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

Period: For the month up to 7 June 2021

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Introduction

An introductory text on 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 some information on 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

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: σ_O > 12 m/s for the Rayleigh and σ_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).

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

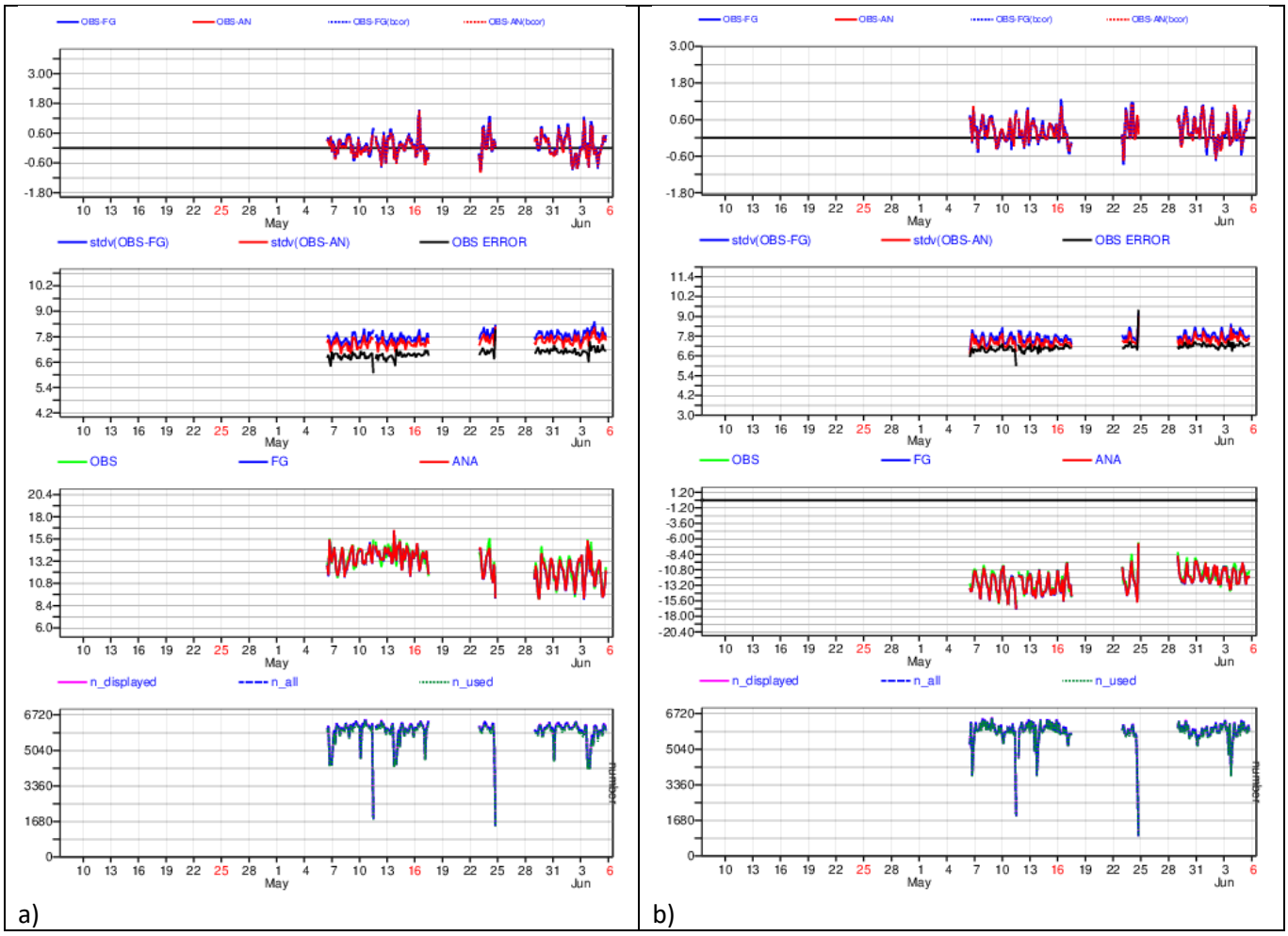

Figure 1. This figure shows changes with time in the O-B and O-A departure statistics of the L2B Rayleigh-clear winds with respect to the ECMWF model. The statistics are calculated every 3 hours for the 0-400 hPa pressure range. Panel a) is for ascending and panel b) is for descending orbit phase. The 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.

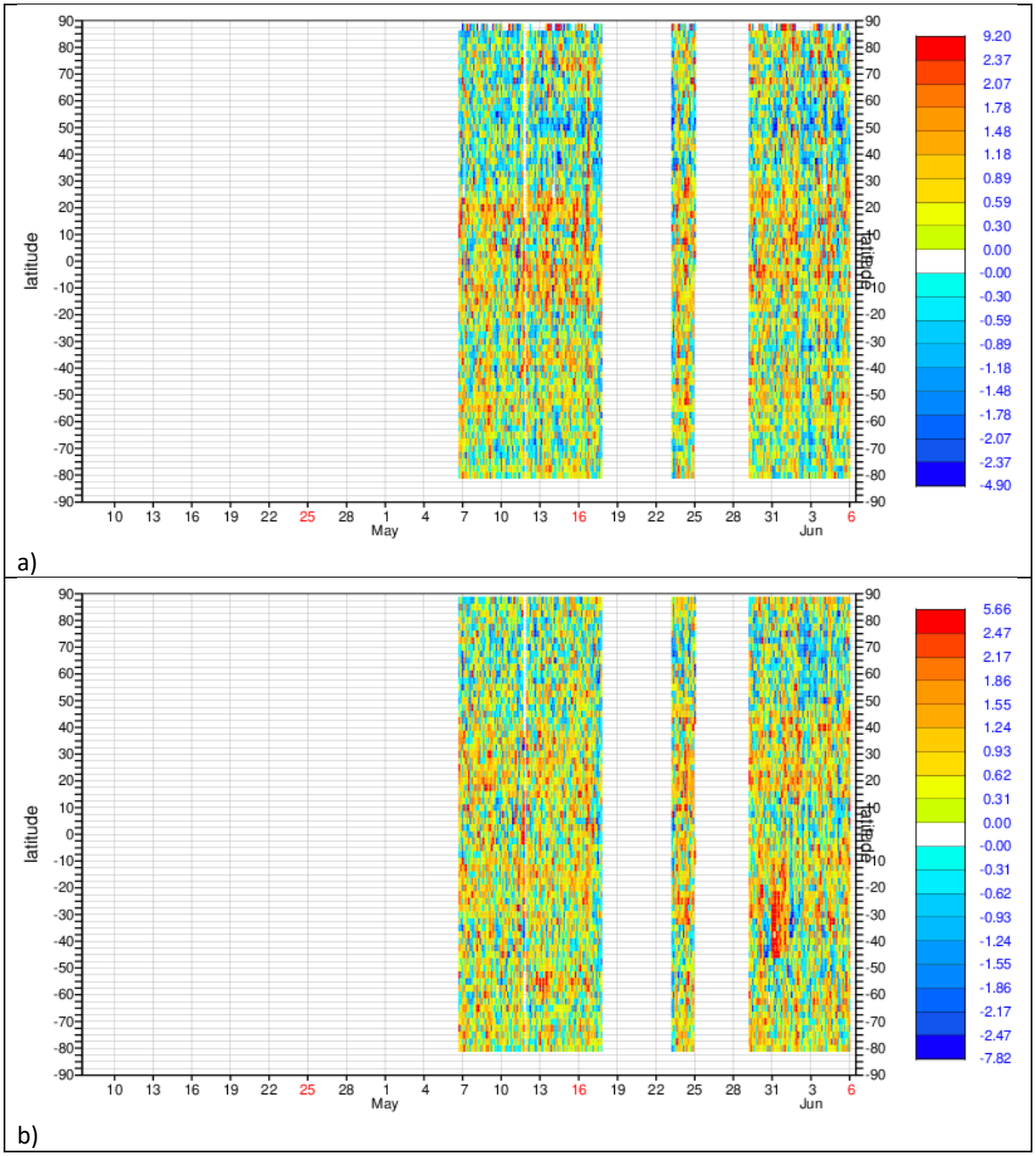

Figure 2. Latitude-time dependence of the mean(O-B) for L2B Rayleigh-clear HLOS winds for the 0-400 hPa pressure range for a) ascending and b) descending orbit phase. Unit: m/s.

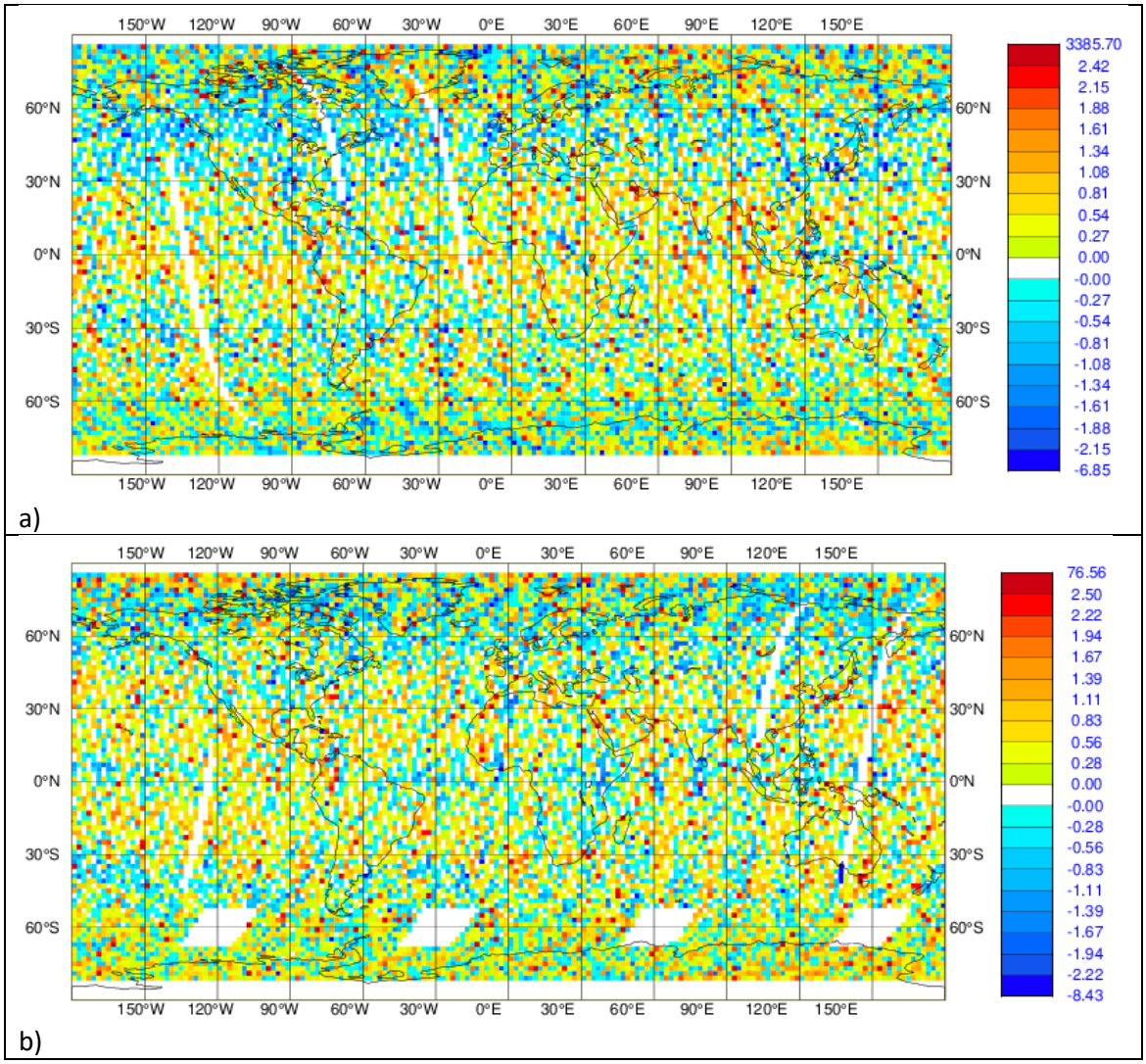

Figure 3. Maps of L2B Rayleigh-clear mean(O-B) for the 0-400 hPa pressure range for a) ascending and b) descending orbit phases. Unit: m/s. For the period: 6 May 2021 to 4 June 2021. These plots are only updated once per week.

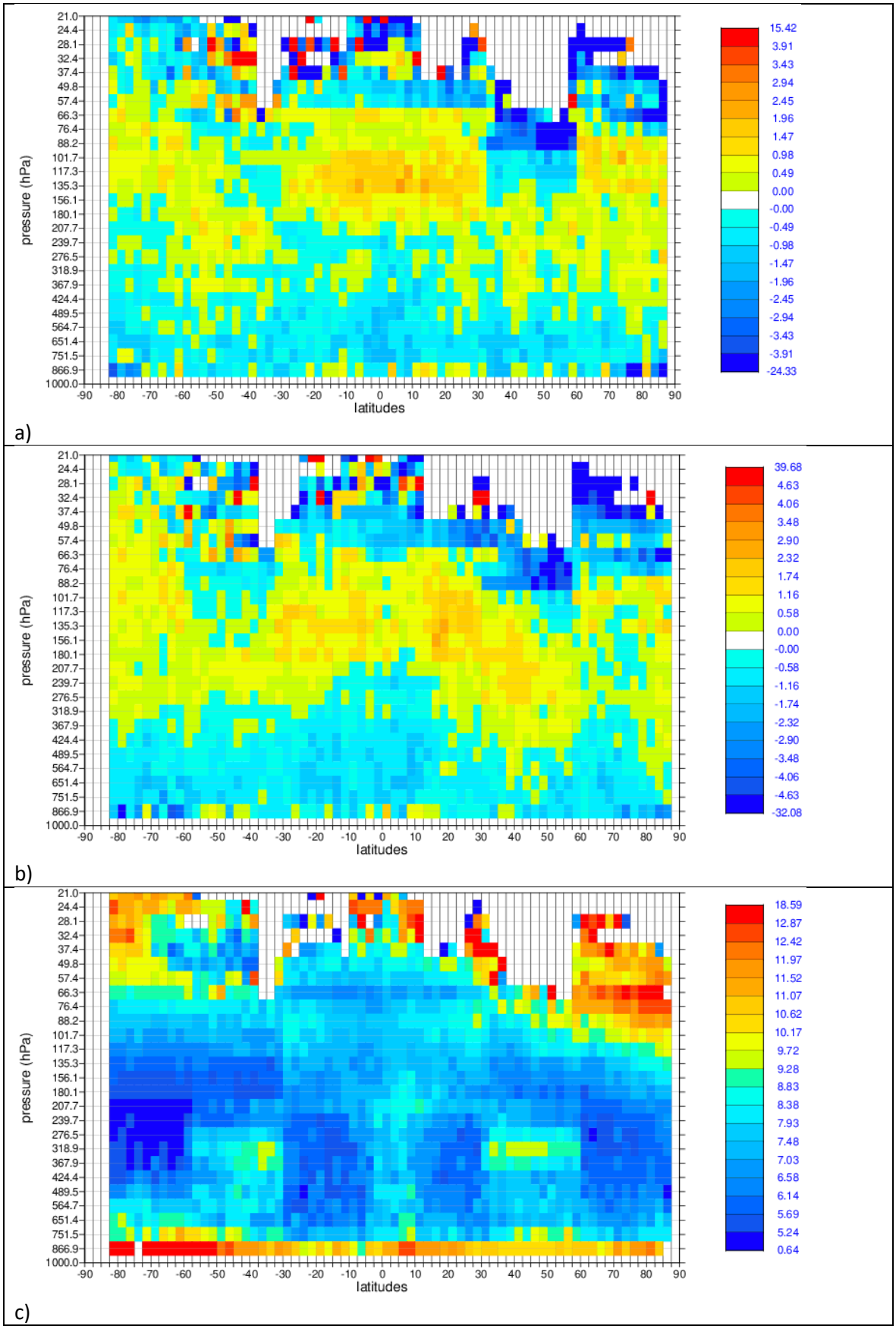

Figure 4. Pressure versus latitude dependence of the L2B Rayleigh-clear mean(O-B) for a) ascending and b) descending orbits. Panel c) is the standard deviation of (O-B) for ascending orbits. Unit: m/s. For the period: 8 May 2021 to 5 June 2021.

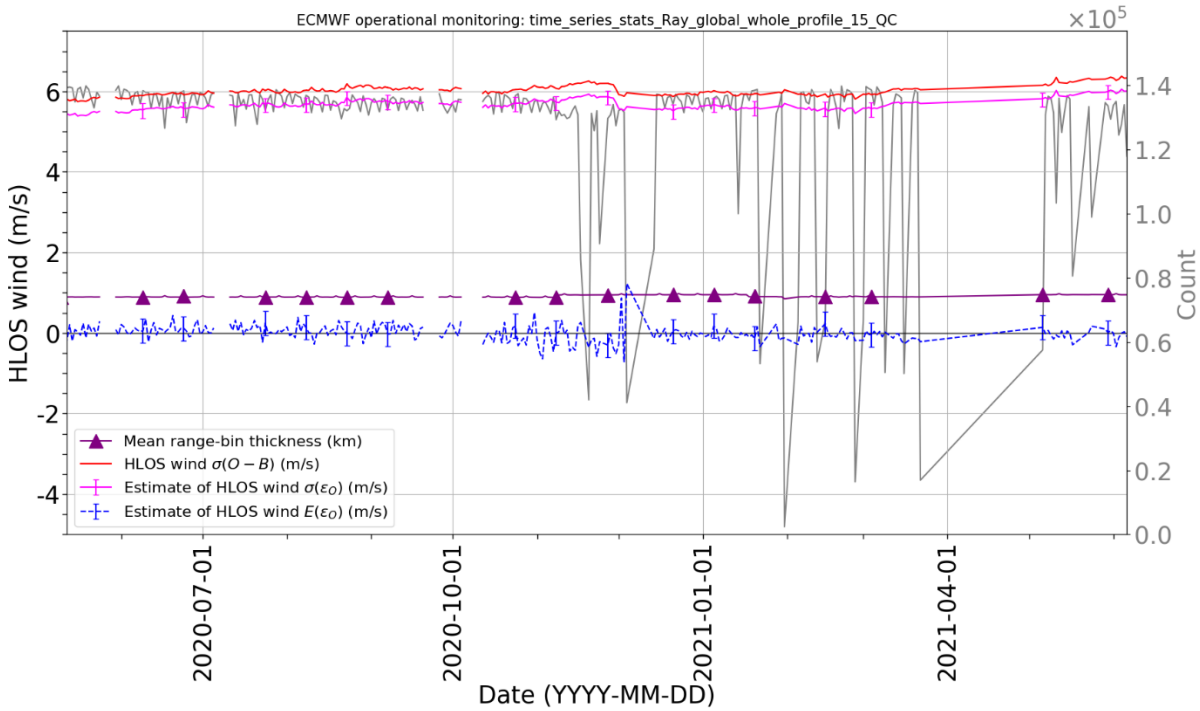

Figure 5. Times-series of daily, global, whole profile L2B Rayleigh-clear HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject winds if abs(O-B) > 15 m/s.

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

- Following the reintroduction of "valid" (i.e. not blocklisted) L2B data after 6 May 2021, after a successful recovery of the laser instrument being automatically switched off (survival mode) in March, there have been two further deliberate data gaps during May (due to blocklisting). They were Special Operations Requests for laser instrument testing (cold plate temperature and transmitter sensitivity tests) with the aim of understanding and hence improving signal levels. Such tests can introduce wind biases and hence it is thought to be safer for operational NWP users to flag the data invalid.
- The random errors have continued to increase during May as a result of increasing solar background related noise over the Northern Hemisphere and continuing useful signal decrease; the increased noise in the N. Hemisphere towards the pole at high altitudes is evident in the zonal average plot of Figure 4c).
- A new ground processing baseline (12) was implemented on 26 May 2021. There was no clear effect on the quality of the L2B Rayleigh-clear HLOS winds from this change.
- The biases have been reasonably stable, apart from a probable moon-blinding (of star tracker) related event on 31 May in the Southern Hemisphere.
- There still exists a relatively positive bias in upper troposphere and relatively negative bias in lower troposphere with the new calibration information after the laser was switched back on. This is correlated with atmospheric temperature.

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

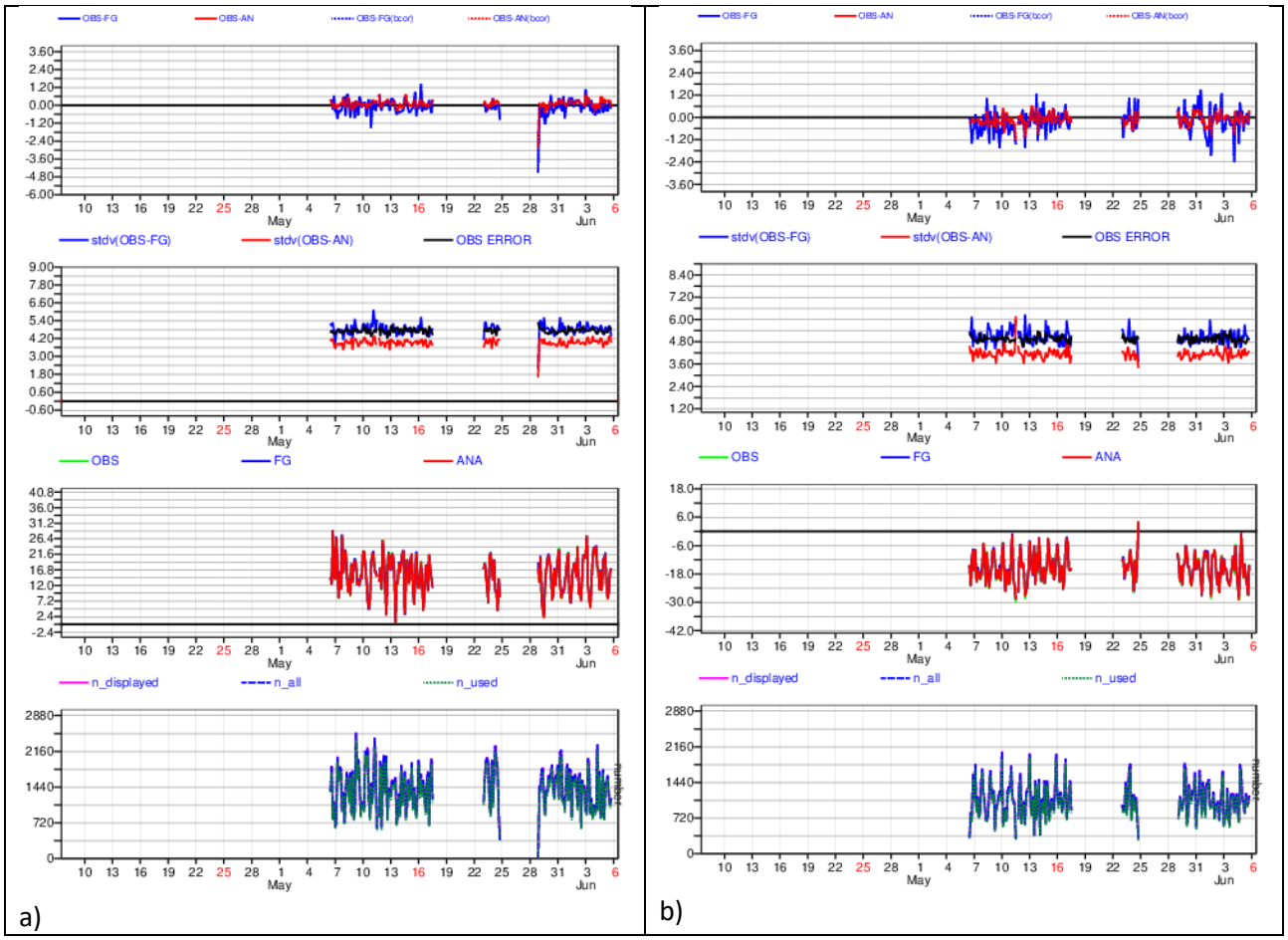

Figure 6. Same type of plots as in Figure 1, but for L2B Mie-cloudy HLOS winds.

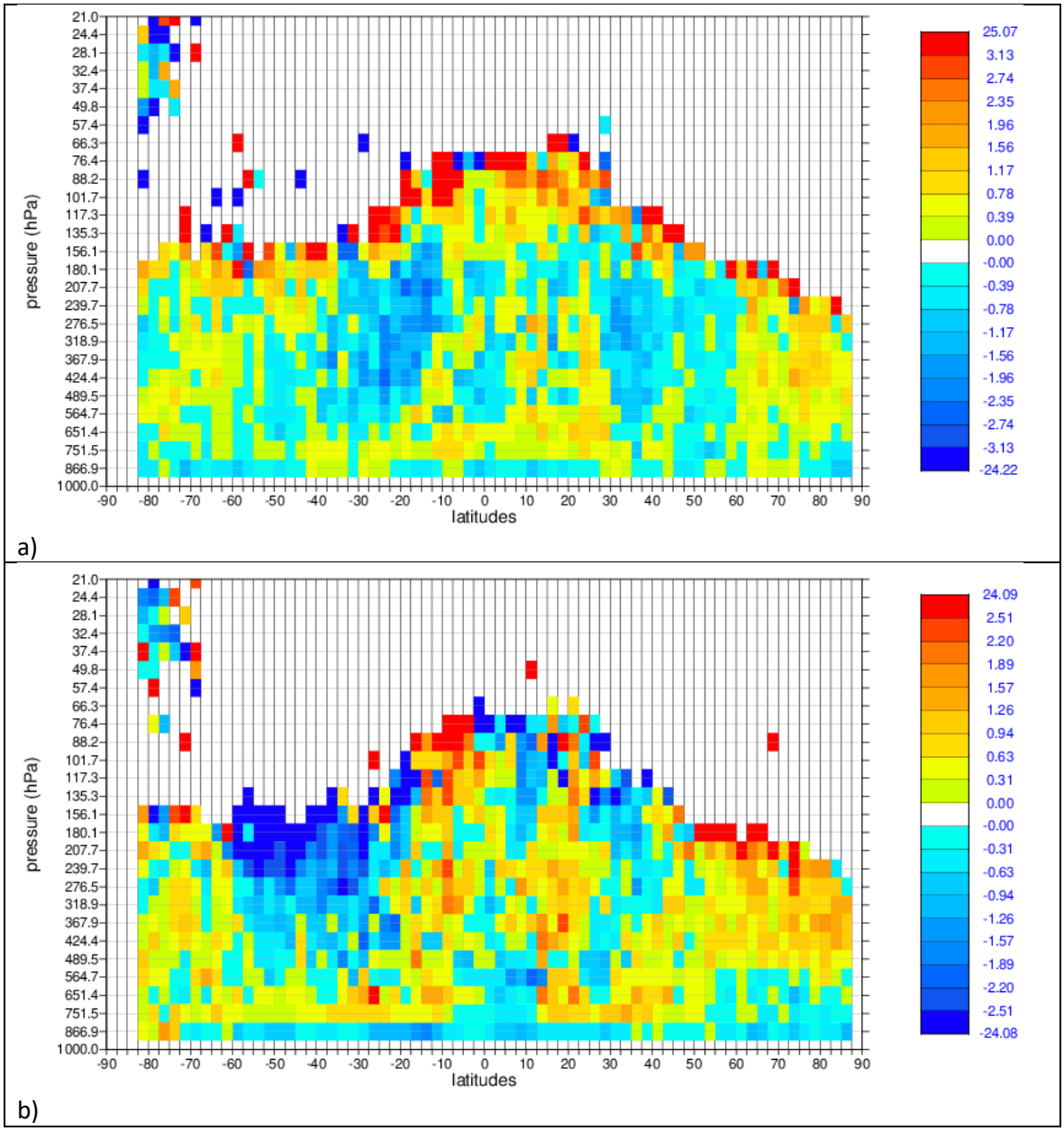

Figure 7. Pressure versus latitude dependence of the L2B Mie-cloudy mean(O-B) for a) ascending and b) descending orbits. Unit: m/s. For the period: 8 May to 5 June 2021.

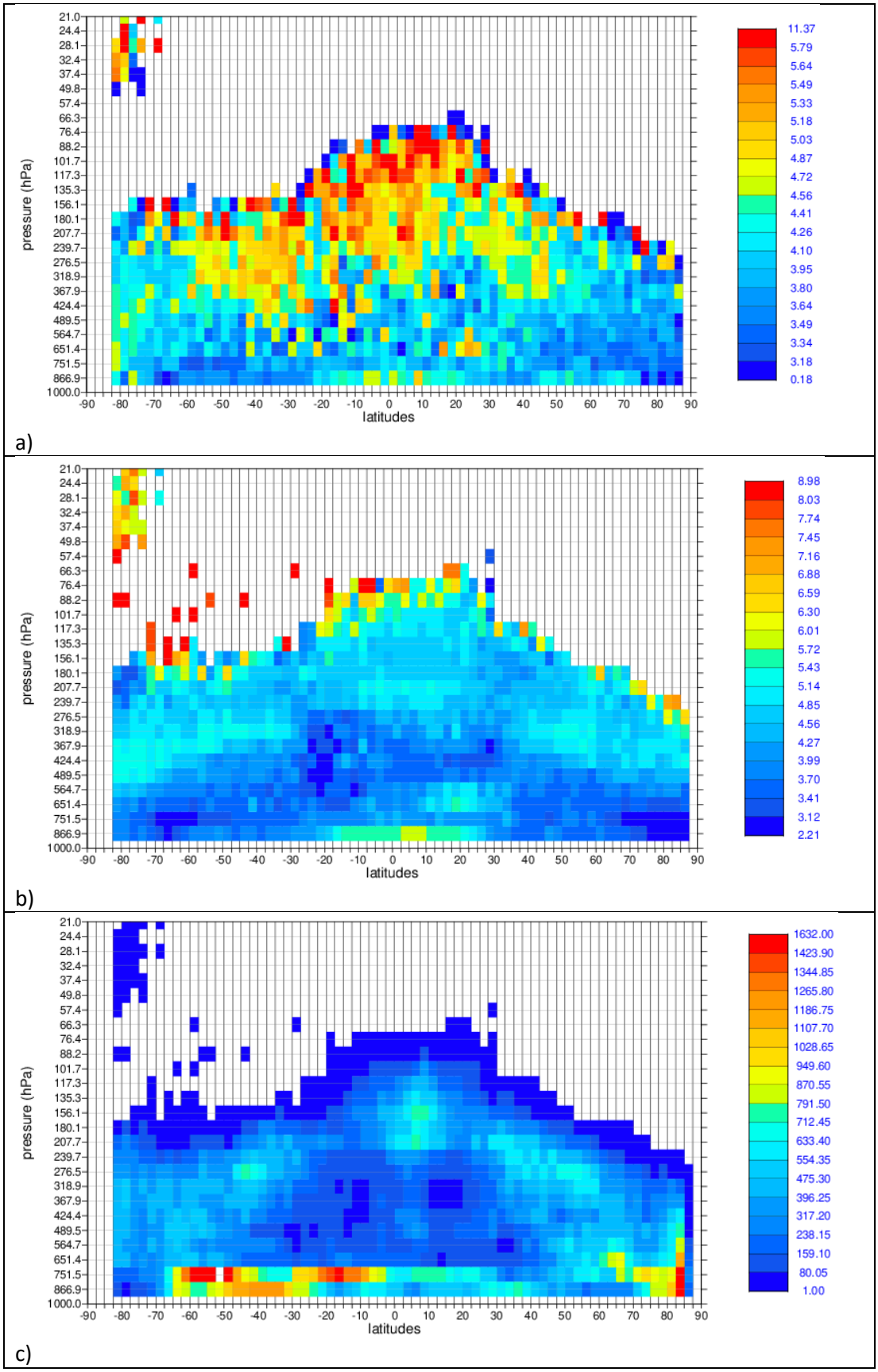

Figure 8. Pressure versus latitude dependence of the L2B Mie-cloudy a) ascending stdev(O-B) m/s, b) corresponding L2Bp estimated observation error m/s (scaled) and c) number of observations. For the period: 8 May 2021 to 5 June 2021.

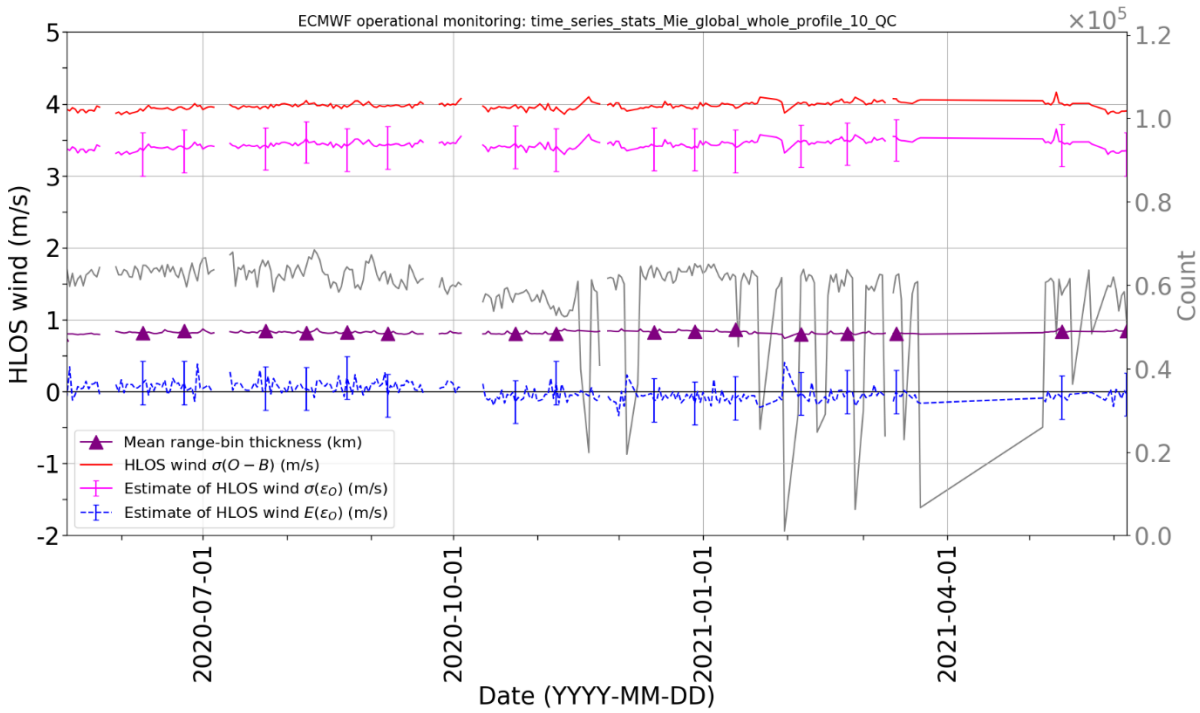

Figure 9. Times-series of daily, global, whole profile L2B Mie-cloudy HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject if abs(O-B) > 10 m/s.

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

- Following the reintroduction of "valid" (i.e. not blocklisted) L2B data after 6 May 2021, after a successful recovery of the laser instrument being automatically switched off (survival mode) in March, there have been two further deliberate data gaps during May (due to blocklisting). They were Special Operations Requests for laser instrument testing (cold plate temperature and transmitter sensitivity tests) with the aim of understanding and hence improving signal levels. Such tests can introduce wind biases and hence it is thought to be safer for operational NWP users to flag the data invalid.
- The biases have been rather stable in the global average sense during this period.
- A new ground processing baseline (12) was implemented on 26 May 2021. There appears to be an improvement in the L2B Mie-cloudy HLOS wind random error from this change. It is unclear what specific processing change led to this improvement.
- Mie winds at low pressures (high altitudes) have started to appear over the S. Pole because of Polar Stratospheric Clouds and the range-bin settings which reach high altitudes over the polar vortex (POLARIS RBS).
- There is a rather large negative bias (<-2.5 m/s) associated with negative HLOS winds (strong westerlies, HLOS <-40 m/s in zonal average) in the latitude range -60 to -30 degrees latitude for descending orbits. It may be due to a wind-speed dependent bias issue that the L2B team are currently working on and hoping to resolve soon.