Validation of Aeolus wind profiles over a tropical location using 205 MHz wind profiler radar

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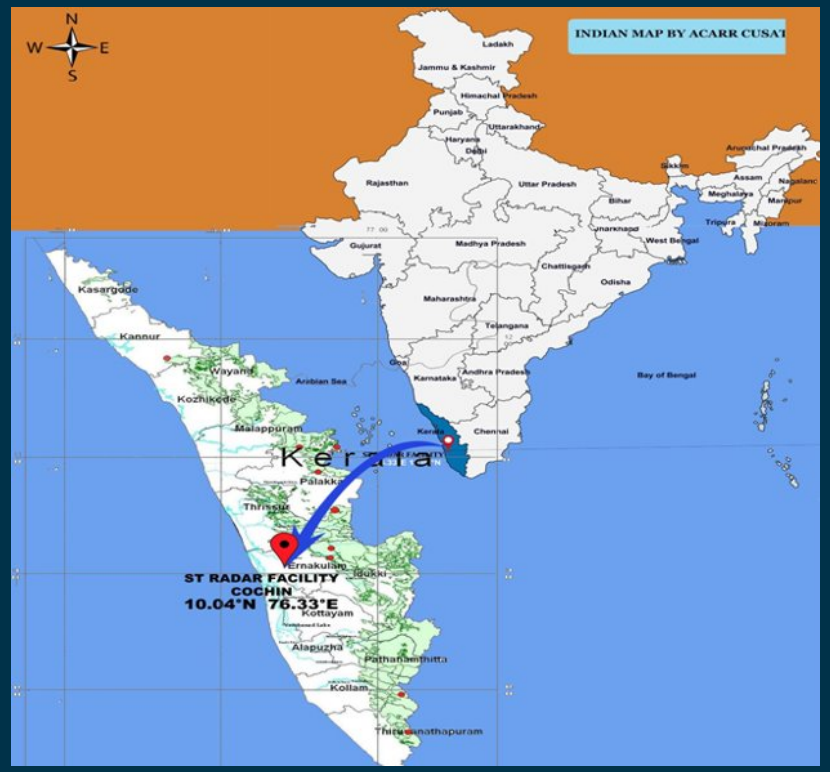
Objectives

- To asses the accuracy of Aeolus wind profiles over a tropical location (10° N ; 76° E) using 205 MHz wind profiler radar
- Determine Aeolus wind bias as function of height (1-18 km), seasons and observed wind speed

About the 205 MHz radar



LOCATION OF THE RADAR

AERIAL VIEW OF THE RADAR ARRAY

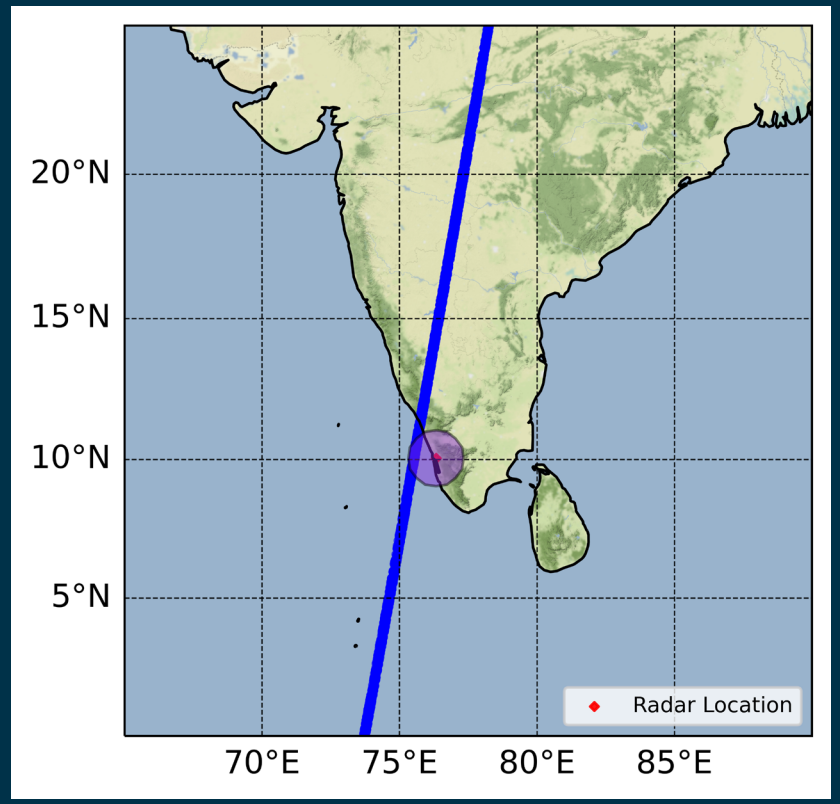
Experimental method

Methodology

- Spatial restriction < 100 km
- Temporal restriction < 2 hours
- Vertical distance < 25 m
- Validation time period: July 2019-September 2021

From the collocated datasets, radar HLOS wind is calculated using the equation

$$HLOS_{radar} = -Uradar.\sin(\varphi_{Aeolus}) - V_{radar}.\cos(\varphi_{Aeolus})$$



Experimental method

Statistics

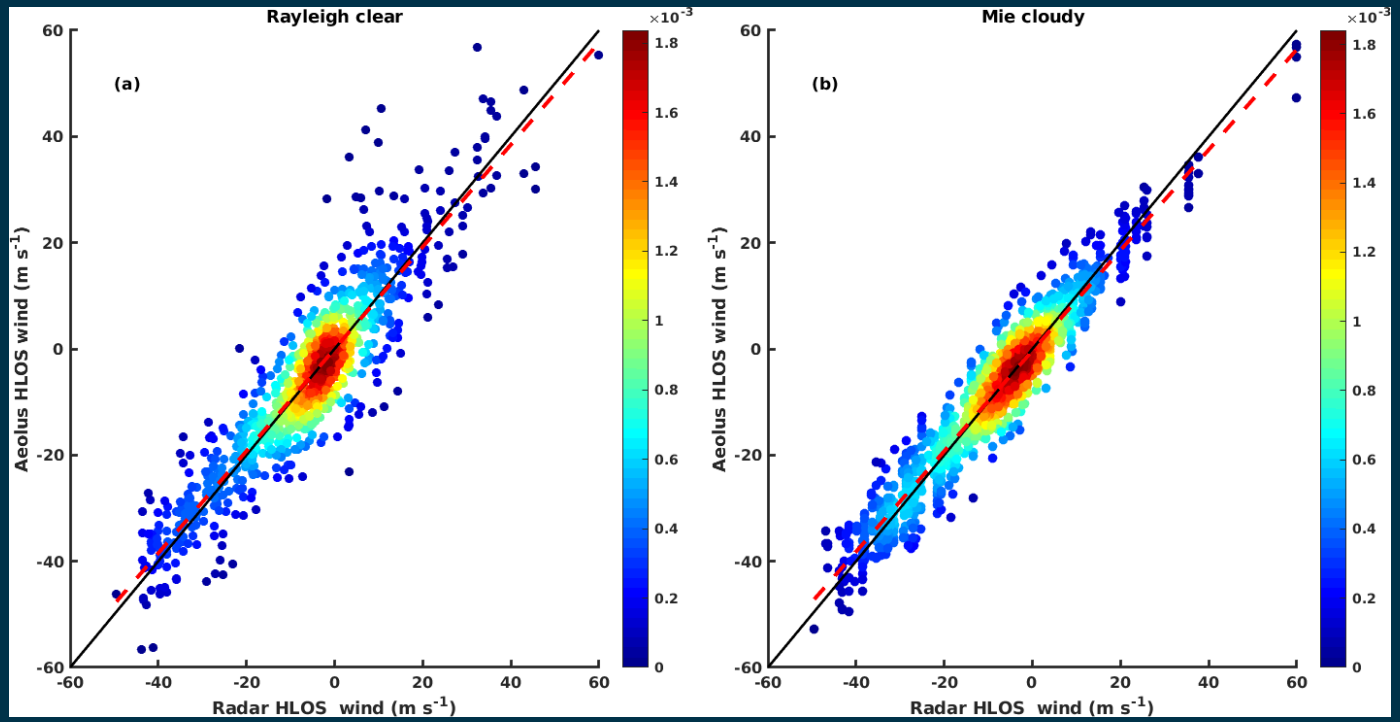
$$V_{diff} = HLOSrad_{ar} - HLOSAeo_{lus}$$

$$bias = \frac{1}{n}\sum_{i=1}^{n} V_{diff}$$

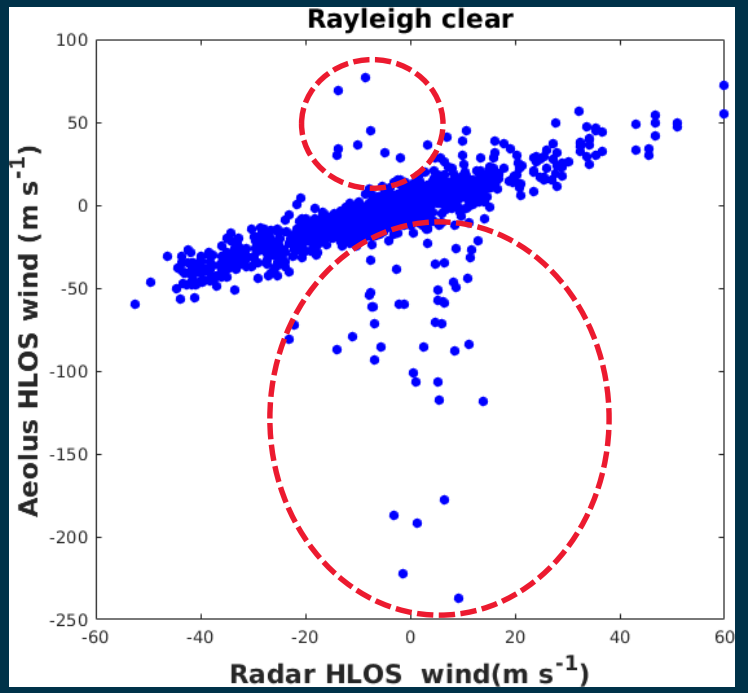
$$SD = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(V_{diff} - bias)^2}$$

$$Scaled\ MAD = 1.4826 \times median\left(\left|V_{diff} - median(Vdiff)\right|\right)$$

Results

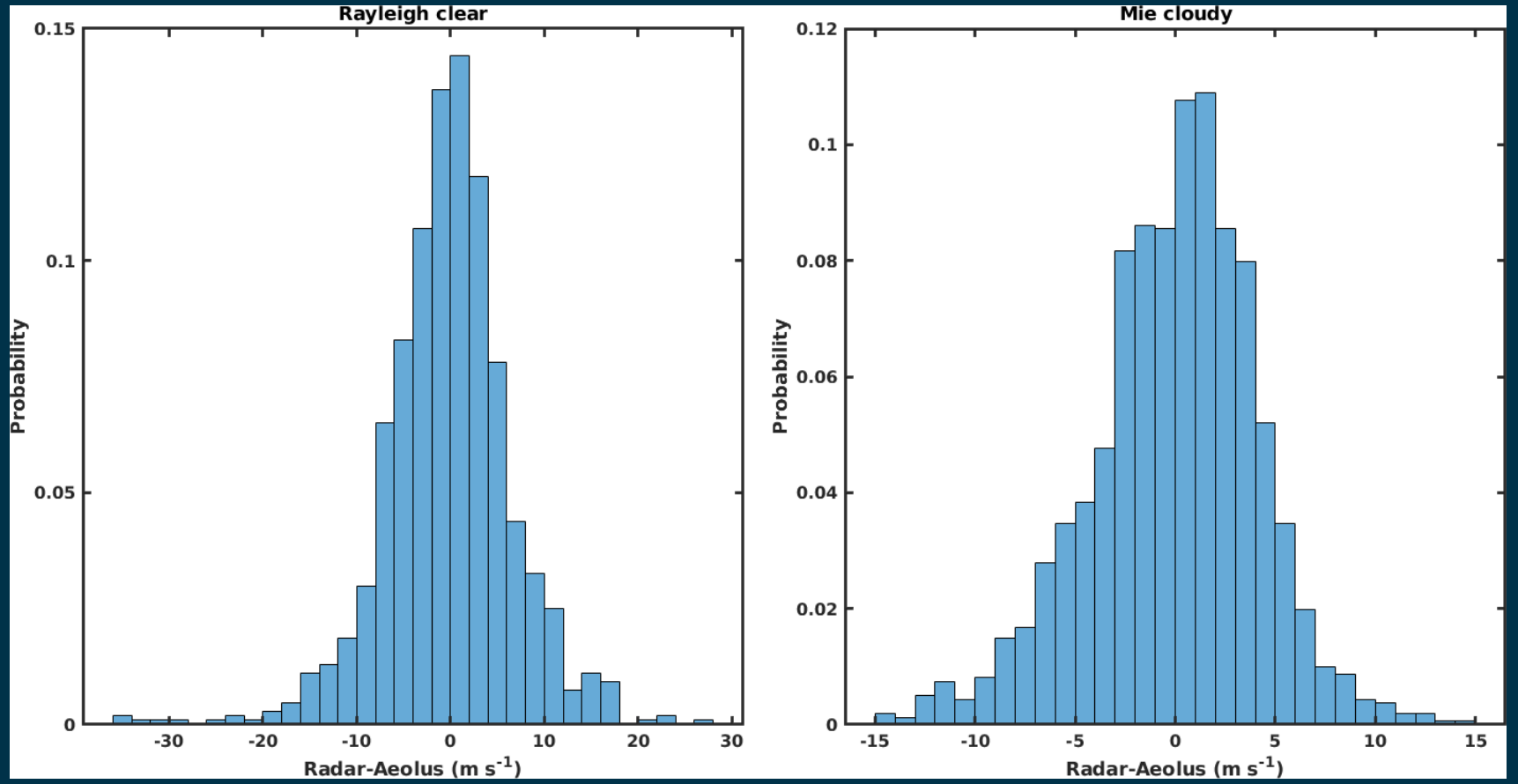


Outliers



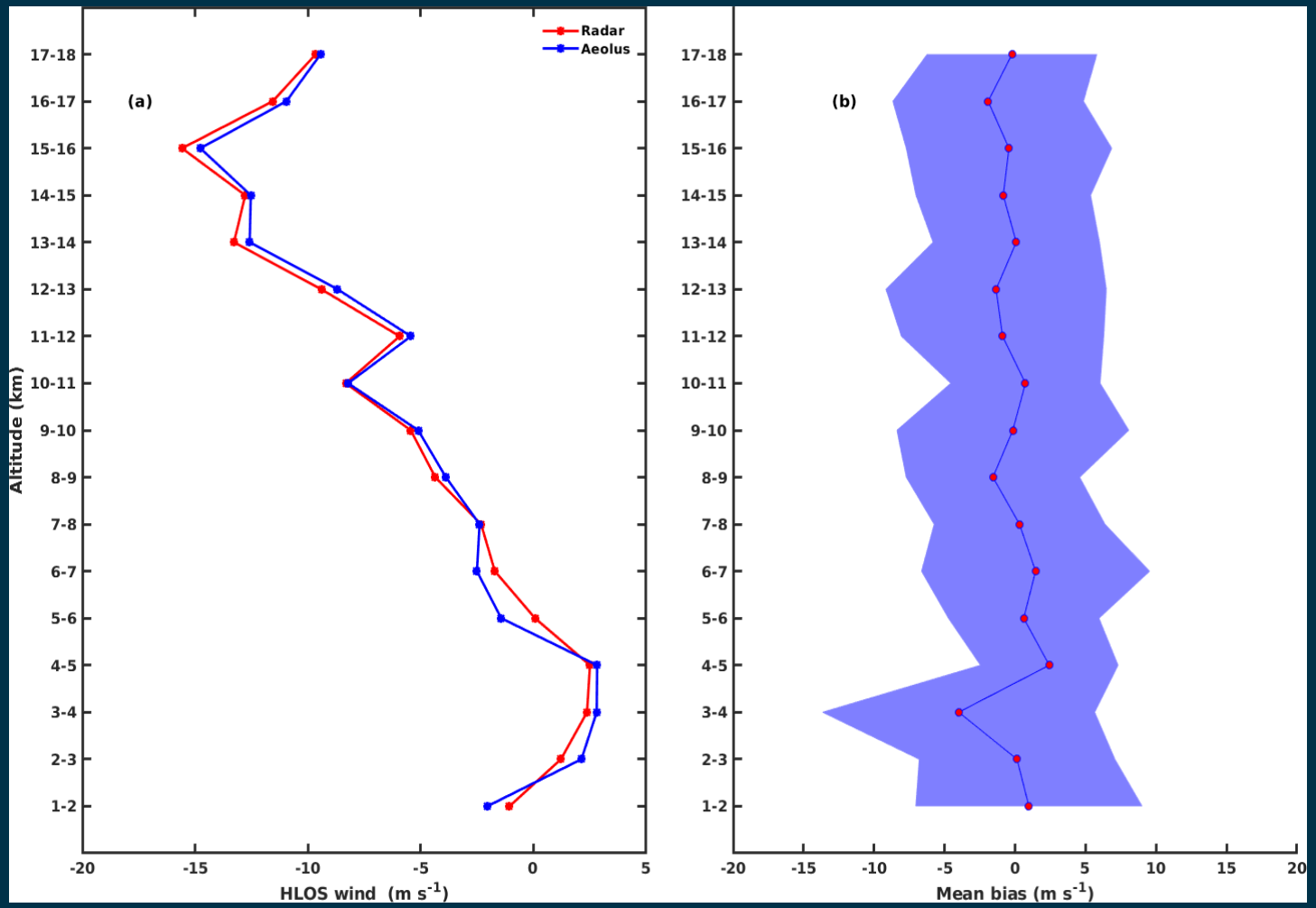
Scatter plot between radar and Aeolus wind for Rayleigh clear and Mie cloudy conditions. Black line is diagonal line and dotted red line is regression line. Colour bar shows the probability density.

Results



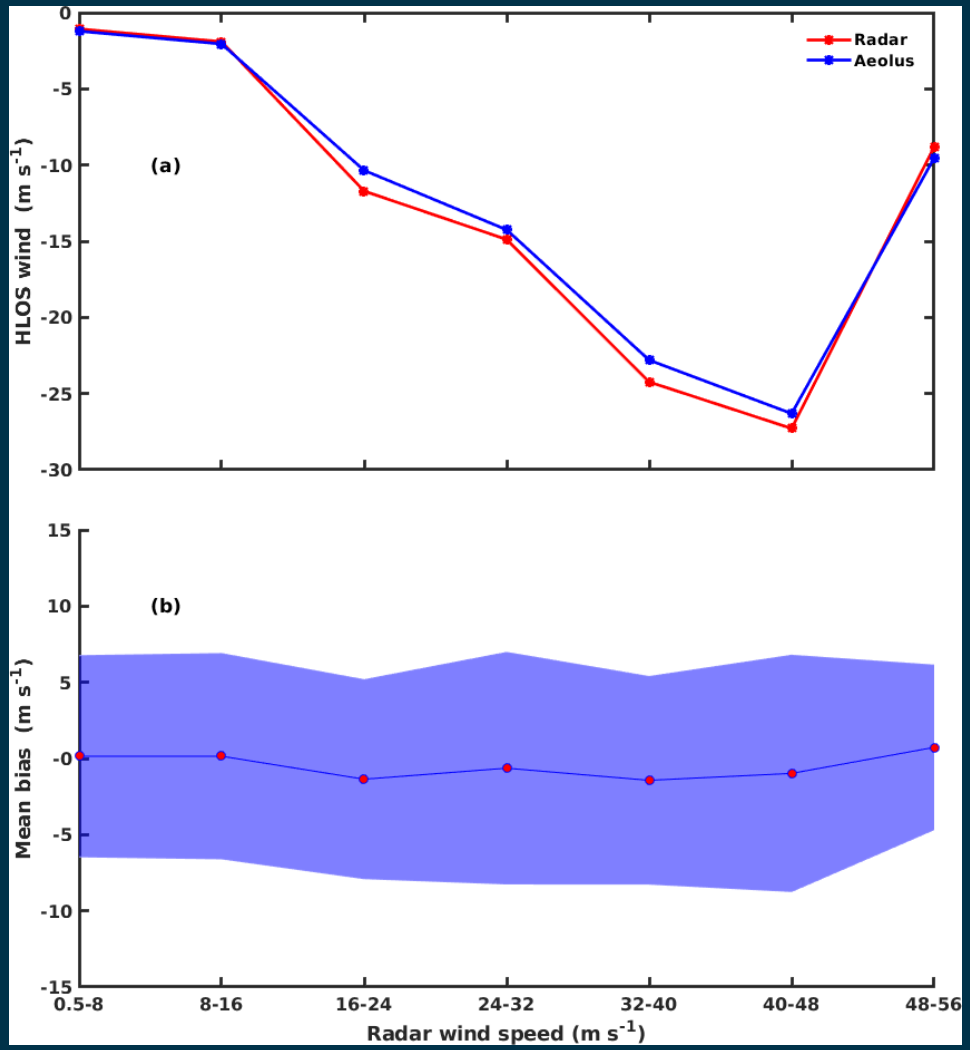
Difference Histogram

Rayleigh clear



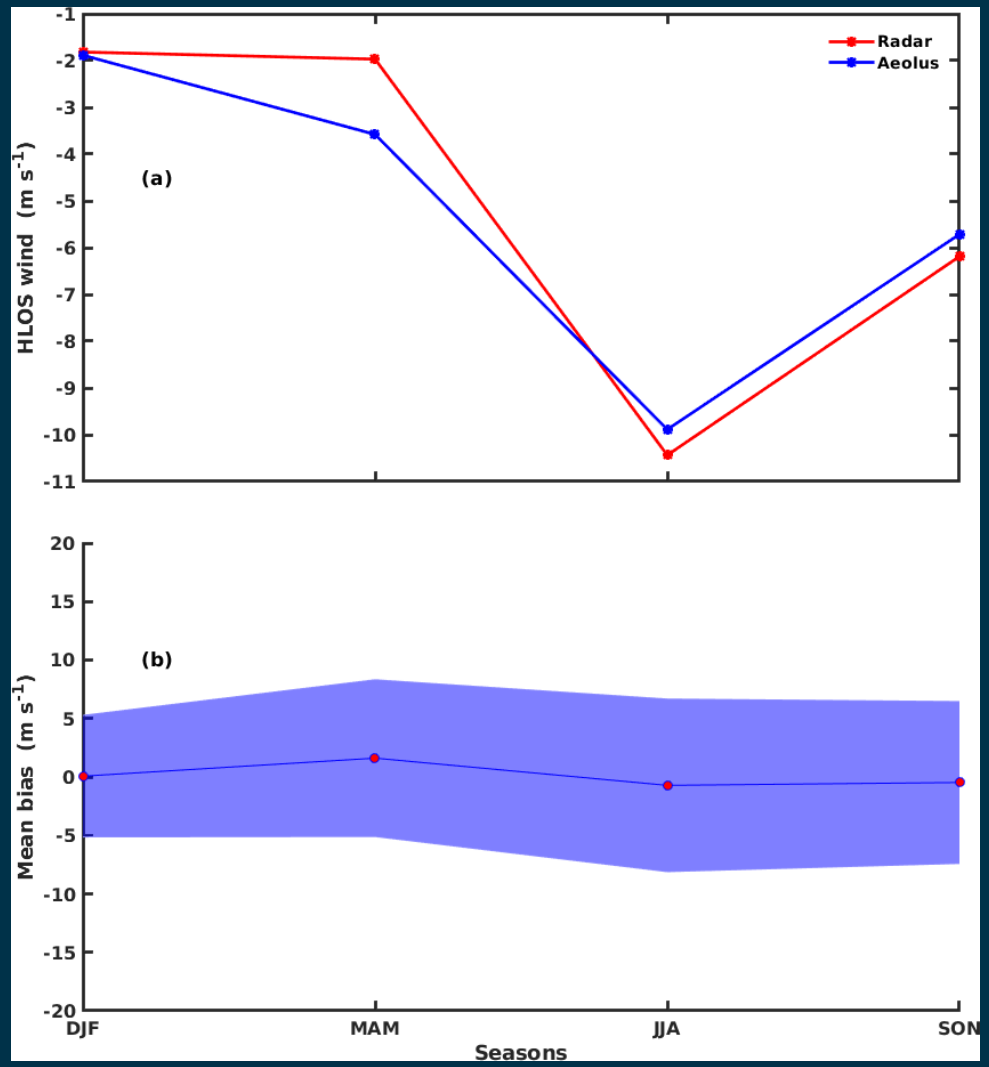
Bias as a function of altitude range: Shaded region is one sigma standard deviation. The random error is below 6 m/s. High error in some altitude ranges is due to lack of adequate samples.

Rayleigh clear



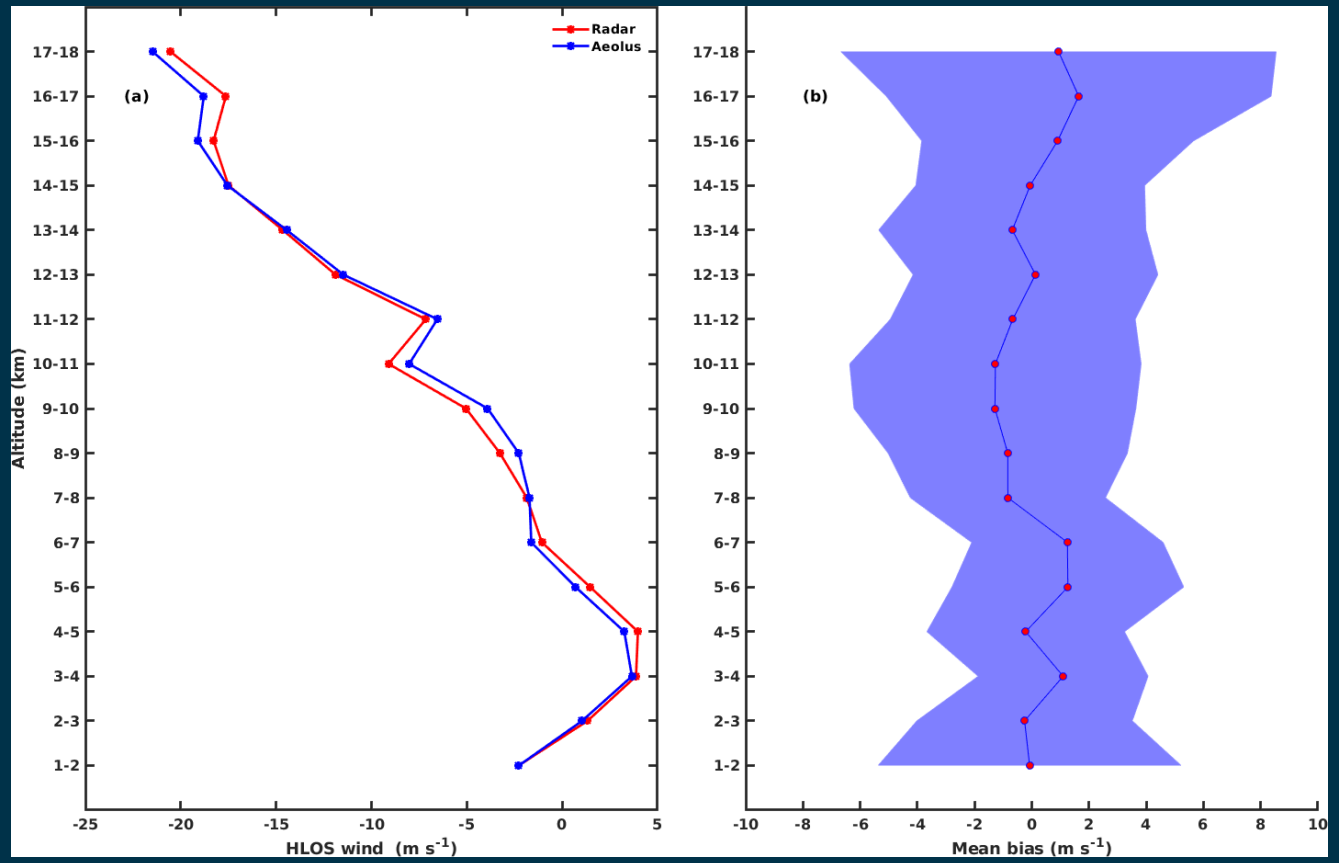
Bias as a function of observed wind speed from the radar. Bias is well below 1 m/s. Random error is of the order of 6 m/s for all wind speed ranges..

Rayleigh clear



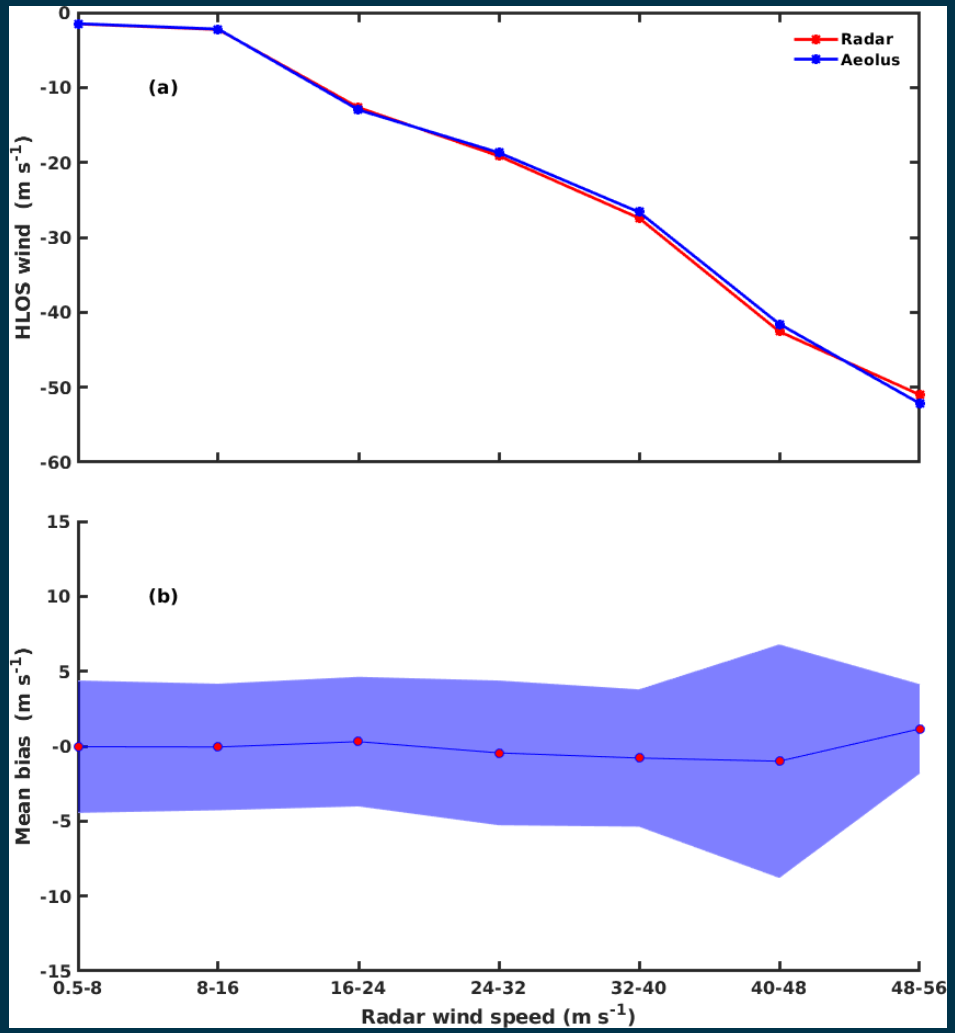
Bias as a function of season. Bias is well below 1 m/s. Random error is of the order of 6 m/s for all seasons.

Mie cloudy



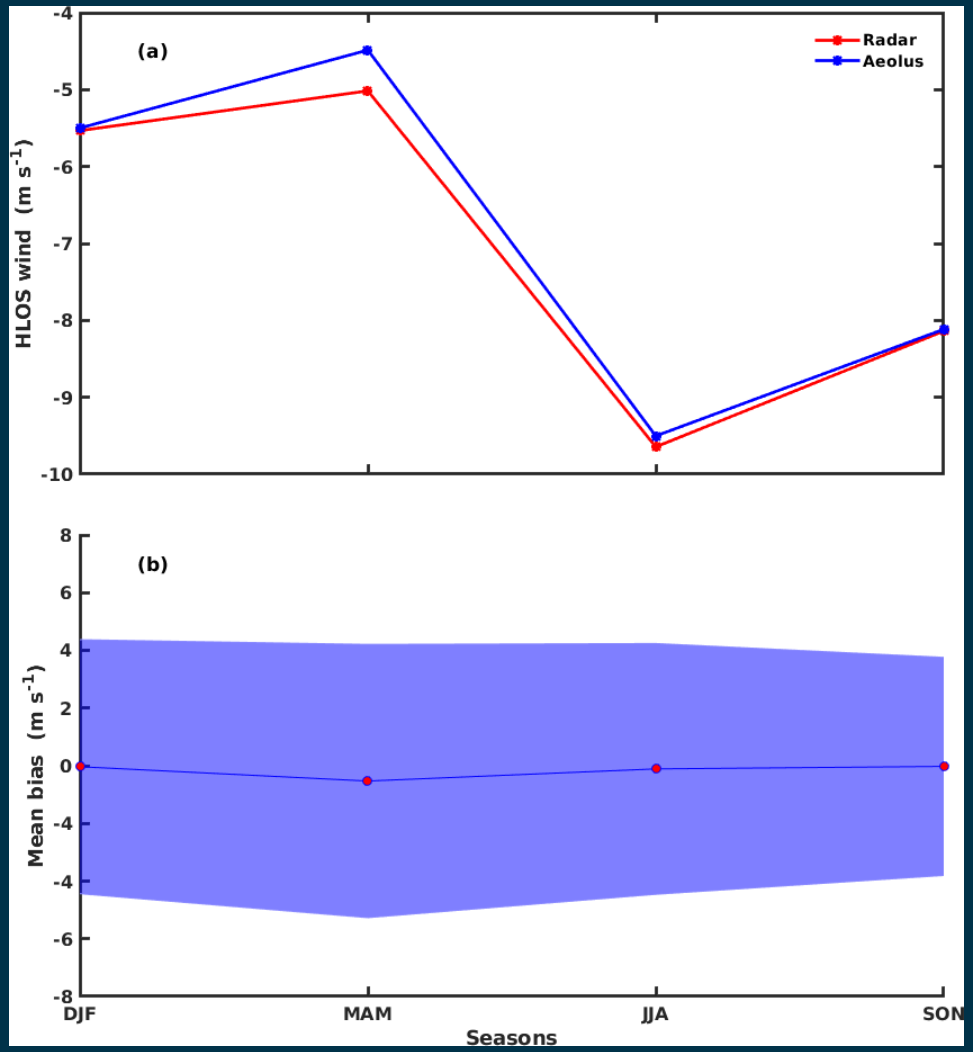
Bias as a function of altitude range: Shaded region is one sigma standard deviation. Random error is below 5 m/s. High values in some altitude ranges are due to lack of adequate samples.

Mie cloudy



Bias as a function of observed wind speed from the radar. Bias is well below 1 m/s. Random error is of the order < 5 m/s for all speed ranges.

Mie cloudy



Bias as a function of season. Random error is of the order < 5 m/s for all seasons..

Summary and recommendations

- Comparison shows that radar and Aeolus wind profiles are in good agreement

- Systematic error in Aeolus wind is very low; Overall comparison shows that mean bias for Rayleigh clear and Mie cloudy are -0.3 m/s and -0.03 m/s, respectively.

- Random error of Aeolus HLOS winds is found to be 5.9 m/s (7 m/s) for Rayleigh wind and 3.38 m/s (3.83 m/s) for Mie wind. This is above the precision requirements defined for Aeolus.

- Mie cloudy wind product is in better agreement with radar wind profiles as compared to Rayleigh wind.

Summary and recommendations

- Systematic and random errors are robust and do not vary much for different altitudes, wind speed ranges and seasons for both Rayleigh and Mie wind.

- We see anomalies in the Aeolus wind even after applying stringent conditions on HLOS error estimate. Unrealistic values can be flagged off by using prior information of wind strengths at different altitudes over different geographical regions.

Future work

- Sensitivity of Aeolus wind errors for different spatial and temporal constraints
- Validation of Aeolus wind profiles over oceanic regions using model outputs

THANK YOU !