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HYPERedu online education initiative

Concept, current status and cooperation opportunities

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and many colleagues

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German
Space Agency
at DLR



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HYPERedu in a nutshell

Basics

Principles of Imaging Spectroscopy



Preprocessing



Sensor Technology and Data Acquisition



Sensor Simulation



Methods

Dimensionality Reduction



Hyperspectral Processing Techniques



Retrieval of Vegetation Traits



Software and Data

EnMAP-Box



EnMAP Portal



PRISMA Portal



Applications

Agricultural Systems



Soil Mapping



Terrestrial Ecosystems

Forest Ecosystems



Geological and Mineral Mapping



Snow and Ice Mapping

Inland and Coastal Waters



Quantifying Carbon Cycling

Natural and Anthropogenic Hazards

Urban Environments



Atmospheric Composition

More to come ...



Slide collection



Hands-on tutorial



YouTube Video Screencast



Massive Open Online Course (MOOC)

Target group
Students and professionals in science, public authorities, companies

Pre-requisite
Basic knowledge in remote sensing

License
CC BY 4.0

Languate
English

Platform
EO-College

EO-College

 eo college eo-college.org

 September 2017

FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

 esa

 DLR

- ❖ Central platform for EO education in Germany with contributions from several groups for different EO fields and target groups
- ❖ Open education repository for online learning materials and courses, discussion platform and information hub

All Resources

BROWSE ALL AVAILABLE
LEARNING MATERIALS

Radar

RESOURCES RELATED TO RADAR
REMOTE SENSING

Hyperspectral

RESOURCES RELATED TO
HYPERSPPECTRAL REMOTE
SENSING

Schools

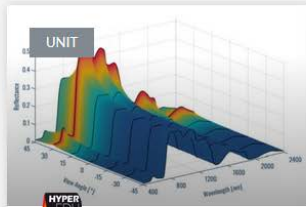
TEACHING MATERIALS ON
REMOTE SENSING, SPECIFICALLY
DESIGNED FOR CHILDREN

Hyperspectral resources



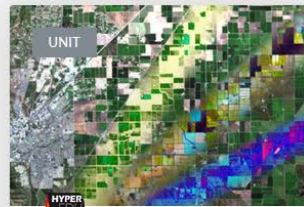
Sensor simulation

HYPERedu • January 15, 2021



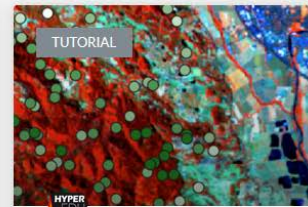
Imaging spectroscopy of forest ecosystems

HYPERedu • November 26, 2020



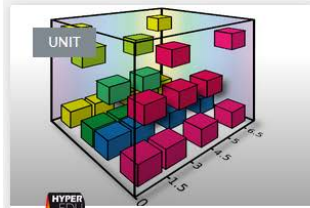
Retrieval approaches of vegetation traits from imaging spectroscopy data

HYPERedu • October 7, 2020



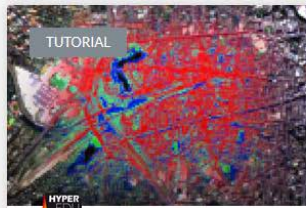
Regression-based mapping of forest aboveground biomass

HYPERedu • September 3, 2020



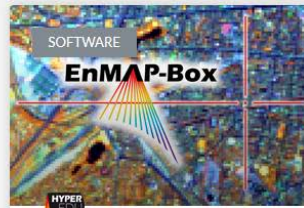
Dimensionality reduction of imaging spectroscopy data

HYPERedu • April 26, 2020



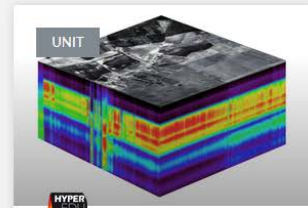
Regression-based unmixing of urban land cover

HYPERedu • March 30, 2020



EnMAP-Box

HYPERedu • September 23, 2019



Principles of imaging spectroscopy

HYPERedu • September 23, 2019

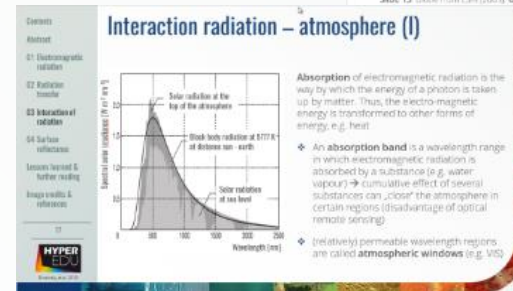
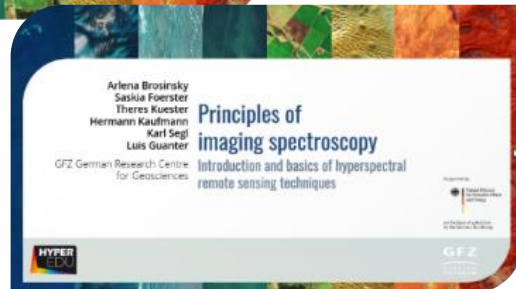
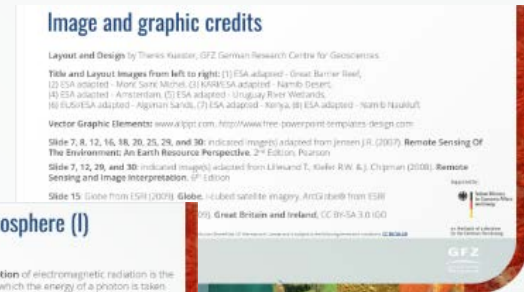
Hyperspectral resources on EO-College



<https://eo-college.org/resource-spectrum/hyperspectral/>

Slide collections

- ❖ First annotated slide collection published in Sept 2019
- ❖ All published in pdf and ppt format following corporate layout and consistent structure



Hands-on tutorials

Exercise A: Urban land cover


Description




Airborne imaging spectroscopy data is well suited for urban mapping. The high spectral and spatial resolution enhances the separability of surface types and preserves the spatial detail of many urban features. This exercise...

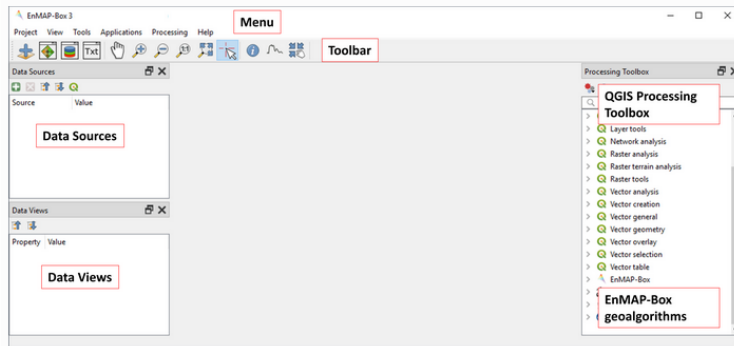
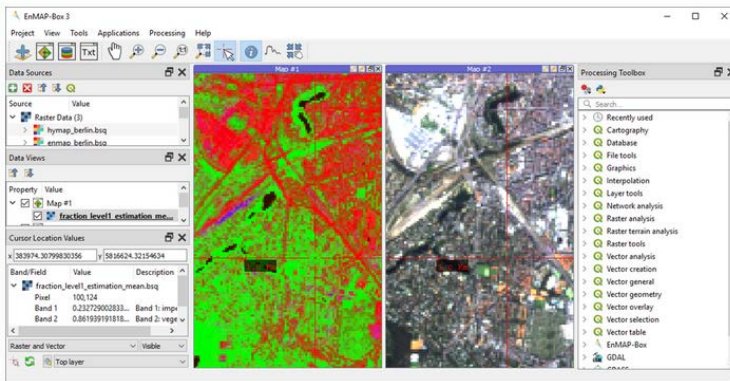
- provides an insight into how urban areas are depicted by airborne hyperspectral images and introduces a hierarchical classification scheme commonly adopted for urban mapping
- introduces basic functionalities of the EnMAP-Box. You will get to know the graphical user interface, and you will learn how to load data, visualize raster and vector data, and use the basic navigation tools

Duration: 15 min

1. Start the EnMAP-Box

- Start QGIS and click the  icon in the toolbar to open the EnMAP-Box. EnMAP-Box consists of a **Menu** and a **Toolbar**, panels for **Data Sources**, **Data Views**, **Processing Toolbox** including the EnMAP-Box geosgorithms

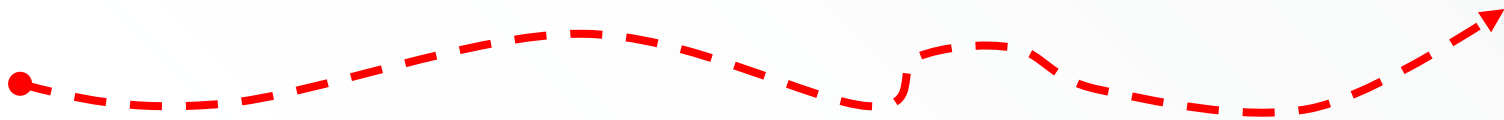
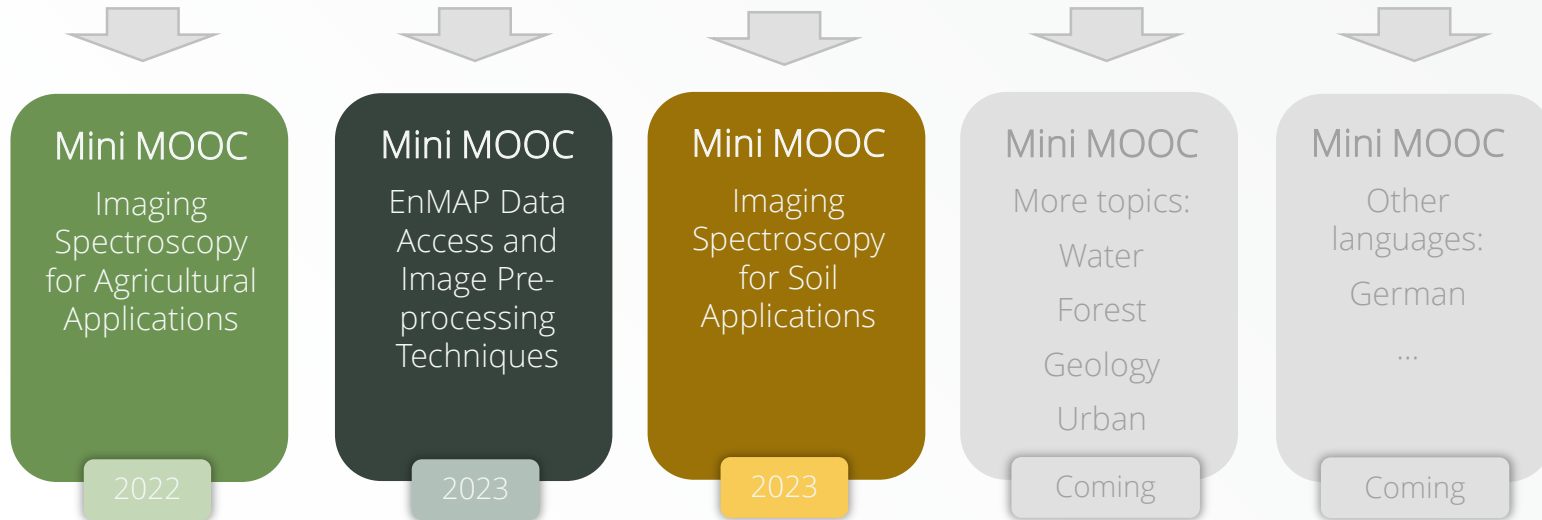
- Visually explore your fraction map. You may open 'enmap_berlin.bsq' in a separate Map Window for comparison. You may use the **Identify** tool together with the **Identify cursor location values** option to display fraction values    of pixels.



Hyperspectral MOOC family

Basic MOOC Introduction to Hyperspectral Remote Sensing

2021



Basic MOOC (published Nov 2021)

Welcome

Pre-Assessment

Principles of Imaging Spectroscopy

- Imaging spectroscopy and electromagnetic radiation
- Interaction with atmosphere and targets
- Spectral reflectance of surface materials

L1

Principles of Sensor Technology & Data Acquisition Techniques

- The four resolutions
- Imaging spectroradiometers
- Data acquisition: spaceborne, airborne and ground-based (field & lab)
- Data products

L2

Hands-On-Training

- From research question to final product
- Data sources: spaceborne, airborne, spectral libraries
- Data preprocessing
- Methods and software
- EnMAP-Box introduction

L3

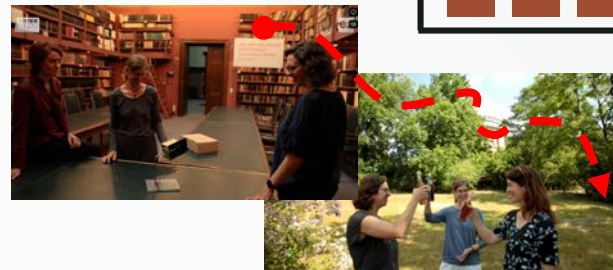
Final exam, user survey and goodbye

Learning elements

- 🔍 Quizzes
- 🖱️ Interactive graphics
- 🎥 Videos
- 📄 Texts
- 📅 Hands on exercises
- 💬 Discussion forum

Documents

- 📄 Offline document
- 📄 Diploma supplement
- 📄 Certificate
- 📄 Data set



Basic MOOC (published Nov 2021)

The screenshot shows the EO College website interface. At the top, there is a navigation bar with the 'eo college' logo and menu items: COURSES, EVENTS, RESOURCES, DISCUSSION, SOFTWARE, and ABOUT. There are also search and login/register buttons. The main content area features a large banner for the course 'Beyond the Visible - Introduction to Hyperspectral Remote Sensing'. The banner includes a 'View Course details' link and a 'HYPEREDU HYPERedu' logo. A smaller version of the course card is overlaid on the right, showing the course title and two buttons: 'Not Enrolled' and 'Login to Enroll'.

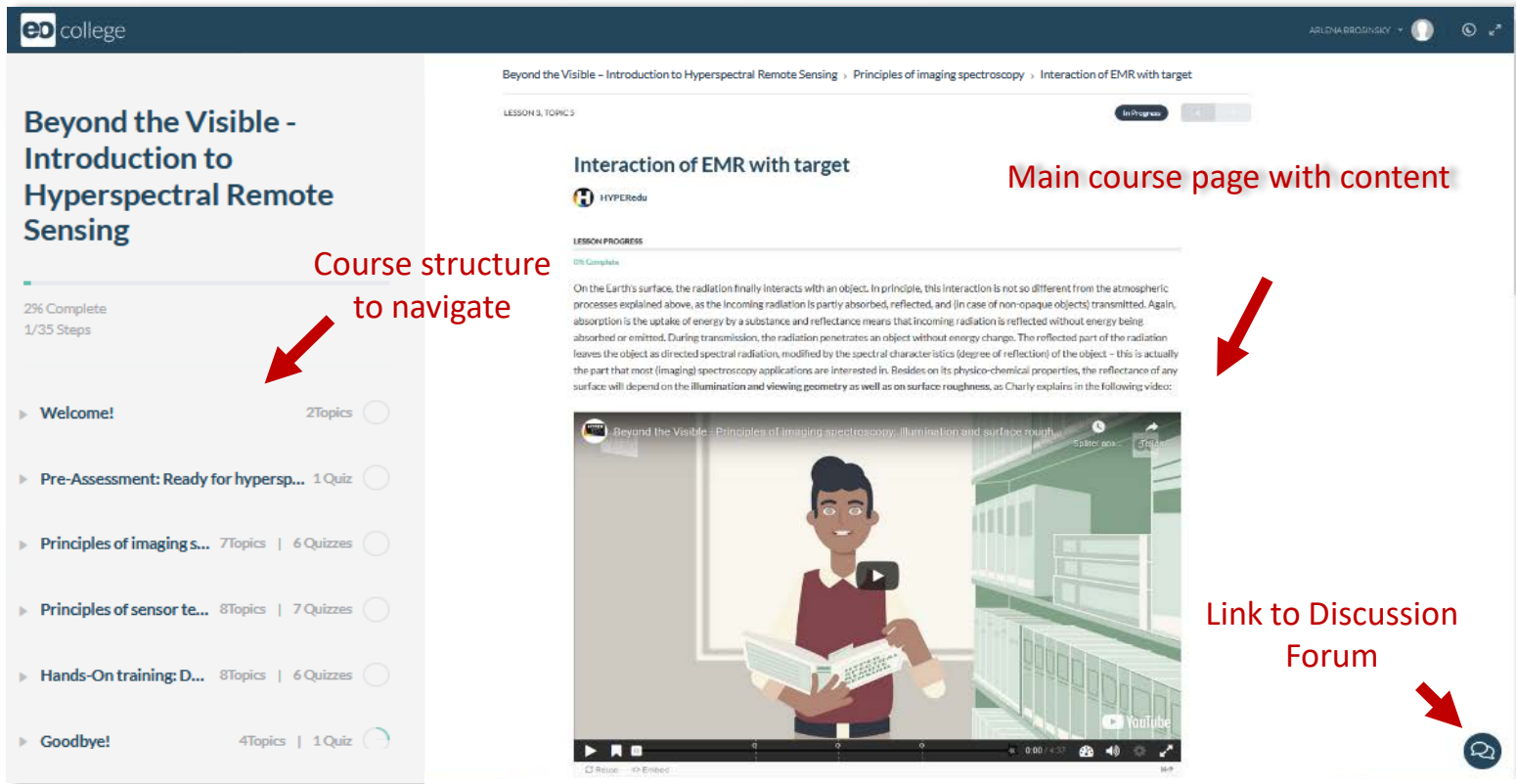
HYPERedu
MOOC "Beyond
the Visible"



[https://eo-college.org/
courses/beyond-the-visible/](https://eo-college.org/courses/beyond-the-visible/)

- ❖ Contents: Principles of imaging spectroscopy, sensor technology and data acquisition techniques, data and software
- ❖ Language: English language
- ❖ Length: ~ 5-8 hours (self paced)
- ❖ Certificate: Final assignment

Basic MOOC (published Nov 2021)



The screenshot shows a MOOC interface. On the left is a sidebar with the course title and a progress indicator (2% Complete, 1/35 Steps). Below this is a list of course sections: Welcome! (2 Topics), Pre-Assessment: Ready for hypersp... (1 Quiz), Principles of imaging s... (7 Topics | 6 Quizzes), Principles of sensor te... (8 Topics | 7 Quizzes), Hands-On training: D... (8 Topics | 6 Quizzes), and Goodbye! (4 Topics | 1 Quiz). The main content area is titled 'Interaction of EMR with target' and includes a video player. A red arrow points from the sidebar to the main content area with the text 'Course structure to navigate'. Another red arrow points from the main content area to a discussion forum icon in the bottom right corner with the text 'Link to Discussion Forum'. A third red arrow points from the text 'Main course page with content' to the main content area.

ed college

Beyond the Visible - Introduction to Hyperspectral Remote Sensing

2% Complete
1/35 Steps

- Welcome! 2 Topics
- Pre-Assessment: Ready for hypersp... 1 Quiz
- Principles of imaging s... 7 Topics | 6 Quizzes
- Principles of sensor te... 8 Topics | 7 Quizzes
- Hands-On training: D... 8 Topics | 6 Quizzes
- Goodbye! 4 Topics | 1 Quiz

Beyond the Visible - Introduction to Hyperspectral Remote Sensing > Principles of imaging spectroscopy > Interaction of EMR with target

LESSON 3, TOPICS

In Progress

Interaction of EMR with target

HYPERedu

LESSON PROGRESS

0% Complete

On the Earth's surface, the radiation finally interacts with an object. In principle, this interaction is not so different from the atmospheric processes explained above, as the incoming radiation is partly absorbed, reflected, and (in case of non-opaque objects) transmitted. Again, absorption is the uptake of energy by a substance and reflectance means that incoming radiation is reflected without energy being absorbed or emitted. During transmission, the radiation penetrates an object without energy change. The reflected part of the radiation leaves the object as directed spectral radiation, modified by the spectral characteristics (degree of reflection) of the object - this is actually the part that most (imaging) spectroscopy applications are interested in. Besides its physico-chemical properties, the reflectance of any surface will depend on the illumination and viewing geometry as well as on surface roughness, as Charly explains in the following video:

Video player: Beyond the Visible - Principles of Imaging Spectroscopy - Illumination and surface roughness

Link to Discussion Forum

Main course page with content

Course structure to navigate

Mini-MOOC “Agriculture” (Nov 2022)

Welcome

Meet the LMU Agri group

Pre-Assessment

Imaging Spectroscopy for Agricultural Applications

- Imaging spectroscopy of vegetation for agriculture
- Biophysical and biochemical variables
- In-situ data acquisition

L1

Methodological Aspects

- Data and software resources
- Methods (general and focus on hybrid techniques)
- Workflow

Field/lab video

L2

Hands-On-Training

- EnMAP-Box introduction
- Hands-on exercises based on Agricultural Apps in EnMAP-Box
- Discussion of accuracy and limitations

Screencasts

L3

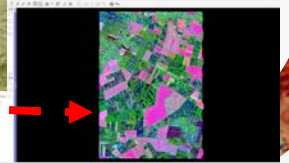
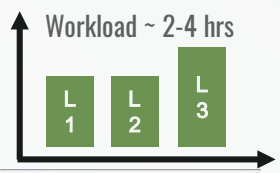
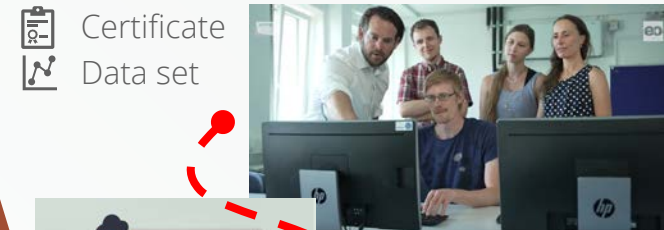
Final exam, user survey and goodbye

Learning elements

- 🔍 Quizzes
- 📊 Interactive graphics
- 📺 Videos
- 📄 Texts
- 📖 Hands on exercises
- 💬 Discussion forum

Documents

- 📄 Offline document
- 📄 Diploma supplement
- 📄 Certificate
- 📄 Data set



Discussion Forum

MOOC 'Data access and preprocessing' (published July 2023)

Welcome

EnMAP mission organization

Pre-Assessment

Hyperspectral Image Preprocessing over LAND

- General introduction (preprocessing steps)
- EnMAP product levels (repetition preprocessing steps)
- Assessment of data quality

L1

EnMAP Data Access

- Registration to portal
- Data from archive
- New acquisitions

Screencasts

L2

Hands-On-Training

- EnMAP-Box introduction
- Hands-on exercise based on EnPT
- Discussion of accuracy and limitations

Screencasts

L3

Final exam, user survey and goodbye

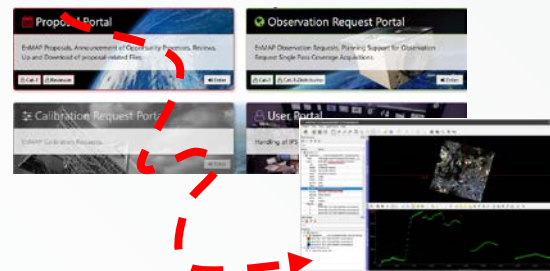
Learning elements

- 🔍 Quizzes
- 🖱️ Interactive graphics
- 🎥 Videos
- 📄 Texts
- 📅 Hands on exercises
- 💬 Discussion forum

Documents

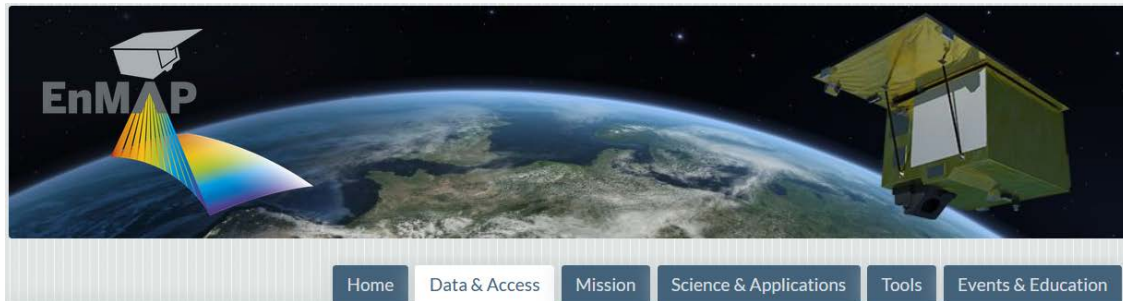
- 📄 Offline document
- 📄 Diploma supplement
- 📄 Certificate
- 📄 Data set

Workload ~ 2-4 hrs



Discussion Forum

Video screencasts on the EnMAP Data Access Portal



[Home](#) [Data & Access](#) [Mission](#) [Science & Applications](#) [Tools](#) [Events & Education](#)

[Data Access Portal](#)

SCREENCASTS

[How to register and assign to user roles](#)

[How to submit a data proposal](#)

[How to plan and request future observations](#)

[How to search and download data from the archive](#)

RELATED DOCUMENTS

[Portal User Manual](#)

[Level 1B, Level 1C, Level 2A](#)

Data & Access

The Data Access Portal in general include two major entry points: the EnMAP Instrument Planning Portal and the EOWEB® GeoPortal.

On the EnMAP Instrument Planning Portal users can register, submit proposals, and plan and request future orders. The EOWEB® GeoPortal contains the full EnMAP Data archive. Users can access EnMAP data using two different options:

- Users can request acquisitions through the EnMAP Instrument Planning Portal. The portal includes the Proposal Portal for proposal submission by all scientific users responding to an Announcement of Opportunity (AO) and the Observation Request Portal providing planning support of observation requests and submission of future orders.
- Users can search and order data in different processing levels from the German Satellite Data Archive (D-SDA) through the EOWEB® GeoPortal.

More information on using the EnMAP Data Access Portal is available in the user manual and in short video

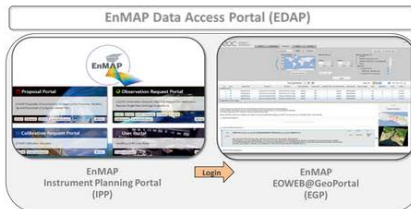
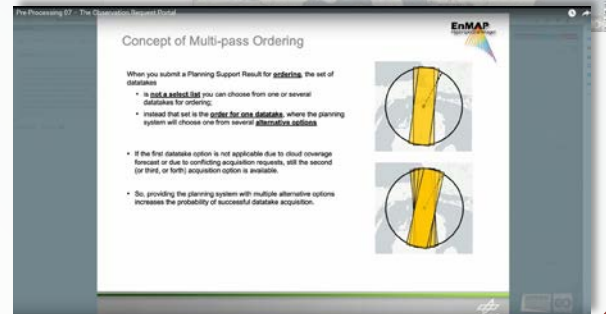
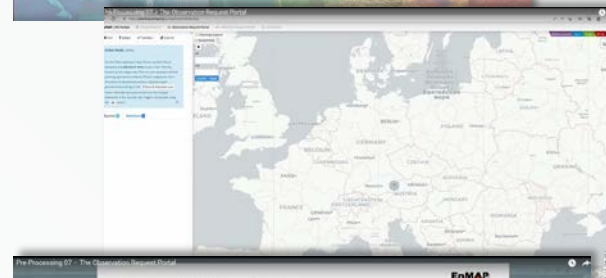


Image: The EnMAP Data Access Portal



HYPERedu YouTube channel



HYPERedu

@HYPERedu_GFZ 565 subscribers 55 videos

> 550 subscribers (since Sept 2021)

Subscribe

In view of the rising number of imaging spectrometers deployed on airborn... >

enmap.org/events_education/hyperedu and 3 more links

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

Latest Popular Oldest



Beyond the Visible - Introduction to Hyperspectral Remote Sensing - Trailer

3.6K views · 1 year ago



Basic-12: Sensor technologies & data acquisition techniques: ASD Field

2.7K views · 1 year ago



Basic-23: Hands-on training: EnMAP-Box Intro

1.6K views · 1 year ago



Basic-18: Hands-on training: PRISMA Archive

1.5K views · 1 year ago



Basic-24: Hands-on training: EnMAP-Box Spectral Library

1.4K views · 1 year ago



Basic-22: Hands-on training: EnMAP-Box Installation

1.3K views · 1 year ago



Basic-07: Principles of imaging spectroscopy: Illumination and surface...

1K views · 1 year ago



Basic-08: Principles of imaging spectroscopy: Electronic processes

1K views · 1 year ago



Basic-10: Sensor technologies & data acquisition techniques: Imaging...

1K views · 1 year ago



Basic-17: Hands-on training: PRISMA User Registration

1K views · 1 year ago



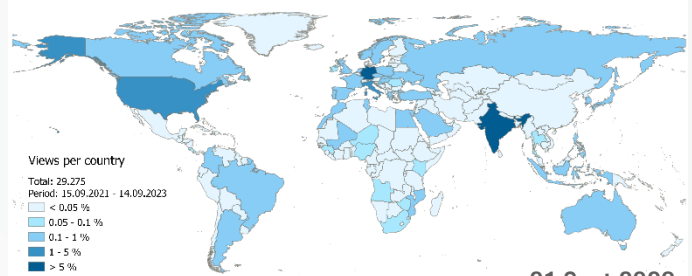
Basic-21: Hands-on training: Methods & software

973 views · 1 year ago



Basic-20: Hands-on training: Data preprocessing

950 views · 1 year ago



Views per country

Total: 29,275

Period: 15.09.2021 - 14.09.2023

< 0.05 %

0.05 - 0.1 %

0.1 - 1 %

1 - 5 %

> 5 %

21 Sept 2023

Most popular

- ❖ Instructional videos
- ❖ Screencasts
- ❖ Animated lecture slides
- ❖ Expert interviews

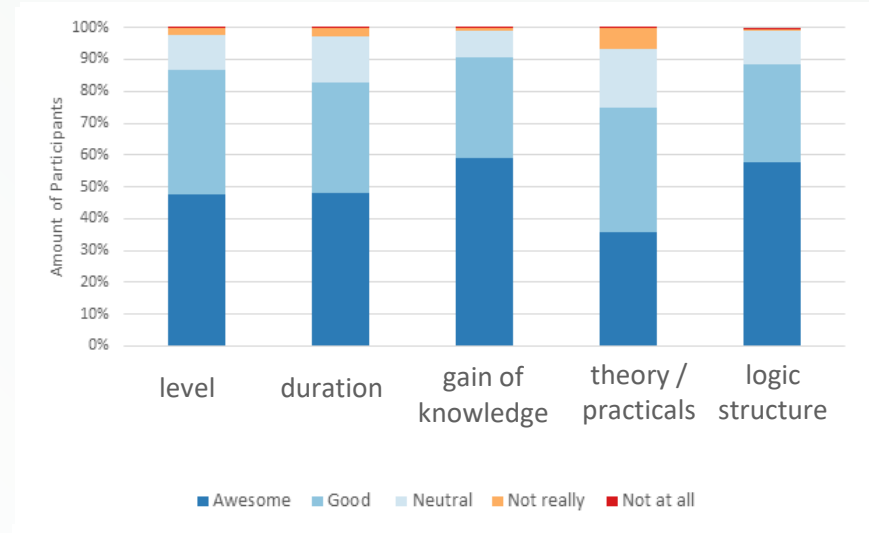
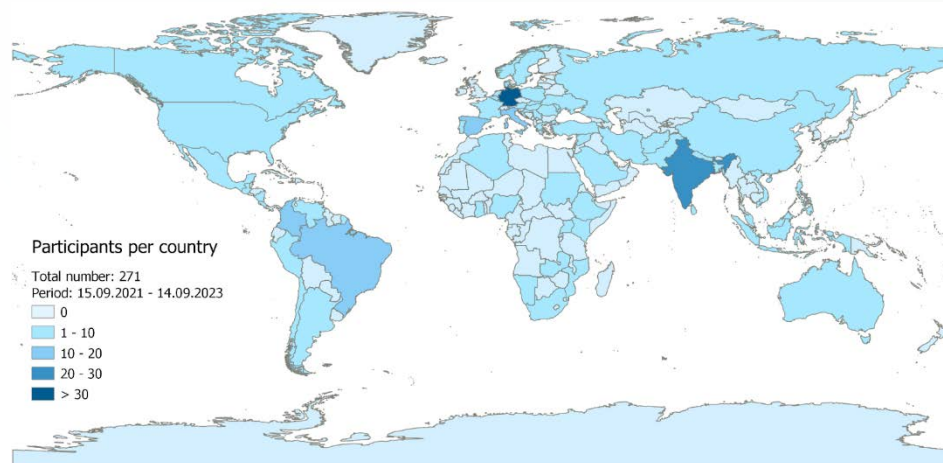


HYPERedu on YouTube

https://www.youtube.com/@HYPERedu_GFZ

HYPERedu MOOCs: Participants and feedback

- ❖ As of September 2023: 2700 enrolled and 650 completed the courses
- ❖ from different countries and continents
- ❖ young (25-45 years) and male (70 %)
- ❖ 60 % no contact with hyperspectral data before



- ❖ More practical exercises
- ❖ More subsequent MOOCs on specific application fields (Agriculture 24%, Water 20%, Soil 17%, Urban 17%, Geology 14%)

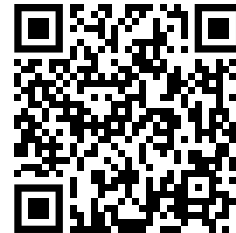
„I had a lot of fun taking this course. I am experienced in the field, but I have learned a lot. Congrats!“

How you can benefit and get involved...

- ❖ Use HYPERedu materials (videos, tutorials, slide collections....)
- ❖ Collaborate in the development of further resources and courses
- ❖ Promote HYPERedu in your networks
- ❖ Give us feedback



HYPERedu
overview



MOOC "Beyond
the Visible"



HYPERedu on
YouTube



Contact

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