Challenges in Validation of L2 EarthCARE Aerosol Products at the Italian atmospheric observatories in Rome-Tor Vergata and Lampedusa

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4: Italian Space Agency (ASI)

EVID11: An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea. Supported by ASI through the EC-ValMed.it project

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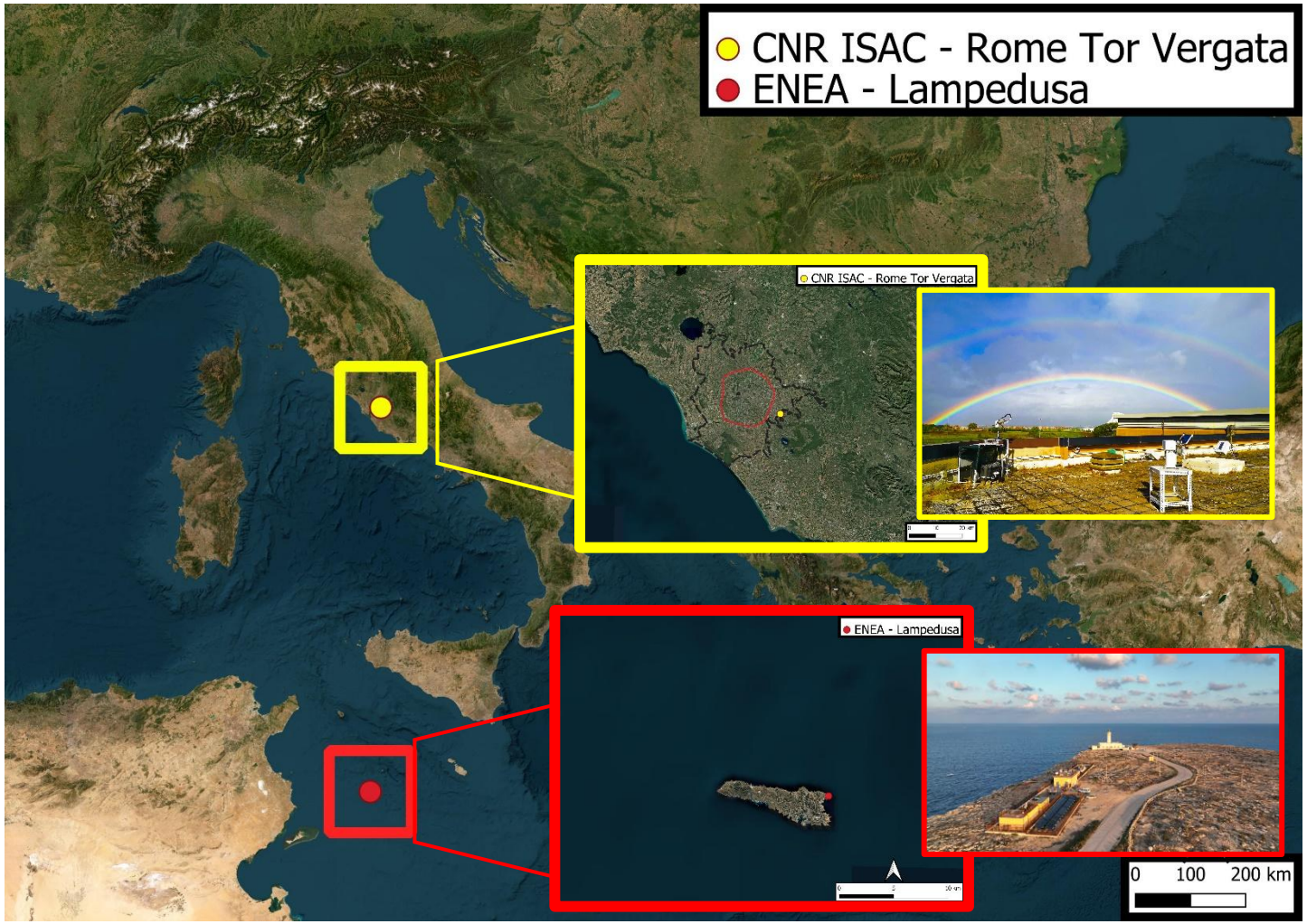
Sites descriptions

The **CNR-ISAC Atmospheric Supersite in Rome Tor Vergata (41.50° N, 12.39° E)** and the **ENEA Climate Observatory at Lampedusa (35.52° N, 12.63° E)** contribute to the validation activities of the EarthCARE mission.

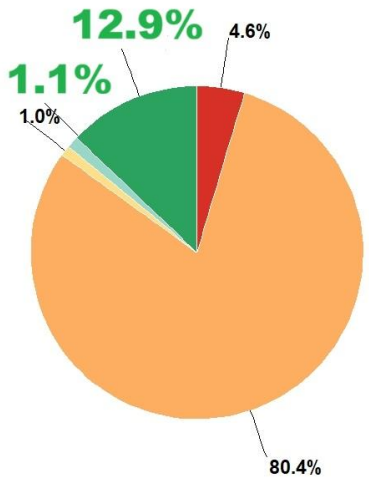


Instruments	Model	Rome	Lampedusa
Photometer	CE318T – CIMEL	✓	
	POM01- PREDE	✓	✓
All Sky camera	ASI eco 16	✓	✓
Celiometer	CHM15k -Lufft	✓	✓
Radar Profiler	MRR Pro -Metek	✓	
Disdrometer	LPM - Thies Clima	✓	✓
Doppler Wind Lidar	XR StreamLine - Metek	✓	
Raman-Mie-Rayleigh LiDAR	In-house developed built	✓	✓
Cloud Doppler radar	MIRA 35C - Metek		✓
Microwave radiometer	Hatpro - RPG		✓

Rome Tor Vergata and Lampedusa
Quality status of AOT data MSI-AOT and ATL-ALD

Quality Status MSI-AOT (150 km)- Rome Tor Vergata

EXBA (N° overpass = 52)



ROME

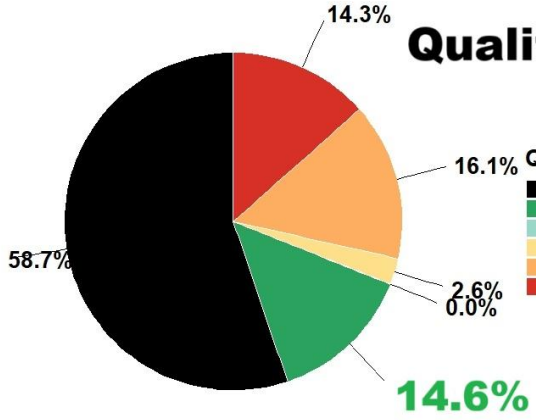
Quality status
- 0: Valid
- 1: Valid quality degraded due to snow/sea ice
- 2: Degraded quality due to twilight/night conditions
- 3: No retrieval
- 4: Bad or missing input data

MSI-AOT (BA)

Quality status (0-1): 14%

Quality Status ATL-ALD (100 km)- Rome Tor Vergata

EXBA (N° overpass = 88)



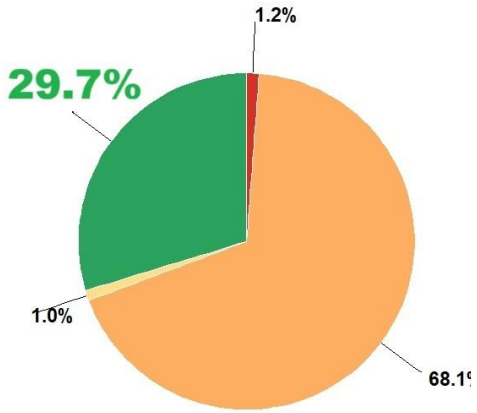
ATL-ALD (BA)

Quality status (0-1): 14.6%

Quality status
- -1: Cloudy profile
- 0: Good data
- 1: Valid but many aerosol layers detected
- 2: Warning,high uncertainty in layer backscatter
- 3: Warning,cloud free profile not detected in A-TC
- 4: Bad data,probably cloud influenced

Quality Status MSI-AOT (150 km) - Lampedusa

EXBA (N° overpass = 37)



LAMPEDUSA

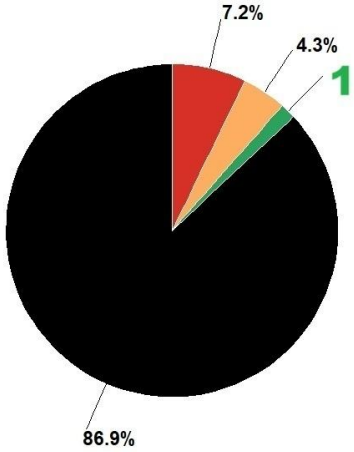
Quality status
- 0: Valid
- 1: Valid quality degraded due to snow/sea ice
- 2: Degraded quality due to twilight/night conditions
- 3: No retrieval
- 4: Bad or missing input data

MSI-AOT (BA)

Quality status (0-1): 29.7%

Quality Status ATL-ALD (100 km) - Lampedusa

EXBA (N° overpass = 44)



ATL-ALD (BA)

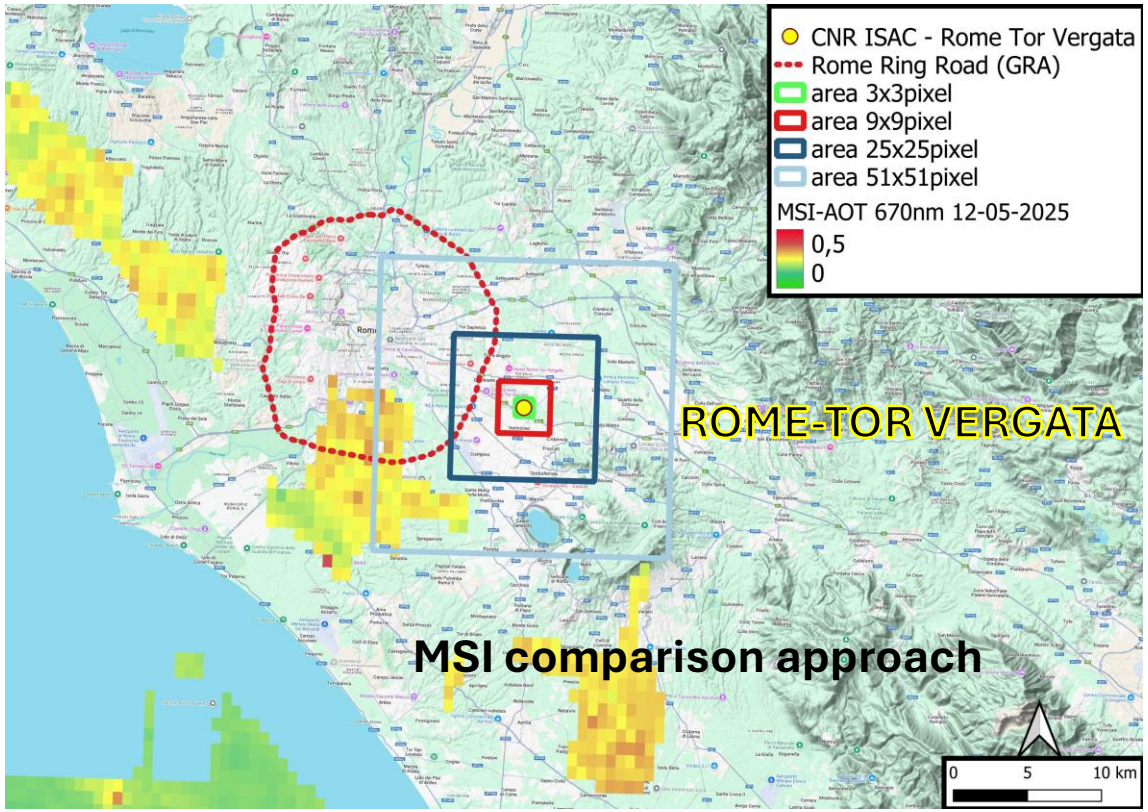
Quality status (0-1): 1.5%

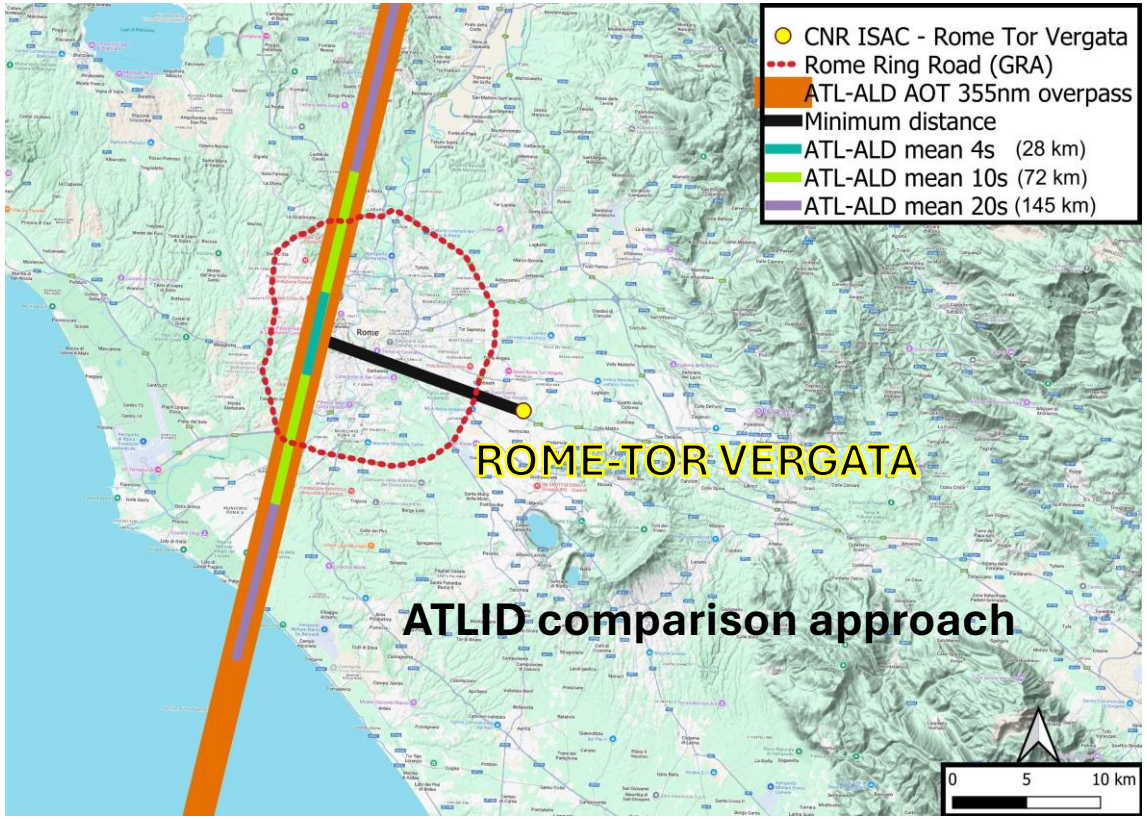
Quality status
- -1: Cloudy profile
- 0: Good data
- 1: Valid but many aerosol layers detected
- 2: Warning,high uncertainty in layer backscatter
- 3: Warning,cloud free profile not detected in A-TC
- 4: Bad data,probably cloud influenced,probably cloud influenced

EarthCARE Variables and methods for ground-based validation

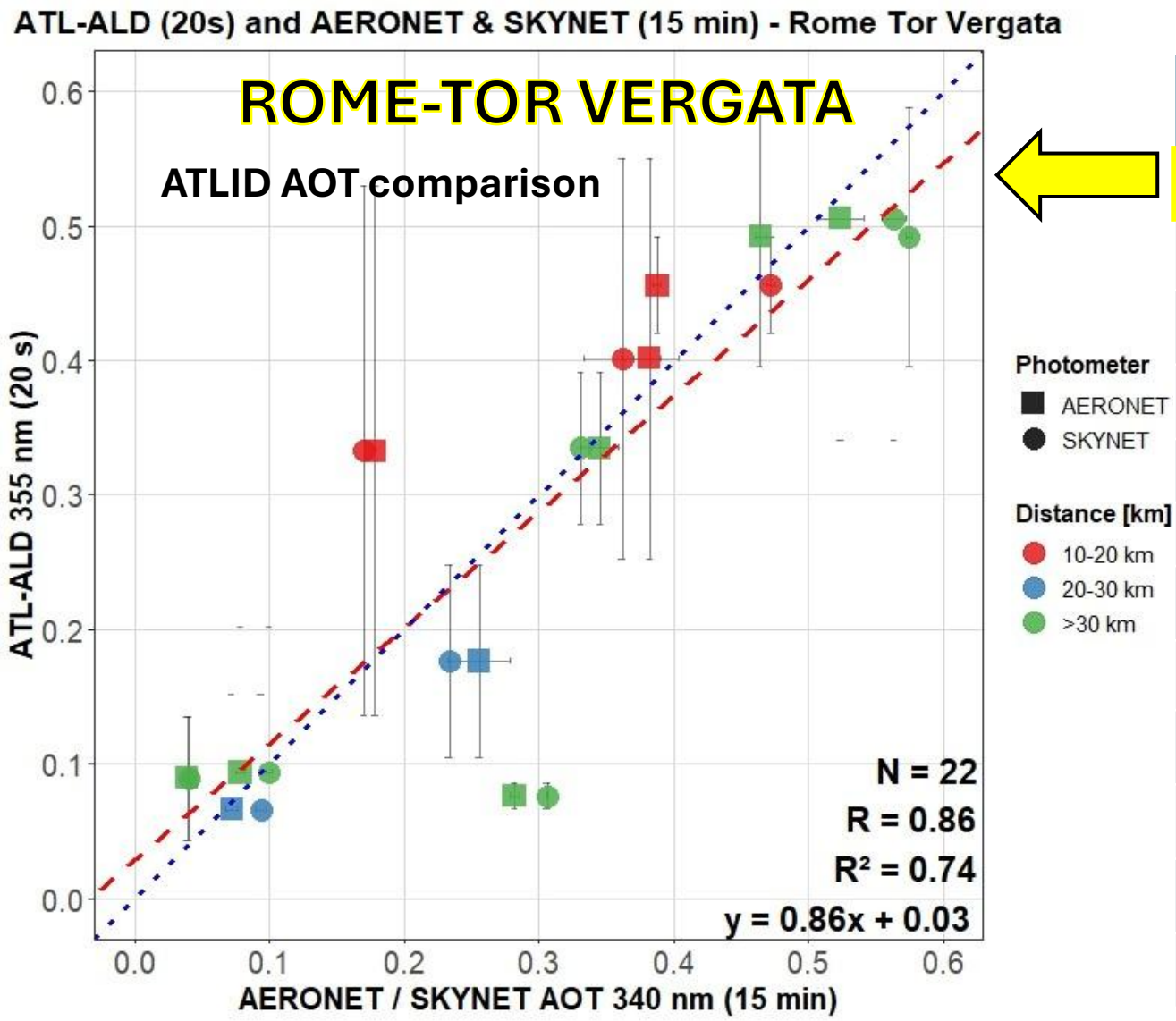
EarthCARE	AOT	Ground based	AOT
MSI-AOT	670nm	SKYNET (L 2)	670nm
MSI-AOT	670nm	AERONET (L 1.5)	675nm
ATL-ALD	355nm	SKYNET (L 2)	340nm
ATL-ALD	355nm	AERONET (L 1.5)	340nm

Photometer	Mean
SKYNET (L 2) AERONET (L 1.5)	15min
	30min
	60min
	120min



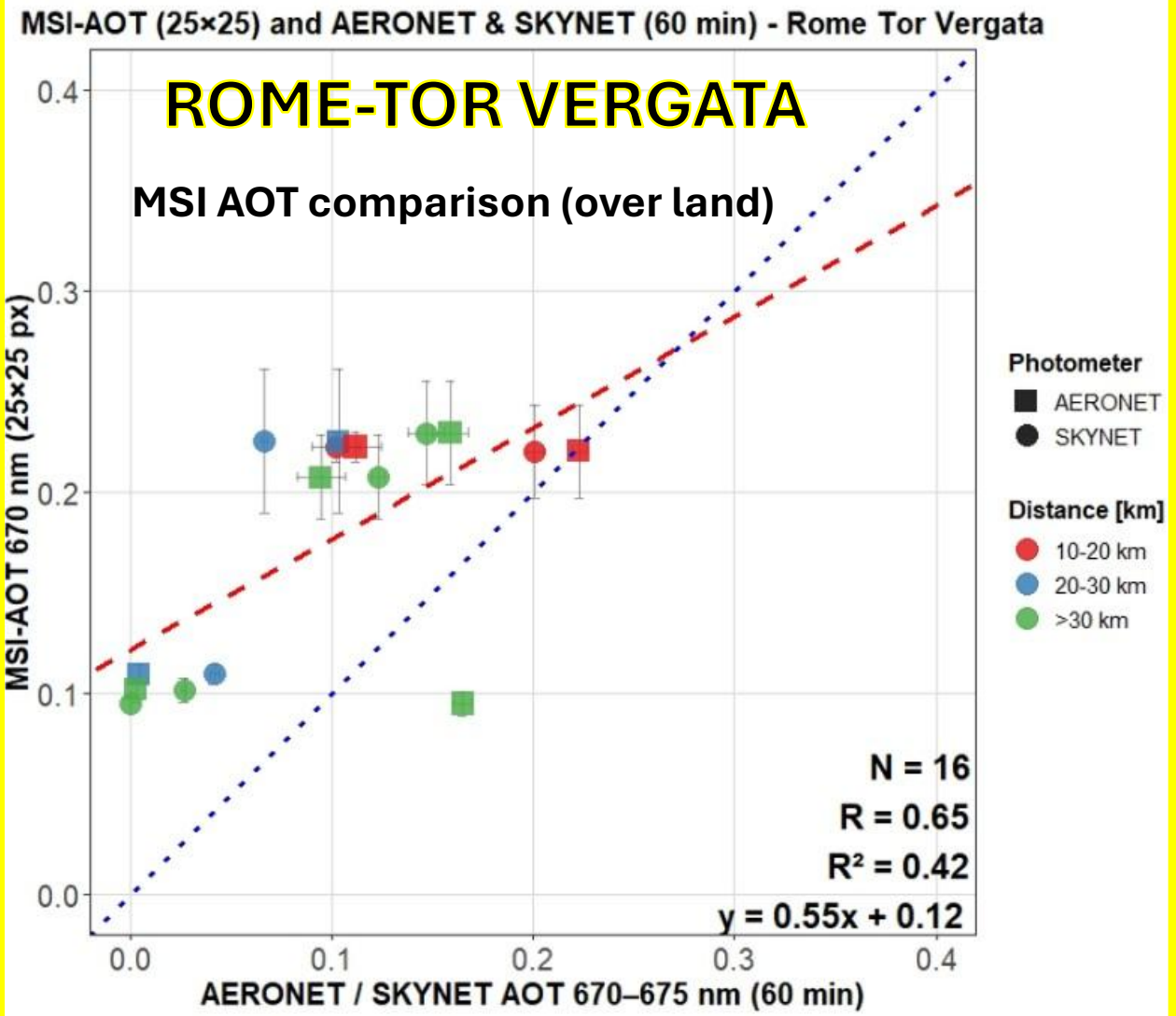


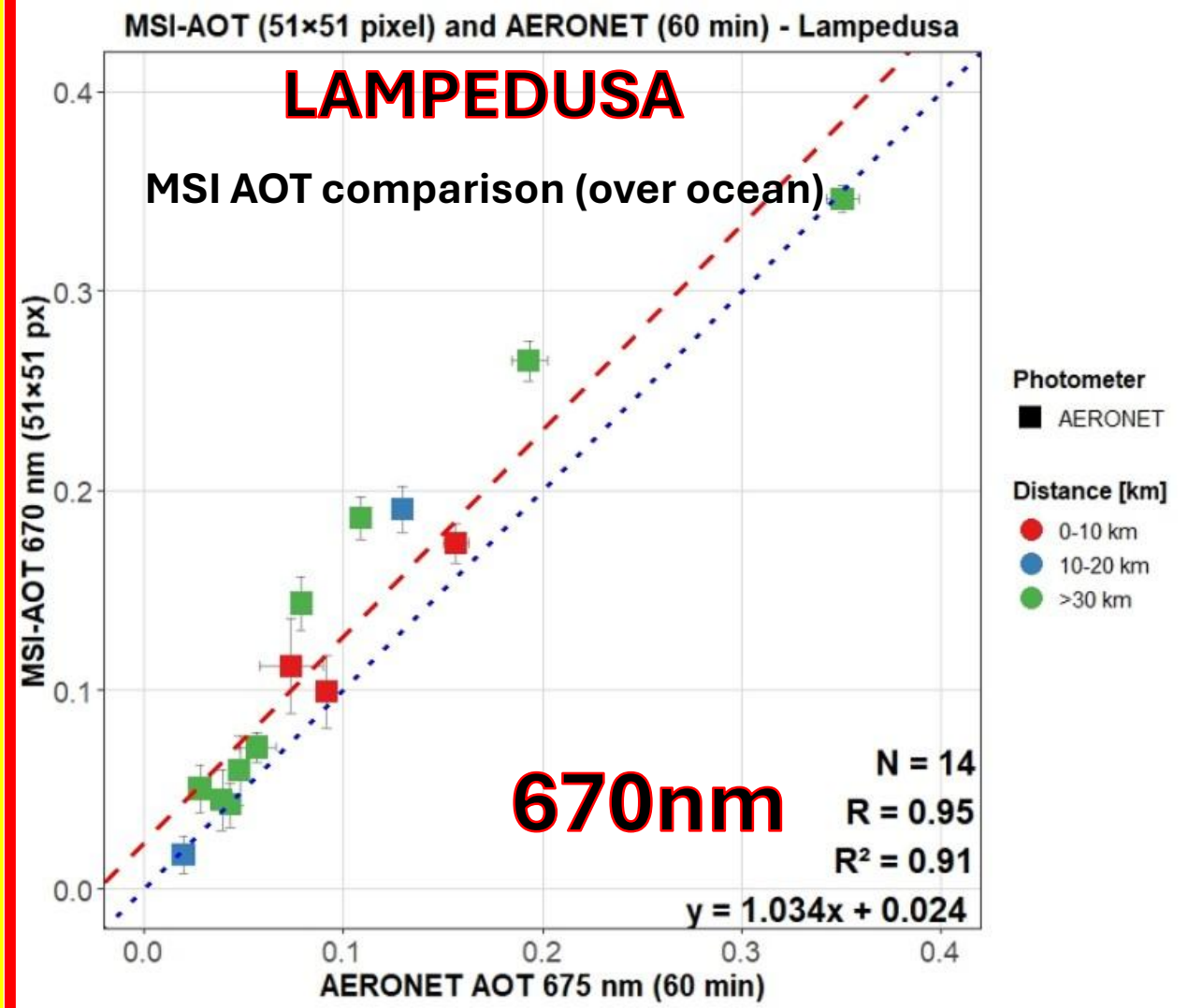
Comparison between ATL-ALD L2 (355nm) and AERONET and SKYNET (340nm)



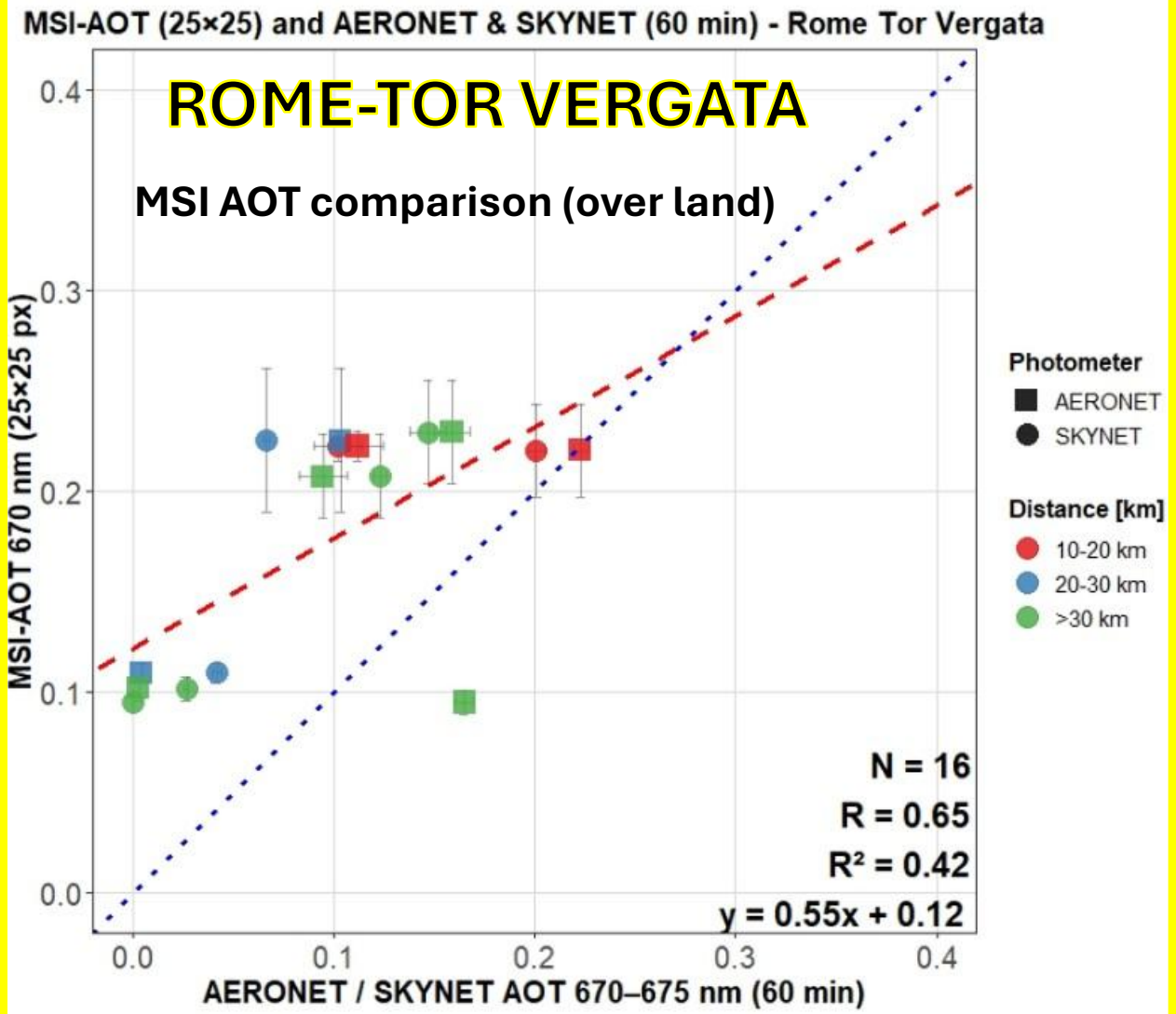
EarthCARE	Ground instrument / Temporal window	R	N°
ATL-ALD 20s	**AERONET & SKYNET 15min**	**0.87**	**22**
ATL-ALD 10s	AERONET & SKYNET 15min	0.85	18
ATL-ALD 20s	AERONET & SKYNET 30min	0.83	26
ATL-ALD 20s	AERONET & SKYNET 60min	0,83	26
ATL-ALD 10s	AERONET & SKYNET 30min	0.81	22
ATL-ALD 10s	AERONET & SKYNET 60min	0.81	22
ATL-ALD 10s	AERONET & SKYNET 120min	0.8	24
ATL-ALD 20s	AERONET & SKYNET 120min	0.8	30
ATL-ALD 4s	AERONET & SKYNET 60min	0.75	18
ATL-ALD 4s	AERONET & SKYNET 15min	0.74	16
ATL-ALD 4s	AERONET & SKYNET 30min	0.74	18
ATL-ALD 4s	AERONET & SKYNET 120min	0.74	18

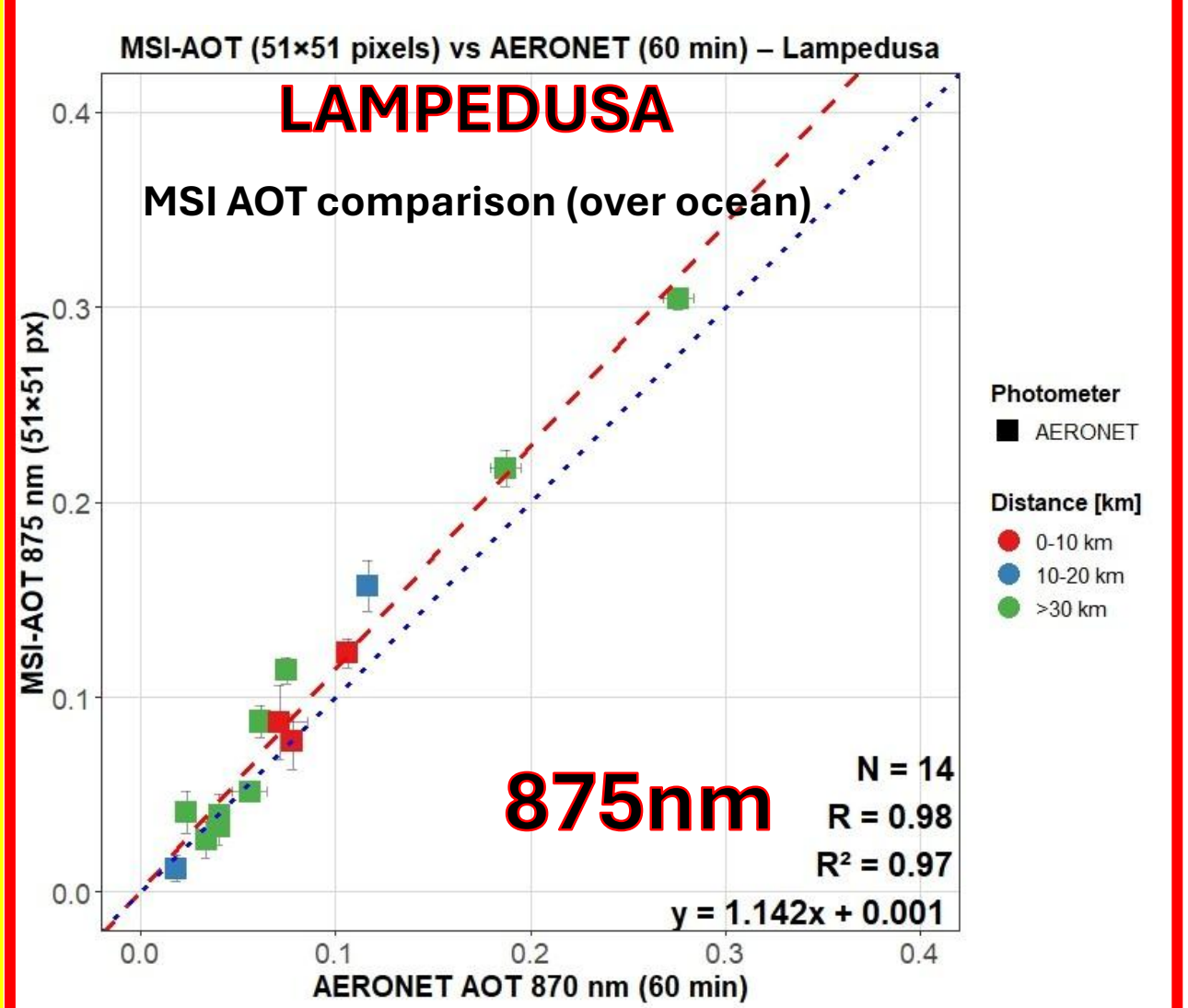
Comparison between MSI-AOT L2 (670nm) and AERONET and SKYNET (670/675 nm)





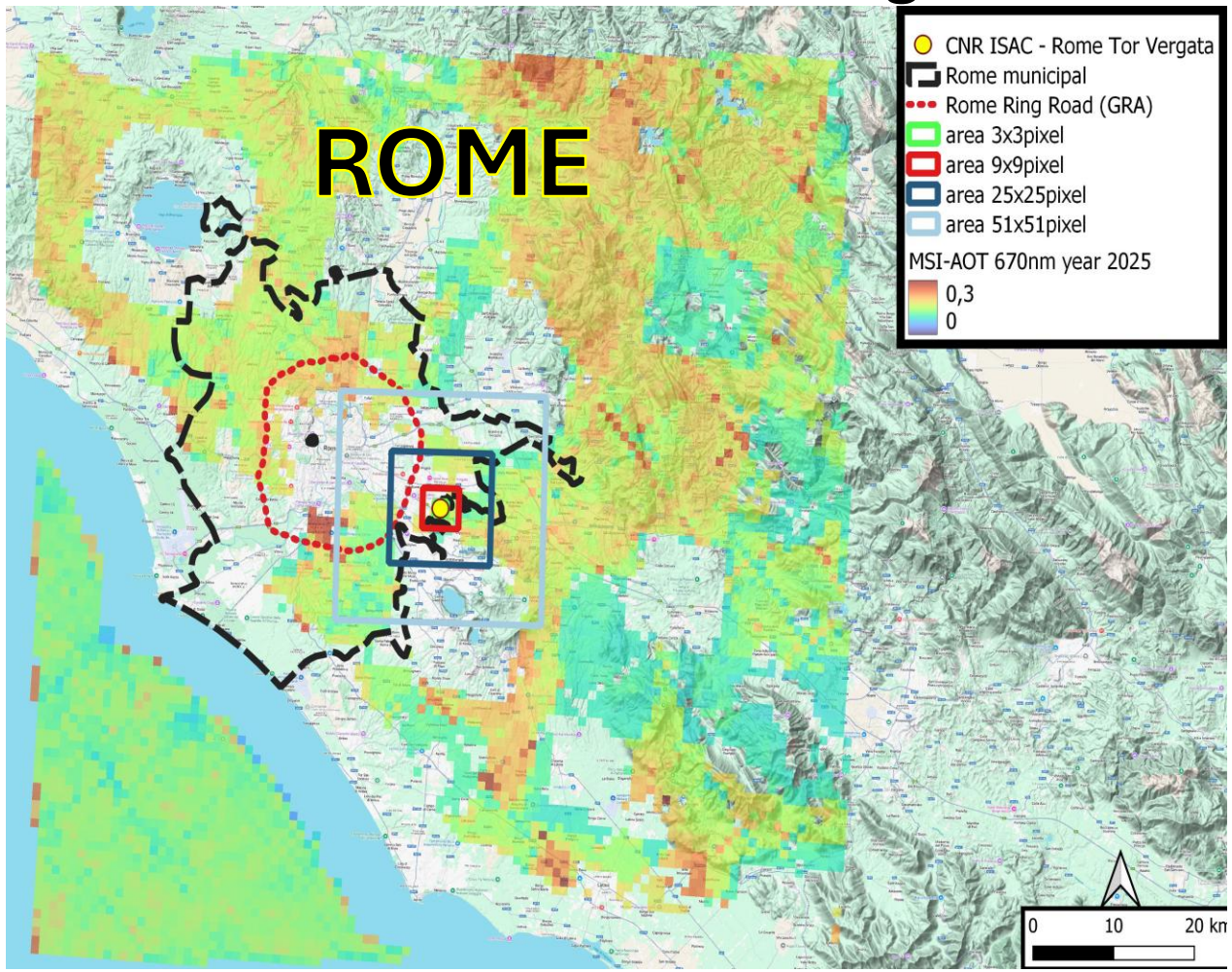
Comparison between MSI-AOT L2 (670nm) and AERONET and SKYNET (670/675 nm)

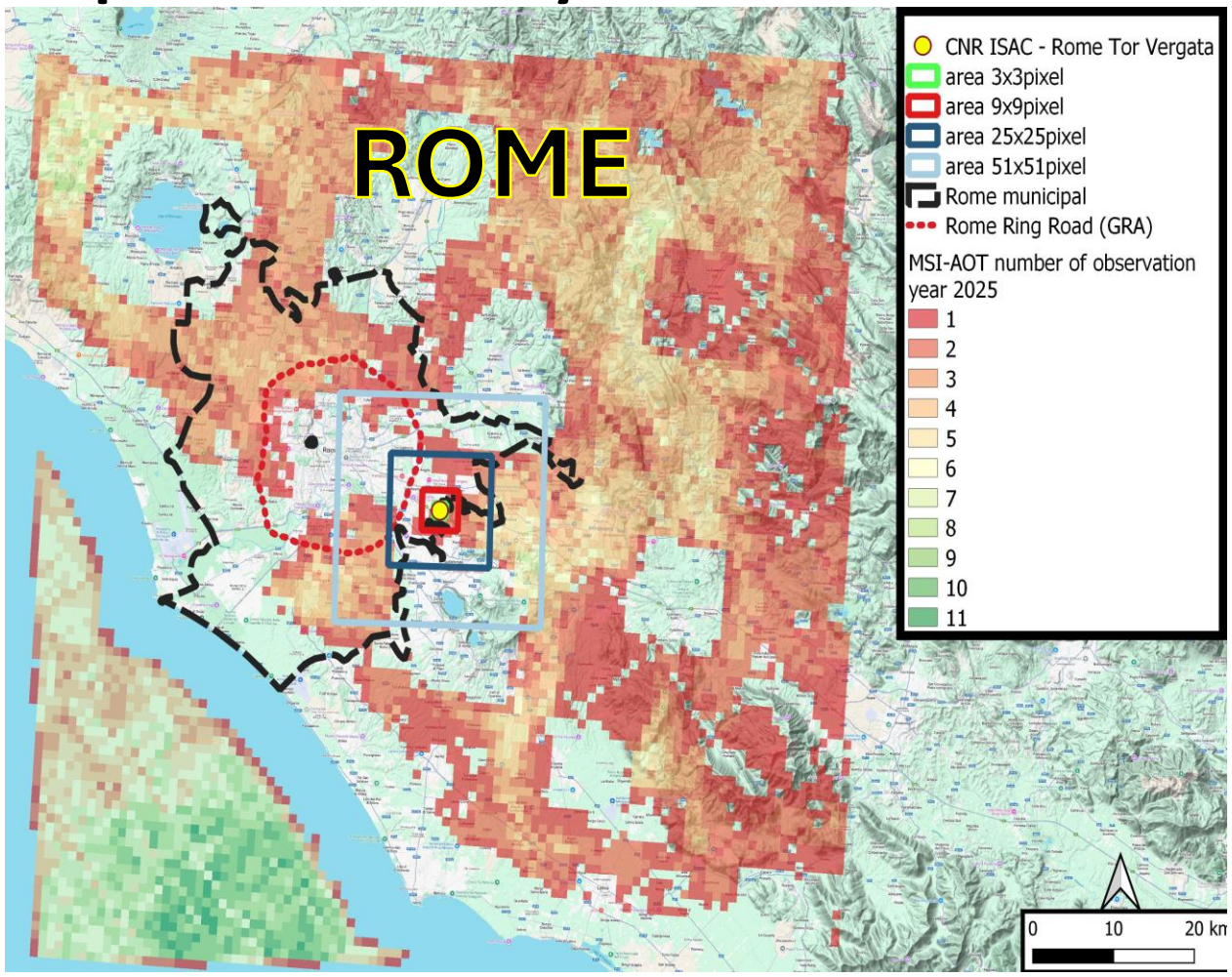




MSI-AOT Rome Tor Vergata

EC MSI AOT data to investigate relevant spatial variability in the Rome area:

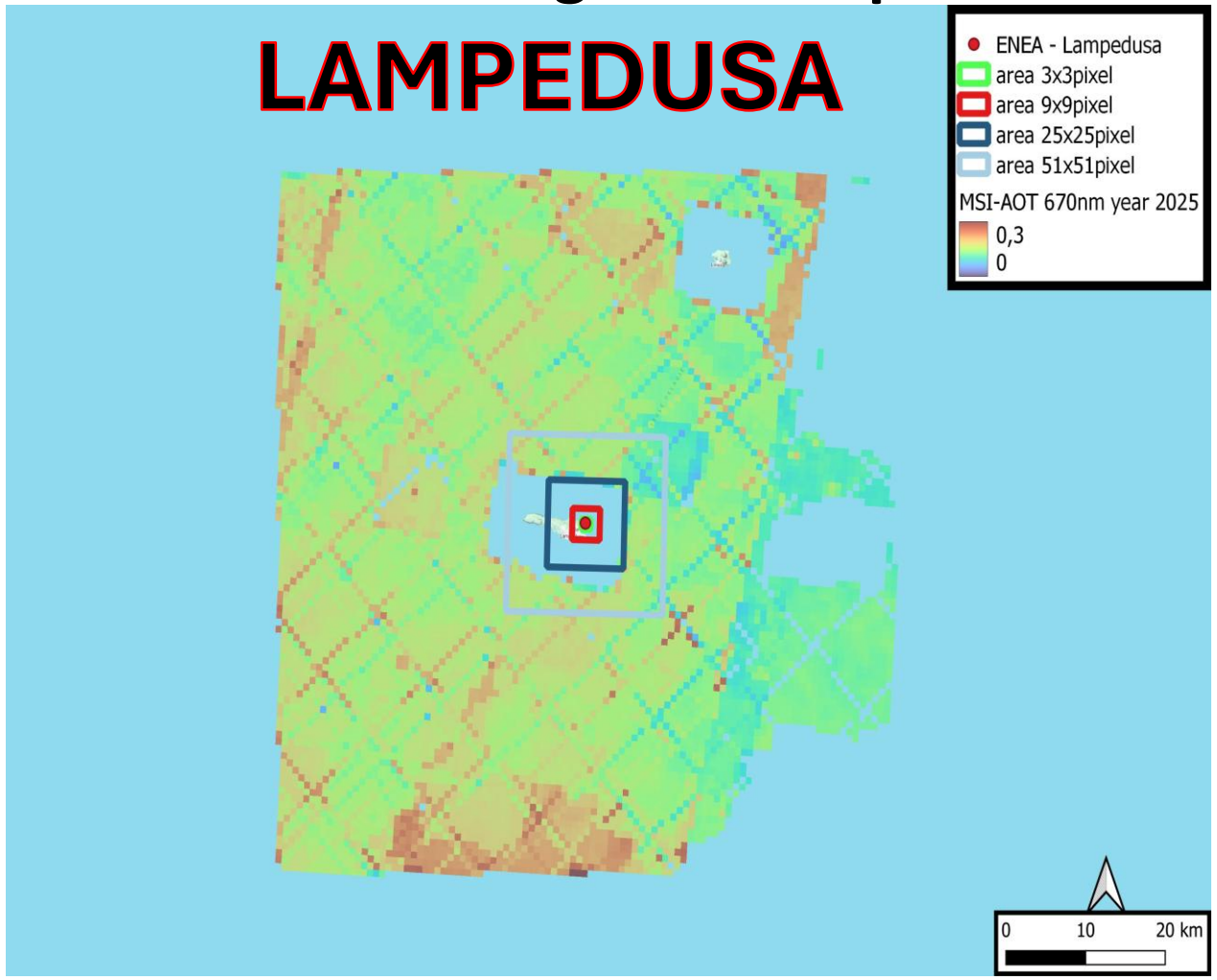


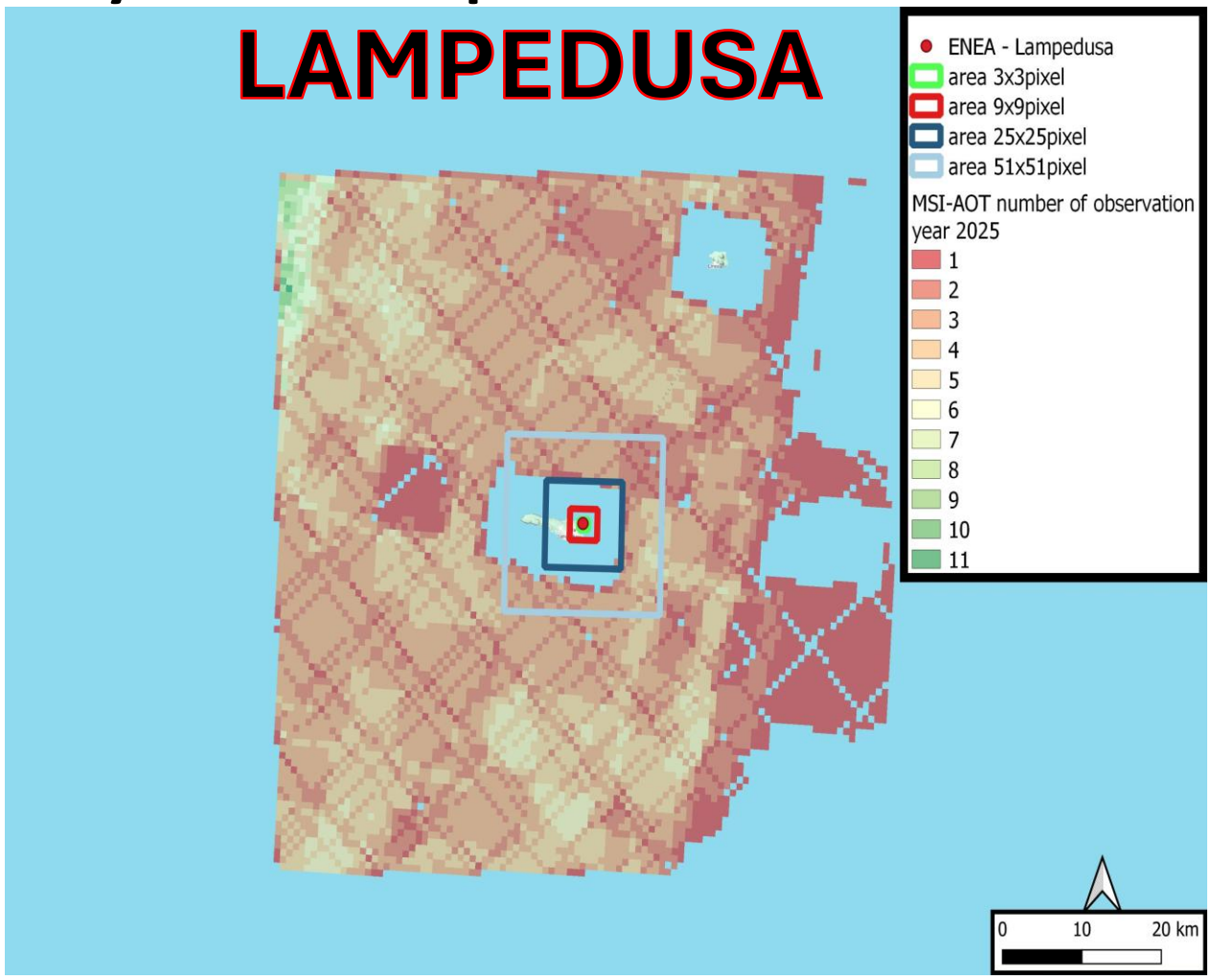


Annual mean AOT at 670 nm (left) and number of 1x1 km pixels (right) for the year 2025

MSI-AOT Lampedusa

EC data to investigate AOT spatial variability in the Lampedusa area:

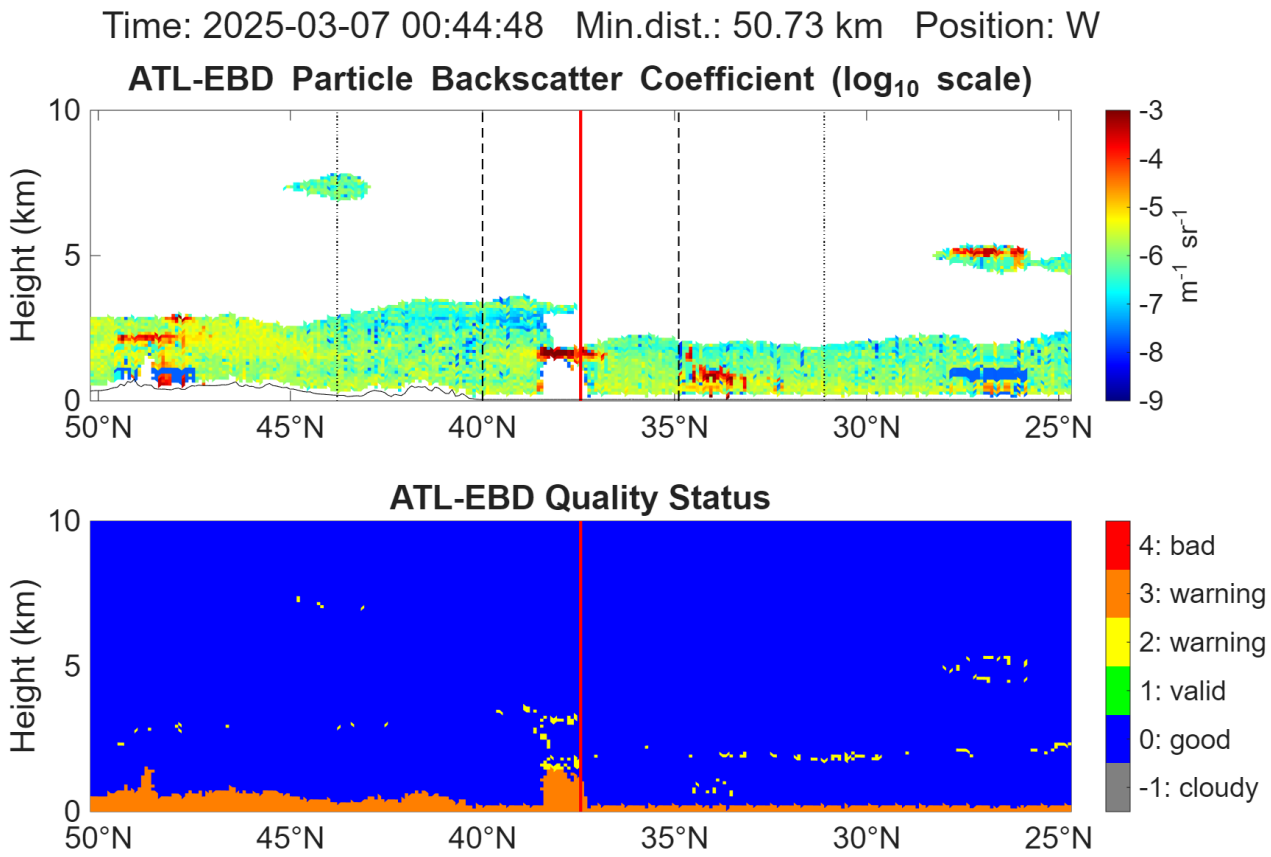


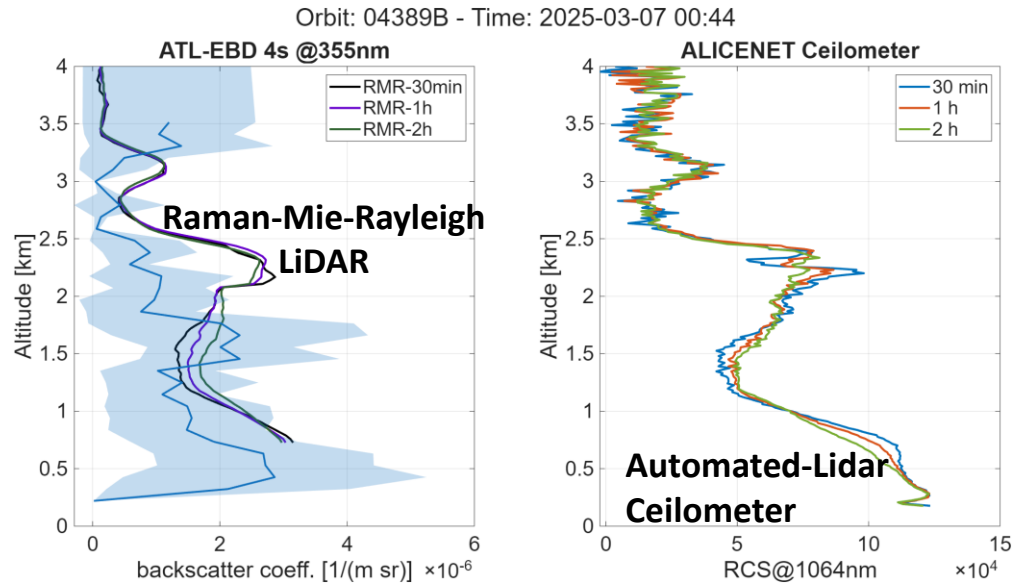


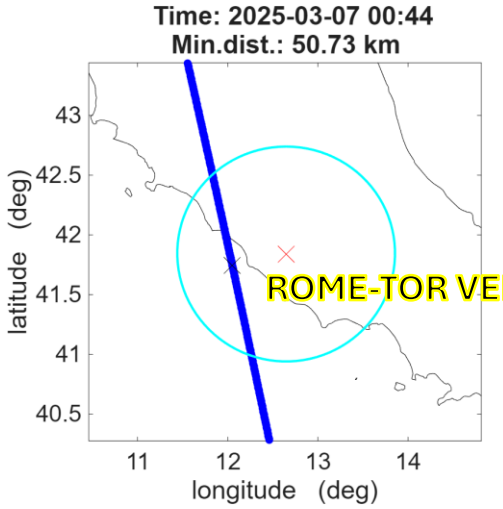
Annual mean AOD at 670 nm (left) and number of 1x1 km pixels (right) for the year 2025

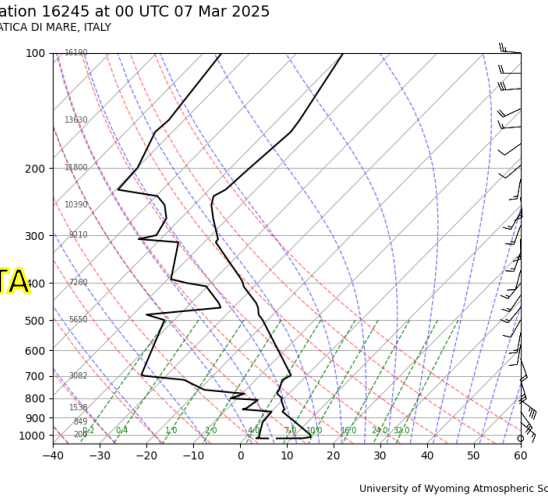
In progress: ATLID validation using aerosol vertical profiling at Rome-Tor Vergata (ACTRIS ARS NF ARTE)

ATL-EBD Particle Backscatter Coefficient averaged over 4s around the point closest to Rome-Tor Vergata (cloud screened, i.e. removing backsc. > 8*10^-6 m^{-1} sr^{-1})









Key messages

1) ASI funded the **EC-ValMed.it Project**, a coordinated framework for the validation of EarthCARE (EC) products in Italy using two advanced atmospheric observatories: the **CNR supersite in Rome Tor Vergata** and the **ENEA Climate Observatory in Lampedusa.**

2) Limited valid EC aerosol data up to now, but aerosol products performance has generally improved from baseline BA to BB: valid aerosol retrievals increase of 15% for ATL-ALD in Rome and Lampedusa, but some valid data decrease in Lampedusa.

3) A **common validation strategy has been defined for both sites**, using the same procedures for MSI-AOT (spatial averaging) and ATL-ALD (temporal averaging) to ensure methodological consistency.

4) For **ATL-ALD, good agreement is found in Rome** between the ATL AOT @355 nm and AERONET/SKYNET AOT @340 nm, with best correlation of R=0.86 (20-s temporal mean ATLID and 15-min AERONET mean). **No useful ATLID overpass for Lampedusa**.

5) MSI-AOT shows good performance, better over Lampedusa (ocean retrieval, R > 0.95 @ both 670 and 870 nm) than over Rome (R = 0.65 @ 670 nm)

6) Spatial-variability analysis indicates interesting features but the number of valid MSI data is still limited (max 10 data points per 1 km pixel over the whole year 2025). This analysis also revealed missing EC aerosol retrievals near coastlines and water bodies, this being particularly critical for the Lampedusa station.

7) This presentation mainly focuses on AOT but **other aerosol properties are addressed exploiting aerosol profiling measurements** by both research lidars and automated lidar-ceilometers at both sites (aerosol layer top/base, PBL H, etc.) .

8) All data matchup processing for the two sites are now fully operational. As soon as additional satellite data will become available, the system is ready to deliver comprehensive validation analyses.

Further information on EC validation at the two sites

Posters

DAY 2 - TUESDAY 2 DECEMBER 2025 (16:30-18:00)

Annex30	Feature matching based validation of ATLID aerosol products: Preliminary results	Gian Luigi Liberti et al.

DAY3 - WEDNESDAY 3 DECEMBER 2025 (15:45-17:15)

Annex34	Challenges in Validation of L2 EarthCARE Clouds and Precipitation Products: the experiences from CIRAS Rome and Lampedusa Italian observatories	Sabina Angeloni et al.
Annex61	EarthCARE validation with ground-based data: a novel approach for satellite data selection based on the homogeneity of level 2 products	Pamela Trisolino et al.

DAY5 - FRIDAY 5 DECEMBER 2025 (10:00-11:30)

Annex69	What is the Effect of the satellite Orbit Boost on Precipitation Products? An answer from GPM and Italian disdrometers	Sabina Angeloni et al.


Thanks for attention
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