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NWP Ocean Calibration for the CFOSAT wind scatterometer and wind retrieval evaluation

Zhen Li, Ad Stoffelen, Anton Verhoef, and Jeroen Verspeek

Royal Netherlands Meteorological Institute

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Outline

- CSCAT L2A data characteristics
- NWP Ocean calibration (NOC):
  - NOC as a function of incidence angle
  - NOC as a function of incidence angle and antenna azimuth angle
- Wind retrieval performance evaluation
- Summary

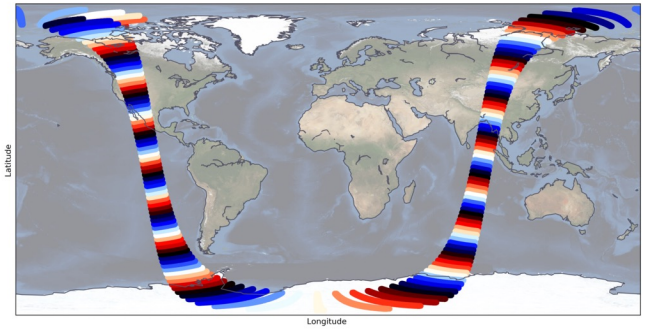
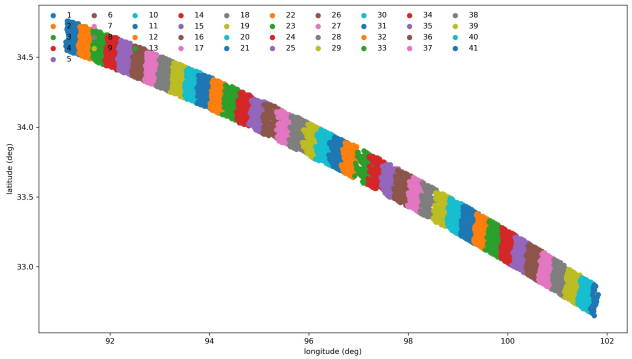
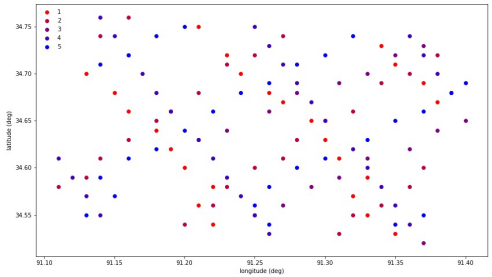


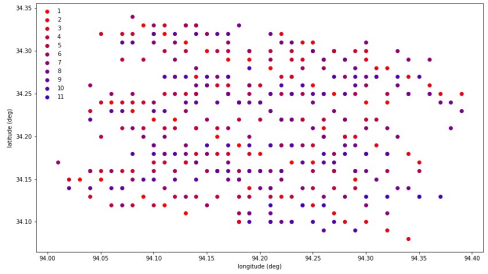
Illustration of the slices organized by rows (10 rows interval)



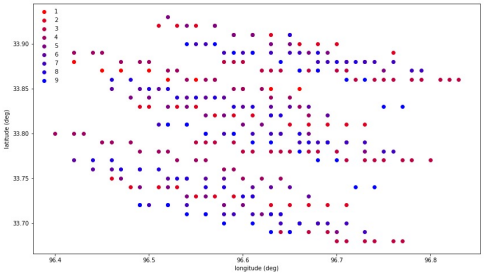
WVC distribution of the row number 300 (different colour indicates different WVCs)



(a)



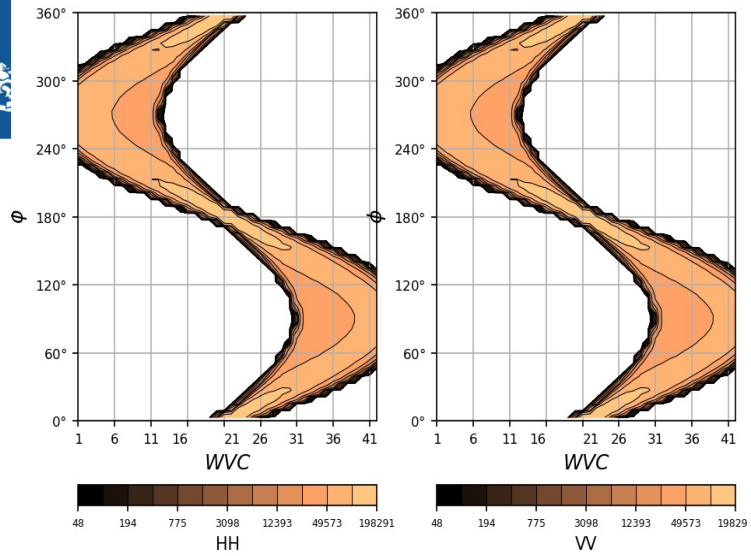
(b)



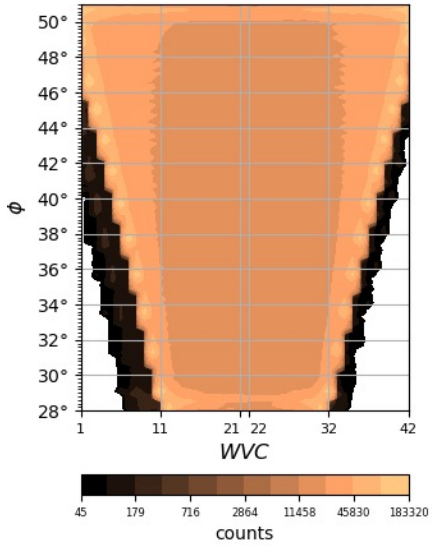
(c)

Slice positions in (a) outer WVC number 2, (b) sweet WVC number 11, (c) nadir WVC number 22, different colour indicates different view.

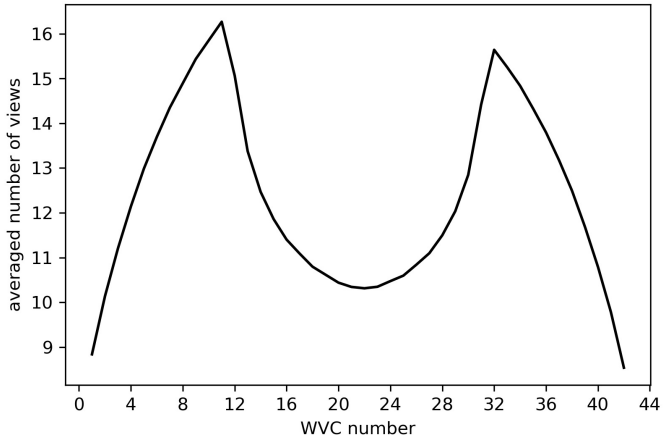
CSCAT data characteristics



Azimuth angle (antenna direction relative to the satellite movement direction) distribution as a function of WVC number across the track.



Incidence angle distribution as a function of WVC number across the track



Average number of views at the WVCs across the swath

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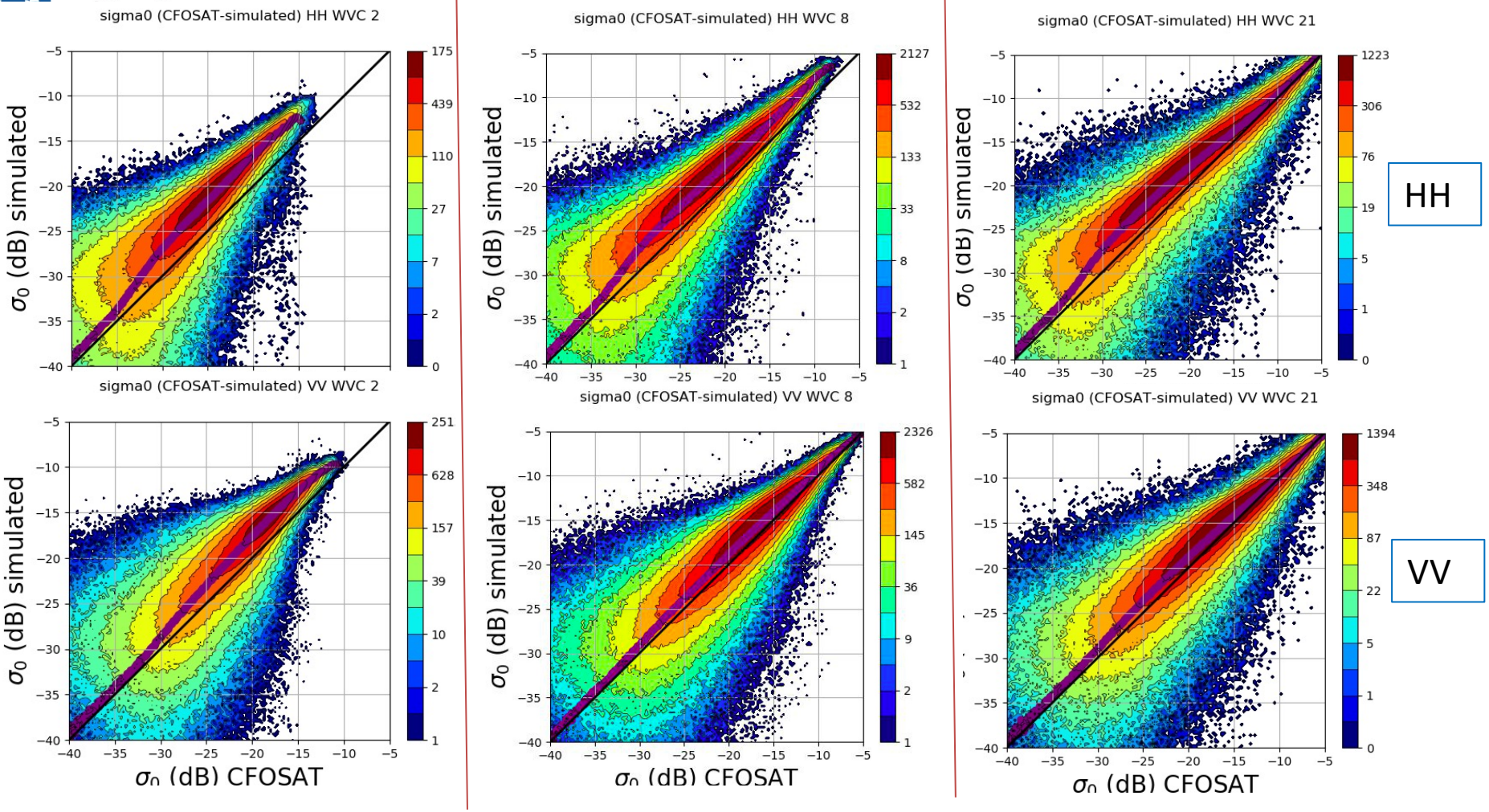
Outer WVC

Sweet WVC

Nadir WVC



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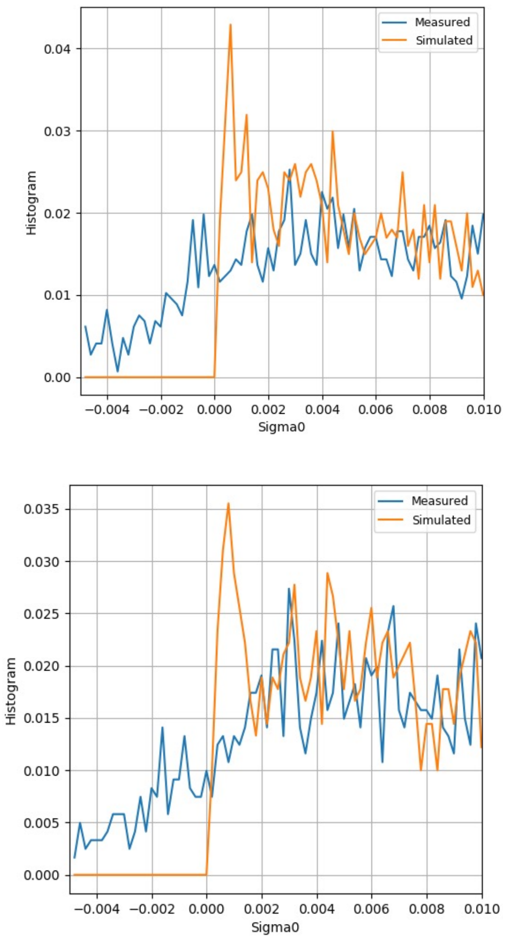
CSCAT data characteristics

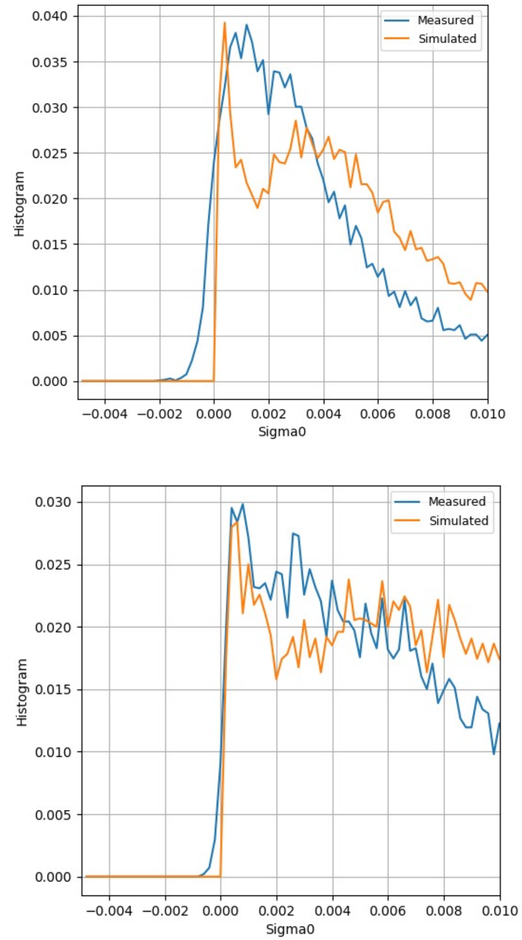
Low inc 30°

Medium inc 42°

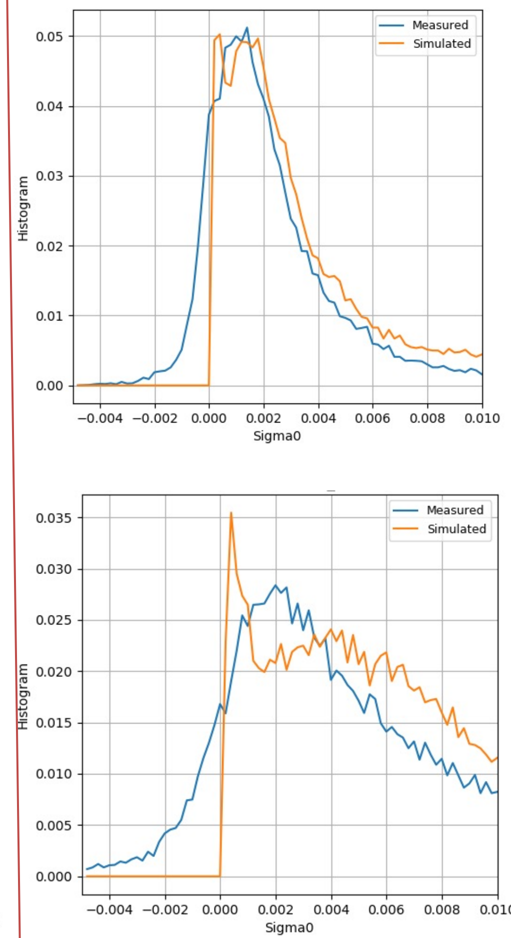
High inc 50°



(a)



(b)

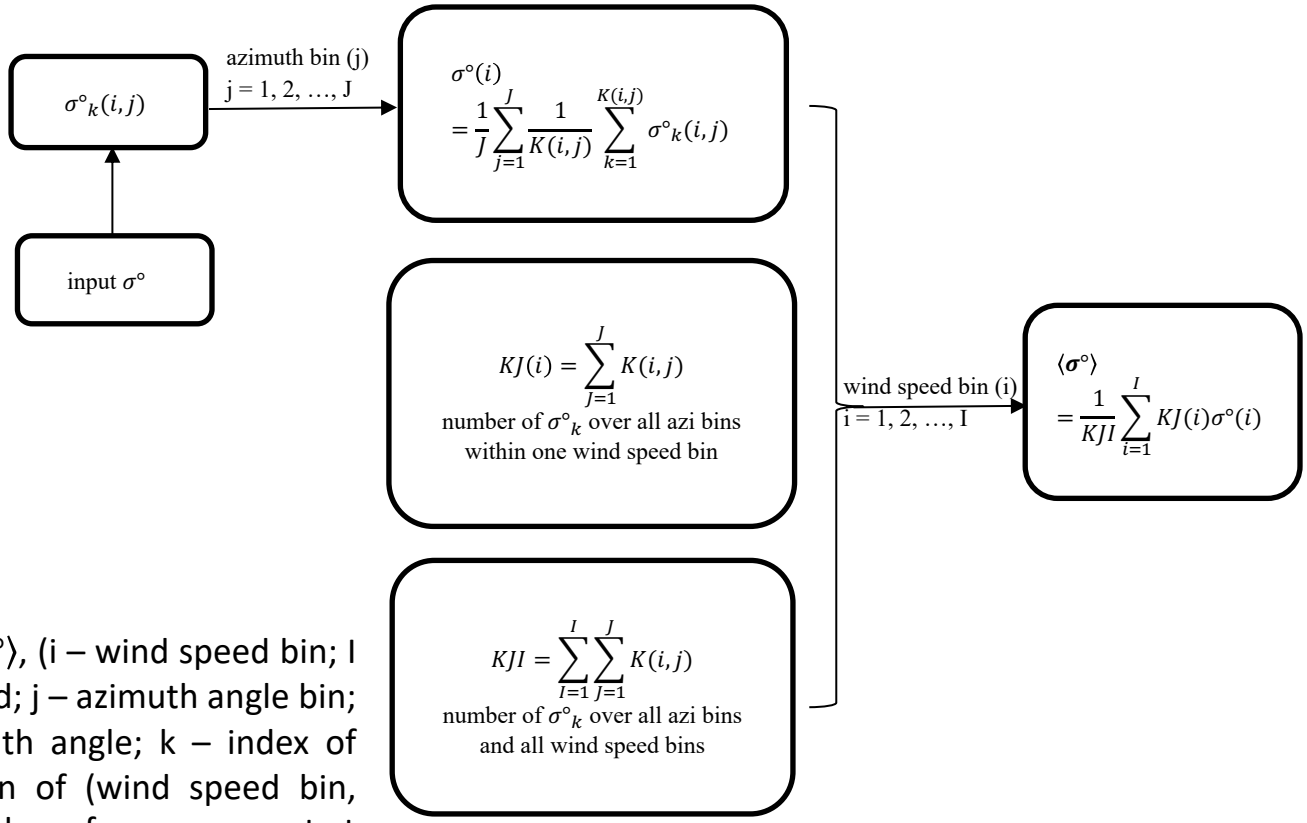


(c)

HH

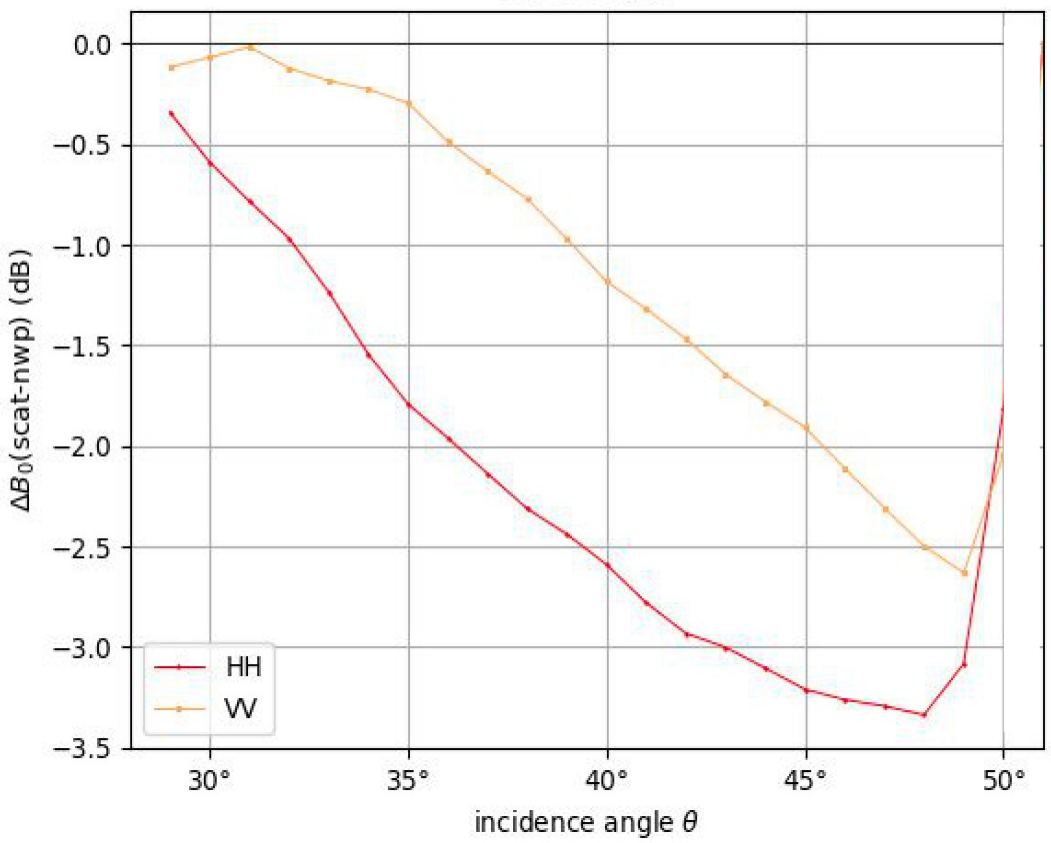
VV

Workflow of the NOC



Calculation scheme of the mean $\langle\boldsymbol{\sigma}^\circ\rangle$, (i – wind speed bin; I – total number of bins of wind speed; j – azimuth angle bin; J – total number of bins of azimuth angle; k – index of individual measurement at the bin of (wind speed bin, azimuth bin) $\sigma^\circ{}_k(i,j)$; K – total number of measurement at the bin of (wind speed bin, azimuth bin) K(i, j).

NOC as a function of incidence angle (**NOCinc**)



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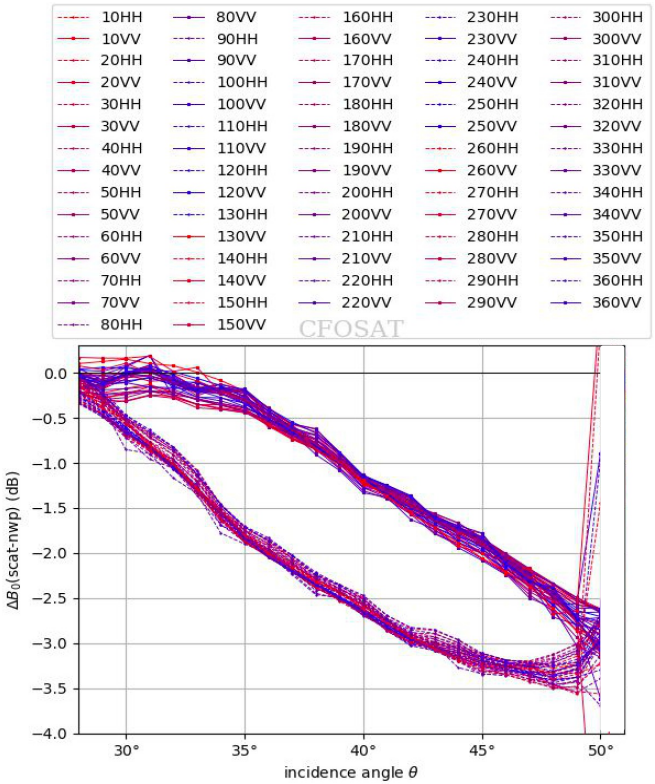
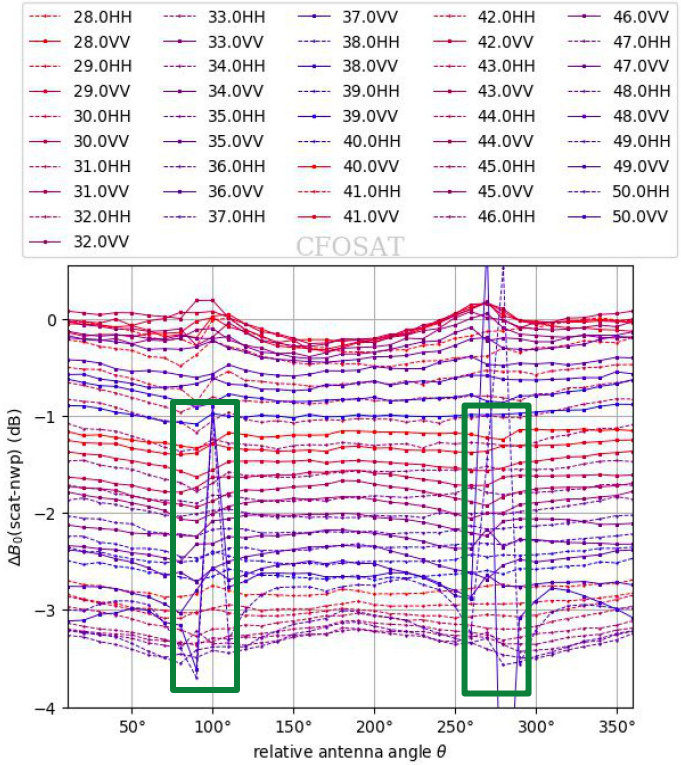
NOC as a function of incidence angle and antenna azimuth angle (**NOCant**)



NOCant for the 25-km product as a function of incidence angle per antenna azimuth angle bin



NOCant as a function of antenna azimuth angle per incidence angle bin. Dashed lines are HH polarization, solid lines are VV polarization

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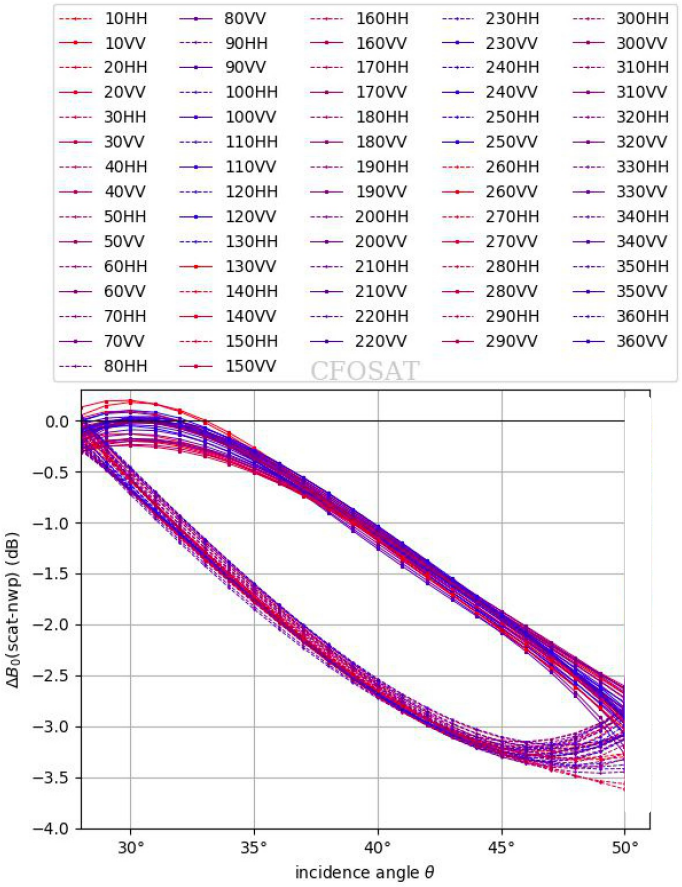

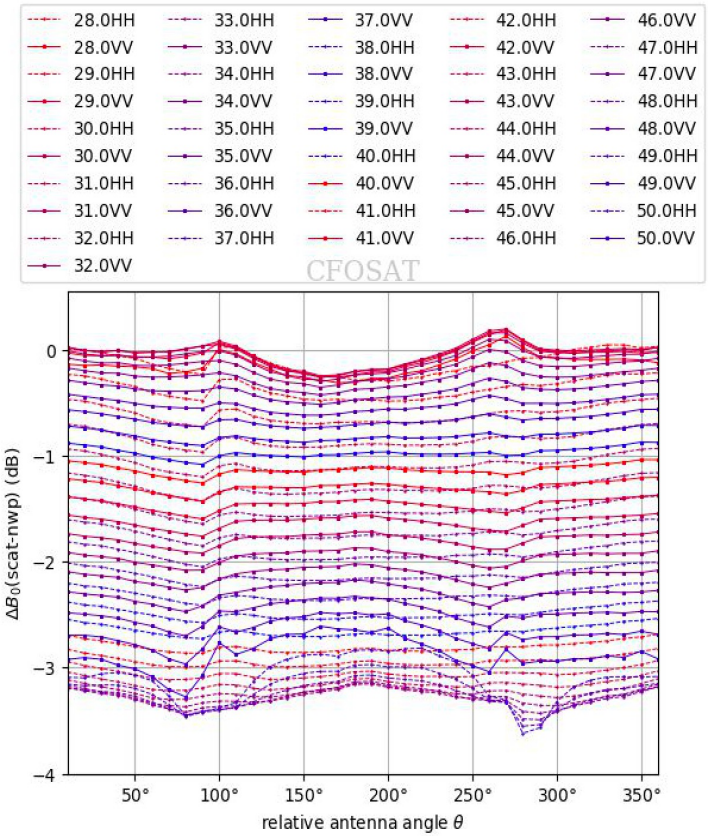

In order to avoid the large oscillation, NOCant is extrapolated at the incidence angle 50° , where the antenna azimuth angles are 90°, 100°, 270°, and 280°. Moreover, the NOCant is not as smooth as the NOCinc due to the binning and the limitation of the number of samples in each antenna azimuth angle bin and incidence bin. A 3rd order polynomial fit function is applied on the extrapolated NOCant in order to have smoother lines.

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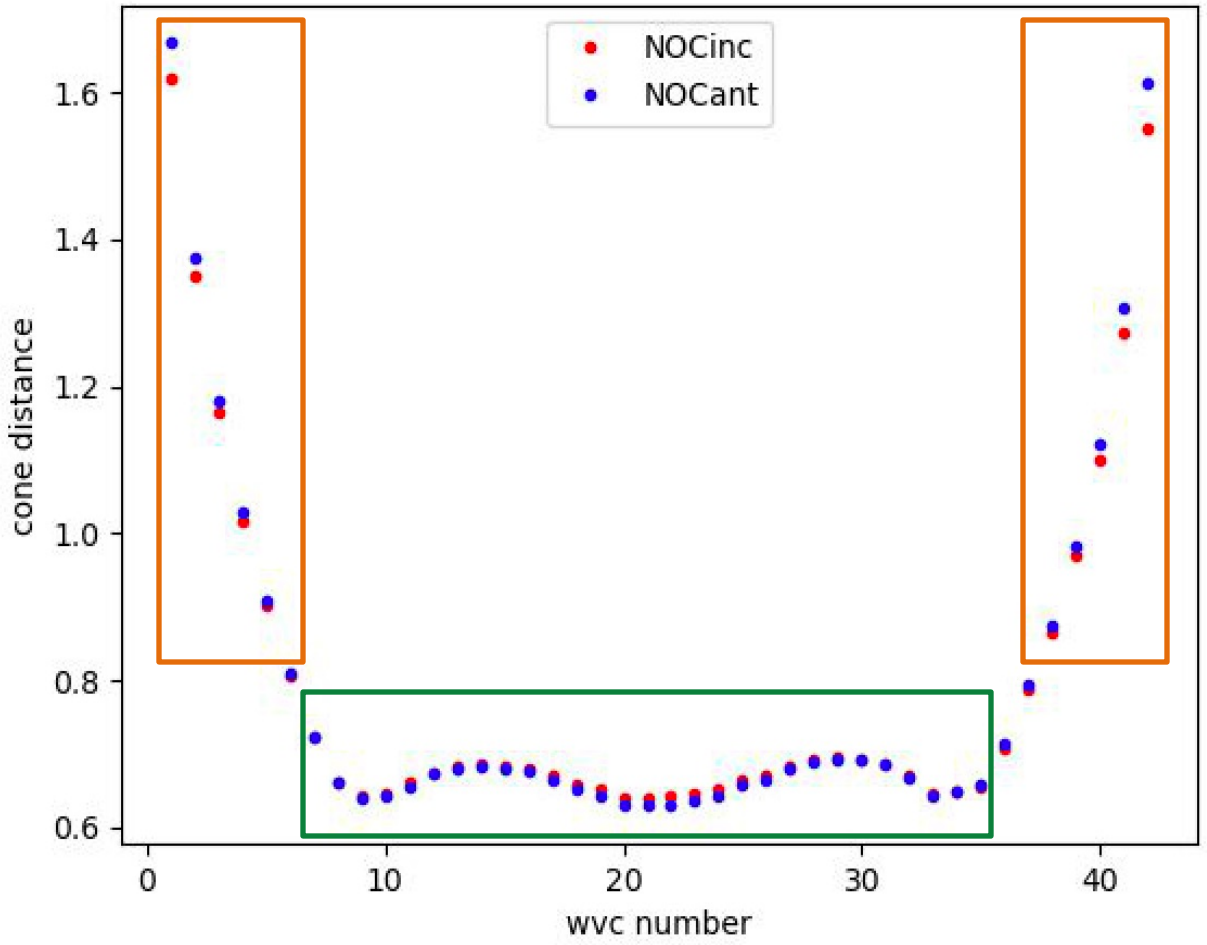
Collocated cone distance as a function of WVC number with the same MLE normalization and quality control threshold



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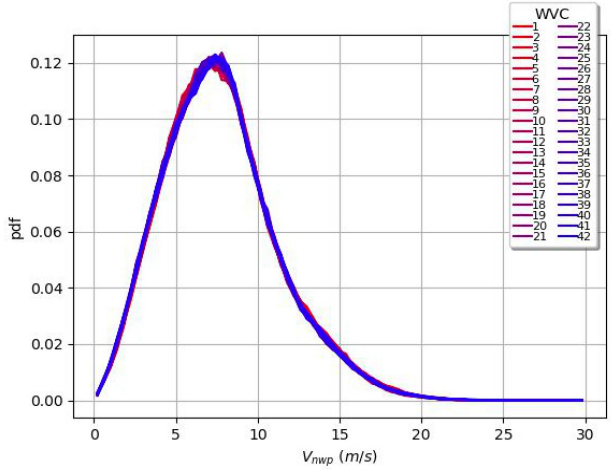
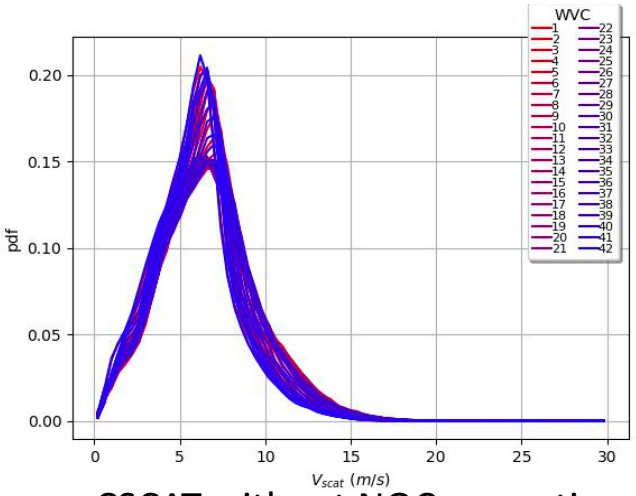
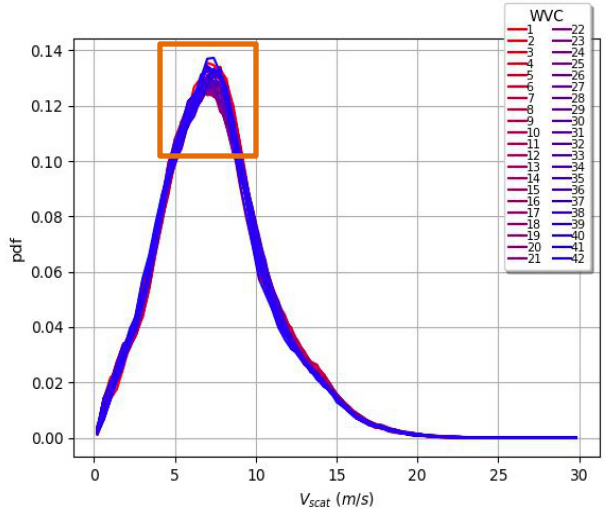
Wind speed PDF per WVC



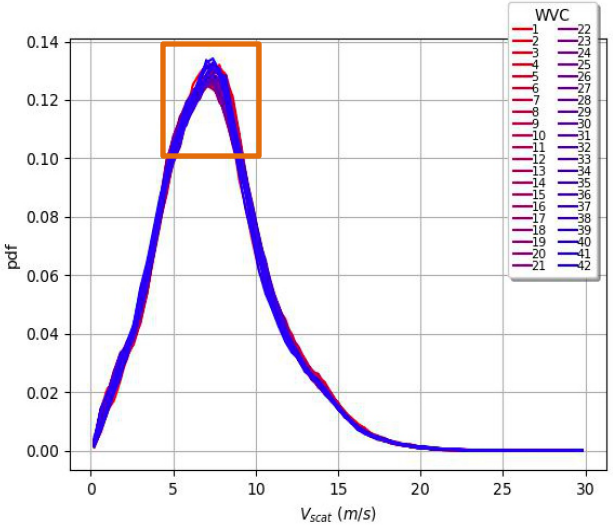
ECMWF



CSCAT without NOC correction



CSCAT with NOCinc correction



CSCAT with NOCant correction

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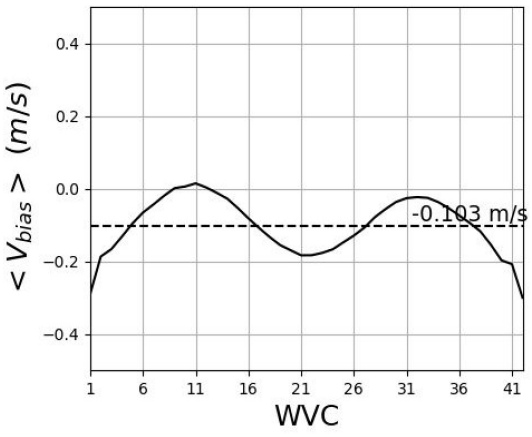
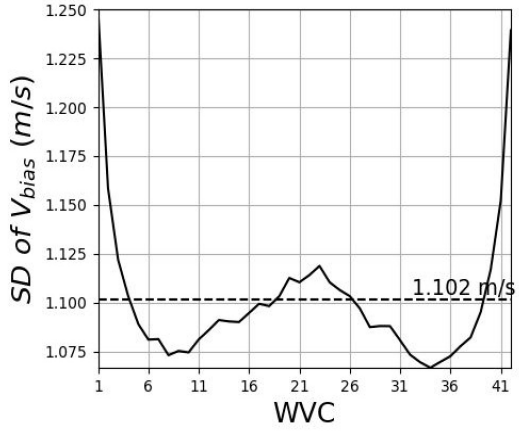
NOCinc

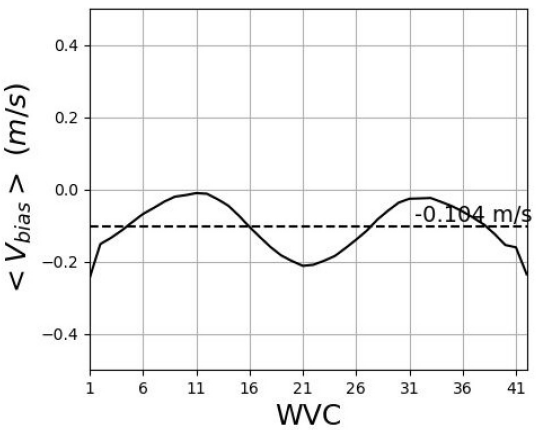


(a)

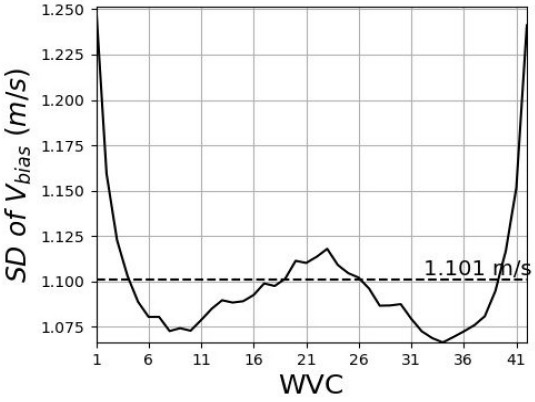


(d)

NOCant

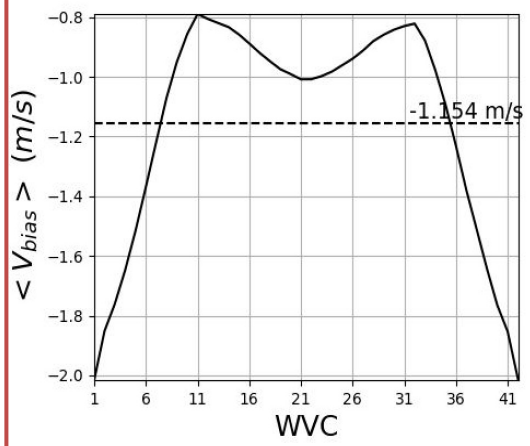


(b)

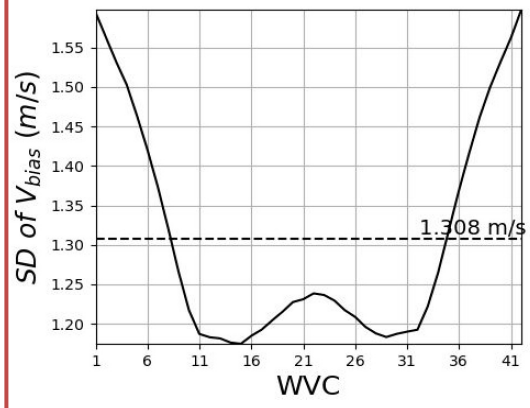


(e)

no NOC



(c)



(f)

(a) wind speed bias as a function of WVC with NOCinc correction; (b) with NOCant correction; (c) without NOC correction.
(d) standard deviation of the wind speed bias as a function of WVC with NOCinc correction; (e) with NOCant correction;
(f) without NOC correction.

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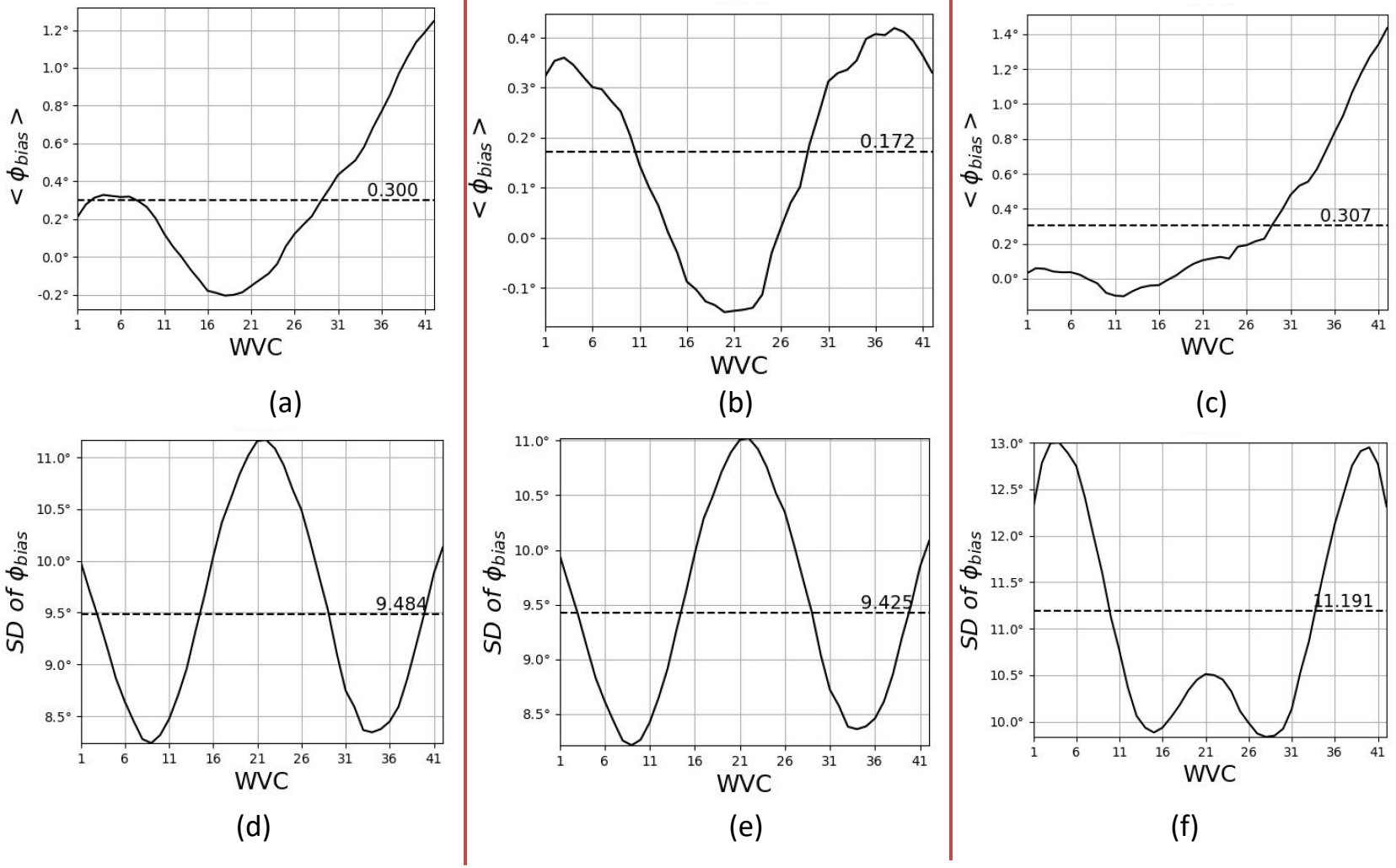
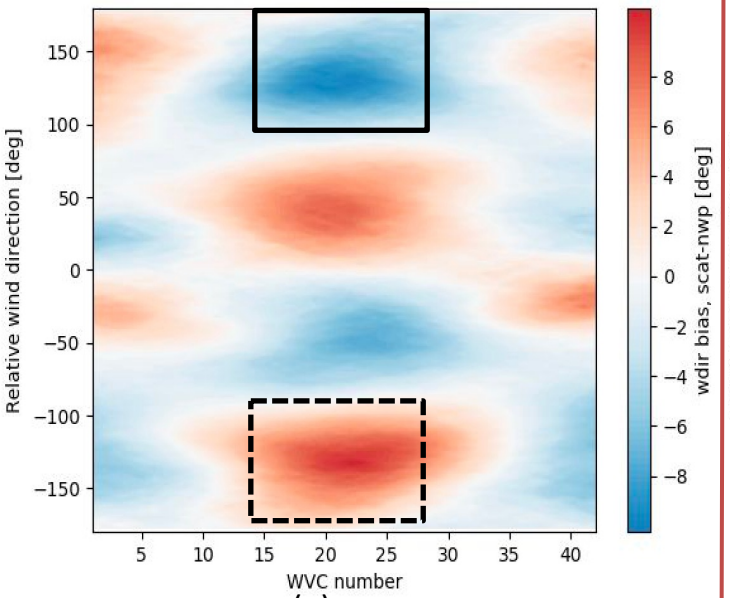
NOCinc | NOCant | no NOC



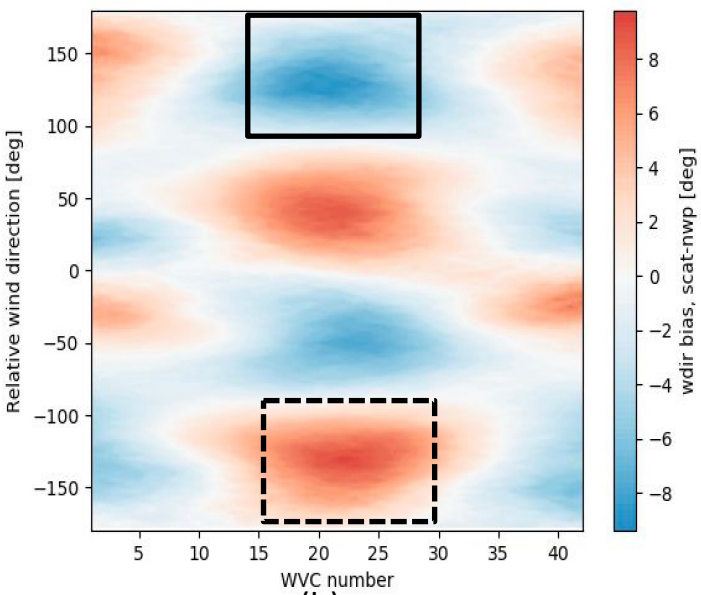
(a) wind direction bias as a function of WVC with NOCinc correction; (b) with NOCant correction; (c) without NOC correction. (d) standard deviation of the wind direction bias as a function of WVC with NOCinc correction; (e with NOCant correction; (f) without NOC correction.

NOCinc



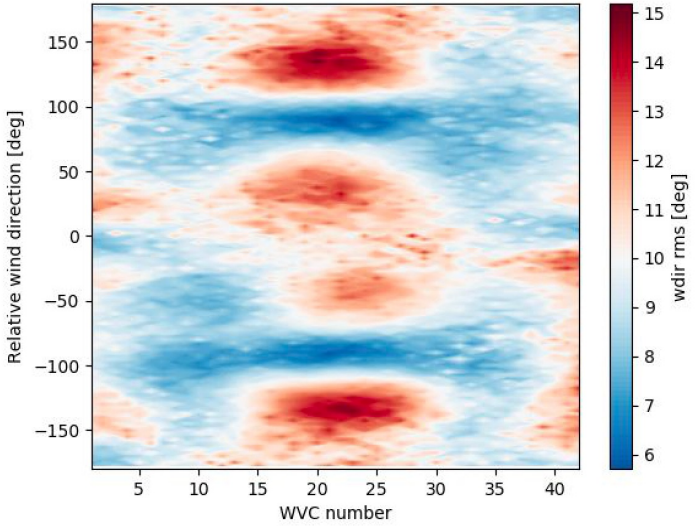
(a)

NOCant

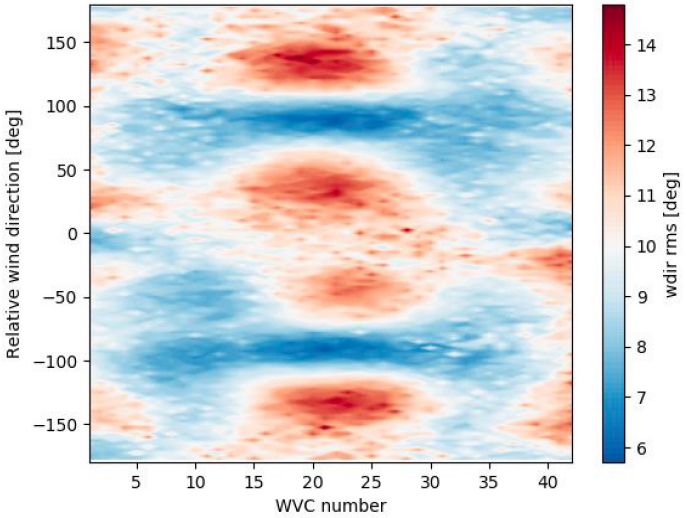


(b)

Relative wind direction bias (relative to the satellite motion direction) per WVC.
(a) with NOCinc correction.
(b) with NOCant correction.



(c)



(d)

Standard deviation of relative wind direction (relative to the satellite motion direction) bias per WVC.

(c) with NOCinc correction.

(d) with NOCant correction.

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Summary

- The characteristics of the CFOSAT SCAT level-2A data are analyzed and the wind retrieval performance strongly depends on the location across the swath.
- NOCant is developed to adapt to the rotation angle of the fan-beam of the SCAT. NOCant and NOCinc corrections are compared, where NOCant corrections makes the σ°s generally fit better to the GMF than NOCinc, except for the outer WVCs.
- NOCant also largely improves the ECMWF wind direction bias, as compared to NOCinc, especially at nadir WVCs.
- For the future study, it might be possible to combine NOCant and NOCinc in a way to eliminate the over correction of the NOCant at the outer WVCs and possibly keep the advantages of NOCant at the other WVCs.