Mission - Update

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IGARSS 2014 – Quebec Canada
EnMAP Mission & Instrument Parameters

• Push-broom imager

• Spectral range from 420 nm to 2450 nm (VNIR-SWIR)

• high spectral resolution of 6.5 nm (VNIR) and 10 nm (SWIR); ~ 244 bands

• high SNR of 500 @ 495 nm; 170 @ 2200 nm

• Swath width 30 km

• Ground sampling distance 30 m at nadir

• 27 days repeat cycle

• 4 days revisit through ± 30° off-nadir pointing

• 5000 km total swath length acquisition per day

• Mission Life Time of 5 years
Hyperspectral Imager EnMAP

**multispectral**

**hyperspectral**

- chlorite
- calcite
- dolomite
- alunite
- gypsum
- kaolinite

Reflectance

2.5, 2.5, 0.4, 0.4 microns

Hyperspectral Imager EnMAP
Science Program / Fields of Applications

Co-operative international Networks

Management of agricultural and forest ecosystems

Hazard assessment

Urban development

Inland & coastal waters

Retrieval of biogeochemical and geophysical parameters

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

extreme natural processes

dry land degradation

mineral exploration

GFZ - Remote Sensing Section
Time Schedule

- 2005 Phase A study accomplished
- 2006 Start of phase B
- 2008 Start of phase C/D
- 2010 CDR Ground Segment
- 2012 CDR Space Segment
- 2013 Start Phase D
- 2017 (Dec.) Launch date

Present Status

Launch and Early Orbit Phase
Commissioning Phase
Decommissioning Phase

Mission Preparation Phase
Phase A | Phase B | Phase C | Phase D

Operational Phase 5 years

Launch 2017/18 (PSLV/India)
EnGeoMAP – Mineralogic Parameters

**Products / Parameters:**

- Geological mapping of resource deposits and monitoring of mine waste
- Detection of e.g. Gold, Copper, Rare Earth minerals
- Full mineral identification and semi-quantification

**Core Activities:**

- Develop algorithms and expert systems for mineralogical mapping
- Develop new algorithms and models for non-linear, weighted unmixing and mineral quantification approaches
Feasibility Studies for the Detection of REEs

Characteristic absorption features in the VNIR range are due to crystal field transitions of some Rare Earth Elements

Source: Clark, 1993b
EnSoMAP – Soil Parameters

Products / Parameter:

- Automatic generation of semi-quantitative soil maps (soil moisture content, organic carbon, iron oxides, clays, carbonates content) + quality layer maps
- User custom option for fully quantitative soil mapping
- Derivation of new L3 products not accessible from multispectral imagery

Availability:

- Currently distributed for airborne users: www.gfz-potsdam.de/hysoma (HYperspectral SOil MApper)

Example L3 soil products
Agricultural Algorithms

Products / Parameters:

- **Improved** derivation of canopy parameters (LAI, chlorophyll content, water content ...)
- **More precise** information on growth conditions of agriculturally used areas
- Allowing for **more sustainable management** (ecologically and economically) of the bio-productive land surface.

Core Activities:

- Library of hyperspectral indices
- Method for the background insensitive analysis of local absorption features
- Derivation of LAI and canopy water content through neuronal-network methods
- Module for the statistical analysis of imagery and field measurements
Correction for Anisotropic Reflectance

Reflectance of winter wheat canopy

- Reflectance different for changing observation geometry
- VI (e.g. NDVI) values also varying
- Each VI value should characterize one canopy stand

Goals for EnMAP:
Function to correct vegetation indices for each observation geometry for e.g. cereal canopies value of nadir observation (comparable with other data)
Forest Ecosystems

Products / Parameters:
- Comprehensive mapping of
  - Tree species and age classes
  - Leaf Area Index and biomass
  - Water and chlorophyll content
  - Timber volume

Core Activities:
- Validation strategies for future EnMAP products
- Hyperspectral detection of plant stress
- Canopy reflectance modeling
  - Model inversion
  - Data fusion hyperspectral - LiDAR
Monitoring Ecosystem Transitions

Products / Parameters:

- Fractional cover of natural vegetation in heterogeneous landscapes
- Biomass estimates along a vegetation succession gradient

Core Activities:

- Implementation and optimization of new algorithms and methodological approaches
- IVMquant: Import vector machines for sub-pixel mapping
- SVRmix: Support vector regression with synthetic libraries
- SCCA: Sparse canonical correlation analysis with spectra
- Quantification of gradual changes, such as shrub encroachment following farmland abandonment, or urban to peri-urban transitions
- Mapping biotic community changes using simulated EnMAP data
Coastal and Inland Waters

Products:
- Algae and dominant algae group detection in spectral complex / small scale waters
- Classification of eulittoral flat surfaces (phytobentos, mussels, sediments …)

Core Activities:
- Several optical parameters ($a_{pig}, a_{tot}, a_{detr}, b, refl, \ldots$) for various coastal- and inland-waters as well as eulittoral flats
- Adaption and optimization of NN-algorithms for hyperspectral analysis over optical complex waters including atmospheric correction.
- Advanced index retrieval for eulittoral surfaces

Windwatt - Map of Phytobenthos Distribution
Products:

- Classification of urban surface materials
- Abundance of vegetation and specific materials

Core activities:

- Implement a comprehensive spectral library based on EnMAP data
- Develop algorithms for quantitative analysis of urban materials with regard to mixed pixel problems and rare pure endmember availability
- Investigate new concepts for the information extraction based on compositional information of spectral mixtures
EnMAP end-to-end Simulation (EeteS)

- Optimization of Sensor Parameters
- Simulation of EnMAP image data & products

Sensor Data (L0 data)

EnMAP Scene Simulator
- Radiometric Module
- Spectral Module
- Spatial Module
- Atmospheric Module

Input Data (Reflectance, DEM, AOT, Clouds)

L1 Processor

L2 Processors
- Co-registration
- Atmospheric Correction
- Orthorectification

Output Data
(L2 Reflectance)

Onboard Calibration
- Non-linearity
- Dark Signal
- Absolute Calibration
EnMAP Data Delivery (Web only)

- Data are freely available
- Data are free of costs to scientist

<table>
<thead>
<tr>
<th>Product</th>
<th>Processor</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>Transcription</td>
<td>Stored in DIMS (no delivery)</td>
</tr>
<tr>
<td>Level 1</td>
<td>Radiance</td>
<td>Processing on Demand; Meta Data updated for User Proc.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Georectification + Co-Registration + Reflectance</td>
<td>Geometric and Atmospheric Correction</td>
</tr>
<tr>
<td>Level 2geo</td>
<td>Georectification + Radiance</td>
<td>Geometric Correction</td>
</tr>
<tr>
<td>Level 2atm</td>
<td>Co-Registration + Reflectance</td>
<td>Atmospheric Correction</td>
</tr>
</tbody>
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EnMAP (TOOL-)Box

- Easy access to processing tools for hyperspectral data
  - widening user community
  - support for training courses
  - state-of-the-art algorithms

- Individual preprocessing tools for EnMAP data

- Platform to test and exchange new and innovative algorithms

- Free download at www.enmap.org

Humboldt Uni, 2013
User Portal

Environmental Mapping and Analysis Program

3rd National EnMAP User Workshop - Presentations are online

Published on 14-February-2012
The third national EnMAP workshop was held on 08th & 09th of February 2012 at the Helmholtz Centre Potsdam GFZ, Germany. The workshop was devoted to first results of the EnMAP preparatory projects. The workshop program and all presentations are now online available. The workshop language was German.

Workshop program (in German)

Young EnMAP

Published on 03-November-2011

YoungEnMAP is a group of young researchers interested in sharing ideas and experiences in the field of imaging spectroscopy. The group was founded during the first EnMAP summer school in Trier, Germany in September 2010.

EnMAP Mailing List

Published on 11-August-2011

Join the EnMAP mailing list to receive exchange information related to the EnMAP scientific mission. Currently about 200 people are interested in EnMAP and hyperspectral remote sensing from research, administration and business are subscribed to the list. Most postings are sent in German. The EnMAP mailing list is managed by the Remote Sensing Section of the GFZ German Research Centre for Geosciences in Potsdam, Germany.

http://www.enmap.org/

Thank you for your attention