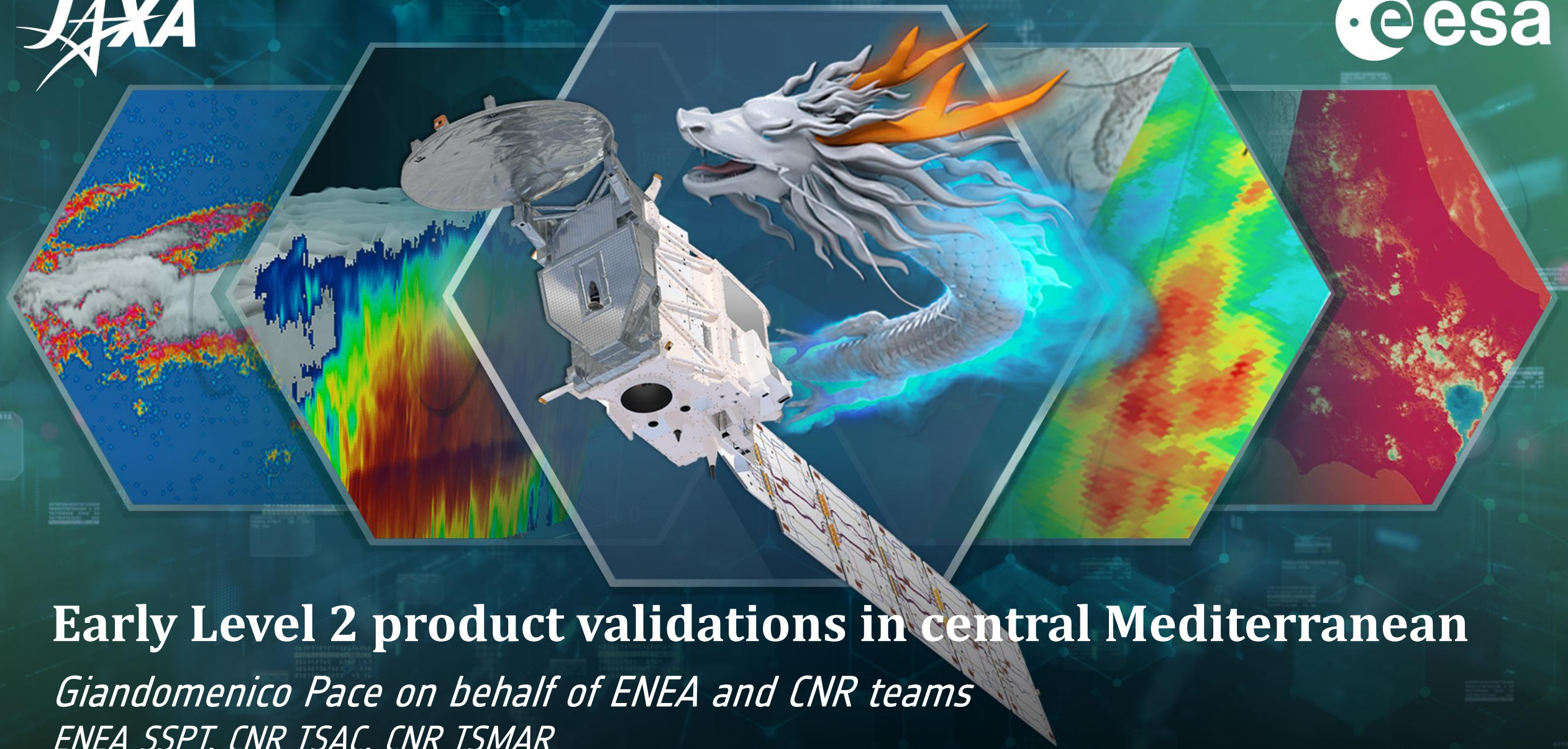


Early Level 2 product validations in central Mediterranean

Giandomenico Pace on behalf of ENEA and CNR teams
ENEA SSPT, CNR ISAC, CNR ISMAR

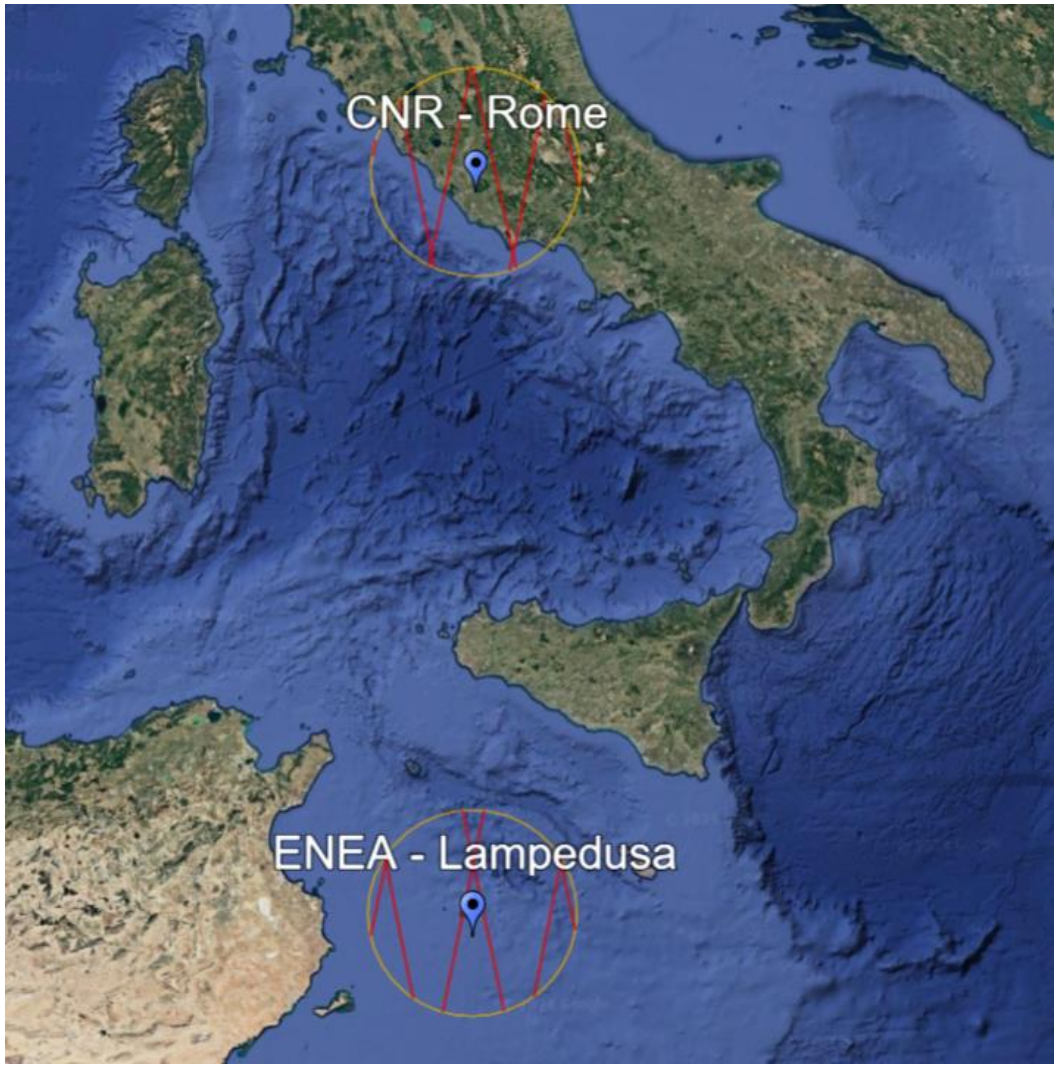
1st ESA-JAXA EarthCARE In-Orbit Validation Workshop
14 – 17 January 2025 | VIRTUAL EVENT

EC-VALMED.IT

Contribution to **EarthCARE** (**EC**) products **Val**idation during the commissioning phase from atmospheric observatories in Central **Med**iterranean in **It**aly, funded by ASI

Project focused on the L2 data of ATLID, CPR, MSI using two observational sites

- ROME – CNR — urban site “close” to mountain
- LAMPEDUSA – ENEA — open marine site, flat surface



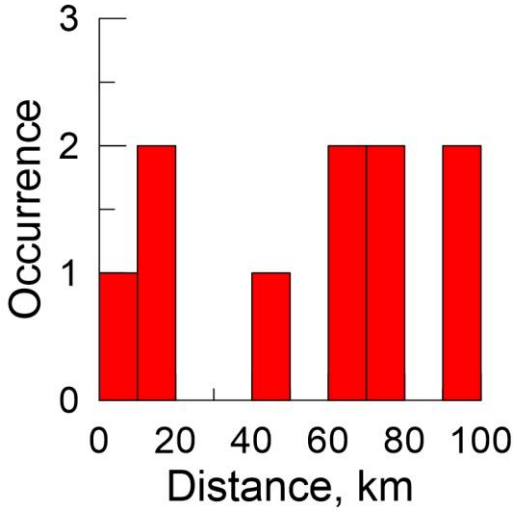
Lampedusa – ENEA Station for climate observation

37 overpasses up to 31/12/2024 in ±100 km

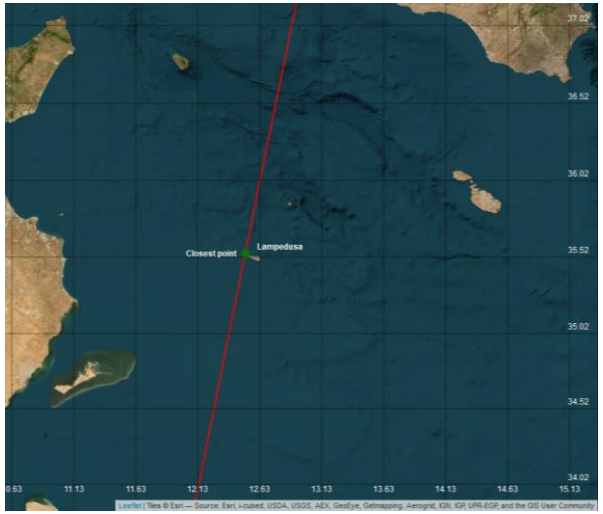
ATLID L2A 13 cases (3 in August, 3 in November, 7 in December)

Analysis of single cases (9 A-CTH, 10 A-ICE, 9 A-ALD)

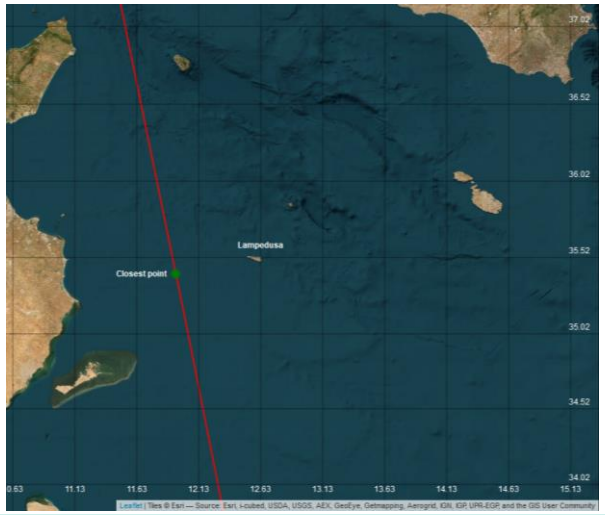
ACTRiS
Exploring the Atmosphere



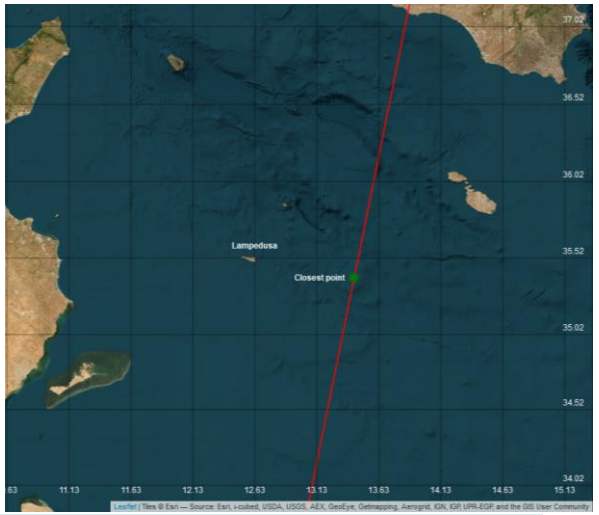
31 Dec. – A-ALD



17 Aug. – A-ICE



15 Dec. – A-ICE



A-CTH
Cloud Top Height

7 cases, quality status 0 (good data) or 1 (valid, but level of confidence low)

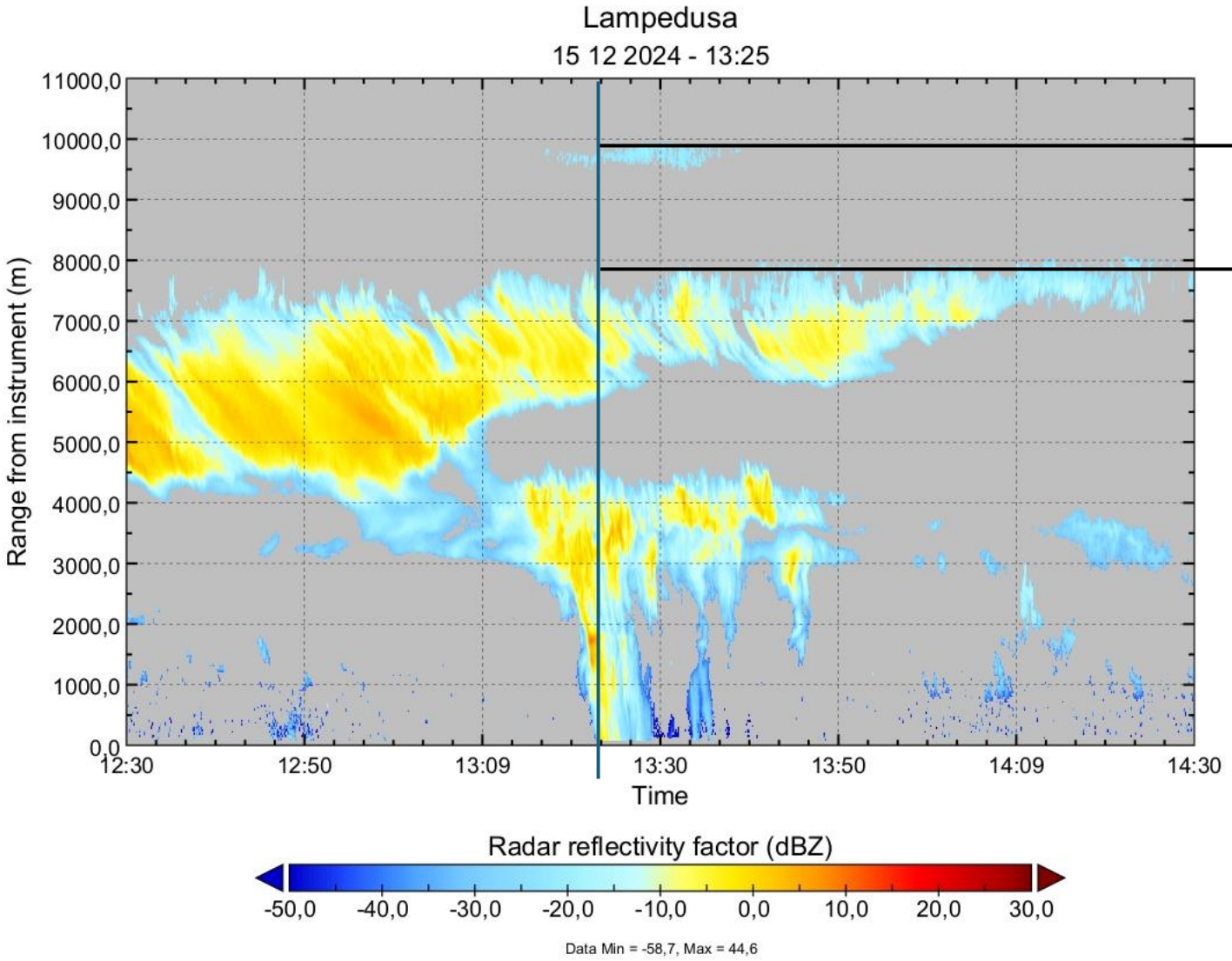
* derived from lidar

Date	Min distance (km)	LAMPE. 5 min	LAMPE. 10 min	LAMPE. 15 min	ATLID 4 sec	ATLID 10 sec	ATLID 20 sec	Comments
17/08/2024 00:54 UT	63.5	**6384±112**	6431±159	6485±165	**6096±174**	6099±162	5632±722	Agreement within uncertainties
06/12/2024 13:29 UT	1.1	1510 (1 value) 1540± 80*	1557± 43 1620±100*	1575± 39 1600±140*	na	na	na	Cloud non detected by ATLID
13/12/2024 00:48 UT	13.0	6146±796 **7400±120***	6443±806 7480±160*	6554±728 7460±200*	**7704± 61**	7677±604	75156±903	Very jagged clouds
15/12/2024 13:25 UT	73.7	**9876± 42**	9874± 75	9872± 75	**7712±127**	7602±765	7737±1186	Upper cloud not observed by ATLID
22/12/2024 00:44 UT	90.6	na	2072±358	2088±375	na	3030± 32	3030± 32	Probably different scene due to distance
22/12/2024 13:32 UT	91.7	na	1043±135	1116±181	3440±159	3483±237	3556±273	Probably different scene due to distance
29/12/2024 00:51 UT	77.7	2016±218	1808±537	1786±581	na	2633±170	2767±201	Non-homogeneous clouds

LAMPE. integration time 5 - 10 - 15 minutes
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

A-CTH
Cloud Top Height

15 December 2024
13:25:38 – dist. 73.7 km

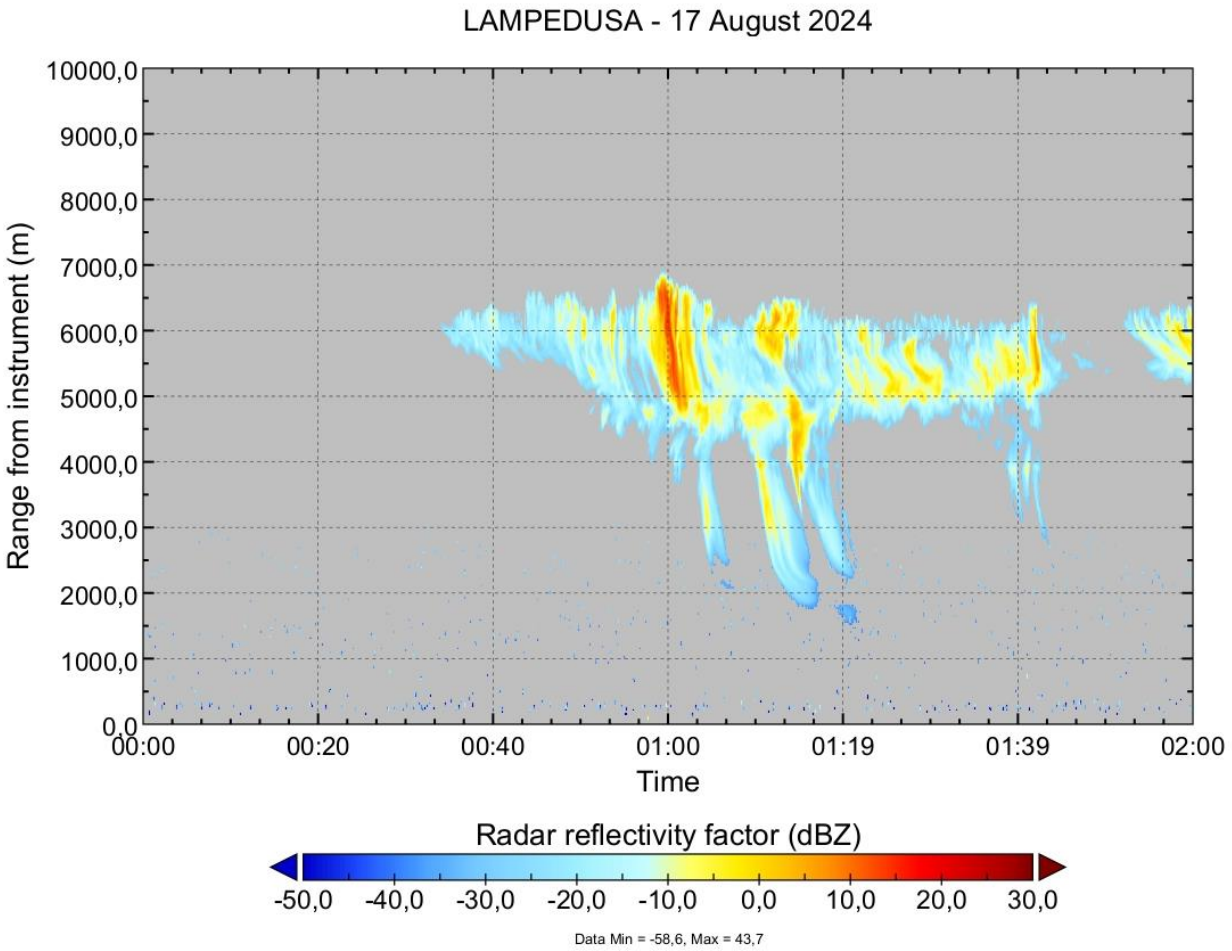


ACTRIS (9876± 42) m

ATLID (7712±127) m

A-ICE
Ice Water Content

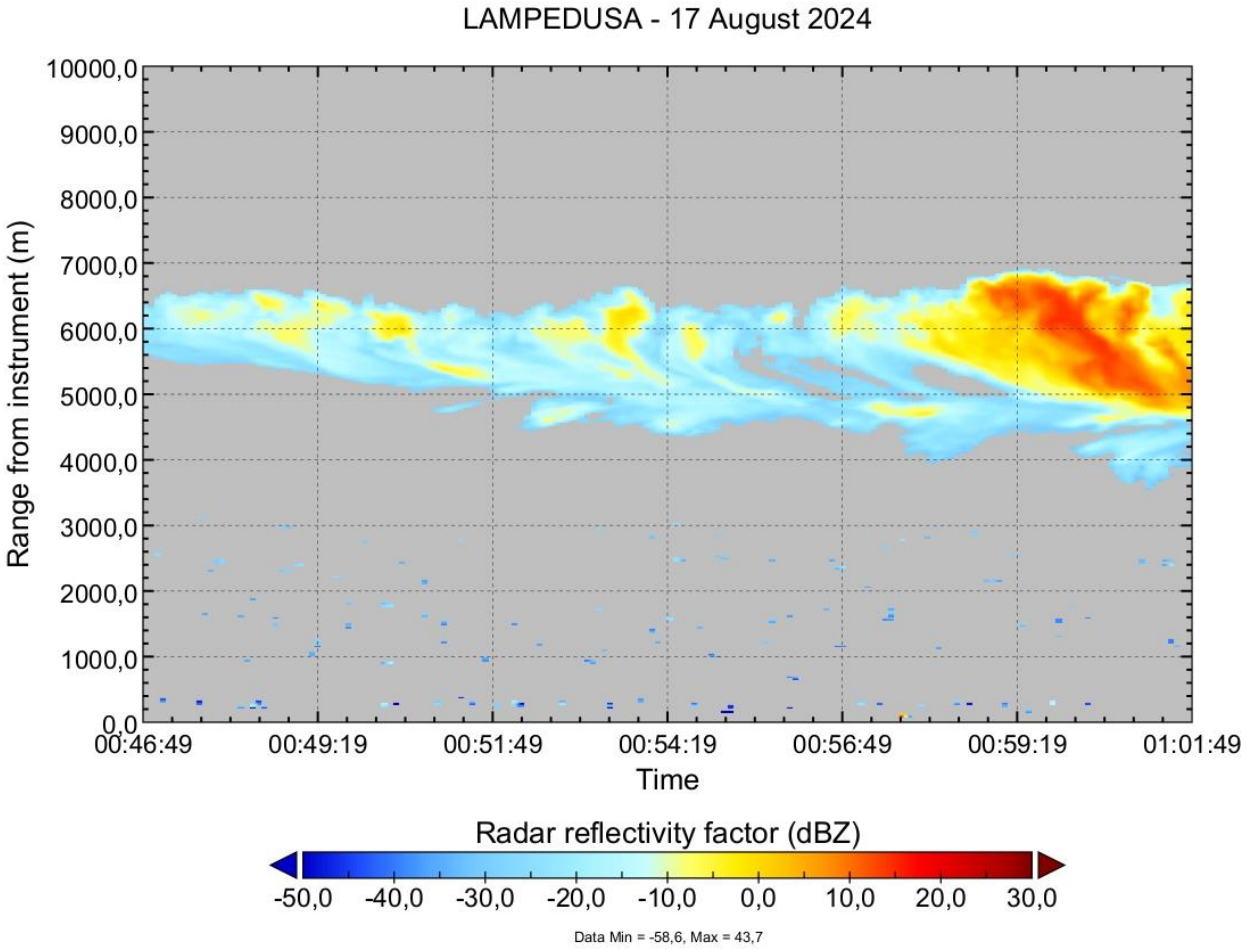
17 August 2024
00:54:18 – dist. 63.5 km

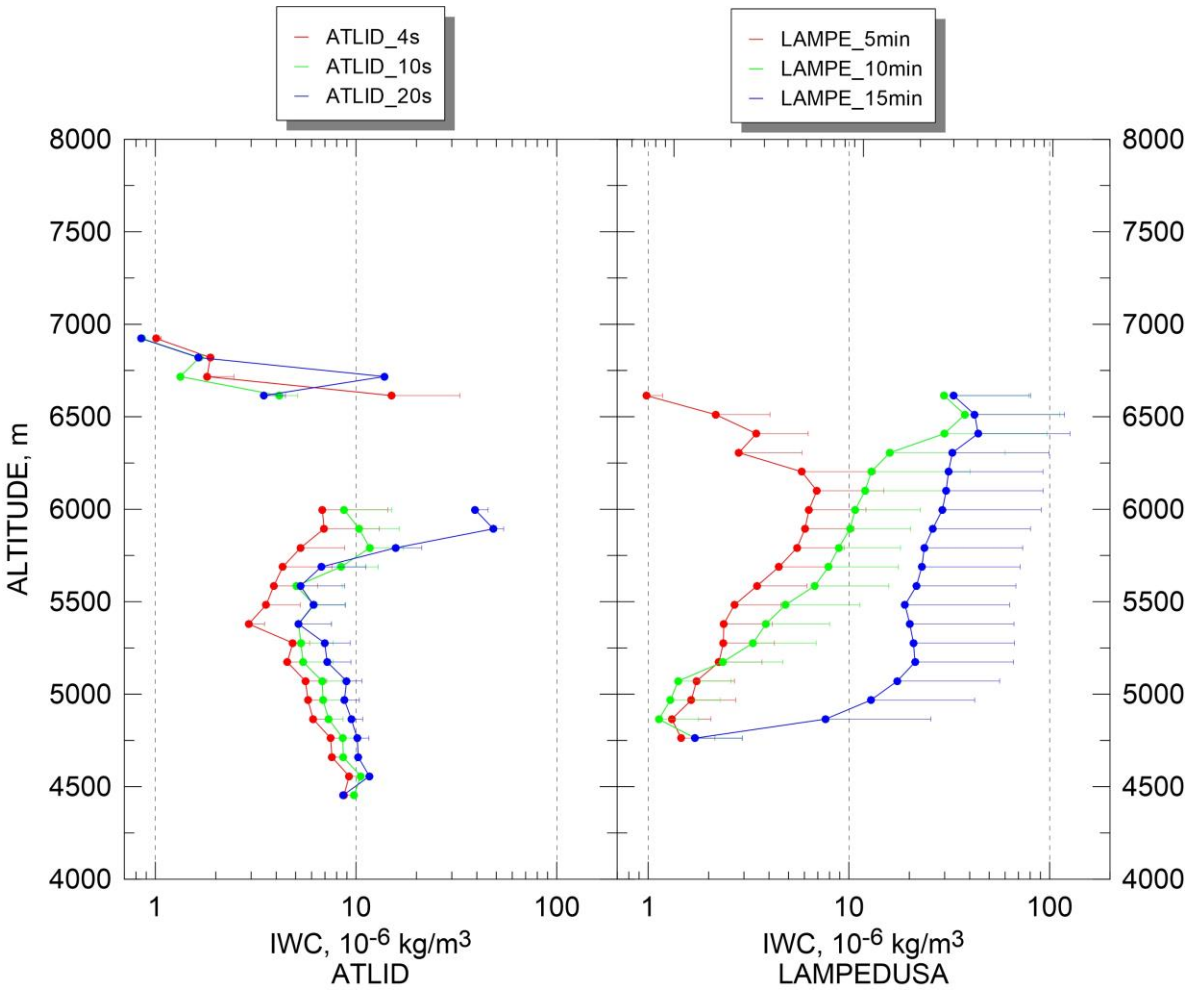


LAMPE integration time 5 - 10 - 15 minutes
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

A-ICE Ice Water Content

17 August 2024
00:54:18 – dist. 63.5 km





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A-ICE
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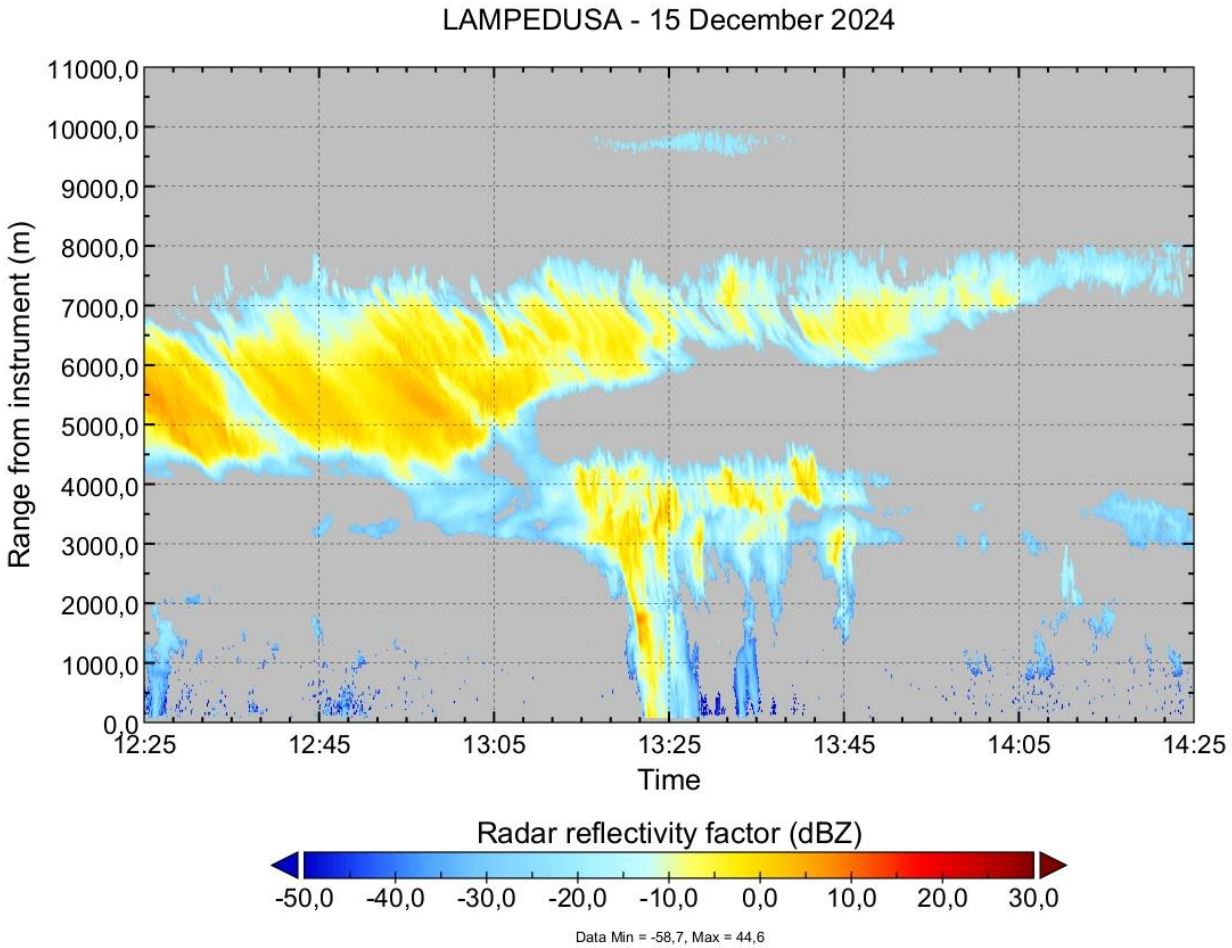

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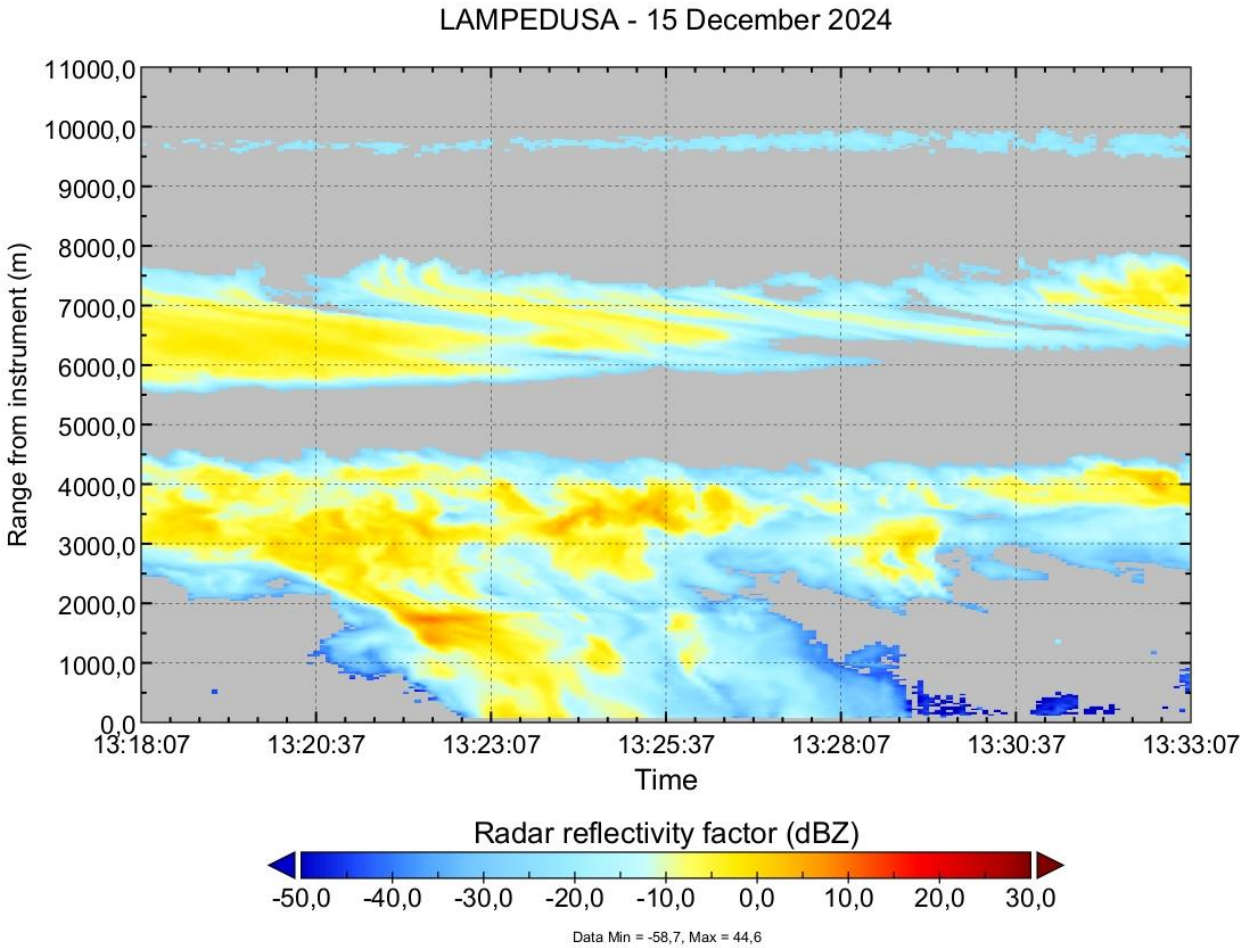
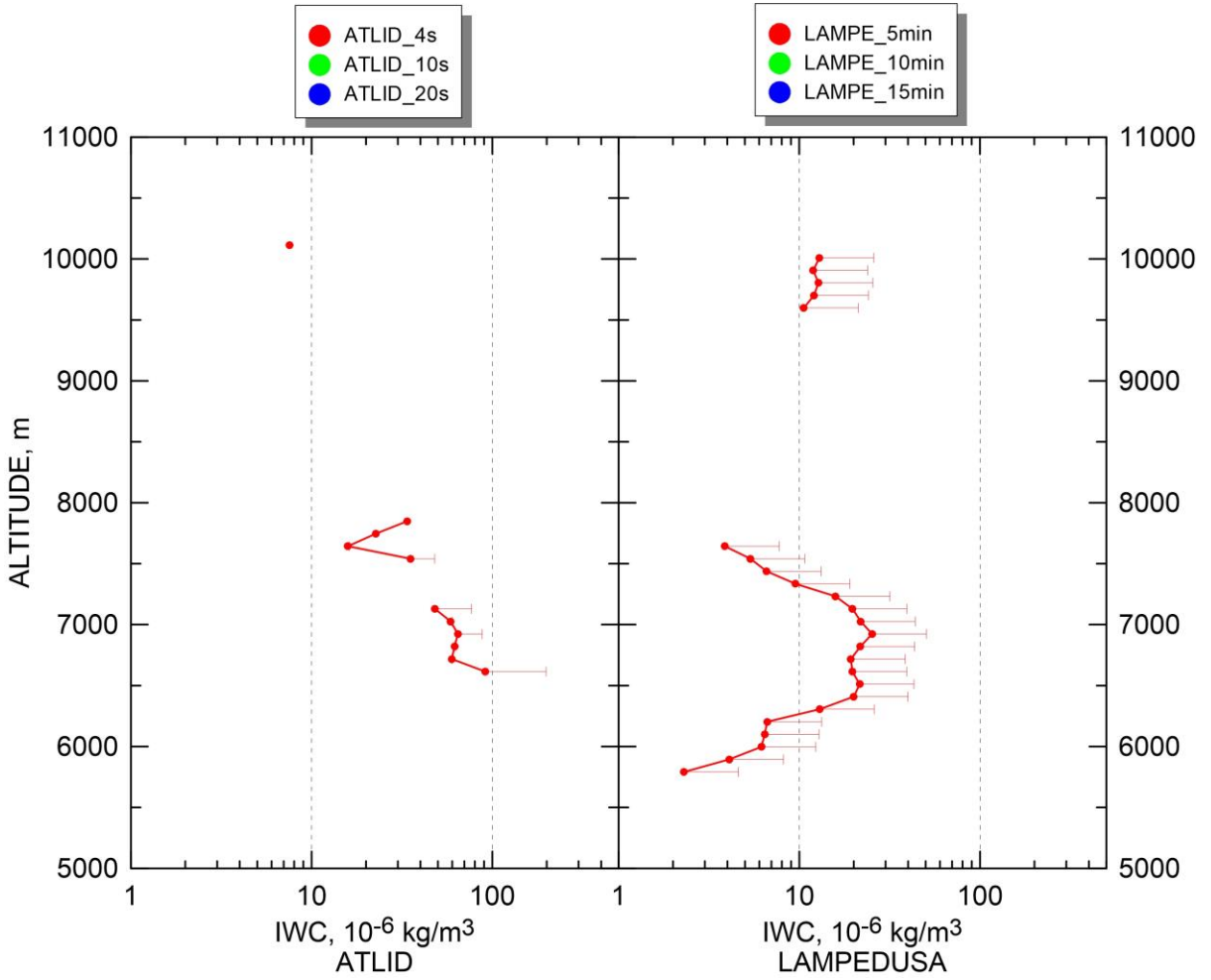
A-ICE
Ice Water Content

15 December 2024
13:25:38 – dist. 73.7 km

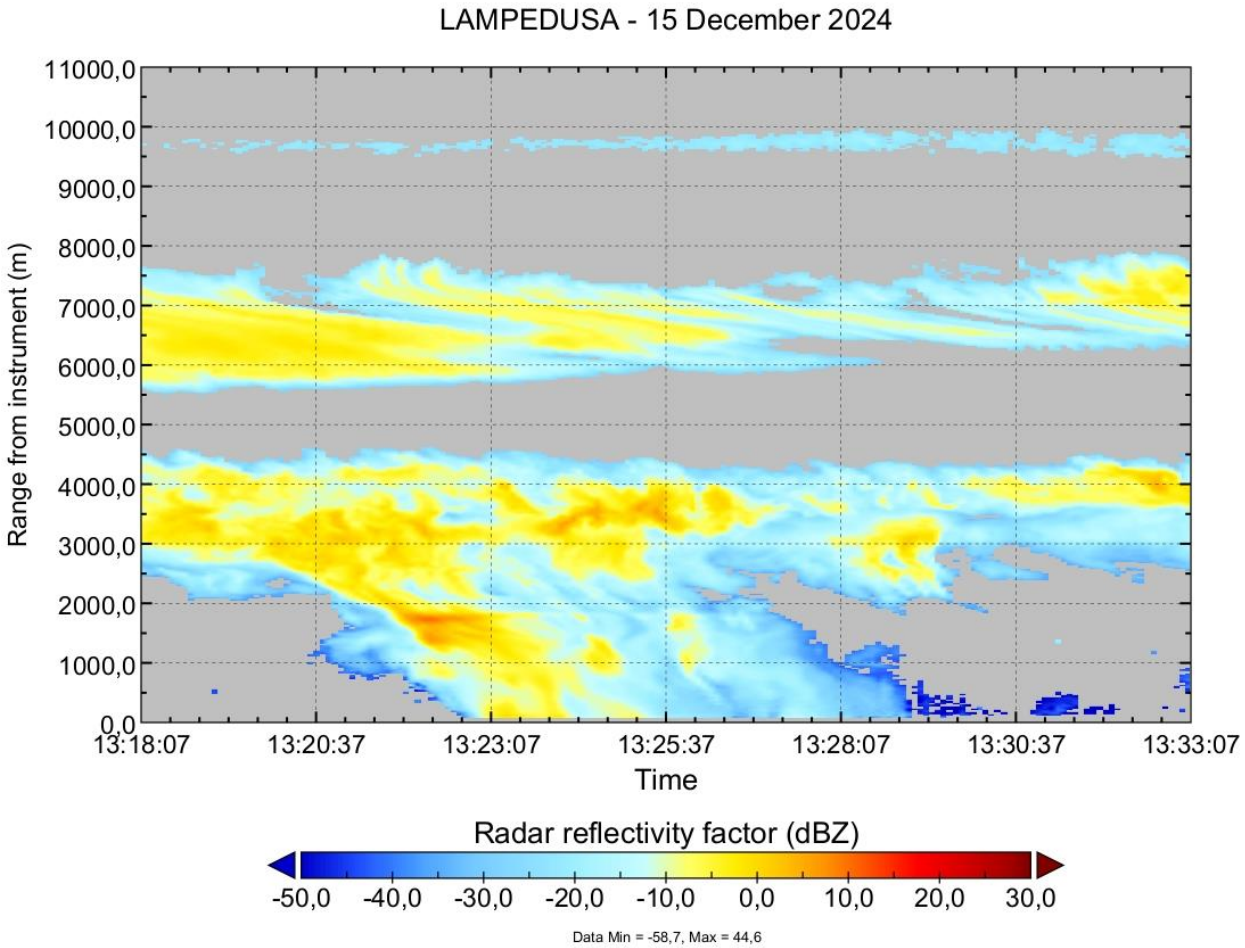


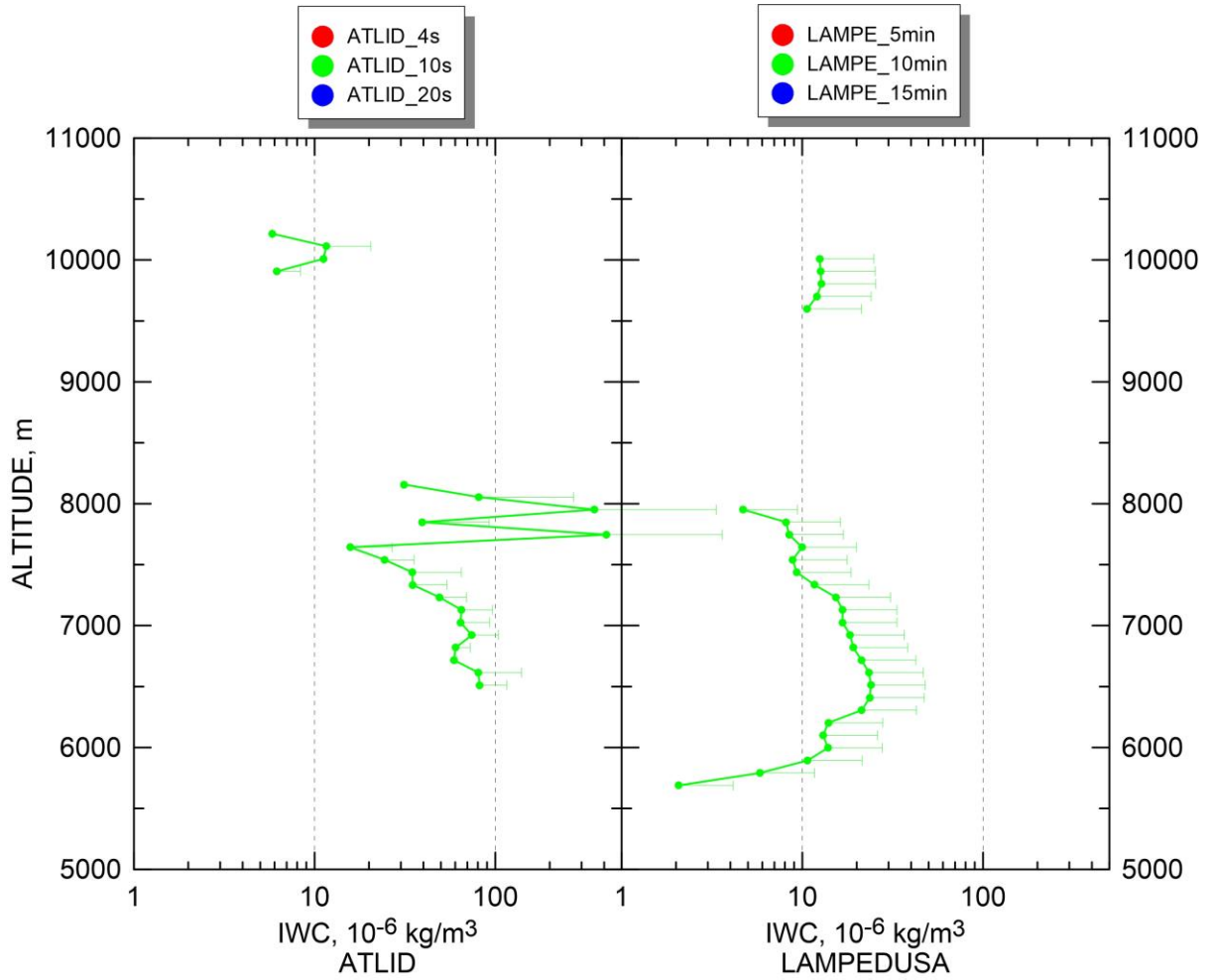


LAMPE integration time 5 - 10 - 15 minutes
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

A-ICE
Ice Water Content

15 December 2024
13:25:38 – dist. 73.7 km





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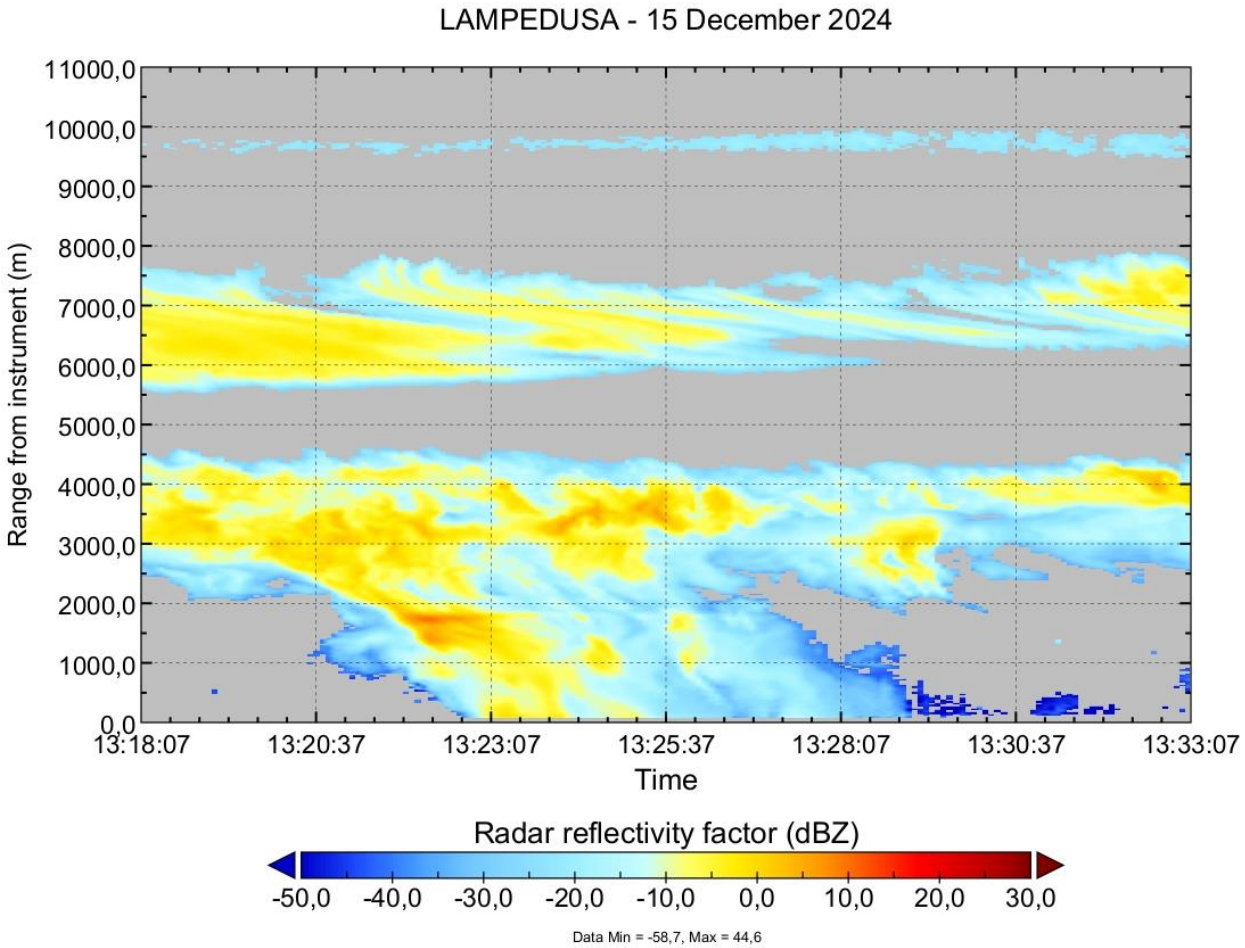
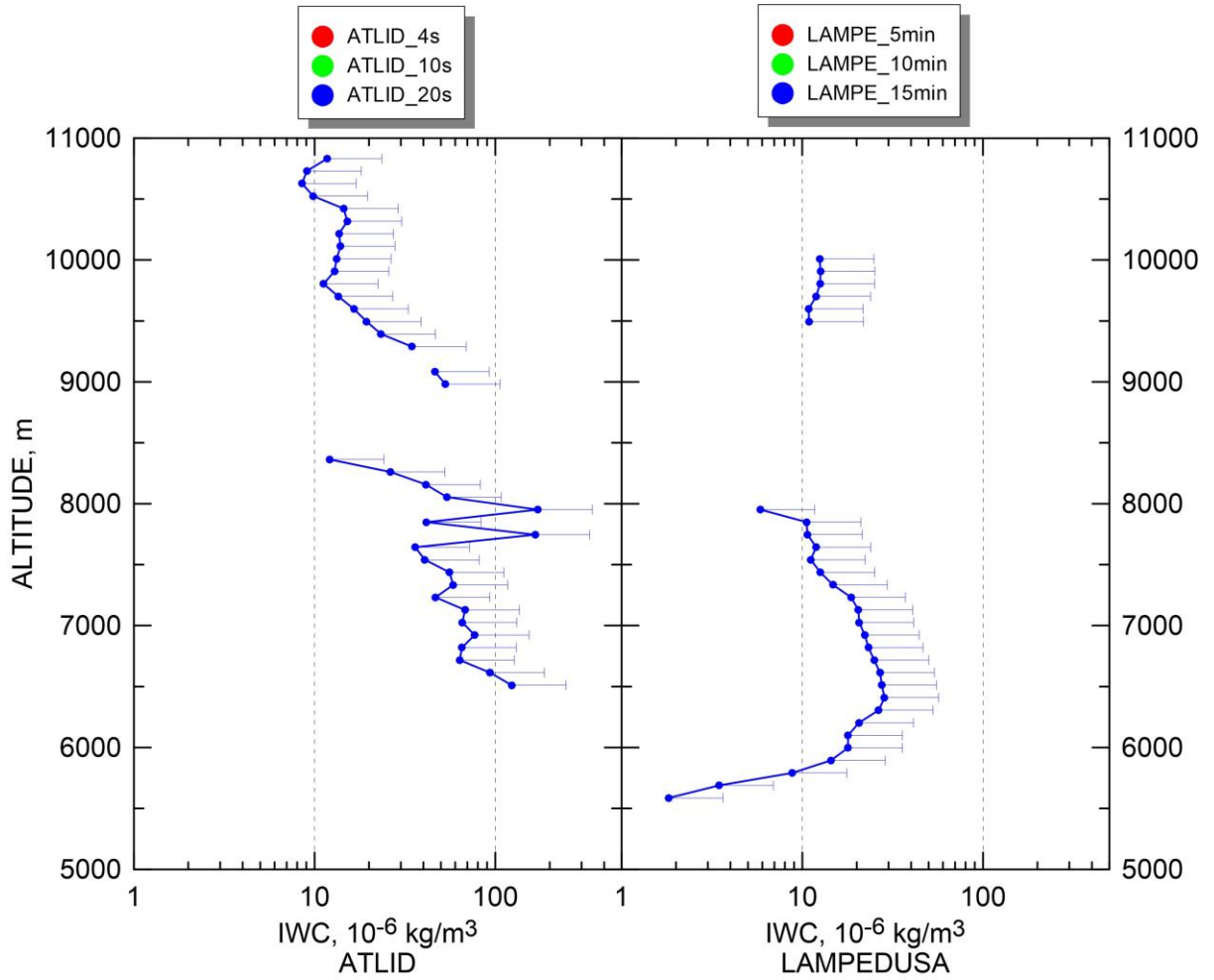
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

A-ICE
Ice Water Content

15 December 2024
13:25:38 – dist. 73.7 km





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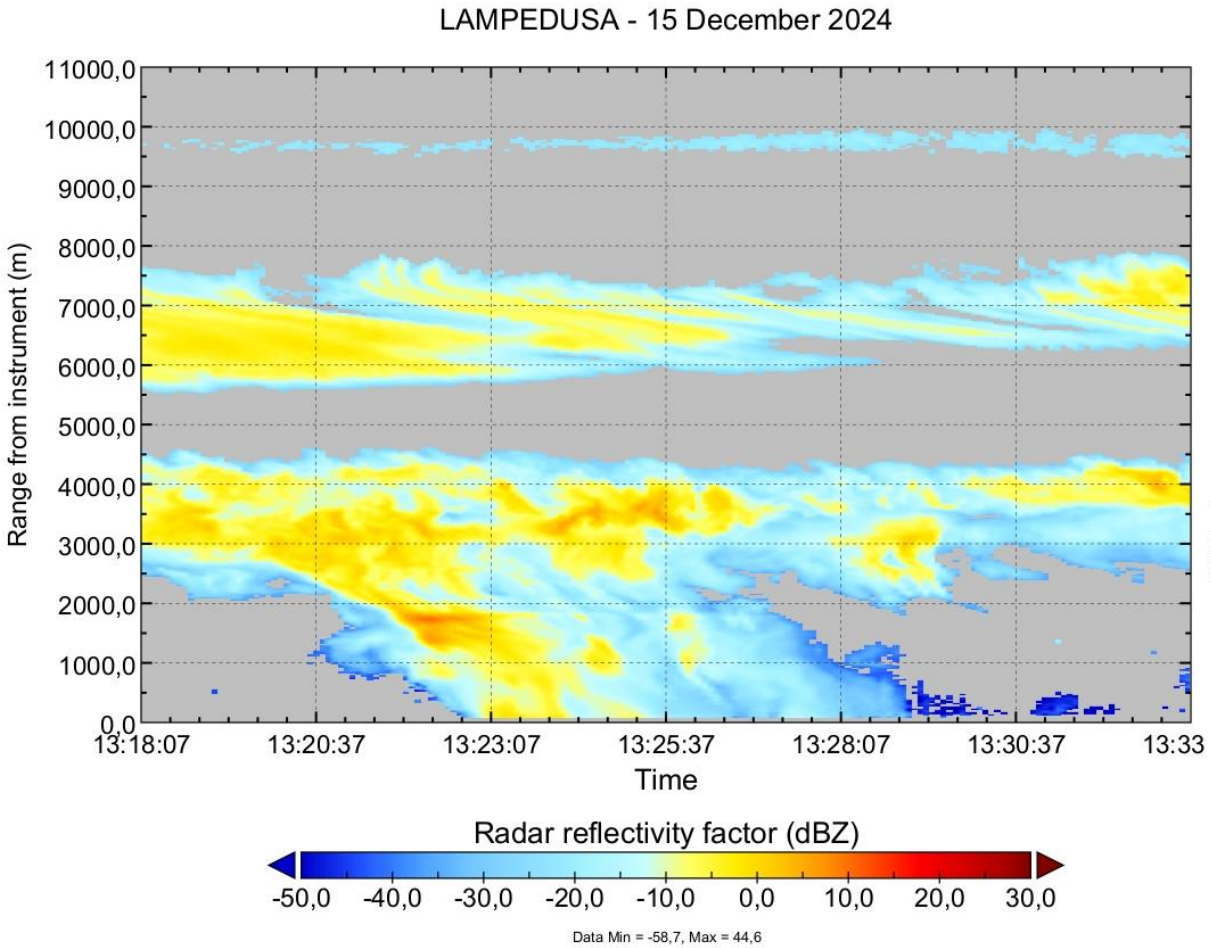
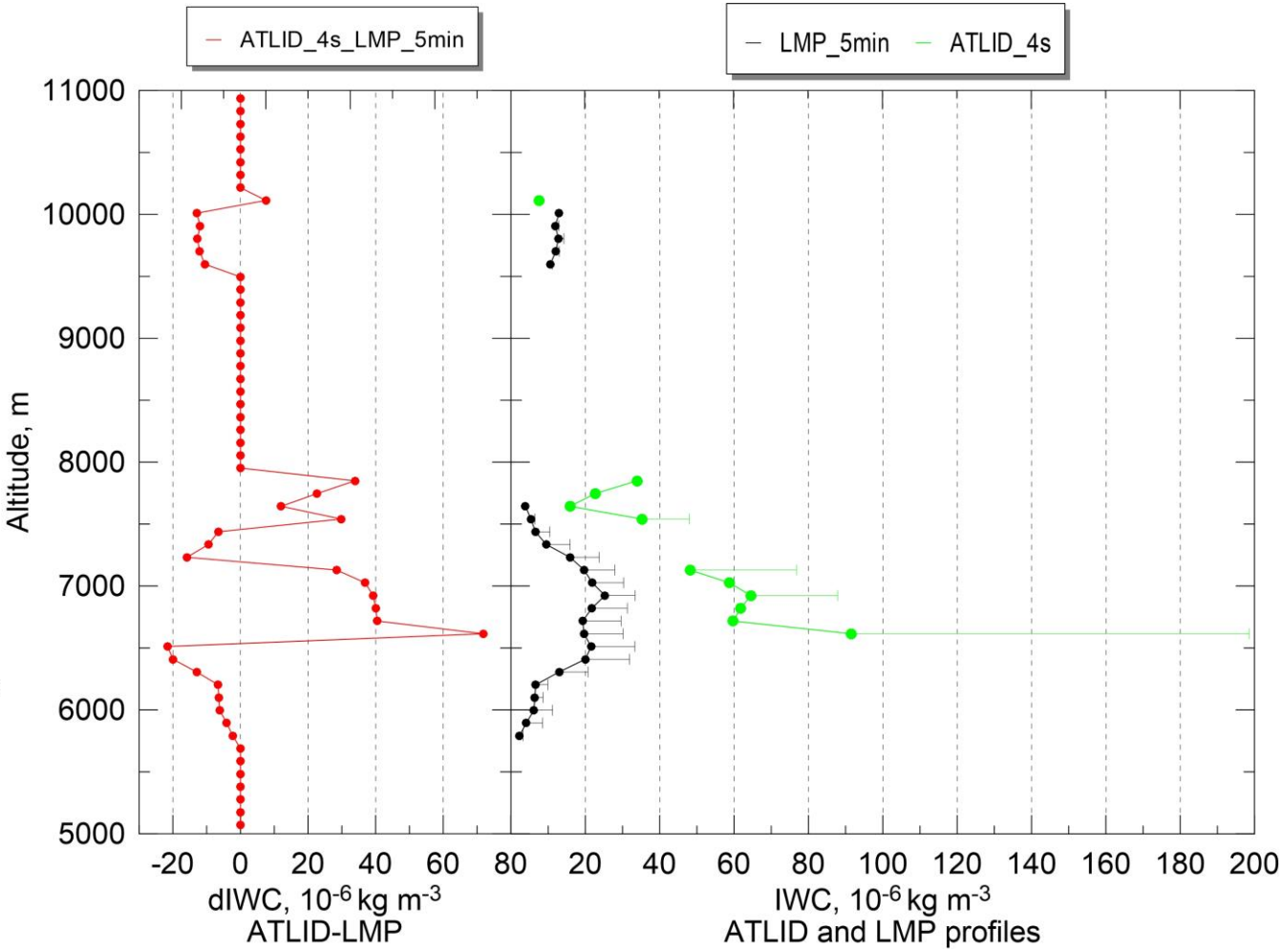
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

A-ICE
Ice Water Content

15 December 2024
13:25:38 – dist. 73.7 km

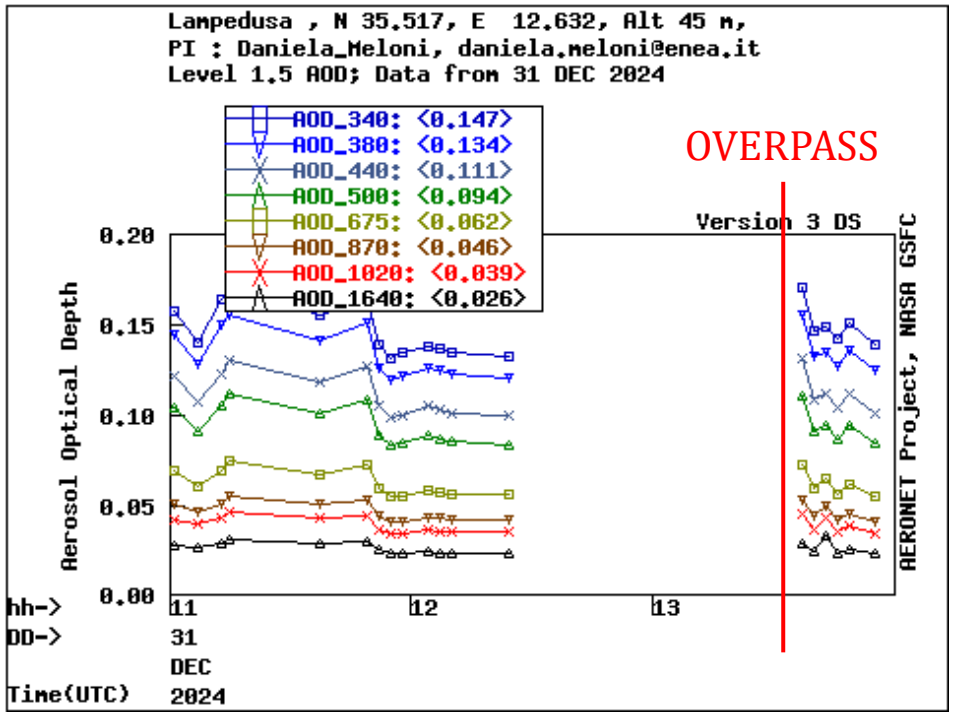




LAMPE integration time 5 - 10 - 15 minutes
ATLID integration time 4 s (~± 7 km) - 10 s (~± 28 km) - 20 s (~± 56 km)

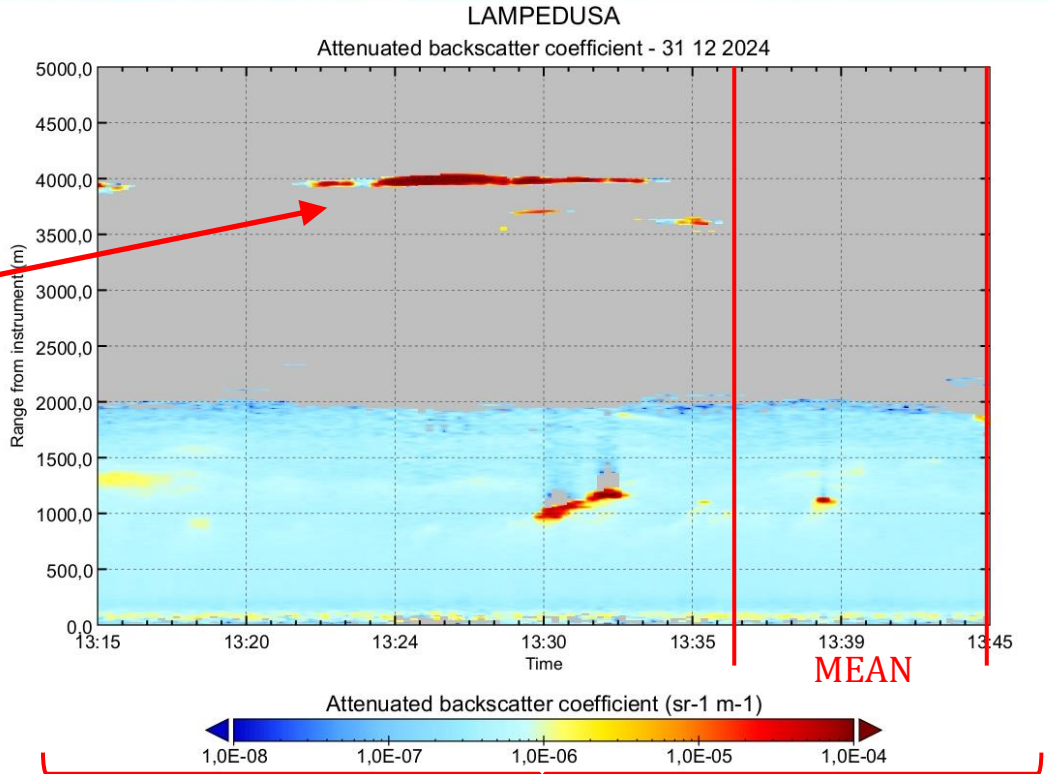
A-ALD AOD at 355 nm

31 December
13:29:07 – dist. 10.9 km



AERONET AOD at 340 and 380 nm.

No AERONET data available before 13:37 UT, due to thin cloud presence



	LAMPE. 13:37-13:45	ATLID 4 s (±7 km)	ATLID 10 s (±28 km)
Mean	**0.147**	**0.148**	0.606
Standard deviation	0.013	0.029	1.084
Number of data	4	8	43

31 Dec. overpass

CNR Isac Rome Atmospheric Observatory, CIRAS, devices

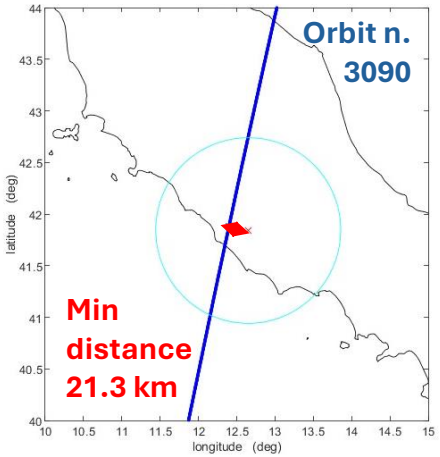
Available devices for *direct* comparison with E arthCare products in Rome CIRAS	Operational mode	Available during EarthCare mission	Data uploaded to the ESA center (EVDC)	EarthCare prodcuts
MRR	Automatic	Yes	In progress	A-ICE, C-TC, C-FMR, C-CD, C-CLD, AC-TC, ACM-CAP
Disdrometer	Automatic	Yes	Yes	C-TC, C-FMR, C-CLD, AC-TC
Doppler Wind Lidar	Automatic	Yes	In progress	A-FM, A-AER, A-EBD, A-ALD, A-TC, A-CTH, C-TC, AM-ACD, AM-CTH
Photometer (SKYNET)	Automatic	Yes	In progress	A-FM, A-TC, M-AOT, AM-ACD, AC-TC
Sun- Lunar photometer (AERONET)	Automatic	Yes	Through AERONET/ACTRIS	A-FM, A-TC, M-AOT, AM-ACD, AC-TC
all sky camera	Automatic	Yes	In progress	A-FM, M-CM
Raman-Mie-Rayleigh Lidar	On-demand	Yes	No	A-FM, A-AER, A-EBD, A-ALD, A-ICE, A-TC, A-CTH, M-CM, M-COP, C-TC, AM-CTH, AC-TC, ACM-CAP, ACM-CPM
C-band Doppler weather radar	On-demand	To be fixed	No	A-ICE, C-TC, C-FMR, C-CD, C-CLD, AC-TC, ACM-CAP
CHM15k celiometer	Automatic	Yes	No	A-FM, A-AER, A-ALD, A-TC, A-CTH, C-TC, AM-ACD, AM-CTH

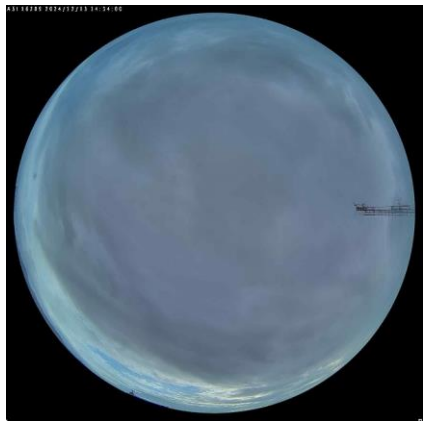
L2 ATLID products
L2 MSI products
L2 CPR products
L2 combined products

CNR ISMAR ISTITUTO DI SCIENZE MARINE
CNR ISAC

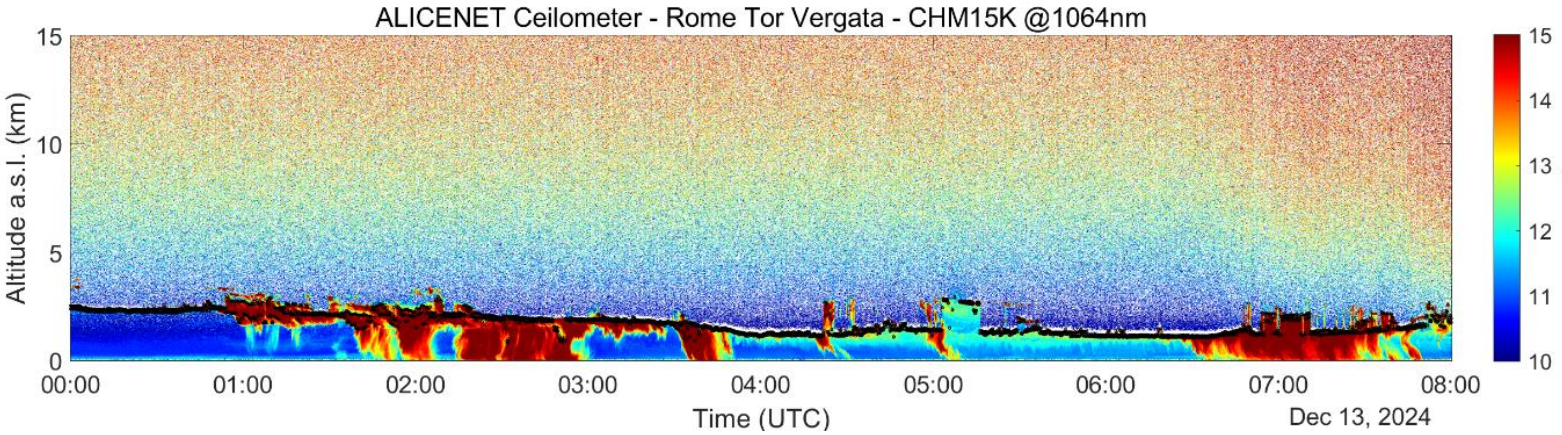
Rome site: overpass of 13/12/2024 13:34

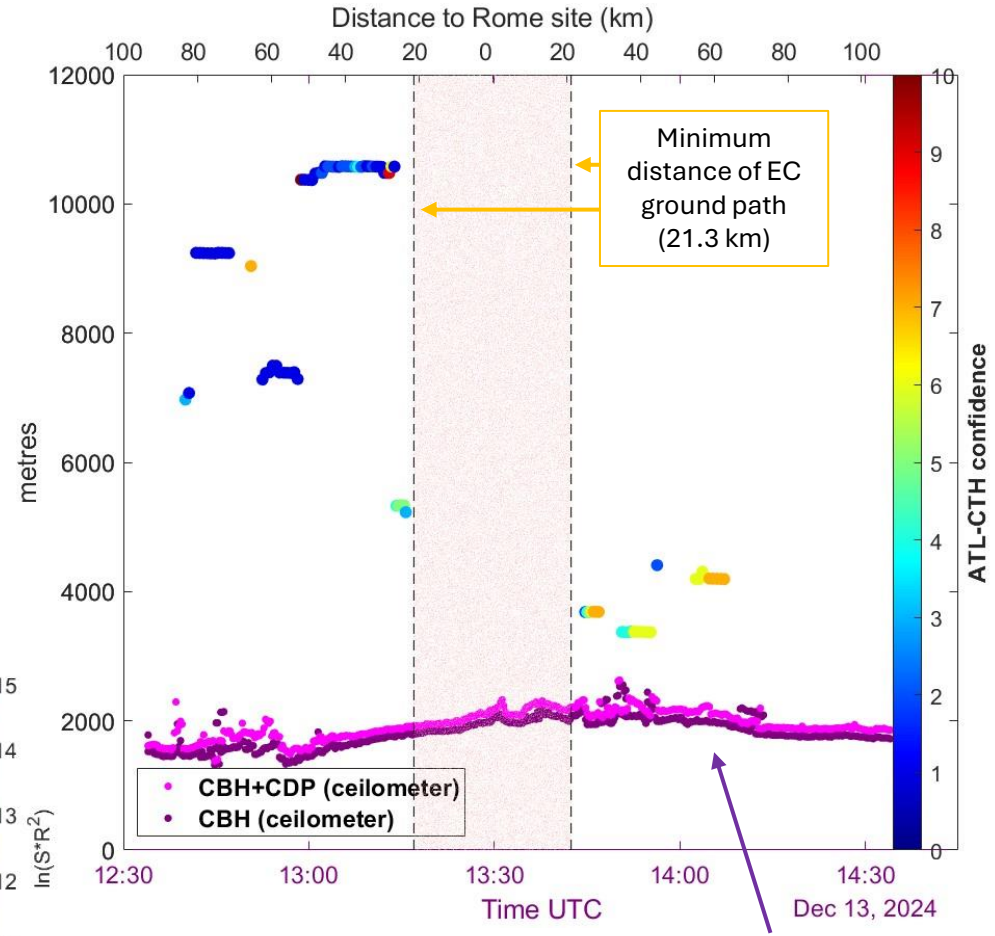
- Very light precipitation detected by the disdrometer (i.e 12 minutes of precipitation with 0.033 mm of total cumulated rain and a maximum rain rate of 0.39 mm/h) → Overcast, comparison of ATLID L2 with photometer data is not possible.
- Comparison of CPR L1 with reflectivity obtained by disdrometer and Micro Rain Radar and ATLID L2 with all sky camera is possible





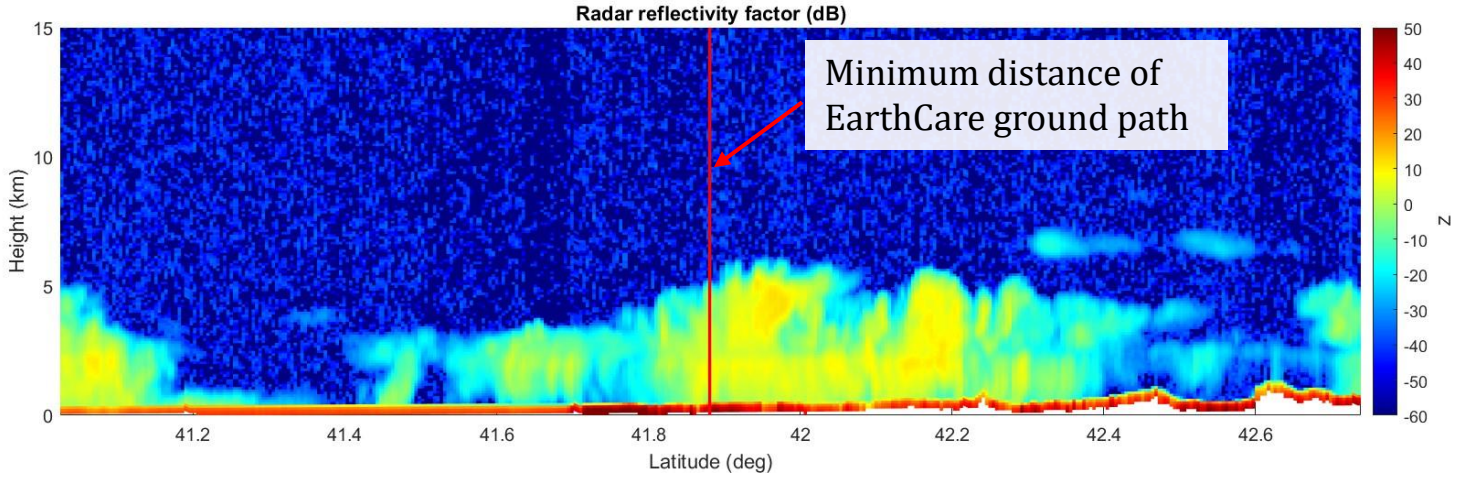
Sky image of an ASI-16 all-sky camera



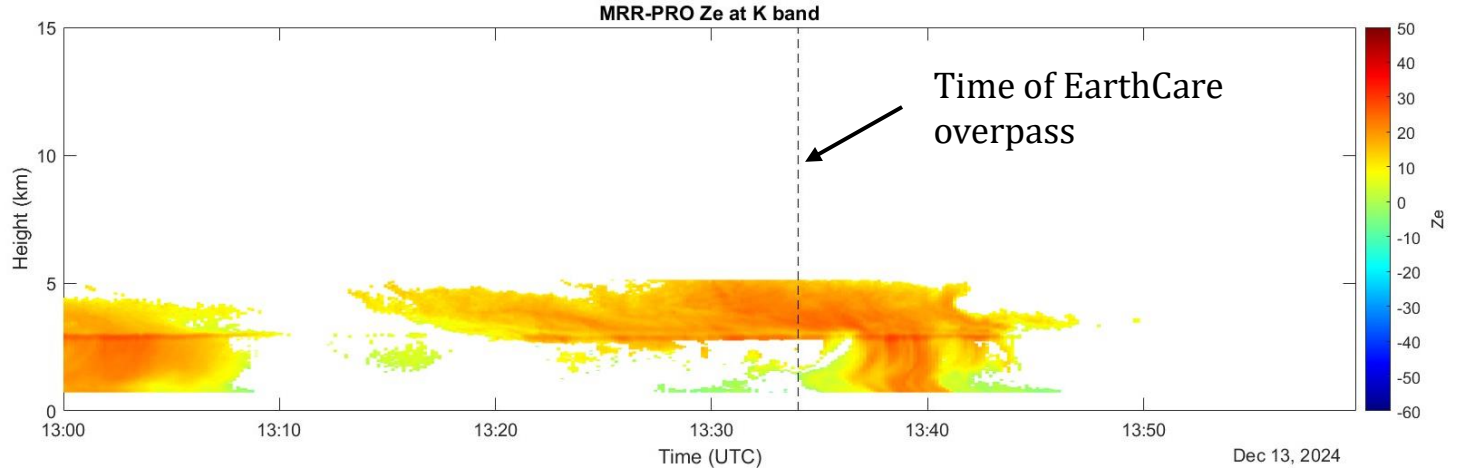


Precipitation and thick clouds produce laser extinction and therefore the thickness cannot be estimated by the ceilometer.

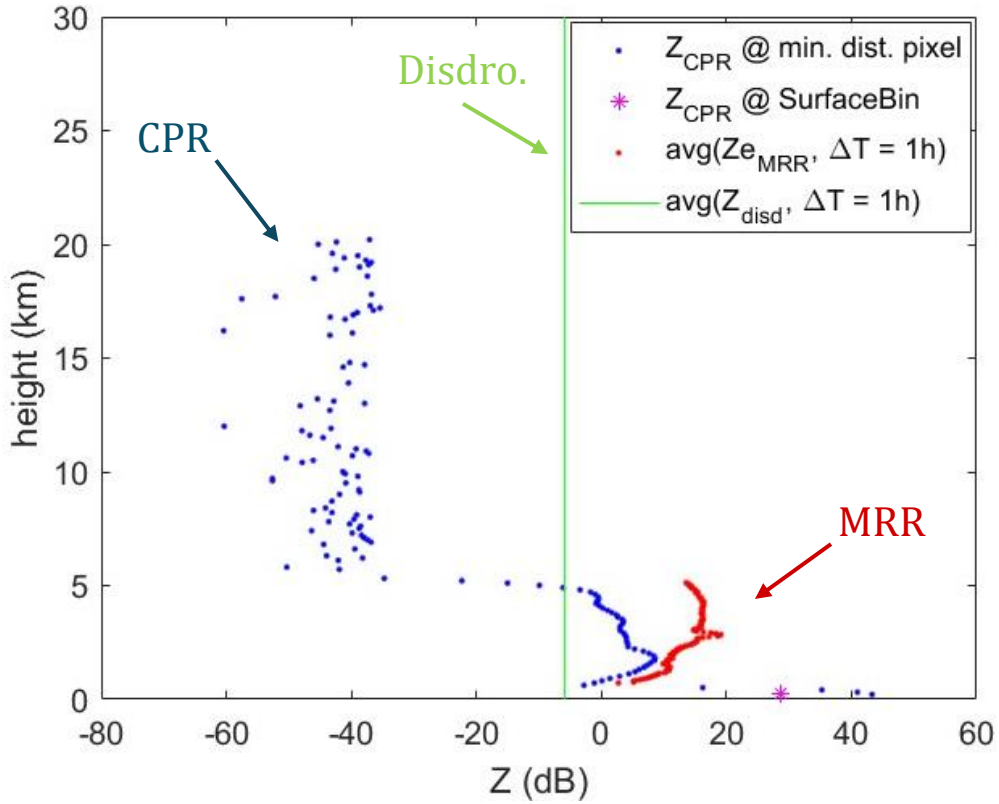
Rome site: overpass of 13/12/2024 13:34
Radar reflectivity factor from EarthCare (CPR L1 product)



CPR L1 reflectivity during the overpass of 13 December



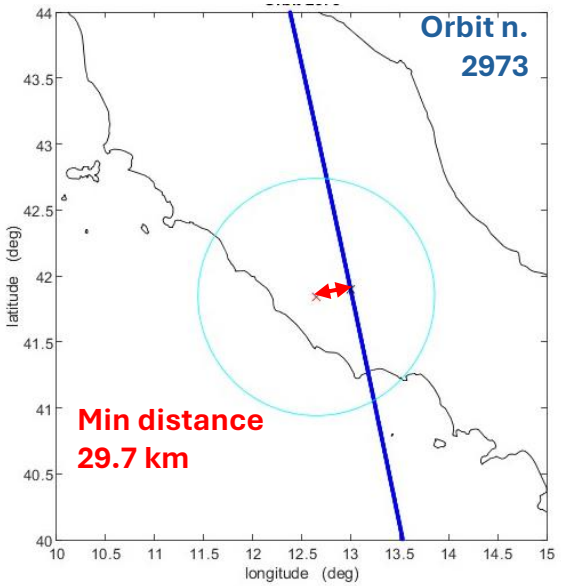
Radar reflectivity factor from Micro Rain Radar (MRR) of Rome. Please note that in these preliminary analyses we consider the MRR data at 24 GHz; we are working on the processing of the data at 94GHz.



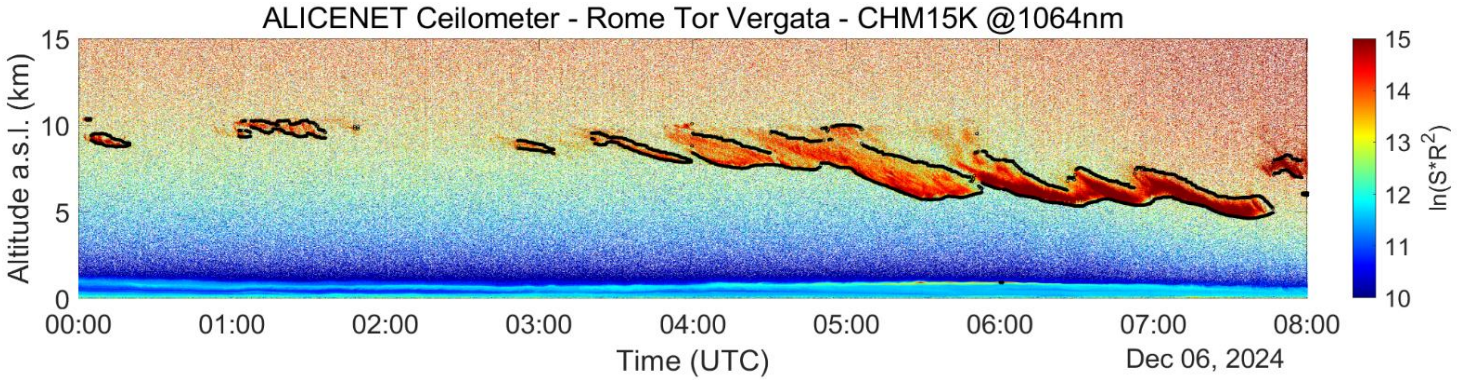
Comparsion of the vertical CPR reflectivity (blue dots) at the minimum distance between Rome site and the EarthCare ground path with 1h mean disdrometer reflectivity@94GHz (green line) and MRR refectivity@24 GHz.

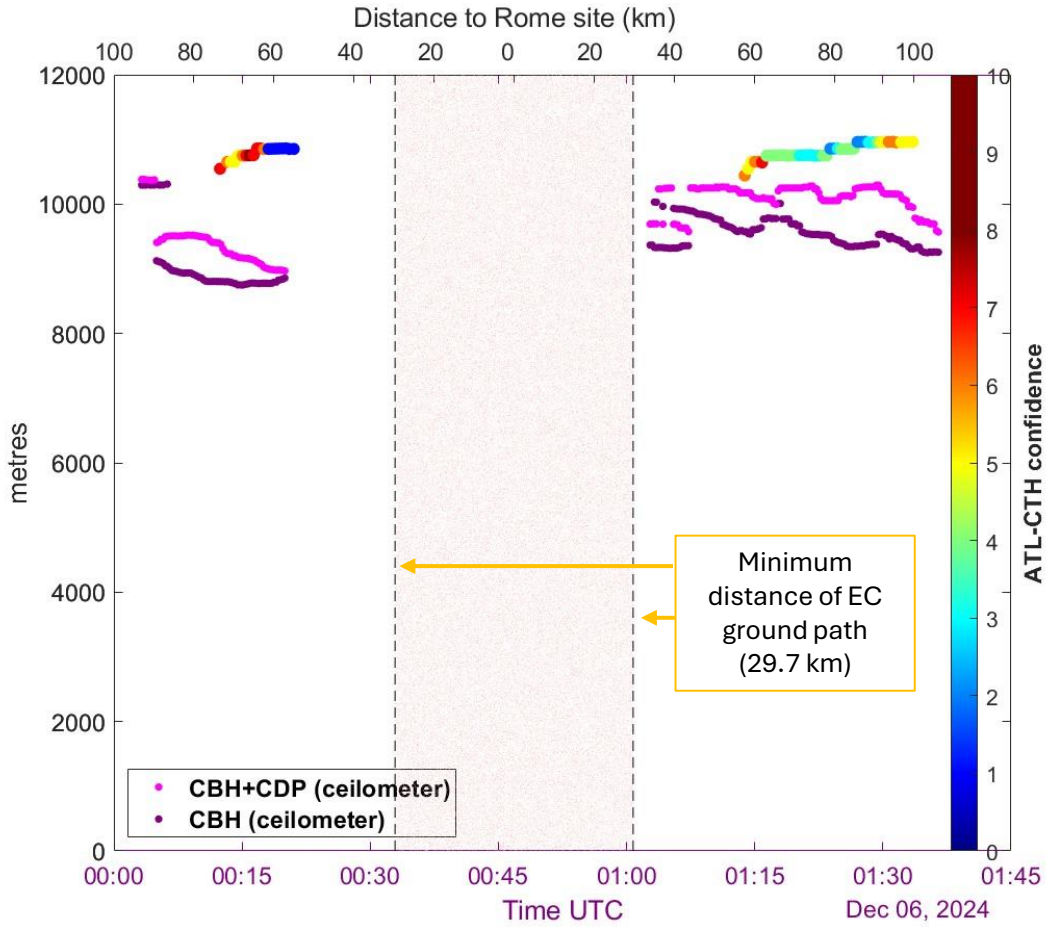
Rome site: overpass of 06/12/2024 00:42

- No precipitation → quantitative comparison is not possible, but no precipitation is confirmed
- Nighttime overpass, not suitable moon → comparison with photometers/sky imager is not possible
- ATL L2 data available → comparison with the sum of Cloud Base Height and Cloud Depth (CBH + CDP) obtained by ceilometer data



*ATL-CTH confidence =
level of confidence for ATLID cloud top height
(0 for no clouds, 1 for lowest and 10 for highest confidence)





Summary

- Validation of the L2 products of different EarthCARE instruments in two sites the Central Mediterranean
- Preliminary comparison based on available ATLID L2 data (A-CTH, A-ICE, A-ALD)
- Single case analysis
- Importance of the spatial-temporal representativeness of data for single case analysis
- MSI L2 data will be useful to define the homogeneity of the observations
- Very good agreement for A-ALD aerosol optical depth

Thank you for your attention!!!

Acknowledgements

Italian Space Agency

ACTRIS Cloud remote sensing data centre unit

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ENEA Team

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CNR Team