Overview of the EnMAP Imaging Spectroscopy Mission

EnMAP: Environmental Mapping and Analysis Program
Conceived as an operational imaging spectroscopy mission for EO
Good data quality & higher level products from ground segment
Open data policy

Core funding from the German Federal Ministry of Economics and Technology
Currently under construction phase, launch ~mid 2018
EnMAP – Main Mission Parameters

- Push-broom imaging spectrometer
- Sun-synchronous orbit, 11h LTDN
- Spectral range
  - VNIR: 420 nm to 1000 nm
  - SWIR: 900 nm to 2450 nm
- Spectral sampling distance
  - VNIR ~6.5 nm
  - SWIR ~10 nm
- Data acquisition
  - 1000 km/orbit
  - 5000 km/day
- Swath width 30 km
- Ground sampling distance 30 m
- Revisit time
  - 27 d nadir
  - 4 d with 30º across-track pointing
- Mission lifetime ≥ 5 years
Dual-spectrometer instrument concept

- Independent VNIR & SWIR FPAs: field splitter & double entrance slit
- Curved Offner prism design to maximize uniformity (smile & keystone <5%)
Onboard calibration units

**Radiometric sphere + LEDs:** detector linearity and pixel mapping

**Spectral sphere + doped spectralon:** spectral calibration

**Sun diffuser:** absolute radiometric calibration

**Shutter mechanism:** dark signal calibration

(See talk tomorrow by André Hollstein)
Radiometric performance

- Prism-based design: SNR scales with $\sim\sqrt{\text{radiance}}$
- Sufficient SNR performance for most applications
- Water and urban, most critical applications
Data Products & Acquisition Priorities

### User products

<table>
<thead>
<tr>
<th>Product</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>Time-tagged instrument raw data with auxiliary information (internal)</td>
</tr>
<tr>
<td>Level 1B</td>
<td>Radiometrically-corrected, spectrally- and geometrically-characterised radiance</td>
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<tr>
<td>Level 1C</td>
<td>Orthorectified level 1B</td>
</tr>
<tr>
<td>Level 2A</td>
<td>Atmospherically-corrected level 1C</td>
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</tbody>
</table>

### Acquisitions:

- Restricted to 1000 km/orbit, and 5000 km/day
- Daily acquisition plan (mostly) based on user requests and categories

<table>
<thead>
<tr>
<th>Priority</th>
<th>Request</th>
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<tbody>
<tr>
<td>1</td>
<td>Internal user</td>
</tr>
<tr>
<td>2</td>
<td>Support for catastrophic events</td>
</tr>
<tr>
<td>3</td>
<td>Registered users (Cat.1) excellent proposals</td>
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<tr>
<td>4</td>
<td>Registered users (Cat.1)</td>
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<tr>
<td>5</td>
<td>Non-registered users (Cat.2)</td>
</tr>
<tr>
<td>6</td>
<td>Requests beyond fulfilled contingents</td>
</tr>
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<td>7</td>
<td>Background mission</td>
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</tbody>
</table>
EnMAP Science Plan

Content:
- General mission framework
- EnMAP perspectives and impact
- Scientific exploitation strategy

Current focus of EnMAP Science Advisory Group:
- Agriculture
- Forest
- Ecosystems
- Soils & Geology
- Coastal and inland water
- Urban
**Objectives:**

1) **Optimization of instrument design**
   - Refinement of instrument specifications
   - Impact of instrumental effects on Digital Numbers

2) **Generating a data base for algorithm development, validation and calibration**
   - Reflectance and radiance for scientific applications
   - Digital Numbers for Ground Segment

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**EnMAP end-to-end scene simulations**

Segl et al., IEEE JSTARS, 2012
EnMAP end-to-end scene simulations

Simulation of (i) EnMAP-like TOA radiance images and (ii) L2 surface reflectance after pre-processing

Many (>100) simulated EnMAP data sets already available

Contact Karl Segl at GFZ if you need simulations for your study site!
EnMAP-Box

- Software for the pre-processing and scientific exploitation of EnMAP data
- Free, open source and platform independent
- Reference algorithms for different application fields being developed by EnSAG partners

Rabe, van der Linden et al. (HU Berlin)

Download from www.enmap.org/?q=enmapbox
EnSoMAP: Digital Soil Mapping

- Expert system for soil mapping
- Automatic generation of semi-quantitative soil maps (soil moisture content, organic carbon, iron oxides, clays, carbonates content) + quality layer map
- User custom option for fully quantitative soil mapping
- Currently distributed for airborne users:
  
  www.gfz-potsdam.de/hysoma

Example L3 soil products

Chabrillat et al.
Airborne hyperspectral images and associated in-situ data provided free of charge to science community under CC BY-SA Licence

Search metadata portal at www.enmap.org → data

Datasets published as data publications (with DOI)

Technical Report will be provided with each dataset (documentation of data acquisition, processing, quality etc.)
Support to young researchers

• **PhD Programme:** 15 PhD projects currently ongoing on different research areas and groups in Germany

• **YoungEnMAP:** International Summer Schools organised every year

EnMAP summer school participants (Lauenburg, March 2015)
Thank you for your attention!

www.enmap.org