# openEO Platform – Basic Training – 14th December 2022

Benjamin Schumacher (EODC)

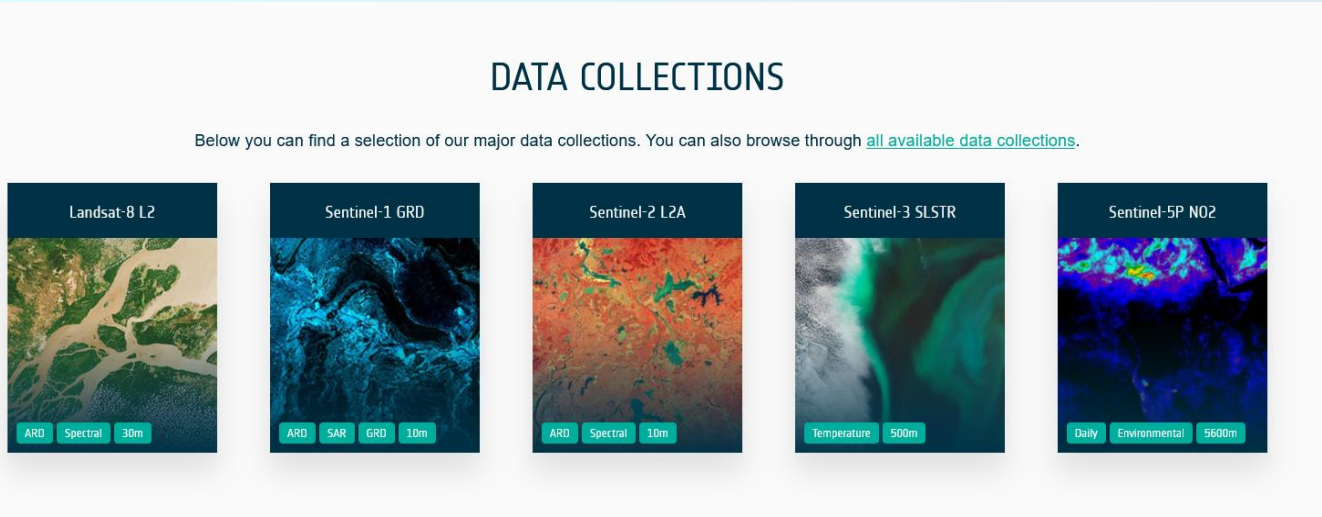
# What programming / EO experience do you have?

https://forms.office.com/r/mArLqhMbY1

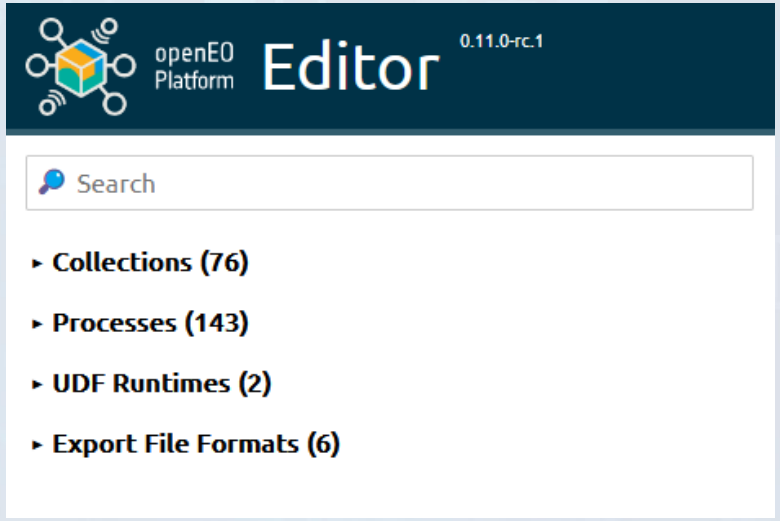
# Let’s have a look at the results

https://forms.office.com/Pages/DesignPageV2.aspx?subpage=design&FormId=Uyeu8jqnHkKLsQFTN1O3kX-Ssovz3sRGufcUNhlANz9UOEMzUloxUElORVVWRVBBODhISzhCUU9YMC4u&Token=c4eda5b1377042e19028fdde7345a776

# What is openEO Platform?




**-> openEO Platform provides intuitive programming libraries to process a wide variety of Earth Observation datasets.**



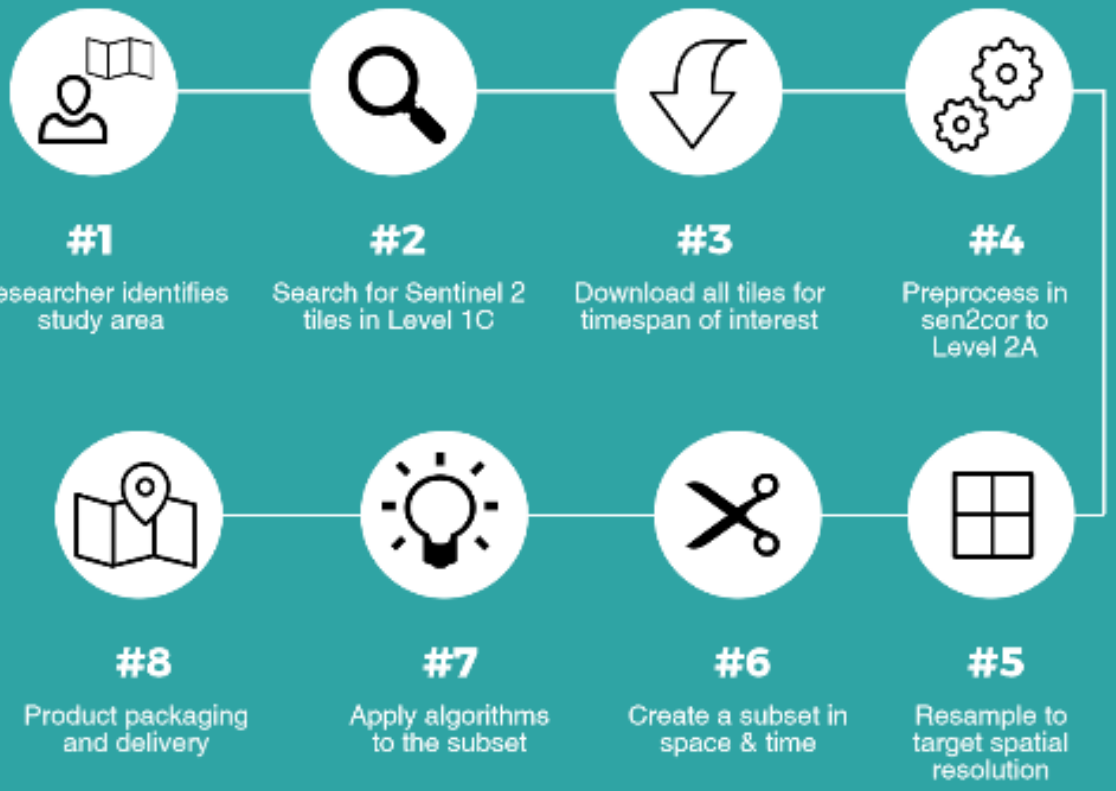

**-> Run your earth observation analysis on our federated infrastructure!**

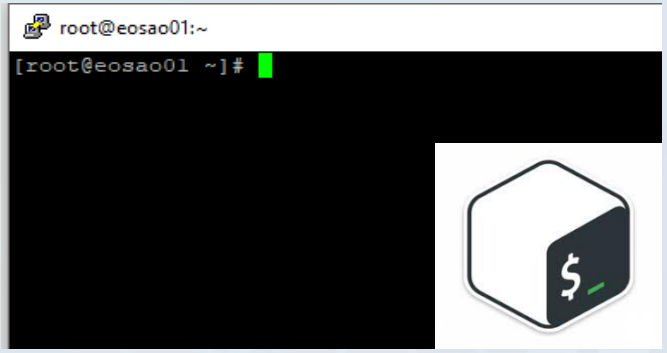
# Why do we need openEO?
# The Data Management Burden…

openEO Platform

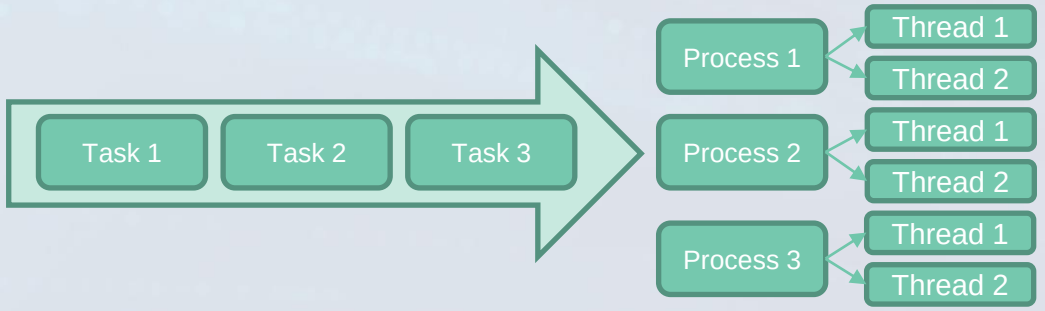
esa

## Traditional remote sensing product process for Sentinel-2



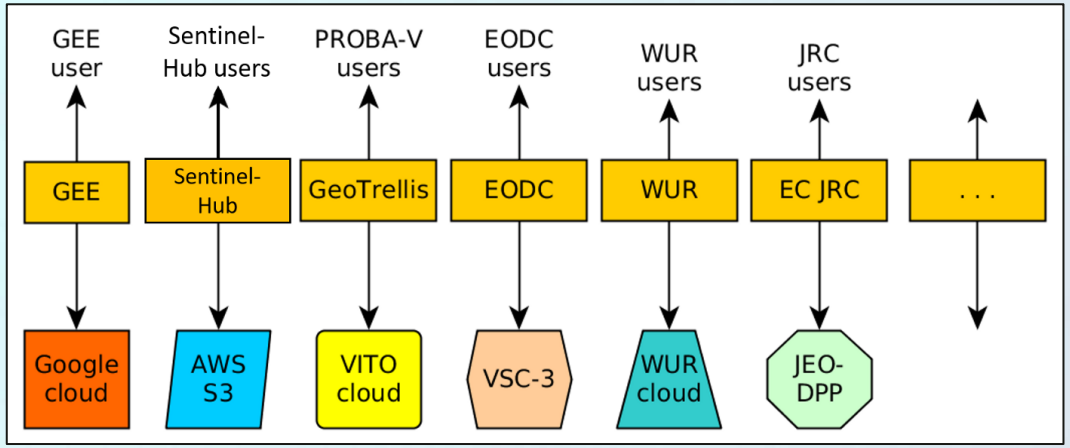

| Allocated CPU | Allocated MEM | Status |
|---|---|---|
| 8200 / 9600 (85%) | 520GB / 1007.3GB (52%) | ON |
| 4700 / 5600 (84%) | 444GB / 503.6GB (88%) | ON |
| 5200 / 5600 (93%) | 358GB / 503.6GB (71%) | ON |



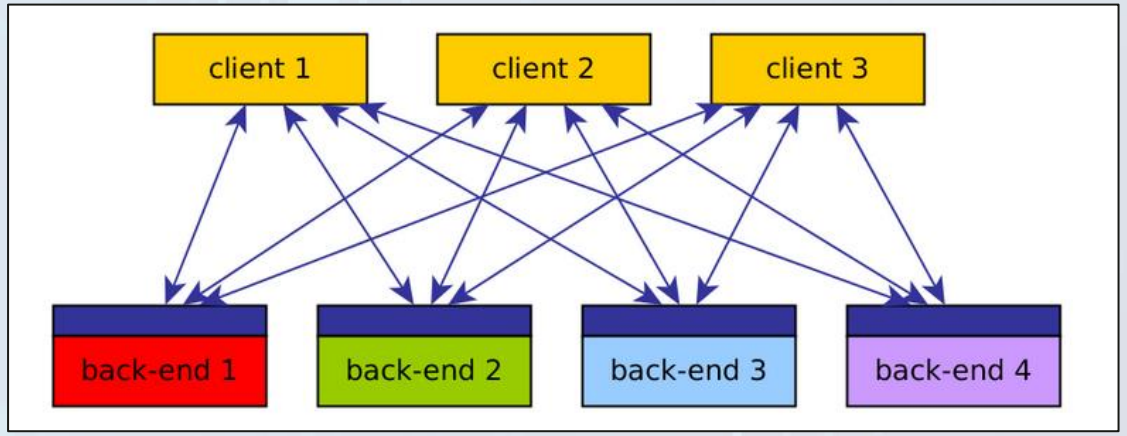

Credits: H. Kristen – ESA open Science 2017

# How does it work?

## Situation before openEO:

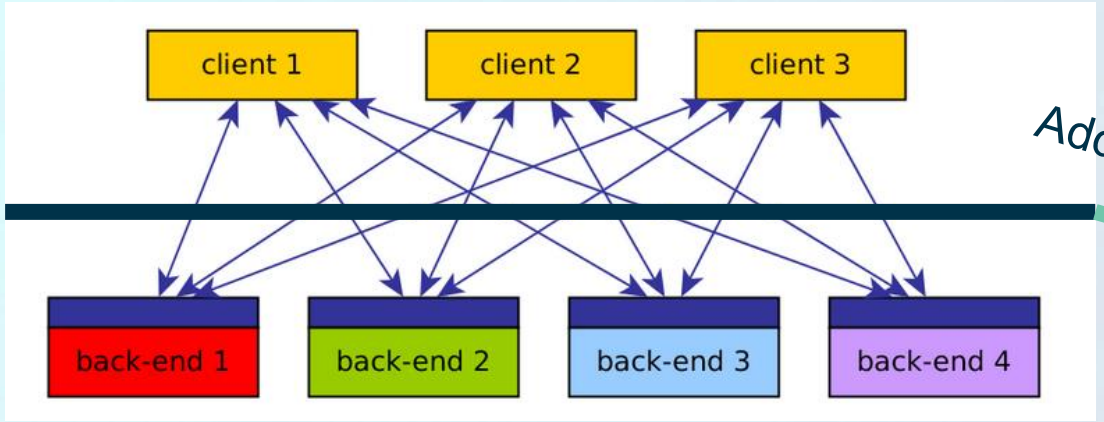



## openEO API:



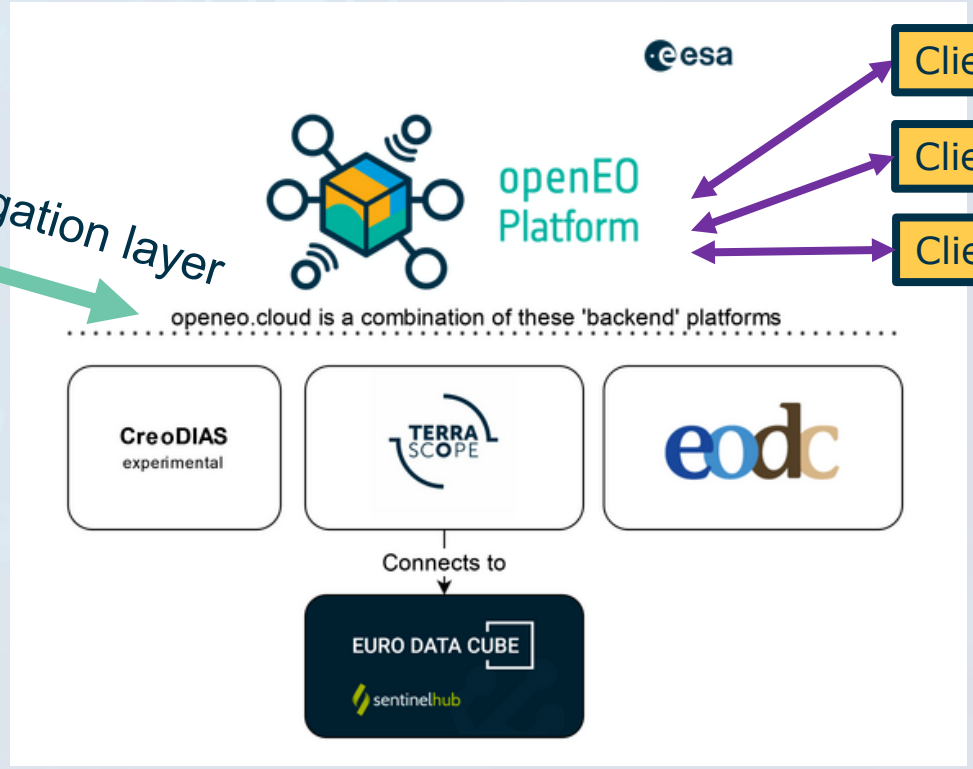
# How does it work?

## openEO API:



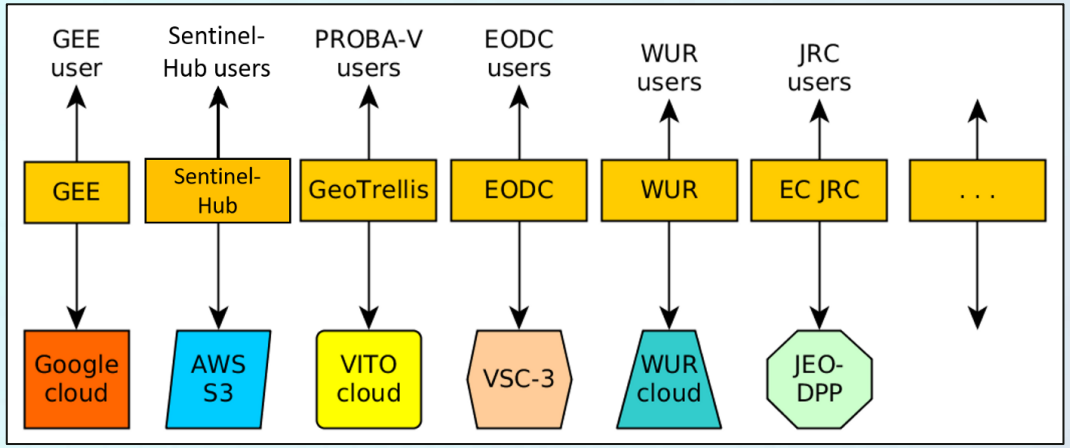

Added aggregation layer

## openEO Platform:

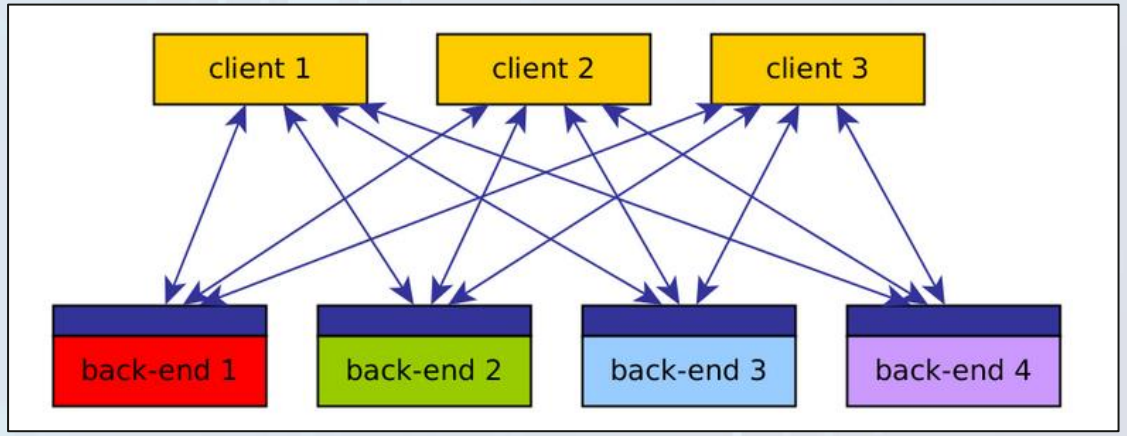


# How does it work?

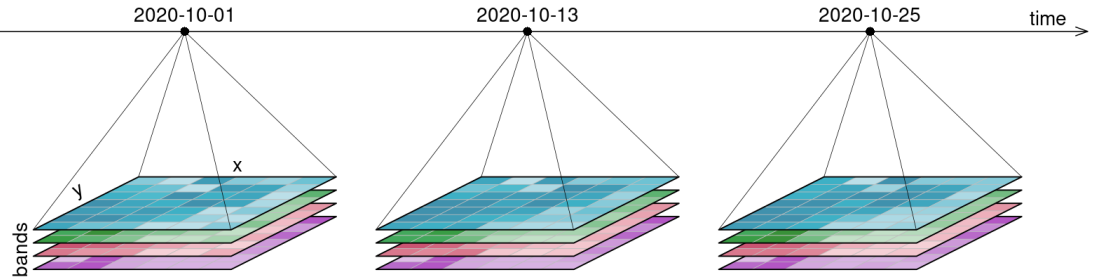
## Situation before openEO:

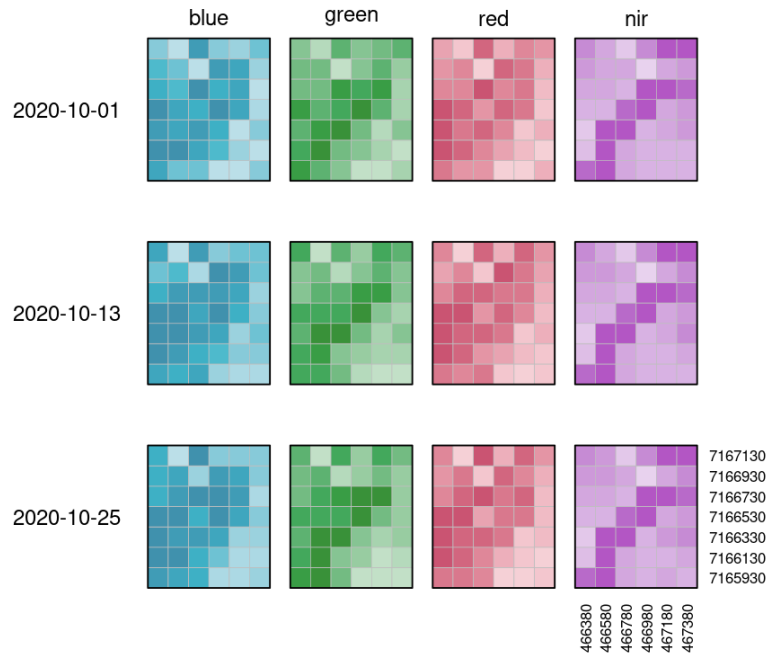



## openEO API:



# Concepts of openEO - Datacubes



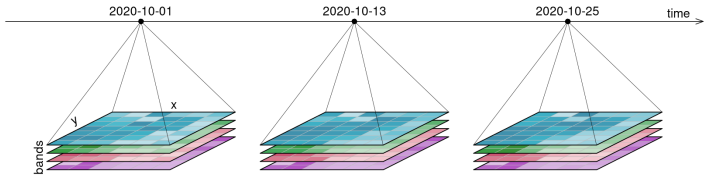




**-> multidimensional arrays with one or more spatial or temporal dimension**

**-> Data in OpenEO is represented in this way**

**-> Any representation of the data cube is fine (meaning – dimensions can be switched in display)**

# Concepts of openEO – Datacubes - Dimensions



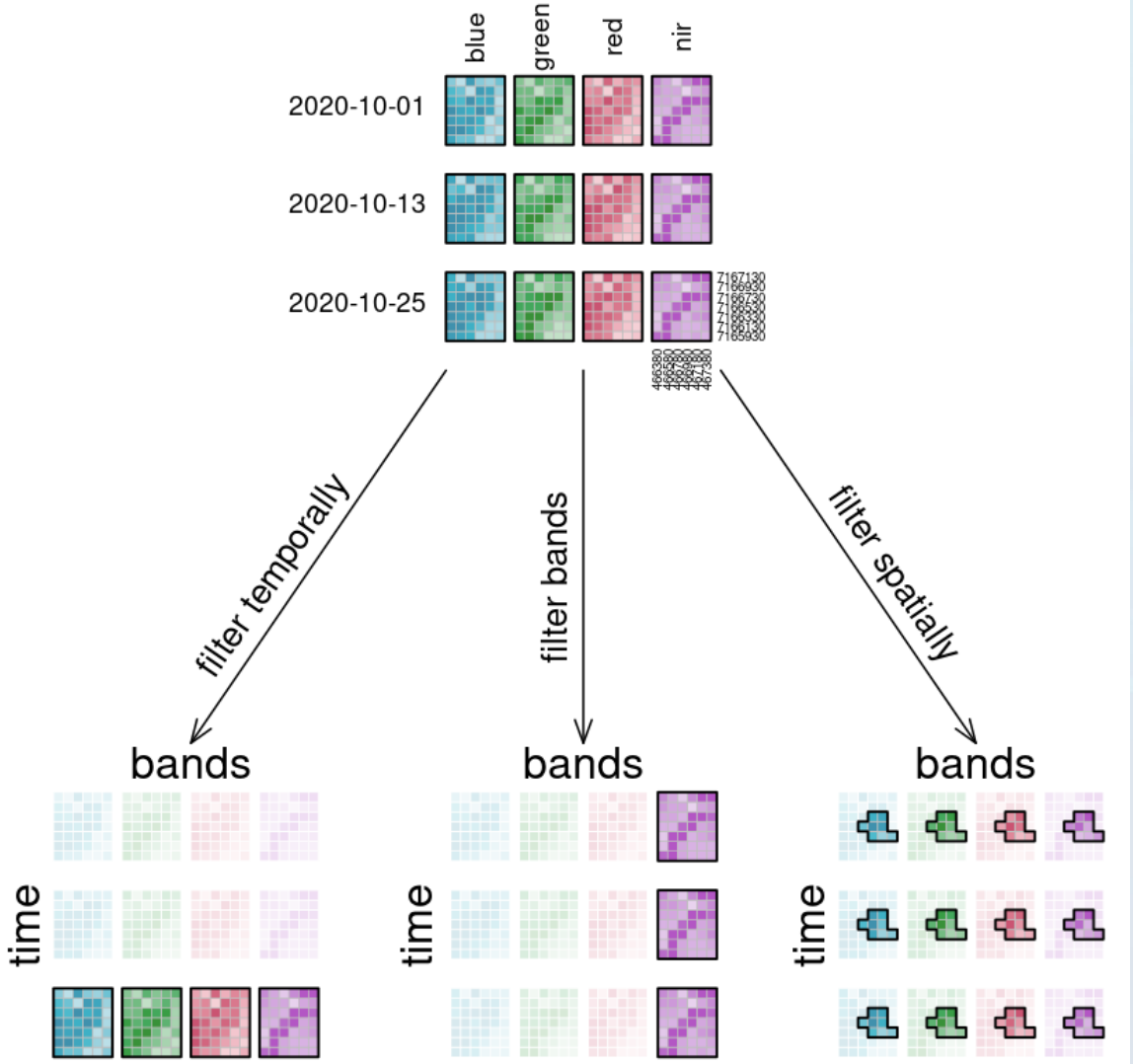

| # | dimension name | dimension labels | resolution |
|---|---|---|---|
| 1 | x | 466380 , 466580 , 466780 , 466980 , 467180 , 467380 | 10m |
| 2 | y | 7167130 , 7166930 , 7166730 , 7166530 , 7166330 , 7166130 , 7165930 | 10m |
| 3 | bands | blue , green , red , nir | 4 bands |
| 4 | t | 2020-10-01 , 2020-10-13 , 2020-10-25 | 12 days |

**Properties:**

- **name**
- **axis / number**
- **type (spatial/temporal/bands/other)**
- **extents or nominal dimension labels**
- **reference system / projections**
- **resolution**

**-> be careful with dimensions and your coordinate reference system – location x,y change in different CRS**
**-> be carful with changing data types of dimensions – do this only if the backend supports it**

# Concepts of openEO – Datacubes - Filters



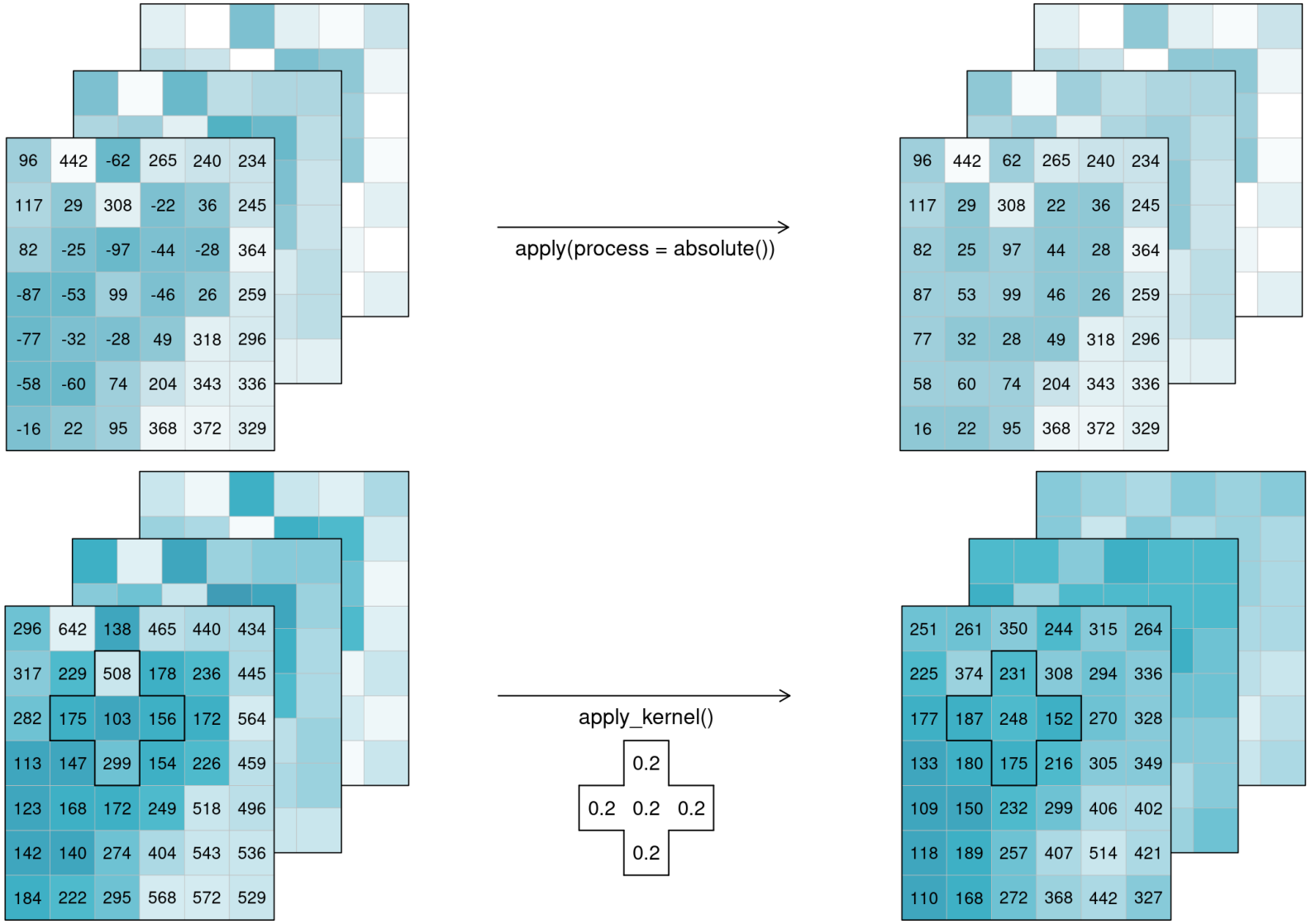

**Filters:**

- **Filter temporal**
- **Filter bands**
- **Filter spatial**

**-> Data that satisfy the condition is returned**

**-> Datacube becomes smaller (selection process)**

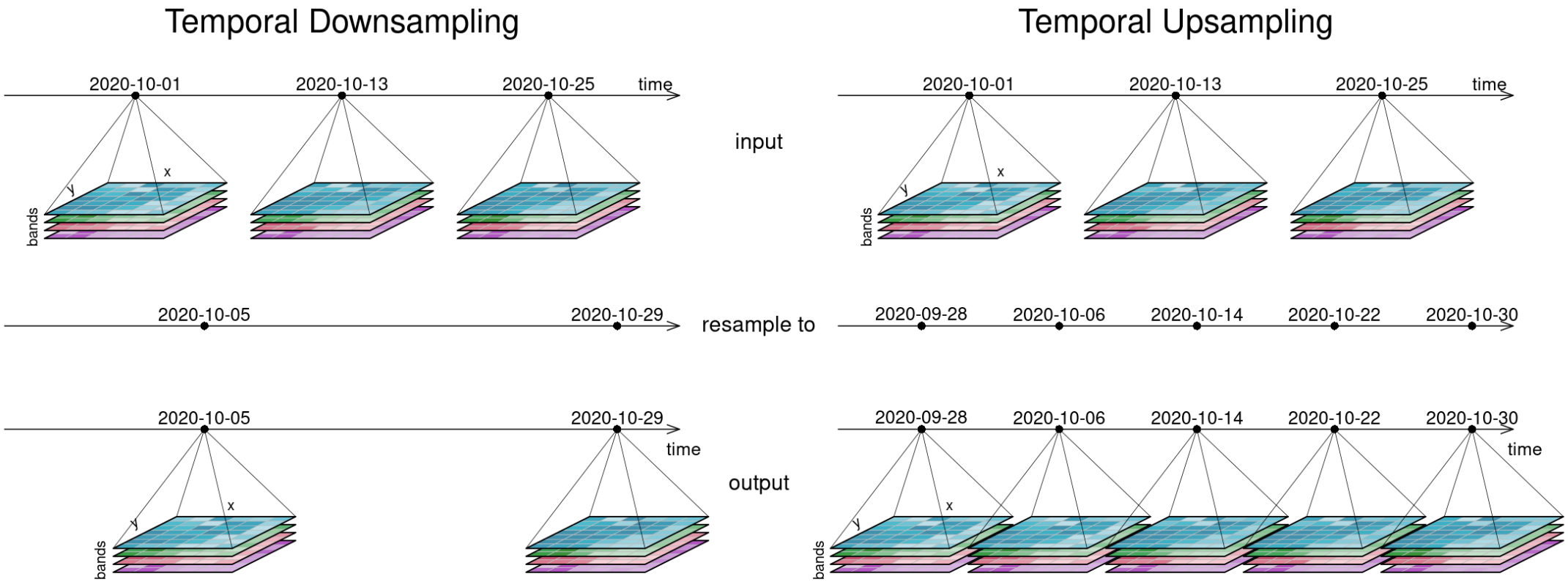
# Concepts of openEO – Datacubes - Apply




**Data manipulation:**

- absolute
- Kernels
- Neighborhoods
- Temporal smoothing
- Spatial smoothing

# Concepts of openEO – Datacubes - Resample



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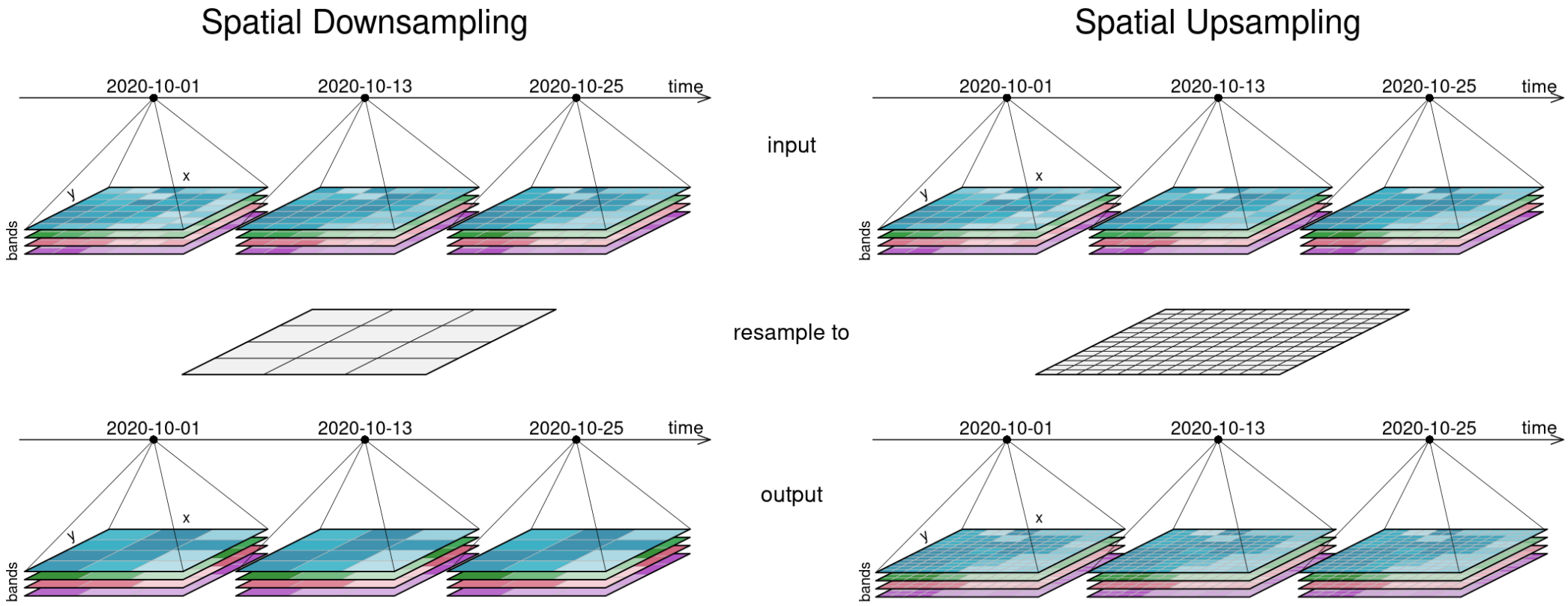
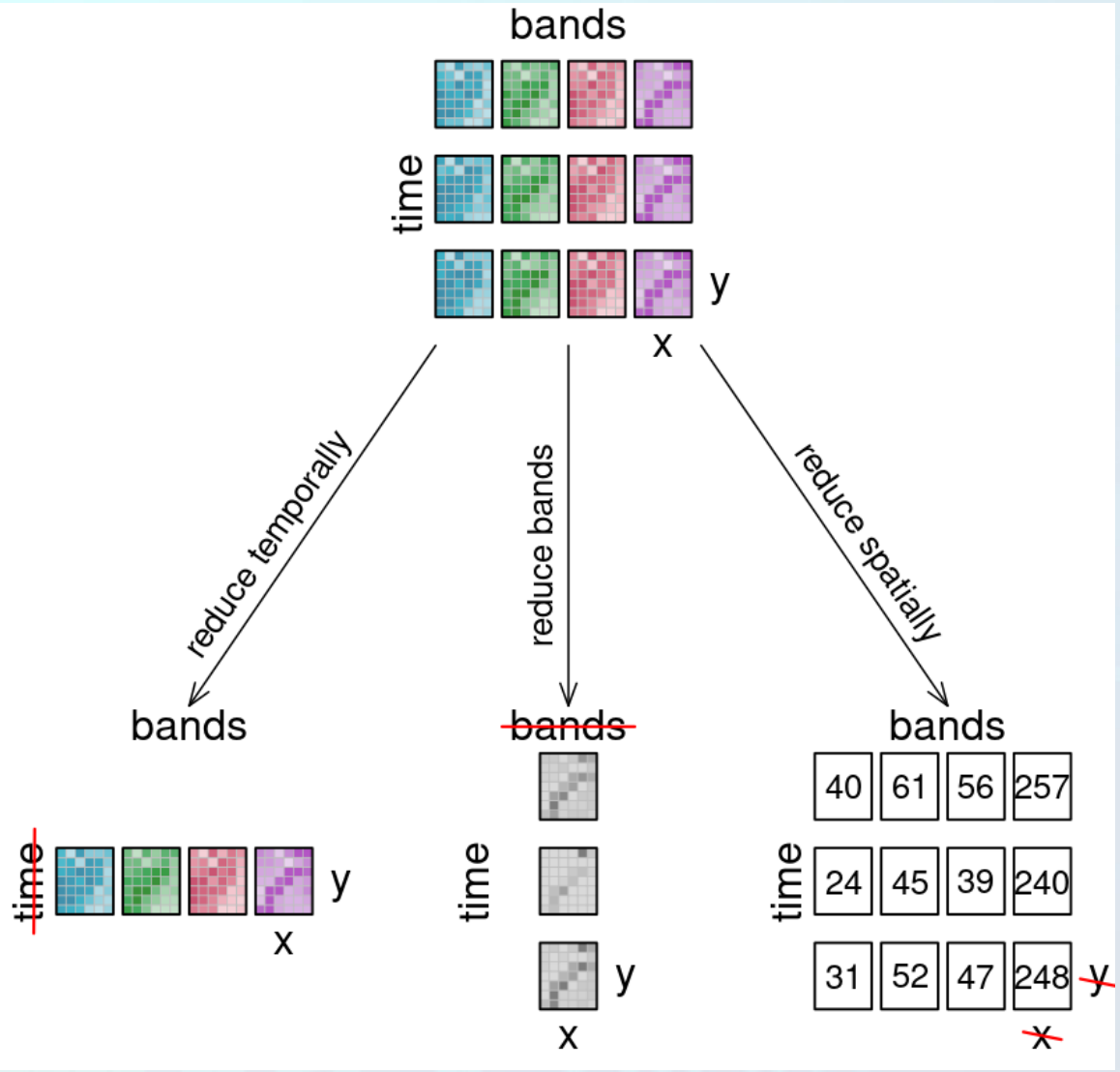


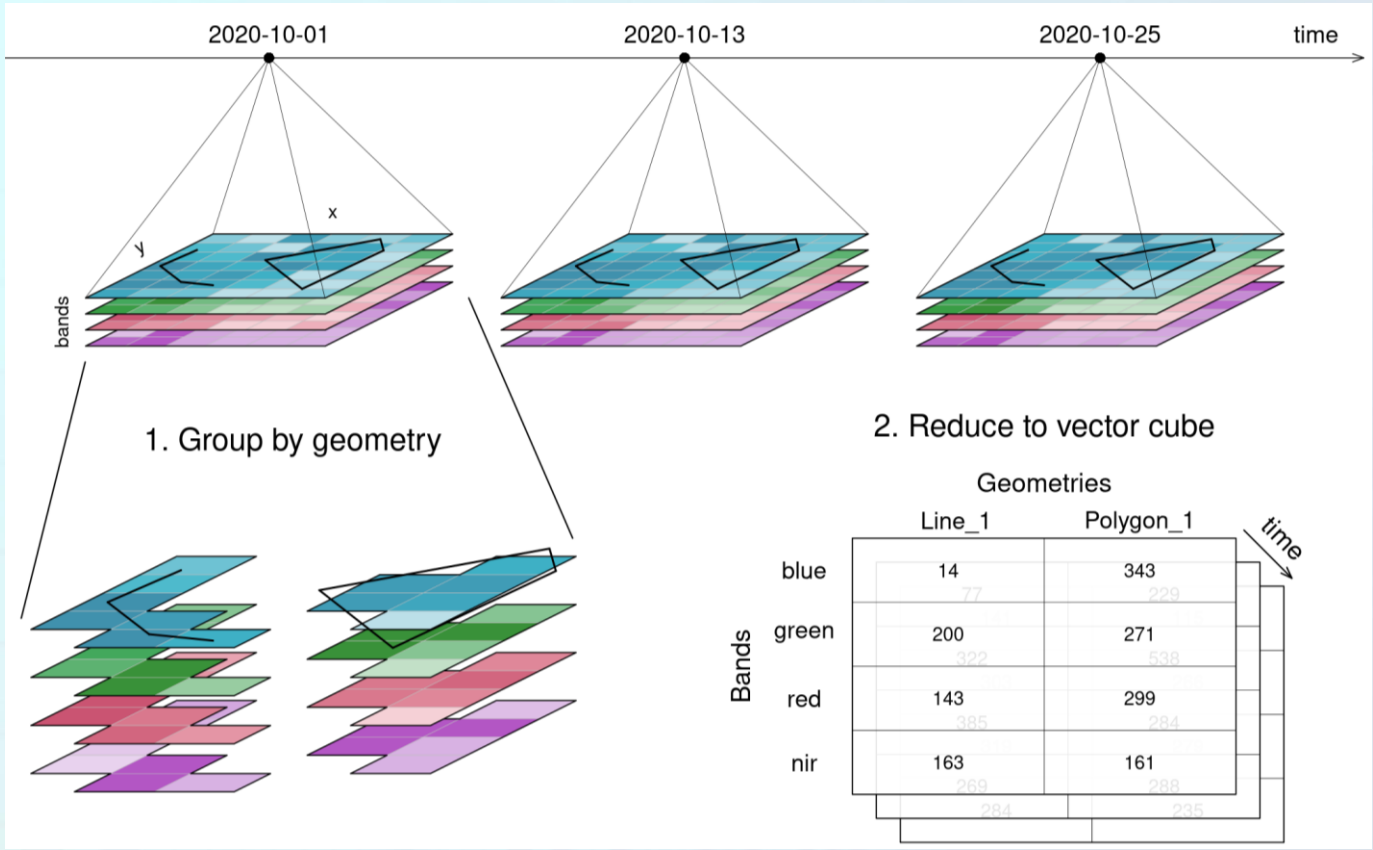
# Concepts of openEO – Datacubes - Reduce




**Reduce dimension:**

- **Collapses one dimension and calculates a single result**
- **Reduce function (e.g. mean, max, min, median…)**

# Concepts of openEO – Datacubes - Aggregate

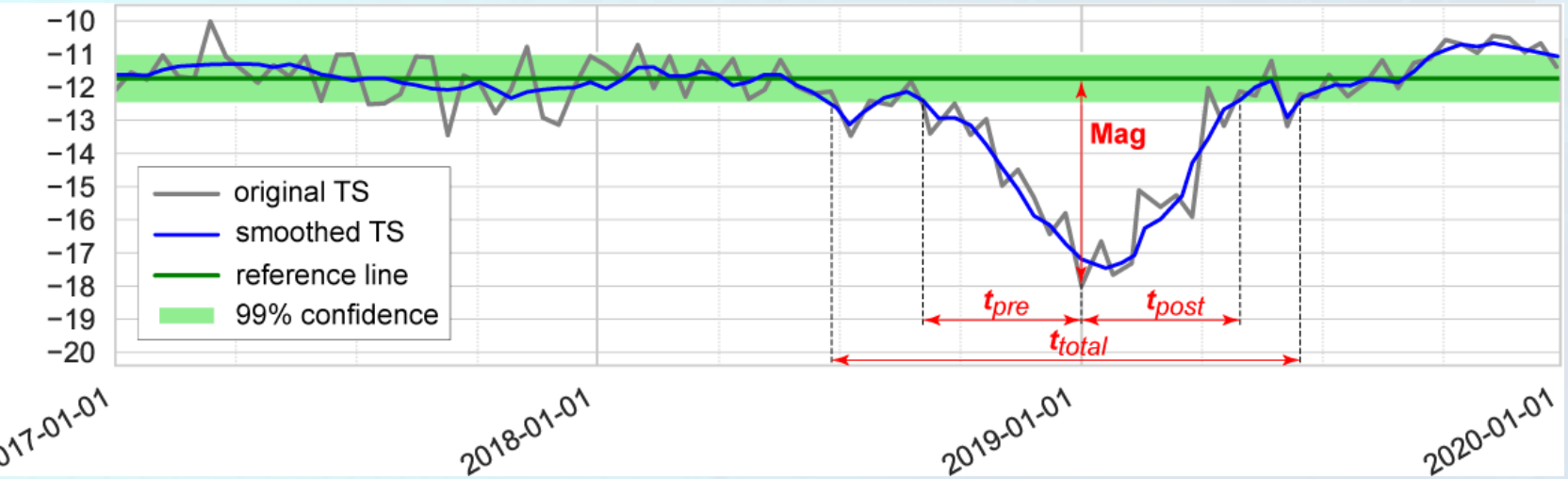



**Aggregate Spatial / Temporal:**

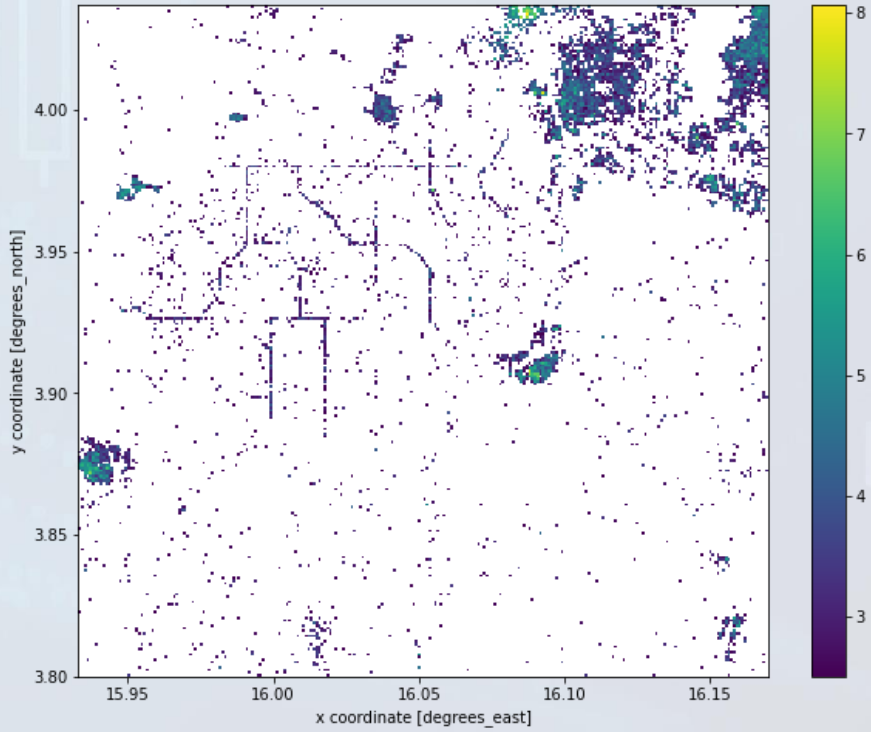
- **Groups over time or geometry and collapses similarly to reduce to a single outcome**

# Selective Logging Sites in the Central African Rep.

**Methodology:** Sentinel-1 Signal Disturbance Features

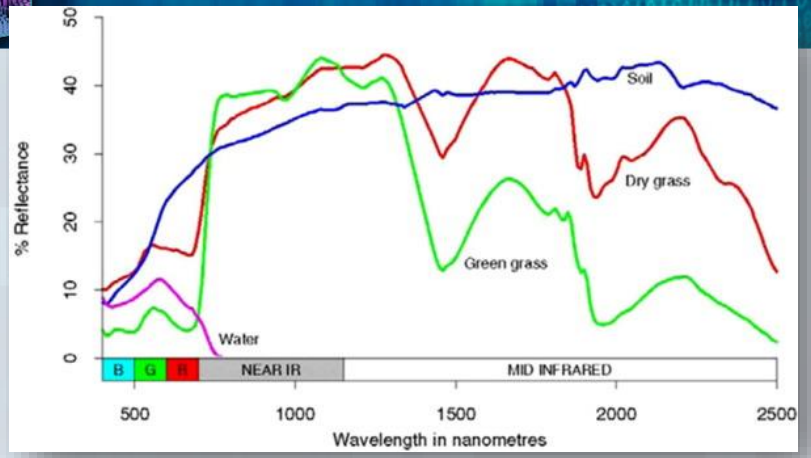


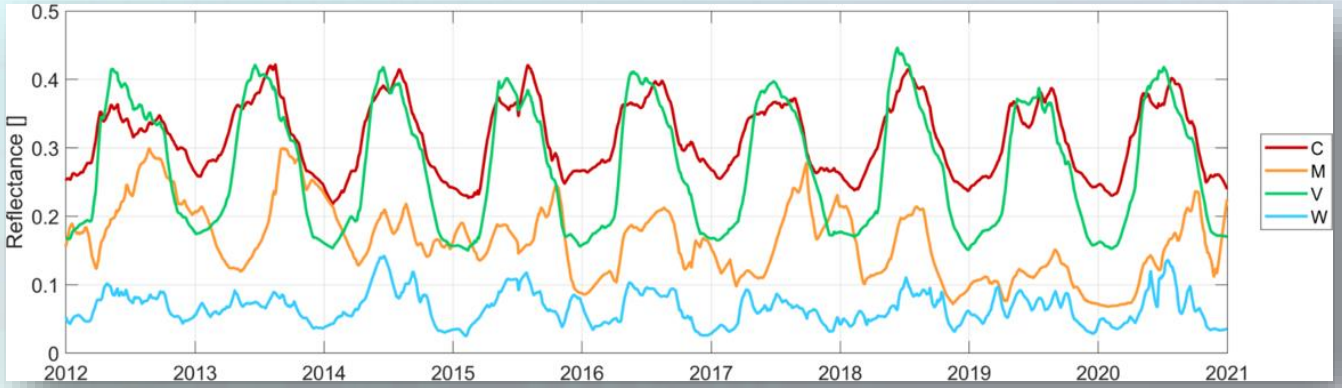

**Disturbance Magnitude > 2.5 (dB)**

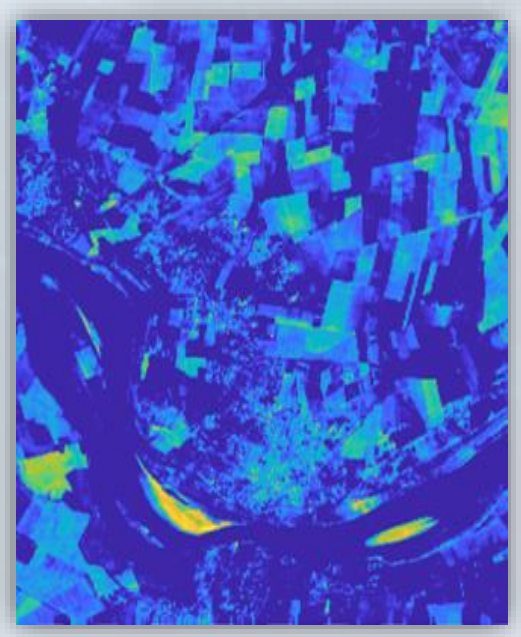


# “Use Cases” from the community

## River discharge from Sentinel 2 imagery

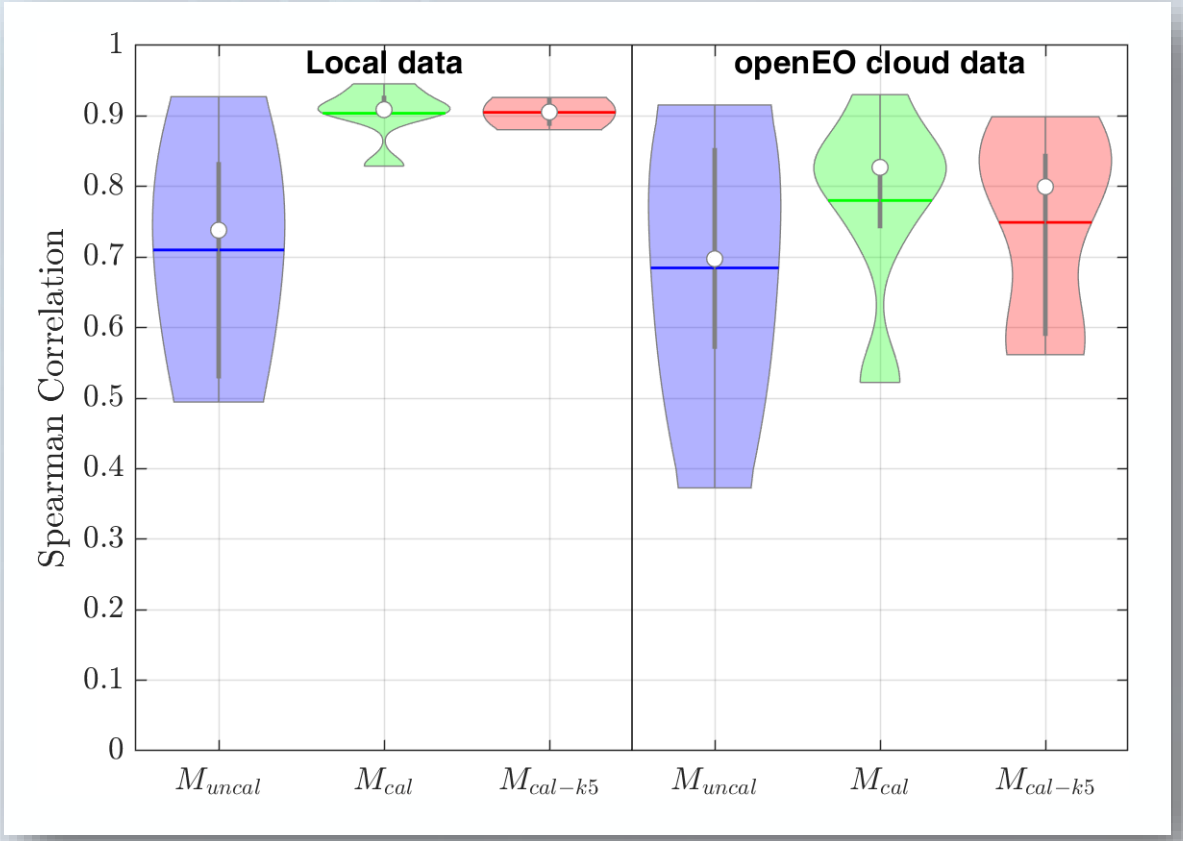



# “Use Cases” from the community

- Po (Italy): 2 stations
- Rhein (Germany): 2 stations
- Mississippi (USA): 2 stations



# Active User Community

## Masked Sentinel 2 standard deviation

openEO Platform python

**paolo.filippucci** openEO Platform Early Adopter

Hi, I have a question regarding the calculation of the reflectance standard deviation
working with spyder, but the standard deviation I obtain with the function "sd" is
I obtain by downloading them. Is there any problem with the NaN ingestion?
I paste below the code I'm using.

```
import openeo
from openeo.processes import is_nan,
import numpy as np
```

## Issue with spatial mean operation

openEO Platform python

**paolo.filippucci** openEO Platform Early Adopter 21g

Hi,
I wanted to extract the spatial average of a cloud-masked Sentinel-2 datacube, and I noticed several issues. I decided to report them below for your knowledge:

1. When the average is downloaded as csv file, the obtained values need to be sorted, since the time variable is not consecutive
2. if the average is operated through the instruction **datacube.aggregate_spatial(rect, lambda pixels:**

ts with both netcdf and csv, while
**ect, "mean")** just the csv file can

formed externally by downloading

## Which is the right function to apply sd

openEO Platform python

**paolo.filippucci** openEO Platform Early Adopter 21g

Hi
I am trying to calculate the temporal standard deviation of the NIR reflectance from Sentinel-2, in order to use the obtained product to create a mask. I have found two ways to do so:
The operation:

**imension='t')**

**.dimension='t')**

move the time dimension after the calculation and
ension" operation after this one, but when I tried to
cide:

0.35

0.25 0.3 0.35

on

Which one is the function to be used?

## Issue with masking procedure

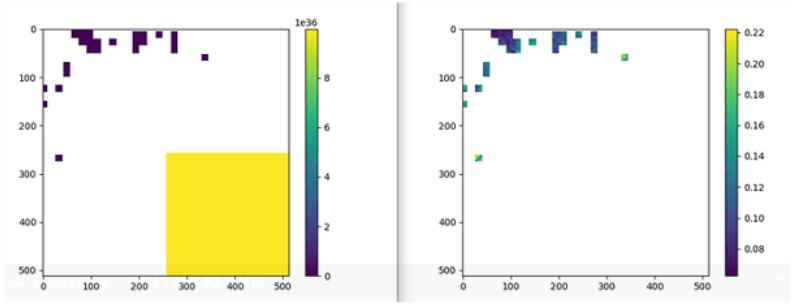
openEO Platform python

**paolo.filippucci** openEO Platform Early Adopter 2g

Hi everyone,

I need to apply a kernel to a Sentinel-2 dataset and to mask the clouds. I applied all the operation, but it seems that there is an issue on masking the dataset after the kernel application.

This is my code:




**Month** 9 MAY - 9 JUN

Last Updated: 8 Jun 2022 20:10

83 users | filter by username | all groups

| Username | Received | Given | Topics | Replies | Viewed | Read | Visits |
|---|---|---|---|---|---|---|---|
| **stefaan.lippens** Stefaan Lippens<br>openEO Platform Developer | 5 | 0 | 0 | 38 | 32 | 146 | 18 |
| **jeroen.dries** Jeroen Dries<br>openEO Platform Developer | 7 | 0 | 1 | 18 | 19 | 129 | 20 |
| **paolo.filippucci** Paolo Filippucci<br>openEO Platform Early Adopter | 1 | 0 | 2 | 18 | 16 | 119 | 14 |
| **m.mohr** Matthias Mohr<br>openEO Platform Developer | 7 | 13 | 1 | 17 | 20 | 162 | 17 |
| **javier.martinez** JAVIER MARTÍ...<br>openEO Platform Early Adopter | 2 | 14 | 4 | 11 | 10 | 50 | 8 |
| **kyr** Christos;Χρήστος Kyranoud...<br>openEO Platform Early Adopter | 0 | 0 | 4 | 10 | 14 | 76 | 8 |
| **michele.claus** Michele Claus<br>openEO Platform Developer | 5 | 1 | 0 | 7 | 14 | 123 | 10 |
| **benjamin.schumacher** Benja... | 5 | 2 | 3 | 7 | 13 | 57 | 15 |
| **milutin.milenkovic** Milutin Mile...<br>openEO Platform Early Adopter | 0 | 0 | 1 | 6 | 10 | 61 | 7 |
| **jaapel** Jaap Langemeijer<br>openEO Platform Early Adopter | 0 | 0 | 0 | 5 | 6 | 39 | 4 |
| **equiros** Elia Quirós<br>openEO Platform Early Adopter | 1 | 0 | 0 | 5 | 0 | 5 | 14 |
| **datascience** Hendrik Wagenseil<br>openEO Platform Early Adopter | 2 | 2 | 0 | 4 | 7 | 40 | 4 |
| **lukas.weidenholzer** Lukas Wei...<br>openEO Platform Developers | 1 | 0 | 1 | 3 | 12 | 46 | 7 |
| **bryanvallejo16** Bryan Vallejo<br>openEO Platform Early Adopter | 0 | 1 | 0 | 3 | 1 | 10 | 14 |
| **peterjames.zellner** Peter Jame...<br>openEO Platform Developer | 1 | 4 | 1 | 2 | 9 | 70 | 9 |
| **florian.lahn** Florian Lahn<br>openEO Platform Developer | 3 | 0 | 0 | 2 | 5 | 42 | 6 |

# What is openEO?

-> Representation of your EO Analysis in a common language. The analysis can be defined in any available client  package!

# ANNEX - Documentation

-> https://openeo.cloud/

**Documentation:**
-> openEO Platform: https://docs.openeo.cloud/
-> openEO: https://openeo.org/documentation/1.0/

**Questions?**
-> Forum: forum.openeo.cloud

# ANNEX - Registration

-> https://openeo.cloud/#plans

## Follow the Step-by-Step Guide:

### How to join OpenEO Platform as Early Adopter (2 Steps)

**TESTING PHASE**

Currently, openEO Platform is only open for Early Adopters or within a free 30 day trial period. Read more about the Early Adopters program on the information page . Read more about the 30 day trial period on the documentation page

To express your interest in becoming an Early Adopter you need to follow 2 steps:

1. Connect an existing account to EGI check-in
2. Apply to the openEO Platform virtual organization

The 2 steps are described in detail below.