



EarthCARE 2026 Science and Validation workshop

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Assessment of ATLID L2a product quality through intercomparison with NASA airborne lidar measurements

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- *What?* Lidar **U**nderflights of **E**arthCARE
- *When?* During **N**ight and day from 3rd to 25th of September 2025
- *Where?* From **B**ermuda, over North Atlantic Ocean and USA
- *How?* With the NASA G-III aircraft carrying the HSRL-2 instrument
- *What is the result?*
 - 16 underflights: 11 nighttime and 5 daytime underflights
 - Final campaign data archive available now: <https://www-air.larc.nasa.gov/cgi-bin/ArcView/earthcare?G3=1>
- Today: Three case studies
 - [7302A&B] Multilayer aerosol scene – gridded data comparison
 - [7286B] Elevated aerosol layer – selection on classification
 - [7426B] Dust cloud above sea salt aerosol layer – outlook to prototype A-PRO

Data and methods [1/2]



- Final campaign data, baseline 0, published April 10, 2026
- EarthCARE data on baseline BA, operational during the campaign
- And prototype data from baseline CA from A-PRO in development
- Low resolution for EBD: 100 km resolution
- Collocation by distance and time difference: within 0.5 – 1.5 km, 30 – 60 min
- Using HSRL-2 extinction derived from backscatter
 - Readme (baseline 0) states: occasional measurement of anomalously low aerosol extinction
 - Related to atmospheric turbulence associated with strong wind shear over ocean
 - 355_extinction_from_backscatter is based on a machine learning method, more information in the readme

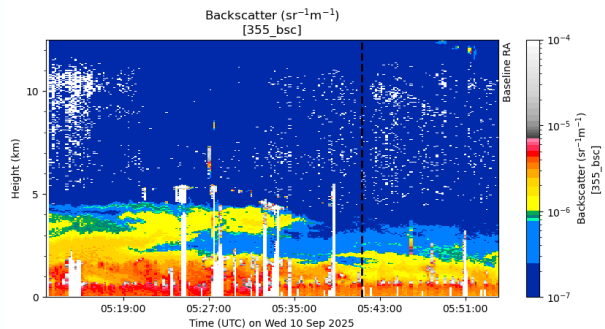
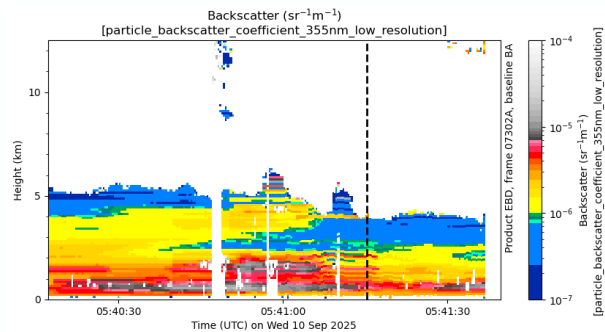
- Main development in this work: EarthCARE and aircraft data on a common grid
 - Weighted average with inverse variance weighting for aircraft data to EarthCARE altitude grid
 - Selecting nearest columns from EarthCARE data: already low resolution
 - For gridding the aircraft classification (Aerosol_ID), select the most common classification
- Data selection
 - EBD and TC: Quality flag 0 or 1
 - Aircraft; cloud-screened variables, EarthCARE; cloud screening through classification of A-TC

For the dataset on the common grid

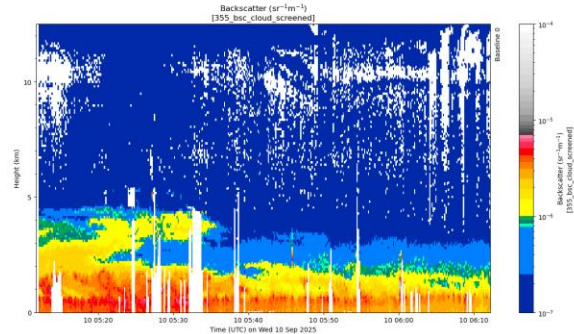
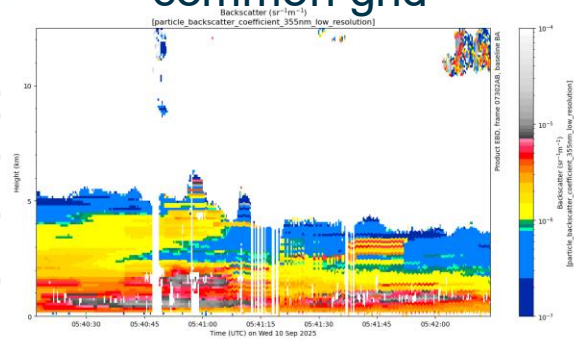
- EarthCARE lidar ratio > 0
- Backscatter $> 3 \cdot 10^{-7} \text{ sr}^{-1} \text{ m}^{-1}$ from both datasets

[7302A&B] Multilayer aerosol scene

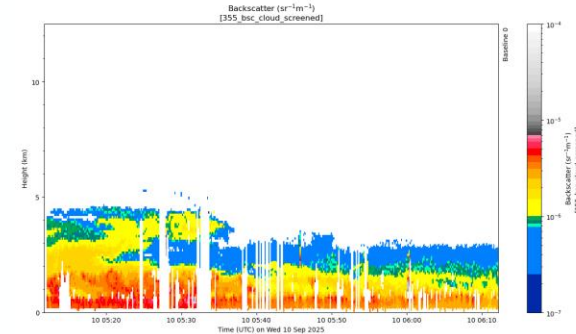
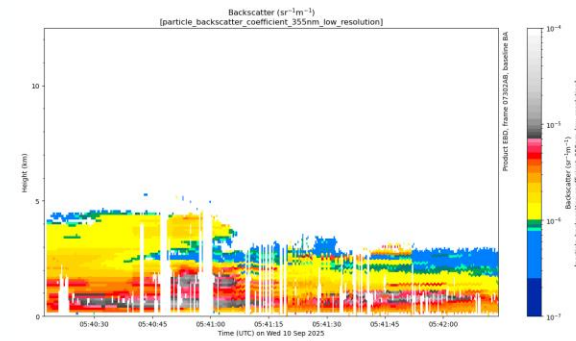
Previously



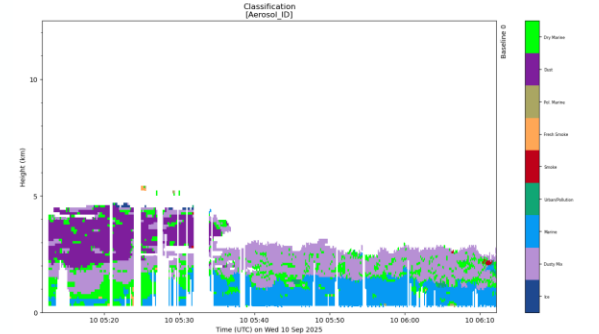
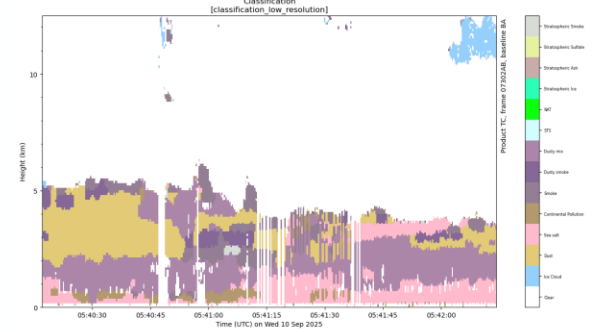
A&B frames combined, cloud screening and common grid



Apply data selection criteria



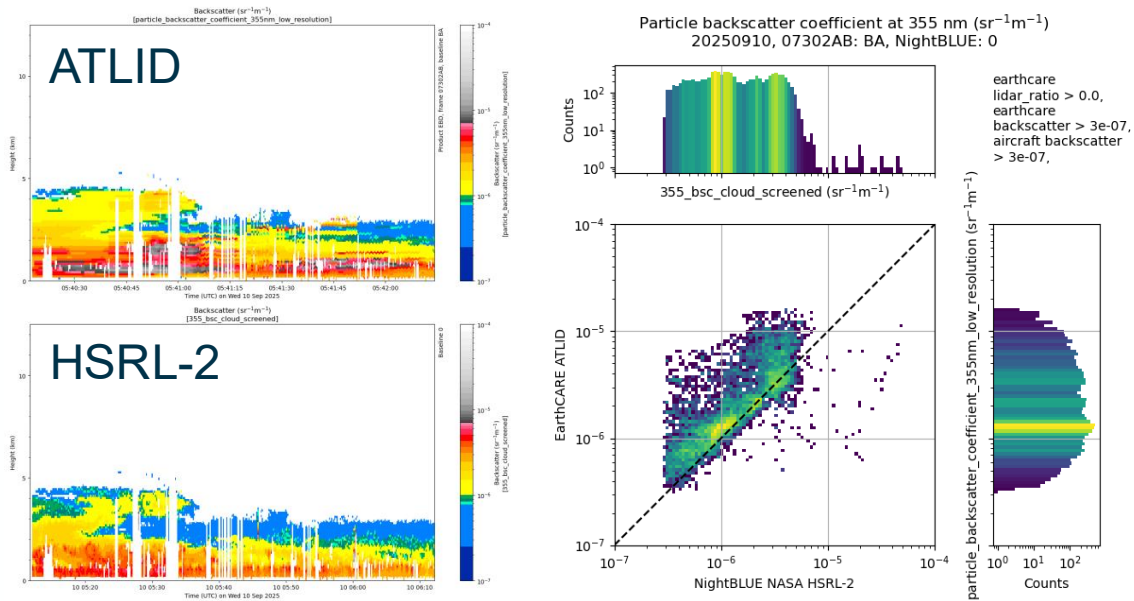
Classification vs Aerosol_ID



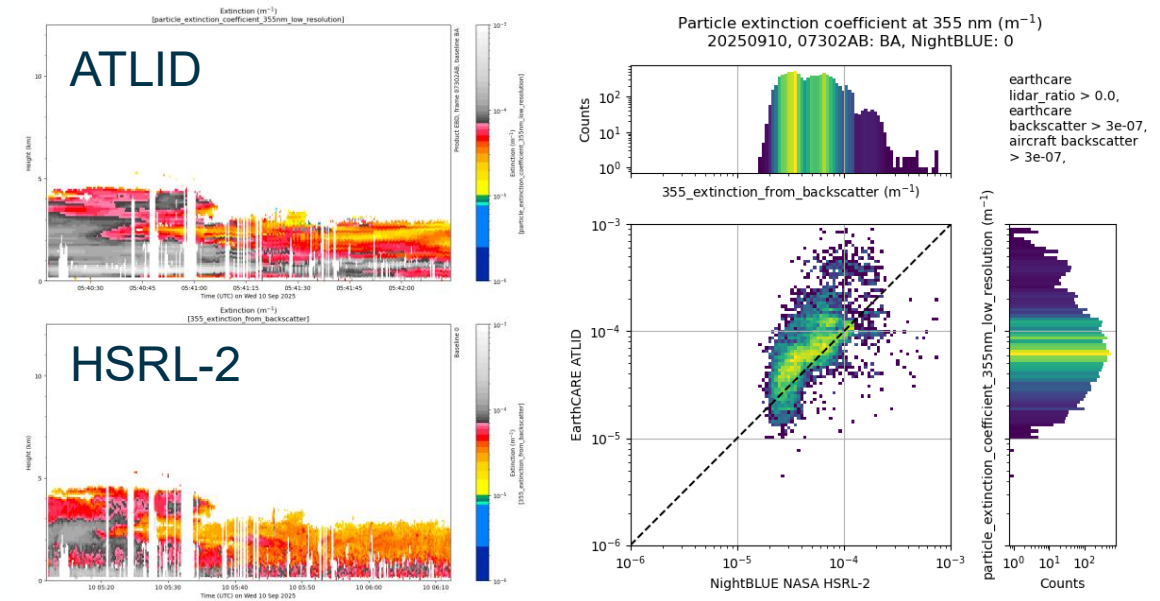
[7302A&B] Backscatter & extinction



Backscatter



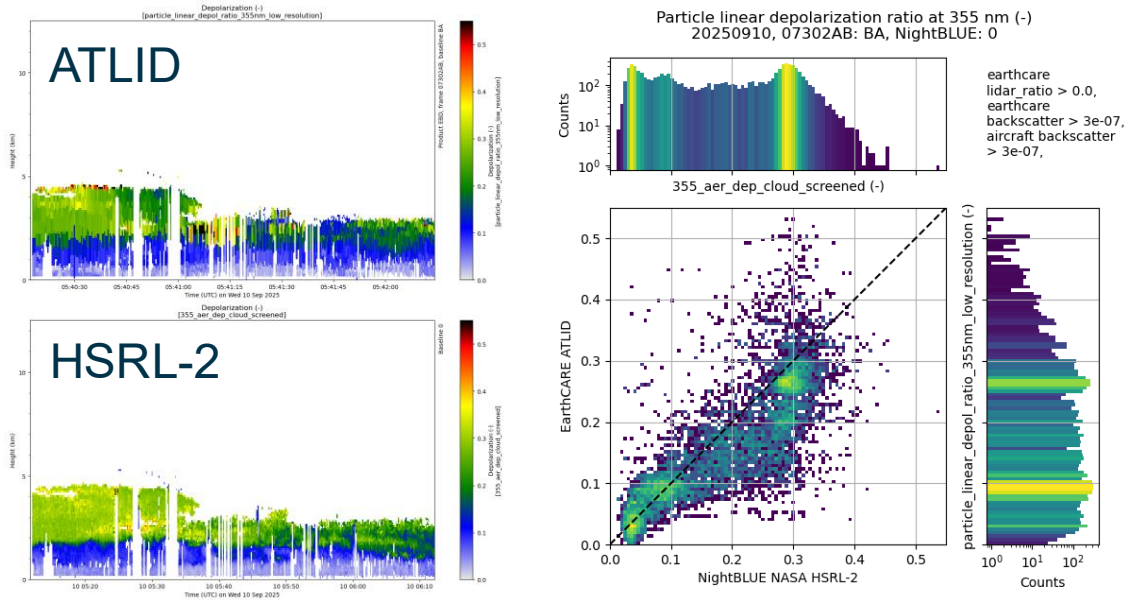
Extinction



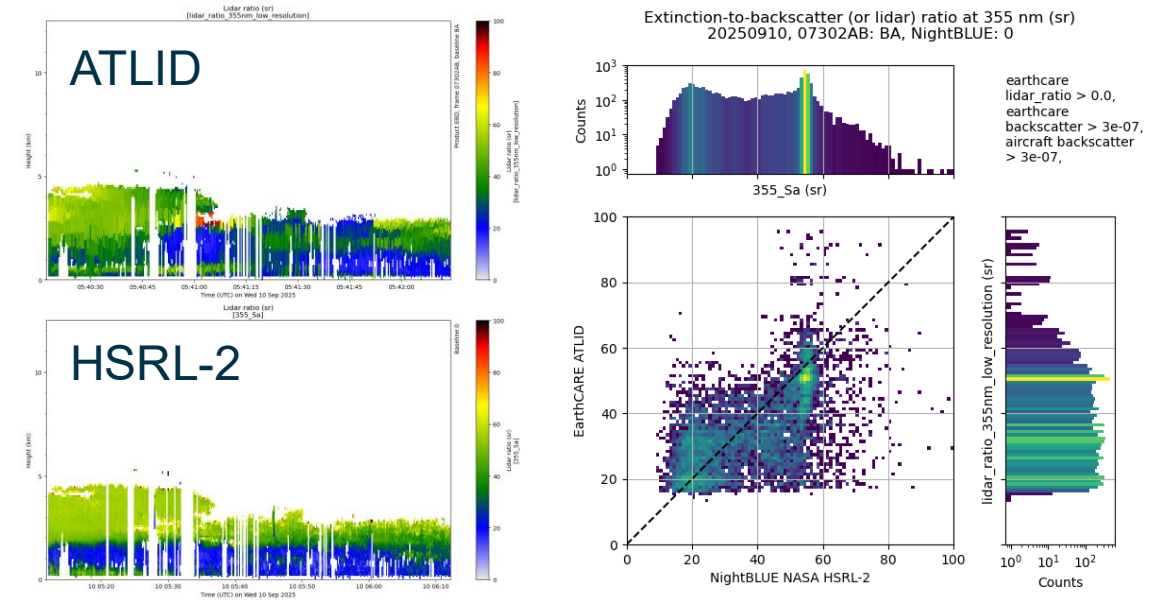
[7302A&B] Depolarization & lidar ratio



Depolarization



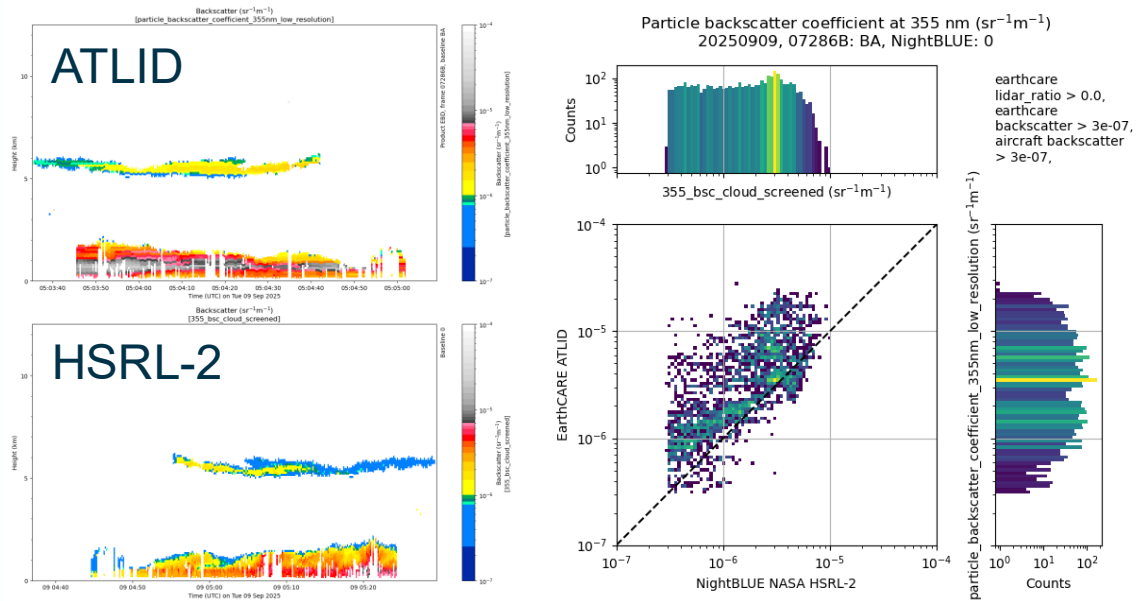
Lidar ratio



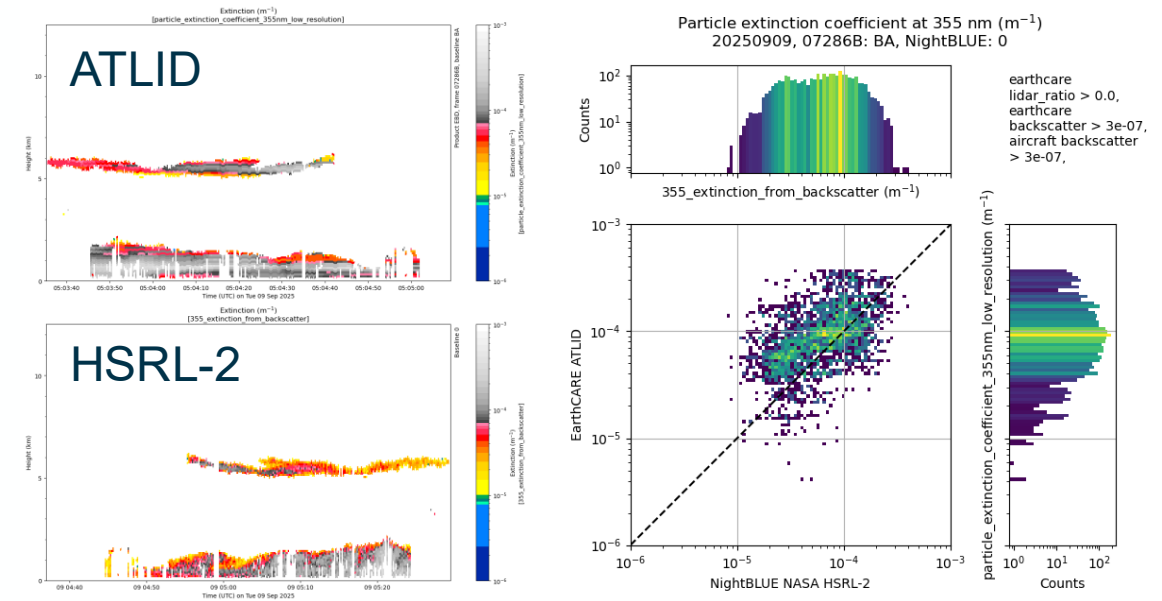
[7286B] Backscatter & extinction



Backscatter



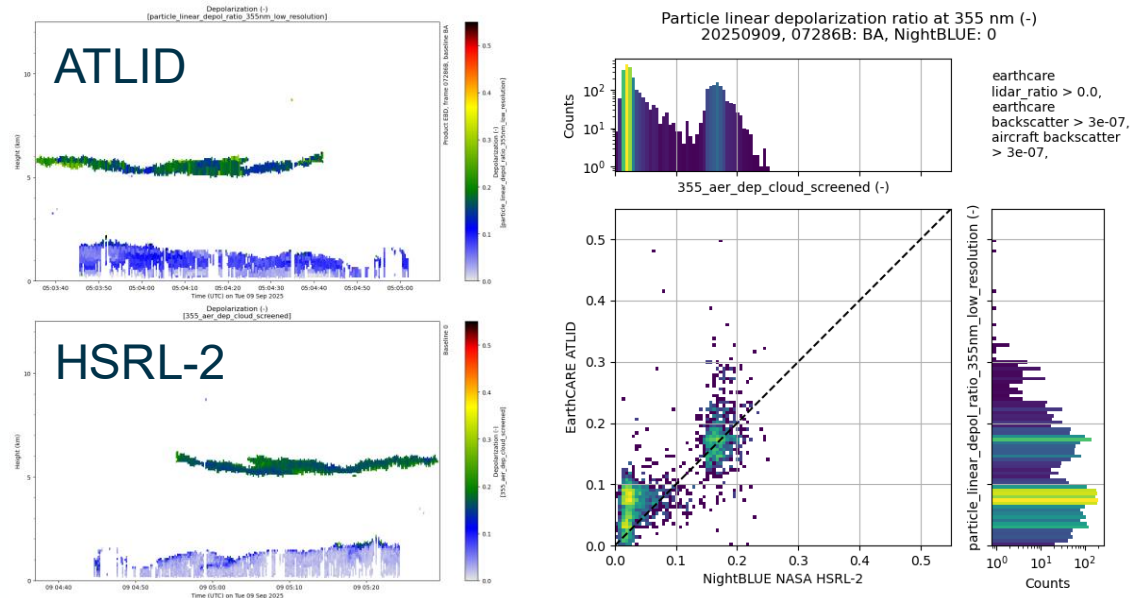
Extinction



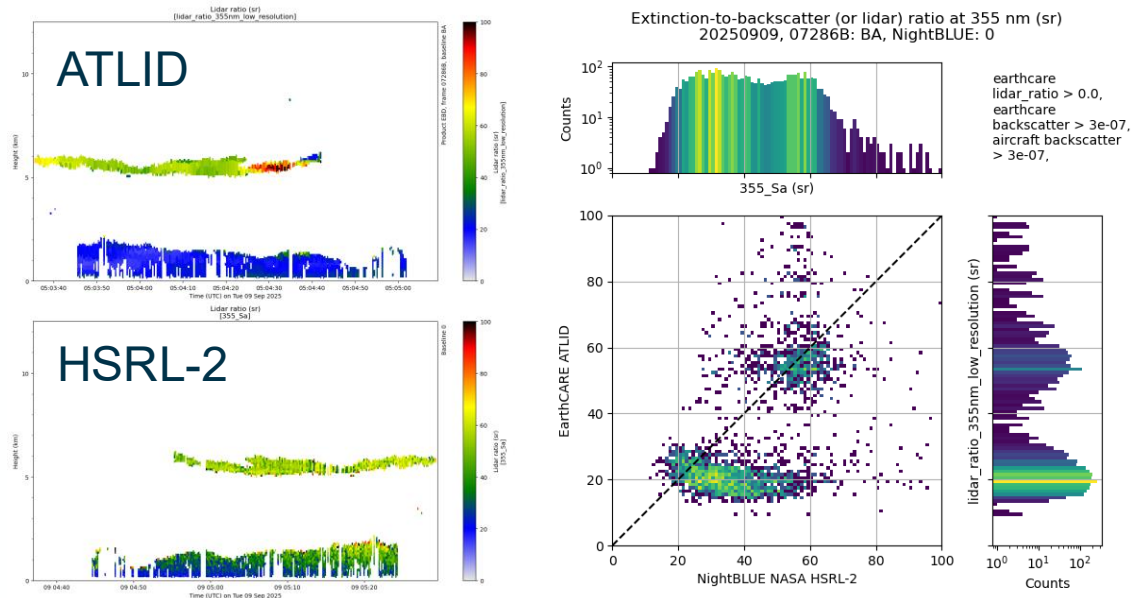
[7286B] Depolarization & lidar ratio



Depolarization

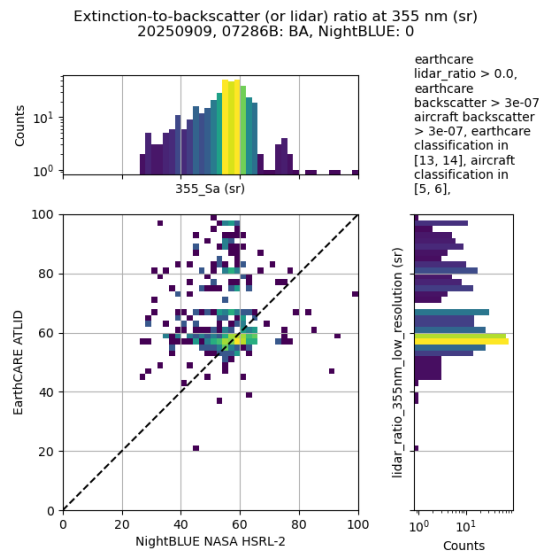
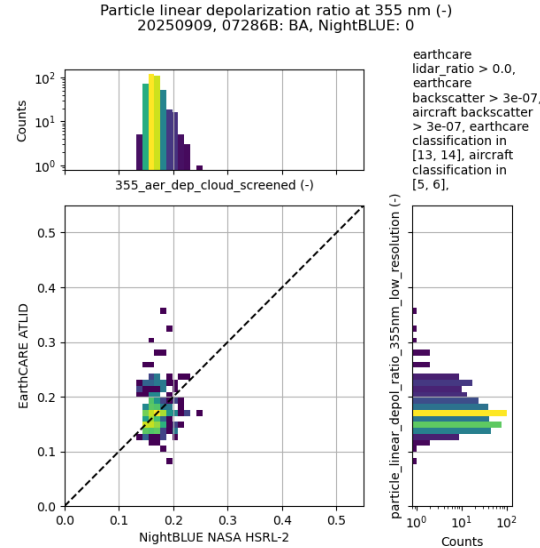
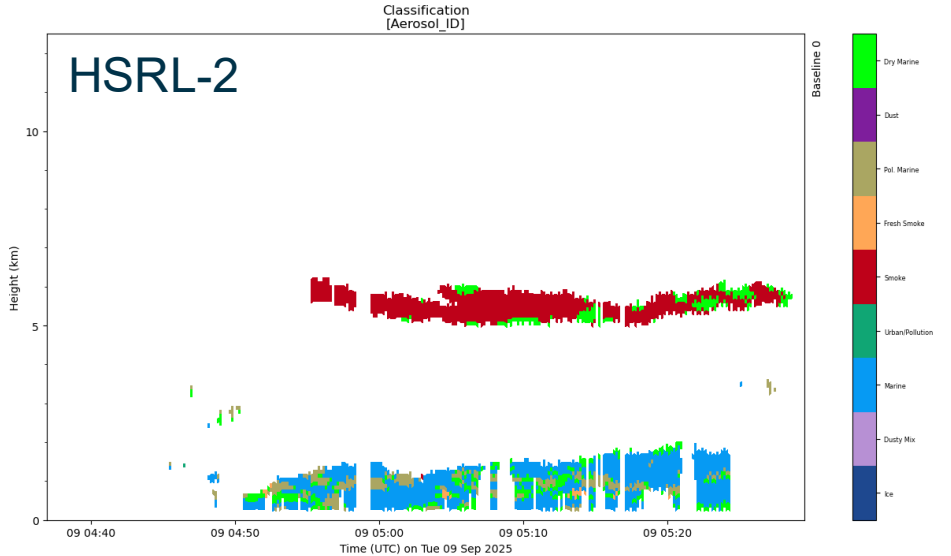
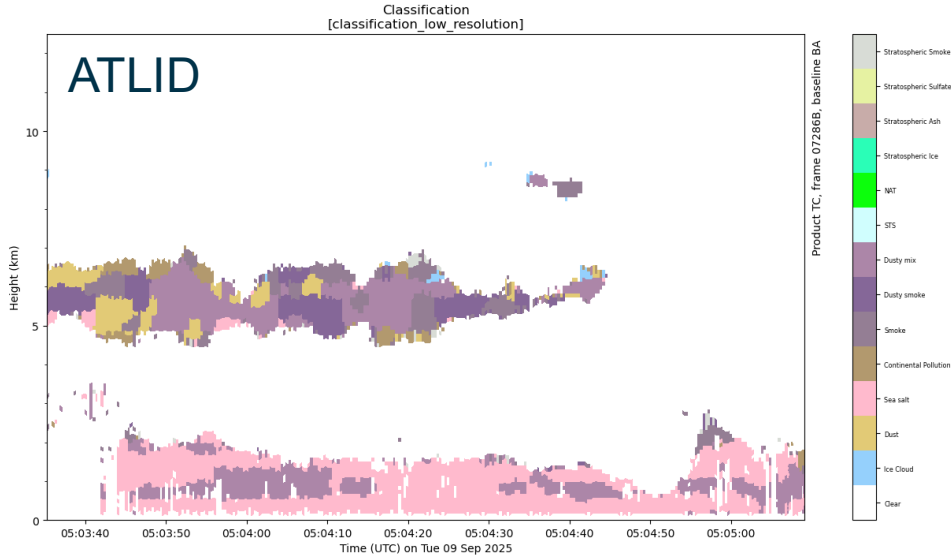
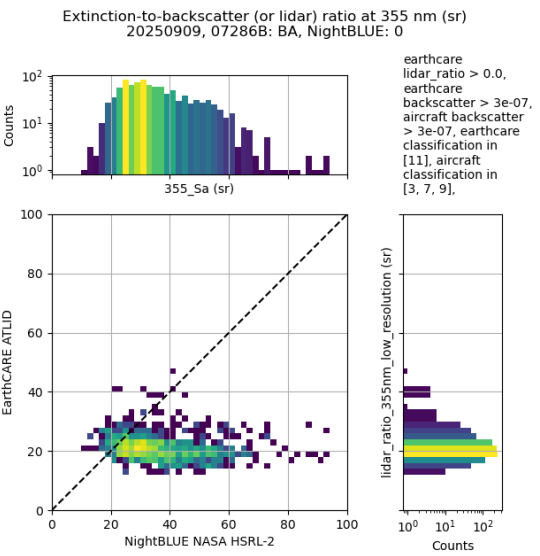
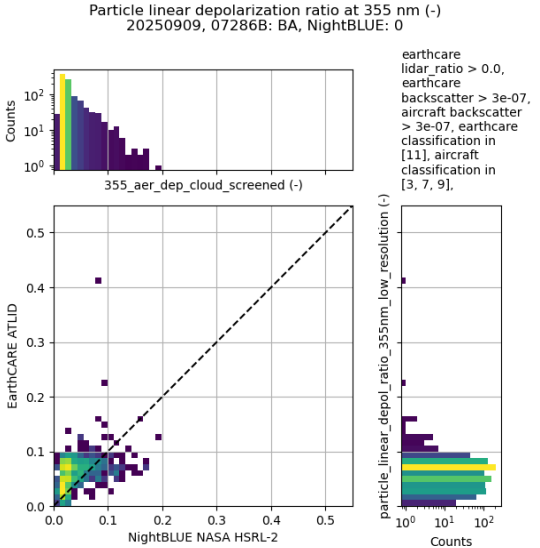


Lidar ratio



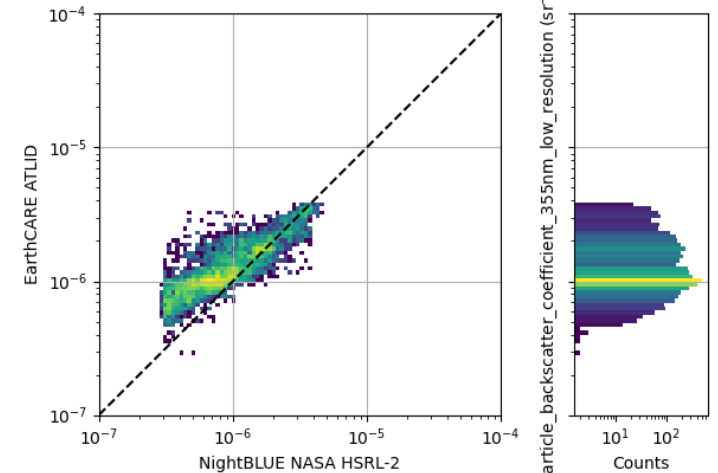
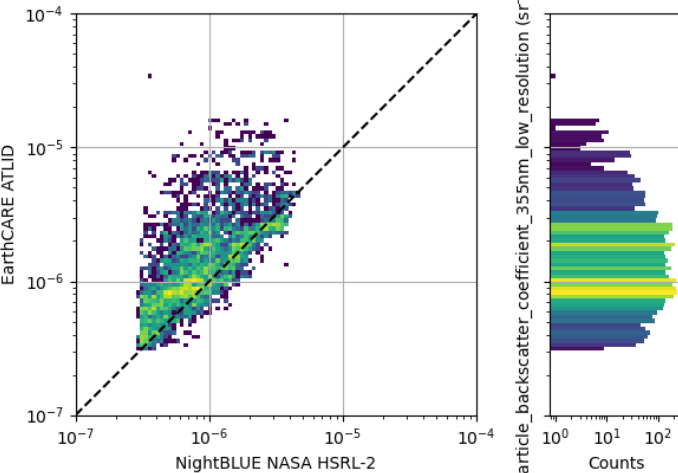
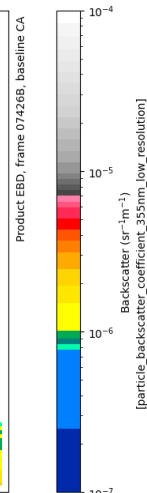
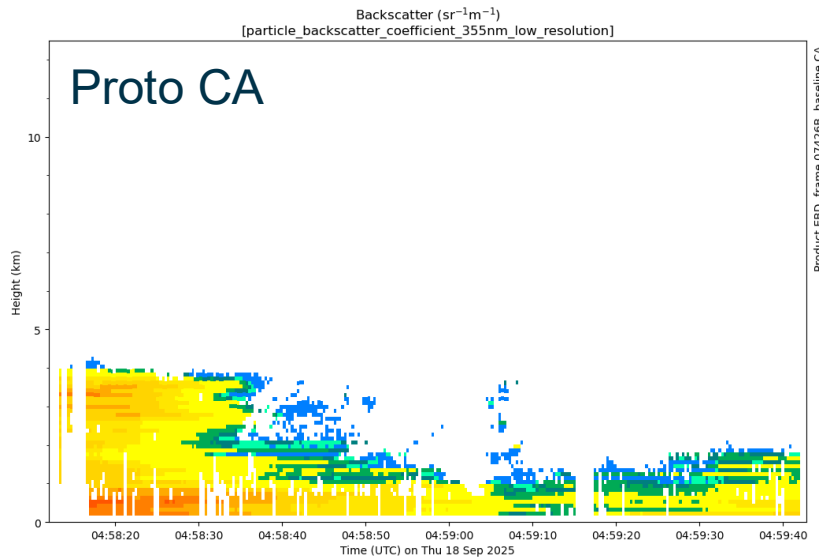
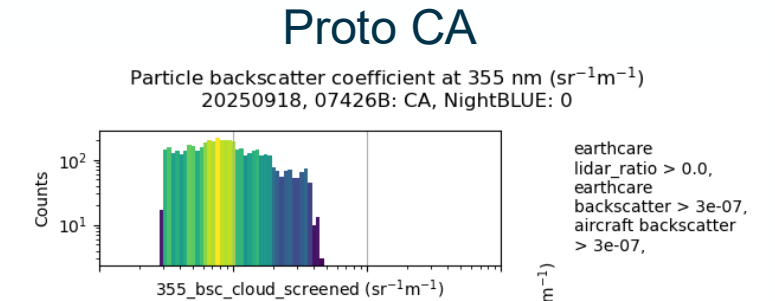
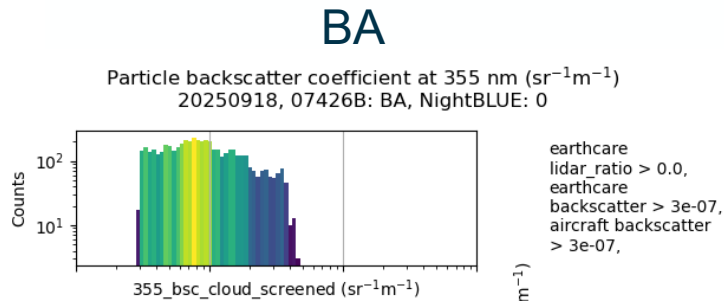
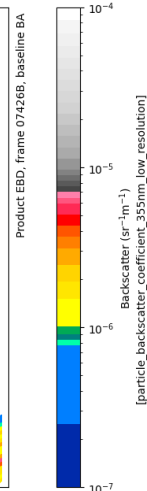
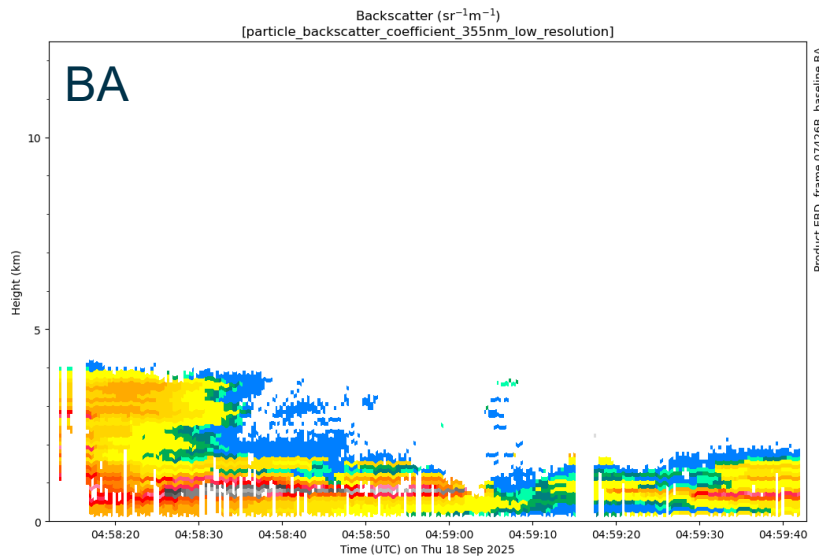
[7286B] Selection on classification

Marine aerosol

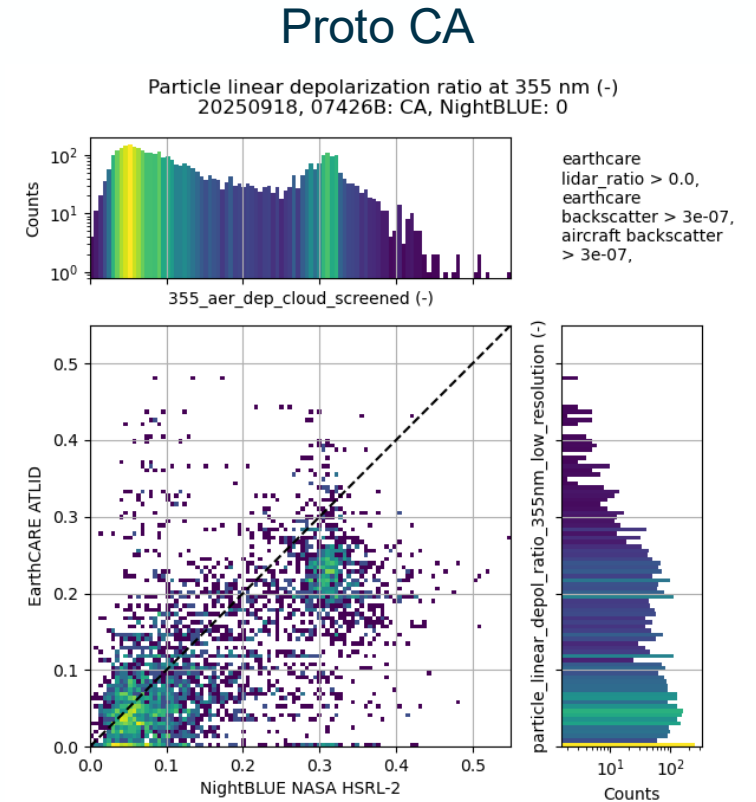
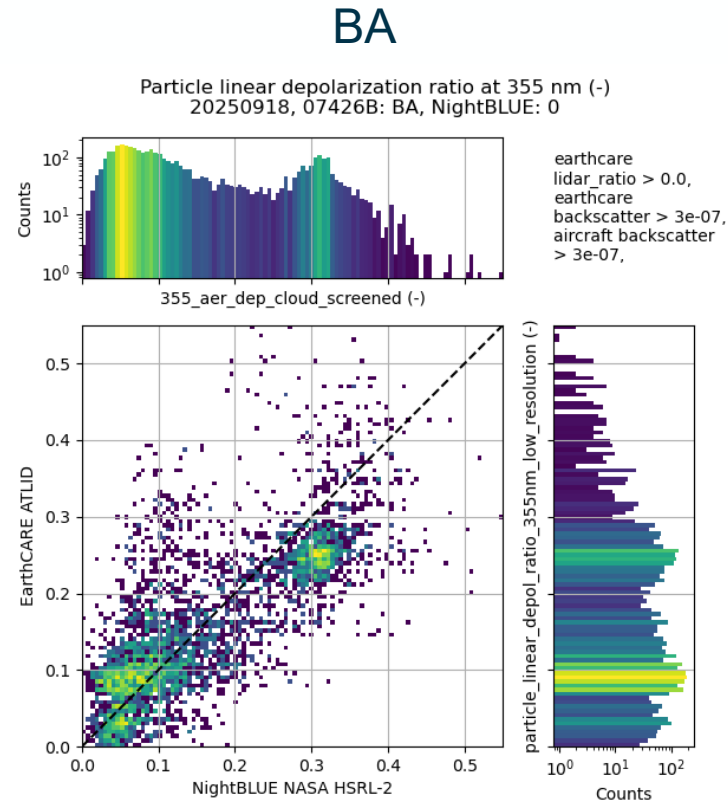
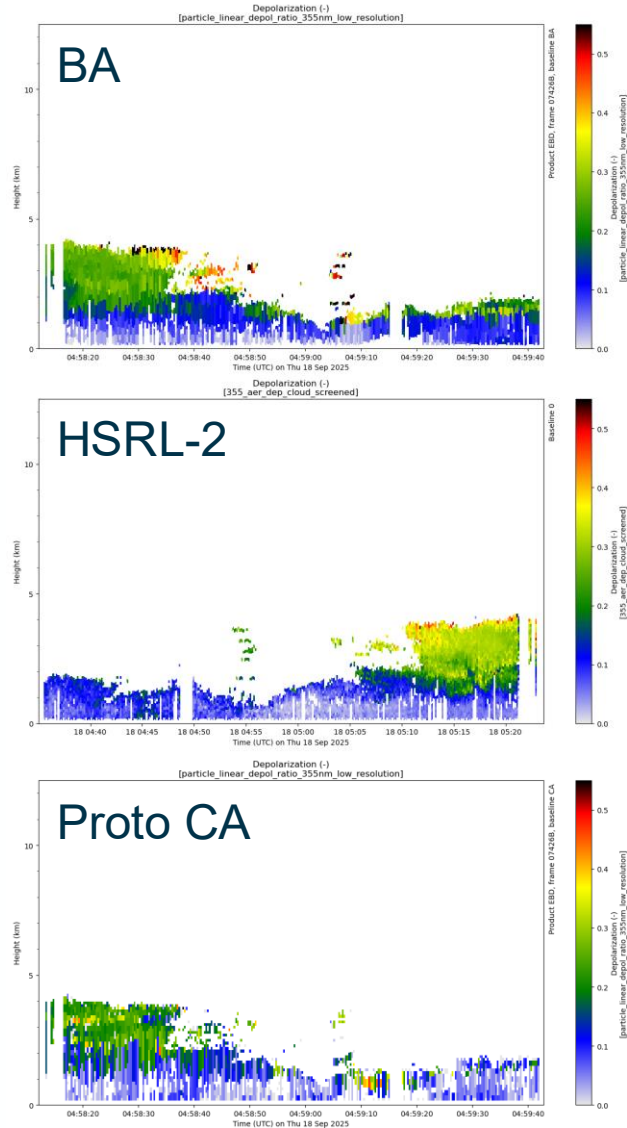


Smoke

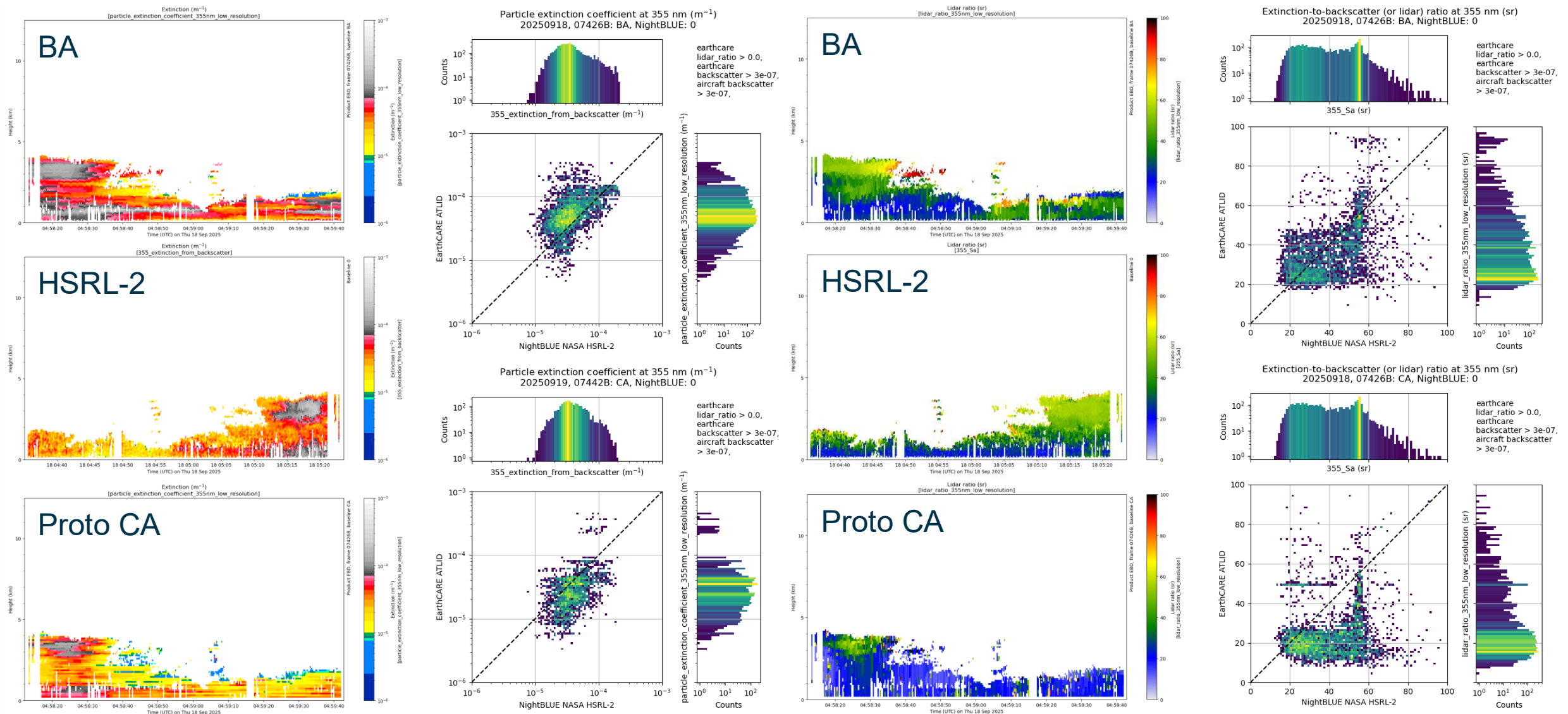
[7426B] Prototype CA: backscatter



[7426B] Prototype CA: depolarization ratio



[7426B] Prototype CA: extinction & lidar ratio



Conclusions



For the case studies presented, on baseline BA:

- Backscatter and extinction match well; from ATLID slightly higher than from HSRL-2
- And both may be impacted by clouds within the aerosol layer
- Depolarization is a good match, for regions of dust and smoke as well as marine aerosol

For the current prototype of baseline CA:

- Improvement in dealing with clouds within the aerosol layer: the high backscatter layer is removed in the presented case, and extinction visually improves as well
- Depolarization of marine aerosol slightly improves, while dust region may slightly worsen
- Extinction may need more care as the shift from slightly too high to slightly too low leads to a worse lidar ratio

Acknowledgements



- NASA and ESA *for providing aircraft, instrument and funding for the campaign*
- ECMWF/CAMS *for the aerosol, cloud and weather forecasts essential to the flight planning*
- And thank you for listening!

Any questions?

