ACTRIS Expert Group on Satellite Cal/Val

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with contributions from ACTRIS' EG-Sat

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Atarri meeting, Limassol, June 17, 2025

Outline

- Potential of ACTRIS for satellite validation

- EG SAT: The experience and pratcises so far

- How to establish the cooperation between ESA/EUMETSAT and ACTRIS

- EG Sat future activities

Harmonized measurements and methodologies

150 atmospheric variables
~35 aerosol variables
65 trace gases
20 cloud variables
58 methodologies
time resolution ranging from seconds to 1 week

Increasing number of sites with NRT data

"*ACTRIS is the new European Research infrastructure Consortium for short-lived atmospheric constituents and clouds, supporting fundamental research and excellence in Earth system observation. The primary objective of ACTRIS is* **to produce high-quality integrated datasets in the field of atmospheric sciences and to provide services, including access to instrumented platforms, tailored for scientific and technological use**."

Laj et al., BAMS, 2024

Atmospheric observations for societal needs

Climate change
Quantifying the radiation balance of the Earth requires four-dimensional observations short-lived atmospheric constituents

Emissions in industrial hotspots
Monitoring and reducing industrial emissions requires enhanced observations and technological research

Air quality in urban areas
Understanding the impact of air pollution on public health requires knowledge on harmful short-lived constituents

Atmospheric hazards
Reducing societal vulnerability to atmospheric hazards requires actions from hazard identification to emergency management
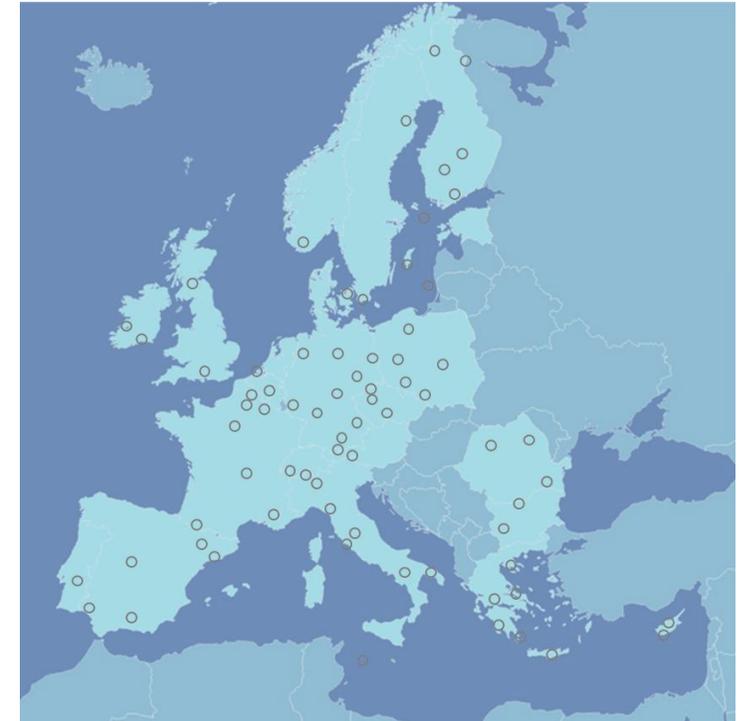
Validation of Earth observations from space
Applying space-borne sensors for Earth observations requires fiducial reference measurements from ground

Evaluation of models and data assimilation
Predicting weather and climate requires observations with a high level of precision, coherence and integration

22 Countries
85 Observational Platforms
38 Exploratory Platforms
6 Topical Centres
1 Data Centre
1 Head Office

The need for an ACTRIS Expert Group on Satellite Cal/Val

➢ The Expert Group on Satellite Cal/Val (EG-Sat) was established in 2024. It is composed of one nominated representative from each ACTRIS Central Facility (8), and up to 13 members selected by the ACTRIS National Facility Technical and Scientific Forum

➢ It is an advisory body which provides recommendations to the ACTRIS Director General (DG) and to the ACTRIS community in support of Cal/Val for satellite atmospheric missions

➢ EG-Sat role is "**to act as the interface with the space agencies and Copernicus regarding the design, planning and implementation of ACTRIS activities in support of Cal/Val for satellite atmospheric missions**."

➢ EG-Sat can give specific mandates to its members for specific issues/topics.
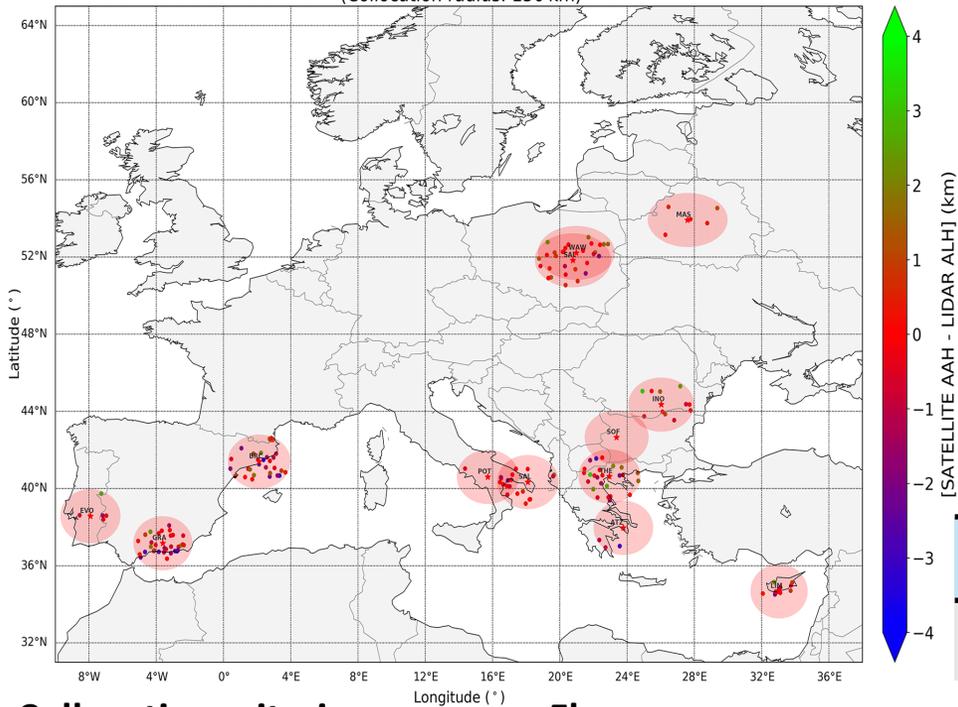
The experience and pratcises so far

- Involvement of ACTRIS stations in operational validation (e.g. ACSAF)

- Use of network data in operational validation (GOME-2, TROPOMI)

- Dedicated campaigns (e.g. CALIPSO, CATS, AEOLUS…)

- Pilot studies – The ATMO-ACCESS framework

- ESA accepted proposal for Calibration and Validation Activities for Sentinel-4 and Sentinel-5

Validation of GOME-2 Absorbing Aerosol Height

13 ACTRIS/EARLINET stations

Spatial distribution of collocated cases GOME2 - EARLINET stations
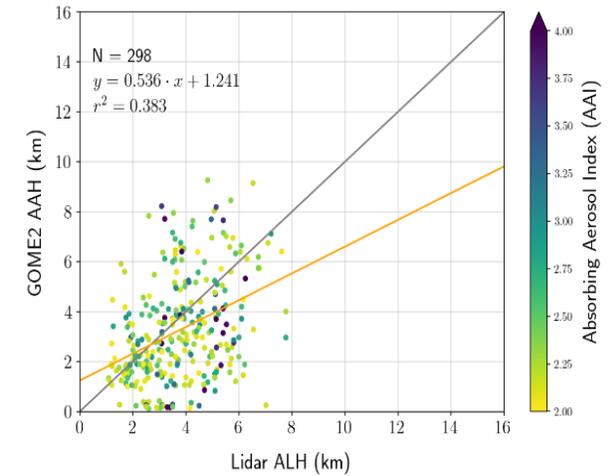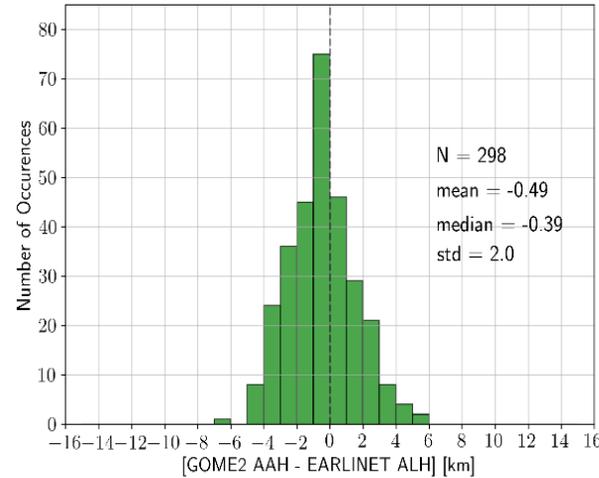(Collocation radius: 150 km)

N = 298
mean = -0.49
median = -0.39
std = 2.0

N = 298
$y = 0.536 \cdot x + 1.241$
$r^2 = 0.383$

We compare the top boundary of the upper most aerosol layer with GOME-2 AAH

Collocation criteria   **Flags**

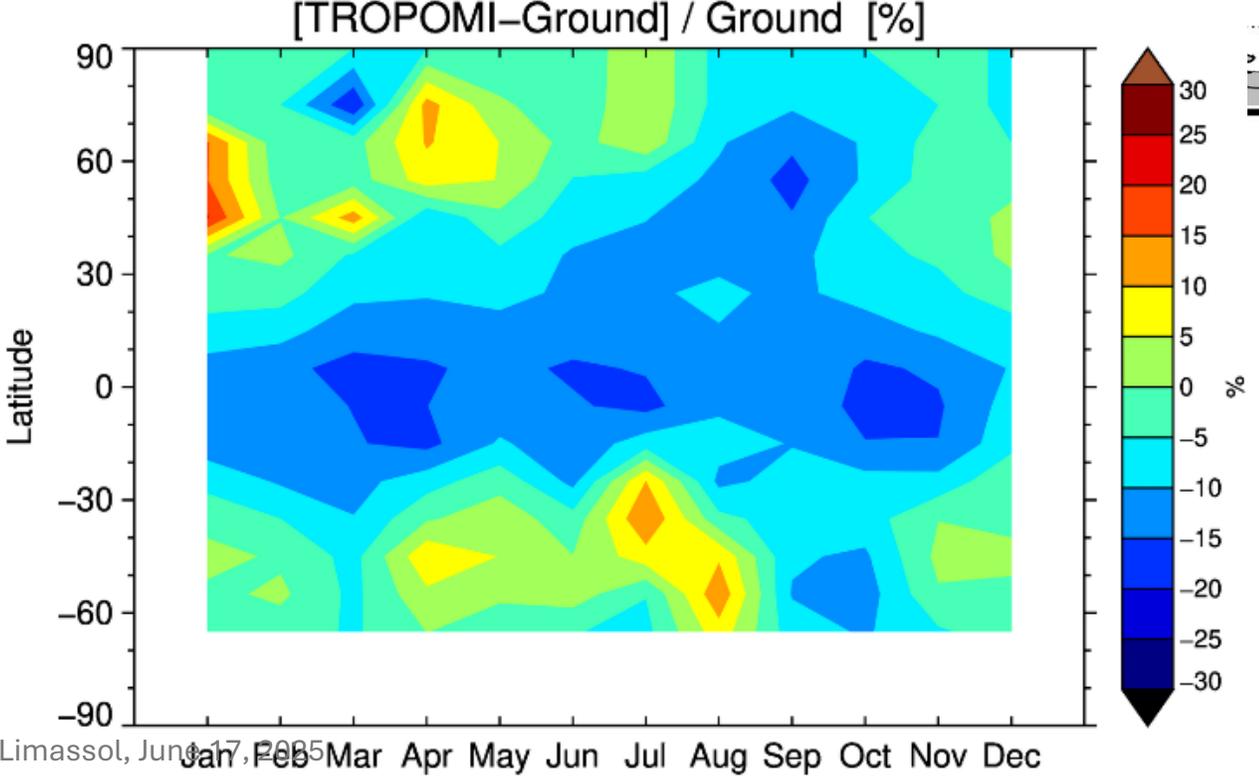Spatial (Δx): **150km**   **Use AAI >2**
Temporal (Δt): **4-h interval**   Flag sun glint

Michailidis et al, ACP, 2021

Metric	
Number of collocated cases	298
Mean difference	**-0.49 km**
Standard deviation	**2.01 km**
Min/Max of the differences	-6.7/5.2 km
Correlation/ Slope / Y-inter.	0.39 / 0.53 / 1.24

Global total water content
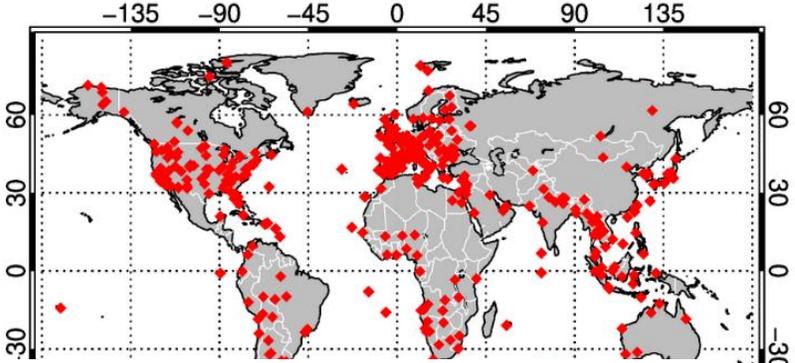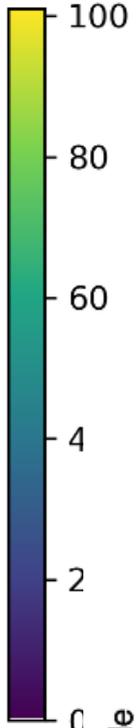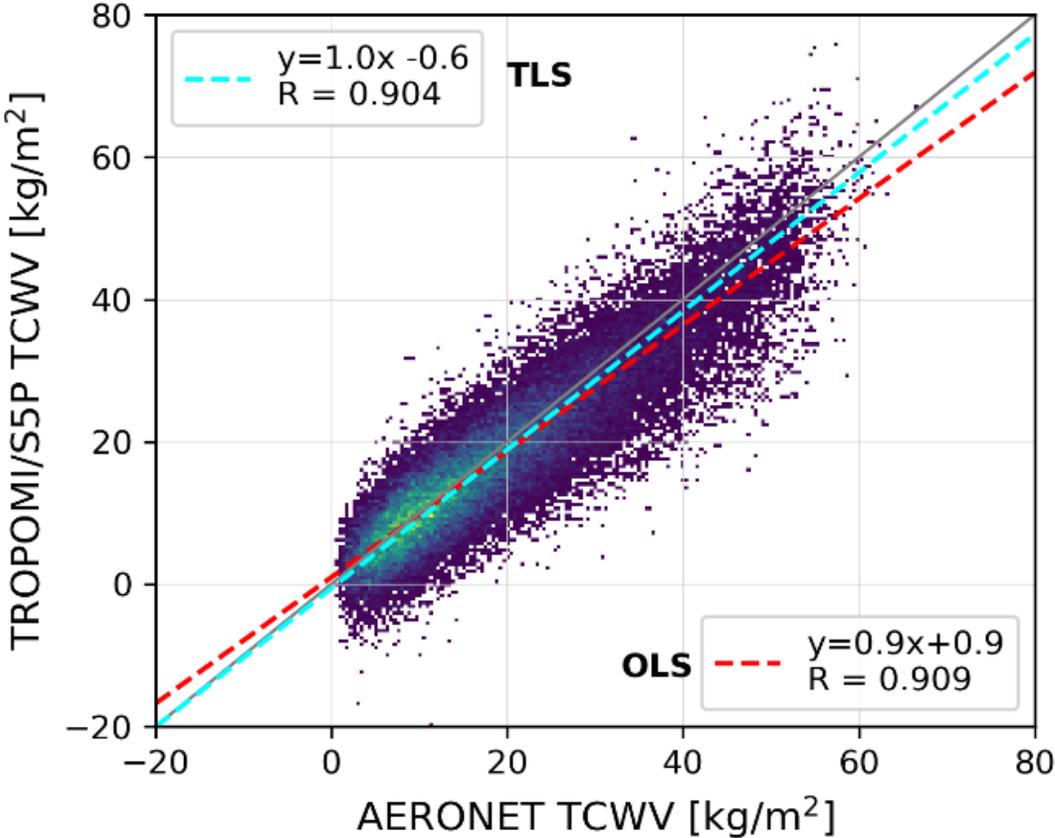
Garane, K., et al., **Atmos. Meas. Tech.**, 2023.

ACTRIS/EARLINET for AEOLUS Cal/Val

Main target: Evaluate the performance of the
AEOLUS satellite L2A product

Overpasses Collected: **06/2019 - 05/2023**

21 Stations
2313 Overpasses

EALRINET Dataset:
- EARLINET DB files --> nominal dataset
- SCC DB files --> experimental dataset

AEOLUS Dataset:
- B11 – B16 L2A files

ATMO-ACCESS pilot for international stakeholders

WG to define the focus of the pilot

Call launch: Cal/Val of satellite atmospheric missions

Establishment of the Expert Group

"GO"/"NO GO" decision

| Mar. 2022 | Apr.-Jun. 2022 | Jul.-Sep. 2022 | Oct.-Nov. 2022 | Dec. 2022 | Jan.-Jun. 2023 | Jun. 2023 | Jul. 2023-Feb. 2025 |

Preliminary discussions with the interested stakeholders

Evaluation of the proposals

Co-design of the projects

Implementation of the pilot(s)

Selected pilot projects	EUMETSAT: Tailored AERONET products (operational products for Cal/Val)
	EUMETSAT: Tailored ACTRIS-CLU products (operational requirements for Cal/Val)
	ESA: EarthCARE Cal/Val (preparation + pre-launch + post-launch + intercalibration)

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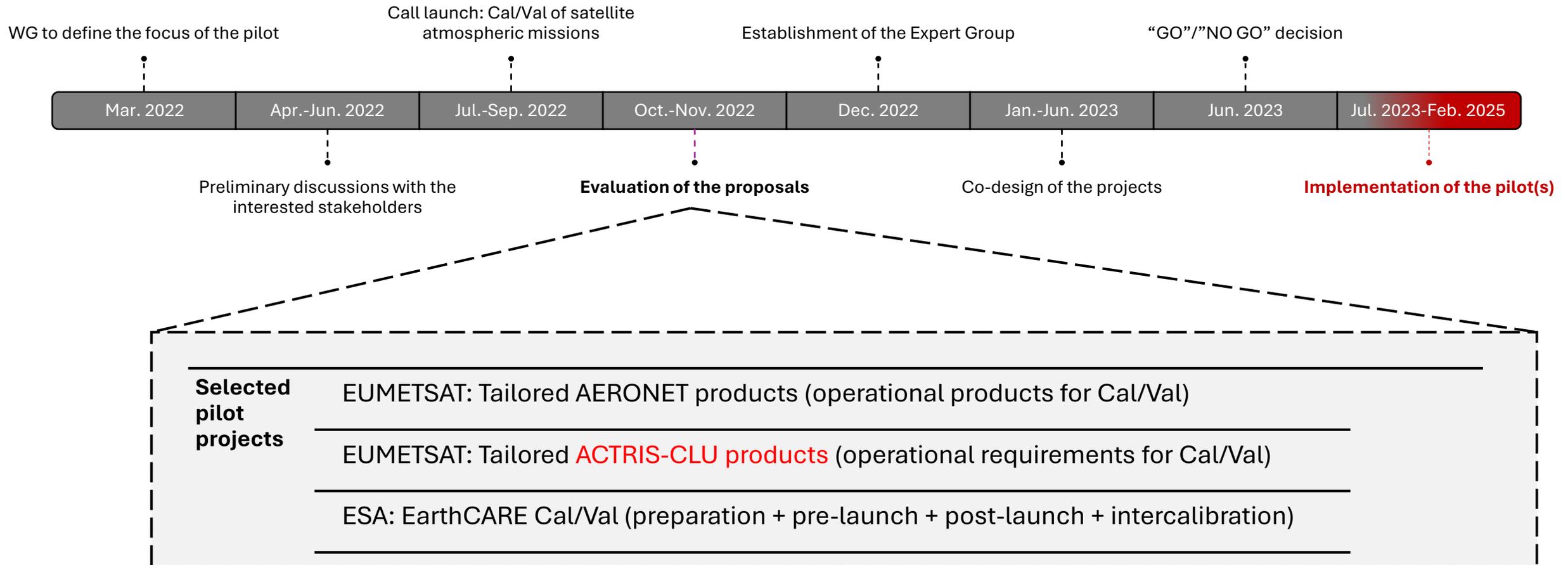
ATMO-ACCESS pilot for international stakeholders – EUMETSAT aerosol pilot

Parameter	Horizontal resolution	Mission	Vertical resolution	Accuracy
Cloud detection	Pixel@4km Pixel@500m	3MI VII	N/A	5%
Aerosol Optical Depth	Clear pixel	3MI	N/A	0.05
Aerosol Type	Clear pixel	3MI	N/A	4 classes
Aerosol Layer height	Clear pixel	3MI/UVNS	N/A	1km
Aerosol Effective Radius	Clear pixel	3MI	N/A	0.6 µm
Aerosol single scattering albedo	Clear pixel	3MI	N/A	0.2
Aerosol refractive index	Clear pixel	3MI	N/A	N/A
Volcanic ash	Clear pixel	VII	N/A	detection
UV Aerosol index	Clear pixel	UVNS	N/A	0.1

ATMO-ACCESS pilot for international stakeholders – EUMETSAT aerosol pilot

* Provision of additional aerosol parameters (e.g. aerosol layer heights) and parameters tailored for specific EUMETSAT instruments/needs

* Provision of ACTRIS products from all available ground-stations (inc. cloud detection)

* Provision of ACTRIS products with i) quality aligned to FRM standards and ii) consistency among all available ground-stations

* Reprocessing of historical data (e.g lidar networks) to obtain ACTRIS products with the format/requirements implemented in the previous tasks.

ACTRIS response to ESA Announcement of Opportunity for Calibration and Validation Activities for Sentinel-4 and Sentinel-5

	Sentinel-4	Sentinel-5
O3	Total column	Total column
Tropospheric column and sub-columns	Profile with 8 sub-columns	
NO2	Total and tropospheric column	Total and tropospheric column
CH2O	Total column	Total column
SO2	Total column	Total column and layer height
CHOCHO	Total column	Total column
CH4	-	Total column
CO	-	Total column
Aerosol	AOD, layer height, UV absorbing index	AOD, layer height, UV absorbing index
Surface reflectance	BRF	Directional LER climatology
Cloud	Fractional cover, top height, optical depth	Effective fractional cover, top pressure
Cloud support	Regridded FCI data	Regridded MetImage/VII data

The way forward for the cooperation between EUMETSAT and ACTRIS

Propose to prepare a Memorandum of Understanding (MoU) between EUMETSAT and ACTRIS for determining the terms of collaboration (**first half of 2025**)

Main topics to be considered:

Thank you

➤ ACTRIS could provide QA/QC data for CAL/VAL needs for EUMETSAT mission

➤ ACTRIS could provide guidelines and consulting for future satellite products

➤ EUMETSAT could provide support to dedicated CAL/VAL campaigns

➤ EUMETSAT could support PhD students involved in the CAL/VAL using ACTRIS data

➤ EUMETSAT could support the maintenance/upgrade of ground-based ACTRIS RIneeded for the CAL/VAL

➤ EUMETSAT could support R&D activities for new instrument concepts within ACTRIS