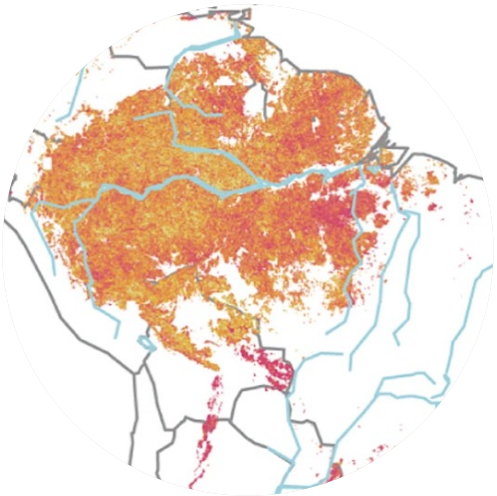
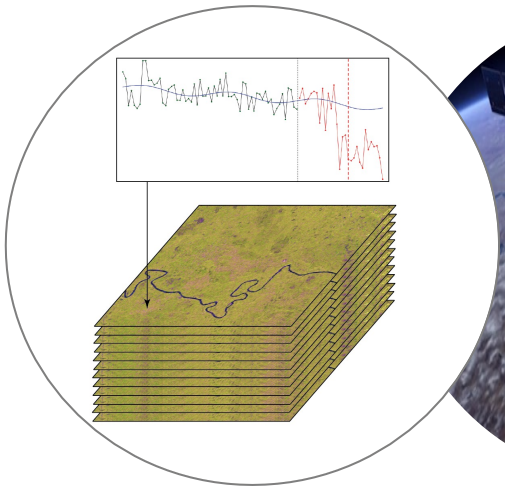
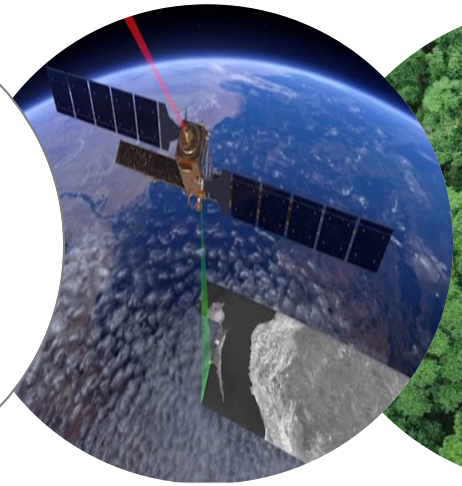
RETURN: Monitoring tropical forest recovery capacity using Big EO data

SURF: Seminar Enabling Copernicus Big Data Analytics through European Open Science Cloud

27.10.2021, Jan Verbesselt and Milutin Milenković







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(July 2019 – **Dec. 2021)**

Resilience of intact tropical forests

nature climate change

LETTERS

PUBLISHED ONLINE: 5 SEPTEMBER 2016 | DOI: 10.1038/NCLIMATE3108

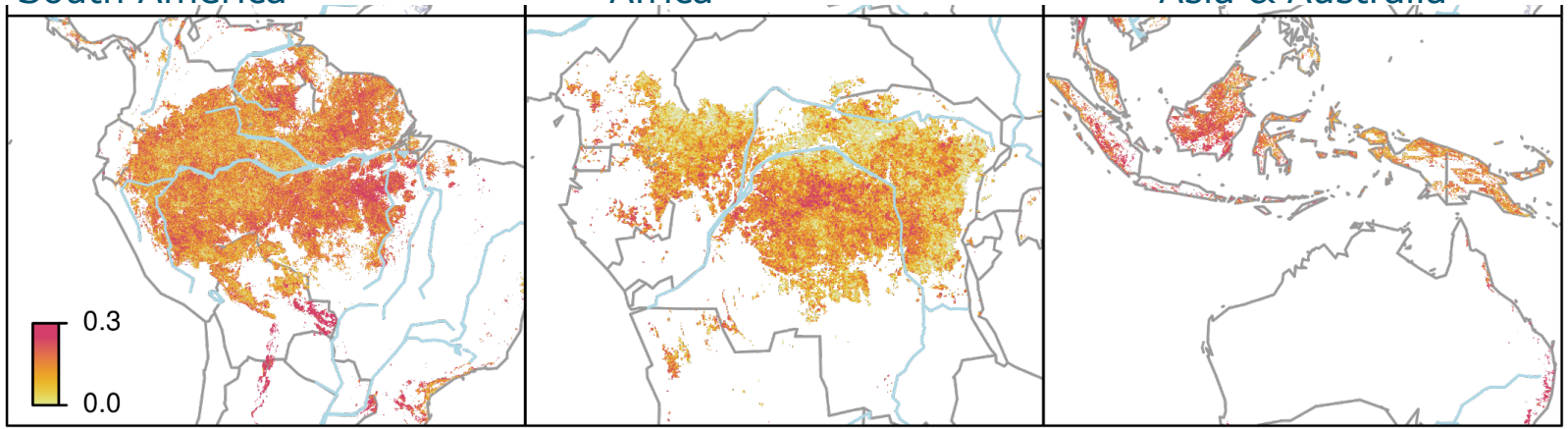
Remotely sensed resilience of tropical forests

Jan Verbesselt[1]*, Nikolaus Umlauf[2], Marina Hirota[3,4,5], Milena Holmgren[6], Egbert H. Van Nes[3], Martin Herold[1], Achim Zeileis[2] and Marten Scheffer[3]*

South America

Africa

Asia & Australia



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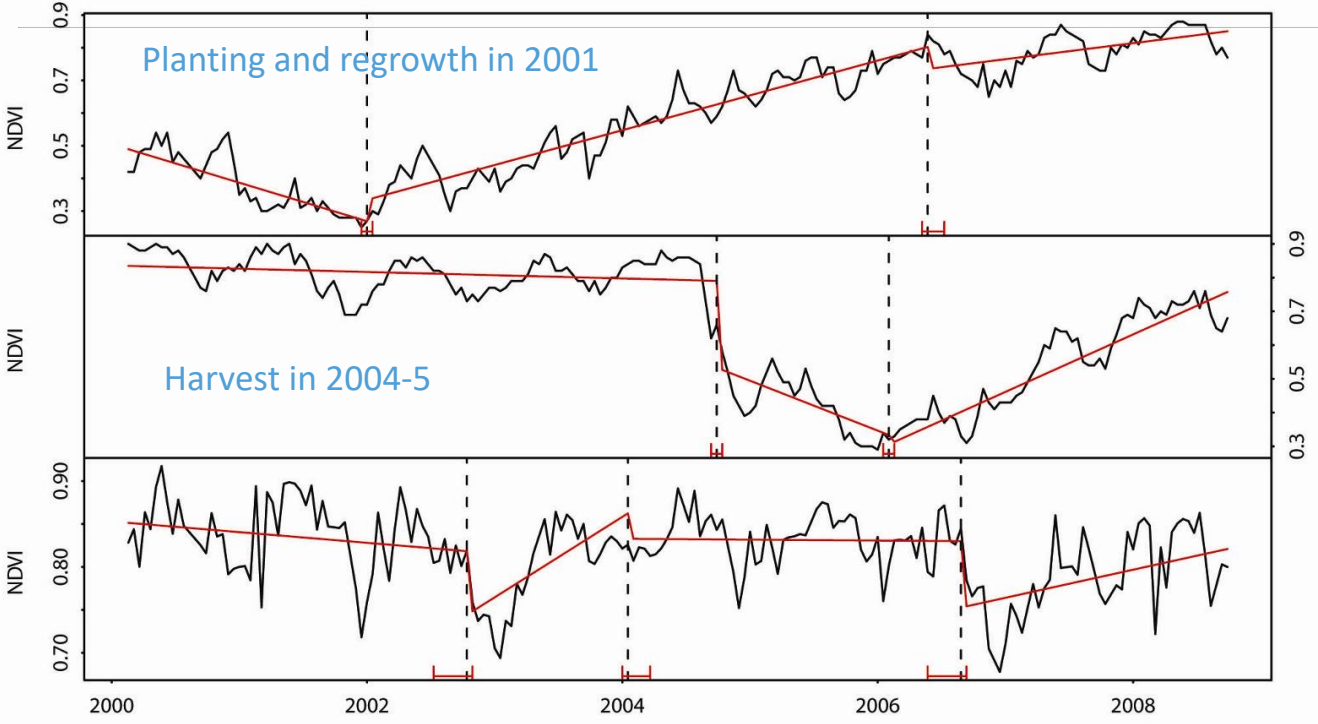
Resilience of disturbed forests

BFAST : Break detection for time series

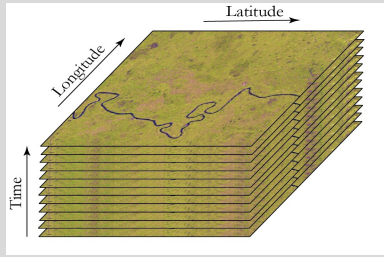


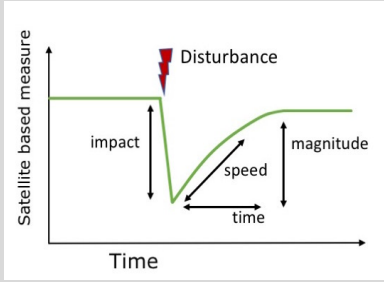
BFAST, Verbesselt, J., et al. (2010). Detecting trend and seasonal changes in satellite image time series. Remote sensing of environment https://github.com/bfast2/bfast

Monitoring tropical forest recovery capacity using:

- Multispectral Images
  - Wanda De Keersmaecker
  - **S2 & L8** surface reflectance
  - **MakeDataCube: R & FORCE**
- Radar Images
  - Milutin Milenković
  - **S1**
  - **Python & SNAP**

Study Area





Methods

Multi-spectral - makeDataCube – Landsat

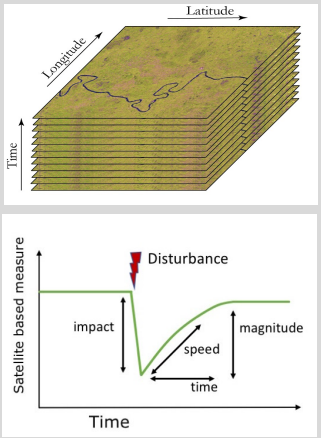
- makeDataCube Tool
  - WUR, eScience, and SURF
  - Analysis Ready Data (ARD) from Landsat images
  - FORCE software: https://github.com/davidfrantz/force
    - SPIDER: SURF computer cluster (in house elastic cloud)
    - Parallelization enabled trough time splitting

https://github.com/RETURN-project/makeDataCube

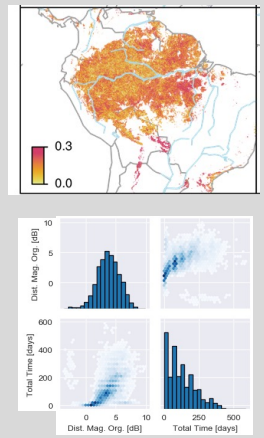
Monitoring tropical forest recovery capacity using:

- Radar Images
  - Milutin Milenković
  - **S1** radiometric terrain corrected
    - „Flattening Gamma“
  - **Python & SNAP**
    - aset of python scripts

Study Area

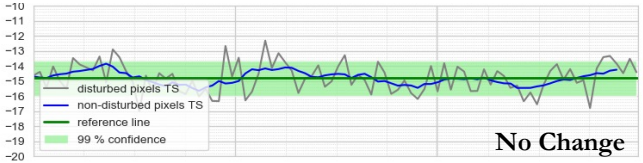


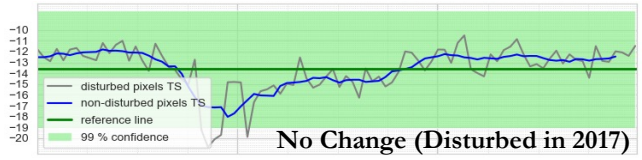
Methods



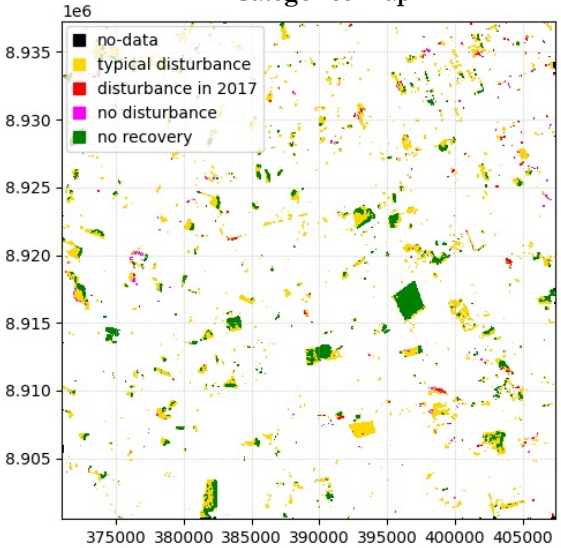
Products

Sentinel-1 Time Series Analysis Framework

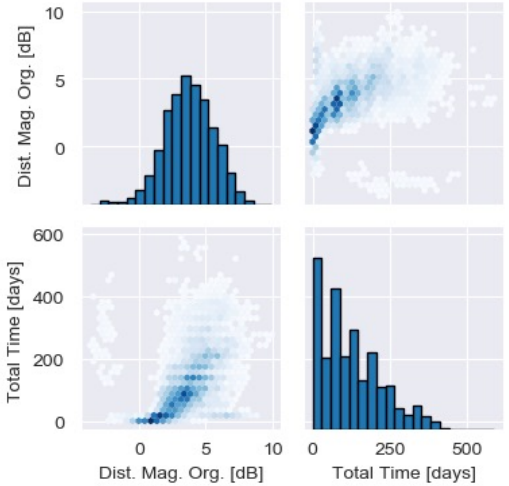




Categories Map



Statistical Analysis



RETURN RADAR Workflow

S1 ARD Image Tiles
- Georeferenced
- BUT NOT Datacube yet
- Mullissa et al. (2021)

collection2xarray

Data Pool
single-date, merged, and tilled Images

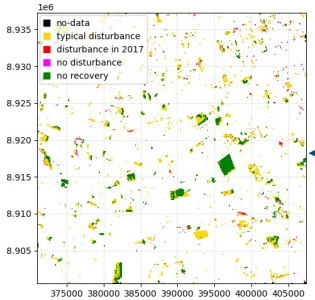
Crop & Transform

Disturbance Image Tiles

TS Categories & Features

Disturbance Map
- Georeferenced

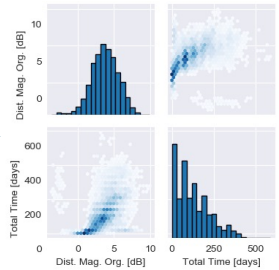
Tile Structure for AOI



Mapping

6-day S1 Data Cube with Disturbance-Recovery Features

Analysis



Visualize TS

RETURN RADAR Workflow

SURF

S1 ARD Image Tiles
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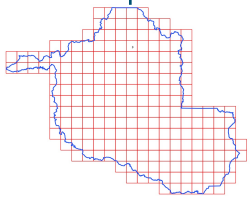
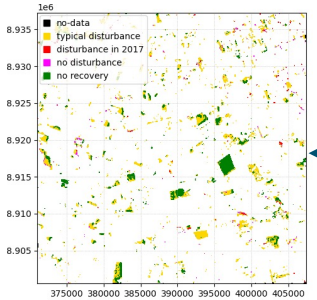
open EO

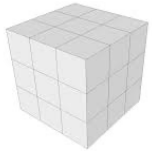


Tile Structure for AOI

Disturbance Map
- Georeferenced



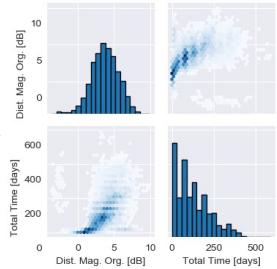
6-day S1 Data Cube with Disturbance-Recovery Features



xarray

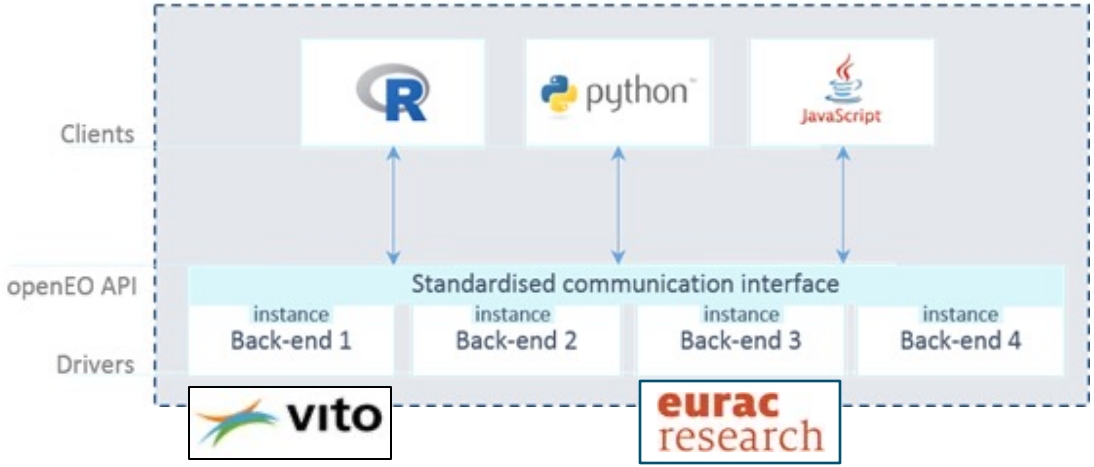
Mapping

Analysis

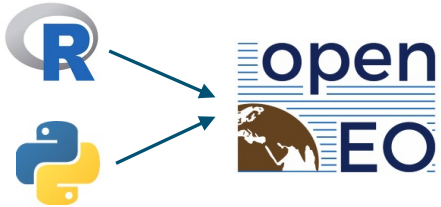


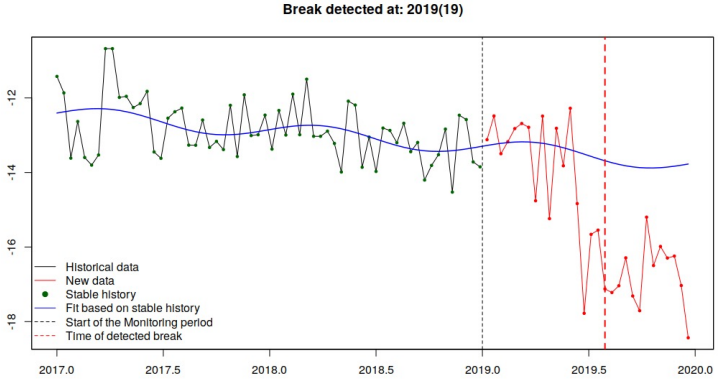
Visualize TS

OpenEO User Defined Functions & BFAST



- openEO BFAST UDF
  - R UDF @ EURAC backend
  - Python UDF @ VITO backend





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Challenges and Solutions

- S1 ARD – Flattening Gamma
  - CEOS Analysis Ready Data for Land (**CARD4L**) **compliant**
  - **Solution 1:** Sigma0 from EODC

    → Collaboration on C-SCALE project
  - **Solution 2:** Flattening Gamma processing @ SPIDER

    → SURF & WUR are currently testing SNAP gpt processing
  - **Solution 3:** Flattening Gamma from VITO

    → openEO Python UDF on the VITO Terrascope platform
- Code & Input Data Structure
  - Different data providers → different data structures and tools
  - Currently assumes xarray DataSet structure
  - **Solution:** code has to be adopted

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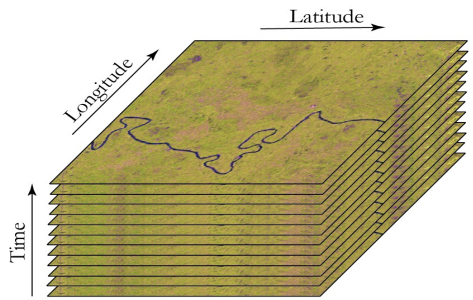
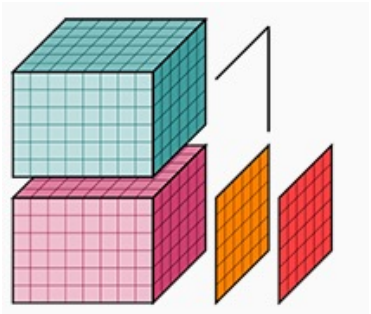
Conclusions and Outlook

- SURF can facilitate reproducible research with Big EO Data, BUT
  - ARD Cubes are prerequisite e.g. via SNAP, MakeDataCube (FORCE), or C-SCALE / data provider
  - Data could be exposed to users e.g. via openEO
  - New challenges beyond ARD Cubes are arriving as well

Image Catalogs



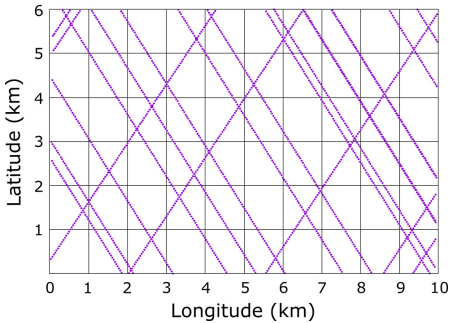
ARD Cubes



SURF

AI/ML

Sparse Data



Thank you!

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