

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 IVGGG XXIV2007 PERUGIA I T A L Y PERUGIA I T A L Y CMANGING PLANET OUR CMANGING PLANET

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Presidenza del Consiglio dei Ministri Ministero degli Affari Esteri Ministero dell'Ambiente e della Tutela del Territorio e del Mare Ministero della Difesa Ministero dell'Università e della Ricerca









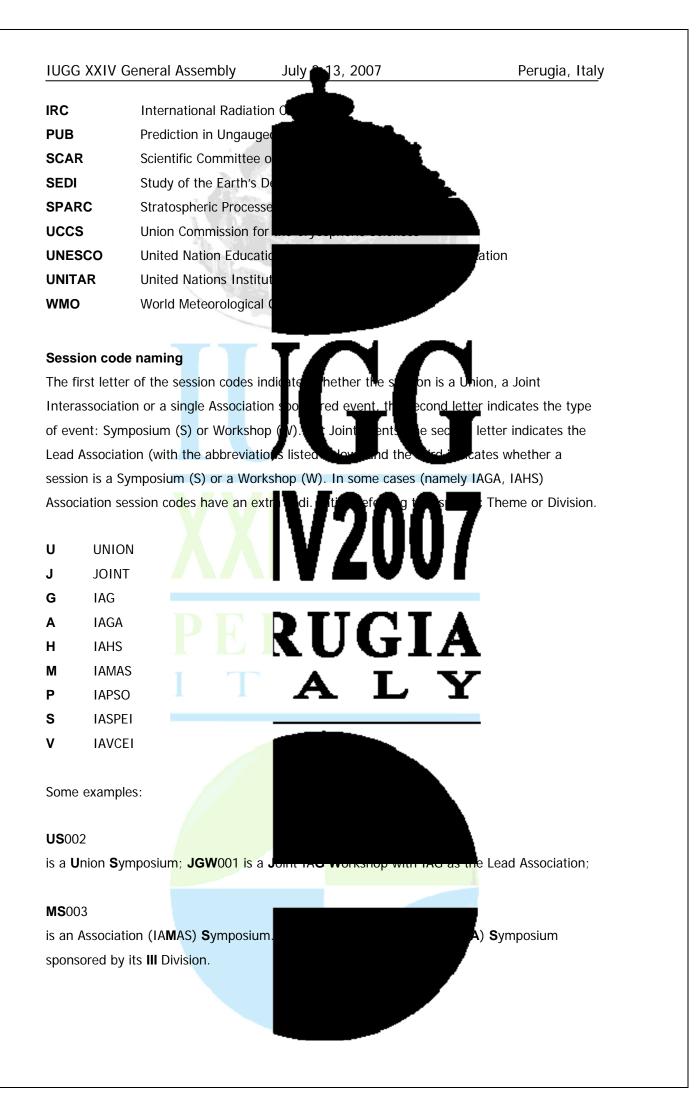
Presidenza della Giunta

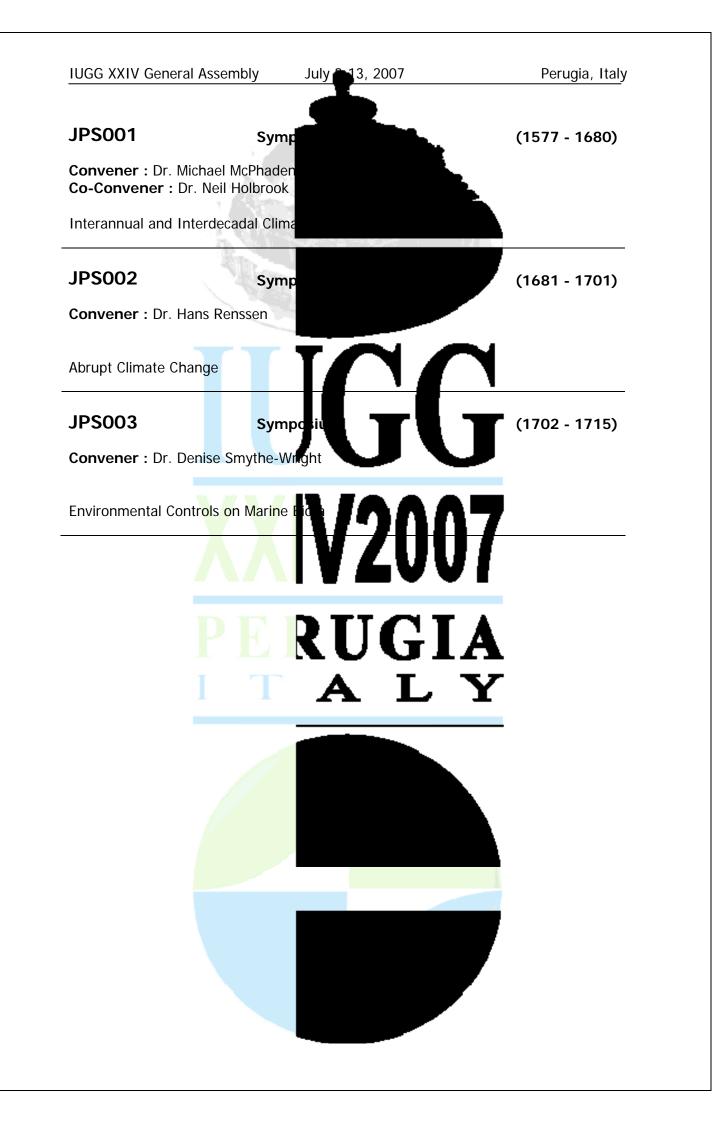
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IUGG XXIV General Assembly	July 13, 2007	Perugia, I	taly
SCIENTIF		IITTEE	
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Paola Rizzoli	Ch Pri	Committee	Usa
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	neral Assembly July 13, 2007	Perugia, 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 explorite intails	
CCL	International Commission & Clining 1	/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 International Center for International Mour	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	





IUGG XXIV General Assembly

July 13, 2007

Perugia, Italy

(P) - IAPSO - International Associat

JPS001

Symposium Interannual and Interdecadal

Convener : Dr. Michael McPhaden Co-Convener : Dr. Neil Holbrook

This symposium will address the causes interdecadal time scales from theoretical interest include ENSO, NAO, Northern and related Interdecadal Pacific Oscillation, the

between dominant modes of natural cli ate encouraged.

Physical Sciences of the Oceans

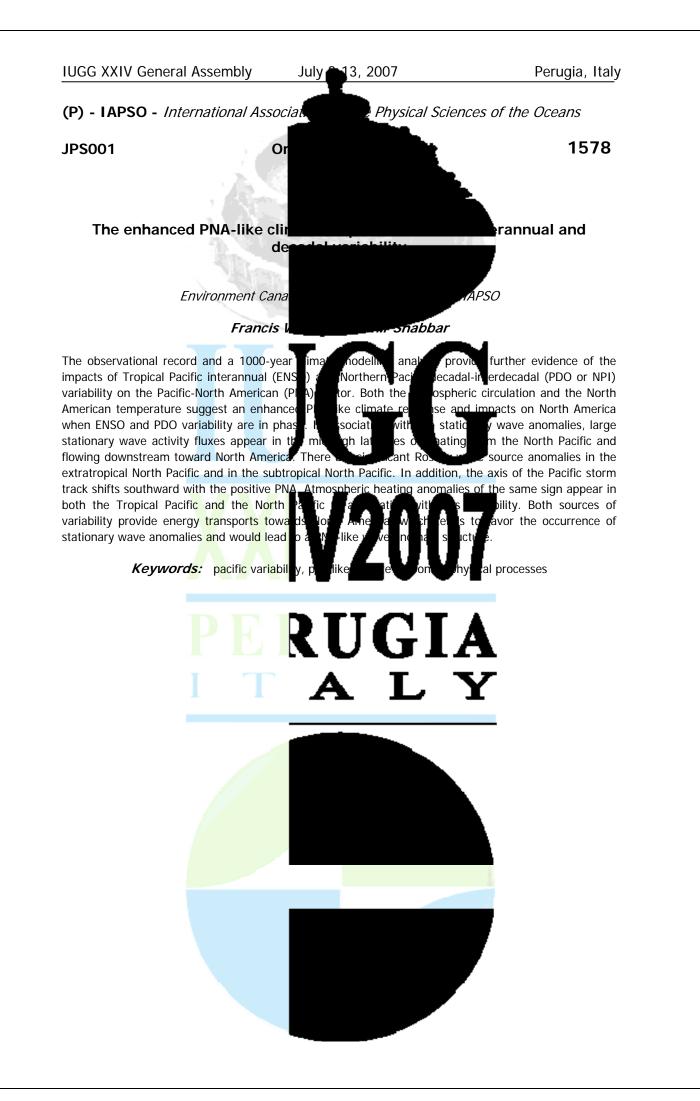
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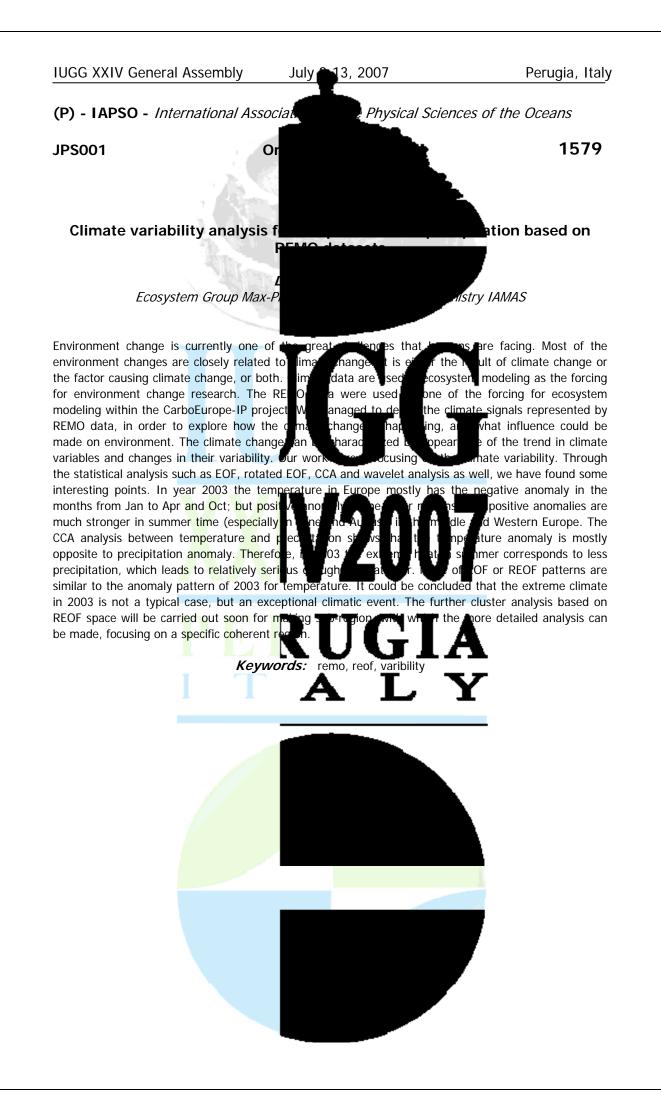
ability on interannual to erspectives. Phenomena of cific Decadal Oscillation and the Atlantic and Benguela Nios, the Atlantic Interhemispheric Gradient Mode, and other dominant modes of variability. Paners dealing with climate dynamics, environmental and societal implicits, environmental and societal implicits, environmental and societal implicits. riability and ic climate change are hropog

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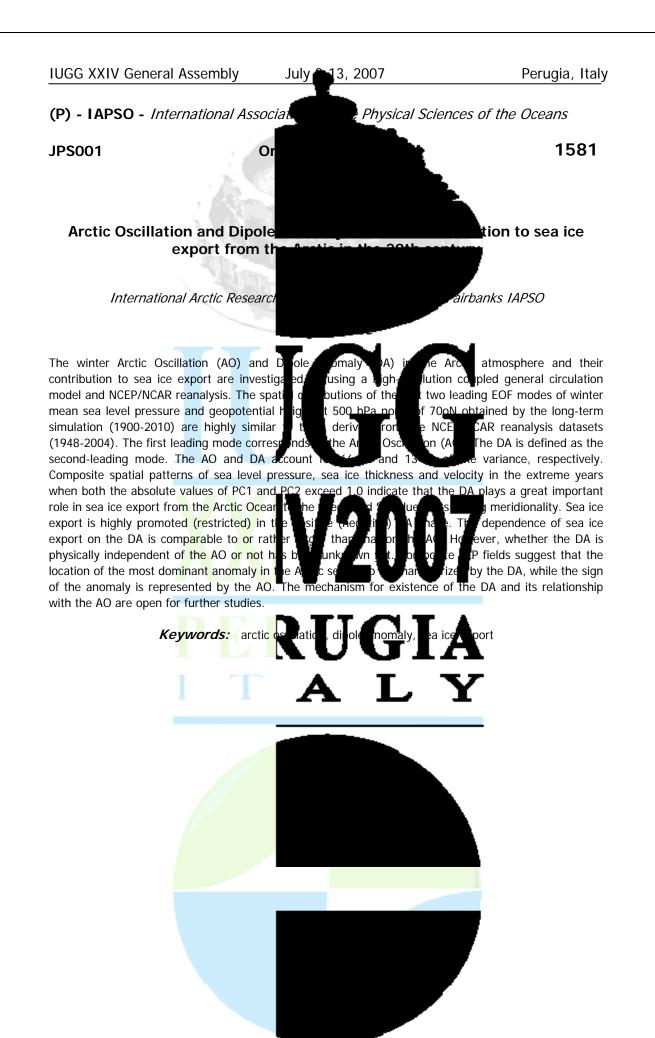
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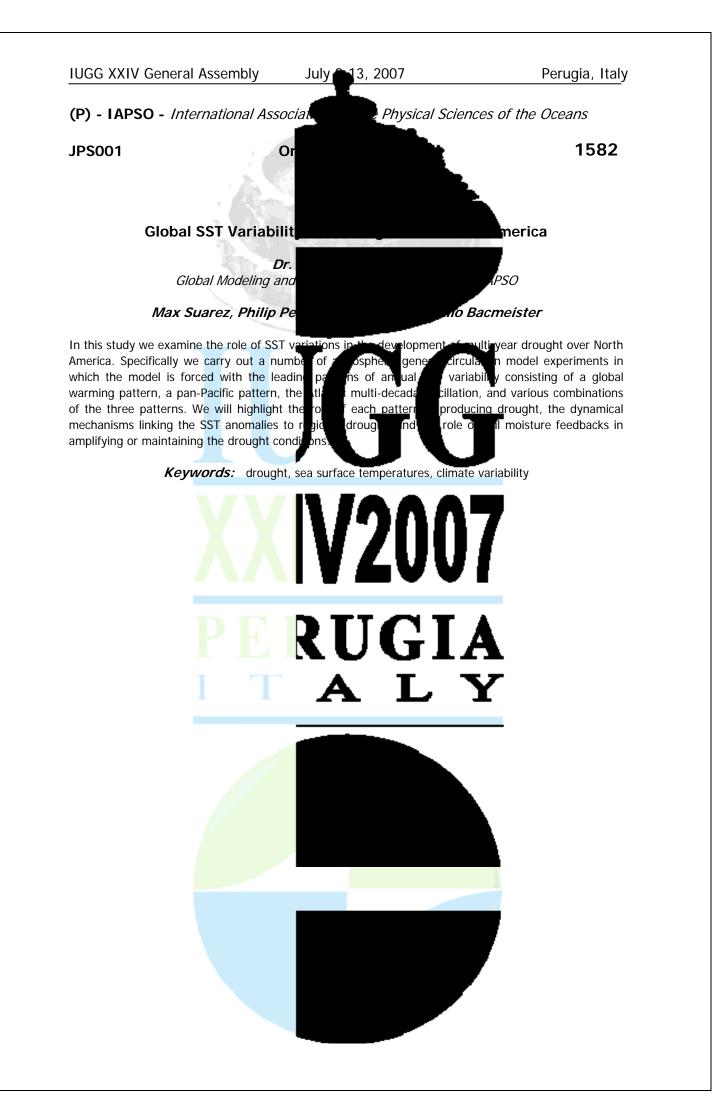




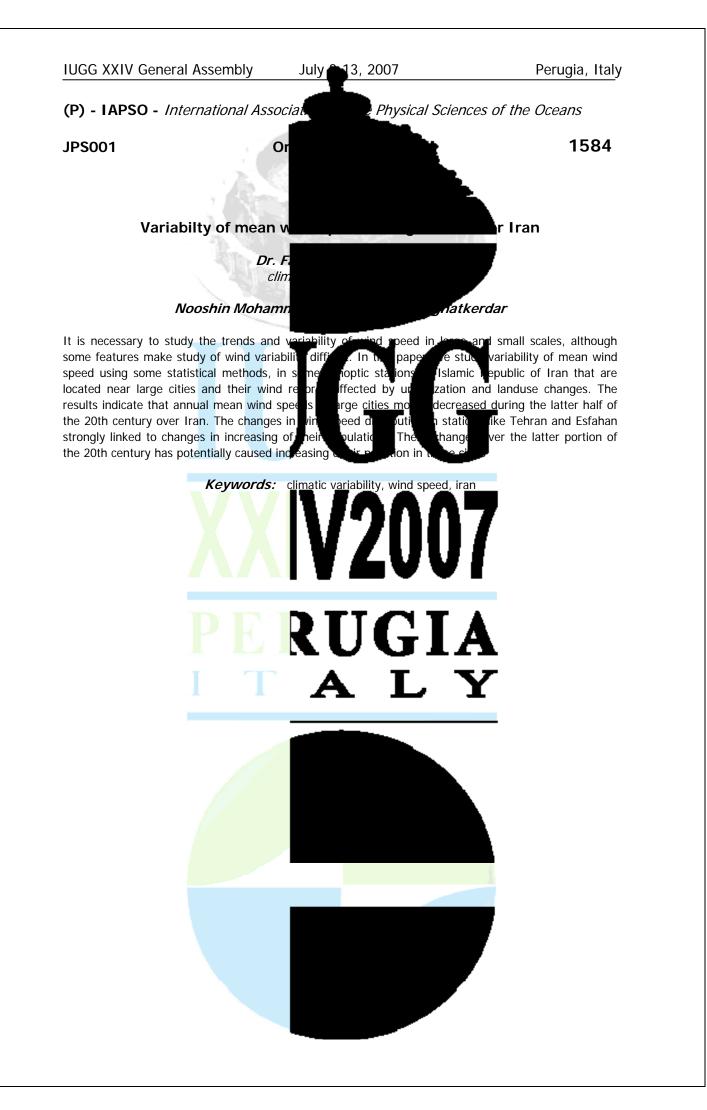


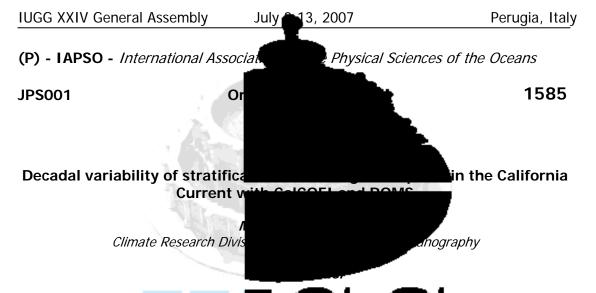












The 55-year CalCOFI (California Cooperativ California Current reveals a significant (buoyancy frequency) across the 1976-77 coastal circulation and nutrient supply int changes, thermocline depth and thermo Thermocline depth was defined as a dep Thermocline temperature increased after the shift

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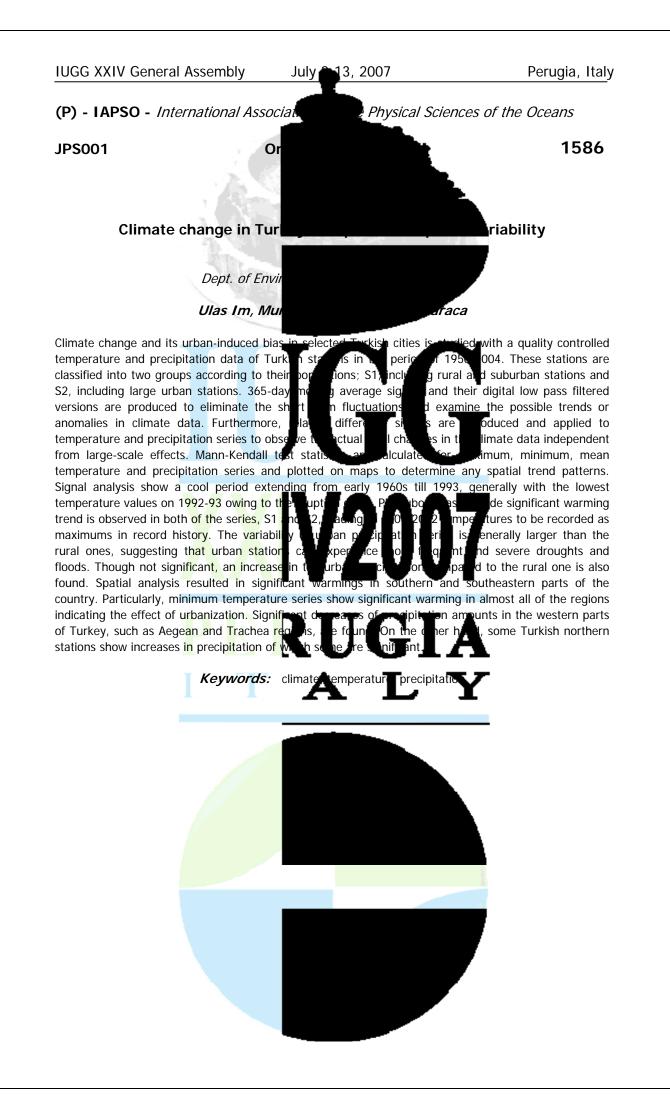
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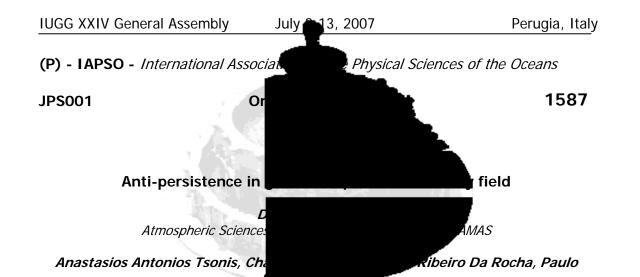
dataset in the southern ing and increased stratification did these physical changes alter o quantify stratification structure using CalCOFI data. calcu of temperature profile. grad warming, however, the

heating strengthened stratification, cross-shelf momentum flux at the interior of the water column by Ekman transport is getting more importa 2004). This affects nutrient supply for increased with depth in the ocean. Thus altered. Three dimensional numerical mod conducted to address details of coastal ci forcings.

average depth of the thermocline did not change significantly across the regime shift. As the surface (Lentz and Chapman, cause major nutrients ave been fundamentally cean Model System) was to different surface SST







The Earths average surface temperature h significant global impacts. However, uncerta the response of the climate system to the r Understanding natural variability of the clim The objective of this study is to improve insights about the spatiotemporal variability temperature anomaly are investigated by mapping

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late 19th century with the natural variability as well as se gases still remain (IPCC 2001). predict non-linear climate forcings. bility by providing new Here v-frequency variations in rds onto random walks.

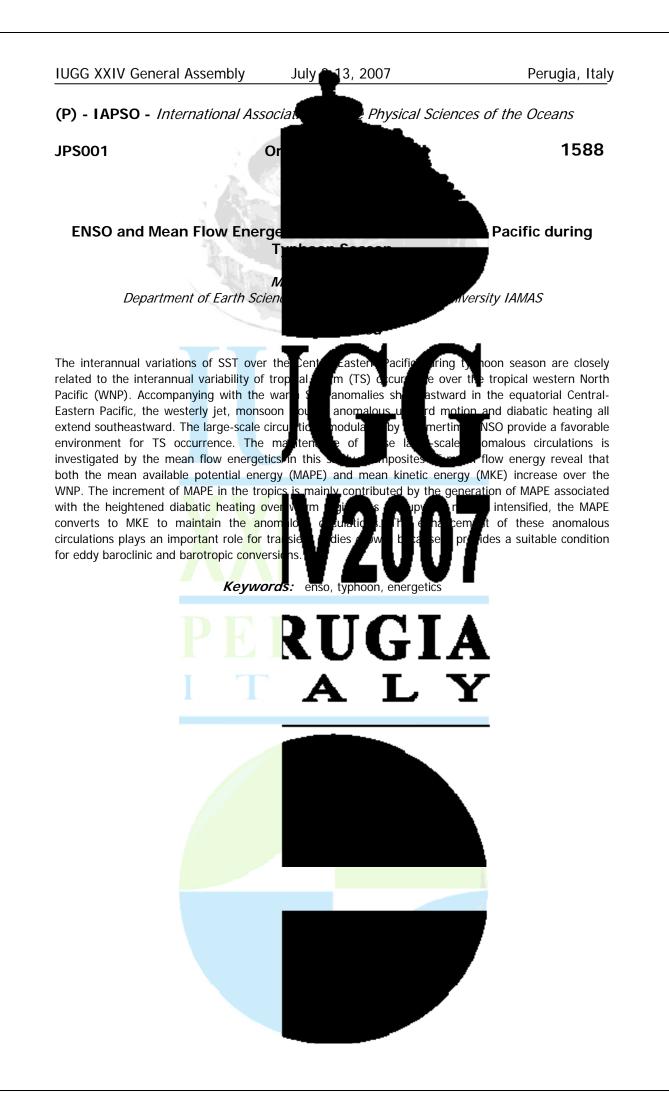
Anti-persistence scaling properties of temperature anomalies are investigated. We show evidence that global overturns in trends of temperature anomalies occur on decadal time-scales as part of the natural variability of the climate system. Paleocli further support for these findings as they

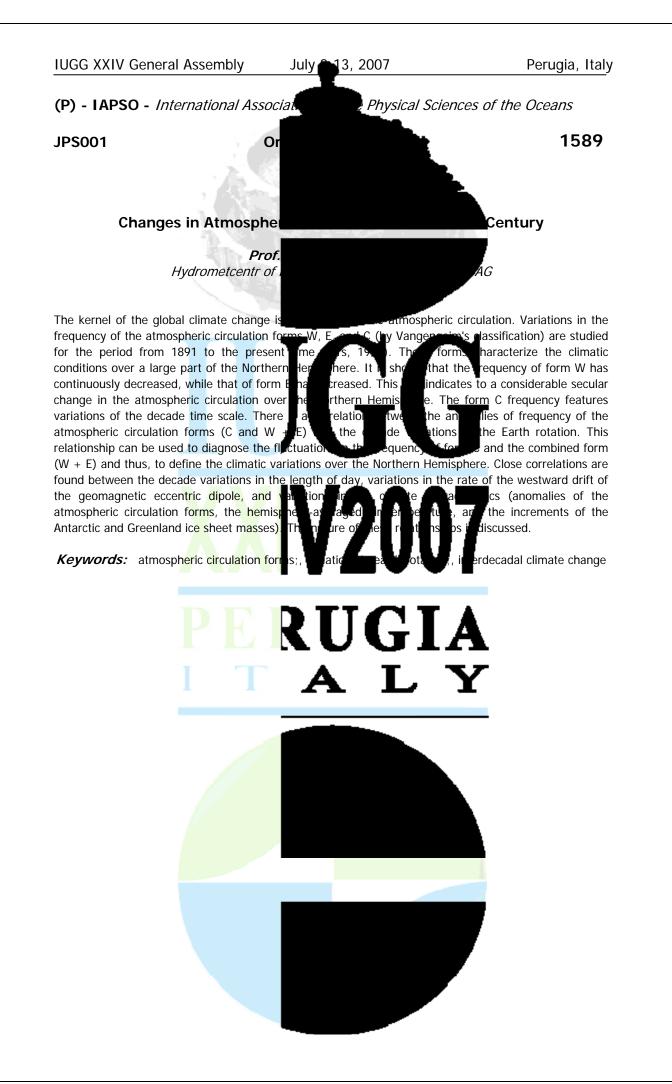
decadal time-scale have occurred in the la latitudes of the SH and interactions with moderate global variations of temperature

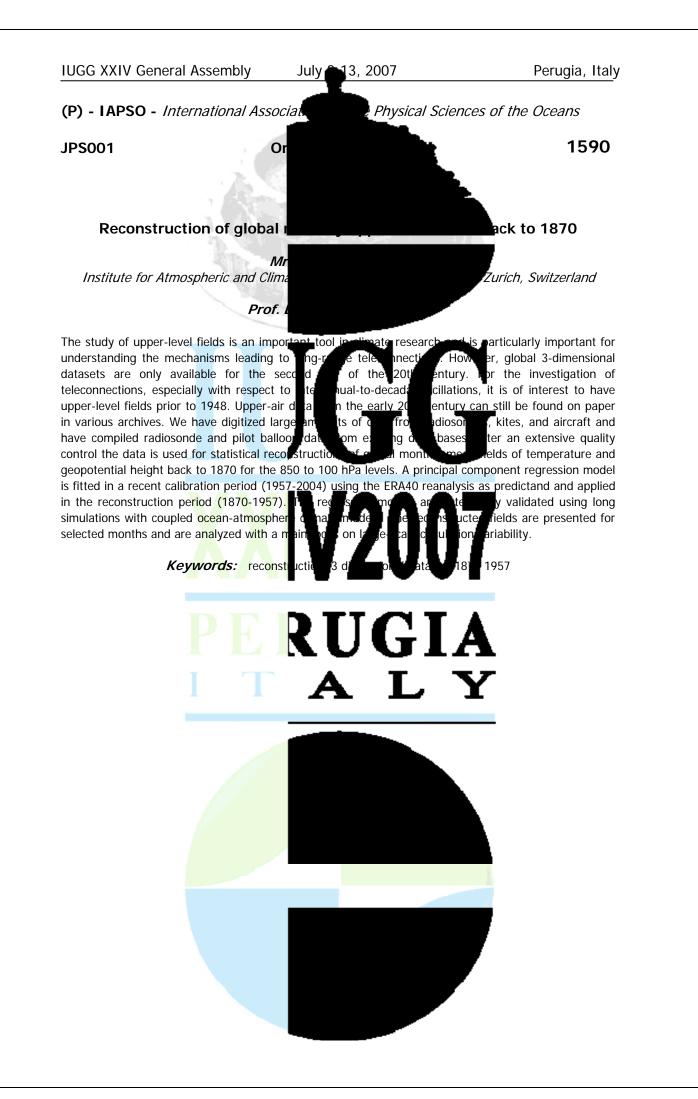
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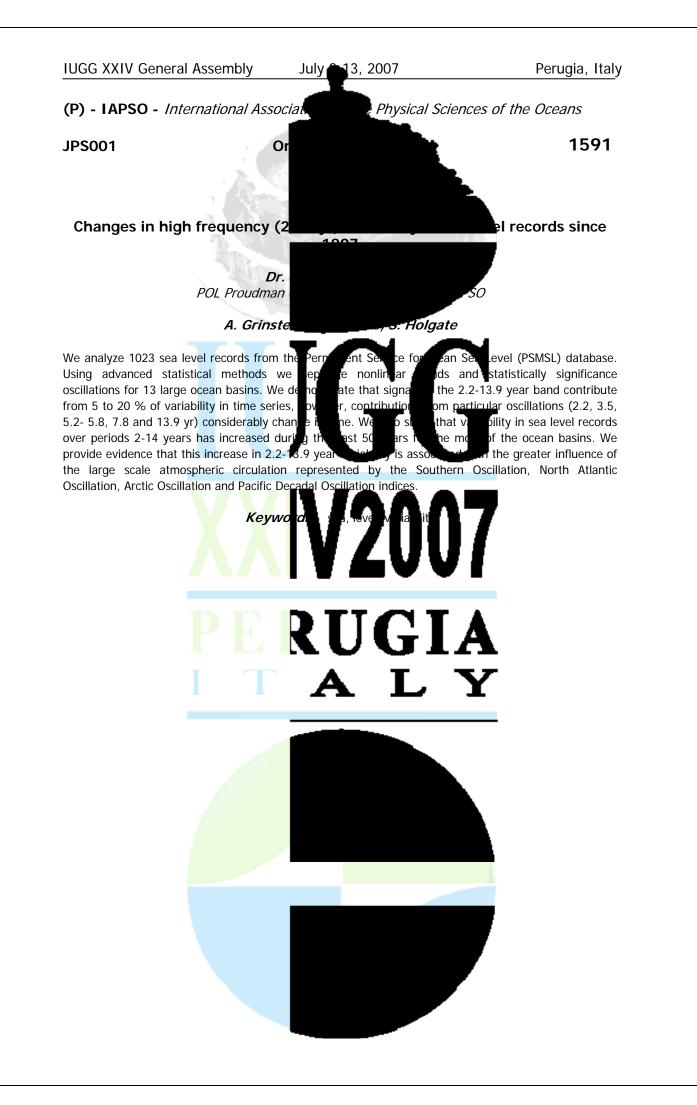
New-Zealand provide perature anomalies on the subtropics and midan important role to λ£

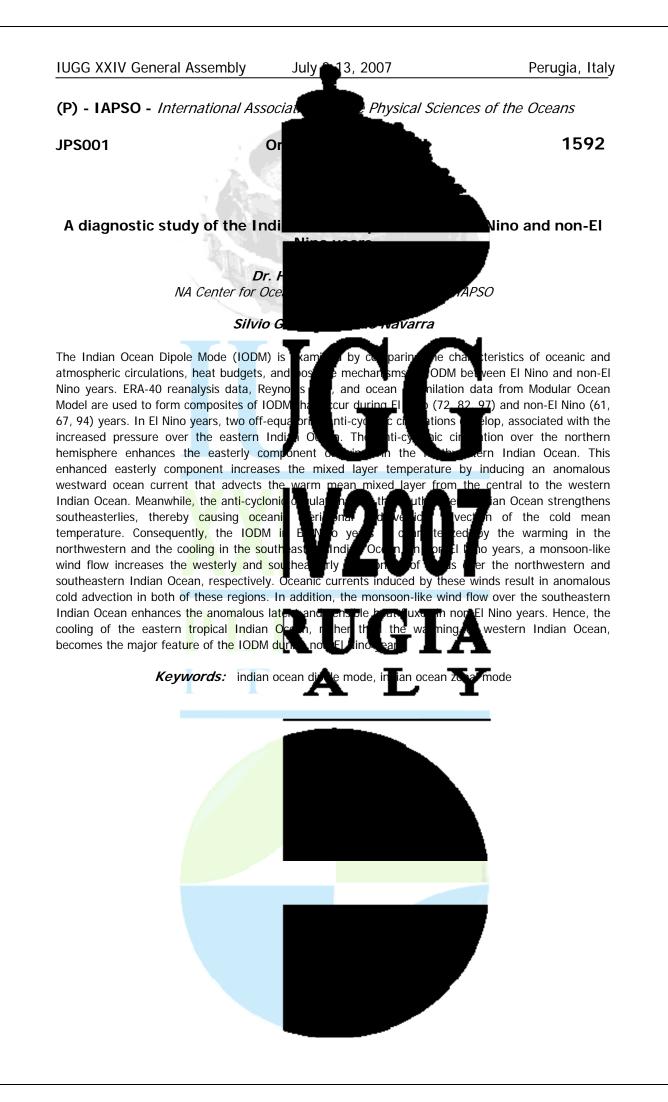
Keywords: decadal, anti persistence, random walks

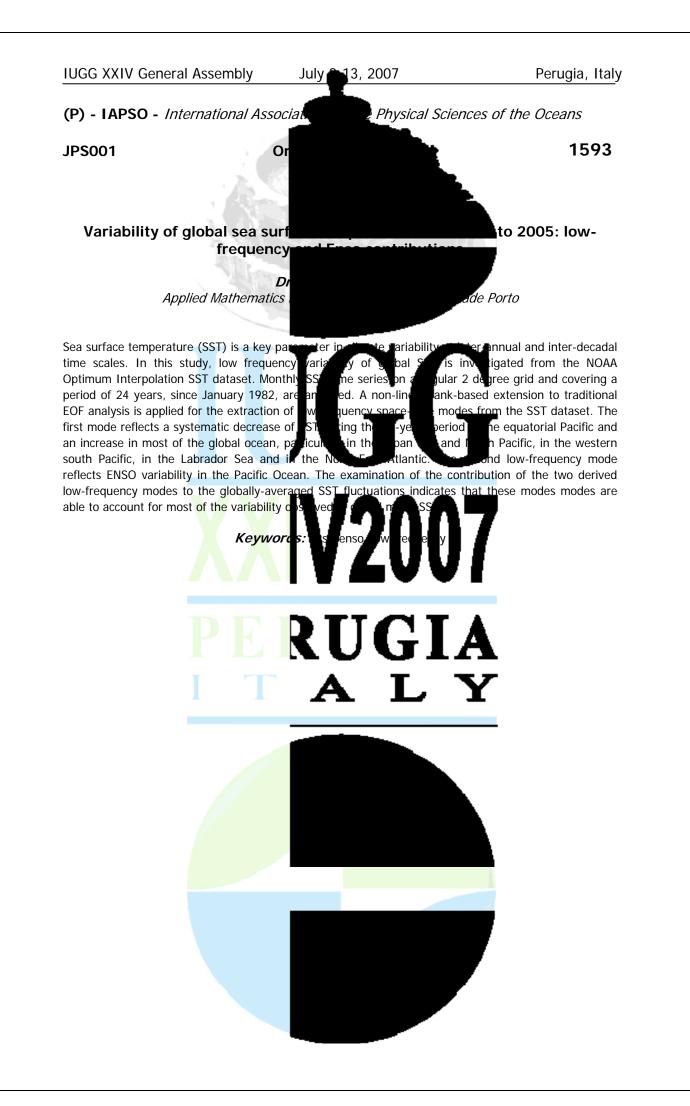


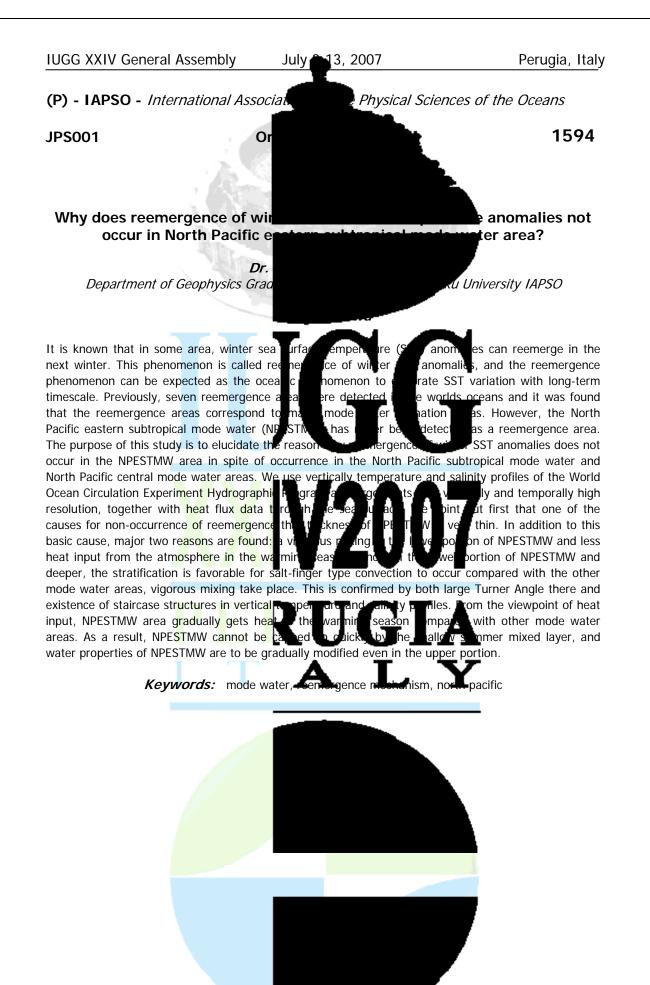






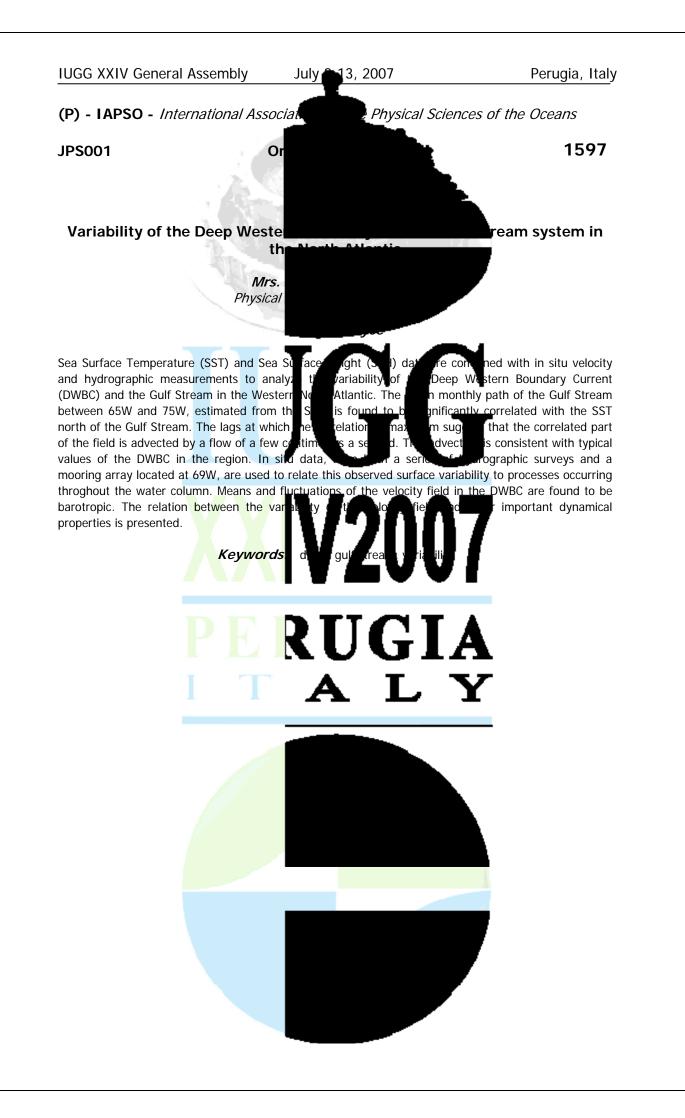


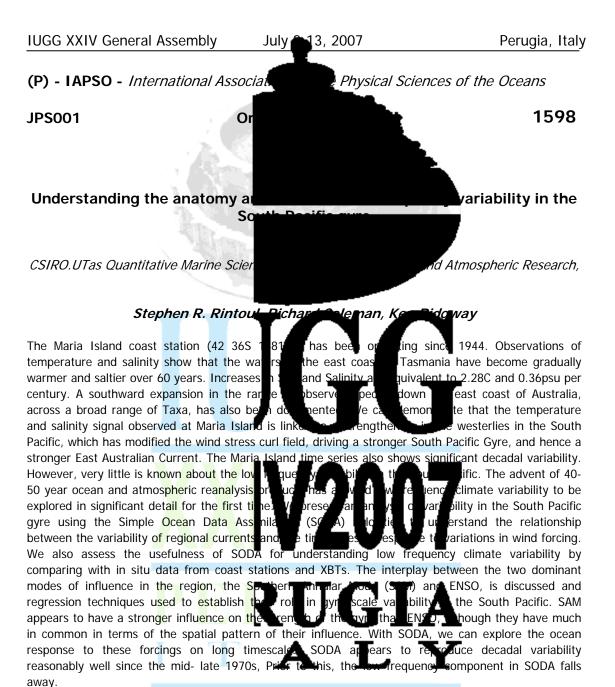


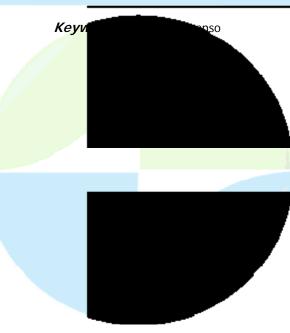




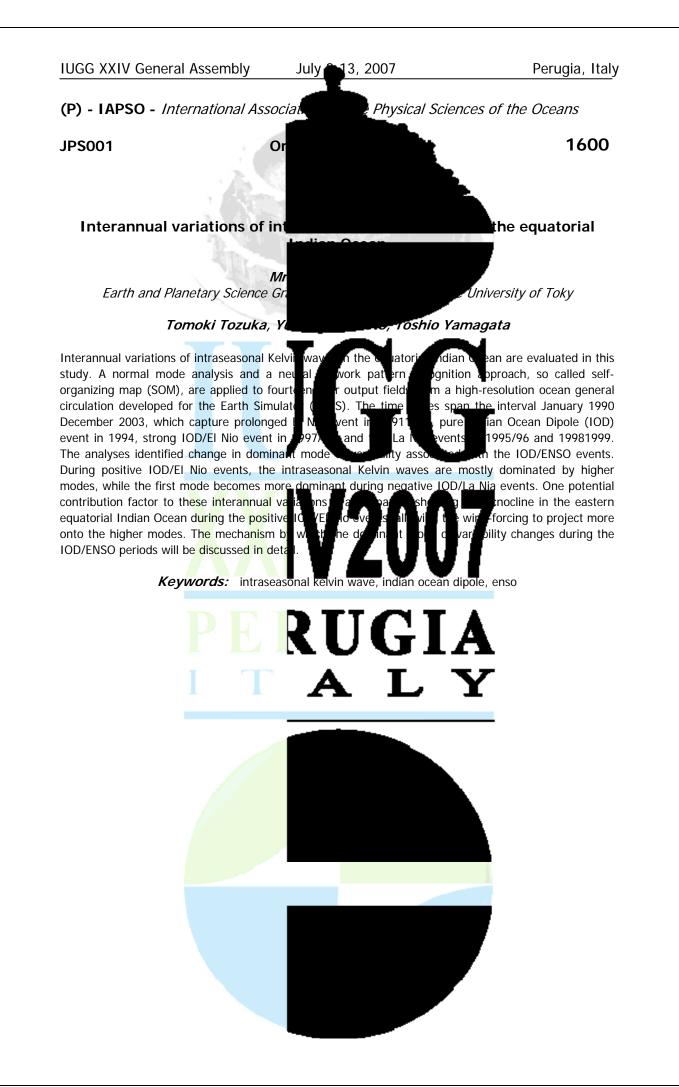


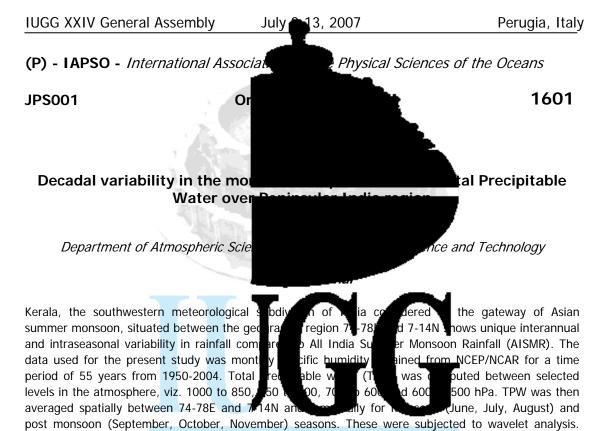










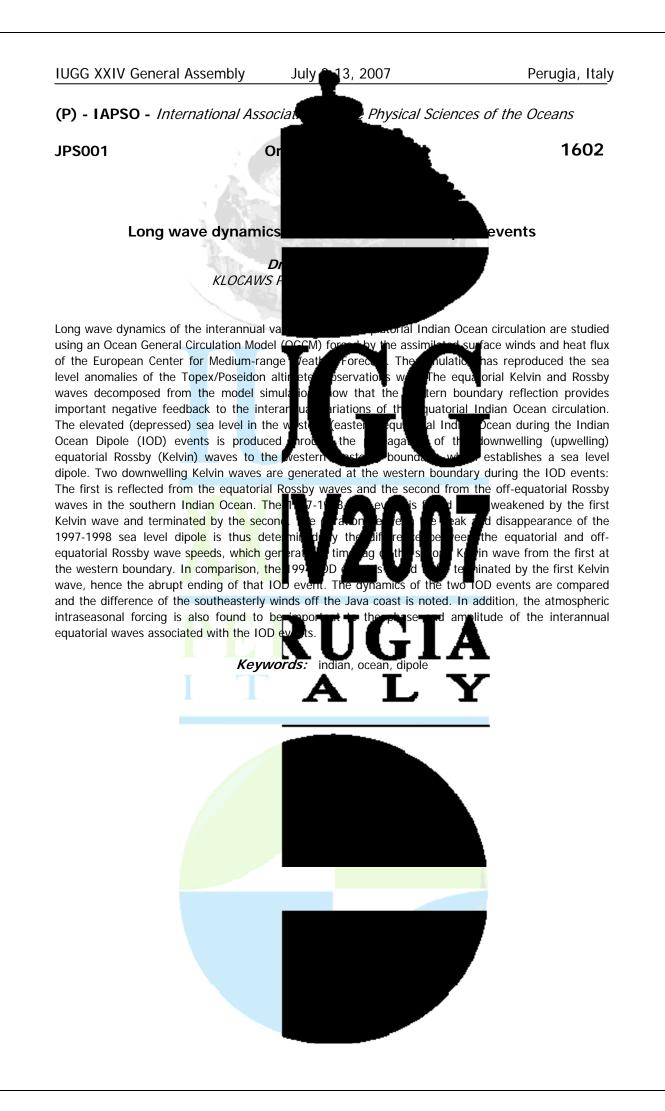


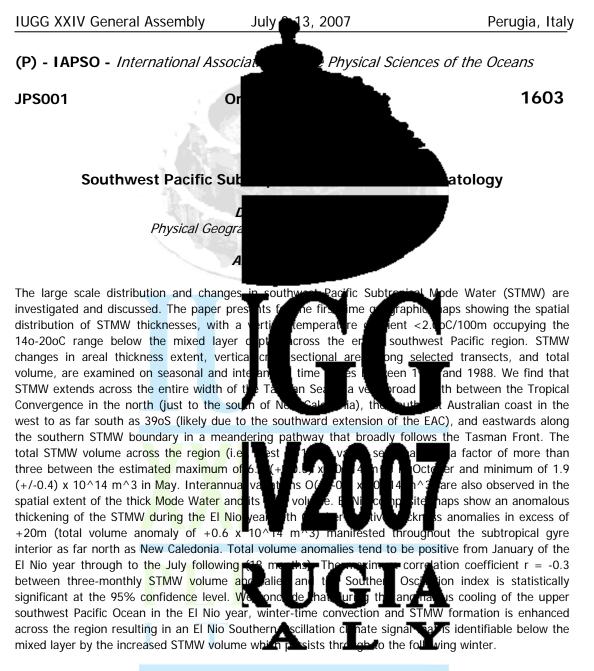
The mother wavelet used was Morlet. During the monsoon season TPW in the layer 850-700 hPa shows 10 to 12 year oscillations, which is signific seventies at the time of climate shift and Similarly, for post monsoon season also th 95% level for integration between 1000-85 shows 10-12 year mode at 90% significand

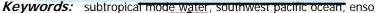
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s weakened after mid ater part of the study. variability significant at um for 600-500 hPa TPW

Keywords: total precipitable water, wavele analysis, statistical significance



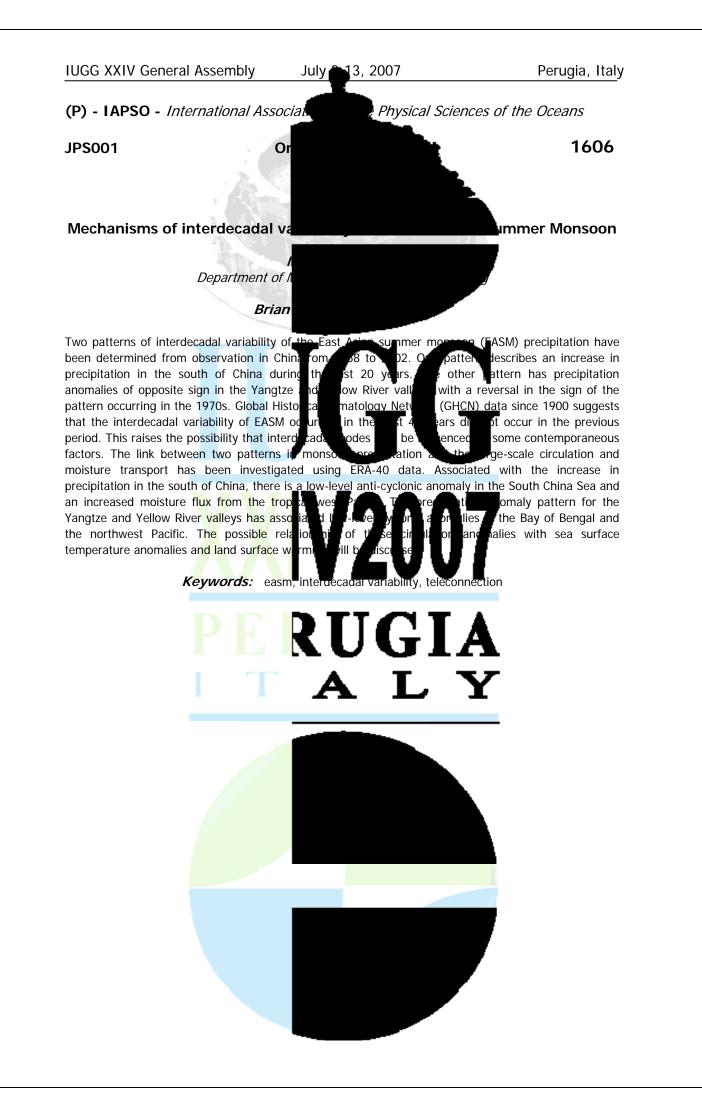


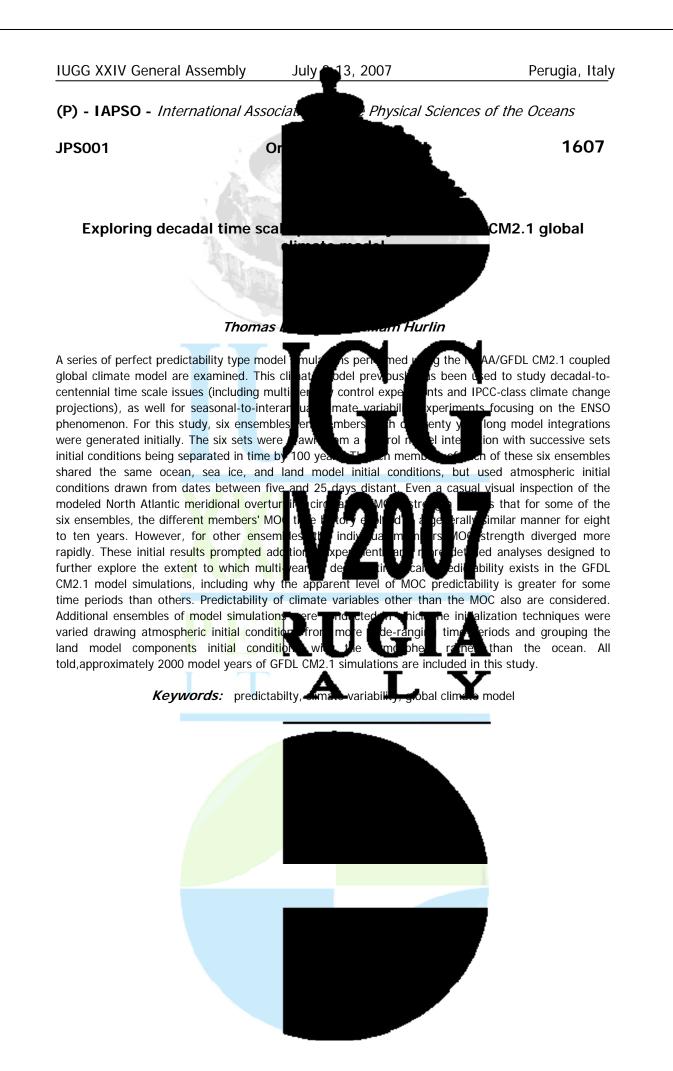


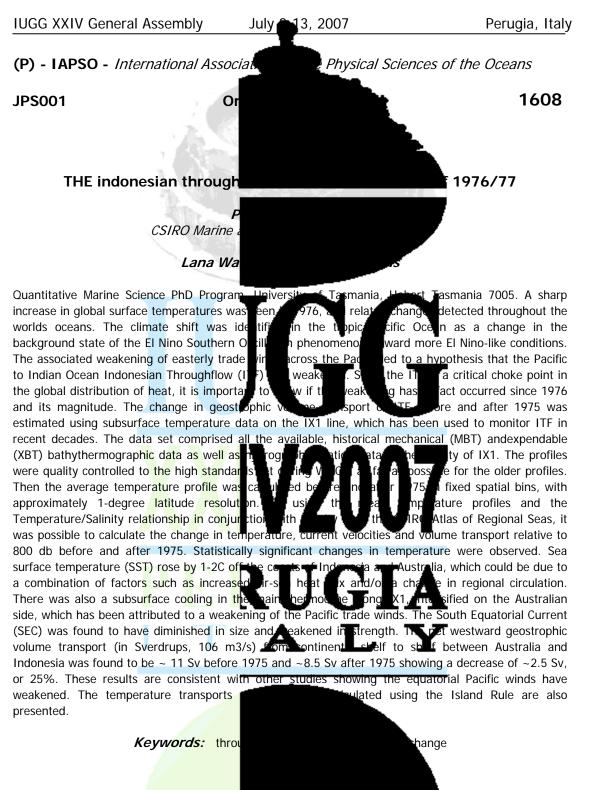


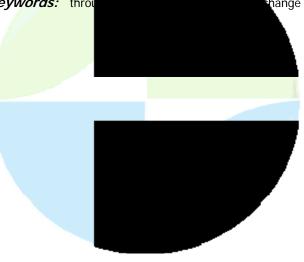




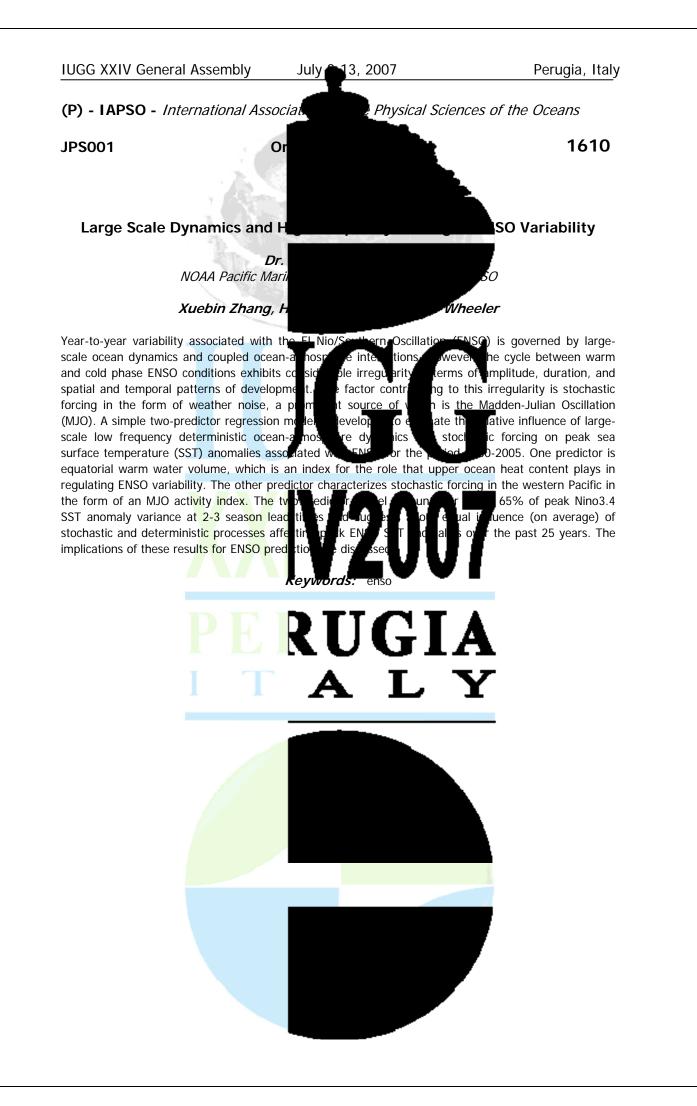


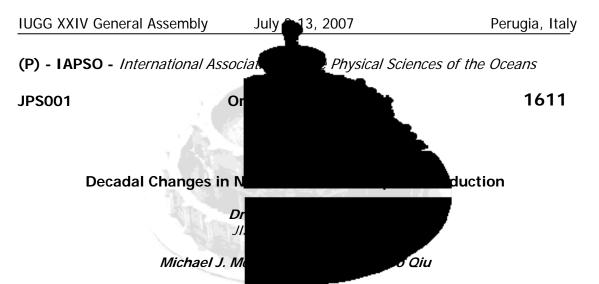












North Pacific subtropical subduction defines process for the ocean to uptake theCO2and between subtropical subduction and tropid slowed down between the 1950s and 1990: SST, and changes in CO2out-gassing in th debate on whether the observed change subduction. In this study, we use historical, rates in the North Pacific over four decad

find that the total subduction rate has decreased by about 25%, from 47 Sv in the 1950s to 36 Sv in the 1990s. This reduction is consistent with previous estimates of STC and upwelling decreases in the tropical Pacific. We further find that the Subtropical Mode Water (ESTMW) and oth tropical Pacific pycnocline. The subductio Mode Water (STMW) and Central Mode W decades, with the maximum subduction rat in different wind products will be addressed by NCEP reanalysis.

the upp circulați ean ther mical ers elling through slowdown has ern t<u>ropical</u> F are ed phic and /dr s: 195 0-19

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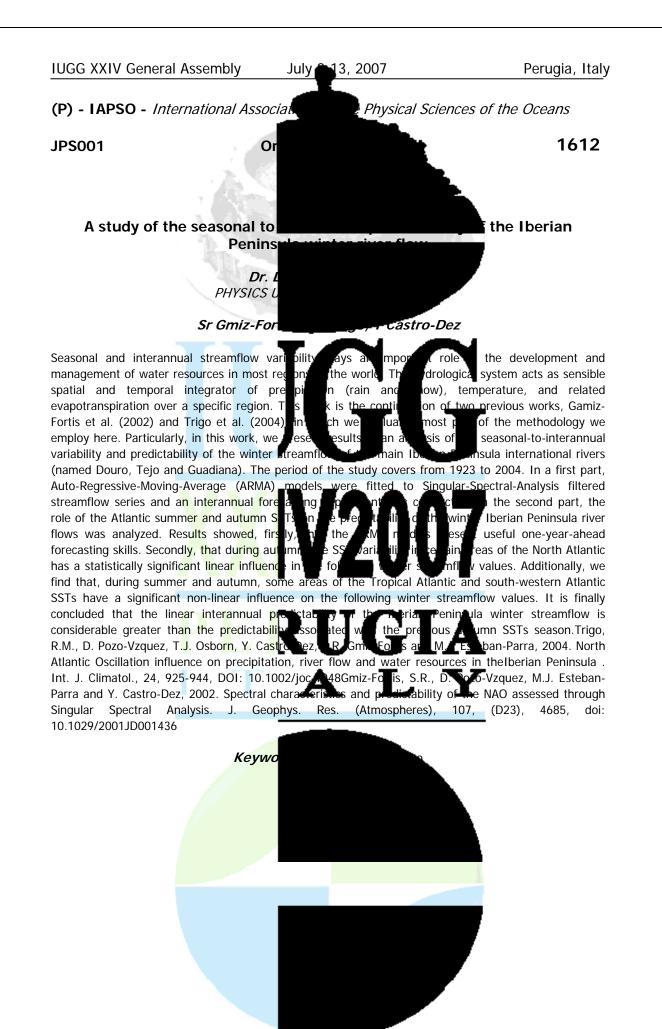
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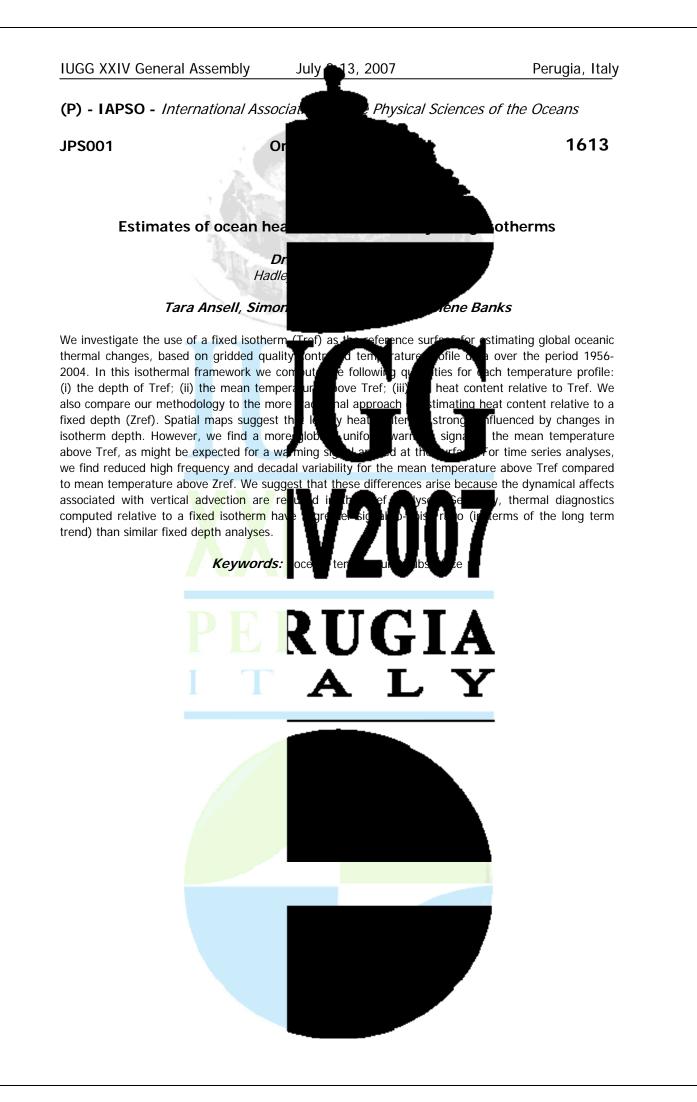
d stratification. It is a key es suggest a connection ént s Subtroi cal Cells (STCs), which n linked to warming of equatorial c. There is however considerable finds or by subtropical to estimate subduction 89, and 1990-1998. We

anges in the Eastern ch dominate the upper ed with the Subtropical

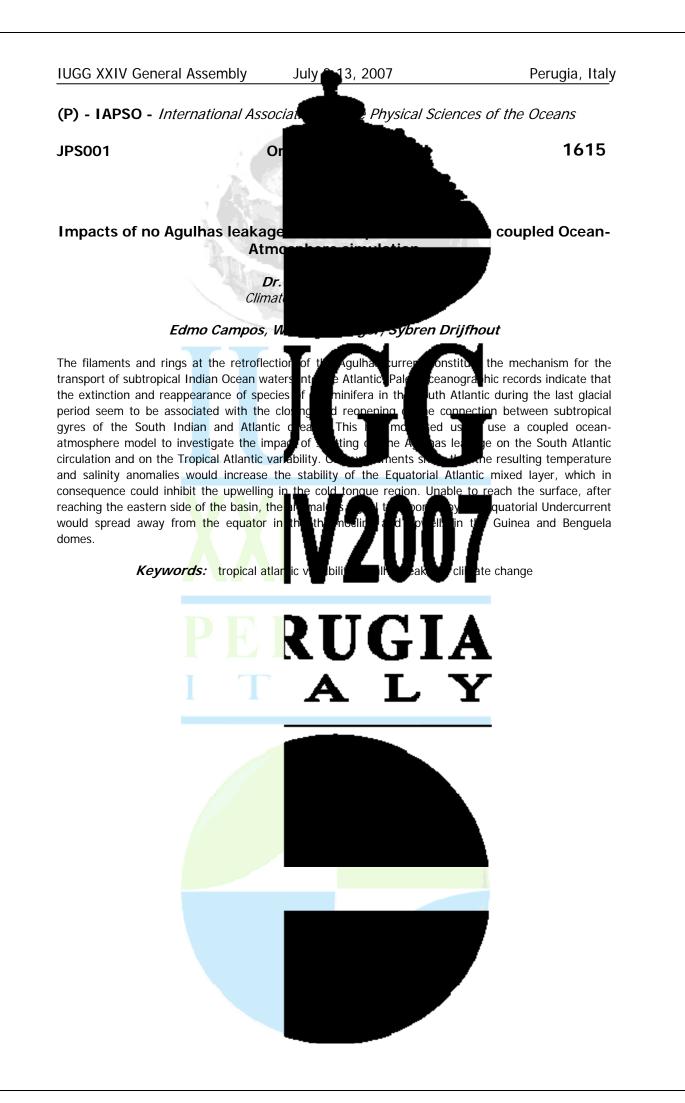
ed over the past several ur results to uncertainties ed on ERA40 to those based on

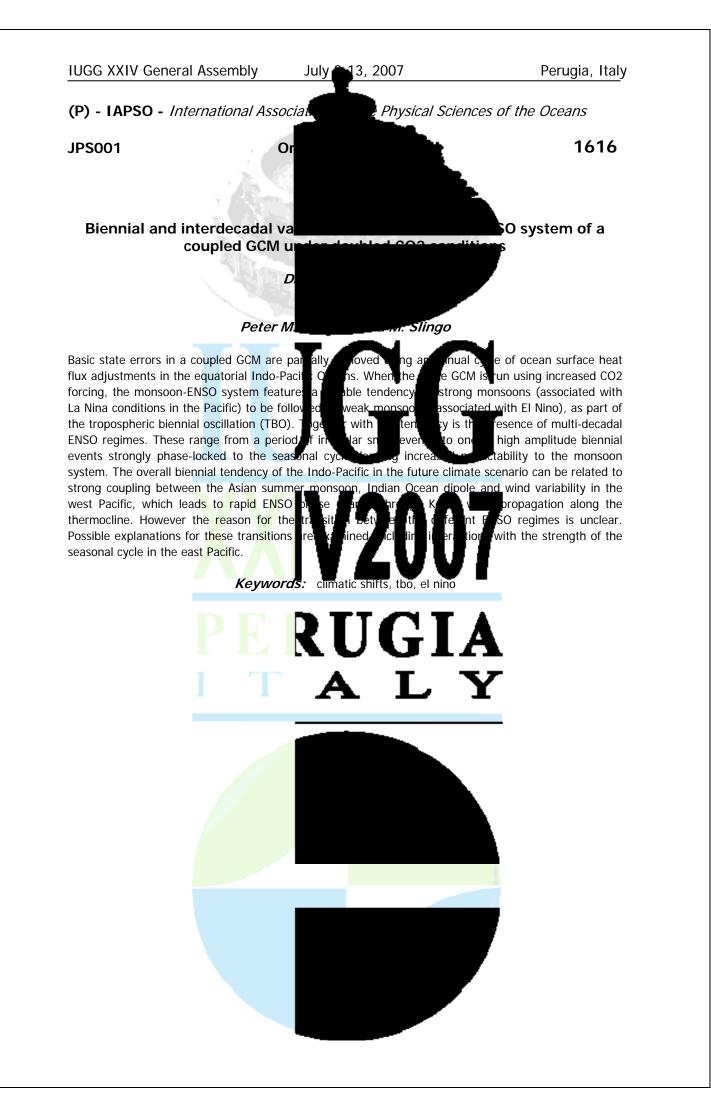


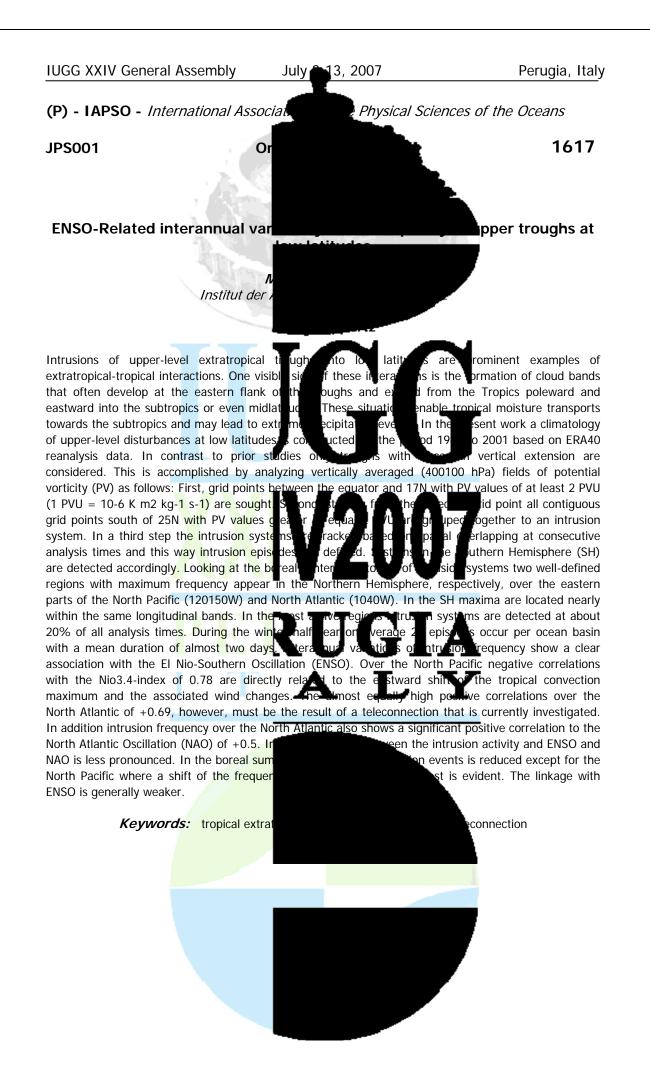


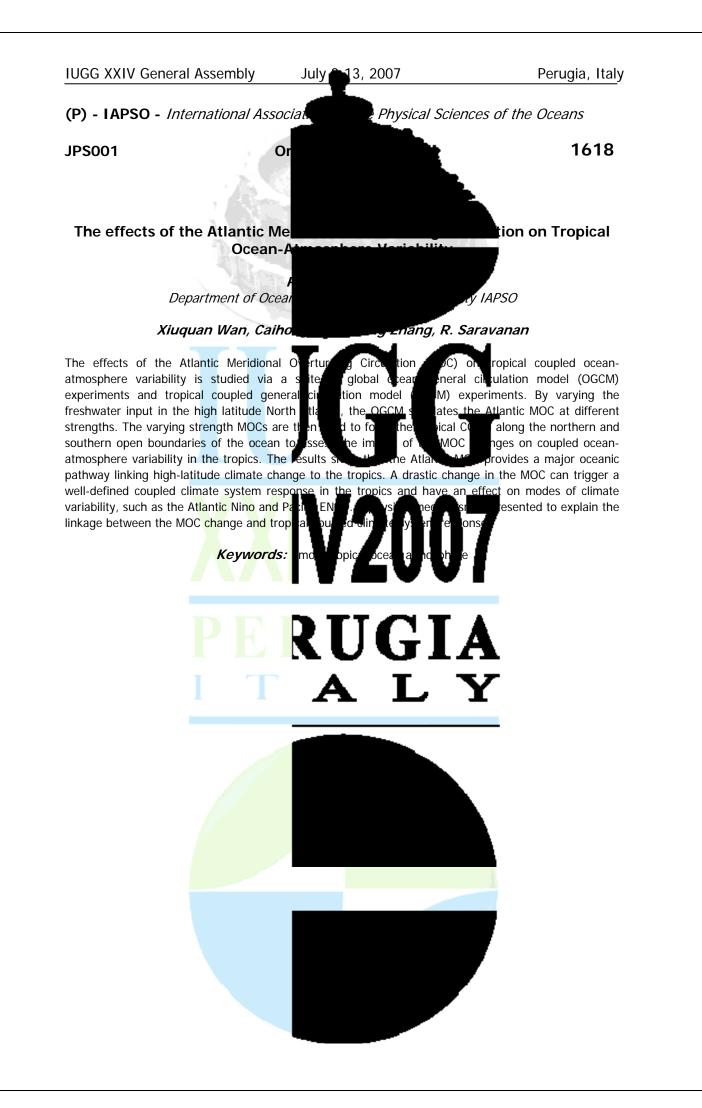




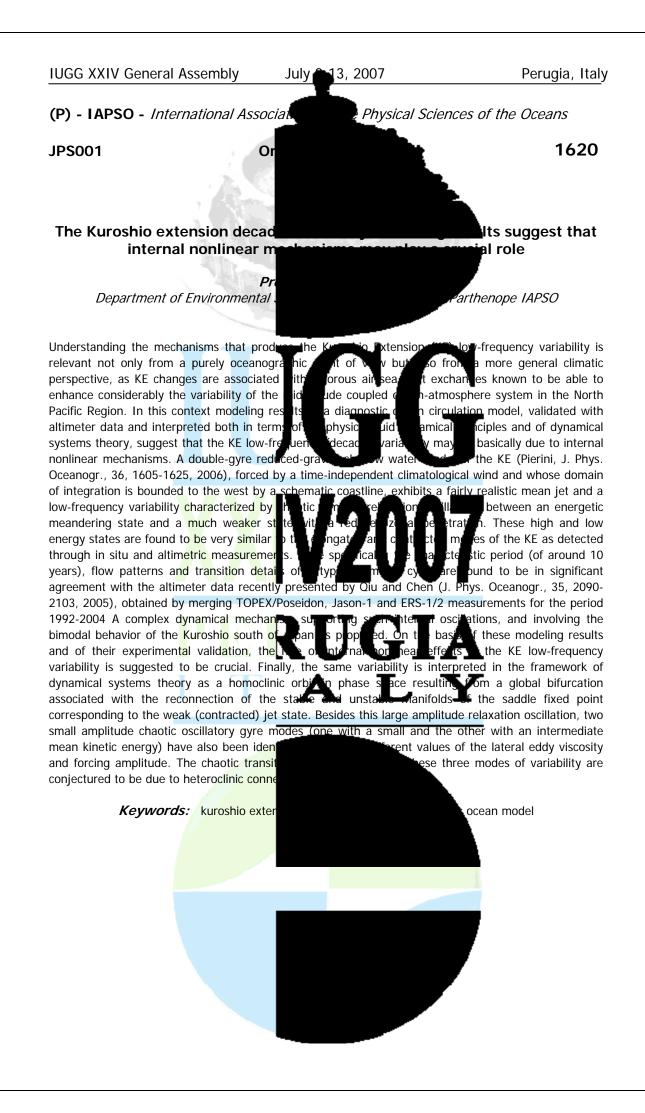














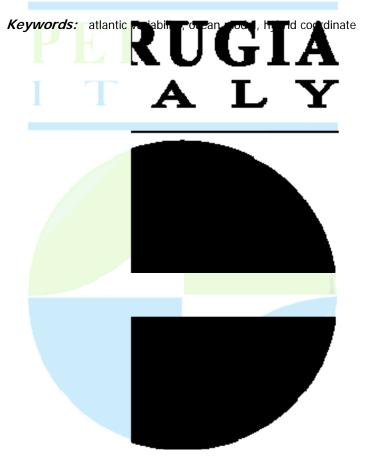
ECMWF ERA-40 reanalysis, and also to assess sen in HYCOM. Sensitivity to the time when the shift from climatological to interannual forcing takes place

Baringer boundary model in the Gulf of Ca surface temperature variations, western b transport, and the meridional overturn demonstrates that the model reproduces gyre responses associated with the NAO. circulation are correlated with the NAO.

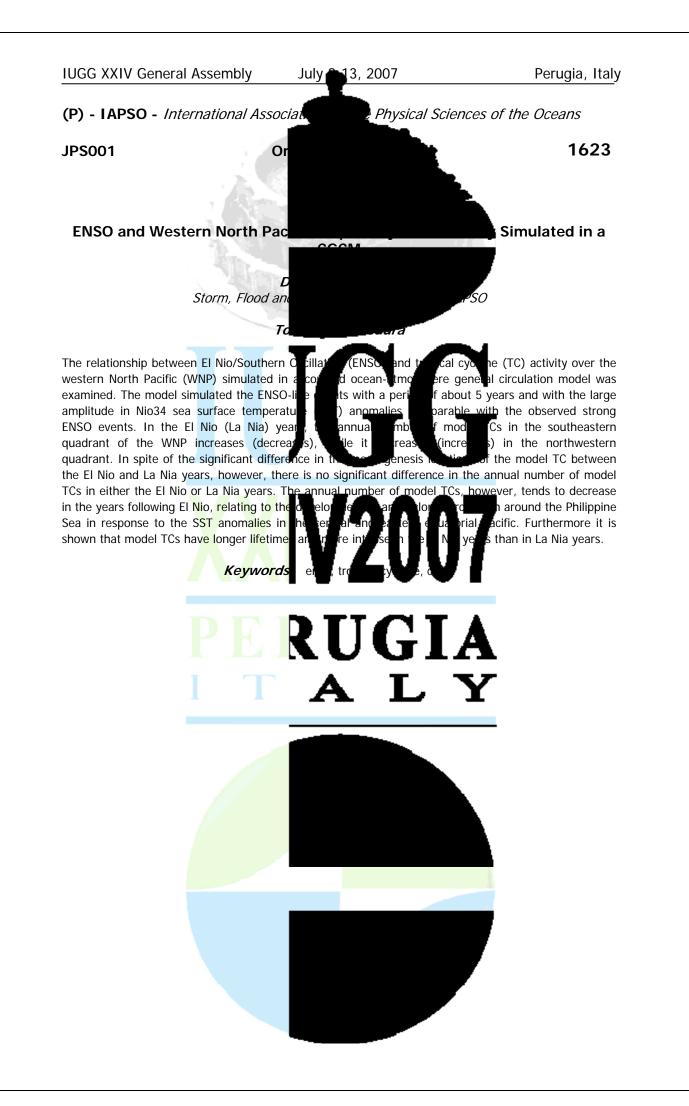
ertical will also be assessed. The salty Mediterranean overflow layer is maintained by using the Price-Yang-

ameterizations contained servations such as sea m front location, deep the NCEP simulation

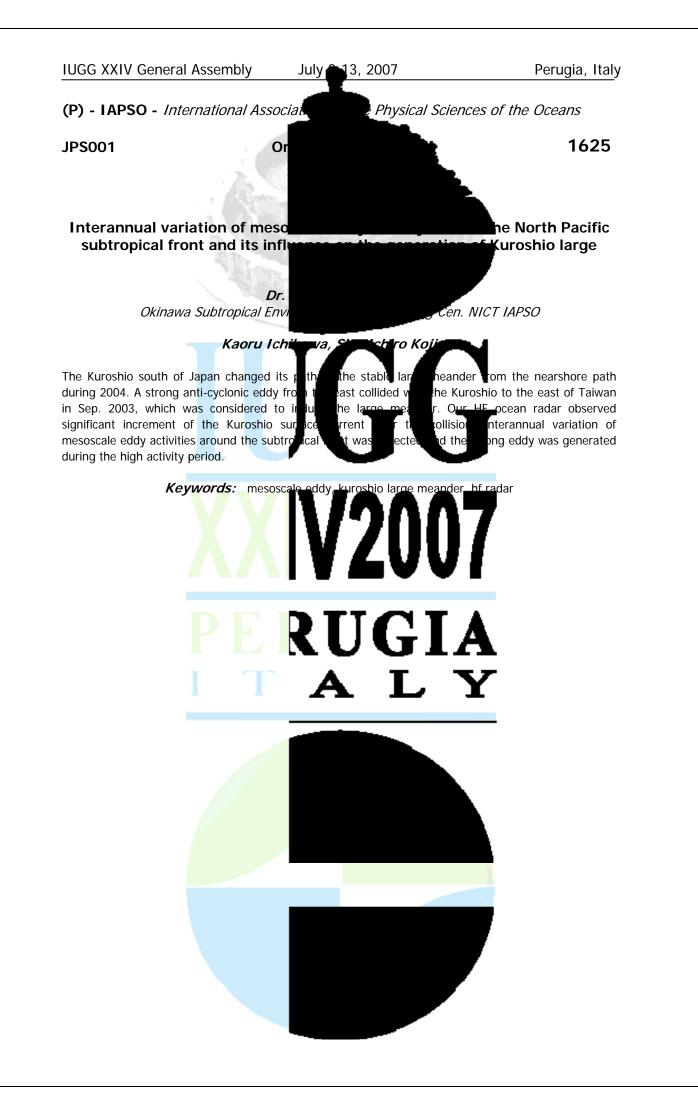
subtropical and subpolar e meridional overturning



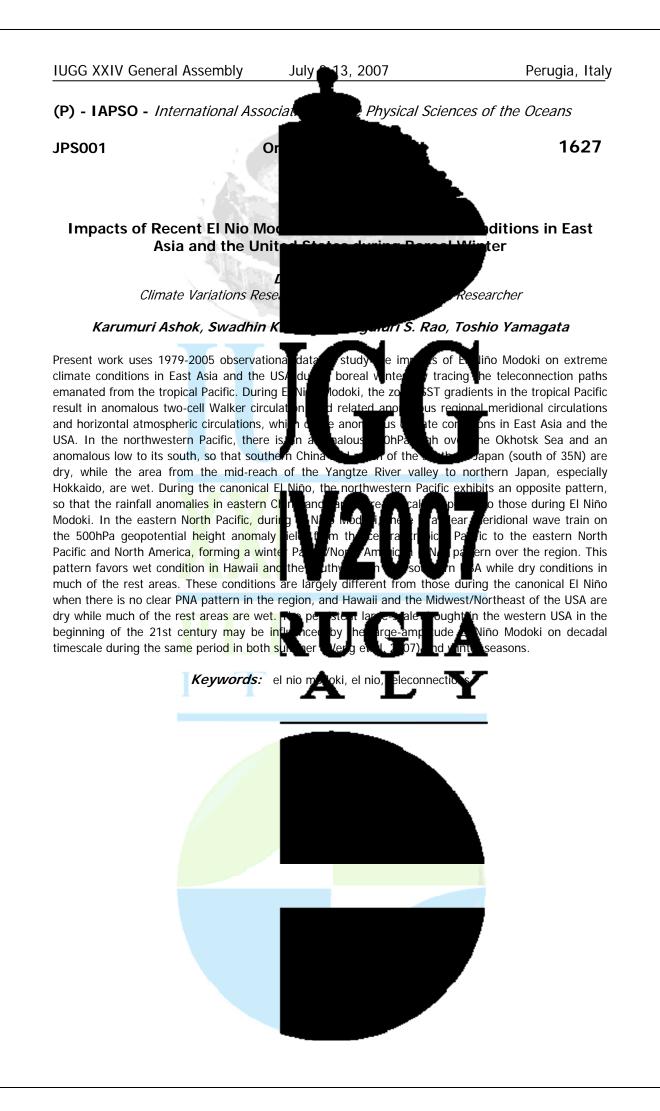






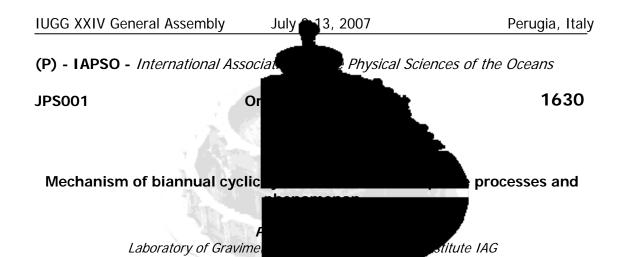












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The oscillation with pe

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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 wi 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 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 I, pp. 45-97. In Russian. .: "Nauka", Fizmatlit, 384 p.

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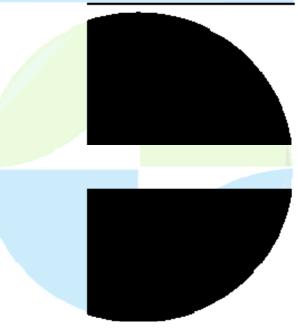
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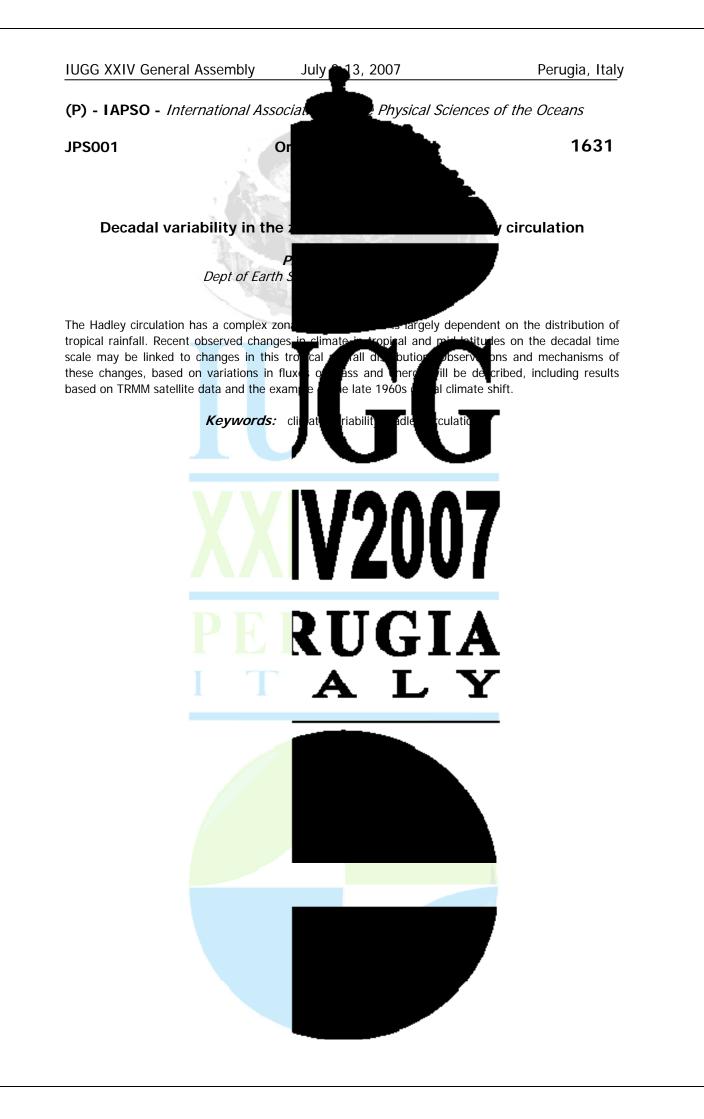
Perugia, Italy

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

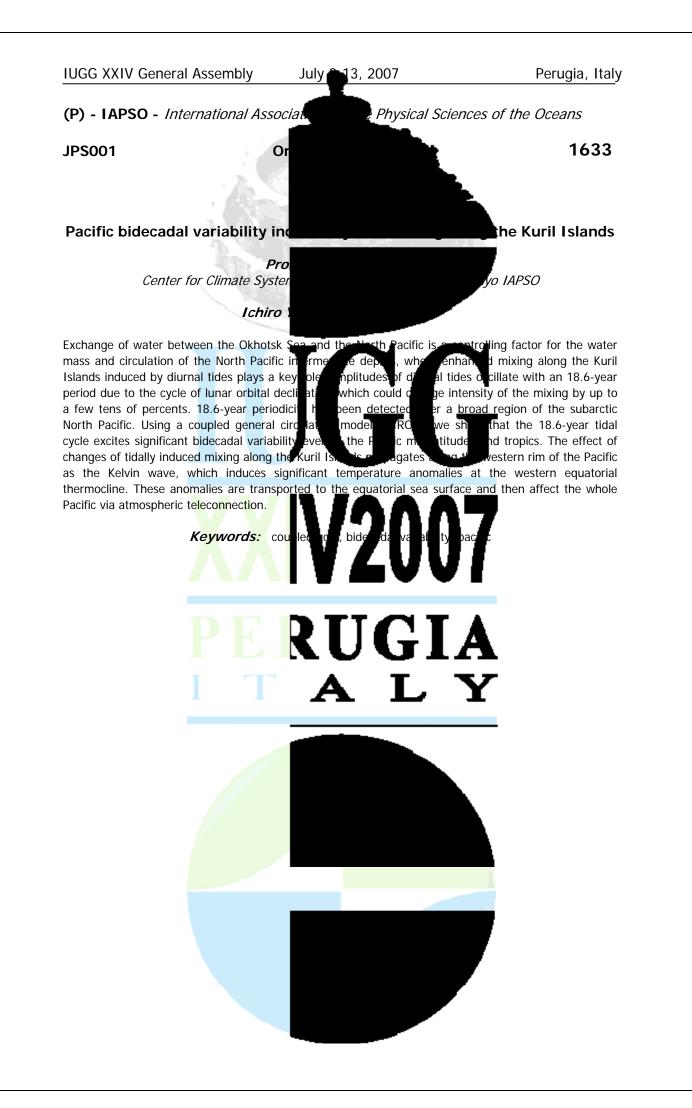
Keywords: biannual oscillation, enso periodicities, core mantled ynamics

I T A L Y

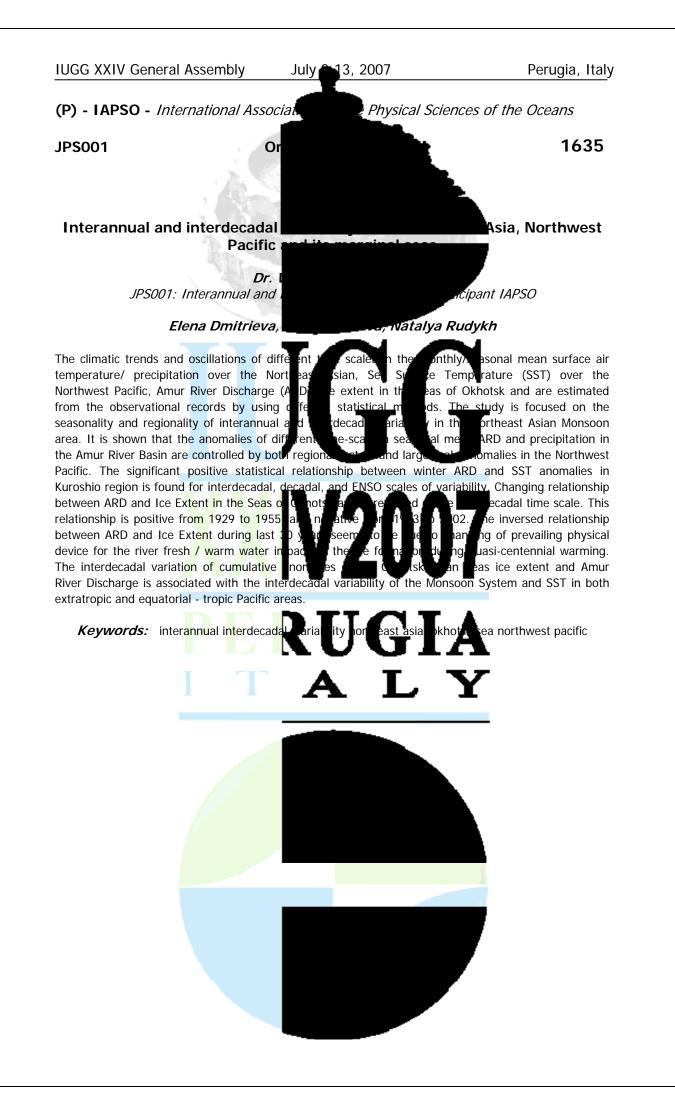


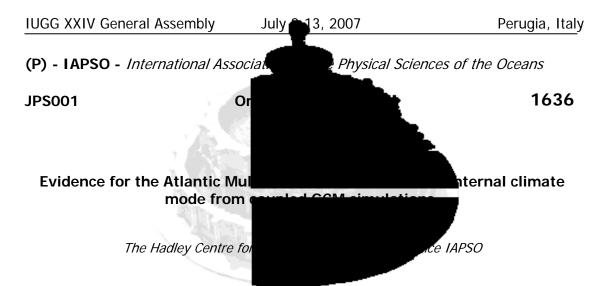






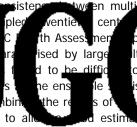






An analysis is presented which tests the (SST) variability in observations and co anthropogenic forcings submitted for the IP the North Atlantic Ocean, where SST is cl Atlantic Multidecadal Oscillation (AMO). It Atlantic SSTs with individual model ensemb the ensemble mean. On the other hand, co creates a super-ensemble of sufficient size to a

ensemble mean can be viewed as a best-estimate of the response to natural and anthropogenic forcings. It is found that using the superfrom the estimated forced response, sugge this case, either (i) past climate forcings a incorrectly to forcings, or (iii) the AMO is in. with results from a 1400 year simulation of the a realistic AMO that persists through the length of the

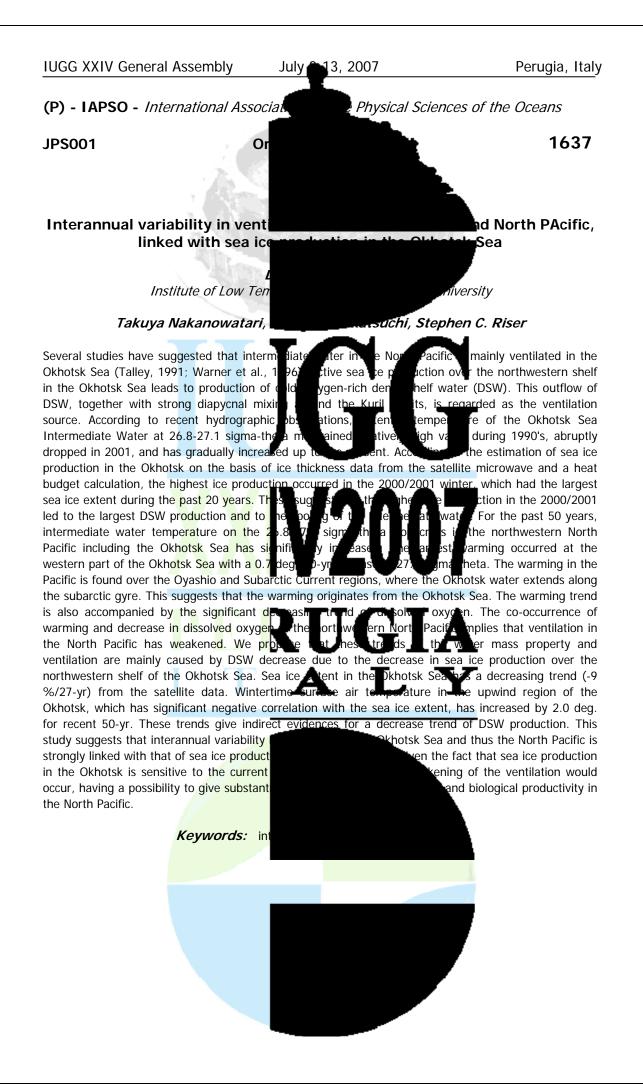


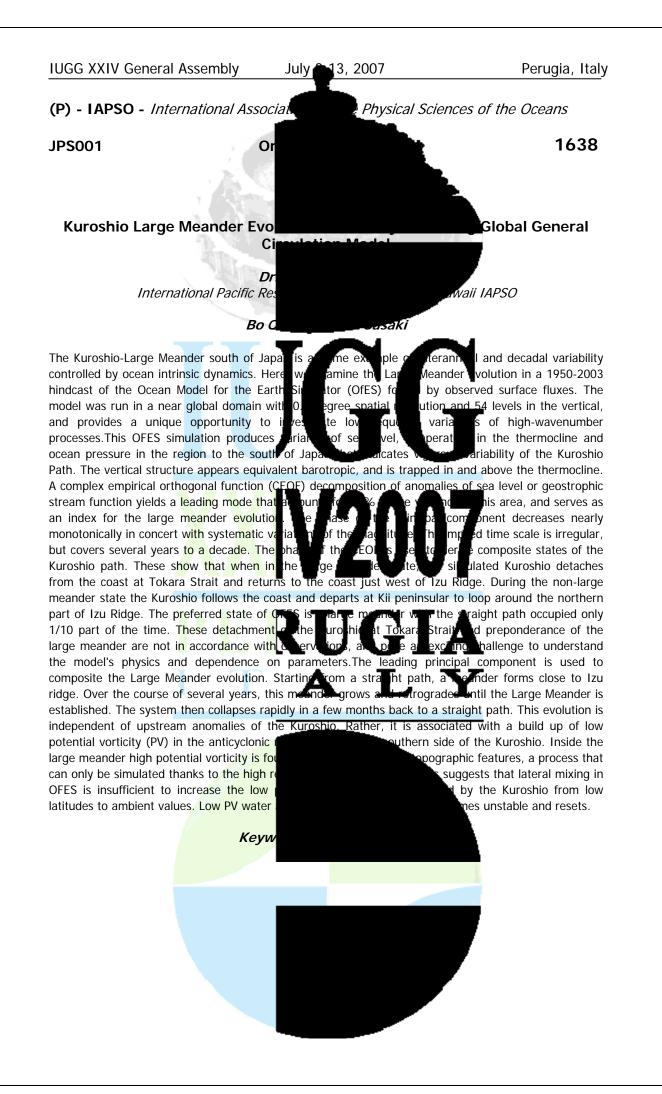
ea-surface temperature ons with natural and sim port. The focus of the study is on Itidecdal variability known as the o assess the consistency of North y too small to constrain s gen s from different models ense super-ensemble mean.

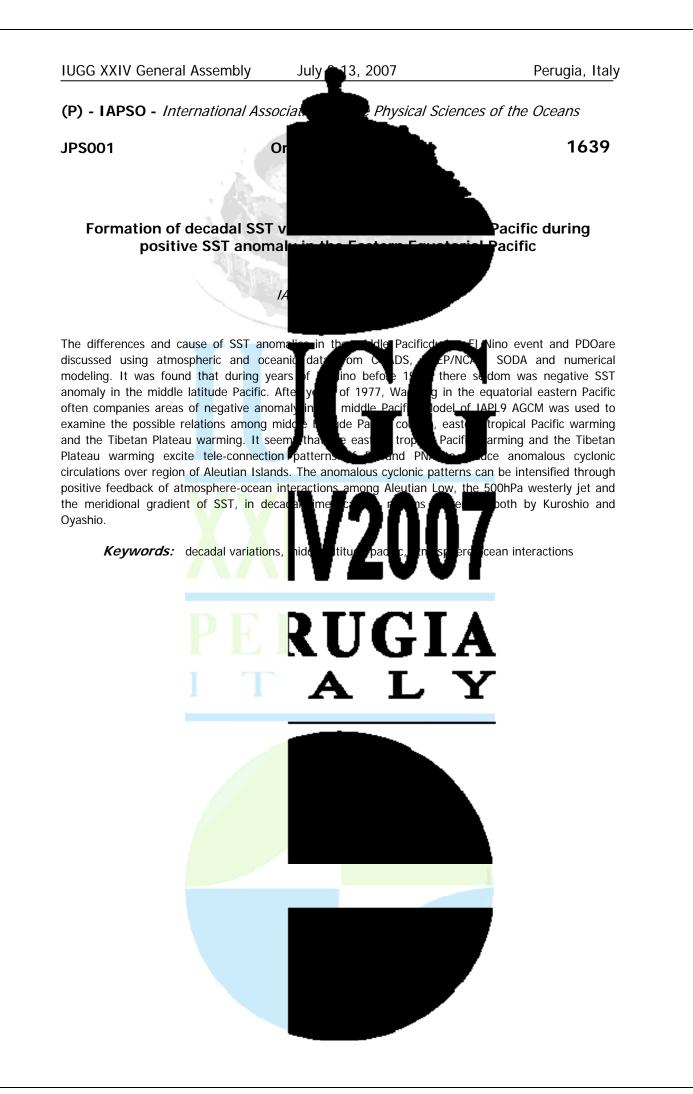
Averaging over ensemble members causes cancellation of the intra-ensemble variability, thus the super-

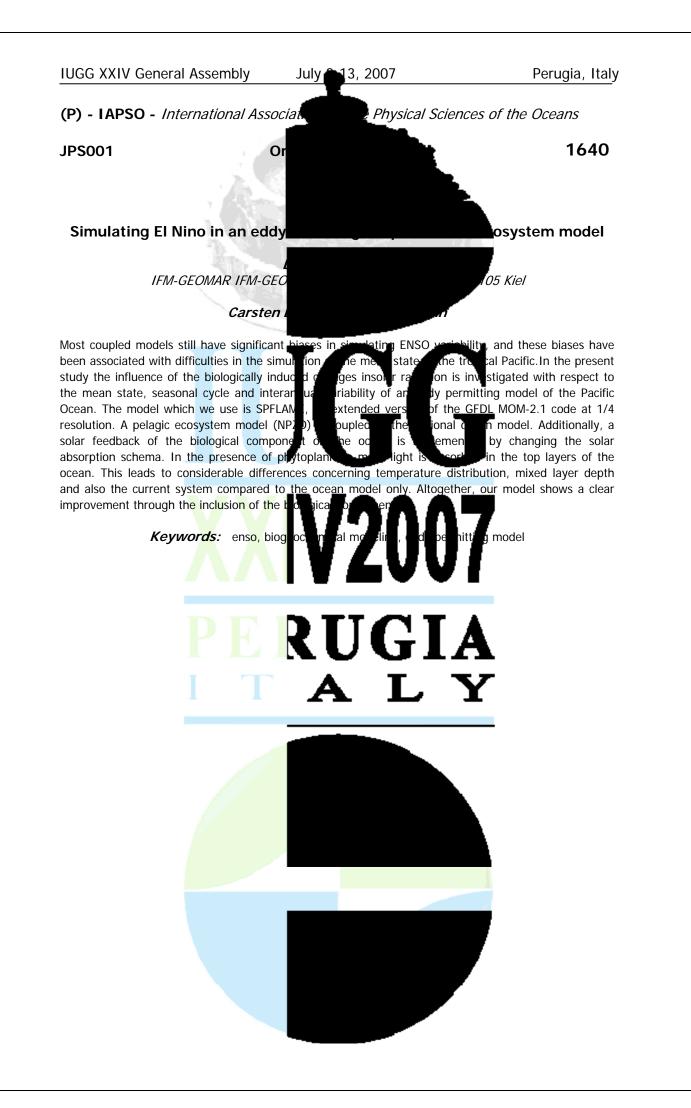
h of the observed SST h historical forcings. In (ii) the models respond possibility is consistent variability. This contains

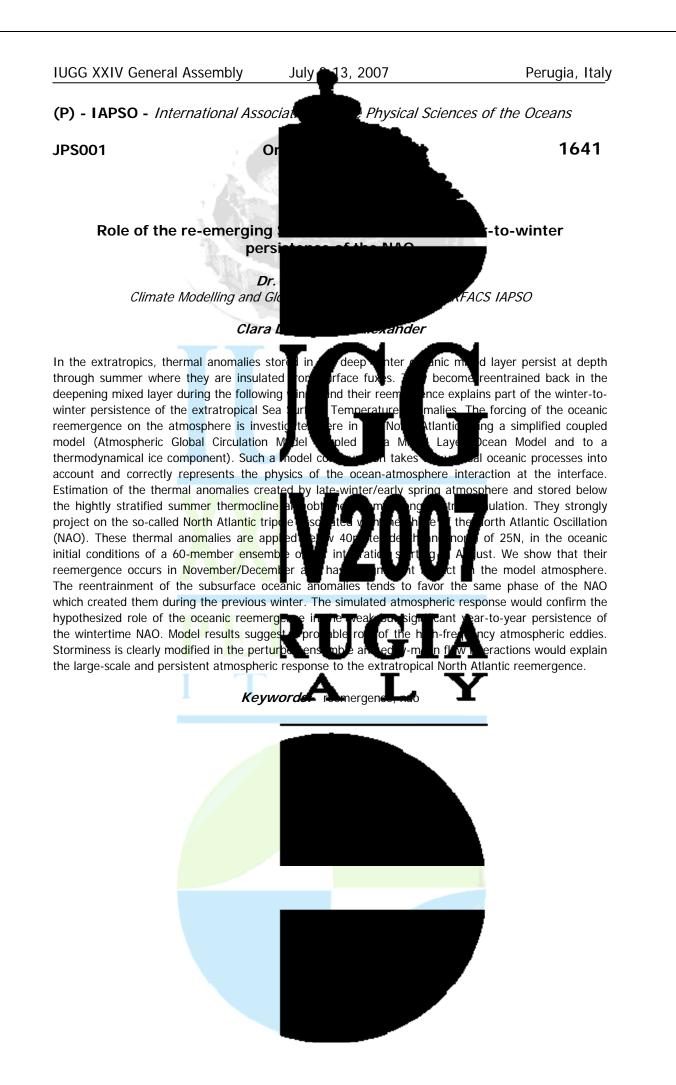


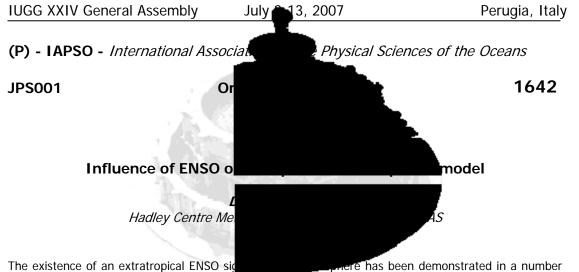












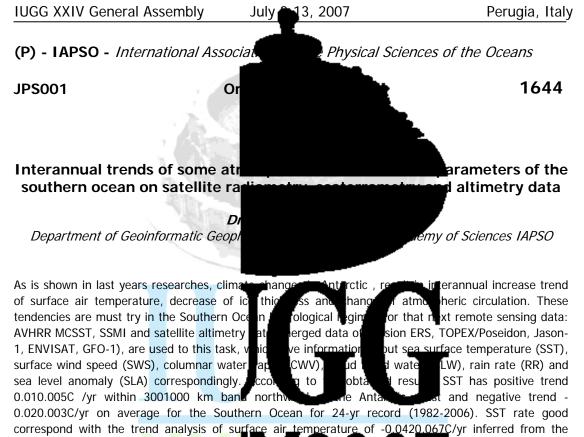
of modelling and observational studies. Filling of the occurs during El Nino and is likely due to increashown a weakened stratospheric jet is associated European conditions resembling the negative plane on all) of ENSO events. Here we show result in simulations from a vertically extended (6) lead observed sea surface temperatures from 1,60-4 infilling of the polar vortex and a negative canuary seasonal predictability for Europe in winter.

cial with more early plan of the polor cyclone and hore and Ross way cial with more early plan of the North in the superior a 4 meter le version f the Ha 604 O. A position huary corus AO sign

duranteeping of the polar night jet diving, eccent studies have also ily tropopheric winds and colder htic Oscillation in the majority (but r ensemble of atmospheric GCM HadGA model. The model uses of El the events shows both an including a potential source of







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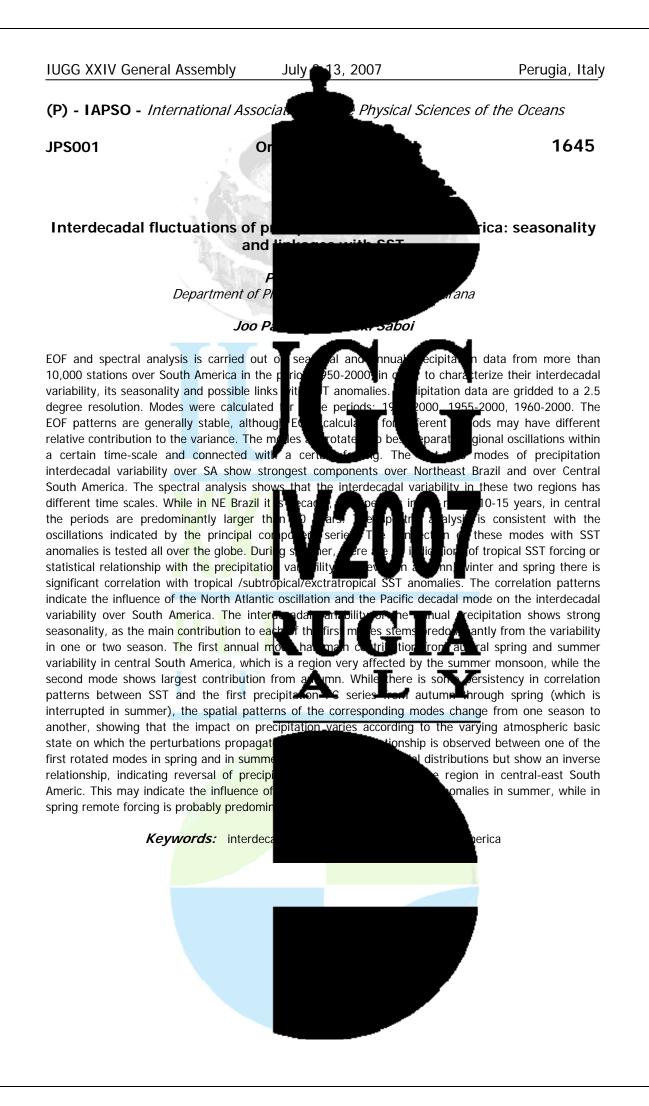
satellite 20-yr record (Comiso, 2000). SLAt 2006). However in some areas (for exa stronger -0.0650.007C/yr and -0.210.05 atmospheric parameters has positive t 0.50.6mm/yr. However in some areas of the is different. This work was partly supported by the Russian

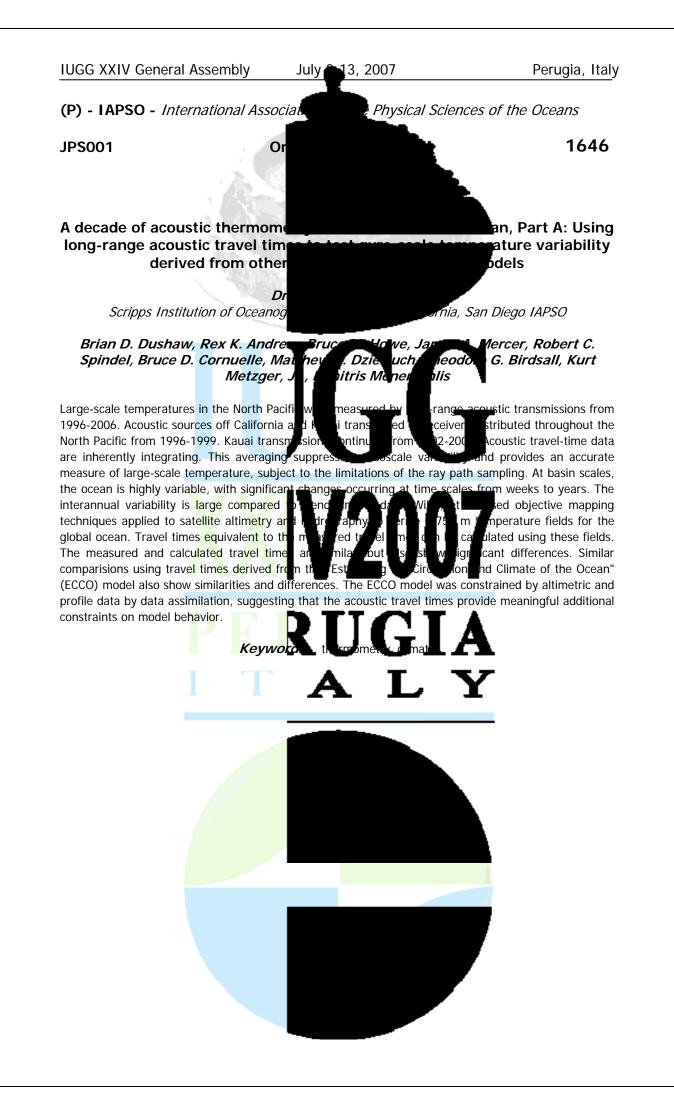
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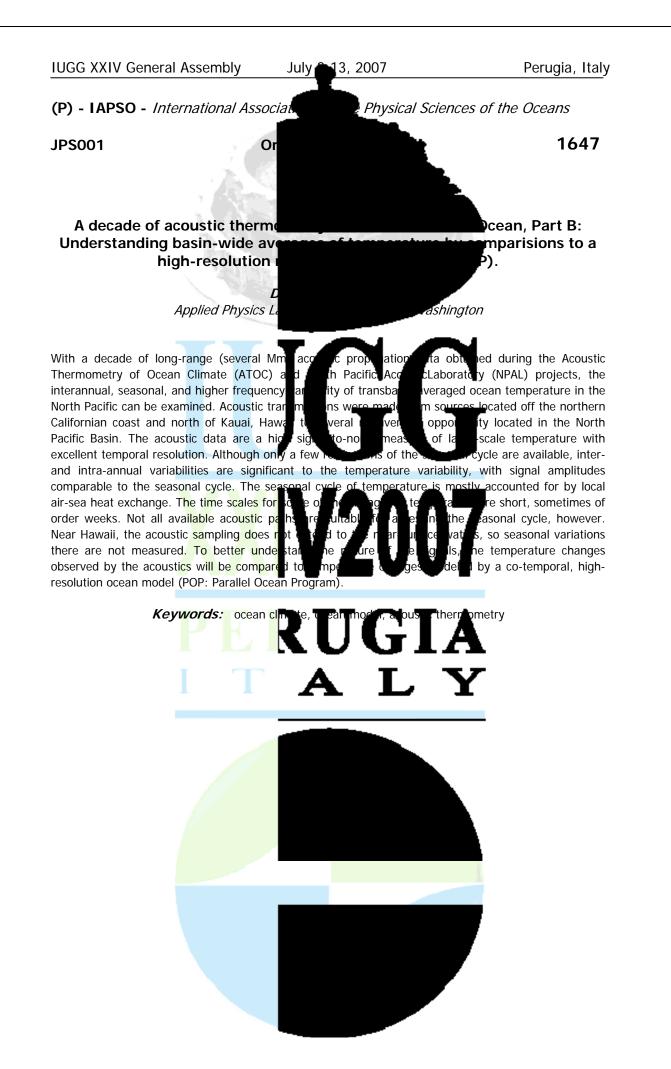
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or 12-yr record (1993and SLAtendencies are cord (1988-2006) next 1.20.7mm/yr and CLW s atmospheric parameter

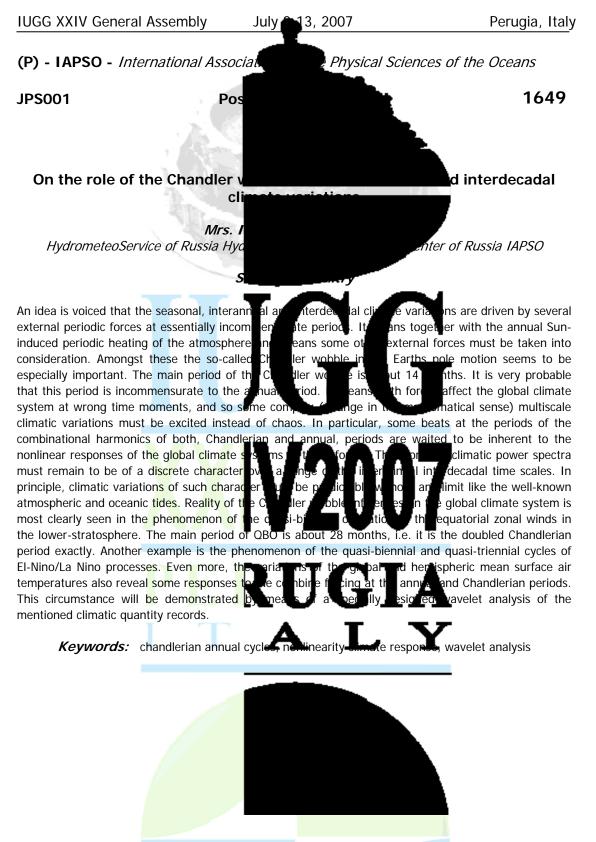
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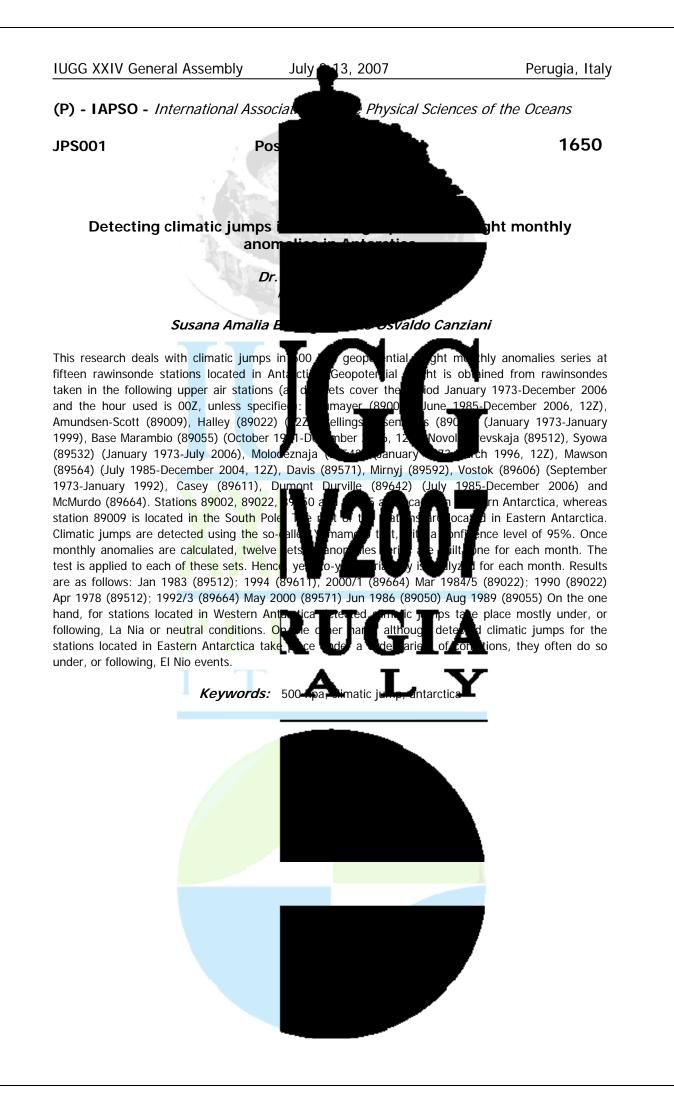


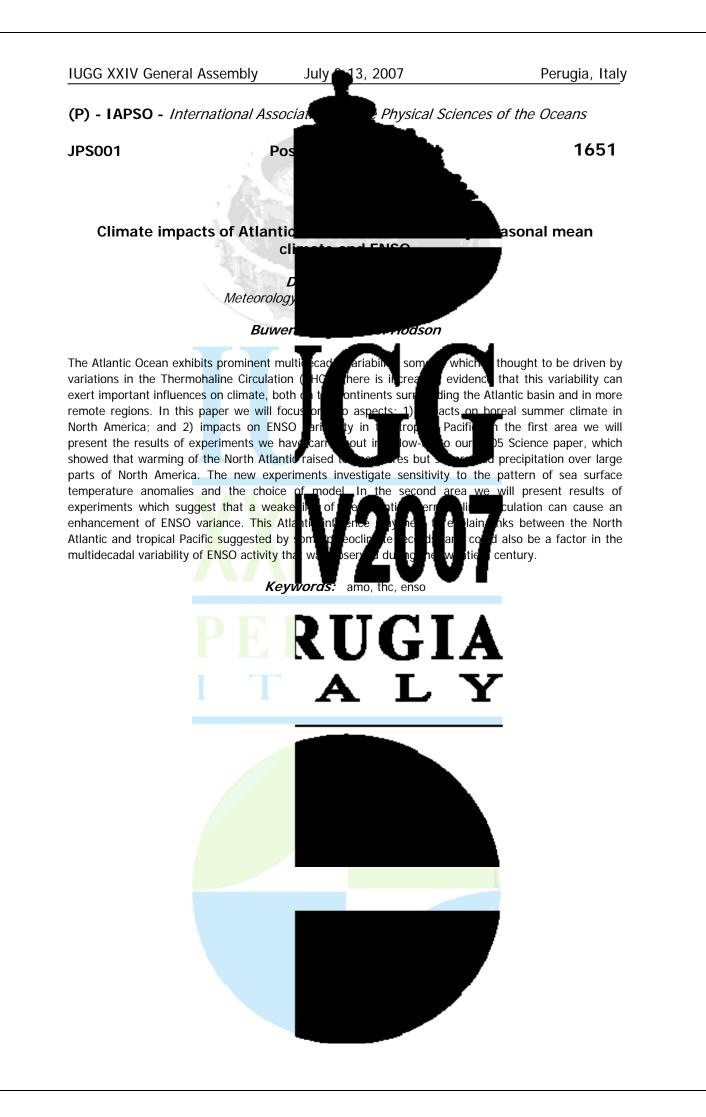


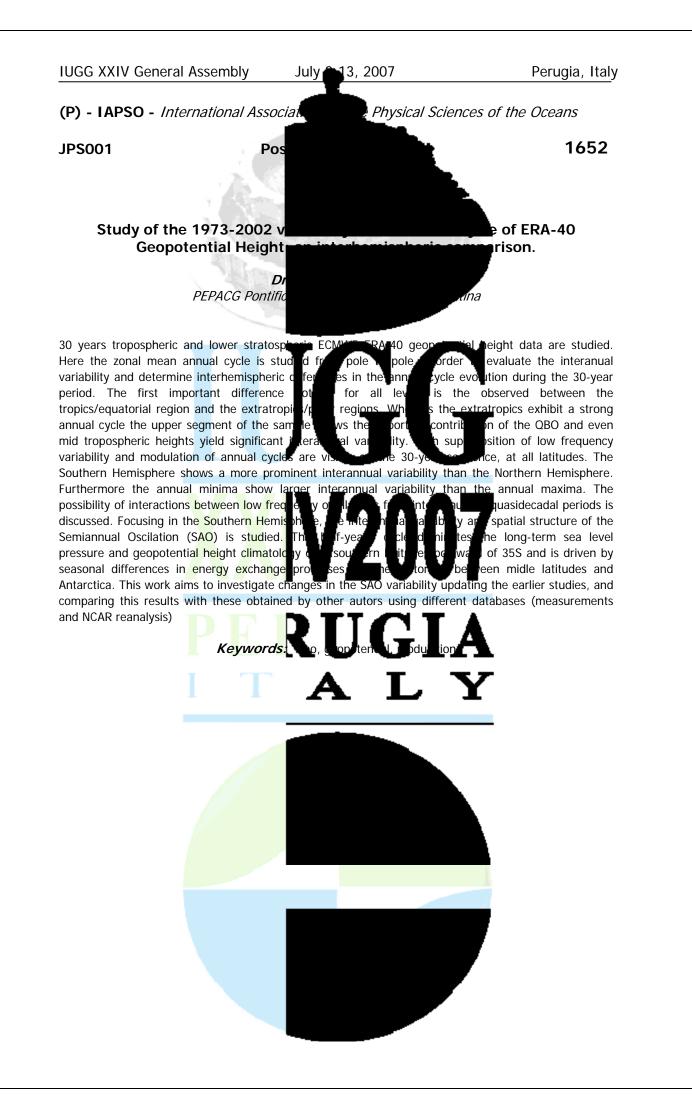


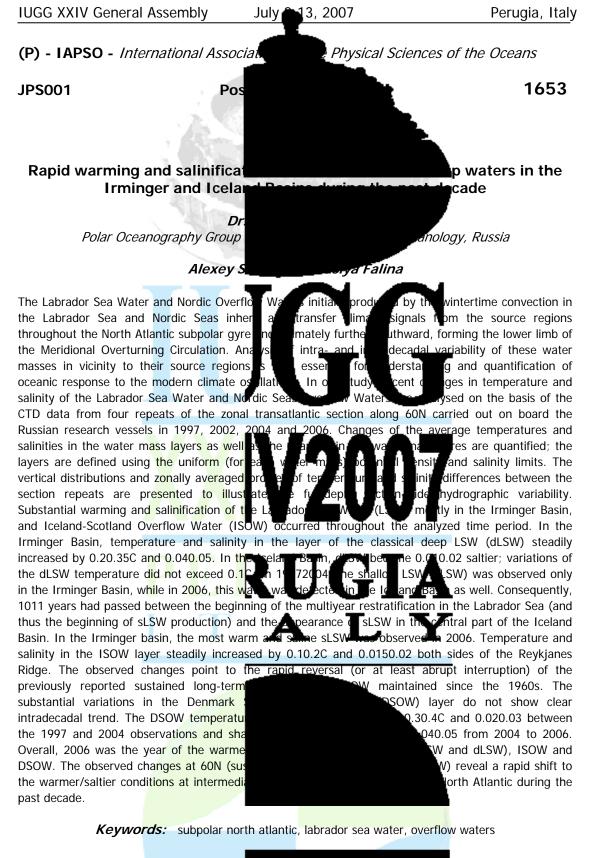






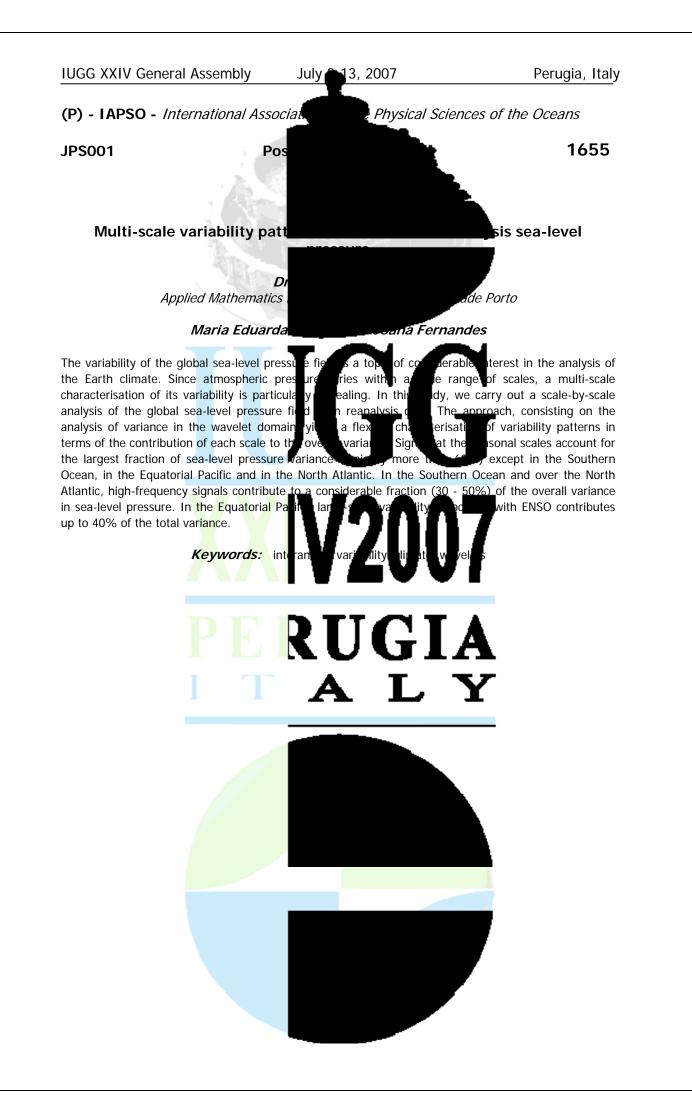


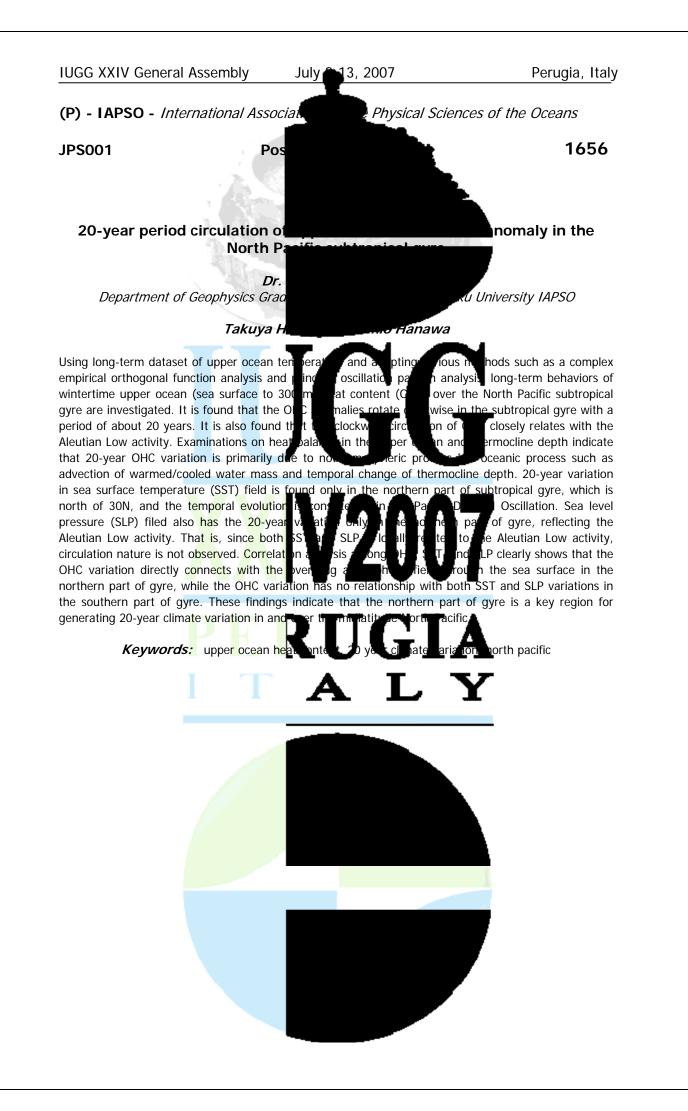


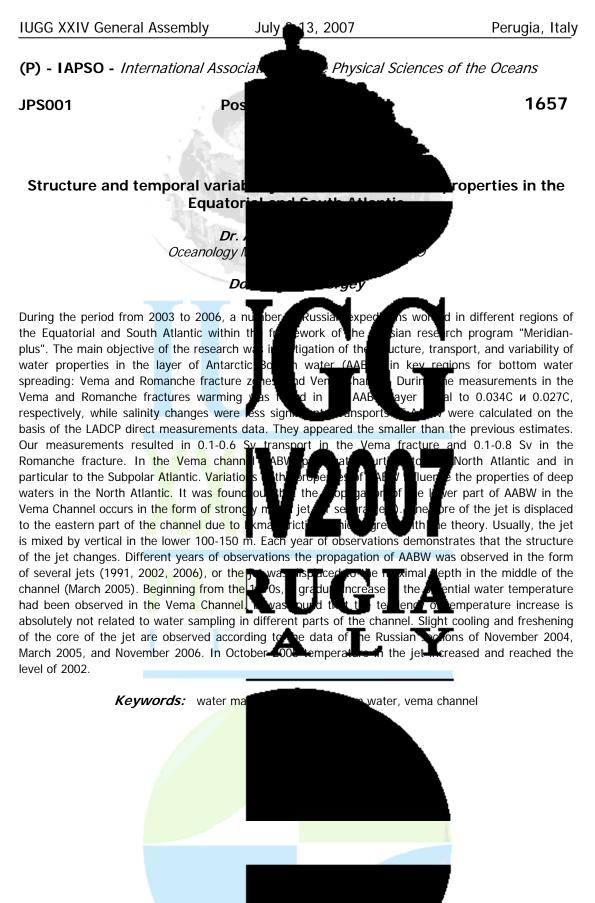




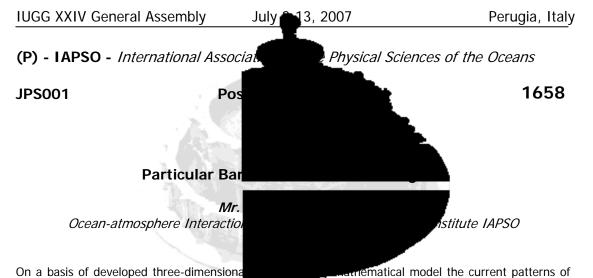












the Barents Sea at various hydrological conditions have been investigat filter and improved numerical scheme are t inconsistent in the temperature, salinity and eve the model adequately describes the main of and ERA40 forcing. The series of numerica summer (August - September) temperat oceanographic database for the Nordic Sea interpolation based on block variant of kriging wa

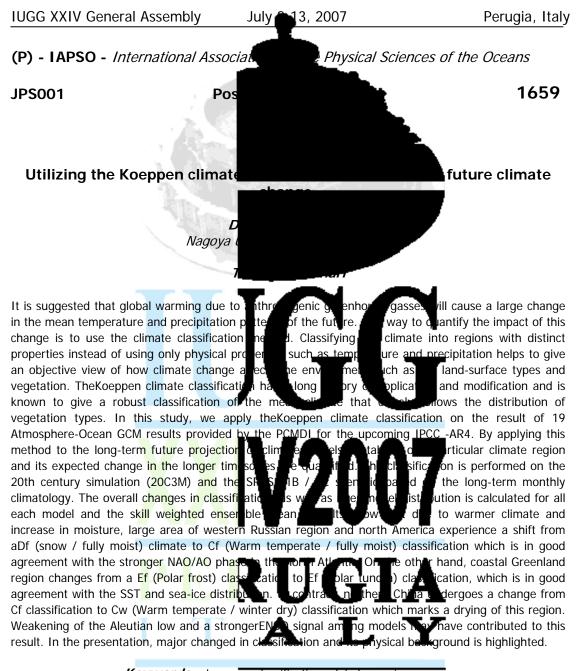
where used for model initialization and veryfication of the results. The significant role of the external forcing (the Atlantic waters inflow through open border) on the circulation regime of the Barents Sea was confirmed. It was shown also that significant from classical climatological circ external atmosphere forsing in the format particular circulation regime was estimat supported by INTAS-4620 project and RFB

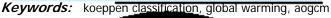
ed effe duce lds. The bsu on features u ments with n salii ped i de hydrog

typo-dimensional numerical cal instability caused by ้ทนที่ numeric I experiments show that PHC 2.0 climatology, NCEP/NCAR were carried out on the basis of incli into new version of 4620 new method of optimal s restoring. These data

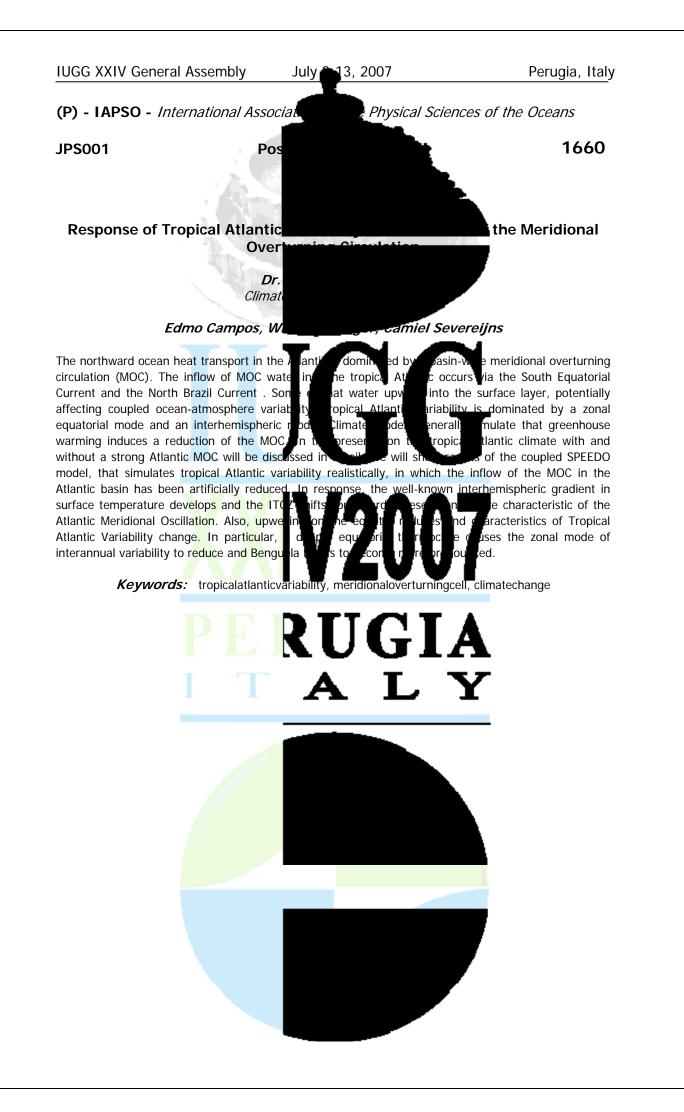
> ecific year may differ show that the role of ch. The time interval of work was particulary

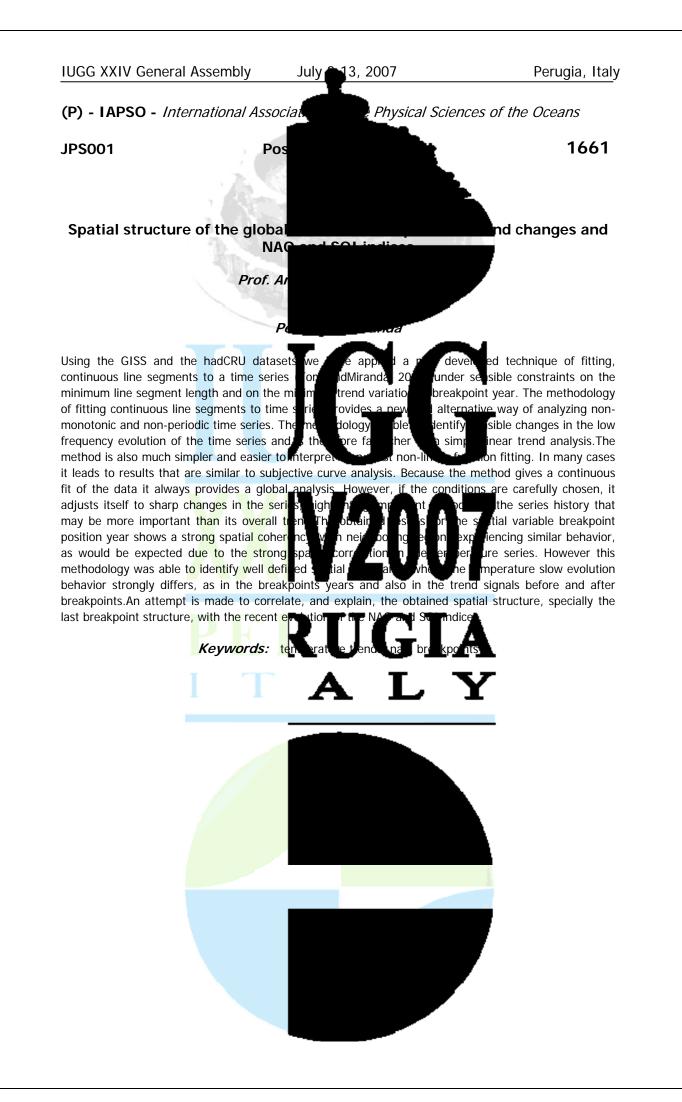
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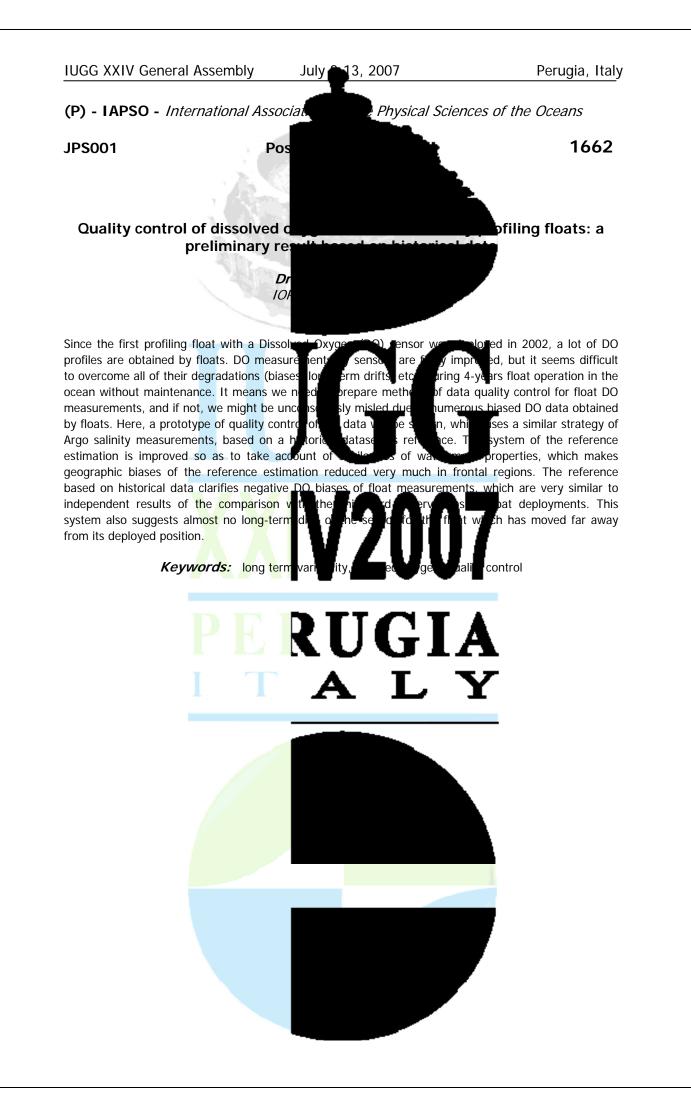




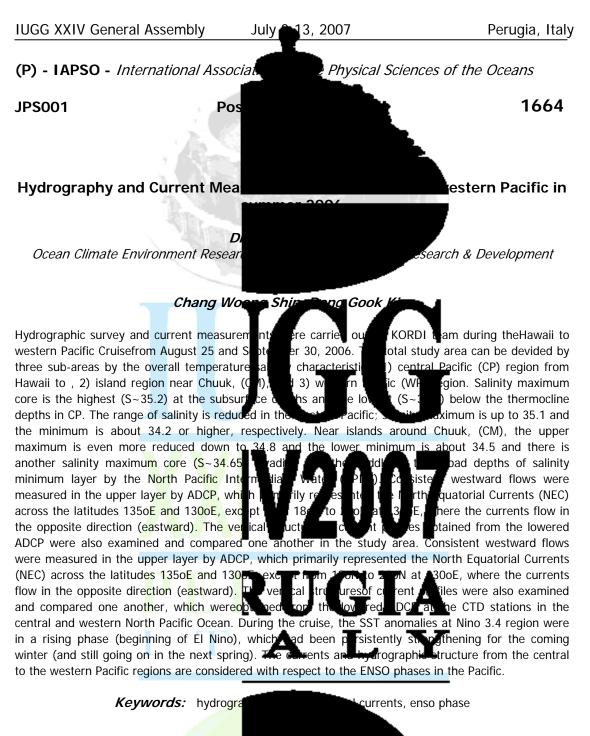


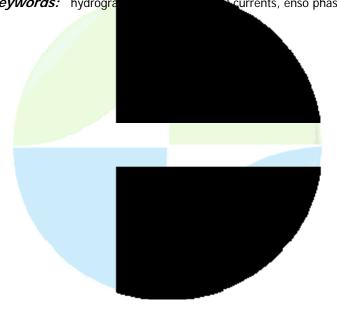












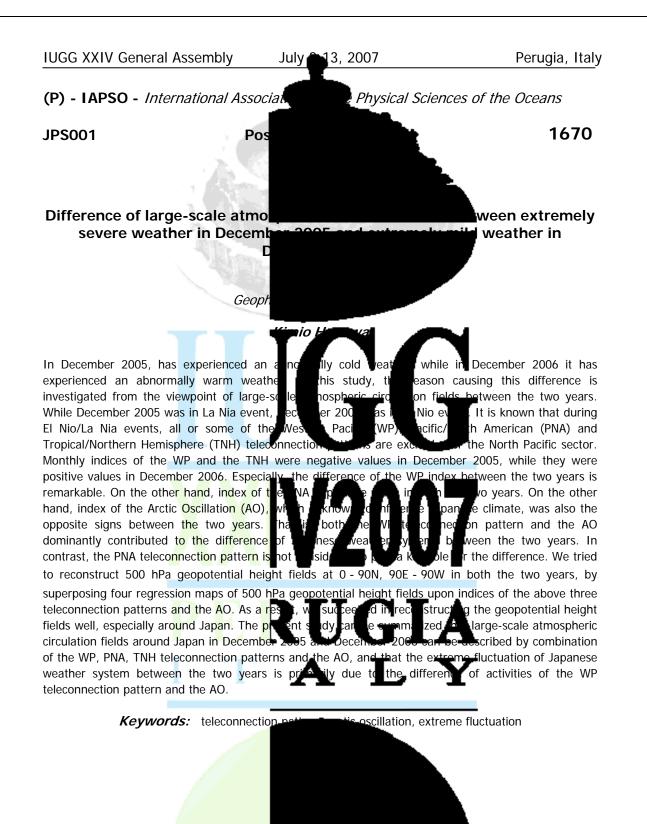


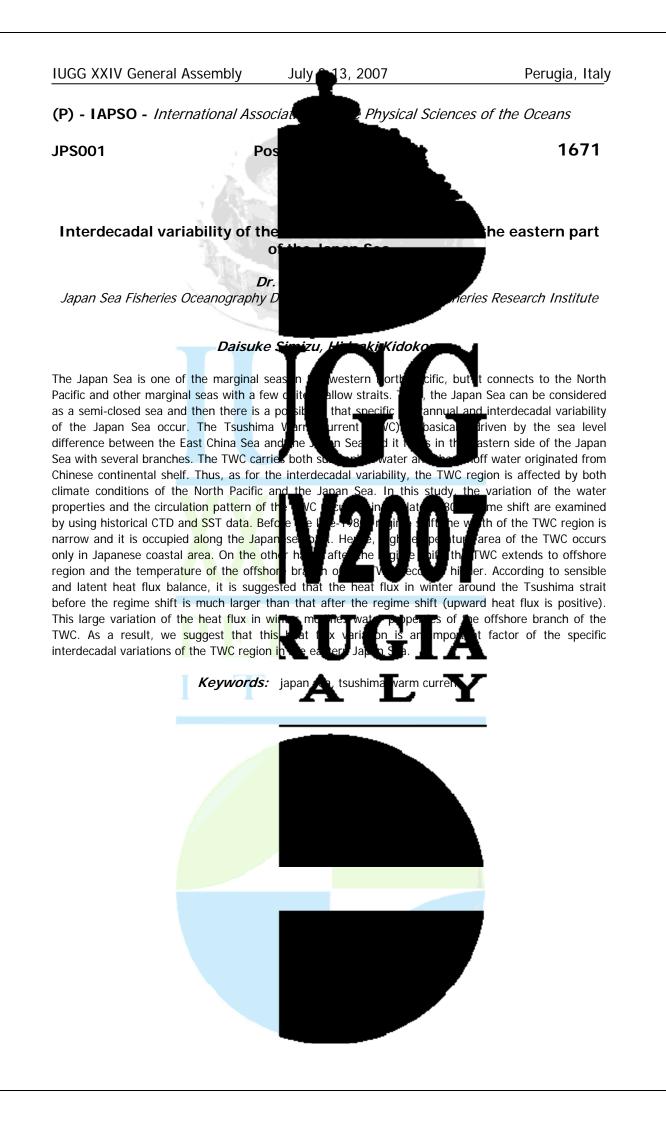




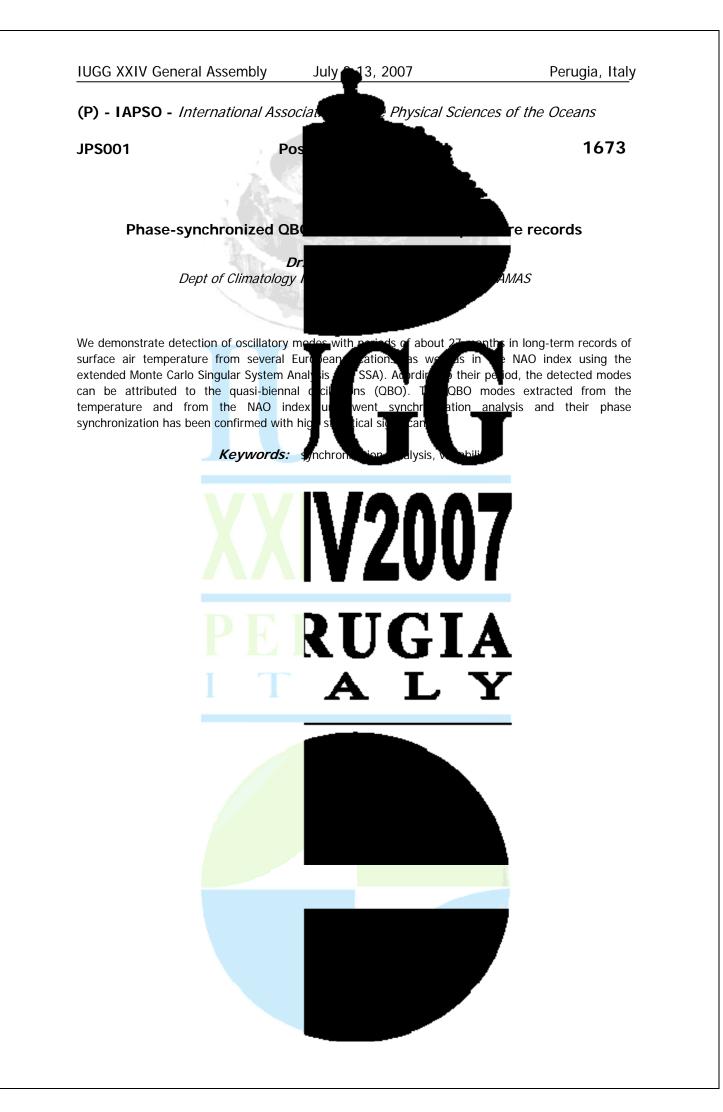


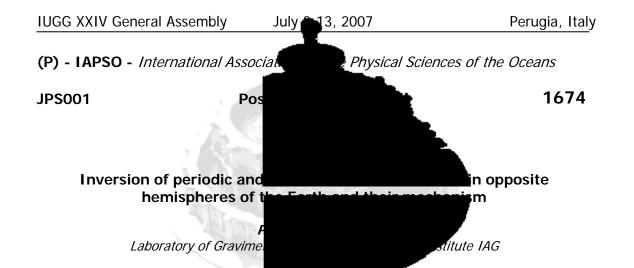












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The gravitational attraction of external ط tial oscillations of the core relatively to elastic han perturbed and are determined by differen hI eccentric and non-spherical shells of the E reflection in observable motions of a geoce the core and the mantle with annual, semithe available observation data about geog htei geocenter the cyclic variations with the periods (h 217.1 +/-1.1, 194.9 +/-1.5, 183.6 +/-0.6, 168.1 +/-0.6, 162.2 +/-1.0, 121.8 +/-0.5, 117.3 +/-0.6,

114.9 +/-0.2, 105.2 +/-0.3, 96.9 +/-0.3, 87.5 +/-0.2, 83.5 +/-0.2, 79.4 +/-0.3, 70.2 +/-0.1, 61.0 +/-0.2, 58.7 +/-0.1, 46.7 +/-0.1, 42.1 +/-0.1, 0.1, 16.2 +/-0.1, 13.4 +/-0.1 are obse components with the interannual periods a 2.1+/-0.1, 2.6+/-0.1, 1.8+/-0.01, 1.6+/-0.01 amplitudes from 1-2 cm up to shares of mm

approximately in 5 times big correspond to the mentioned periods. Decade and long-periodic variations in position of the Earth core should be observed also (Barkin, 2002). The gravitational attraction of moving core (of its superfluous mass) will mantle, including the top layers. Cyclic stime heat in contrast styles with respect to hemis vigorous stimulation, apparently, takes place on core-mantle boundary. Atmospheric and oceanic masses cyclically are forced to be redistributed at ween the appropriate style and type of circulations. The complex all temperature, to variations of atmospheric pressure and to others changes of climate. Therefore the geodynamic cyclicities marked above and a wide number of others (longer periods) are actually

observed in variations of mean temperate pressure etc. (Atlas, 1998). Thus, on the relation to opposite hemispheres of the Ea hemisphere corresponds to decrease of phenomenon should be observed for eve shall specify recently found out phenome Pacific sectors of northern hemisphere. asymmetric positive trend of ground tem

notion and small cyclic ements of the core are l disp es of the Moon and the Sun on lacements of the core obtain the types of relative displacement of ities can be restored on ther c in v tions of z coordinate of 2 +/-2.0, 317.0 +/-2.2,

> 21.1 +/-0.1, 20.3 +/-4). Rather confidently 2, 3.6+/-0.1, 5.5+/-0.3, mass of the Earth with he core with amplitudes

resu p rhythmic generating of ich ne pre oscillates. Especially artispheres and to change 🖌 results observable variations of tmospheric circulation, in variations of of inversion of climatic modes in reasing of temperature in one hisphere. And the specified ature. As an example we nate in the Siberian and as it was observed an

rension state of all layers of the

. In 20 century in the

Siberian sector some backlog of a temperature course from its linear trend, and in Pacific on the contrary - an advancing of a course of temperatures was observed (Byshev et al., 2005). The mentioned phenomenon is universal and should be shown for various hemispheres of the Earth in

various time scales. From preliminary dyna should be observed in northern and sou relatively to elastic mantle (with significar Sun and the Moon should result in cycles Explanation of endogenous activity of pla

variations of a climate placements of the core fary perturbations of the rencesBarkin Yu.V. (2002) licity. Izvestia cekzii nauk o

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Zemle. Rus. Acad. of Nat. Sciences, Issue 9, atlas of time variations of natural, anthropa a nature and a society. M.: Scientific we contrast directions of changes of a global sciences, V. 400, N 1, pp. 98-104.Barkin paleoclimate. Proceedings of Milutin Milan climate system" (Belgrade, Serbia, 30 At Sciences and Art, pp. 161-164.

2002, M.: VINITI, pp. 45-97. In Russian. The processes (1998). V. 2. Cyclic dynamics in V.G., Romanov J.A. (2005) About ceans. Reports of the Academy of Earth shells and variations of Paleoclimate and the Earth de, Serbian Academy of

Keywords: inversion temp

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I T A L Y

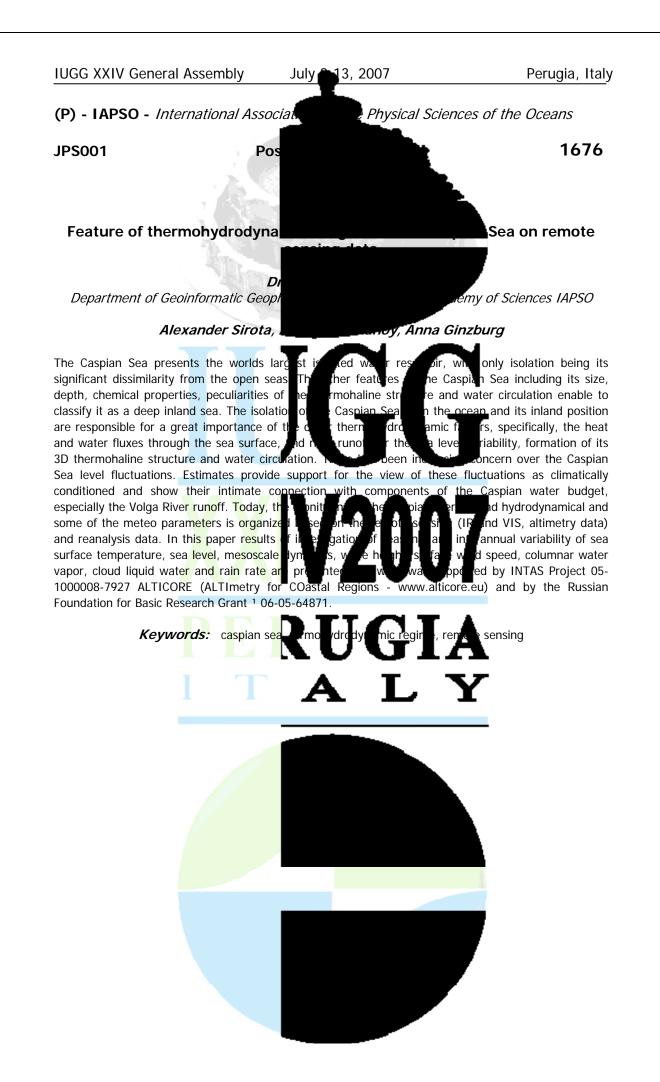
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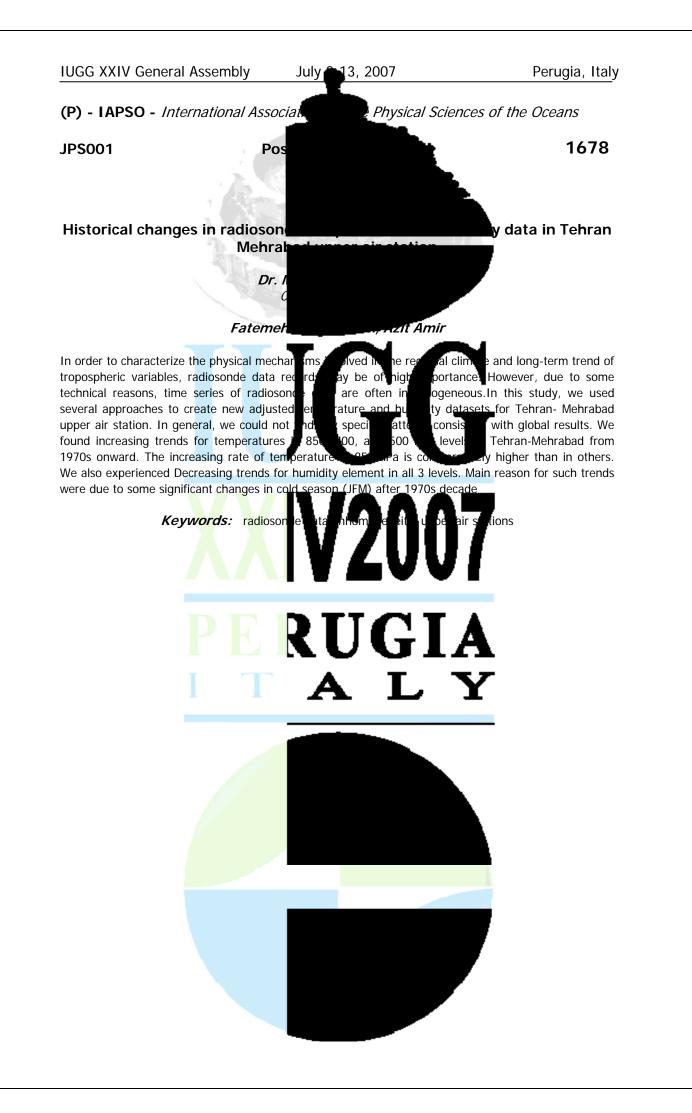


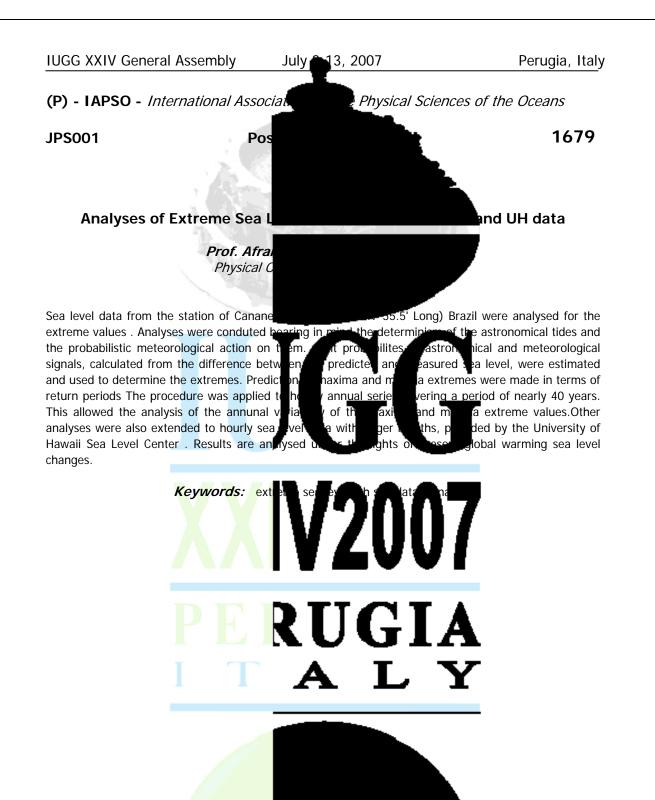
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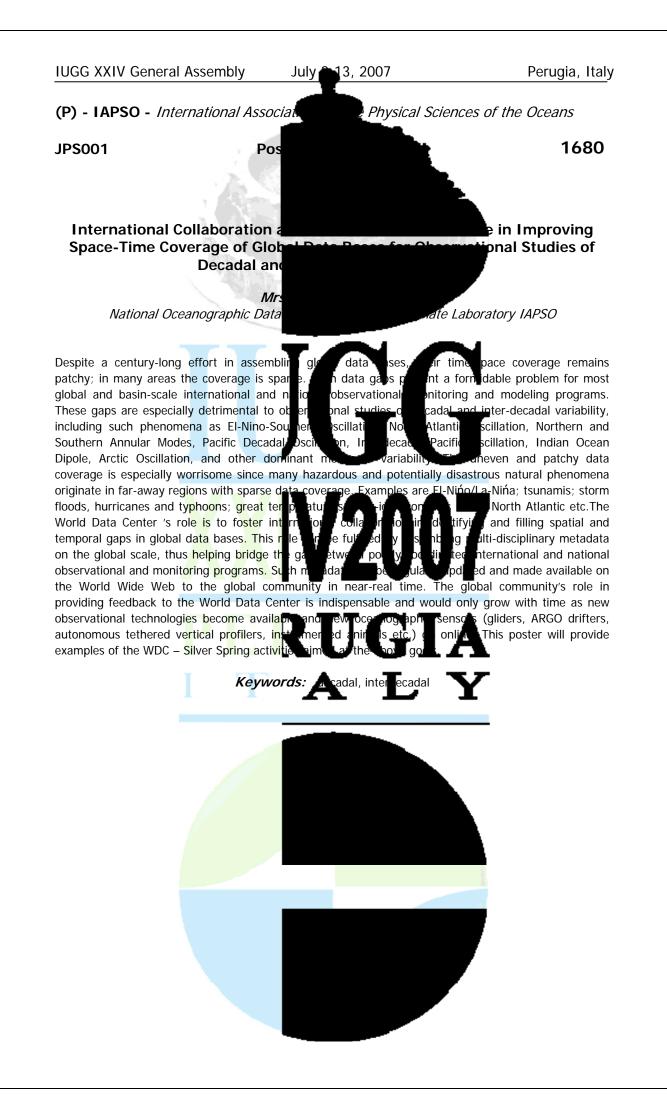






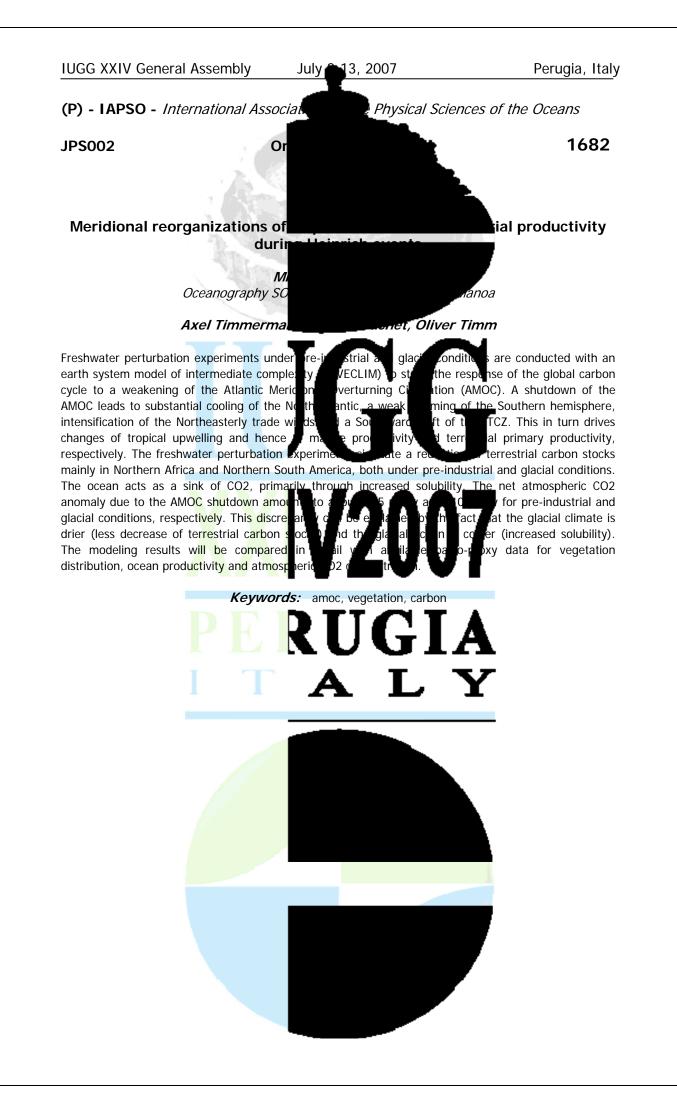


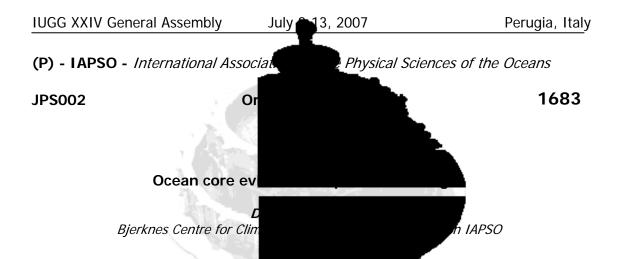












Ocean circulation changes may play a fu climate transition seen in numerous climate records Atlantic Ocean clearly document that char consistent change with ice core records, records (SST), or in changes in deep oce current mode of ventilation is not unique different states with severe and far-re hypothesized to have driven these past oce reliable assessments of oceans vulnerability to concerning the behaviour of the ocean circulation, and its role in rapid climate change, are to be

answered it is clear that research as to focus on investigating the full range of time scales that are recorded in the geological archive, from se contemporary physical oceanographic obse of the Atlantic Meridional Overturning C property gradients can be estimated along ltra MOC. Some of these issues will be discus during glacial time, D/O events and the dec

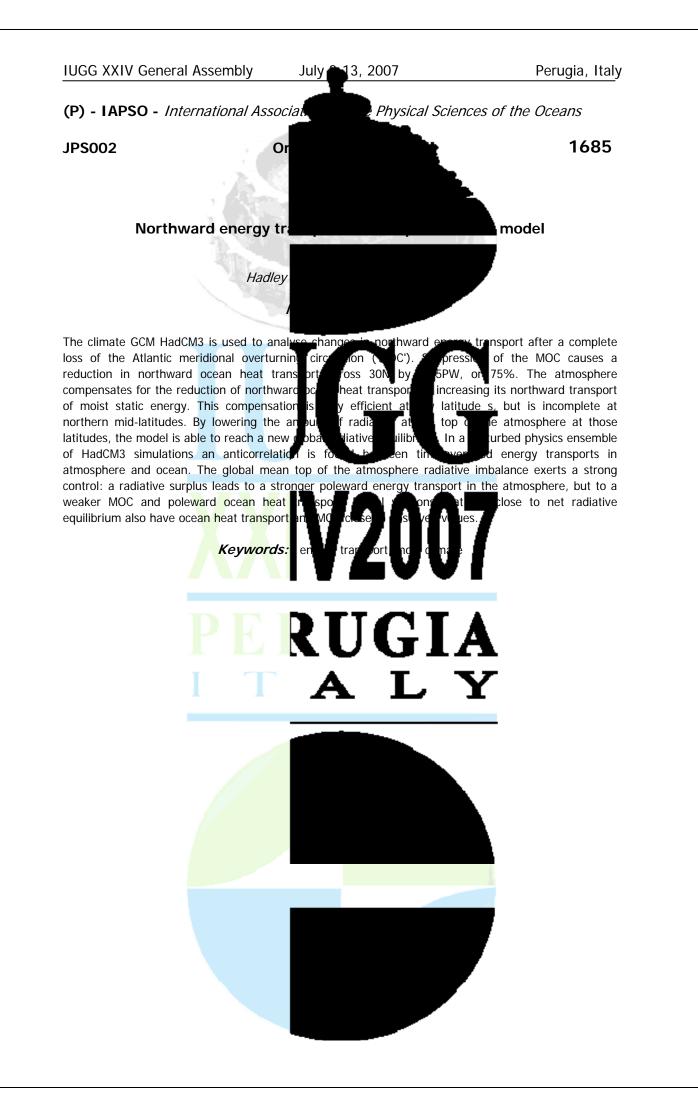
ne control of climate change and rapid d the world. es in po cord corded re y records. It n, an<u>d has</u> reper 'n anizat rer ges.

regolution records from the records are showing a ice d tructed ea surface temperature ncreasingly clear that the oceans hed <u>rapidly</u> between dramatically oweve the various processes constrained, preventing largel fundamental questions

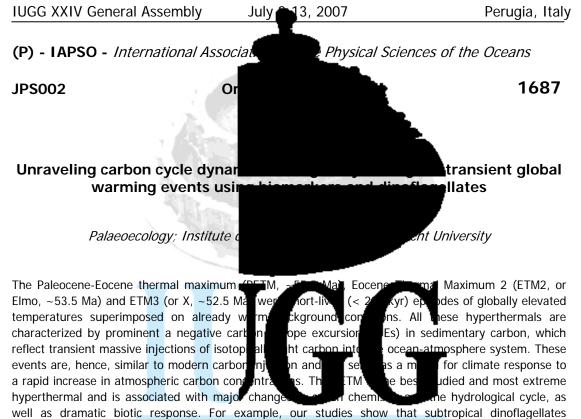
> al, and should emulate hanges in the dynamics er constrained if paleoean currents feeding the ation of ocean circulation











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inhabited the Arctic Ocean during the PETM at temperatures exceeding 23C. Such temperatures cannot be reproduced by current generation fully boundary conditions. Many authors have global greenhouse warming during the PE record that both the onset of the global a surface-ocean warming as recorded by T offset between Apectodinium and the CIE was confirmed in other sites from New Jersey, the North Sea

the expected lag between bottom water suggesting that the latter mechanism inde studies will be presented, focusing on e.g. Ocean, and ETM3 in the Tethys. The research presented is a result of collaborations with researchers from, amongst others, the Institute of Environmental Biology and Earth Scie University, the Royal Netherlands Institute for feat the University of California Santa Cruz, the Department of Earth Sciences at Rice University, Department of Paleoclimatology and Geomorphology at the <u>Vrite Universiteit Amsterdam</u>, the Earth and Atmospheric Sciences Department at Purdue Univers University and the Department of Geose

provided by the Integrated Ocean Drilling

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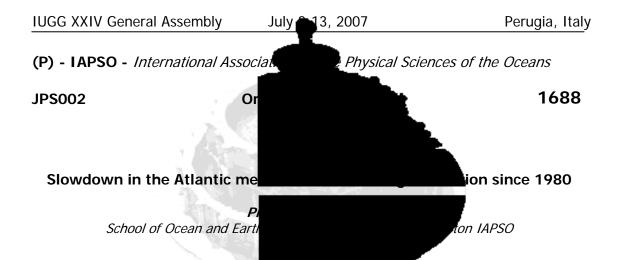
with Paleocene-Eocene bon led to pronounced cord in New Jersey, we gellate Apectodinium and thousands of years. The

and New Zealand. The ~3 kyrs time lag between the onset of warming and the CIE is consistent with ne hydrate dissociation,

meth ew results from ongoing llow ific, ETM2 in the Arctic stern P Department at Utrecht 💓, the Ea Sciences Department at

er

of Geology and Geophysics at Yale ity. This research used samples



Analysis of transatlantic hydrographic sed circulation (MOC) has varied in strength by approxi overturning in 2004 than in previous years decomposition of the Atlantic MOC at this lated climatology, transport of the Florida Current transport from CTD or moored temperature addition to interannual fluctuations in streng weakening of the MOC between 1980 and

associated with an increased increased basinwide thermocline slope and hence stronger southward transport of these waters. Freshening of Lower North Atlantic Deep Water (LNADW) near the western boundary, which is consistent with observe a reduced southward flow of LNADW by transport of thermocline waters and ded although of reduced magnitude, with the re dud hydrographic sections. We discuss these datasets for quantifying interannual variability.

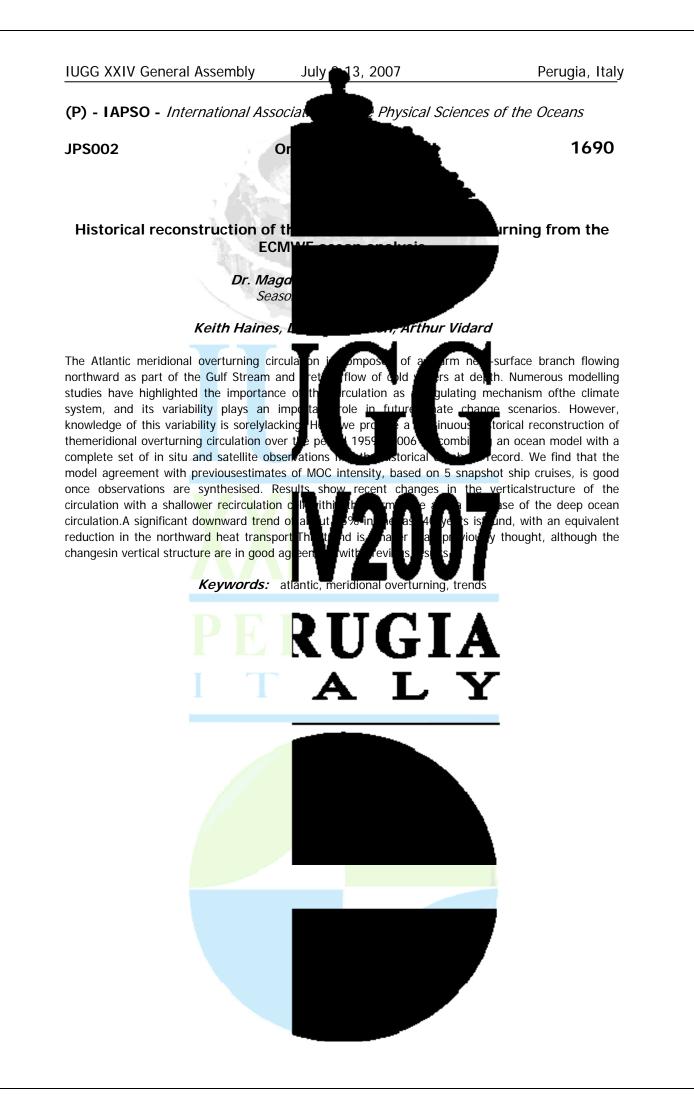
5% ove Tem ion al res to its Ekn an m cable obs essure derive e MO 00 e sho ۱at been stronger since 1997 when thermocine tem at the

mat the Atlantic meridional overturning as 50 years, with weaker et is increased through e da onent computed from wind stress tions and mid-ocean geostrophic unda<u>ry dyna</u>mic height profiles. In e pres evidence for a 2 to 3 Sv south d upper ocean flow has bundary rose. This was

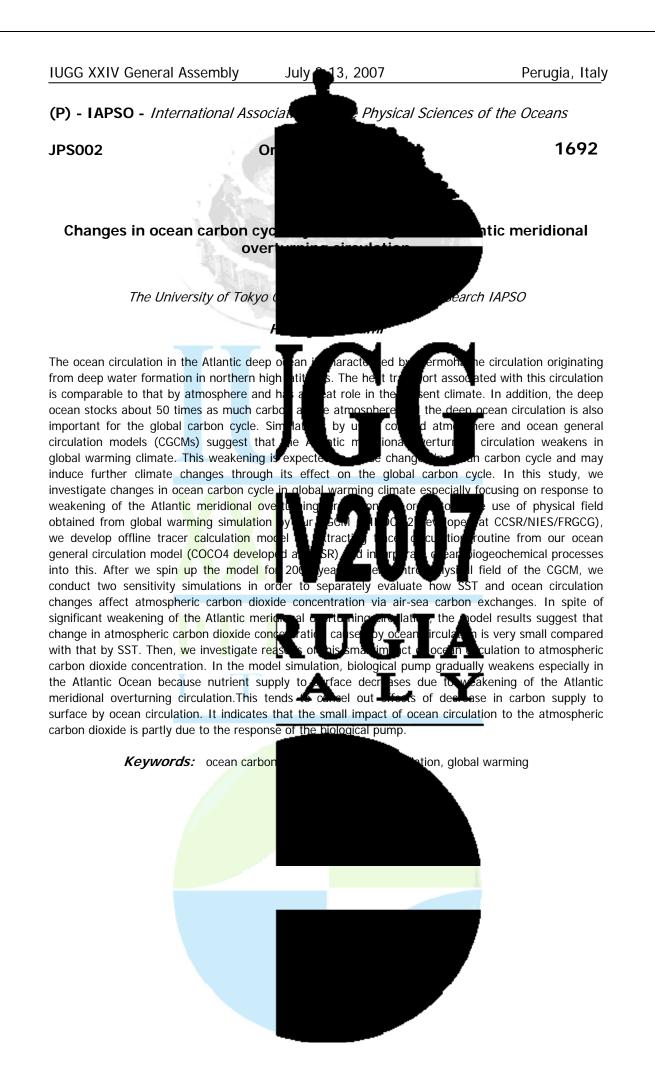
> northern sills, leads to mid-ocean southward are consistent in sign, analysis of transatlantic ative merits of different

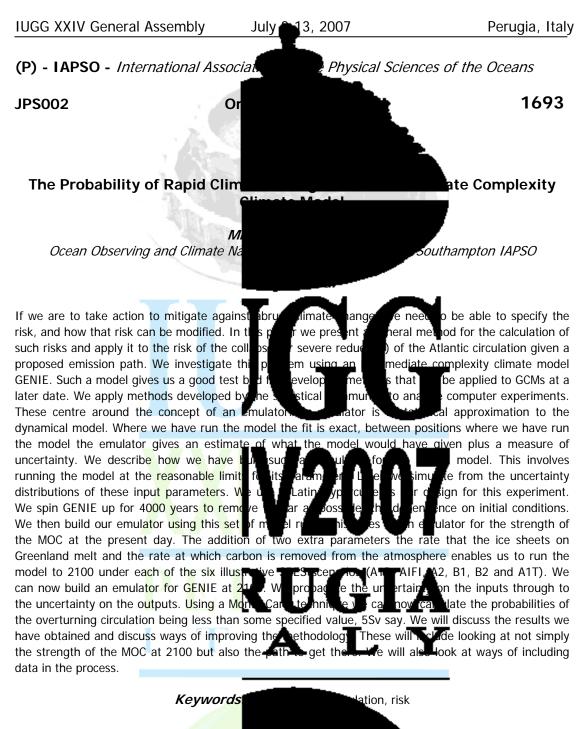


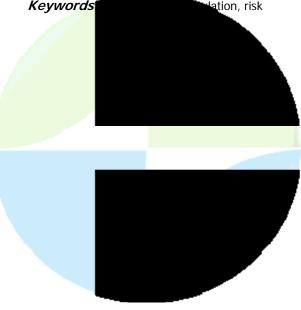






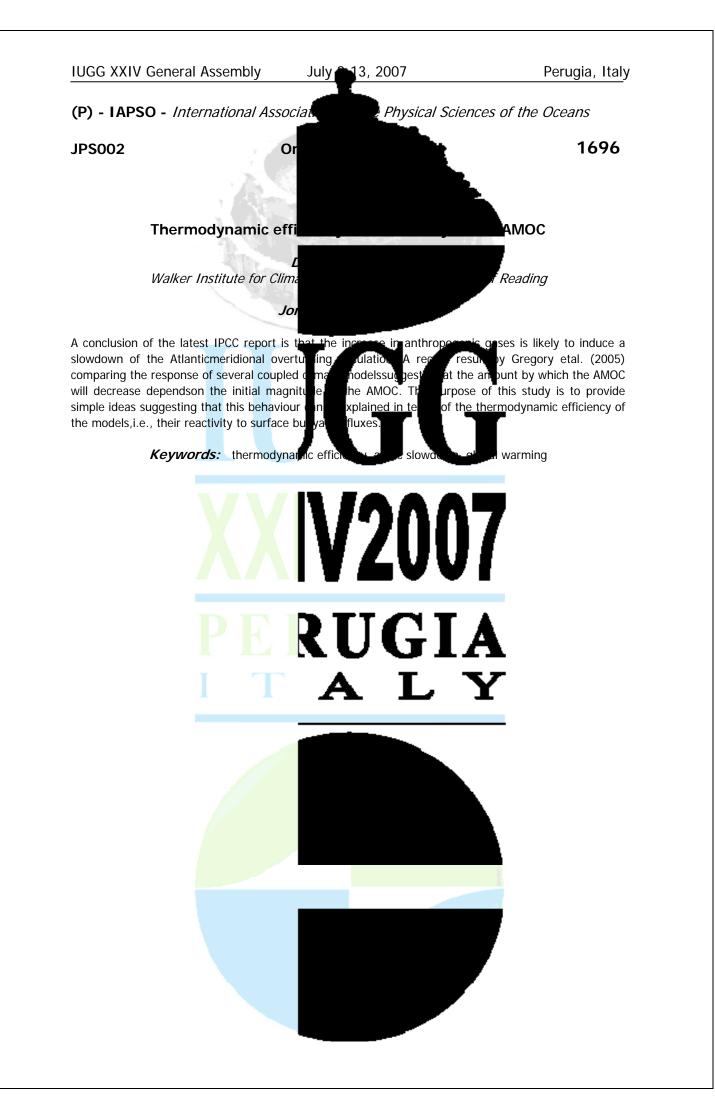


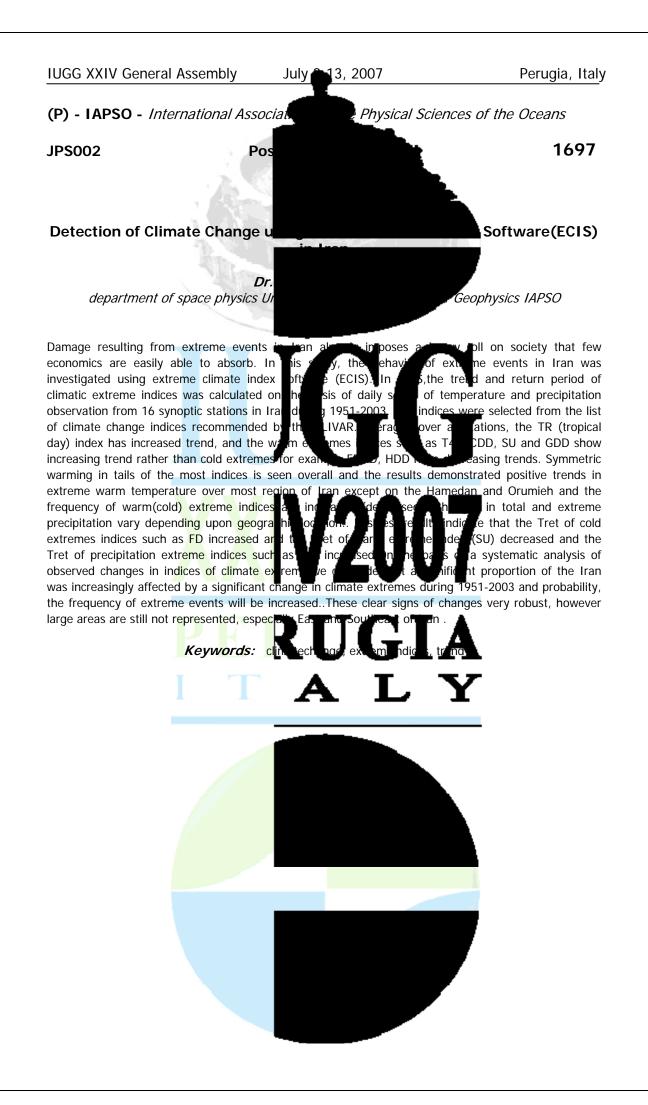


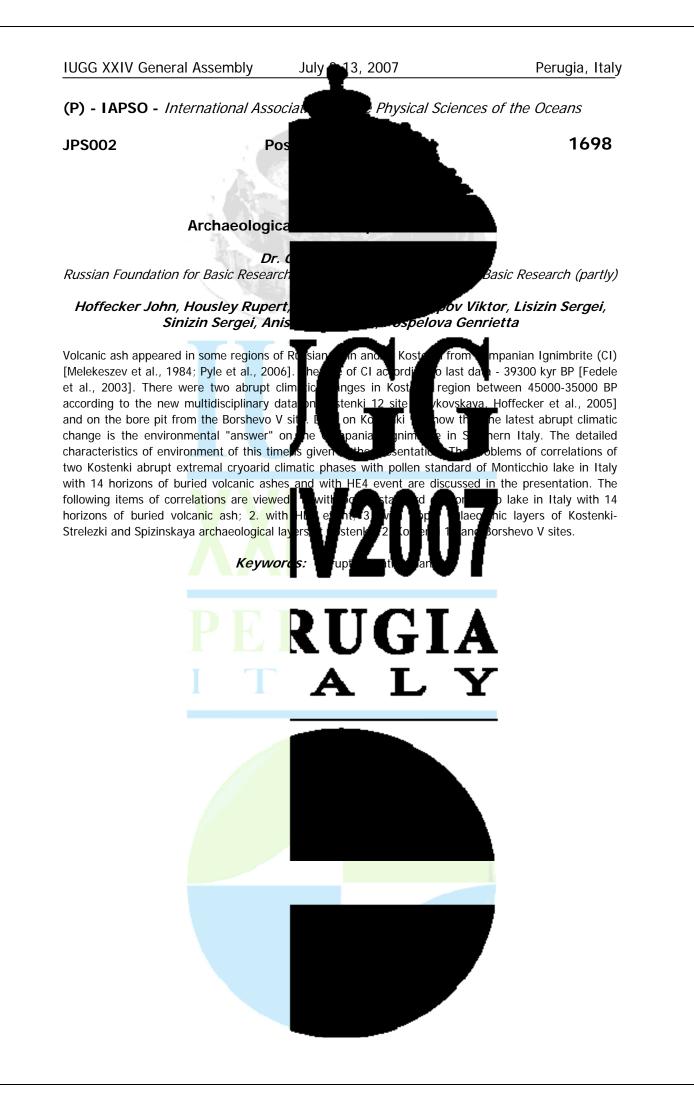




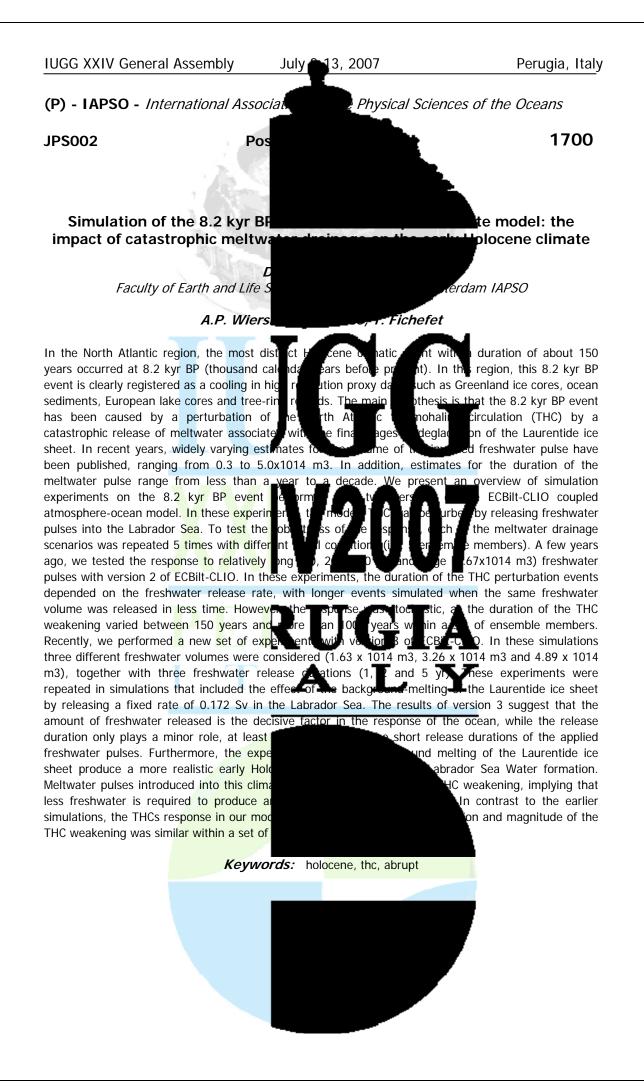


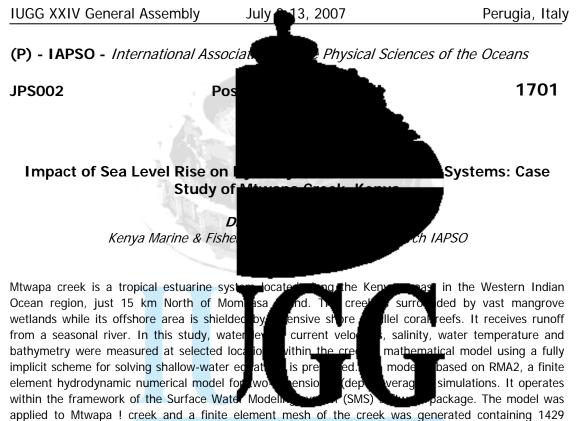












quadratic elements defined by 4544 nodes assuming that the flow is incompressible resulting in a hydrostatic pressure distribu the set of nonlinear equations. The model i Using the model, the sensitivity of Mtwap been investigated. This involved applying conditions at the mouth of the creek using projected values by Intergovernmental Panel on Climate

and neap tides are computed. It is conclude

storm surges and tropical cyclones.

model scenarios of climate change induced extra

cr LICC Change (IPCC). The model results suggest that if the morphology of the creek remains constant, sealevel rise could have some significant impart the numerical model, estimates of Mtwapa

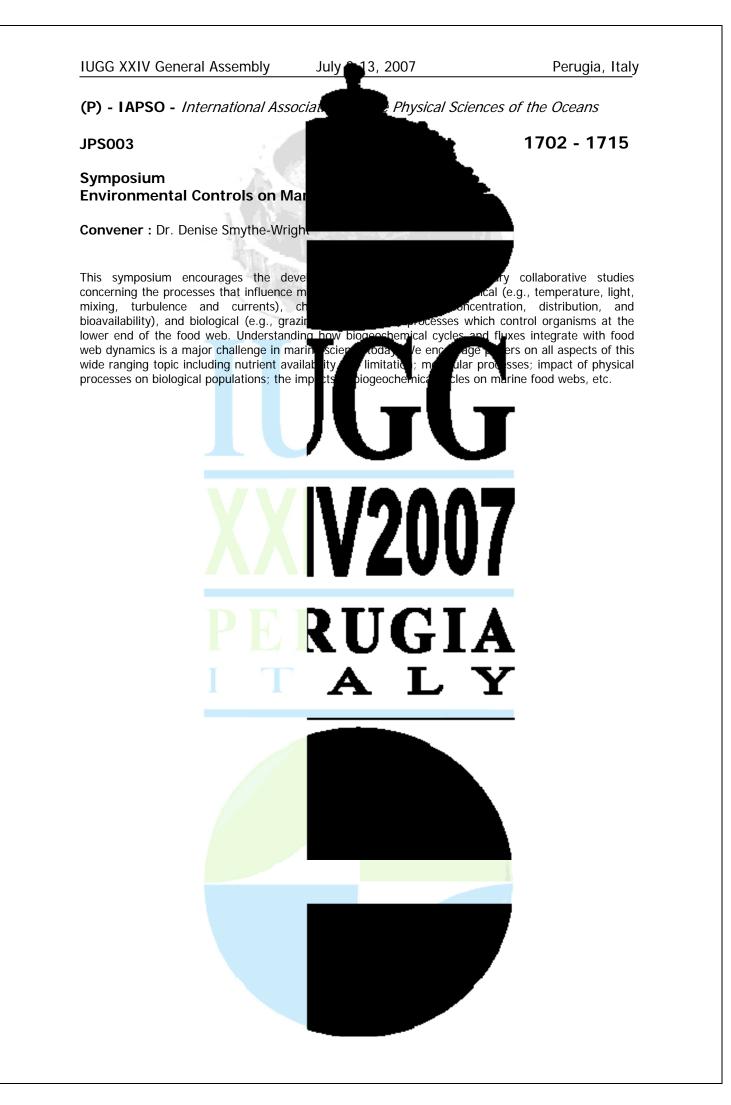
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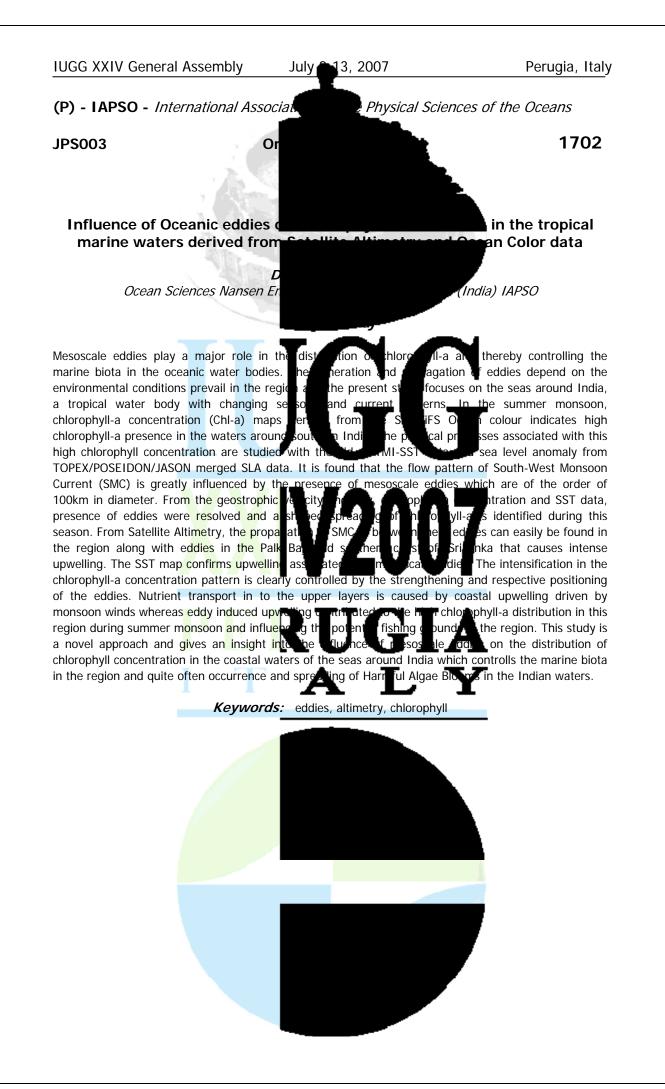
The_equations are integrated over the flow depth by considered negligible cheme is used to solve the mouth of the creek. in the 21st century has vel to the tidal boundary

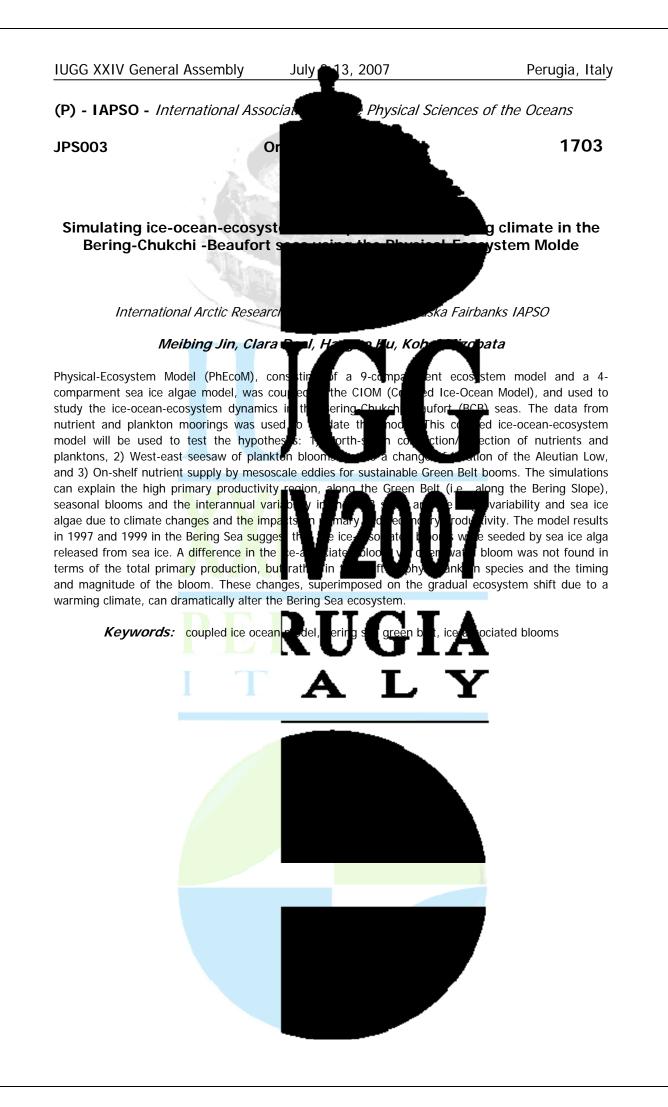
he ! 🕯 stem. Furthermore, using ea a tidal prism during spring ed in this study can be hui mg el plese used as a research tool for investigations of estuarine hydrodynamic processes. It can also be used to vents such e oceanic sea-level rise, tsunamis,

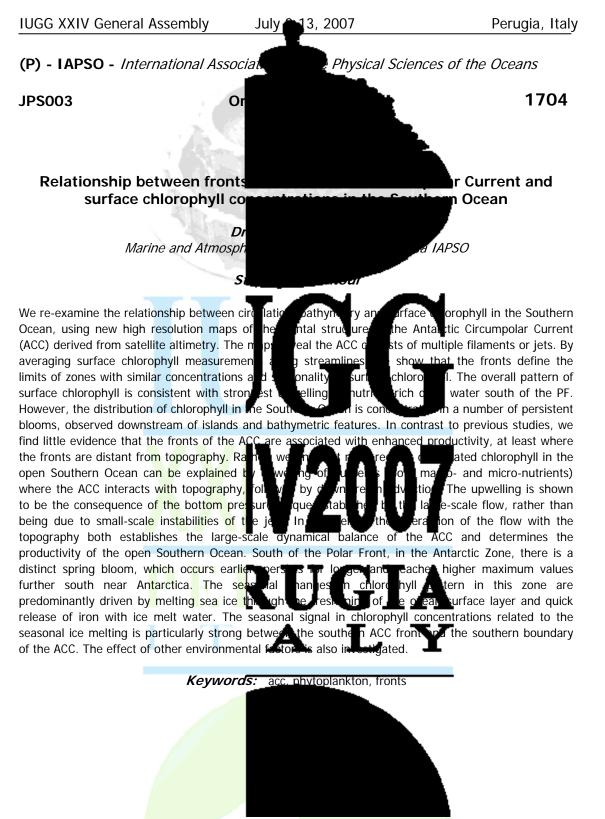
Keywords: sea level rise climate change, estuary numerical model, mtwapa creek kenya



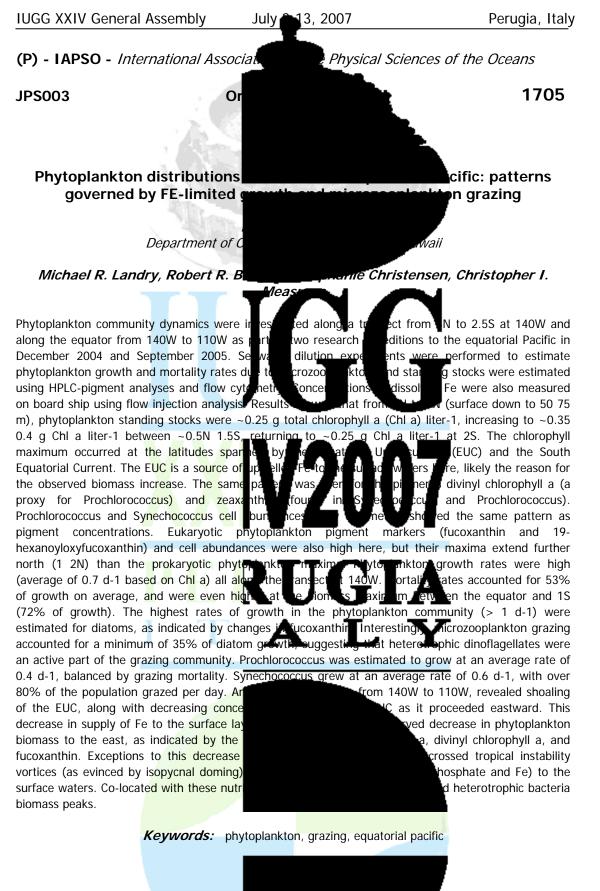


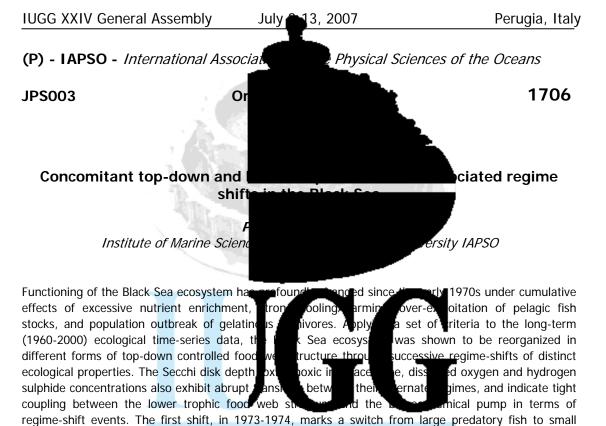












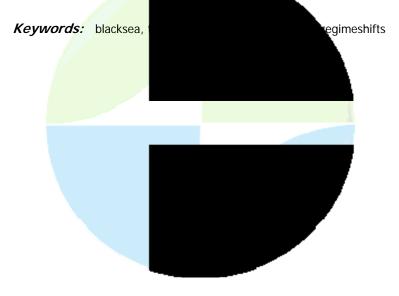
planktivore fish-controlled system, which persisted until 1989 in the form of increasing small pelagic and phytoplankton biomass and decreasing zoo further supported by a bottom-up contribution nutrient load and the concurrent shift of ~20-year persistence in the warm climate planktivores and the transition to a gelatious small planktivore populations take over control of the system again. Concomitantly, their top-down

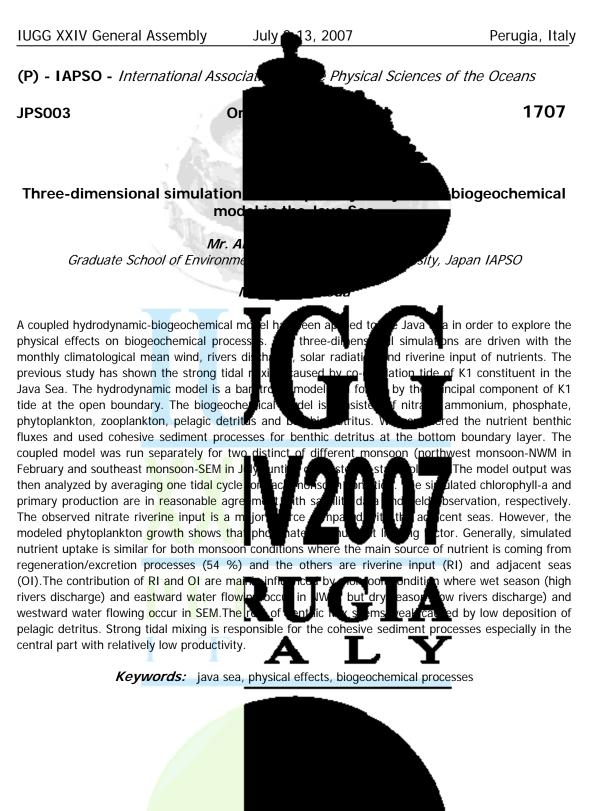
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toplankton biomass is to high anthropogenic ate regime following its es the depletion of small y the end of the 1990s,

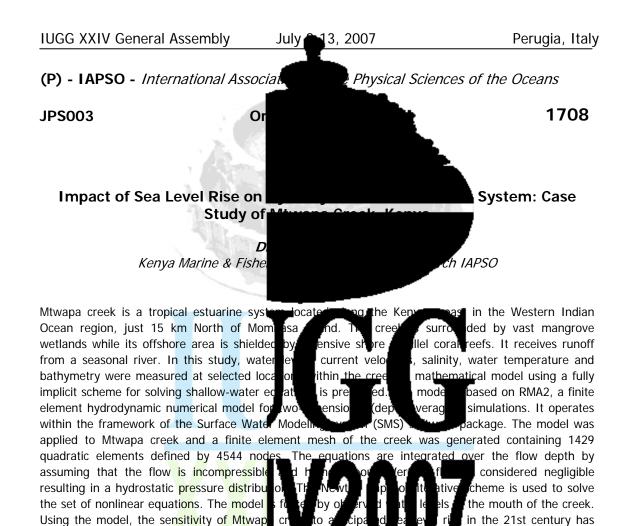
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pressure when combined with diminishing anthropogenic nutrient load and more limited nutrient supply into the surface waters due to stabilizing ter conditions switched the high production regime of phytoplankton to its regi The Black Sea regimeucti shifts appear to be sporadic events forced dal ber bations, and therefore bno tra deg differ from the multi-decadal scale cyclical events observed in pelagic ocean ecosystems under lowfrequency climatic forcing. The Black Sea observations illustrate that eutrop. fishery ey can exert sufficiently exploitation can indeed induce hysteresis in kinge arine stems, if strong forcing onto the system. They further illustrate the link between the disruption of the top predators, proliferation of new predator stocks, and regime-shift events. Examples of these features have been reported for some aquatic extremely limited for large marine ecosystems.









Keywords: sea level rise climate change, estuary numerical model, mtwapa creek kenya

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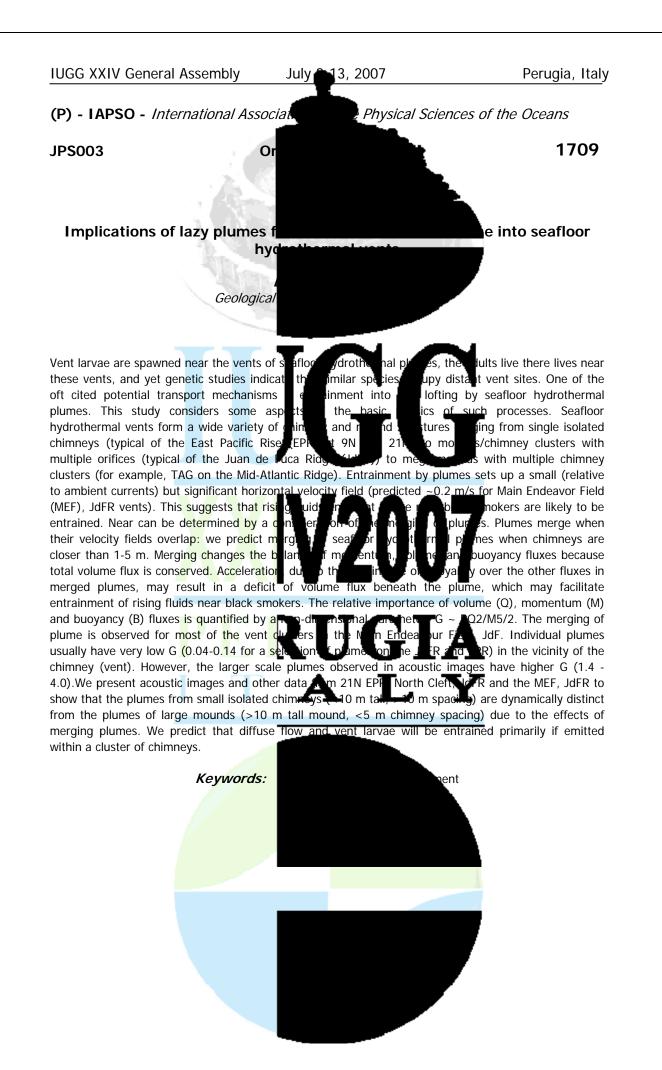
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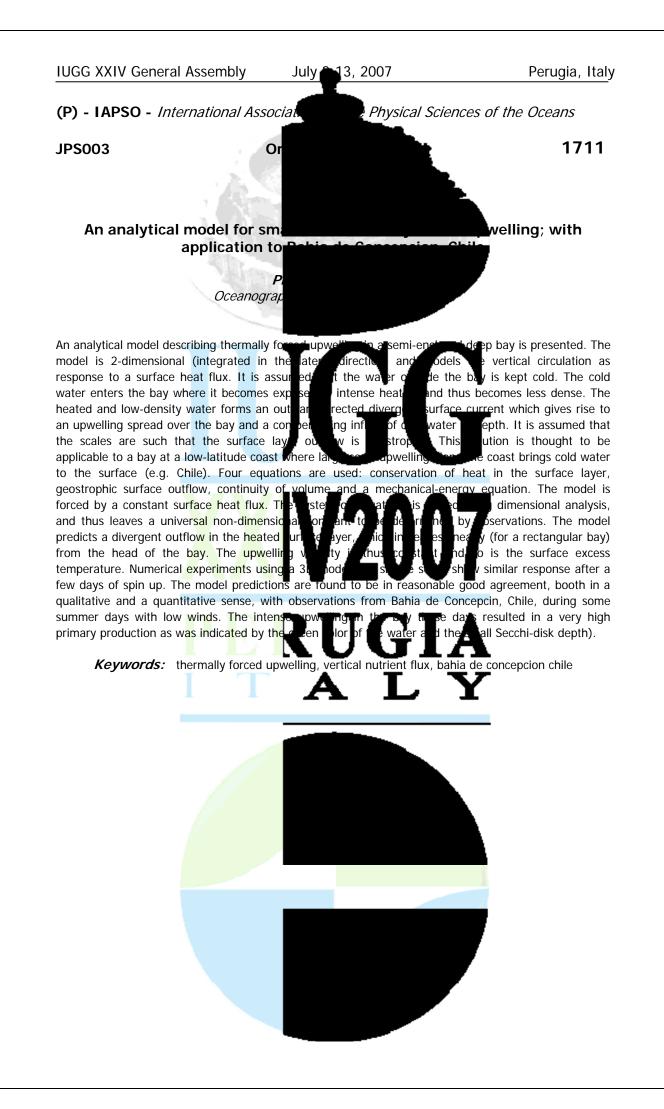
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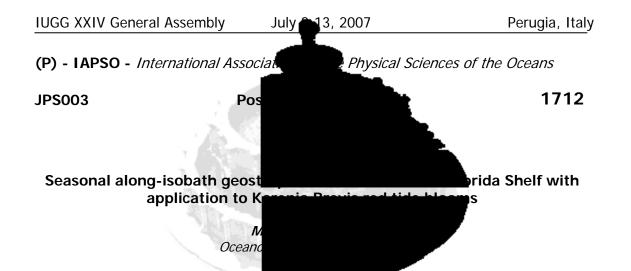
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TOPEX/Poseidon (T/P) sea surface height West Florida Shelf (WFS) are used to estima the knowledge that geostrophic flow appro seasonal along-isobath geostrophic flows. correlated with the seasonal along-shore w predicted in December, January, February, predicted in June, August, and September. The

small in the remaining months. Karenia brevis, the Florida red tide organism, usually blooms on the south/central WFS in the summer and fall months. It is likely that the northwestward along-isobath flow in June, August, and September transports during these months. K. brevis blooms in northward transport mechanism. Above hurricane activity in the Gulf of Mexico m 2005 while below average along-shore w hd central WFS was not observed farther north

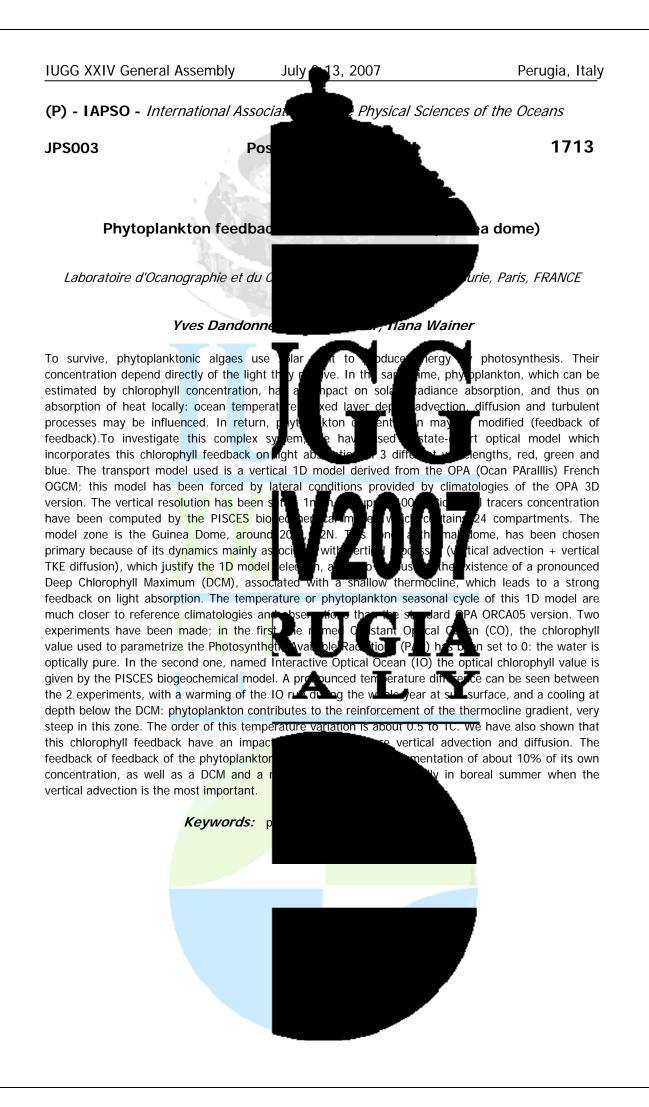
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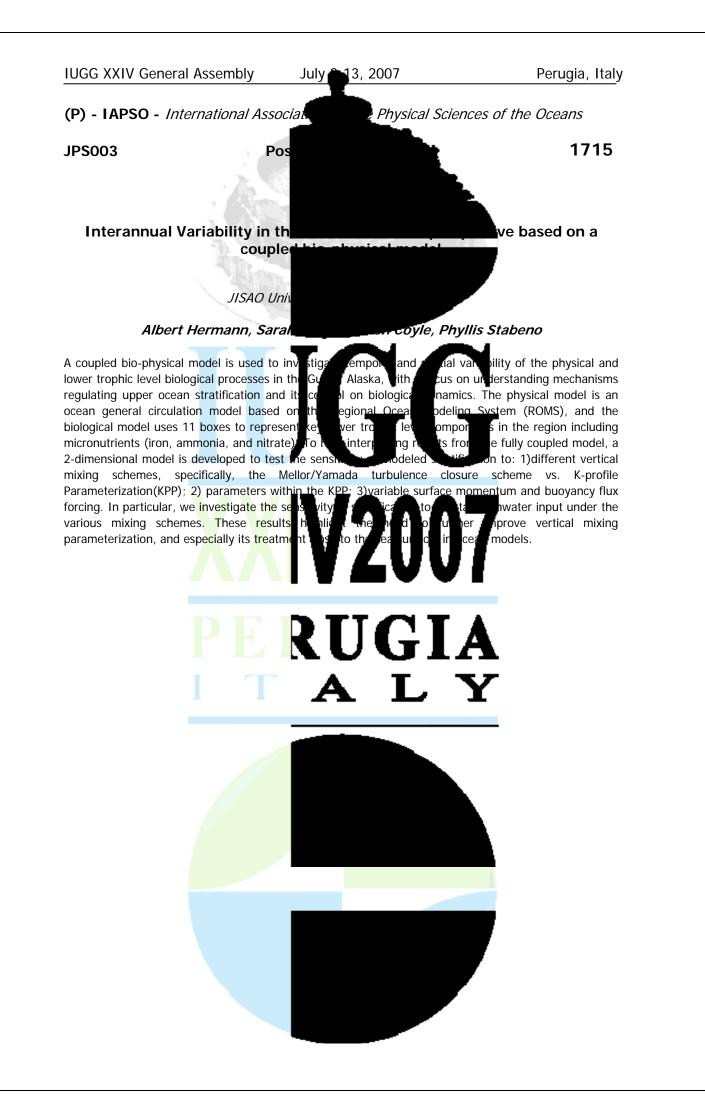
91 and 15 crossing the SH gradients. These gradients and aths enables an estimation of the ic along-isobath flows are highly dired along-isobath flows are dire along-isobath flows are mponent of the flow is

> Big Bend shelf region study to examine the wind stress caused by transport of K. brevis in K. brevis bloom on the









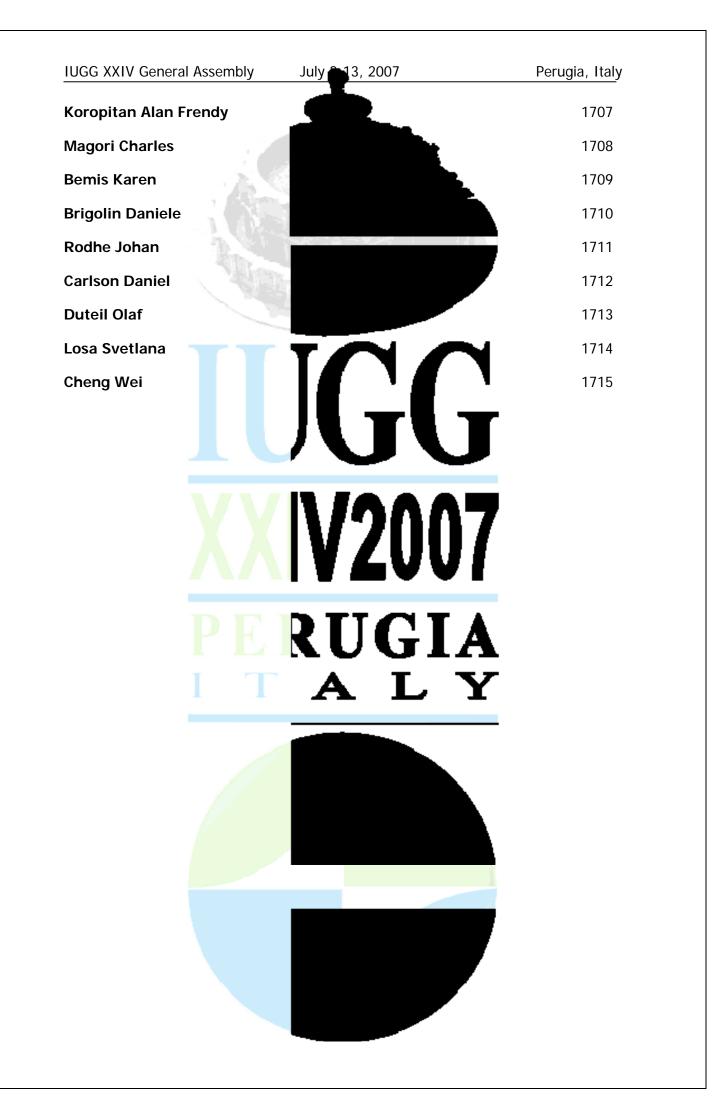
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Chang Ping	DICI	1618
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