

Synergy of instruments on EPS-SG – an outlook

Rasmus Lindstrot
Atmospheric Chemistry CAM

AC-VC#22, SRON, Leiden, NL, 2026/06/02





Instruments on board of EPS-SG

**Synergy opportunities for
atmospheric composition
monitoring**

3MI

- Aerosol – optical thickness, particle size, type, height, absorption; volcanic ash; cloud phase, height, optical depth; surface albedo

IASI-NG

- Temperature/humidity profile at high vertical resolution in clear air, clouds, trace gases (O_3 , CO, CH_4 , CO_2 ,...), sea/land/ice surface temperature, aerosols, volcanic ash

METimage

- Hi-resolution cloud products, incl. microphysics; aerosols; polar AMVs; vegetation, snow, fire; sea/ice/land surface temperature; support to sounding missions

MWS

- Temperature/humidity profiles in clear and cloudy air; cloud liquid water total column; imagery: precipitation

RO

- Refractivity profiles at high vert. resolution; temperature / humidity profiles; PBL top and tropopause height; ionospheric electron content

Sentinel-5

- Ozone profile and column; columns of CO_2 , SO_2 , NO_2 , H_2O , CO, CH_4 , aerosol optical depth; columns of BrO, HCHO, OCHCHO; volcanic plumes

SCA

- Ocean surface wind vectors; soil moisture; snow equivalent water; sea-ice type

MWI

- Precipitation and cloud products; water vapour imagery; sea-ice, snow, sea surface wind

ICI

- Cloud products, in particular ice clouds; snowfall detection and quantification; water-vapour profiles and imagery



Numerical Weather Prediction

• IASI-NG, METImage, MWS, RO, SCA, MWI, ICI



Nowcasting

• 3MI, IASI-NG, METImage, MWS, SCA, MWI, ICI



Oceanography

• METImage, SCA, MWI, ICI



Hydrology

• METImage, SCA, MWI, ICI



Atmospheric Composition and Air Quality

• 3MI, IASI-NG, Sentinel-5

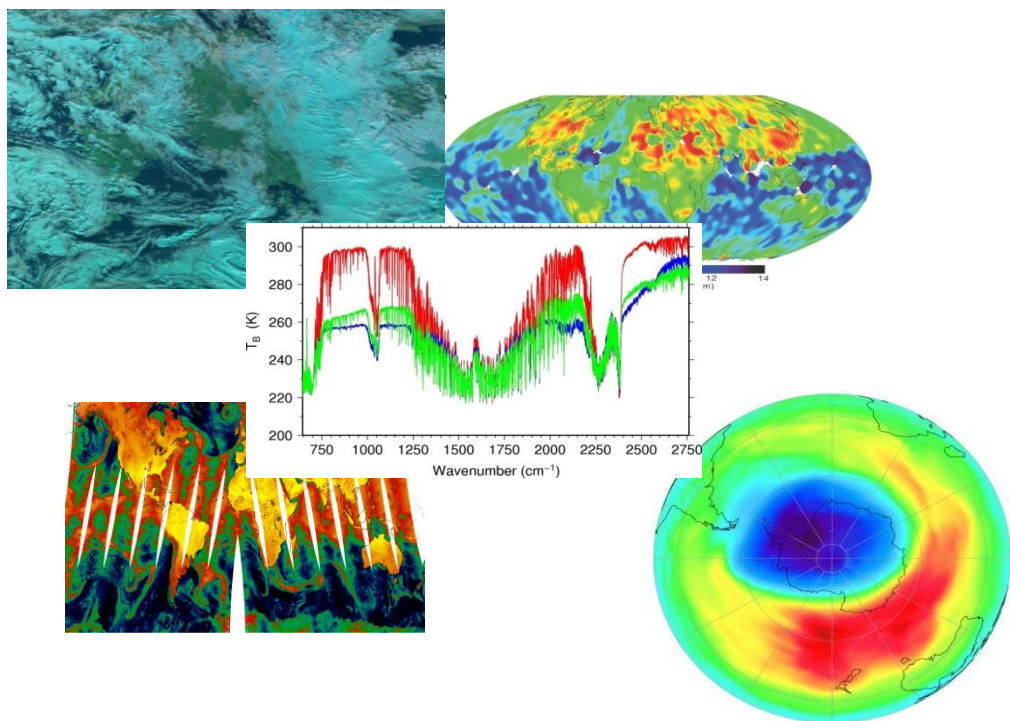


Climate Monitoring

• 3MI, IASI-NG, METImage, MWS, RO, Sentinel-5, SCA, MWI, ICI

Observation missions are highly complementary

- Co-registration of measurements will allow optimal information content to be extracted
- Synergy considered in the payload distribution of a dual satellite configuration

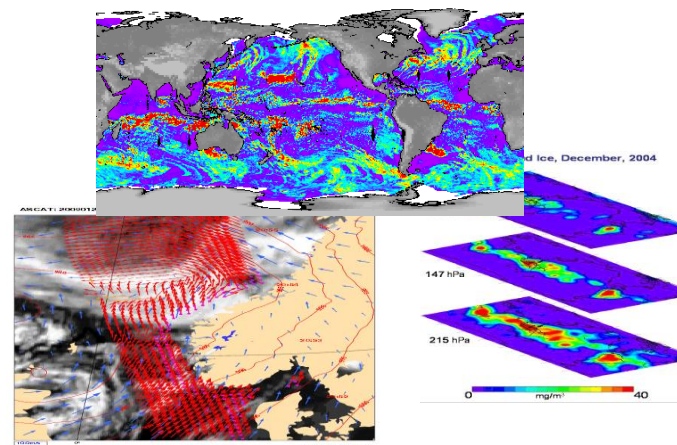


Essential co-registrations

- IASI-NG – METImage – S5/UVNS
- MWI – ICI

Desired co-registrations

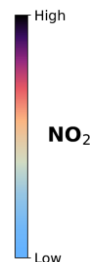
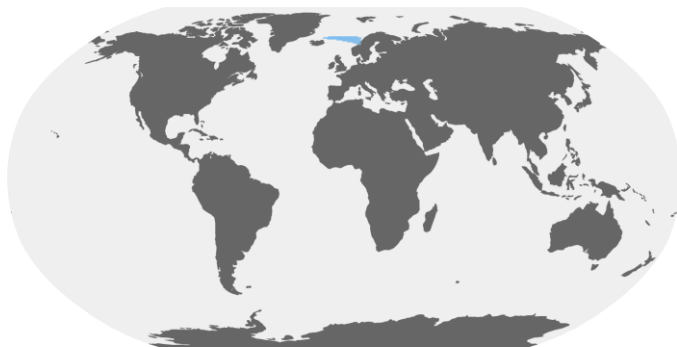
- IASI-NG – MWS
- METImage – 3MI
- IASI-NG – S5/UVNS – 3MI
- MWI – SCA – METImage





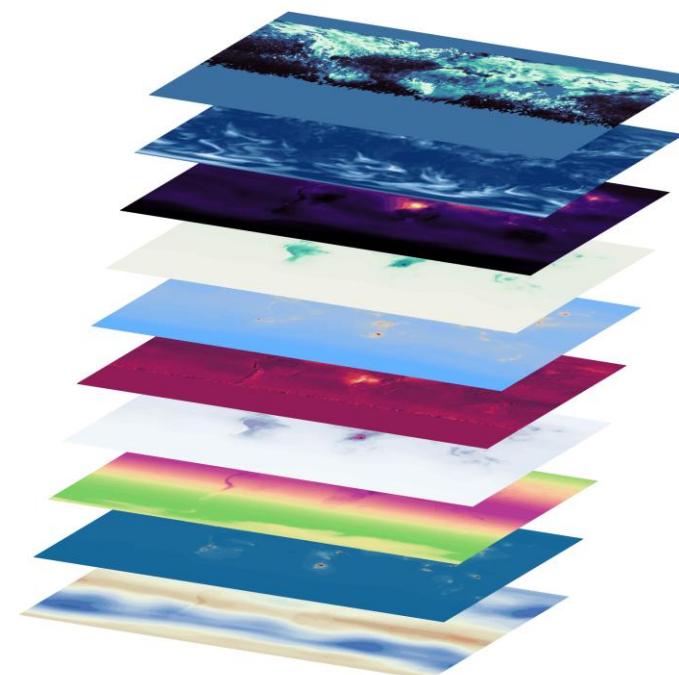
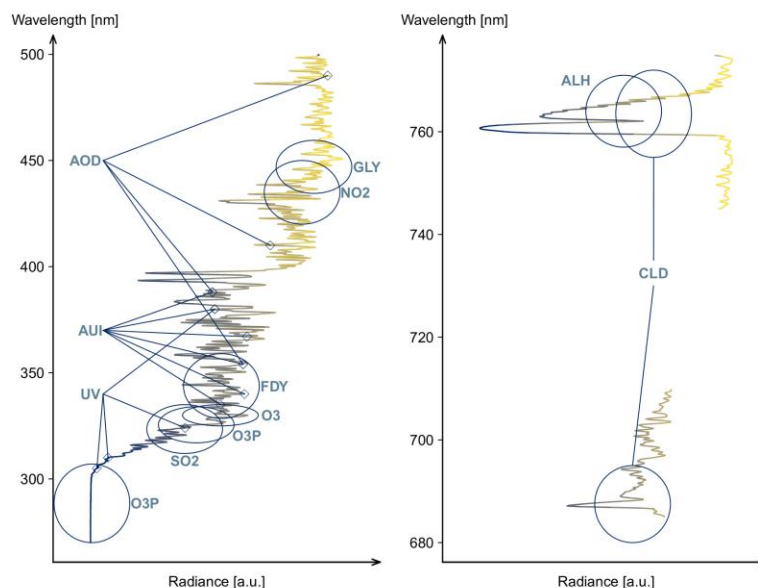
Sentinel-5 in short

Copernicus Sentinel-5 will monitor air quality, trace gases and aerosols at high spatial resolution with near-daily global coverage



Atmospheric composition is revealed through spectral fingerprints in the UV, VIS, NIR, and SWIR spectral regions:

- Data will be used by the Copernicus Atmosphere Monitoring Service (CAMS), supporting global air quality and pollution monitoring as well as climate applications
- Compared to S5P, S5 includes an additional SWIR band, enabling a faster proxy retrieval of CH₄, which is complementary to the more computationally intensive full-physics CH₄ retrieval



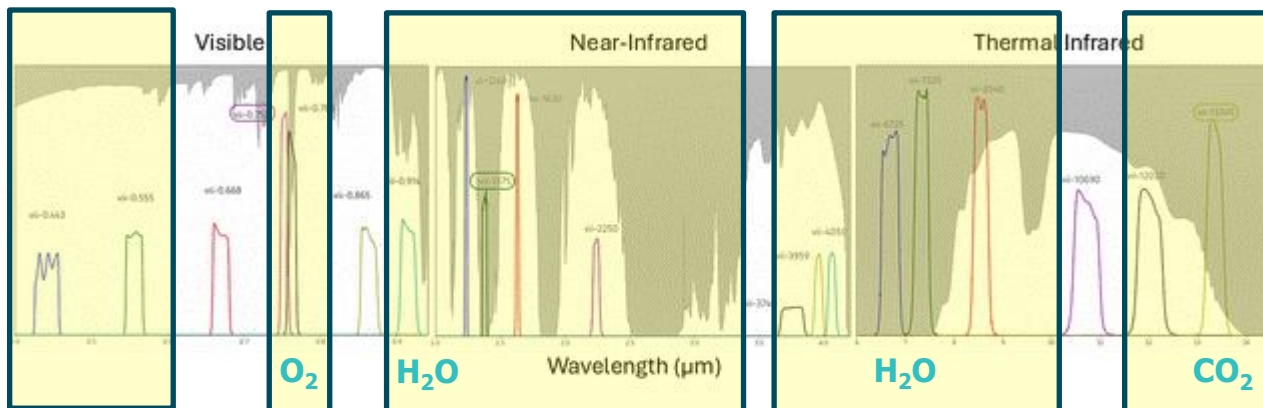
Carbon monoxide
Methane
Aerosol layer height
Cloud properties
Aerosol optical depth
Glyoxal
Nitrogen dioxide
Aerosol UV index
Formaldehyde
UV index
Sulfur dioxide
Ozone



METImage in a nutshell



High-resolution imagery and enhanced spectral information, outperforming AVHRR and extending the capabilities of MODIS and VIIRS

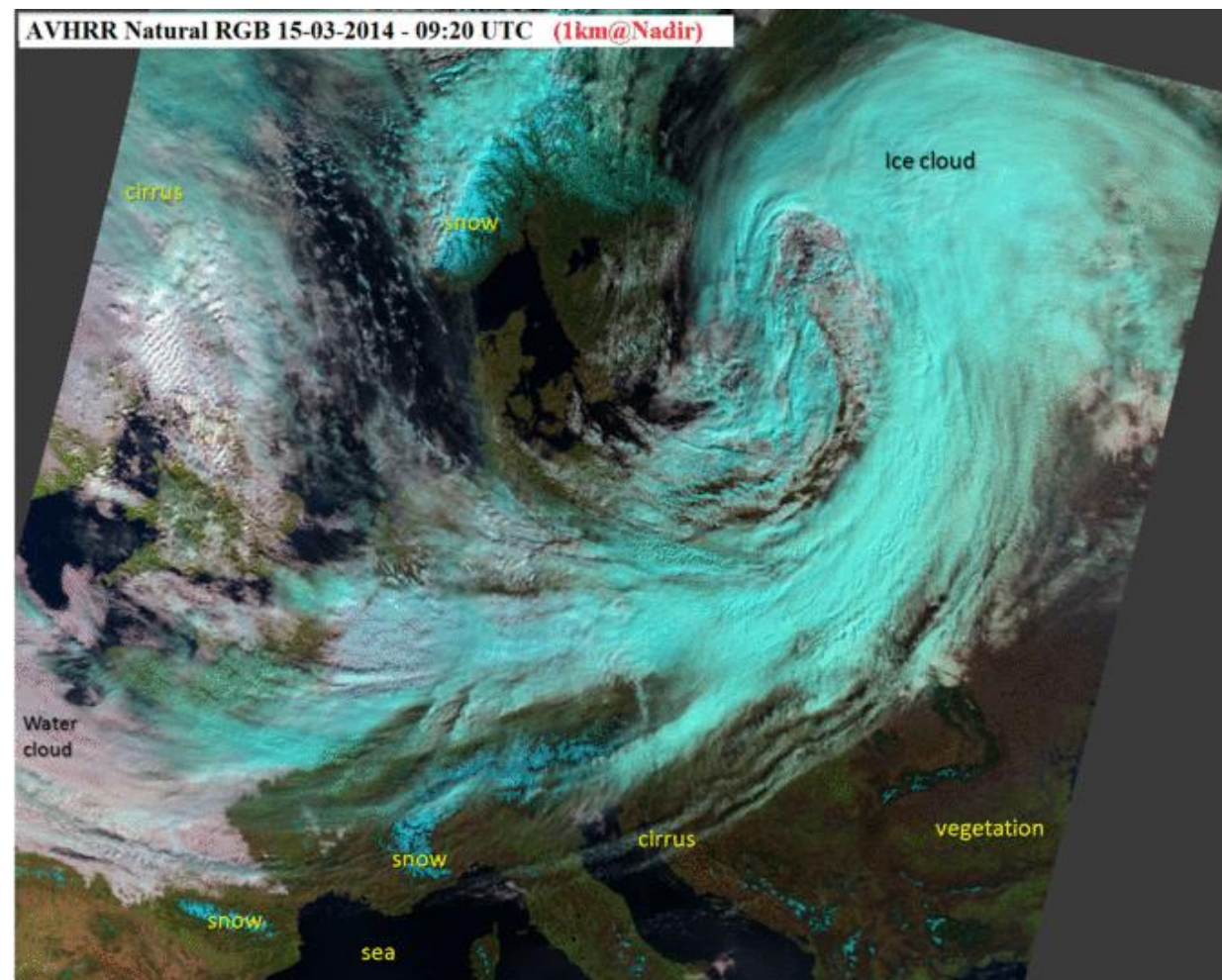


Enhancement vs AVHRR
Extension vs MODIS and VIIRS

↓
Precise surface feature identification
(albedo, snow/ice, vegetation, fires, sea surface temperature, etc.)

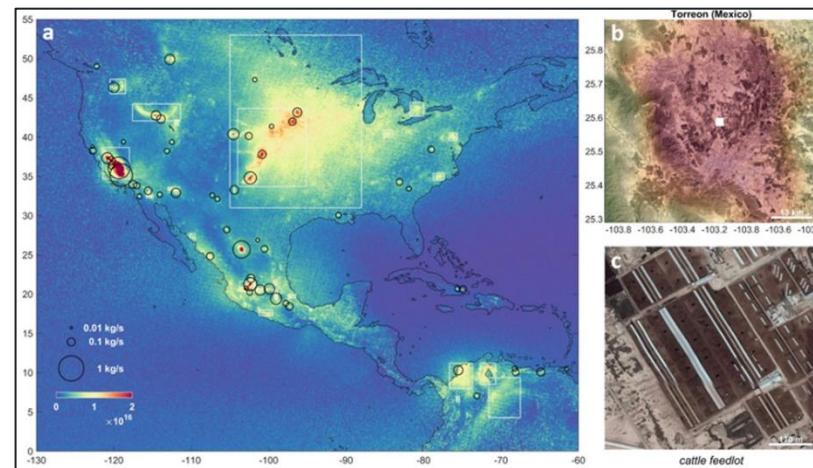
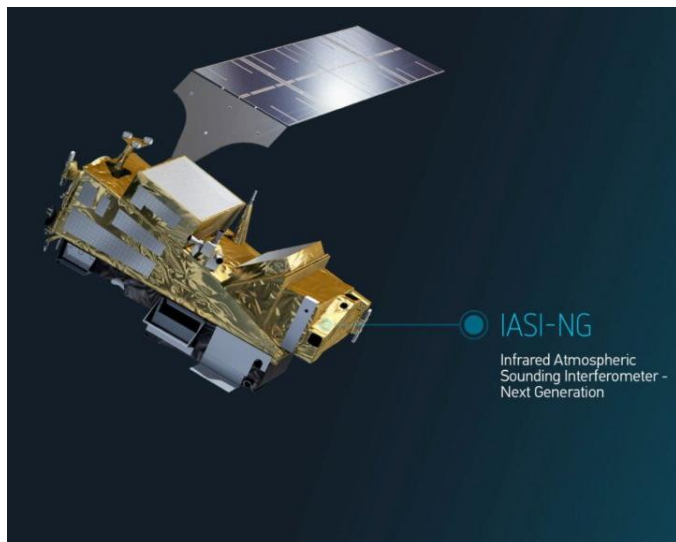
↓
Advanced atmospheric analysis
(clouds, aerosols, humidity, winds, etc.)

↓
Unparalleled insights into Earth's dynamic systems



Credit: Loredana Spezzi & the EUMETSAT Cloud and Aerosol Competence Area

EPS IASI contributes to the monitoring of currently **33 atmospheric species** including **greenhouse gases** (CO_2 , CH_4 ...), **pollutants** (CO , NH_3 ...) and **ozone depleting molecules** (CFCs)



Van Damme, M., Clarisse, L., Whitburn, S. et al. Industrial and agricultural ammonia point sources exposed. *Nature* 564, 99–103 (2018). <https://doi.org/10.1038/s41586-018-0747-1>

IASI-NG will:

- **Continue** the extraordinary legacy of IASI for another 20 years for numerical prediction and climate monitoring;
- **Improve** the detection of pollution sources, such as the detection of local industrial pollution, thanks to its fine spectral resolution and low noise;
- Give the opportunity to **detect new species** such as isoprene which can't be detected with IASI

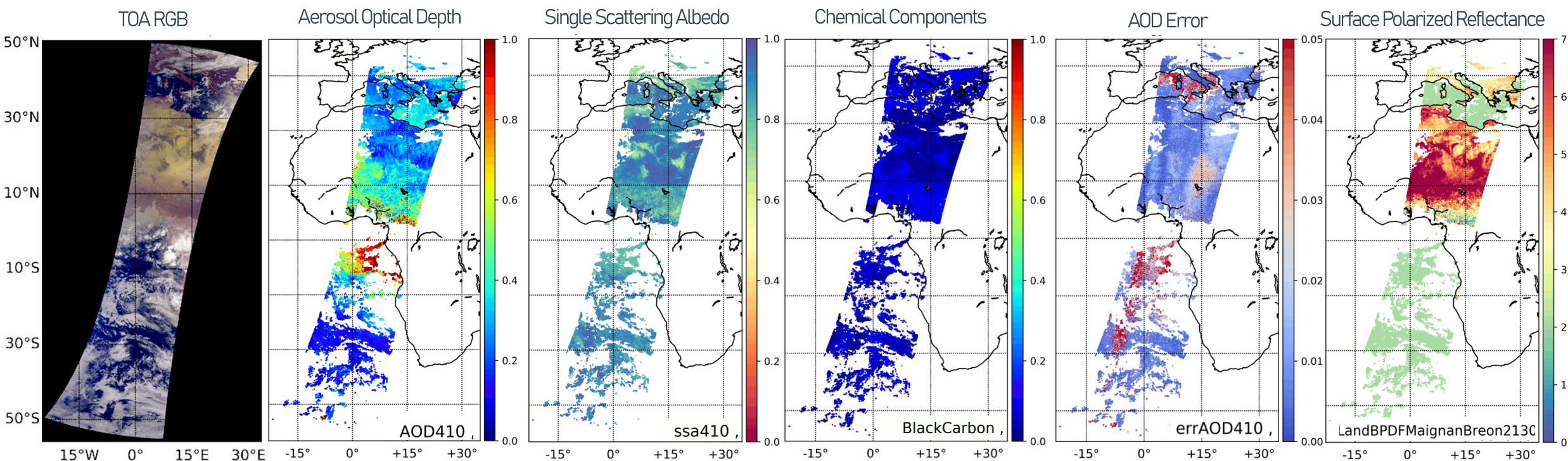
The **primary objective** of the 3MI mission is to provide **high quality imagery of aerosol variables** over ocean and land.

Next generation with the 3MI polarimeter = Better performance + Enhanced capability (i.e. more parameters)

Scientific development lead by EUMETSAT/RSP:

- Polarimetry with 3MI = Very extensive information content – optimised for aerosol/cloud
- Opens the door to **>25 years of operational** aerosol observation –
- Suite of parameters, **more extensive characterisation, (spectral optical and microphysical properties)** support to **Air Quality application, NWP, Climate models and data records.**

More parameters

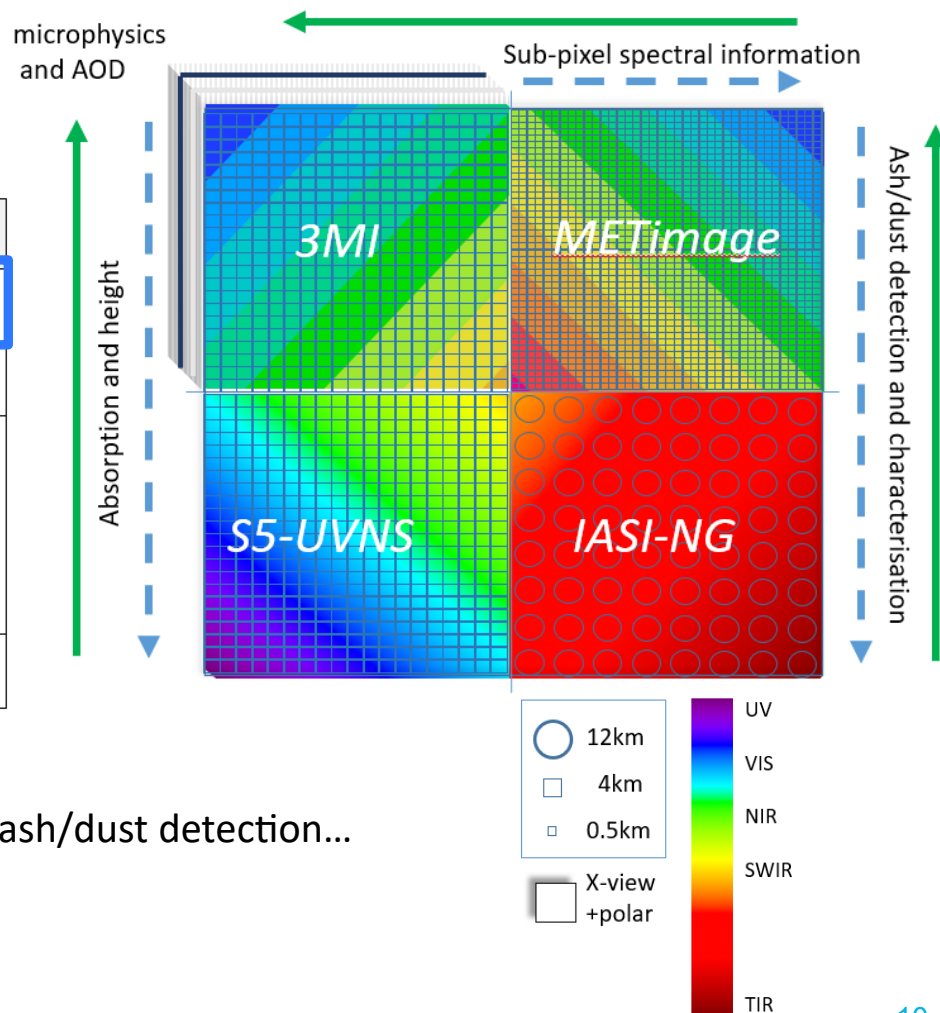


Next generation of synergy aerosol product from EPS-SG: MAP

(follow-on PMAp on EPS)

- Retrieval of **aerosol properties** using a hyper-instrument synergy of instruments on-board the platform
 - 3MI - Multi-View, Polarisation, -Spectral Imager;
 - UVNS - UV/Near- and Shortwave Infrared Sentinel-5 spectrometer (Sentinel 5);
 - METImage - Visible Infrared Imager (VII);
 - IASI-NG - Infrared Atmospheric Sounding Interferometer.

Sensor	Spatial resolution	Swath	Spectral type	Spectral bands	Spectral range	Additional capabilities
3MI	4x4 km ²	2200 x 2200 km ²	VIS/NIR/SWIR	12 bands	410 to 2130nm	14 views Polarisation (I/Q/U)
METImage	0.5x0.5 km ²	2670 km	VIS/NIR/SWIR TIR	11 bands 9 bands	443 to 2250nm 3.3 to 13.3μm	
S5-UVN	7.5x7.5 km ² 50x50 km ² (<300nm)	2670 km	UV/VIS/NIR/SWIR	1669 bands (0.25nm in SWIR to 1nm in UV)	270-300nm 300-370-500nm 685-710nm 755-773nm 1590-1675nm 2305-2385nm	
IASI-NG	12km spot	2000 km	TIR	16921 bands (0.25cm ⁻¹)	645 to 2760cm ⁻¹	



- Baseline for the design of MAP version 1:
 - PMAp synergy adapted to EPS-SG: colocation, cloud masking, pre-classification, ash/dust detection...
 - AOD and model retrieval from 3MI/GRASP
- Extension to other parameters: improve ash & dust, aerosol height, SSA, PM25?

- Use of IASI-NG derived temperature and humidity profiles as prior information for S5 trace gas retrievals.
- S5 - IASI-NG data fusion and/or synergy retrieval for
 - O3 profile
 - CO, column + vertical profile
 - CH4, boundary layer - free troposphere separation
 - SO2, improved plume height,
 - water vapour,
 - ...
- CO2M-proxy: S5 - 3MI - METImage combination for greenhouse gas retrieval.
- Feasibility will be explored in the frame of targeted ITTs and existing science cooperations and services, followed by potential operationalization at EUMETSAT HQ / AC SAF.



Thank you!
Questions are welcome.