

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	Thematic Services	Identity & Security	Operations
 <p>B2HANDLE Register your research data</p> <p>EGI DataHub Access selected public datasets and efficiently consume them from EGI compute services</p> <p>B2STAGE Transfer of data between data resources and external computational facilities</p> <p>B2SAFE Distribute and store large volumes of data based on data policies</p> <p>B2NOTE Data annotation service to create annotations on research data</p> <p>B2DROP Secure and trusted data exchange service for researchers</p> <p>EGI Online Storage Store, share and access your files and their metadata on a global scale</p> <p>CernVM File System CVMFS Application software distribution service</p> <p>B2SHARE Store and publish research data</p> <p>Services for sensitive data Collect, store and analyse sensitive research data in a secure environment</p> <p>B2FIND Metadata-based data discovery</p>	 <p>ENES Climate Analytics Service Analyze and process data from multiple communities with the Ophidia Big Data Analytics framework.</p> <p>Dynamic On Demand Analysis Service Simplify the access and management of computing resources</p> <p>DARIAH Science Gateway Cloud applications and services for Arts & Humanities researchers</p> <p>WeNMR suite for Structural Biology A suite of computational tools for structural biology</p> <p>OPENCoastS On-demand operational coastal circulation forecast service</p> <p>Component MetaData Infrastructure Services for Social Sciences and Humanities provided via the national CLARIN centres.</p>	 <p>B2ACCESS AAI platform for federated authentication to EUDAT services</p> <p>EGI Check-in Secure and user-friendly federated authentication and authorisation</p>	 <p>Argo Service monitoring Monitor the performance of IT services</p>
	<p>Compute</p>  <p>EGI Cloud Compute Run virtual machines on-demand with complete control over computing resources</p> <p>EGI High-Throughput Compute Execute thousands of computational tasks to analyse large datasets.</p> <p>Screenshot EGI Cloud Container Compute Run Docker containers in a lightweight</p>		

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

The screenshot shows the INTEGRAL ISGRI web interface. It includes a header with the University of Geneva and CERN logos, and navigation tabs for HOME, PROJECTS, DATA ANALYSIS, SOFTWARE, DATA, TEAM, and CONTACT US. The main area displays instrument query parameters such as OSA Version (OSA10.2), Radius (15), Energy Min (20.0 keV), and Energy Max (40.0 keV). A spectral plot shows counts versus energy with a constant fit and a linear fit. A Jupyter notebook interface is overlaid on the bottom left, showing Python code for data analysis and a resulting image plot.

```

In [5]: energy_axis = MapAxis.from_edges(
        np.logspace(0, 1.0, 5), unit="TeV", name="energy", interp="log"
    )
        geom = HcsGeom.create(
            skydir=(83.633, 22.014),
            binsz=0.02,
            width=(5, 5),
            coordsys="CEL",
            proj="TAN",
            axes=[energy_axis],
        )

In [6]: %%time
        maker = MapMaker(geom, offset_max="2.5 deg")
        maps = maker.run(observations)
        images = maker.make_images()

CPU times: user 15.1 s, sys: 329 ms, total: 15.4 s
Wall time: 4 s

In [7]: maps.keys()

Out[7]: dict_keys(['counts', 'exposure', 'background'])

In [8]: images["counts"].smooth(3).plot(stretch="sqrt", vmax=2);
    
```

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

The top screenshot shows the Space Science Data Center (SSDC) website, featuring a navigation menu with links like Home, About SSCD, News and Communication, Quick Look, Missions, Multimission Archive, Catalogs, Tools, Links, and Bibliographic services. Below the navigation is a banner for the Multi-Mission Interactive Archive for Space Science Astrophysics/Cosmology, with sub-sections for Astrophysics/Cosmology, Exploration of the Solar System, Particle Astrophysics, and Atmospheric Physics TCE.

The bottom screenshot shows the Open UNiverse website, which is part of the United Nations Office for Outer Space Affairs. It features a navigation menu with links like Open Universe @ ASI, Space Astronomy, Ground Astronomy, Planetary Science, Solar data, ISS, VO and General services, Bibliography, Cosmic Rays, and Astronomical tools. Below the navigation is a section for Help & video tutorials, a Feedback button, and a Login button. The main content area displays a search bar for object names or coordinates, with a version number of 1.5 and a list of categories: Astronomy, Planetary Science, Cosmic Rays, and Atmospheric Physics.

Data analysis services for multi-messenger astronomy

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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.



Version 1.5
Enter object name or coordinates:
e.g. 3C279 or 194.04625, -5.789167 or 12 56 11.1, -05 47 21.0

Publication services for multi-messenger astronomy

Email Circulation: 4597
Get Telegram #:

Apply Subject Selections

Combine With: (Show All) AND OR

Radio
 Millimeter
 Sub-Millimeter
 Far-Infra-Red
 Infra-Red
 Optical
 Ultra-Violet
 X-ray
 Gamma Ray
 GeV
 TeV
 VHE
 UHE
 Neutrinos
 A Comment
 AGN
 Asteroid
 Asteroid (Binary)
 Binary
 Black Hole
 Blazar
 Cataclysmic Variable
 Comet
 Cosmic Rays
 Direct Collapse Event
 Exoplanet
 Fast Radio Burst
 Gamma-Ray Burst

Telegram Index

Telegrams Posted Within the Last 30 Days (All)
80 Selected of 12311 Telegrams

12311 SALT high-resolution optical spectroscopy of ASASSN-18abr
E. AYO, D. A. H. BUCKLEY, L. CHIRIB, A. KAWADA, K. MIKAI, K. SAKOJOSKY, AND J. STRADER
29 Dec 2018; 05:08 UT

12310 Large NIR Flare of high redshift blazar BZJQJ0348-2748
L. CARBASSO, G. TORRESO, E. RICULAS, A. PERRAZ, V. CHAVIRIEN, D. Y. MAYVA
29 Dec 2018; 04:58 UT

12309 INT/WFC improved position and follow-up photometry of the red LPV AT2018hed (= XMINGS1) in M31
M. FERNANDEZ-TORRESO, A. ALMIR, S. SAUTERA, R. M. DUBOIS-CARRERA, D. SUELLAN-JACQUA, A. ALVAREZ-HERNANDEZ
19 Dec 2018; 14:46 UT

12308 MASTER Pre-discovery Observations of the Possible Nova in M31
O. GRES, N. BERDAN, V. LARSON, D. KOROTKOV, E. GORODKOV, V. KOROTKOV, A. TAYLOV, V. SENE, D. DUBASHEVTOV
18 Dec 2018

12307 MASTER: OT in Andromeda direction
D. KOROTKOV, GORODKOV, RALONTEVA, KOROTKOV, S.
18 Dec 2018

12306 MASTER: dwarf novae outburst detection
T. POKORNY, LARSON, R. F. C. FRANCIS, D. BRUCKER
18 Dec 2018

12305 Palomar Gattini-IR J band detections of AT 2018jro
K. DEL, M. H. KARLINA, A. ADAMI, M. A. A. DELACROIX
18 Dec 2018

12304 Fermi LAT detection of GeV flares from the two southern-hemisphere blazars, PKS 0252-549 and PMN J2211-7039
C. C. CHENG, P. F. LAM, G. COLLIARD
17 Dec 2018


12303 ePESSTO spectroscopic classification of optical transients
M. PERRAZ, S. SUGITA, M. S. DUBOIS-CARRERA, J. ANON, D. H. FROBERGER
17 Dec 2018

12302 ASASSN-18abr: Discovery of a Probable Supernova in the TESS Field
P. CASELLA, J. VALLER, K. KUCHANIK, J. THOMPSON, B. THOMPSON
17 Dec 2018

12301 ePESSTO spectroscopic
N. CASTRO-SOLÍS



Sky Event Reporting Metadata (VOEvent) Version 1.0



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Subject search and browse:

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5 Sept 2018: [arXiv looks to the future with move to Cornell CIS](#)
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Listed in reverse serial number order -- newest first)

- 23546 GRB 181217A: Insight-HXMT/HE detection
- 23545 GRB 181213A: Swift/UVOT Observations
- 23544 GRB 181213A: Mondy optical observations
- 23543 GRB 181213A: continued TSHAO optical observations
- 23542 GRB 181213A: Insight-HXMT/HE detection
- 23541 GRB 181212A: Insight-HXMT/HE detection
- 23540 Konus-Wind observation of GRB 181212A
- 23539 GRB 181213A: AbAO optical observations
- 23538 GRB 181213A: HMM-0.5m, NEXT-0.6m, CNEOST-1m optical observations
- 23537 GRB 181213A: NOT optical observations
- 23536 GRB 181213A: Swift-XRT refined Analysis
- 23535 GRB 181213A: Enhanced Swift-XRT position
- 23534 IPN Triangulation of GRB 181212A (long)
- 23533 GRB 181213A: Swift-BAT refined analysis
- 23532 GRB 181213A: GWAC-F60A upper limit
- 23531 GRB 181126A: MeerKAT radio observation
- 23530 GRB 181213A : TSHAO optical observations
- 23529 GRB 181213A: Swift/UVOT Detection
- 23528 GRB 181213A: Swift-XRT observations
- 23527 GRB 181213A: BOOTES-5/JGT optical observations
- 23526 SWIFT GRB181213A Global MASTER-Net bright OT discovery
- 23525 GRB 181213A: Swift detection of a burst
- 23524 GRB 181212A: Fermi GBM Detection
- 23523 GRB 181126B: KAIT Follow-Up Observations of a Fermi Short GRB (Trigger 564897175)
- 23522 GRB 181213A: continued optical observations in Mondy

Portal **Simbad** VizieR Aladin X-Match Other ~ Help

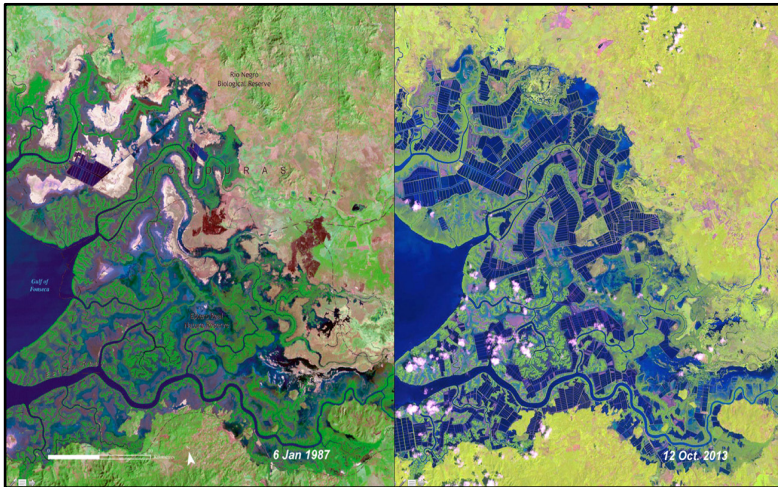
SIMBAD Astronomical Database - CDS (Strasbourg)

What is SIMBAD ?

Queries	Documentation
basic search	User's guide
by identifier	
by coordinates	
by criteria	Query by url
reference query	Nomenclature Dictionary
scripts	Object types
TAP queries	List of journals
	Measurement description
	Spectral type coding
	User annotations documentation
Display all user annotations	Acknowledgment

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.

Multiple science domains: multi-messenger astronomy and environmental sciences



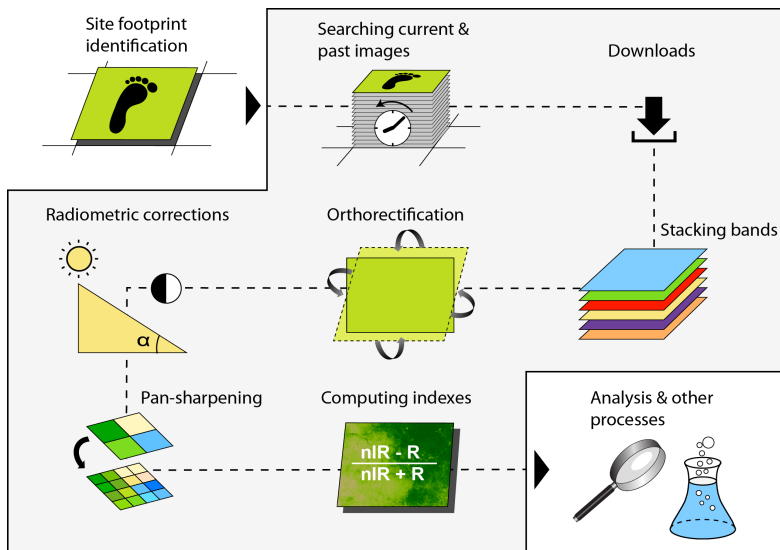
The H2020 call imposes that the developed services should be useful not only in the initial science domain which motivated service development, but in multiple domains.

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

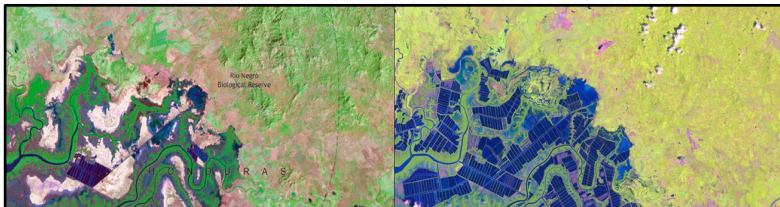
UNEP/GRID-Geneva (United Nations Environmental Protection agency joint institution with the University of Geneva) develops “Live Monitoring of Earth Surface” (LiMES) which runs online data analysis services for multi-wavelength satellite imagery which provides monitoring of natural sites protected by 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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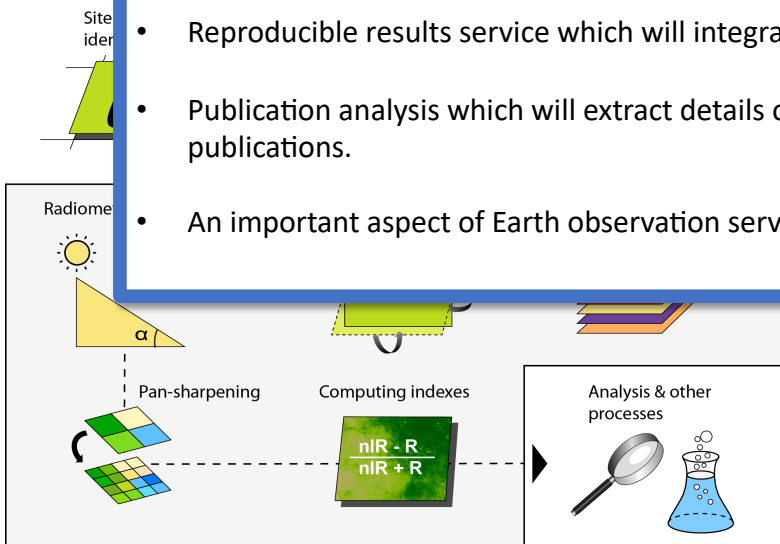
Similar trend of porting data analysis services online and combining them into Earth Observations

The idea is to

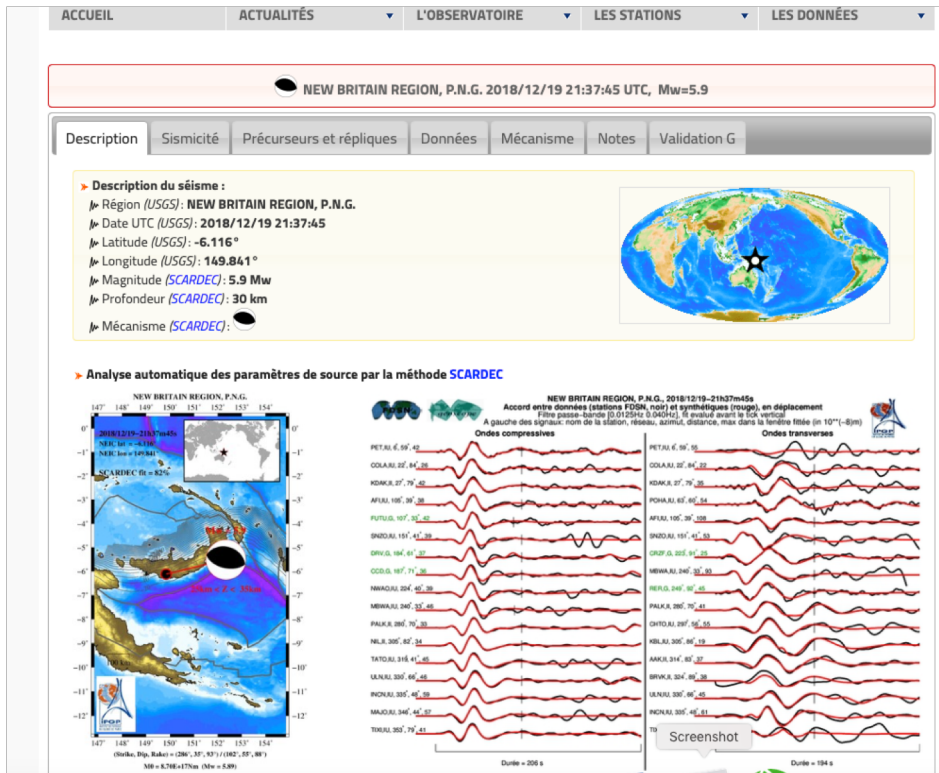
- Integrate Earth Observations use case into EU-MMO platform, and run the same types of services for both multi-messenger astronomy and multi-probe environmental monitoring:
- Generation of Knowledge Base which could be integrated into services to assist users in analysis workflow composition
- Reproducible 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).

ation agency joint
Monitoring of Earth
or multi-wavelength
s protected by

on sites, share them
will be also accessible



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 ↔ gravitational wave analyses
- Magnetic field ↔ cosmic ray and gamma-ray analysis
- Airglow monitoring ↔ mini-EUSO data.