Meteorological Missions

Meteosat SG

MetOp

Meteosat TG
MTG-I1 2022

MetOp SG
2025

Arctic Weather Satellite

Current Systems

Next Generation Systems

ESA-Developed Earth Observation Missions
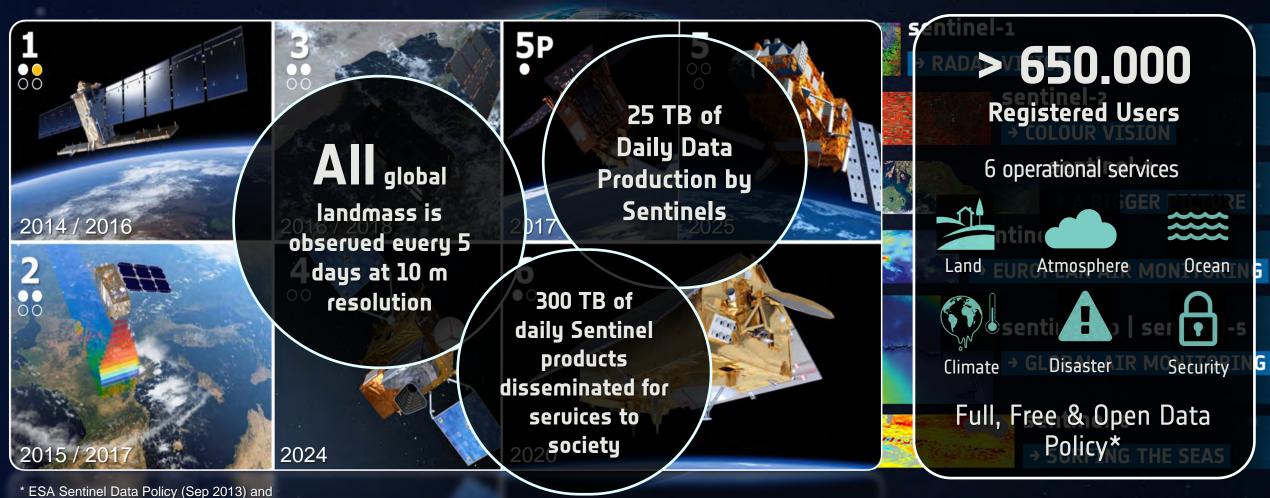
The Copernicus Space Component – Sentinels

Copernicus is the largest producer of EO data in the world

All global landmass is observed every 5 days at 10 m resolution

25 TB of Daily Data Production by Sentinels

300 TB of daily Sentinel products disseminated for services to society

1 — 2014 / 2016
2 — 2015 / 2017
3 — 2016 / 2018
4 — 2024
5P — 2017
5 — 2025
6 — 2020

> **650.000 Registered Users**

6 operational services

Land
Atmosphere
Ocean
Climate
Disaster
Security

Full, Free & Open Data Policy*

* ESA Sentinel Data Policy (Sep 2013) and
EU Delegated Act on Copernicus Data and Information Policy (Dec 2013)

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Φ-lab-powered satellites and constellations

FFSCAT / Φ-sat1

First IOD with GPU and AI model for EO with miniaturised hyperspectral

UBOTICA (IE) | COSINE (NL)

Launch : 2020

Φ-sat2

Pushing agility with easy deployment/update of AI

Open Cosmos (UK)

Launch : 2024

Wild Ride

IOD with in-orbit Rapid Flood Mapping

D-Orbit (IT/UK)
UNIBAP (SE) | FDL (UK)

Launch : 2021

Dashing Through the Stars

IOD with first-ever onboard training of AI model for EO

D-Orbit (IT/UK)
UNIBAP (SE) | FDL (UK)

Launch : 2022

Intuition-1

Optimized AI pipeline from raw data, with ground/onboard continual learning

KpLabs (PL)

Launch : 2023

Progres.LU

Polarimetric radio-occultation mission

SPIRE (LU)

Launch : 2023

OroraFire

Thermal IR constellation for wildfire detection

OroraTech (DE)

Launch : 2024

MicroLidar

Greenhouse-gas detection

AIRMO (DE)

Launch : 2025

MSCM

MultiSpectral companion mission of Sentinel-2

Aerospacelab (BE)

Launch : 2024

AI EXPRESS

HPC and AI in-orbit platform

Planetek (IT)

Launch : 2024

MANTIS

Constellation of VHR MS satellites

Open-Cosmos (UK)

Launched : 2023
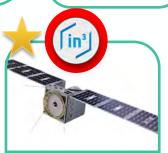
SAT4EOCE

VHR MS payload w/ TDI on CMOS detector, AOCS

DEIMOS (ES)
SSTL (UK) | Te2v (UK)

Launch : 2024

HIVE

Thermal IR constellation for agro-industry

Constllr (DE)

Launch : 2024

Hyperfield

Highly integrated satellite combining HYP and AI/ML-based analytics

Kuva Space (FI)

Launch : 2024

⭐ Fully Φ-lab supported   by Φ-lab Explore Office   by InCubed

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Earth Observation at ESA: Programmatics of Latest Financing Cycle

FutureEO

Many opportunities in all down- and upstream aspects of missions, bringing together science and applications

Copernicus

Sentinel Next Generation

Multiple opportunities for payload

Digital Twin Earth

Incubed-2

InCubed
Commercial EO

Meteorology
Aeolus-2

TRUTHS

Climate-Space

Basic Activities

EARTHNET
third party missions
international presence
international charter space & major disasters

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ESA Climate Change Initiative: Climate Space

21 Essential Climate Variabe (ECV) Being Monitored
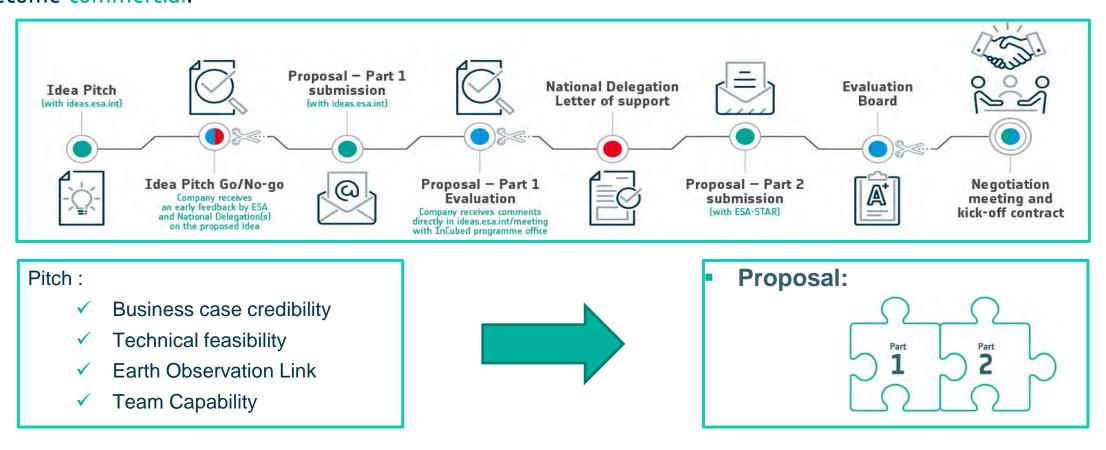
- CCI is a response to UNFCCC's need for systematic global climate observation

- ECV datasets provide long-term empirical evidence to predict & understand key parts of the climate

- 54 defined ECVs, 36 monitored from space, 21 under development by ESA

climate modelling user group
cci

sea level budget closure
cci

reccap-2
cci

Our InCubed Programme

InCubed: programme to provide funding (co-funding) and technical expertise to industry to develop upstream and downstream Earth Observation-related products and services, which a strong potential to become commercial.

Pitch :
- ✓ Business case credibility
- ✓ Technical feasibility
- ✓ Earth Observation Link
- ✓ Team Capability

Proposal:

SPACE FOR A GREEN FUTURE ACCELERATOR

esa

Space bends the Curve

- **Co-governed & independent non-profit partnership of Green Transition actors**
- Engaging governments, businesses, multilateral institutions, civil society groups, end users and citizens
- Developing practical space-based solutions supporting Carbon Neutrality and greening of society by 2050.
- Partnering with stakeholders and users, aggregating the priorities of Green Transition sectors and seed solutions that address real needs.
- Accelerating the use of space by mobilizing resources and scaling solutions to full sectorial and global levels.

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Green Transition Information Factories (GTIF)

ENABLE INSIGHTS: Demonstrate added value of EO and digital technologies for addressing the information needs of the Green Transition and the European Green Deal.

ACTIONABLE INFORMATION: enable users (e.g., citizens, policy makers, industry professionals) better understand related challenges and opportunities & join the public debate.

DEDICATED CAPABILITIES: value-added products, indicators & interactive tools, reproducible workflows.

Initial focus on set of 5 Green Transition **PRIORITY DOMAINS**:

ENERGY TRANSITION   **MOBILITY TRANSITION**   **SUSTAINABLE CITIES**   **CARBON ACCOUNTING**   **EO ADAPTION SERVICES**

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ENERGY TRANSITION MOBILITY TRANSITION SUSTAINABLE CITIES CARBON ACCOUNTING EO ADAPTION SERVICES

ECO

ECO

Green Transition Information Factory
Demonstrator for Austria

https://gtif.esa.int/

EO for Energy

Typical Energy-Related Scenarios Where EO Can Support

Renewable energy resource mapping, by providing detailed and long-term statistics on solar irradiance, wind speed and direction, runoff due to snow cover, geothermal anomalies, biomass crops, etc.

Energy demand characterisation, by mapping settlements, important public infrastructure, potential irrigation areas and other indicators of high electricity consumption economic activity.

Production and transmission infrastructure site selection, by combining resource information with information on the local or regional environment, existing land and infrastructure characteristics, natural hazards, etc.

Production and transmission infrastructure construction monitoring, by repeated observation techniques at regular intervals.

Creating inventories of existing energy infrastructure, by mapping features such as HV (high-voltage) and, more importantly MV (medium-voltage) and LV (low-voltage) power infrastructure and networks, etc. Monitoring of electrification progress.

Managing energy production operations, by providing information on available and/or forecasted biomass crops, available solid fuel in the form of waste accumulated at managed waste sites, extreme weather events that would cause significant variations in the expected energy demand, etc.

Assessing energy infrastructure vulnerability by estimating climate and disaster risks (floods, landslides, erosion, etc.), and by monitoring external threats such as human and natural (vegetation) encroachment on transmission lines, etc.
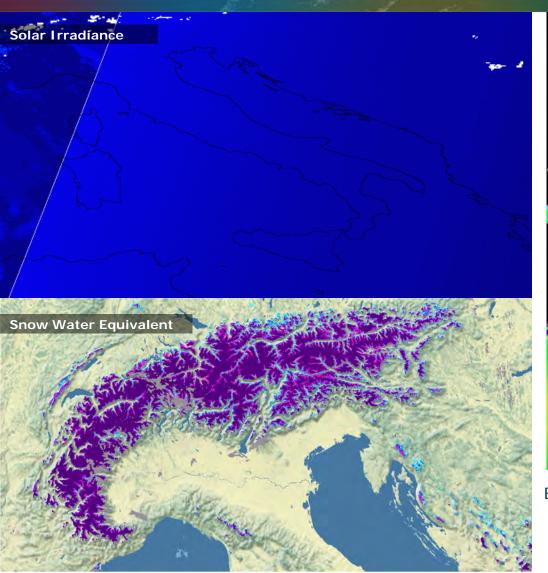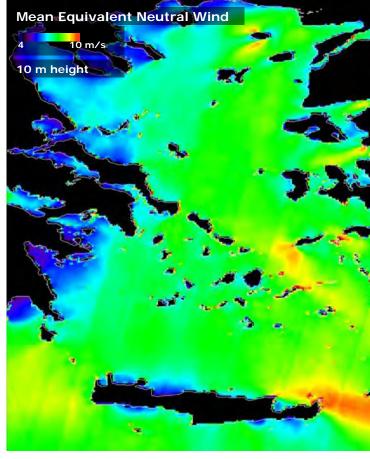
EO Products for Renewable Energy

	Marine	Wind	Hydro	Solar	Biomass	Storage	Electrification
Wave/current/tide resource data	●	●					
Offshore wind speed and direction resource data	●	●					
Snow cover extent			●	●			
General land cover type and change			●	●	●	●	●
Digital Elevation Models		●	●	●		●	●
Soil moisture, precipitation			●		●		
Infrastructure and ground stability indicators (displacement rates, etc.)		●	●	●		●	●
River and lake parameters			●				
Solar irradiance				●			
Land surface temperature				●	●		
Atmospheric composition (aerosols)				●			
NRT parameters as input to mesoscale modelling/forecasting	●	●	●	●	●		
Basic mapping (proxies of electricity demand)							●

Renewable Energy Resource Assessment

Solar Irradiance

Snow Water Equivalent

Mean Equivalent Neutral Wind

4   10 m/s

10 m height

Biomass Potential

Example: EO feeding into:

IRENA — International Renewable Energy Agency

Global Atlas — FOR RENEWABLE ENERGY

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Renewable Energy Resource Assessment

Cloud cover statistics

Land use & land cover

Solar potential

Building/rooftop extraction

Rooftop solar potential
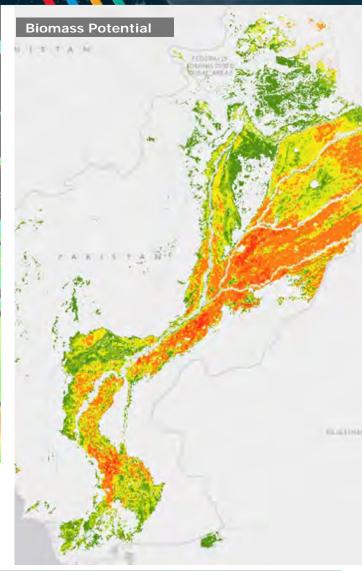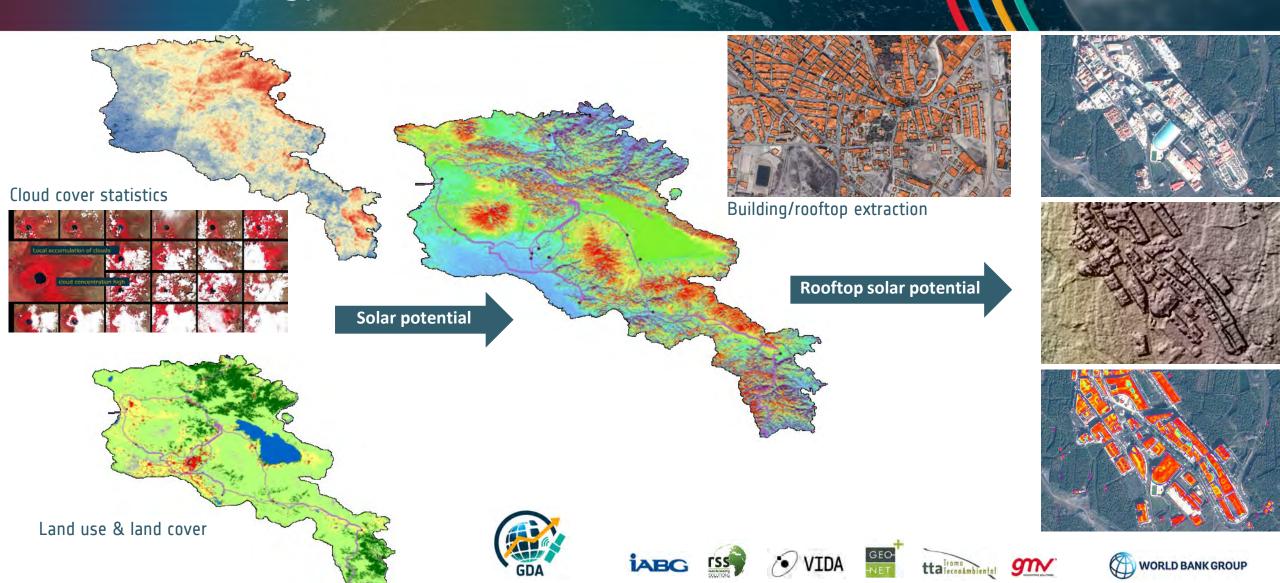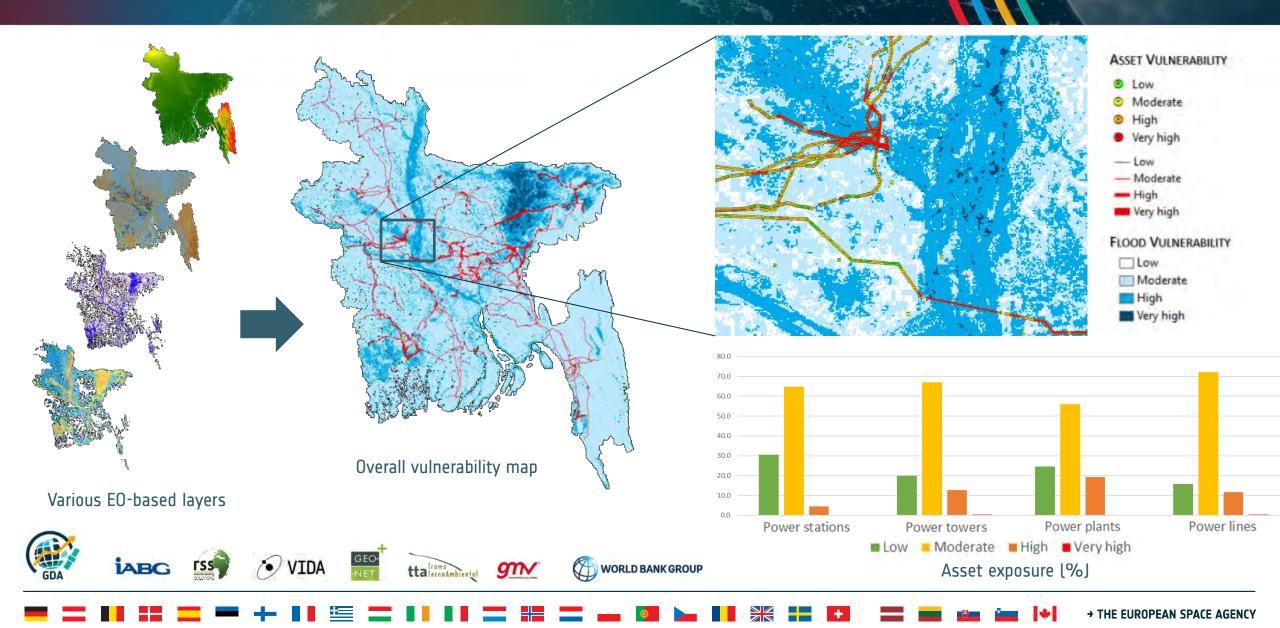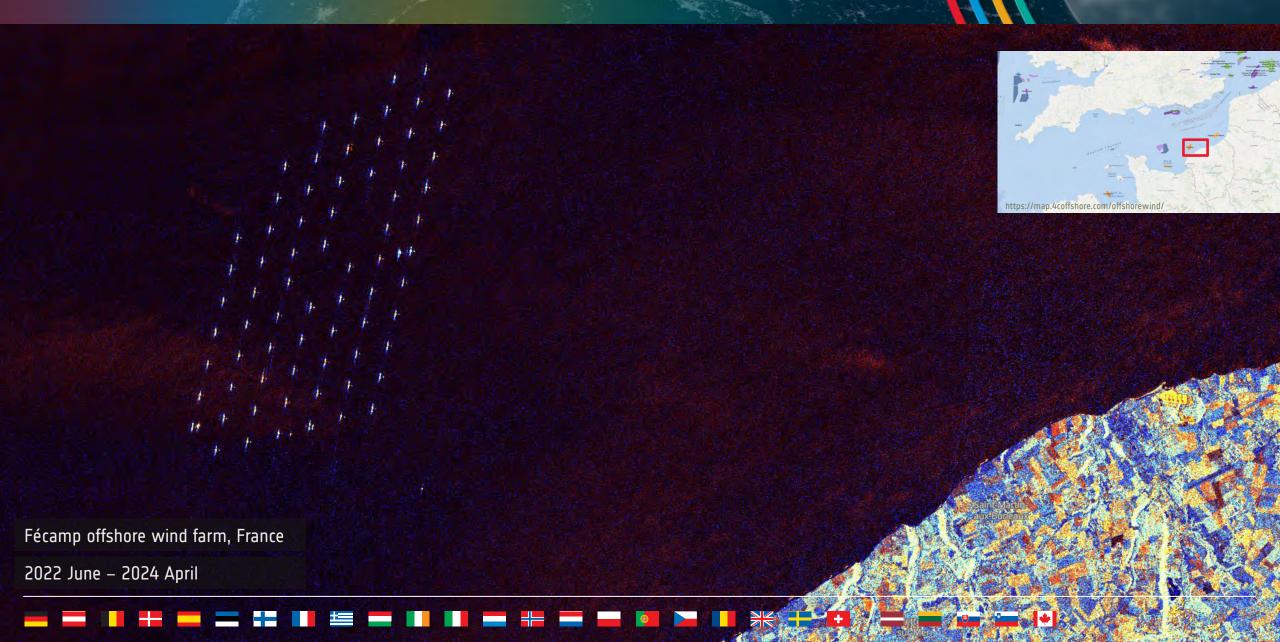
Example: Network Vulnerability to Flooding, Bangladesh

Various EO-based layers

Overall vulnerability map

ASSET VULNERABILITY
- 🟢 Low
- 🟡 Moderate
- 🟠 High
- 🔴 Very high

- ─── Low
- ─── Moderate
- ━━━ High
- ━━━ Very high

FLOOD VULNERABILITY
- ⬜ Low
- 🟦 Moderate
- 🟦 High
- 🟦 Very high

Asset exposure (%)

Low · Moderate · High · Very high
Power stations · Power towers · Power plants · Power lines

https://map.4coffshore.com/offshorewind/

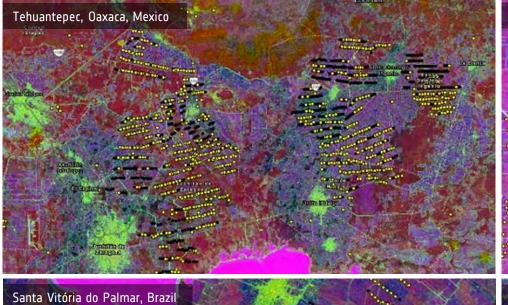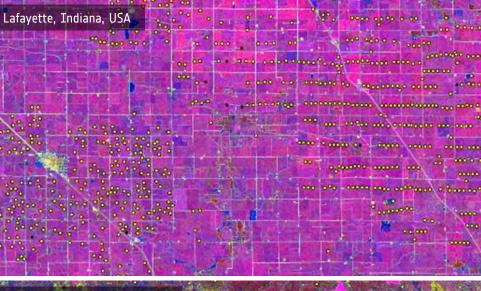Fécamp offshore wind farm, France

2022 June – 2024 April
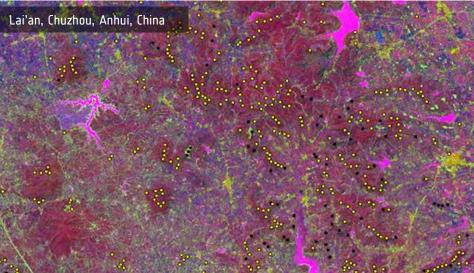
Example: Global Inventory of Wind Turbines

Using advanced object detection Machine Learning methods for fully automatic global detection of relevant infrastructure based on free and open imagery.

DLR

- Reference data
- Faster R-CNN results

Tehuantepec, Oaxaca, Mexico

Lafayette, Indiana, USA

Santa Vitória do Palmar, Brazil

Lai'an, Chuzhou, Anhui, China

MAKE SPACE FOR EUROPE

www.esa.int

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