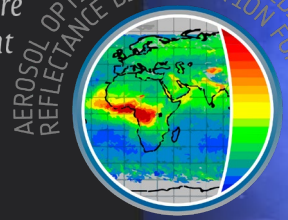
TROPOMI

SENTINEL-5P+ INNOVATION

ESA EOP-SDR initiative (IT)

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management



Development of TROPOMI Directional Lambertian Equivalent Reflectivity (DLER) and Aerosol Optical Thickness (AOT) products

M. de Graaf & L.G. Tilstra (KNMI)

GRASP

Catalysts
software is our passion

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AEROSOL OPTICAL DEPTH AND BIDIRECTIONAL REFLECTANCE DISTRIBUTION FUNCTION

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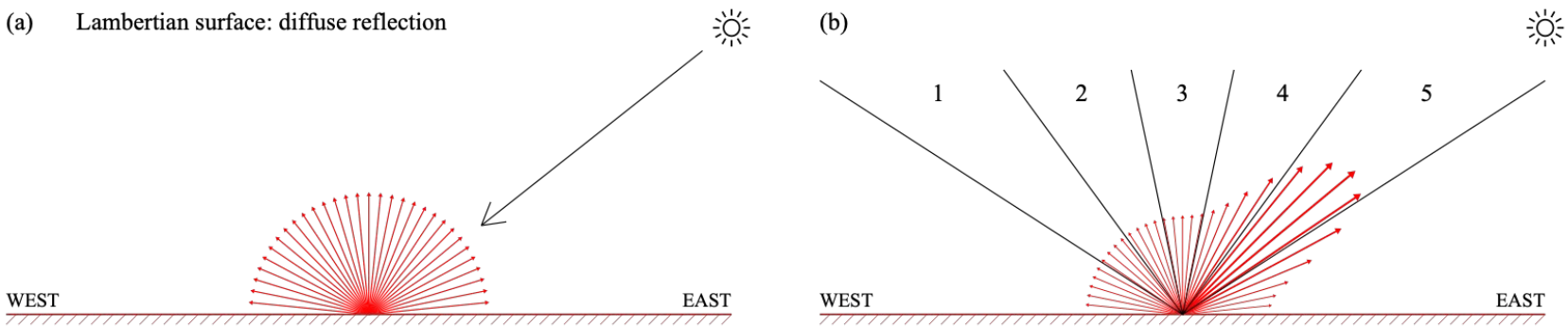
Directional Lambertian Equivalent Reflectivity (DLER)



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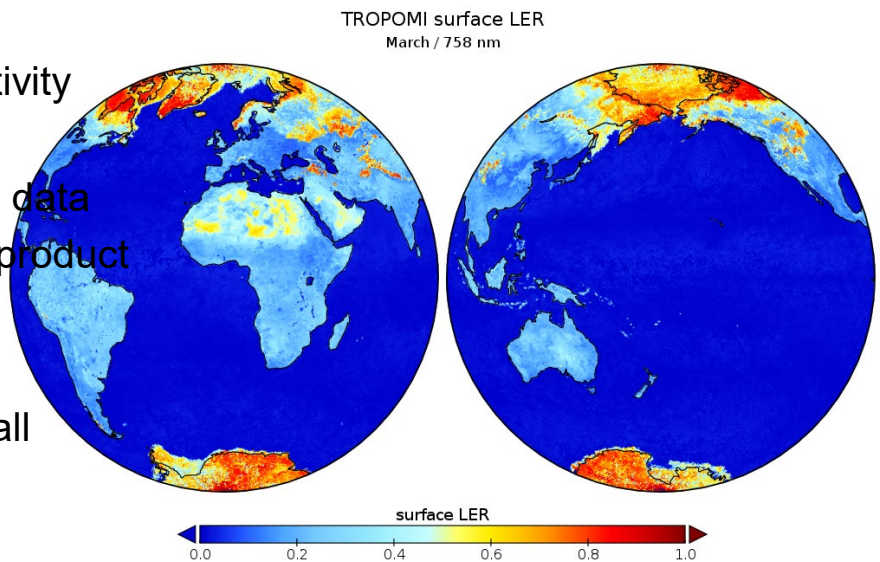
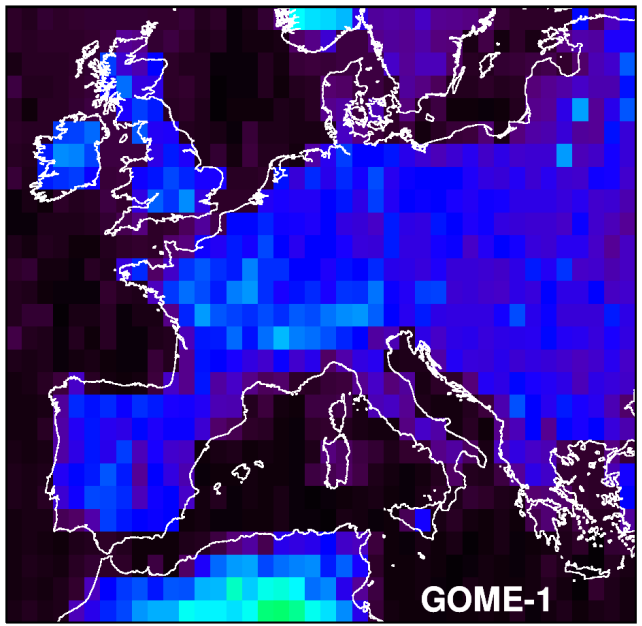
TROPOMI surface DLER database features

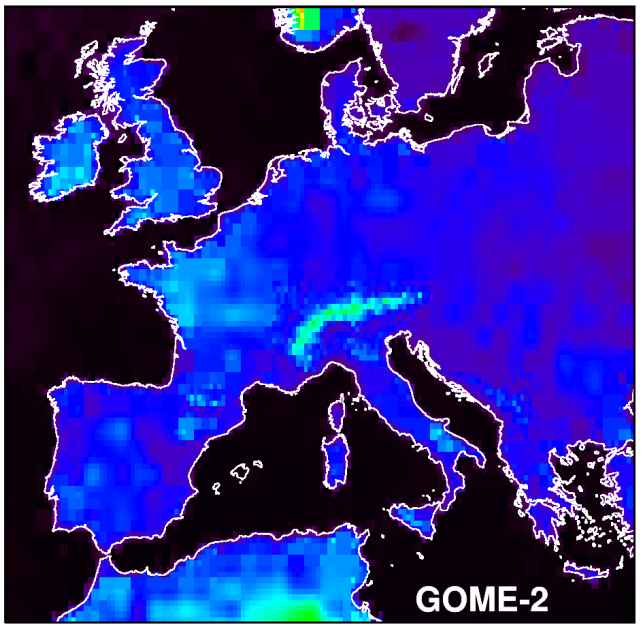
- ✓ 21 one-nm wide wavelengths from UV to NIR
- ✓ Monthly 0.125ºx0.125º grids of directional minimal reflectivity
- ✓ Cloud screening based on NPP VIIRS cloud product
- ✓ DLER current version (v0.7) based on 3 years of mission data
- ✓ Daily L1 to L2 processing on S5P-PAL of L2__SCNLER product
- ✓ Monthly L2 to L3 processing step executed on S5P-PAL
- ✓ DLER database now contains validated data
- ✓ Documentation (ATBD v1.1.0 ; PUM v0.1.0 ; VR v1.1.0) all available

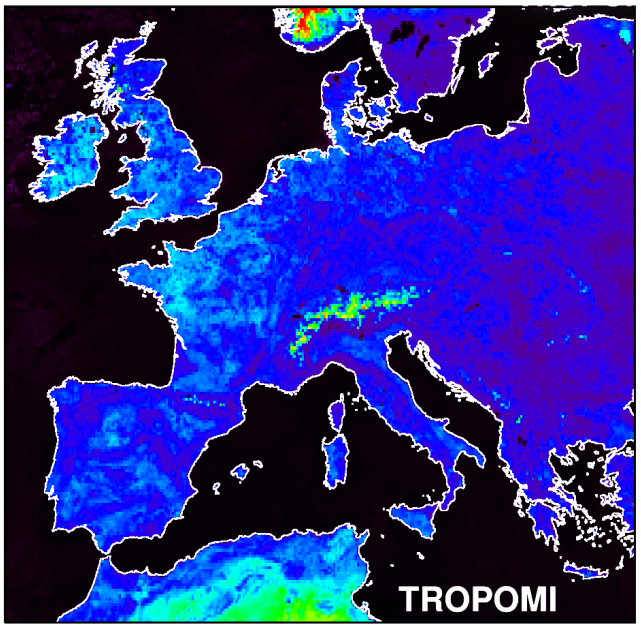


TROPOMI_Sentinel-5P_0125x0125_surface_LER_v0.2-beta.nc

Spatial resolution compared to previous surface albedo databases: (ATBD: Sec 5.3)







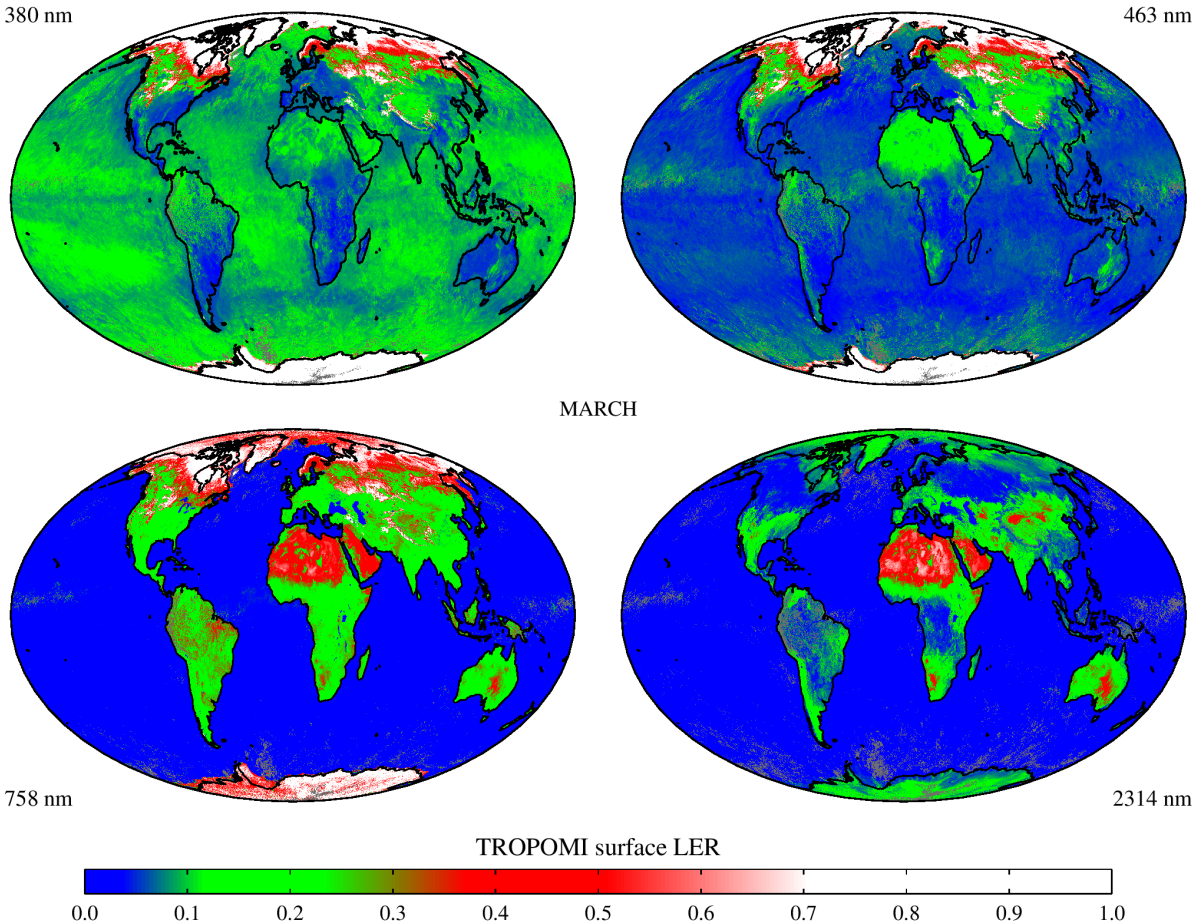
GOME-1: 1° × 1°
Too low resolution, ragged coastlines
Cloud contamination
Low quality

GOME-2: 0.25° × 0.25°
Note: real intrinsic resolution varies via dynamic gridding techniques between 0.25° × 0.25° and 1° × 1°

TROPOMI: 0.125° × 0.125°
Huge increase of information content

March / 758 nm

Examples of LER fields before post-processing (1)

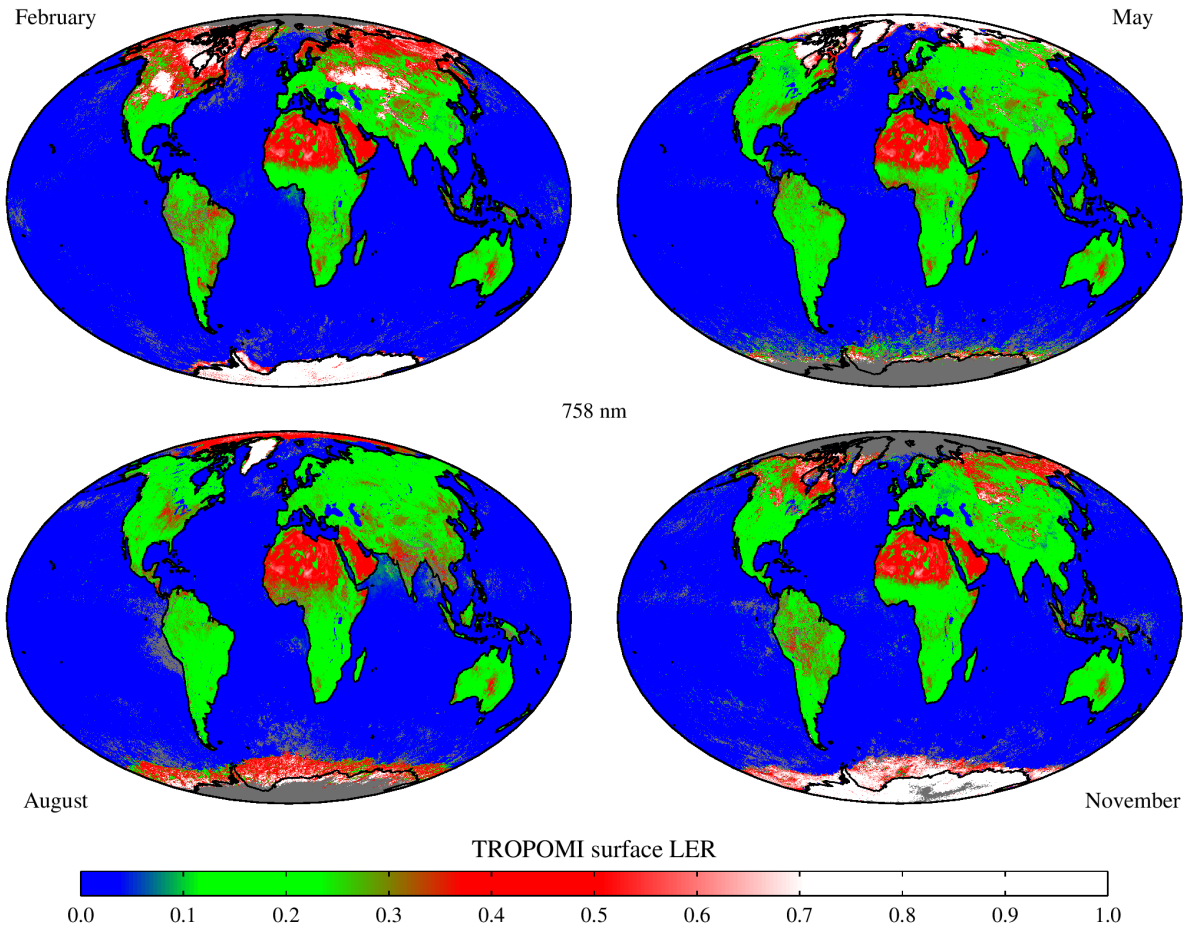


Gray = missing pixels

One year of data used.

Qualitatively ok.

Examples of LER fields before post-processing (2)



Gray = missing pixels

One year of data used.

Qualitatively ok.

Post-processing needed.

Post-processing steps

(ATBD: Sect. 6.4 / Fig. 9)

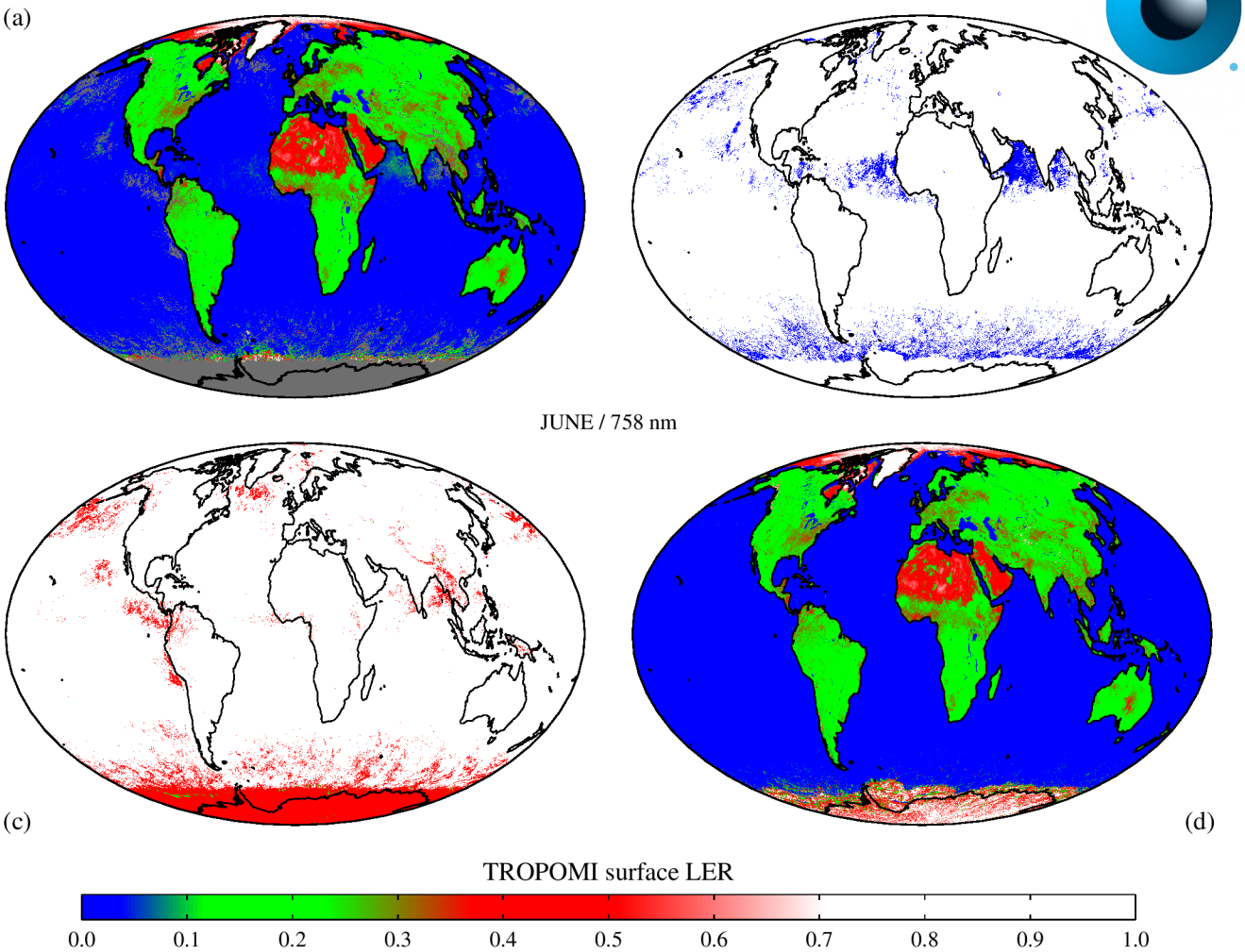
(a) before post-processing

(b) cloud contamination

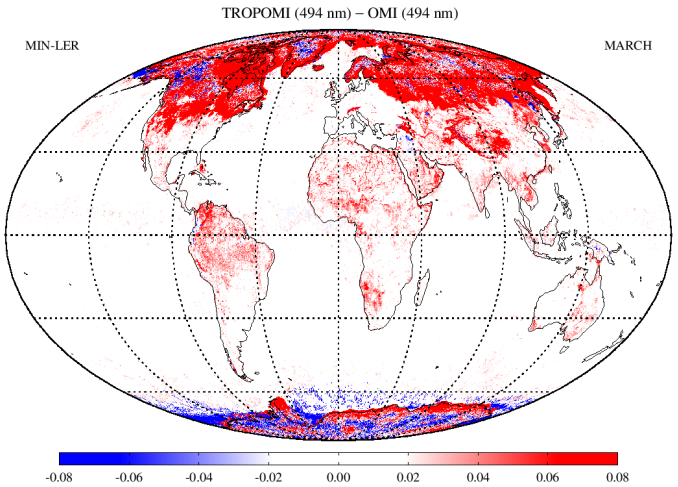
(c) missing data

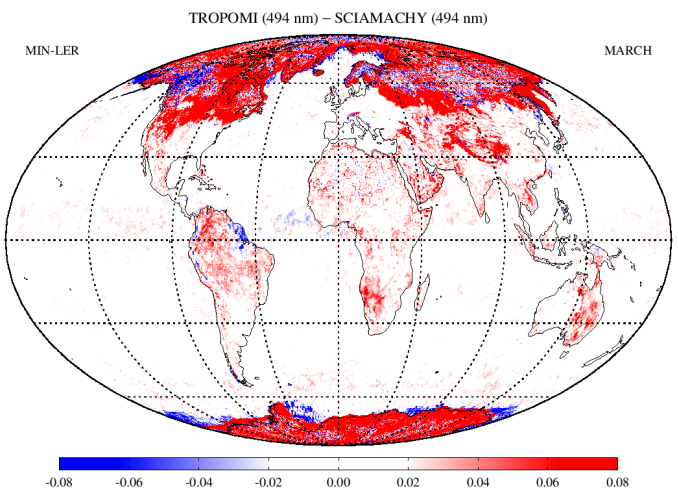
(d) after post-processing

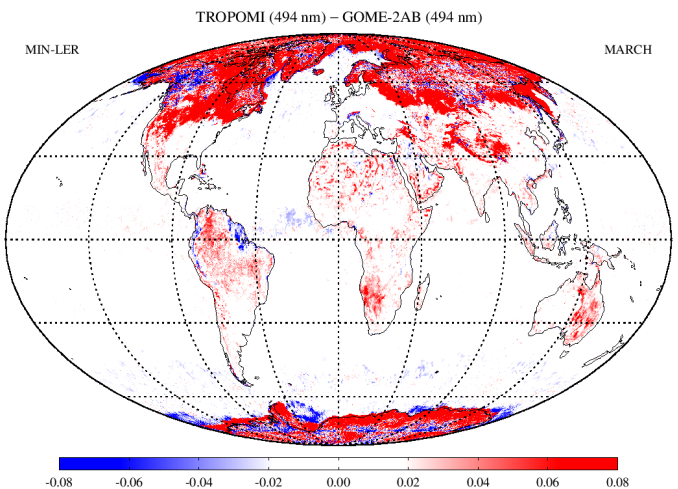
(based on 1 year of data)



Comparison with other surface LER databases: **494 nm**





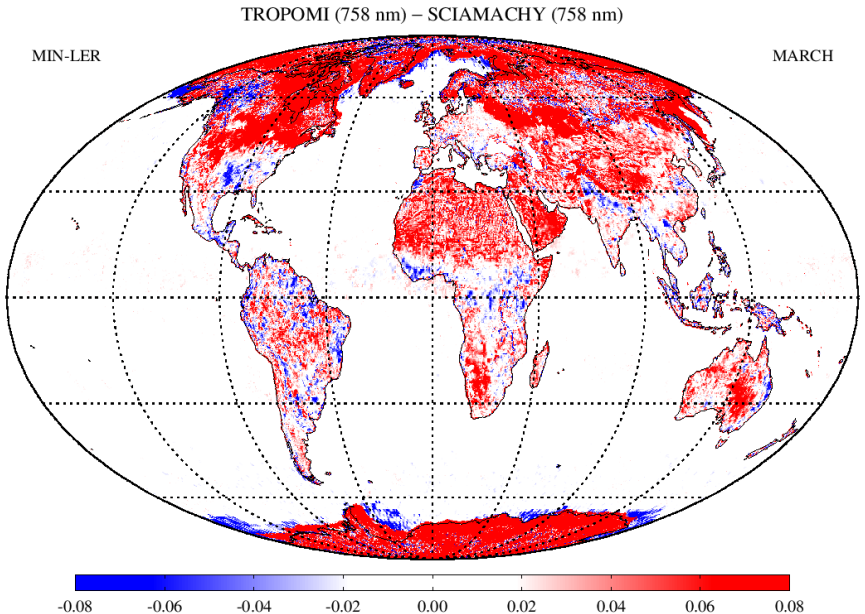


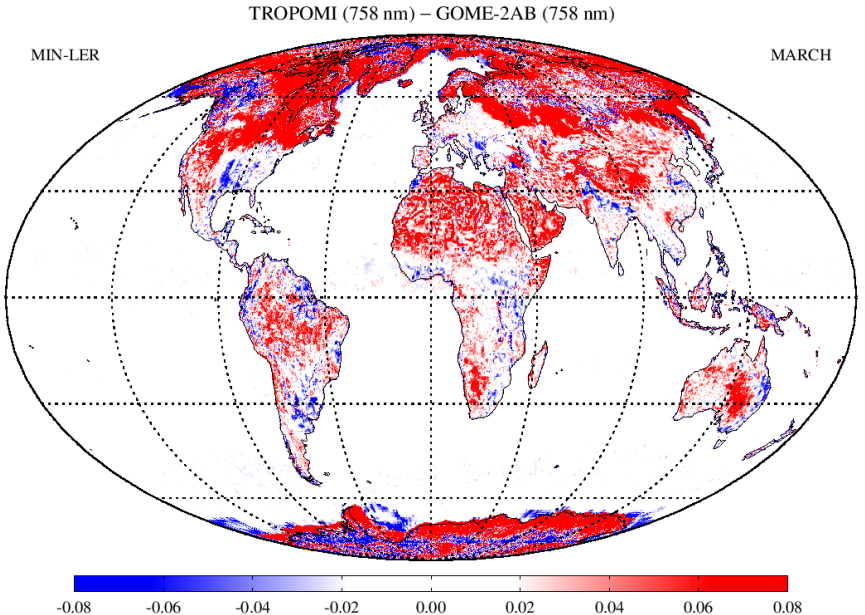
Good agreement, overestimation can be explained by known calibration problems.

Cloud contamination is visible in some parts over the ocean.

Only one year of TROPOMI data used!

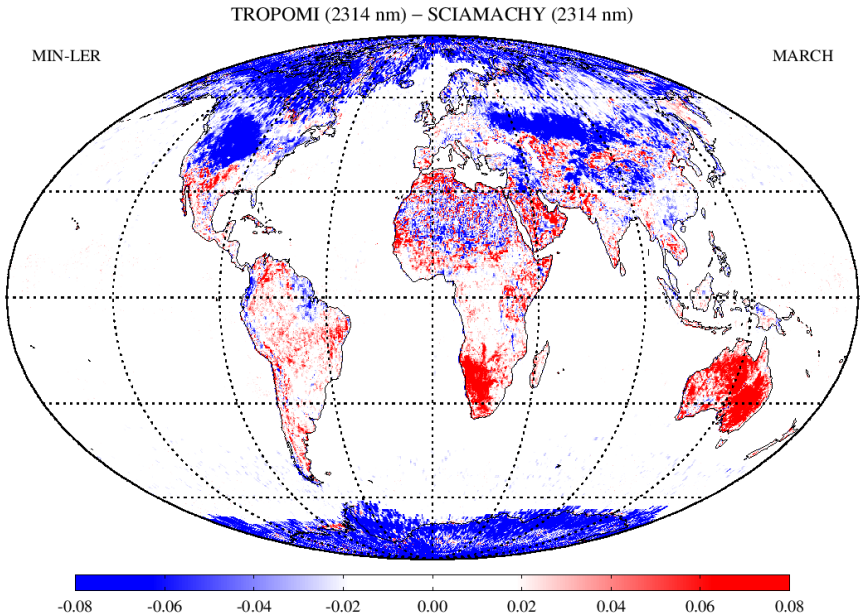
Comparison with other surface LER databases: **758 nm**





Good agreement, overestimation can partly be explained by known calibration problems.
Only one year of TROPOMI data used!

Comparison with other surface LER databases: **2314 nm**



Fair agreement, deviations can only partly be explained by known calibration problems.
Only one year of TROPOMI data used!

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AEROSOL OPTICAL DEPTH AND BIDIRECTIONAL REFLECTANCE DISTRIBUTION FUNCTION

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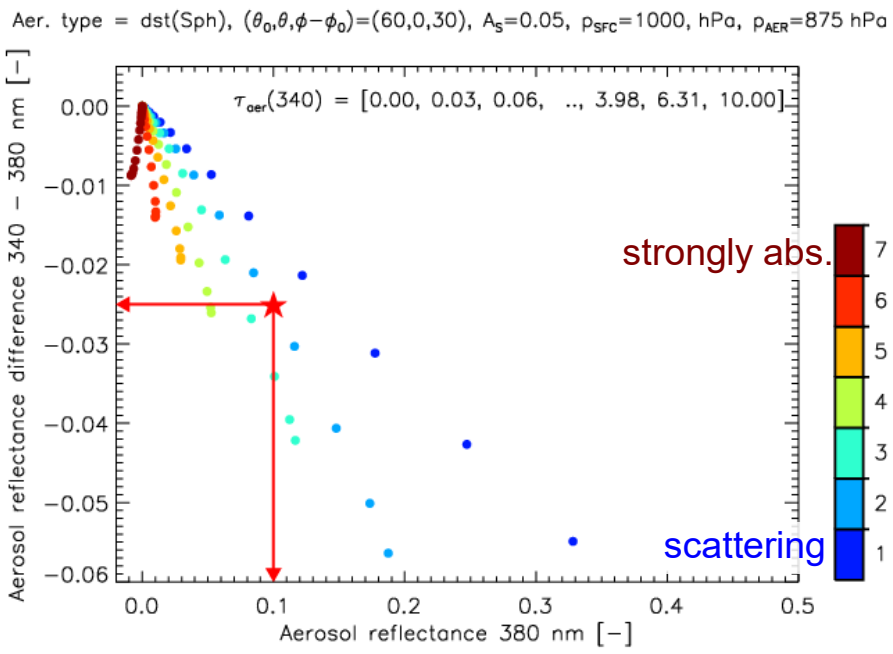
S5P-TROPOMI AER_OT PRODUCT

Global aerosol optical thickness and single scattering albedo



TROPOMI AOT is based on

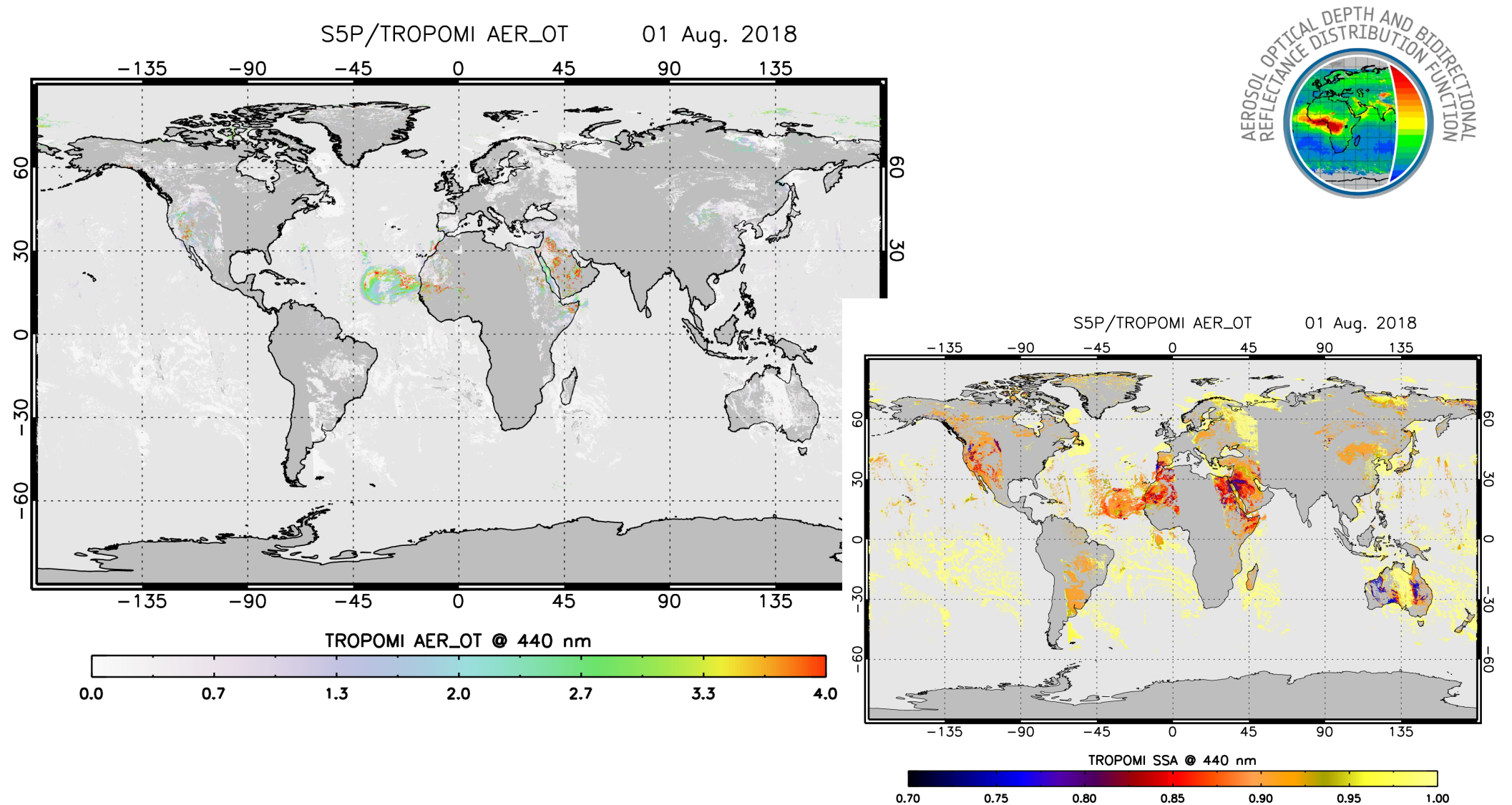
- LUT approach, based on OMI AOT
- Retrieved in UV at 340, 380, 416, 440, 494 nm
- Dust model is based on spheroids

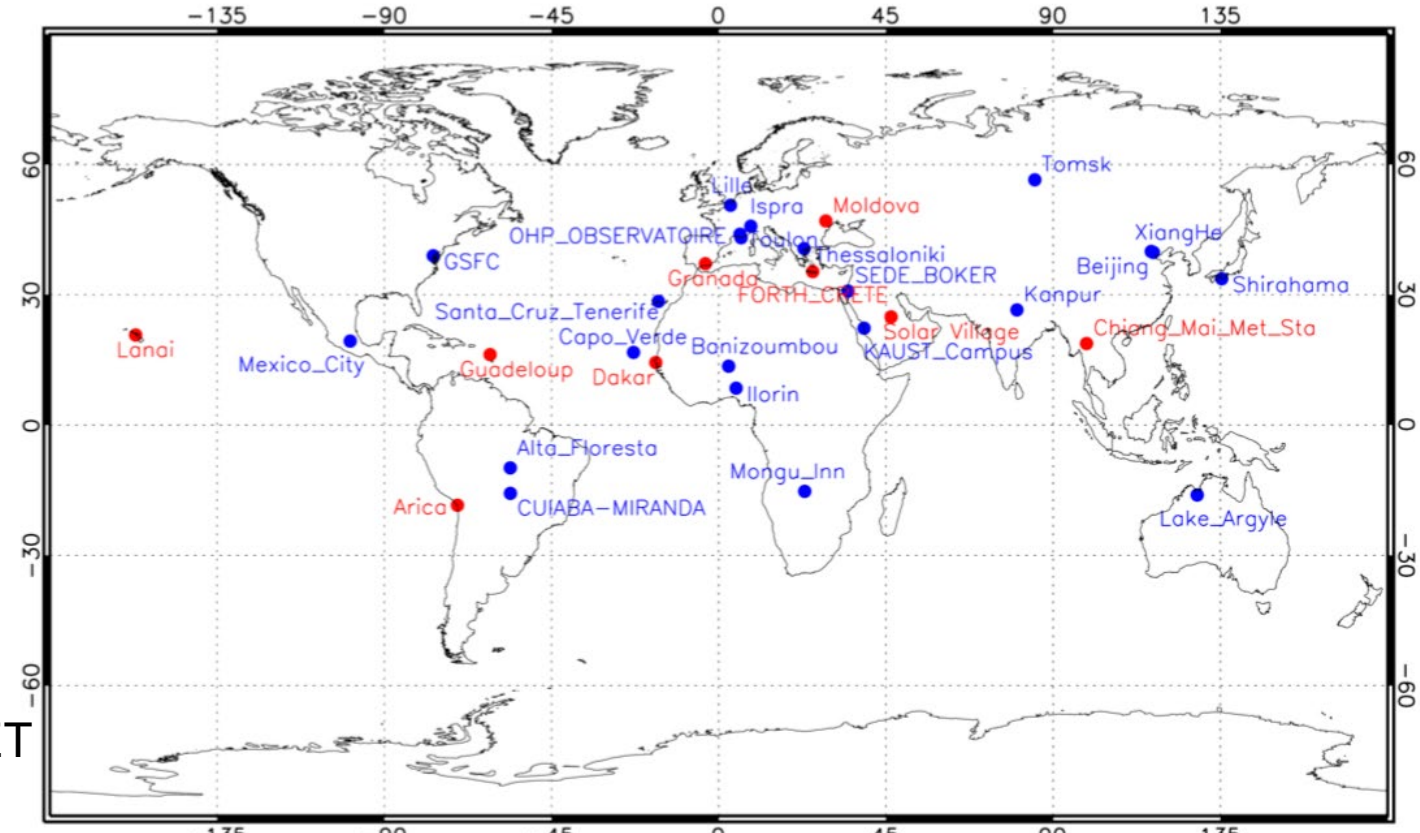
Inputs:

- VIIRS Cloud fraction
- S5P DLER
- CO, AAI and surface type for Aerosol model selection
- CAMS model scale height for Aerosol height (to be changed to ALH)

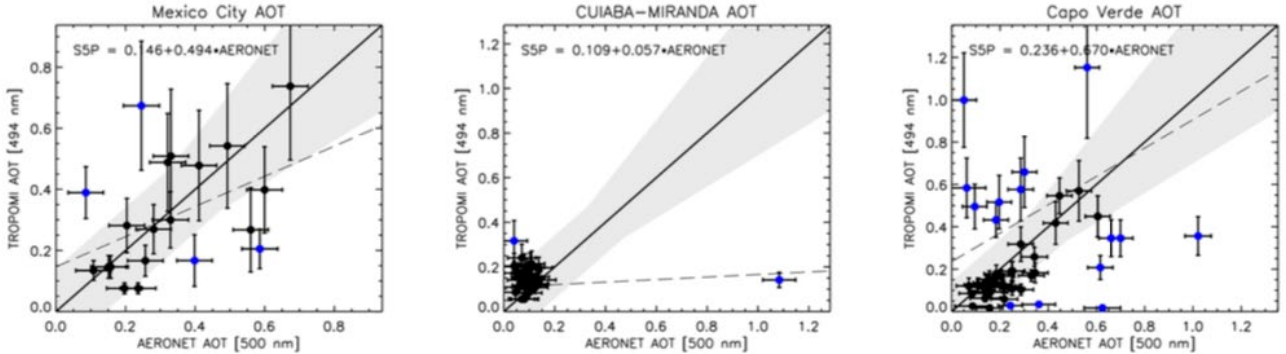
Output:

- L2 files in standard S5P format (NetCDF)


S5P/TROPOMI AER_OT 01 Aug. 2018
−135 −90 −45 0 45 90 135
60 30 0 −30 −60
TROPOMI AER_OT @ 440 nm
0.0 0.7 1.3 2.0 2.7 3.3 4.0
S5P/TROPOMI AER_OT 01 Aug. 2018
TROPOMI SSA @ 440 nm
0.70 0.75 0.80 0.85 0.90 0.95 1.00
AEROSOL OPTICAL DEPTH AND BIDIRECTIONAL REFLECTANCE DISTRIBUTION FUNCTION



AERONET stations

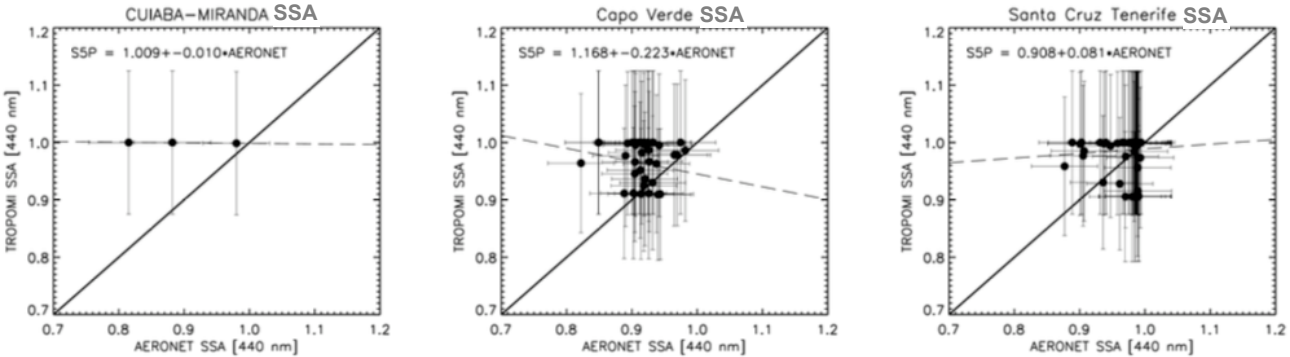


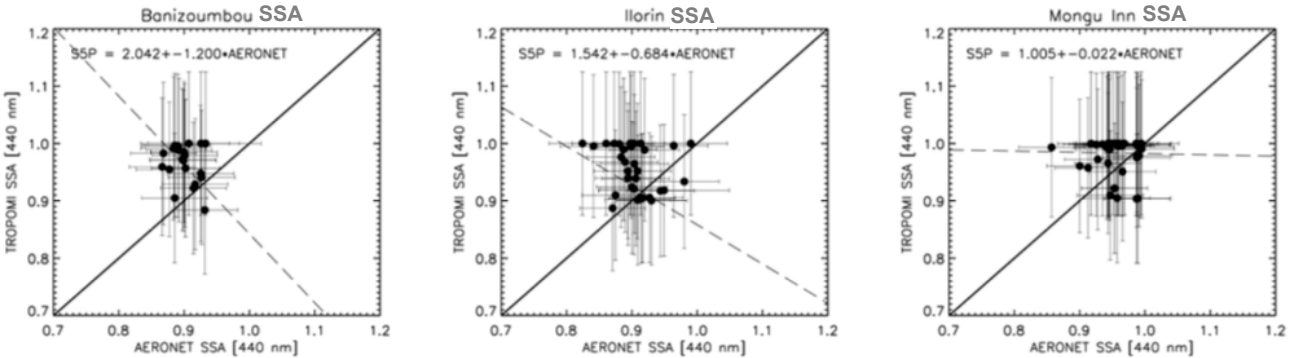
AEROSOL OPTICAL DEPTH AND BIDIRECTIONAL REFLECTANCE DISTRIBUTION FUNCTION

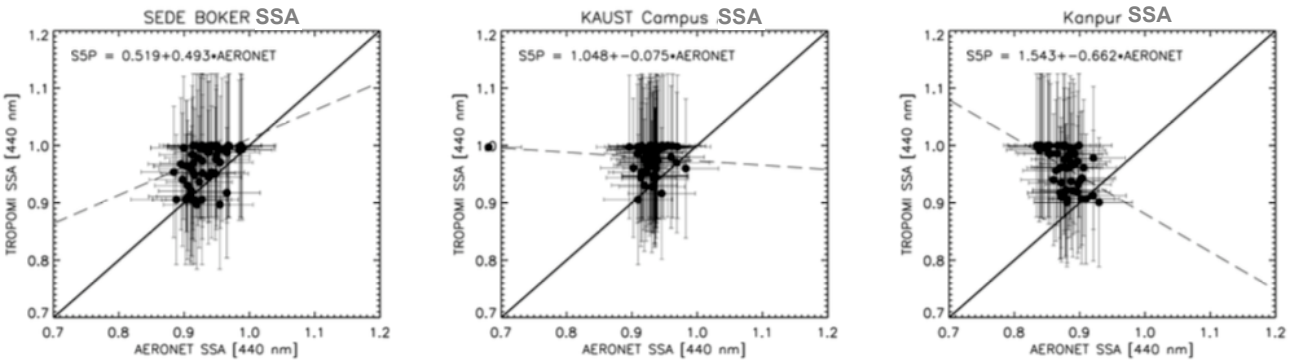
AERONET vs TROPOMI AOT:

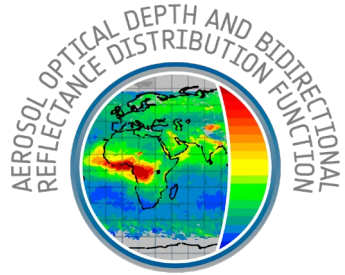
S5P <200 km, < 15 min processed on PAL.

AERONET: Version 3, Level 1.5









AERONET vs TROPOMI SSA:

S5P <200 km, < 15 min processed on PAL.

AERONET: Version 3, Level 1.5

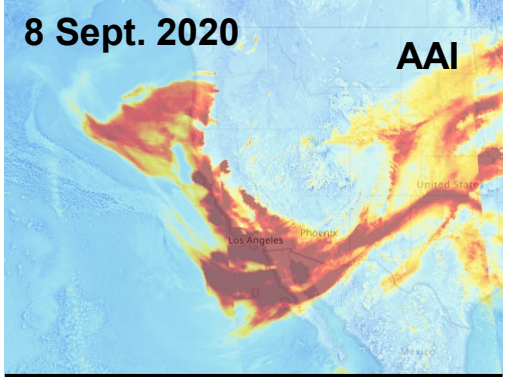
Complete TROPOMI aerosol product suite:

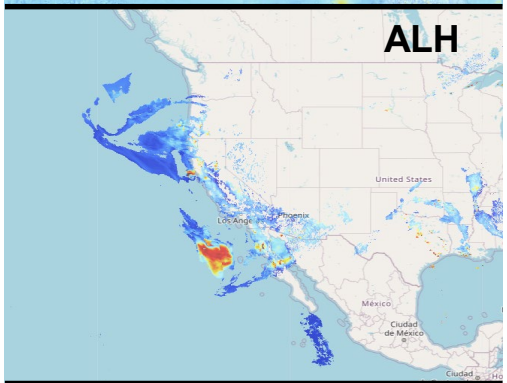
Absorbing Aerosol Index (S5P-AAI):
- Degradation corrected in V2 (D. Stein-Zweers)
- New definitions will be introduced to account for cloud effects

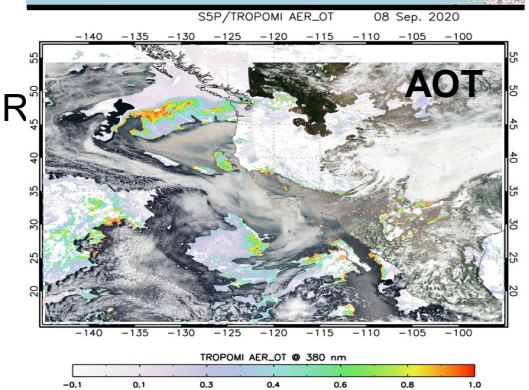
Aerosol Layer Height (S5p_ALH):
- New, fast, global operational product
- Global, based on VIIRS cloud mask
- Over land accuracy should be improved.

Aerosol Optical Thickness and Single Scattering Albedo in UV (**S5p_AOT**):
- Based on OMI OMAERO and OMAERUV algorithms in UV: 340, 380, 416, 440, 496 nm
- Uses S5P input (CO, AAI, LER), will be improved to include S5P-ALH and S5P DLER
- Cloud fraction from VIIRS

All these aerosol products should provide a consistent and complete view of the aerosol macrophysics and microphyics in the UV and SWIR







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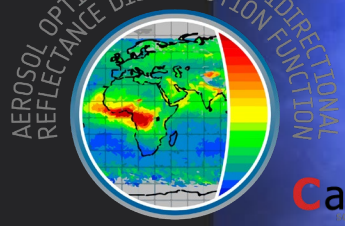

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S5P-TROPOMI AER_OT and DLER

→ THE EUROPEAN SPACE AGENCY esa

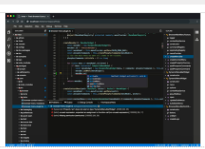
S5P-PAL

THE SENTINEL 5-P PRODUCT ALGORITHM LABORATORY

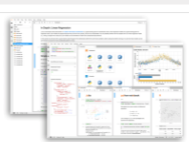
Welcome to your S5P-PAL workspace.

User documentation is available. If you encounter any problems or have any questions, please contact the support desk.

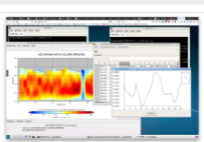
The following services are available for you to run:



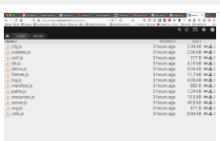
CODE DEVELOPMENT
ECLIPSE THEIA IDE



DATA ANALYSIS
JUPYTER NOTEBOOK EDITOR



DATA VIEWERS
PANOPLY, HDFVIEW, AND VISAN



FILE TRANSFER
UPLOAD / DOWNLOAD

AOT (and DLER) were developed on S5P Product Algorithm Laboratory, developed by ESA:

- Online
- Meant to aid algorithm developers
- Fast
- Ready for implementation at PDGS (Payload Data Ground Segment)

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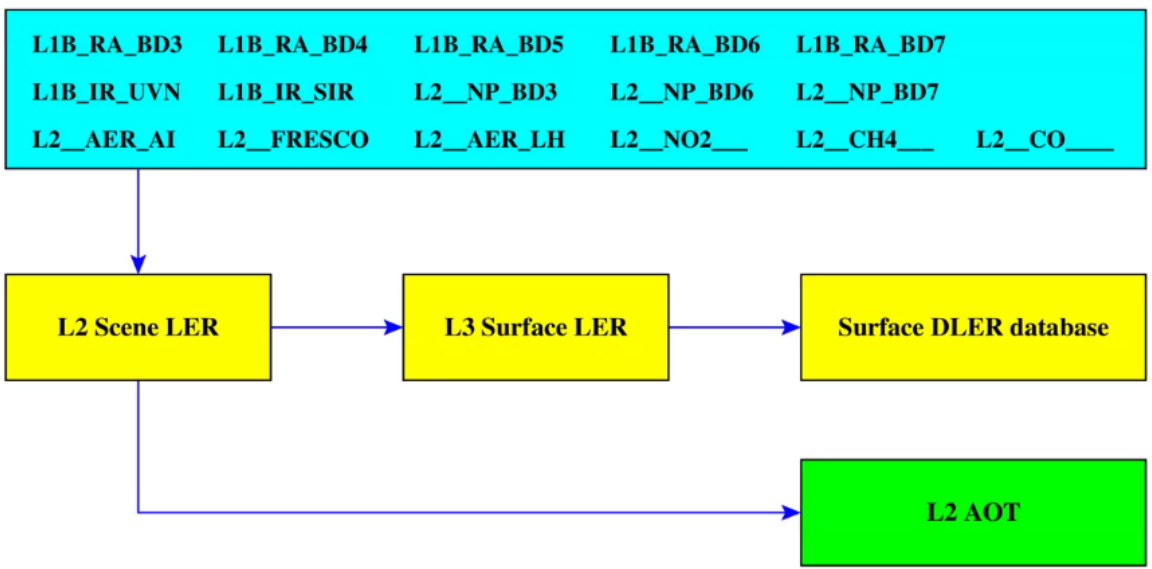
Logic behind the DLER processing on S5P-PAL:



A scene LER product is also being made for Sentinel-5/UVNS. Since the scene LER product contains band reflectances it can also be used to generate L2 AOT.

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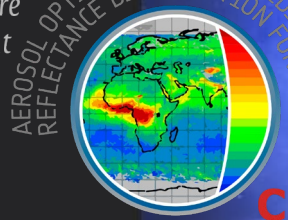

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Conclusions:

- ✓ AOT and DLER products are developed for S5P/TROPOMI and ready for use
- ✓ Data are validated and all documentation is ready
- ✓ Implementation on PAL resulted in very efficient data production
- ✓ Ready for implementation as an operational product
- ✓ More information: martin.de.graaf@knmi, tilstra@knmi.nl

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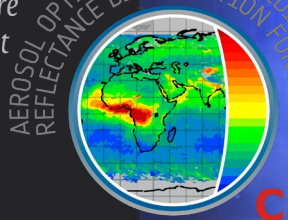

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