Getting started with Satellite Data in Python

EOX IT Services
PyLadies Vienna
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Mentorship Programme
Meetups
Python Beginners courses
Application close tonight!
What are EO data and why **should** we care

- Data captured from Space
- New missions every year
- Only Optical data here today - Sentinel 2
- What are bands?
  - Many different types:
    - different resolution
    - different processing levels
    - different instruments
    - different revisit times
    - different bands available

- But everything is basically numpy array
Possible applications

- Land classification
- Crop type monitoring
- Sea ice monitoring
- Water events and changes
- Soil monitoring
- Forest monitoring
- Plane detection
- ...

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Where and how to find your Data

- Web catalog clients with a map interface and filtering
- Direct API access - search queries
  - STAC, OpenSearch, OData, CSW

Metadata and Properties

- Filter using metadata
- Bounding box (spatial)
- Time interval
- Maximum cloud coverage

Platforms

- Copernicus Data Space Ecosystem
  - official access point by ESA
- the Big Five host public Sentinel 2 data as well
Data formats - size vs utility

- Cloud optimized formats for read access
  - overviews, header allowing range HTTP requests
- GeoTIFF, COG
- SAFE (Standard Archive Format for Europe)
- JPEG2000
- HDF5
Data Processing

- Raw data from satellite are usually pre-processed to different levels
- Different levels of corrections
  - Atmospheric correction
  - Radiometric correction
- GDAL as underlying tool
- → Python bindings
- Rasterio
  
  - Reprojection
  - Clip by geometry
  - Merge bands
  - Format exchange
  - Mosaic creation
  - → AR data often available
EO Data Analysis

- ML models based on standard architectures
- Mainly classification and detection task
- "big data" processes - large volumes and large scales even using small areas
- Problem of never enough training data and labelling
- Nodata values - common pitfall

But:

- For many task indexes are used
- ...and they are (still) in many cases enough!
- Enhancement with another data - census data, energy grid, ...
NDVI Index

- Normalized Difference Vegetation Index
- \( \frac{(NIR - RED)}{(NIR + RED)} \)
- In theory from -1 to +1
- In practice - close to zero means no vegetation
- Harvest detection
Datacubes

- Not only data storage in EO world
- Data are together with temporal dimension
- Different data information put together
Visualization

- UInt16 -> RGB conversion for display
- Different band combinations to highlight phenomena
- Map overlays or background maps (mosaics)
Summary

- Satellite data are cool!
- Play EOGuesser and share your score on social media :) [https://s2maps.eu/eo-guesser/](https://s2maps.eu/eo-guesser/)
- If you want to know more, just find me (I can talk about EO data for hours)
- New free MOOC just launch - Cubes and Clouds
- We are looking for a DevOps engineer to join me in a team