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"
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

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

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.
EO-me — Earth Observation Metadata Enhancer

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[Image of EO-me interface]

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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

EO-me metadata processing backend

EO-me frontend: Web interface

Currently deployed at IPT Poland for ESA

EO-me backend

Clients using WMS and GRASS REST API

GeoServer

- WMS Server uses GRASS REST API to receive images from GRASS GIS DB

Server 1

Server 2

Server 3

Server 4

Server 5

Cluster Network

Workers

Storage Network

Storage

- SSD storage for GRASS GIS DB:
  - Tile database
  - GIS database

GRASS GIS 7.2 REST API

Flask, NGINX, Redis

Web Mapping Service

HTTPS Load Balancer

Web interface

EO-me metadata processing backend

Newly arriving tiles are immediately processed

EO-me frontend:

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

The workers operate independently

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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_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

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

Caching effects (slightly faster)  I/O saturation (... add more nodes = $$)
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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

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

Contact us for more details!

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