# ATLID NRT quality monitoring using NWP

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**1st ESA-JAXA EarthCARE**
**In-Orbit Validation Workshop**

ECMWF esa JAXA

# What are the benefits of validating ATLID against NWP?

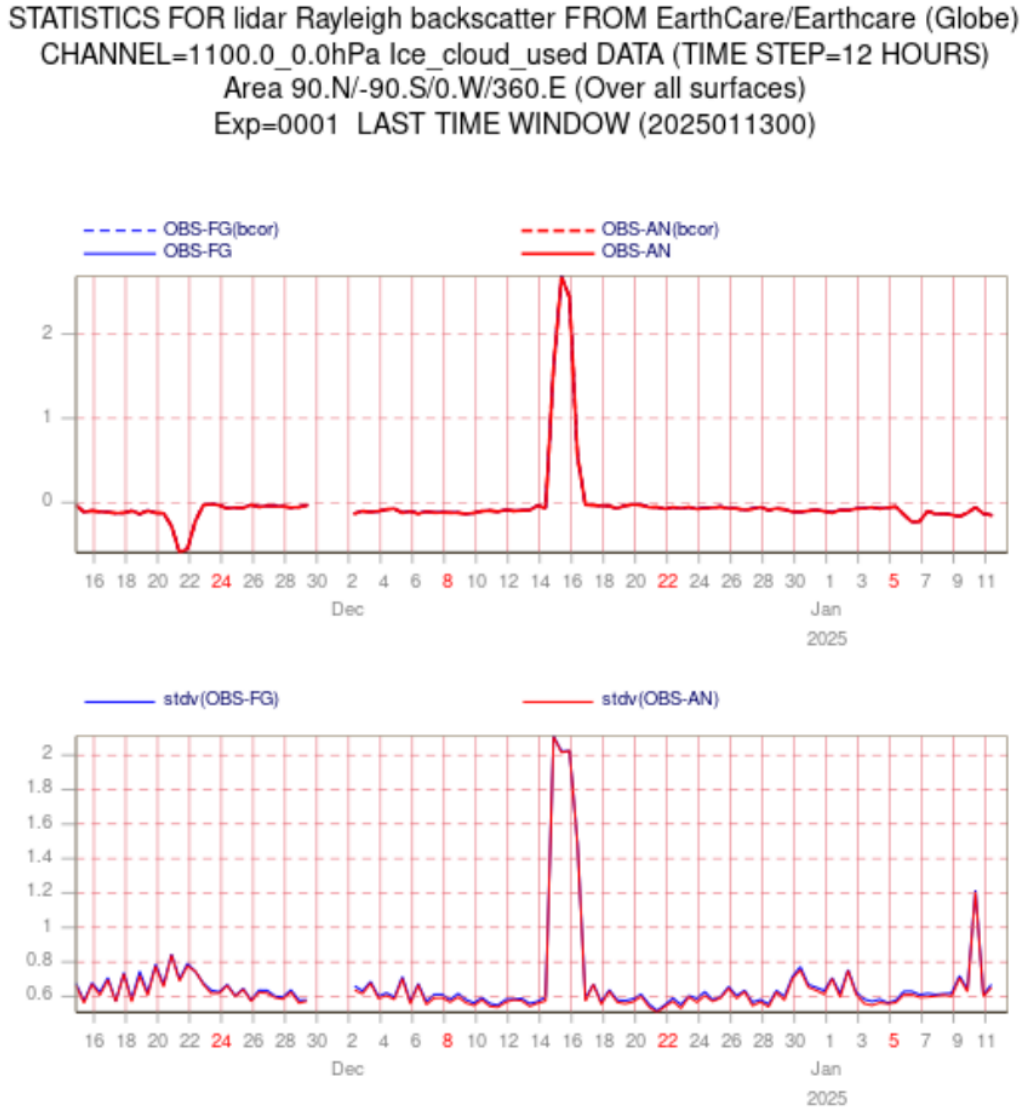
- **Rapid detection** of instrument issues

(removes most of day-to-day variability)

- **Continuous evaluation** in space and time

- Platform for **comparison with other instruments**, including historical missions

- Precursor for **data assimilation**






https://charts.ecmwf.int/catalogue/packages/obstat/products/hist_ECare_LRBSC_v3

# Observation processing for ATLID

Commissioning phase / monitoring

ATL_NOM_1B -> Rayleigh+mie+cross

-> Rayleigh (co-polar)

L2 product monitoring / assimilation

ATL_EBD_2A -> Particle attenuated backscatter

➔ Rayleigh attenuated backscatter

➔ Particulate Extinction

**BUFR**

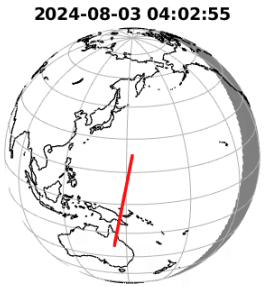
Binary data format used at operational NWP centres

Re-gridding to 137 model levels and averaging horizontally to TCo319 (~30 km grid spacing), L1B uses basic threshold for cloud mask

**ODB**

In-house observation database, ready for comparison with model

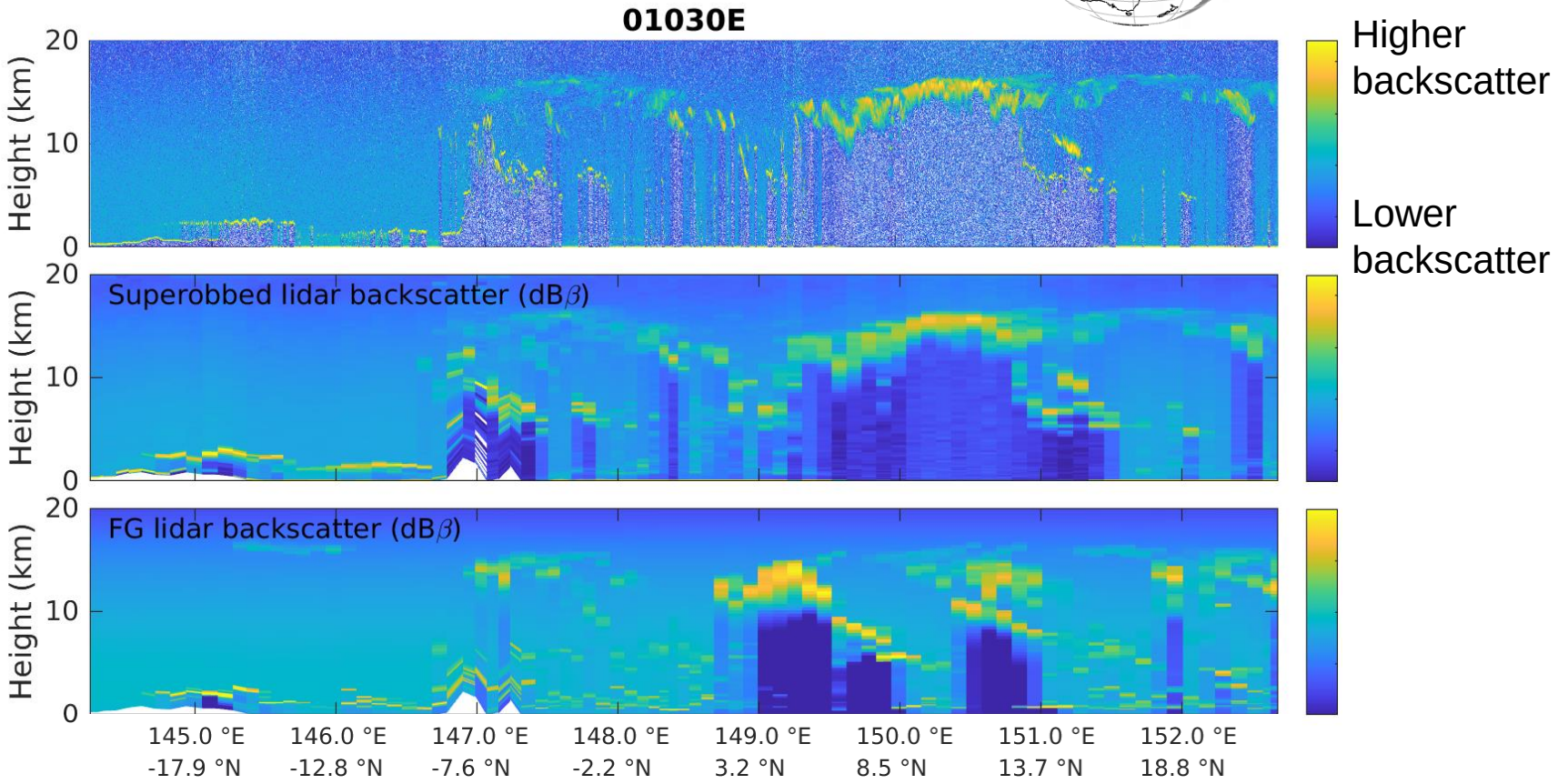
# Comparison of model with observations




EarthCARE ATLID total attenuated backscatter

**ATLID** averaged to model scale

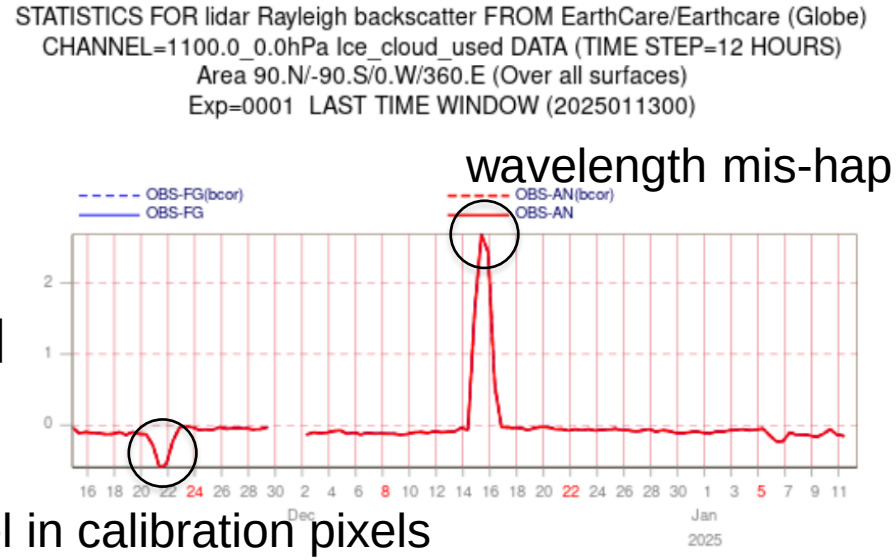
**IFS** total attenuated backscatter




**-> Monitor ‘FG depatures’ (obs minus model) with various screening criteria**

# Routine monitoring examples – Rayleigh channel

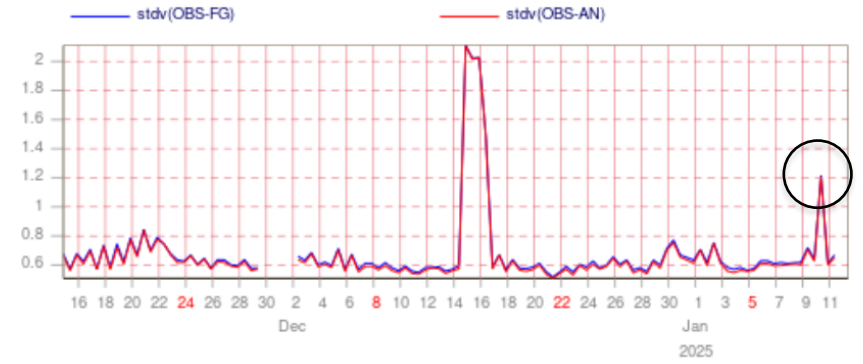
Mean
FG dep [dB]




wavelength mis-hap

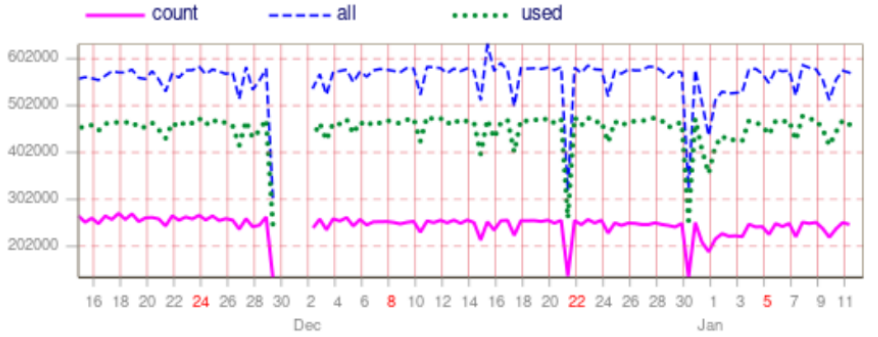
Hot pixel in calibration pixels

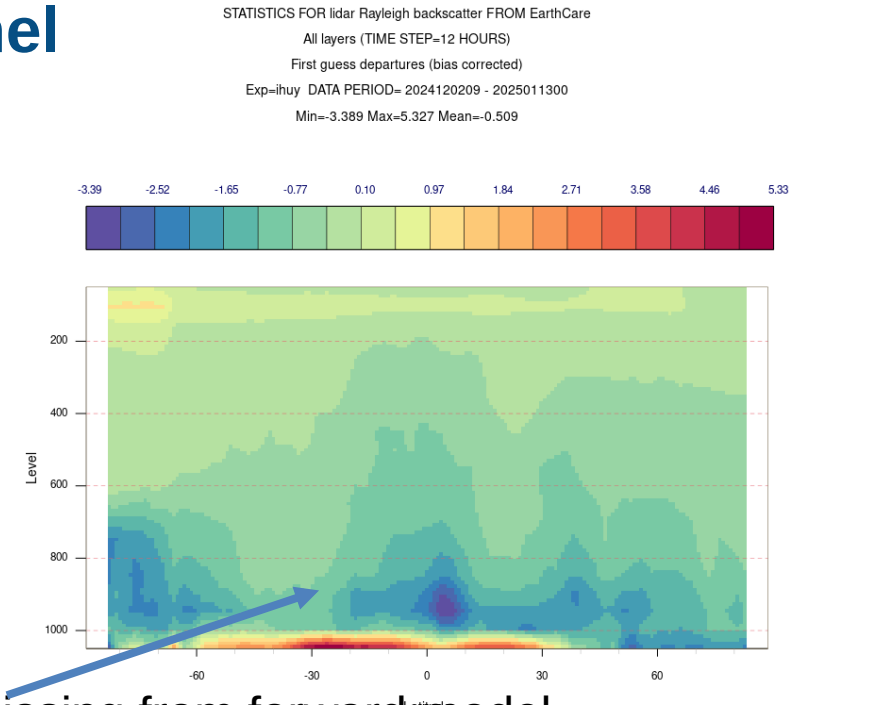
Std. dev.
FG dep [dB]



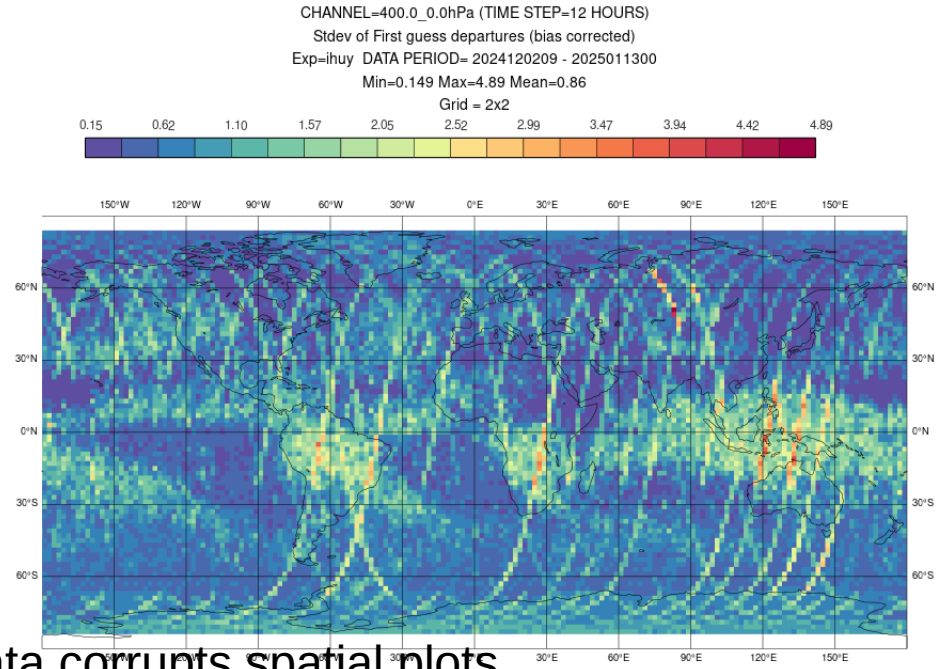

?

Number
of obs



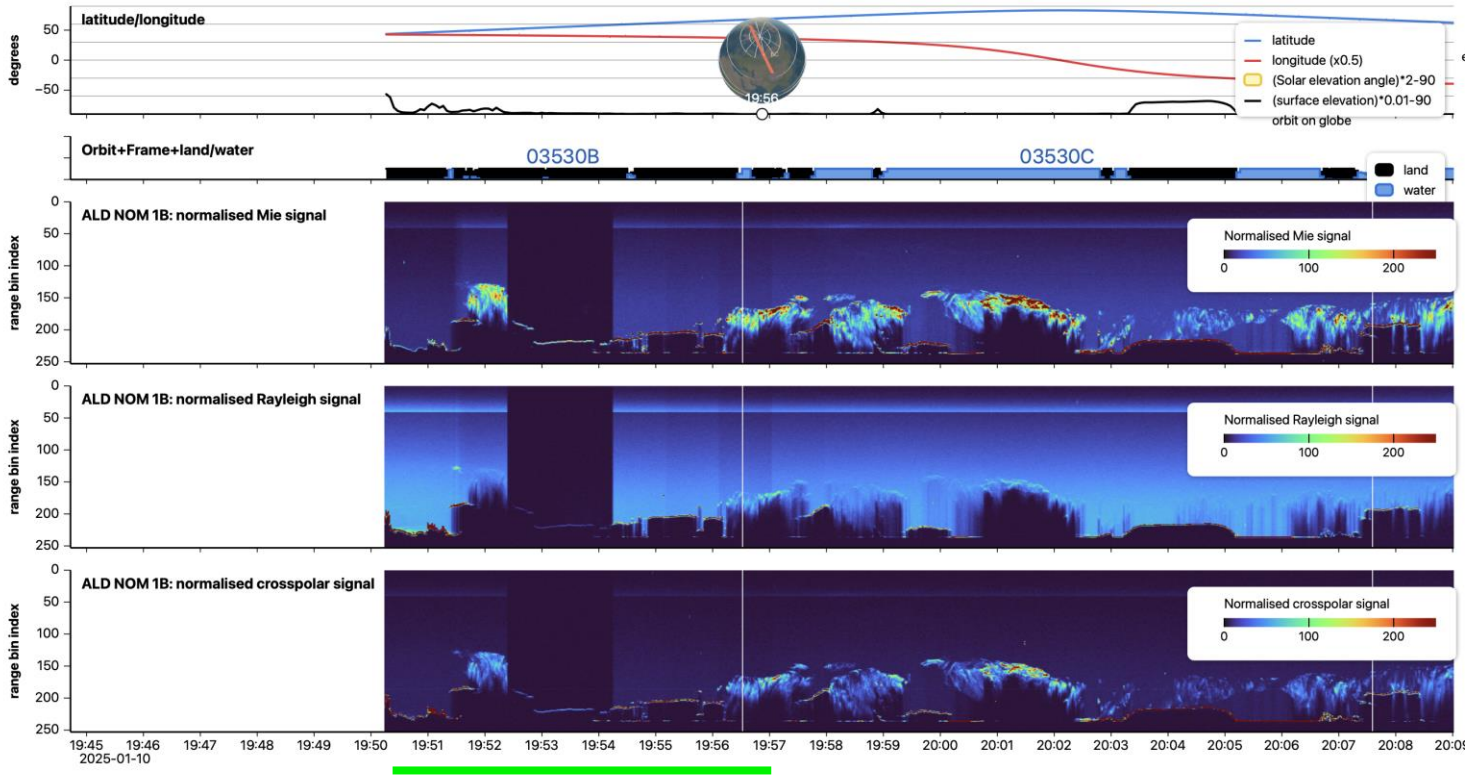




Aerosol missing from forward model

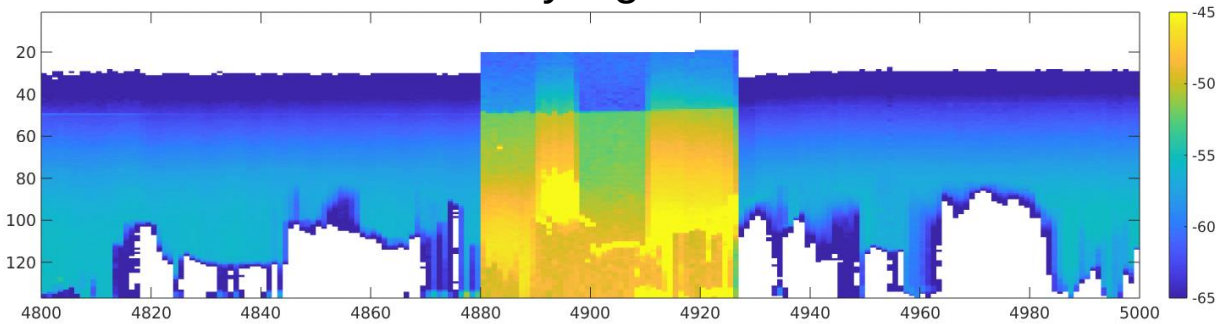



Bad data corrupts spatial plots

# Issue with frame 03530B

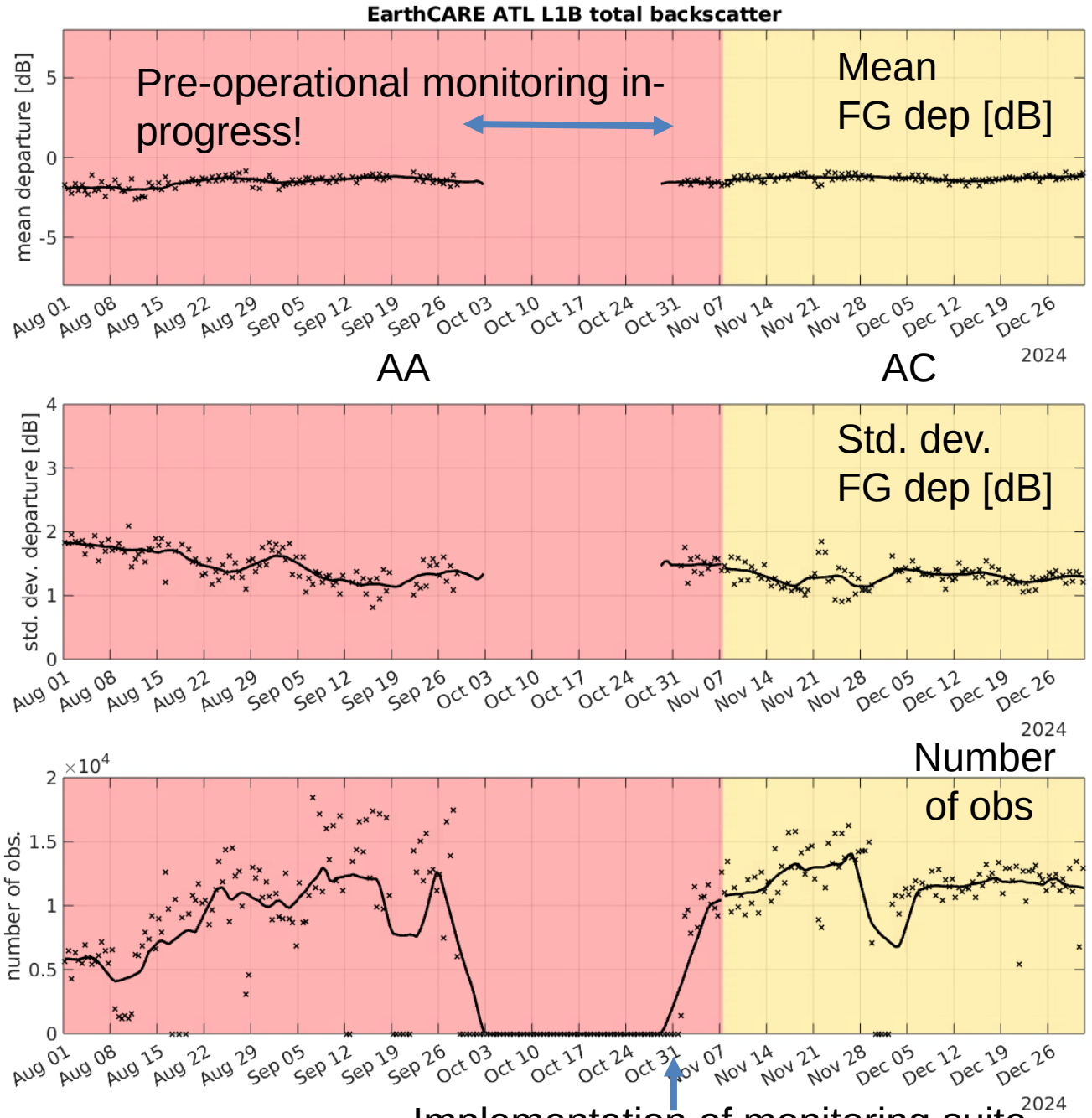



ATLID Rayleigh attenuated backscatter

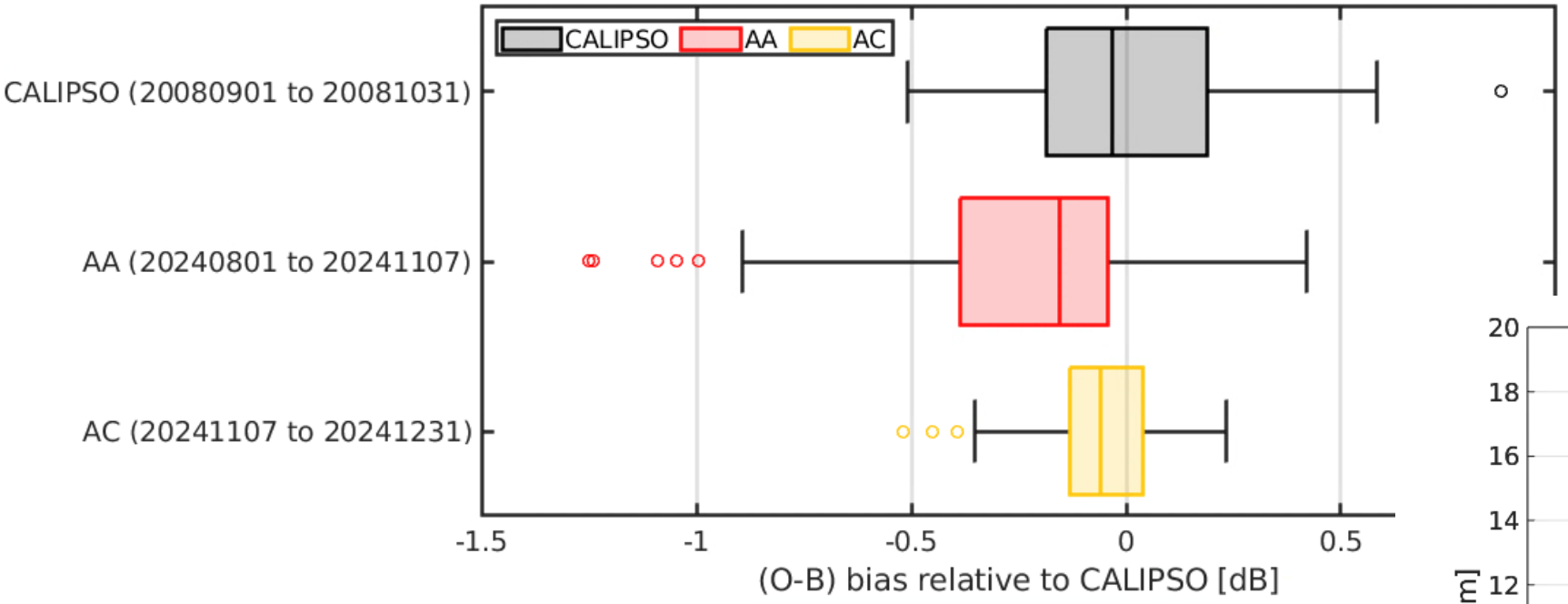


# Monitoring total attenuated backscatter in ice cloud

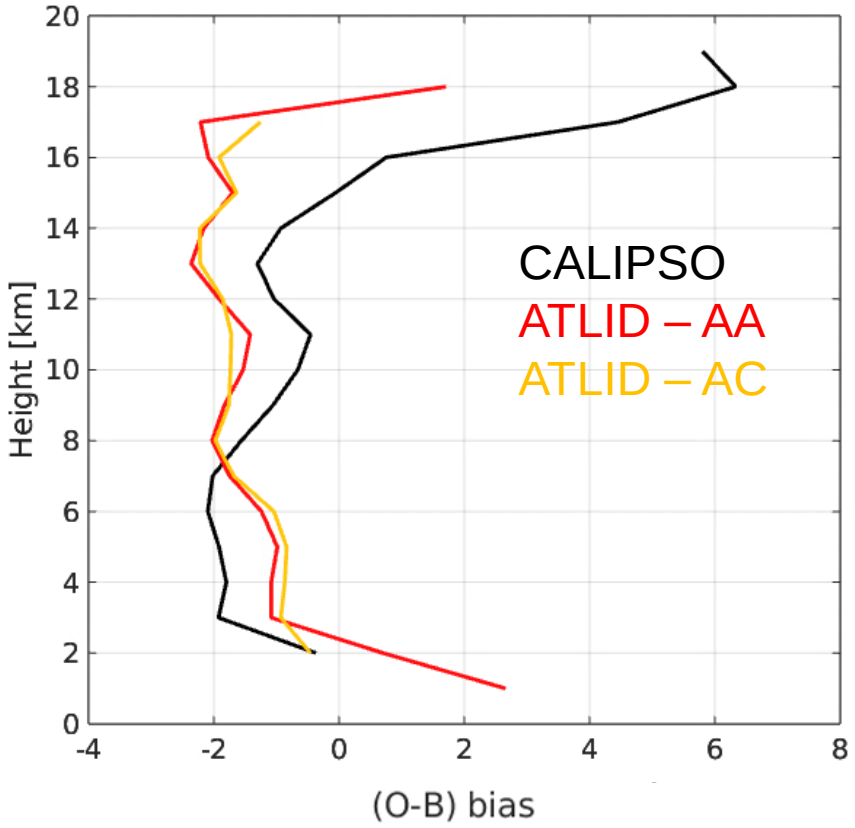
- Monitoring of signal in ice-cloud reduces impact of attenuation of lidar signal and multiple scattering.
  - Remove incidence of liquid water cloud by restricting observations to where T < 233 K and using a cloud threshold of – 56 dBβ
- Monitoring shows ATLID cloud detection stable since lidar switch-on
- Some bias compared to model is expected - model clouds not perfect!



# Comparison of ATLID and CALISPO in ice cloud (12-hour global mean samples)



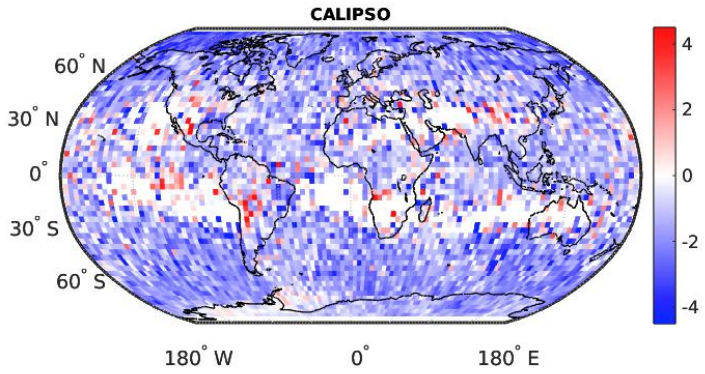

Result somewhat serendipitous – expect different sensitivities due to different wavelengths

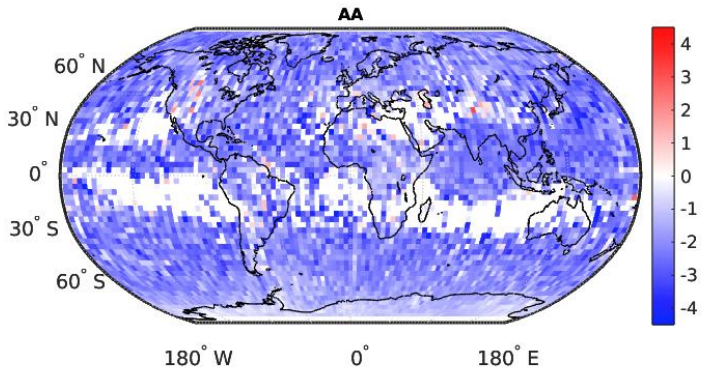


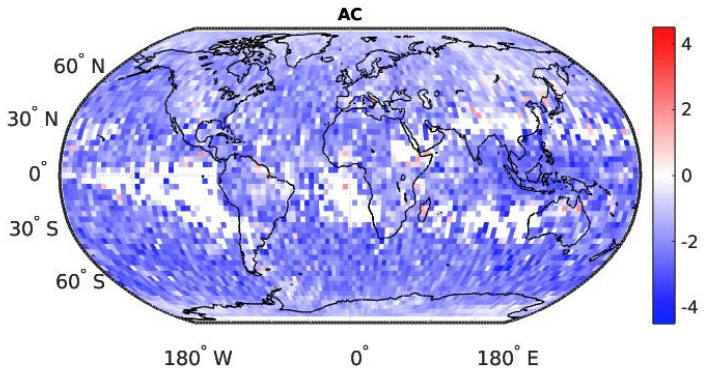

- Can sanity check ATLID observations to CALIPSO by using model as ‘stepping stone’.
- Same processing applied to both CALIPSO and ATLID.
- AC processing agrees well with CALIPSO in global mean.

# Comparison of ATLID and CALISPO FG departures in ice cloud

## Mean bias [dB]

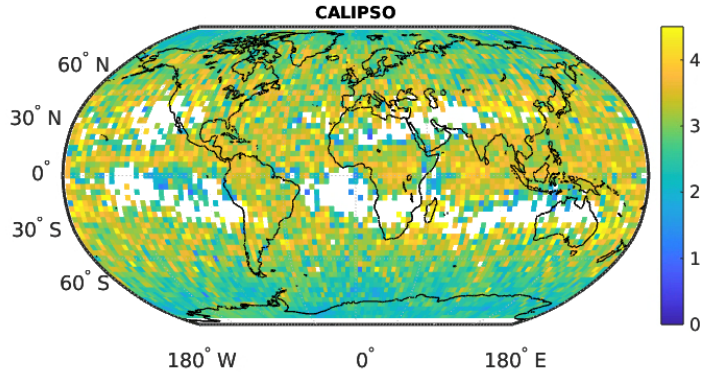


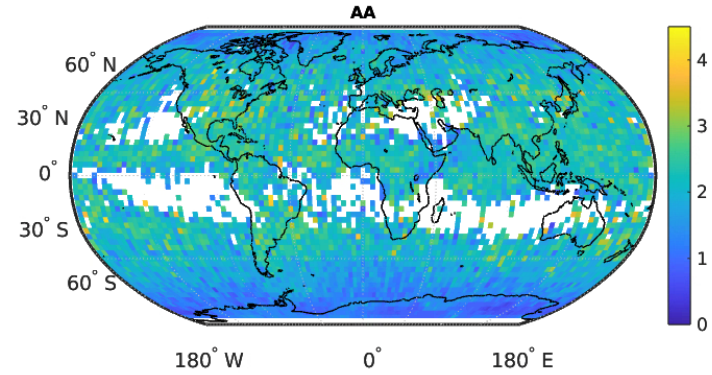



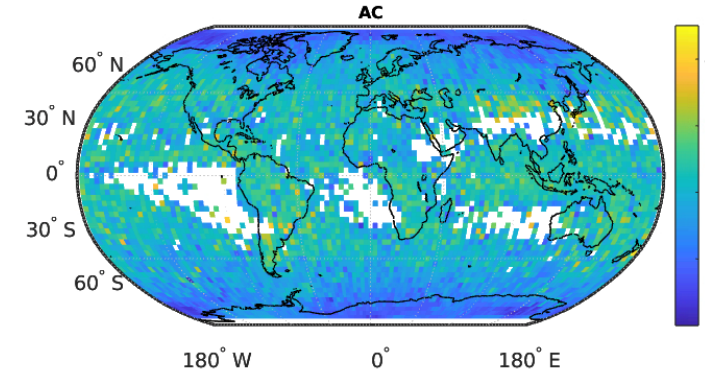




## Mean std. dev. [dB]

ATLID generally has smaller std. dev. compared to CALIPSO – larger component of (known) Rayleigh scattering in total backscatter



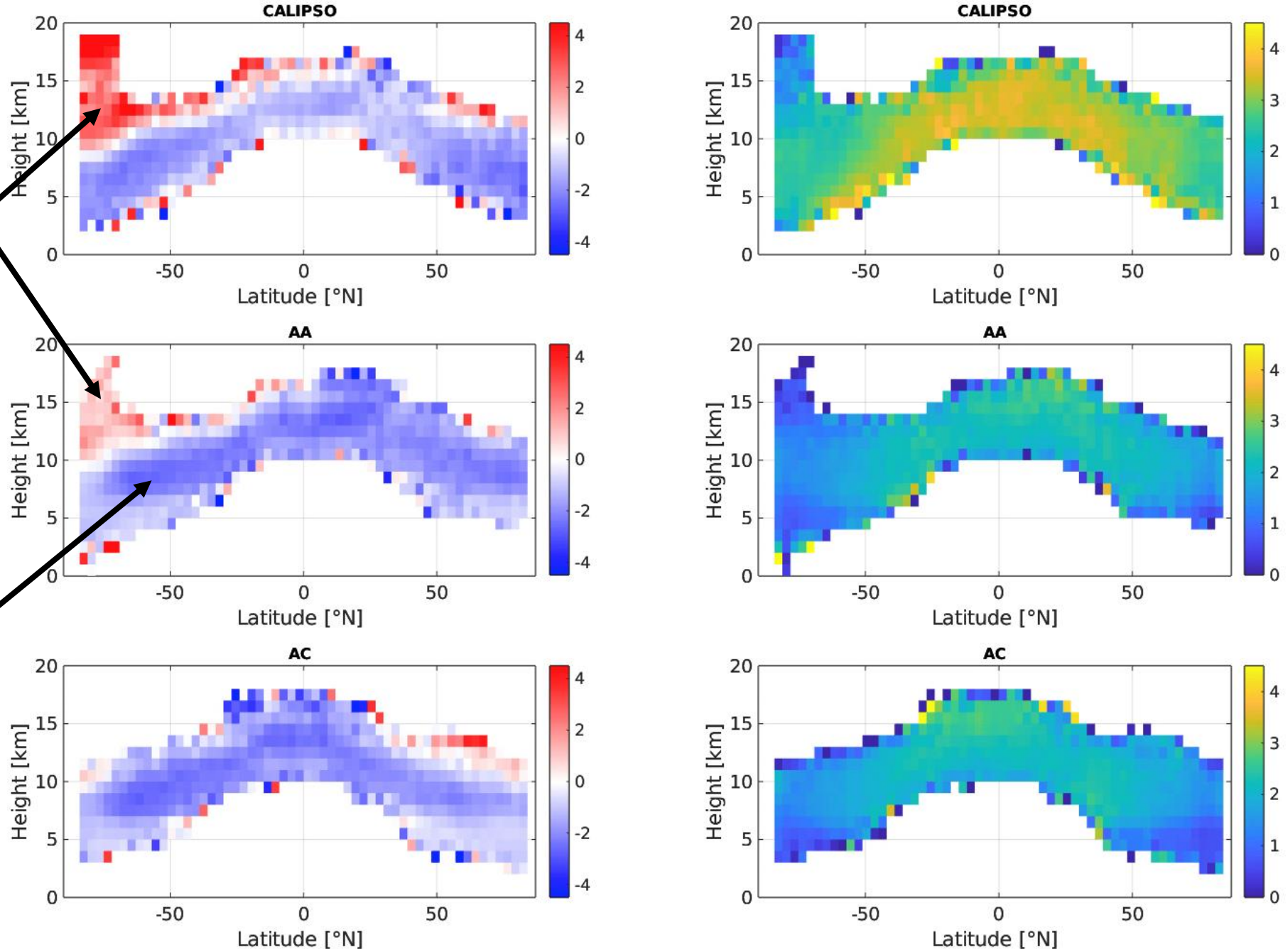



## Mean bias [dB]

## Mean std. dev. [dB]

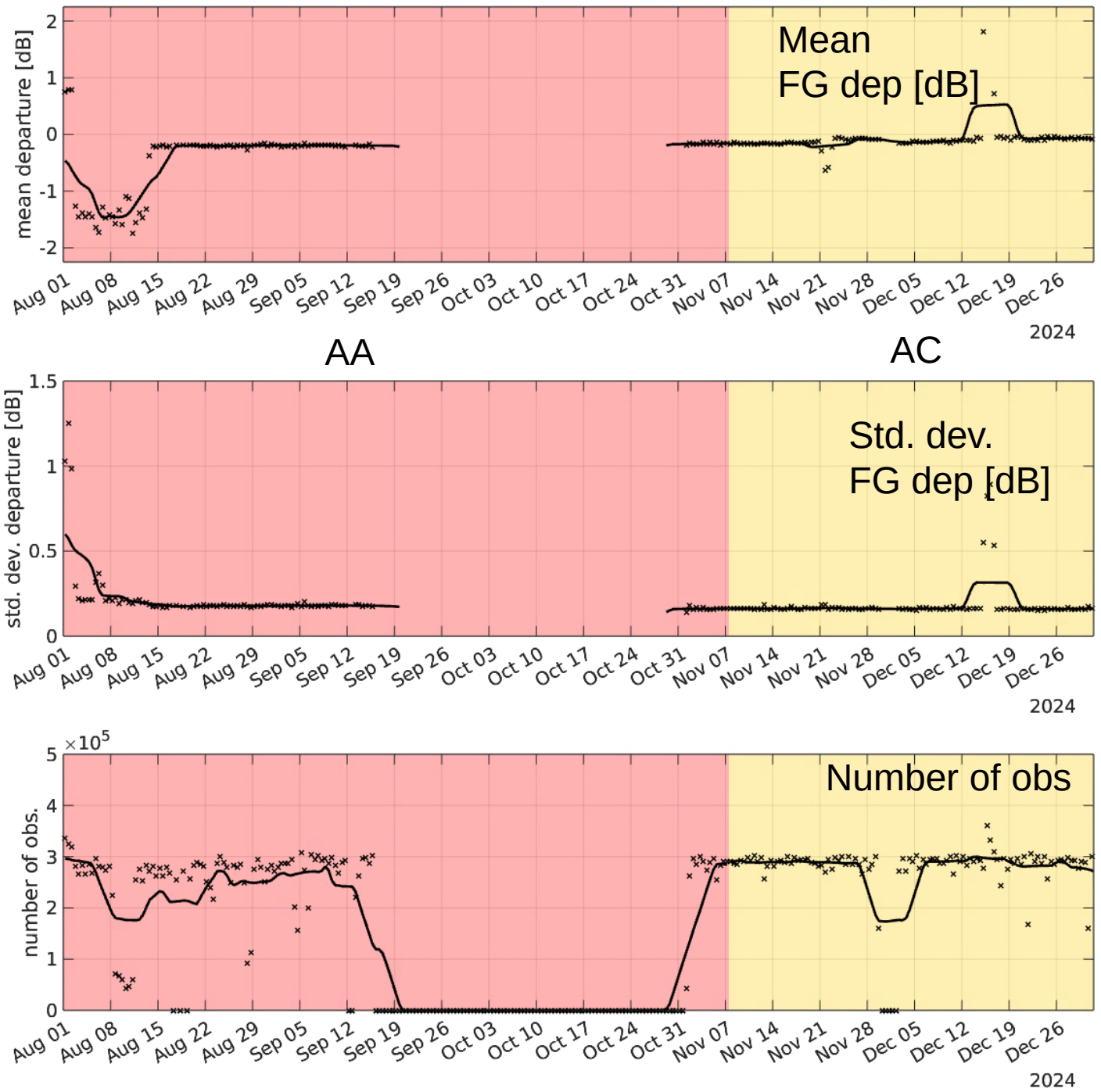
Missing PSCs in model

Too much light snow in model



# Monitoring Rayleigh backscatter in clear-sky only

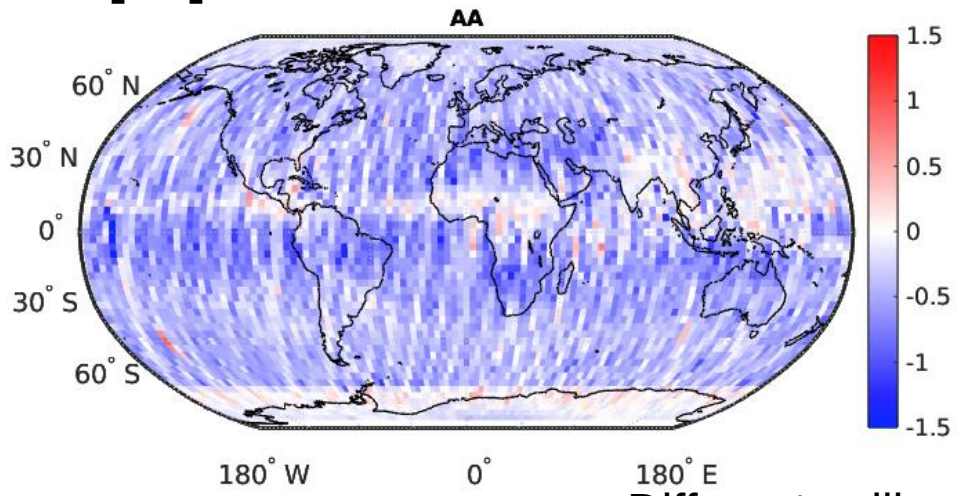
- Monitoring of Rayleigh co-polar backscatter against model total Rayleigh backscatter
  - Remove incidence of clouds using a threshold of – 56 dBβ
- Monitoring shows ATLID Rayleigh backscatter stable since Aug 15.

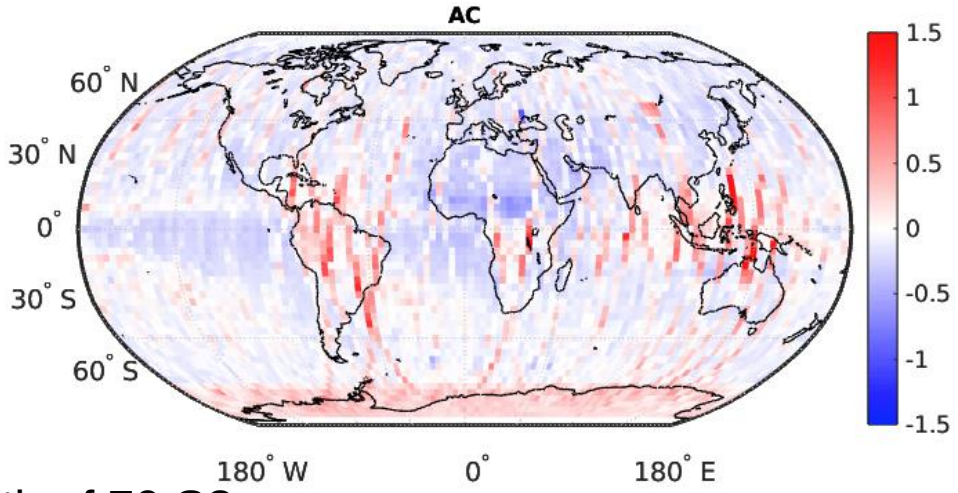


# Mean bias and Std. dev. of cloud-free ATLID Rayleigh backscatter departures

**Mean bias [dB]**

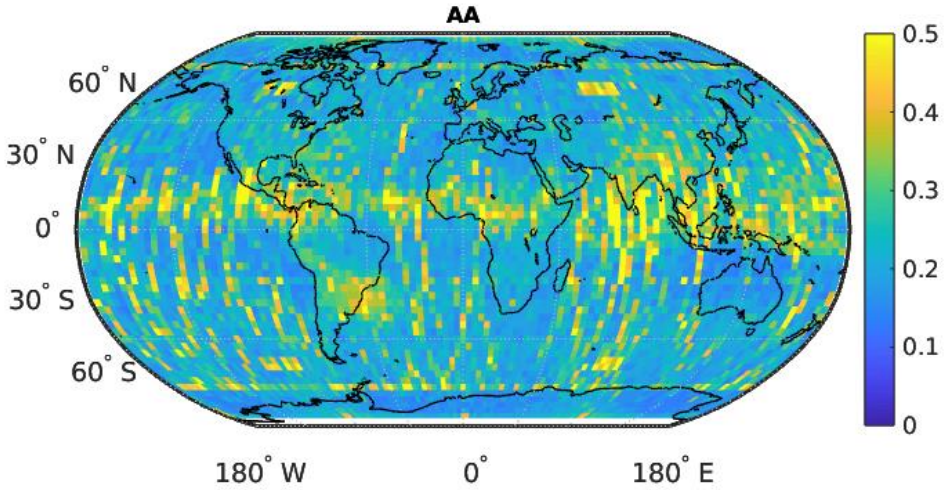
Correction of background noise

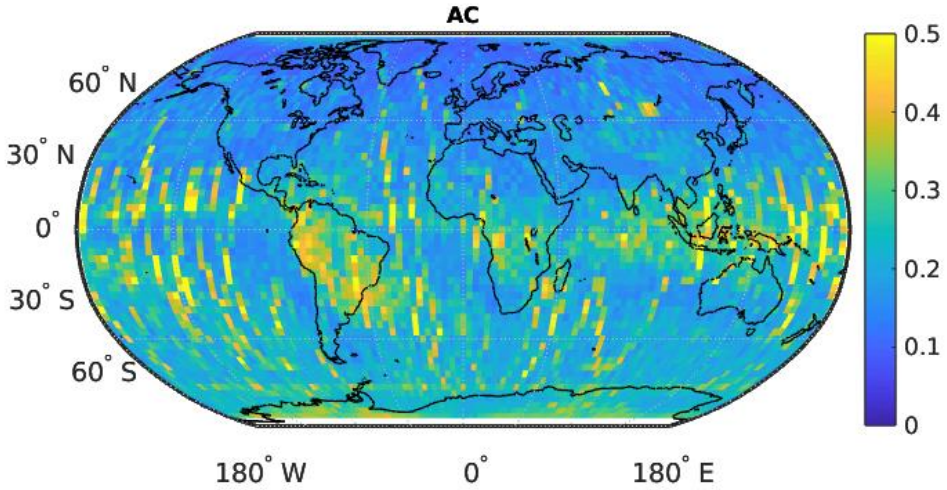



**Mean std. dev. [dB]**

Different calibration south of 70 S?

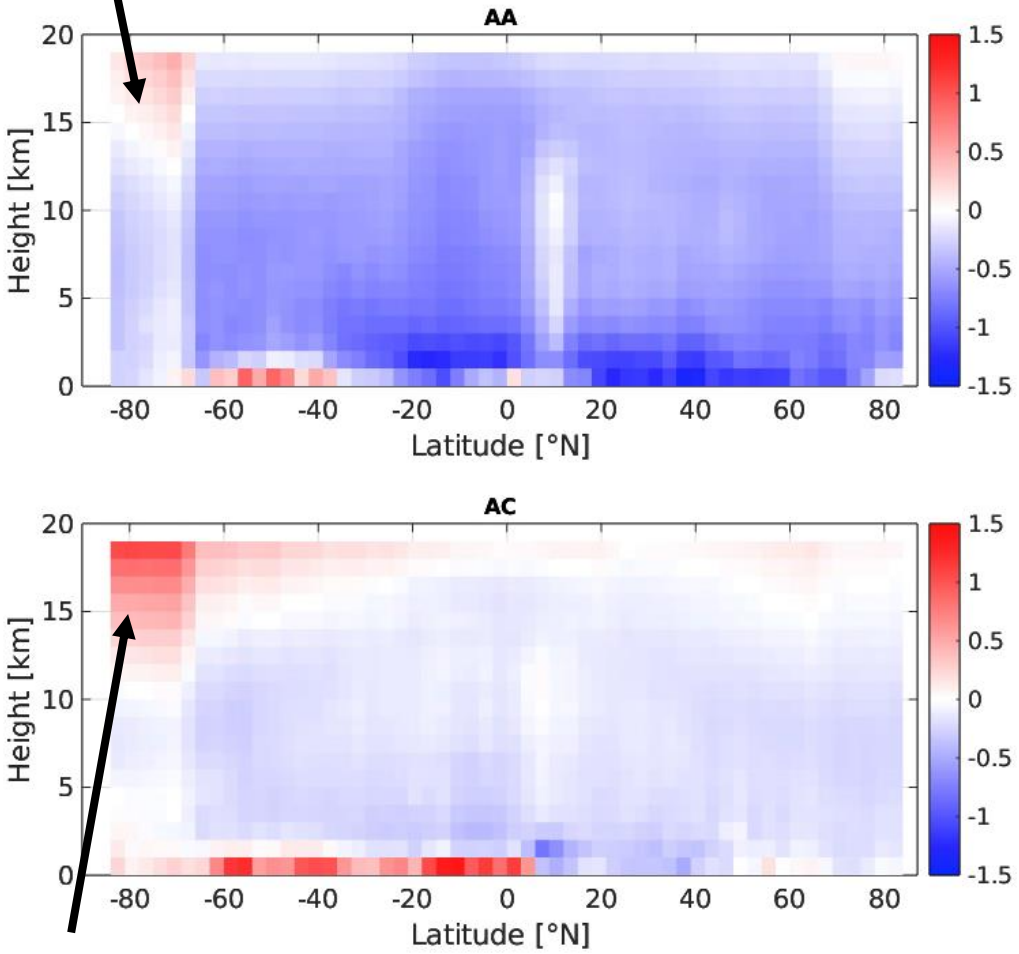


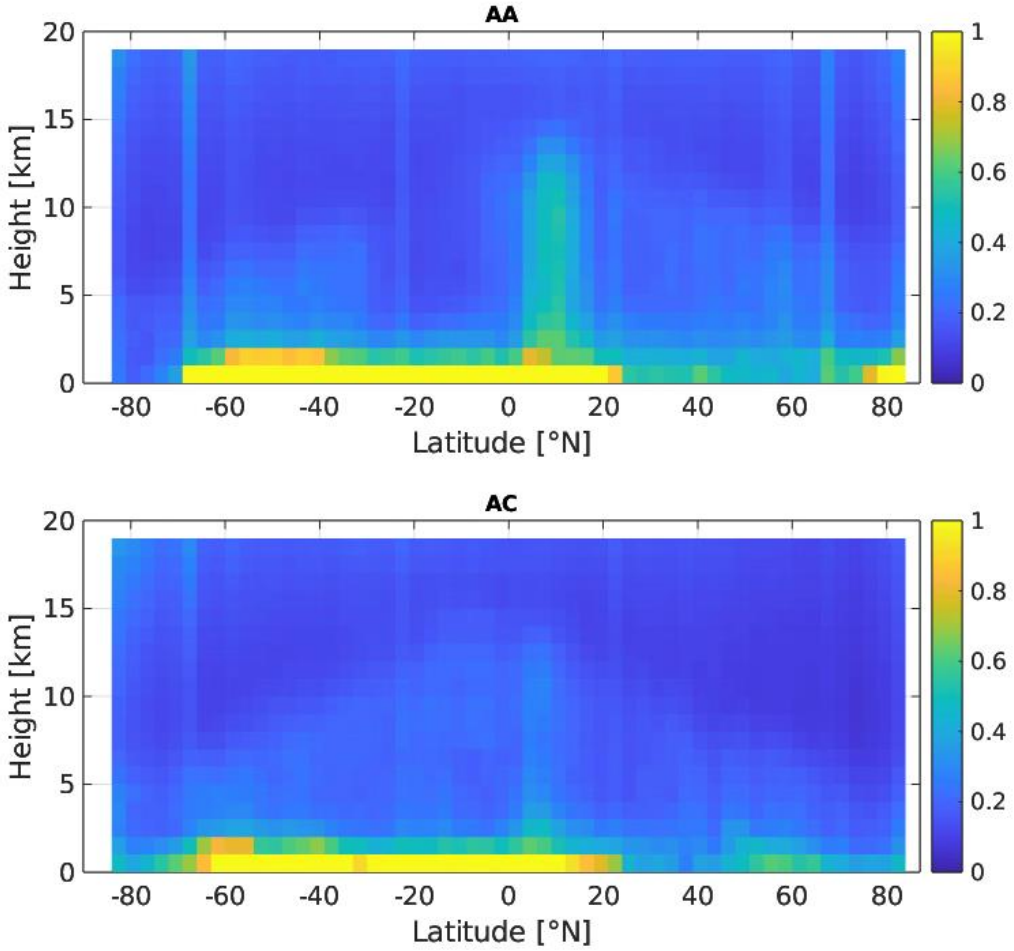
# Zonal average bias and std. dev. of Rayleigh backscatter FG departures

Missing PSCs in model?

**Mean bias [dB]**



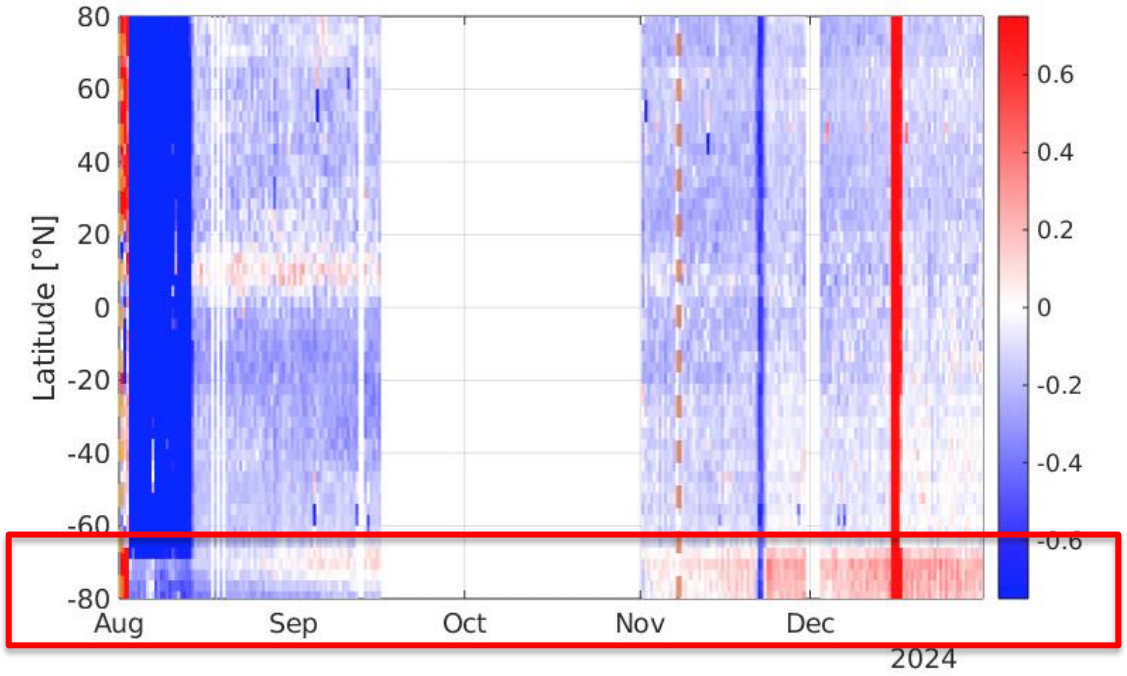

**Mean std. dev. [dB]**



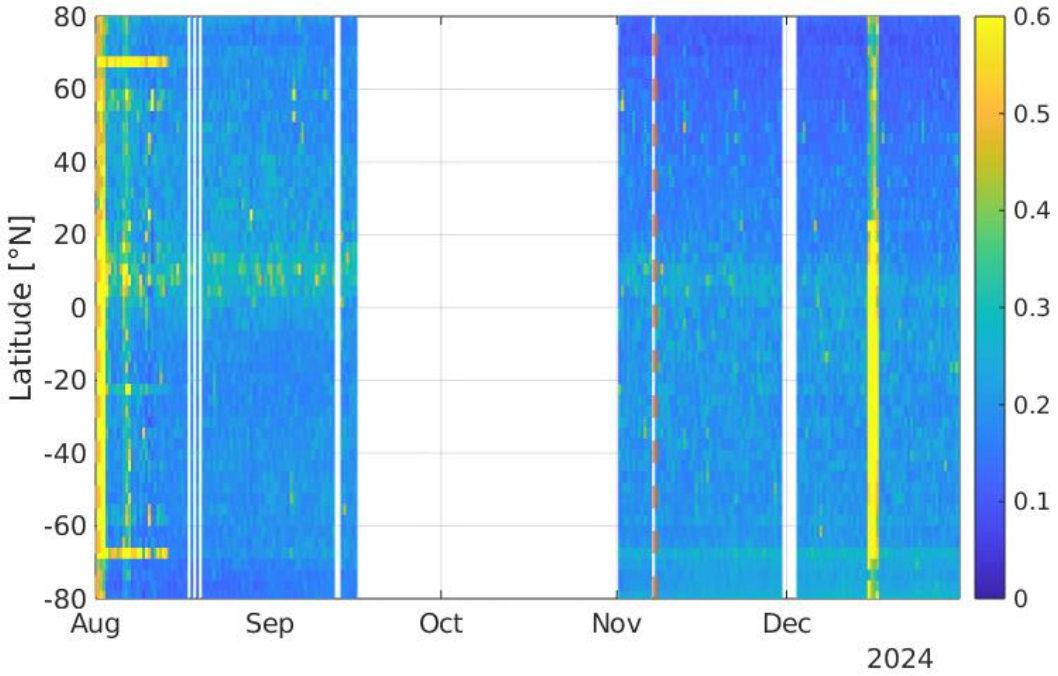

Calibration or aerosol effect?

# Bias in Rayleigh backscatter increases after PSC season?

**Mean bias [dB]**




**Mean std. dev. [dB]**



# Bin-by-bin monitoring of total attenuated backscatter

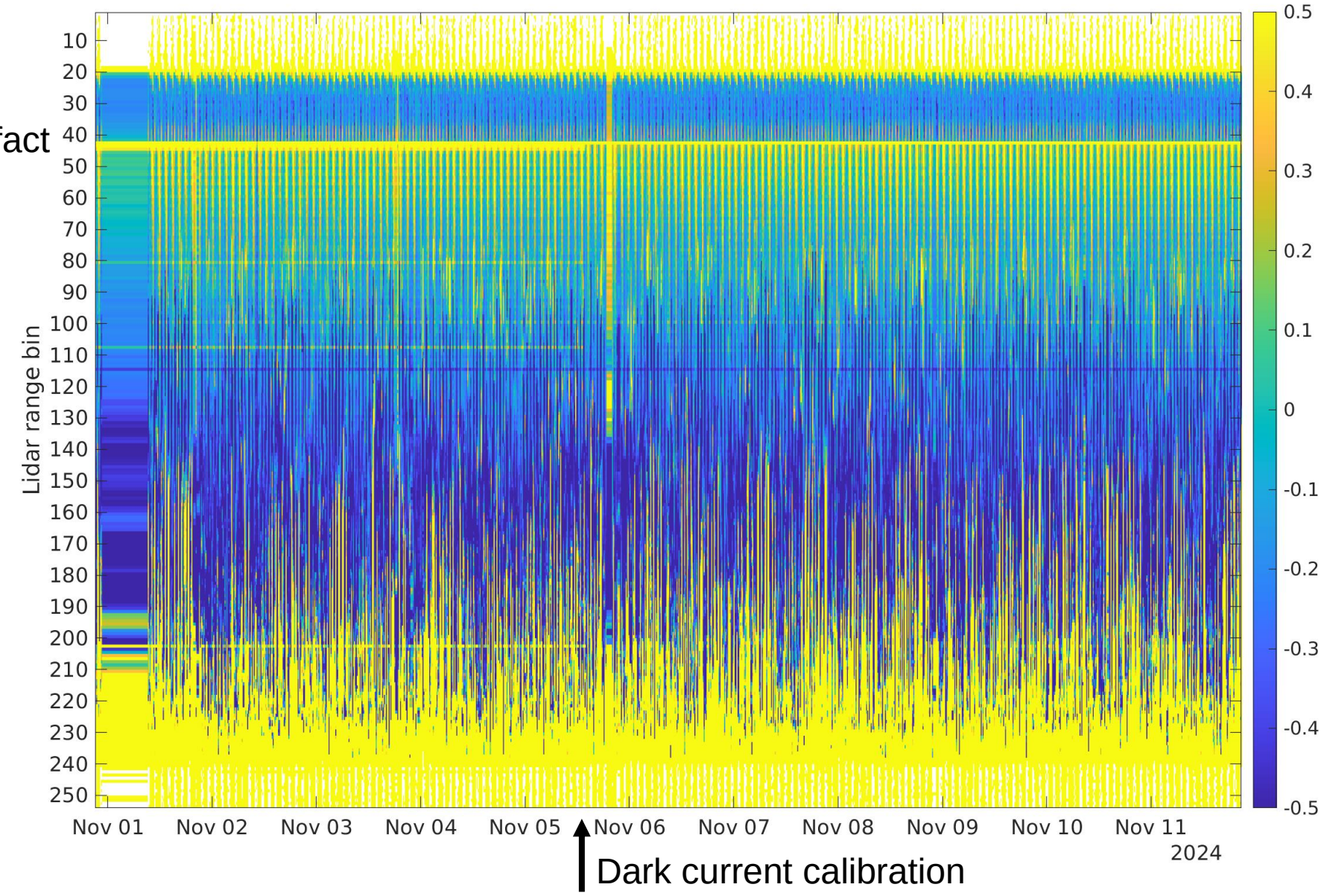
20km artefact

Hot pixel

Hot pixel

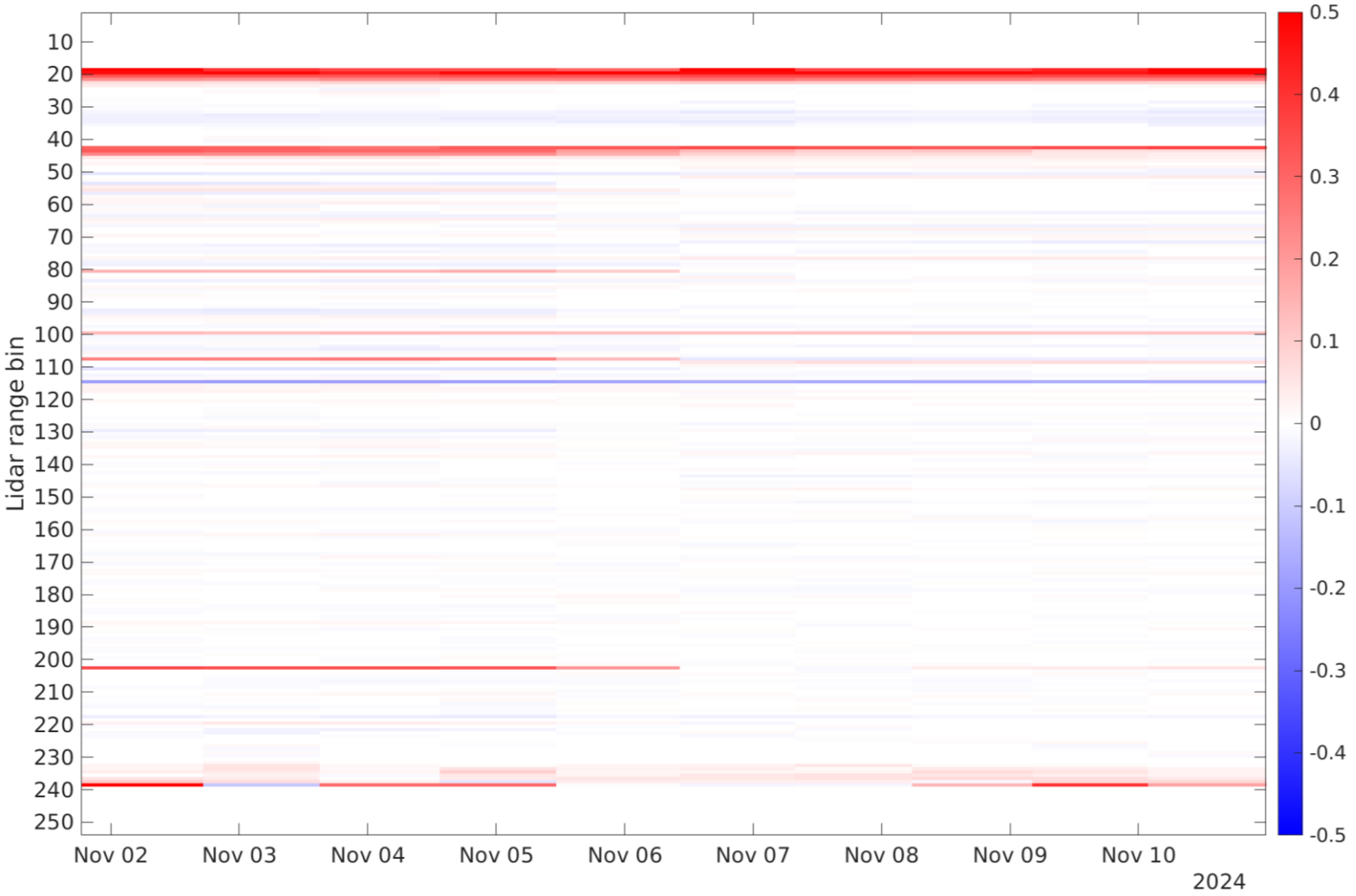
Cold pixel

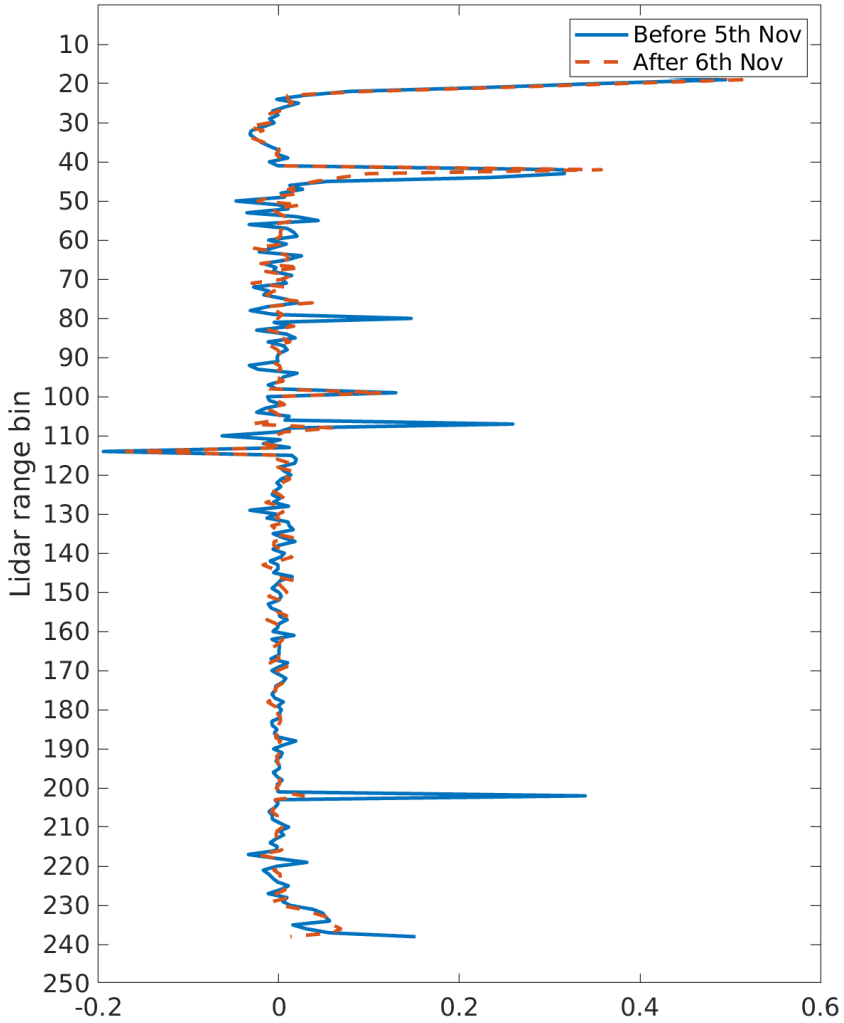
Hot pixel




**Obs minus model [dB]**

# Remove ‘model’ bias with local median across nearby lidar bins




**Normalised obs minus model [dB]**

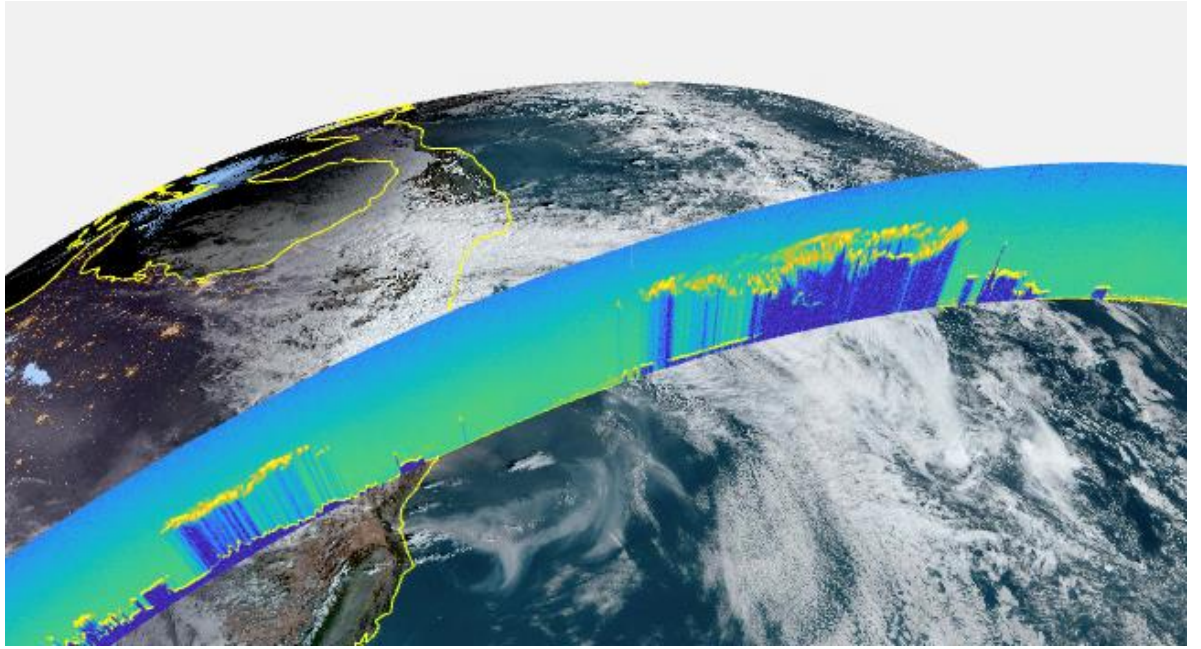
# Key points

- ATLID L1B NRT quality monitoring is live:

  https://charts.ecmwf.int/catalogue/packages/obstat/products/hist_ECare_LRBSC_v3

- Data quality appears excellent when compared to ECMWF model data apart from well documented periods of degradation
- Initial comparison with CALIPSO is reassuring
- Rayleigh backscatter bias in SH high latitudes is increasing.
- Hot/cold pixel monitoring is ongoing

ATLID L1B 3500D/E + GOES VIS 08-01-25 2200 Z



ECMWF IFS lidar backscatter + CAMS 2200 Z