

# The contribution of ERATOSTHENES CoE to the EarthCARE validation: CARO NF, Limassol, Cyprus



Funded by the European Union

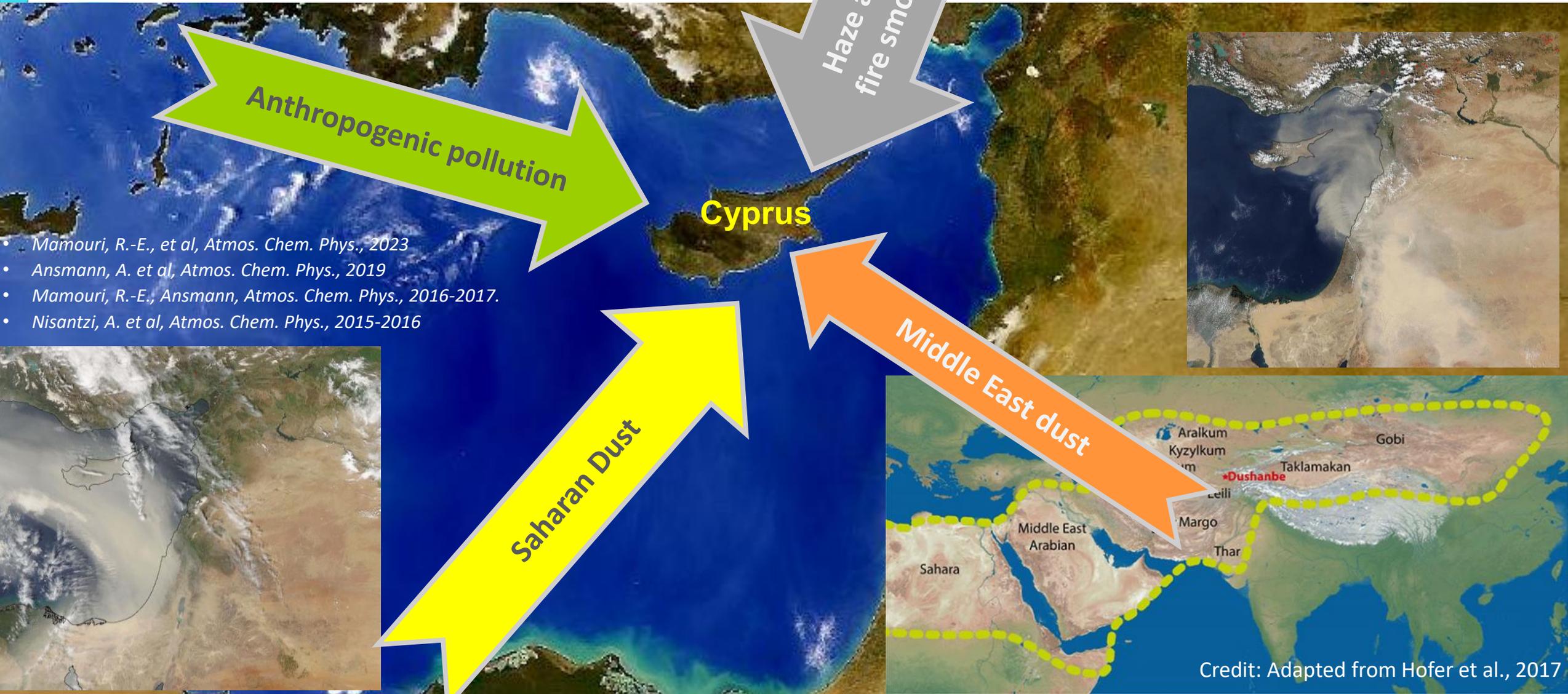
GA No 101160258



*Rodanthi-Elisavet Mamouri, George Kotsias, Hossein Panahifar, Maria Poutli, Argyro Nisantzi, Athina Savva*

ERATOSTHENES Centre of Excellence | Cyprus University of Technology





- Mamouri, R.-E., et al, *Atmos. Chem. Phys.*, 2023
- Ansmann, A. et al, *Atmos. Chem. Phys.*, 2019
- Mamouri, R.-E., Ansmann, *Atmos. Chem. Phys.*, 2016-2017.
- Nisantzi, A. et al, *Atmos. Chem. Phys.*, 2015-2016

Credit: Adapted from Hofer et al., 2017

## ERATOSTHENES Center of Excellence:

- Limassol, coastal area
- CARO National Facility
- ACTRIS Aerosol and Cloud Remote Sensing Observational Platforms [under Labeling]
- Solar Radiation observations



## CARE-C of the Cyprus Institute

- Nicosia, urban and inland areas
- Cyprus Atmospheric Observatory (CAO)
- ACTRIS aerosol in situ observational platform
- Unmanned Systems Research Laboratory (USRL) – ACTRIS exploratory platform





# ERATOSTHENES CARO National Facility

## Cyprus Atmospheric Remote Sensing Observatory

Limassol, Cyprus [34.7°N, 33°E]

less than 2 km from the coastline; conditions representative of typical Mediterranean and Middle East region



### • AEROSOL RS OBSERVATIONAL PLATFORM

- AERONET Sunphotometer – May 2010
- PollyXT [3β+2α+2δ] October 2020
- StreamLine Doppler Lidar – February 2021



### CLOUD RS OBSERVATIONAL PLATFORM

- microwave radiometer – July 2024
- ceilometer, **disdrometer** – February 2024
- **35 GHz MIRA** cloud radar – July 2024



Operates since October 2020



Operates Since July 2024





# ERATOSTHENES CARO National Facility

## Cyprus Atmospheric Remote Sensing Observatory

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### CLOUD RS OBSERVATIONAL PLATFORM

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- ceilometer, **disdrometer** – February 2024
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Operates since October 2020

### ERATOSTHENES Cyprus Solar Station



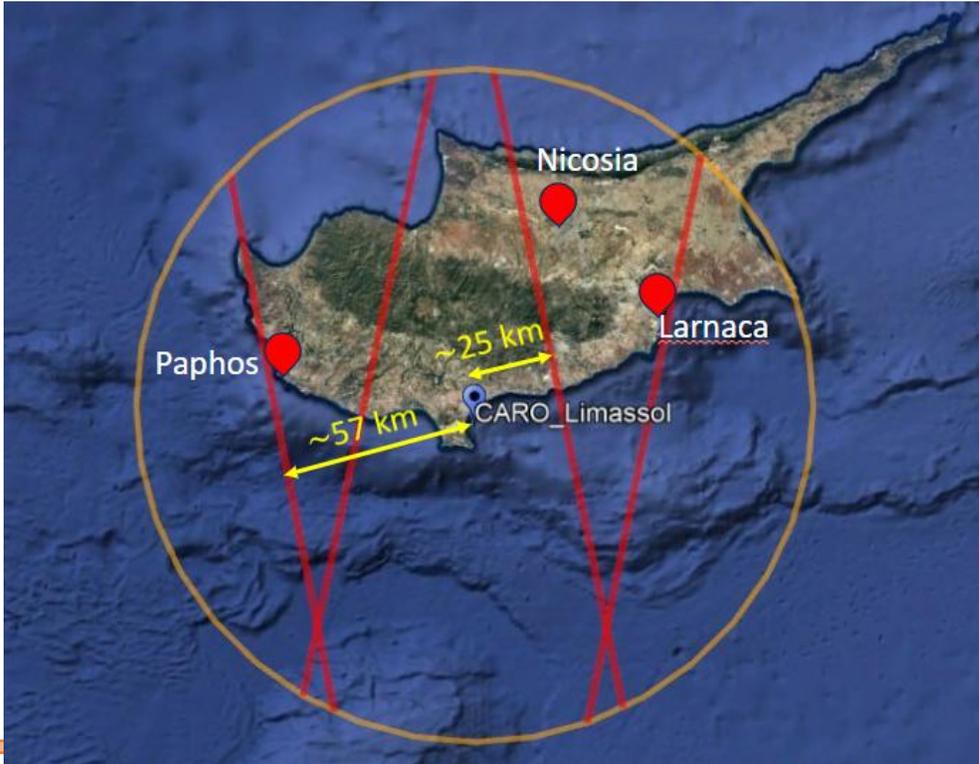
Operates December 2023



Operates Since July 2024

# Limassol overpasses

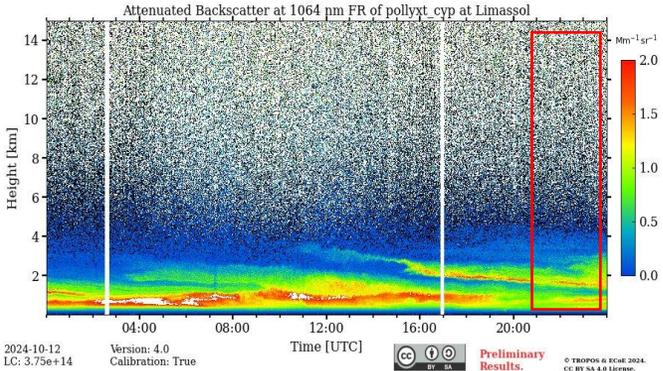
- 48 overpasses within 100km
- 32 ATLID-PollyXT-CYP common measurements
- 29 CPR-MIRA35 common measurements
- 12 cases of PollyXT+MIRA35
- 4 cases aerosol+clouds



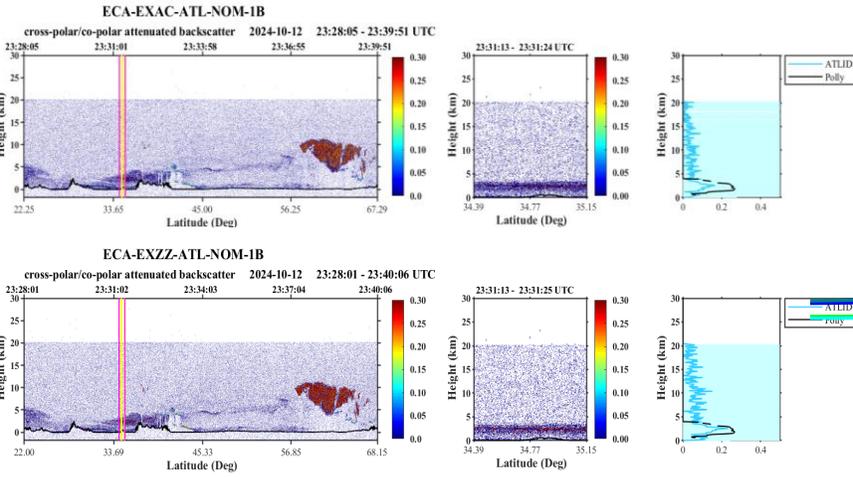
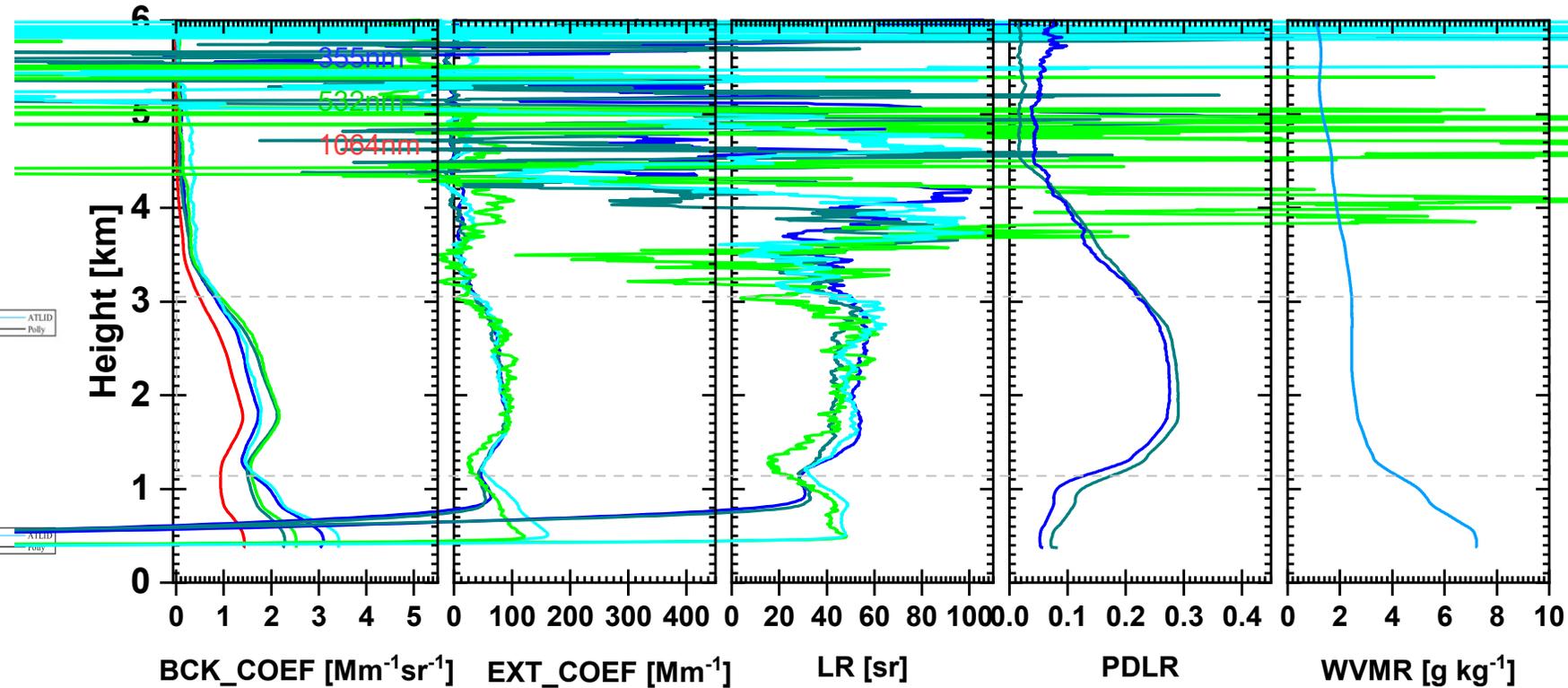
PASS	DATE	DISTANCE TO MID SWATH	ASCENDING/DESCENDING PHASE	UTC TIME START	INSTRUMENT AVAILABILITY		
					Aerosol	Ceiliometer	Cloud
1	2025-03-23	51.340838	DESC	T12:02:25.101382	☑	☑	☑
2	2025-03-20	25.015134	ASC	T23:24:51.158924	☑	☑	☑
3	2025-03-14	31.794807	DESC	T12:06:13.289602	☑	☑	☑
4	2025-03-11	58.129918	ASC	T23:28:42.718667	☑	☑	☑
5	2025-02-26	51	DESC	T12:03:15.372505	☑	☑	☑
6	2025-02-23	25	ASC	T23:25:44.429443	☑	☑	☑
7	2025-02-17	31	DESC	T12:07:06.037747	☑	☑	☑
8	2025-02-14	58	ASC	T23:29:31.745763	☑	☑	☑
9	2025-02-07				☑	☑	☑
10	2025-02-01	51.34056	DESC	T12:03:18.600752	☑	☑	☑
11	2025-01-29	25.015401	ASC	T23:25:44.658287	☑	☑	☑
12	2025-01-23	31.795086	DESC	T12:07:06.789024	☑	☑	☑
13	2025-01-20	58.129652	ASC	T23:29:36.218002	☑	☑	☑
14	2025-01-07	51.188308	DESC	T12:03:39.491724	☑	☑	☑
15	2025-01-04	25.168217	ASC	T23:26:05.769968	☑	☑	☑
16	2024-12-29	31.947926	DESC	T12:07:28.417129	☑	☑	☑
17	2024-12-26	57.977407	ASC	T23:29:58.029417	☑	☑	☑
18	2024-12-13	51.188325	DESC	T12:04:08.241349	☑	☑	☑
19	2024-12-10	25.168183	ASC	T23:26:34.519587	☑	☑	☑
20	2024-12-04	31.947909	DESC	T12:07:57.166740	☑	☑	☑
21	2024-12-01	57.97744	ASC	T23:30:26.779035	☑	☑	☑
22	2024-11-18	51.188428	DESC	T12:04:36.990949	☑	☑	☑
23	2024-11-15	25.168095	ASC	T23:27:03.269192	☑	☑	☑
24	2024-11-09	32.234191	DESC	T12:08:22.806013	☑	☑	☑
25	2024-11-06	57.692418	ASC	T23:30:52.762151	☑	☑	☑
26	2024-10-24	50.903332	DESC	T12:05:04.998022	☑	☑	☑
27	2024-10-21	25.454125	ASC	T23:27:31.690140	☑	☑	☑
28	2024-10-15	32.234008	DESC	T12:08:55.305474	☑	☑	☑
29	2024-10-12	57.692568	ASC	T23:31:25.261663	☑	☑	☑
30	2024-10-06	31.852081	DESC	T12:09:15.412446	☑	☑	☑
31	2024-10-03	58.072862	ASC	T23:31:44.910254	☑	☑	☑
32	2024-09-29	50.903358	DESC	T12:05:37.497513	☑	☑	☑
33	2024-09-26	25.454087	ASC	T23:28:04.189640	☑	☑	☑
34	2024-09-20	38.265223	DESC	T12:09:43.860276	☑	☑	☑
35	2024-09-17	25.072412	ASC	T23:28:21.016135	☑	☑	☑
36	2024-09-11	42.930503	DESC	T12:10:13.171896	☑	☑	☑
37	2024-09-08	74.788961	ASC	T23:33:00.626293	☑	☑	☑
38	2024-09-04	51.005026	DESC	T12:06:11.190332	☑	☑	☑
39	2024-09-01	74.413799	ASC	T23:26:34.445434	☑	☑	☑
40	2024-08-26	1.258111	DESC	T12:08:34.166997	☑	☑	☑
41	2024-08-25	6.511388	ASC	T23:29:37.044277	☑	☑	☑
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43	2024-08-17	28.45347	DESC	T12:10:04.830126	☑	☑	☑
44	2024-08-14	16.607746	ASC	T23:30:55.311648	☑	☑	☑
45	2024-08-08	58.368392	DESC	T12:06:32.186185	☑	☑	☑
46	2024-08-05	98.484601	ASC	T23:26:18.762820	☑	☑	☑
47	2024-08-03	99.576832	ASC	T23:35:07.655859	☑	☑	☑
48	2024-07-28	15.072982	DESC	T12:08:44.366994	☑	☑	☑
49	2024-07-25	89.796254	ASC	T23:27:01.079948	☑	☑	☑
50	2024-07-23	81.525471	ASC	T23:34:36.753890	☑	☑	☑
51	2024-07-12	38.947596	ASC	T23:29:48.414533	☑	☑	☑

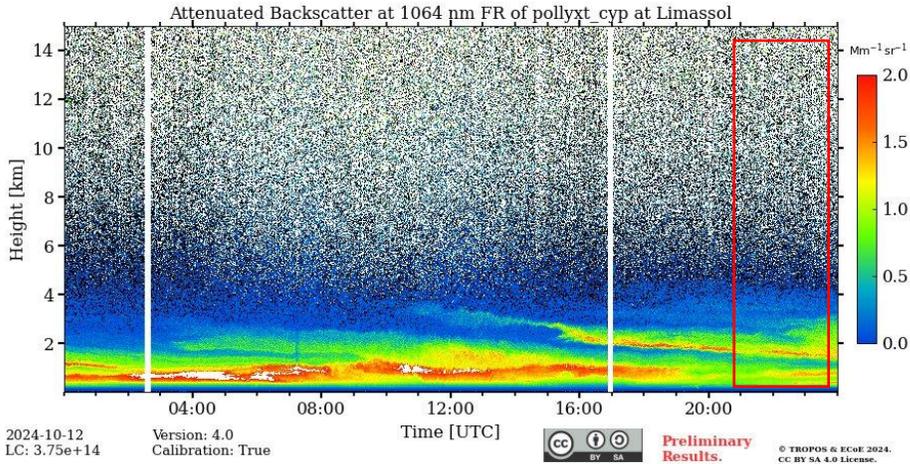


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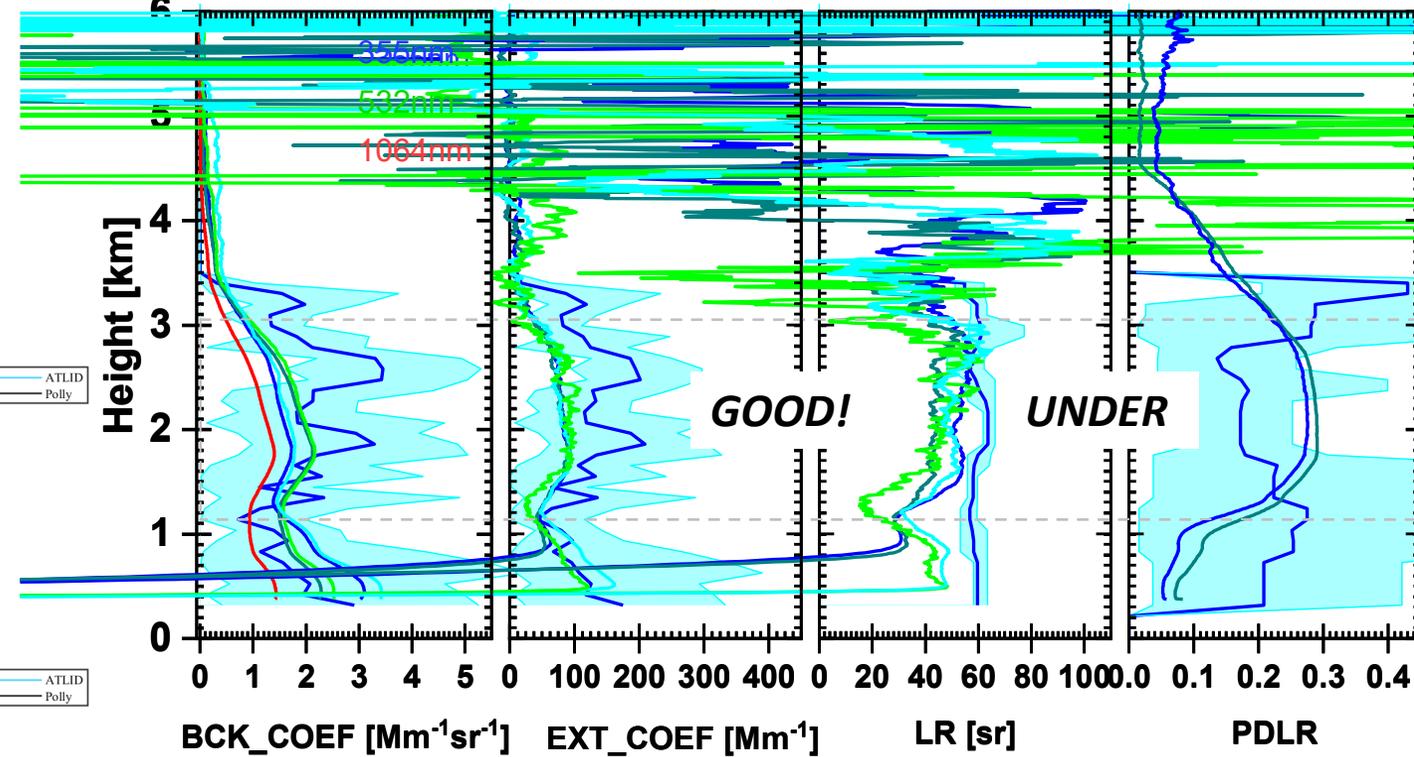


## CARO-LIM: 12.10.2024, 23:00-24:00 UTC

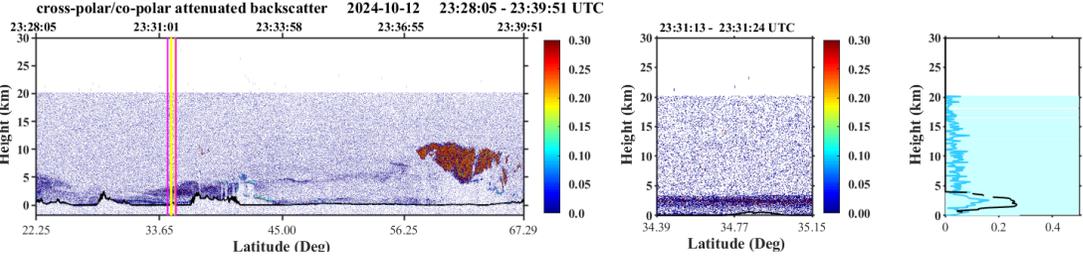




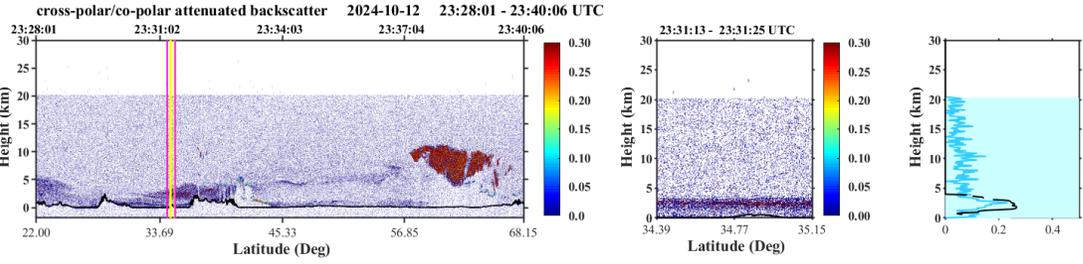
CARO-LIM: 12.10.2024, 23:00-24:00 UTC  
EARTHCARE: 12.10.2024, 23:30UTC

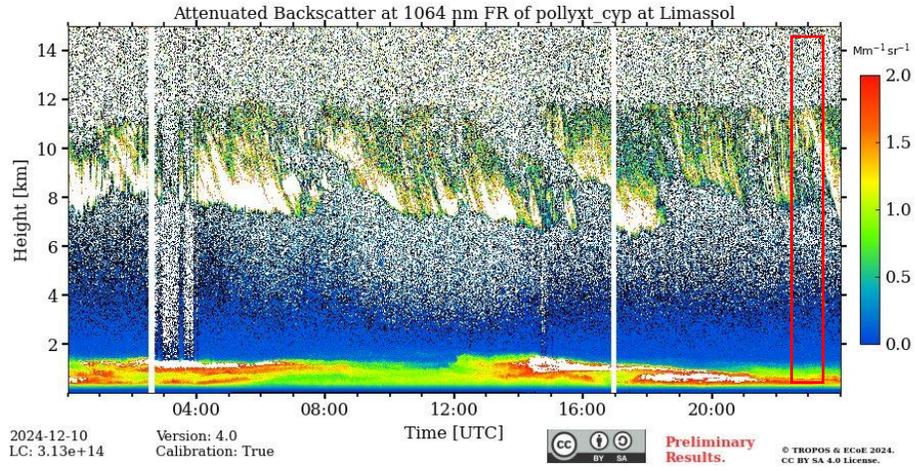


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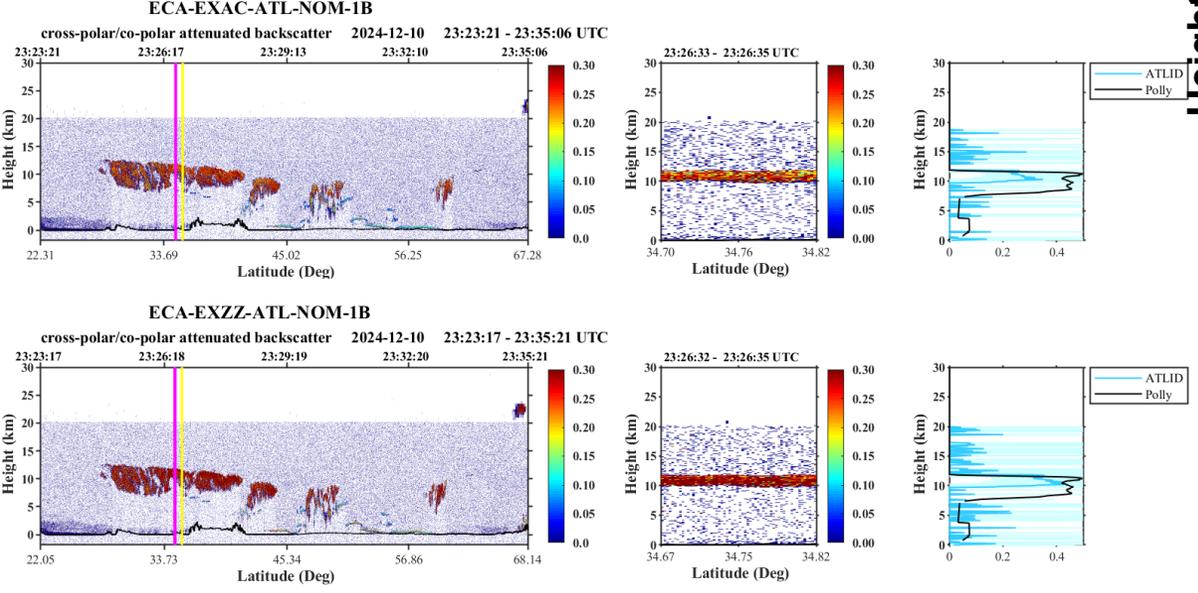
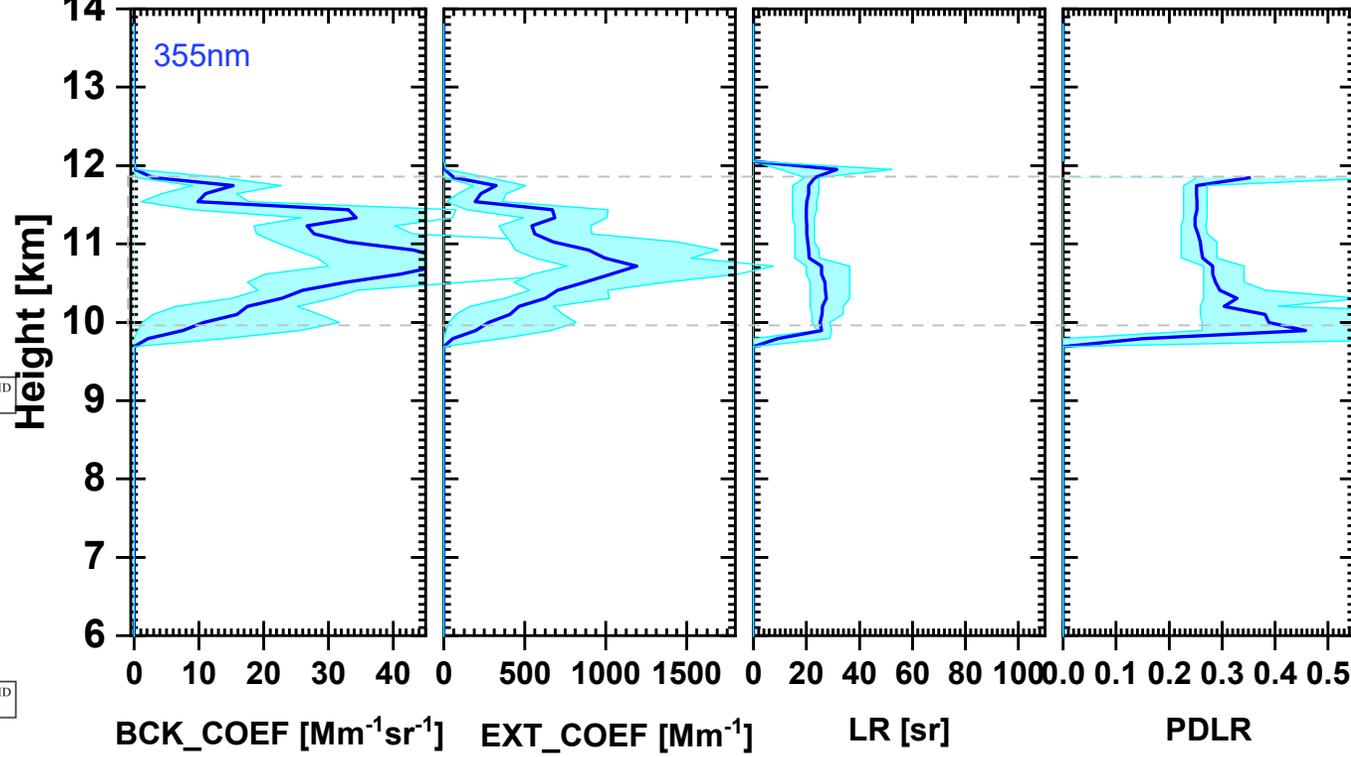


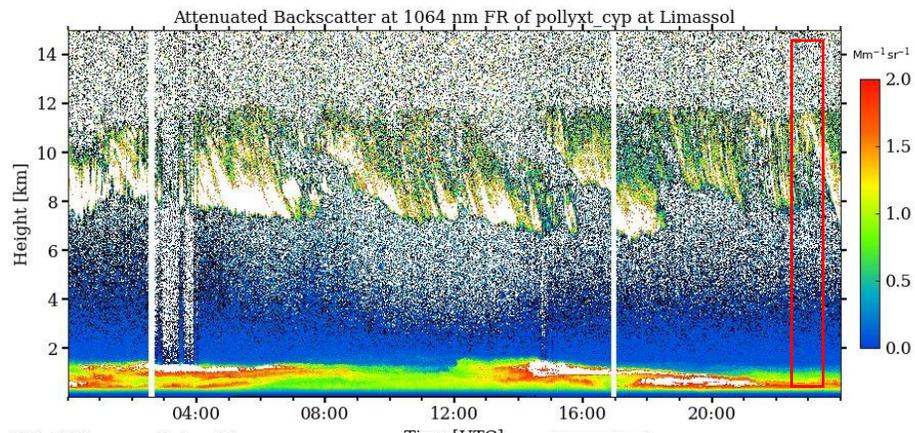
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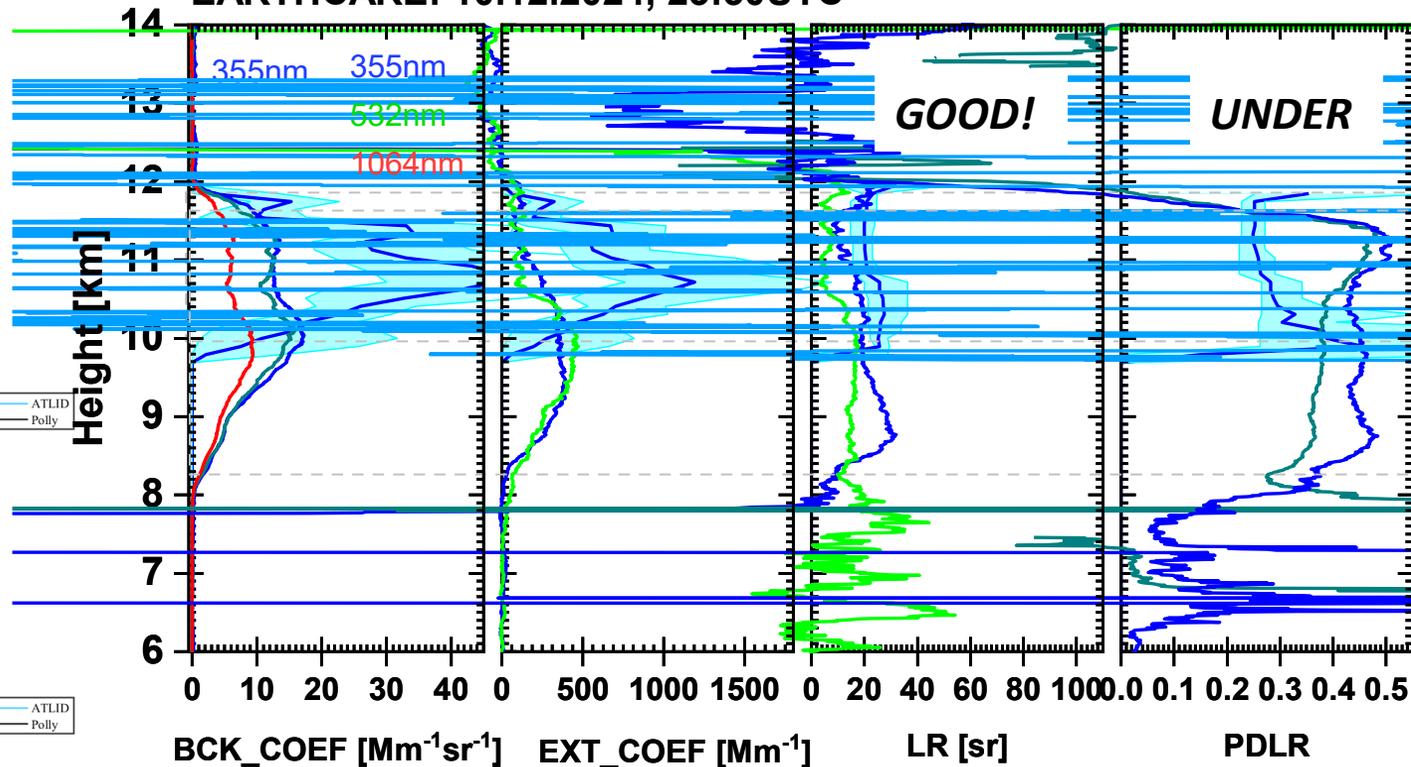


EARTHCARE: 10.12.2024, 23:30UTC



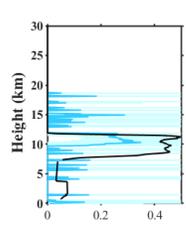
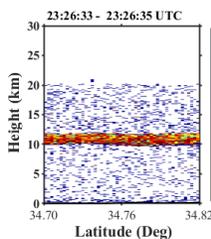
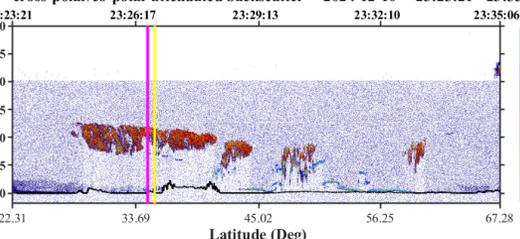


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EARTHCARE: 10.12.2024, 23:30UTC



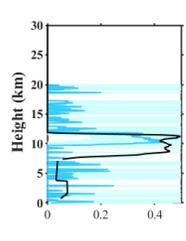
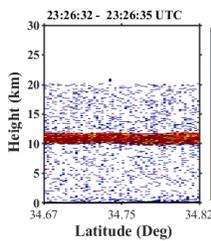
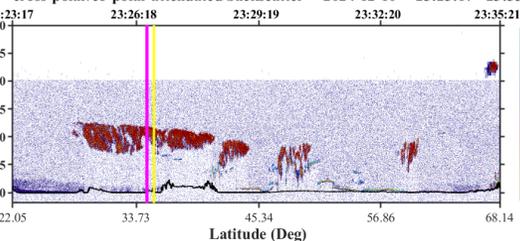
ECA-EXAC-ATL-NOM-1B

cross-polar/co-polar attenuated backscatter 2024-12-10 23:23:21 - 23:35:06 UTC

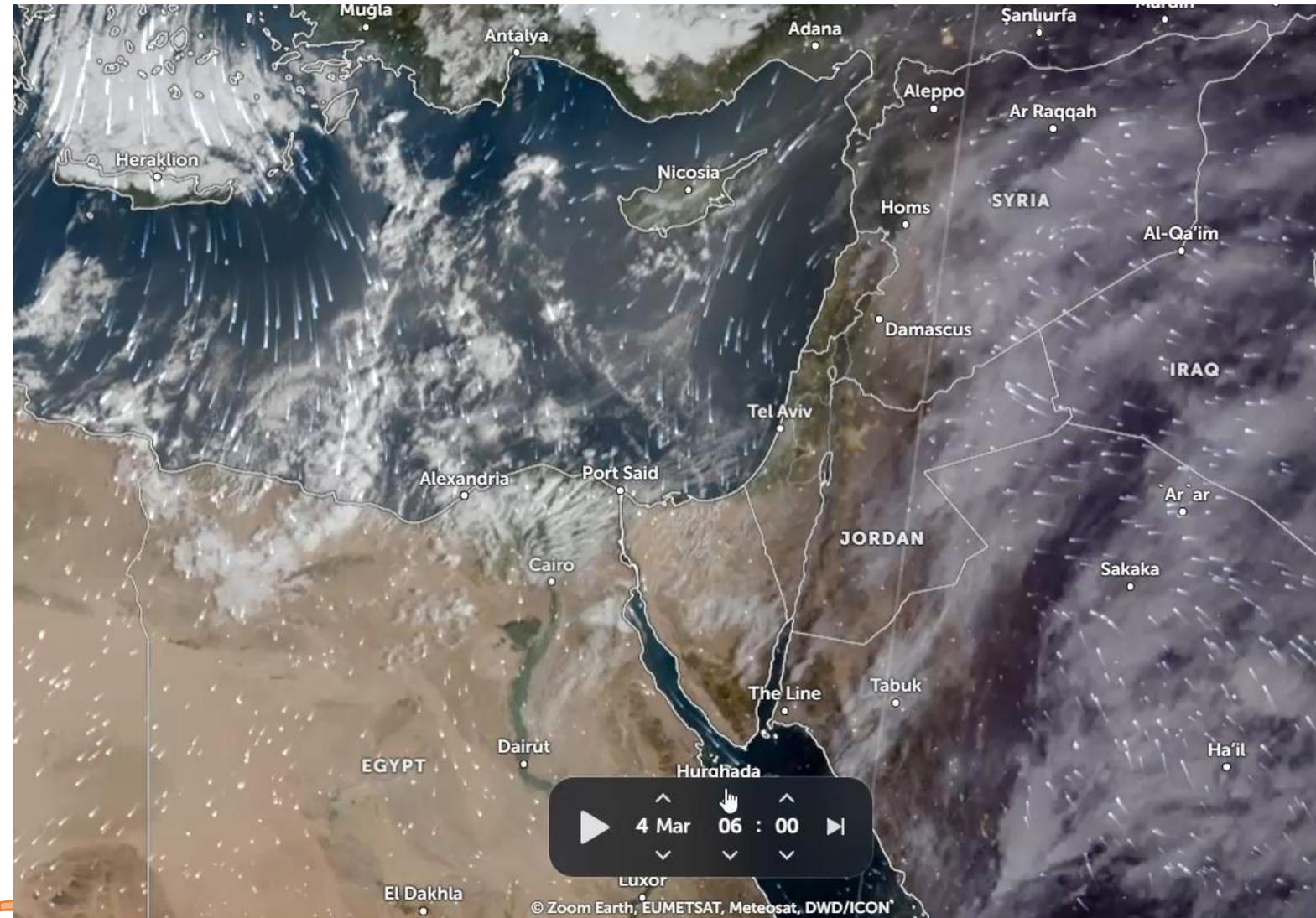


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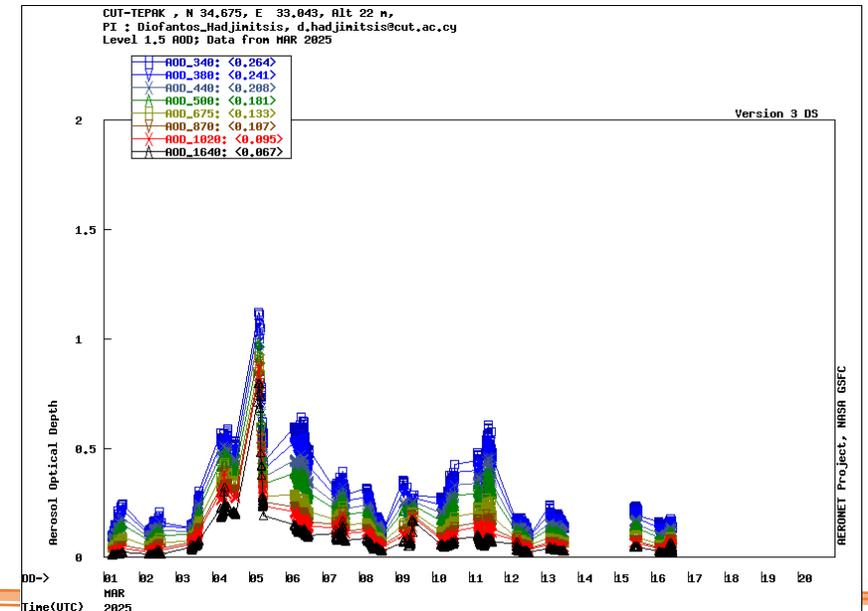
cross-polar/co-polar attenuated backscatter 2024-12-10 23:23:17 - 23:35:21 UTC



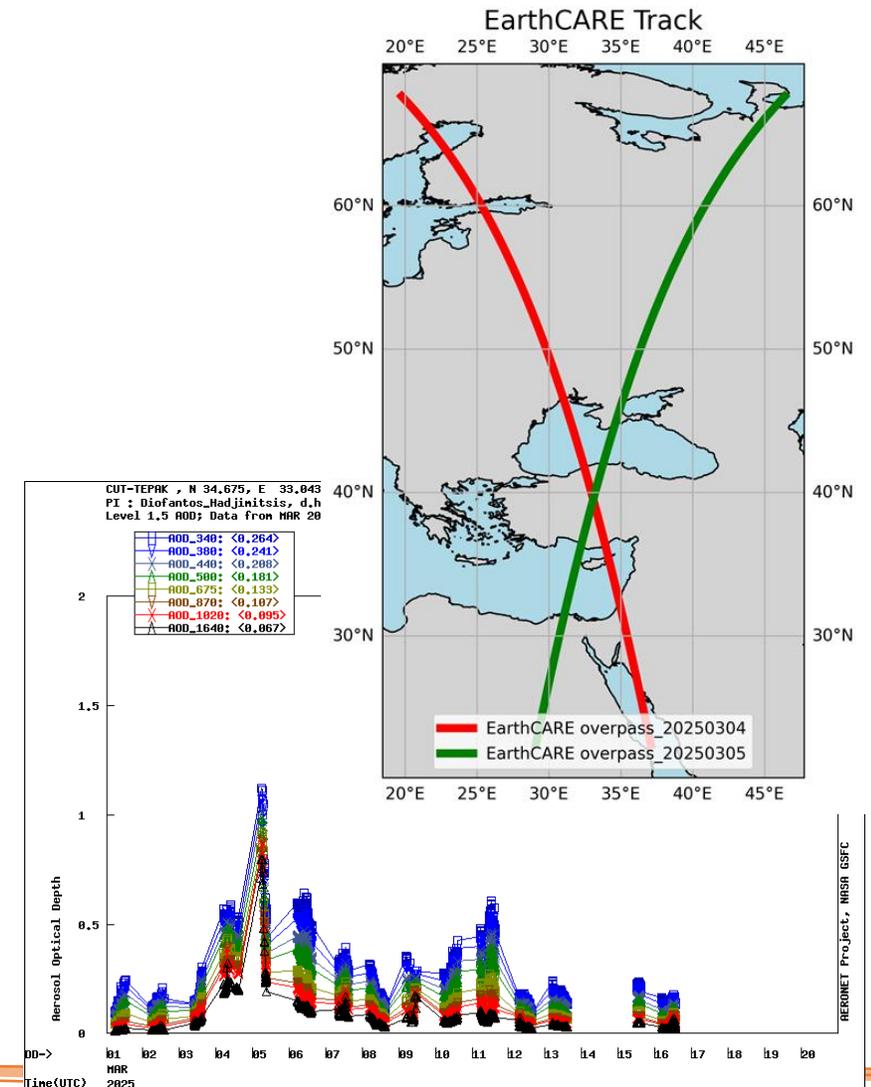
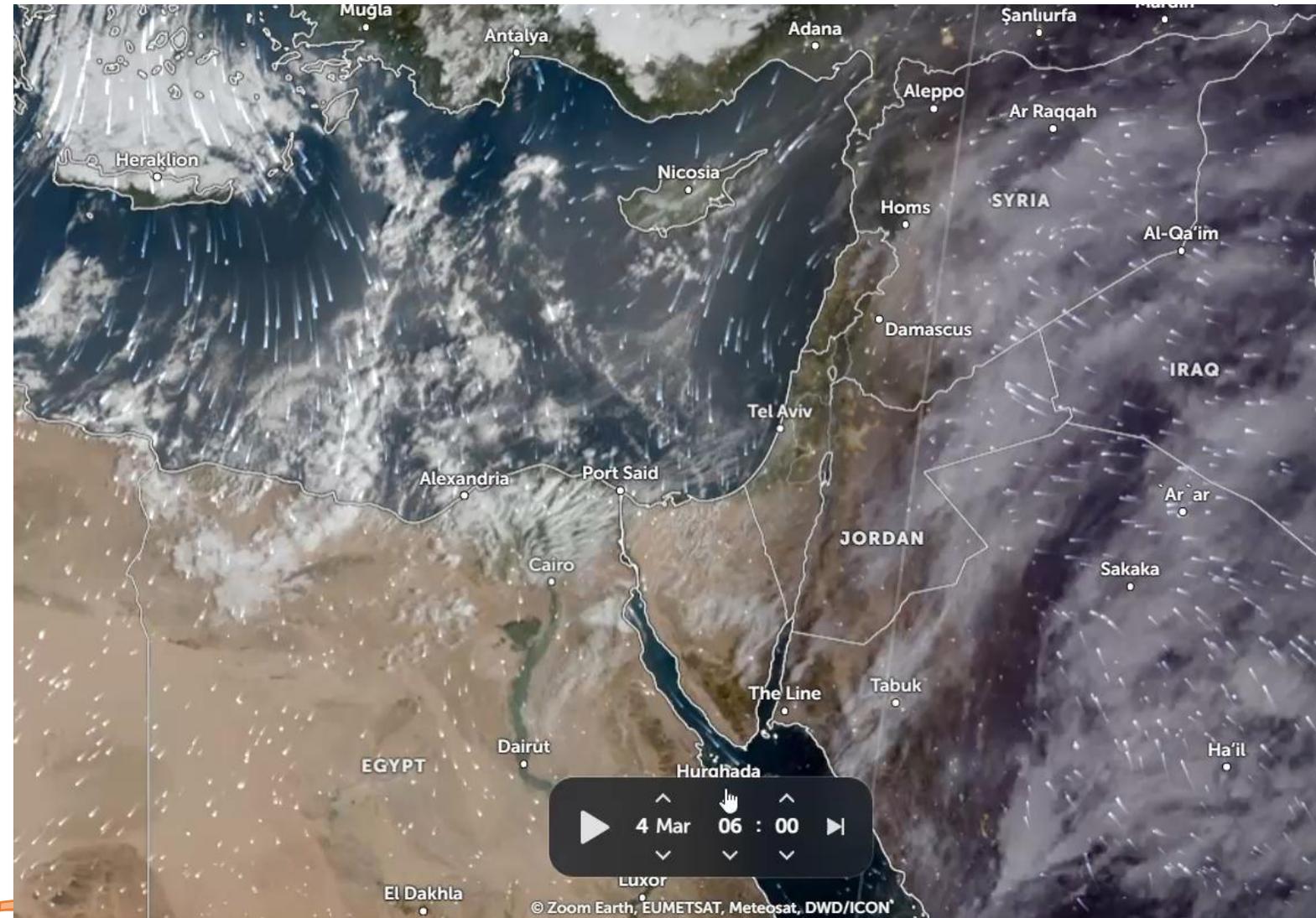
# 4-5 March 2025: Eastern Mediterranean cross path



**DUST EVENT!!**

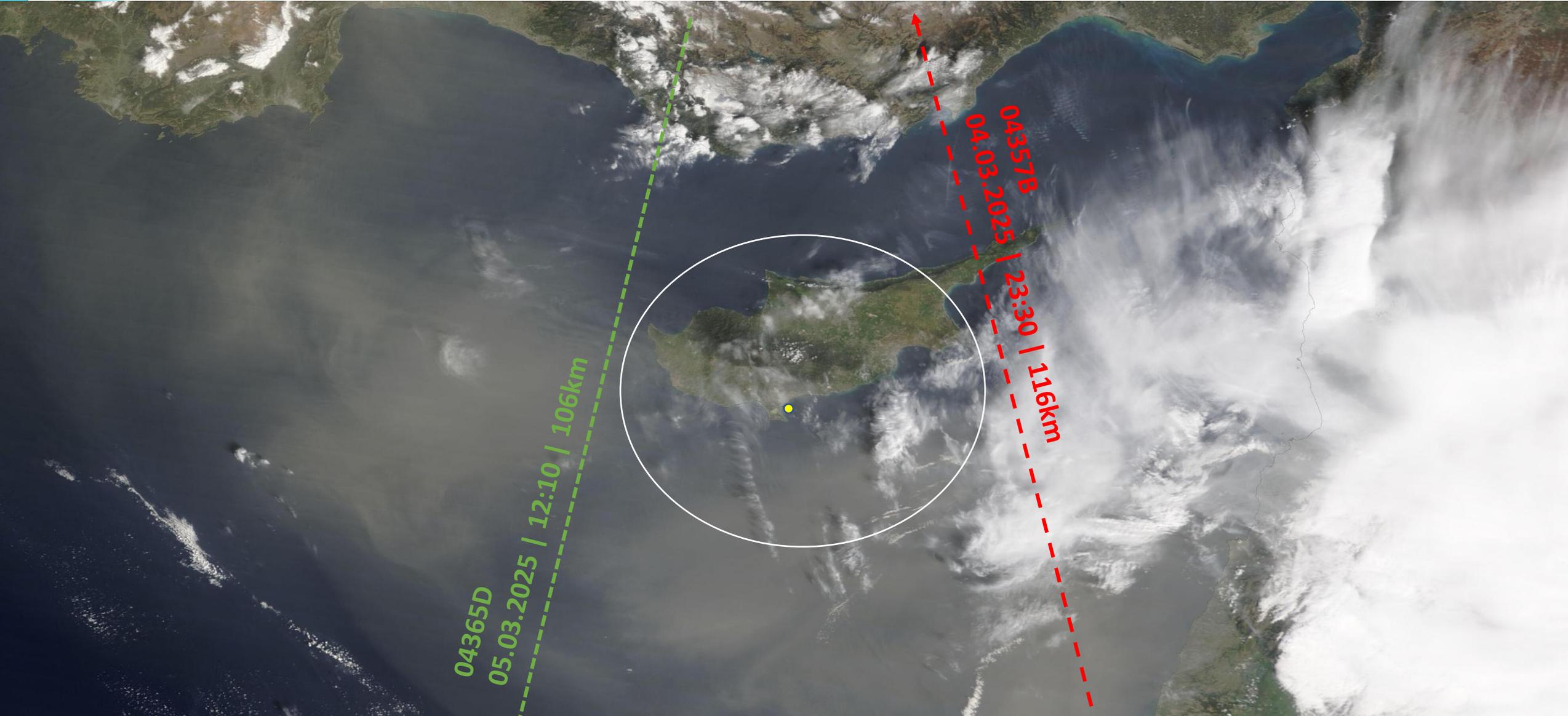


# 4-5 March 2025: Eastern Mediterranean cross path





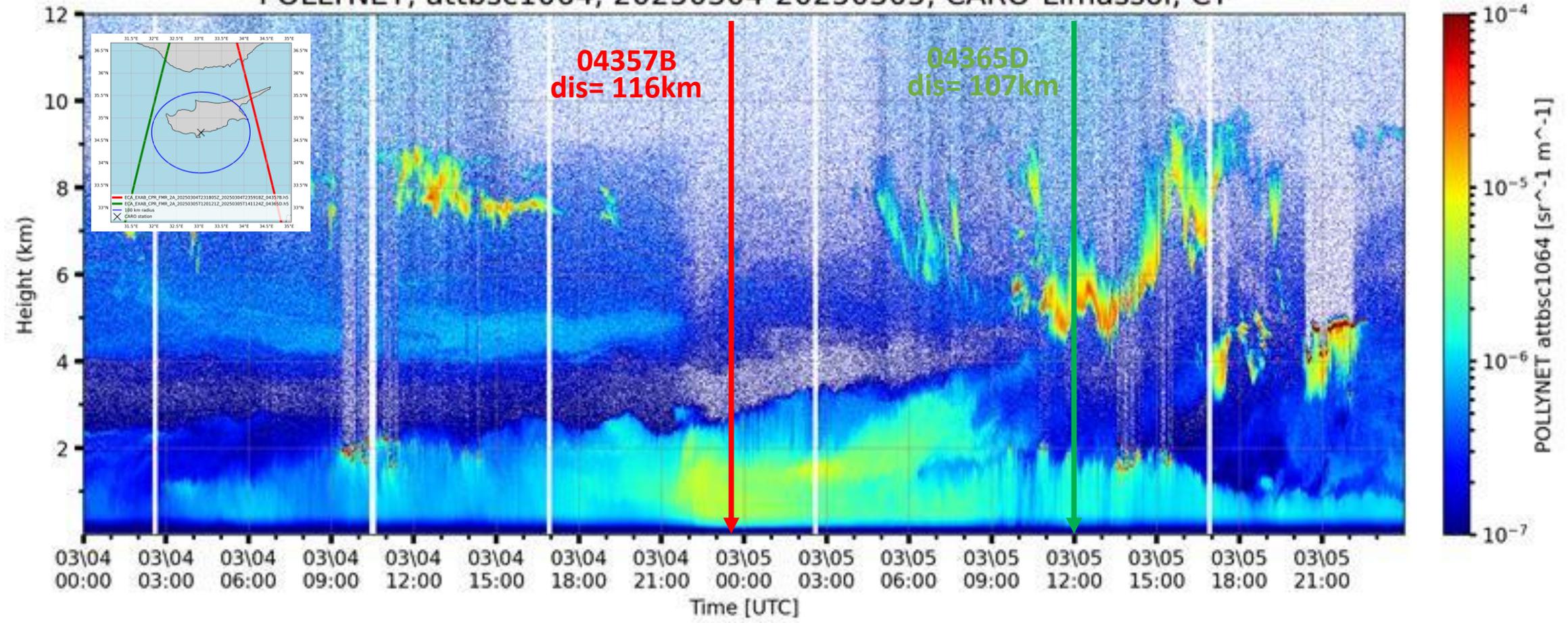
# Two "NO" Limassol Overpasses



# PollyXT-CYP observations: Atmospheric Structure



POLLYNET, attbsc1064, 20250304-20250305, CARO-Limassol, CY



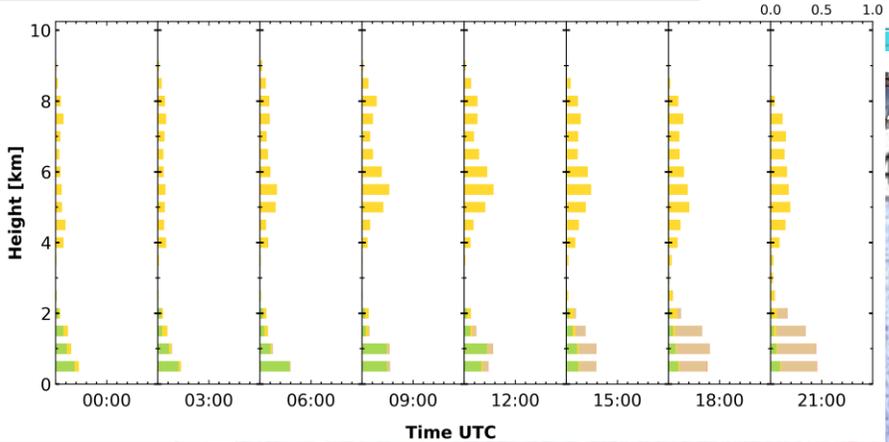


20250304 Limassol, Cyprus region\_below2.0km

Endpoint: file

- cont\_europe
- arabian\_peninsula
- far\_east\_deserts
- persia
- india
- sahara

norm. reside

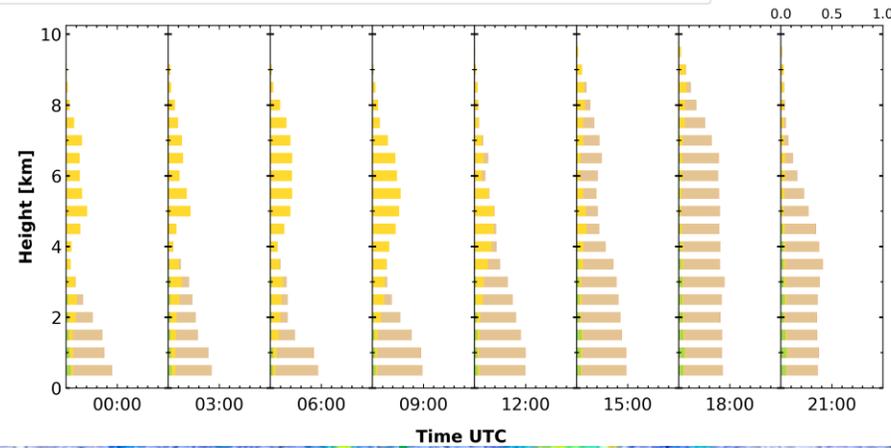


20250305 Limassol, Cyprus region\_below2.0km

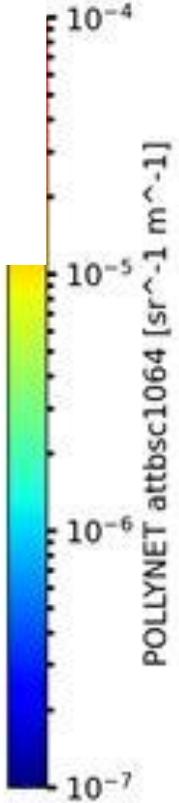
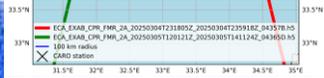
Endpoint: 34.7 33.0 flex

- cont\_europe
- arabian\_peninsula
- far\_east\_deserts
- persia
- india
- sahara

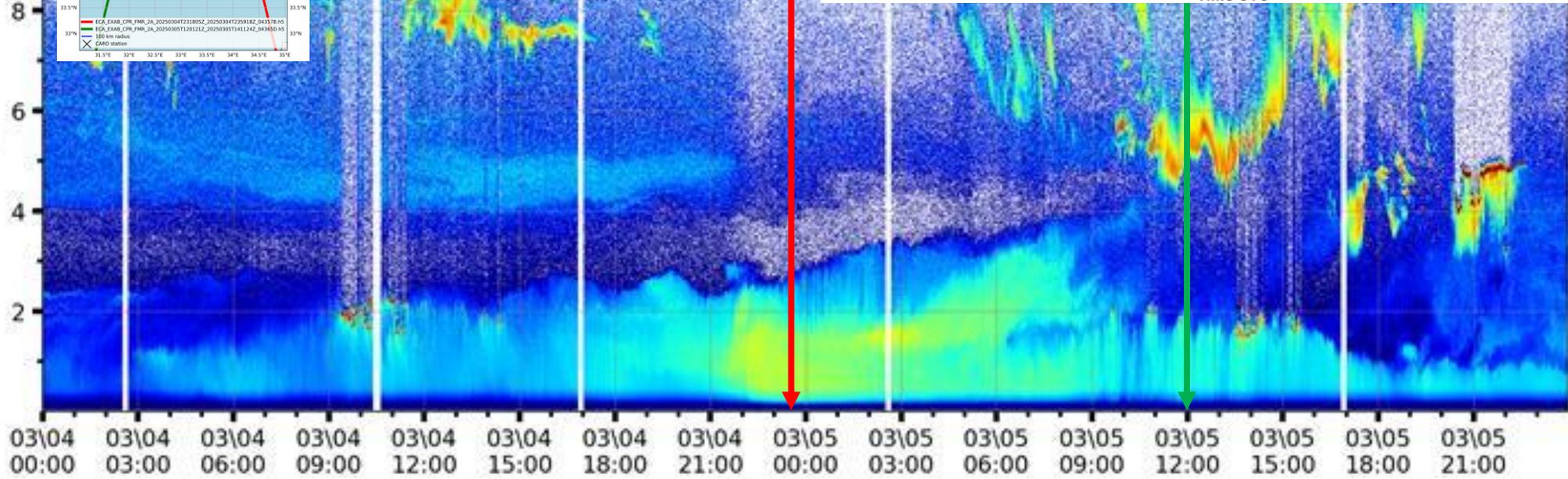
norm. residence time



Height [km]



POLLYNET attbbsc1064 [sr^-1 m^-1]



04357B  
dis= 116km

04365D  
dis= 107km

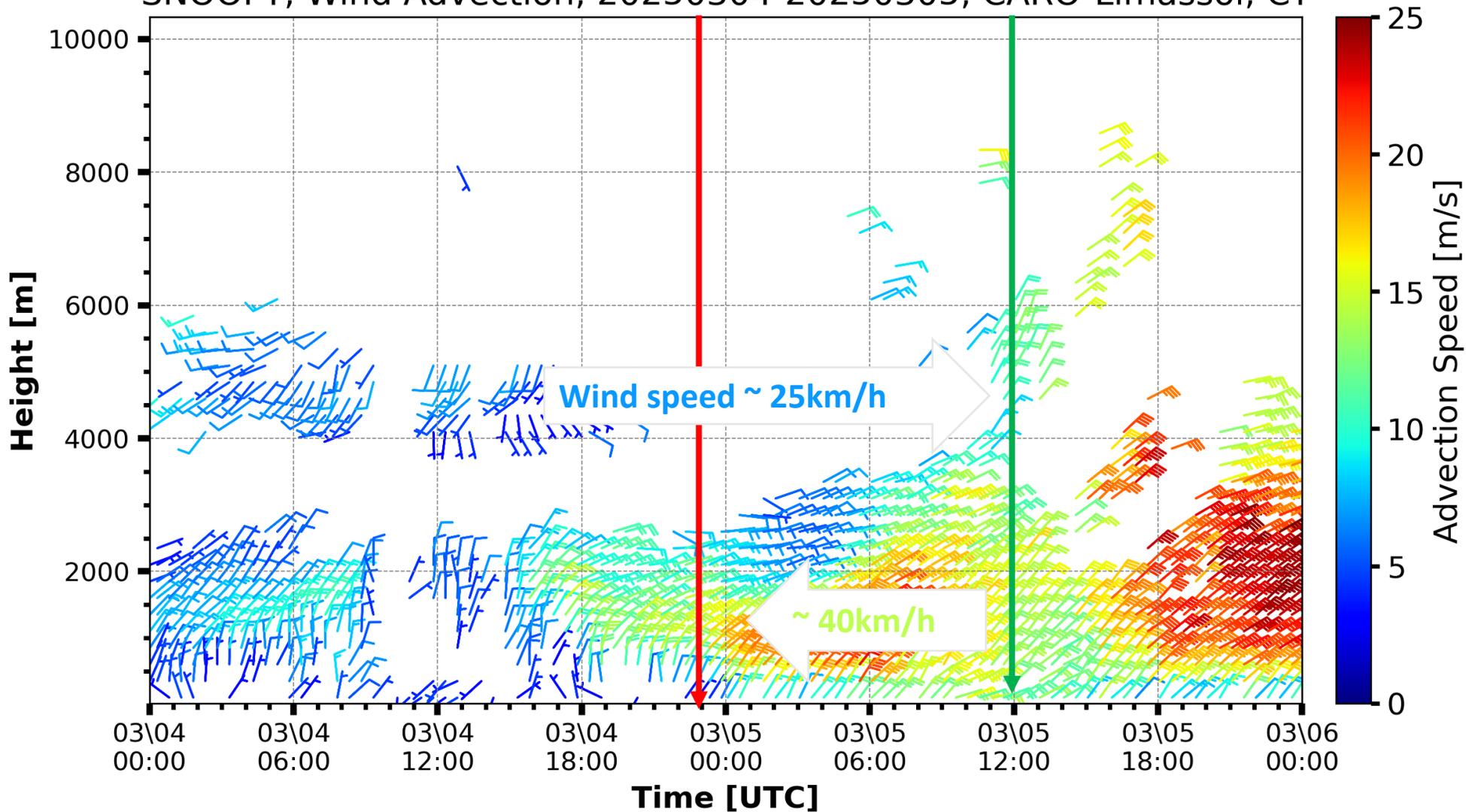


pnmod wrc

# Snoopy Doppler Lidar observations – Wind profiles



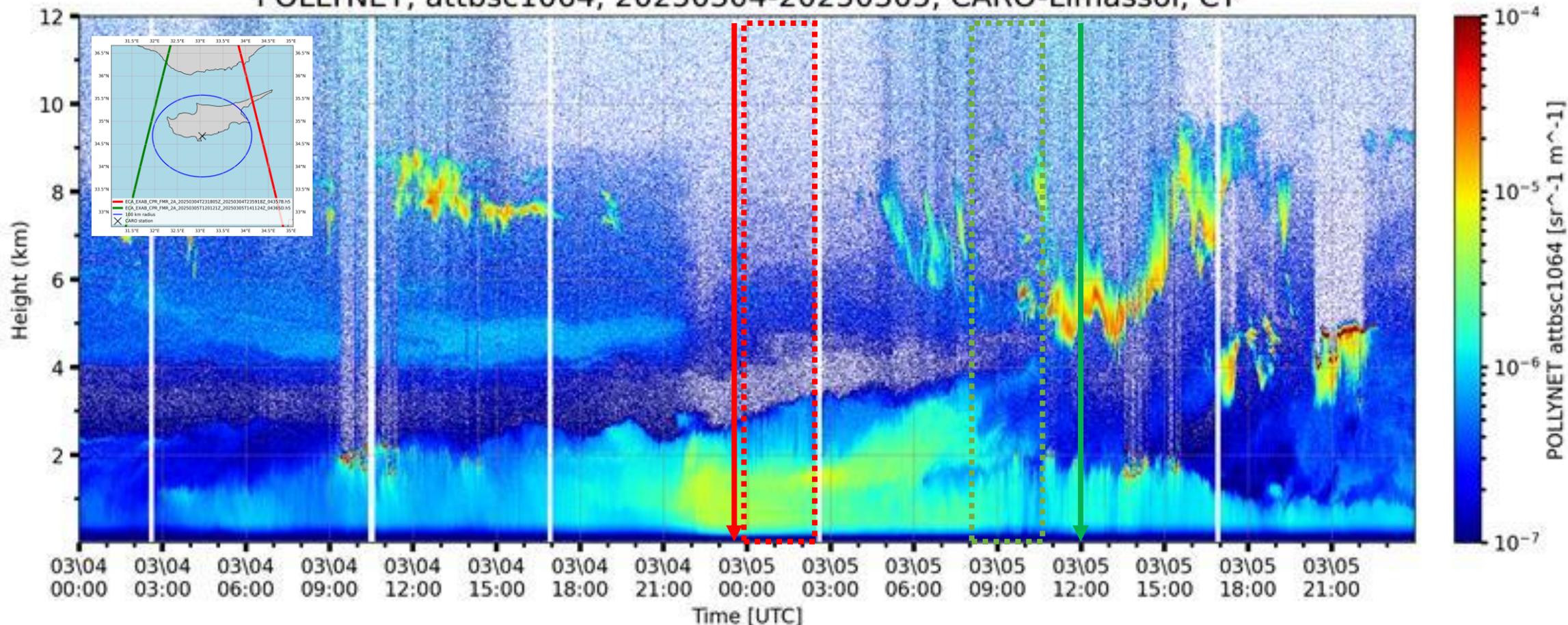
SNOOPY, Wind Advection, 20250304-20250305, CARO-Limassol, CY



# PollyXT-CYP observations: Atmospheric Structure



POLLYNET, attbsc1064, 20250304-20250305, CARO-Limassol, CY



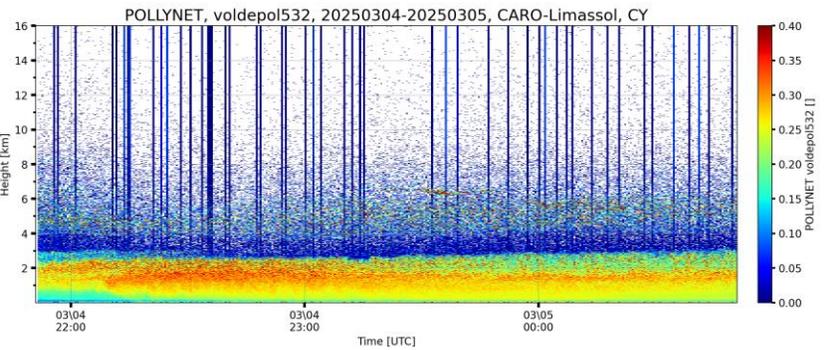
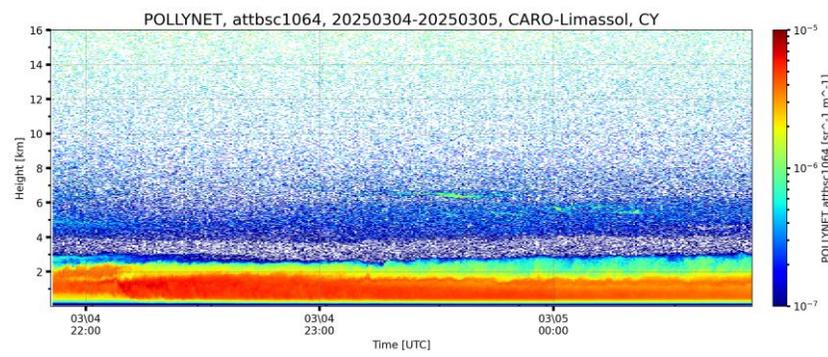
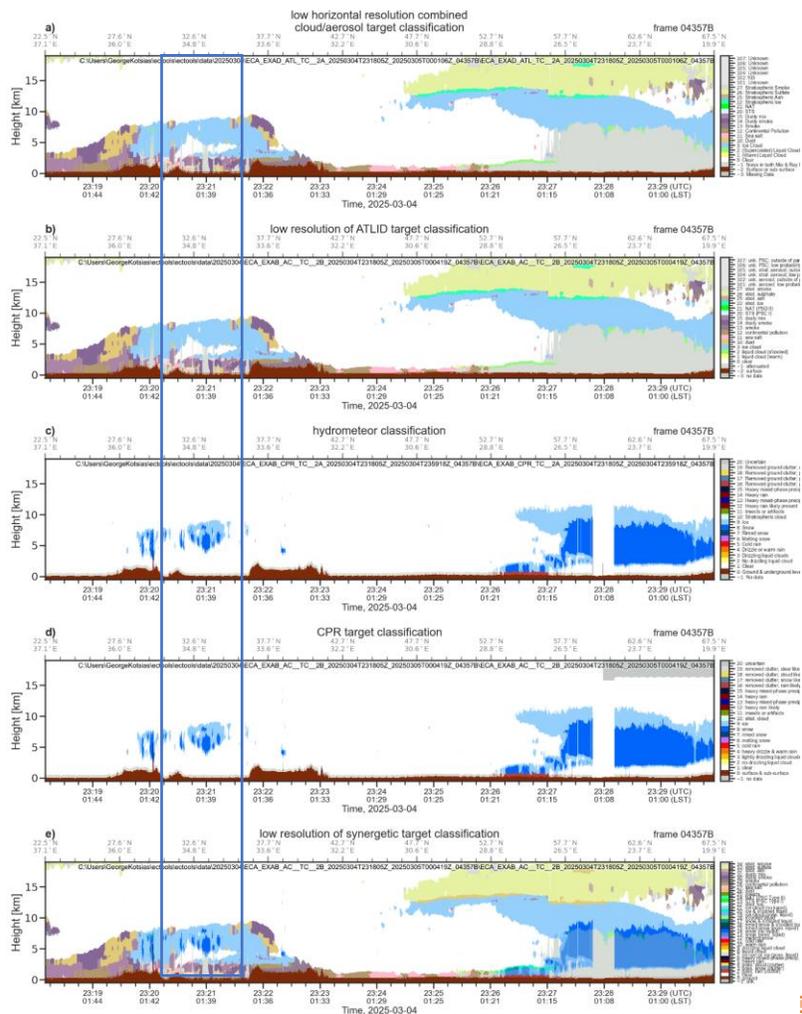
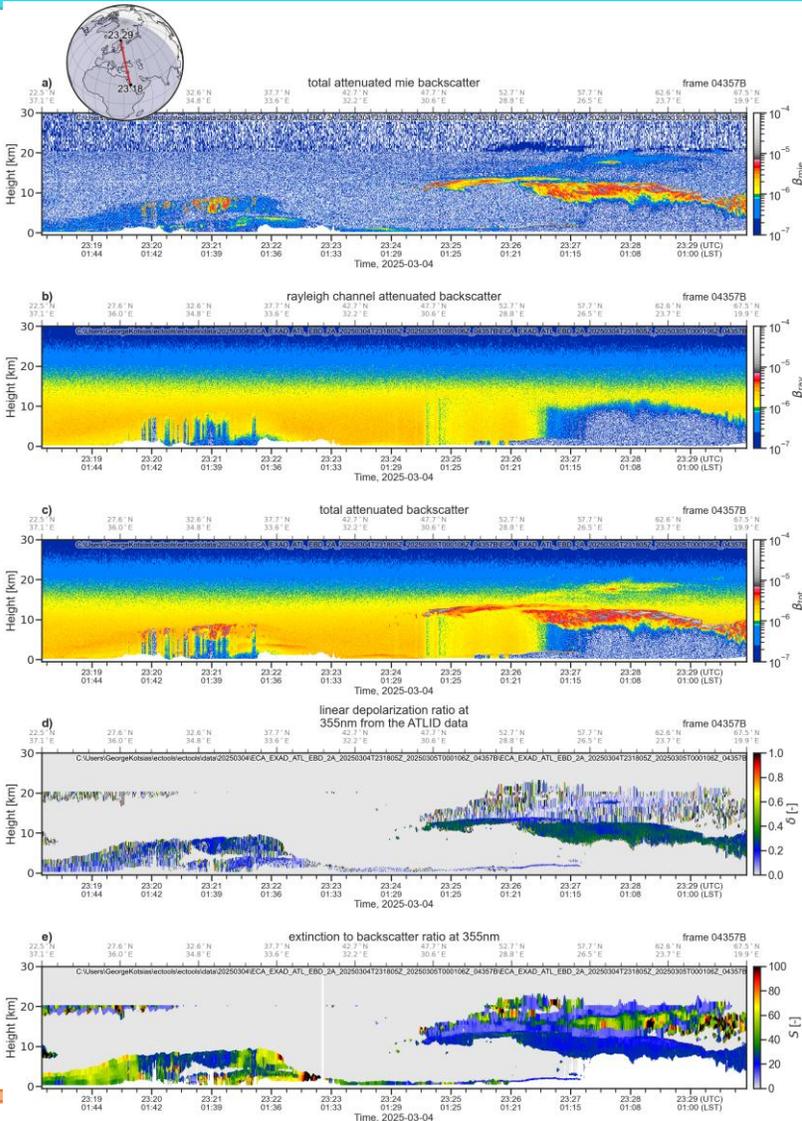
2-3 hours delay at

GB observations

2-3 hours before overpass time

GB observations

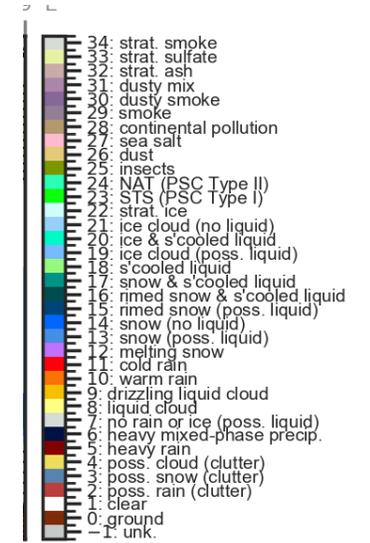
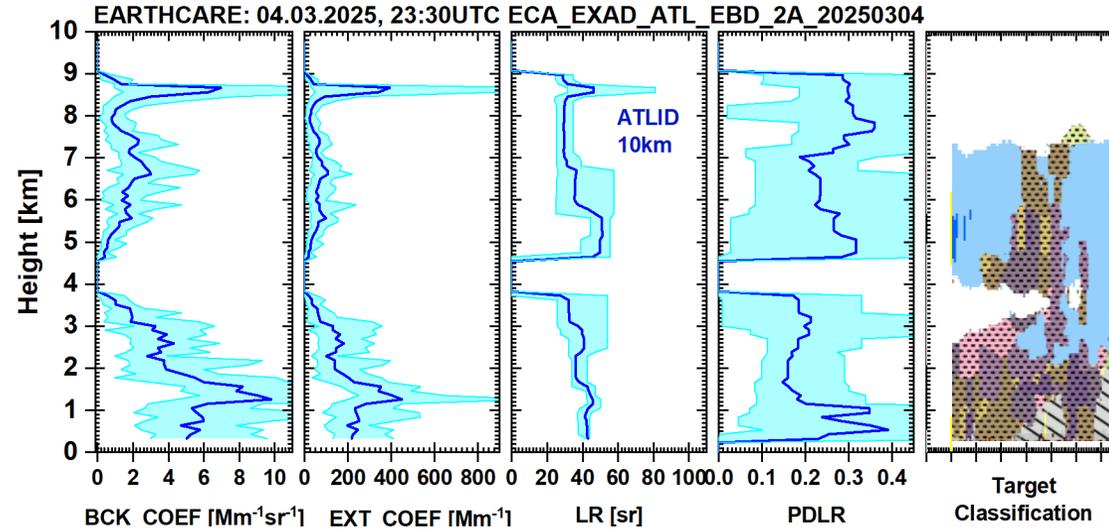
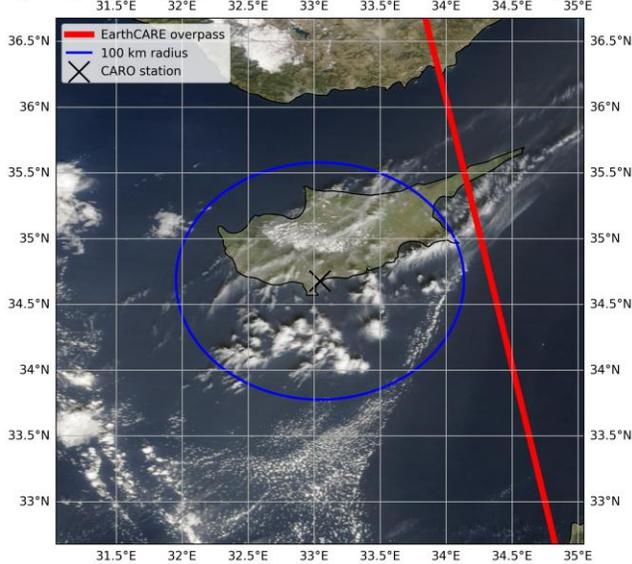
# POLLY VS EARTHCARE





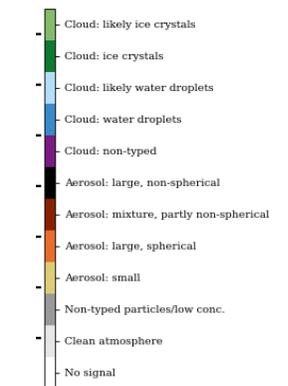
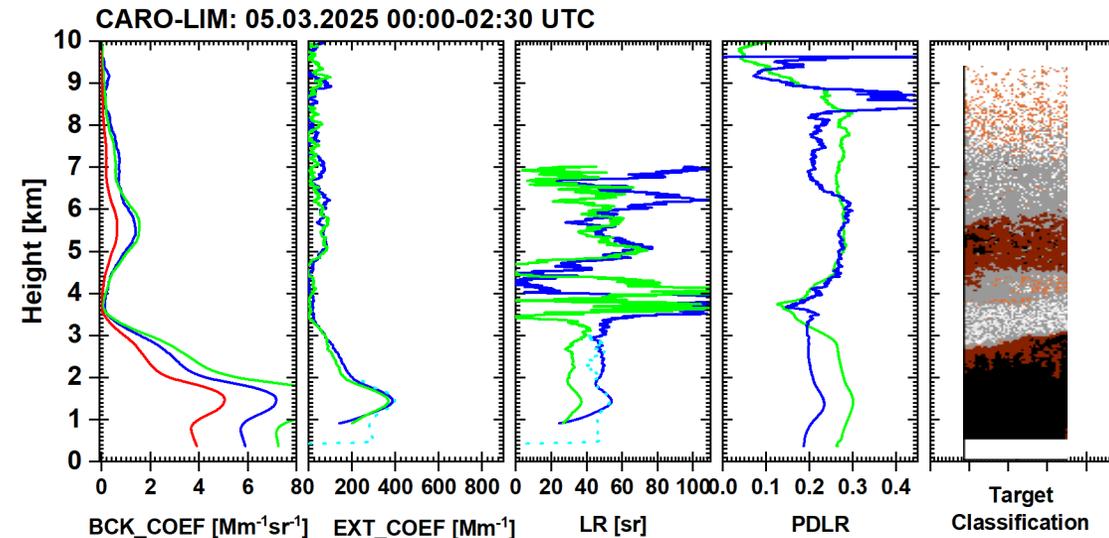
# FRAME: 04357B | 4.03.42025 | 23:30 UTC | 106km

ECA\_EXAB\_CPR\_FMR\_2A\_20250304T231805Z\_20250304T235918Z\_04357B.h5



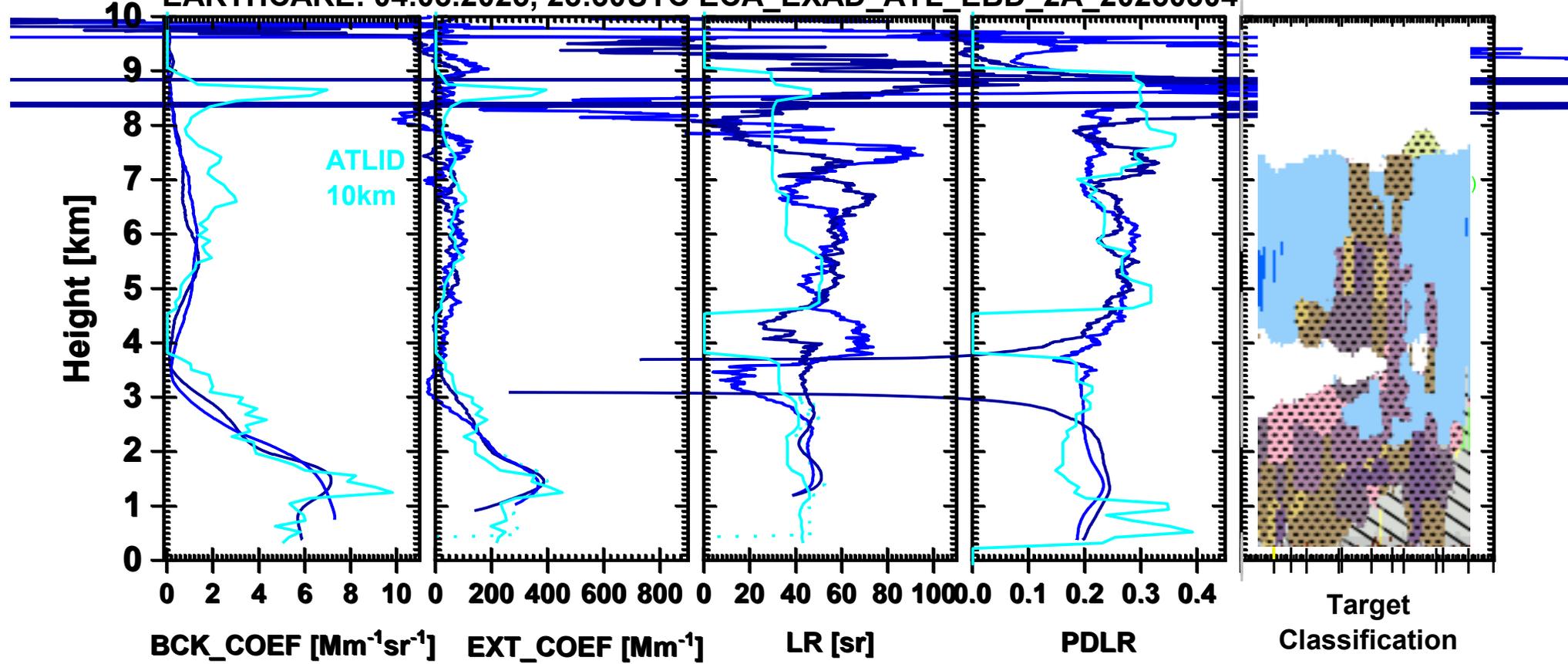
PollyXT\_CYP, Limassol, Cyprus,  
 5 March 2025, 00:00-02:30UTC  
 + EarthCARE ATLID A-EBD (AC)

Ascending overpass  
 Min distance= 116Km  
 Wind speed= 34-40km/hour  
 Wind dir = East  
 2-3 hours delay at GB observations



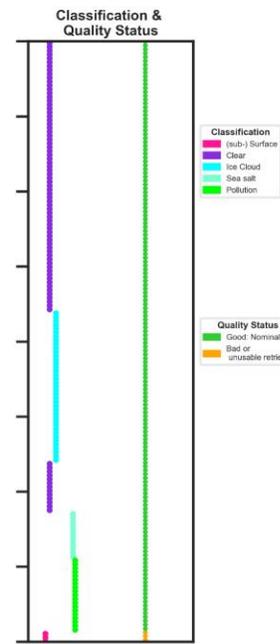
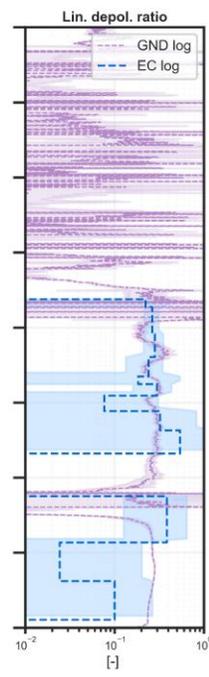
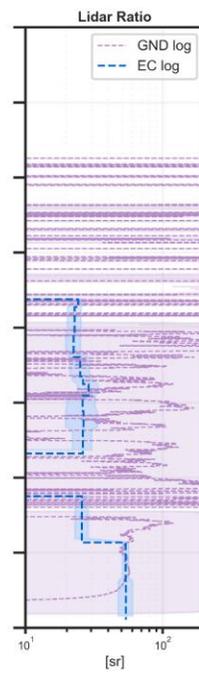
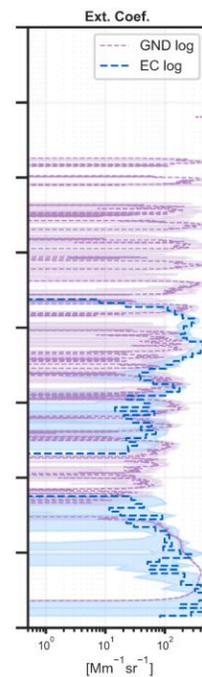
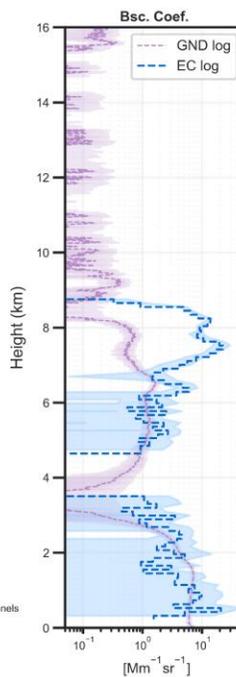
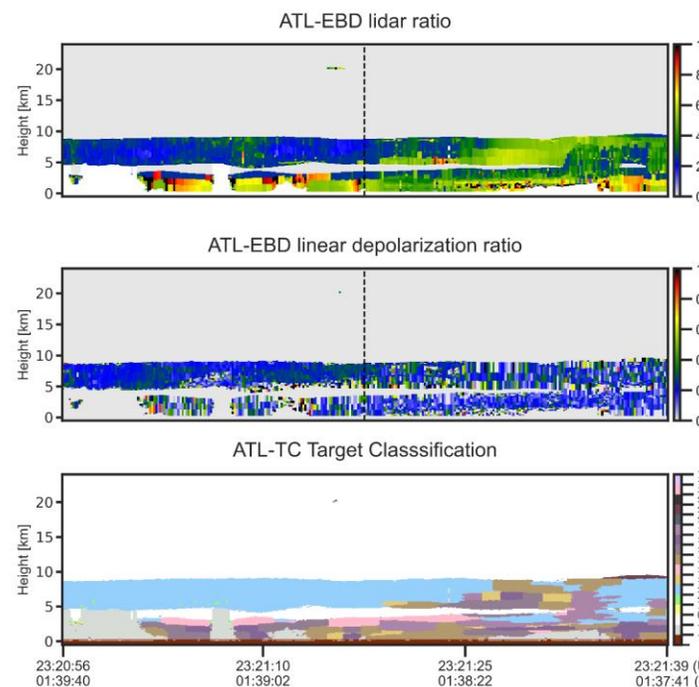
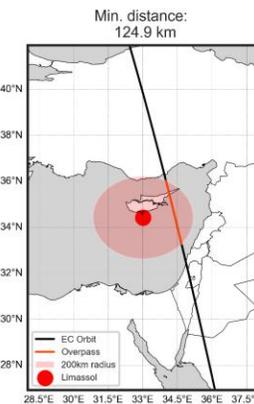
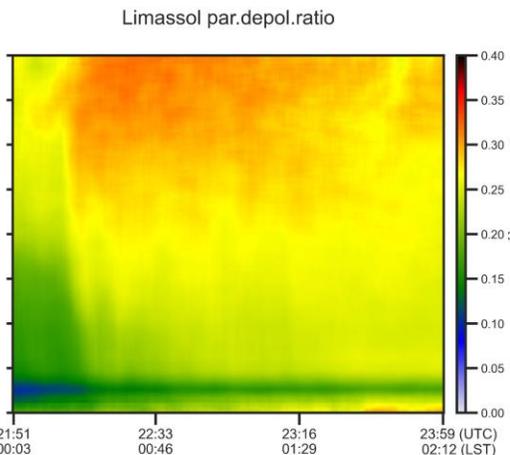
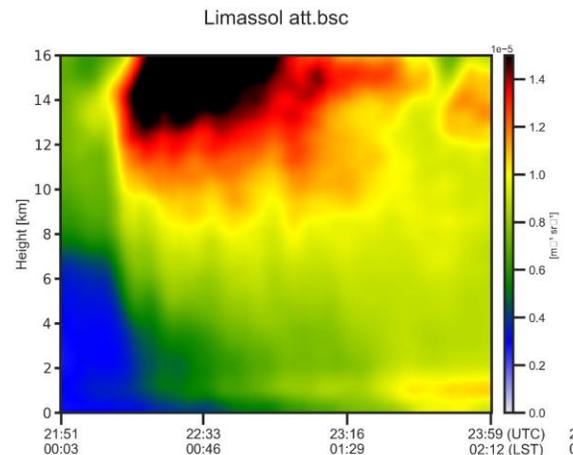
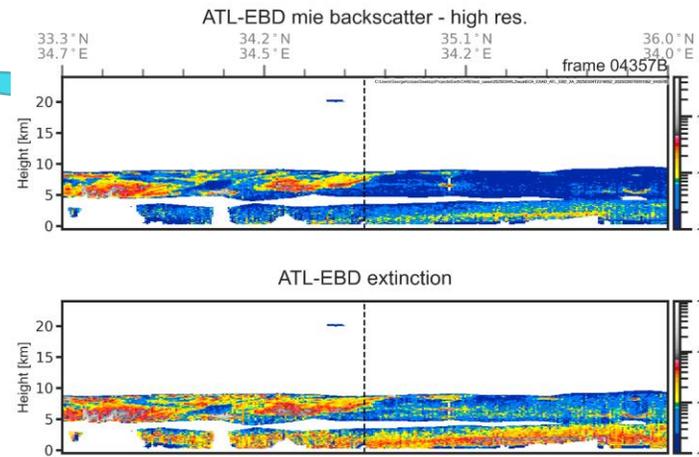
CARO-LIM: 04.03.2025, 23:00-24:00 | 05.03.2025 00:00-02:30 UTC

EARTHCARE: 04.03.2025, 23:30UTC ECA\_EXAD\_ATL\_EBD\_2A\_20250304





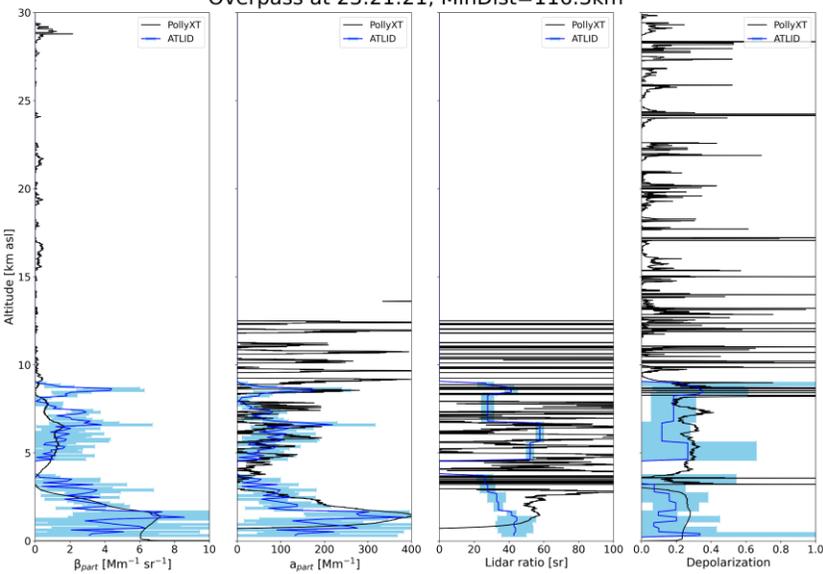
# EarthCARE A-EBD(AD) & A-TC(AD) Comparison with Limassol Ground Station L2 POLLYXT - Raman Retrieval 04-03-2025 23:21:18.18 UTC



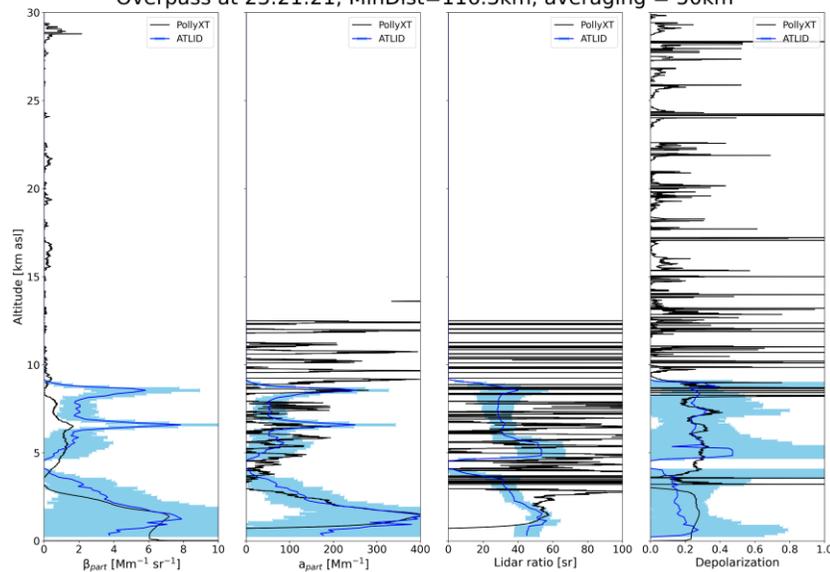


# EARTHCARE vs POLLY LV2 Auto processing

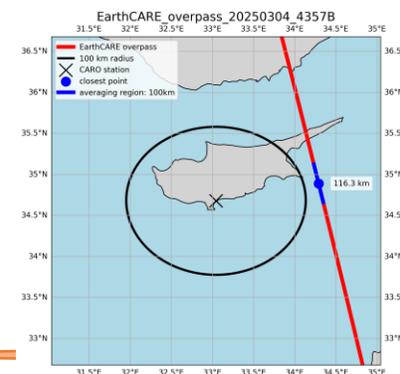
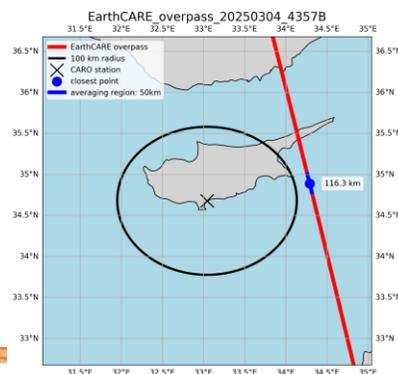
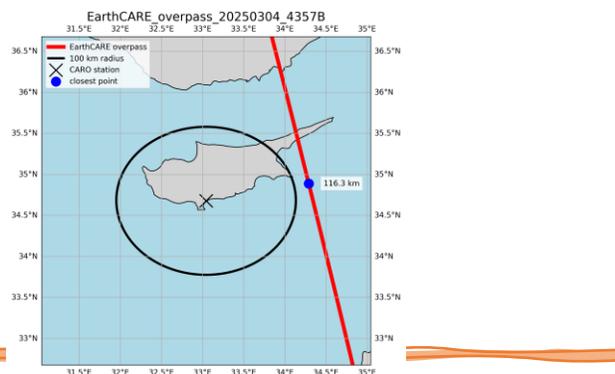
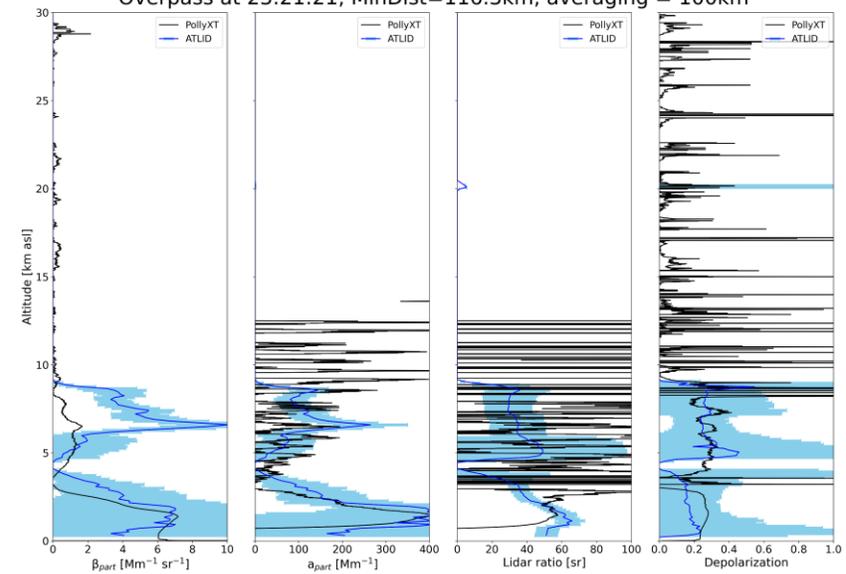
AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km



AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km, averaging = 50km

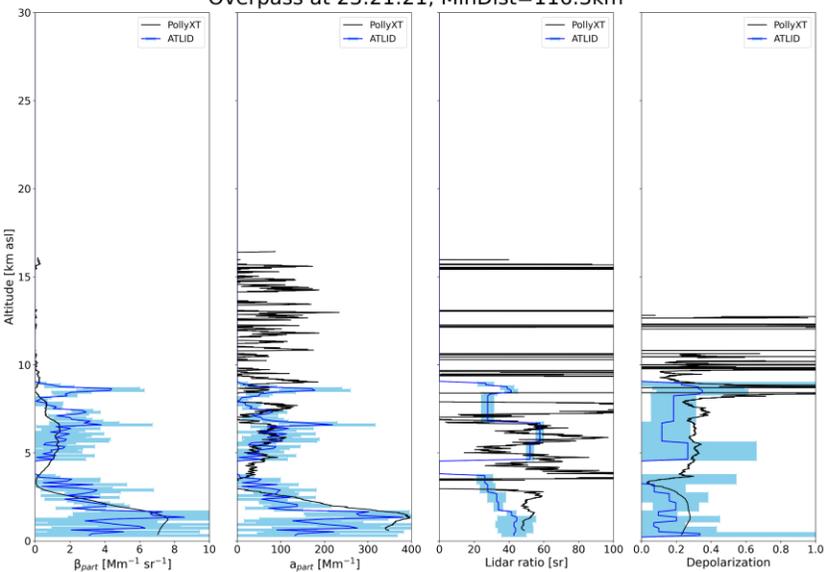


AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km, averaging = 100km

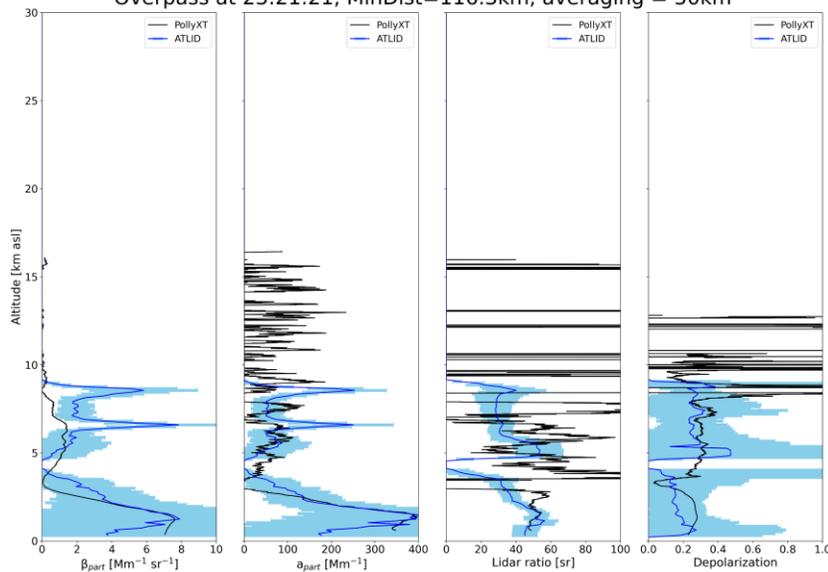


# EARTHCARE vs POLLY manual processing

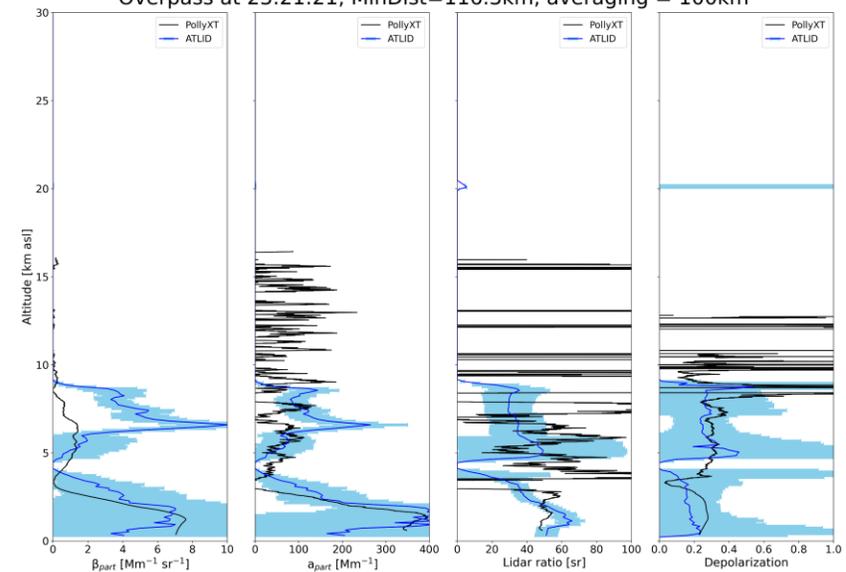
AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km



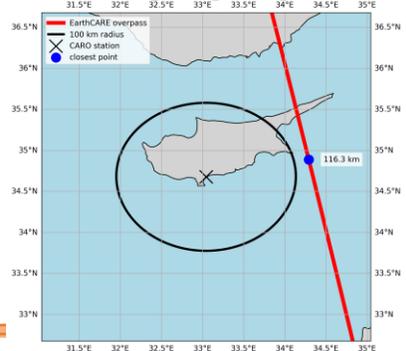
AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km, averaging = 50km



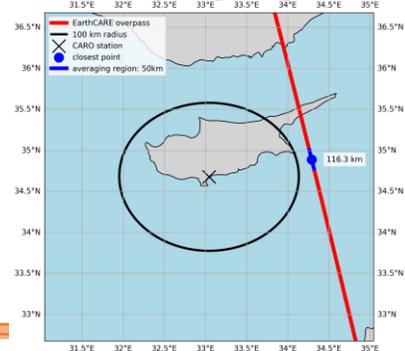
AEBD(AD)\_20250304\_4357B  
Overpass at 23:21:21, MinDist=116.3km, averaging = 100km



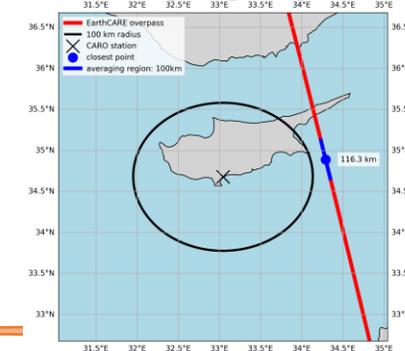
EarthCARE overpass\_20250304\_4357B



EarthCARE overpass\_20250304\_4357B



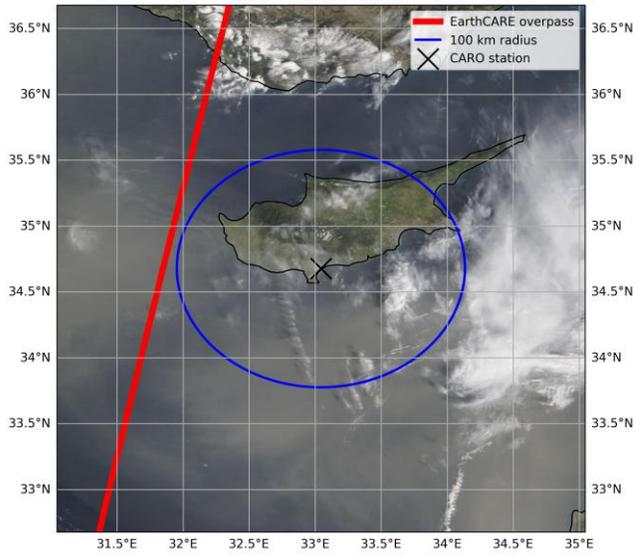
EarthCARE overpass\_20250304\_4357B



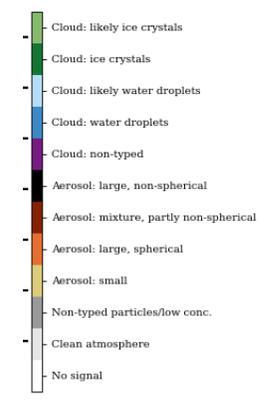
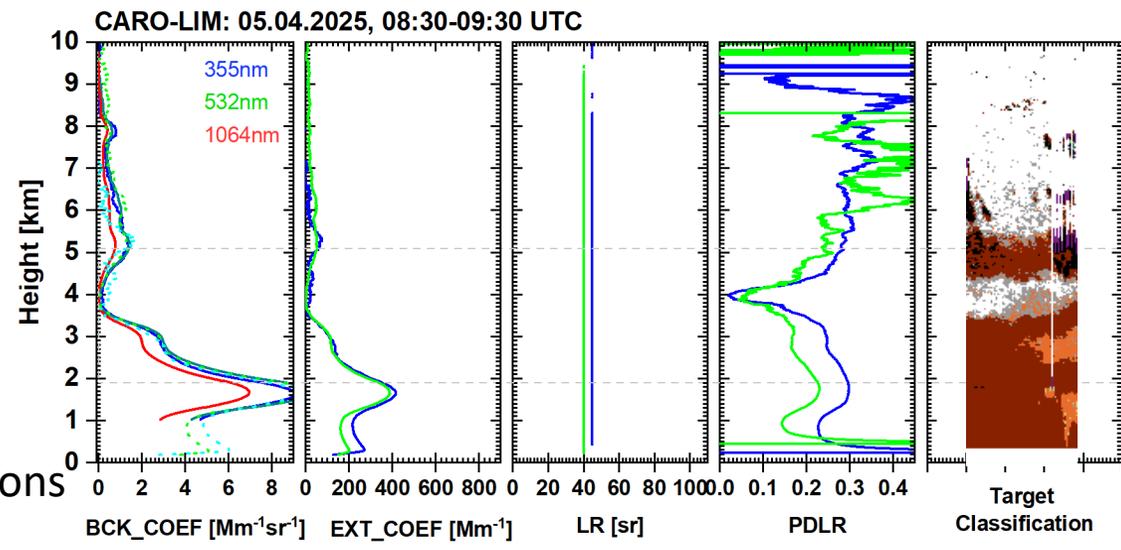
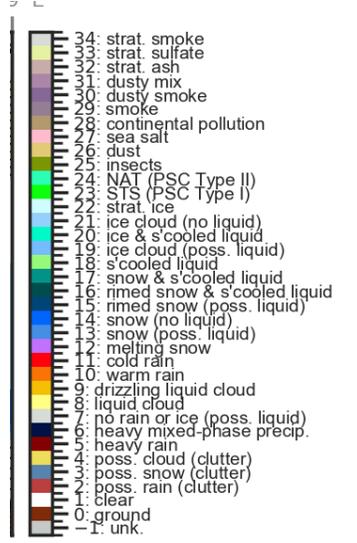
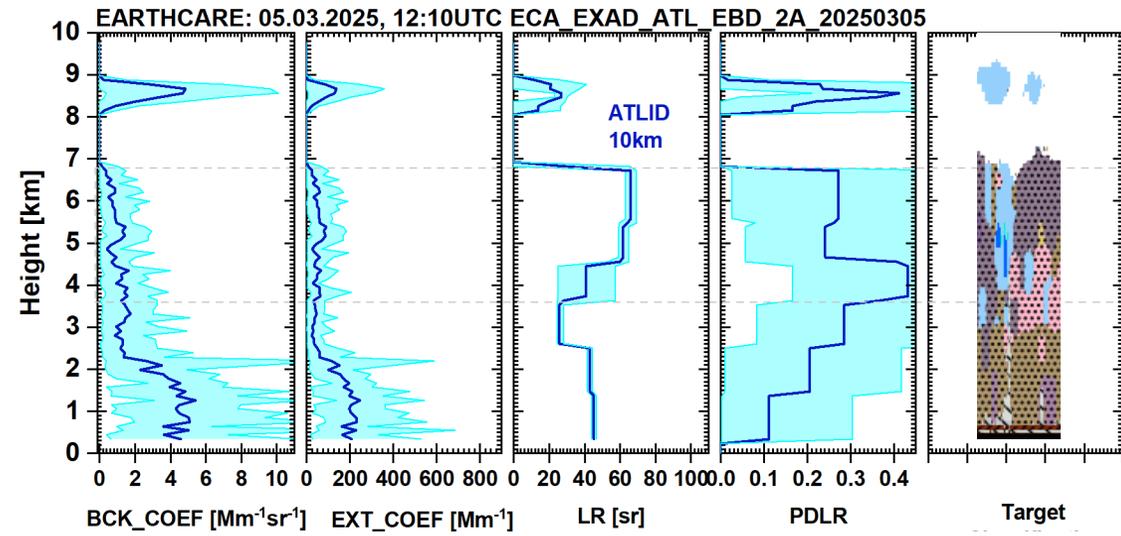


# FRAME: 04365D | 05.03.2025 | 12:10 UTC | 108km

ECA\_EXAB\_CPR\_FMR\_2A\_20250305T120121Z\_20250305T141124Z\_04365D.h5



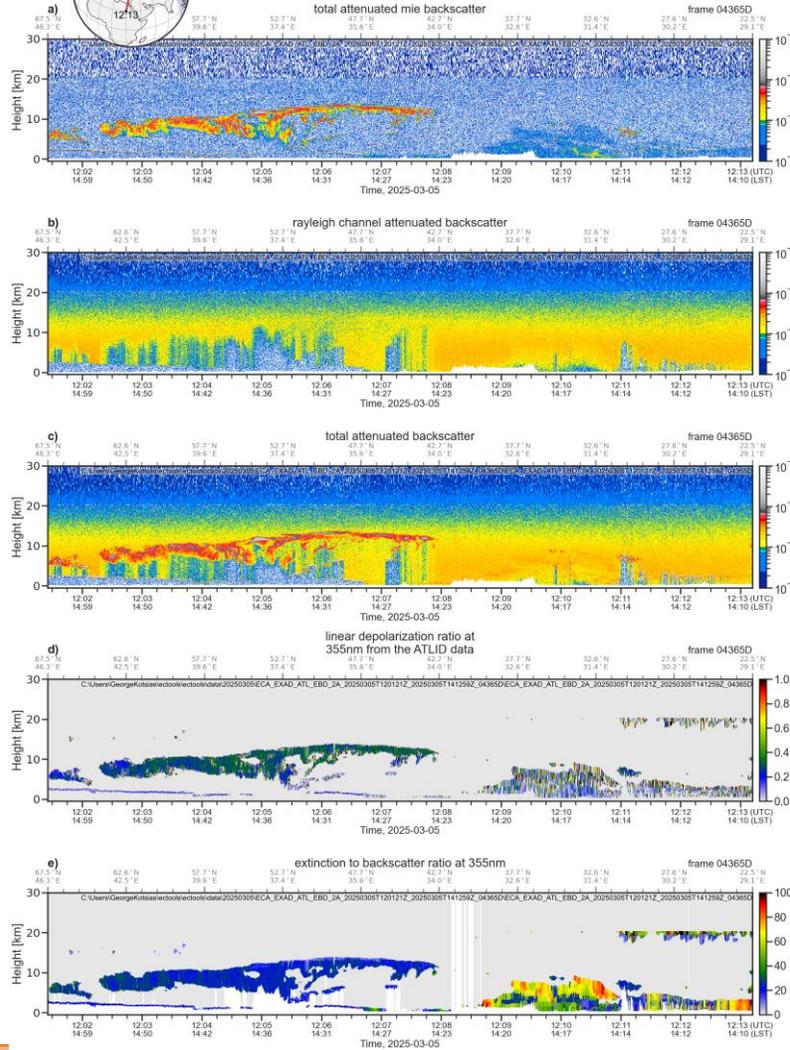
PollyXT\_CYP, Limassol, Cyprus,  
 5 March 2025, 08:30-09:30UTC  
 + EarthCARE ATLID A-EBD (AC)  
 Descending overpass  
 Min distance= 108Km  
 Wind speed= 34-40km/hour  
 Wind dir = East  
 2-3 hours before overpass time GB observations





ATARRI

# FRAME: 04365D | 05.03.2025 | 12:10 UTC | 108km

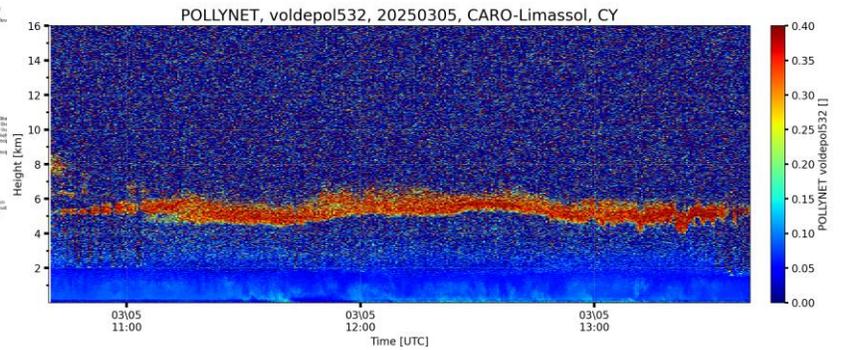
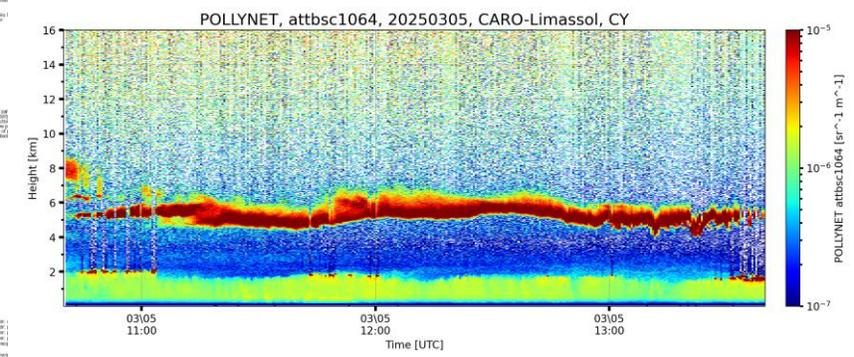
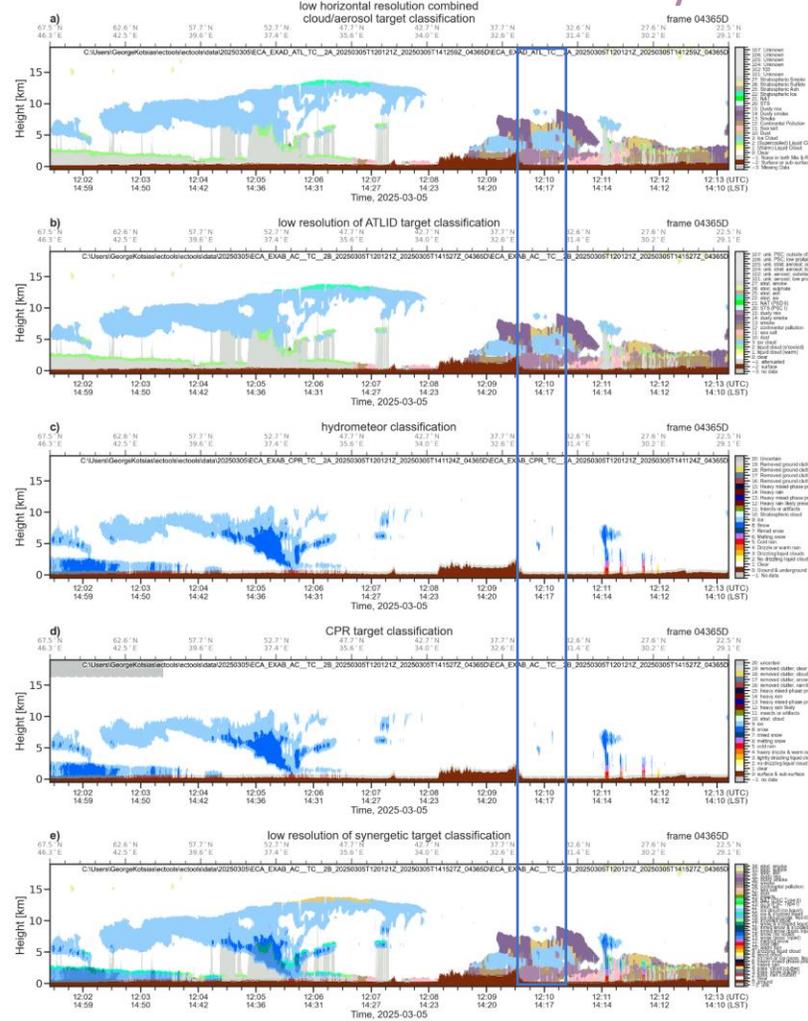


Dusty smoke

Ice clouds

Dust

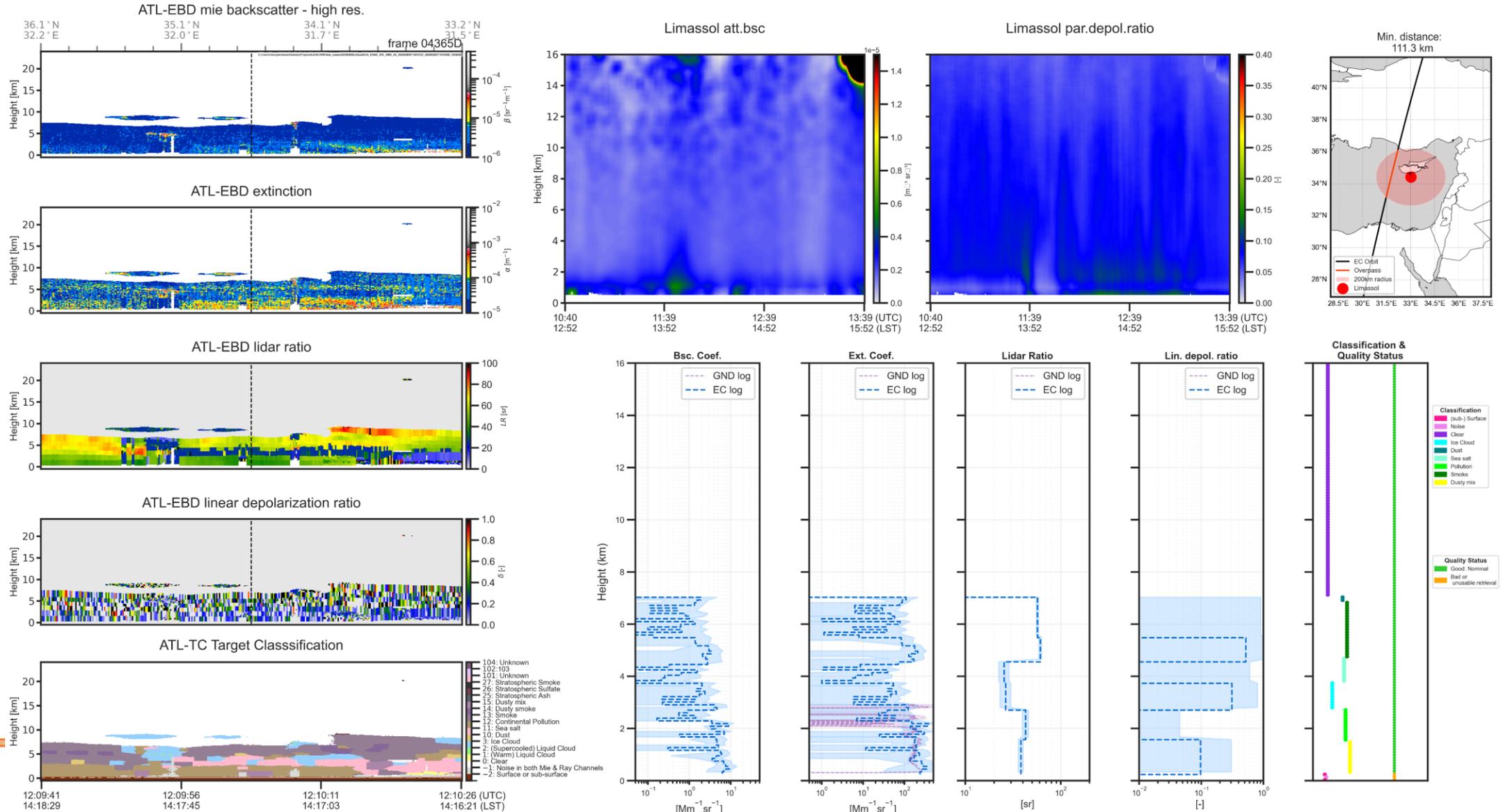
Dusty mix





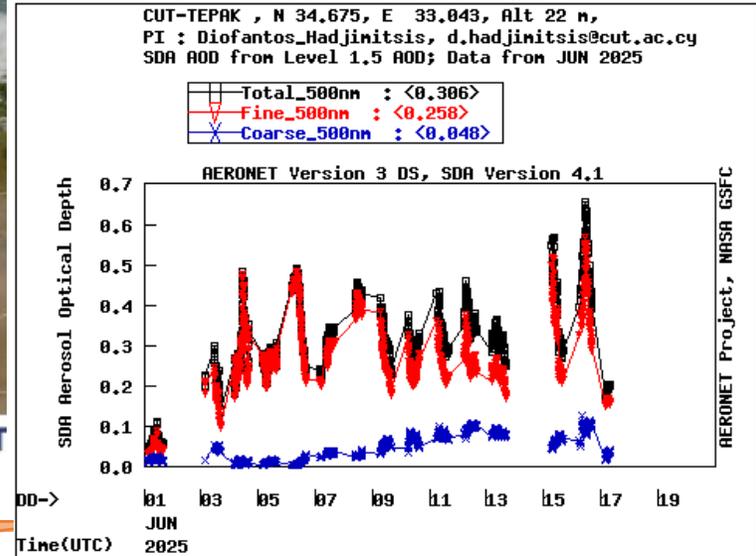
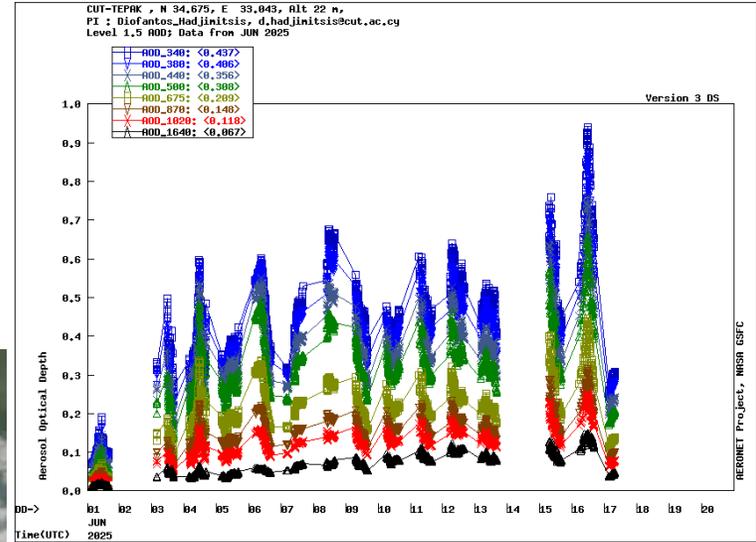
# EC-VALTOOL (RAMAN)

EarthCARE A-EBD(AD) & A-TC(AD) Comparison with  
Limassol Ground Station L2 POLLYXT - Raman Retrieval  
05-03-2025 12:10:04.28 UTC

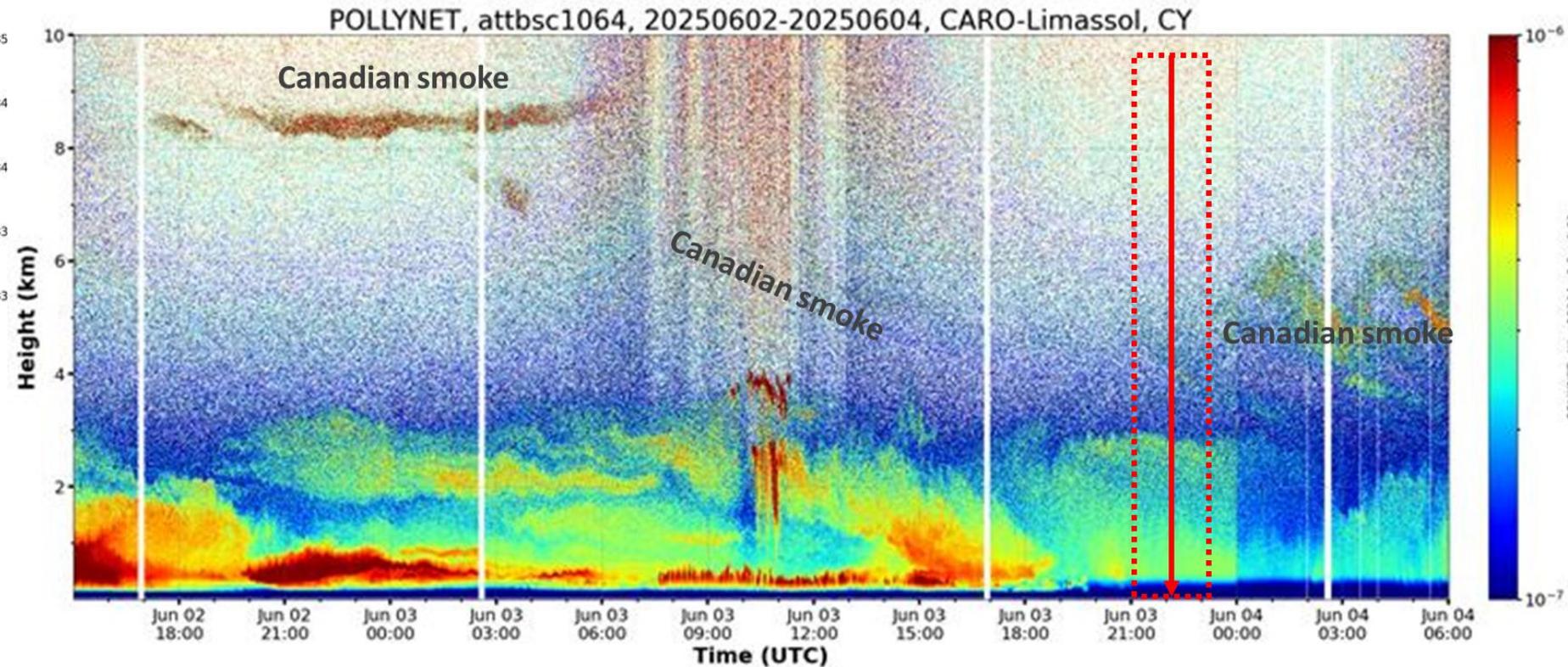
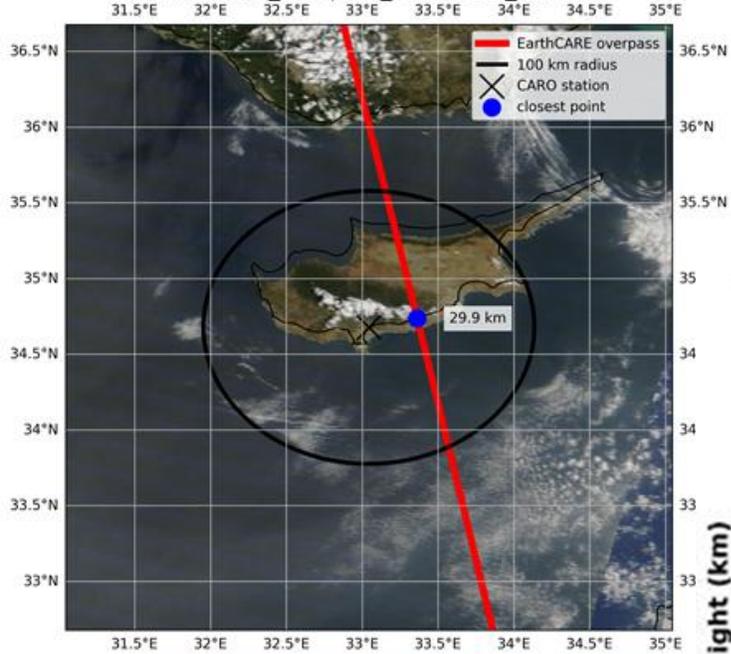


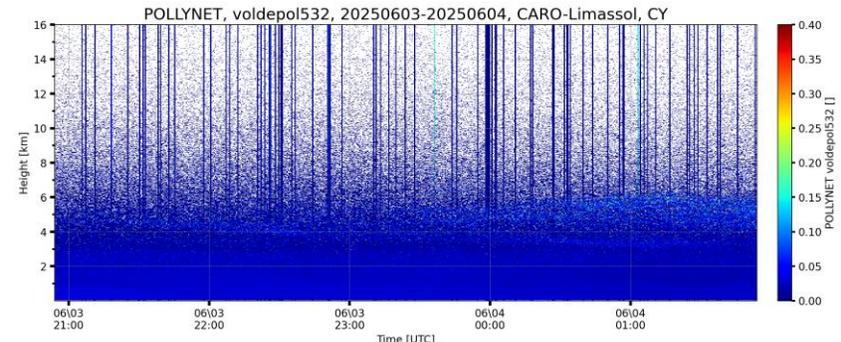
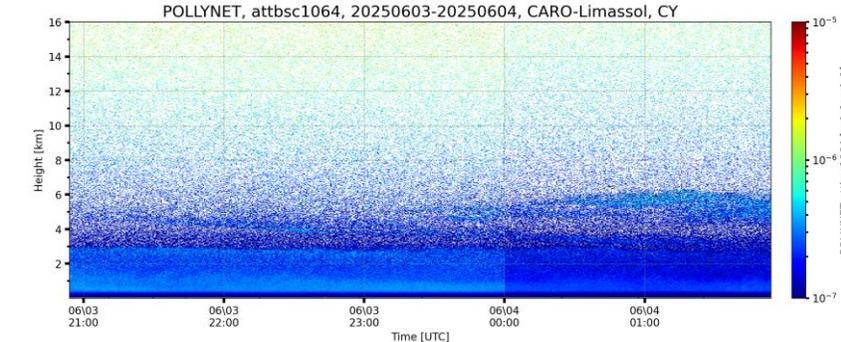
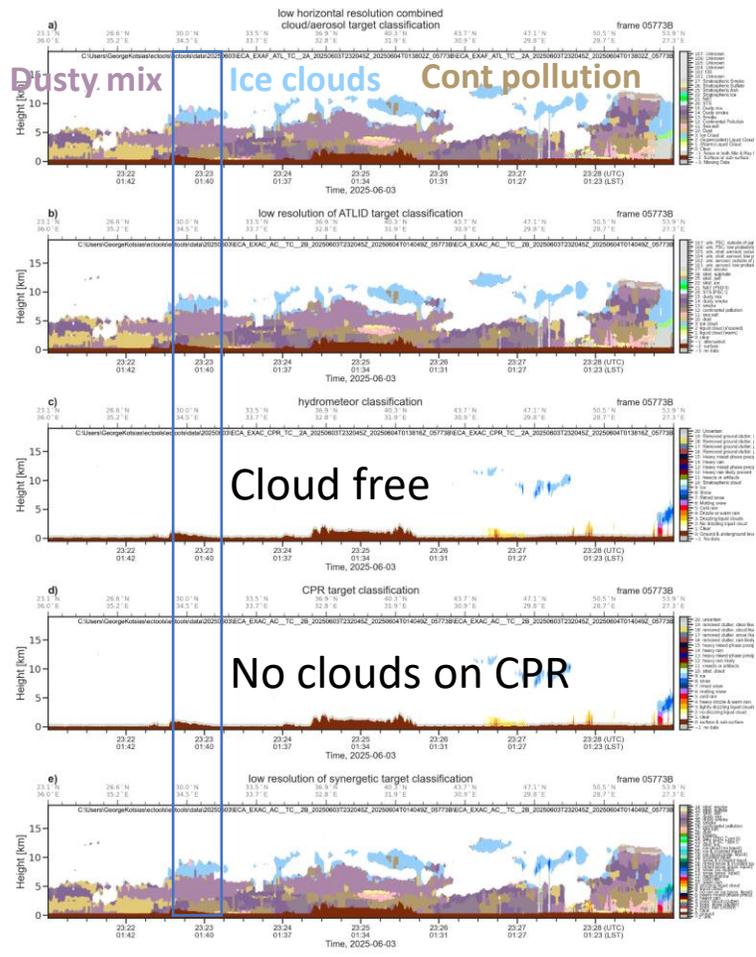
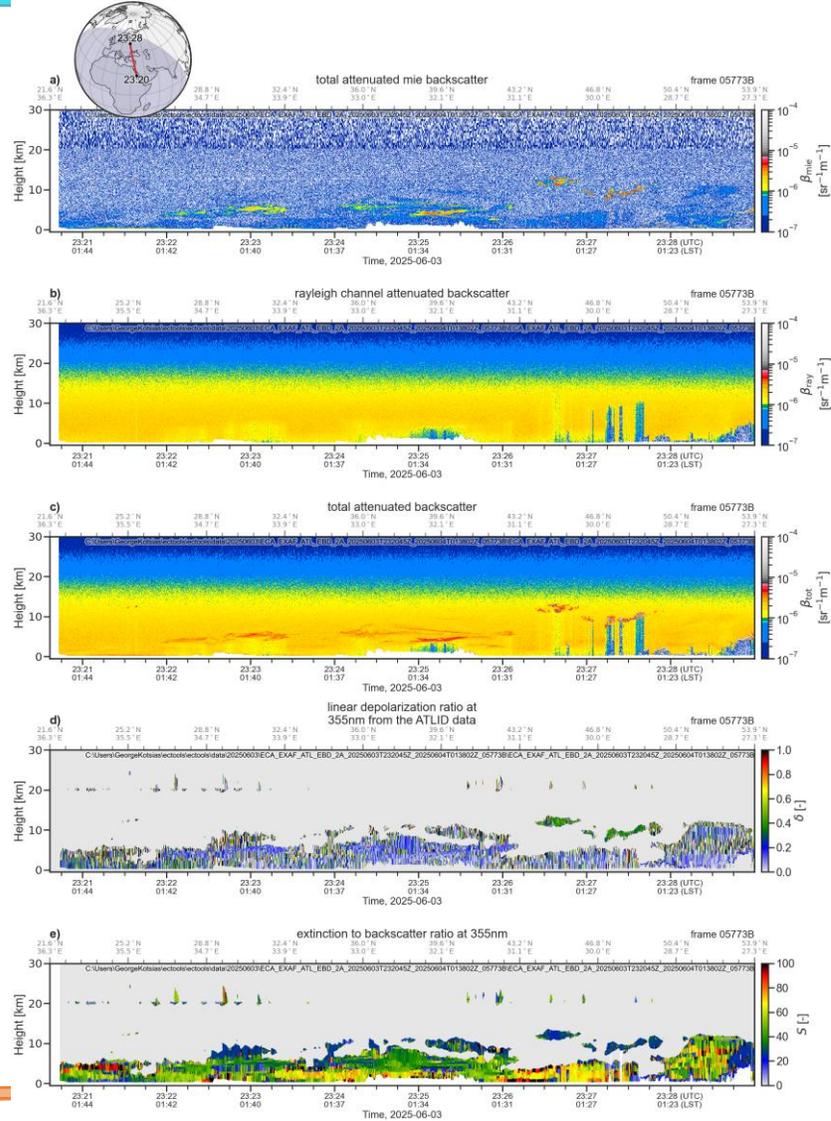
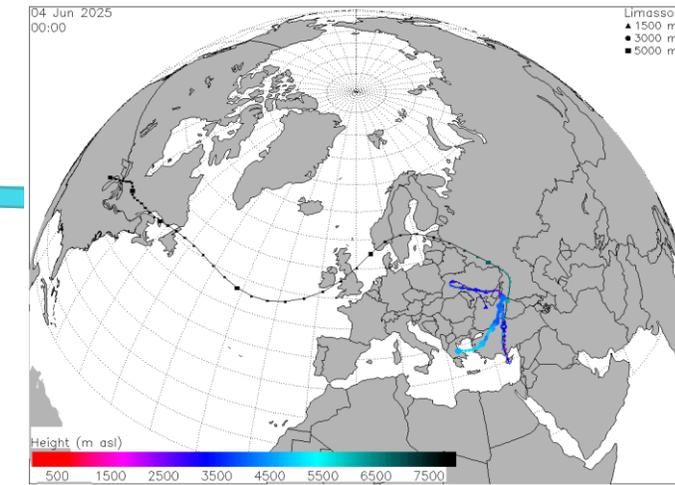
# CANADIAN FIRES: SMOKE PLUME OVER EUROPE

**SMOKE PLUM!**



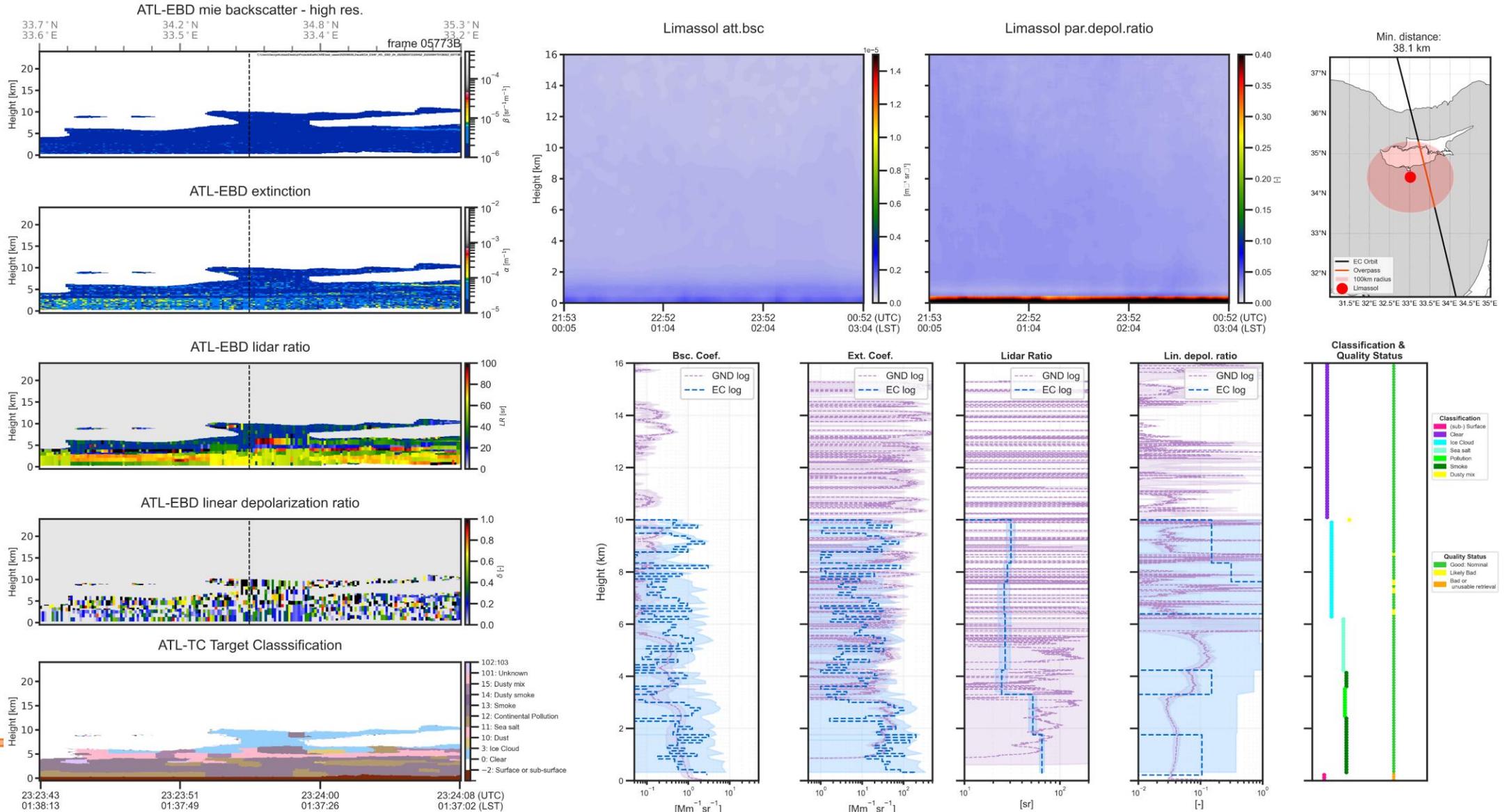
EarthCARE\_overpass\_20250603\_5773B





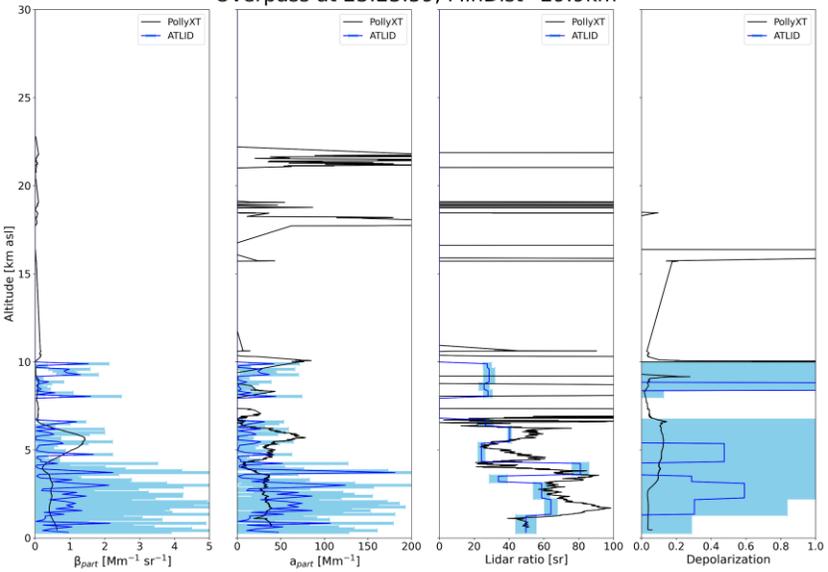
# EC-VALTOOL (RAMAN)

EarthCARE A-EBD(AF) & A-TC(AF) Comparison with  
Limassol Ground Station L2 POLLYXT - Raman Retrieval  
03-06-2025 23:23:56.10 UTC

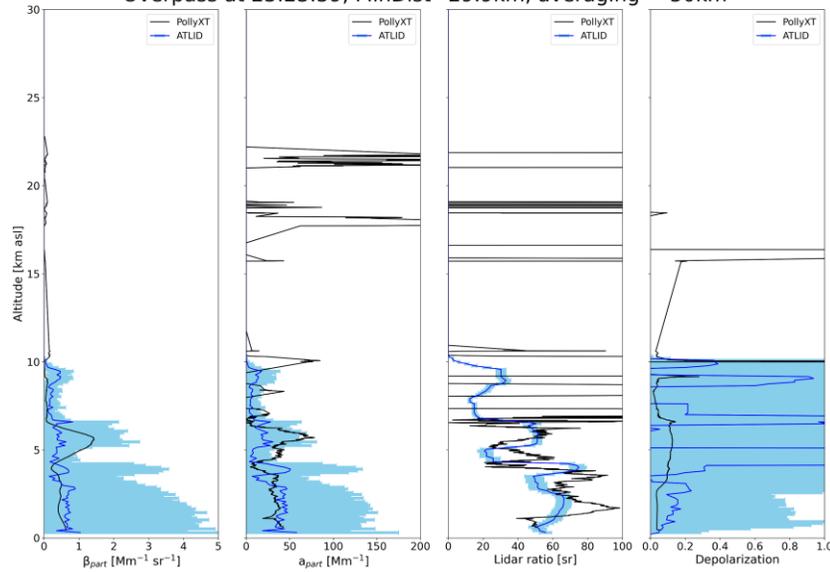


## EARTHCARE vs POLLY manual processed DATA

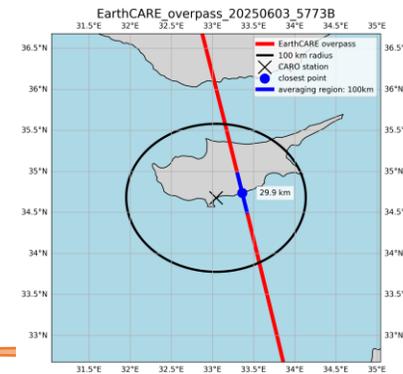
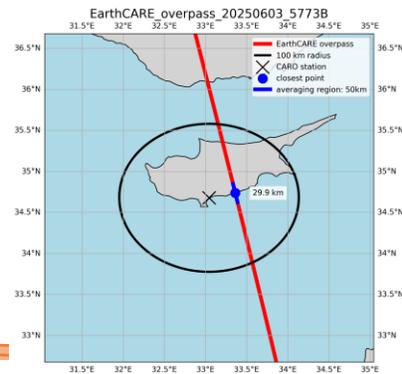
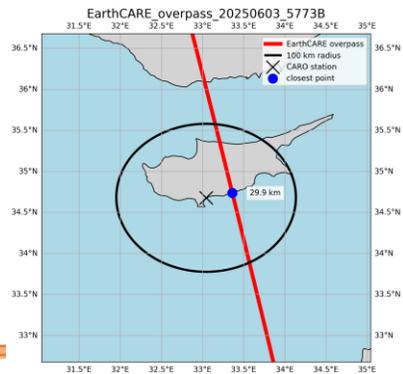
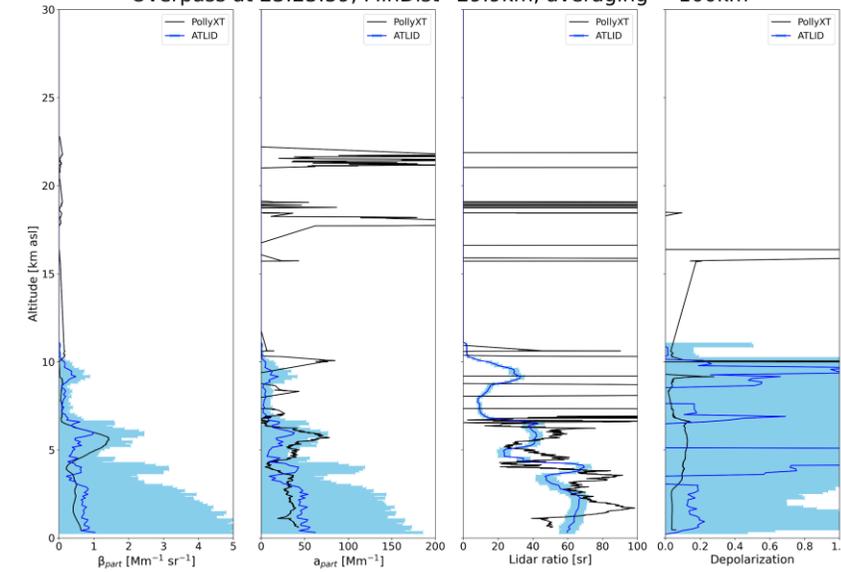
AEBD(AF)\_20250603\_5773B  
Overpass at 23:23:59, MinDist=29.9km



AEBD(AF)\_20250603\_5773B  
Overpass at 23:23:59, MinDist=29.9km, averaging = 50km



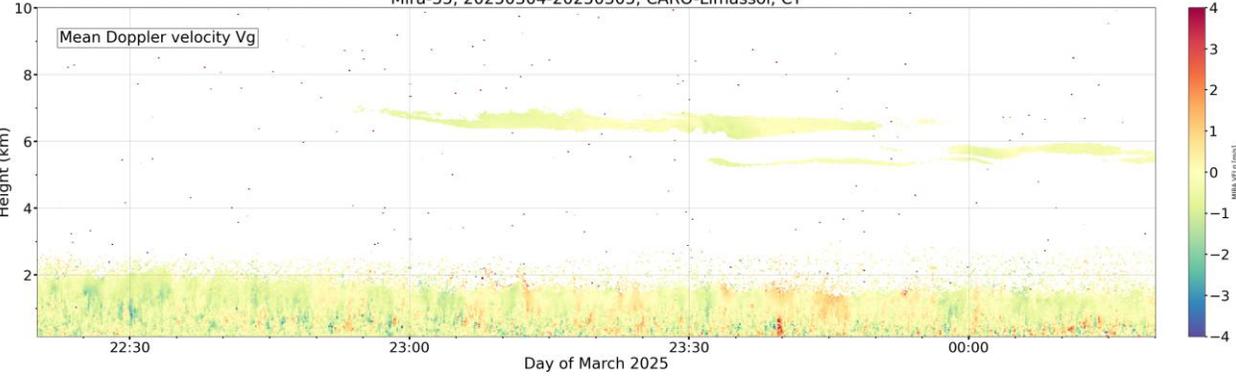
AEBD(AF)\_20250603\_5773B  
Overpass at 23:23:59, MinDist=29.9km, averaging = 100km



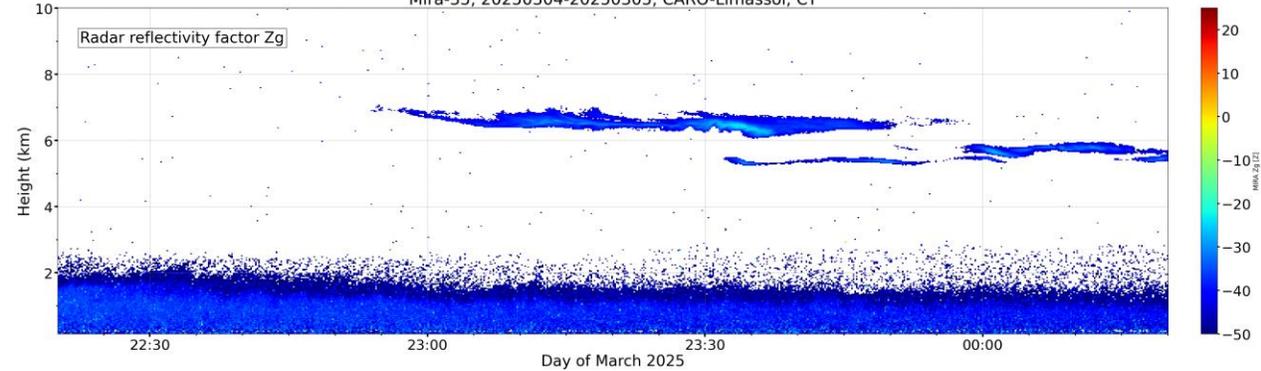


# Future steps: CPR products

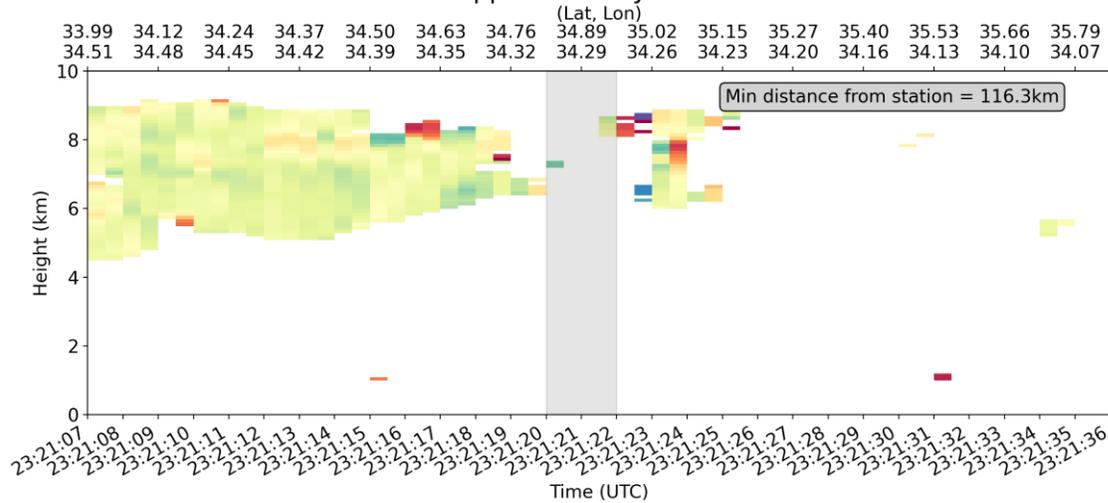
Mira-35, 20250304-20250305, CARO-Limassol, CY



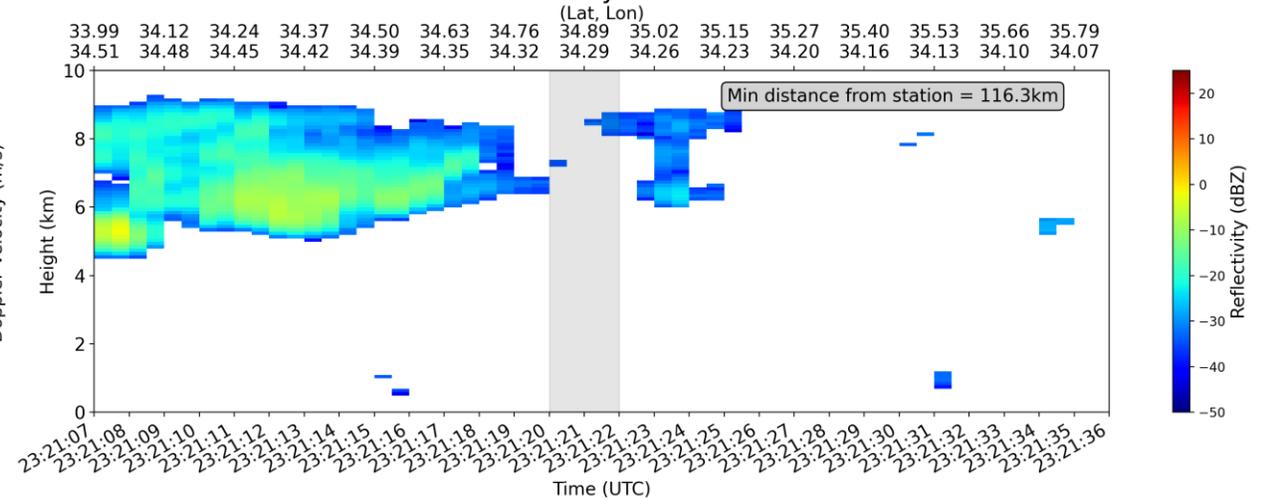
Mira-35, 20250304-20250305, CARO-Limassol, CY



CPR Doppler Velocity at 20250304



CPR Reflectivity at 20250304



- **Continuous suborbital measurements with CARO-Limassol Lidar and Radar**
- Continue measurements & quantification of L2 product differences
- To expand the evaluation to different aerosol types
- Participation to the activities of the RACE and ACROSS community intense operations including radiation/cloud/in-situ measurements
- Use of CLOUDNET observations for CPR validation

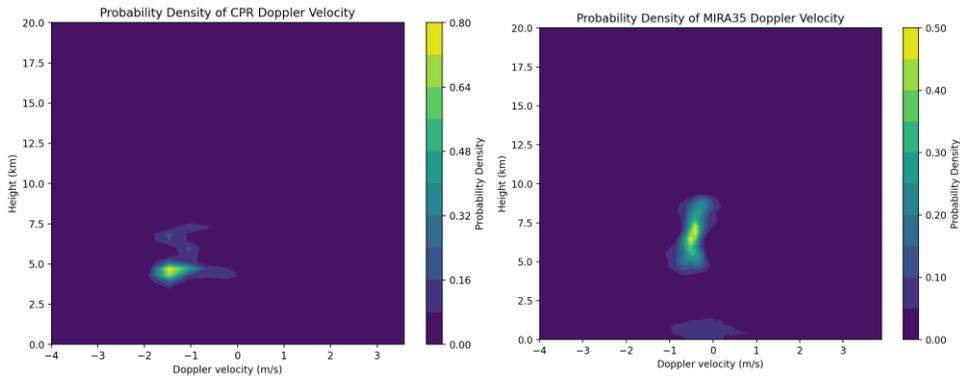


## EarthCARE Campaign

Thessaloniki, Greece  
22 April – 22 May 2025

**Objectives of the Campaign**

- Direct EarthCARE validation
- Spatiotemporal variability of aerosol-cloud-radiation interactions
- Low-cost sensor intercalibration
- 3D cloud structures





Funded by the  
European Union

# THANK YOU

*This project has received funding from the European Union's Horizon Europe Framework Programme under the grant agreement No 101160258. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union.*





POLLYNET, attbsc1064, 20250304-20250305, CARO-Limassol, CY

