HELLENIC REPUBLIC
National and Kapodistrian University of Athens
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EXTREME EARTH

ExtremeEarth Overview

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Creating platform-driven e-Infrastructure innovation on EOSC, 7th Hellenic Forum

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Outline

Background

Objectives

Consortium

Partner Expertise

Impact

Background - Copernicus

- Satellite data is probably **the most important digital resource** available to mankind today.
- Europe is a champion in the area of satellite data given its **Copernicus program.**
- Copernicus data is a paradigmatic case of **big data.** We have all the Vs**:**
  - **Volume** (>191*10^3 users, >11*10^6 products, >106 PB of data in the Copernicus Open Access Hub)
  - **Velocity** (as of 2017, 10TB of data were generated and 93TB were disseminated every day)
  - **Variety** (many kinds of satellite images, many kinds of collateral data)
  - **Veracity** (quality is important)
  - **Value** (13.5 billion and 28.030 job years are projected for 2008-2020)
- **Information and knowledge** extracted from this wealth of EO data is also **voluminous**: 1 PB of Sentinel data may contain >750*10^3 products which will result in >450TB of information and knowledge (e.g., classes of objects).

Background - DIAS

- The five **Data and Information Access Service (DIAS)** platforms are now operational:
  - CREODIAS (https://creodias.eu/)
  - Mundi Web Services (https://mundiwebservices.com/)
  - SOBLOO (https://sobloo.eu/)
  - ONDA (https://www.onda-dias.eu)
  - Wekeo (https://www.wekeo.eu/)

- The five DIASs offer **computing power close to the data to** facilitate the development of EO applications.

Background – ESA TEPs

- **ESA thematic exploitation platforms (TEPs):** virtual environments for **user communities** so they can find relevant EO data and develop applications using this data by taking advantage of available computing resources. There are 7 TEPs currently:
  - Coastal
  - Forestry
  - Geohazards
  - Hydrology
  - **Polar**
  - Urban
  - **Food Security**

ExtremeEarth Main Objective

- To develop extreme earth analytics techniques and technologies that **scale to the PBs of big Copernicus data, information and knowledge**, and applying these technologies in **two of the ESA TEPs: Food Security and Polar.**
- The technologies to be developed will **offer unprecedented scale-out ability to distributed deep learning for Copernicus data**.
- The technologies to be developed will **leverage LD/SW concepts to facilitate data integration and cataloguing**.

Consortium and roles

- National and Kapodistrian University of Athens: Big linked geospatial data
  LogicalClocks: Big data and deep learning infrastructures
  National Center for Scientific Research “Demokritos”: Data integration
  Royal Institute of Technology (KTH): Scalable deep learning
- University of Trento: Deep neural network techniques for remote sensing
  German Aerospace Center (DLR): Deep neural network techniques for SAR data
- VISTA GmbH (VISTA): Remote sensing for hydrology, leads Food Security TEP
  The Arctic University of Norway (UiT): Remote sensing
  Polar View: Commercialization of remote sensing products, leads Polar TEP
  Meteorologisk Institutt: Production of ice maps for the Arctic
  British Antarctic Survey: Remote sensing, Polar TEP members

ExtremeEarth Detailed Objectives

- **To develop scalable deep learning architectures for Sentinel images**.
  - The developed architectures will target determining **crop boundaries and type,** and **sea ice mapping**.
  - The developed architectures will **run on the Hops data platform**.

- To develop **very large training datasets consisting of millions of images** for deep learning architectures targeting the classification of Sentinel images.
  - The training datasets will target the developed deep architectures.

Detailed Objectives (cont'd)

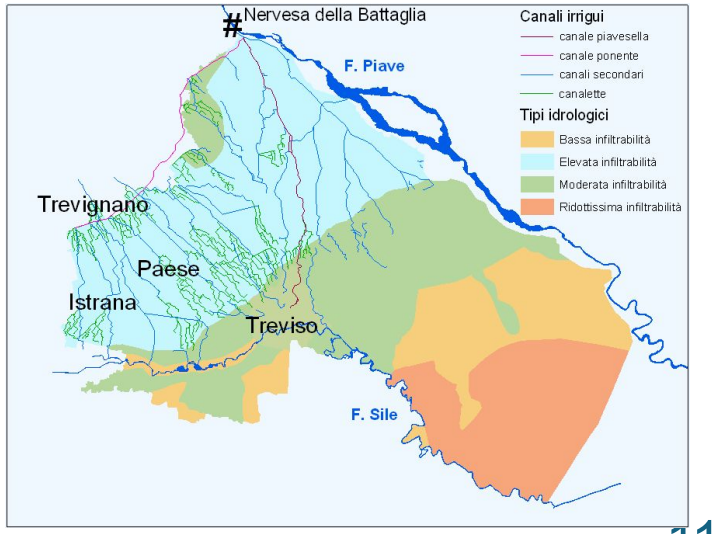
- **To develop techniques and tools for linked geospatial data querying, federation and analytics that scale to big Copernicus data, information and knowledge**.
  - Reengineer the UoA systems **GeoTriples**, **JedAI** and **Strabon** so that they scale to the PBs of Copernicus big data.
  - Reengineer the NCSR-D system **Semagrow** so that it scales to federations of Copernicus big data sources.

Detailed Objectives (cont'd)

- **To extend the capabilities for EO data discovery and access with semantic catalogue services that scale to the big data, information and knowledge of Copernicus.**
  - Allow the expression of **sophisticated queries** such as "How many icebergs were embedded in the Norske Øer Ice Barrier at its maximum extent in 2017?"
  - Implement the catalogue on the Hops data platform and demonstrate it on the selected DIAS.

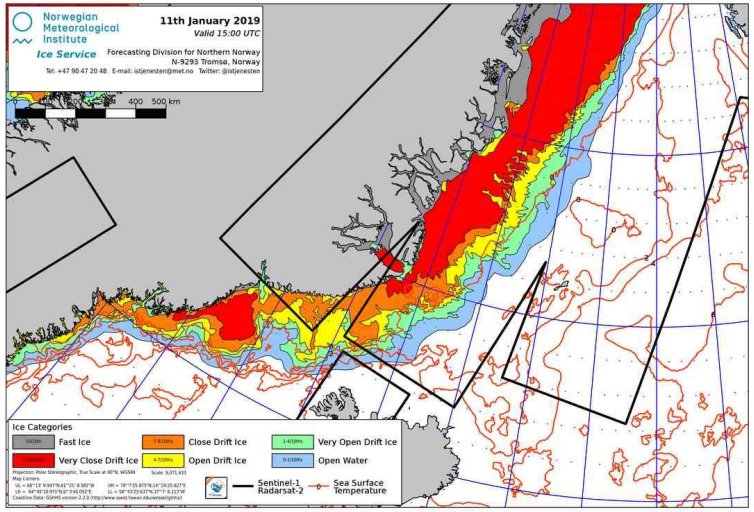
Use cases

- **To develop high resolution water availability maps for selected agricultural areas in Europe allowing a new level of detail for wide-scale irrigation support.**
  - The maps will be available as linked data together with other geospatial layers (e.g., OpenStreetMap, field boundaries, crop types etc.) and will be made available to the Food Security TEP users.



Use cases

- **To produce high resolution ice maps from massive volumes of heterogeneous Copernicus data.**
  - The maps will be made available as linked data and will be combined with other information such as sea surface temperature and wind information for informing maritime users and Polar TEP users.



Thank you!

Impact – From the ICT12-2018-2020 call on “Big data and extreme-scale analytics”

- “Increased productivity and quality of system design and software development thanks to better architectures and tools for complex federated/distributed systems handling extremely large volumes and streams of data”
- “Demonstrated, significant increase of speed of data throughput and access, as measured against relevant, industry-validated benchmarks”
- “Demonstrated adoption of results of the extreme-scale analysis and prediction in decision-making (in industry and/or society)”

Impact – Additional

- Competitive advantage for the European industry (Copernicus data, big data, deep learning, the two use cases).
- Shaping the Integrated Ground Segment of Copernicus and the Sentinel Collaborative Ground Segment.
- Enable the development of EO services using Copernicus data by European companies that are **not** consortium members.
- Bridging the gap between Remote Sensing and Informatics in the academic sector, and the Earth Observation and ICT industry sectors.
- Enhancing innovation capacity and creating new market opportunities and new jobs in the European EO and ICT sectors.

Impact – Use cases

- Positive impact on **field irrigation in Europe in terms of harvest, quality assurance and financial cost.**
- Positive impact on **maritime navigation and safety in the Arctic.**

Impact – International and European Activities

- GEO, GEOSS and EuroGEOSS
- INSPIRE
- Big Data Value Public-Private Partnership
- AI4EU (http://ai4eu.org/)
- Other projects funded in the same call

Impact – Research Areas

- Remote Sensing and Earth Observation
- Big Data and Extreme Earth Analytics
- Deep Learning techniques for Remote Sensing
- Geospatial Semantic Web and Linked Geospatial Data

Impact – Standards

- Use relevant W3C and Open Geospatial Consortium standards.
- Suggest improvements if needed.
- Follow closely new relevant standardization work.