Petabytes mit einem Klick: Sentinel-Daten in der Cloud

Dr. Markus Neteler, C. Tawalika, T. Adams, H. Paulsen

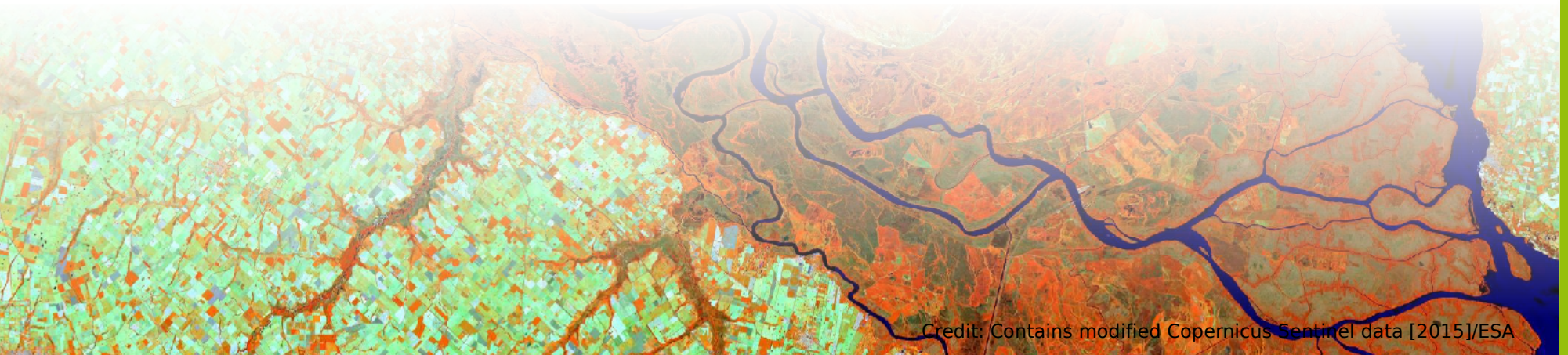
mundialis GmbH & Co. KG
www.mundialis.de
Bonn, Germany

Fachsession B.2 - Der Weg:
"Von der Cloud-Plattform bis hin zur operationellen Anwendung und dem Endnutzer"

Who we are

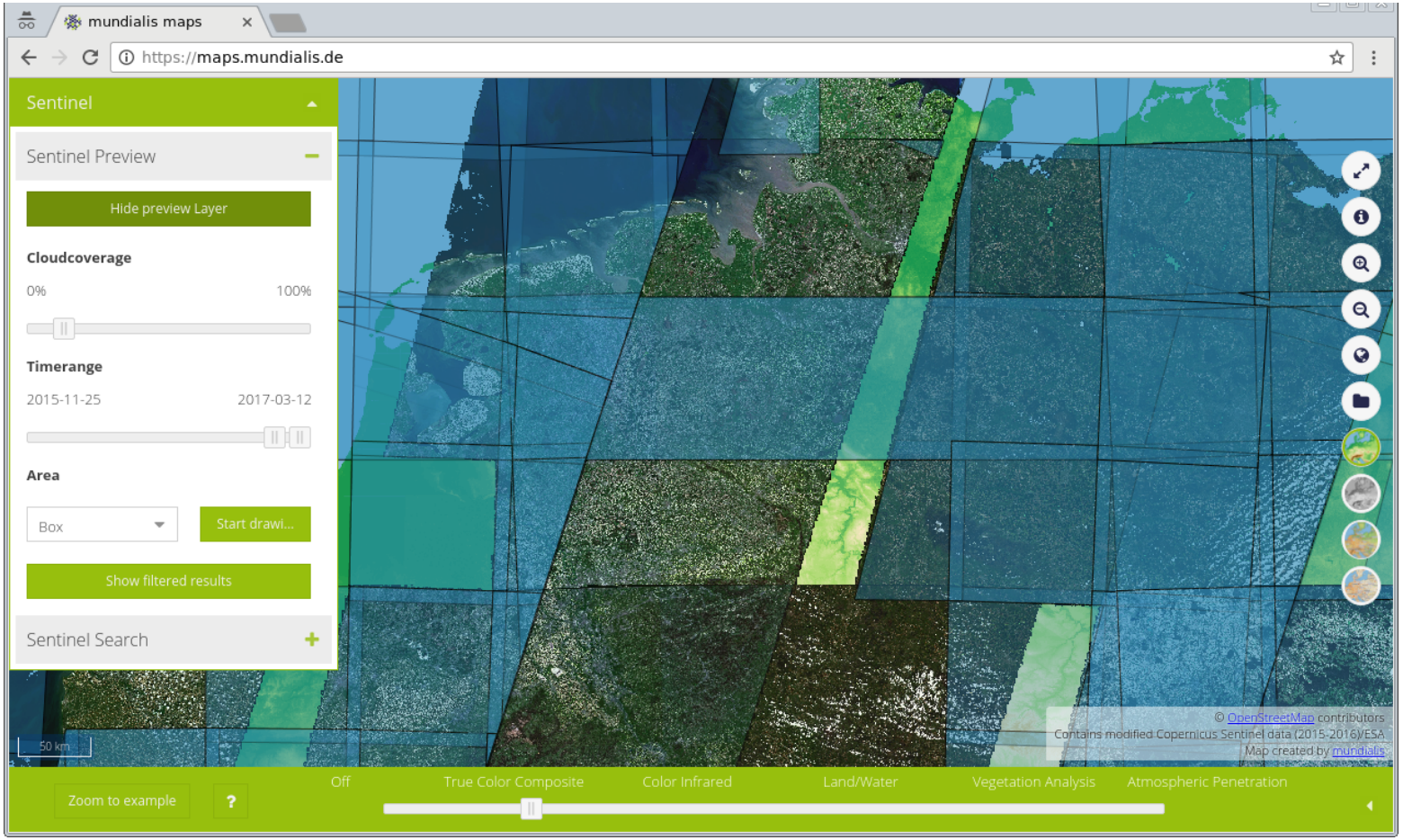
mundialis GmbH & Co. KG, Bonn

- Startup – founded in May 2015 by T. Adams, H. Paulsen and M. Neteler
- currently 7 staff
- massive GIS data processing and Earth Observation
- offers decades of experience in Open Source GIS (especially GRASS GIS development)
- gained HPC experience through processing of MODIS Land Surface Temperature : “EuroLST” – 15 years of gap free daily data at 250m resolution



Copernicus from a user's point of view

- freely accessible data → cost effective!
- a tremendous amount of data → how to deal with that?
- conflict between small areas of interest and large satellite data tiles → extracting snippets?



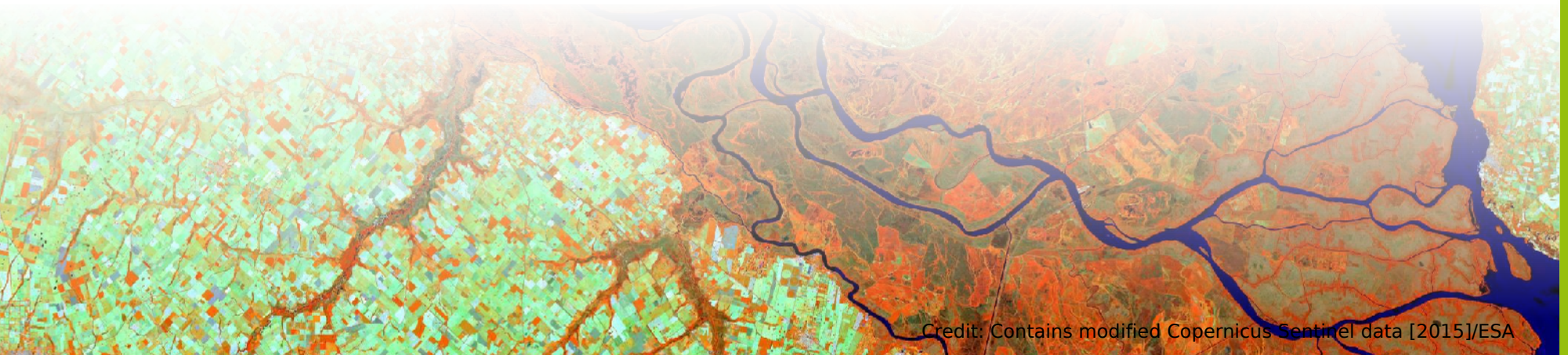
Copernicus from a user's point of view

mundialis

User needs (in simple terms)

- **select easily** the satellite scenes of interest by multiple criteria
- send them to **processing** (e.g. NDVI time series along with identification of anomalies)
- receive **results** both **visually** as well as in **digital** form (files, web services, …) quickly

Expectations: Easy to use … fast … reliable.



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

Copernicus from a user's point of view

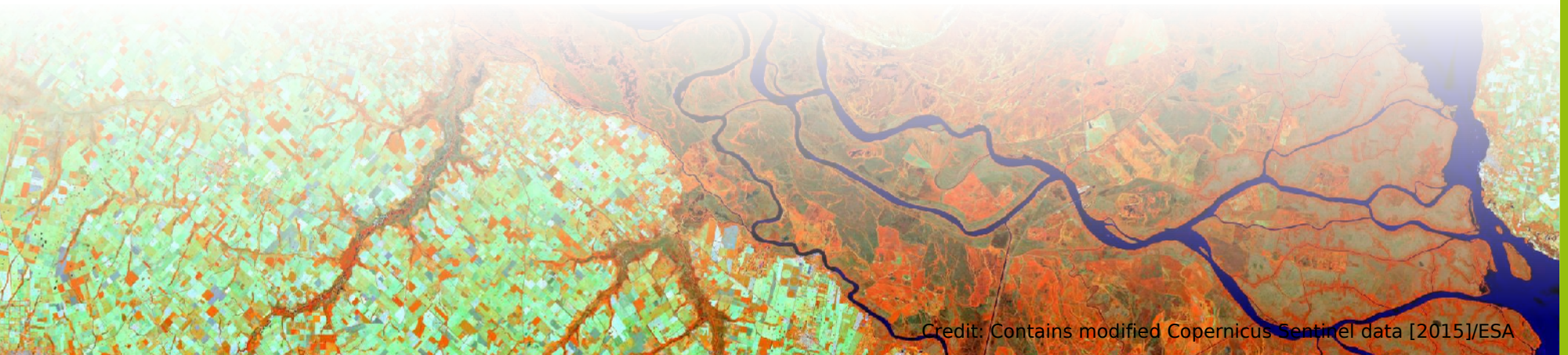
mundialis

User needs (in simple terms)

1. **select easily** the satellite scenes of interest by multiple criteria

2. send them to **processing** (e.g. NDVI time series along with identification of anomalies)

3. receive **results** both **visually** as well as in **digital** form (files, web services, …) quickly



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

The EO-me solution by mundialis: find your satellite scene

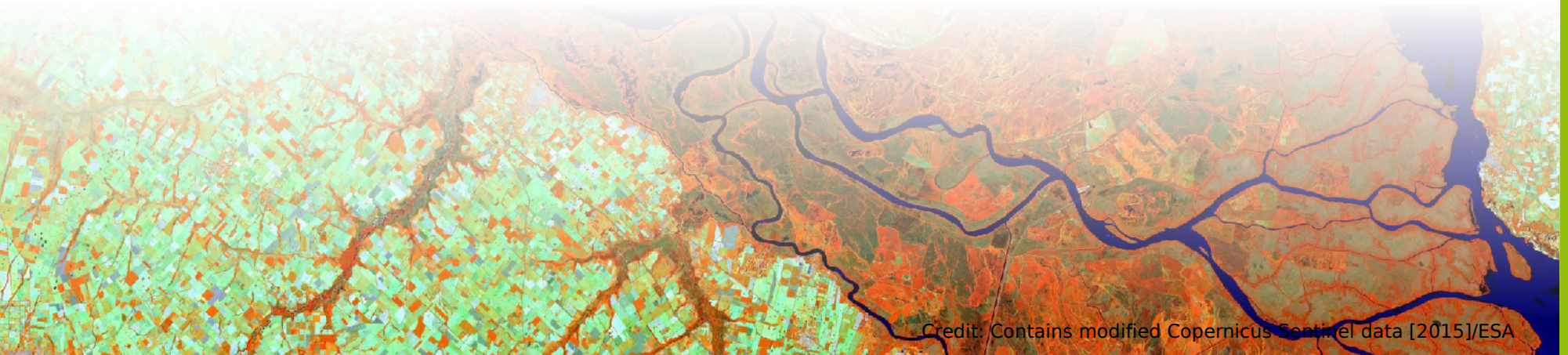
mundialis

Earth Observation metadata enhancer (EO-me)

Sentinel-2A and Landsat-8: already > 750.000 tiles

- **EO-me backend:** enriches all tiles in the database with **tile specific metadata**,
    - terrain statistics, human population, NDVI, climatic parameters – **static** and **dynamic data**
- **EO-me frontend:** a **filter system** allowing users to identify image scenes by specific parameters.

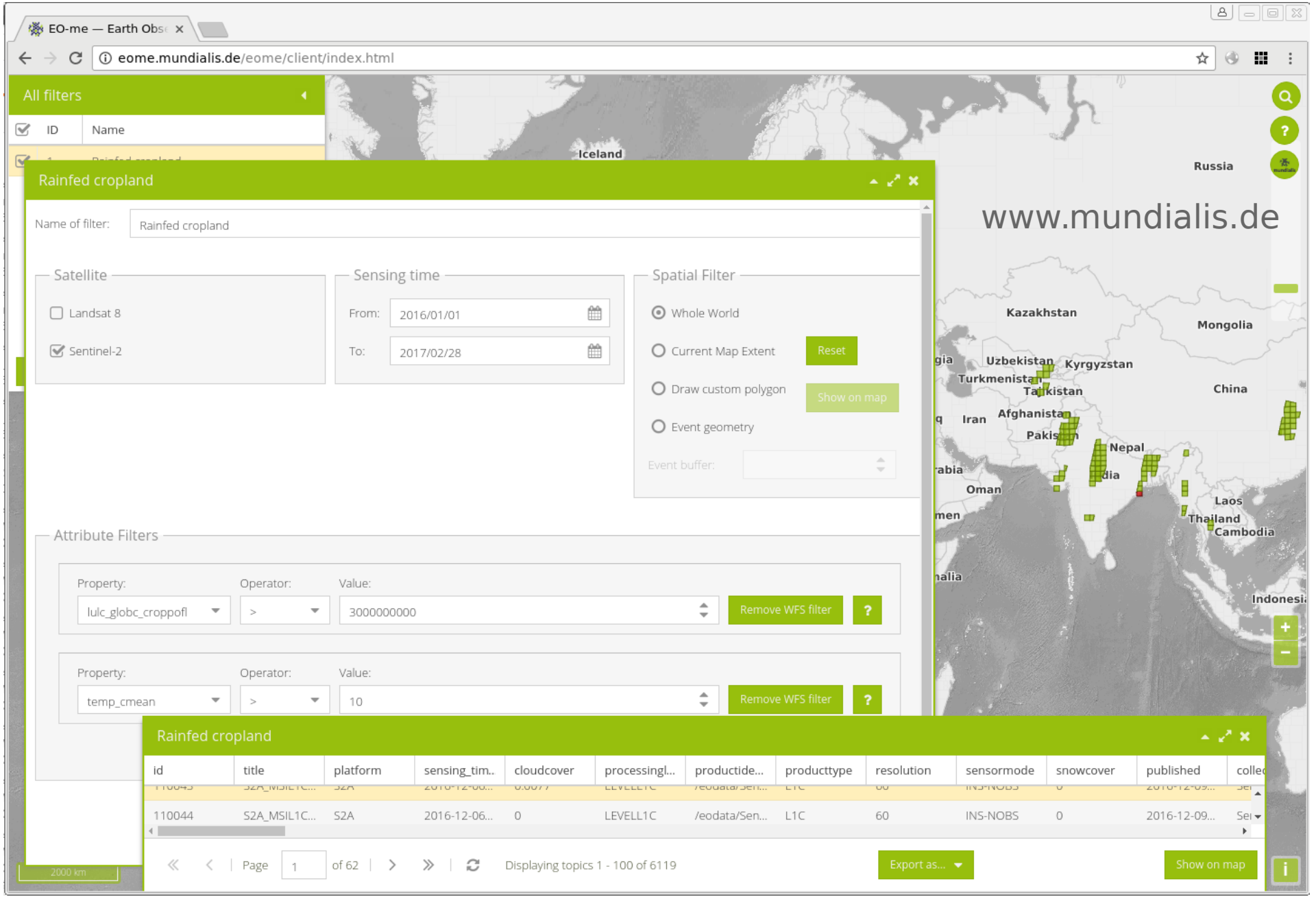
- EO-me supports any satellite tile collection.



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

EO-me —
Earth Observation Metadata Enhancer

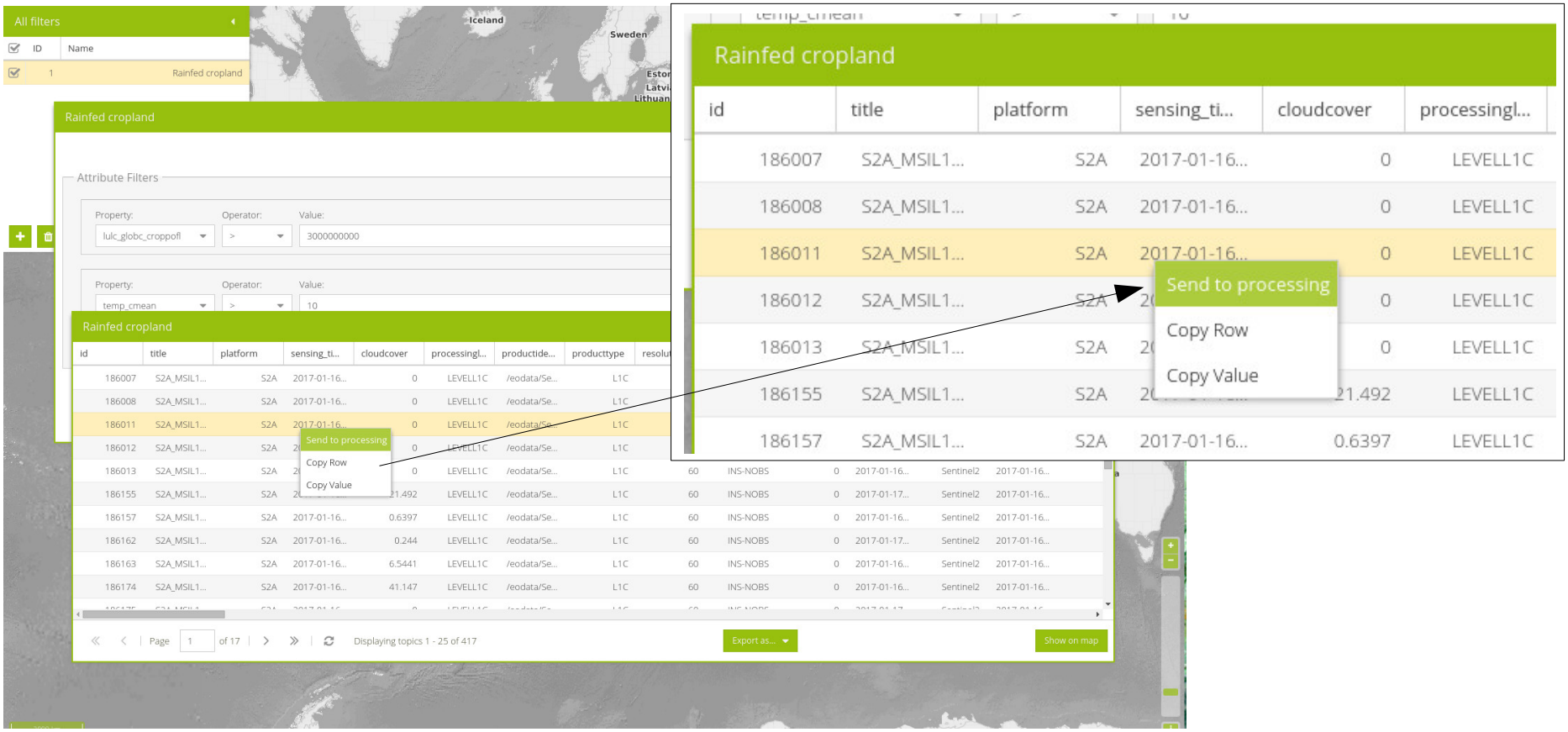
mundialis



EO-me functionality

- EO-me ships with **numerous global data layers**
  - static data (elevation, 30 years climatic data, etc.)
  - dynamic data (e.g. NDVI at overpass time)

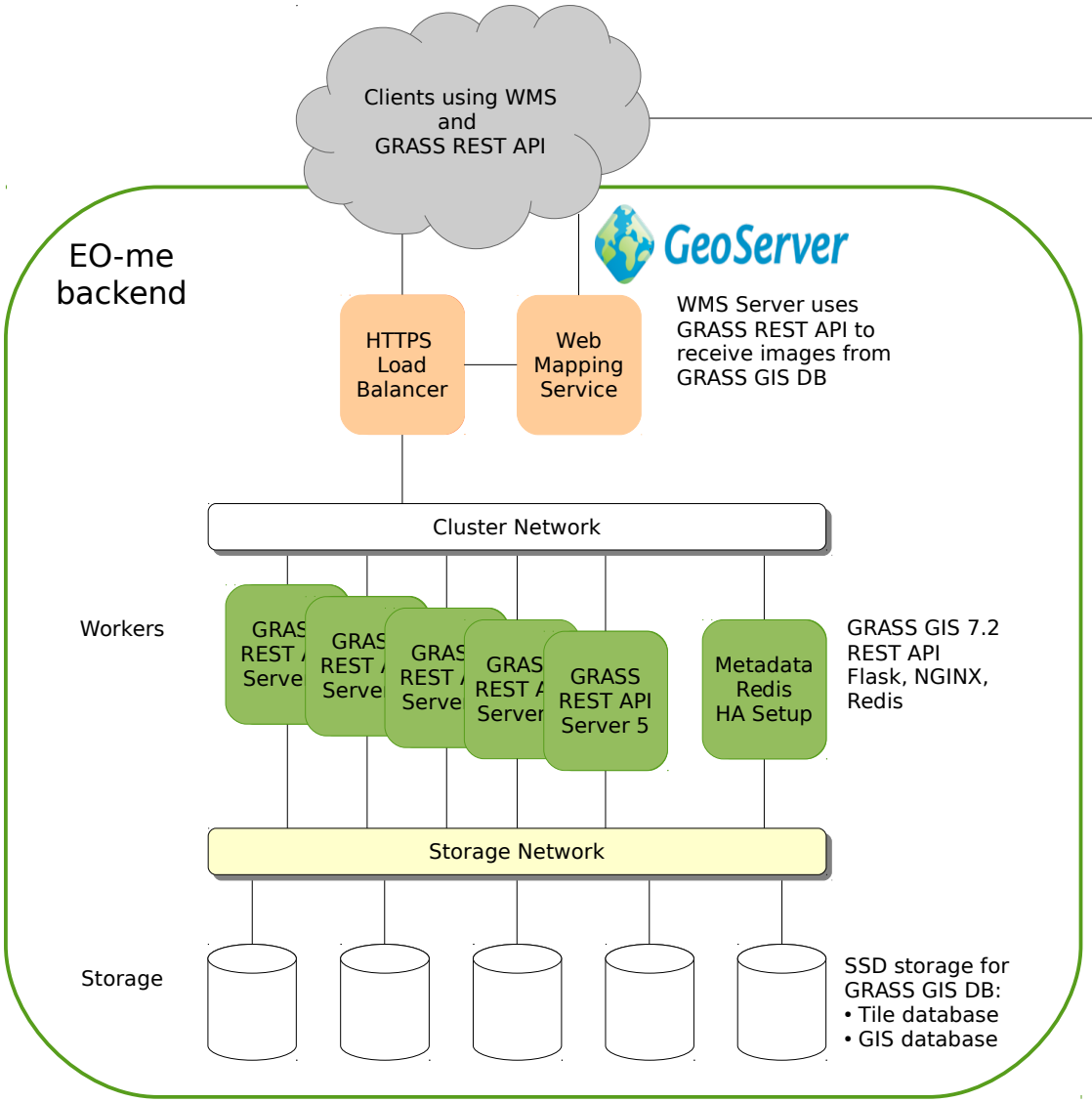
- “workers” on a **HPC infrastructure** (OpenStack system) calculate for each tile new metadata using univariate statistics



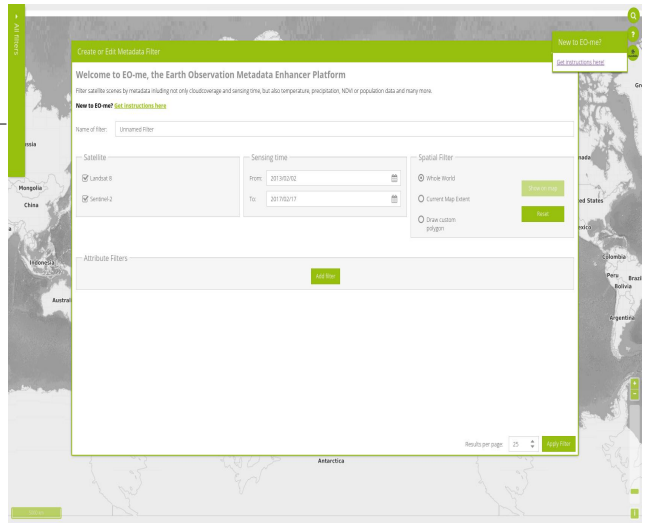
EO-me architecture

mundialis

EO-me metadata processing backend



EO-me frontend: Web interface



Currently deployed at IPT Poland for ESA

Newly arriving tiles are immediately processed

EO-me: tile based GIS data processing on High Performance Computing (HPC)

mundialis

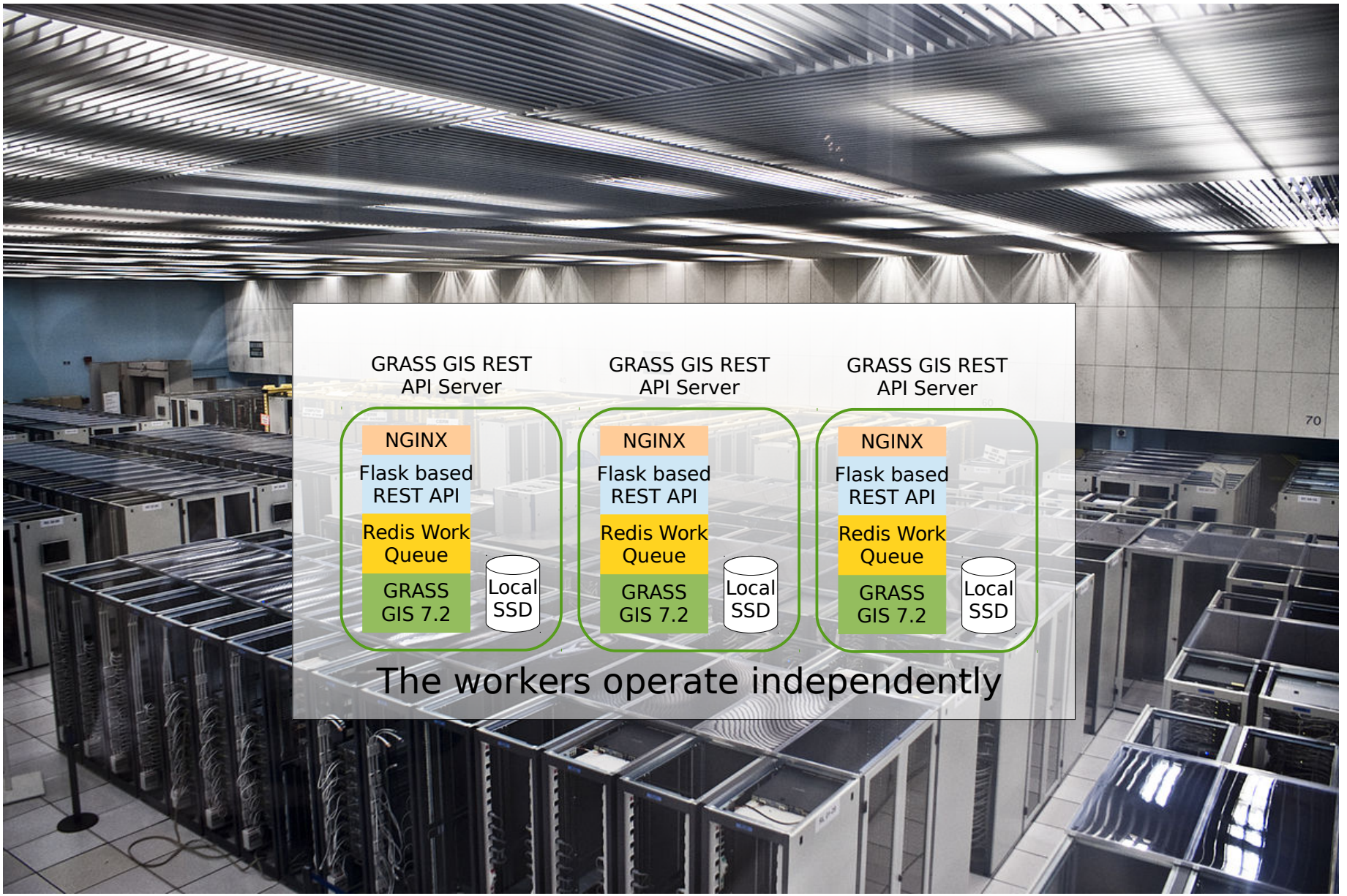


Photo: Florian Hirzinger - www.fh-ap.com - Own work (Florian Hirzinger), CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=6212692

Copernicus from a user's point of view

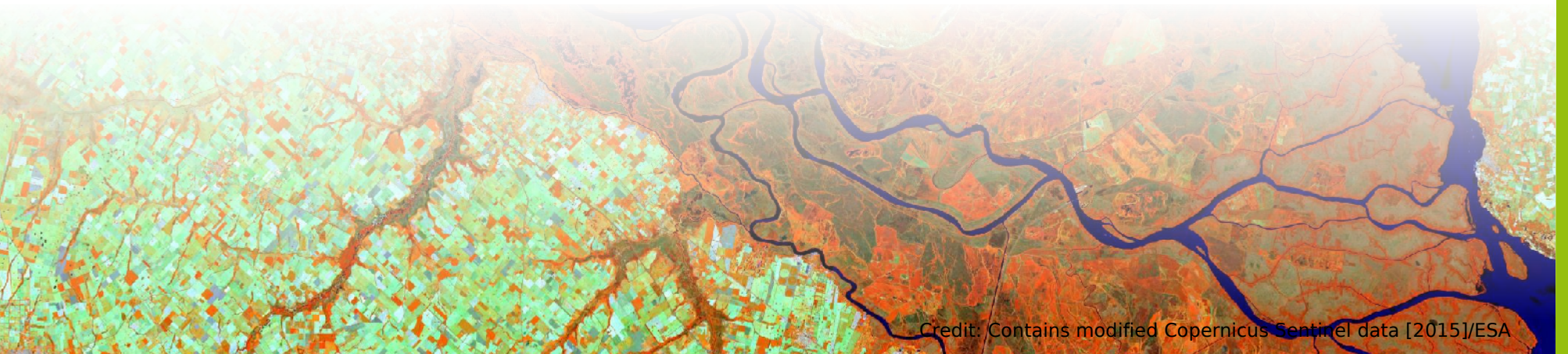
mundialis

User needs (in simple terms)

1. select easily the satellite scenes of interest by multiple criteria

2. send them to processing (e.g. NDVI time series along with identification of anomalies)

3. receive **results** both **visually** as well as in **digital** form (files, web services, …) quickly

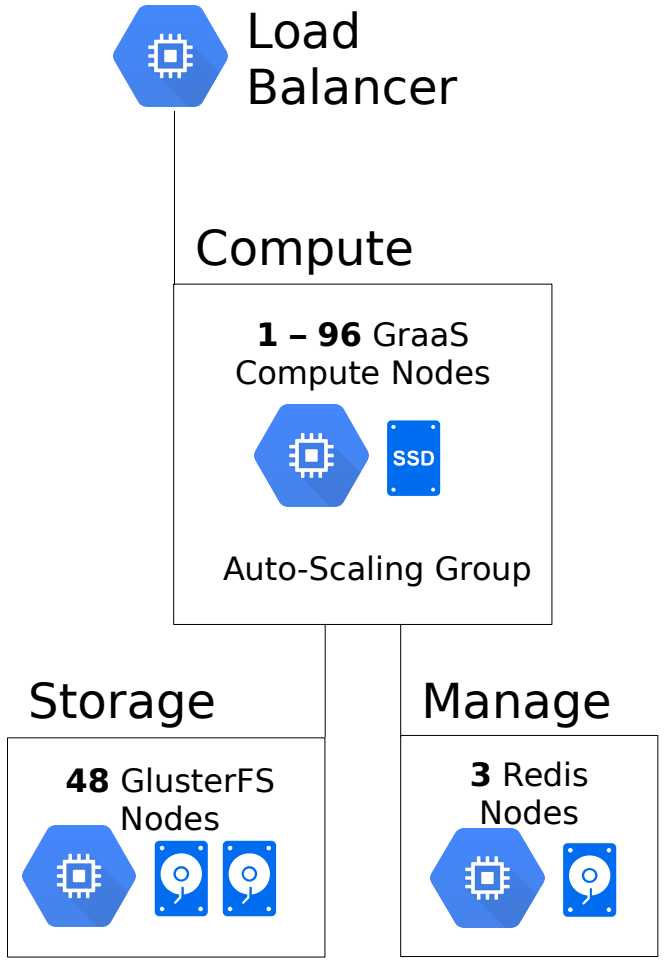


Credit: Contains modified Copernicus Sentinel data [2015]/ESA

New: GRaaS – REST API implementation for easy deployment of processing jobs

Purpose

- Software as a Service (SaaS)
- Horizontally **scalable** processing, analysis and visualization service
- **REST API** to perform
  - Massive parallel processing
  - Resources and user management



Deployment:

currently on Google Cloud Platform

Scope: **European Cloud!**

GRaaS – REST API: the 1-click solution for Sentinel-2 processing

Two modes are provided: ephemeral and persistent

a) Sentinel-2 ephemeral services

- Methods and algorithms are ready-to-use (more on demand)
- 1-click solution: example Sentinel-2A NDVI:

  POST request:

  https://server/service/ndvi/scene-id

```
https://104.199.xx.yy/sentinel2_process/ndvi/S2A_MSIL1C_20170212T104141_N0204_R008_T31TGJ_20170212T104138
```

This simple call launches the preprocessing of the scene and the calculation of NDVI

…. check status by *GET request call* […]

GRaaS – REST API: the 1-click solution for Sentinel-2 processing

a) Sentinel-2 ephemeral services (cont'ed)

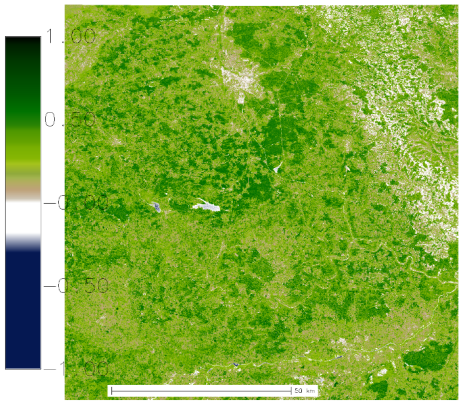
- **Results:**
  - **Preview image (PNG)**
  - **NDVI map in GeoTIFF format (here: 407MB)**

"resources": [

"http://104.199.xx.yy/resource/resource_id-a833fcc0-47b5-4dc3-9e76-f4c5035fad35/**tmpM28daa.png**",

"http://104.199.xx.yy/resource/resource_id-a833fcc0-47b5-4dc3-9e76-f4c5035fad35/**ndvi.tiff.gz**"

],



120 million pixels – 2:30min

(Optionally DEMO here)

GRaaS – REST API: the 1-click solution for Sentinel-2 processing

mundialis

b) Sentinel-2 persistent services

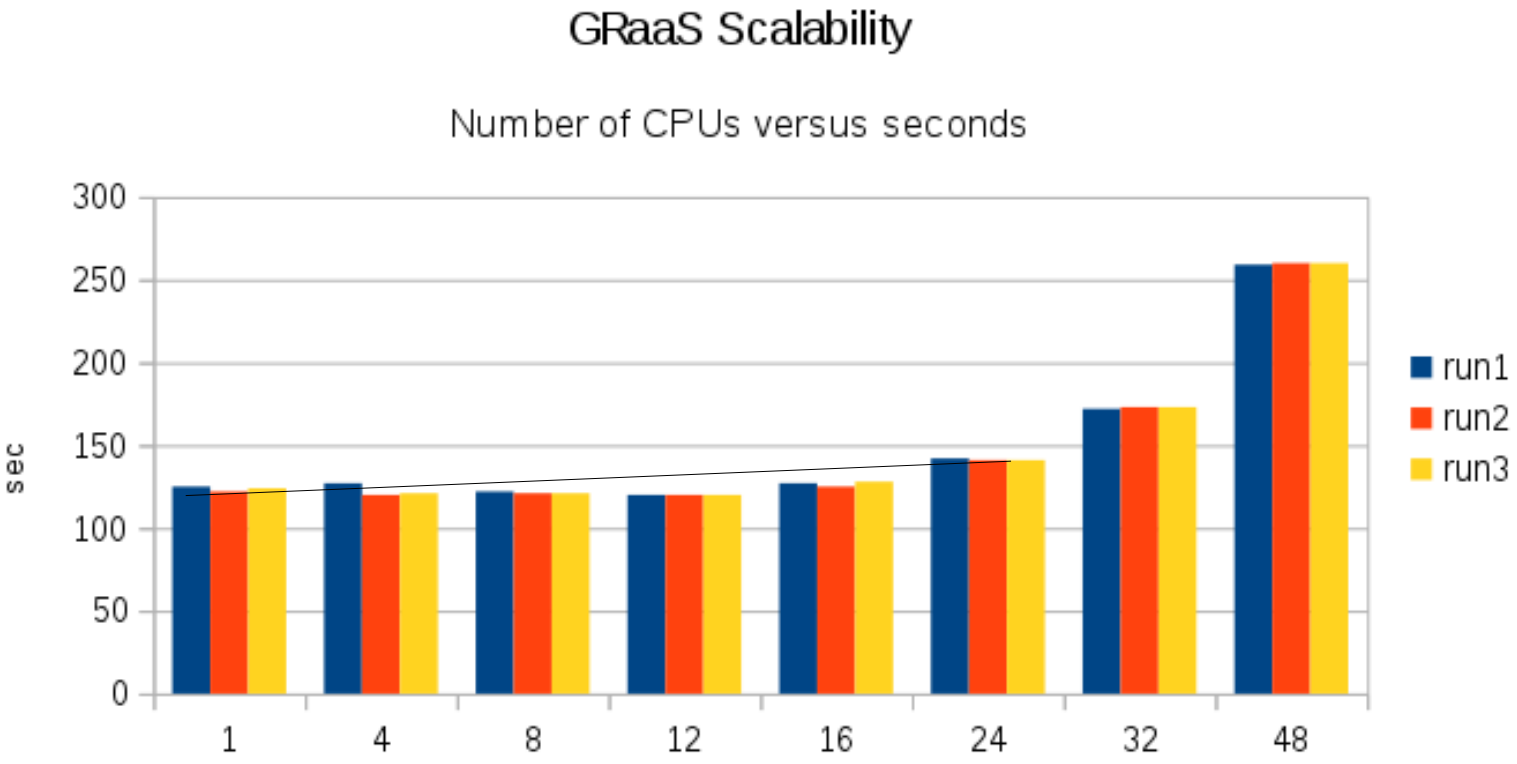
- Processed S2 data are stored in a persistent database
- Implementation of customer algorithms
- Processing of time series, using **temporal algebra**
  - Massive parallel computation
  - Easy to grasp algebra:

```
graas-algebra -s http://104.199.xx.yy "ndvi = (S2A_B08 -
S2A_B04) / (S2A_B08 + S2A_B04)" -n 24
```

… behind the scenes:

- S2A_B08 and S2A_B04 are **time series** exported from *EO-me* Web portal (~60 S2A maps)
- In total 24 parallel jobs are deployed by the Load-Balancer listening on http://104.199.xx.zz

New: GRaaS – REST API implementation for easy deployment of processing jobs



Tests on Google cloud

Caching effects (slightly faster)

I/O saturation (... add more nodes = $$)

Copernicus from a user's point of view

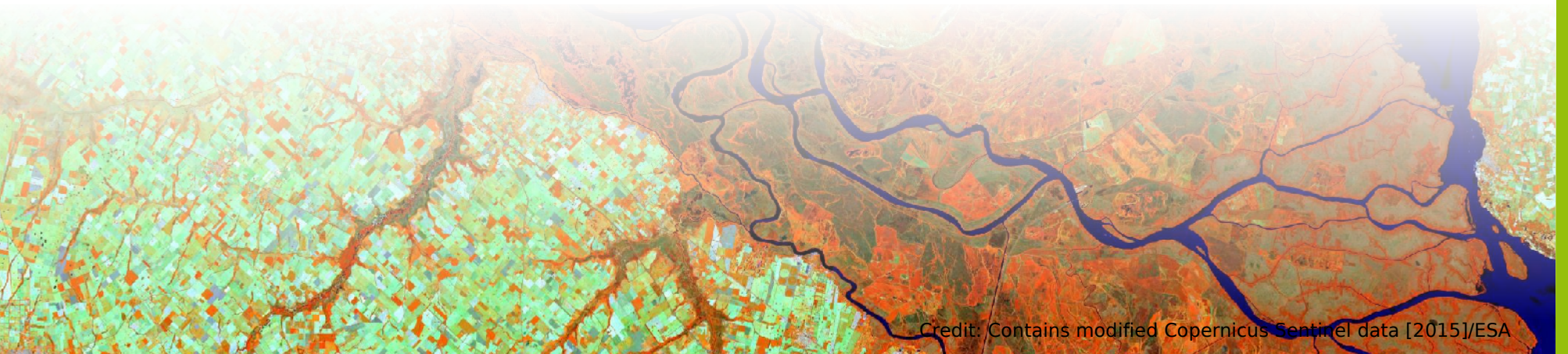
mundialis

User needs (in simple terms)

1. select easily the satellite scenes of interest by multiple criteria

2. send them to processing (e.g. NDVI time series along with identification of anomalies)

3. receive results both visually as well as in digital form (files, web services, …) quickly



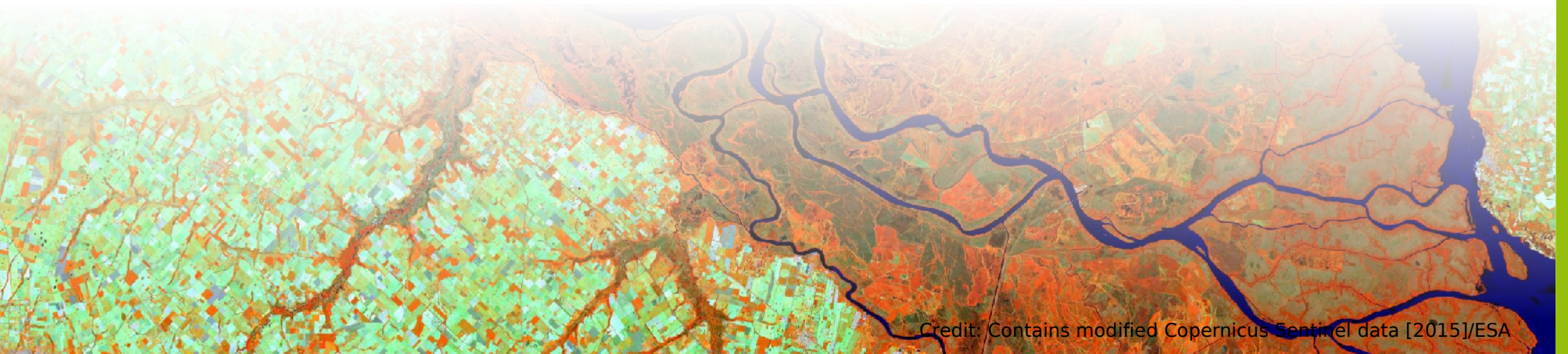
Credit: Contains modified Copernicus Sentinel data [2015]/ESA

GRaaS – REST API: the 1-click solution

mundialis

Key features

- **SaaS** with intuitive URLs to process data
- Standardized **interfaces**: REST API, openAPI, and Web Services
- Highly scalable, **massive parallel processing** in the cloud while paying only for used resources
- Open source based – i.e. full peer review
- Support of ephemeral and persistent processing modes
- Can be deployed on “any” **cloud** infrastructure



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

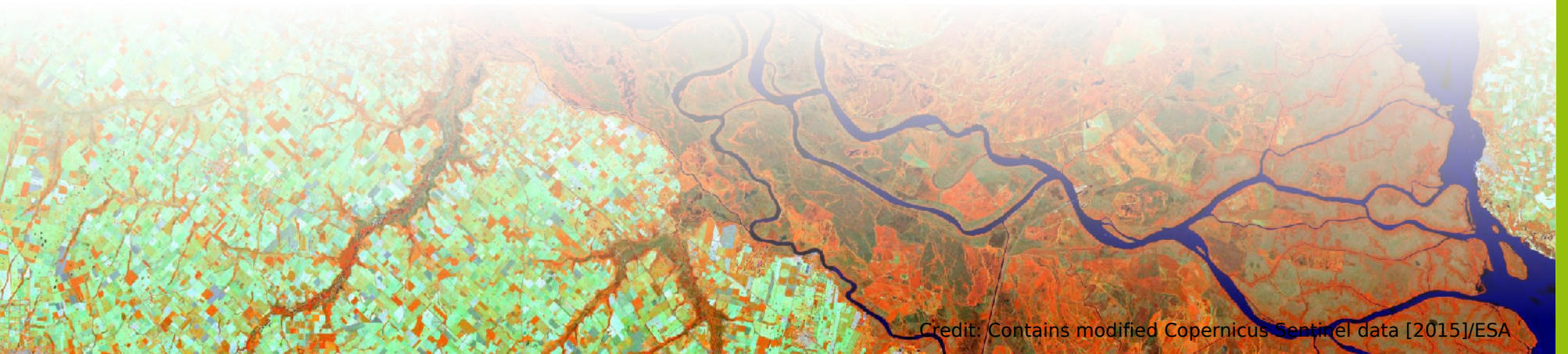
… and from a provider's point of view

mundialis

Provider needs (in simple terms)

- Access to a computing infrastructure which is
  - **reliable** over long time (think ROI)
  - provides complete **satellite data archives**
  - **scalable** on demand (for massive parallel processing)
  - provides **resource consumption tracking** and an integrated **billing API**

Especially startups and SME need low barriers to deploy their innovative products!



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

What we offer

mundialis

EO-me: Earth Observation metadata enhancer

- extended tile metadata and satellite scenes selection by multiple criteria

GRaaS: GRASS as a Service

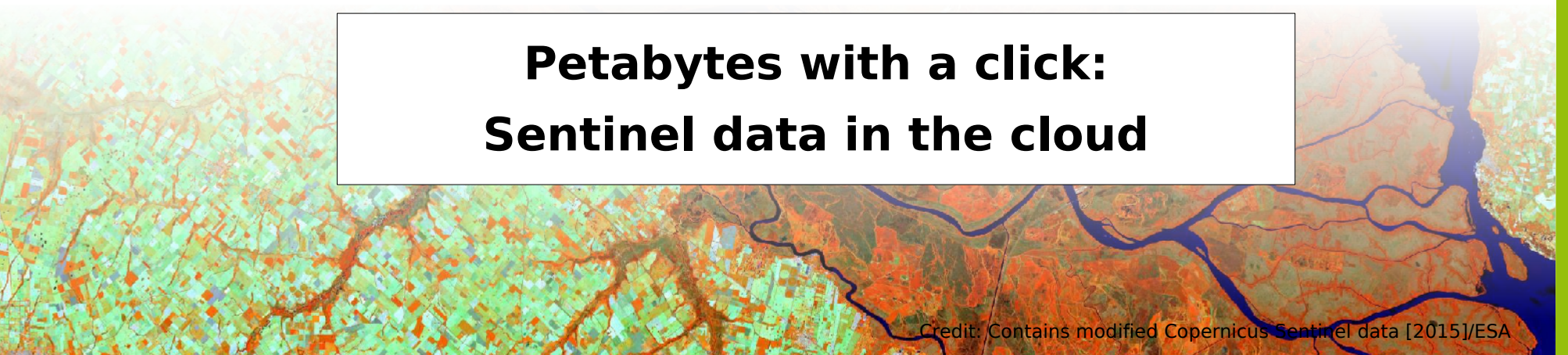
- data management in a space-time cube along with parallel processing of time series in the cloud

REST API and openAPI:

- delivery of processing results to the user (preview, file output, web services)

Petabytes with a click:

Sentinel data in the cloud



Credit: Contains modified Copernicus Sentinel data [2015]/ESA

mundialis

Free data with free software

...thank you...

Contact us for more details!

Dr. Markus Neteler
mundialis GmbH & Co. KG
Kölnstraße 99
53111 Bonn, Germany

Email: neteler@mundialis.de
Web: http://www.mundialis.de