Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat

aeolus
DISC

Aeolus – the first Doppler wind lidar in space – how well does it perform?

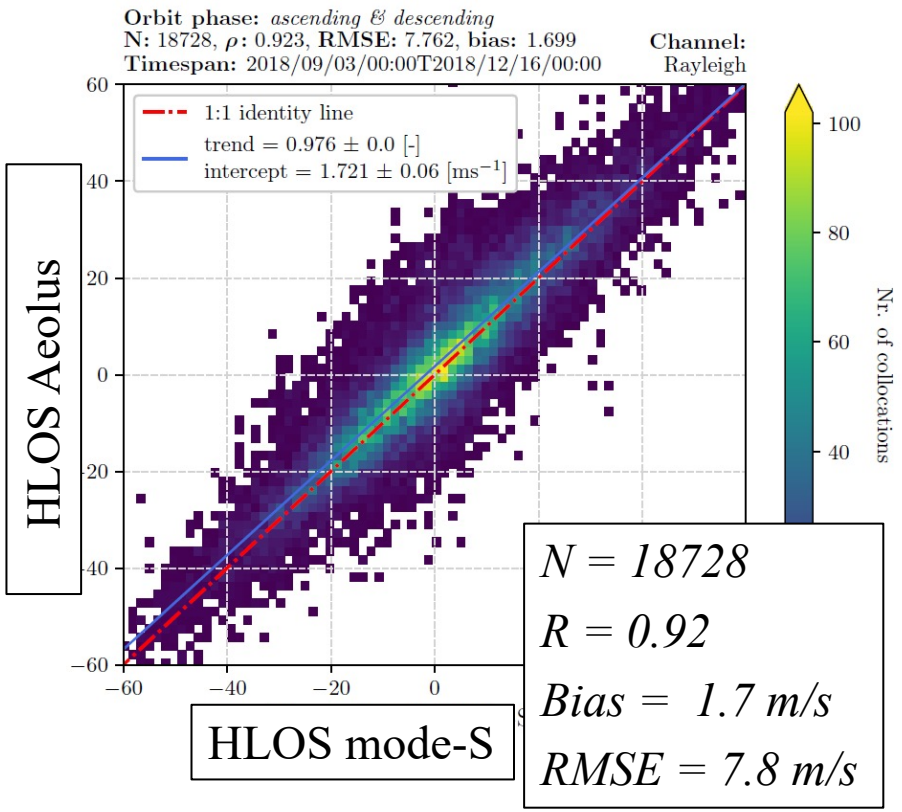
Gert-Jan Marseille
KNMI

Aeolus validation against Mode-S EHS aircraft derived winds period: 3 Sept. – 16 Dec. 2018

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat

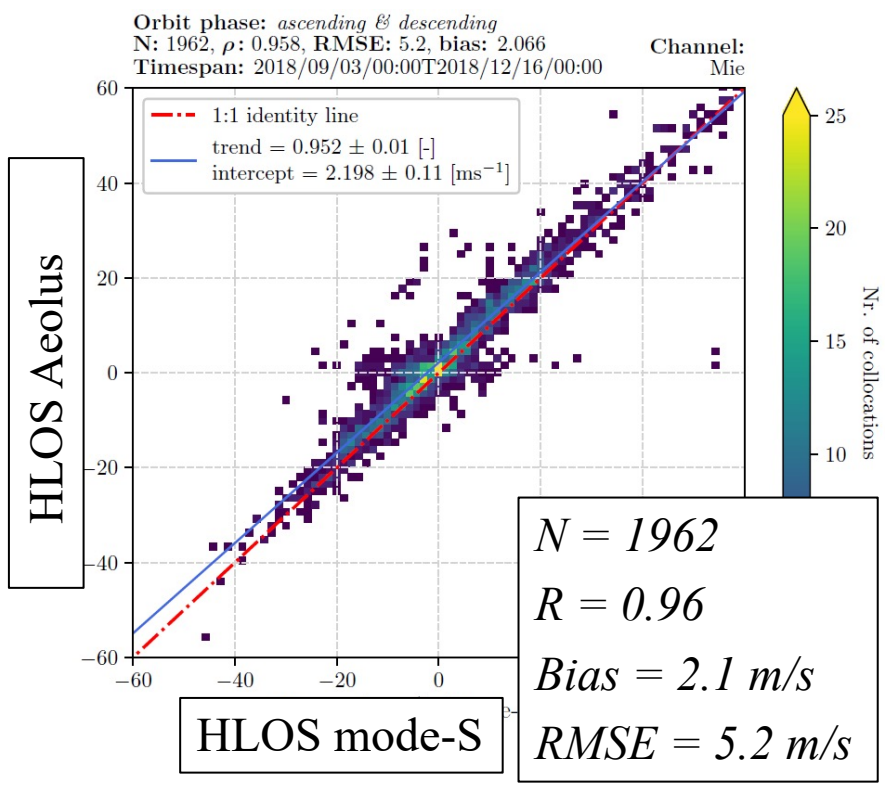
aeolus DISC

Rayleigh winds



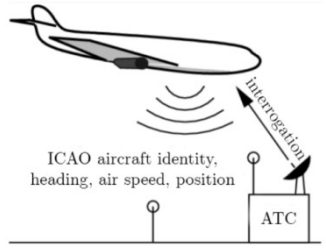
N = 18728
R = 0.92
Bias = 1.7 m/s
RMSE = 7.8 m/s

Mie winds

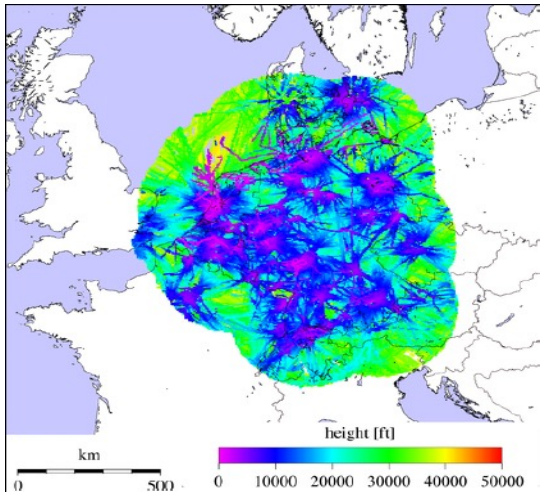


N = 1962
R = 0.96
Bias = 2.1 m/s
RMSE = 5.2 m/s

courtesy: Steven Albertema – master thesis



- contact with air traffic control every 4 seconds
- infer atmospheric wind and temperature
- spatial resolution ~ 1km
- wind quality ~ AMDAR



Work is currently continued at the Institute of Marine Sciences (ICM) – Barcelona – Spain!

~~*Aeolus – the first Doppler wind lidar in space – how well does it perform?*~~

Aeolus data quality in cloudy conditions

Gert-Jan Marseille

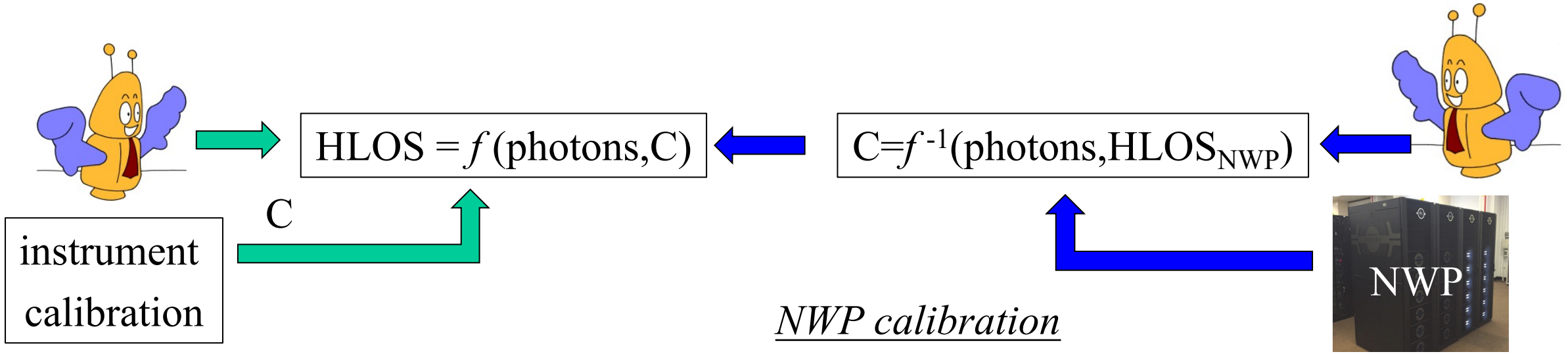
KNMI

NWP calibration

- Both Mie and Rayleigh winds show issues in cloudy conditions
- Most probably related to imperfect calibration strategies (and instrumental drift)

- Alternative approach: NWP calibration

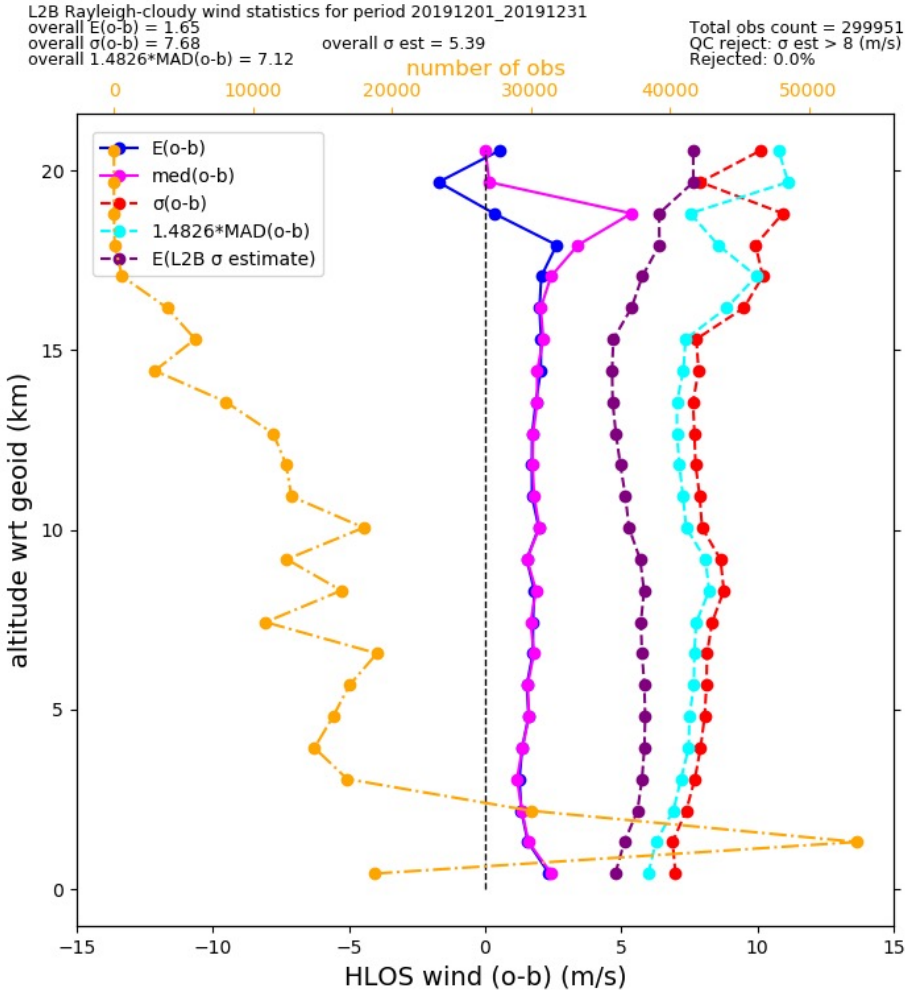
For each Aeolus observation there is an NWP representative!

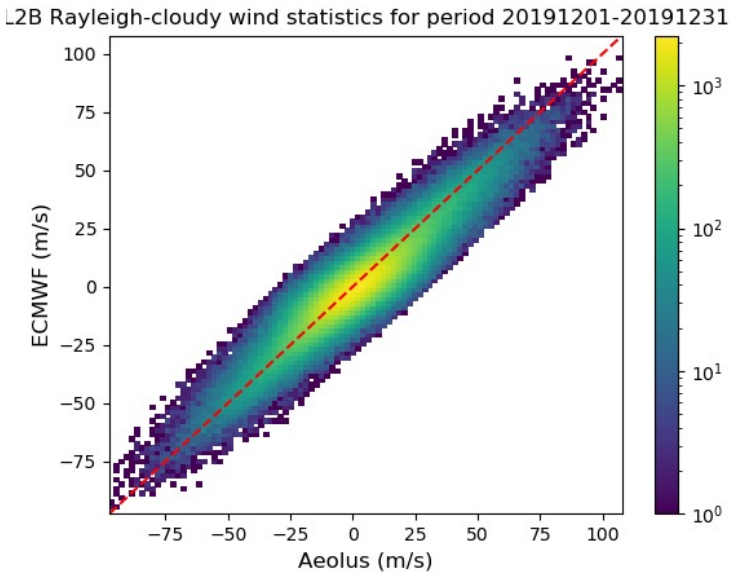


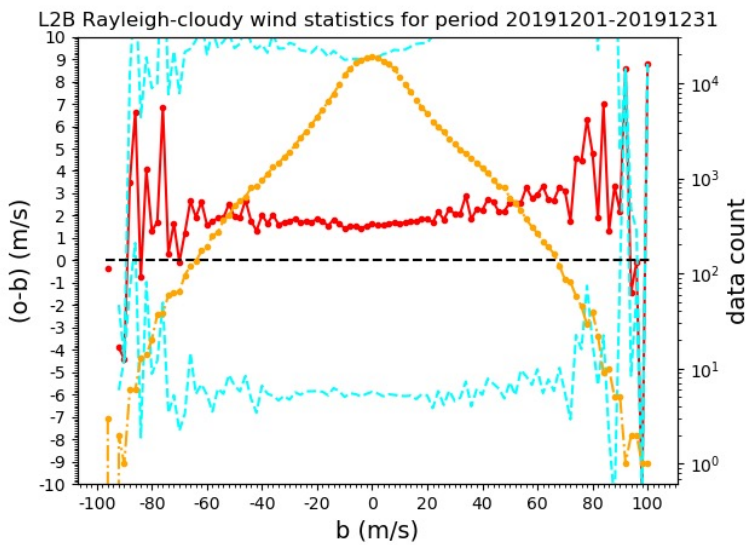
Rayleigh-cloudy winds – reprocessed data

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat

aeolus DISC







December 2019

0.3 million observ.

overall bias: 1.65 m/s

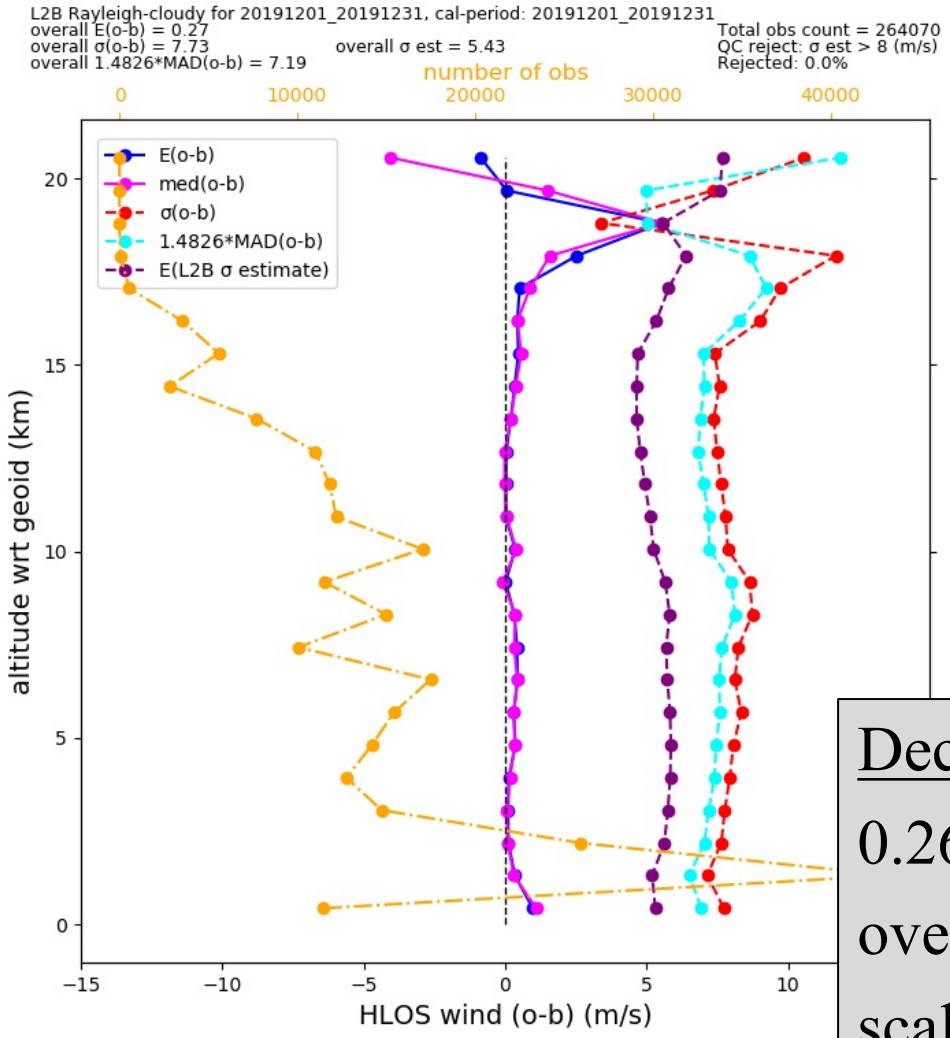
scaled MAD: 7.12 m/s

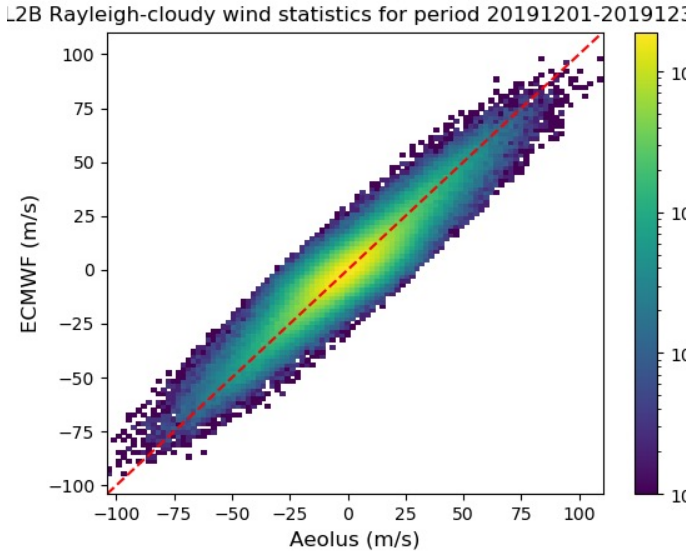
Not good enough for use in NWP!

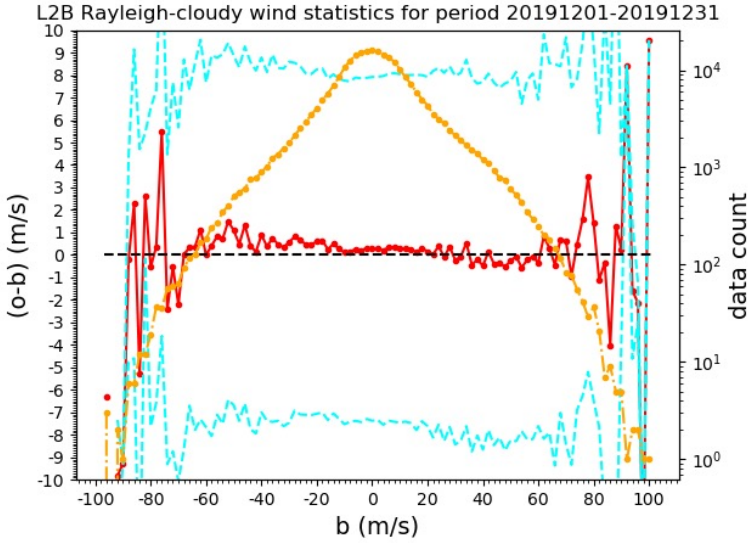
Rayleigh-cloudy – based on NWP calibration

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat

aeolus DISC







December 2019

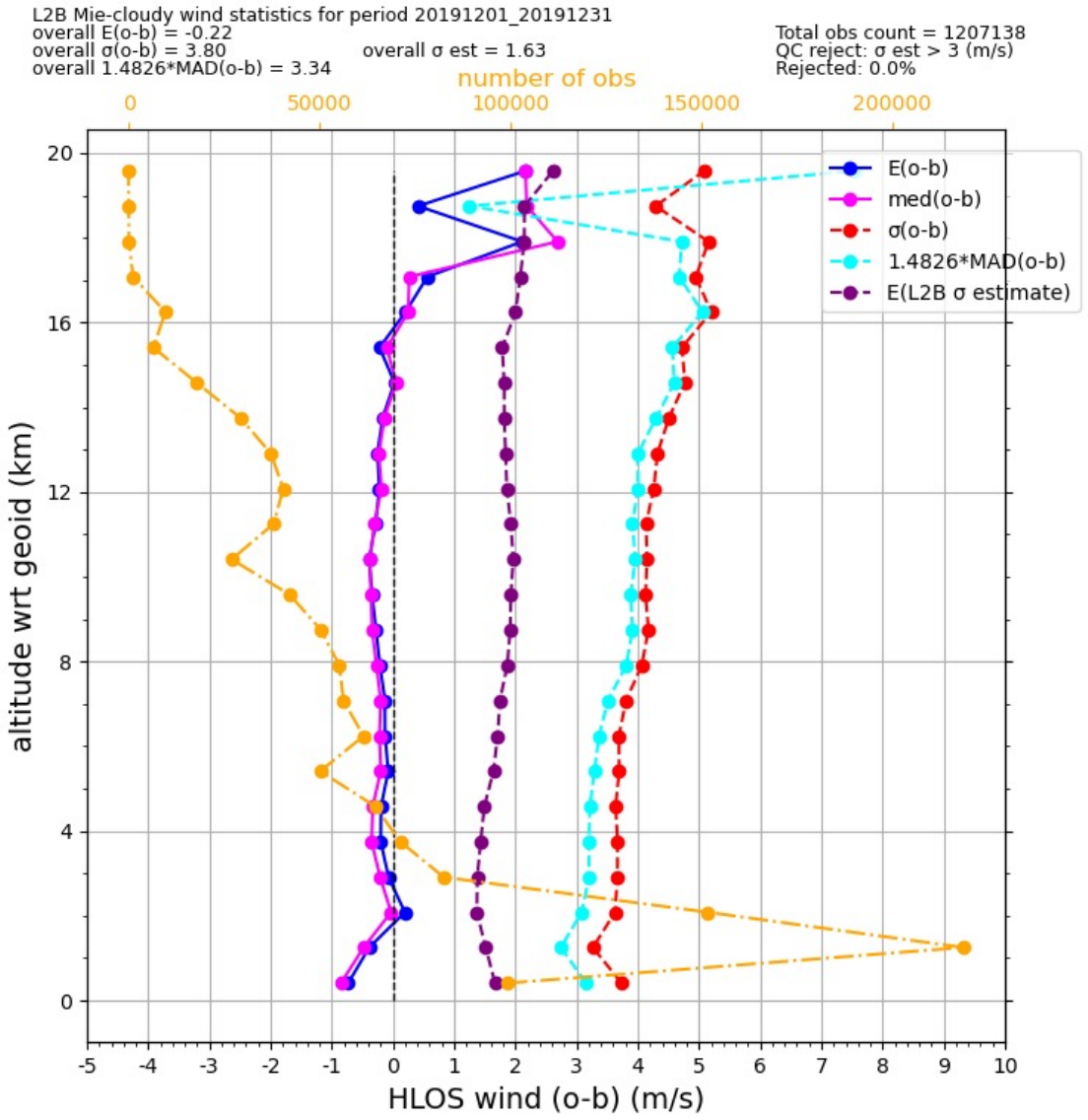
0.26 million observ.

overall bias: 0.27 m/s

scaled MAD: 7.19 m/s

- Bias reduced from 1.65 m/s to 0.27 m/s!
- No indication of wind speed dependent bias

Mie-cloudy winds



Reprocessed data

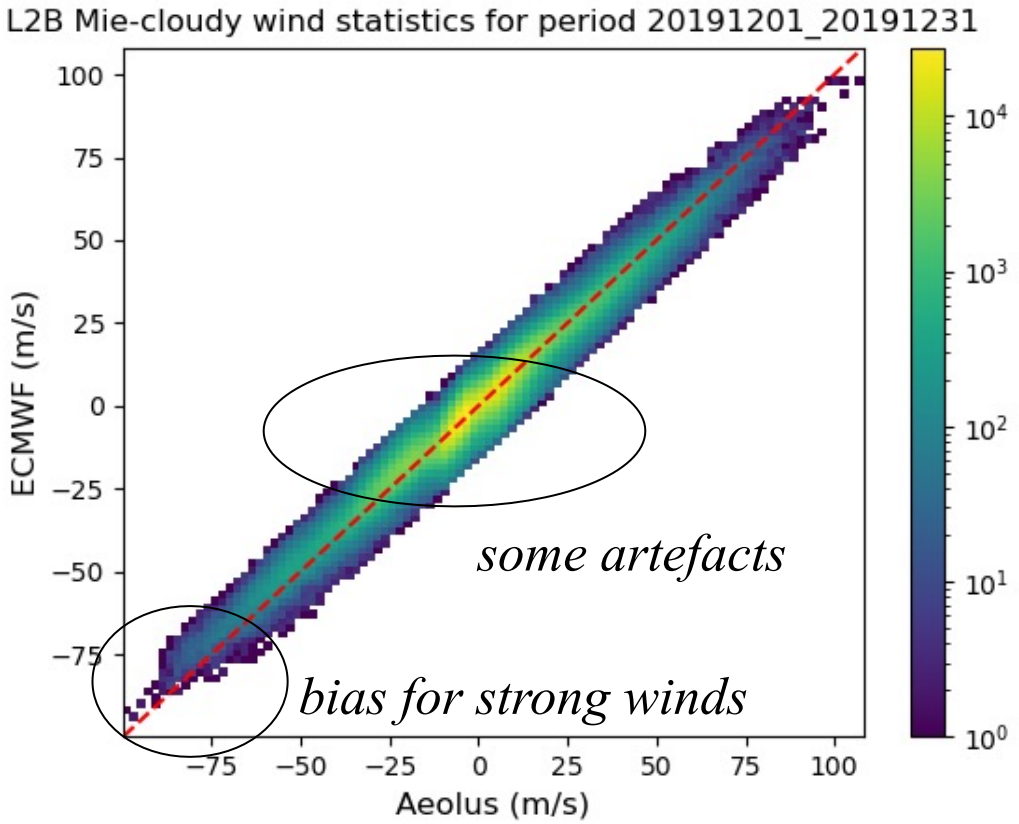
December 2019

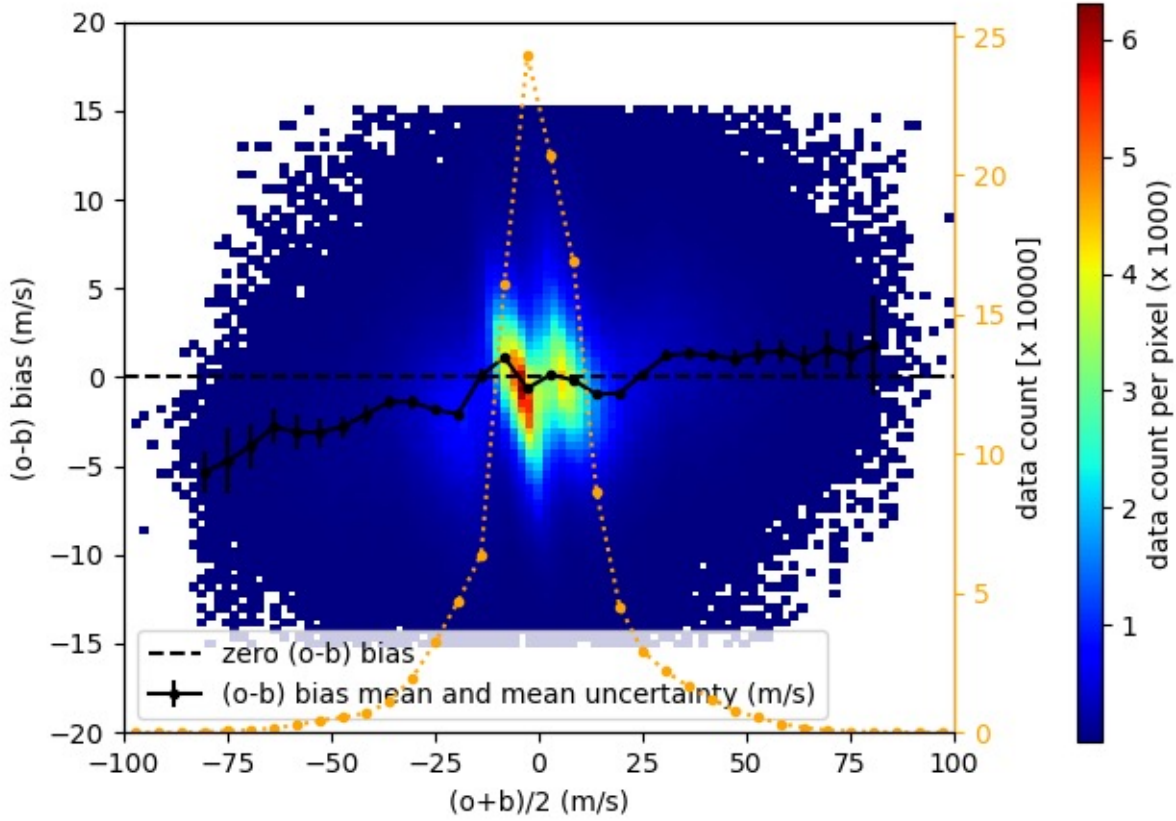
1.2 million observations

overall bias: -0.22 m/s

scaled MAD: 3.34 m/s

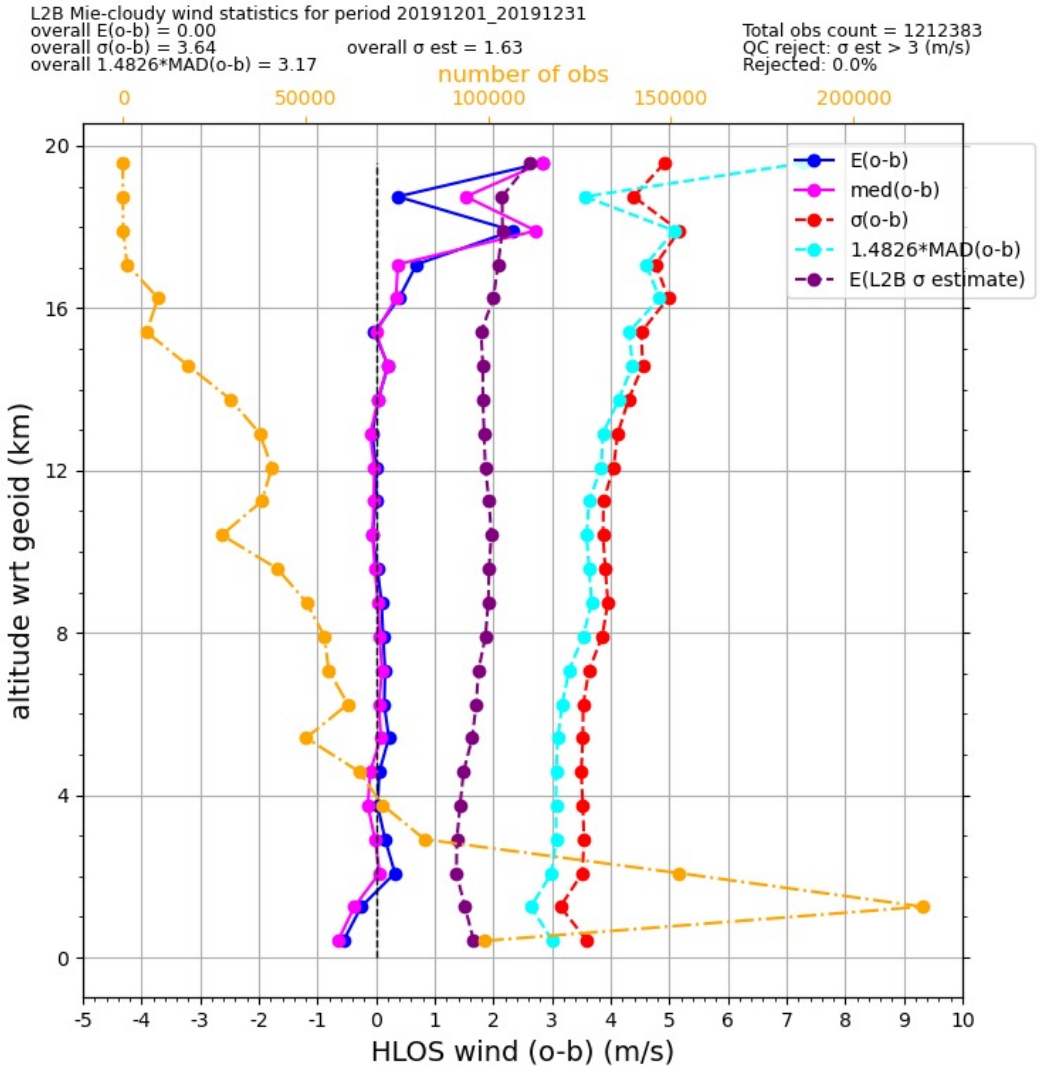
Mie-cloudy – reprocessed data (ctd.)





- Wind speed dependent bias
- Strong "wiggling" in wind speed dependent bias

Mie-cloudy based on spectral non-linear correction from NWP calibration



December 2019

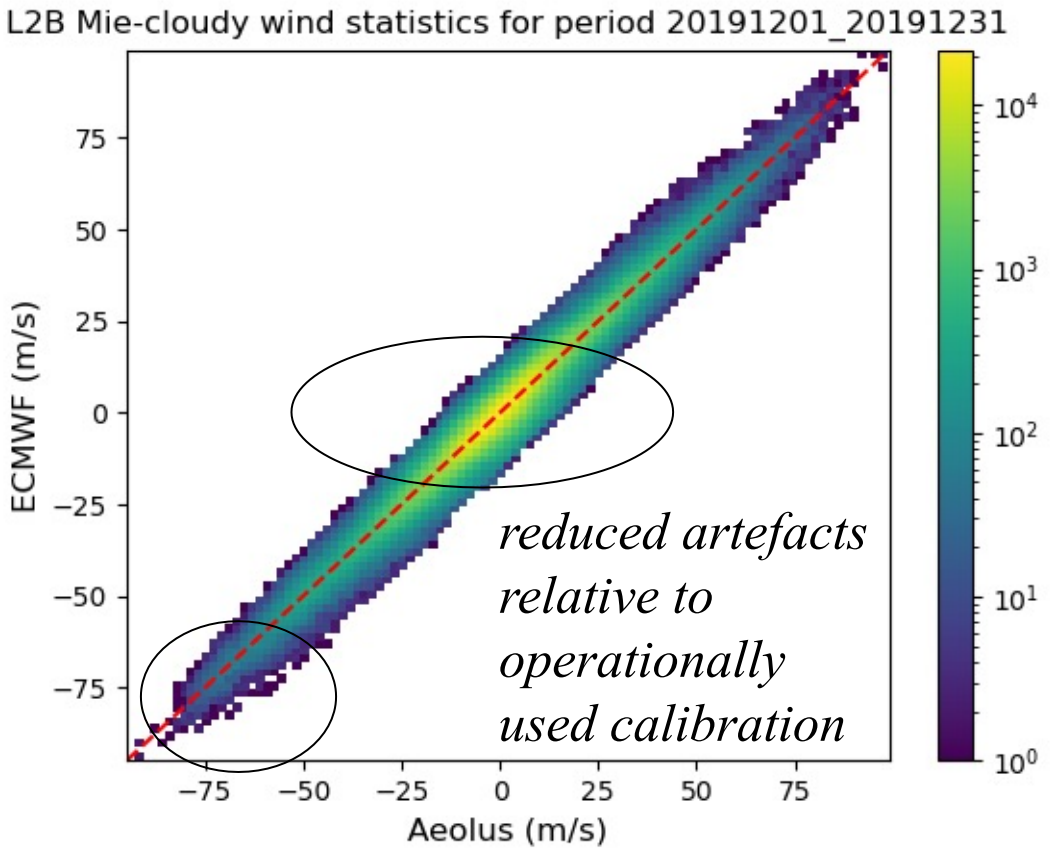
1.2 million observations

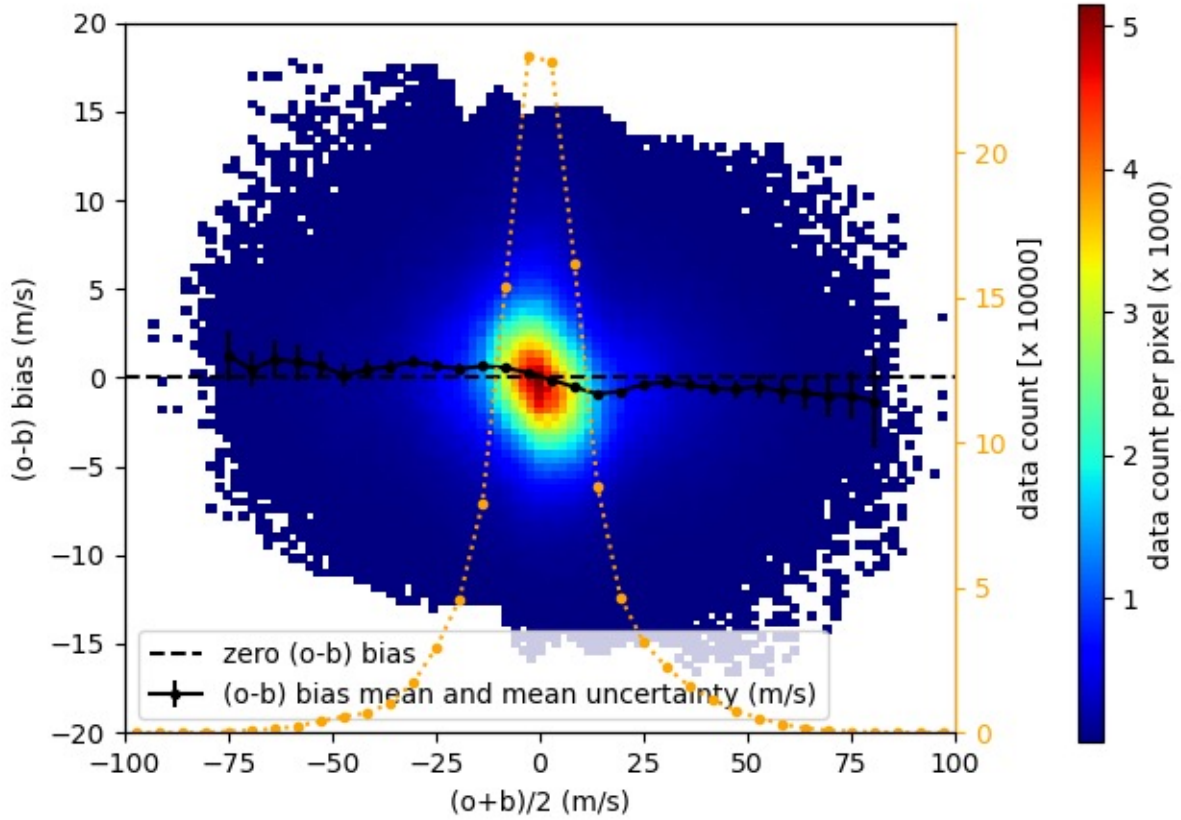
overall bias: 0.00 m/s

scaled MAD: 3.17 m/s

compare to -0.22 m/s bias and 3.34 m/s scaled MAD from operational settings

Mie-cloudy – based on NWP calibration





- Much reduced wind speed dependent bias
- Much reduced "wiggling" in wind speed dependent bias

Conclusions

- We have substantial biases in operational Rayleigh-cloudy and Mie-cloudy winds
- Without use of NWP we would not have good quality winds from Aeolus today, also not from the Rayleigh channel in clear (aerosol/cloud-free) conditions.

- NWP calibration gives good quality winds, in cloudy conditions too
  - Mie-cloudy and Rayleigh-cloudy winds sample the same atmosphere
  - Useful for assessing error characteristics of Mie and Rayleigh winds (height assignment)
  - Implementation in L2Bp scheduled for the next delivery
- High quality Aeolus winds in cloudy conditions are useful for NWP and comparison with AMV
  - Study height assignment errors