



EnMAP Flight Campaigns

Technical Report

Köthen 2011/2012
An EnMAP Preparatory Flight Campaign

Thomas Jarmer, Bastian Siegmann



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Köthen 2011/2012
An EnMAP Preparatory Flight Campaign

Thomas Jarmer, Bastian Siegmann

University of Osnabrück, Germany



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on the basis of a decision
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Abstract

The dataset is composed of hyperspectral imagery acquired during airplane overflights on May 10th, 2011, June 27th, 2011 and May 24th, 2012 consisting of 367 and 368 spectral bands, respectively, ranging from VIS to SWIR (400 - 2500 nm) wavelength regions. The hyperspectral image datasets were acquired in the framework of the EnMAP preparation project HyLand (Hyperspectral remote sensing for the assessment of crop and soil parameters in precision farming and yield estimation). Within the project, innovative techniques were developed to derive crop and soil parameters from hyperspectral remote sensing and terrestrial laser scanning, which served as input parameters for novel yield estimation models.

Coordinates: center: 51.80 N / 11.92 E

Keywords: Hyperspectral imagery, plant- and soil parameters, yield estimation, EnMAP, aisaDUAL

Related Work:

An overview of the EnMAP mission is provided in Guanter et al. (2015):

Guanter, L., Kaufmann, H., Segl, K., Foerster, S., Rogaß, C., Chabrillat, S., Küster, T., Hollstein, A., Rossner, G., Chlebek, C., Straif, C., Fischer, S., Schrader, S., Storch, T., Heiden, U., Mueller, A., Bachmann, M., Mühle, H., Müller, R., Habermeyer, M., Ohndorf, A., Hill, J., Buddenbaum, H., Hostert, P., van der Linden, S., Leitão, P., Rabe, A., Doerffer, R., Krasemann, H., Xi, H., Mauser, W., Hank, T., Locherer, M., Rast, M., Staenz, K., Sang, B. (2015): The EnMAP Spaceborne Imaging Spectroscopy Mission for Earth Observation. - Remote Sensing, 7, 7, p. 8830-8857, <http://doi.org/10.3390/rs70708830>

The datasets described here are used in the following key publications:

Kanning, M., Siegmann, B., Jarmer, T. (2016): Regionalization of Uncovered Agricultural Soils Based on Organic Carbon and Soil Texture Estimations. Remote Sensing, 8(11), 927, <http://doi.org/10.3390/rs8110927>

Siegmann, B., Jarmer, T., Beyer, F., Ehlers, M. (2015): The Potential of Pan-Sharpened EnMAP Data for the Assessment of Wheat LAI. Remote Sensing, 7(10), p. 12737-12762, <http://doi.org/10.3390/rs71012737>

Siegmann, B., Jarmer, T. (2015): Comparison of different regression models and validation techniques for the assessment of wheat leaf area index from hyperspectral data. International Journal of Remote Sensing. 36(18), 4519-4534, <http://doi.org/10.1080/01431161.2015.1084438>

1 Introduction

The Environmental Mapping and Analysis Program (EnMAP, Guanter et al. 2015) is a German hyperspectral satellite mission that aims at monitoring and characterizing the Earth's environment on a global scale. EnMAP serves to measure and model key dynamic processes of the Earth's ecosystems by extracting geochemical, biochemical and biophysical parameters, which provide information on the status and evolution of various terrestrial and aquatic ecosystems. In the frame of the EnMAP preparatory phase, pre-flight campaigns including airborne and in-situ measurements in different environments and for several application fields are being conducted. The main purpose of these campaigns is to support the development of scientific applications for EnMAP. In addition, the acquired data are input in the EnMAP end-to-end simulation tool (EeteS, Segl et al. 2012) and are employed to test data pre-processing and calibration-validation methods. The campaign data are made freely available to the scientific community under a Creative Commons Attribution-ShareAlike 4.0 International License. An overview of all available data is provided in in the EnMAP Flight Campaigns Metadata Portal (<http://www.enmap.org/?q=flights>).

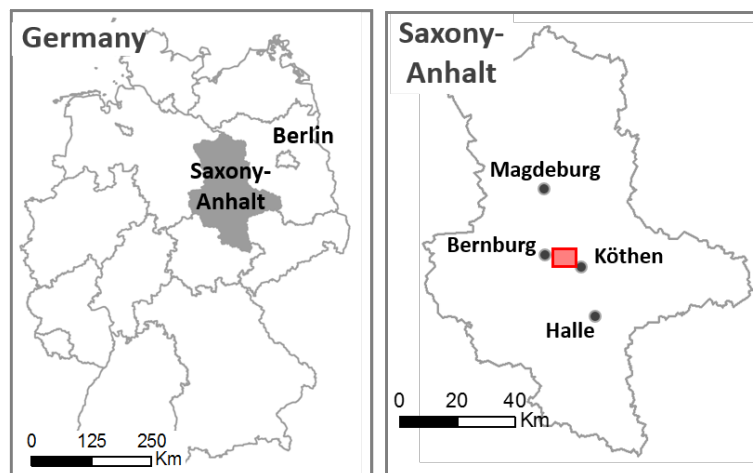


Figure 1: Location of the study area

Flight Campaign “Köthen”

The study area is located in the eastern part of Germany in the federal state of Saxony-Anhalt and belongs to the Magdeburgian-Anhaltinian Börde. The entire area was formed during the last ice age about 10,000 years ago. At this time, the region was the preferred run-off area of the main local rivers (Elbe, Saale, Mulde, Weiße Elster), which accumulated Pleistocene sediments in the region. Later, during the Weichselian period, the area was covered by loess, such that the existing relief structures were nearly compensated (Schröder 2000). Today, the region is characterized by a slightly undulated plain. The altitude of the study site varies between 65 and 88 m above sea level. The area is covered by a loess layer up to 1.2 m depth. Chernozems, in conjunction with Cambisols and Luvisols, represent the predominant soil type characterized by highly diverse soil properties, resulting in a fine-scale pattern of soil texture and organic matter. The soils from the study site have an average quality number [Ackerzahl (in German), Schröder, 2000] of about 85 and, therefore, belong to the most fertile soils in Germany (Schröder 2000). Since the area is situated in the rain shadow of the Harz Mountains, it is distinctly dry with 500 mm mean annual precipitation. The mean annual temperature is 9°C.

2 Data Acquisition

Hyperspectral image data of the test site were acquired by the airborne hyperspectral scanner aisaDUAL (Specim Ltd., Finland) operated by the Helmholtz Centre of Environmental Research (UFZ). The aisaDUAL system is a hyperspectral push broom scanner consisting of two separate sensors, namely, aisaEAGLE (VIS/NIR, 400–1000 nm) and aisaHAWK (SWIR, 1000–2500 nm). The image data have a geometric resolution of 3 m with 367/368 spectral bands in the wavelength range 400–2500 nm. For data correction, the ROME destriping algorithm (Rogaß et al. 2011) was used to reduce mis-calibration effects, which were present as deficient lines along the track in the images. Afterwards, an atmospheric correction was conducted using FLAASH (campaign 1) and ATCOR (Richter and Schläpfer 2002, campaign 3) for transferring the radiance values of each pixel to reflectance data. Additionally, an empirical line correction with spectral ground measurements of different dark and bright targets, which were collected at the study site during the time of aisaDUAL overpass, was necessary for removing spectral artefacts that were still in the data after atmospheric correction. The geometric correction of the aisaDUAL data was realized with the software CaliGeo (Specim Ltd., Finland), while orthorectification was performed with the software ENVI (Exelis Inc., USA).

2.1 Campaign 1:

Geographic coverage: NW: 51.82 N / 11.87 E
NE: 51.82 N / 11.97 E
SW: 51.77 N / 11.87 E
SE: 51.77 N / 11.97 E

Time: May 10, 2011 start: 09:32:18 end: 11:07:26 (UTC)

Bands: 367

Wavelengths: 400 – 2497 nm

2.2 Campaign 2:

Geographic coverage: NW: 51.82 N / 11.87 E
NE: 51.82 N / 11.97 E
SW: 51.77 N / 11.87 E
SE: 51.77 N / 11.97 E

Time: June 27, 2011 start: 08:35:23 end: 10:16:44(UTC)

Bands: 367

Wavelengths: 400 – 2497 nm

2.3 Campaign 3:

Geographic coverage: NW: 51.88 N / 11.84 E
NE: 51.88 N / 11.94 E
SW: 51.77 N / 11.84 E
SE: 51.77 N / 11.94 E

Time: May 24, 2012 start: 09:06:57 end: 11:12:3 (UTC)

Bands: 368

Wavelengths: 401 – 2500 nm

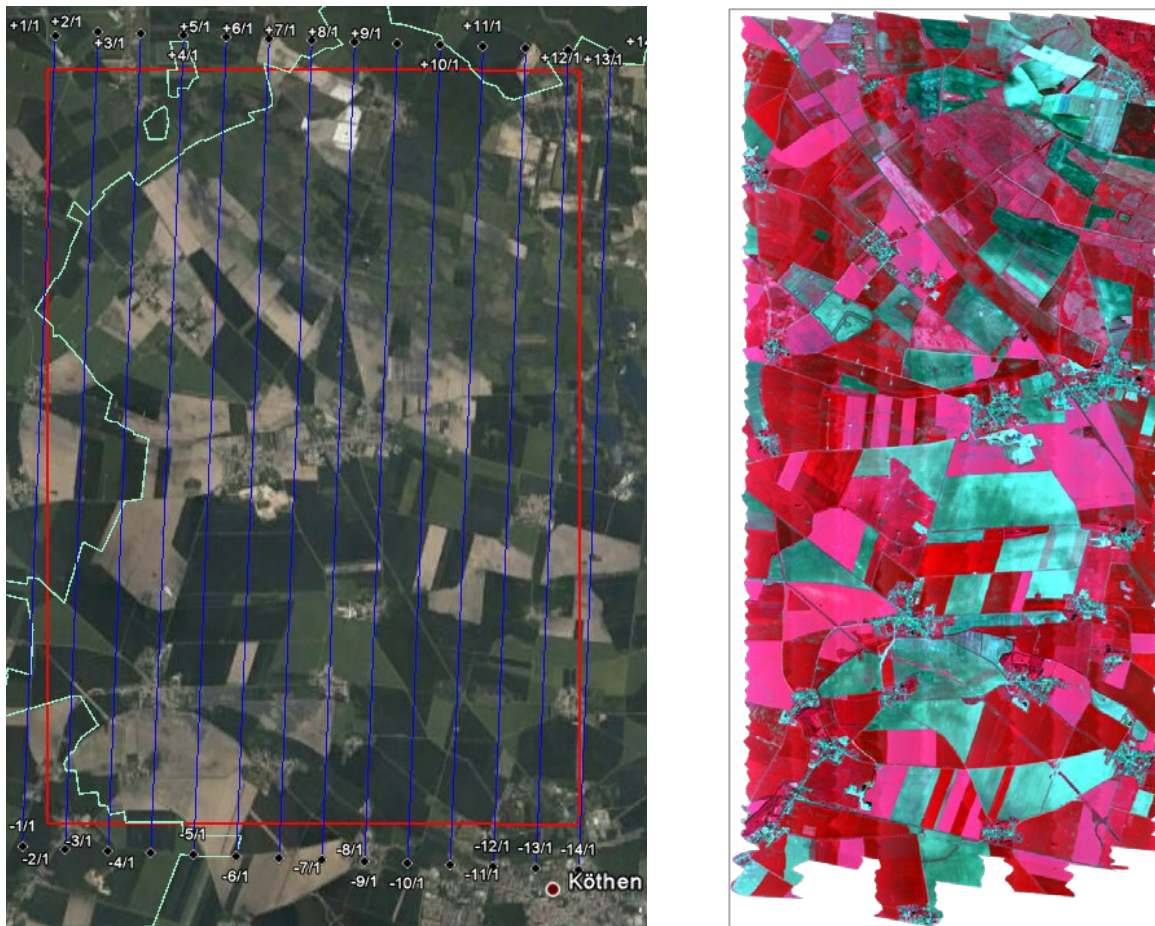


Figure 2: Flight lines for campaign 1, 2 (left), mosaic of the flight lines from campaign 3 (right)

3 Data Processing and Products

3.1 Hyperspectral airborne data

Level 1 (available for all three campaigns): At sensor radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ converted from DN using laboratory radiometric calibration information.

Level 2 atm/geo¹ (available for campaigns 1 and 3): top of the canopy reflectance after atmospheric correction using radiative transfer model provided in ENVI FLAASH (Berk et al. 1998) (Campaign 1) and ATCOR (Richter and Schläpfer 2002) (Campaign 3). Ortho-rectified reflectance data (for campaigns 1 and 3) were derived on a parametric model using recorded altitude and flight path data (inertial measurement unit). Subsequently, the outer orientation was adjusted with ground control points sampled on a reference image.

3.2 Simulated EnMAP data

Simulated EnMAP data for three flight lines of campaign 1 and four flight lines of campaign 3 were generated using the EnMAP end-to-end simulation software EeteS (Segl et al. 2012).

¹ Data levels used here are out-dated and not in line with the future EnMAP data levels.

4 File Description

4.1 File Format

Band Interleaved by Line or Band Sequential Image File [* .dat] and file header [* .hdr]

4.2 Data content and structure

Image files are described in the header file by the following attributes:

ENVI description, samples, lines, bands , header offset, file type, data type, interleave, sensor type, byte order, map info, wavelength units, band names, wavelength, FWHM.

5 Data Quality/Accuracy

There is no quality assessment of the data available.

6 Additional Data

- Additional data available upon request directly from the authors, see dataset contacts: field spectral measurements (ASD, SVC) of wheat and maize, LAI (LAI 2000, SunScan), SPAD, fresh/dry matter and plant height measurements, organic carbon and nitrogen content
- laboratory measurements of soil samples, organic carbon content

7 Dataset Contact

Thomas Jarmer

Email: tjarmer@uos.de

Phone: +49 (0) 541 969 3914

Bastian Siegmann

Email: bsiegmann@uos.de

Phone: +49 (0) 541 969 3930

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9 References

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<http://doi.org/10.1109/JSTARS.2012.2188994>

10 Appendix

10.1 List of available datasets

Köthen 2011 05 10 (Radiance)

Filename	Extension	Format	Size	Content
01_koethen_01_0510_0932_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 1
01_koethen_01_0510_0932_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 1
01_koethen_02_0510_0940_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 2
01_koethen_02_0510_0940_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 2
01_koethen_03_0510_0947_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 3
01_koethen_03_0510_0947_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 3
01_koethen_04_0510_0954_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 4
01_koethen_04_0510_0954_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 4
01_koethen_05_0510_1001_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 5
01_koethen_05_0510_1001_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 5
01_koethen_06_0510-1009_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 6
01_koethen_06_0510-1009_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 6
01_koethen_07_0510-1016_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 7
01_koethen_07_0510-1016_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 7
01_koethen_08_0510_1023_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 8
01_koethen_08_0510_1023_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 8
01_koethen_09_0510_1031_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 9

01_koethen_09_0510_1031_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 9
01_koethen_10_0510-1038_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 10
01_koethen_10_0510-1038_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 10
01_koethen_11_0510-1045_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 12
01_koethen_11_0510-1045_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 11
01_koethen_12_0510-1053_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 11
01_koethen_12_0510-1053_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 12
01_koethen_13_0510-1100_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 13
01_koethen_13_0510-1100_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 13
01_koethen_14_0510-1107_rad	*.dat	ENVI Band interleaved by line	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 14
01_koethen_14_0510-1107_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 14

Köthen 2011 05 10 (Reflectance)

Filename	Extension	Format	Size	Content
01_koethen_06_0510-1009_rad_rome_geo flaash_ortho	*.dat	ENVI Band interleaved by line	1.2 GB	At canopy reflectance flight strip 6
01_koethen_06_0510-1009_rad_rome_geo flaash_ortho	*.hdr	ENVI Header-File	76 KB	Metadata flight strip 6
01_koethen_07_0510-1016_rad_rome_geo flaash_ortho	*.dat	ENVI Band interleaved by line	1.2 GB	At canopy reflectance flight strip 7
01_koethen_07_0510-1016_rad_rome_geo flaash_ortho	*.hdr	ENVI Header-File	76 KB	Metadata flight strip 7
01_koethen_08_0510_1023_rad_rome_geo flaash_ortho	*.dat	ENVI Band interleaved by line	1.2 GB	At canopy reflectance flight strip 8
01_koethen_08_0510_1023_rad_rome_geo flaash_ortho	*.hdr	ENVI Header-File	76 KB	Metadata flight strip 8

Köthen 2011 06 27 (Radiance)

Filename	Extension	Format	Size	Content
koet_1_sn_2011_0627-0822_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 1
koet_1_sn_2011_0627-0822_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 1
koet_2_ns_2011_0627-0839_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 2
koet_2_ns_2011_0627-0839_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 2
koet_3_ns_2011_0627-0854_cut_rad	*.dat	ENVI Band sequential Image data	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 3
koet_3_ns_2011_0627-0854_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 3
koet_4_sn_2011_0627-0901_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 4
koet_4_sn_2011_0627-0901_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 4
koet_5_ns_2011_0627-0907_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 5
koet_5_ns_2011_0627-0907_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 5
koet_6_sn_2011_0627-0914_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 6
koet_6_sn_2011_0627-0914_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 6
koet_7_ns_2011_0627-0921_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 7
koet_7_ns_2011_0627-0921_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 7
koet_8_sn_2011_0627-0927_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 8
koet_8_sn_2011_0627-0927_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 8
koet_9_ns_2011_0627-0934_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 9
koet_9_ns_2011_0627-0934_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 9
koet_10_sn_2011_0627-0941_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 10
koet_10_sn_2011_0627-0941_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 10
koet_11_ns_2011_0627-0948_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 12
koet_11_ns_2011_0627-0948_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 11
koet_12_sn_2011_0627-0955_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 11

koet_12_sn_2011_0627-0955_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 12
koet_13_ns_2011_0627-1002_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 13
koet_13_ns_2011_0627-1002_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 13
koet_14_sn_2011_0627-1009_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 14
koet_14_sn_2011_0627-1009_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 14

Köthen 2012 05 14 (Radiance)

Filename	Extension	Format	Size	Content
1_3m_koethen0524-0904_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 1
1_3m_koethen0524-0904_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 1
2_3m_koethen0524-0917_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 2
2_3m_koethen0524-0917_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 2
3_3m_koethen0524-0928_cut_rad	*.dat	ENVI Band sequential Image data	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 3
3_3m_koethen0524-0928_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 3
4_3m_koethen0524-0938_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 4
4_3m_koethen0524-0938_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 4
5_3m_koethen0524-0949_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 5
5_3m_koethen0524-0949_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 5
6_3m_koethen0524-1000_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 6
6_3m_koethen0524-1000_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 6
7_3m_koethen0524-1010_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 7
7_3m_koethen0524-1010_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 7
8_3m_koethen0524-1020_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 8
8_3m_koethen0524-1020_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 8
9_3m_koethen0524-1031_cut_rad	*.dat	ENVI Band sequential	1 GB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 9
9_3m_koethen0524-1031_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 9
10_3m_koethen0524-1043_cut_rad	*.dat	ENVI Band sequential	700 MB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 10

10_3m_koethen0524-1043_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 10
11_3m_koethen0524-1049_cut_rad	*.dat	ENVI Band sequential	700 MB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 12
11_3m_koethen0524-1049_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 11
12_3m_koethen0524-1056_cut_rad	*.dat	ENVI Band sequential	700 MB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 11
12_3m_koethen0524-1056_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 12
13_3m_koethen0524-1102_cut_rad	*.dat	ENVI Band sequential	700 MB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 13
13_3m_koethen0524-1102_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 13
14_3m_koethen0524-1109_cut_rad	*.dat	ENVI Band sequential	700 MB	Radiance in $\mu\text{W} / (\text{cm}^2 \text{sr nm})$ flight strip 14
14_3m_koethen0524-1109_cut_rad	*.hdr	ENVI Header-File	10 KB	Metadata flight strip 14

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Filename	Extension	Format	Size	Content
6_3m_koethen0524-1000_cut_rad_rome_geo flaash_ortho_calc	*.dat	ENVI Band sequential	2.7 GB	At canopy reflectance flight strip 6
6_3m_koethen0524-1000_cut_rad_rome_geo flaash_ortho_calc	*.hdr	ENVI Header-File	100 KB	Metadata flight strip 6
7_3m_koethen0524-1010_cut_rad_rome_geo flaash_ortho_calc	*.dat	ENVI Band sequential	2.7 GB	At canopy reflectance flight strip 7
7_3m_koethen0524-1010_cut_rad_rome_geo flaash_ortho_calc	*.hdr	ENVI Header-File	100 KB	Metadata flight strip 7
8_3m_koethen0524-1020_cut_rad_rome_geo flaash_ortho_calc	*.dat	ENVI Band sequential	2.7 GB	At canopy reflectance flight strip 8
8_3m_koethen0524-1020_cut_rad_rome_geo flaash_ortho_calc	*.hdr	ENVI Header-File	100 KB	Metadata flight strip 8
9_3m_koethen0524-1031_cut_rad_rome_geo flaash_ortho_calc	*.dat	ENVI Band sequential	2.7 GB	At canopy reflectance flight strip 9
9_3m_koethen0524-1031_cut_rad_rome_geo flaash_ortho_calc	*.hdr	ENVI Header-File	100 KB	Metadata flight strip 9