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Using EnMAP data to improve services in the smart farming and renewable energies sector – a first overview

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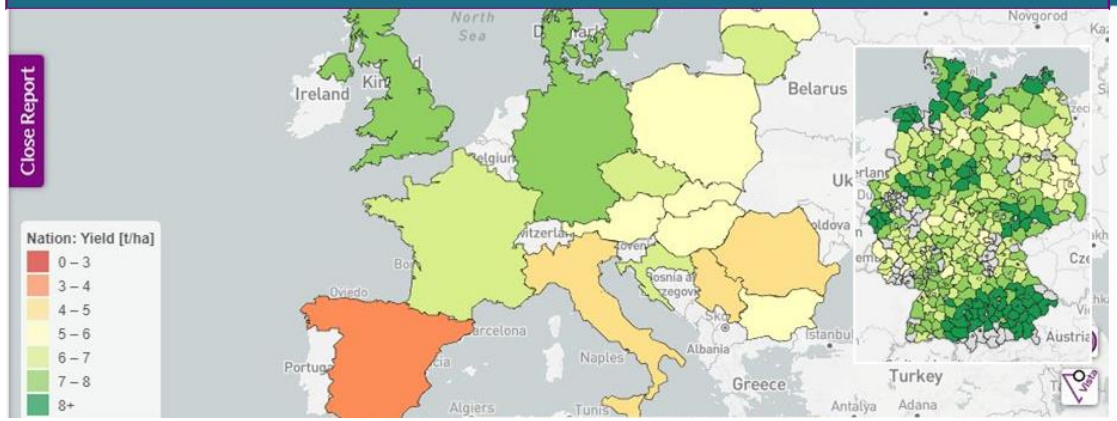
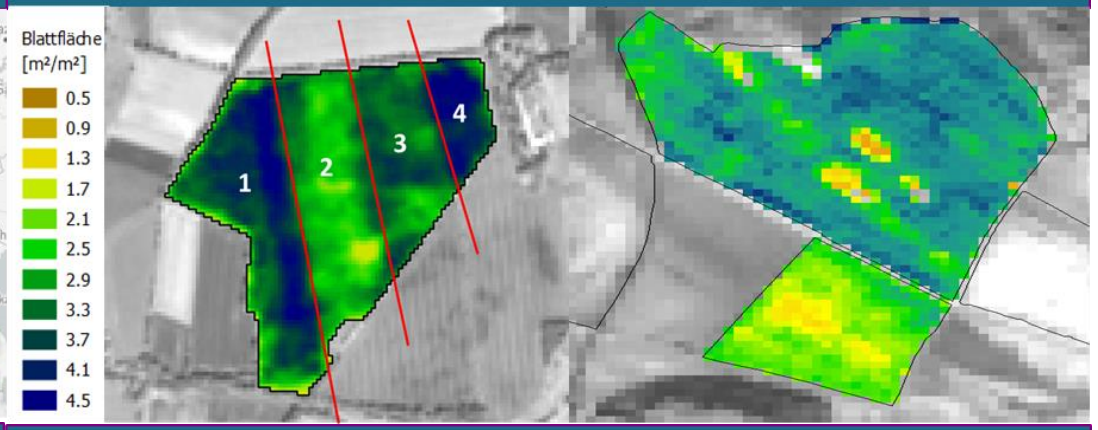
Vista‘s core competencies

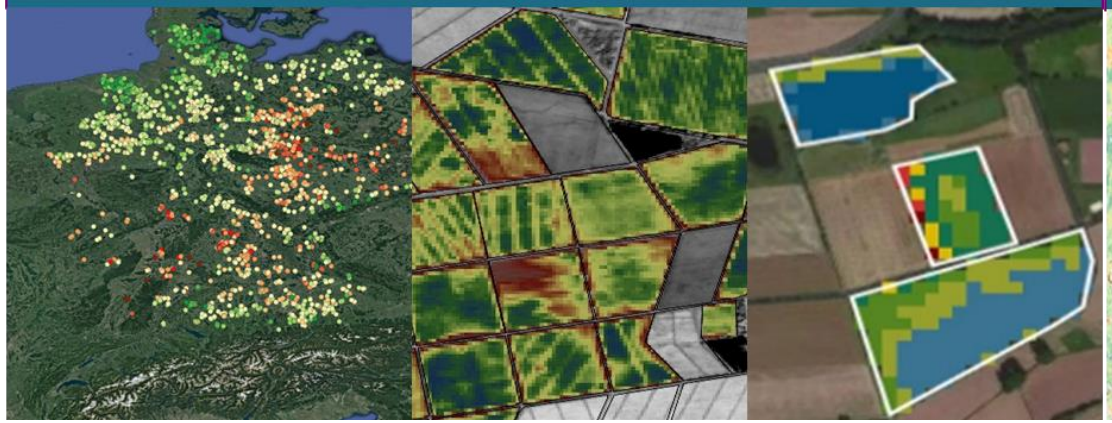
Harvest and Yield Prediction



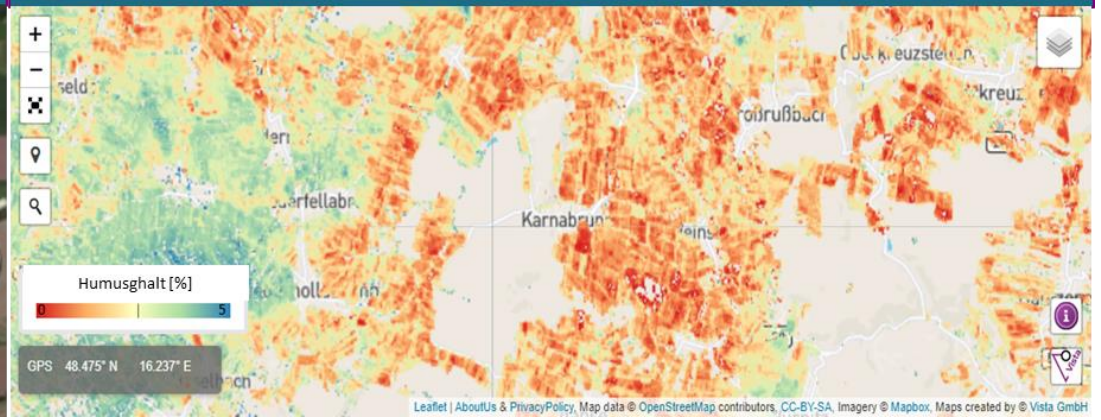
Optimization of Agricultural Measures



Crop Monitoring and Risk Management



Sustainability and Carbon Farming



Generating Training Data for Machine Learning: HyperPin

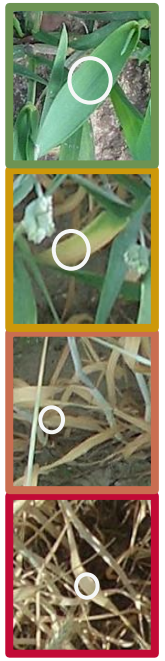
- **HyperPin** project:
  - Duration: 2 years; Kick off in October 2023
  - Funded by the Bavarian Ministry of Economic Affairs, Regional Development and Energy under the funding line BayVFP Förderlinie Mobilitat - RaumfahrtSustainable management in agriculture
  - HyperPin involves the development of a low-cost modular and customizable hyperspectral mission and instrument concept and an innovative data fusion concept for commercial applications based on it.
  - In the HyperPin project we will use hyperspectral data for generating training data for machine learning algorithms.
  - Applications are not limited to agriculture (e.g. crop rotation classification, detection of winter greening, flower strips and other biodiversity elements), but can be used for a wide range of applications (e.g. monitoring of installed solar power capacity).

Funded by:

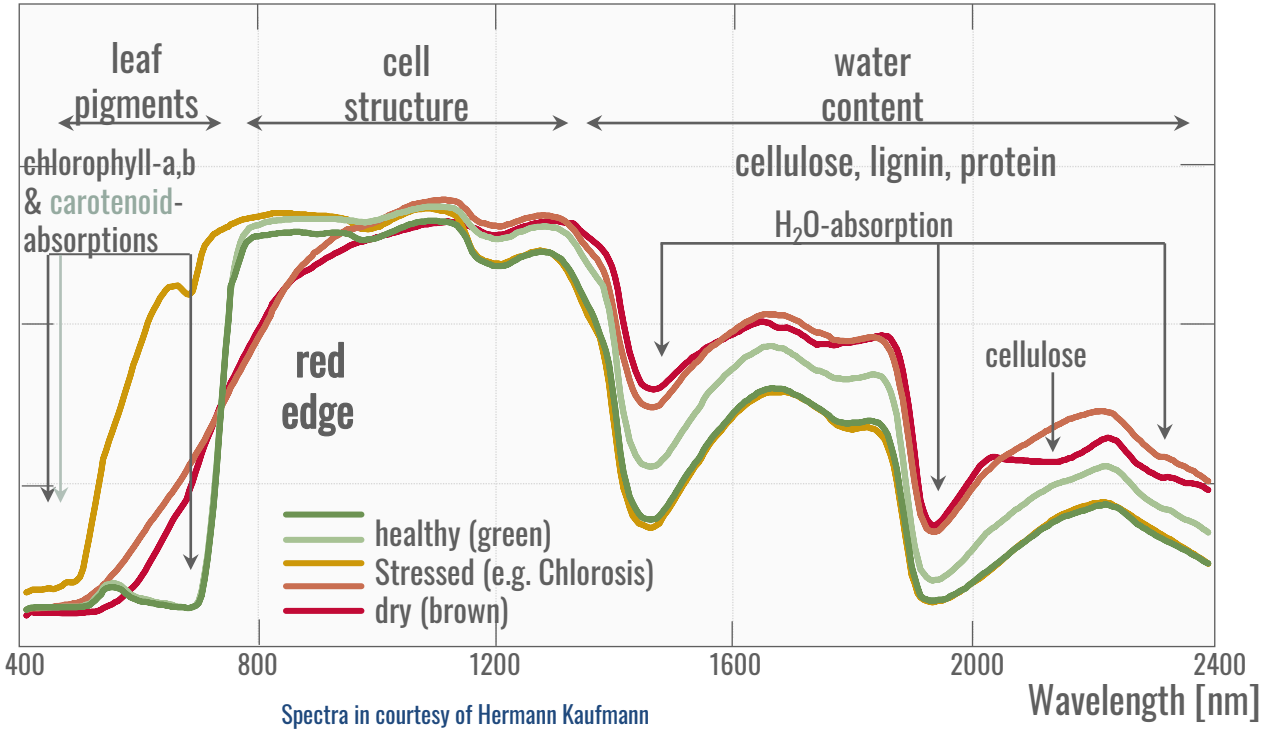
Bavarian Ministry of Economic Affairs, Regional Development and Energy

Generating Training Data for Machine Learning: HyperPin

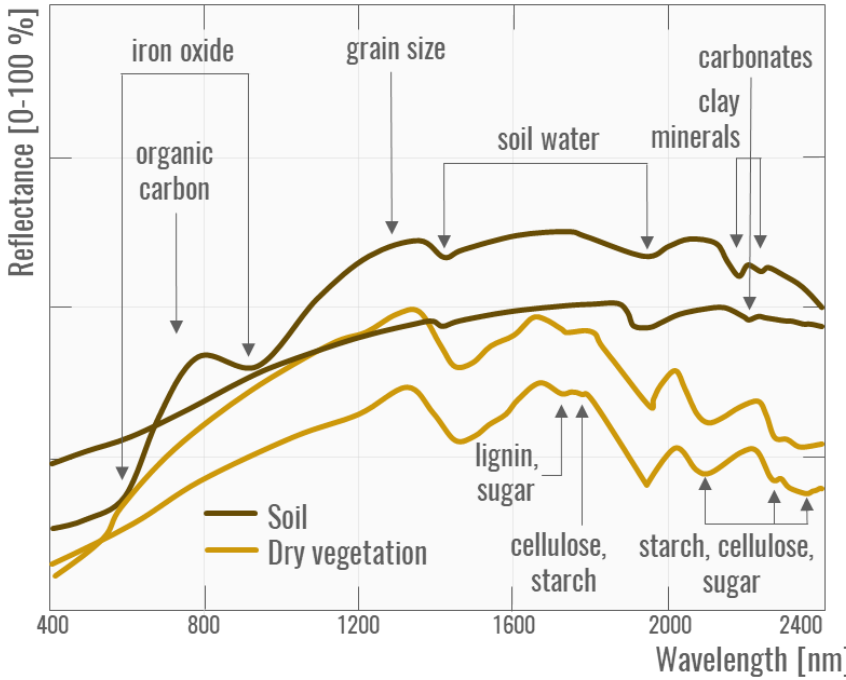
- Problem: AI models need a lot of training data, but training data are often not sufficiently available
- → hyperspectral data are used to derive physical parameters from EO by using indices, radiative transfer model (RTM) inversion or qualitative spectra
- Pins can be set by using the wide information content of hyperspectral data to find and generate test und training data



Photos in courtesy of Theres Kuester



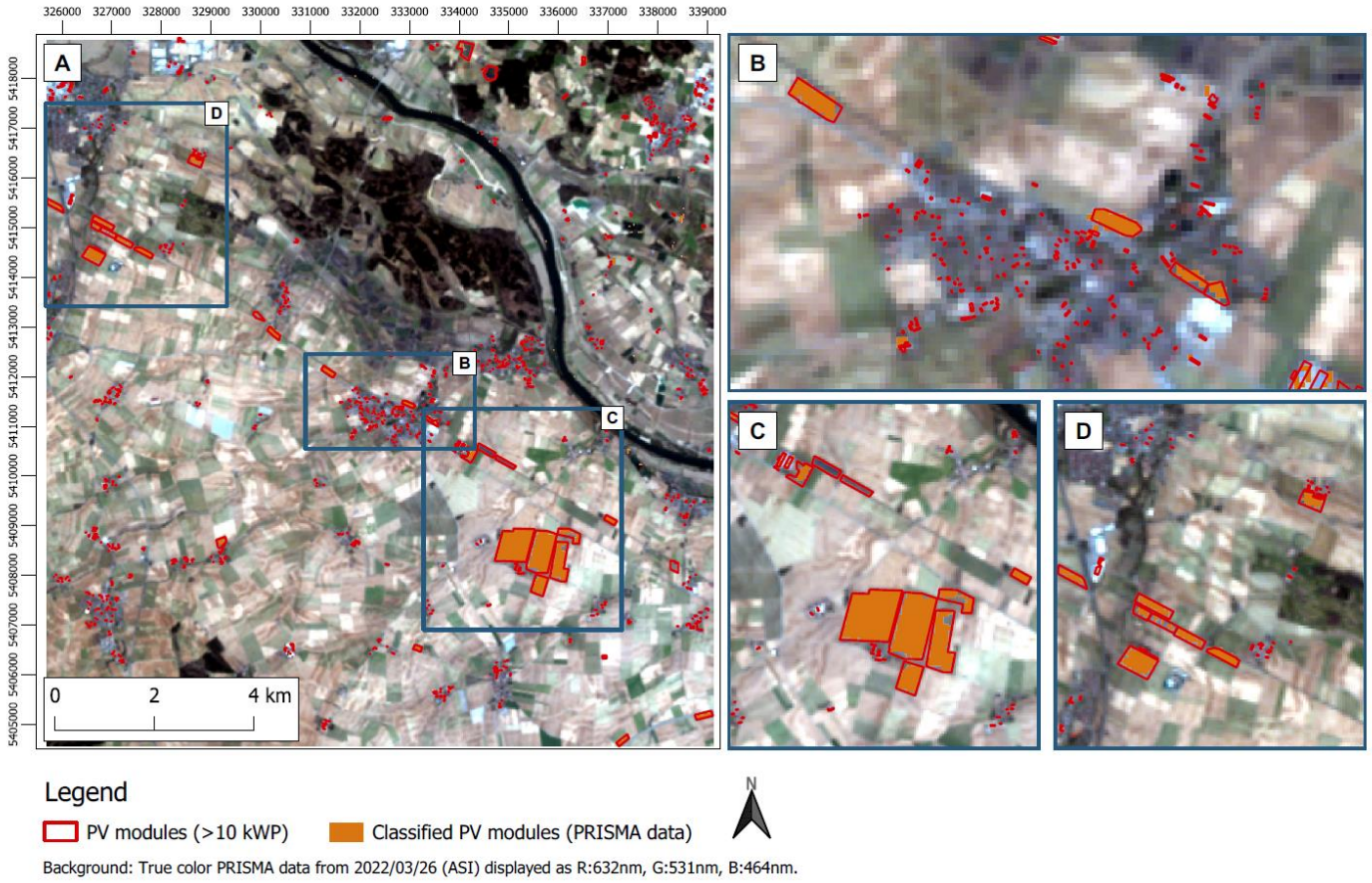
Spectra in courtesy of Hermann Kaufmann



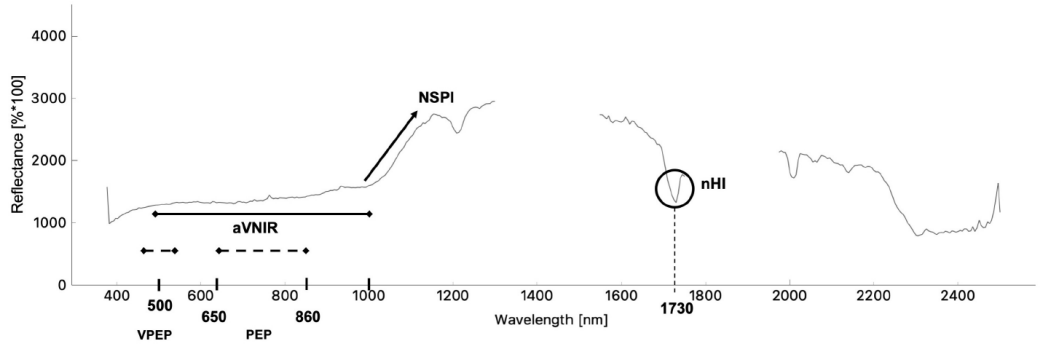
Spectra in courtesy of Sabine Chabrillat

Source: A. Brosinsky, T. Kuester, S. Foerster, H. Kaufmann, K. Segl, L. Guanter (2019). ***Principles of imaging spectroscopy - Electromagnetic radiation and its interactions with earth surface materials****. HYPERedu, EnMAP education initiative, German Centre for Geosciences GFZ; originally published October 2019, 2nd revision February 2023.*

Use case: Generating Training Data for Machine Learning for PV Detection



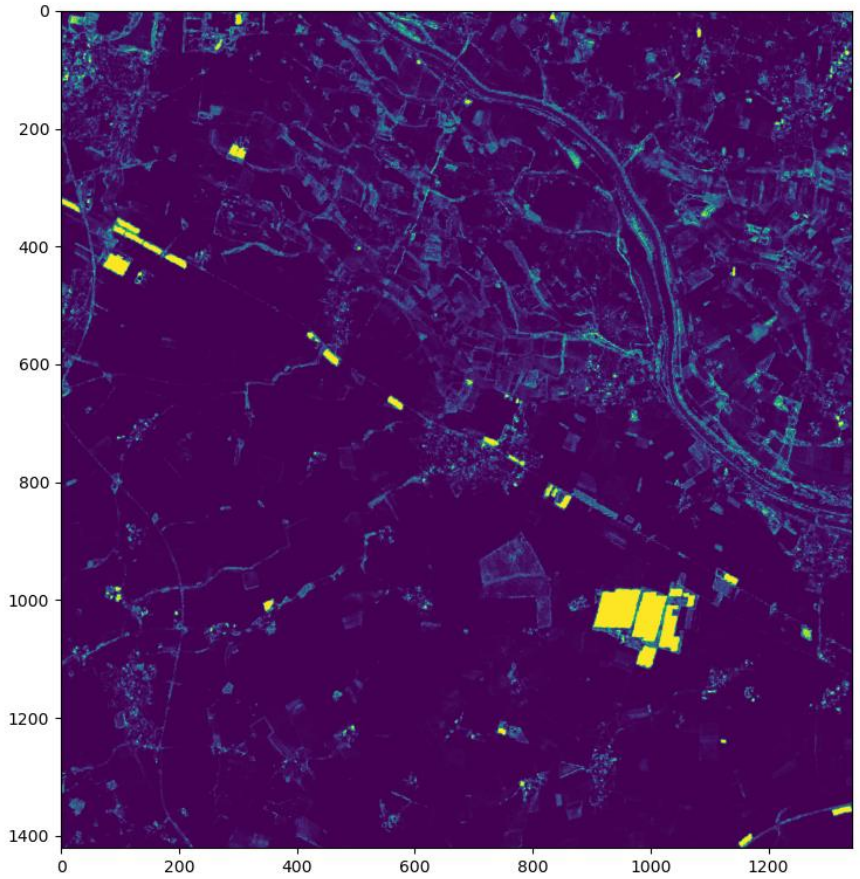
- Identification of ‚PINs' from hyperspectral data
- Using physically-based spectral indices to detect photovoltaic power plants
- Spectral ‚fingerprint' required for indices calculation

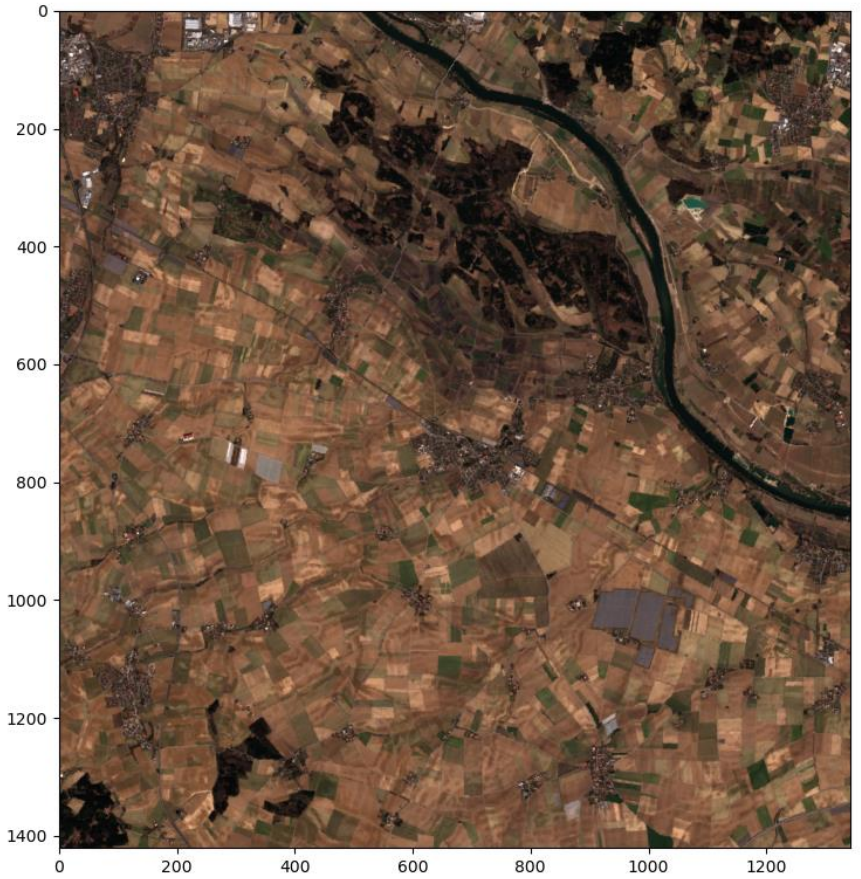


Source: Jörges, C.; Vidal, H.S.; Hank, T.; Bach, H. Detection of Solar Photovoltaic Power Plants Using Satellite and Airborne Hyperspectral Imaging. Remote Sens. ***2023****, 15, 3403. https://doi.org/10.3390/rs15133403*

Photovoltaic Detection using HyperPins & Sentinel-2 Machine Learning

- Results of Sentinel-2 PV Detection:





Overall accuracy: 0.97

Fuzzy detection of PV power plants in study area.
Left: Results of ANN output (yellow=1, blue=0). Right: RGB Sentinel-2 Input data.

Experience with Enmap data 2023: Limitations/Challenges

- Data take planning portal
  - It is not possible to make the request for the same location with a different date, or a list of dates.
  - It is not possible to enter the center coordinates of the data take.

Feedback from the workshop:

It is now possible to enter center coordinates!

- Data availability 2023
  - Requested: 5 regions (3x Germany, Spain, Austria), every 2 weeks, from April 2023 – November 2023
  - → possible data takes: 60
    - **0** data in Germany
    - Austria: 2/**5** data takes completely clouded, 1 data take from archive --> 3 useable data takes from April to October, 11th
    - Spain: 1/**7** data takes completely clouded → 6 usable data takes from April to October, 11th

Experience with Enmap data 2023: Limitations/Challenges

- Data processing
  - Data of the area of interest available in archive from someone else‘s data take → Is it possible to activate an alert in the data archive portal for a certain region? → **not possible**
  - Data with 100% cloud cover are delivered (weather forecast worse than expected…) → is it possible to check again the metadata before delivery? → **within the given acquisition window EnMAP will try to redo the data take, if cloud thresholds have not been met**
  - (Slightly) changing band specifications in the enmap images make it hard for automatic data processing (inversion)…
    - We did not find any document wich defines the official wavelengths and spectral response per band and processing version → **as spectral response function a Gauss function can be assumed.**

(Feedback from the workshop)

Thank you for your attention!

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