Data quality of the Second Reprocessed Aeolus L2B Wind Data

Saleh Abdalla
And many DISC members

3rd Aeolus NWP Impact & L2B Quality Working Meeting

December 1st, 2021; Webex

ECMWF

Introduction

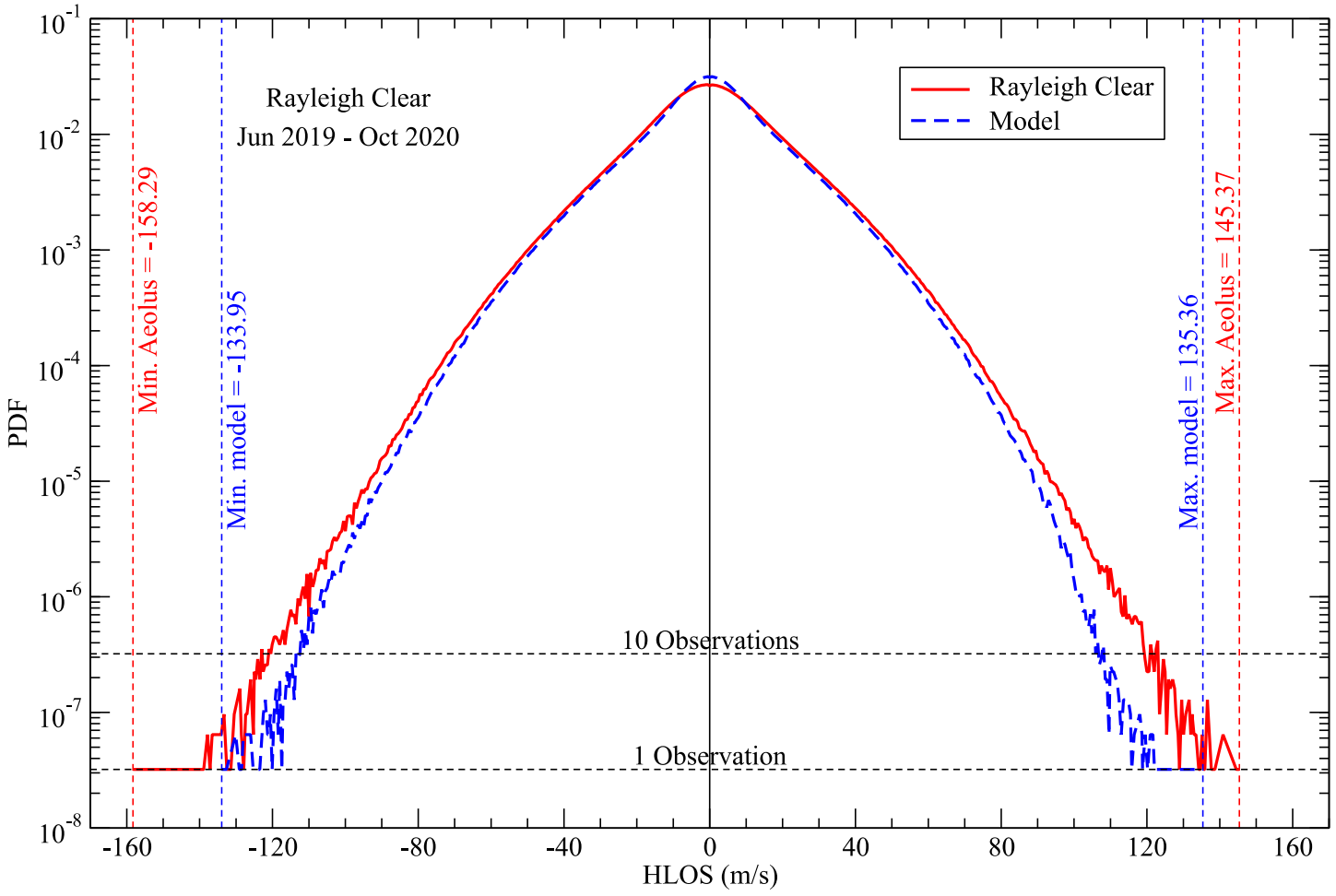
- Verification of the Aeolus second reprocessed L2B dataset effectively covering the FM-B period:
  - 28 June 2019 – 8 October 2020
- L2B: Horizontal Line Of Sight (HLOS) wind from Rayleigh clear, Rayleigh cloudy & Mie cloudy.
- Verification was carried against ECMWF IFS model based on O-B statistics from AUX_MET files (which are profiles of ECMWF IFS TcO1279 L137 background forecast along Aeolus predicted ground-tracks).
- Rep 2: Refers to the **second** full reprocessed data set (under evaluation) produced using processing baseline 11 (B11).
  Rep 1: Refers to the **first** full reprocessing.

- **The final conclusion is that the second reprocessing introduces further improvements to Aeolus L2B wind products (on top of those introduced through the first processing). Long and homogeneous dataset is achieved when complemented by NRT product produced with B11.**
- **As expected, there is still room for improvement for forthcoming reprocessings.**

Rayleigh Clear

Histograms for Rayleigh clear & ECMWF model HLOS wind

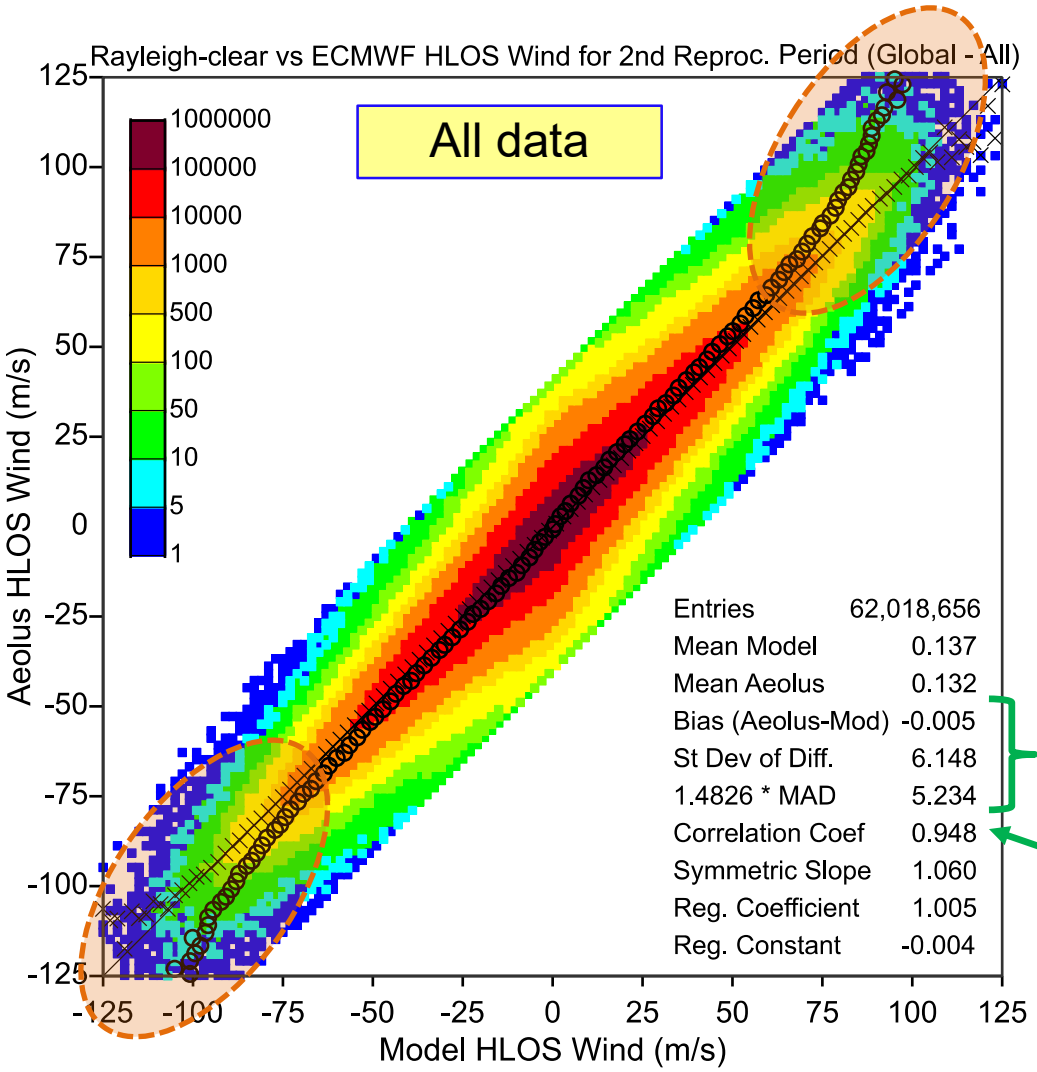
(full period: June 2019 – October 2020)

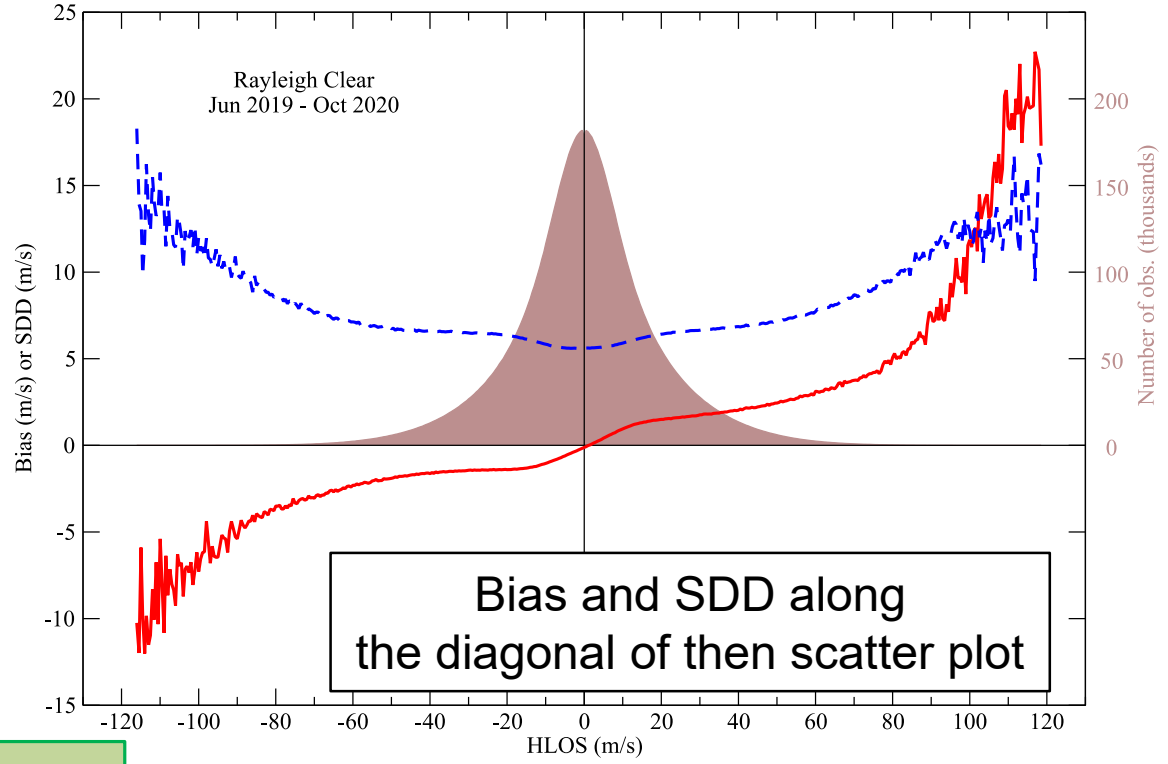


All data

Comparison between L2B Rayleigh clear & ECMWF model HLOS wind

(full period: June 2019 – October 2020)



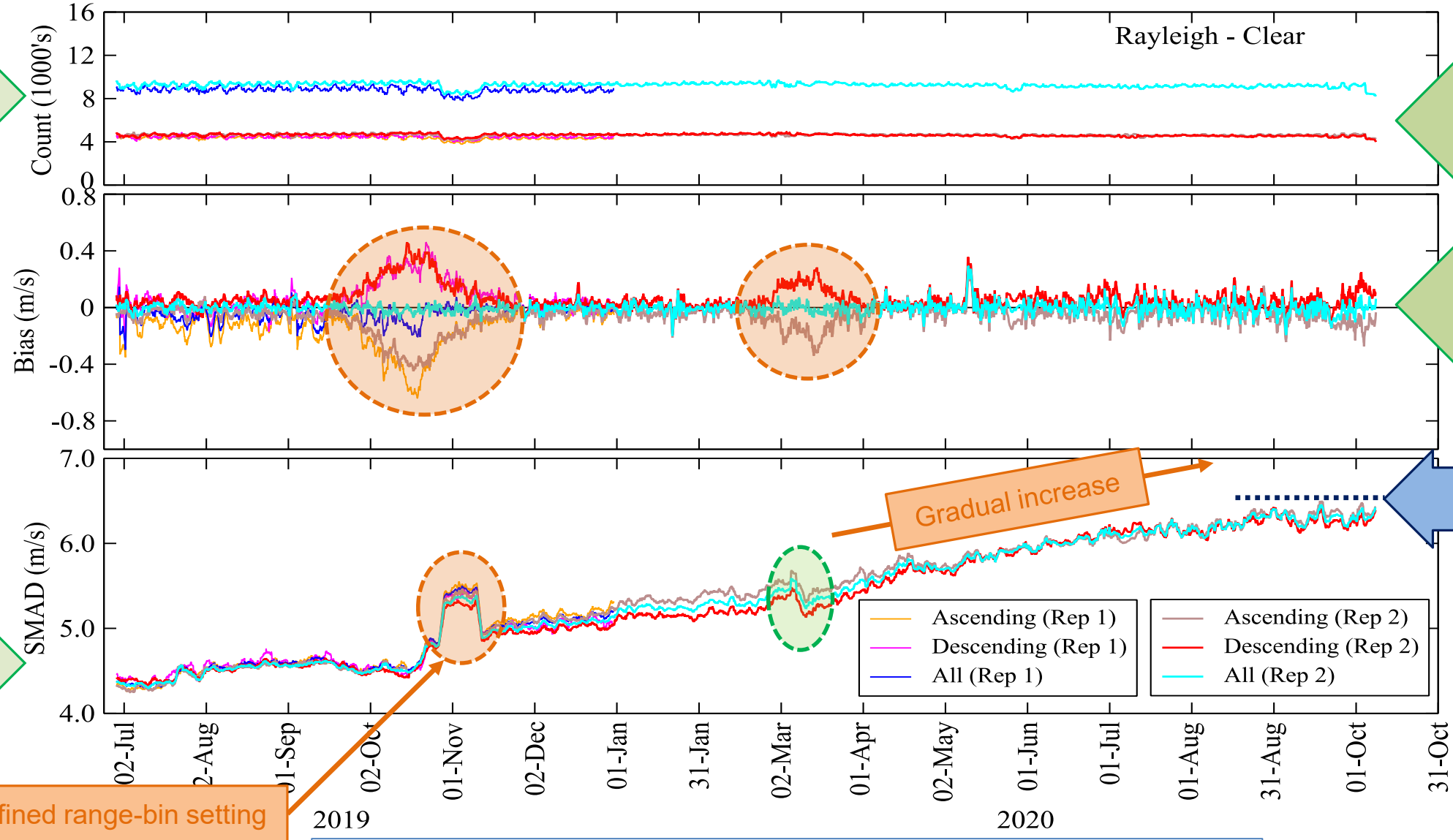


Very good

~ 0.95 ➔ Good

Bias: Mean of the difference.
SDD: Standard deviation of the difference.
SMAD: Scaled (i.e. multiplied by 1.4826) median absolute difference.

Time series of number, bias and SMAD of Rayleigh-clear wind wrt model



More obs. in Rep 2

Number of obs. Is constant

No bias ➔ Excellent

Less solar background

Gradual increase

Small SMAD

Special refined range-bin setting

SMAD = scaled median absolute difference = 1.48 MAD

Summary – **Rayleigh Clear** (1/2)

- Number of valid Rayleigh clear wind observations in the second reprocessing (Rep 2) is marginally higher than that of first reprocessing (Rep 1). The number of Rayleigh clear observations has been almost constant over the whole period (apart from few dips).
- Rep 2 wind is almost unbiased compared to the model. Rep 2 wind shows marginally lower bias compared to the already almost unbiased Rep 1.
- Rayleigh clear wind bias shows small positive bias in the Tropics and small negative bias in the extra tropics with the exception of Greenland and the Antarctica where the bias is positive.
- Rep 2 wind random differences (SMAD and SDD) are similar to those of Rep 1. SMAD is slightly above 5 m/s while SDD is slightly above 6 m/s. SMAD (and SDD) show a clear increasing trend with time. However, this trend seems to have stopped towards the end of August 2020.
- Observations from descending orbits show lower SMAD (and SDD) compared to those from ascending orbits (similar to Rayleigh cloudy and opposite to Mie cloudy) between December 2019 and April 2020.
- Higher SDD (and SMAD) values can be seen over Antarctica, main mountains and the monsoon region. Slightly lower values occur over the ITCZ.

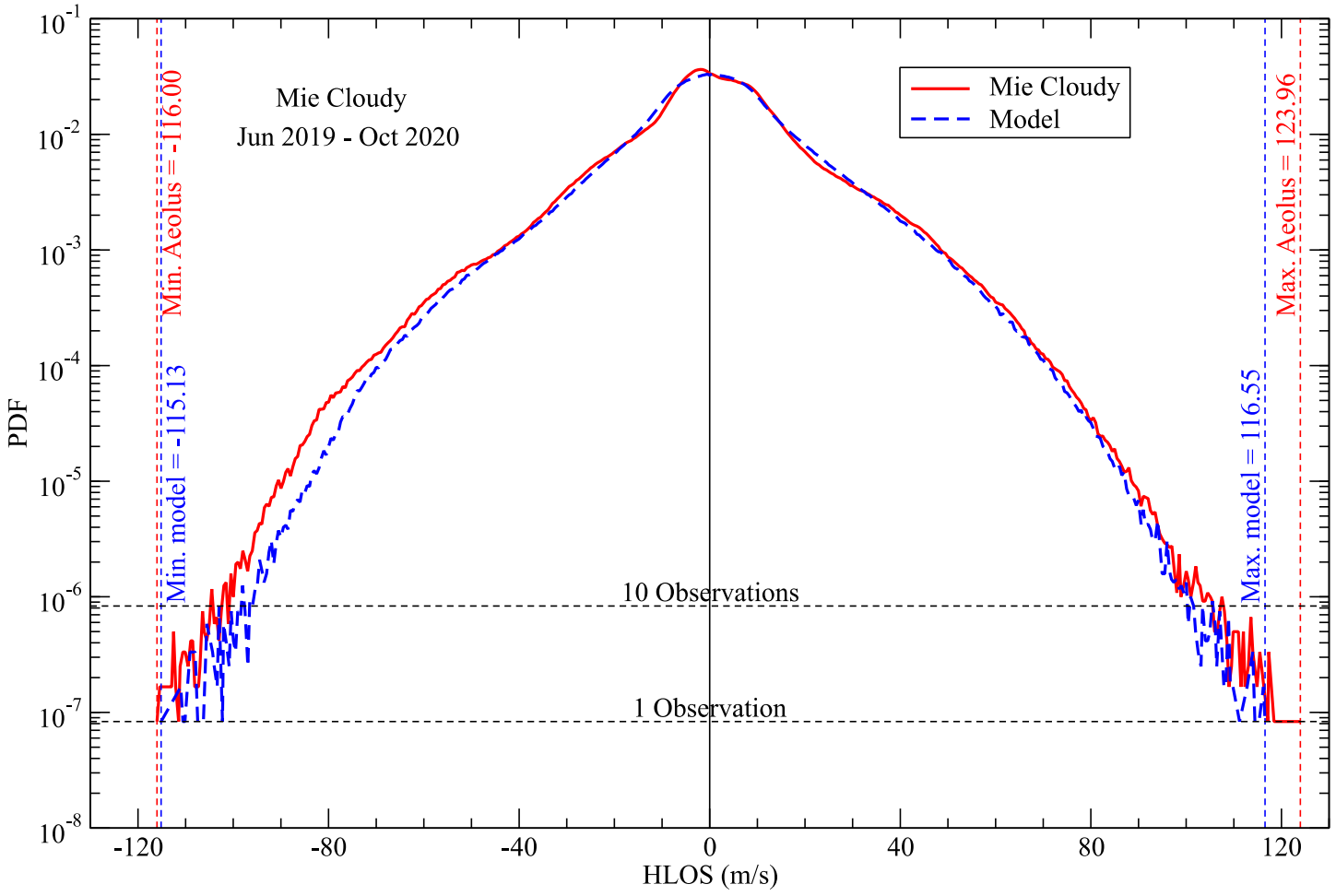
Summary – **Rayleigh Clear** (2/2)

- The distribution of Rayleigh clear versus model winds shows a secondary distribution around the model low values. This behaviour is most obvious in the Tropics between October and April. It seems that this is a model issue.
- The Rayleigh clear wind bias is almost independent of the altitude between altitudes 8 and 25 km with small underestimation below 8-km altitude and small overestimation above that.
- Random differences (SMAD and SDD) decrease (~linearly) by altitude in the lower 5 km of the atmosphere. They fluctuate around their minima between altitudes from 3 and 14 km. At altitudes higher than 4 km, SMAD and SDD increase linearly with altitude and reach ~14 m/s at altitudes higher than 25 km. There are at least 3 SMAD/SDD inversions: at altitudes 5, 9, 12 km.

Mie Cloudy

Histograms for Mie cloudy & ECMWF model HLOS wind

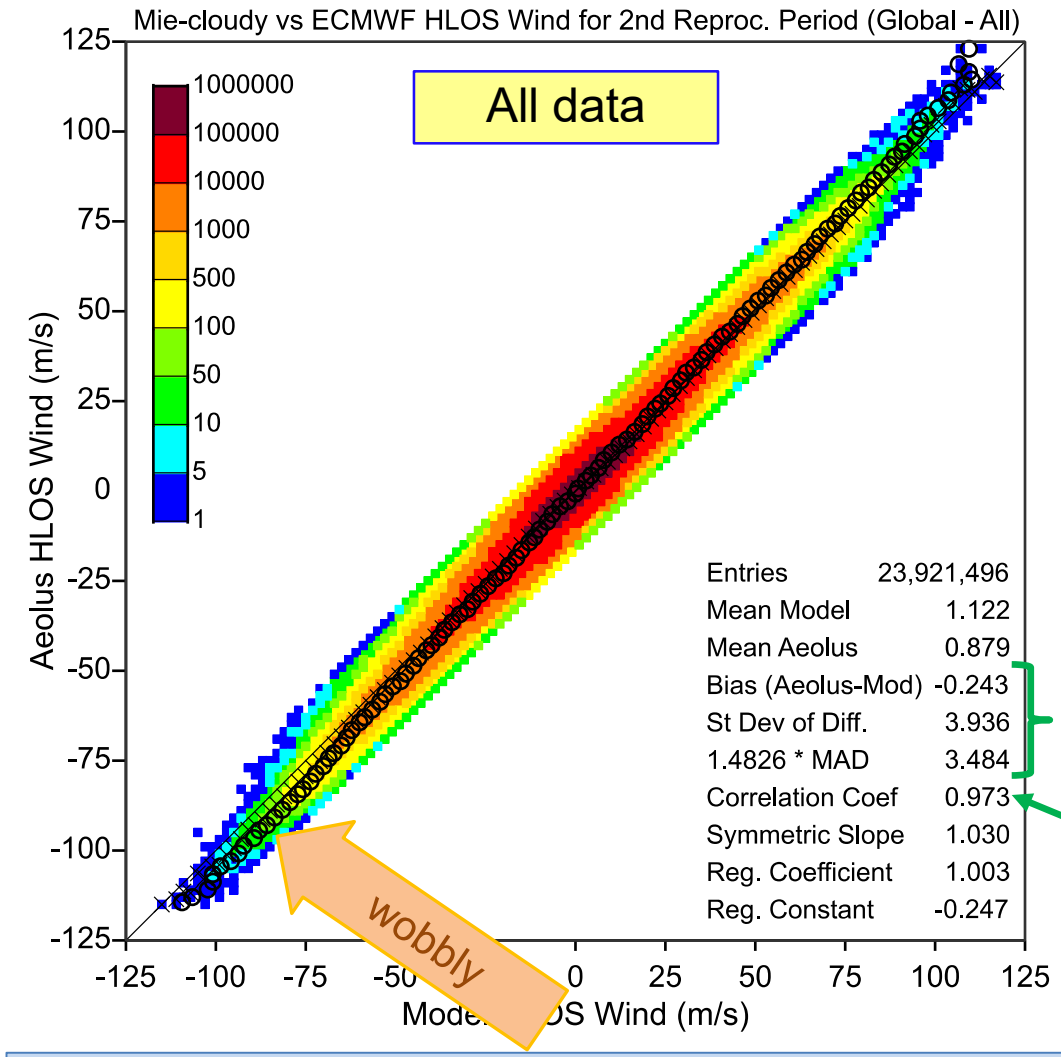
(full period: June 2019 – October 2020)



All data

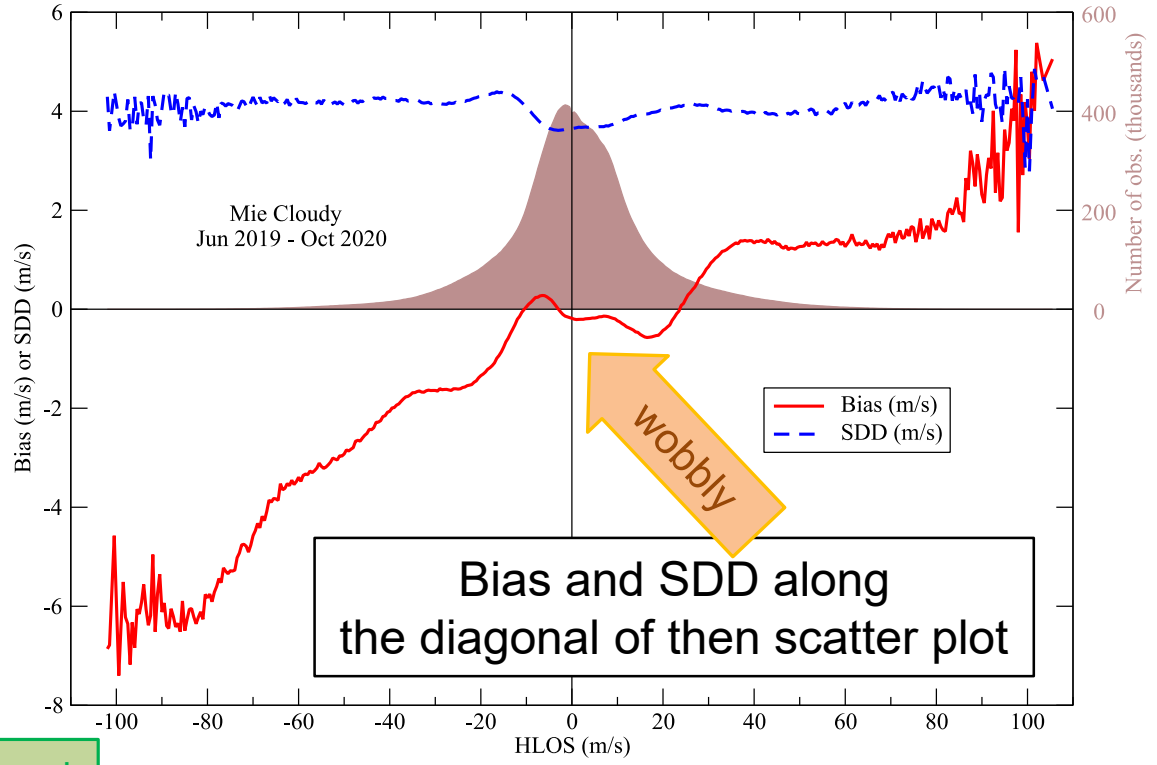
Comparison between L2B Mie cloudy & ECMWF model HLOS wind

(full period: June 2019 – October 2020)



Small ➔ good

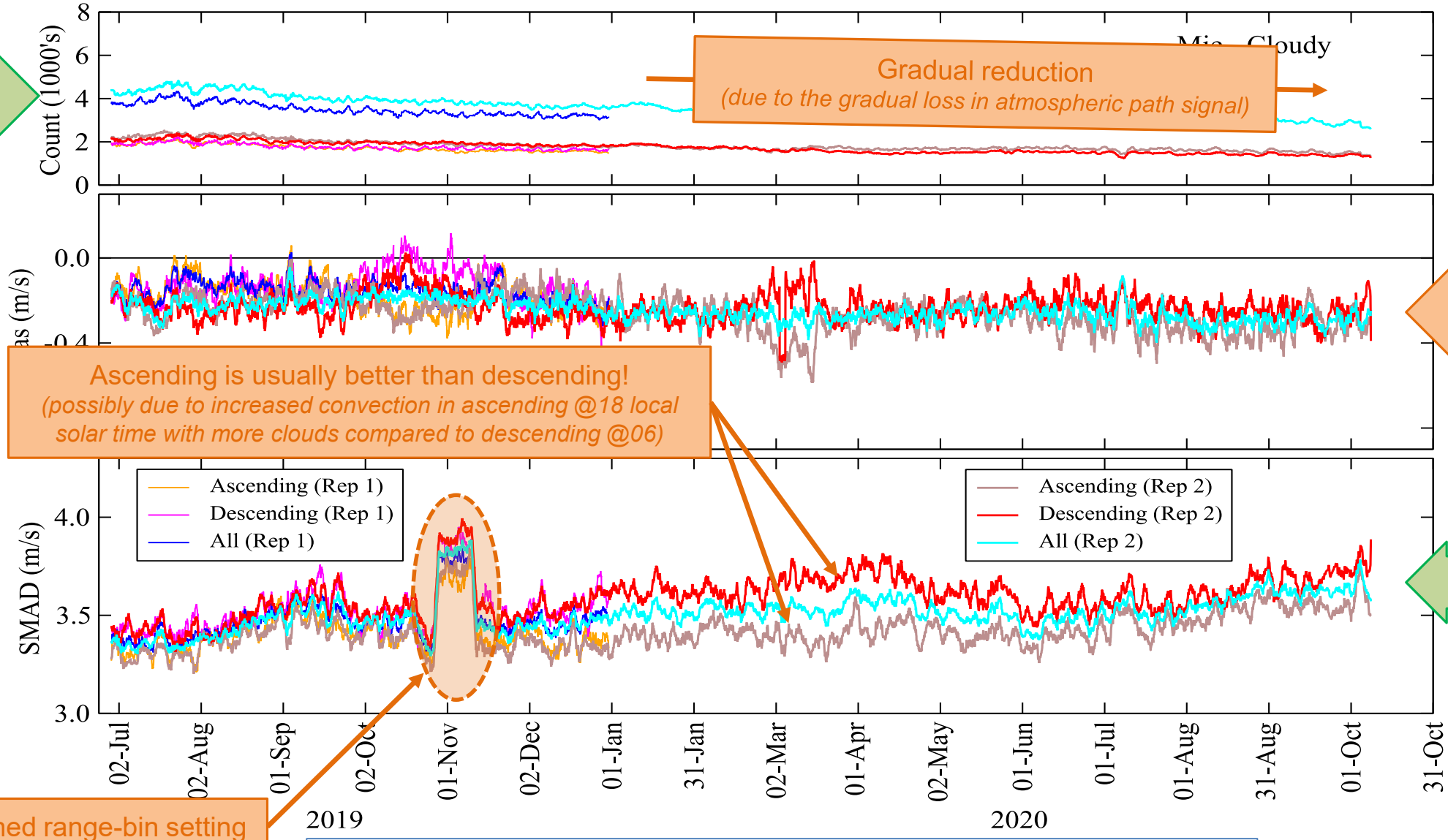
~ 1.0 ➔ good



Bias: Mean of the difference.
SDD: Standard deviation of the difference.
SMAD: Scaled (i.e. multiplied by 1.4826) median absolute difference.

Wobbly bias variation (will be corrected in next reprocessings)

Time series of number, bias and SMAD of Mie-cloudy wind wrt IFS model



SMAD = scaled median absolute difference = 1.48 MAD

Summary – **Mie Cloudy** (1/2)

- Number of valid Mie cloudy wind observations in the second reprocessing (Rep 2) is slightly higher than that of first reprocessing (Rep 1). The number of Mie cloudy observations shows mild gradual decline with time.
- Rep 2 wind bias with respect to model is small and very close to that of Rep 1 (in 2019). The bias, which is about 0.25 m/s, is constant with time. Slightly higher biases can be seen over Antarctica and mountains.
- Rep 2 wind random differences (SMAD and SDD) are very close to those of Rep 1 in 2019. (SDD is not shown). SMAD is ~3.5 m/s while SDD is ~4.0 m/s. SMAD (and SDD) show mild increase with time.
- Observations from ascending orbits show lower SMAD (and SDD) compared to those from descending orbits. The difference gets higher between months of December and May.
- Slightly higher SDD (and SMAD) values can be seen over mountains, ITCZ (Intertropical Convergence Zone) and the monsoon region!
- The difference between Mie cloudy and the model winds varies with wind speed in an irregular pattern. This issue was corrected after the reprocessing and will improve forthcoming reprocessing(s).

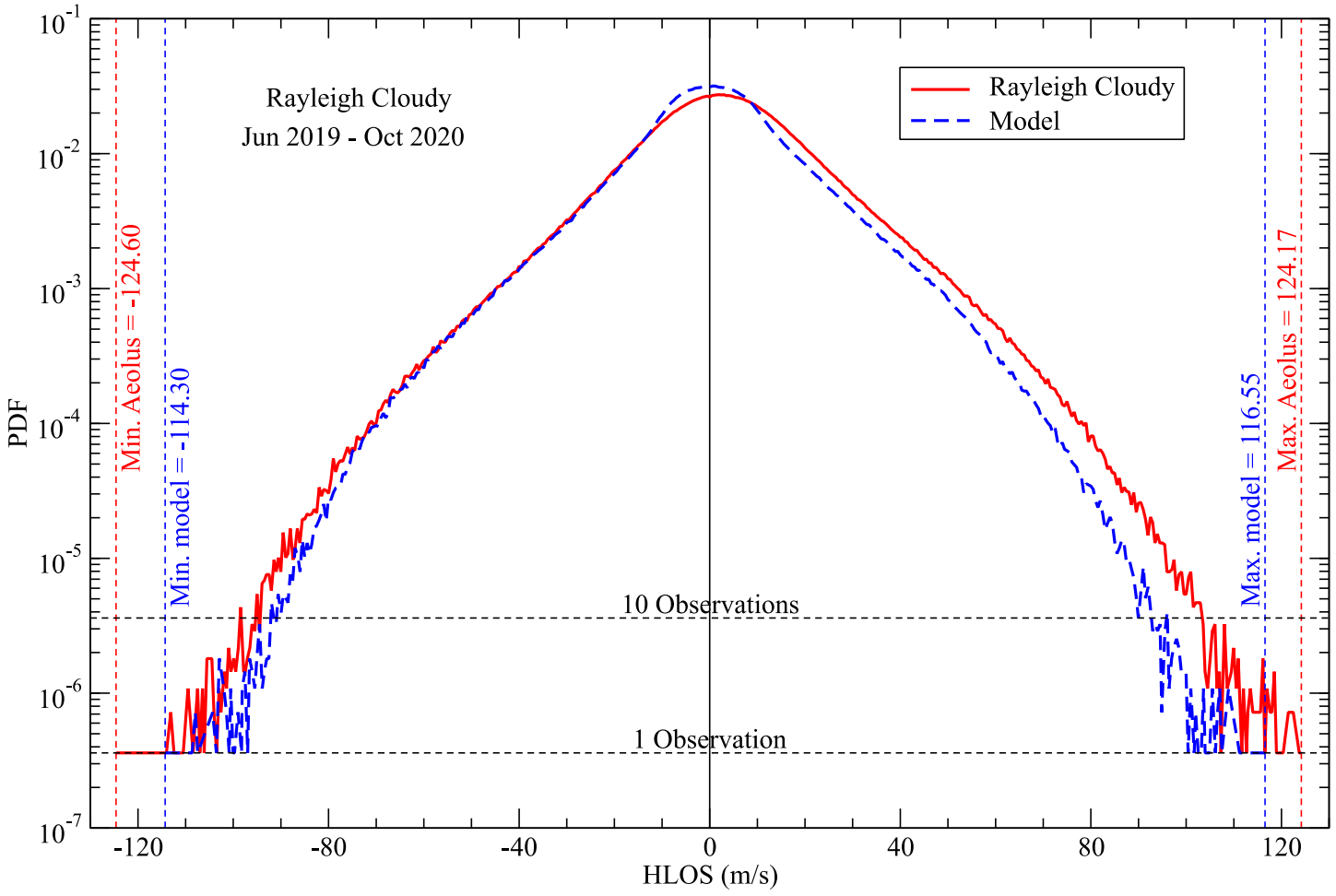
Summary – **Mie Cloudy** (2/2)

- The bias is almost independent of the altitude between altitudes 3 and 23 km.
- Random difference increases (~linearly) by altitude with two SMAD/SDD inversions: at altitudes of 16 & 21 km.

Rayleigh Cloudy

Histograms for Rayleigh cloudy & ECMWF model HLOS wind

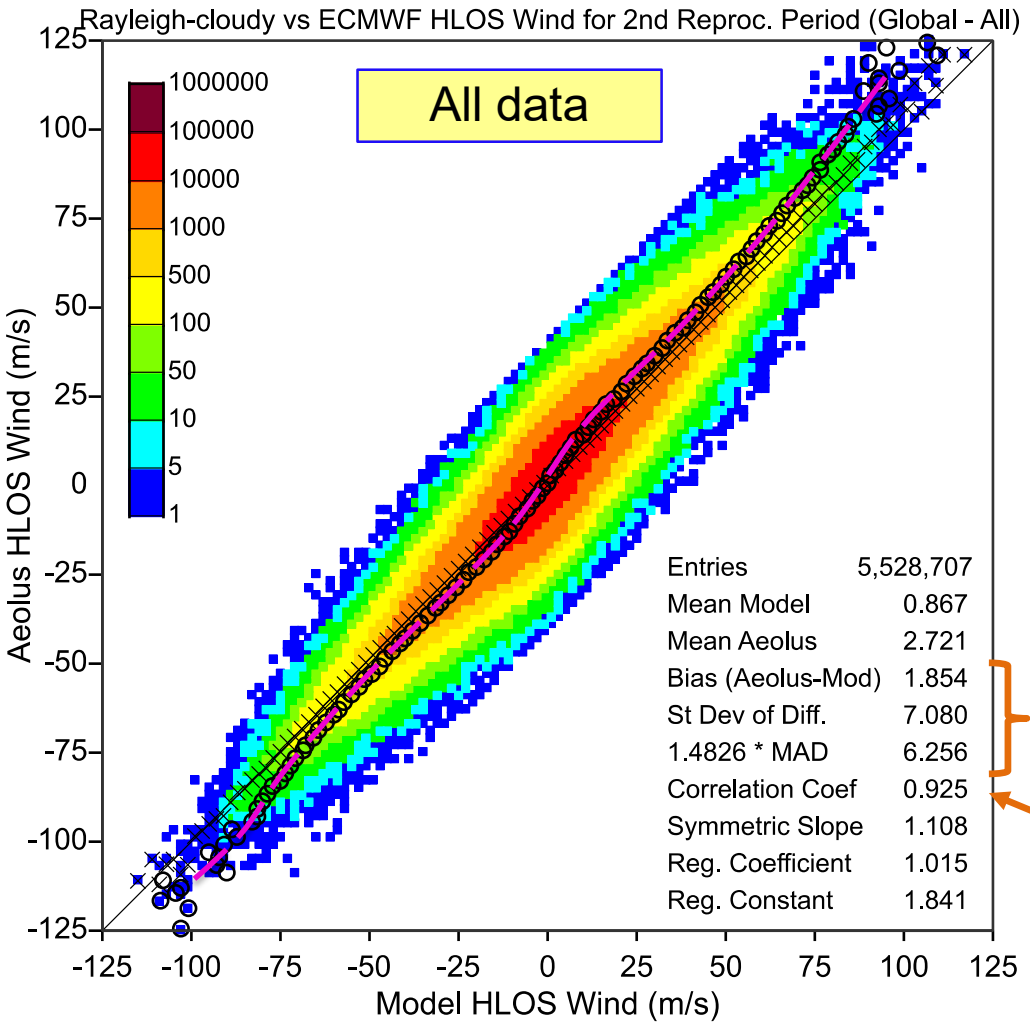
(full period: June 2019 – October 2020)

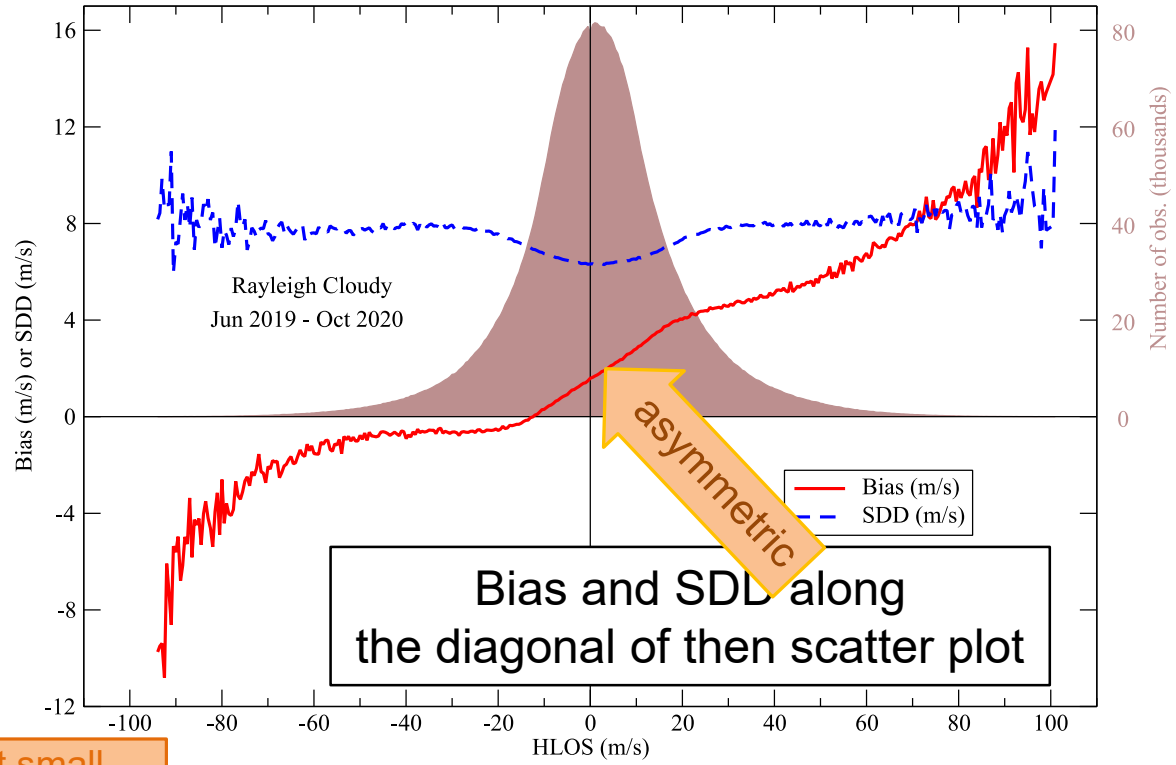


All data

Comparison between L2B Rayleigh cloudy & ECMWF model HLOS wind

(full period: June 2019 – October 2020)



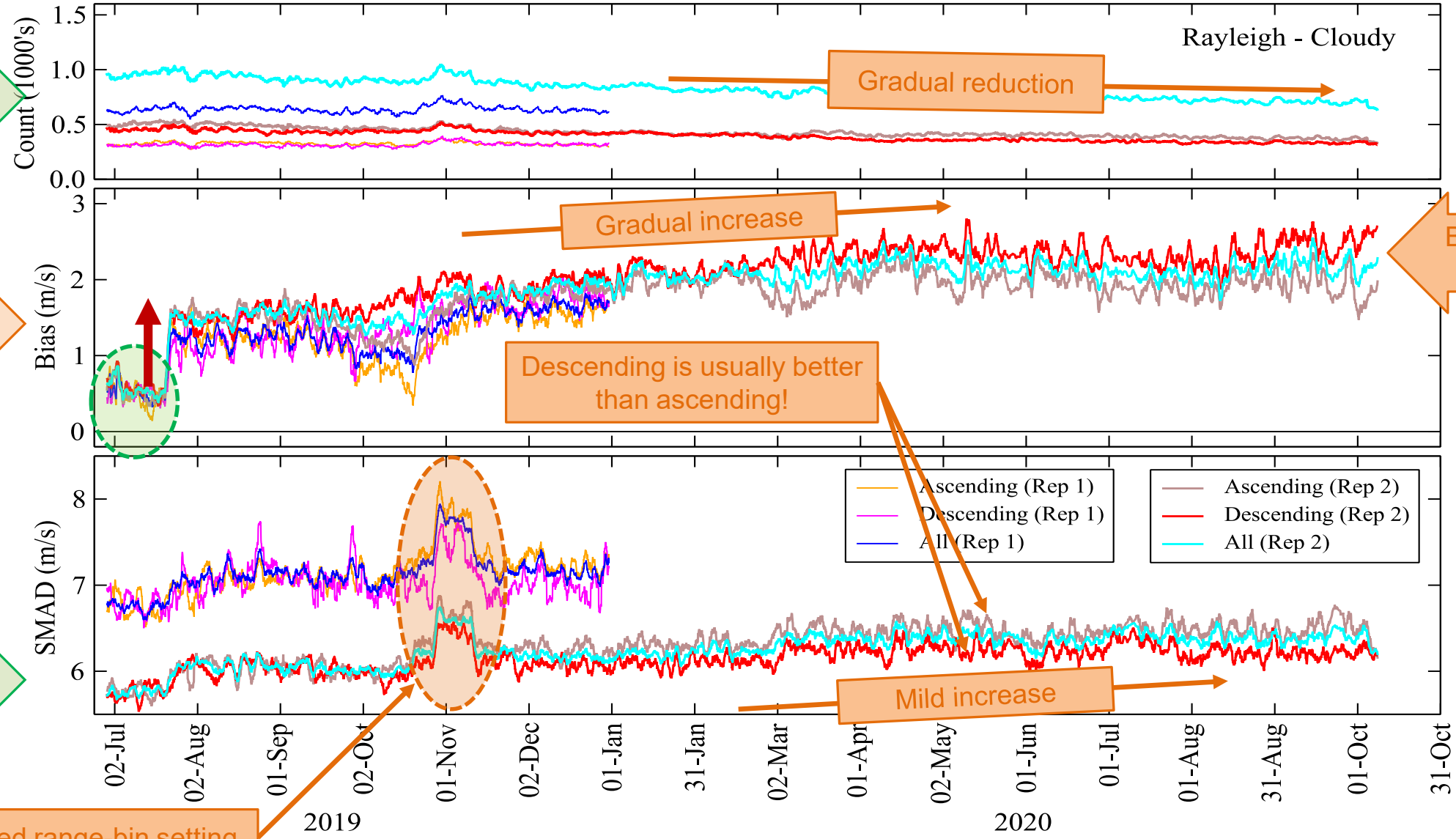


Not small ➔ ~ OK

~ 0.9 ➔ OK

Bias: Mean of the difference.
SDD: Standard deviation of the difference.
SMAD: Scaled (i.e. multiplied by 1.4826) median absolute difference.

Time series of number, bias and SMAD of Rayleigh-cloudy wind wrt model



~50% more obs. in Rep 2

Rep 2 bias > Rep 1

Rep 2 SMAD < Rep 1

Bias ~ 2 m/s ➔ OK

Special refined range-bin setting

SMAD = scaled median absolute difference = 1.48 MAD

Summary – **Rayleigh Cloudy** (1/2)

- Number of valid Rayleigh cloudy wind observations in the second reprocessing (Rep 2) is about 50% higher than that of first reprocessing (Rep 1). The number of Rayleigh cloudy observations shows mild gradual decline with time.
- Rep 2 wind bias with respect to the model, which shows an average overestimation of ~1.8 m/s, is slightly higher than that of the Rep 1 (for 2019). The bias during the first 4 weeks of FM-B (late Jun. to late Jul. 2019) is small (~ 0.5 m/s) for both reprocessing data.
- Rep 2 wind bias with respect to model increased during 2019 and then stabilized afterwards. Lower biases can be seen over Antarctica.
- Although, Rep 2 wind random differences (SMAD and SDD) are lower than those of Rep 1 by about 1 m/s, they are still relatively high. SMAD is slightly above 6 m/s while SDD is slightly above 7 m/s. SMAD (and SDD) show very mild increasing trend with time.
- Observations from descending orbits show lower SMAD (and SDD) compared to those from ascending orbits (opposite of Mie cloudy). The difference keeps increasing slowly by time.
- Slightly higher SDD (and SMAD) values can be seen over continents, ITCZ and monsoon region!

Summary – **Rayleigh Cloudy** (2/2)

- The distribution of Rayleigh cloudy versus model winds follows an S-shape with high biases at higher wind values. This behaviour is most obvious in the Tropics. It seems that this is a model issue.
- The bias is almost independent of the altitude between altitudes 3 and 23 km.
- Random difference increases (~linearly) by altitude with at least 4 SMAD/SDD inversions: at altitudes 9, 13, 18.5 & 21 km.

Conclusions

Conclusions

- Second reprocessing, which is based on baseline 11 (B11), provides Level 1 and 2 (L1A, L1B, L2A and L2B) data products as well as all corresponding auxiliary files from 24 June 2019 to 9 October 2020 ➔ a homogenous high quality and low-biased data product from 24 June 2019 (start of the second reprocessing) till 26 May 2021 (the date when B11 was replaced by B12 in the NRT processing).
- Number of valid L2B wind observations is higher than that of first reprocessing and NRT.
- Improved quality (lower bias, lower random error, higher correlation wrt model).
- **As expected, there is still room for improvement for forthcoming reprocessings.**

- **The second reprocessing introduces further improvements to Aeolus L2B wind products (on top of those introduced through the first processing).**