Aeolus Level-2B HLOS (horizontal line-of-sight) wind product quality report

Period: For the month up to 4 January 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 on how the Aeolus O-B departure statistics are calculated; it is 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 this report have been taken):
https://www.ecmwf.int/en/forecasts/charts/obstat/?facets=Data%20type,Aeolus%20HLOS%20Wind

Quality Control 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 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. $O - B > 5\sqrt{\sigma_O^2 + \sigma_B^2}$

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

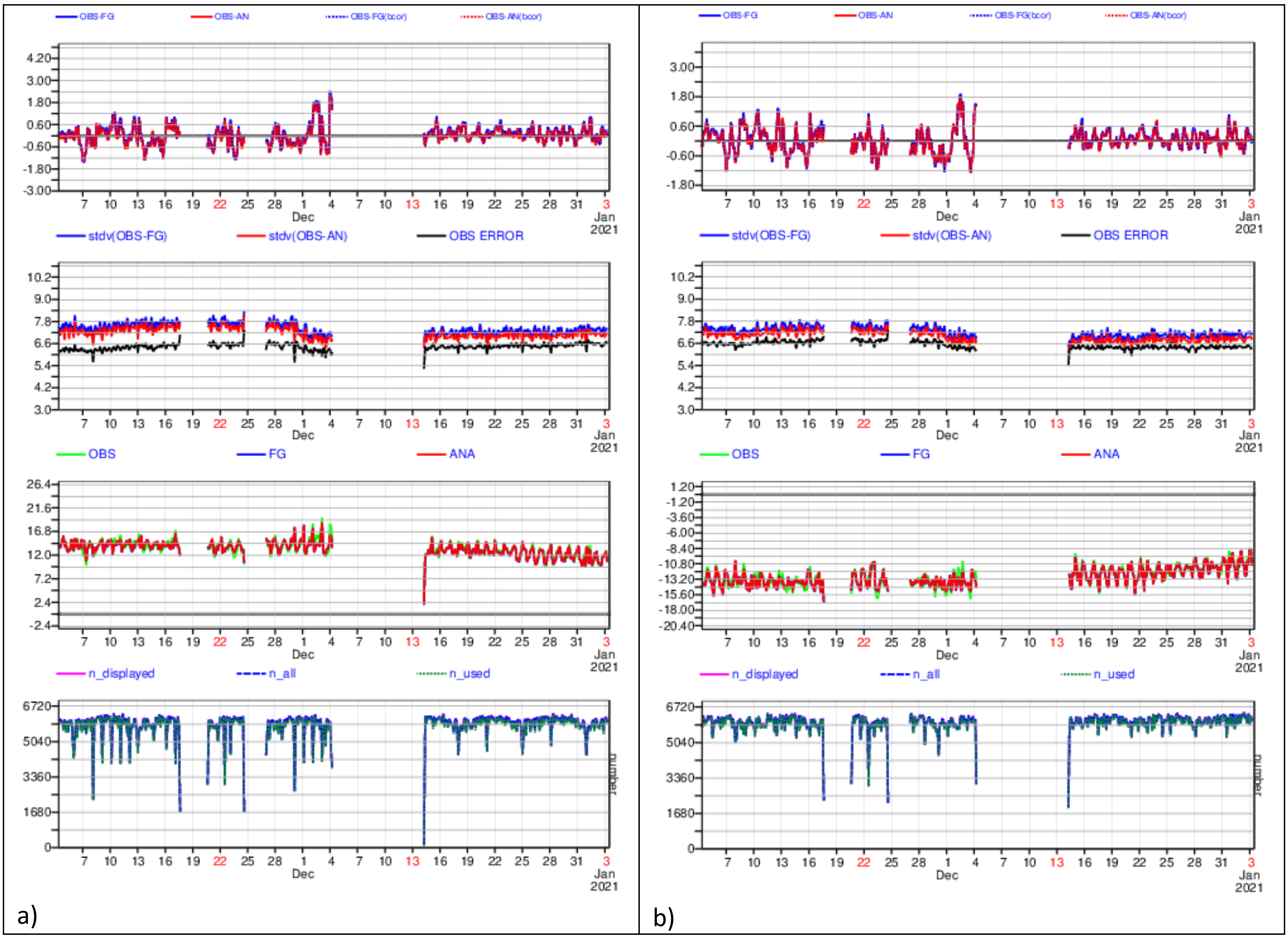


Figure 1. This figure shows changes with time in the O-B and O-A departure statistics of the L2B Rayleigh-clear winds with respect to the ECMWF model. The statistics are calculated every 3 hours for the 0-400 hPa pressure range. Panel a) is for ascending and panel b) is for descending orbit phase. The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

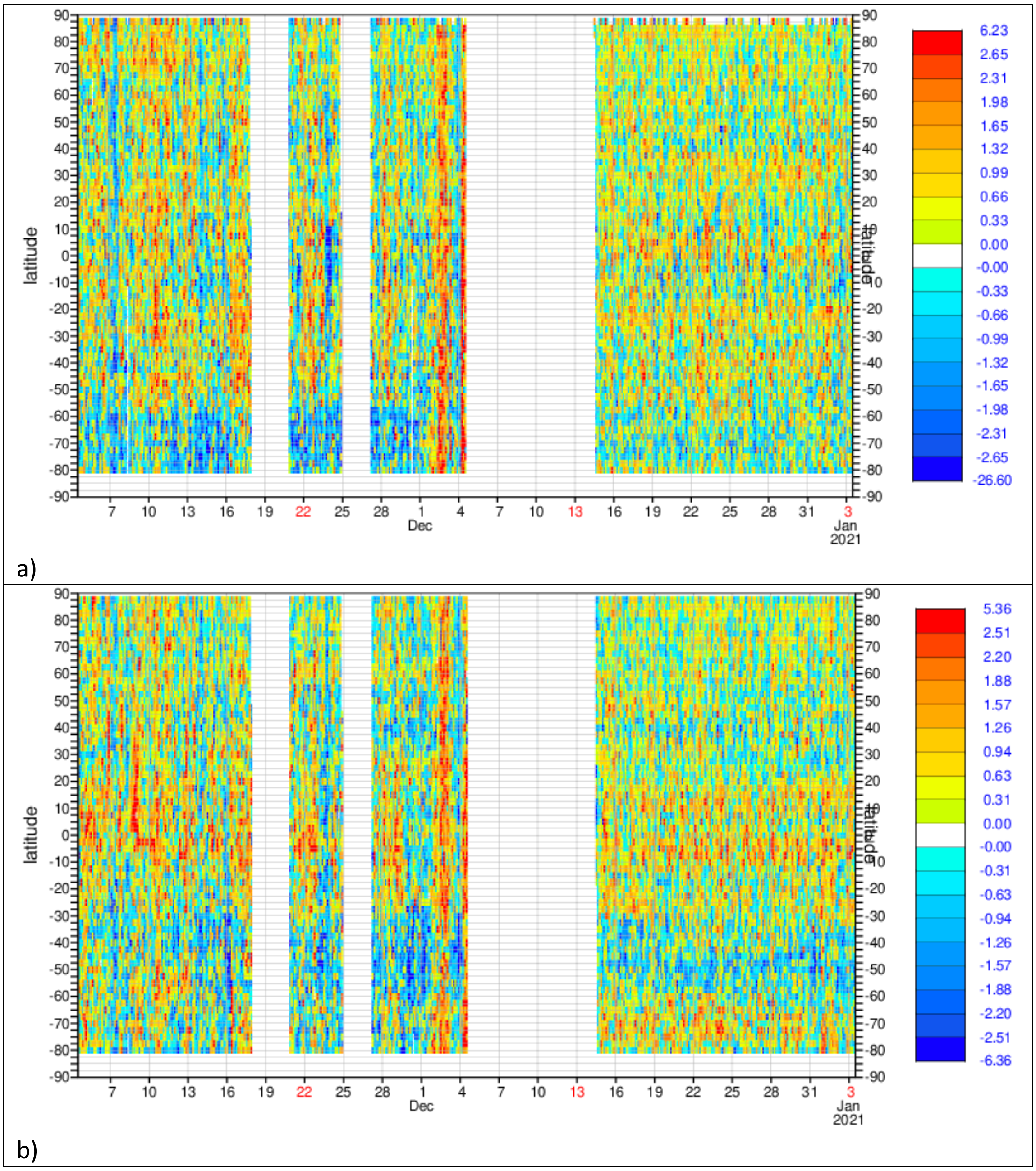


Figure 2. Latitude-time dependence of the mean(O-B) for L2B Rayleigh-clear HLOS winds for the 0-400 hPa pressure range for a) ascending and b) descending orbit phase. Unit: m/s.

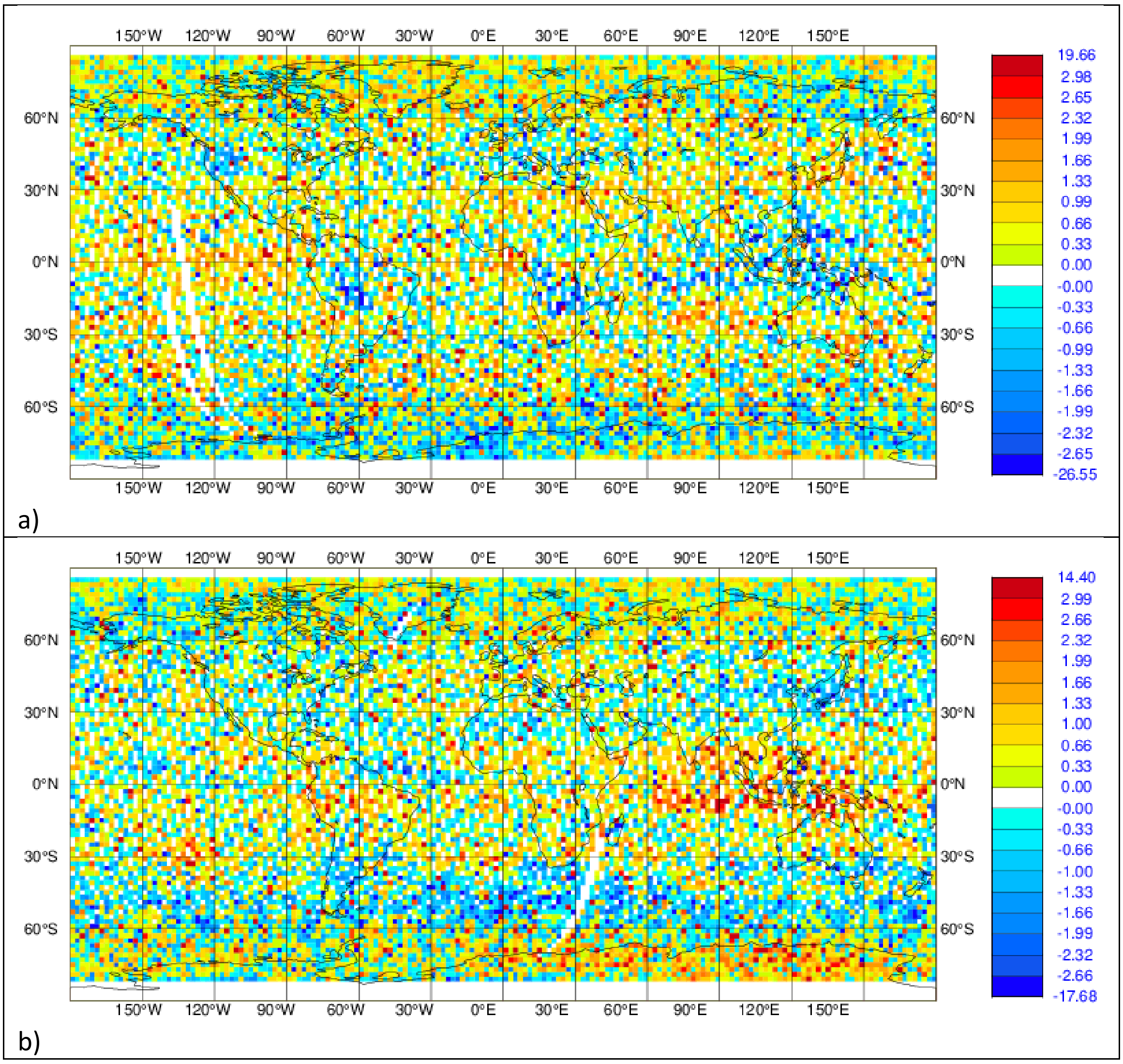
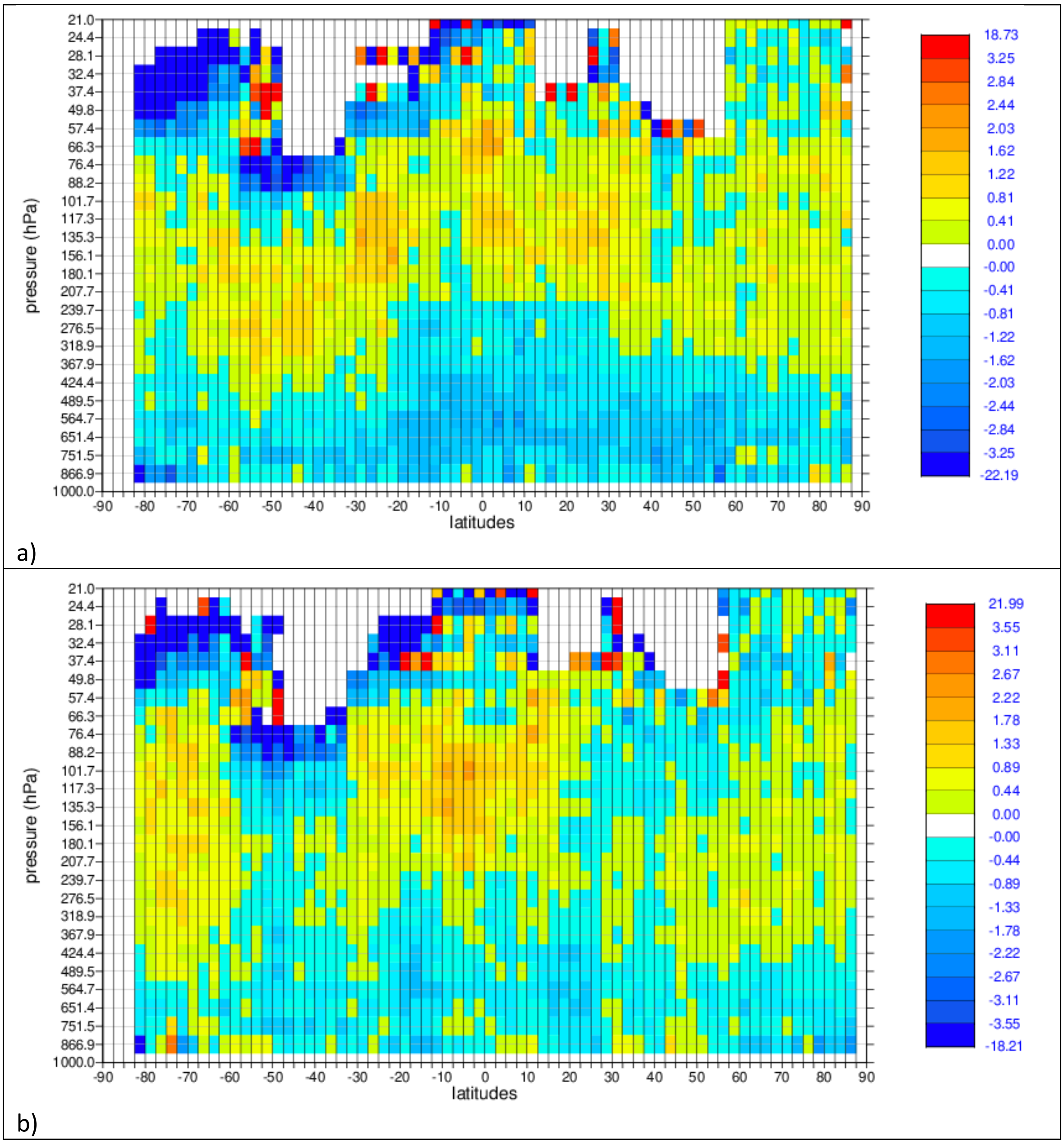


Figure 3. Maps of L2B Rayleigh-clear mean(O-B) for the 0-400 hPa pressure range for a) ascending and b) descending orbit phases. Unit: m/s. For the period: 13 December 2020 to 1 January 2021.


a)
pressure (hPa)
21.0
24.4
28.1
32.4
37.4
49.8
57.4
66.3
76.4
88.2
101.7
117.3
135.3
156.1
180.1
207.7
239.7
276.5
318.9
367.9
424.4
489.5
564.7
651.4
751.5
866.9
1000.0
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
latitudes
18.73
3.25
2.84
2.44
2.03
1.62
1.22
0.81
0.41
0.00
-0.00
-0.41
-0.81
-1.22
-1.62
-2.03
-2.44
-2.84
-3.25
-22.19
b)
pressure (hPa)
21.0
24.4
28.1
32.4
37.4
49.8
57.4
66.3
76.4
88.2
101.7
117.3
135.3
156.1
180.1
207.7
239.7
276.5
318.9
367.9
424.4
489.5
564.7
651.4
751.5
866.9
1000.0
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
latitudes
21.99
3.55
3.11
2.67
2.22
1.78
1.33
0.89
0.44
0.00
-0.00
-0.44
-0.89
-1.33
-1.78
-2.22
-2.67
-3.11
-3.55
-18.21

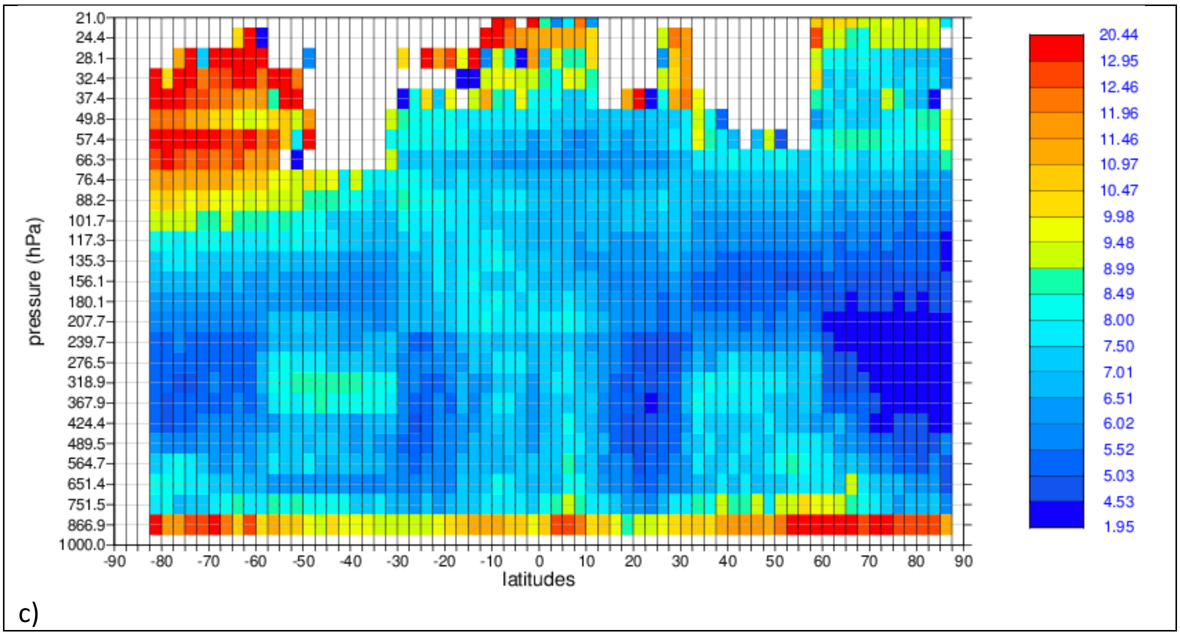


Figure 4. Pressure versus latitude dependence of the L2B Rayleigh-clear mean(O-B) for a) ascending and b) descending orbits. Panel c) is the standard deviation of (O-B) for ascending orbits. Unit: m/s. For the period: 13 December 2020 to 2 January 2021.

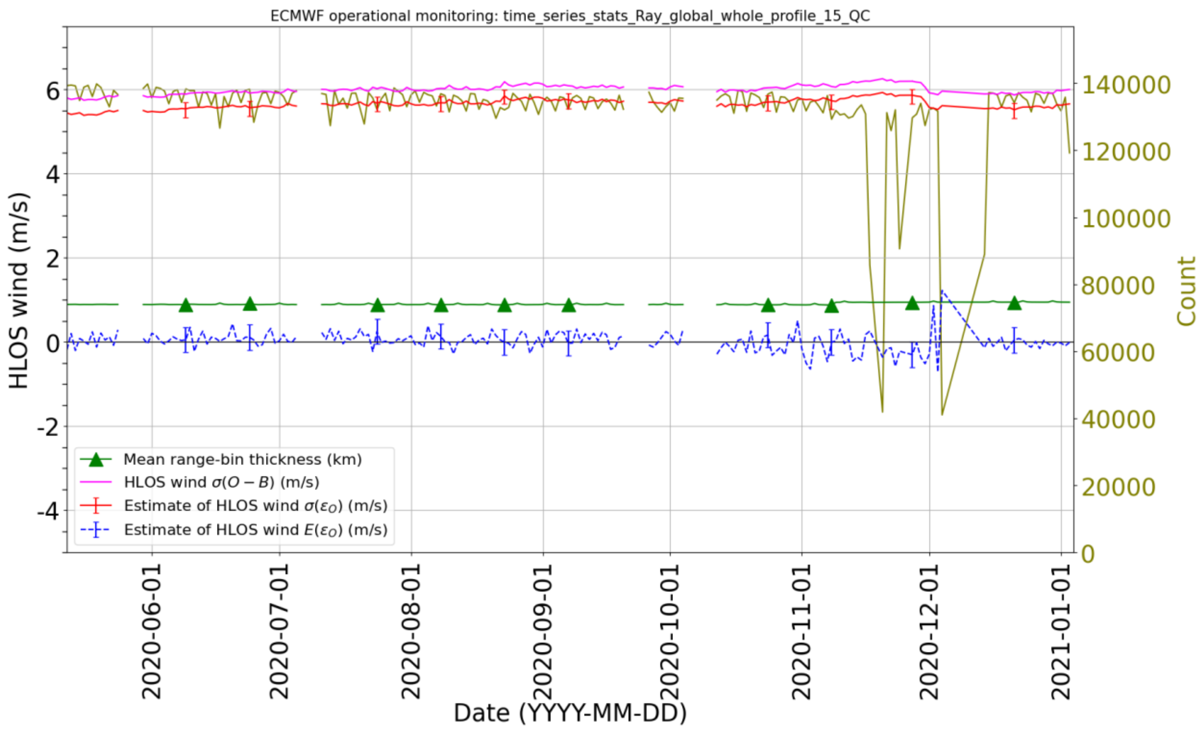


Figure 5. Times-series of daily global, whole profile L2B Rayleigh-clear HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject winds if abs(O-B) > 15 m/s.

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

- After the Level-2B processor fix for the jumps in internal path Rayleigh response was implemented from 14 December 2020 onwards, the Rayleigh-clear biases have been significantly more stable with time.

- Random errors have remained almost stable since then - perhaps a small increase with time is evident.
- The Hovmöller type bias plots also show that the biases have been varying much less with latitude since the fix came in.
- For descending orbits, positive bias continues to persist in the tropical upper troposphere and more negative bias for 30-60 degrees south. It is unclear what is causing this.
- Overall, the zonal average bias continues to show some similarities for ascending and descending orbits: with a generally negative bias at lower altitudes (higher pressures) and more positive bias at higher altitudes. There are indications in offline testing that this related to the Rayleigh response calibration curves as a function of atmospheric temperature (Rayleigh-Brillouin Correction) being not quite right - this will hopefully be improved in the upcoming months.
- There is bias for Southern more polar latitudes for which there is strong negative bias at the highest range-bins. This seems to be related to very low SNR due to high solar background noise and decreasing atmospheric signal with time due to the instrument.

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

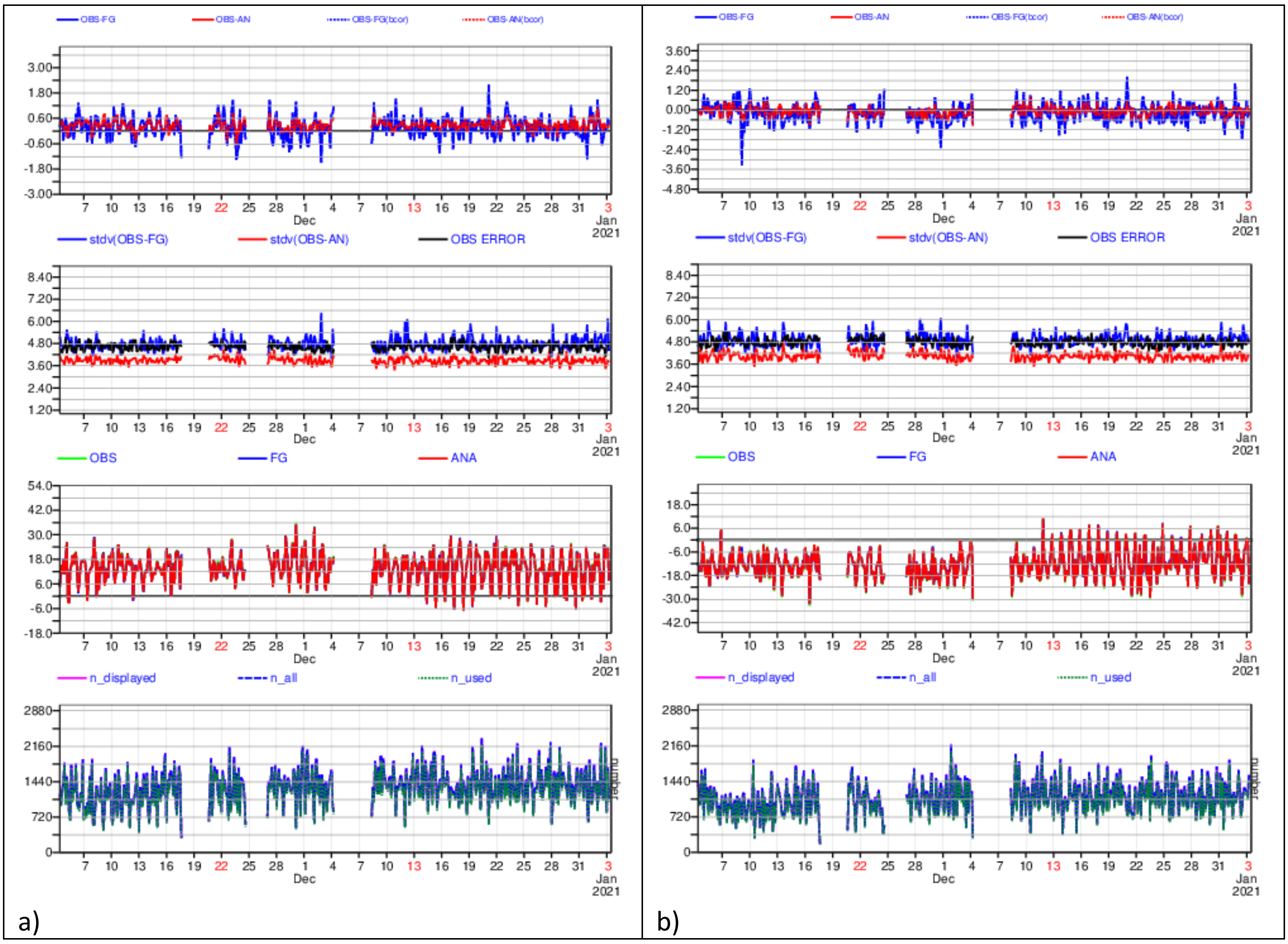


Figure 6. Same type of plots as in Figure 1, but for L2B Mie-cloudy HLOS winds.

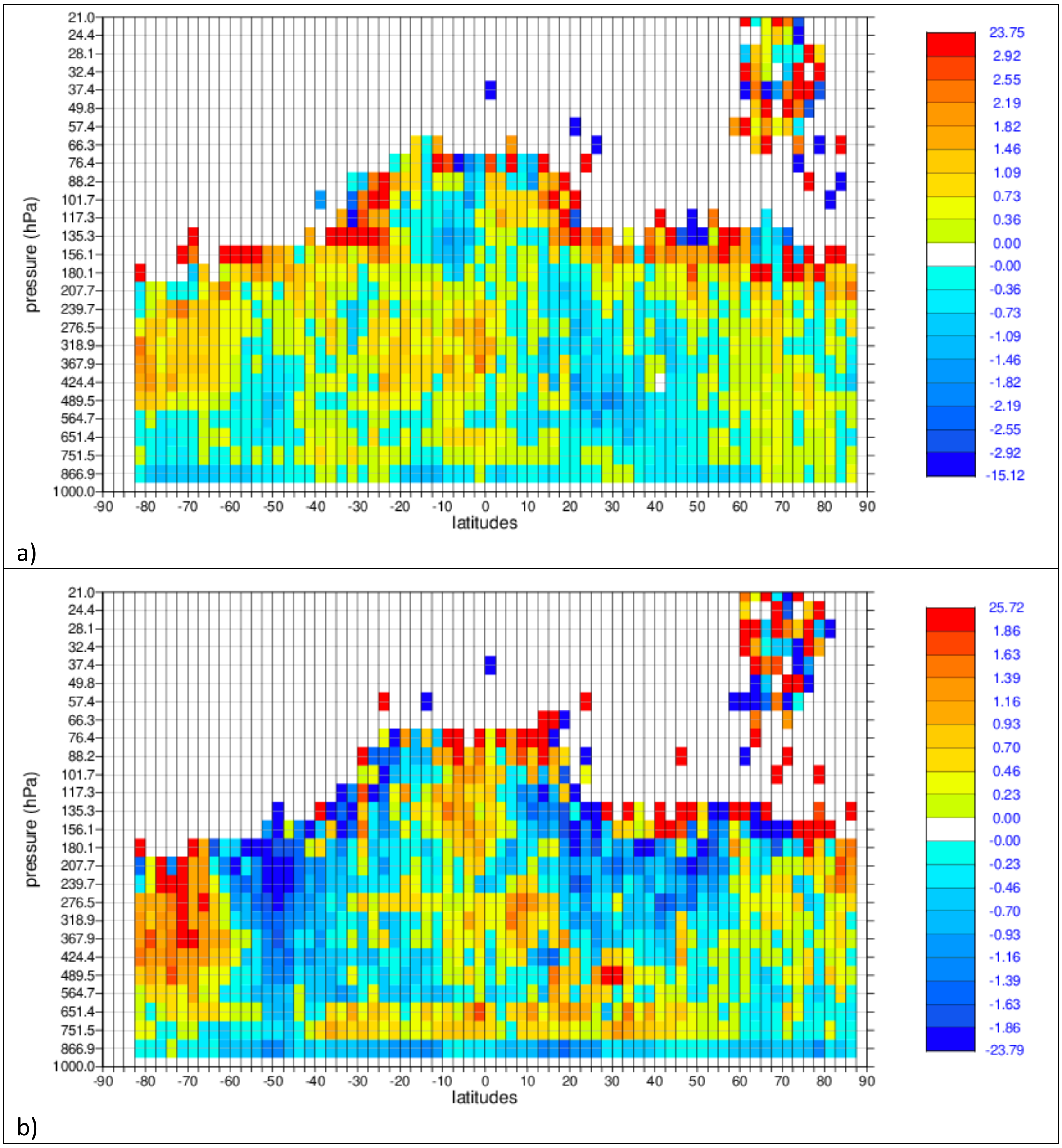


Figure 7. Pressure versus latitude dependence of the L2B Mie-cloudy mean(O-B) for a) ascending and b) descending orbits. Unit: m/s. For the period: 13 December 2020 to 2 January 2021.

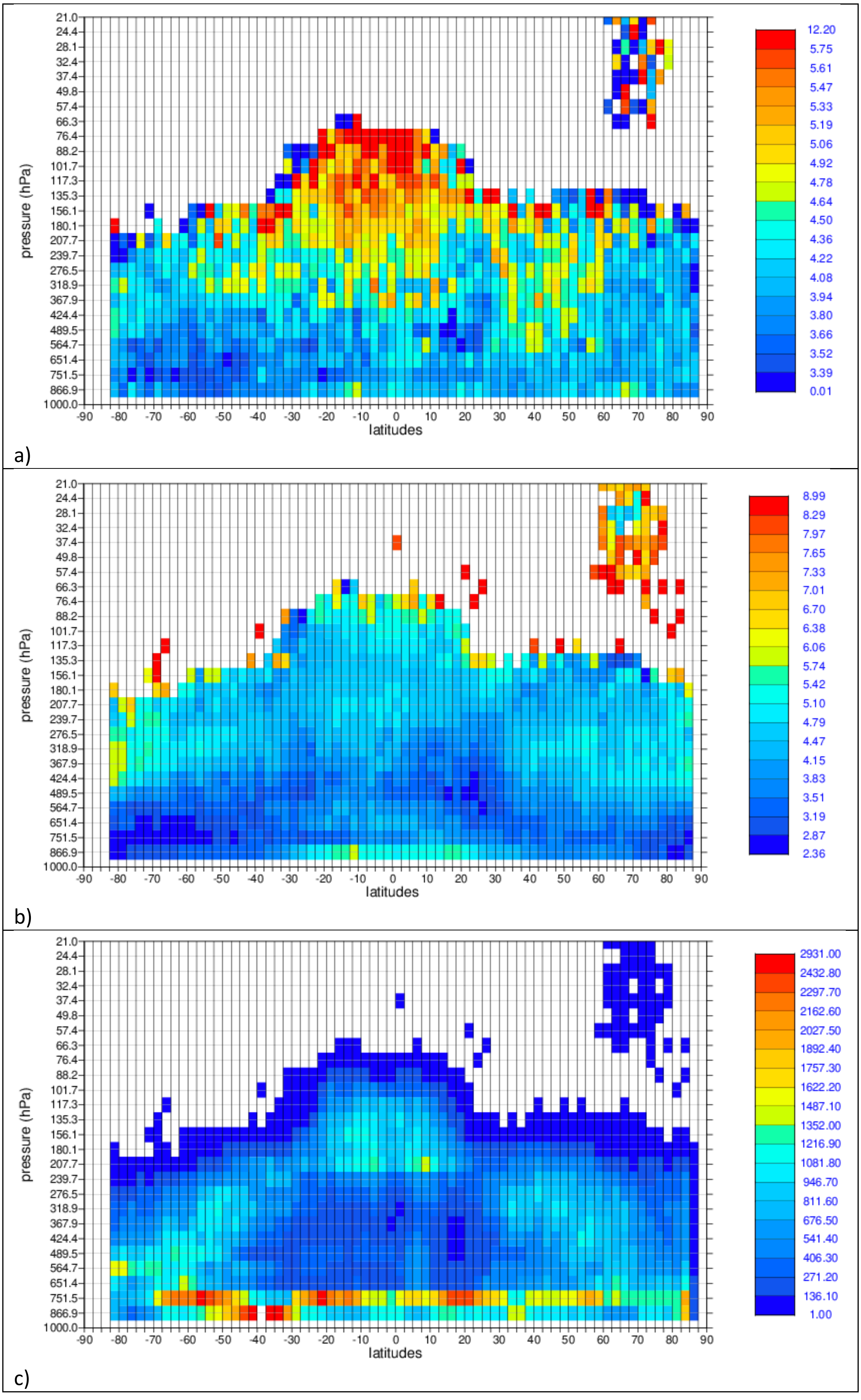

pressure (hPa)
21.0
24.4
28.1
32.4
37.4
49.8
57.4
66.3
76.4
88.2
101.7
117.3
135.3
156.1
180.1
207.7
239.7
276.5
318.9
367.9
424.4
489.5
564.7
651.4
751.5
866.9
1000.0
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
latitudes
12.20
5.75
5.61
5.47
5.33
5.19
5.06
4.92
4.78
4.64
4.50
4.36
4.22
4.08
3.94
3.80
3.66
3.52
3.39
0.01
a)
8.99
8.29
7.97
7.65
7.33
7.01
6.70
6.38
6.06
5.74
5.42
5.10
4.79
4.47
4.15
3.83
3.51
3.19
2.87
2.36
b)
2931.00
2432.80
2297.70
2162.60
2027.50
1892.40
1757.30
1622.20
1487.10
1352.00
1216.90
1081.80
946.70
811.60
676.50
541.40
406.30
271.20
136.10
1.00
c)

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: 13 December 2020 to 2 January 2021.

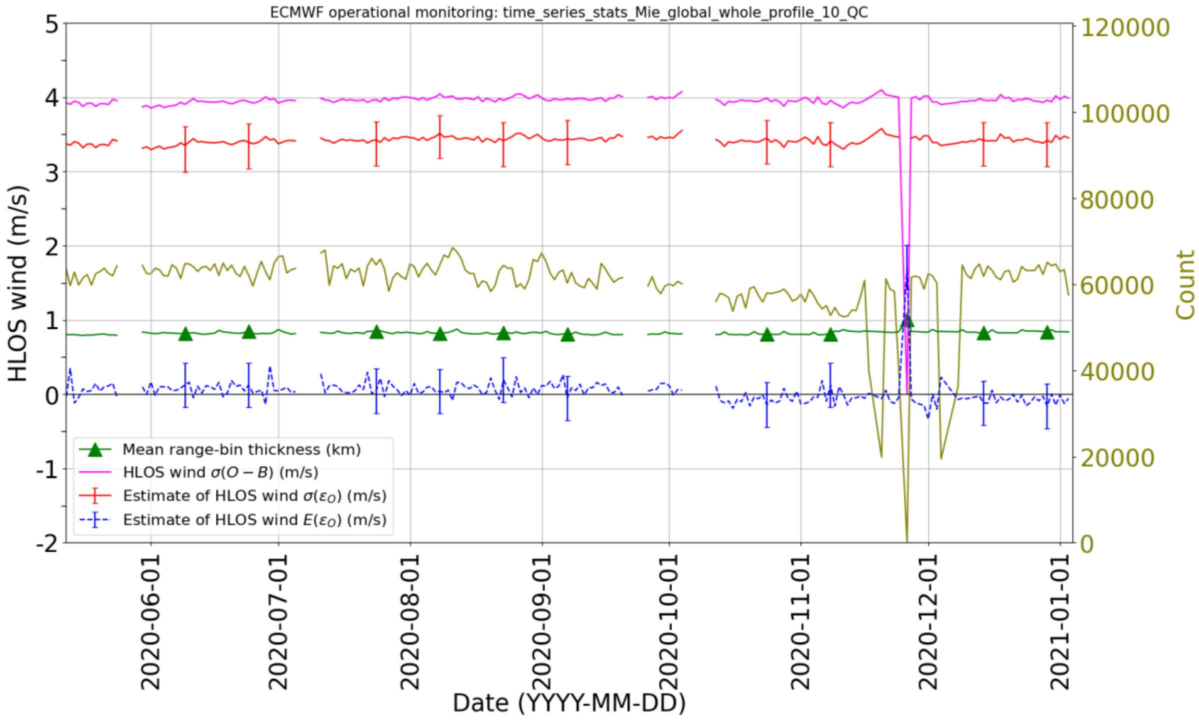


Figure 9. Times-series of daily, global, whole profile L2B Mie-cloudy HLOS wind related statistics since 12 May 2020. QC for this type of plot is to reject if abs(O-B) > 10 m/s.

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

- Statistics remain similar to last months.
- There are a few Mie winds appearing at high altitudes in Arctic, which is assumed to be the appearance of Polar Stratospheric Clouds (CALIPSO data supports this).