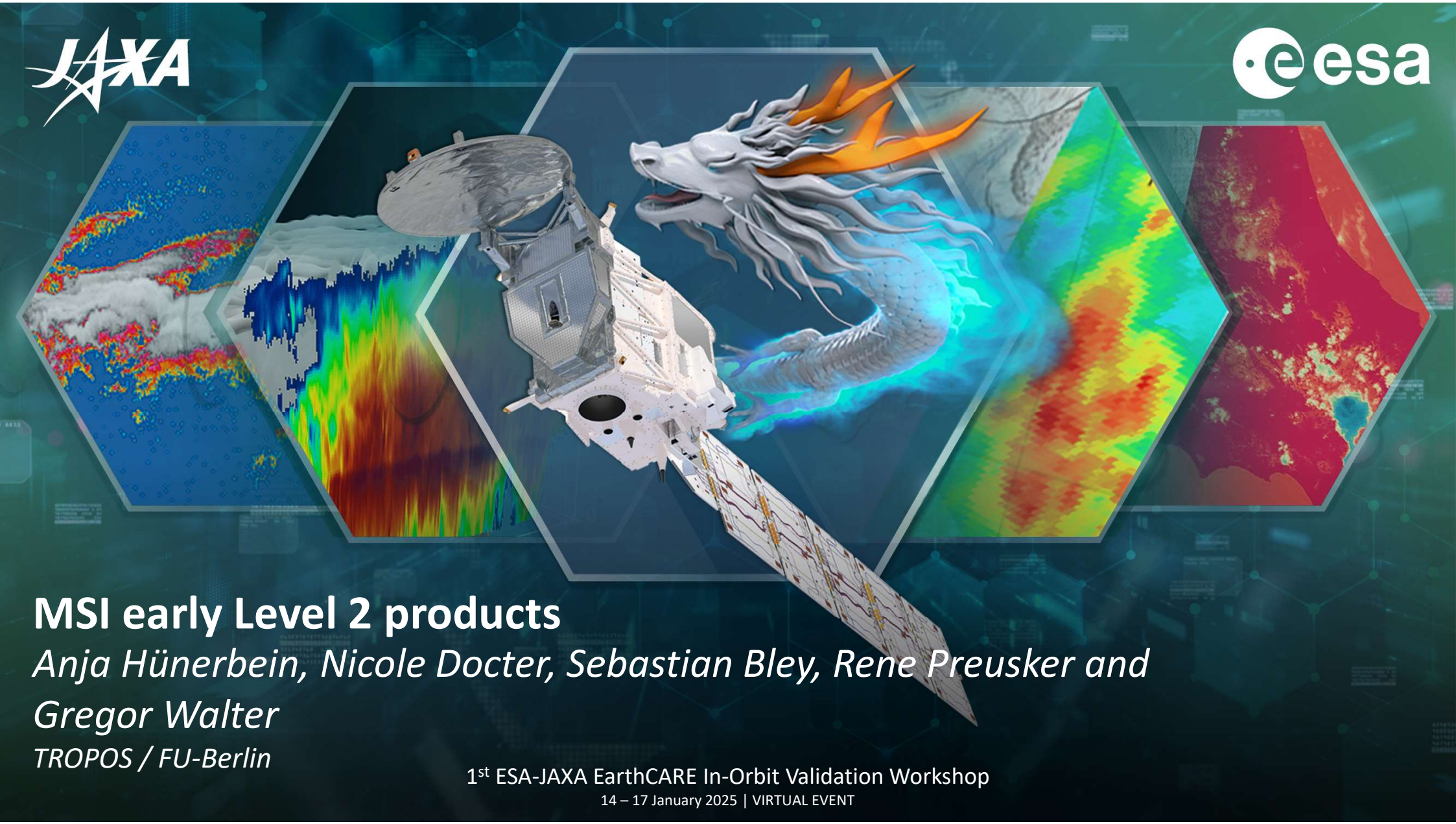


MSI early Level 2 products

Anja Hünerbein, Nicole Docter, Sebastian Bley, Rene Preusker and Gregor Walter

TROPOS / FU-Berlin

1st ESA-JAXA EarthCARE In-Orbit Validation Workshop

14 – 17 January 2025 | VIRTUAL EVENT

MSI level 2 products M-CM, M-COP and M-AOT

MSI L2 products since July until now

M-CM
the cloud mask product

cloud_mask
cloud_type
cloud_phase
surface_classification

quality status
cloud_mask_quality_status
cloud_type_quality_status
cloud_phase_quality_status

Hünerbein, A. et al., 2023
https://doi.org/10.5194/amt-16-2821-2023

M-COP
the cloud optical and physical properties product

cloud_optical_thickness
cloud_effective_radius
cloud_top_temperature
cloud_top_pressure
cloud_top_height
cloud_water_path

cloud_optical_thickness_error
cloud_effective_radius_error
cloud_top_temperature_error
cloud_water_path_error
Quality status

Hünerbein, A. et al., 2024
https://doi.org/10.5194/amt-17-261-2024

M-AOT
the aerosol optical and physical properties product

aerosol_optical_thickness_670nm
aerosol_optical_thickness_865nm
angstrom_parameter_670nm_865nm

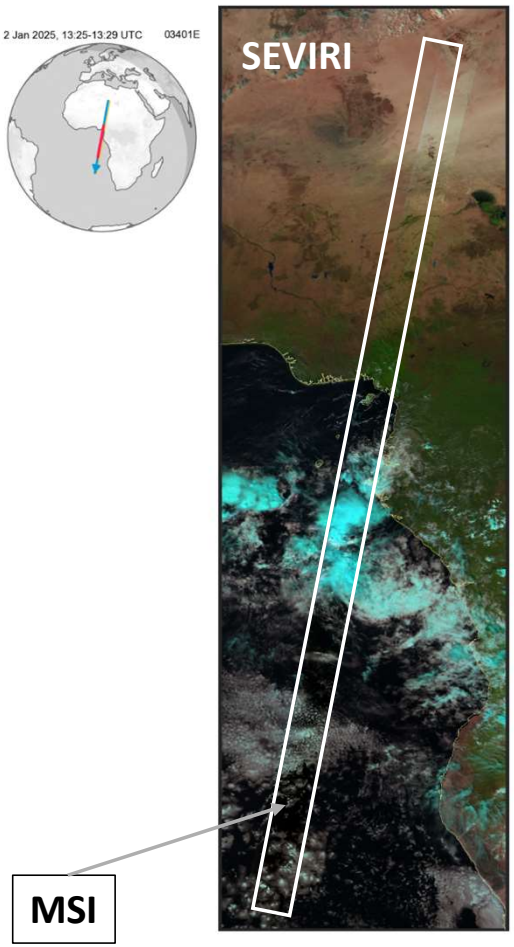
aerosol_optical_thickness_670nm_error
aerosol_optical_thickness_865nm_error
quality status

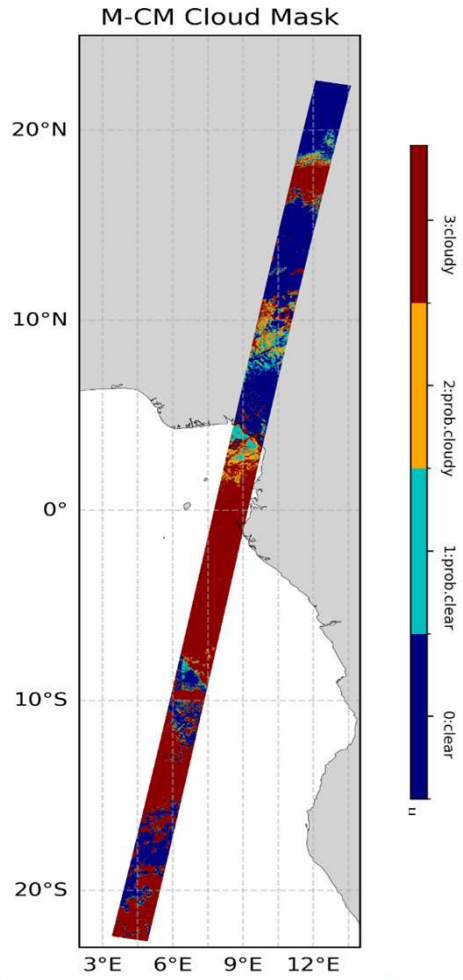
Docter, N. et al., 2023
https://doi.org/10.5194/amt-17-2507-2024

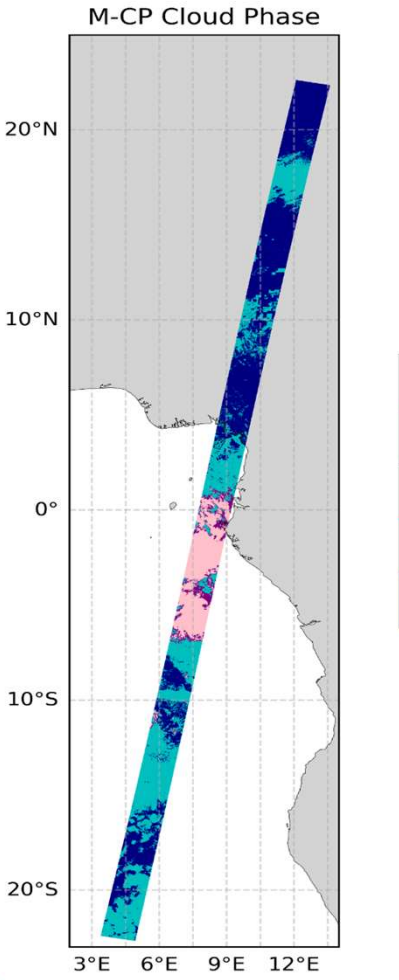
MSI level 2 products M-CM, M-COP and M-AOT

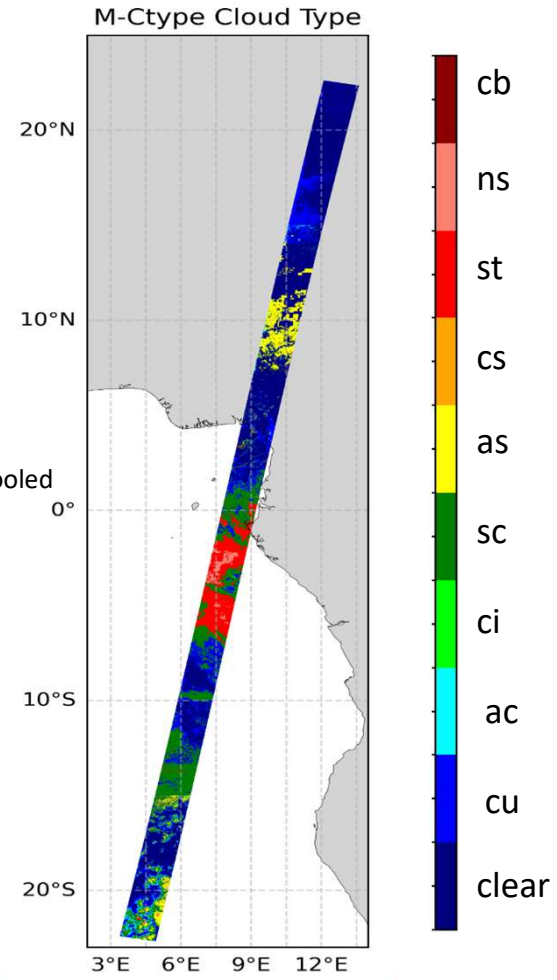
ECA_EXAD_MSI_RGR_1C_20250102T132052Z_20250102T145422Z_03401E

SEVIRI_20250102T133011Z_20250102T134243Z





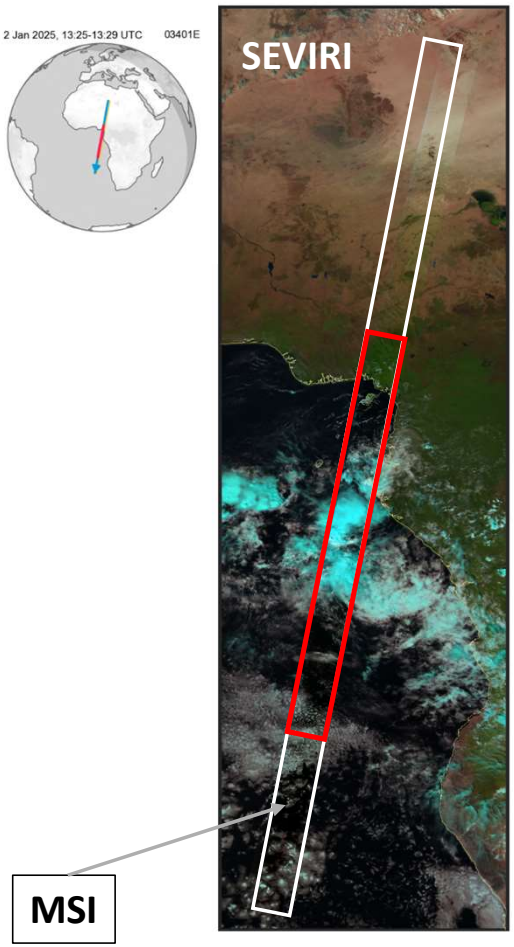




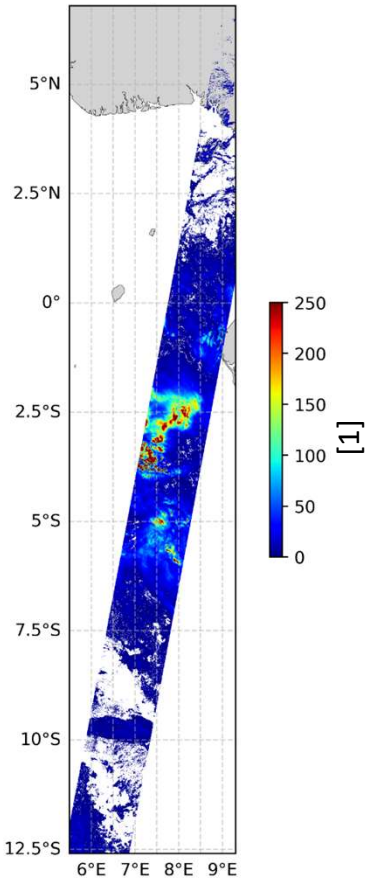
MSI level 2 products M-CM, **M-COP** and M-AOT

ECA_EXAD_MSI_RGR_1C_20250102T132052Z_20250102T145422Z_03401E

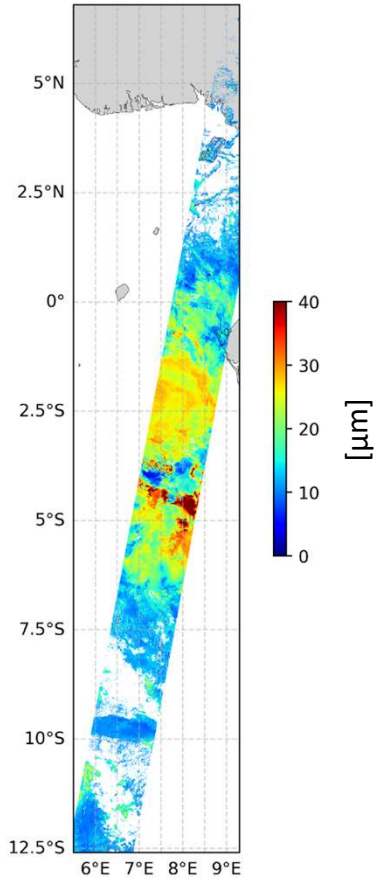
SEVIRI_20250102T133011Z_20250102T134243Z



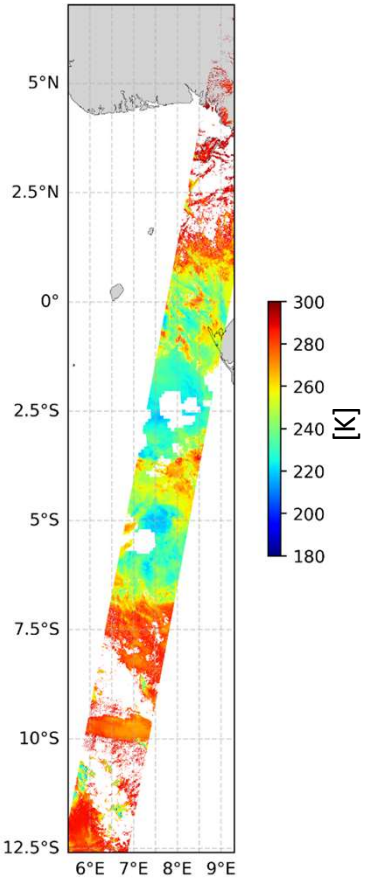
M-COT
Cloud optical thickness



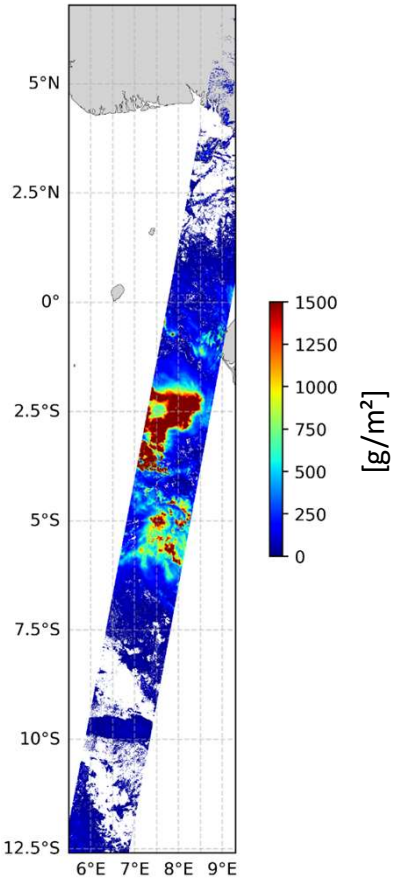
M-REFF
Cloud effective Radius



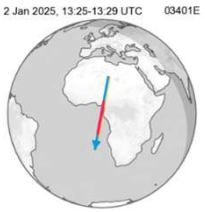
M-CTT
Cloud Top Temperature

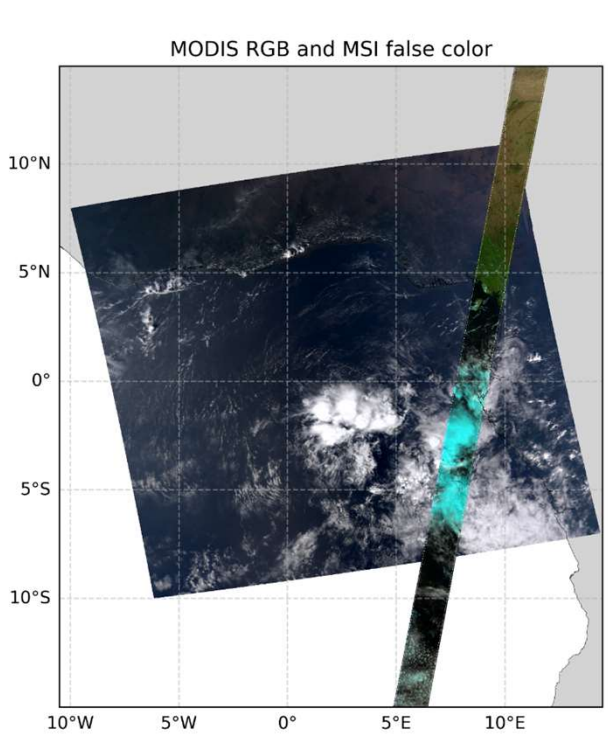


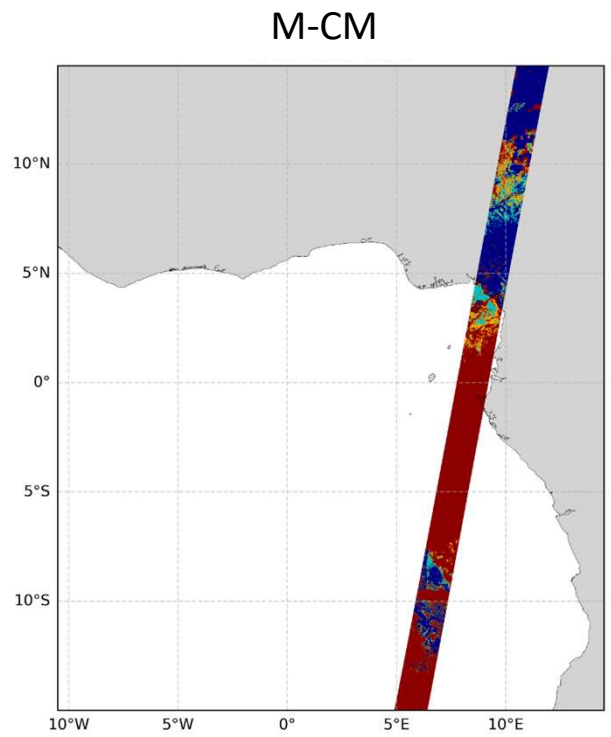
M-CWP
Cloud Water Path

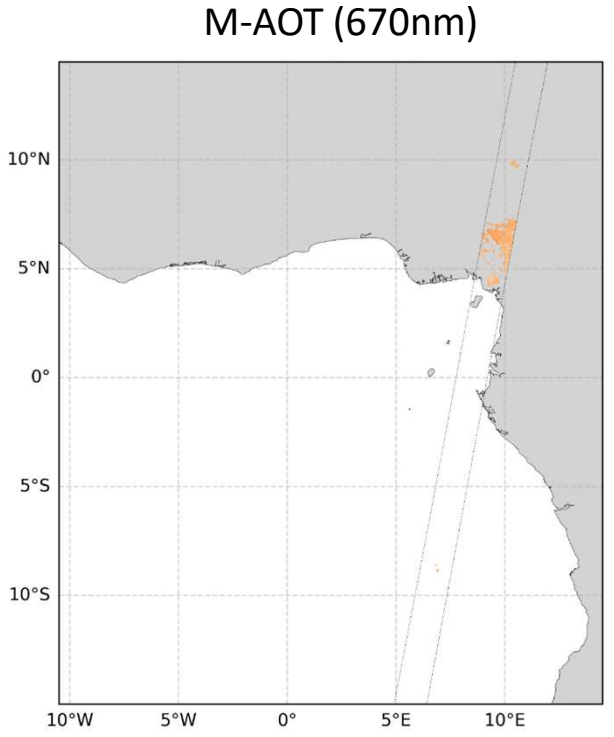


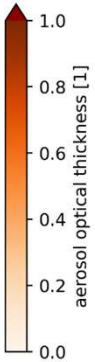
M-AOT - MSI aerosol optical thickness



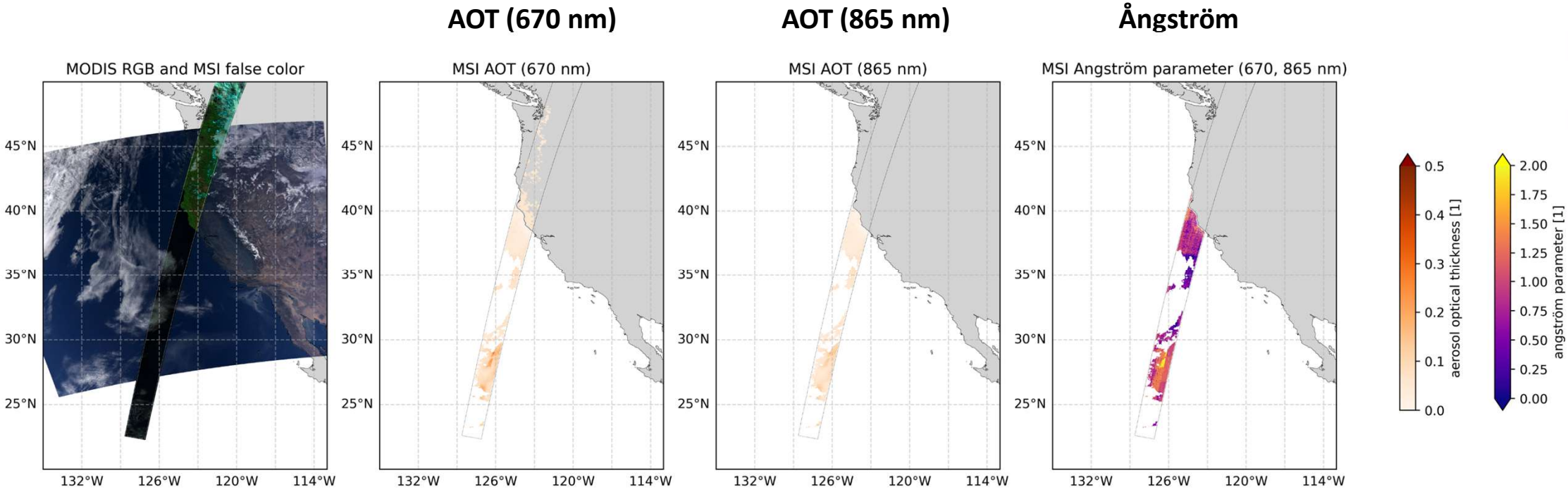








M-AOT - MSI aerosol optical thickness



Carlifornia wildfire

09/01/2025 frame 03516D

Pitfalls

For the solar channels:

diffuser related “solar irradiance” **variations** in the across-track dimension **are leading to a not negligible effect** on cloud and aerosol products since the solar irradiance is used for the calculation of spectral TOA reflectances:

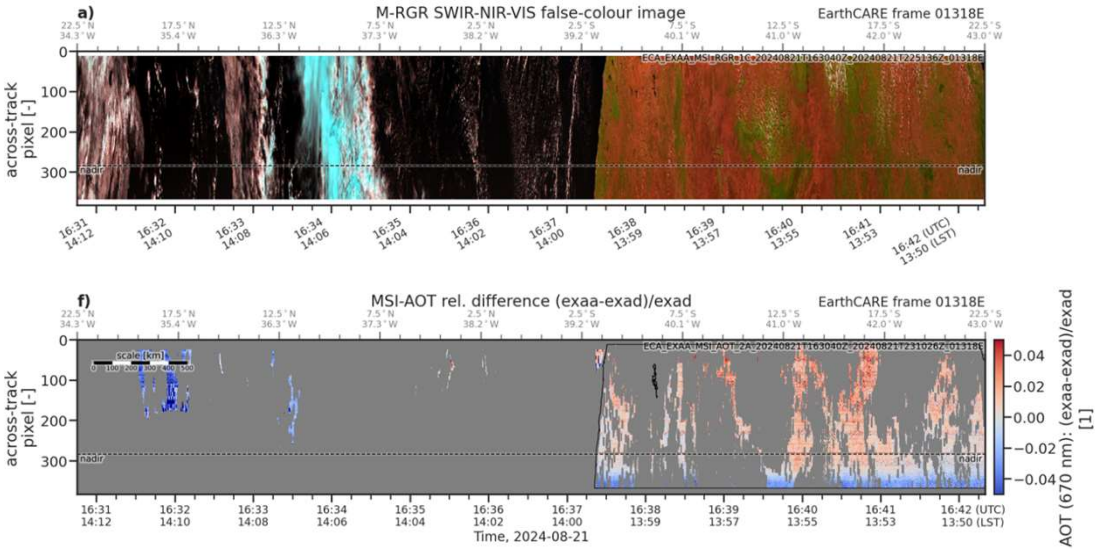
$$\rho_\lambda = \frac{L_\lambda \cdot \pi}{I_{\lambda,c} \cdot \cos(\theta_{sol})}$$

$I_{\lambda,c}$ spectral solar irradiance for each band and MSI across-track pixel

L_λ spectral radiance (pixel values for band 1 to 4) on MSI along- and across-track grid

θ_{sol} solar zenith angle

Example highlights influence of changed VIS spectral solar irradiance change specifically for M-AOT



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$I_{\lambda,c}$ spectral solar irradiance for each band and MSI across-track pixel

L_λ spectral radiance (pixel values for band 1 to 4) on MSI along- and across-track grid

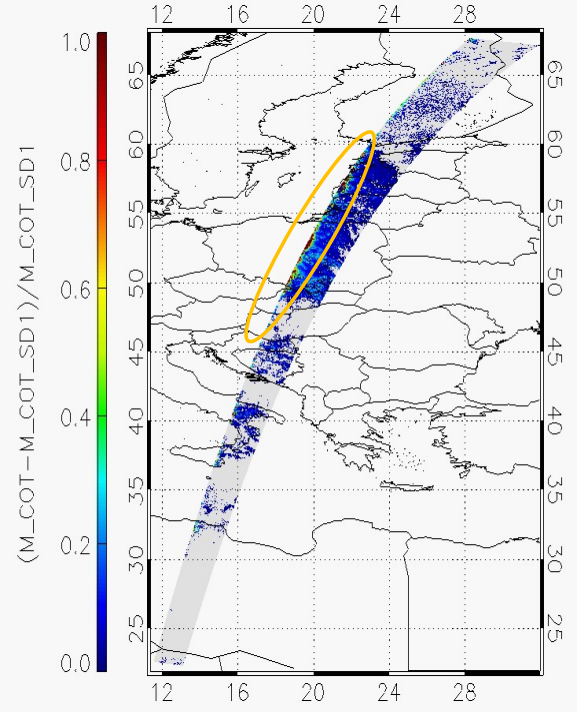
θ_{sol} solar zenith angle

- the spectral solar irradiance will be updated and corrected in the life time of MSI

➢ update is on the way

Example highlights influence of changed VIS spectral solar irradiance change specifically for M-COT

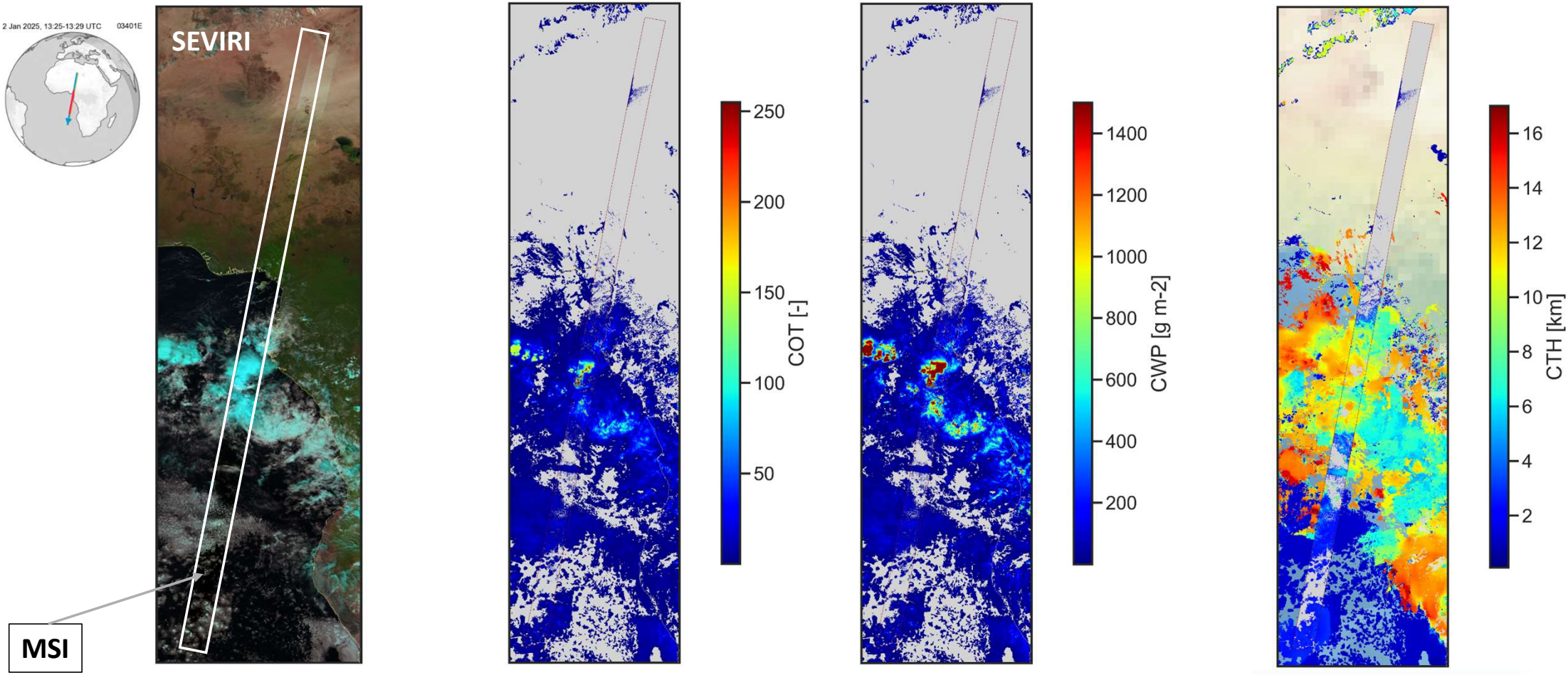
relative differences M-COT



M-COP vs SEVIRI

ECA_EXAD_MSI_RGR_1C_20250102T132052Z_20250102T145422Z_03401E

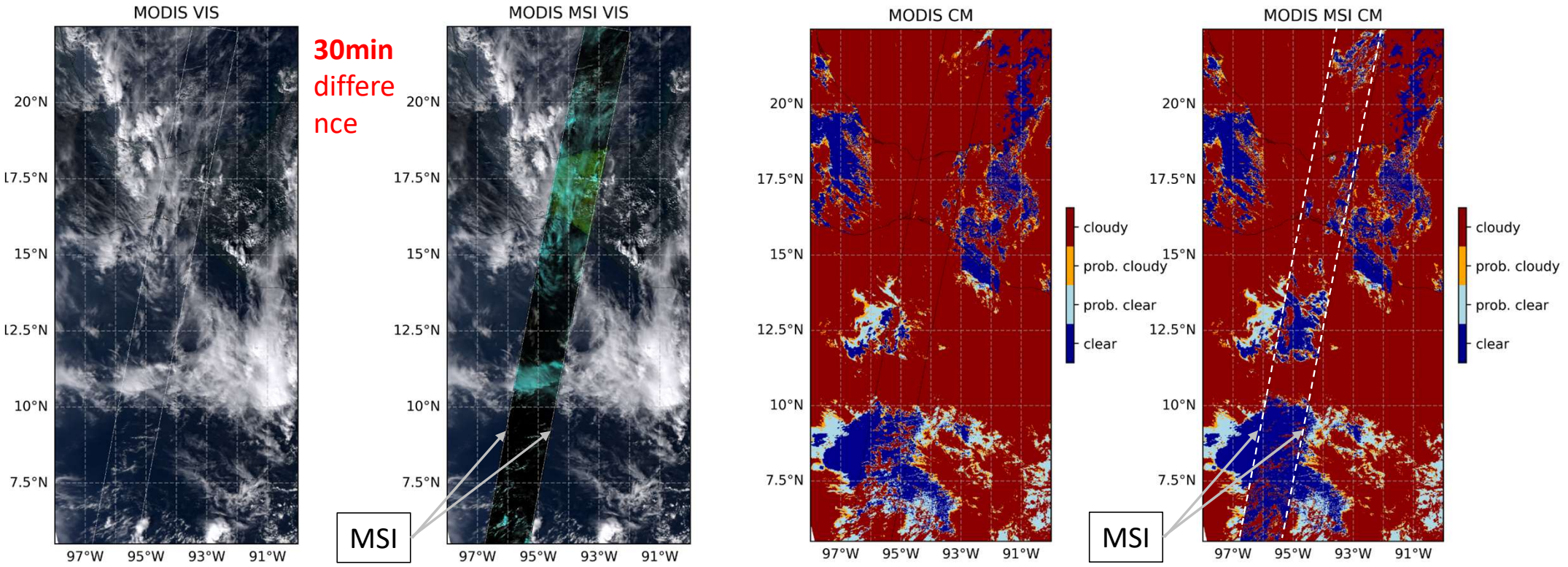
SEVIRI_20250102T133011Z_20250102T134243Z



M-CM vs MODIS

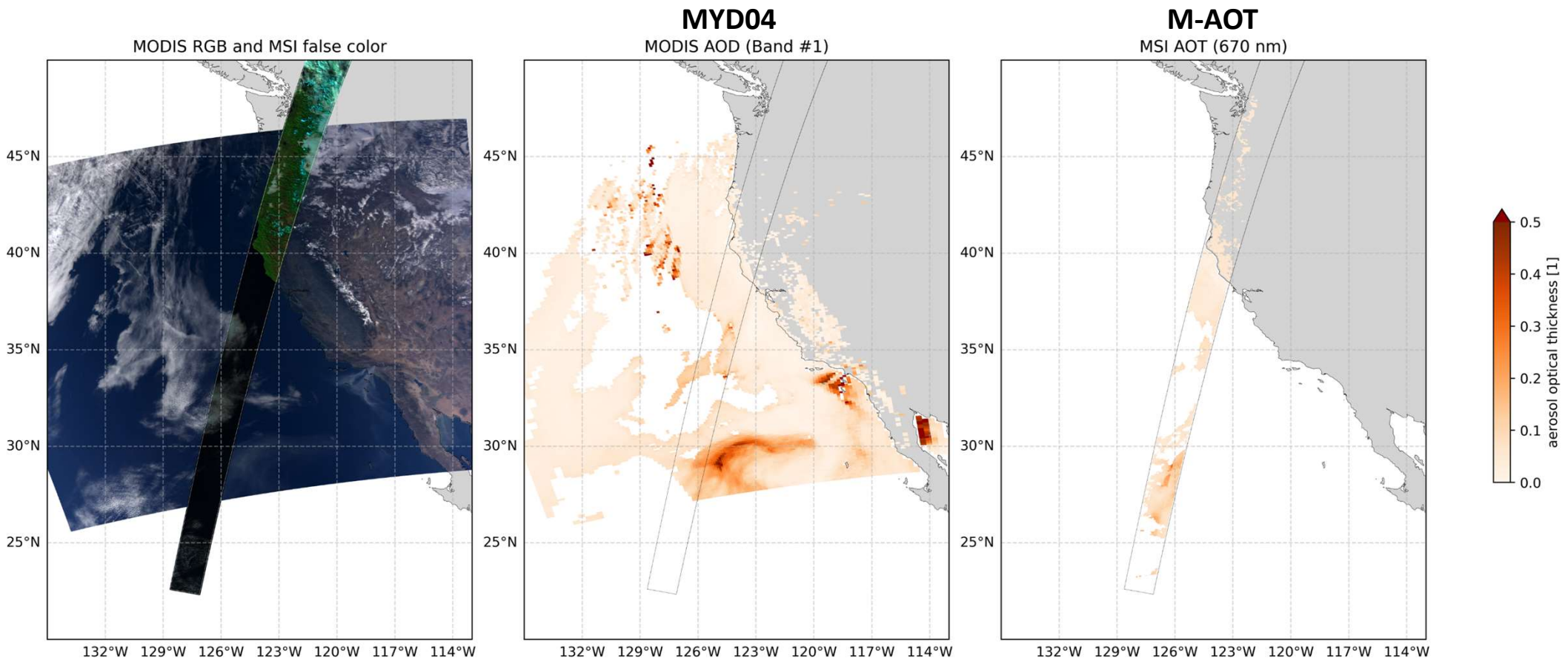
Geostationary SEVIRI/ polar orbiting MODIS (Aqua 30min differences)

Cloud mask



01/01/2025 frame 03390E

M-AOT vs MYD04_L2



09/01/2025 frame 03516D

MSI L2 validation needs

Usage of all types of reference data, e.g.,

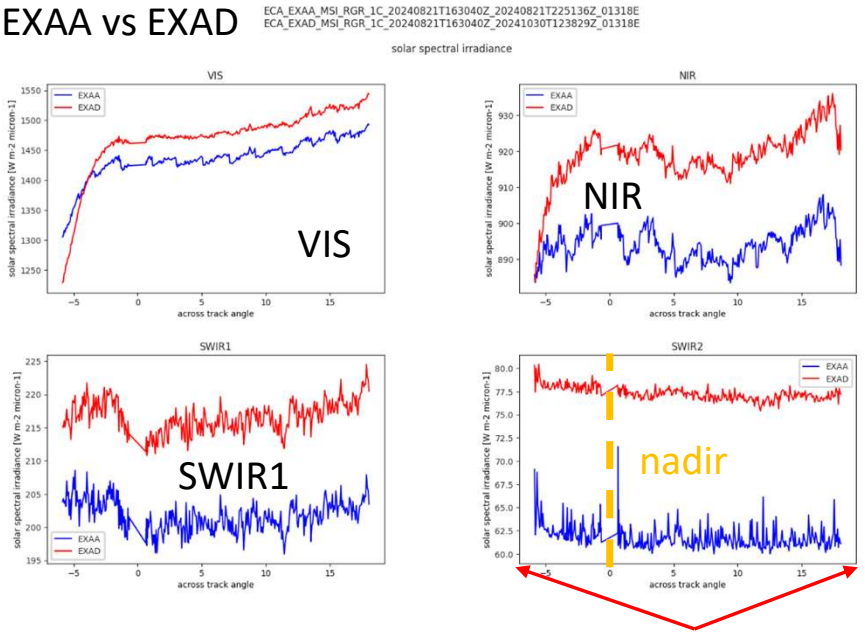
- ground-based measurements (AERONET, ACTRIS, etc.)
- satellite-based (e.g., MTG-FCI, Sentinel-2 MSI, MODIS, VIIRS, etc.)
- airborne-based

Separation of validation results with respect to geophysical conditions, e.g.,

- cloudiness
- surface type (different biomes: ocean, vegetated land, desert, ice, snow, etc.)
- day-night
- (e.g., frame-based)
- etc.

Consideration of the across-track dependency wherever possible, due to effects caused by

- MSI diffuser dependency of the spectral solar irradiance
- MSI smile (Docter et al. 2024)



Thank you!