Validation of Aeolus wind measurements on Cape Verde using radiosondes

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Radiosonde schedule and launches at Sal airport

Launches: Daily 12 UTC + Aeolus overpasses

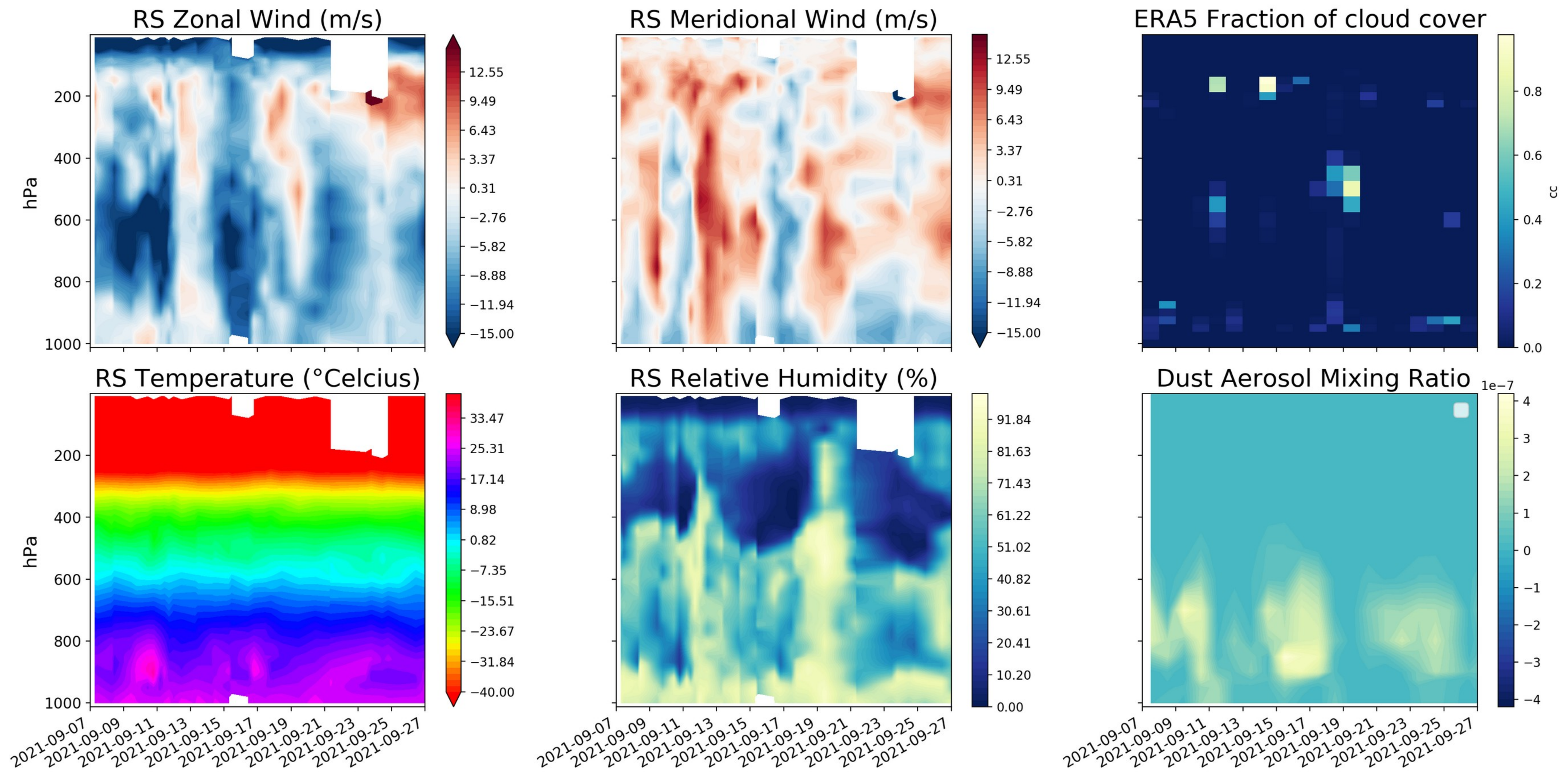
Period: 04 to 30 September 2021

All data were ingested in the Global Telecommunication System (GTS)

Day of week	Orbit node	Distance to Sal	Number of profiles
Tuesday	Descending	0 km	4
Thursday	Ascending	120 km	3
Friday	Ascending	220 km	3

Radiosonde measurements: time series

Time series over 37 measurements from 2021-09-07 to 2021-09-27



- Three dust events crossed Sal Island (visible in T and RH profiles) associated with a stronger African Easterly Jet (AEJ)
- Passages of several Tropical Disturbances, African Easterly waves, Tropical Cyclones (visible from meridional wind profiles)

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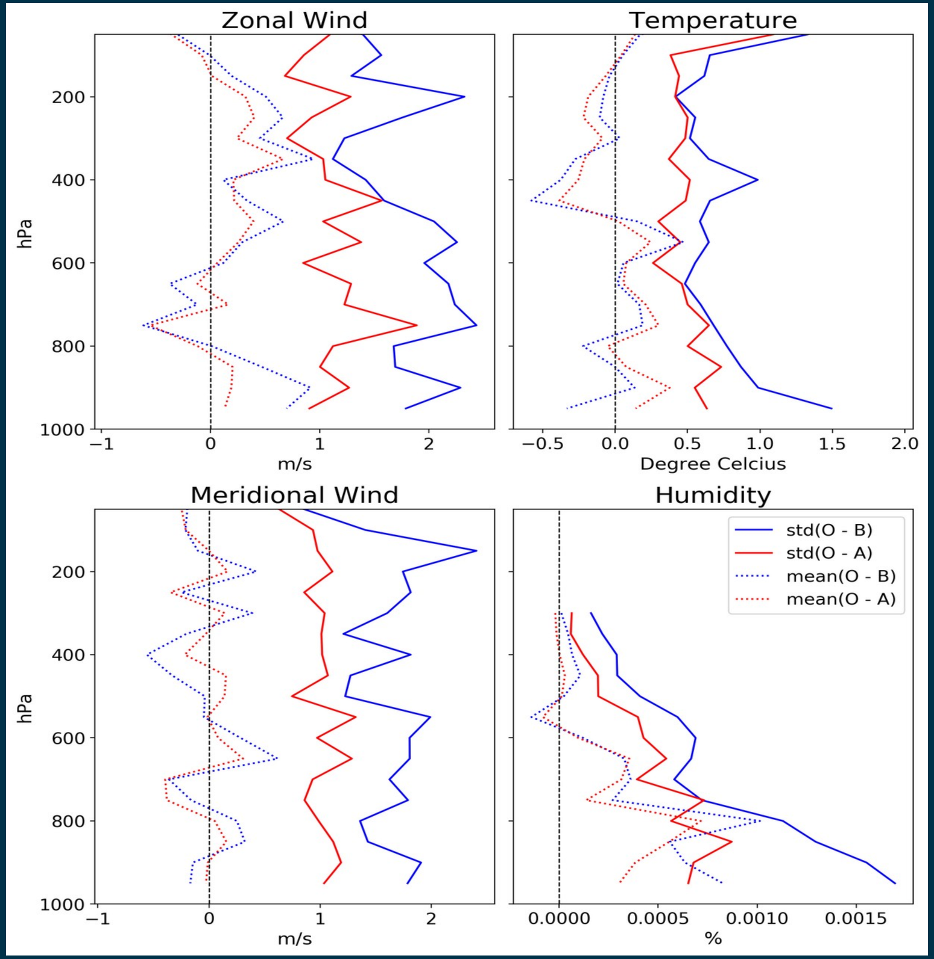
Radiosonde measurements: ECMWF statistics

Average over 20 measurements performed at 12 UTC from 2021-09-07 to 2021-09-27



- Improvement in the standard deviation in the analysis (as expected)
- Overall improvement in bias
- Model bias for humidity in lower troposphere (possibly due to dust events)

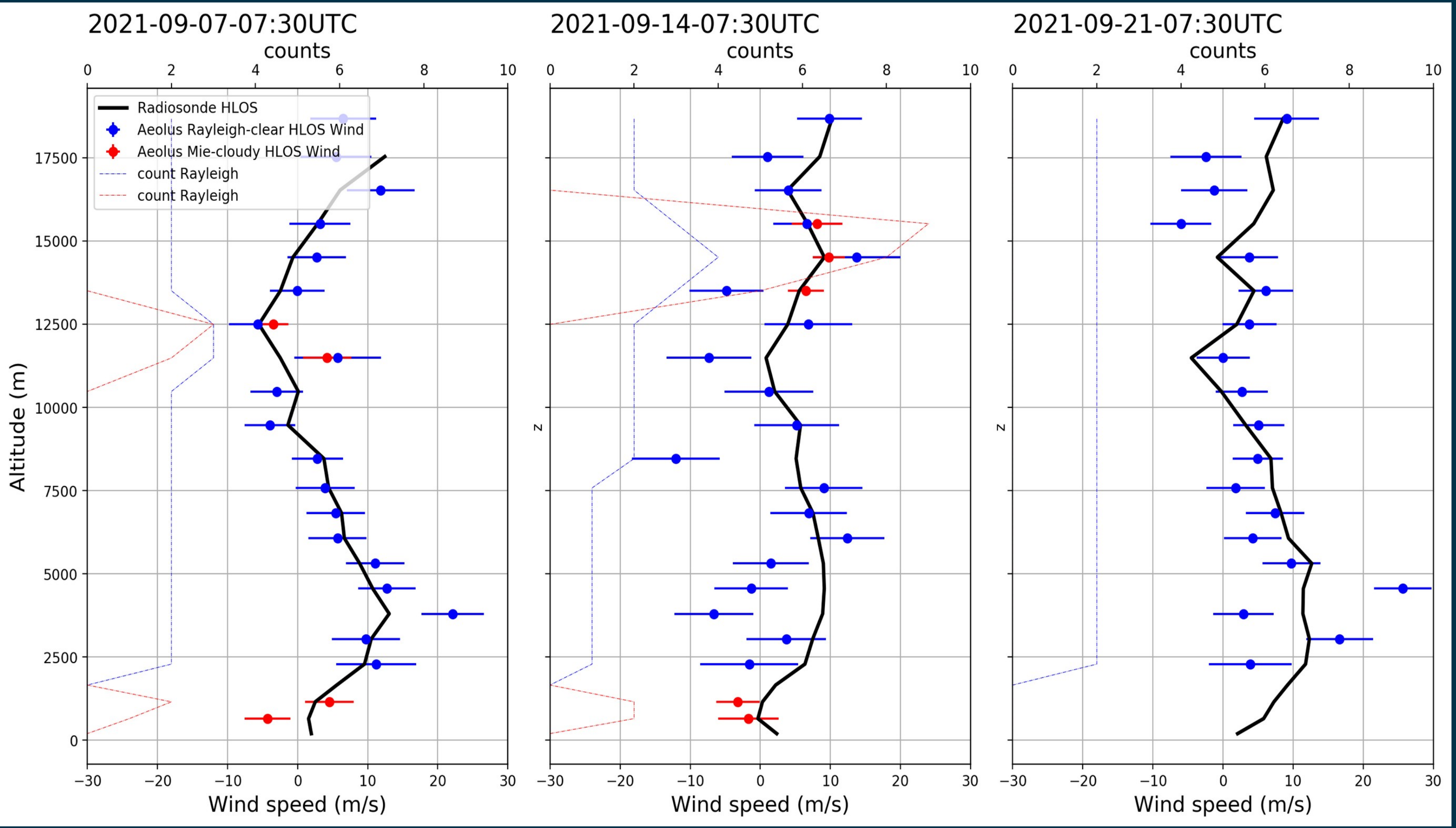
Aeolus validation using radiosondes

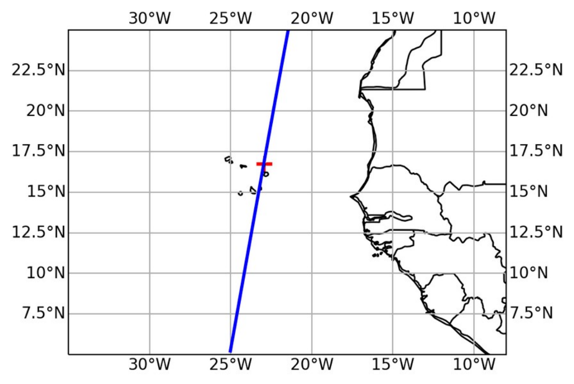
- Collocation criteria
  - From 120 to 220km distance to Aeolus track
  - Projection along Horizontal Line of Sight
  - Average over 24 Range Bin settings (RBS)

- Error thresholds (used at ECMWF):
  - Mie-cloudy: 5 m/s
  - Rayleigh-clear:
    - Above 200 hPa : 12 m/s
    - Below 200 hPa : 8.6 m/s

- Mission requirement:
  - Bias: 0.7 m/s
  - Precision
    - PBL: 1 m/s
    - Free Troposphere: 2.5 m/s
    - Lower stratosphere: 3 m/s

Aeolus Tuesday Descending orbit above Sal





Collocation criteria: 120 km around Radiosonde, average over 24 RB

Low Rayleigh-clear quality can be attributed to the decreasing atmospheric path signal and attenuation effects of clouds/aerosols.

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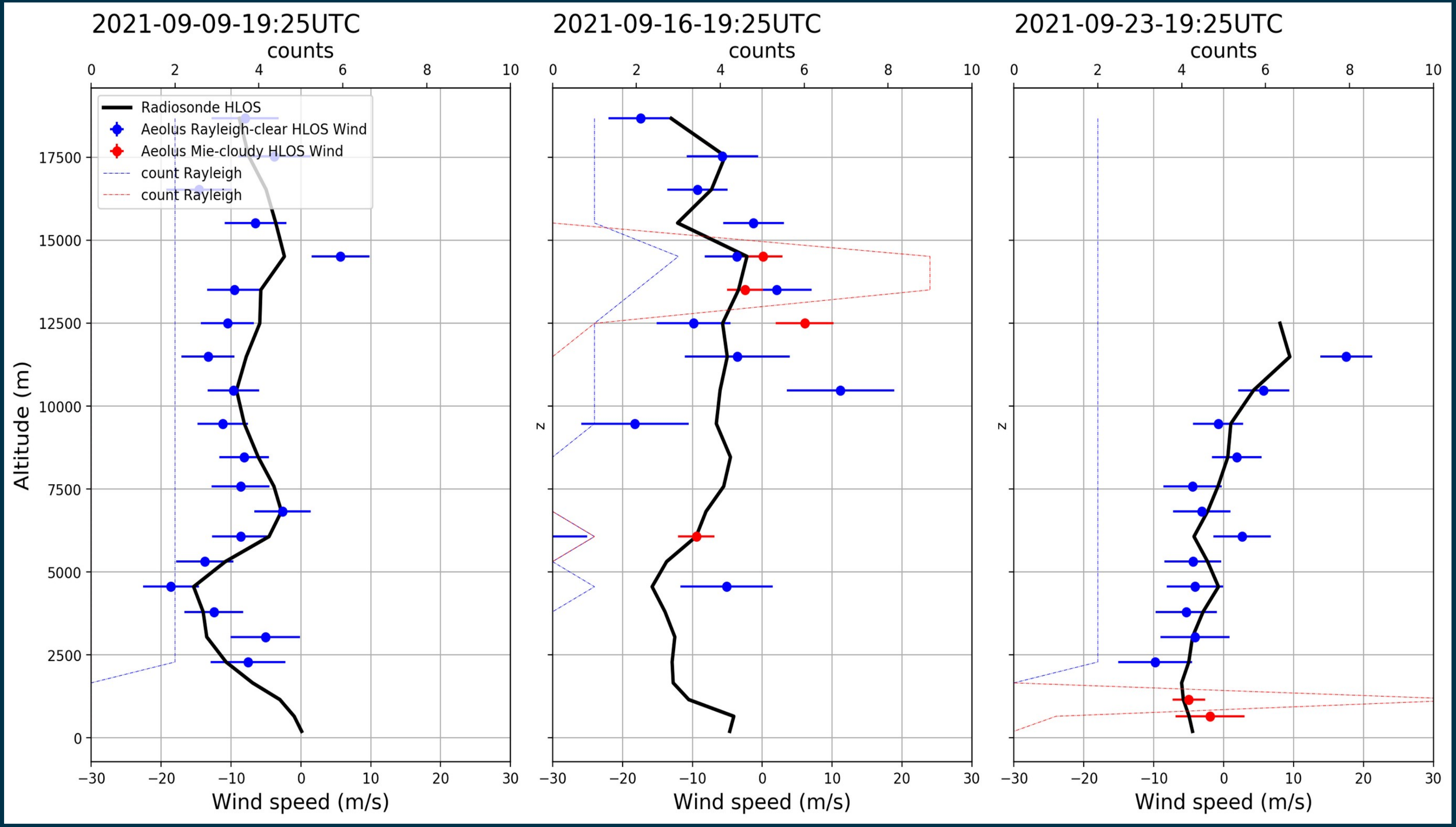
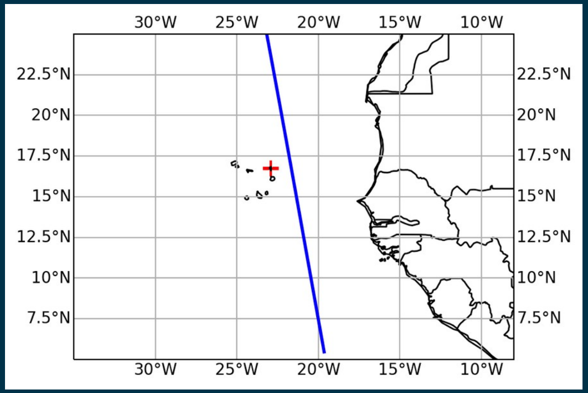
Aeolus Thursday Ascending orbit 120km from Sal

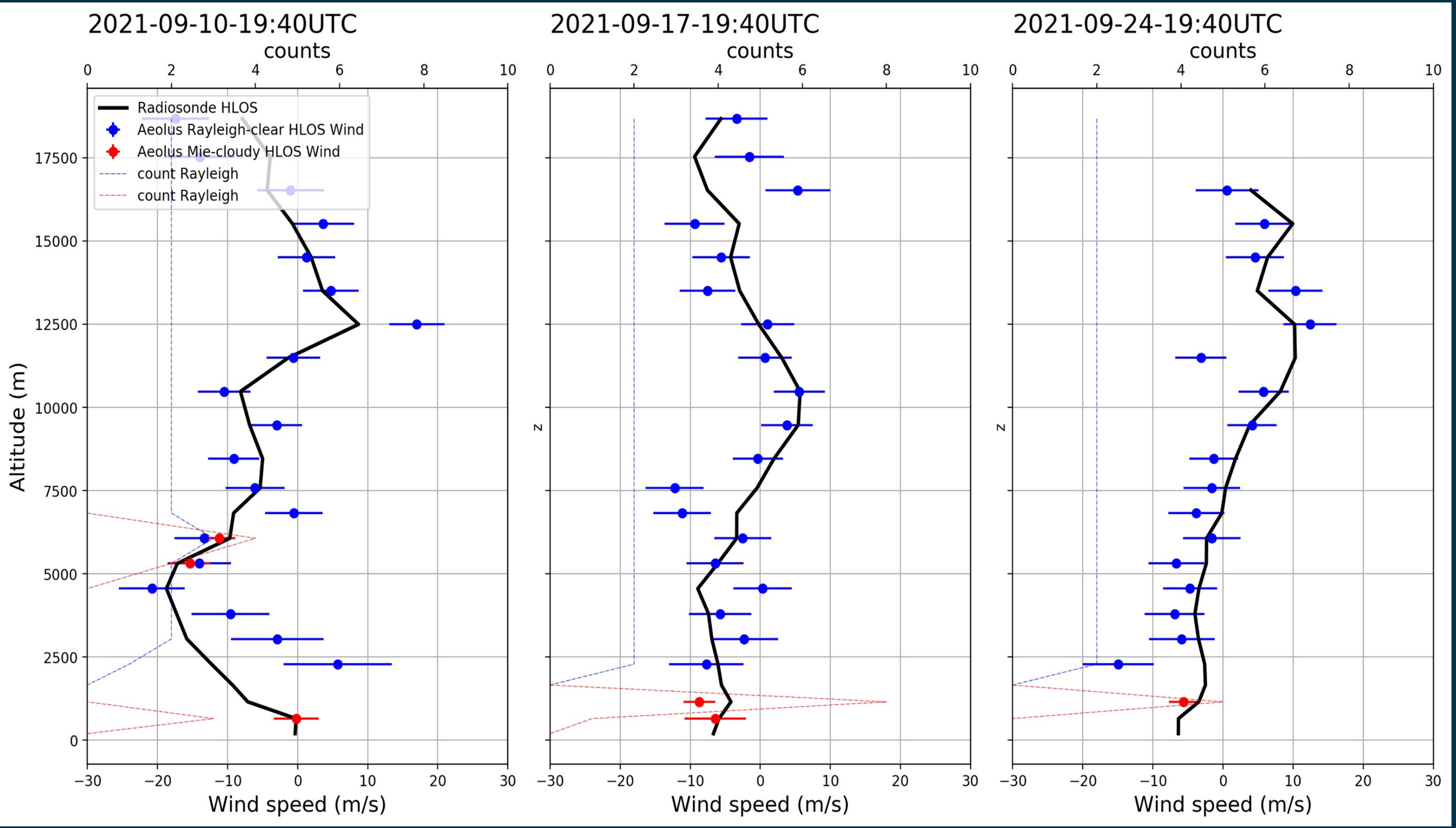


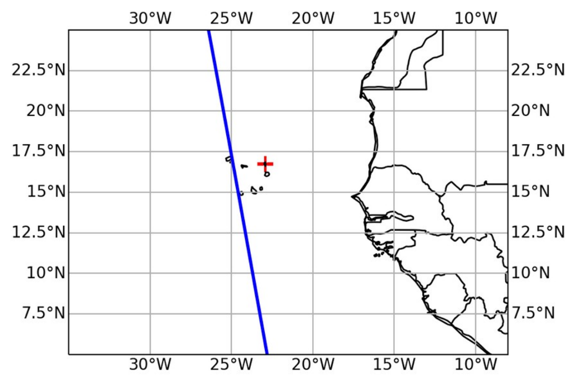


Collocation criteria: 160 km around Radiosonde, average over 24 RB

Low Rayleigh-clear quality can be attributed to the decreasing atmospheric path signal and attenuation effects of clouds/aerosols.

Aeolus Friday Ascending orbit 220km from Sal (Mindelo)

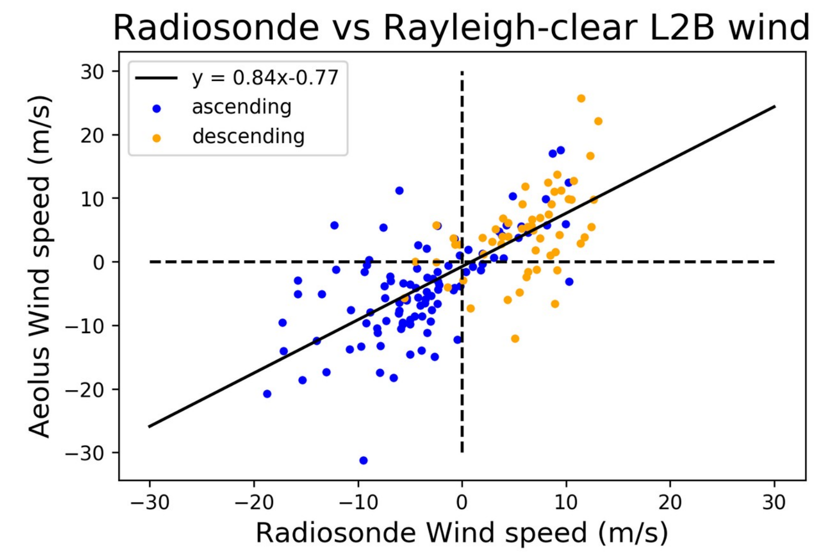


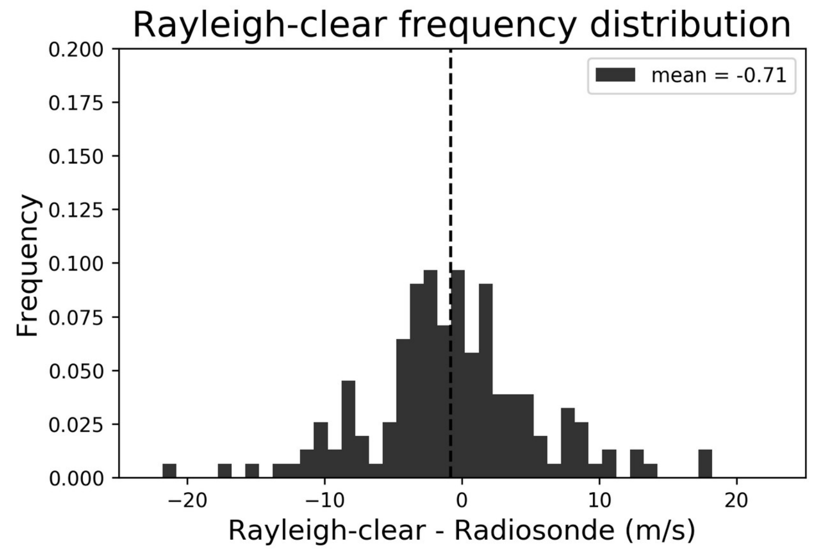


Collocation criteria: 220 km around Radiosonde, average over 24 RB

Low Rayleigh-clear quality can be attributed to the decreasing atmospheric path signal and attenuation effects of clouds/aerosols.

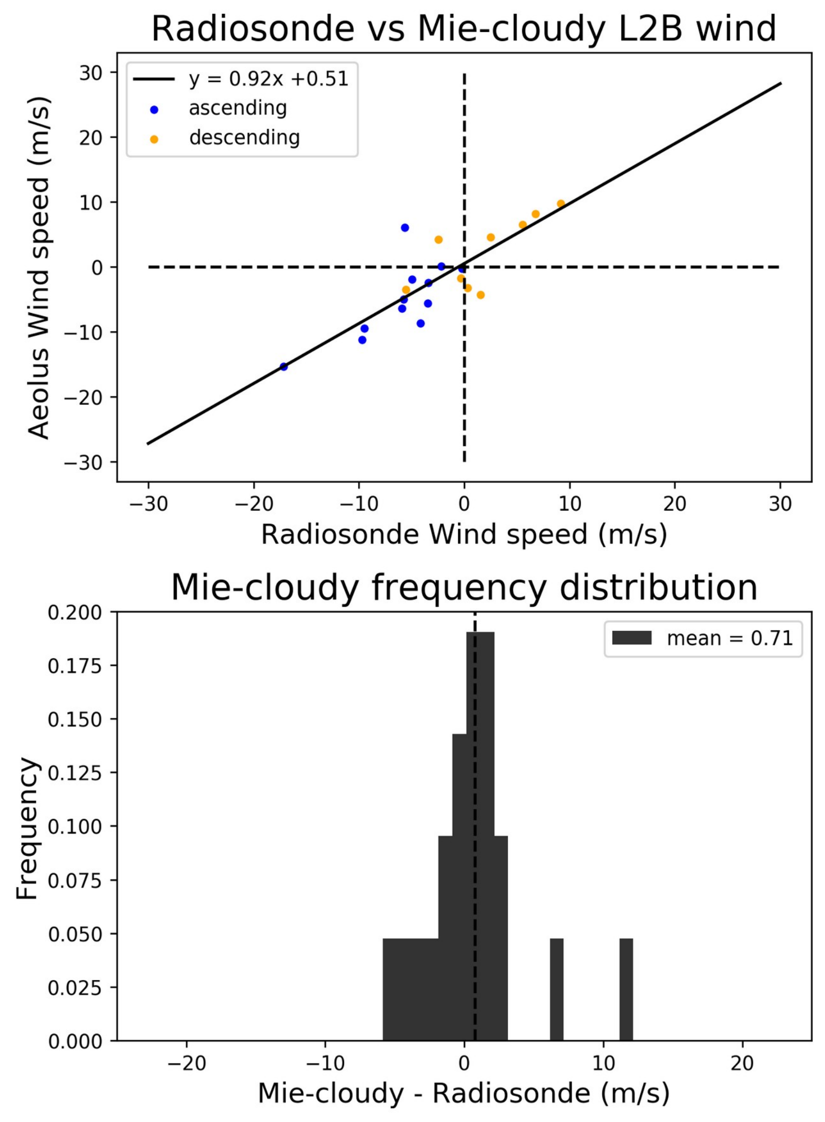
Rayleigh-clear error





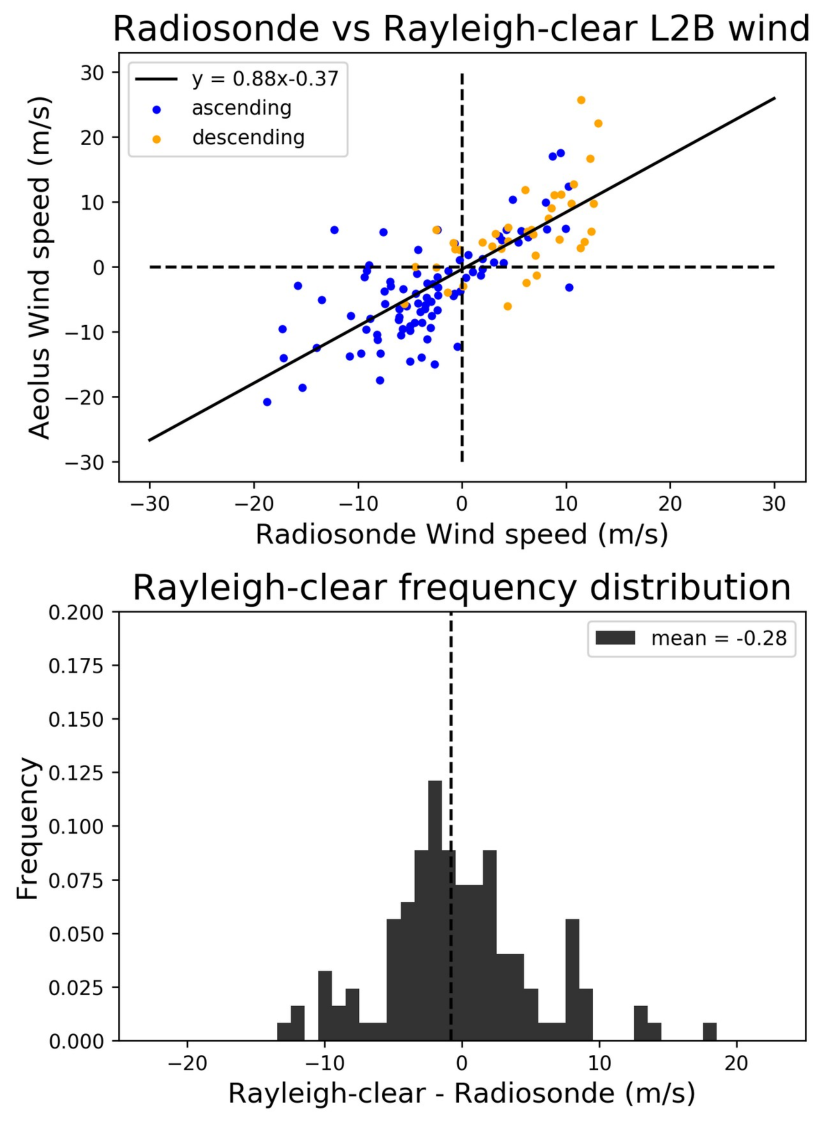
Wind type	Mean Bias	Median Bias	Regression Bias	Scaled MAD
Rayleigh-clear	-0.71	-0.82	-0.77	4.47

Mie-cloudy error



Wind type	Mean Bias	Median Bias	Regression Bias	Scaled MAD
Rayleigh-clear	-0.71	-0.82	-0.77	4.47
Mie-cloudy	0.71	0.78	0.51	1.91

Rayleigh-clear error (without "contamination")



Wind type	Mean Bias	Median Bias	Regression Bias	Scaled MAD
Rayleigh-clear	-0.71	-0.82	-0.77	4.47
Mie-cloudy	0.71	0.78	0.51	1.91
Rayleigh-clear clean	-0.28	-0.79	-0.37	4.18

Removing broken-cloud scene profiles improves the bias and random deviation

Conclusion

- JATAC: 37 Radiosondes were launched from Sal airport during September 2021. 9 Radiosonde-Aeolus comparisons (3 ascending and 6 descending)

- Radiosondes assimilated at ECMWF: Overall improvement in the standard deviation and bias in the analysis.

- Rayleigh-clear quality is related to the atmospheric cloud and dust conditions: can possibly be attributed to the decreasing atmospheric path signal and attenuation effects of clouds/aerosols. Improving QC within broken-cloud scenes has potential to improve the quality of Aeolus data.

- Rayleigh winds have a bias of 0.71 m/s and a random deviation of 4.48 m/s (SMAD). Mie cloudy winds have a bias of 0.71 m/s and a random deviation of 1.9 m/s. Both Rayleigh and Mie channels meet the Aeolus mission requirements of a systematic error equal to 0.7 m/s, but the random errors are still higher than required.