Satellite data analytics for land change monitoring

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Motivation

BBC NEWS

Science & Environment

Climate change: 'Bleak' outlook as carbon emissions gap grows

By Matt McGrath
Environment correspondent

26 November 2019 | 1649

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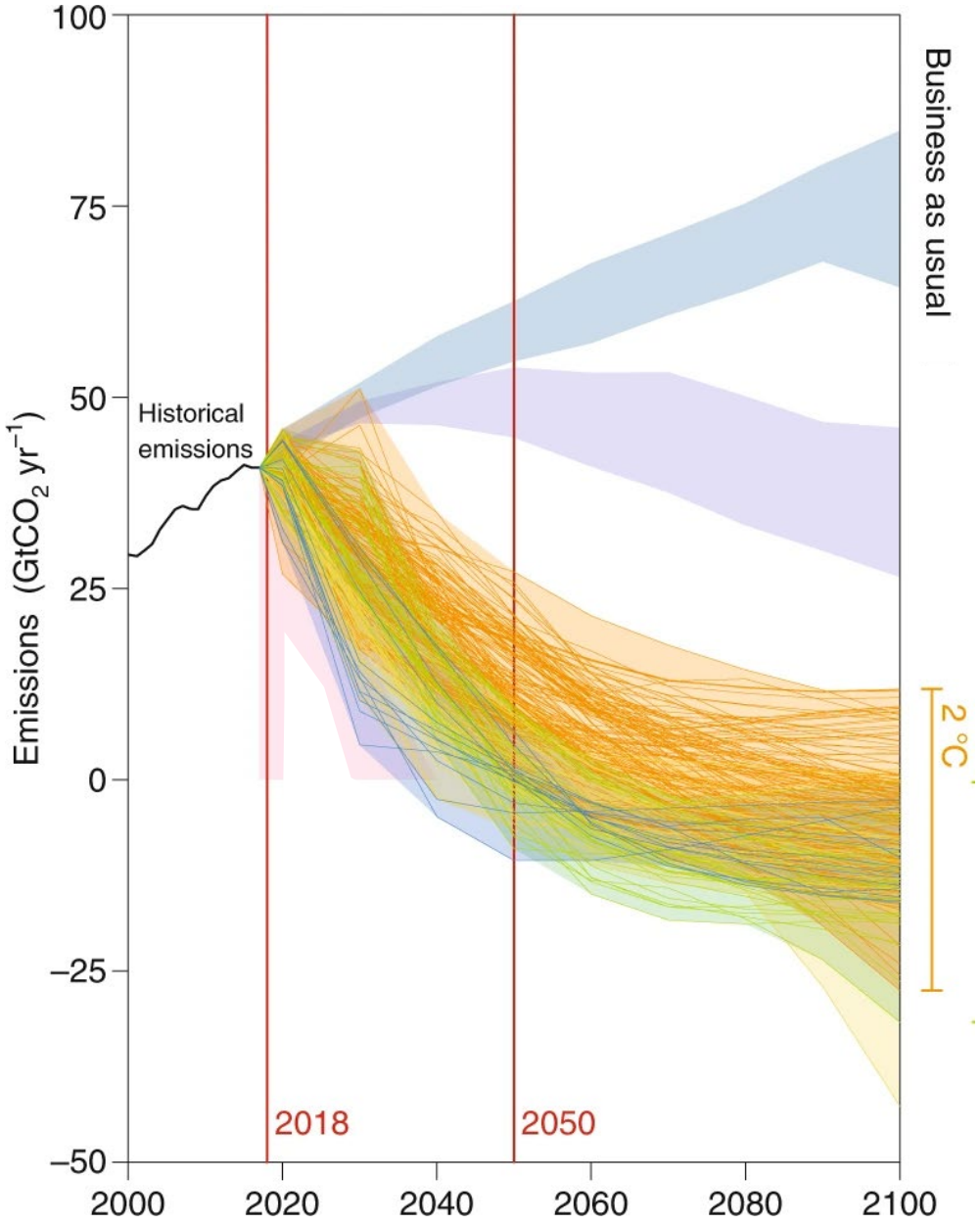


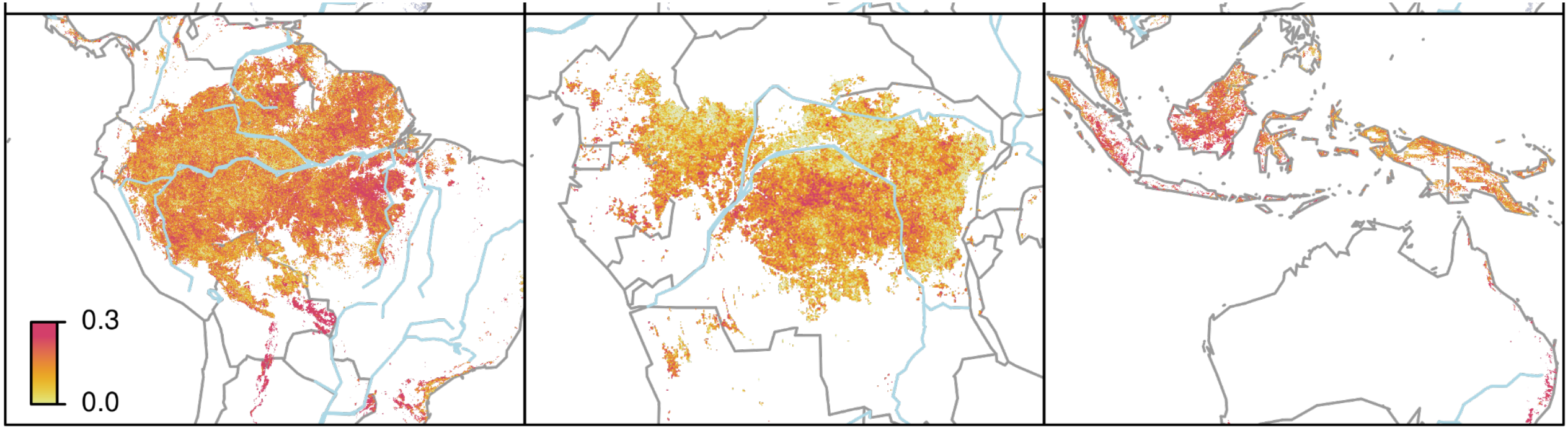
Roe, S. et al. Contribution of the land sector to a 1.5 °C world. Nature Climate Change (2019).

Motivation

South America

Africa

Asia & Australia



vrt NWS

BBC NEWS

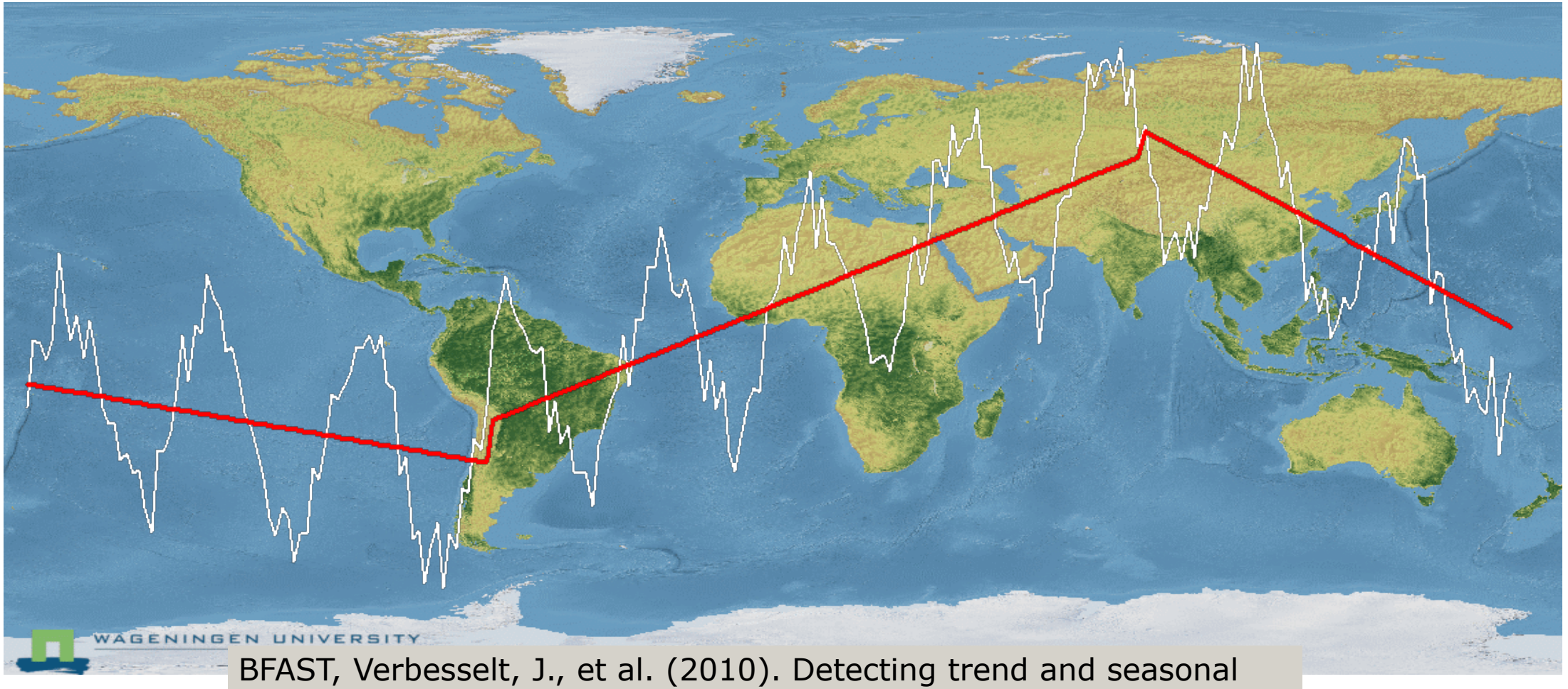
nature climate change
LETTERS
PUBLISHED ONLINE: 5 SEPTEMBER 2016 | DOI: 10.1038/NCLIMATE3108

Verbesselt, J. *et al.* Remotely sensed resilience of tropical forests. Nature Climate Change(2016).

Challenge

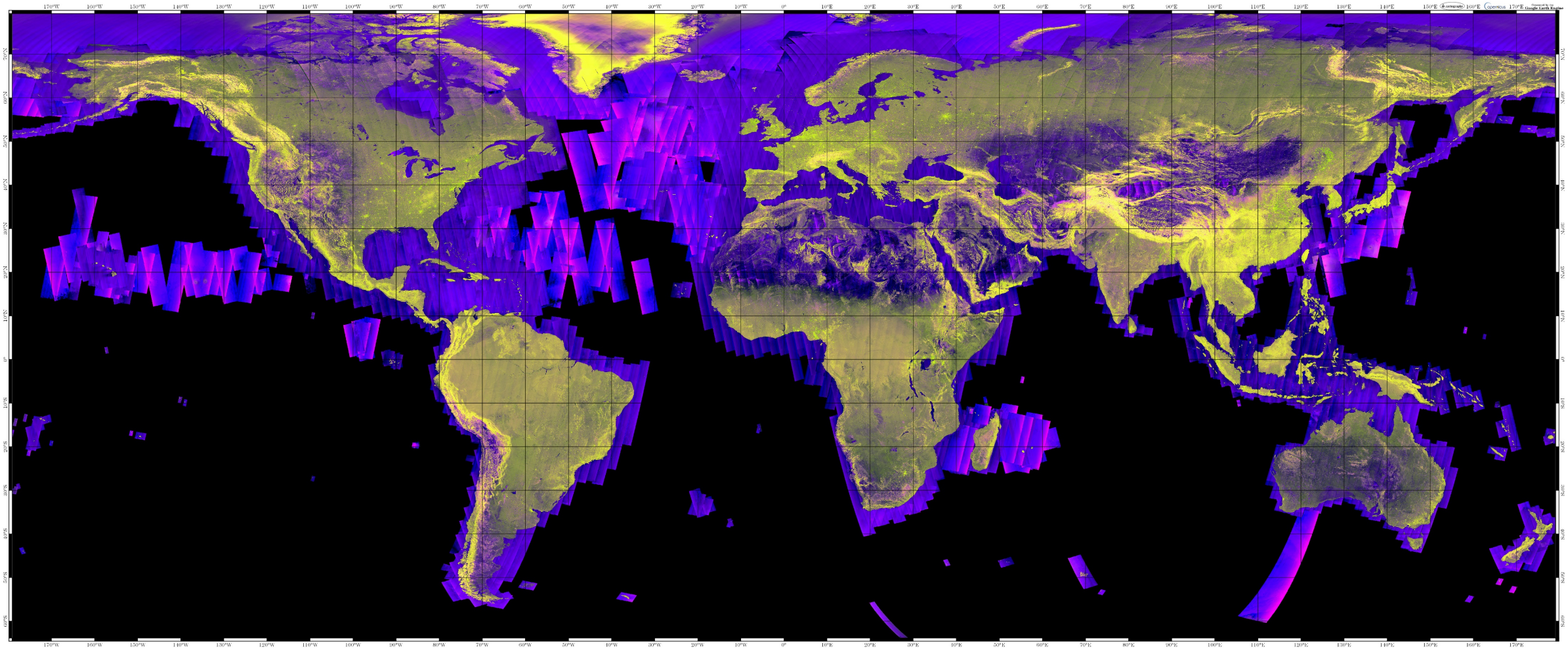
Provide accurate information on land change to empower sustainable management

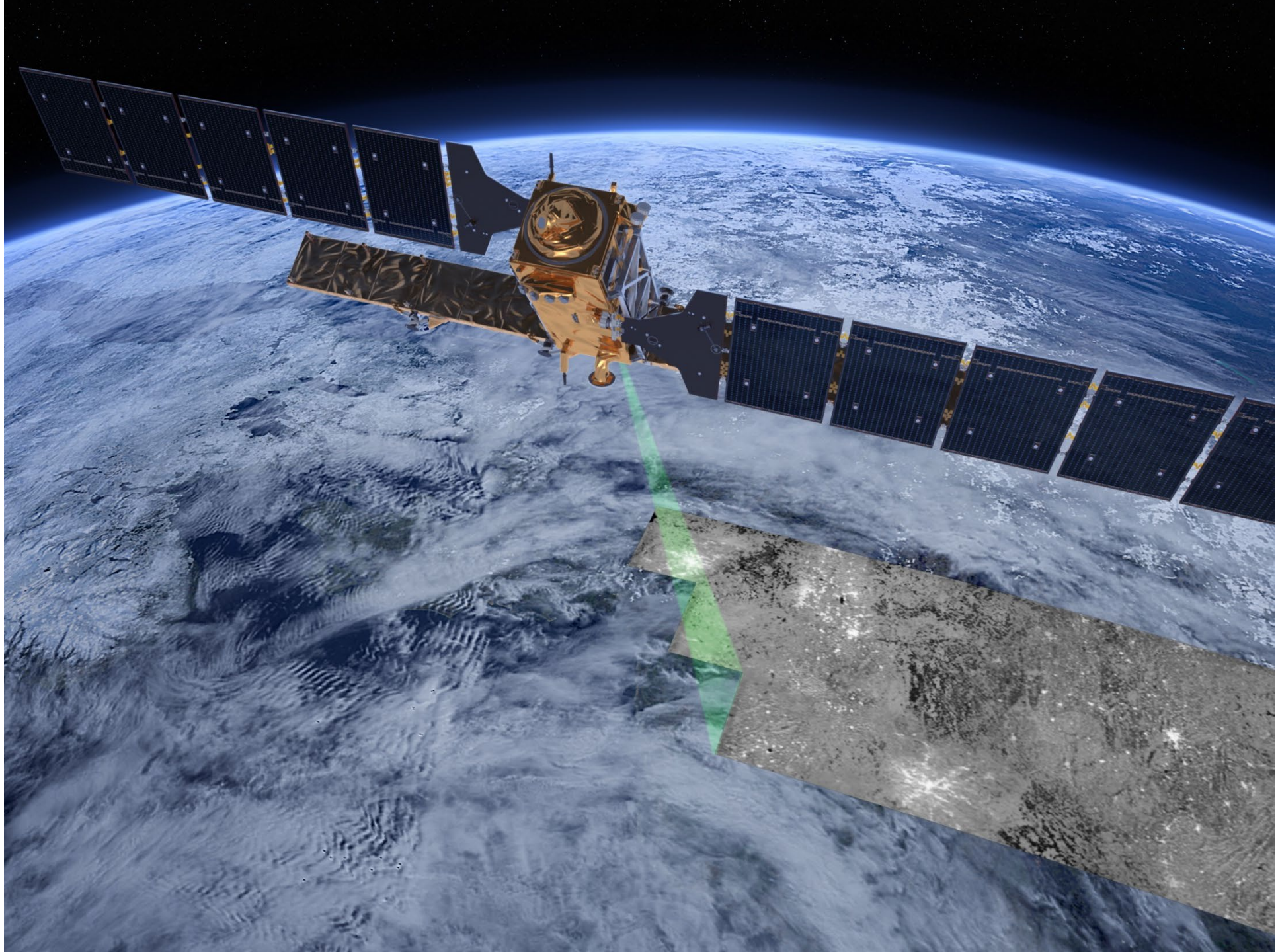
Challenge



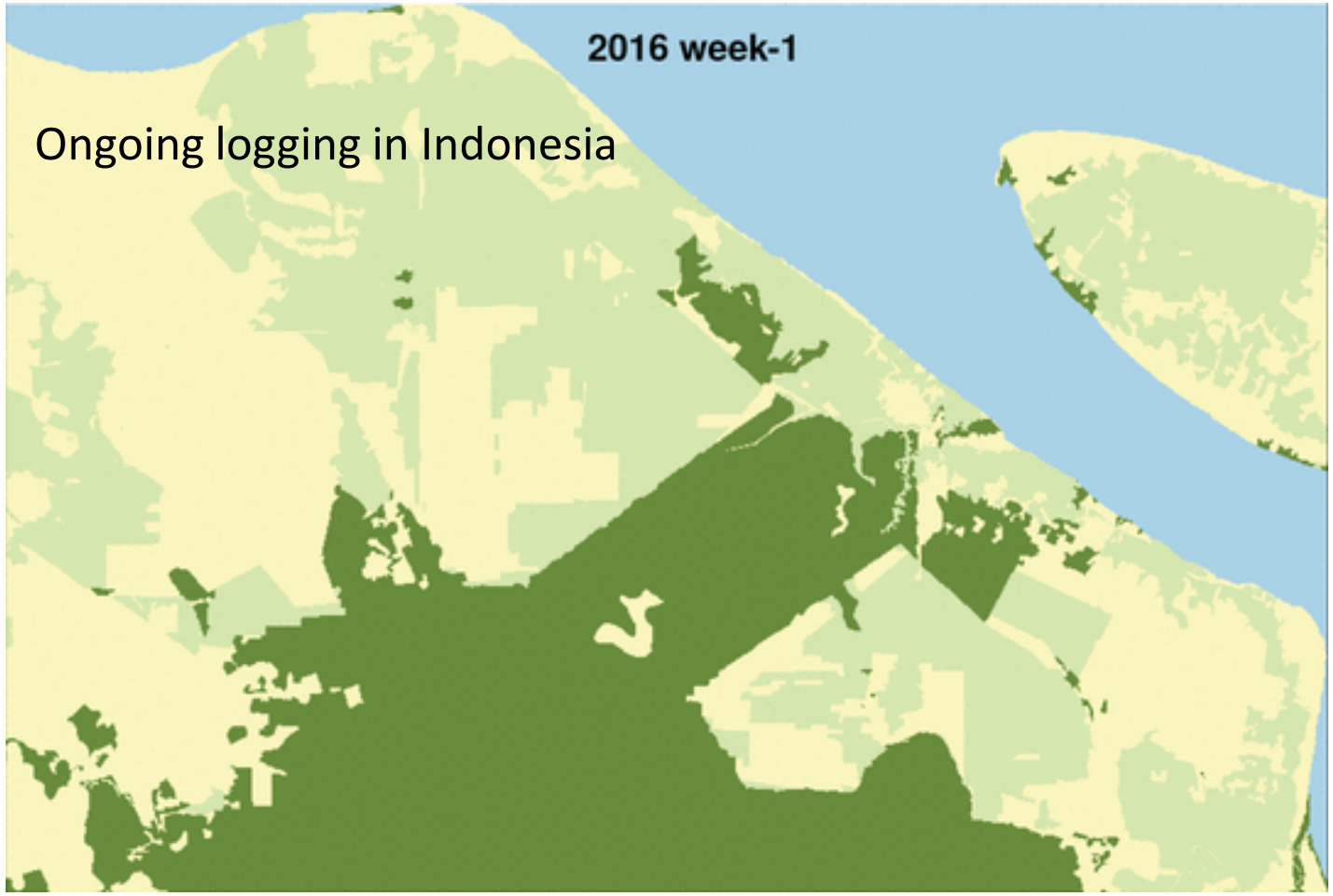
BFAST, Verbesselt, J., et al. (2010). Detecting trend and seasonal changes in satellite image time series. RSE.
https://github.com/bfast2

Challenge





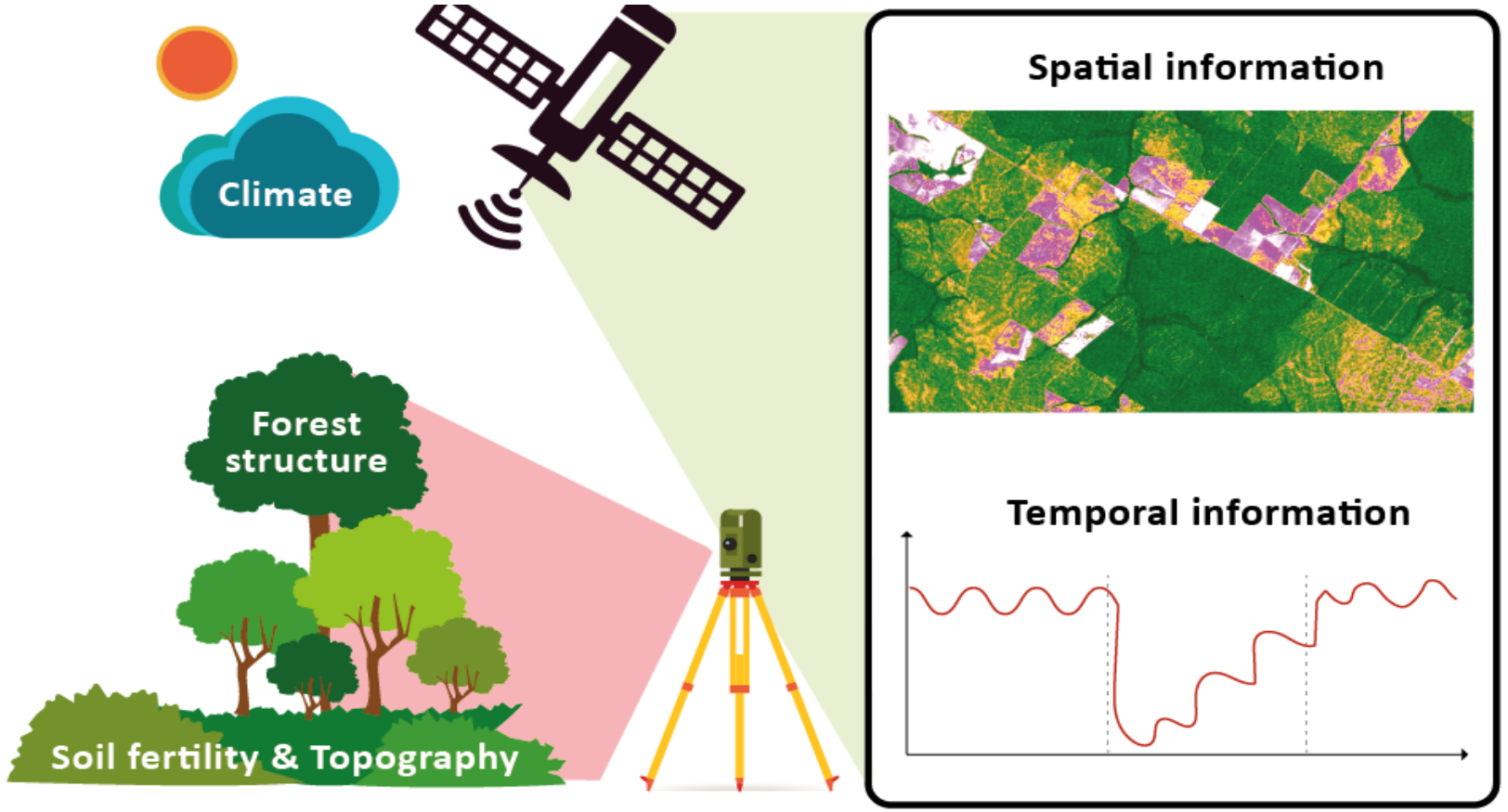
Land change monitoring

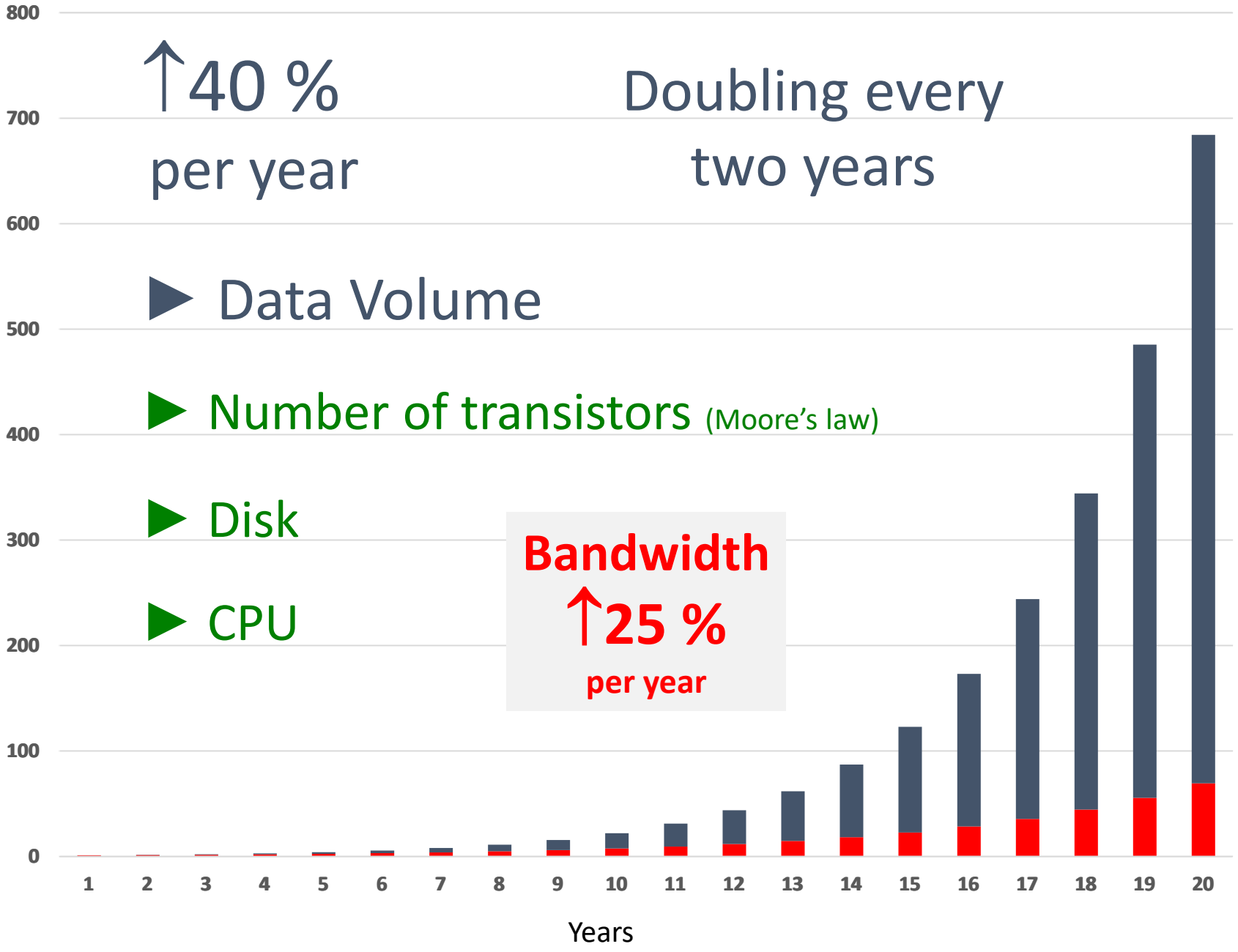


Natural forest
Plantations
Old clearing
New clearing

Change detection, Verbesselt et al. (2012, 2019) and Reiche et al. 2016, 2018

Monitoring disturbance and recovery



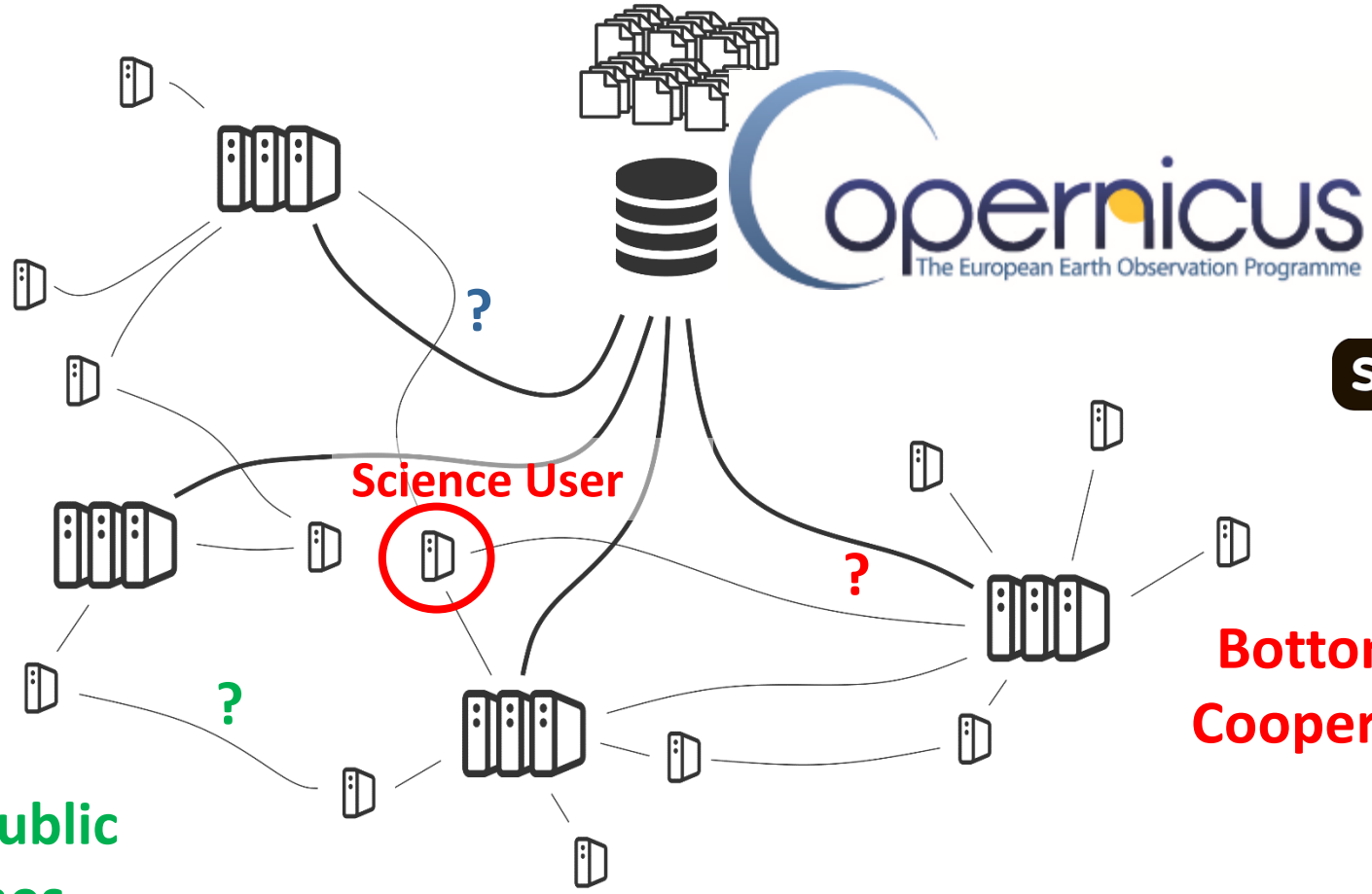

↑40 %
per year
Doubling every
two years
Data Volume
Number of transistors (Moore's law)
Disk
CPU
Bandwidth
↑25 %
per year
800
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Years

Today's Zoo of Earth Observation Platforms

Google Earth Engine

Commercial Services

Amazon Web Services



Copernicus
The European Earth Observation Programme

SURF SARA

netherlands eScience center

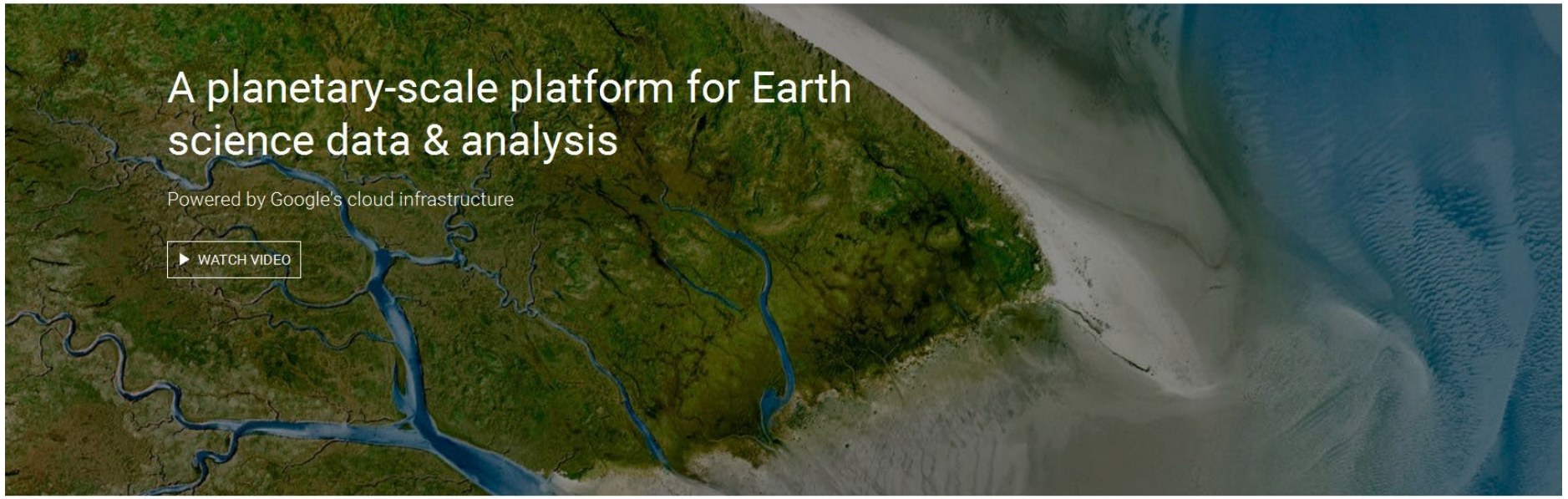
CODE-DE

Bottom-Up Cooperatives

Top-Down Public Programmes

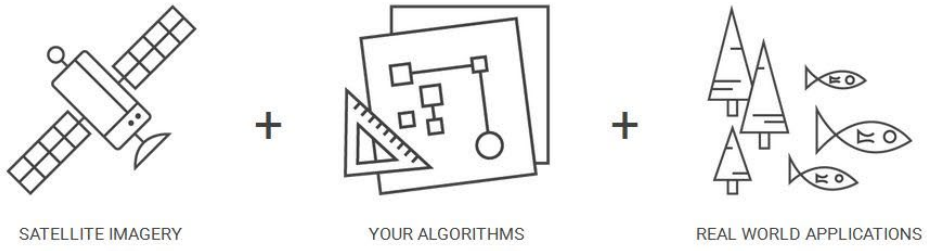
ESA-managed DIASes

Google Earth Engine https://earthengine.google.com/



Meet Earth Engine

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface.



Gorelick et al. (2017) Google Earth Engine: Planetary-scale geospatial analysis for everyone, Remote Sensing of Environment 202, 18-27

Data Access and Information Services (DIAS)

led by Creotech Instruments S.A.

led by Atos

implemented by

led by Serco Italia S.p.A.

led by Airbus

implemented by EUMETSAT, ECMWF and Mercator-Ocean

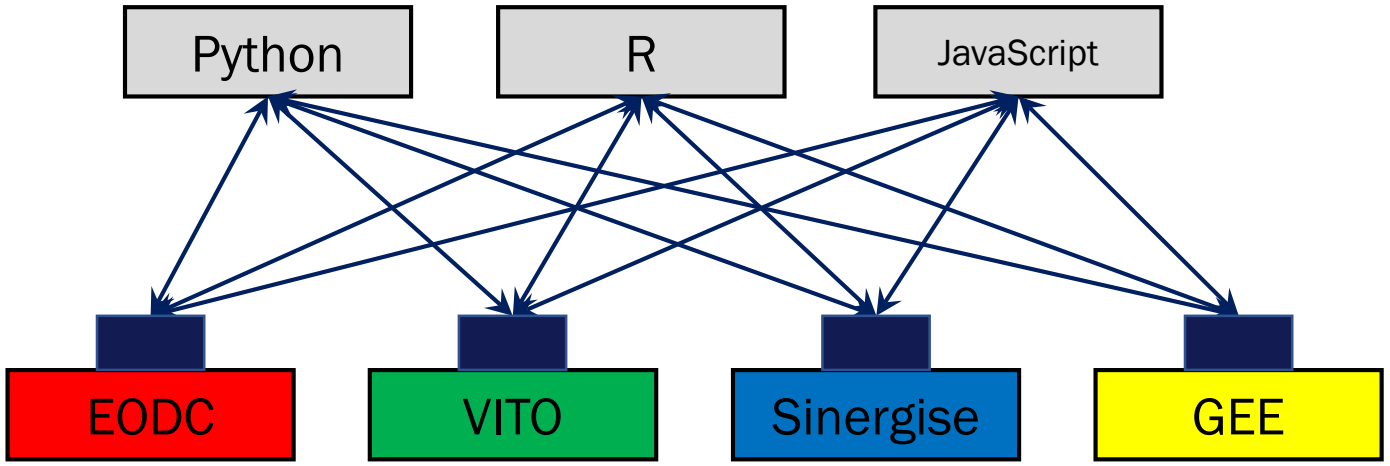
Copernicus is managed by the EC's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG Growth)

Which cloud service to rely on?

- Which platform will still be around in 10 years?
- Which platform is affordable?
  - Commercial scalable cloud resources can be more expensive than well-utilized computer clusters
- Quality of service
  - Availability, quality & documentation of data
  - Data access and processing speed
  - Software & utilities

Tools for Making Platforms Interoperable

openEO develops an open API to connect R, python, javascript and other clients to big Earth observation cloud back-ends



http://openeo.org/

H2020

https://github.com/open-eo/

Research HPCs as Backbone for EO Science Cloud?

- Research HPC centres are attractive because they
  - serve the scientific community (and not some other interests)
  - have expertise in providing compute capabilities
  - have started to build up expertise in Big Data technologies

VIENNA SCIENTIFIC CLUSTER

SURF SARA

DLR

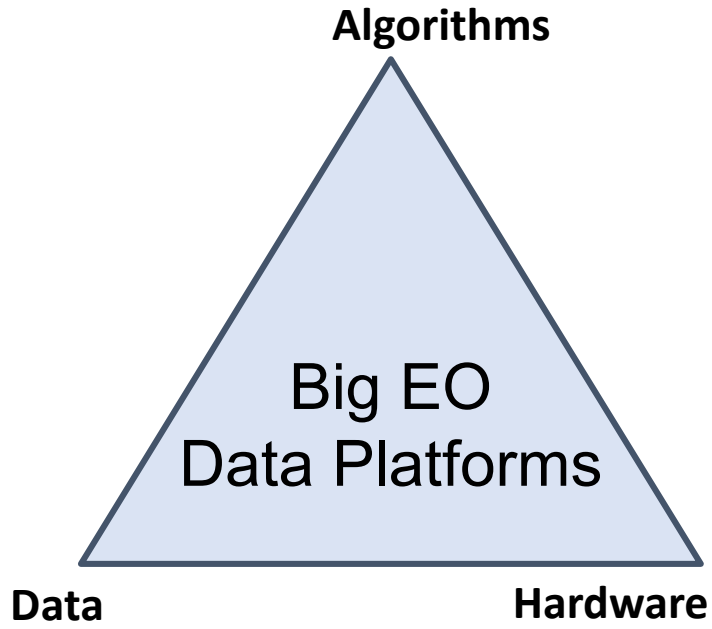
Vlaams Supercomputer Centrum

lrz Leibniz-Rechenzentrum der Bayerischen Akademie der Wissenschaften

Some Observations

- There is lots of replication
  - Same data sets
  - Similar interfaces

- For users data & algorithmic expertise is as important as IT power
  - Most EO applications are complex
  - Users appreciate scientific advice



Key Challenge

Compute resources can be managed on national level

This is not true for scientific data

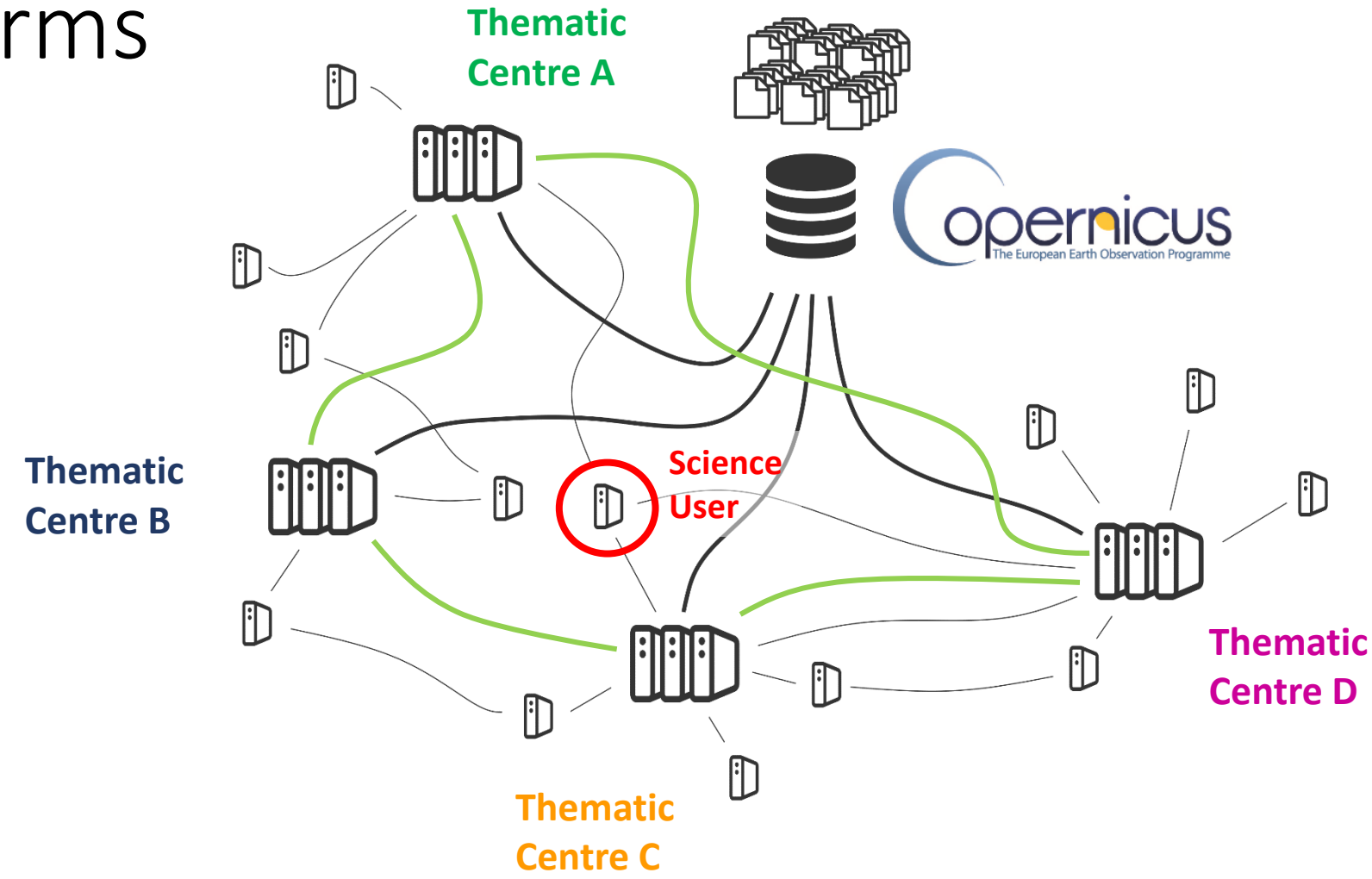
Data becomes more valuable the more people work with them!

Scientific data must be processed over and over again to stay relevant

Scientific data must be managed on European-international level

This is in stark contrast to current practices in Earth observation where many do the same things

Towards a Network of Thematic Data Platforms



ASDI RETURN – Measuring tropical forest recovery capacity

Scaling algorithms: need for distributed computing frameworks and tools

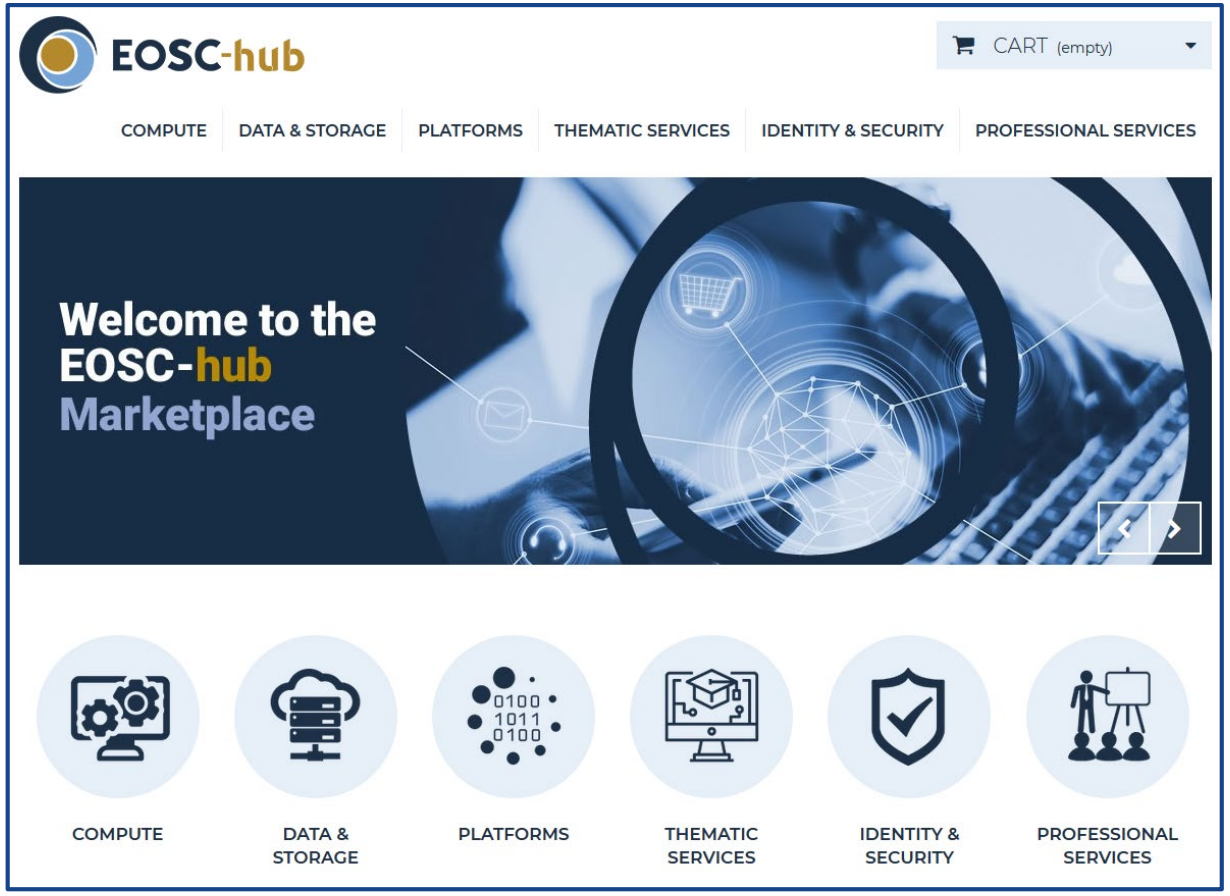
SURF SARA

netherlands eScience center

Satellite data on
SURFsara infrastructure
for post-processing
with R/python/...

Data infrastructure?
- data storage?
- efficient access?

European Open Science Cloud



EO Cloud-, Data-, and Platform Services

Partners: EODC (EO-Pillar Coordination), CloudFerro, CNR – IREA, GRNET, MEEO, RASDAMAN, Sinergise, Terradue
Supported by: EGI, Cineca (Task Lead: Thematic Services), Cyfronet, ESA

https://www.eosc-hub.eu/

Wrapping up

- Many building blocks are there to build an Open Earth Observation Data Science Cloud in Europe through a federated approach
- Focus of EOSC on FAIR data is very important
  - Note that scientific data need to be processed over and over again
- Nonetheless, there are still significant challenges
  - How to naturally grow the network of thematic expert centers?
  - How to open national infrastructures to users from other countries?

Acknowledgements
Prof. Wolfgang Wagner, for big satellite data overview
ASDI: ASDI RETURN project (2019-2021)
NWO: Big satellite data analytics 15839 (2019-2023)
H2020: EO-2017 Number 776242 “openEO”

Thanks
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https://github.com/bfast2