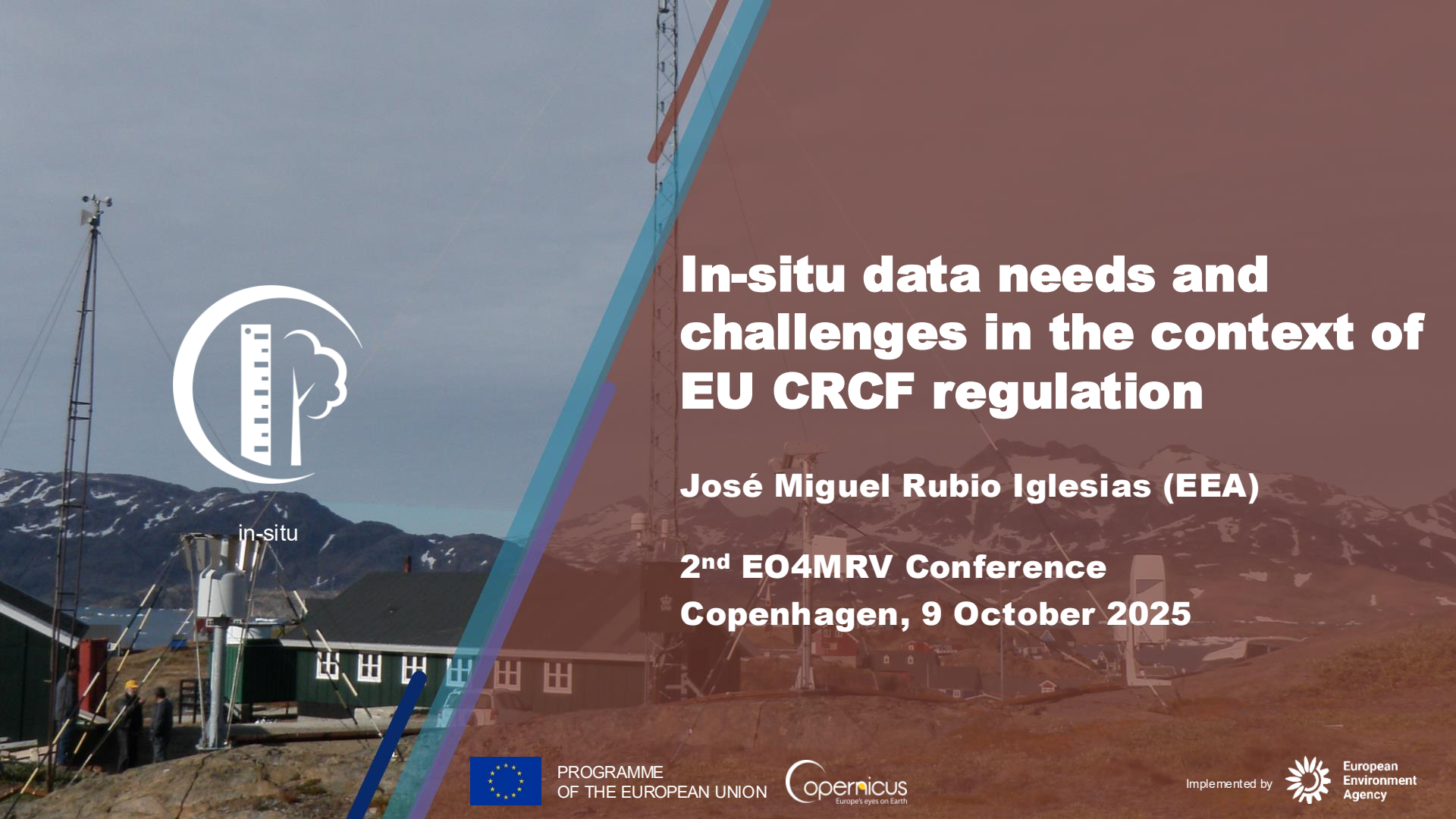

in-situ

In-situ data needs and challenges in the context of EU CRCF regulation

José Miguel Rubio Iglesias (EEA)

2nd EO4MRV Conference
Copenhagen, 9 October 2025

PROGRAMME
OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

Implemented by European Environment Agency

In-situ data in EO applications

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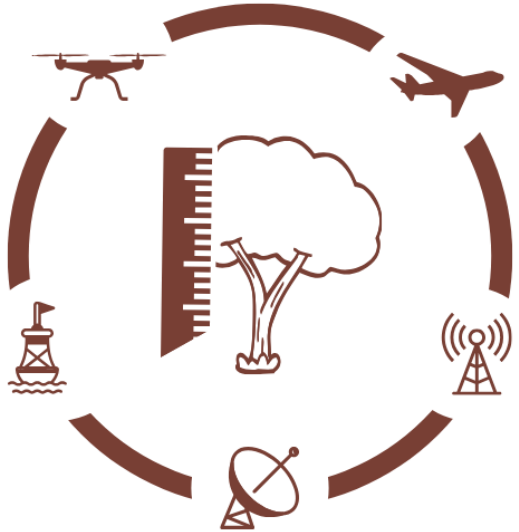
In-situ data are **observations** - ground-based, airborne, seaborne -, **reference** and **ancillary data** provided for their use in EO applications [1]

In-situ data are essential for, i.a.:

- **Calibrating and validating** satellite sensors and their products
- **Enriching** data and information to improve accuracy, consistency and reliability
- Developing, training and improving **algorithms**
- Running **models**
- Adding information **not accessible from space**
- Providing a **geographical framework**/reference for EO products



[1] As defined in the EU Space Regulation (for Copernicus)

Where does in-situ data come from?

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European and national institutions and networks

International organisations and networks

Collaboration with in-situ data providers is essential!

Research, academia and private companies

Copernicus In-Situ Component

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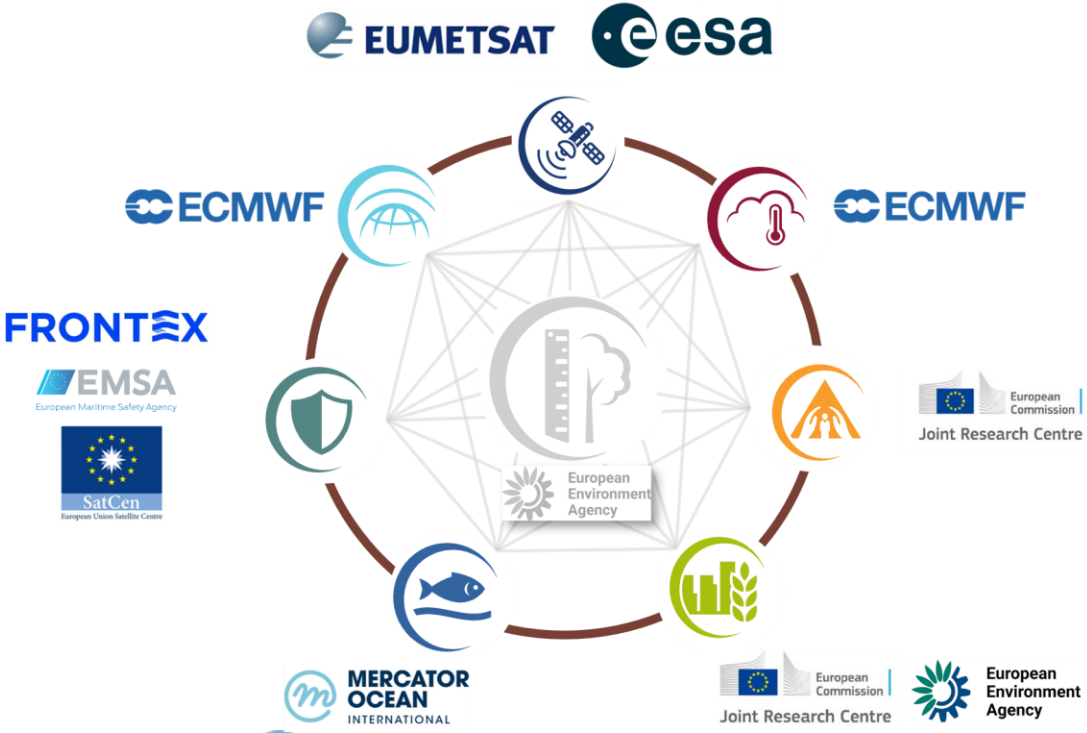
Copernicus In-Situ Component: **ground-based, air and sea borne monitoring systems**, **geospatial and ancillary data** licensed or provided for their use by **Copernicus**



The **Entrusted Entities** manage and use in-situ data daily to meet their operational needs.

Copernicus In-Situ Component

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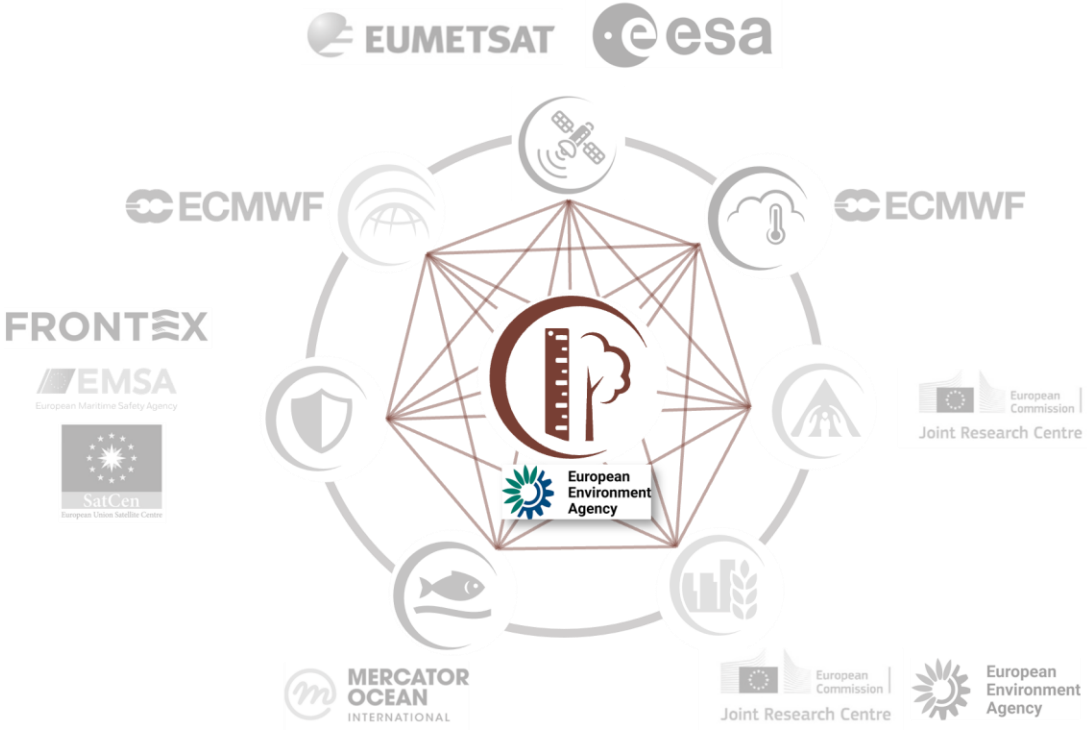
Copernicus In-Situ Component: **ground-based, air and sea borne monitoring systems**, **geospatial and ancillary data** licensed or provided for their use by **Copernicus**



The **EEA** steps in when a coordinated, programmatic approach is needed across Copernicus.

EEA Copernicus In-Situ activities (2021-2028)

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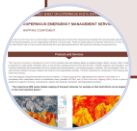
State of Play

- State of Play report
- CIS²
- In-Situ Strategy (2028-2034)



Support and Advice

- In-Situ Working groups
  - Reports, inventories
  - GEO, R&D

Data Access

- CORDA
- Pilot activities
- Specific in-situ data requests

Engaging with data providers

- Licensing agreements
- Partnerships
- Use Cases

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

Implemented by European Environment Agency

In-situ in EO & EU CRCF regulation

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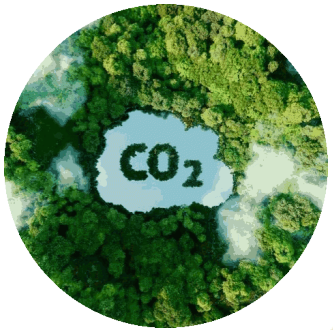
EO-based MRV combines satellite observations with in-situ data from local, national and European institutions and networks

In-situ data…

- …enable calibration, (independent) validation, and model assimilation for EO-based MRV
- …provide the ground truth ensuring accuracy and compliance with QU.A.L.ITY criteria
- …support the entire CRCF chain – from operators to the EU registry
- …are integral part of Copernicus services and other EO-based applications



In-situ data is foundational for EO-based MRV under the EU CRCF

In-situ needs for EO applications supporting EU CRCF (I)

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Domain	Data needed	Exemplary data providers & networks	Use in EO-applications for CRCF
Atmospheric GHG Monitoring	• CO_2, CH_4, N_2O concentrations (surface & column) • Vertical profiles & flux measurements • Meteorological parameters (wind, temperature, pressure)	• ICOS Atmosphere • WMO-GAW • TCCON • EUMETNET, National Met Services • Research institutions (flux towers)	• Use for Cal/Val of EO GHG retrievals and models • Input to atmospheric inversion models estimating regional carbon fluxes • Supports detection of regional anomalies and reversal events • Contributes to L-T trend assessment & baseline estim.
Land and Soil Carbon Monitoring	• Forest biomass and structure • Soil carbon content and fluxes • LiDAR and terrestrial laser scanning data • Land-use and management information	• National Forest Inventories • LUCAS Soil Survey, ESDAC (JRC) • ICOS Ecosystem, eLTER, AnaEE • National, regional LiDAR campaigns	• Supports Cal/Val of EO-based biomass, soil and veg. products • Contributes to quantify land-based carbon stocks and fluxes • Informs EO-based assessments of LU change and ecosystem disturbance • Provides local context for CRCF MRV methodologies

In-situ needs for EO applications supporting EU CRCF (II)

in-situ

Domain	Data needed	Exemplary data providers & networks	Use in EO-applications for CRCF
Blue Carbon Monitoring*	• Biomass & extent of coastal blue carbon habitats • Surface & subsurface pCO_2, pH, alkalinity, DIC • Biogeochemical parameters	• ICOS-Ocean • Euro-Argo ERIC • EMODnet • National marine institutes • Coastal monitoring programmes	• Feeds into EO-based models of ocean carbon fluxes • Supports validation of EO-derived ocean colour and coastal ecosystem products • Contributes to monitoring of carbon uptake & reversals in marine ecosystems
Geospatial Reference and Activity data	• Land parcels, cadastral boundaries • Administrative & management data • Land-use/land-cover maps, infrastructure, ownership	• LPIS/GSAA (CAP) • National mapping and cadastral agencies • INSPIRE data infrastructures • Local land registries	• Provides spatial reference to link EO to operators and activities • Enable traceability and verification in CRCF certification and EU Carbon Removal Registry • Ensure geospatial consistency for EO-based MRV systems

*Not currently covered, but potential area of expansion

Key challenges

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Spatial, temporal and thematic gaps

- Uneven spatial coverage across EU
- Large gaps in critical domains (soil carbon, blue carbon)
- Discontinuous temporal coverage: campaign-based rather than continuous datasets

Harmonisation and standardisation

- Heterogeneous sampling methods, formats, QA/QC across MS
- Limited interoperability with Copernicus req.
- Insufficient metadata and traceability for MRV/certification

Coordination, governance, data access

- Fragmented responsibilities (MS, EU, research infr.)
- Uneven data access and sharing rules
- Some data are sensitive/restricted (privacy)
- Need to balance GDPR, open data and commercial confidentiality

Sustainability and long-term support

- Many networks rely on research/project-based funding
- Institutional fragmentation → uncertain responsibilities
- Capacity disparities across MS
- Technological obsolescence

Conclusion

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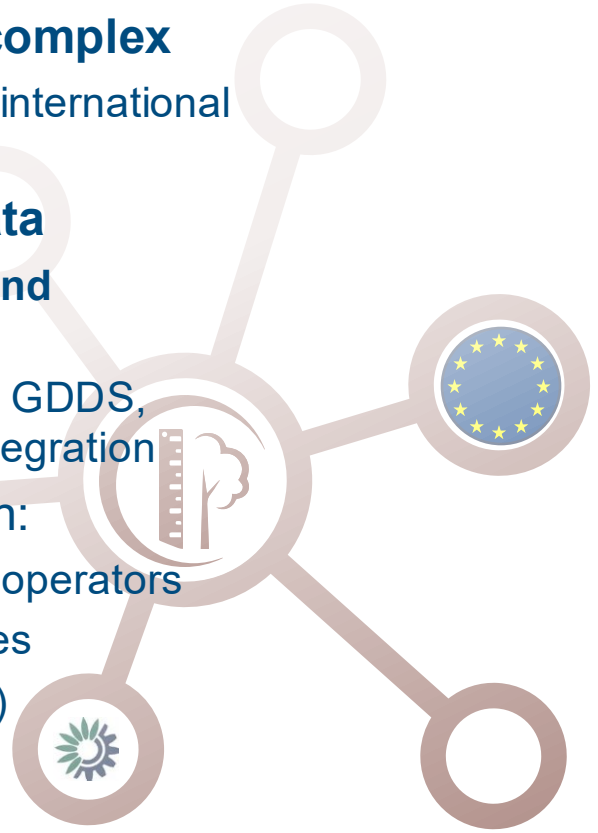
- The in-situ data landscape is **multi-layered and complex**
  - Includes research infrastructures, public authorities, international networks and private and commercial actors
- EO-based MRV for CRCF **depends on in-situ data**
  - Yet in-situ systems face **technical, sustainability, and governance challenges**
  - **BUT opportunities** lie ahead: HVD implementation, GDDS, DestinE, new technologies, AI, closer Copernicus integration
- As **Copernicus In-Situ Coordinator**, the EEA can:
  - **Act as a broker** between data providers and CRCF operators
  - **Promote** in-situ harmonisation across Member States
  - **Identify** in-situ data gaps (spatial, temporal, domain)
  - **Advocate** sustainability of key in-situ networks



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insitu.copernicus.eu

copernicus.insitu@eea.europa.eu