Spatial distribution analysis of the TROPOMI Aerosol Layer Height: A pixel-by-pixel comparison to EARLINET and CALIOP observations

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04. Synergistic use of multiple instruments and techniques, networks and campaigns

27-Jun, 14:15

Monday_ 04_P07

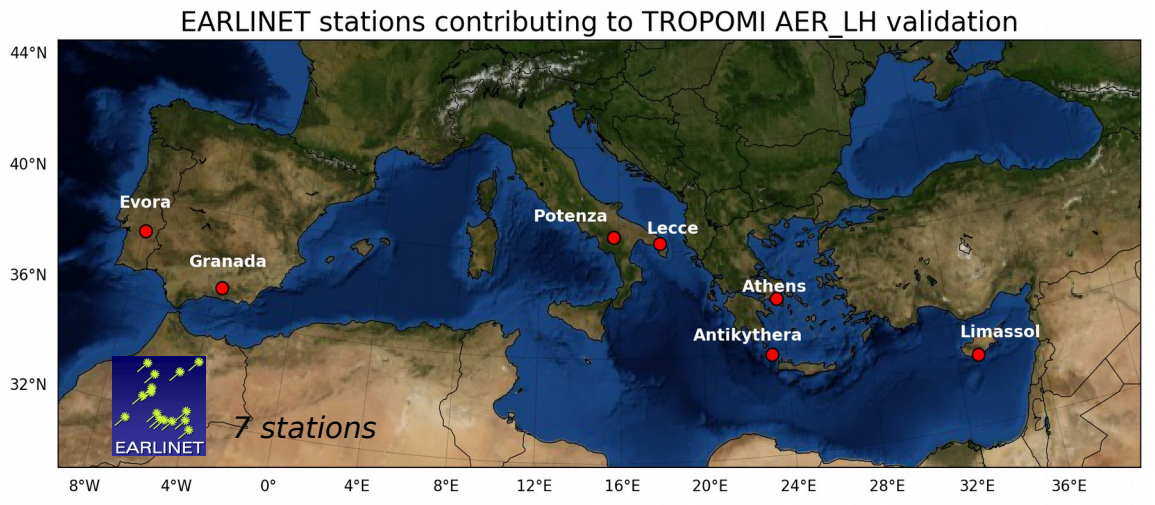
The 30th International Laser Radar Conference (ILRC) virtual conference, June 26th – July 1st, 2022.

Instrumentation and Datasets

Scope of study: Validation of TROPOMI Aerosol layer height (ALH) product with the retrievals of the GB lidar systems of EARLINET (+ CALIPSO)

*** Lidar profiles from the EARLINET & CALIPSO mission are a good source of data for validating retrieved ALHs from TROPOMI S5-P** → **Vertical structure of the atmosphere**

* Offer high accuracy and validation results **BUT** their geographical coverage is spatial limited.



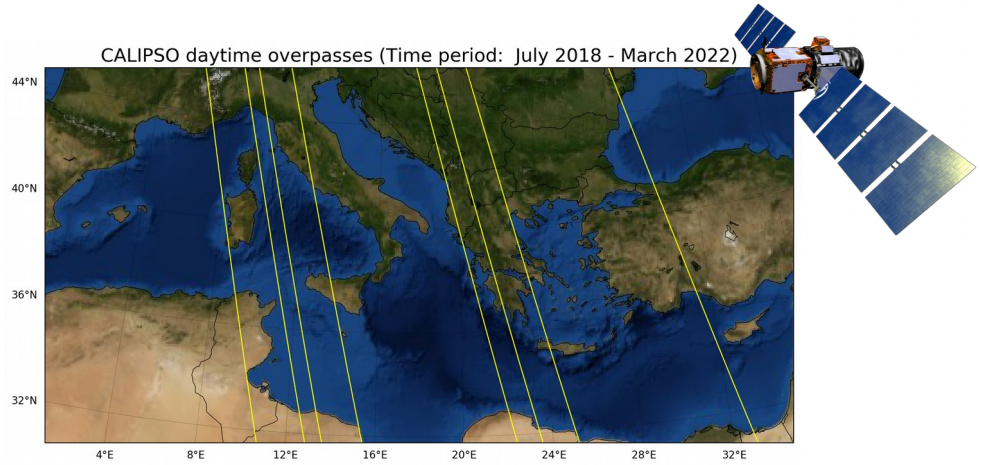
Study Period: April 2018 – Sep 2021

- The Lidar measurements used for the validation are analyzed centrally by EARLINET's SCC algorithm, following common QA procedures before being upload on EARLINET DB.
- Only data labeled as Level-2 are included in the validation process.

Only CALIOP dust plume heights over central-easten Mediterranean are analyzed, filter out *by Feature_Classification_Flags*.

A total of 8 coincident CALIOP lidar measurements are presented.

*(*validation procedure following Nanda et al., 2020)*

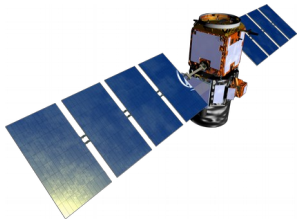


Validation Methodology

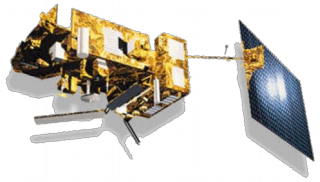
Operational

EARLINET

TROPOMI



CALIPSO



GOME-2

Optionally

AERONET

HYSPLIT

Validation strategy and development

- EARLINET DB files up to September 2021 are analyzed here
- New lidar files have been just recently uploaded to the SCC & EARLINET DB by stations
- We are currently collecting and filtering the new lidar data

Quality assured lidar data - Single Calculus Chain (SCC)

- We use the backscatter profiles (1064 or 532nm) to retrieve aerosol layer height.
- High-quality aerosol optical products (Level-2)

TROPOMI pixels QA>=0.5 & additional flags

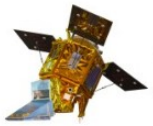
- Sunglint effect, snow/ice pixels, Cloud screening

Co-location criteria:

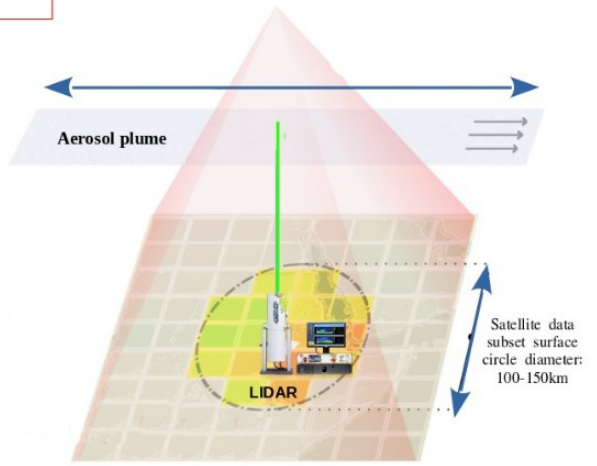
- Spatially averaged TROPOMI pixels in a radius of **150km**
- A maximum time difference of **±4h** for collocation pairs

Lidar weighted height

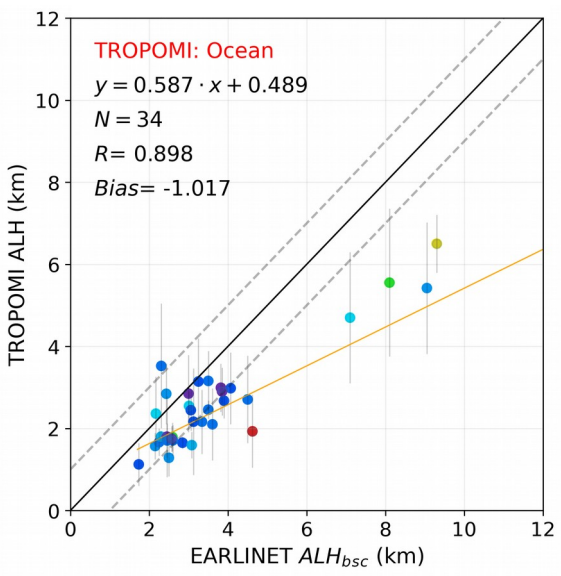
$$ALH_{bsc} = \frac{\int_{z_{i=1}}^{z=n} z_i \cdot \beta_{aer,i}(z)\,dz}{\int_{z_{i=1}}^{z=n} \beta_{aer,i}(z)\,dz}$$

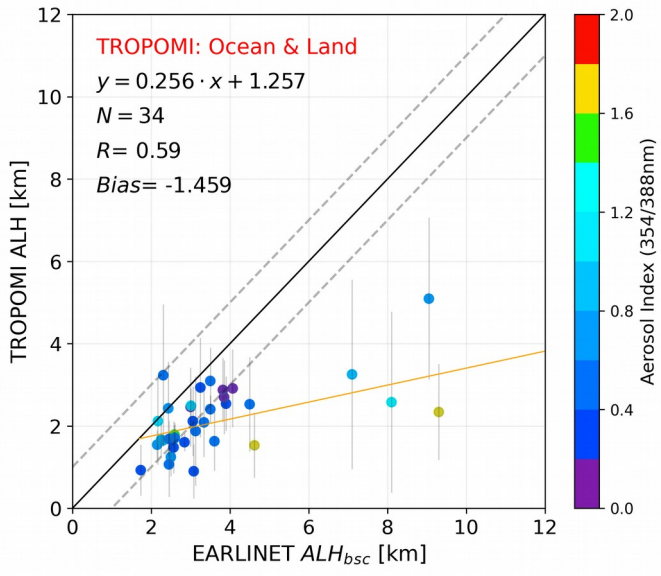


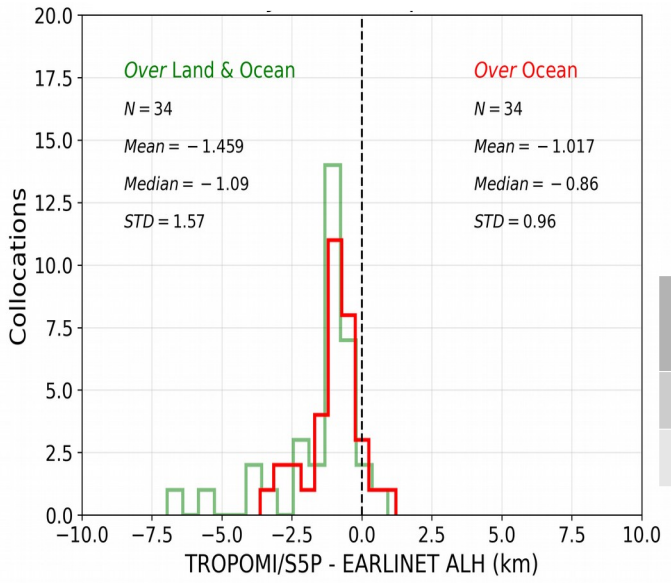
TROPOMI S5-P



Validation Results





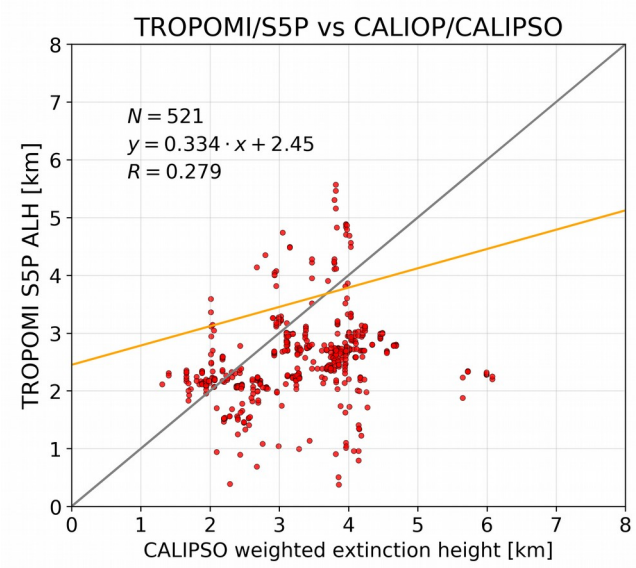


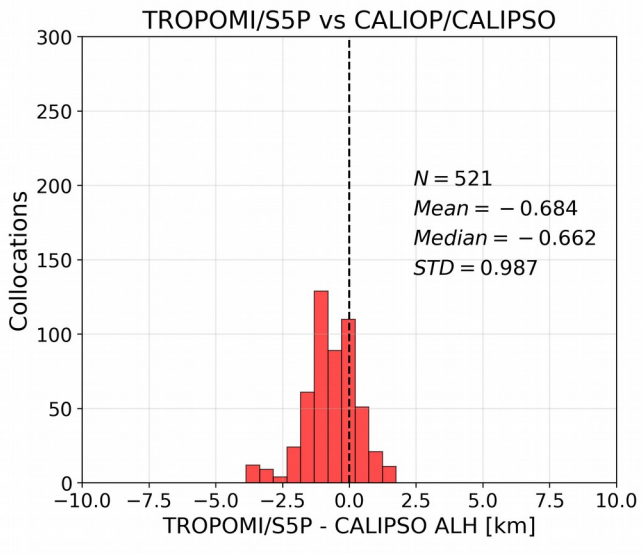
Study Period:

April 2018 – Sep 2021

34 collocated cases

TROPOMI pixels	R	Bias (km)
Sea	0.9	-1.017
Land & Sea	0.6	-1.459





* EARLINET & CALIOP calculated height is consistently lower than TROPOMI ALH.

* Different instrument sensitivity lidars against TROPOMI/S5P.

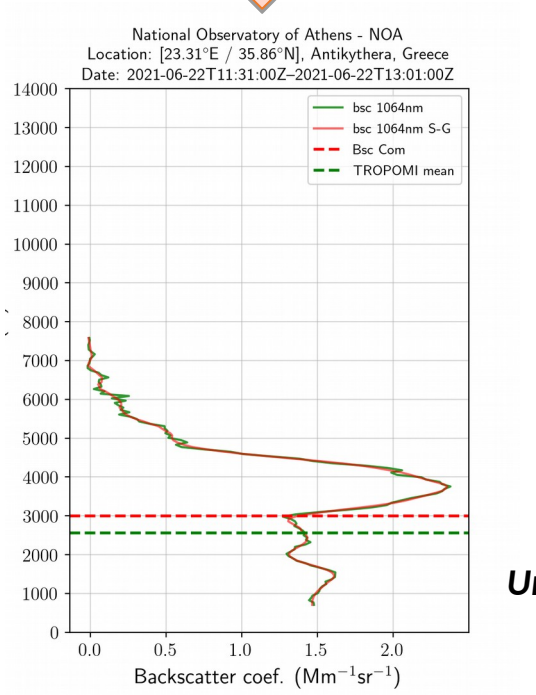
* Over land, TROPOMI ALH becomes unreliable for increasing surface albedo.

8 day/cases – 521 collocated pixels

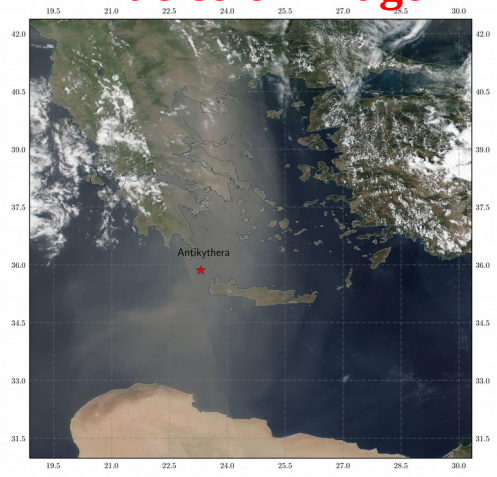
Results - A case study: Dust event over Greece (22 June 2021)

PollyXT 24/7 lidar system

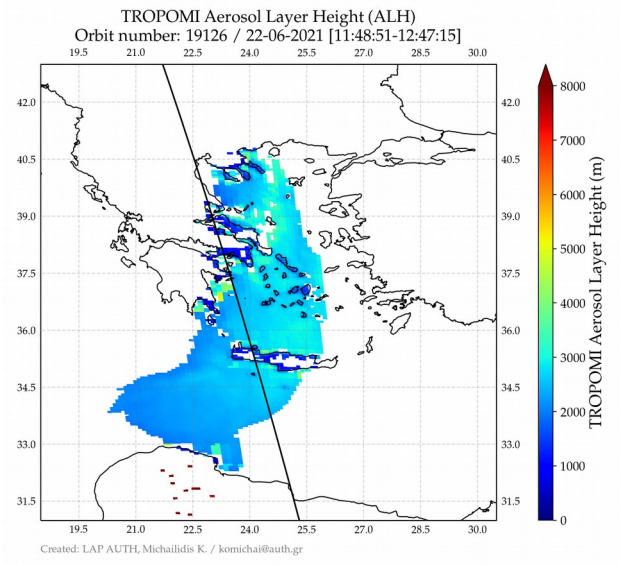
PANGEA station



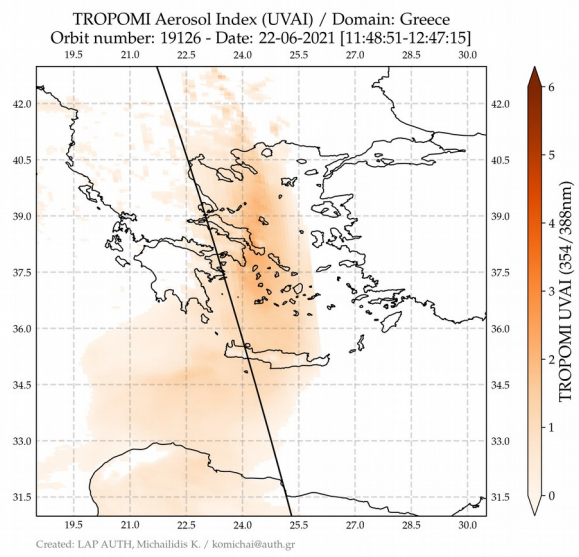
VIIRS/Suomi True color image



TROPOMI ALH



TROPOMI UVAI



Aerosol Height retrievals:

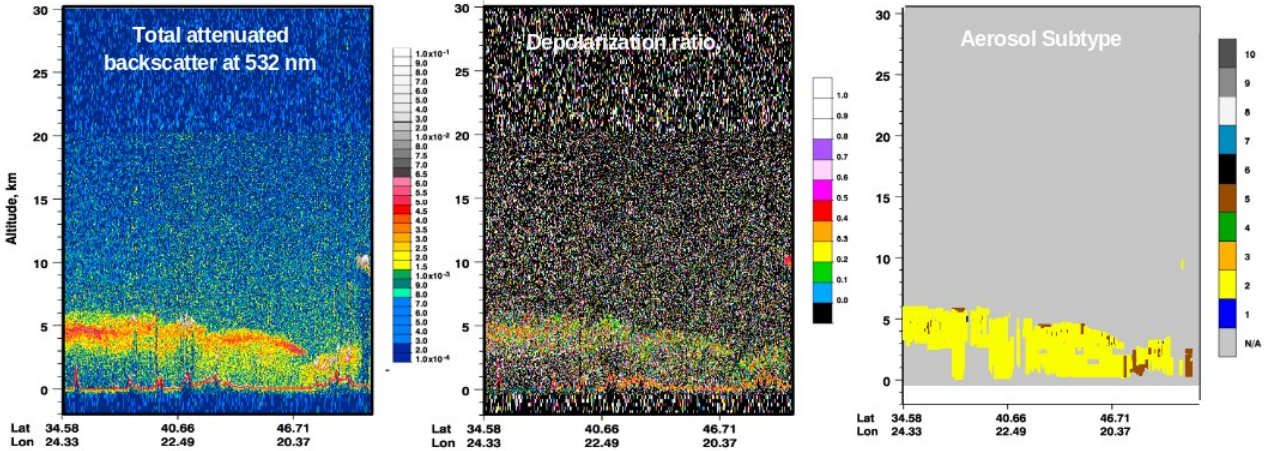
TROPOMI: 2.55±0.4km

PollyXT: 3.01km

CALIPSO: 3.98km

Under a homogeneous cloud-free the mean TROPOMI ALH agree well with lidar ALH

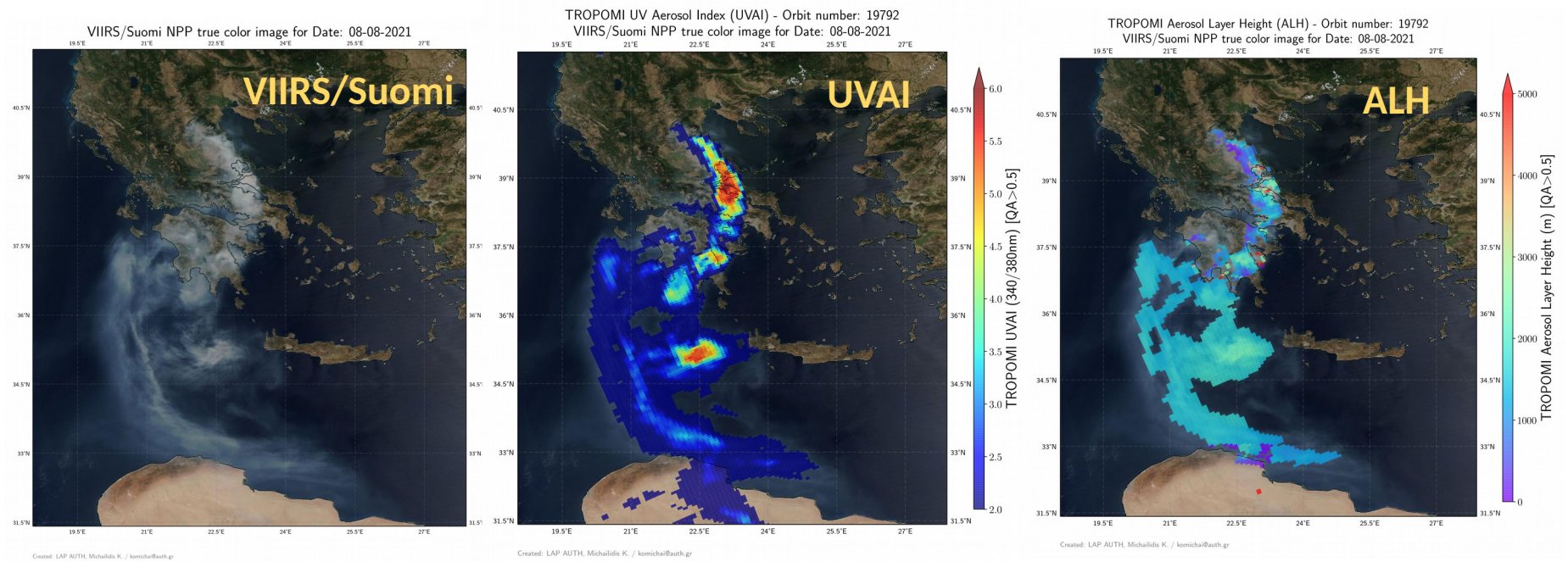
CALIPSO overpass over Greece 2021-06-22 12:21:19Z – 12:34:48



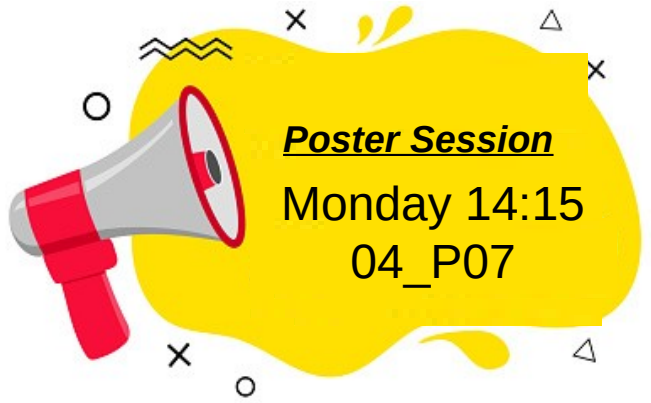
PANGEA station PI: V. Amiridis (ReACT Team)

Summary and conclusions

Highlight: A smoke case - Greek fire during summer 2021 (Aug 8)



* The dispersion of the smoke plume is clearly visible.
* High UVAI values (>5.0)
* ALH values ranging: 1.5 - 2.5km.
* No cloud detected during this event.



- ✓ The TROPOMI - EARLINET study is focused on selected desert dust cases and fires plumes.
- ✓ EARLINET & CALIOP calculated aerosol height is consistently lower than TROPOMI ALH.
- ✓ Several cases between Oct 2021 - May 2022 have been characterized as Saharan dust cases and are expected to be analysed and compared to measurements by EARLINET stations.
- ✓ We have investigated the optimum search radius around an EARLINET stations for TROPOMI, considering the high spatial resolution of instrument.