RETURN – Monitoring Amazon Rainforest Recovery Capacity with terabytes of RADAR satellite images processed on EOSC infrastructures

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with contributions from:
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Novel Data Ecosystems for Sustainability (NODES), IIASA

Geo-information Science and Remote Sensing Lab, Wageningen University

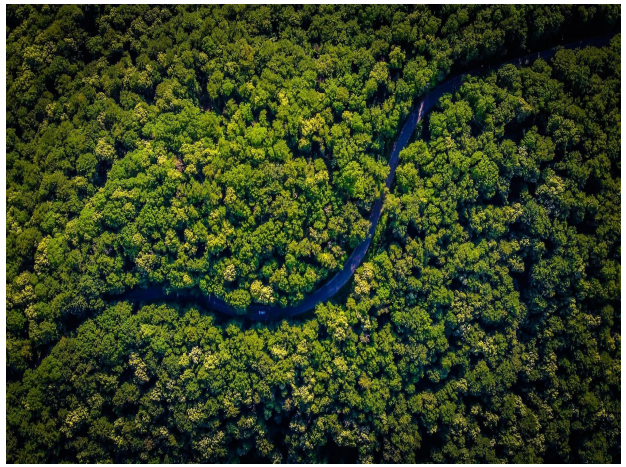
5. December 2022, EOSC Webinar

Pan-European digital assets supporting research communities – Benefits & opportunities

Session: Digital assets supporting SDG 13: Climate action

Resilience

Non-disturbed

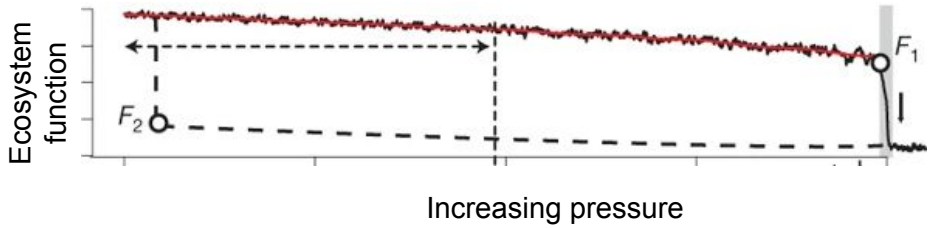


Credit: Unsplash/ Vlad Hilitanu

Disturbed

Credit: www.earthjournalism.net

M. Scheffer *et al.* (2009) *Nature*



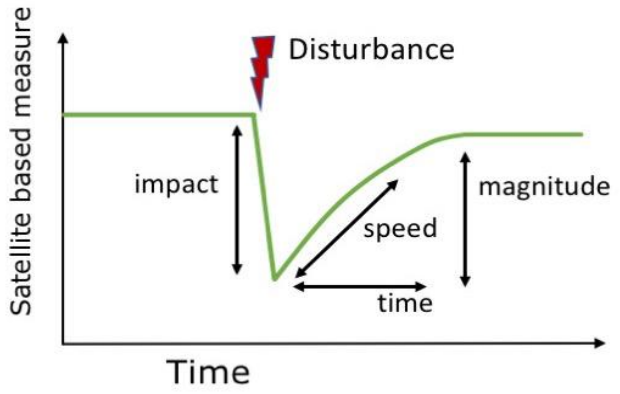
van Belzen, J. *et al.* (2017)

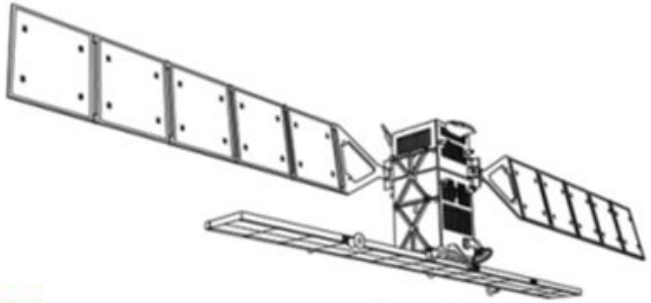
Resilience

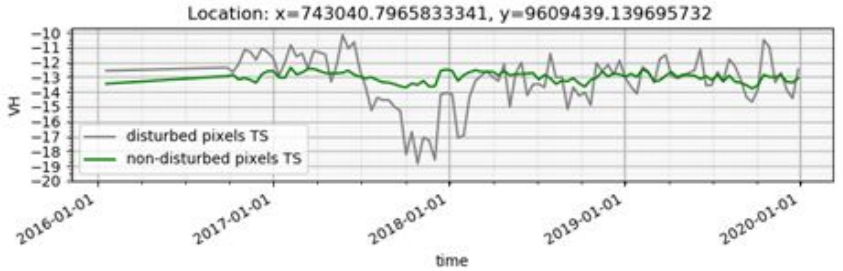
Credit: www.earthjournalism.net

Challenges & research questions:

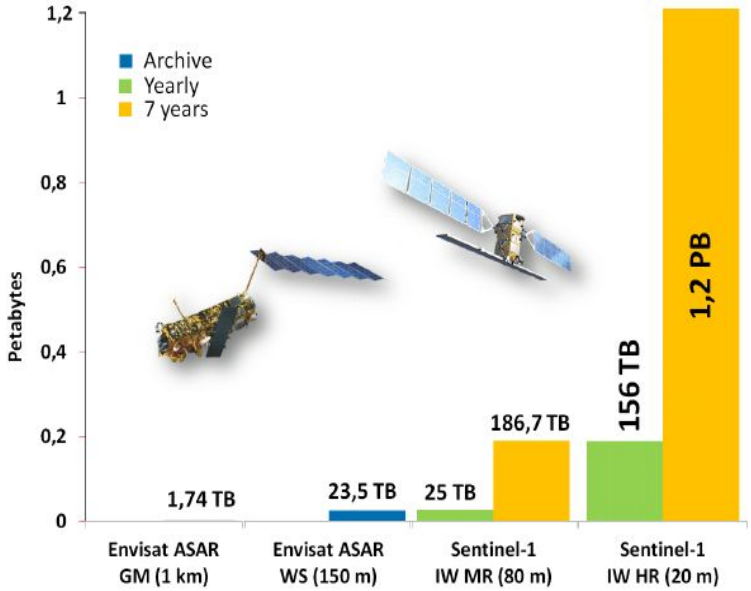
- What are the characteristics of signal recovery indices?
- What EO signal properties are related to forest recovery?
- **What Big EO data approaches are available for upscaling?**



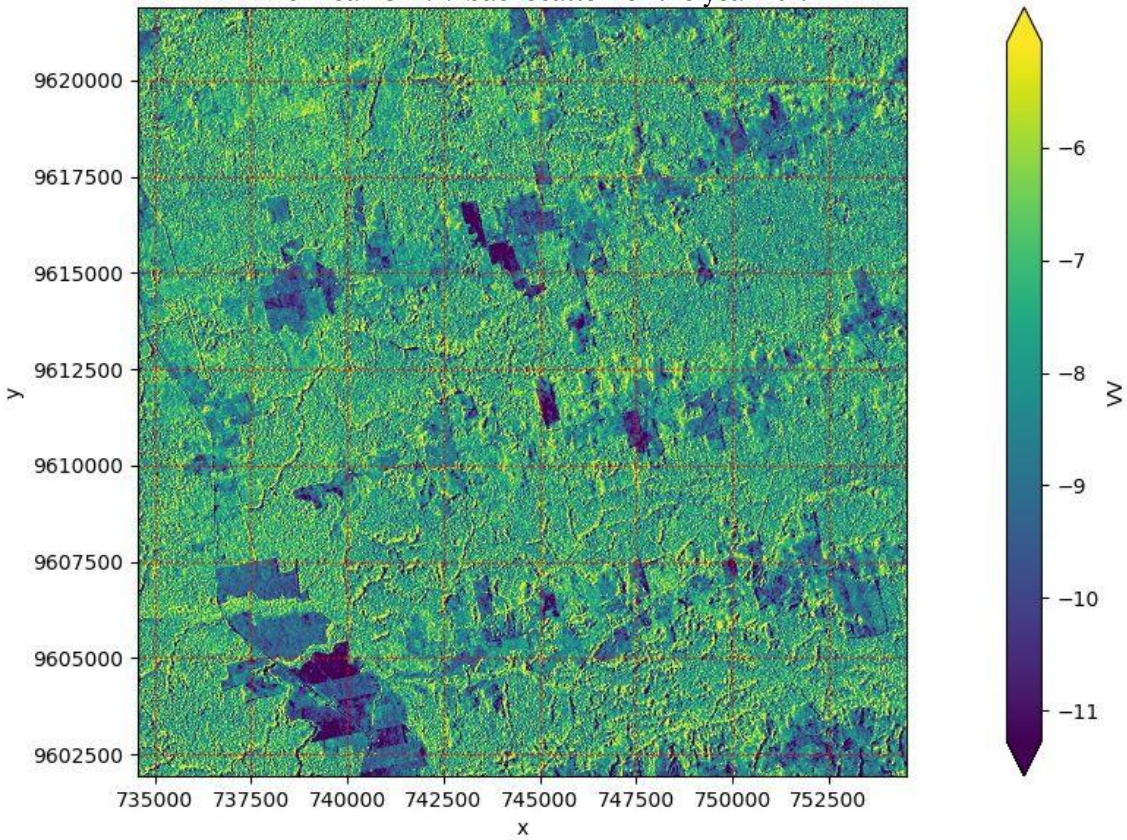




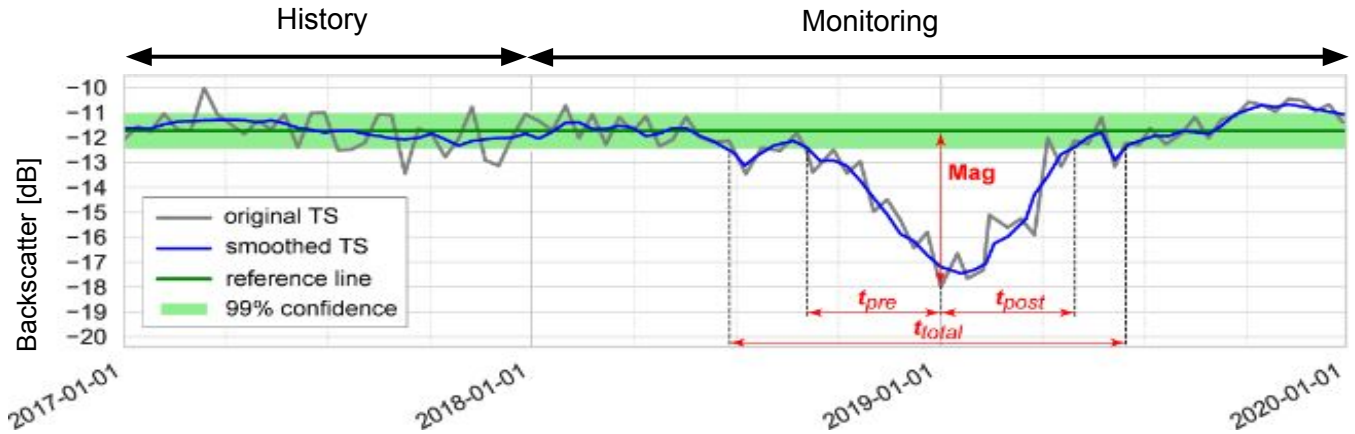
Wolfgang Wagner (2015)

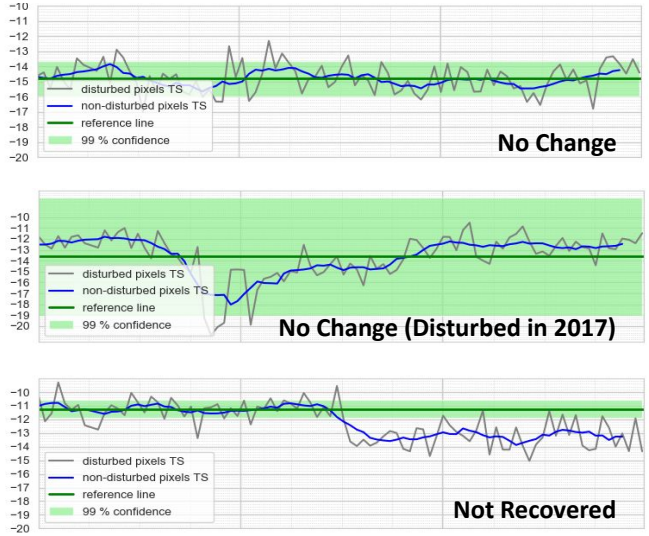


The mean S1-VV backscatter for the year 2019

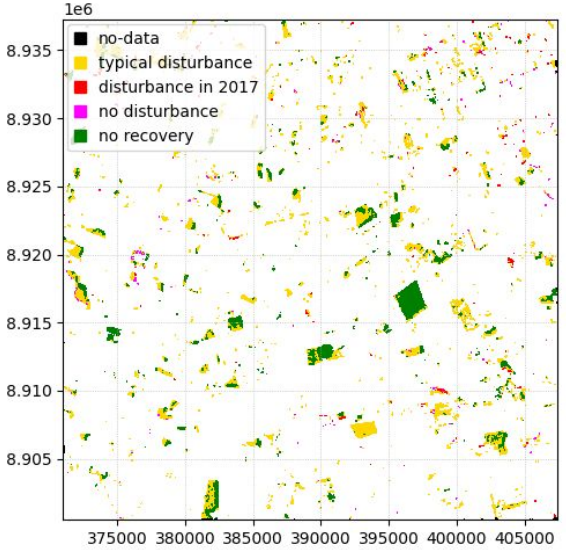


Analysis Framework for Sentinel-1 Time Series

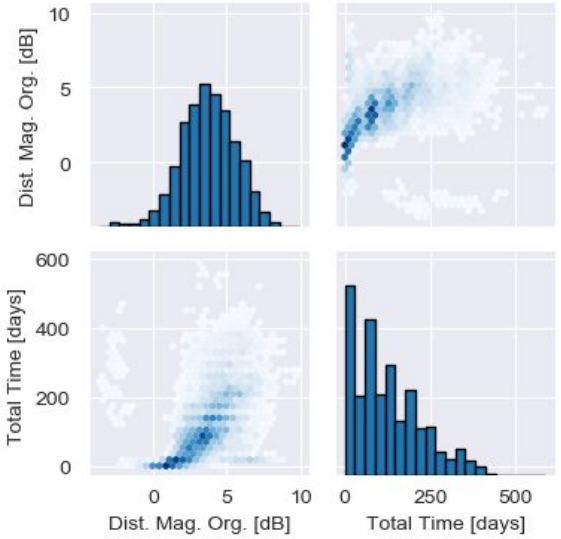




Time series type



Index interrelation



C-SCALE: Implementation Framework

JS

S1 ARD Image Tiles

Georeferenced, BUT NOT Datacube yet:

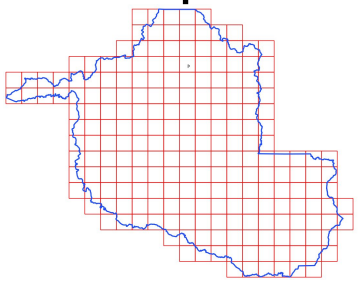
- GRD granules
- irregular time stamps
- along-track geometry and split
- missing dates

collection2xarray

Data Pool

single-date, merged, and tilled Images

xarray



Crop & Transform BASH

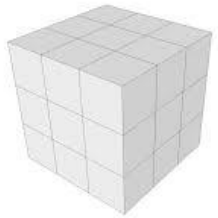
Disturbance Image Tiles

TS Categories & Features

Disturbance Map

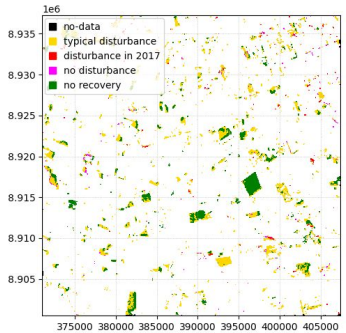
- Georeferenced
- Wall-to-wall coverage

6-day S1 Data Cube with Disturbance-Recovery Features

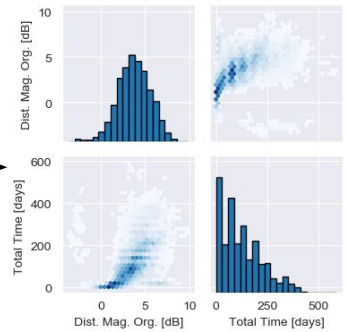


xarray

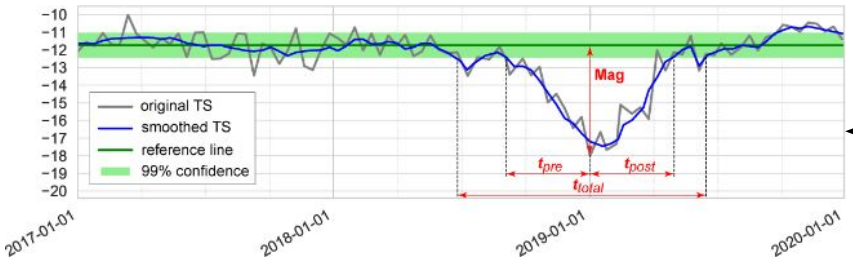
Mapping



Analysis



Visualize TS



C-SCALE: Implementation Framework

eodc

Data transfer

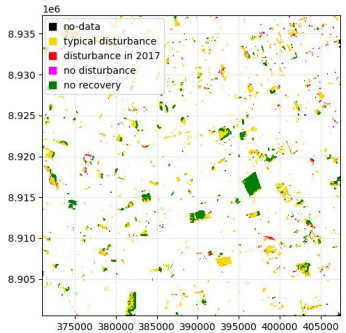
SURF

EUROPEAN OPEN SCIENCE CLOUD

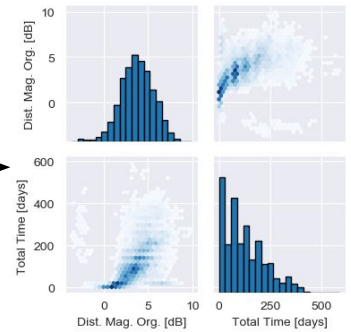
6-day S1 Data Cube with Disturbance-Recovery Features

xarray

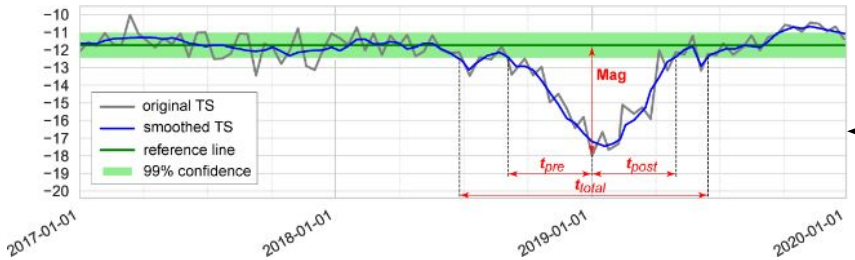
Mapping



Analysis



Visualize TS



C-SCALE: Implementation Framework

eodc

Data transfer

RCLONE

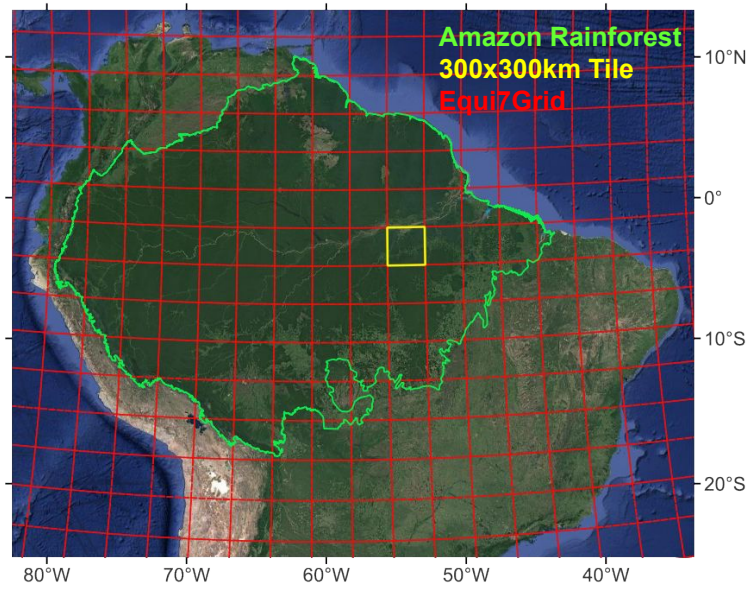
SURF

EUROPEAN OPEN SCIENCE CLOUD

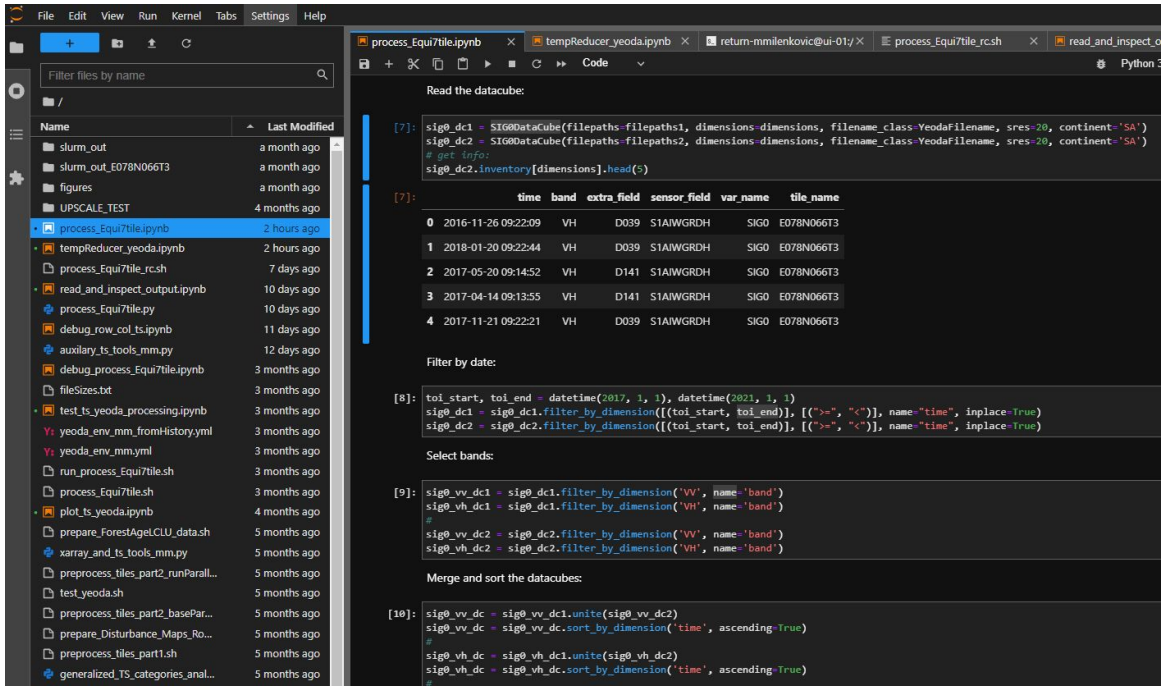
xarray

yeoda

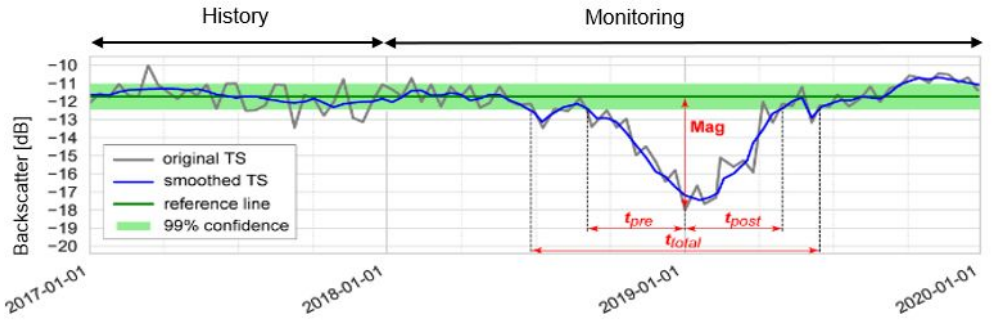
slurm workload manager



Credits: Bernhard Bauer-Marschallinger, TU Wien



C-SCALE: Computational Setup



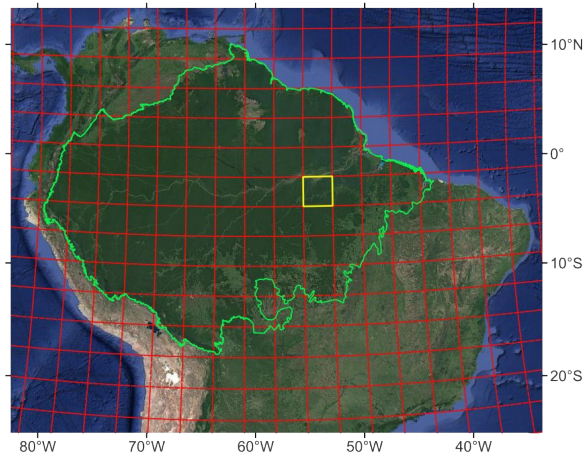
Multi-level Spatial Indices:

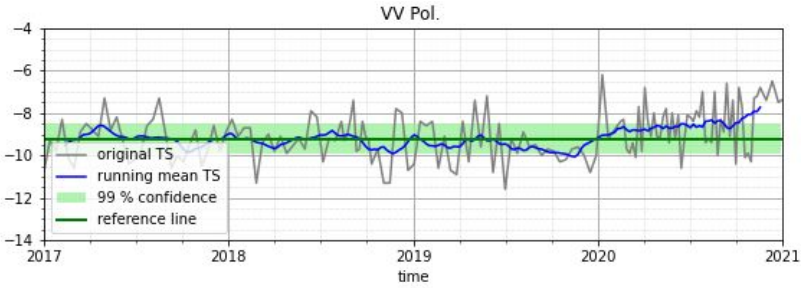
- 106 Equi7Grid Tiles 300 x 300 km^2
- 18170 Processing chunks (1000 x 1000 pixels) x ~1050 images
- **18.1 billion of pixels** - 20 x 20 m in size

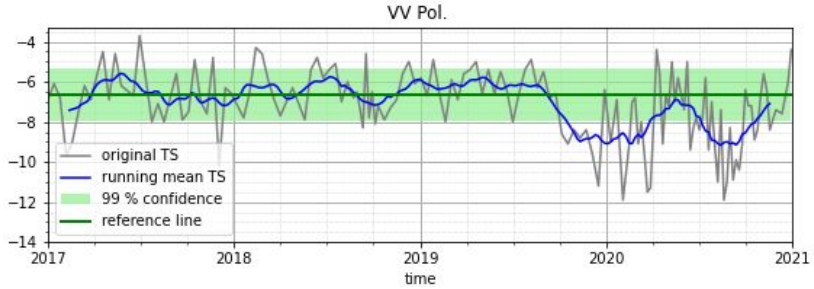
Processing characteristics:

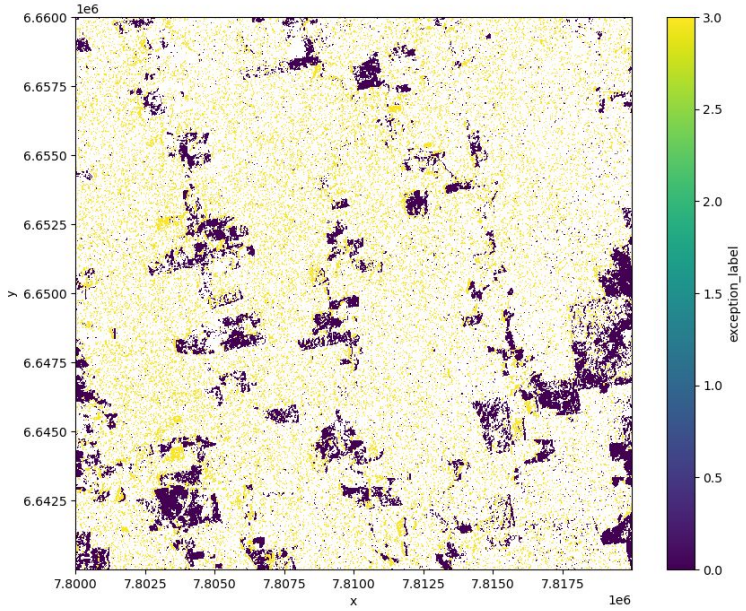
- 200 concurrent jobs (800 max)
- ~11h processing time / single chunk □ 36.4 km^2/h
- 3 cores/job
- **0.6 M CPUh and 41 day in total**

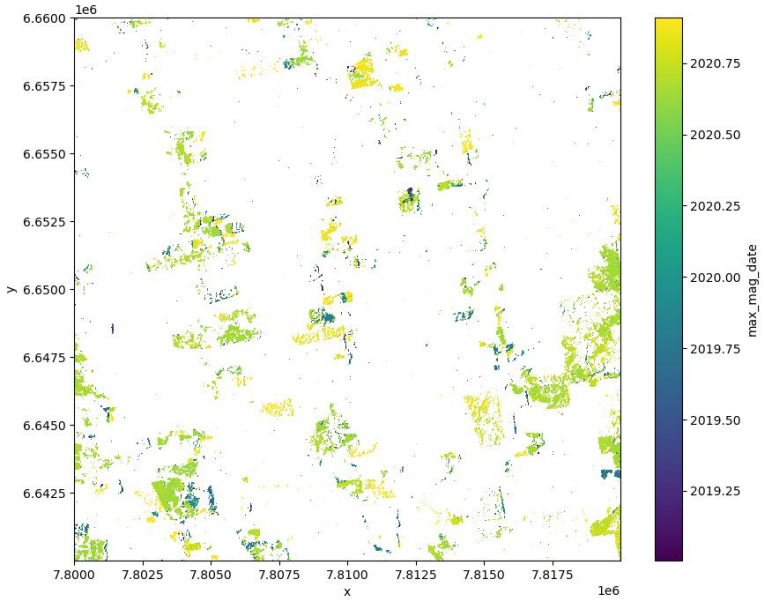
C-SCALE: Preliminary Results

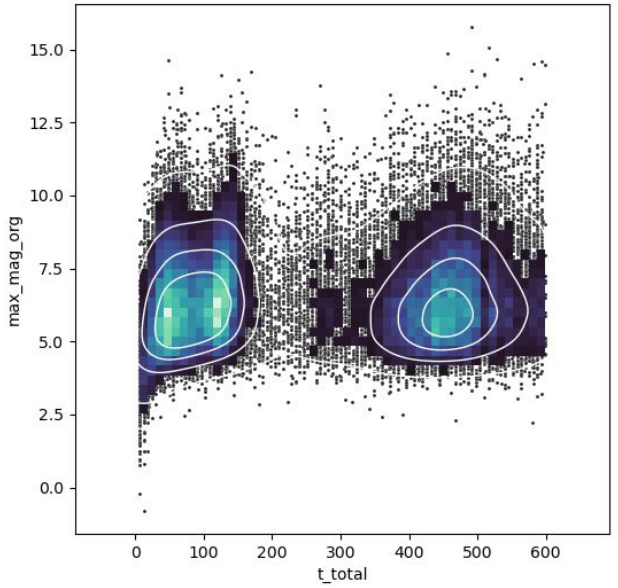










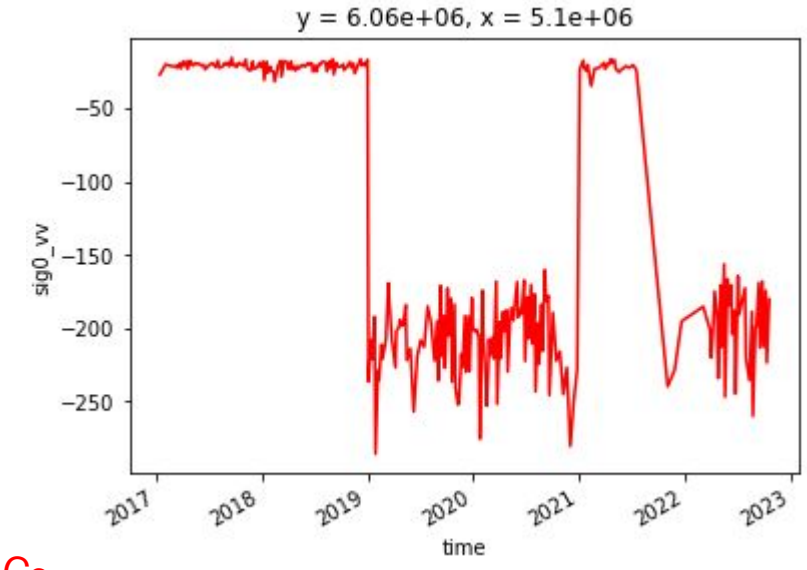


Lessons (hopefully) learned

Concurrent jobs and potential python errors

```
[return-mmilenkovic@ui-01 use-case-return]$ squeue -u $USER
             JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
3343832_[3-4%2]    normal process_ return-m PD       0:00      1 (JobArrayTaskLimit)
      3343832_1    normal process_ return-m  R    5:27:32      1 wn-hb-03
      3343832_2    normal process_ return-m  R    5:27:32      1 wn-hb-03
```

Differently scaled data



Corrupted tiff files

```
[return-mmilenkovic@ui-01 S1_SA_output_new]$ cat slurm_out/2999280_9.out
Mon Sep 19 09:56:01 CEST 2022
wn-hb-04.spider.surfsara.nl
return-mmilenkovic
START PROCESSING process_Equi7tile_rc.sh
srun python /home/return-mmilenkovic/mm_tools/use-case-return/process_Equi7tile.py -t 'E078N060T3' -r 1 -c 10 -s 1000 -o '/project/return/Share/mm/S1_SA_ou
tput_new/E078N060T3/'
ERROR 1: TIFFFetchDirectory:/project/return/Share/EODC_SA020M/V1M0R1/E078N060T3/SIG0_20180807T091643__VV_D141_E078N060T3_SA020M_V1M0R1_S1AIWGRDH.tif: Can n
ot read TIFF directory count
ERROR 1: TIFFReadDirectory:Failed to read directory at offset 38
```

Running archive at the data provider side

```
rclone copy --dry-run -i -c eodc_surf_sftp:S1_CSAR_IWGRDH/SIG0/V1M0R1/EQUI7_SA020M/V1M0R1/ /project/return/Share/EODC_SA020M/V1M0R1/

Transferred:          2.405 TiB / 2.405 TiB, 100%, 64.246 GiB/s, ETA 0s
Checks:         163743 / 163743, 100%
Transferred:     66769 / 66769, 100%
Elapsed time:      40.1s
```

RCLONE

Conclusions

Interface – built by the user

- Time-consuming to build
- Potential barrier for a general user

Data – transfer is required

- Data transfer is error prone

Code – flexible & manual upscale

- Debugging friendly
- Taking care of upscaling

	openEO Platform	C-SCALE	GEE
User Interface	In-place	Build by user	In-place
Data	In-place	Data transfer required	In-place
Code	Predefined + UDFs	Flexible	Predefined
Upscaling	Automatic	Manual	Automatic
Reproducibility	Fully	Fully	?

OPEN EARTH MONITOR

Thank you!

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Novel Data Ecosystems for Sustainability, IIASA