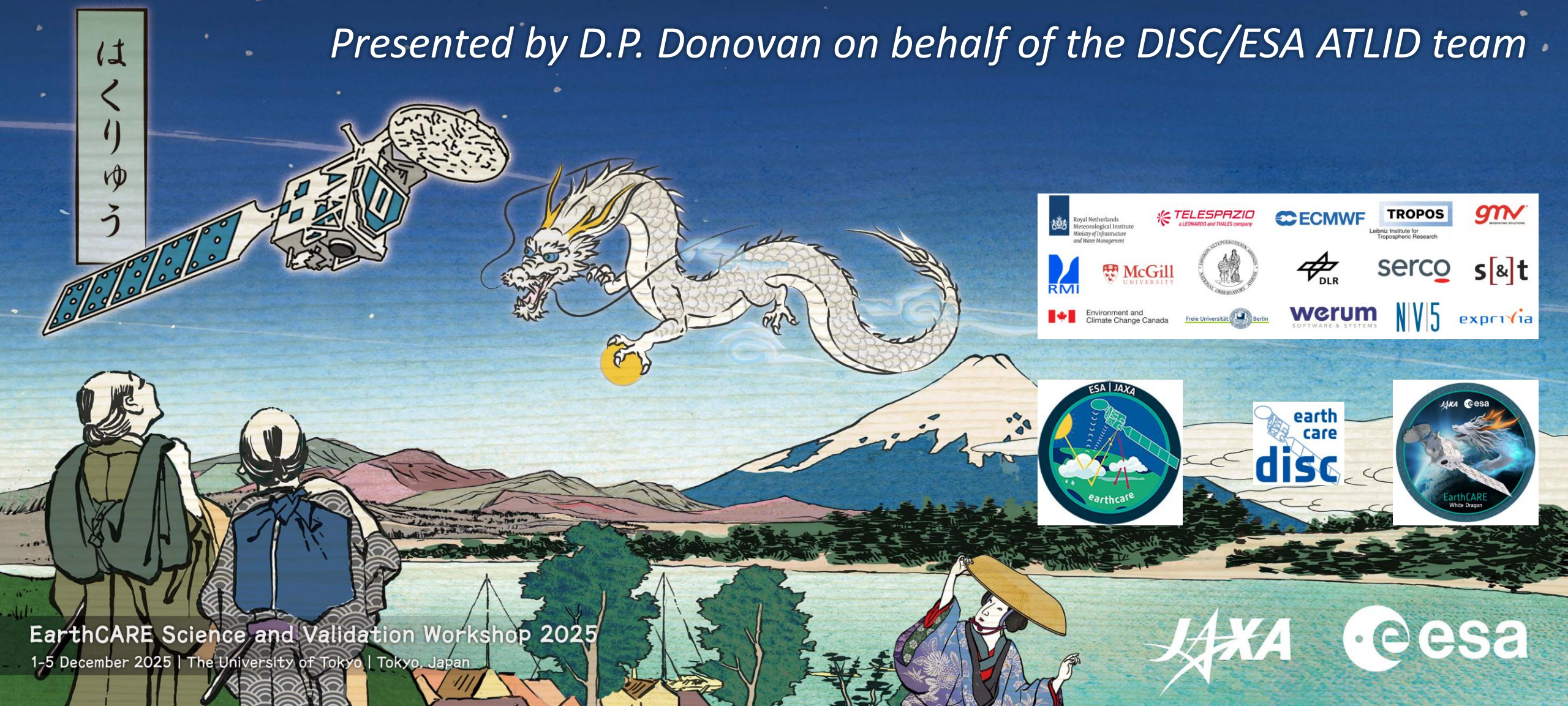
# ATLID L1 Performance

*Presented by D.P. Donovan on behalf of the DISC/ESA ATLID team*



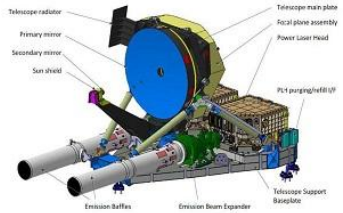

EarthCARE Science and Validation Workshop 2025

1-5 December 2025 | The University of Tokyo | Tokyo, Japan

# Outline

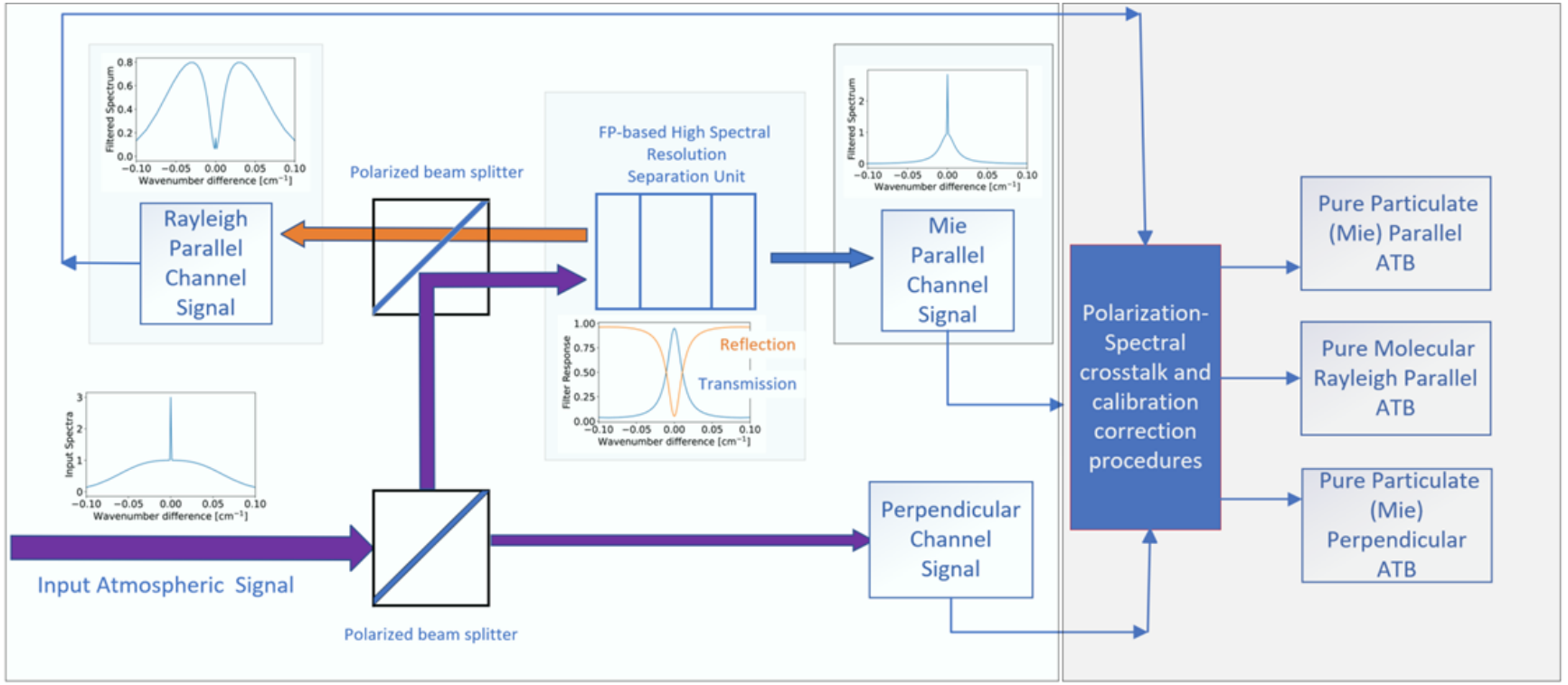
- Quick ATLID overview
- Known L1 Issues (e.g.)
  - Radiation Noise Spikes and Pixel Damage (Hot Pixels)
  - Depolarization measurements issues.
  - Background and Offset issues.
- Monitoring results
  - Laser Power and Lidar Constants
  - Spectral Cross-talk coefficient monitoring
- Wrap-Up

# ATLID: 355nm HSRL system

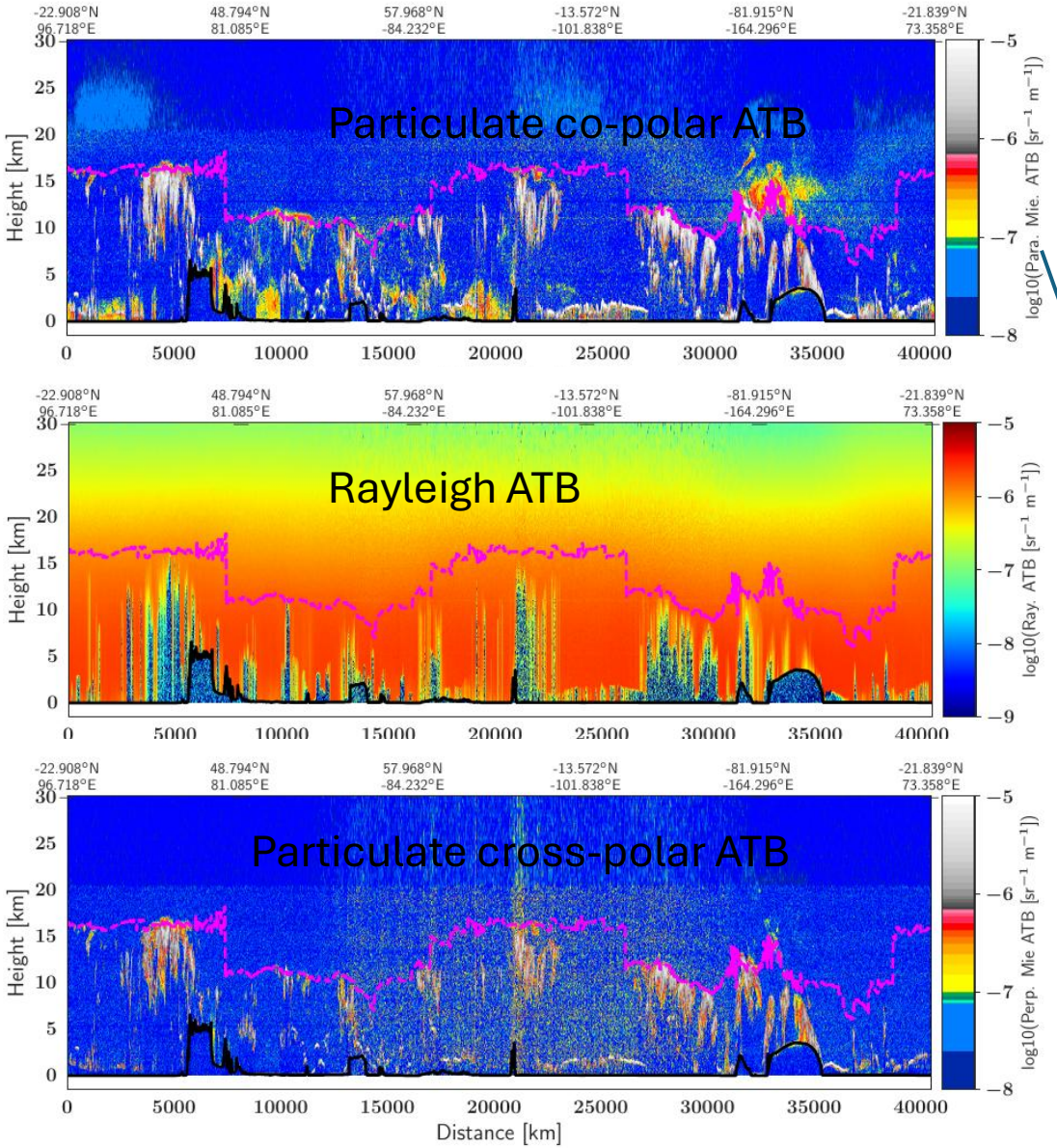



HSRL
⇒ Good daylight performance
⇒ Both Extinction + Backscatter are retrieved.
⇒ Good detection of weak aerosols (in spite of strong molecular scattering at 355 nm compared to e.g. 532 nm)

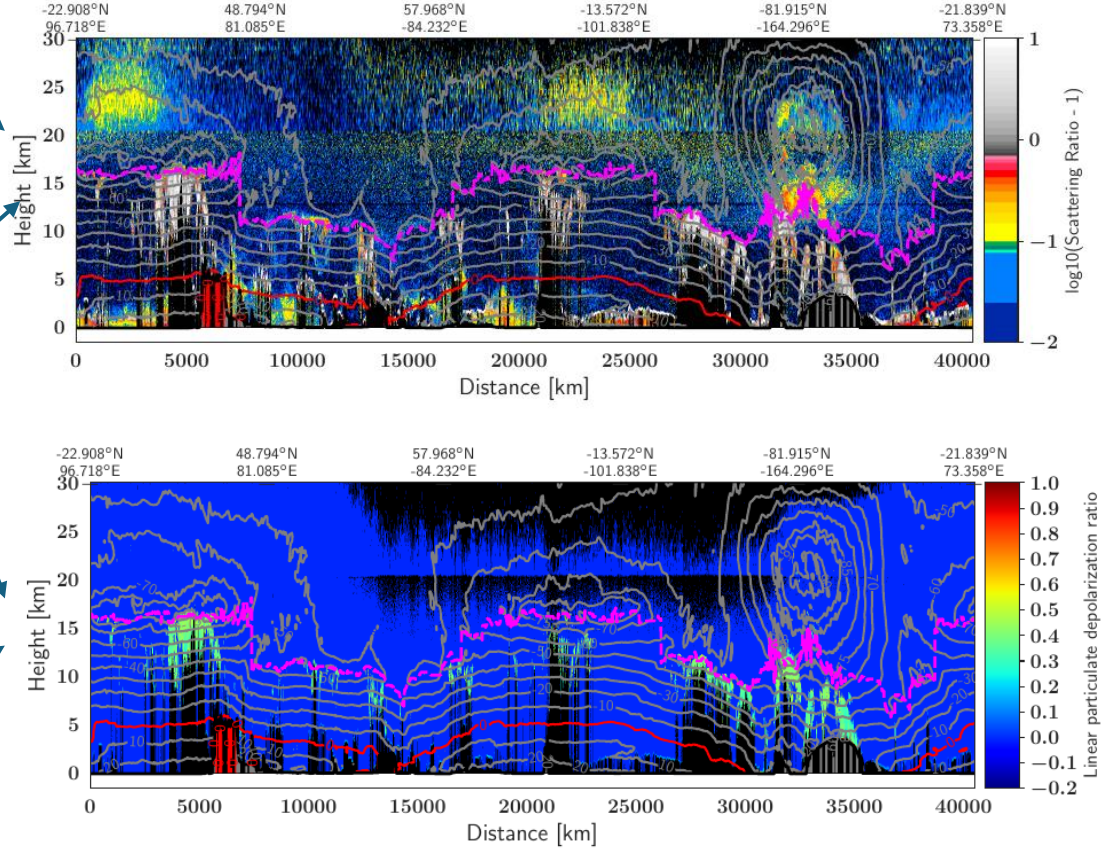
| Parameter | |
|---|---|
| Operating Wavelength | 354.8 nm |
| Emitted Energy | 38 mJ |
| Receiver Footprint Diameter | ≤ 30 m |
| PRF | 51 Hz |
| Transmit Pulse Width | 20 ns |
| Altitude Range | -0.5 to +40 km |
| Vertical Sampling Interval | 103 m (up to 20.2 km)<br>500 m (20.2 km - 40 km) |
| Along Track Sampling Interval | 285 m<br>(2 shots accumulated onboard) |
| Channels | HSRL particulate<br>HSRL Molecular<br>Depolarization channel |



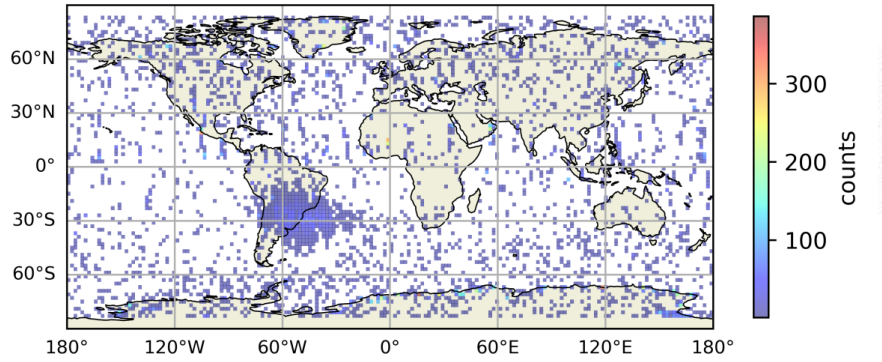
# An example Orbit

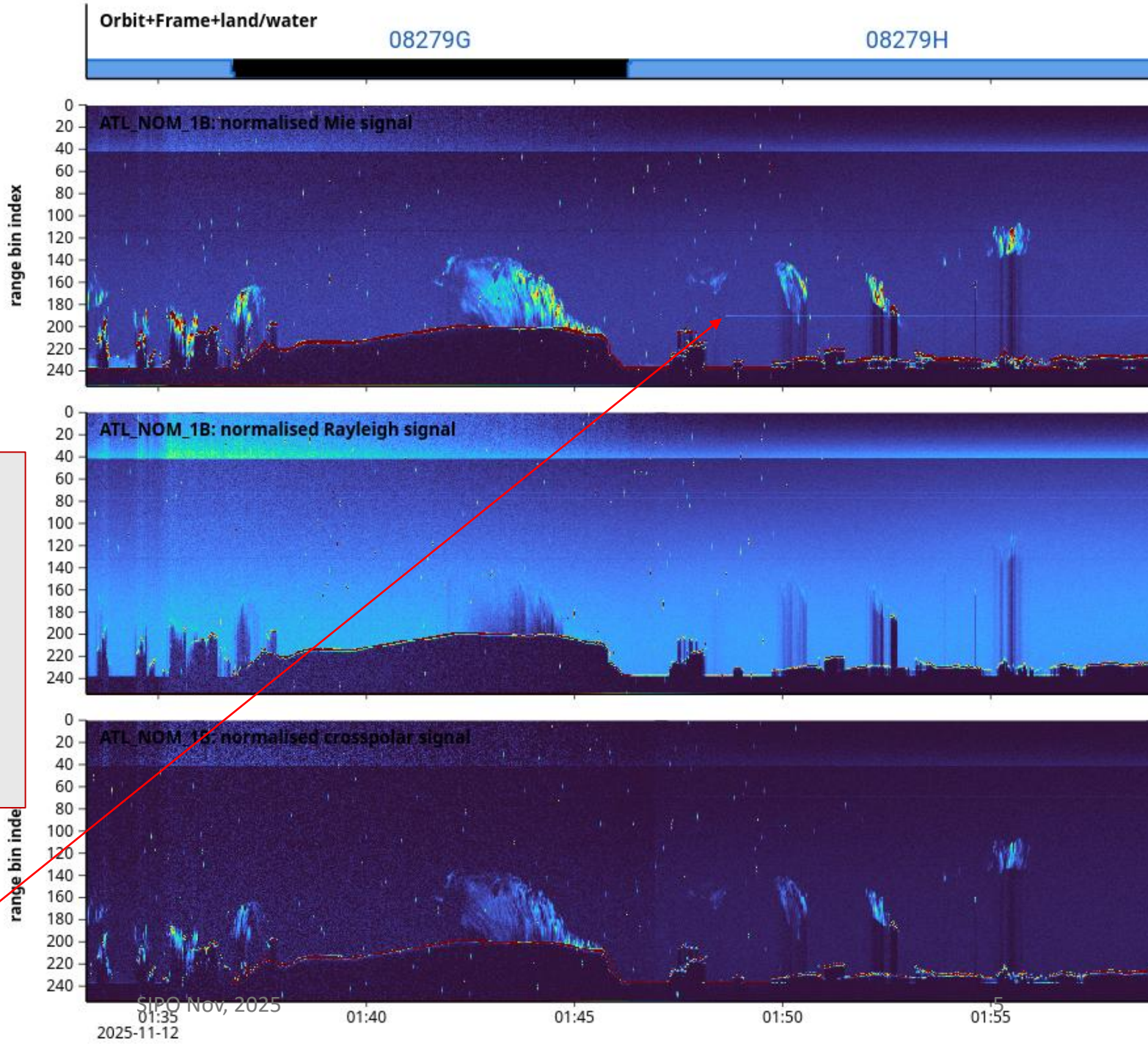



L1 ATBs are calibrated and cross-talk corrected !



# Radiation noise Spikes



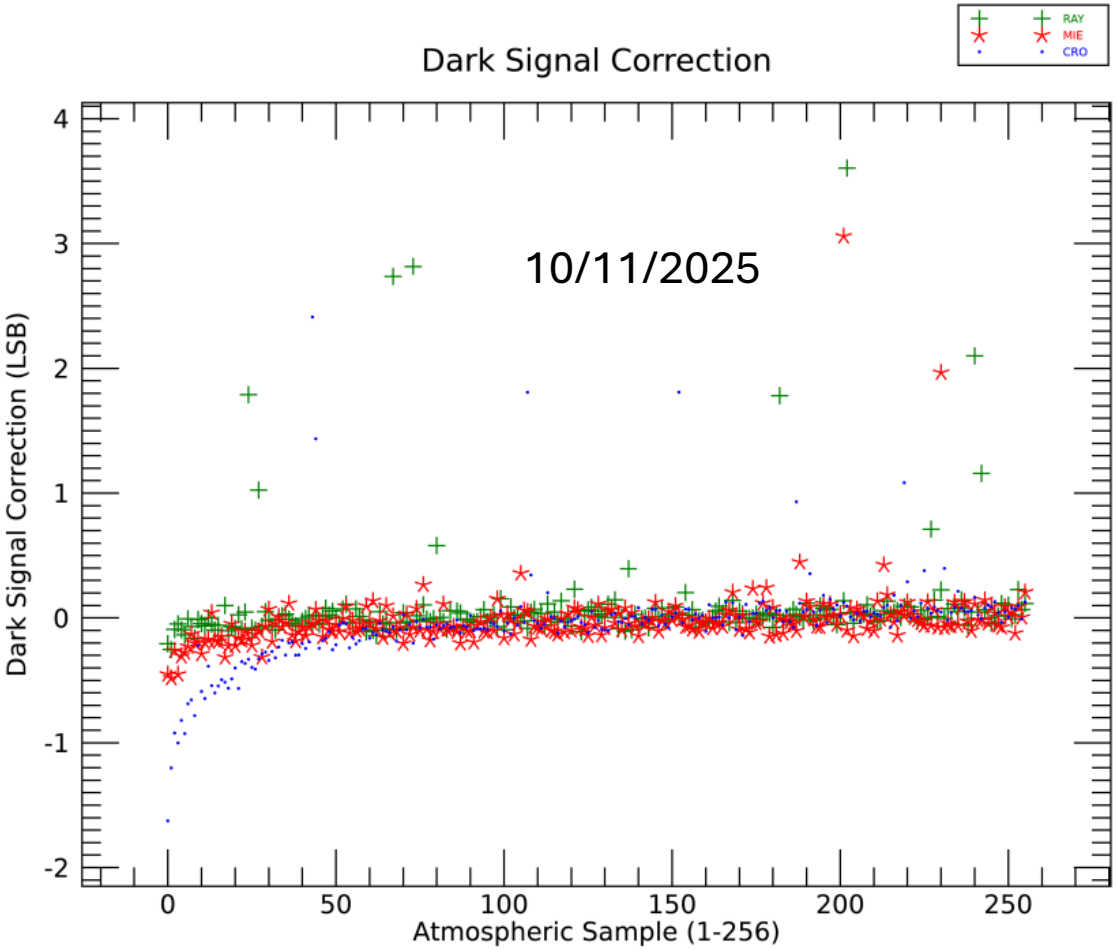

The Spikes keep coming…

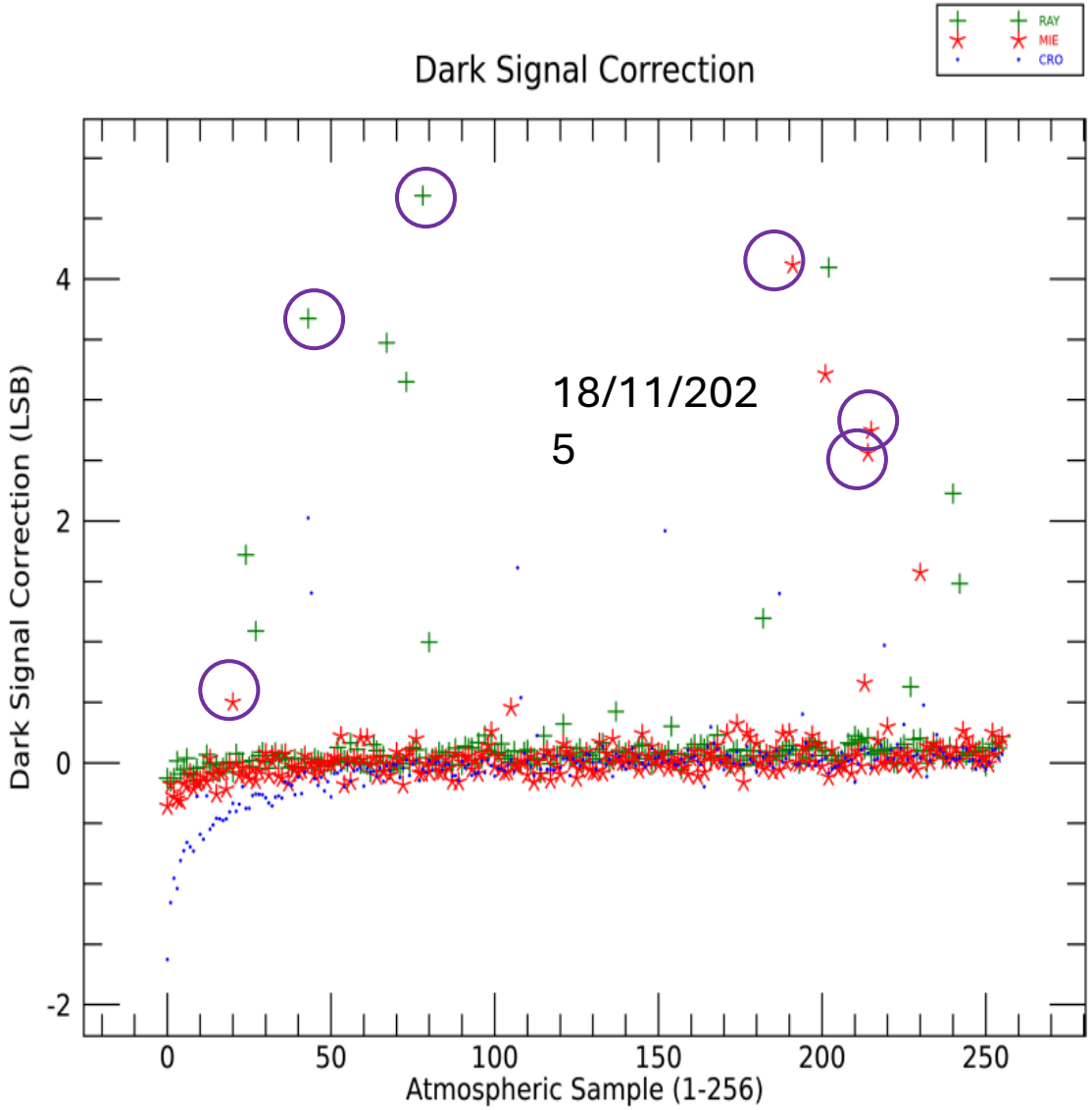
Esp. bad in early to mid November (worst Solar Flare to hit Earth in almost 10 years)

They are effectively filtered out…but, every so often a pixel is damaged (made Hot!)

New HP

# Mid-November was very bad for HPs




12/16/2025

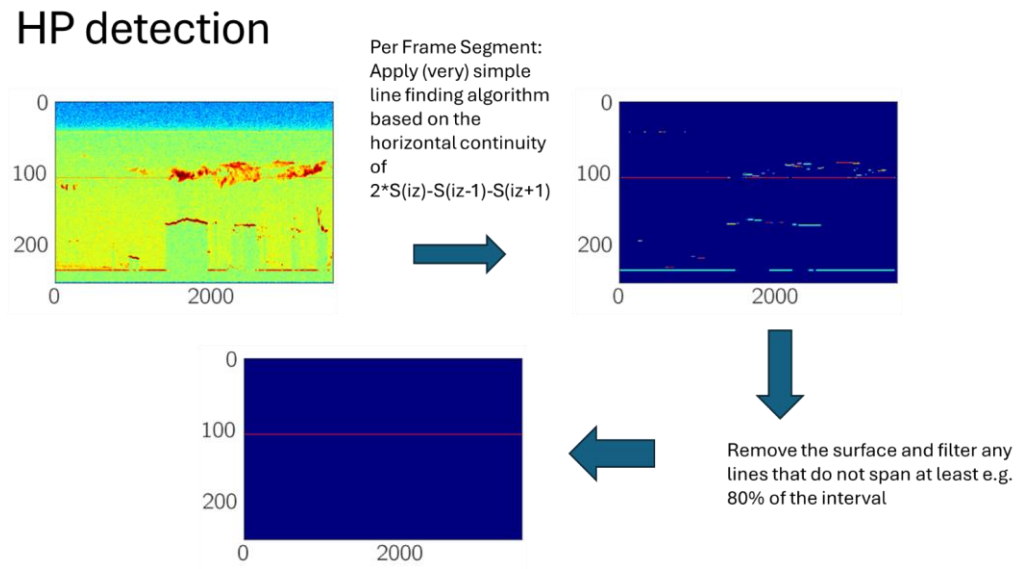
# HP Software Mitigation

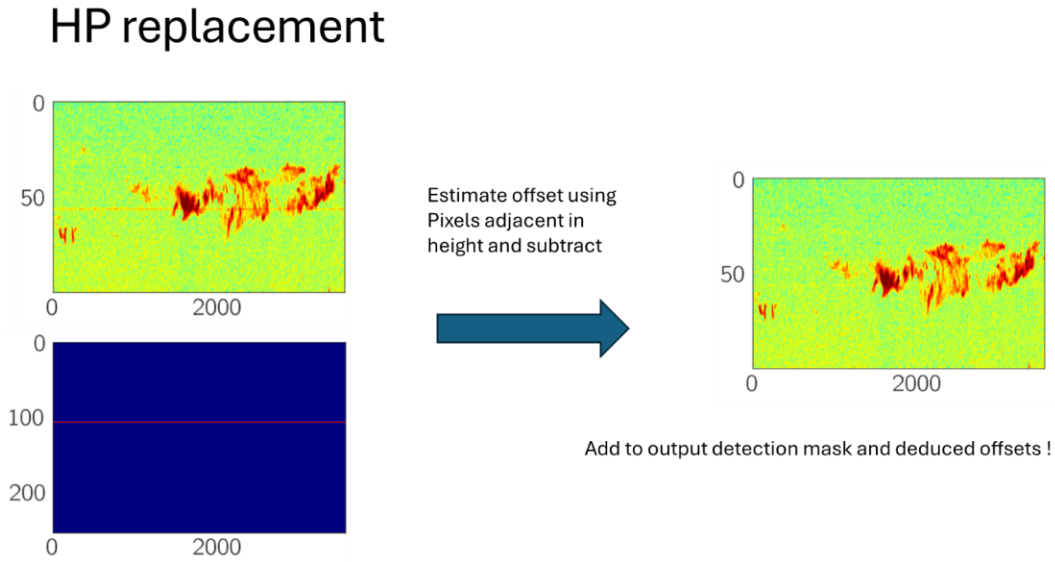
A HP detection and correction algorithm was developed and deployed.

Does not replace dark count map acquisitions but helps improve data quality between the map acquisitions and contributes to the overall HP tracking.

The procedures generally work well, but recent solar flare activity exposed some weakness!

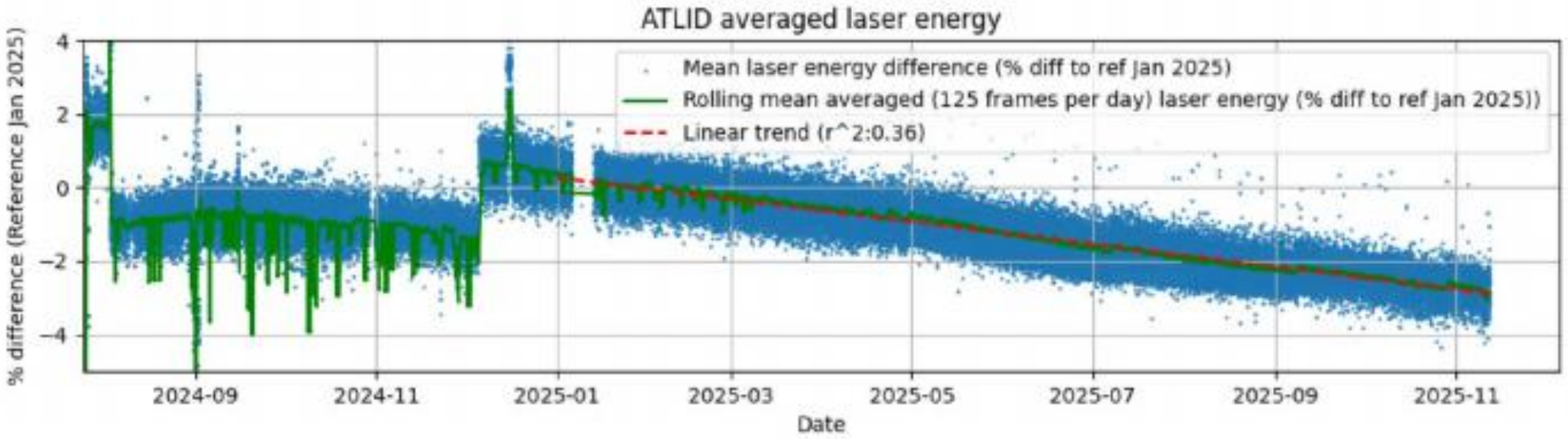
Procedures will need to be improved !



# Trends in Laser Power and Lidar Constants

Measured UV Laser power Trend. Now about -2% per year.

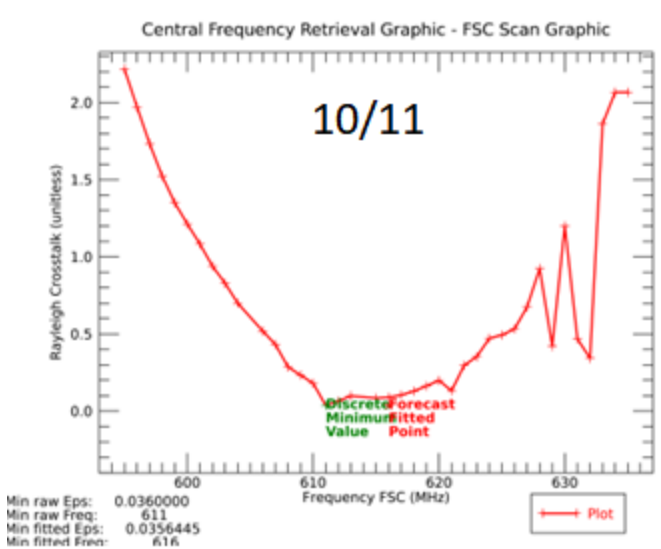


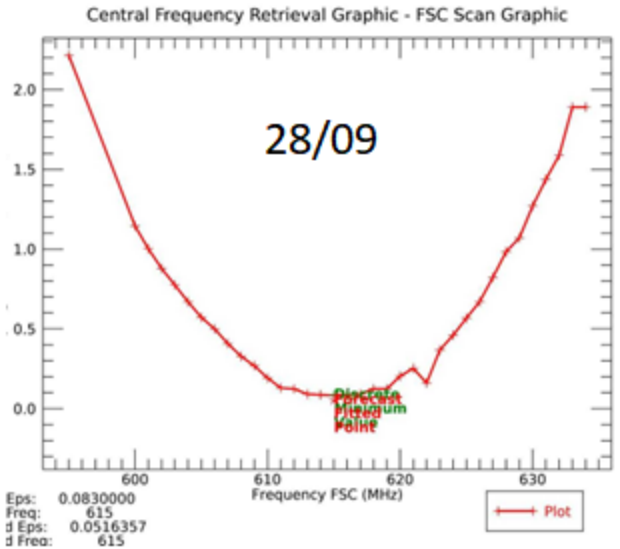

**Further: Trends in Lidar Constants for all three channels are consistent with laser power trend.**
**➔No quantifiable degradation on the receiver side!**

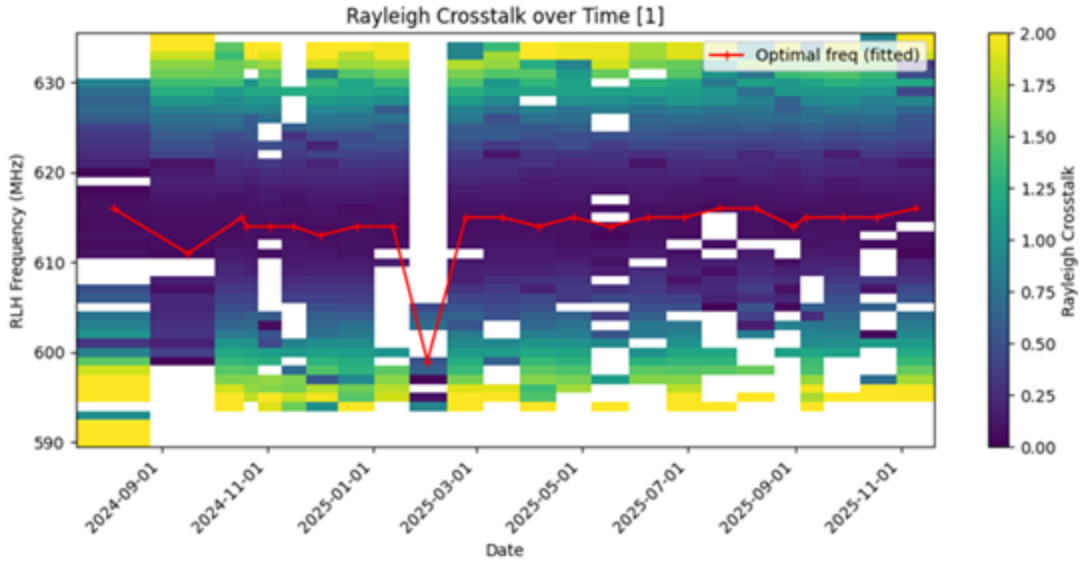
See presentation by R.D. Garcia (Long-Term Stability of EarthCARE Level-1 Data).

# Cross-talk coefficient monitoring

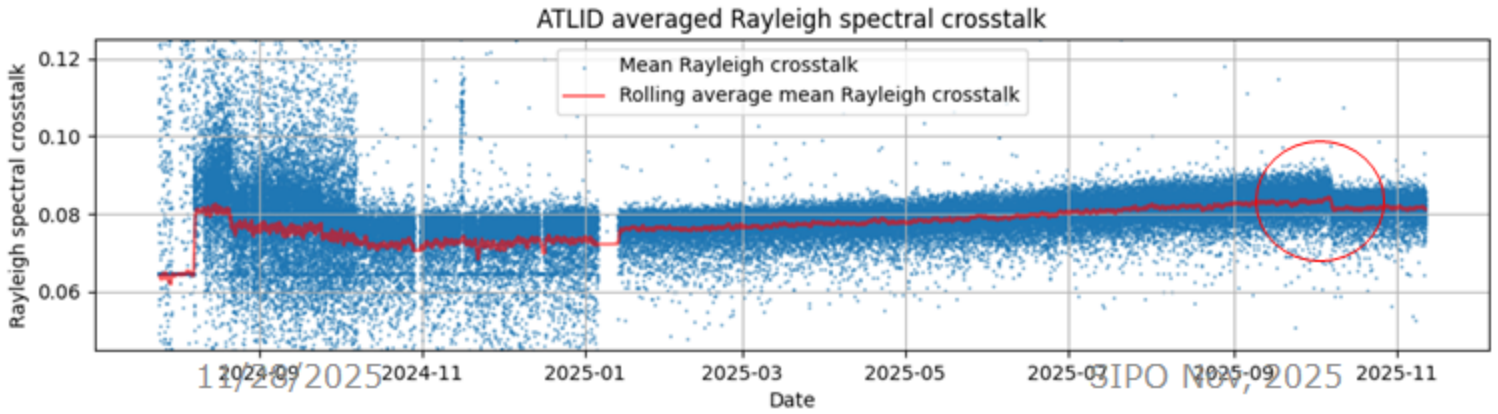
Mie➔Ray assessed using ground returns During Fine-Spectral-Calibration mode data (Laser Frequency is scanned)




Mie➔Ray assessed continuously using L1 operational data



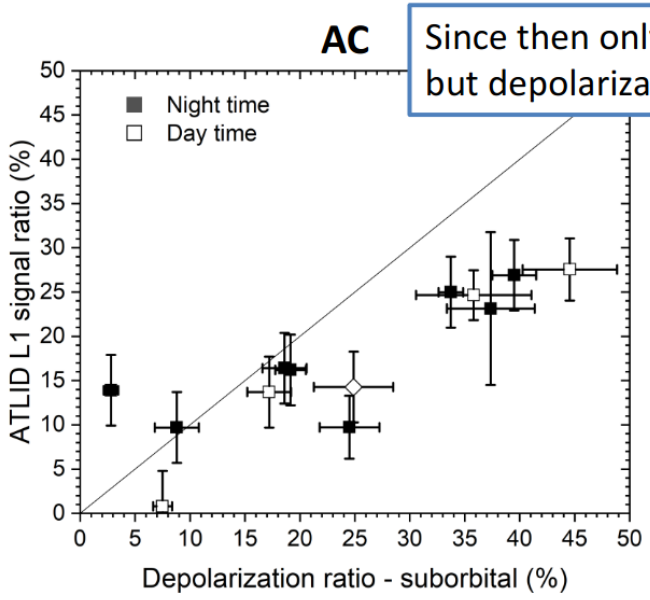

Captured shift in Frequency set-point 614=>615!

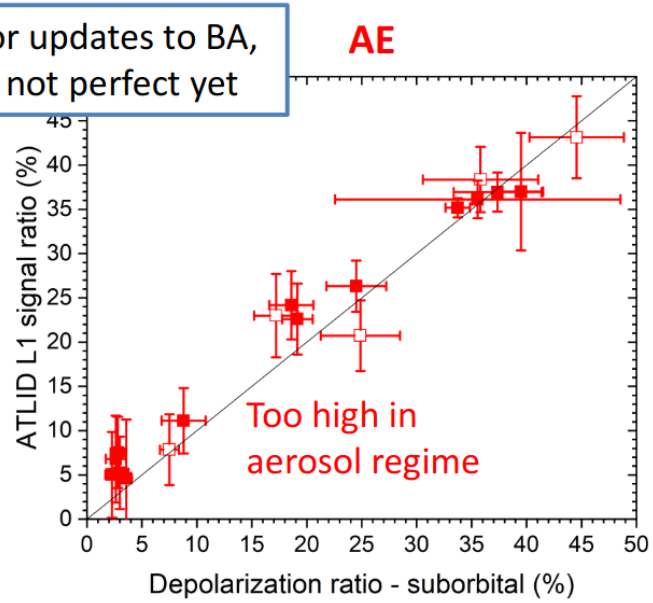
Courtesy: Raul and Silvia

# Depolarization ratio Measurements

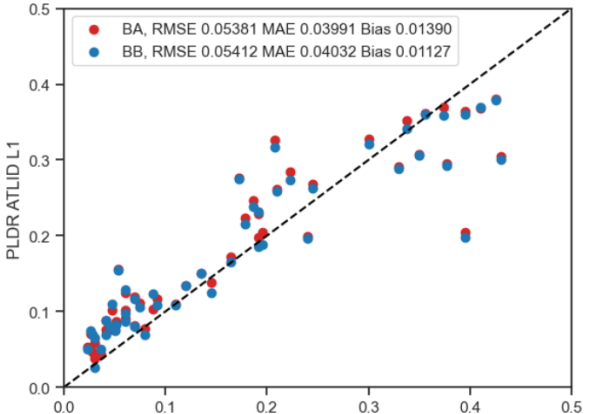
Major update from baseline AC to AD → improvement of daytime depolarization ratio

Since then only minor updates to BA, but depolarization is not perfect yet

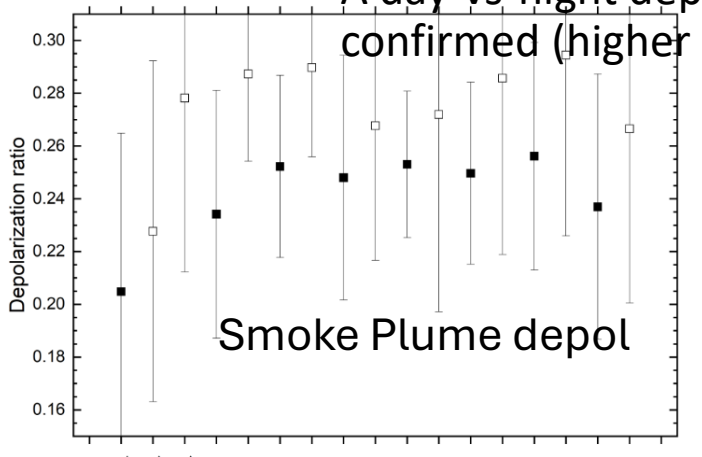


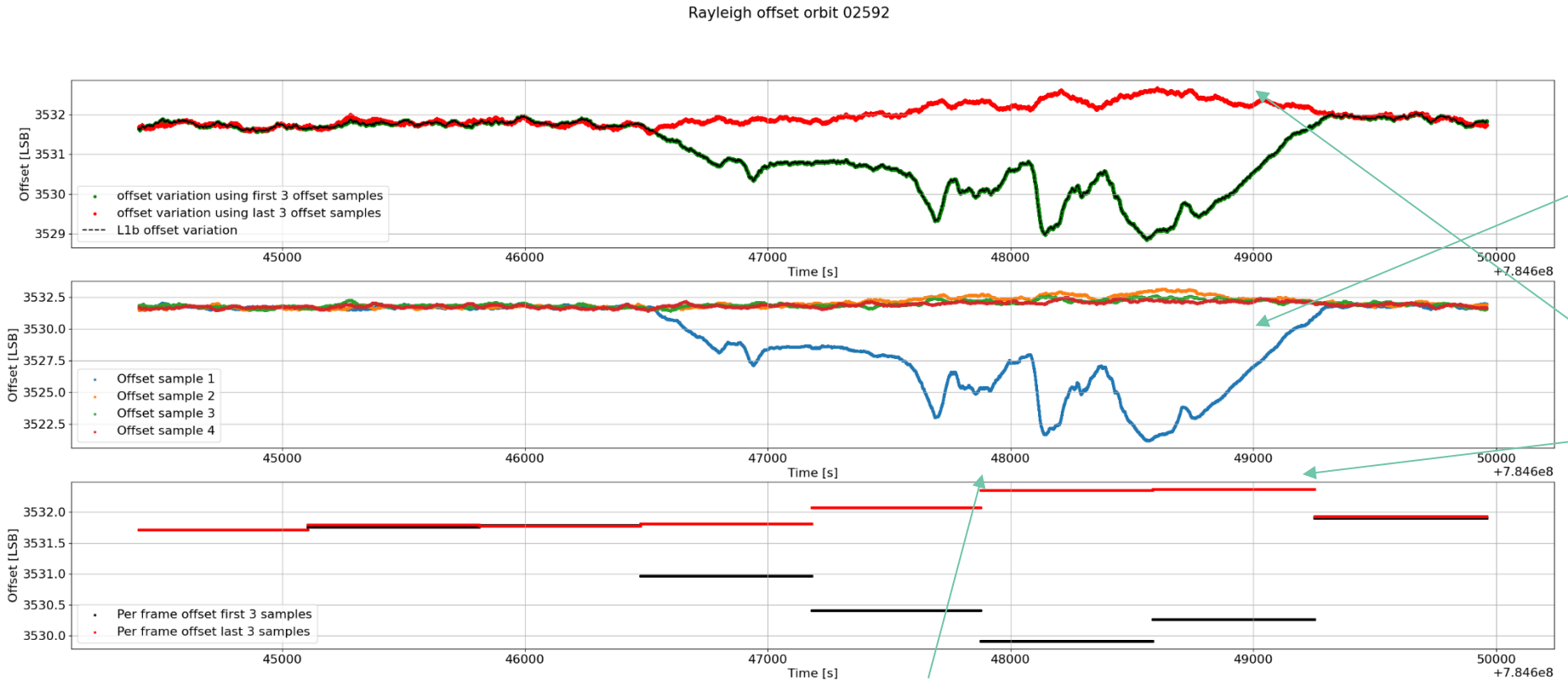

Recent updates have not been so dramatic...but




A day-vs-night depolarization bias has been confirmed (higher in the daylight).



# Detection Chain Offset Issues

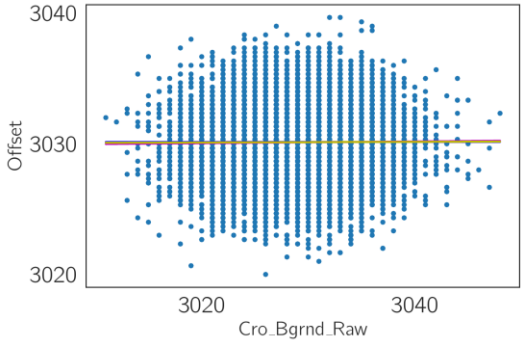



Biased 1st offset sample in blue

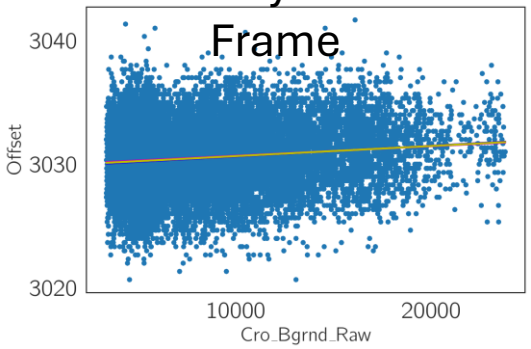
Switched to using the other 3 samples: results shown in red

# Daylight Offset Issues

Night-Time Frame

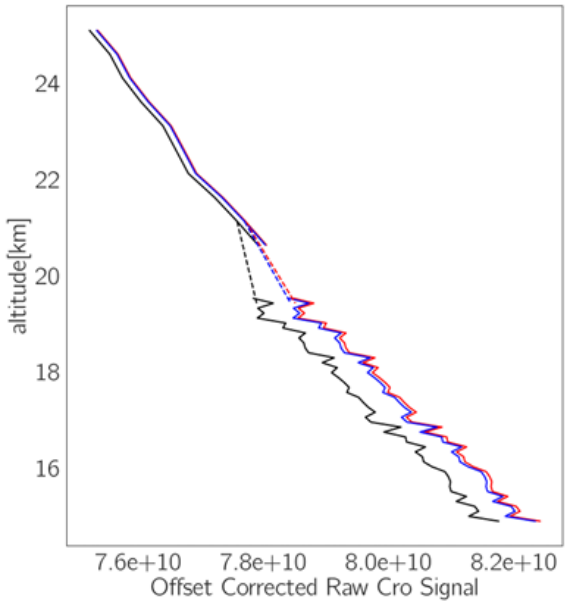



Day-Time Frame




Use correlation to estimate the "True DC Offset" level.

Correction is "small" but enough to greatly improve consistency between LR and HR altitude regions




This makes an earlier Ad-Hoc fix obsolete! This addressed the 20km discontinuities in daylight but was not optimal.

Removing the obsolete procedure and using the better offset estimates, improves the depolarization measurements!

# Wrap-Up

- Could not cover everything.
  - Charge transfer correction being tested which could replace 2 Ad-Hoc corrections
  - ECMWF monitoring activities are in place and will include HP mointering soon.
- ATLID's performance continues to be impressive !
  - Lifetime of 10 Yrs+ is completely plausible !
- However:
  - Rad. Spikes and HPs etc. are a challenge and have demanded a large amount of effort. Further work still needs to be done (Esp. HP management!).
  - Improving the Offset estimation will be a significant improvement esp. for Depol!
  - Next in the list is a revisit of the missed HP/AP* software detection and correction.

*Anomalous Pixel