

Aeolus Level-2B HLOS (horizontal line-of-sight) Wind Product Monthly Quality Report

Period: For the month up to 3 September 2021

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Introduction

An introduction to the Aeolus Level-2B HLOS wind monitoring statistics is provided on the Aeolus CAL/VAL webpage (under L2B Data Quality Handbook); for those that have access. The ECWMF Technical Memorandum 864 (Section 2.3) provides information about how the Aeolus observation minus background (O-B) departure statistics are calculated. Available here:

<https://www.ecmwf.int/en/elibrary/19538-nwp-impact-aeolus-level-2b-winds-ecmwf>

ECMWF's daily updated, automatically produced statistics of observation minus background (O-B) and observation minus analysis (O-A) are available from the following website (from which many of the plots used in these reports are obtained):

<https://www.ecmwf.int/en/forecasts/charts/obstat/?facets=Data%20type,Aeolus%20HLOS%20Wind>

Some Quality Control (QC) is applied to produce the ECMWF automated statistics, which consists of:

- Rejecting observations with Level-2B processor estimated instrument error beyond a thresholds: $\sigma_o > 12$ m/s for the Rayleigh and $\sigma_o > 5$ m/s for the Mie.
- Rejecting observations when the Level-2B HLOS wind result overall confidence flag is set to invalid.
- A model based "first-guess check" i.e. reject if first-guess departure is deemed to be too large, indicating gross errors i.e. $O - B > 5\sqrt{\sigma_o^2 + \sigma_B^2}$ (a 5-sigma check).

ECMWF also have some daily data coverage plots for Aeolus:

<https://www.ecmwf.int/en/forecasts/charts/monitoring/dcover?facets=undefined&obs=Aeolus&Flag=all>

Other Aeolus L2B wind monitoring websites

- Météo-France:
<http://www.meteo.fr/special/minisites/monitoring/SATELLITE/LIDAR/lidar.html#>
- Met Office:
<https://nwp-saf.eumetsat.int/site/monitoring/winds-quality-evaluation/doppler-wind-lidar/doppler-monthly-monitoring/>
<https://nwp-saf.eumetsat.int/site/monitoring/nrt-availability/data-timeliness/>

1. L2B Rayleigh-clear O-B and O-A departure statistics

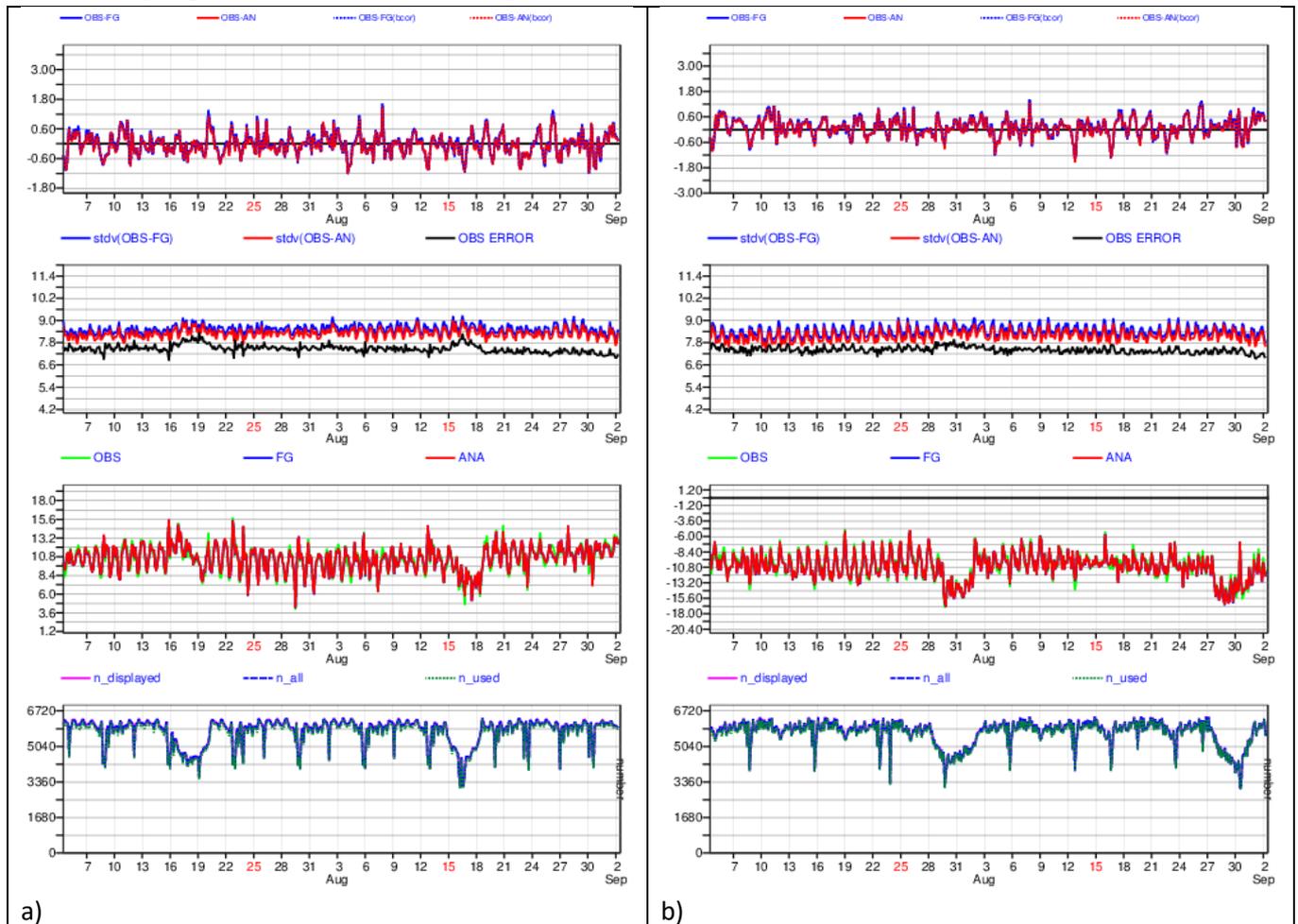


Figure 1. This figure shows changes with time in the O-B and O-A departure statistics of the L2B Rayleigh-clear winds with respect to the ECMWF model. The statistics are calculated every 3 hours for the 0-400 hPa pressure range. Panel a) is for ascending and panel b) is for descending orbit phase. The top plot is the mean of departures i.e. bias; the second plot down is the standard deviation of departures and the assigned observation error in data assimilation (OBS ERROR) i.e. information on random error; the third plot down is the mean observation value and mean model equivalent and the bottom plot is the number of observations per sample.

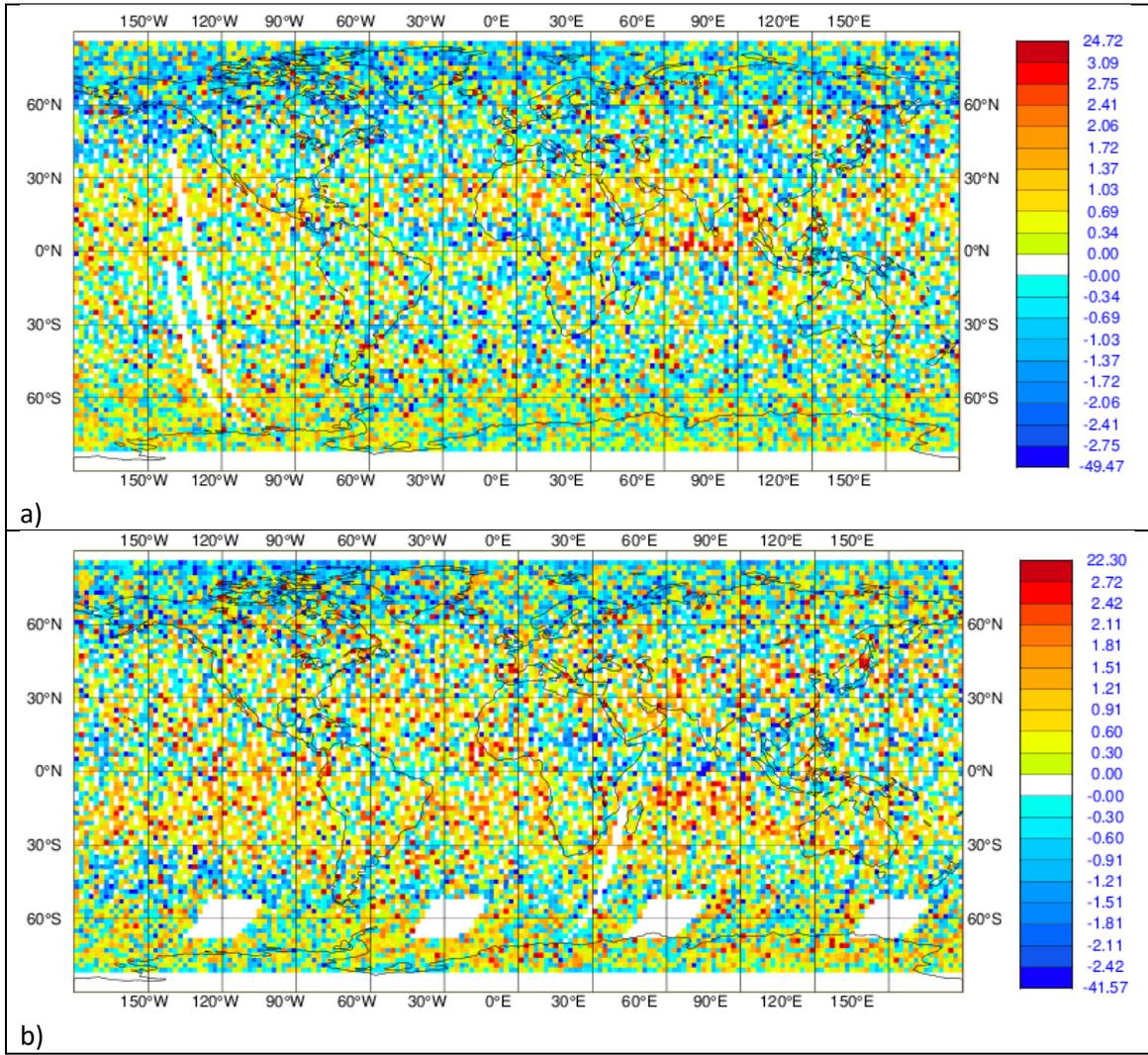


Figure 3. Maps of L2B Rayleigh-clear mean(O-B) for the 0-400 hPa pressure range for a) ascending and b) descending orbit phases. Unit: m/s. For the period: 31 July 2021 to 27 August 2021. These plots are only updated once per week.

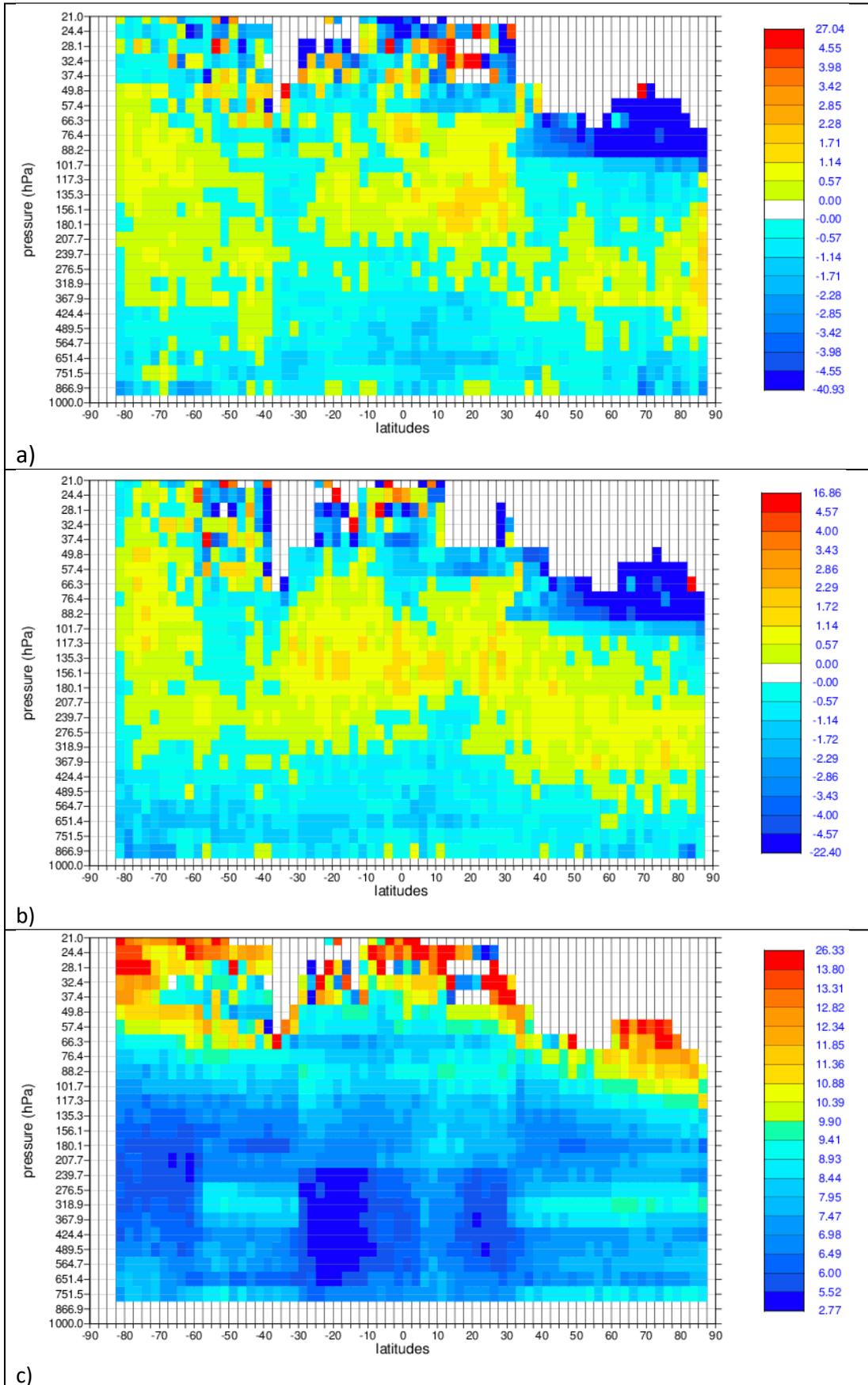


Figure 4. Pressure versus latitude dependence of the L2B Rayleigh-clear mean(O-B) for a) ascending and b) descending orbits. Panel c) is the standard deviation of (O-B) for ascending orbits. Unit: m/s. For the period: 8 to 28 August 2021.

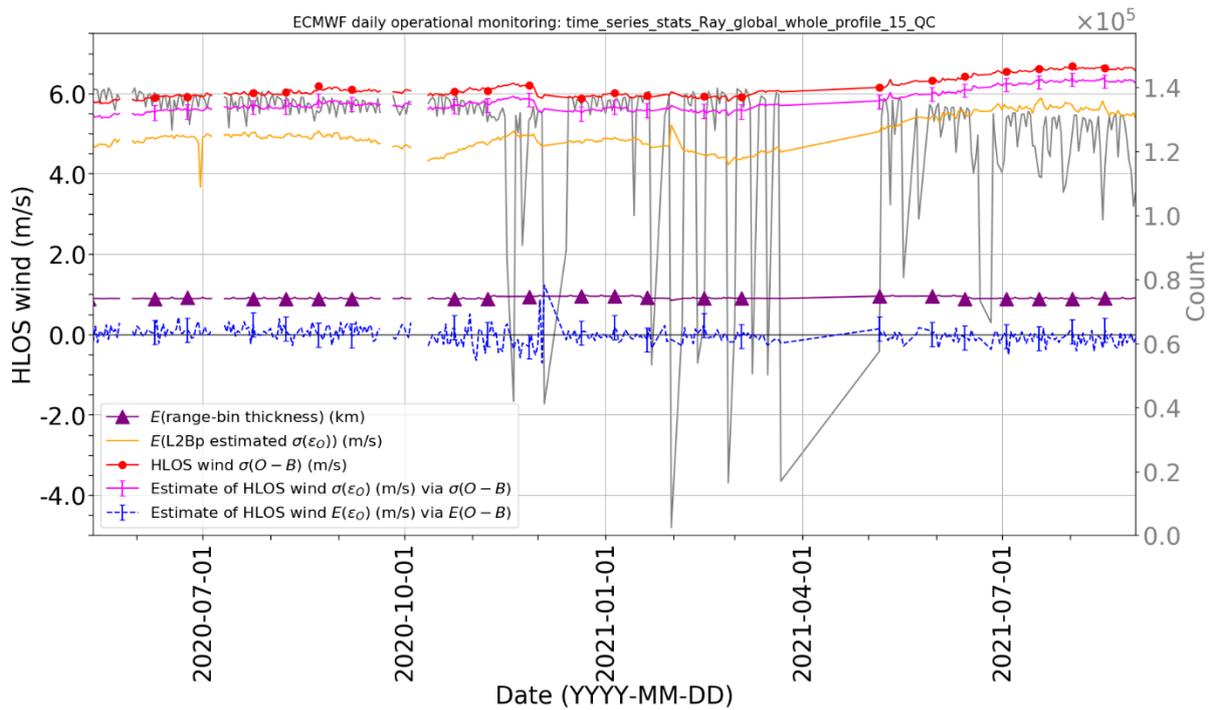


Figure 5. Times-series of daily, global, whole profile L2B Rayleigh-clear HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject winds if $\text{abs}(O-B) > 15$ m/s.

Comments and assessment of L2B Rayleigh-clear winds for this period:

- The random errors have remained fairly stable for August 2021 despite the atmospheric path signal continuing to decrease. This is because the solar background noise is reducing as we approach the Autumn.
- Some vertical stripes to the bias as a function of latitude and time are evident from Figure 2. These bias jumps have been traced to be associated with fluctuations in the dark current levels on existing hot pixels. These fluctuations become more significant as the atmospheric path useful signal decreases with time. To improve knowledge of the dark current fluctuations and hence correct for them better, the number of DUEs per day (currently 4) is planned to be increased to 7 per day in September 2021 to try to reduce the bias jumps.
- Looking at the longer term trends; the number of Rayleigh-clear observations passing QC for assimilation is dropping with time as the signal decreases. Also, the moon-blinding QC is particularly affecting the numbers available in the tropics every 2 weeks on average.

2. L2B Mie-cloudy O-B and O-A departure statistics

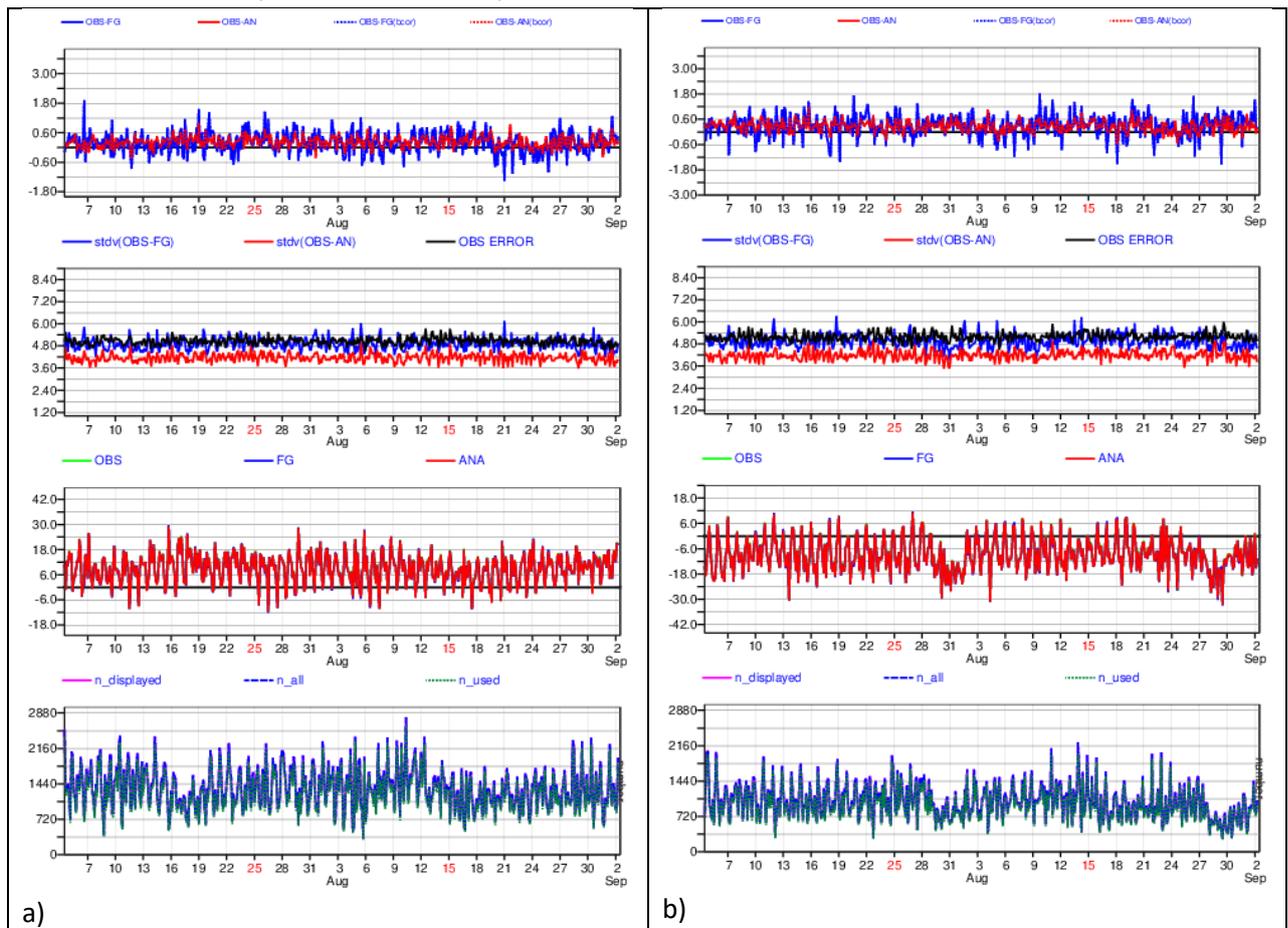
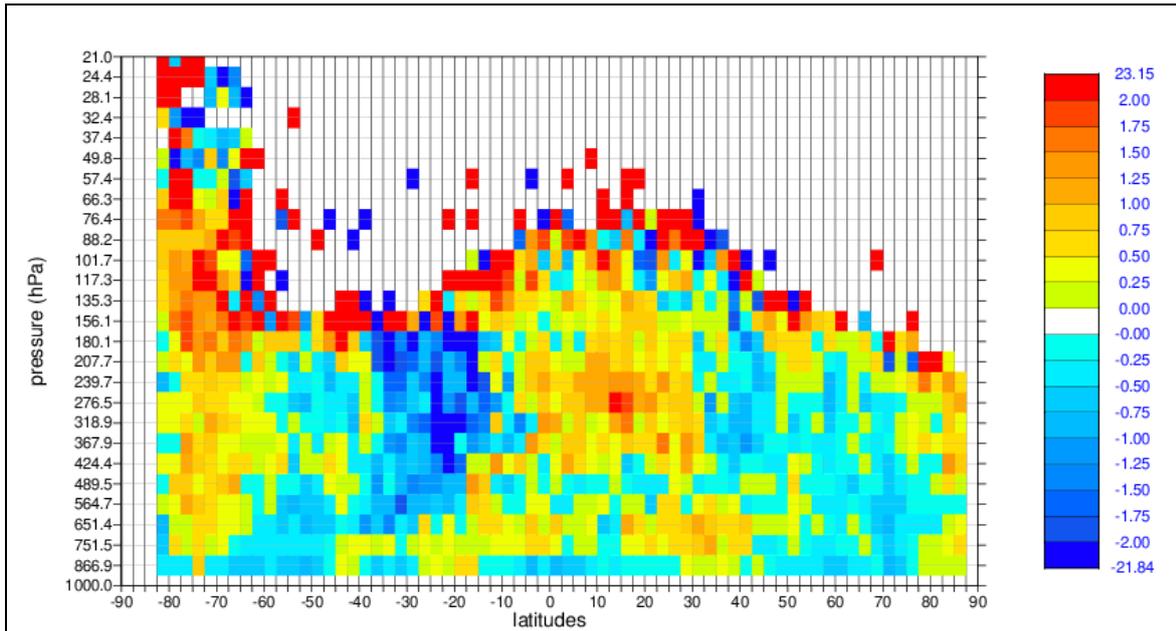
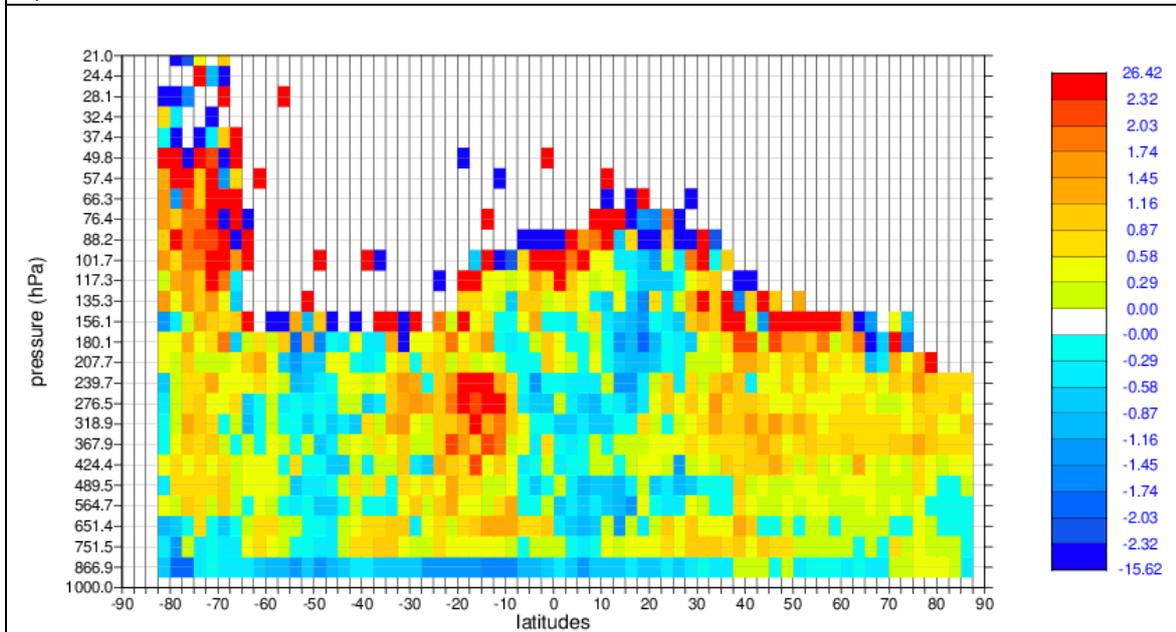


Figure 6. Same type of plots as in Figure 1, but for L2B Mie-cloudy HLOS winds.



a)



b)

Figure 7. Pressure versus latitude dependence of the L2B Mie-cloudy mean(O-B) for a) ascending and b) descending orbits. Unit: m/s. For the period: 8 to 28 August 2021.

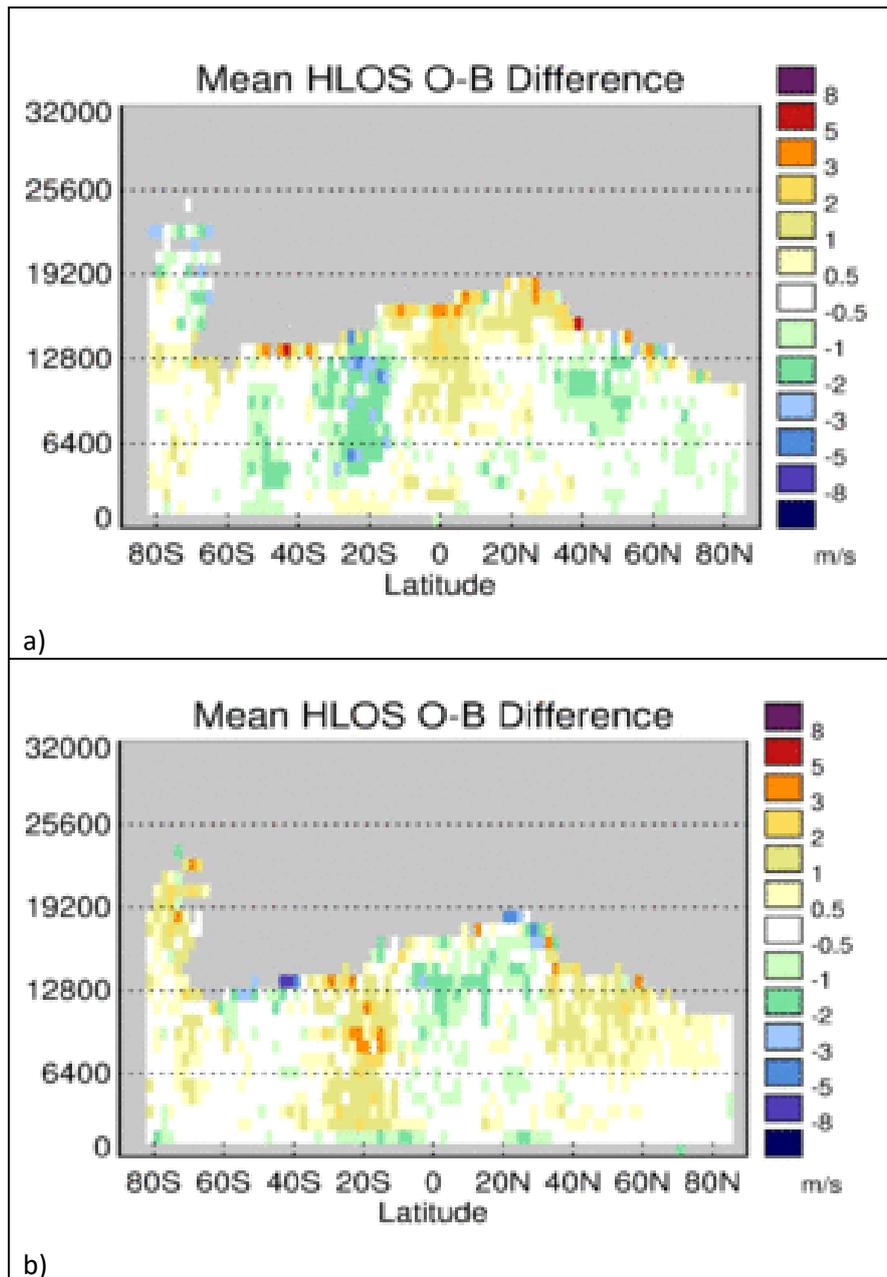


Figure 8. Altitude versus latitude dependence of the L2B Mie-cloudy mean(O-B) from the **Met Office model** for a) ascending and b) descending orbits. Unit: m/s. For the period: **July 2021**. Courtesy of Met Office: <https://nwp-saf.eumetsat.int/site/monitoring/winds-quality-evaluation/doppler-wind-lidar/doppler-monthly-monitoring/>

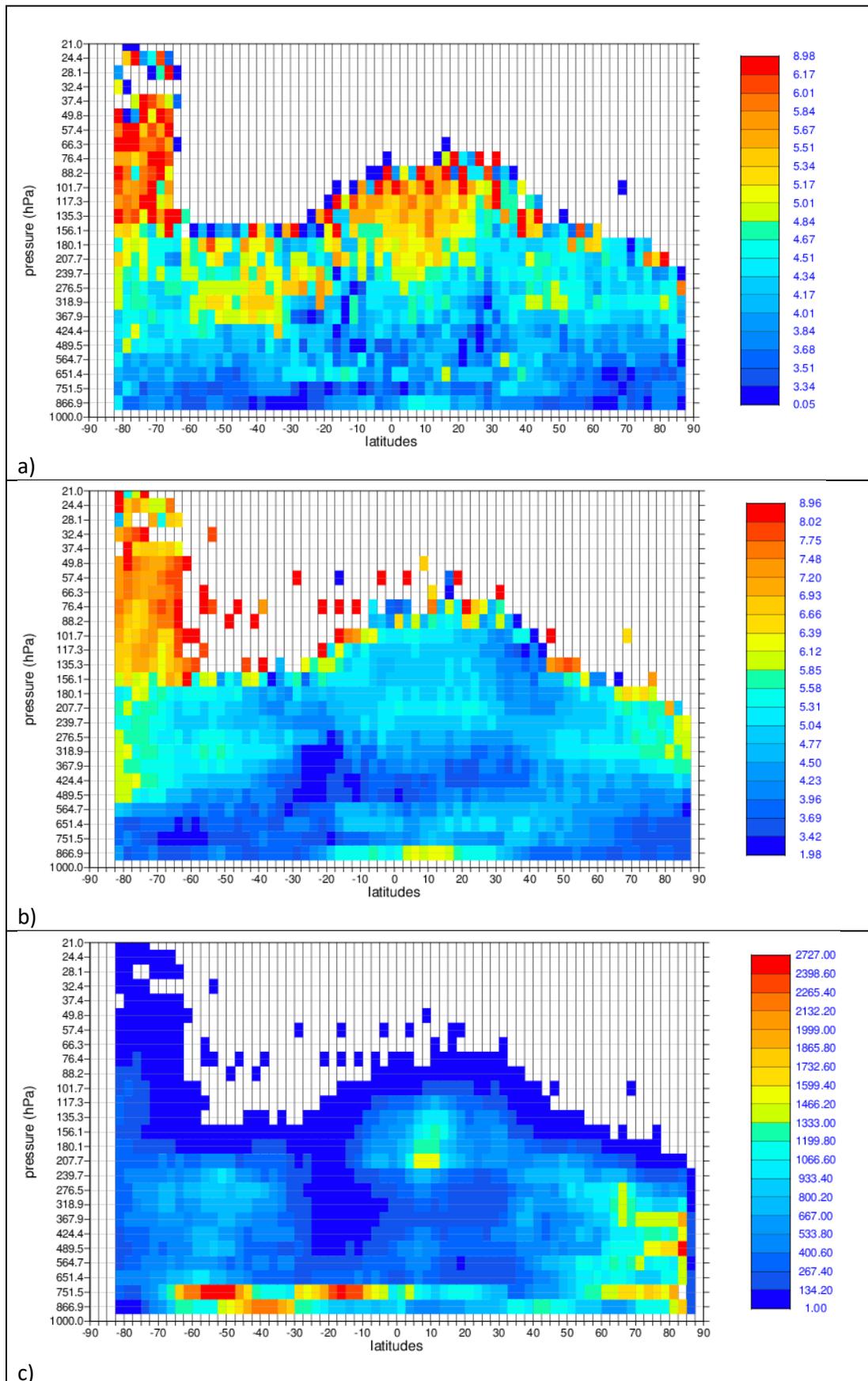


Figure 9. Pressure versus latitude dependence of the L2B Mie-cloudy a) ascending stddev(O-B) m/s, b) corresponding L2Bp estimated observation error m/s (scaled) and c) number of observations. For the period: 8 to 28 August 2021.

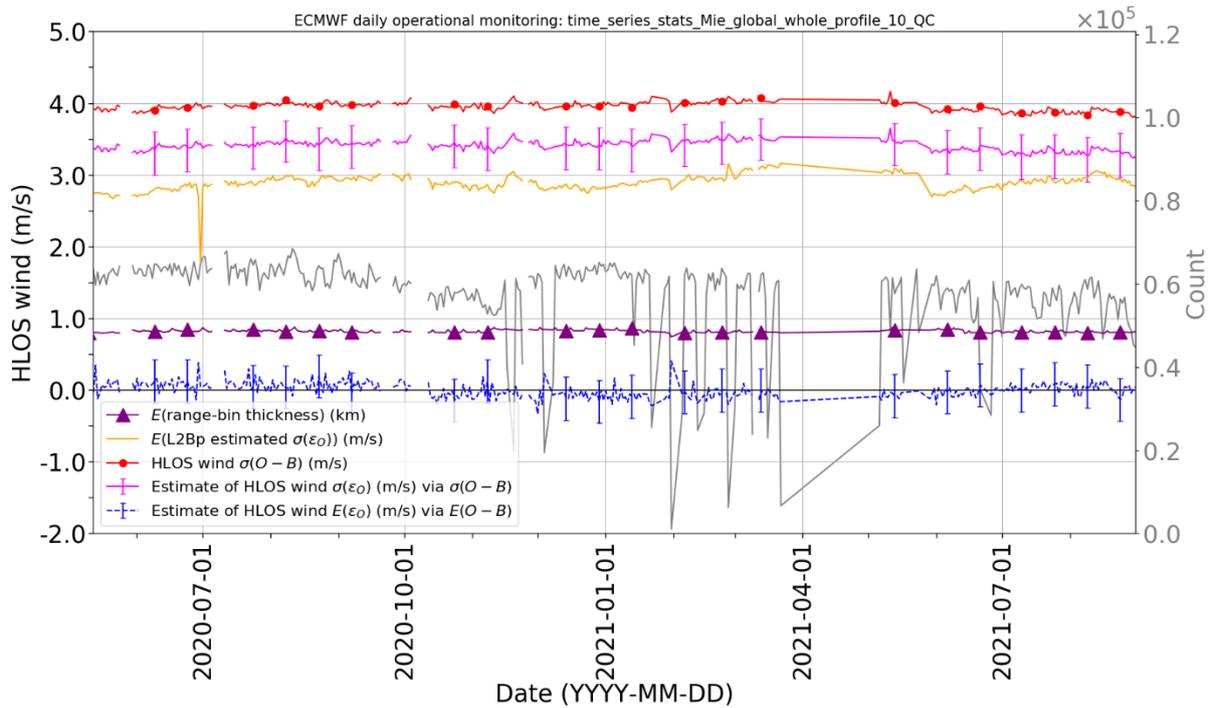


Figure 10. Times-series of daily, global, whole profile L2B Mie-cloudy HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject if $\text{abs}(O-B) > 10$ m/s.

Comments and assessment of on L2B Mie-cloudy winds for this period:

- Bias and random errors have remained fairly stable in August 2021.
- The number of Mie winds at low pressures (high altitudes) over the S. Pole because of Polar Stratospheric Clouds remains relatively high.
- There are some interesting patterns in the zonal average bias plots. Given that the bias patterns are rather similar e.g. at 20°S in both the ECMWF and Met Office models — this might suggest Aeolus is to blame. However, there could be similar systematic model and analysis errors for ECMWF and the Met Office.