

agentia spatiala romana – romanian space agency

# Space data and technology in support of disaster management

## Infrastructure SPERO

**Alexandru Badea**

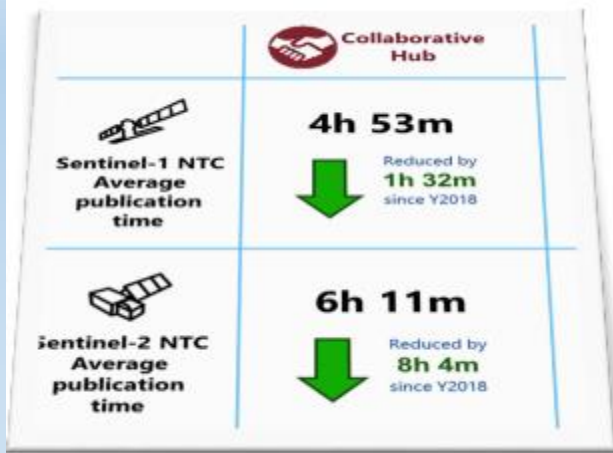
**Ion Nedelcu**



# Context

- EO community challenged by the need to exploit the spectral, spatial and temporal resolution characteristics of the Copernicus satellites huge data volume enabled by free and open data policy
- Efforts still need to be made on the way to **integrate satellite data derived information in more social and economic sectors and policy making and to increase the current use**
- Major actions launched by EC, ESA and EU MSs towards making full use of an unprecedented data volume and diversity mainly coming from the Copernicus space and in-situ activities and to extend the use of data and information up to the local level

# Context



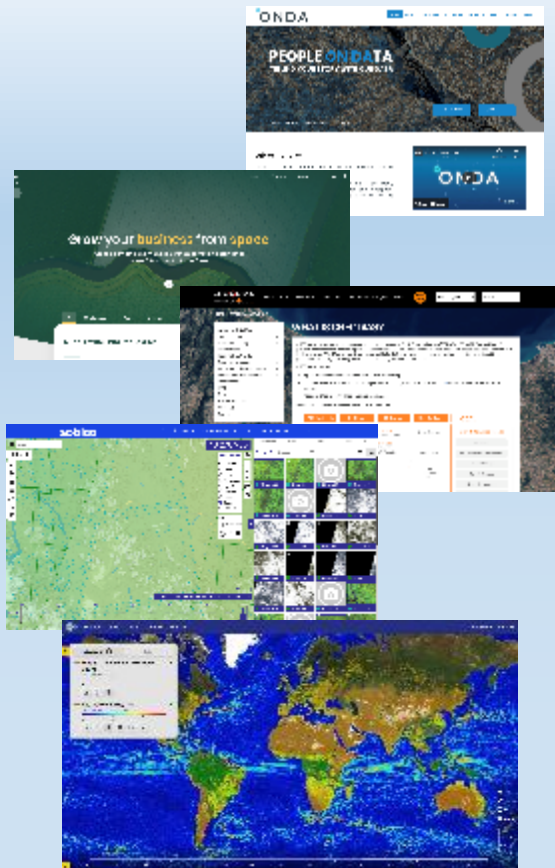
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Copernicus Sentinel data Access Annual Report (ESA, 2019)

# Context

## DIAS, TEP, Regional and National platforms

- DIASs\*: CREODIAS, MUNDI, ONDA, SOBLOO, WEKEO
- TEPs\*\*: COASTAL, FORESTRY, FOOD SECURITY, GEOHAZARDS, HYDROLOGY, POLAR, URBAN

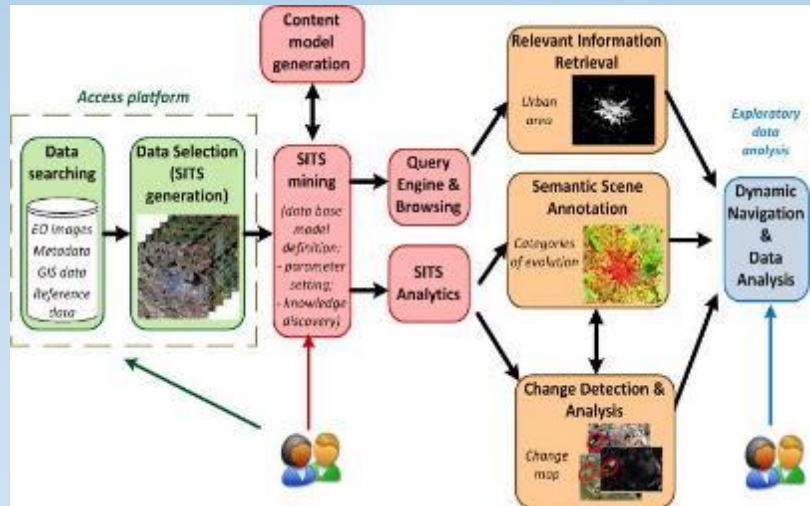


\*TEP – Thematic Exploitation Platform

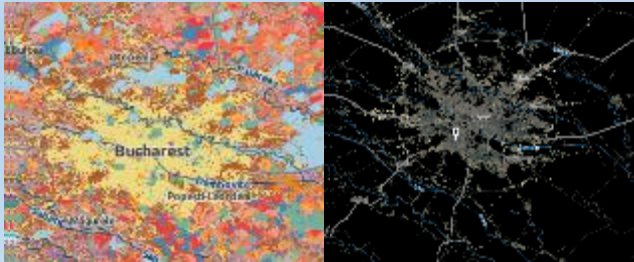
\*\*DIAS - Data and Information Access service

# DAMATS

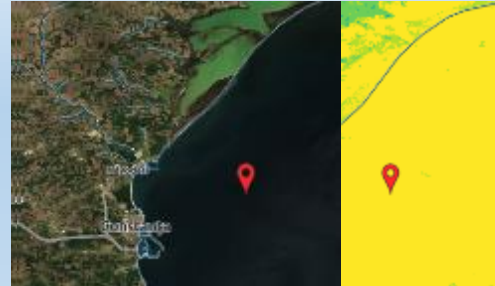
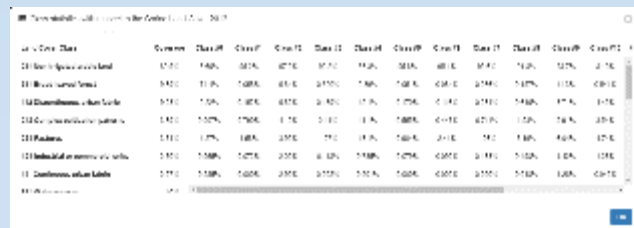
- **Data Mining For Analysis and Exploitation of Next Generation of Time Series**
- **GSTP activity involving Terrasigna (Romania), CEOSpaceTech (Romania) and EOX (Austria)**



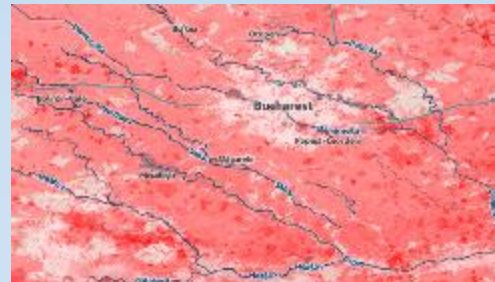
# Data Mining in Time Series



Mask of urban area and land cover classification based on spatio-temporal evolutions using LDA analysis on Landsat SITS over Bucharest, Romania. Illustrates: 15 classes.



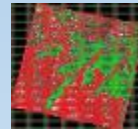
Left) Query example for semantic search corresponding to "water"; Right) Temporal evolution corresponding to the "water" class.



Cumulative change map (NDK) corresponding to the Bucharest Landsat SITS. The changes are marked intensities of Red (more intense = more change) and white means "no change".

# Content Based Image Retrieval- OSIRIDE

- **Open Source Image Retrieval – Integration of Developed Tools** is a GSDP activity involving Terrasigna (Romania), CEOSpaceTech (Romania)
- OSIRIDE is a CBIR systems integrating several modules dedicated to specific data processing, learning and query, enabling the exploration of multiple information sources and several use case scenarios and applications.

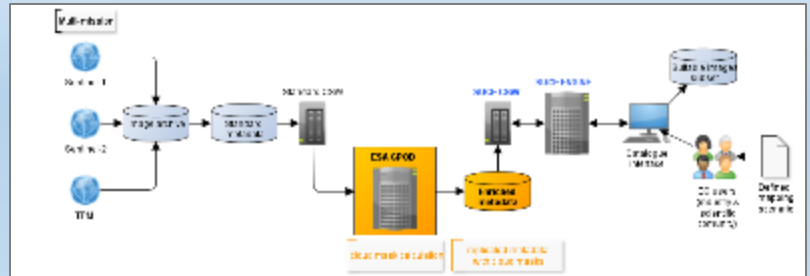


Use Case Diagram - Client interaction with OSIRIDE system

1. Access web platform and database
2. Content based image retrieval / knowledge discovery
3. Exploratory data analytics / Interactive and Dynamic Navigation

# Suitability Coverage Engine

- GSTP activity involving GISAT (Czech Republic), Terrasigna (Romania)
- **effectively select EO products** from catalogues and **obtain Optimized Coverage** for given user AOI
- Calculation/Computation based **only on image metadata** i.e. cloud mask (and derived valid pixel layer)
- Proposed solution **reduces both manual work and transfer** of unsuitable EO products



### Temporal coverage

Provides coverage/density information as number of clear-sky observations per pixel for chosen time period and AOI.



### Spatial coverage

Composes optimal EO image single coverage for chosen time period and area of interest.



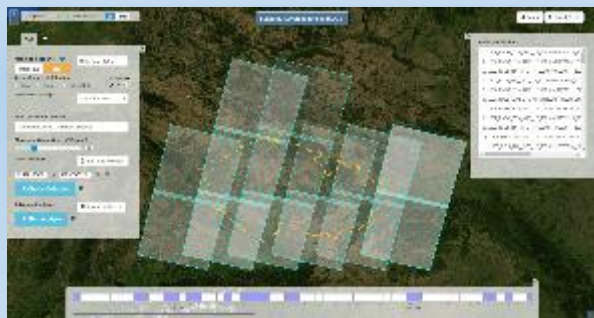
## SAR coverage

Searches for optimal SAR image pairs suitable for Snow Mapping for chosen time period and area of interest.





# SUCE\*

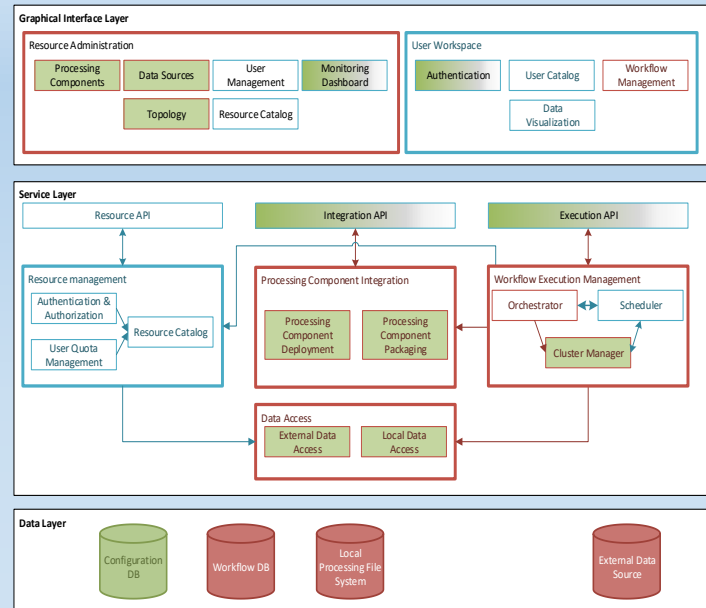


\*Development of Suitability Coverage Engine

# TAO

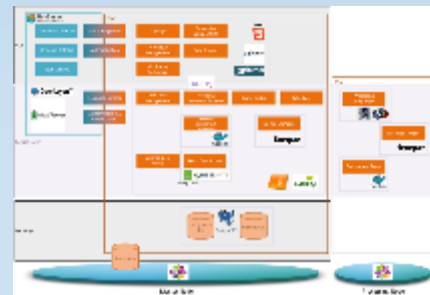
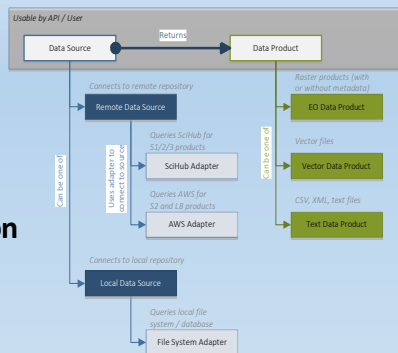
## Tool Augmentation by User Enhancement and Orchestration, a framework for

- integrating in an uniform way existing heterogeneous EO processing toolboxes (such as OTB, SNAP, GDAL, etc.)
- querying and retrieving EO products from various sources (SciHub, AWS, PEPS, USGS, etc.)
- building scientific workflows
- distributing the execution of processing components



# TAO

- Service Registry
- Web Services
- User Management
- Authentication and Authorization
- Topology Management
- Processing Components Management
- Processing Components Deployment
- Data Sources Management
- Workflow Management
- Orchestration
- Data Visualization
- Resource Catalog



# SPERO

- **Financed as top-down project under the national R&D program by UEFISCDI (Executive Unit for Financing Higher Education, Research, Development and Innovation)**
- **Main objective to develop a platform allowing effective management and processing of EO satellite and in-situ data in support of emergency response**
- **First in a series of project aiming to steer the development of the national EO data infrastructure based on use cases (crisis management, land, marine and atmosphere monitoring, etc)**
- **Project team involving ICI (coordinator, R&D), UPB (Uni), UTI (Ind), ACTTM (R&D), TERRASIGNA (Ind), ISS (R&D), IAAR (R&D) si ATM (Uni)**

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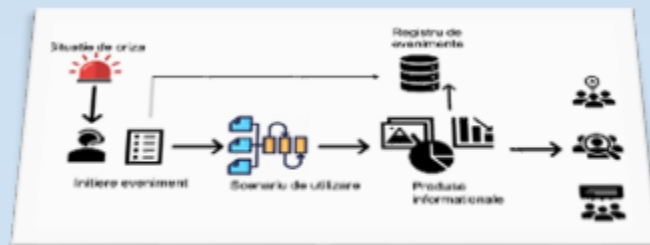
# SPERO

- Requirements collected by considering an extended set of phenomena and cases generating emergency situations: natural (flood, drought, landslides, space weather and NEO) and man made (fire, pollution, environmental damages)
- Address observations needs and data processing requirements of legally mandated organizations and population for prevention, during and post crisis events, including SAR operations
- Consider the European and international context of developing infrastructure and services in support of environment and security



# SPERO

- Integrate results of the past and current activities in a modern, cloud-based, state-of-the-art architecture
- Main data sources: national SDI data, Copernicus satellite and in-situ (mirroring site, view and download services)
- Main nodes based on ROSA infrastructure; ready to scale and use e.g DIAS, national, regional infrastructures

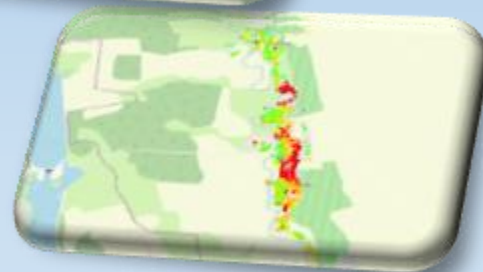


# SPERO

**Information supporting  
decision making in case of  
disasters:**

- Land slides
- Floods
- Fires

**Made available in a  
thematic portal**



# SPERO

**Information related to  
space and on-Earth  
weather:**

- NEO
- Solar activity
- Extreme weather events

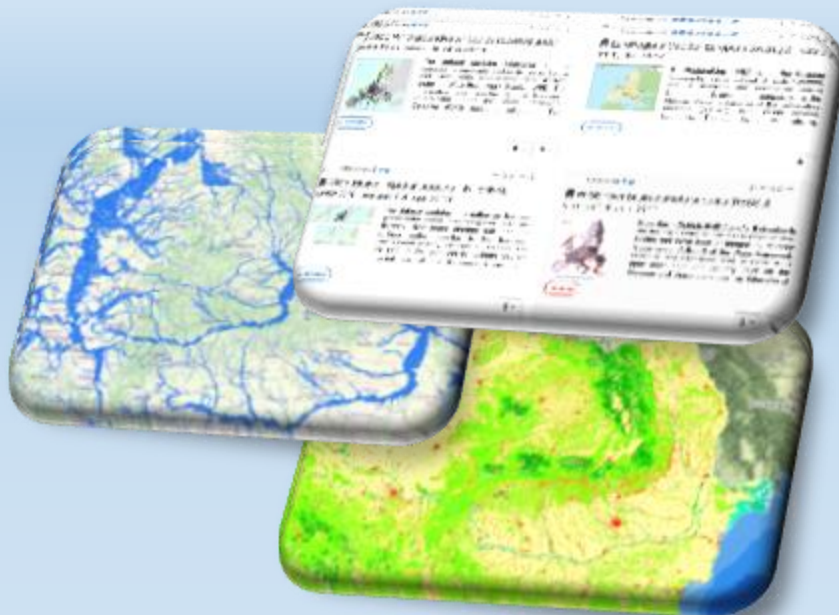
**Made available in the  
thematic portal**





# SPERO

**Integrate data from various sources by means of geo-catalog services harvesting metadata from European and national sources; the geocatalog is available for public access**



<http://geocatalog.rosa.ro/>

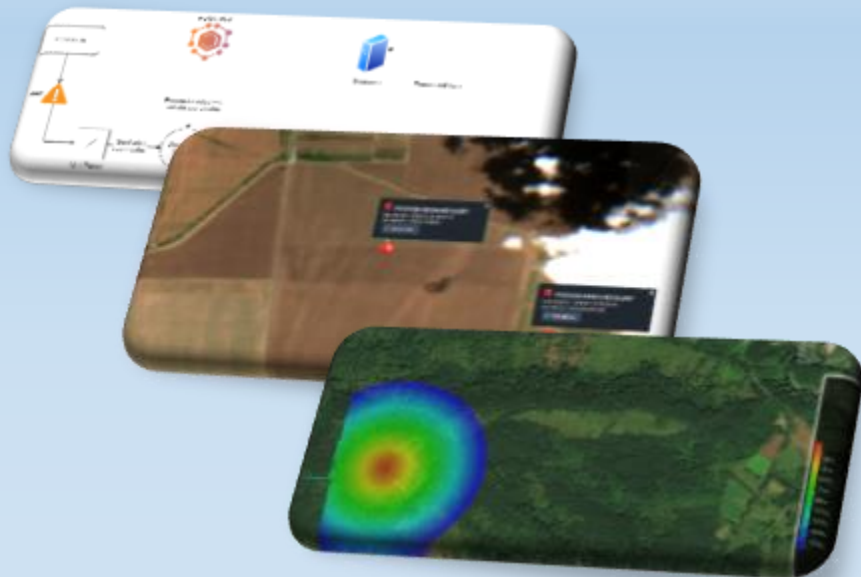


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# SPERO

**Operational  
Workflow for actions  
operational for  
search and rescue  
actions (SAR):**

- Positioning display
- On site image displaying
- Visibility Study



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# SPERO

**Jupyter Hub available for rapid application prototyping and algorithm development and validation; allows fast access to Sentinel data in the RO Hub; scalable computing resources**



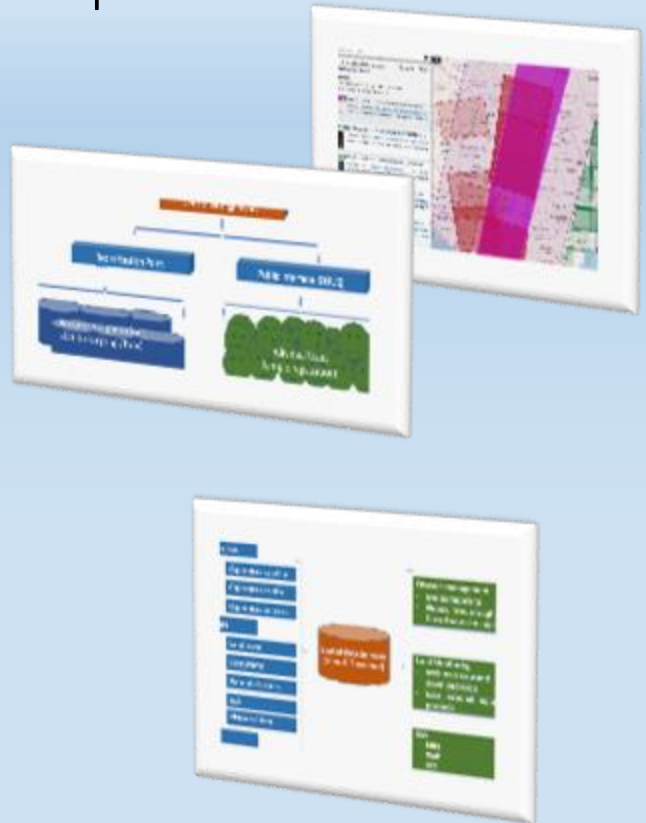
[\(https://jupyter.sentinel.ro/\)](https://jupyter.sentinel.ro/)



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## Mirroring site and thematic portals

- Based on agreement signed with ESA as part of the collaborative ground segment activities
- Copy of the Sentinel (1,2,3) satellite data –missions, 5 months
- Romanian territory –to be extended to the entire Danube basin
- Already available at <https://sentinels.rosa.ro>; more information to be added and user guide in Romanian
- Central point of access to “heavy” user organizations (e.g. Meteo Romania), universities and R&D organizations



# Romanian Sentinel Mirror site



# Short term goals and results

- Continue the development of **knowledge and tools** for the exploitation of **satellite and in-situ data** and develop and maintain a national infrastructure for the access and exploitation of satellite and relevant in-situ data **based on results achieved in the past and current activities**
- Promote the use of space technology and satellite data in particular in various fields and **increase the awareness of expert users and decision makers** based on demonstrations of **downstream and custom tailored services**, with the help of industry
- Get involved in **regional activities** aiming to support these goals increase their **sustainability** and make steps towards adopting a **suitable governance model**

# Conclusions

**Sustained actions need to be planned / continued towards**

- ensuring reliable and sustained access to satellite and in-situ data, addressing both infrastructure, human resources and policy**
- establishing centres and rely on them to setup and maintain regional and thematic platforms, promoting and supporting activities for the implementation of specific policies in a coordinated manner**
- sustained actions need to be planned towards establishing regional centres linked by the DIASes and relying on them to setup and maintain regional and thematic platforms, managed by legally mandated actors, promoting and supporting activities for the implementation of European regional and national specific policies in a coordinated manner**

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