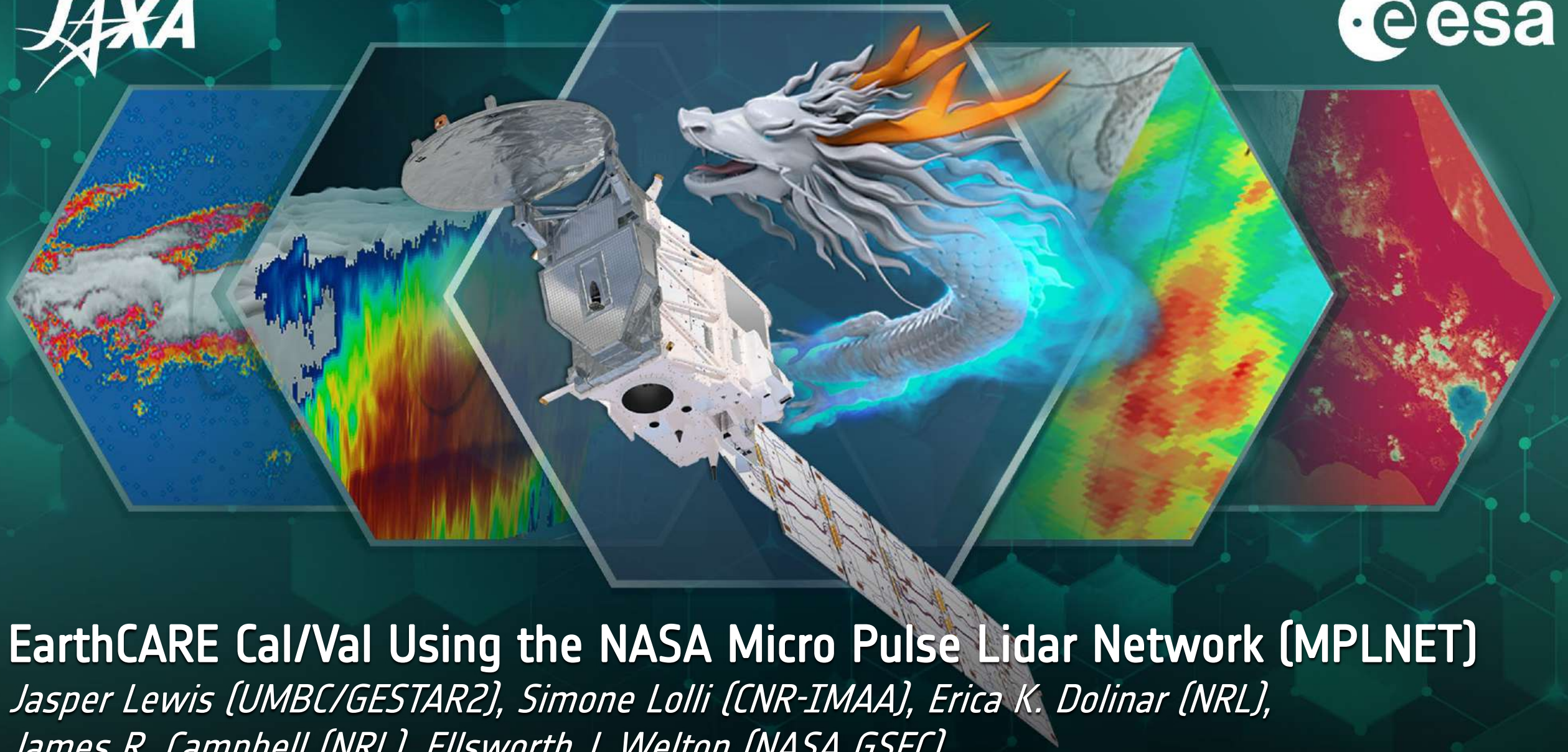

EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET)

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2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop
17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

MPLNET Validation Overview

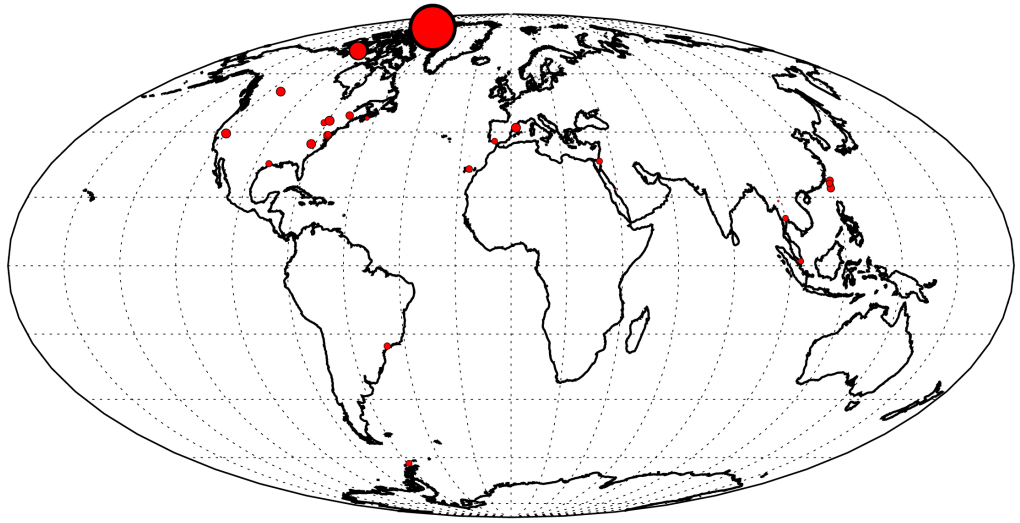
- MPLNET is a global, federated network of Micro Pulse Lidars for aerosol and cloud profiling (**Website: mplnet.gsfc.nasa.gov**)
- Eye-safe single wavelength (**532-nm**) elastic backscatter with narrow FOV (**~100 µrad**)
- Autonomous, 24/7 measurements spanning **25+ years**. Several sites with over 5 or 10 years of observations

- Funded through NASA Earth Science US Participating Investigator Program (NNH20ZDA001N-EUSPI; 2021 – 2026) for EarthCARE validation
- Primary task is to validate **ATLID L2** products, including aerosol, cloud, and PBL heights
- Producing **L3** time-gridded MPLNET diurnal products and **L3-EC** products corresponding to EarthCARE overpasses with the goal of assessing **representativeness** of both datasets

- Started processing MPLNET Version 3, L2 products for input to L3/L3-EC products
- EarthCARE comparisons are made using L2 target classification **(A-TC),** aerosol layer descriptor **(A-ALD)** and extinction, backscatter, and depolarization products **(A-EBD)**
- Upload to EVDC for L2 and L3-EC products in GEOMS format is semi-automated. MPLNET L3 products will be available for download through our website.

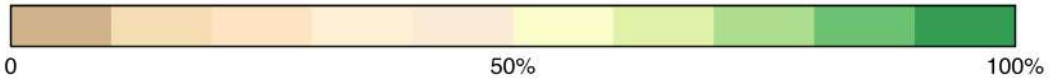
MPLNET Validation Data Collection

Number of overpasses (September 2024 – February 2025)



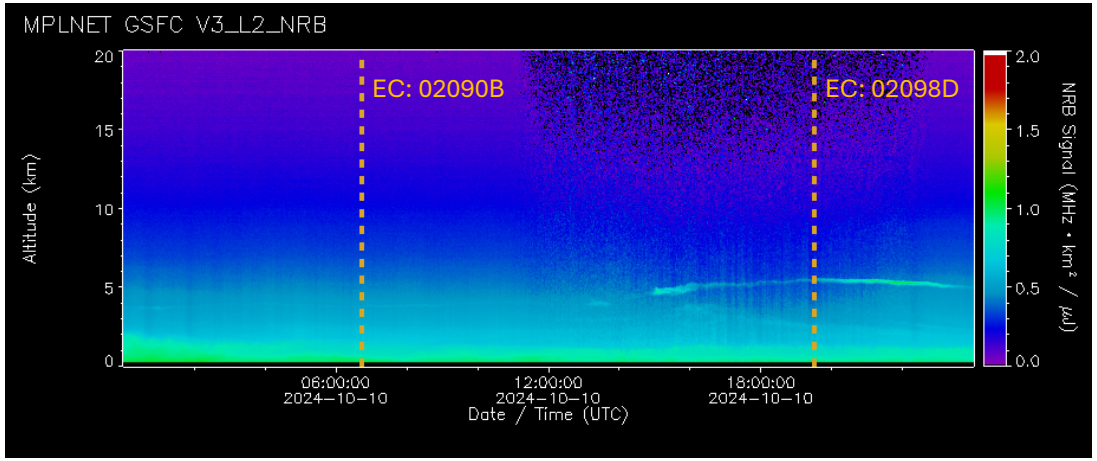
- Twenty-seven active sites during validation period
- Median number of overpasses per site = 31
- Most have signal data collections between 80-100%, though QA may reduce actual data availability
- **Note:** Level 2 aerosol products are limited by AERONET availability. Clouds products can be processed independently.

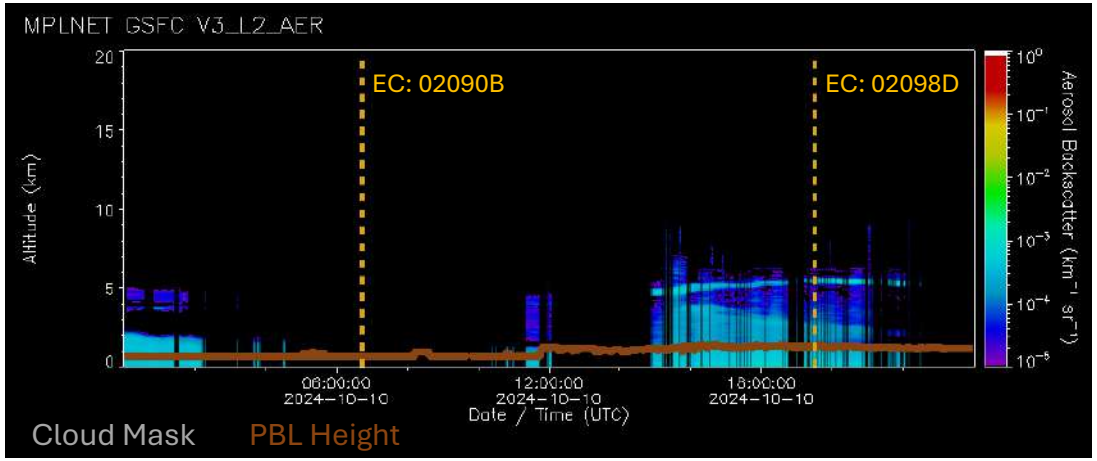
SITE	LAT	LON	EC	MPLNET+EC	MPLNET	AERONET+EC	AERONET
Appalachian_State	36.215	-81.694	36	31	155	0	0
Barcelona	41.386	2.117	29	29	179	0	0
CARTEL	45.379	-71.931	37	37	181	0	0
Cambridge_Bay	69.121	-105.040	86	28	62	0	0
Douliu	23.712	120.545	31	31	180	0	0
EPA-NCU	24.967	121.181	36	36	181	0	0
El_Arenosillo	37.105	-6.734	22	22	181	11	71
GSFC	38.993	-76.840	22	22	181	1	16
Izana	28.309	-16.499	27	24	153	7	56
Kaohsiung	22.676	120.292	37	37	181	10	51
London-CDN	43.008	-81.270	31	31	181	0	0
OPAL	79.990	-85.939	181	180	180	0	0
SEDE_BOKER	30.855	34.782	30	27	163	0	0
Sandy_Cove	44.469	-63.553	21	19	85	N/A	N/A
Santa_Cruz_Tenerife	28.472	-16.247	33	33	180	0	0
Sao_Paolo	-23.562	-46.735	32	26	149	0	0
Silpakorn_Univ	13.819	100.041	22	18	161	0	0
Singapore	1.298	103.780	28	27	175	0	0
Stony_Plain	53.547	-114.109	43	22	105	0	0
Toronto_Downtown	43.660	-79.399	43	43	181	N/A	N/A
UH_Liberty	30.097	-94.763	31	17	107	0	0
UMBC	39.255	-76.710	15	15	179	0	0
Univ_of_Nevada-Reno	39.541	-119.814	22	17	139	8	75
Xitun	24.162	120.617	31	31	181	0	0
P. S. AstroPark	18.851	98.958	8	2	17	0	0
King_George_Island	-62.202	-58.966	30	27	83	N/A	N/A
KAUST_Campus	22.305	39.103	10	4	19	0	0



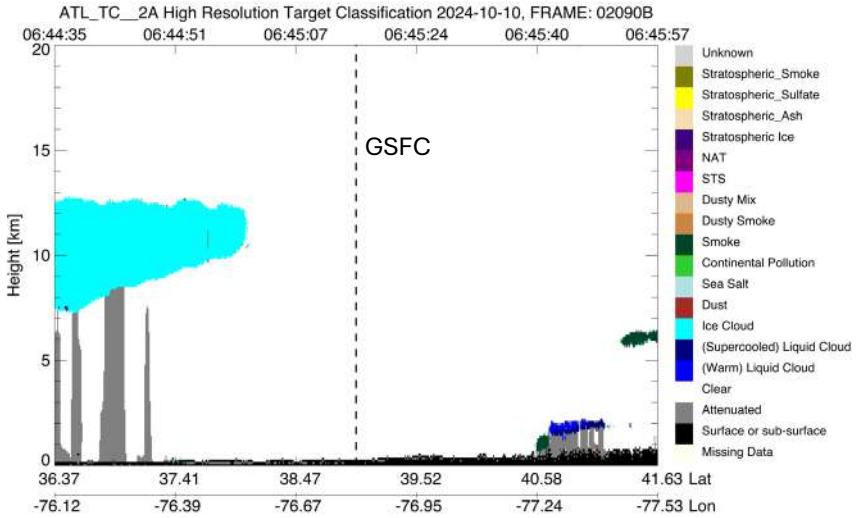
Case Study 1: GSFC, 10 Oct 2024

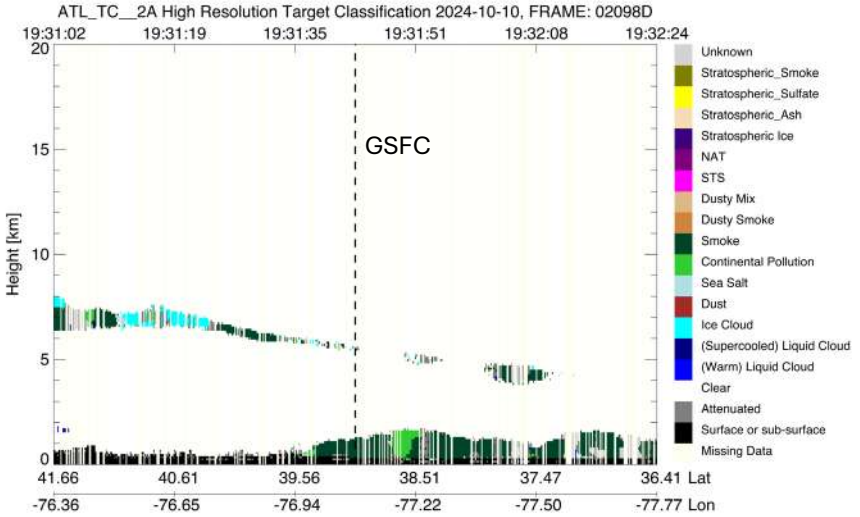
MPLNET

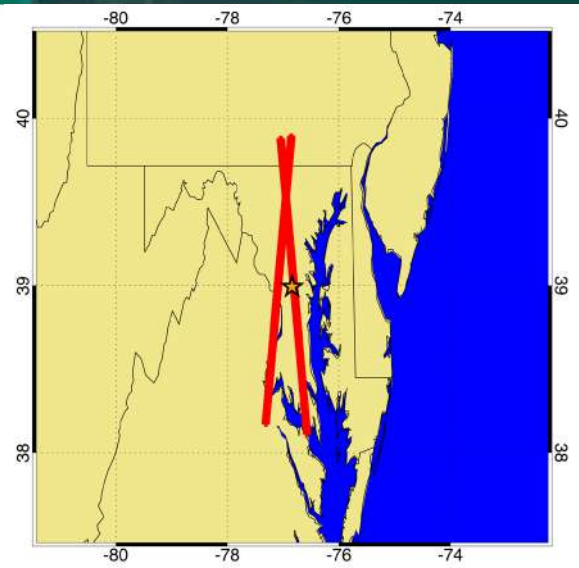




EarthCARE





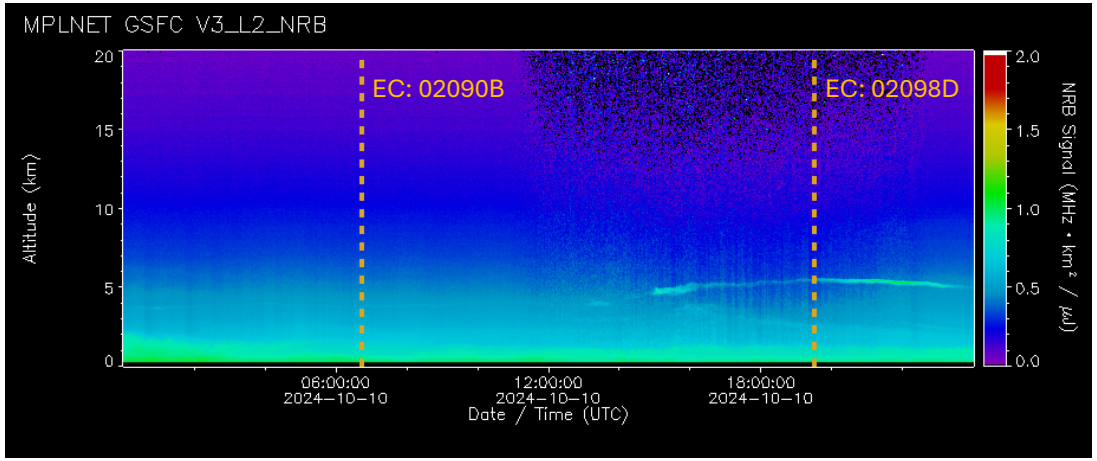


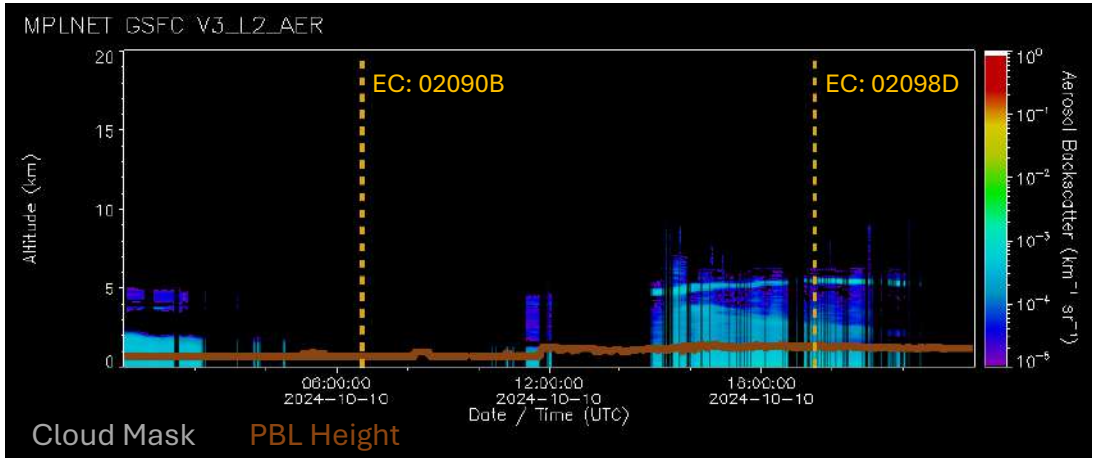
Conditions: Aerosol/No clouds
Frames: 02090B, 02098D
Baseline: AC, AD
Distance: 3 km, 22 km

- Aerosol plume detected by MPLNET and ATLID ~5.5 km
- ATLID surface-attached aerosol and MPLNET PBL between 1.3 – 1.5 km

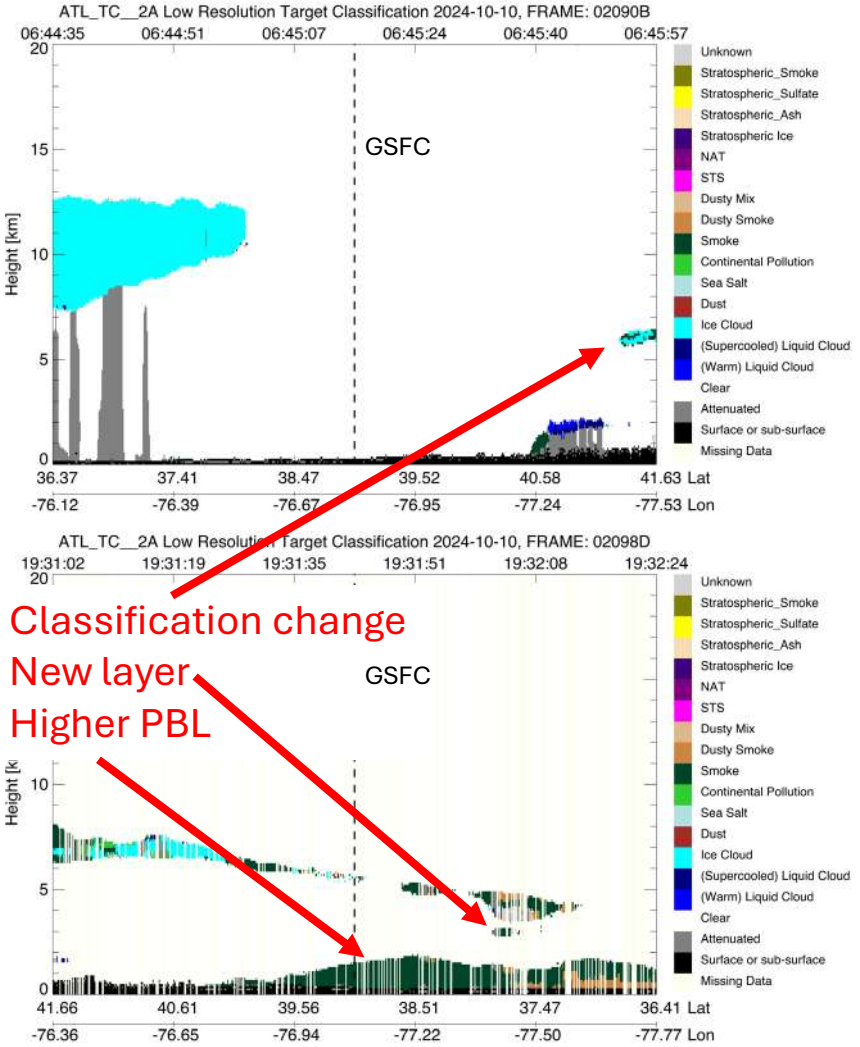
Case Study 1: GSFC, 10 Oct 2024

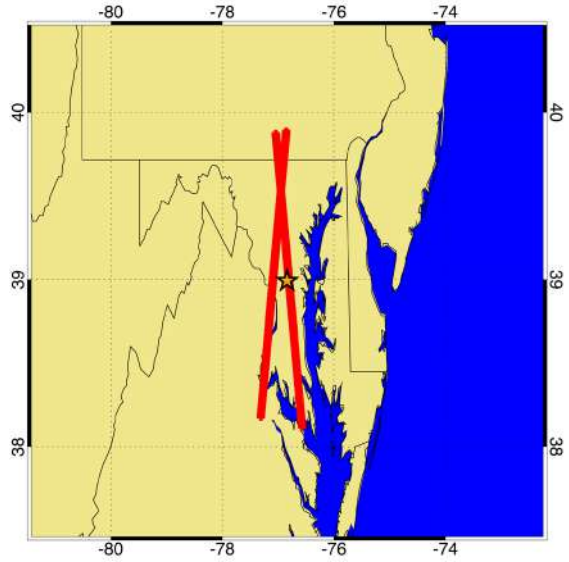
MPLNET





EarthCARE (Low Resolution)



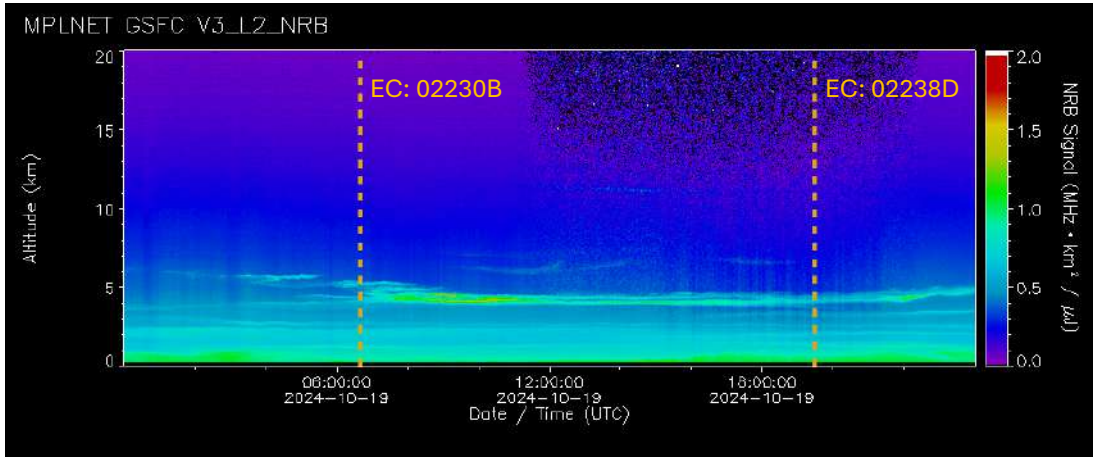


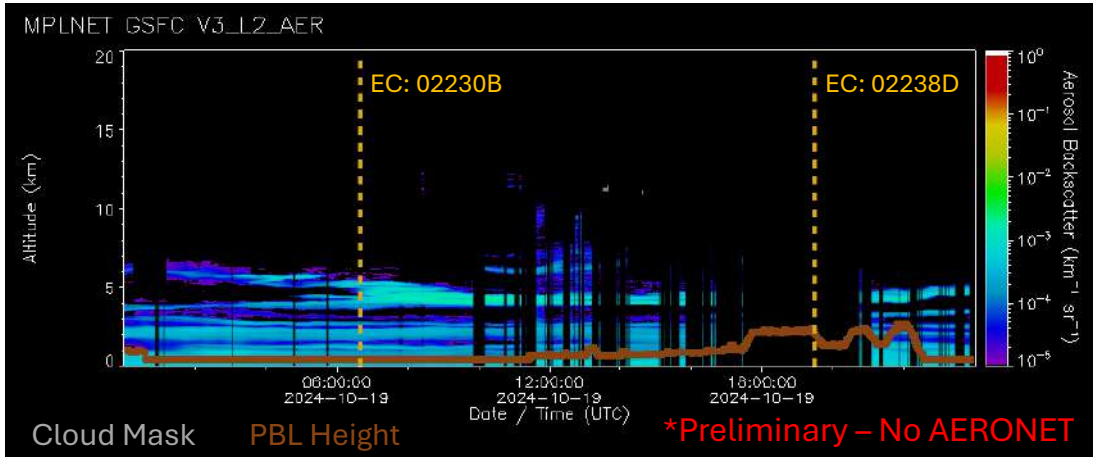
Conditions: Aerosol/No clouds
Frames: 02090B, 02098D
Baseline: AC, AD
Distance: 3 km, 22 km

- Aerosol plume detected by MPLNET and ATLID ~5.5 km
- ATLID surface-attached aerosol and MPLNET PBL between 1.3 – 1.5 km

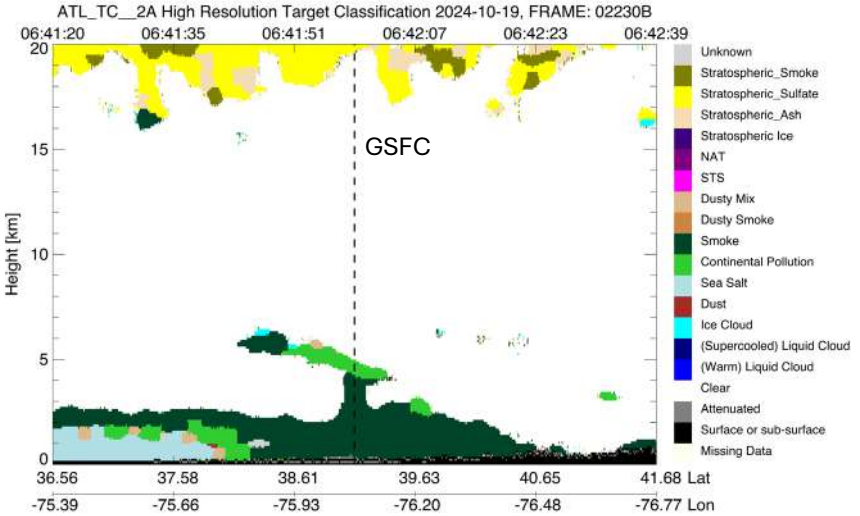
Case Study 2: GSFC, 19 Oct 2024

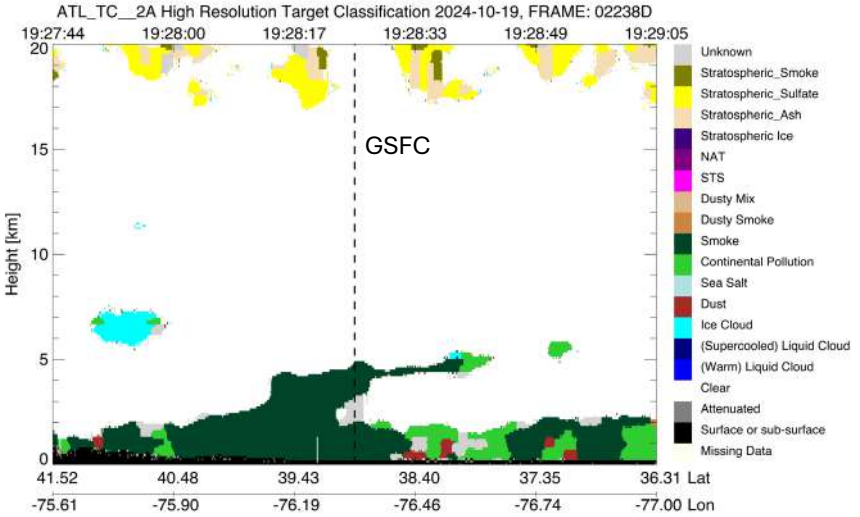
MPLNET

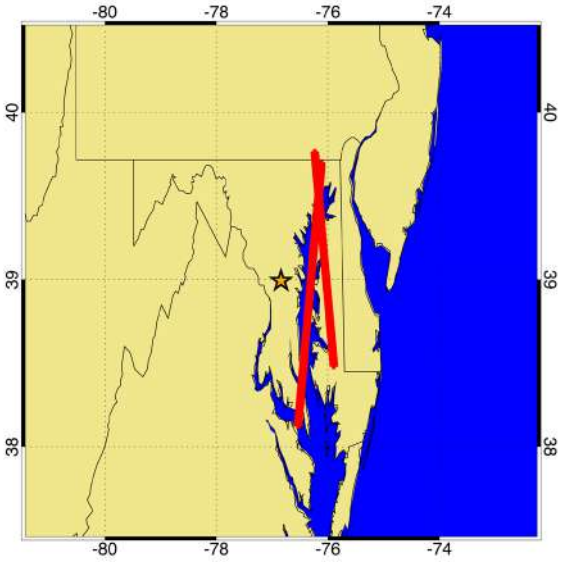




EarthCARE





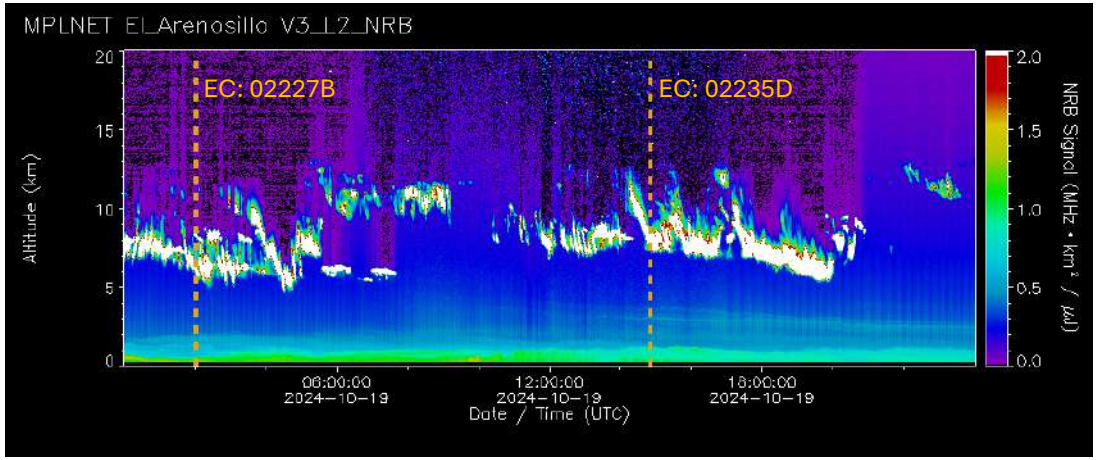


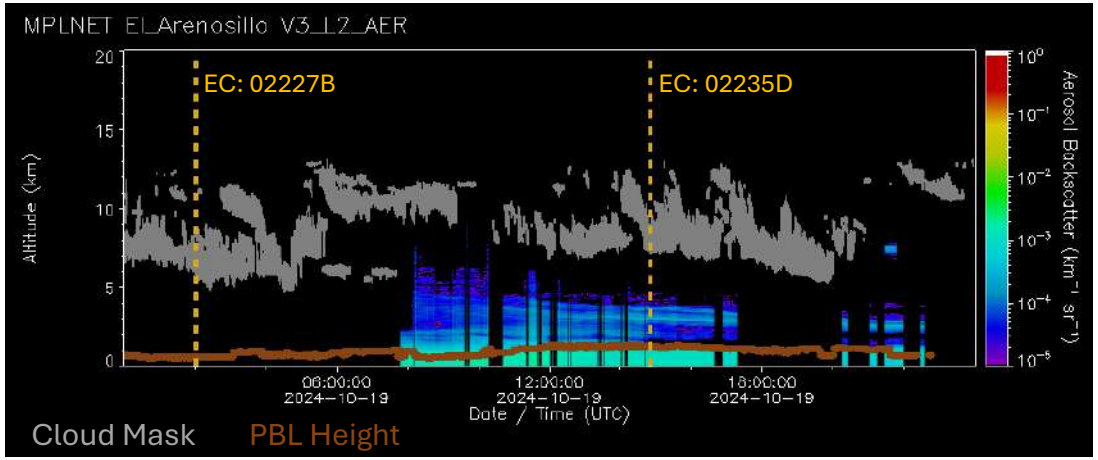
Conditions: Aerosol/No clouds
Frames: 02230B, 02238D
Baseline: AC
Distance: 69 km, 45 km

- Aerosol plume detected by MPLNET and ATLID ~5 km
- ATLID surface-attached aerosol and maximum MPLNET PBL near 2 km

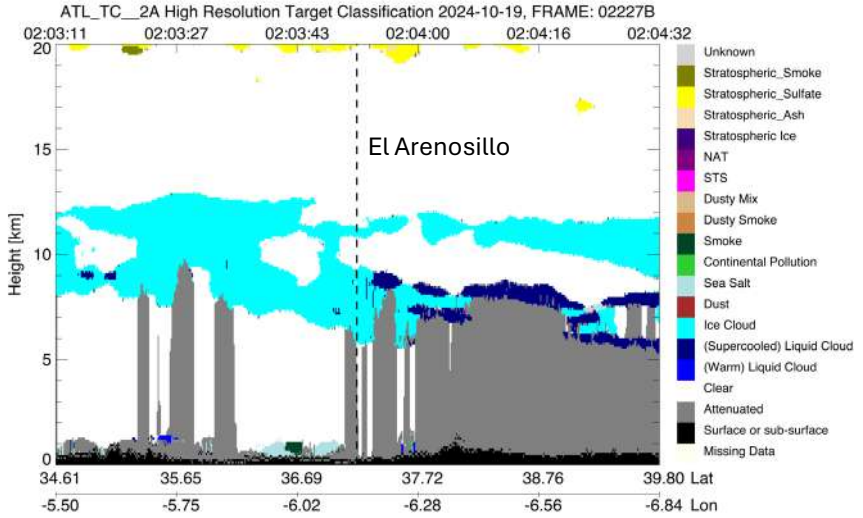
Case Study 3: El Arenosillo, 19 Oct 2024

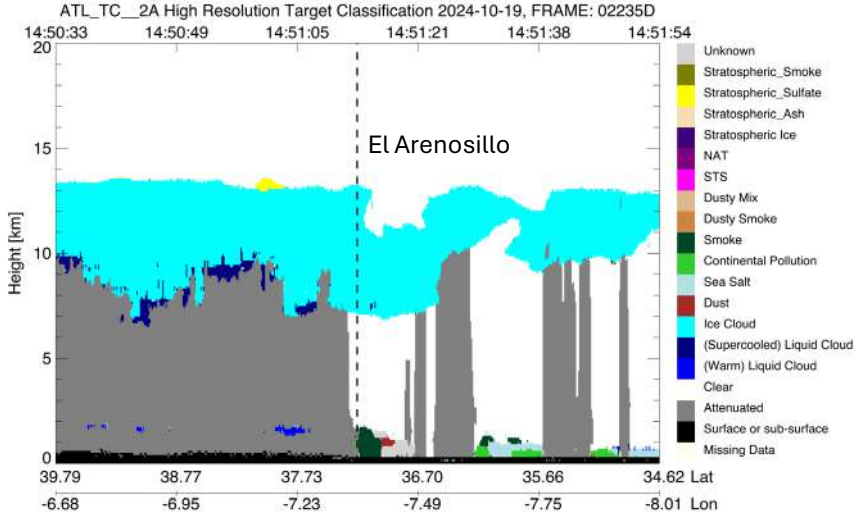
MPLNET

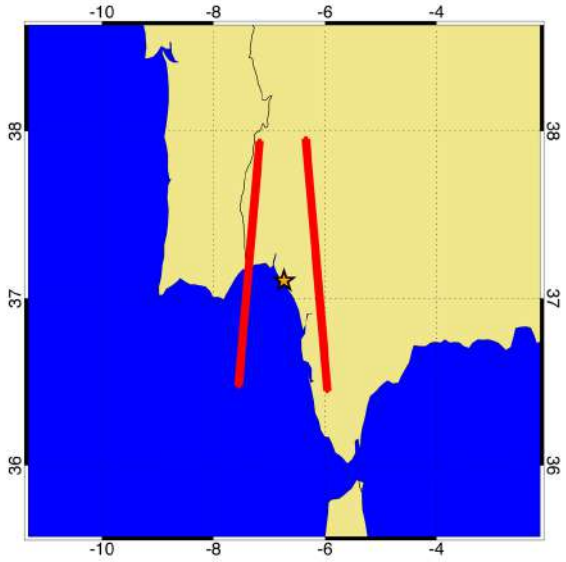




EarthCARE





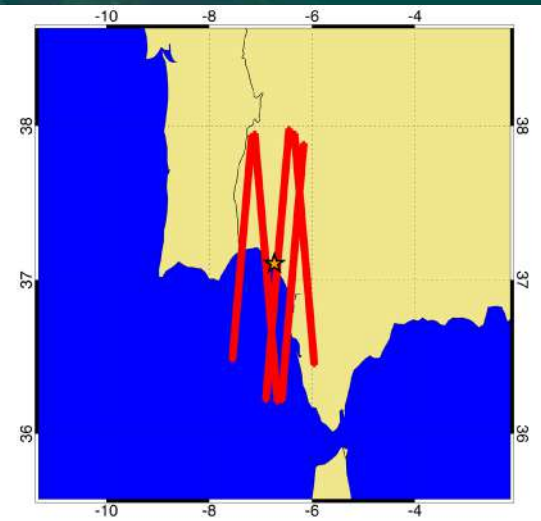


Conditions: Cirrus clouds
Frames: 02227B, 02235D
Baseline: AC
Distance: 53 km, 57 km

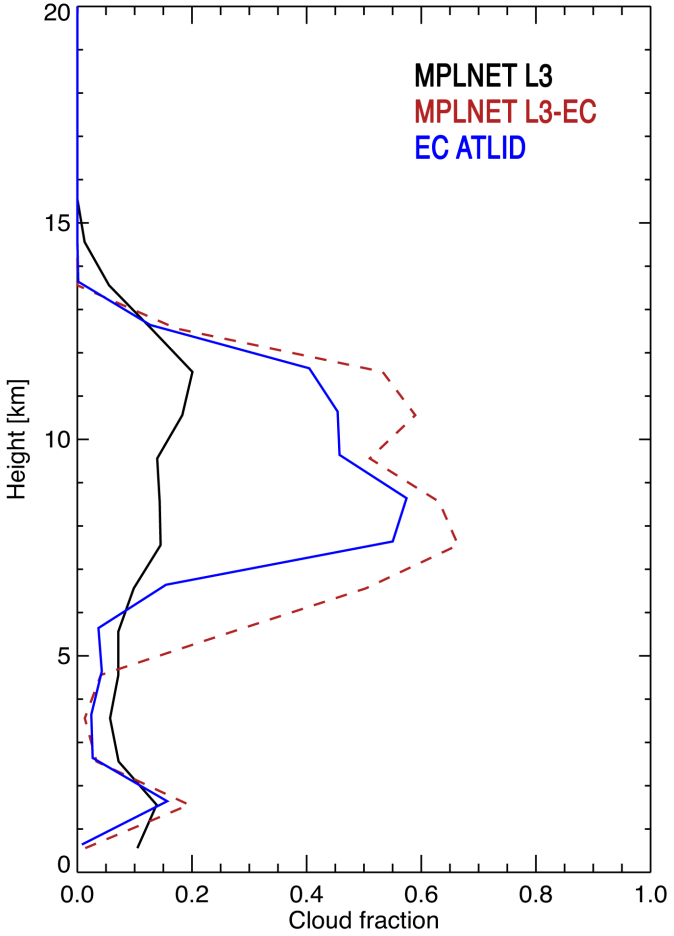
- Ice clouds detected by MPLNET and ATLID between 6 – 13.5 km
- ATLID surface-attached aerosol and maximum MPLNET PBL near 1.5 km

El Arenosillo, L3 Comparison Oct 2024

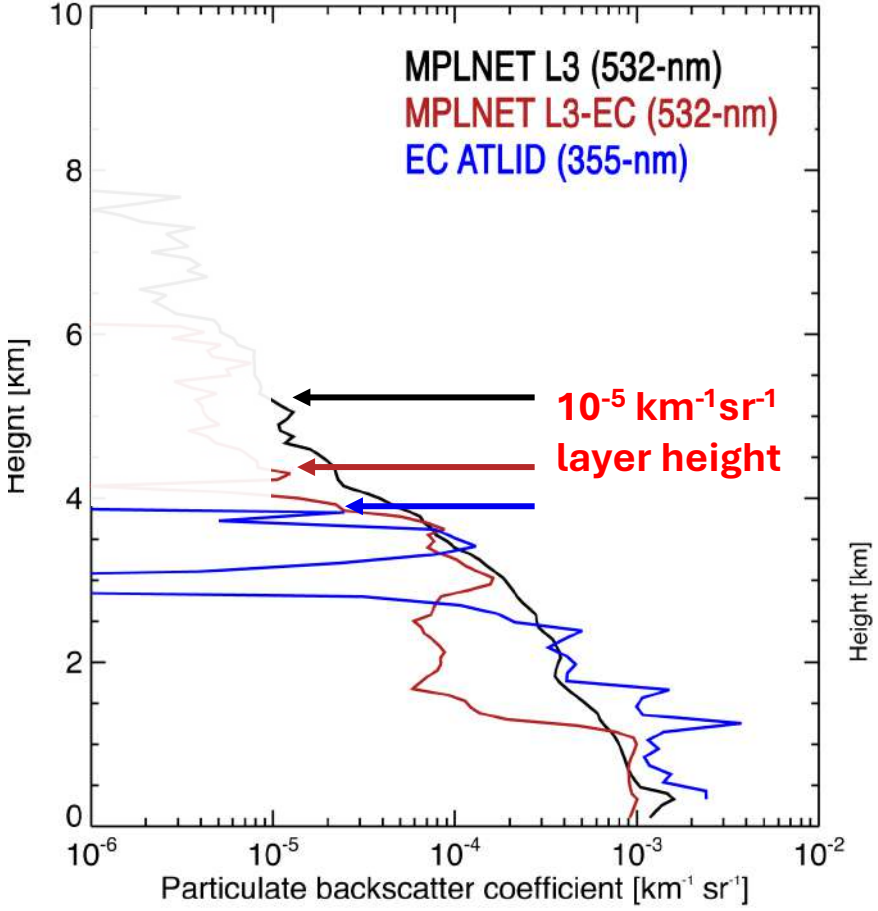
*Due to the difference in MPLNET/ATLID wavelengths, we focus on aerosol layer heights – not the actual backscatter



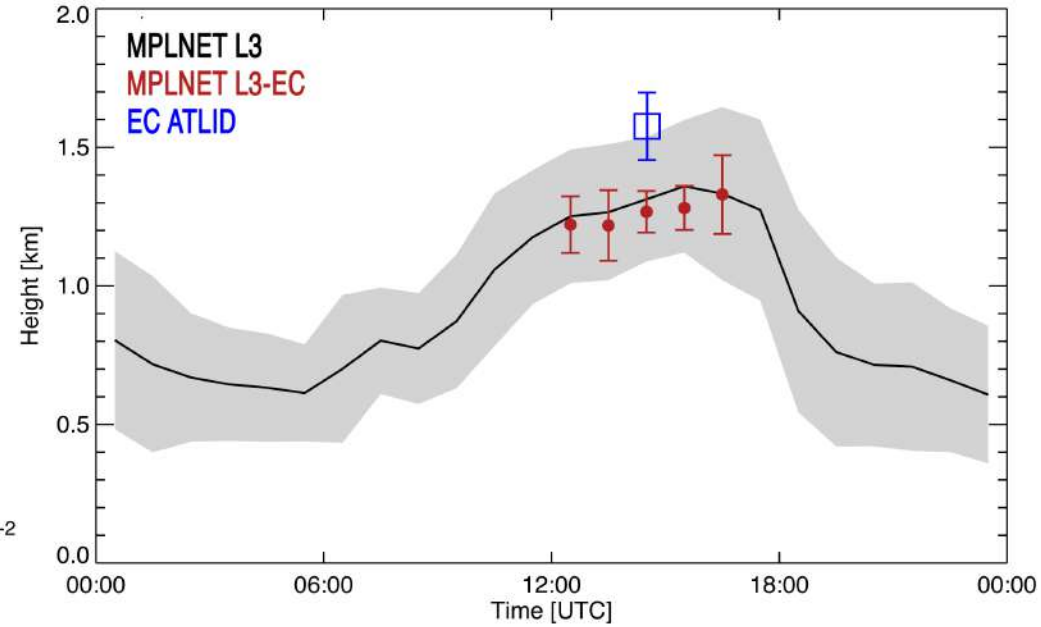
Clouds



Aerosols (cloud-free)

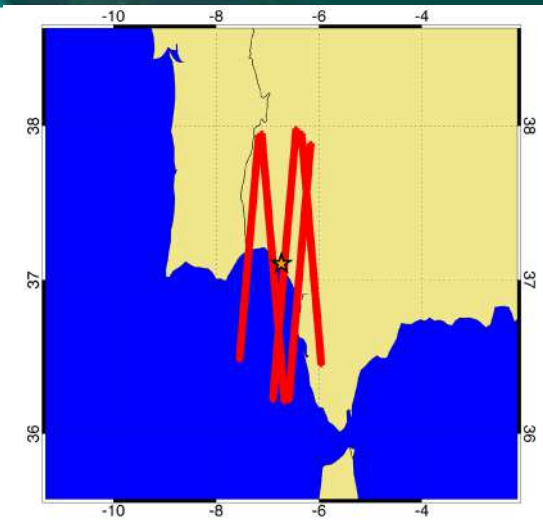


Mixed layer heights (PBL)

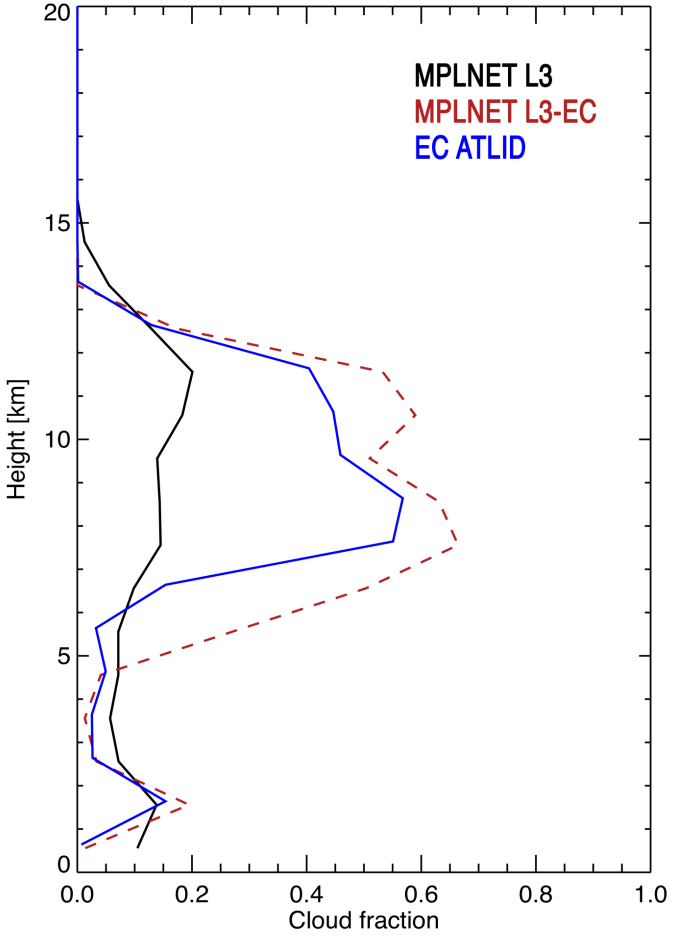


El Arenosillo, L3 Comparison Oct 2024

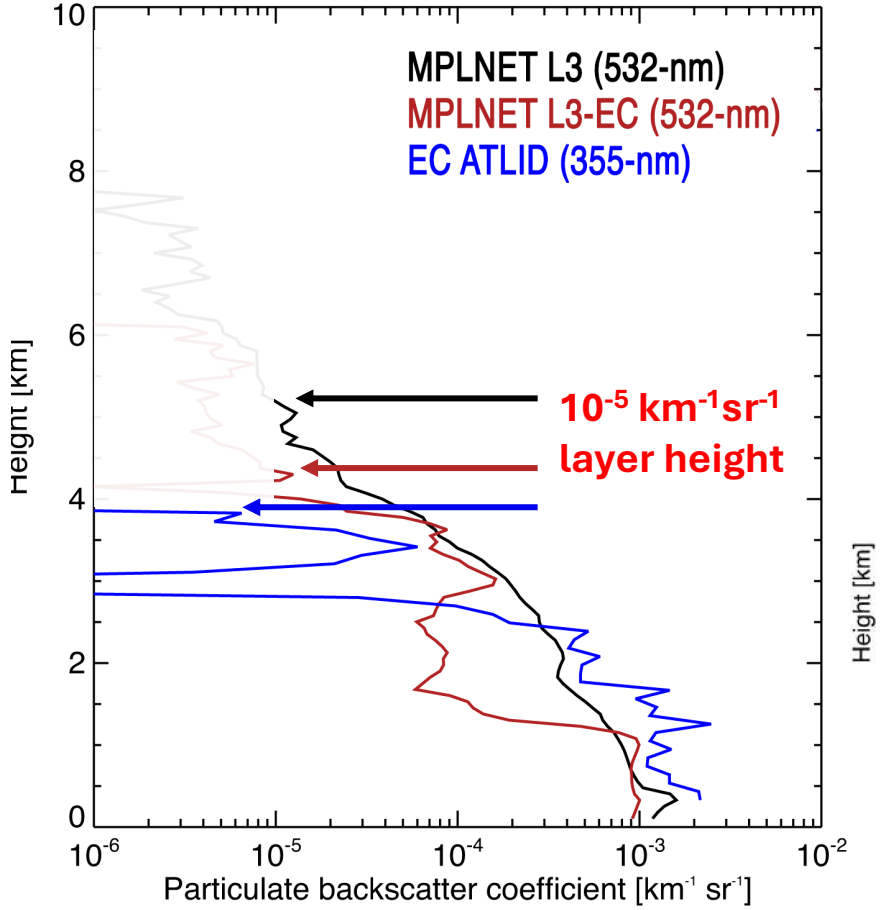
Using EarthCARE Low Resolution



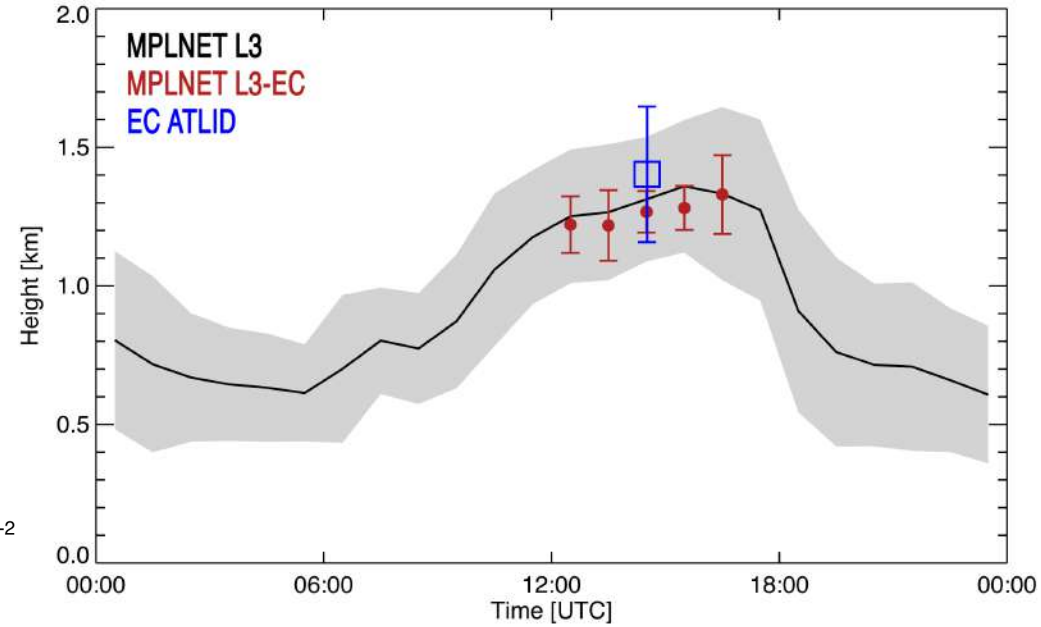
Clouds



Aerosols (cloud-free)



Mixed layer heights (PBL)



Summary and Future Plans

- Initial MPLNET L2 and L3-EC products show very good agreement with ATLID L2 products for layer heights under favorable conditions, but more data are needed
- Selection of EarthCARE horizontal resolutions (high, medium, low) can affect results, but differences are expected to be minor for long-term comparisons
- Release of aerosol and PBL products will be delayed due the need for AERONET Level 2 data post-calibrations
- As more data are available, we will compare with similar studies using CALIPSO overpasses of MPLNET sites
- Other MPLNET-EarthCARE tasks:
  - Comparison of drizzle occurrence between MPLNET and CPR
  - Evaluation of EarthCARE cirrus datasets for top-of-atmosphere cloud radiative effect

Funding: NASA Radiation Sciences Program and Earth Observing System, Earth Science US Participating Investigator
Acknowledgements: We thank the MPLNET PIs for their effort in establishing and maintaining MPLNET sites: Judd Welton (Principal Investigator: GSFC), Margarita Yela Gonzalez (Principal Investigator: El Arenosillo)