

ESA Earth Observation initiatives for the Cultural and Natural Heritage monitoring and protection

Dr. Gordon Campbell
Head of Enterprise
Green Solutions Division
Earth Observation Programmes Directorate

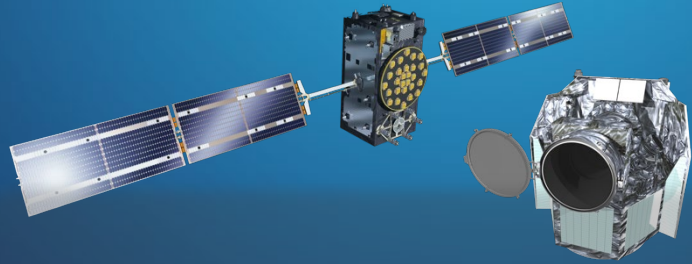
ESA Earsel Workshop on EO for Cultural Heritage
15-16 October 2025 ESRIN

ESA UNCLASSIFIED – For ESA Official Use Only



What is the European Space Agency?

Make Space
for Europe



Promoting cooperation among European States in space research, technology, applications, and infrastructures for exclusively peaceful purposes



5 500+

ESA Workforce

22

Member States

2024 Budget

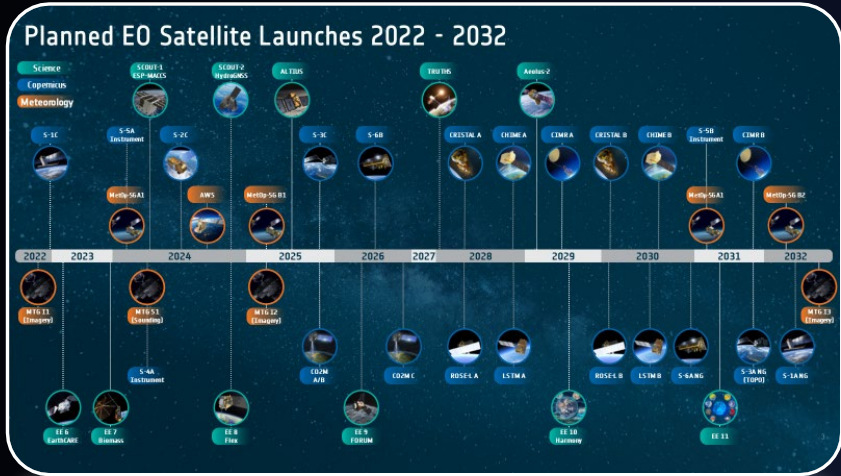
€ 7.79 billion =
10.5 per European



Earth Observation Activities at ESA



Building satellites



Managing Missions



Cal/Val & Data Distribution



Earth System Science

Emergency Response

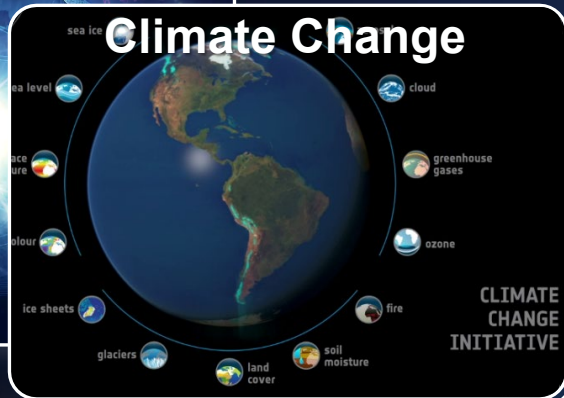


Digital Twins



Applying the Data

Climate Change



Innovation & Commercialisation

Φ-lab



Observing the Earth: Natural and Cultural Heritage from Space

→ UNDERSTAND

- Subsidence, ground motion detection
- Urban sprawl monitoring
- Climate Change indicators
- Sites monitoring and detection (buried sites)

→ SECURE

- Monitoring of the destruction or looting of sites
- Air pollution monitoring
- Coastline monitoring (erosion)

→ BENEFIT

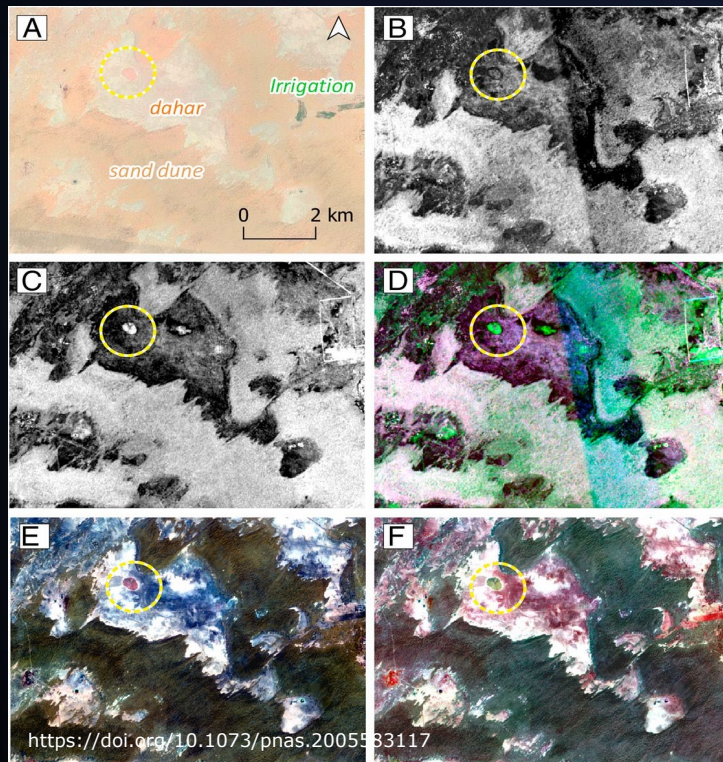
- Risk assessment/Land use change maps
- Preventive investigation for infrastructures realization
- Dissemination of culture awareness



EO use to date: which applications (1)

DISCOVERY AND MAPPING

Identification of new archaeological sites and further exploration of existing ones



Cholistan Desert, Pakistan

ESA and the Vatican Apostolic Library: preservation, management and exploitation of archived information



DATA PRESERVATION

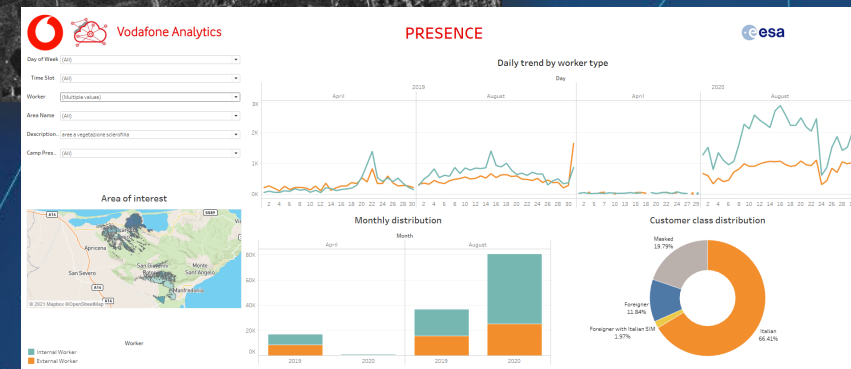
EO use to date: which applications (2)

ANTHROPOGENIC IMPACT

- Intentional site destruction (terroristic acts or)
- Indirect site destruction (side-effect of a local human-made crisis)

- Urban sprawl and tourism impact –combined use of EO and Mobile derived analytics

(High frequency of observations
VHR imagery
Near Real Time observation)

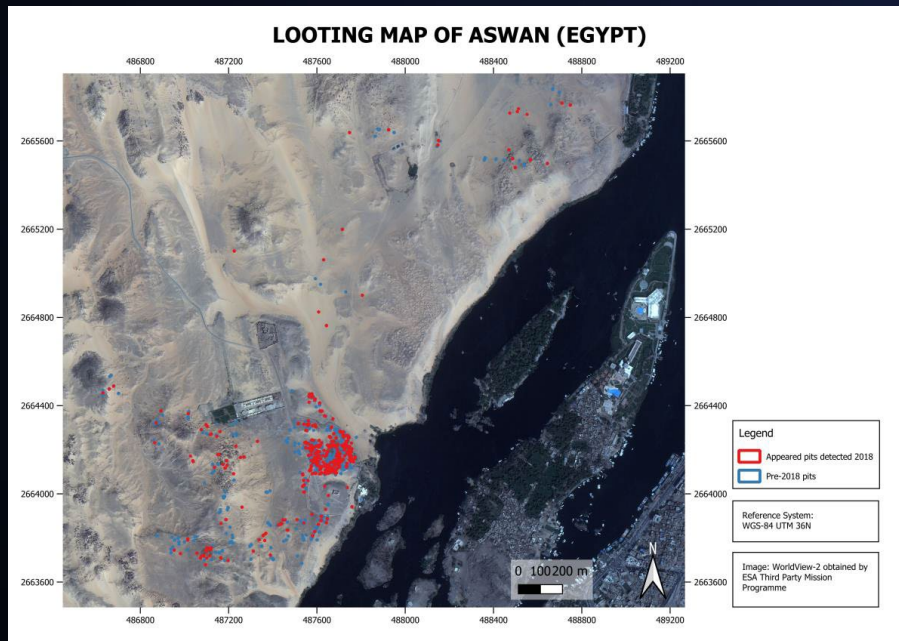


Nimrud Citadel, Iraq, UNESCO site

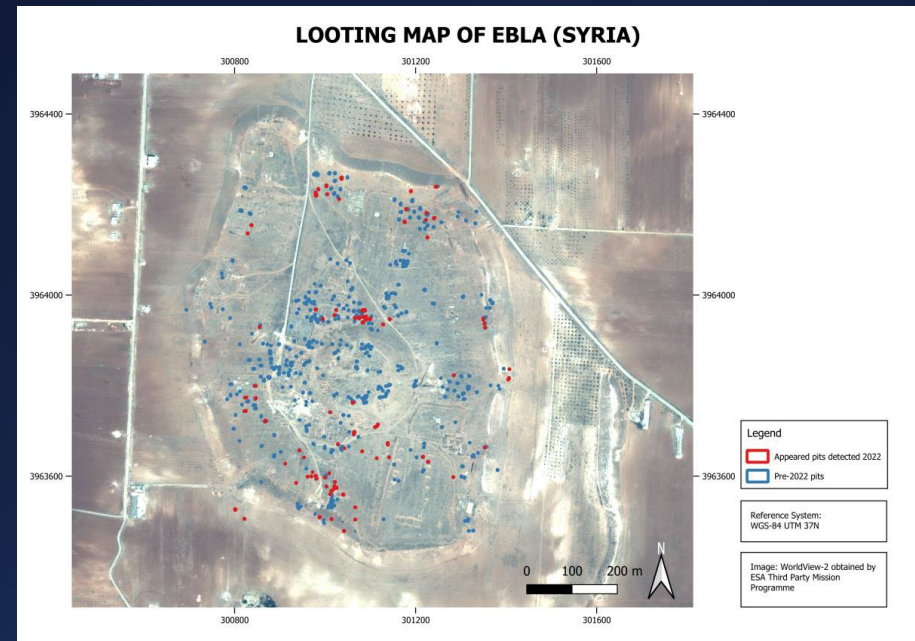
EO use to date: which applications (3)

Poaching of hidden archaeological artefacts / Illegal Looting

Aswan (Egypt) UNESCO site



Ebla (Syria) - Bronze Age archaeological UNESCO site



ANTHROPOGENIC IMPACT

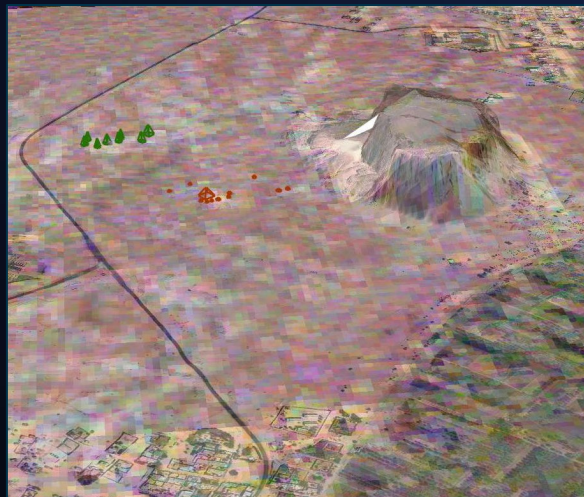
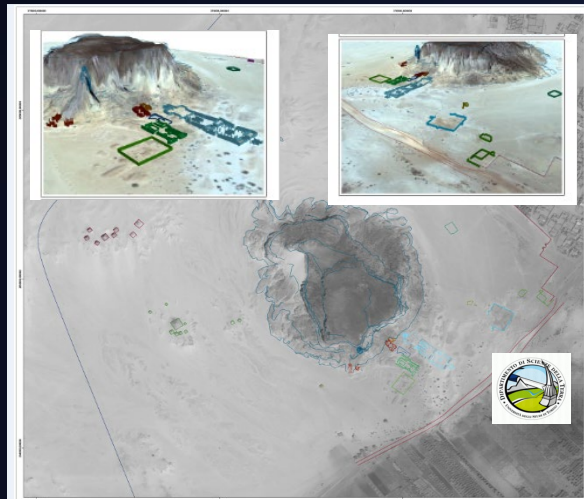
ESA –Open Call Project ALCEO



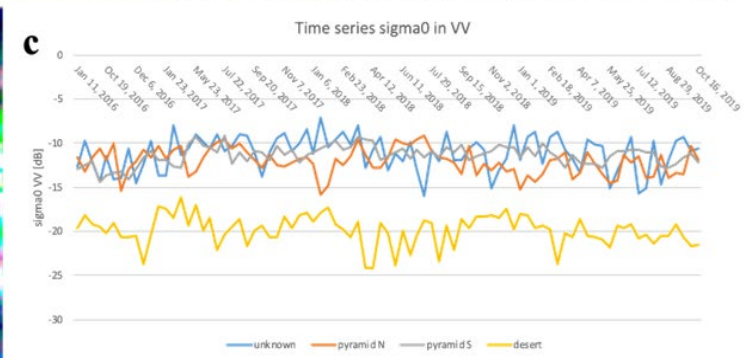
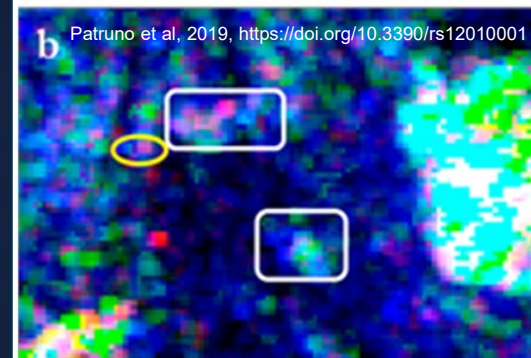
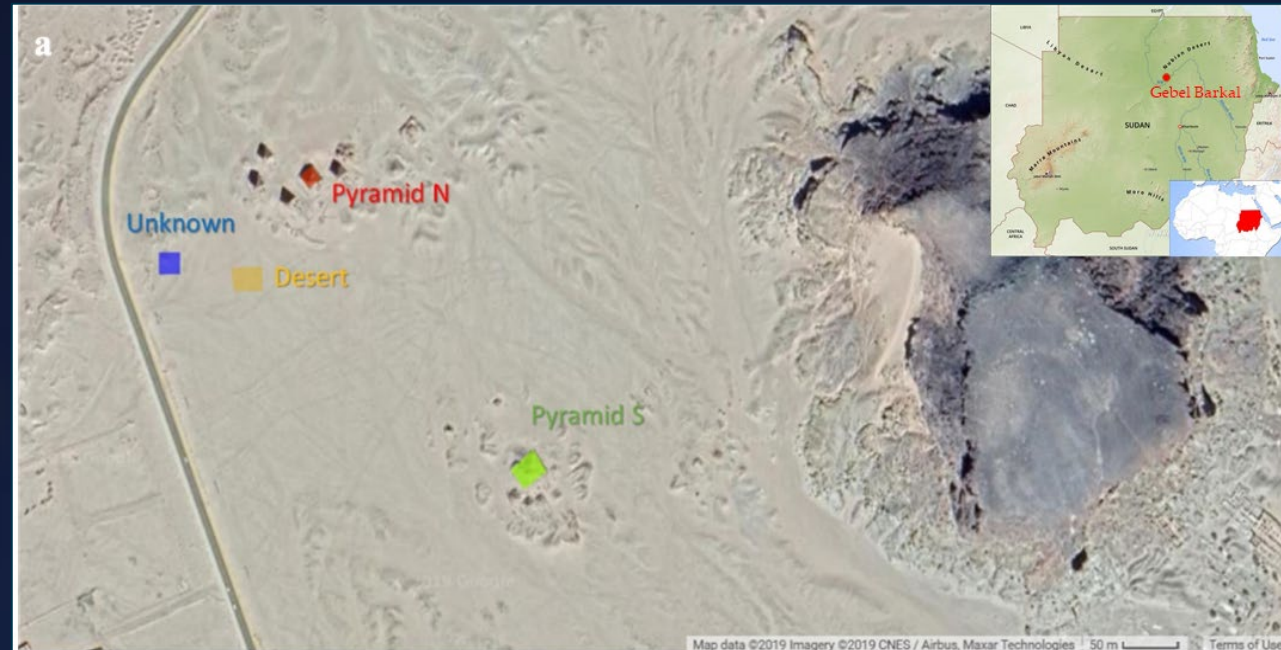
EO use to date: which applications (4)

SITES MONITORING/DETECTION

- 3D rendering of existing structures
- Integration of multiple data sources (GIS)
- Cartography from Satellite data
- Polarimetric SAR multi-frequency analysis and SAR backscatter anomalies detection in dry environments



UNESCO site of Gebel Barkal (Sudan).



Disaster Risk Management and CH

NATURAL IMPACT



<https://www.lagazzettadelmezzogiorno.it/news/matera/1189257/matera-allerta-maltempo-per-domenica-comune-massima-prudenza.html>



<https://puglia.gazzettadelsud.it/articoli/cronaca/2022/08/06/grosso-incendio-a-castel-del-monte-evacuato-il-maniero-e-le-abitazioni-vicine-3b809cd3-3d81-49bf-b109-15251a7d368b/>



<https://www.fondoambiente.it/luoghi/grotte-di-nerone?ldc>



<https://www.lastampa.it/cronaca/2014/03/03/news/a-pompei-il-terzo-crollo-in-48-ore-1.35773118>

ESA supports the Multilateral Environments Agreements



Convention on Biological Diversity (CBD)

Post 2020 Global Biodiversity Framework (GBF)



At least 30% of global land and sea areas conserved through effective, equitably managed, ecologically representative and well-connected systems of protected areas (and other effective conservation measures)

Sustainable Development Goals (SDGs)

6 CLEAN WATER AND SANITATION

SDG Target 6.6

Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

14 LIFE BELOW WATER

SDG Target 14.2

Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts.

15 LIFE ON LAND

SDG Target 15.1

Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services.

Ramsar Convention on Wetlands

Ramsar Strategic Plan (2016 – 2024)

Conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.

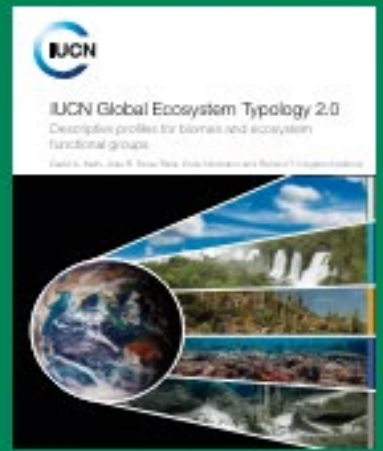
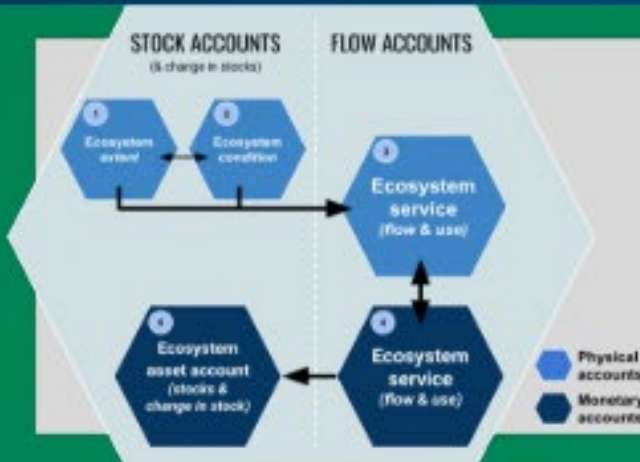


SEEA Ecosystem Accounting

New international standard on Ecosystem Accounting which regulate the production on statistical accounts on ecosystem extent, condition and services.

Measurement framework underpinning the development of monitoring frameworks of other MEA, such as the CBD post-2020 GBF, the Ramsar Convention on Wetlands, and the 2030 Agenda on Sustainable Development.

System of Environmental-Economic Accounting Ecosystem Accounting



How the pandemic affected the CH fruition



THE WAY FORWARD

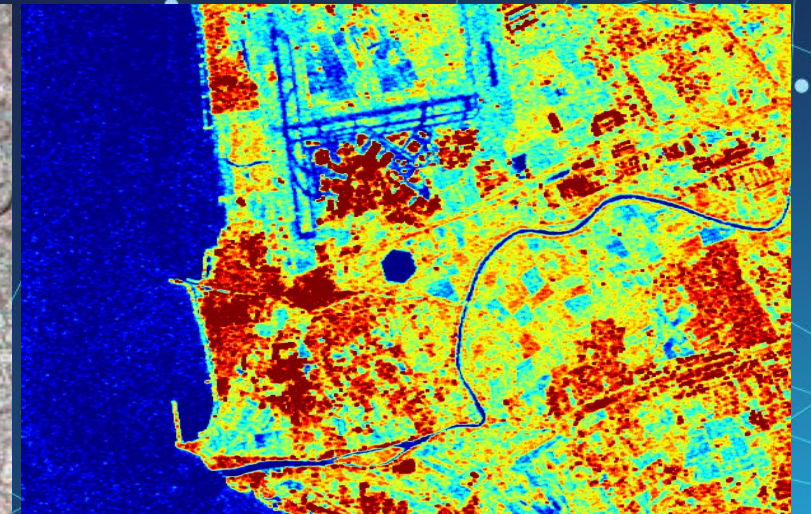
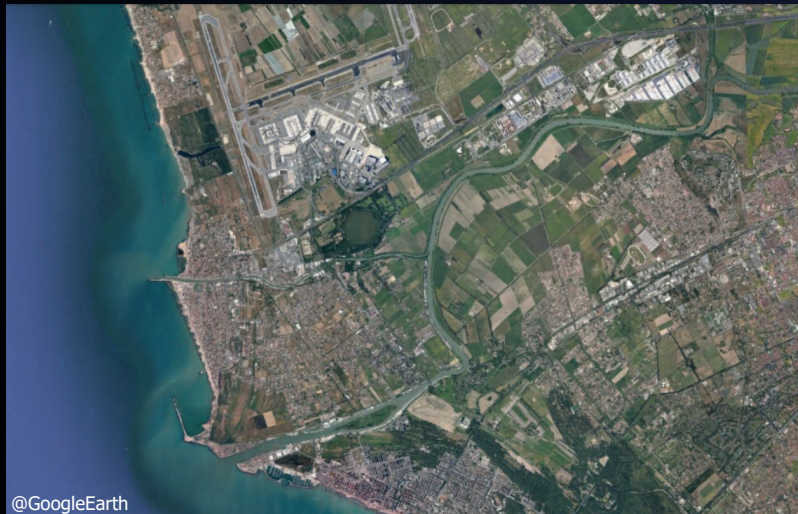


Privilege
PREVENTIVE ACTIONS
VS
REACTIVE ACTIONS

<https://earth.esa.int/eogateway/missions/skysat>

Recommendation for a way forward

- Enhance communication and foster synergies between EO experts and cultural heritage community to develop effective valorization plans.
- Provide user-ready products that bridge the gap between data providers and end-users, such as site managers.
- Support the development of processes and practices that integrate technology with cultural heritage management



@GoogleEarth

Harbor of Trajan in the first Sentinel-1 acquisition over Rome. @Copernicus Sentinel-1 data (2014) processed by Dr. J. Patruno

Future EO –Open Call for EO Innovation



Scope of new Call:

Open call Framework to:

- rapidly respond to new innovative ideas
- maximize opportunities for industry and science.
- core of activity is EO data exploitation and Innovation

Implementation

- Innovative Regular project
- Smaller, more rapid actions (eg earlier levels of maturity)
- 3 Submission batches per year
- Rapid communication to unsuccessful bidders debriefing

Financial aspects: 100% of funds covered

- Innovative Regular projects – max value 200k Euro
- Rapid verification and testing – max value is 100k Euro
- No need to submit letters from the national delegation
- INFO: eo4society page and ESA-STAR (ITT 6-60008)



ESA EO Resources and tools



Network of Resources (platform of platforms):

A lot of ESA resources are free to download and/or use, but for the ones that are not, students, teachers, and researchers can request ESA sponsorship (full cost) of their use through the Network of Resources.

Can save you a lot of money and give you access to professional EO processing tools and cloud computing capabilities! On these slides **Green = free**, **red = request sponsorship**



Data access and processing/analysis platforms:

MAAP (ESA/NASA platform for BIOMASS/NISAR exploitation)

DeepESDL (earth system science cloud platform + AI integration)

OpenEO Platform (Cloud based platform for level 1 + 2 data, similar to Google Earth Engine)

Copernicus Browser (free + easy in-browser Sentinel data analysis (time-series, spectral analysis, custom band visualizations, and more) + 3)

EO processing software:

SNAP (for Sentinel data processing), **PoISARPRO** (for Polarimetric data processing) + python implementation of these **EARTH-CODE** (Open science/open data/open-source solution for ESA scientific activities. Single infrastructure for better storage, discoverability and reproducibility, documentation + code for ESA-funded scientific work under open science principles).



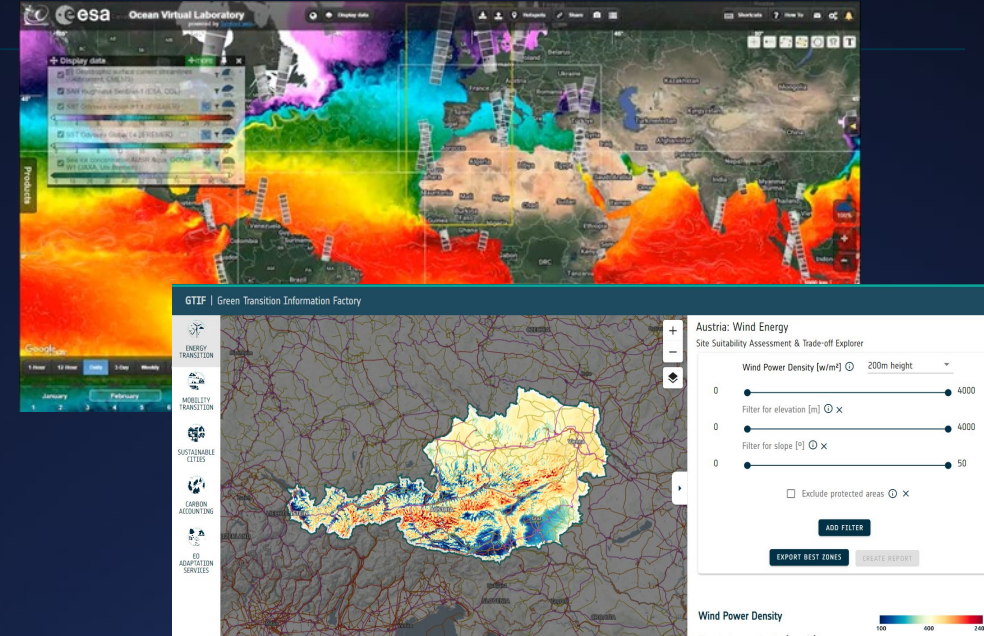
ESA EO Training courses + more tools



[EO4Society](#) (full training calendar and material repository)

Some upcoming Activities:

- Joint DLR/ESA online PolInSAR webinar series (April – July 2024)
- ESRIN Workshop on Superresolution (May 2024)
- ESRIN EC JRC Workshop on Environmental Crimes (June 2024)
- ESA/DLR/ASI/NASA Joint training on hyperspectral RS (October 2024)
- SELPER Mexico training on natural disasters (November 2024)
- ESA/CONAE SAOCOM PoISAR training (Q4 2024)
- ESA/ISRO PoISAR and InSAR trainings (Q4 2024)



[EO College MOOCs](#) (free online courses with practical trainings – equivalent to doing remote sensing intro courses at uni!)

Land Applications, SAR (Echoes in Space), Cloud computing, Zero Hunger

Other tools and websites!:

[Open Science Catalog](#) (250+ datasets and EO Data collections to use for free from ESA research covering (almost) every topic)

Virtual Labs: (specialised tools and data divided by topic): [Atmosphere](#), [Ocean](#), [Cryosphere](#), [Agriculture](#)

ESA [WorldCereal](#) and [WorldCover](#): free 10m resolution world-wide landcover products (Cereal is dedicated to just grains)

[Green Transition Information Factory](#): EO data visualisations for green economy transition (energy, mobility, carbon, etc.)

Being rolled out over Europe. Great for sustainability projects!



Thank you!

www.eo4society.esa.int
www.esa.int

COSMO Second Generation © ASI

