EnMAP
Hyperspectral Imager

EnMAP – Technical Update and future Science Issues

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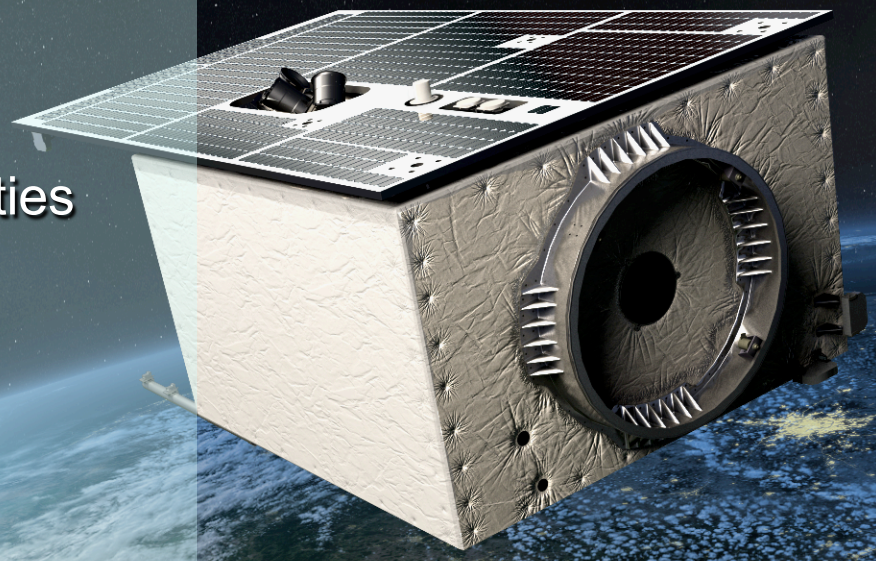
GFZ Helmholtz-Zentrum Potsdam
DLR
KAYSER-THREDE
OHB TECHNOLOGY

HyspIRI Science Workshop 2011, Washington DC

Outline

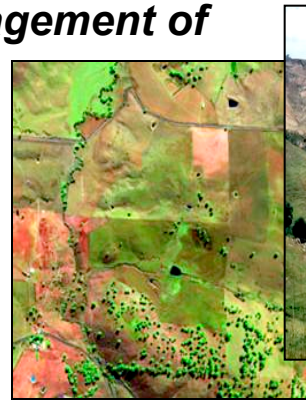
- Mission introduction and current status
- Updates on instrument
- Calibration and validation activities
- Recent Advances
- Scientific program activities
- Synergies to HysplRI (Hisui)

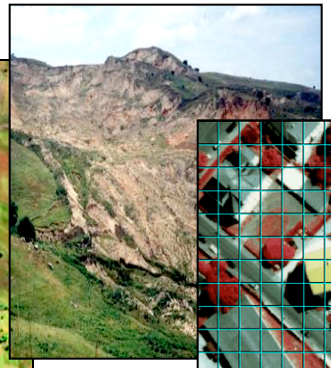


Science Program / Fields of Applications

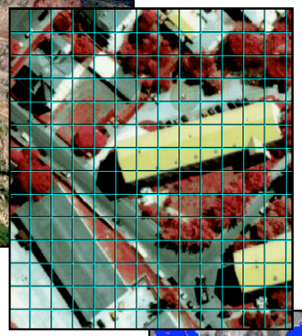
Co-operative international Networks

management of agricultural and forest ecosystems





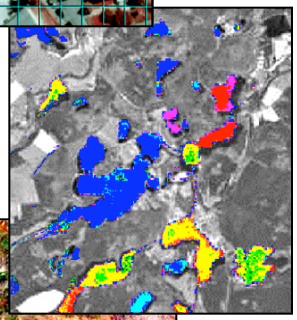
hazard assessment

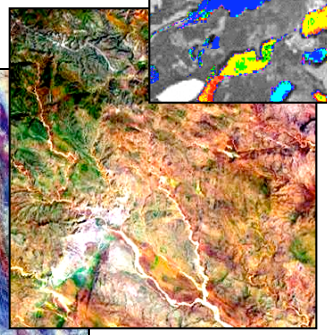


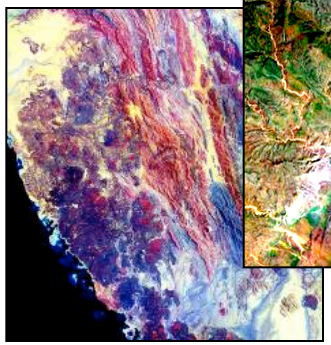
urban develop-ment

Retrieval of bio-geochemical and geophysical variables

inland & coastel waters

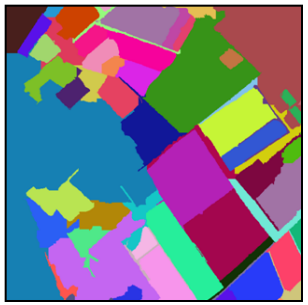






mineral exploration

dry-land degradation



- *methodological development*
- *synergies to xs and radar (InSAR)*

Project Partners

EnMAP Hyperspectral Imager

DLR

Universität Trier

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

HUMBOLDT-UNIVERSITÄT ZU BERLIN

University of Lethbridge
FIAT LUX

esa

Scientific Principal Investigator
GFZ-Potsdam

Core Science Team
ECST

Project Management
DLR Agency

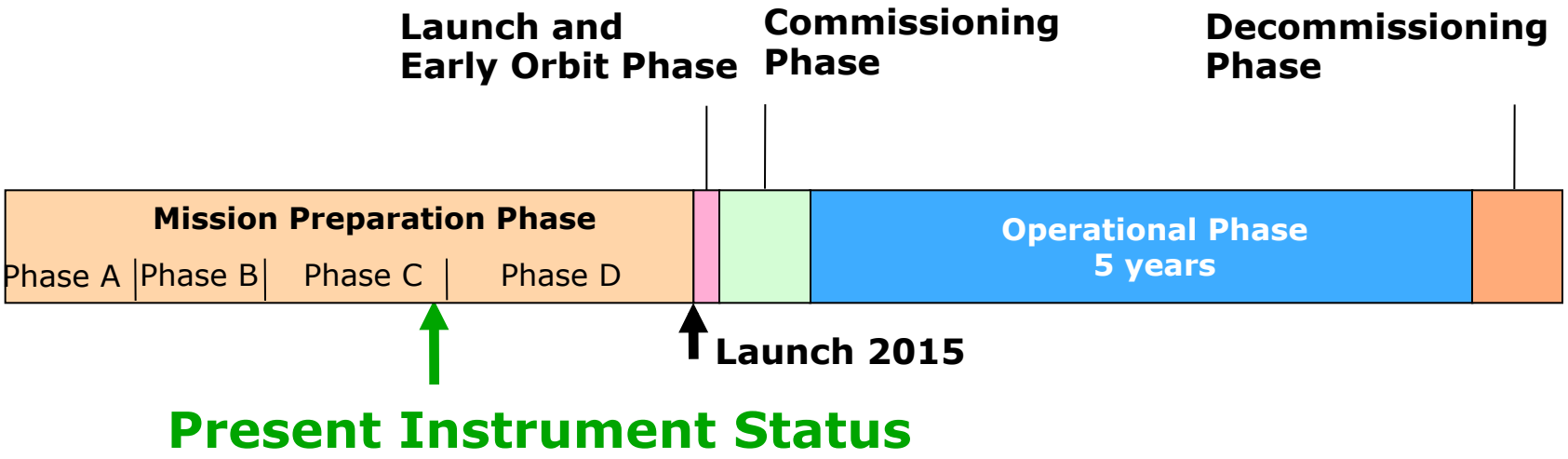
Space Segment
Kayser-Threde - Spectrometer
OHB Bremen - Bus Technology

Ground Segment
DLR-Oberpfaffenhofen

Status: Aug. 2011

Introduction - History and Current Status

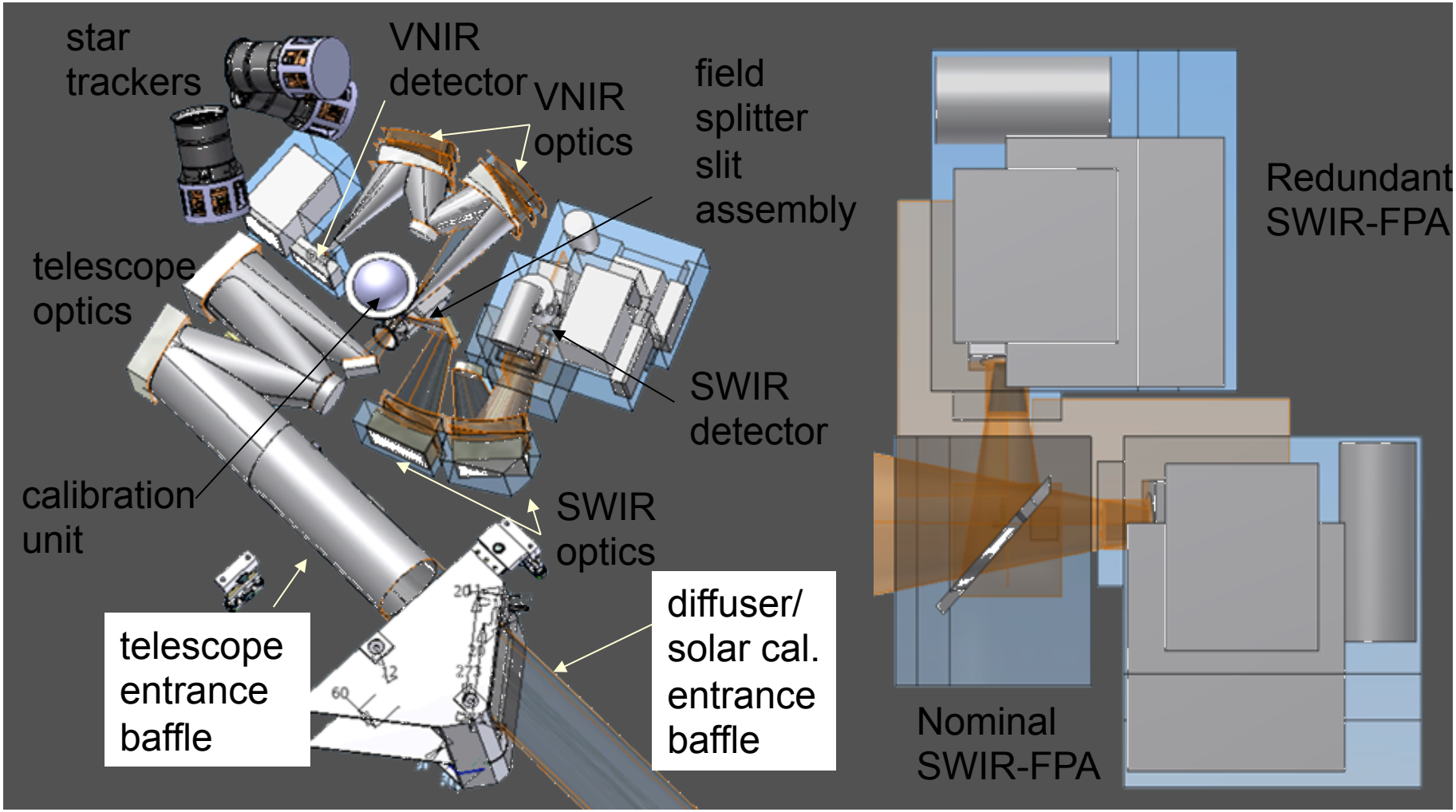
- 2005 Phase A study accomplished
- 2006 Start of phase B
- 2007 End of phase B
- 2008 Start of phase C/D
- 2010 CDR Ground Segment
- 2011 CDR Space Segment
- 2015 Launch date



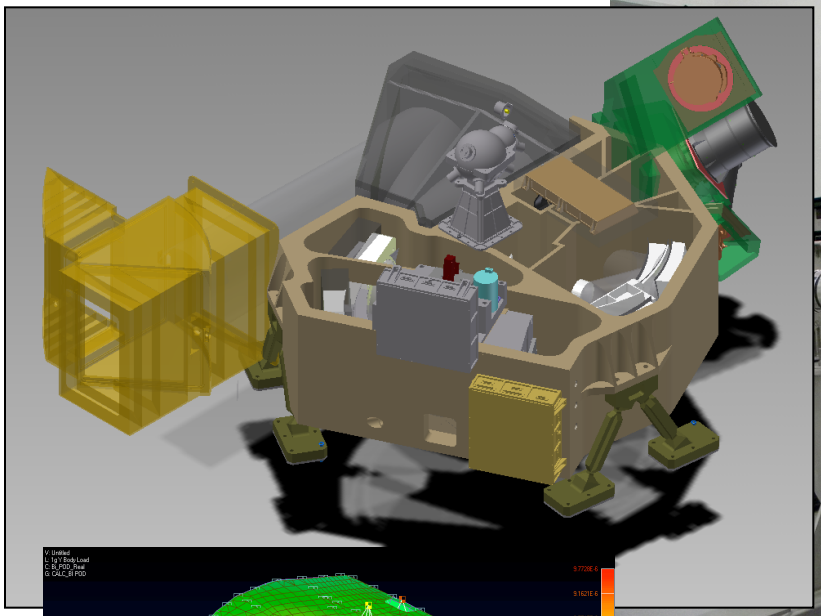
Instrument - Main Sensor/Orbit Parameters

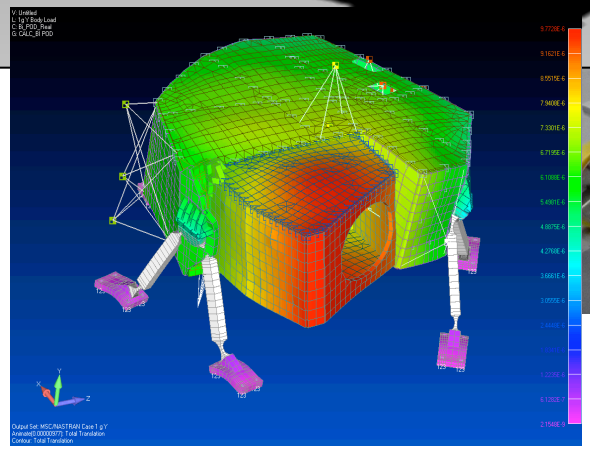
Signal-to-noise ratio (SNR) at 30% reflectance; 30° sun zenith angle; visibility 21 km; target 500 m a.s.l.	VNIR: > 500:1 (at 495 nm) SWIR: > 150:1 (at 2200 nm)
Quantification / Radiometric stability	14 bit / < 2.5 %
Spectral Sampling	6.5 nm VNIR; 10 nm SWIR
Ground sampling distance (GSD)	30 m x 30 m (at nadir; s. l.)
Swath width	30 km
Swath length	1000 km /orbit; 5000 km /day
Geometric co-registration	≤ 0.2 x GSD
Data Rate / Compression method	860 Mbit/s / loss less
Downlink rate (X-band) / Daily downlink	300 Mbit/s / 389 Gbit
Inclination	97.96°
Repeat cycle	23 days
Repeat rate	4 days (± 30° tilt)
LTDN	11:00 ± 15 min

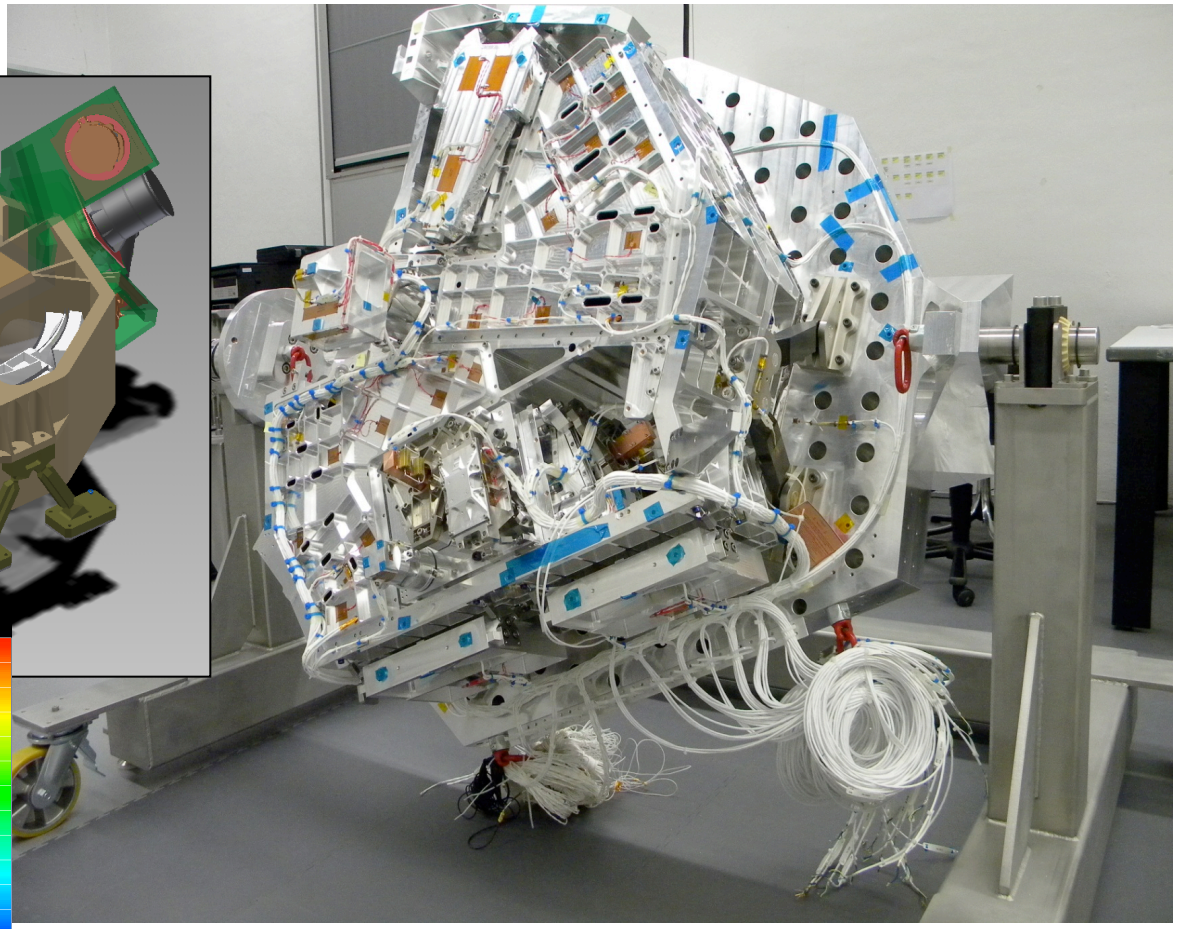
Instrument Optics Unit (IOU) - Main Elements



Instrument - CADs and STDM of Current Instrument Design Status







Problem: Thermoelastic deformation

Calibration and Validation

Objectives

- Data quality check and incidence reporting
- Assurance of L1 & L2 products traceability to international standards

Onboard calibration and long term monitoring

Validation

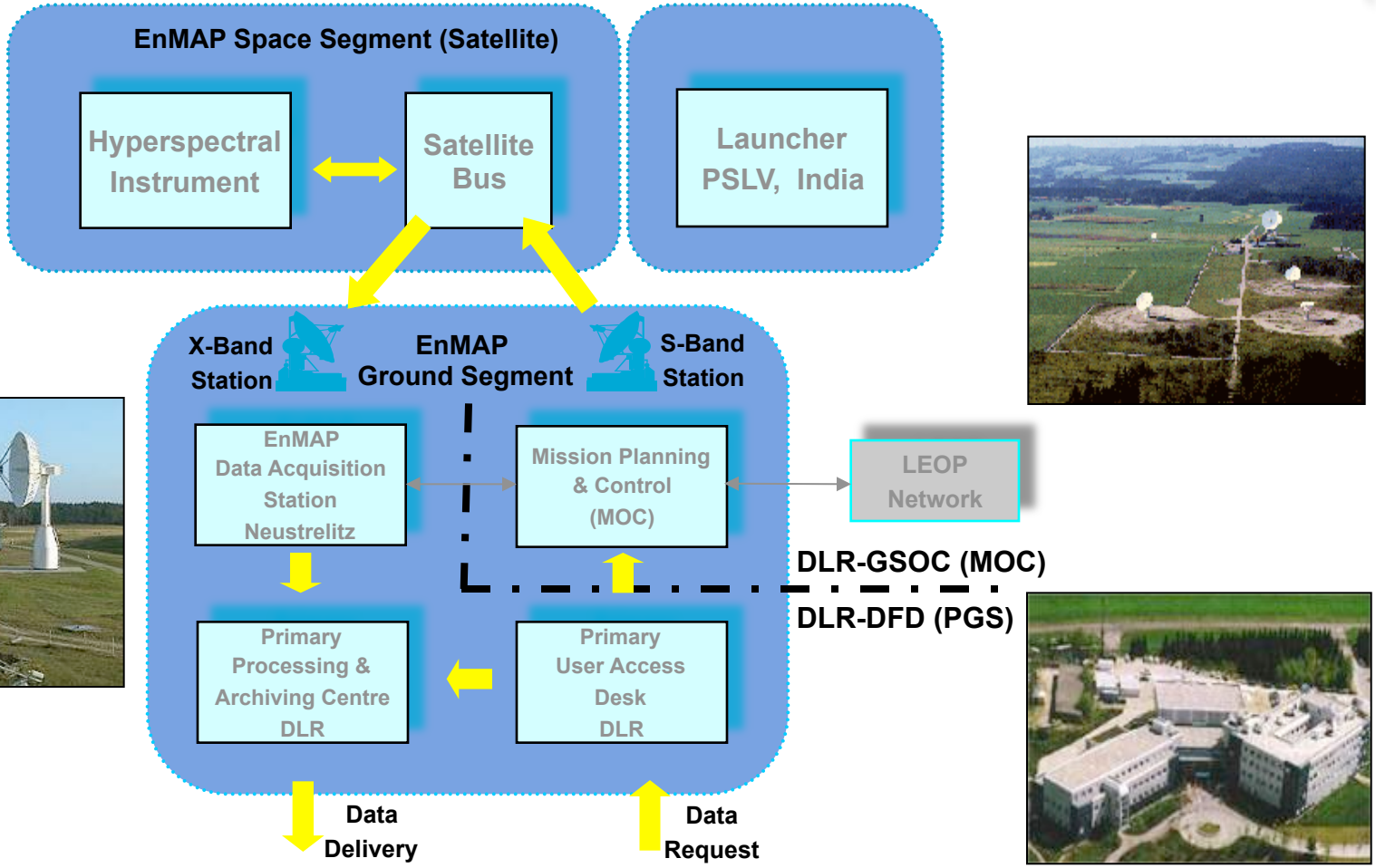
- Image-based analysis: image processing techniques to assess EnMAP instrument performance and data quality (e.g. SRFs, PSF, MTF assessment)
- Field-based validation using in-situ measurements of atmospheric and surface parameters for the validation of L1 and L2 products.
- Validation plan being framed in the internat. Cal/Val scenario (CEOS/WGCV)

Establishment of international partnerships in progress:

USA/JPL: White Sands; Australia/CSIRO: Lancelin & LJCO; Israel/Tel Aviv Uni.: Negev

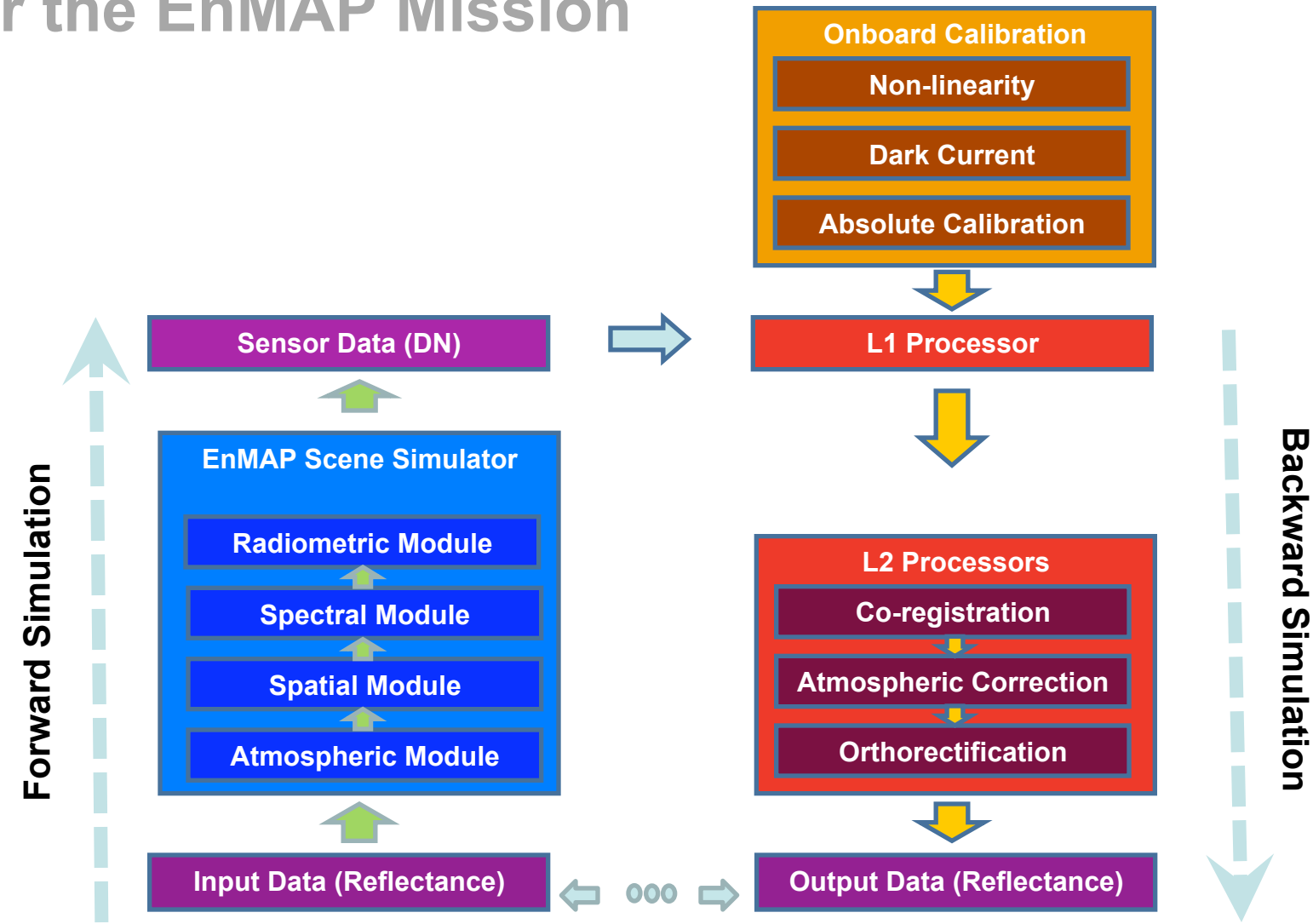
Guanter, L., Segl, K., Sang, B., Alonso, L., Kaufmann, H., and Moreno, J., 2009, Scene-based spectral calibration assessment of high spectral resolution imaging spectrometers. *Optics Express,*17-14, 11594-11606, 10.1364/OE.17.011594.

Ground Segment

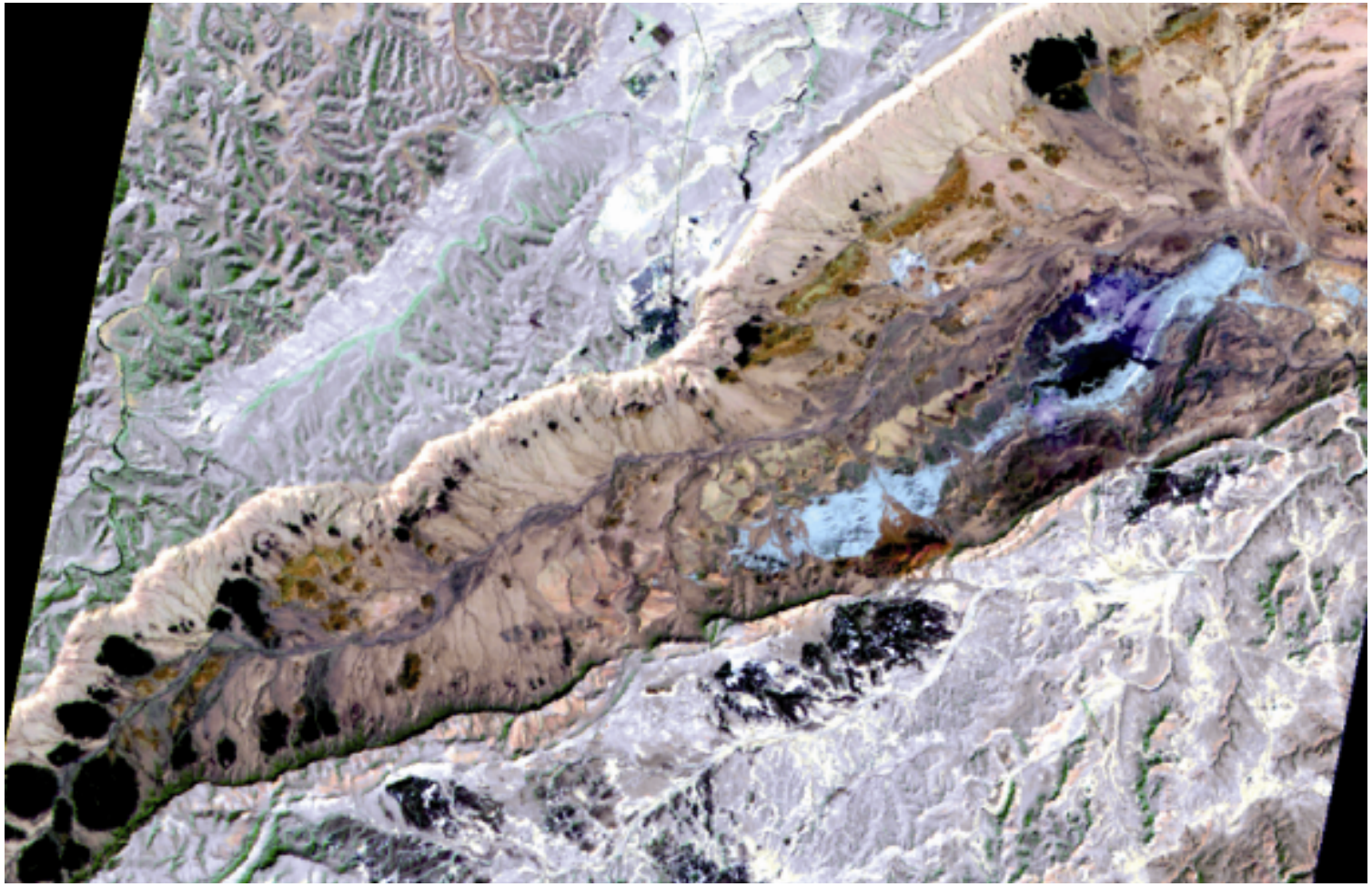


International EnMAP User Community

EeteS: an End-to-End Image Simulation Tool for the EnMAP Mission



Simulated EnMAP Data – M. Ramon, Israel



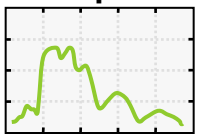
Guanter, L., Segl, K., Kaufmann, H. (2009): Simulation of Optical Remote-Sensing Scenes With Application to the EnMAP Hyperspectral Mission. - IEEE Transactions on Geoscience and Remote Sensing, 47, 7, 2340-2351

BRDF Issues

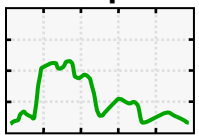
→ Simulation of any canopy structure (e.g. row distance, plant density)
→ Simulation of each growth stage
→ Simulation of plant stress and disease

MATERIAL ASSIGNMENT

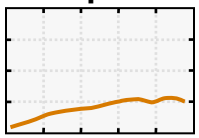
Leaf spectra



Stem spectra



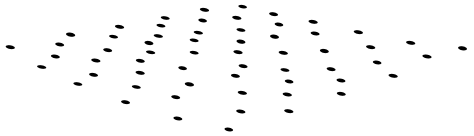
Soil spectra



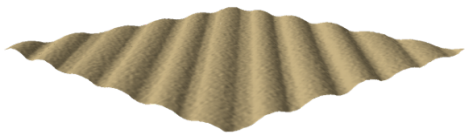
3D GEOMETRY

4D plant model

Plant positions within the canopy



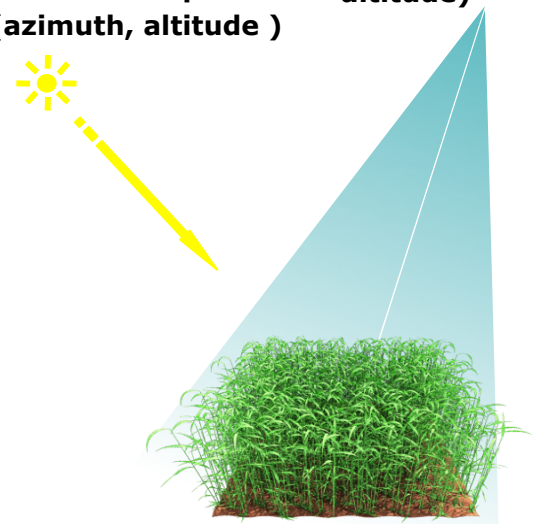
3D soil surface model



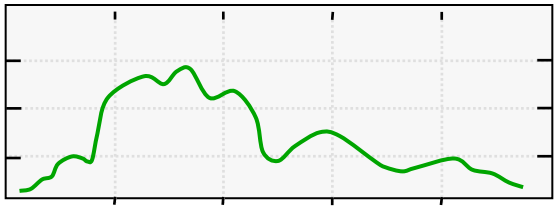
RAY TRACING

Illumination position (azimuth, altitude)

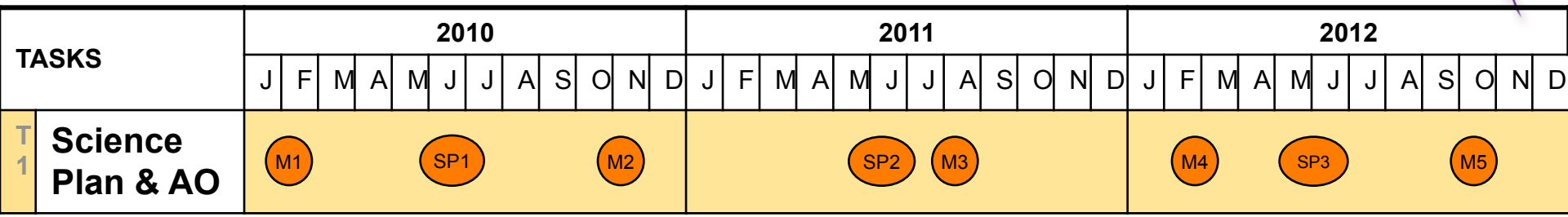
Viewing position (azimuth, altitude)



RESULTING CANOPY SPECTRUM



Science activities - Core Science Team (ECST)



Geology and Soil Science	**Prof. Dr. Hermann Kaufmann (Principle Investigator and Chair) GFZ German Research Centre for Geosciences**
Coastal and Inland Waters	**Dr. Roland Doerffer** **HCG Research Centre**
Forest and Vegetation	**Prof. Dr. Joachim Hill** **University of Trier**
Ecosystems and Gradual Transitions	**Prof. Dr. Patrick Hostert** **Humboldt-University Berlin**
Agriculture	**Prof. Dr. Wolfram Mauser** **Ludwig-Maximilian-University München**
Urban Areas	**Andreas Mueller** **DLR German Aerospace Establishment**

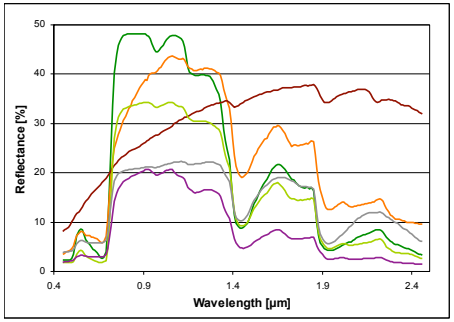
Themes within the young EnMAP Program

Hdhhd

kskks

Science activities - Core Science Team (ECST)

TASKS		2010												2011												2012											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
T1	Science Plan & AO	M1					SP 1					M2								SP 2		M3																	
T2	Summer Schools										S1								S2																	S3		

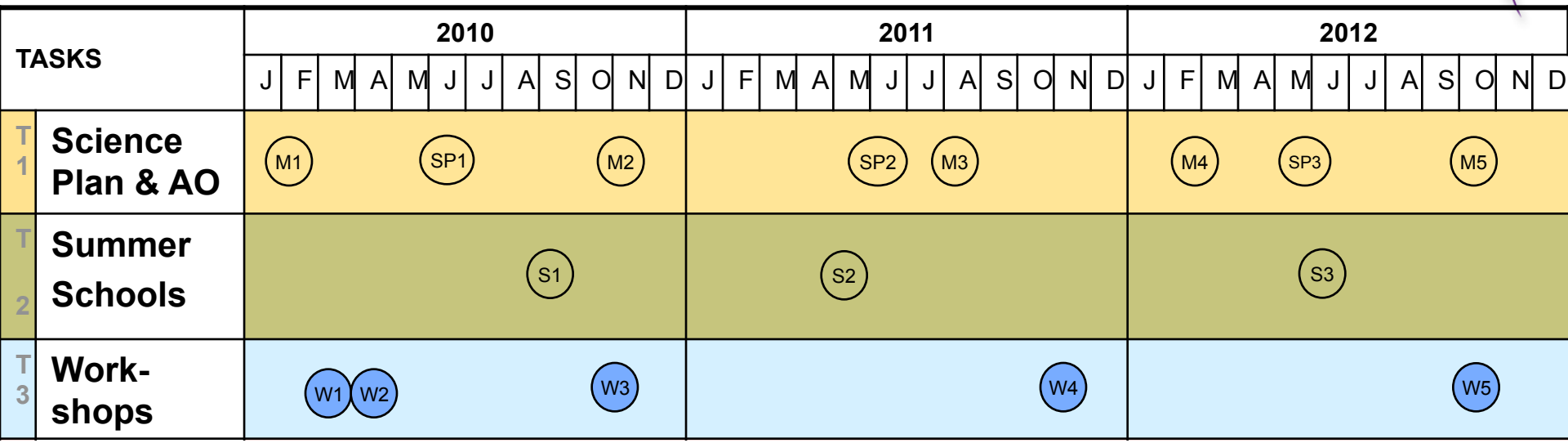


2010: 1st Summer School, Trier: Introduction to hyperspectal image analysis

2011: 2nd Summer School, Munich: Hyperspectral field campaigns: Methods, Instruments, Planning Strategies

2012: 3rd Summer School, Berlin

Science activities - Core Science Team (ECST)



W1 Int. Hyperspectral Workshop 2010 (Frascati, Italy)

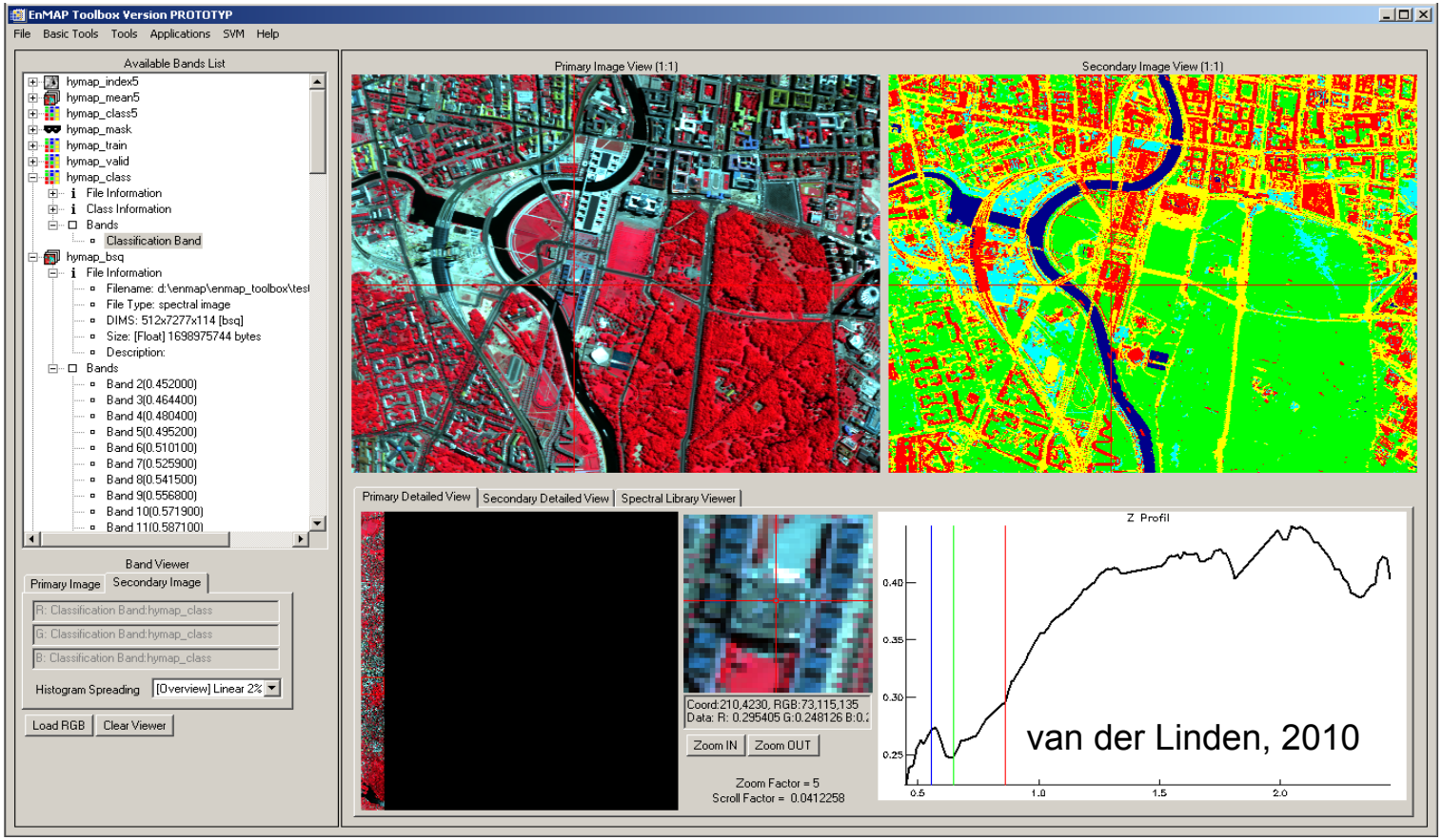
W2 Soil Workshop (GFZ)

W3 National Workshop 2010 (GFZ Potsdam)

W4 National Workshop 2011 (GFZ Potsdam)

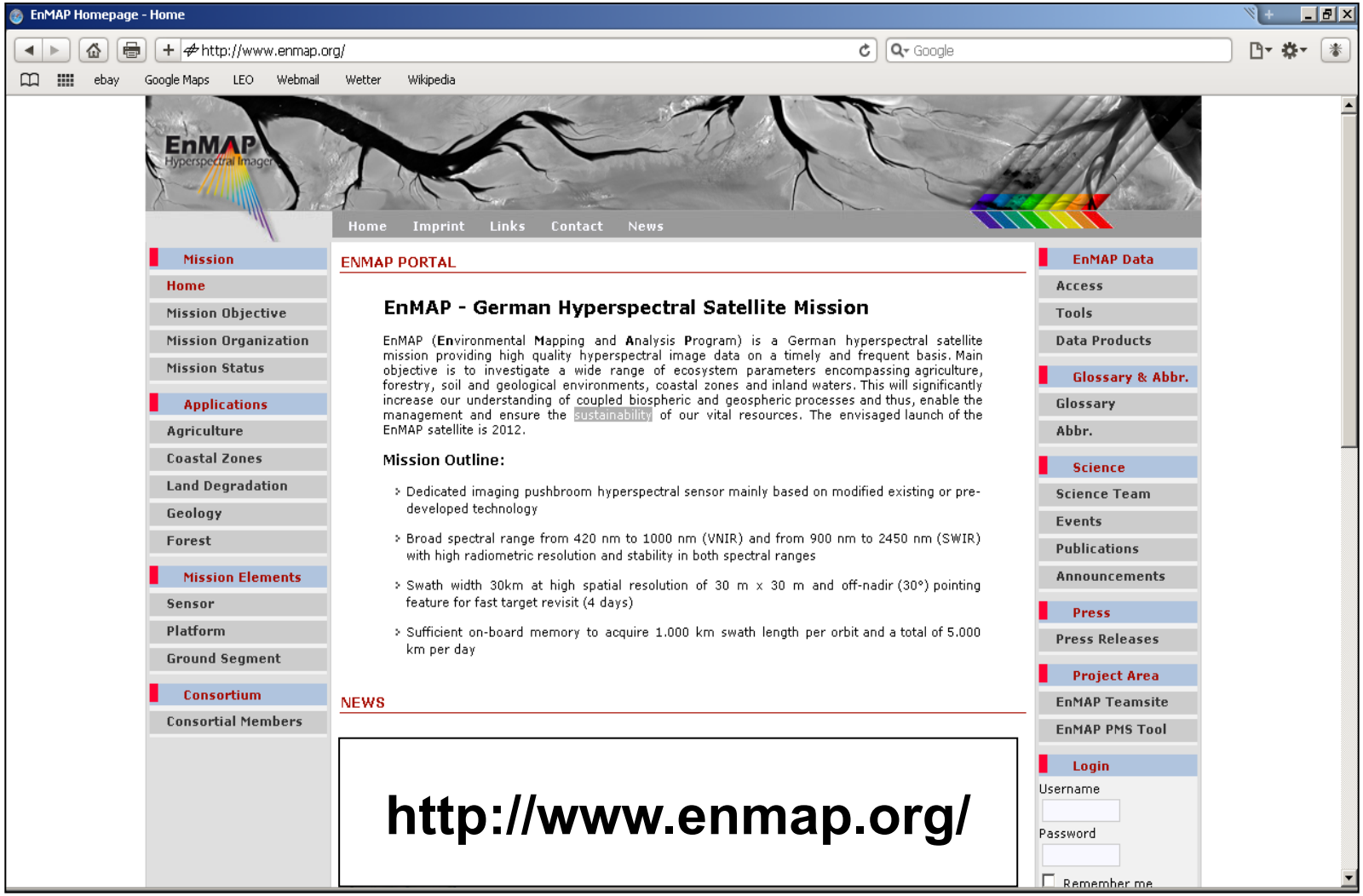
shifted to Feb. 2012

EnMAP Toolbox



- License free and platform independent processing environment
- Optimized for EnMAP/hyperspectral processing
- Shortly (autumn) available via www.enmap.org
- Developed by Humboldt-Universität zu Berlin, Geomatic Section

User Portal


EnMAP Homepage - Home
http://www.enmap.org/
Google
ebay
Google Maps
LEO
Webmail
Wetter
Wikipedia
EnMAP
Hyperspectral Imager
Home
Imprint
Links
Contact
News
Mission
Home
Mission Objective
Mission Organization
Mission Status
Applications
Agriculture
Coastal Zones
Land Degradation
Geology
Forest
Mission Elements
Sensor
Platform
Ground Segment
Consortium
Consortial Members
ENMAP PORTAL
EnMAP - German Hyperspectral Satellite Mission
EnMAP (Environmental Mapping and Analysis Program) is a German hyperspectral satellite mission providing high quality hyperspectral image data on a timely and frequent basis. Main objective is to investigate a wide range of ecosystem parameters encompassing agriculture, forestry, soil and geological environments, coastal zones and inland waters. This will significantly increase our understanding of coupled biospheric and geospheric processes and thus, enable the management and ensure the sustainability of our vital resources. The envisaged launch of the EnMAP satellite is 2012.
Mission Outline:
Dedicated imaging pushbroom hyperspectral sensor mainly based on modified existing or pre-developed technology
Broad spectral range from 420 nm to 1000 nm (VNIR) and from 900 nm to 2450 nm (SWIR) with high radiometric resolution and stability in both spectral ranges
Swath width 30km at high spatial resolution of 30 m x 30 m and off-nadir (30°) pointing feature for fast target revisit (4 days)
Sufficient on-board memory to acquire 1.000 km swath length per orbit and a total of 5.000 km per day
NEWS
http://www.enmap.org/
EnMAP Data
Access
Tools
Data Products
Glossary & Abbr.
Glossary
Abbr.
Science
Science Team
Events
Publications
Announcements
Press
Press Releases
Project Area
EnMAP Teamsite
EnMAP PMS Tool
Login
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Cooperation with HysplRI (and Hisui)

- Common identification of environmental relevant core themes and resp. sites for long term observation and analyses
- Common aircraft campaigns (esp. TIR capability)
- Exchange program for seniors and young academics

- Technical issues
  - Sensitivity studies to
    different GDS's (30m<->60m) for various applications
    compatibility for long term observations
    extended end to end simulation for TIR range
  - Cross calibration of systems
  - .....

Thank you
for listening

Contact:

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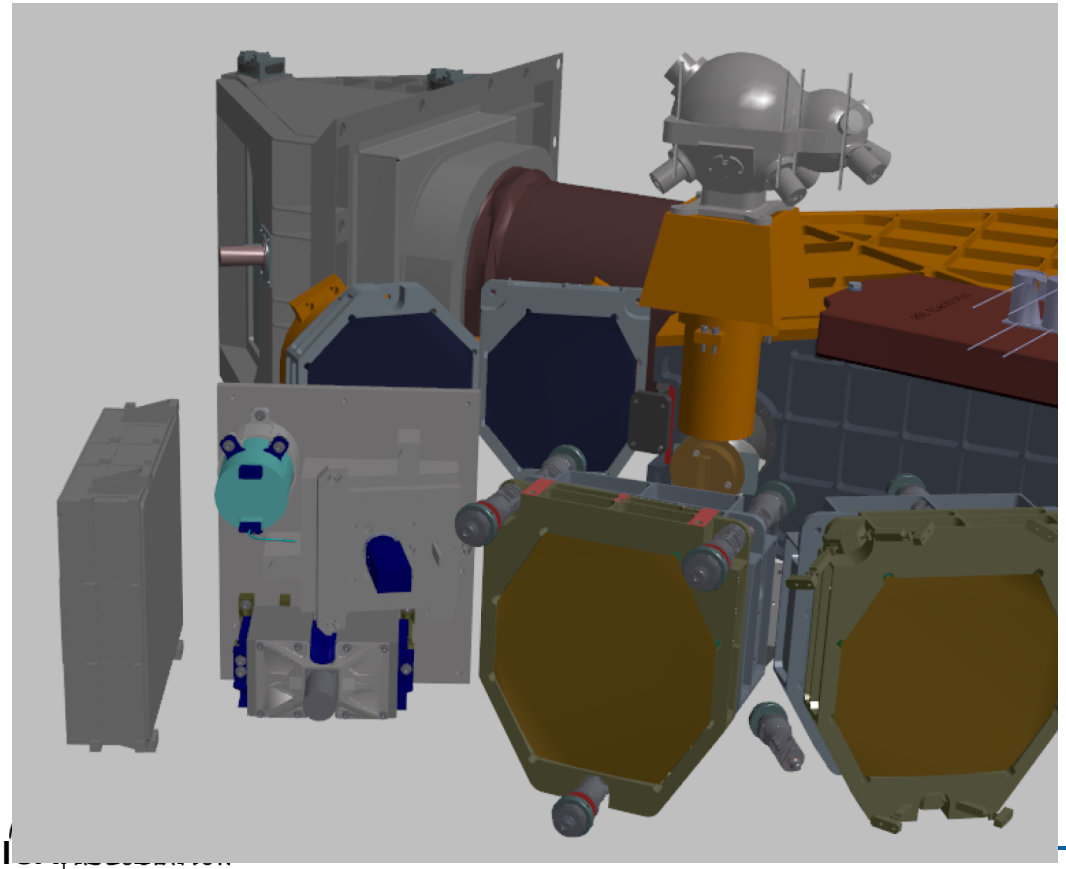
www.gfz-potsdam.de

Calibration and Validation

Objectives

- Data quality check and incidence reporting
- Assurance of L1 & L2 products traceability to international standards

Onboard calibration and long term monitoring



Radiometric and spectral calibration

- Dark value
- Relative radiometric calibration
- Sun calibration
- Spectral calibration
- Linearity measurements
- House keeping data analysis