Aeolus Level-2B HLOS wind product quality report

Period: For the month up to 7 September 2020

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Introduction

Some introductory text on the Aeolus Level-2B wind monitoring statistics is provided on the CAL/VAL confluence page.

Daily updated, automatically produced statistics of observation minus background (O-B) and observation minus analysis (O-A) are available here (from which many of the plots in this report have been taken):
https://www.ecmwf.int/en/forecasts/charts/obstat/?facets=Data%20type,Aeolus%20HLOS%20Wind

Quality Control is applied for these automated statistics, which consists of:

- Rejecting observations with L2Bp estimated σ_O > 12 m/s for the Rayleigh and σ_O > 5 m/s for the Mie.
- Rejecting observations if HLOS wind overall confidence flag is invalid.
- Model based first-guess check i.e. reject if first-guess departure is too big i.e. $O - B > 5\sqrt{\sigma_O^2 + \sigma_B^2}$

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

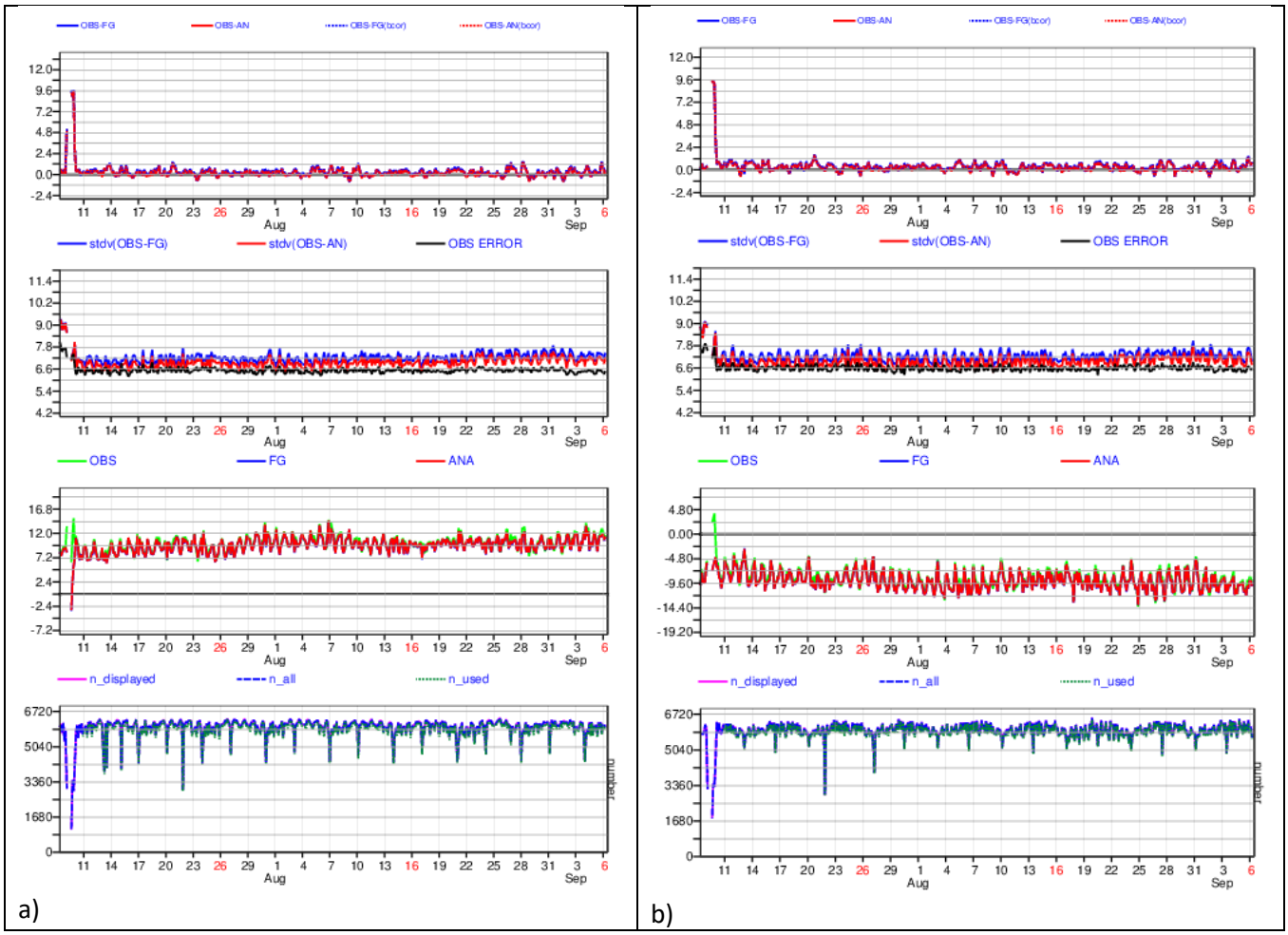


Figure 1. This figure shows changes with time in the O-B and O-A departure statistics of the L2B Rayleigh-clear winds with respect to the ECMWF model. The statistics are calculated every 3 hours for the 0-400 hPa pressure range. Panel a) is for ascending and panel b) is for descending orbit phase. The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

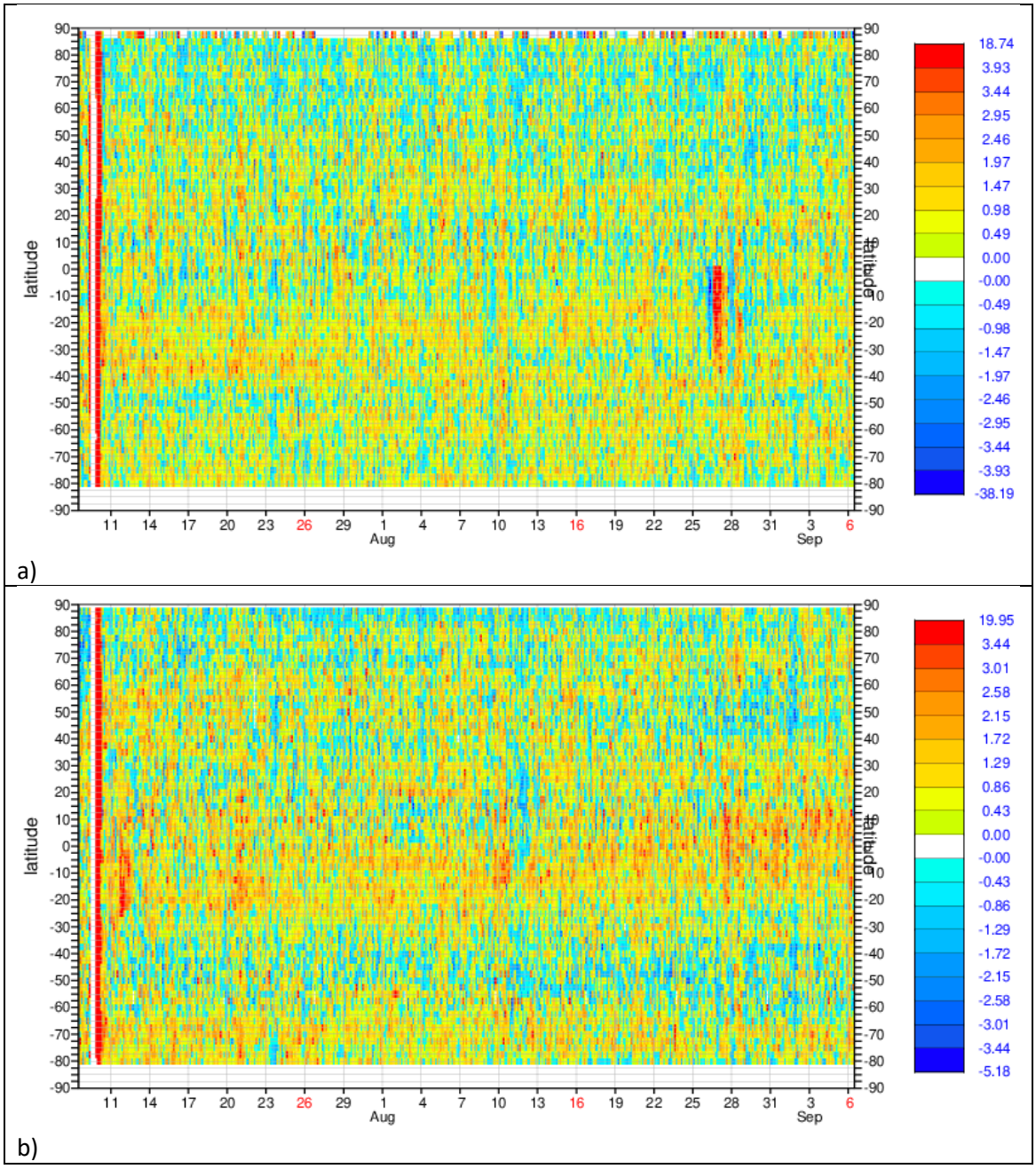


Figure 2. Latitude-time dependence of the mean(O-B) for L2B Rayleigh-clear HLOS winds for the 0-400 hPa pressure range for a) ascending and b) descending orbit phase. Unit: m/s.

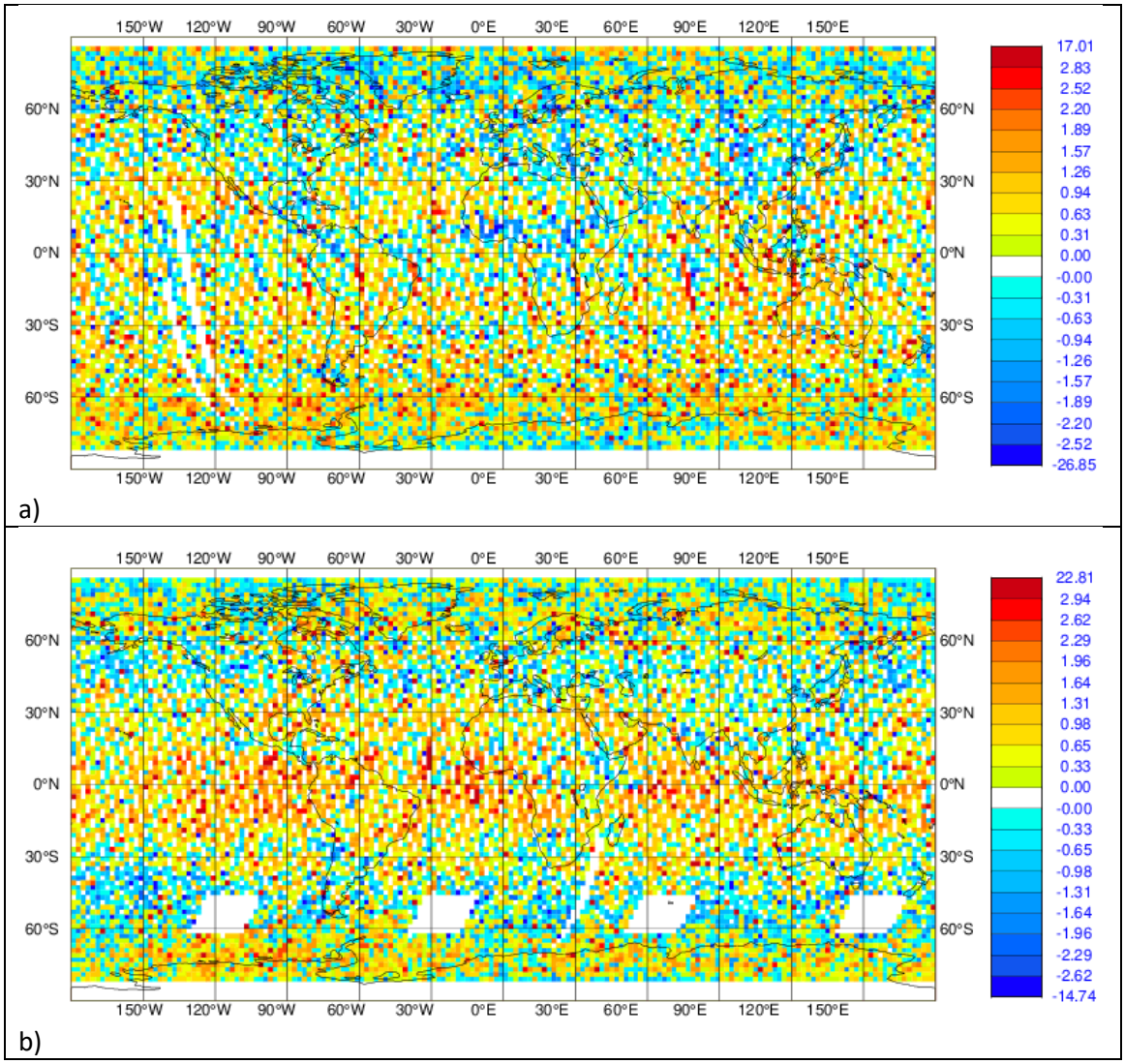
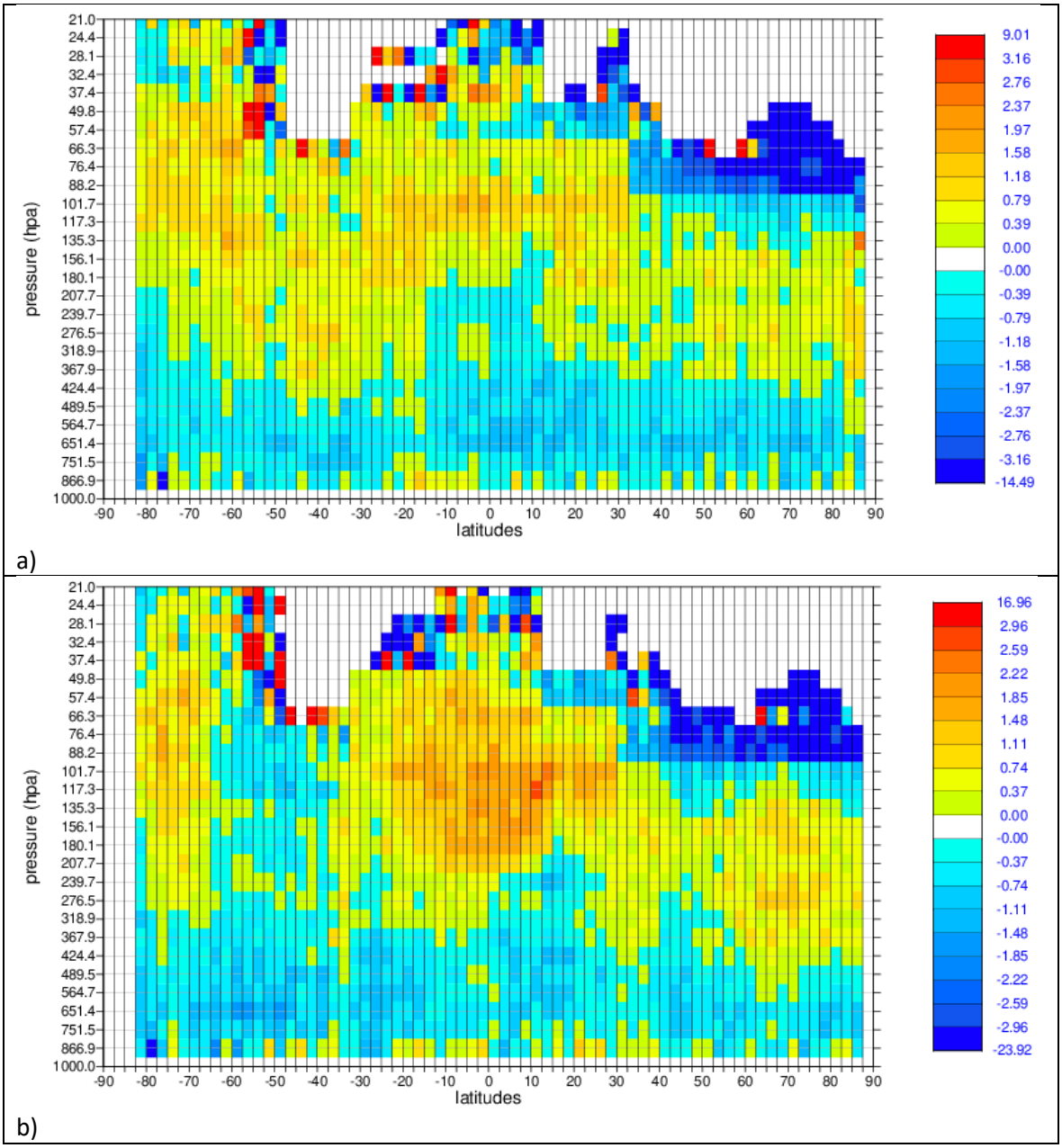


Figure 3. Maps of L2B Rayleigh-clear mean(O-B) for the 0-400 hPa pressure range for a) ascending and b) descending orbit phases. Unit: m/s. For the period: 13 August 2020 to 4 September 2020.


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
9.01
3.16
2.76
2.37
1.97
1.58
1.18
0.79
0.39
0.00
-0.00
-0.39
-0.79
-1.18
-1.58
-1.97
-2.37
-2.76
-3.16
-14.49
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
16.96
2.96
2.59
2.22
1.85
1.48
1.11
0.74
0.37
0.00
-0.00
-0.37
-0.74
-1.11
-1.48
-1.85
-2.22
-2.59
-2.96
-23.92
b)

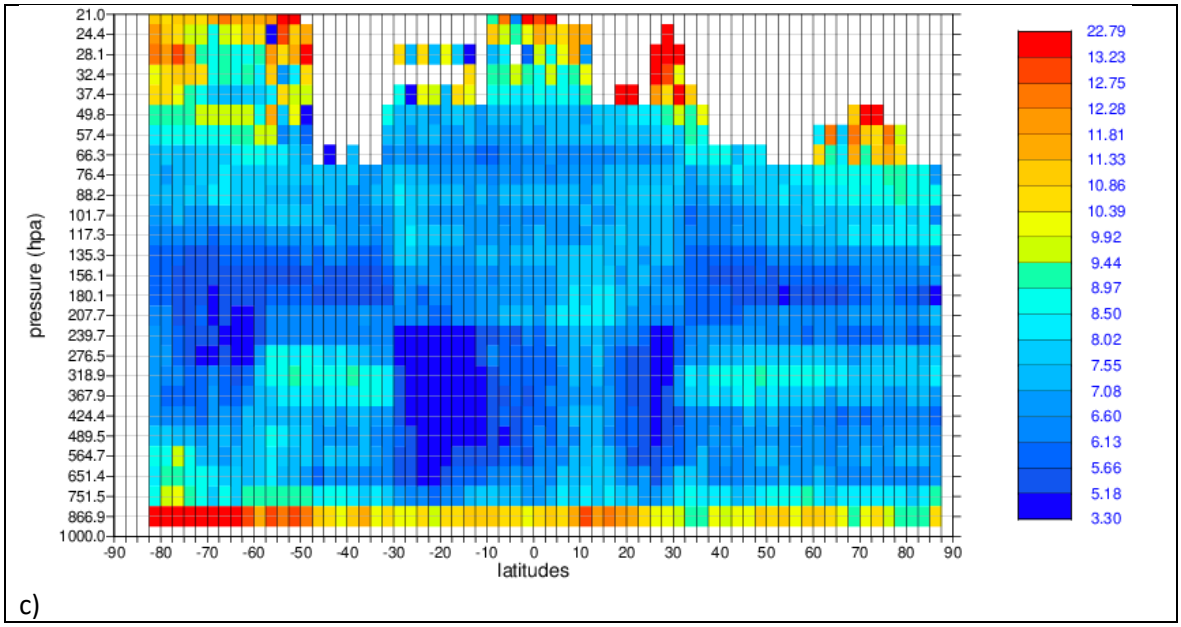


Figure 4. Pressure versus latitude dependence of the L2B Rayleigh-clear mean(O-B) for a) ascending and b) descending orbits. Panel c) is the standard deviation of (O-B) for ascending orbits. Unit: m/s. For the period: 16 August 2020 to 5 September 2020.

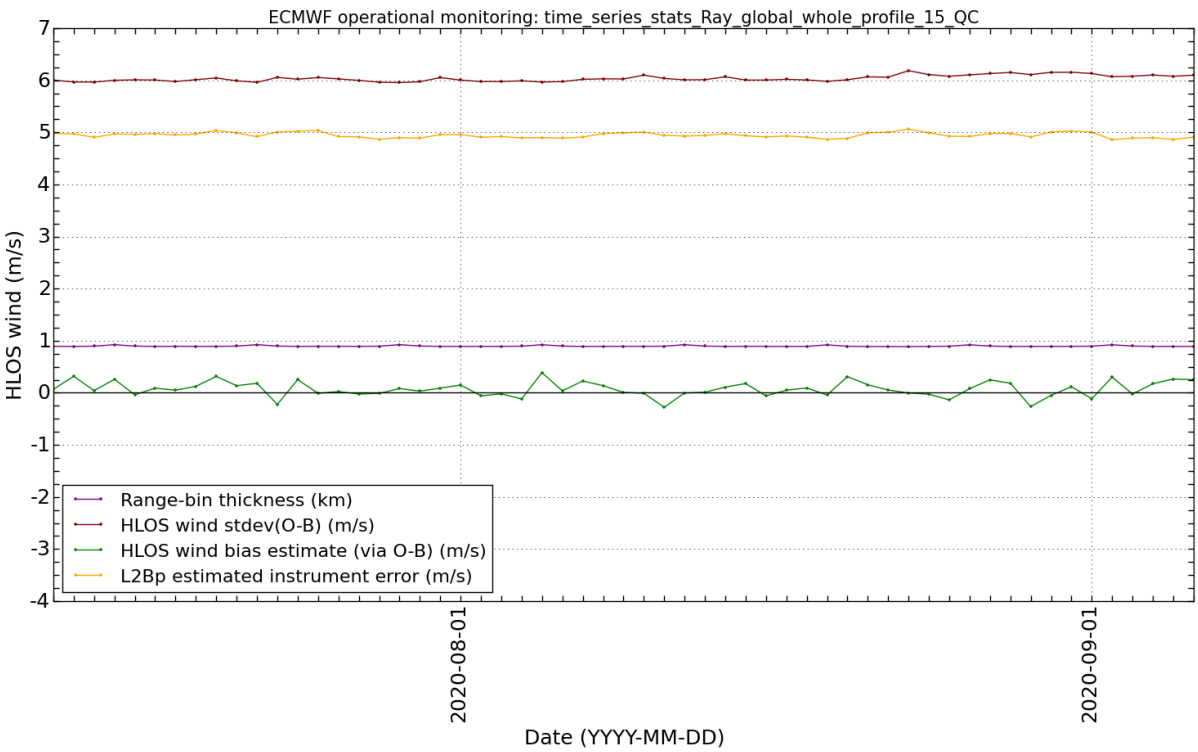


Figure 5. Times-series of daily global, whole profile L2B Rayleigh-clear HLOS wind related statistics for the recent period. QC for this plot is reject if abs(O-B) > 15 m/s.

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

- The global stdev(O-B) and mean(O-B) has increased a little in the past month; by ~0.1 m/s, although the L2Bp estimated instrument noise looks fairly flat.

- Maps, Hovmöller and zonal average type plots show that there is a developing positive bias in the tropical upper troposphere for descending orbits. It is unclear what is causing this. It may be an ECMWF model issue.
- Overall, the zonal average bias plots look similar for ascending and descending orbits, with a generally negative bias at lower levels and more positive bias higher up, except for the Northern high latitudes for which there is strong negative bias around 80 hPa. There are indications in offline testing that the negative bias at lower altitudes may be related to inappropriate Rayleigh response curves for warmer atmospheric temperatures.
- There was a strong star-tracker moon-blinding event related bias for ascending orbits, just south of the equator on ~27 August 2020.

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

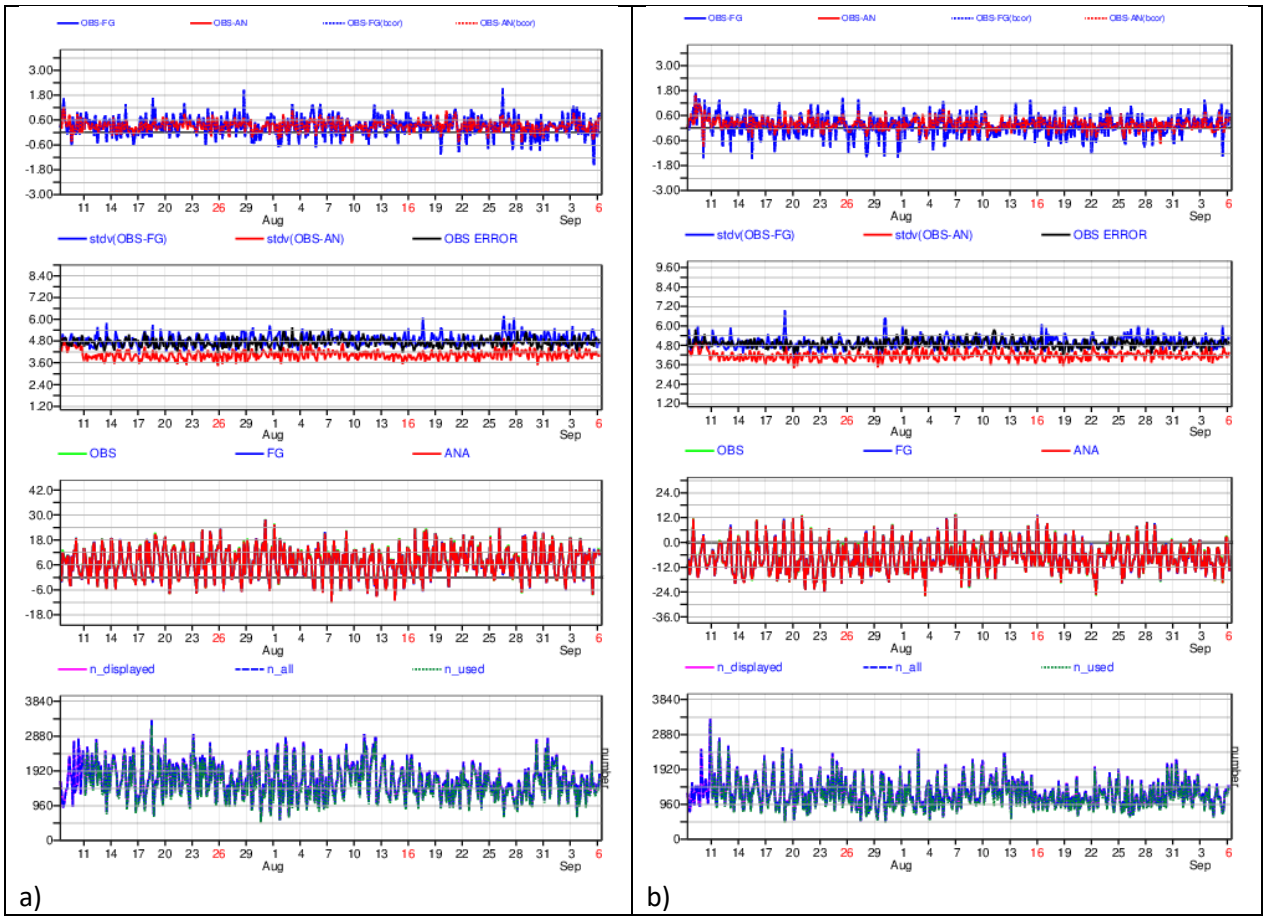


Figure 6. Same type of plots as in Figure 1, but for L2B Mie-cloudy HLOS winds.

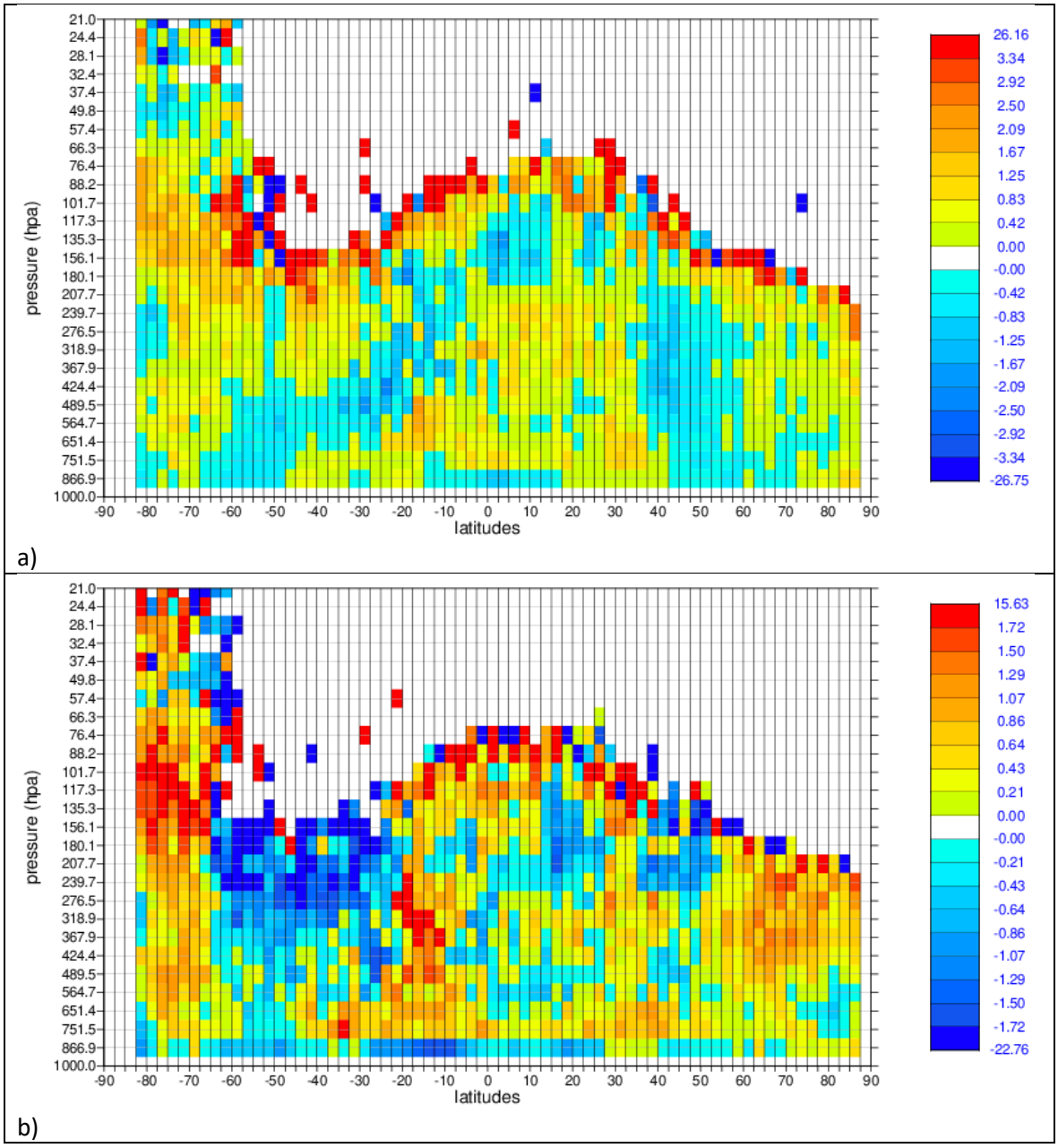


Figure 7. Pressure versus latitude dependence of the L2B Mie-cloudy mean(O-B) for a) ascending and b) descending orbits. Unit: m/s. For the period: 16 August 2020 to 5 September 2020.

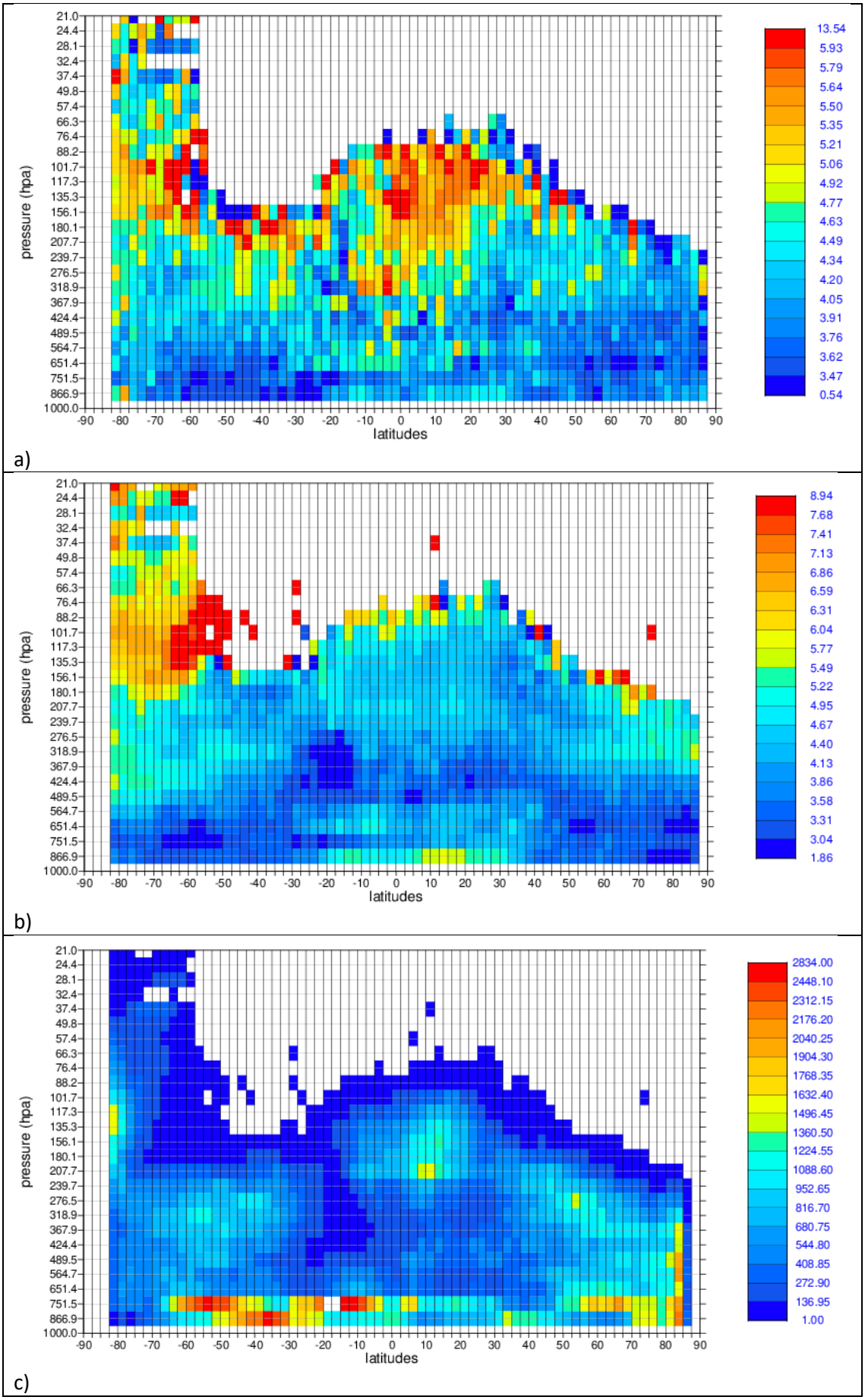

pressure (hpa)
latitudes
13.54
5.93
5.79
5.64
5.50
5.35
5.21
5.06
4.92
4.77
4.63
4.49
4.34
4.20
4.05
3.91
3.76
3.62
3.47
0.54
a)
8.94
7.68
7.41
7.13
6.86
6.59
6.31
6.04
5.77
5.49
5.22
4.95
4.67
4.40
4.13
3.86
3.58
3.31
3.04
1.86
b)
2834.00
2448.10
2312.15
2176.20
2040.25
1904.30
1768.35
1632.40
1496.45
1360.50
1224.55
1088.60
952.65
816.70
680.75
544.80
408.85
272.90
136.95
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: 16 August 2020 to 5 September 2020.

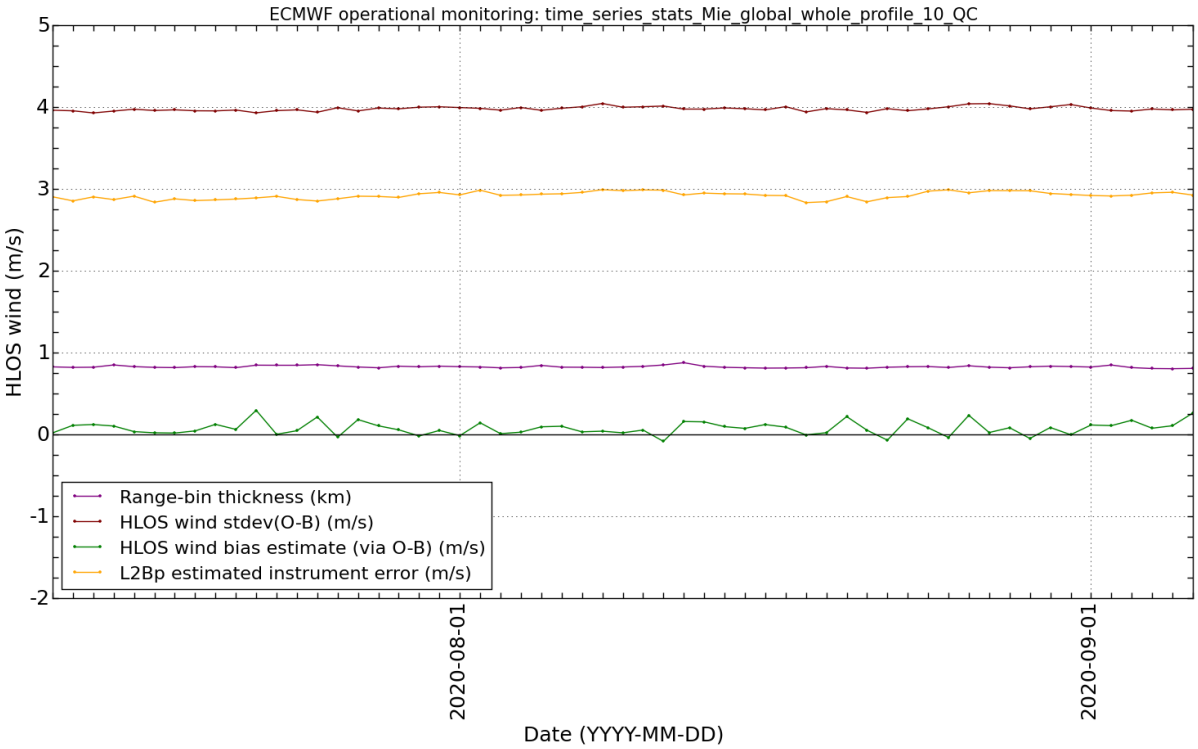


Figure 9. Times-series of daily, global, whole profile L2B Mie-cloudy HLOS wind related statistics for the recent period. QC for this plot is reject if abs(O-B) > 10 m/s.

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

- Global average random error shows perhaps a tiny increase in the past month or two.
- The zonal average biases have a complex pattern and change between ascending and descending orbits (although the magnitude is not huge i.e. ±2 m/s). It is unclear if these are Aeolus or model wind biases (probably a mix of both). Similar pattern in previous monthly report.
- There remains a very good sample of Mie winds at the South Pole between 20-120 hPa due to polar stratospheric clouds. The quality of this data is very good for such a high altitude and remote location. This justifies the much higher top range-bin settings for < -60 degrees latitude.
- The highest standard deviation of O-B departures is in the tropical and S. Hemisphere extratropical upper troposphere - which is thought to be an ECMWF model error feature.