



# Updates from our International Partners: EUMETSAT

Ewa Kwiatkowska and Bertrand Fournie  
*EUMETSAT*

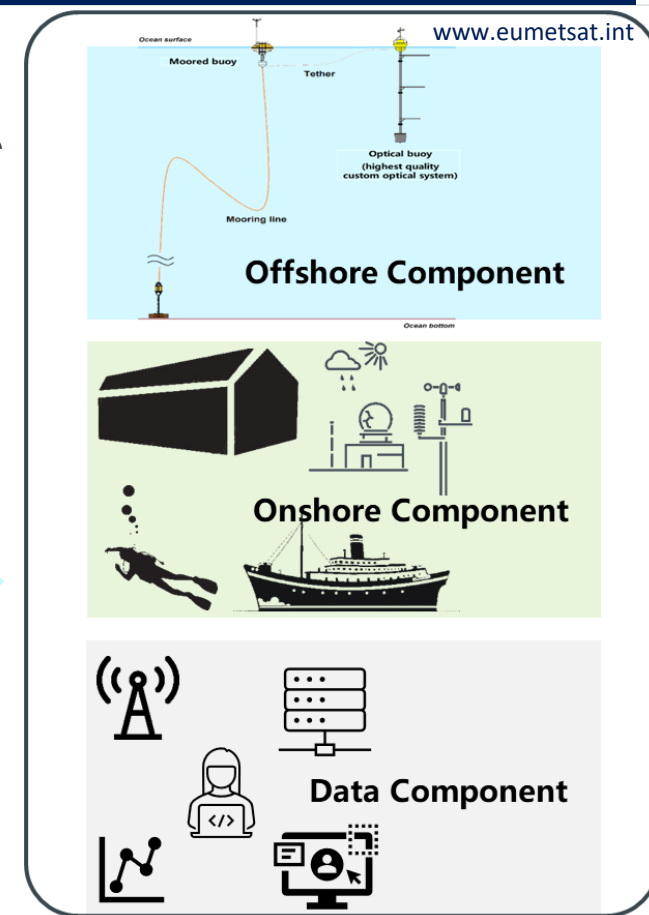
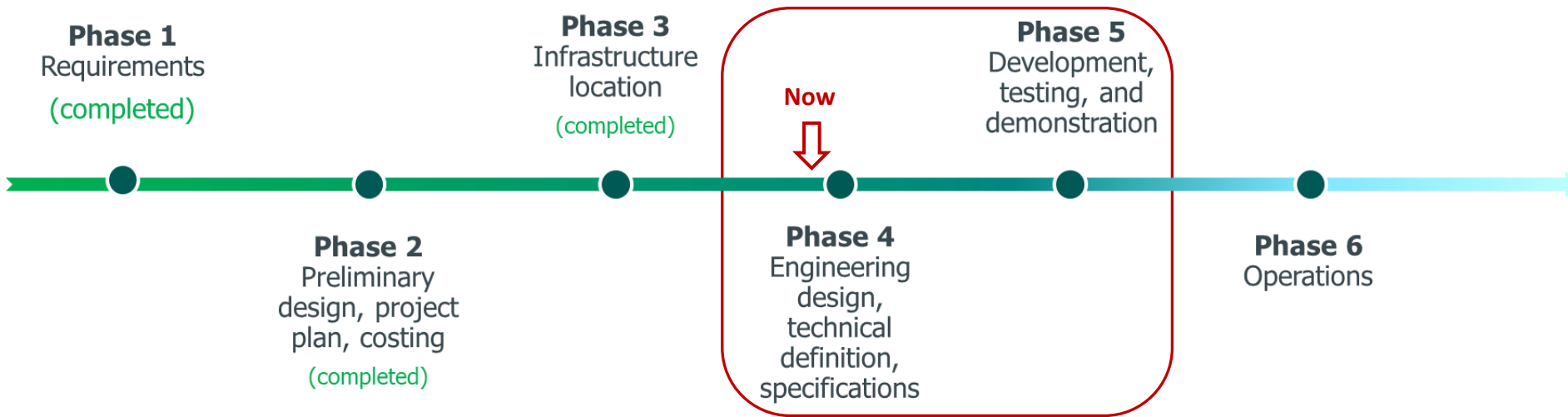
*PACE-SAT3 meeting, 20 February 2025*



# Copernicus OC-SVC infrastructure development

EUMETSAT manages OC-SVC activities on behalf of the European Commission Copernicus Programme <https://www.eumetsat.int/OC-SVC>

- ITT call issued in Sep 2024, close 4 March 2025
- Design based on NASA's MarONet MOBY-like system



- Collaborating with NASA, PACE SAT, and NASA's MarONet team on the development
- Establishing a European node of these unique OC-SVC infrastructures and standardising with equivalent global assets, NASA's MarONet and NOAA's MOBY
- Free, full and open policy on data and code, complete infrastructure documentation
- **Goal:** water reflectance measurements that meet the requirements for System Vicarious Calibration



# Developments into Fiducial Reference Measurements

www.eumetsat.int



**Copernicus FRM4SOC-2025 Training in Above-Water Radiometry – APPLY NOW!**

19-22 May 2025

The Second Edition of the EU Copernicus Programme FRM4SOC Training for in situ Ocean Colour Above-Water Radiometry towards Satellite Validation will be held in July 2025 in Venice and nearby Acqua Alta Oceanographic Tower (AOT) in the Adriatic Sea.

**The second FRM4SOC-2 WORKSHOP on Calibration and Characterisation of Ocean Color Field Radiometers**

20 – 22 May 2025  
@ Tartu Observatory, University of Tartu, Estonia



9. Review, test and promote: field comparisons, training, international workshops, periodical feedback from experts

8. Maintenance of Ocean Colour In-Situ Database OCDB, Fiducial Radiometer Data Base FidRadDB and promotion of their use  
<https://ocdb.eumetsat.int/>

7. Complete end-to-end uncertainty budget included in HyperCP, thoroughly documented and clear to users



6. Contributions to HyperCP community processor for hyperspectral above-water radiometry, enhance and expand use cases  
<https://github.com/nasa/HyperCP/tree/master>



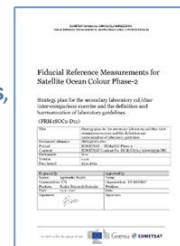
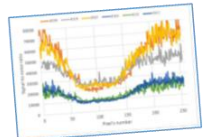
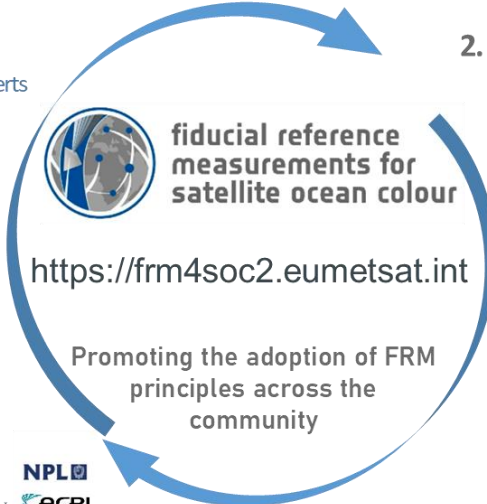
1. Field radiometer classes to conform to the FRMOcnet standards

2. Full characterisation of batches of field radiometers and a service of calibrations and rentals of fully calibrated/characterised instruments

3. Community guidelines on radiometer cal/char standards and FRM certification

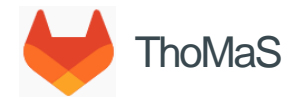
4. Radiometer cal/char guidelines for laboratories, international lab exercises and continuous communication with manufacturers and users

5. In situ measurement procedures, specific to the radiometer classes, and recommendations that complement those in the IOCCG protocols



- ThoMaS tool** for *in situ* multi-mission matchups now has PACE OCI implemented, and additionally
- hyperspectral reconstruction, *Talone et al., 2024*, to use AERONET-OC for PACE validation
  - basic uncertainty propagation from *in situ* and satellite to the matchup performance metric

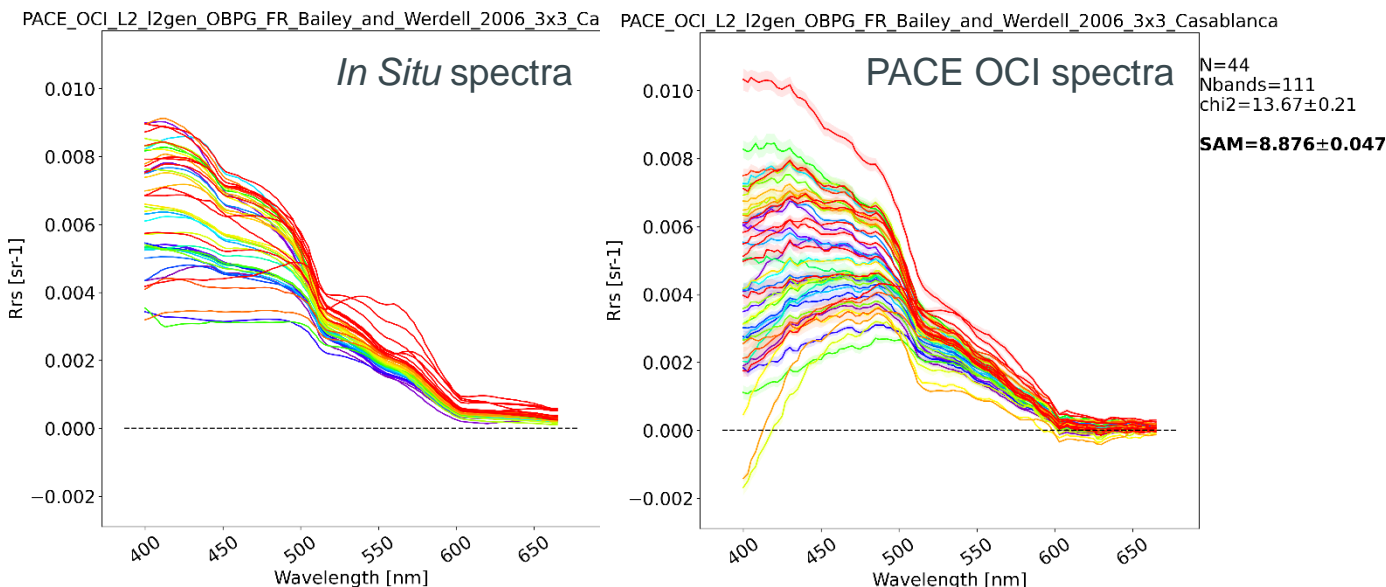
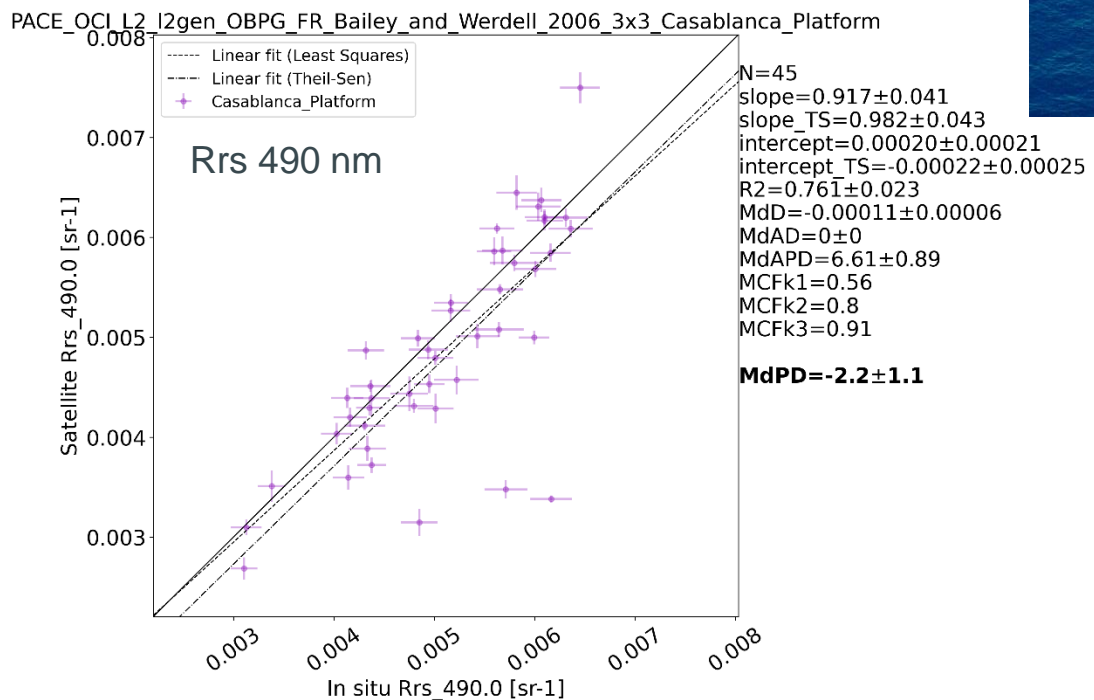
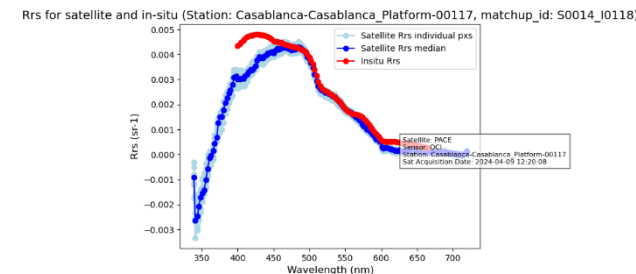
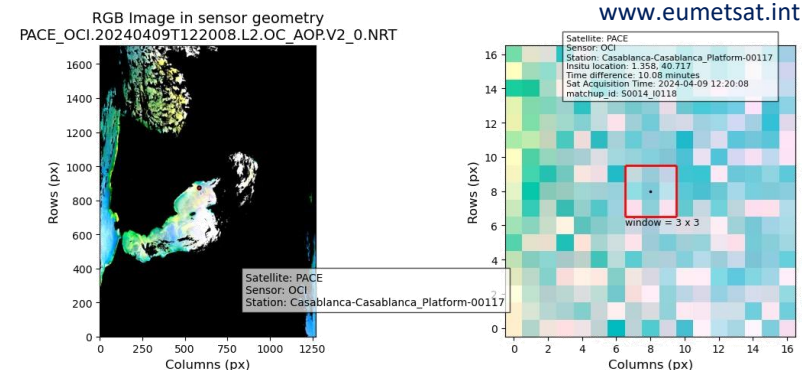
<https://gitlab.eumetsat.int/eumetlab/oceans/ocean-science-studies/ThoMaS>





# PACE OCI early findings – AERONET-OC Casablanca site

- AERONET-OC Casablanca platform
- Clear water site in the Med off Spain
- PACE OCI matchups with **ThoMaS tool**
  - OCI → initial operational version, no reprocessing
- Time range: March to October 2024





# Algorithm developments for aquatic retrievals

www.eumetsat.int

## Atmospheric Correction



- Revising the Standard Atmospheric Correction: <https://www.eumetsat.int/oc-sac>
- Investigating Spectral Matching approaches: <https://www.eumetsat.int/SACSO>

## BRDF correction



- Intercomparisons Morel'02, P&R'05, Lee'11 (He'17, T&T'18); extending to complex waters O'25
- <https://www.eumetsat.int/brdf-correction-s3-olci-water-reflectance-products>

## Blended chlorophyll algorithm



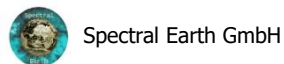
- Blended chlorophyll algorithm based on optical water classes, [link](#)

## IOPs



- $a_{nw}$ ,  $b_{bp}$ ,  $a_{phy}$ ,  $a_{cdm}$ ,  $a_{cdom}$ ,  $K_d$ ,  $b_{bp}$  spectral slope, optical water classes
- <https://www.eumetsat.int/S3-OLCI-IOP>

## Fluorescence



- Fluorescence peak height
- <https://www.eumetsat.int/S3-OLCI-FLUO>

## PAR

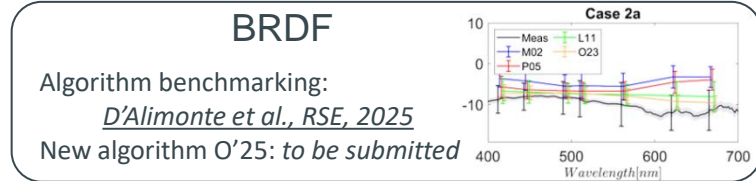


- Daily PAR planar above water, uncertainties, daily PAR scalar under water, instantaneous PAR
- Additional PAR test products in an offline tool
- <https://www.eumetsat.int/daily-photosynthetically-available-radiation-s3-olci-ocean-colour>

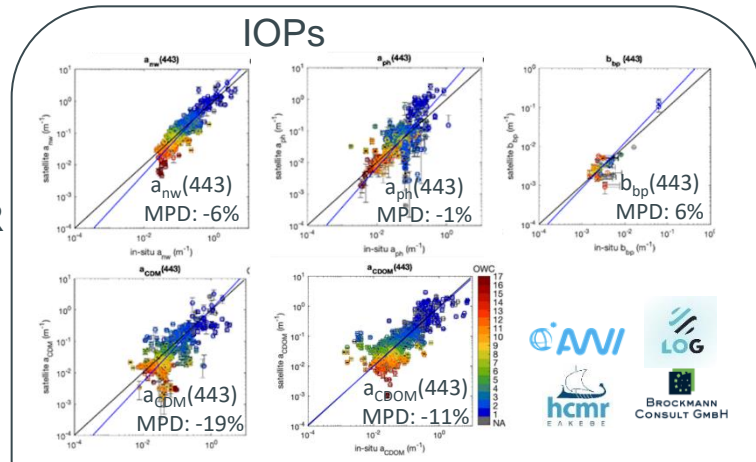
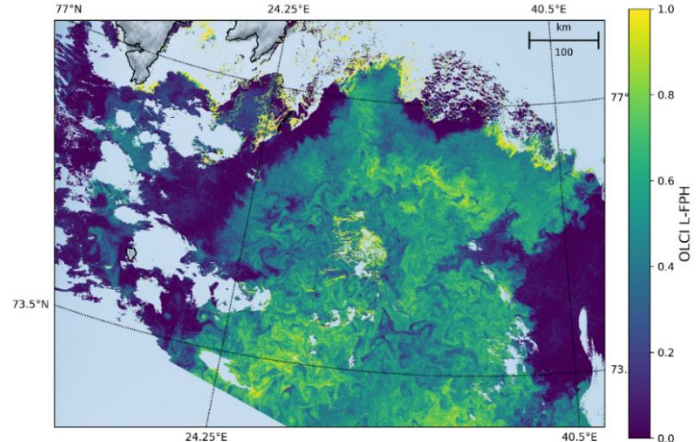
## Flagging



- E.g. CLOUD\_SHADOW flag, [link](#)



## Fluorescence Peak Height in Barents Sea [1/sr]



Algorithm: IOP *Jorge et al., 2021*, CDOM *Bonelli et al., 2021*  
Validations: *Zibordi et al., 2023*, *Bracher et al., 2025*

Courtesy of  
Paolo Cipollini and Simon Proud

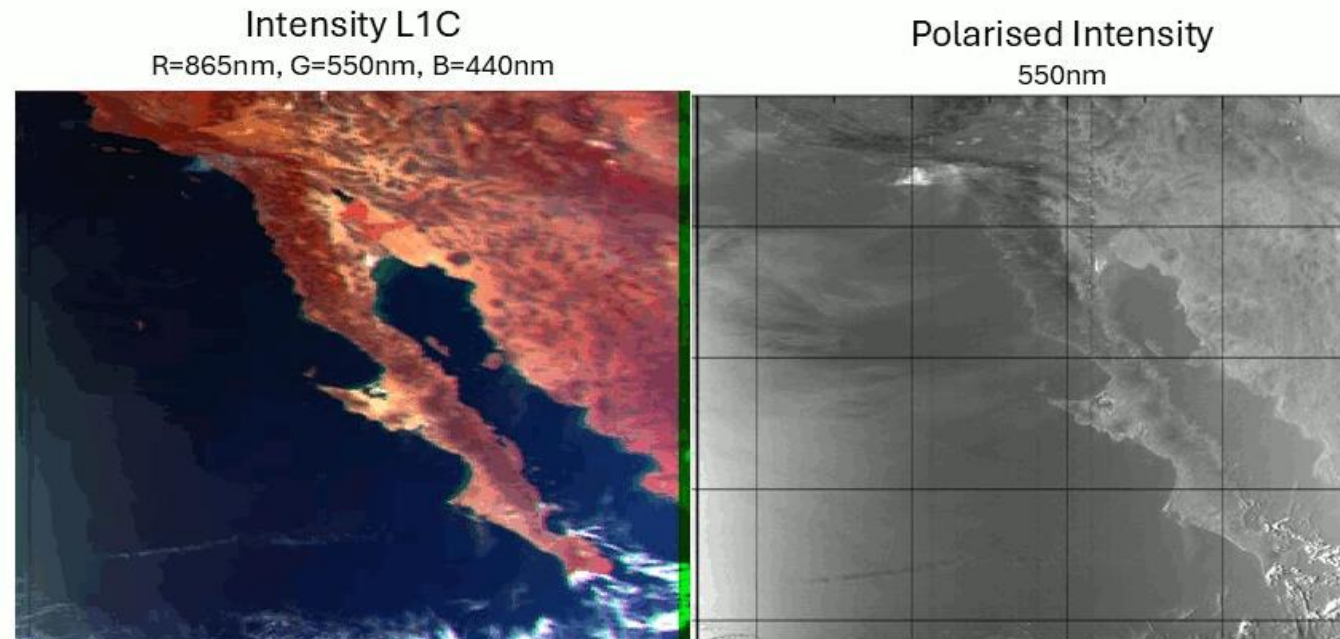


- Sentinel-3 Next Generation Optical will include Advanced OLCI and Advanced SLSTR instruments
- S3NGO = enhanced continuity of the EC Copernicus Sentinel-3 Visible and Infrared measurements
- Preparatory (Phase A/B1) studies and Mission Advisory Group (MAG) activities started in 2023
- Definition of the Mission Requirements Document (MRD) is supported by the MAG
- AOLCI industrial studies are in progress to define technology capabilities against user needs / MRD
  - constellation of 2 satellites
  - revisit time  $\leq 2$  days over ocean
  - as hyperspectral as possible, tentatively several hundred bands in the range 340 nm – 1040 nm
  - spatial resolution  $\leq 150$  m
- Enhancements in the synergistic use of AOLCI and ASLSTR
- First launch for S3NGO-A tentatively in mid-2030s

➔ PACE OCI is a crucial precursor for S3NGO, supporting requirements definition and implementation

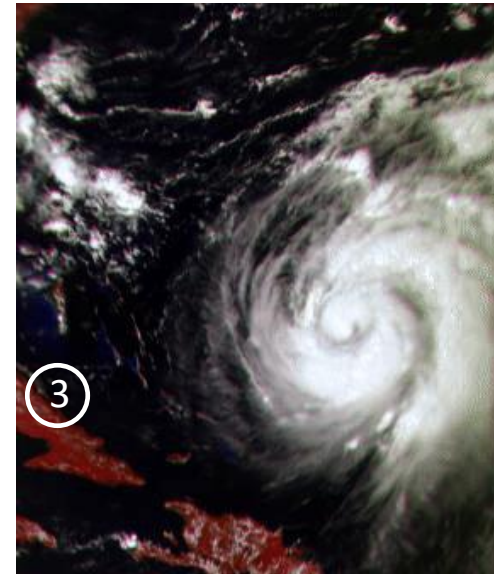


- HARP2 version 2 data have been explored
  - Mostly L1C (some L1B)
- Qualitative evaluation of the products
- Focus on Polarised radiance =  $Dolp \times I$ 
  - Useful signal for aerosol (& clouds)
  - Specific signature from scattering (& absorption) by aerosol & cloud particles
  - Reduced contribution from surface
- Ability to detect aerosol events
  - Biomass burning
  - Volcanoes
  - Pollution
  - Desert dust
- Highlight specificity of polarimetry

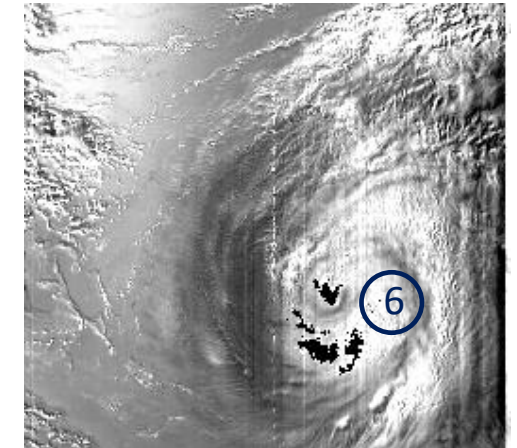
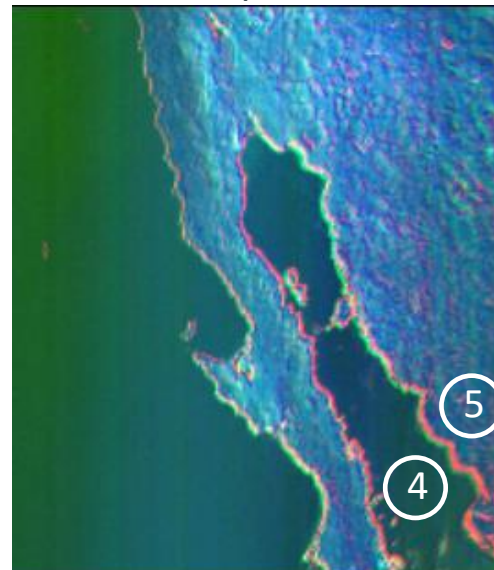


## Qualitative analysis - based on POLDER experience

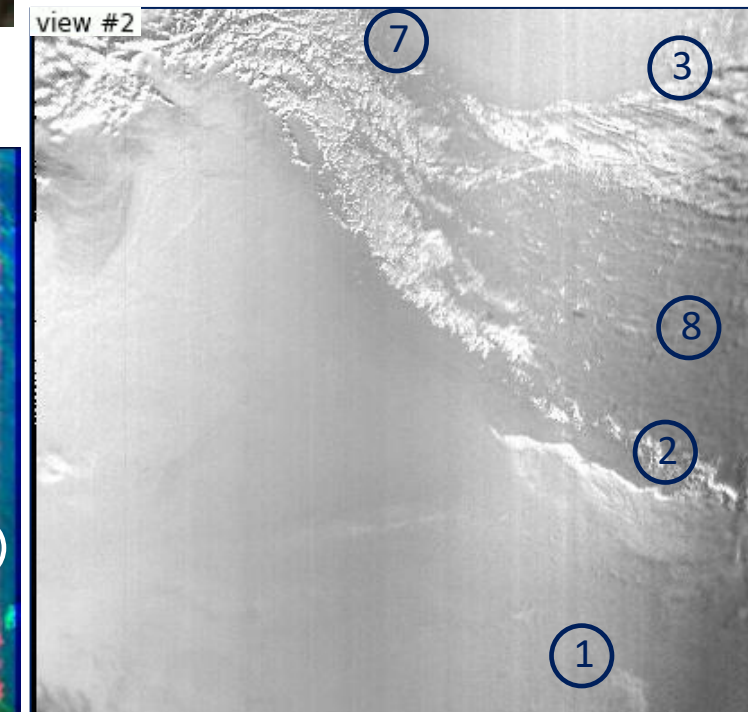
- 1) Vertical striping on some bands and/or views
- 2) Anomalies in L1C reprojection
  - shifted product in South Africa, circular features
- 3) Misregistration of some views
  - Especially first and last views
  - Geolocation error for all ?
- 4) Misregistration of some bands (eg NIR @865nm)
  - Maybe degradation in the recent months
- 5) Misregistration of polarisation
- 6) Saturation (may be nominal)
- 7) Maybe anomaly in the polarisation calibration in some bands or views
- 8) Degraded MTF for some views



RGB TOA reflectance  
RGB TOA polarisation



Rayleigh-corrected TOA polarisation 550nm





# PACE / HARP2 – Dramatic beauty of Wildfires

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**16<sup>th</sup> September 2024**  
**Portugal**

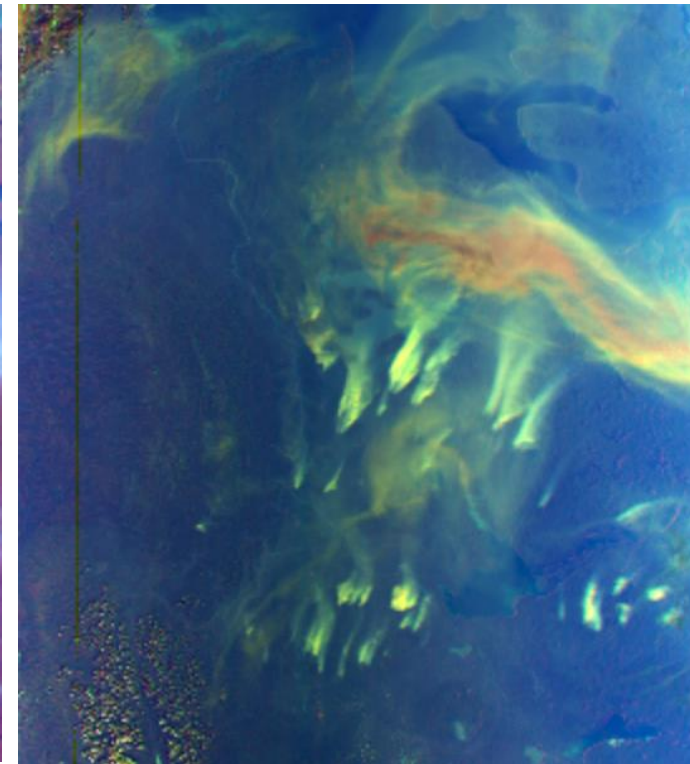
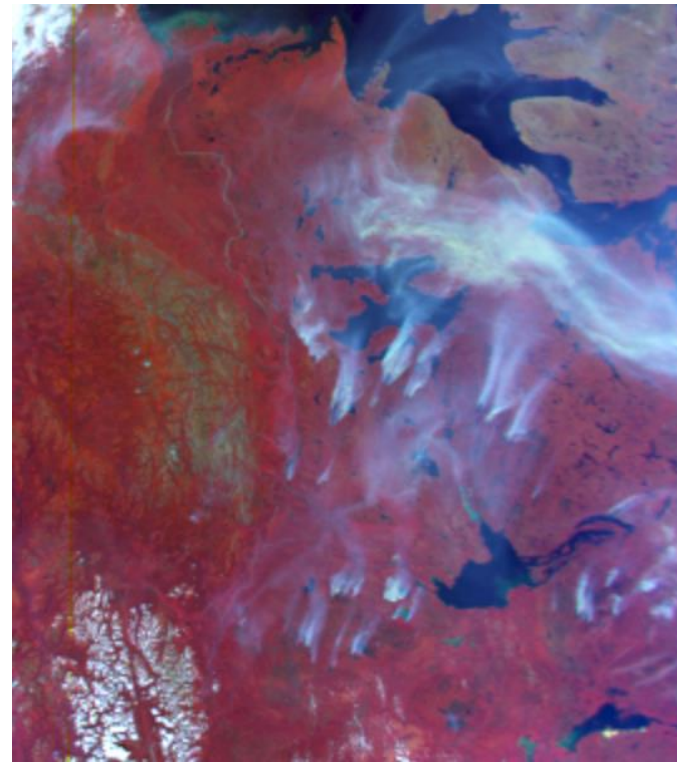
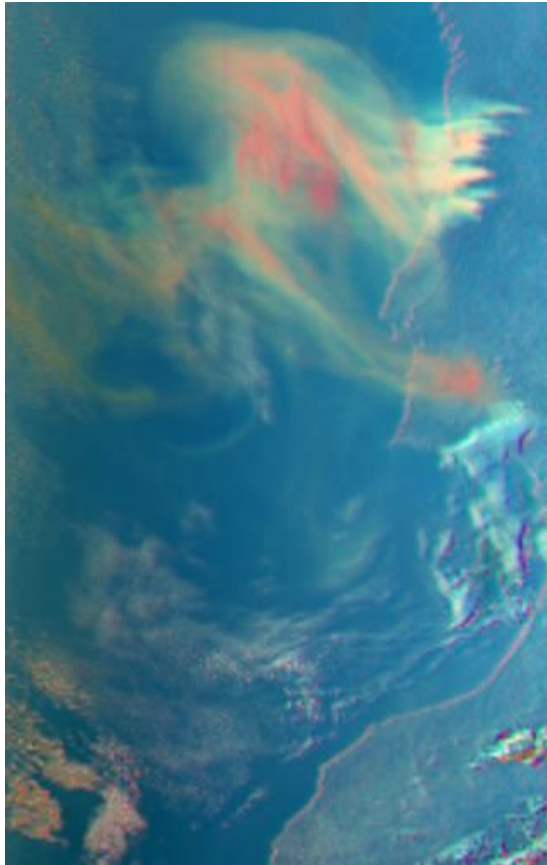
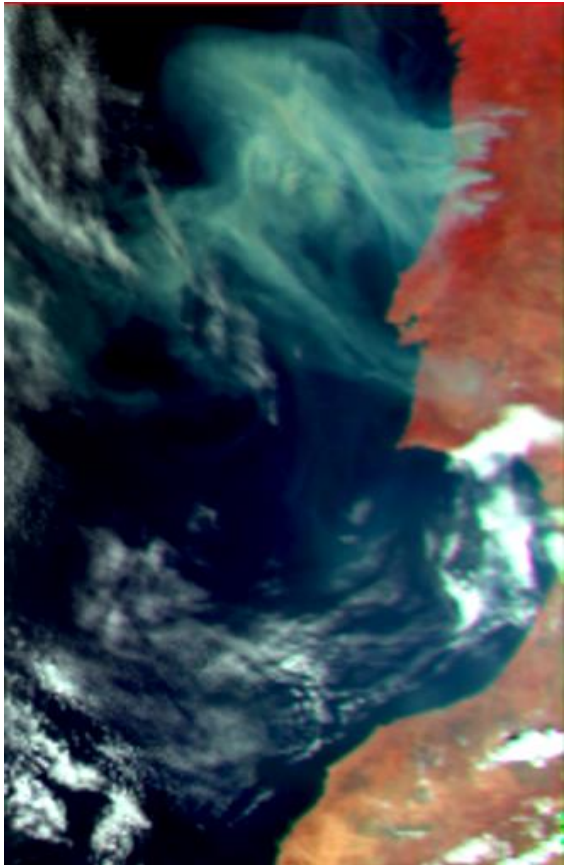
**8<sup>th</sup> August 2024**  
**Canada**

***Intensity***

***Polarised Intensity***

***Intensity***

***Polarised Intensity***



***RGB = 865/550/440nm***

***RGB = 865/670/440nm***



# PACE / HARP2 – Dramatic beauty of Wildfires

www.eumetsat.int

**26<sup>th</sup> August 2024**

**Amazonia**

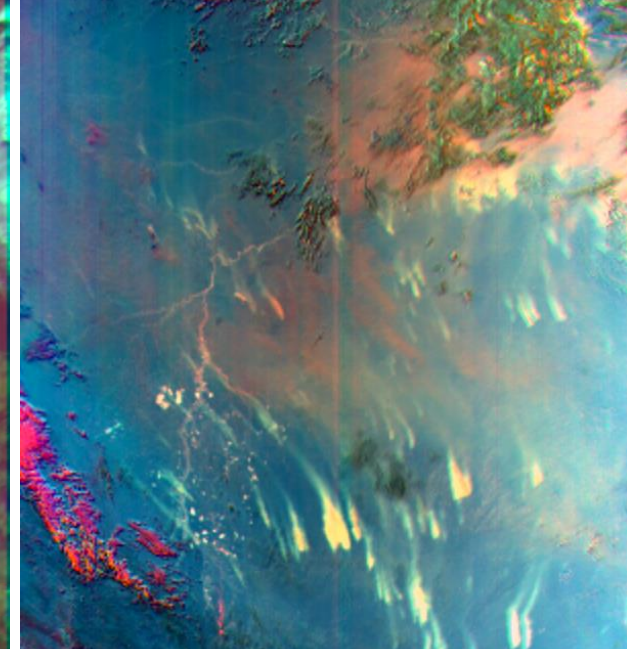
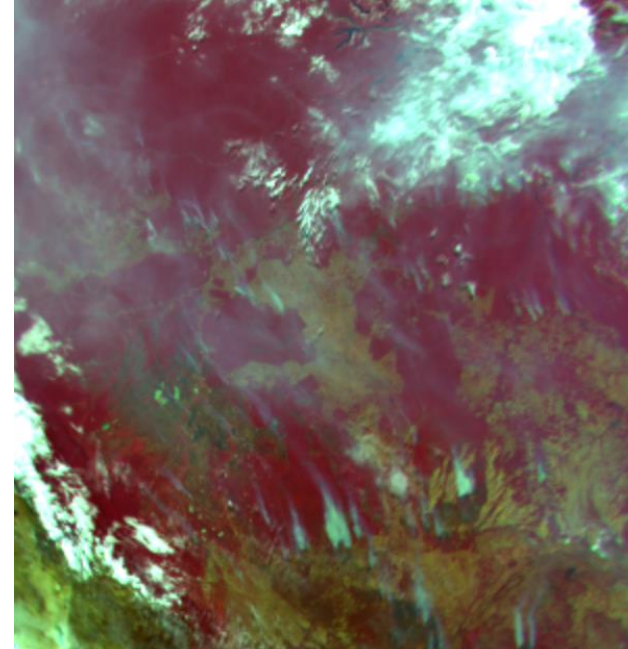
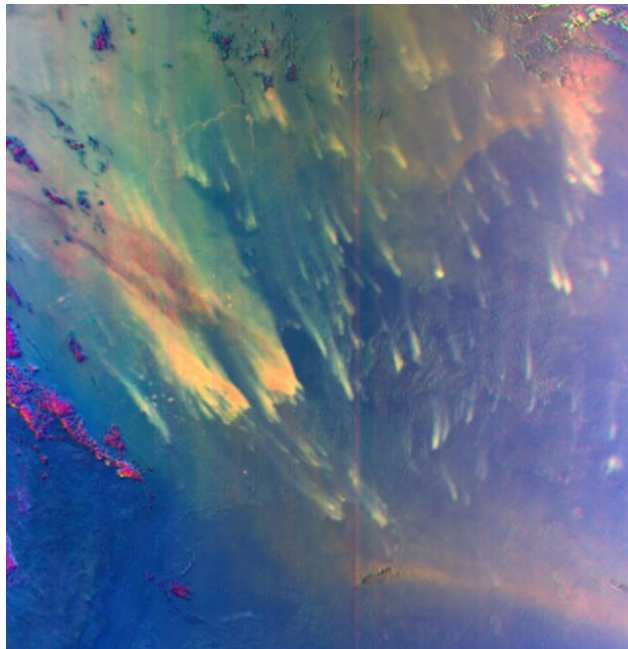
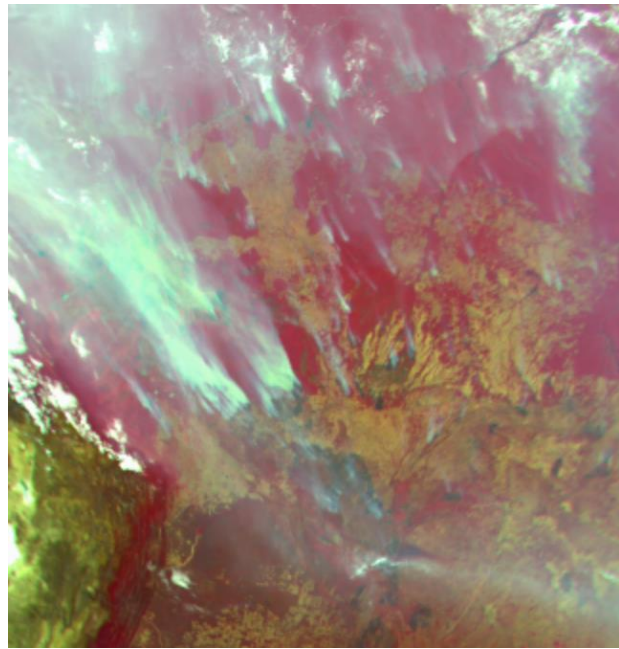
**12<sup>th</sup> August 2024**

*Intensity*

*Polarised Intensity*

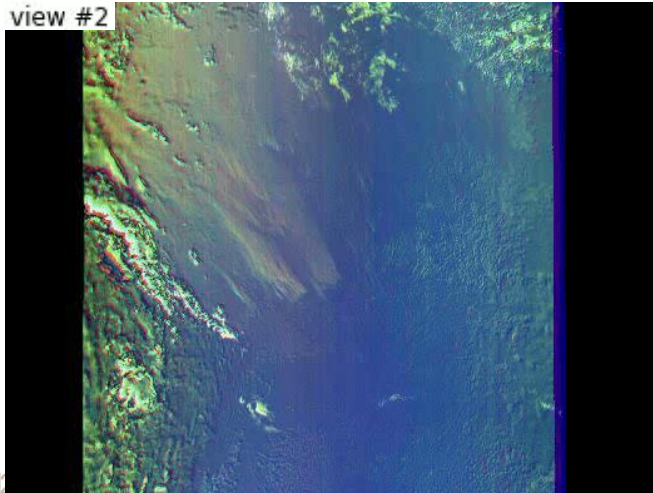
*Intensity*

*Polarised Intensity*

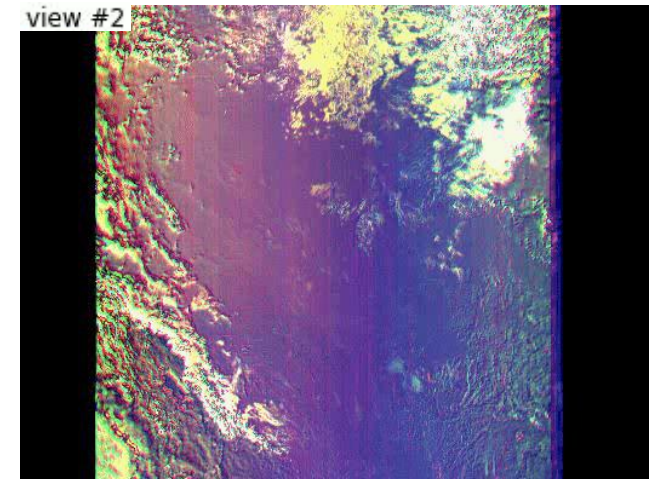


**RGB = 865/670/440nm**

view #2



view #2

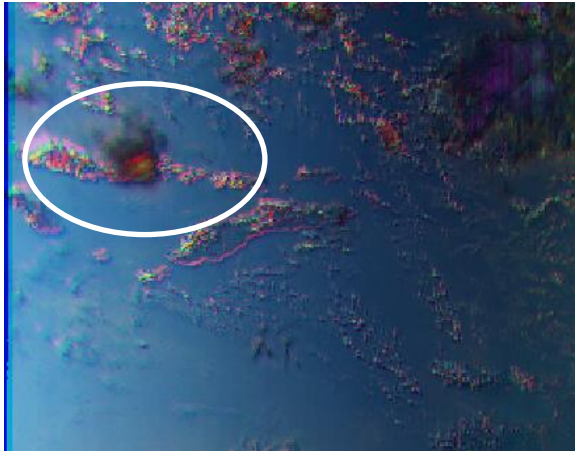


- High ability to capture “fine” particles
  - linked to the multi-view
  - Maximised for scattering angle  $<120^\circ$

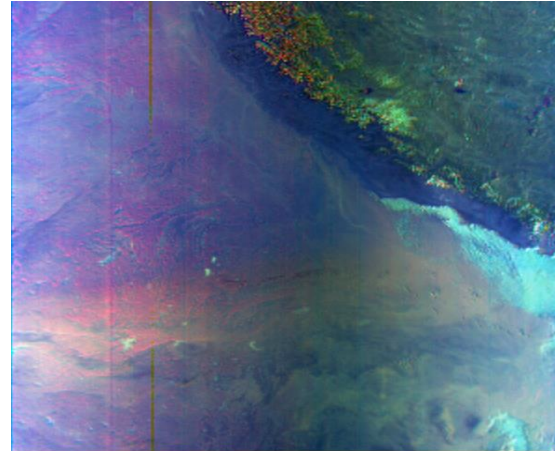
← RGB Rayleigh-corrected polarised reflectance →

- The qualitative analysis of the HARP2 images exhibits:
  - the high ability to observe fine particles (high asset of polarimetry)
  - but also, when combined with spectral and directional, the other aerosol sources

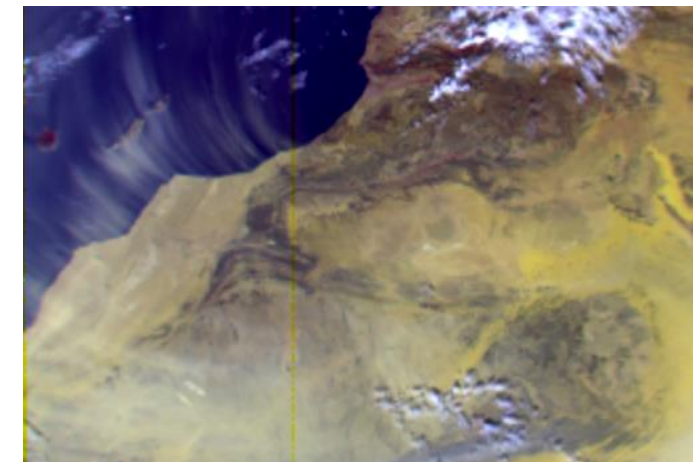
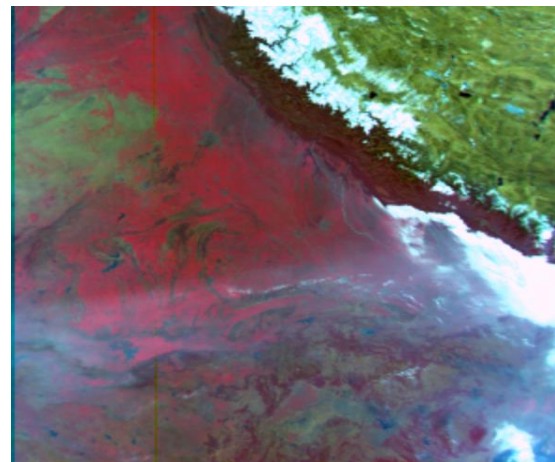
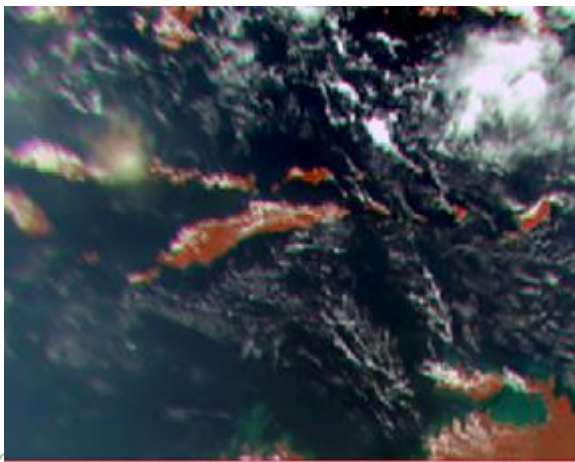
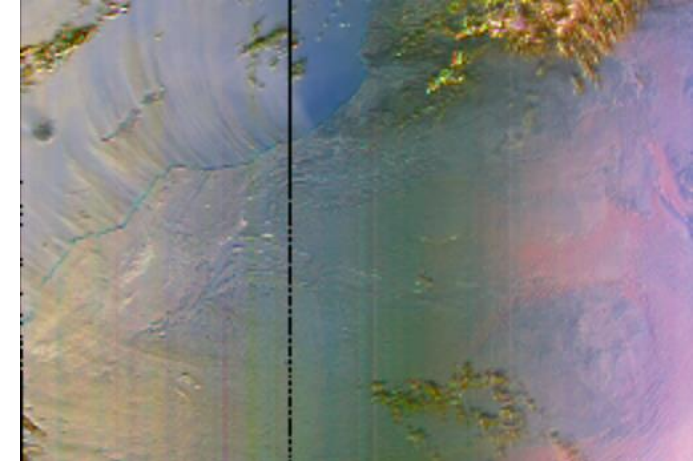
*9<sup>th</sup> November 2024  
Mount Lewotobi Laki-Laki - Indonesia*



*24<sup>th</sup> January 2025  
Anthropogenic plume - India*



*17<sup>th</sup> December 2024  
Desert dust - Morocco*



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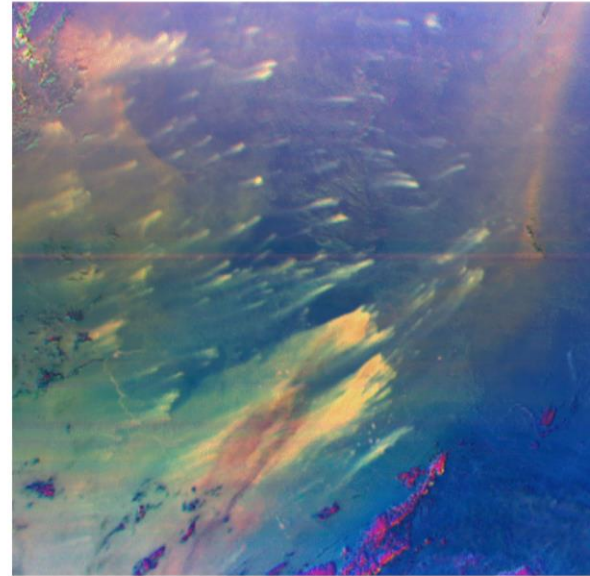
- Data exchange on polarimetry
  - HARP2 of high interest – preparation of CO2M/MAP
  - 3MI to be launched mid-2025 – high interest for validation & cross comparison
    - 3MI aerosol product definition (processor and product) read

*Hubble Telescope*



**Helix Nebulae**

*HARP2 Polarimeter*



**Amazonia Wildfires (26/8/24)**

- Out of polarimetry, other contributions for PACE atmospheric aspects
  - Cloud products validation: OCI versus FCI/VII (OCA product)
  - Validation of OCI aerosol product with PMAp & Sentinel-3, and later 3MI
  - NO2 retrieval from OCI – preparation of S3-NGO