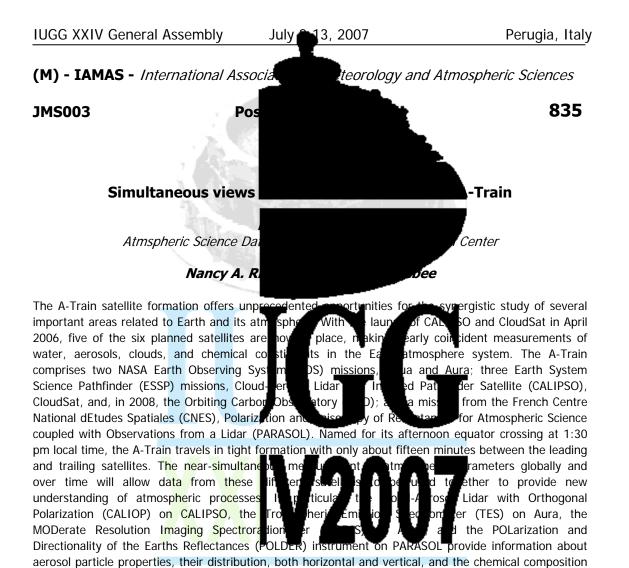












of the atmosphere. These data can be com plete characterization of aerosol ts. D/ phenomena such as dust storms, biomass b ution eve from these instruments, including CALIPSO and TES data available f Scie ce Para n th At enter (ASDC) at NASAs host eri Langley Research Center, are used to demonstrate complementary views of specific aerosol events. CALIOP is a two-wavelength polarization-sensitive lidar with horizontal resolution. It measures vertical profiles the atm resolution and 333 m 0 meter ve vides information on the phere and p vertical and horizontal distributions of aerosols and clouds and their properties. MODIS makes measurements in 36 spectral bands at 250 meter, 500 meter or 1 kilometer resolution, viewing the entire Earth's every 2 days, and derives a cluding aerosol optical thickness, type, and size distribution. The POLDER instrur polarizing filters. The instruments wide fi

several viewing angles, providing direction

aerosol optical thickness, sphericity, and

imaging infrared Fourier-transform spectro

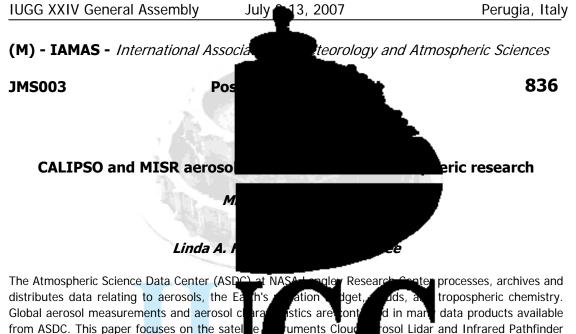
TES standard Level 2 data products includ

of ozone, water vapor, carbon monoxide,

ectral bands, three of which have to see the same scene from aerosol parameters include ument is a high-resolution and limb-sounding modes. I column measurements s every other day. The

ASDC provides data access, services and tools for over 35 projects in the discipline areas of Earths radiation budget, clouds, aerosols and tropospheric chemistry. Additional information is available from our web site, http://eosweb.larc.nasa.gov.

Keyword



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Satellite Observations (CALIPSO), part SpectroRadiometer (MISR), currently orbitin synchronous orbit on April 28, 2006, where jo CALIPSO's three-year mission is to make a global and their physical properties needed to improve climate predictions. CALIPSO comprises three instruments, the Cloud-Aerosol LIdar with Orthogonal Polarization (CALIOP), an Imaging Infrared Radiometer (IIR), and a Wide Field Camer lidar that provides information about the and the altitudes of cloud and aerosol laye in the thermal infrared window (8.65 mm, 10 particle size. The high resolution, nadir-vie win single spectral channel (645 nm). CALIPSO Level 2 aerosol data products include an aerosol layer product at 5 km resolution (height, thickness, optical depth, and integrated attenuated backscatter) and an aerosol profile product with a horizon (backscatter, extinction, and depolarization launch on December 18, 1999 on the Terra tell data never before obtained by satellite instruments. The additional information contained in these data make it possible to set limits on particle size an composition over ocean. These data are also used to de the aeros heterogeneous land and dense dark vegetation. Different methods to derive aerosol properties over different types of surface are used. MISR also uses a systematic, global monitoring program to collect data about particle type and amount. This planetary energy balance, and for modelin

aerosol data product contains tropospher exponent and single scattering albedo of parameters. MISR Level 3 global aerosol averaged over daily, monthly, seasonal a and NetCDF file formats. Additional infor available from the ASDC web site, http: charge.

ation, and Multi-angle Imaging as launched into a sun-The primary objective of e of clouds and aerosols , polarization-sensitive

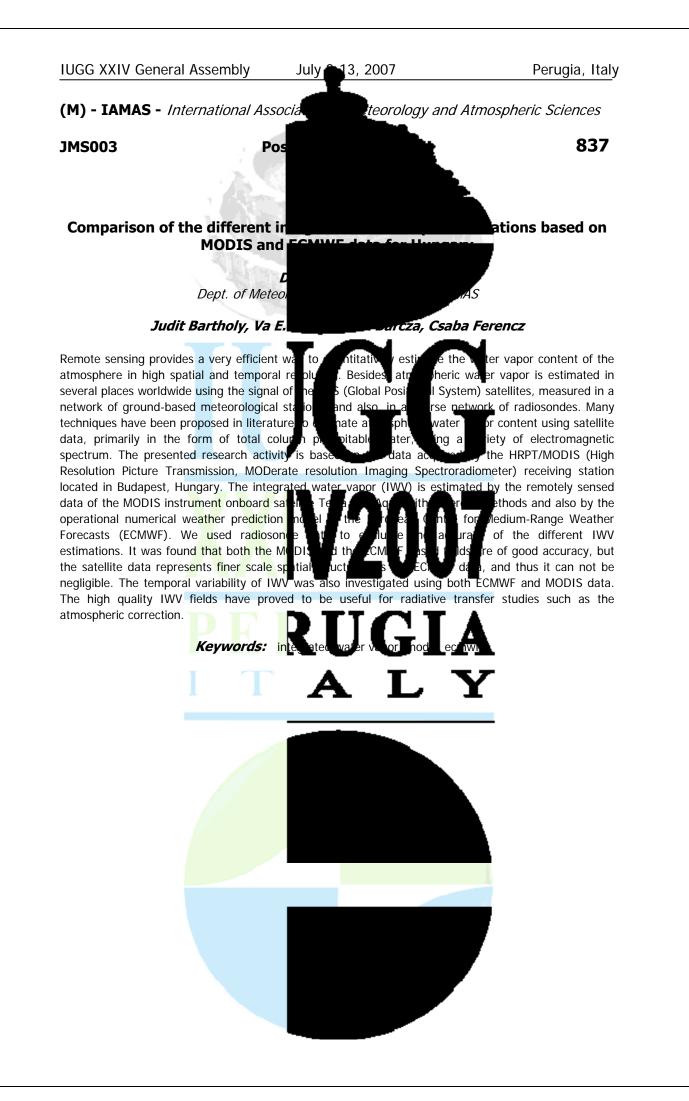
and sizes of aerosols, on at three wavelengths nine cloud emissivity and nd the lidar footprint in a

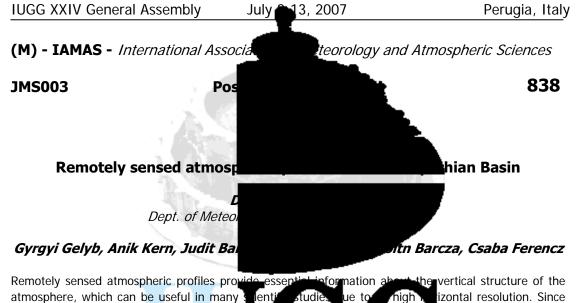
continuously since its

d ventical resolution of 120 m

s m ti-a igie s well as multi-spectral , as well as ac osol amount, measured h the atmosphere over p operties as Clim-Likely, is used in studies of the ds in Earth's climate. MISR Level 2 sol physical model, Angstrom xture identifier and related 0.5 by 0.5 resolution grid is available in HDF-EOS ts, images and tools is are distributed free of

Keywords: aerosol, aerosol characterization, satellite observations





atmosphere, which can be useful in many 2002, the Faculty of Science at the Etvs brŋ receiving facility. This station currently received polar orbiting environmental satellites. Usin IAPP (International ATOVS Processing Pack profiles of temperature, water vapor mi ۱g Operational Vertical Sounder (ATOVS) instrument

MODIS/AIRS processing package (IMAPP) software we are able to transform the Terra and Aqua based Moderate Resolution Imaging Spectroradiometer (MODIS) Level 1A raw data into Level 2 science products, such as the MOD07 product Temperature inversion is a specific and fr winters. Our aim is to compare and verify retrieved from the measurements of differ validation.

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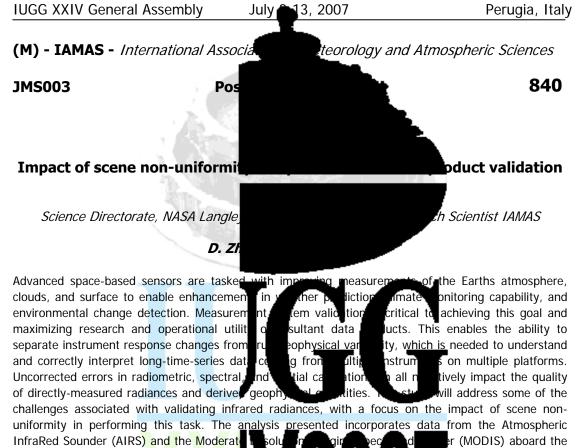
data

izontal resolution. Since st, Hungry) operates a satellite ta from the NOAA and Terra/Aqua AVHRR Processing Package) and e to derive atmospheric the Advanced TIROS Using the International

> he same parameters. athian Basin during the Са and the cloud products use radiosonde data for

Keywords: temperature profile, humidity profile, modis



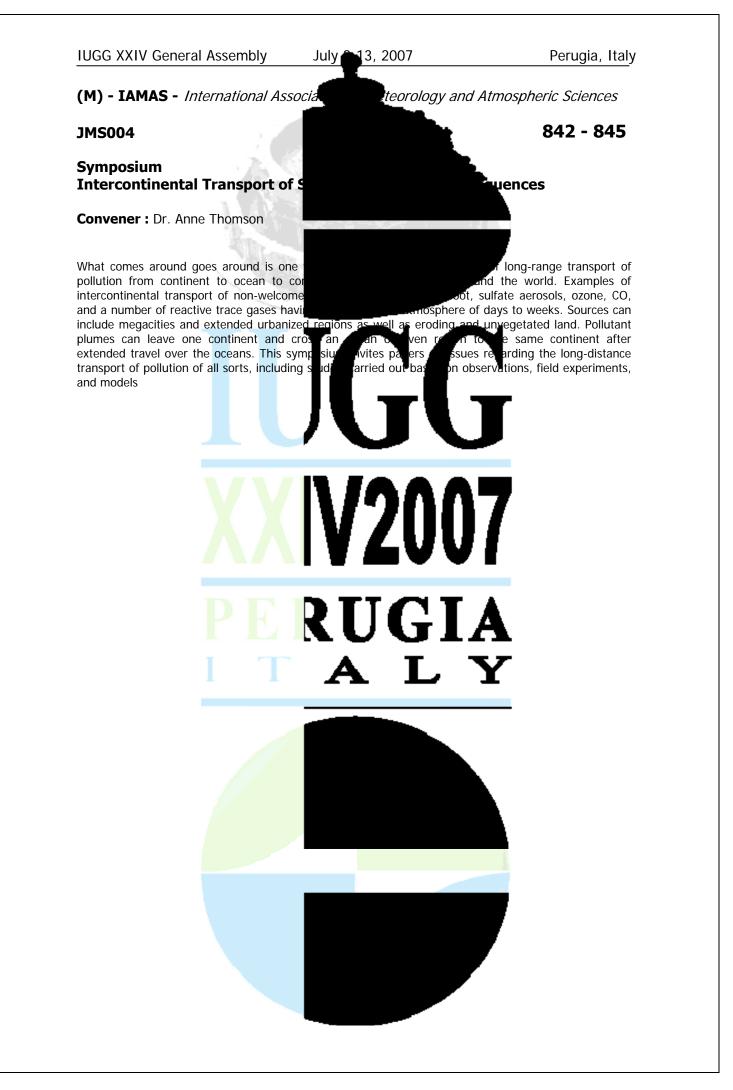


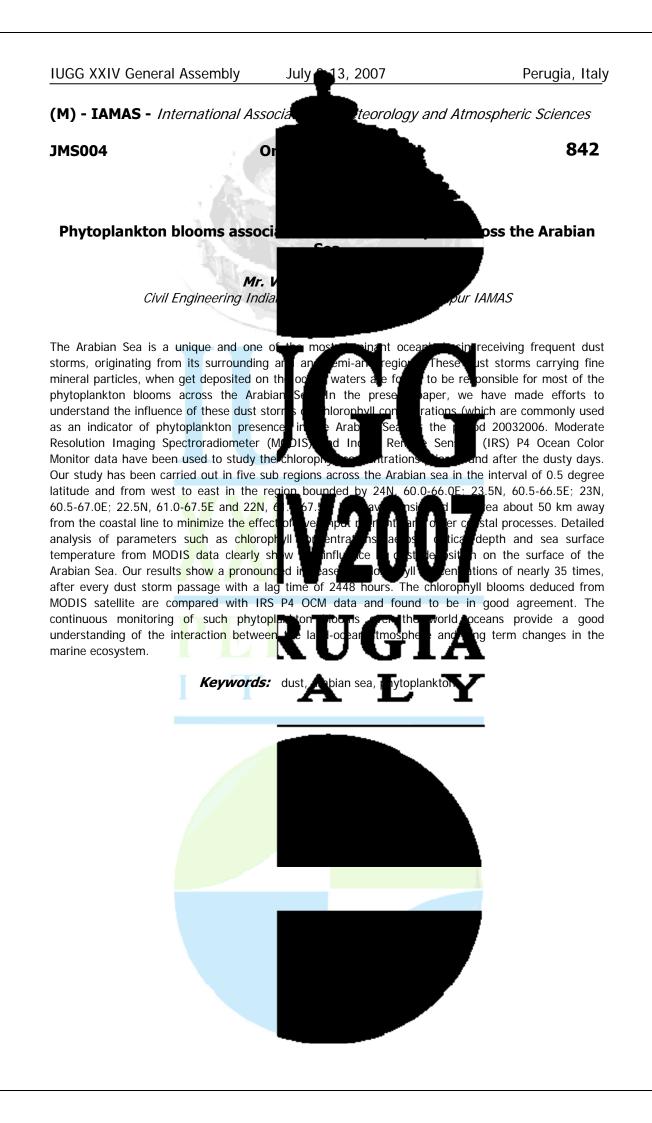
Aqua satellite, as well as high-altitude airt orbiting Operational Environmental Sa Interferometer (NAST-I) from recent fie applied to validation of the newly-launch hyperspectral and ultraspectral systems. radiances, with a focus on the solution of the

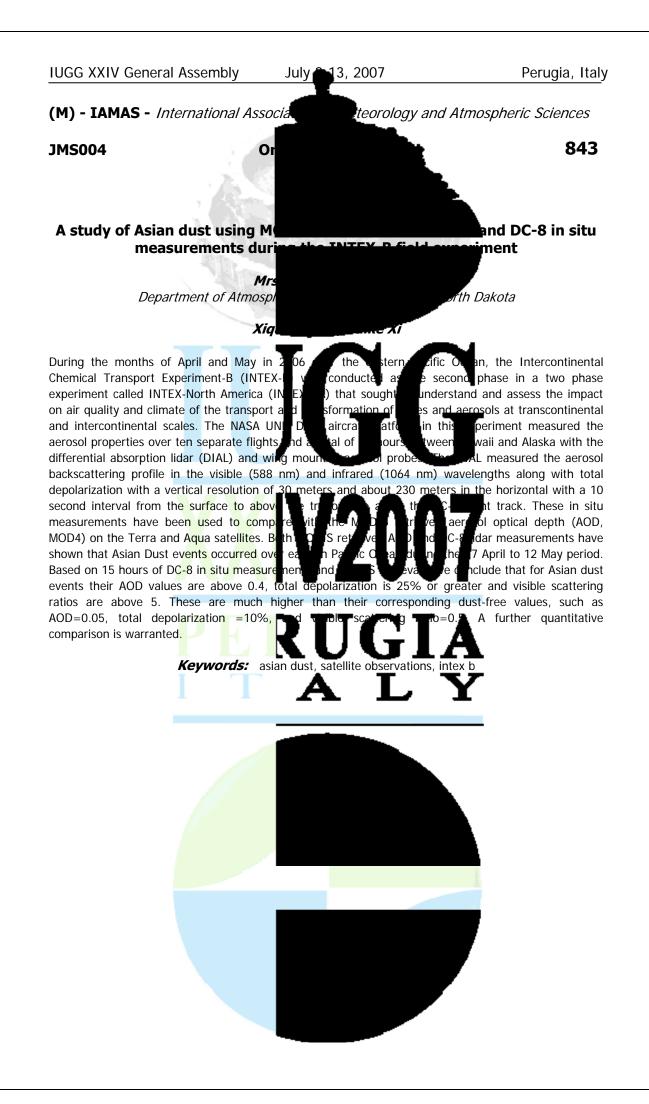
er (MODIS) aboard the om the National Polarle Sounder Testbed-ed herein will soon be other, future advanced

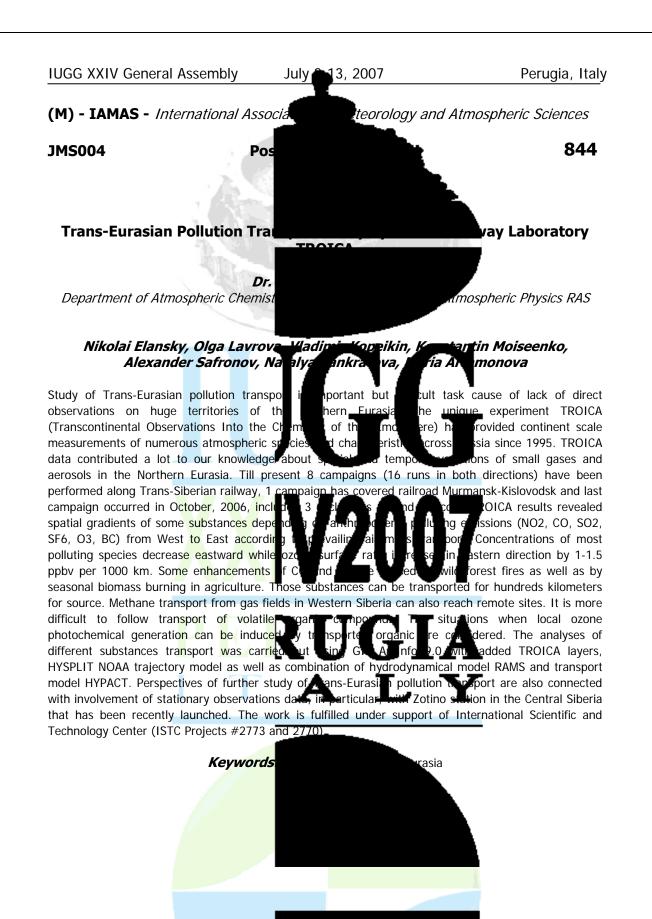
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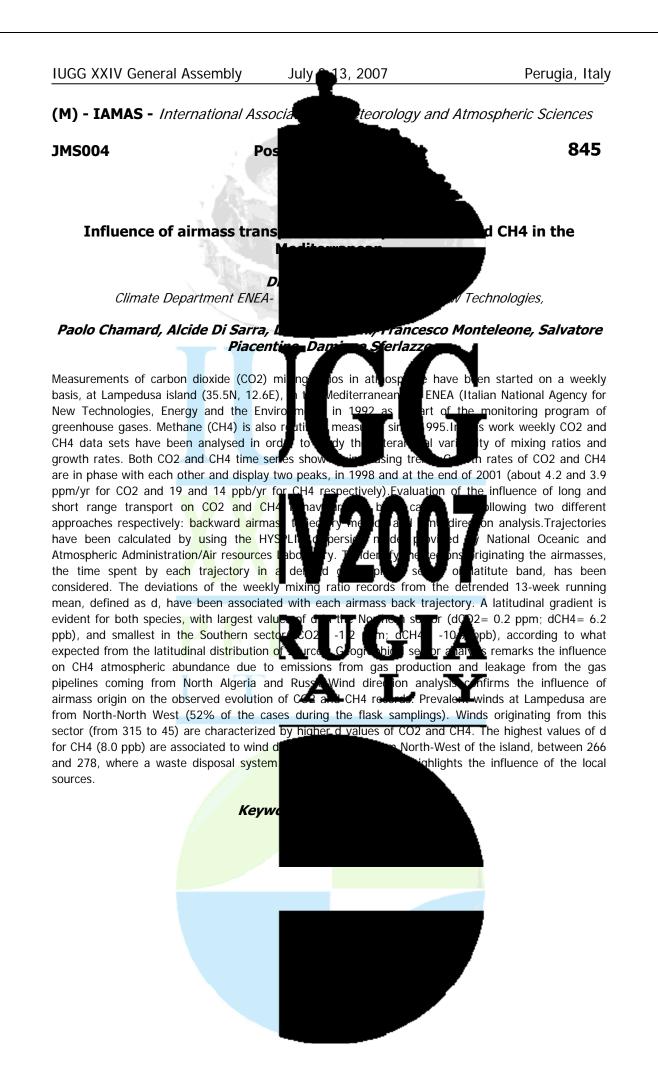












### **IUGG XXIV General Assembly** July 13, 2007

Perugia, Italy

(M) - IAMAS - International Associa

### **JMS005**

# Symposium Aerosols, Biomass Burning and

### **Convener:**

Co-Convener: Prof. Ulrike Lohmann,

This session will explore recent progress in aerosols and biomass burning, and prec encourage contributions of the role of aero on the impact of aerosols on cloud micror

cloud-precipitation interactions for climate id at reports on field campaigns and laboratory st die scales

teorology and Atmospheric Sciences



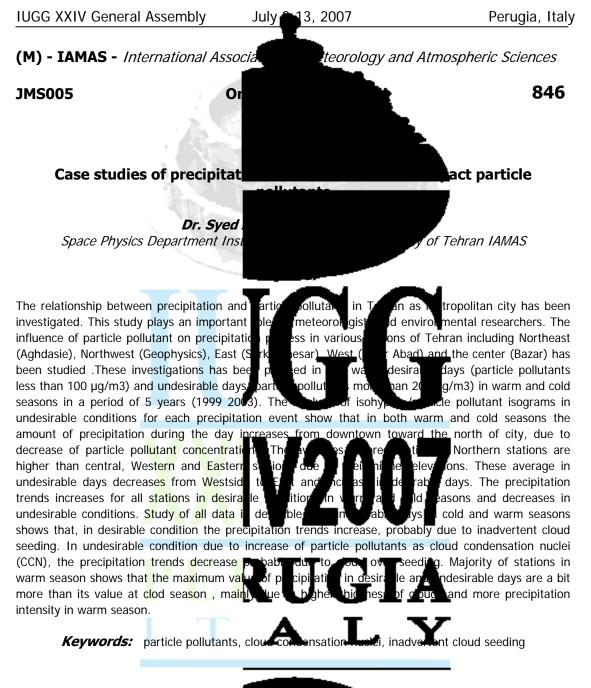
ons between atmospheric for the Earth's climate. We volution of water and ice clouds, nd especially on the processes that lead to the formation of precipitation. The session encourages presentations on the implications of aerosolchemi esentations will include Τr d modeling studies at all nve itions,

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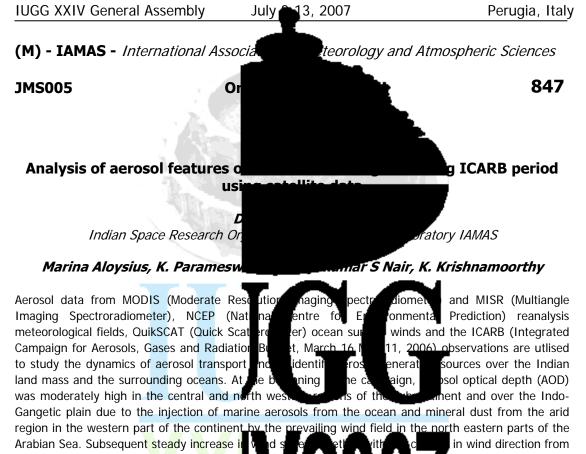
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north westerly to south westerly intensifie over the entire land mass by March to M aerosols remained confined mostly to the India. Over the oceans, the moderately high ad intensified towards the end of the campaign in the northern and the southeastern Arabian Sea and in

the north western Bay of Bengal. A pocket of high AOD located in the south eastern Arabian sea in March intensified and expanded into the mode fraction. The presence of a high A north western Bay of Bengal (around 18 N confirmed further by the direct measurements carried out on board ORV Sagar Kanya could be attributed to subsidence induced by a strong vorcity seen i analysis shows that over the land the AOD variation over the oceans, atmospheric subsidence caused by wind vorticity is found to be the prime mechanism determining the spatial distribution of AOD.

Keywords oort

enhancement of AOD ne mode component of ain and the east coast of near the coasts in March

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45) of size ~ 3x3 in the

last week of March and

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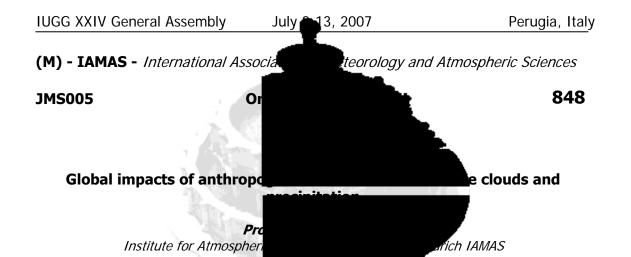
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Interactions of

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Aerosols are an integral part of the atm budget, with many possible feedback mech modify through direct emission and secon properties in warm, mixed-phase and ice ( occur through the role of aerosols in cloud condensation nuclei and ice nuclei. Because phase, changes of the properties of ice nu increase in ice nuclei can result in a rapid glacial

environment of high supersaturation with respect to ice, quickly reaching precipitation size, and with that can turn a non-precipitating into a aerosols on convective clouds is not precipitation from individual cloud syste suggestions for precipitation enhanceme presentation, I am going to evaluate the precipitation globally using the ECHAM5 general circulation model (Roeckner et al. 2003). ECHAM5

includes a double moment aerosol microphysics scheme ECHAM5-HAM that predicts the evolution of an ensemble of microphysically interacting in their size distribution and composition (S superposition of log-normal modes. In the black carbon, particulate organic matter, sea salt, and mineral dust are included. The cloud scheme, originally developed for stratiform clouds and recently extended also to convertive clouds, predicts the number and mass mixing ratios of cloud drop ats 2002; Zhang et al., 2005). Results from the coupled ECHAM5-HAM - cloud microphysics scheme will be

aerosol concentrations will be compared v order to evaluate the impact of anthropod and in different geographical regions and a and J. E. Penner, 1999: Predicting the nur 104, 9169-9198. Lohmann, U., 2002: Pos Atmos. Sci., 59, 647-656. Lohmann, U. an Atmos. Chem. Phys., 5, 715-737. Roeckr Giorgetta, S. Hagemann, I. Kirchner, L. K

Max-Planck-Institut fr Meteorologie Technical Report No. 349, 127pp. Stier, P., J. Feichter, S. Kinne, S. Kloster, E. Vignati, J. Wilson, L. Ganzeveld, I. Tegen, M. Werner, Y. Balkanski, M. Schulz, O. Boucher, A. Minikin, and A. Petzold, 2005: The aerosol 1156. Zhang, J. H., U. Lohmann, and P. clouds in the ECHAM5 climate model: Atmospheric Radiation Measurement Progr

atmospheres radiation d yet. Human activities inder s aerose parameters and cloud rosols with the hydrological cycle as aerosol particles act as cloud edominately via the ice rigina ice fo e hydrological cycle. An water cloud due to the

difference in vapour pressure over ice and water. Unlike cloud droplets, these ice crystals grow in an

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The global impact of changes in convective are inconclusive, with Feichter, 2005). In this on convective clouds and

ion is represented by a

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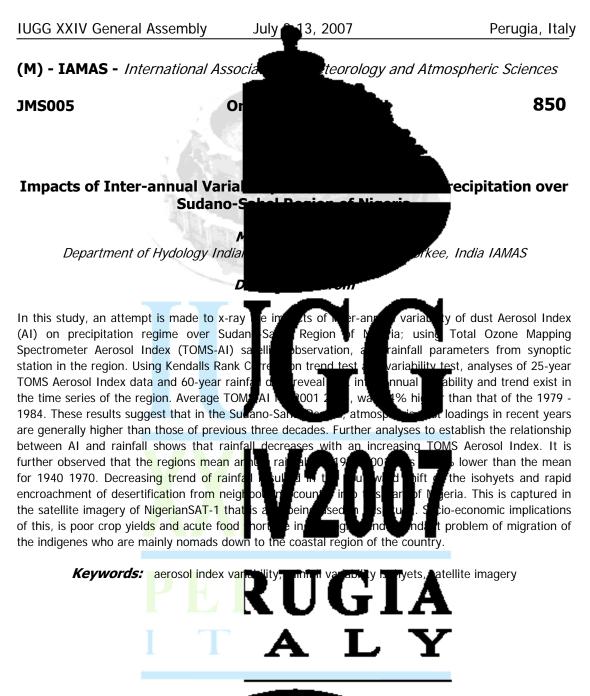
aer of populations as well as

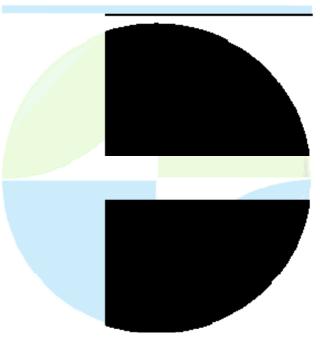
compared with different present-day observations...Thereafter sensitivity simulations with present-day pre-industrial aerosol concentrations in e clouds and precipitation globally U., J. Feichter, C. C. Chuang, AM GCM. J. Geophys. Res., via contact nucleation. J. erosol effects: A review. Brokopf, M. Esch, M. chlese, U. Schulzweida, and A. Tompkins, 2003: The atmospheric general circulation model ECHAM5. PART I: Model description,

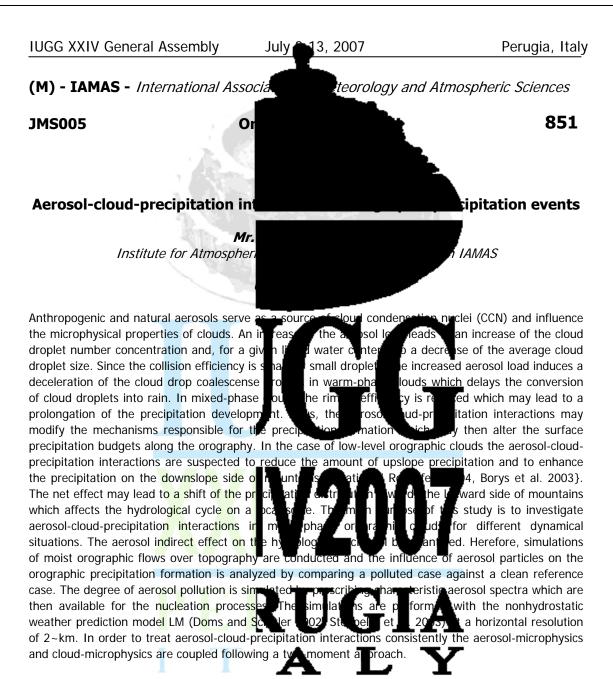
> Chem. Phys., 5, 1125erization for convective uated at the Oklahoma S07



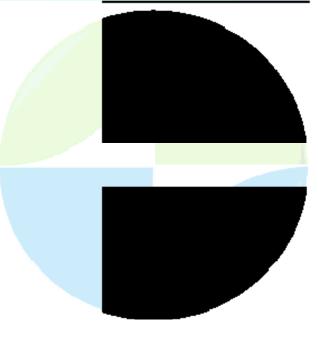




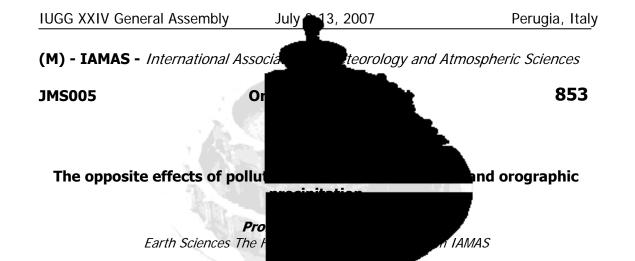




Keywords: aerosols, clouds, precipitation







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Reviewing the impact of smoke and pollution consideration provides much better defined bictu physical factors have been already docun presentation. The factors that affect clouds above cloud depth for onset of warm rain (D determine by the CCN concentrations in a range of environments. Therefore, some shallow clouds with depth respective to the small

about -10C, where mixed phase precipitation can form even in very polluted clouds. 2. Added small CCN that cause smaller supercooled cloud droplets reduce the rate of conversion of cloud water into ice hydrometeors for given liquid water cont smaller drops. The combined effects of enhancement factor of precipitation in area orographic clouds are typically shallow convective clouds prevents early rainout a that water freezes onto ice hydrometeors. The added release of latent heat of freezing aloft along with

the added low level cooling when the ice hydrometeors melt means transferring upward more heat for the same amount of surface precipitation. kinetic energy and hence greater convection surface precipitation from deep convective condensates in (3) would add surface precipitation only if requires moist environment. Therefore, polluting m

CCN, but cannot com-pletely eliminate the radiation from reaching the surface and aerosols (optical depth > 1) can eliminate dominate over the invigorating microphys convection. Measured and simulated exam by references and will be presented to the

tion according to physical SAG report. The guiding the I that we be referenced in the of the aerosols are: 1. The depth at feed from the boundary layer is to be similar in a wide appe n shu f completely rain from loud top temperature of

> ming efficiency of the decrease in orographic ased. This is so because p warm base maritime upercooled levels, where

on of static instability into

n ins ility. 4. The amount of bet vec the two large terms of ma dif ren condensation minus evaporation of both cloud and hydrometeor particles. Therefore, adding le evaporati Mosses are small, which ophysio aritime e uds would almost always invigorate them, but will add surface precipitation in moist environment, and will decrease surface precipitation in dry environment. The addition of giant CCN works to reduce the impacts of the small ts of absorbing aerosols intercept solar Very large amounts of absorbing

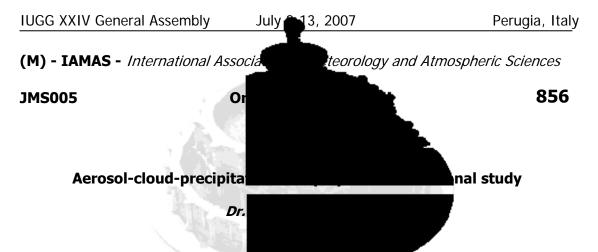
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pr deep clouds this effect can suppress the vigor of the tion of all these processes the presentation.

Keyword







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# P. Ernest Raj, K.K. Dani, R.L. Bha

Atmospheric aerosols exhibit large temporal and s removal and transport processes. Although their known to some extent, the magnitude of understanding of the processes that control nuclei (CCN) and ice nuclei (IN), and contrib cycling mechanisms modify aerosol propert clouds and precipitation has been a challeng and climate, satellite remote sensing, a

investigations. The aerosol-cloud-precipitation cycle is the major and not-clearly-understood mechanism responsible for the modification of aerosols in the troposphere, which leads to cloud growth and subsequent precipitation under favorable direction using the lidar, sun-sky radio communication. Over 800 weekly-spaced urban station in India) obtained from the t period from 1987 through September 200 has been computed by height integrating each vertical profile from 20 m to 1100 m. The concurrent weekly total rainfall data from the India Meteorological Department (IMD), Pune, and TOMS estimated

Aerosol Index (AI) have been used in them negative value indicates non- or less-absor the study indicate (i) greater concentra n (December-February) and coarse-mode particles during the pre-monsoon (March-May), (ii) The year-toyear variation in the aerosol column content shows go precipitation over the experimental station, (iii) AI during pre-monsoon and minimum during winter, (iv) Dominance of absorbing aerosols during premonsoon and less-absorbing aerosols during winter, (v) variation of AI is significantly larger and negative during 1987, 2002 (weak mon monsoon years) and (vi) Both aerosol load to be smaller during 1987, 2002 in con between the variations in AOD and tempe More details of the study and results will be

variations wit eraci teraction is ributions. Cer the c<u>loud for</u>r ne tro hus, ť 'nе lem. ldit he im hg i and lity hà

variety of production, terrestrial radiation are far a y constrained because of limited aerosols act as cloud condensation n / development, and hence cloud tudy of their impact on of aerosols on weather subject of numerous

dithurai, S.M. Sonbawne

tigations made in this are presented in this density over Pune (an spread over the 20-year aerosol column content

ols. The main results of

les during the winter

le ce with seasons total d correspon AI shows bell-shape with maximum pared that during 1988, 2004 (active pitable water content are observed 004, and (vii) The association during weak monsoon years.

ndicates absorbing aerosols and

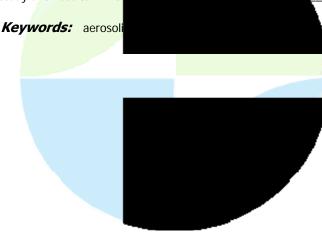
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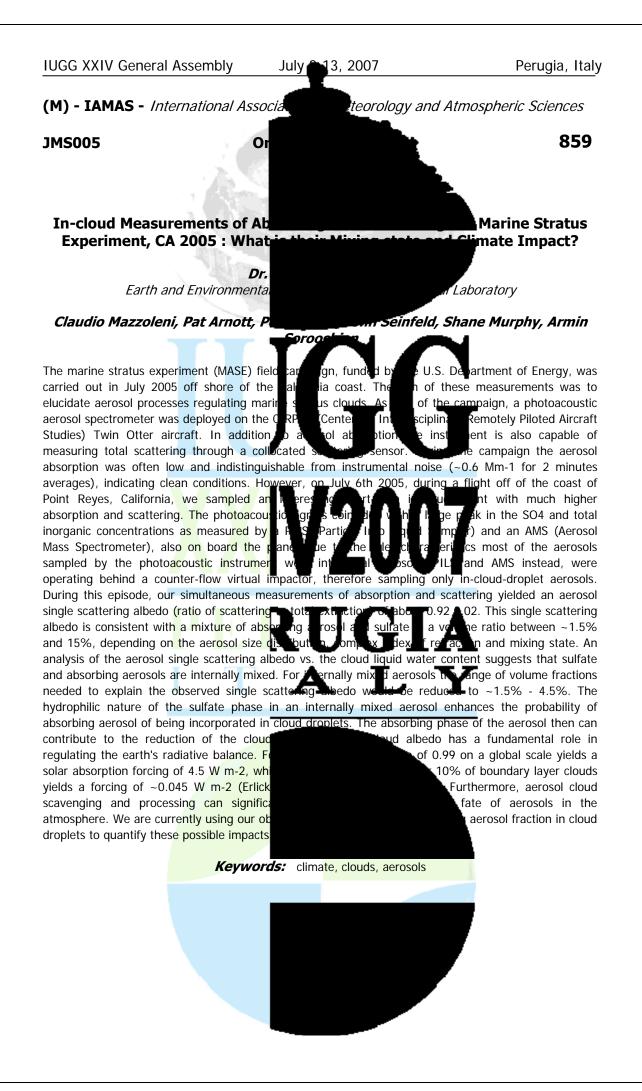
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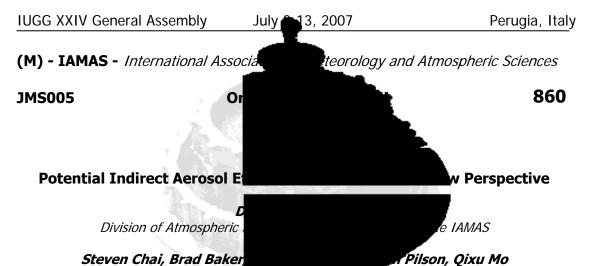


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### Steven Chai, Brad Baker

As measurements of the ice particle size distribution considerable evidence that the measured h m) in some cirrus are real and not an artifa optical probes. For example, PSD exhibiting when the concentrations of larger ice partic shapes of the small crystals generally appea shape), and do not appear fragmented a remote sensing techniques indicate high concentral

-45 oC, the PSD generally appears quasi-bimodal with an inflection point around 60 µm denoting two ice particle populations differing in shape and size, based on measurements by the FSSP, the Cloud Particle Imager (CPI) and the 2DC probe. The large to the small particle mode. The small m ranged from about 10 µm to 20 µm, ice total IWC, and number concentration ran range of -65 oC to -30 oC. We were interes modes of the PSD could be explained theoretically. Taking the view that the small mode crystal concentrations are not measurement artifacts, we postulate that most ice nucleation events proceed

first through the liquid phase as haze subsequently freezing to form quasi-spheric temperatures warmer than -35 oC. In an kplo investigated what type of mechanistic behavior could possibly explain the bimodality presumably observed in natural cirrus. For example, if these why concent exist, why are there two distinct populations of central articles i and what physics are responsible for maintaining this bimodal structure? And how can we

typically observed in cirrus? The parcel m using mass- and area-dimension power observed crystal growth rates from labora tunnel results were generalized for any su that part of the reason for the observed b crystals have linear growth rates much attributes, a two-step nucleation process measured are a small subset of the total id result from the freezing of a small subset of the cloud droplet population. In step 1, the ice particles

droplets freeze (possible mechanisms inclu Durran 2005). This produces a sudder supersaturation over ice to near-zero valu bimodal structure. The mean size, fractiona typically observed was reproduced reason

al shape improve, there is nall ice crystals (D < 60 '3) o larger i particles at the inlet of mall ice crystals sometimes occur atively insignificant or absent. The act (w large enough to resolve shatt g events. Moreover, IR nperatures warmer than

> s a shoulder appended an dimension (length) out 10% to 80% of the based on a temperature tes of the small and large

rogeneous nucleation at

hase parcel model, we

me ubset of this population

tions of small compact ice crystals truly tor hs of PSI shape and crystal shape.

mechanistically account for the mean size, IWC and number concentration of the small crystal mode ts the diffusional growth of ice crystals stal growth rates are based on pdraft) experiments. The wind w of Diffusion. It was found ct that the small compact explain all the bimodal the ice nuclei normally small compact crystals

building the large mode nucleate first on traditional ice nuclei. In step 2, in cloudy regions with negligible updraft, the Bergeron-Findeisen process evaporates cloud droplets and a subset of these described by Shaw and rystals and drops the

owth and locking in the f the small mode that was tive to observed changes in

# IUGG XXIV General Assembly

aerosol concentration. But this two-step concentrations observed in cirrus containing a simpler process that is also active that is that processes may exist in cirrus clouds t may be nucleated from a subset of the cle will have an indirect aerosol effect that p less than -45 oC, the small mode appea tropical cirrus clouds. These clouds may be does not account for the high ice crystal bishs. Therefore, if it occurs, there may be bain purpose of this study is to show I PSD, and that the small crystals If that were true, then cirrus of the PSD. At temperatures tites of mid-latitude and ffect.

Keyword

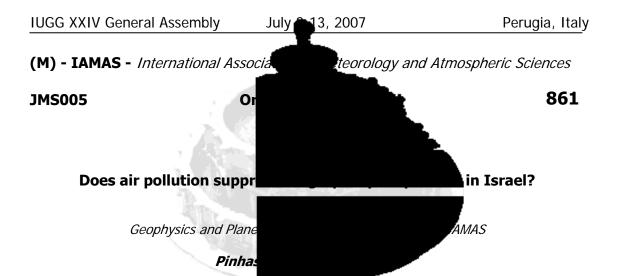
# I T A L Y

13, 2007

July



Perugia, Italy



The effects of air pollution on precipitation have importance of the subject to water supply and to reported that air pollution in both central and Q the mountains as compared to the amount second look at data from and found differe past 50 years and divided it based on geogr and downwind of pollution centers on the precipitation in both places increased. Fu

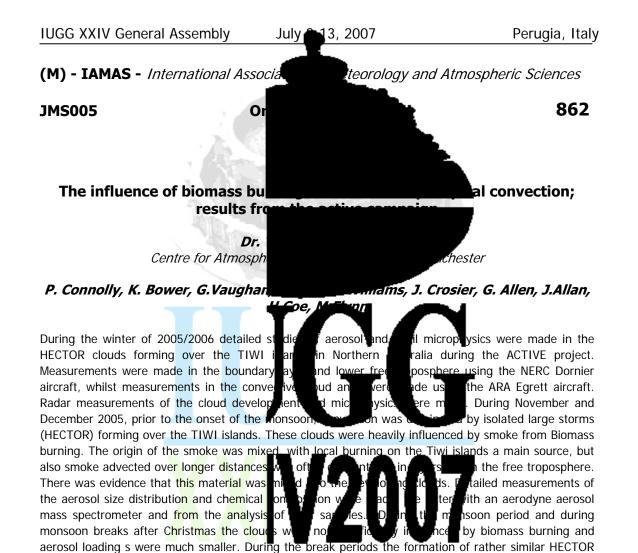
divided by the precipitation over the coast (called the orographic ratio, RO) has generally remained the same. In some areas, especially in the central part of and downwind of the major urban polluted area of the country, R0 actually increased. This is Rosenfeld (2004). Moreover, the ratio of the mountain) to the amount on the up Galilee Mountains ) has decreased, in c Rosenfeld (2005). The possible reasons for

a grea late. ent frnia reduced upwind of t ts. I<u>n this s</u>tu ocatio f the nta thermo

f attention due to the ti and Rosenfeld (2004) by ipitation over the upslope side of olluting urban centers. We took a we analyzed rainfall data from the f polli centers along the coast I it we observe that the In ge tion over the mountain

reported by Givati and (on the eastern side of e northern part of (the me area by Givati and ults will be discussed.

Keywords: orographic, rainfall, pollution

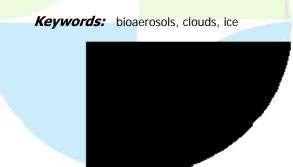


storms to the pre-monsoon period were observed. In this paper modelling studies of these clouds will be presented using a combination of a Clop plicit microphysics model. Using these models the sensitivity of precipitation the aerosol entering the il micro nysic cloud will be examined with a particular ems h biomass burning. The sis e r he ros i m role of these aerosol as both cloud condensation nuclei and ice nuclei (in competition with other particles found in the area) will be explored. The consitivity to erosol will be Explored in the context of variations in the structure of the atmosphere h the cle orm. The elative importance of the

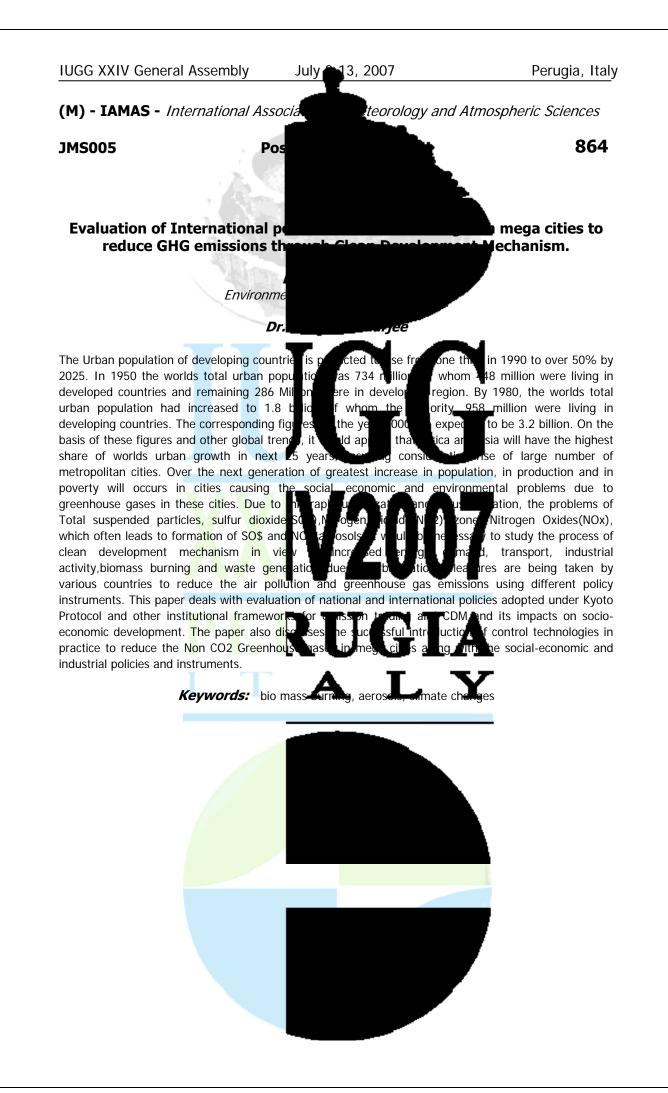
aerosol and the atmospheric structure were investigated. It is found that changes to the aerosol input

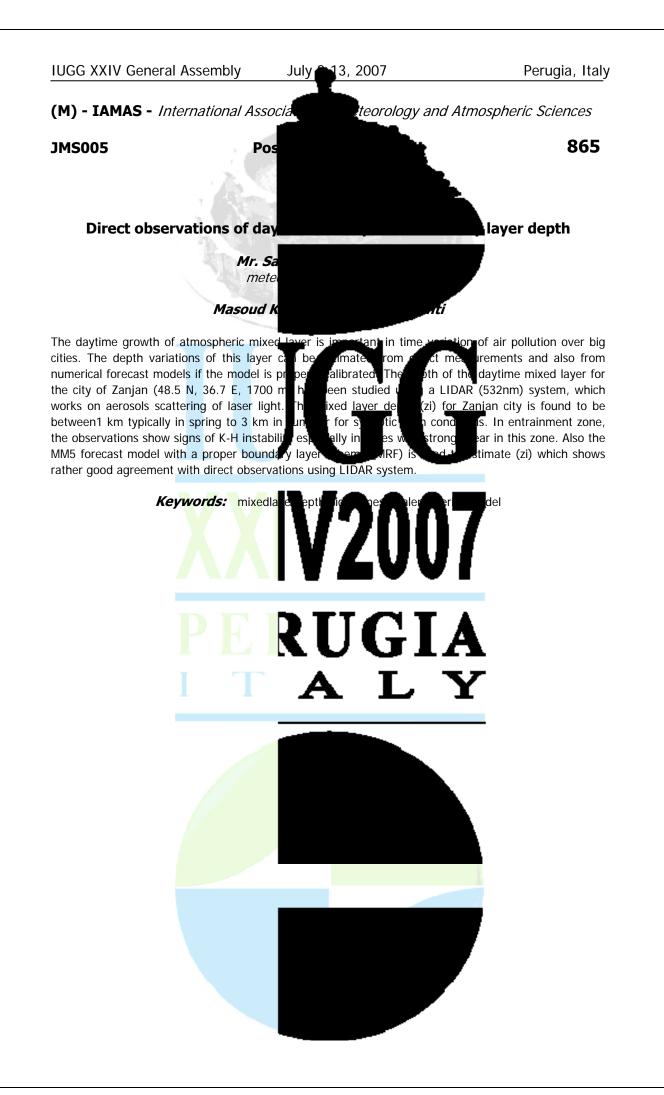
can have a significant impact on the timing of precipitation from the cloud system; however, the impact on the total amount of precipitation was s the cloud where latent heat of freezing homogeneously then this was able to caus the cloud. This increased both the cloud was an optimum number of both CCN an vertical structure of the atmosphere in whi the cloud to the aerosol. For example, implications of the results for role of bioma

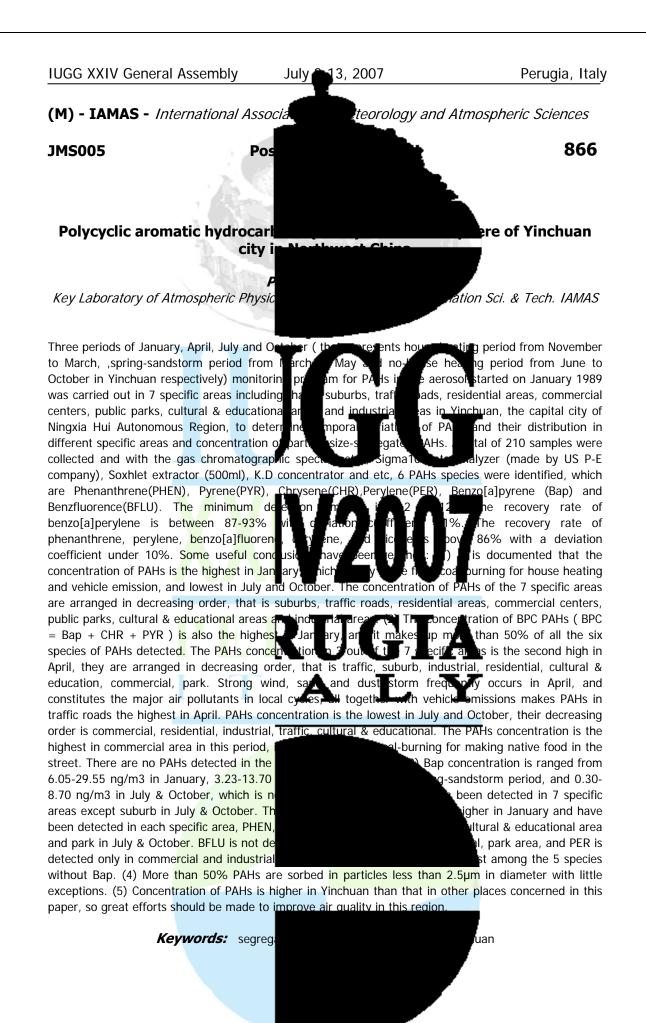
effect was found to be the position in tial amount of liquid water froze up draught close to the top of e anvil region. Hence there elopment. Aspects of the luenced the sensitivity of a marked effect. The ation will be explored.

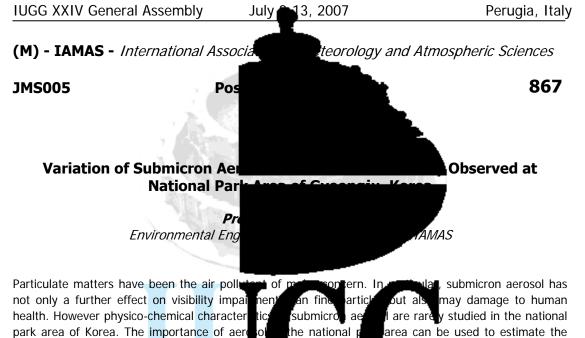












park area of Korea. The importance of aer possibility of its regional or long-range tra submicron aerosol, atmospheric aerosol Gyeongju. Size- resolved submicron aeroso a MOUDI sampler. In this study, size-resolved elem

and quantified by PIXE analysis using a Tandem van de Graaff proton accelerator. Impact of air mass pathway on characteristics of particulate matters was also analyzed in the end point of Gyeongju with backward trajectory results from HYSPLIT were classified into soil related mineral s metal species (Cr, Mn, Ni, Cu, Zn, Br, and mass concentration of AI to Pb elements a submicron particle mass. The elemental c park area where there was not such a big local source air mass pathways.

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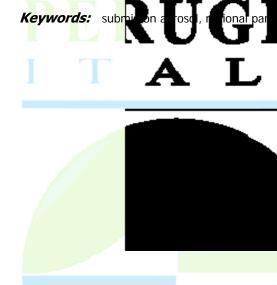
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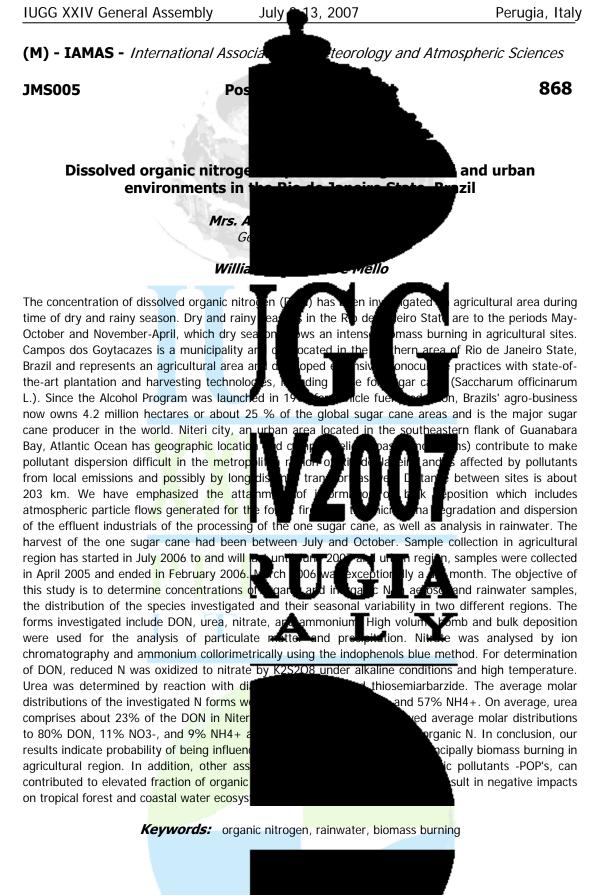
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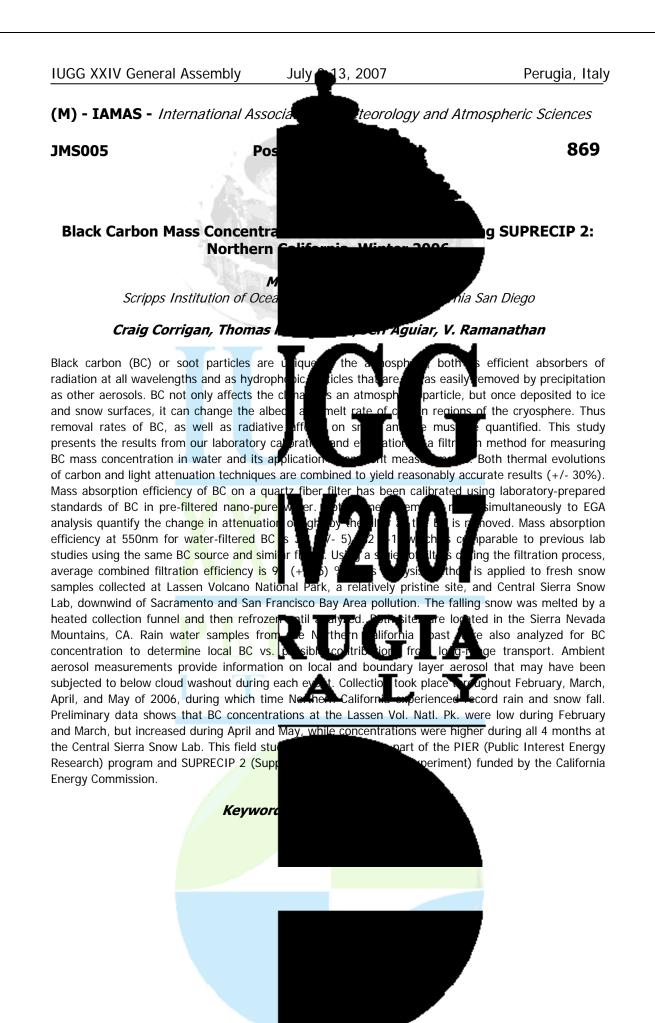
area can be used to estimate the estigate elemental composition of d at national park area of ing a 1.0 cyclone sampler and on aerosol was qualified

s of submicron aerosol opogenic related heavy ant ement of S. The sum of unted for 33 ~ 45 % of measured at the national represented dissimilar patterns among different



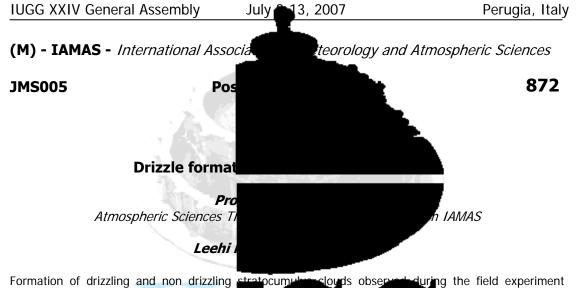












DYCOMS-II is reproduced using a novel tr computational area is fully covered by 1000-00 about 40-50 m. Since the parcels are adjace located below and grow by collection of sm microphysical structure of both non-drizzlin comparatively small number of lucky parce size distributions. The history of these ucky

supersaturation, vertical velocity, droplet concentration, etc. along the parcel trajectories. Simulations indicate that drizzle formation and rain flux in the stratocumulus clouds dramatically sensitive to the aerosol concentration. An increase in the formation. The physical mechanism leading increase in aerosol concentration decrease evaporation. Therefore, small droplets downdrafts. Application of the results to re

louds obser ecto mod insen rgangianair le forming in lets. <u>It is sho</u>r drizzlin loc near clo vesti

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undary layer (BL). The of the Is with caracteristic linear size of parcel can fall through the parcels hat the model reproduces well the that drizzle forms in a aving the widest droplet nalyzing the values of

> an fully prevent drizzle d. It is shown that the ases the rate of droplet n comparatively strong

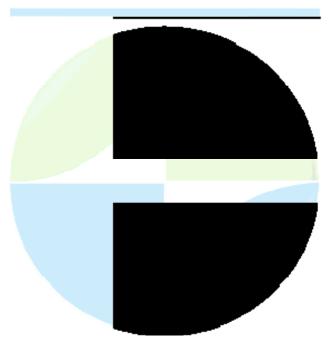
Keywords: drizzleformation, cloud aerosolinteraction, remotesensing

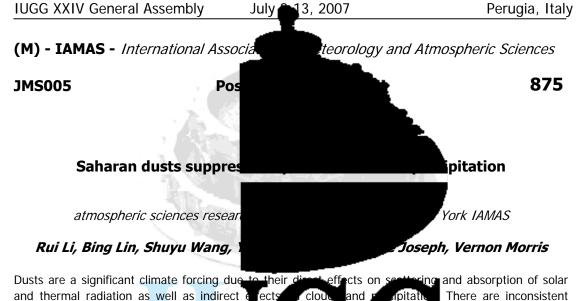




during the week-days was higher than this quantity during the week-days 2.8 times. The sum of liquid and solid precipitation during the week-day was approximately 1.65 times higher than during the weekends. The analysis of the data about the intersity of hell during the increasing region showed that the analogous effect was observed also in the middle of the eightieth years of past century.

Kevwords: tion, p





and thermal radiation as well as indirect results of aerosol indirect effects on clouds on rainfall internal structures. We utilize m layer impact on cloud and precipitation over dust-cloud interaction. We found that dusts additional ice nuclei. Consequences of mig spectrum from heavy precipitation to light pred

Microphysical processes of dust-cloud interaction impact on water phase changes, reducing latent heating and cooling rates in both convect dust-cloud interaction had strong feedback of heating profiles in both convective an changes and resulted in a weak but long fraction and decreasing stratiform precipita

fects clou and of directevi hd, sors on multi<sub>i</sub> ti Ocean, with rong orted al eff bph of nd sui

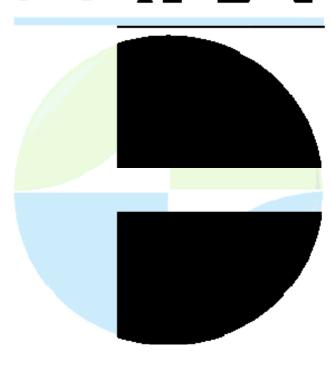
There are inconsistent e that receal the impacts of dusts forms to investigate Saharan dust sing on microphysical processes of ection updraft acted as hifting precipitation size recipitation. Dusts also

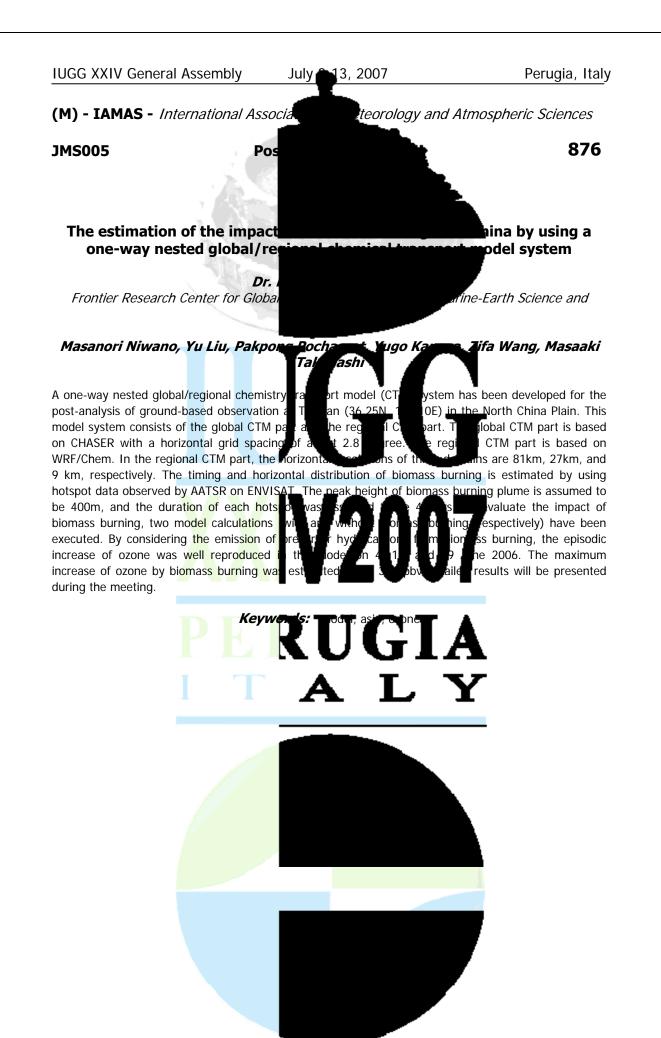
enhanced evaporation processes, which further reduced the precipitation reaching surfaces.

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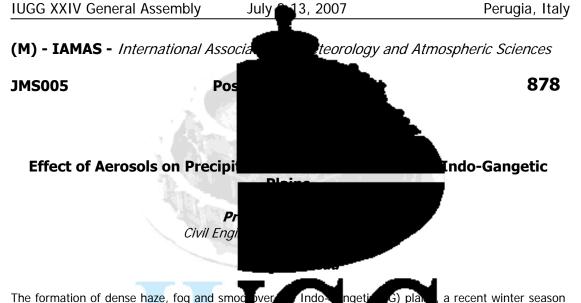
ophysical processes of ed the vertical gradient adjusted itself to these convective precipitation

Keywords: dust, precipitation, clouds









phenomena since last one decade, affects r increasing aerosol loading and pollution on a conditions in the IG plains. In the presparameters from MODIS, MISR, TOMS and be highly variable in space and time and t the aerosol sources. The aerosols characteristics of

the IG plains. In the eastern part, the sources of aerosols are mainly from coal based power plants whereas in the western part the aerosols sources are due to forest fire and biomass burning. The eastern part of the IG plains are affected atmospheric moisture regime over the IG p the precipitation and formation of dense aerosols are found to show one to one re other part it shows negative relation. Suc light of aerosol and cloud parameters.

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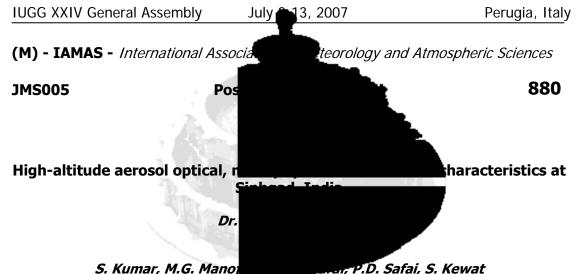
sha

a recent winter season studies have shown the effect of ion, hydrological cycle and climatic spatial distribution of aerosols barameters are found to ct the characteristics of om the western part of

> year which affect the w contrast influence on The increasing trend of ion in some part and in will be discussed in the







S. Kumar, M.G. Manor

Measurements over high-altitude stations eld these stations generally lie in the boundary nighttime, thus provide unique opportunity from / between the boundary layer to / and distribution of aerosols and gases in the fr region of the planet. Moreover, under seas halli the free troposphere during night, become very in

during early morning / night transition period. In order to address some of these issues, extensive observations of aerosol optical, microphysical and radiative parameters have been carried out at Sinhgad, a high-altitude rural background road, to the south-west of Pune during studying also the interesting phenomeno consisting of multi-channel CIMEL sun-sk Kipp & Zonen short-wave pyranometer GRIMM real-time aerosol spectrometer and McGee aethalometer have been deployed in the study.

Simultaneous measurements using these facilities have been made on some selected experimental days during December 2006-January 2007. The (AOD) of about 0.17 at 440 nm, water vap 2) as well as at the top-of-the-atmosphere high-altitude station of the type under study, and they are found to be very smaller as compared to those observed over an urban station like Pu radiometer-derived AOD and size distribution meteorological parameters. The aerosol size distribution derived from direct as well as remote sensing methods have been examined in conjunction with HYSPLIT model back trajectories to understand the long-range transport of aerosols and pre details of the complete observational pro results obtained will be presented.

Keywords

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concentration. Added, in the free troposphere during the bort/mixing of aerosols and gases ere is lack of knowledge about the one of the less studied titude stations, being in of pollutants, particularly

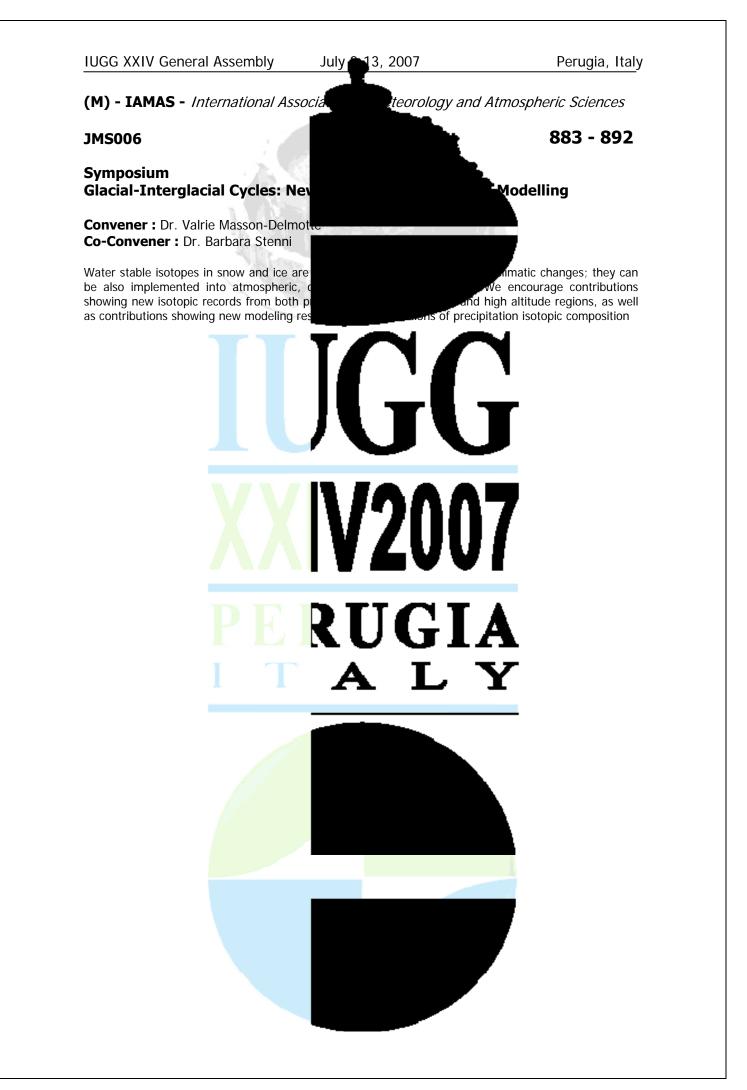
> errain, about 40 km by beriod was chosen for A suite of instruments hotometer, ozonometer; ng instruments including

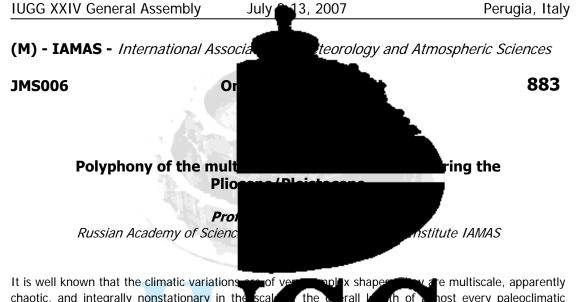
mn aerosol optical depth le col ng at surface (-52 W m re c vpical characteristics of orecent ts also sho an association between black . rbon concentration and

arly during the periods of haze. The s deployed and more interesting









chaotic, and integrally nonstationary in the record being considered. Moreover a gener Millions years. This trend probably is induce system as a whole. According to the moderr suppose that the shortest-term (the interan as essentially nonlinear and apparently char forces (to the annual periodic heating of the clim

frequency (the centennial and millennial) variations can be of a quasi-linear character like oceanic and atmospheric tides. Usually they are of neutral stability, climatic variations of the supra-long scales external forces like the famous Milankovitc a great challenge for the international wavelet and cross-wavelet analysis has paleoclimatic variations. This technique is records covering the Pliocene/Pleistocene time period. As results, many evidences of nonlinearity and fingerprint of different external forces were obtained such as amplitude and frequency modulations of

rall the seems te be general evol mati<u>cal nonl</u>ii d inter da nses e c from

nost every paleoclimatic ting in the largest scales of many h of the Earth planet and the Solar dynamical systems theory one can tions reveal themselves natic to the different external e sys ainly). Some more low-

and so nonchaotic in principle. At last, the to the slowly varying ex climatic variations is new technique of the up the essence of such and ice cores) climatic

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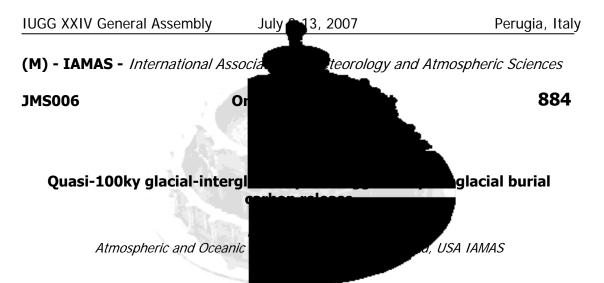
the paleoclimatic variations within a very years. The well-known 100-kyr problem se and near-equatorial paleoclimatic variations fo particular, the equatorial variations look to be quasi-linear responses to the Milankovitchs eccentricity and obliquity. In sum, paleoclimatic variations veal them elves as a adjusted complexity like Polyphony of musical

Keywords: nonlinearity climate dynamics, chaos and order, wavelet analysis

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A new mechanism is proposed in which clim produce a feedback that can produce quarter 100 burial and preservation of organic carbon interglacial CO2 change. Allowing carbon hypothesize that the switch from glacial ma glacial burial carbon when icesheets grow significant. Glacial inception may be initiated transient interglacial CO2 value as the land-origin

circulation and CaCO2 compensation. Also important for glacial inception may be the CO2 uptake by vegetation and soil regrowth in the previously ice-covered Boreal regions. When tested in a fully coupled Earth system model with comprehensive d components, it produced under certain par durations of 93 ky, CO2 changes of 90 pp not be easily explained by the weak M hnk icesheet mechanism provides a strong feedback major observed Quaternary climatic variations. In particular, some terminations maybe triggered by this internal feedback while others by orbital forcing.

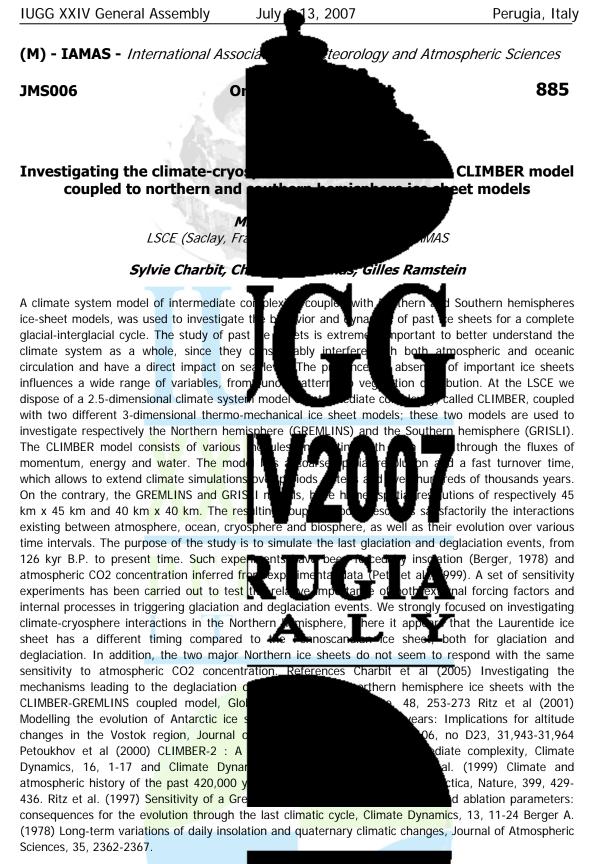
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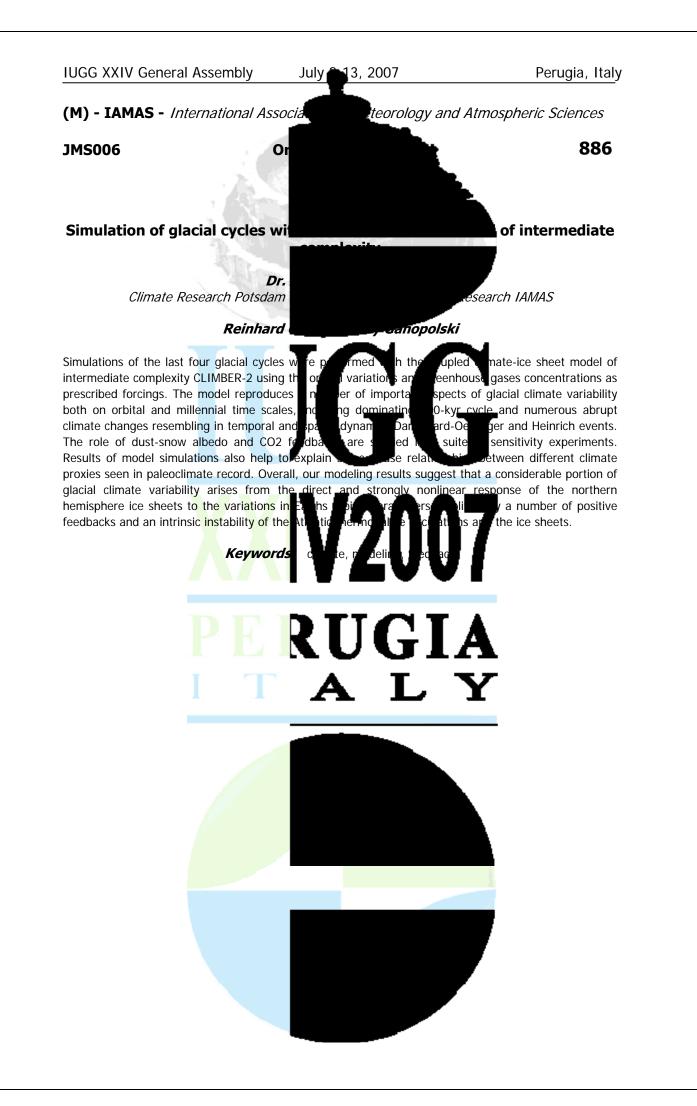
neract with each other to central process is the cycle tributes the observed glacialphysical climate, here I further an be triagered by the ejection of and si acial transport becomes xation' from a high but ocean via thermohaline

> pirical physical climate -interglacial cycles with alad e the 100 ky cycles can ne, this carbon-climateal forcings to produce the

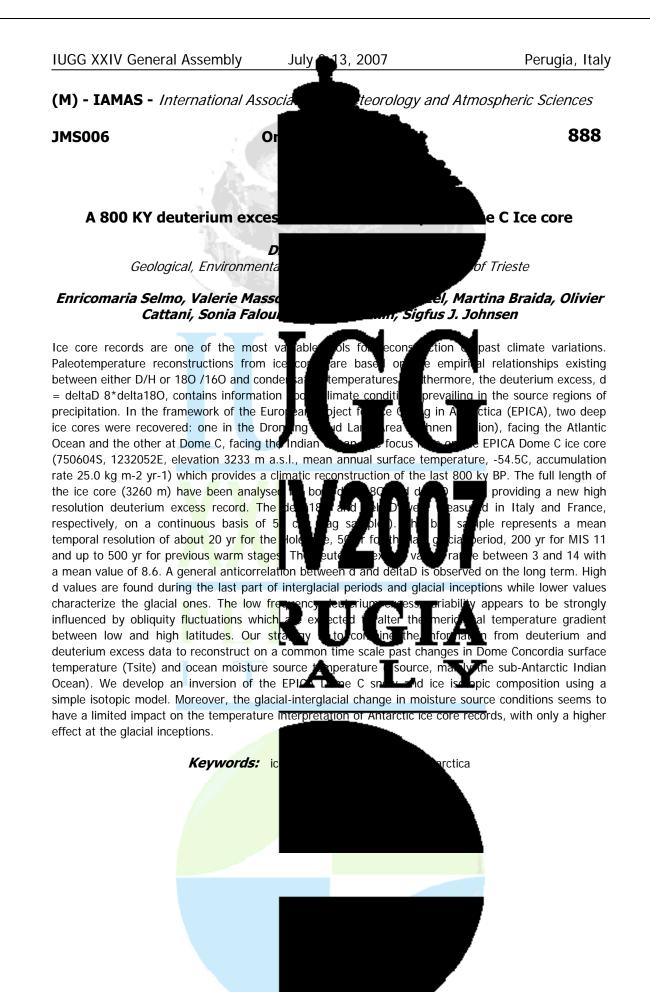




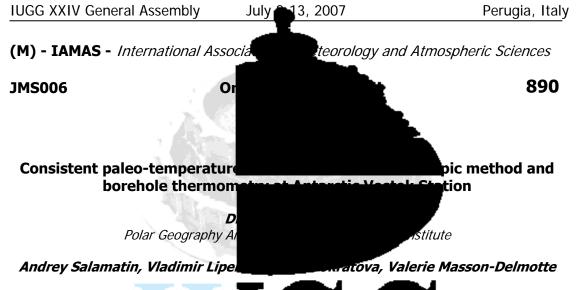
Keywords: modelling











The most common way of paleo-temperatur the present-day geographical isotope-tempe to the isotopic variability in the remote past noted, however, that this classical isotopic 30-50% (Jouzel et al., 1997, 2003). Pos bl conditions; not clear effective condensation affecting isotopic composition; change in precipit

smoothing and other post-depositional processes, etc. One of the most reliable alternative approaches of paleotemperature reconstructions is a p modeling aiming to convert the measur (Salamatin, 2000, Tsyganova and Salama Vostok paleotemperature amplitudes by is of 2. Recently, the latter approach was modeling (Tsyganova and Salamatin, 2004). At the same time new improved version of simple isotope model has been suggested (Salamatin et al., 2004). The results of Vostok paleotemperature

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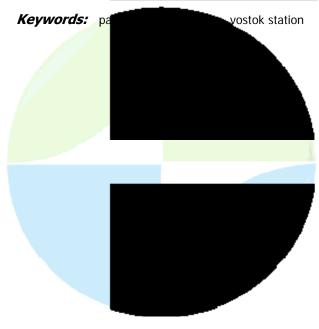
data is a direct apply of isoto med by timple isotope modeling) al., 1999). It has been repeatedly he past temperature variations by ce of moisture source e: inf eristic ther than temperature tic (stratigraphic, relief-

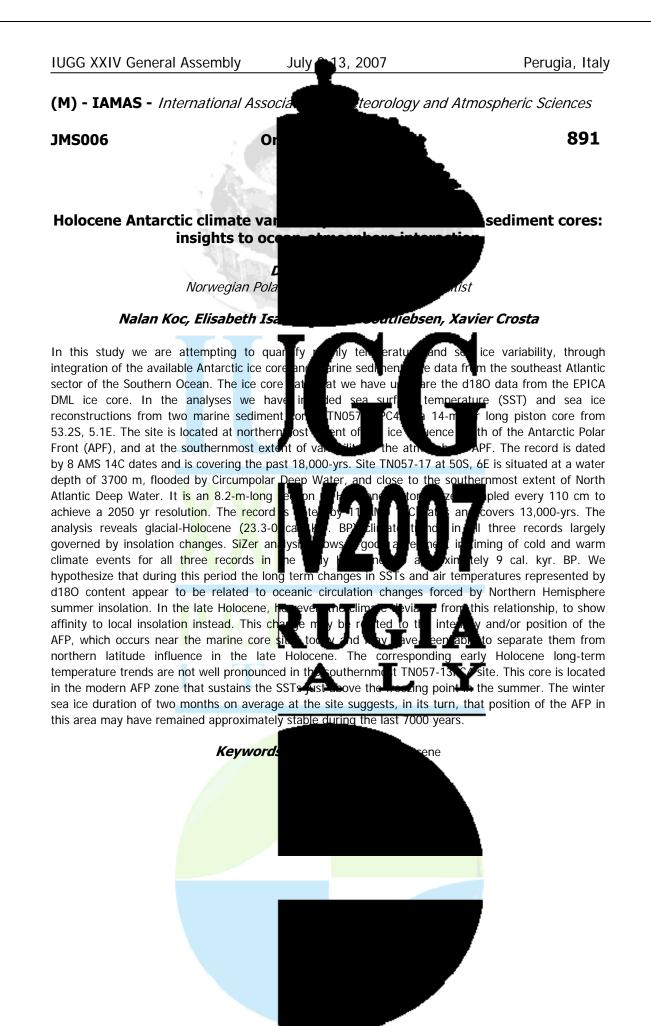
related etc.) noise occurring in vertical isotopic profiles; alteration of isotopic signal due to diffusive

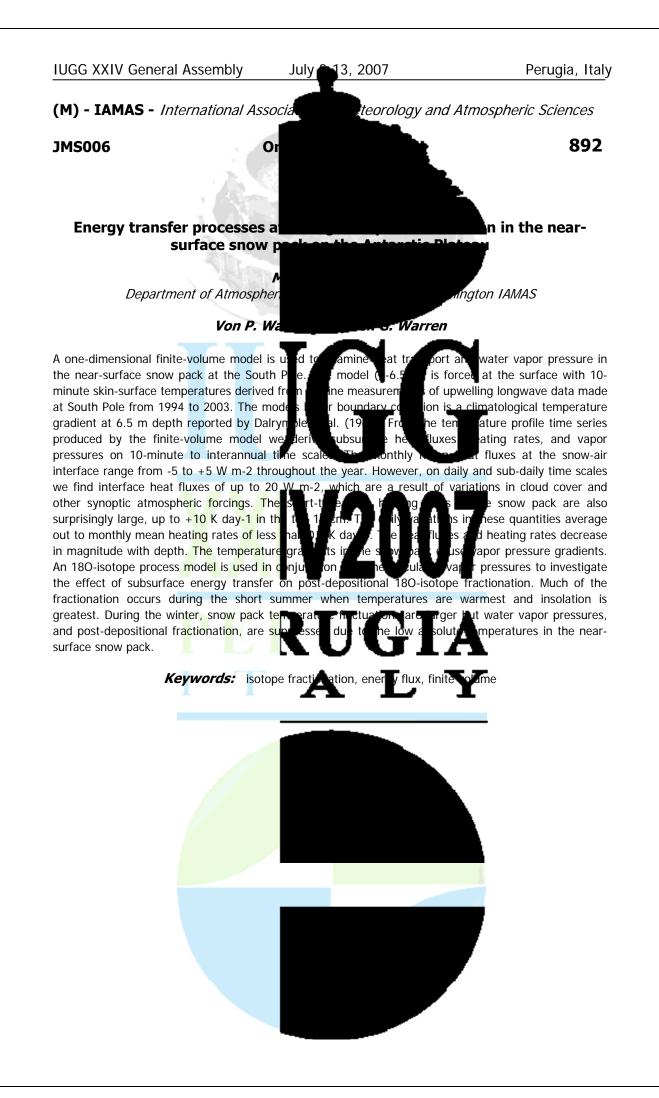


by ice sheet dynamics a temperature history runs, the estimates of thods varied by a factor 2D Vostok ice flow-line

reconstructions by the both refined method Glacial Maximum Holocene surface air term e same, showing the Last ally t t 12 Ve also should note the difficulty in comparing the two methods, produces condensation lind be od∉ing temperature that has to be transformed to the surface air temperature, while borehole thermometry deals with the effective ice sheet surface temper the lat sarily equal to the surface er is not nec air temperature, too (Lipenkov et al., 2004). rk is car out in fram s of Project 4 of Russian FTP Antarctica. The A.E.s stay at ILTS is supported by Japanese Society for Promotion of Science.







IUGG XXIV General Assembly

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Perugia, Italy

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## JMS007

Symposium Stable Water Isotopes: from Ba

**Convener :** Dr. Kendal McGuffie **Co-Convener :** Prof. John Gibson

Stable water isotopes are a novel means of Recent measurement campaigns (e.g. IAE Isotopes in the Biosphere and Atmosphere intercomparisons (e.g. the World Climat Atmosphere Processes Studies (iLEAPS) iPILPS). This session provides

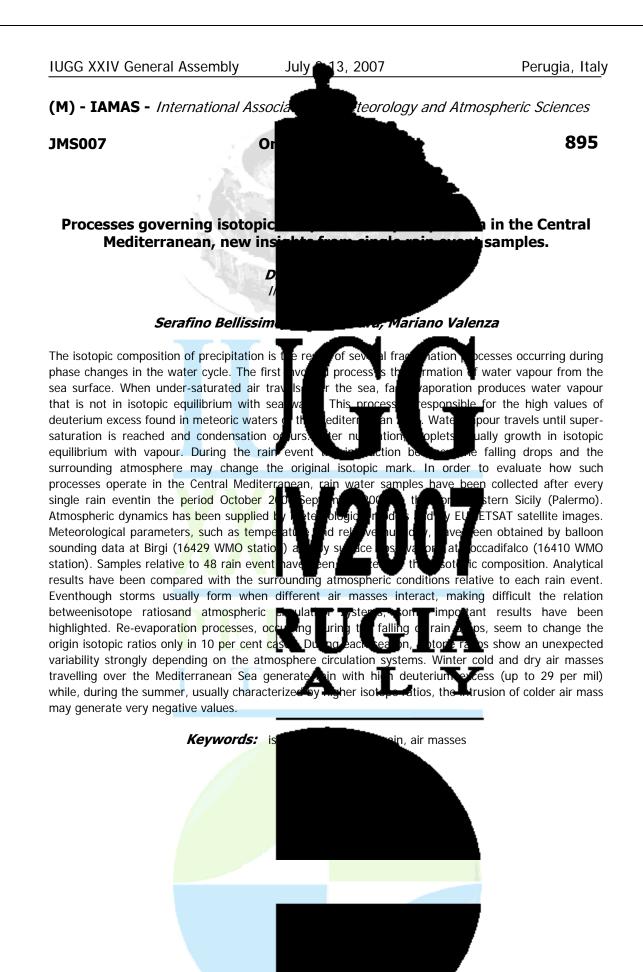
work on stable water isotope techniques and too techniques for field and laboratory measurem together with basin to global scale integratio teorology and Atmospheric Sciences

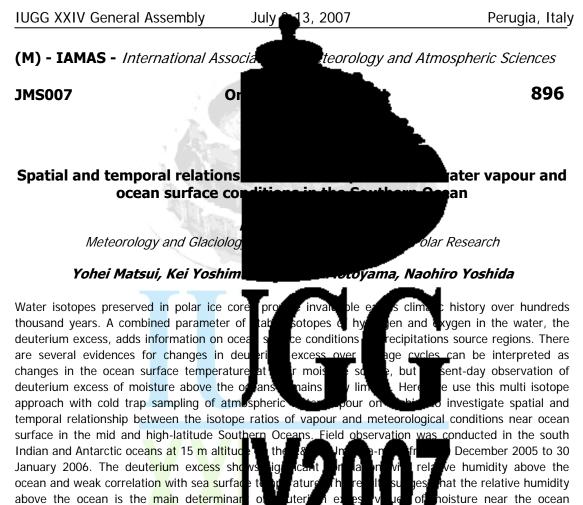
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of hydrological processes. Rivers (GNIR) and Moisture and the Integrated Land Ecosystem provides an opportunity to present new basin that to be global scale, including teristical of vegetation and soil effects





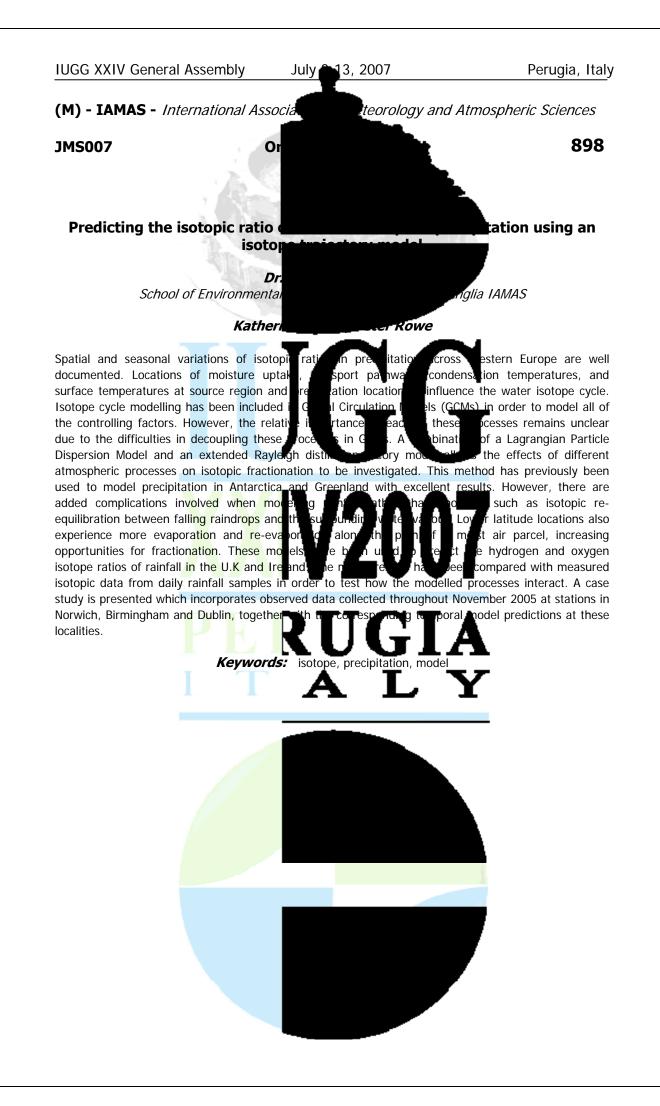




surface. We will discuss possible causes for superely and by popping with the results from simple and complex models. These results provide a basis for interpretation of the d-excess in polar ice cores and present day water singulation

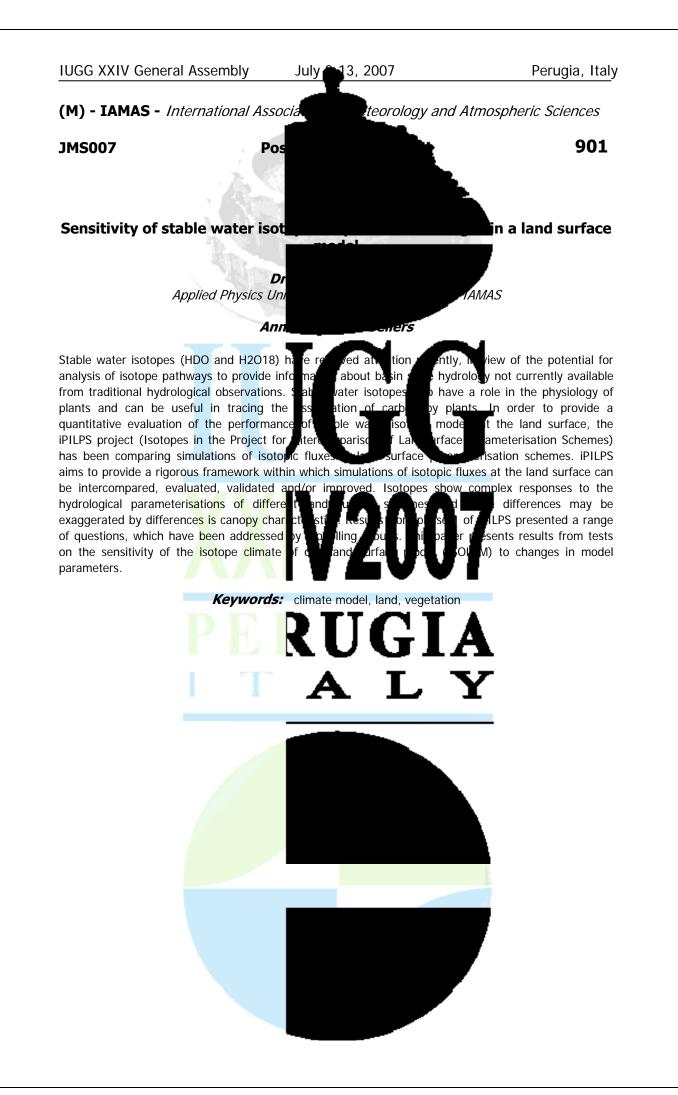




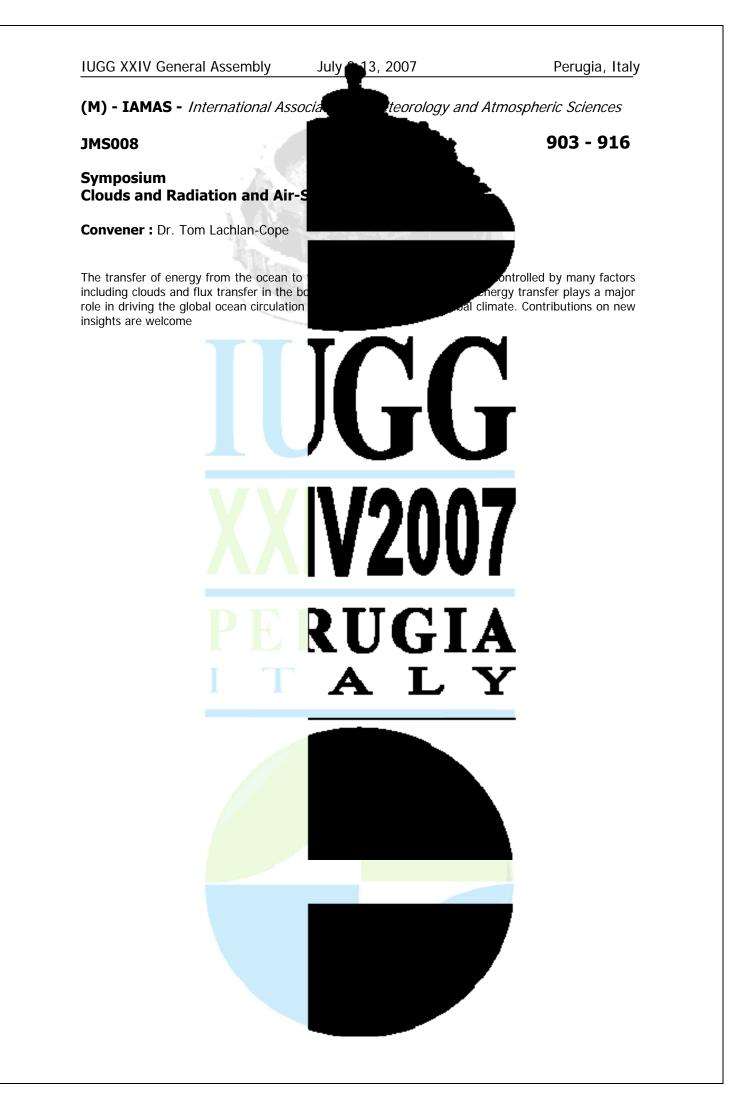


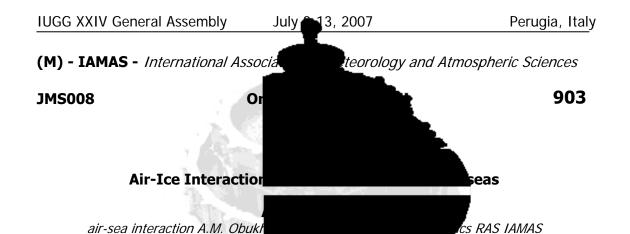












There are many methods reliable enough t ice cover. However, over the areas of young thin ice and leads, the conditions of heat exchange ang and the turbulent heat flux changes its sign processes. The present work is focused on s at the ice covered surface on heat ad mo surface. Transformation of air flow caused fast ice - thin one year ice) is also envisag

the following tasks: - Research of energy exchange measurements of turbulent heat and momentum fluxes in subsurface layer of atmosphere. - The determination of coefficient for parametric\_methods\_of calculating turbulent fluxes. The data are used for determinations of heat and momentur measurements were carried out both durin spatial distribution of surface temperature essentially depend on the type of the Inc measurements of turbulent fluxes under hari reliable both in the Arctic and in the Antarctic. measurements do not correlate with any single meteorological parameter, but rather depend on an ensemble of factors, which are usually diffi provides results, which coincide with direct Obukhov theory is valid. Calculation of ture surface requires careful selection of method of calculation and type of parameterization of coefficients. Measurements of the atmospheric turbulence char effect and vibration, allow to receive more a fluxes. When breaks are formed in ice, strong outgoing fluxes are formed due to a large difference in temperature. The heat fluxes over polynyas are one or two orders of magnitude greater than those over the pack ice. However, up to 50% of the w occurs over this small area. The value of was 1.49 x 10 -3, which is smaller than th the open ocean. The effect of the bottor surface layer of the atmosphere is discuss to be intensified in the region of the she considered in the IPY tasks frame.

reponents of the energy balance for an old

especially o the noone w there are the effects of m ex<u>change</u> ge of ind g diff t pá osphe

en water areas in polynyas balance increase rapidly, of he eliable parameterizations of these ctural and thermal non-uniformity een\_atmosphere and underlaying /ing si e type (ice open water, ts our team carried out experi ace (open water, ice) by

eter of a surface. The tions: measurement of es in the polar regions e method allows direct is method proved to be Exchange coefficients, calculated using direct

conditions when Monin-

ith irregular underlying

The absence of the ship ectly from it selecially attemal values of turbulent nge between the ocean and atmosphere perimentally obtained for polynyas ocks, but greater than that for the processes in the nearnge processes were found ons in polar regions are

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Keywords: turbulence, polynya, parameterization

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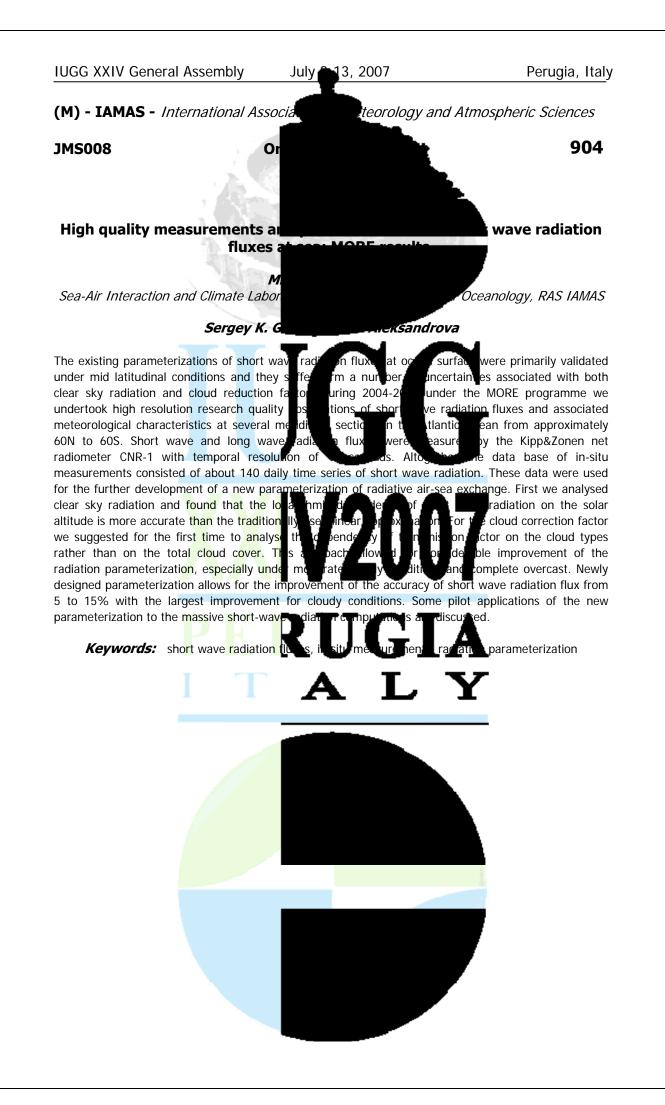
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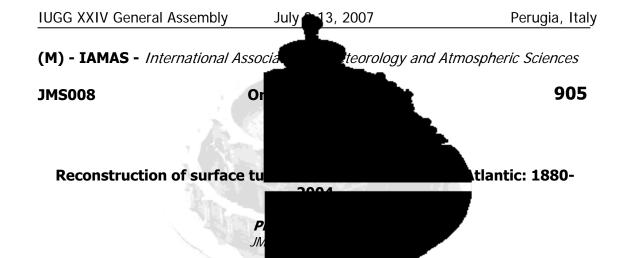
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Using 125 years (1880-2004) of Volunt reconstruct surface ocean-atmosphere heat flux time and variable (2-degree to 5-degree) res the homogenization of sampling density, ap fluxes for minimizing sampling errors and bulk-algorithms. In particular, a multi-regres playing important role in estimation surfag using the time series from VOS and reanalyses for

sea flux fields show reasonable minimization of sampling errors and allow for the analysis of regional heat balances and estimation of long-term changes in surface fluxes. Further analysis included computation of monthly anomalies of surfa freshwater budgets. These were computed coordinates of sea-air temperature differe trends, implying, for example, about 4 W/ Sea and about 2 W/m2 per decade secula are represented by the decadal-scale and multidecadal

(VOS) Vorth ver lu in space. Met of the doubl of specially oroach ise vater fré es. mpled

tions from ICOADS we h monthly resolution in antic logy of reconstruction is based on ponential distributions of turbulent ted for incomplete data coverage t atmospheric humidity, recon meth logy was first validated decades. Produced air-

ubpolar gyre heat and of surface fluxes in the fluxes reveal long-term at fluxes in the Labrador gyre. Non-secular signals (about 40-50 years variability). Decadal scale

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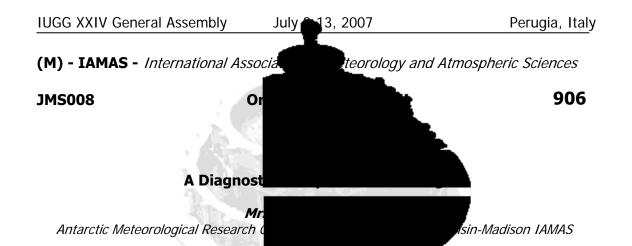
signal has a clear association with the NAO-like atmospheric circulation variability during 1880-1915 and after 1955, but has a little association with

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Like all other continents on the Earth, Ar operations in the support of research activities on an States Antarctic Program (USAP) hosts a sin hifica year, many of which fly through the main h number one weather phenomenon impacting U history of Antarctic fog, and the overlapping Island region of the Antarctic presented he simple fog particle collection experiment wij are on order of 7.5 to 10 microns in diameter. The

year record at McMurdo Station, Antarctica will be reviewed with some key relationships to the nearby skiways and runways. Next a classification of fog types is analyzed along with an introduction to modern satellite methods used to distinguish fog, a occur in the Antarctic (such as mixing for case study is used to demonstrate the envi Antarctic an environment very close to that Antarctic fog are outlined from microphysic

rog events that in turn impact logistic ound the cor tions air or IcMurdo tati aviation activ of stu<u>dy that</u> l inenta issed wil matoľ

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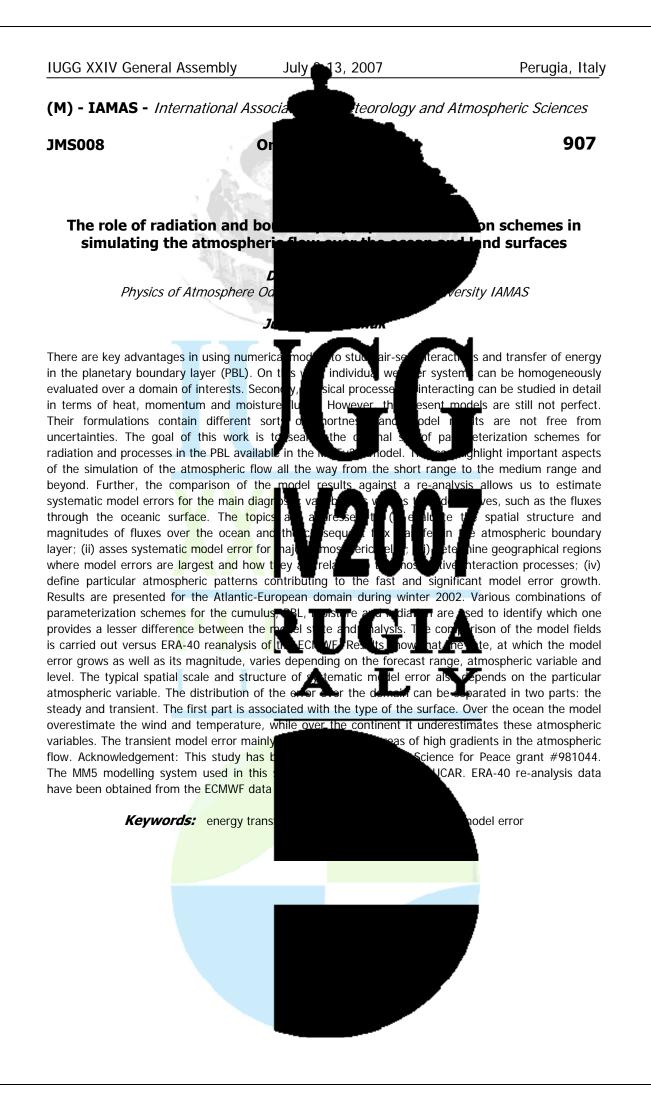
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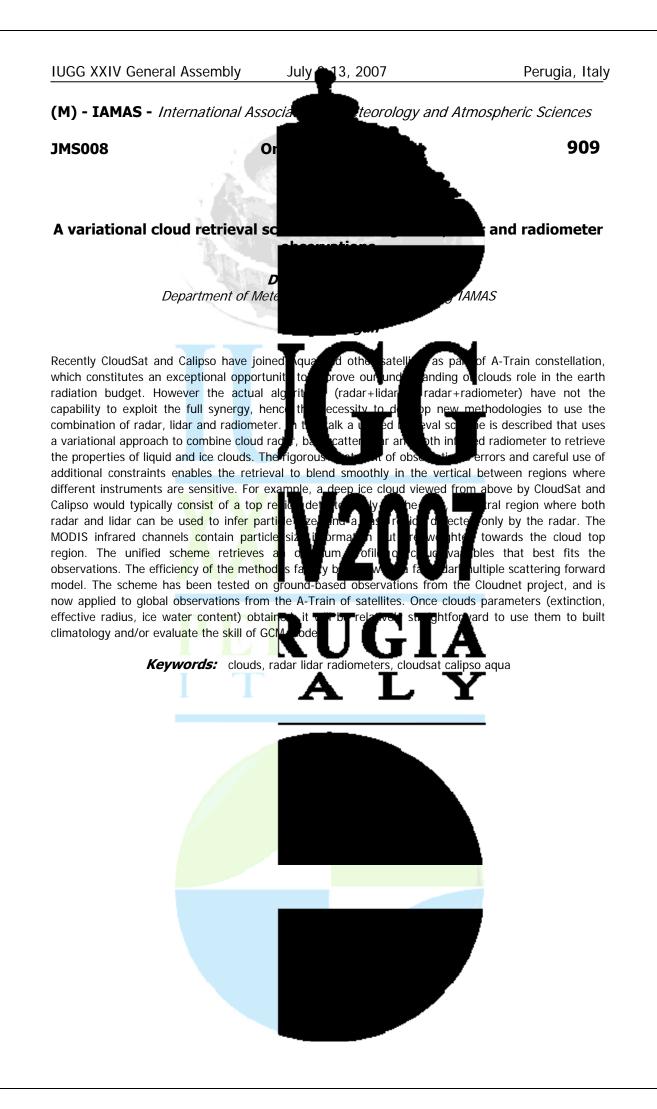
ase in point, the United 00 flights planned each Ross Island, Antarctica. Fog is the This presentation will offer a brief to th<u>e diagn</u>ostic study in the Ross influence this region. A as that fog particle sizes events from a thirty plus

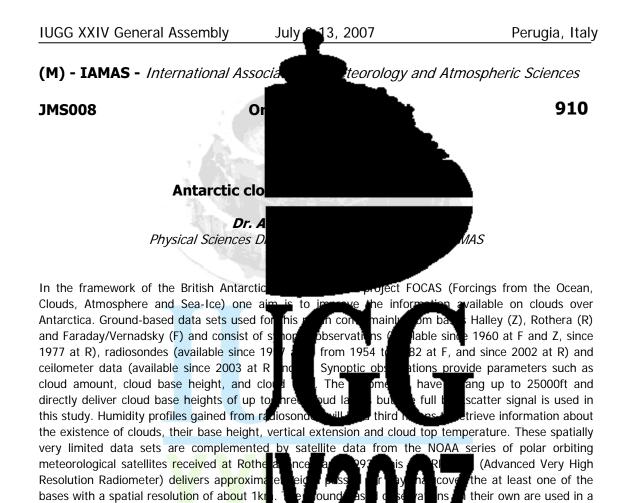
kpected fog types may bear as often. Finally a Ross Island region of the

lirections for the study of cales. Keywords: fog, antarctica, observation











themselves are used and they are also fed into CASPR, a model for Cloud And Surface Parameter

create the beginning of high-resolution cloud climatology for the Antarctic. This presentation will show

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tarctica at a high spatial

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surfs from the combination

ground-based data as tie points

me radiometer measurements at different wavelengths

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first step to set up a climatology of cloud

trends. In a second step data from the s

Retrieval, especially developed by NOAA for

the satellite data will be used to retrieve clou

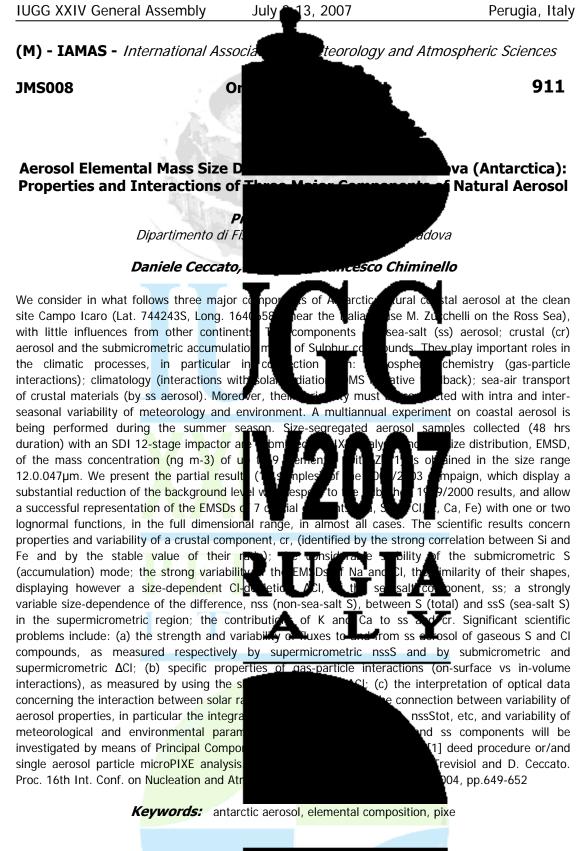
resolution. Applying the coherences gained

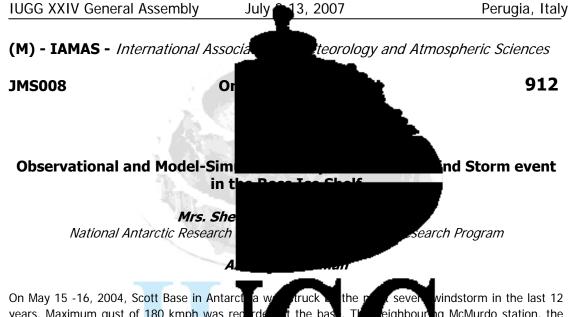
of satellite and ground based data.

results from the analysis of the ground-based obs

satellite data. For this part of the investigation







years. Maximum gust of 180 kmph was rec largest base of the United States Antarctic wind caused damages to the outlying struc one was injured due to the arrival of the se to carry out detailed observational analysis as the results of numerical simulation from the P

tried to investigate the nature of the high wind event that occurred 14 May 2004. In the simulation work, four polar stereographic domains, viz addition, the model is initialised twice d simulation results from both the Antarctic F. Steinhoff of Byrd Polar Research Cent performance and capability of the two mod region. The comparison indicates that ing skill of the model in simulating the certain features

the bas (USAP), also well veh dstorr th usir ay st MM<sub>5</sub>)

60km stic

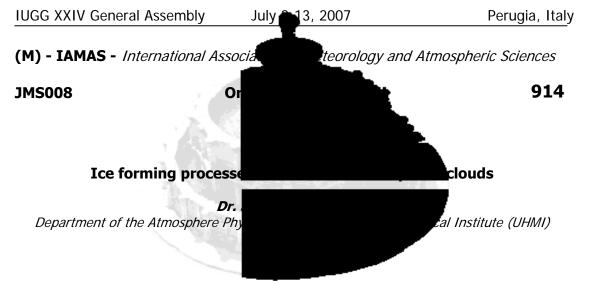
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eighbouring McMurdo station, the orded high wind speed. This high at the Scott Base. Fortunately, no ly mor hours. This paper aims ailabl servational data as well this study we have also

30 km, 10 km and 3 km resolutions are used. In comparison of similar Obtained from Daniel ertaken to highlight the m features over the Ross into AMPS shows better







The presented study is focused mostly on clouds over the Antarctic Peninsula for the Combined Model of the Cloudy Troposphere and 1D microphysical prognostic numerica diagnostic model on the domain 1500x100 vertically was constructed based on uppermodel included spectral microphysics with raindrops, ice crystals approximated by condensation nuclei (CCN) and interacted with one another by collision, condensation, evaporation, sublimation, freezing, etc. This 1D model was constructed based on the outputs of the above 3D model

as the most close to the observed thermod cloud particles and the following integral point on the 3D domain: rain and snow (d water contents (LWC) and particles conce cloudiness microstructure with the above r cloud was much larger than would be expected at the time, very few observations made high on top of the Antarctic Peninsula from the ground suggested the

the inve ion of ice fo ith ai fere asor which is a co C۱ s developed i wit<u>h resolu</u>t ding d ngshai of for ea types pheres forme

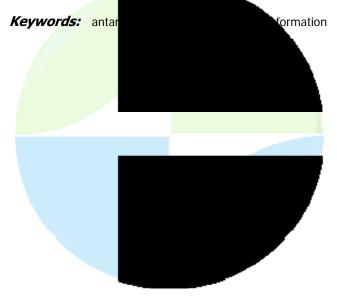
processes in precipitating al models. So-called the num hation of BD mesoscale diagnostic HMI was applied. 3D mesoscale of 25 km horizontally and 100 m radiosonde station. 1D loud particles (droplets, ted ice (IN) and cloud

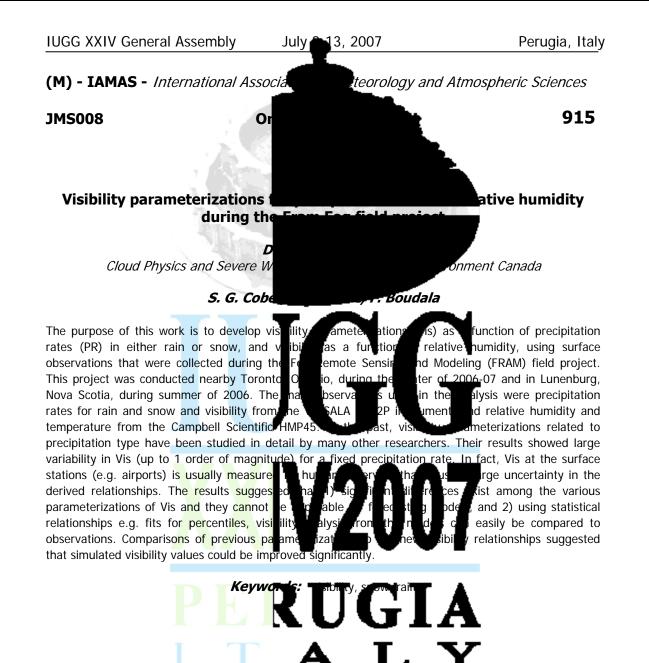
taining both spectra of hg in time over a fixed ums, ice (IC) and liquid simulations of Antarctic ce crystals present in the same temperature at mid-latitudes. At the same

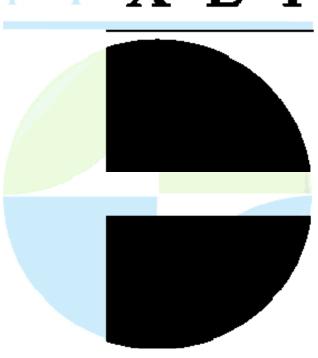
same: ice particle concentrations were type nagnizede greater than those in mid-latitude clouds at similar temperatures. extr ely high attention to the ice forming processes in Antarctic mixed-ph reç meterization in GCM or еc sii ра other atmospheric models would eliminate errors, e.g., in a highly sensitive radiative transfer, etc.New publication parameterizations from the recent Khvorostyan droplets and crystals and for rates of homogeneous T terminal velocities of and Curr ous nucleation were implemented in nd heter the model. Preliminary results and the comparison with the previous parameterizations will be presented. We hope to get a possible verification of the above parameterizations of the ice forming processes in Antarctic mixed-phase clouds

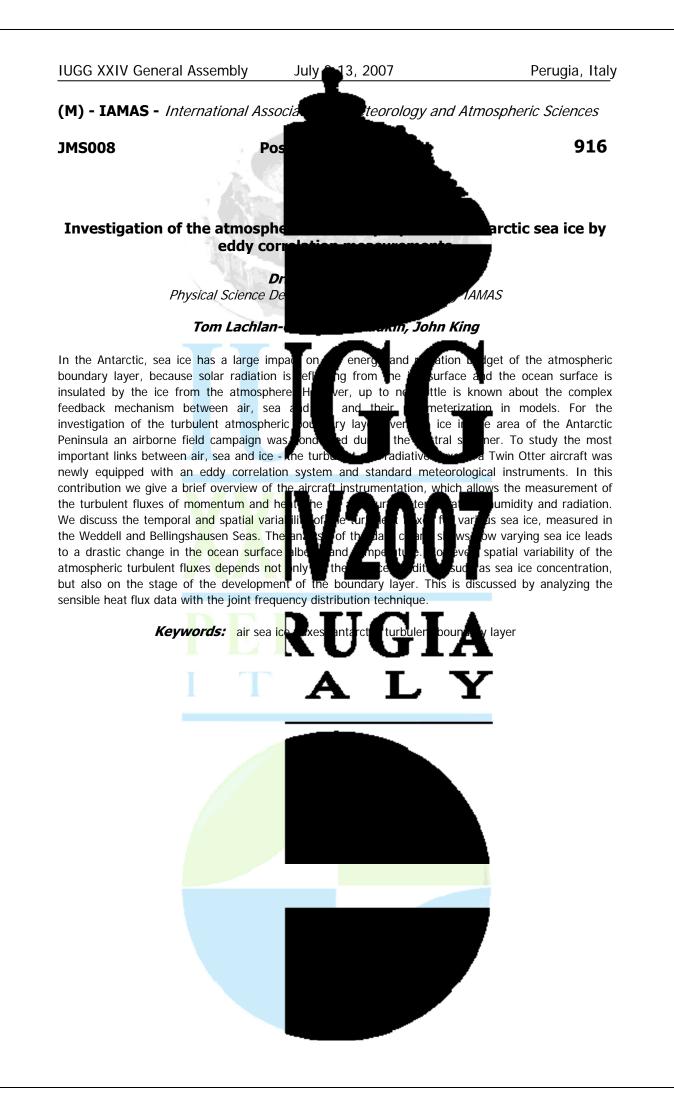
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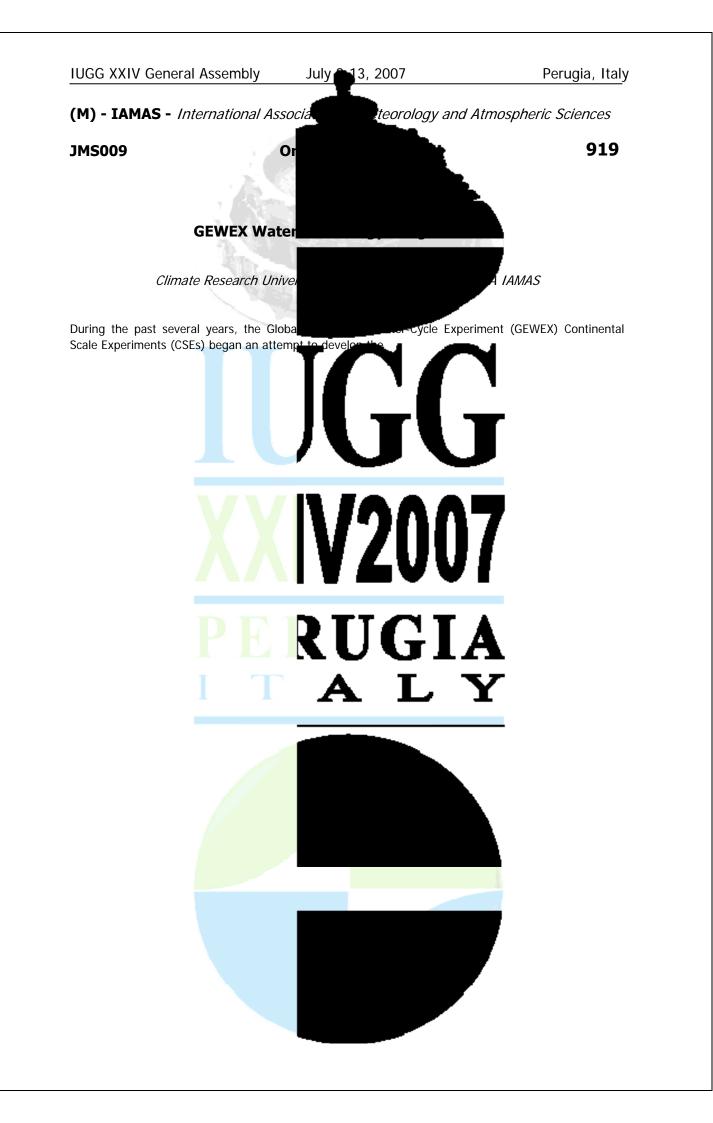








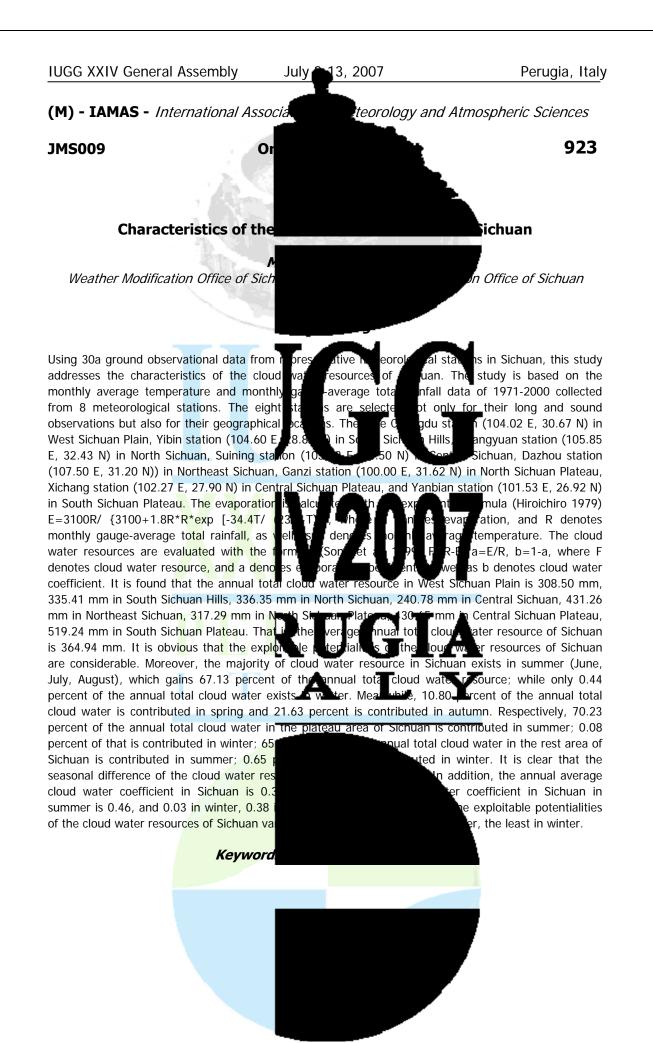


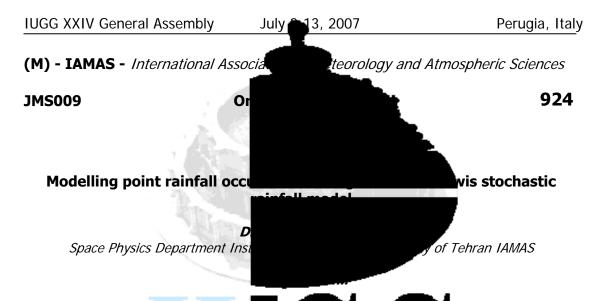












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The simulation of continuous rainfall time research. A developed random pulse mode Gamma and Weibull Distributions (MBLMPG) obtained from two Iranian sites. The model process. In the first step parameters in relat up Poisson's process, calculated. These pa the other parameters in Delta method, and finally were calculated using Newton Rafson successive approximation. For testing and evaluating of simulated

drawing, scatter diagram, correlation coeff model in simulating 1 and 24 hours maxin Simulated extreme rainfalls which have b with observed data. The possible reason f monitoring rainfall cells and intensity of stor comparison to exponential, Gamma and Pareto distributions has better flexibility for various tails.

n as Mo ifie applied to 24 ameter estim andom ar then rd ste

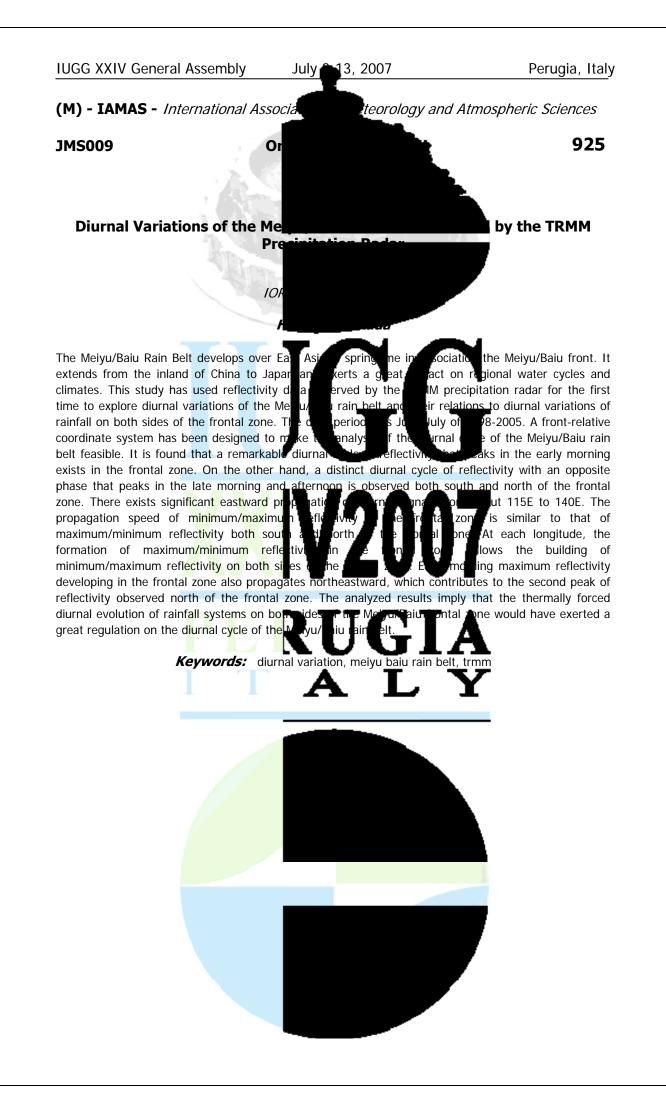
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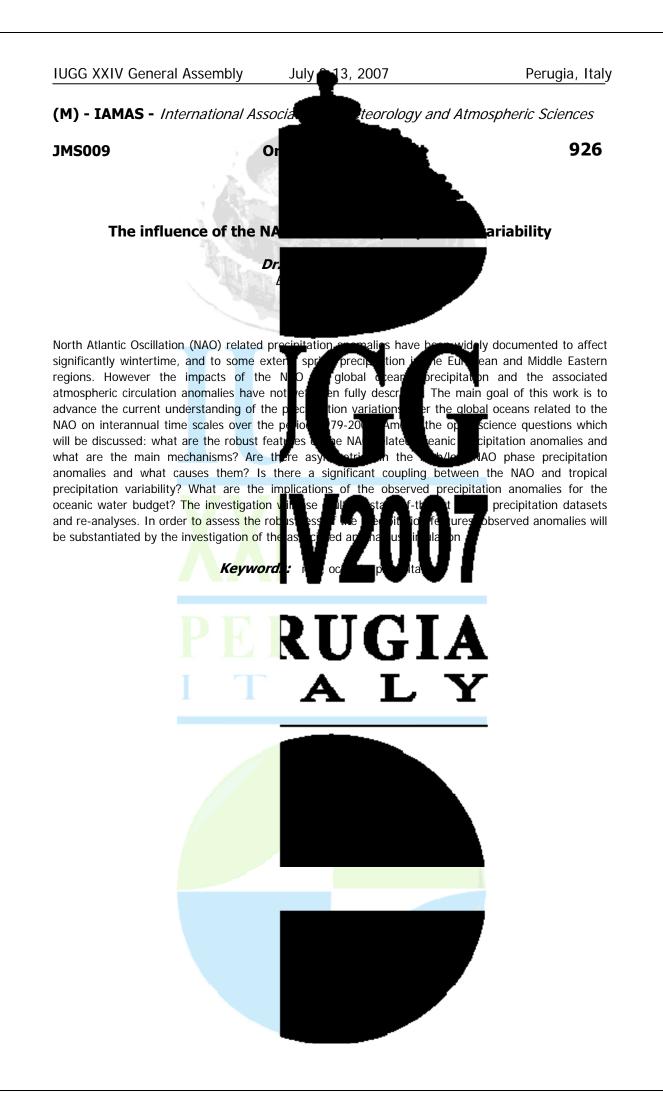
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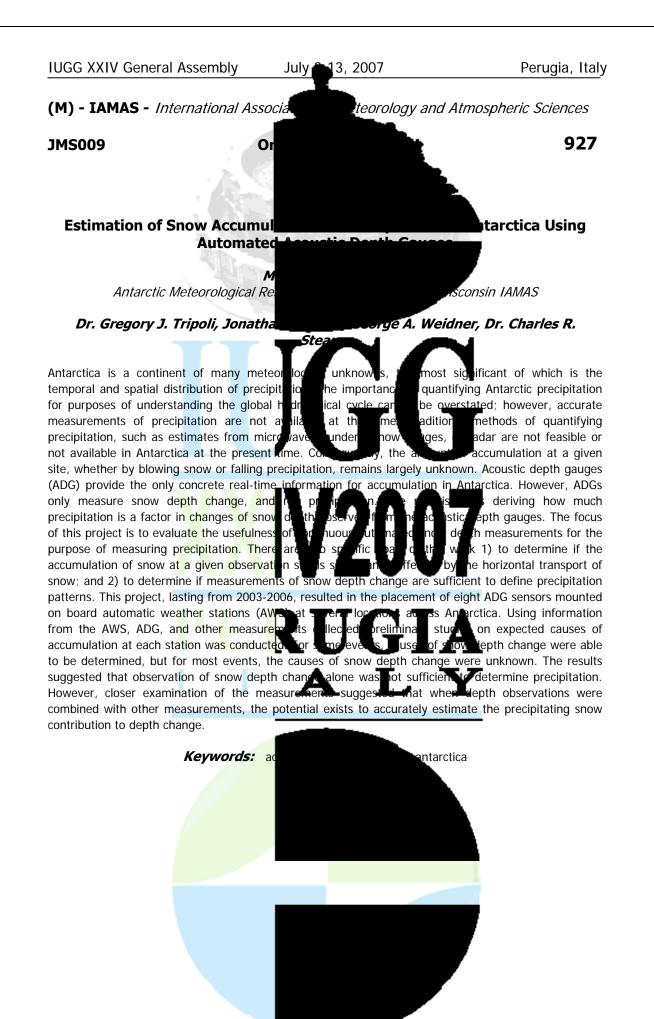
area of meteorological rtlett-Leves Model Using Poisson, s maxima and hourly rainfall data, is carried out using a three-stage hd cells, which following data for calculation of distribution parameters

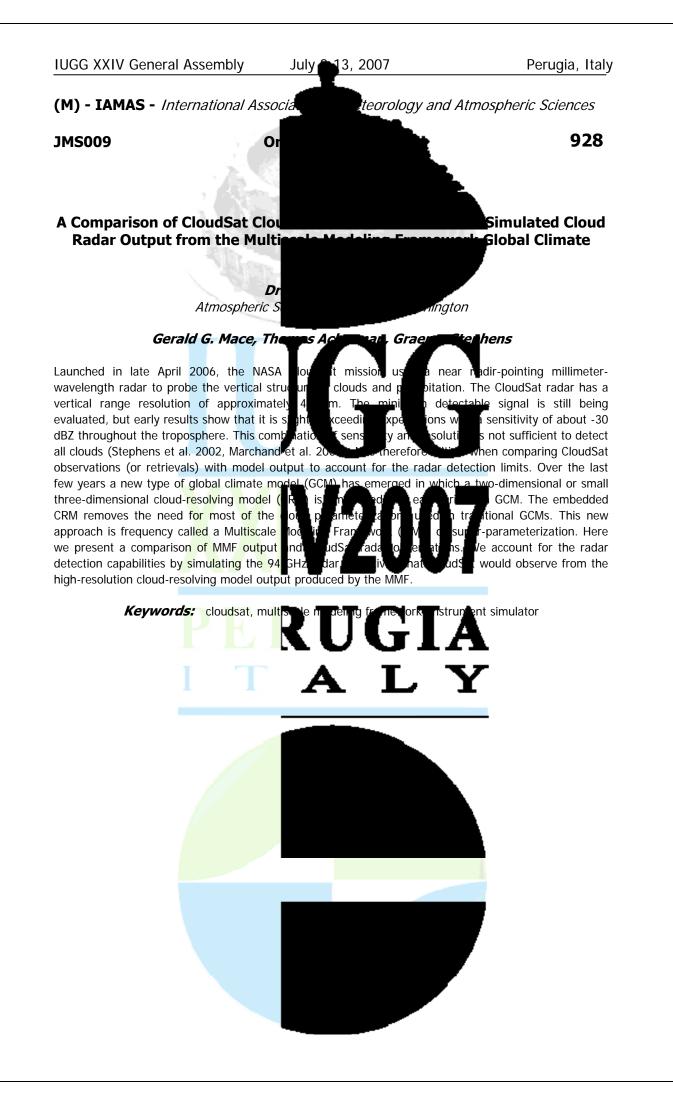
quantities produced by model, Heidke skill score and various statistic criteria such as simulated graphic ere used. MBLMPGWD Bartlett-Lewis models. properly in agreement f Weibull distribution for t Weibull distribution in

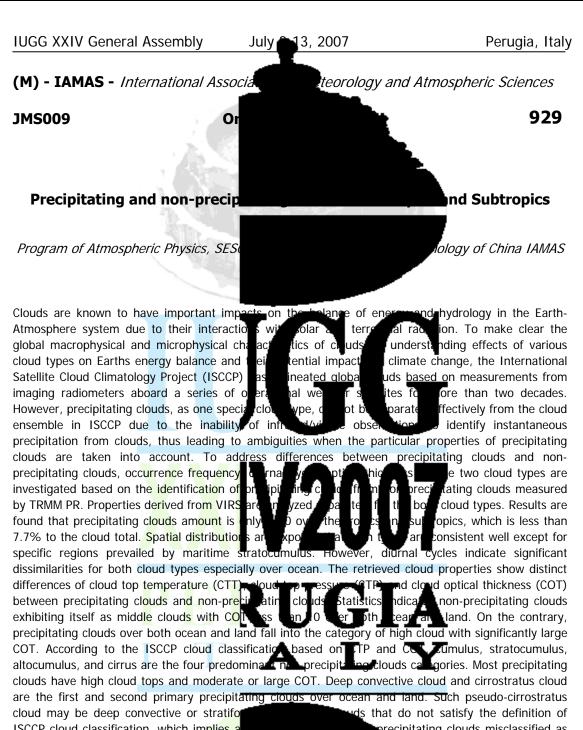










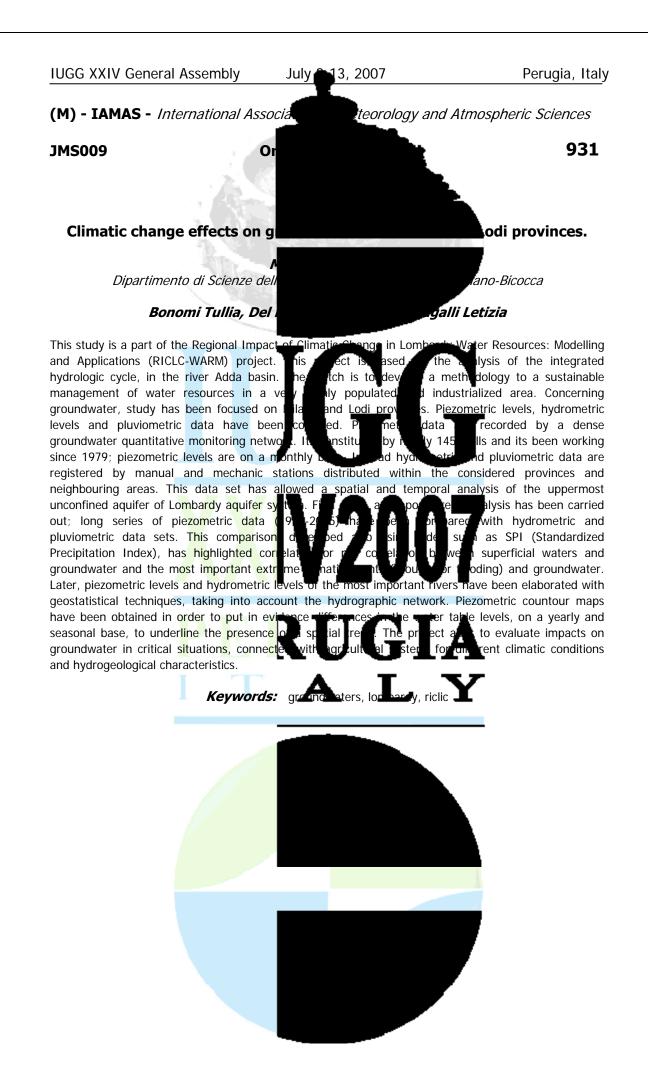


ISCCP cloud classification, which implies a cirrostratus using ISCCP criterion.

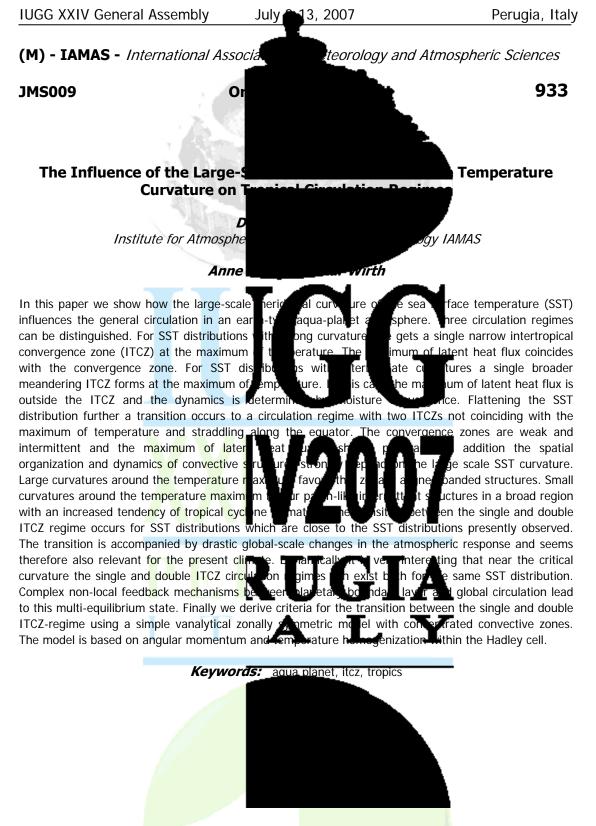
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recipitating clouds misclassified as

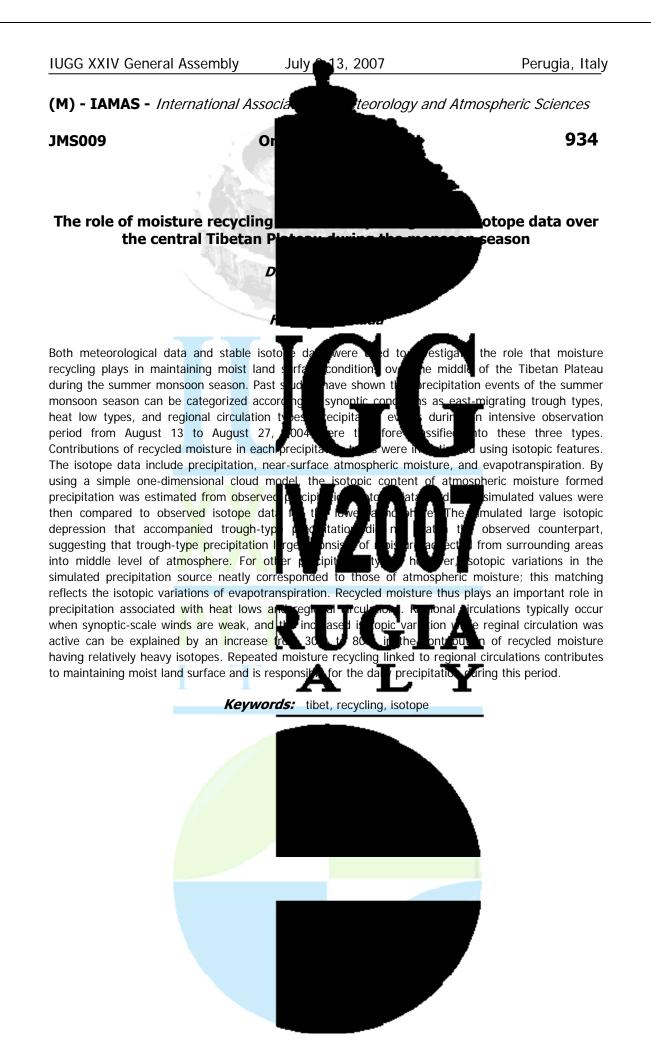


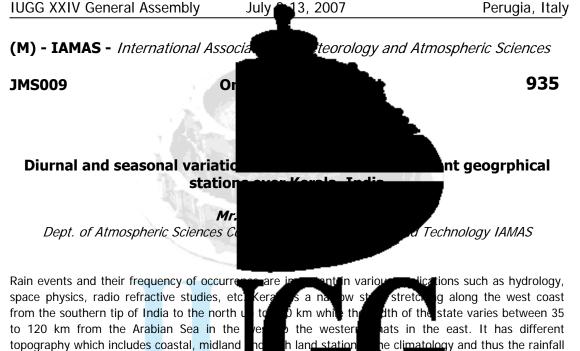












pattern differs with topography. The state is % of the annual rainfall. The average annual in certain elevated stations. The total annual rainfa

the monsoon is around 40-50 % and in the northern areas it is around 80%. Here, we examined the temporal and spatial variation of the rainf high land stations. The hourly rainfall dat department. To understand the seasona geographical regions, we carried out and Kerala. In the north Kerala coastal static season. More rain events around 12 numbers are found to occur between 10 to 12 hours (IST) in the

month June. Over this station, more events are seen during southwest monsoon season. In the middle land, the bimodal variation is seen on an northeast monsoon seasons. Here, the ma hours. Over the high land, the bimodal itself. The diurnal variation of the rain events is seen in the day hours (maximum occurrence between 12 to 16 hours during June month and 7 to 12 💆 rainfall pattern is found, one is in the monston distributed all over the monsoon months. The second mode is found in the October. The midland station shows similar pattern of the coastal station, but the diurnal pattern differs. For the high land, the frequency of rain occurrence is less than the situated in the rain shadow region. It is in seasonal pattern during March, July and

November. In all the three modes the diurr

of Ke rai is a ate dif northern parts to about 180 cm to the south. In the southern region, the contribution of rainfall during

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rainfall and is about 71 nonsc 300 with more than 500 cm 80 cm over the extreme

> coastal, midland and red from the hydrology ver the three different ns in north and middle found in the monsoon

southwest monsoon and

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he southwest monsoon ccurin igust). Over Kerala station, bimodal 📫 rain e ts are almost uniformly midland stations because the station is tation exhibits three modes in the

the rain events is high during

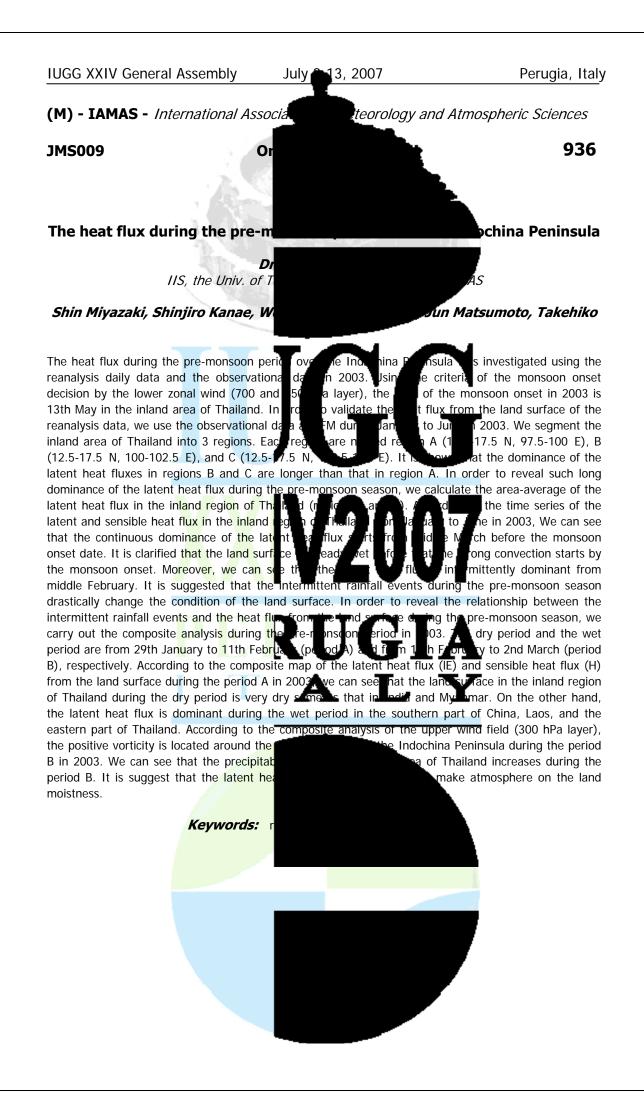
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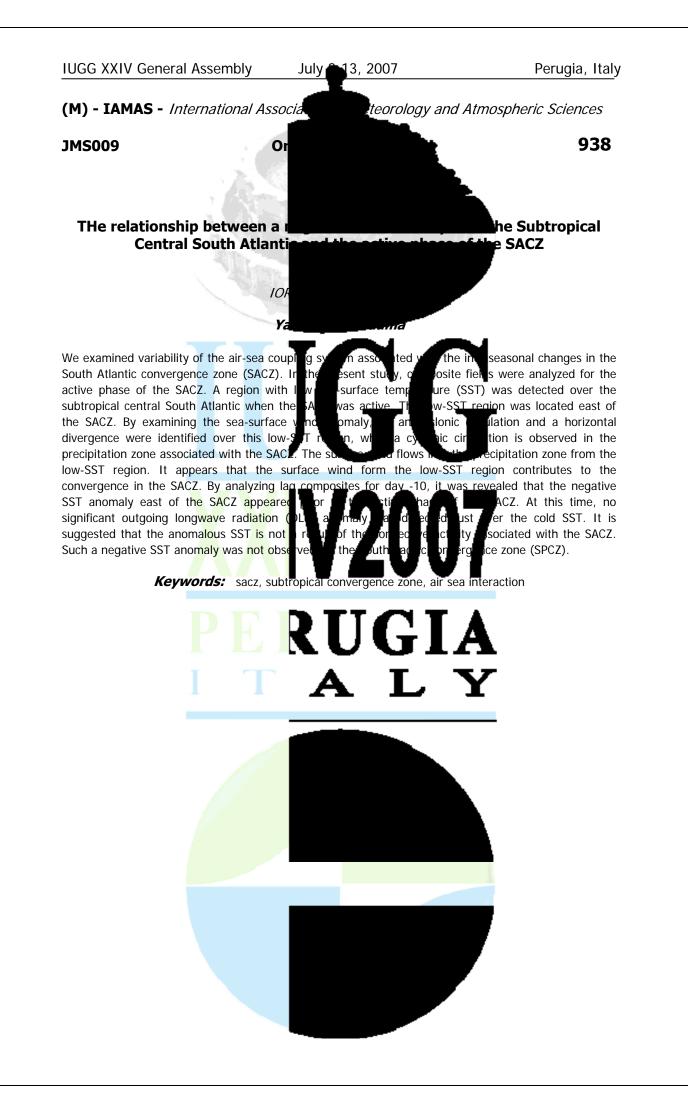
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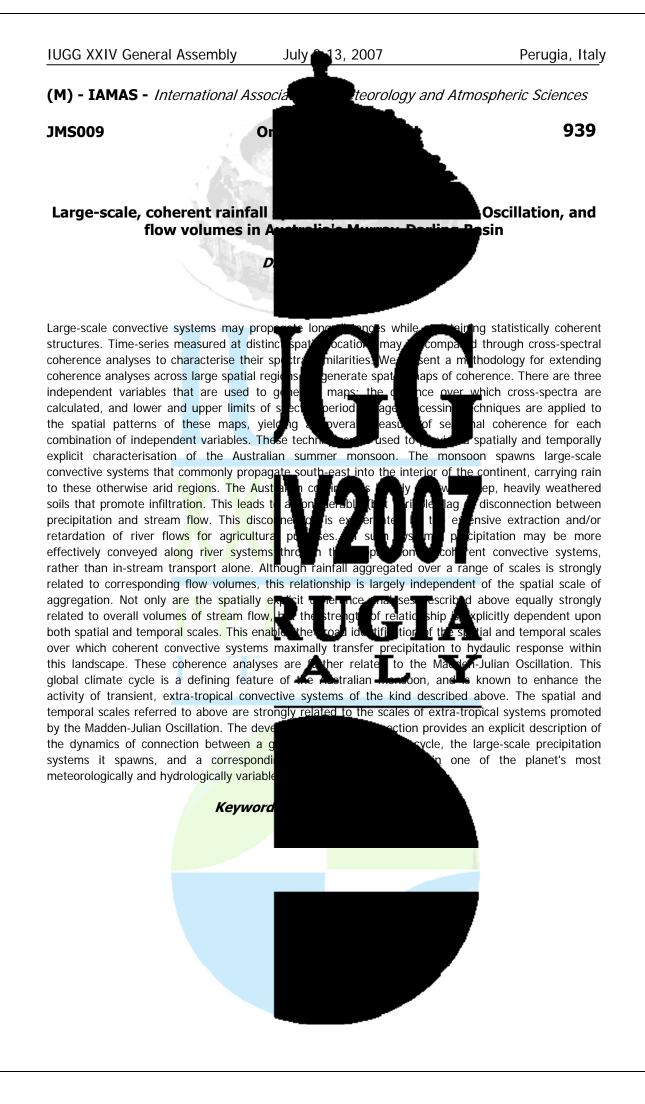
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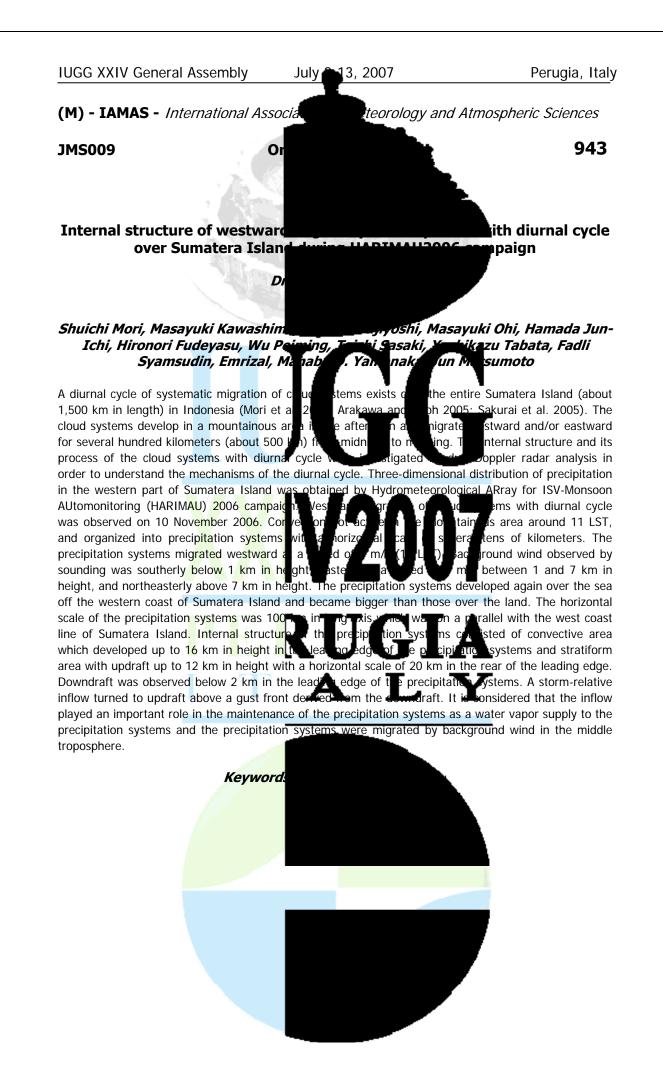


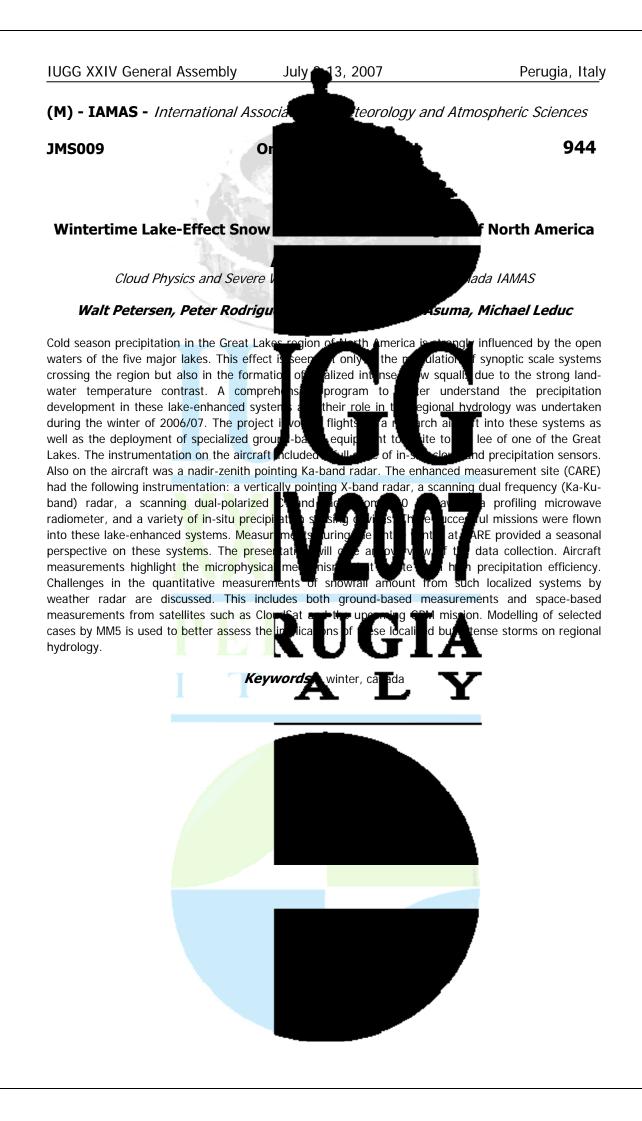


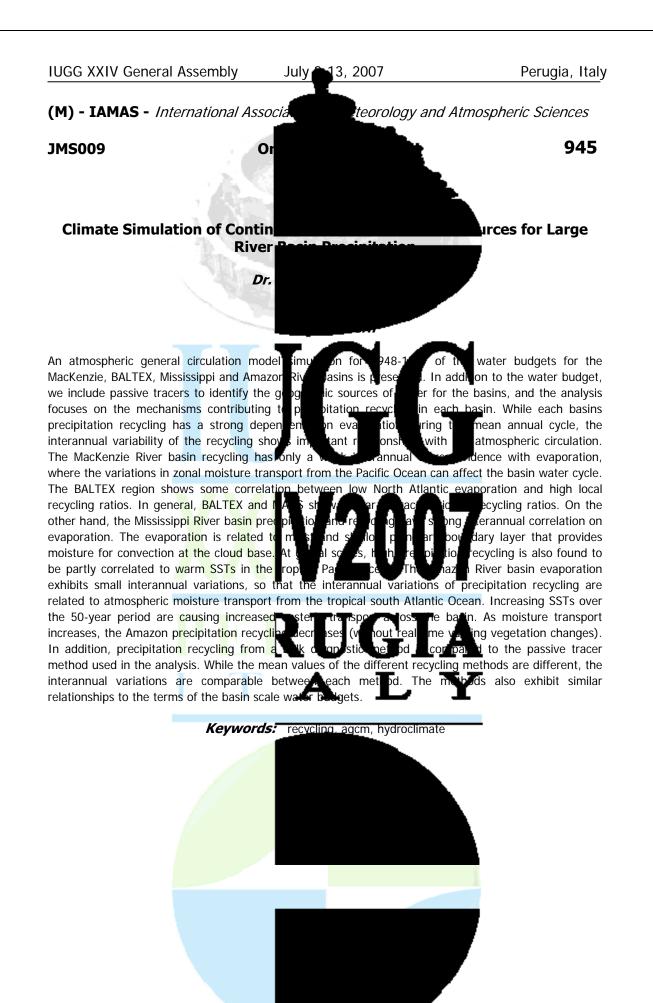


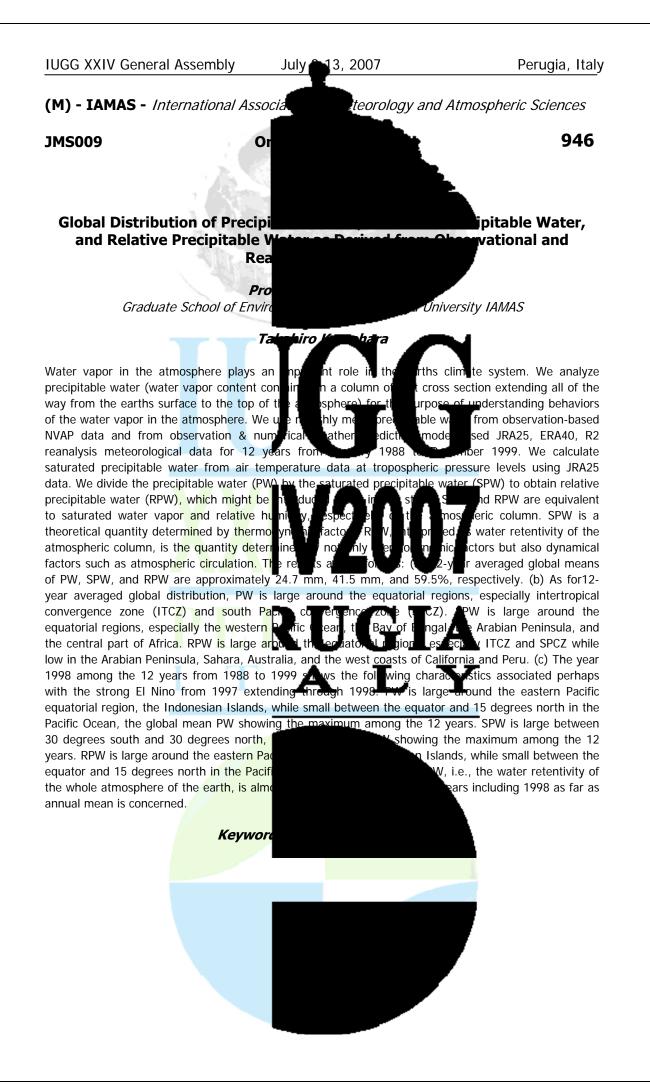


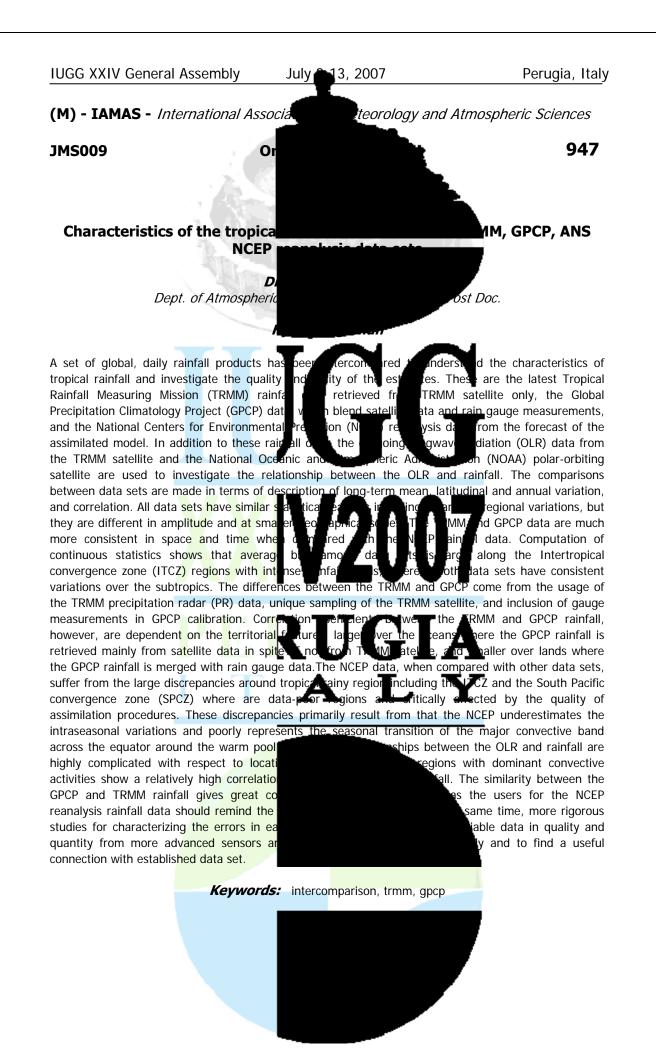




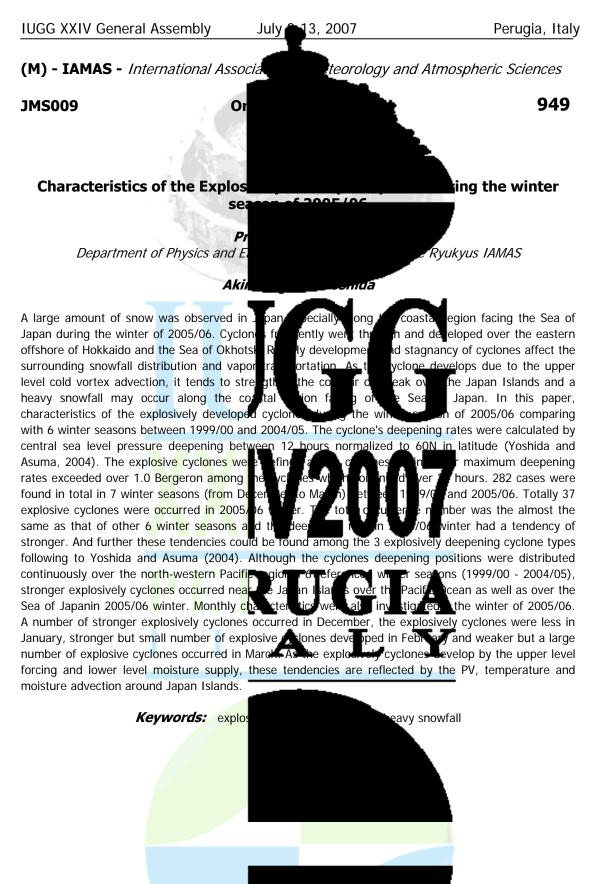


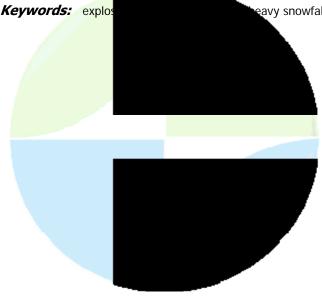


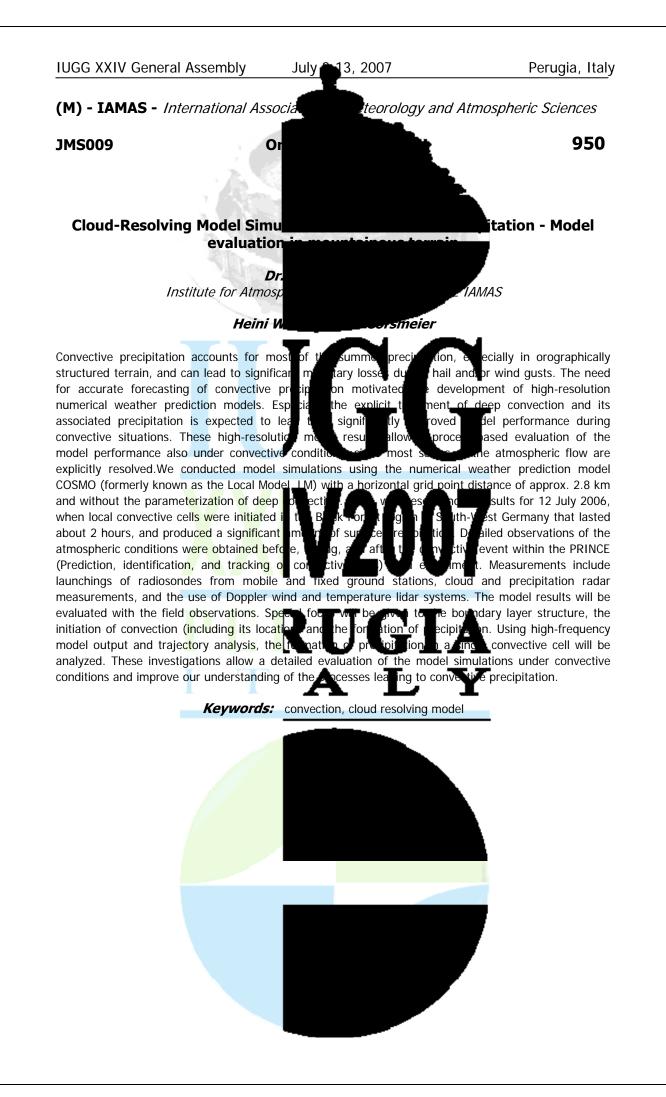


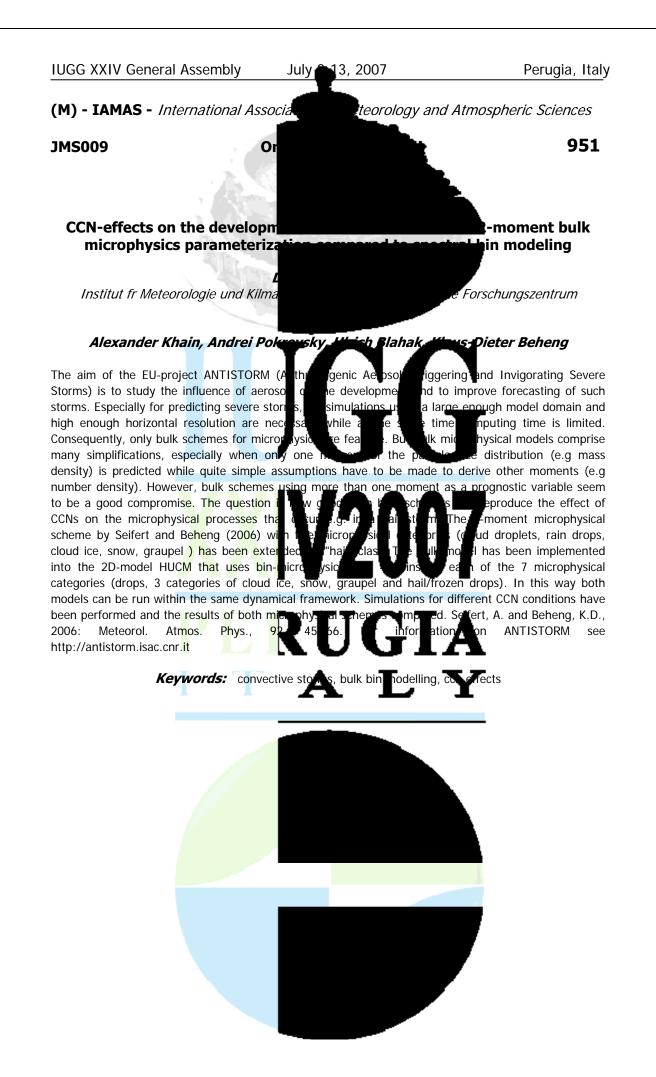


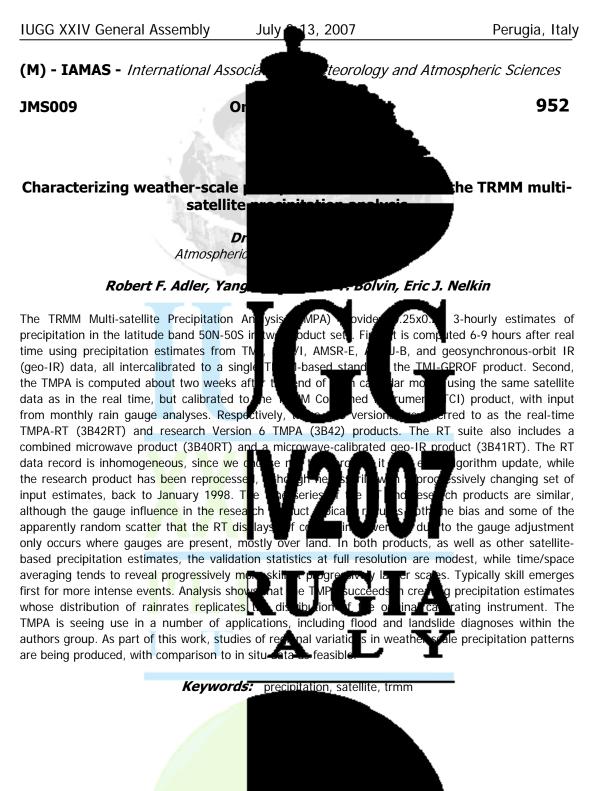




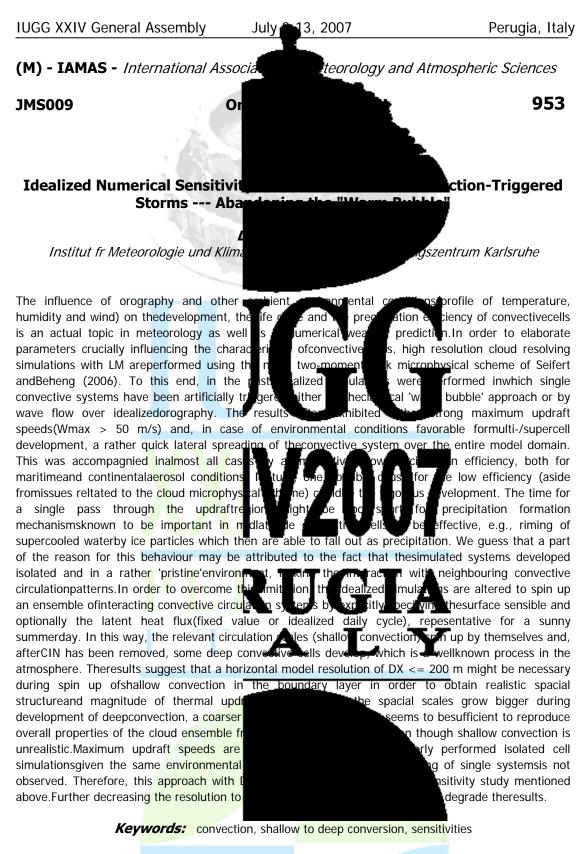




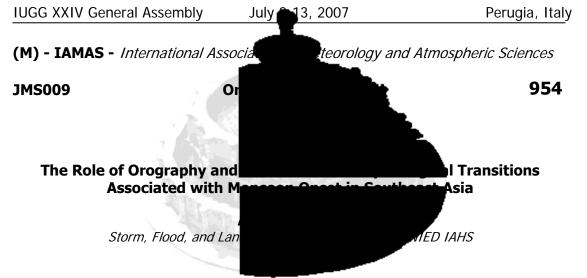












Floods and droughts caused by Asian mon of many Asian countries where billions of p linked components: the South Asian, East strong convection over the Indochina Per monsoon over the Asian continent. The first between late April and early May over inlar The first transition of the ASM is of great subsequent monsoon evolution. This study used a

is affe ture, wa bple The ian nd South las is indicative tions<u>\_into\_th</u>e ;hina, re nce fo iric np imate

ces, and the economies omposed of three inter-Soon an monstons. The appearance of he earliest start of the summer an Summer Monsoon (ASM) occur transi occur along the coast. s and may foreshadow al pra ucidate the influence of

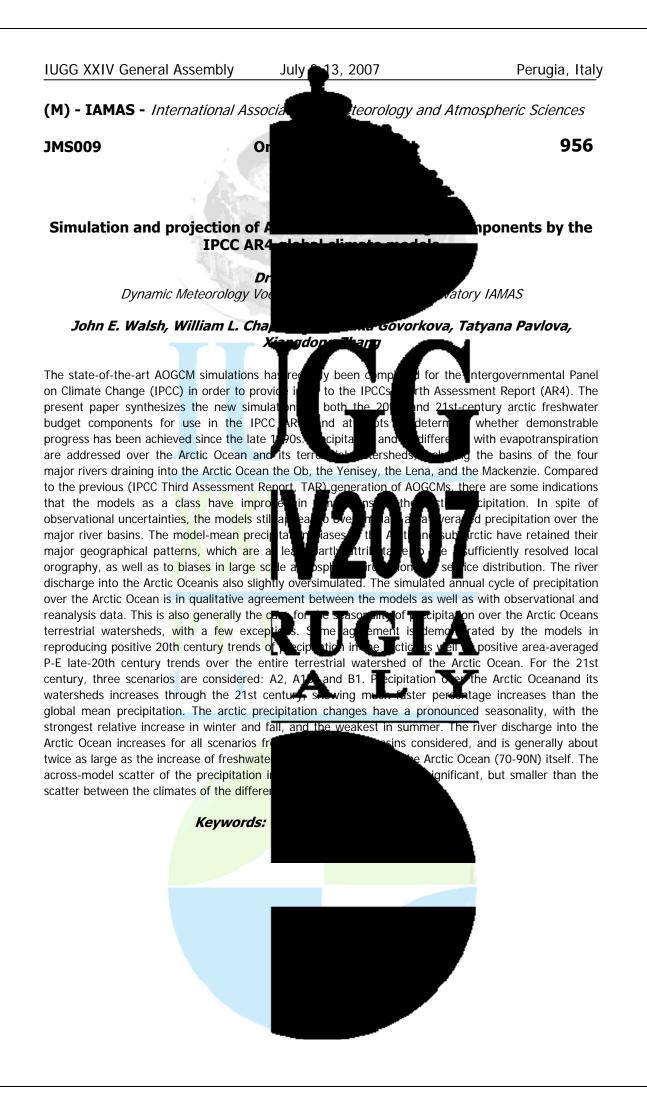
orography and ground wetness on sub-continental-scale hydrological processes. The model reproduced many elements of the onset of the Southeast Asia Monsoon (SEAM) associated with land surface conditions, including the abrupt transition conditions were combined in the model wetness, combined with realistic increases changes in the surface energy budget. A increases the moisture source for further p



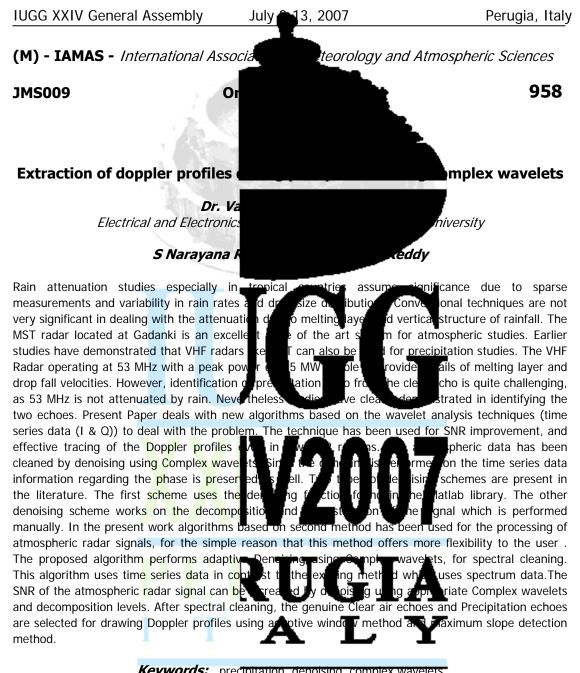
and relatively dry soil mountains and ground drological cycle through bisture and precipitation od.

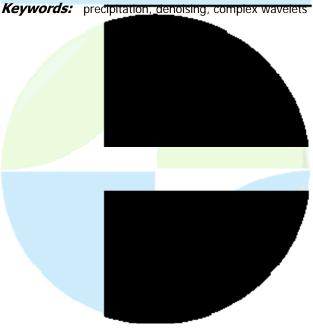




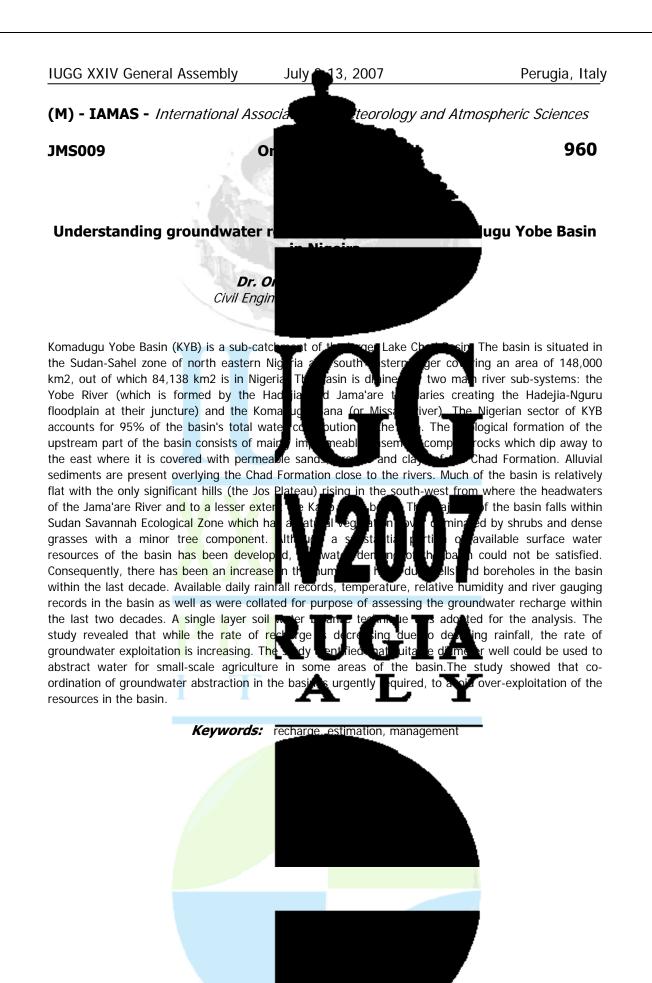


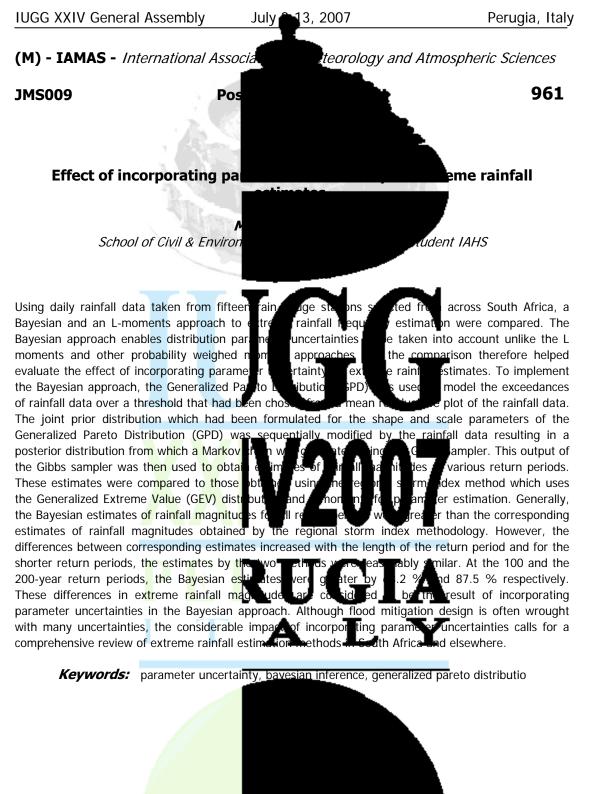






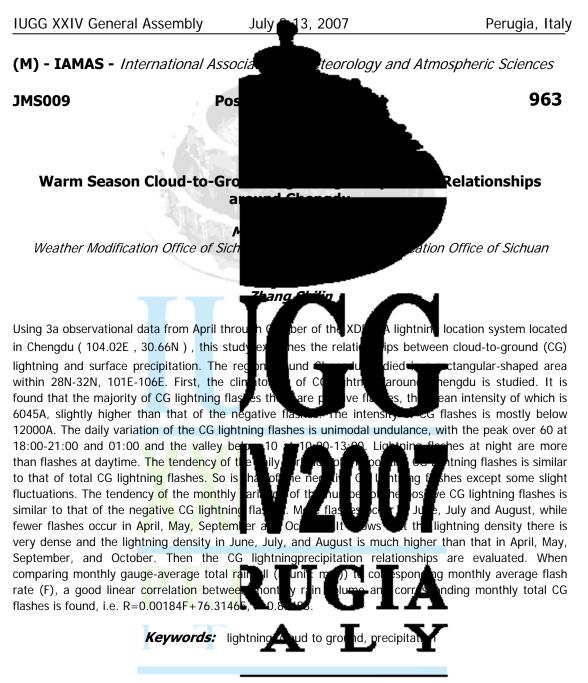


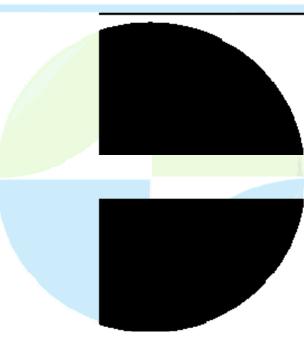


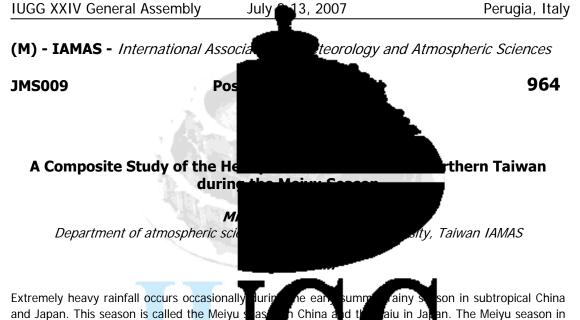












Taiwan is usually during the period of May a season is the Meiyu front. Unlike the front latitudes, they only move southeastward slo quasi-stationary front at the later stage. In he Meiyu season are attributed to many large-scale

The object of this study is to investigate the roles of different scales of atmospheric circulation in the heavy rainfall events occurring over northern Taiwan by applying techniques of composite analysis and scale separation of meteorological observ weather maps of 12hr interval are the bas further classified by differences in weather Environmental Prediction) reanalysis data meteorological features. In this presentat bn. scale and synoptic scale circulations for each category

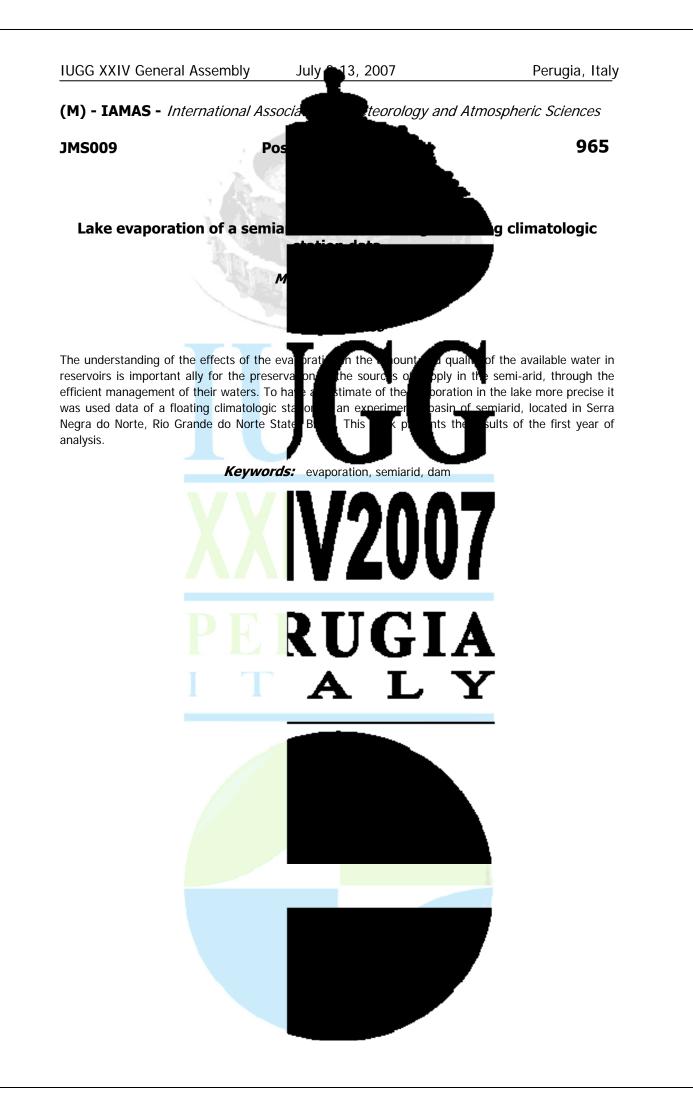
The most s iated with ng thể an ar nea lo-synd

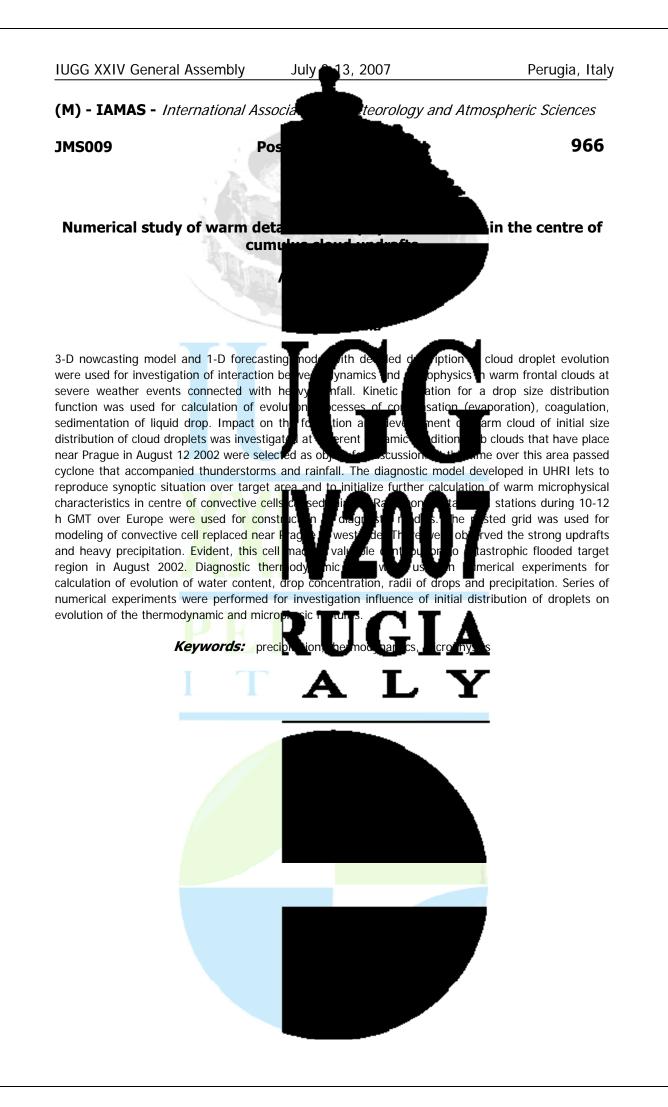
icant weather system in the Meiyu tude cyclones observed in higher of the fetimes and appear as a infall nts occurring during the meteorological features.

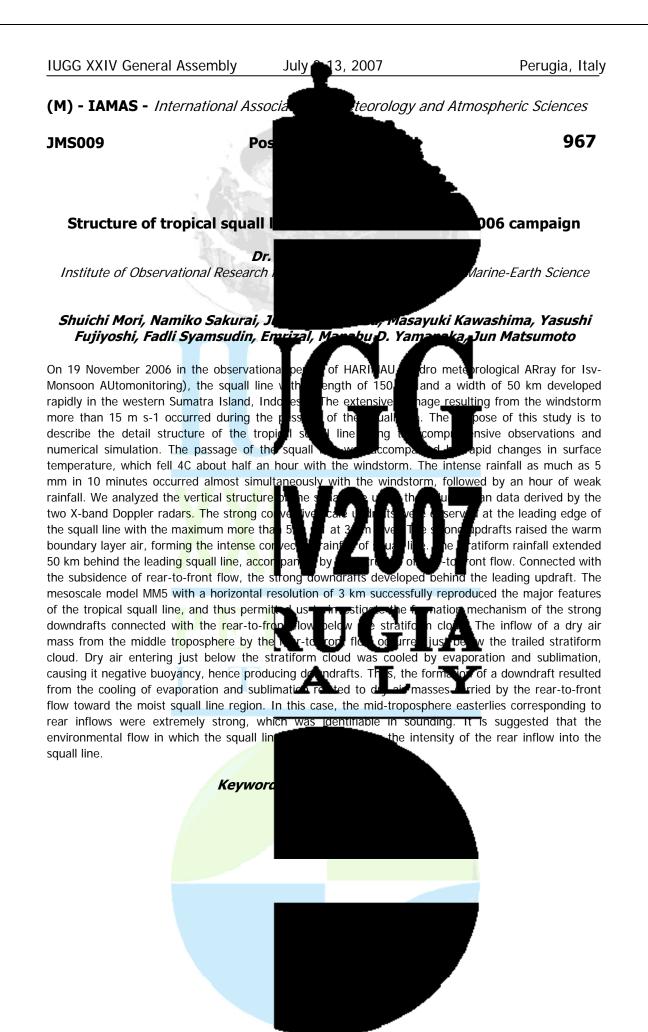
data and East Asian The selected cases are CEP (National Center for and scale separation of characteristics of largerainfall events will be discussed.

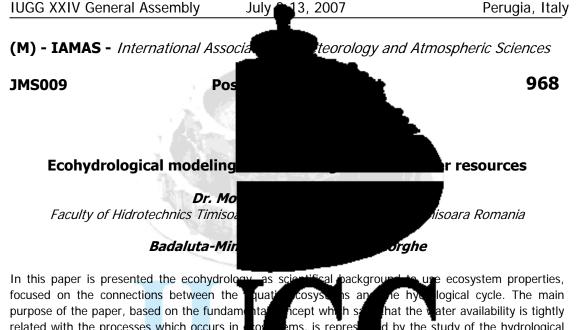


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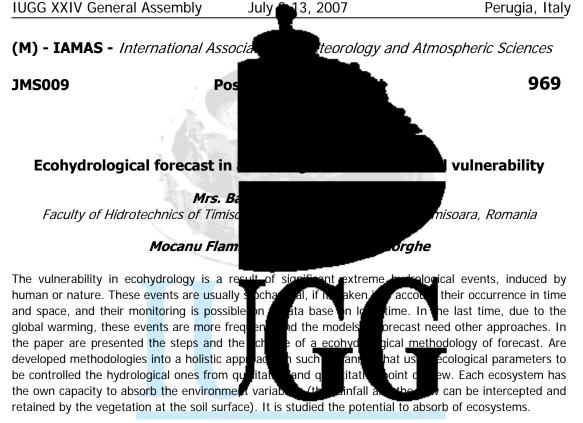
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related with the processes which occurs in regime of surface waters, depending on the scale. Are formulated and developed model the study, starting from a data base, hy presented the possibilities to integrate the management plan.

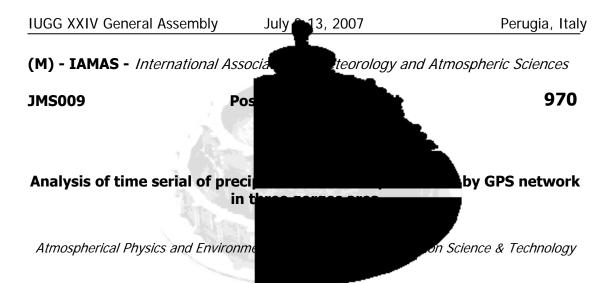
ems, is repres ses f<u>rom aq</u>u integ ie. ydrol ar cal

d by the study of the hydrological ecosystems at the catchment area hydr y-ecology, the steps for nodels. In the end are ologid the water resources









## Wei Wang Guoguang Zheng, Kenneth How <u>Wei</u>hua Zhang

ne

The Three Gorges Region is located in the and Hubei . The Three Gorges Reservoirs temperate zone and the subtropical zone, about 1100 mm. Precipitation makes such a factor for precipitation, water vapor change Project constructing. After the first impoundment

2003, the acreage covered by water increased from 452km2. Because of the increased water cover over land during the initial filling stage, the transportations in the local area could be detailed observations of Precipitable Wa Network of China and the Yangtze River analyzed. The PWV data were retrieved fro sites in the two networks. There are three step (RS) data are matched with GPS data in space and in time. 2. In Retrieval of PWV from GPS data, local

modifications, which include the localization of the relationship of atmospheric weighted average temperature (Tm) and surface temperatur and found in good agreement with Radios retrieval methods are physically reasonable after the initial impoundment of TGR were analyzed respectively. 1. With the monthly max PWV over two sites (BADN and GUFU) by the Yangtze from 200 2004, an

and some abnormal oscillations occurred in winter between Jan. and Apr. in 2004. 2. With daily max PWV at 2 target sites and 1 reference site in 2001 and 2003, the seasonal oscillations indicated that the peak value of PWV in 2003 summer is 5 region. 3. The 10-day average of the local average before the impoundment.Further, after the impoundment. Possible causes

weather and climate will be discussed.

the PWV peaks and valleys after the first impound.

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River at he boundary of Sichuan e transfer between the southern ns a lot with the annual rainfall of environment. As a key ydrold pecia uring the Three Gorges e first ten days of June

atmospheric dynamical conditions and water vapor urred and how much, Movement Observation g System) Network are ys measured by the GPS Surface and radio sonde

ved PWV were compared

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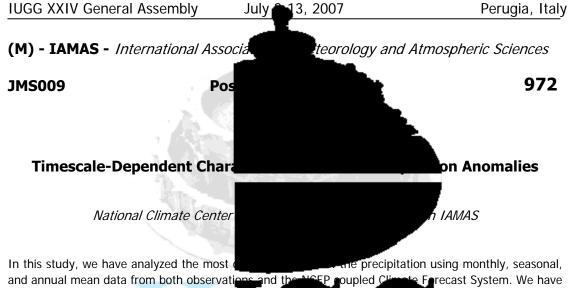
) is 3-5 m

eference site outside the TG reservoir nt is 6mm higher than the 10-day the local PWV became smaller ential impacts on the local

Keywords: precipitat

ervoir



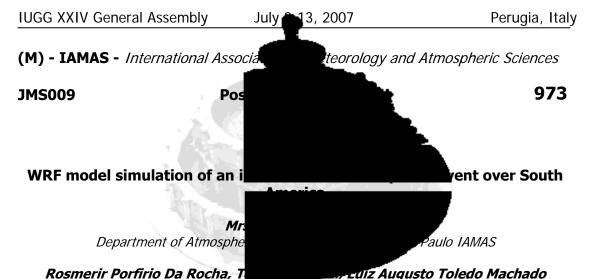


and annual mean data from both observations and focused on the timescale- and season-dopend precipitation variability. Empirical Orthogona Fu the variability of precipitation of different times dominant patterns of different timescales an atmospheric circulation in different ways. Compi the time-lag relationship between precipitation predictability of the precipitation, for the various se timescales in different locations.

Ind the NSEP coupled indication features and opin analysis and is posses differ inked to patter on of operate bon of operate is secons and entity

Climate Forecast System. We have the physical mechanisms of the avelet analysis have indicated that t loadings of spatial patterns. The of sea surface temperature and with number results and analysis of useful upprmation to assess the uppotternal predictors for different





## Rosmerir Porfirio Da Rocha, T

Convective systems are usually related to h However, in spite of the advances in numer In some aspects it is because of the comple interaction involved. In this work the effe conditions and grid size are analyzed in W related to a heavy rain event observed in Ja (South American Low Level Jet Experiment). Satell

and rain gage data are used in the final comparisons. Simulated wind fields present good relation to observed ones. The multicelular structure in the observed precipitation seems to be better represented in the results based on Betts-Miller-Janjic also sensitive to initial conditions, some se is used the model significantly improves t the life cycle the system much closer to the here has already been discussed by many rev analysis described here has not been done before

leling, co**r**veo he dynamic a liffere<u>nt</u> cum ather ar Q3, 1 and are

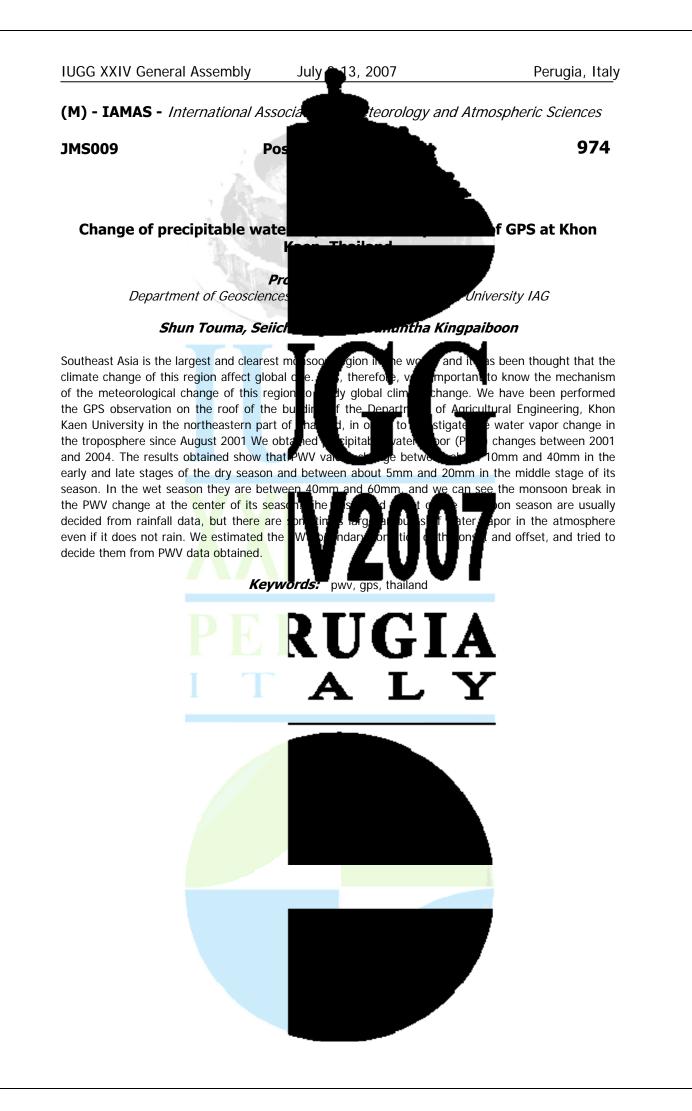
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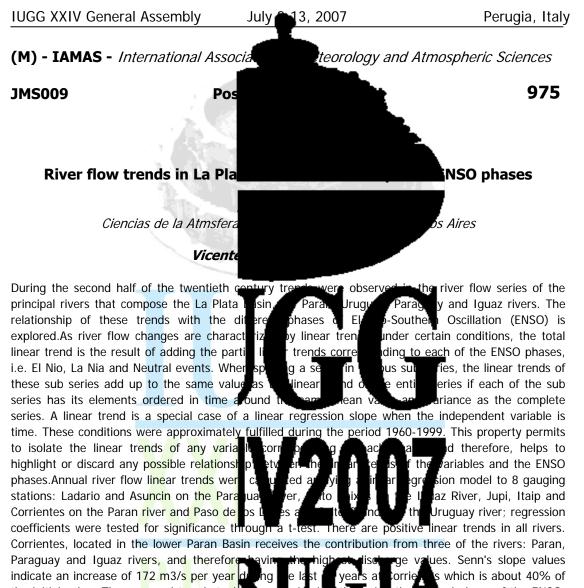
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nd economical impacts. system for ecasting is still difficult. hermodynamic and the multiscalar parameterization schemes, initial d For ting Model) simulations ָן, dur the SALLJEX experiment the system. Radiosonde

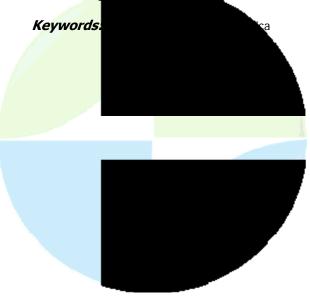
grid size. Results are better data assimilation hd it is able to maintain m chose to be simulated ed simulated precipitation



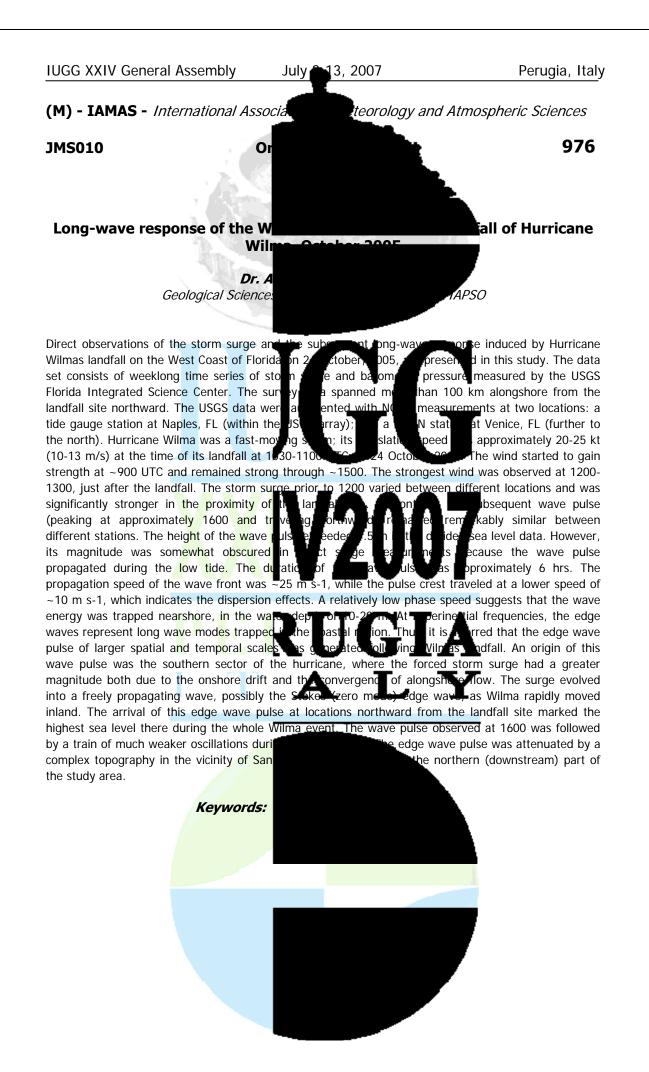


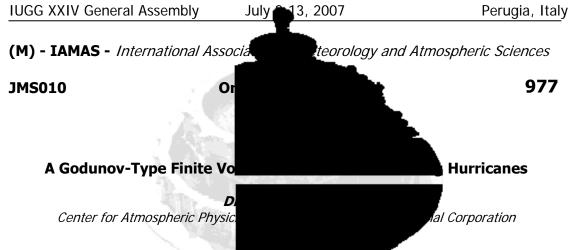


the initial value. These annual trends took these medianinally furiful the mean phase of the ENSO, except in the Brazilian stations of Jupi and Itaip where the slope values are higher during El Nio events. At Saltos Caixas slope values are quite similar turing both the neutration. El Nio phases. Almost everywhere in the region, no trends or very smaller to is took place during La La periods. Hence, in most of the La Plata Basin river flow trends during the extreme phases of the ENSO constitute only a small part of the trends of the last 40 years of the twentieth century. These results are consistent with those found when analyzing rainfall trends during









Hurricanes are characterized by extrem quantities such as potential temperature. In addition, of 1km) with large scale synoptic flow (or er of problem. An accurate numerical simulation computational domain to capture the largeresolution to maintain the intensity of the prohibit the use of a uniform high spatial re interest, significant efforts have been made,

and adaptive unstructured grids. In this Fudy, mesh refinement is proposed for simulating hurricanes. The Riemann problem for calculating Godunov fluxes is solved using a flux-based wave decomposition. The scheme is fully-conservative and exhibits minimal numerical diffusion and dispersion which are characterized by steep gradients design and implementation of the flow so solutions. Comparisons are made with r Research's state-of-the-art Weather Rese rcł achieved by using adaptive mesh refinement is

velocities and other thermodynamic interactions of kila hdred hurricane, w which, stee ne ci<u>rculatio</u>n that pr p alte d ive type fi

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en convective clouds (order es it a truly multi-scale ler) i efore, requires not only a large he hurricane, but also a high mesh ce, the computational constraints ve the smallest scale of nodol s, such as, moving nests scheme with adaptive

> d for simulating flows describes in detail, the ated against benchmark Center for Atmospheric Computational efficiency

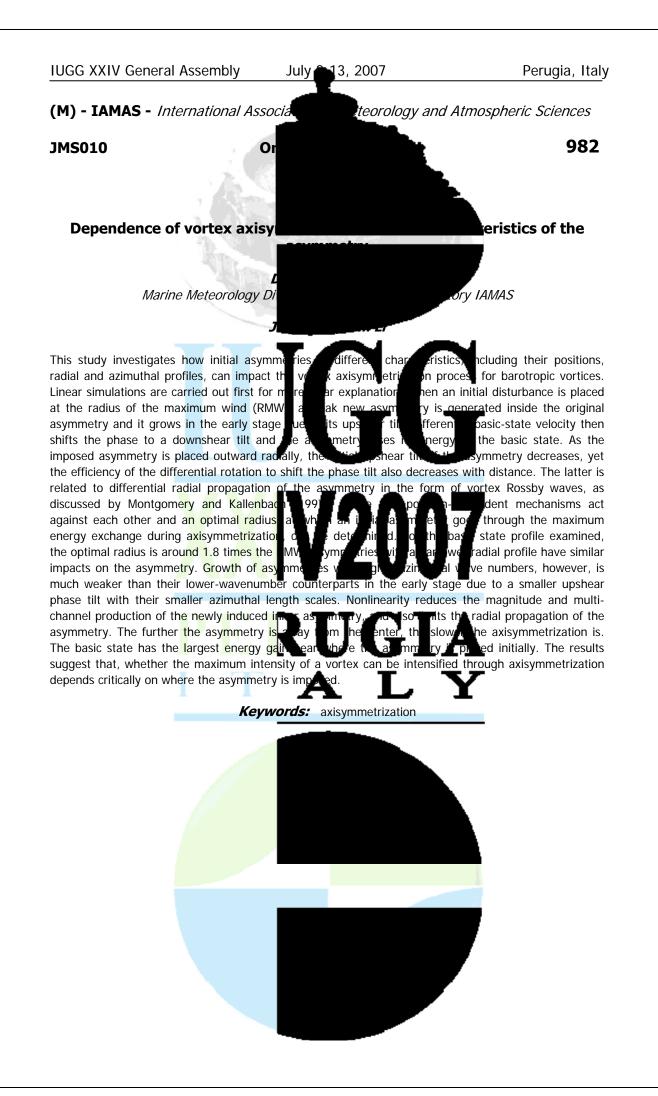


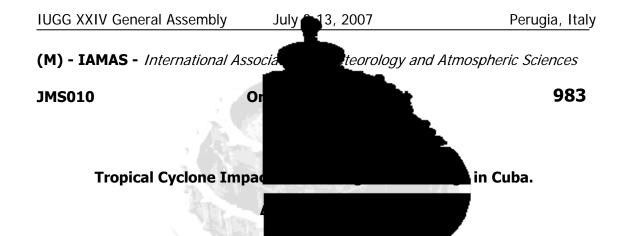












Cuba is a small island country located in th entrance of the Gulf of Mexico, where Tropical Cycle Hurricane Season, from June to November, The frequent and stronger Tropical Cyclones si affected by 14 Tropical Cyclones, of which fatalities, however, were few, the lowest fig achieving such an outstanding result by an presentation, as well as the models presen impacts of winds, rainfall, storm surge and coas

Cuban modified version, an statistical-sinoptic model for wind intensity, as well as the Cuban Monsac-3 model for storm surge and the application of MET-OLAS and the SWAN models for the forecast of coastal flooding caused by hurricanes. The at the Cuban National Forecast Centre, le hit) and Warnings (up to 72 hours before disseminated, with the clear objective of n people to take appropriate protective meas

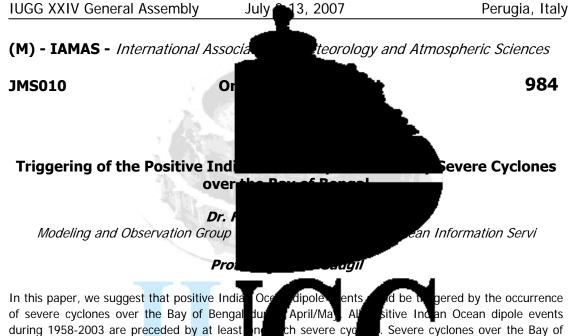
ubean Sea, in a position just at the very hare a verv n har intic én in <u>be</u> 5. In the 12 vere hurrican a co<u>untry in</u> velop uch a Sur ional at th bar

occurrence throughout the ersed in an era of more period of 1995-2006 Cuba was Material losses have been large; Hurricane basin. The methods for ba are discussed in this ecast Centre to forecast M5v3 mesoscale model

> al methodology in use rs before any potential

ich they are issued and the forecast and urging

Keywords: hurricane, forecast, cuba



during 1958-2003 are preceded by at least Bengal strengthen the meridional pressure and hence lead to the intensification of the Severe cyclones can also lead to a decre se convection over the EEIO. We suggest that the su

to the enhancement of convection over the western equatorial Indian Ocean (WEIO) and hence to the weakening of the westerlies along the central equatorial Indian Ocean (CEIO). This can lead to a positive feedback between suppression convergence and convection over the WEI CEIO become easterlies, the convection of than the synoptic scale. The strong up vel southeasterlies along the Sumatra coast de equatorial Indian Ocean very rapidly and a positive dipole event gets triggered

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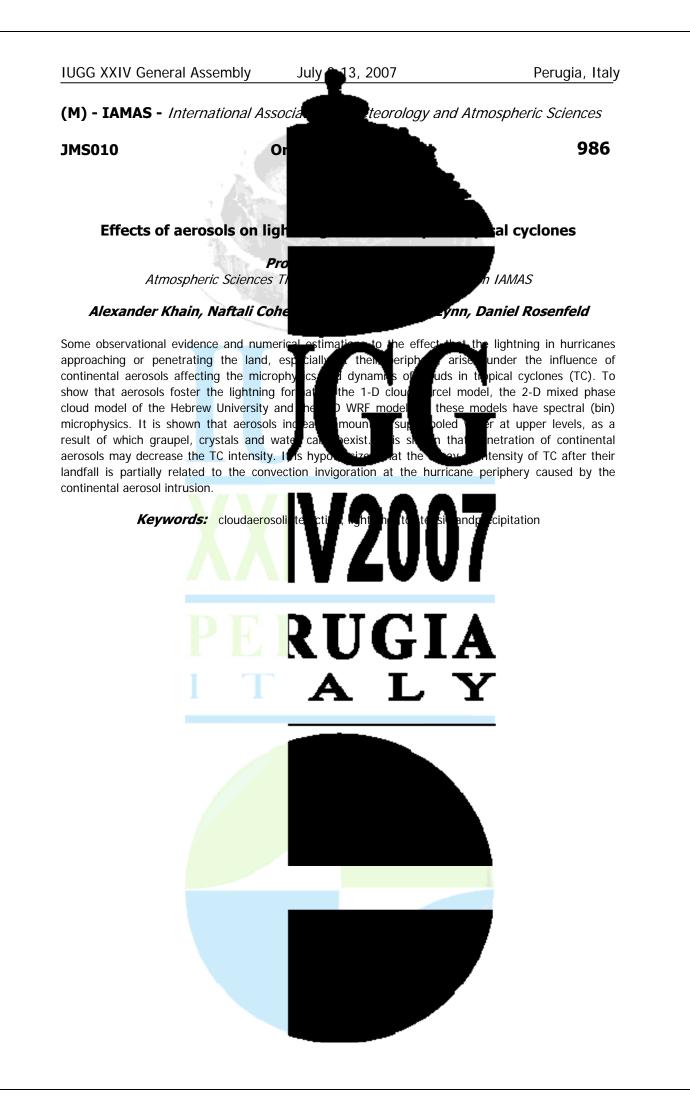
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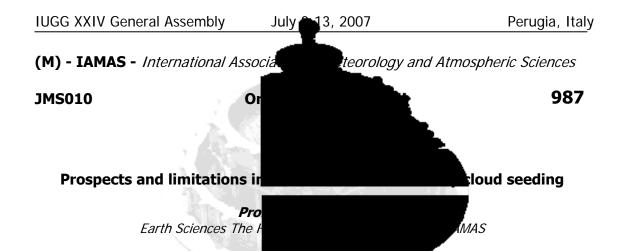
Severe cyclones over the Bay of n equatorial Indian Ocean (EEIO) asterl long the Sumatra coast. content and suppress ter v the EEIO in turn, leads

> enhancement of the until the winds over the r a period much longer along the equator and perature of the eastern









An experiment to reduce the intensity of h submicron cloud condensation nuclei was computer aimed at suppressing the low-level warm ra heat of freezing in the periphery aloft, resulting The first sub-experiment involved the shuto to the seeding. Although this reduced hurric unrealistic because in the real world the g spray in the region of strong winds will like

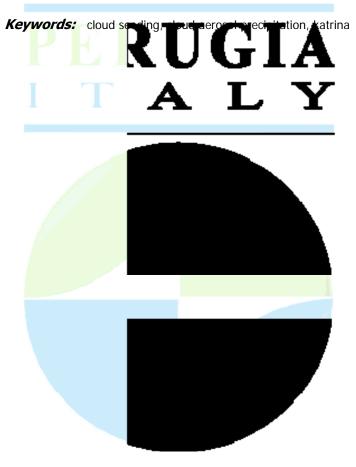
expected weakening of Katrina was obtained in the numerical simulations of this sub-experiment when the hurricane was in its initial stages, but a winds overwhelmed the effect of the seed seeding-induced weakening of the hurricar be reversed. Although the initial model intensity of hurricanes and potentially even explicit microphysics is of interest.

a their clouds with large concentrations of ulated for h h at bud oute reduced her warm rain th ensit<u>y throua</u>h n of c copic 'n elm t lpb micron hygroscopic nuclei. The second secting sul nt is

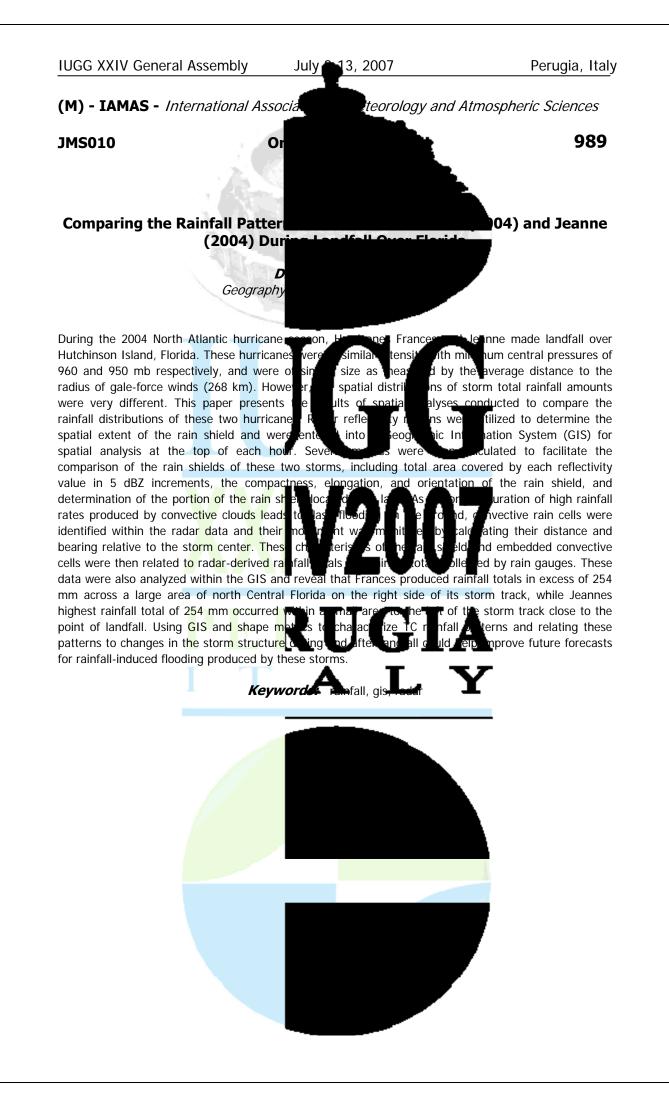
e Katrina. The seeding is y releasing more latent s the gradients and hurricane intensity. hout the hurricane circulation due he <u>3-day period</u> of simulation, it is ei from the intense sea ve eff of seeding with the subbre realistic because the

shutoff of the warm rain is limited to the hurricane periphery where sea spray is not a major factor. The

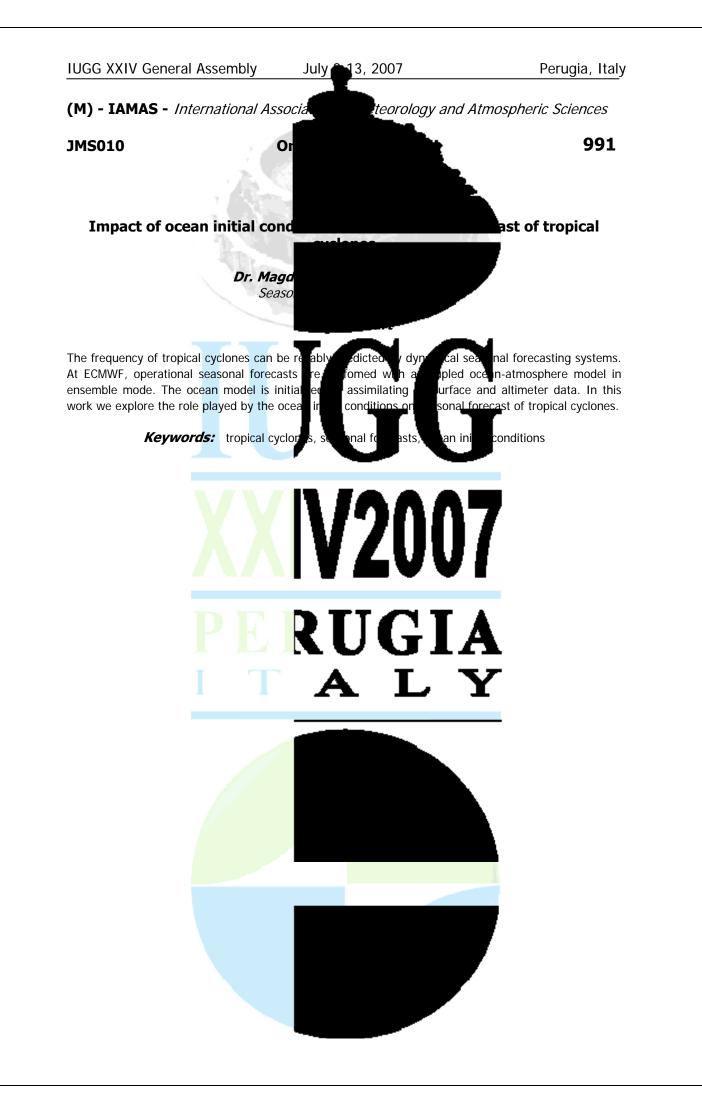
y raised by the strong rain. This reduced the hat the weakening might possible to modify the detailed simulations with

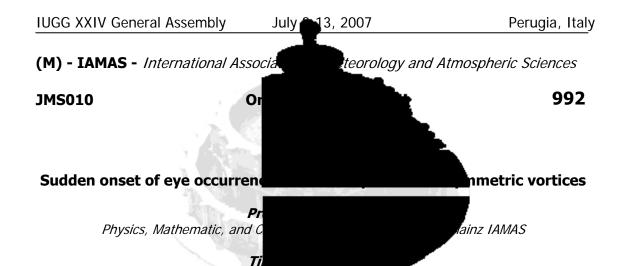












This paper investigates axisymmetric balanced flow g the f-plane. The flow is forced by heating towards a specified equilibrium temperature assumed to be almost inviscid in the interio in this system are controlled by the ratio F = and cD quantifies the strength of surface fri between hurricane-like vortices (which occ occur in the limit of small F). The present conti

may occurr even though the equilibrium temperature Te does not predispose any such structure. Key parameter for the existence of an eye t develped eye' is rather sudden, suggest transition is related to vortex properties I mechanism for eye-formation in our nume hand, the maintenance of an eye in steady Implications for eye formation in tropical cy

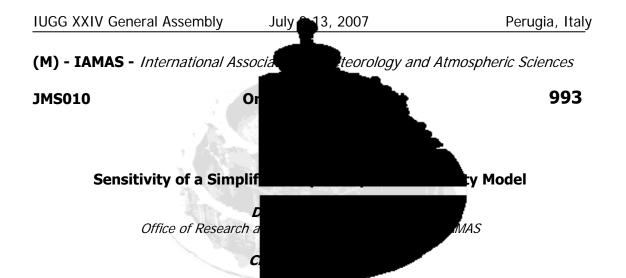
stratifie abl ĥtb ortex nter flow is a te. ous work has / cD, where a giv uri limit in irge

Boussinesq atmosphere on blemented as relaxation h is through surface friction, and it is vn that essential vortex properties aT is the rate of thermal relaxation wind. e is a smooth transition and m oon-like vortices (which urrence, formation and

maintenance of an eye, which is defined with reference to the radial profile of the vertical wind. An eye

en 'no-eye' and 'fullyocesses. The point of tion to f. Given Te, the y inviscid. On the other nich is a viscous process.





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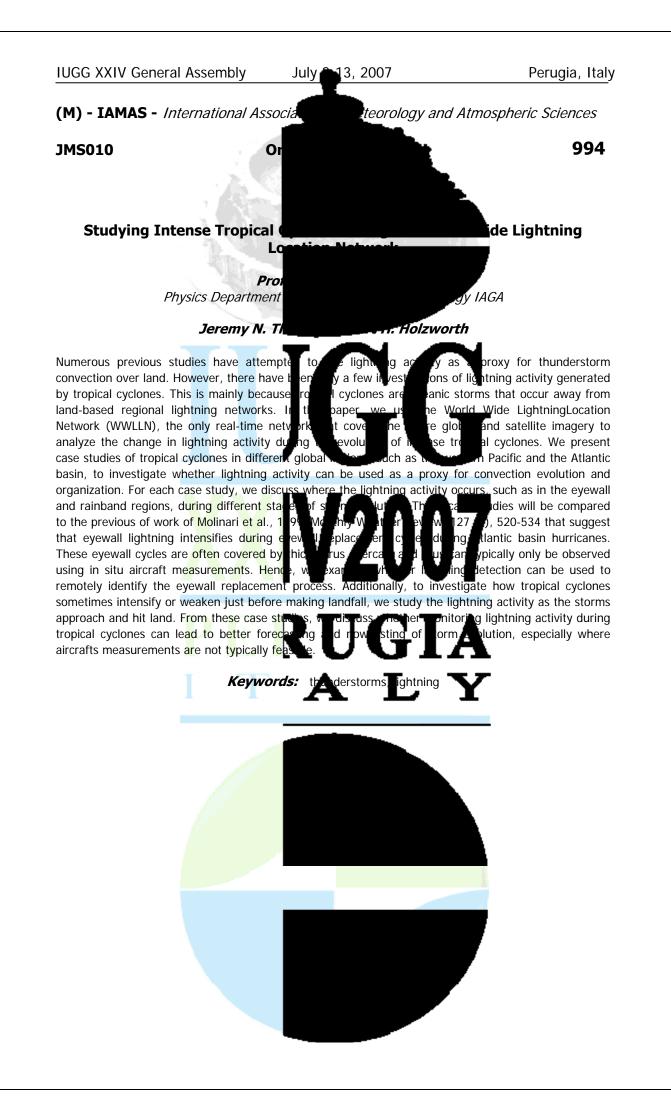
The skill of operational tropical cyclone int ensity fo forecasting. One of the primary factors i tro circulation by the surrounding large-scale obtained from a model that predicts the circulation are not adequately represented. scale and storm scale motions be accurate surface is also an important factor for changes, simplified prediction systems have show dimensional coupled ocean-atmosphere models. These simplified systems range from 2-dimensional axisymmetric hurricane models coupled with a slab ocean model (the Coupled Hurricane Intensity Prediction System (CHIPS) developed by K relationships between intensity change an shear (the Statistical Hurricane Intensity Kaplan). In this paper, a new simplified in ens based than the SHIPS model, but is still r lies determined by a logistic growth equation (LGE), where the intensity (as measured by the maximum surface winds) is relaxed towards the maximum potential intensity (MPI) when atmospheric factors are favorable. The MPI for this system is determined from operational sea surface temperature Centers for Environmental Prediction (NCE aloł model has just one free parameter, which is the growth rate. The growth rate is determined by empirical relationships with vertical wind shear and a convect LGE model can predict intensity changes with sensitivity of the LGE model to the thermodynamic environment is determined by comparing results from forecasts with operational SST analyses to those with experimental high resolution SST analyses based upon microwave satellite observation cooling parameterization, where the cool satellite altimetry data. The sensitivity of the by comparing forecasts with soundings f retrieval techniques. Results show that the comparable to that due to variations in opinions, and findings in this report are th NOAA and or U.S. Government position, po

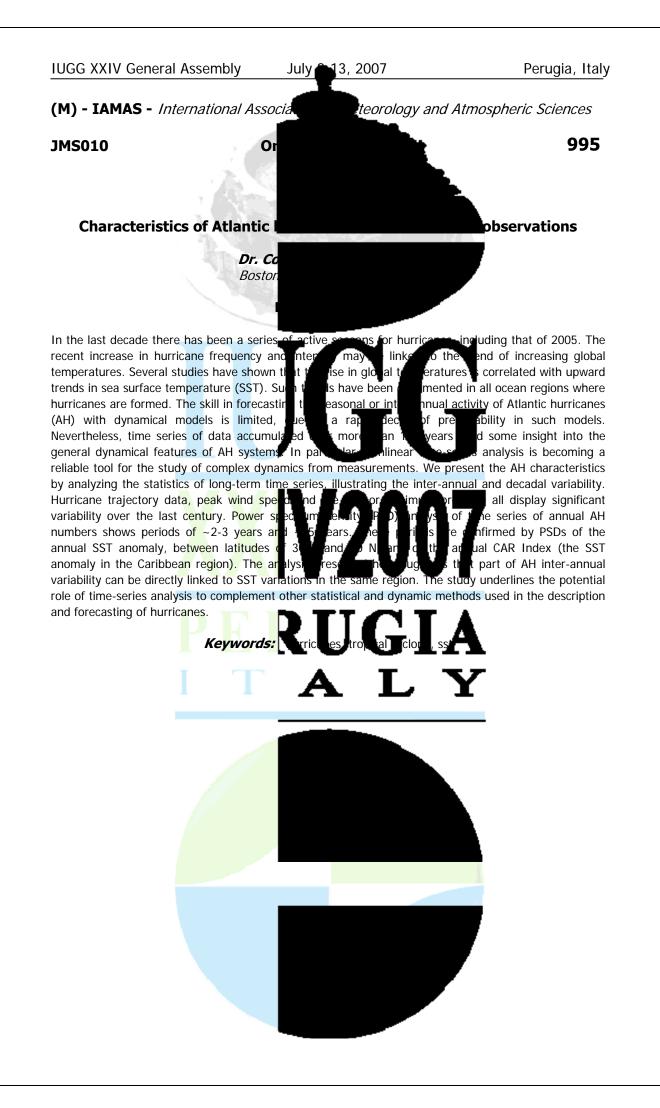
bly less than that for track advection of the storm 'is tP accurate track forecast can be even if the details of the storm ediction requires that the synoptic action h the underlying ocean of complexity of intensity reater than fully threeed purely on empirical

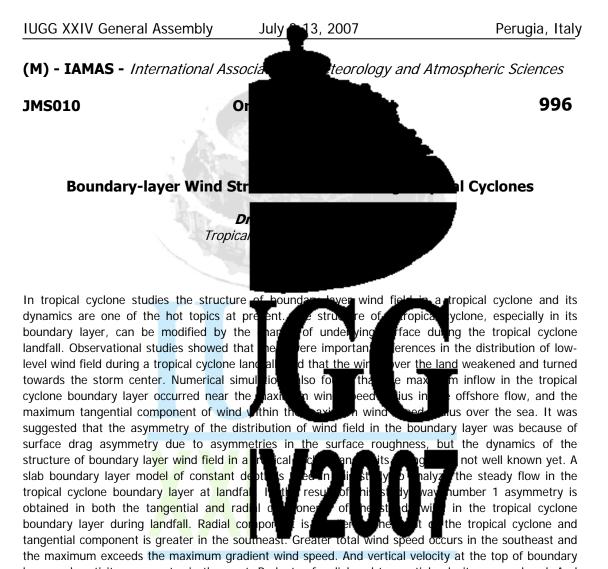
s such as vertical wind d by M. DeMaria and J. d that is more physically s. The model evolution is ped by K. Emanuel, using input eric s ndings from the National atrhosi Given the MPI the LGE ի (ն meex. It is shown that the e instability the operational SHIPS model. The Lis also evaluated by inclusion of an SST anic heat content estimated from ric environment is investigated ith soundings from satellite permodynamic variability is Disclaimer: The views, construed as an official

Keywords: hurricane, tropical cyclone, satellite data

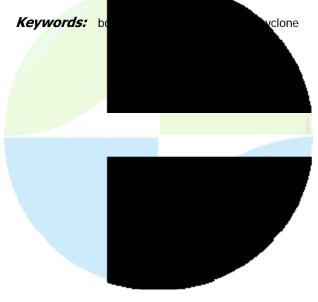


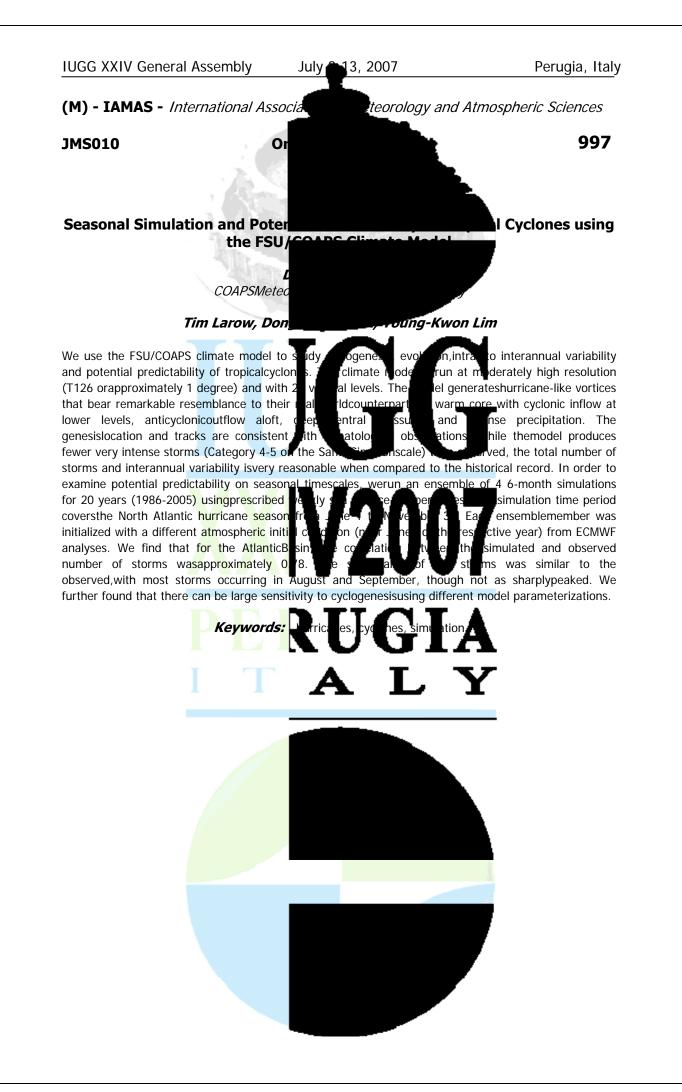


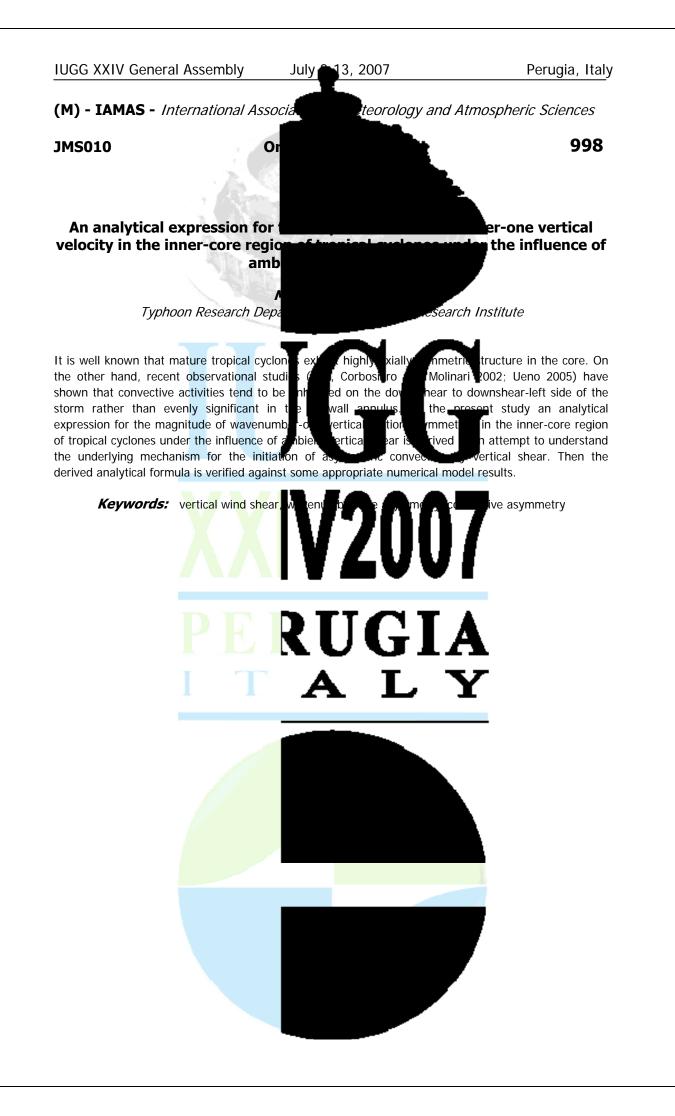


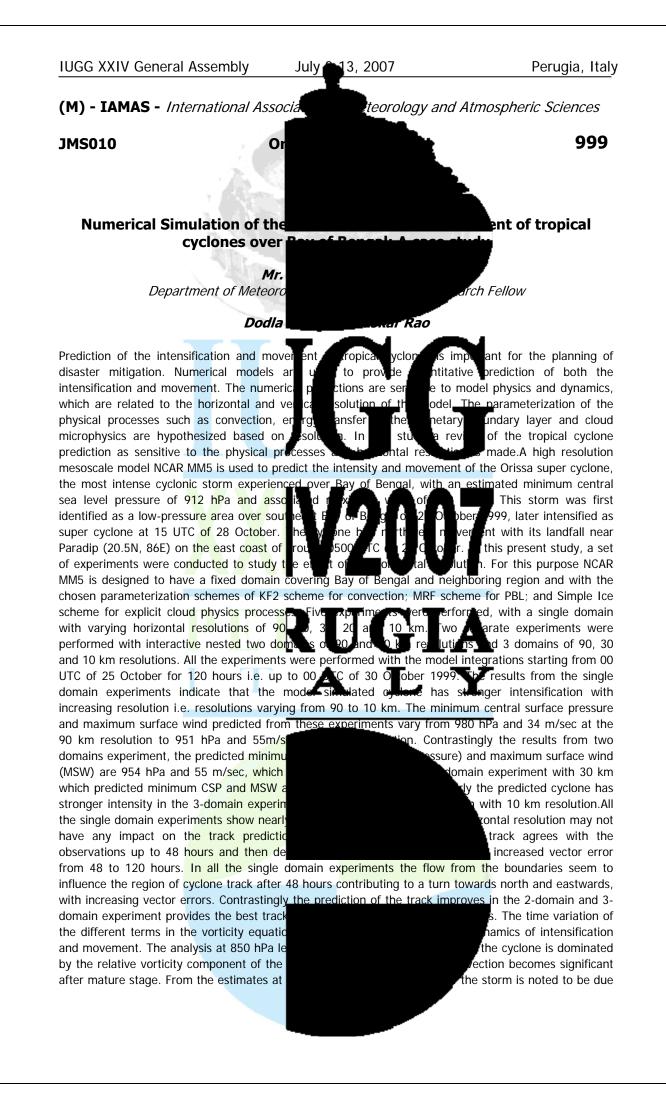


layer and vorticity are greater in the west nudge ntial elocity are analyzed. And symmetric structure of boundary layer wind ld. clone a ove t homogeneous underlying surface is compared to the asymmetric The direct cause for lan lfa ppic су s o ION producing such an asymmetric structure of boundary layer wind field in the landfalling tropical cyclone is the asymmetric surface friction and the radial adjection. Terr s of advect n Triction, curvature effect he balance of the model and steady gradient wind at the top of boundary portant for aver are equations. Different distances of the core of tropical cyclone to the coastline dont strongly affect the pattern of the boundary layer wind field when the tropical cyclone is very near the coastline. But the amount of the extremum of the radial or ta hanged.









## **IUGG XXIV General Assembly**

to the horizontal advection as well as the change of movement towards north an influenced by sudden change of the tilting formation of convection, contributing to i factor for the intensification of the tro significant only after the storm attains its r is also made in order to study the relation PV anomalies are positive (negative) towa storm. This result indicates that the distrib tropical cyclone movement.

Keywords: tropicalcy

icity component of the stretching term. The ngle domain experiment seem to be bese observations indicate that the of the vertical velocity is a major orizontal advection becomes al vorticity (PV) at 500 hPa ent. It is noted that the m, there by indicating that the PV anomaly gradient from negative towards positive clearly agrees with the movement of the as a predictor for the

ntialvorticity

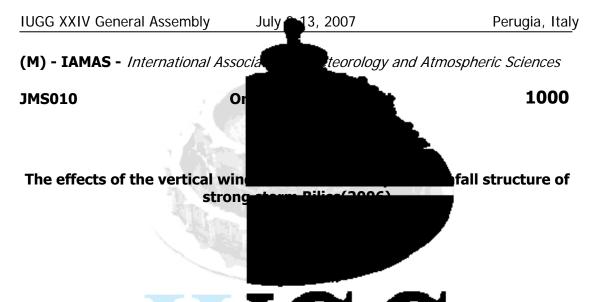
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July

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Perugia, Italy



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The relationships between the strength of the and rainfall structure are analysed by virtue TRMM, wind speed on 850hpa and 200hp observing station each 5 minutes interval directions data of storm Biliss from its do between the vertical wind shear and the 0.57438 respectively with 0.01 faith standard. The

for some inhibiting Biliss intensification. The average azimuthally rainfall rate is smaller in eyewall than in outer spiral rainbands and the maximi intensity become stronger. The relationsl rainfall structure propose that the heavy r storm , which is similar to the effects of around the eyewall . The asymmetries of one wave asymmetries are greater for bigger wind shear

urface ra fall NCEP/NCAR Chin<u>ese lan</u>d The ilts nsity tem tical active process, which locates at a little greater standard than the moderate, and then it is responsible

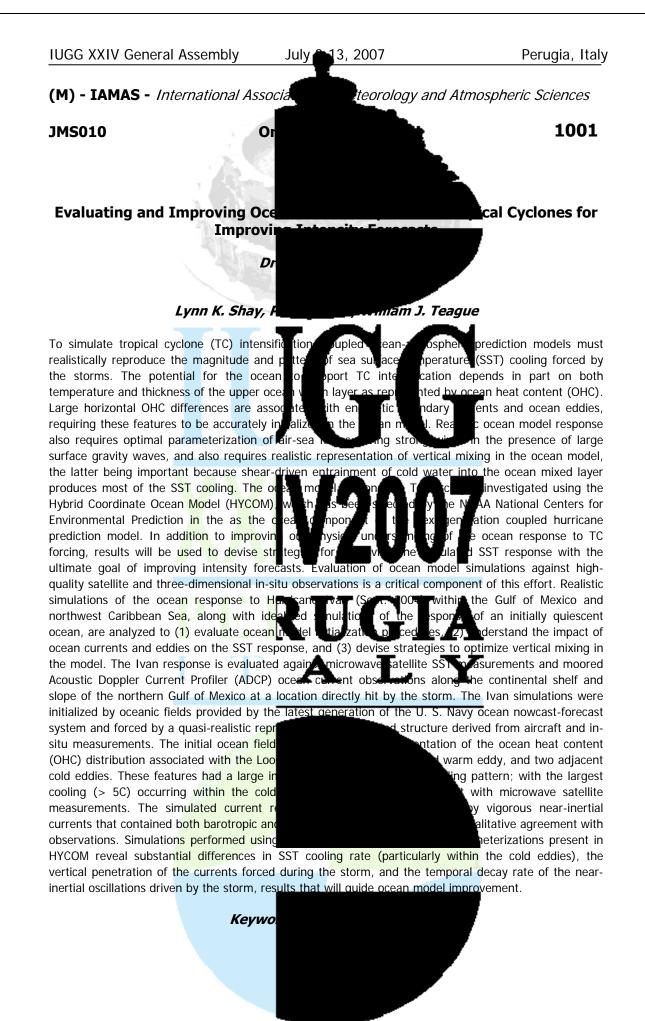
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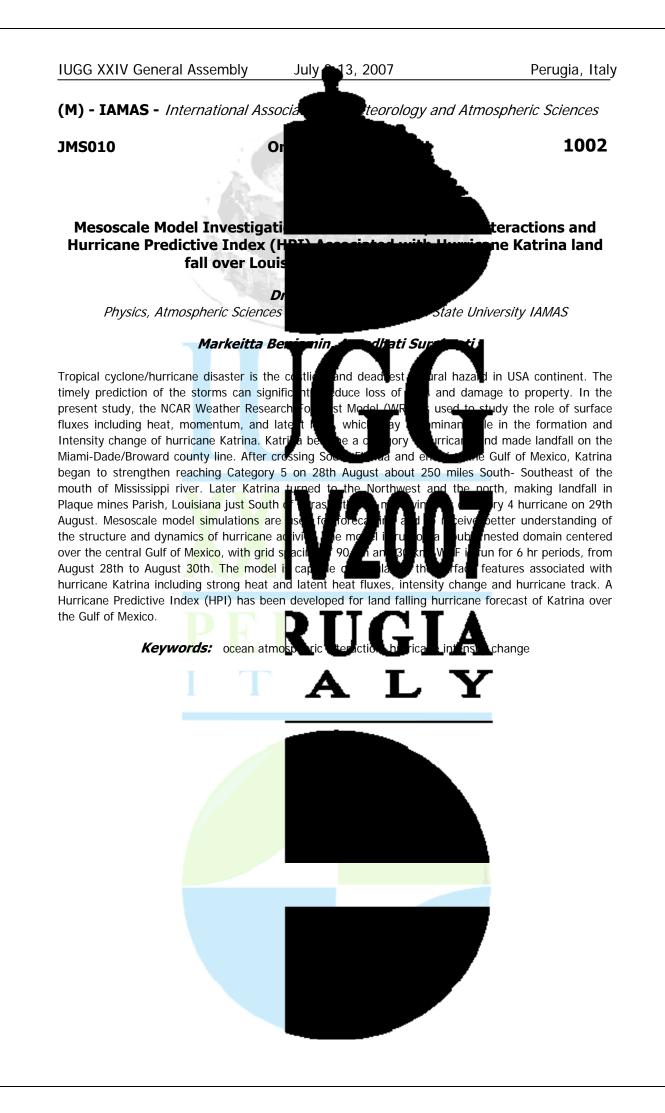


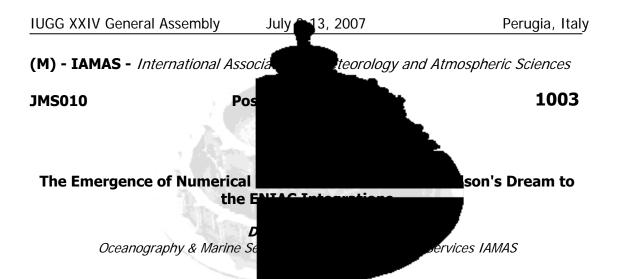
and the storm intensity nd s estimated from TMI orbit data of ervation precipitation from autothe intensity, positions, moving w tha e relational coefficients ry an ter 6h are 0.59145 and is 10.9 ms-1during Biliss

> enter when the storm and the asymmetrical t and downshear of the netrical rainfall structure radial position. Besides,









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With its unmistakable spiral shape and cent typhoons, is the most memorable feature d floods that pose threat at landfall and ir development and application of contempor ocean response in tropical cyclones. The me to develop definitive extreme ocean respon hallmark of these endeavors is the meticy space evolution of sea surface wind field in cyclo

observations over the vast waters are extremely sparse, limited to a few island stations and a ship report. Occasionally, reconnaissance aircraft fill some of this void, but this resource is expensive. With the advent of remote sensing, the detec activities of the storm are made possible mission (TRMM) is a TC package that inc lde Lightening Imaging Sensor (LIIS) and a v ibl demonstrate their contribution in observation forecast and the overriding consideration in emergency response and disaster management. Specific

eye, ppital cyclor cean caus everal ir ern hniques for t e refined. ria for İgı ts di be g both

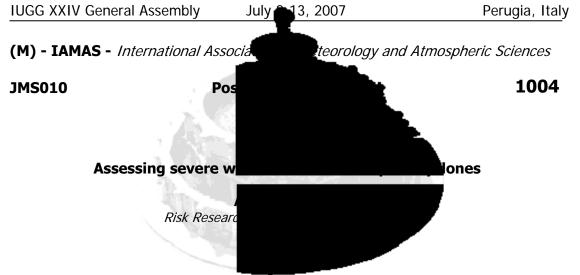
ncluding hurricanes and its da erous strong winds and al activities have pioneered the pecification of surface winds and ed, and applied in hindcast studies nd coastal structures. A offshol ds s ication of the time and d satellite data. Surface

> inner-core convective ical Rainfall Measuring TMI), a rain radar (PR), ntent of this article is to t on numerical weather

validation results from various research agencies are briefly presented here-in.



are



To quantify the tropical cyclone risk to-Geoscience Australia is developing a statis component of a complete risk assessment m local, long-term wind hazard over the Austr with engineering-based vulnerability models will provide a complete view of the tropical of hazard model uses a random-walk techniqu including parameters such as origin, speed and

characteristics are sampled from distributions based on historical observations of tropical cyclones in the Australian region. The maximum wind speed field associated with each of the synthetic cyclones is determined with parametric, asymmetric v simulated cyclones are then used to dete level. When combined with high-resolution big simulated local wind fields provide a spatia primary goal of this modelling work is to c hazard posed to the Australian region by tropical cyclones. The 2D model will be combined with high

tho Aus pmmunit fal bical one t l of is 2D statistic de gion arising d natio<u>nal buil</u>o risk po Austra to rate a aba fsynt moti

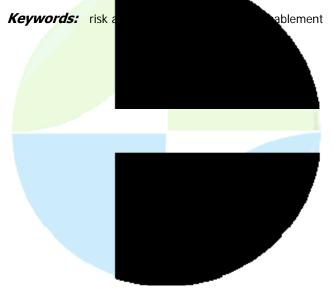
isk Research Group at s and wind fields as a odel is designed to determine the tropical cyclones. In combination exposure database, the risk model community. The cyclone tropical cyclone events pressure and size. The

> The wind fields of the at the 50-to-1000 year shielding databases, the to tropical cyclones. The nt of the long term wind

resolution topography and terrain datasets to obtain the local (house-by-house level) wind hazard for exposed regions of Australia. Additional includ provision of an impact statir assessment tool for emergency managers de cyclone impact, cyclone ere it is combined with characteristics (position, speed, intensity, s od∉, v fhe. ) c be detailed topographic and terrain data to determine the areas within the impact zone that are likely to have experienced the worst damage. Individual used as forcing for inundation models to study for ents may the resulting wind field e modelled I is being developed with surge e te The mo an open-source philosophy, so it can be released to the risk research community and allow users to contribute to ongoing development of the model. This will also encourage use of the model in other regions of the world, improving the unders of tropical cyclones across the globe.

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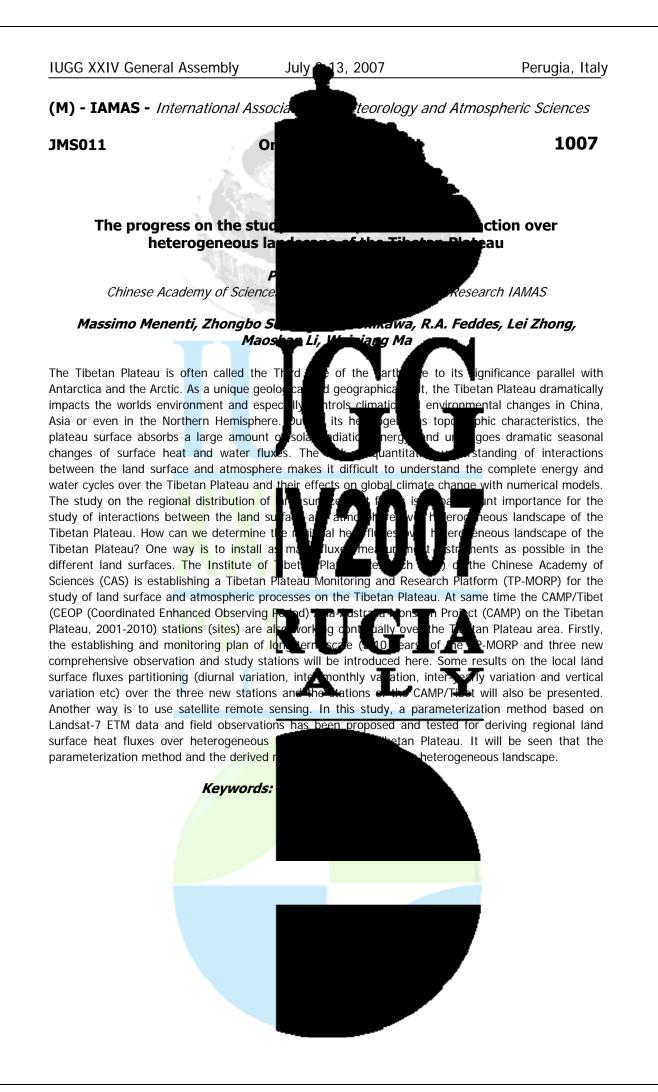
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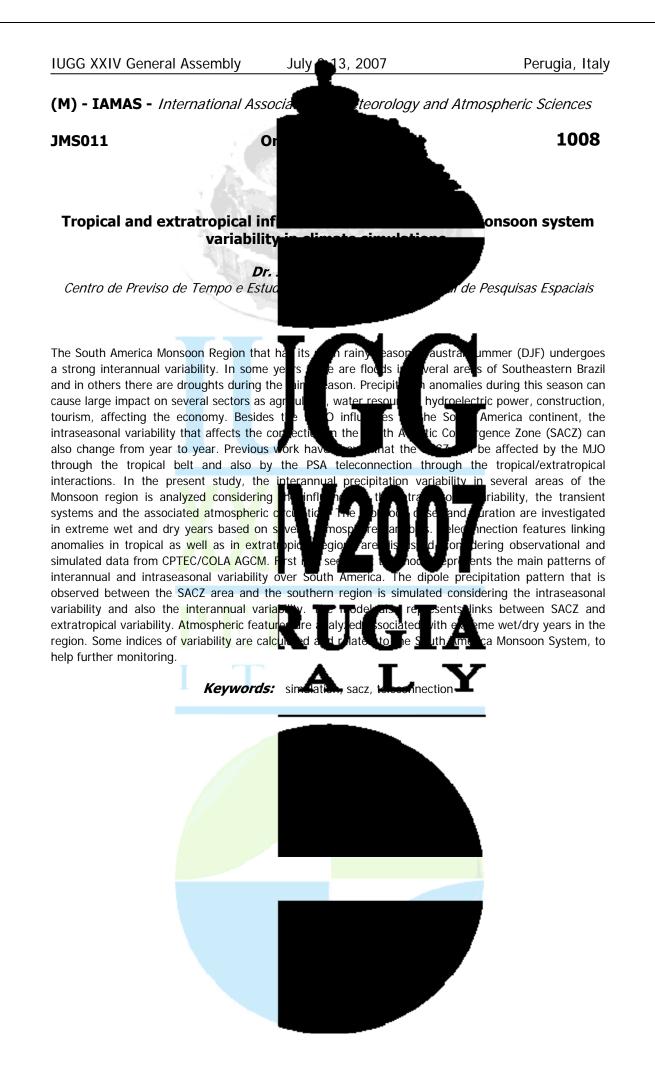


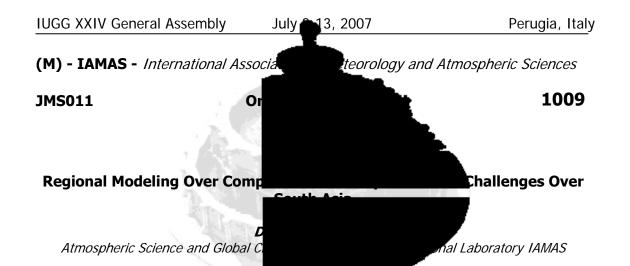


IUGG XXIV General Assembly Perugia, Italy July 13, 2007 (M) - IAMAS - International Associa teorology and Atmospheric Sciences 1006 - 1106 **JMS011** Symposium **Monsoon Systems** Convener: Prof. Guoxiong Wu Monsoons are among the most complex o involving processes on a wide range of space and time scales. T If of the tropics, and their variability on even the largest scales is n The energy released in these systems also has impact on weather in m in years, observations from a variety of field studies and satellite data have provided much more information on monsoons, and progress is being made. This symposium invites presultation on dynamics, including spect m on observations, modeling and forecasting stud dies inv with the ocean, and the vina ractions es. effect of processes on a variety of scales on are particular lught hir **V2007** UGIA









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The climate of South Asia is greatly influe represented by complex terrain features inc ldi such as the western Ghats and Arakan Yom that mountains anchor convection, which le upstream. The impacts of the diurnally var centers, particulary those related to narry understanding of the regional energy and water cy

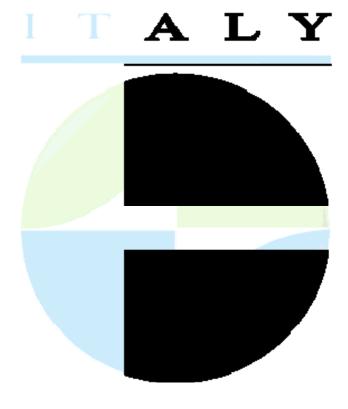
Mesoscale Model (MM5) has been used to develop a regional analysis of the hydroclimate of South Asia. The model was applied at 50 km horizonta circulation. Temperature and winds from the the MM5 grids and assimilated in the red performed for 1998 2004. Evaluation and regional hydrological cycle and effects of th

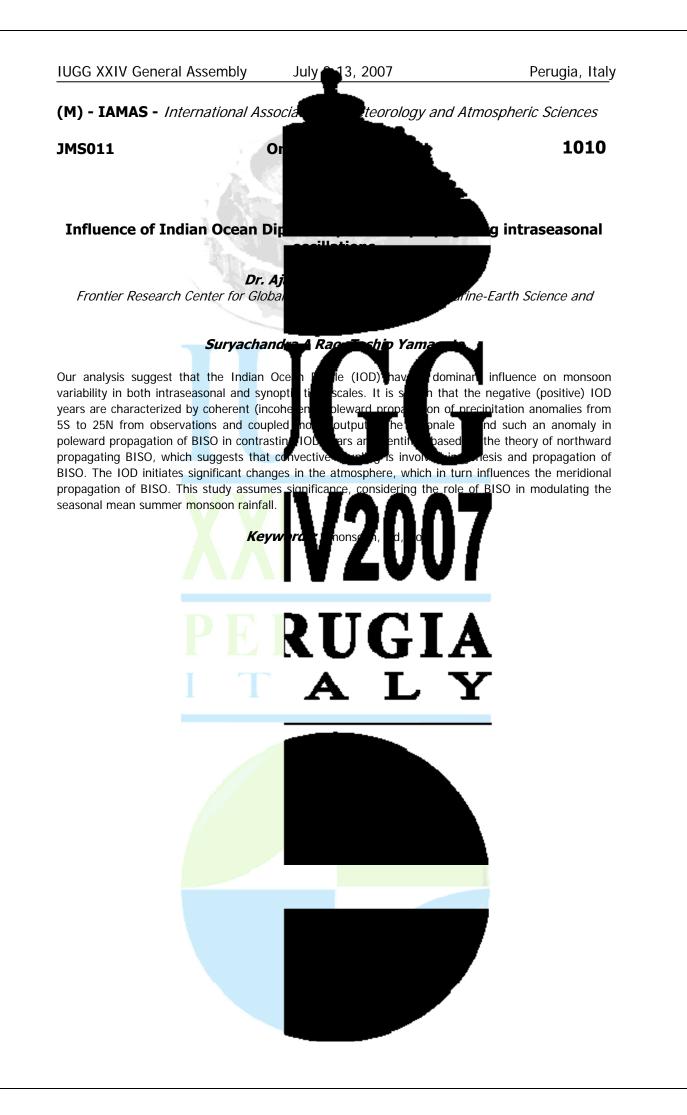
and mesoscale mountains must be assessed and realistically simulated. Recently, the Penn State/NCAR

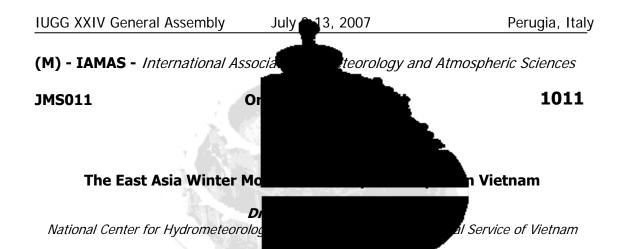
and topographic forcing fulatio In Plateau, and narrow mountains outgoing longwave radiation show n on the windward side or further d with these convection assoc ell u stood. To advance our s of the Tibetan Plateau

> nstrain the large scale spatially interpolated to ng. The simulation was esented, focusing on the seasonal time scale.

Keywords: monsoon, mountains, diurnal rainfall







Vietnam is located in the South East Asia, activity has a big impact in Vietnam. During the winter Northern Vietnam and the Central Vietnam and

the Southern Vietnam. The cold air surges dramatic effects in the Northern and Center direction and speed that lead to significant v large areas, etc. Especially, in the early propagation in combination with easterly cause torrential rains lasting for several dars, som

a consequence, in this region severe floods, flash floods and inundation occur affecting the life of millions population causing serious damages for human being and properties. Therefore, predicting the cold air surges and associated significant In National Center for Hydrometeorologic done using NWP, statistic methods and prepaper will present climatology on winter surge and associated significant rain event

o the tropical monsoon climate. Monsoon East Asia m affects the weather in the West monsoon affects he S winter honsoon bring the most us changes in temperature, wind ong wind with gust, heavy rains in air es, like gravity - wave me with tropial cyclone sor the Central Vietnam. As

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Keywords: winter, monsoon, vietnam

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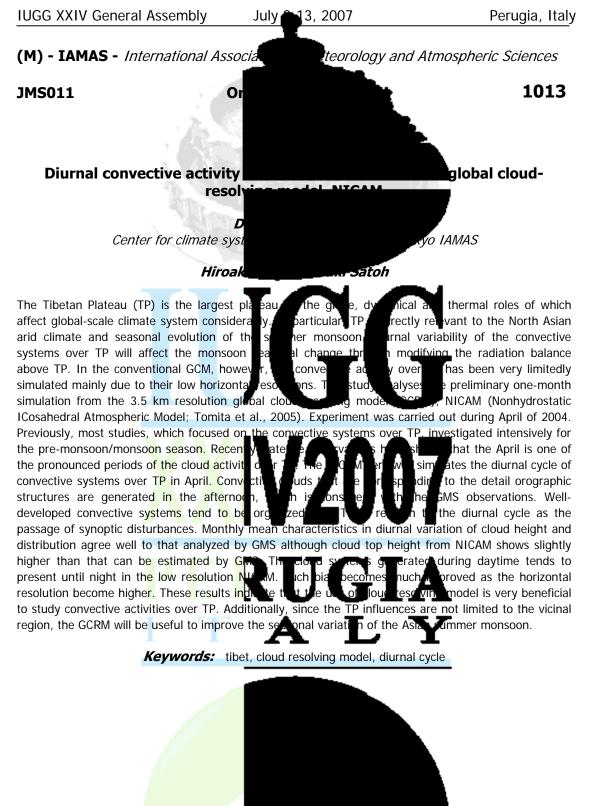
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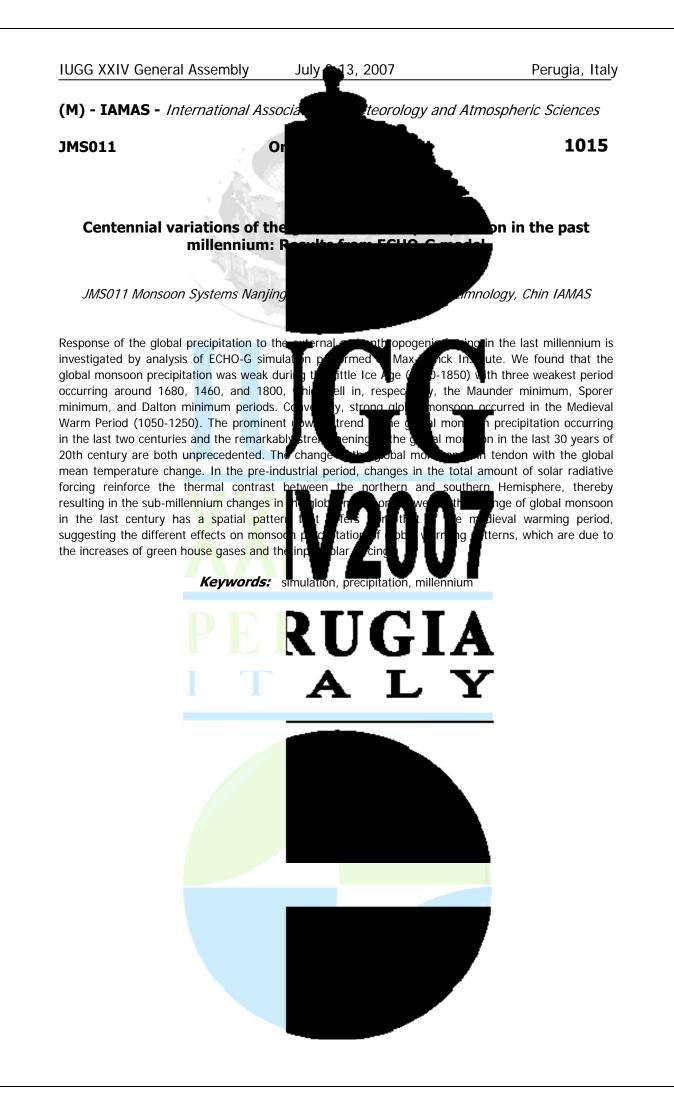
disaster preparedness. vice of Vietnam this is on satellite images. This predicting the cold air

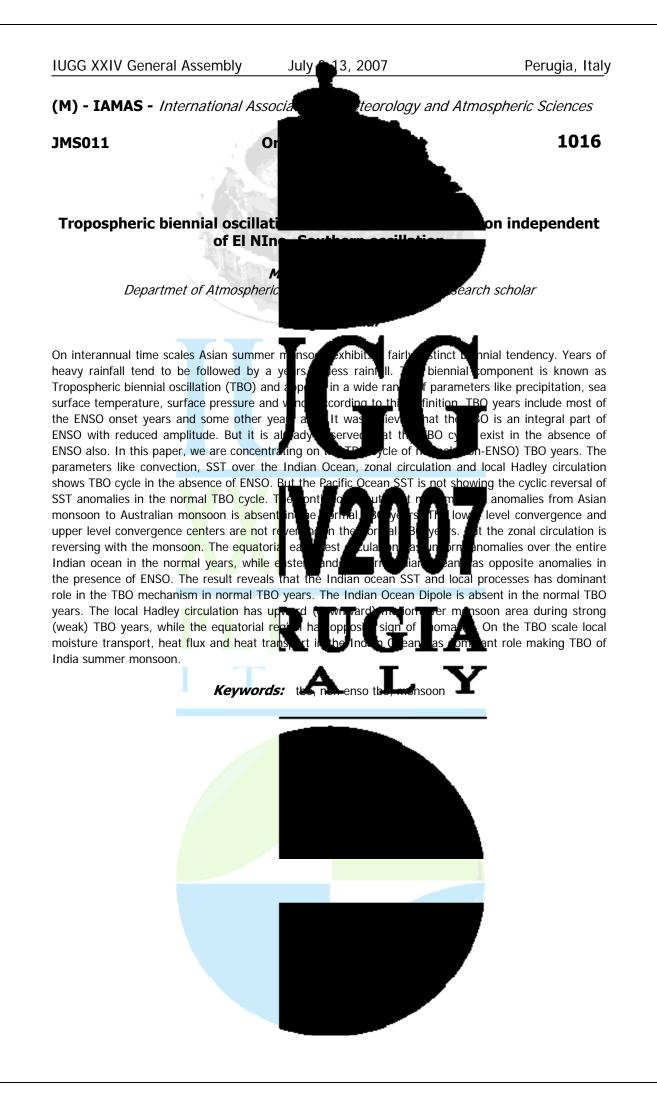


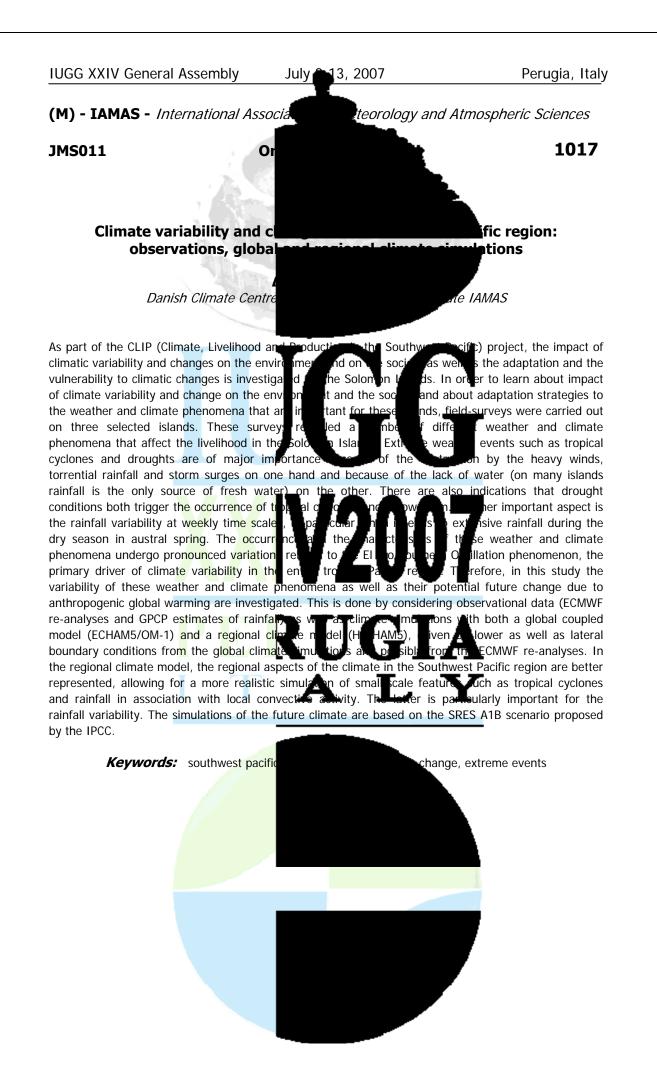


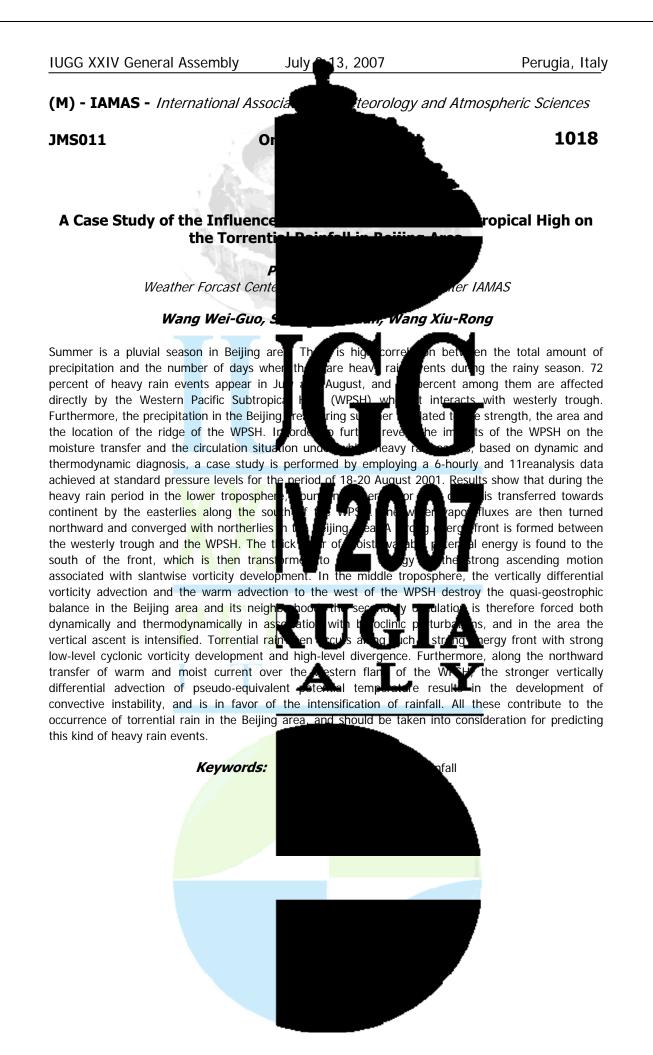


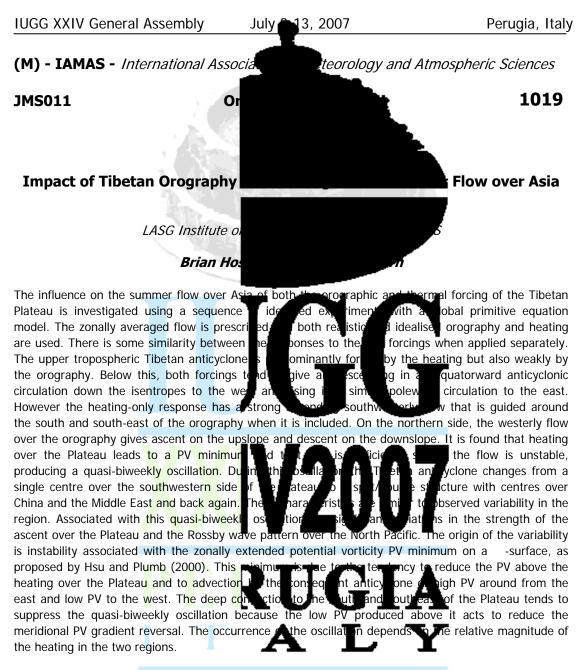


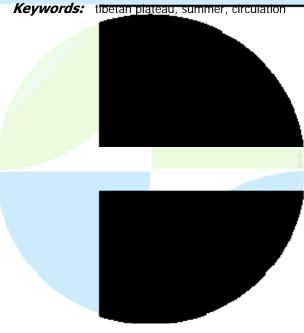


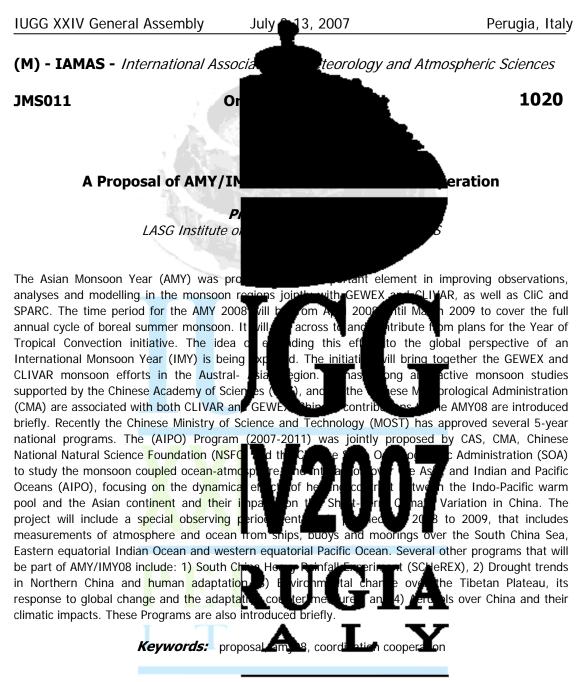


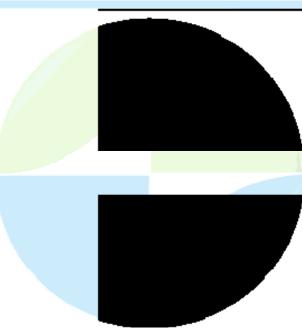


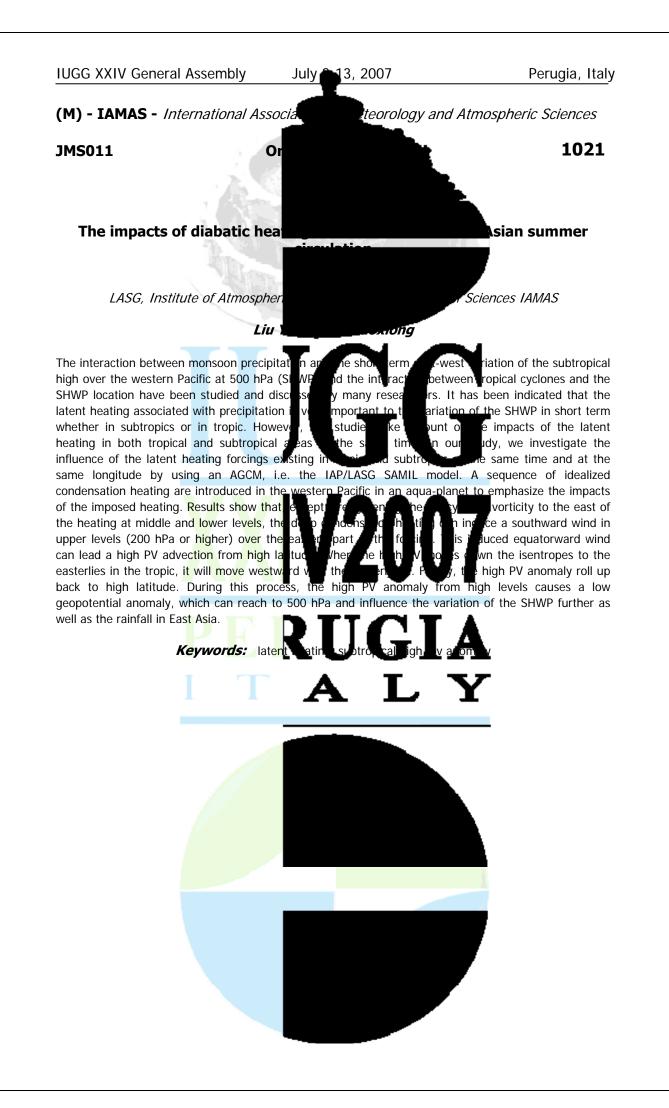


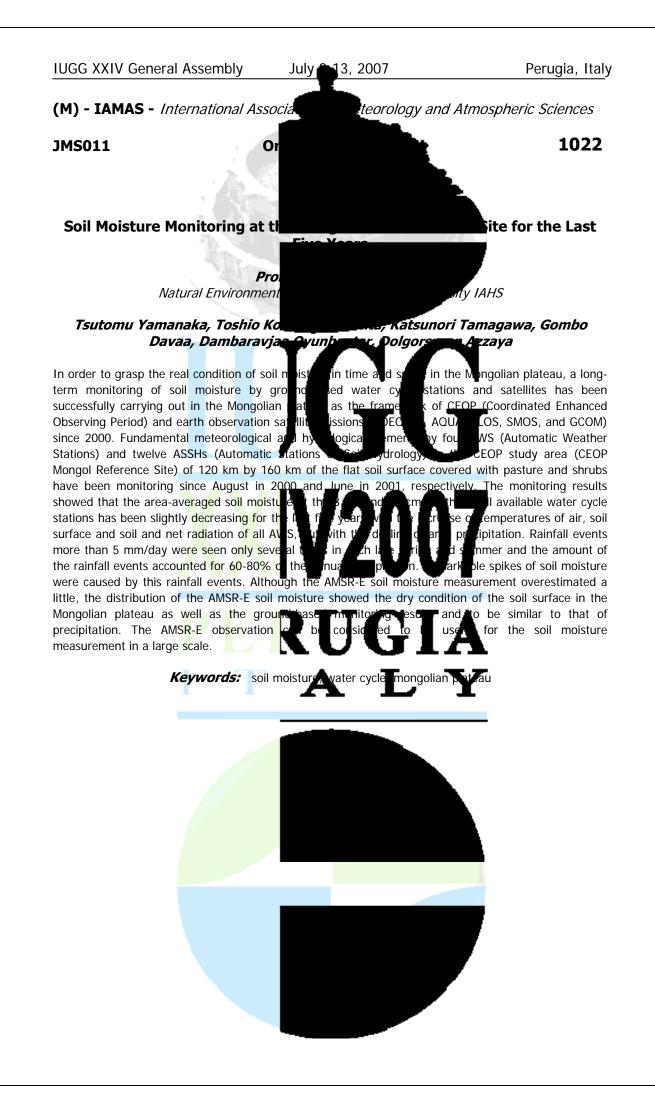


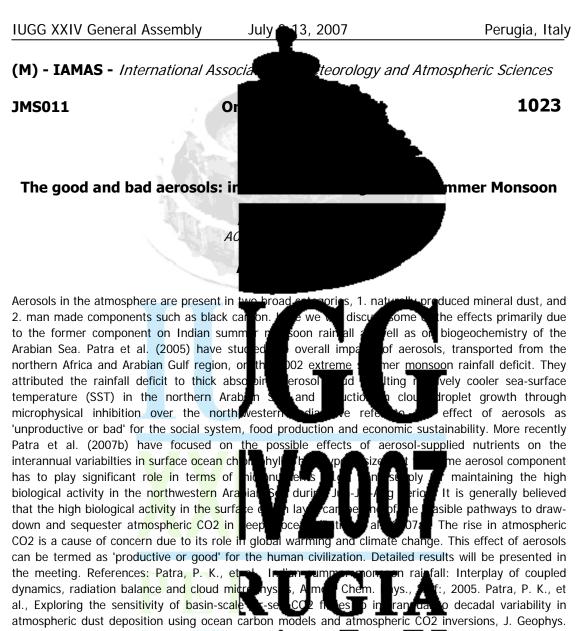




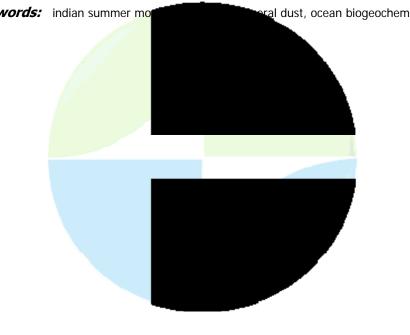


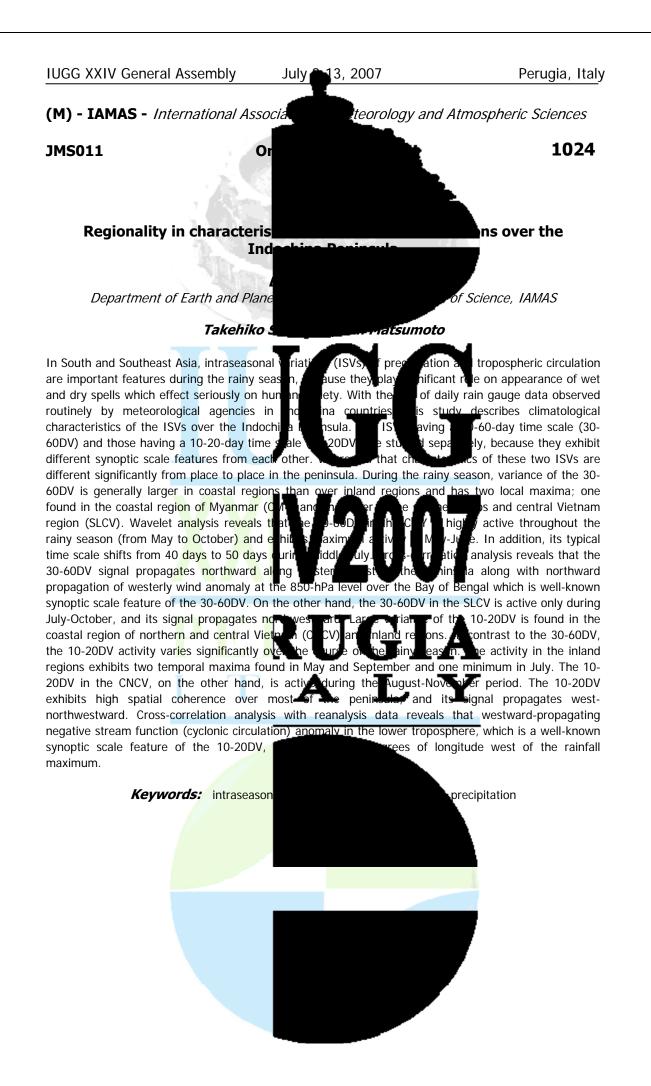


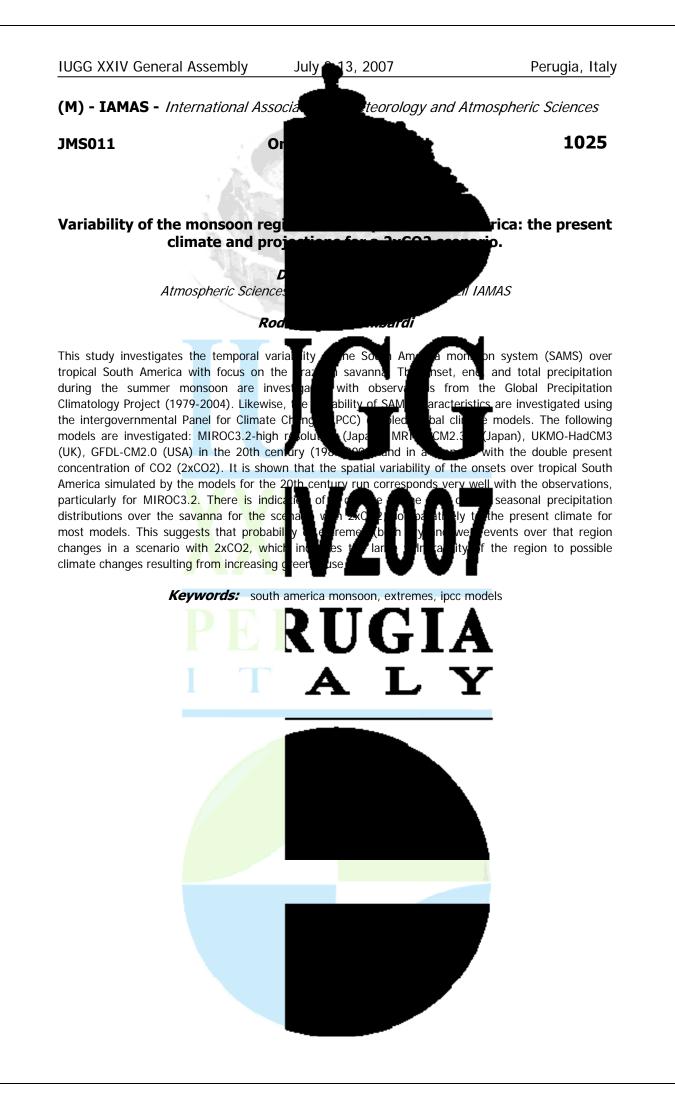


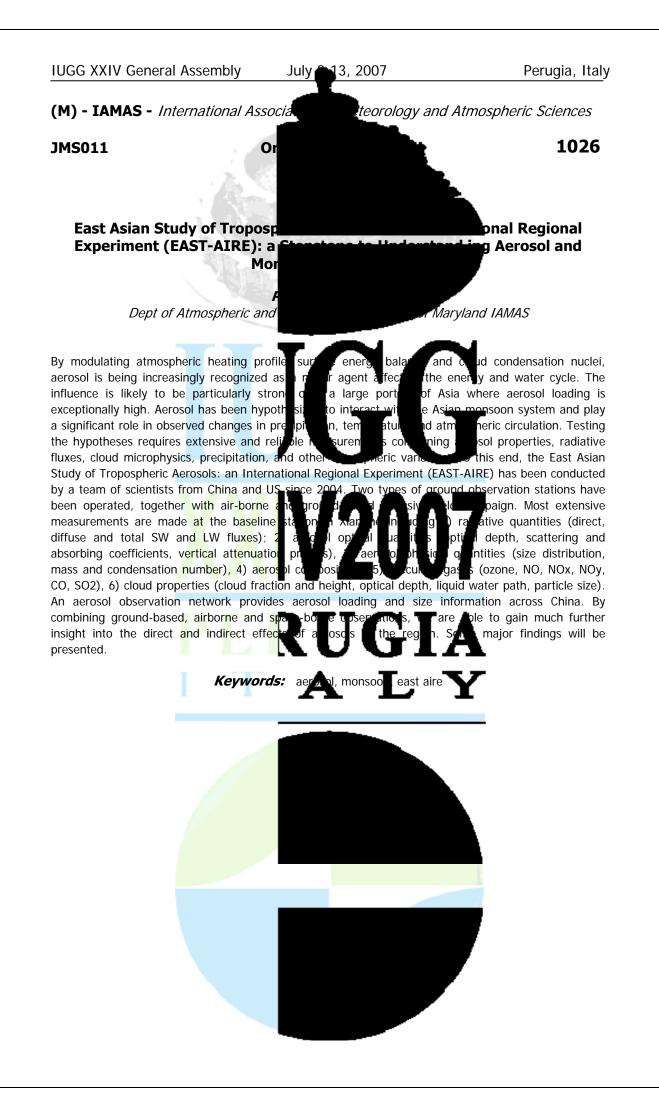


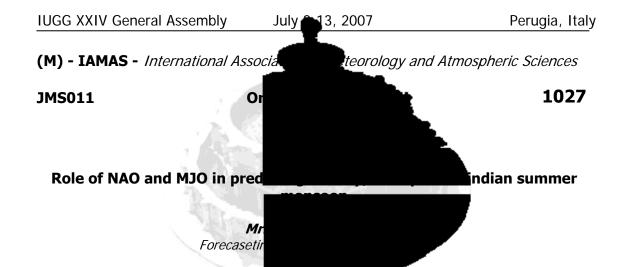
atmospheric dust deposition using ocean carbon models and atmospheric CO2 inversions, J. Geophys. Res., doi:2006JG000236, 2007a. Patra, P. K., et a Atmospheric deposition and surface stratification as controls of contrasting chlorophyll abundance in North Indian Ocean, Geophys. Res., revised, 2007b. Keywords: indian summer more and atmospheric dust, ocean biogeochemistry











mint 30

The Indian summer monsoon exhibits prorain interrupted by dry periods i.e. "Break monsoon cover the entire Indian Ocean influ dry/wet period will result in severe drought/ water cycle, agriculture and societal activi general circulation models have great dif Therefore, it is necessary to study the em which are responsible for the ISO. In this paper, the

and Madden Julian Oscillation Index (MJOI) on daily scale is carried out in relation to daily Indian summer monsoon rainfall (June-September) The analysis is carried out for period 1979-2001. Since the potential predictability limit for monsoor correlation analysis between the NAOI and lag relationship between NAO and MJO remains negative throughout the break m days lag relationship between NAO and M over Indian region. The analysis is verified for major drought year 2002. Probable physical linkage for

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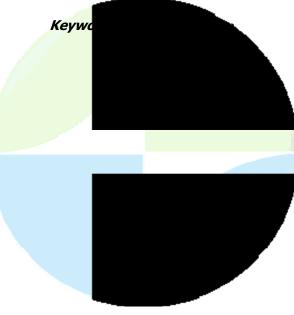
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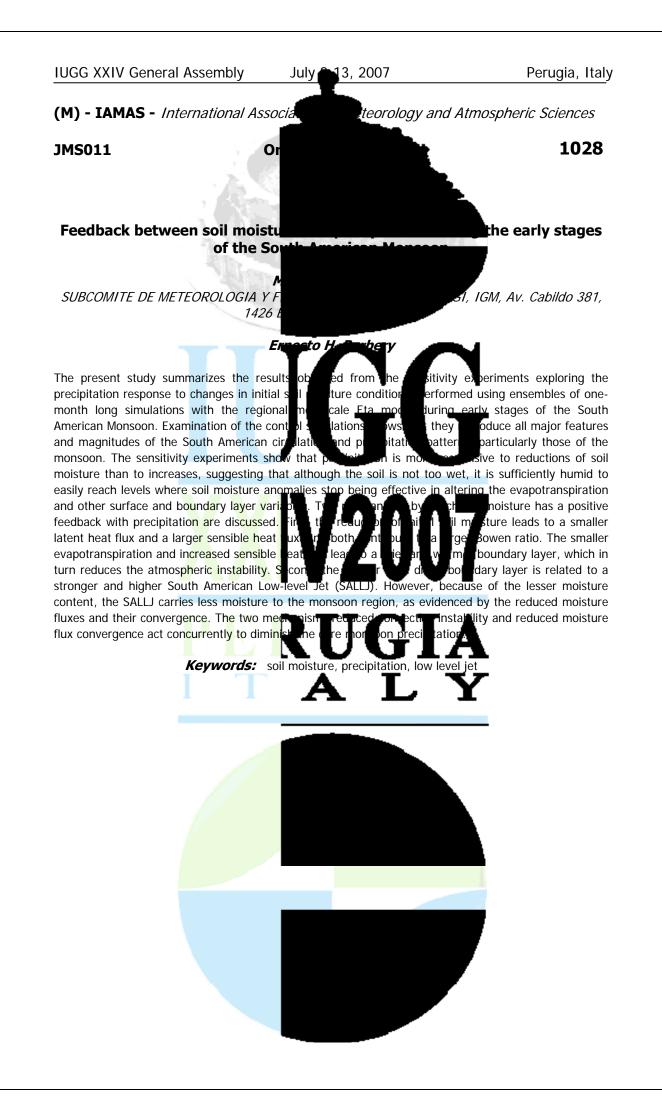
h\_active periods of heavy iated with active/break les as North Pacific Ocean. A prolonged ound influences on the south Asia e billion people. The atmospheric Intra sonal oscillation (ISO). n vari atmospheric processes, Oscillation Index (NAOI)

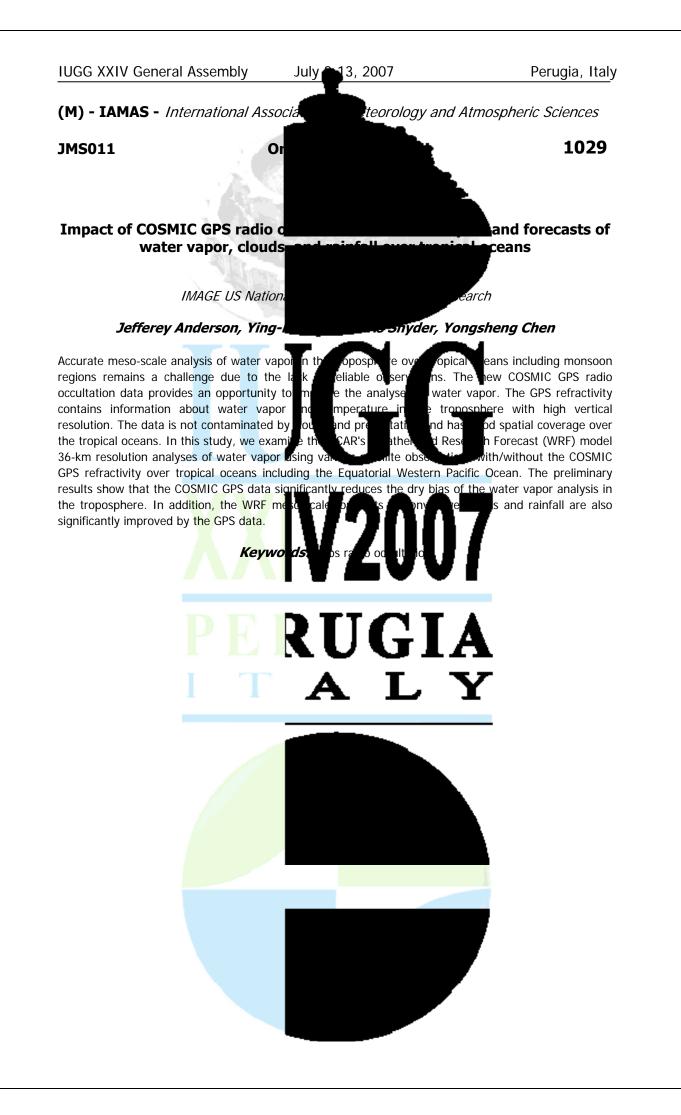
> lays running lag/lead s observed that 20-day I) and this relationship it reverses. This twenty active monsoon condition

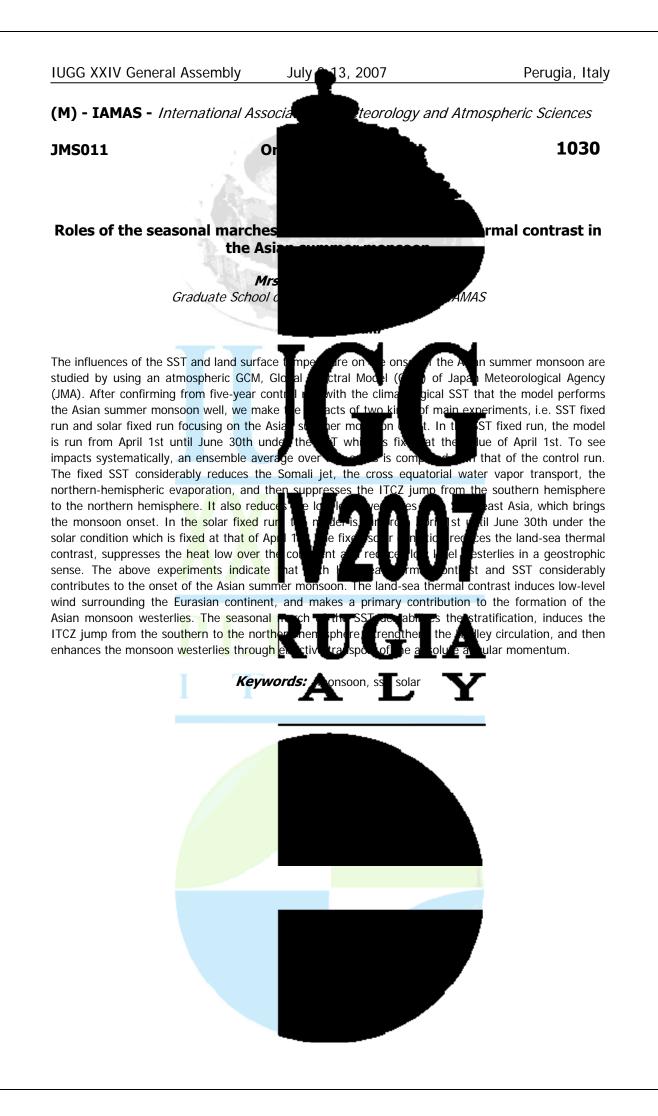
studies have established that the active gered by organized northward propagation of heavy precipitating or c al regions towards the equa continental land mass. This northward prop the inc n monsoon region was atir de OV weaker (stronger) during drought (flood). It is also known that the MJO interacts with the NPM in the dulate the temperature Indian monsoon region; it is plausible that the lifferent ph ses of NAO onsible fe gradients cold/warm in upper troposphere. Heree, night be the increase in the period of the NPM. A longer period NPM could possibly lead to longer monsoon break periods causing the major drought condition and vie versa.

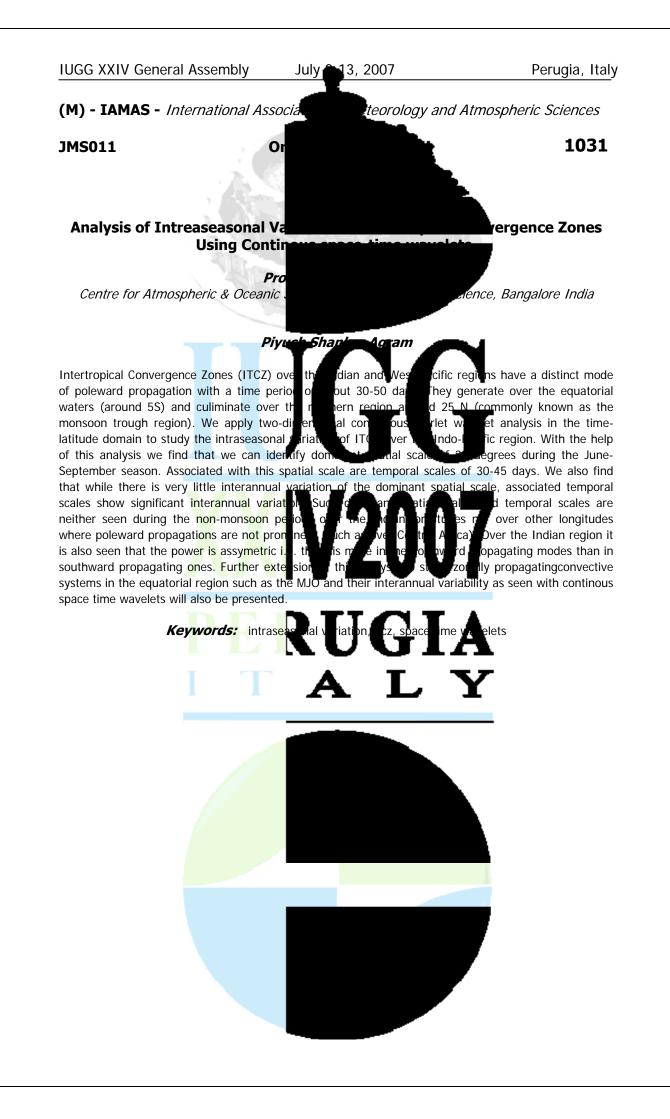
using this relationship for predicting the dry/wet spell in monsoons period could be like this, previous

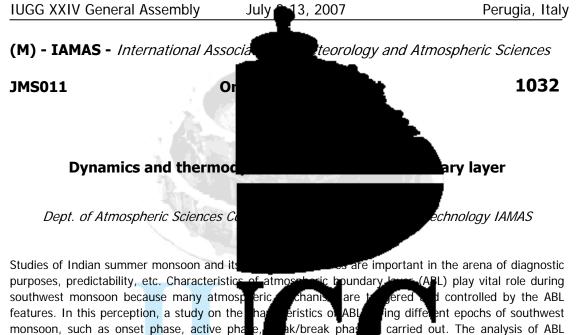












monsoon, such as onset phase, active pha characteristics is made using the radiosor (southern tip of peninsular India) and Mar Dynamic and thermodynamic features of vertical profiles of the zonal and mericional Conserved variable analysis (CVA) is also carried out to infer the degree of convection during the

1) during active monsoon situation in both 1). The wind core height is confined to 1. during the weak phase is widened to a smaller than active situation and vertical w hd nearly zero in Mangalore but that over Tri and additional along shore component is noticed in convective cloud band in the equatorial Indian Ocean as the part of the next monsoon surge. The magnitude of the alongshore component i CVA analysis, we found that the level of g the QR is less while comparing that with no

while comparing the active and weak over Mang

monsoon phase and might be due to the non preserve

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carried out. The analysis of ABL ervations made over Trivandrum ntral peninsular India). are studied using the potential temperature.

different epochs of monsoon. The study reveals that zonal wind around 1.5 km height is strong (23 msphase is weak (10 msh the stations but that weak core maximum is se the meridional wind is d. In the weak phase, an stations due to the formation of an organised (12 me-1, southward). From the /andr and the profile in which Mangalore, the height เลเ of QR level is found in lower levels in both active and weak/break monsoon phases. It is also noticed Topher in the weak/break

*Keywords:* thermodynamics, monsoondynamics, boundarylayer

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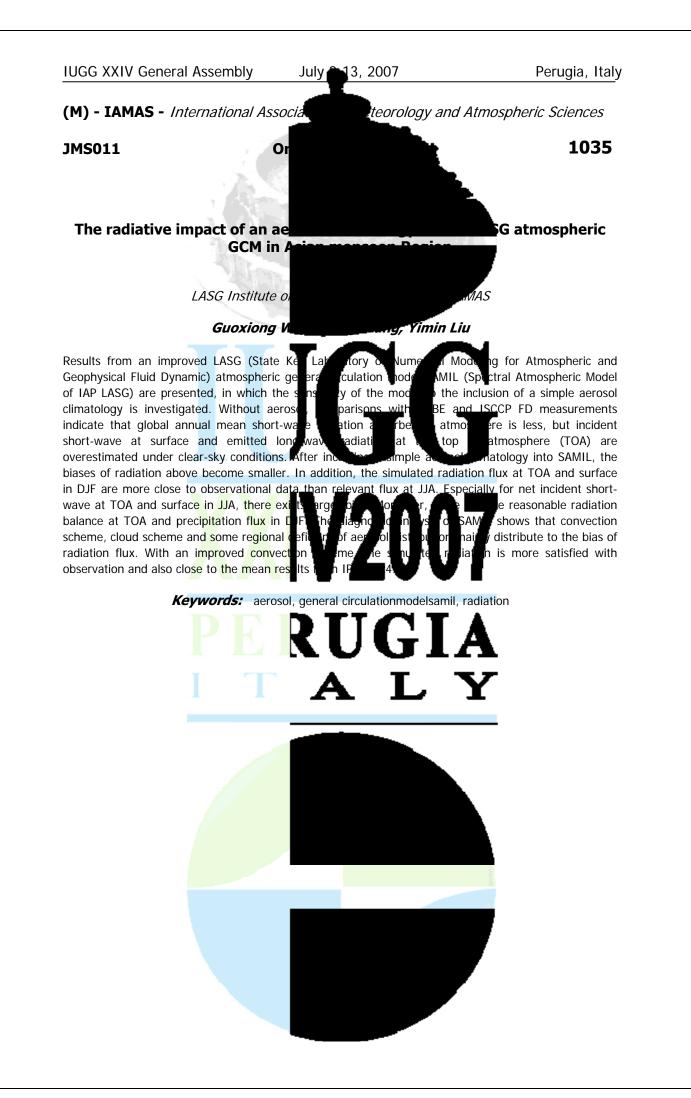
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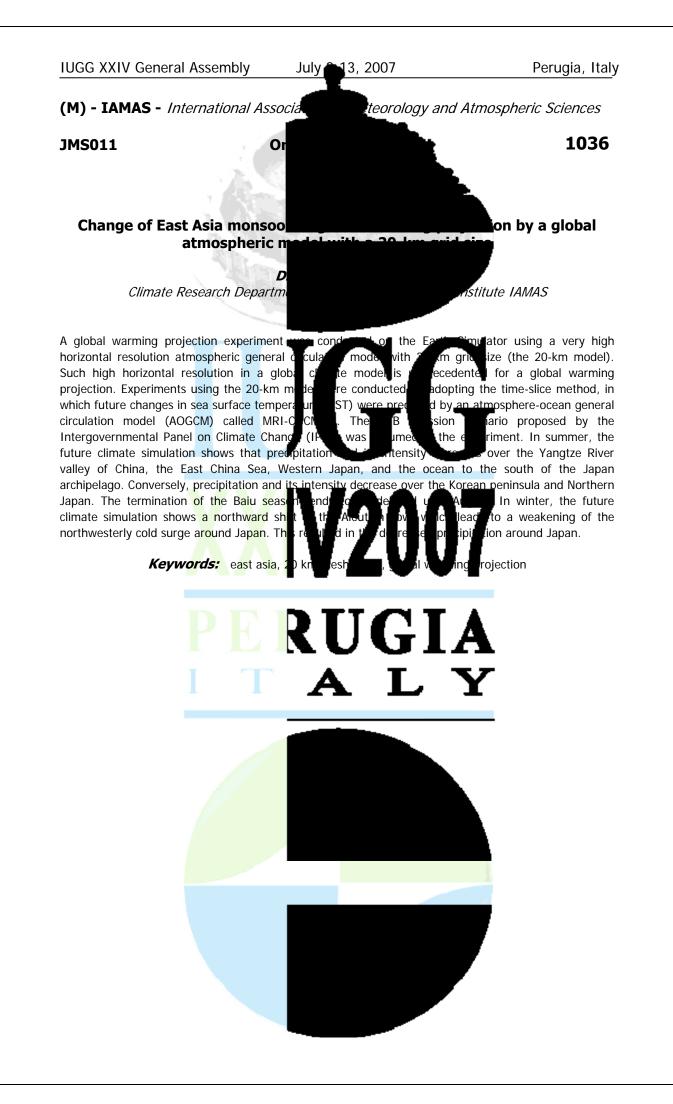
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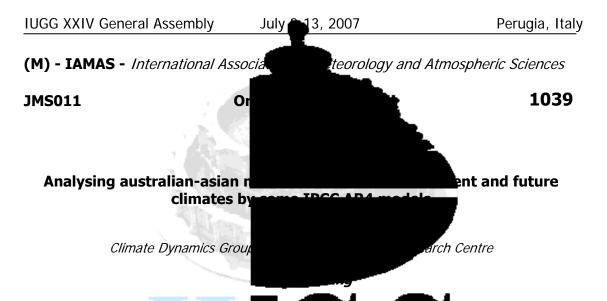












As part of the activities under an Australia Chin some preliminary analysis of coupled model model skill in simulating observed surface global model simulations from the IPCC AR Furthermore, we have analysed vertically (U850, V850) daily fields from the model s 40 reanalysis. The model skills in simulating season

ange mate ons in Alstra in the monso base for the ed atr he and npai s of m

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ject, this study reports sian moreoon regions. Firstly, the egion are analysed by comparing century with observational data. recipit water (PW) and wind hem nst results derived ERAulation and atmospheric

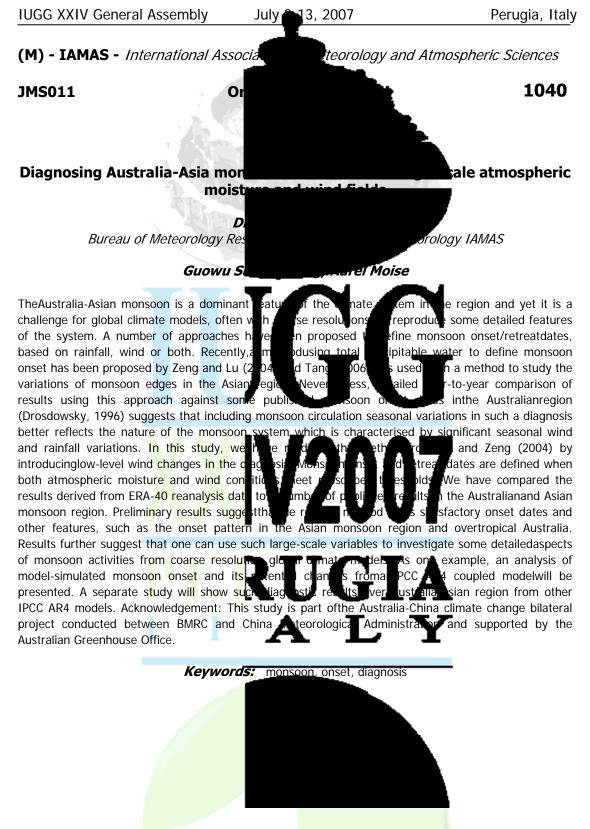
moisture conditions are discussed. Based on a modified approach, to be presented by a separate study,

by combining total precipitable water and low-level wind in defining monsoon onset and retreat, the current climate model skills in simulating are evaluated. We then further examine h will change under climate change condition Finally, we also tempt to investigate possil change scenarios based on the coupled medel is funded by the Australian Greenhouse Office (AGO)



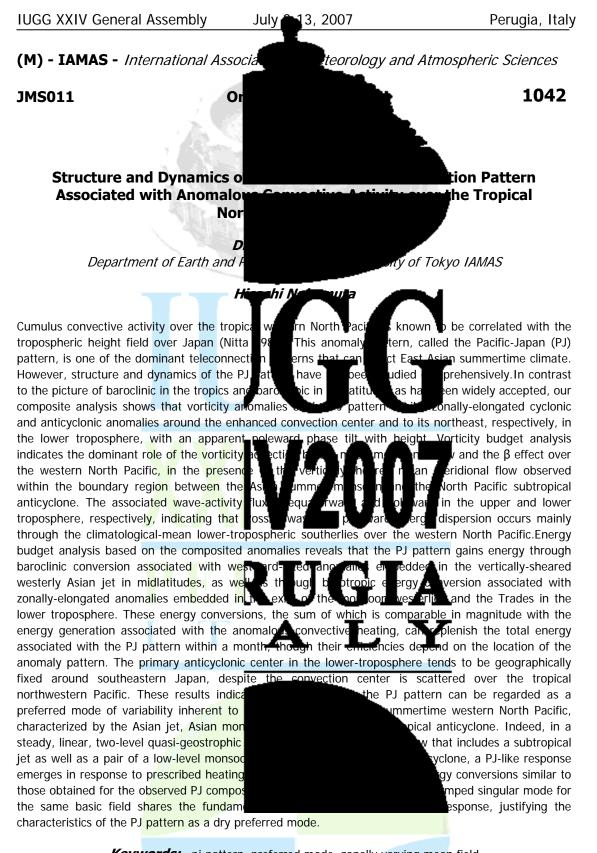
such as onset/retreat hd monsoon circulation the SRES A2 scenario. t dates in future climate owledgement: This study



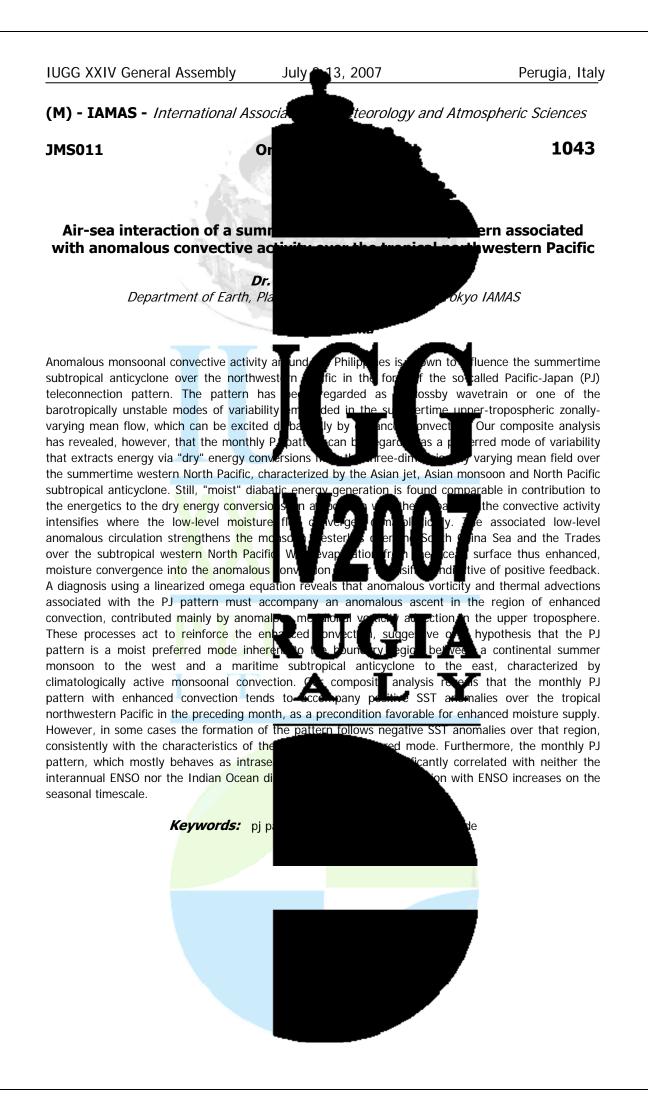


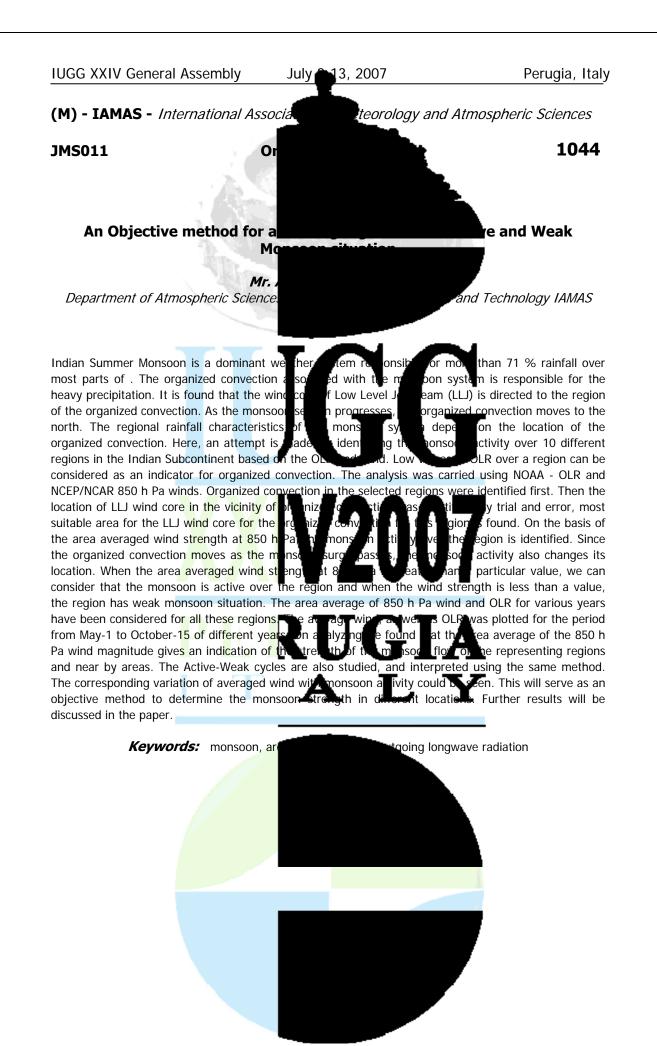


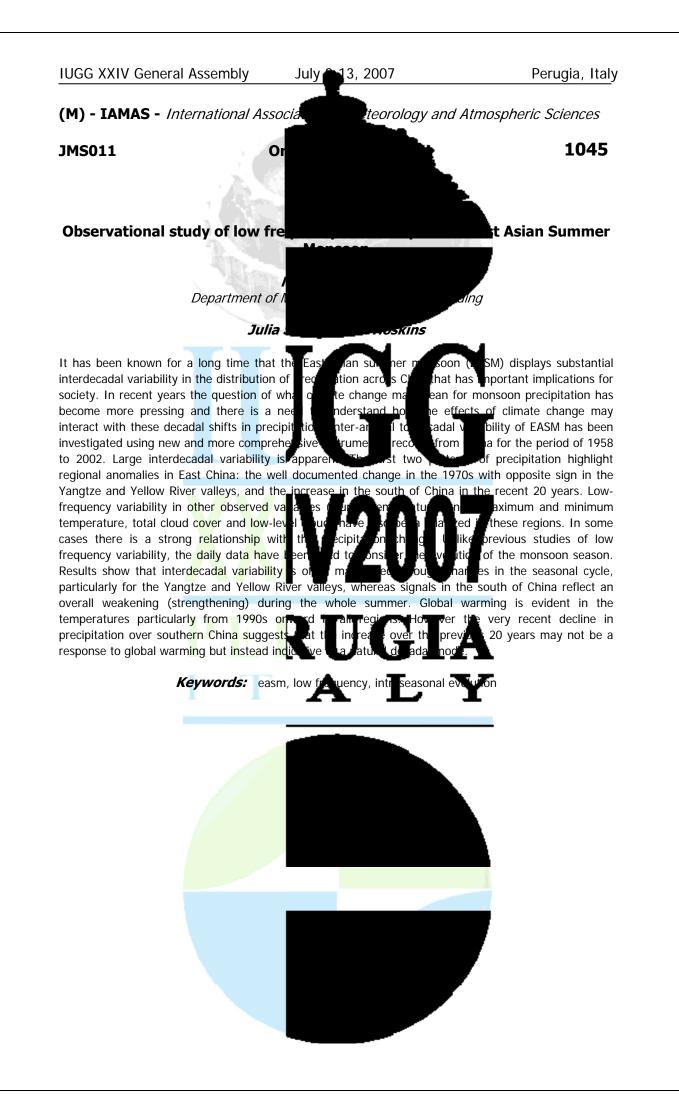




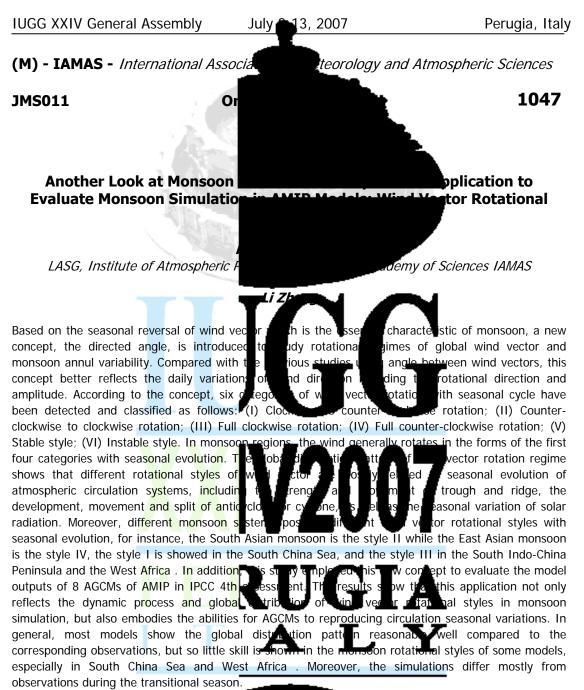


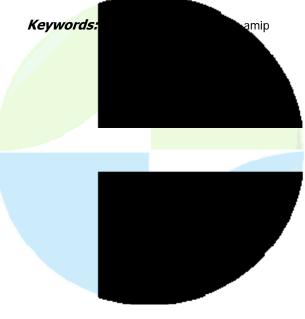


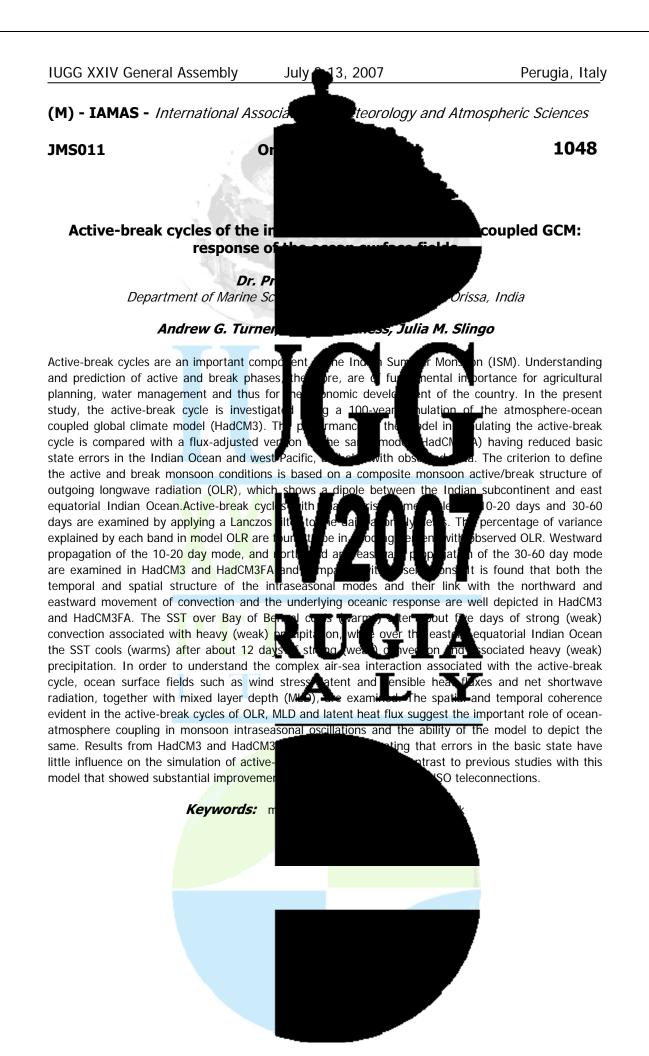


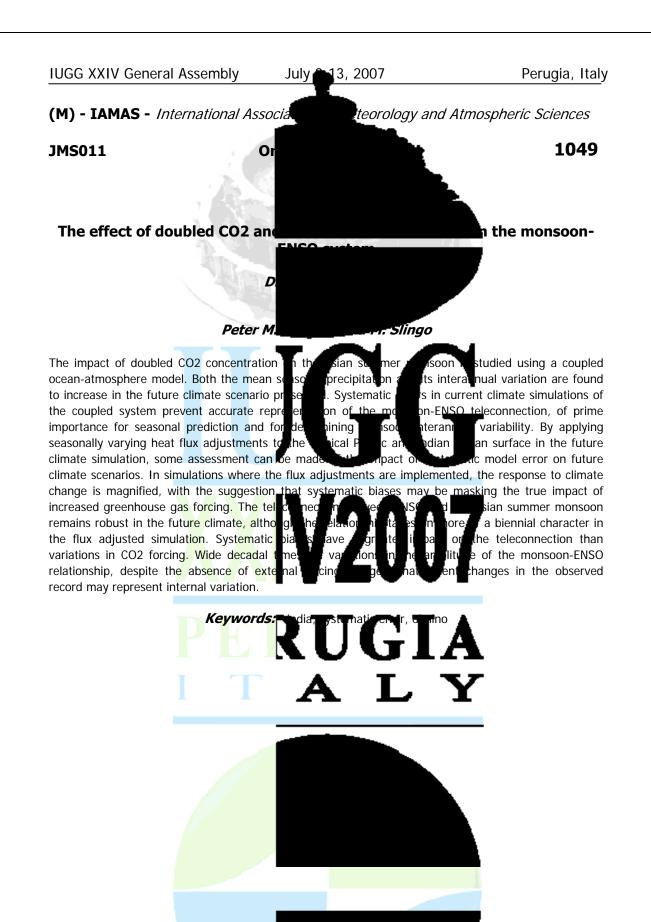


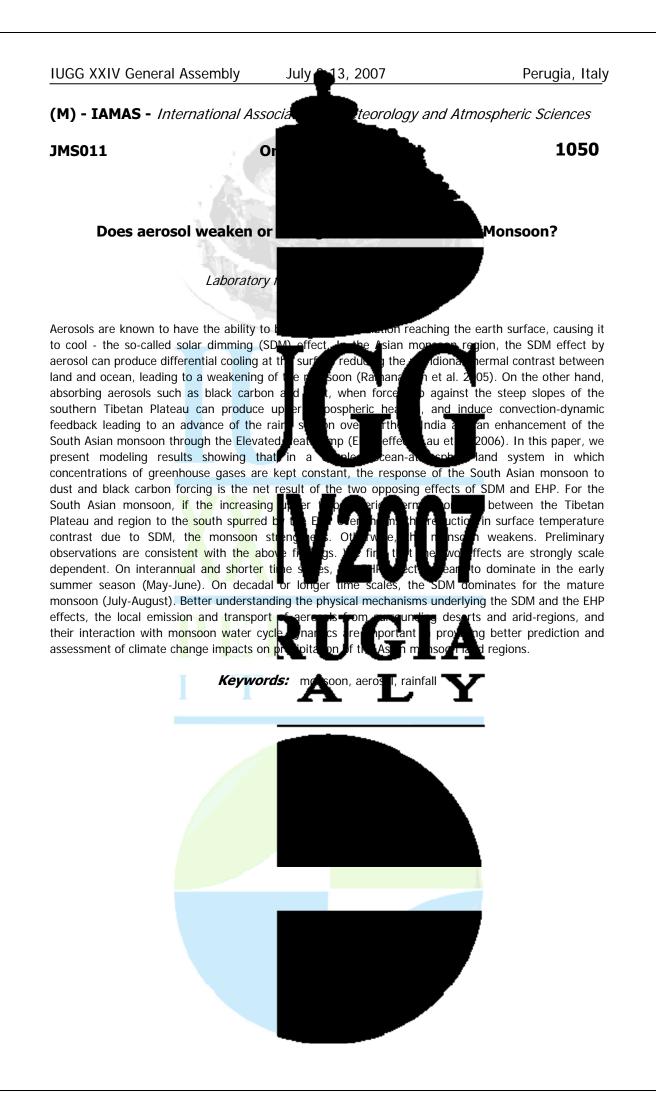




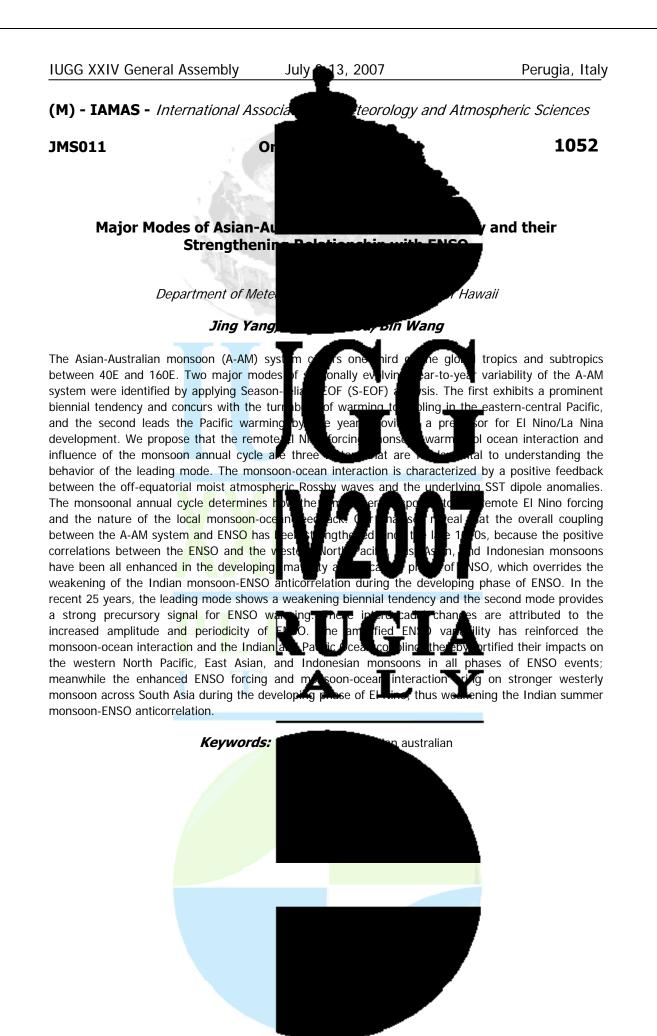


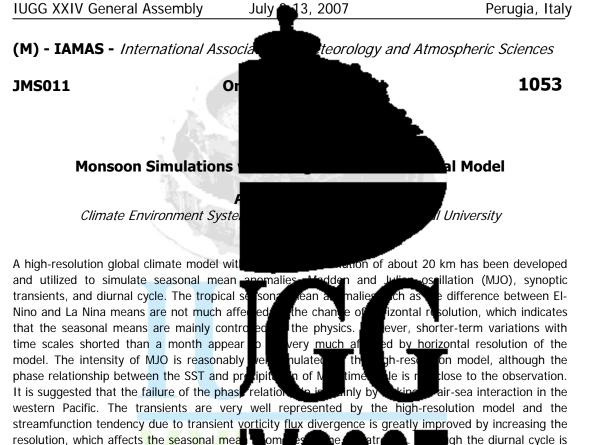












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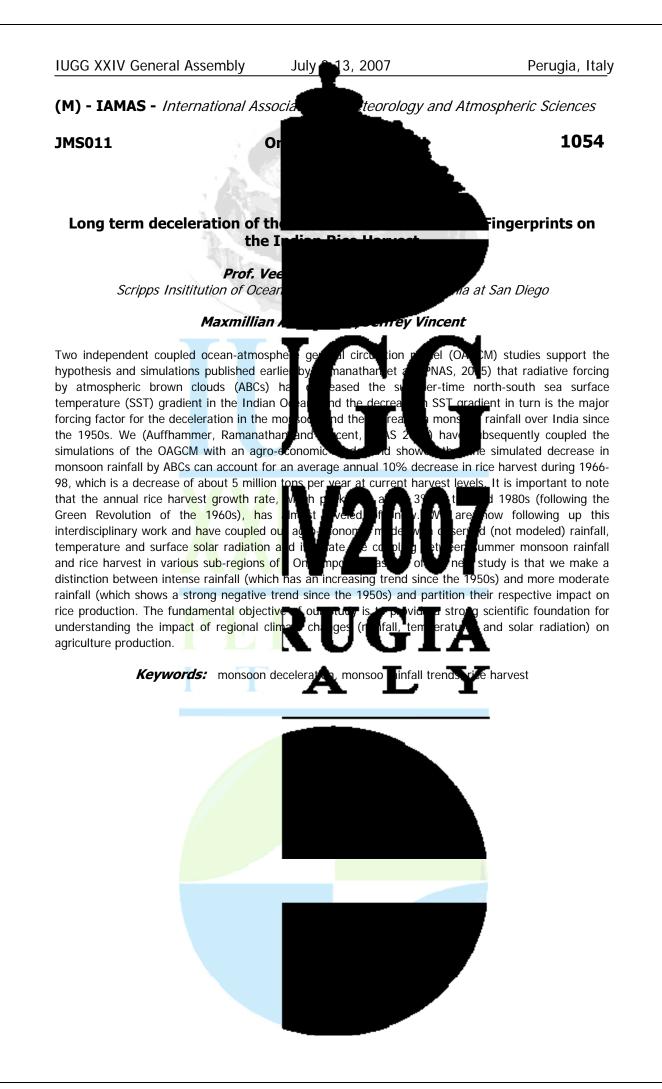
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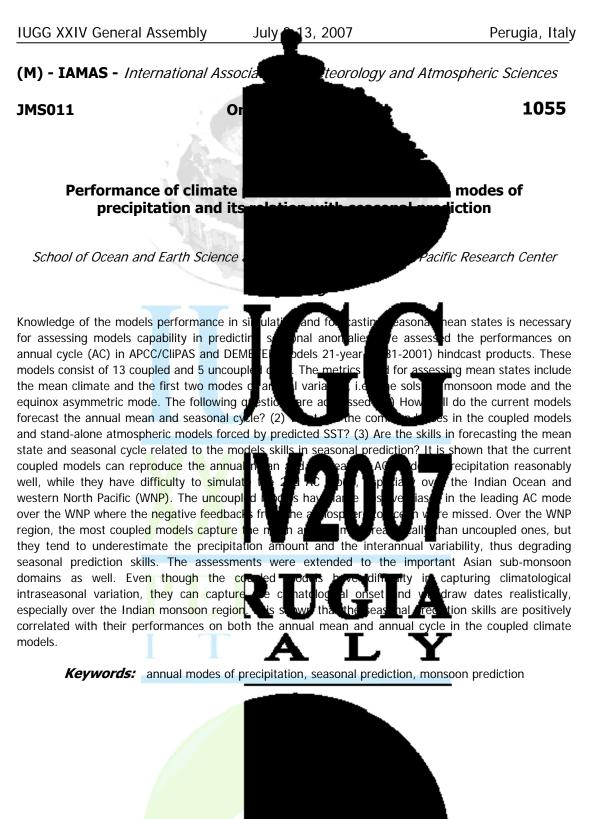
gh the diurnal cycle is lating the diurnal cycle ctive parameterization.

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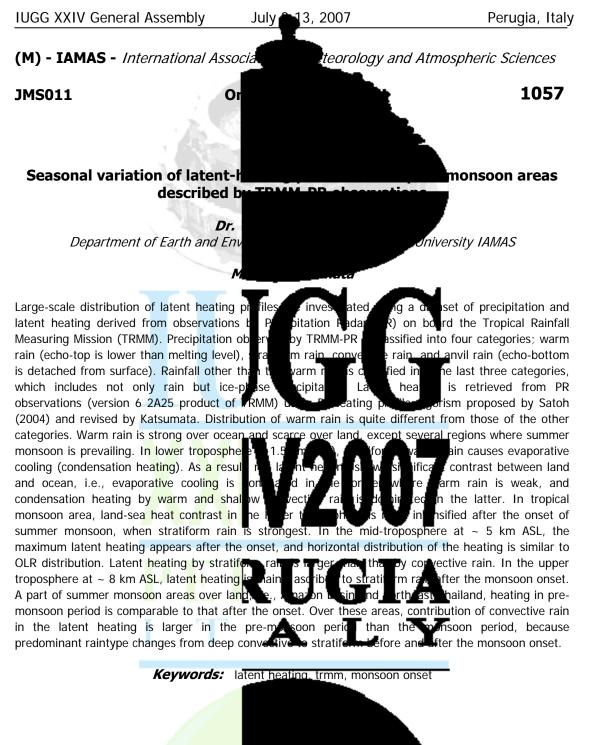
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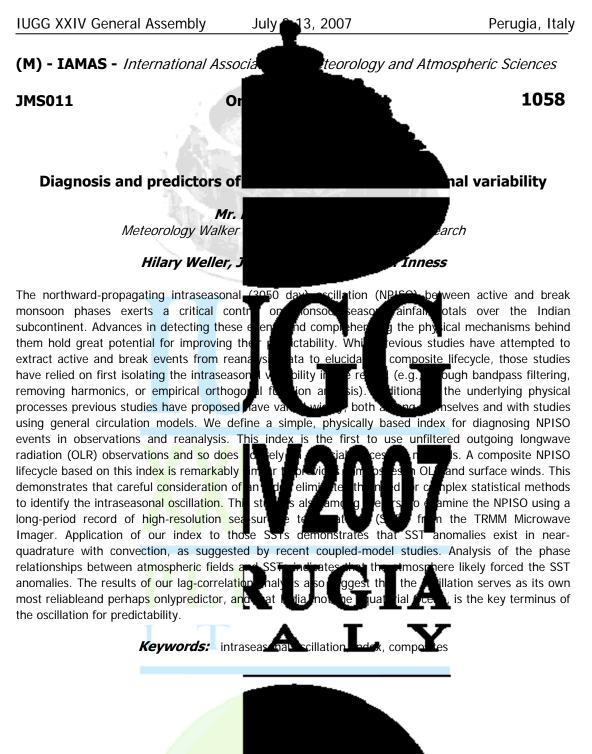


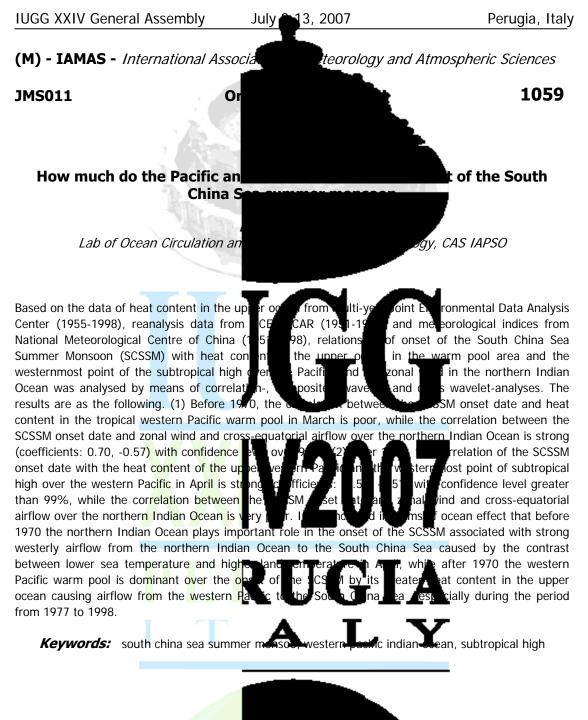






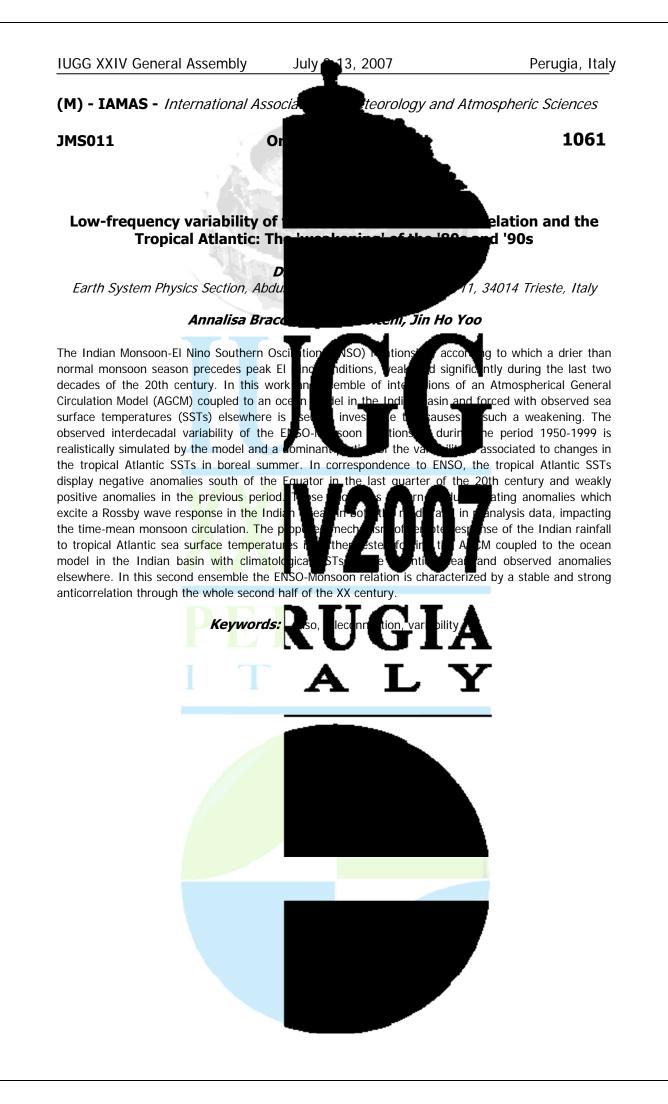


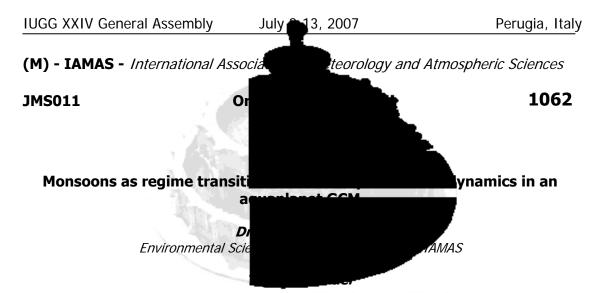












In simulations with an idealized aquaplane rapid regime transitions in the course of a s by strengthening and broadening of the cr subtropics and intensification of precipitatio reverse transition occurs in late summer. The reversed transition) of Earth's monsoons. 2007), the rapid rearrangements of the circulation

dominates near the center of the Hadley cell\_to regimes in which the eddy momentum flux divergence is negligible and the mean momentum flux subtropics just equatorward of the lower-le boundary between the winter and sum precipitation zones are examined and dis monsoons as circulations driven by land-s baroclinic eddies and the mean flow as dynamics.

GCN e tro cycle. A ran atorial winter eversals in th ated tr ioi with ilar ts in tl

al circulation undergoes nerid in early summer is characterized lley cell, rapid relocation into the per-level and lower-level winds. A semble onset (and end, at the s (Schneider & Bordoni simul balance of the vertically

averaged zonal momentum equation, from regimes in which the eddy momentum flux divergence

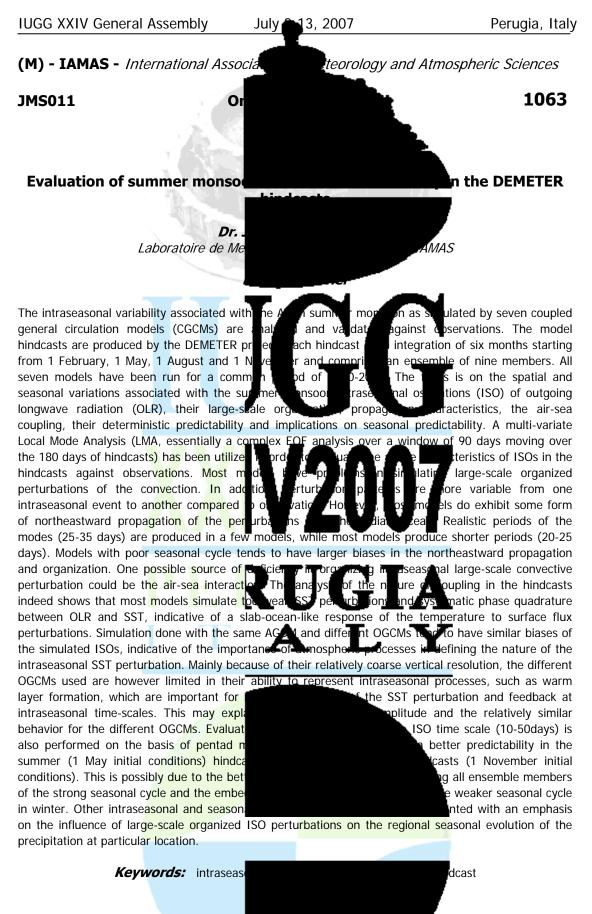
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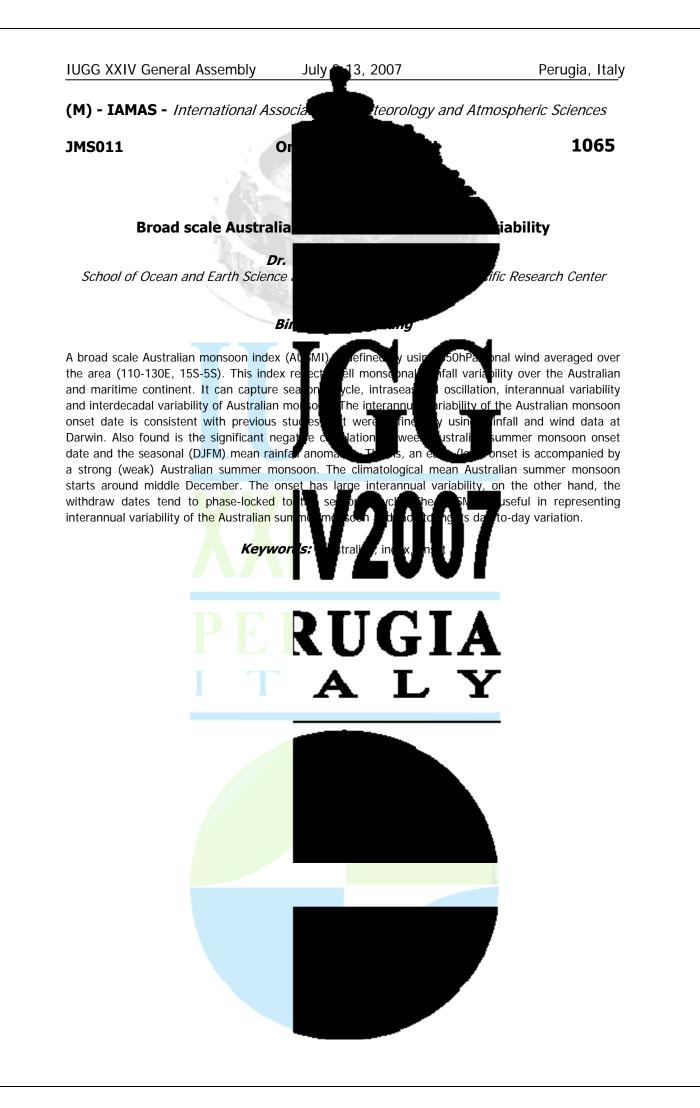
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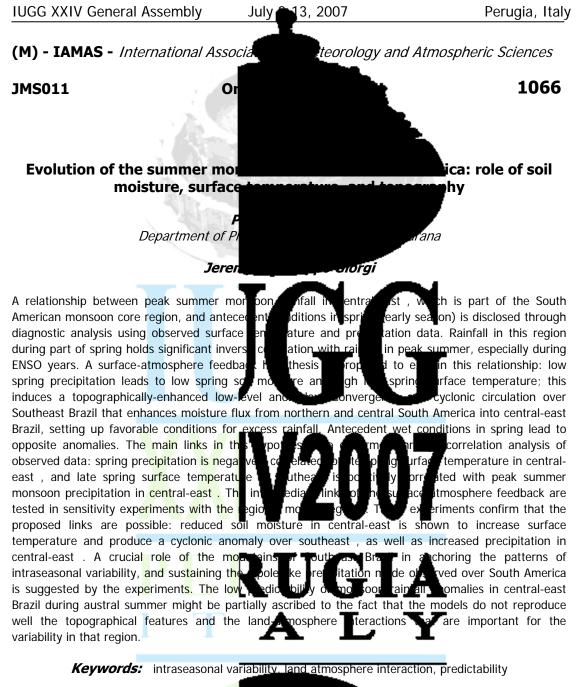
ence zones form in the ch is colocated with the exact location of these the traditional view of between the large-scale dynamical mechanisms involved in monsoon







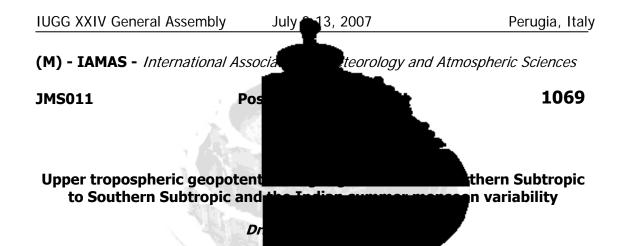












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Serious concern has been raised regarding dealining 1960s notwithstanding increased evaporation there are large-scale reorganization/char convergence over the boarder region of Afro southern subtropical highs after crossing the Iran-Irag-Afghanistan-Pakistan-Northwest I merge together over Arabian sea, Bay of Be airflow passes through the passage of the low pres

western North Pacific subtropical ridge which eventually merges with the northern mid latitude westerlies, northeast of Korea-Japan latitudes (~ southern to northern hemisphere occurs ov flow is shallow (upto 850 hPa) and confin and east China. With the advance of the se North West India, the whole Indian subc htir and Japan and the depth increases to 70 hP depth and spatial spread from 1st week of August and the ITCZ and the equatorial trough are back to their normal position by the end of November. During June-July-August the outflows from upper

tropospheric anticyclone over Afro-Eurasian highlands) after crossing the equator m objective of the present study is to examine the two hemispheres and its effect on the Indian Monsoon. The geopotential height data of the NCEP-NCAR reanalysis is used in the present study. At 200, 200 and 100 hPa isotopic levels rectangular area showing of the subtropical highs over Afrocura demarcated. The time series (1949-2004) of monsoon monthly geopotential height for the rectangular

geopotential height of the northern subtre northern subtropic to southern subtropic h attempted to determine the association b Analysis of the geopotential height was ca are discussed for the significant cases. subtropics showed almost comparable li subtropic and south subtropic is significan and 100 hPa) showed linear increasing tre

correlation of 0.66 with the all-India July rainfall series. August- Geopotential height difference of only 200 hPa level from northern subtropic to southern subtropic showed significant correlation (CC=0.43). September- Difference between mean geo to southern subtropic showed correlation of obtained from the monthly data of the hemispheres. Increasing trend is amply geopotential height from northern subtrop

rainfall over India since During boreal summer, varmii anticyclunes and the area of Indo-Pacific Ocean. Outflows from I high over northern Africa-Arabiasubtropical anticyclone ו Pad th Pa Ocean and the combine alaya highlands and the

N). Low-level cross equatorial flow from the itially the depth of the engal, southeast China th Arabian Sea, extreme and central China, Korea ulation starts receding in

de westerlies. The sole

Pacific ocean has been

Ocea (covering Tibet-Himalaya

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box has been prepared from the NCEP-NCAR\_2.5\_square grids data. Fluctuation analysis of the ubtropic high as well as the slope from ent years numerous studies have s and the summer monsoon. Pa isobaric levels but results hPa level over both the nce between the north three levels (300, 200 ference between mean geopotential height of the three levels from the northern hemisphere to southern hemisphere showed

> rom northern subtropic al mean series has been 100 hPa for both the er, the difference in the fown decreasing trend which

## **IUGG XXIV General Assembly**

paralleled the all-India monsoon rainfall serie geopotential height of the southern subtr which means northern subtropic is warm subtropic (0.188 C/10-year). The resulta two hemispheres is the weaker monsoon eastern hemisphere there is sharp decline 100 hPa isobaric levels from northern sub indicative of reduced exchange of mass hemisphere. The result is vindicated by the decreasing trend in the all-India monsoon rainfall from 1962.

parameters are closely related (CC=0.68). The er rate than its northern counter part, C/10-year) than the northern

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temperature fluctuation over the over India. Conclusively over height of the 300, 200 and monsoon period. This is nisphere and southern

Keywords: subtropical

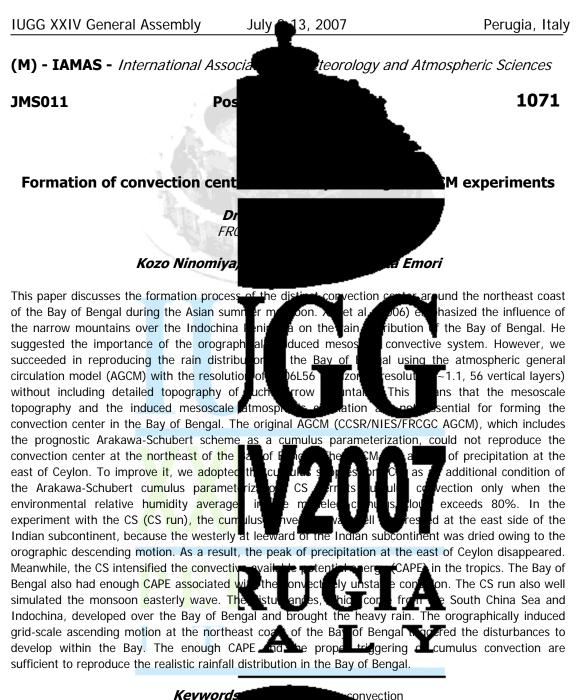
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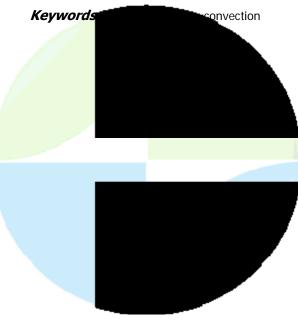
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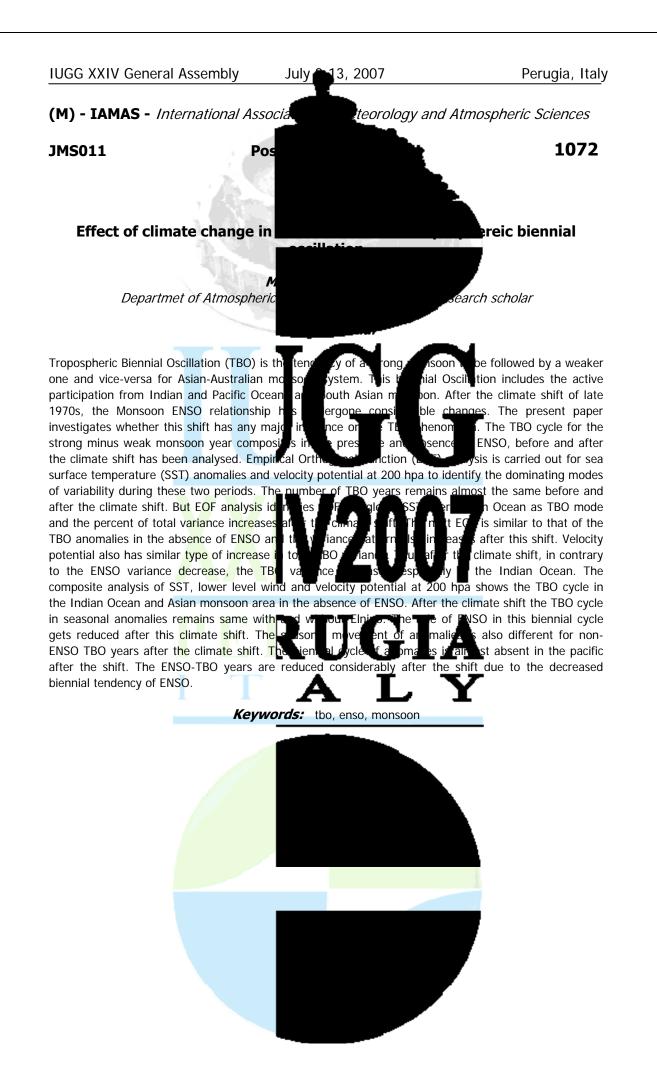


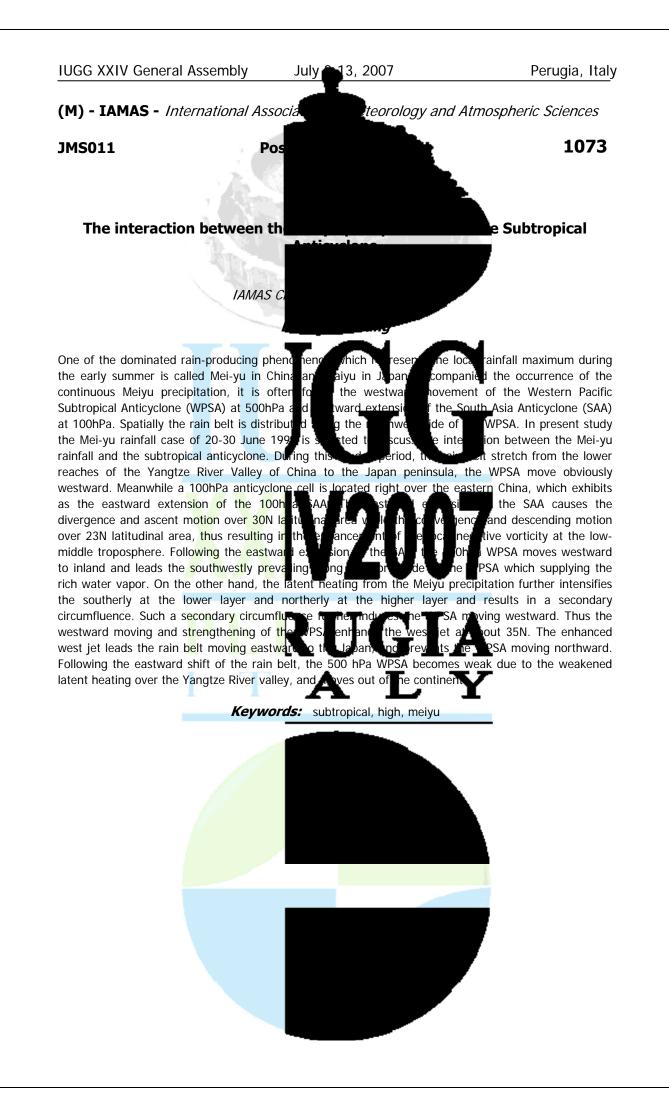
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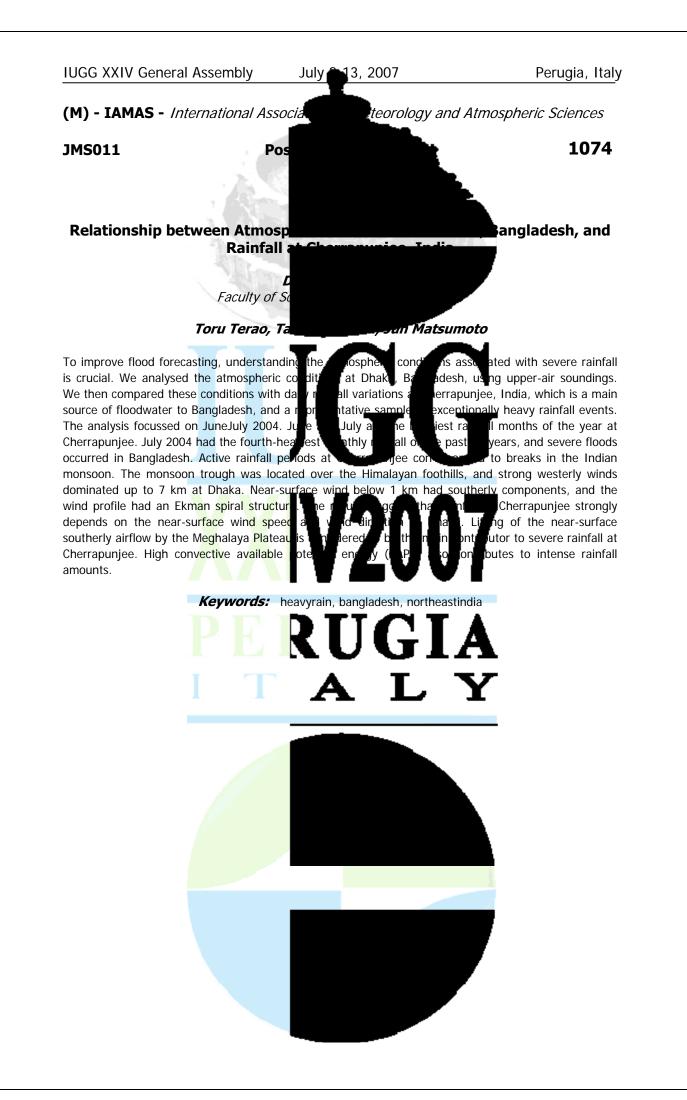


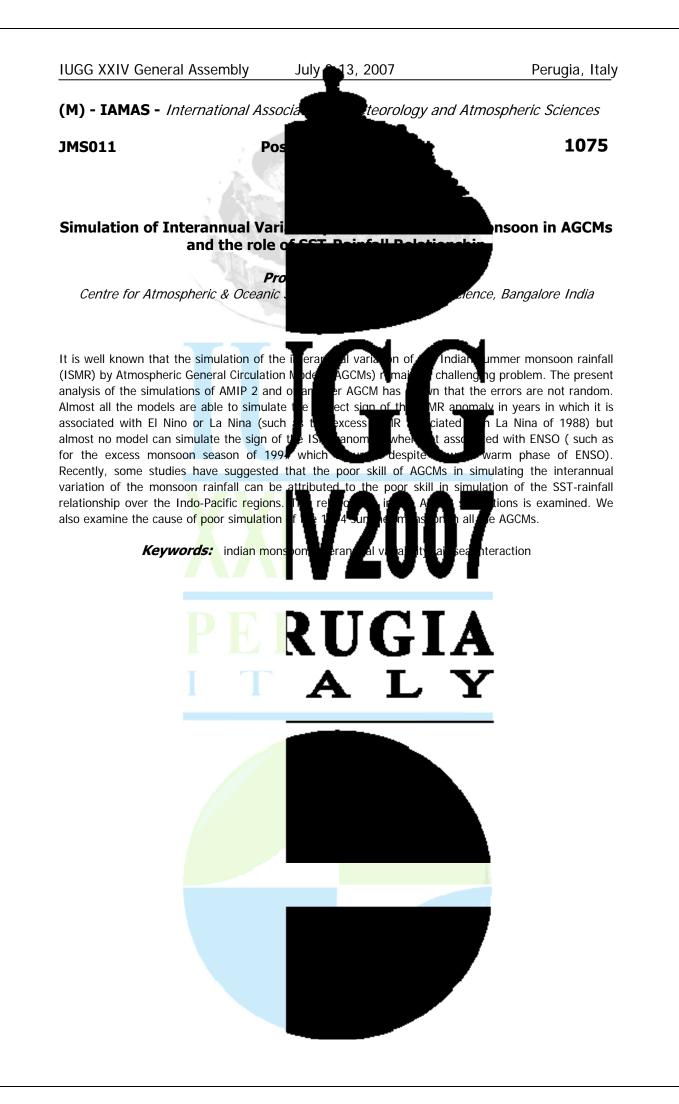


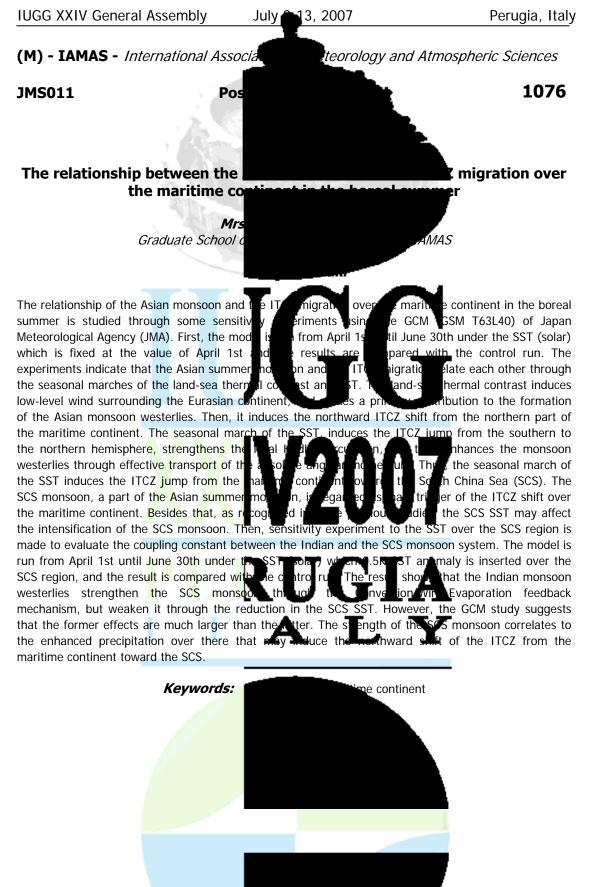


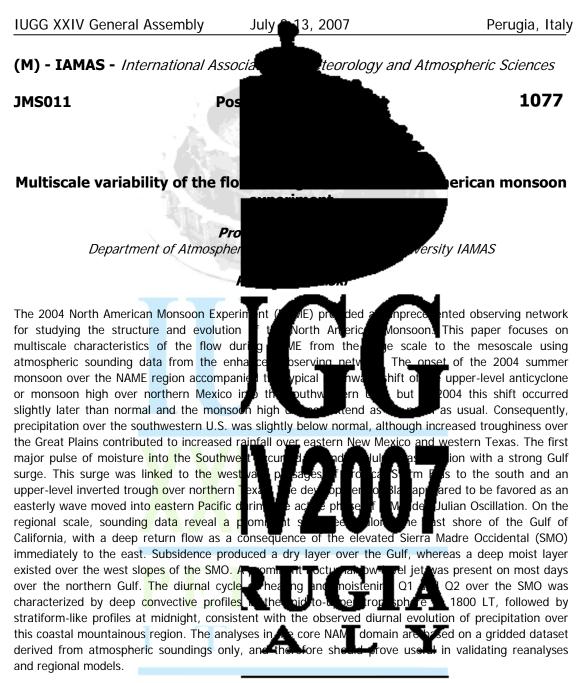


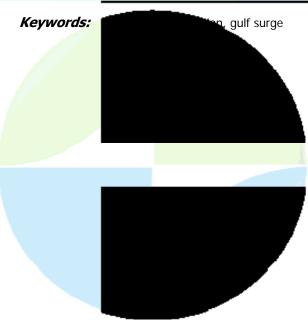


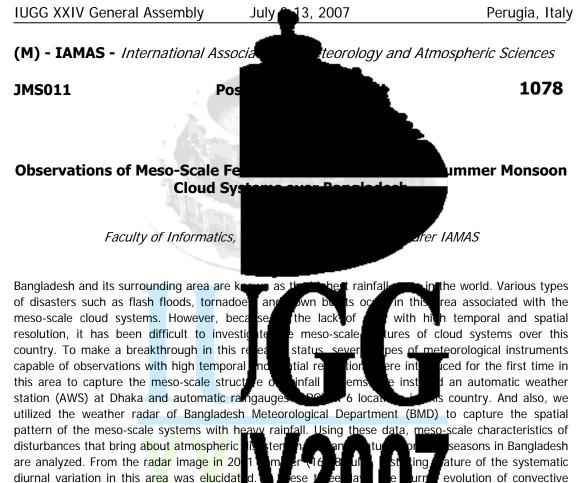












activity was remarkably similar to each oth response of local cloud systems to the d urna situation. In the central to south-western part of country, a lot of scattering small echoes develops in the daytime. From evening time, relatively well organized echoes appear in the north-eastern part of

country. They form initially linear shape al northeastern most area of Bangladesh with characteristics of rainfall between pre- and tends to occur more frequently in the pre-monsoon season than the mature monsoon season. The premonsoon rainfall also has clear diurnal variation the northern part the rainfall peak is found

daytime in central to western part of country. Two disaster cases caused by meso-scale disturbances are analyzed. Although they occur in the same season, the structure of cloud systems was largely different from each other. The disturbance spherical shaped cloud systems with about tragic river water transport accident on 2 case was captured by the AWS located at observed clearly, showing typical structure

oes on 14 April 2004 consisted of many and, another one that caused the ain band structure. The latter d and pressure change was

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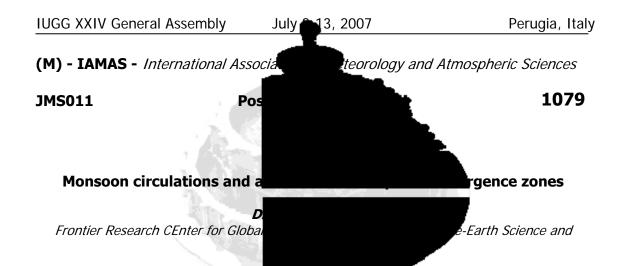
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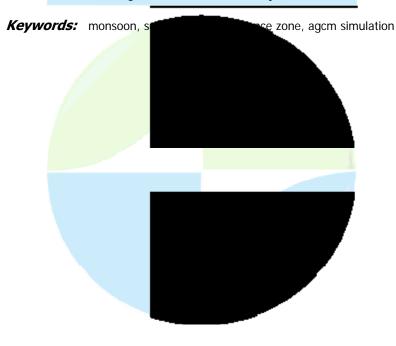
Features of monsoon circulations and associated sub converge an AGCM (T106L56: a primitive equation bect mode hich 56 spectral truncation at wave-number 106) a d. The -V( the model under constrains with observed s ace temperati this study. The detailed analysis is made for ical <u>case of t</u> South Indian Ocean convergence zone (SIC ne Sou conver (tla from the simulation in 1985-1996. The As ner m latior on northeastward from the southern part of Tina to easor confluence and convergence of the Indian monsoon westerly with the easterly trade wind around the North Pacific subtropical anticyclone are the essential condition for the formation of MBFZ. The Asian winter monsoon circulation and SICZ, whi South Indian Ocean, are reasonably repro South Indian Ocean monsoon westerly w subtropical anticyclone are the essential bor American monsoon circulation and SACZ, nicl to the South Atlantic, are also reasonably reproduced. American monsoon westerly with the easterly trade wind around the South Atlantic subtropical anticyclone are the essential condition for

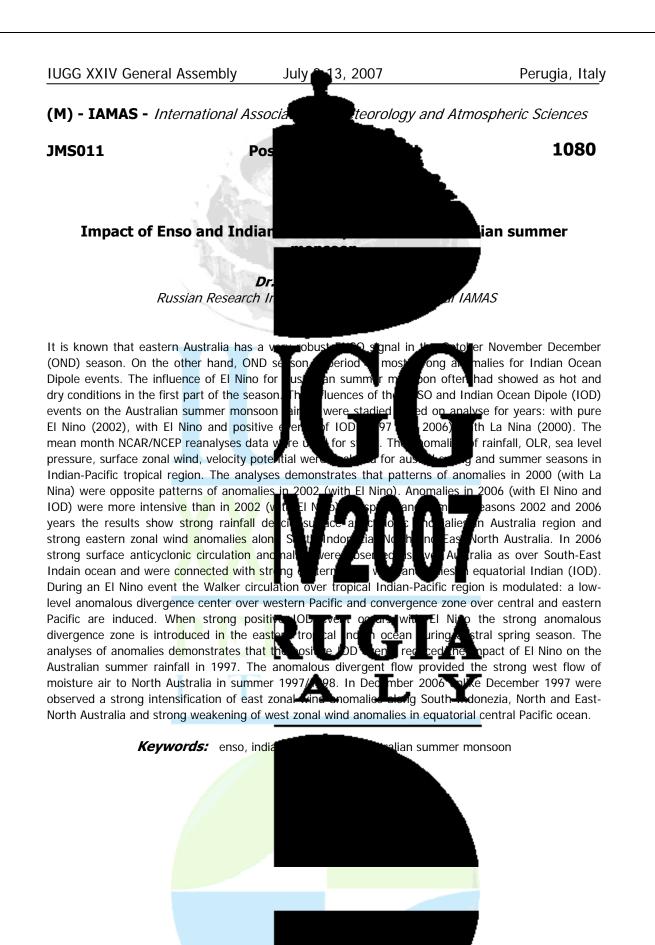
na-levels and triangular tegration from 1979 to 2002, by nd sea-ice distribution, is used for eiyu-Baiu frontal zone (MBFZ), the ce zone (SACZ) selected d MBFZ, which extends uced by the model. The

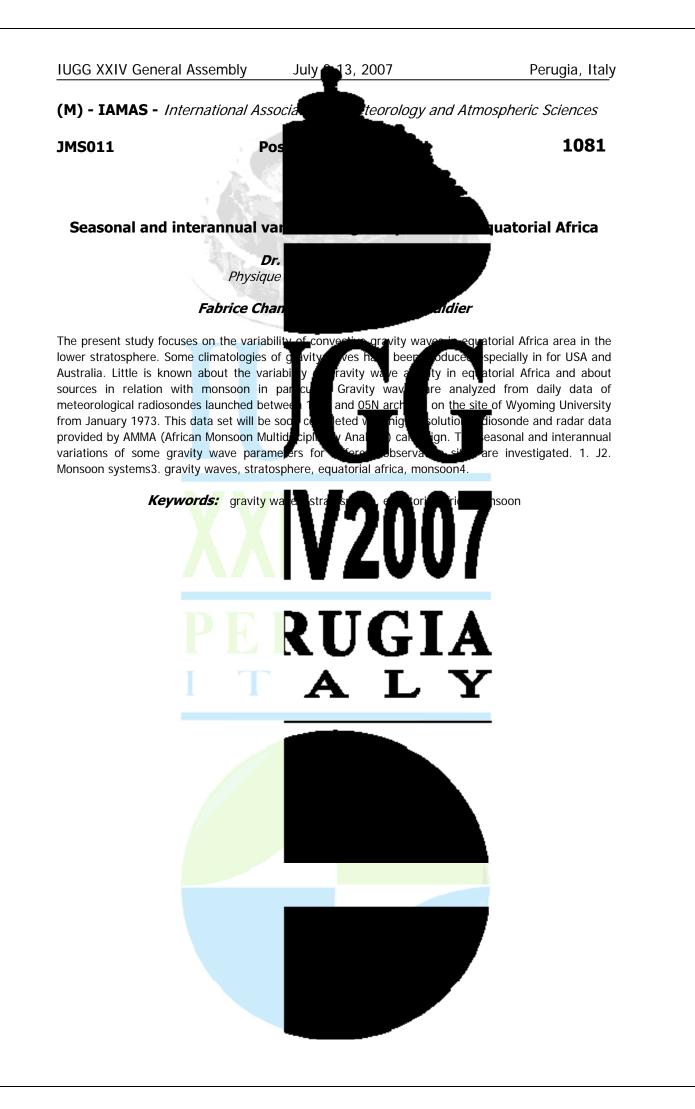
ones (STCZs) simulated by

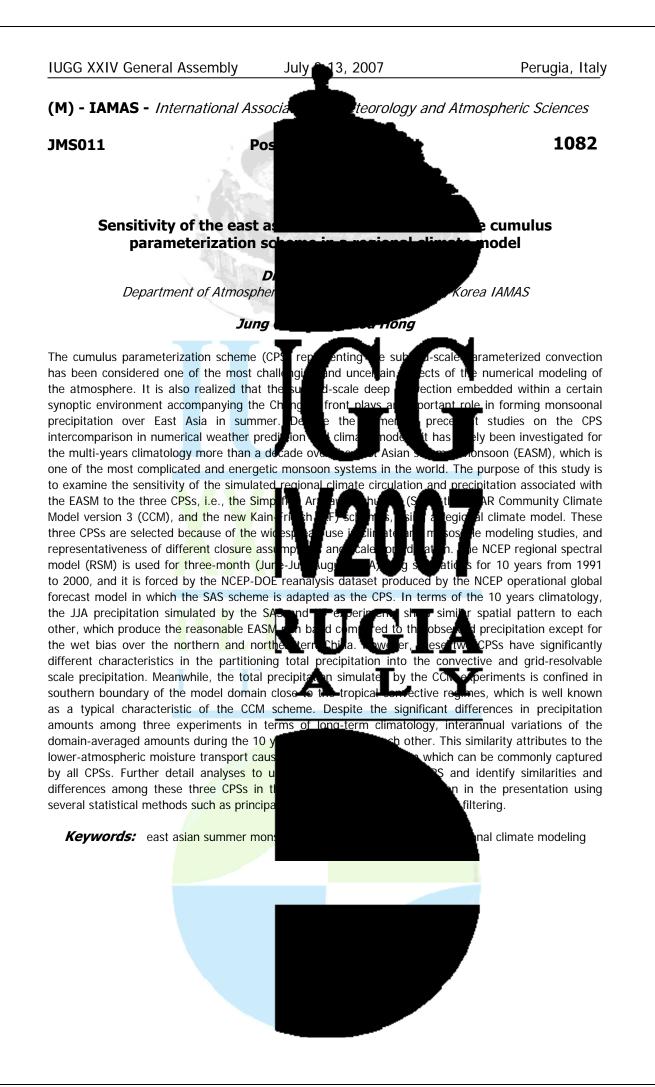
rican Continent to the and convergence of the he South Indian Ocean CZ. Likewise, the South he southern part of Brazil The confluence and convergence of the South common features are found in

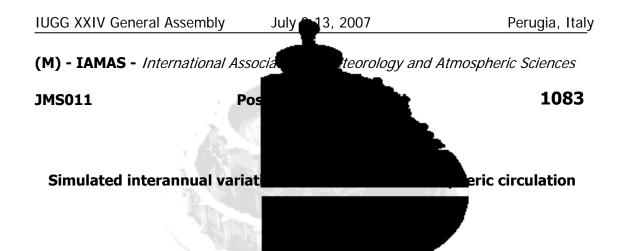
the simulated MBFZ, SICZ and SACZ, in repair structur and t associated synoptic- and meso- -scale disturbances, and the relation clone and the monsoon Бtra cal, a th пu circulation. However important difference is seen between their geographical environments. The cold south Atlantic in the pole-ward side of the SACZ the cold south a SICZ provides the significant baroclinicity for SACL and SIC apoin the pole-ward side of n Indian Oc tence of warm land mass while the e to the pole-ward side of the MBFZ brings on the weak baroclinicity of the MBFZ.





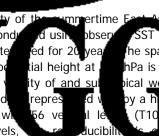






The reproducibility of the interannual variability of the using an AGCM. An ensemble experiment is ond a lower boundary condition and each run is inte the first principal mode of observation of ge wavy pattern extending over eastern Siberi component (PC) time series of the leading r AGCM with horizontal resolution T106 ar resolution version, T42 and 20 vertical vevels,

reproducibility by AGCM suggests the importance of SST as a boundary condition. However, the simulated interannual variations show alternating appearance of two distinct circulation regimes, cold summer regime and hot summer regim distribution in PC phase space. This imp boundary condition includes nonlinearity. breaking in the westerly region of the hig Using the T106L56 model, another ensem The climate change appears as an increase i principal patterns of the present-day climate.



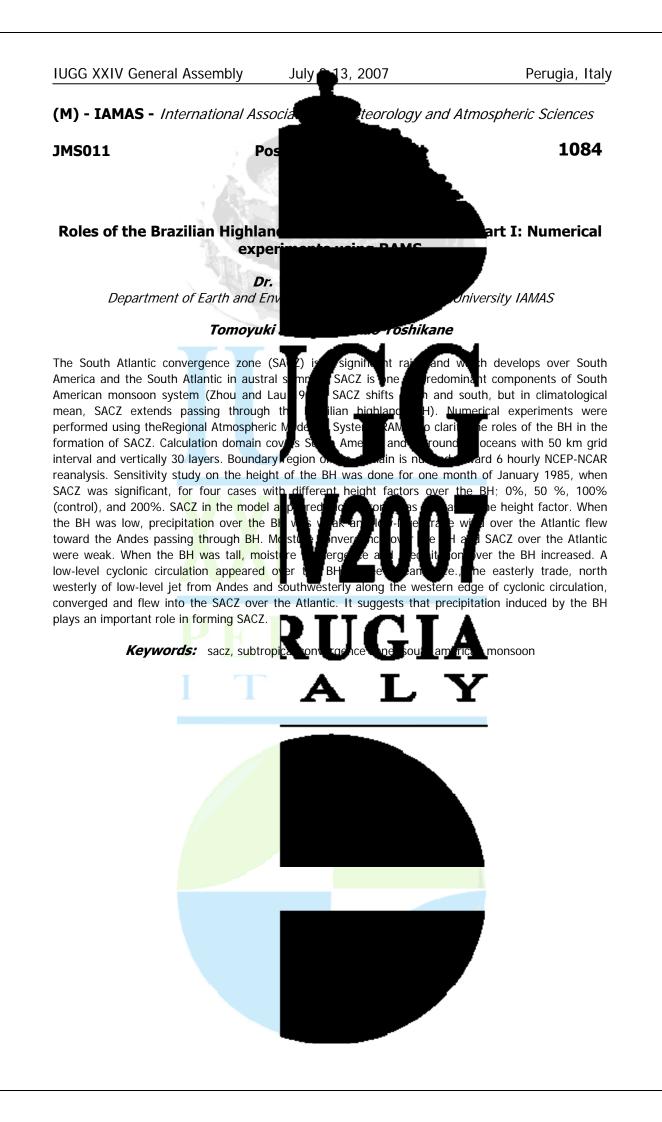
ian circulation is examined seaice concentration as he spatial pattern associated with hPa is characterized by meridional ical western Pacific. The principal esolution version of the 6), while with a lower derably degraded. The

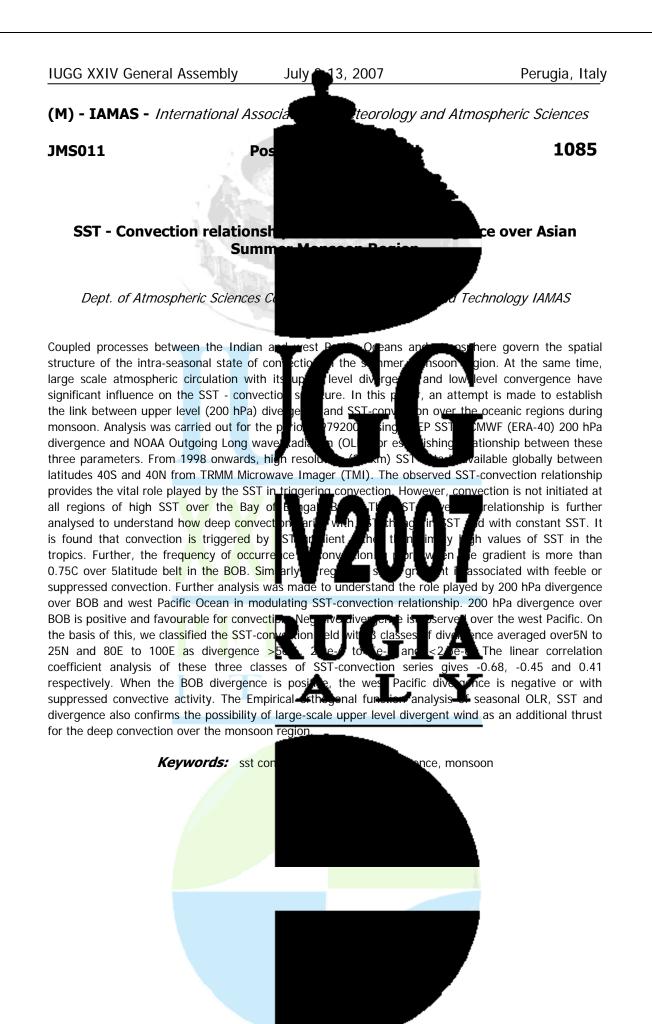
> in probability density e continuously varying

suggested to be wave on for the reproduction. doubled CO2 condition. cold summer regime of the

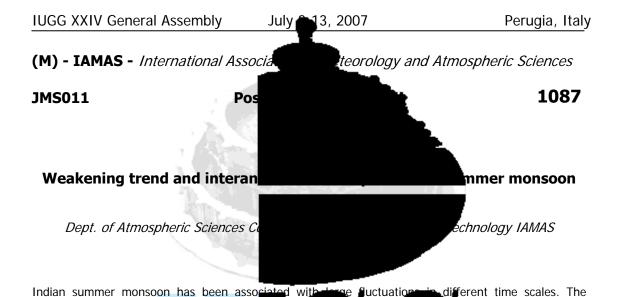


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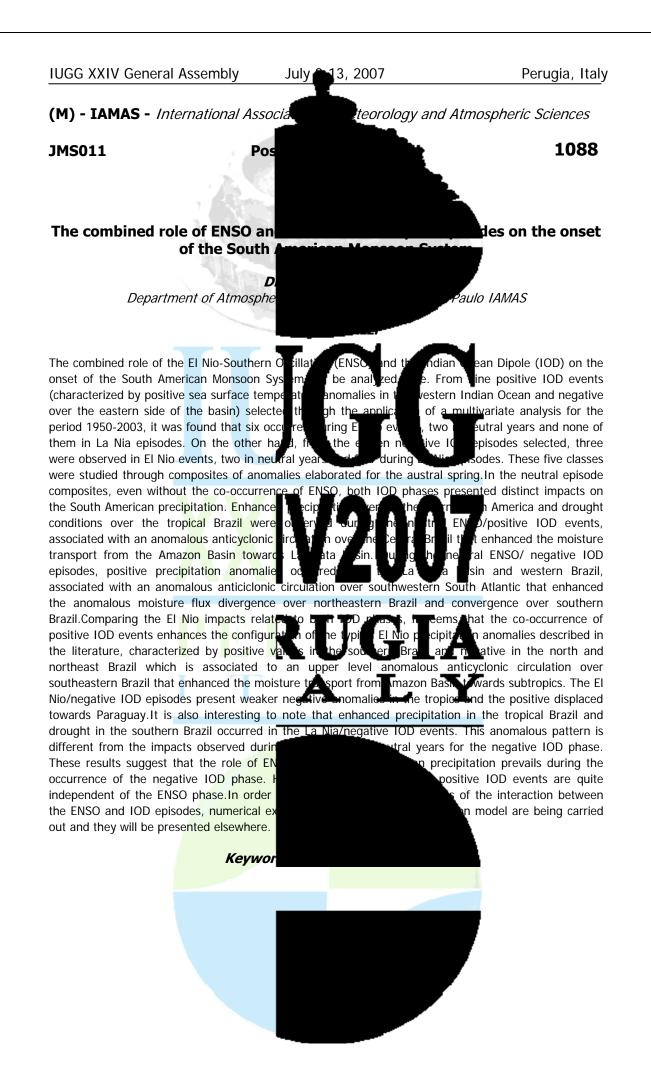


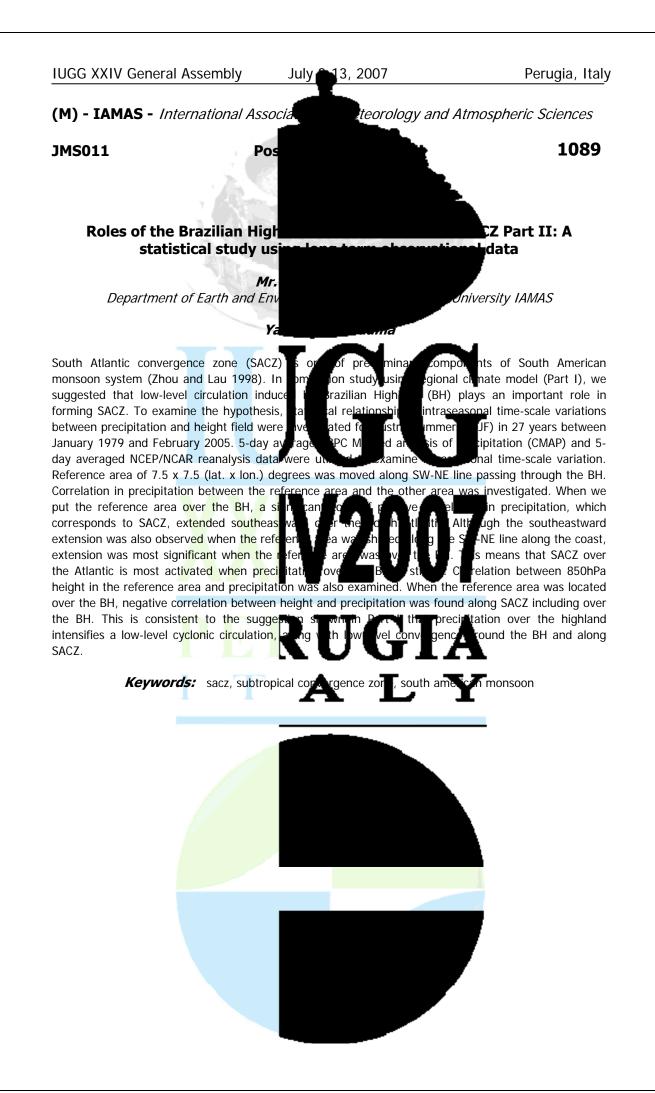


magnitude of the fluctuation varies with nual summer monsoon Catio edae inter Akr rainfall variability is essential for planning Itural preduction and the Indian lly for tl economy. The analysis was made using dail II data (AIDM which was procured from the India Meteorological Department (IMD). Southwe soon <u>season</u>a nfall was derived from the AIDMR from 1901 to 2002. In addition, the zon EP/NCAR was used to at 8 m thể understand its role for bringing good and nsoor Th ata set has a temporal bad resolution of a day and spatial resolution 2.5 X longit ea averaged zonal wind at 850 hPa over 70E-80E & 10N-20N is considered for the study. Here, good monsoon years are identified when the annual rainfall of the vear is more than 10% of the normal rainfall (103 cm) and bad monsoon years when it is less than 1 variability of ISMR in different time scales were also found using erm trend analysis, we noticed that ISMR has two phases, based of d. It is found that in the first phase, the rainfall increases from year cillation. This phase lies to from 1901 to 1964. The wind characterist econd phase starts from 1965 to 2002. In this phase, the rainfall trend is exactly opposite. The slopes of the trend in the first phase and second phase are 2 and -6.5 respectively. This indicates that ISMR shows a decadal weakening trend in the second phase. This r another few years. The le de variability of the ISMR and wind show all avior<sup>a</sup> in al and seasonal scales. variability of monsoon Another important feature is a 5 decadal ong abili 5q\_ the bel rainfall and this mode of variability causes to the phase change of the ISMR. In addition to the decadal variability, an 11 year mode and biennial mode Souther the second phase, te also pres nt. It is fou the zonal wind at 850 hPa and AIDMR are almost hase. The precentage of bad monsoon the same years is high in the second phase (32 %) in comparison with the first phase (15 %) and vice versa in the case of good monsoon years. The linear correlation coefficient between zonal wind at 850 hPa and AIDMR for good monsoon years is 0.77 an on is 0.91. In both the cases, the value of correlation coefficient is confident. The values indicate strong influence of zonal wind at 850 hPa for bringing the mor

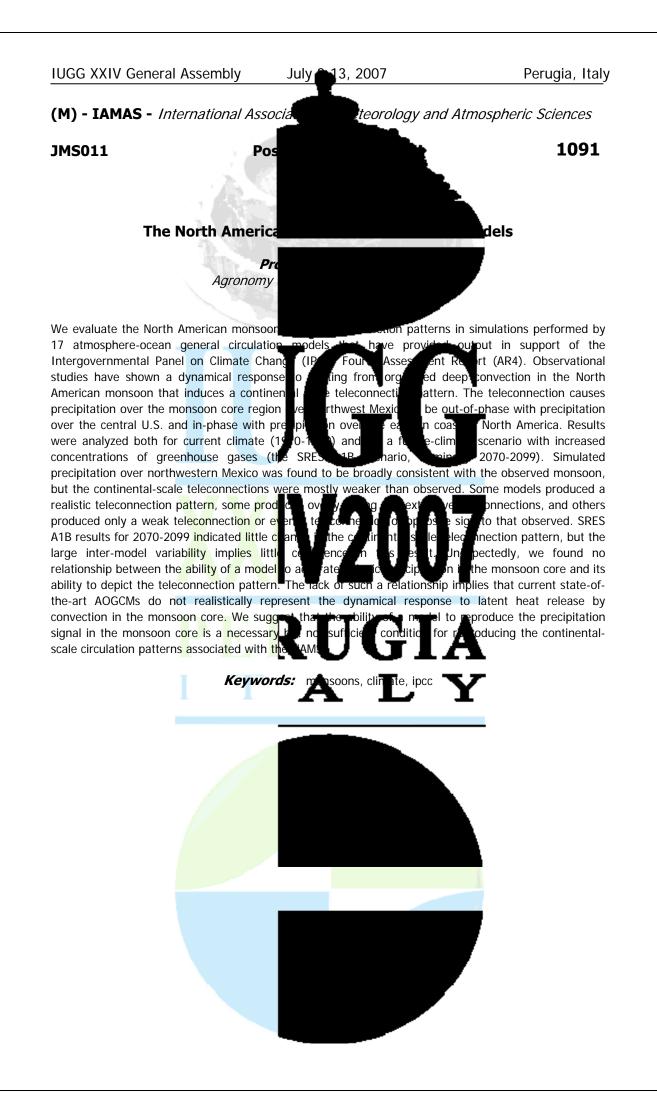
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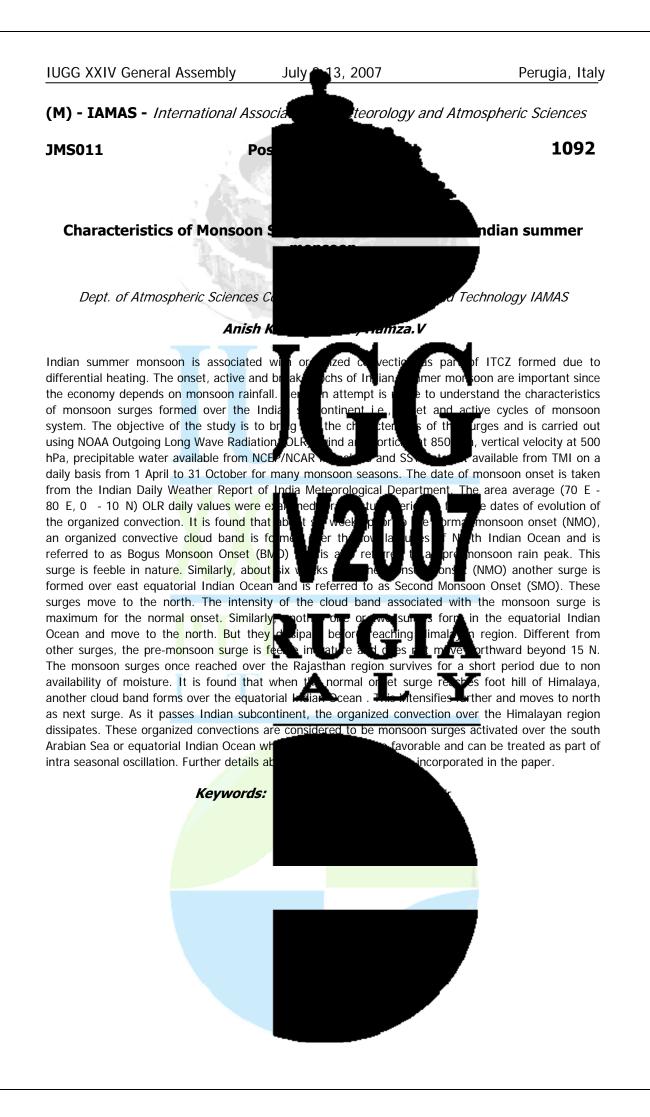
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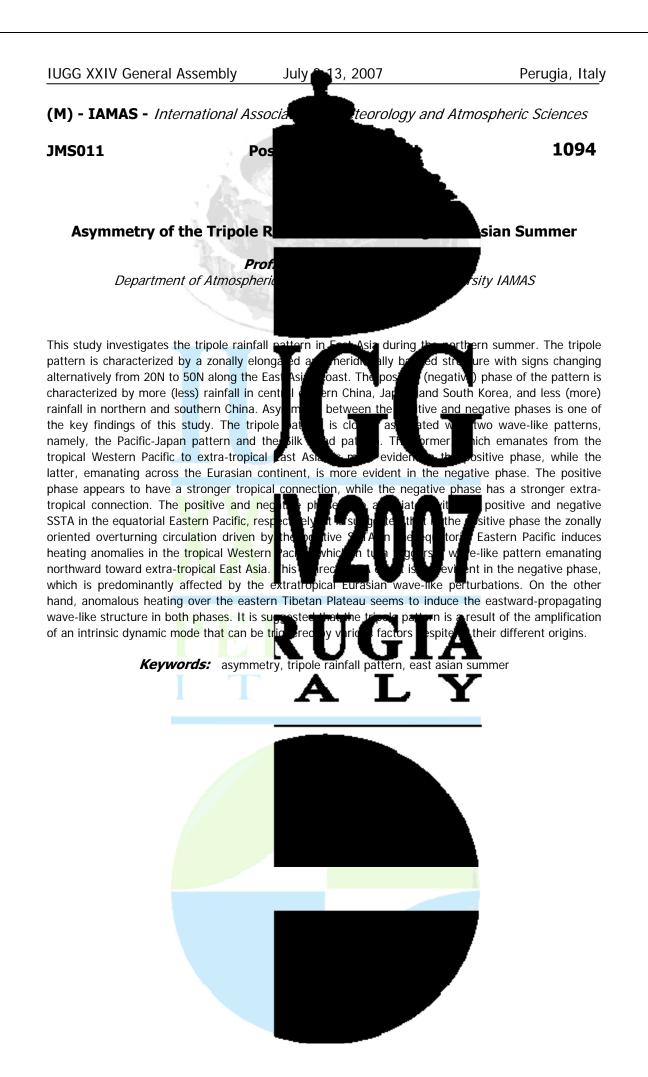


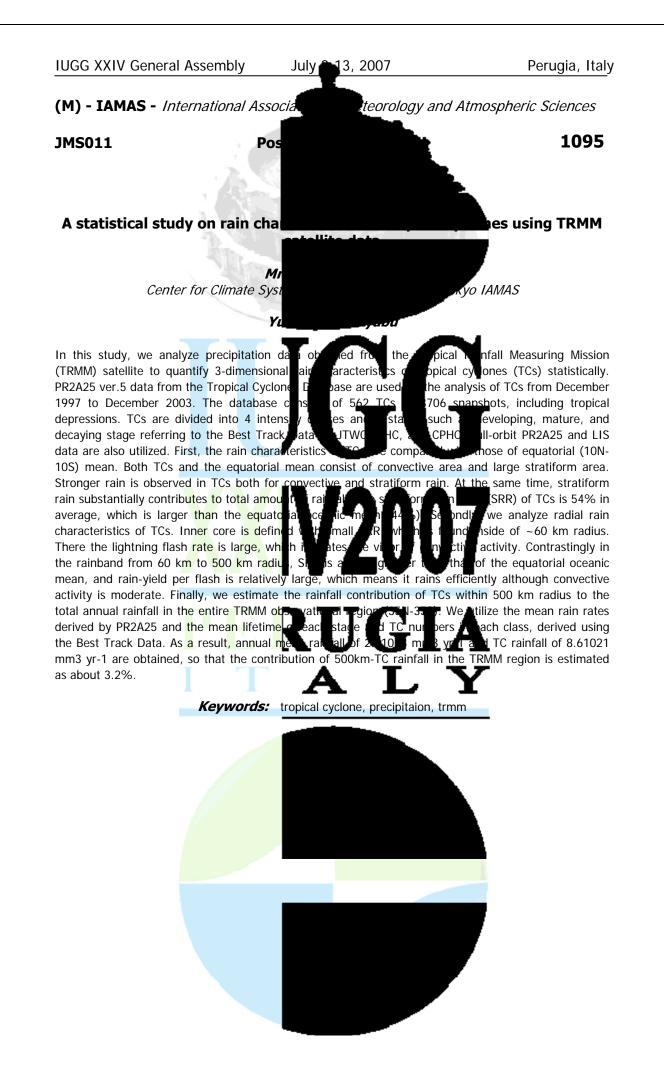


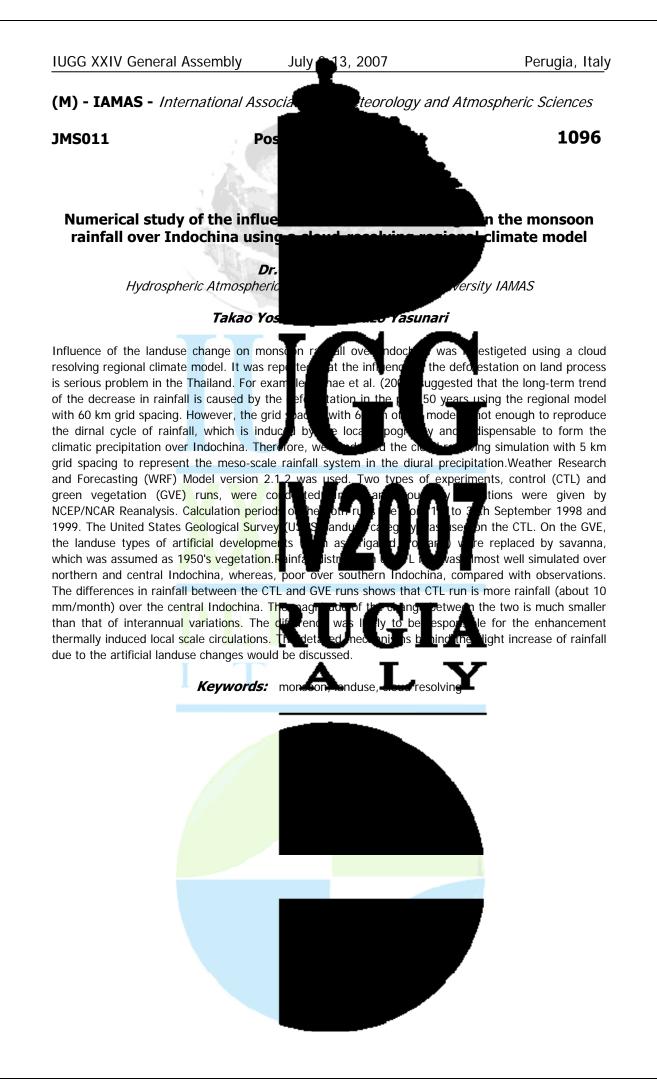


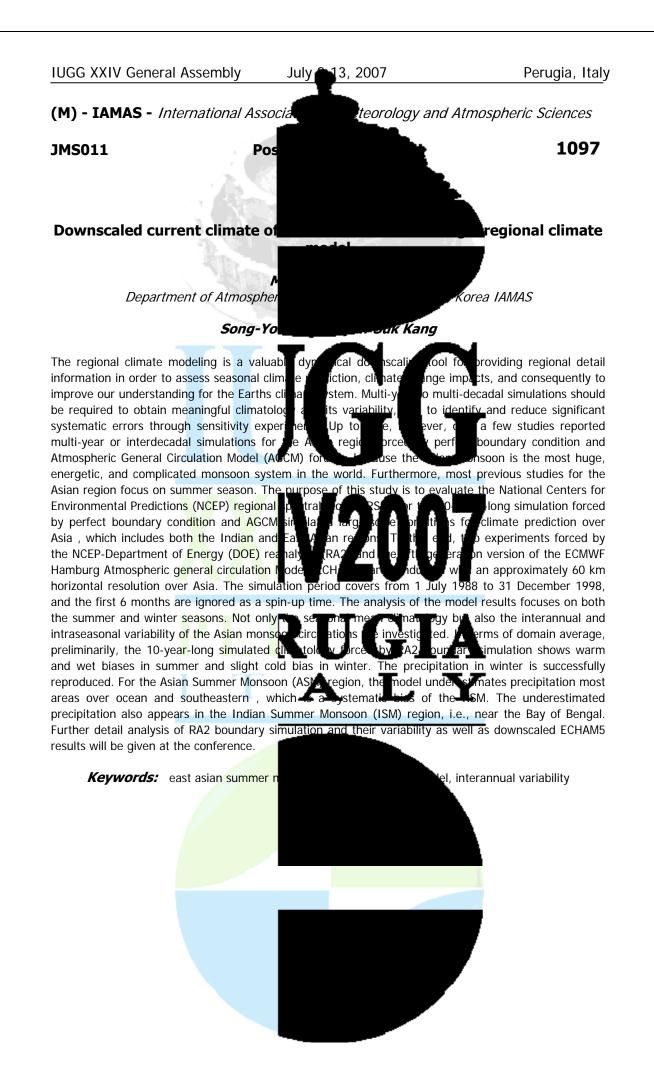






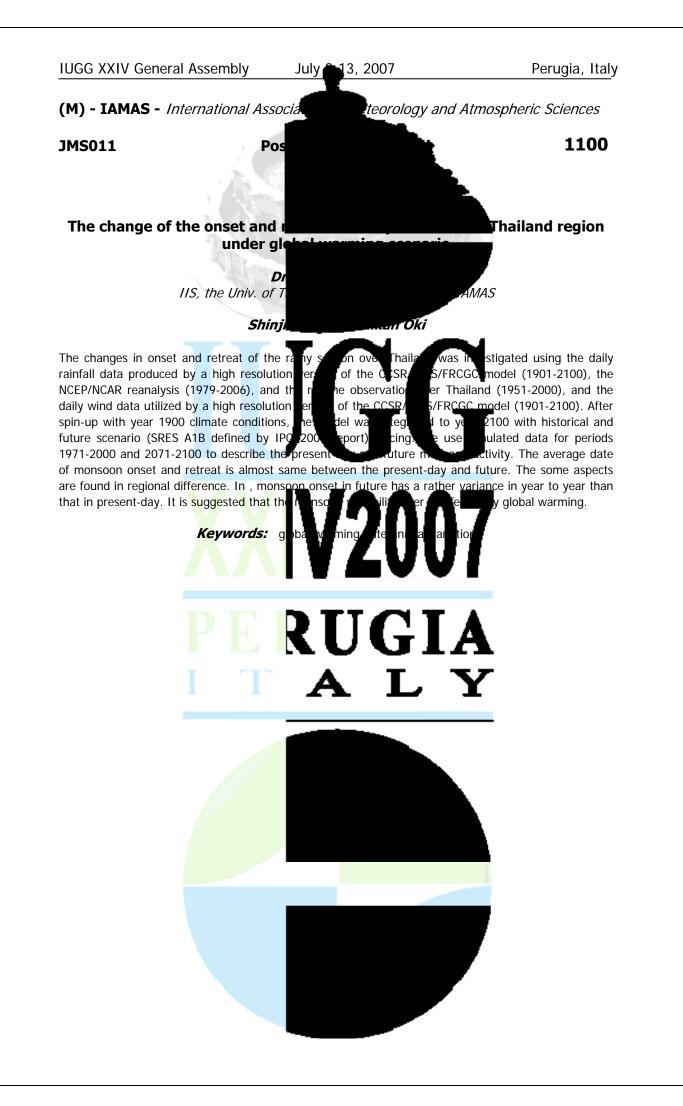


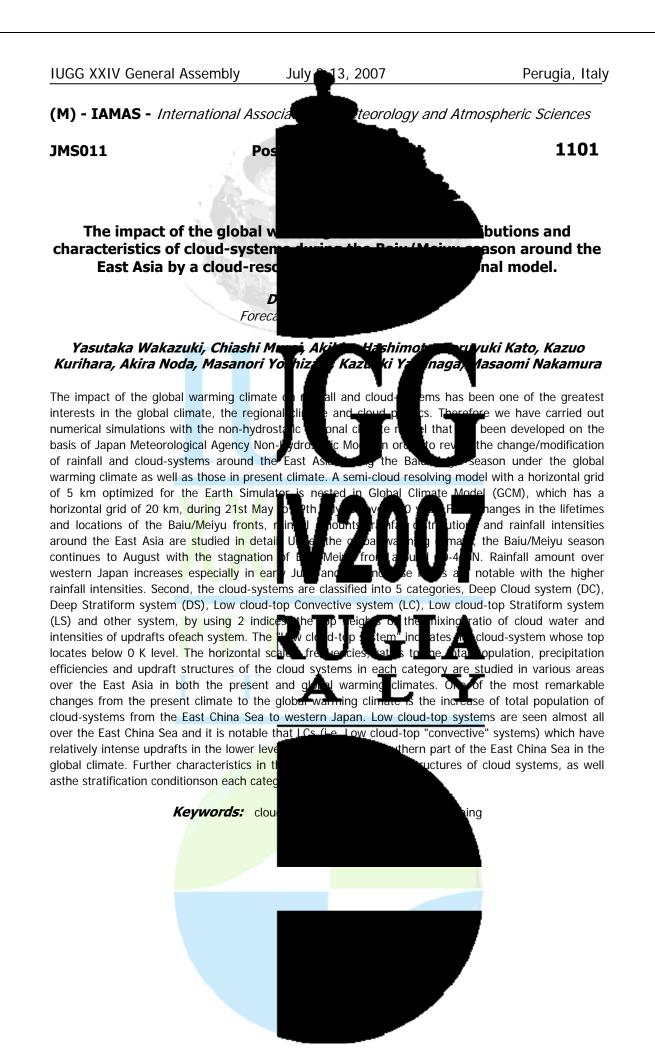


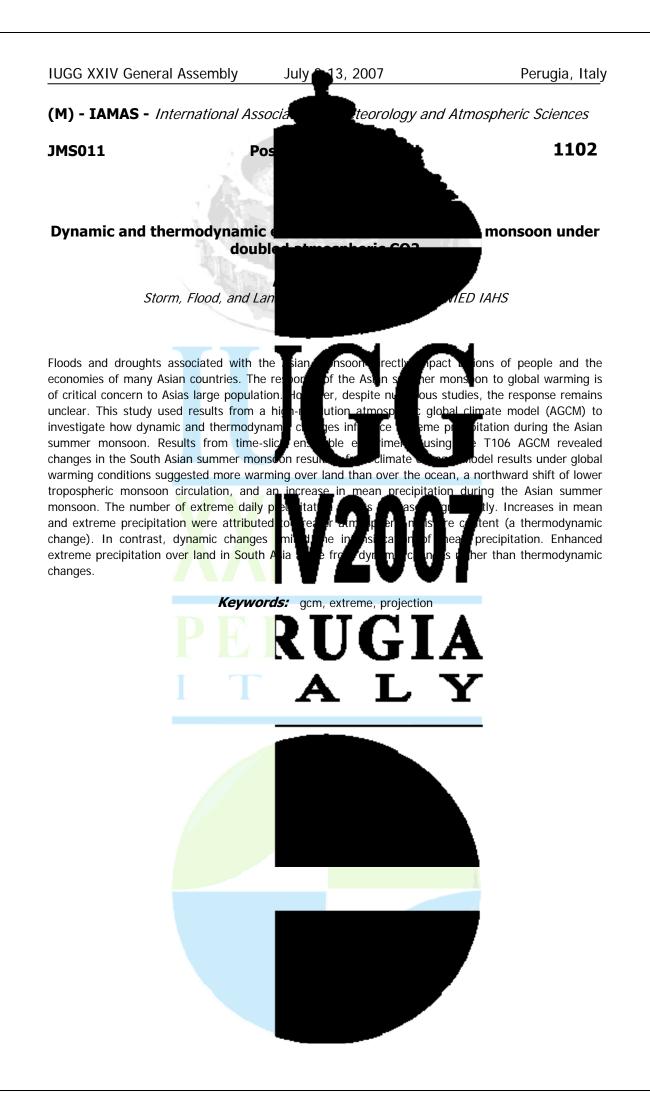


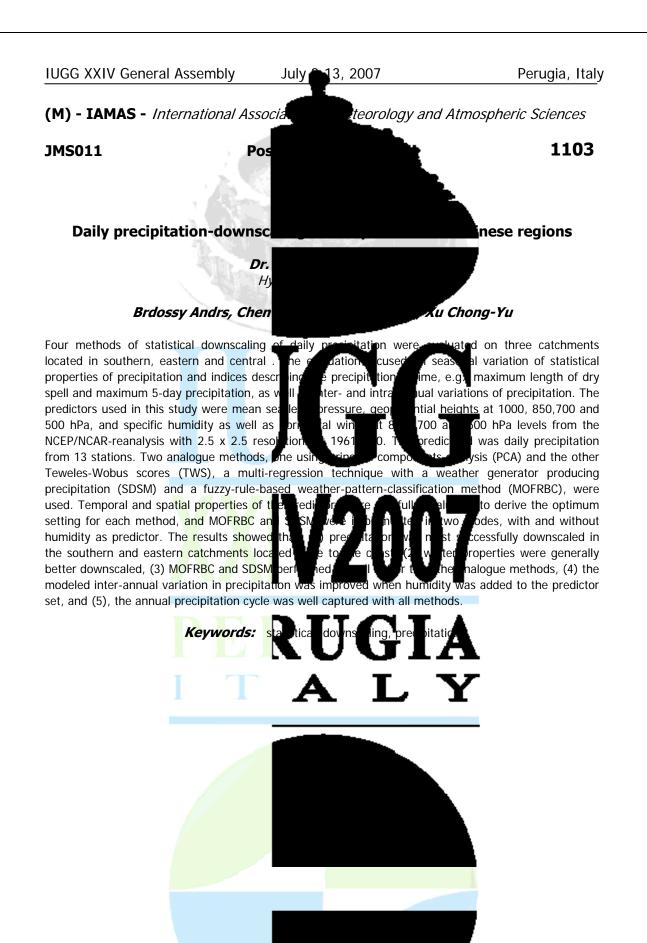


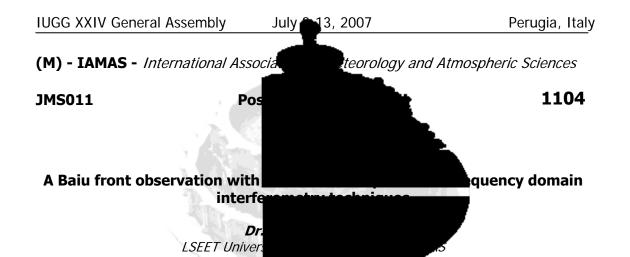












The Baiu front is one of the most major se in Japan during June and July. The Baiu fr brought a new record rainfall of more than middle and upper atmosphere (MU) radar is Japan, and is operated by the Researc University. We conducted the MU radar obse the Baiu front passed over the MU radar large variations and echo powers from atmosperic

which corresponds to a tropopause height. A C-band radar observation was also conducted at the MU radar observatory, and showed that rain drop echoes were widely distributed up to about 6 km without rain band, which indicated deep convecti eastward to south-eastward, vertical wind to around 10 km altitude, atmosperic turbe will show wind variations, atmospheric tur ule front, and discuss their detail structures, tin

mal ph which s ht p d ove apar bO. at maxir um atmospheric ute <u>for Sus</u> 0 (LT) from ( to 30 (L at ť also s

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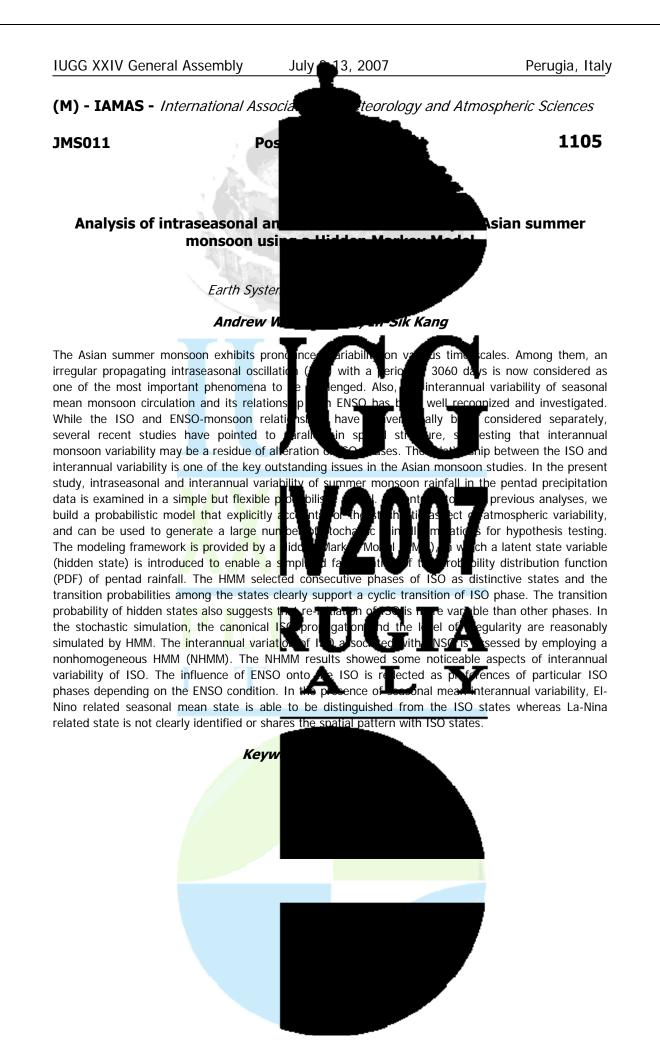
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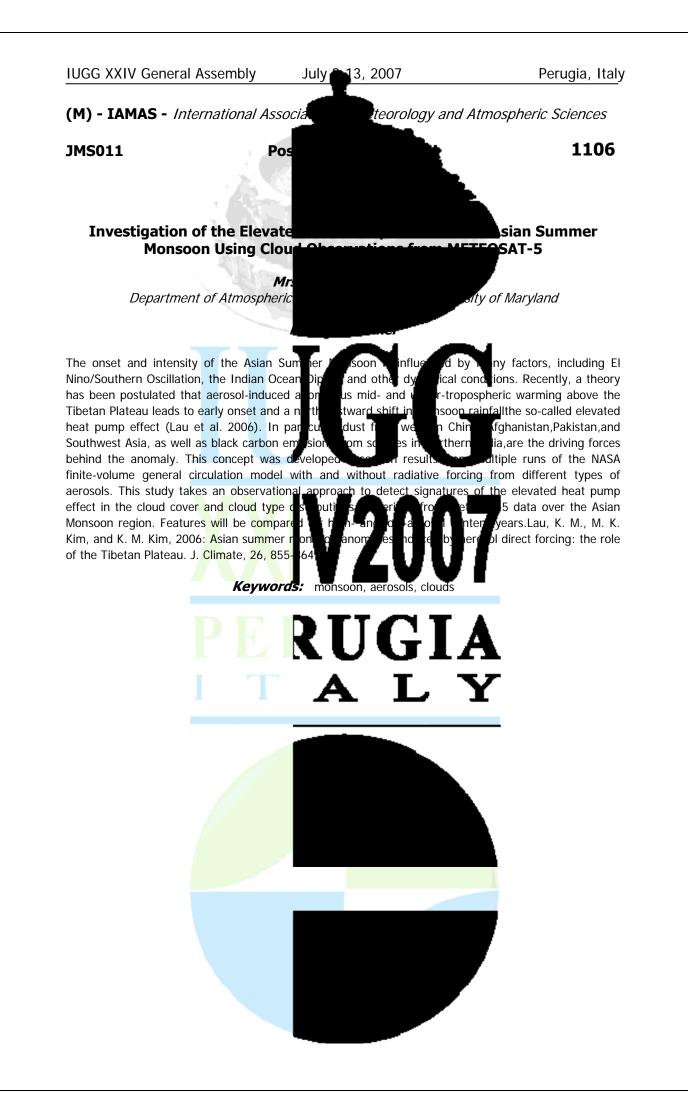
causes so much rainfall 19th July 2006, and it these two days in mid-Japan. The ars, which is located on Shigaraki, ble Humanosphere(RISH), Kyoto 9th July, we found that vertical winds showed ng up to 13 km altitude,

> changed from northause height went down In the presentation, we

> > er a passage of the Baiu

Keywords: mu radar, baiu, turbulence





IUGG XXIV General Assembly

Perugia, Italy

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## **JMS012**

## Symposium Planetary Atmospheres and Th

Convener : Prof. Darrell Strobel, Dr. Co-Convener: Prof. Piergiorgio Casa

Papers are invited which report important evolution of atmospheres of all planets, r from recent space missions, including atmosphere-related objectives of the rele

model simulations of atmospheric evolution are also welcome. Invited Enceladus to Pluto: the Nitrogen content in the Deep Atmosphere of Saturn: New Insig Cassini/VIMS" Nick Schneider: "Escape fro composition" M. Dougherty : "MAG results planetary atmospheres" F. Ferri : "Titar measurements" M. Flasar : "Dynamics of "Monitoring Titan's cloud activity during observations by Cassini" S. Lebonnois : Review

today's Titan GCMs" J-P. Lebreton : "Cassini-Huygens: past, present and future" J. Lunine : "The origin & evolution of Titan" F. Raulin: "Organic compounds in planetary atmospheres and the search for life" D. Strobel : "Titan Aeronomy" H. Niemani Dynamic Meteorology" V. Vuitton : " Titan's

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ent understanding of the

s : "Polar Views of the

Global Circulation from

ssini-Huygens in situ

CIRS data" M. Hirtzig :

instruments and in-situ

esses and problems) of

" T. Tokano : "Titan's

s will be on insights gained

Contributions describing the

Speakers: S. Atreya : "From

Coustents : "Titan stratospheric

enaz : "Spectroscopy of the outer

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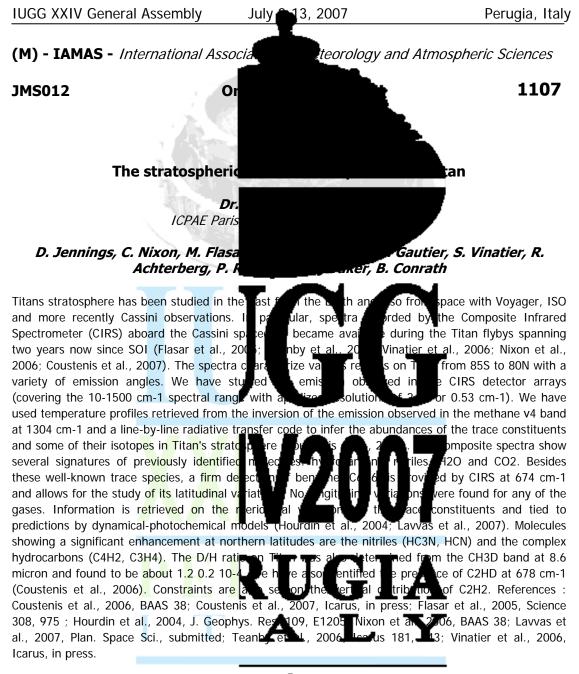
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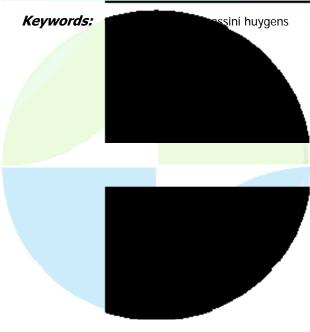
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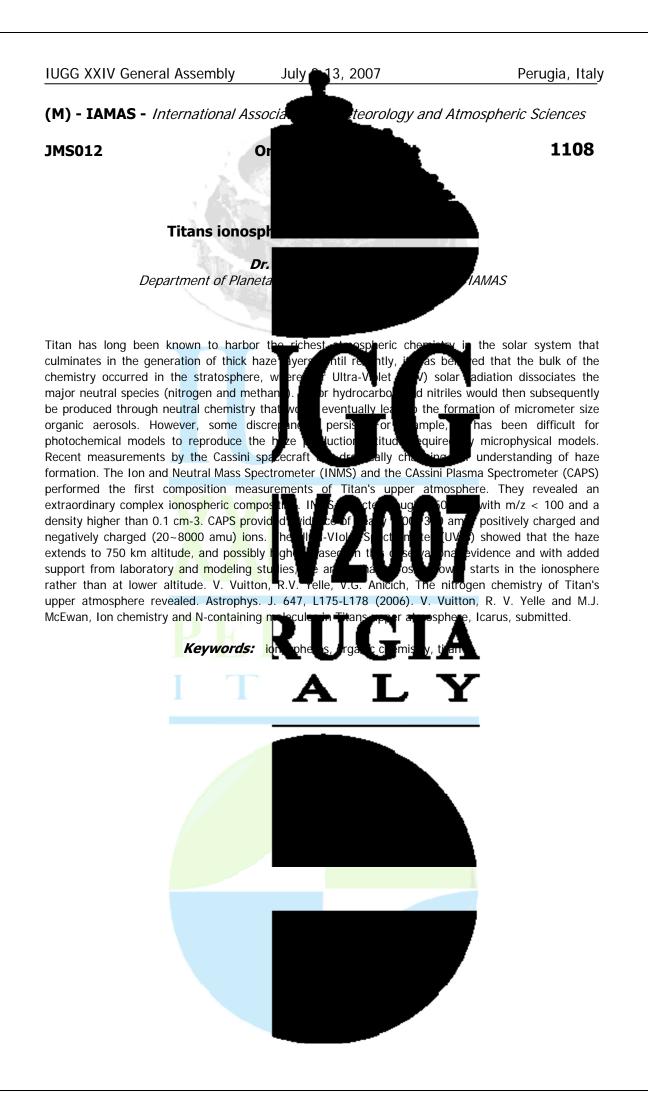
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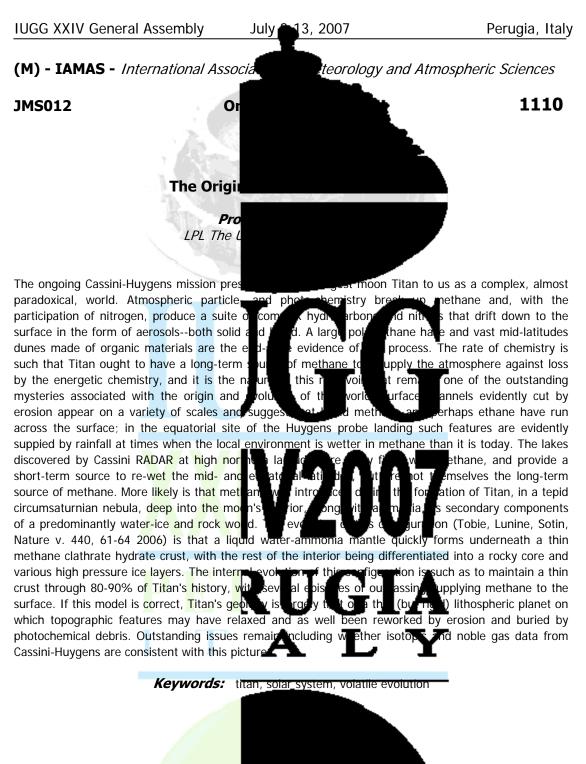
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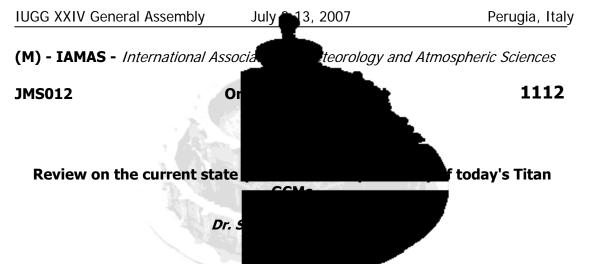








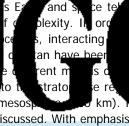




## David Luz, Frdric Hou

With the space missions and new generation atmospheric system reveal its high degree models need to include more and more p Circulation Models (GCMs) of the atmosphered over the last fifteen years. In this review, t atmosphere are presented, from surface up below the stratopause (250km) to the low mesos

superrotation of zonal winds, the role of the different processes represented in the GCMs can be studied (coupling between the aerosols structur compounds, boundary conditions), as wel mean meridional and zonal circulation, and atmospheric main controls ? How may we some lessons that can be learned from observations.



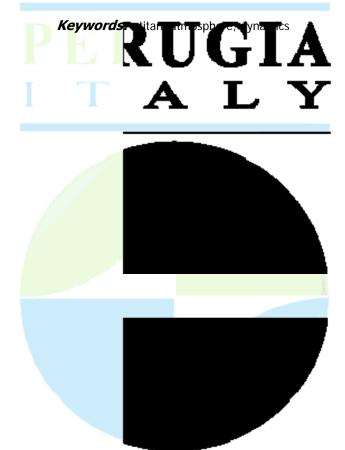
observations of Titan's o unders and these observations, each others. Therefore, General eloped with increasing complexity oped nd the world for Titan's with b altitudes ranging from , parameters, couplings,

and the resulting limits for each model are discussed. With emphasis given to the stratosphere and the

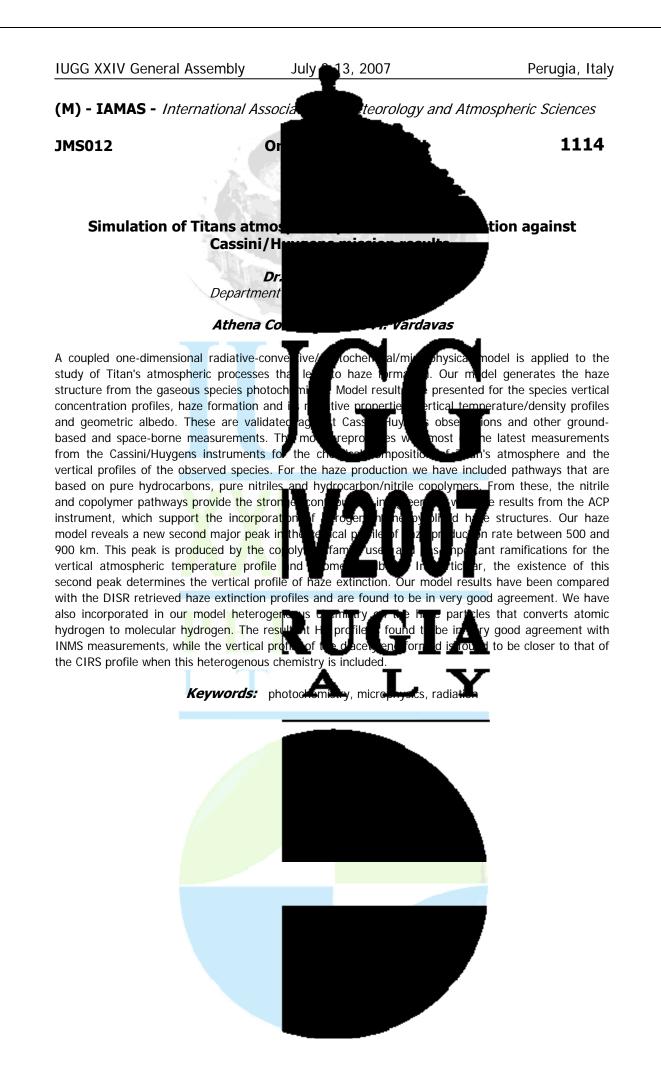
nou, Tetsuya Tokano

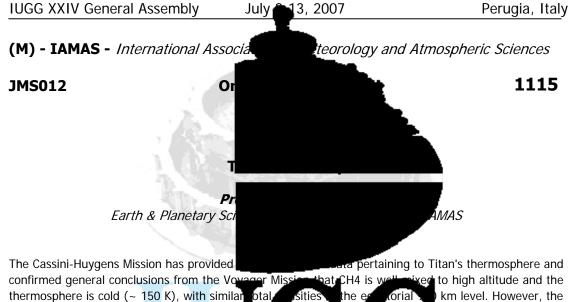
lla ao

of stratospheric trace lors: thermal structure, ric waves. What are the This review summarises dels, and with available









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ove <u>950 km,</u> 4) complex molecules

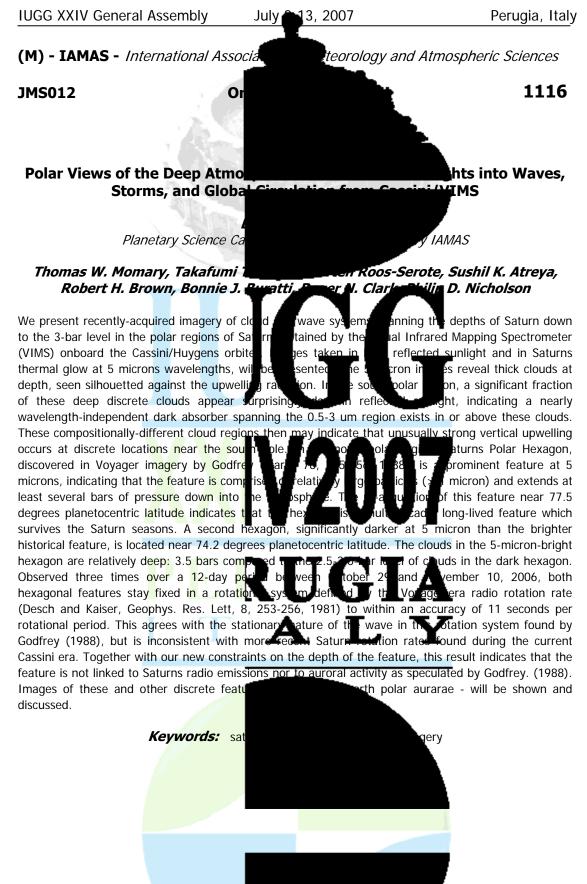
Huygens photochemical

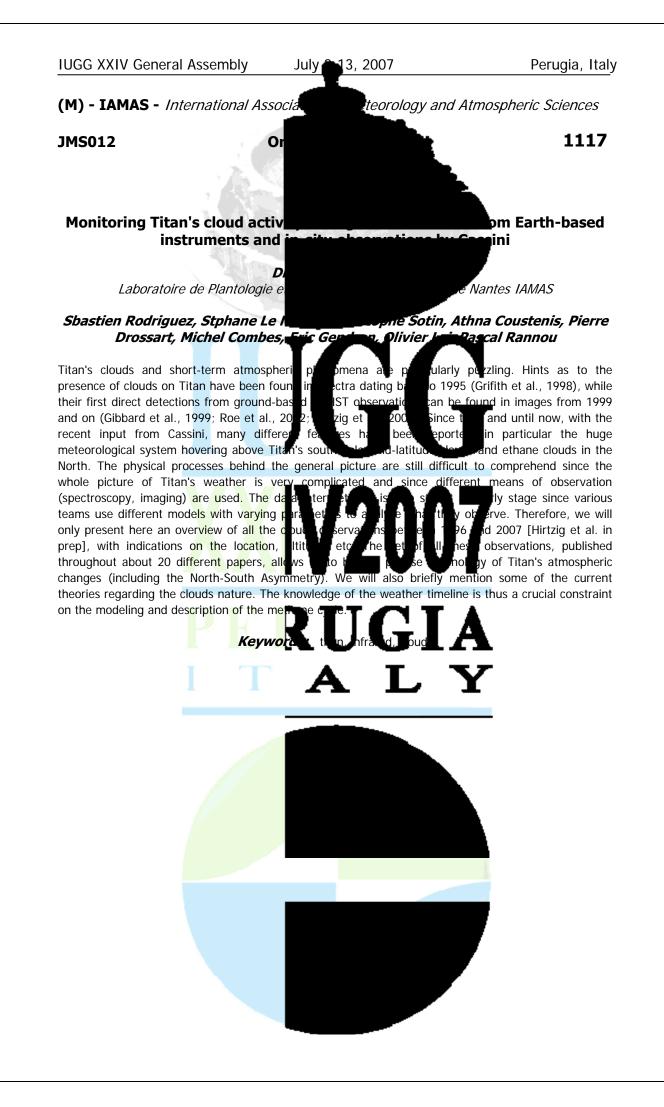
1000 km level, and 6)

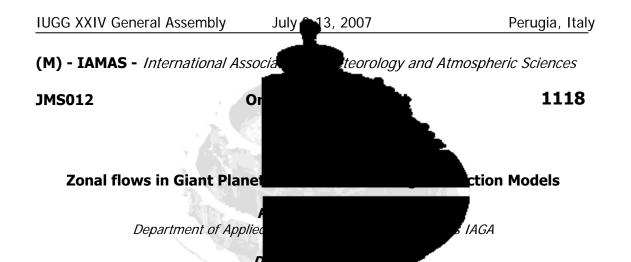
t chemical and physical

thermosphere is cold (~ 150 K), with similar otal, sities thermospheric structure is not consistent hith Voyage heating is important. Some of the surprises 1) suggestive fluxes H2 and CH4, 2) large amplitude wave uatorial bulg and ions in abundances above 950 km far ir exped models, 5) magnetospheric induced electr inte dyn significant high energy ion fluxes penetrating be consequences. A selection of these topics will presented consistent with the allocated time.









The large scale zonal flows on Jupiter molecular H/He layer above the metallic hy the surface. Boussinesq simulations of deer successful in reproducing the strong eastwa the alternating bands of eastward and wes magnitude from the metallic hydrogen trans the Galileo probe. Here we examine the simulations of rapidly rotating convection in a sphe

that the equatorial eastward current that lies outside the tangent cylinder surrounding the magnetically dominated metallic hydrogen core still extends into the deep interior in anelastic models with large density variation. However, the alternation affected by compressibility. As the surfa rapidly, giving rise to a large thermal wind the azimuthal flow varies significantly wit constant on cylinders no longer holds. We weakly electrically conducting region above the

d\_Saturr due e forci foge fre o tion in a rapi сo ent near the e ow. <u>Howeve</u>r er at ĥd f this nsit sing

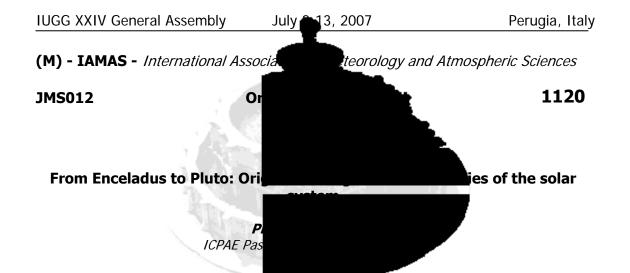
o deep convection in the ably stratified zone near h thè otating pherical shell have been tor in both Jupiter and Saturn and density varies by many orders of par to 20 bar level reached by riatior fully three-dimensional approximation. We find

> cylinder are strongly tropy fluctuation rises sphere. This means that an-Taylor effect of flow the magnetic field on the



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Nitrogen is one of the main elements of the abundant elements in the solar system. and it is giant planets, it is found in the form of nitrogen (N2). On the contrary, nitrogen Enceladus is secondary. The planetesimals converted to nitrogen. With the exception primordial past of these bodies. Photodissog N2 under appropriate conditions. Thermal dissocial

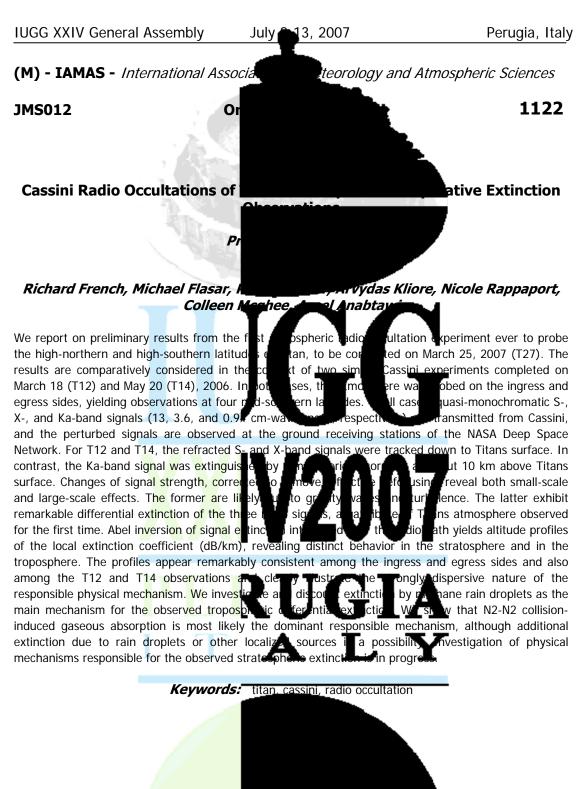
original nitrogen atmosphere could be produced on timescales of the order of ten million years by photolysis of NH3 [1,2]. Because of its low gravity, Enceladus cannot have a bound atmosphere, therefore its nitrogen must be produced interior seems to be at play [3]. The ext ammonia to exist in gas phase, thus its o Triton must be primordial. [email: webpag 201, 611, 1978. [2] Wilson, E.H., Thesis, L [3] Castillo, J., et al., in press. 2007.

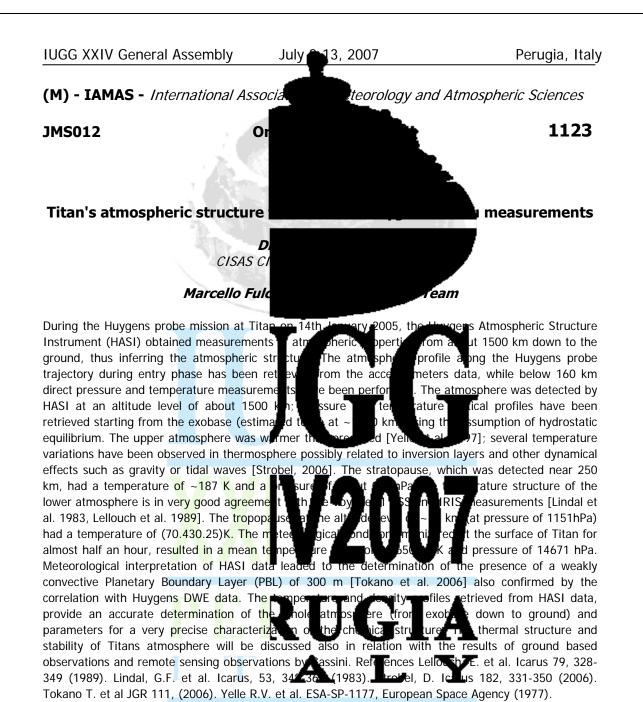
w it. It is the fifth most of life a cing atmospheres of the the re delivered to them originally as the terrestrial planets Titan and es delivered ammonia, which was st have occurred in the ersion fective eans of turning NH3 into n Titan, 5-8 bars of the

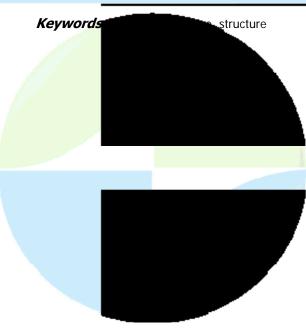
> nia in Enceladus' hot hd Pluto do not permit rogen. N2 on Pluto and ya, S. K., et al., Science sis, Univ. Michigan, 2006.

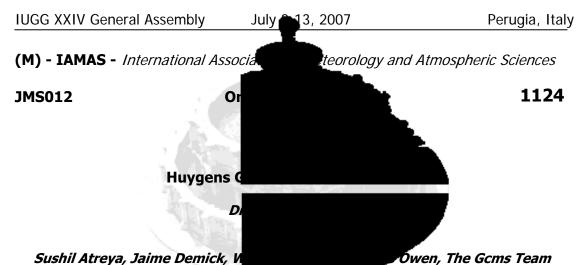












The Huygens Probe executed a successful entry, des January 14, 2005. The Gas Chromatograph Jass the Huygens Probe, and conducted isotopic and one half hour descent from 146 km altitude the orbiting Cassini spacecraft. The GCMS e multiplier detection system and a gas s composition measurements and batch sam

chemical scrubber and a hydrocarbon errichmer condensation, and to evaporate volatiles from the surface after impact. Data products from the GCMS included altitude profiles of the major atmospheric constituents dinitrogen (N2) and methane (CH4), isotope ratios of 14N/15N, 12C/13C, and I argon (36Ar), and upper limits on the mol be absent. Surface measurements confirm Later data products expanded atmospher acetylene (C2H2), and carbon dioxide (CO and molecular hydrogen (H2).

ndeimpact o er (G ctron npositional m the surface ( a q<u>uadrupo</u>l g con syste 5ro pugh e GCM

Salurnian moon of Titan on instrument payload on was rements throughout the two and 9 minutes until loss of signal from ass filter with a secondary electron ous direct atmospheric hrom raphic (GC) columns, a was heated to prevent

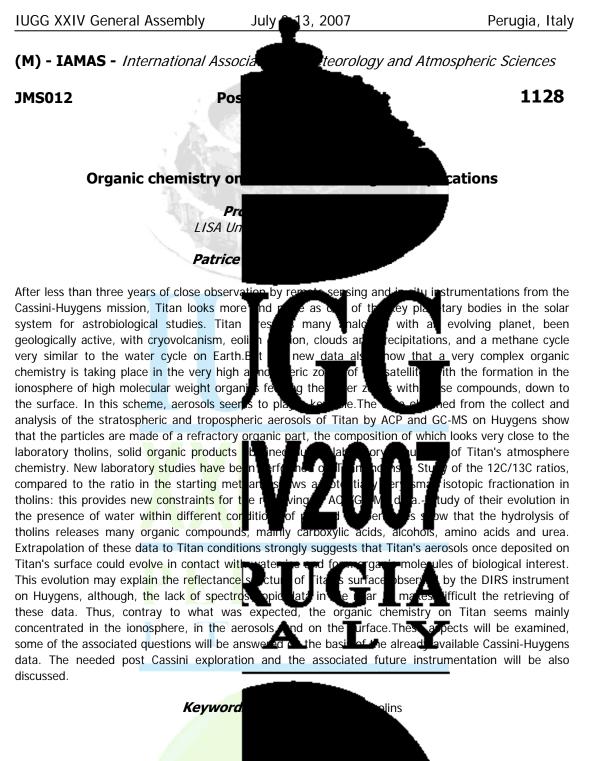
(40Ar) and primordial h, which were found to and cyanogen (C2N2). ponse of C2N2, C2H6, ofiles of benzene (C6H6)

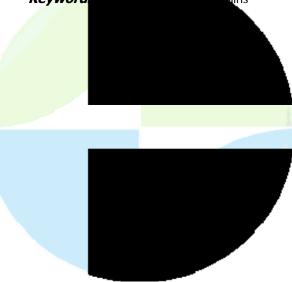




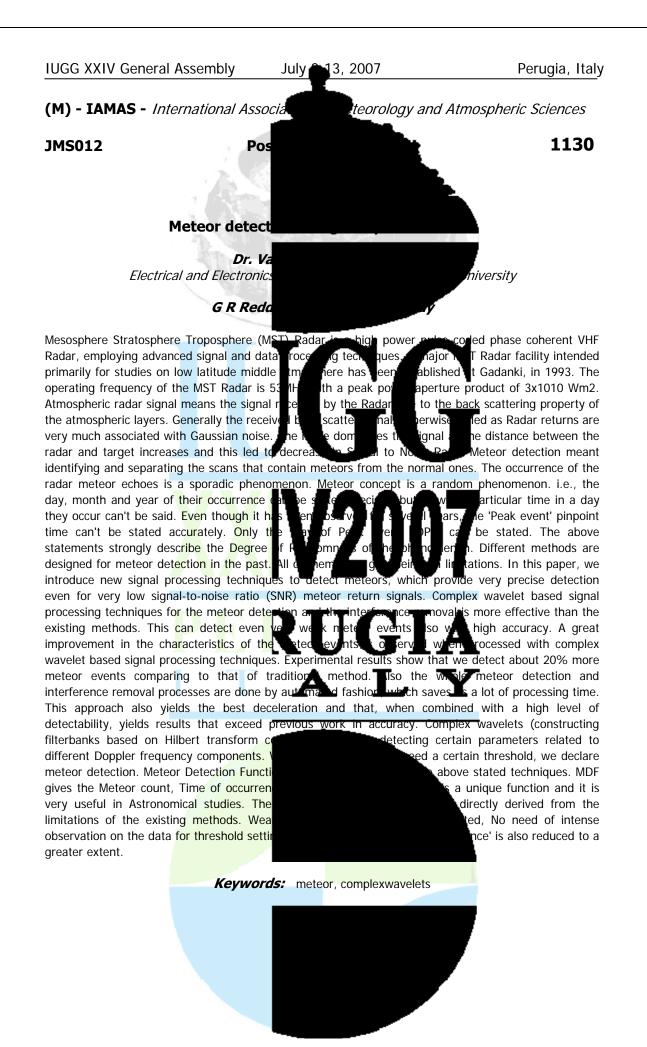


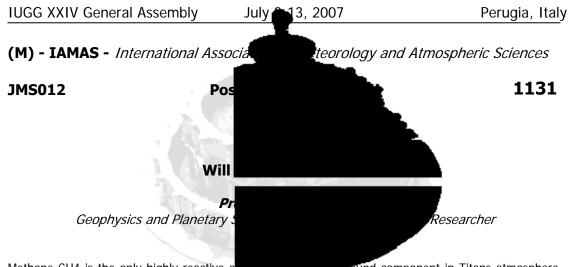






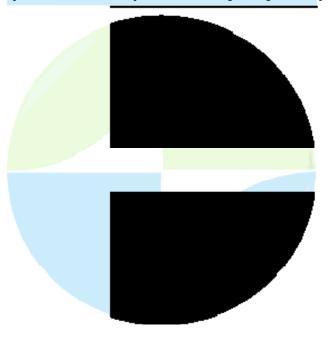






Methane CH4 is the only highly reactive a ground component in Titans atmosphere, so its overall reserve predetermines both features and duration of atm ic chemical activity. Titan's global chemical activity is considered in tems cycle is defined as a period hetha ie ci observable atmospheric content T0=7.0.1014s of complete photochemical ion of n etha CH40= 2.33.1017 kg [1]. Cycle duration T0, of the past 20020, future NF=500 50 and total Nmax=NP+NF=70070 cycles are the main tive indices of e glo<u>bal che</u>mical activity [2]. The fact that the period TO is much smaller t Titan [cur= 1017s implies that the eti current methane content CH40 is continuou ished glob rculation. There are two me sources of methane replenishment, i.e. the recyclin rapped in Titans interior imorɗi as the clathrates, and the ground liquid-phase reduction of non-saturated final products of the atmospheric photochemical process. Internal reserve provides the dominant portion (~95%) of general recycle, while the reduction reconversion is lance. Yet, there is the problem of the availability of the offe total trapped stock (CH4)max=(15.3-33.3).1020 kg, the con the whole Titan's life TSun~5.0.1017s can be provided if the a a.(CH4)max exceeds the crucial value (CH4)crit≥1.65.1020 kg. This ate cage-filling efficiency a equals respectively to a  $\geq$  acrit1= (TSun/T0).[(CH4)0/[(CH4)max1]  $5.45.10-3 \ a \ge acrit2=$ (TSun/T0).[(CH4)0/[(CH4)max2] = 2.51.10-3 Thus, the total stock (CH4)max and a-values 5.45.10-3=acrit2≥a≥acrit1=2.51.10-3{kg CH4/kg (CH4)crit≥1.65.1020 kg ck (CH4)real≤ (CH4)crit that in turn predetermine the very fate of I rea∎aco history"), otherwise than the Titan will lose its veil ine th than the Titan will lose its veil ineversity (scenario) the "rost history"), otherwise (CH4)real≥(CH4)crit the veil survives down to Titan's dying day ("continuous history"). The specification of the exp ebg of Titans chemistry. of a seems to be one of the most relevant problem rimental mo

*Keywords:* methane cycle, clathrate, cage filling efficiency



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## **JMS013**

## Symposium Aeronomy of Planetary Atmosp

Convener: Dr. Dmitry Titov, Prof. Da Co-Convener: Prof. Piergiorgio Casa

Papers are invited on the physics and c ionosphere of the inner and outer planet including the atmospheres of Venus, Earth and similarities in their climates. Results

particular interest. Reports on improvement in general circulation models of the thermosphere and lower atmospheres of the planets and descinctions of utual laneta consistent are also invited. Invited Speakers A. Coradini: "Kuiper Belt Objects and "Mars : new view on the planet history" J-Venus upper atmosphere" E.Chassefire : terrestrial planets" P. Drossart: "Non-LTE er Forget: "Modeling of the general circu atio Climate/Surface/Interior Evolution of Venus D. from MRO" G. Piccioni: "Dynamical phenomena in

Svedhem: "Venus Express: results of the one year in orbit" F. Taylor: "The Present Climate of Venus" D. Titov: "Radiation on the atmospheres of terrestrial planets" N. Balucani: "Gas-phase neutral-neutral reactions in planetary atmospheres" J. Bru Dutuit : "Titan Ionospheric Chemistry" degradation way of ions in planetary ionos the Formation of PAHs in Titan's Atmosphere reactions of relevance to Titan's atmosphe complex organic molecules in Titan's up ber spectral properties of the atmospheric gases" (TBC) B. Bzard: "Spectroscopic issues related to infrared investigations of planetary atmospheres'

teorology and Atmospheric Sciences

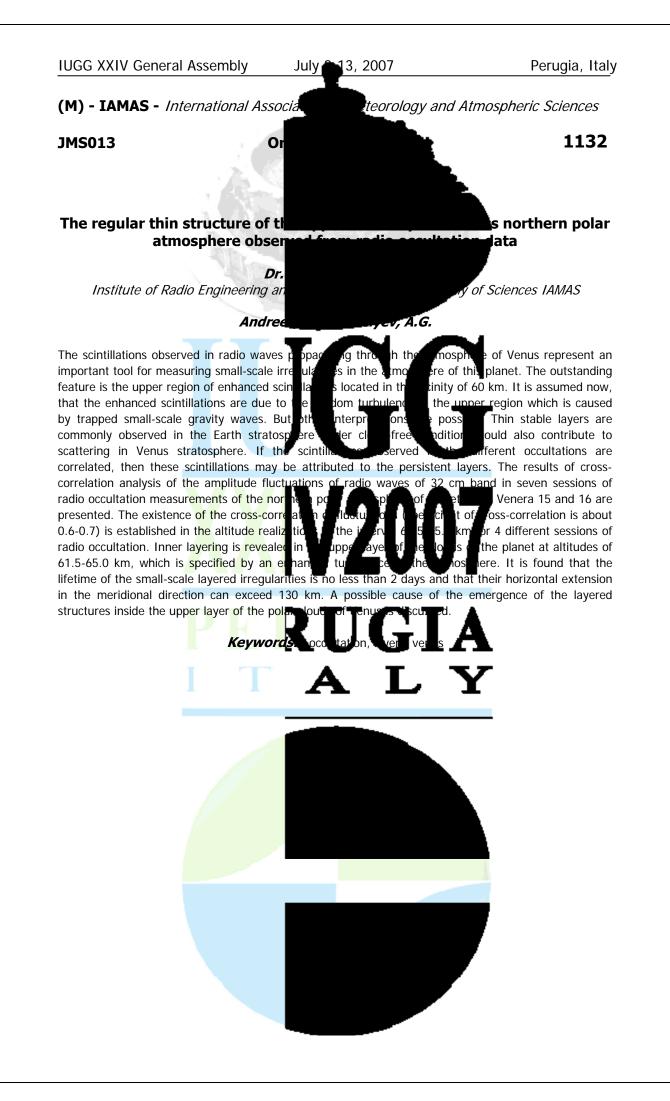
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## etology

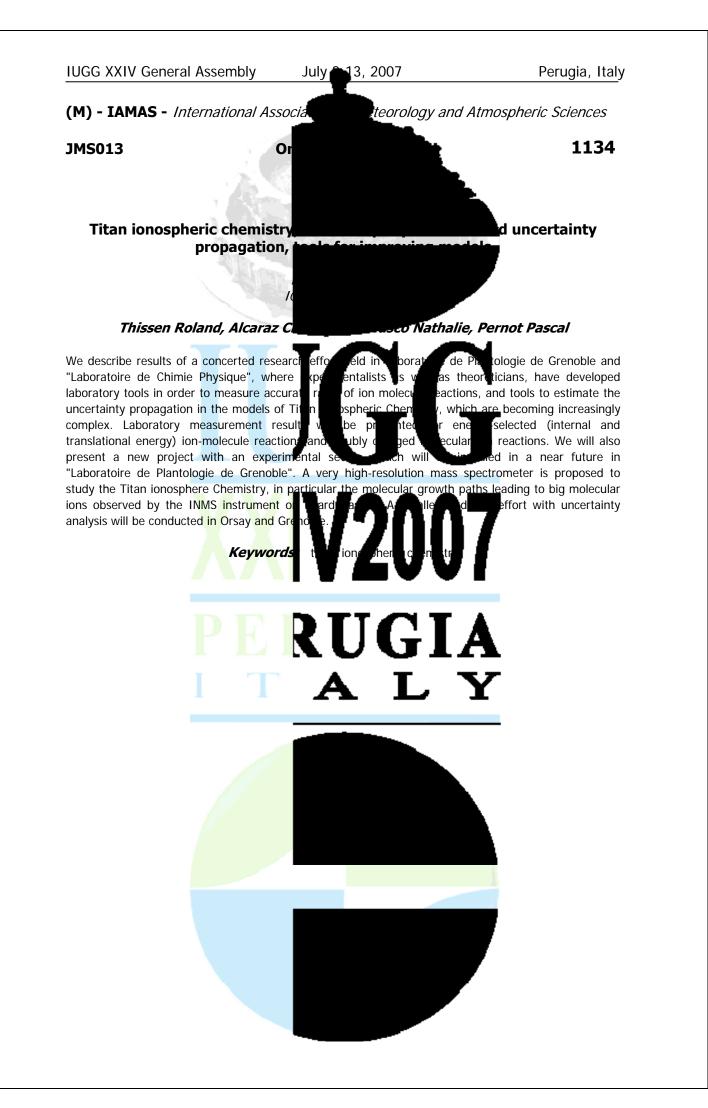
upper atmosphere and comparative atmospheres, with emphasis on the differences to Mars and the outer planets are of thermal evolution" J-P. Bibring : Structure and composition of the r wind and escape processes on nosphar f terrestrial planets" F. anets" Grinspoon: "Coupled ults o e atmospheric sounding rved by VIRTIS/VEX" H.

> enic temperatures" O. ination - an efficient ts" R. Kaiser: "Towards ate constants for neutral ation in the formation of ratory measurements of





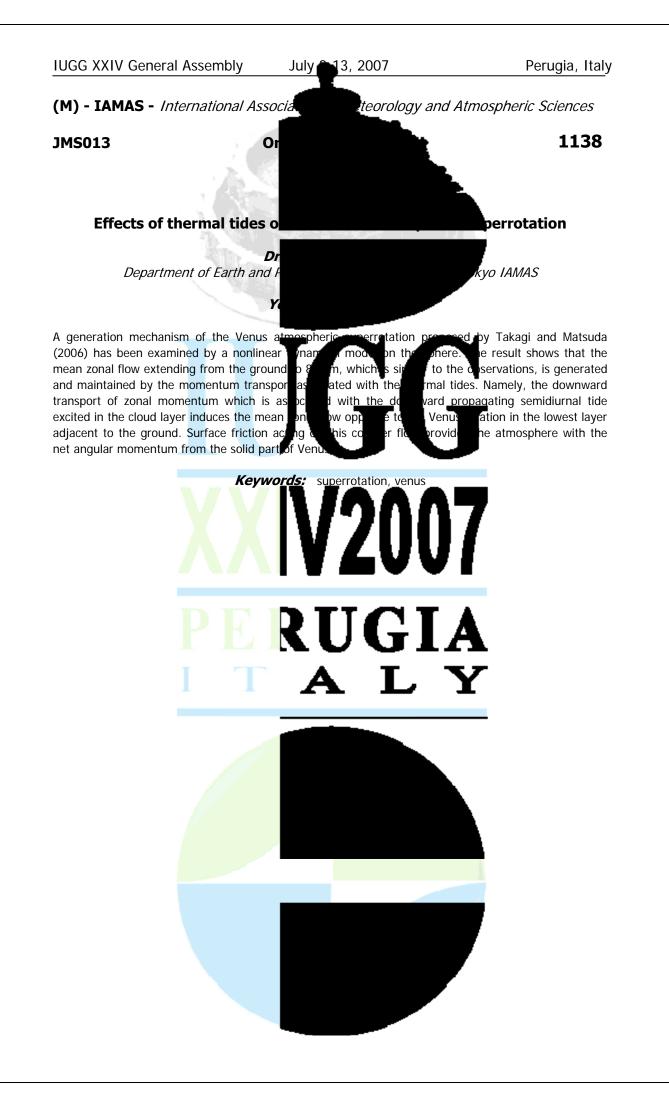


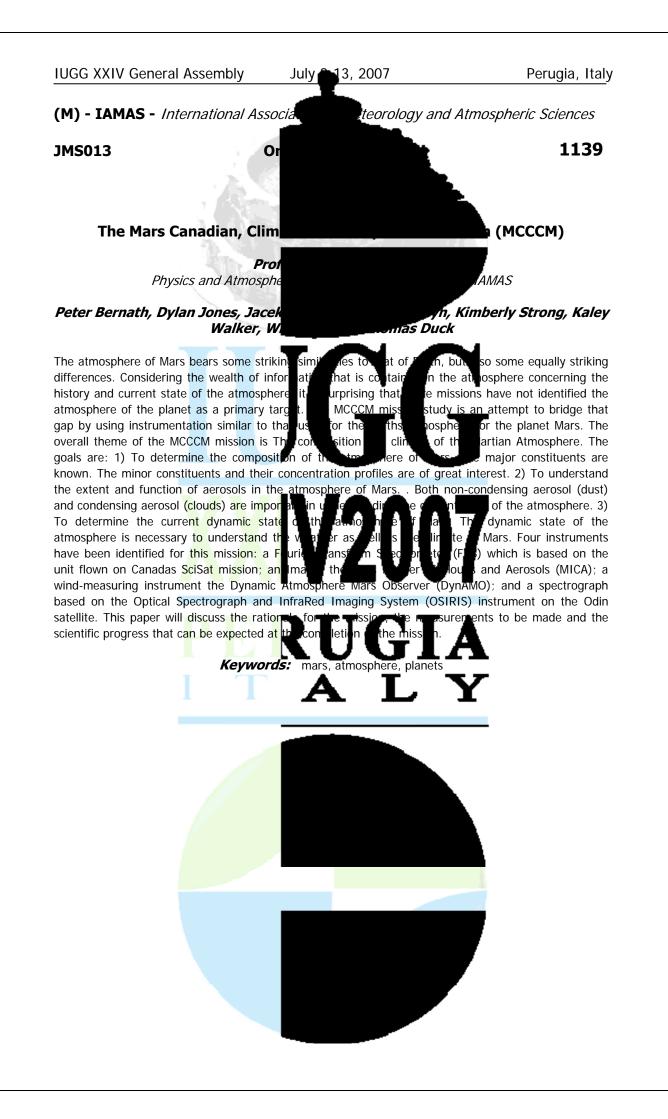


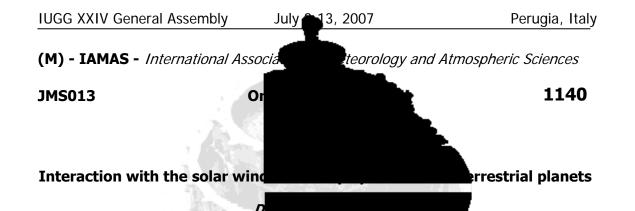






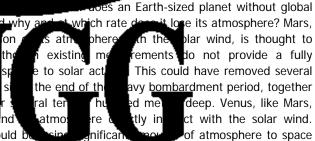






A major question of comparative planetol magnetic field interact with the solar wind and why a due to its small size and the direct interaction undergo significant non-thermal escape, consistent picture of global escape and its tens or hundred of millibars of carbon dioxid with the equivalent of a global layer of wat does not possess a global magnetic field, Although more massive than Mars, Venus could b and as such provide some clues to the potential role of Earths magnetosphere in protecting its

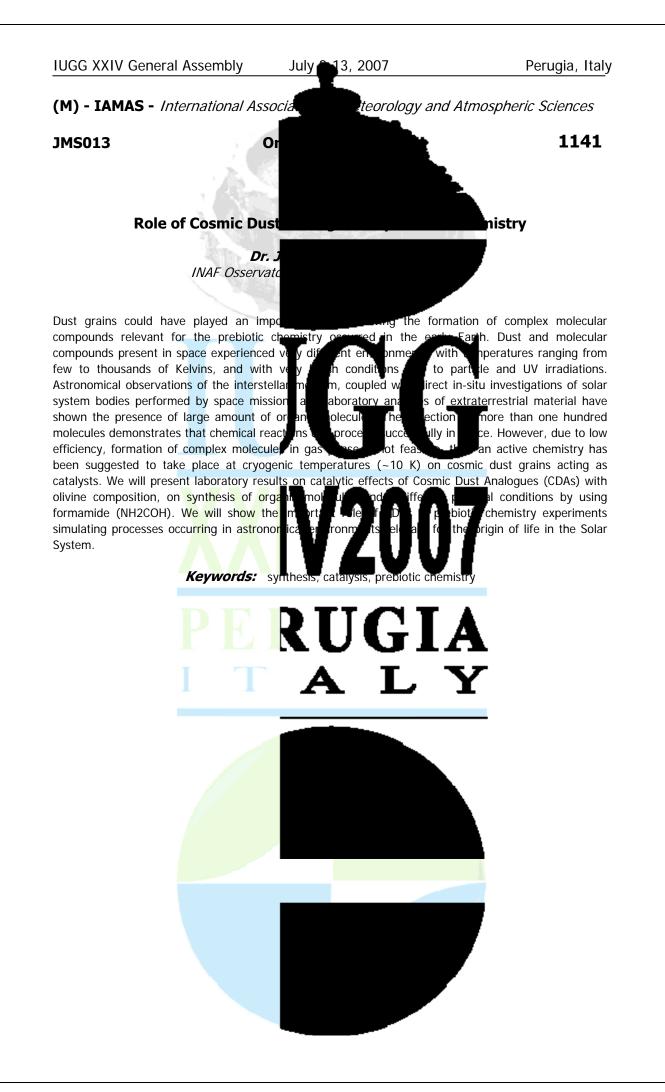
atmosphere and hydrosphere from the solar wind. The answer to the question if significant fractions of Mars and Venus atmospheres were lost to sputtering and thermal escape (as testifie few heavy isotopes, on Venus by the stror of crucial importance for understanding t comparative approach. Direct measuremen in the atmospheres of Mars and Venus will question.

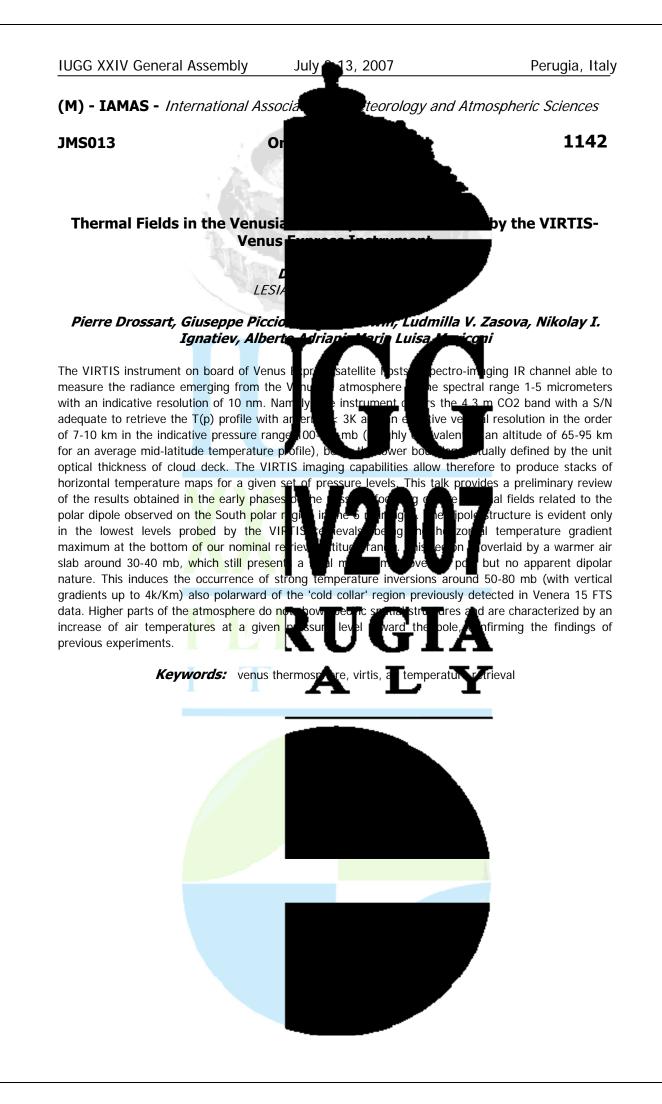


lose its atmosphere? Mars, lar wind, is thought to h the ements do not provide a fully This could have removed several avy bombardment period, together d me deep. Venus, like Mars, tly in ct with the solar wind. of atmosphere to space

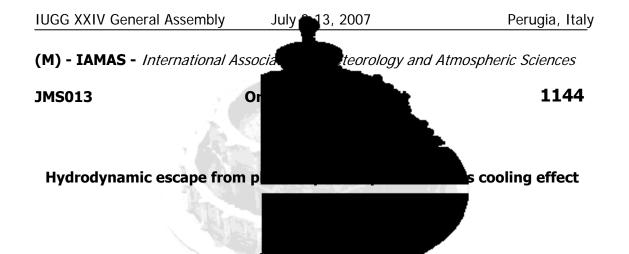
in answeringthe abovementioned key

nd sputtering, later by and enhancement of a pheric water vapour), is terrestrial planets, in a oble gas characterization









Atmospheric escape is one important process atmospheres. During the early stage of plan arys young Sun, thermal escape probably was hydrogen. If the atmosphere is forced to b exobase temperature of early CO2-domina over10,000 K (Kulikov et al. 2006). Such planetary atmosphere to be in a "blow-off" atmosphere may not bedescribed accurately by hy

atmosphere understrong stellar EUV radiations could have experienced significant cooling effect associated with thefast escape, which has been demonstrated in previous hydrodynamic escapemodels (Watson et al. 1981, Kasting and Pollack 1 use a newly developed multi-component e from early terrestrial planetary atmosphe effect related to the fast escape, estimate conditions, and compare the upper atmosp Applications of the model to otherplanetary bod

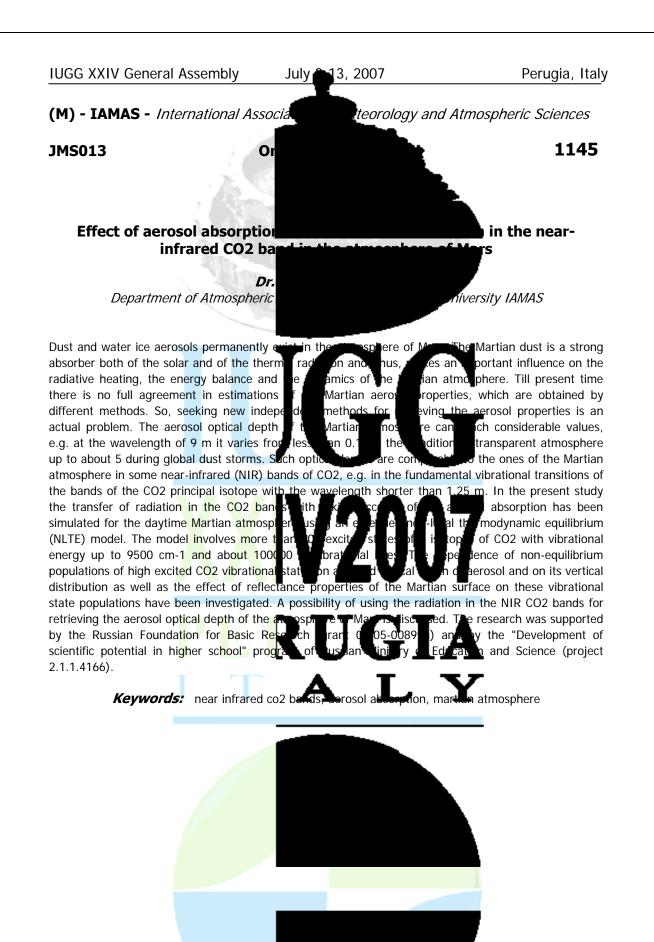
ermine the ation, to hinant es drostaticequili restr<u>ial plan</u>e obase ĥр (trem ast tať quilibr

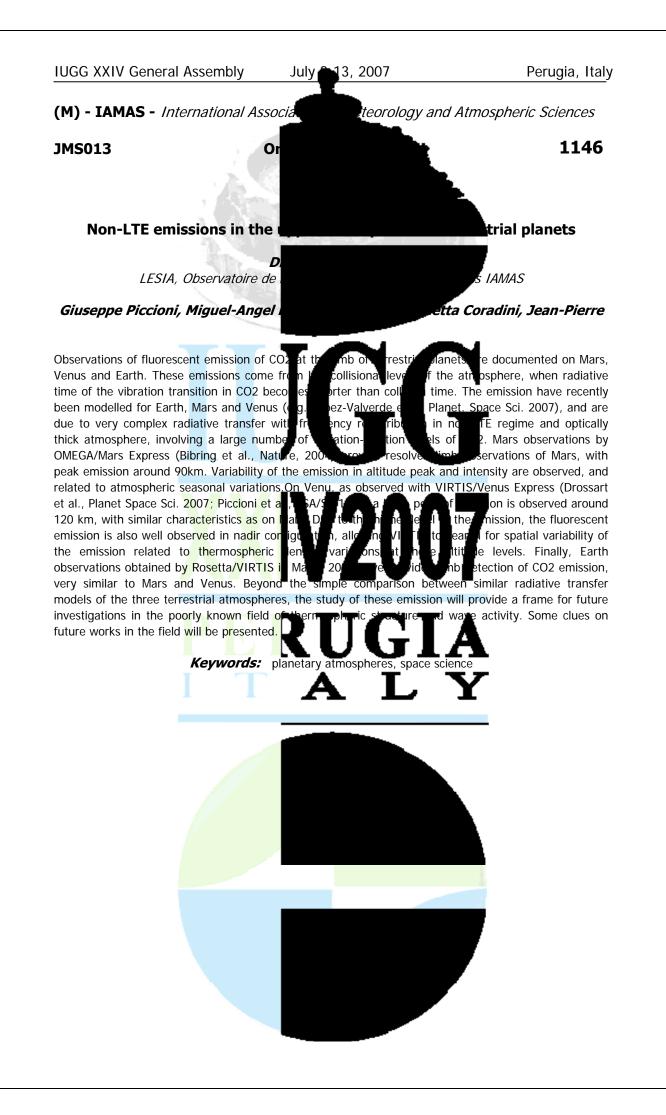
tionarypaths of planetary r EUV energy flux of the arge chanism for lightgases such as n, it has been suggested that the atmosphere could have reached re sho havecaused the upper pe m occur and the planetary lition to this, a planetary

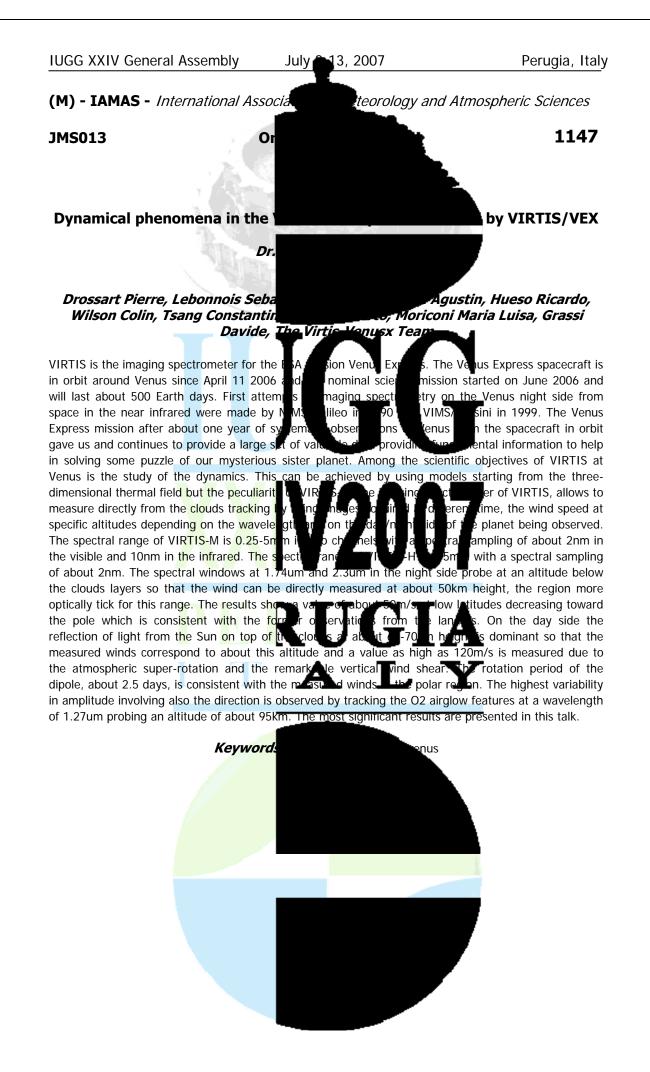
> ). In this paper we will hic escape of hydrogen will discuss the cooling different solar radiation equilibrium assumption.

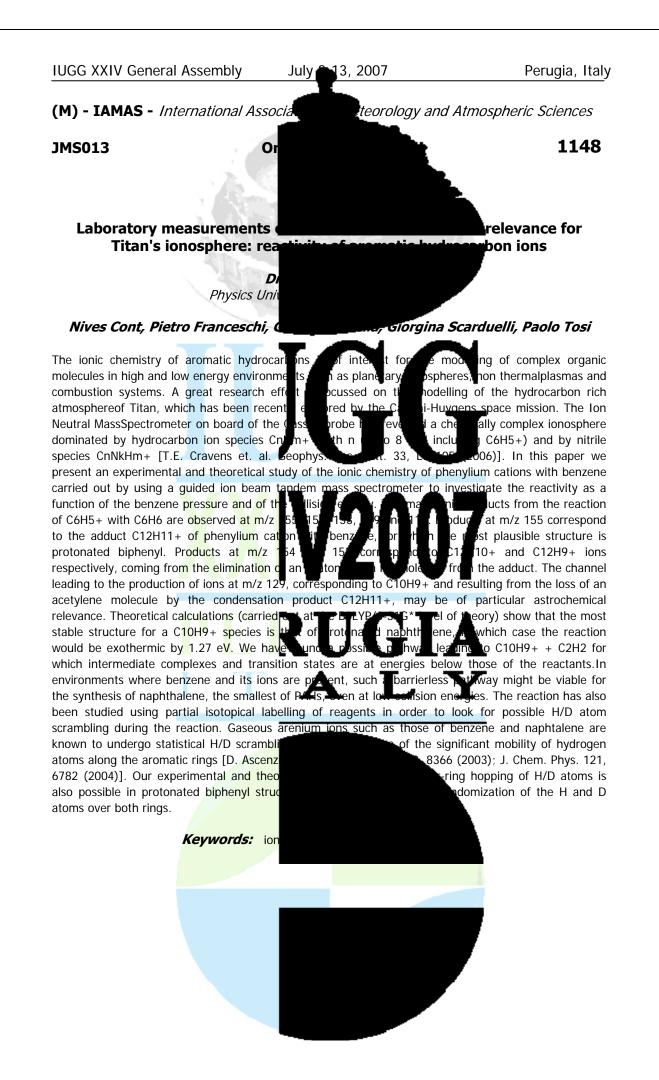


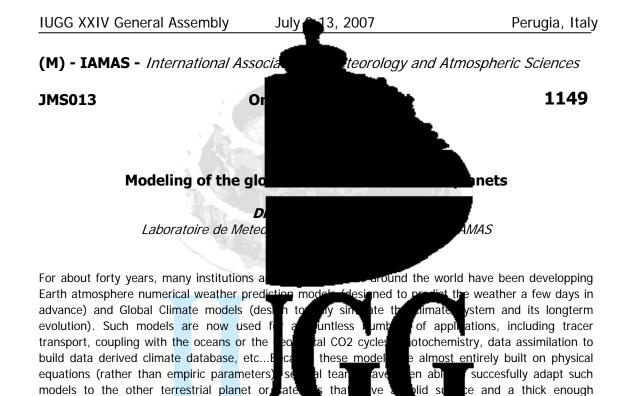
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atmosphere. In our solar system, that includes M pionneer work of Leovy and Mintz (1969) and Pollack et al. (1981,1990), in the past ten years, several teams around the world have developed general circulation model of the martian atmosphere and apply these models to various projects. The first thermal structure and atmospheric circulati active and highly variable, they have be bm observations. Just like on Earth as well,GO ls the dust cycle, CO2 cycle and water cycle. The

of the atmosphere, couple the atmosphere with the thermosphere of the subs-surface, etc... On this basis, GCMs can now be used to predict the climate that could have existed on Mars when the orbital parameters were different ("middle Mars") they are becoming more and more useful to geomorphical and mineralogical observation have been succesfully developped and applied to various scientific topics. Teams from France (LMD/SA in paris) and Germany (Koln) have used such models to pre and explain the observed distribution of chemical the formation of ethane and methane clouds in the atmosphere of Titan. More recently, in the context of the Venus-Express mission, our team at LMD is developping a new General Circulation Model for the atmosphere of Venus (Lebonnois et al. combining a3D fluid dynamics solver w atmosphere and, in term, the microphysic one could mention Triton. Triton's atmos primitiveequation of meteorology used in LMD to interpret the observations (plume during its flyby of Neptune in 1989. Using that are so different is highly instructive atmospheres.

the prediction of the atmosphere is also verv pret the meteorological e model able to simulate study the photochemistry

the enigmatic martian

I body on which GCMs

("ear Mars"). For this purpose,

ct the general inculation and transport the structure of the organic hazes and

On Mars, following the

the first true Global Climate model the radiative transferthrough the osphere photochemistry. Last, that is enough to apply the model was developped at gathered by Voyager 2 simulate climate system arative view of these

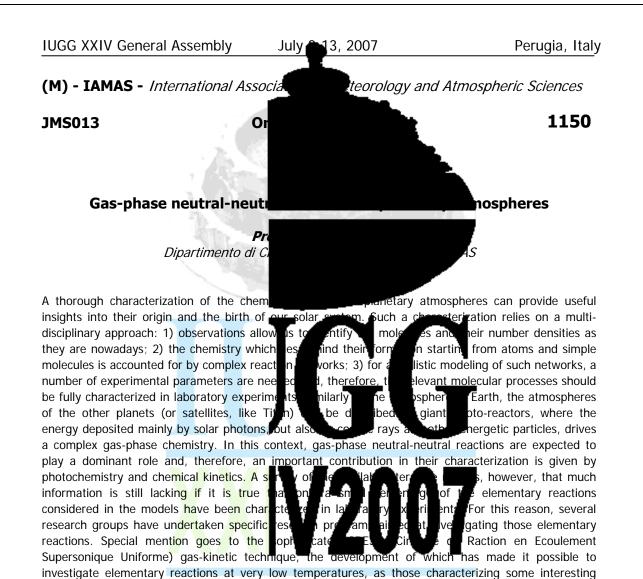
Keywords: atmosphere, modeling, planets

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to include the correct product branching ratios for each reaction considered in the models. To address

this issue, a complementary and powerful appr ch is the c with mass spectrometric (MS) detection. This te an e, widel to address fundamental aspects of reactive processes, has more recently been extended to the study of the elementary reactions of interest in the chemistry of planetary atmospheres. In all cases investigated it has been possible to characterize (a) the with respect to the expected results (b) t microscopic reaction mechanisms and (d) the destiny of the reaction products. The models will be illustrated and possible exte

Keywords: planetary atmosp

atmospheres like that of Titan. Reaction

but, more rarely, are able to determine the

since the products of one reaction are going

mpeting reaction channels, (c) the g, which can strongly influence tions and their effect in the

v reaction products, with some surprise

ith the reaction rate constants,

anching ratios. However,

one, it is quite relevant

lar beam (CMB) technique mical physics community

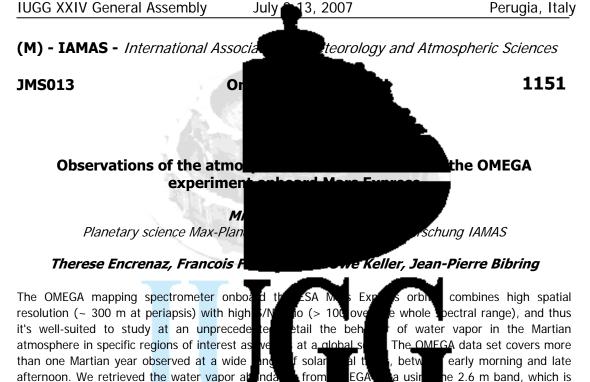
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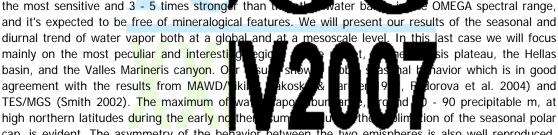
d in the c

nase reactions



the most sensitive and 3 - 5 times stronger than and it's expected to be free of mineralogical features. We will present our results of the seasonal and

mainly on the most peculiar and interesti basin, and the Valles Marineris canyon. O agreement with the results from MAWD/ TES/MGS (Smith 2002). The maximum of high northern latitudes during the early no the cap, is evident. The asymmetry of the behavior between the two emispheres is also well reproduced.



ne 2.6 m band, which is OMEGA spectral range,

sis plateau, the Hellas havior which is in good orova et al. 2004) and - 90 precipitable m, at tion of the seasonal polar The detailed retrieval over interesting regions of Mars' surface marks instead the importance of local

sis volcanoes is peculiarly

raphy of the region.

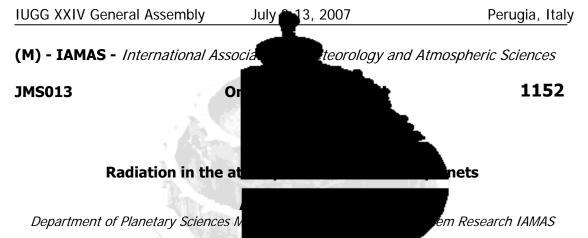
explained only if we take

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phenomena for the water cycle. For instan enriched in water vapor, compared to their into account the influence of the local circula

> Keywords: atmosph



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## Fredric W. Taylor, David

Radiation plays an important role in varie structure, controls photochemistry, forces information about the planetary atmosph sensing.Observations, numerical modeling important role that radiation plays in various large opacity of the atmosphere and the aerosols give Venus its unique place amo clearly been very effective in forming the curre

distribution of the radiative energy sinks and sources drives the remarkable super-rotation of the entire atmosphere. Chemical interactions between different gaseous and aerosol species and the importance of non-linear feedbacks make the Venus radiation in the Venus atmosphere provi sources and sinks of radiative energy, an climate. At the same time they left a great open issues in this field is the variability of htm active gases, cloud microphysical and optical properties and total opacity, and the influence of these on the energy balance. The second problem concerns the radiative forcing of the atmospheric global circulation. How does the distribution of the dynamics? The thermodynamics of the Vehi

quantified. New studies of the fluxes and nala processes and efficiency of the Venus heat engine will help us to understand the Venus climate-forming mechanisms. The forth open question concerns he role of atmosphere, the early greenhouse effect and the apof water perturbations during global resurfacing. Resolving these open issues in Venus physics would result in significant progress in comparative planetology and climatology of the terrestrial planets in general and in the study of the Earths climate evolution knowledge about the radiation field in the

dynamics, current climate and its evoluti planets.

Keywords

Nilton O. Renno

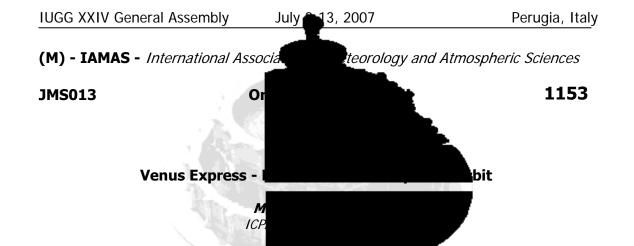
t determines temperature also the main carrier of tion s being widely used in remote have all revealed the extremely h now and early in its history. The ts of tively active gases and The nhouse mechanism has hus, while the peculiar

> ious investigations of distribution of fluxes. hospheric dynamics and e of the most important abundance of radiatively

ve energy drive the atmospheric issue eding to be clarified and the role of dissipative and entr <u>bb</u> adiation in the evolution of the Venus the plane as well as recent climate per will give an overview of our current

the radiation on the atmospheric

radiative effects on terrestrial



After a launch from the Baikonur cosmodr the Venus Express spacecraft reached Venus on operational, 24 hour polar orbit on 5 May sent back a wealth of new and exiting info carry out a comprehensive study of the interaction with the solar wind, and to st h١ optimised payload composed of two multi ch wide angle camera, a multi-sensor energet experiment, allows all elements of the objectives

November 2005 and afive-month cruise, April 2006. 606. first ing t The objective h۲ here of Ven tain <u>aspects</u> pectro R-Vis instr nt, pa

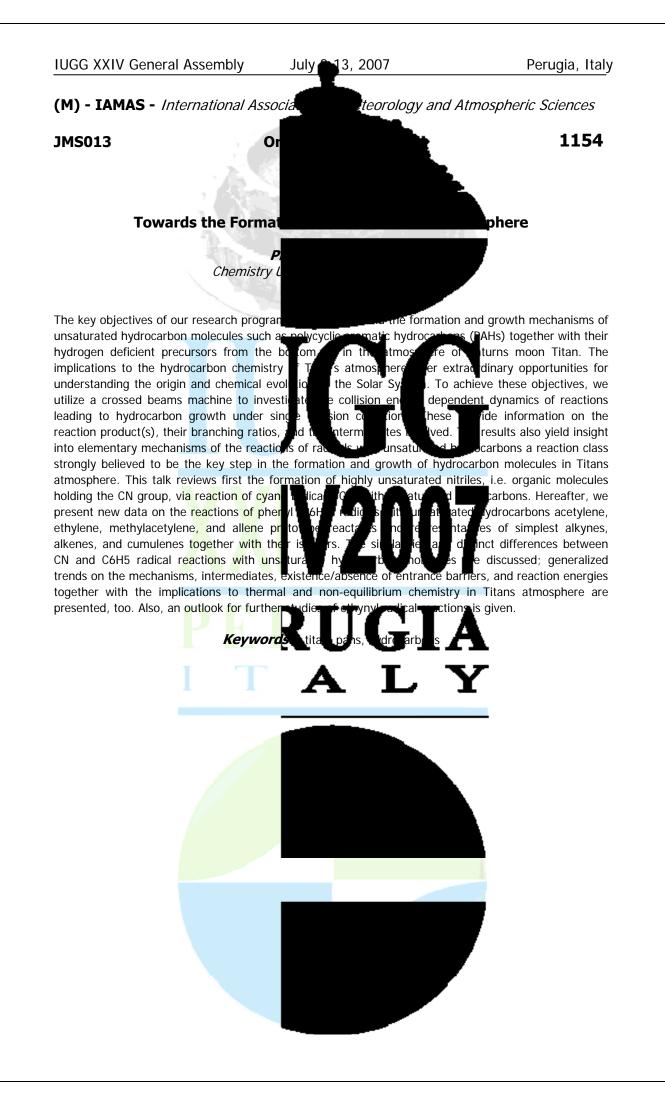
agecraft reached its final ation the spacecraft has 'in o the Verus Express mission is to the plasma environment and its he surface of the planet. A well maging spectrometer, a agnet ter, and a radio science nt depth. Venus Express

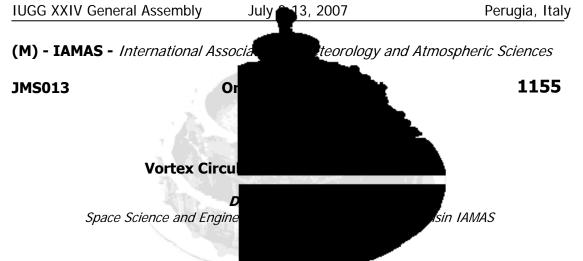
has been developed in record time, less than four years, using an efficient concept of re-using elements of recently developed spacecraft, mainly Mars Express and Rosetta. The first data has shown a highly dynamic atmosphere, including close-ups interest and among the top priority objed minor species at various depths of the atr Express is the first mission fully exploit hg atmosphere in three dimensions. The data ta extraordinary quality and has already led to new insignts in several fields. This talk will summarize the

indeed topics of high lers are finding several hction of altitude. Venus in order to map the ring the first year is of

the major findings and report on the status of the spacecraft and the plans for the future activities.







Vortex organization of the Venus atmosph acquired in 1974. This organization was subseque obtained during 1978 1983. Venus Expres circulation on Venus (south hemisphere) fr (day side) and shown that the vortex externation between the circulation of a hurricane or a Venus discussed by Suomi and Limaye (Sci existence of whorls in the core region as physical scale. Whorls or swirls seen with many (Kossin, J.P., B.D. McNoldy, and W. H. Schubert, Month. Wea. Rev., 130, 3144-3149, 2002) and it is

possible that the same may be true on Venus in the core region of the hemispheric vortices. The life times of tropical storms on Earth are typi observed over more than three decades. I long term stability of this circulation and th related to the processes that maintain the atmospheric environment on Venus.

a from Mariner 10 ultraviolet image data from P eer miş has *N* pr VIRTIS (Tight p below the cyclo<u>ne and</u> t ol. 20 011, pite ell ast clone

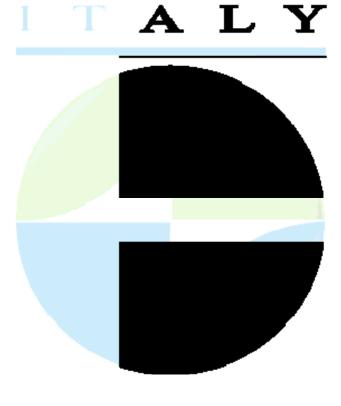
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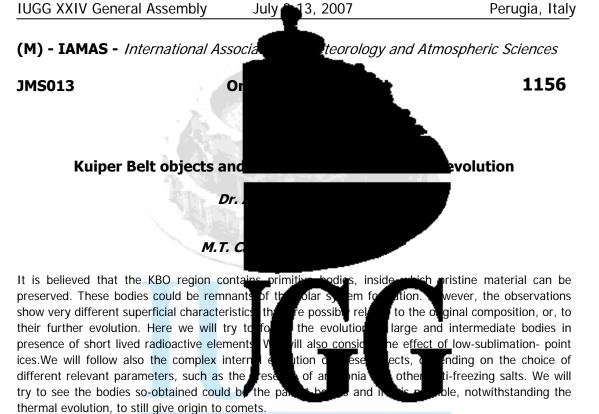
prder

Menus ultraviolet images ith views of the vortex and the day side) and the VMC violet clouds. To these similarities of th<u>e two h</u>emispheric vortices on ), we can now add the magnitude difference in to dynamical instability

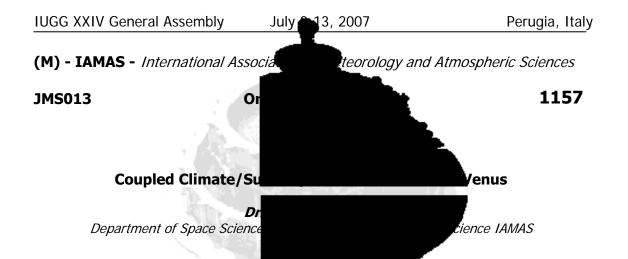
> Venus has now been Venus atmosphere. The or is subject to may be physical properties of the

Keywords: venus, vortex, circulation









Venus is commonly thought to have expe Earth-like past to its current highly desiccated state. revealed by the sparse, randomly distribute rapid decrease in resurfacing rate between 1993; McKinnon et al, 1997). The accomp caused large climate changes (Bullock deformation (Solomon et al, 1999). We are part of a single planetary transformatio photodissociation and H escape would hav

plate behavior, as the shut-off of subducting hydrated sediments led to the desiccation of the mantle and consequent loss of an asthenosphere. <u>Current estimates of the timescale for water loss are highly</u> unconstrained, with error estimates larger in wet, hot atmospheres in an effort to be water loss. If clouds stabilized the moist years, rather than the canonical (but unco have initiated changes in global convectiv features. This might mean that Venus was a ( history.

ting 1988). and stine fively 1000 M 00 a precipitous d inspo<u>on,</u> 200 ng the sik oss tmd event a trañ

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, early in its history, from a wet, more recent global transition is lation, which indicates a Schaber 🖣 al, 1992; Bullock et al, e in outgassing rate would have and <u>globally</u> synchronous plains two transitions may be through evaporation, plate tectonics to single

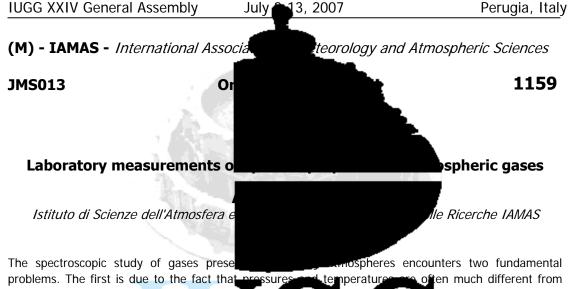
> ve are modeling clouds ance and timescale for sisted for several billion the loss of water could rrently observed surface habitable planet for most of its



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problems. The first is due to the fact that pressu those on earth and sometimes difficult to or ain it the main interest is focused on the so-called itm of the main constituents combined with lor a paths of 200-300 meters can be achieved by us Transform Spectrometers. Effective paths of se technique, which is based on optical cavities equi band lasers. Here a survey is presented of experim on Venus and Titan.

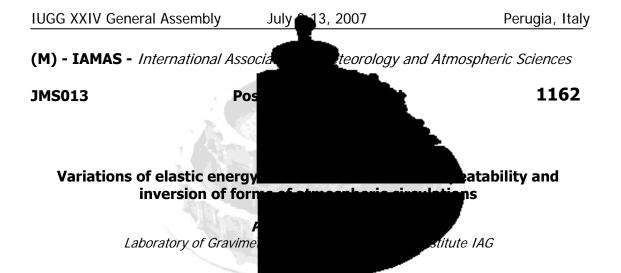
ssures and temperature in incoorate experiheric win ows rption paths. multipass set I km c in e d the d with h rerim shall we on the

recurse often much different from ents. The second problem is that lich implies very weak absorptions laboratory experiment absorption often in combination with Fourier ned by long the cavity ring down tance whors coupled with narrow list incortant atmospheric gases









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The correlations of variations of elastic en latitudinal and longitudinal atmospheric circulation for which in the bottom and average tropo zonal stream with waves of small amplitud high-altitude crest is located above the ea hollow is above East European plain; E is Atlantic and Western Siberia the deep hollo a high crest. Cyclic regular changes and change

repeatability) are observed. So during last hundred years repeatability such as circulation of C type changed approximately with rhythm in 30 years. The frequency of occurrence of types of circulation W decreased, and for forms E the frequency place - the repeatability of events W has in long-periodic and decade variations and in At increasing of repeatability of form E repeatability of form C. And peak value of approximately for the same dates. A similar inversion is observed and for the third type of circulation W

with the E type. The basic phenomenon which here is discussed, is a correlation of dates of peak values of variations of repeatability of types of cire of elastic energy of the Earth luni-solar tide calculated under analytical formulas at the s and the Sun. On the other hand due to the differential gravitational action of the Moon and the Sun on the Earth shells the core tests small oscillations elatively to elastic many perturbated directly by mentioned celestial bodies cyclically displaced superfluous mass of the core. The atmosphere and its behaviour are rather sensitive

between northern and southern hemispher periods. In the future interannual and hemispheres of the Earth will be observed 18.6 (in years) etc. Thus, the atmospl influences of the Moon and the Sun both (first of all on the core and the mantle). S atmospheric tides of an inversion type, an masses in the certain rhythms and at th

with cyclic changes of circulation of zonal type W is ropean sector the western quasin type of circulation at which the estern Europe and a high-altitude on at which above East n circl East opean plain is observed spheric circulation (their

> he situation has taken d (Evseeva, 2002). The d C types are observed. ly in the same rate of f circulation have place

The elastic energy was

al motions of the Moon

Thus the atmosphere is

uences from the party of

value of envelope of the curve

to displacements of the core. For example, it is observed rhythmical change of atmospheric masses ennual period, but also with the monthly pheric masses between opposite tions are 2.1, 3.6, 4.5, 6, 9.3, connected to gravitational other shells of the Earth re and the mantle cause udinal redistributions of ferences Barkin, Yu.V.,

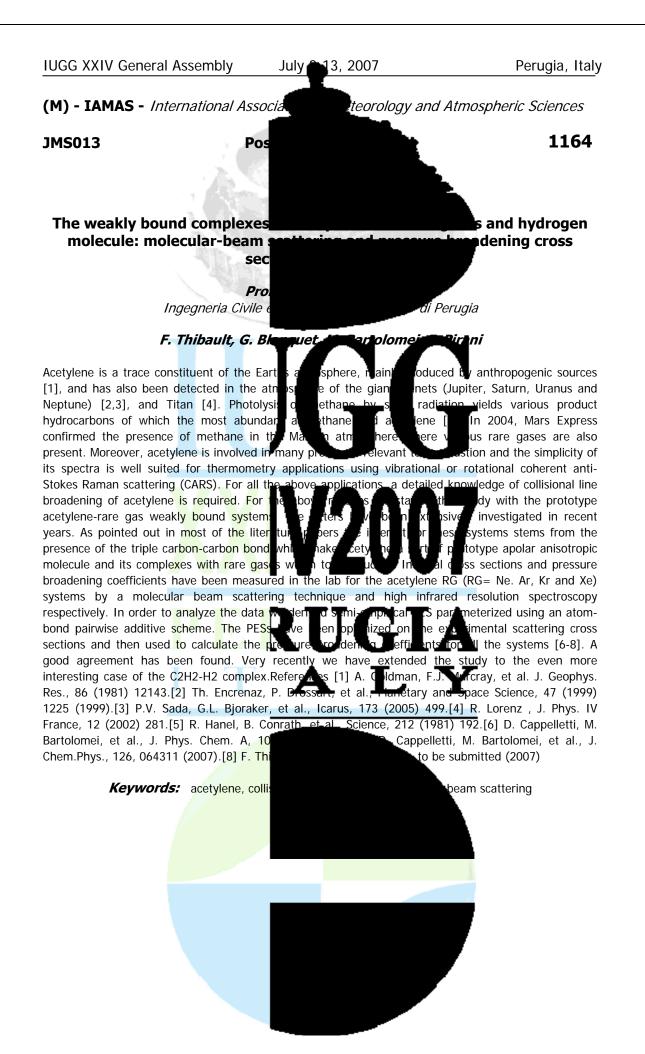
Ferrandiz, J.M. (2004) Tidal elastic energy in planetary systems and its dynamic role. Astronomical and Astrophysical Transactions, v. 23, Issue 4 (August 2004), pp. 369-384. Barkin, Yu.V. (2002) Explanation of endogenous activity of planets and satellites and its cyclicity. Izvestia cekzii nauk o Zemle. Rus. Acad.

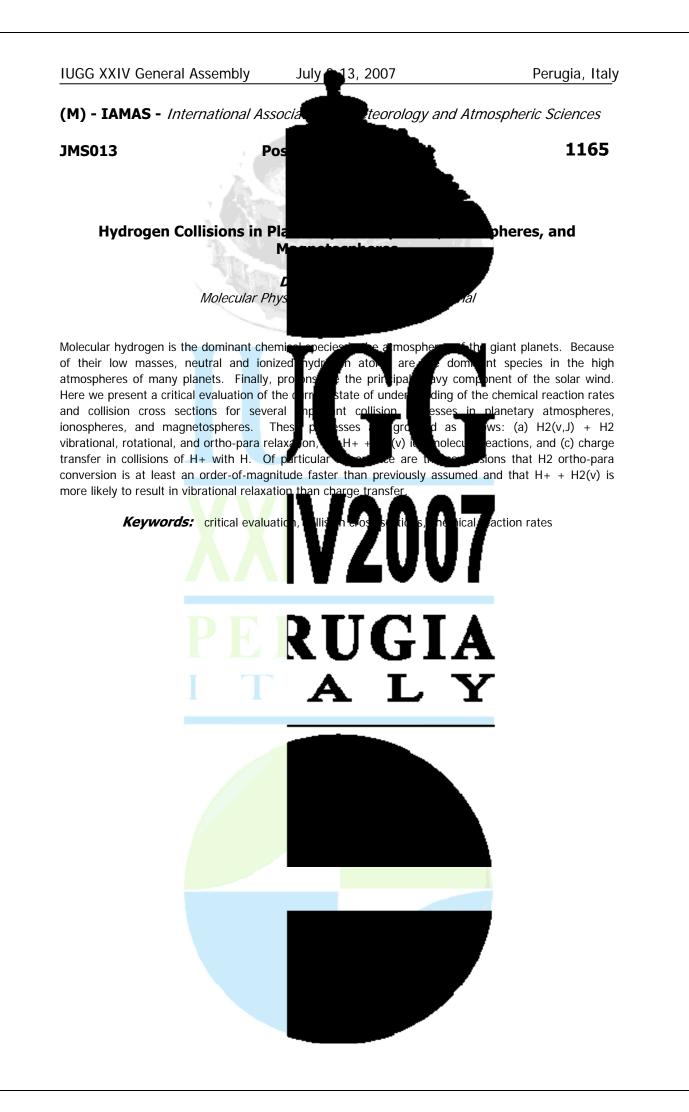
of Nat. Sciences, Issue 9, December 200 climate outside of tropical latitudes. In the two volumes (Eds. N.S.Kasimov, R.K.Klige (2002) Long-term variations of circulation anthropogenous and social processes. T.3.

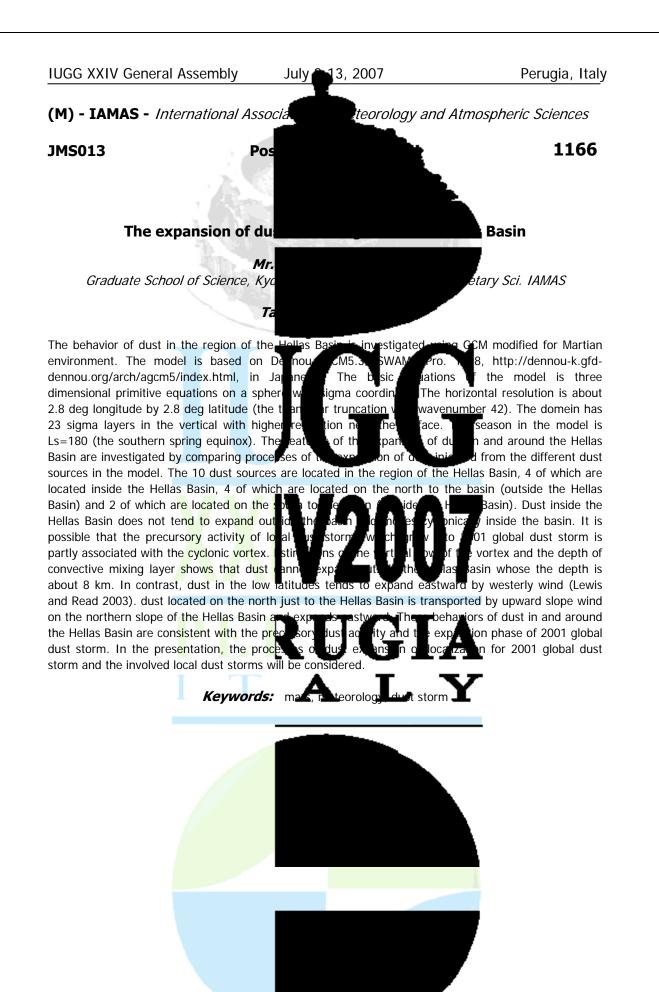
(2006) Changes of a natural environment. In 5. 175-184. Evseeva L.S. ooral variations of natural,

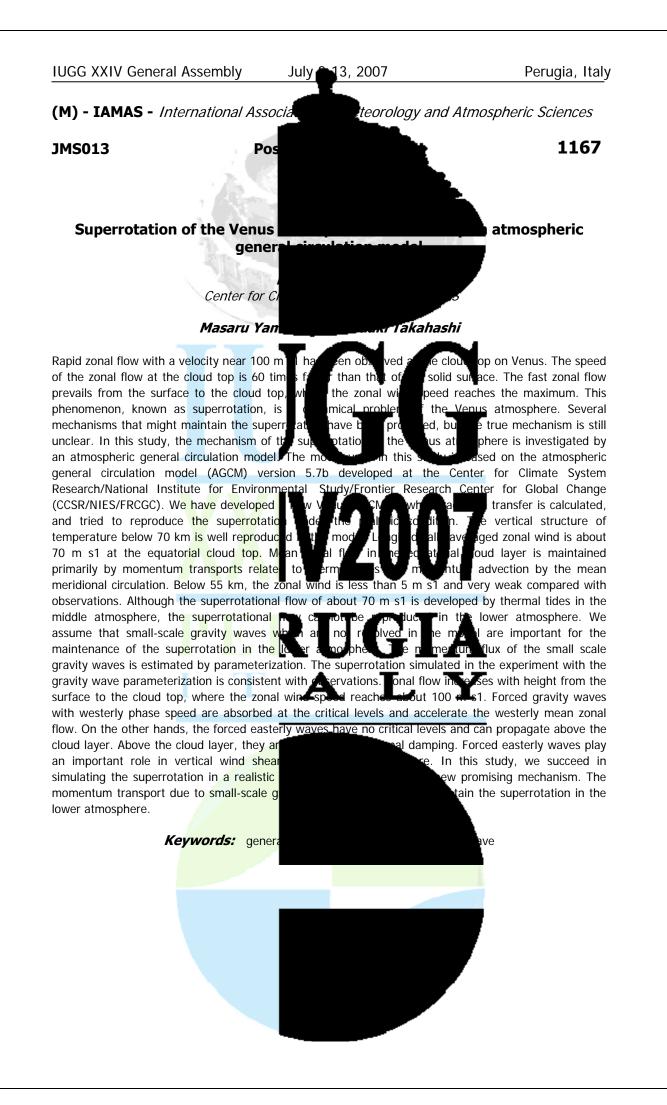


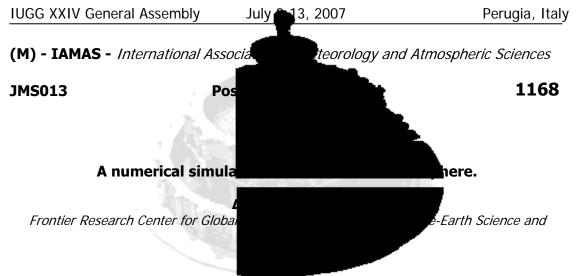












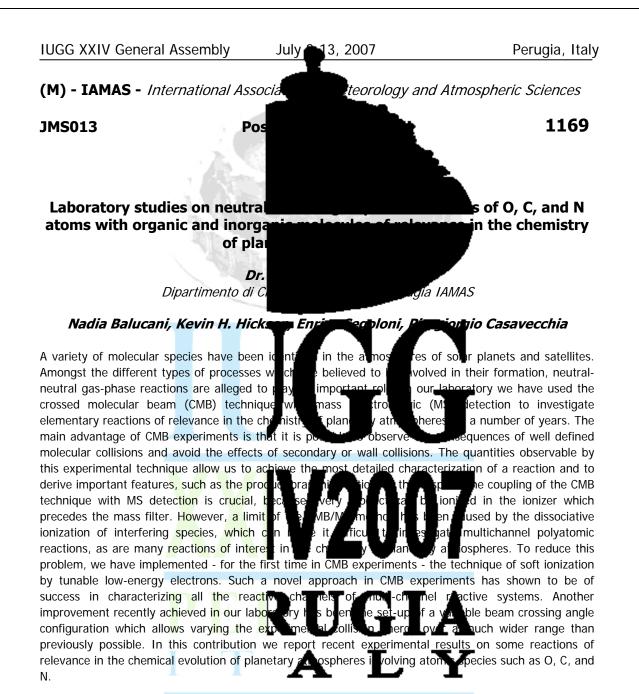
Superrotation of Venus atmosphere is mysterious ph than ground ). Many theories about its ge erati observations and simulations are not enough (atmospheric general circulation models)ha them are not successful to generate su superrotation in lower Venus atmosphere 0<z<40km) with simple grey-atmosphere strength is generated in lower levels by the me shown at the meeting.

a (i.e. cl ien mech m h support hem to simulate ion <u>in lowe</u>r lated а For еc posed

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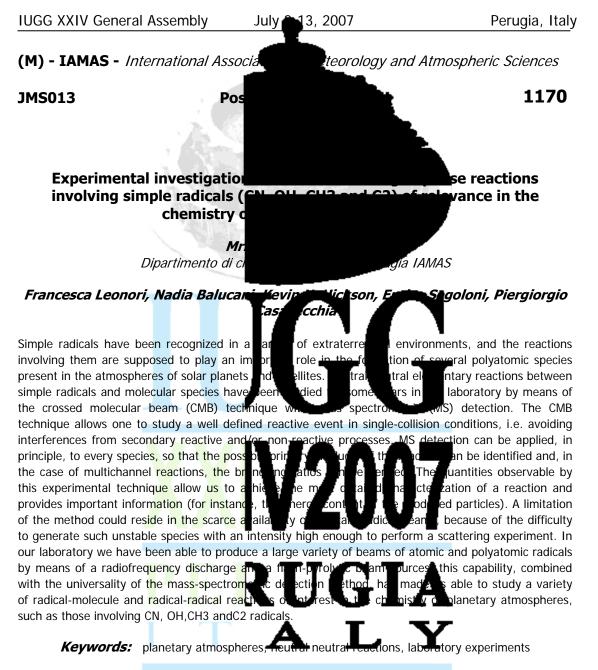
ye rotates 60 times faster posed in the past, but been ecently, hany Venus-like AGCMs is atmosphere. However, most of nosp<u>here. In</u> the present study, ple dy lical core AGCM (T21, ion, rrotation with sufficient h(1975). Details will be

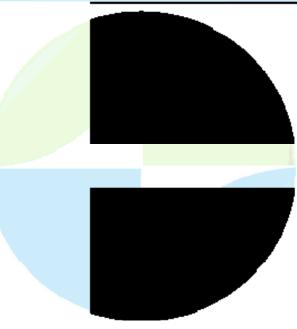




Keywords: planetary atmospheres\_neutral neutral reactions, laboratory studies







## IUGG XXIV General Assembly July 3, 2007

Perugia, Italy

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## JMS014

Symposium Ocean-Atmosphere Coupling

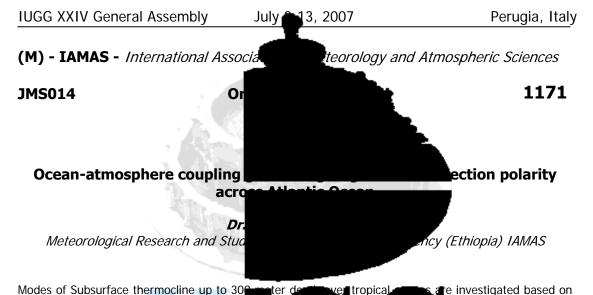
**Convener :** Dr. David Woolf **Co-Convener :** Dr. De-Zheng Sun

The ocean and atmosphere are coupled biogeochemical species. This symposium atmosphere and ocean, in particular, the o coupled atmosphere-ocean system at latitu teorology and Atmospheric Sciences

## 1171 - 1201

mass, momentum, and feedbacks that couple the biogeochemical cycling of the to the poles





Modes of Subsurface thermocline up to 30 1950-1999 on monthly timescale using sind lar unravels a giant dipole in the equatorial Parfiq generates a polarity in velocity potential in Atlantic Ocean over the terrestrial body. The of action for east-west circulation Pacific procedure, modes of variability equatorial positive single mode east of 300W with maximum

equator globally from surface -100-hPa. The correlation pattern replicates the zonal circulations entail Pacific Walker and Atlantic Zonal Circulati Ocean from surface 300-meter depth is st that subsurface produces spatial structure deep understanding of subsurface variabili long-lead prediction of resources (climate, lay the future avenue of ocean-atmosphere coupling understanding.

ean unde hea pper atmosph es o<u>ver tron</u>i and nti bsur ten ant boast d depth. The temporal mode is interplayed with zonal wind during boreal summer averaged over the

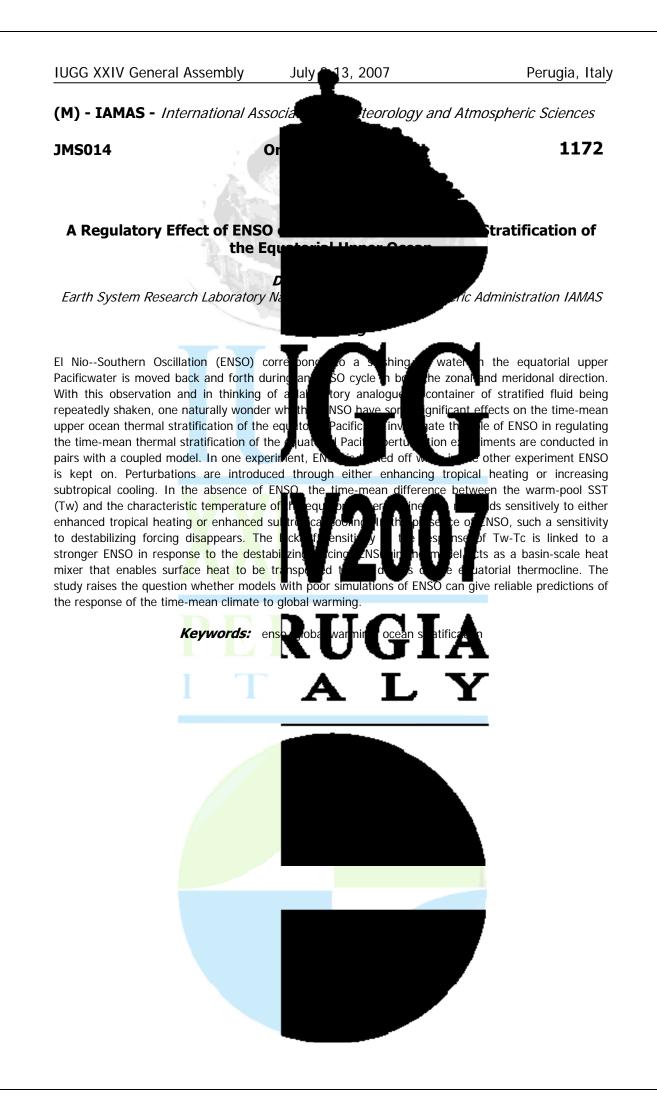
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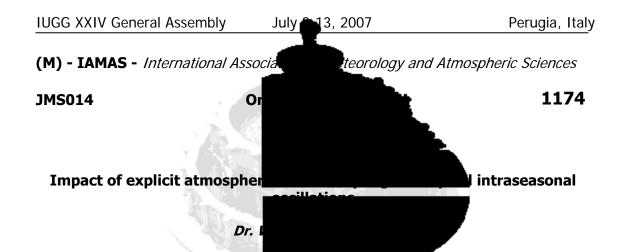
e investigated based on he leading spatial mode (SVD his equatorial Pacific global wave and convection on either side of frica and South America are center nal C ations. Following same ature analysis. SVD unravel a ica within 0-100 meters

> e of equatorial Indian poral mode, it is found ENSO. Harnessing the coupling knowledge and likes). This research will









Tropical intraseasonal oscillations concern several days and a few months and are th Their best known example is the Madden-Ju convection, large-scale circulation, and seathe tropical warm pool (eastern Indian and is poorly represented in climate models and ocean phenomenon, where the atmospher variability. This conjecture is supported by simulating

enhanced intraseasonal variability is observed when atmospheric model is coupled to the interactive ocean model. This talk will show that this conclusion does not hold when the same problem is investigated in idealized aquaplanet simul mixed-layer ocean model. In these simul atmospheric forcing, with, if anything, the explanation of these conflicting views, atmosphere and the negative convection-S

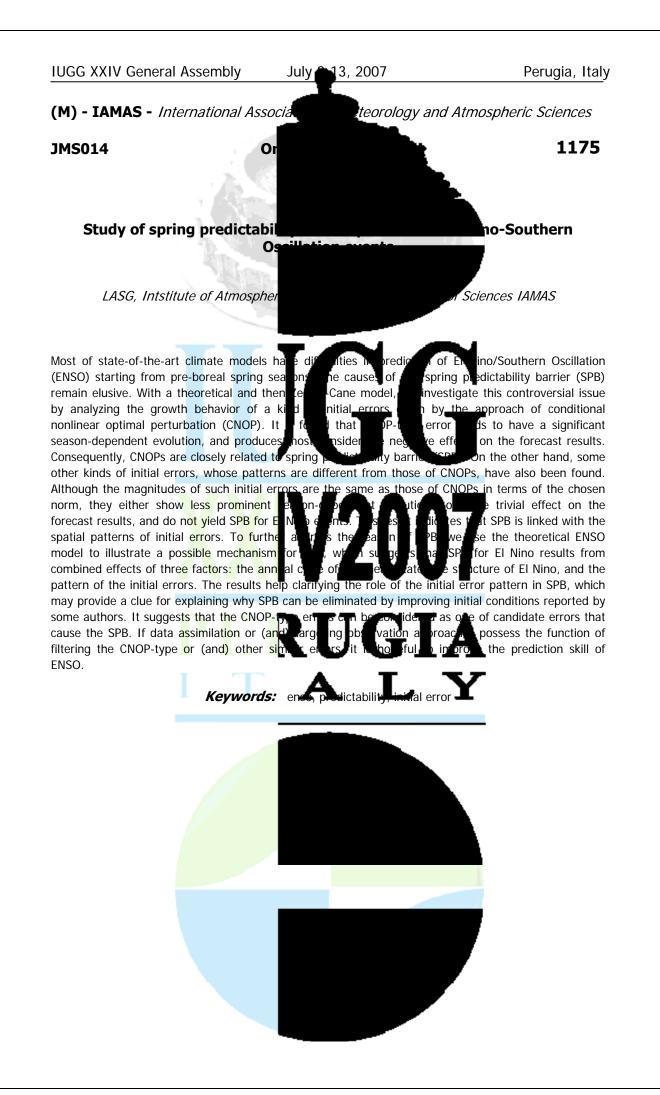
<u>iabili</u>ti ne tropical str of a st m cillation (110) lar temperature Pacific Ocea been s and oce vorl raditioi

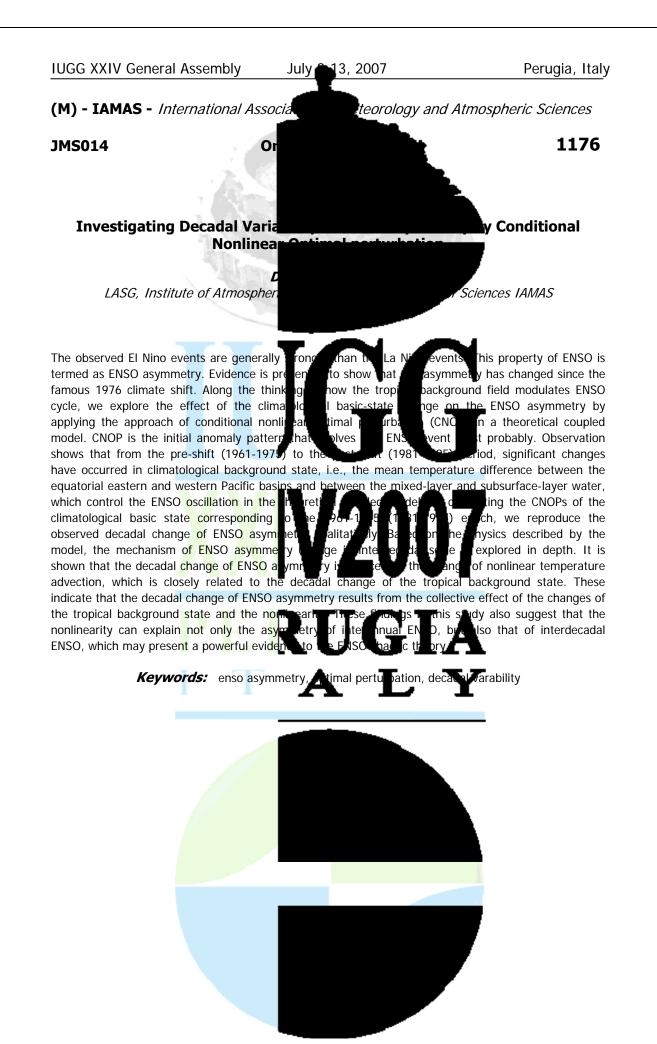
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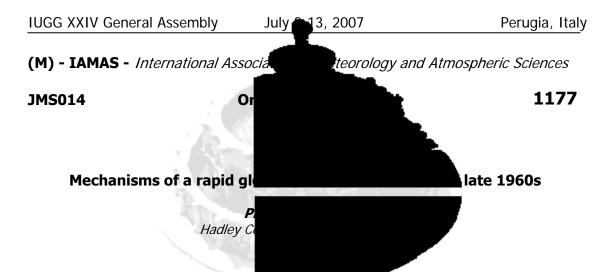
on time scales between ariability in the tropics. spher hich is a oherent pattern of deep propagates toward the east across vith <u>a typical</u> speed of 5 m/s. MJO nat MJ a coupled atmospherel-in-h to create the observed models where, typically,

> n coupled to a simple rely responding to the on the atmosphere. An vection feedback in the cussed.









A number of important characteristics of the global near monotonic fashion over the decade, or or commonest in tropical regions, the Sou ler, Hemisphere. Some, such as the decrease in to be new, but their combined extent is glo list of affected variables includes patterns of Amazon basin and North East Brazil, press Juthern Central Pacific; various branches of the s

Hemisphere storm track. These changes are often strongest in June-August; changes are also seen in December-February, but are generally sm affected strongly, reflecting similar change North Atlantic. Possible causes for these co northward oceanic heat flux associated wi n t 1970s which was nearly in phase with a r pid 1950s and 1960s, particularly over Europe and No

eric circ spl e lat SS. fed o emispher an in the African dynamical lin ropica ifa ST in tro ulatio

and climate changed in a se changes were largest e Atlantic sector of the Northern el, are well known. Others appear es between them are evident. The Sahel and Soudan, the antic and the West and southern subtropical jet

stream; the summer North Atlantic Oscillation; south Greenland temperature and the Southern

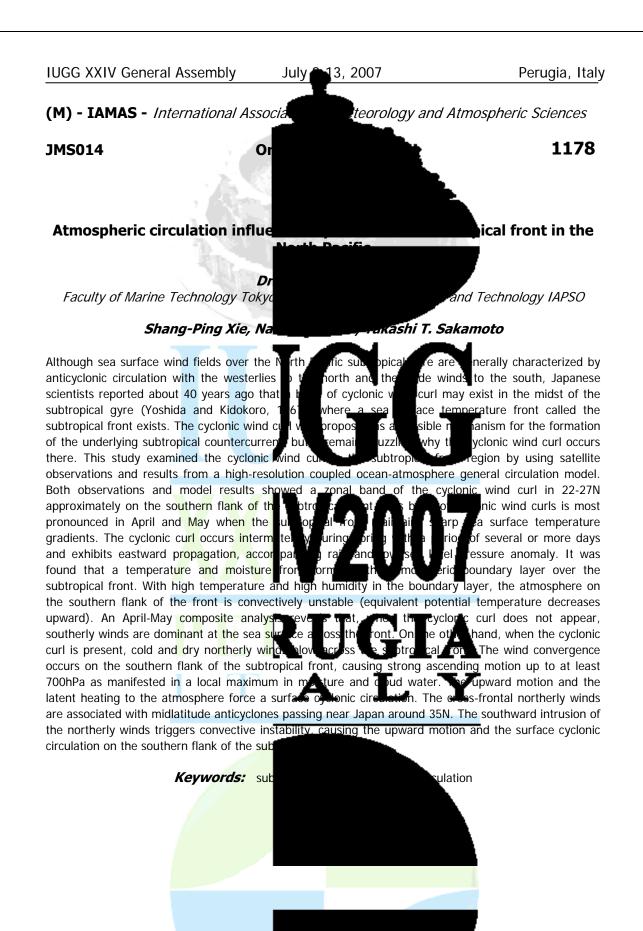
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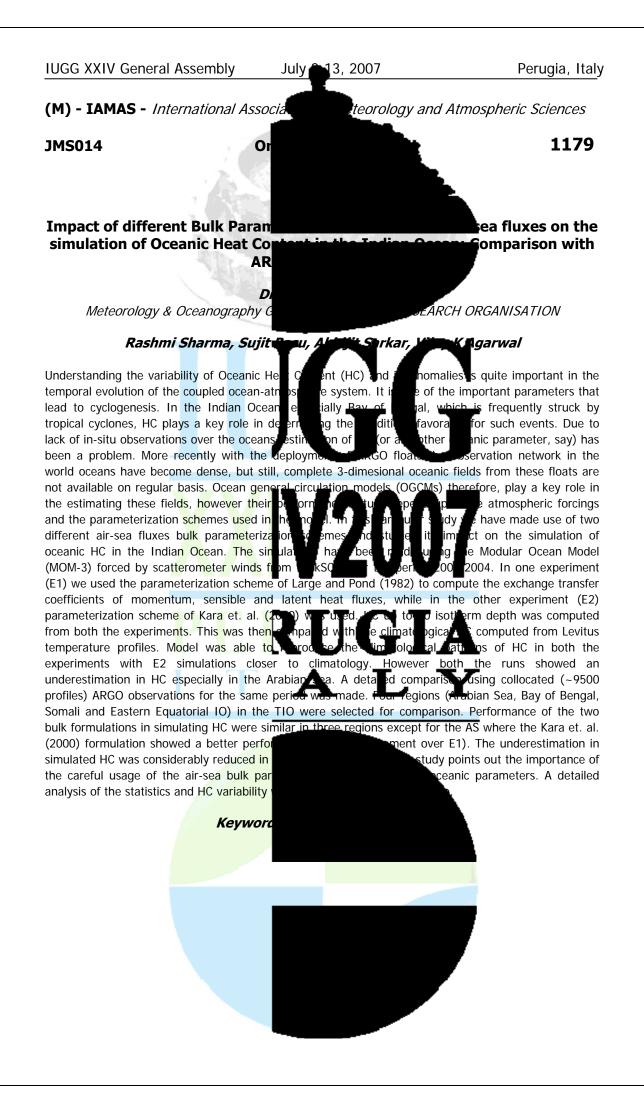
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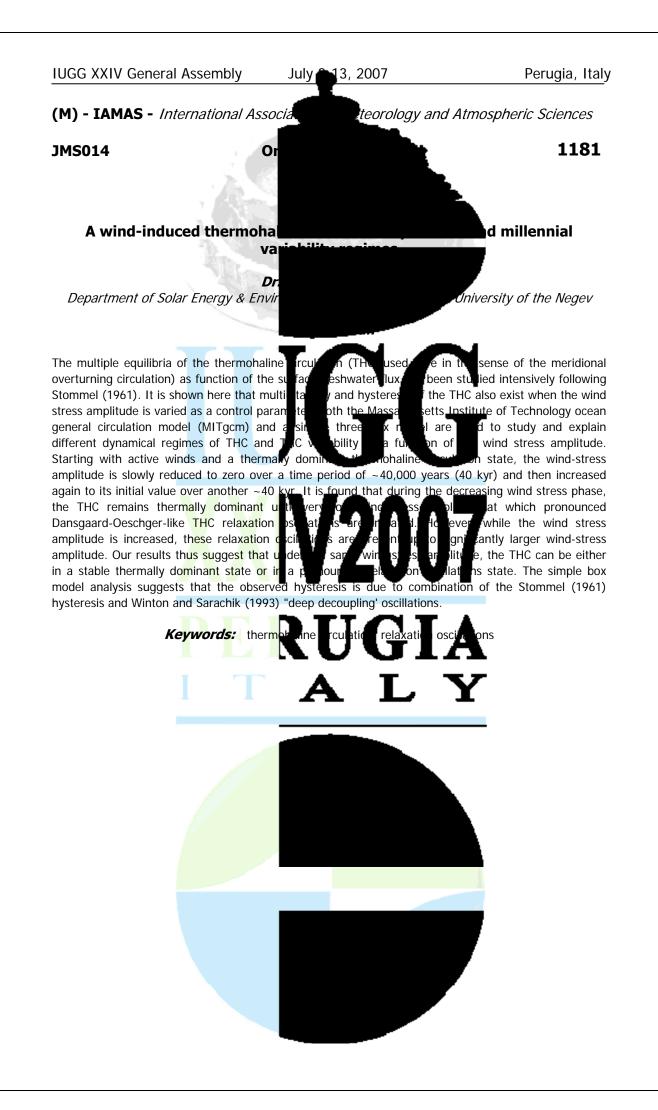
perature seems to be higher latitudes of the a likely reduction in the rculation in the 1950s to sol emissions during the



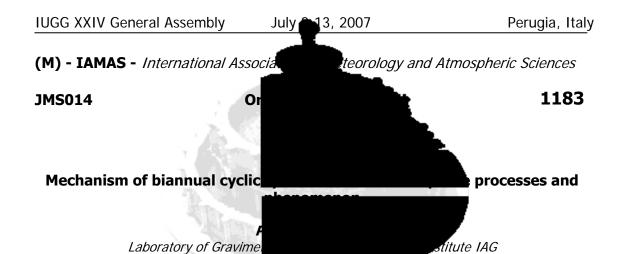












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In the report the data of modern geodetic author hypothesis (Barkin, 2002) about u processes of the Earth are discussed. This m small turns and mutual deformations of the gravitational differential influence on the p the centre of mass of the Earth (with a wi caused first of all by identical relative displa Thus the superfluous mass of the core by its motio

atmosphere and ocean. These tides, naturally, the most direct image influence on the activity practically of all planetary natural processes. Told proves to be true by observed cyclicities and phases of the corresponding atmospheric and oceanic pr 1993 - 2003.8 oscillations of geocenter with atmospheric and oceanic processes have 2.1 (3.9 mm); 2.1/2 (1.8 mm); 2.1/3 ( conditional amplitudes are presented in n basic period of 2.1 approximately in the plane of meridian 90 E and has mainly the polar character. The

oscillation of 1.8 mm occurs to the period of 2.1/2 approximately along the Greenwich equatorial axis. The equatorial oscillation with period of 2. (with amplitude of 3.4 mm) occurs to th meridian. The oscillation of geocenter with is allocated. At what it, as well as oscillation with period of 2.1 yr, occurs approximately in the plane of meridian 90 E. And also has mainly polar charac amplitude of 4.5 mm) occurs along the equator al a of 3.6 +.-0.1 yr and amplitude of 7.0 mm has a polar character. On our geodynamic model the similar

natural processes, including El Nino. Really since 1866 yr till 1996 yr and index DT sir periods 6 yr, 3.6 yr, 2.8 yr, 2.4 yr. A featu extent multiple to the period of precession pole motion of 1.2 years (Sidorenkov, 200 others) cyclicities caused by the gravitat (relatively to elastic mantle) are studied. Earth are investigated. The obtained re-

ng for the benefit of the s of activity of natural varia m of the perturbed relative swing, other shells of the Earth under the odies\_Observed displacements of geodynamic model are es) on mass he core and the mantle. he elastic mantle, and in

> bservations for period henomenon El Nino, for 04; Barkin et al., 2007): kets the estimations of of 3.9 mm occurs to the

the plane of Greenwich

t amplitude (11.2 mm)

3.24 +.-0.5 years (and

he oscillation with period

tude f 1.4 mm. The oscillation

cyclicities characterize relative displacements of the Earth shells and, hence, they should be shown in all of long temporal series of indexes SOI allowed to reveal oscillations with ticed - all of them are to some p the Chandler period of the ides with mentioned (and luous mass of the core emporal display on the he data of studies of

spectrums of variations of gravity and variations of heights on gravimetry stations: Moscow, Hestakhavi, Hannover etc. (measurements on absolute gravimeters in 1996-2000; Kaftan et al., 2004). In more wide sense discussed here mechanism of the mutual interaction and oscillations of the Earth

shells directs, dictates and controls all kno Modes, Pacific Decadal Oscillation and oth (2002) Explanation of endogenous activity o Zemle. Rus. Acad. of Nat. Sciences, Is Sidorenkov N.S. (2002) Physics of no stab

and Southern Annular References Barkin Yu.V. icity. Izvestia cekzii nauk <sup>1</sup>, pp. 45-97. In Russian. 1.: "Nauka" Fizmatlit, 384 p.

# IUGG XXIV General Assembly

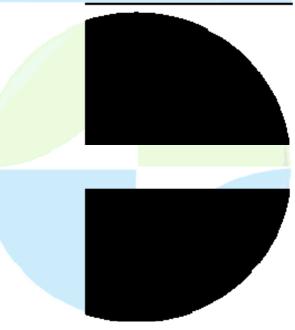
July 🚵 3, 2007

Perugia, Italy

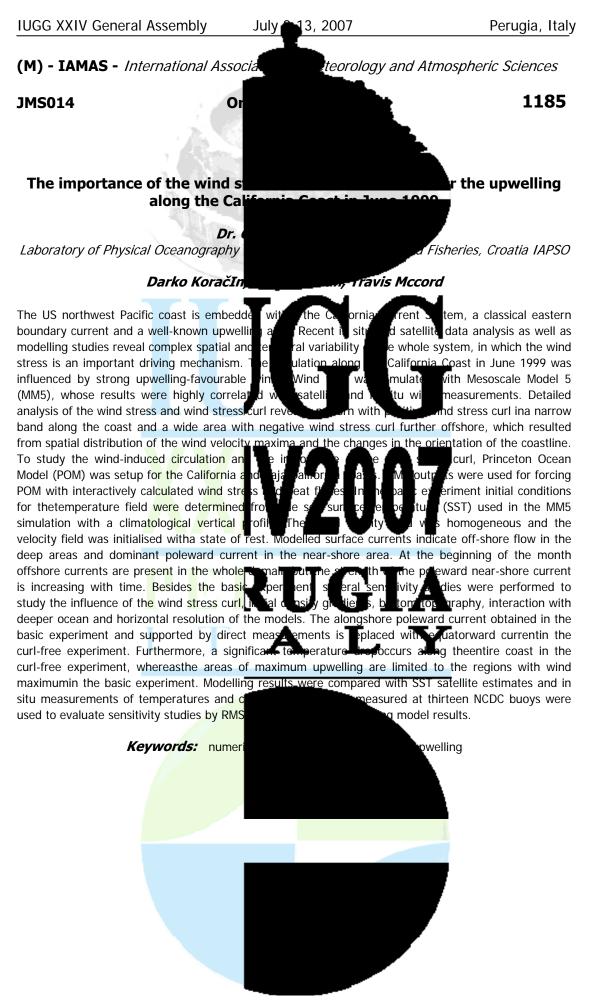
Tatevian, S.K., Kuzin, S.P., Kaftan, V.I. (200 and DORIS data. Report of EGU (25-30 Temporal changes of a gravity at Mosco geodesy, aerospace photo cartography (" Yu.V., Lyubushin A.A., Zotov L.V. (200 Materials of Sagitov Conference (5-6 Febr www.sai.msu.ru. son of geocenter variations derived from GPS France).Kaftan V.I., Gusev N.A. (2004) IGAIK, v. 5, pp. 136-146. Barkin its geodynamical contents. Stronomical Institute, MSU:

Keywords: biannual oscillation, elnino, core mantledynamics

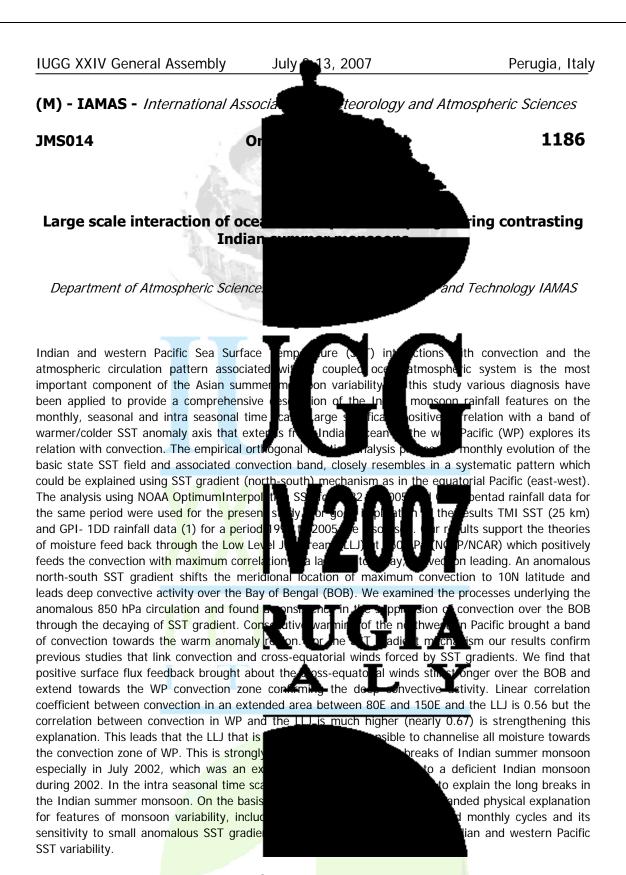
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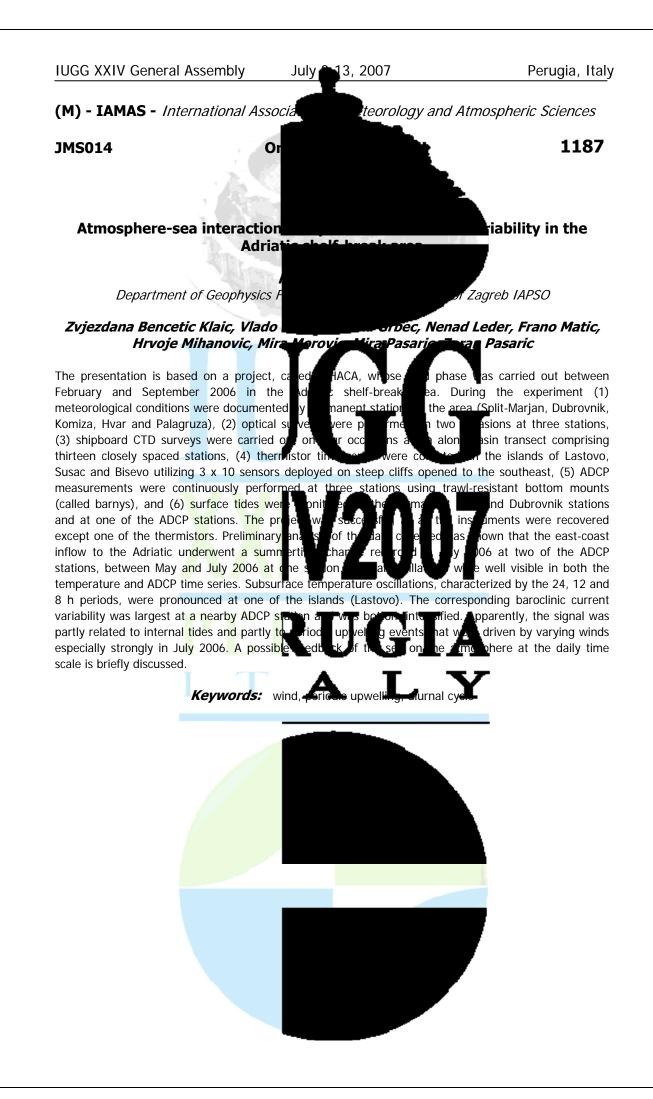


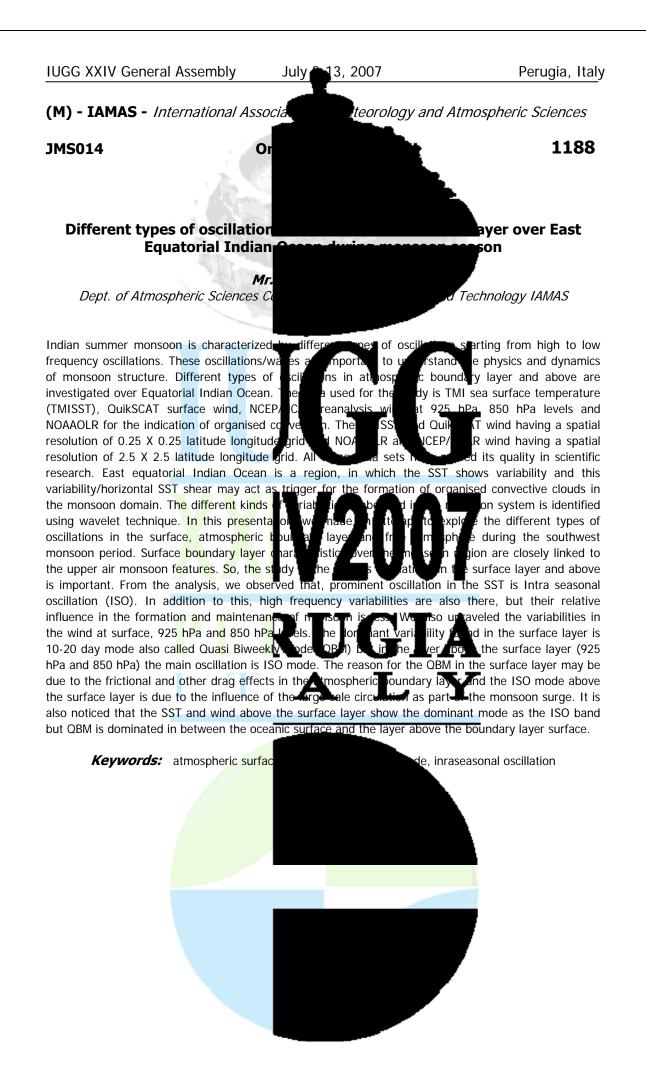


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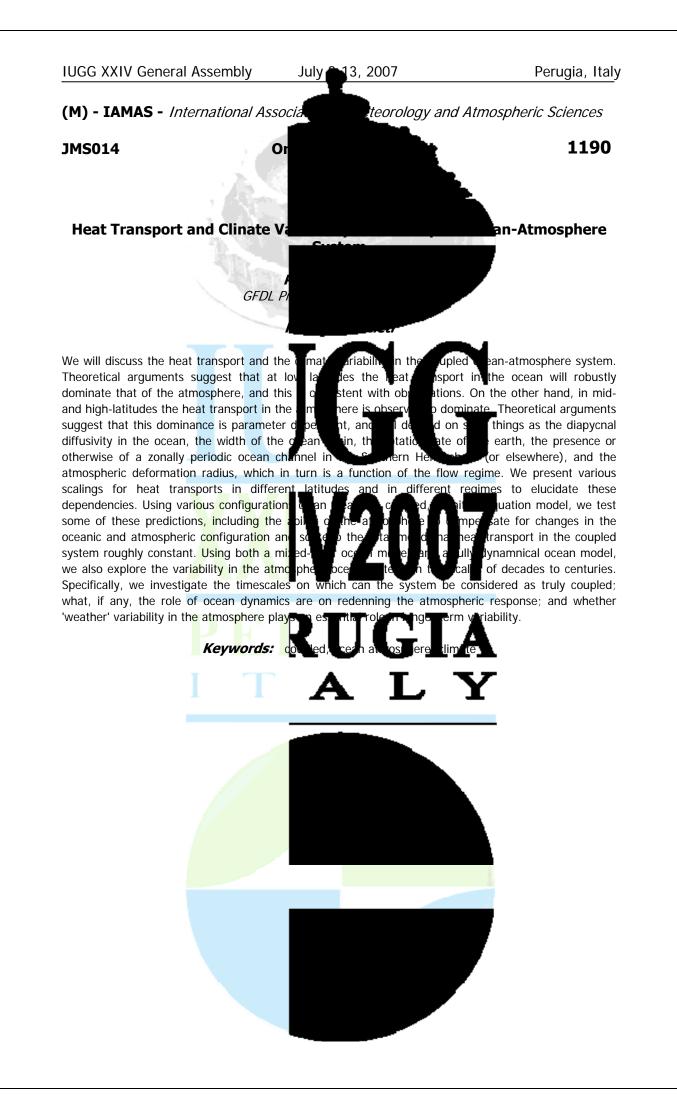


Keywords: sstgradient, IIj, longbreaks

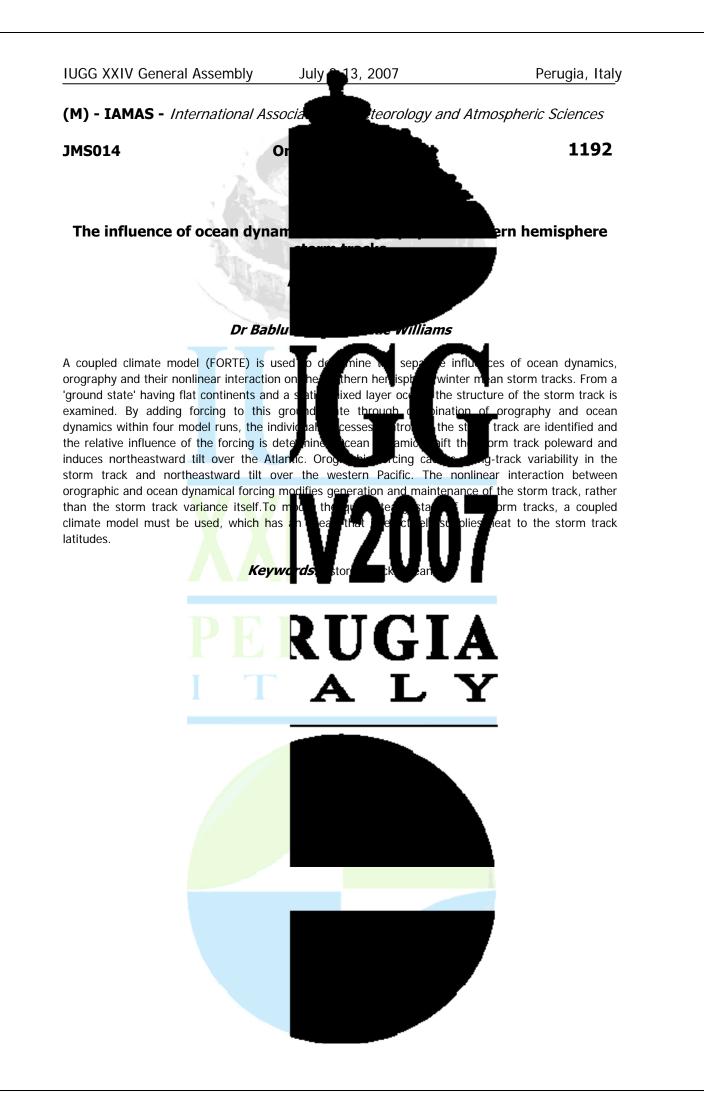


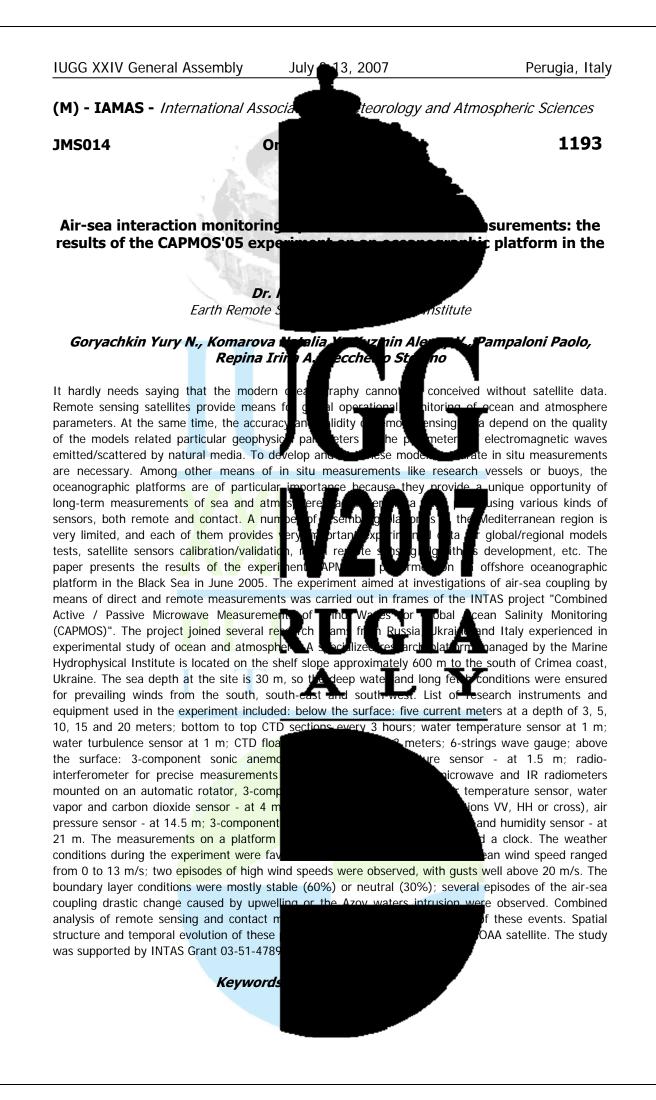


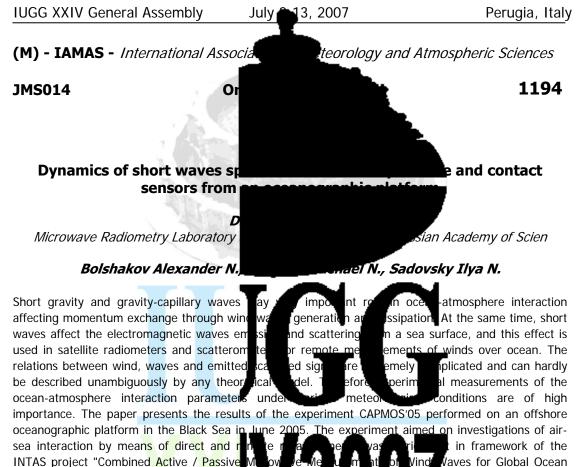












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Salinity Monitoring (CAPMOS)". The proje and Italy. A specialized research platform ma unique opportunity of long-term measurement contact sensors. The following remote sensors

measurements of water surface; Ku-band scatterometer (polarizations VV, HH or cross); L-band radiometer; S-band radiometer (V-pol.); K (3 Stokes parameters); W-band radiometer camera. List of contact sensors for atmospheric component sonic anemometers at 1.5, 4 and 21 meters above the surface; air pressure and humidity sensors; three air temperature sensors; water varer and carb two CTDs; five current meters at a depth of 345 measurements on a platform were carried during June 1-20 round a clock. The weather conditions

13 m/s; two episodes of high wind speeds layer conditions were mostly stable (60%) drastic change caused by upwelling or th gravity wave spectrum were measured by waves and gravity waves slope variance v an original algorithm. The dynamics of wa variable wind was investigated. The study 05-05-64451.

during the experiment were favorable for the measurements. The mean wind speed ranged from 0 to custs well above 20 m/s. The boundary episodes of the air-sea coupling observed. The parameters of pectrum of gravity-capillary etric measurements using under the conditions of 1-4789 and RFBR Grant

hs from Russia, Ukraine

sical Institute provided a

meters using remote and

12 mkm); optical digital

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Parameters); Ka-band radiometer

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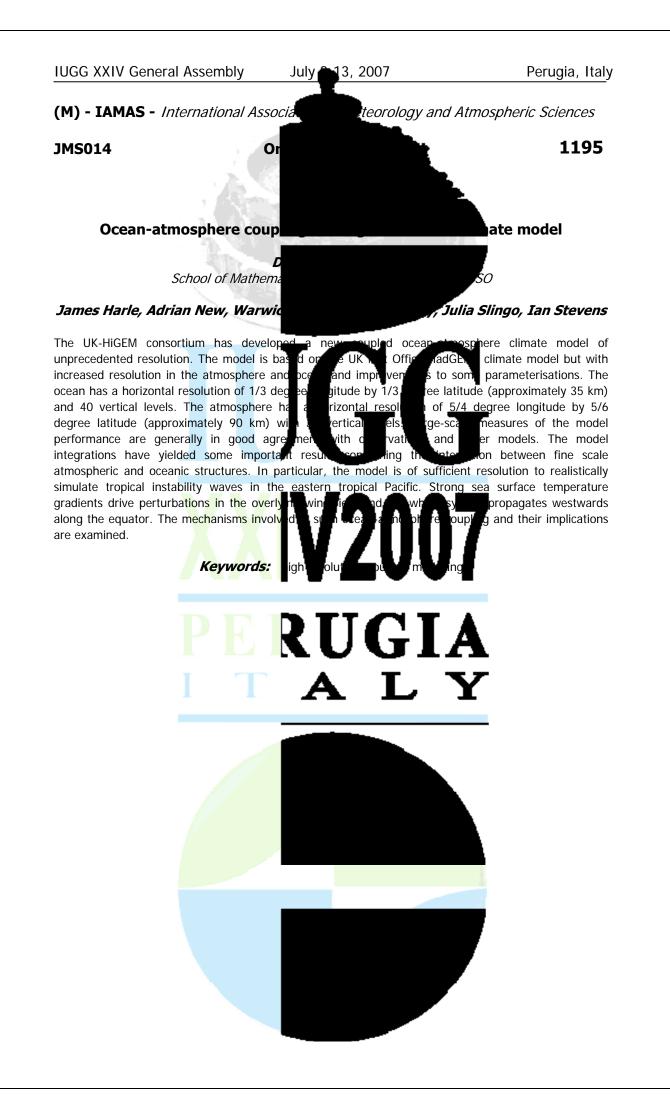
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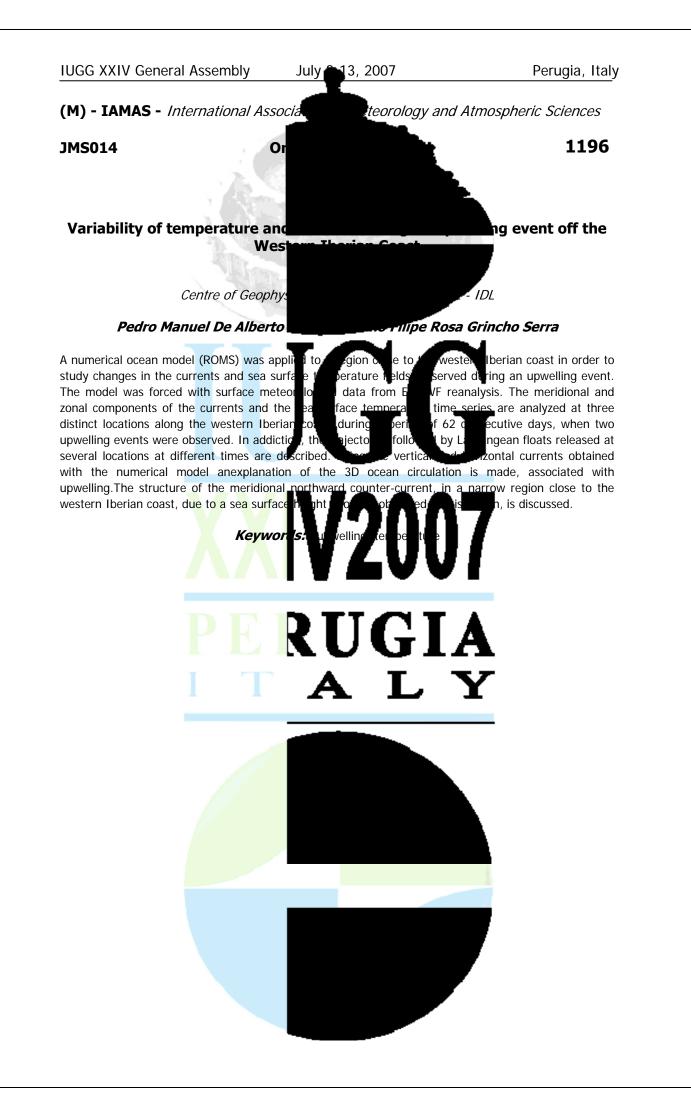
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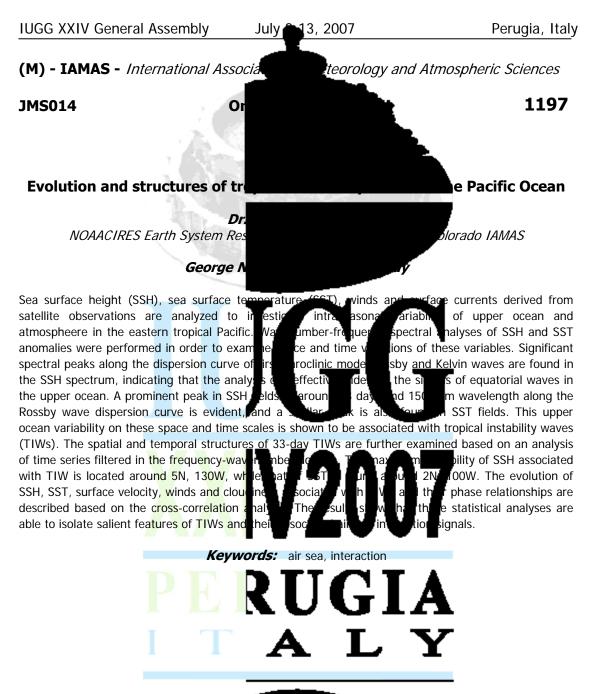
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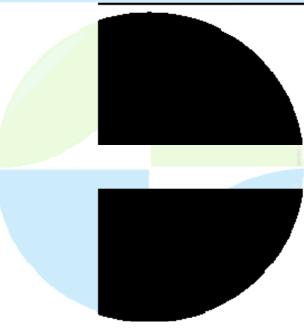
**Keywords:** microwave radiometry, gravity capillary waves

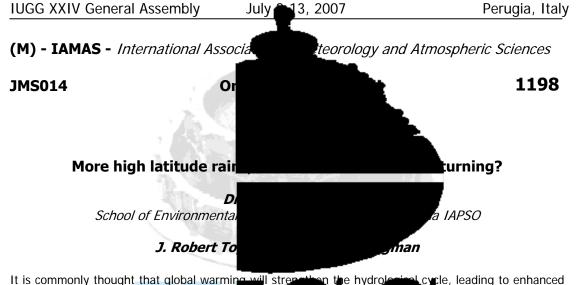












freshwater input to the North Atlantic and propose instead that, at least over multi-cer en increase the Atlantic meridional overturning circulation model (MOM4) coupled to an atmosphere. The hydrological cycle is artific models atmospheric temperature in the stronger hydrological cycle reduces convection

increasesconvection in the North Atlantic. The results can be understood if we combine the following two arguments. 1) If the interaction between the hydrological cycle and the continental orography is causing the Atlantic to be the preferred stronger hydrological cycle will amplify this large scale circulation suggest that it is un everywhere under a steady mechanical e er freshwater input will reduce the deep conv cti due to (1), and over long timescales an in

n the hydrole tima ed m 'a re timescale on. Here, we el a<u>nd an e</u>i hance of sat outhe

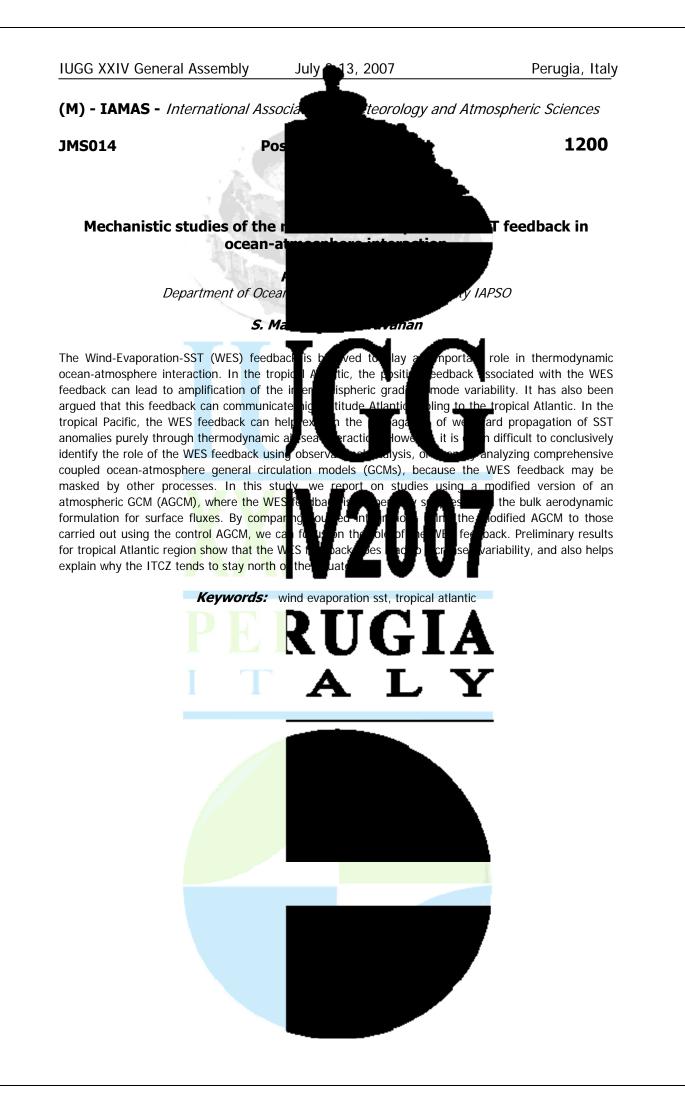
Leading to enhanced rturning circulation. We onal nger hyd ological cycle will in fact sent results from an ocean general -moisture balance model for the d) by easing (decreasing) the ratio. We find that a on mi and North Pacific but

convection

ands to reason that a an energy constrained be significantly reduced increased high latitude Ocean and North Pacific In the North Atlantic will









## **IUGG XXIV General Assembly**

### July 13, 2007

Perugia, Italy

(M) - IAMAS - International Associa

# **JMS015**

Symposium Mid-latitude Droughts in a Cha

Convener : Prof. Christoph Schär Co-Convener : Dr. Sonia Seneviratne

The aim of this session is to bring together perspectives using observational, diagnos from a wide range of themes: case studie the Iberian drought of 2005), mechanisms and/or proxy data), and modeling studies a for the occurrence of droughts.

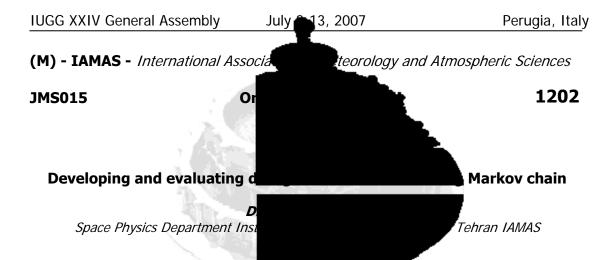
teorology and Atmospheric Sciences

1202 - 1230

de droughts from various symposium invites papers e European heat wave of 2003, sughts (including the role of oceanic and atmospheric drivers and land-surface processes), variability and trends of droughts (using observations and/or proxy data), and modeling studies and ressource the second end of clinice characteristic drivers and climate variability e and climate variability

**V2007** 

UGIA



Drought is common yet not commonly u drought characteristics within a probabilistic framework to evaluate the probabilities of the occurrences of of wet and dry spells help in understanding precipitation data from several climatologica the drought-proneness, based on the param used to compute 1) absolute probabilities; 3) expected value of the length of drought

53 years '1951-2003' of monthly precipitation data several climatological stations in Iran. Drought classes, derived from SPI, were used as input to the Markov chain model. Markov chain model was used in order to estimate: 1) the probability of different drought severity classes; 2) the expected particular class; 4) the expected time for the short term conditional probabilities of tends to dominate, hence limiting the p drought class is moderate or severe, the p class is higher than the probability of changing

Markpv chain of we quent ght- proilene ns for the pe the Markov bilities dr he st Irdi d anđ

has been used extensively eriods. These sequences id dry means **T** a simple index. Weekly 1961-2003 are used to determine model. Markov chain model were ger than 12 weeks and on index (SPI) based on bneness is estimated for

per provides an approach for expressing

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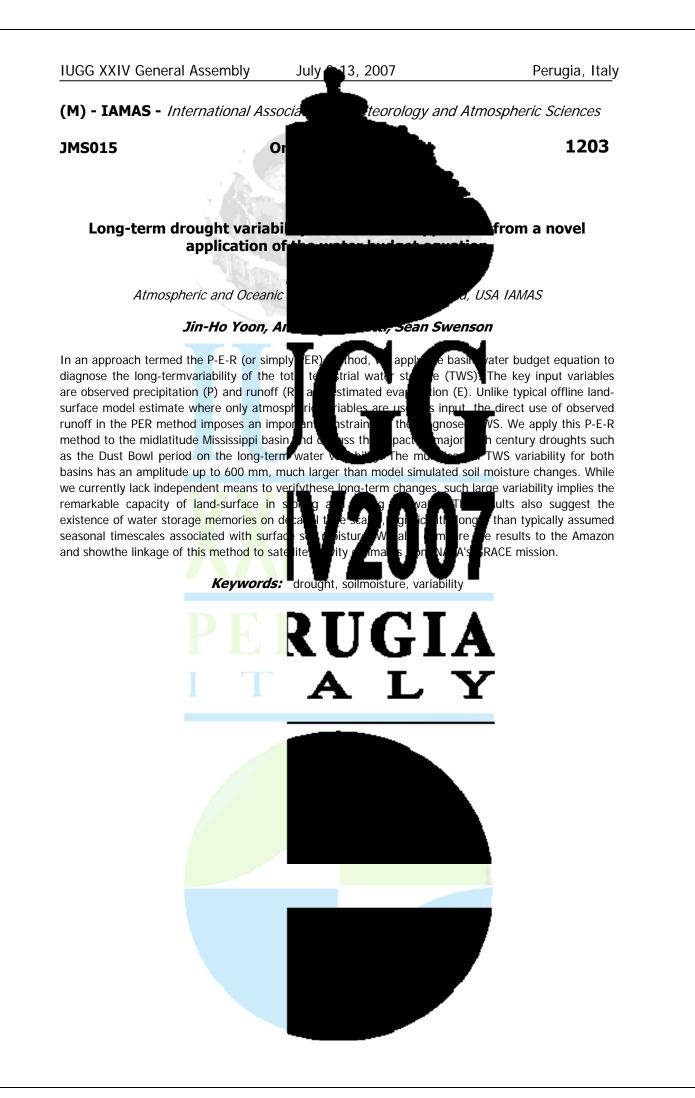
recurrence time for a ass to another, and 5) recent climate condition model. If the present how in the same drought class. Results show that the Markov chain



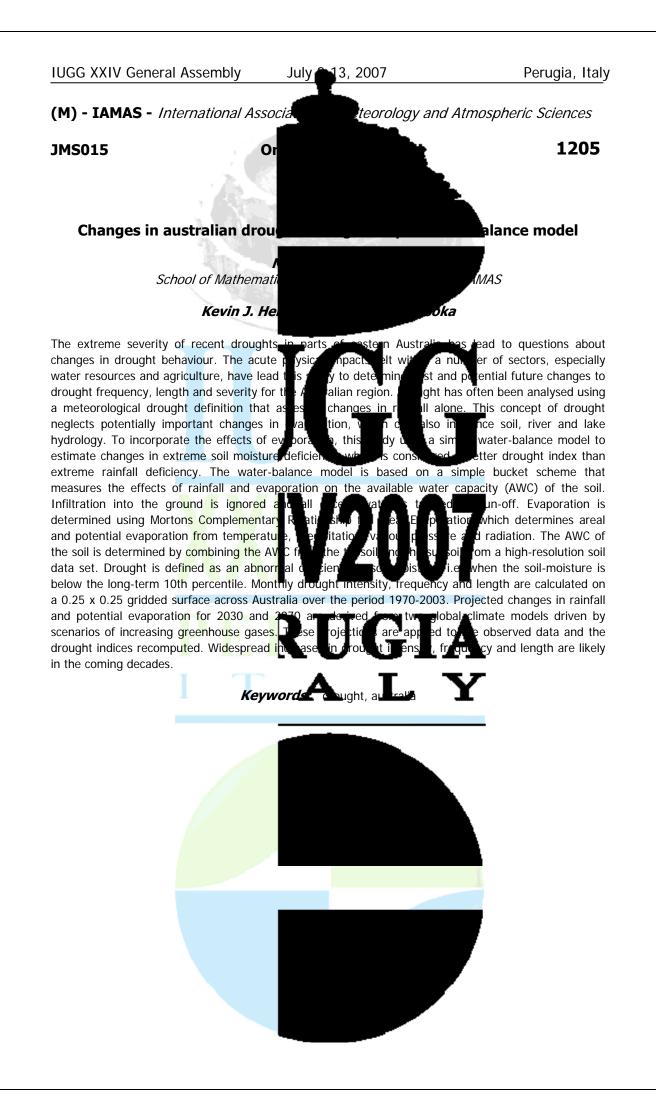
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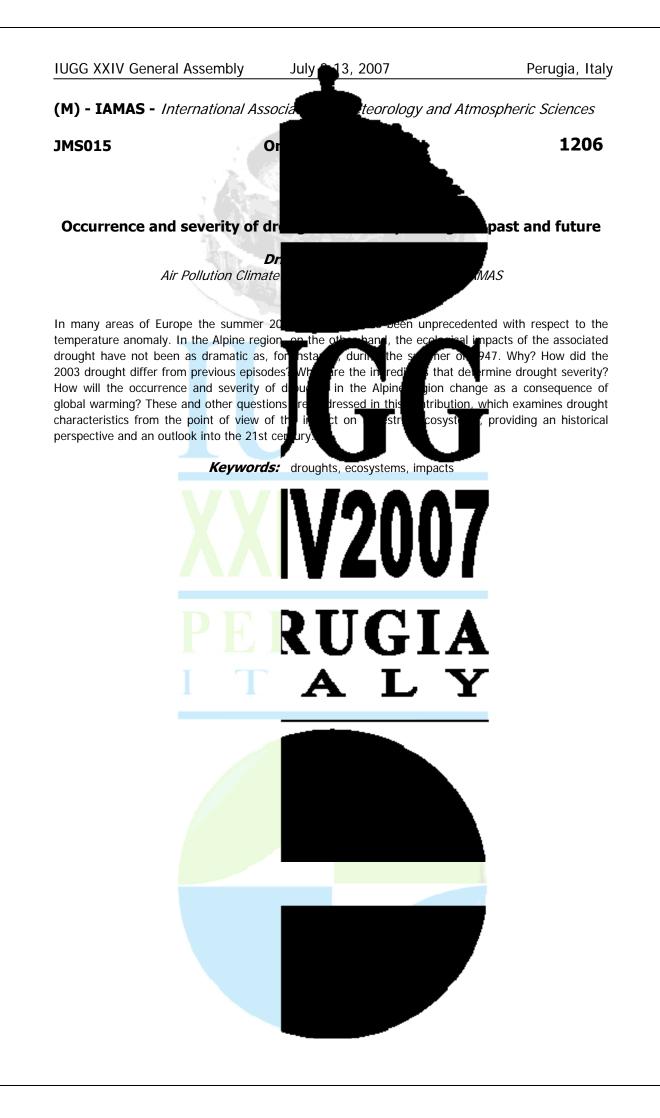
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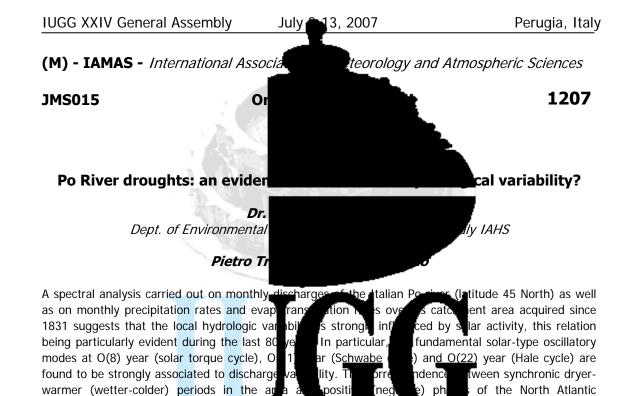
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O(8) year periodicities,

erved since 1920, i.e.,

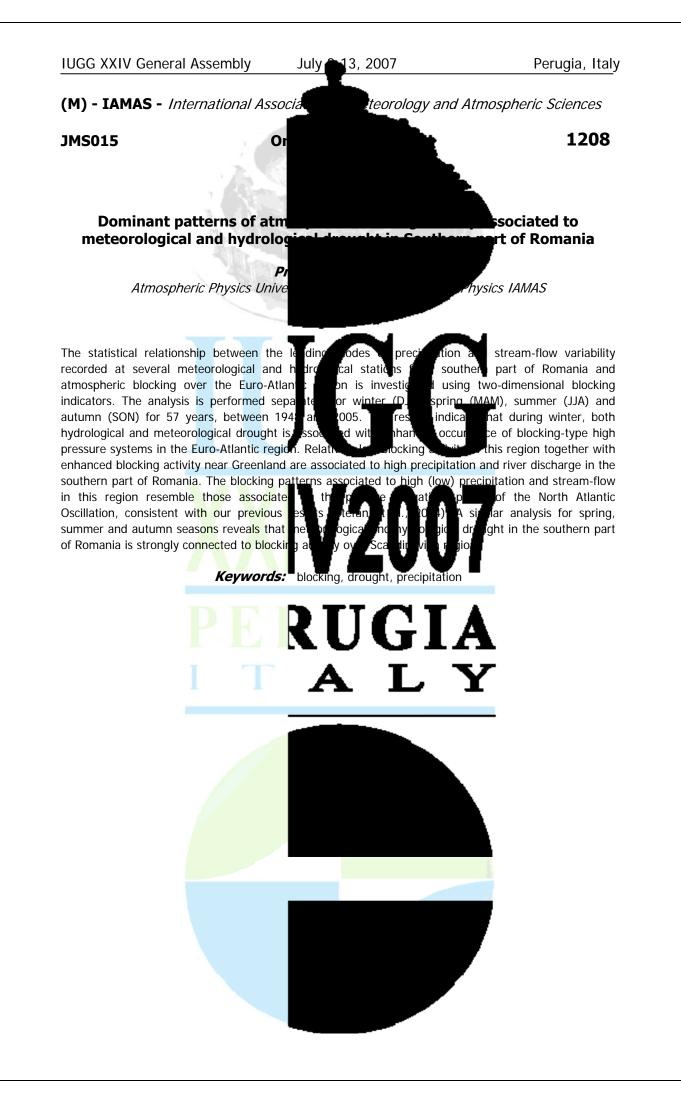
(downward shift) and

that prolonged drought

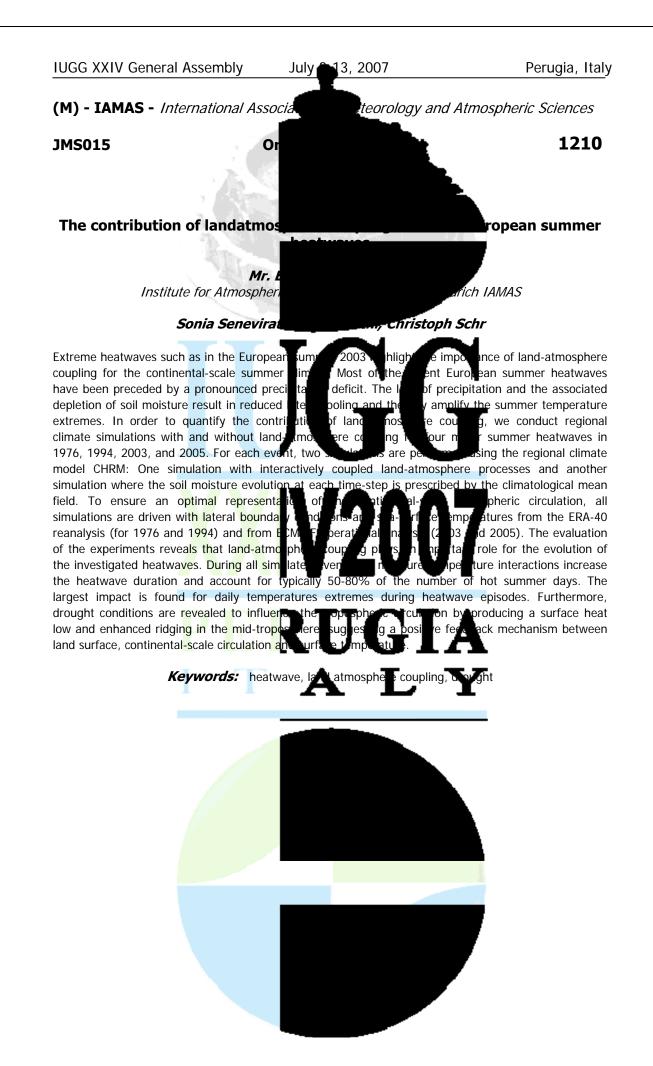
t observed before 1920,

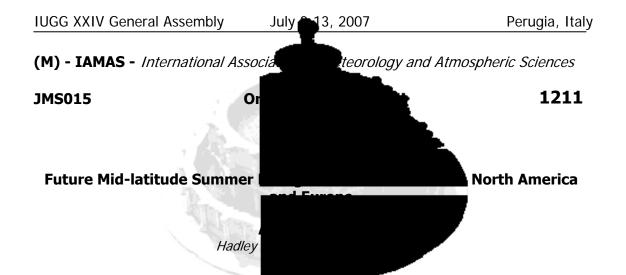
Oscillation, which are driven by strong weak) provides additional support to a scenario in which solar activity constitutes a major forcing of the regional climate of Northern Italy at interannual to decadal time scales. In particular, this contribution shows that the apparent progressive solarwhen concomitant sudden changes (regi evapotranspiration (upward shift), is amount periods as those observed in the 1940s ar when accumulation of reservoirs occurred.

Keywords: solar activity, po river, reservoirs dynamics









Many models predict that summer rainfall will decline to anthropogenic forcing. It is known, how North America, and it is the aim of this s regional difference. This contrasting uncerta model ensemble and the Met Office Hadle uncertainties are systematically sampled by summer rainfall decline is more robust of (rather than the spread) of the PDF of ruture-n

shown that the decline of projected European summer rainfall is driven by a combination of (a) an earlier and more rapid decline in soil moisture during spring, and (b) an enhanced summer landsea contrast in surface warming, leading to re Large-scale atmospheric changes, includin role. The relative importance of these mec from the perturbed physics ensemble, which model. Further contrasts in mechanisms of the western part of North America and the eastern part anomalies.

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d continental regions due over Europe than over d the reasons for this important ata from both the IPCC-AR4 multisics ensemble in which modelling In both ensembles the difference in the mean lies. Previous work has

ed onto the continent. s, play a much smaller o continents, using data versions of the HadCM3 etween the mountainous is more directly upstream of tropical climate







The SSTA from January and February can

over Europe in August. In its return atmos

of discharge in September. In order to rev

Danube lower basin, the teleconnection us

ve been also identified. atmospheric circulation igust influences the state the discharge level in the 100 years) was tested. The

Perugia, Italy

July 13, 2007

ENSO was quantified both by SOI and TNI. over December, January, February and Ma and early summer. Related to the four significant results (95% confidence level) f in January, February and March as pr September. The ENSO signal is generally higher than 95%) of ENSO quantified by can be considered as predictors for disch of local regional (local) factors lead to in

discharge level in the Danube lower basin.

**IUGG XXIV General Assembly** 

period, the NAO from winter time (averaged or for discharge level during the spring drought in 2003, the statistical 970 have been obtained for NAO ne, August and respectively ignal (with confidence level alues in March and April s considering complex indices which combine general factors at planetary scale with the indices that define the characteristics the prediction of the

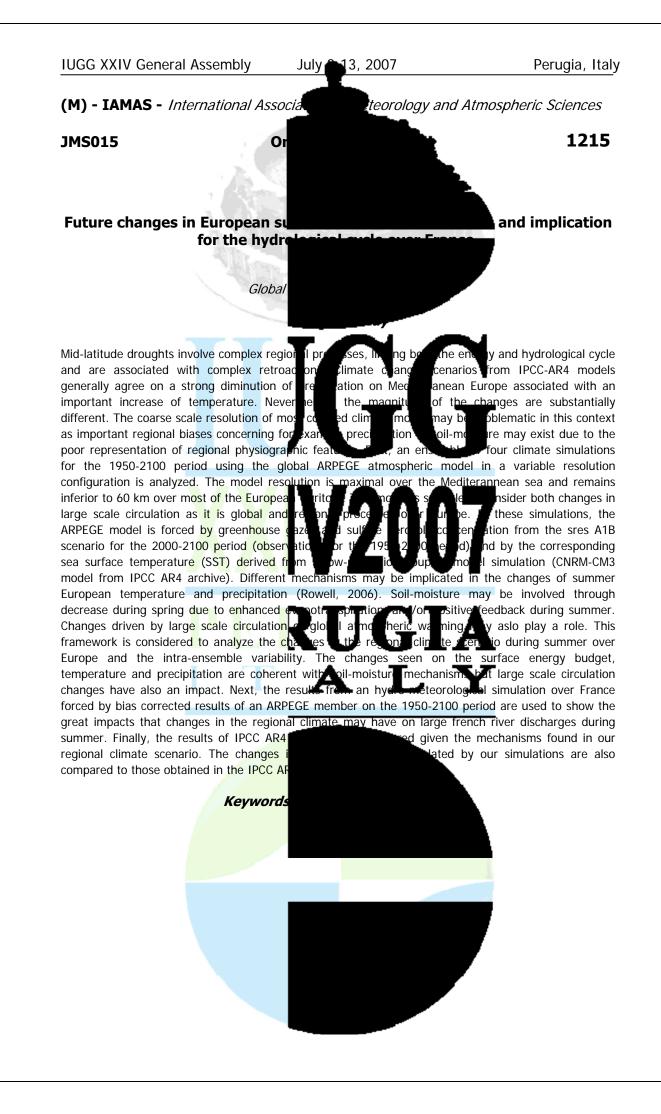
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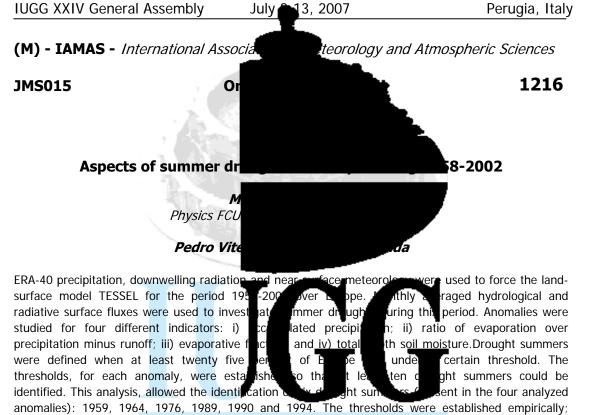
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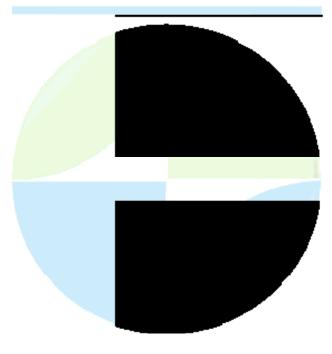


however, the minimum spatial coverage requirement and coherency in the identified summers indicate a robust classification.Drought summers we the variety of indicators used illustrate hyd The preceding seasons (for each dry sumn possible precursors of summer anomalies. factor in assessing future impacts of climat

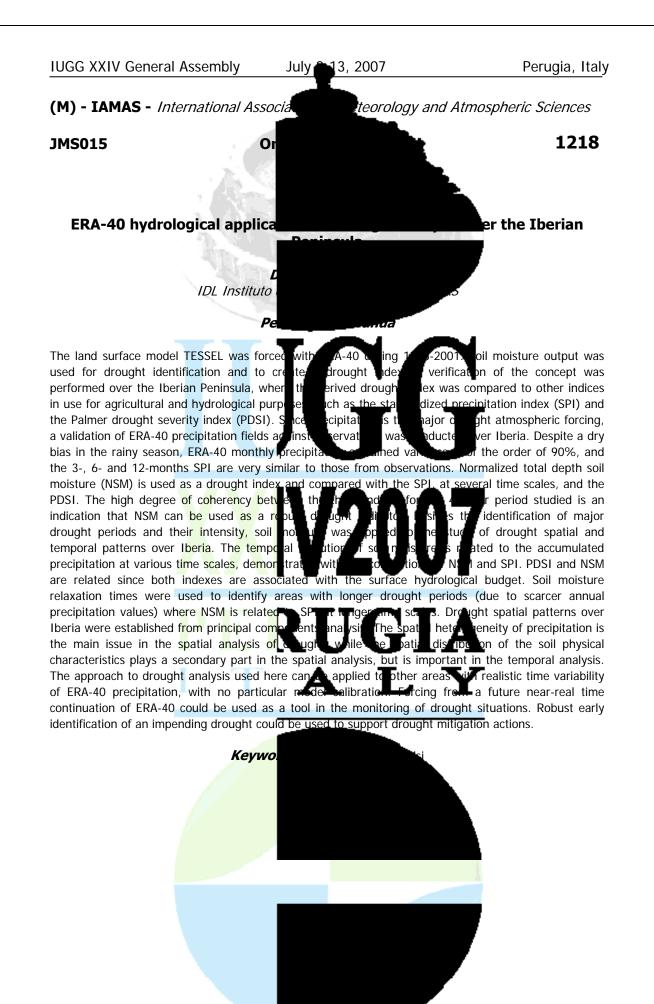
and spatial extension;

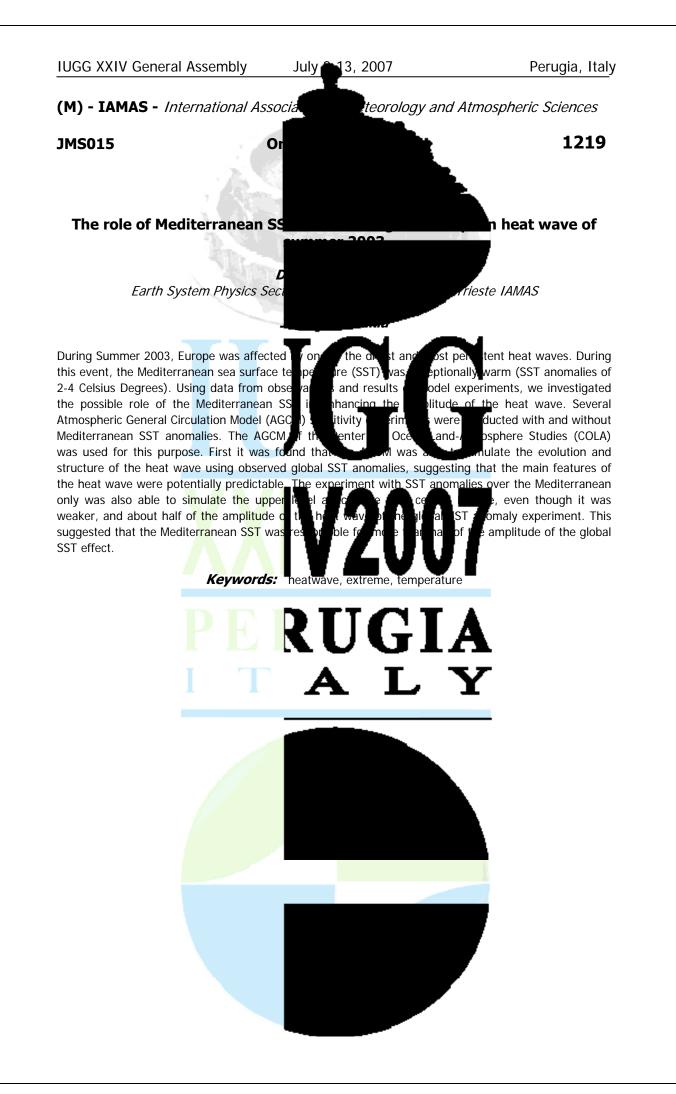
ral aspects of drought. temporal evolution and phts phenomena is a key

Keywords: drought, reanalysis, hydrology



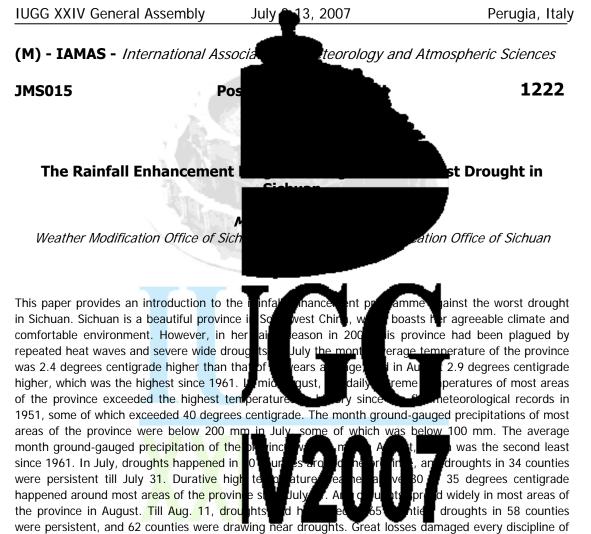












commenced in Aug. 12 in the province. T Office of Sichuan Province (WMOSP) and engineers and managers, 1906 subordinate aid of the meteorological staff. The telecommunicating video consultation meetings on cloud-seeding times were held every morning from August to stember jourtly by National Climate Center, National Meteorology Center, National Satellite Meteorologic and Chongqing Meteorological Station. In addition, the telecommunicating video meetings on cloudseeding times were held jointly by WMOSP. Sichuan Meteorological Station, the subordinate

meteorological stations and weather modifi and the subordinate weather modificat communicating through LOTUS NOTES, f addition to routine meteorological observat locating networks, and raingauge networks were predicted by synoptic diagnoses, mo determined by radar observations. Evalu statistical tests and physical tests. Grour

the society from agriculture, industry, to everyday life. Then the Rainfall Enhancement Programme was ed by the Weather Modification uan<sup>®</sup> Pro nce ( ernment. 82 operational e programme with the mp ner ed Center, MOSP, Sich an Meteorological Station

> ties every afternoon. Moreover, WMOSP ots ran all day and all night, hones and mobile phones. In ation radars, satellites, light Cloud-seeding potentials als. Seeding clouds were words, and data by vere conducted in 112

counties across the province. 380 artilleries and 102 rocket-launchers were employed during the emergency time from Aug. 12 to Sept. 5. 11593 artillery shells and 2233 rockets were launched in 1424 operations. There were four types of rockets in use in the programme, which were BL-1, WR-98, WR-

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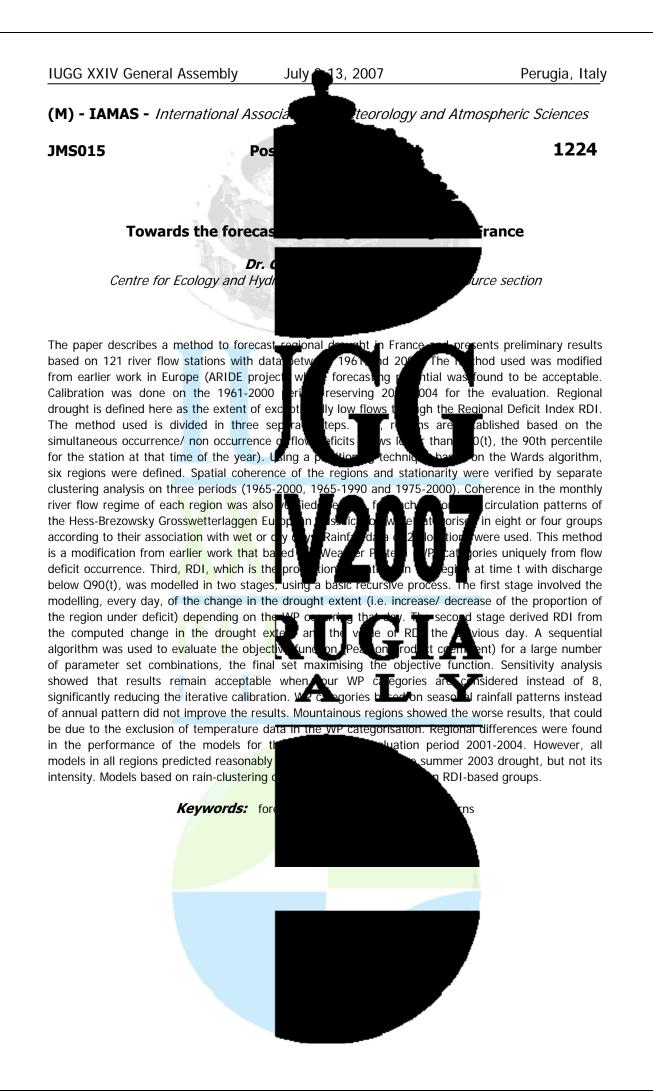
hera

1D, and JFJ. And 1173 JFJ rockets, 10 introduced as seeding material with spec artillery shell, 3 g per JFJ rocket, 10.5 g p rocket. And silver iodide was released in a artillery shells, JFJ rockets, BL-1 rockets,

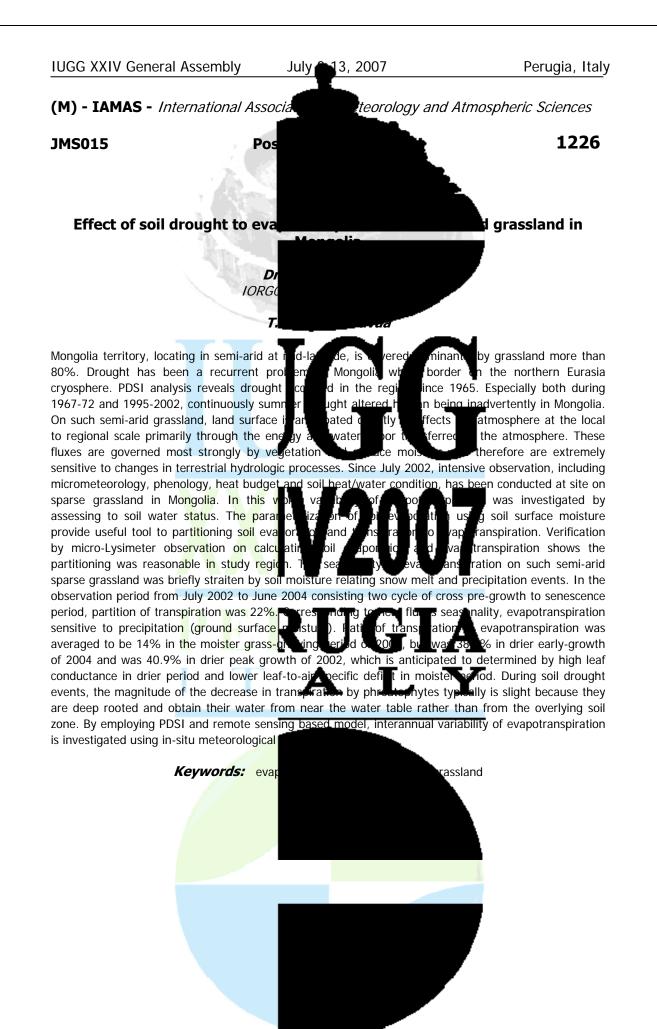
hed. Silver iodide was y 1 g silver iodide per ket, and 11 g per WR-1D which were explosive for -1D rockets respectively. In



















## **IUGG XXIV General Assembly**

## July 13, 2007

Perugia, Italy

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## **JMS016**

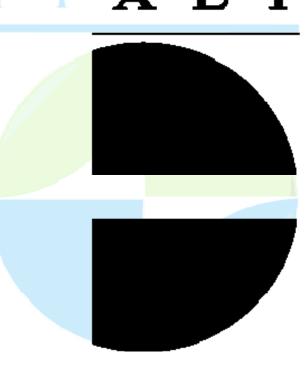
## Symposium **Cryospheric Change and Sea Le**

Convener : Dr. Steve Harangozo Co-Convener: Prof. Konrad Steffen,

Major changes have occurred in the cryos record low values, glaciers retreating in all the Arctic and snow cover extent reducing decreasing in size with implications for s monitoring and modeling the cryosphere, and determining the possible impact on sea level. We welcome papers of sea ice, the ice sheets, s ow conv, glaces, ice so wes a permafrost.

sea ice extent reaching sappearing in many parts of that the Greenland ice sheet is posium invites papers on all aspects of

teorology and Atmospheric Sciences

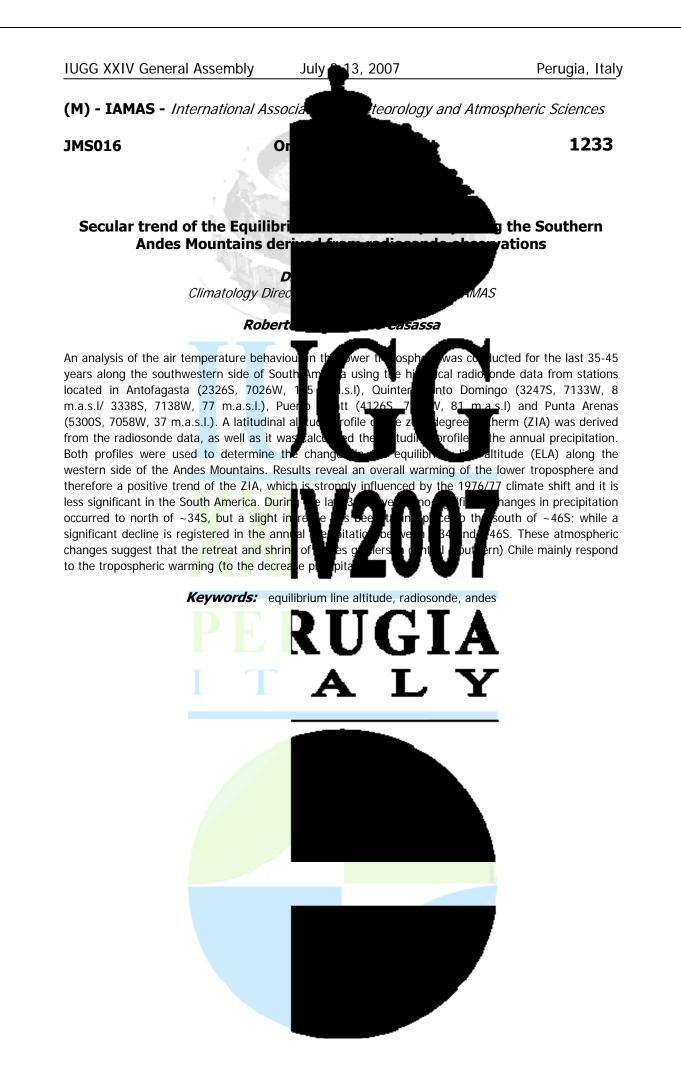


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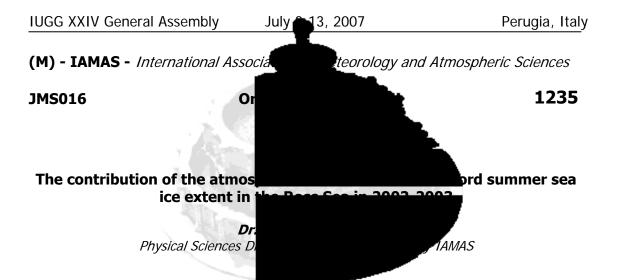
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In the Antarctic the Ross Sea sector stand seasons of the year since the late 1970s. affected the area in summer in several yea supply of the U.S McMurdo base. As yet, ho unclear. This paper examines recent cases identify some of the factors that lie behind mainly on the 2002-03 summer leading up, the ice cover will be studied using ice concentration

how unusual the ice drift patterns were. Atmospheric circulation reanalyses as well as in-situ, e.g. ship, data will also used to investigate ice-atmosphere atmosphere interactions and ice dynamics 2003 summer, especially as air temperatu cover was able to stay intact because the i preceding spring. This compaction arose f extended period in the 2002 spring. In fa

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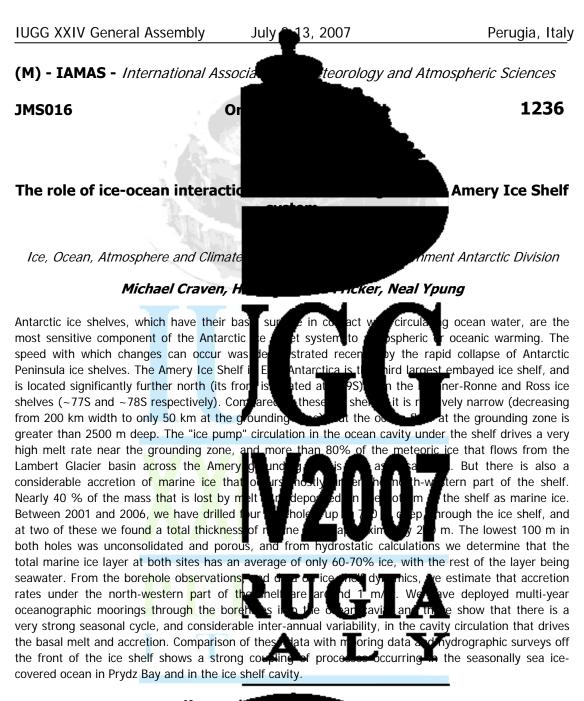
ice has increased in all e conditions have even t case, reatly hampered the reis increasing sea ice cover remain er ice in the Ross Sea in order to r ice extent. It focuses in sur record. The evolution of vill be used to determine

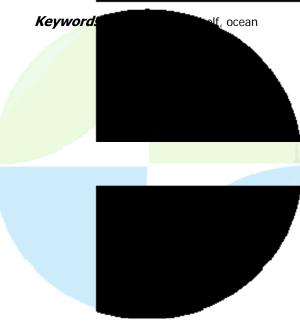
interactions. Results indicate that strong icestaying intact into the al. In particular, the ice ly compacted during the wards the coast over an highly anomalous in the

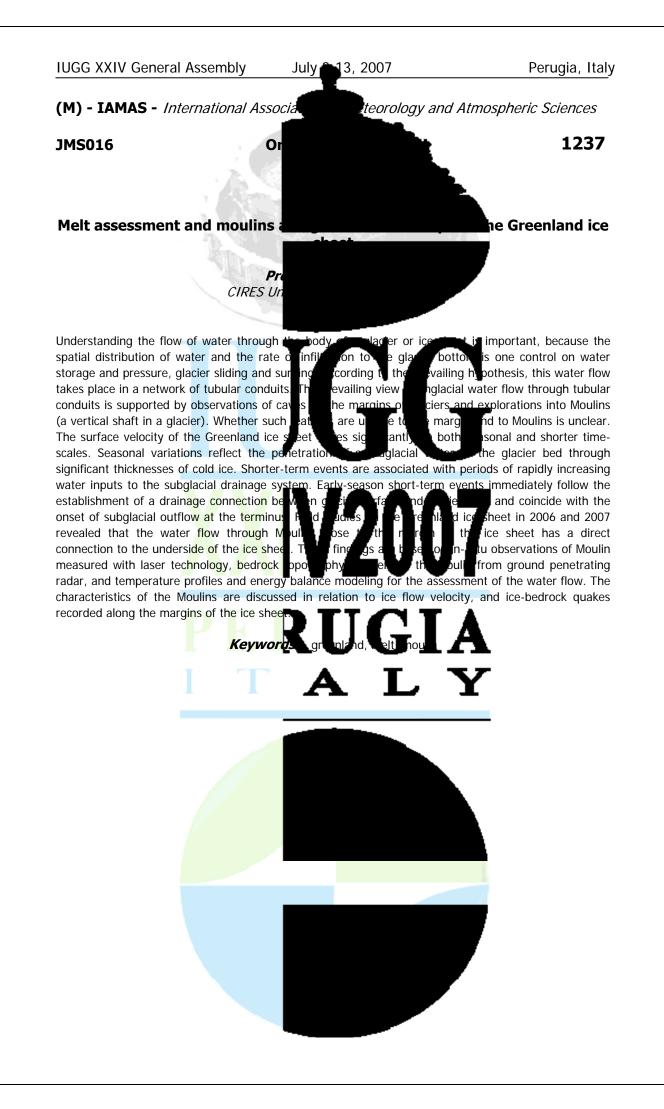
2002 spring. El Nino events appear to be associated the anomalous atmospheric circulation at this time and in other years of extensive summer ice.

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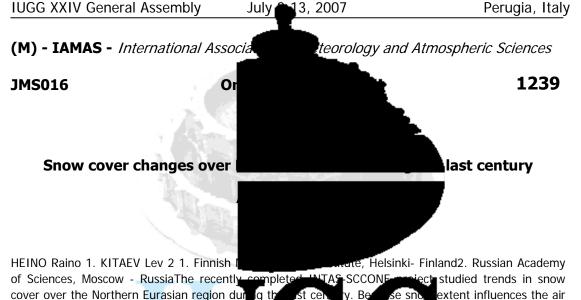






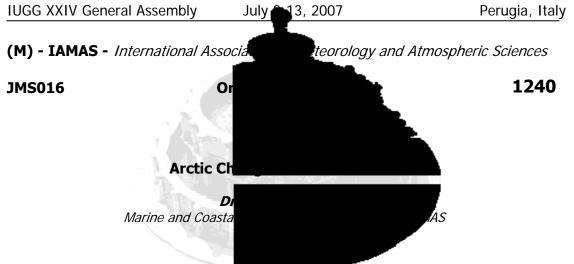






cover over the Northern Eurasian region dur ig th y. Be st cel se sn nderstand long-term trends. The temperature through positive albedo feedback is import nt general objective of the project was t the trend limatic causes and hydrological ks the 20th century. This objective consequences of the snow-cover changes ern Eurasia d was accomplished by extracting and analy able to all participating were torical countries. - The duration of snow-cover sho ern S linavia and in the southive tr in west of the East European plain, but mainly positi f Northern Eurasia . For the i the larger part of northern Eurasia, the snow-cover duration and snow depth is still increasing despite recent global warming.



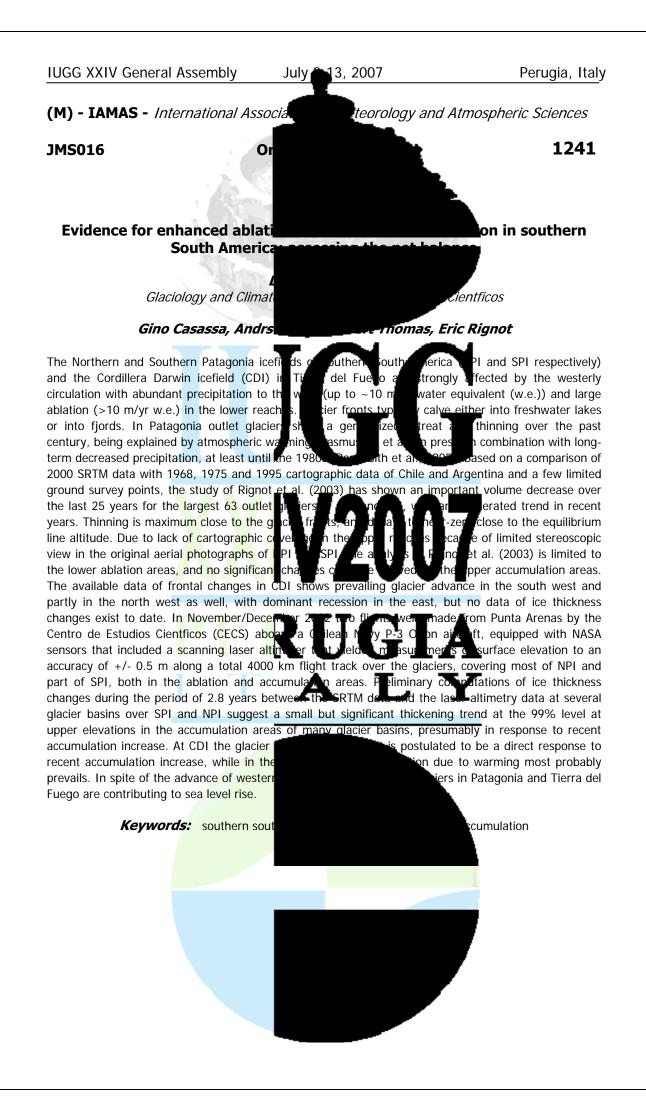


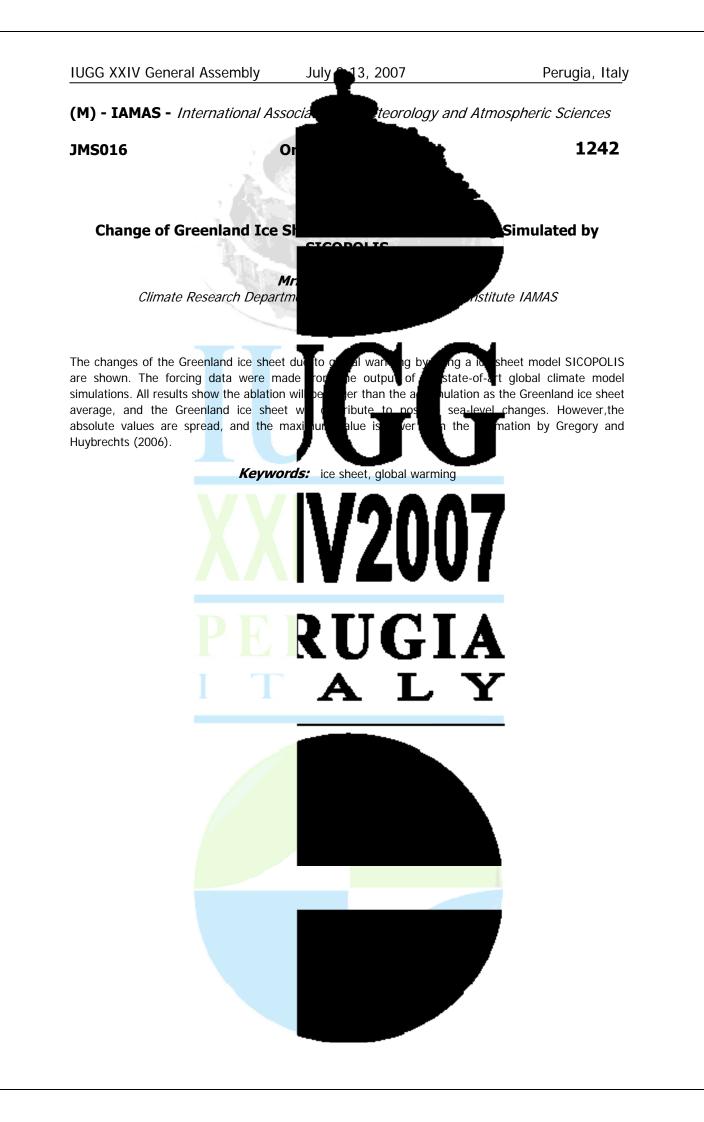
The only thing that has been constant in the Ar Observations of almost every aspect of the climate with warmer temperatures and less permatent it, perennial sea ice. Global climate models have he accelerate the Arctic's response to increased and observations exhibited signs of this predictice by rapid decline, this presentation will focus of new which appears to have accelerated during the pasatmosphere and model predictions for the future.

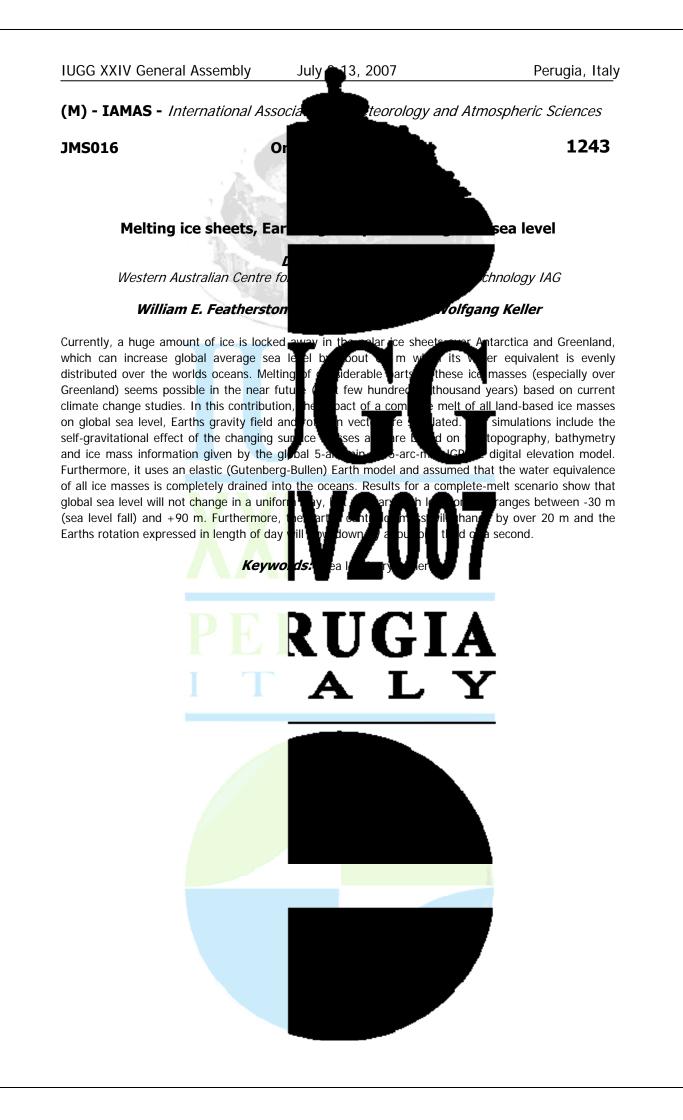
the Arctic during recencilime exysten suggestents, the most considered of the most consider

entrolocades is sweeping change. I cohere shift toward an Arctic cuous in icator being the loss of the sea-ice-albedo feedback will entrations, but only recently have rms of manent Arctic ice are in s light or drivers of sea ice loss, connections to changes in the

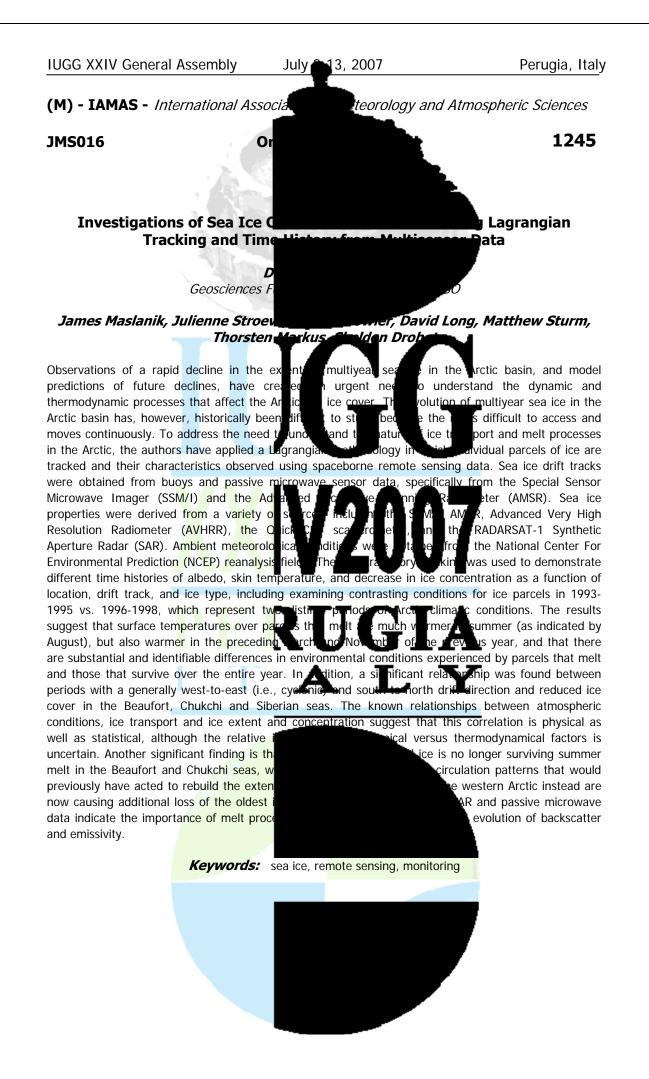




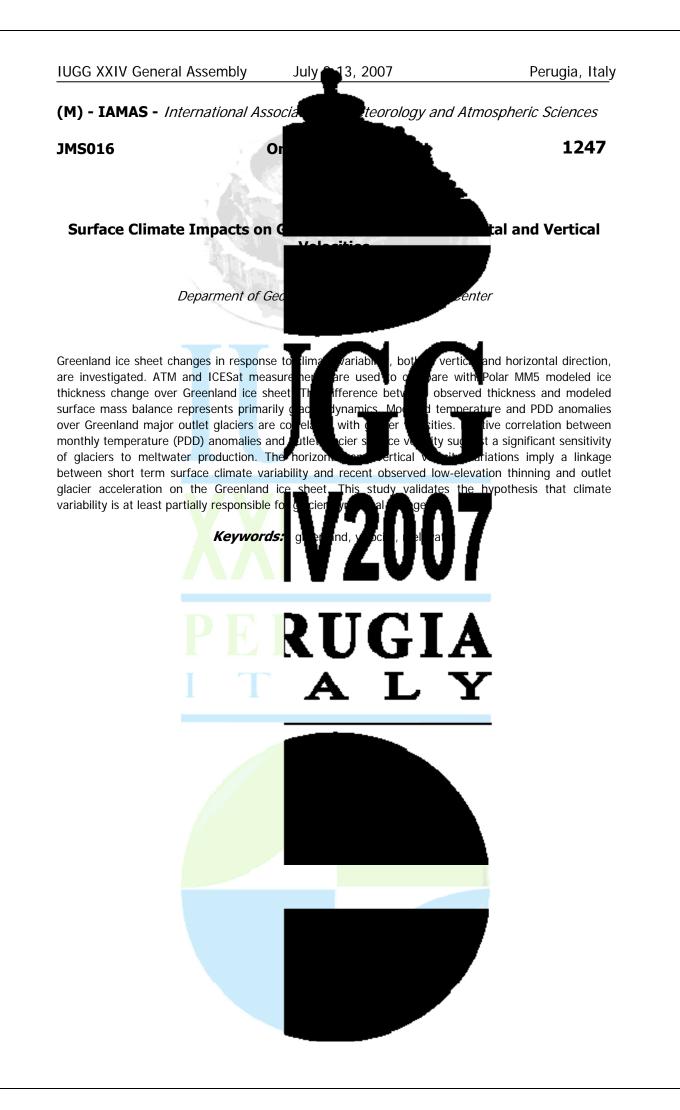


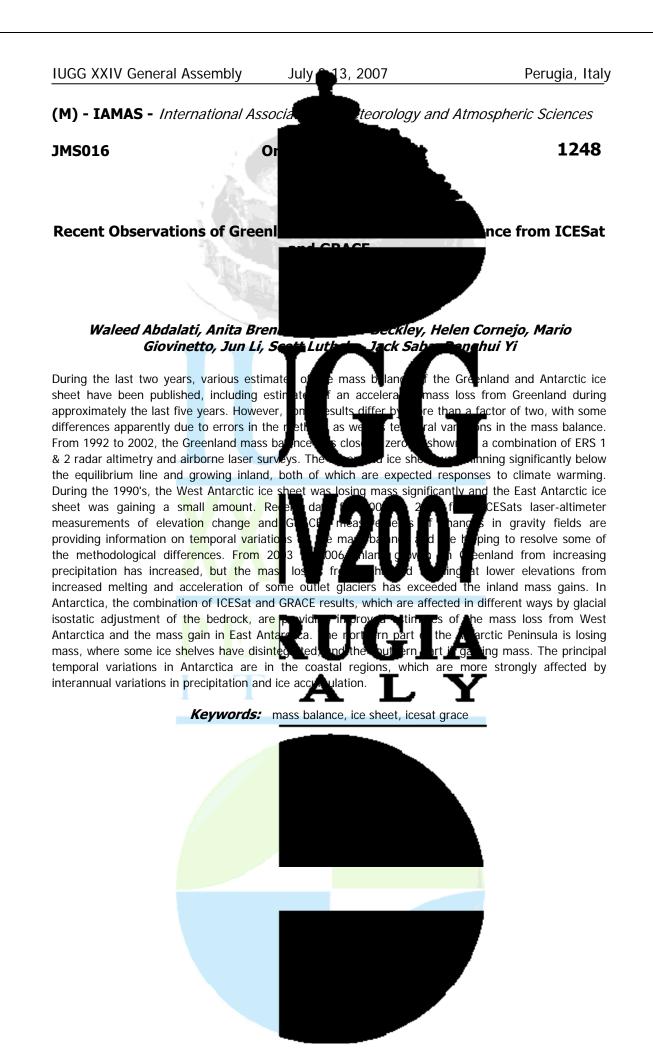


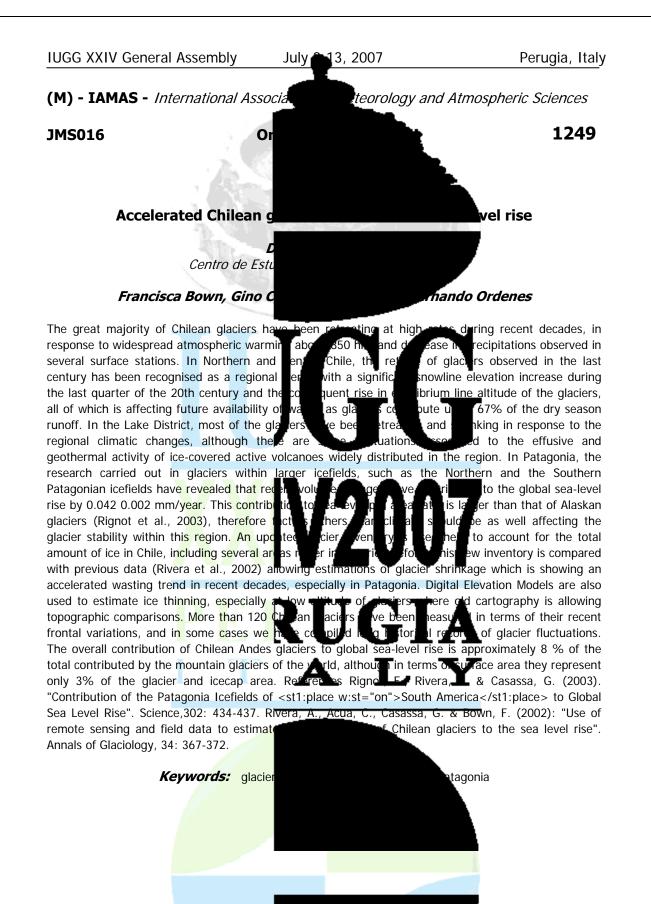


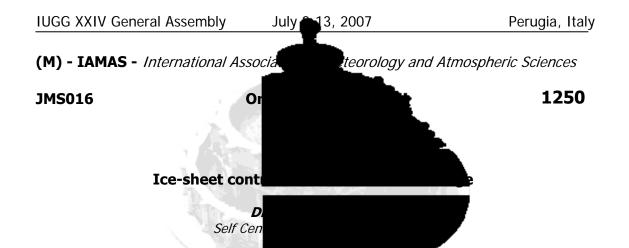












The rate of sea-level rise has increased fr years. Much of this increase was caused by very large the ocean, both by increased melting and

increase was from small glaciers outside substantial increases in losses from the big by the application of new remote-sensing quantify the mass balance of the polar ice s attempt to reconcile them in order to recon in both polar regions. This suggests that: (i) High

thickened at accelerating rates, probably because of increasing snowfall. (ii) Despite this, total ice losses have increased substantially during the last 10 years, partly because of warming summer temperatures in Greenland, and partly because of increa is a strong correlation between increas extensions of the glaciers. These conclusi both the atmosphere and the ocean. The most concern for the future.

to more than 3 mm/yr over the last 20 ases in the ier by i ised enland hd lof e sheets. Thi ques<u>that p</u>r ere, T lts fro histor prob re n part

large

fer of ice on land to water in o the sea. Most of this rctica, but there have also been rease has been revealed primarily e different, independent ways to is new information, and ice-sheet mass balance eenland Ice Sheet have

> lar regions. (iii) There or breakup of floating ce sheets to changes in od, and could well be of

Keywords: ice sheet, sea level

# IUGG XXIV General Assembly July 3, 2007 Pe

Perugia, Italy

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## JMS017

# Symposium The Holocene-Anthropocene Tr Dominance of the Earth System

Convener : Prof. Michael Mann

Until recently, the Holocene climate of the global basis. This period, also characteria provides the context for human-induced (magnetic commajor factor in the climate, altering atmospheric com-

the rates of change to continue, we are tra sitio has been coined to describe this emerging p Holocene climate (observational/ proxy or m de that have affected the climate in the past; to changes; and projections of how these changes

composition and the provide to a summarid. This symp ); the forcings entation, deterring development

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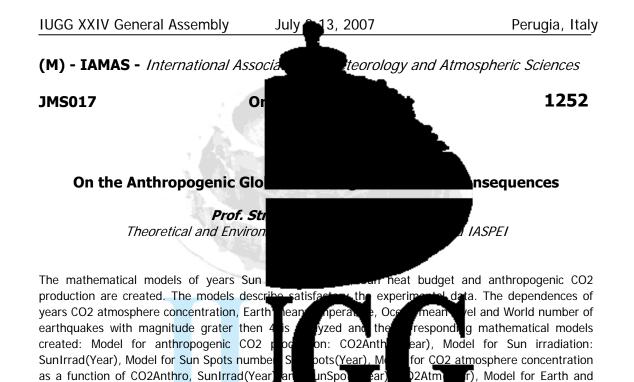
at 1750, human activities have become a and the key burghad

teorology and Atmospheric Sciences

Human-

innate elimatethe Anthropocene im invite papers describing the thumans are adding to the factors n, and attribution of the resulting ure





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and Earth ecosystem

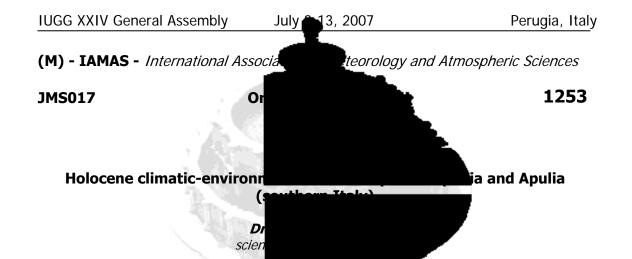
of Earth temperature,

Model for magnitude spectral numbers as function of Earth temperature. From such model independent analysis and the functions presentation\_follow\_that\_the Earth temperature increase is straight consequence of CO2 anthropogenic prod evel and earthquakes number. A way for estimation of regiona the atmospheric CO2 concentration time series (Mauna Loa, Sc its fit functions (Mauna Loa, Schauinsland and Monte Cimone) is a or better scientific based lop definition of the source contribution for C erosols. A model for the local and Earth mean year temperature is presented on the basis of station and global CO2 data which allow predicting the next year temperature with an accuracy of about 0.5-0.7 degrees Celsius. Such technique has been tested with the data eissemberg and Monte Cimone g of observatories and for the Earth as well. Sho ost real time system for he analyzing the experimental data, testing models solutions and fer t p'ysi reliability of their predictions. The including in the Stern report for estimation of Global Warming economical costs the seismicity part is proposed.

some local stations year mean temperaty

(Ocean- El Nino) response: TempEarth(Year), Mod

 Keywords:
 vernadsky, antropogenic, changes



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High-resolution paleoclimatic studies (e.g. of the Holocene climatic variability. They give but they dont are unable to provide direct landscape and human ecosystems. geomorphologic/pedo-sedimentary systems ancient human communities, detailed stratig out. In addition to indications provided by li the study has recurred to historical, archaeological

approach has allowed to better understand the significance of the changing events, enable us to distinguish the modifications induced by local/accidental agents (e.g. anthropogenic, physiographical) from those effectively due to potential acquired geoarcheological, tephrastratigra resolution paleoclimatic records, from the Antonioli et al., 2000; Siani et al, 2004), 2001), showing a substantial variability of the main regional cyclical climatic changes, centred at c. 5.5-5.0; 4.0-3.7; 3.0-2.5; 1.5-1.0 ka BP, appear to coincide with significant changes of the morphodynamical processes recognised in the

investigated successions. More precisely principally by arresting or enhancing specif different environmental contexts of the modifications seem to have influenced human societies as well, affecting settlements, local occupation, circulation and the economic strategies. Many time the o Neapolitan Volcanoes and climatic changes acted of able to destabilize the ecological balance, forcing interregional migrations of human groups which in turn could have caused social-economical crisis and even conflicts. References: Allen, J.R.M., Watts, W.A., McGee, E., et al. (2002) Holocene Monticchio, Italy. Quaternary International Cyclical climatic-environmental variations of

Geologica Italiana, 55, 345-352 Anton Quaternario, 13, 95-128 Bond, G., Kromer, Atlantic climate during the Holocene. Scie J.C., et al. (2004) Holocene climate variabi Paterne, M., et al. (2004) Tephrostratigra

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detailed reconstructions nperatures and rainfalls, ffects of the climatic changes on e response of the subaerial and their potential impact on the Italy have been carried hological investigations, Such a multidisciplinary

> The work shows the o some selected high-02; Allocca et al., 2000; t al., 2004; Bond et al., Ilennial cyclicity. Some of

> subaerial environments

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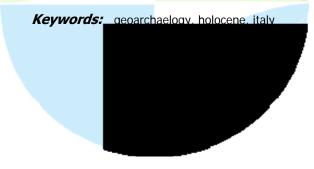
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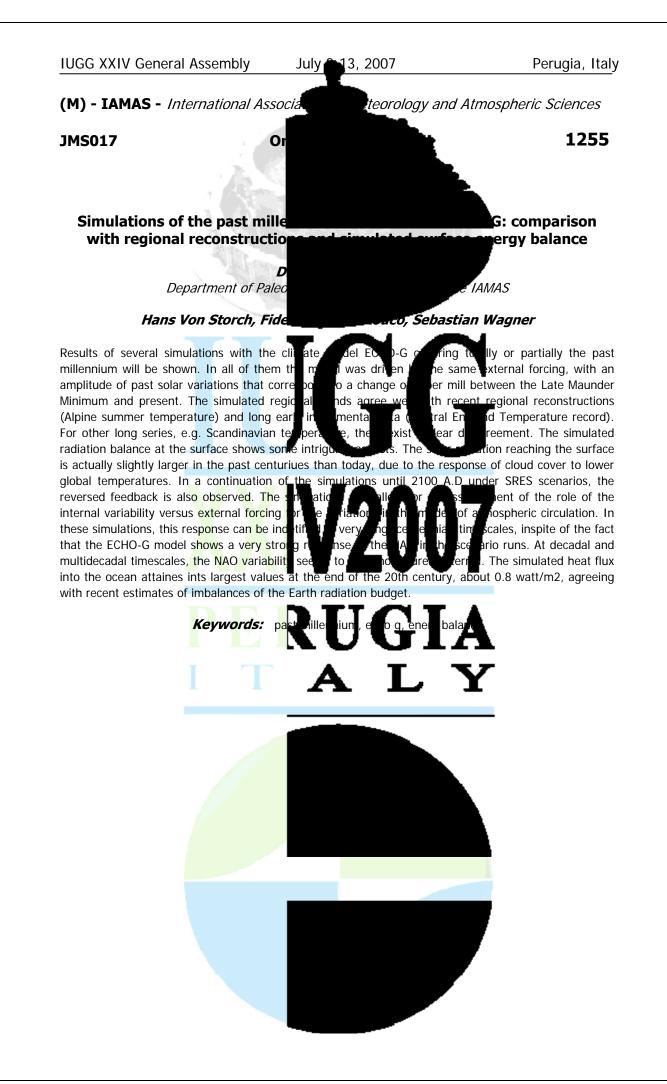
clinate induced environmental mbined act of eruptions from the and hist ic communities as factors bility the record from Lago Grando di ato, V.; Coppola, D., et al. (2000) aia and Apulia. Memorie Societ del clima nellOlocene. Il t solar influence on North , Rohling, E.E., Stager, 5. Siani, G., Sulpizio, R., ars deep sea sediment

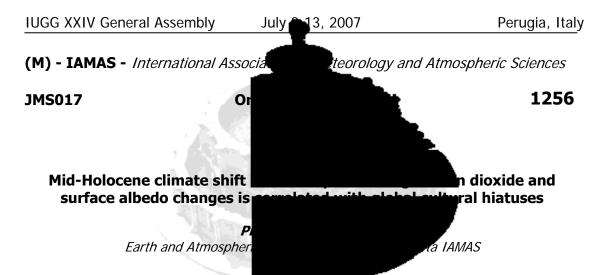
sequence for the South Adriatic. Quaternary Science Reviews 23, 2485-2500.











Apparent from proxy data collected from wetter conditions in the early Holocene (price drier conditions after 6ka BP, with a relative data come from archeological sites and hemispheres (Asia and Brazil) demonstra coincident with this climate change. Global here and do show the 7k-6k transition that shift correlates well with a variety of proxy data ta

significant role in the cultural hiatuses red

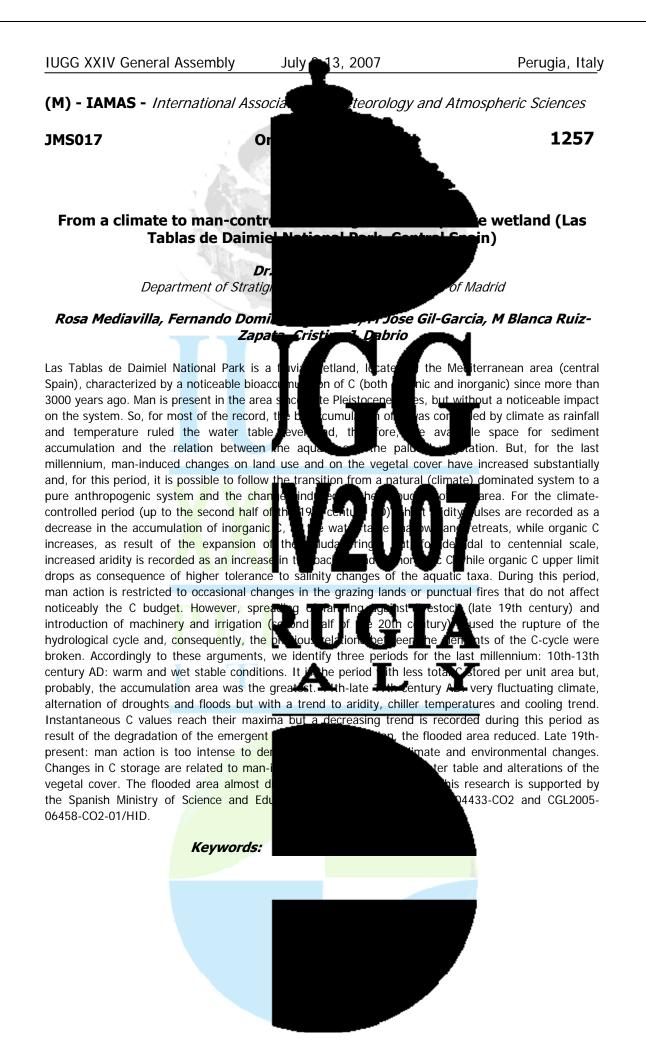
hem hem particula to 0 yea befor transition bet surrounding iral <u>biatuses</u> al sim bns rapid egi hd aro

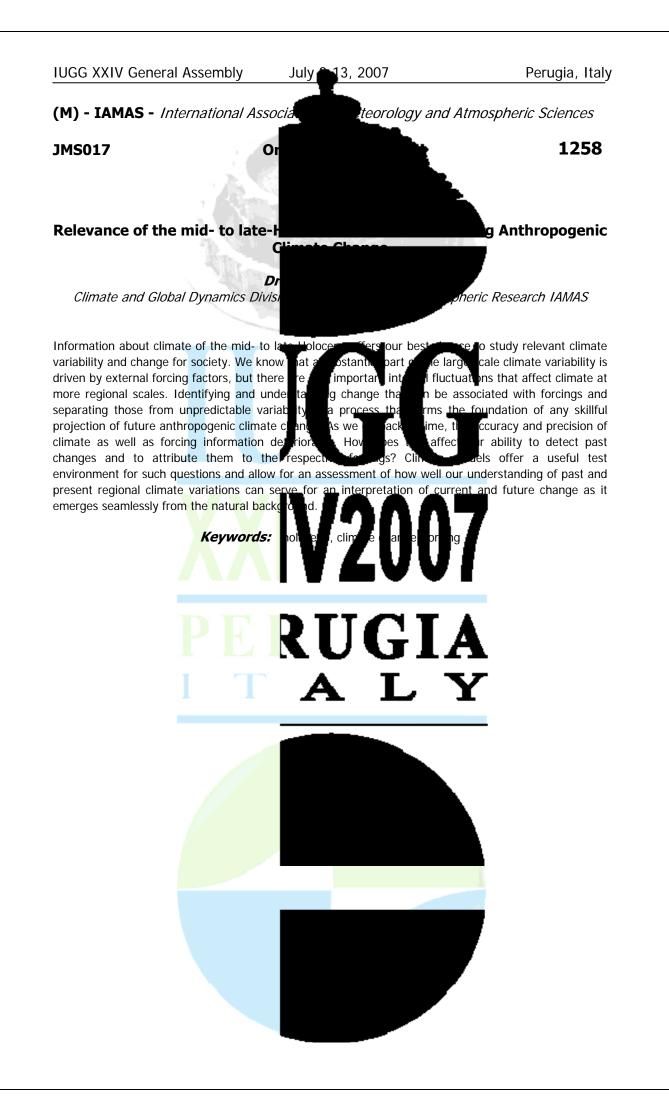
experienced colder and a BP)) and warmer and esent h 6ka and 7ka. Some of the proxy Archeological sites from both cultural replacement) that are Holocene are presented nning entral Asia. This climate uch aikal in Russia and Lake

Hovsgol in Mongolia. The simulated mid-Holocene climate shift is attributed to the gradually increasing values of atmospheric carbon dioxide as well as to changes in the land surface albedo associated both with the elimination of the remnants of the cover. These two mechanisms combined from the changes in carbon dioxide alone. these results nevertheless suggest that

hitant changes in snow h would have occurred ffect from a correlation, ikely to have played a aid in interpreting the











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### **JMS018**

## Symposium **High Latitude Modes of Climate**

Convener : Dr. David Bromwich

The climates of the Arctic and Antarctic variability such as the Northern and Sou Oscillation that is manifested in high latitud (PNA/PSA) patterns. The impacts of the

Oscillation will also be explored. The symposium will be concerned how the affecting high latitude climate, how the diverent occurs, the roles of high latitude versus tre initiating and/or amplifying change, stratosp of natural versus anthropogenic forcing. Co these topics, such as observational analyse and all types of numerical modeling

eract des <sup>r</sup>cing, tl rol rsus troposph ons are solic eana

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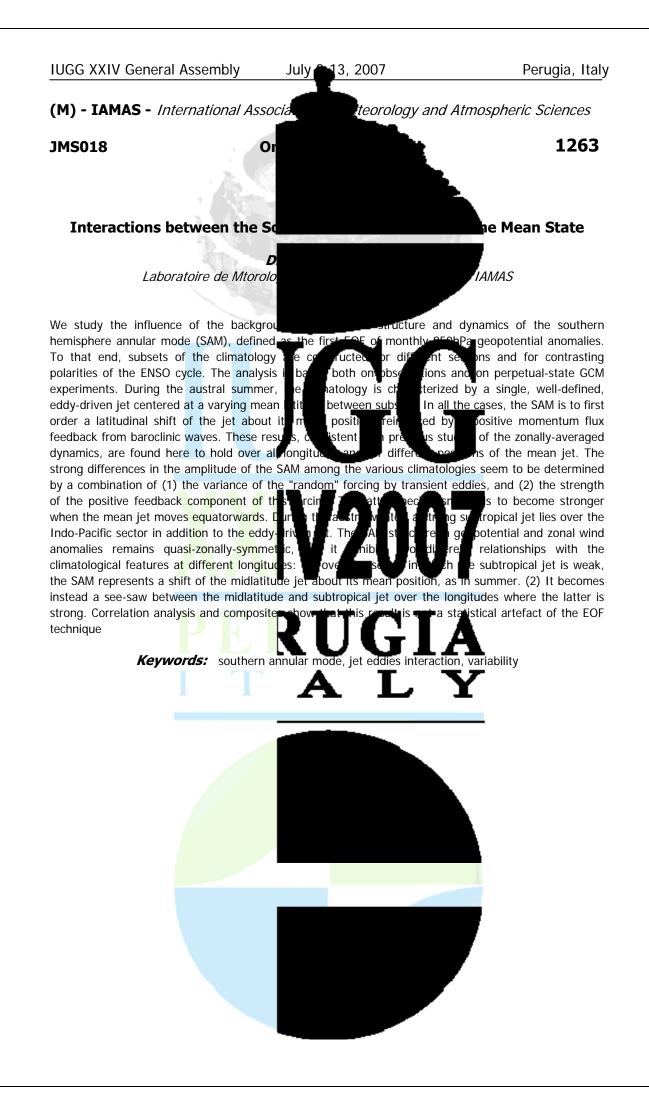
modes of atmospheric ), and the El Nio-Southern fican and Pacific-South American cillation and the Atlantic Multidecadal ese patterns are changing and

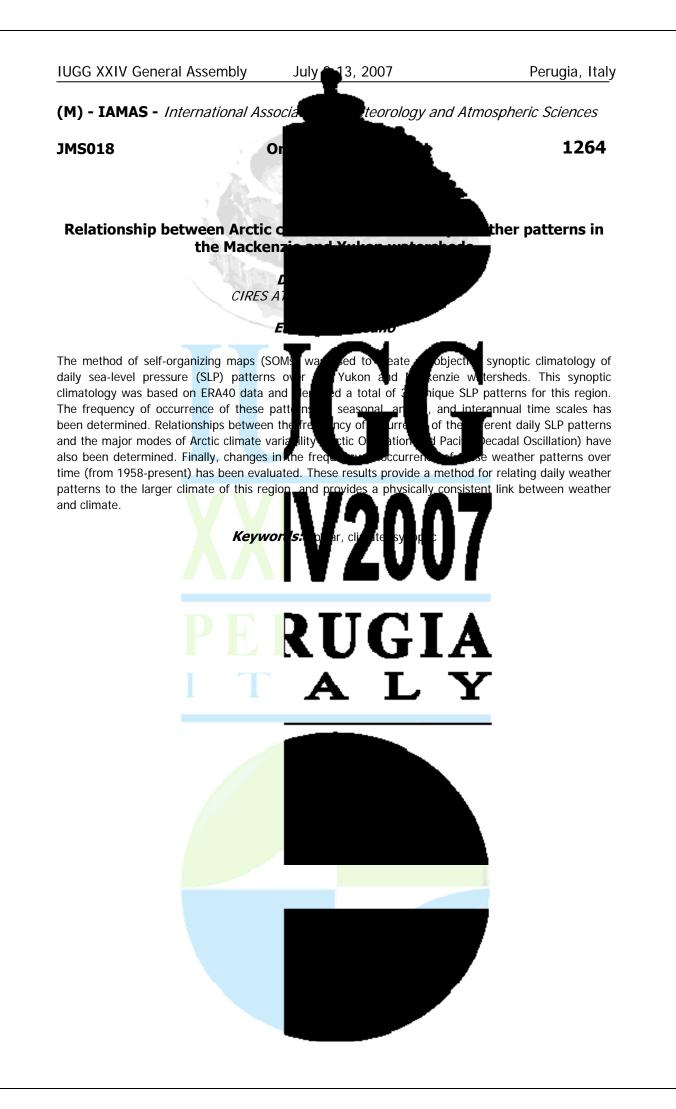
teorology and Atmospheric Sciences

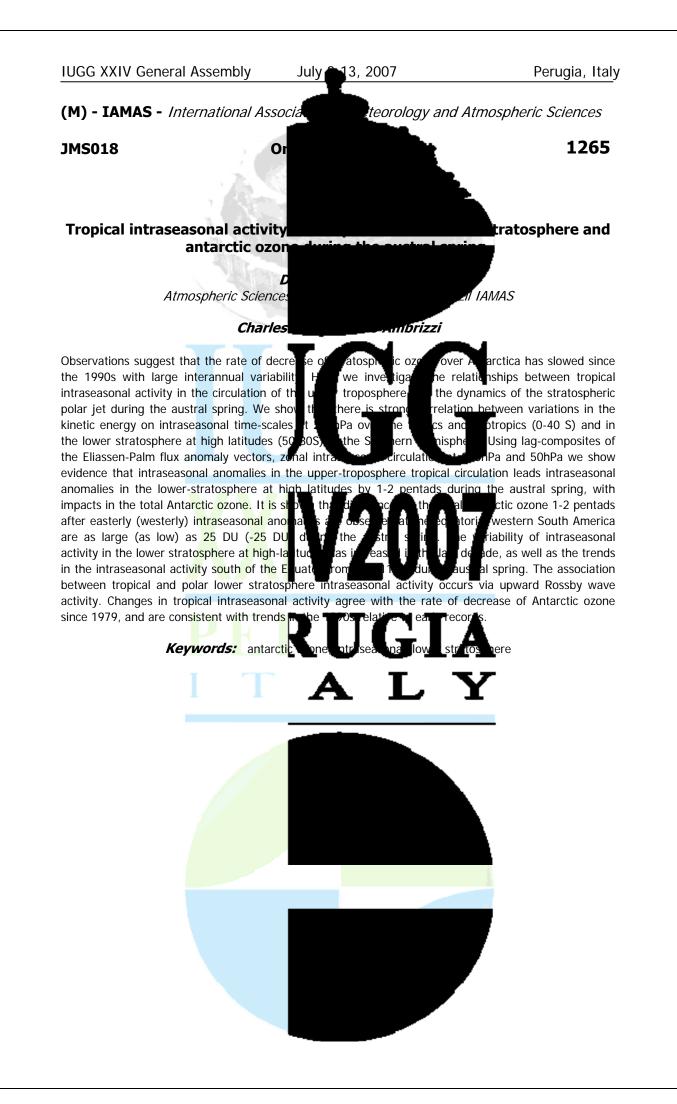
chanisms by which this the f the ocean and sea ice cover in causes of variability, and the issue from all approaches that bear on ends, theoretical studies, con

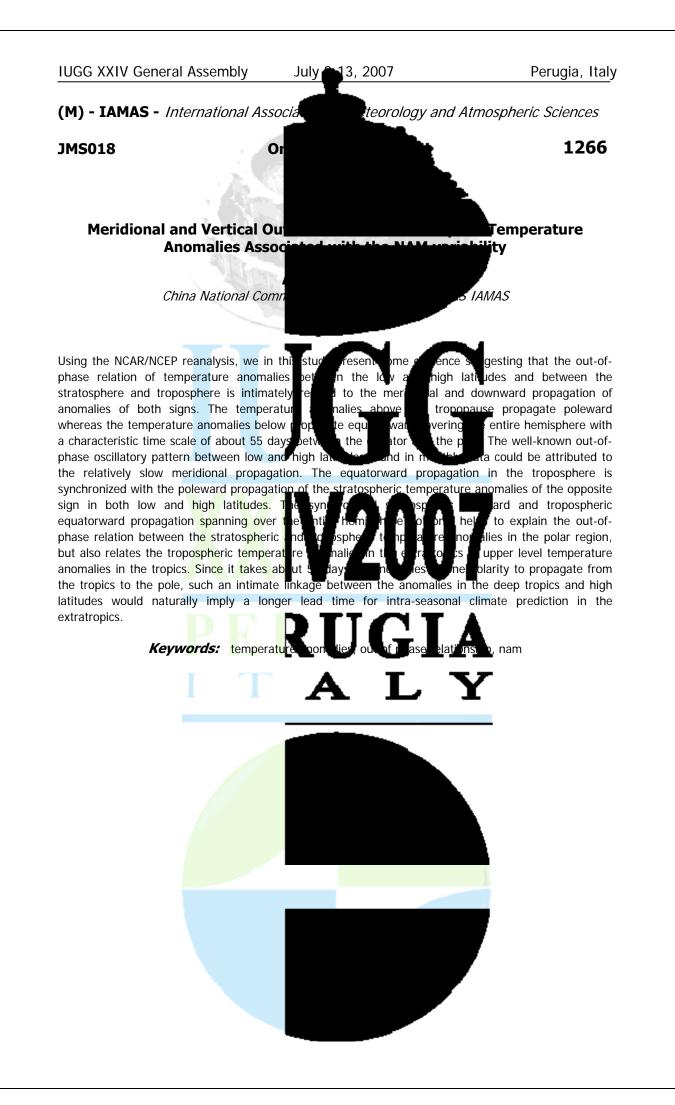






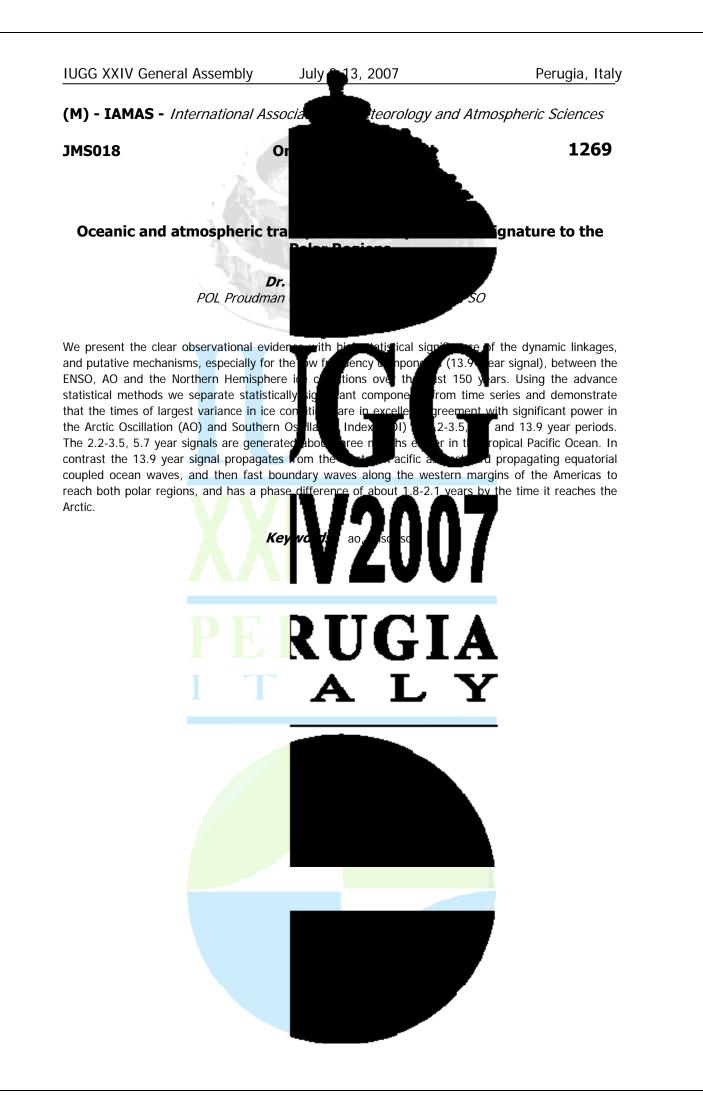


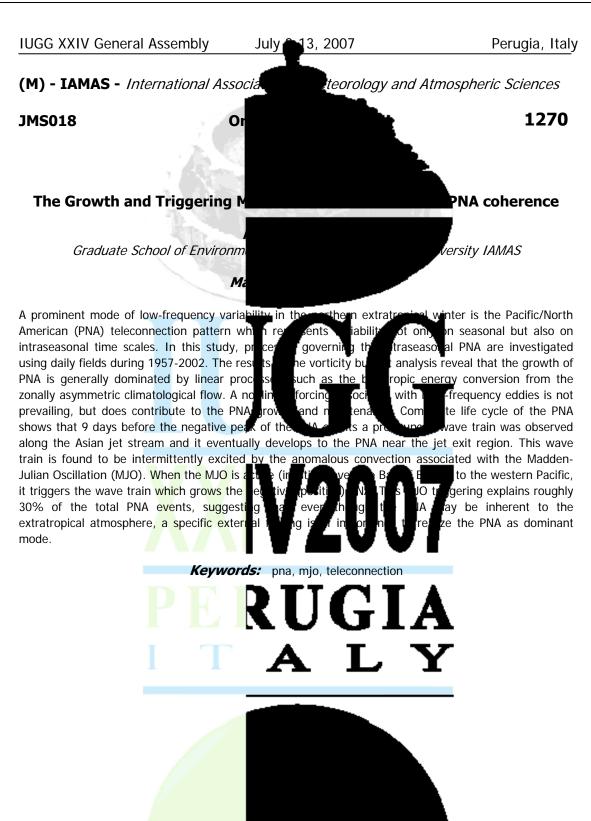




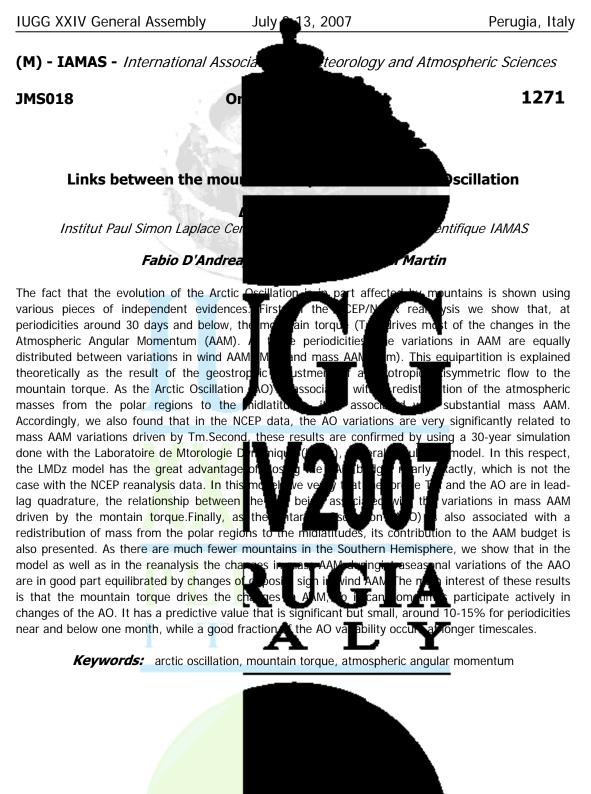




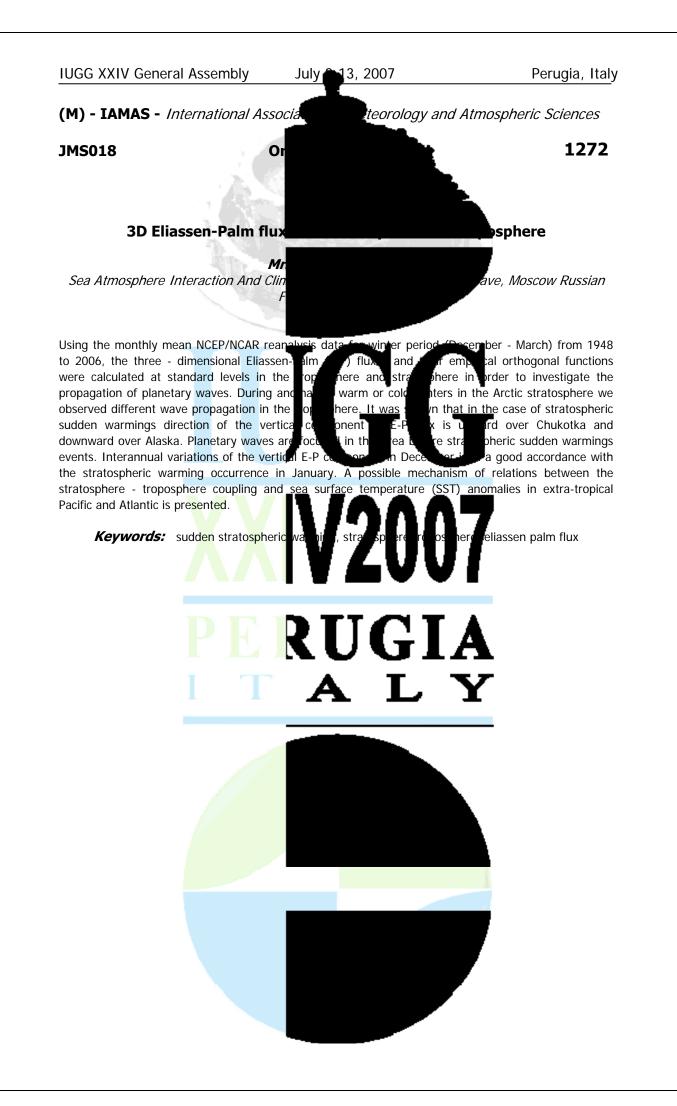


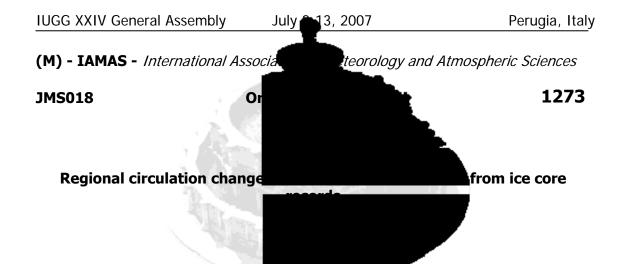












We present preliminary results from a new shall accumulation site (Gomez) on the southw Antarctic Peninsula region has experience observational record: annual temperatures Hemisphere and many ice shelves fringing changes in the regional atmospheric circul Hemisphere annular mode (SAM), an index of the

summer and autumn. The aim of the new core is to extend our understanding of atmospheric circulation in this region beyond the period of observational record and thus to set the recent climate change in a longer temporal framework. Analysis of a Weather Forecasts re-analysis (ERA-40) between the SAM and accumulation in analysing the Gomez core we compare an hua records from the Peninsula will also be preser significant SAM-accumulation relationships exist

(130 Antarctic atic changes ncreased are Penins ĥa e als een west

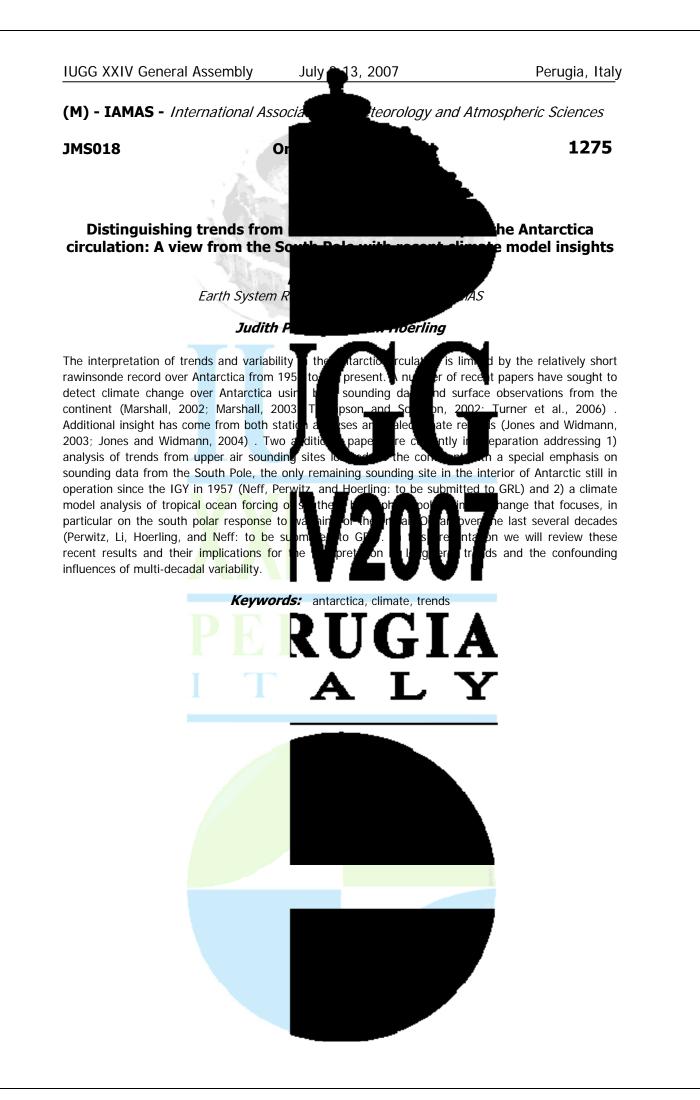
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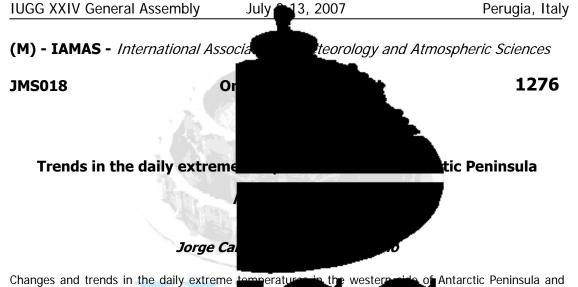
lled in a relatively high core a during the 2007 season. The limate over the past 50-years of than elsewhere in the Southern isinted d. Contemporaneously, particular the Southern erved become more positive in

> tre for Medium-Range statistical relationship as the initial step in ndex. Additional ice core al extent over which any









the composite synoptic-scale pattern asso ated Climatological indices were selected from t Research Programme on Climate Variability constructed using the ERA-40 database. Th those minimum temperatures falling below function. As preliminary results, a decrease being statistically significant at the level of 90

hand, a positive trend of warm nights in summer (December-January-February) and autumn (March-May) was observed being significant at Fre over Bellingshausen Sea. The observed wa nights, this implies a decrease of the extre the daily extreme temperature accumulati negative (positive) trend of cold (warm) (northern) airflow, i.e., decrease of cold Antarctica.

the cline ate edictability (C and warm % or perce av/ Vei associated with positive anomalies in sea-level pressure (SLP) over Bellingshausen Sea. On the other

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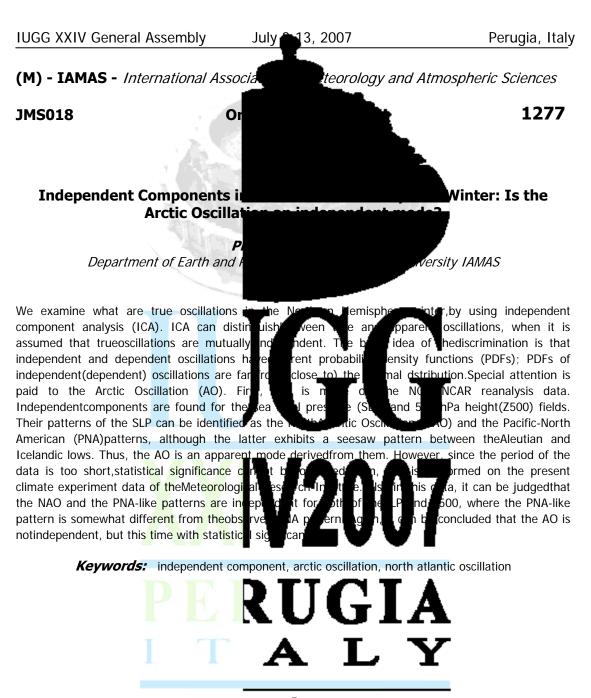
the 1971-2000 period. hge indices recommended by the R) and the synoptic pattern were s were respectively defined as all ccumulative distribution d nigł vas found in the region Frei station, which is

tive anomalies on SLP ostly due to fewer cold rming on the cold tail in nalysis indicates that the e (increase) of southern western side of the Peninsula

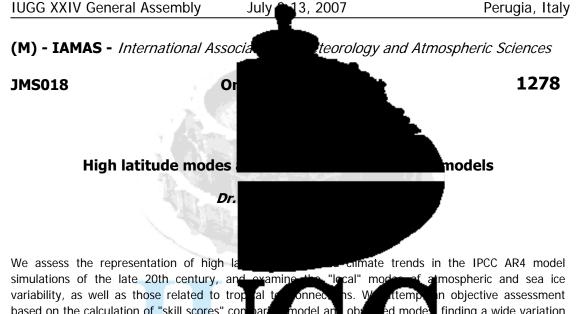


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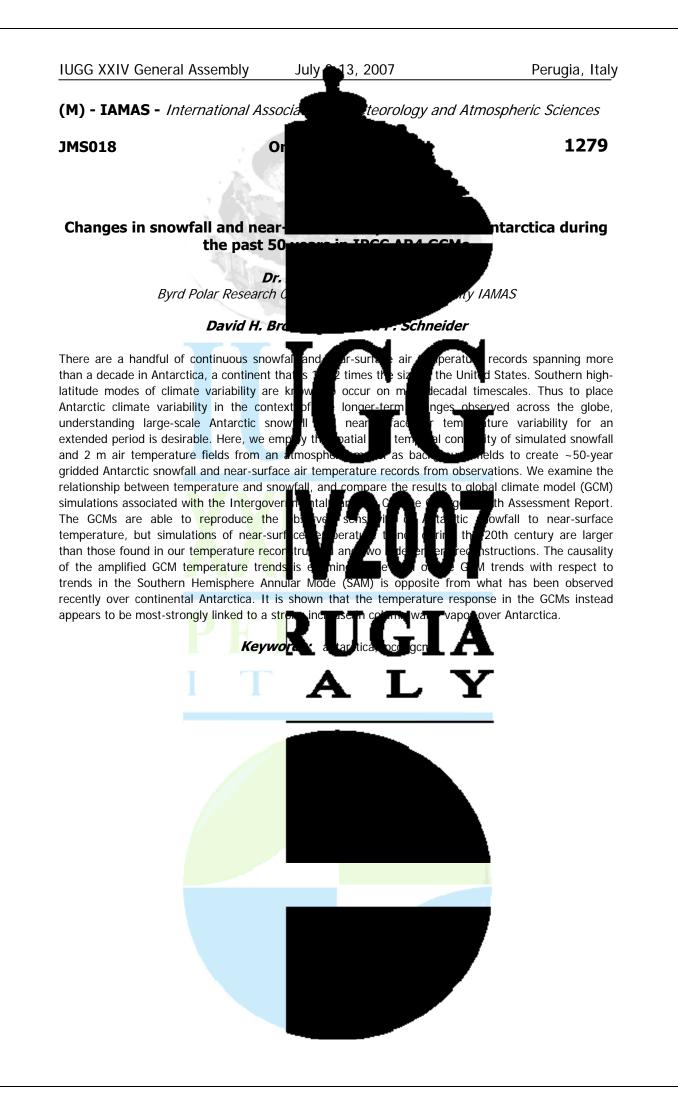


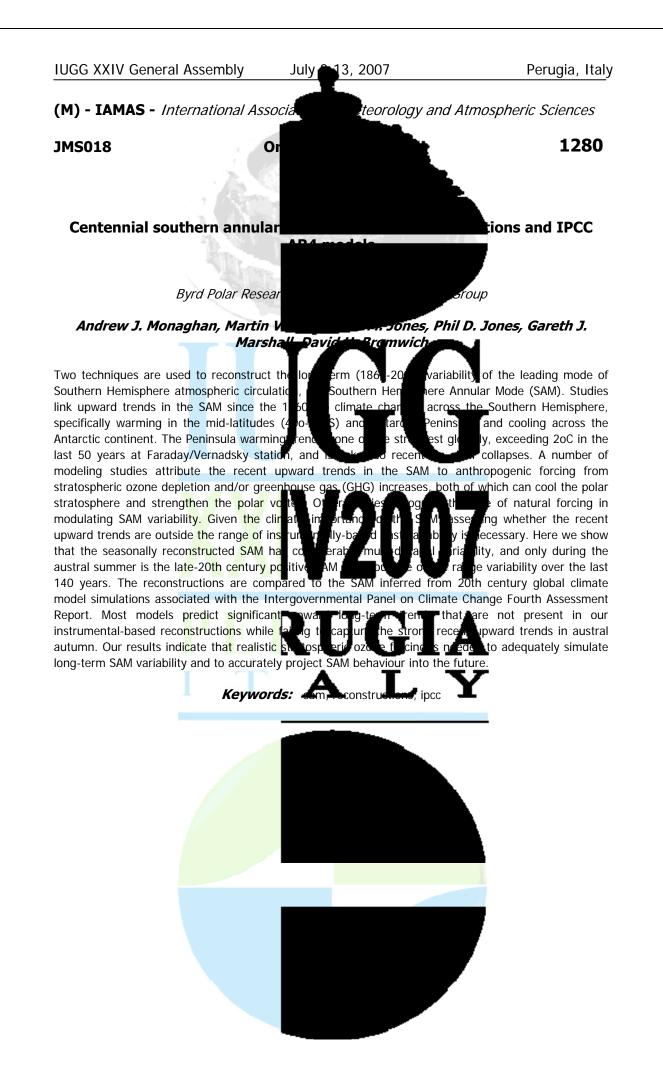


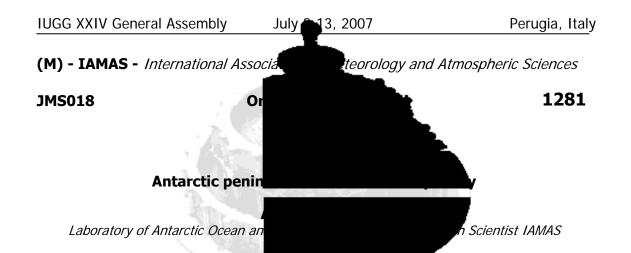


based on the calculation of "skill scores" conpar ed model finding a wide variation nodel an ob in skill between various models. More particula we consider erature trends over the continent y wi<u>de scatt</u>e over the last 40 years. Individual models sho their<u>simulat</u>ed temperature trends over this period. The large trend over the ter is well represented, which penir makes it clear that whatever has been drivi capt by many GCMs. Only a trend b ti not few individual models produce creditable simulation . Trends in temperature ias be are clearly linked to the sea ice simulation, another variable that most models do not simulate well.









Recent numerical estimations of climate v ر ility الطعنة eters for Sc demisphere indicate that the Western Antarctic Peninsula region is hot bhenomena is traced in lain hisph E Th surface and troposphere warming trends, irculation form, surface pressure iling larg -SC decreasing, in sea ice retreat tendency decreasing tarctic Circumpolar warm water propagation over Peninsula shelf, land ic melting, in earance of natural emissions of greenhouse gases from ornitogenic soils at arctic so or wever, the Climate and ids cenarios are not able to General Circulation Models based on moder heric e g conte atr reproduce evident warming conditions near Antarc y of current and historic a. The regional climatic variations based on observed data is very important for numerical model development using different relationships between Antarctic Climate System parameters. Some ideas for physical processes parameterisation can be obtain parameters distribution and from their va based on manned stations data comp Environmental Research) Projects and SCA Ŕκ are presented. The results of the probat listi temperature, sea level pressure and other key climate parameters in this region undertaken for determining the inter-annual variability characteristics showing the annual cycle modulation by synoptic scale variability are demonstrated. Current on, ozone, hydrological, sea ice, biological and greenhouse gases concentrati measur hents riod are used for unique ne series demonstrated local climate regime formation description atis lo te 11 that inter-annual tendencies of seasonal surface and troposphere temperatures over Antarctic Peninsula are more prominent than those observed in continental An rctica. Res. sof prevailing large-scale atmospheric circulation forms and extra-tropical parameters statistics obtained from ne climat AARI synoptic archive and NCEP/NCAR reanalysis are presented. Statistical characteristics of interannual variations parameters, annual rhythmics, synoptic scale processes and of diurnal course are calculated with account of low-frequent correlation. To parameterize the synoptic applied. It is demonstrated, that modulation variations of annual mean values (additiv over different ranges of variability are pro data at standard synoptic hours allowed scale processes into formation of observ

atmospheric layer in the vicinity of the Anta

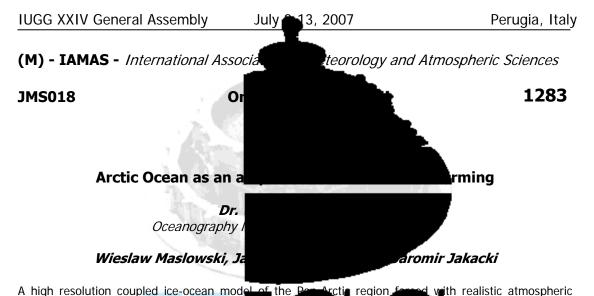
arctic Climate system ate variability pictures hce Antarctic Data for up information resources me series of surface air

uggestion of stationary and periodic of stochastic impulse process is variability significantly exceeds estimates of annual trends eteorological observations ribution of different time ameters of the surface

*Keywords:* climate change, estimation, trends







A high resolution coupled ice-ocean model of the data from ECMWF for 1979-2004 is used to system. Recent warming in the Arctic has m ice pack. It has been commonly associated over the Arctic . Those in turn have been li this approach is about the dominant role of processes internal to the Arctic Ocean . through the under-ice ablation and laterar melt

inve s an ate d d itself m hif, bst homalies of s the Arctic Os nal atr ar, th nal model results suggest that the significant portion of sea ice variability might be due to the increased

with realistic atmospheric trends of Arctic climate ariabi igh the reduction of multiyear sea ce air temperature and circulation ion (AO). The main assumption of orcing the minimal effects of amic control of sea ice nermo been overlooked. Our

advection of warm Atlantic and summer Pacific waters into the Arctic Ocean during the late 1990s and 2000s. Such ice-ocean interactions may no which would help explain some of the fo variability in the 2000s. In addition, we determined ice extent data might be too present model results to argue that chang quantify the rate of Arctic sea ice decline.

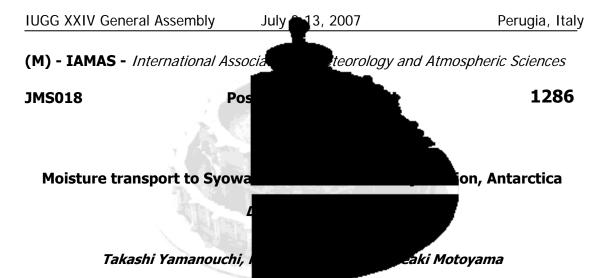
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e-correlate AO forcing, ric forcing and sea ice ce melt using satellitedimensional change. We be known to accurately









In order to see the characteristics of the air transpo we assort backward trajectories using the ground-based observations. Based upon the snow days at each station. At Syowa Statio without any relation to their arriving heights point of 850hPa on clear days. There is a lo condition", on the other hands, a low press pressure area over Syowa Station in the lear co

brought to Syowa Station from Atlantic Ocean closely associated with the activity of disturbances. As for Dome Fuji Station, trajectory comes from every direction in both cases of "snow condition" and "clear condition". Any remarkable difference bet the distribution charts of trajectories. How the snow condition that would bring the explain moisture transport routes further snowfall. Transport routes with records as bliz Air parcels come from Atlantic Ocean and Indian

ten to Syow clou othe SS we compare ow days, traj trast, they ar ure ar appe o tl is suc

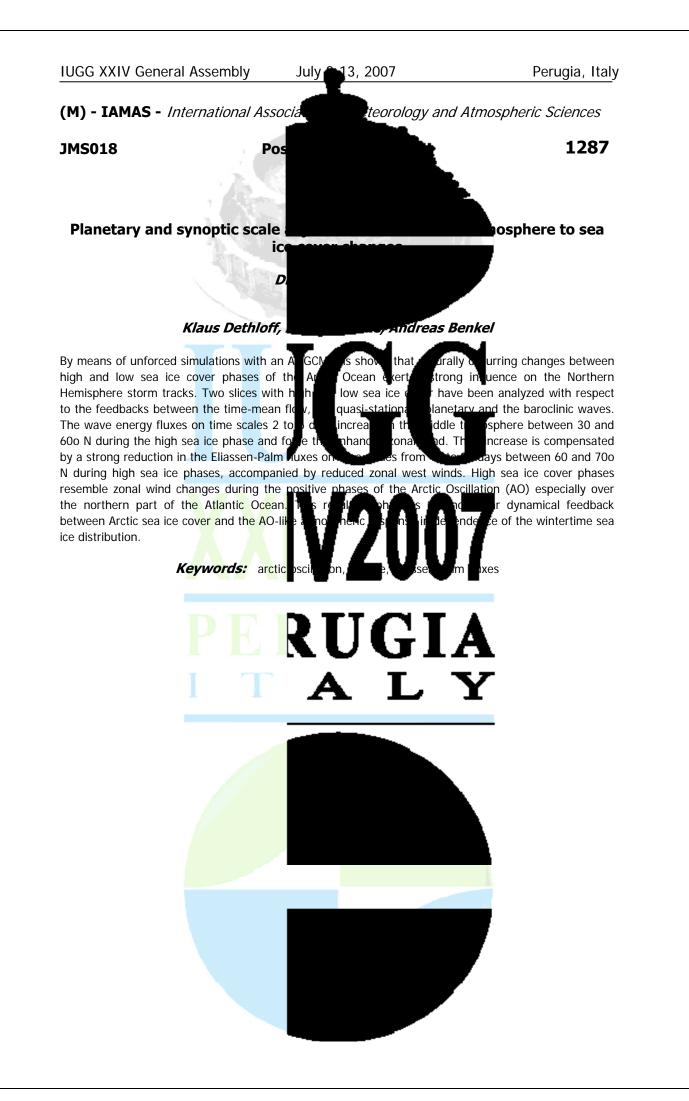
tion and Dome Fuji station, nformation obtained by eathe ransport outes on clear days and ries come from the Atlantic Ocean from the continental interior to the est of wa Station in the "snow st of wa Station and the high t the moisture is mainly

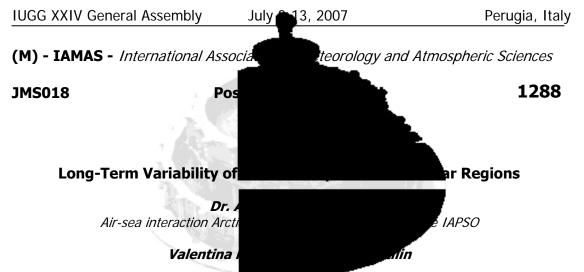
> dition" is not found in er Dome Fuji Station in tal interior. In order to llect the case of heavy emarkable characteristics.

with rapid upward advections before arriving at Ocean the station. It is considered that we might have obtained typical moisture transport routes into Antarctica.

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New analyses of recently compiled time set free atmosphere in the Arctic and Antarc temperature trends in the Arctic is inhomige negative higher 70hPa, especially above N decrease in total ozone content and increa temperature anomalies averaged for the troposphere and significant cooling in the l of low stratosphere in the Antarctic. There data

Arctic. It could result to increase of radiation cooling over Eurasian Arctic and decrease over Canadian sector; Our analyses of sounding data, Region and 30 drifting stations North Pole and positive trends of inversion strength d cloudiness, surface air pressure, and posi some agreement with observed long-term study and variations of heat advection in the low

of mo mean parar sho foi is. Its a Europe. This reen<u>house g</u> and spher the ne dis

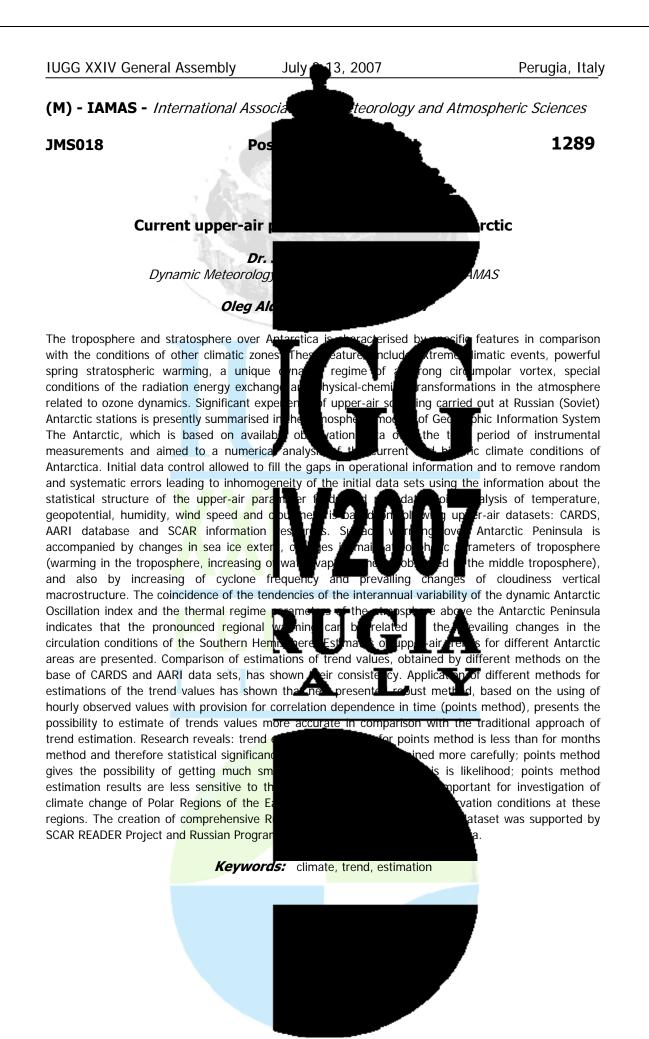
representing conditions of distribution of the air sp e in the lower troposphere and robably because of the observed concentration; - annual mean air anifest warming in the upper re to very weak cooling ic, co with results of GCMs; -

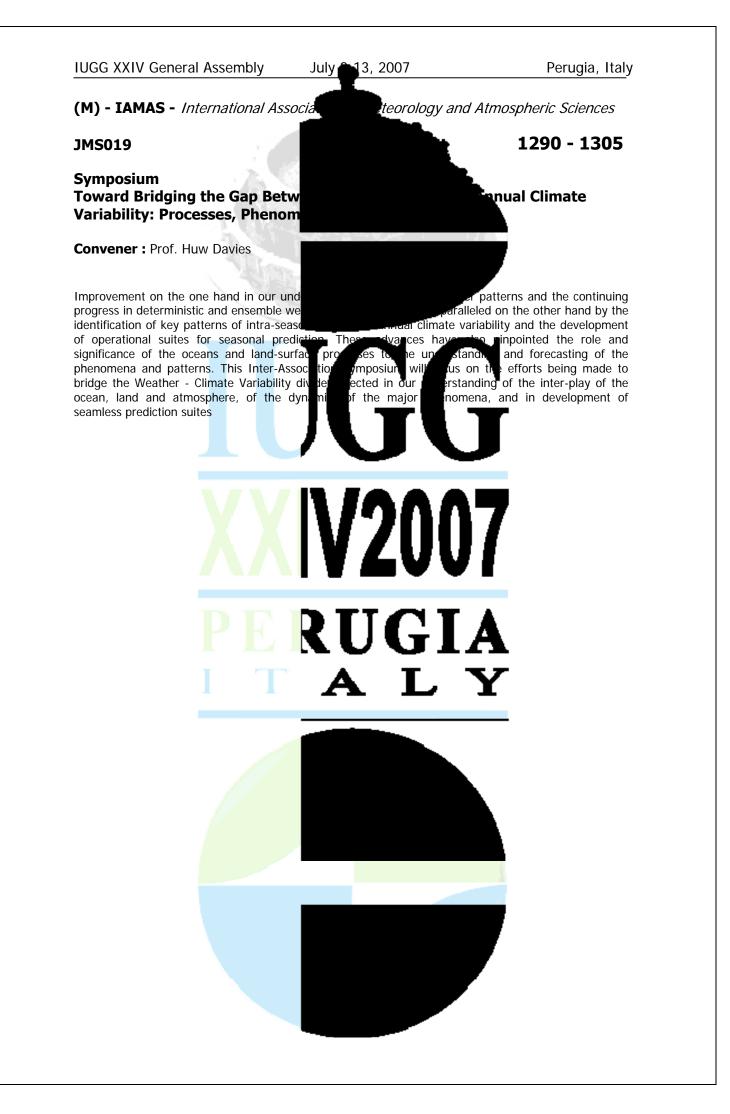
specific humidity trends are positive in the Canadian sector and negative over Eurasian part of the

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ounding East-Siberian based inversion height negative trends of total re. These trends are in ation in the region under

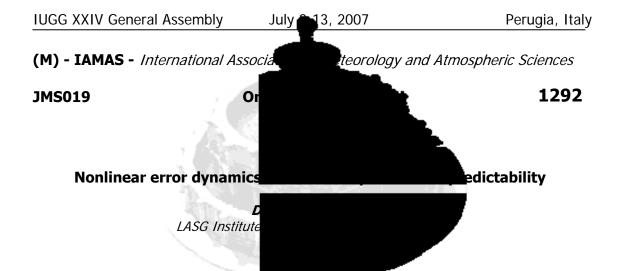












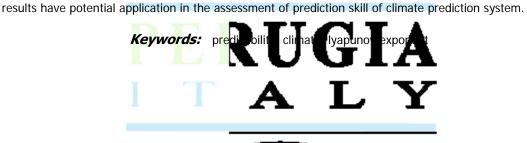
Since atmosphere itself is a complex nonlinear s linearized error growth equations to study new approach based on nonlinear error dyn mi paper, we first applied nonlinear error grow approximation equations to discuss the evol nonlinear finite-time Lyapunov exponent (FT or finite-time Lyapunov exponents. With t that the predictability limit of chaotic system can

traditional Lyapunov theory in quantifying the predictability can be efficiently overcome. Then, based on above theory, we present a reasonable algorithm that allows the estimation of climate predictability from atmospheric observation data. It i geopotential height field is high in the tro monthly predictability is generally about 6 predictability is only about 1~2 months. Ir the most regions in the Northern and S higher than that in summer, especially over the

there exis e a edict pher or quantinging ions of nonlin initial pertur ich is hlir gener deriv ear F and ativel

pf limitations using the necessary to propose a ity. It atmospheric predictability. In this dynamical system instead of linear ns, and introduced the concept of tion to the existing local es, the results indicated d and the limitations of

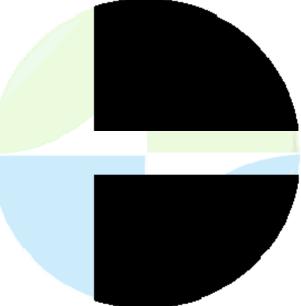
0-hPa monthly mean he tropics, the limit of ics, the limit of monthly es with the seasons. For bredictability in winter is acific, north Atlantic and Antarctica. These



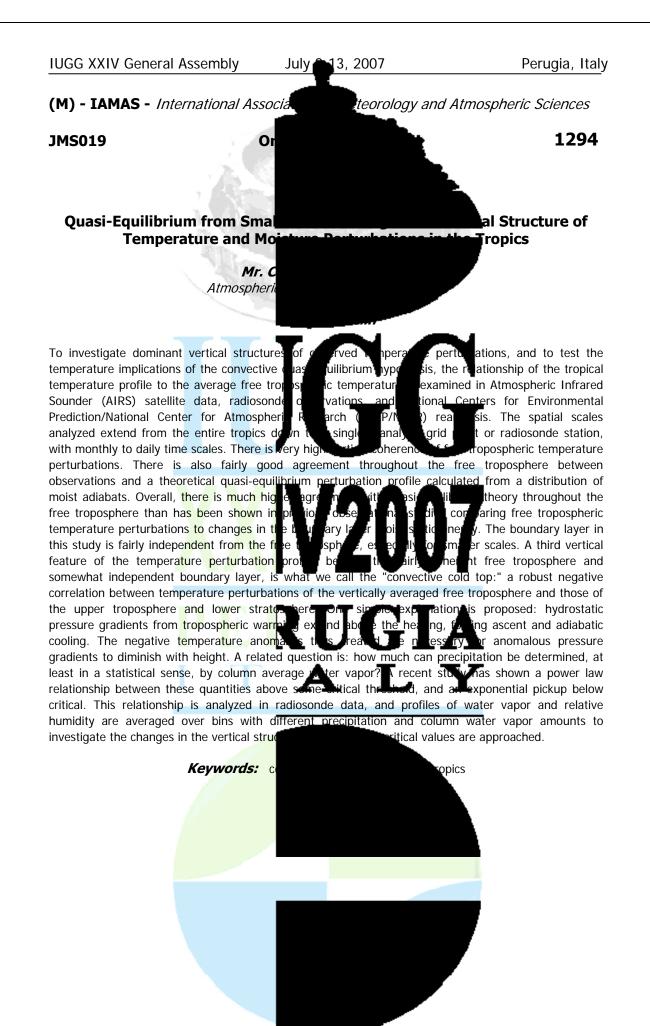
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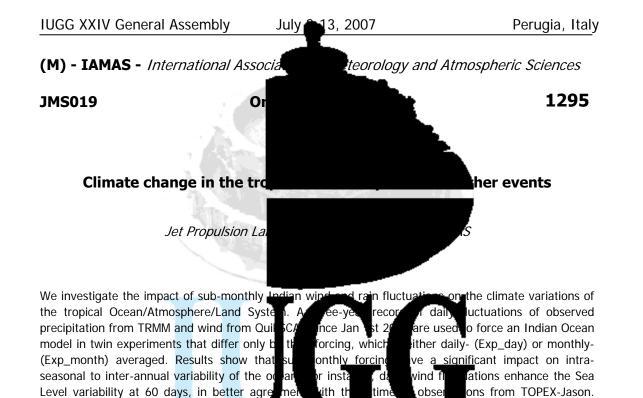
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season from May to November: the Andaman Sea is saltier by as much as 1.3 psu for Exp\_day. The frequency shift between the sub-monthly rain forcing and the yearly salinity response is due to

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in deficits increase the

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ns impact the seasonal

e associated atmospheric

Daily rain fluctuations modify the Salinity mostly

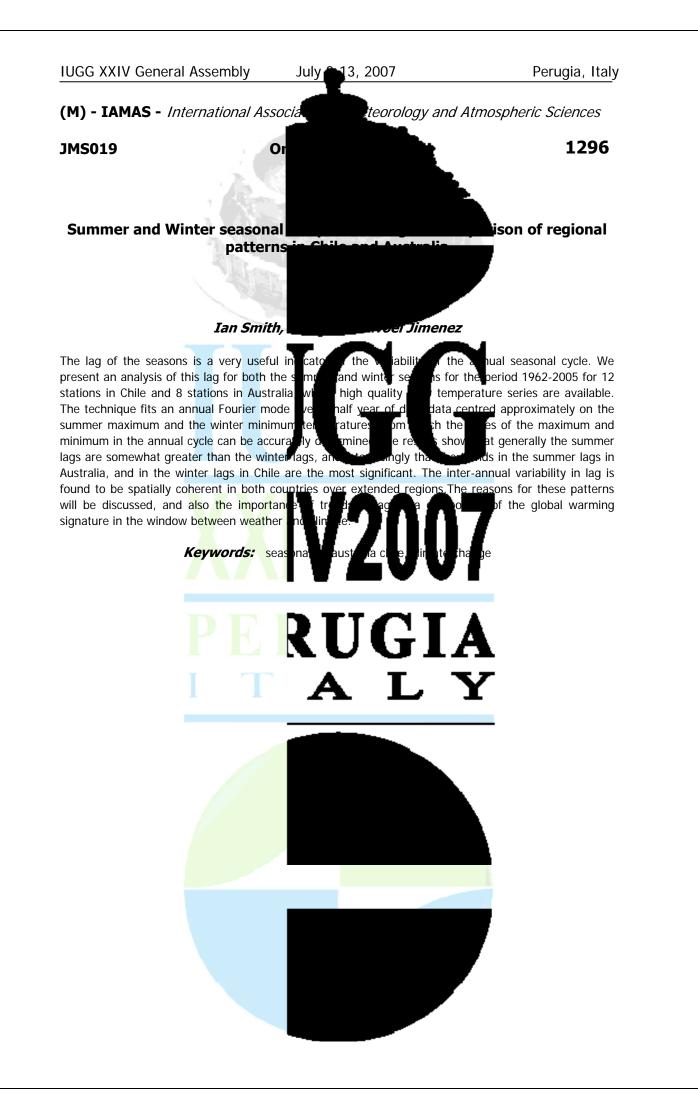
accumulation in time of nonlinear mechanic

SLS by entraining salty waters from below,

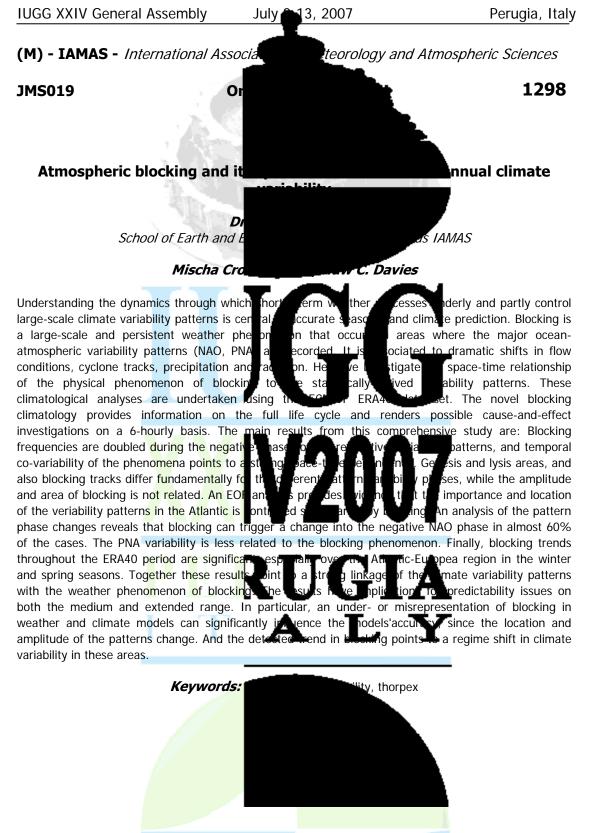
of the thick surface layer. In addition, v

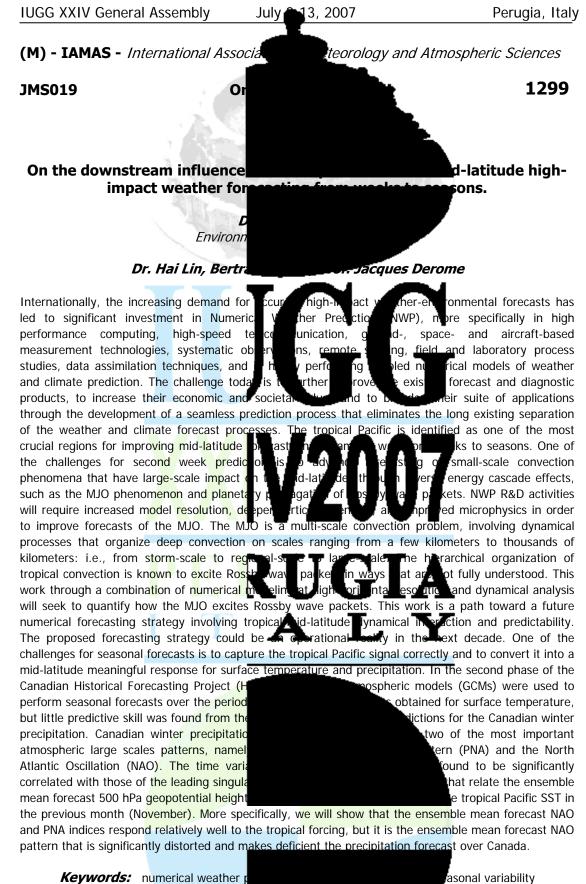
cooling and warming of the surface ocean

response at various time scales.

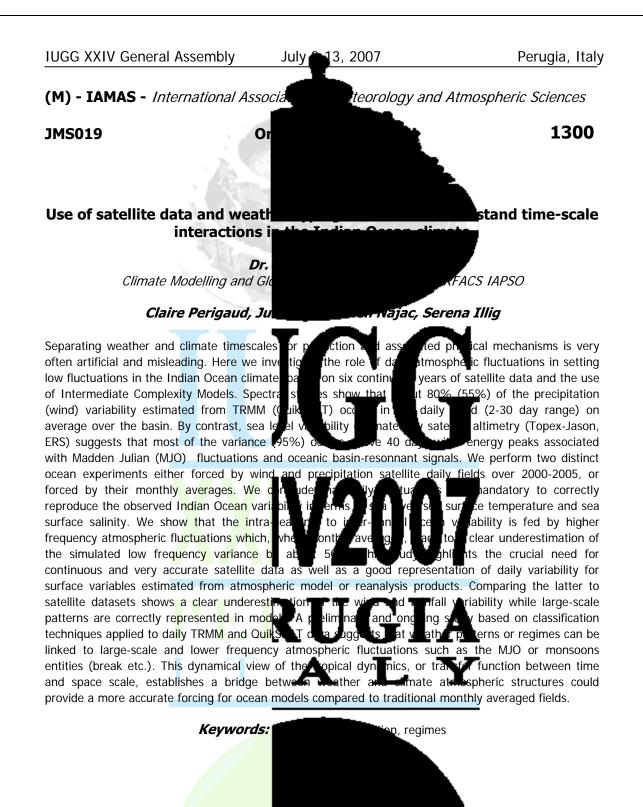






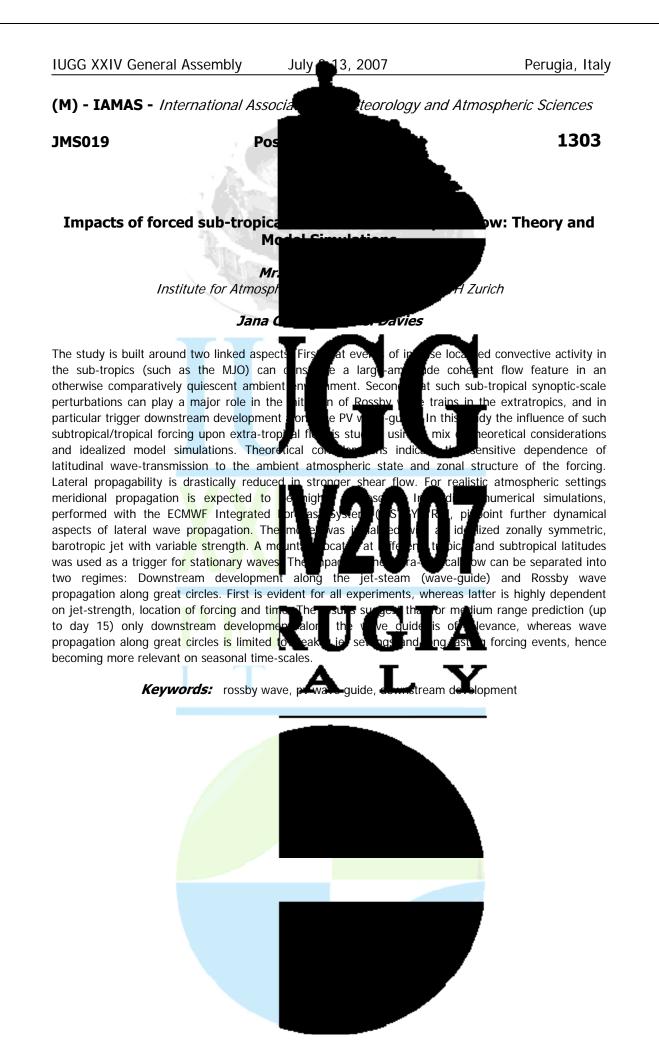


asonal variability

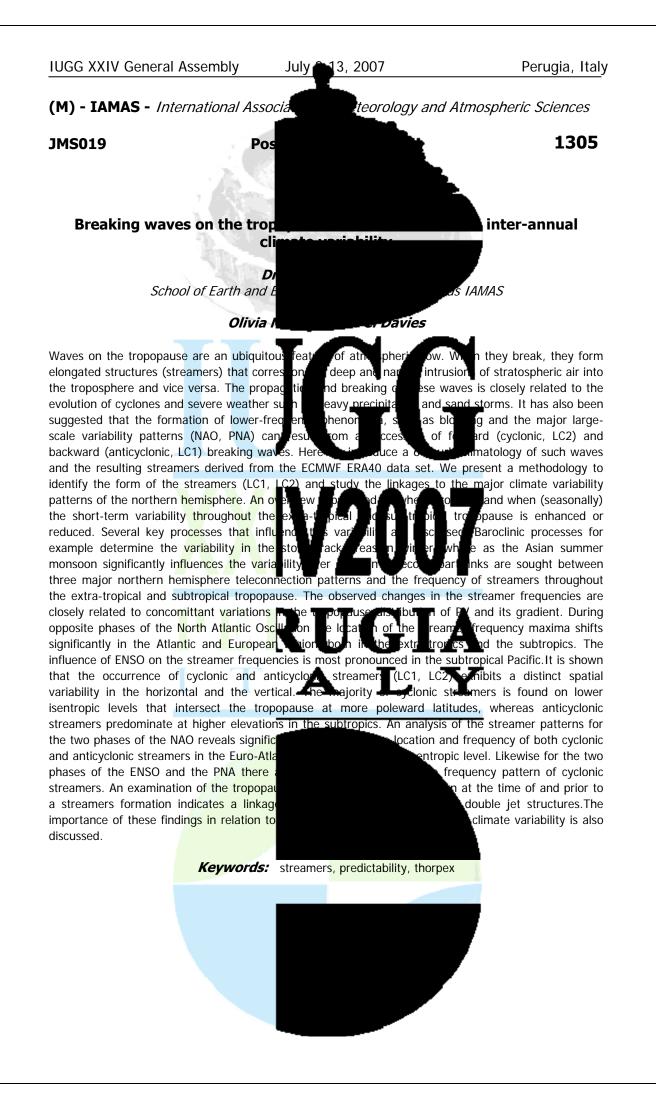












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## **JMS020**

## Symposium Assessing & Exploiting Re-anal

Convener : Dr. Phillip Arkin Co-Convener : Dr. Annarita Mariotti

The compilation of spatially and temporal with associated variables at the underlyin state and soil moisture) has presented the It has become possible to derive globa weaknesses of the data sets, highlight the developments

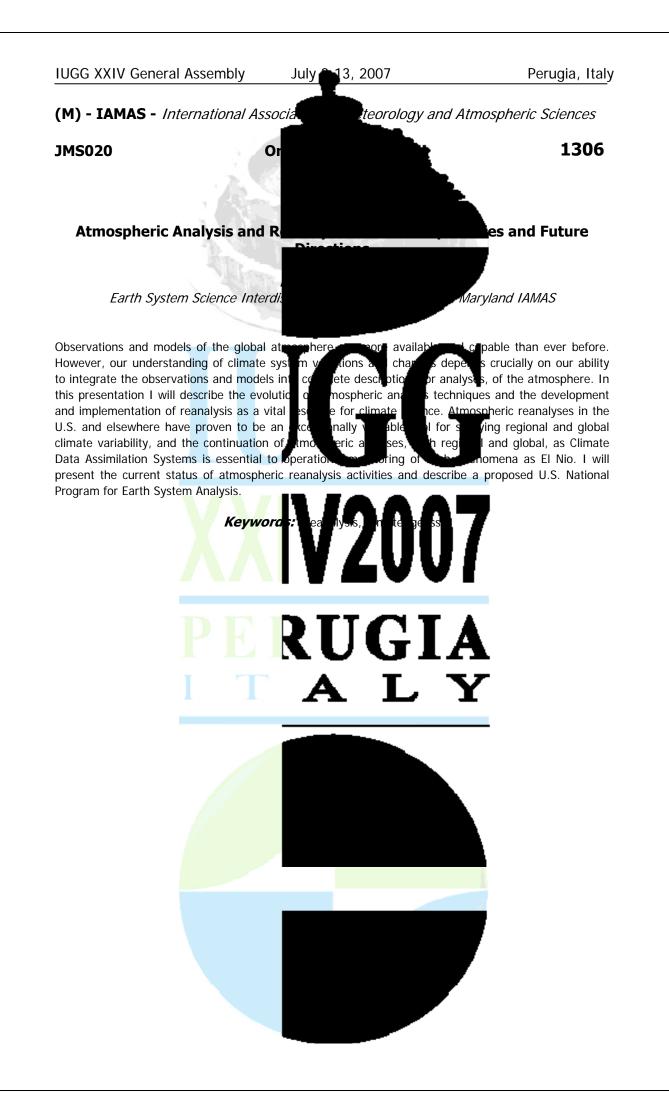
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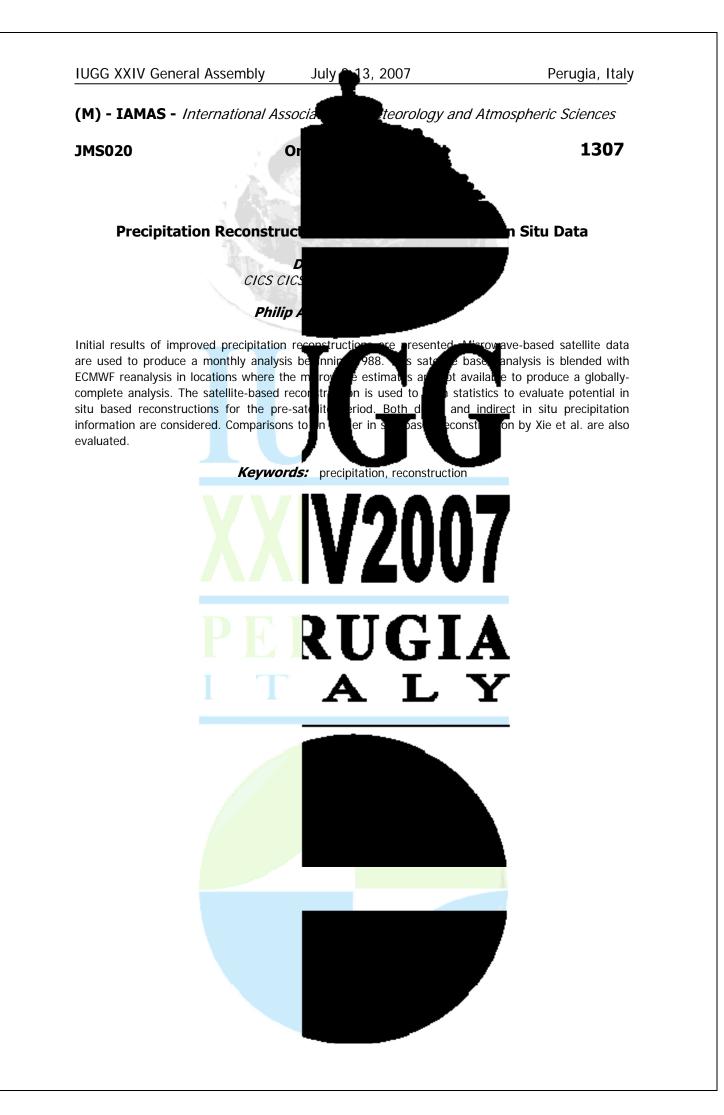
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hosphere variables along e, wind stress, land surface th unprecedented opportunities. for a range of variables, to compile climatologies of a myriad of phenomena, and to undertake detailed diagnostic analyses of environmental processes. This Inter-Association supposed will all at as assing the strengths and ies, and preview future d bstic sti made

**V2007** 

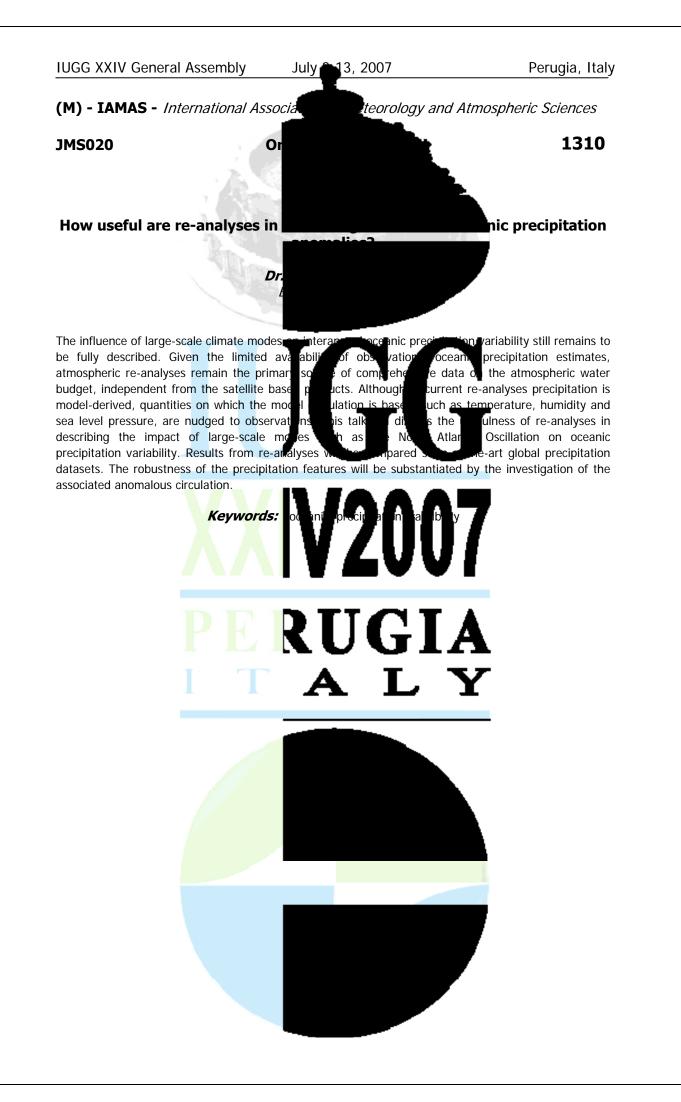
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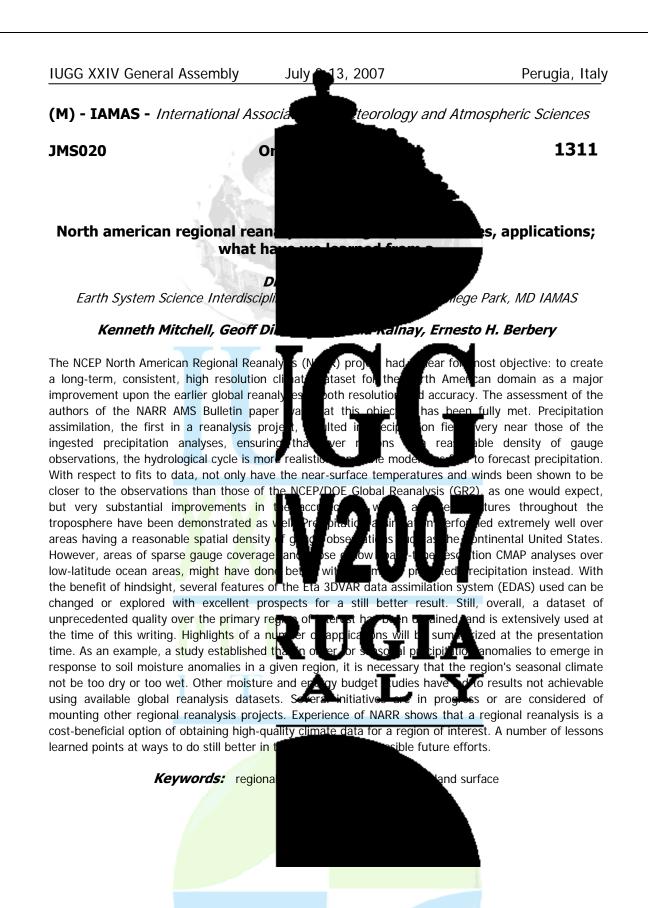


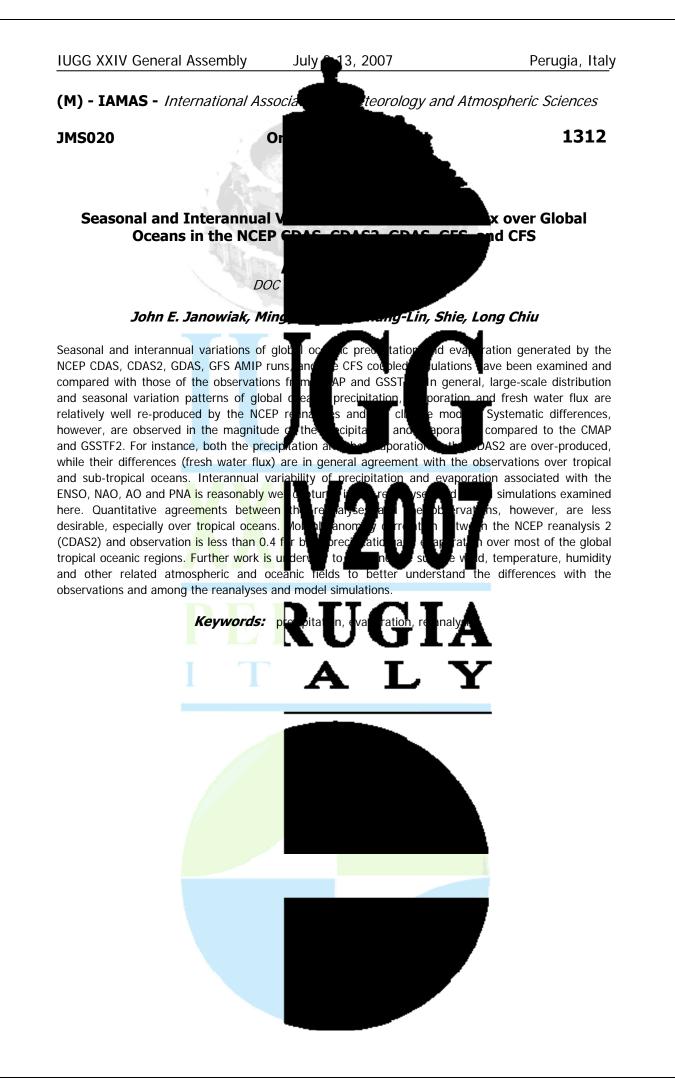




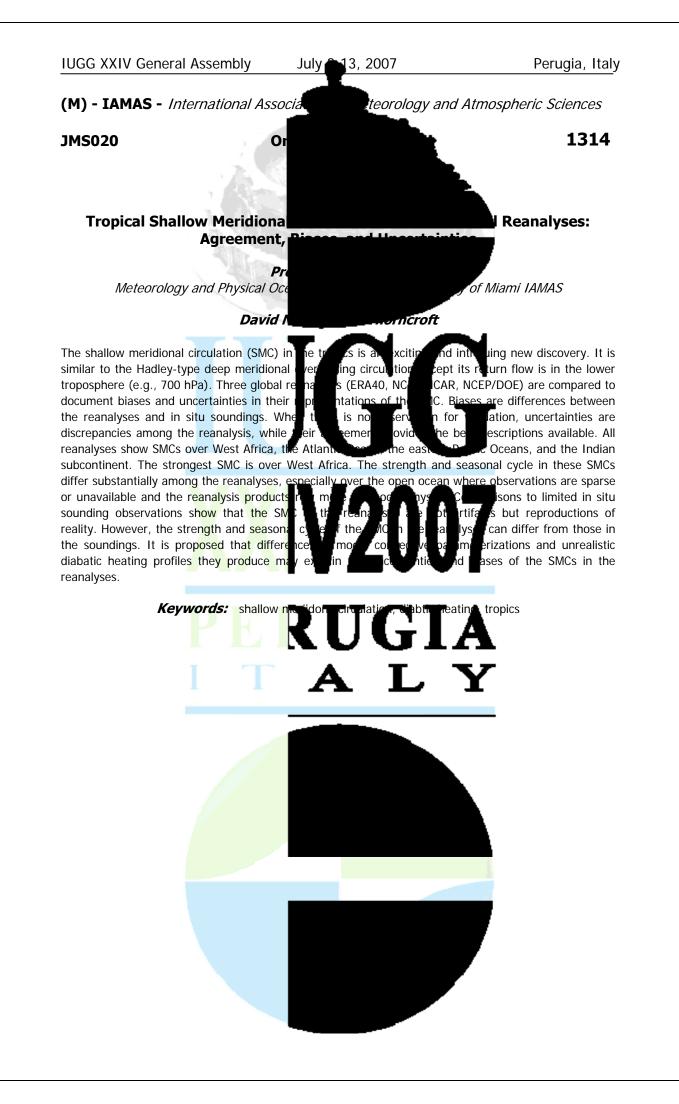


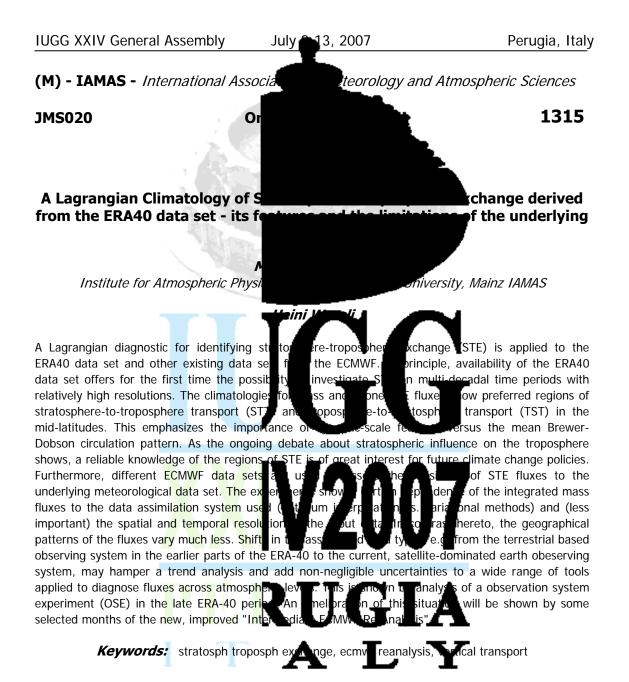


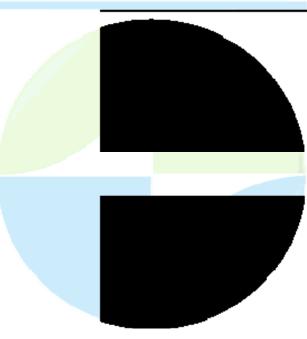


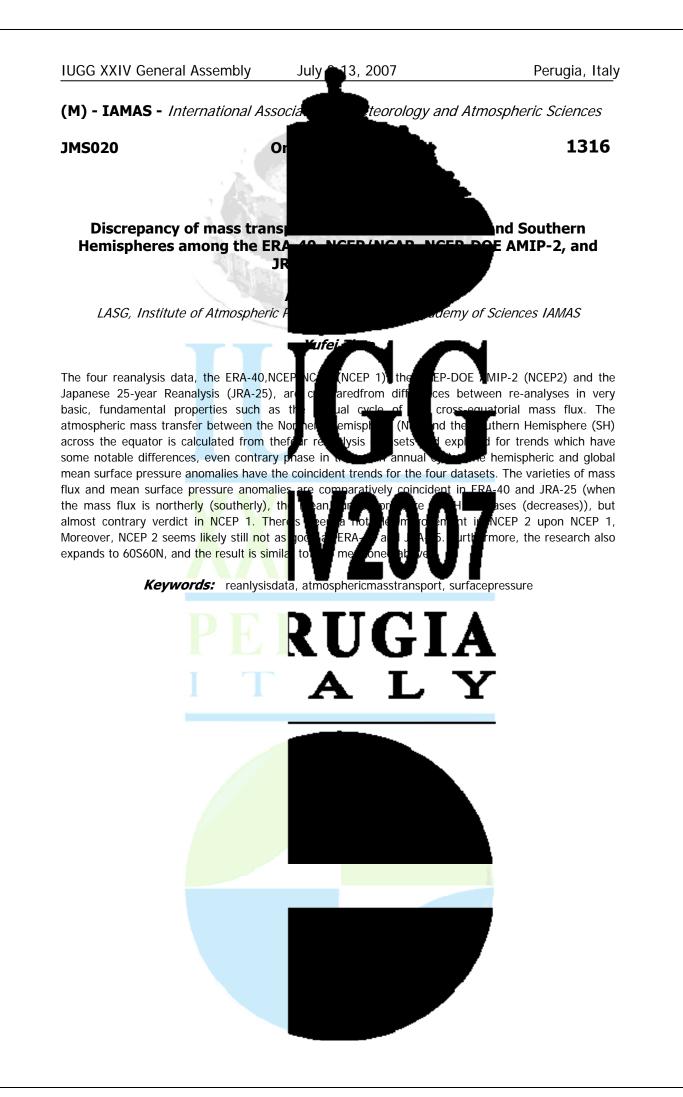




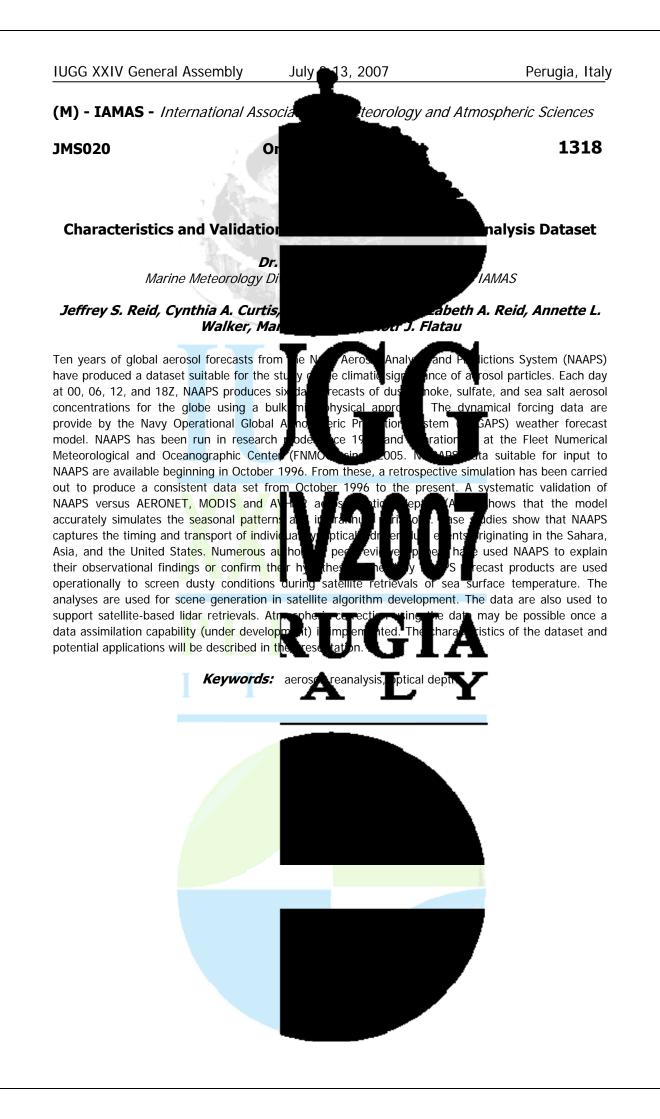




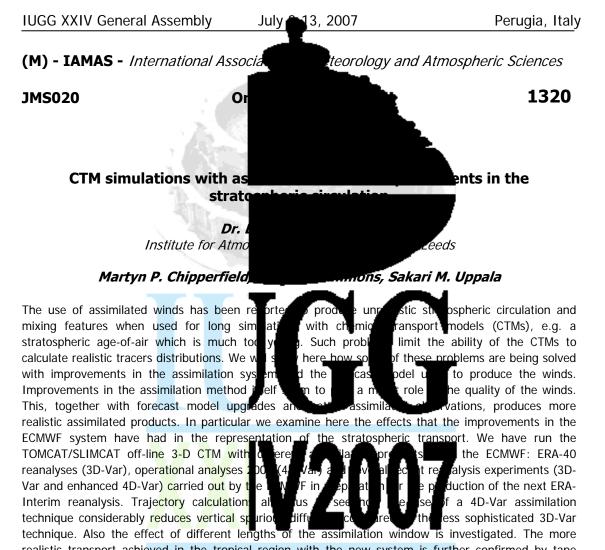










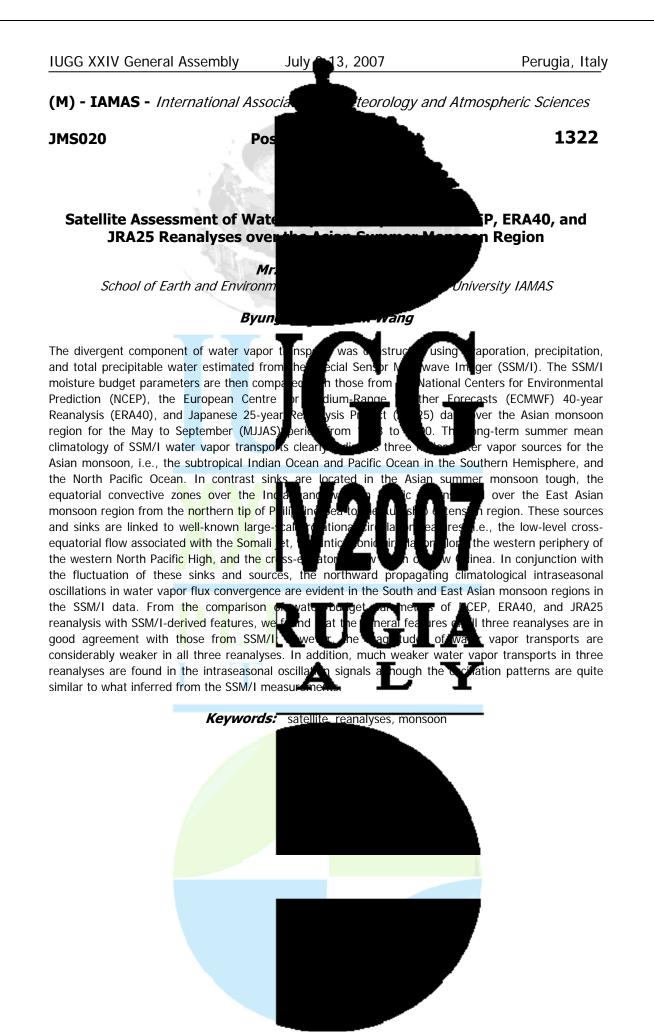


realistic transport achieved in the tropical region with the new system is further confirmed by tape recorder simulations. The tape recorder sign CMW ERA-Interim experiments ob is in good agreement with observations, a obta with assimilated winds than tha s demonstrate that the from previous ECMWF systems (ERA-40 and -air per AI). alcy ativ improvements consistently extend outside the tropical region. These results are encouraging as they demonstrate the increase in the quality of the will allow more realistic atospheric eanalyses. CTMs simulations for examining, for example, longposition. m trend femical o

Keywords: stratospheric\_reanalyses, ctms, multiannual runs

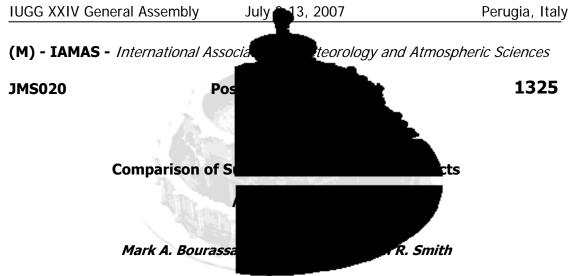












Surface turbulent fluxes (stress, sensible here sets based on weather models include the sets based on in situ observations include include those from IFREMER and HOAPS. A included in this comparison. Sea surface t monthly scale) from satellites, and can be satellite-based standards for heat and mois which are closely related to these fluxes.

FSU3 flux products have been developed with detailed bias correction (suggesting that they could be viable standards of comparison), and are relatively similar; however, there are still substantial differences in these products. We ident including characterizations of their differen and heat fluxes. The reanalyses based or from the observation-based products. For have differences in zonally averaged late differences of sensible heat of 5 to 10 Wm-2.

and 1 heat) are co FPF :MW formerly 600 IO NWP model a tures<u>, winds</u>, compa sas ārc heric s, no atr le atmo nperati

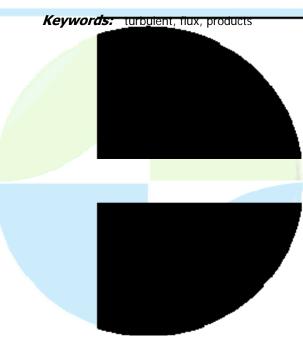
ed for many products. Data analysis), and JRA. Data Land d FSU3. Purely satellite products atellite product from WHOI is also stresses are well sampled (on a h. There are no similar peratures and humidity, midities in the NOC and

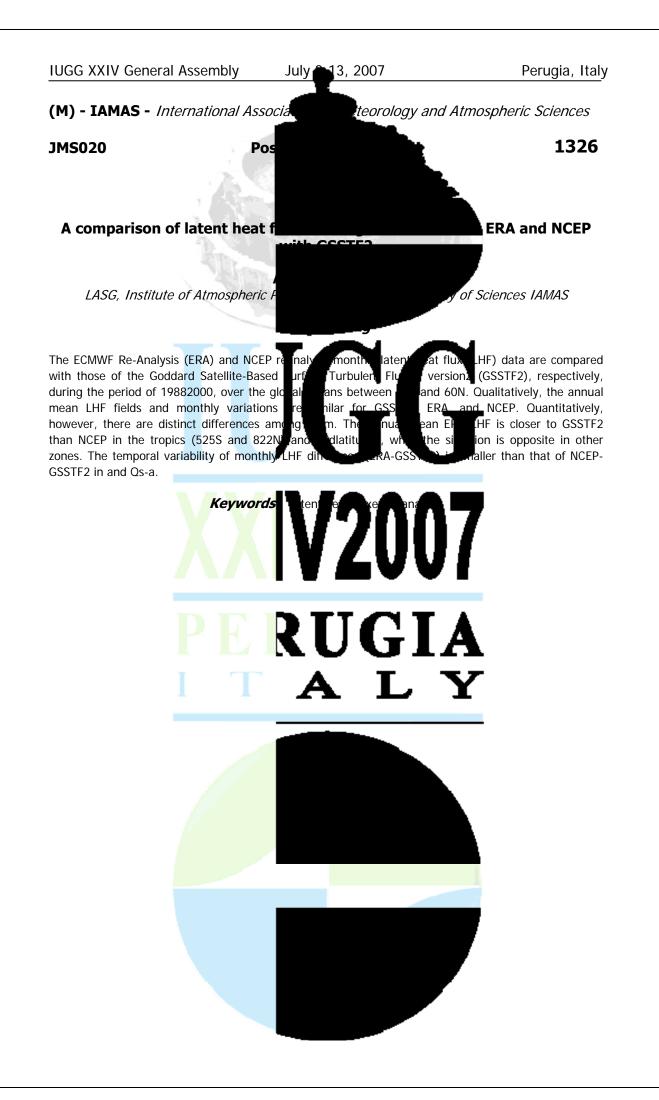
s of these products, n estimates of stresses P) stand out as outliers hs, the various products 2, and zonally averaged differences are large from the point of view of

climate modeling. Monthly averaged satellite winds (from QuikSCAT and SSM/I) are extremely similar to the FSU3 and NOCS winds. In general, diffe e to the choice of flux model or biases in the input data to the flux model exam d to identify biases that s and heat fluxes are would lead to biases in the fluxes. The lode d s е res discussed, and the credibility of NWP-based air/sea fluxes are assessed. The presumed NWP biases are substantial in the context of global change, as hough to have a large to be stro hey appea influence on model temperatures in long-term

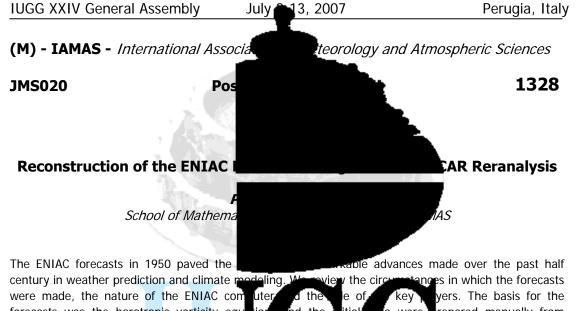
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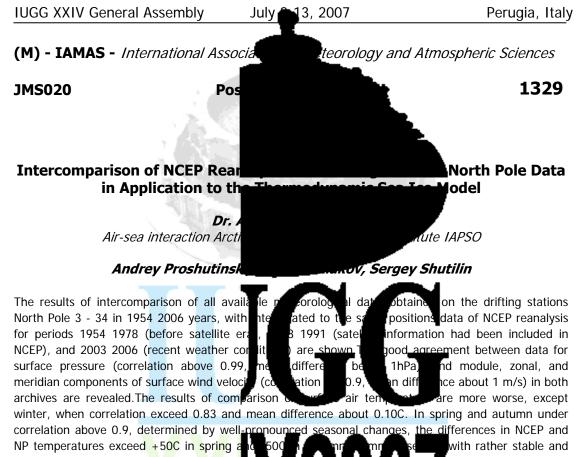




ng. We review the cir read the sele of ind the initial R reanalysis e igital <u>form</u>. V egratic Ob sation ght

key , eyers. The basis for the ta were orepared manually from ds back to 1948, the initial height escribe the reconstruction of the ve scolution shows that they all e bee will better. We provide a





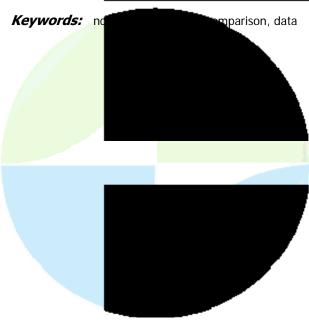
closed to melt point surface air temperatur in relation to mean square deviation me humidity shows similar results: the signi summer, when its values are maximal and end analysis confirms well-known information that reproducing of cloudiness by NCEP reanalysis is quite inadequate, especially in summer. Same times in winter under sliding averaging by 5 days the

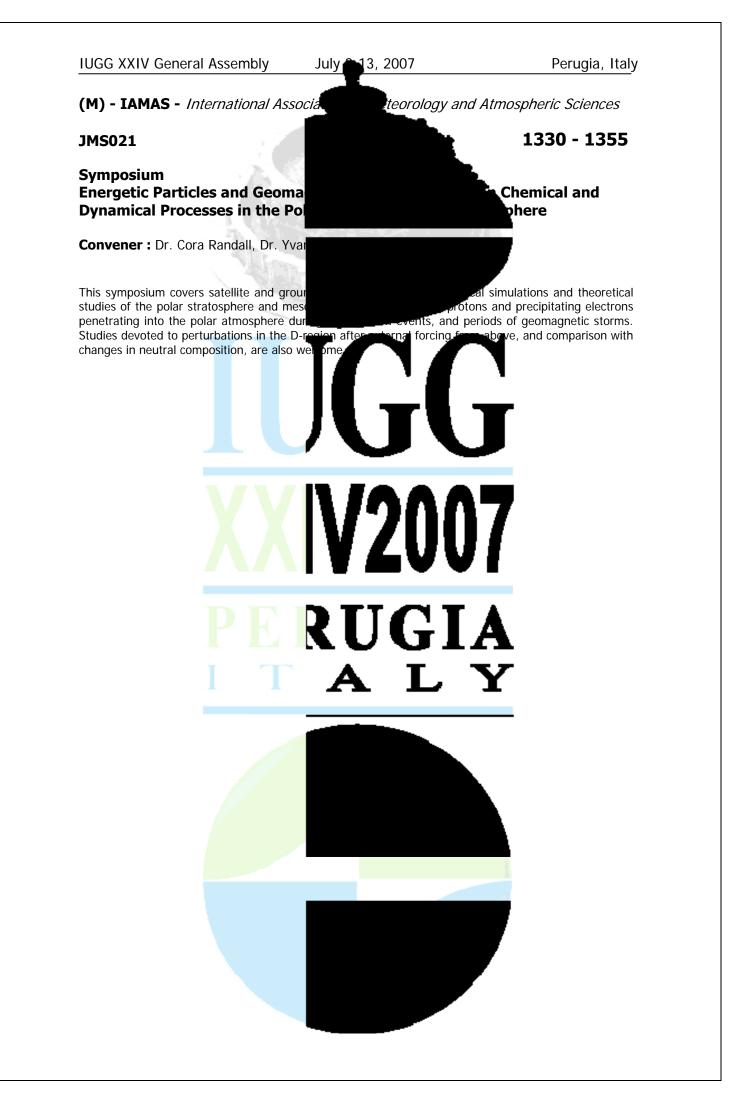
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lation 0.55 and highest the data about specific specific humidity during surface heat balance.Our

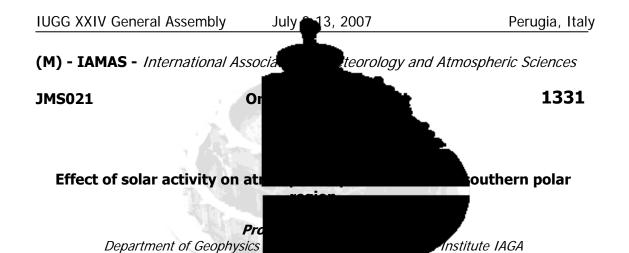
distributions of repeatability of cloudiness othe This circumstance allows recommending to use sliding averaged clo r ins used in climatic sea ice models.Compariso of dať experiments with zero-dimensional sea ice model under NCE and NP for feedbacks existing in nature and reproduced be me el artifici educe the forcing parameters on calculating sea ice thickness, but distort values of surface heat fluxes.

climatic values, usually ds does not show any ree per significant improvements after beginning of satellite era. In conclusion the results of some numerical Trevealing that negative nfluence of inaccuracy of









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Fluxes of galactic cosmic rays altered by sol as one possible mechanism of solar activity meteorological data from Antarctic station: dramatic changes of the troposphere tempe interplanetary shocks, accompanying Forbi temperature effects on the ground level are (IMF) and corresponding variations of the The warming is observed at altitudes h<5 km and

component are negative and ESW increases. The effect reaches maximum within one day and is damped equally quickly. The availability of the katabatic type of atmospheric circulation in the southern near-pole region and opposite character o wind speed deviations in cases of the nega geoeffective electric field ESW promotes development the cloud layer in the upper long wavelength radiation going from the i As a result of the radiative cooling reduction the atmosphere would be heat below the cloud layer and

bserved in th reases (FD) by qui nar ve el loe c fi h>8 ki

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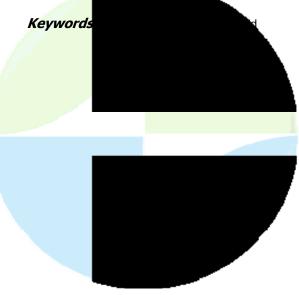
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ths a

ys are usually examined spher he detail analysis of the ade it possible to conclude that ntral Antarctica, are related to the solar protons events (SPE). The f the planetary magnetic field rying by the solar wind. ESW) e changes in the IMF BZ

berature, pressure and sible to suggest that the t, the appearance and efficiently backscatter the liabatic warming process. would be cool above the layer, as it was observed. Indeed, analysis of the aerological observations at

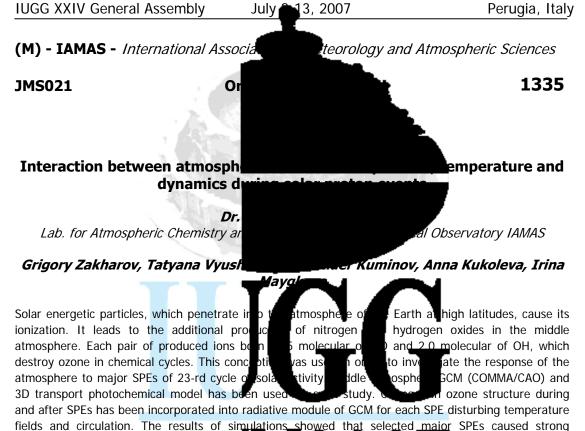
Under conditions of the negative Vostok station demonstrated the cloudnes IMF Bz. The troposphere warming in the within few days by the owe e dramatic deviation of reconstruction of the wind pattern above the gio . 1 atmospheric winds from the regular pattern (anomalous winds) at the Antarctic continental and coast stations, succeeding strong southward IMF, lear to decay of the circul Mar vortex at about the periphery of the Antarctic continent. As a result, the Irface e des at the ast stations are replaced by southerlies, and the cold air masses rush from Antarctica to the Southern Ocean. Mechanism for influence of the global electric circuit on the cloud layer properties is unclear and needs in further consideration.









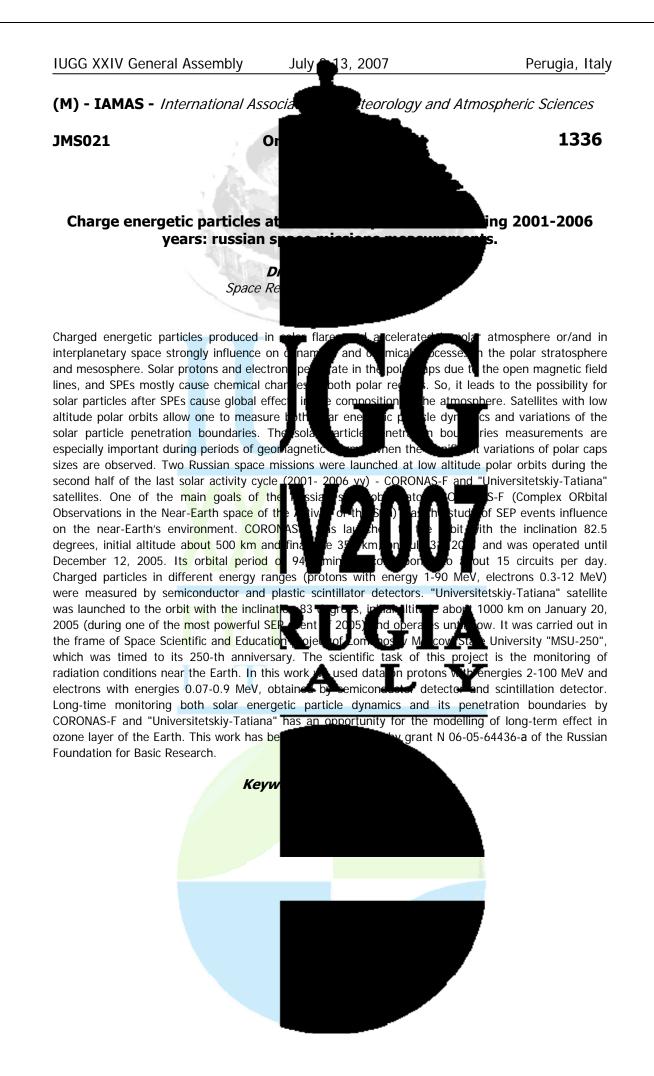


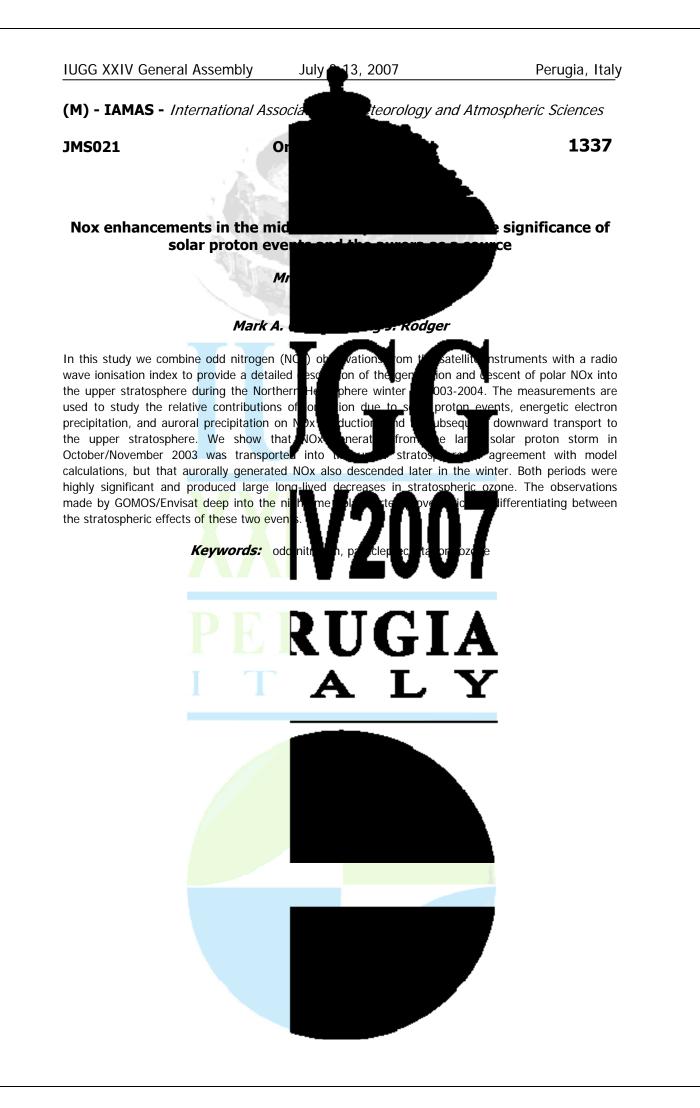
fields and circulation. The results of simulatic depletion in ozone at high latitudes. How very south polar region (polar night conditions) Prefound over S.P. for this SPE. It was found itso the magnitude of gravity wave drag reducing during SPE of July 2000. This effect was wea simulations illustrate the effects of interaction during strong SPEs.

adiative module of GCM for each utations showed that selected r von Standard von included Plastic dy zer records an import some SPE-included a less no ng noning route the state of a wear for the the state of records off tion between chemistry and dy

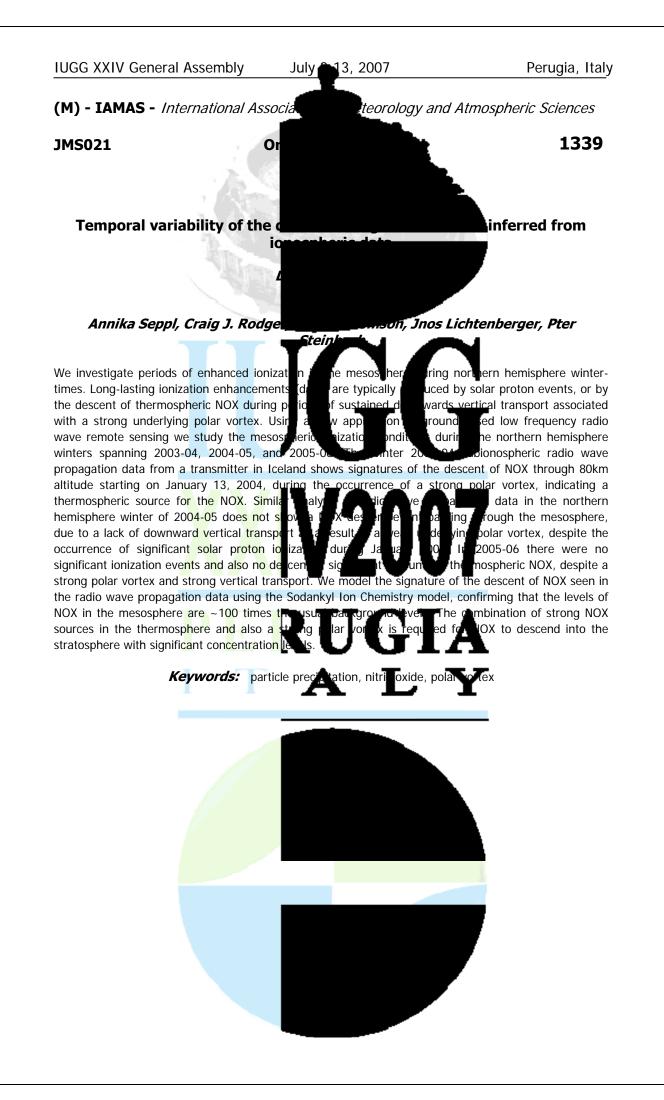
lected major SPEs caused strong or ozone response over h imperiture and dynamics was even z dal wind change (reduce) er lover summer pole (northern) conter seasons. So, 3D model and dynamics in the atmosphere





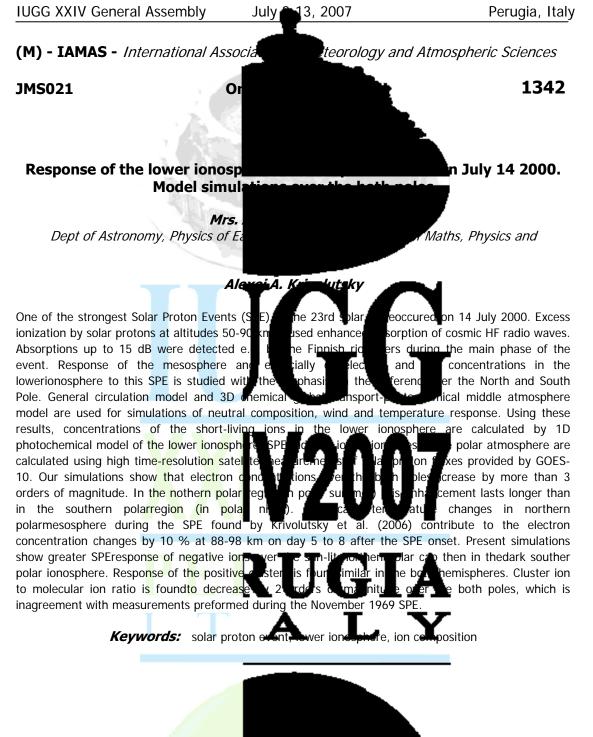


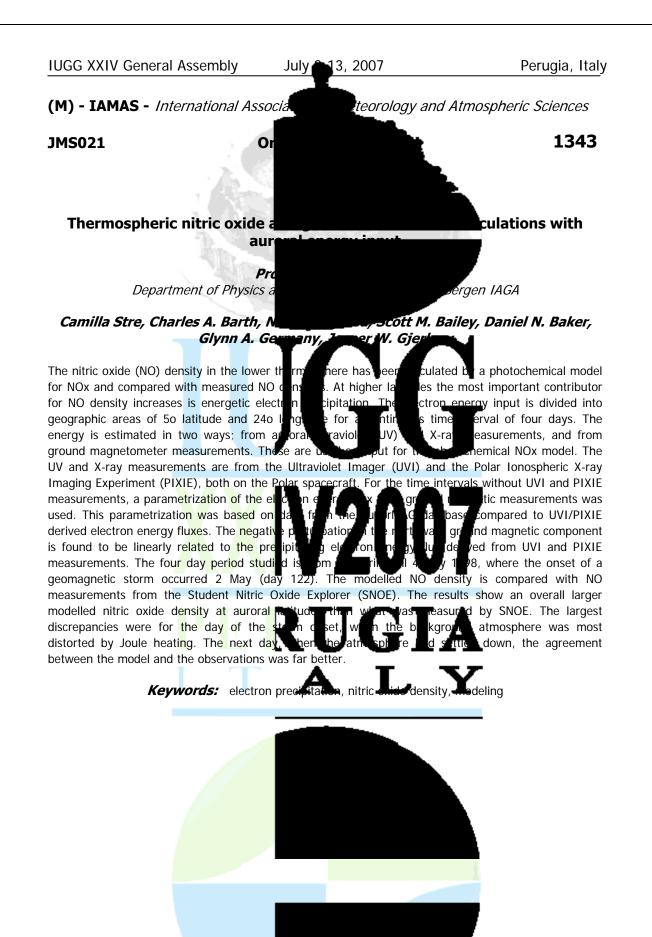


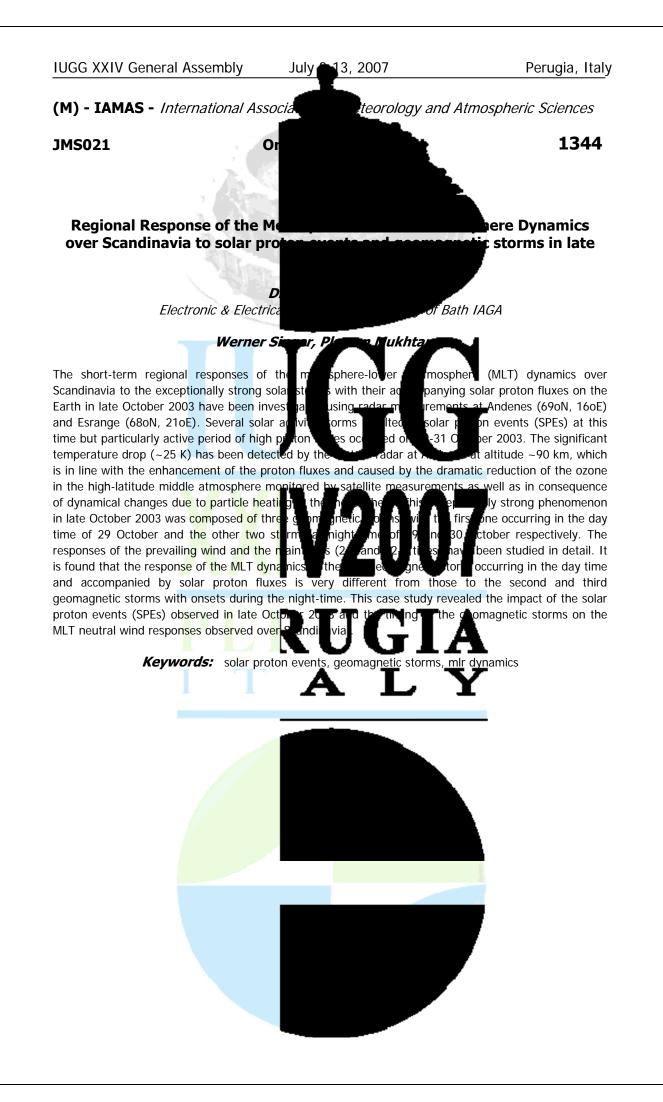


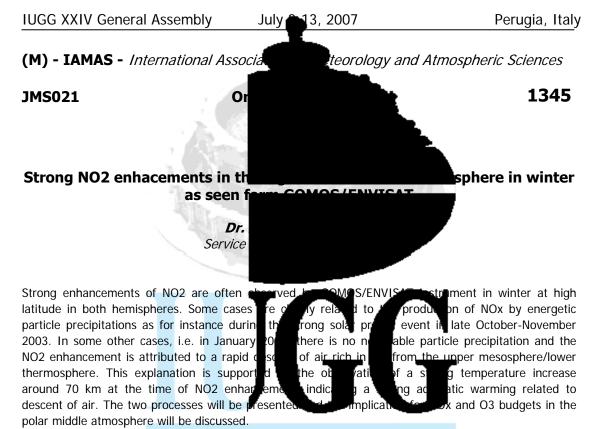






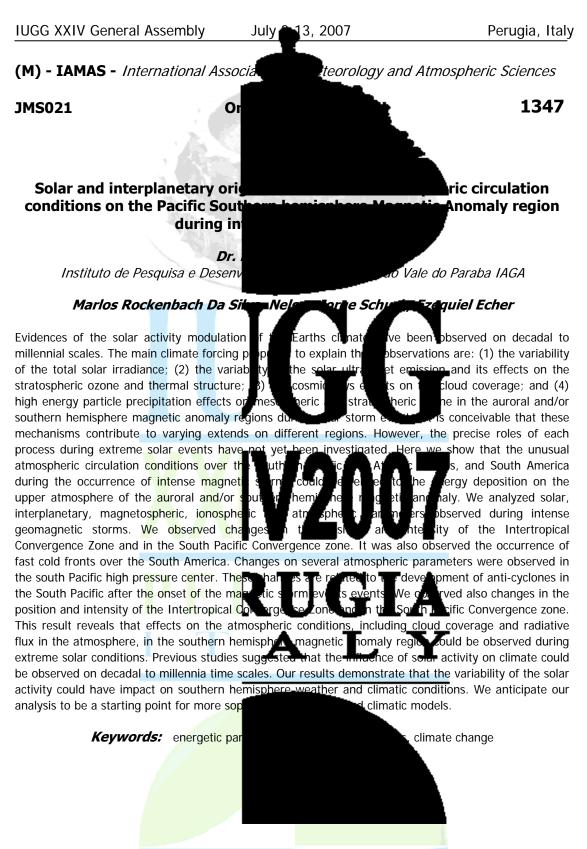


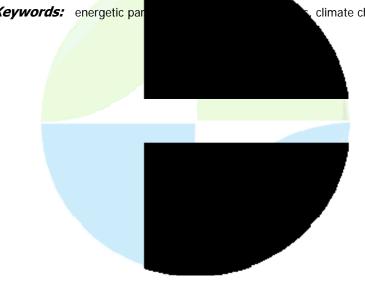


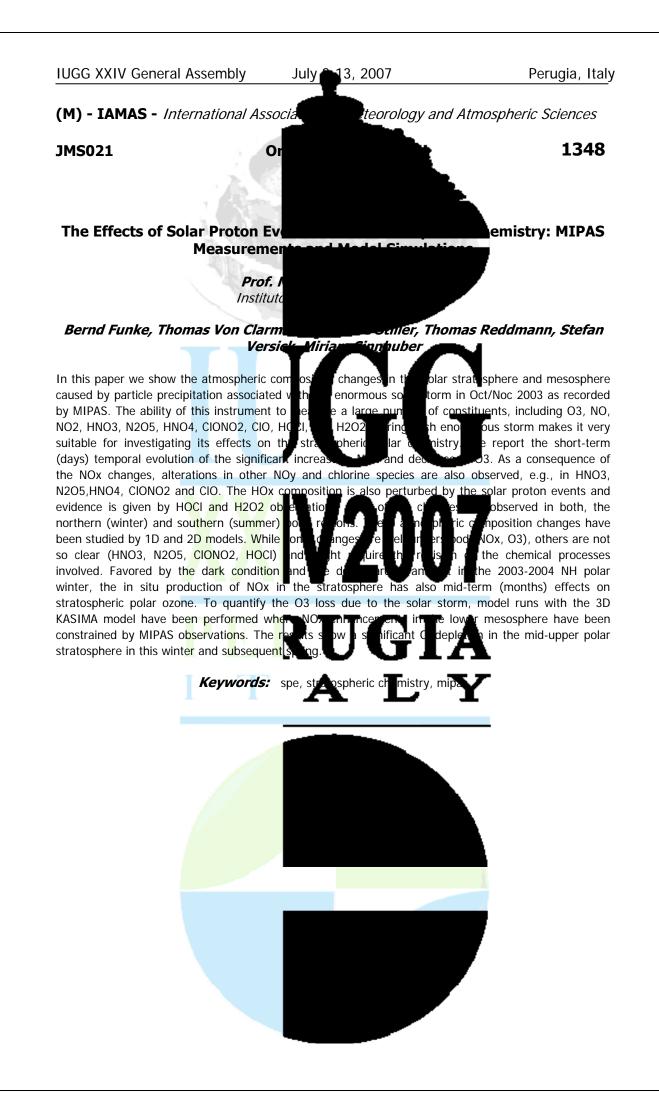




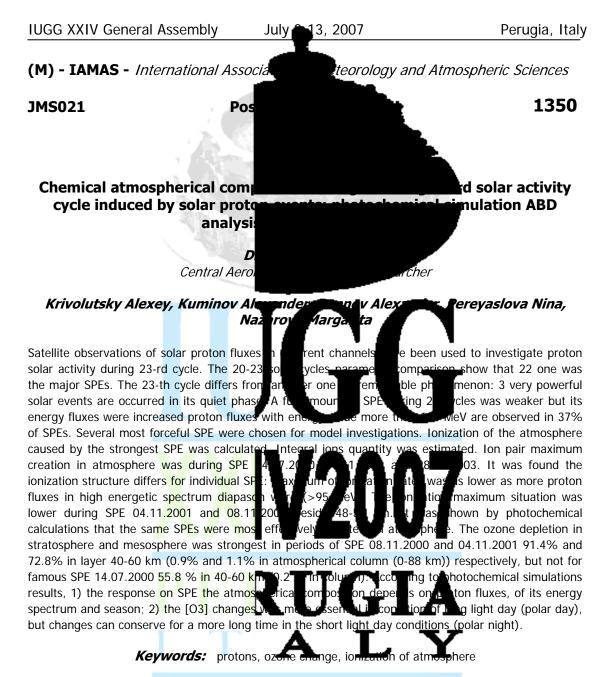


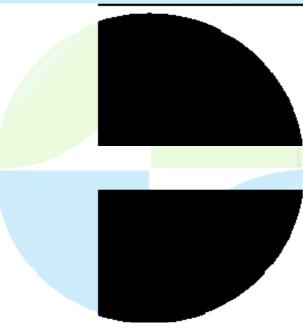






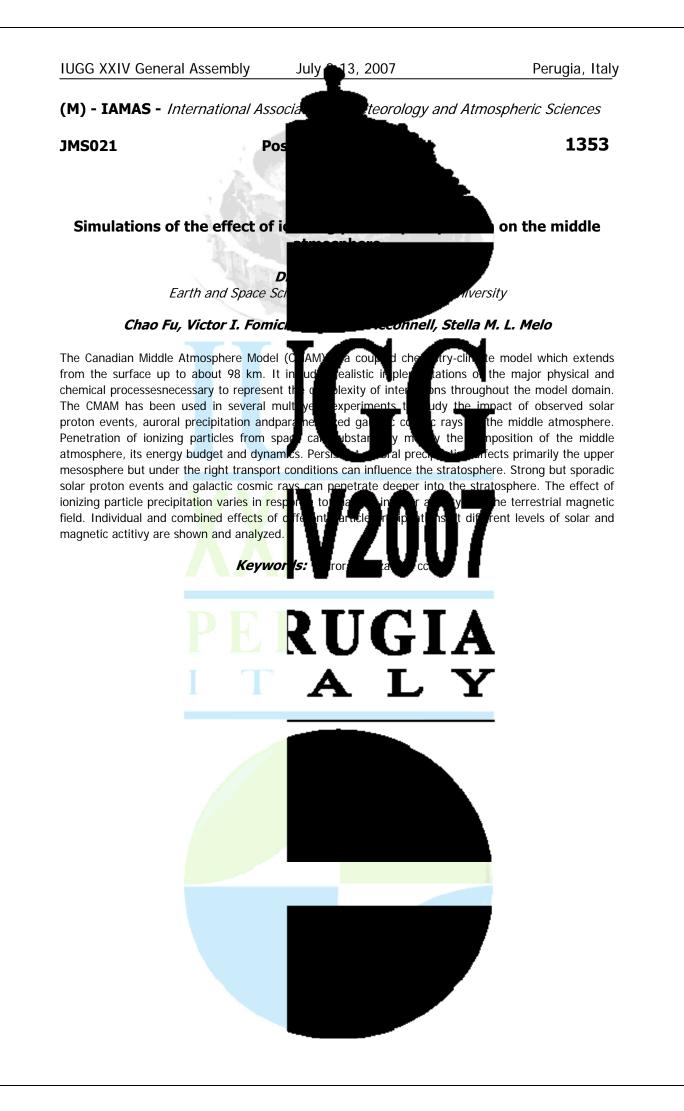






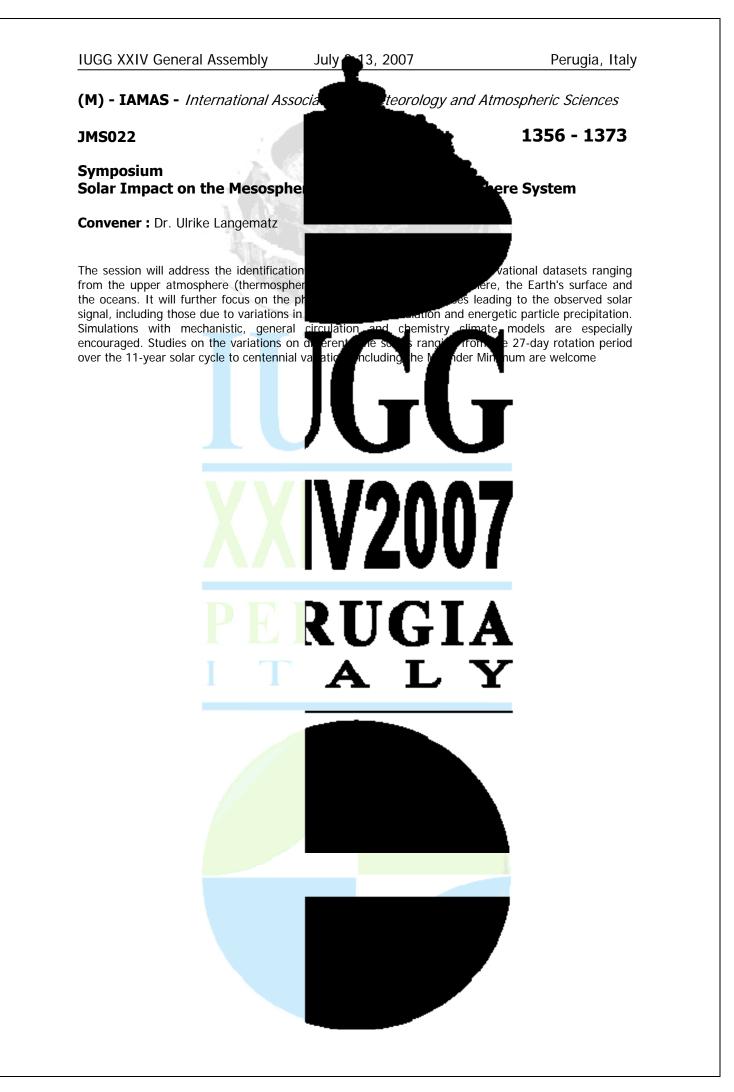




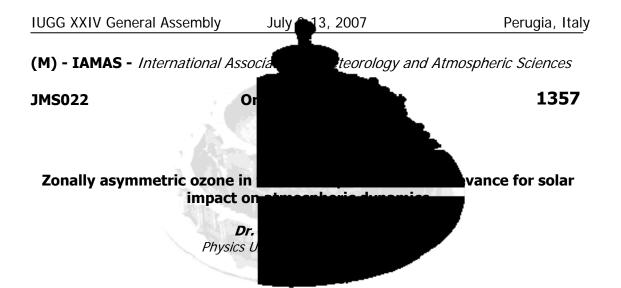












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For boreal winter decadal averages of zonal (ERA-40). With the GCM MAECHAM5 we inve on temperature and planetary Rossby wave mesosphere. The analyzed stratospheric oze during the last decades, with amplitudes of The vertical structure is in agreement with we found that the related radiation perturbations

the impa is i ation charact RA-40 show 10% asure nts. lificanť

from ECMWF Reanalysis ed by solur radiation perturbations cs in the tropo-, strato- and lower rong increase in wave 1 structure one during the 1990ies. mear d on et of model calculations, temperature increasing

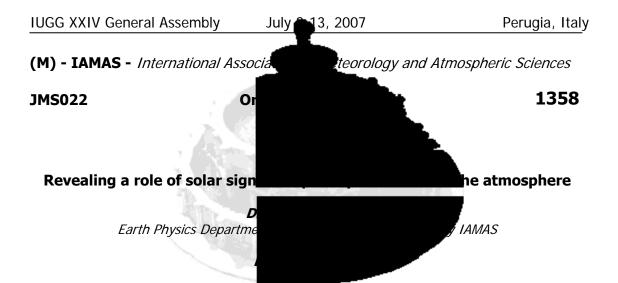
with height (we found maximum changes of about -4 K in the lower stratosphere and -8 K in the lower

mesosphere) due to an induced increase in amplitude and shift in phase of the stratospheric wave 1, i.e. an enhancement and shift of the p dimensional wave activity flux vector reve become much weaker over the Asian / Nor North Atlantic region. The feedback mech nis polar vortex shifts induced by zonally asym dynamics and Rossby wave propagation will be discu

net

ng changes in threeropagating wave trains over the North America / wave breaking through nce between large-scale





The aim of our research is to study solar and space f climate of the Earth. The main question is the solar variability and what can be a med an studying influence of solar activity on trans This investigation is continuation of our prevariations of solar activity in the variation properties of atmospheric aerosol such measurements. Now we added to our analysis s such as variations of aerosol optical depth (aerosol index TOMS). The TOMS (Total Ozone Mapping

indicates how much light is scattered or a atmosphere. The daily variations of aeroso amount of the data distributed over the over Equator, Northern and Southern He cosmic rays into atmosphere of the Earth hav latitudes. Opposite effect has place after decrea

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atmosphere respond to e Ear we present some new results of e and optical aerosol parameters. the effect of long- and short-term sphere and the optical from background lidar rosol optical properties,

tmpspheric parameters and

Spectrometer at NASA spacecraft) aerosol index is related to aerosol optical depth, which, in turn, ough a column of the 996 to 2005. The great y variations of aerosols ase of penetrating solar rosol particles at various galactic cosmic rays.



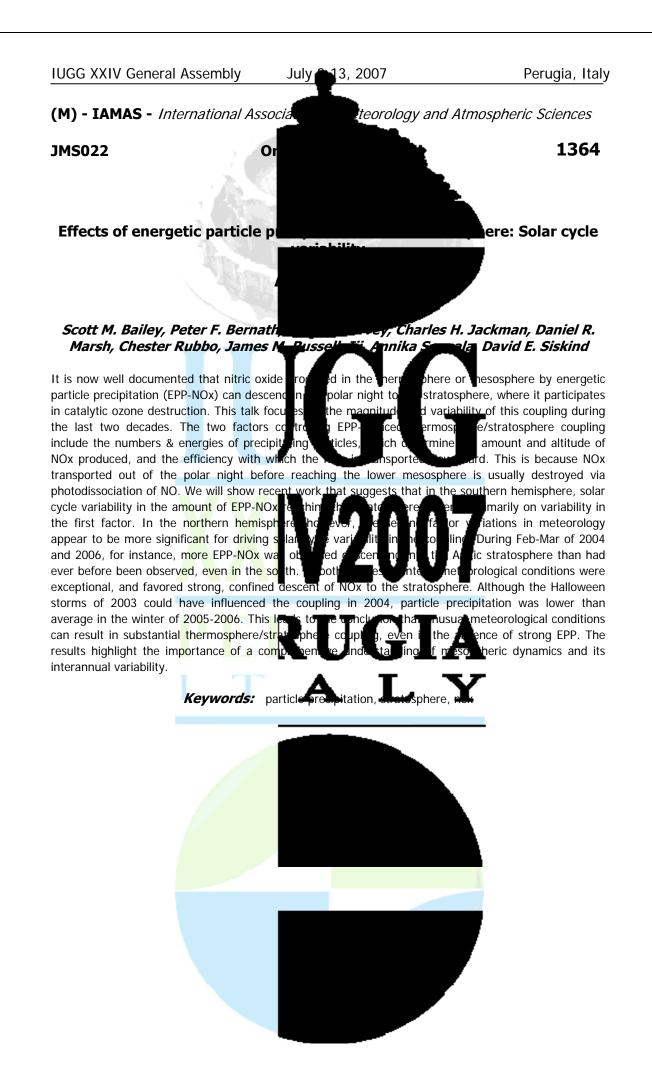




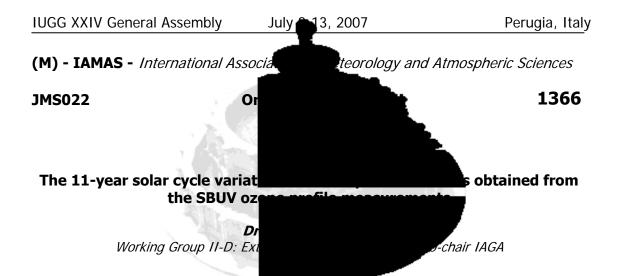












🛾 key

The observed solar cycle variation of ozon ozone / dynamical coupling as a sun-clima that the largest percentage ozone increase and lower (30-100 hPa) tropical and subtr occurs in the tropical middle stratosphere ( in the middle and lower stratosphere contra predict a maximum ozone increase in th stratosphere. Here, we apply standard multiple regi

cycle component of stratospheric ozone variability using the Version 8 SBUV (/2) satellite ozone profile data set over the 1979 to 2003 time period\_Results show strong ozone responses in the low-latitude upper and lower stratosphere (2-3 % of t latitude middle stratosphere. Our analysis structure appears to be sensitive to the response in the tropical middle stratospher winter (DJFM) the area of the minimum oz bne that such seasonal displacement is related to the

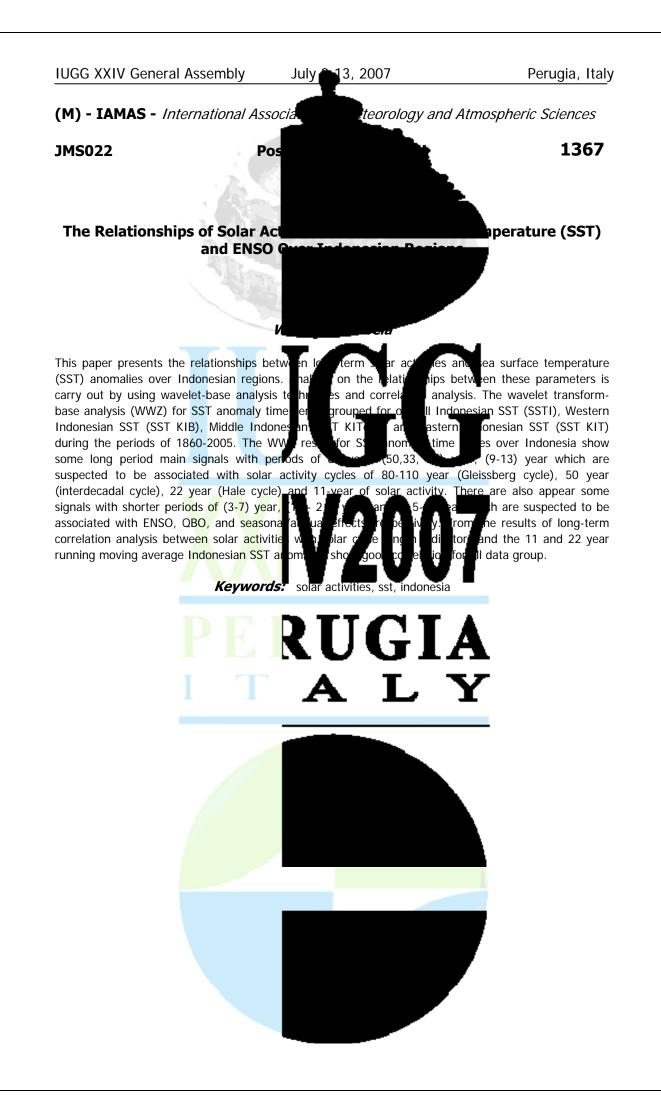
for ism med lar minimum tratosphere a). T<u>his obs</u>e the re O. strat mi nere istical

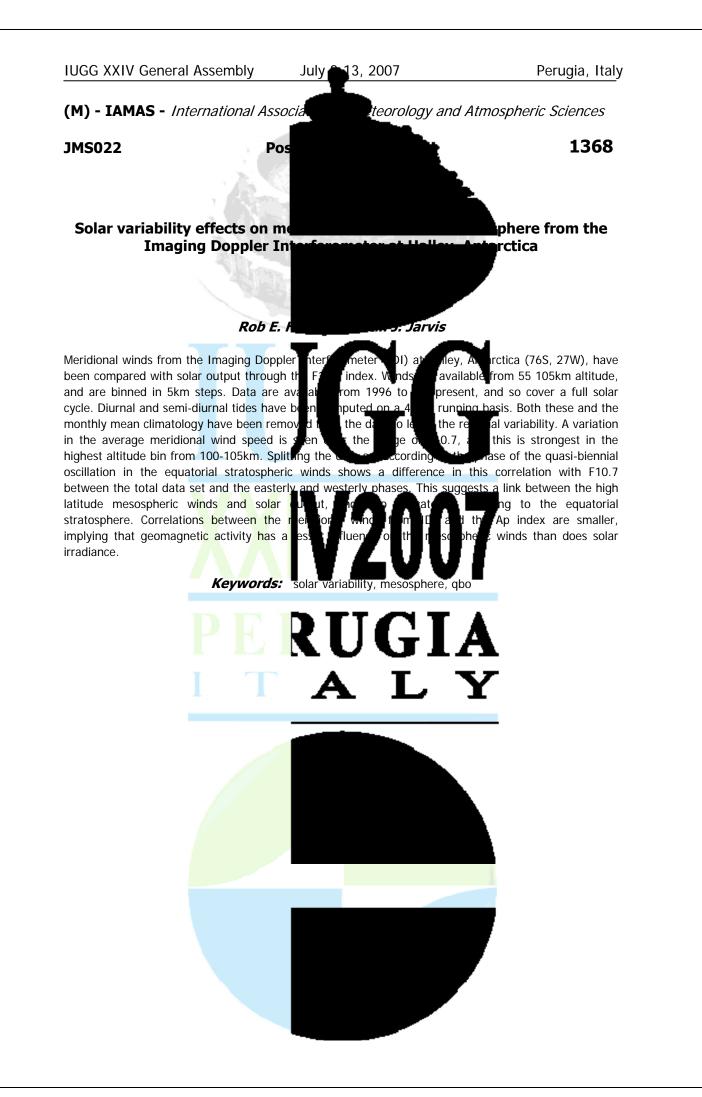
on clim

s that include solar UV / pirical analyses indicate vious aximum in the upper (1-3 hPa) a minimum percentage increase nally derived altitude dependence ativeochemical models which а increase in the lower timate the 11-year solar

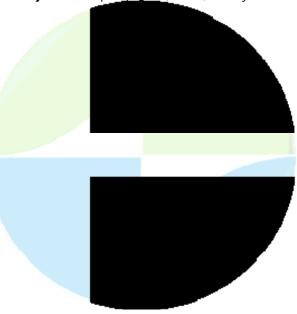
e response in the lowh of this tropical 3-cell of the minimum ozone here up to 150S, while in or and 150N. We suggest changes in the stratospheric dynamics.

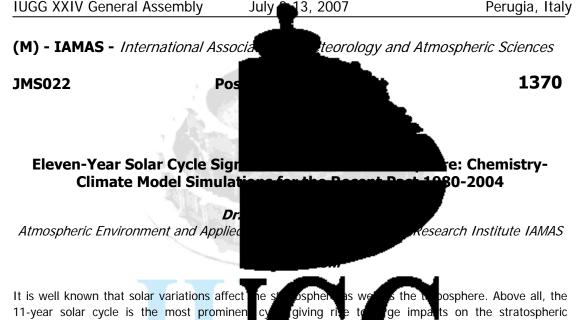












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temperature and ozone through substantial Though the total solar irradiance variation of evidently detected from the upper stratosph Indeed the 11-year solar cycle effect on the understood as a direct result of the UV irradiance

the lower stratosphere is not necessarily well clarified as for the mechanism. In this study, the 11-year solar signals were investigated in the simulation of Meteorological Research Institute chemistry-climate model (MRI-CCM), which was driven by o based, for a dynamical module, on a M reproduce the quasi-biennial oscillation (C wave drag (GWD) scheme of Hines [1997] tropics, instead of Rayleigh friction. In addition middle atmosphere, where the e-folding time at the maximum wavenumber 42 is set at 150 hrs, being slightly less than the previous value of 180 hrs [Shibata and Deushi, 2005a]. The chemical module

includes 36 long-lived and 15 short-lived spa with 9 heterogeneous reactions. MRI-CCM longitude-latitude space and has 68 layers hPa) with 500m vertical spacing from 100 to 10 hPa. MRI-CCM adopts a hybrid semi-Lagrangian transport scheme, in which a new PRM5 scheme developed y improving procedures to simulate better distributions of clean piecewise rational method (PRM) [Xiao and Peng, 2004] and the horizontal procedure uses a quintic

in which both natural and anthropogenic f year solar cycle, and volcanic aerosols are The integration period covers the period f up integration was made for more than se in Eyring et al. [2005]. There are two giant 1982 and Mount Pinatubo (15.1 N, 120.4 multiple regression analysis is used to iso ozone data for the simulation and observ trend, the QBOs at 20 and 50 hPa, volcanic aerosols of El Chichn and Mount Pinatubo, El Nio/Southern

Oscillation (ENSO), and the 11-year solar cycle. It is found that MRI-CCM can more or less realistically reproduce observed trend of annual-mean temperature and ozone. The annual-mean QBO signals of temperature and ozone is well reproduced latitude total ozone QBO is also quantitati hemispheres. The vertical three-cell of alternative the middle stratosphere, and positive temperature due to the 11-year solar cycle

out several % at UV wavelengths. is at most 0,1 %, its signal can be erved geopotential data. n the ' ightfo rd enough to be readily ect through dynamics on

> 980-2004. MRI-CCM is bata et al., 1999]. To non-orographic gravity ity wave source over the usion is weakened in the

py 2.8 degrees (T42) in

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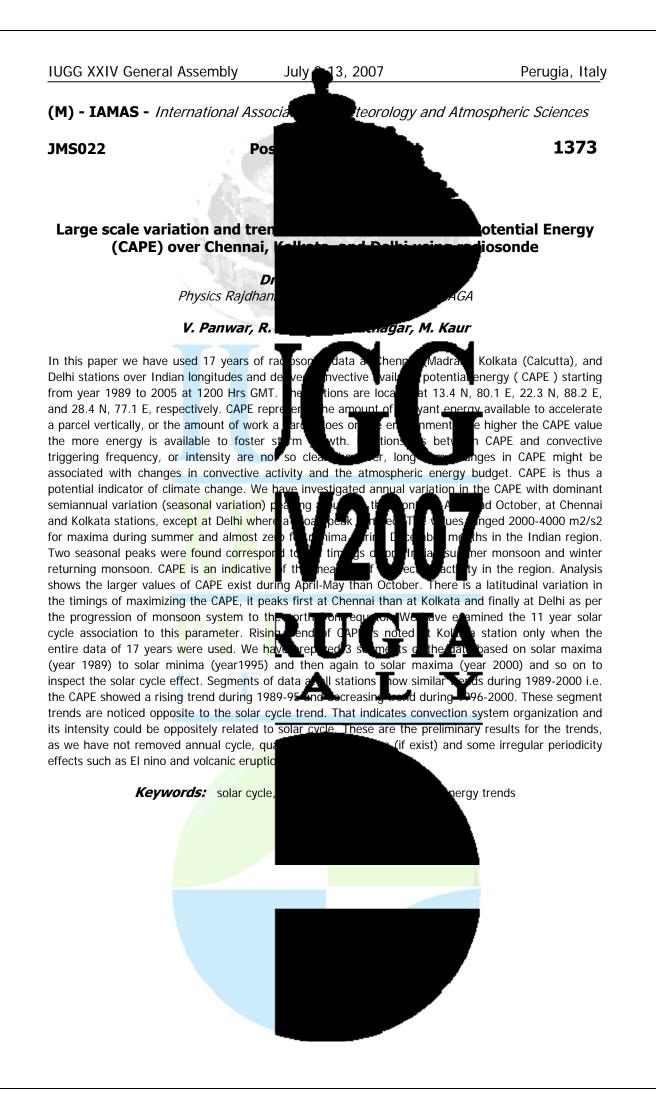
interpolation.Ensemble CCMsimulation was made under the CCMVal REF1 scenario [Eyring et al., 2005], greenhouse gases, halogens, the 11lation from monthly mean values. ber 2004, prior to which spins of the REF1 are described N, 93.2 W) in March/April ntegration period. Linear lies in temperature and mean value, the linear

> seasonality of the midto hi-latitudes in winter stratosphere, negative in the tropical stratospheric he other hand, the simulated

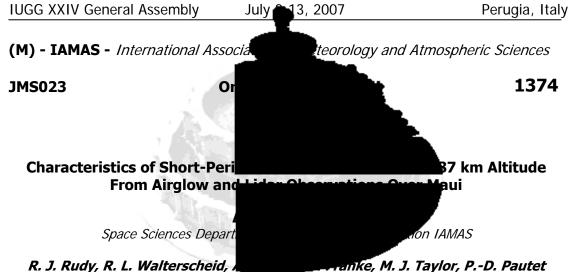












## R. J. Rudy, R. L. Walterscheid,

Small scale (less than 15 km horizontal common occurrence in OH airglow images. either convective or dynamical instabilities. and period. The Maui-MALT Observatory wind/temperature lidar which allows the d convectively unstable, and a fast OH airc sensitivity high enough to see the ripples. This

The imager results suggest that instability features occur in the 85 to 90 km region of the atmosphere around 20 percent of the time. The nomina While there are clear night to night variati and 2004 observations. In addition, a fe instabilities, but rather have features consi ten waves. Their fractional intensity fluctuation s ai Unlike the instabilities, the origin of the evanescent

like ase studes a , little is know d on NЛt ation d era ta orts

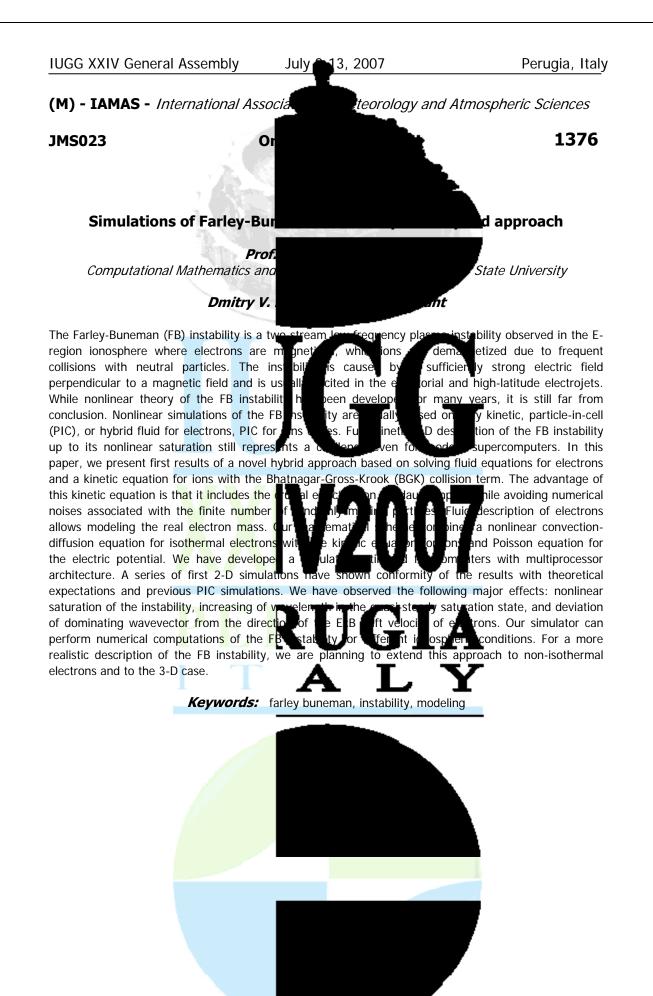
nown as ripples are a ute their prigin to the presence of bout their frequency of occurrence kala is instrumented with a Na the at phere is dynamically or imag very 3 seconds with a hths of observations in

October/November 2003 and in August 2004, 8 nights of which also included Na lidar measurements.

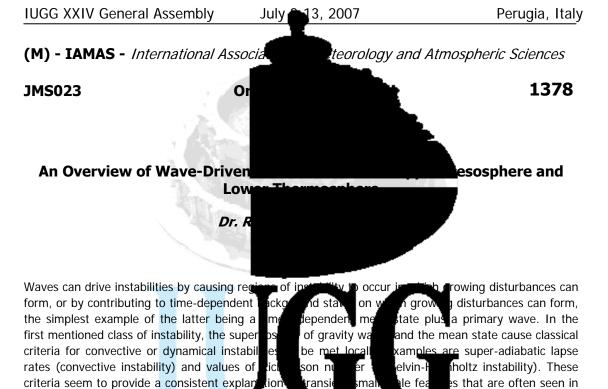
ween 2 and 4 minutes. milar for both the 2003 not ripples caused by wavelength evanescent of the ripple instabilities.











observations. However, wave structures occur i reasonable explanation is that they are disturbances on a wave background and occur because a primary wave forces coefficients of the governing equations to vary in time (a Floquet system when the parameters vary periodically). These distu classical criteria. This presentation will brie and will review instabilities of the Floque

transient small-scale wave-like structure se ln i

re stable according to ng with some caveats), ector) that might cause

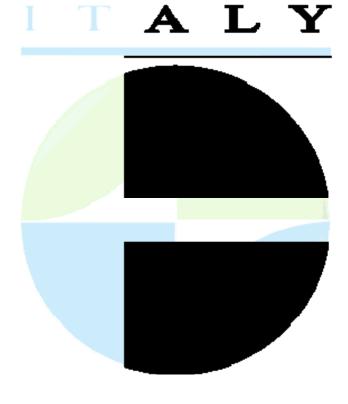
t the classical view. A

Keywords: wave instabilities, dynamical abilities, parametric instabilities

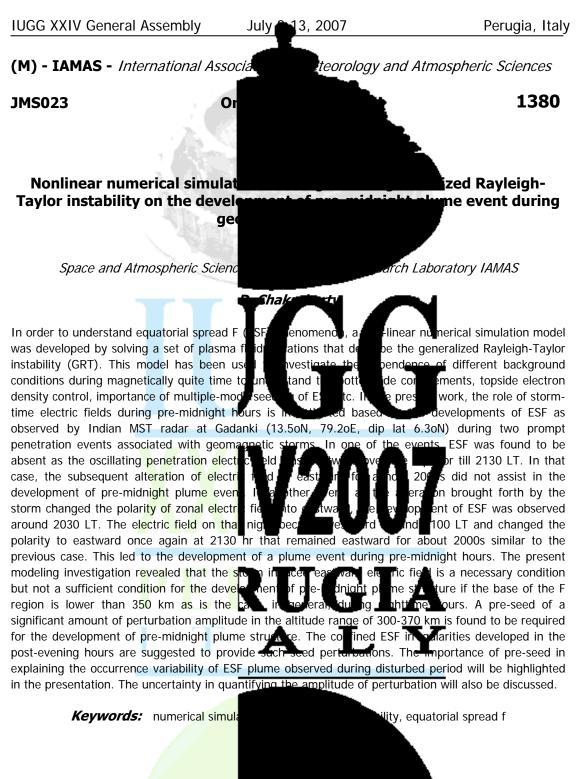
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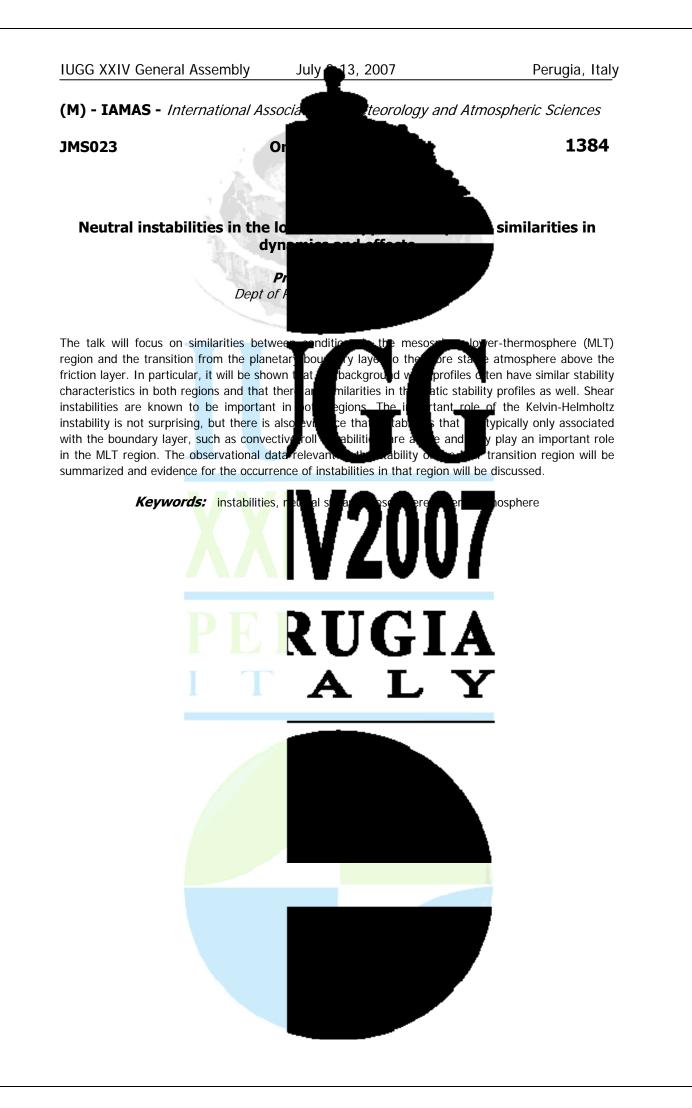


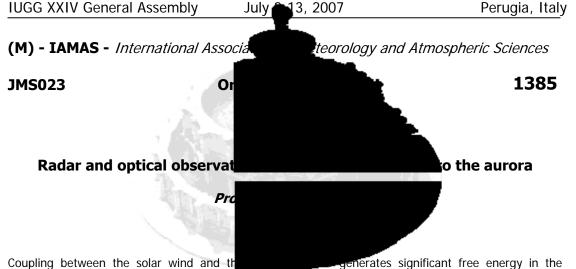












magnetospheric plasma. This free energy, manifested i and anisotropic particle distributions, provides a throughout the magnetosphere. In many of se observed using ground-based radar and morphologies in auroral video, and perturb scatter radar. Ground-based sensors are crit provide time-dependent information in an E thorbiting platform. In this talk I will review under an MHD processes in the auroral magnetosphere.

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beams, electrical currents, of instabilities observed roduce ffects which are readily xamples include spatio-temporal arameters observed by incoherent dynamics because they ive not possible from an to instabilities and non-







**IUGG XXIV General Assembly** 

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## **JMS024**

Symposium Data Assimilation for the Atmo

Convener : Dr. Richard Swinbank Co-Convener: Prof. Mu Mu

Data Assimilation is a key technique in Ea measurements of the atmosphere, ocean a range of data from research satellites, s increasing amount of data from operationa

of data from both satellite and in situ platforms to analyse the current state of the Earth System and form the basis of improved forecasts from t scientists working across a broad range assimilation methods, - weather and clim atmospheric chemistry, - oceanography, - la

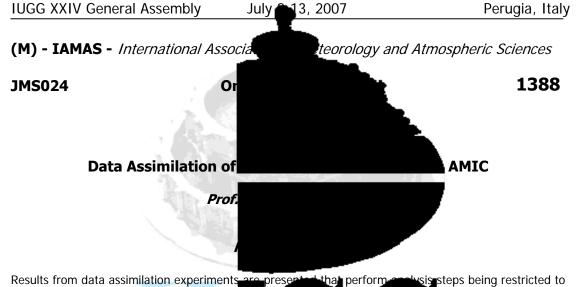
teorology and Atmospheric Sciences

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urface

h of the vast quantity of golden age in which a wide and CloudSat, complements the ata assimilation can organise the wealth

> ssion will bring together The ular are s will include: - novel ale and cloud-scale processes, -



correcting vertical normal modes. Such a poced accuracy achievable if only certain observation (barotropic or baroclinic) vertical structures These assimilation experiments are carried model AMIC (Atmospheric Model of Intern (using resolutions T45 or T106) with six g quasigeostrophic potential vorticity equation. properties of the atmosphere, auch as time scales, dynamics, and error growth behavior, to a reasonably satisfactory degree. Data assimilation experimentation with AMIC is also facilitated as this model contains a complete tangent-line assimilation experiments will be presented subsequent forecast error, as well as on th the short-term forecast period over whi

Preliminary results suggest that correction

analysis accuracy.

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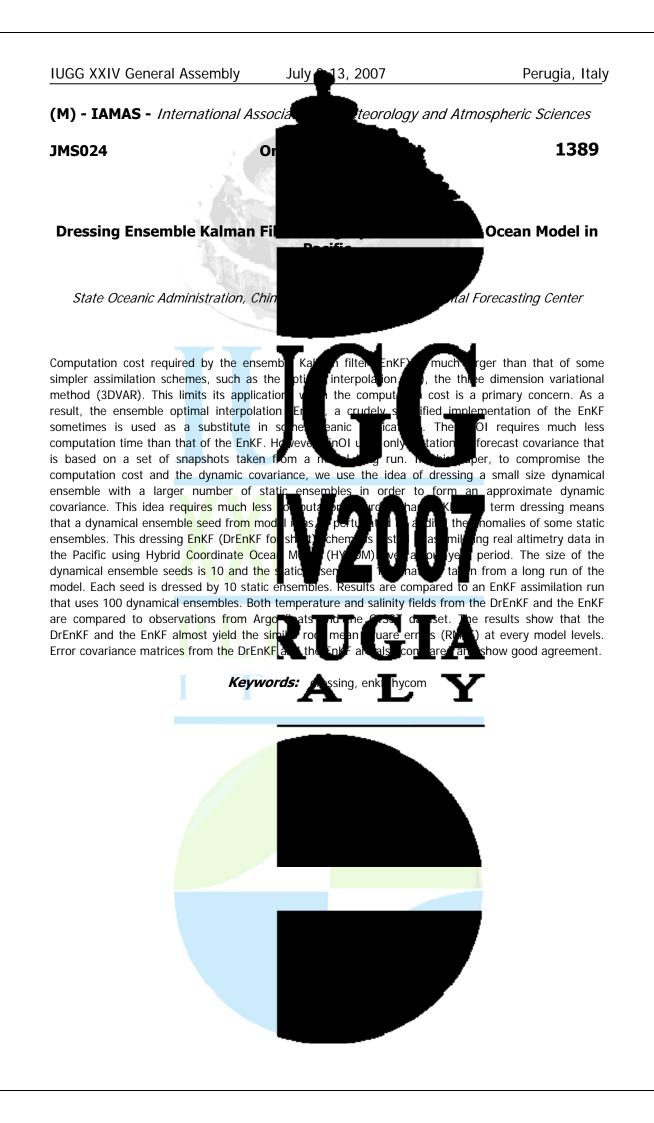
is a

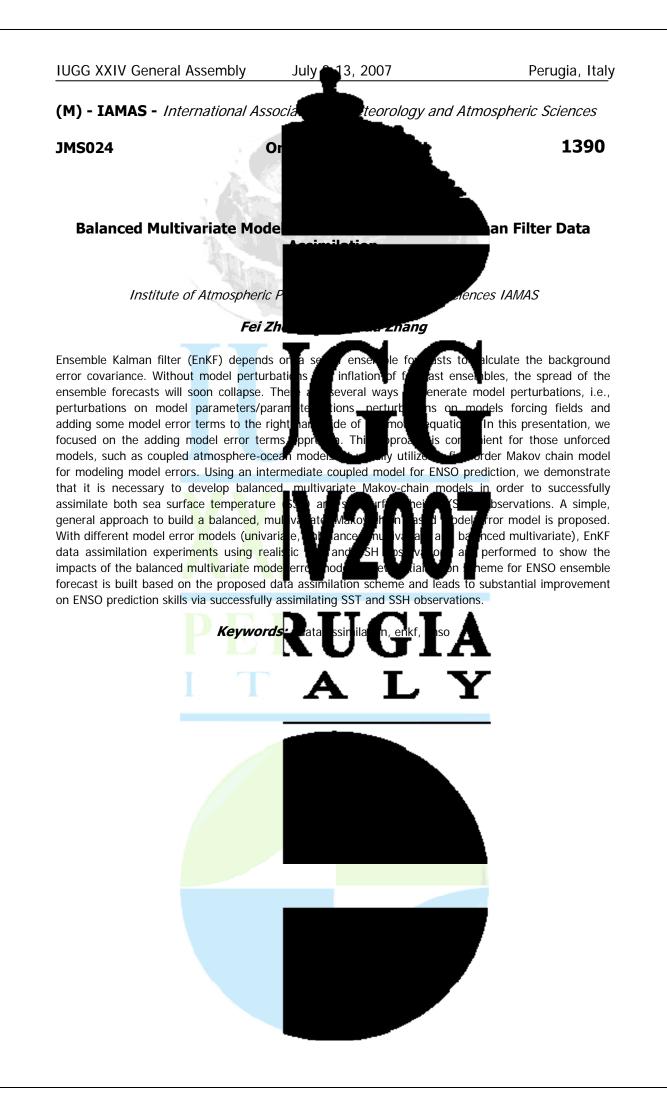
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nprovements in analysis exten essure) are available, or if certain by the background error statistics. rk of the intermediate-complexity izontally spectral model ng the dynamics of the AMIC reflects several

> y results from these is itself, the impact on ht vertical modes during ng errors is important. dy substantially improve

Keywords: vertical normal modes nmodal error growth

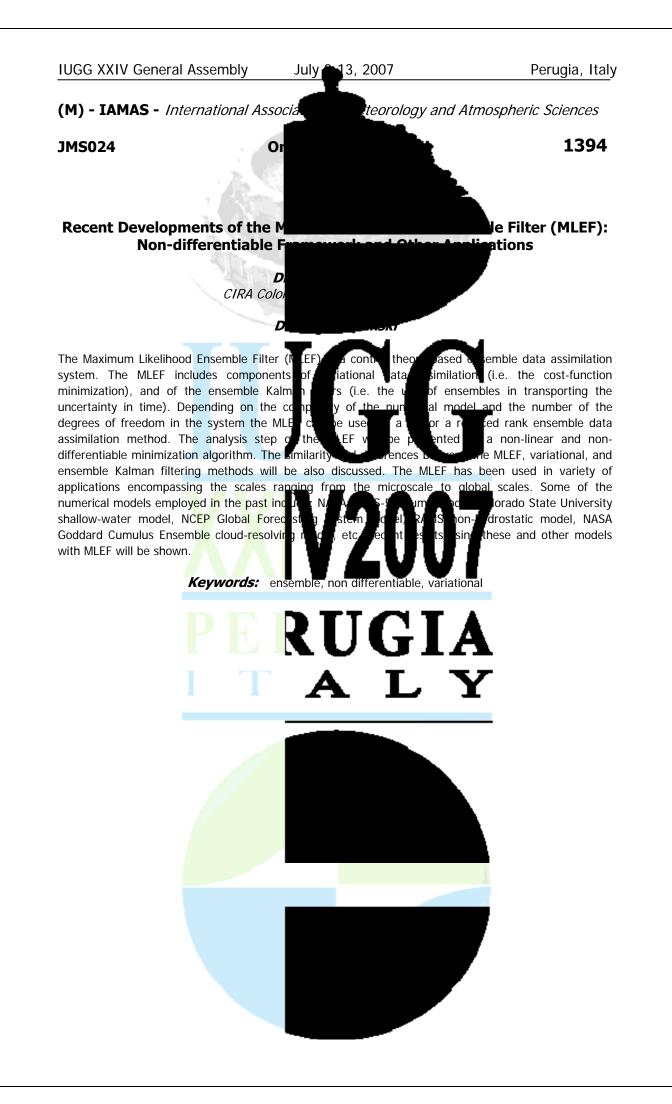




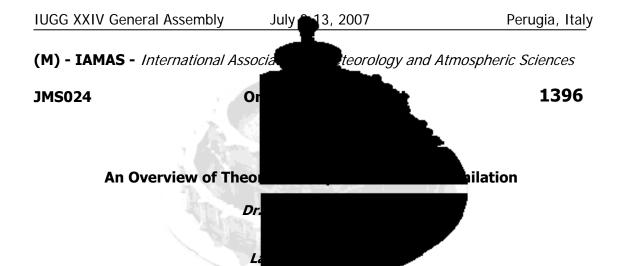












The purpose of data assimilation can be destate of the atmospheric or oceanic flow, essentially consists of the observations prop practice in the form of a discretized numeri with some uncertainty, which can be descr framework for assimilation is therefore bay distribution for the state of the system, algorithms for data assimilation can be d

least-squares linear estimation, which achieves bayesian estimation in the linear and gaussian case, to moderately nonlinear situations. As is well known, two broad classes of algorithms exist in that general framework. In sequential assimilation, which observations are introduced successively assimilation, the model is globally adjusted assimilation requires repeated integrations its own advantages and disadvantages, present on the theoretical aspects of assimilation

cribed as reconst sing avai rel of the physica lel. Any piece a probability timatio ims at vhi lable ned he scribe

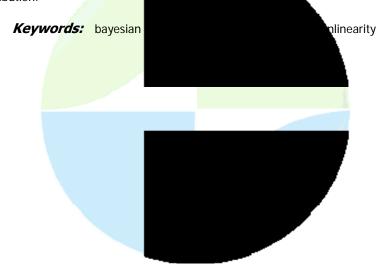
ccurately as possible the ation. That information it info vs govering the flow, available in hformation will always be affected ribution. A convenient conceptual ermining the probability rmation. Most present extensions of statistical

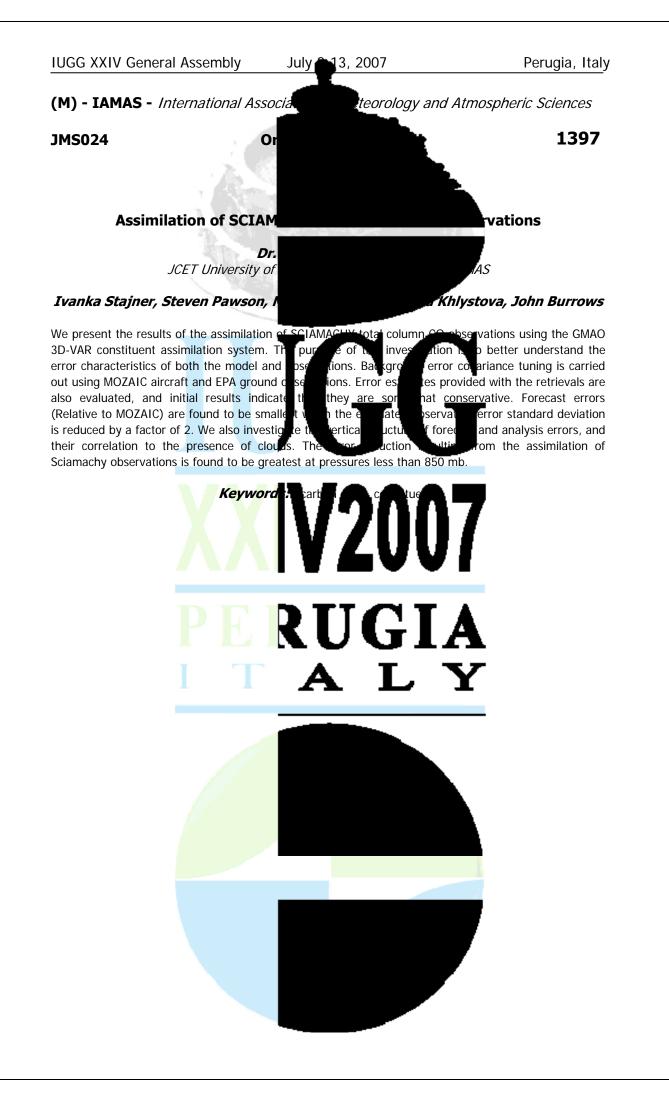
in the linear case, the model. In variational ime window. Variational del. Either approach has of the research done at bears on two aspects : how to evaluate and take onto

account the errors in the assimilating model, and how to introduce nonlinearity and nongaussianity. Concerning nonlinearity, sequential ensemption ensemble of states is integrated in parallel, eliminates any need for a linear th s of system. The updating of ussian. And unpleasant the ensemble elements with new observation till, lin ir ar u y is sampling problems occur in the updating phase. Nonlinear and nongaussian algorithms exist in the form of so-called particle filters, but are too costly at rge dimens resent for n applications. Concerning variational assimilation, nonlinearity can be deal ariational Assimilation, in h throug Ouasi-Static which the length of the assimilation window is progressively increased. Ensemble methods, which seem to be the only way to practically achieve bayesian estimation, look very promising. Active work is being done on the development of methods for assimilation. One important aspect of ensemble methods is the objective evalu embles as deors of the bayesian probability distribution.

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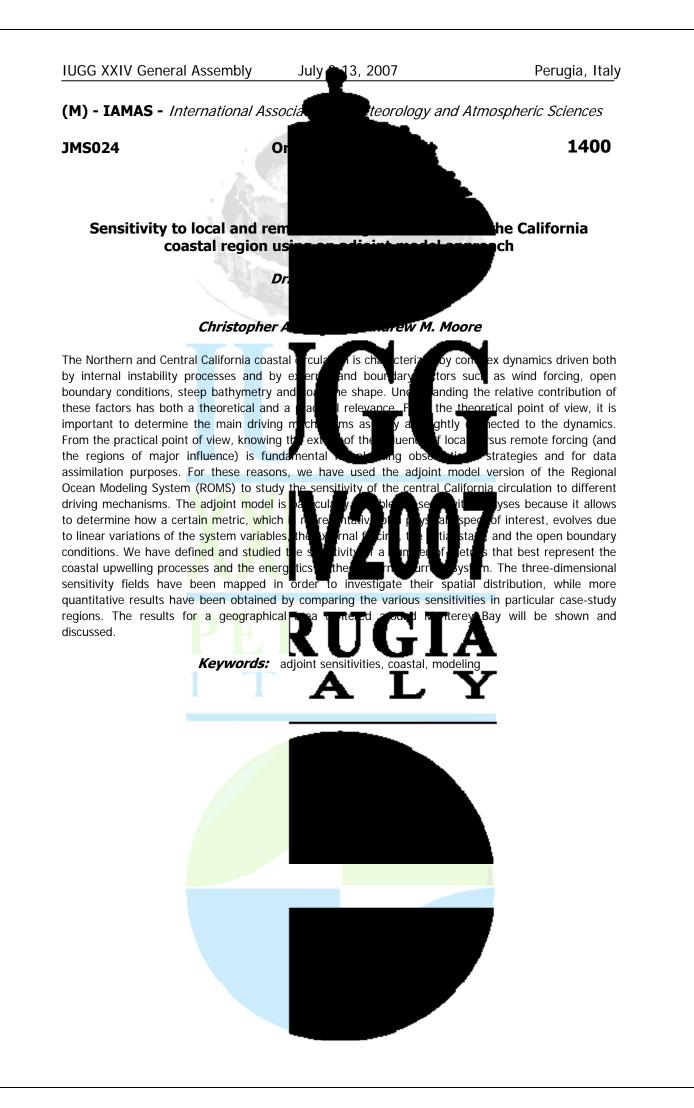
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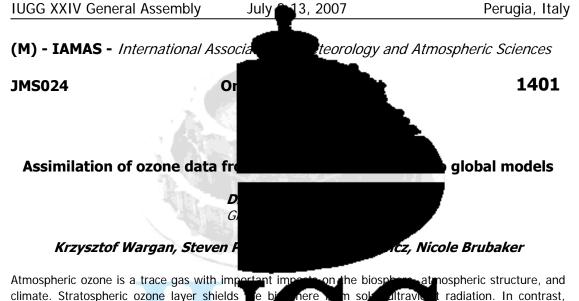






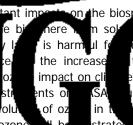






climate. Stratospheric ozone layer shields elevated ozone in the atmospheric bounda radiation by ozone provides the heat sou stratosphere. According to model simulation changes. Assimilation of ozone data from i provided insights into the distribution and the tropopause. The quality of assimilate ozone

data from ozone sondes, aircraft, and occultation instruments. These instruments provide high-quality, but sparse ozone measurements. The vertical resolution of limb sounding instruments has been most beneficial for advances in the representation Small horizontal footprints of advanced na biomass burning. Tropospheric ozone colu and limb viewing satellite data into mode and ozone in the boundary layer are not provide an overview of the progress in ozone a



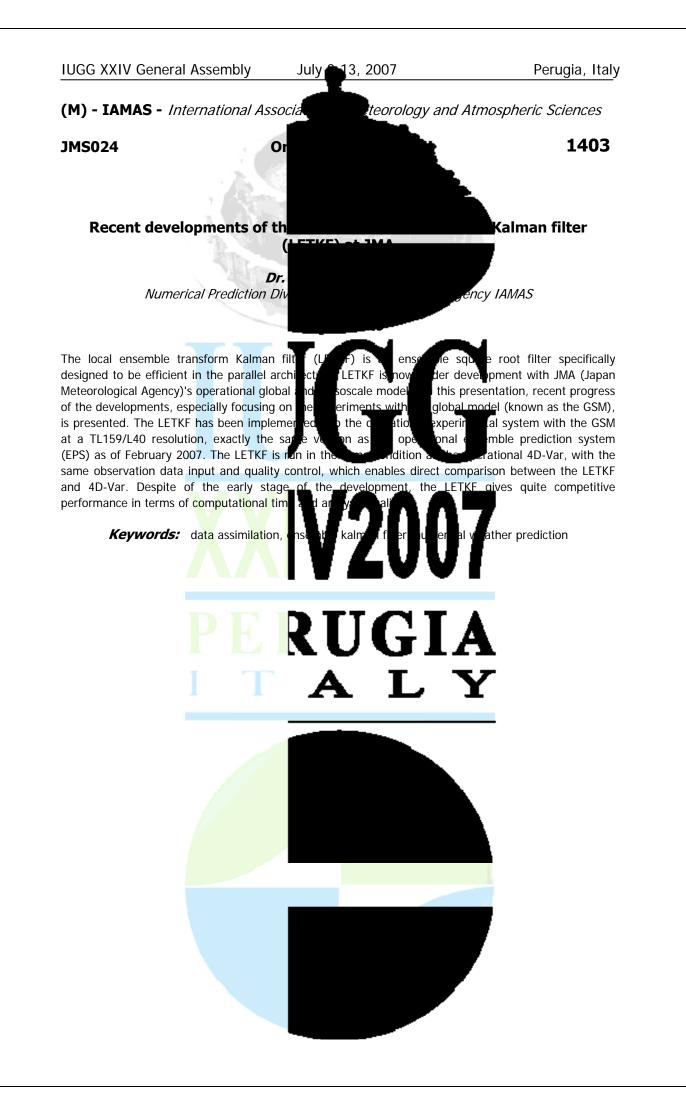
radiation. In contrast, uman health. Absorption of solar temperature with altitude in the e depends on the altitude of ozone and ESAs Envisat has ra sat tratos re and in the vicinity of arison with independent

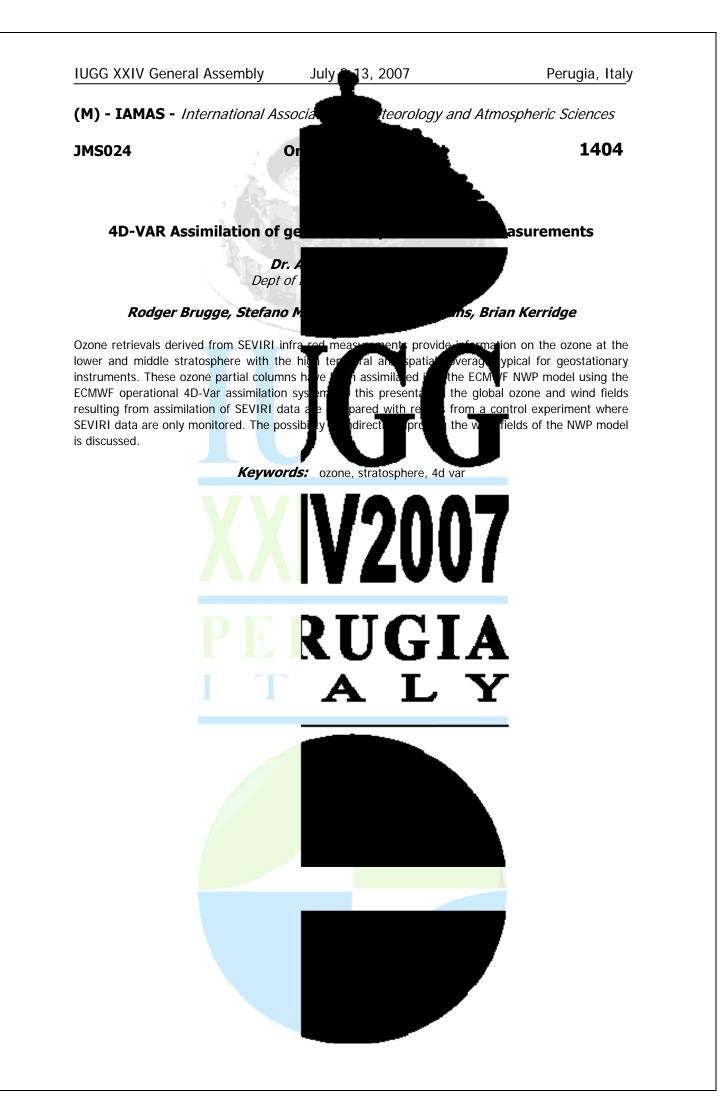
> sing data assimilation. from urban centers or by assimilation of nadir ofiles, diurnal variability, tellite data. This talk will

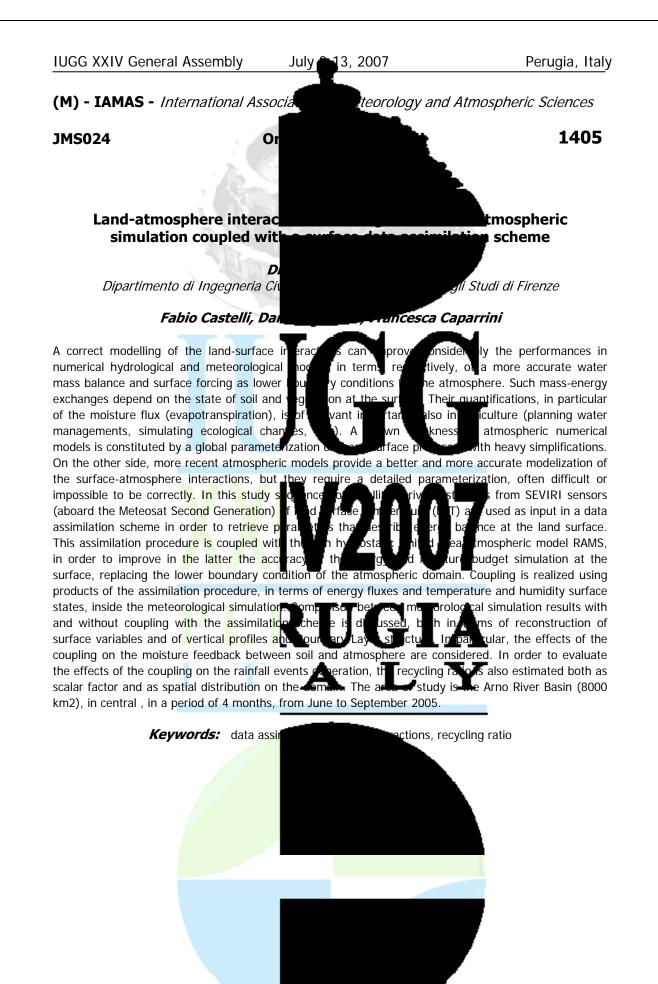
at NASA's Global Modeling and Assimilation Similation Office including: impacts of limb data, assimilation of ozone within a general circulation model, and inclusion of stratospheric and tropospheric

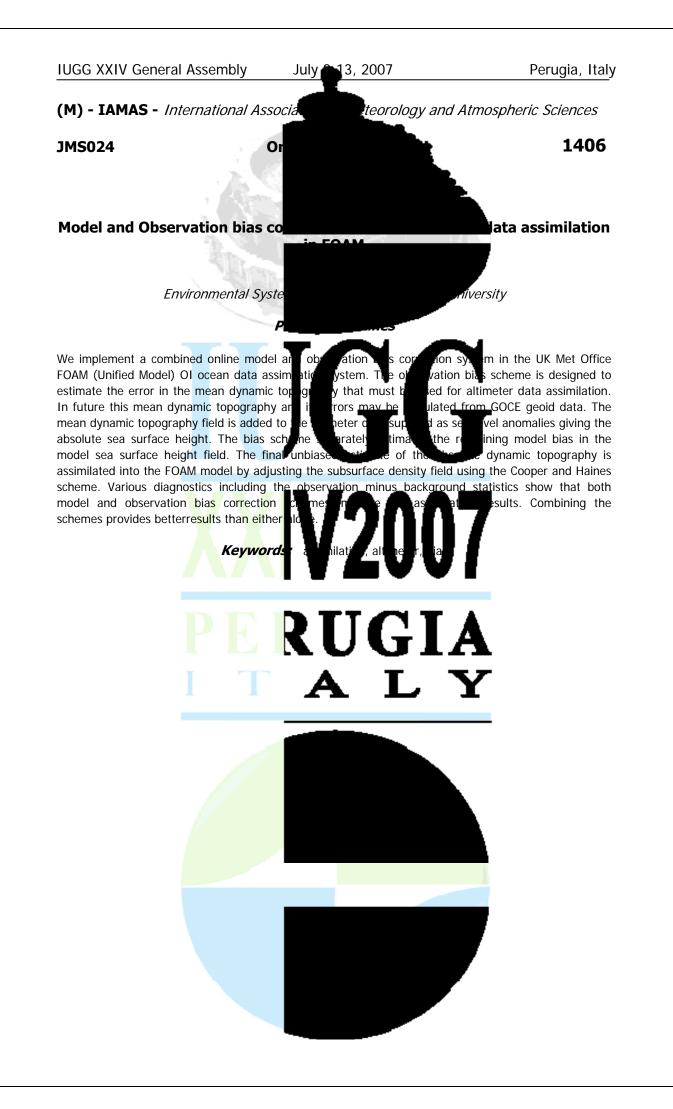


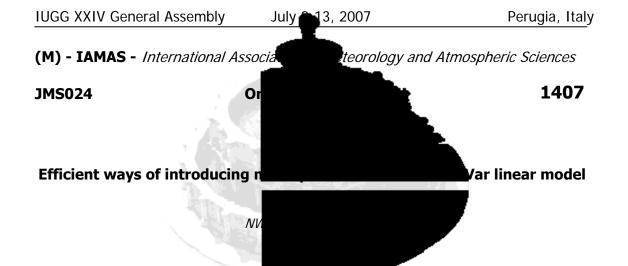












In the last years 4D-Var assimilation systems have operational centres. At the heart of these sy match with the full nonlinear NWP mod linearisation of a dry adiabatic model is to this linear NWP model is very challenging as parametrisations are notorious for their un nature makes their direct linearisation very Nevertheless, the strong impact of moist p linear moist parametrisations have been developed at different centres. In this talk the Met Office's

numerically very efficient (which is essent great benefit in forecast trials. These linearisation test runs which demonstrate considerably when these linear parametris quite general approximation which should statistically based cloud parametrisations. This is a great advantage when applied in operational centres

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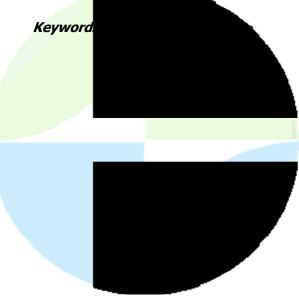
ith great success at many (and its adjoint) whose uality of the forecast. While the rd, including moist processes into nonlinear. Particularly convection tion with their nonlocal s and even instabilities. priority task and some

newly developed linear convection and large scale cloud parametrisations are presented. They are ame time have shown II are consistent with onlinear model improves d scheme is based on a rognostic and diagnostic)

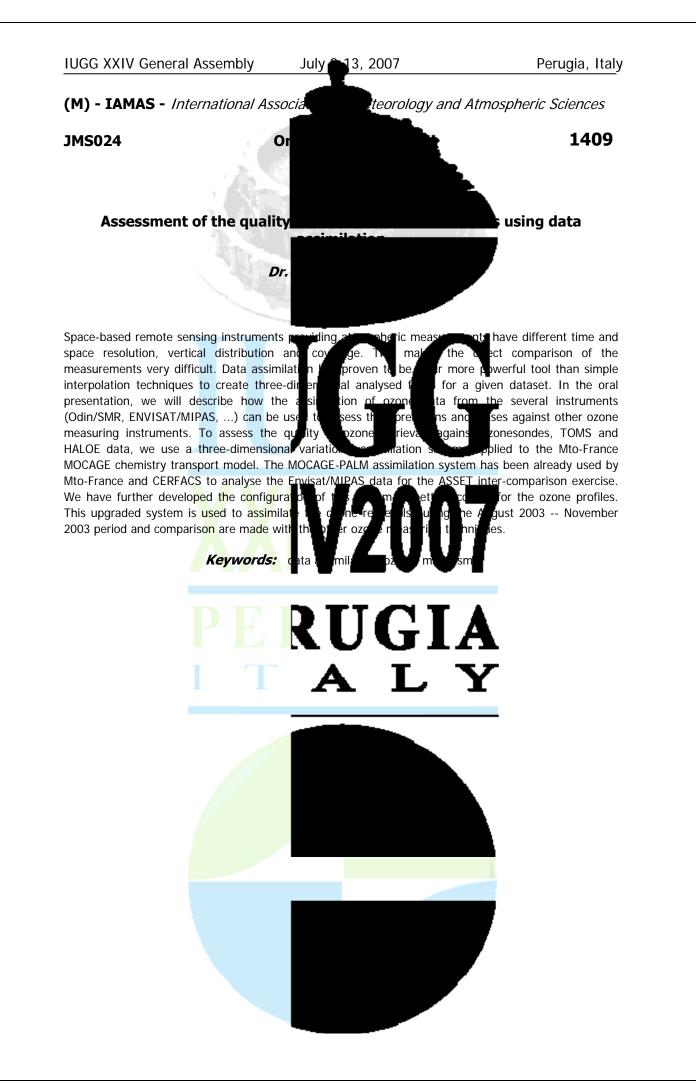
where the nonlinear parametrisations are subject to frequent improvements and alterations. The strongest forecast improvements are achieved parametrisation. Using several fields from the full nonlinear convection ba the eakthrough in this work an linp came through a statistical (time averaged) the unsteady nature of eat belv smo uns wł these nonlinear input fields. So far this linear parametrisation considers only two of the leadingterms pt of the line relation state mass flux on from the nonlinear scheme. The first, which desc es the imp the mo field on this is basically the term the assimilation increments, has a positive implicit which was considered in the first parametrisation that was operational at ECMWF until last year). The benefit for the dynamical fields is entirely due to the second term which is related to perturbations of the CAPE closure

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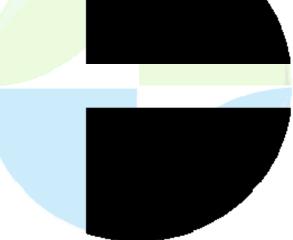
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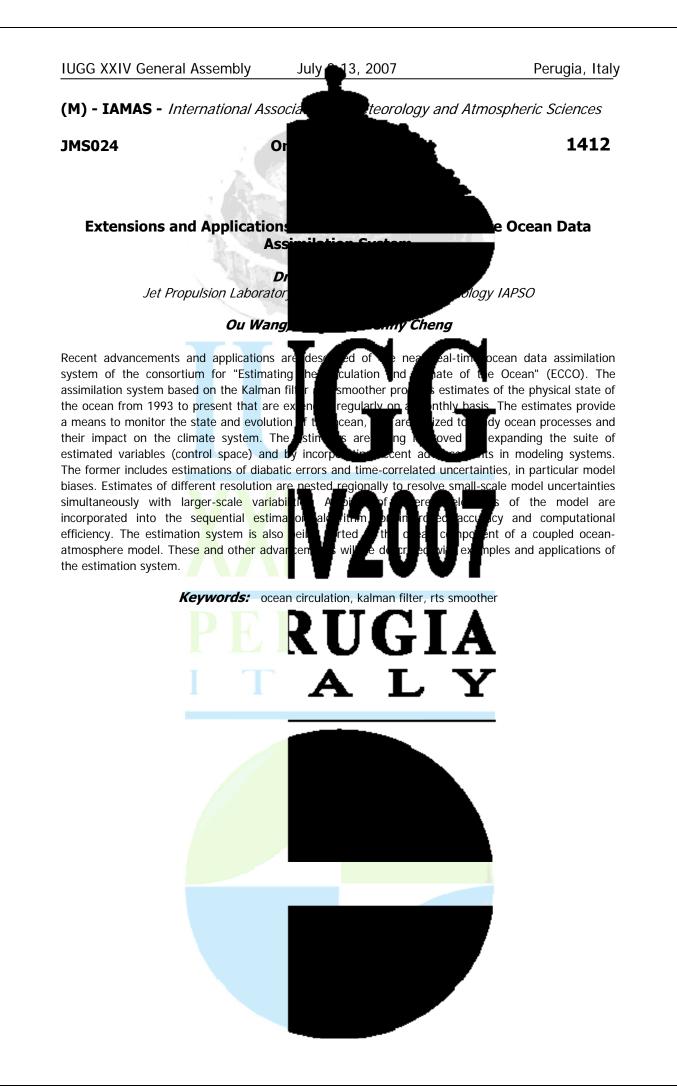


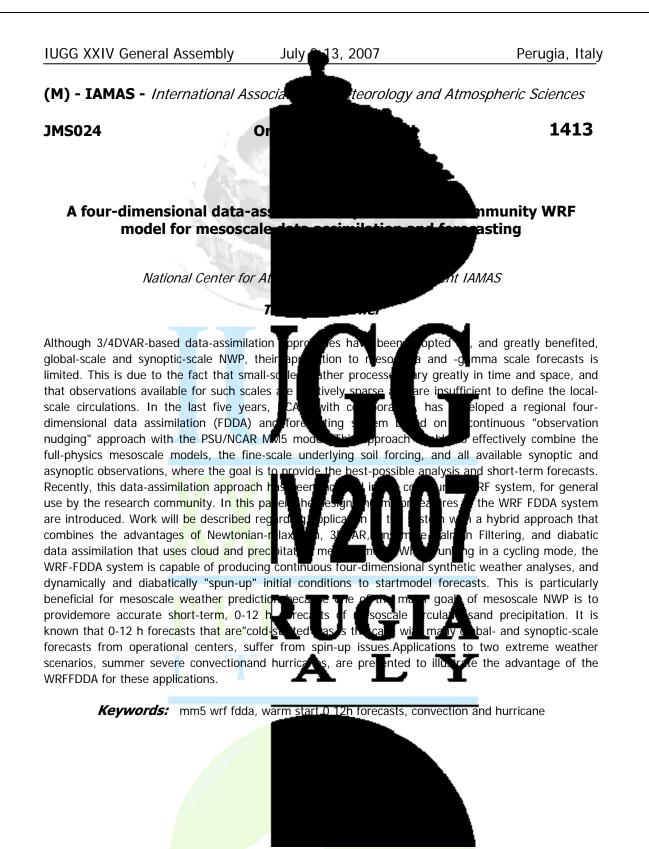


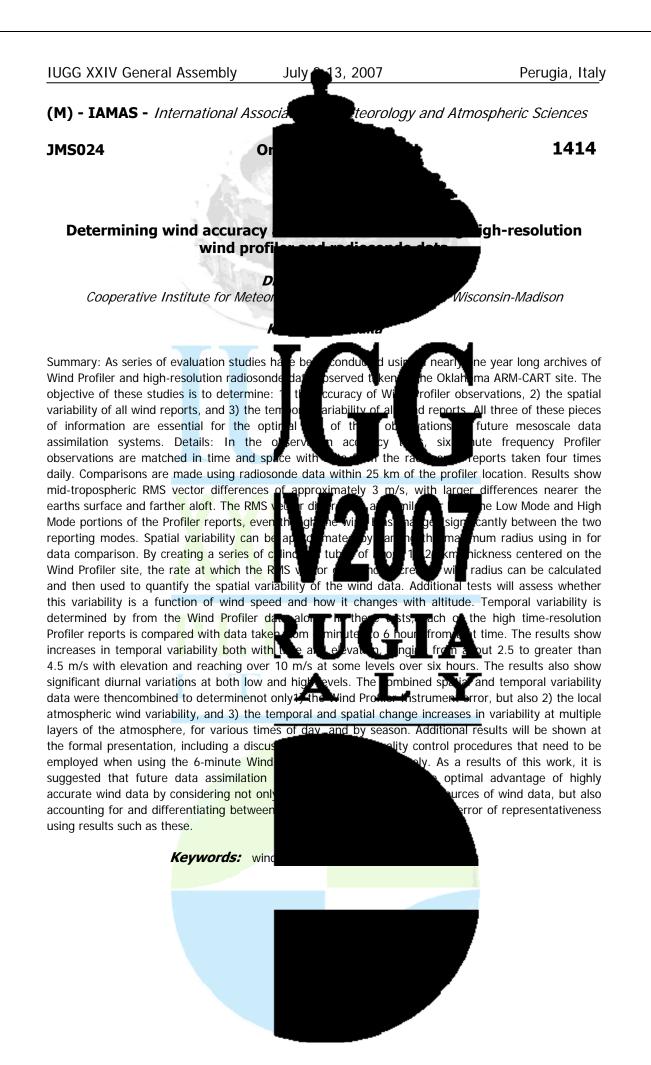


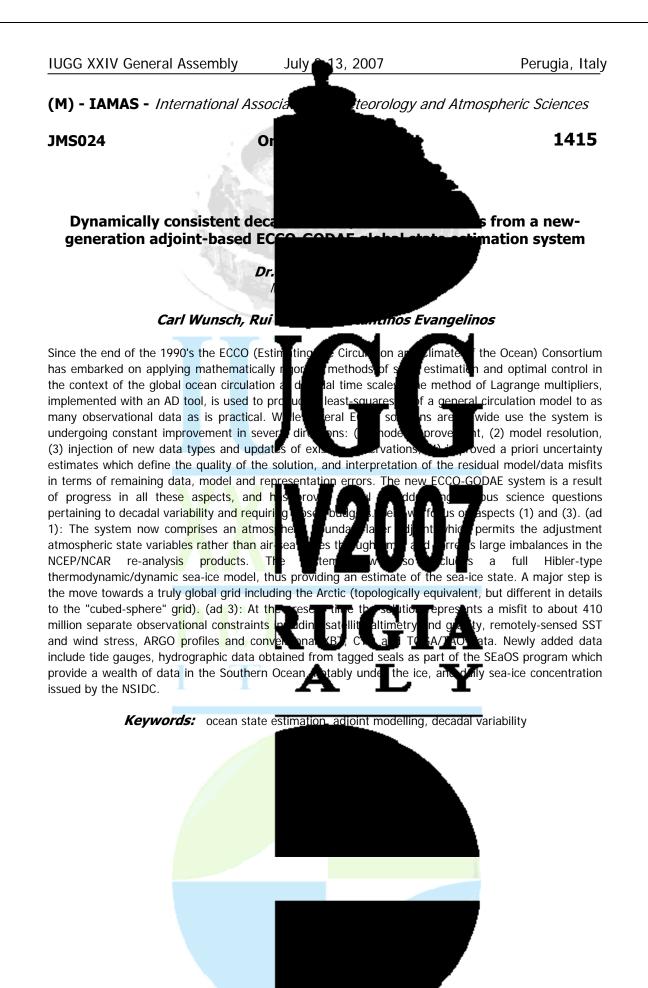




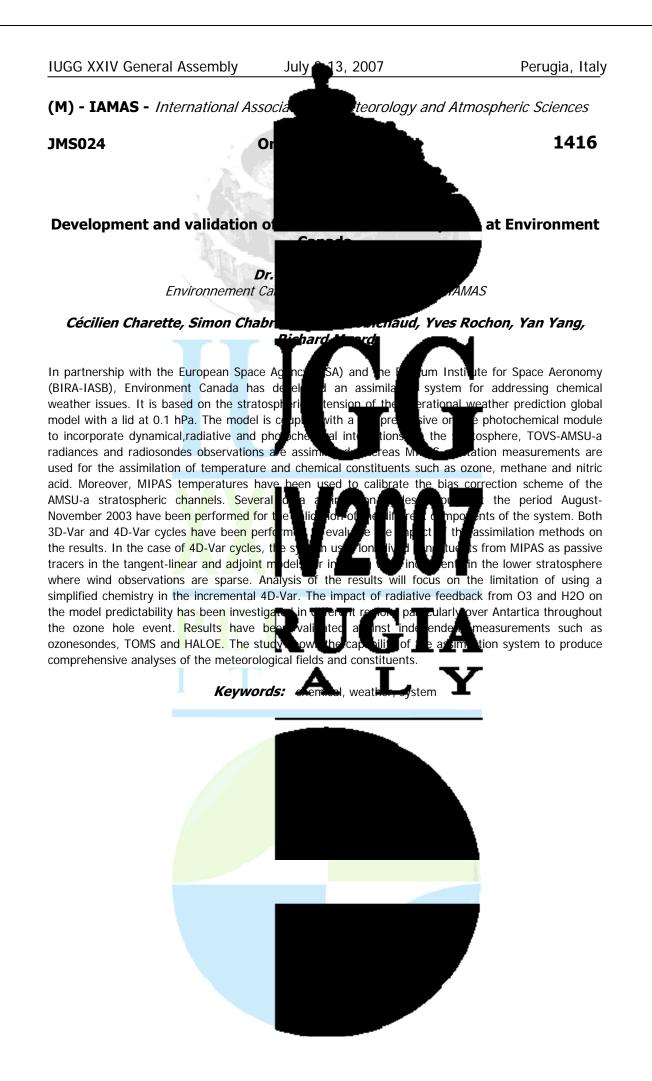




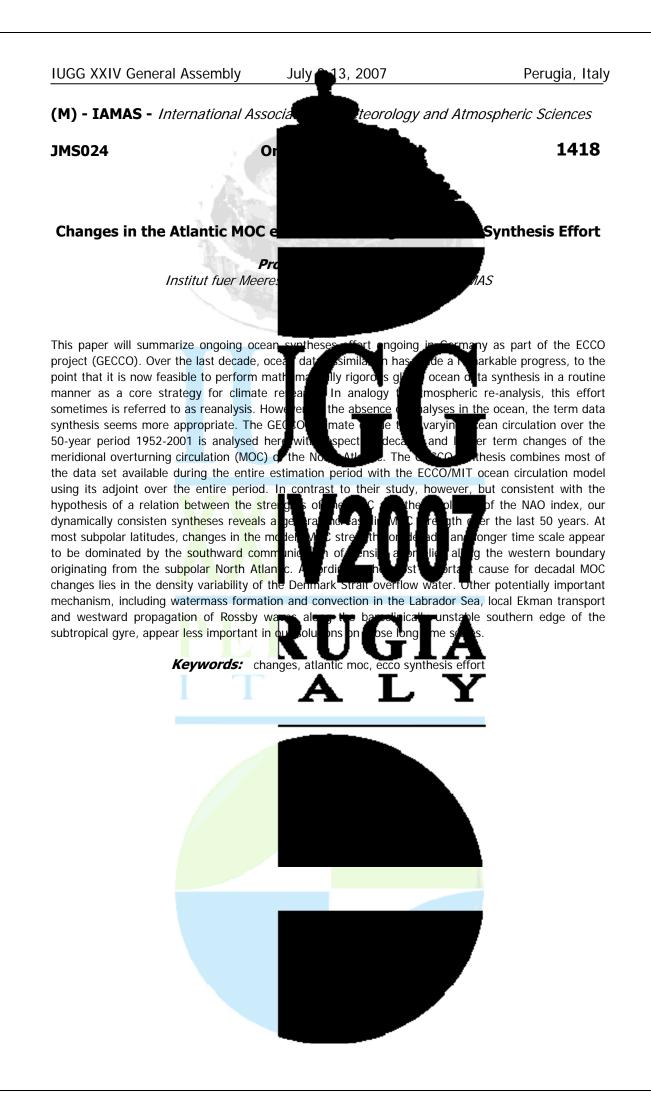


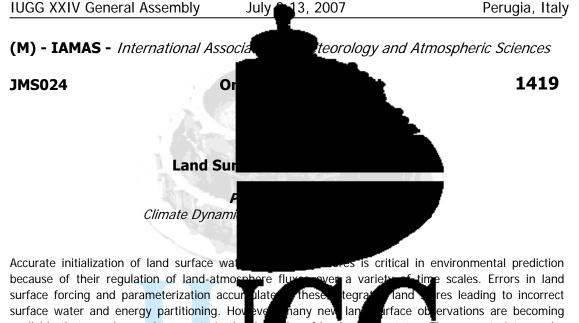


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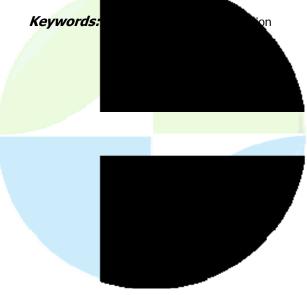


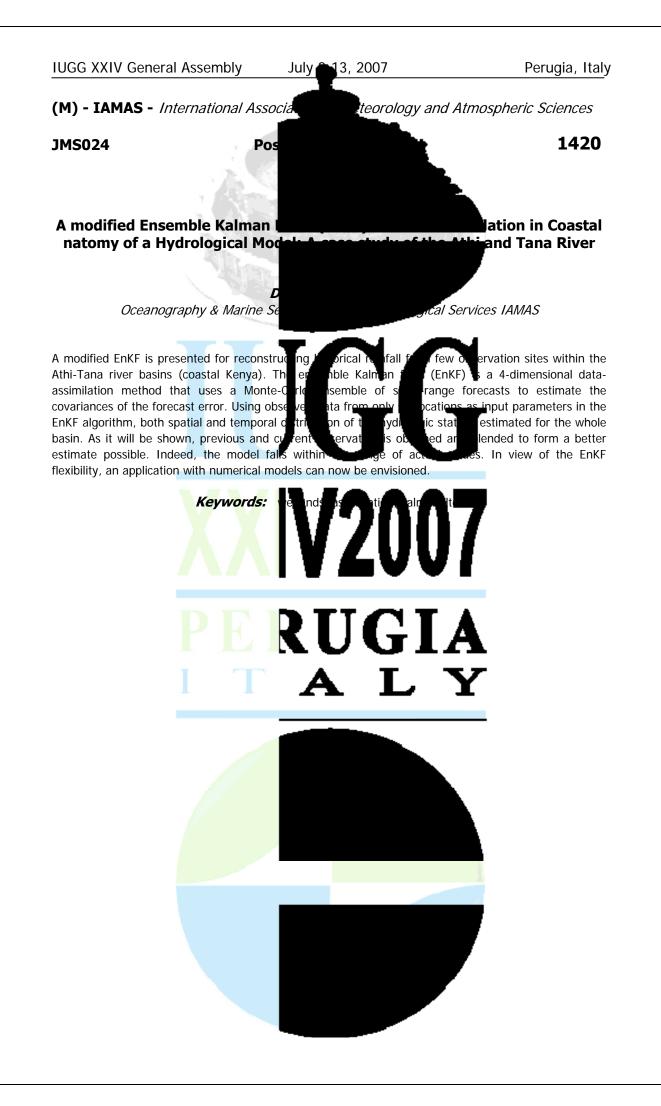
available that may be used to constrain the imposed by (1) forcing the land surface pr numerical weather prediction biases, and (2 storage dynamics. Significant progress has le Inte wide range of scales. Projects such as t (ISLSCP), the Global Soil Wetness Project (GSWP), and the GEWEX Continental-Scale International Project (GCIP), among others have paved the way for the development of an operational land data assimilation. Several of these systems ha resolution for North American, European, from numerical prediction models, satell incorporate land state observations as a CO assimilation methods. Results of assimila on showing great promise to improve predictability and understanding of model realism. Because of its importance, and our increasing ability to observe relevant land surface information remotely, it is

ics of land sy e states. These constraints can be by o<u>bservati</u>d thereby avoiding the often severe data a techni to constrain unrealistic fila e obs ade ir ation and modeling at a d-s ace Climatology Project htellite

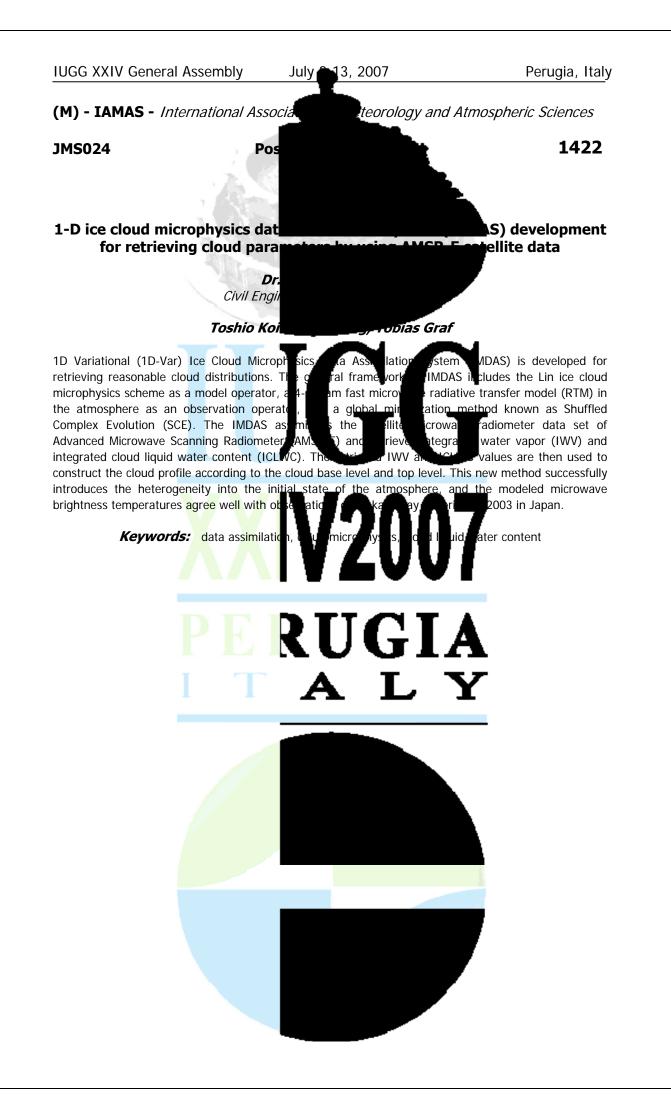
he and at high spatial with real time output heasurements, and can s using hydrologic data moisture, and snow are

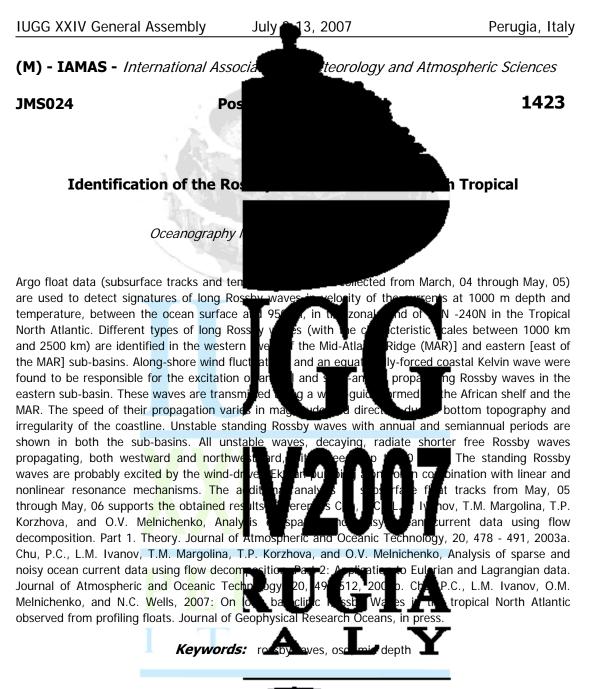
ing data will grow exponentially expected that the amount of hydrologic an over the next decade. However, its usefulne ility t nalyze and integrate this diverse information with land models. atif√ will require innovative arial inty interpretation of potentially large observation volumes, due to observation type, scale, and error disparities. The effect of variations in instrumentype, plac remote sensing and in-situ observations must also equantifie ment, calibities and accuracy of both The completies of future land surface observation scenarios will require systematic methods to organize and comprehend this information. Therefore a comprehensive land surface data assimilation framework will be a critical component of future terrestrial observation and modeling





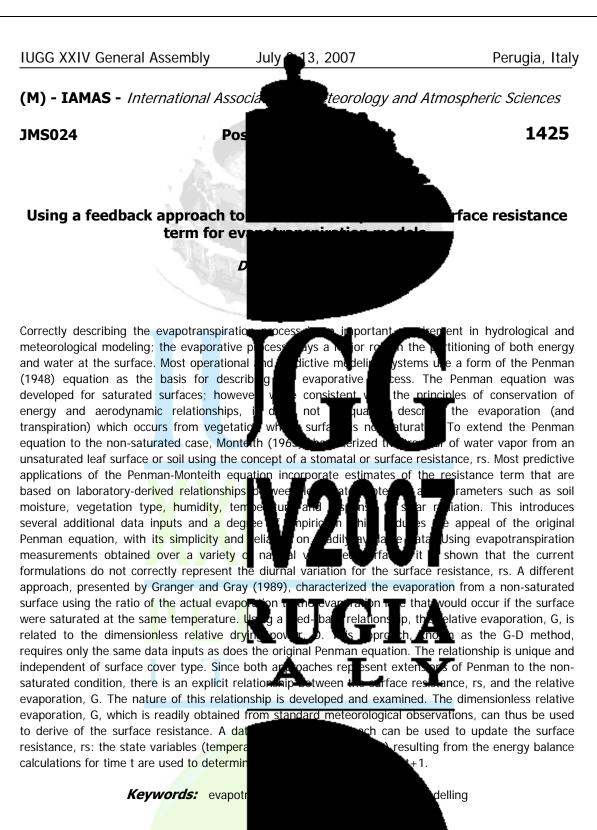






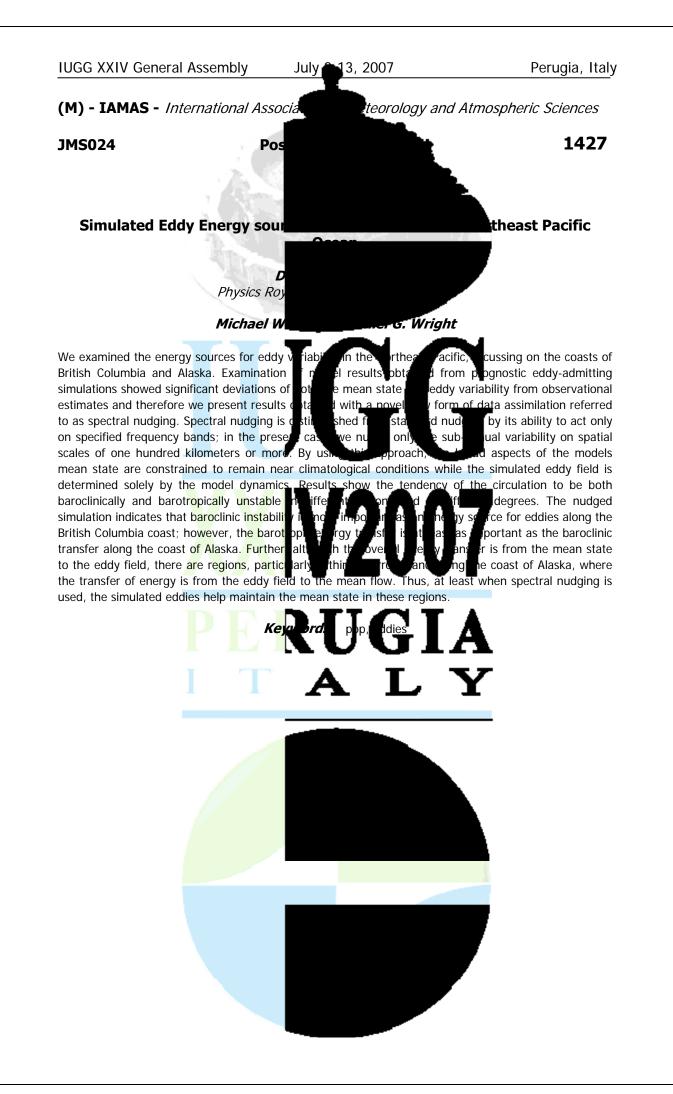


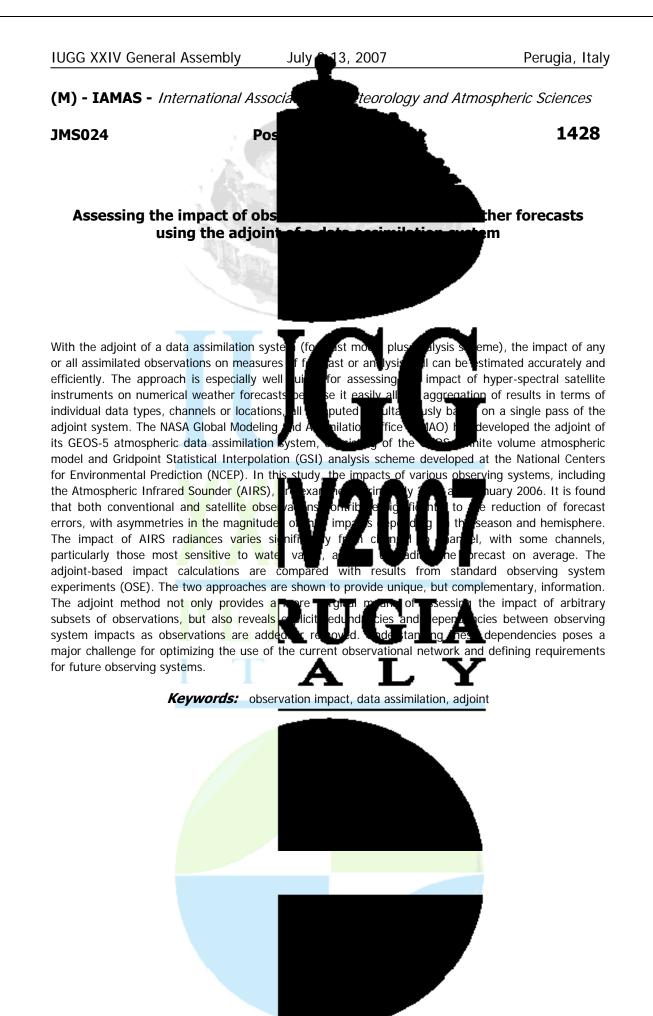






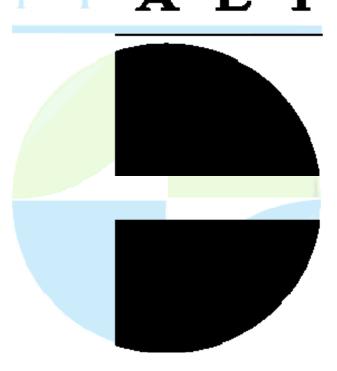


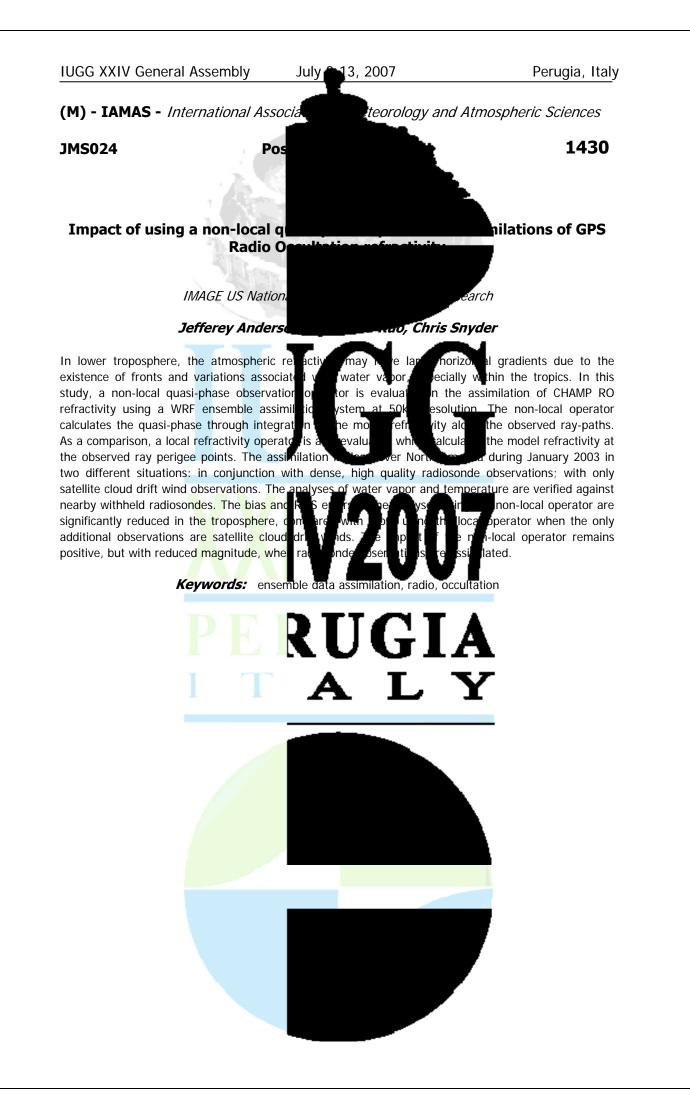


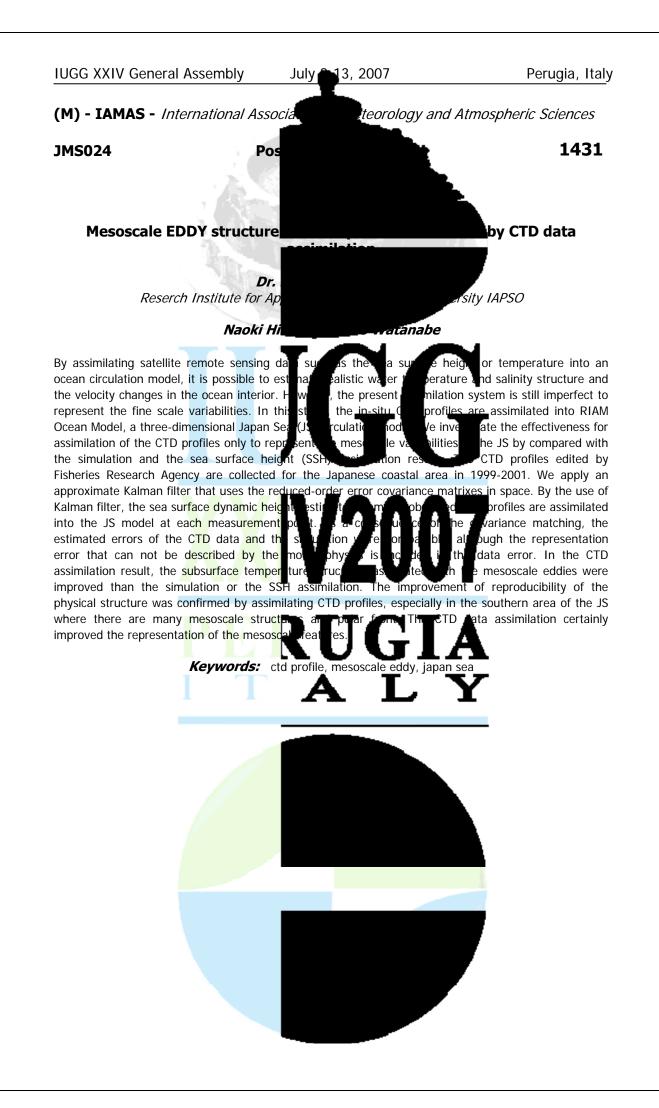


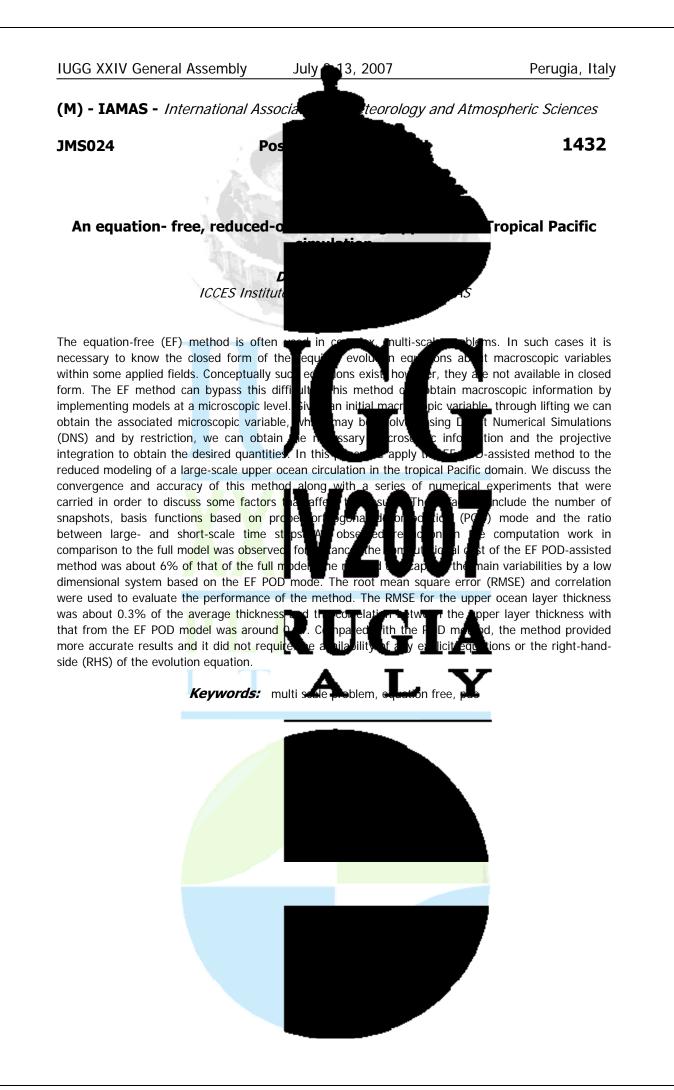
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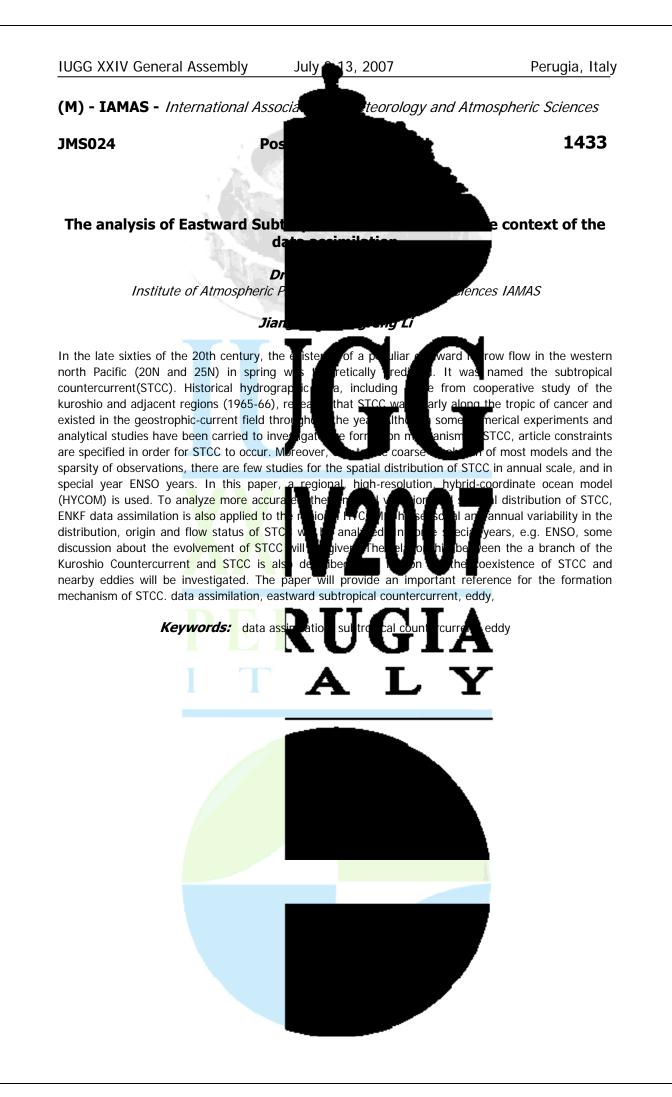




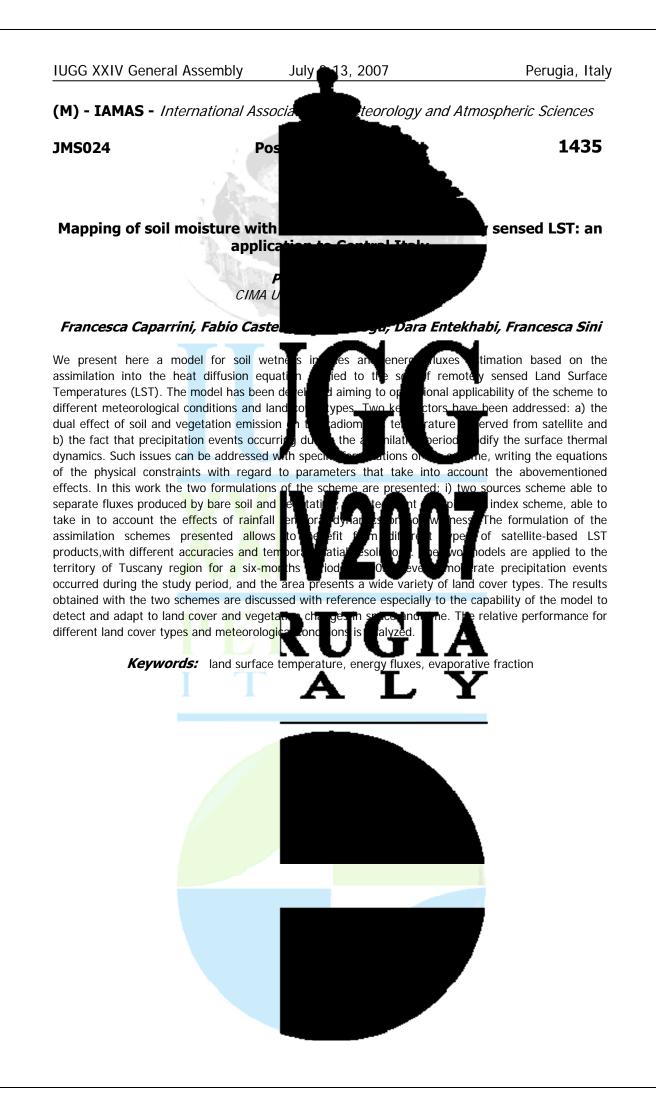






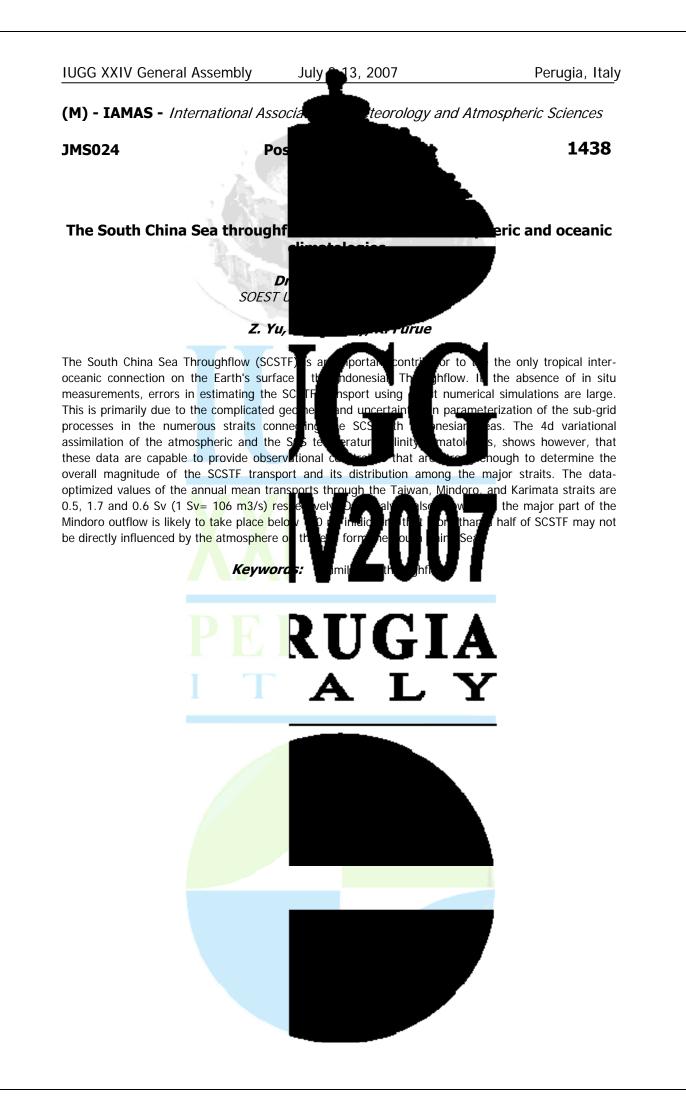


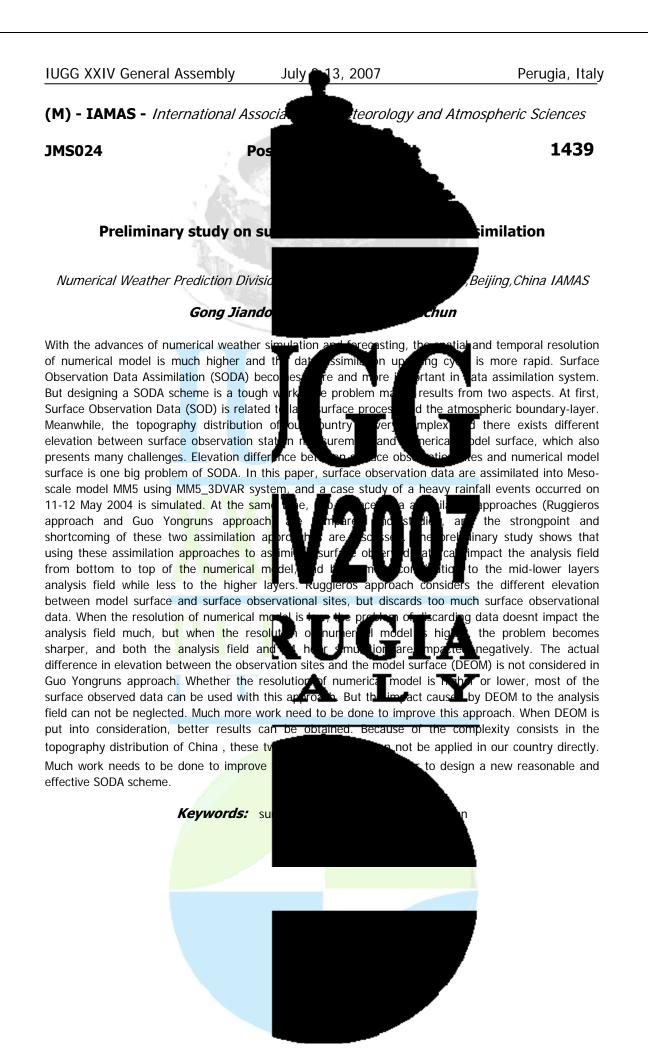






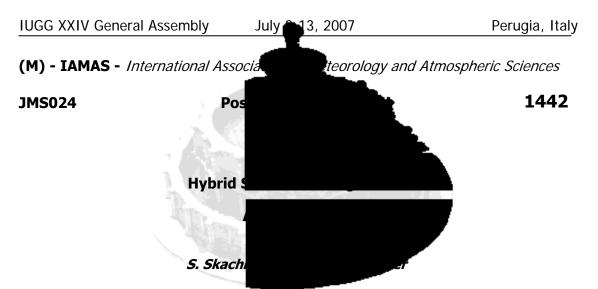












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The singular evolutive interpolated Kalmanfilter (S (Pham, 2001) has been implemented and tested, data within twin experiments framework. behaved in the presence of instability (Ho performance. For example, in the assimi approximated by a covariance matrix whose used for representing the forecast error cov the rank of this covariance matrix is often small, le

order to stabilize the filter. As an alternative we propose the hybrid of the SEIK and a 3DVar algorithm. The performance of this hybrid algorithm twin experiment set up and a simplified (FEOM) developed at the Alfred Wegene generated by baroclinic instability. In this observations of the sea surface height (SS sea surface velocities only. In particular, we co model fields.

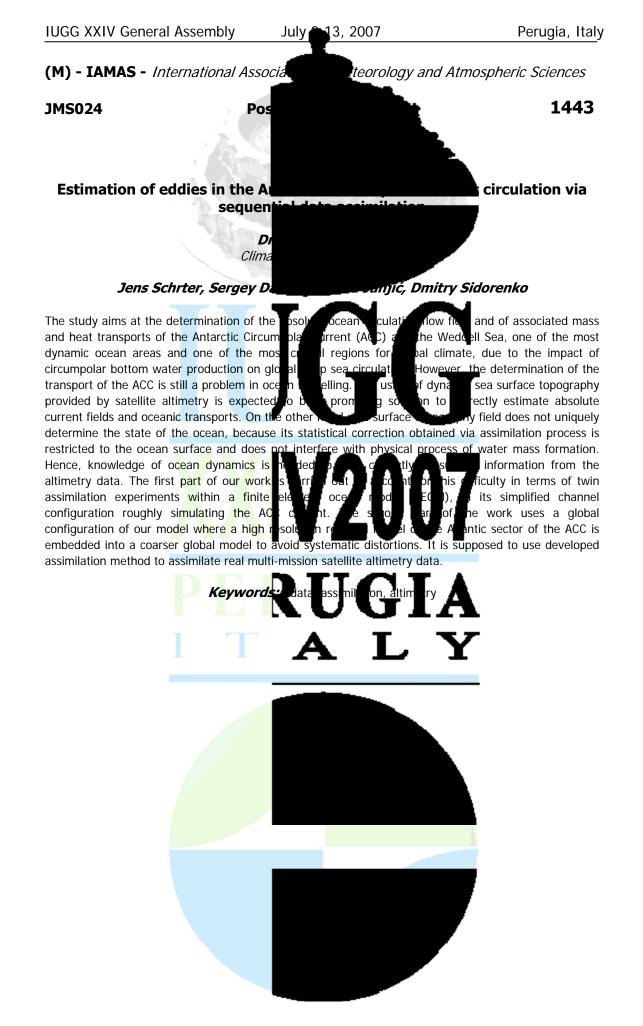
varian n in applic evi studies hdd al. 2002). Ho algori<u>thm, th</u>e corres ne nur ls ompu n orc h oblem For this reason, previous implementations of the algorithm often introduced the forgetting factor in

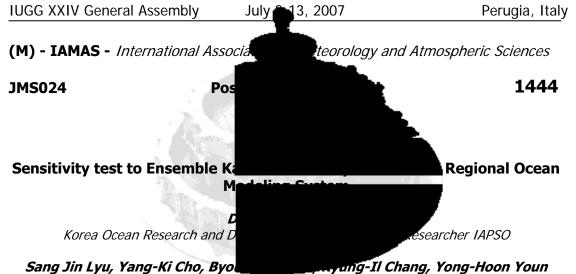
the ensemble Kalman filter y assimilating altimetric anogr that this ilter is reasonably weller, problems still remain with its alysi<u>s error</u> covariance matrix is of ensemble members nally efficient algorithm onvergence of the filter.

> SEIK algorithm using Element Ocean Model ts, we deal with flows

assimilation when only se of observations of the RMS errors with height in all







## Sang Jin Lyu, Yang-Ki Cho, Byo

The Kalman Filter is a powerful framework error covariance is evolved by a forecast however, has kept from the practical imple introduced by Evensen (1994) and has bee are few oceanographic applications. The En (ROMS) in this study. The technical appro (1994) and modified by Houtekamer and Mitchell

some issues due to the finite ensemble size, which can make the estimated forecast error covariance noisy. Furthermore, the EnKF can underestimate the rank of the error covariance since the forecast error covariance is estimated from the fini diverge. To deal with these issues in the and Cohn (1999) and covariance inflation lbν EnKF to implement to the ROMS, sensitiv conducted using twin experiments in the imp with or without the covariance localization and inflation

ita a he previd on. Though th ed successful empld fo e ba on spite ð

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which the background sis. The expensive computation, hsemble Kalman Filter (EnKF) was meteorological applications, there Ocean Modeling System Regio algori suggested by Evensen the EnKF, there can be

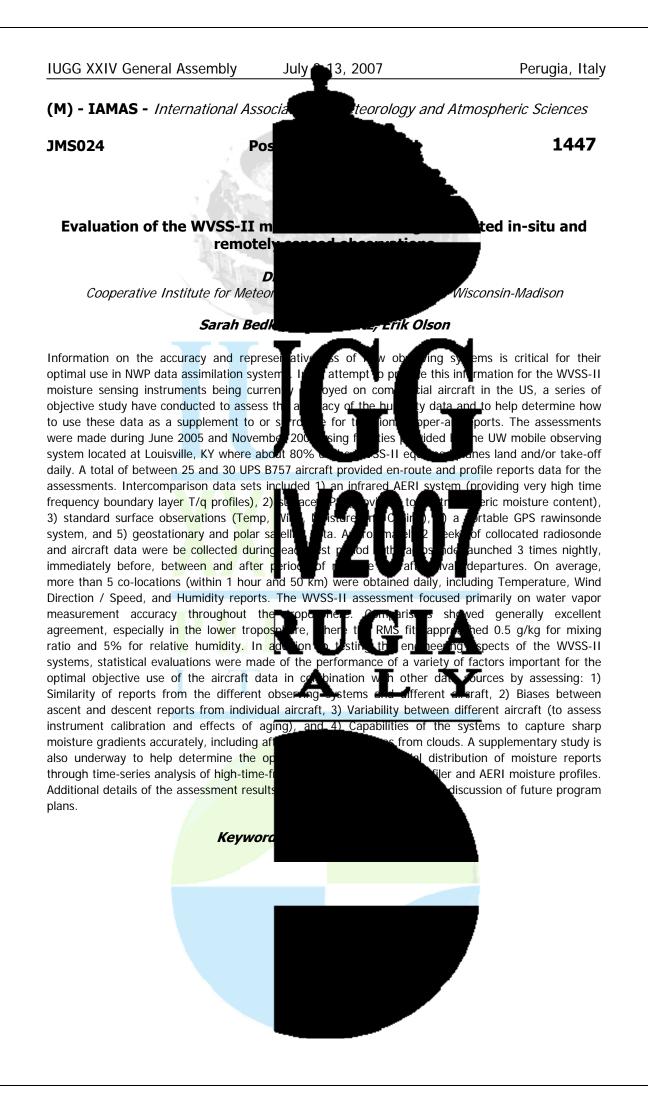
e the Kalman Filter to h suggested by Gaspari scuss the issues of the n and inflation has been error and its uncertainty be discussed. In addition, the multivariate







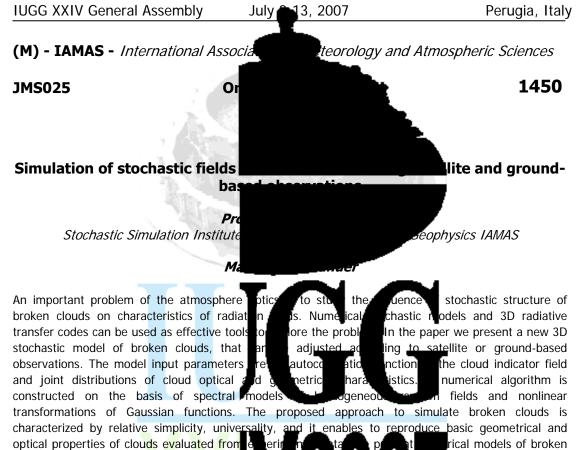






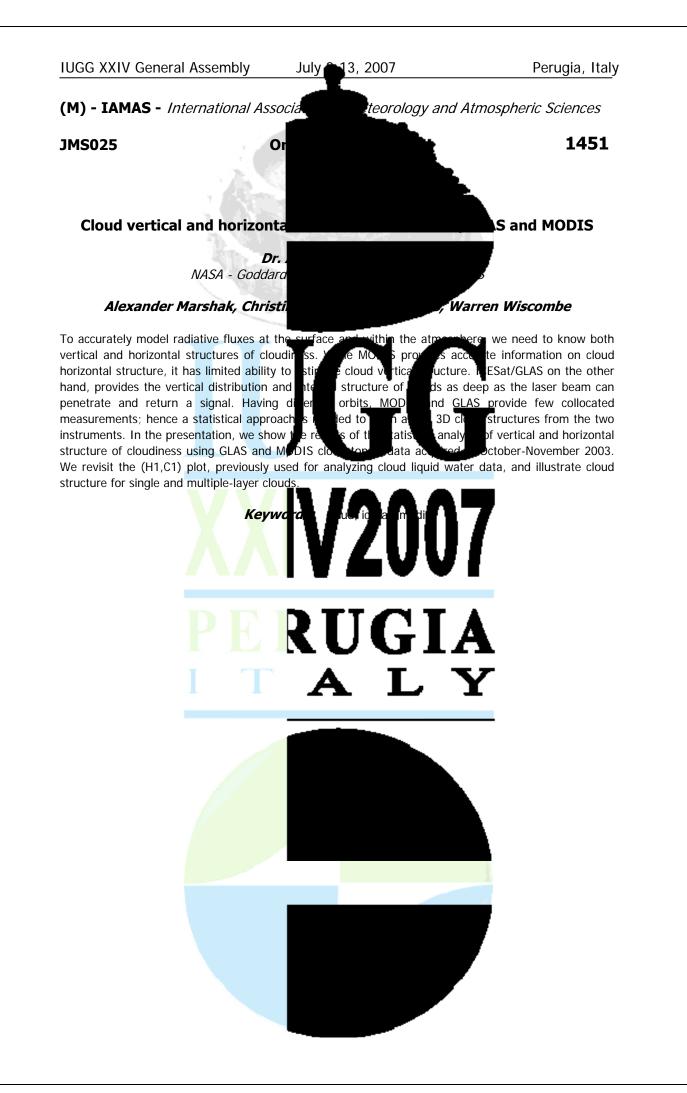


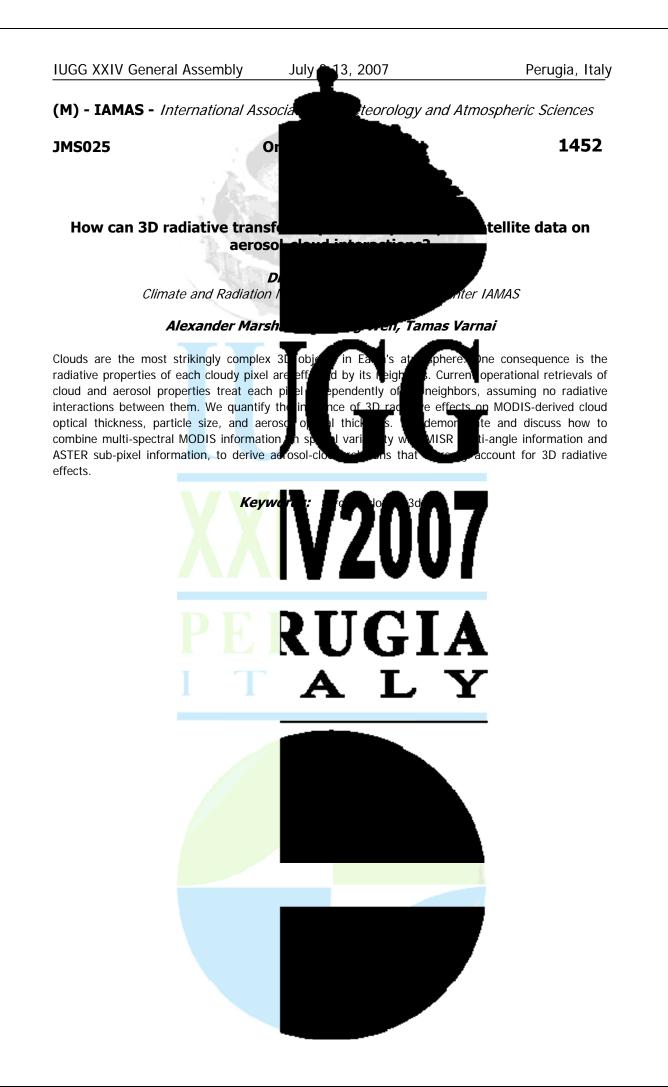


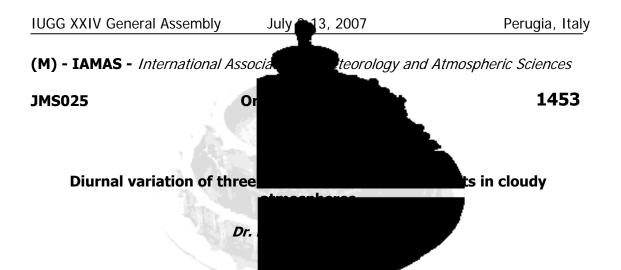


clouds adapted to MODIS observations an research was partially supported by INT. Presidential Program Leading scientific Marshak, 2005: Simulation model of broke Optics, 18, 256-263. rical models of broken the ARM TWP site. The 5-64484a), and Russian [1] S.M. Prigarin, A.L. Atmospheric and Oceanic









The one-dimensional radiative transfer app Many studies showed that this approximation depending on horizontal inhomogeneity of radiative effect, which is notable especiall negligible when the solar hight is low and th three-dimensional radiative effects in cloudy It is possible that the three-dimensional ra height and cloud inhomogeneity change with

ati atmosphere-ocean-land system are different by cloud types, we carried out simulations for two cases with different cloud types; tropical convective clouds and marine stratocumulus clouds. Using the cloud and atmospheric fields simulated by a clo rates in the solar and infrared spectra are model basically uses Monte Carlo multipl radiative flux and heating rate of the firstbrd model. Relationship between spatial detrib

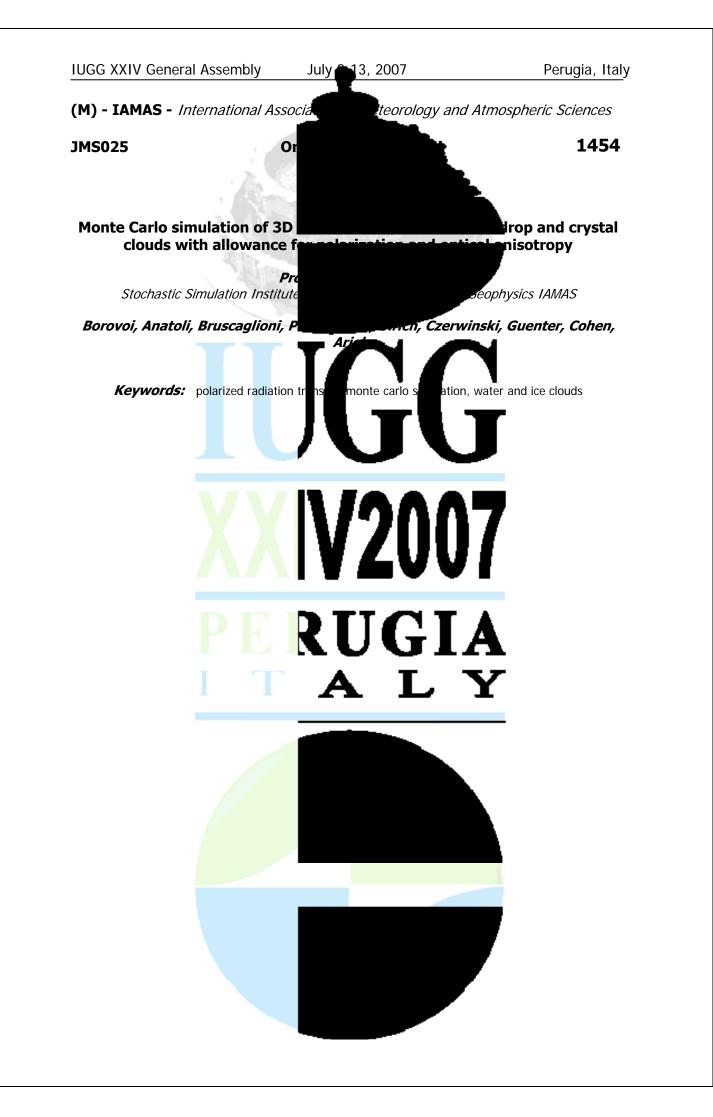
rimatic ts the sola ca erro he error tan. al scales. Th noge<u>neitv is</u> heres ud ffects y in' limings

izental radiative transport. diativ uxes and heating rates, egarded as the three-dimensional omain-averaged error is also not In this study, diurnal variation of or sev types of cloud systems. diurr ycle, in which the solar the diurnal cycles of

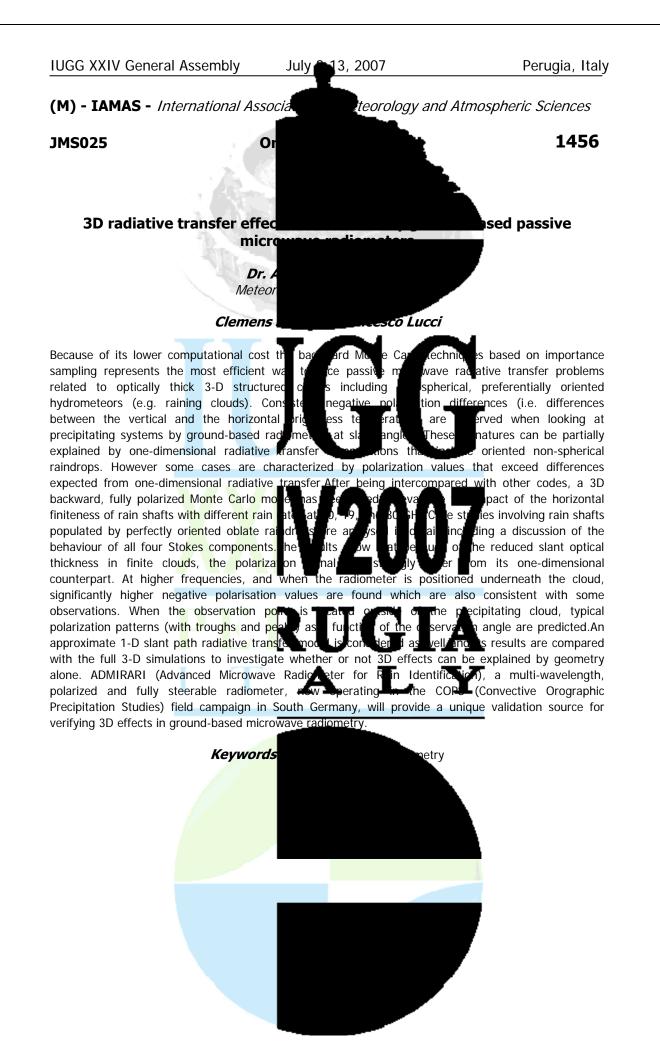
ve fluxes and heating ve transfer model. The irect component of the emi-analytical way in the and radiative quantities (direct/diffuse fluxes and heating rates) are examined, and we discuss possibilities of economical

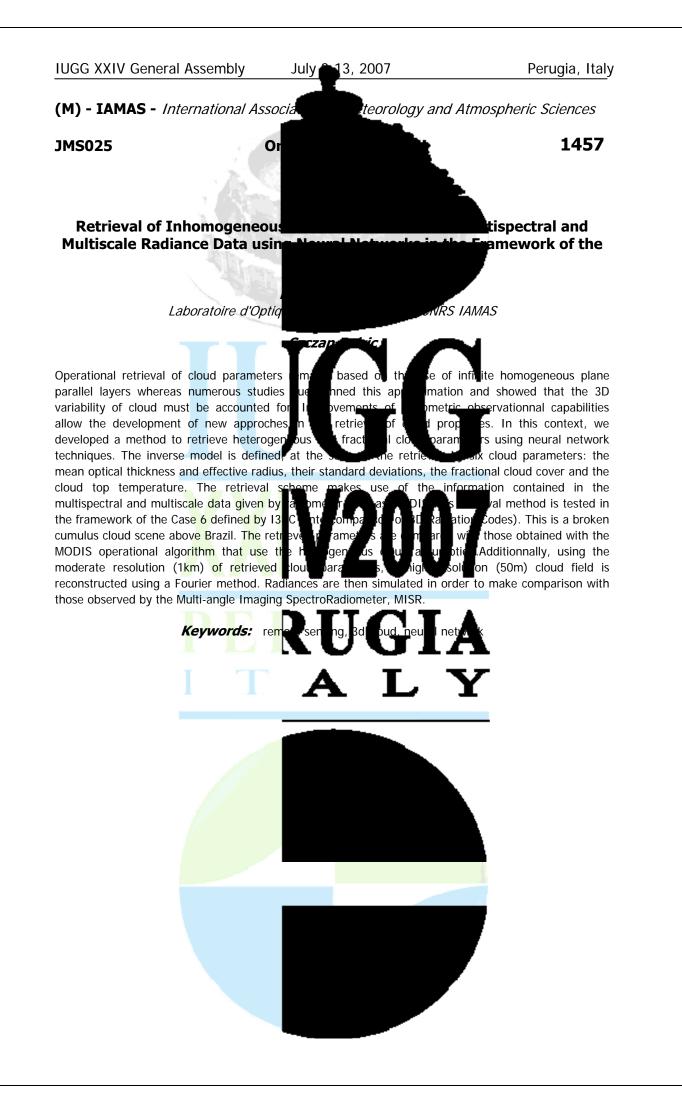
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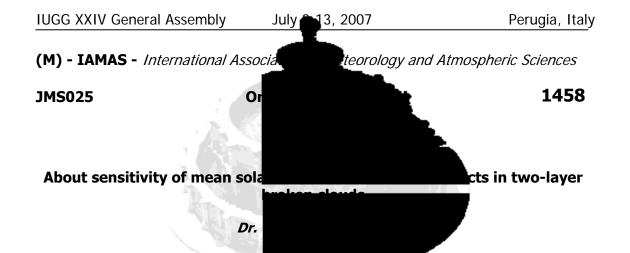












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It is well known that the horizontal inhomo regime of single-layered clouds. So, a inhomogeneity influence the radiative prope aspect of the problem, namely the variation broken clouds due to the 3D cloud effects. two layers are occupied by broken clouds. W of different layers (low, middle, or high), a of complicated cloudy systems. In each layer

mathematical cloud model constructed on the basis of the Poisson point fluxes on the straight lines. To calculate the mean fluxes of solar radiation at different atmospheric levels, we use the method of closed equations, based upon Monte Carlo soluti shown that, in comparison with the clas equation with deterministic optical charac approach has an advantage of providing m and the radiative interaction between the t the typical two-layer systems of the broken clouds, whose upper layer is occupied by optically thin stratiform ice clouds (thigh ~1, aspect ratio yhigh=H/D<<1, H is the geometrical thickness, and D is

the mean horizontal cloud size). The optic either stratiform (γlow<<1) or are the cor solar radiation is determined to a considera depend on ylow for different solar zenith angles SZAs) and oud amount shown that the influence of 3D effects of low-level from 40 to 20% for medium Nlow. We changes when the ice clouds are modeled

Russian Fund for Basic Research (under gra

Keywords.

situated within the limits etween the components d independently, using mean intensity. It is n of radiative transfer m/random overlap, this

prmation of the radiative

y does the horizontal

? The present work explores one

visible solar radiation in two-layer

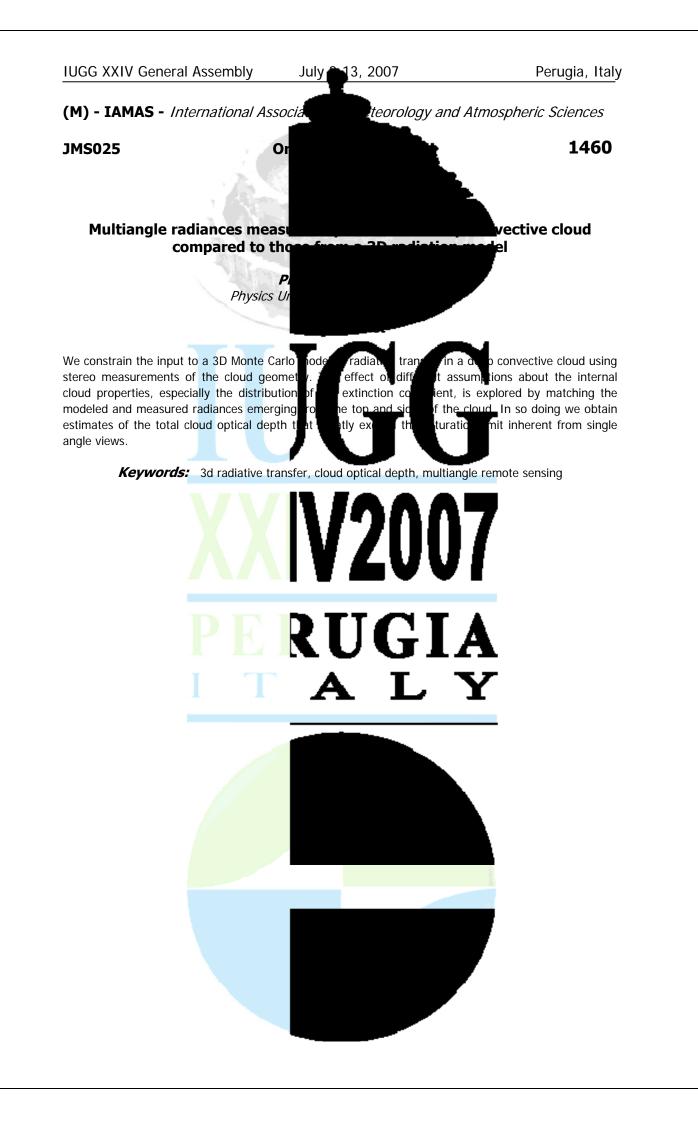
eric model is considered, in which

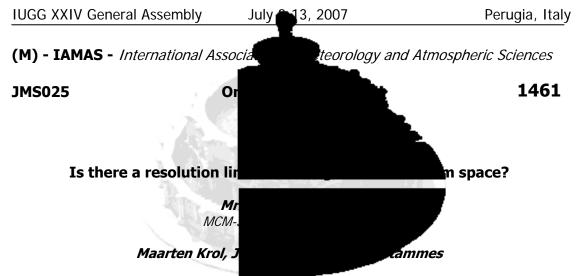
c structure of real clouds consider in detail one of Water clouds (Tlow ~10-40) are

in ch the transformation of f the su hastic geometry of the de by cloud field. The paper discusses how strongly the mean albedo and transmission of two-layer clouds Twithin each layer. It is uds on ean radia on regime decreases with growth of Nhigh: in particular, for large SZA>60 and with variations of cloud amount in the upper layer from Nhigh=0 to Nhigh=1, the relative difference in system albedo, caused by the 3D effects, decreases radiation regime of two-layer clouds

is work is partially supported by







New sensors to measure the UV-vis radiance from better horizontal spatial resolution, in order retrievals of vertical amounts of trace gas determined directly, but using retrieval algo gas columns.Since radiation does not nece satellite instrument, the information carried nature, especially in the presence of cloud effects, reducing the pixel sizes beyond a certain in

this smoothing of trace gas absorption is well known from theory, it is largely ignored in discussions that aim at nadir-looking instruments with high horizontal resolution. In this presentation a first attempt is presented to evaluate the impact of radia Monto Carlo 3D radiative transfer model atmospheric absorption and scattering, is ground pixels (e.g. 4x4 km, 440 nm for tro more from from outside the sub-satellite uniform cloud cover and uniform aerosol distribution

have been d fre lo m hize ever, the col hat translate travel from t radiati 5a rosol the ot inc

loped. These sensors have thus allow more useful xels. amount of trace gases are not sured radiances into vertical trace un to the earth and back to the the s te is normally diffuse in ral range. Due to these vis s tual resolution. Although

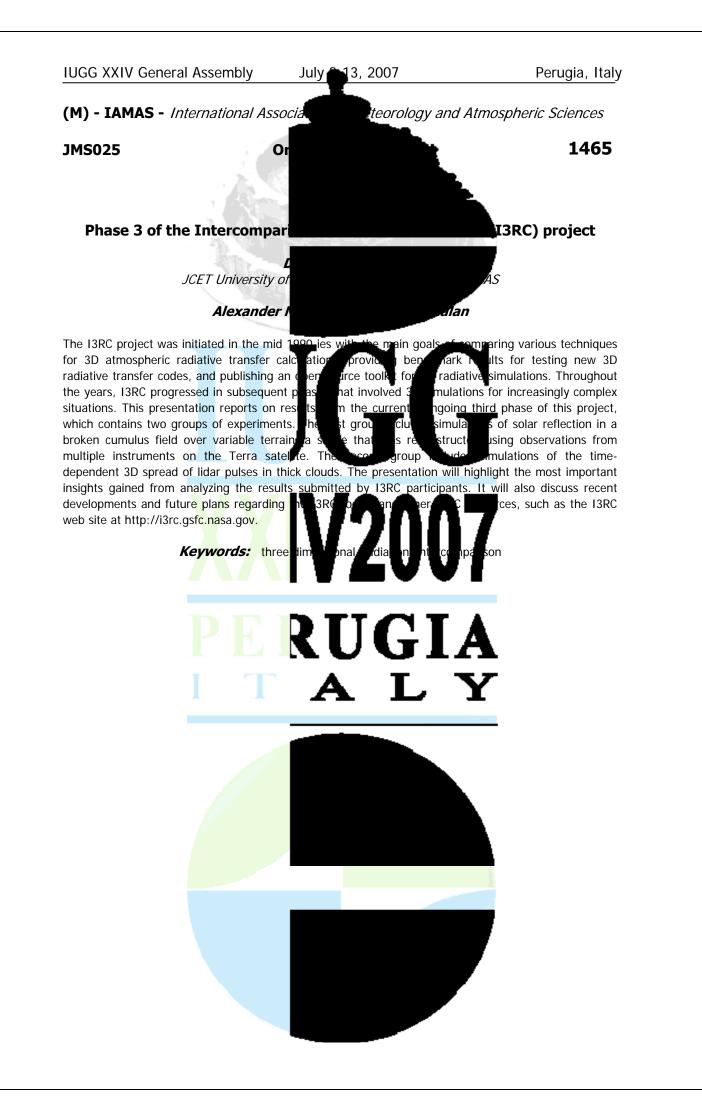
> sing. Here the adjoint Theorem to seperate cases with very small ut trace gases is coming timate of effects due to

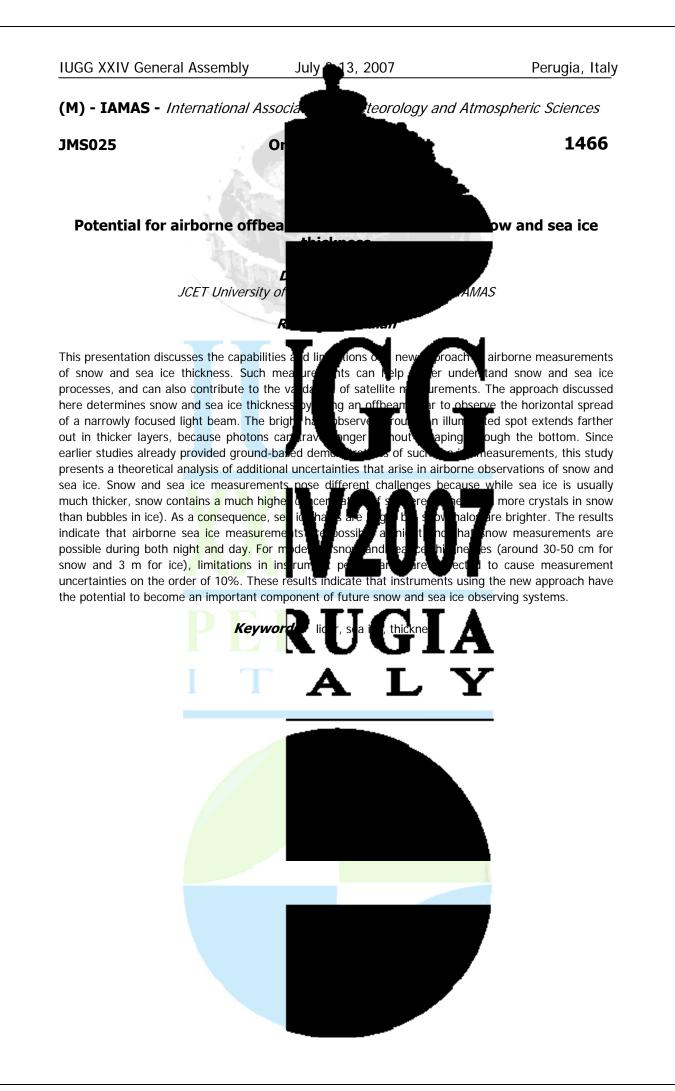


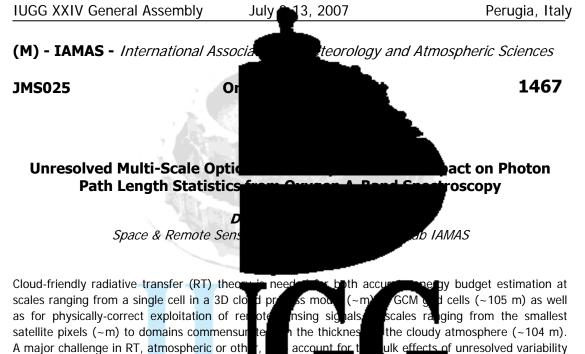












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irrespective of the artificial computational o the study of dense clouds and cloud fields dominated by complex multiple scattering/reflectio with the generic time-dependent 3D RT equation, general probabilistic arguments and tractable stochastic models lead to robust predictions for the statistical properties of the mean propagation kernel in homogeneous and isotropic but otherv longer exponential; rather, it has a power-

RT theory for domain-average 3D RT that 1D RT theory with power-law jump probab different asymptotic properties than its v between scatterings. We will present a spectacularly successful application of this new statistical radiation transport physics to recent state-of-the-art absorption-line spectroscopy in the "A" band of

molecular oxygen (760-770 nm) from gr excellent out-of-band rejection, these high lengths for solar radiation in cloudy atmosp. RT theory makes the outlook towards space-based capability in O2 A-band spectroscopy (with NASA's Orbiting Carbon Observatory) very exciting. shortwave RT will be discussed.

eferen This is especially true in eflect surface, at wavelengths space and time. Starting

> ptical media. It is no formulate a mean-field RT. However, this new tions and it has radically entially-distributed jumps

cloudy skies. Thanks to lety of well as variance of path mear ccess of large-scale 3D r, † is . M parameterizations of ations for

Keywords: solar radiative transfer. 3d clouds, gcm parameterization

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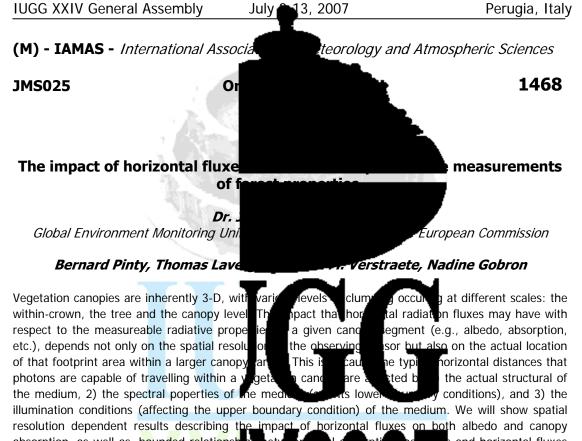
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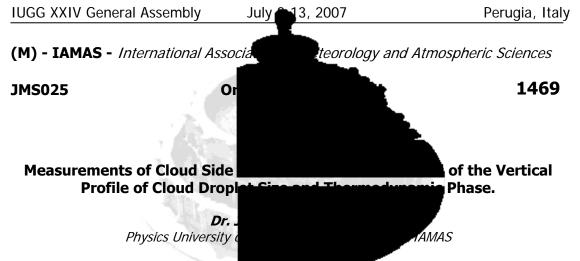


absorption, as well as, bounded relationsh at very high spatial resolutions. We will al pixel-based inversion efforts of remote sen in the design of future space missions and sensed products over land.

and horizontal fluxes atial resolution limit for on are of relevance both the validation of remote

Keywords: vegetation canopy, horizontal fluxes, multiple scales

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Alexander Marshak, Tobias Zinne

Cloud side measurements provide a unique cloud droplet size, and thermodynamic pl provide a quasi-instantaneous snapshot of the a function of height and brightness temper situ measurements have provided insights time evolution of deep convective clouds, a side remote sensing can facilitate the measuremer

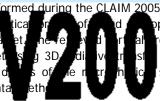
emer, Roberto Fernandez-Borda ppo ty for a functi droplet micr clouds irectio le' ne inti ris crophy

of the vertical profile of mperature. These measurements sical and thermodynamic states as development stages. Although in ays ha limitations with the fast flying de strong storms. Cloud rties of such clouds but,

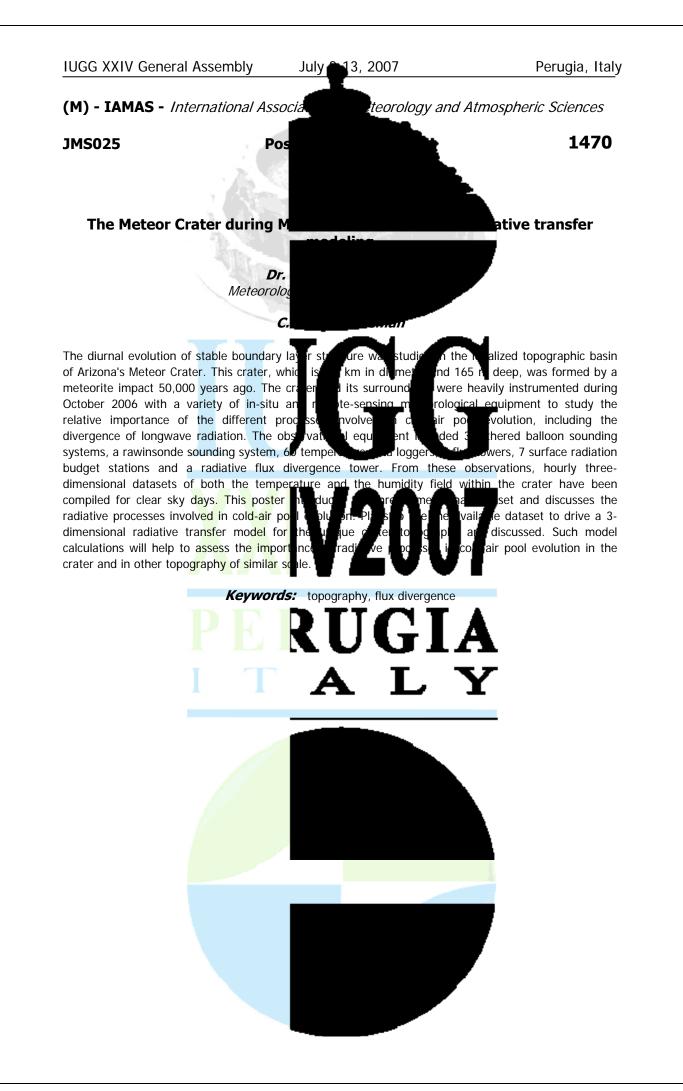
it unequivocally runs into the problem of treating clouds as 3D objects. In this work we will show results of measurements of cloud side radiances performed during the CLAIM 2005 experiment in Brazil and the

Keywords: cloud side, 3d

modeling effort involved in retrieving the properties of convective clouds from this d was performed on the experimental data Monte Carlo simulations. The results sho cannot be obtained today by other experim



and thermodynamic of cloud effective radius ulations by SHDOM and cture of the clouds that

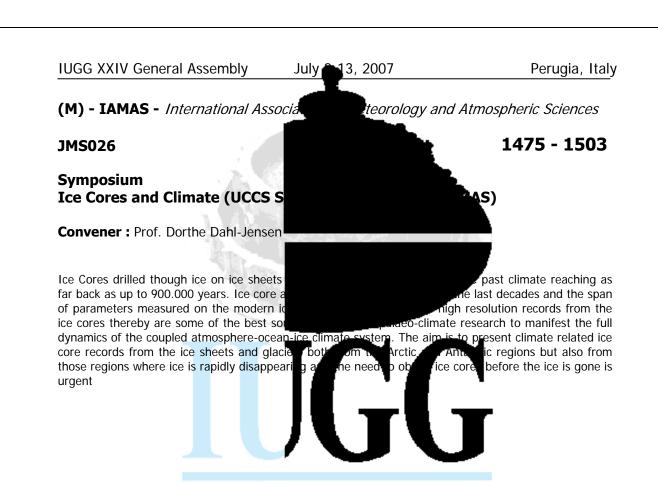






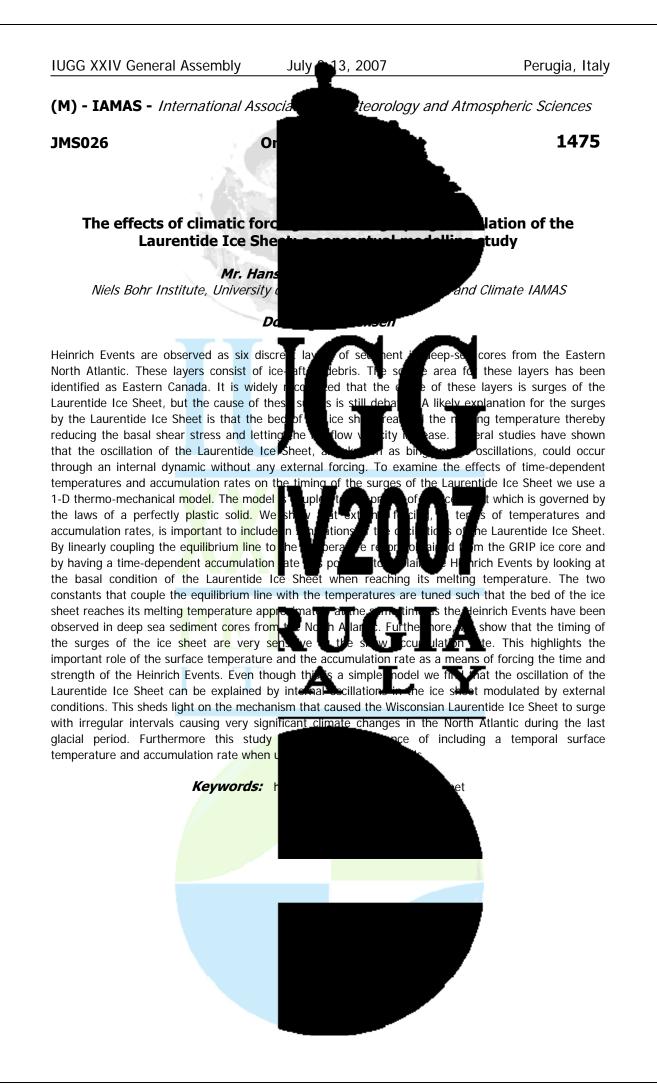






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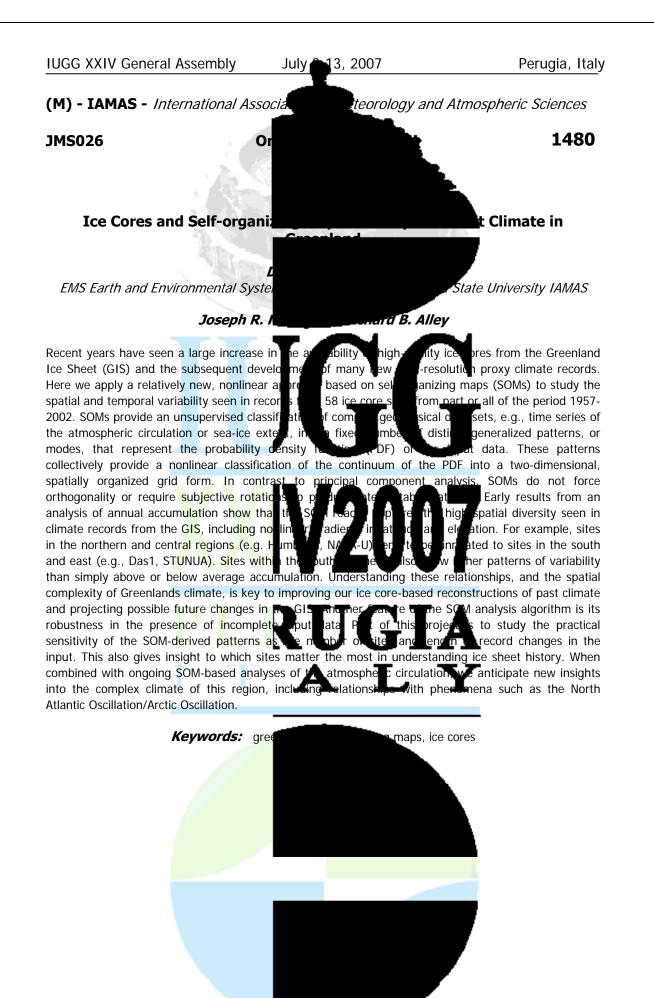




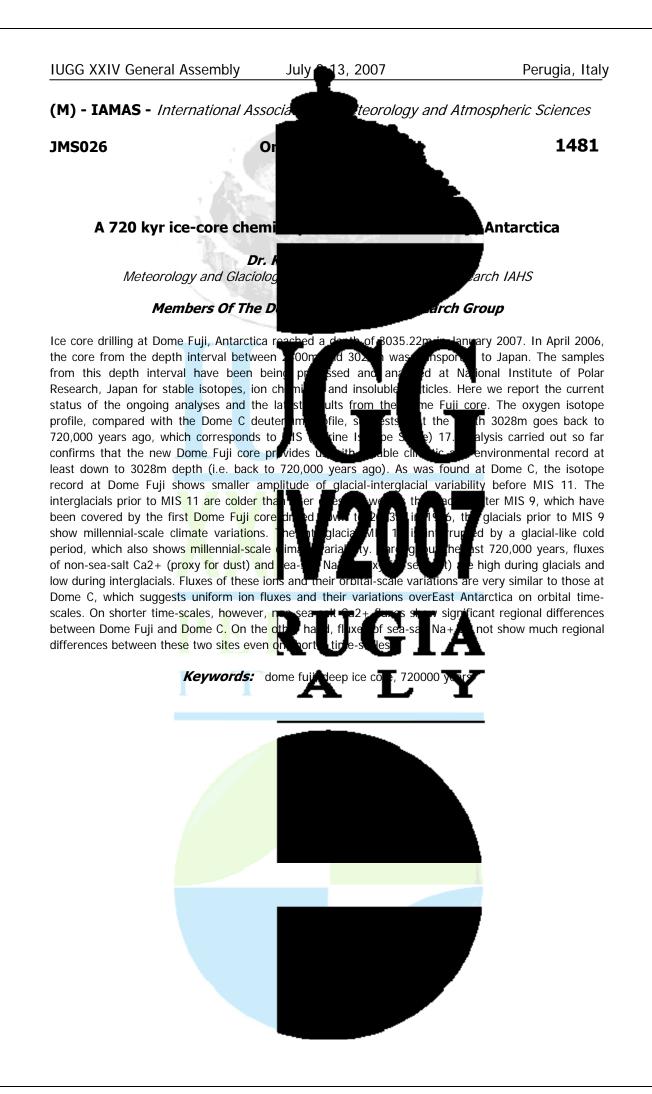






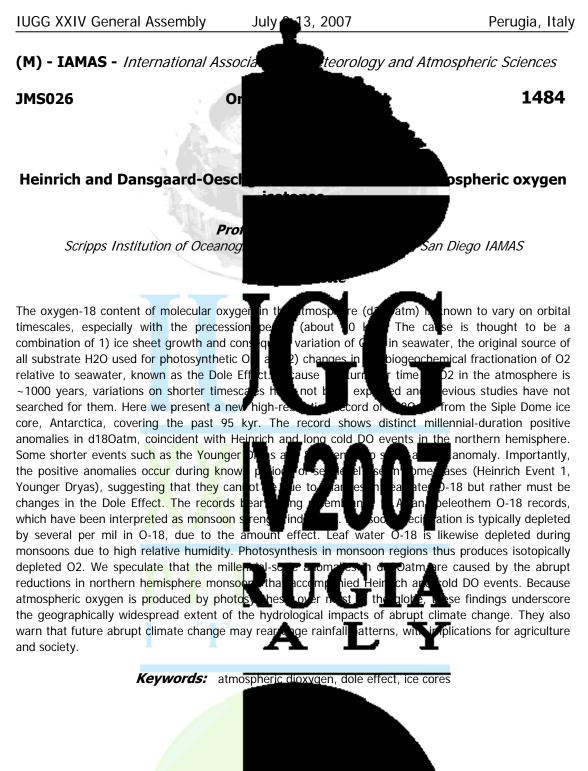


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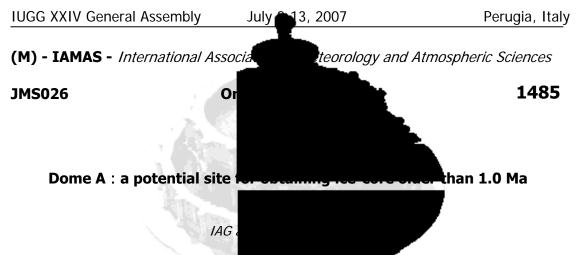








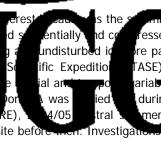




## Qin Dahe, Sun Bo, Hou Shugui,

Dome A is a point of international scientific is a location where the ice layers are deposi by ice flow. Hence it is a site where very lo obtained. The International Trans-Antarctic SCAR and IGBP PAGES, aims to determine t part of ITASE, the surface investigation at Antarctic Research Expedition (21st CHIN investigationshave been undertaken at this site before

include: (1) Relaying an automatic weather station to measure snow accumulation rate and meteorological characteristics. (2) Radio sc an ice core with length 110 meters. (4) survey for ice motion and surface mapping is -58.5C water depth per year, respective the close-off depth at Dome A is around there are locations where ice thicknessar



he Antarctic ice sheet, it essed situ without disturbance re paleo-limate records might be TASE) , a program sponsored by Antarctic climate. As a durin e 21st Chinese National mer. ground-based scientific by 21st CHINARE at Dome A

Tan Allison, Li Yuansheng

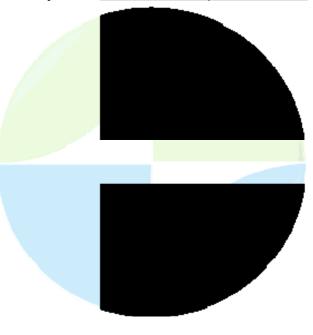
e thickness. (3) drilled nulation rate. (5) GPS ture at Dome A in 2005 mixing ratio shows that unding radar shows that mparing the isochronous

layers between Dome A and Dome Fuji, the ice thickness at Dome A is approximately 300 meters larger than Dome Fuji, where the bottom ice is believed to be at least 1 million years old. Low accumulation rate, low temperature and thick ice layers flux between ice /rock hnd brokal therm a interface (no underglacier lake) are the t ice. Dome A satisfies ōrab these conditions thus is a potential site in an 1 million years are expected to be a robust tool to explain the climate cycle to 100,000 years' transitior cycle occurred 1 million years ago.

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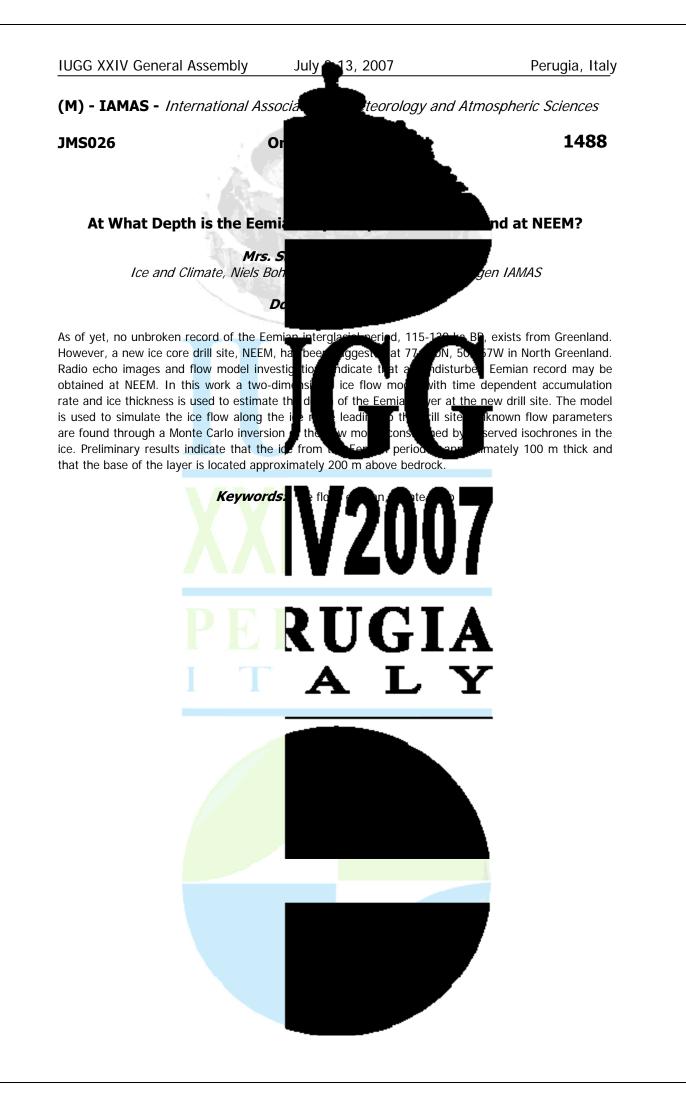
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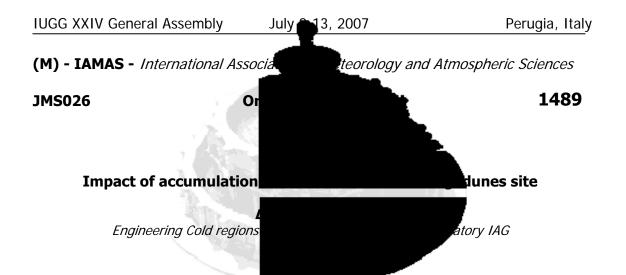
Keywords: dome a. ice core, palioclimate











Gas transport in the porous and permeable firm from ice core record of past climate change. Che hical well as convection induced by wind moveme low accumulation rate regions, where the I significant alteration of both the firn grains retrieved from a megadunes area of East Ar 30 meters vary significantly with depth du m), long wavelength (2 to 5 km) bands will perce

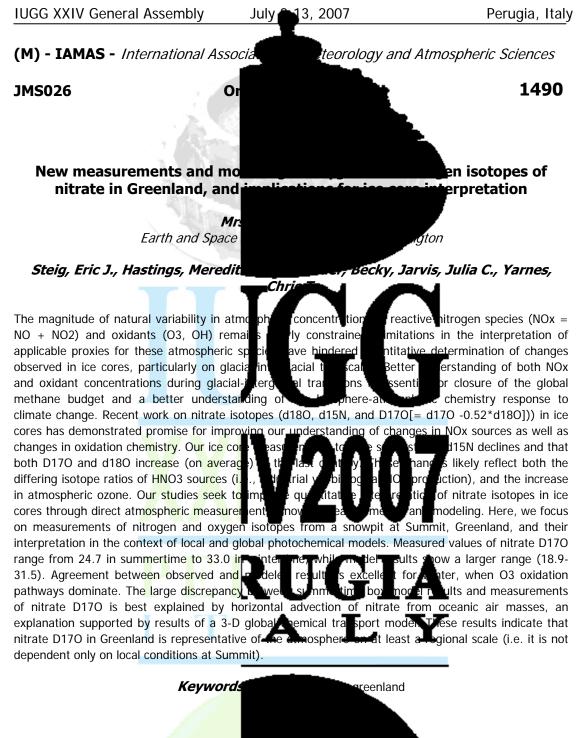
1) and accumulation hiatus within several kilometers proximity, as determined by remote sensing, surface feature classification, and GPR (ground penetrating radar) profiling. While the leeward face of a megadune experiences a hiatus in sr accumulation. Differences in grain size, profile are due to spatial accumulation va Relatively small differences in accumulation rať physical properties. The differences in ph sic accumulation-hiatus areas are sufficiently distinct so that

ections play rate cies se processes idence time t e ga<u>ses fou</u>n revea mig n. w acc

cial role in determining the firn due to diffusion, as նցի 1 especially important to consider in rn spends at the surface leads to thin the pore structure. Firn cores al prop es of the core in the top dune e low-amplitude (2 to 8 less than 40 mm w.e. a-

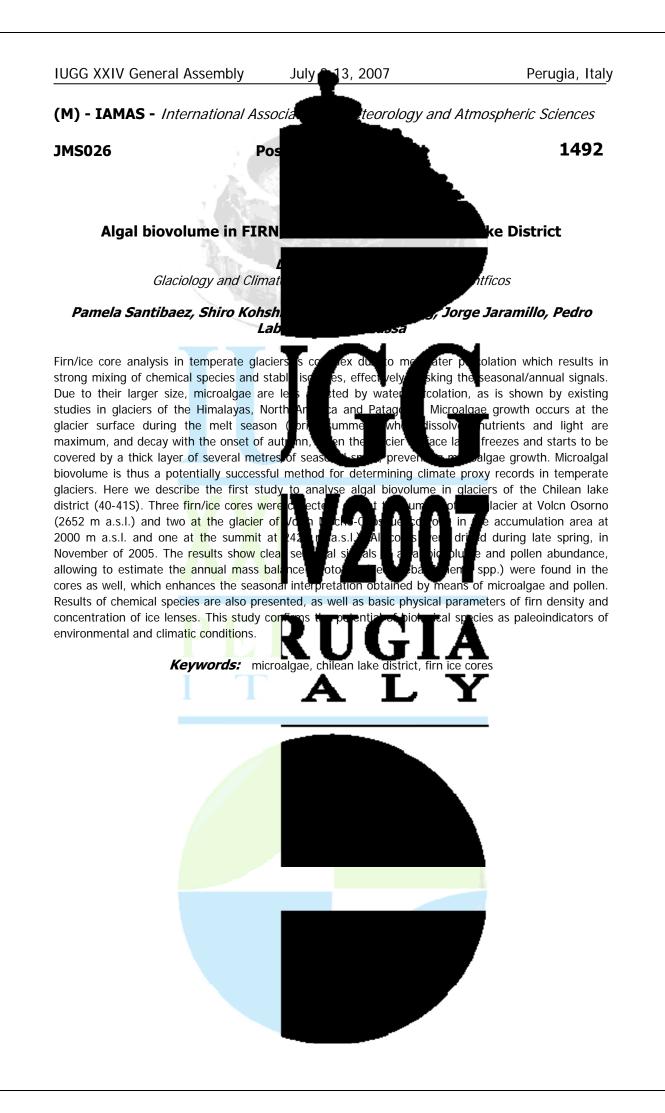
ace does experience ly across a megadune microclimate variations. ult in large differences in -accumulation areas and evidence of past accumulation hiatus should

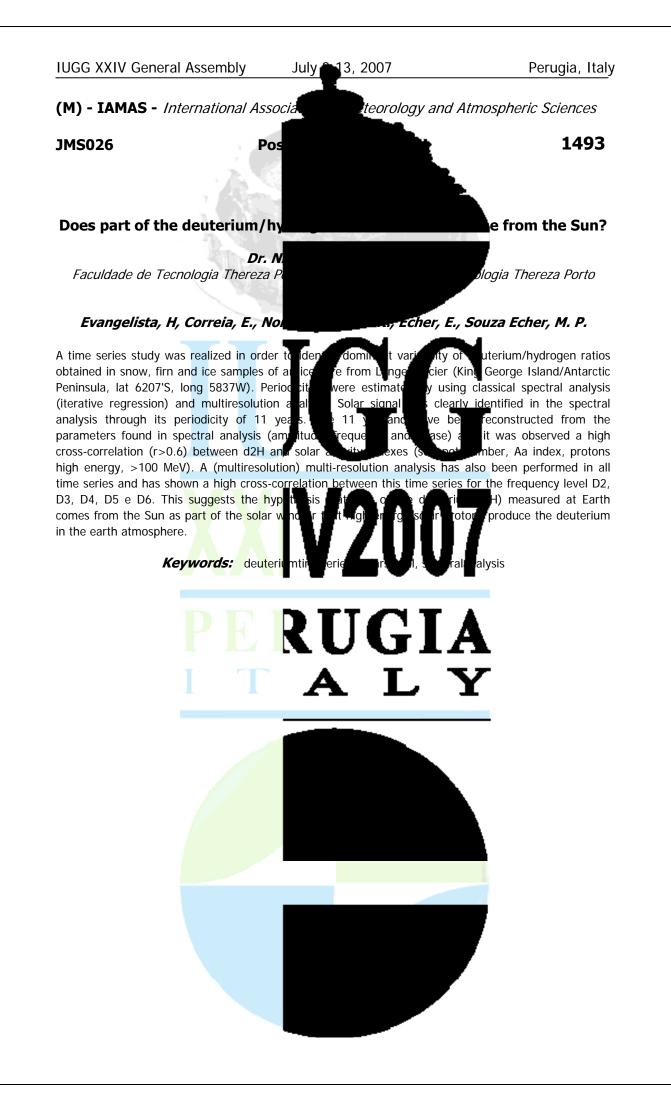




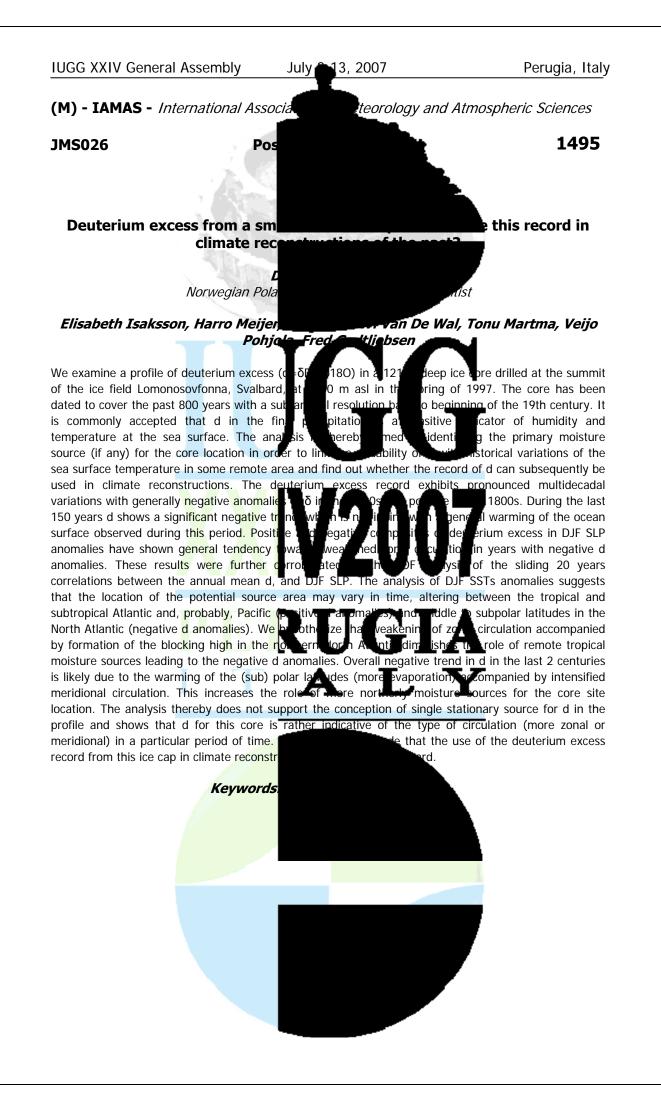


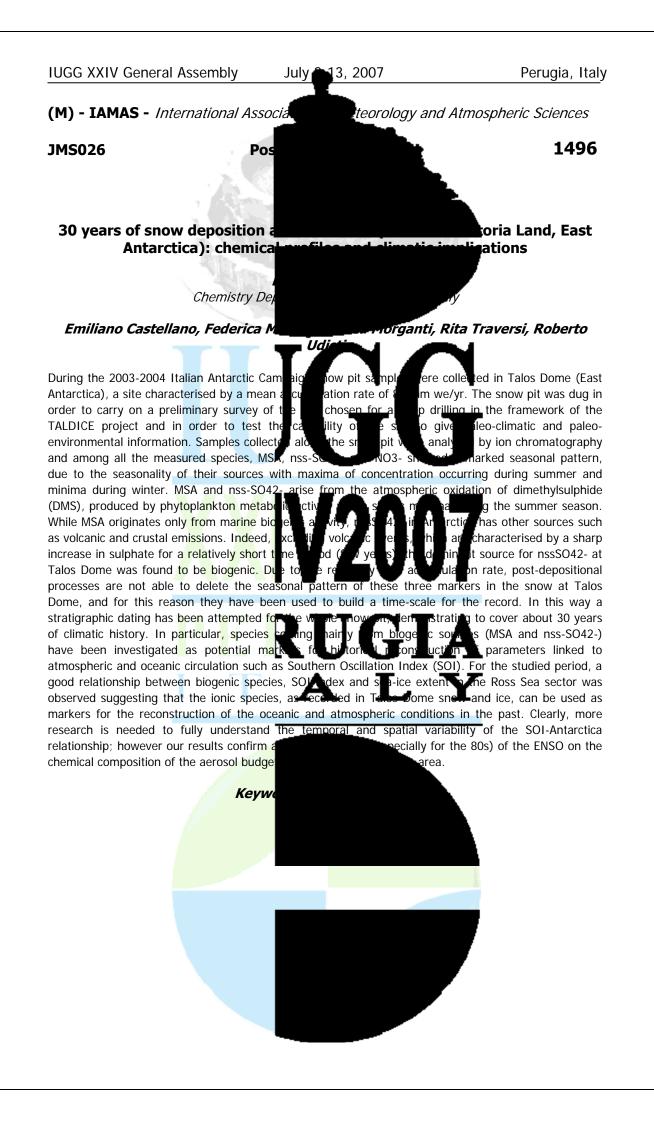


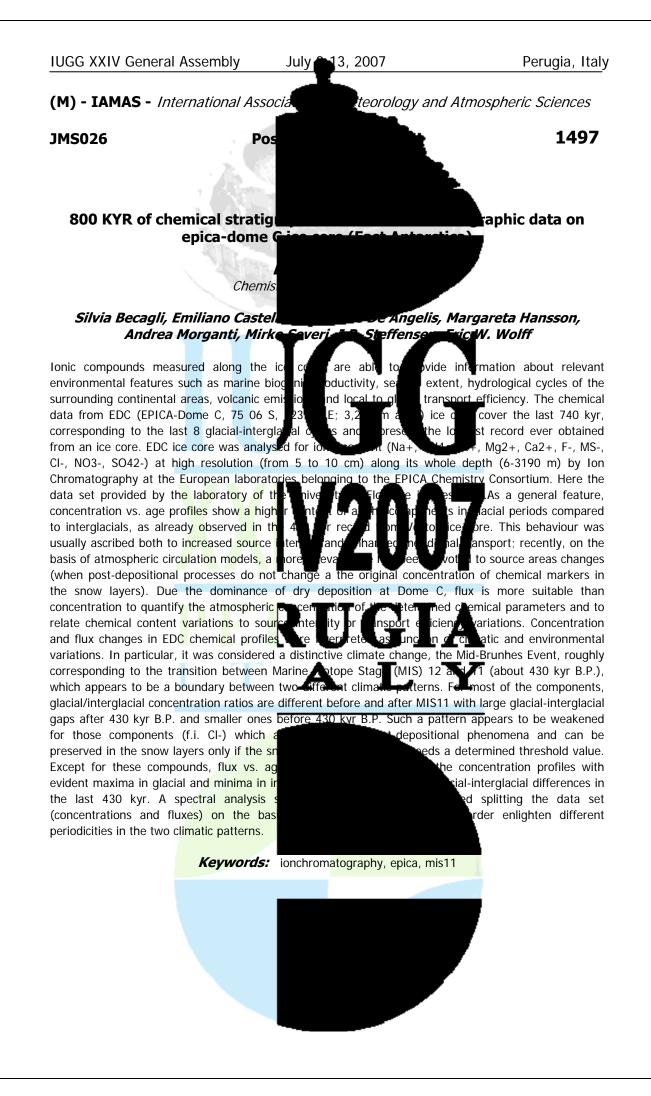






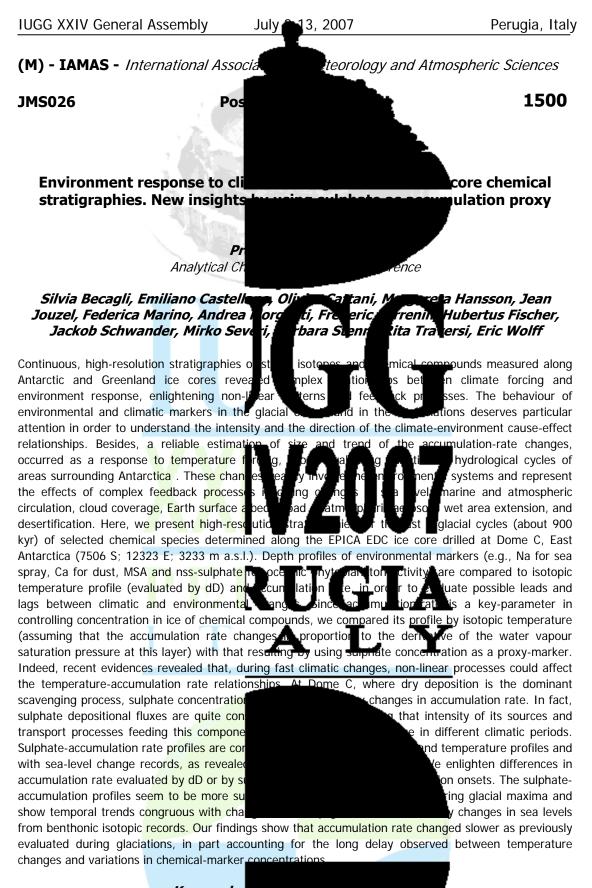




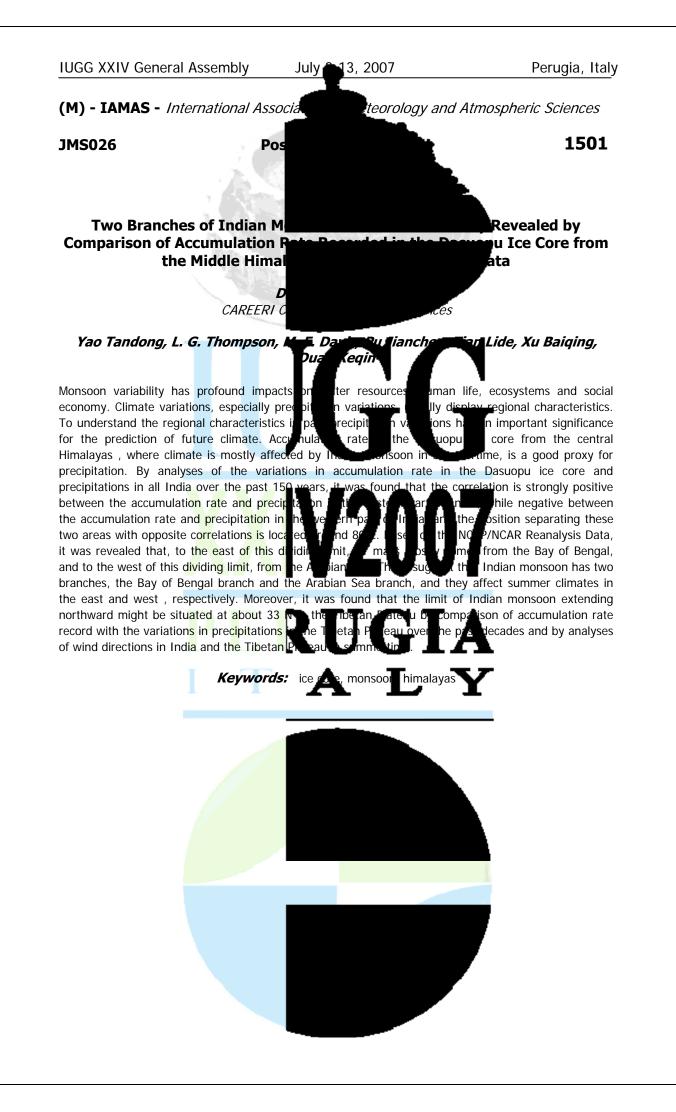


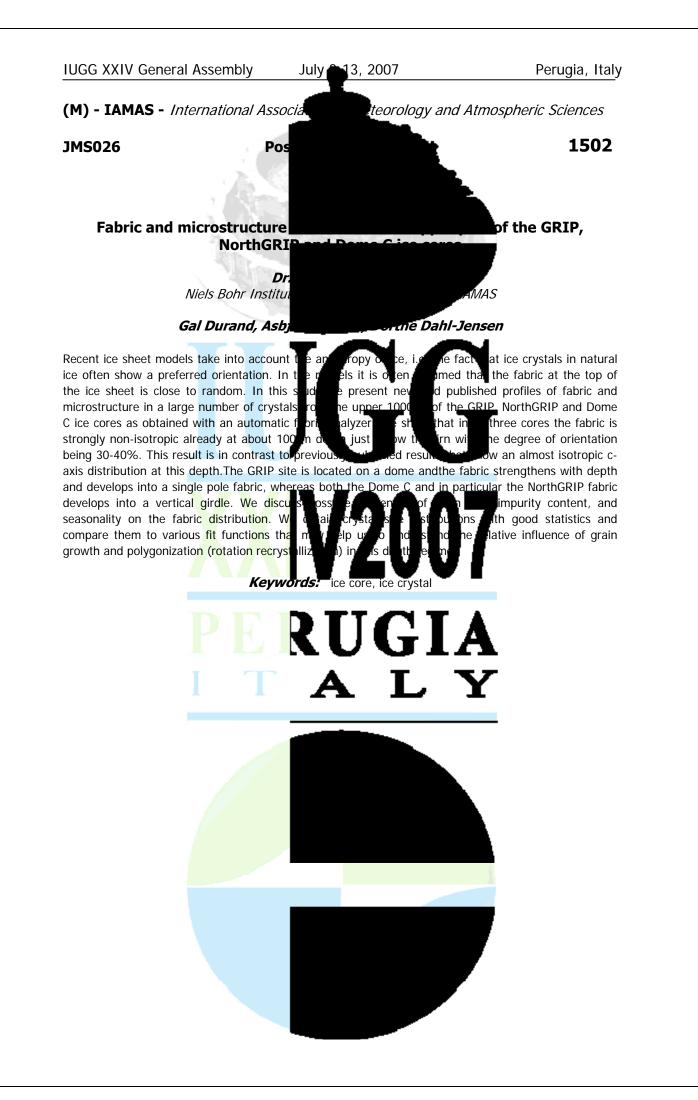


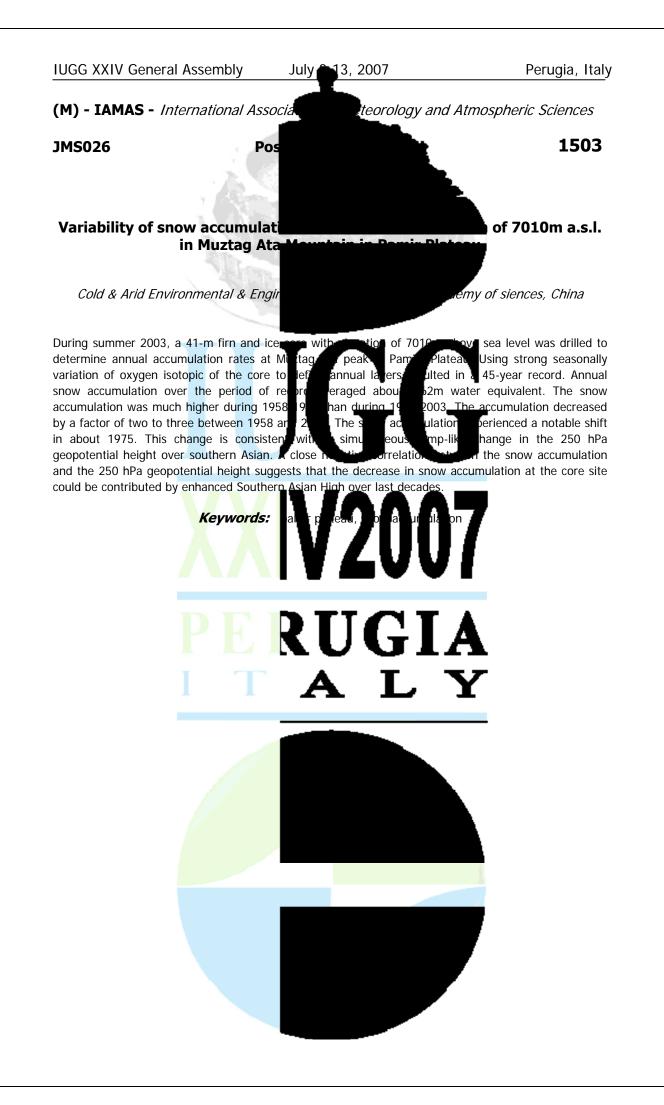




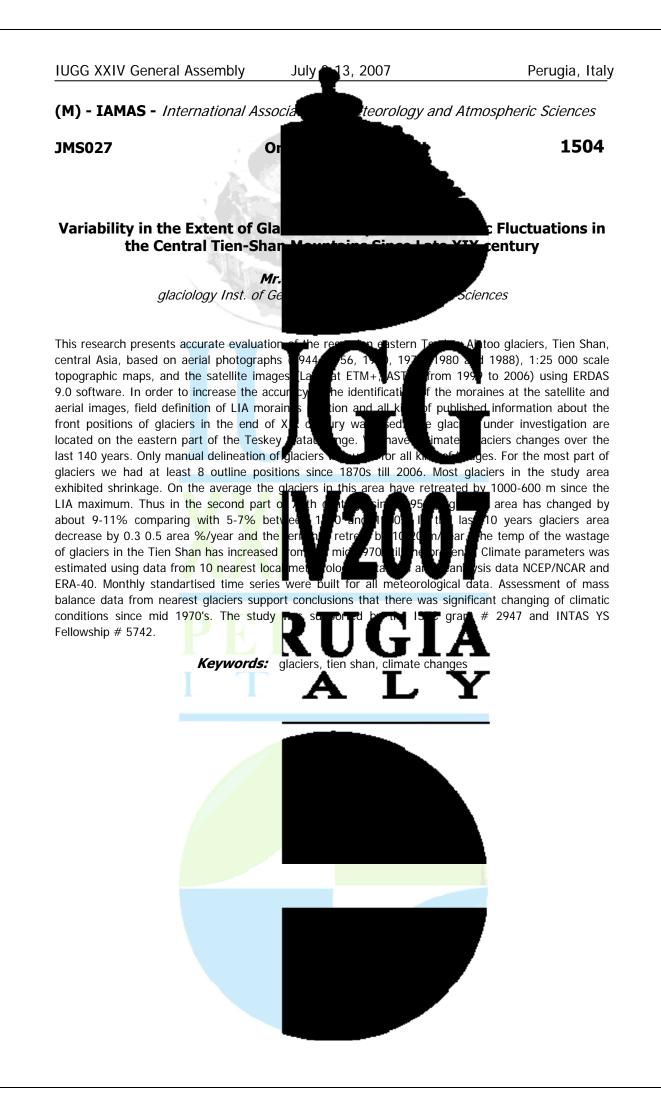
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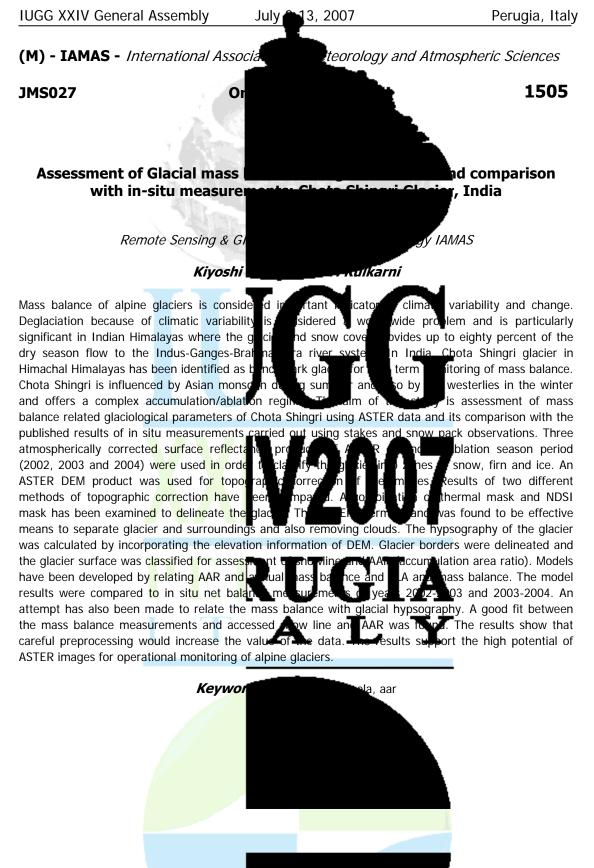


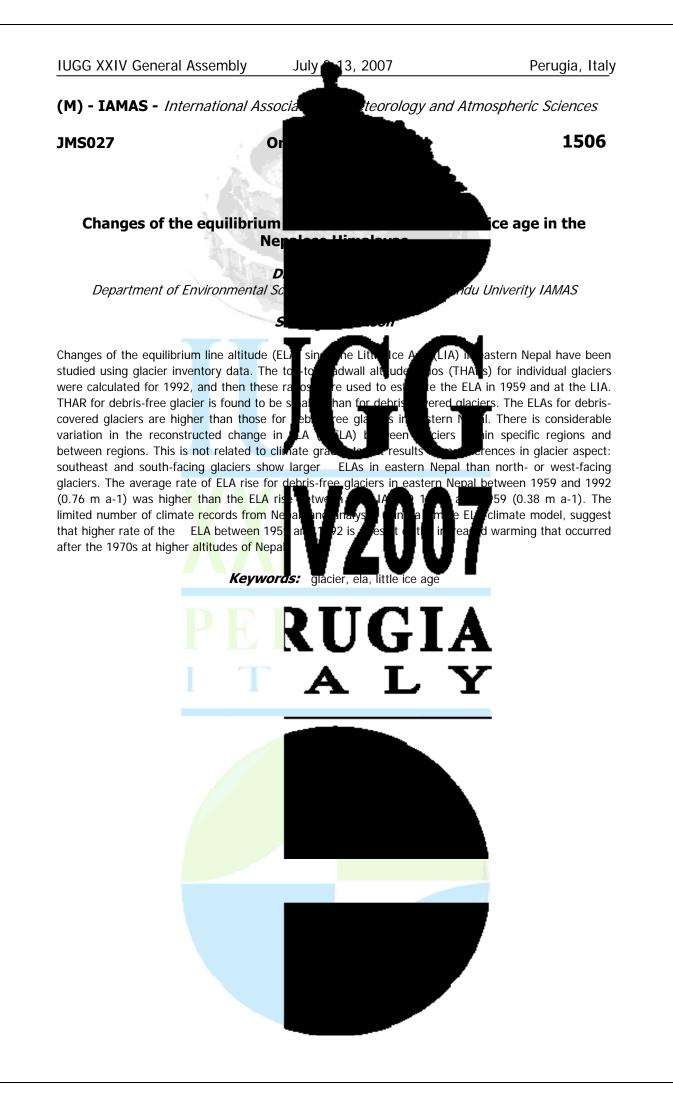


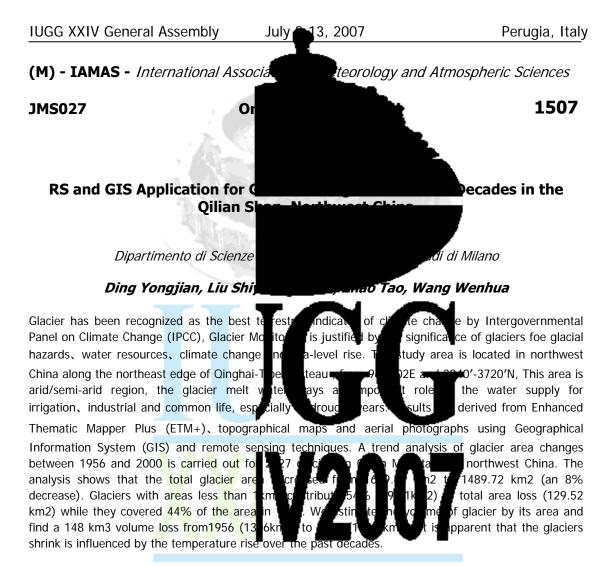




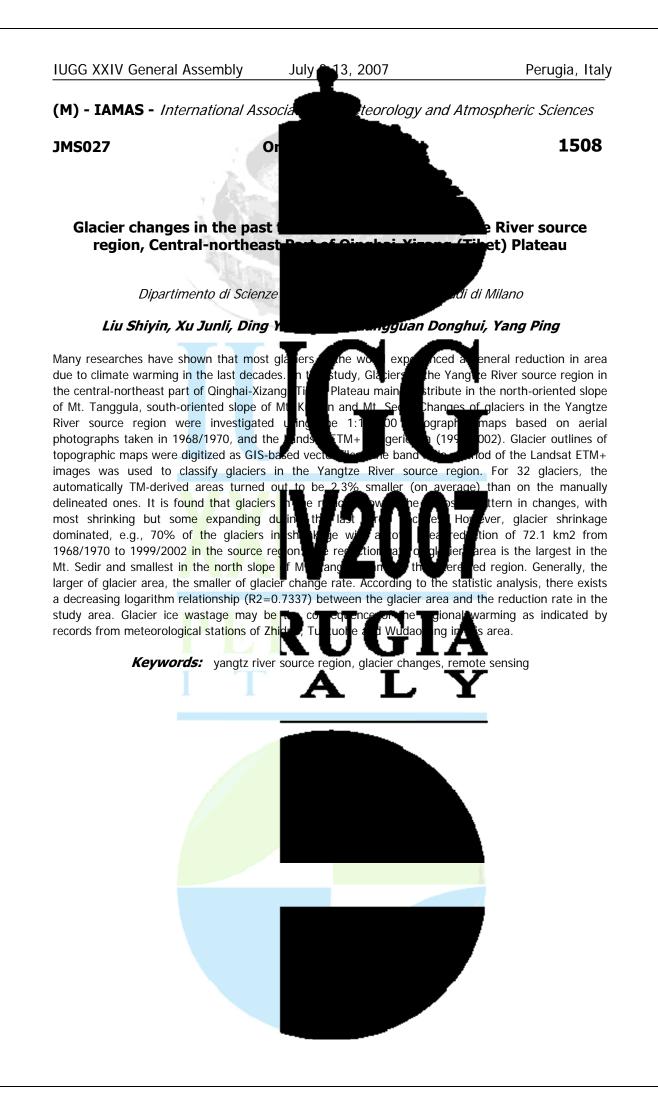




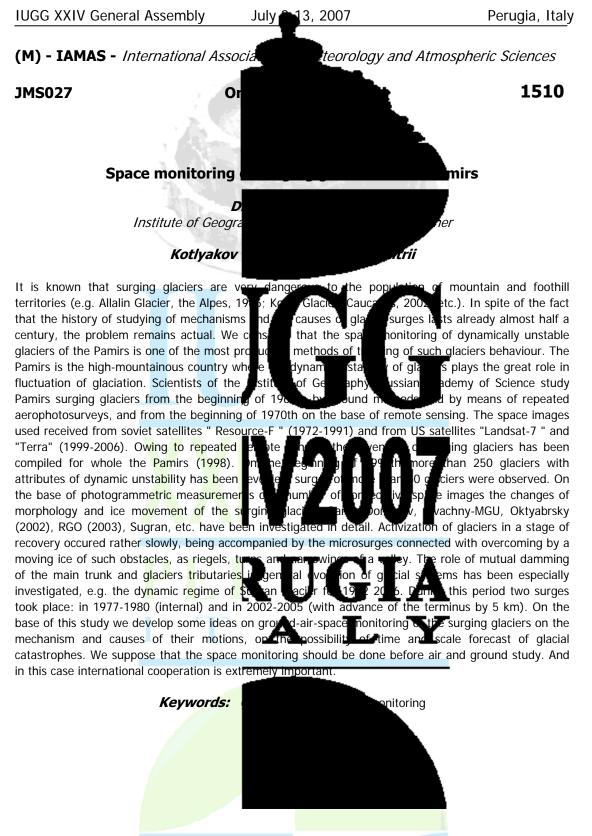


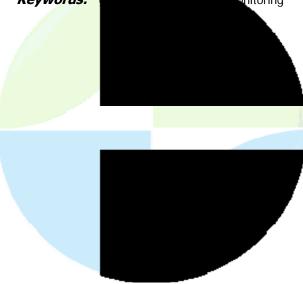




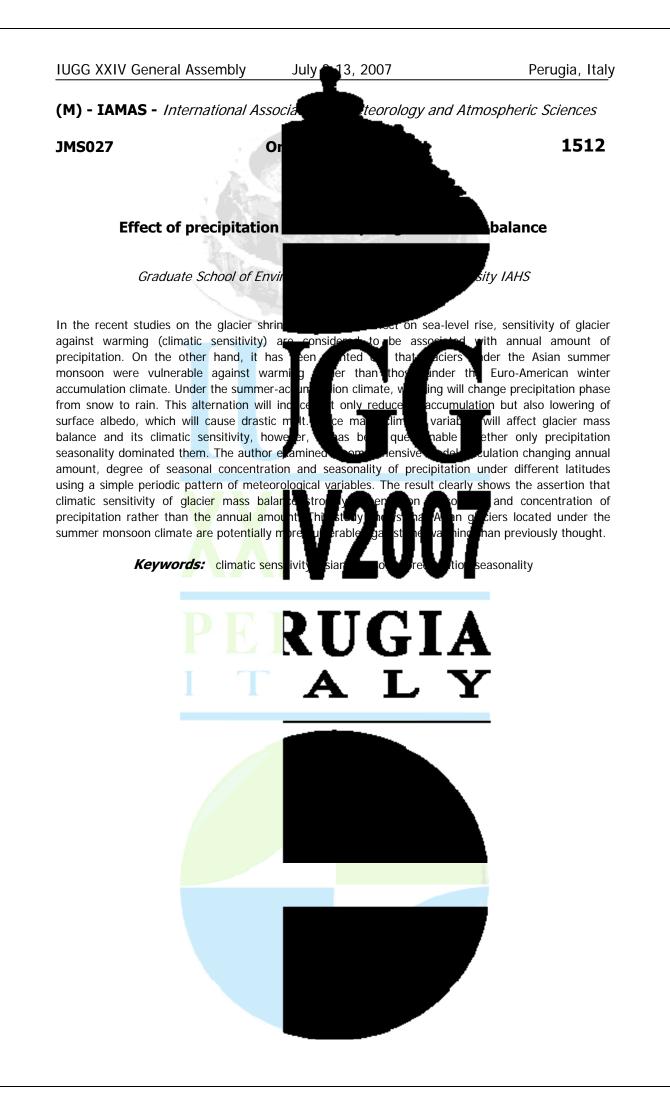








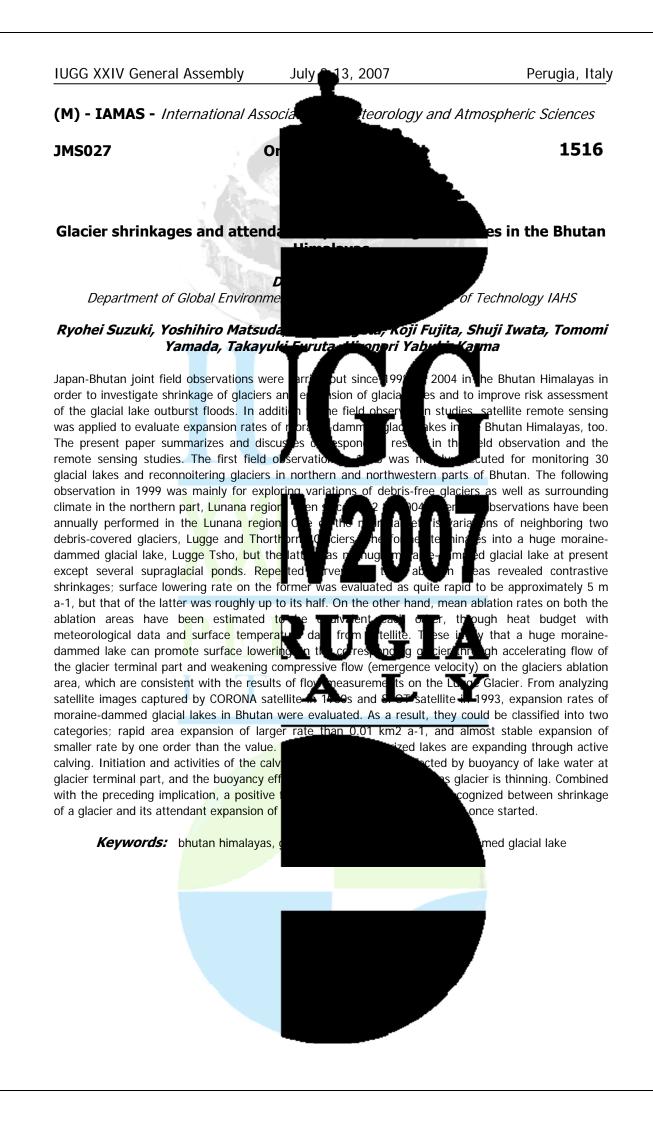




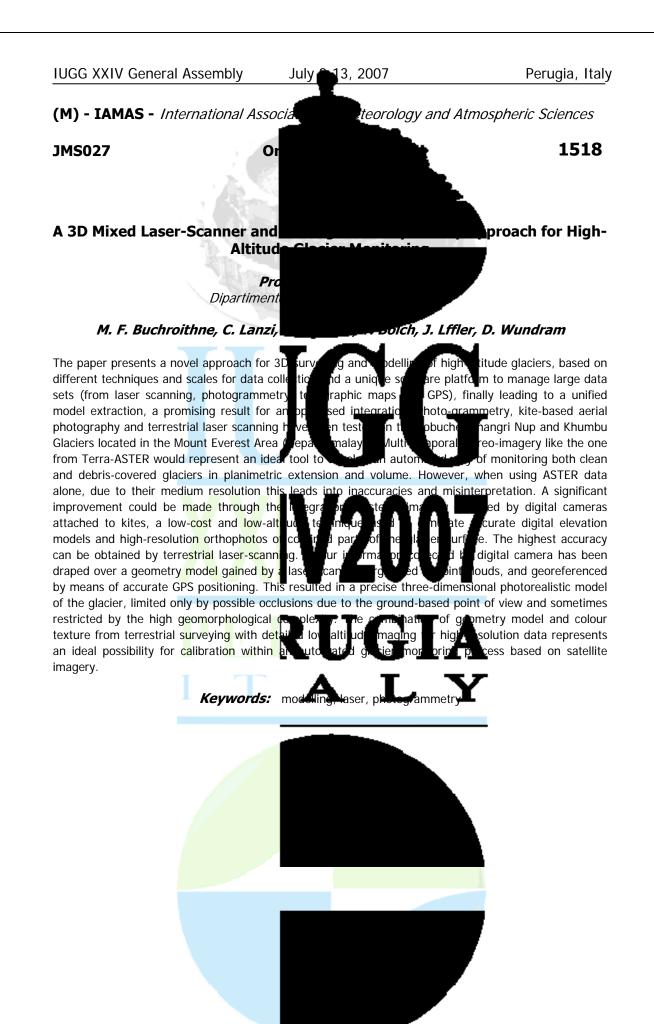




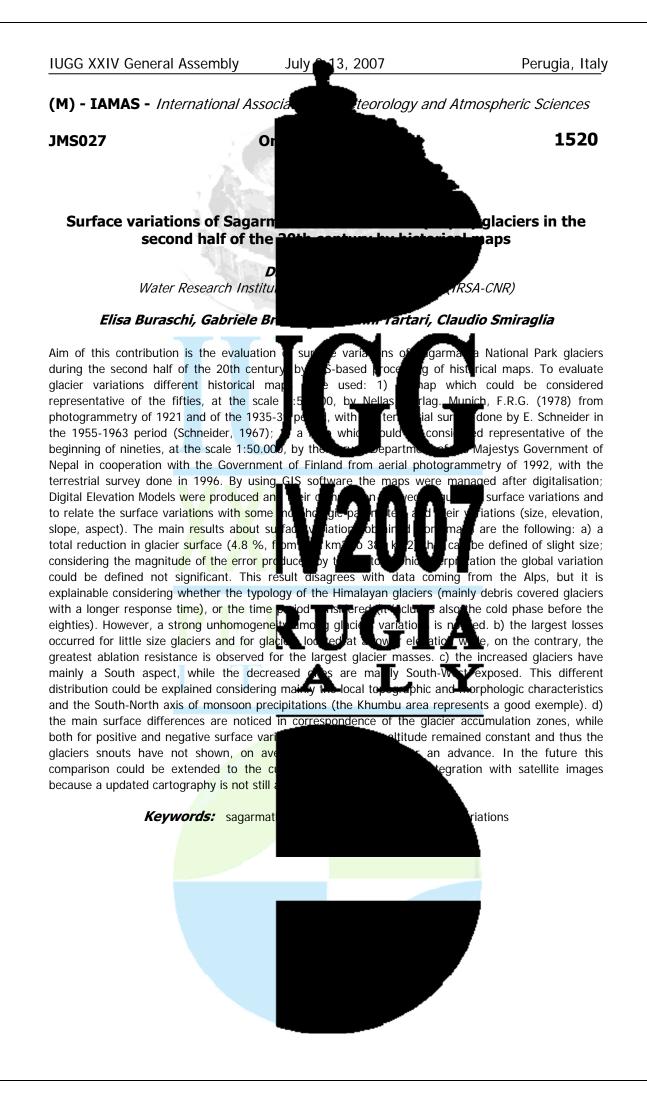






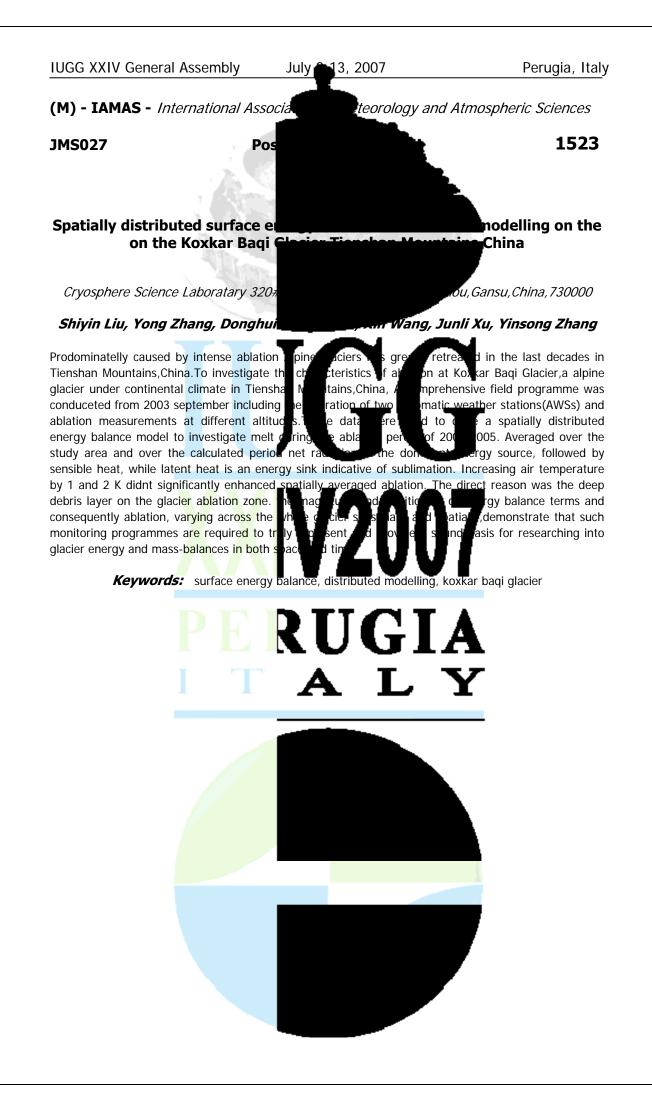


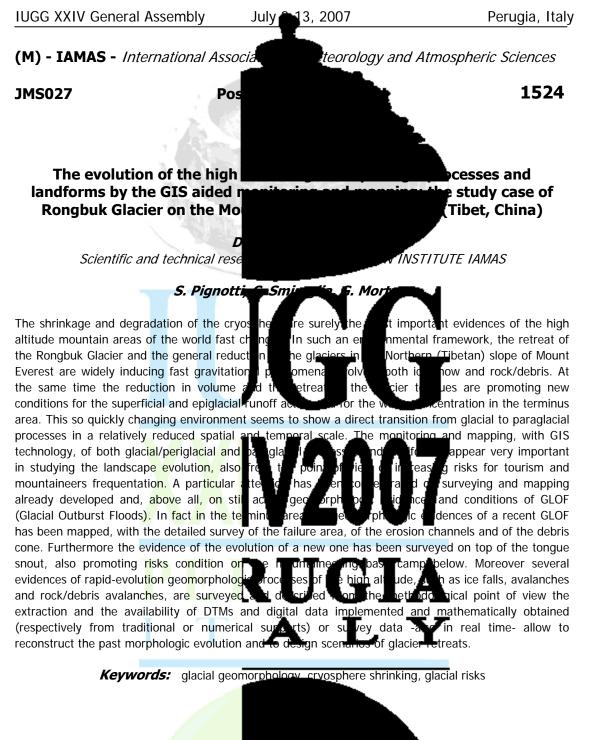




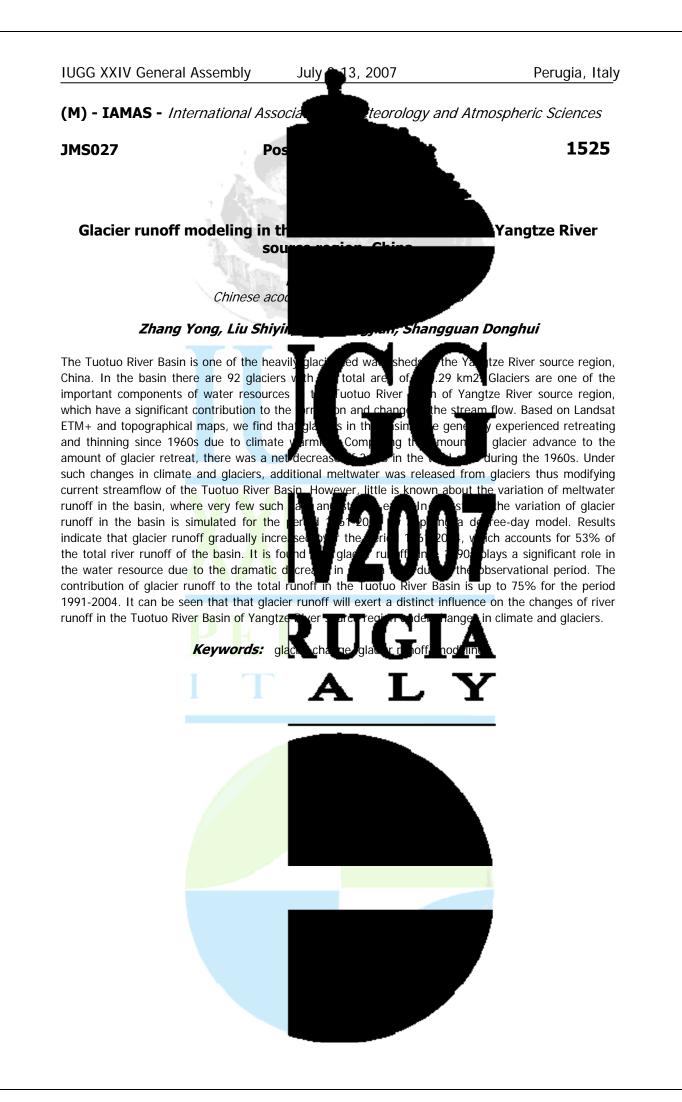




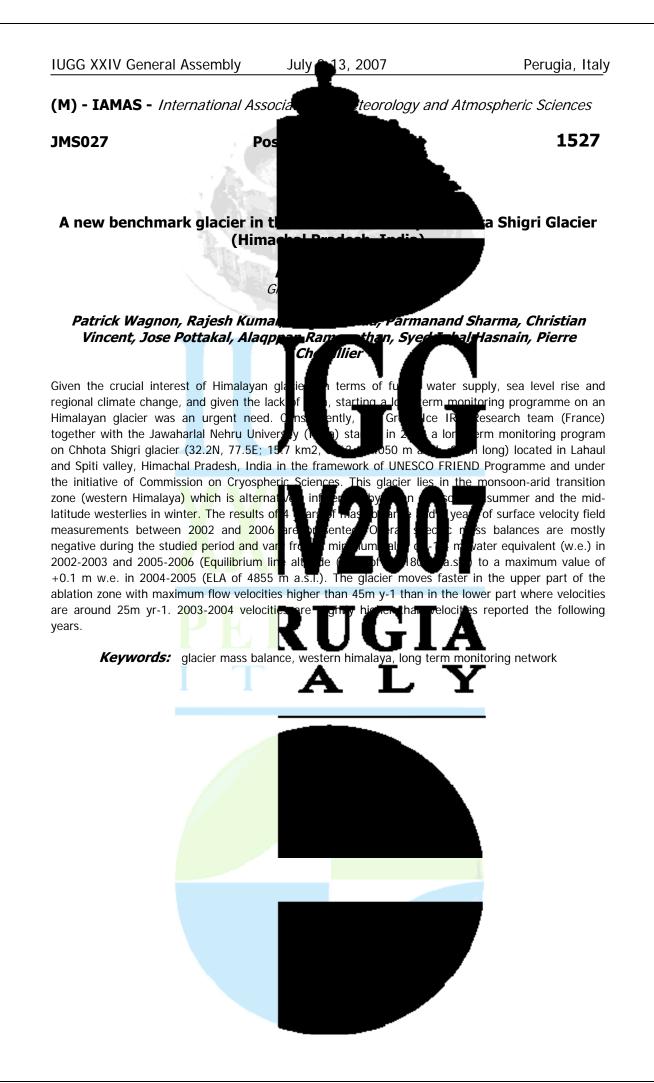


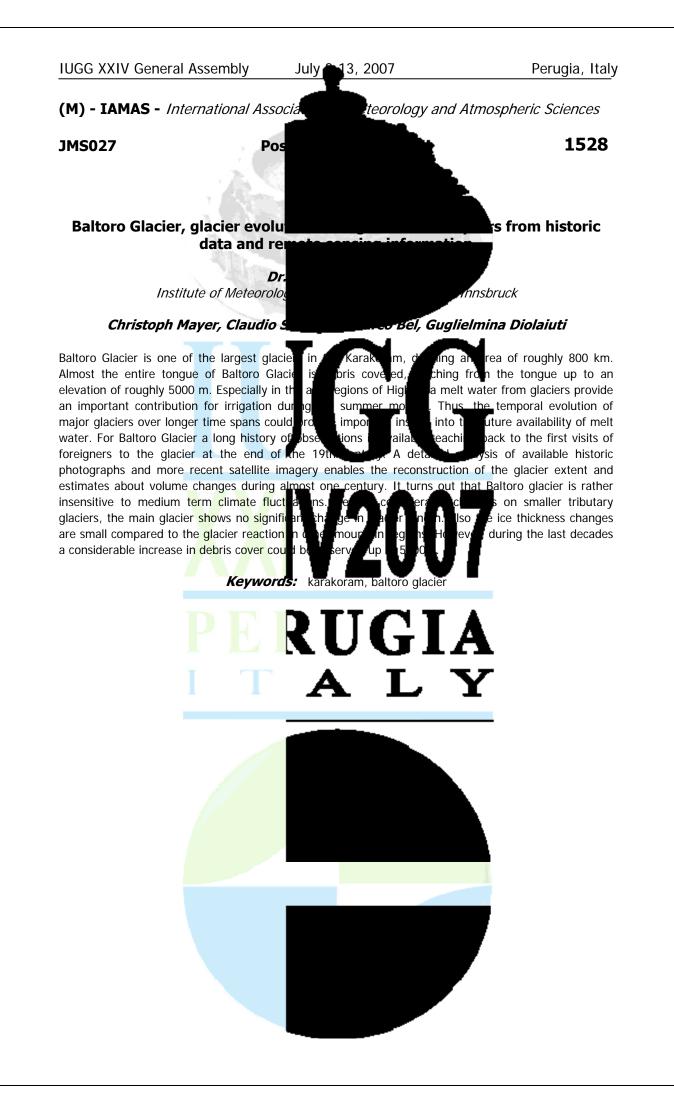




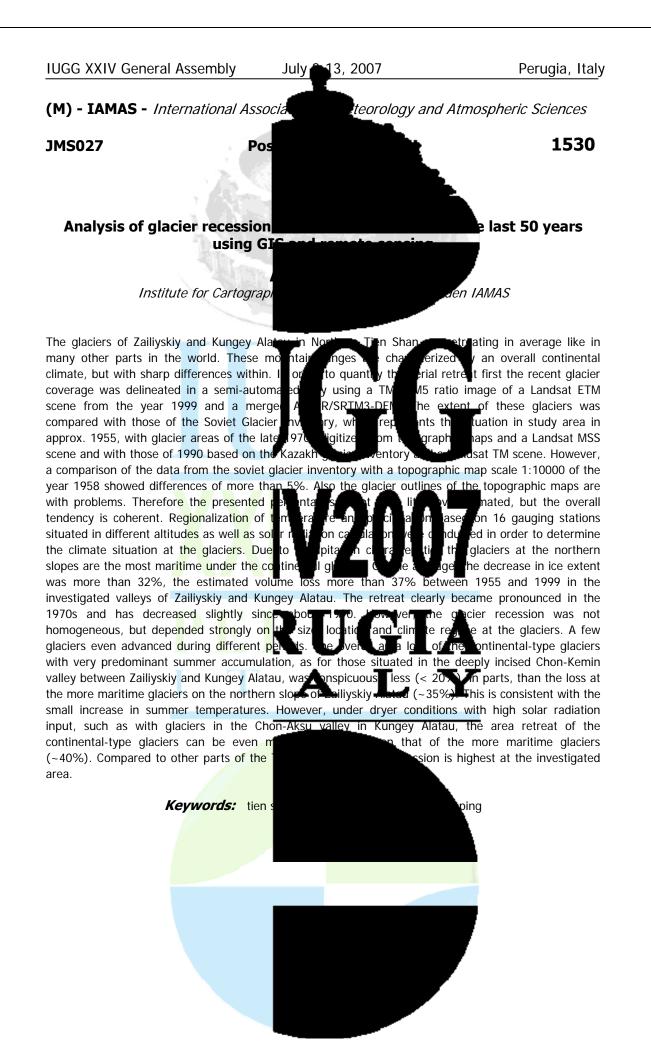


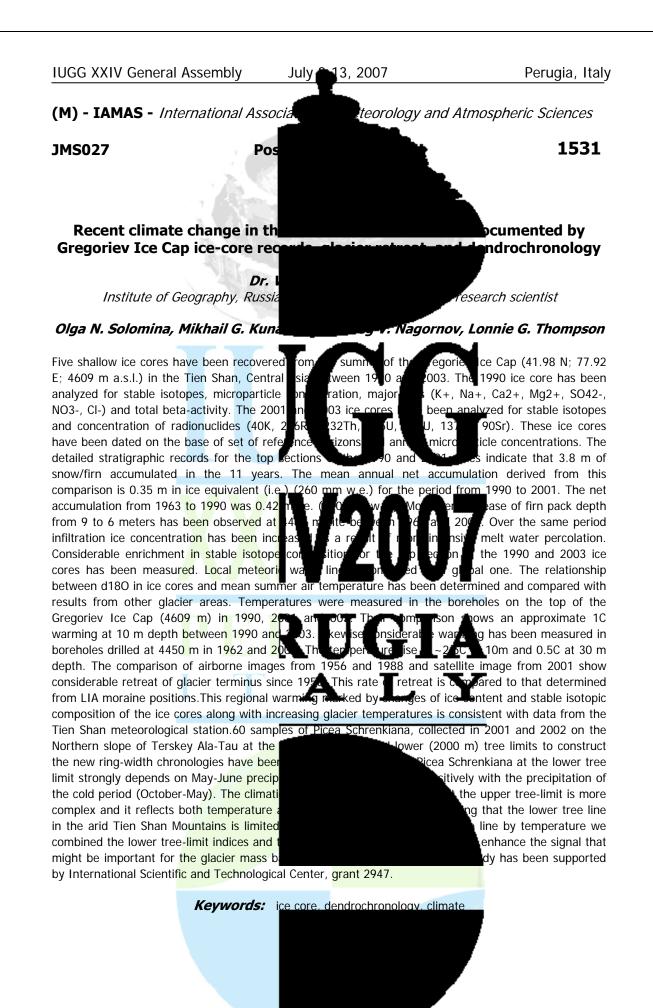


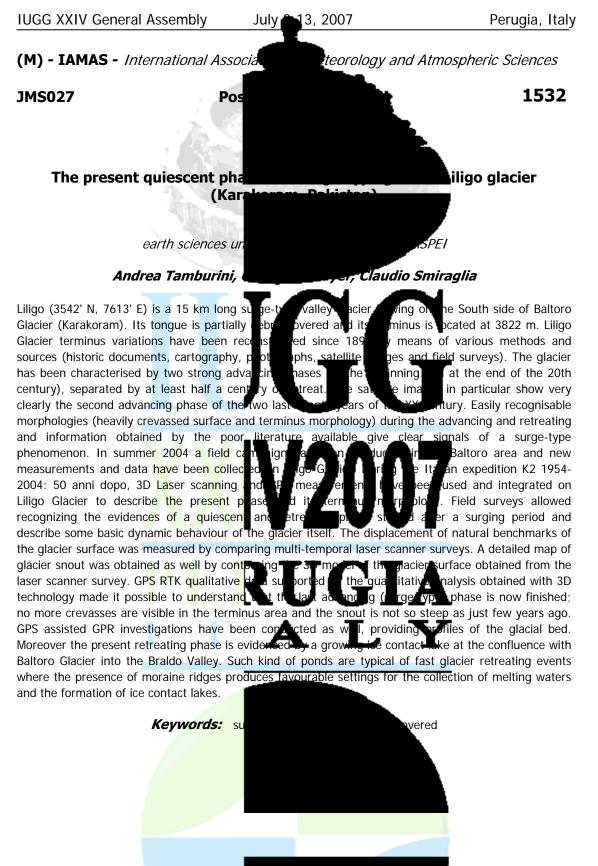




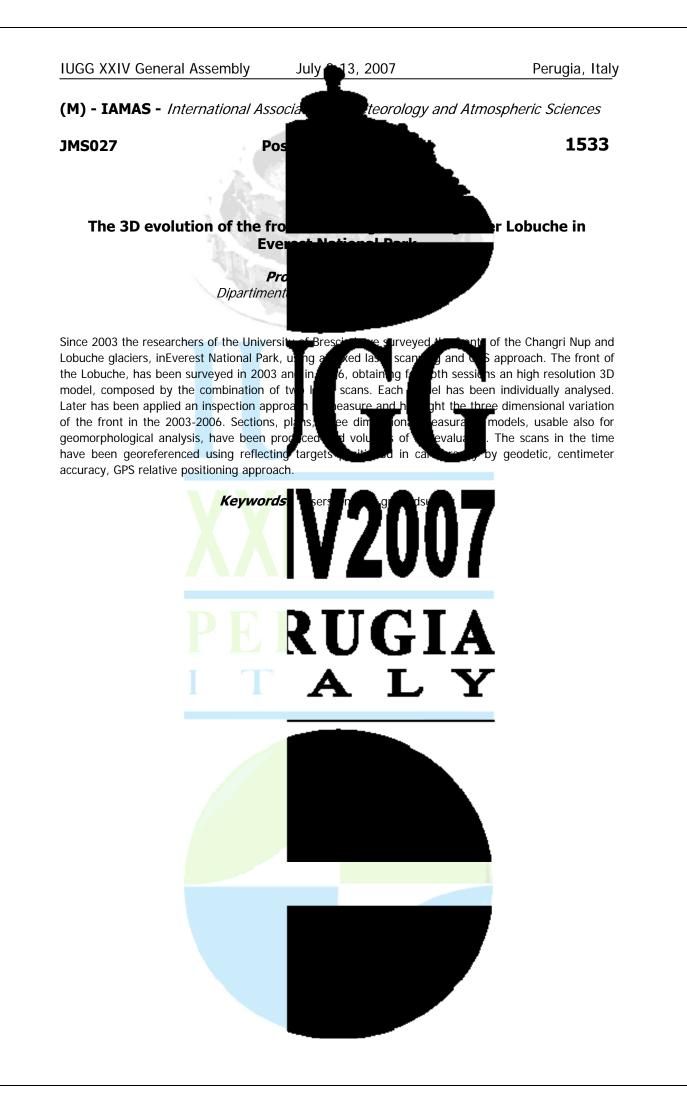


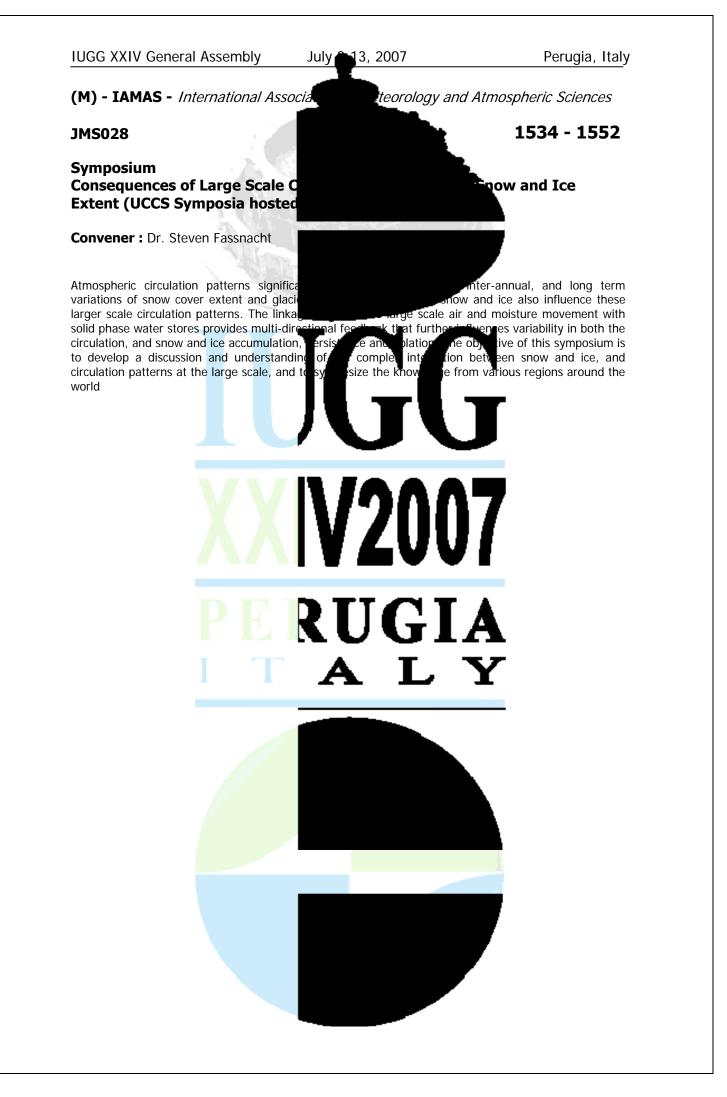


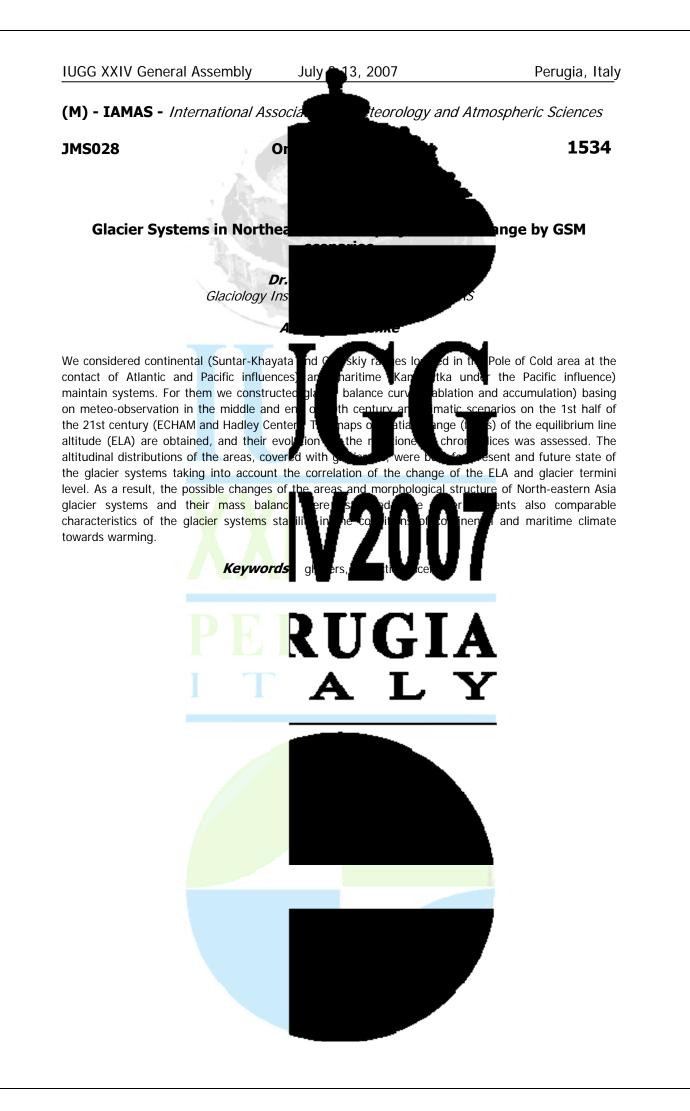


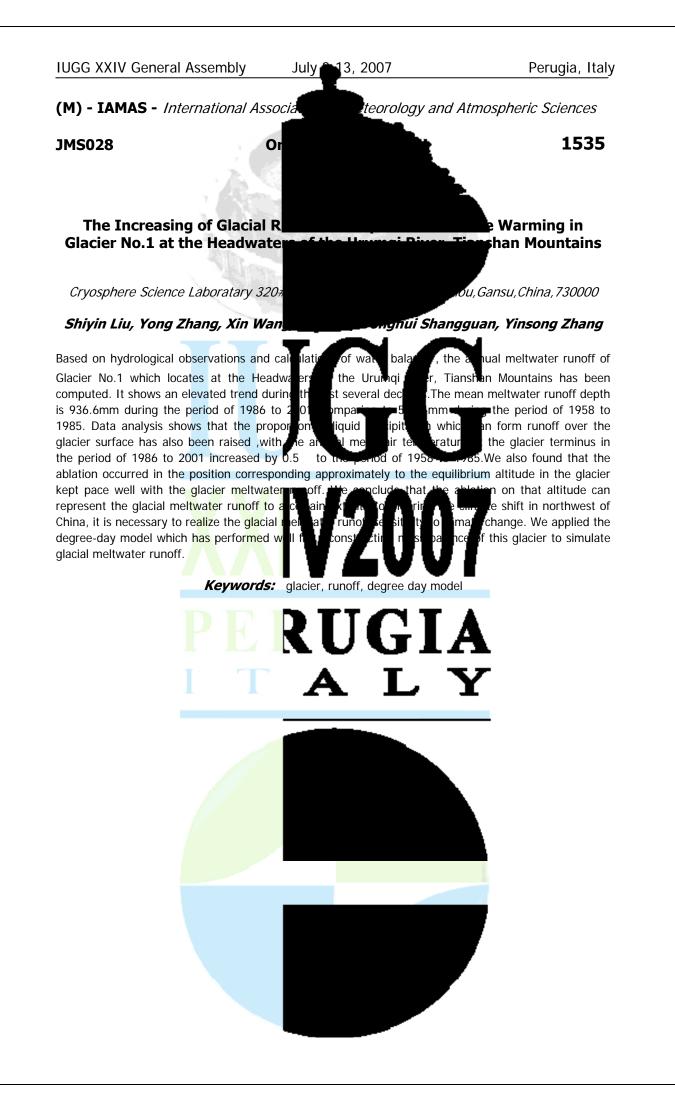


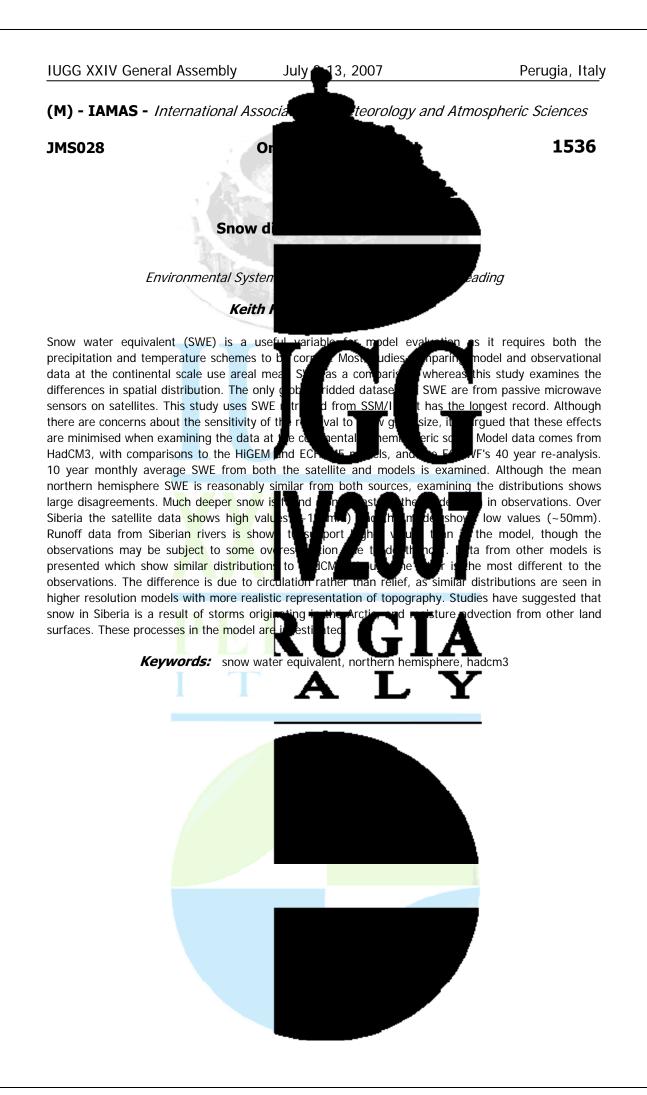


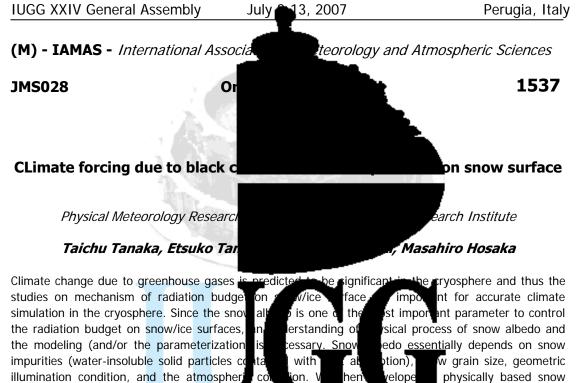












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albedo model, which predicts the visible and near black carbon (BC) and mineral dust for snow impurities, snow grain size, and solar zenith angle for direct and diffuse components of solar radiation. The concentrations of the BC and mineral dust in the snow are calculated from wet and dry d transport model. Since the light absorptid introduced a snow impurity factor (SIF), w mass fractions of impurities. The physica surface process (LSM) in a chemical transp Atmosphere (MASINGAR). The result of climate case and snow impurity free case showed that radiation budget difference at the top of the atmosphere

mulations

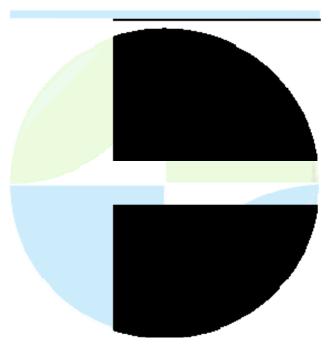
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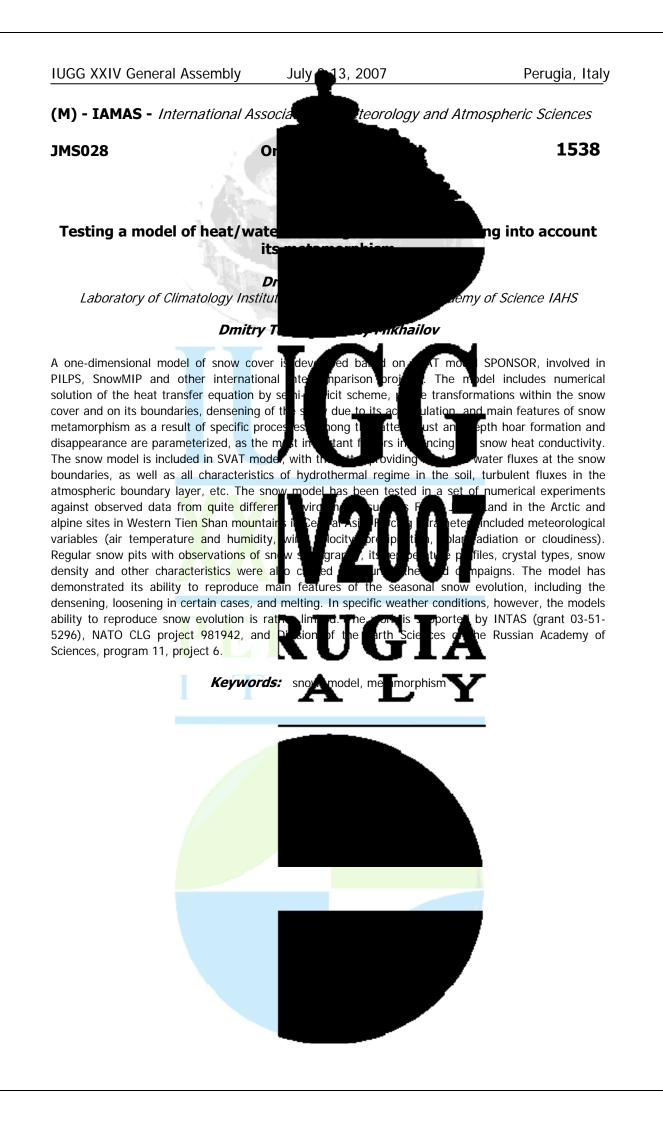
physically based snow of the concentrations of

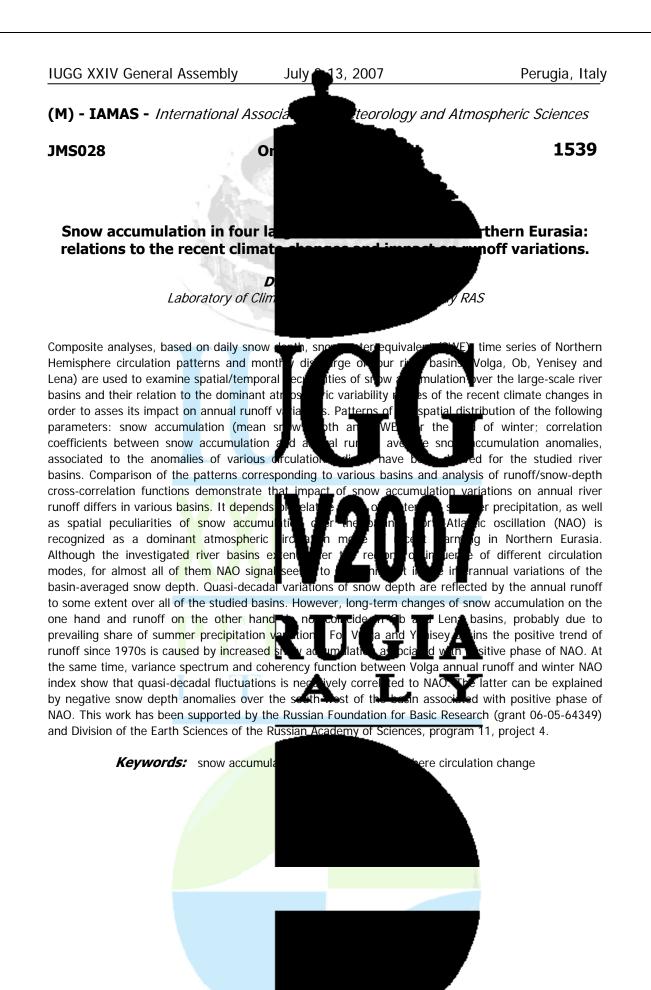
sols using a chemical rities are different, we sorption efficiencies and corporated into the land sol Species IN the Global with MASINGAR for the snow contaminated

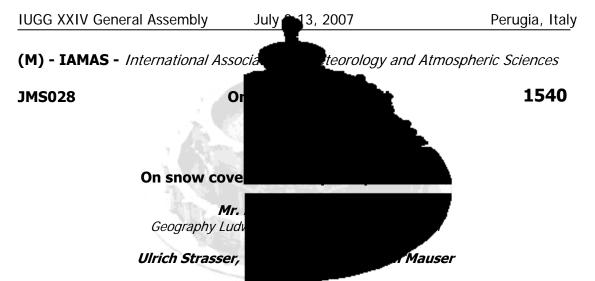
g due to snow impurities) for all between both the cases is +0.7 W/m2 (pop parak sky conditions and +1.12 W/m2 for clear to the direct or indirect effect of radiative forcing due to the atmost creases of BC and dust pos ic bie emissions would enhance the snow albedo reduction and thus snow melting in theArctic.

Keywords: snow albe



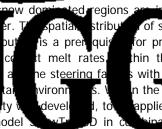






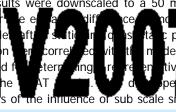
In terms of water availability for mankind snow do collecting, storing and delayed release of wa context. A profound knowledge of this distinguith balance of the surface and, consequently precipitation and snowvegetation interaction and ablation patterns of snow in alpine mou parameterisation for the spatial snow variab 1km scale. We used the snow transport model

evolution. The original 200 meter MM5 results were downscaled to a 50 meter resolution by using a semi-empirical approach which accounts for well as aspect, inclination and vegetation. vegetation, average wind speed and direct on the 50 meter scale. The results were us snow cover for any 1km grid cell of subsnow\_ALPS for this purpose. First results of water balance will be shown.



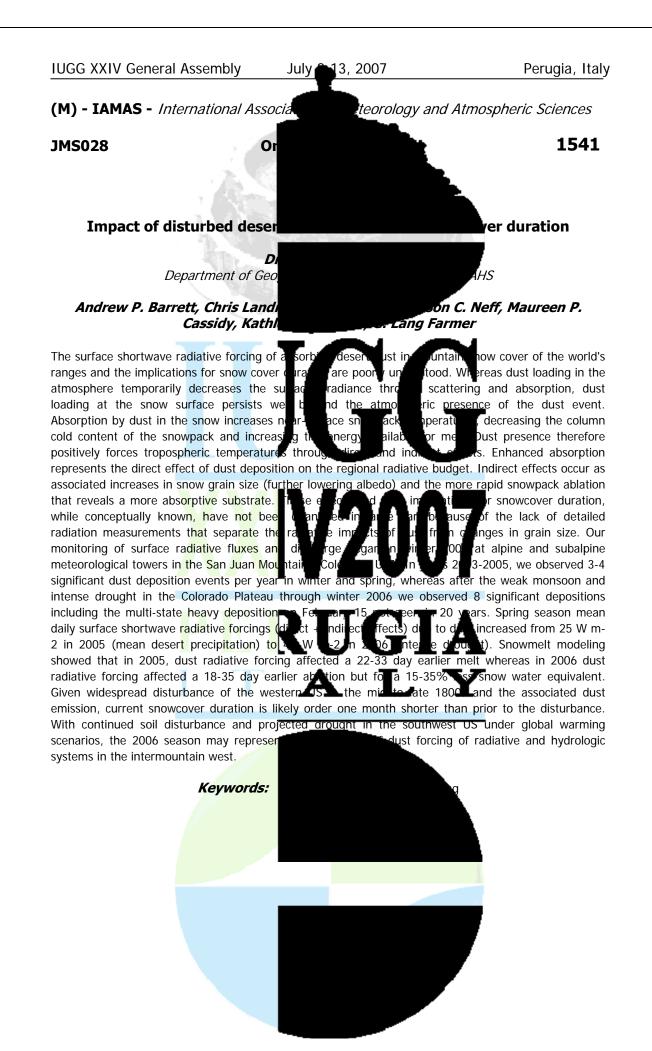
portant in their function of is one factor within this of si or prediting an accurate energy thin this context snow transport, with respect to the accumulation ented study a numerical th a SVAT model on the applie with MM5 (Penn State

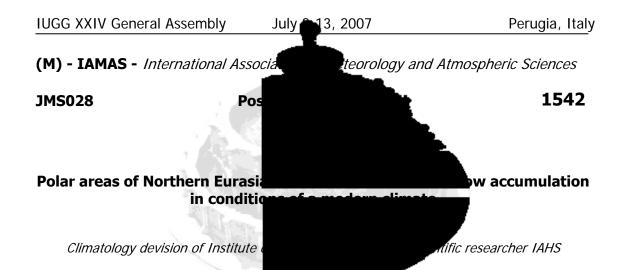
University - MM5 model) generated wind fields for the distributed simulation of the seasonal snow cover



nd real topography, as meters like topography, snow cover distribution subscale variability of the the regionalisation tool scale show heterogeneities on the







The basic purpose of researches is revealing tendence in conditions of modern changes of a climite. seasonal variations in conditions of regiona snow storage are revealed for Northern tendency to reduction in the autumn and p role in the tendency of large-scale increase January. This situation is characteristic first Turan lowlands and the south of Siberia. For variou

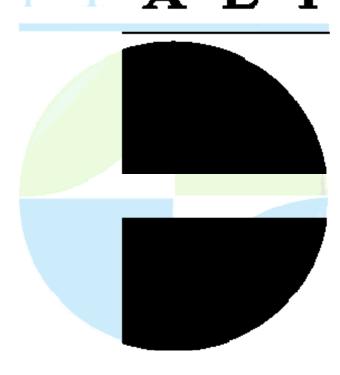
variability are revealed for Northern Eurasia to the north 50. Wood vegetation bring the most essential contribution to the long-term tendency of snow sroragve (exceeding a standard deviation) the area of extrema of a snow cover are no February. Process corresponds to long-ter beginning of winter exceeds a standard de iati temperature has already come for extrem sh winter. In case of double standard deviation for achievement of a limit of snow storage increase.

inges of prim goal lity of a lim The monthly rend<u>in lanu</u>: v stora ara the h a NDV

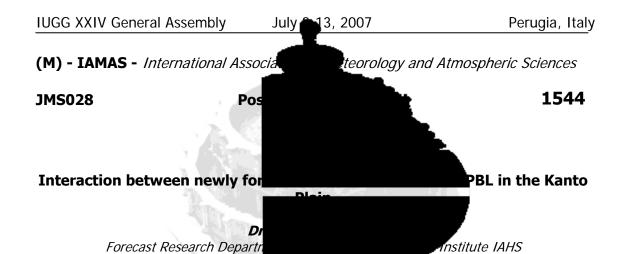
over of Northern Eurasia es consists in revealing resea In result the seasonal features of ement of snow storage has the 0.156 mm / year). Thus, the basic y pas rom autumn months to je cer of East European Plain, endencies of snow cover

storage increase. The area with extreme of snow Long-term changes of positive in January and emperature of air in the ase at increase of winter ature of the beginning of

is possible to speak about the current all parameters it Keywo







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Shallow snow cover produced by extratropi serious damage to transportation systems plain because snow cover seldom appears t keep the lower PBL cold for the formation of completely before reaching the ground. An snow cover is necessary to reproduce corre Non-Hydrostatic Model (JMANHM, in short graupel. The operational NHM in the default usage

deal with snow cover evolution. Meanwhile, a new land surface model MRI/JMA-SiB (hereafter referred to MJ-SiB), which consists of a vegetation canopy of SiB, newly designed snow sub-model and soil one, has the ability to forecast adequately snow a large amount of snowfall in a band region new snow cover 10-20cm in depth was for with MJ-SiB (NHM/MJ-SiB) and NHM/DEF PBL. The results are summarized as follo predominant above the PBL and a large amount of snow particles was produced there. Some fell over

the band region with incomplete melt, and the others over the coastal region with complete melt. 2) Simultaneously, at first a weak N wind app NE wind did. Both winds originated from wind was coming over snowy land and remain the Pacific Ocean as a NW wind, then was deflected clockwise by the cyclone and finally re-landed as the NE wind. The initial dry cold air was modificas it was region, new snow cover was made by snow p temperature of the weak N wind. The succeeding warmed NE wind was again cooled by the appearance

ratio of snow in sleet and snow water temperature in the lower PBL was high er was laid, snow cover acted as a cold he accordance of surface temperatures by NH in the case of no snow cover by NHM/DEF.

h coast of Japan, causes okohama on the Kanto yo ar o temperate that it is essential to allen snow particles must not melt solid precipitation as a source of del. JMA cloud resolving erical pred ation of rain, snow and /DEF), however, cannot

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6, a cyclone produced of the Kanto plain, and ried out using the NHM ow cover and the lower the plain, SE wind was

orth of the plain. The N

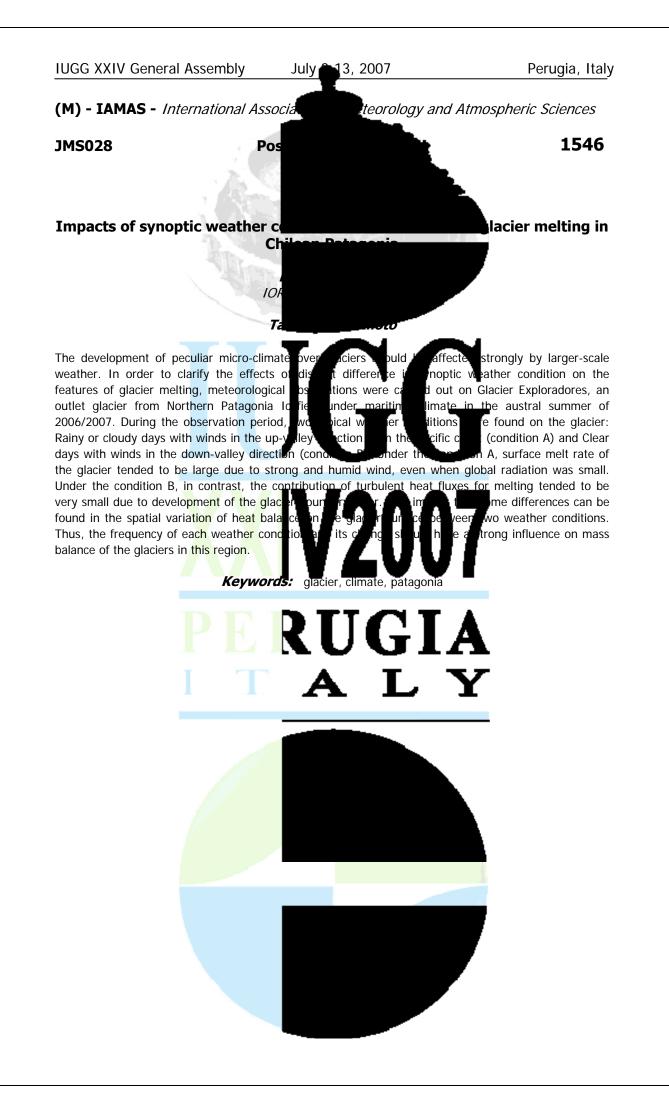
atter initially flowed out

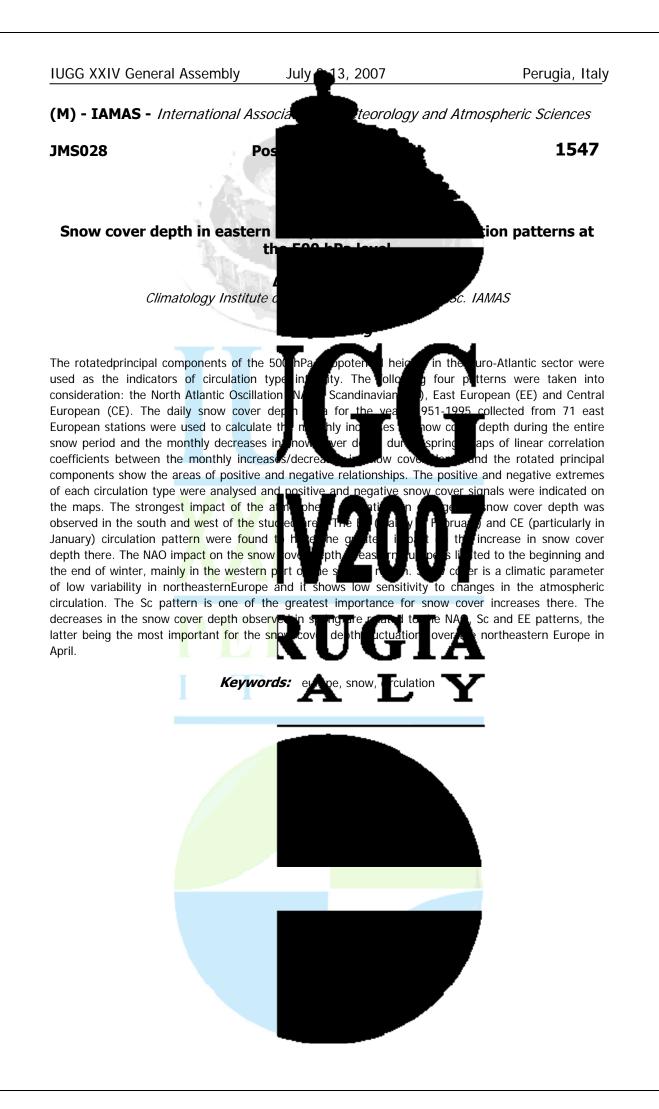
armed over Ocean. 3) In the band incomp e melt due to the low of new snow cover, in proportion to the fetch from the seashore. Thus, the longer the fetch is, the more In contrast, in the coastal region air, 4) Once very shallow snow cover This is indicated by a good higher surface temperatures

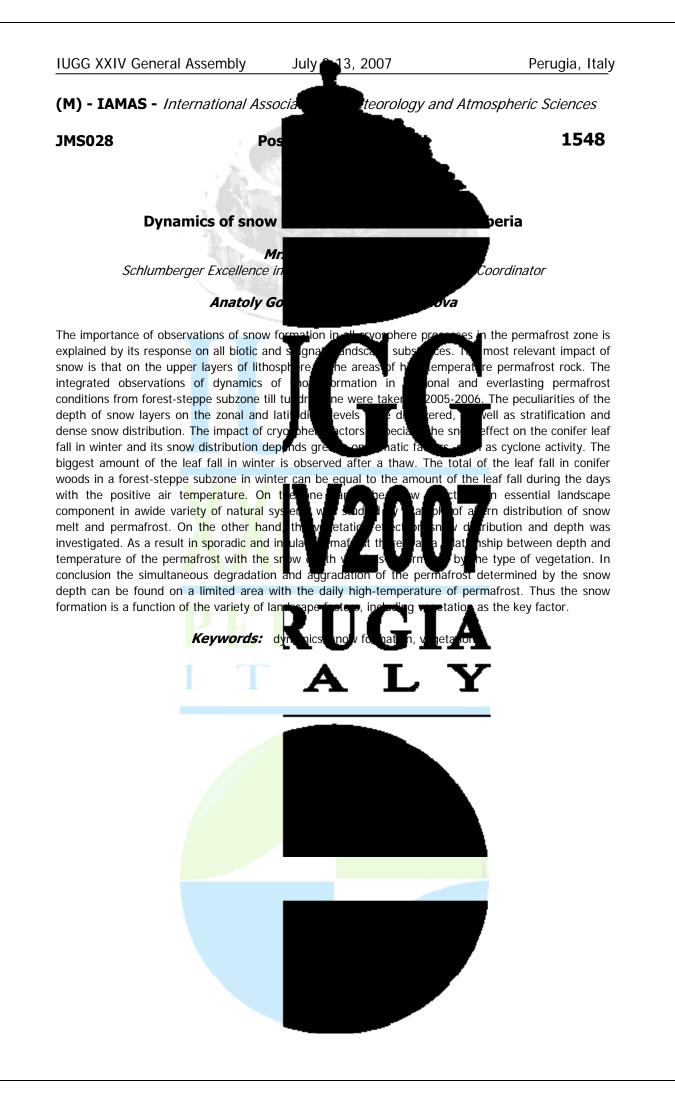
Titude of 1 km, then a moderate

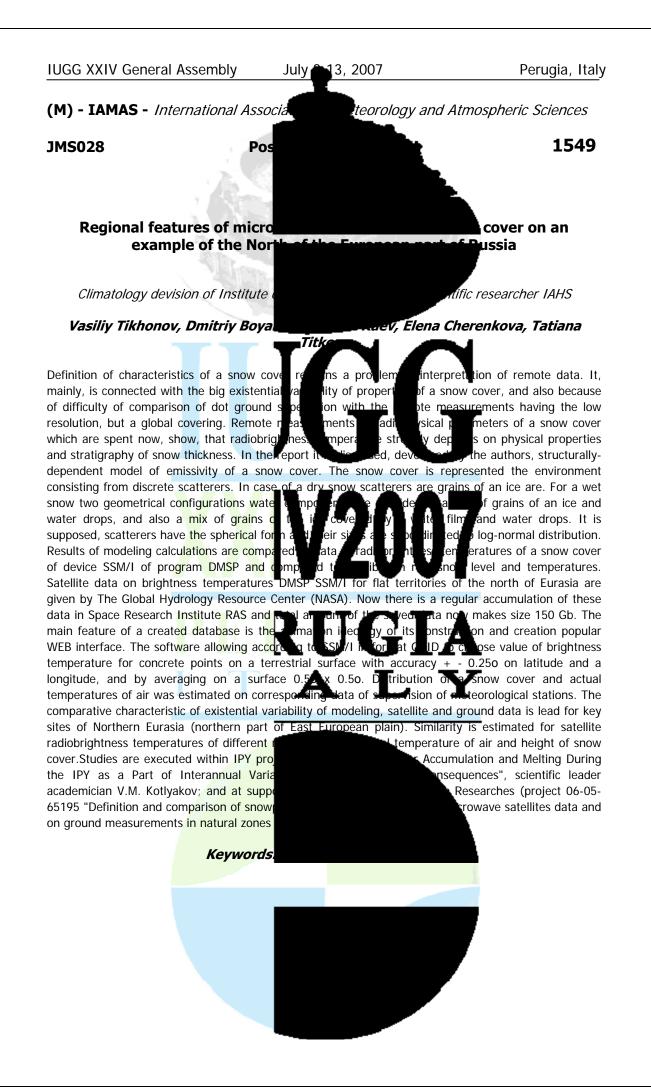
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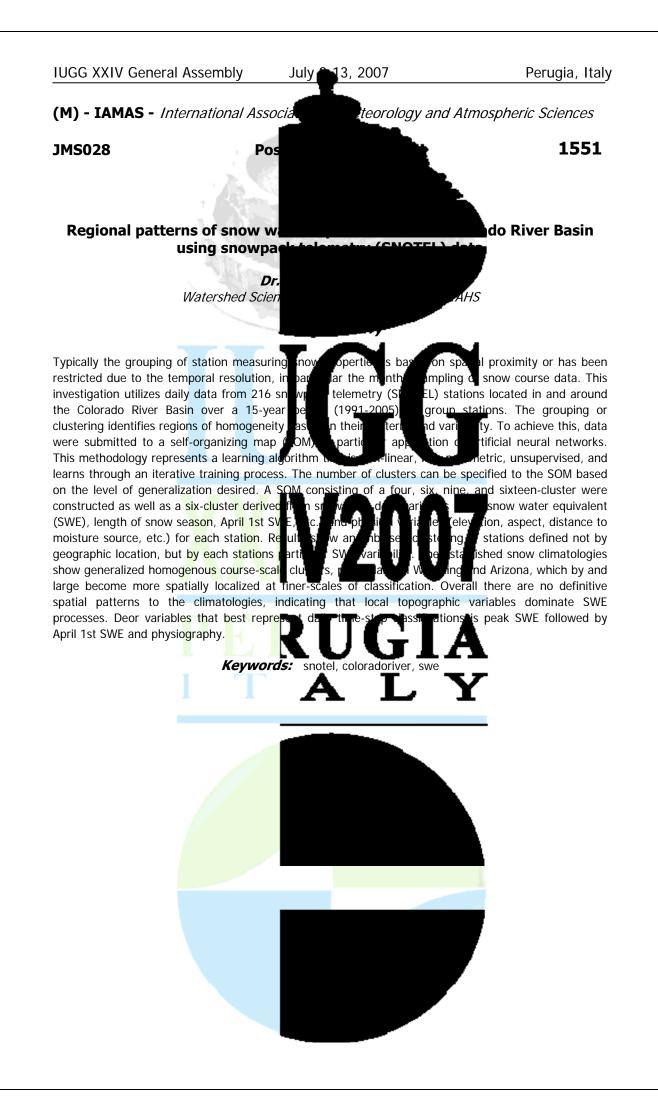














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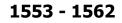
## **JMS029**

Symposium **Snow Avalanches Field Observ** hosted by IAMAS)

Convener : Dr. Karl Kleemayr Co-Convener: Dr. Sovilla Betty, Dr. /

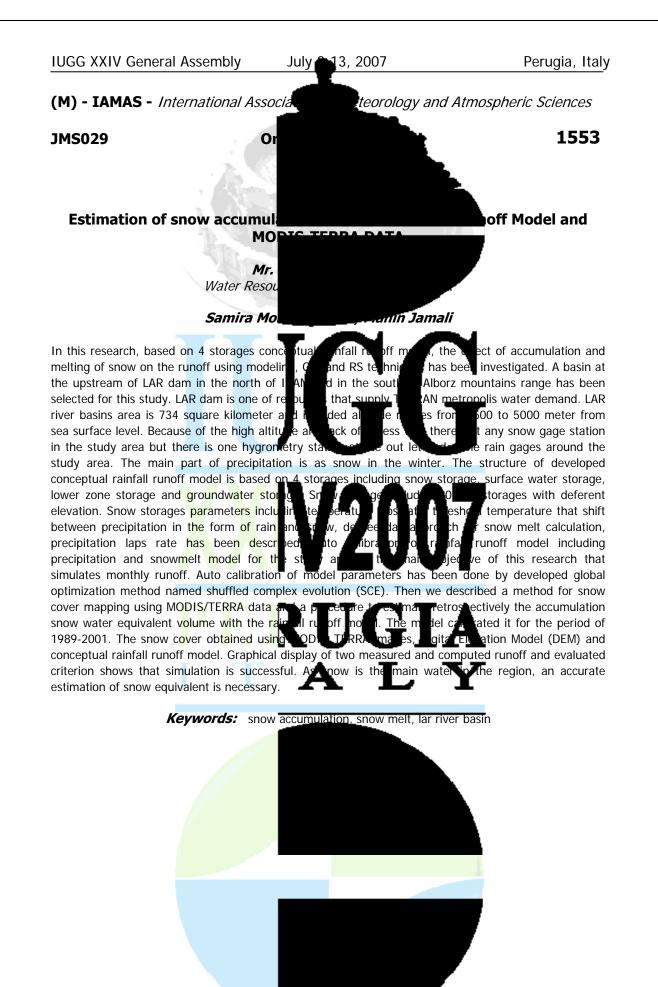
Most of the currently used avalanche sim restricted to avalanche tracks that fit in models. Additionally, the avalanche path h is difficult to obtain and therefore rare. The deformation of the avalanche body. Twomechanics are able to predict the avalanch and request for additional verification cri determining the snow pack distribution in a

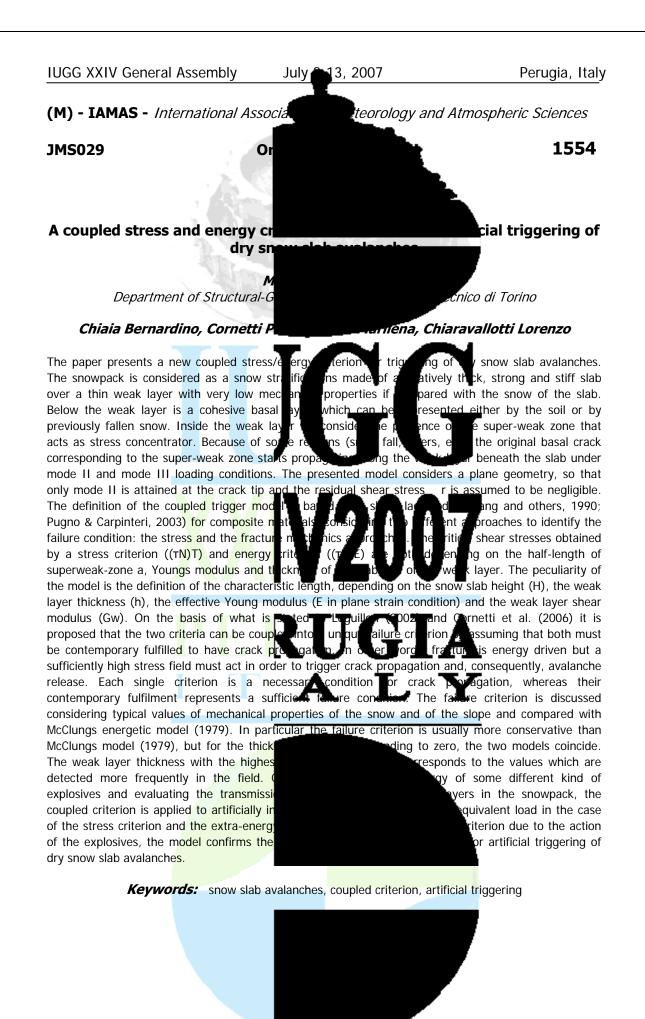
teorology and Atmospheric Sciences

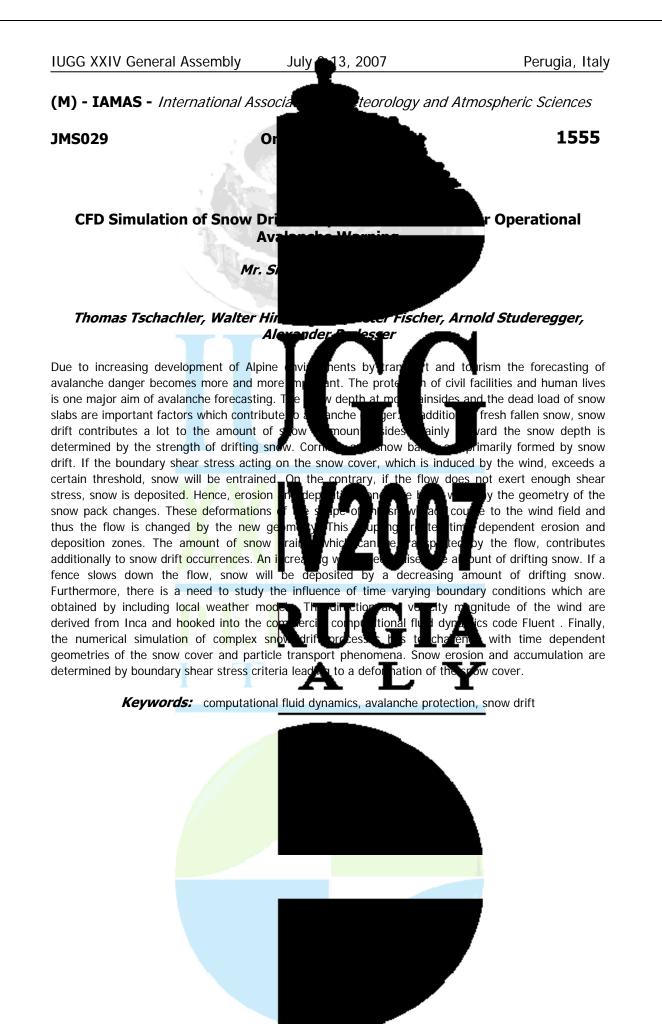


## S Symposium

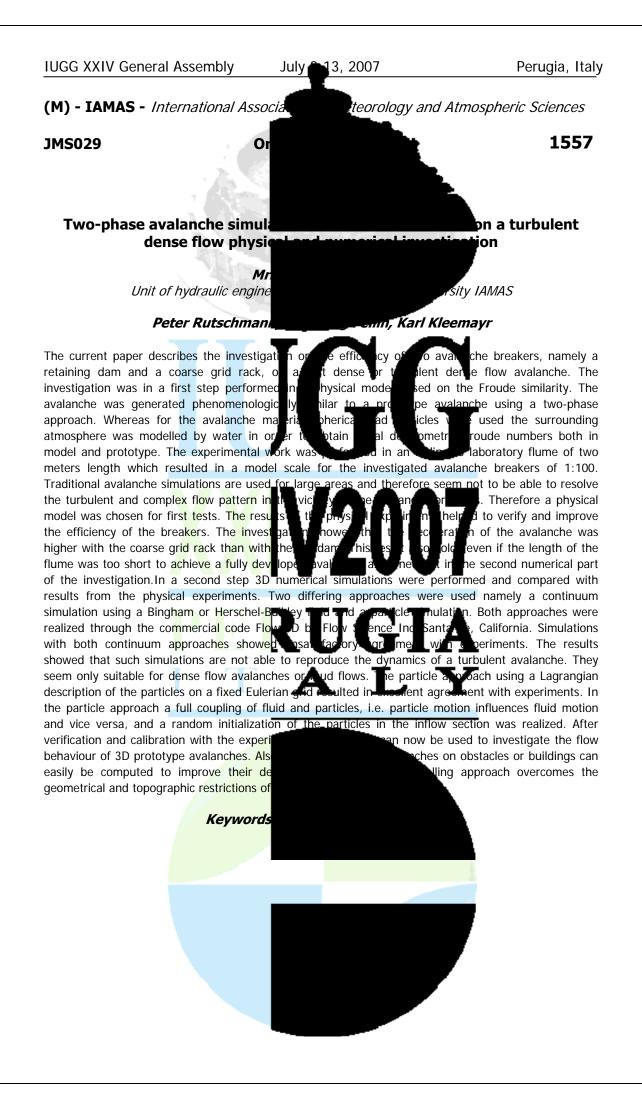
lical run-out models that are one-dimensional centre of mass by the user. Field evidence for verification simplify ver hand cannot describe the ed on fundamental fluid onal els b spreading and run out distances, define the state of the art of lat he session i nporal and sp resolution



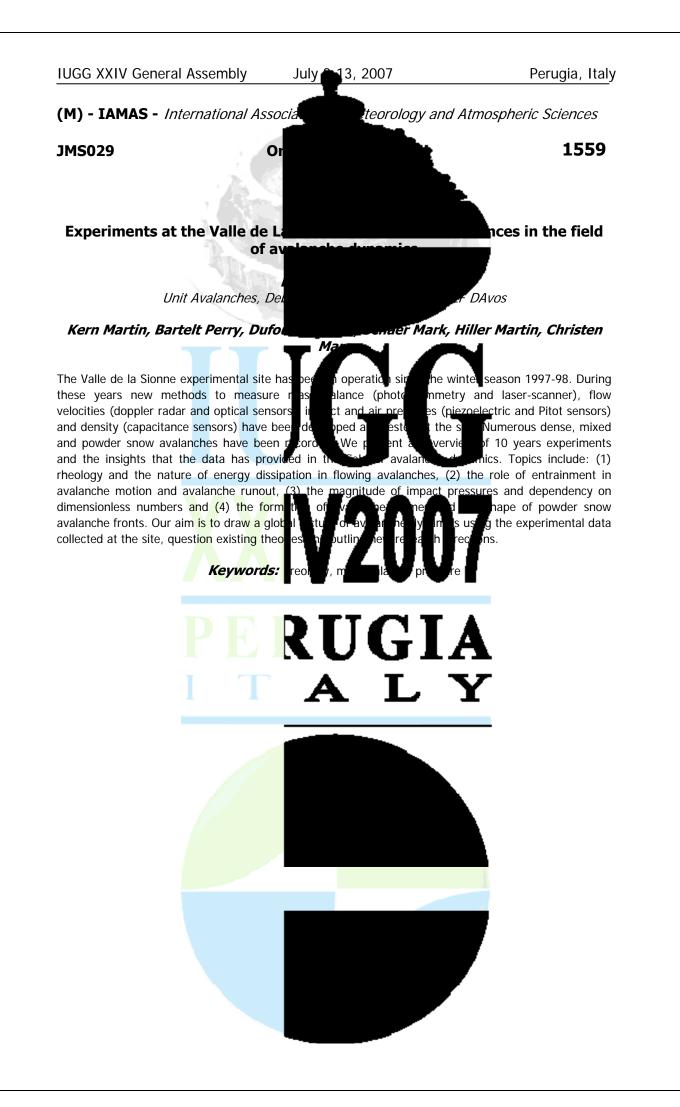






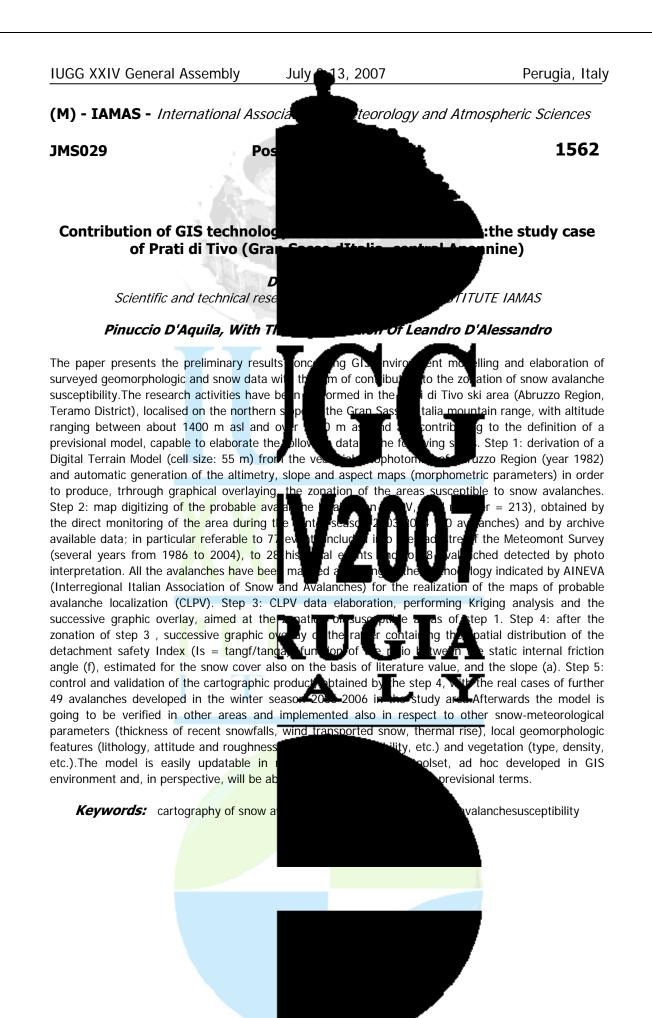












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## **JMS030**

## Symposium Extraterrestrial Ice (UCCS Sym

Convener : Prof. Manfred Lange Co-Convener : Prof. Ralf Greve

Ice, either as H2O or CO2 ice (or other cor most notably, on the surfaces of the inner solar system. Knowledge about the occurre stems primarily from astronomical and sat of geophysical parameters that reveal information on their internal structure.

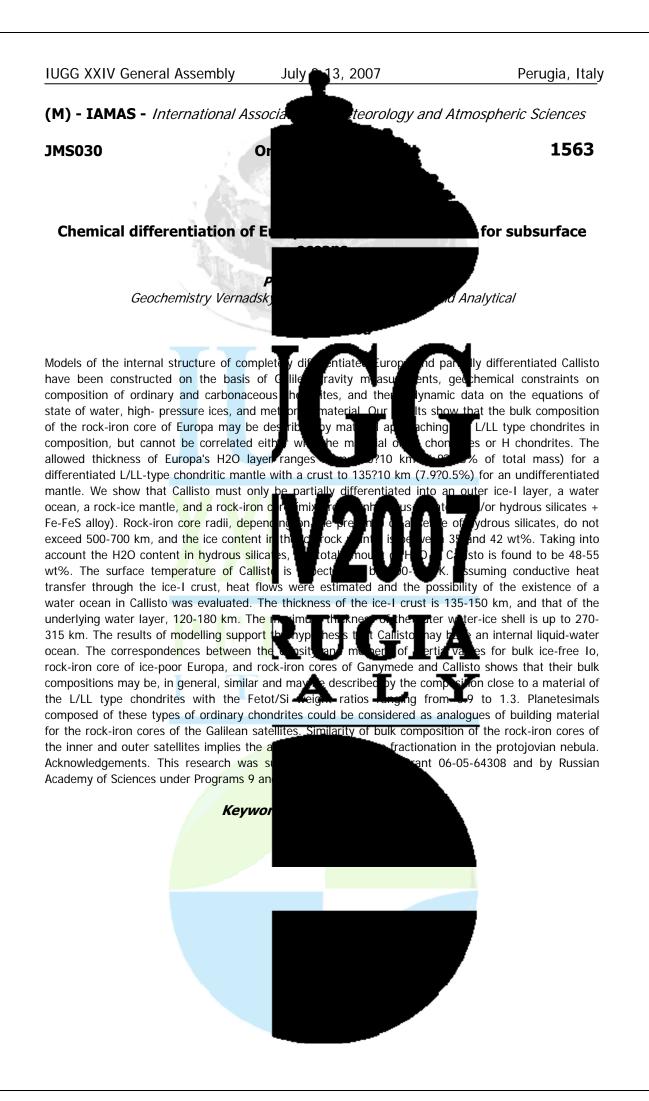
exact properties, the development and the eser This symposium is intended to provide an extraterrestrial ices, their main characteristic ar

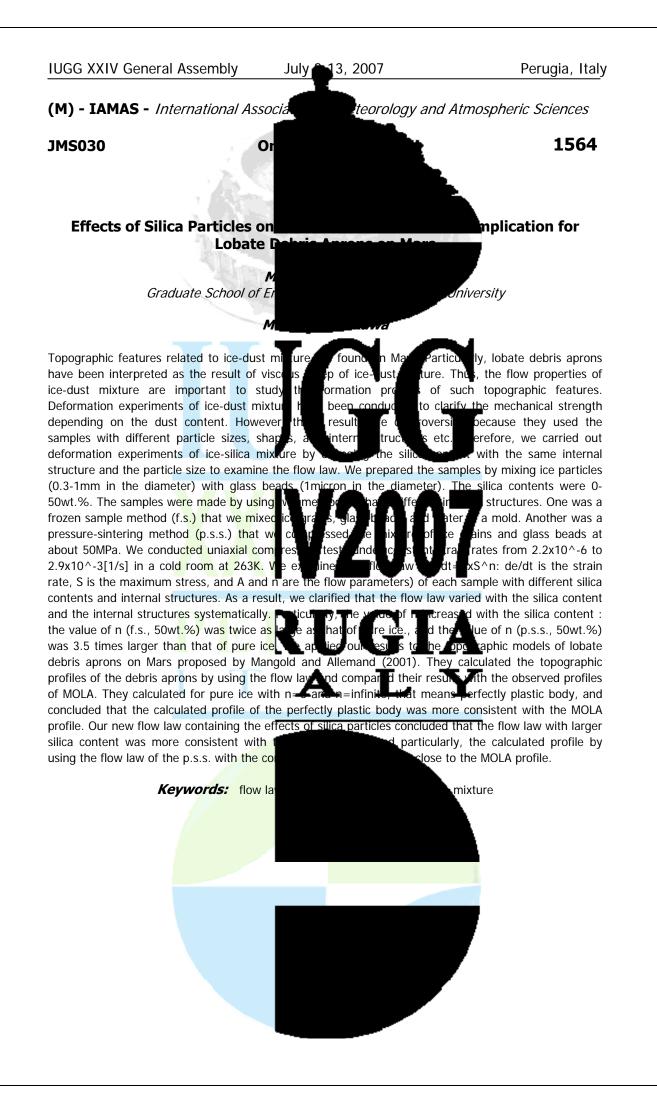
teorology and Atmospheric Sciences

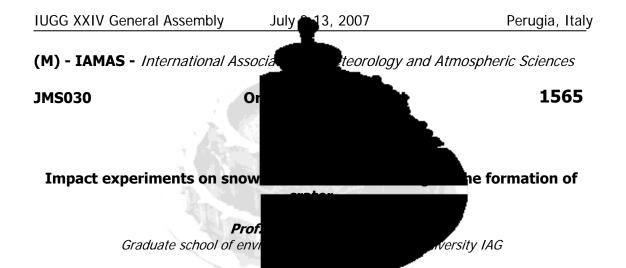
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ature in the solar system, is of the moons in the outer ce or inside the planetary bodies their surfaces and from measurements

Little is known about the extraterrestrial planets. of ice ŌSIT understanding about bou curi eir developm







Introduction: Recent planetary exploration small bodies could be a mixture of silicate porous small bodies could be a sintering of t evolution by sintering and the thermal hist showed that the mechanical structure of thermal evolution. Therefore, we studied strength of icy bodies and the effect of si Experimental method: Impact experiments on si

mechanism of crater and the disruption mechanism of the sintered porous materials. The target was made of ice particles with the size of about 500 microns. The ice particles were put in a cylindrical container with the diameter of 13.5cm and porosity was in between 35 % to 45 % minutes to 16 hours. We used the projectil projectile was a cylinder with the diameter impact velocity less than 150 m/s. Every in temperature of -5 to 18C. Results: We have found that the crater size clearly increased with increasing

reveale he in tant S. Sirono nd mall icy bodi ngth<u>develo</u>p ributi n the erii nat condu

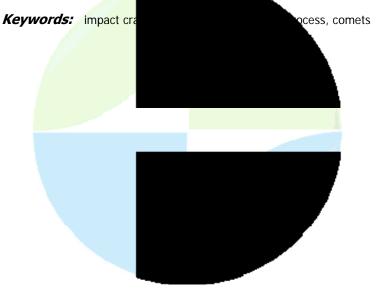
ey have a large. These to give the strength in chani amoto (197) studied the porosity r the implication to comets. They y sintering in the process of the trolling the mechanical ing in f imp craters made on snow. ke clear the formation

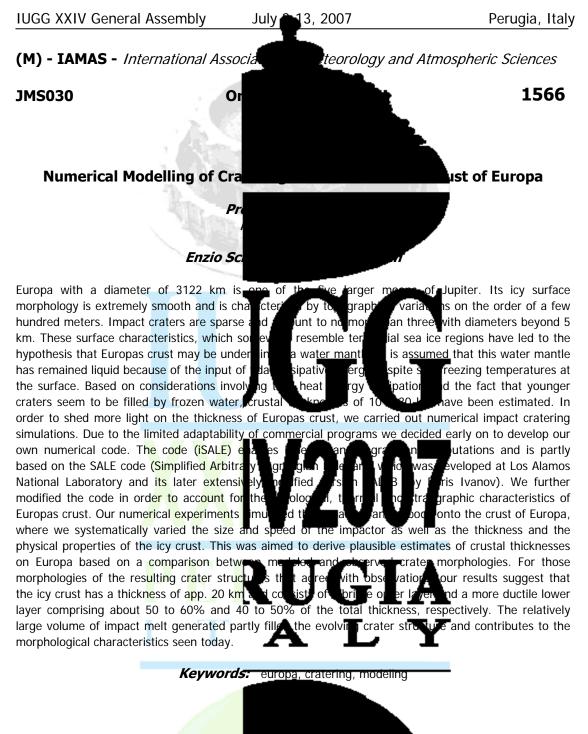
> kperiments. The target m for sintering from 3 osity of about 30%. The d by a He-gas gun at the a large cold room at the

h

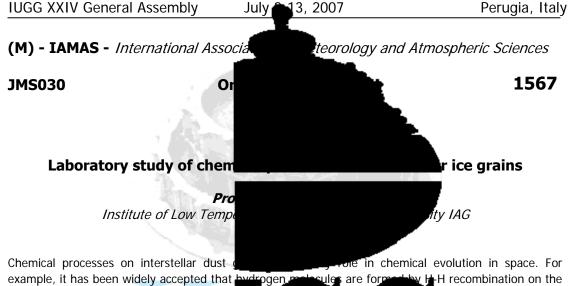
the impact velocities at 10 deg. C. The snow projectile was recovered intact at low velocity impacts, but point was observed as ring-like it was broken completely at high velocitie structure. At lower temperatures, the crate the act velocity. In contrast, ame. the crater size became smaller at higher ten be we the crater volume (Vc) rat bnsk The and the projectile kinetic energy (Ek) was fit by power law equations for each temperature and projectile. The power law index derived from the sting for each data was out 0.5 irrespective of the temperatures. The Vc of the lower temperatures be mes larg the same k because of the effect of sintering. The Vc at 18 deg. C is noted to be three times larger than that at 5 deg. C. We also found that the crater size simply decreased with time from 3min. to 6hrs. at 10 deg. C. Sirono and Yamamoto (1997) Planet. Space. Sci. 45, 827-834.

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surface of dust grains. Furthermore, observation such as CO, CO2, and simple organic moled les grains. Most of these molecules can not be processes of ice mantles. Since reactions composition of ice, theoretical approach to the experimental study is desirable to unde tar results of our recent experiments regarding the grains via surface hydrogen atom reactions and photolysis of water ice containing CO which are

hydrogen atoms (hydrogenation) in the molecular clouds, we performed the exper primordial ice mantle (H2O-CO binary ice) wi The major difference in the results betwee Photolysis yields CO2, HCOOH, H2CO, CH

and 1 atom) and the total amount of the

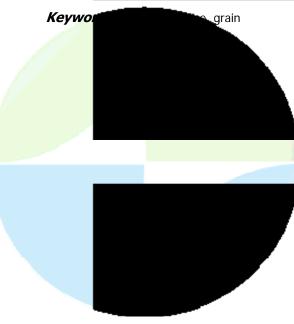
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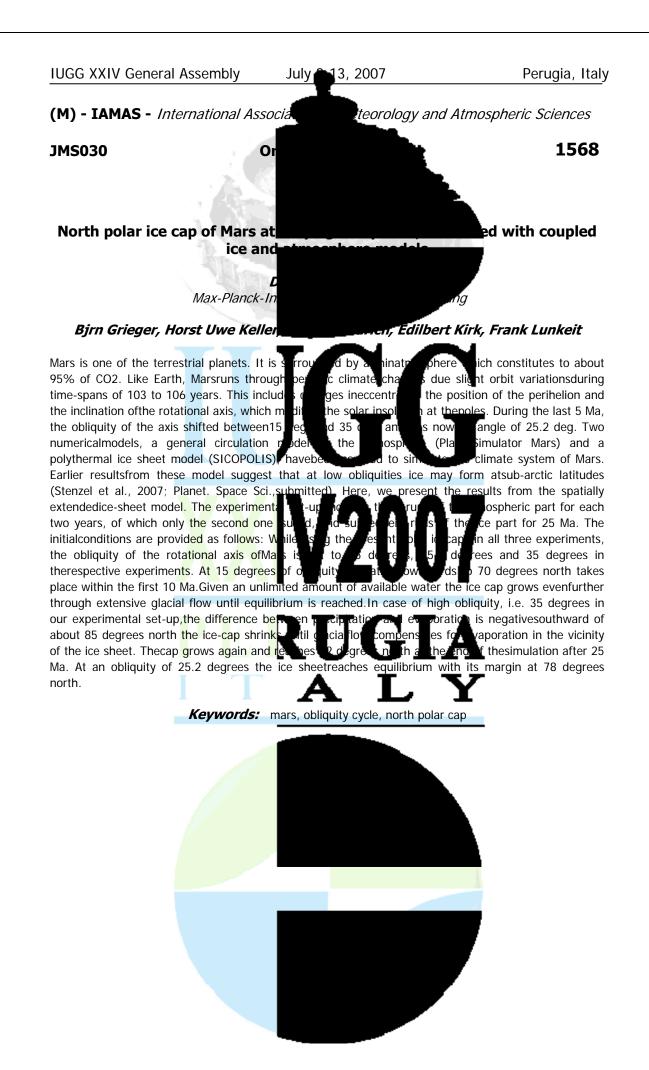
rs of molecular species ter ice mantles of interstellar dust as phase and require the chemical depend on the structure and the as-phase reactions. So, st grains. We report the olecule in ice mantle of

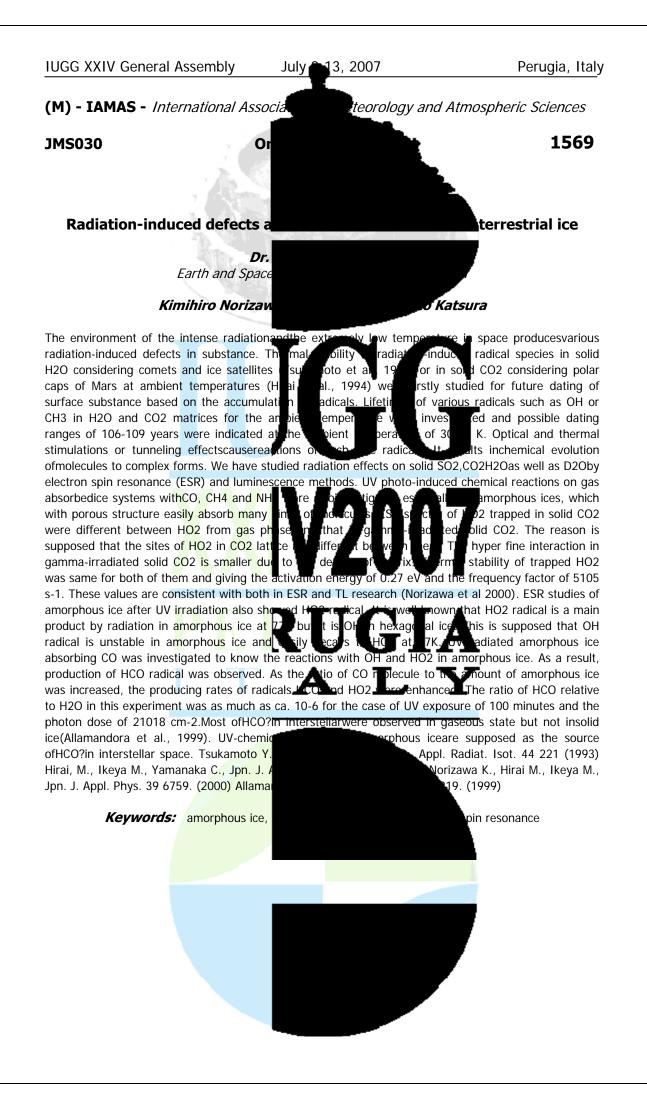
dominant processes in interstellar molecular clouds. To evaluate the roles of photolysis and reactions of various conditions of on of the analogues of at various temperatures.

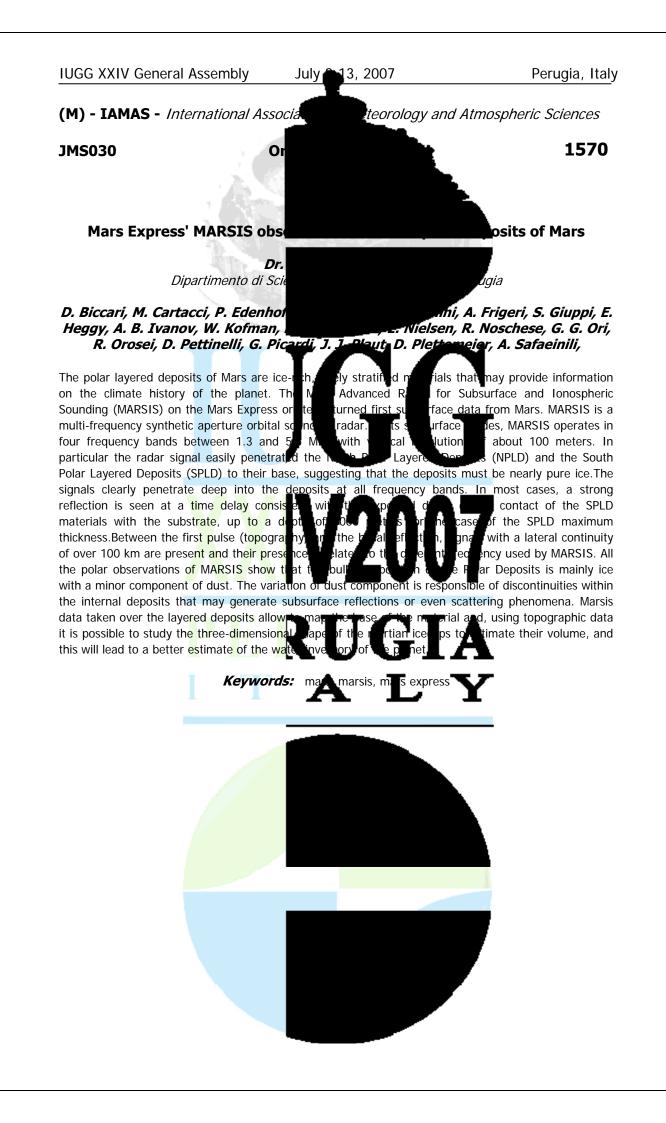
the number of products. ectable small amount of other products, while only H2CO and CH3OH are obtained in hydrogenation. The main channel of photolysis is the production of CO2. The efficiency of H2CO and CH3OH formation (yields for 1 photon ation are higher than those for photolysis. Hydrogenation of CO was found tunhelir read and to be much more er molecules makes the

sensitive to ice temperature and structure the sensitive to ice temperature and structure than platfolvsis. The presence of where molecules makes the range of reactive temperature wider in hydrogenation. Considering the conditions of molecular clouds, we conclude that production of CO2 is owing to protolysis, wh and CH3OH. The results for simultaneous expours on hydrog Toris responsible for H2CO e hydrogena V photon reproduced the atoms and observed abundances of CO2, formic acid, formaldehyde and methanol fairly well.









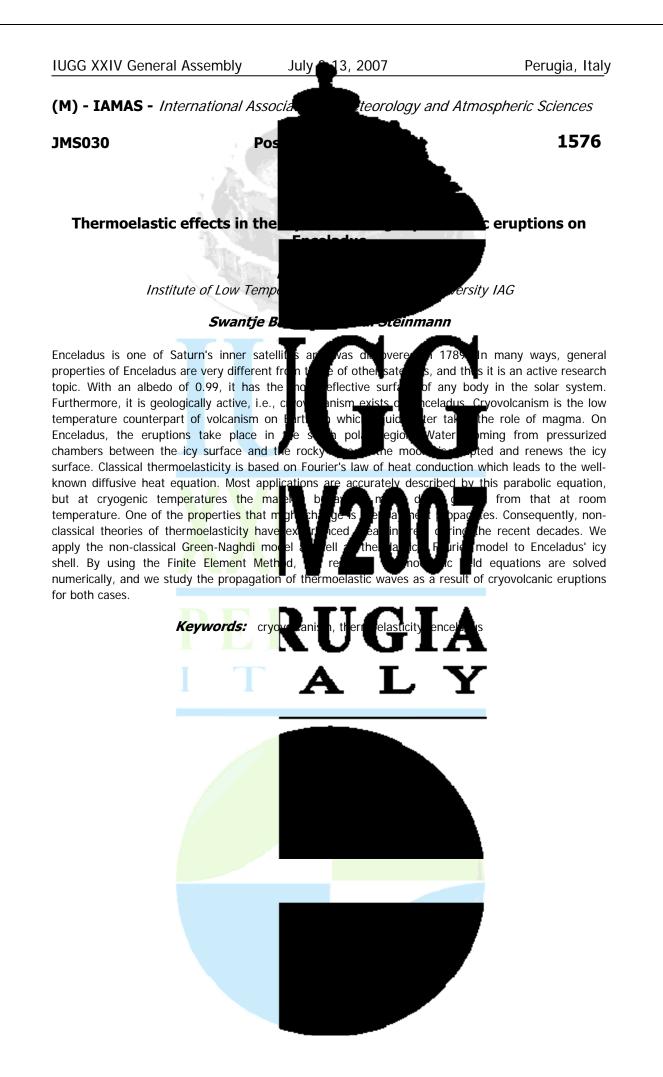












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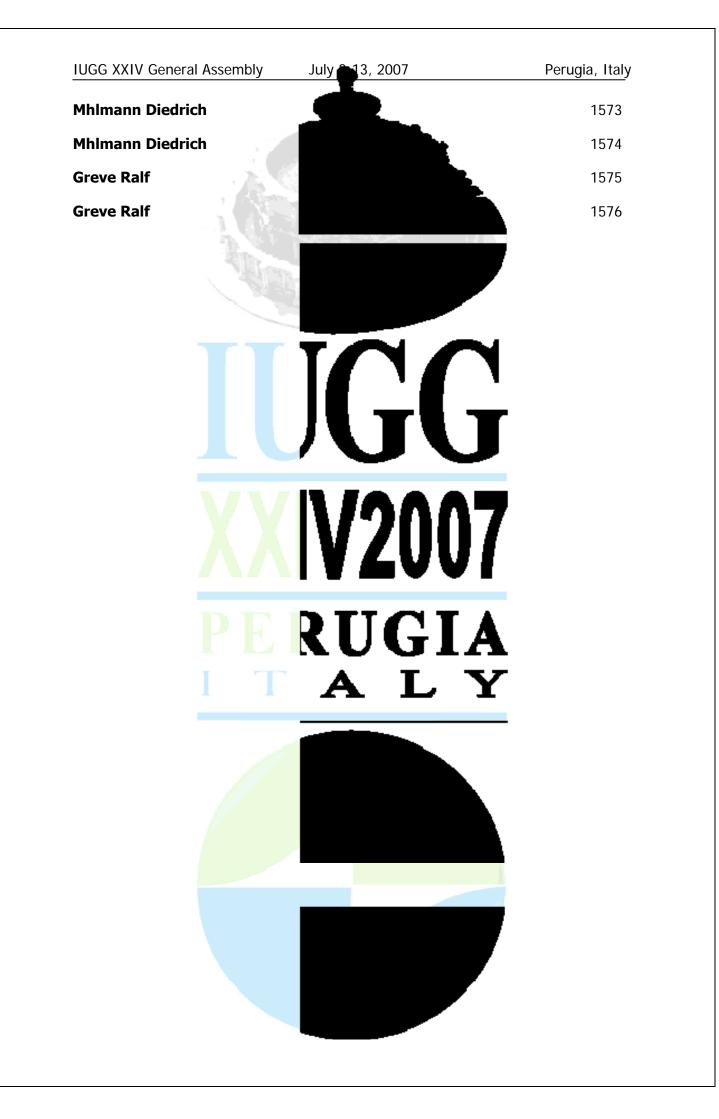
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