European ground-based Research Infrastructures building future Earth Observation capabilities

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Research Infrastructures

- Facilities, resources and related services provided mainly for the scientific community to conduct high quality research
- Highly coordinated and managed (own legal entities)
- Provide open access (on data and facilities)
- Long-term funding (not projects)
- RIs may be single-sited, distributed and/or virtual

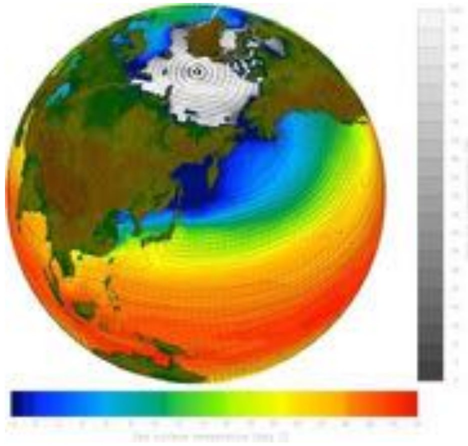


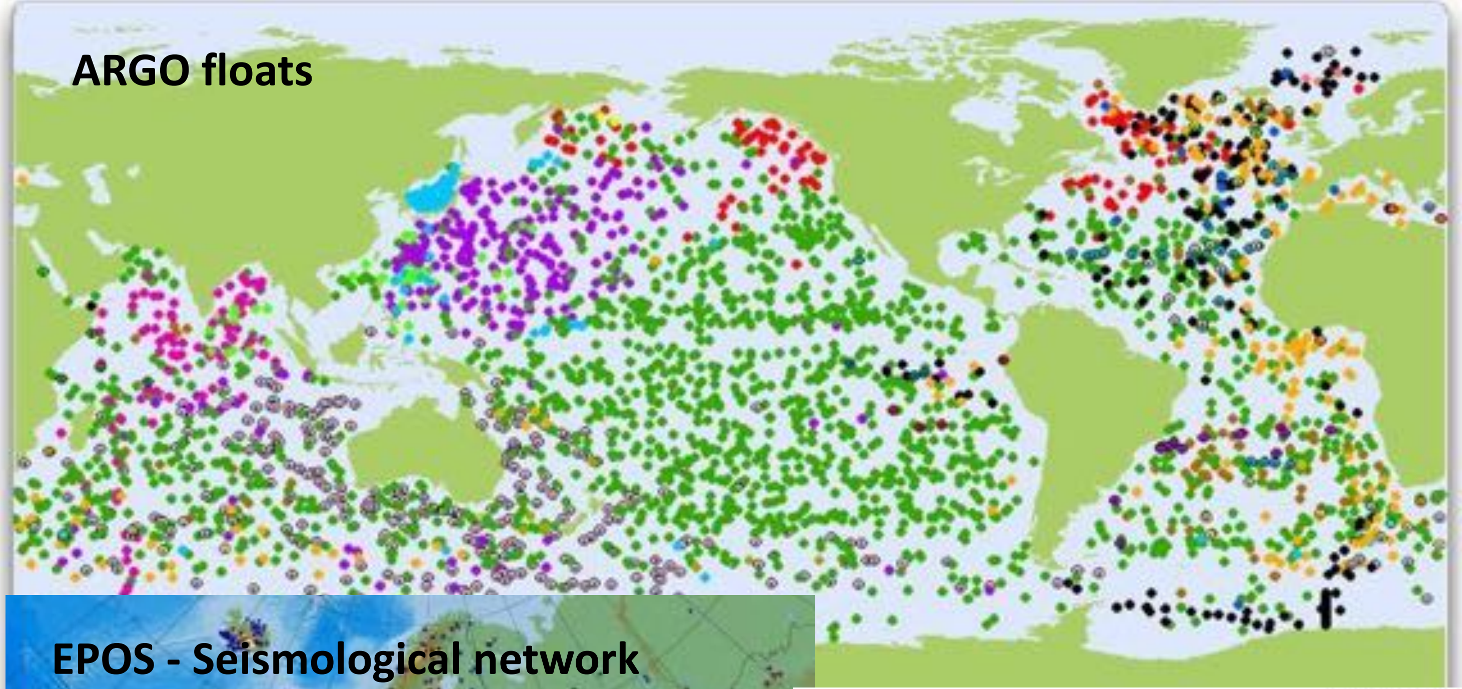

European Environmental Research Infrastructures

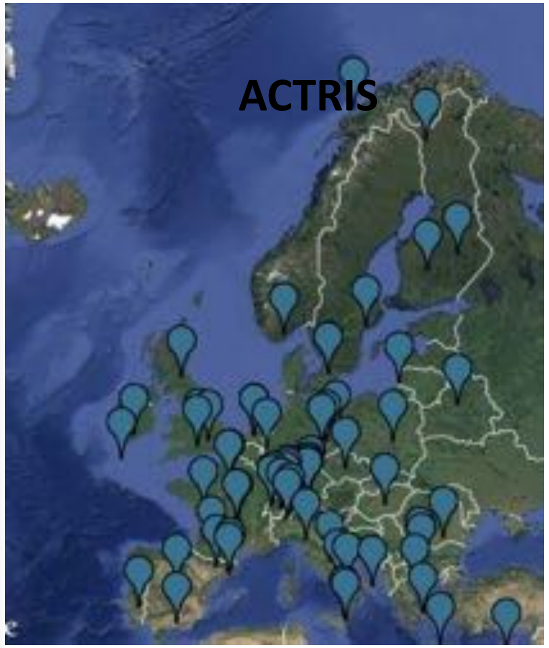
Construction costs over 1 billion €, annual operational costs around 150 M€

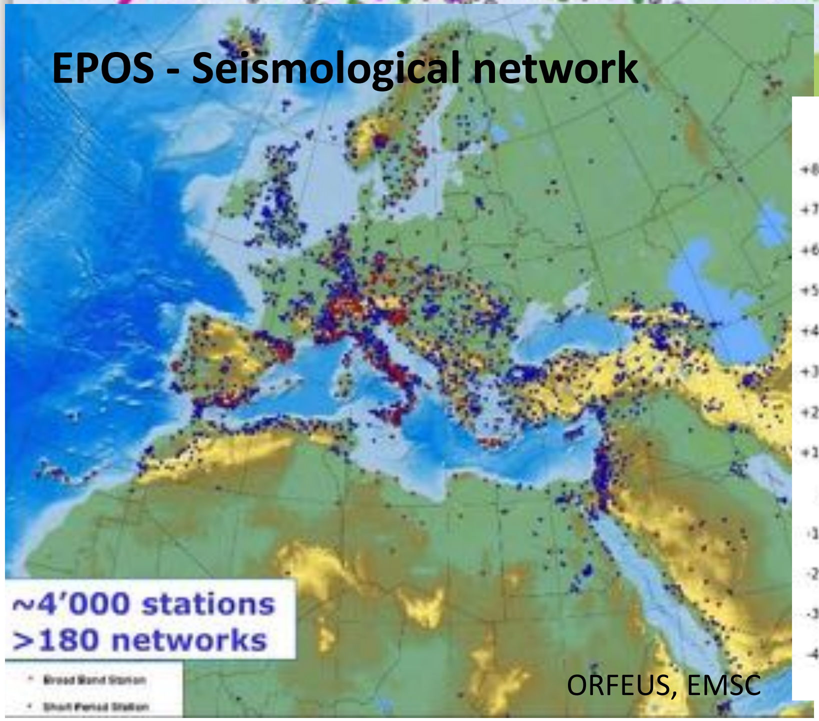
RIs have different maturity level (planning, construction, operational)

Observations – Experiments – Models – e-infras




ARGO floats


ACTRIS


EPOS - Seismological network
~4'000 stations
>180 networks
ORFEUS, EMSC


IAGOS
7032 flights since July 2011 - Status 12/10/2015
Airlines
AIRFRANCE
CATHAY PACIFIC
CHINA AIRLINES
IBERIA
LUFTHANSA

A European Community of Environmental Research Infrastructures supporting the Global Earth System Science

ENVRI community

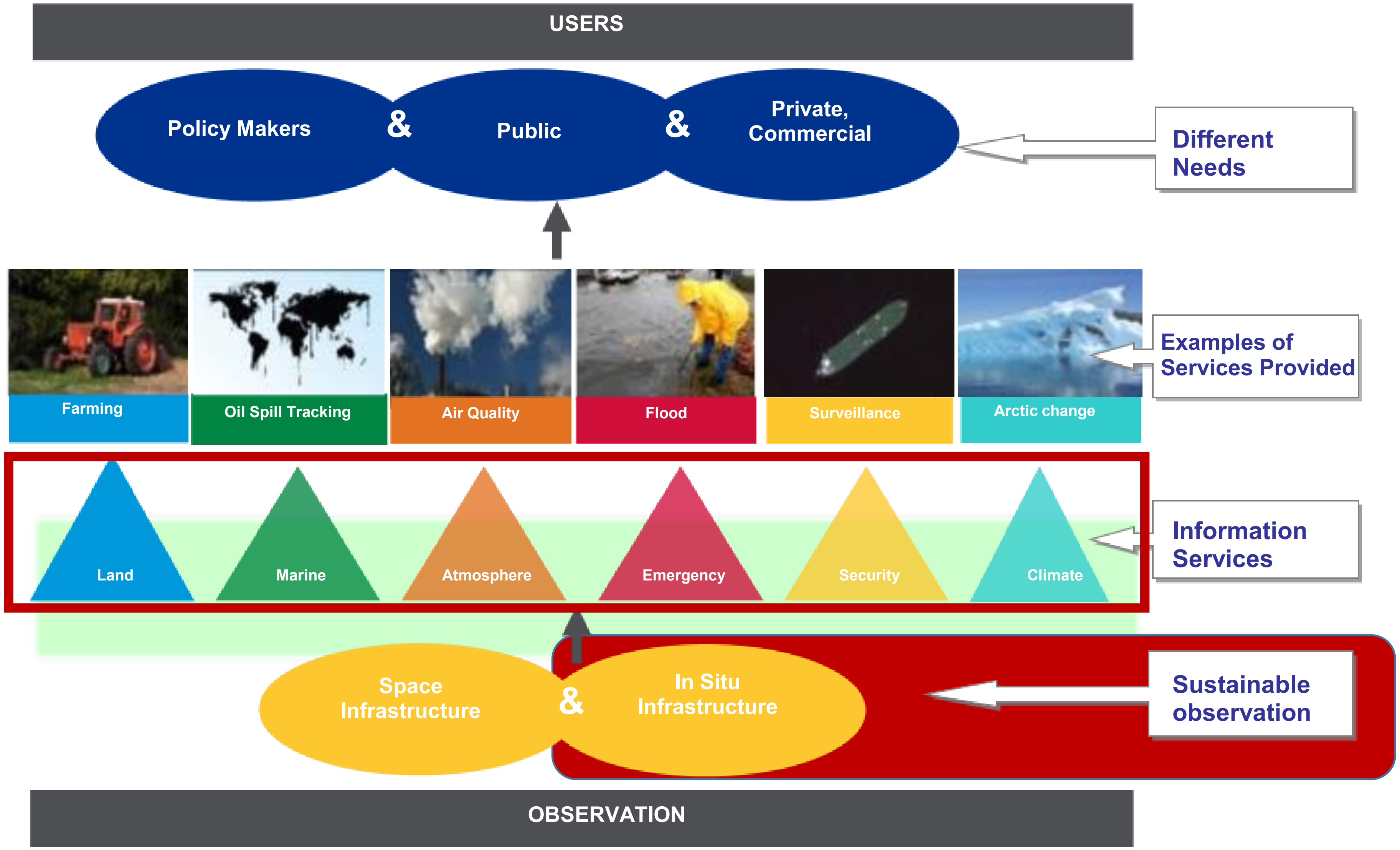
Studying the environment today
to solve the challenges of tomorrow
- the Earth is our lab

Environmental Research Infrastructures contribute environmental & societal challenges and sustainable development goals

European Environmental Research Infrastructures

- Ground-based infrastructures are important data providers for Earth observations
- Changing from loose networks to highly managed institutional research infrastructures
- Environmental research infrastructures work together (ENVRI cluster)
- Essential collaboration with remote sensing and modelling communities
- ENV research infrastructures provide sustainable e-infrastructure solutions to support Open Science
- EO framework is important for ENVRI, working and collaborating closely with satellite communities, Copernicus and GEO activities.

OBSERVATIONS – BACKBONE OF THE SERVICES



ENVRI community is contributing to build a EO framework where policies, standards, protocols, technical solutions, and services are worked together with other EO communities and service providers.

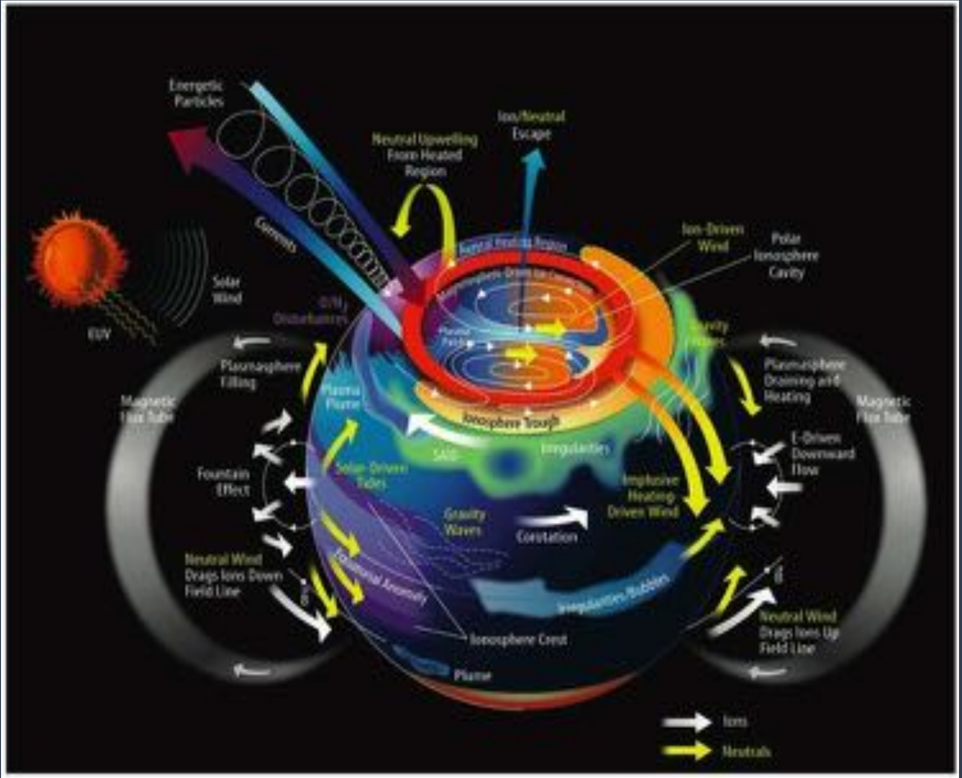
EISCAT – European Incoherent Scatter Facility

OBSERVING THE NEAR-EARTH SPACE ENVIRONMENT

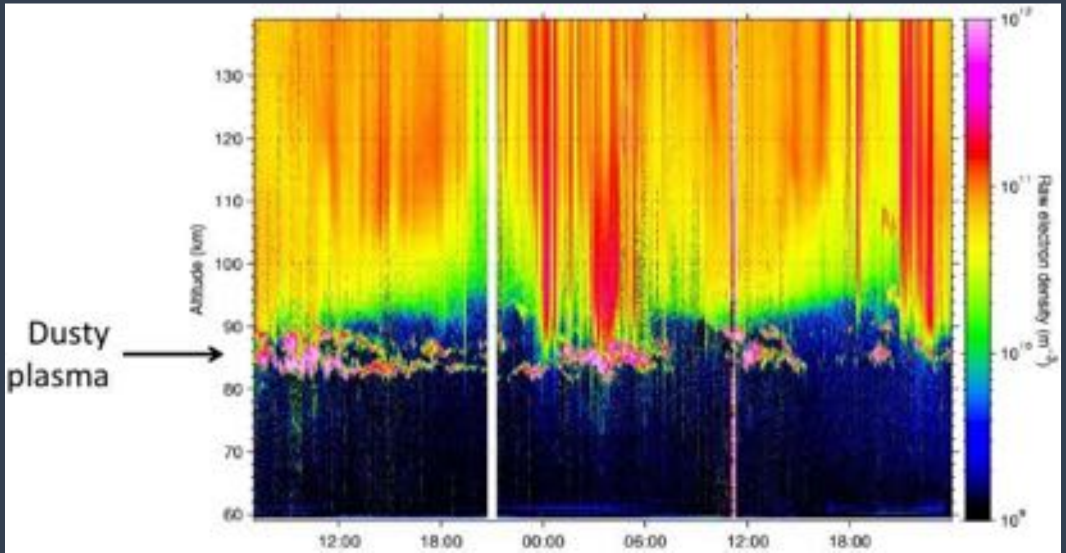
- Resolution of spatial and temporal variations
- Placing in-situ satellite observations into context
  - Both time and space
- Providing ionospheric boundary conditions to studies of magnetosphere-ionosphere coupling
- Quantitative estimates from combined data

OBSERVING THE NEAR-EARTH SPACE ENVIRONMENT

How is Earth's atmosphere coupled to space?



- Space weather effects
- Climate change
- Space debris



- Near-Earth object studies
- Radio astronomy
- Micrometeors
- Basic plasma physics via active experiments
- e-Science

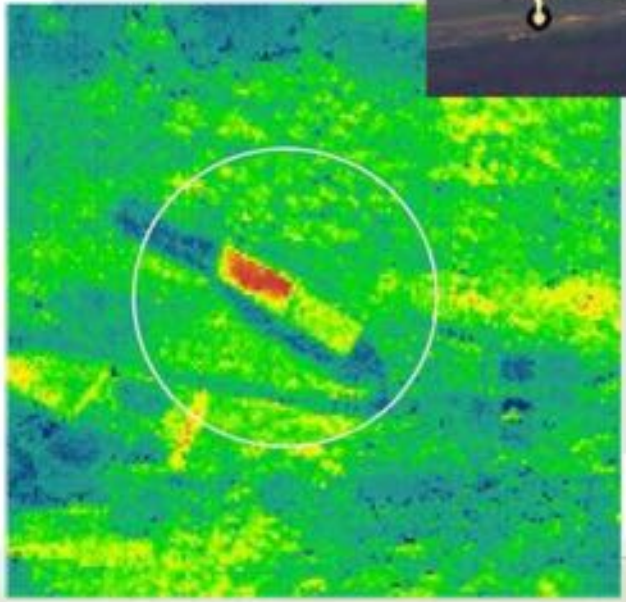
CO-DEVELOPMENT OF TECHNOLOGIES

CzechGlobe Global Change Research Institute CAS

AnaEE
Analysis and Experimentation on Ecosystems

ESA – FLEX Fluorescence Mission - detection of invisible stress in vegetation using chlorophyll fluorescence detection

HyPlant sensor on CzechGlobe airborne carrier – collaboration accross Europe

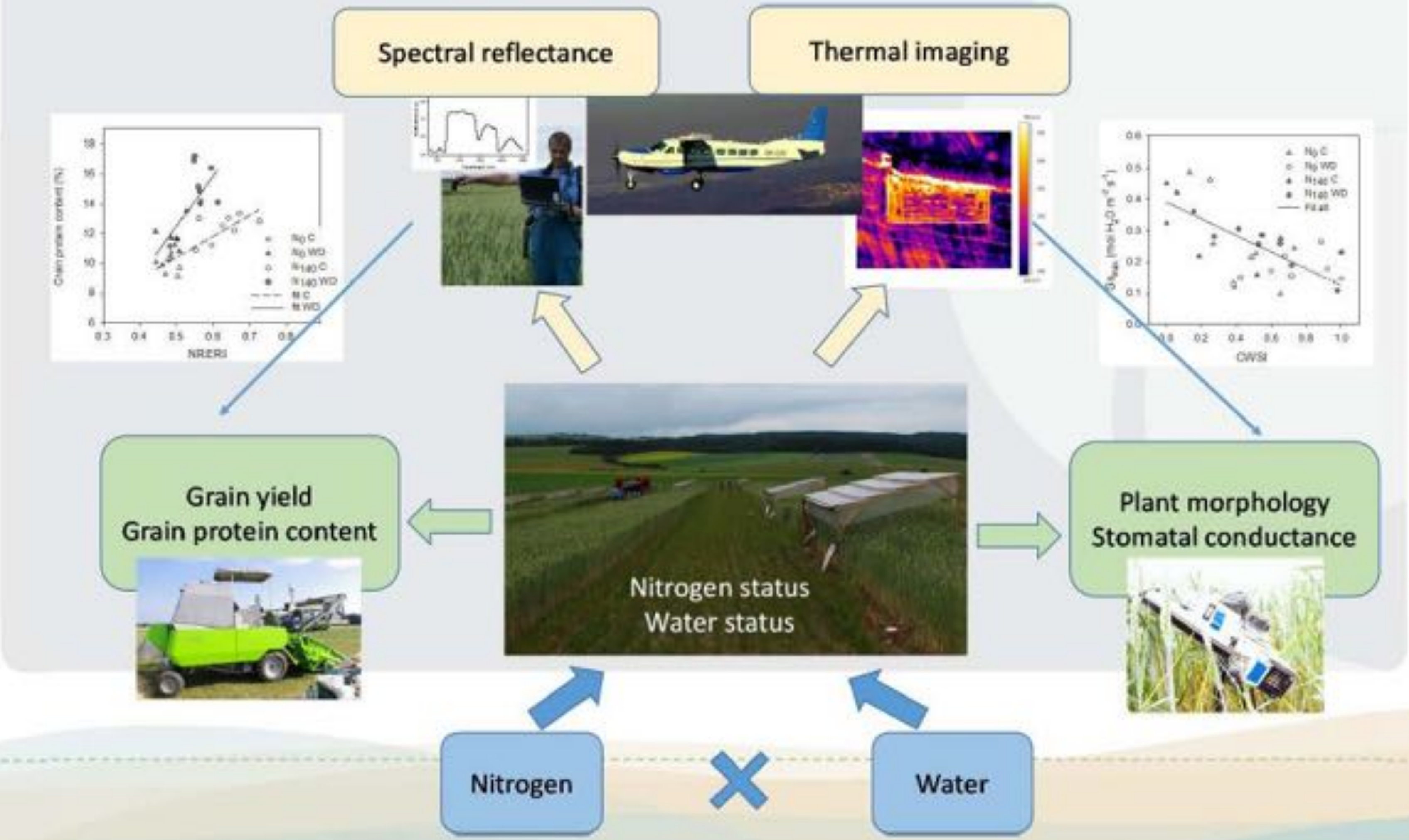


CO-DEVELOPMENT OF TECHNOLOGIES

CzechGlobe Global Change Research Institute CAS

AnaEE Analysis and Experimentation on Ecosystems

Development of remote sensing methods for detection water and nutrient status using manipulation experiments



CAL / VAL ACTIVITES

ACTRIS

Aerosols, Clouds, and Trace gases

**EUROPEAN CONTRIBUTION
FOR INTERNATIONAL NETWORKS**

CAL / VAL ACTIVITES

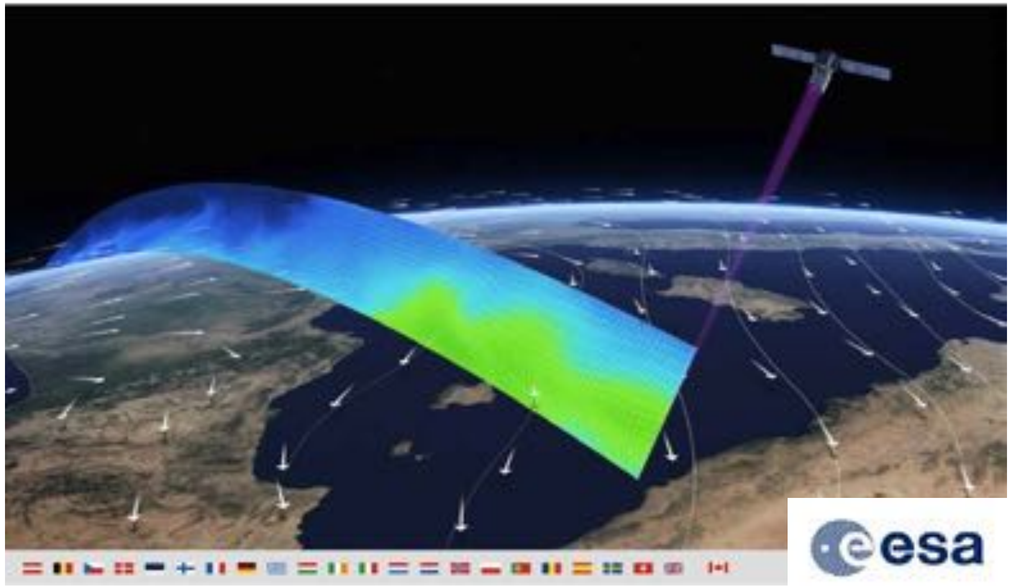
ACTRIS support for ESA's Aeolus mission (launched Aug 2018)

1st satellite mission for measuring wind profiles on a global scale

Based on lidar technology (laser remote sensing)

Provides also cloud and aerosol products

NRT observations to improve the accuracy of numerical weather and climate prediction and advance our understanding of tropical dynamics and processes relevant to climate variability



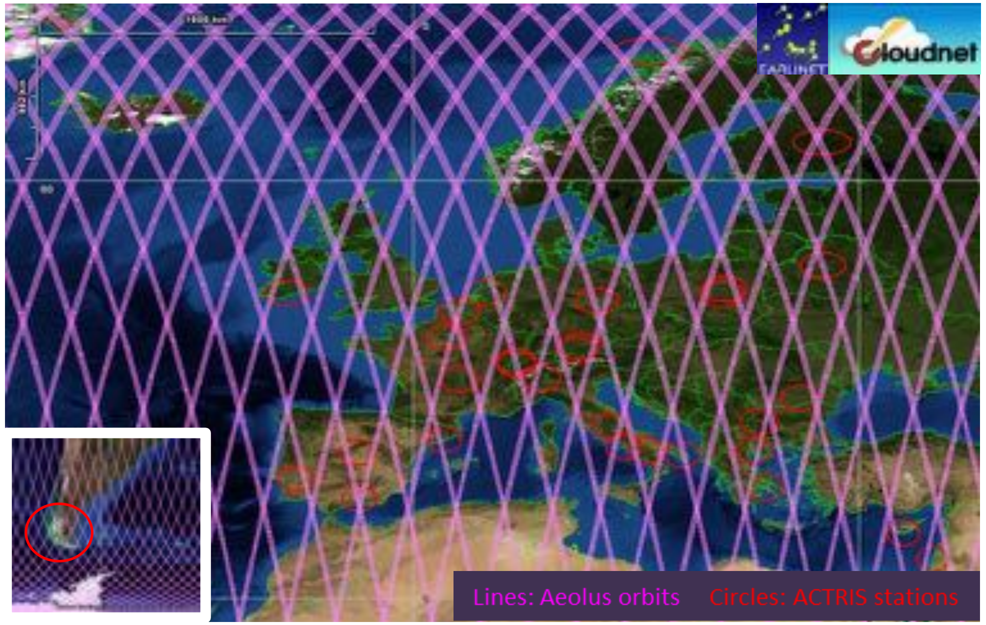
ACTRIS Aerosol and Cloud Remote Sensing Stations

Ground-based Cal/Val program for Aeolus wind, aerosol and cloud products

Synergistic view on atmospheric processes

About 30 fixed aerosol lidar and 10 fixed cloud radar sites distributed over Europe

Mobile facilities for support at remote locations



CAL / VAL ACTIVITES

Drifts or jumps in altimeter missions through comparison with Argo floats

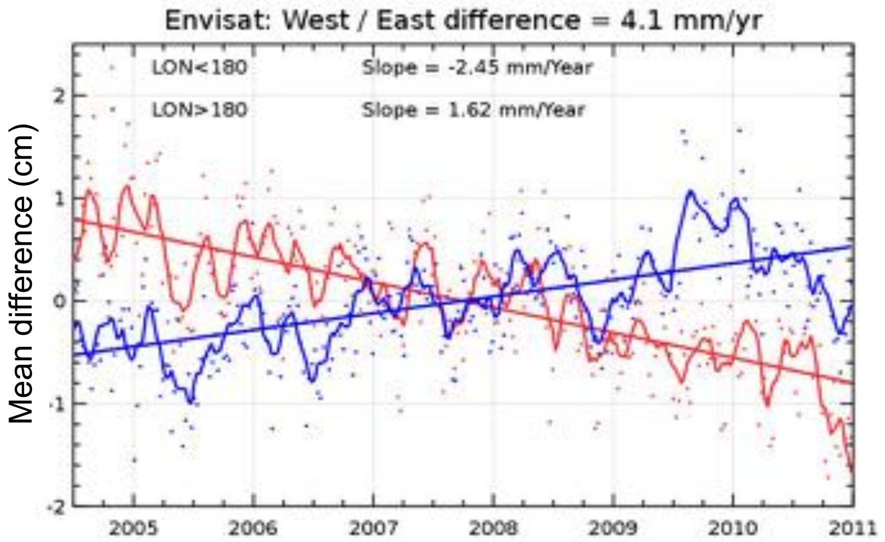
East/West Sea Level Anomaly differences between Envisat and Argo+Grace data

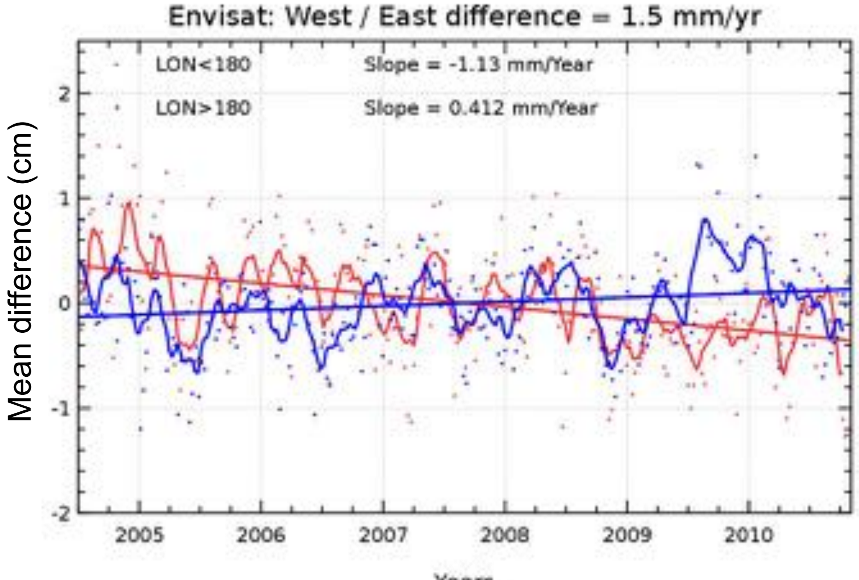
Strong trend difference for Envisat (ΔEast/West = **4.1 mm/yr**) instead of **-0.1 mm/yr** for Jason-1

➔ The anomaly is mainly observed on **Envisat**

Test of the impact of new preliminary CNES GDR-D orbit solutions (where long-term evolution of gravity fields has been improved)

➔ Strong impact on the East/West trend difference on Envisat, now reduced to **1.5 mm/yr**





Valladeau G. et al., 2012: Comparing Altimetry with Tide Gauges and Argo Profiling Floats for Data Quality Assessment and Mean Sea Level Studies. Marine Geodesy, Vol 35, DOI: 10.1080/01490419.2012.718226.

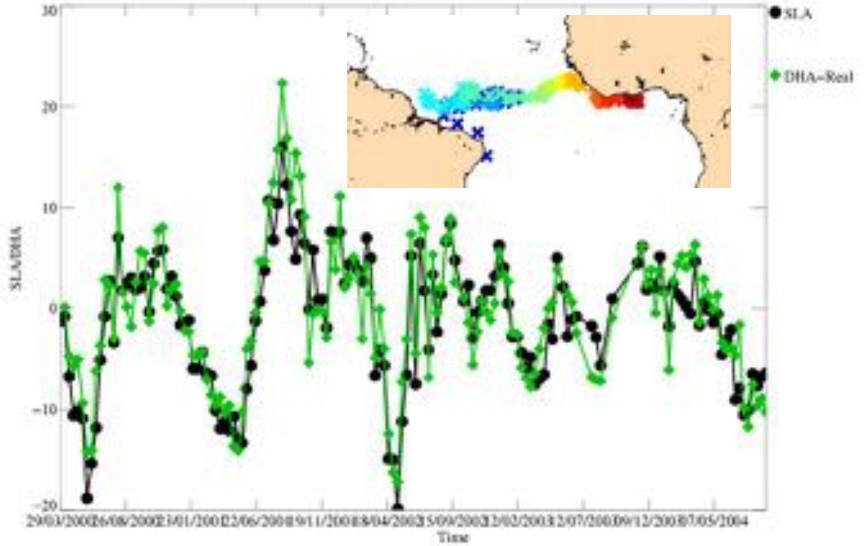
CAL / VAL ACTIVITES

Validation of Argo floats through comparison with altimeter observations

For each Argo float time series:

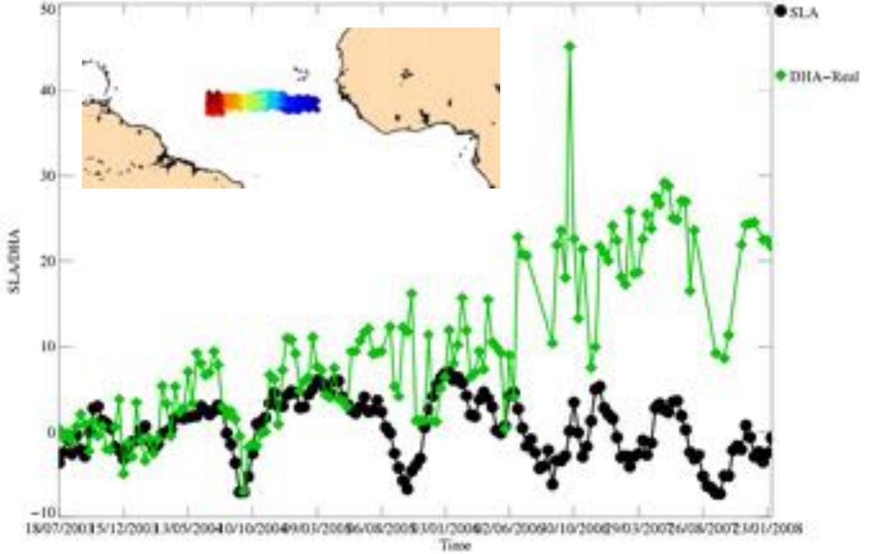
Comparison of co-located altimeter Sea Level Anomaly (**SLA**) and Argo Dynamic Height Anomaly (**DHA**)

Very good consistency ➔ the majority of floats !



Representative anomalies

An alert is sent to the production center which correct the time series in delayed mode (when possible) or exclude the observations



CLS

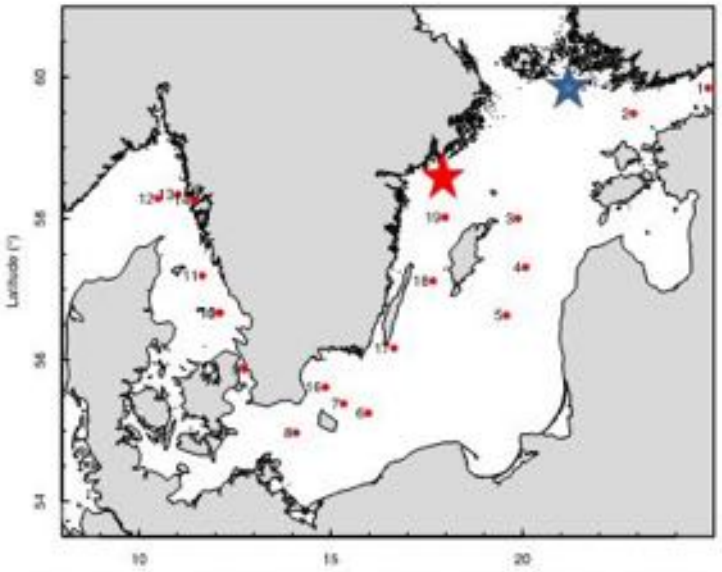
Coriolis

Guinehut, S., et al., 2009: On the use of satellite altimeter data in Argo quality control, J. Atmos. Oceanic. Technol, Vol. 26, No. 2, pp 395-402.

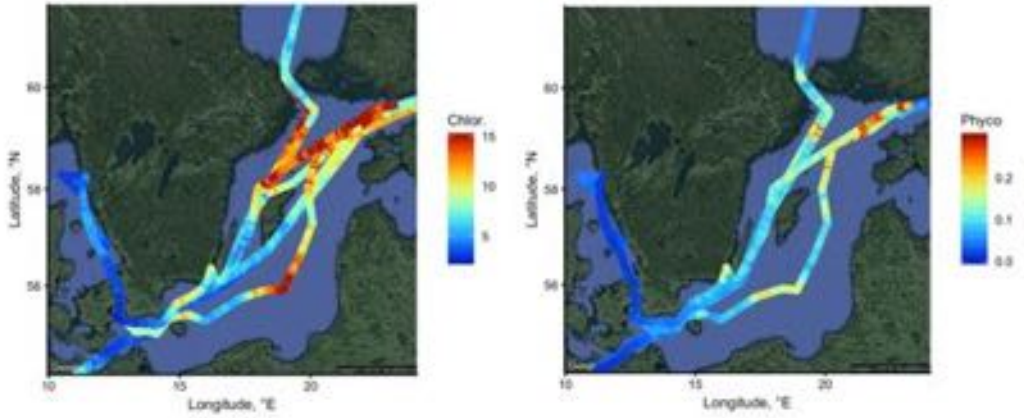
EVALUATION OF SATELLITE PRODUCUTS

Baltic Sea truth for Sentinel 3 – OLCI

- Phytoplankton biomass and diversity
- Focus on cyanobacteria
- Ferrybox systems in the Baltic Sea operated for several decades
- SMHI monthly cruises
- In situ data on
  - Horizontal and depth distribution of cyanobacteria
  - Phytoplankton biomass
  - Phytoplankton diversity
- SYKE Utö observatory ★
- SMHI oceanographic buoy ★



Sampling stations visited 10-17 July 2017

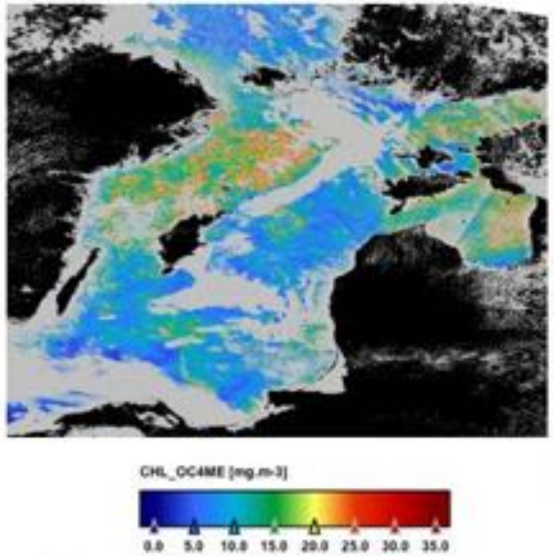


Data from Ferrybox systems 10-17 July 2017

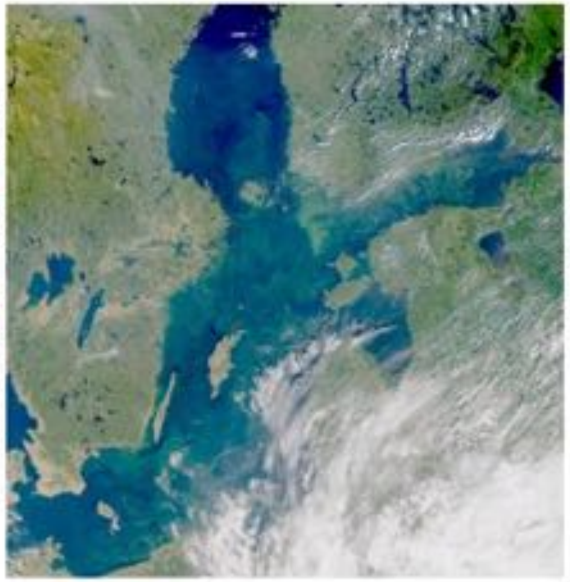
Karlson et al. unpublished

EVALUATION OF SATELLITE PRODUCTS

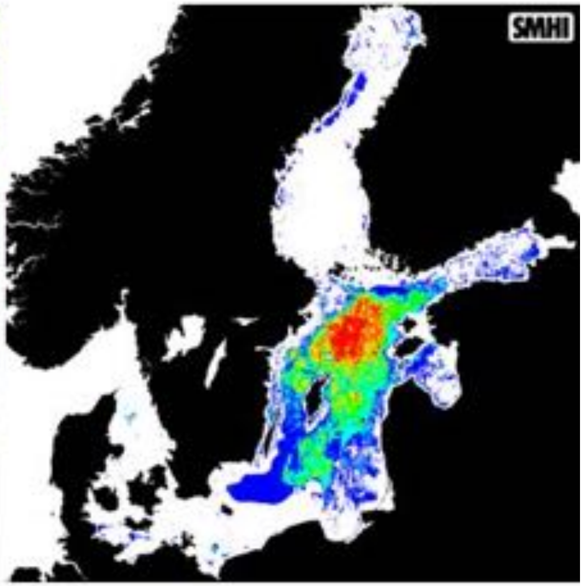
Satellite products



Chlorophyll a (preliminary data) 10 July 2017, Sentinel 3A, OLCI, ESA processed by SMHI



Surface accumulations of cyanobacteria
16 July 2017, Sentinel 3A, OLCI, ESA processed by SMHI



Surface accumulations of cyanobacteria, 7-day composite 10-17 July 2017, Baltic Algae Watch System, www.smhi.se

Karlson et al. unpublished

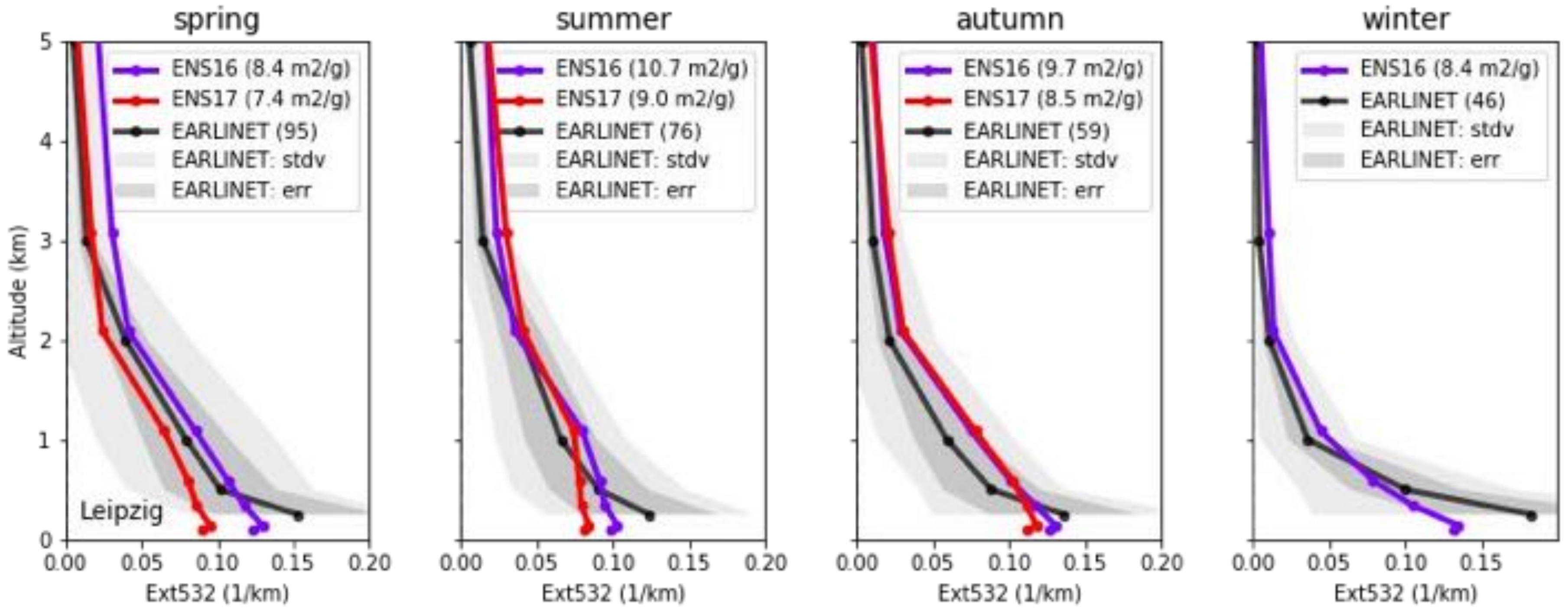
EVALUATION OF COPERNICUS SERVICE

Operational Validation of regional model ensemble

Copernicus ENSEMBLE air quality forecast (ENS-2016 & ENS-2017)

Above Ground Aerosol Concentration Evaluation using ACTRIS lidar climatology (EARLINET)

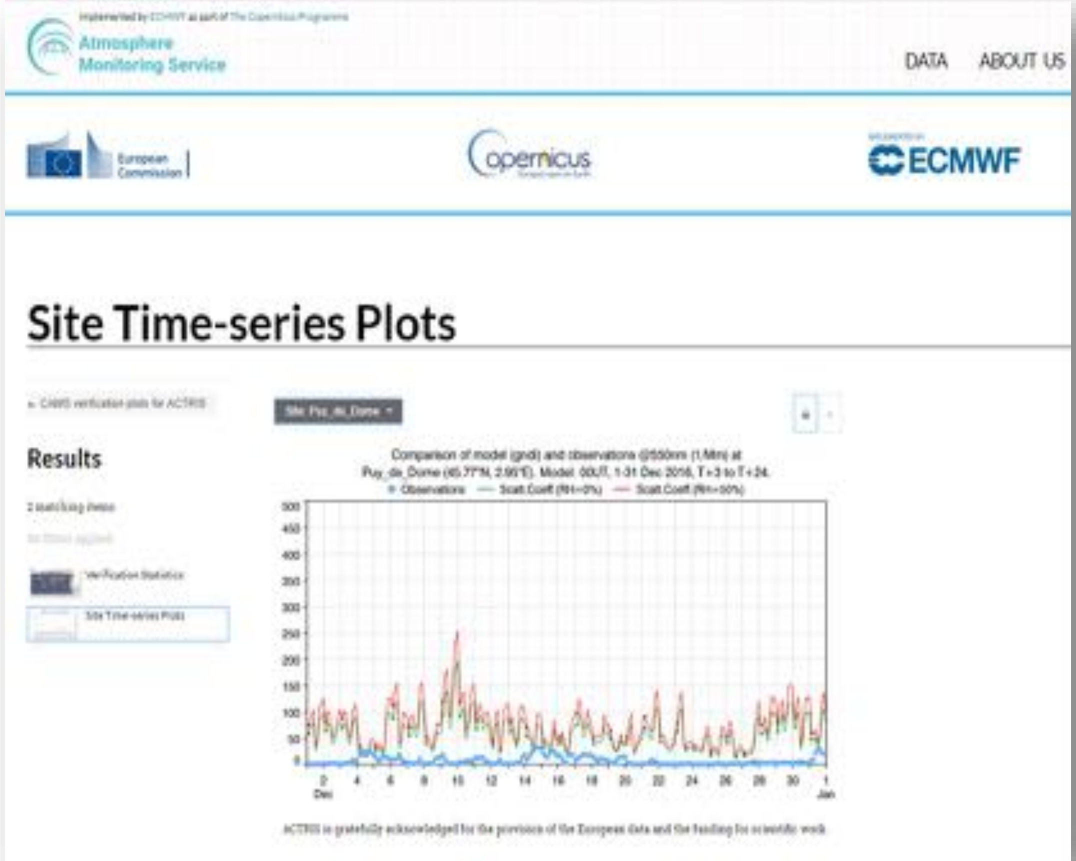
=> Models underestimate surface concentrations, along with too much mixing to upper air



LEIPZIG, Germany

EVALUATION OF COPERNICUS SERVICE

Evaluation within CAMS



https://atmosphere.copernicus.eu/charts/cams_actris_deliverable/
http://actris.nilu.no/Content/?pageid=7b82e9ef225b4630a9ee709e616a0fec

EVALUATION OF COPERNICUS SERVICE

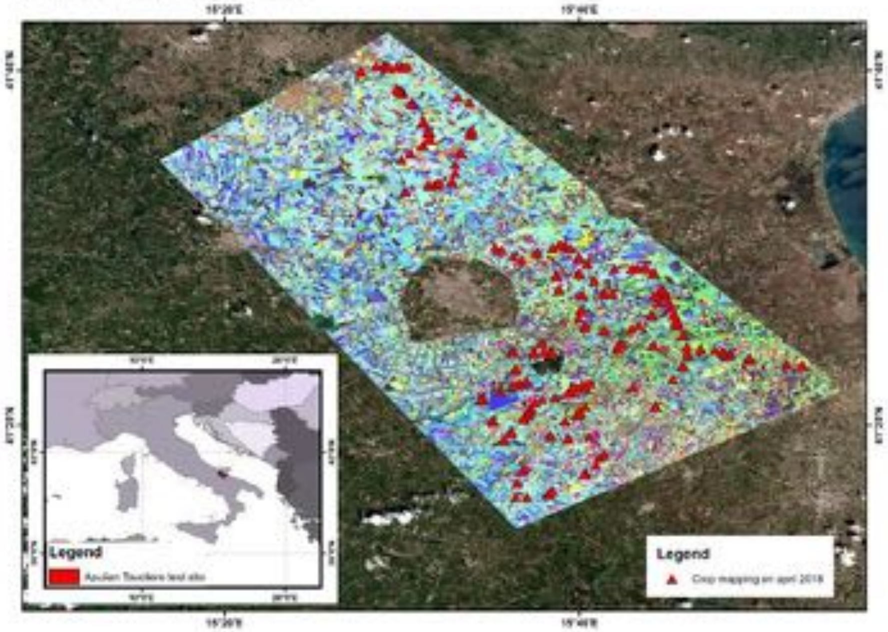
SENSAGRI project

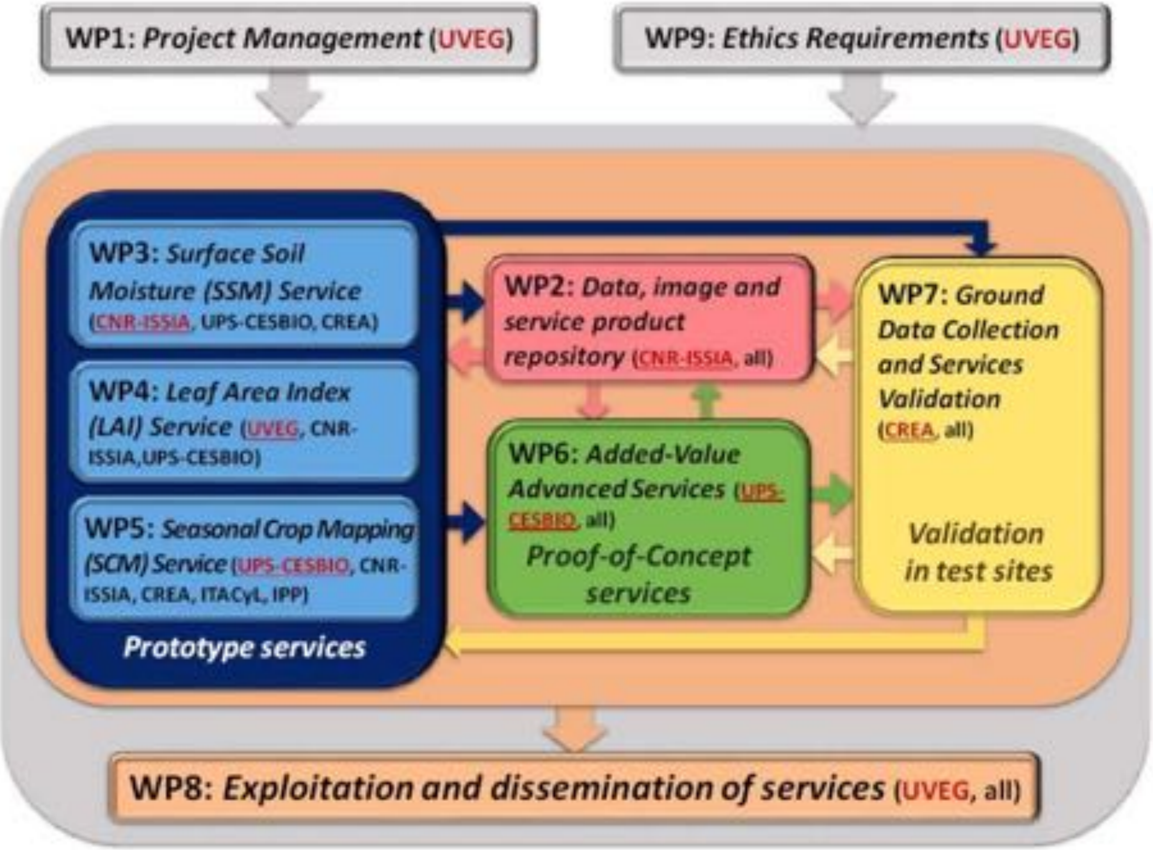
EO Work programme "EO-3-2016: Evaluation of Copernicus Services"

Sentinels Synergy for Agriculture (SENSAGRI) aims to exploit the synergy of optical and radar measurements to develop three prototype services capable of near real time operations:

(1) surface soil moisture;
(2) green and brown leaf area index;
(3) crop type mapping.

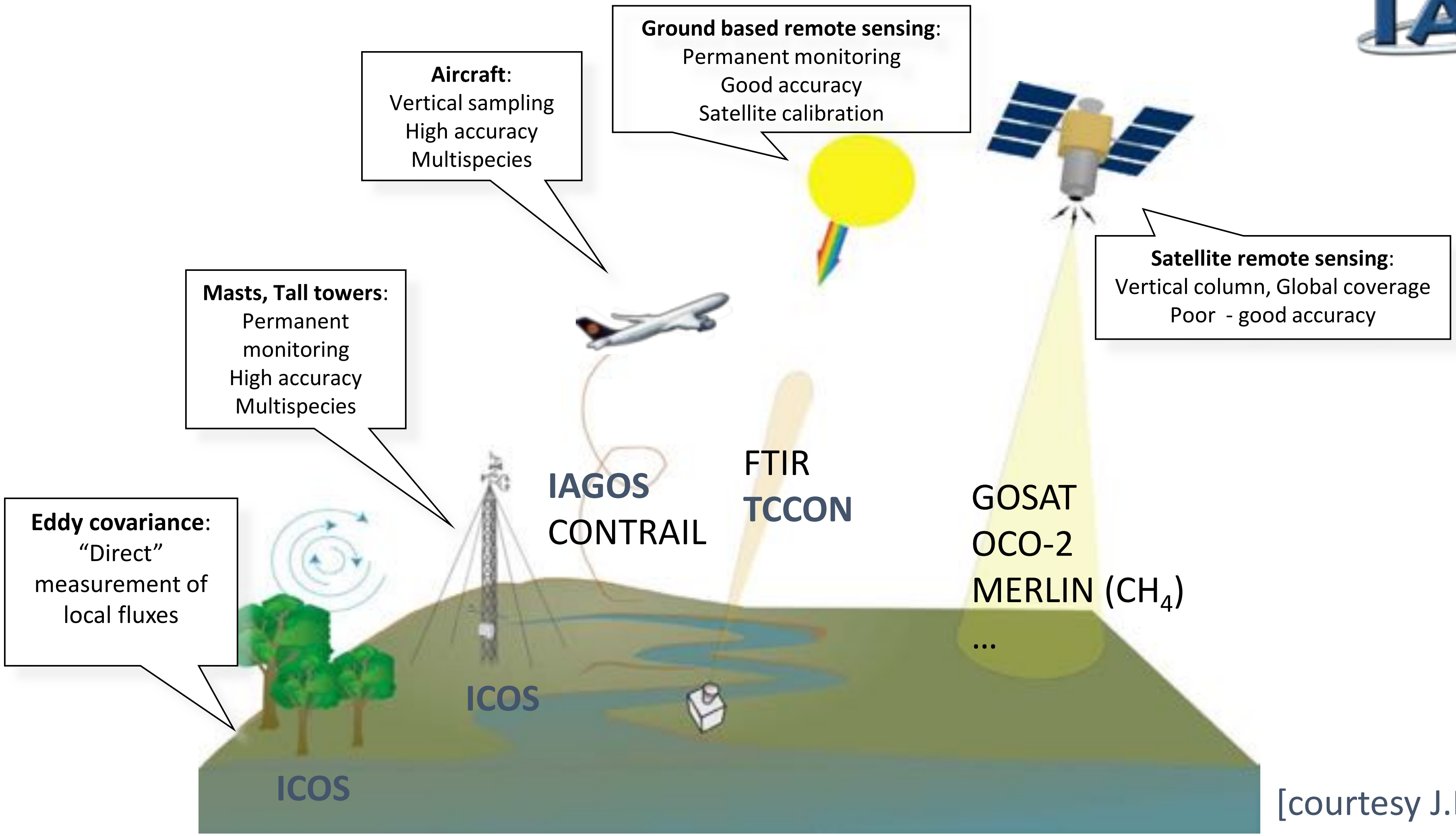
Sentinel 2 series of images (18.01.2018 – 09032018 – 13052018) and ground surveys of April 2018





BUILDING THEMATIC EO FRAMEWORK

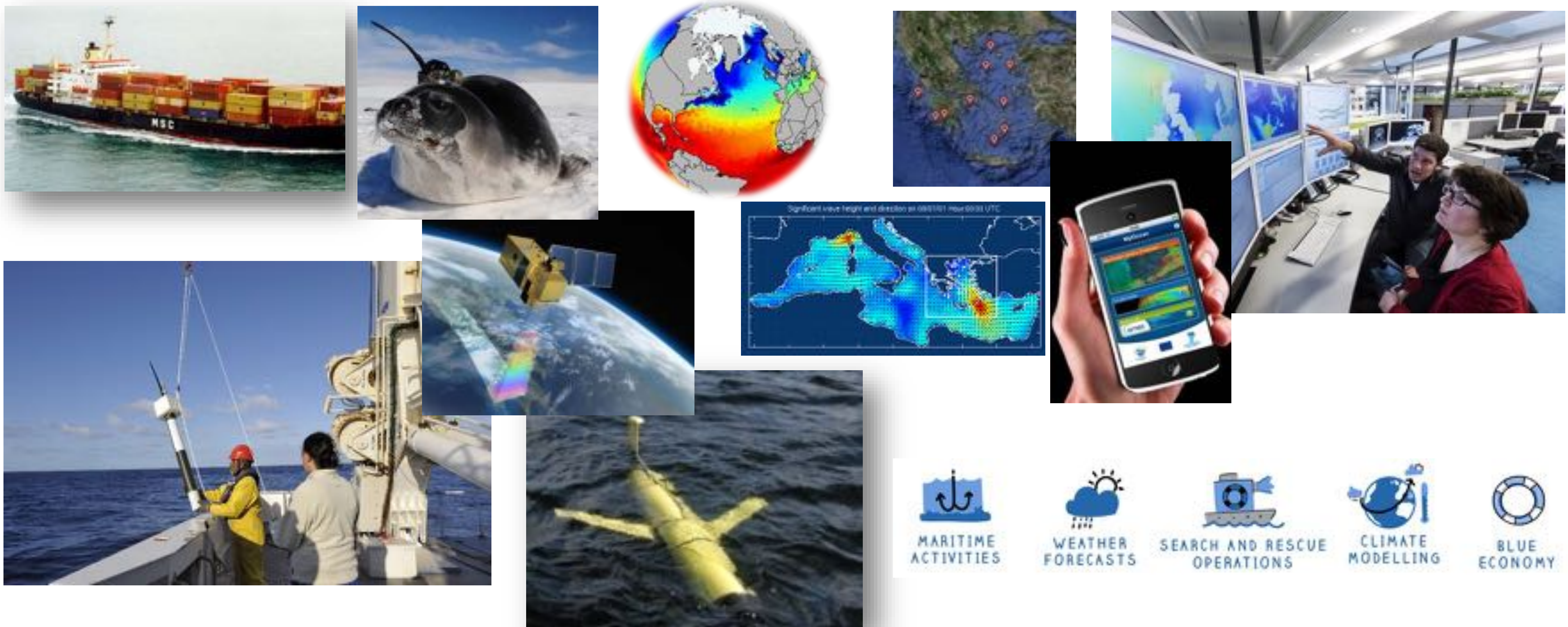
Carbon and GHG observations



[courtesy J.D. Paris]

PROVIDING RI DATA FOR SATALLITE PRODCUTS

From observations to information



PROVIDING RI DATA FOR SATALLITE PRODCUTS

In situ operational observations data for EO products

EuroGOOS European Global Ocean Observing System

Some examples:

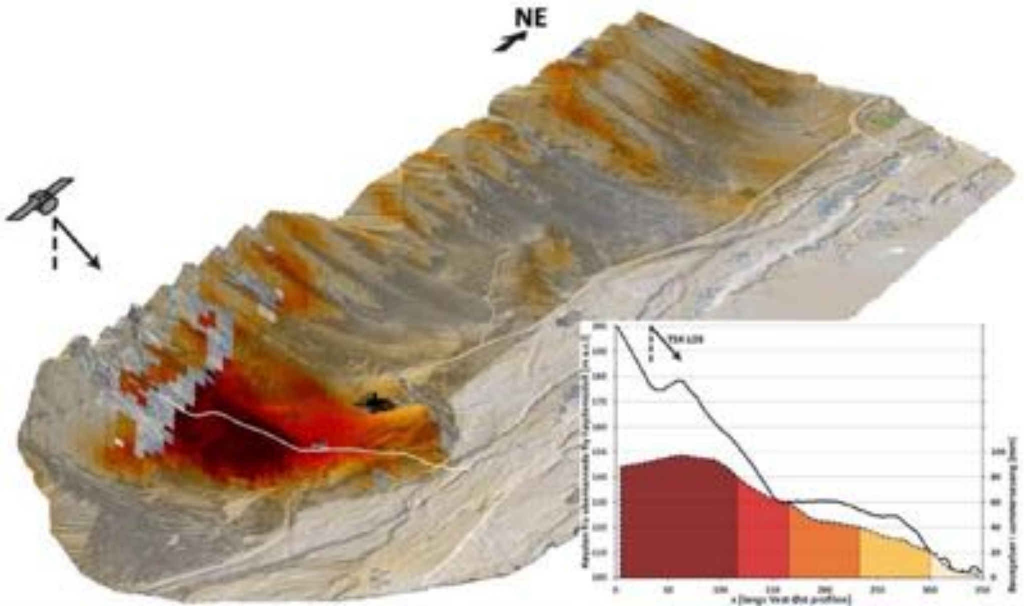
- Maps of SST, sea ice, ocean circulation, plankton distribution, harmful algae blooms, oil spill detection, etc.
- Assimilation and validation of ocean forecasting models.
- Among activities showcasing this: Copernicus in situ coordination

In Situ

https://insitu.copernicus.eu/

PROVIDING RI DATA FOR SATALLITE PRODCUTS

Integrating Copernicus products with in situ products for sustainable field studies in Svalbard



InSAR Based surface movements coupled with in situ ground validation.

Summer 2017 a big crack in the terrain and a small lake drained > a sign that changes in permafrost lead to increased deformation > changes in the terrain that may affect infrastructure.

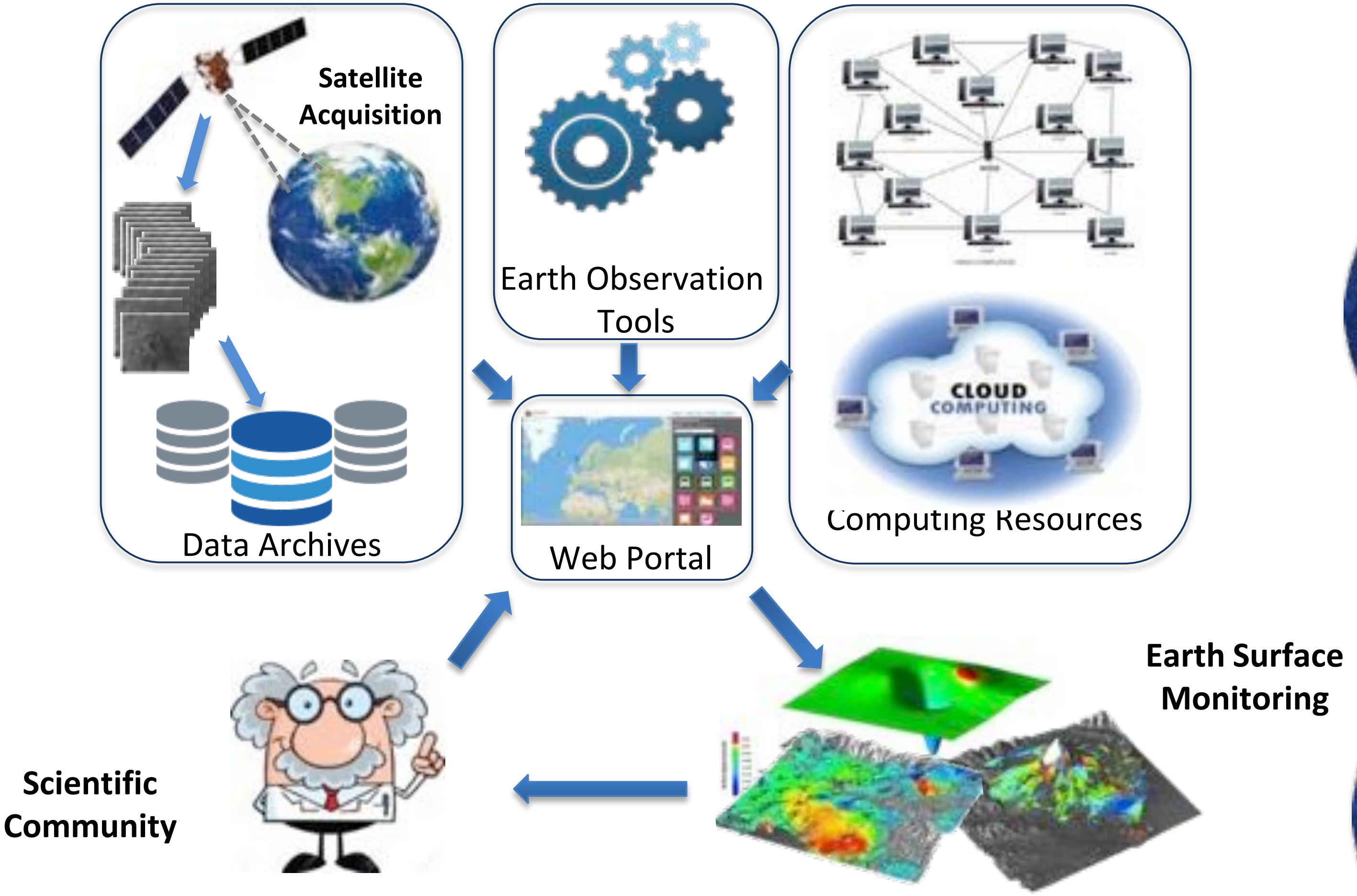
SIOS
SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM

SIOS member: Northern Research institute (NORUT)

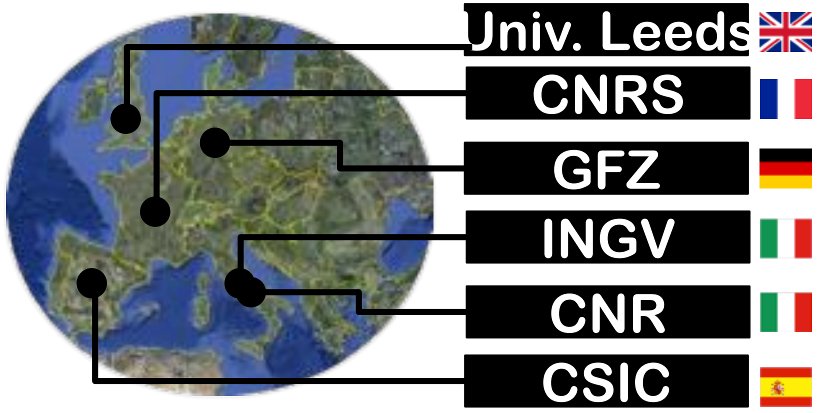
COMMON SERVICES

EPOS Thematic Core Service: Satellite Data – Components

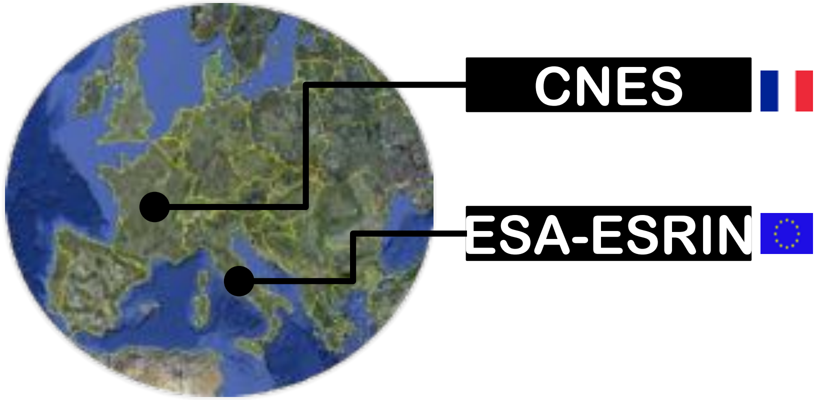
EPOS
EUROPEANPLATEOBSERVINGSYSTEM



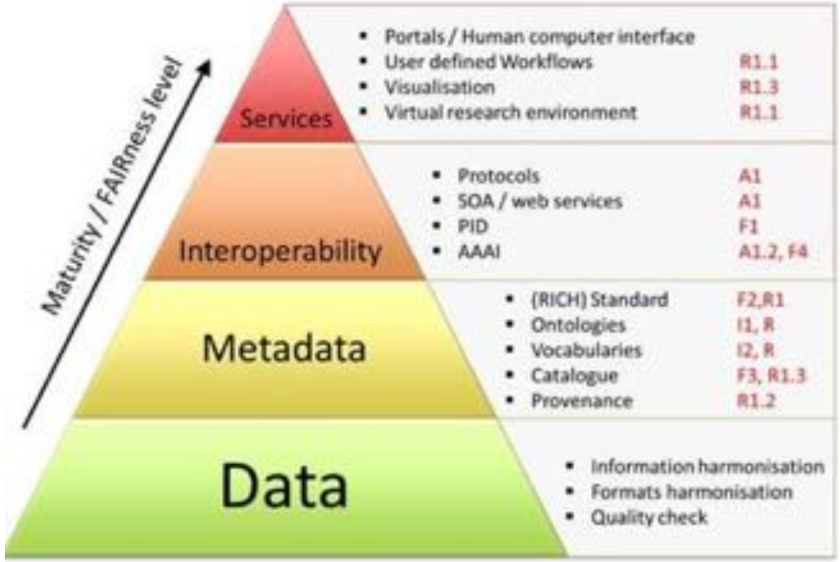
TCS Satellite Data – Partnership



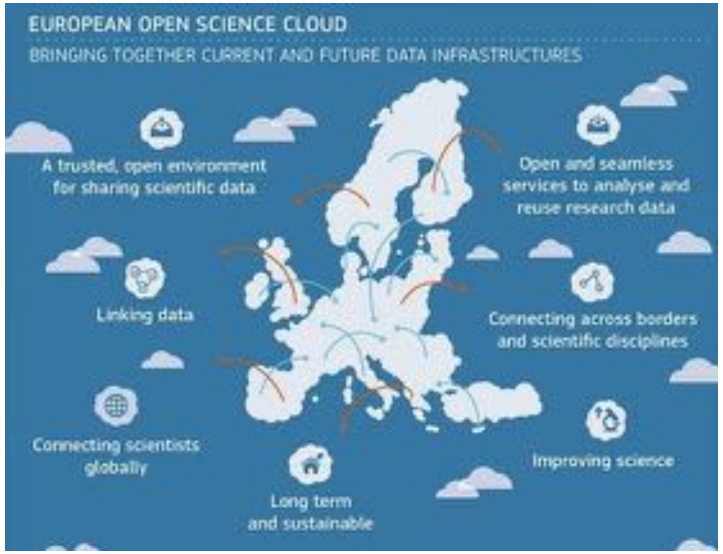
Associated partner



ENVRI-FAIR
Building FAIR environmental services platforms in Europe



European Open Science Cloud



FAIR principles and Open Science

What does ENVRI FAIR do?

Common strategies

Common FAIR policies

Common standards

Technical implementation at the RI level

Liaisons, collaborations, users

Agree on common FAIRness polices in ENV RIs

Train the RI staff on standards and policies

Implement standards and policies on the ENV RIs services

Select ENV services (inc. data) for European Open Science Cloud

Liaisons, collaborations, users

Standards and implementation will be hierarchical (Cluster level, Subdomain level, RI level)

THANK YOU FOR YOUR ATTENTION

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Find us on:

Twitter - @ENVRIplus
Facebook page – ENVRIplus
LinkedIn Group – ENVRIplus

Websites: www.envri.eu and www.envriplus.eu

User requirements for open science

- open, fair and transparent access to large volumes of high-quality data
- easy to combine/merge large volumes of complex data from various data sources and disciplines
- availability of open analysis tools, computing facilities/services
- easy to reach user support services
- provision of data storage for user’s data results (data management plans, reproducibility)

Data provision requirements

- attribution and traceability (single data provider)
- coordinated data management (RI level)
- metadata and workflow descriptions (RI level)
- common reference model / agreed framework (RI cluster level)
- brokering systems for federated data (RI cluster level)

Open Science requires institutional framework (cores)

Attribute	Network	Research Infrastructure
Science / content	scientists, creators, inventors	scientists, managers, directors, delegated
Design flexibility	flexible, creative	fixed, baselined
Fabricated by	in-house craftwork, "make"	industrial approach, "buy"
Team		ers, accountants,
Governance		lders/owners)
Project process	internal	iterative
Success defined by	scientists, creators, inventors, peers	scientists, managers, reviewers, sponsors, peers
Funding	short-term, project-based	long-term, member states, business model with financial plan

Sustainability

Connection to user communities