Earth and Universe Multi-Messenger Observatory (EU-MMO)

H2020 call

Oct 27, 2017

Prototyping new innovative services

ID: INFRAEOSC-02-2019

Type of action:

○ RIA Research and Innovation action   Deadline Model : single-stage   Opening: **16 October 2018**   Deadline: **29 January 2019 17:00:00 Brussels time**   Open

Specific Challenge:

Develop an agile, fit-for-purpose and sustainable service offering accessible through the EOSC hub that can satisfy the evolving needs of the scientific community by stimulating the design and prototyping of novel innovative digital services. Innovative models of collaboration that genuinely include incentive mechanisms for a user oriented open science approach should be considered.

Scope:

Research and Innovation Actions that target gaps in the service offering of the EOSC hub and develop innovative services that address relevant aspects of the research data cycle (from inception to publication, curation, preservation and reuse), for example allowing implementation of new scientific data-related developments and intelligent linking and discovering of all research artefacts.

Earth and Universe Multi-Messenger Observatory (EU-MMO)

Storage & Data

B2HANDLE
Register your research data

EGI DataHub
Access selected public datasets and efficiently consume them from EGI compute services

B2STAGE
Transfer of data between data resources and external computational facilities

B2SAFE
Distribute and store large volumes of data based on data policies

B2NOTE
Data annotation service to create annotations on research data

B2DROP
Secure and trusted data exchange service for researchers

EGI Online Storage
Store, share and access your files and their metadata on a global scale

CernVM File System CVMFS
Application software distribution service

B2SHARE
Store and publish research data

Services for sensitive data
Collect, store and analyse sensitive research data in a secure environment

B2FIND
Metadata based data discovery

Thematic Services

ENES Climate Analytics Service
Analyze and process data from multiple communities with the Ophidia Big Data Analytics framework.

Dynamic On Demand Analysis Service
Simplify the access and management of computing resources

DARIAH Science Gateway
Cloud applications and services for Arts & Humanities researchers

WeNMR suite for Structural Biology
A suite of computational tools for structural biology

OPENCoastS
On-demand operational coastal circulation forecast service

Component MetaData Infrastructure
Services for Social Sciences and Humanities provided via the national CLARIN centres.

Compute

EGI Cloud Compute
Run virtual machines on-demand with complete control over computing resources

EGI High-Throughput Compute
Execute thousands of computational tasks to analyse large datasets.

Screenshot

EGI Cloud Container Compute
Run Docker container in a lightweight

Identity & Security

B2ACCESS
AAI platform for federated authentication to EUDAT services

EGI Check-in
Secure and user-friendly federated authentication and authorisation

Operations

Argo Service monitoring
Monitor the performance of IT services

Proposed project should target gaps in EOSC-hub service offering.

EOSC hub is a service registry which aggregates groups of services developed in previous projects and made visible through a centralized "hub".

- Among thematic services, there is no services for **astronomy / cosmology / astroparticle physics / Earth observations**.

- Among generic services there are services which provide "FAIR" data storage, but there is no service which enables **knowledge extraction from the FAIR data**. This has to be done by deployment of "FAIR" analysis workflows.

- There is no service which targets "**reproducible research**" (possibility to trace lineage of results to raw data and model assumptions and to re-generate the results).

Data analysis services for multi-messenger astronomy

Data analysis of telescopes and astronomical messenger detectors could now be done on remotely via dedicated services accessible via
- Web interface (in a browser)
- Application Programming interface (API) from e.g. Jupyter notebooks

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The idea is to

- port data analysis of multiple telescopes and astronomical messenger detectors into EOSC

- make them live as services connected to common EU-MMO platform "multi-messenger analysis" environment

- enable combination of different type of workflows (raw data analysis, post-analysis of spectra, images and lightcurves) for specific persistent and transient sources.

- Extract and memorize metadata on workflow structure, interfaces, parameter choices, usage statistics, and scientific context. Organize it in a **Knowledge Base**. Use machine learning to analyse the Knowledge Base content to develop in-built "intelligence" and "expertise" within EU-MMO platform.

- Set up a network of on-the-flight data analysis services, accessible via web interfaces and API and using the Knowledge Base to advice users on the choices of parameters, in composition of multi-messenger workflows etc.

Publication services for multi-messenger astronomy

Data analysis of multi-messenger astronomy is reported through different types of publications: from rapid "nano-publications" (ATEL, GCN, VOEvent, human and machine-readable) to full scale journal articles, data analysis manuals etc.

Publication services for multi-messenger astronomy

The idea is to

- Link cloud-based data analysis workflows deployed through EU-MMO to publications in three different ways:

- 1) users of EU-MMO could explicitly link data analysis workflows to published results
  2) information on astronomical sources and results of data analysis could be extracted automatically from machine-readable nano-publications;
  2) information on details on astronomical sources, data analysis and scientific context of data analysis could be extracted using ScienceWISE text mining engine (currently linked to arXiv.org)

- Extract and memorize workflow metadata extracted from publications and link it to the **Knowledge Base**.

- Set up a service which uses the Knowledge Base to search for relevant data and identify data analysis workflows, and then deploy them in response to ATELs, GCN, VOEvent and report the results of analysis.

- Set up a "reproducible results" service linking deployable data analysis workflows to scientific publications.

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Multiple science domains: multi-messenger astronomy and environmental sciences
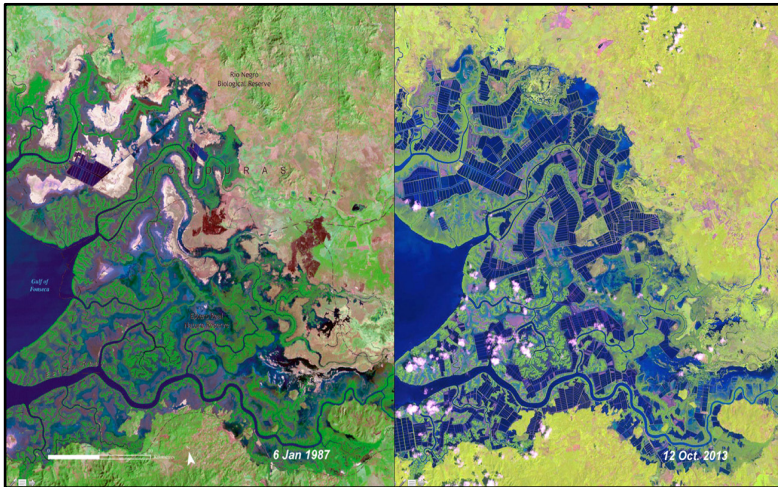
6 Jan 1987 / 12 Oct. 2013

Site footprint identification

Searching current & past images

Downloads

Radiometric corrections

Orthorectification

Stacking bands

Pan-sharpening

Computing indexes

$\dfrac{nIR - R}{nIR + R}$

Analysis & other processes

The H2020 call imposes that the developed services should be useful not only in the initial science domain which motivated service development, but in multiple domains.

Similar trend of porting data analysis services online and combining them into complex multi-messenger framework is observed in the **Earth Observations** domain.

UNEP/GRID-Geneva (United Nations Environmental Protection agency joint institution with the University of Geneva) develops "Live Monitoring of Earth Surface" (LiMES) which runs online data analysis services for multi-wavelength satellite imagery which provides monitoring of natural sites protected by different conventions

- World heritage sites
- Wetlands of international importance
- UN-REDD (reducing emissions from deforestation) sites

The platform will integrate analysis results in UN information sites, share them through Group of Earth Observations (GEO) services and will be also accessible to public.

Multiple science domains: multi-messenger astronomy and environmental sciences
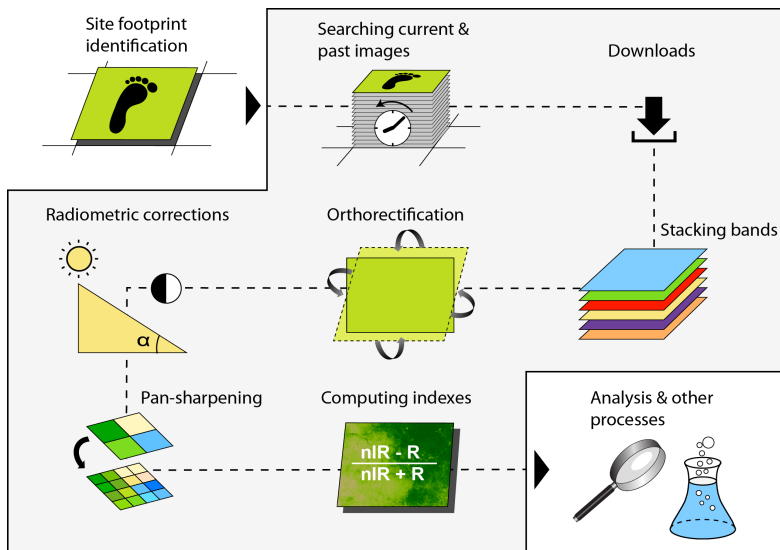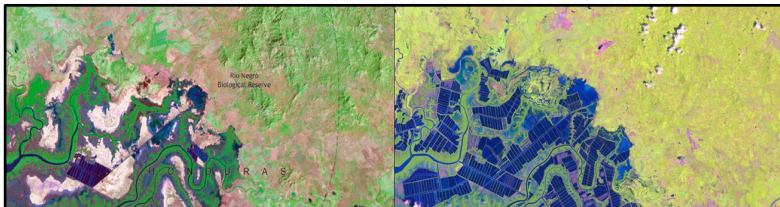

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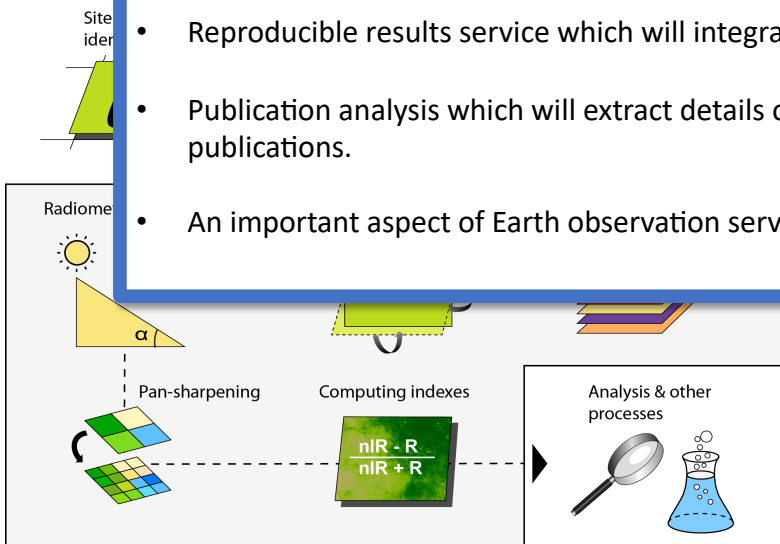...s protected by

...on sites, share them
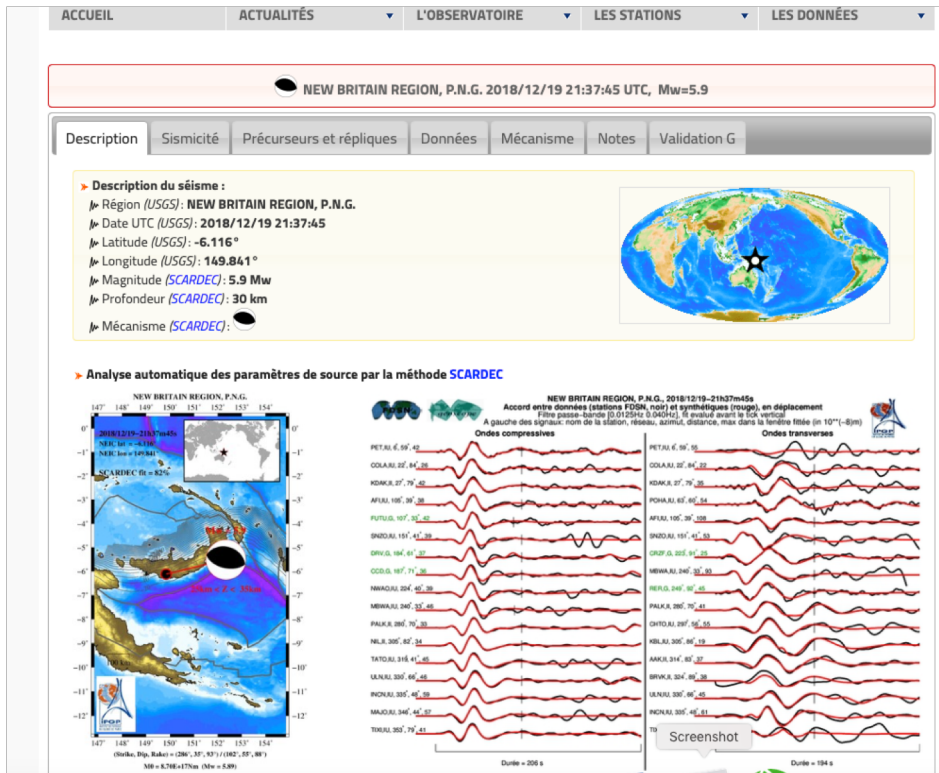...will be also accessible

The idea is to

- Integrate Earth Observations use case into EU-MMO platform, and run the same types of services for both multi-messenger astronomy and multi-probe environmental monitoring:

- Generation of Knowledge Base which could be integrated into services to assist users in analysis workflow composition

- Reproducible results service which will integrate deployable analysis workflows into publications

- Publication analysis which will extract details of data lineage and scientific context of data analysis workflows from publications.

- An important aspect of Earth observation services will be in enabling "crowdsourcing" (citizen science).

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Radiom...

Pan-sharpening

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$$\frac{nIR - R}{nIR + R}$$

Analysis & other processes

EU-MMO @ APC + IPGP, outside H2020 proposal context

Most of the relevant multi-messenger astronomy facilities are represented at APC. Development of multi-messenger "added value" data analysis platform at APC (e.g. in the FACE framework) seems to a useful task (irrespectively of H2020 context).

IPGP collects multi-messenger Earth observations data and runs online services for them:
- Seismology (GEOSCOPE)
- Magnetic field monitoring (ground-based stations and from space)
- Airglow monitoring for tsunami prediction

These data / services could be included in the common added value "multi-messenger" data analysis platform.

Synergies between two types of multi-messenger services are possible (in principle, needs to be assessed):
- Seismology $\leftrightarrow$ gravitational wave analyses
- Magnetic field $\leftrightarrow$ cosmic ray and gamma-ray analysis
- Airglow monitoring $\leftrightarrow$ mini-EUSO data.