First intercomparison between CARO Lidar and ATLID Level 1 over Cyprus, Limassol

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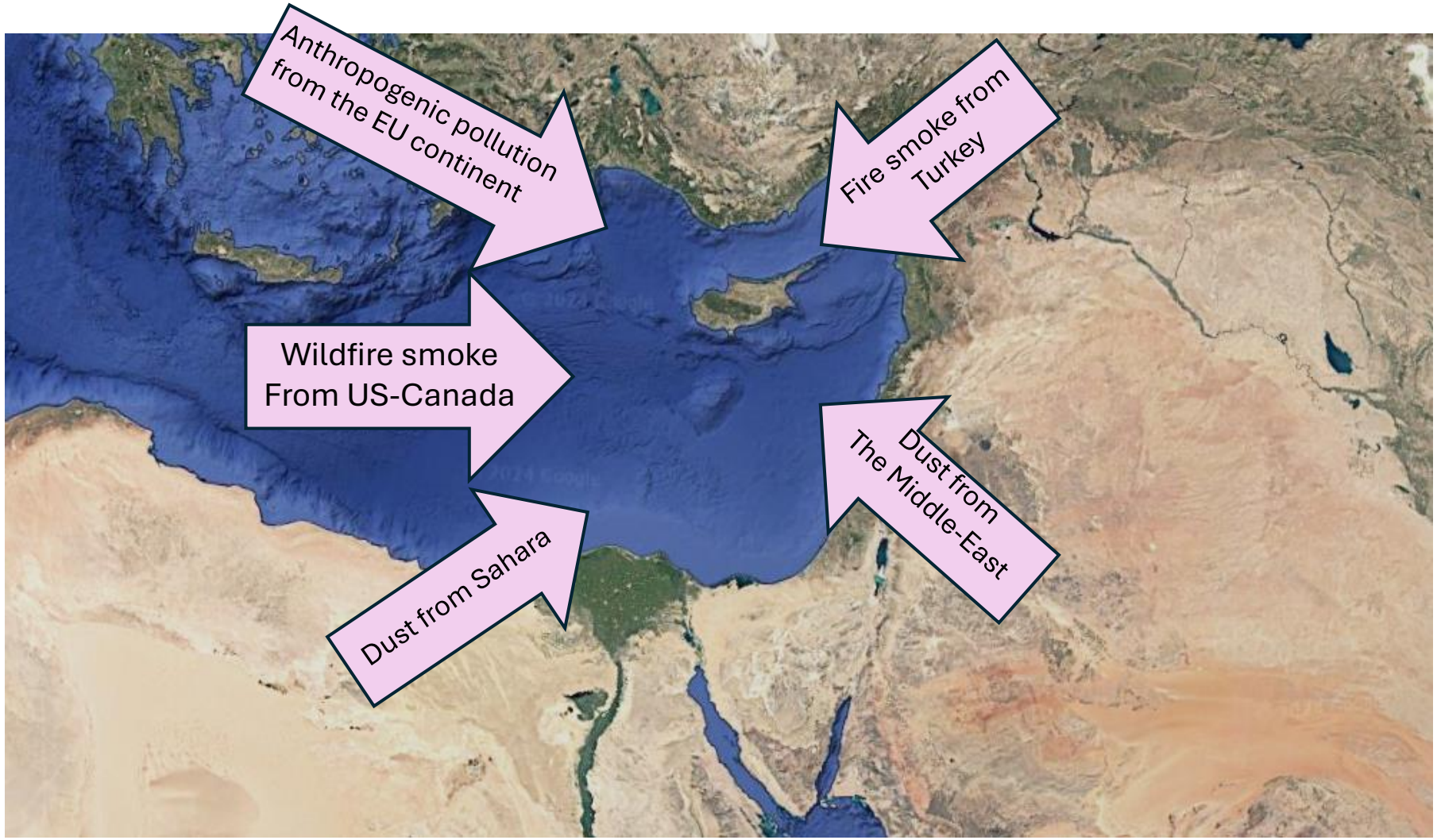
(1) Eratosthenes Centre of Excellenceand and (2) Cyprus University of Technology, Limassol, Cyprus

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



Cyprus is located in a very unique location regarding atmospheric monitoring

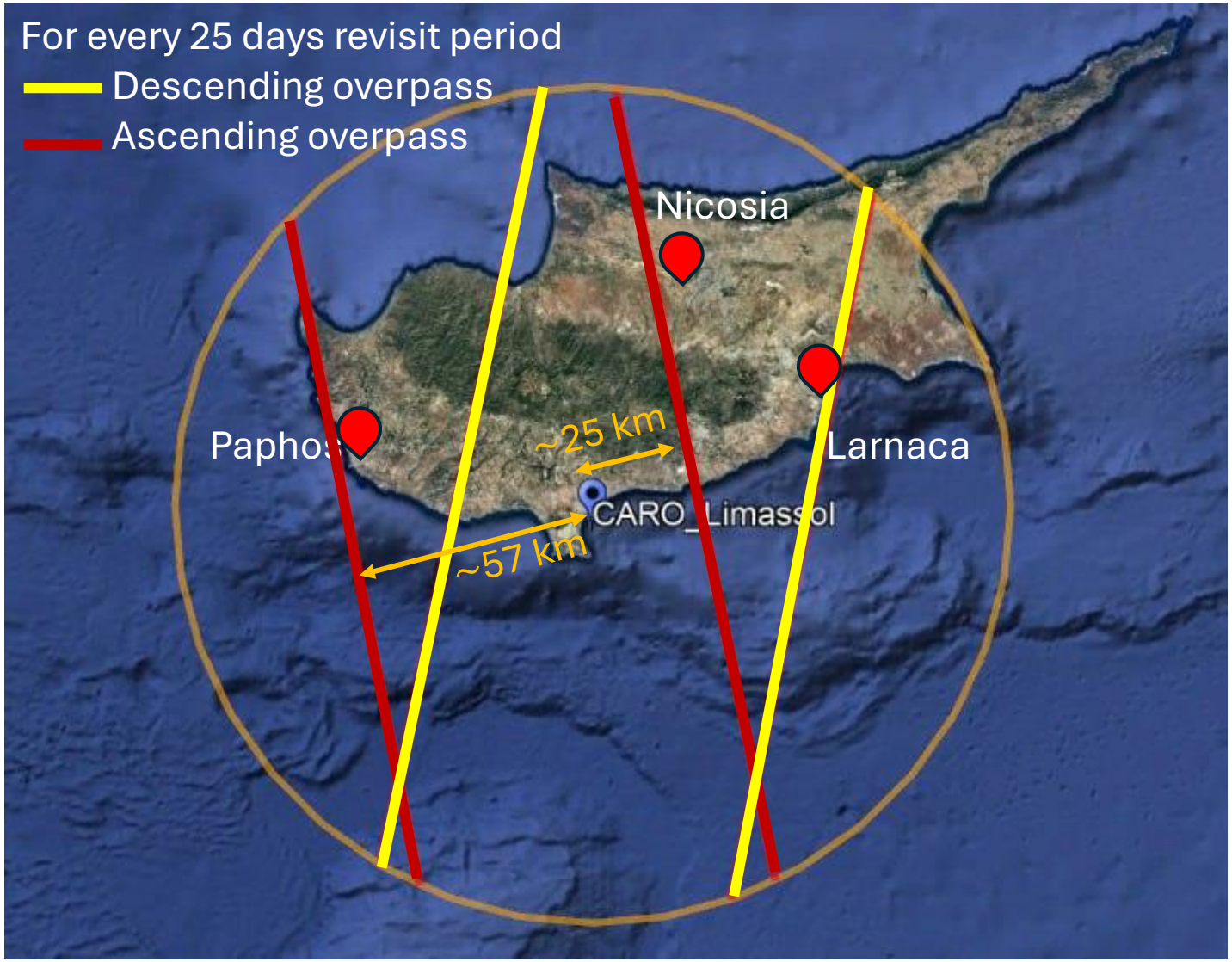
Mamouri, R.-E., et al, Atmos. Chem. Phys., 2023.

Ansmann, A. et al, Atmos. Chem. Phys., 2019.

Mamouri, R.-E., Ansmann, Atmos. Chem. Phys., 2017.

Mamouri, R.-E., Ansmann, Atmos. Chem. Phys., 2016.

Nisantzi, A. et al, Atmos. Chem. Phys., 2015.



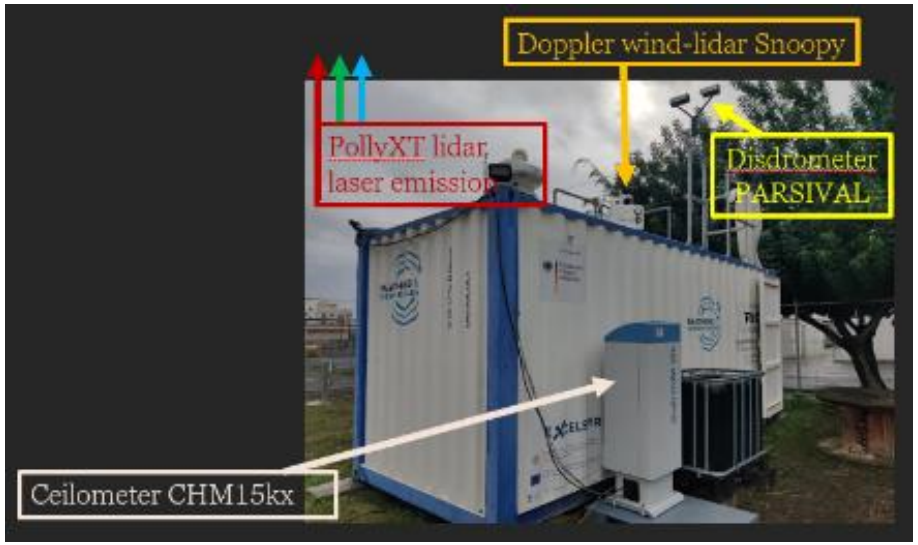
Cyprus participates in the CAL\VAL activities by the EVID39: **CORAL** project.

- There are 3 ground-based stations in Limassol, Nicosia and Ayia Marina/Orounda.
- Nicosia's station operates a cimel depolarization lidar
- Limassol's station is running a pollyXT 24/7 lidar, a MIRA35 Could radar and a solar radiation station as part of ACTRIS/ERLINET/CLOUDNET

ECoE-CARO\CARO_Limassol:
The ERATOSTHENES Centre of Excellence (ECoE) coordinates the Cyprus Atmospheric Remote Sensing Observatory (CARO).

ECoE-CARO is a multi-instrument aerosol-cloud Ground-based observatory

• Active sensors preforming continues measurements in the CARO observatory includes:
A) A multi-wavelength dual field of view Raman polarization Lidar >>Dual-FOV PollyXT
B)A 35-GHz scanning polarimetric cloud Doppler radar >> Mira-35
C)A Streamline-XR Doppler lidar>> Halo Lidar Snoopy
D)A 1064-nm ceilometer >> CHM 15kx
• Passive sensors preforming continues measurements in the CARO observatory includes:
E) A 14-channel microwave radiometer>> HATPRO G5
F) An optical 1-d precipitation disdrometer>> PARSIVEL
G) A CUT-TEPAK AERONET Sun-photometer>> CUT-TEPAK CE318
H) A Radiation station>> Sun-traker STR22G, Pyrgeometer, …



Ref of the Dual-FOV PollyXT:
Jimenez et al., 2020a and 2020b

- Total overpasses from August 2024 for CARO_Limassol: 38

- Night-time (ASC): 21
- Day-time (DESC): 17

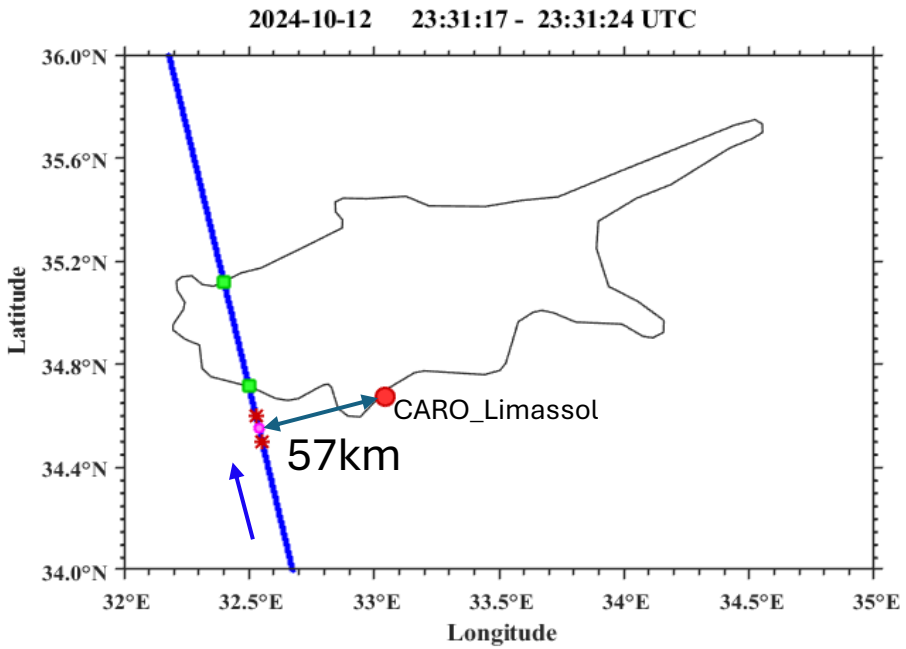
- PollyXT operation: 20
- Cloud radar operation: 25
- Ceilometer operation: 38

					INSTRUMENT AVAILABILITY		
					Aerosol		Cloud
PA	DATE	DISTANCE_TO_MID_SWATH	ASCENDING/DESCENDING PA	UTC_TIME_START	PollyXT	Ceilometer	MIRA 35
1	2025-01-07	51.188308	DESC	T12:03:39.491724	☑	☑	☐
2	2025-01-04	25.168217	ASC	T23:26:05.769968	☑	☑	☐
3	2024-12-29	31.947926	DESC	T12:07:28.417129	☑	☑	☐
4	2024-12-26	57.977407	ASC	T23:29:58.029417	☑	☑	☐
5	2024-12-13	51.188325	DESC	T12:04:08.241349	☑	☑	☐
6	2024-12-10	25.168183	ASC	T23:26:34.519587	☑	☑	☐
7	2024-12-04	31.947909	DESC	T12:07:57.166740	☑	☑	☐
8	2024-12-01	57.97744	ASC	T23:30:26.779035	☑	☑	☐
9	2024-11-18	51.188428	DESC	T12:04:36.990949	☑	☑	☐
10	2024-11-15	25.168095	ASC	T23:27:03.269192	☑	☑	☐
11	2024-11-09	32.234191	DESC	T12:08:22.806013	☑	☑	☐
12	2024-11-06	57.692418	ASC	T23:30:52.762151	☑	☑	☐
13	2024-10-24	50.903332	DESC	T12:05:04.998022	☑	☑	☑
14	2024-10-21	25.454125	ASC	T23:27:31.690140	☑	☑	☑
15	2024-10-15	32.234008	DESC	T12:08:55.305474	☑	☑	☑
16	2024-10-12	57.692568	ASC	T23:31:25.261663	☑	☑	☑
17	2024-10-06	31.852081	DESC	T12:09:15.412446	☑	☑	☑
18	2024-10-03	58.072862	ASC	T23:31:44.910254	☑	☑	☑
19	2024-09-29	50.903358	DESC	T12:05:37.497513	☑	☑	☑
20	2024-09-26	25.454087	ASC	T23:28:04.189640	☑	☑	☑
21	2024-09-20	38.265223	DESC	T12:09:43.860276	☐	☑	☑
22	2024-09-17	25.072412	ASC	T23:28:21.016135	☐	☑	☑
23	2024-09-11	42.930503	DESC	T12:10:13.171896	☐	☑	☐
24	2024-09-08	74.788961	ASC	T23:33:00.626293	☐	☑	☑
25	2024-09-04	51.005026	DESC	T12:06:11.190332	☐	☑	☑
26	2024-09-01	74.413799	ASC	T23:26:34.445434	☐	☑	☑
27	2024-08-26	1.258111	DESC	T12:08:34.166997	☐	☑	☑
28	2024-08-25	6.511388	ASC	T23:29:37.044277	☐	☑	☑
29	2024-08-23	16.207973	ASC	T23:30:40.684001	☐	☑	☑

Notice

The best comparison case should include Cirrus, dust and any types of the high depol. targets

Orbit track number: 2132, Orbit Frame: B, Baseline: AC
DISTANCE_TO_MID_SWATH: 57 km
DURATION of satellite overpass: 22s



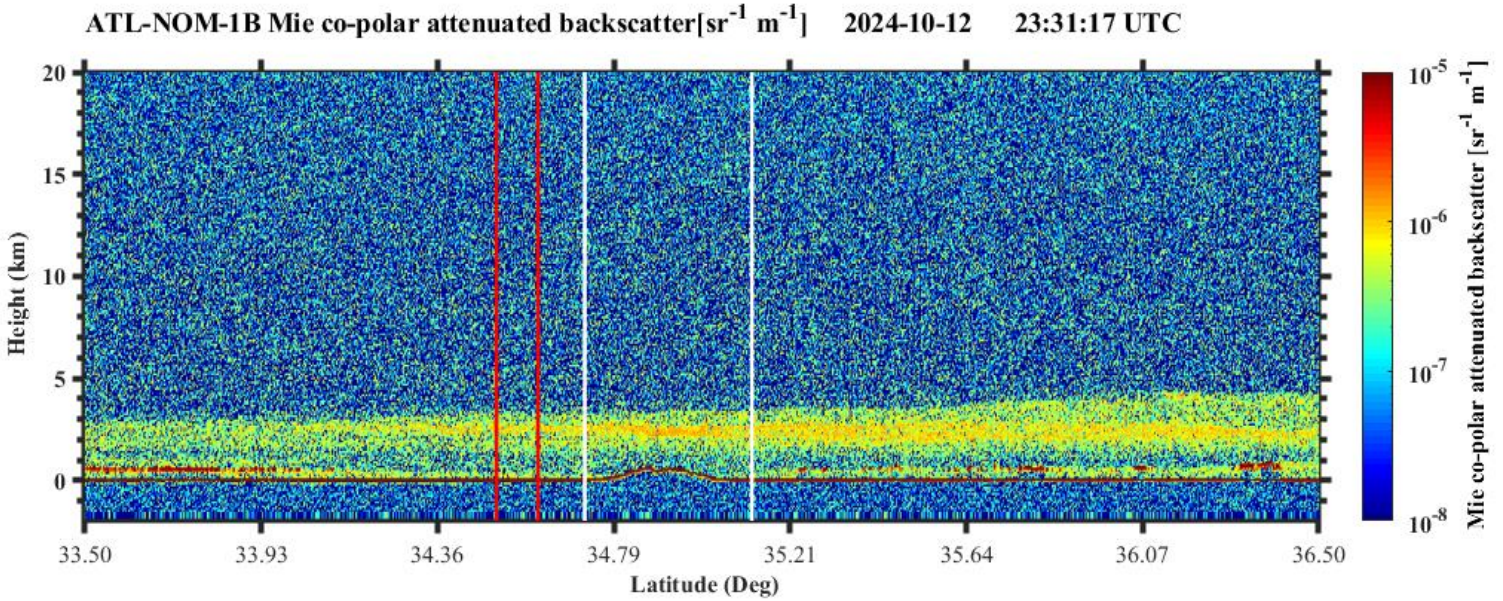
Satellite ground track

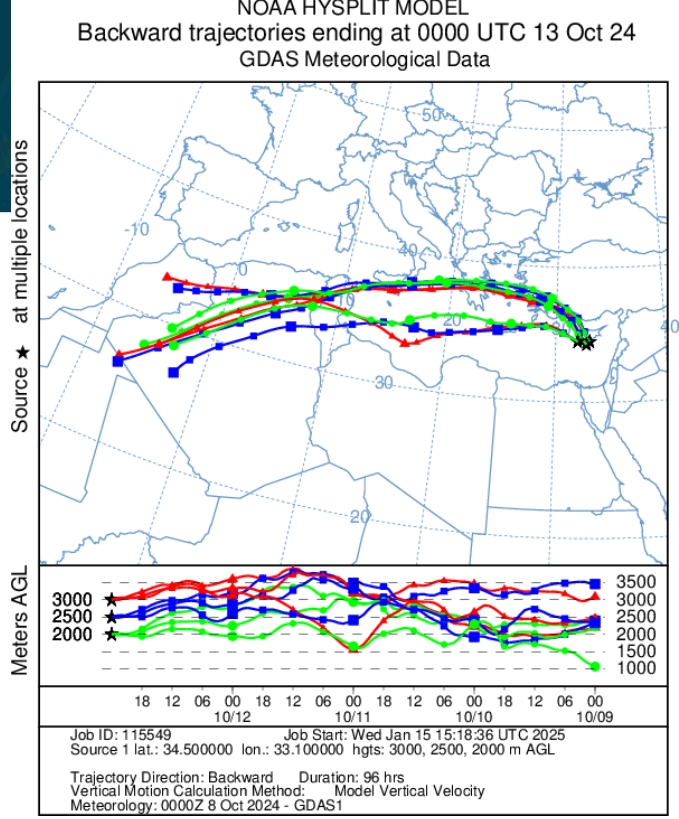
Limassol ground based PoolyXT station

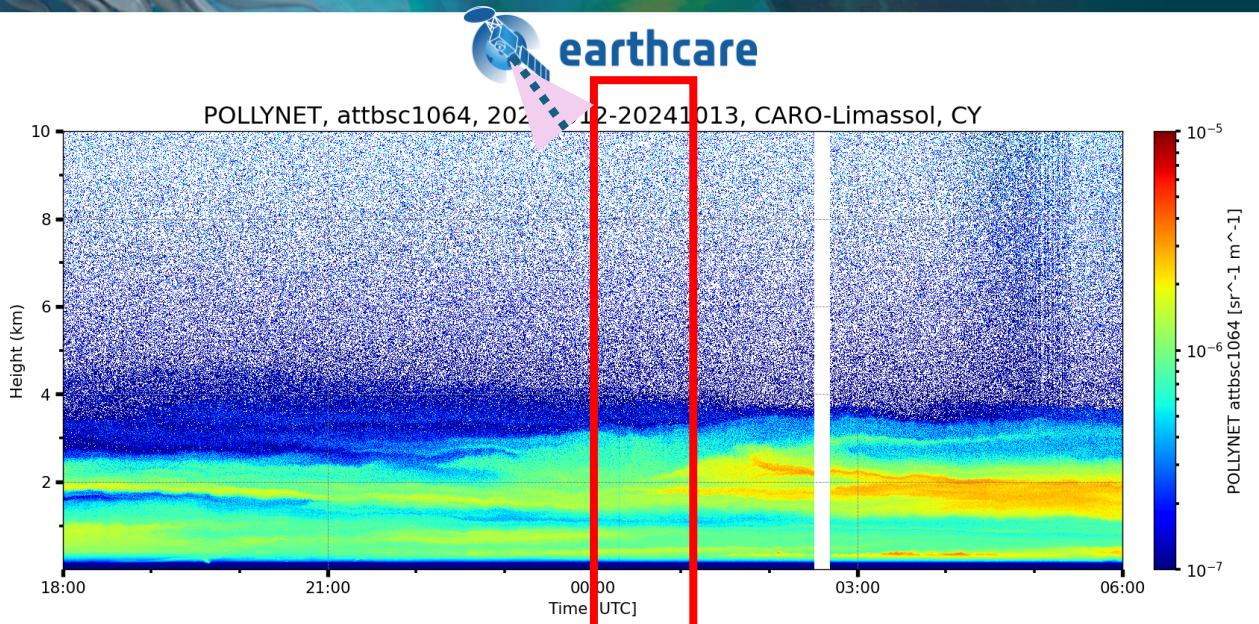
The location where satellite enter the land of Cyprus corresponding with white line in the EarthCARE's Quick look

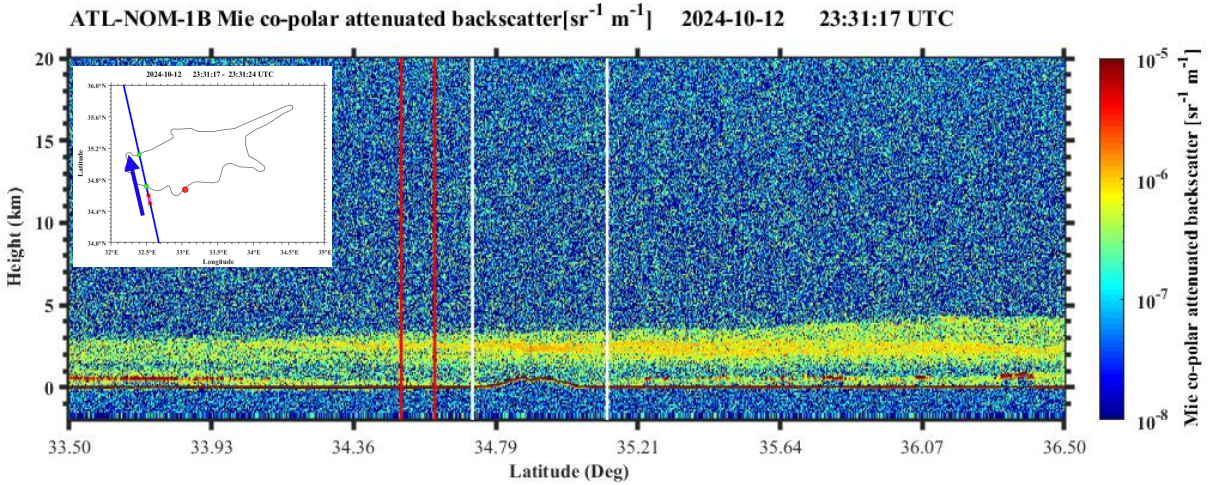
The location of the closest satellite single shot on the ground track to the Limassol ground based PollyXT station

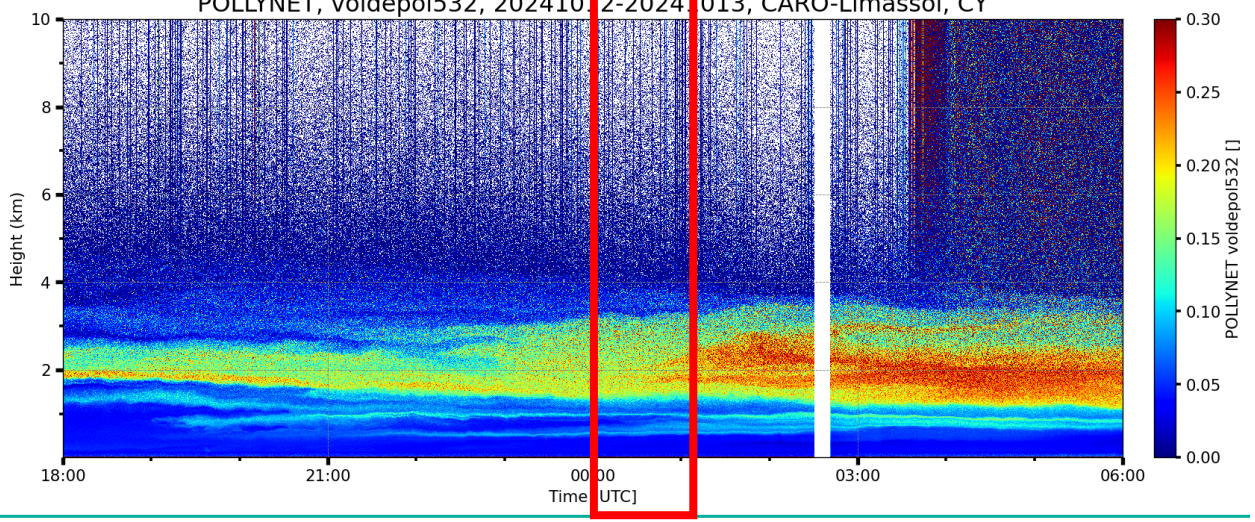
The integration region corresponding with red lines in the EarthCARE's Quick look







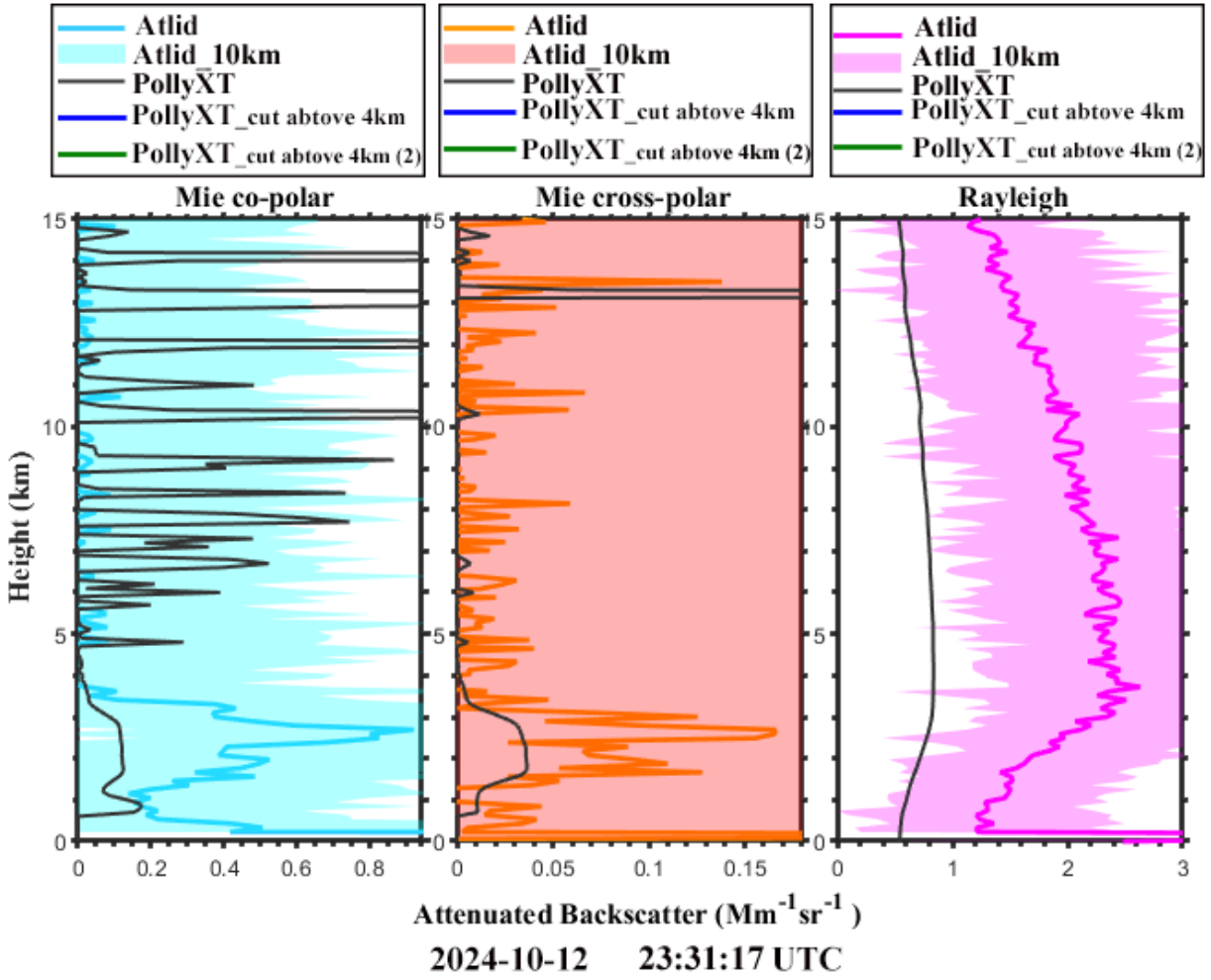




Orbit track number: 2132, Orbit Frame: B, Baseline:AC

Notice

It is necessary to use CARDINAL Campaign Tools (CCT) ATLID simulator.



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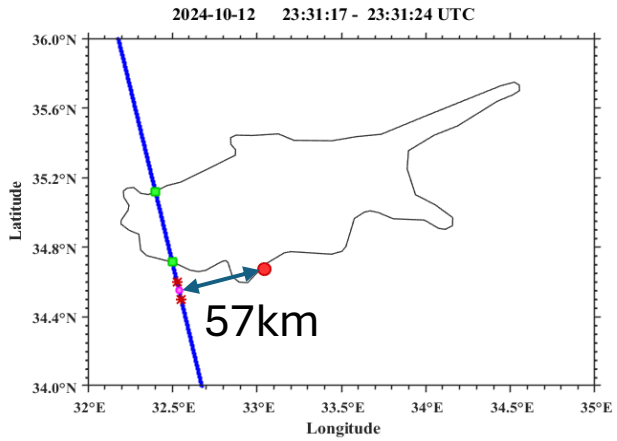

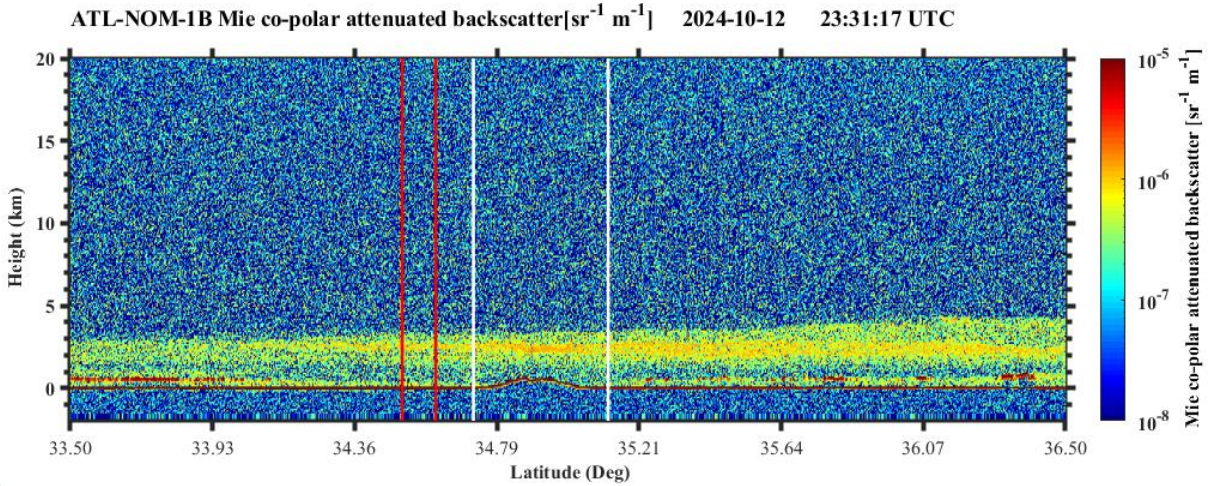

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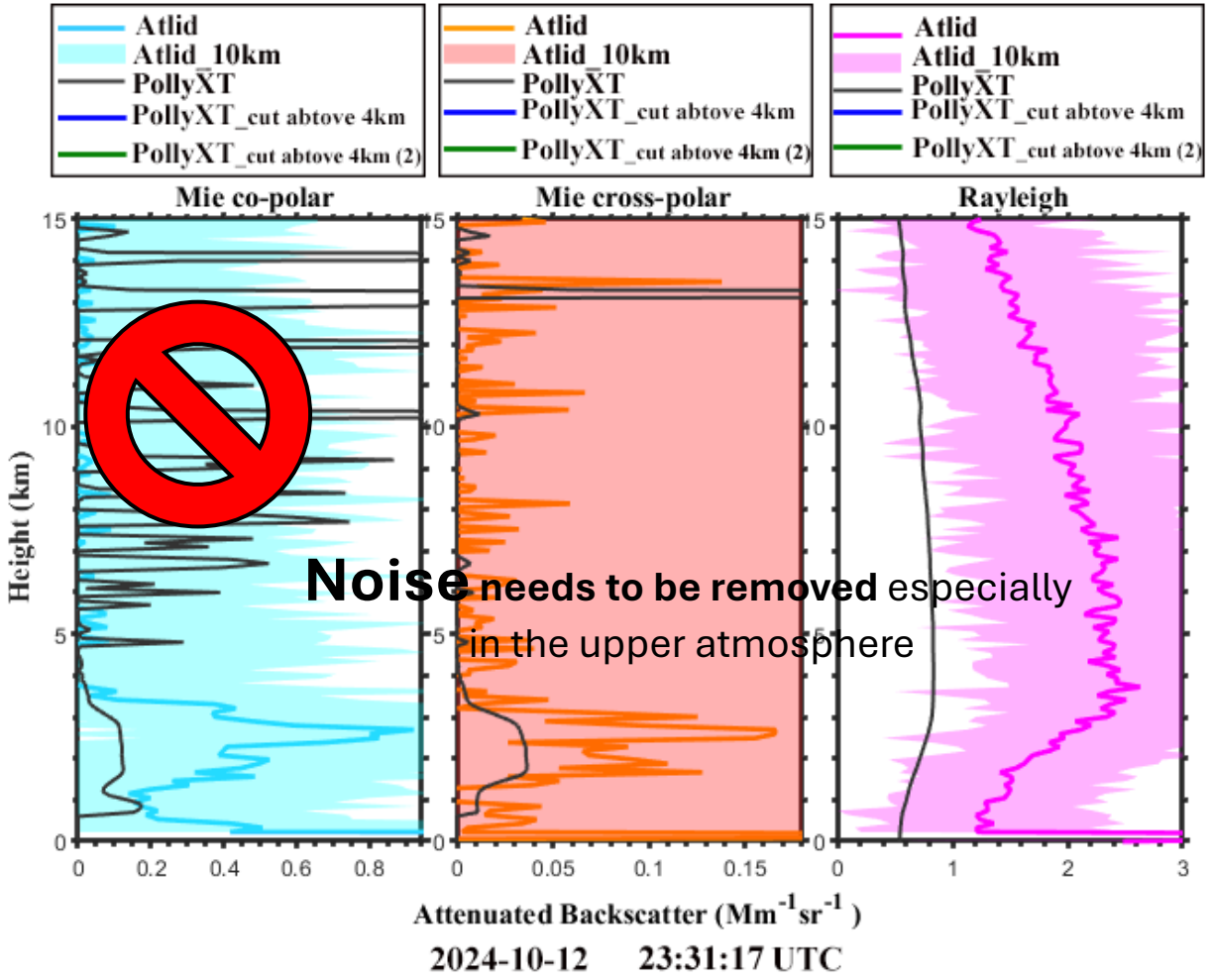

Noise needs to be removed especially in the upper atmosphere

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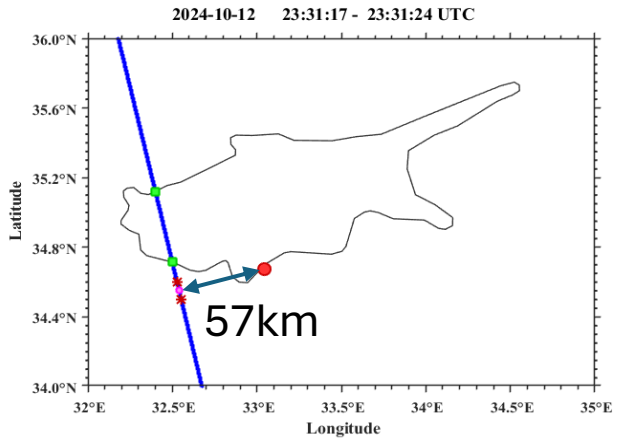

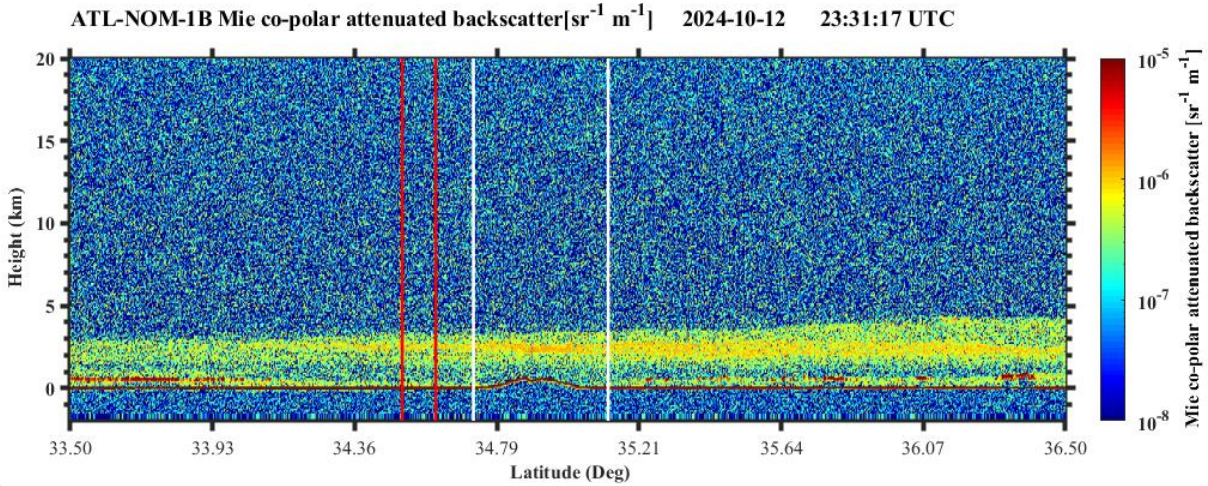

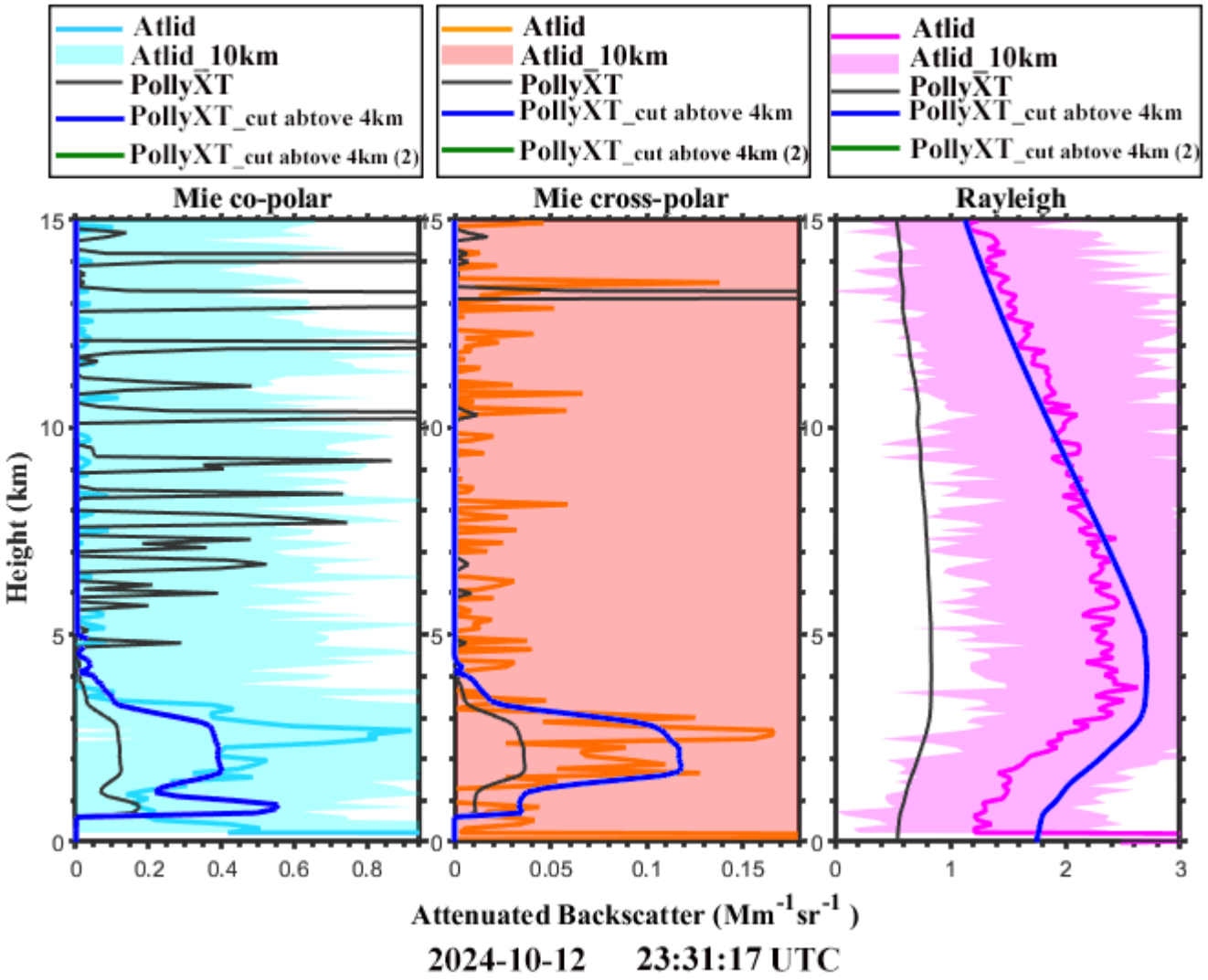

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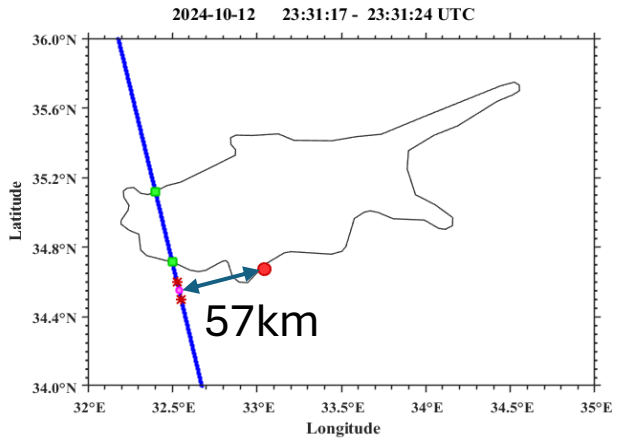

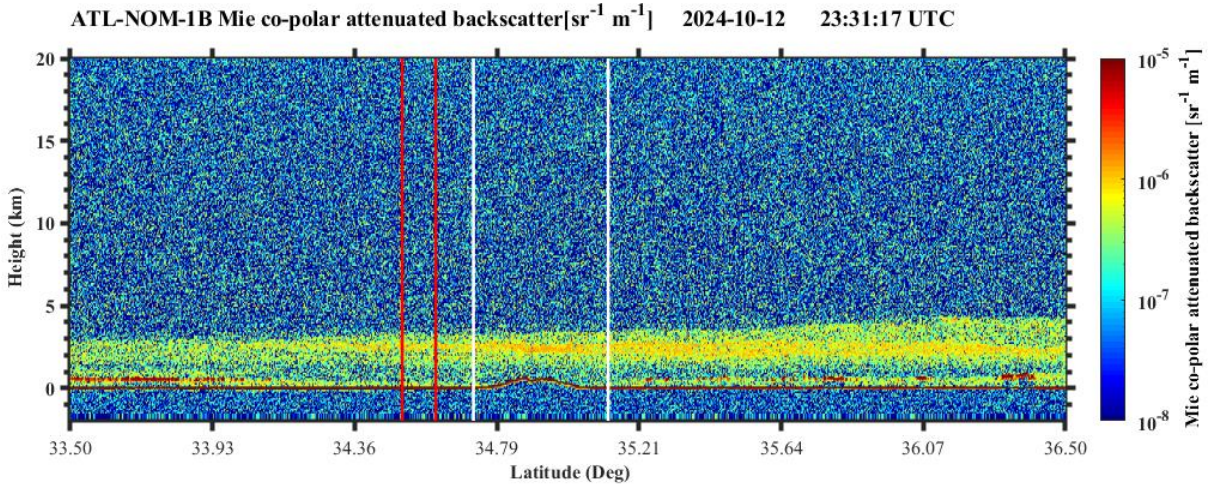

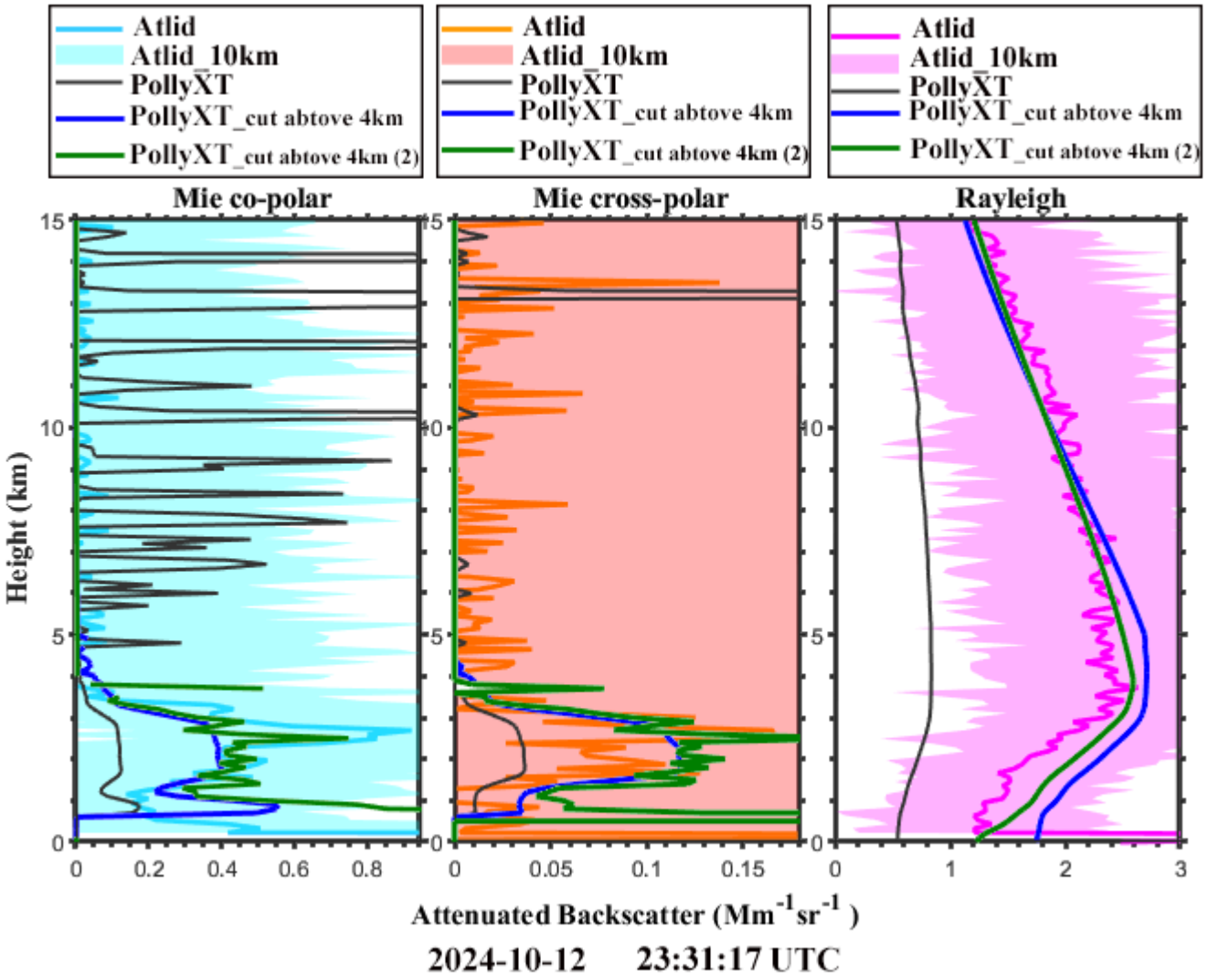

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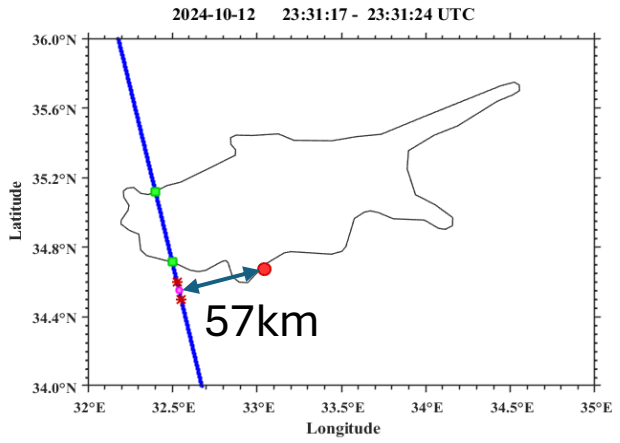
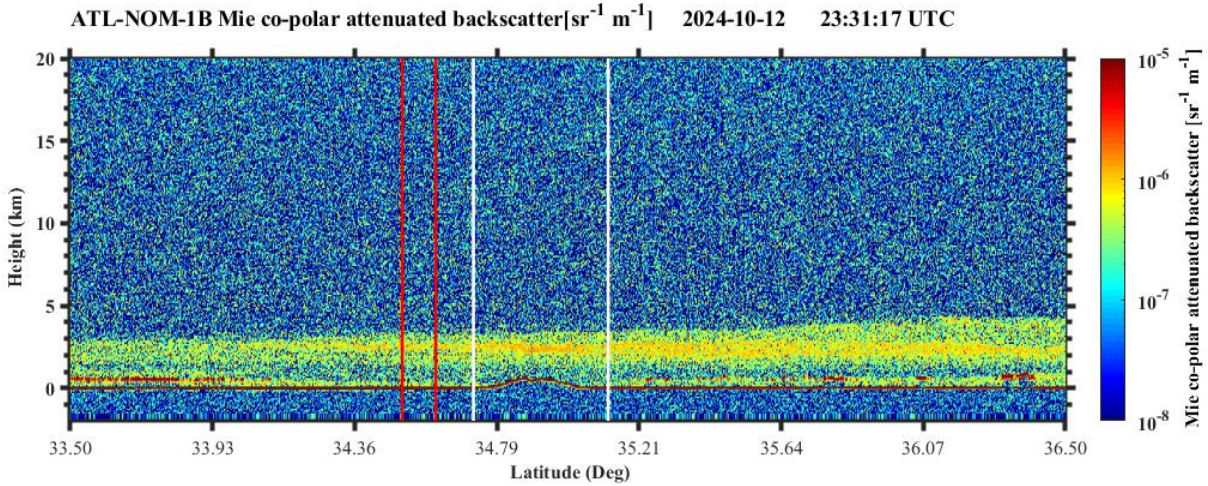
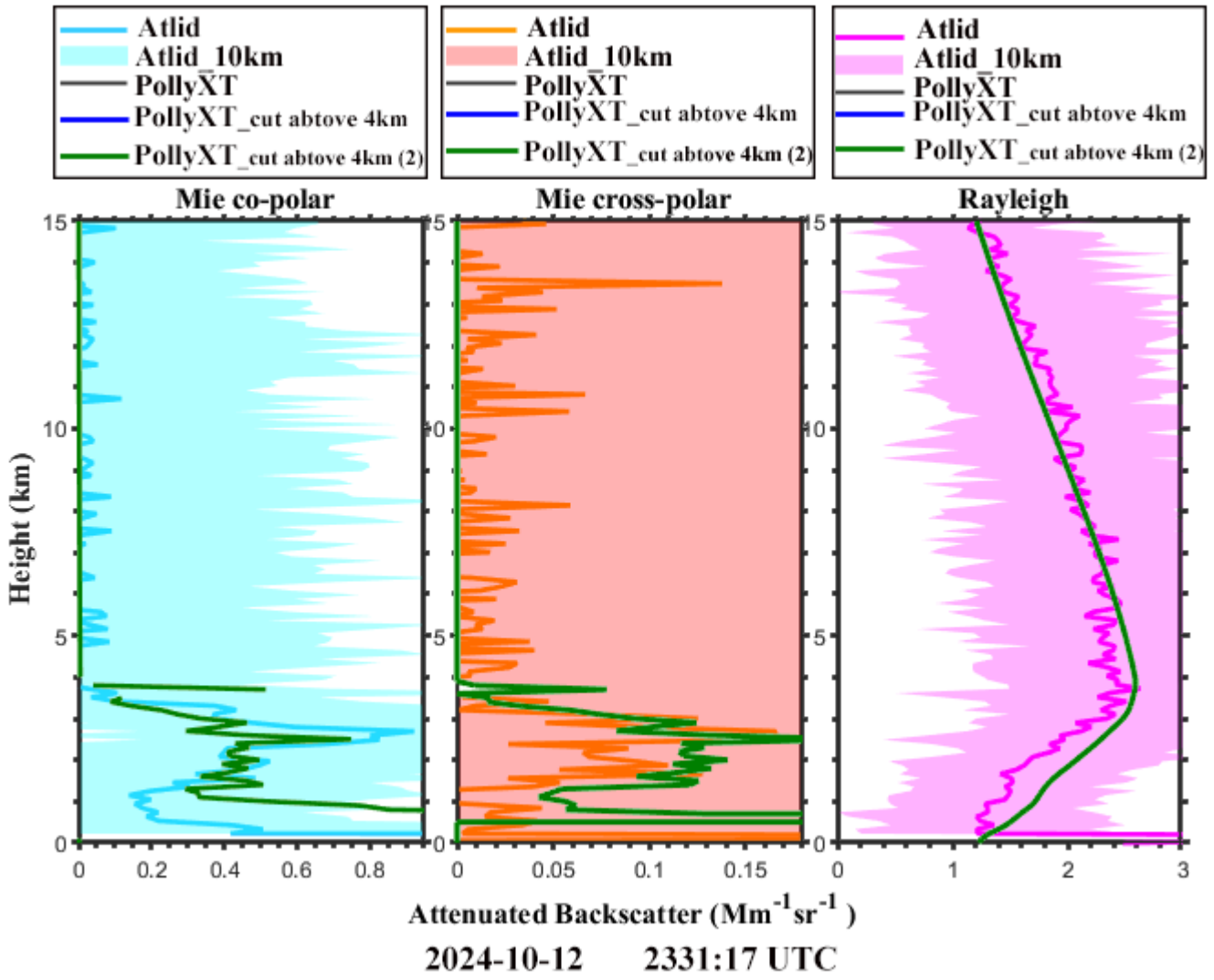




PollyXT_cut above 4km (2) means before using the CCT simulator we change threshold in denoising the PollyXT signal



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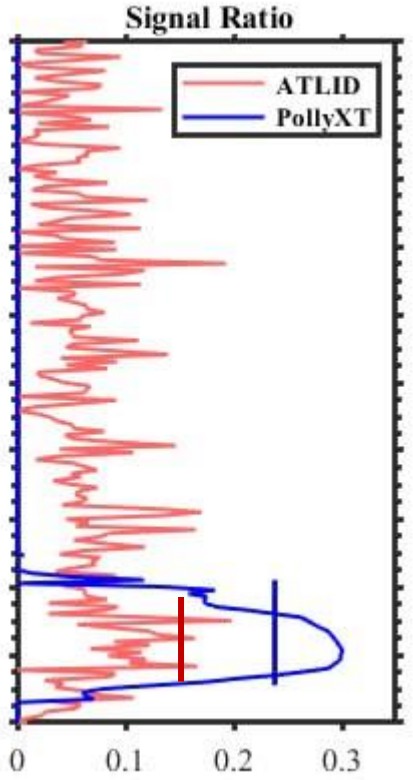
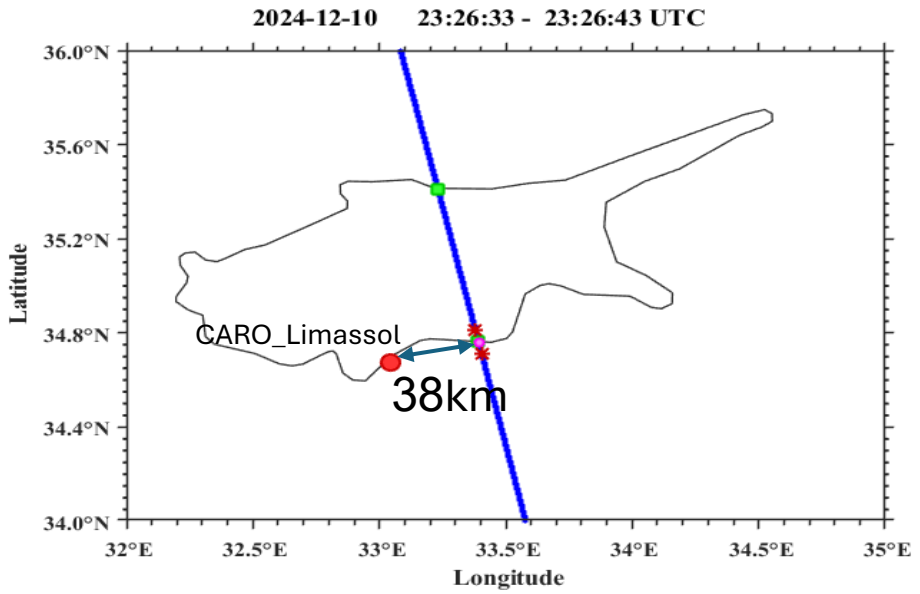


$SR_{avg} \sim 0.16$

$\delta_{avg} \sim 0.24$

Orbit track number: 3050, Orbit Frame: B, Baseline:AC
DISTANCE_TO_MID_SWATH: 37.9 km
DURATION of satellite overpass: 22s



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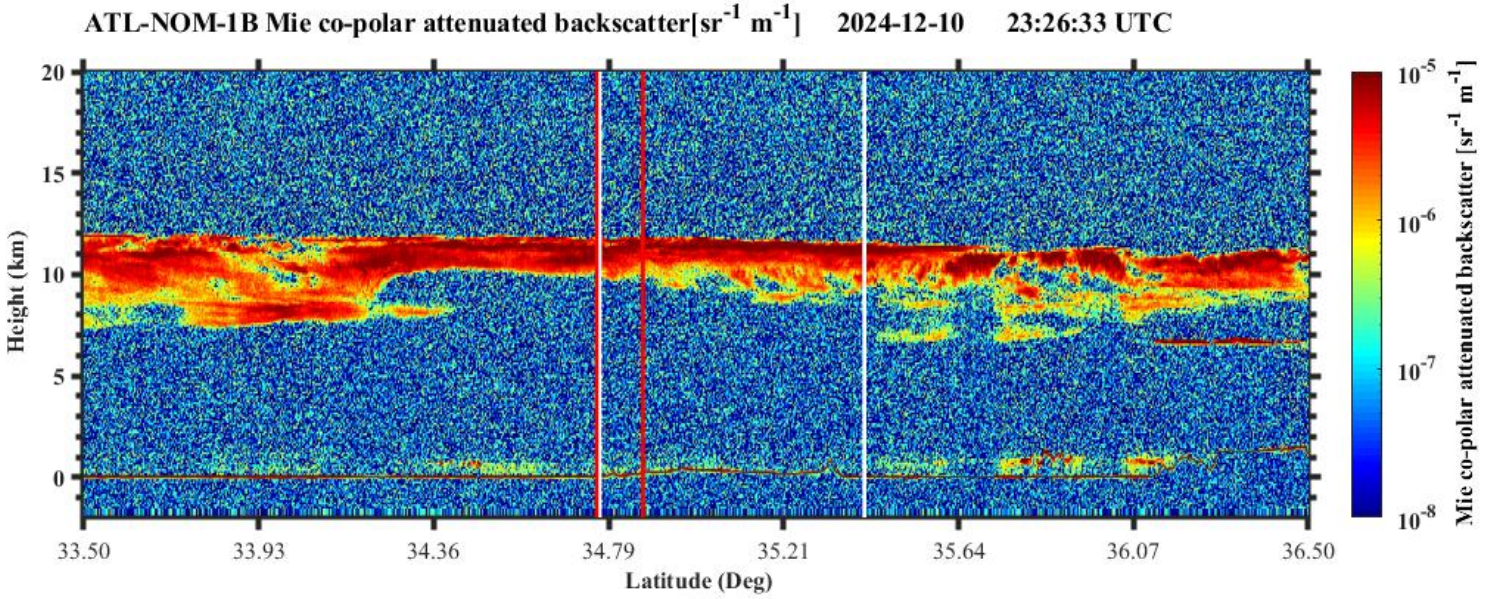
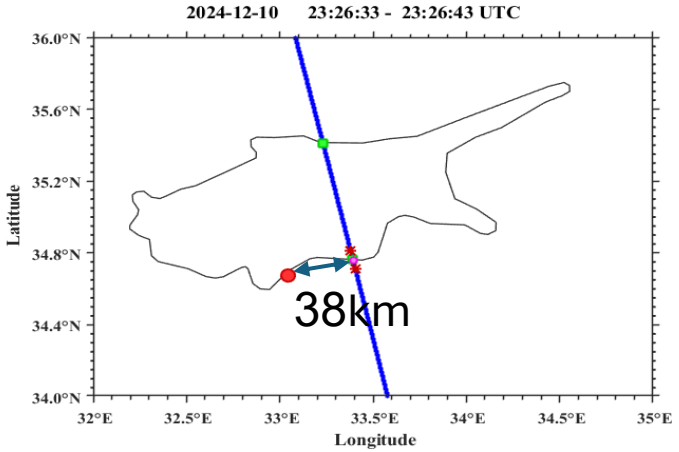
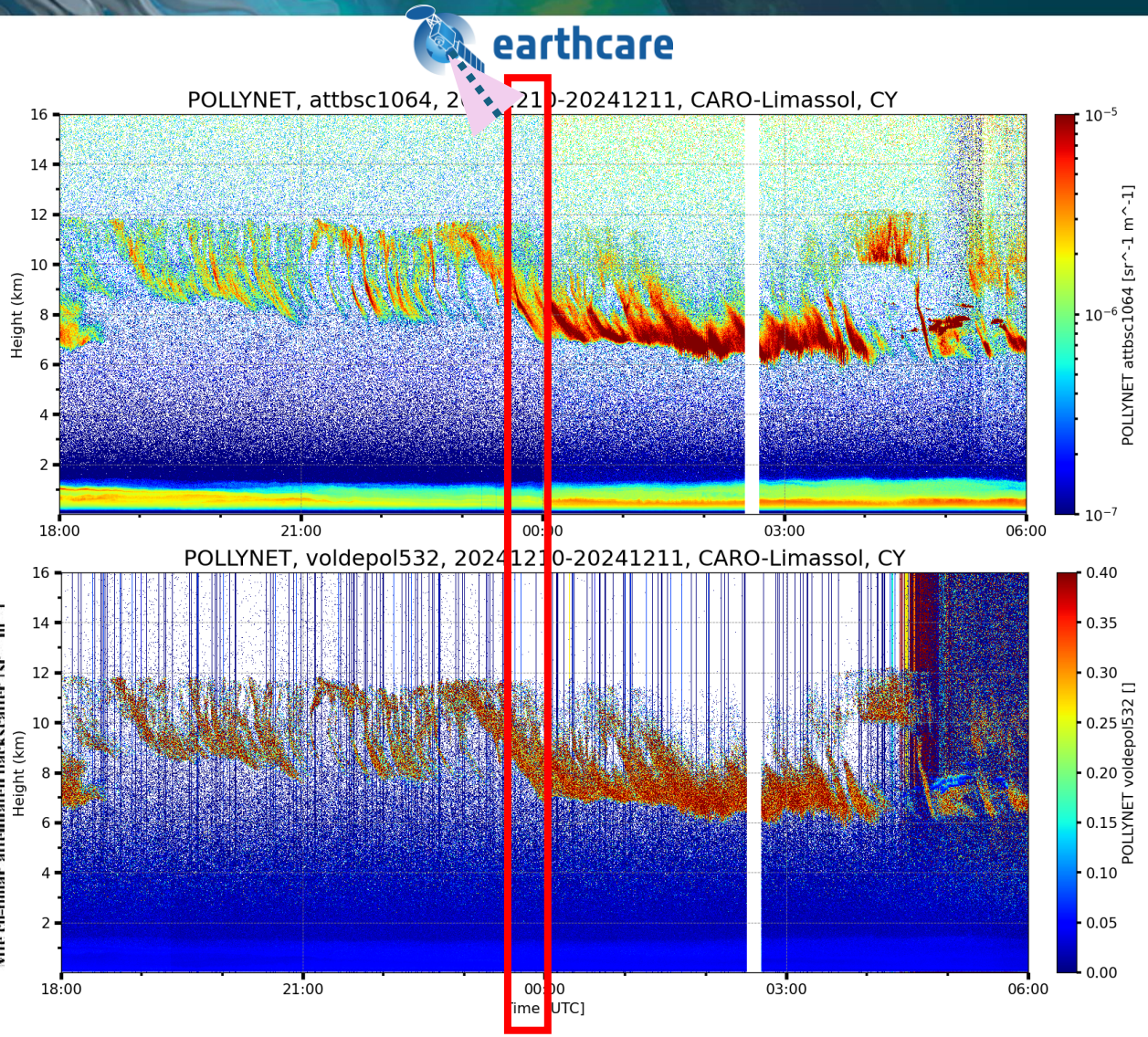
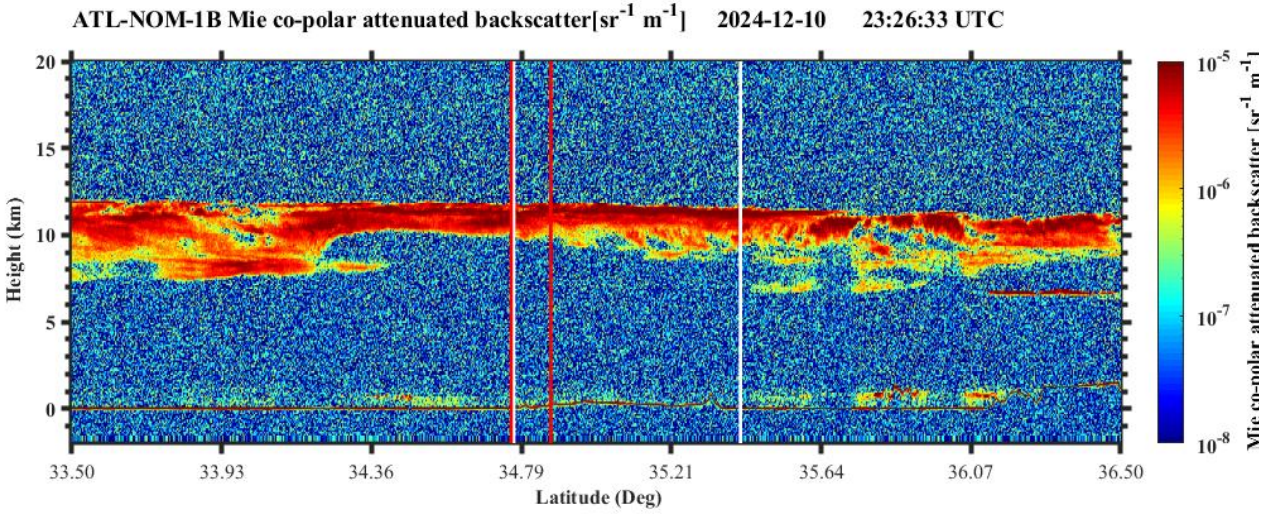
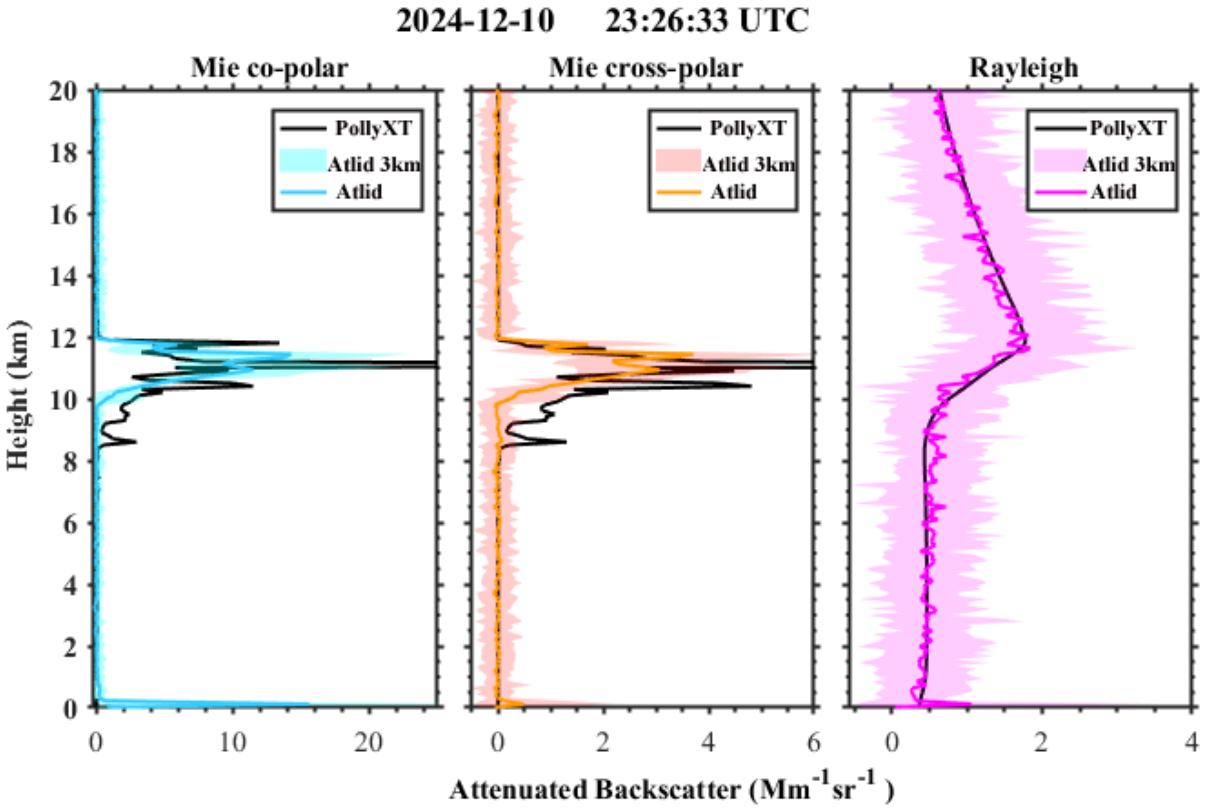


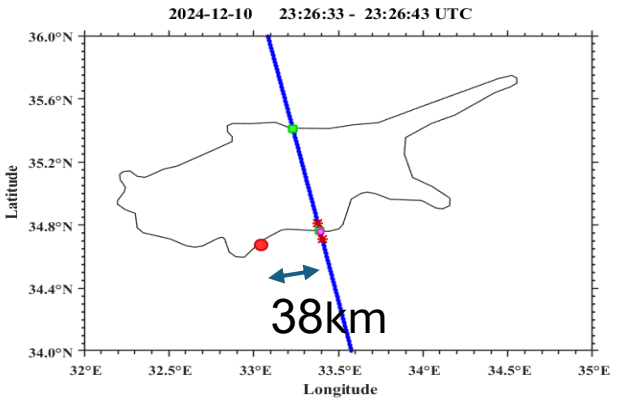

2024-12-10 23:26:33 - 23:26:43 UTC
36.0°N
35.6°N
35.2°N
34.8°N
34.4°N
34.0°N
Latitude
32°E
32.5°E
33°E
33.5°E
34°E
34.5°E
35°E
Longitude
38km

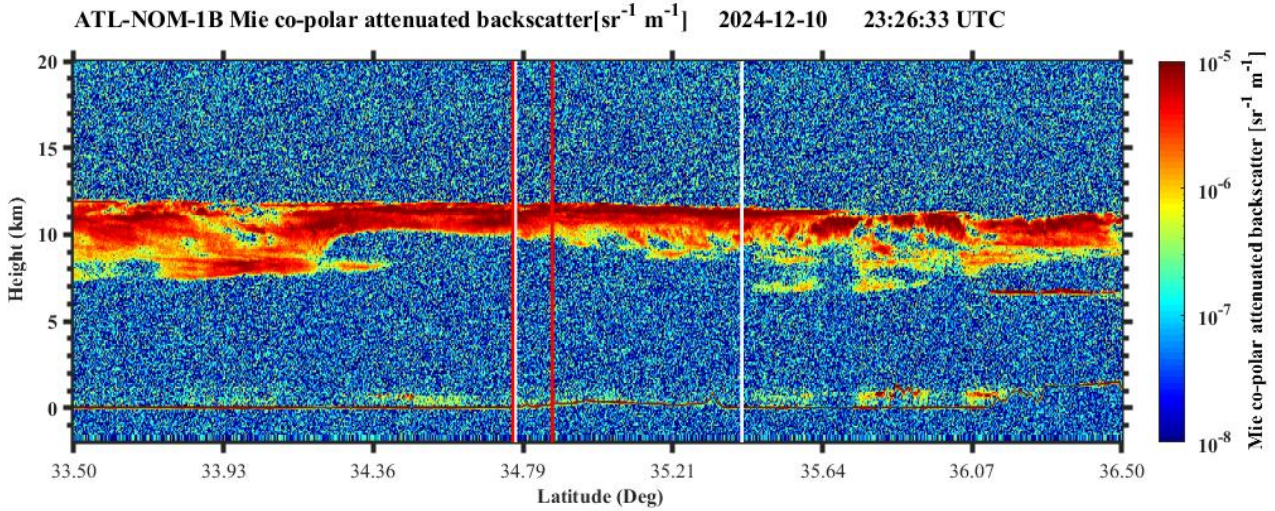

POLLYNET, attbsc1064, 2[illegible]-20241211, CARO-Limassol, CY
Height (km)
18:00
21:00
03:00
06:00
POLLYNET attbsc1064 [sr^-1 m^-1]
POLLYNET, voldepol532, 2024121[illegible]-20241211, CARO-Limassol, CY
Height (km)
Time [UTC]
POLLYNET voldepol532 []

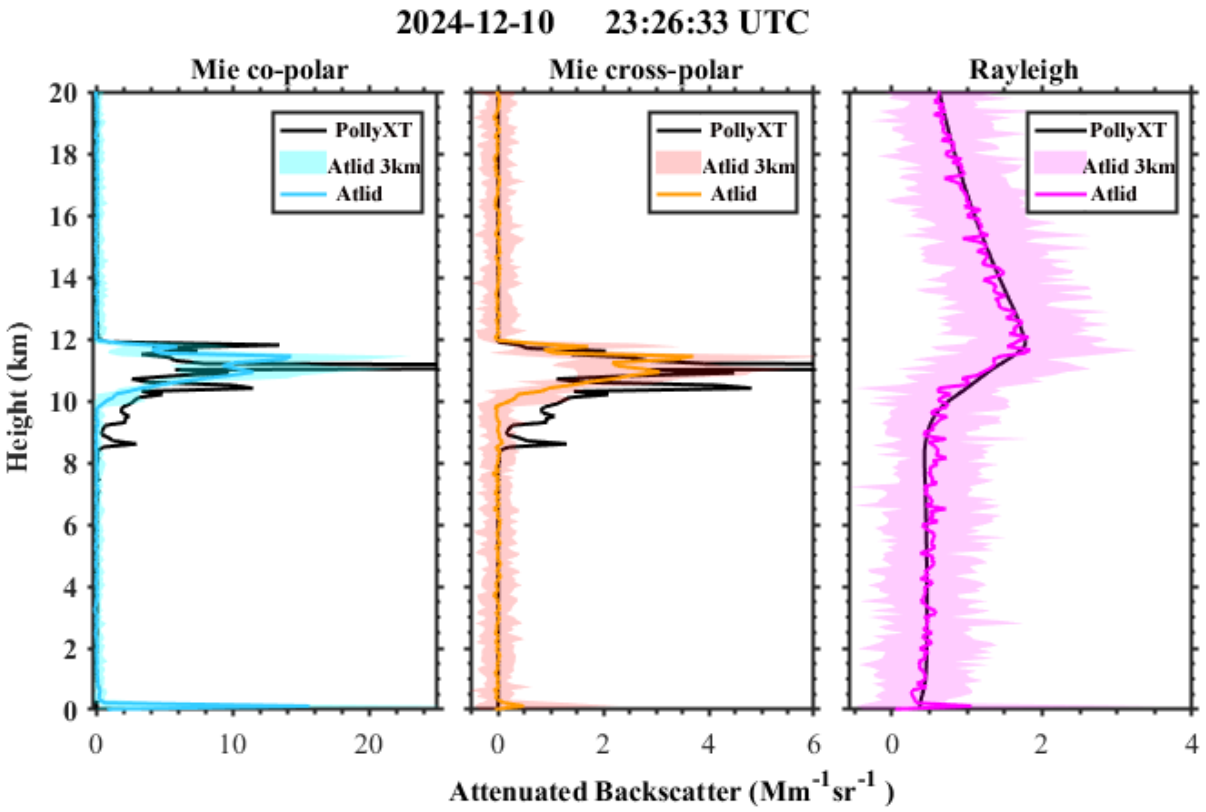

ATL-NOM-1B Mie co-polar attenuated backscatter[sr^{-1} m^{-1}] 2024-12-10 23:26:33 UTC
Height (km)
33.50
33.93
34.36
34.79
35.21
35.64
36.07
36.50
Latitude (Deg)
Mie co-polar attenuated backscatter [sr^{-1} m^{-1}]



Orbit track number: 3050, Orbit Frame: B, Baseline:AC
DISTANCE TO MID SWATH: 37.9 km







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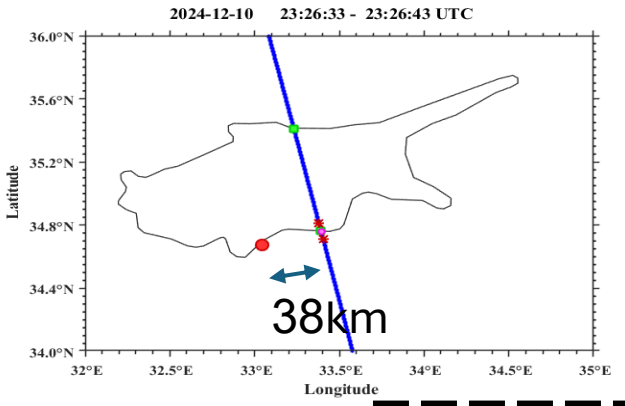
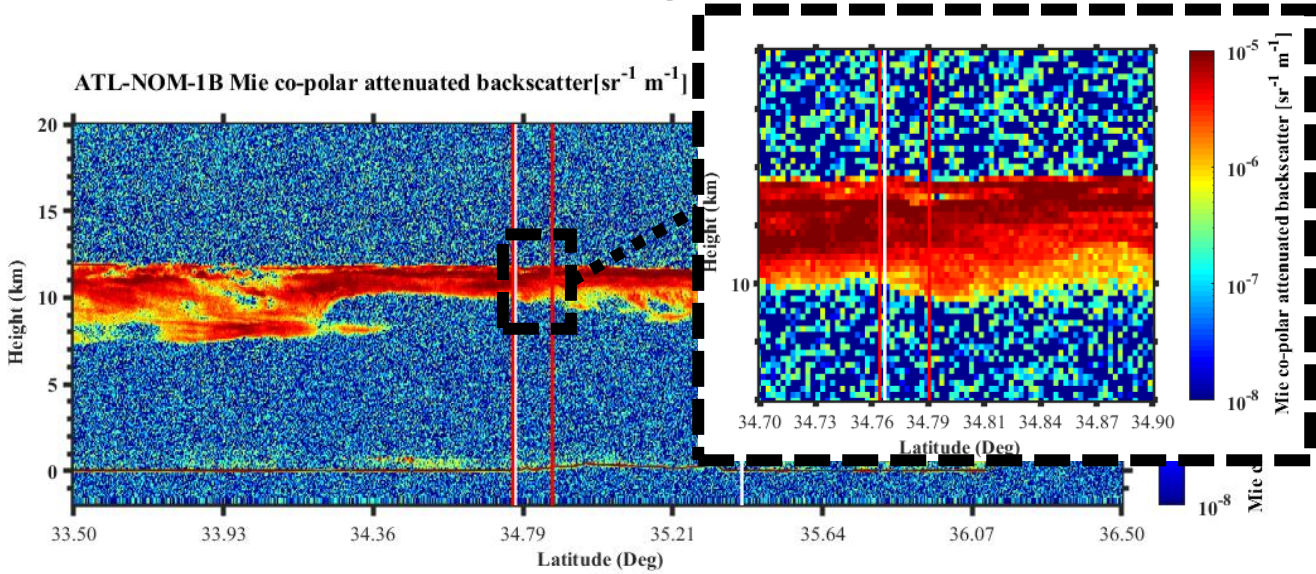
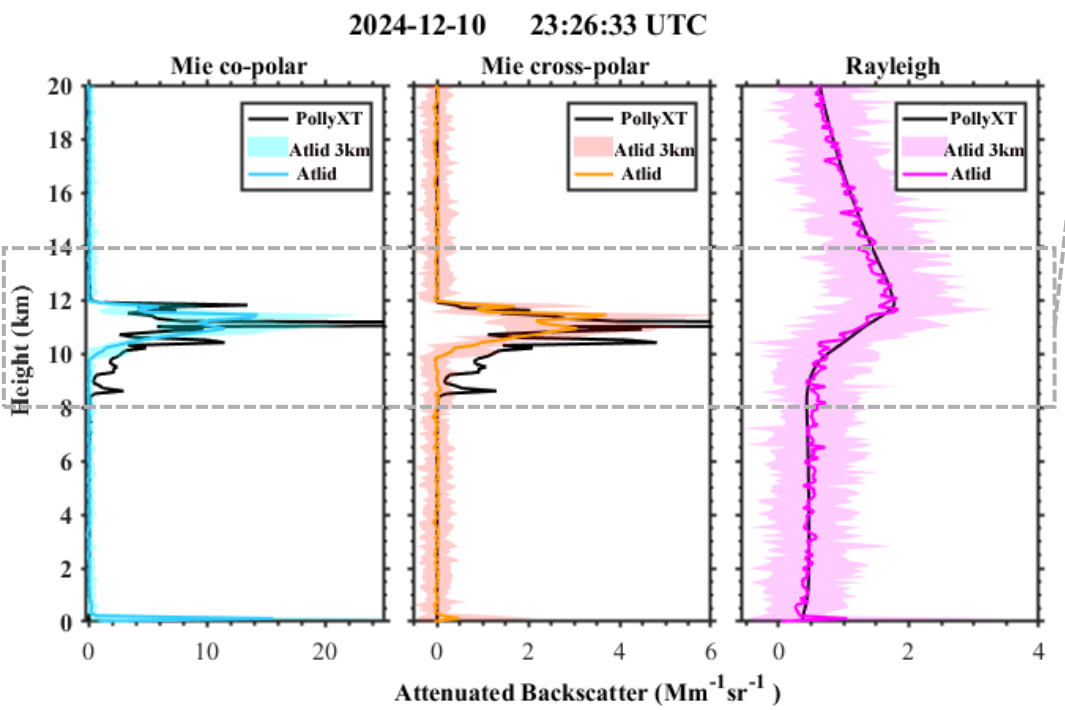
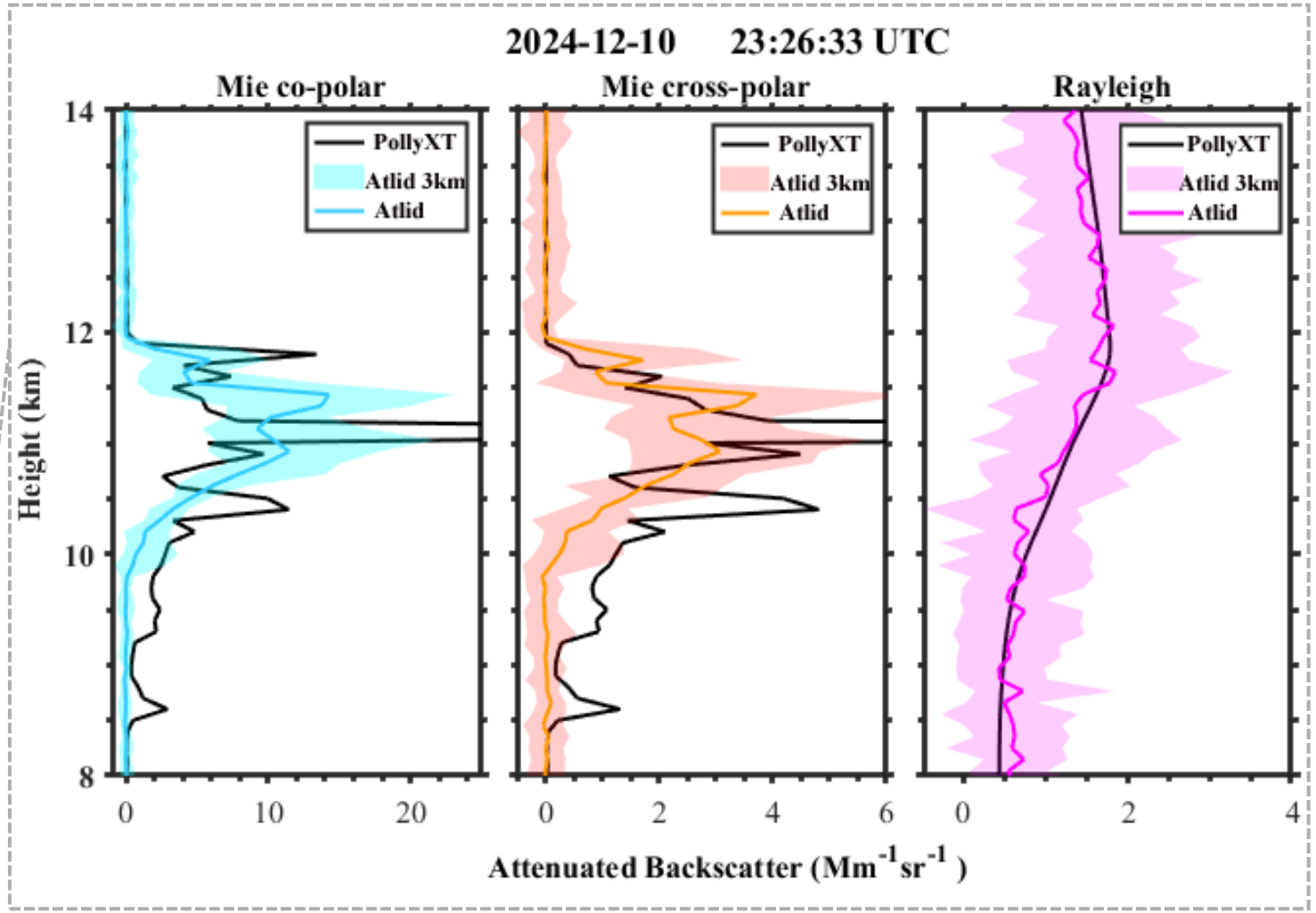





2024-12-10 23:26:33 UTC
Mie co-polar
Mie cross-polar
Rayleigh
PollyXT
Atlid 3km
Atlid
Height (km)
Attenuated Backscatter (Mm-1sr-1)


2024-12-10 23:26:33 UTC
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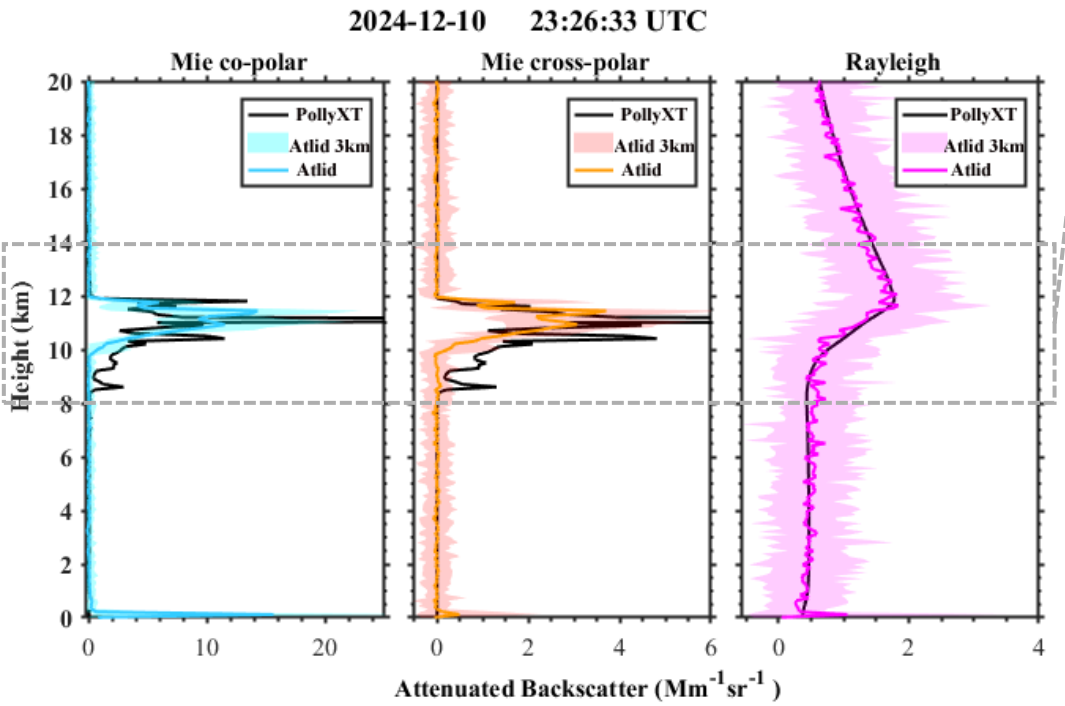
2024-12-10 23:26:33 UTC
Mie co-polar
Mie cross-polar
Rayleigh
PollyXT
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Atlid
Height (km)
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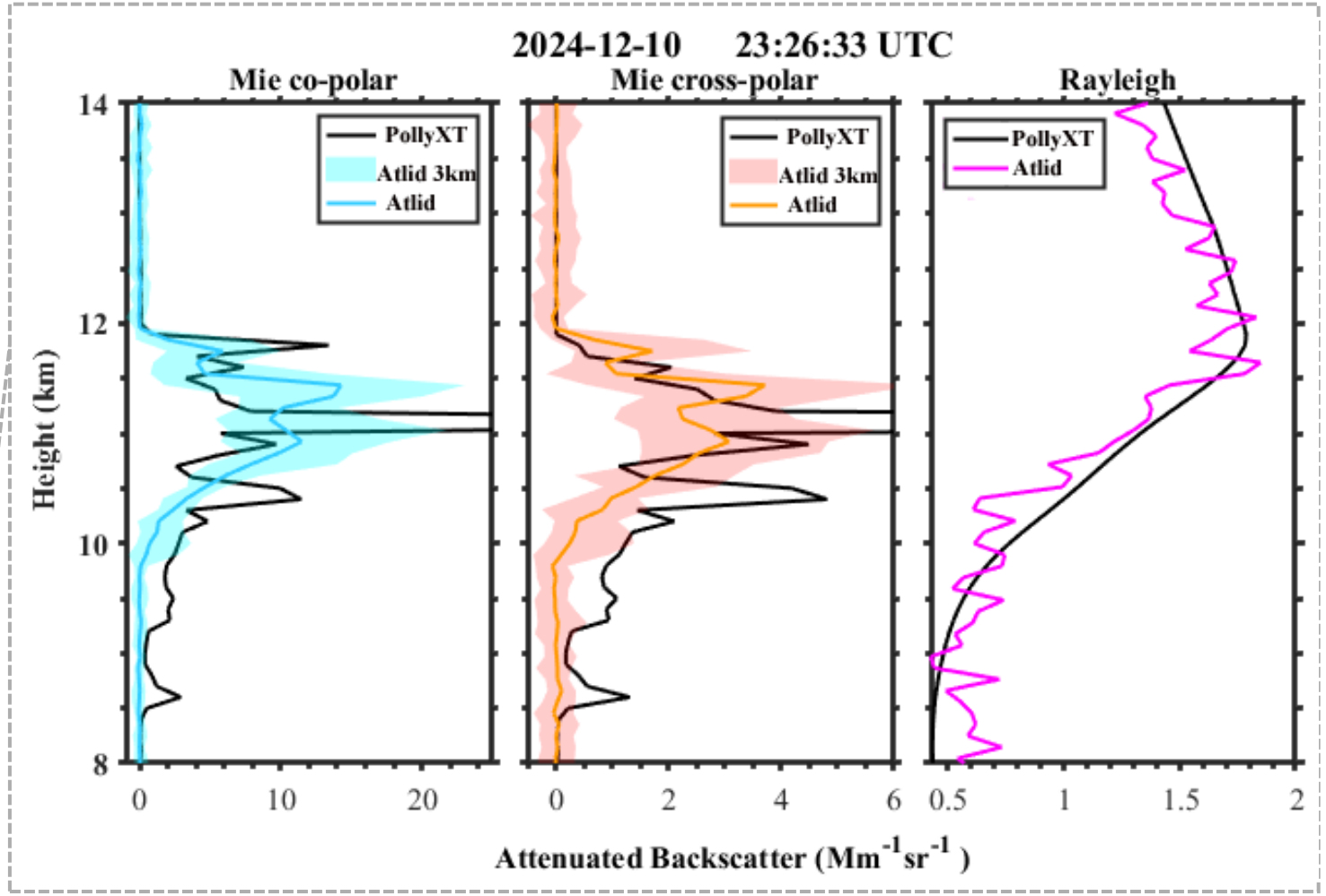
2024-12-10 23:26:33 UTC
Mie co-polar
Mie cross-polar
Rayleigh
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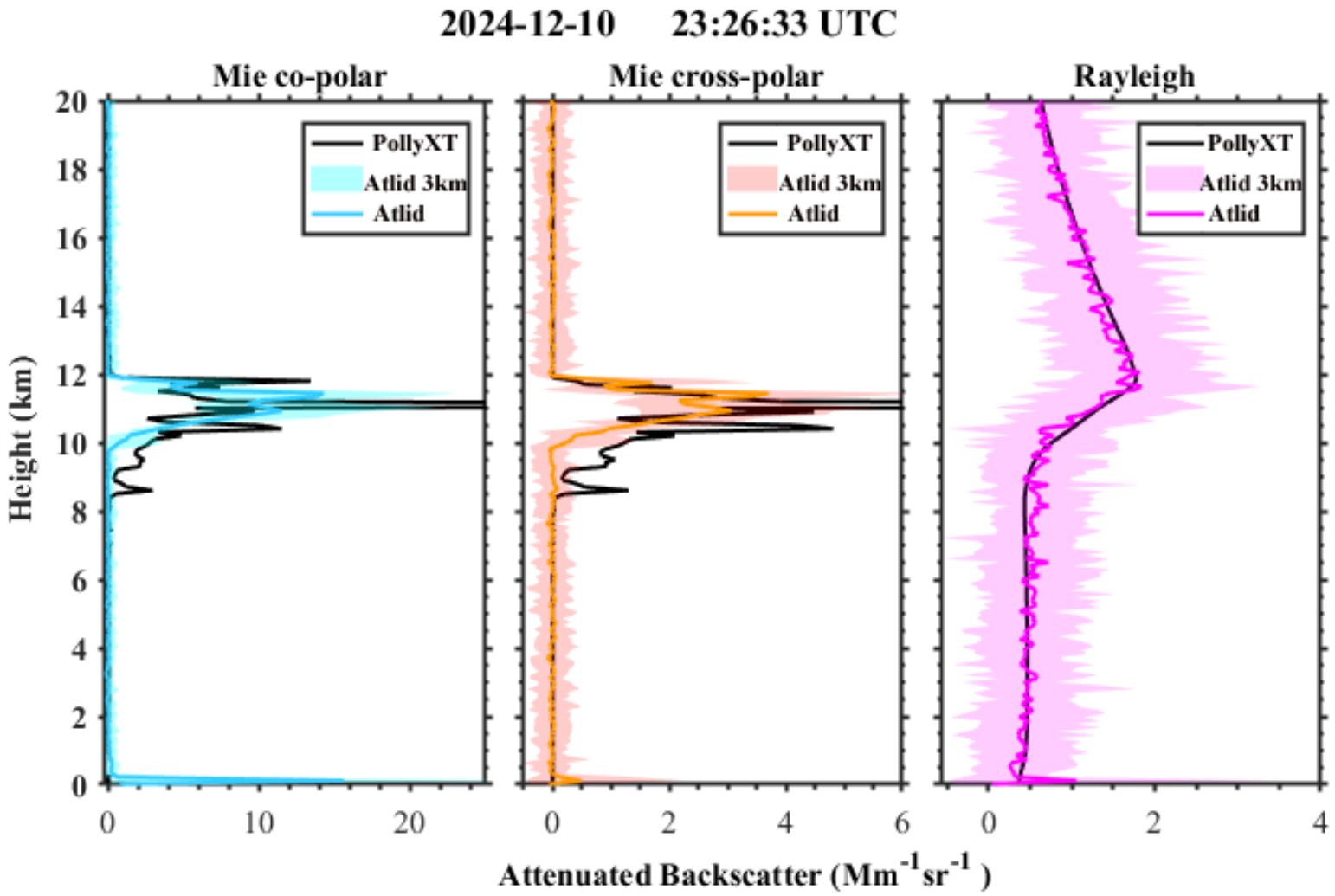
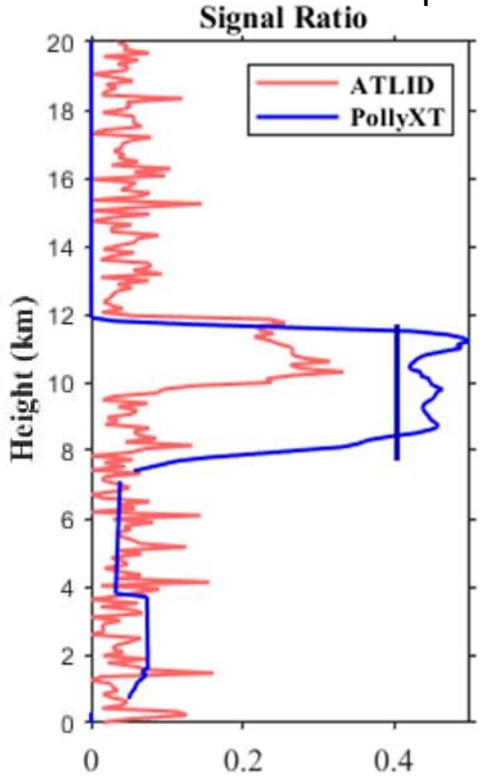
Atlid 3km
Atlid
Height (km)
Attenuated Backscatter (Mm-1sr-1)



Orbit track number: 3050, Orbit Frame: B, Baseline:AC
DISTANCE_TO_MID_SWATH: 37.9 km
DURATION of satellite overpass: 22s



SR_{avg}~0.26

δ_{avg}~0.38

summary:

- It is necessary to use of the **CARDINAL Campaign Tools (CCT) ATLID simulator** for comparison.
- Before using the CCT ATLID simulator, **Noise needs to be removed** especially in the upper atmosphere high noise peaks can lead to the simulation of strong attenuation and thus also results are not comparable anymore.
- The Mie-co and Mie-cross polar signal show good comparison with ground-based PollyXT recordings.
- The ATLID signal ratio compares with the PollyXT depolarization ratio, but it shows lower values in both dust and cirrus cases. An updated level-1 data set will be released which this offset is fixed.
- Signals are significantly negative especially in the Mie-cross polar channel. More Action is required!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