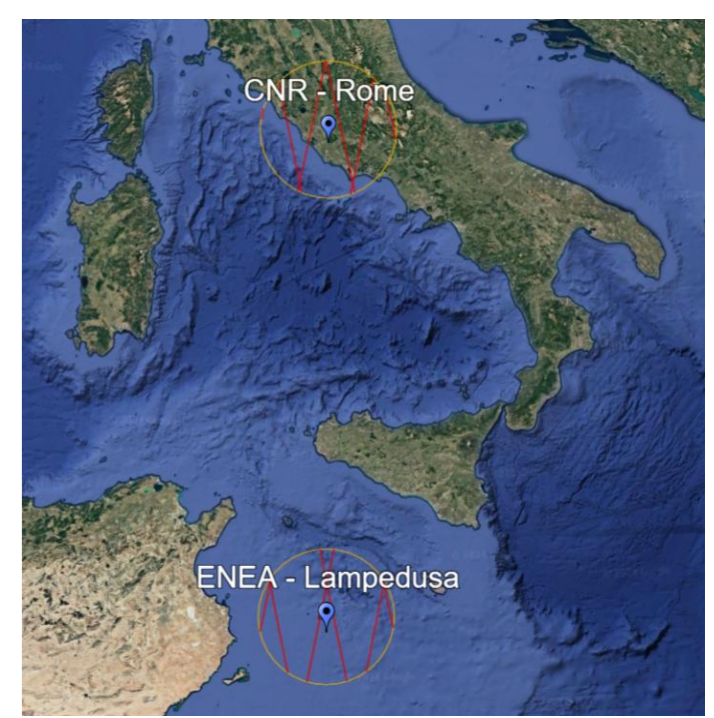


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## Introduction

The CNR ISAC Rome Atmospheric Supersite (CIRAS, 41.50° N, 12.39° E) and the ENEA Station for Climate Observations at Lampedusa Island (35.52° N, 12.63° E) participate in the validation activities of the EarthCARE (EC) mission Commissioning phase in the framework of the EC-Valmed.it project, funded by the Italian Space Agency (ASI), EVID05 and EVID11. The observatories are equipped with similar aerosol remote sensing instruments, such as solar/lunar/sky AERONET photometer, Raman-Mie-Rayleigh lidar and ceilometer profilers. A SKYNET photometer is also installed at Rome Tor Vergata.

The same strategy for the selection and analysis of ground-based data and EC aerosol products obtained from the ATLID and MSI sensors (**BA baseline and successive**) since July 2024 has been applied to the two sites, although taking into account the environmental differences.

## Aerosol optical depth at 355 nm (A-ALD product)

The AOD at 355 nm (AOD355) has been averaged over ±10 sec. interval centred at the time of the minimum ATLID ground track and ground site distance (MINDIST). Only data with **QS=0** are selected.

AOD at 340 nm (AOD340) from AERONET and SKYNET is averaged over **15 min for Rome** (with urban aerosol and occasional dust/smoke transport) and **120 min for Lampedusa** (with marine background and long-range transported dust/smoke) around the time of MINDIST. For Lampedusa, thresholds on AOD355 (<6) and on the error associated to the data (errAOD355≤0.04) had to be applied in order to filter out some cloud-contaminated data (**Figure 1**). The statistics are reported in **Table 1**.

Table 1. Statistics for the AOD355 comparison at Rome and Lampedusa

	Mean bias	Mean abs. bias	RMSD
Rome	0.01	0.09	0.11
Lampedusa	0.01	0.04	0.05

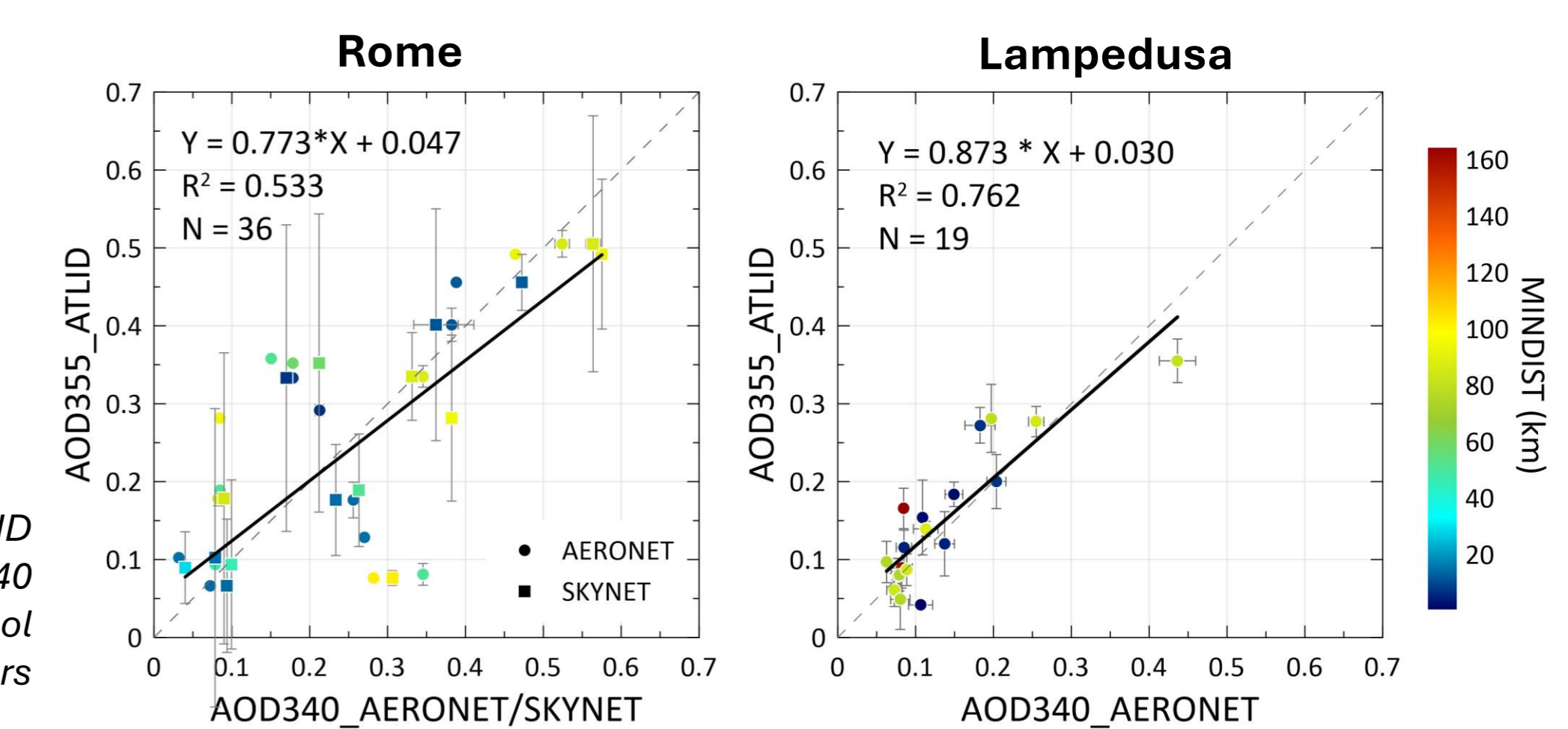


Figure 1. Scatterplot of the ATLID AOD355 versus the AERONET AOD340 (and SKYNET for Rome) with the symbol colours indicating MINDIST. The bars represent the standard deviations.

## Aerosol optical depth at 670 nm and 865 nm, and AE(670,865) (M-AOT product)

The comparison is made for MSI AOD at 670 nm (AOD670) for Rome and Lampedusa, with the additional analysis of the AOD at 865 nm (AOD865) and the corresponding Ångström exponent (AE) for Lampedusa. Only data with **QS=0** are selected.

The AERONET and SKYNET AODs at 675 and 870 nm, and the corresponding AE are selected for the comparison. MSI data are averaged on a **25x25 pixel area** centred at Rome and on a **51x51 pixel area** centred at Lampedusa or at the closest pixel within 150 km (CPXL). Averages of ground-based data are over **15 min for Rome** and **120 min for Lampedusa**. The results are shown in **Figure 2** and **Table 2**. A general overestimation for MSI AE(670,865) is observed.

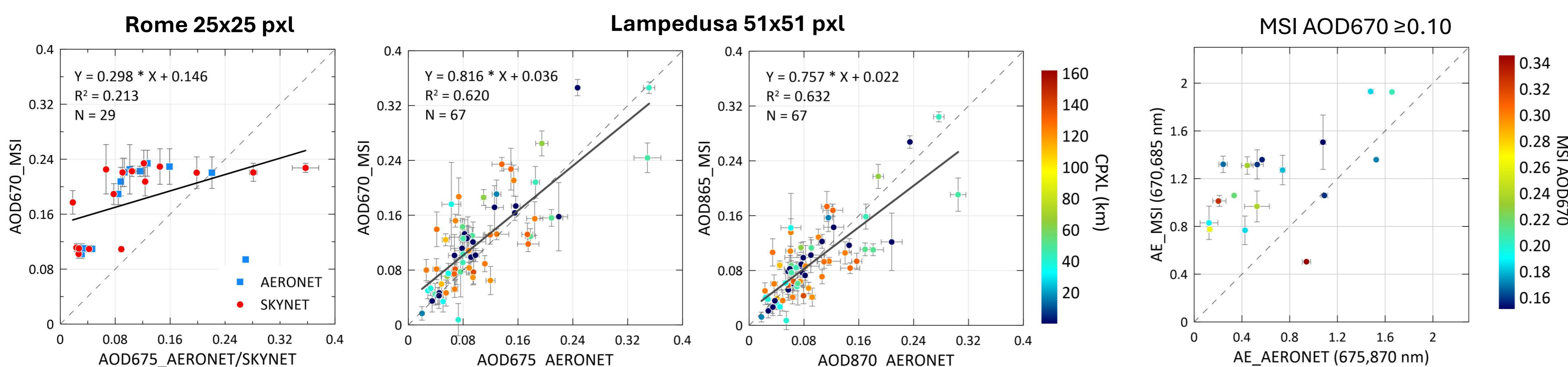


Figure 2. Scatterplot of the MSI AOD670 versus the AERONET/SKYNET AOD675 for Rome (left plot). Scatterplot of the MSI versus the AERONET AOD670, AOD865, and AE. The bars represent the standard deviations of the spatial (for MSI) and temporal (for AERONET/SKYNET) averages.

Table 2. Statistics for the AODs comparison at Rome and Lampedusa

	Mean bias	Mean abs. bias	RMSD
Rome (AOD670)	0.07	0.09	0.10
Lampedusa (AOD670)	0.02	0.04	0.05
Lampedusa (AOD865)	0.00	0.03	0.04

The results for Rome evidence a poor agreement that may be ascribed to the AOD retrieval for continental sites (see poster P035 by S. Sensi et al.).

## Case studies: August 2025 smoke and mixed-dust transport events

The summer of 2025 in Europe was one of the worst in the past twenty years for wildfires, both in terms of burned area and total emissions of carbon and other smoke pollutants. August was characterized by persistent conditions of extreme heat, droughts and strong winds, which created favourable conditions for large and intense fires. In addition, smoke from the Canadian wildfires was transported to Europe and was detected also in Italy.

### Rome 18 August 2025: smoke transport

The HYSPLIT air mass backtrajectories (**Figure 5**) show the possible loading of fine particles either from local and Canadian wildfires.

Lidar backscattering coefficient at 355 nm and fluorescence (422-509 nm) profiles on 18 August (**Figure 3**) show persistent fluorescent aerosol layers, consistent with organic aerosol, in particular smoke.

The ATLID backscattering profile is consistent with the aerosol stratification detected from the ground measurements.

ATLID TC identifies a mixture of dusty smoke and continental pollution up to 4 km (**Figure 4**).

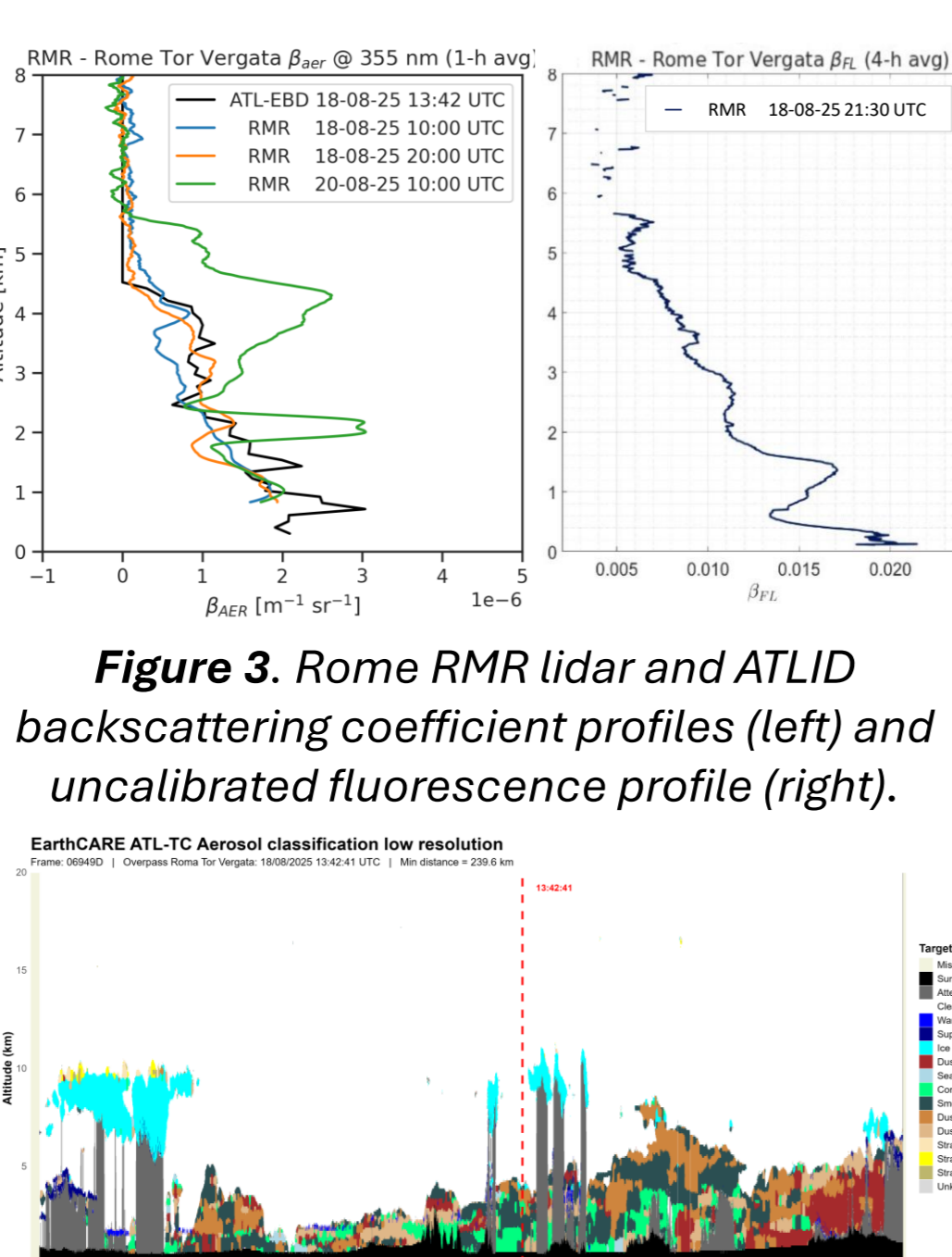


Figure 3. Rome RMR lidar and ATLID backscattering coefficient profiles (left) and uncalibrated fluorescence profile (right).

Figure 4. A-TC classification for the daytime overpass.

Table 3. AODs and AE comparison for Lampedusa 20 August 2025 (CPXL=43 km).

MSI			AERONET		
AOD670	AOD865	AE	AOD675	AOD870	AE
0.35±0.01	0.30±0.01	0.50±0.00	0.35±0.01	0.28±0.01	0.94±0.04

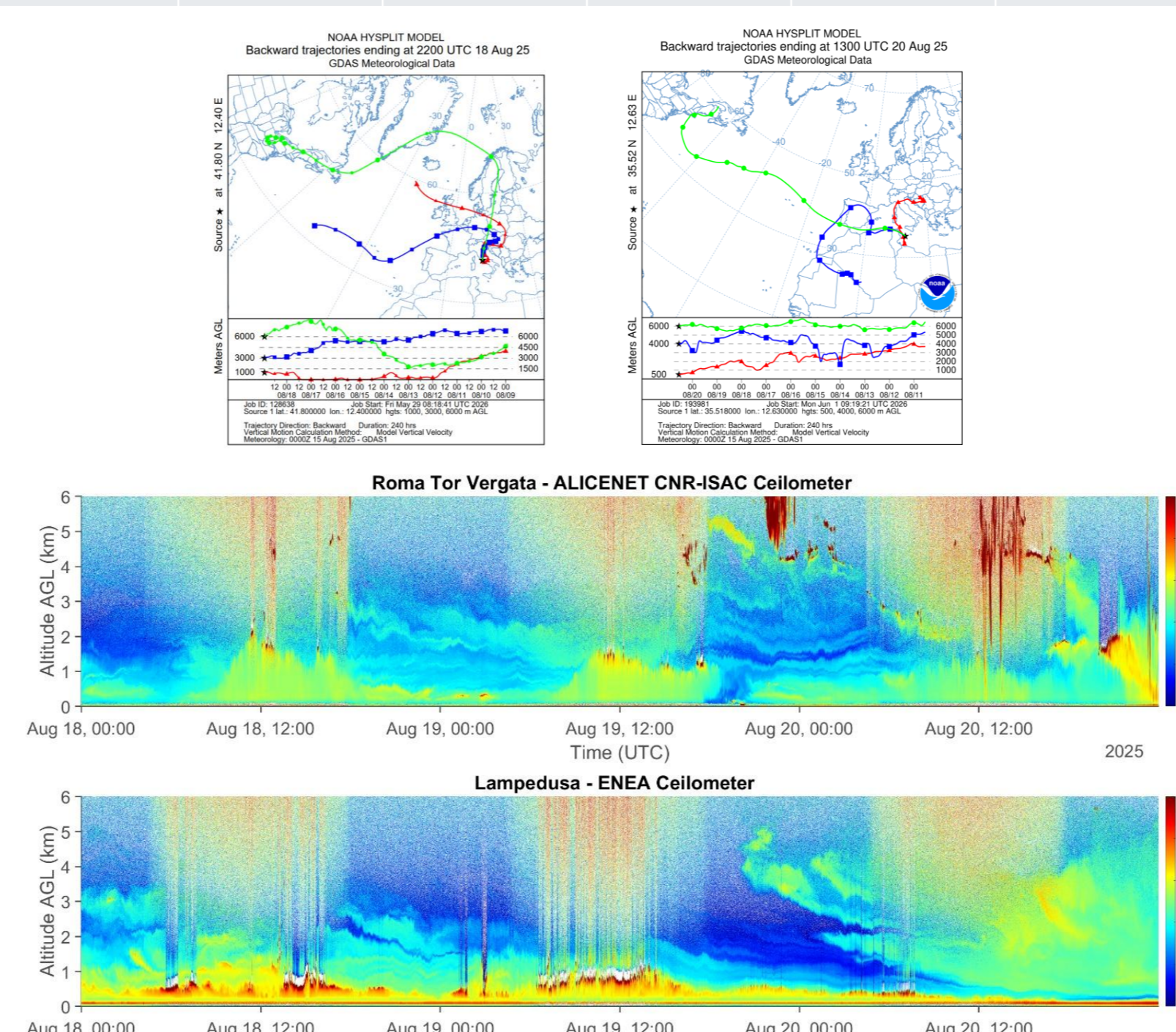


Figure 5. (top) HYSPLIT backtrajectories arriving to Rome and Lampedusa; (bottom) evolution of the ceilometer signal 18-20 August.

### Lampedusa 20 August 2025: dust and smoke transport

This case has the largest AOD measured both by MSI and AERONET, with good agreement for AOD670 and a slight MSI overestimation of AOD865 (**Table 3**).

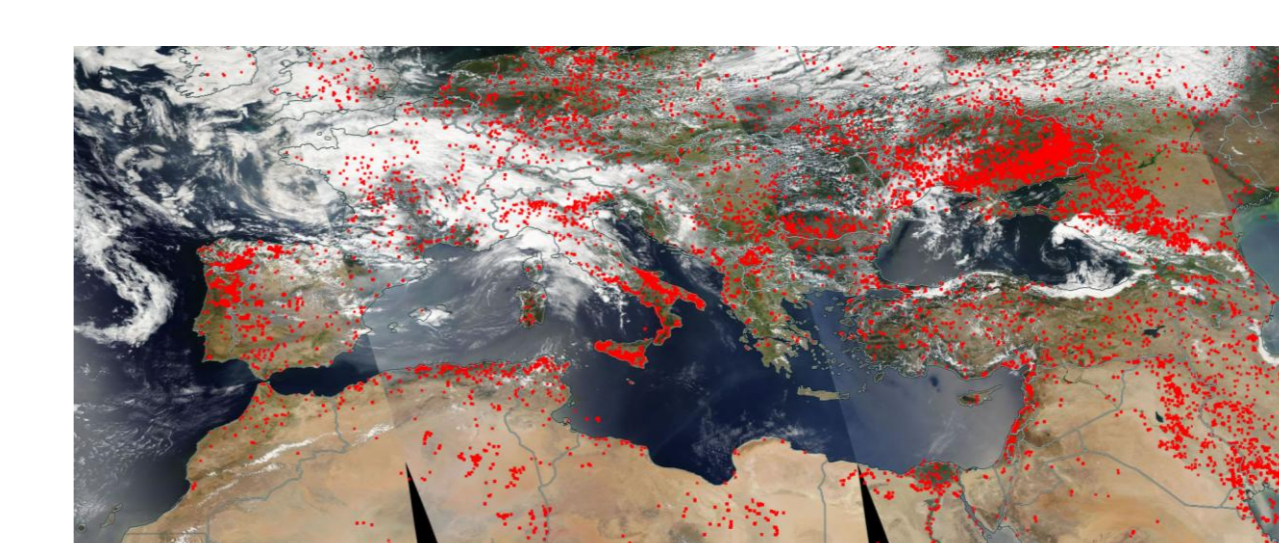


Figure 6. NASA FIRMS fires in the 14-20 August 2025 week superimposed to MODIS AQUA image.



Figure 7. A-TC classification for the nighttime overpass.

The AERONET AE value 0.94 points to a mixing of dust and fine particles, possibly from European and Canadian fires, confirmed by HYSPLIT backtrajectory analysis (**Figure 5**) and NASA active fires map (**Figure 6**), while the MSI AE value 0.50 is associated to the prevalence of large particles.

The ceilometer detects dust up to 4.5 km, while the ATLID TC product identifies dusty smoke and smoke, and some low-level continental pollution (**Figures 5 and 7**).

## Acknowledgements

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