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Petabytes mit einem Klick: Sentinel-Daten in der Cloud

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



Copernicus@work

Nationales Forum für Fernerkundung
und Copernicus vom 14.-16. März 2017 in Berlin

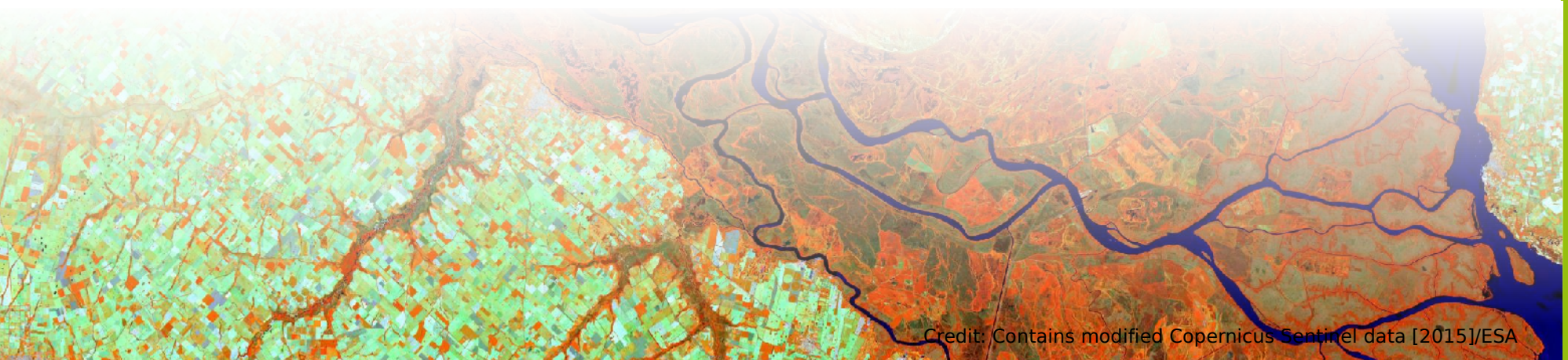
www.d-copernicus.de



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

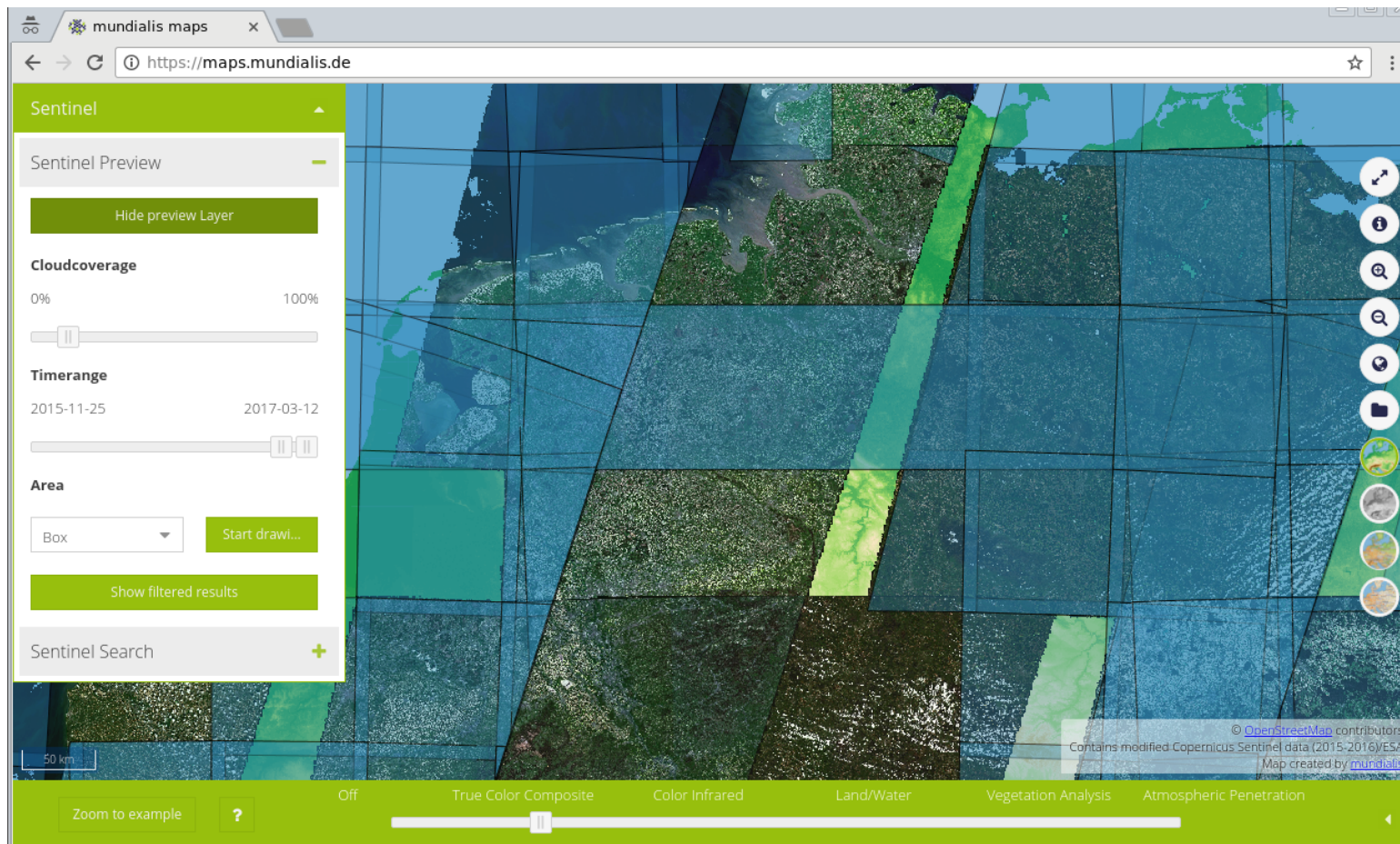


Copernicus from a user's point of view



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- 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?

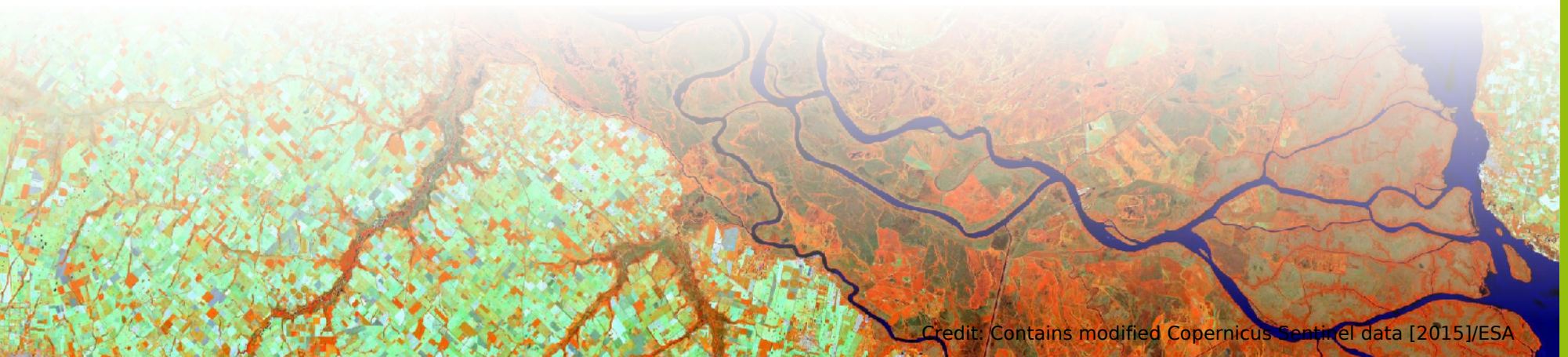


Copernicus from a user's point of view

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

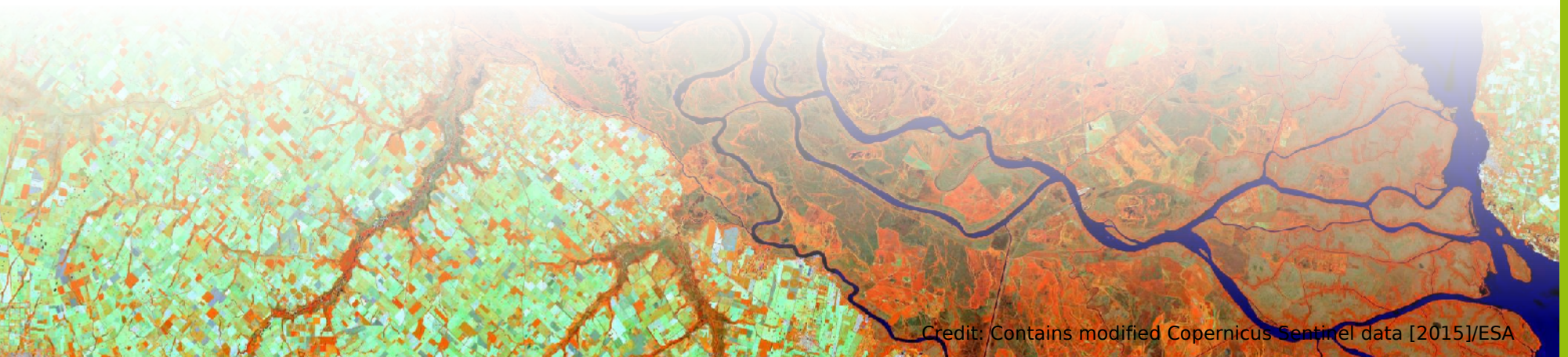
Expectations: Easy to use ... fast ... reliable.



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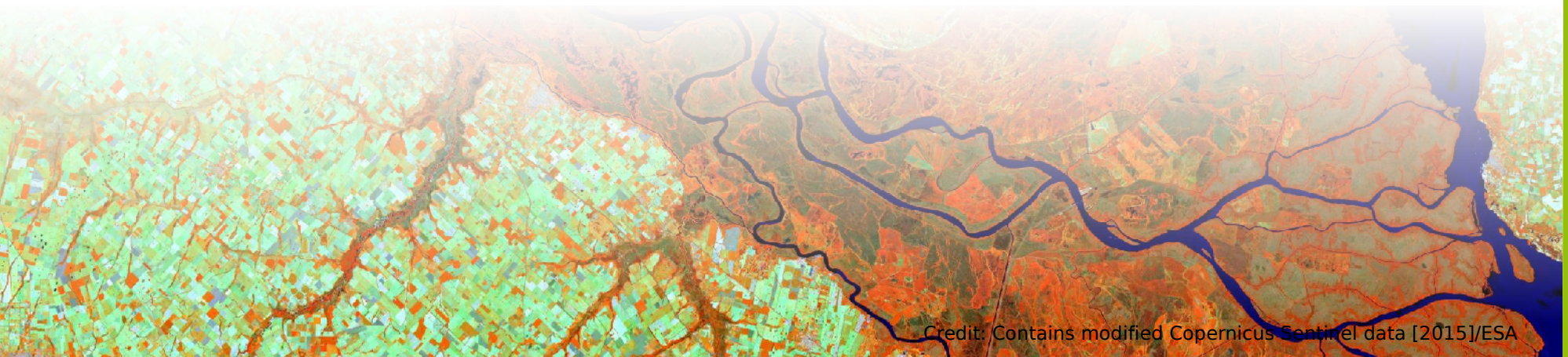


The EO-me solution by mundialis: find your satellite scene

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.





The screenshot shows the EO-me web application interface. The browser address bar displays `eome.mundialis.de/eome/client/index.html`. The interface includes a search panel on the left with the following sections:

- All filters:** A table with columns for ID and Name.
- Rainfed cropland:** A filter configuration window with:
 - Name of filter: Rainfed cropland
 - Satellite: Landsat 8, Sentinel-2
 - Sensing time: From: 2016/01/01, To: 2017/02/28
 - Spatial Filter: Whole World, Current Map Extent, Draw custom polygon, Event geometry. Includes buttons for "Reset" and "Show on map".
 - Event buffer: [input field]
 - Attribute Filters:
 - Property: lulc_globc_croppofl, Operator: >, Value: 3000000000. Buttons: "Remove WFS filter", "?"
 - Property: temp_cmean, Operator: >, Value: 10. Buttons: "Remove WFS filter", "?"

The main map area shows a satellite view of Asia with green grid overlays. The URL `www.mundialis.de` is overlaid on the map. A metadata table is visible at the bottom of the filter window:

id	title	platform	sensing_tim...	cloudcover	processingl...	productide...	producttype	resolution	sensormode	snowcover	published	collec
110043	S2A_MSIL1C...	S2A	2016-12-06...	0.0077	LEVEL1C	/eodata/Sen...	L1C	60	INS-NOBS	0	2016-12-09...	Sei
110044	S2A_MSIL1C...	S2A	2016-12-06...	0	LEVEL1C	/eodata/Sen...	L1C	60	INS-NOBS	0	2016-12-09...	Sei

At the bottom of the interface, there is a pagination control showing "Page 1 of 62" and "Displaying topics 1 - 100 of 6119". There are also buttons for "Export as..." and "Show on map".

EO-me functionality



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- 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

The screenshot displays the EO-me web interface. On the left, there are filter controls for 'All filters' and 'Attribute Filters'. The main area shows a data table titled 'Rainfed cropland' with columns: id, title, platform, sensing_ti..., cloudcover, processingl..., productide..., producttype, and resolu... A context menu is open over the row with id 186011, showing options: 'Send to processing', 'Copy Row', and 'Copy Value'. The table contains the following data:

id	title	platform	sensing_ti...	cloudcover	processingl...	productide...	producttype	resolu...
186007	S2A_MSIL1...	S2A	2017-01-16...	0	LEVELL1C	/eodata/Se...	L1C	
186008	S2A_MSIL1...	S2A	2017-01-16...	0	LEVELL1C	/eodata/Se...	L1C	
186011	S2A_MSIL1...	S2A	2017-01-16...	0	LEVELL1C	/eodata/Se...	L1C	
186012	S2A_MSIL1...	S2A	2017-01-16...	0	LEVELL1C	/eodata/Se...	L1C	
186013	S2A_MSIL1...	S2A	2017-01-16...	0	LEVELL1C	/eodata/Se...	L1C	
186155	S2A_MSIL1...	S2A	2017-01-16...	21.492	LEVELL1C	/eodata/Se...	L1C	60
186157	S2A_MSIL1...	S2A	2017-01-16...	0.6397	LEVELL1C	/eodata/Se...	L1C	60
186162	S2A_MSIL1...	S2A	2017-01-16...	0.244	LEVELL1C	/eodata/Se...	L1C	60
186163	S2A_MSIL1...	S2A	2017-01-16...	6.5441	LEVELL1C	/eodata/Se...	L1C	60
186174	S2A_MSIL1...	S2A	2017-01-16...	41.147	LEVELL1C	/eodata/Se...	L1C	60

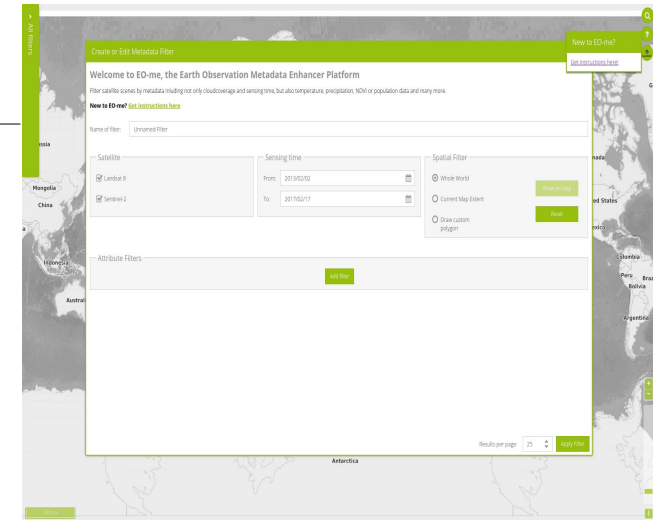
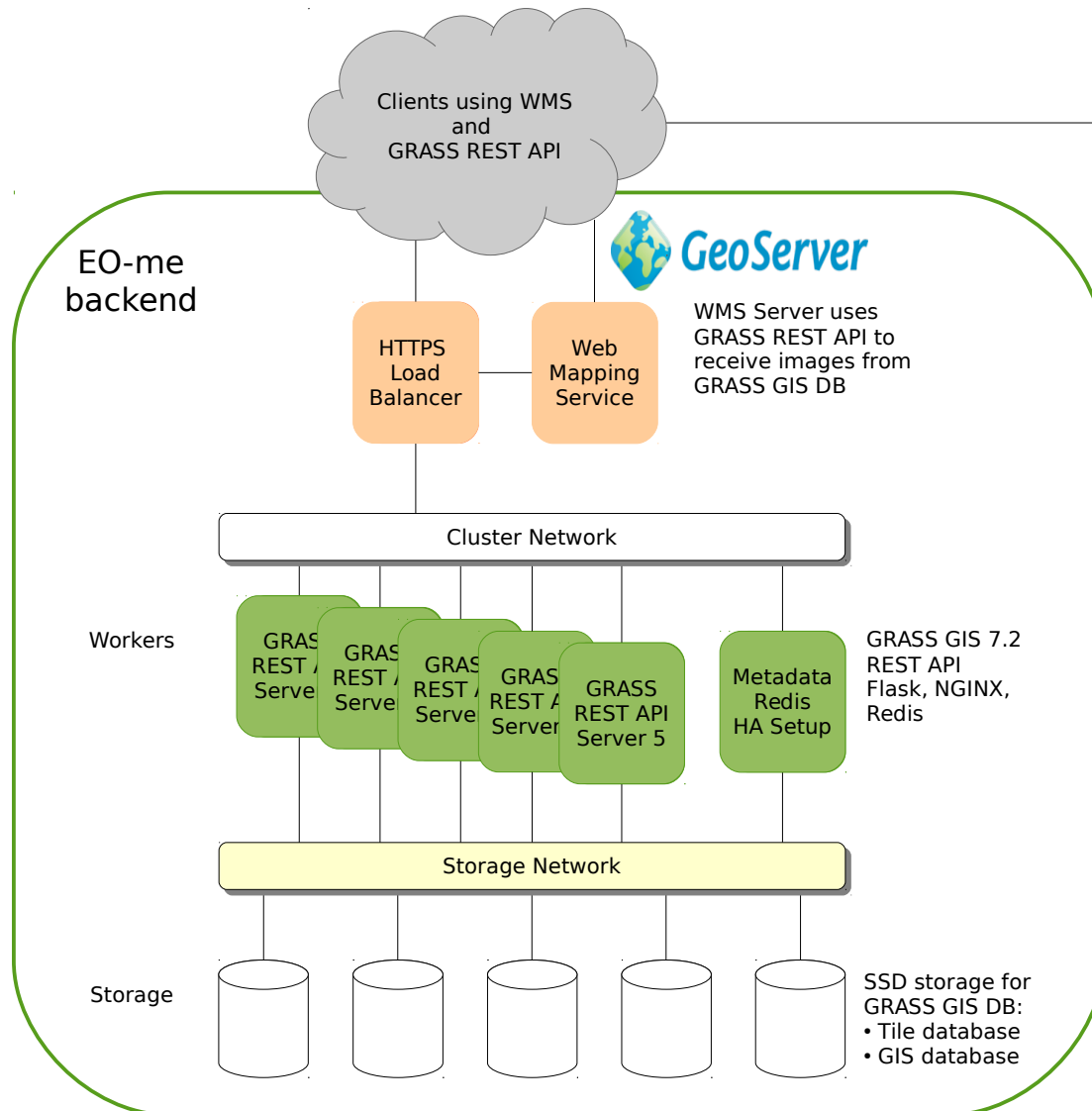
EO-me architecture



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EO-me metadata processing backend

EO-me frontend: Web interface



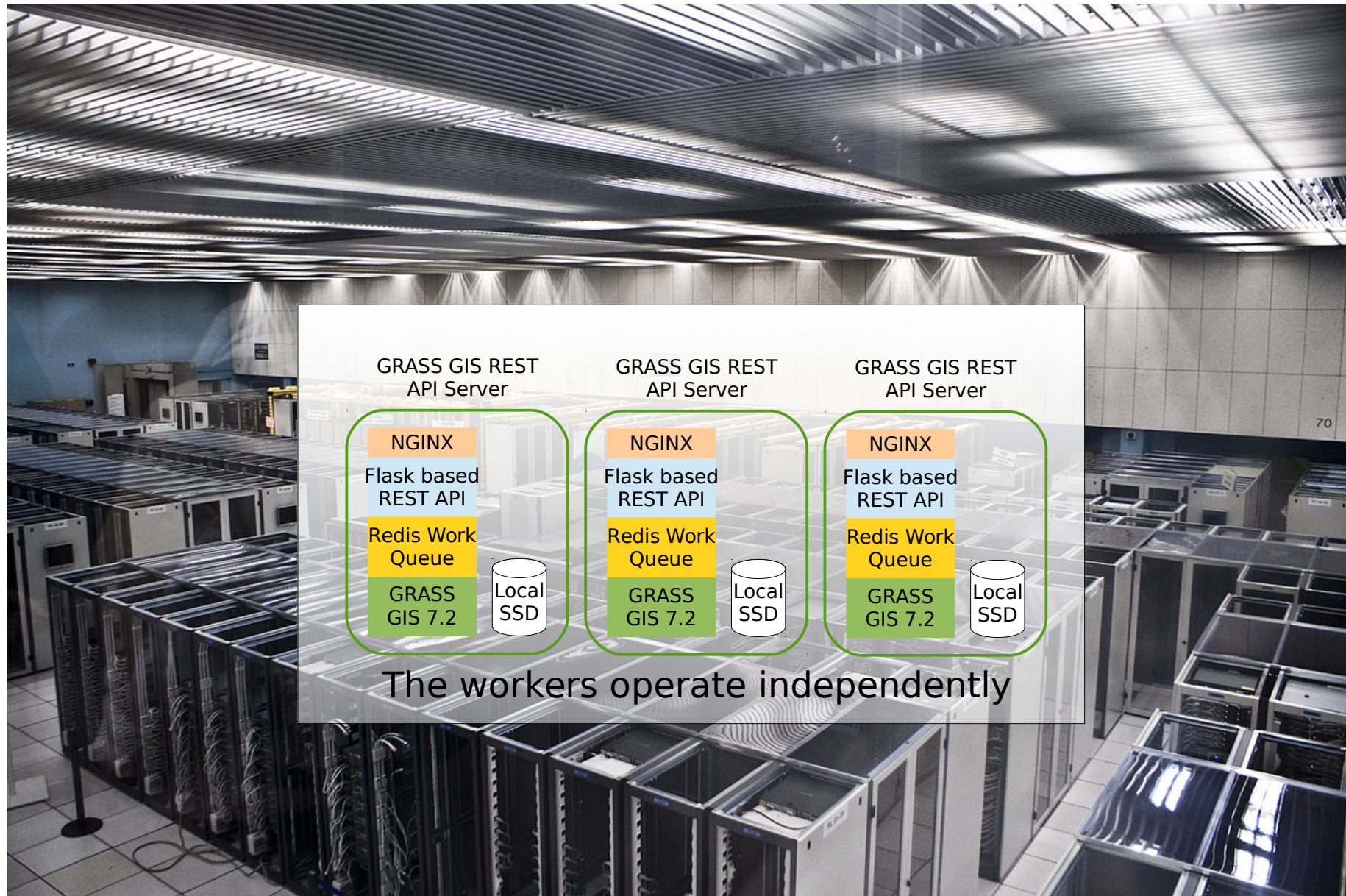
Currently deployed at
IPT Poland for ESA

Newly arriving tiles are immediately processed

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



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GRASS GIS REST
API Server

NGINX

Flask based
REST API

Redis Work
Queue

GRASS
GIS 7.2



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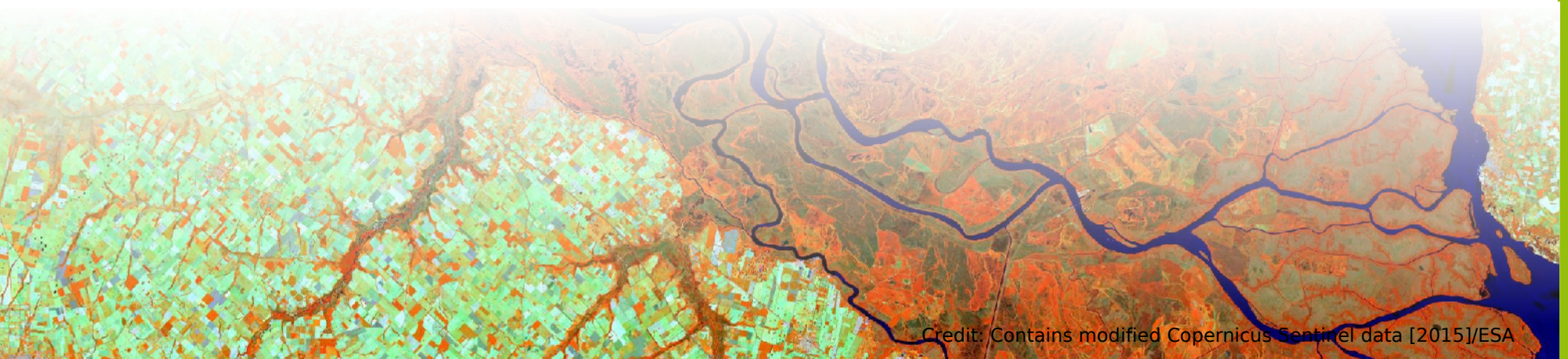
The workers operate independently

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

User needs (in simple terms)

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

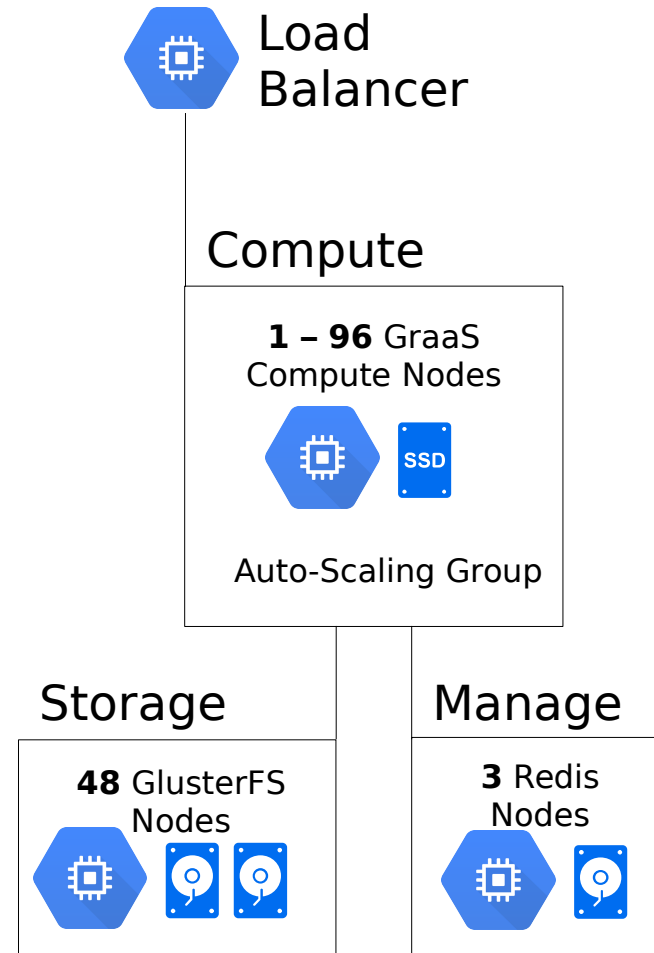
Purpose

- 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_MSIL  
1C_20170212T104141_N0204_R008_T31TGJ_20170212  
T104138
```

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)

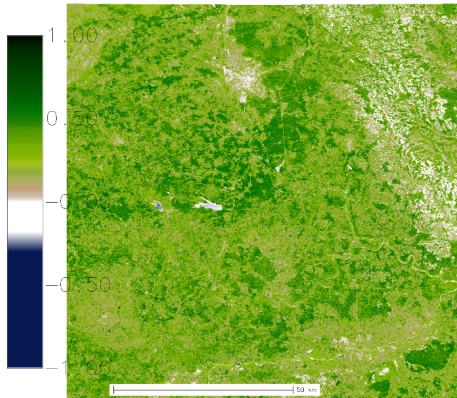
- **Results:**
 - **Preview image (PNG)**
 - **NDVI map in GeoTIFF format (here: 407MB)**

"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

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
```

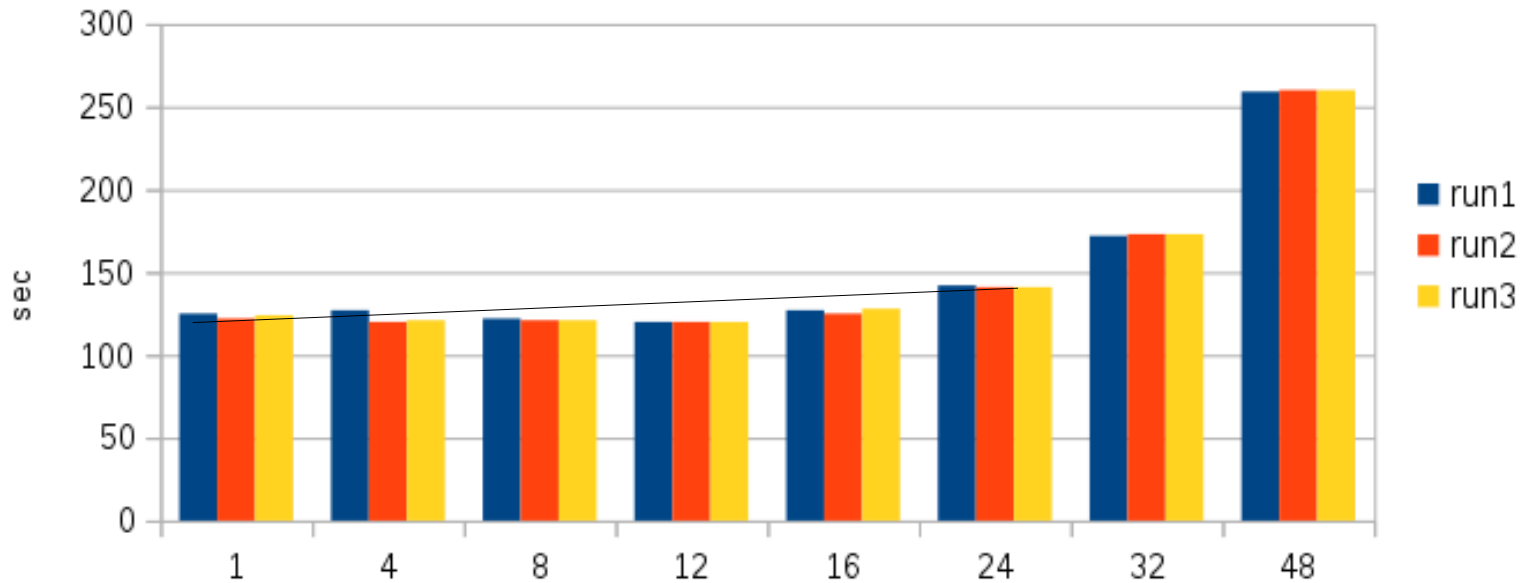
... behind the scenes:

- 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

GRaaS Scalability

Number of CPUs versus seconds



Tests on Google cloud

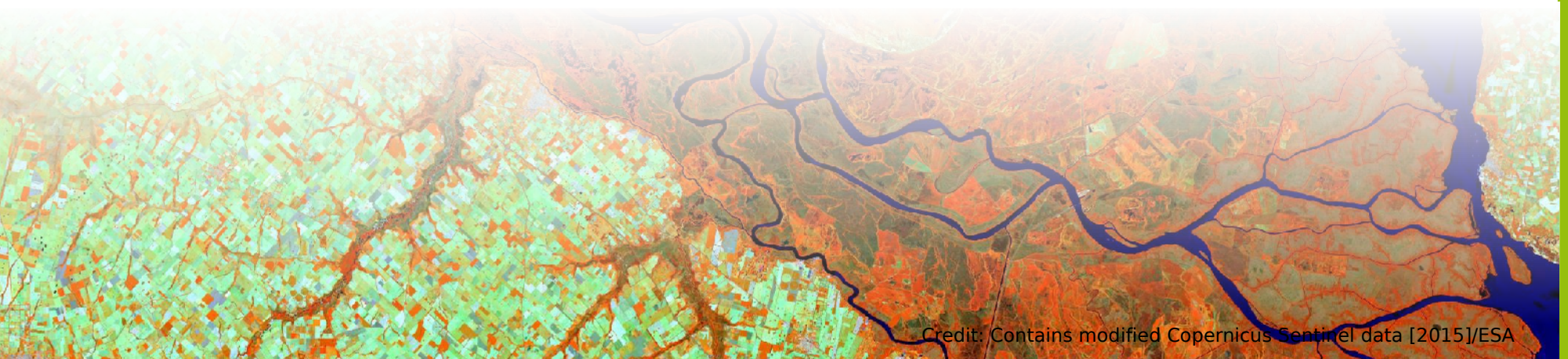
↑ CPUs
Caching effects
(slightly faster)

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

Copernicus from a user's point of view

User needs (in simple terms)

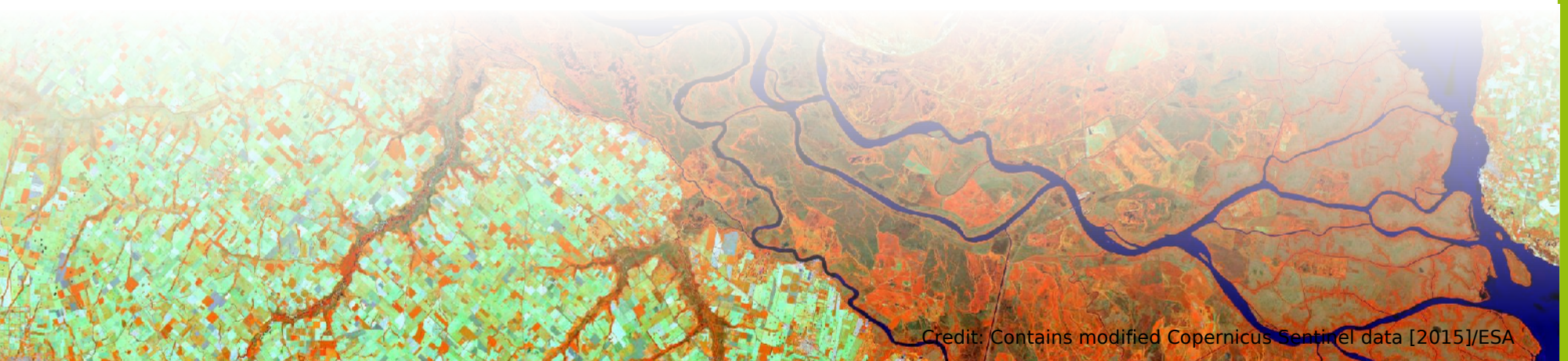
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GRaaS – REST API: the 1-click solution

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

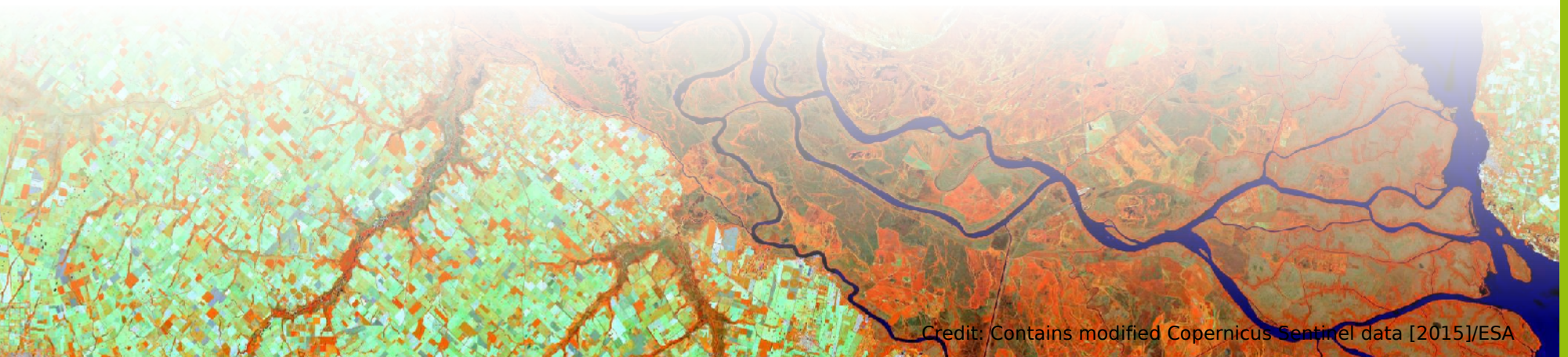


... and from a provider's point of view

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!





What we offer

EO-me: Earth Observation metadata enhancer

- extended tile metadata and satellite scenes selection by multiple criteria

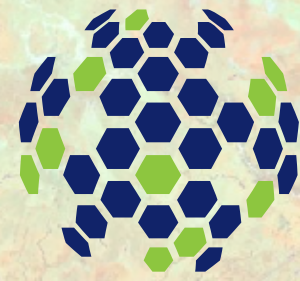
GRaaS: GRASS as a Service

- 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**



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Free data with free software

...thank you...

Contact us for more details!

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