Royal Netherlands
Meteorological Institute
Ministry of Infrastructure
and Water Management

Oceansat-3/EOS-06

Initial assessment of OSCAT3 scatterometer data by KNMI

Anton Verhoef, Zhen Li and Ad Stoffelen

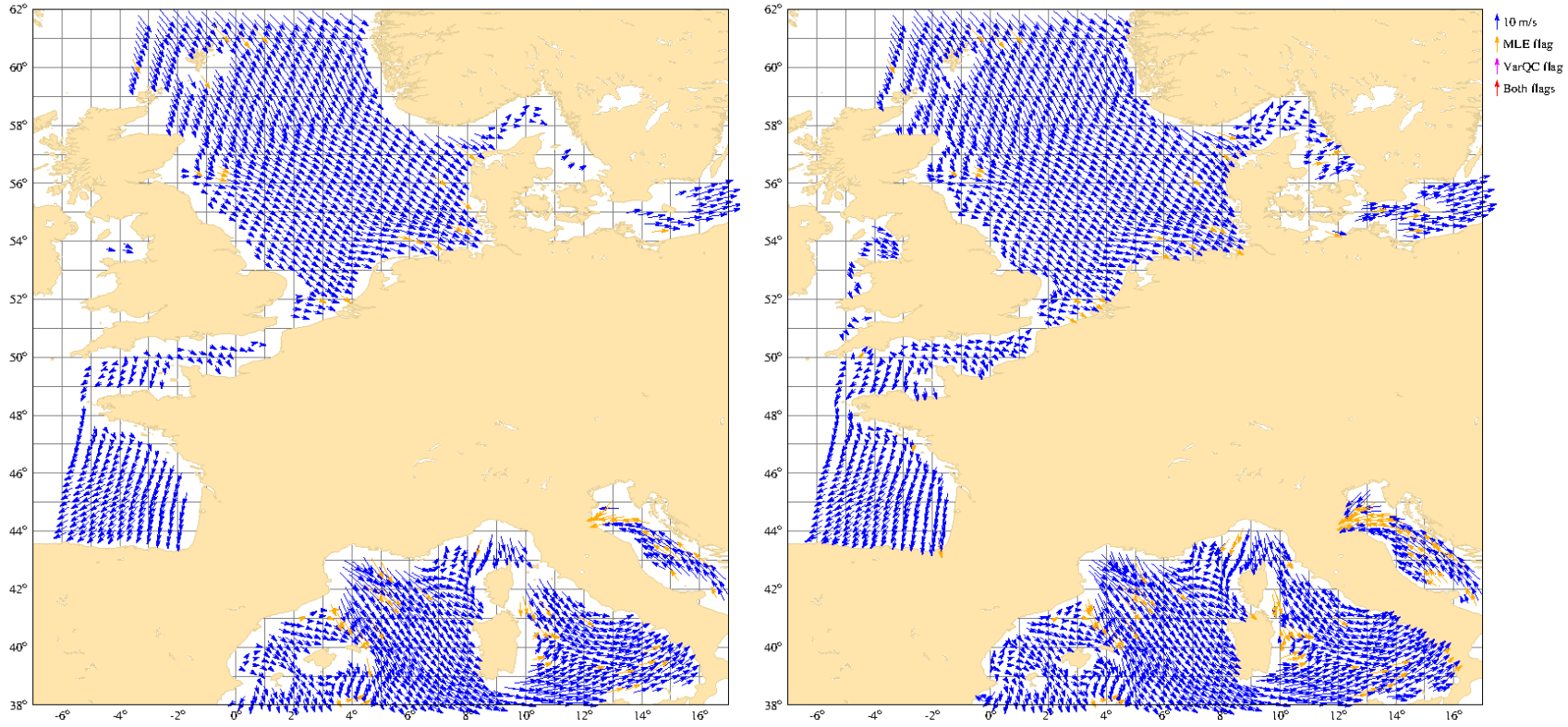
November 2023

Input data

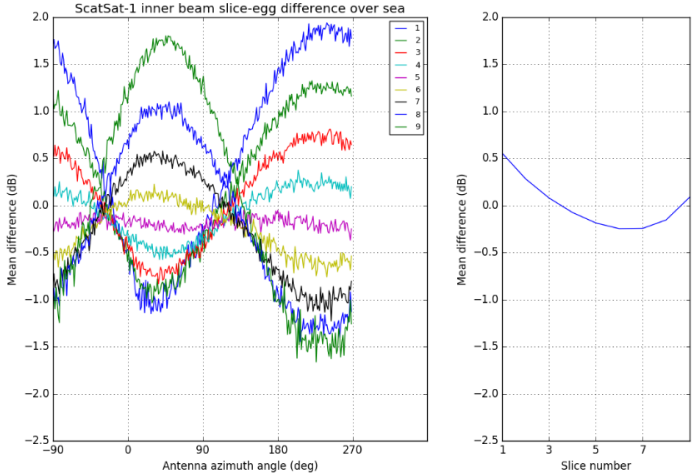
- We have received Oceansat-3/EOS-06 Level 1B for the period from 2023-136 (16 May 2023) to 2023-151 (31 May 2023)
- We are very grateful for this! Oceansat-3/EOS-06 scatterometer winds fill an important temporal gap in the virtual scatterometer constellation and is very complementary to other missions
- Generally, the data look very good and good quality winds can be retrieved
- As compared to Oceansat-2 and ScatSat-1, the number of data footprints (eggs) per antenna rotation has been increased from 281 to 360, at the same time the antenna rotation rate has been decreased from ~20 rpm to ~16 rpm
- Unfortunately, the download speed from the MOSDAC server was quite low; since recently a data link between EUMETSAT and ISRO provides a faster data flow and routine processing started at KNMI
- Many half orbit files have duplicates (from reprocessing?), we decided to use only the largest file for each half orbit

Wind field example

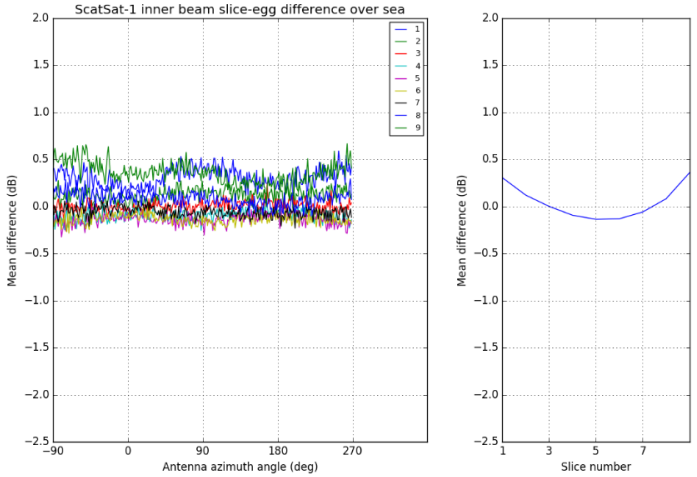
- Wind field from 16 May, ~12 UTC
- Left hand image: no coastal processing, land flagging on WVC level
- Right hand image: coastal processing on slice level, i.e., slices with land contamination are not used in a WVC
- The coastal processing increases the coverage significantly and still yields a consistent wind field
- Coastal processing will be used as default



Egg – slice consistency (inner beam)

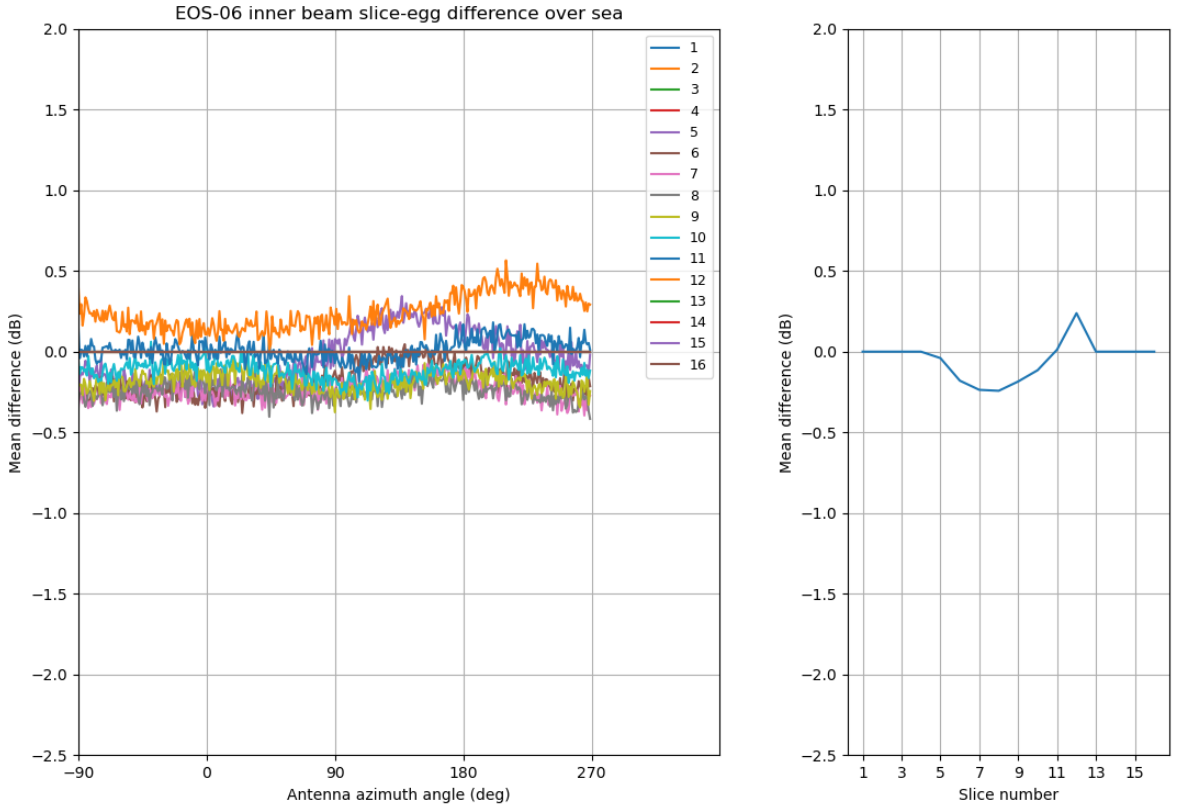


< ScatSat-1 (old)



< ScatSat-1 (after correction by ISRO)

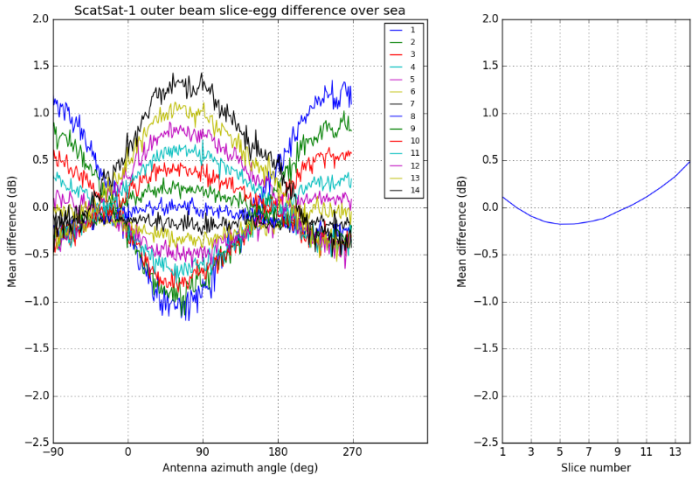
> Oceansat-3 (after skipping slices 1-4 and 13-16)



The plots show the difference between egg σ_0 and slice σ_0 per slice number, as a function of antenna azimuth (left) and the difference over all azimuths per slice number (right)

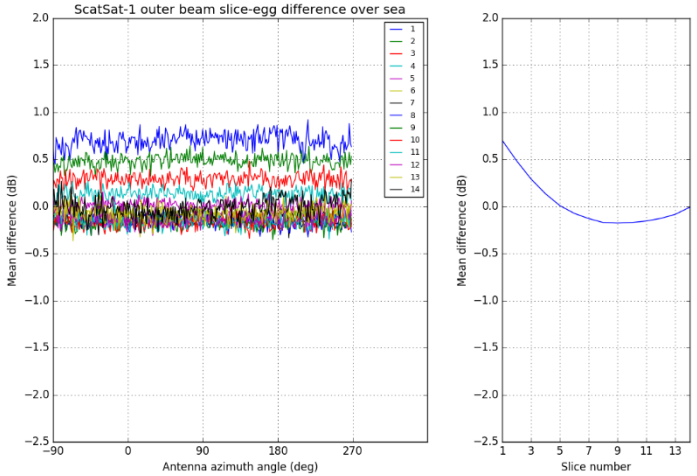
ScatSat-1: 9 slices/egg, Oceansat-3: 16 slices/egg

Egg – slice consistency (outer beam)

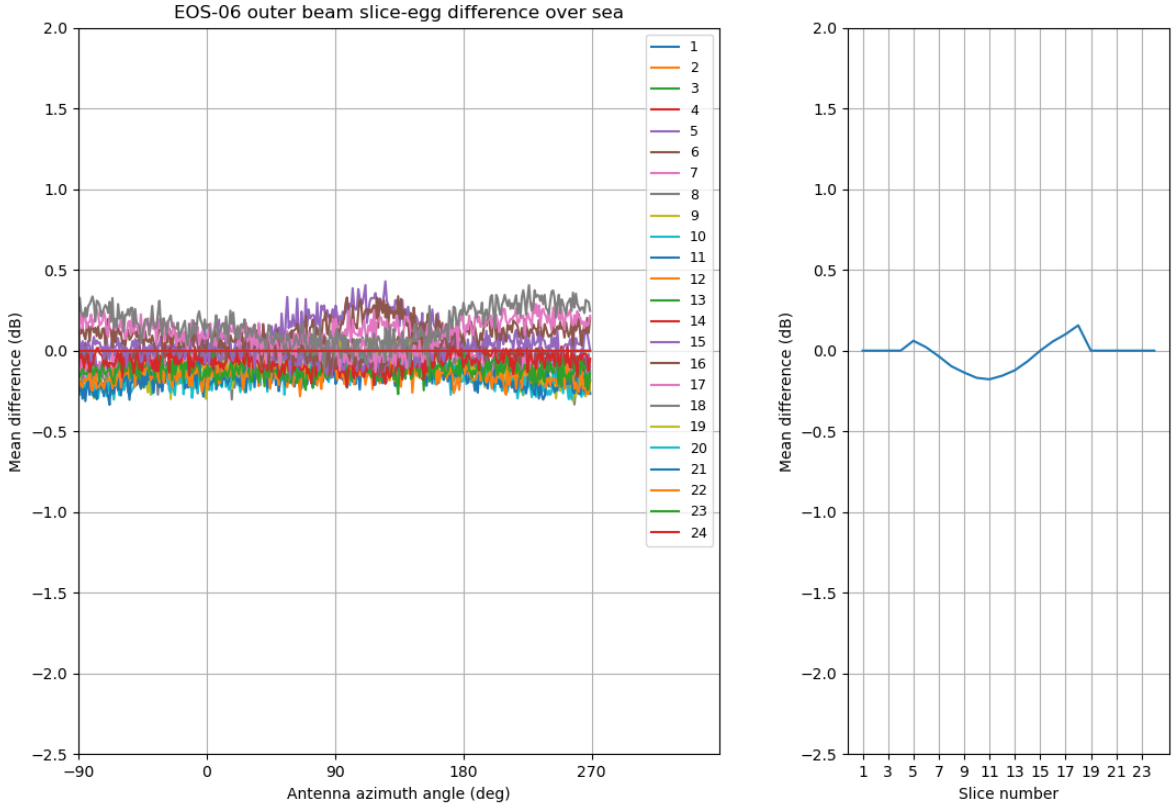


< ScatSat-1 (old)

> Oceansat-3 (after skipping slices 1-4 and 19-24)

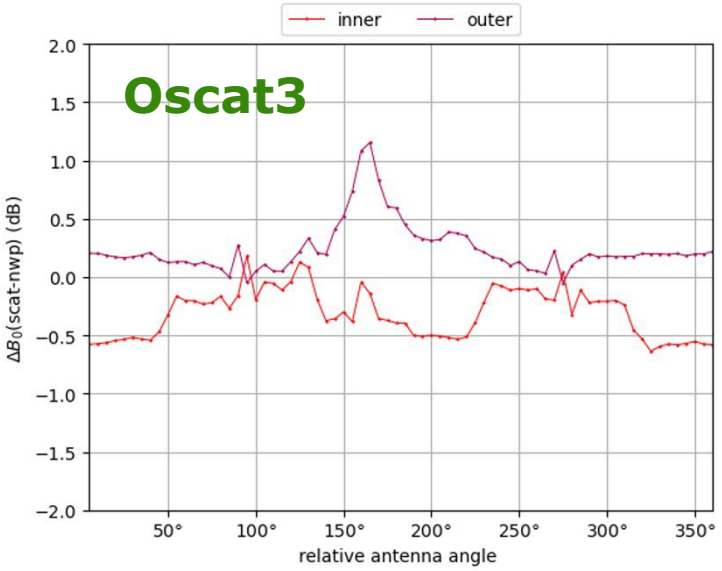


< ScatSat-1 (after correction by ISRO)



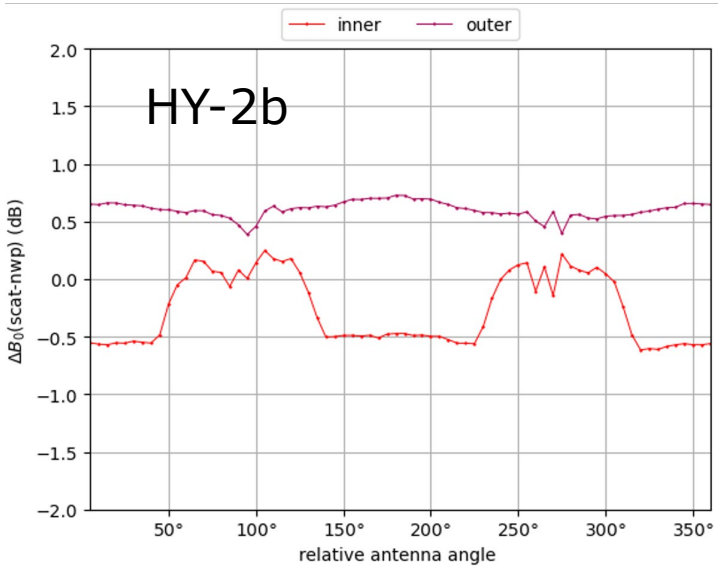
The plots show the difference between egg σ_0 and slice σ_0 per slice number, as a function of antenna azimuth (left) and the difference over all azimuths per slice number (right)

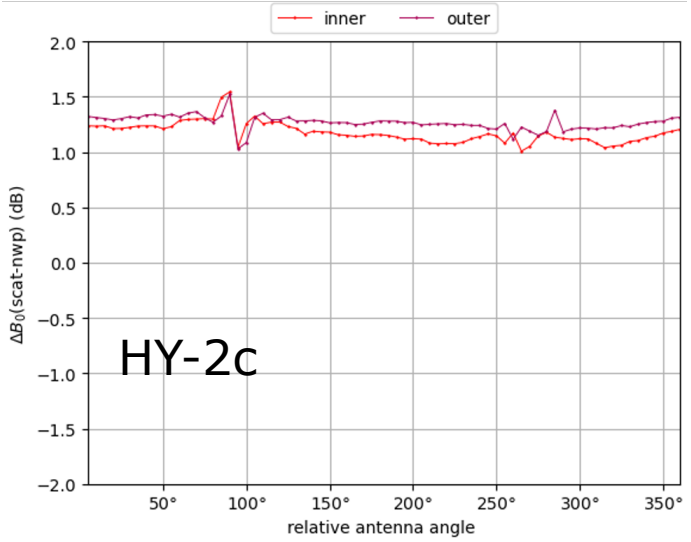
ScatSat-1: 15 slices/egg, Oceansat-3: 24 slices/egg

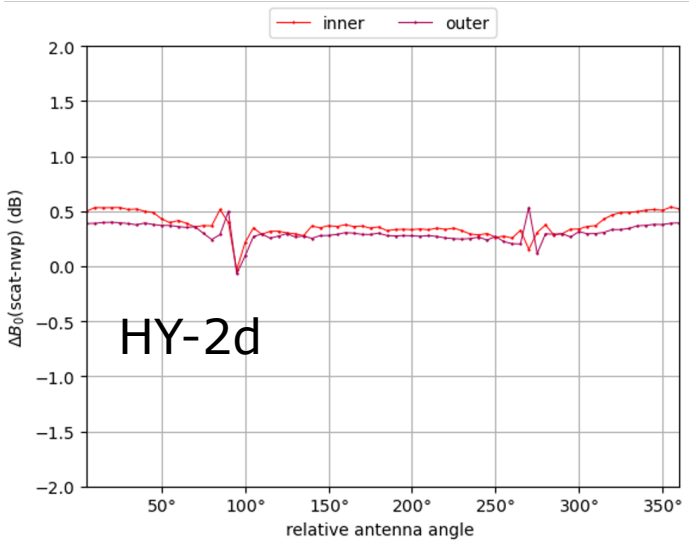


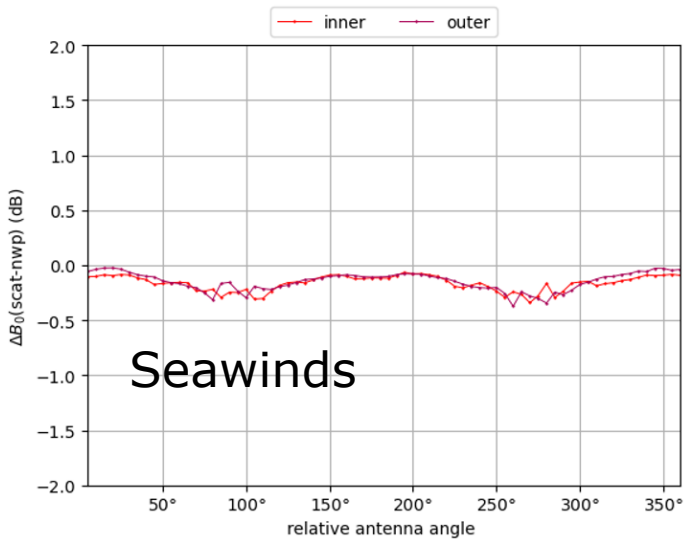
NOC as a function of relative antenna azimuth

- Anomalous outer peak at 180 degrees
- Similar inner behavior of Oscat3 and HY-2b





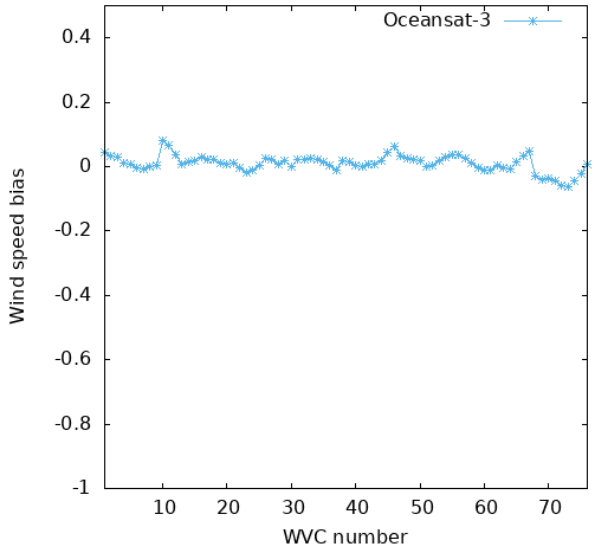


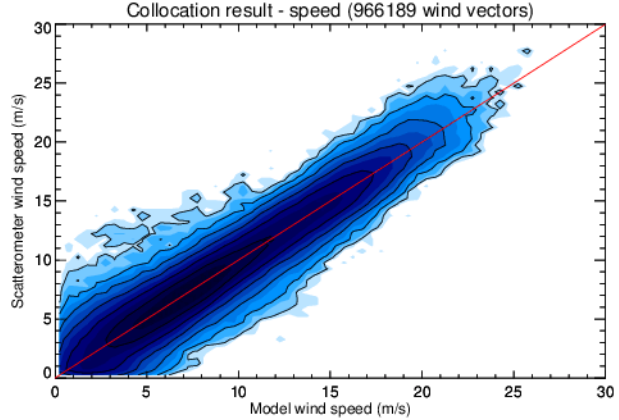


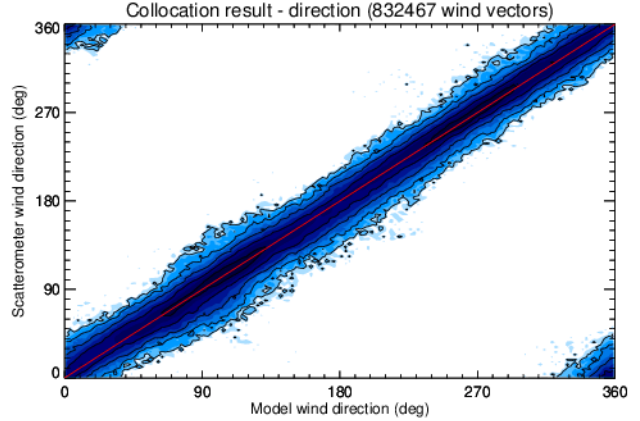
- The virtual constellation is very relevant for intercalibration

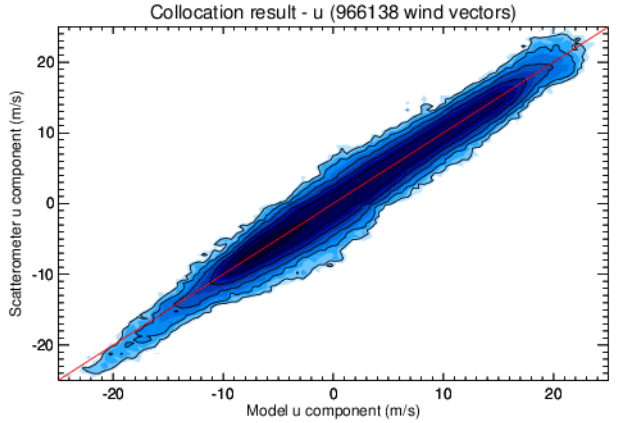
Wind statistics, all slices

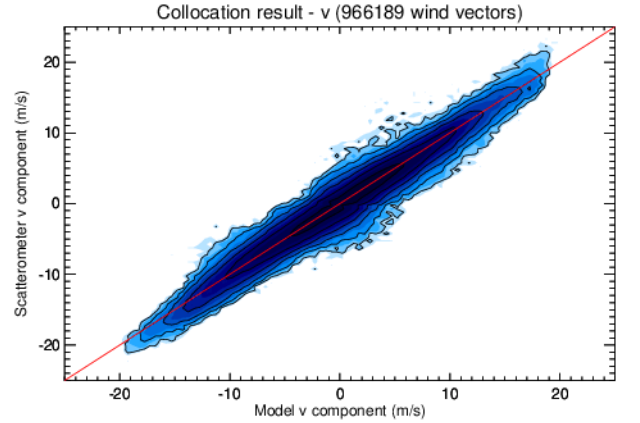
- Calibration coefficients: +1.06/-0.15/+0.13
- Wind speed bias +0.01 m/s
- Stdev u, v: 1.23, 1.18 m/s
- Data from 16 May 2023

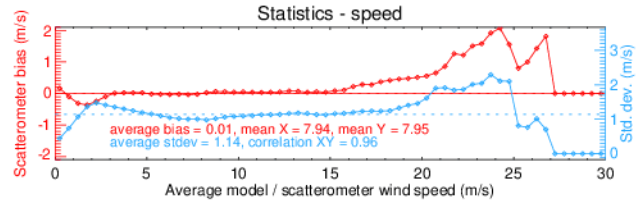


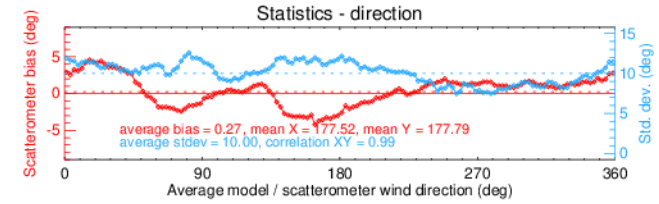


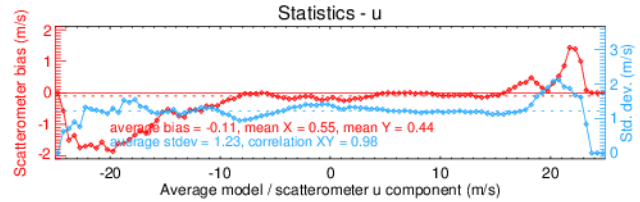


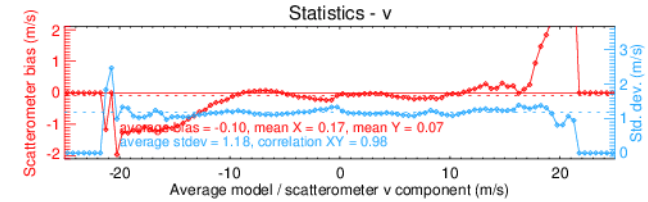






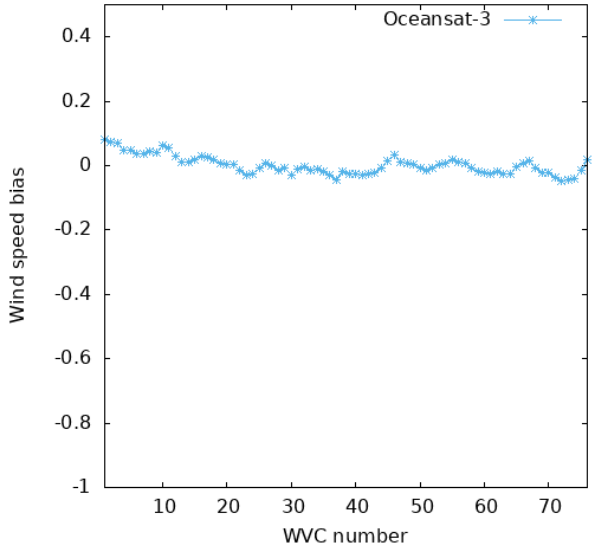


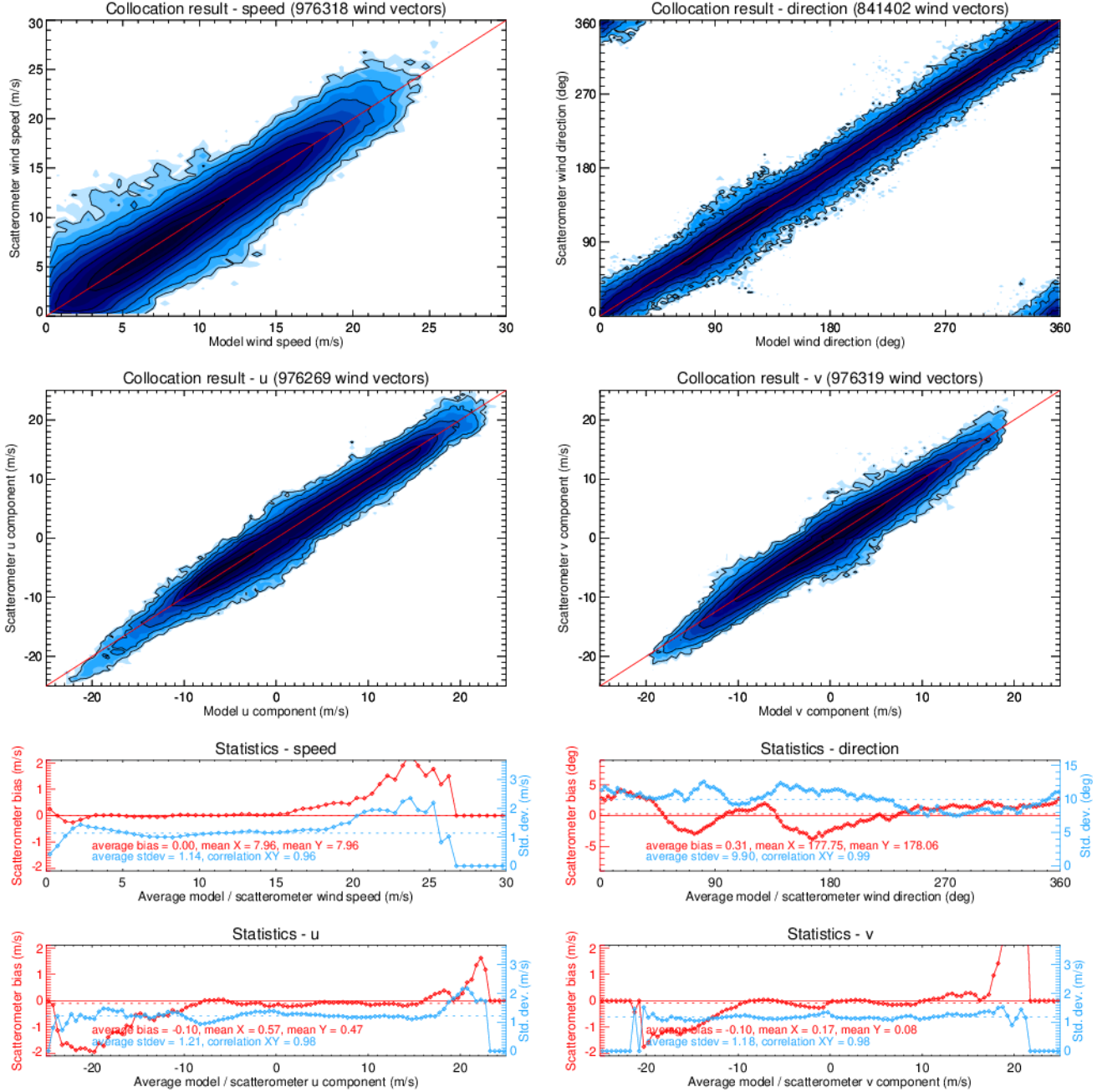




No outermost slices

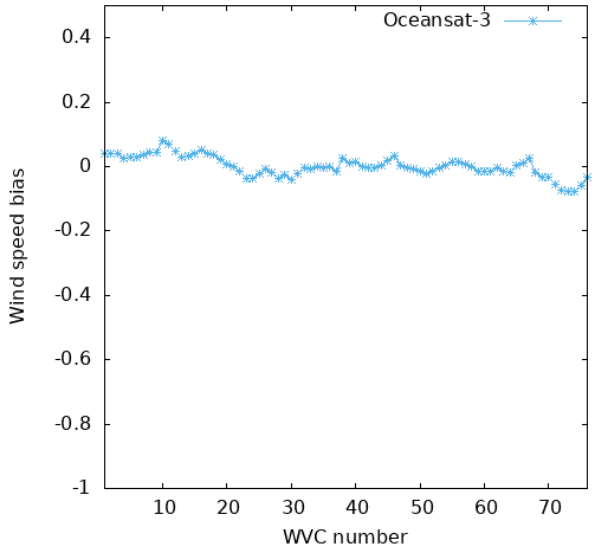
- Calibration coefficients: +1.12/-0.10/+0.19
- Wind speed bias 0.00 m/s
- Stdev u, v: 1.21, 1.18 m/s
- Data from 16 May 2023
- More winds (~1%) retrieved, i.e., better consistency with the GMF

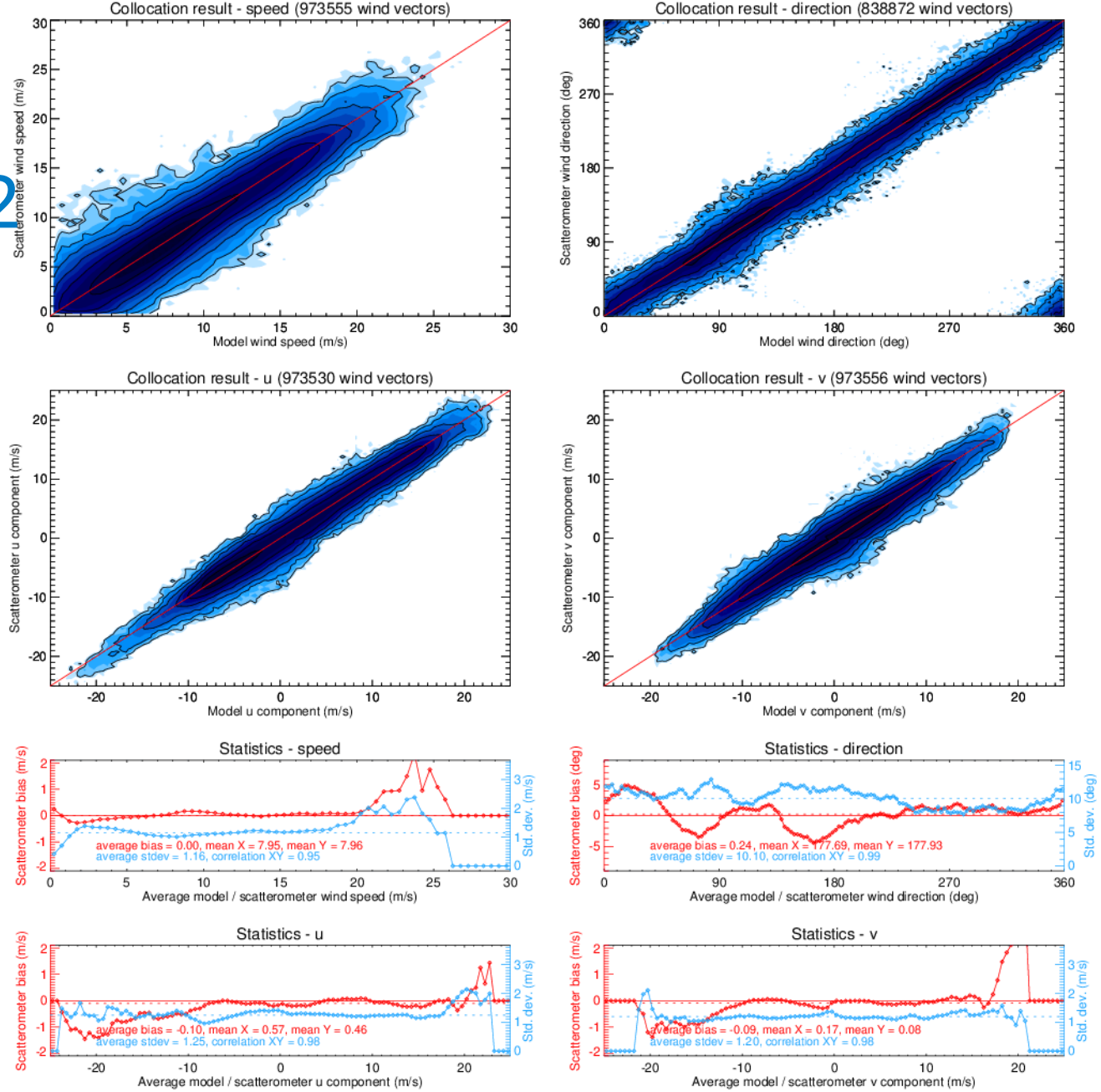




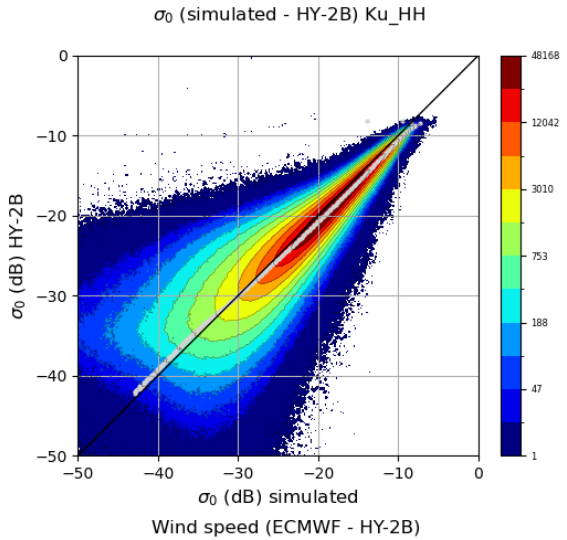
Oceansat-3, NSCAT-4HY2

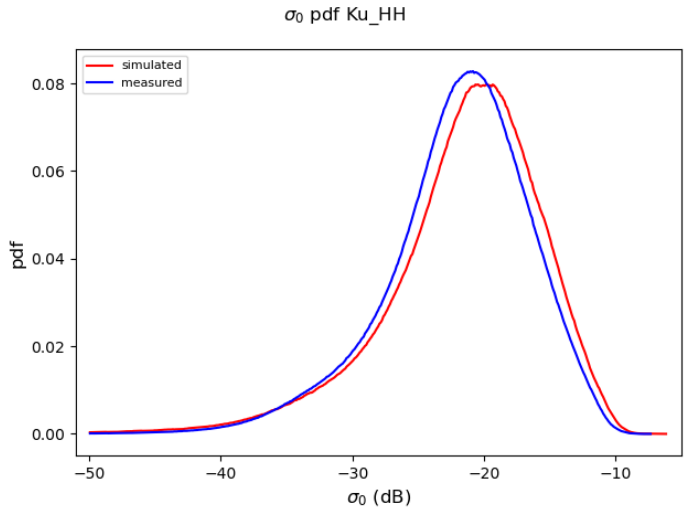
- Calibration coefficients: +0.98/-0.30/+0.05
- Wind speed bias 0.00 m/s
- Stdev u, v: 1.25, 1.20 m/s
- Data from 16 May 2023

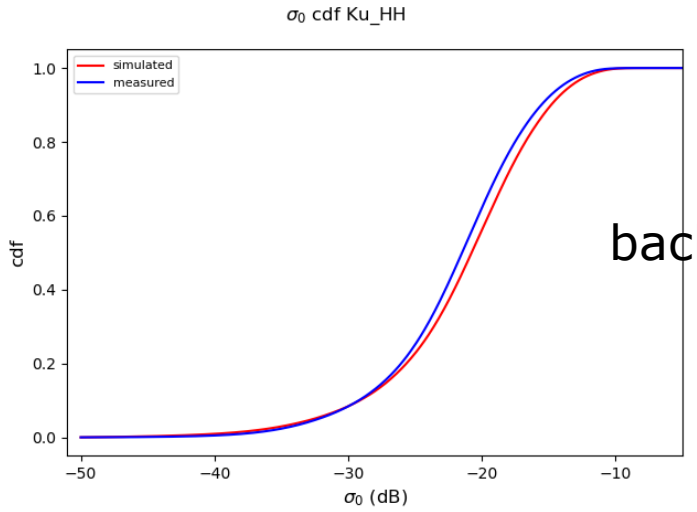




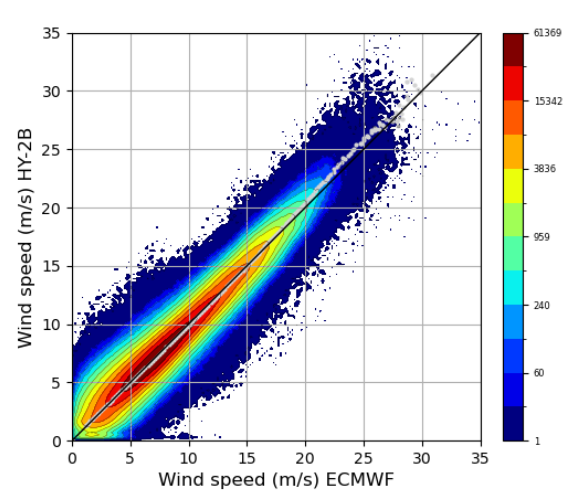
Cumulative Density Function matching

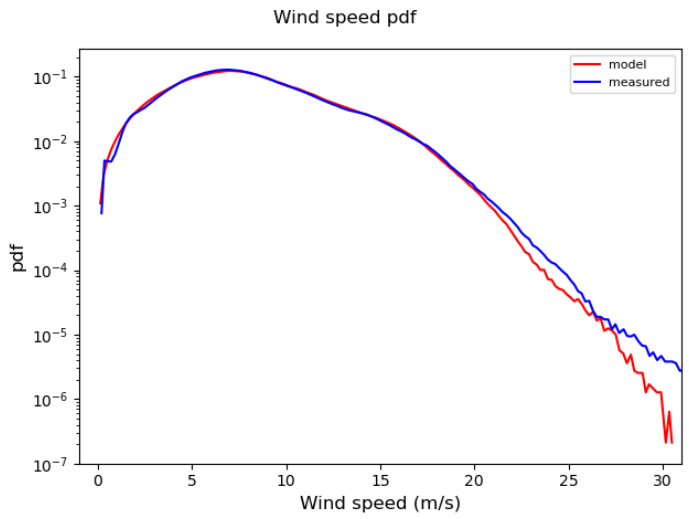


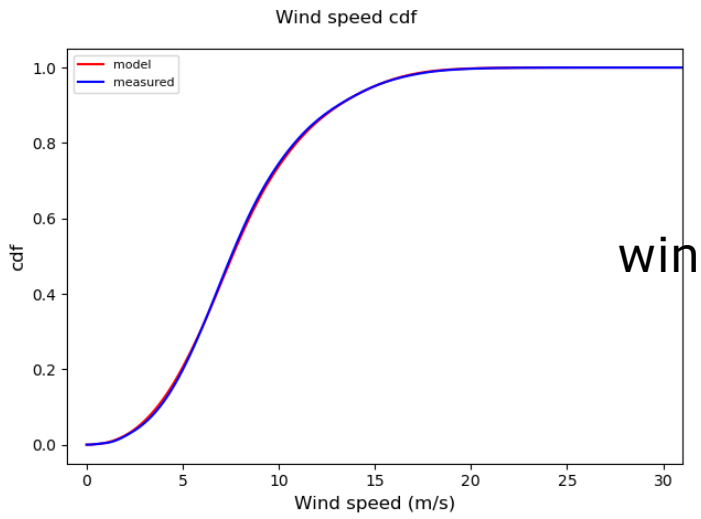




backscatter

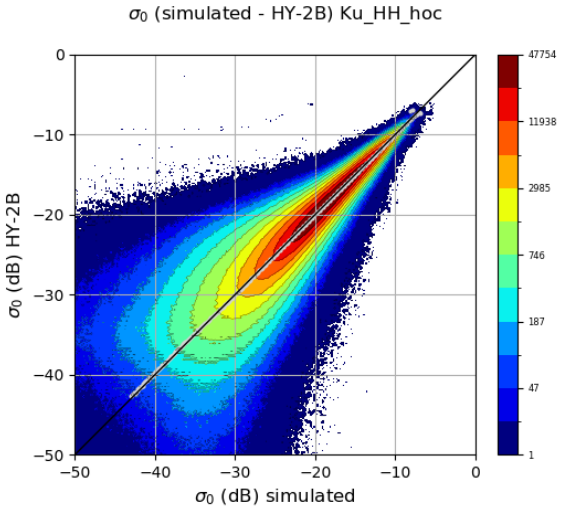


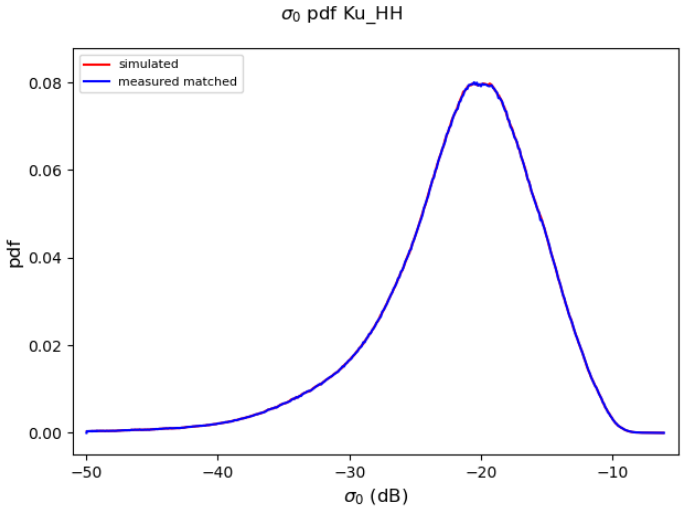


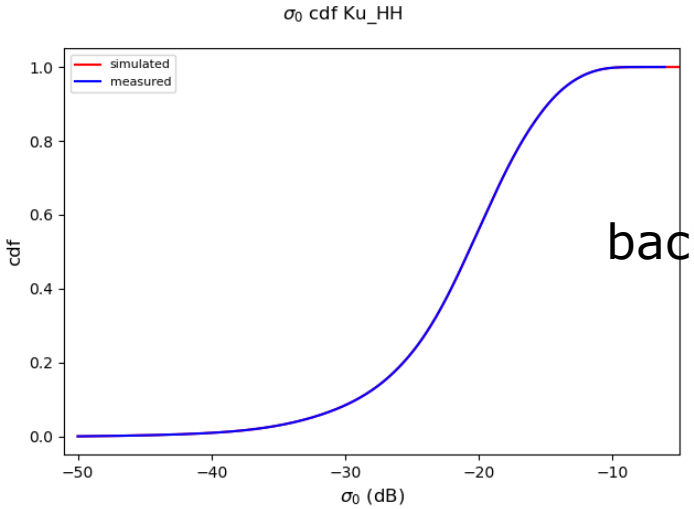


wind speed

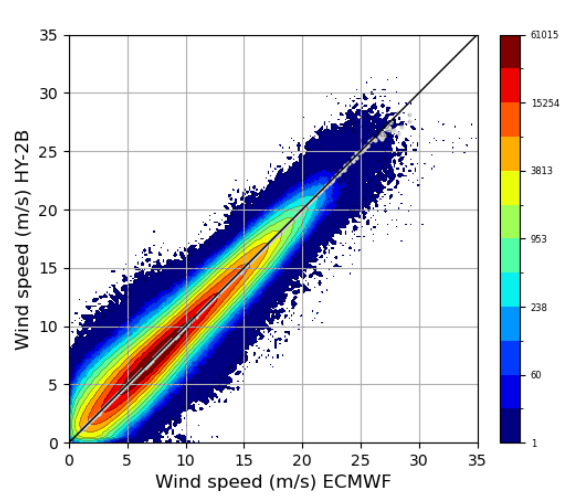
Cumulative Density Function matching

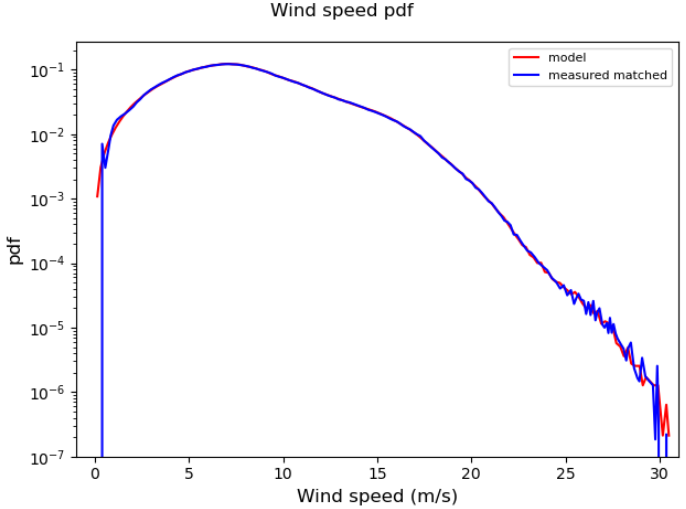


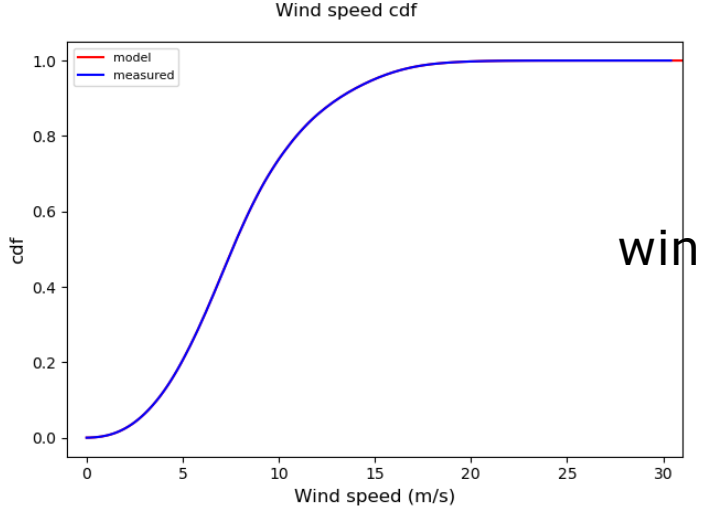




backscatter



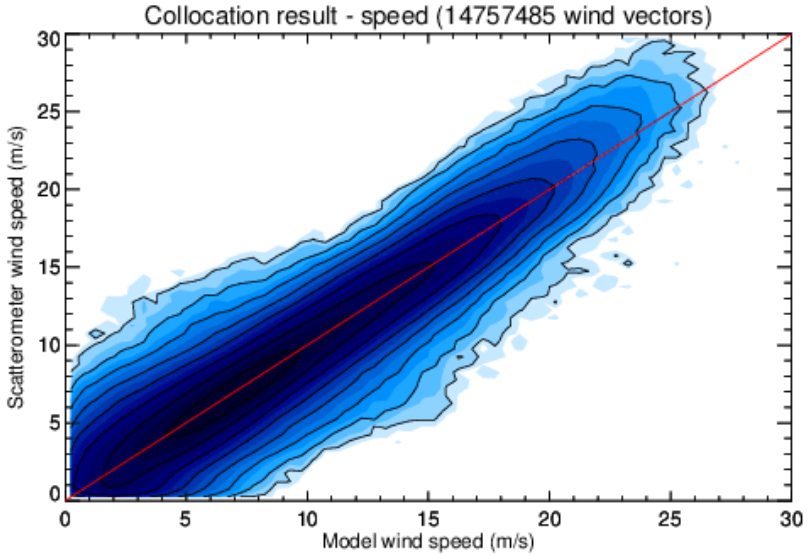


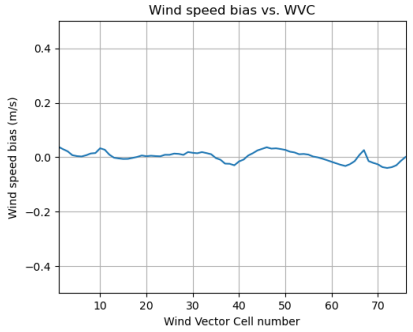


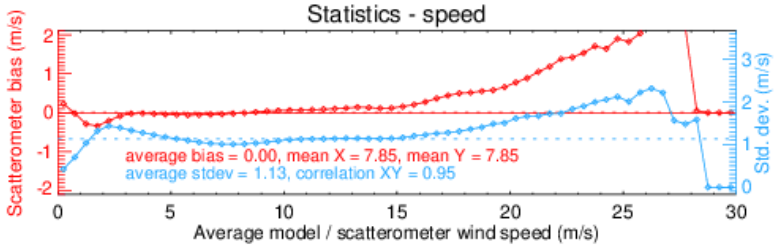
wind speed

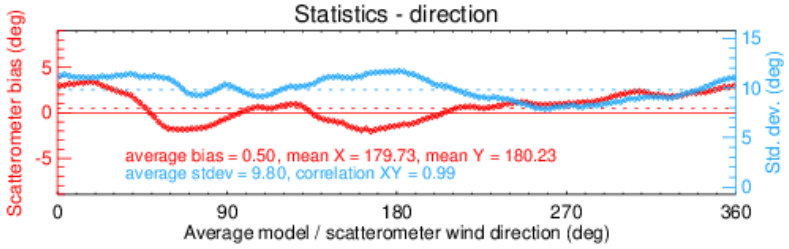
Oceansat-3 NSCAT-4DS NOC

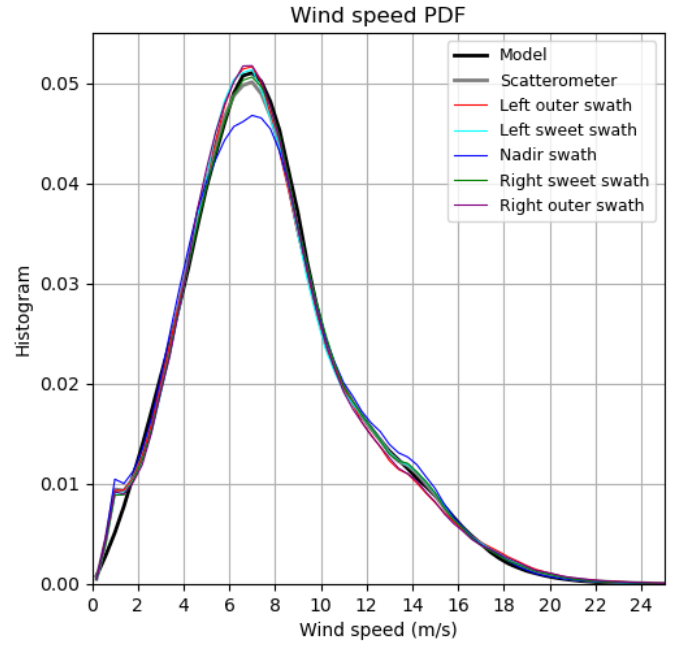
- Calibration coefficients: +1.12/-0.10/+0.19 - optimised for zero bias in May 2023
- Wind speed bias 0.00 m/s
- Stdev u, v: 1.23, 1.17 m/s
- **Reference for Oceansat-3**





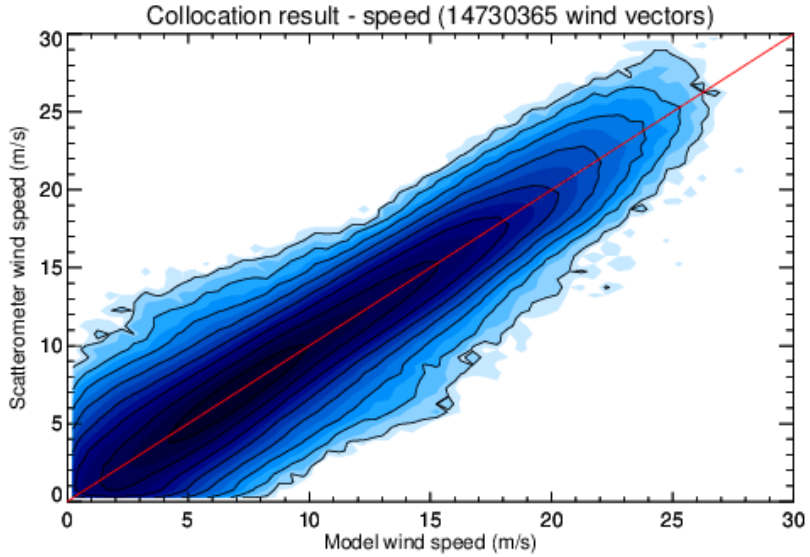


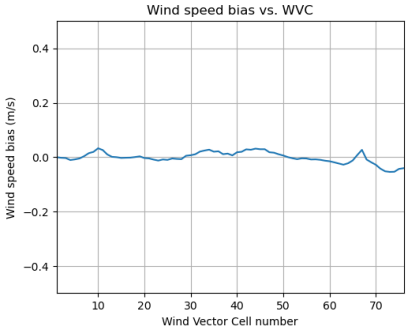


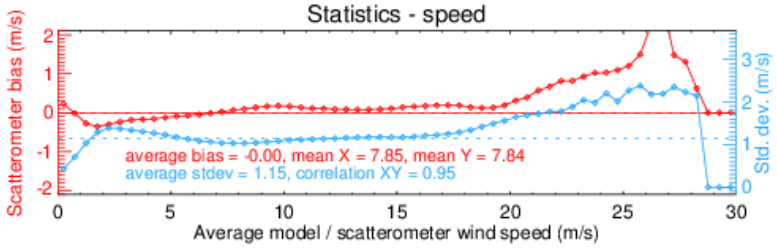


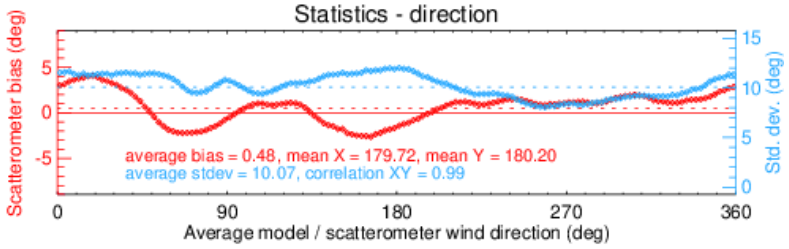
Oceansat-3 NSCAT-4HY2 NOC

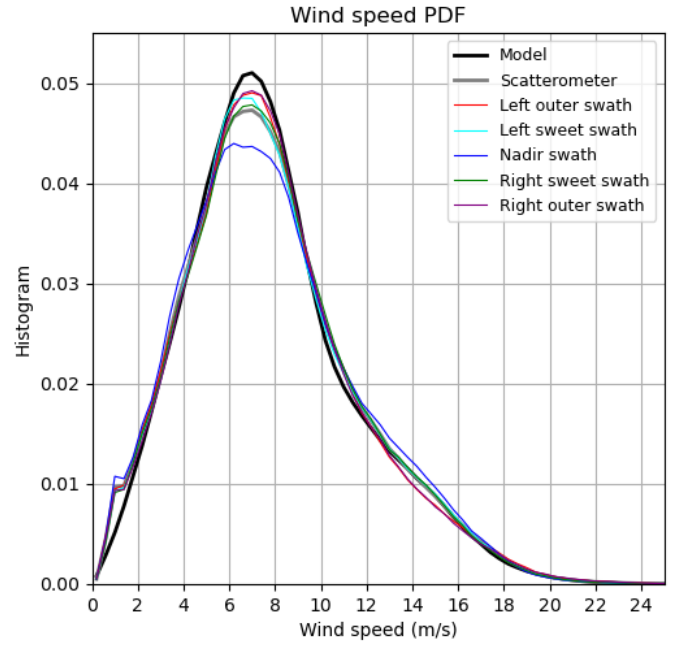
- Calibration coefficients: +0.95/-0.30/+0.05 - optimised for zero bias in May 2023
- Wind speed bias 0.00 m/s
- Stdev u, v: 1.26, 1.19 m/s





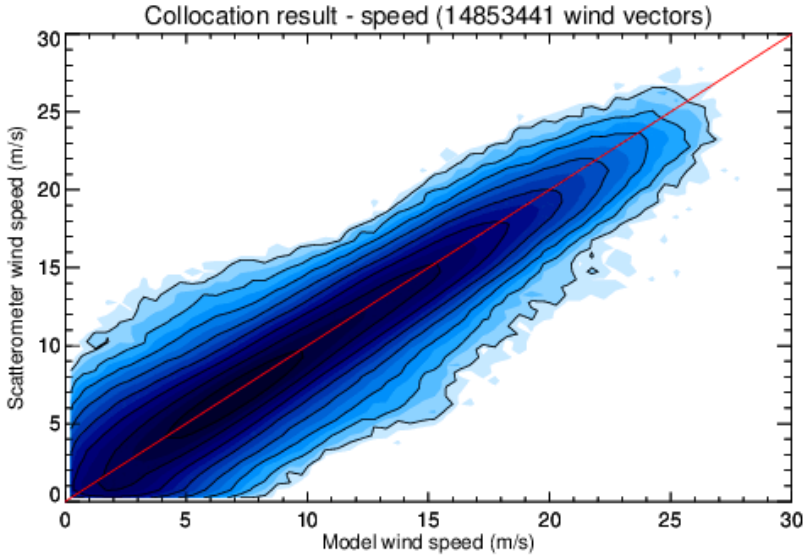


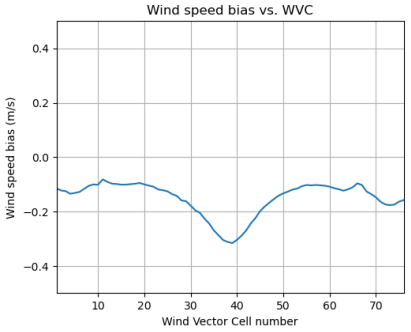


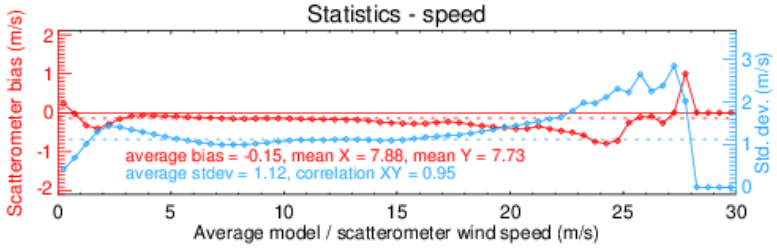


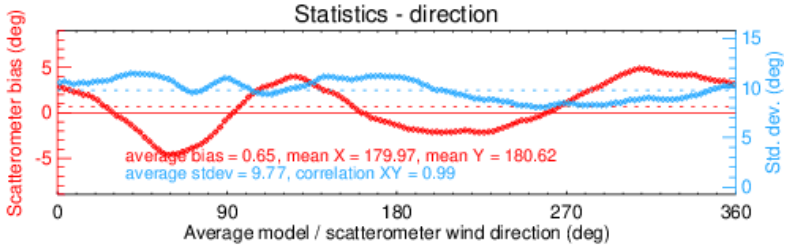
Oceansat-3 NSCAT-4DS HOC σ_0

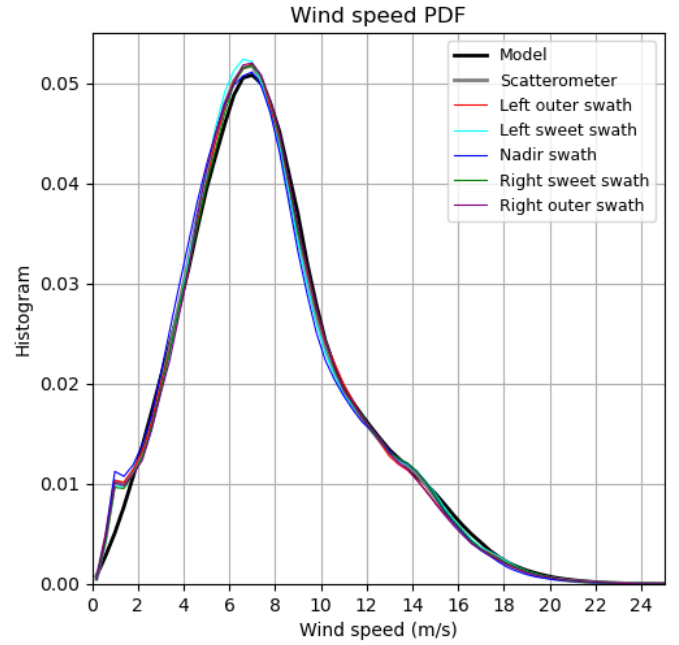
- Calibration coefficients: dependent on antenna pol and σ_0
- Wind speed bias -0.15 m/s
- Stdev u, v: 1.20, 1.16 m/s





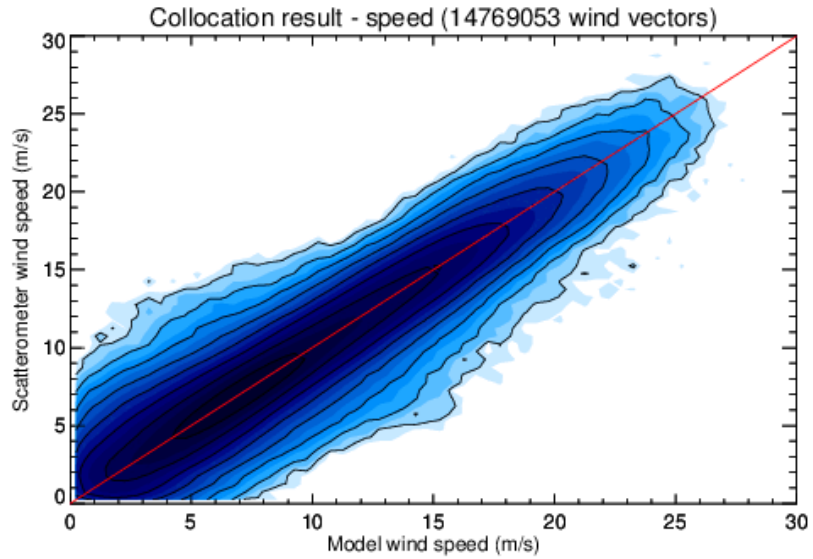


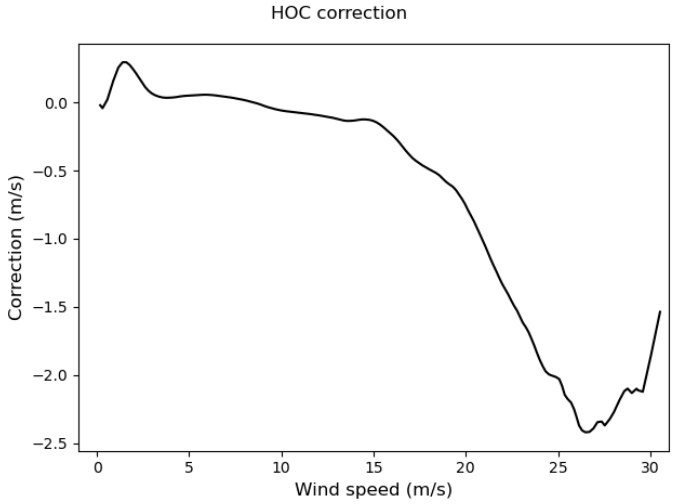


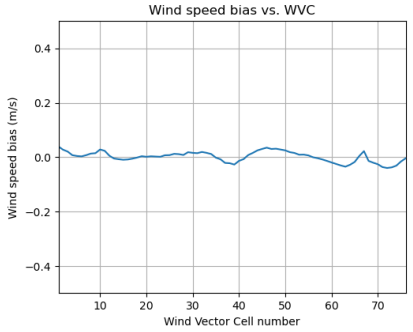


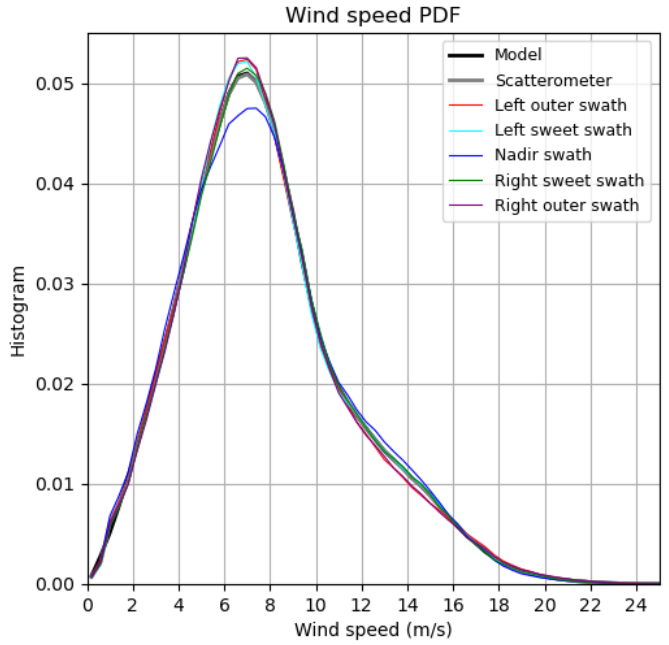
Oceansat-3 NSCAT-4DS HOC wspd

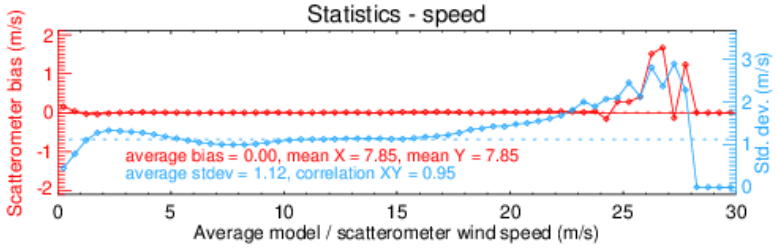
- Calibration coefficients: +1.12/-0.10/+0.19 – equal to NOC, and a wind speed dependent calibration on top
- Wind speed bias 0.00 m/s
- Stdev u, v: 1.22, 1.17 m/s

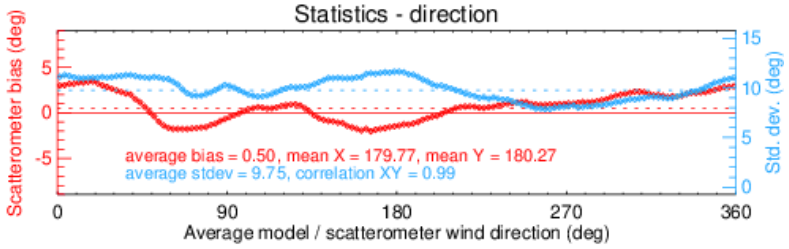




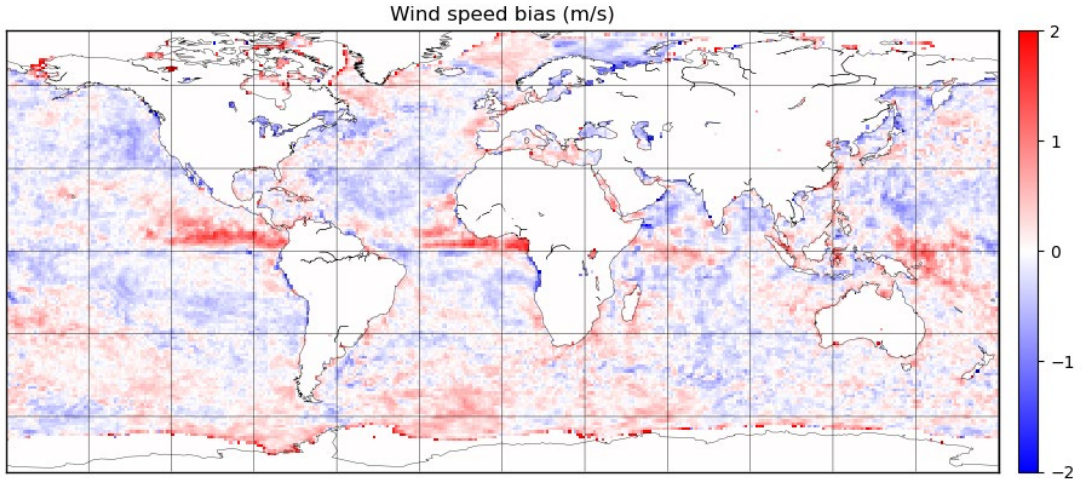




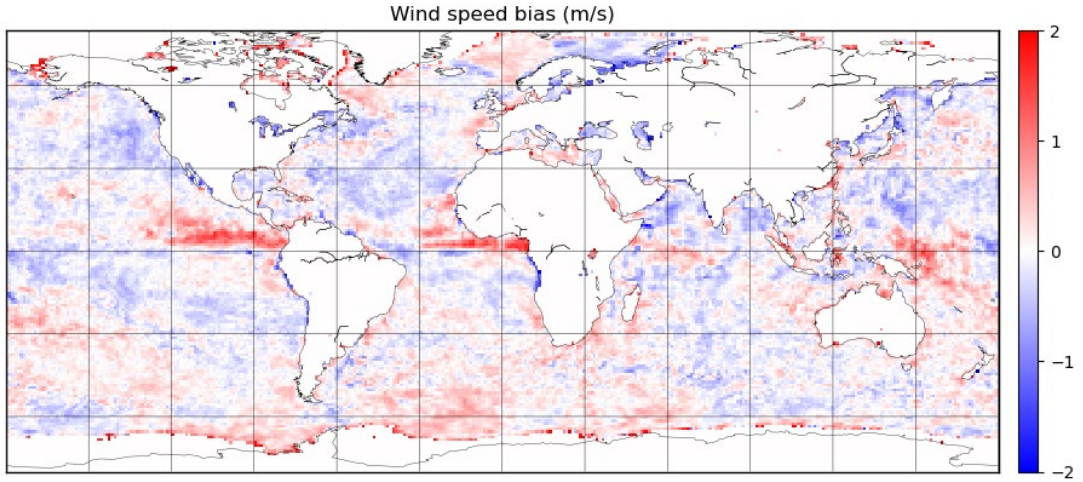




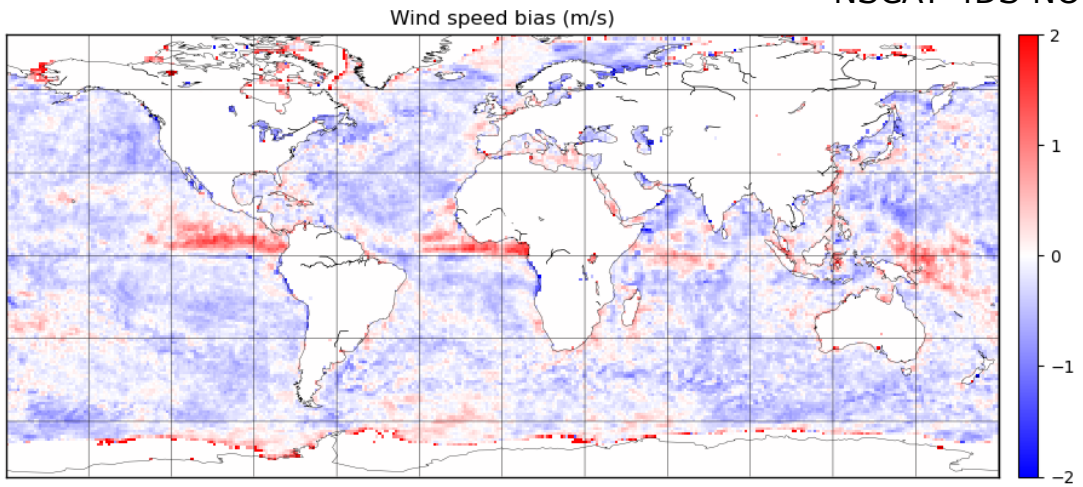
Wind speed bias w.r.t. ECMWF Oceansat-3



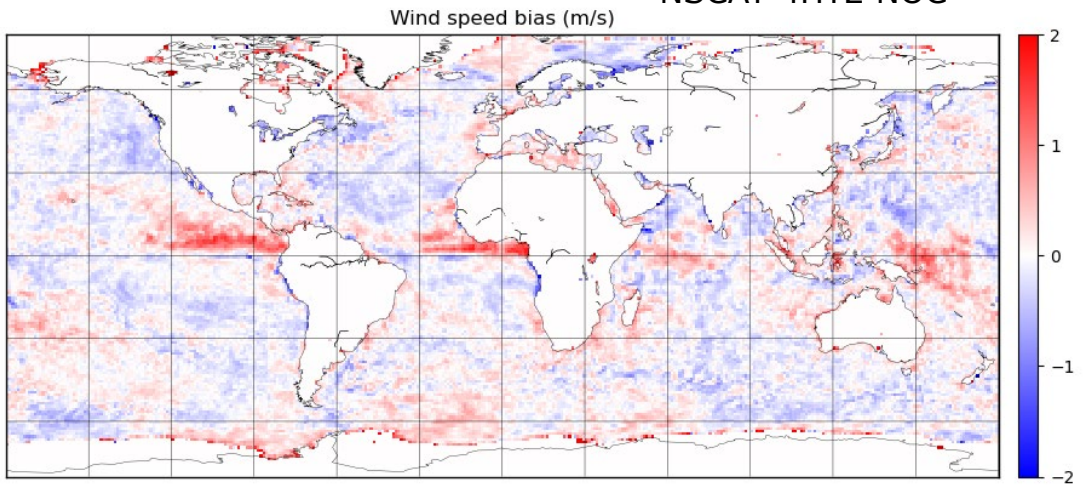
NSCAT-4DS NOC



NSCAT-4HY2 NOC

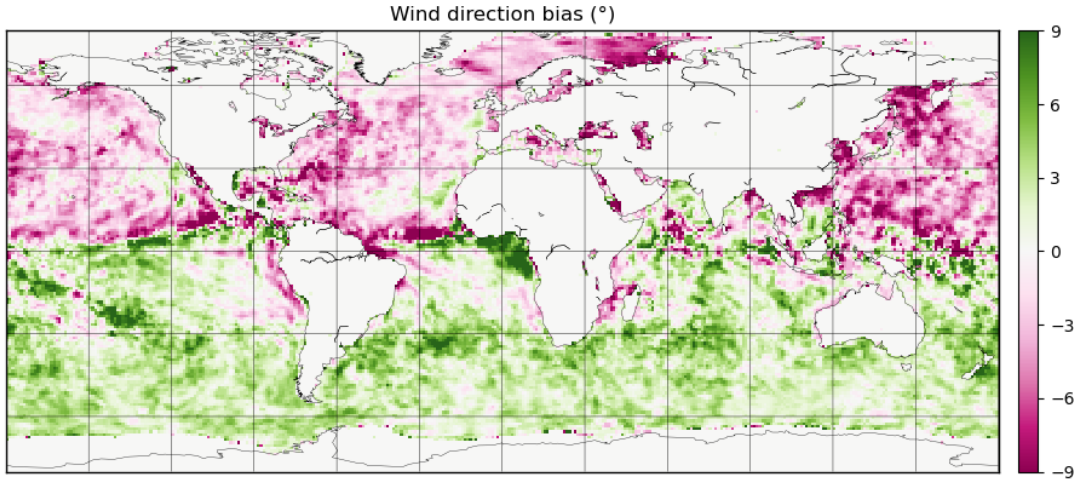


NSCAT-4DS HOC σ_0

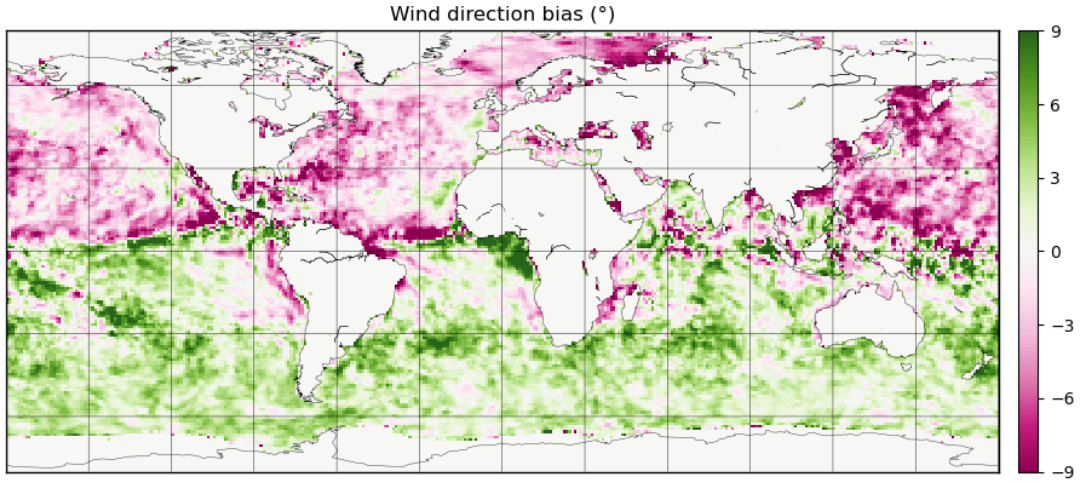


NSCAT-4DS HOC wind speed

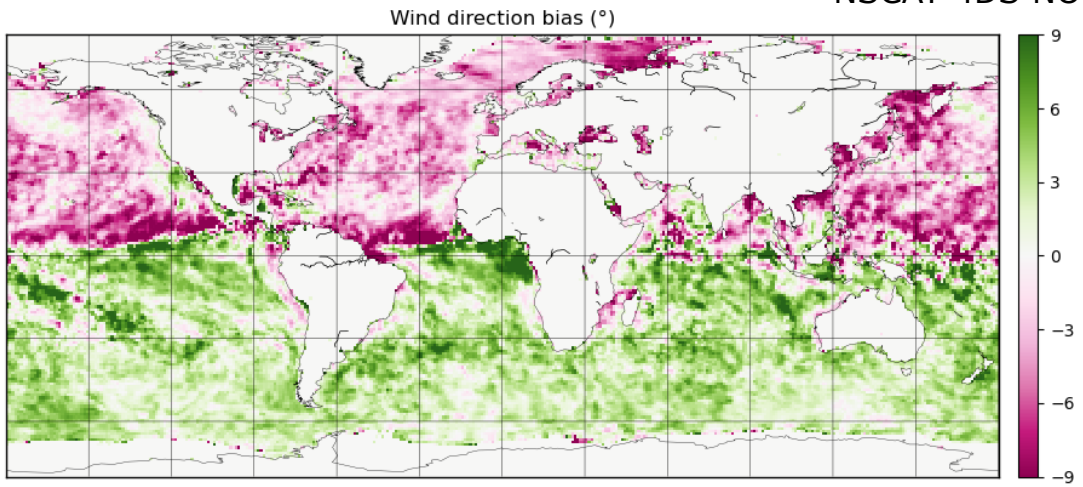
Wind direction bias w.r.t. ECMWF Oceansat-3



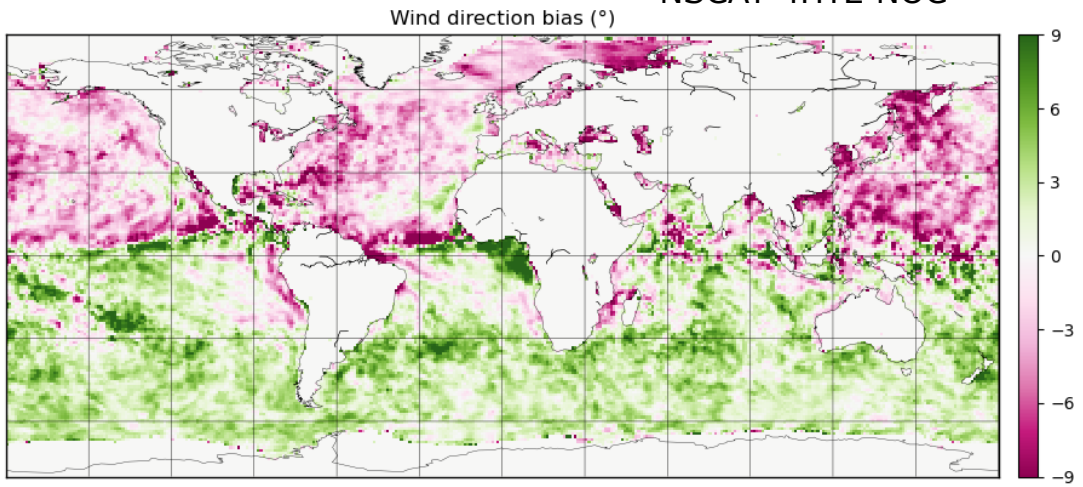
NSCAT-4DS NOC



NSCAT-4HY2 NOC

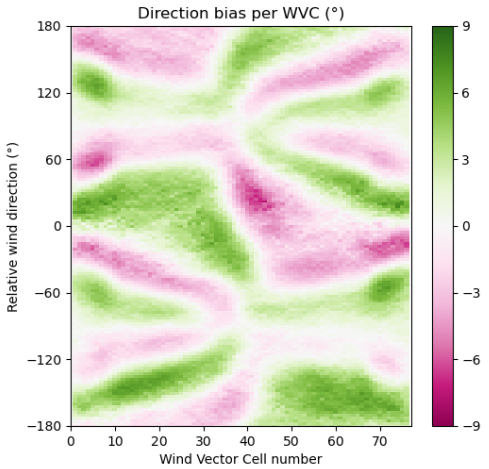


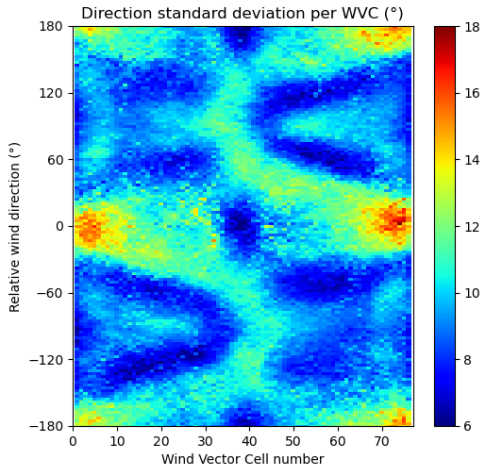
NSCAT-4DS HOC σ_0



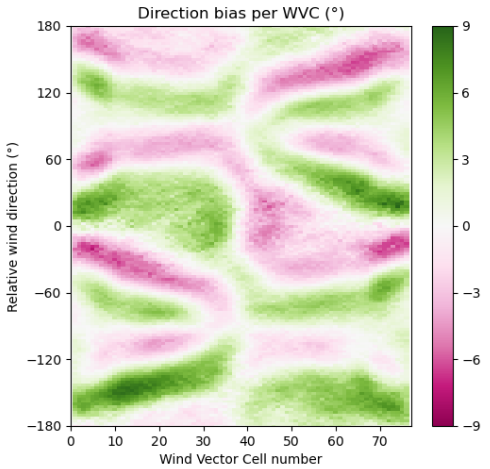
NSCAT-4DS HOC wind speed

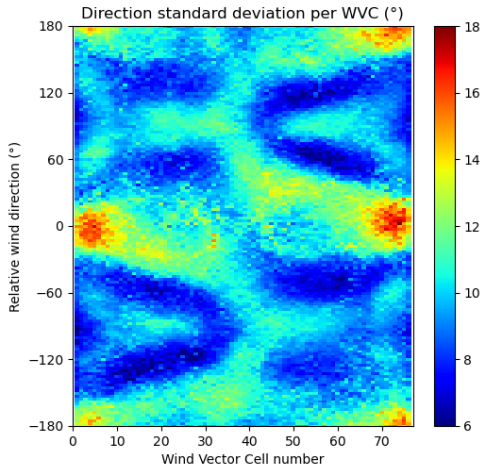
Wind direction bias per WVC Oceansat-3



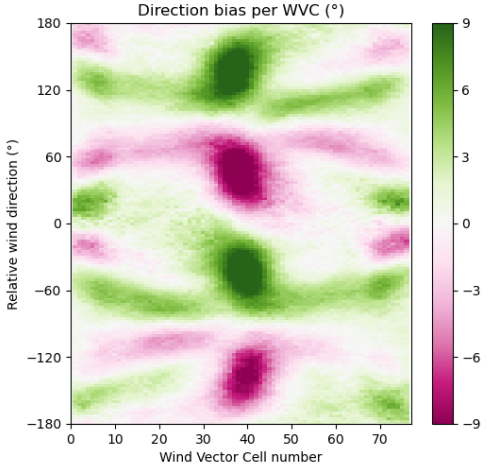


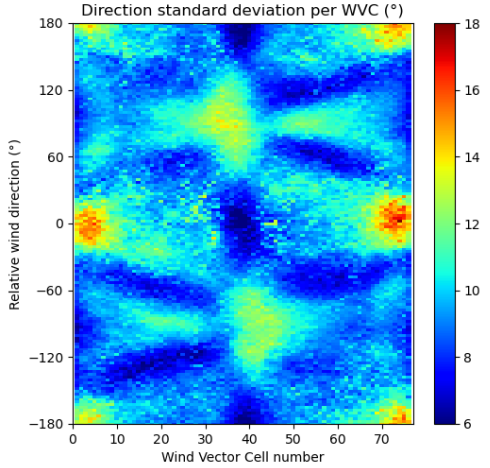
NSCAT-4DS NOC



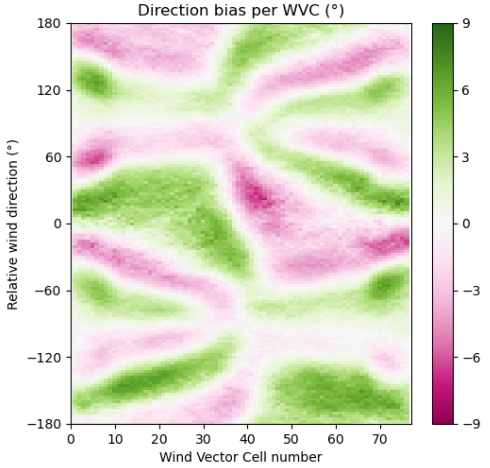


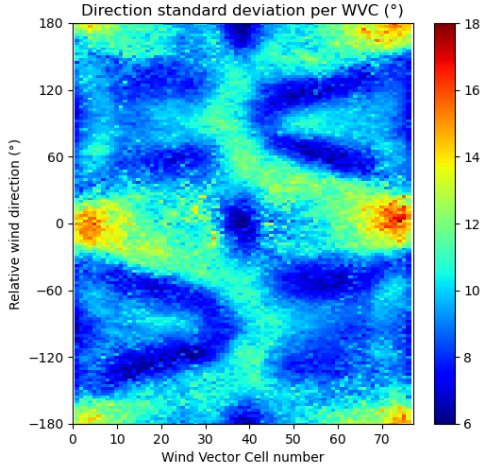
NSCAT-4HY2 NOC





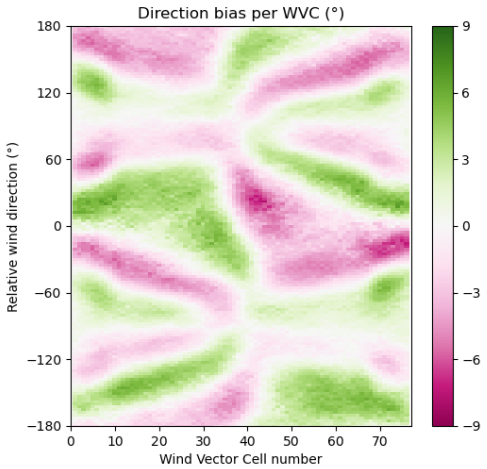
NSCAT-4DS HOC σ_0

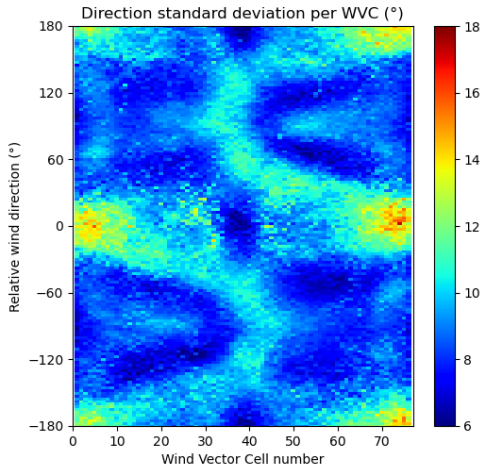




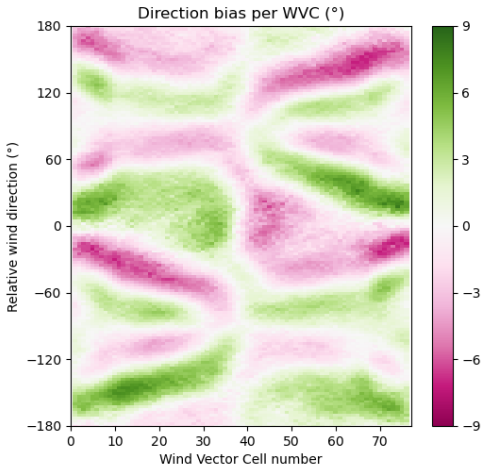
NSCAT-4DS HOC wind speed

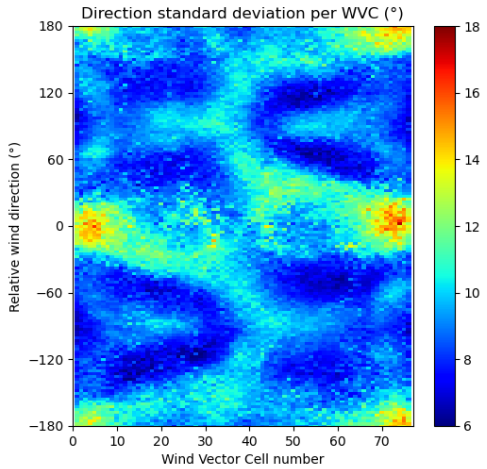
Corrected for lat/lon dependent (model) biases



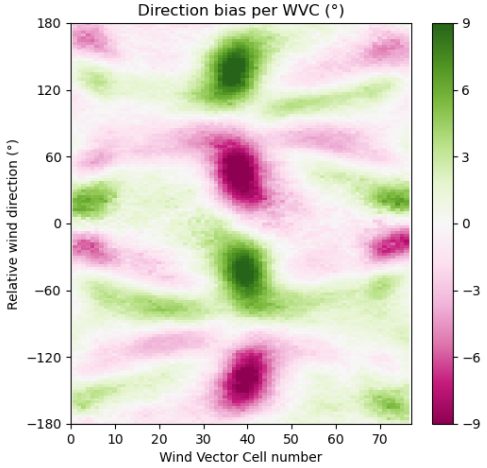


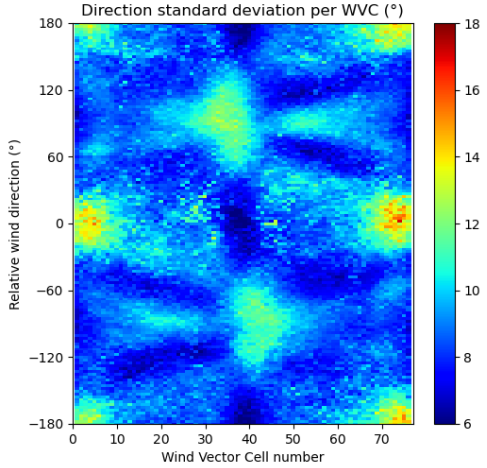
NSCAT-4DS NOC



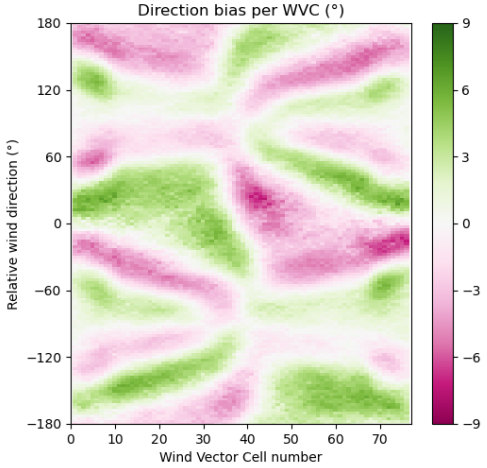


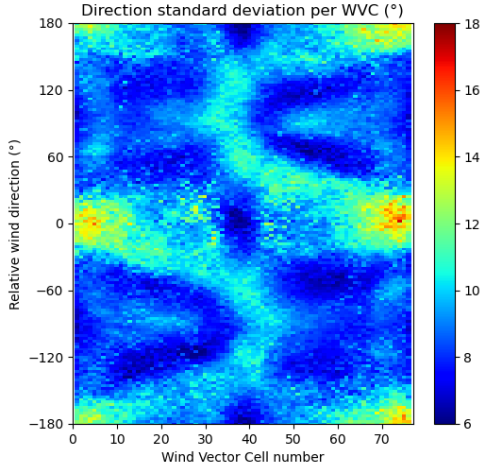
NSCAT-4HY2 NOC





NSCAT-4DS HOC σ_0





NSCAT-4DS HOC wind speed

Conclusions

- The Oceansat-3 OSCAT instrument performs well and good quality winds can be retrieved
- Coastal processing yields consistent results; it will be used in our processing, unlike for ScatSat-1
- The innermost and outermost full resolution slices in the footprints (eggs) appear to have slightly inconsistent σ_0 values and they are not used in the wind retrievals for now;
- Outer azimuth peak at 180^o needs further attention
- The wind statistics w.r.t. ECMWF winds are comparable to those from ScatSat-1
- Both HY-2B and Oceansat-3 show an increasing positive wind speed bias for higher wind speeds, this trend is stronger for Oceansat-3 than for HY-2B.
- The NSCAT4-HY2 GMF results in a flatter wind speed bias as a function of wind speed, but slightly deteriorates the wind direction and u/v statistics. It works better for HY-2B than for Oceansat-3.
- Backscatter data can be corrected with HOC prior to the wind inversion. This results in a flatter wind speed bias as a function of wind speed, but at the same time a negative overall wind speed bias and a deterioration of the wind speed bias as a function of WVC number and also a deterioration of the wind direction and u/v statistics. This effect is stronger for Oceansat-3 than for HY-2B.
- Retrieved wind speeds can also be corrected using HOC. This results in a flatter wind speed bias without introducing overall biases and without changing the wind direction and u/v statistics.
- QuikSCAT shows an increasing wind speed bias for higher wind speeds, comparable in magnitude to Oceansat-3, ASCAT shows an almost flat wind speed bias for high wind speeds.
- OPS* improves differences between scatterometer and ECMWF model winds