



Training event “Climate change and air quality: challenges and objectives for the atmospheric research.”

Heritage Missions – Long term data preservation

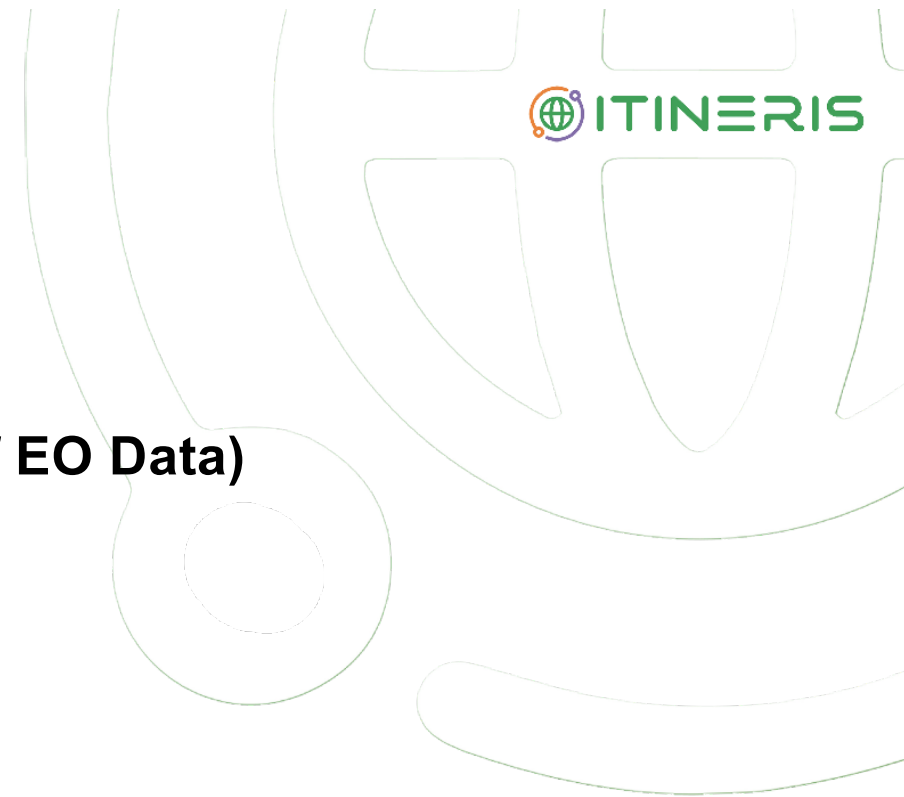
Paolo Castracane - Starion for ESA/ESRIN paolo.castracane@ext.esa.int
Sabrina Pinori (Serco), Mirko Albani (ESA), Iolanda Maggio (Starion) and
Gabriele Brizzi (Serco)

IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
(D.D. n. 130/2022 - CUP B53C22002150006) Funded by EU - Next Generation EU PNRR-
Mission 4 “Education and Research” - Component 2: “From research to business” - Investment
3.1: “Fund for the realisation of an integrated system of research and innovation infrastructures”



Table of Contents

- **ESA Intro and EO Missions**
 - Sentinel-5P
 - EarthCARE
- **ESA Heritage Missions (Long Time Series of EO Data)**
 - FDR – Fundamental Data Records
 - ARD – Analysis Ready Data
 - Applications



We are committed to the peaceful exploration
and use of space for the benefit of people,
society and our planet

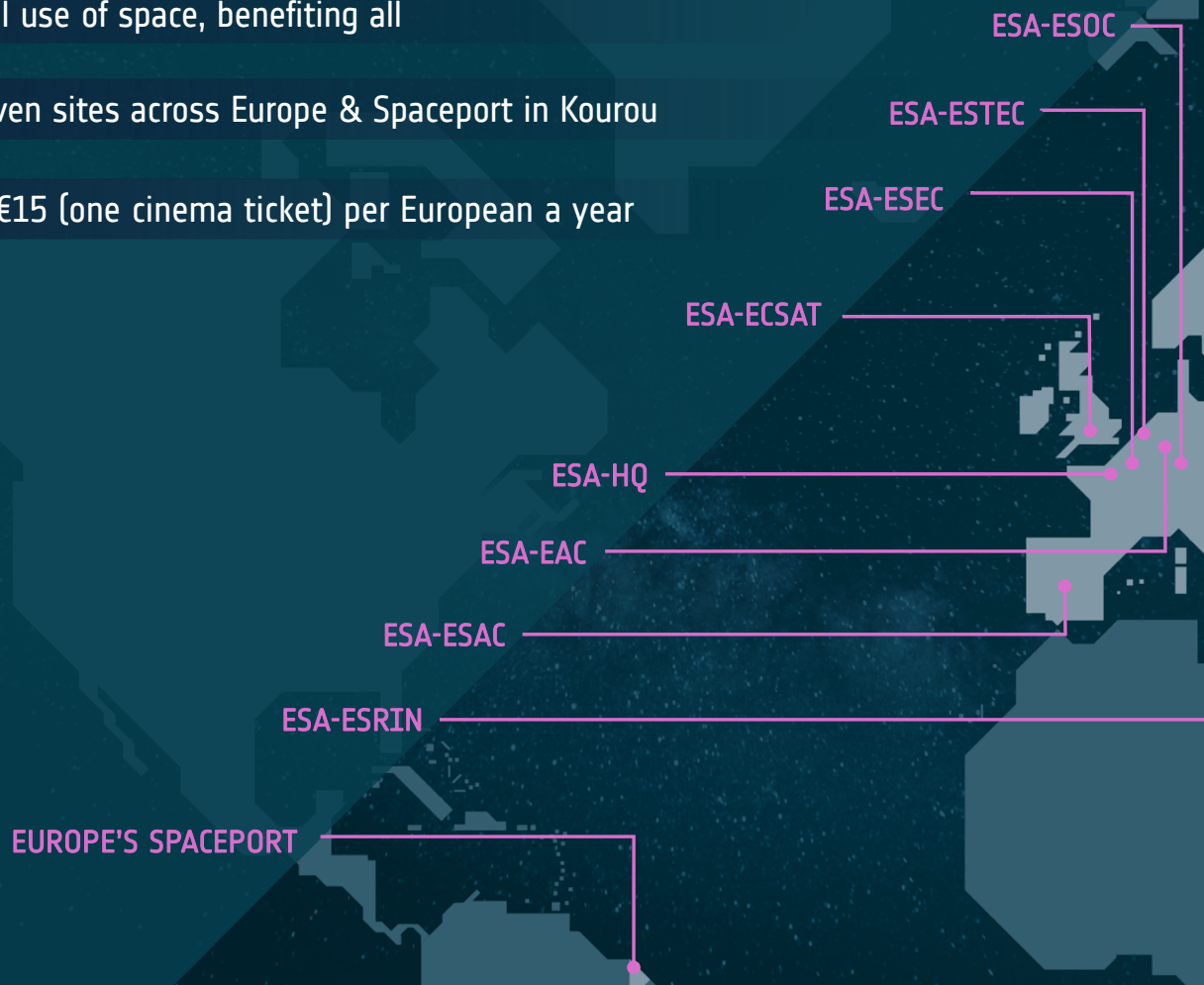


WHO 23 Member States, 2500+ staff members and total workforce of 6000+

WHY For the peaceful use of space, benefiting all

WHERE HQ in Paris, seven sites across Europe & Spaceport in Kourou

BUDGET €7.79 billion = €15 (one cinema ticket) per European a year



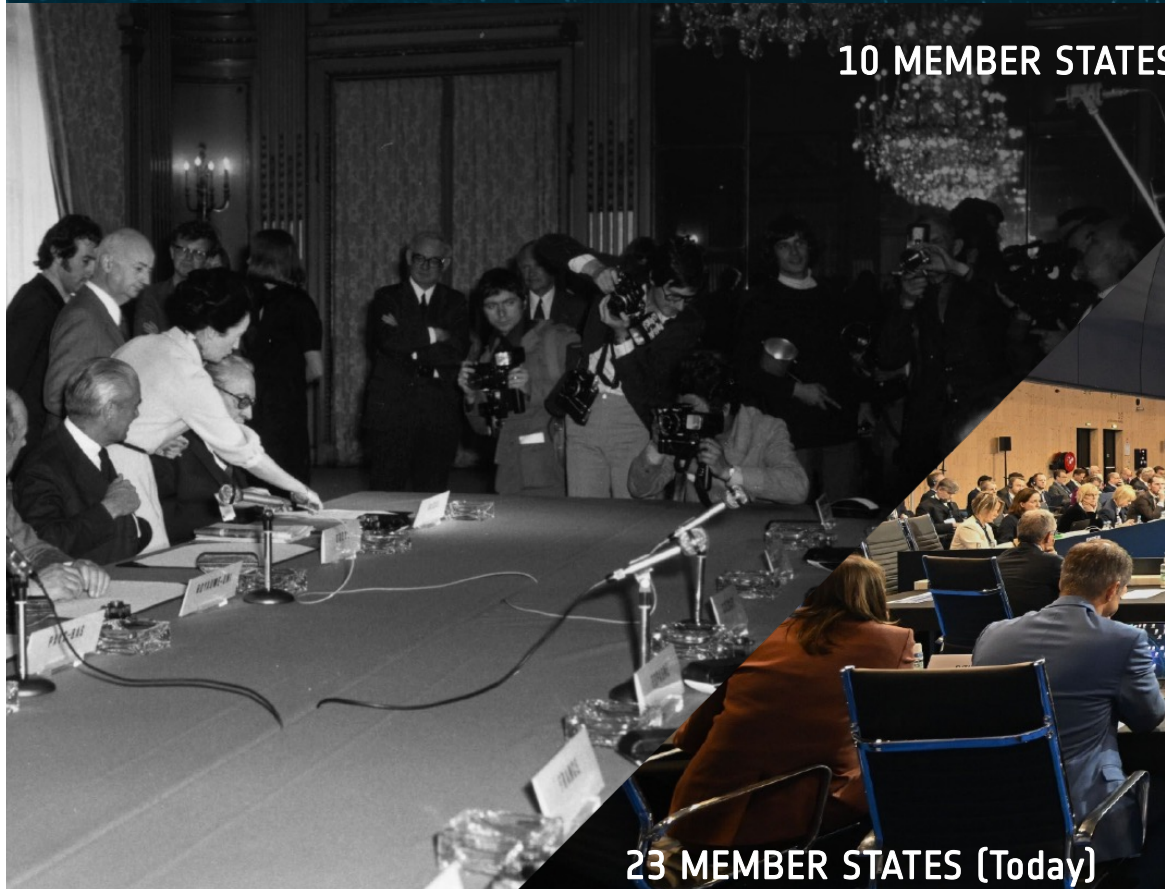
SCOPE Active across every area of the space sector

EXCELLENCE World leader in space science & technology

MISSIONS 100+ satellites and spacecraft since 1975

SPACEPORT 295+ launches from Kourou since 1979

10 MEMBER STATES (1975)



23 MEMBER STATES (Today)



AGENCY

50 years of esa

ESA is celebrating its 50th anniversary!

For half a century, the European Space Agency (ESA) has been serving Europe as its space agency and inspiring its citizens. On 30 May 1975, the ESA Convention was signed by 10 founding Member States and has since now expanded to 23 Member States, three Associate Members, four Cooperating States and a Cooperation Agreement with Canada. This anniversary year provides the opportunity to reflect not only on ESA's past achievements, but even more so on its future perspectives.



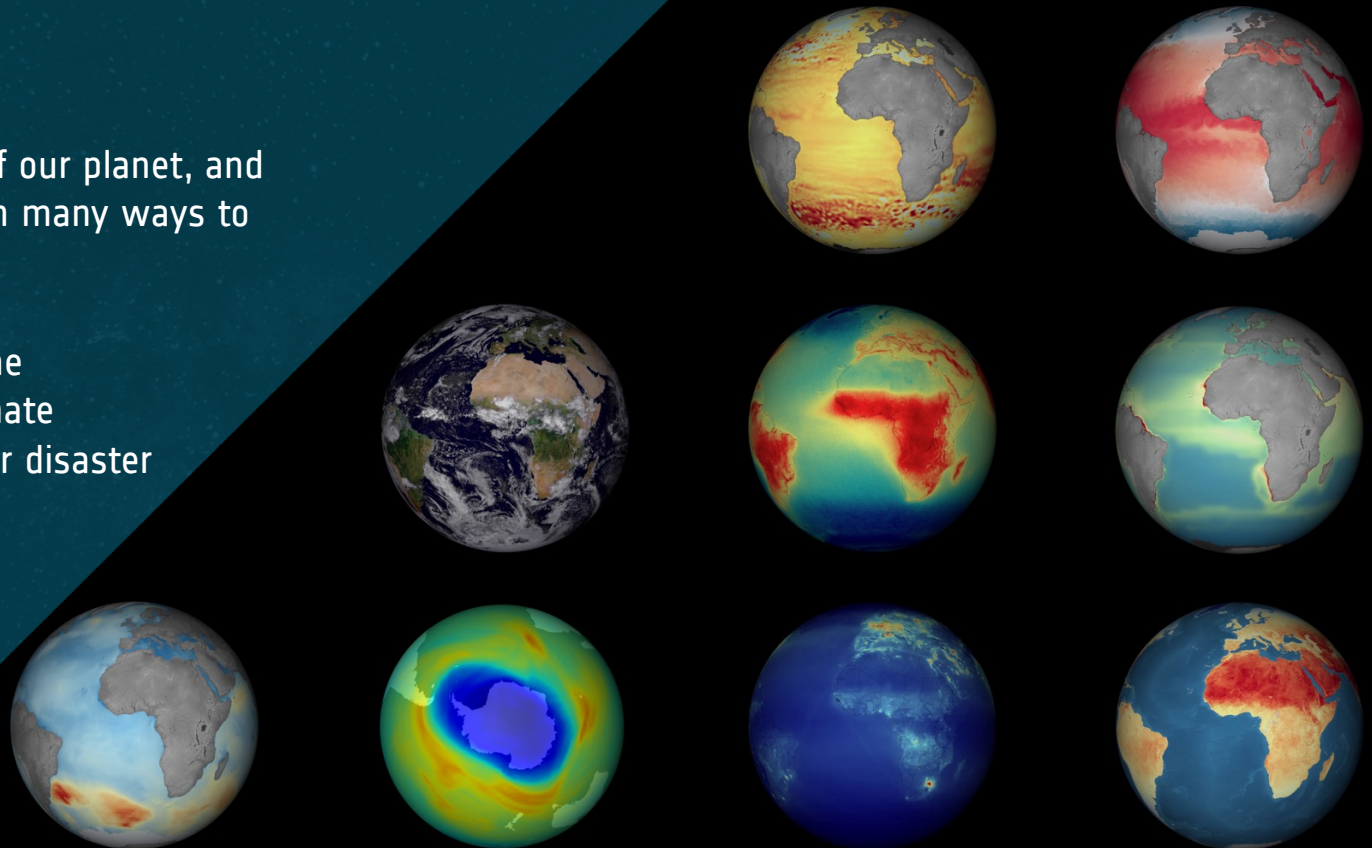
applications

EARTH OBSERVATION

Understanding Earth, improving lives, and fostering sustainability through space technology

Satellites offer an unparalleled view of our planet, and enable us to observe and contribute in many ways to sustainable life on Earth including to:

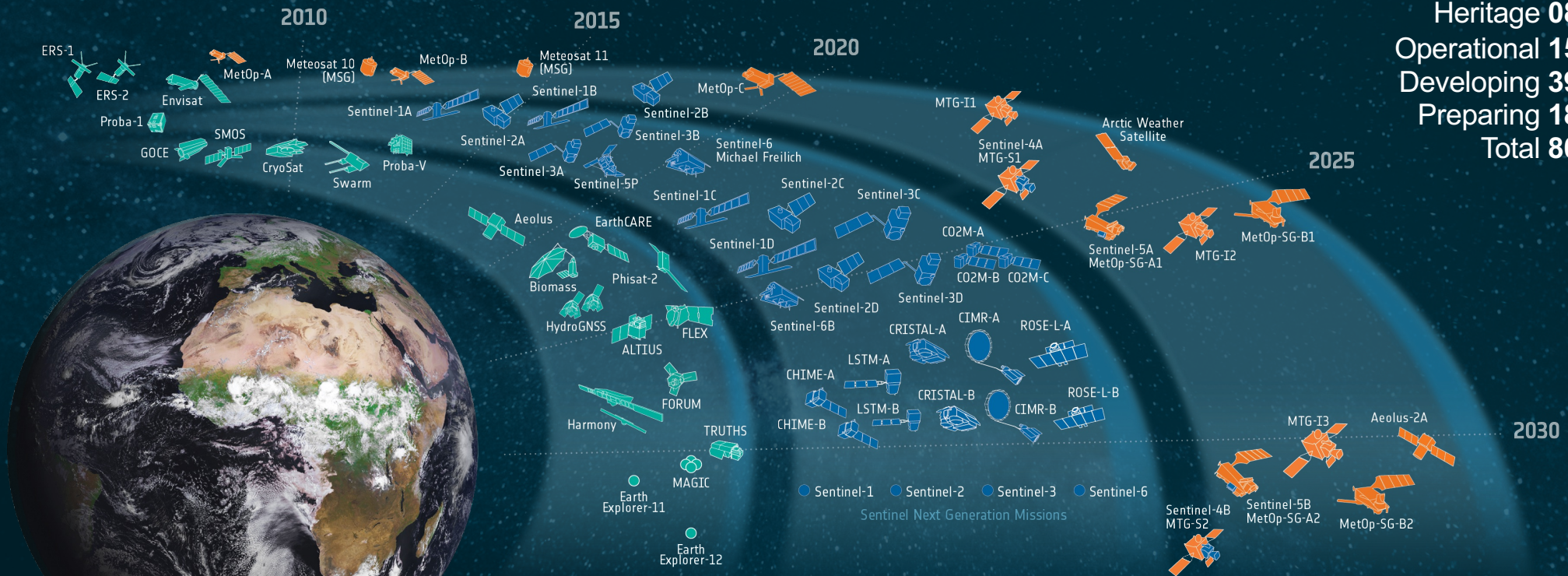
- ◆ Provide essential information on the environment and our changing climate
- ◆ Help plan rescue and aid work after disaster
- ◆ Forecast weather patterns
- ◆ Answer important questions on Earth's systems



ESA-developed Earth observation missions



Satellites
 Heritage **08**
 Operational **15**
 Developing **39**
 Preparing **18**
Total 80



Science

Copernicus

Meteorology

Earth Explorers

Earth Explorers are ESA-developed satellites that use cutting-edge technologies to help maintain European scientific and technological leadership. They are part of FutureEO, ESA's Earth observation research and development programme.



- ◆ The Earth observation component of the European Union's Space programme is the largest such programme in the world.
- ◆ The family of Sentinel satellite was developed by ESA to meet the operational needs of the Copernicus services.
- ◆ The technology of each mission, such as radar and multi-spectral imaging instruments, depends on the application requirement for land, ocean and atmospheric monitoring.



- ◆ Europe's fleet of cutting-edge meteorological satellites are enabled through the long-standing partnership with the European operational satellite agency (EUMETSAT).
- ◆ The resulting missions are critical for monitoring and forecasting of weather and climate change.



Information products for Earth Action

ESA delivers actionable climate and environmental information, as well as green solutions for society, while fostering disruptive innovations and business ideas.

- ◆ Support climate and environmental policies from local to international level
- ◆ Build strategic partnerships for space applications
- ◆ Enable understanding of impacts of policy actions using digital twin models of Earth's systems



Sentinel-5P Mission Overview

Sentinel-5P: Copernicus Atmosphere Mission

- **Launched:** 13 October 2017, Plesetsk
- **Launcher:** Rockot
- **Main Payload:** TROPOMI (co-funded by The Netherlands and ESA) - Hyper-spectral push-broom imaging spectrometer, 4 spectrometers with 2D detectors with 4000 spectral channels
- **Orbit:** Altitude of 820 km, 227 orbit repeat cycle
- **Daily Global Coverage:** 13:30 ascending node crossing time
- **Spatial Sampling:** 5.5 x 3.5 km (mission requirement: 7 x 7 km)
- **Mission Control:** ESOC
- **TROPOMI Mission Planning:** KNMI
- **Ground Stations:** Svalbard (NOR) and Inuvik (Canada)
- **Operational Data Processing:** DLR (on behalf of ESA)
- **Mission Design Life Time:** ~7 years
- **National co-funding during Routine Operations** (e.g. on Algorithm Development/QA Monitoring): Belgium, Germany, and The Netherlands
- **Key User:** Copernicus Atmospheric Monitoring Service (ECMWF)



- ▶ UV-VIS-NIR-SWIR nadir view grating spectrometer.
- ▶ Spectral range: 270-500, 675-775, 2305-2385 nm
- ▶ Spectral Resolution: 0.25-1.1 nm

Sentinel-5P: Mission Objectives

1. Ozone, Air Quality, and Climate Monitoring and Forecasting
2. Extending the time series of GOME, SCIAMACHY, OMI, GOME2 measurements
3. Precursor of the Copernicus Sentinel-4 and Sentinel-5 missions



Sentinel-5P Products

Sentinel-5 Precursor mission operations → in operations since April 2018 and in routine operations since March 2019

Sentinel-5P TROPOMI
NO₂ tropospheric column
April 2018 - March 2019

Ozone Profile (O₃ Profile) – November 2021

Aerosol Layer Height (ALH) - September 2019

Methane (CH₄)

Tropospheric Ozone Column (trop. O₃) - March 2019

Sulfur Dioxide (SO₂)

Formaldehyde (OCHO) - October 2018

Total Columns of Ozone (O₃)

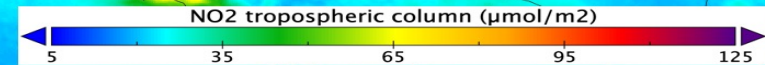
Nitrogen Dioxide (NO₂)

Carbon Monoxide (CO)

Cloud information

Aerosol information

Radiances/Irradiances – July 2018



Latest ESA EO satellites

5 Satellites (4 Launches in 2024)



29 May EarthCARE



4 September
Sentinel-2C

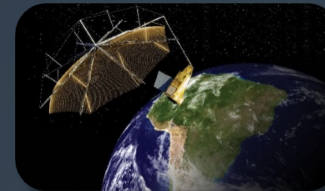


16 August Φ sat-2 +
Arctic Weather Satellite



Early December
Sentinel-1C

6 Launches in 2025 (TBC)



Q1: Biomass



Q1: HydroGNSS



Q3: MTG-S1



Q4: MetOp-SG A1

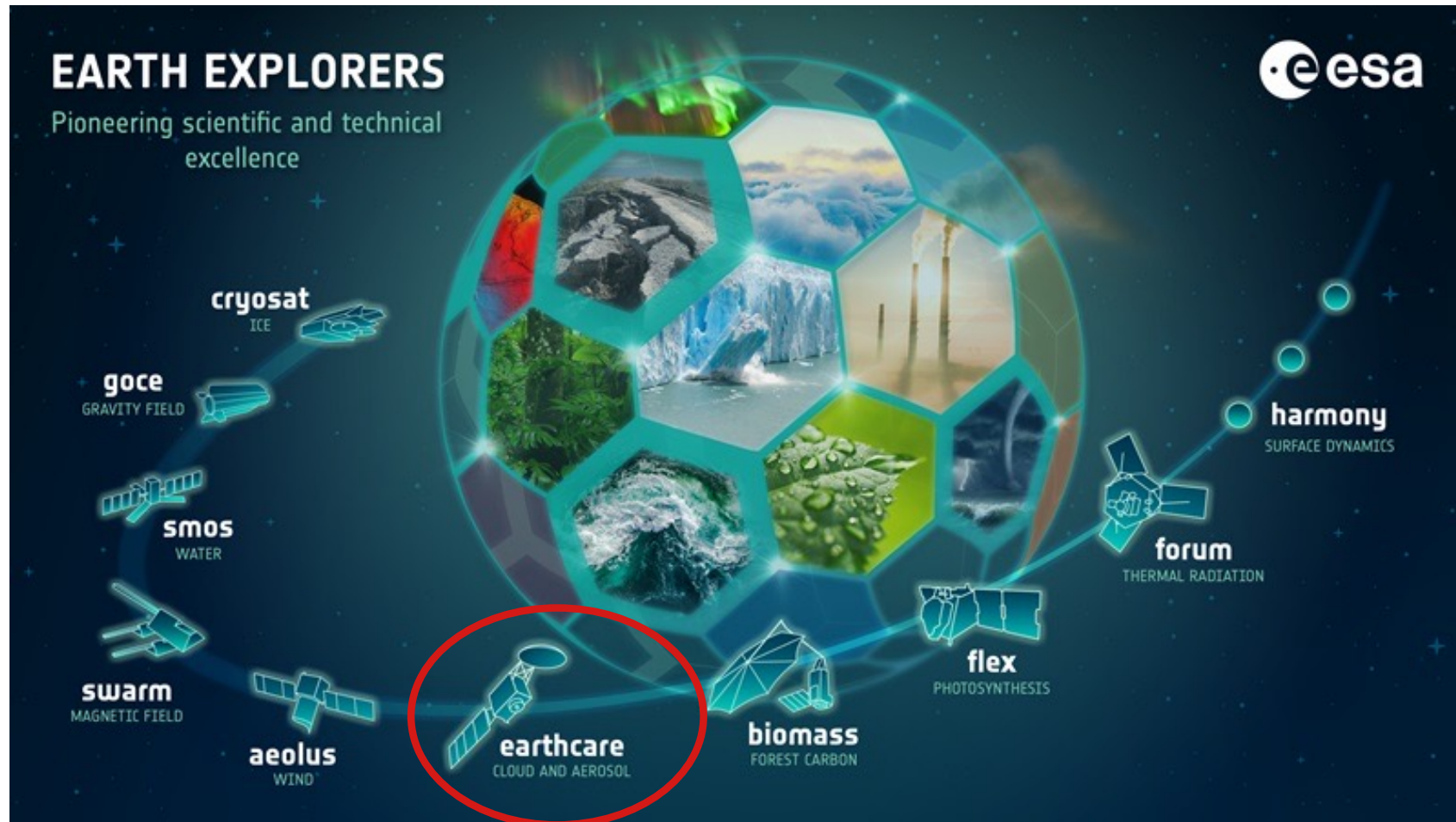


Q2: Sentinel-1D



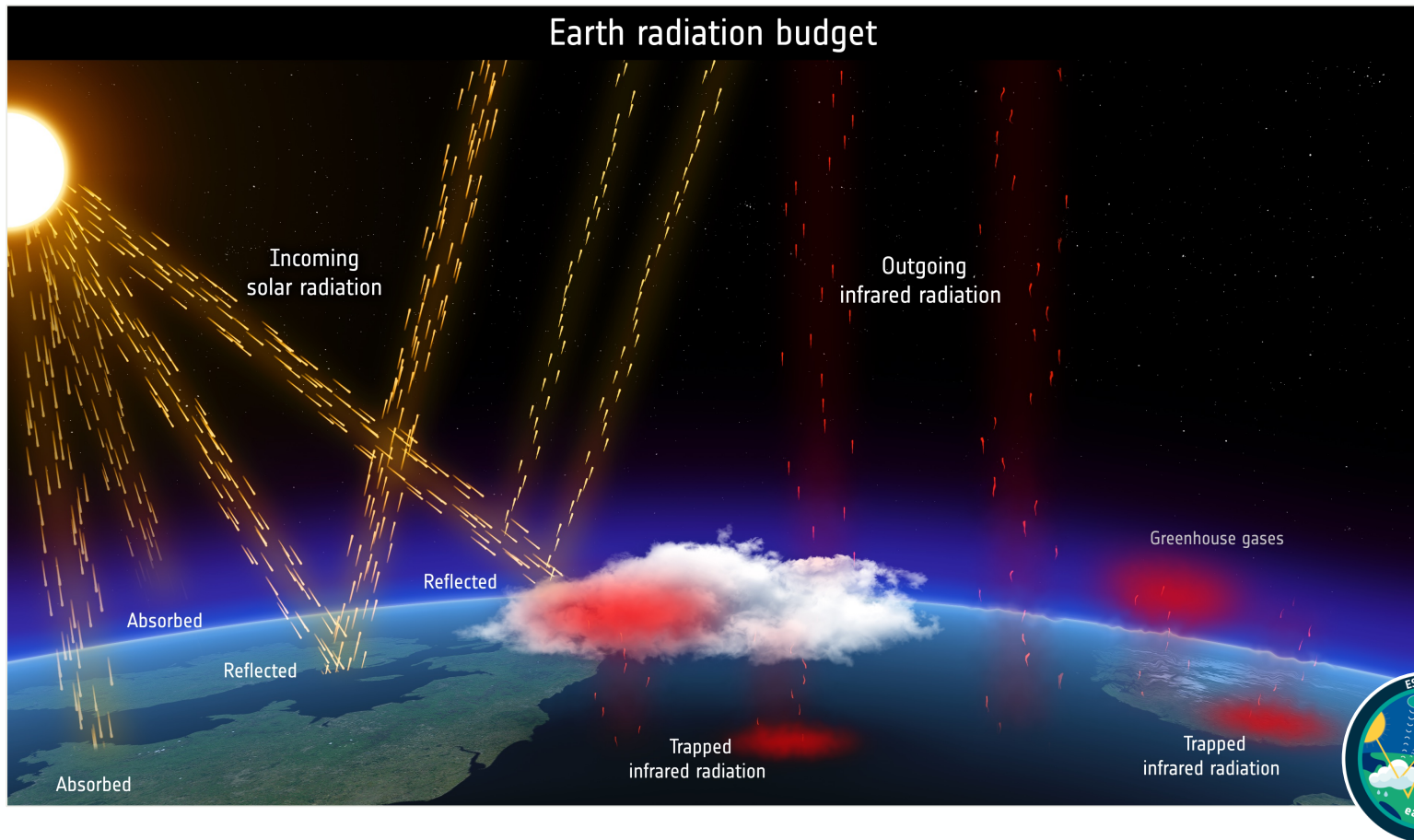
Q4: Sentinel-6B

ESA EOP vision: Earth Explorer



EarthCARE Mission Overview

EarthCARE - Mission

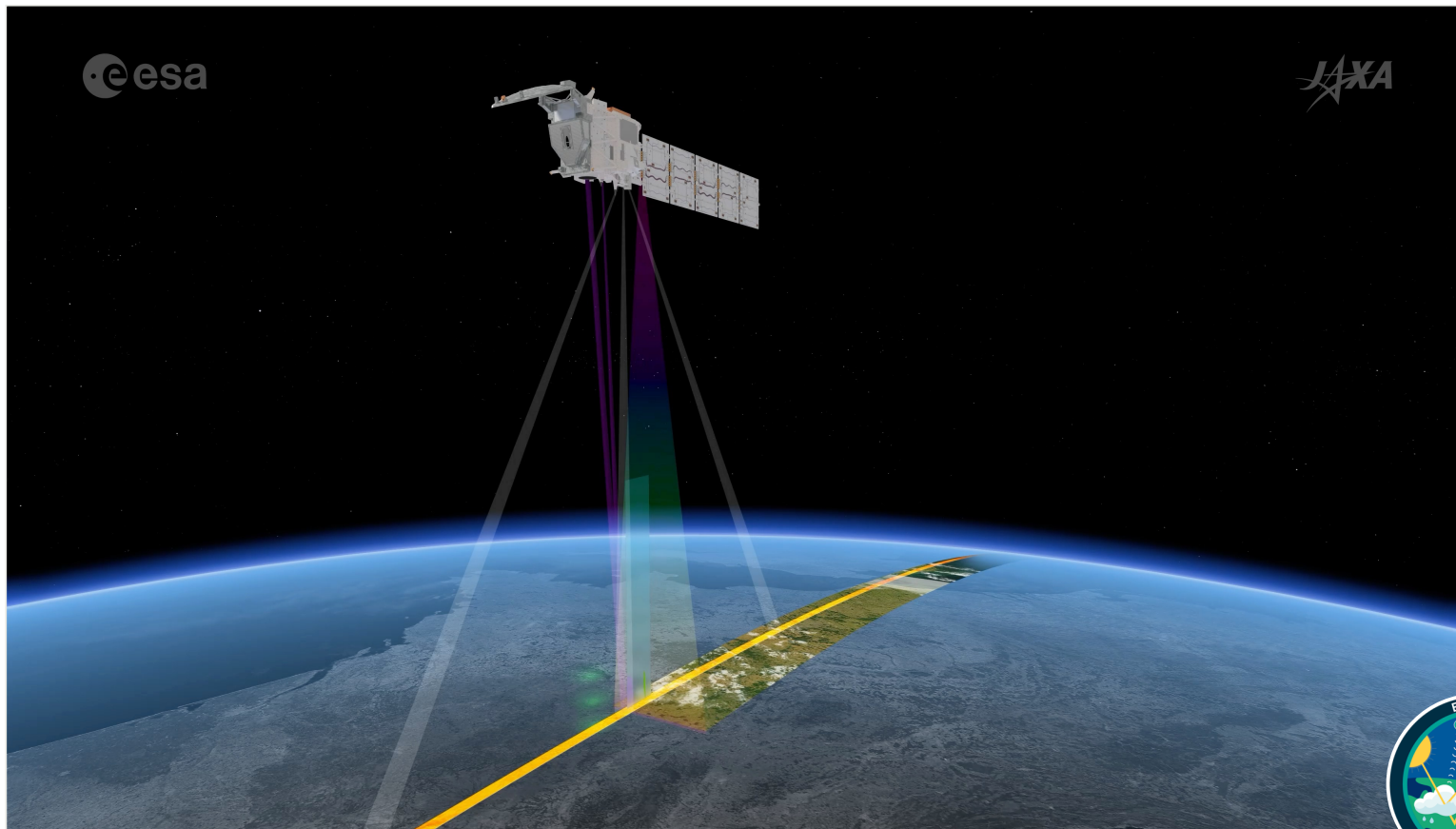


Largest uncertainty in projections of the future climate, to be addressed in order to improve numerical weather prediction and climate modelling, comes from cloud, aerosol and radiation interactions.

How do aerosols and clouds, heat or cool the Earth?



EarthCARE – Mission Objective



Systematic provision of vertical profiles of clouds and aerosols, with measurements of solar and emitted thermal radiation.

How do aerosols and clouds, heat or cool the Earth?

Direct verification of impact of clouds and aerosols on atmospheric heating rates and radiative fluxes.



EarthCARE – Space Segment



CPR

ATLID

MSI

BBR

...a (VNS)



→ THE EUROPEAN SPACE AGENCY

Data Release Schedule



14 Jan 2025 Level 1b Single Sensor Products

17 March 2025

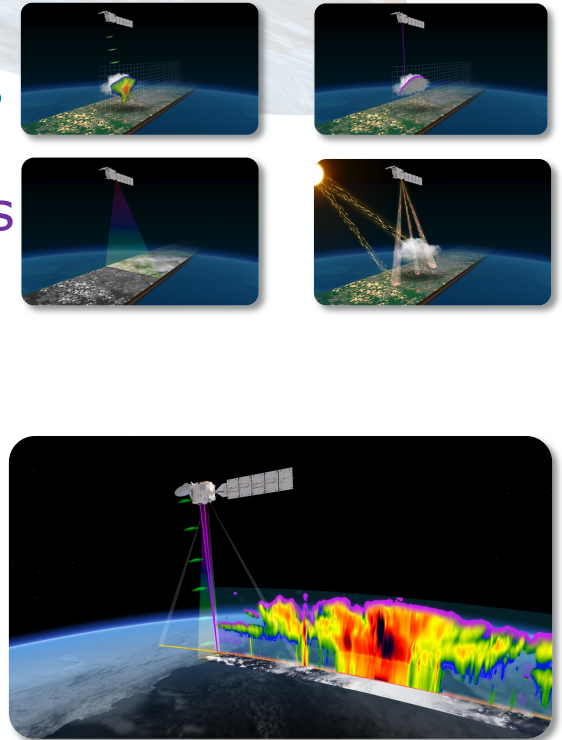
Level 2a Single Sensor Products
Level 2b Two Sensor Products

Dec 2025

Level 2b Synergistic Products*
* Earlier release possible if of sufficient quality

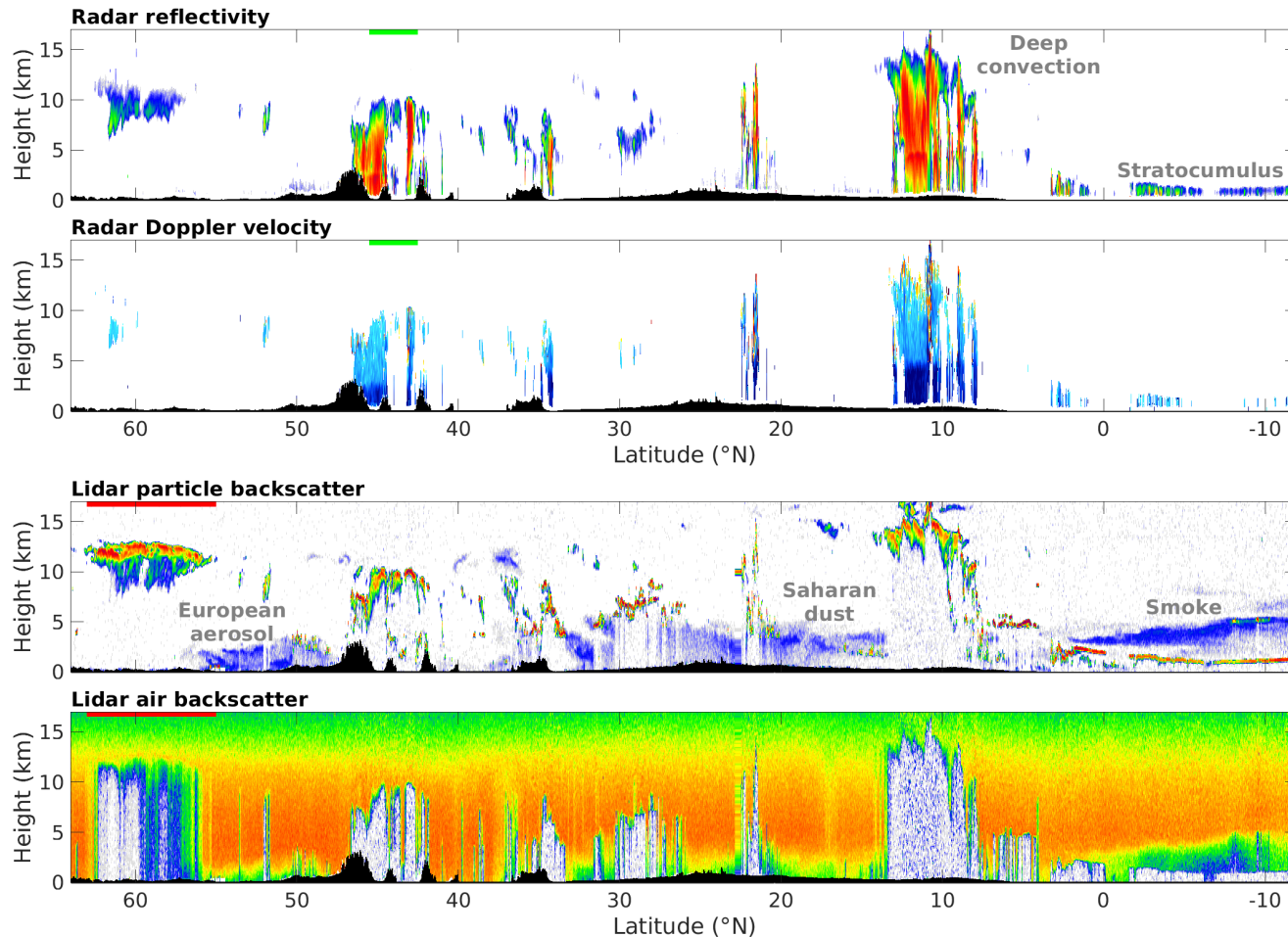
Free and Open Data Policy

<https://earth.esa.int/eogateway/missions/earthcare/data>



First Results: Level-1

Credits: Robin Hogan (ECMWF)



CPR:

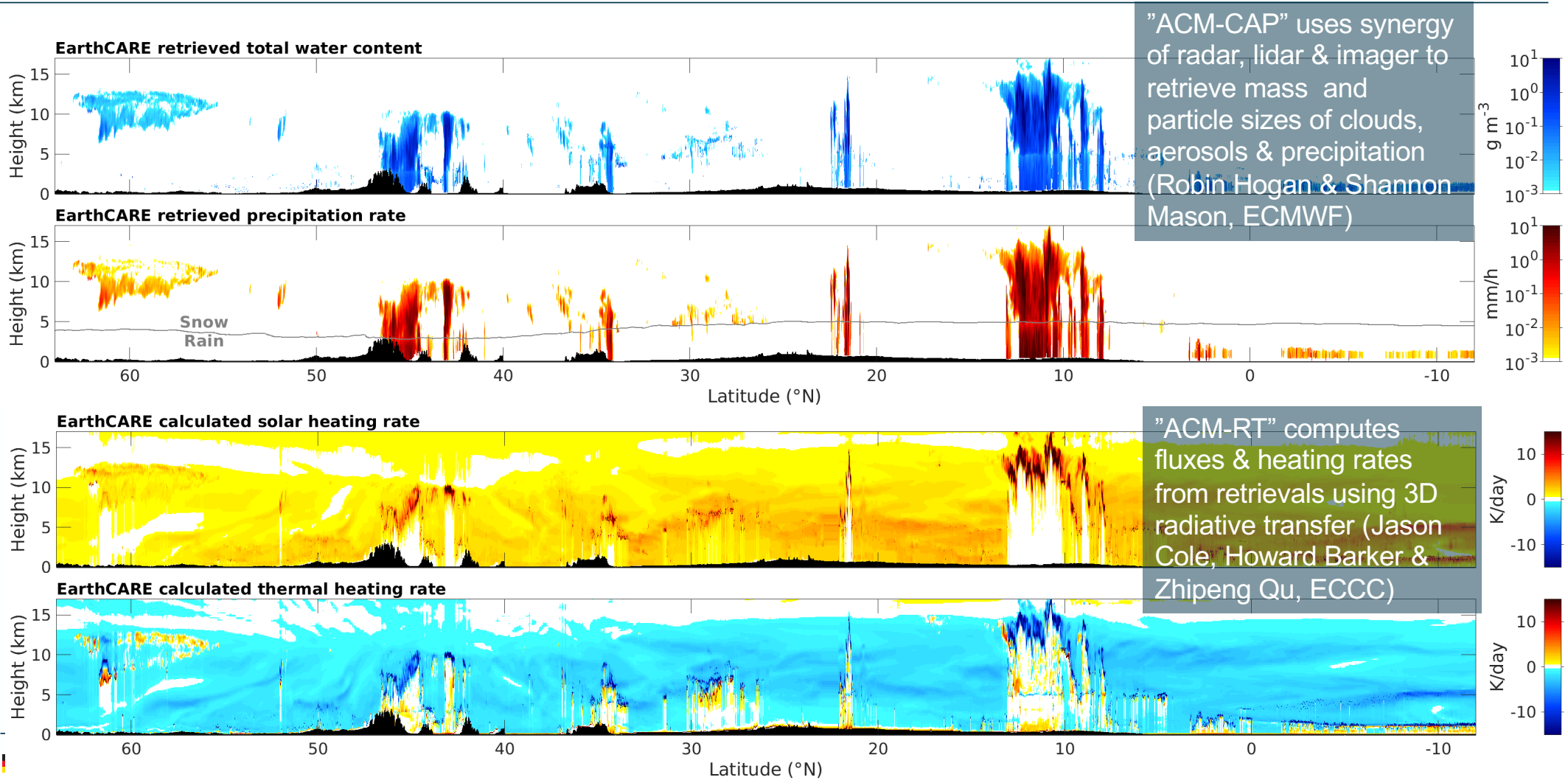
- In stratiform clouds we measure rain and snow fall speeds
- Infer raindrop mean diameter and snow rimed fraction, as well as rain/snow rates
- Strength and width of modest updrafts can be characterized (folding velocity 5-6 m/s)

ATLID:

- HSRL separates backscatter due to particles (“Mie”) and air (“Rayleigh”)
- Attenuation of air gives unambiguous estimate of profile of particle extinction coefficient, most important radiative property of clouds or aerosols

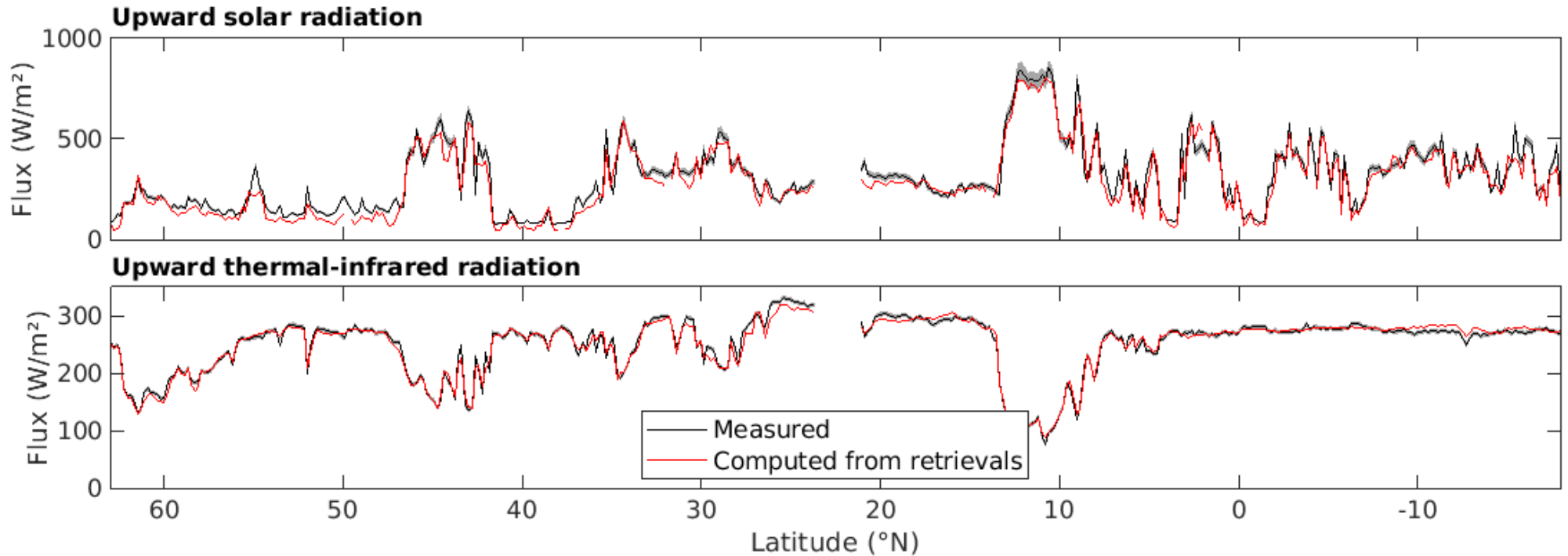


First Results: Level-2



First Results: Level-2

Credits: Robin Hogan (ECMWF)



- If model and measurements agree, it gives us confidence in the retrieved cloud properties, if they disagree then we have something to improve in our algorithms or something to learn about the atmosphere!
- Thermal fluxes calculations now $+3 \pm 7$ W/m² from broadband radiometer measurements: **RADIATIVE CLOSURE!**



EarthCARE Work in progress

- Commissioning activity finalized with industry and **L1 and L2a + two-sensor L2b data public**
- **Validation activities** show very promising results and good performance.
- Data delivery performance is being optimised with **data latency** target at Level 2 being 60% of data within 5.5 hours
- **Cal/Val Workshops:**
 - Level 1b in 14-17 January 2025 (online)
 - Level 2a + 2b two-sensor synergy 17-20 March 2025 (ESA-ESRIN, IT)
- **Science Workshop:**
01-05 December 2025, Tokyo, Japan
- **EarthCARE Science Meeting** in the frame of ESA's Living Planet Symposium (LPS25) in June 2025 (Vienna, AT)



Long Terms Data Preservation:

Why is it crucial to preserve data for a long time?

Why? ... not just why... but also When? And How?

Preserving data (*and all information and content surrounding the data*) for the long term is crucial for ensuring that valuable information remains accessible and useful for future generations. Whether for scientific progress, legal compliance, cultural heritage, or innovation, long-term data preservation plays a key role in shaping a sustainable and informed future.

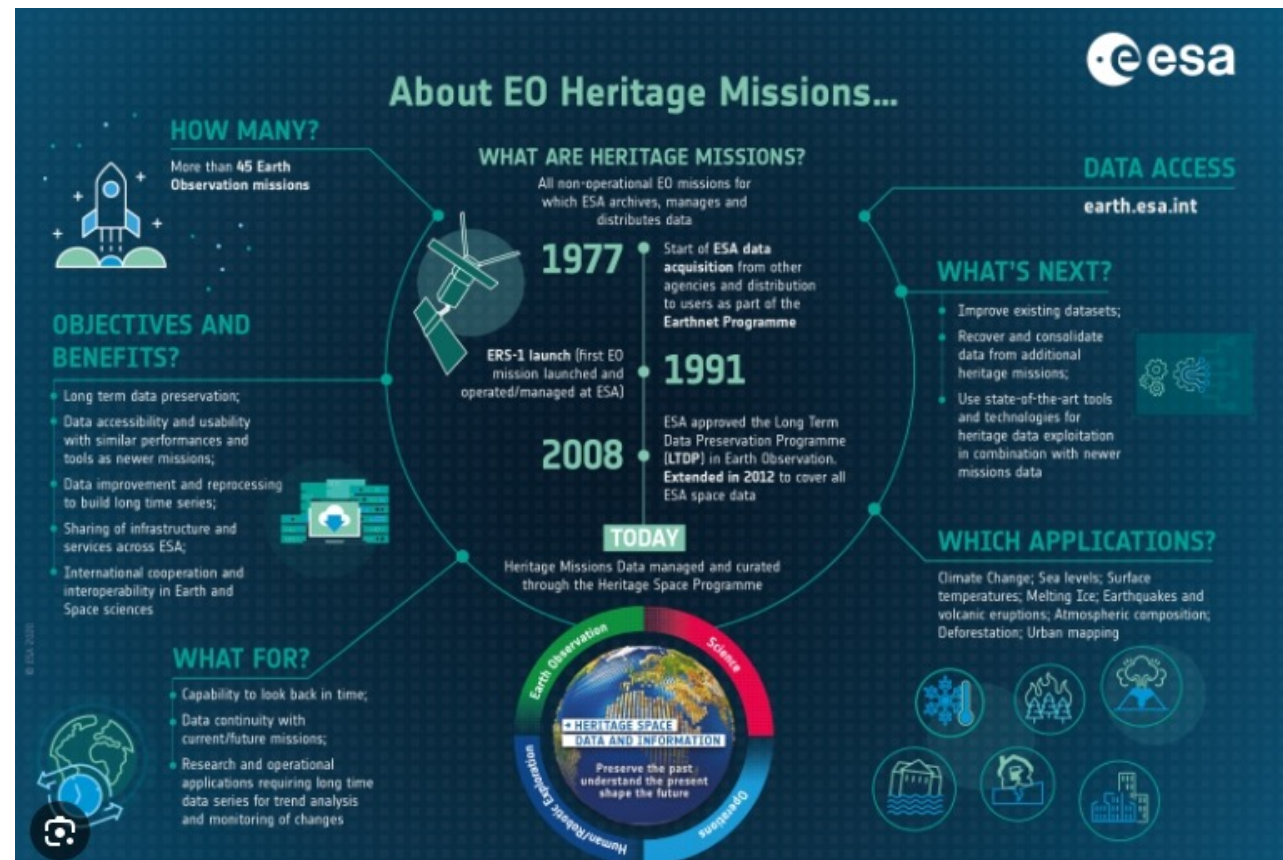


The importance of digital preservation to prevent data loss

"Data loss is not just an inconvenience, it's a piece of our shared history that slips away, that's one of the main reasons why digital preservation is important"

Why? ... not just why... but also When? And How?

- Long-Term Studies: In scientific research, long-term data is often critical for understanding trends and making discoveries over time. For example, climate data collected over decades is necessary for studying climate change.
- Building on Previous Knowledge: Scientists and researchers often rely on older datasets to build new knowledge. Preserving data ensures that future research has access to the data needed.



When? And How?

Space data preservation **should** ideally start during a mission's planning phase and continue throughout its lifecycle and beyond. For current missions, preservation activities should be initiated while the mission is still operational to ensure comprehensive data and information recovery. Long-term preservation is crucial for ensuring the continued usability of data for future scientific research.

- **Early Engagement:** Preservation activities should not be an afterthought. Starting during the planning phase allows for the inclusion of necessary information and tools for future use, ensuring the long-term usability of the data.
- **Continuous Process:** Preservation should not be a one-time event. It's a continuous process that needs to be integrated into all stages of a mission's lifecycle, from planning and operation to decommissioning and archiving.
- **Beyond the Mission:** Preservation extends beyond the mission's operational life. Even when a mission is no longer active, the data it generates remains valuable for future research. Long-term preservation ensures that this data remains accessible and usable.
- **Importance of Associated Knowledge:** To maintain the integrity and usability of preserved data, it's essential to preserve not only the raw data but also associated information, such as metadata, calibration data, processing information, and software.

Long Term Preservation FRAMEWORK

A preservation framework refers to a structured approach or set of guidelines designed to ensure the long-term maintenance, accessibility, and integrity of information or digital assets. This term is most commonly used in the context of digital preservation, where it helps organizations and institutions plan, implement, and manage strategies for the ongoing protection of digital content, like documents, websites, multimedia, and software, over time.

The goal of a preservation framework is to safeguard digital materials from obsolescence, degradation, or loss due to technological changes or other factors. It often involves strategies related to storage, data migration, format sustainability, and access management.

Preservation and Stewardship Best Practices and Guides

Data Preservation and Stewardship						
Doc. Ref.	Document	Curator	Version	Document Date	Status	Last Review Date
DSIG.CLIM	Shared Collection Lifecycle Management Principles for Earth Observation Data	DSIG	1.0	Mar-2025	Up to date	Mar-2025
DSIG.DSMM	WGISS Data Management and Stewardship Maturity Matrix White Paper Maturity Matrix Schema (.xlsx) User Guide	DSIG	1.1	Oct-2024	Up to date	Oct-2024
DSIG.ATE	Archive Technology Evolution White Paper	DSIG	1.0	Jun-2023	Up to date	Jun-2023
DSIG.PIDBP	CEOS Persistent Identifier Best Practice	DSIG	1.4	Mar-2023	Up to date	Mar-2023
DSIG.GLOS	EO Data Stewardship Glossary of Acronyms and Terms	DSIG	1.3	Apr-2021	Up to date	Apr-2021
DSIG.TCAIPBP	CEOS Technical Content and Associated Information Preservation Best Practice	DSIG	1.2	Mar-2023	Up to date	Mar-2023
DSIG.MEODU	Measuring EO Usage Best Practice	DSIG	1.1	Mar-2023	Up to date	Mar-2023
DSIG.DSRM.TN	Data Stewardship Reference Model White Paper	DSIG	1.0	Dec-2018	Up to date	Dec-2018
DSIG.TN	Data Purge Alert White Paper	DSIG	1.0	Apr-2016	Up to date	Apr-2016
DSIG.PW	Preservation Workflow	DSIG	1.1	Mar-2023	Up to date	Mar-2023
DSIG.EODPG	EO Data Preservation Guidelines	DSIG	1.1	Mar-2023	Up to date	Mar-2023
DSIG.GEODSCP	Generic Earth Observation Data Set Consolidation Process	DSIG	1.0	Mar-2015	Up to date	Mar-2015
DSIG.EOPDSC	EO Preserved Data Set Content	DSIG	1.1	Mar-2023	Up to date	Mar-2023
DSIG.BDG	Browse Guidelines	DSIG	2.0	Aug-2013	Up to date	Aug-2013
DSIG.TN01	Long Term Archive Strategies	DSIG		Sep-2011	Up to date	Sep-2011

CEOS Committee on Earth Observation Satellites

Search

CEOS / Our Groups / Working Groups / WGISS

Our Groups

- Other Groups
- Ad Hoc Teams
- Virtual Constellations
- Working Groups

WGISS

- Data Discovery and Access
- Data Interoperability and Use
- Data Preservation and Stewardship
- Technology Exploration
- Best Practices and Guides
- Meetings
- Collaborations & Past Activities
- Contact Us

WGDisasters
WGClimate
WGCv
WGCapD

WGISS Organizational Structure

WGISS Principals

- AIM: Adrian Guzman
- CASIRI: Deyang Liu
- CASINRSC: Chuang Liu
- CNES: Pierre-Marie Brunet
- CONAE: Innocencio Lopez
- CSA: Paul Briand
- COSRO: Matt Paget
- DLR: Jonas Eberle
- EC: Daniel Quirant
- ESA: Mirko Albani
- EU/ETSAT: Michael Schick
- GA: Michael Wellington
- GISTDA: Panu Srestasathien
- HRF: Lubia Vrhovac
- ISRO: Nitant Dube
- JAXA: Makoto Natsusaka
- NASA: Katie Barnes
- NDA: Kenneth Casey
- NISQ: Raymond Stuber
- ROSCOSMOS: Tamara Ganna
- UKSA: Robert Fretcher
- USGS: Tom Sohre
- VSNIC: Vu Anh Tuan

Chair: Tom Sohre, USGS
Vice-Chair: Nitant Dube, ISRO
Secretariat: Libby Rose, Symbols for USGS

Data Preservation and Stewardship Interest Group: Mirko Albani, ESA

Data Interoperability and Use Interest Group: Nitant Dube, ISRO

Data Discovery and Access Interest Group: Damiano Guerrucci, ESA
- IDN Michael Morahan, NASA
- Fedro Damiano Guerrucci, ESA
- CWIC Minnie Wong, NASA

Technology Exploration Interest Group:
Yousuke Ikehata, JAXA
Maral Bayaraa, UKSA

The Working Group on Information Systems and Services (WGISS) promotes collaboration in the development of systems and services that manage and supply Earth observation data. WGISS addresses the internal management of EO data, the creation of information systems and the delivery of interoperable services. The activities and expertise of WGISS span the full range of the information life cycle from the requirements and metadata definition for the initial ingestion of satellite data into archives through to the incorporation of derived information into end-user applications.

WGISS Activities

WGISS has a wide range of ongoing and past activities, separated broadly into the four interest groups below. WGISS welcomes participation from the wider community, and invite you to [get in touch](#).

<https://ceos.org/ourwork/workinggroups/wgiss/documents/>

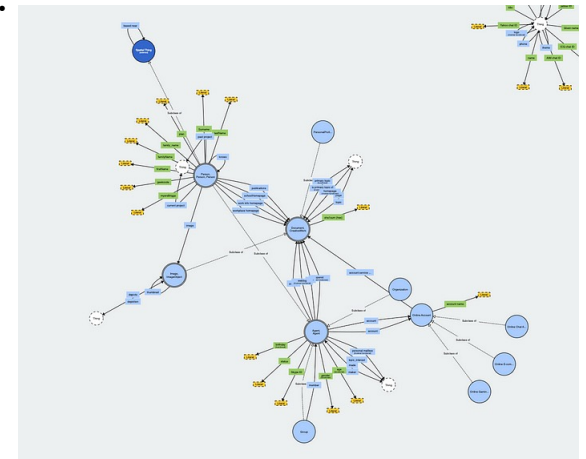
Data Provenance and Context

"**Space Data Provenance**" refers to the ability to trace the **origin, history, and contextual meaning** of data generated by space systems such as satellites, space probes, rovers, or space stations. It is a crucial aspect of ensuring the **integrity, reliability, and usability** of space-derived information. "**Context**" provides the **background and situational awareness** necessary to interpret the data.

Data Provenance in Space Systems

Data provenance refers to the **documentation of the data lifecycle**, including:

- **Where** the data originated (e.g., specific satellite sensor)
- **When** it was collected (timestamping)
- **How** it was processed (calibration, transformations)
- **Who** or what processed it (software, algorithm version)
- **Why** it was created (mission objective or research goal)



Heritage Missions

Long Time Series of EO Data

Earth Observation Heritage Missions



ERS-1 **ERS-2**

Envisat **GOCE**

ESA Heritage Missions

EO Campaigns

HCMM **Nimbus 7** **MOS-1/1b** **JERS-1** **LANDSAT 1-2-3** **MODIS** **IRS-P3**

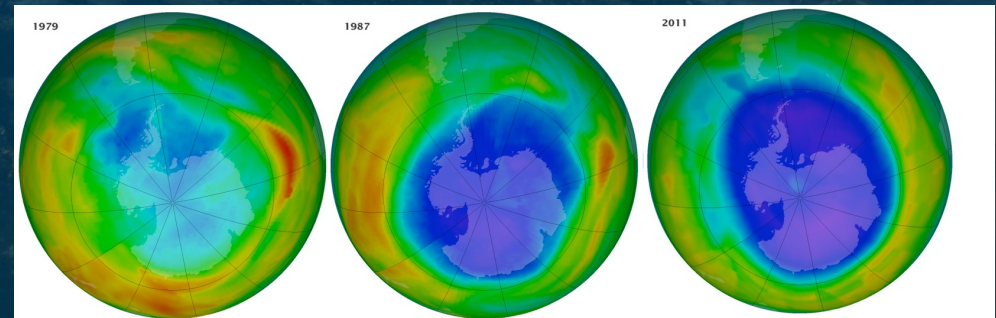
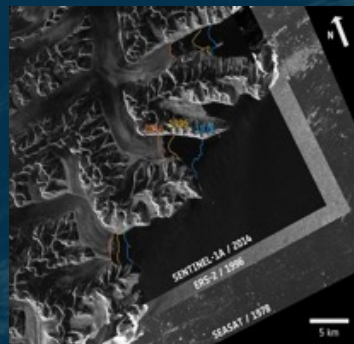
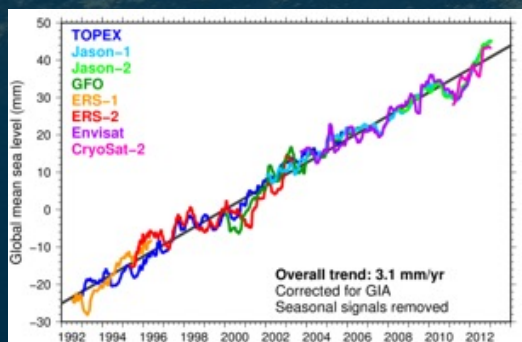
Quickcat **SEASAT** **ADEOS-1** **ALOS 1** **LANDSAT 4-5** **Terra/Aqua** **RADARSAT-1**

Ikonos-2 **SPOT 1 to 5** **Orbview-2** **SeaWiFS** **POES AVHRR 7 to 17** **LANDSAT 7** **QuickBird-2**

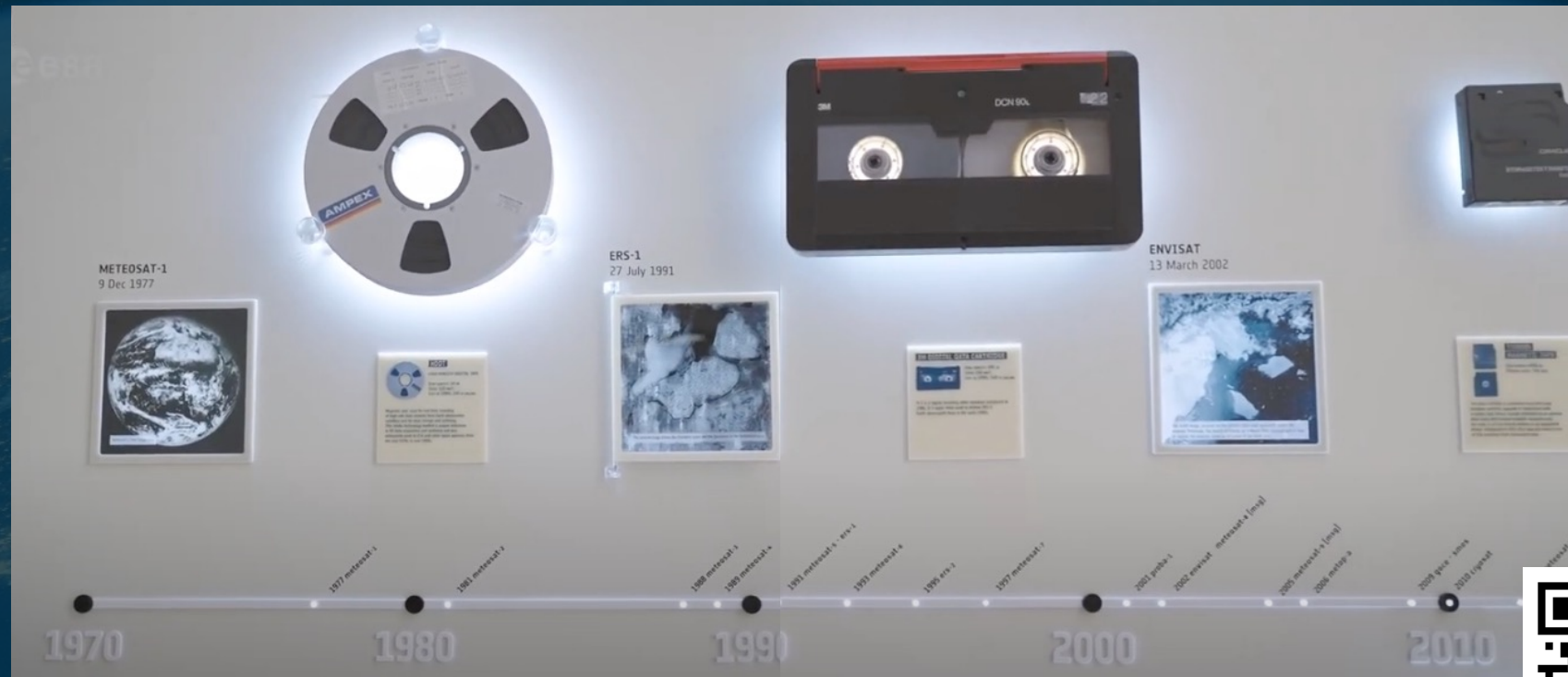
IRS-1C/1D

Thematic Collections

ESA Heritage Third Party Missions



preserving the past to understand the present and better shape the future



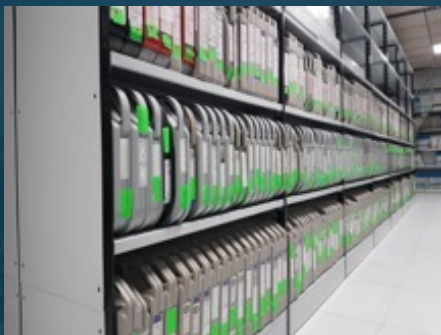
[How ESA stores Earth observation data](#)



Heritage Data Consolidation (including media transcription) & Archiving



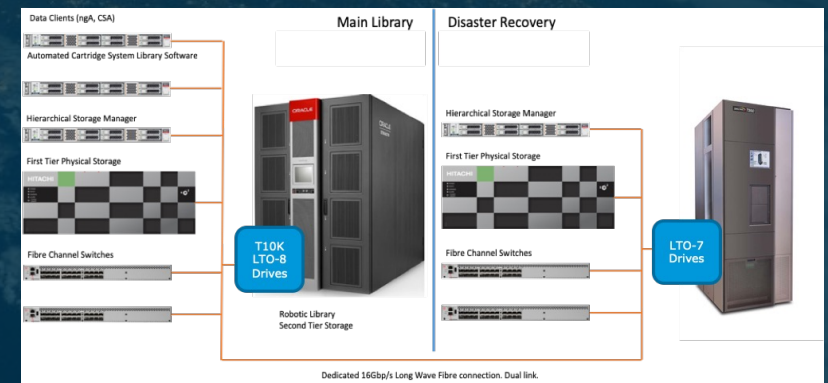
All EO heritage missions: data & information *consolidation, archiving/preservation to prevent loss*



ERS SAR Master consolidation overall results	2016	2022
Estimated completeness ERS-1 (data coverage vs recorded unavailabilities)	82%	95%
Estimated completeness ERS-2 (data coverage vs recorded unavailabilities)	88%	97%

Sensor / Type of product	Estimated completeness % (data coverage vs recorded unavailability's)
RA / ERAC	97.82%
MWR / EMWC	97.83%
SWM / EWAC	93.56%
WSC / EWIC	96.06%
ATSR-1 / RATSr	99.50%
Telemetry / EGH	96.69%

Sensor / Type of product	Estimated completeness % (data coverage vs recorded unavailability's)
RA / ERAC	96.53%
MWR / EMWC	97.56%
SWM / EWAC	84.62% (*)
WSC / EWIC	86.16% (*)
ATSR-2 / EATC-2	91.51%
GOME / EGOC	98.95%
Telemetry / EGH	82.74%



Heritage Data Reprocessing and Curation

High priority missions: *valorisation* activities to facilitate data exploitability & usability, and generation of *few Fundamental Data Records (FDRs)*

- Improve data quality (e.g. new algorithms, new auxiliary files)
- Align heritage missions datasets to new missions (e.g. Sentinels) using new IPFs / algorithms to generate long time data series
- Change data format to facilitate usability and better exploit modern technologies/tools (e.g. Data Cubes)
- Ensure compliance to CEOS Analysis Ready Data (ARD) specifications
- Generate new products

Mission	Instrument	Product type	
ERS	AMI/SAR	SAR_IMM_1P	
ERS	AMI/SAR	SAR_IM__BP	
ERS	AMI/Scatterometer	WSC_ASP_15	
ERS	AMI/Scatterometer	WSC_ASH_2P	
ERS	AMI/Scatterometer	WSC_ASN_2P	
ERS	AMI/Scatterometer	WSC_HEY_1P	
ERS	AMI/Scatterometer	WSC_UWI_2P	
ERS	ATSR-1/2	ATS_TOA_1P/AT_1_RBT	
ERS	ATSR-1/2	ATS_TOA_1A	
ERS	AMI/SAR	SAR_IMM_1P	Snow-CCI

ERS Full (Re)processing activities (example)

Heritage Data and Information Discovery and Access



All EO heritage missions: *Discoverability/accessibility* possibly with same performance as new missions

- **Online access** through ESA dissemination systems
- **Open and free** according to ESA EO Data Policy
- User **Registration** and acceptance of Terms and Conditions of use
- Restrained dataset access initiated via *Data Service Requests*
- Visualization and analysis tools

The image shows a composite of two screenshots. The top screenshot is the 'Updated ESA Earth Observation Data Policy (Simplified version)' document, which outlines the objectives and legal framework for the use of ESA EO data. The bottom screenshot is the 'HERITAGE MISSIONS' page on the Earth.esa.int website, featuring a navigation menu, a search bar, and a central content area with a satellite image and text about heritage missions.

DATA ACCESS <https://earth.esa.int/eogateway/missions/heritage-missions>



→ THE EUROPEAN SPACE AGENCY

ESA Fundamental Data Records (FDR4*) projects



- Addressing **valorisation** of heritage assets (e.g. ERS-1/-2, Envisat)
- Generating ESA-specific **multi-mission long-term datasets**
- **Relevance for applications and ESA CCIs**
- **Two projects** started in 2019 with 3-year duration
 - **for Altimetry (FDR4ALT)**
 - **for Atmospheric Composition (FDR4ATMOS)**

• Key aspects

- Pursue **harmonization** of different sensors and improve calibrations
- **Uncertainty characterization** based on EO metrological guidelines
- Target a **wider user community**
- Allow **interoperability** and continuity towards current & future projects



Fundamental
Sensor data (L1)



Thematic Geophysical
Parameters (L2+)



**Completed and data opening to users
since Q1 2024**

**Follow-on activities started in
2024**



Maximising the value of Heritage Data through ESA's Fundamental Data Records (FDR)

What

An FDR is a consistently reprocessed record of uncertainty-quantified sensor observations that are calibrated to physical units and located in time and space. FDRs contain also all supplementary and lower-level instrument data, used to calibrate and locate observations, and to estimate uncertainty

Why

Time series of data are of increasing importance not only for climate, but also for operational services and applications. Expanding these time series improves our capability to look back in time, and to address major challenges affecting our planet and environment

Applications and user benefits

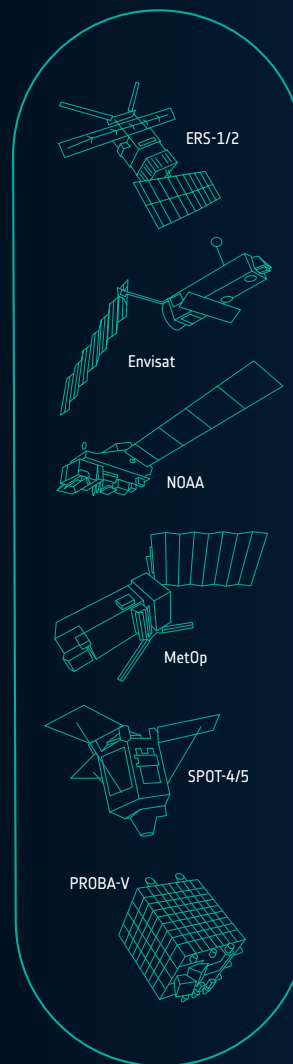
- Availability of multi missions heritage data series
- Availability of new thematic products addressing several applications domains
- Availability of improved quality heritage datasets with improved calibrations, to reduce multi-mission bias
- Heritage data harmonisation with newer missions
- Allow interoperability and continuity
- Enhance traceability of satellite-derived EO data
- Improve uncertainty estimates (metrological principles)
- Support new applications and services for a wider user community

How

ESA is building long time series of improved quality heritage data, through several FDR projects, boosting the data quality and alignment with current missions. In addition, such projects build new Thematic Data Products (TDP), addressing several application domains

Which

ESA's dedication to FDRs dates back to 2019, with the launch of two initial projects: FDR4ALT and FDR4ATMOS for which first version datasets have been released. Follow-on and additional FDR projects were started in 2023, to address other datasets



FDR4ALT

MISSION (INSTRUMENTS)

ERS-1/2, Envisat
(Radar Altimeter & Microwave Radiometer)

PRODUCT

FDR and TDP datasets for Radar Altimeter and Microwave Radiometer

DATE RANGE 1991 - 2012

STATUS

1st version released.
Follow-on project in progress

FDR4ATMOS

MISSION (INSTRUMENTS)

ERS-2, Envisat
(GOME), (SCIAMACHY)

PRODUCT

FDR dataset for Atmospheric composition

DATE RANGE 1995 - 2012

STATUS

1st version released.
Follow-on project including MetOp GOME-2 in progress

FDR4ATSR

MISSION (INSTRUMENTS)

ERS-1/2, Envisat
(ATSR), (AATSR)

PRODUCT

FDR dataset for Along Track Scanning Radiometers compatible with Sentinel-3 SLSTR

DATE RANGE 1991 - 2012

STATUS

Project in progress

FDR4LDYN

MISSION (INSTRUMENTS)

ERS-1/2
(Scatterometer (ESCAT))

PRODUCT

FDR for Land Dynamics dataset from C-band Scatterometer compatible with MetOp (ASCAT)

DATE RANGE 1991 - 2011

STATUS

Project in progress

FDR4AVHRR

MISSION (INSTRUMENTS)

NOAA, MetOp
(AVHRR)

PRODUCT

FDR reflectance and brightness temperatures dataset for Advanced Very-High-Resolution Radiometer

DATE RANGE 1981 - 2024

STATUS

Project in progress

FDR4VGT

MISSION (INSTRUMENTS)

SPOT-4, SPOT-5, PROBA-V
(VGT1), (VGT2), (VGT)

PRODUCT

FDR for Vegetation dataset based on land and coastal surface reflectance measurements by VGT instruments

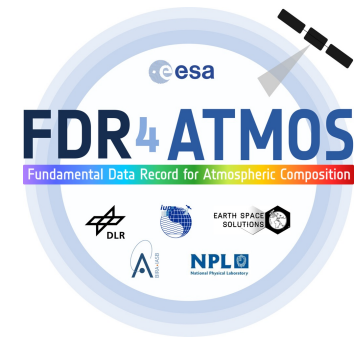
DATE RANGE 1998 - 2014

STATUS

Project in progress

See first release of the [FDR4ALT](#) and [FDR4ATMOS](#) data collections

FDR4ATMOS

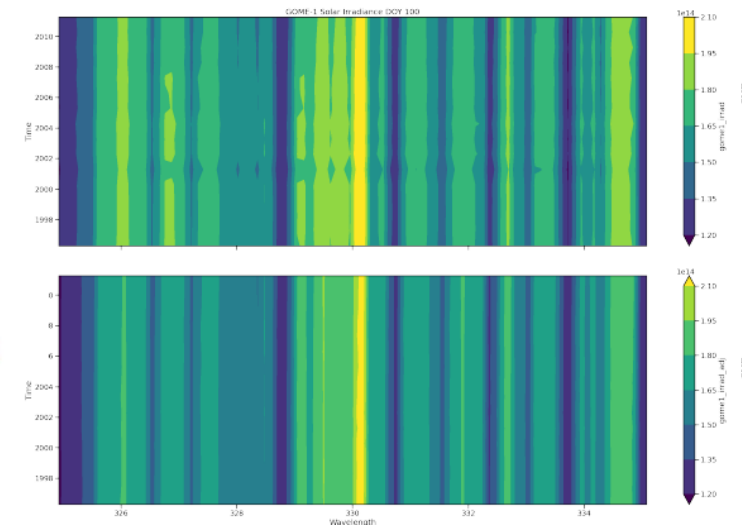


- The Fundamental Data Record for ATMOSpheric Composition (FDR4ATMOS) project builds cross-instrument harmonised irradiance and reflectance time series (L1B) in the UV, VIS and NIR spectral windows used for O3, SO2, NO2 total column retrieval and the determination of cloud properties.
- Project phases:
 - 2019-2024: Harmonisation ERS-2/GOME-1 and Envisat/SCIAMACHY,
 - 2024-2026: Add MetOP/GOME-2 to timeseries, in cooperation with EUMETSAT. V2
- <https://doi.org/10.5270/ESA-852456e>
- Corrected for instrumental effects (aging, etalon)
- Harmonised the broadband signal offset while keeping spectral structures
- Reflectance harmonisation over matching scenes (PICs) to derive scaling factors

GOME Solar Irradiances Harmonisation to independently validated SCIAMACHY SMR

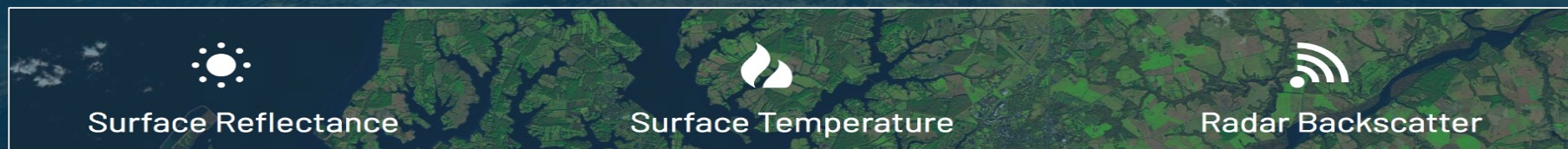
$$S_{inst1} = S_{inst2} \times C_{\Delta inst} \times C_{1,scene}(geometry, S_{inst1,2}, \dots) + C_{2,scene}$$

- V1 data set released Q3/2024



CEOS-ARD ANALYSIS READY DATA

CEOS: « Analysis Ready Data are satellite data that have been processed to a minimum set of requirements and organized into a form that allows **immediate analysis with a minimum of additional user effort** and **interoperability both through time and with other datasets**



CEOS-ARD SR

Sentinel-2
Proba-V
MERIS

CEOS-ARD ST

Sentinel-3
(A)ATSR

CEOS-ARD NRB

Sentinel-1
(A)SAR

Pilot activities completed

Follow-on activities started in 2024



- **Living Collection, 80+ Campaigns currently included**

- *ground-based*
- *ship-borne*
- *balloon-borne*
- *airborne*

- *small satellite field experiments that validate orbiting ESA EO satellites and support future mission development*



Full list of ESA EO Campaigns Data Collections available on [ESA Earth Online](#)

Online access upon registration

EVDC Overview

STARION

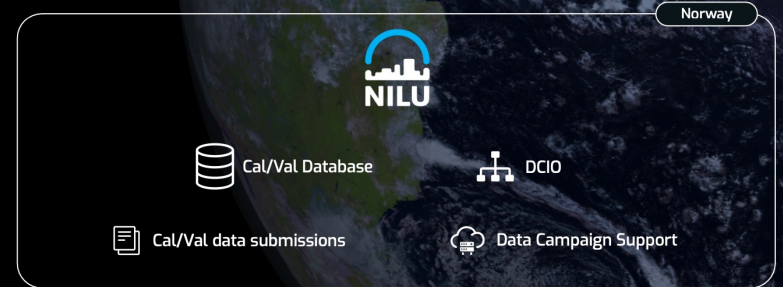
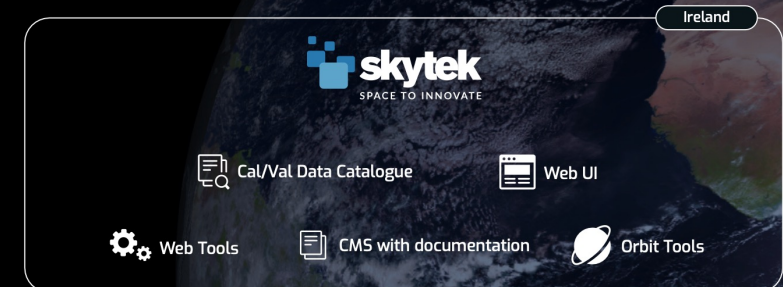
skytek

ICHEC
Irish Centre for High-End Computing

nilu

esa

- The ESA atmospheric Validation Data Centre (EVDC) is the official ESA repository for correlative data in the atmospheric domain . It provides access to:
- Groundbased, aircraft and balloon Cal/Val files and **Fiducial Reference Measurements (FRMs)**
- Complete and up-to-date access of Sentinel 5P, Aeolus, MIPAS and the forthcoming **EarthCARE products**
- Tools, processes and documentation for data submitters (**GEOMS** standarization activities, data sharing agreements)
- Tools for data collection campaign planning (**Orbit Prediction and Overpass Tool - OPOT**)
- **Collocation Reference Database**
- Tools for processing data in the cloud (subsetting, merging, visualisation etc)
- CWL Based processing system with visual workflow builder, including EarthCARE tools (e.g.: CIS, MSI, Lidar, Radar tools)



EVDC Cal/Val Database



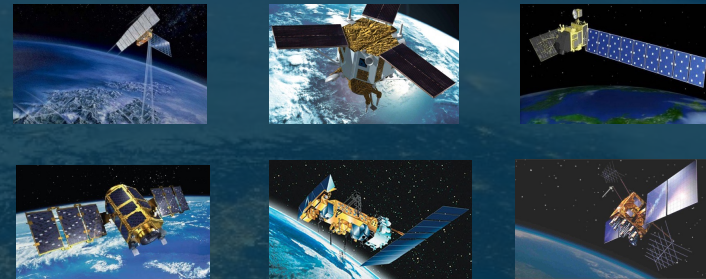
- ESA atmospheric Validation Data Center (EVDC), ESAs in-house Cal/Val database covering:
- Data from historical and ongoing campaigns
- Remote sensing and in-situ measurements from ground-based and airborne stationary and mobile platforms (aircraft, balloon, bouy, drone, ship)
- Operational data in near-real-time from research infrastructures in Europe and America such as ACTRIS (CloudNet, EARLINET), TOLNet, MPLNet, Pandonia Global Network.
- Links to other data archives and network e.g. AVDC, NDACC
- Data from 1965 until present
- More than 1400 users where more than 200 for EarthCARE Cal/Val

Cal/Val search UI

Data Protocols

HERITAGE THIRD PARTY MISSIONS (TPM) - excerpt

- *ALOS (AVNIR/PRISM/PALSAR)*
- *DMC 1st Generation*
- *IKONOS-2*
- *IRS-1C/1D*
- *JERS-1 (SAR/Optical)*
- *Kompsat-1/2*
- *Landsat 1-7 Series (MSS, TM)*
- *MOS-1/1b*
- *NOAA POES AVHRR*
- *QuickBird-2*
- *IRS-P3*
- *SeaSat*
- *SPOT-1 to 5*



Full list of Heritage TPM ESA Data
collections available on
[ESA Earth Online](#)

In Summary



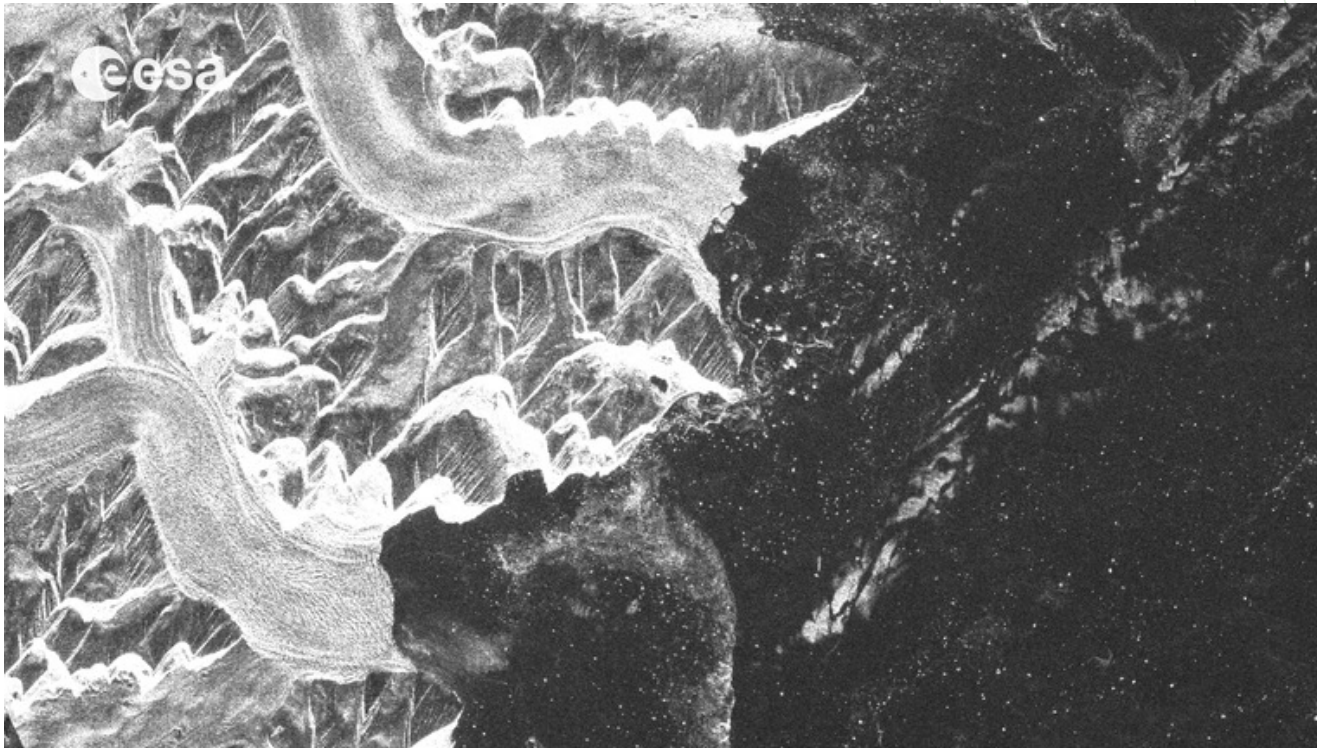
1. ESA Heritage Data Holdings consists of 150+ ESA and Third Party missions & ESA EO Campaigns data from mid 70's → providing a unique capability to look back in time
2. These assets are preserved, maintained accessible (open and free) and curated in the frame of the Heritage Space Programme; Several activities are ongoing to:
 - Recover unique data from old media and private/public entities not providing access
 - Generate new products from heritage data and build long time series with newer missions

→ **Several new datasets accessible**



Applications

36 years of glaciers retreat - Greenland



ESA copyright - ©ESA

Deforestation – Bolivia (1986-2022)



ESA copyright - ©ESA



THANKS!

IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
(D.D. n. 130/2022 - CUP B53C22002150006) Funded by EU - Next Generation EU PNRR-
Mission 4 “Education and Research” - Component 2: “From research to business” - Investment
3.1: “Fund for the realisation of an integrated system of research and innovation infrastructures”

