On the development of SST-dependent GMFs for Ku-band scatterometers: SCATSAT-GMF

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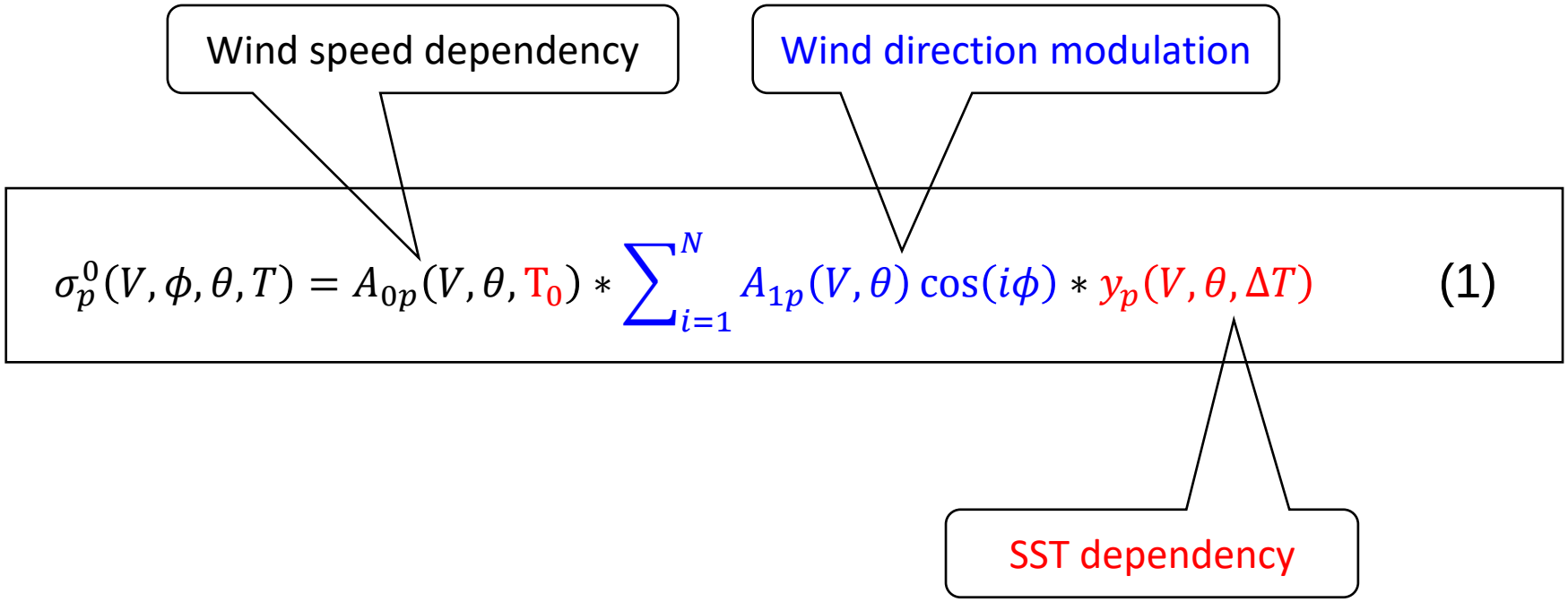
Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

Institute of Marine Sciences

CSIC
Consejo Superior de Investigaciones Científicas

Basic formulation of an SST-dependent GMF

NSCAT-5 GMF:

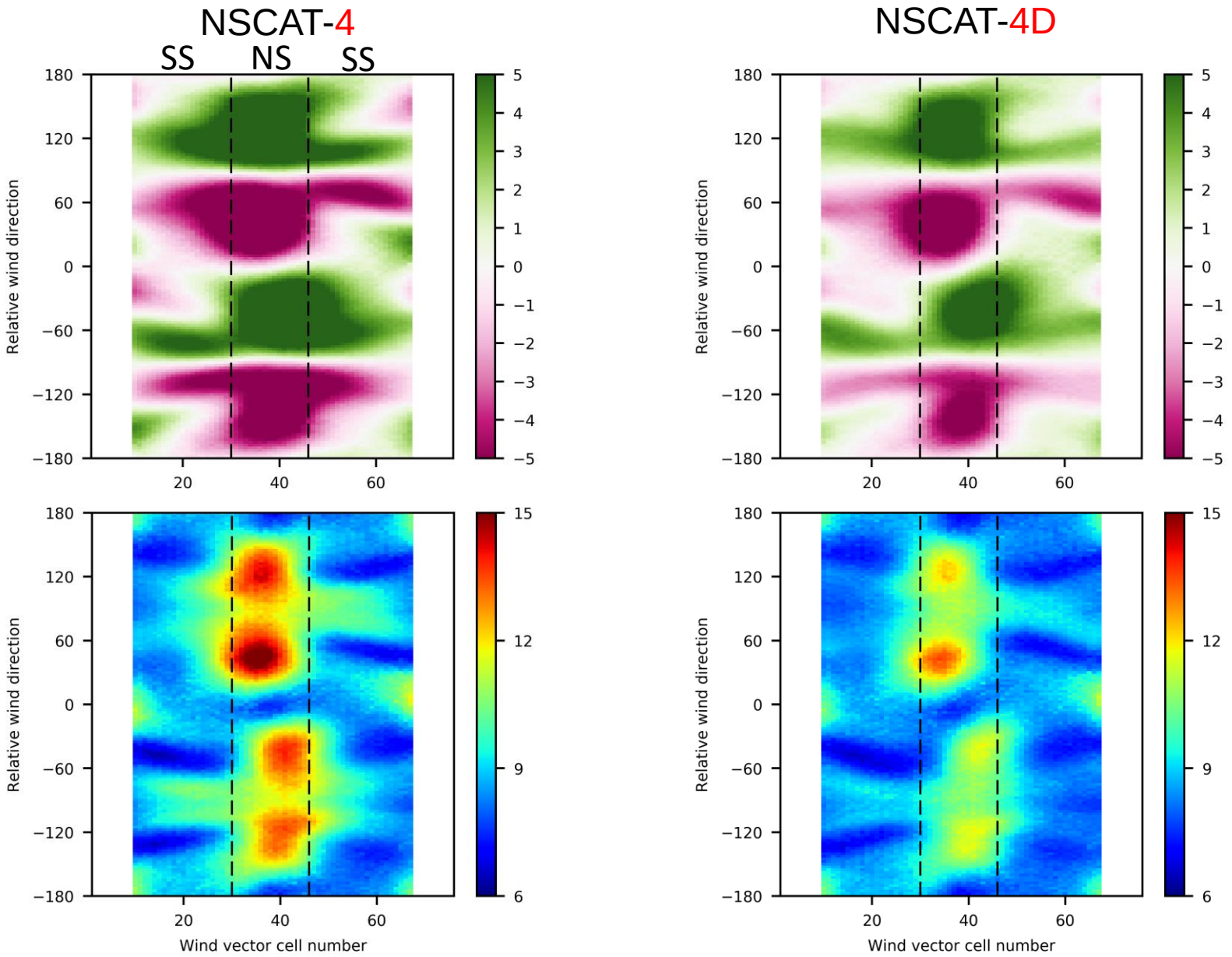


Wang et al., 2017, JGR.

- **What has been improved?**

Wind directions

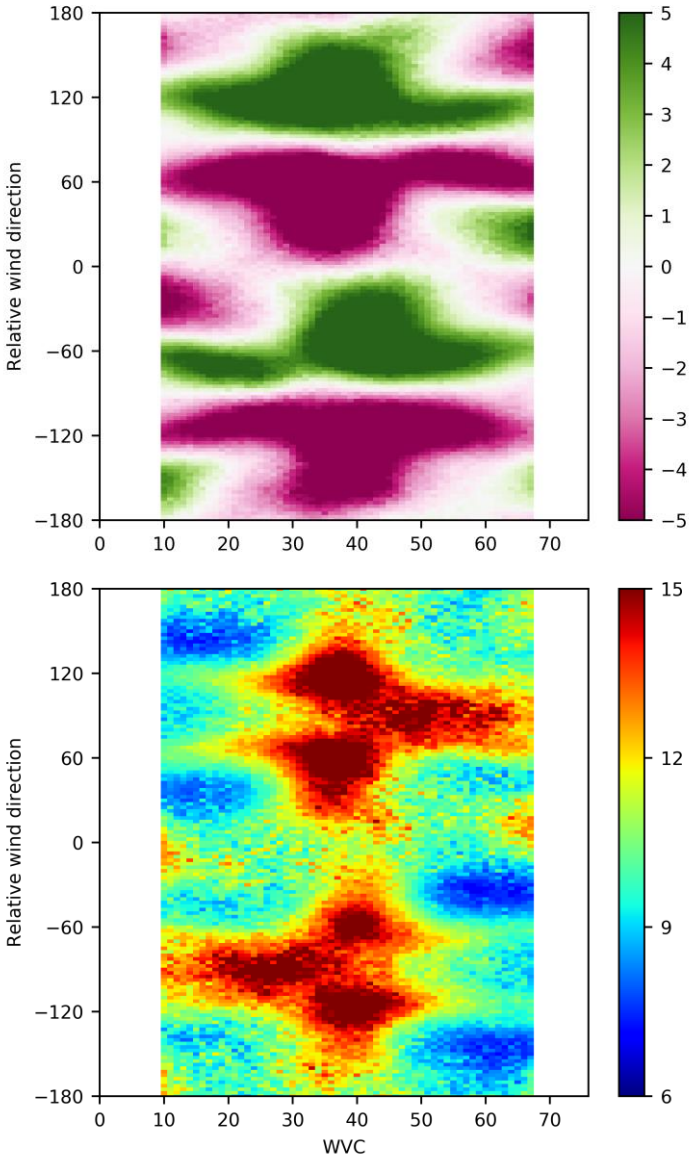
Comparing to NWP



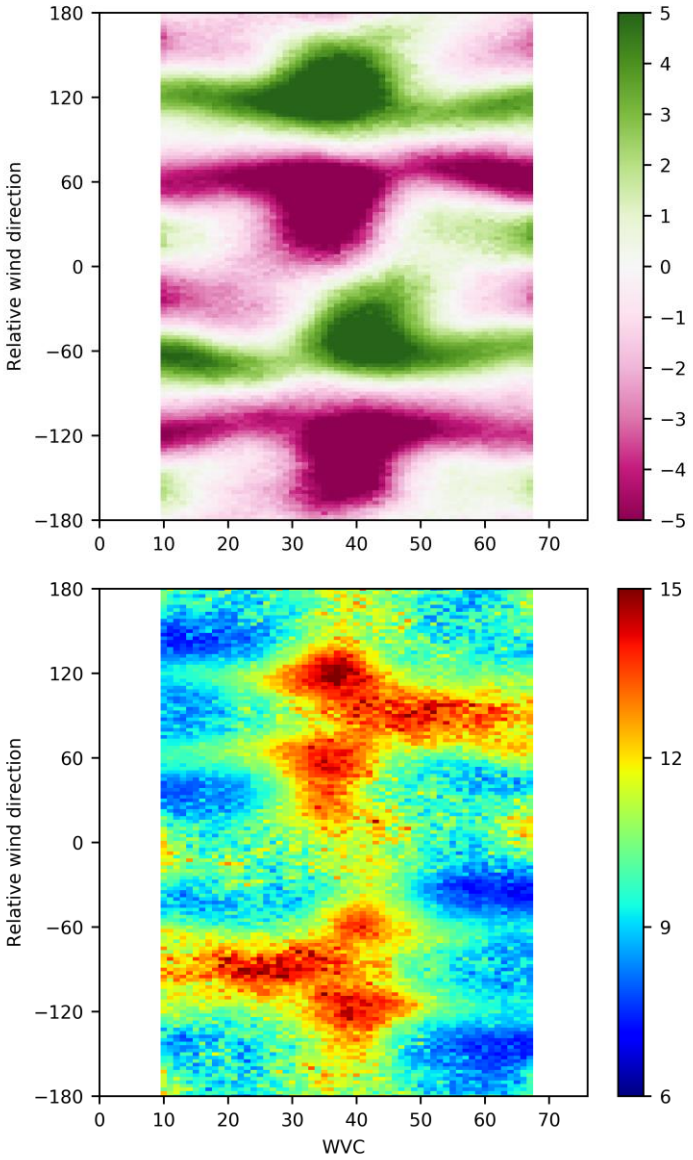
Wind directions

Comparing to ASCAT-A

NSCAT-4



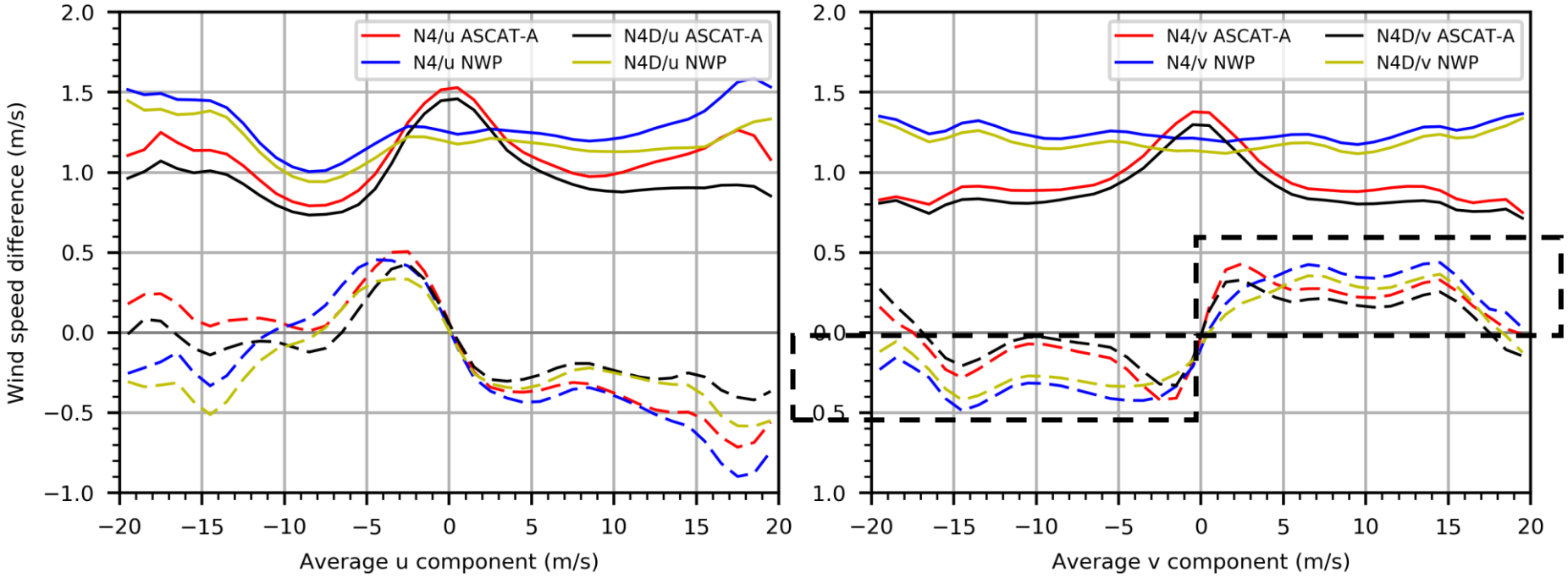
NSCAT-4D



Wind directions

Comparing to ASCAT-A or NWP

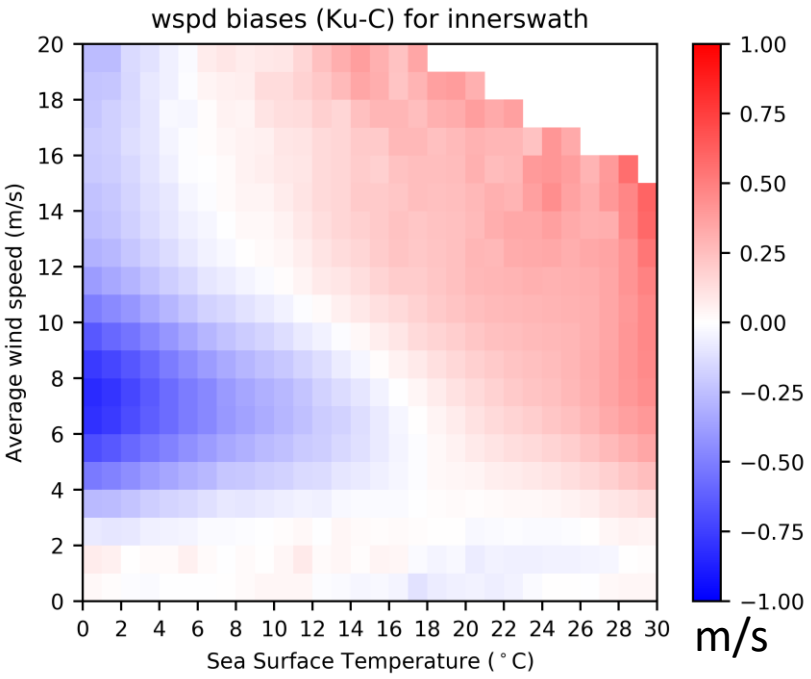
NSCAT-4 *vs* NSCAT-4D

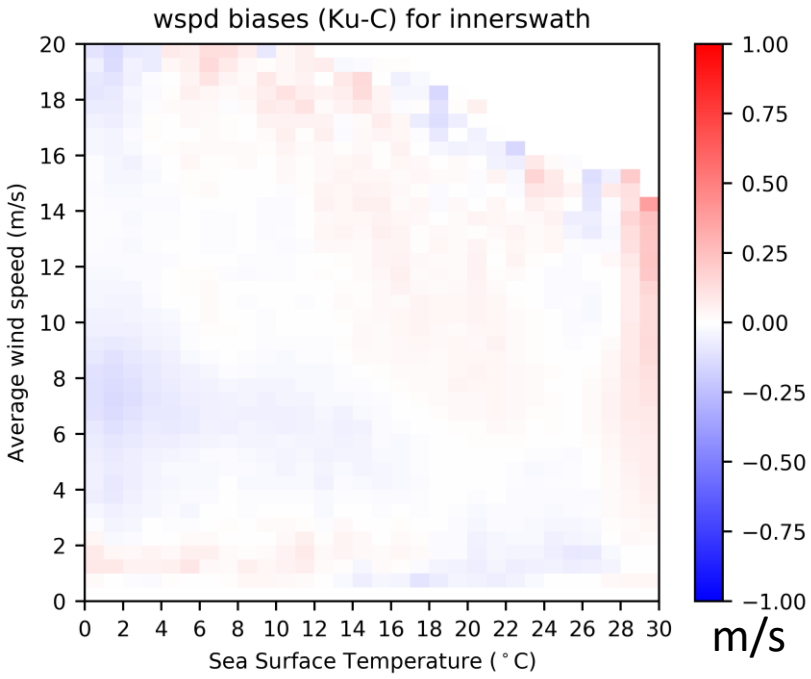


SST effects

Comparing to ASCAT-B

NSCAT-4 *vs* NSCAT-4T

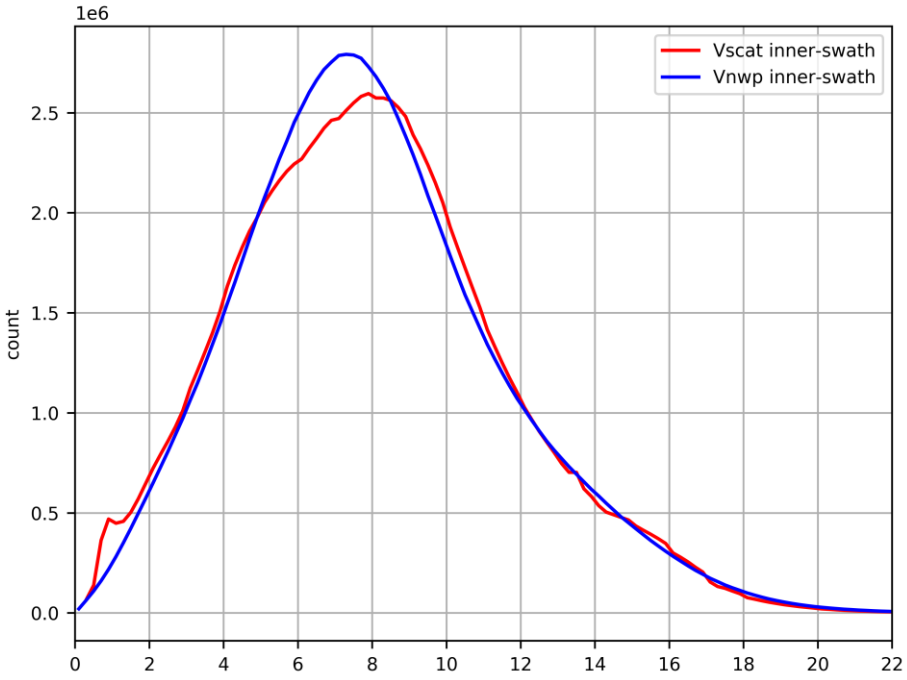


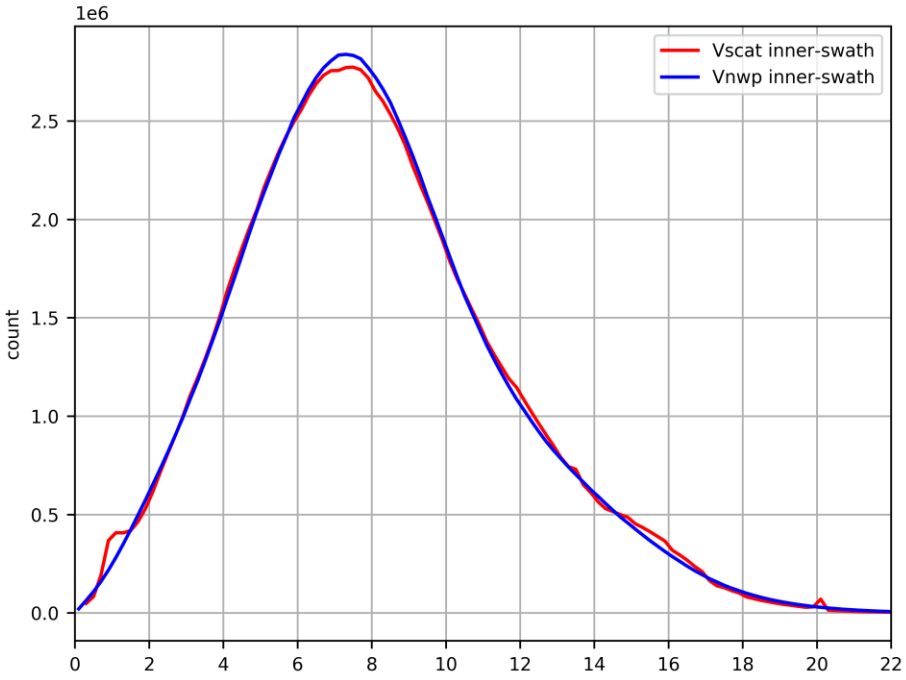


Wind speeds

Comparing to NWP

NSCAT-4 *vs* NSCAT-4S





Such deformed shape of PDF cannot be found/reported by other wind validation method (e.g. TC, RMS).

NSCAT-5 GMF

NSCAT-5 = NSCAT-4D.T.S

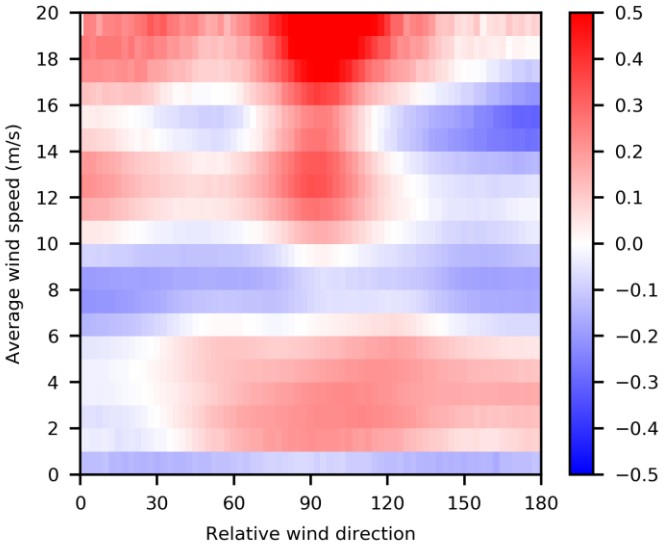
- **What has been done?**

Wind directions

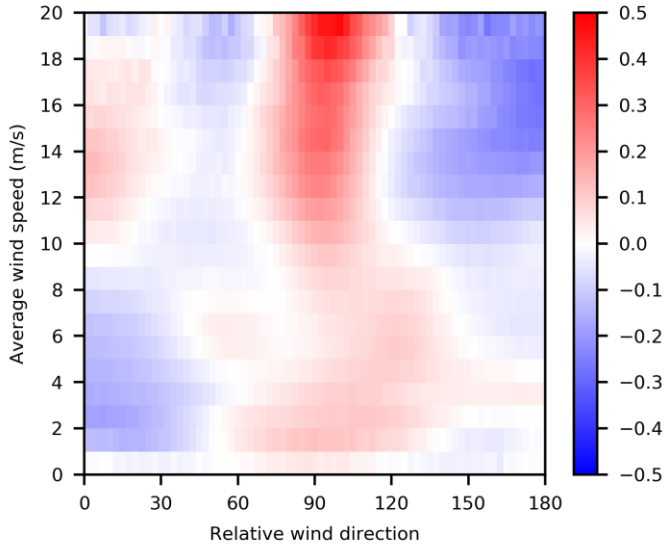
Remove wind speed bias caused by other factors

wind speed bias (m/s)

(1)



(2)



$$\Delta V(V,\phi) = V_{\mathrm{S}} - V_{\mathrm{Ref}} \qquad (1)$$

$$\Delta V'(V,\phi) = \Delta V(V,\phi) - \overline{\Delta V(V)} \qquad (2)$$

Wind directions

Methodology for improving the wind direction modulation:

$$J_p(V,\phi) = \frac{\sigma^0_{\mathrm{m},p}(V,\phi)}{\sigma^0_{\mathrm{s},p}(V,\phi)} * \frac{\overline{\sigma^0_{\mathrm{s},p}(V)}}{\overline{\sigma^0_{\mathrm{m},p}(V)}} \qquad (3)$$

Constant wind speed bias is removed!

$$D_p(V,\phi) = \left[\sigma^0_{\mathrm{N4},p}(V,\phi) + J_p(V,\phi)\right] / A^{\mathrm{N4}}_{0,p}(V) \qquad (4)$$

$$D'_p(V,\phi) = 1 + \sum_{i=1}^{4} A'_{i,p}(V) * \cos(i * \phi) \qquad (5)$$

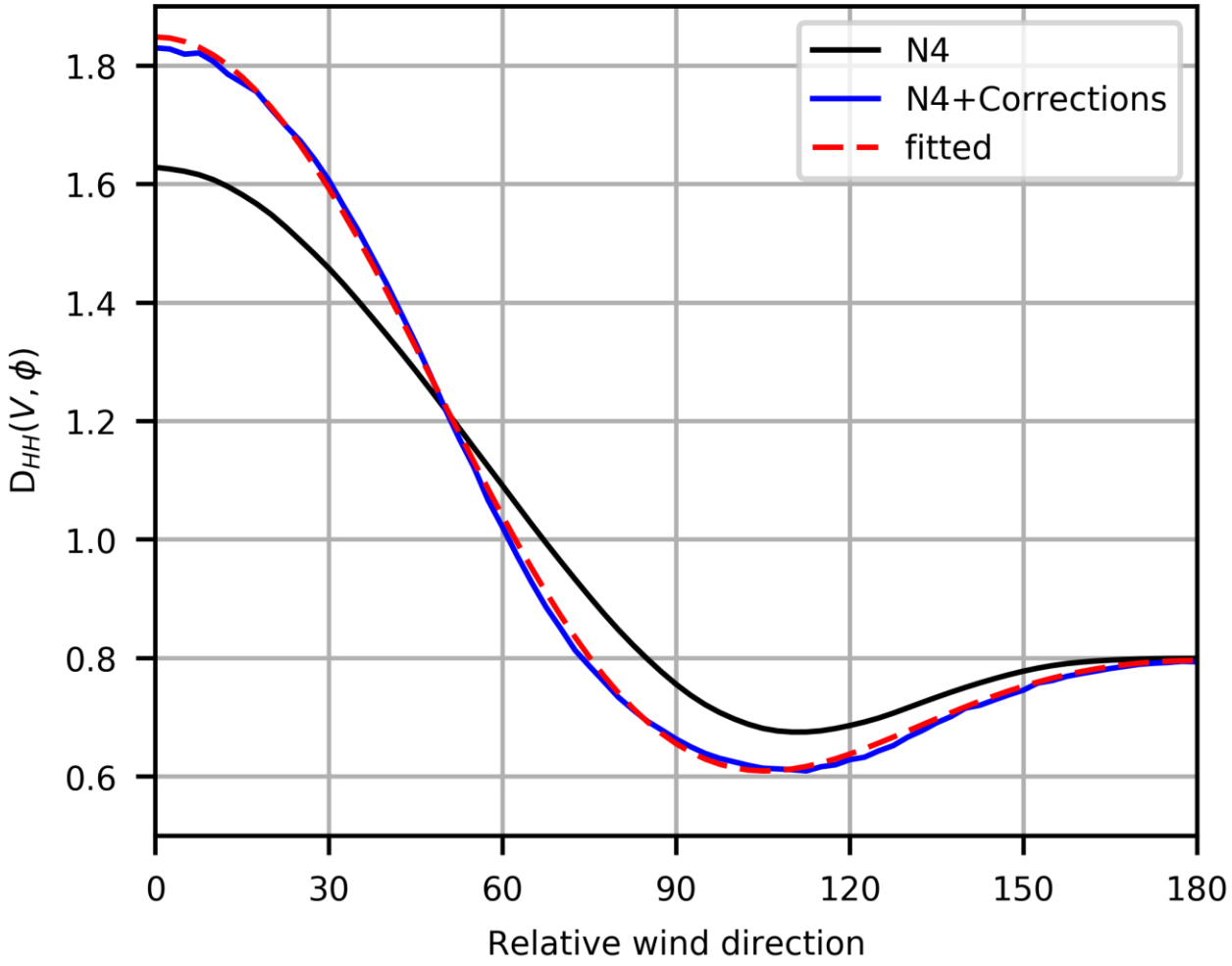
$$\sigma^0_{\mathrm{N4D},p}(V,\phi) = A^{\mathrm{N4}}_{0,p}(V) * \left[1 + \sum_{i=1}^{4} A^{\mathrm{N4D}}_{i,p}(V) * \cos(i * \phi)\right] \qquad (6)$$

NSCAT-4D GMF

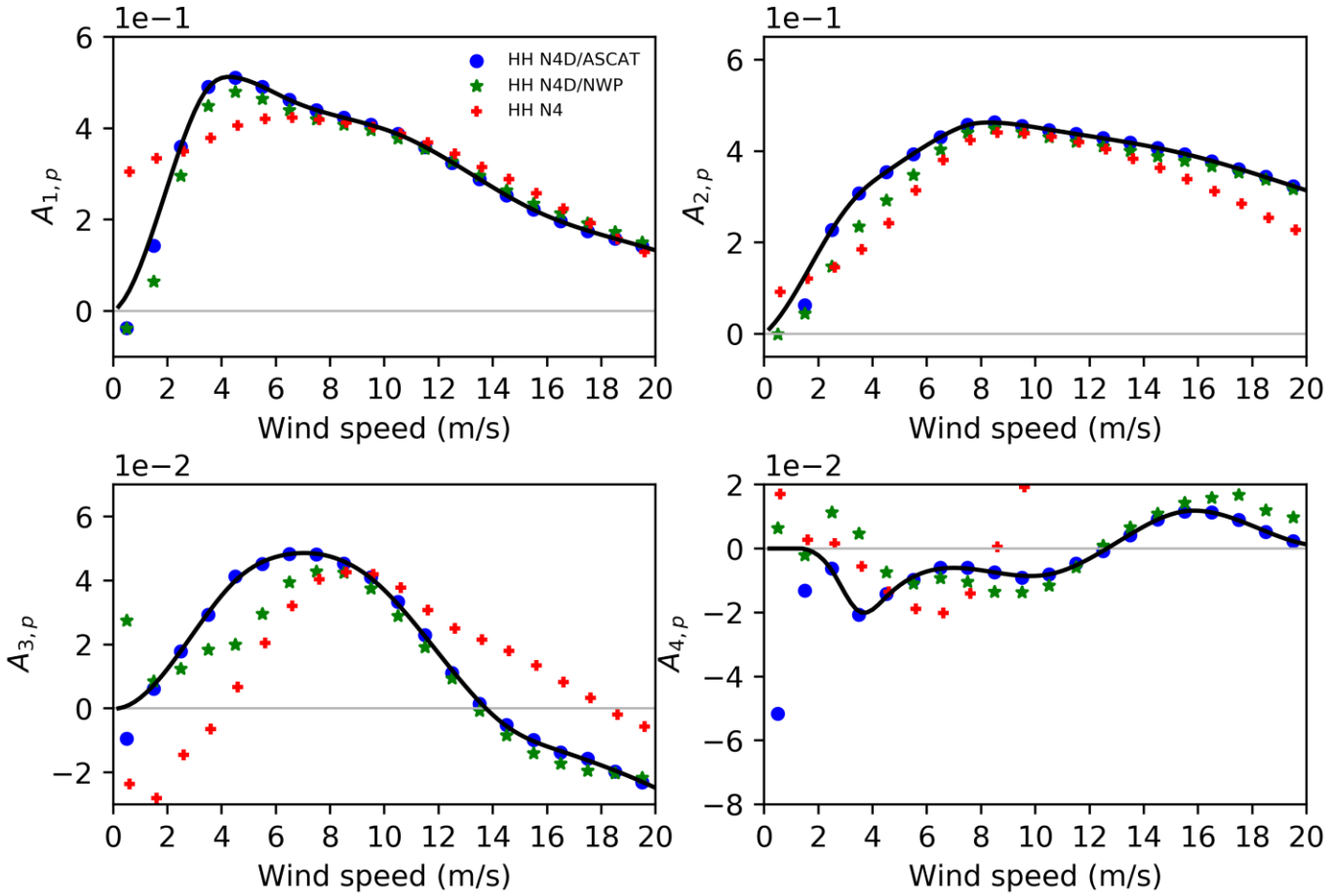
Wind directions

An Example for Fitting the New Wind Direction Modulation

HH, for wind speed center at 4.5 m/s

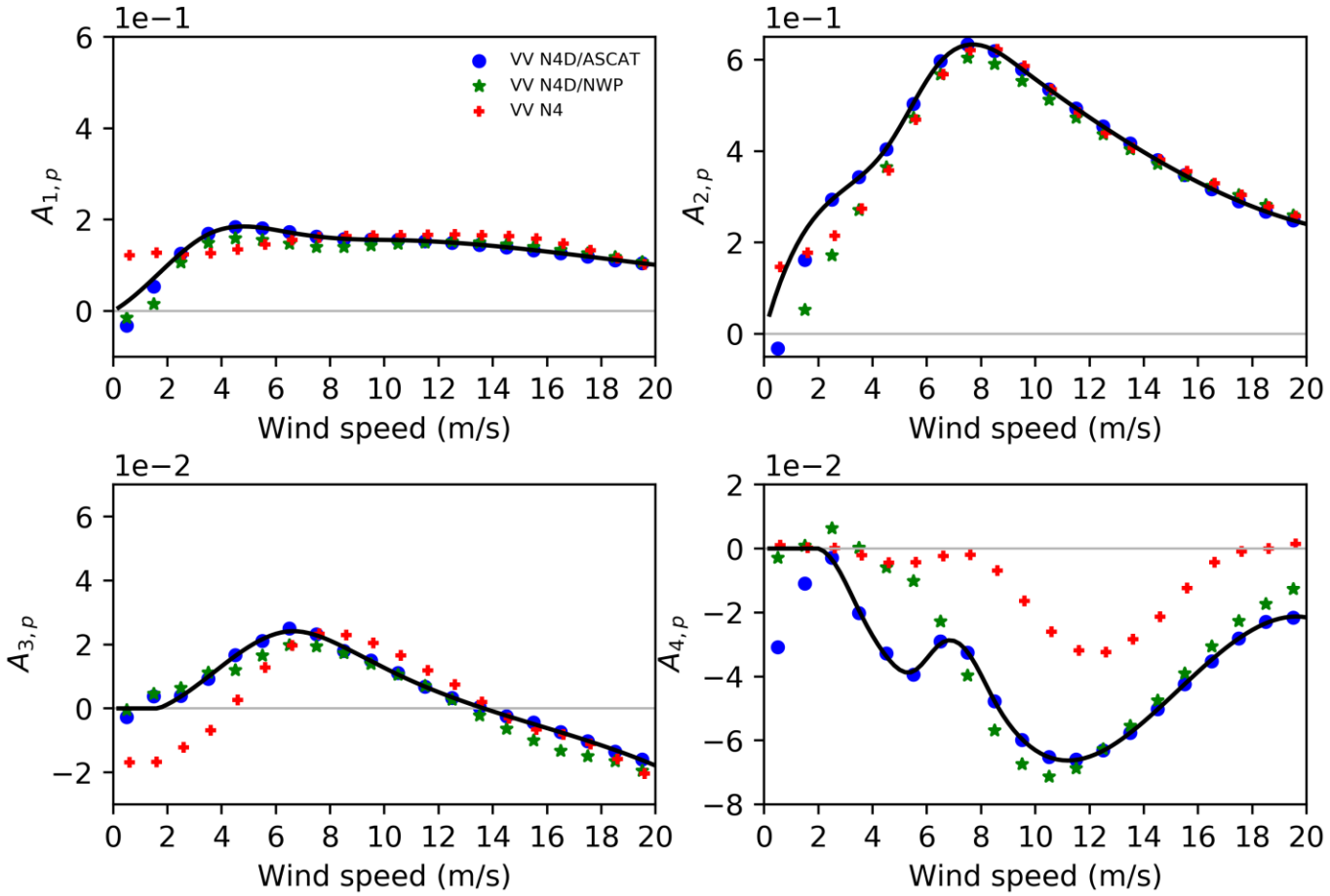


Wind directions HH



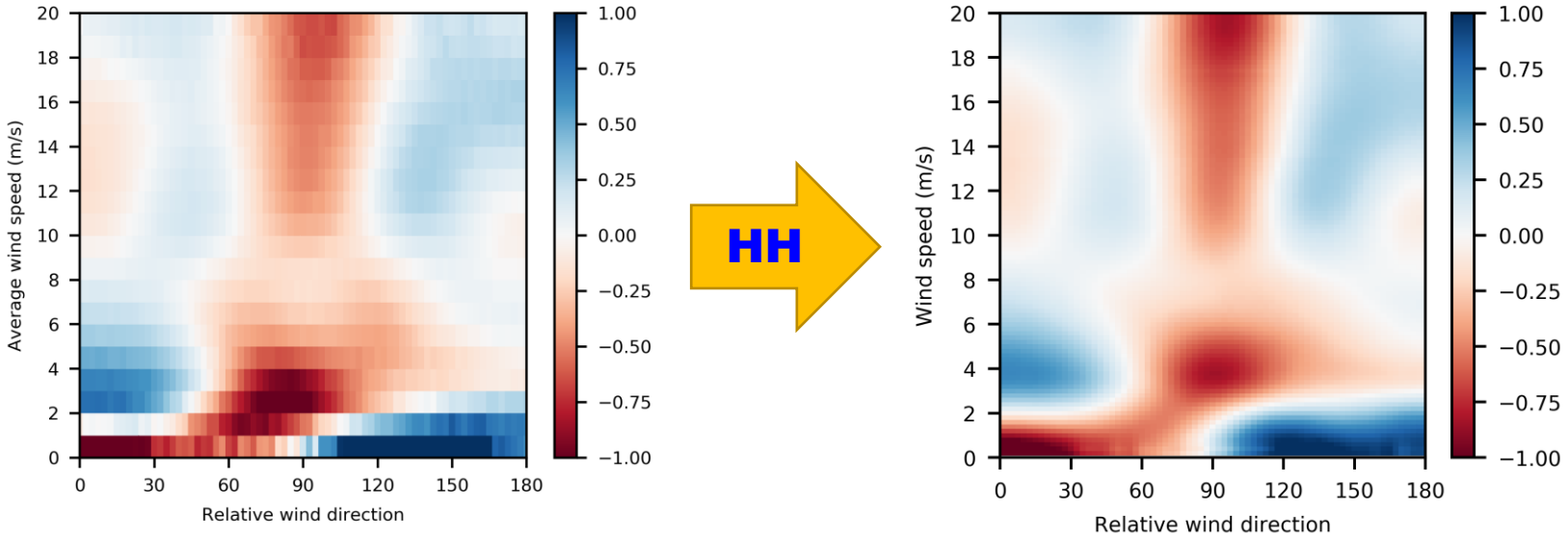
$$1 + A'_{1,p}(V) * \cos(\phi) + A'_{2,p}(V) * \cos(2\phi) + A'_{3,p}(V) * \cos(3\phi) + A'_{4,p}(V) * \cos(4\phi)$$

Wind directions VV

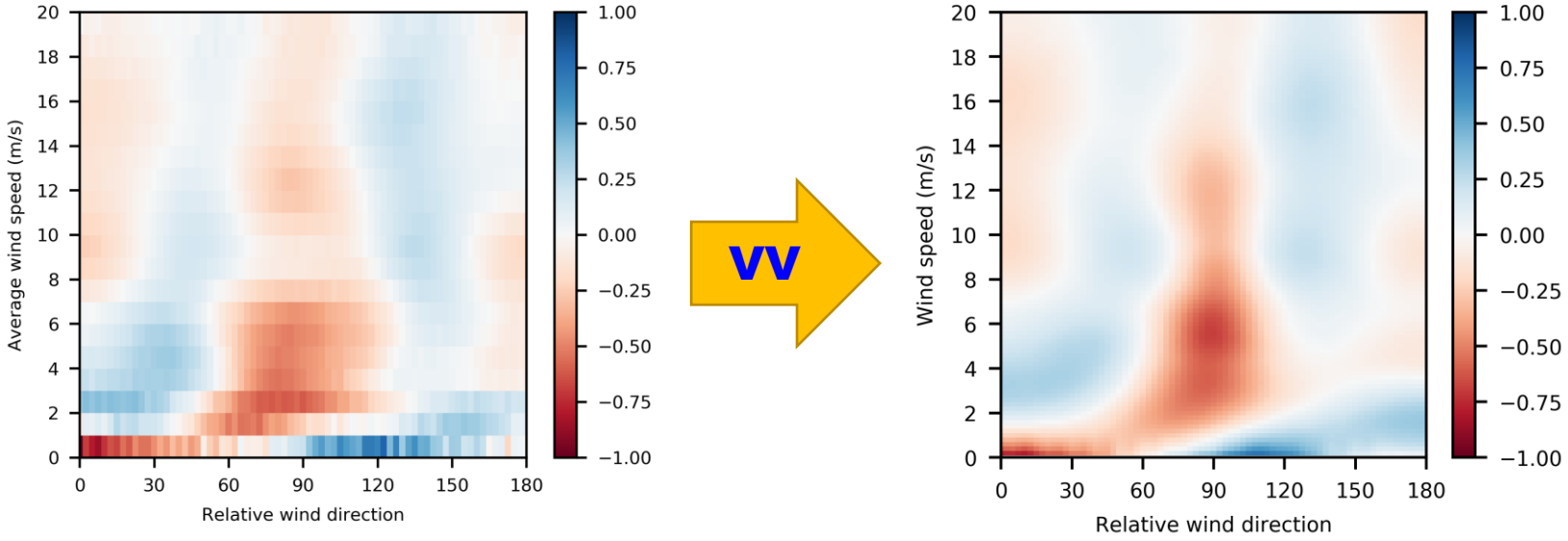


$$1 + A'_{1,p}(V) * \cos(\phi) + A'_{2,p}(V) * \cos(2\phi) + A'_{3,p}(V) * \cos(3\phi) + A'_{4,p}(V) * \cos(4\phi)$$

Wind directions

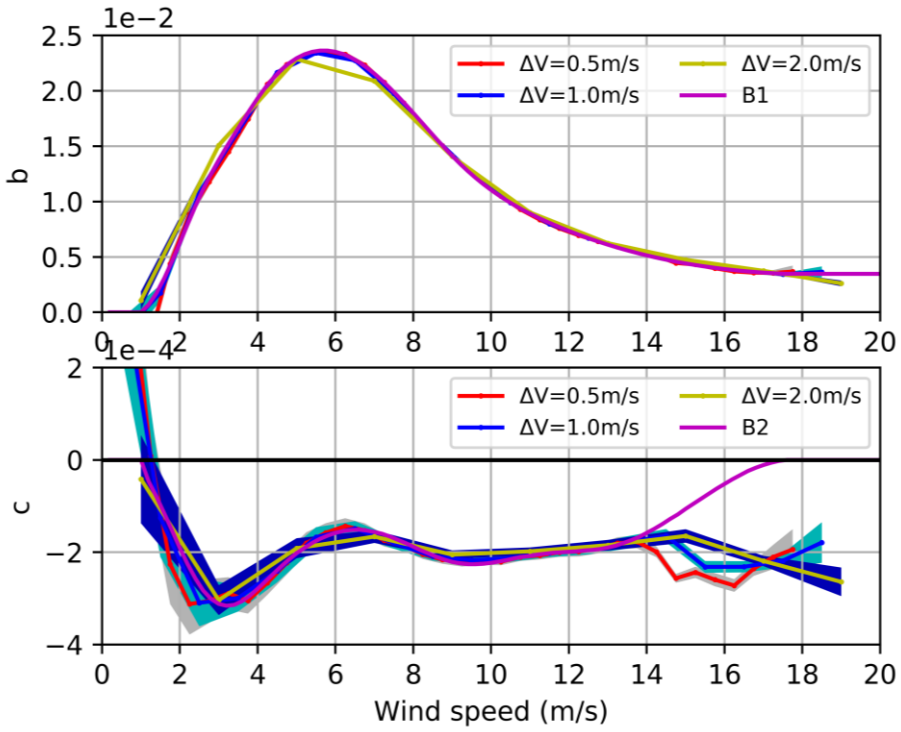


dB

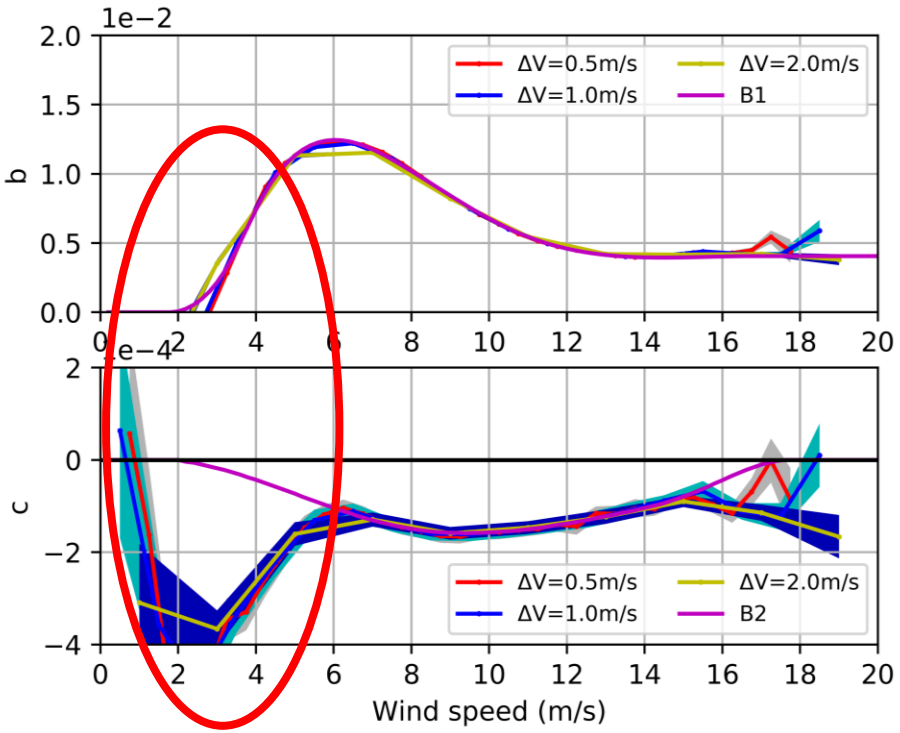


SST effects

HH



VV



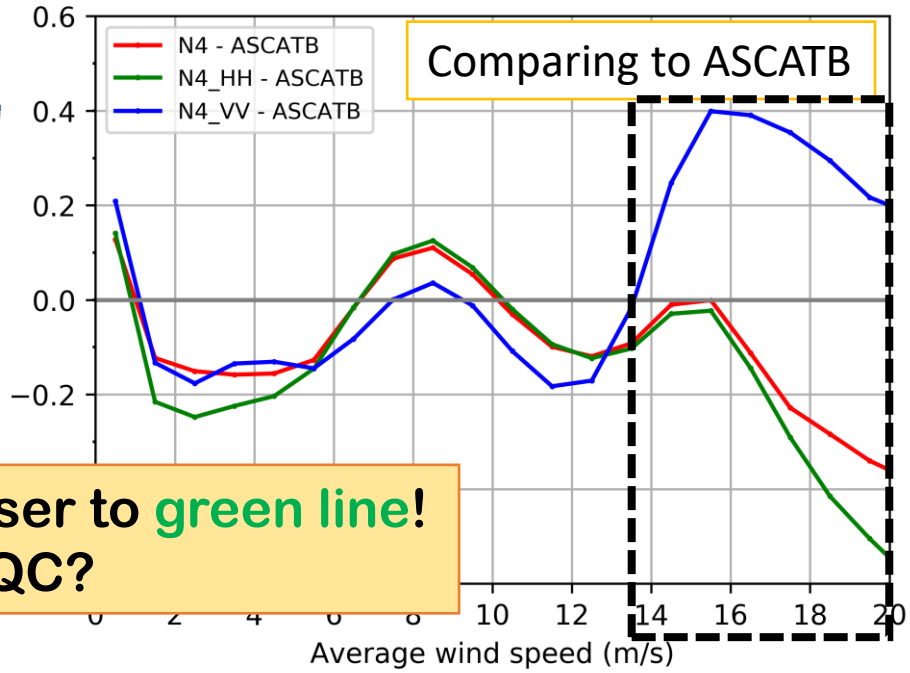
Acceptable results can be achieved for V<6m/s!

If we have more collocations??

The methodology for the derivation of SST dependencies has been introduced in a JGR paper (2017).

Wind speeds

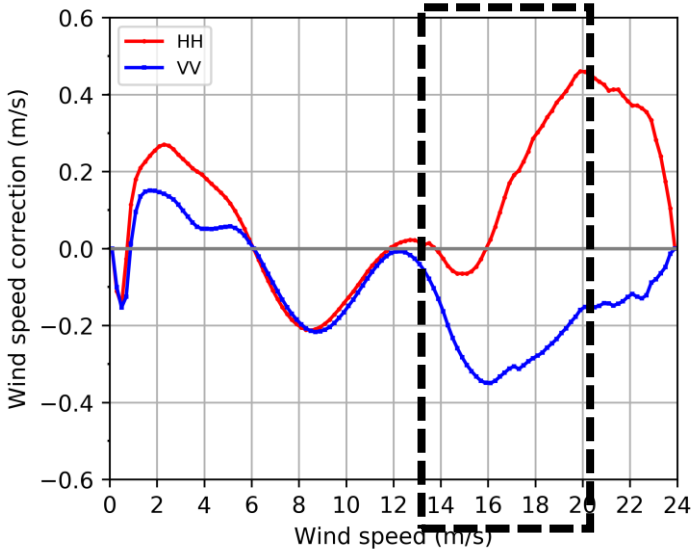
Wind speed biases can be removed by using PDF matching method (HOC)!



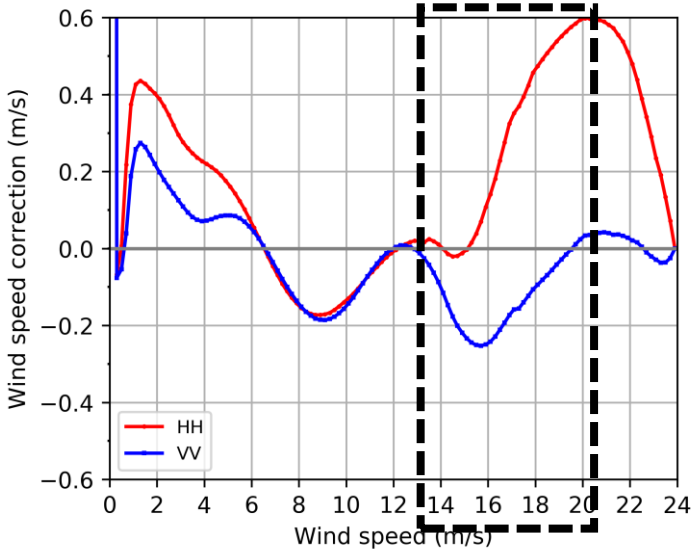
The red line is excessively closer to green line!
Because of wind sensitivity? QC?

HOC results for:

referring to ASCATB winds

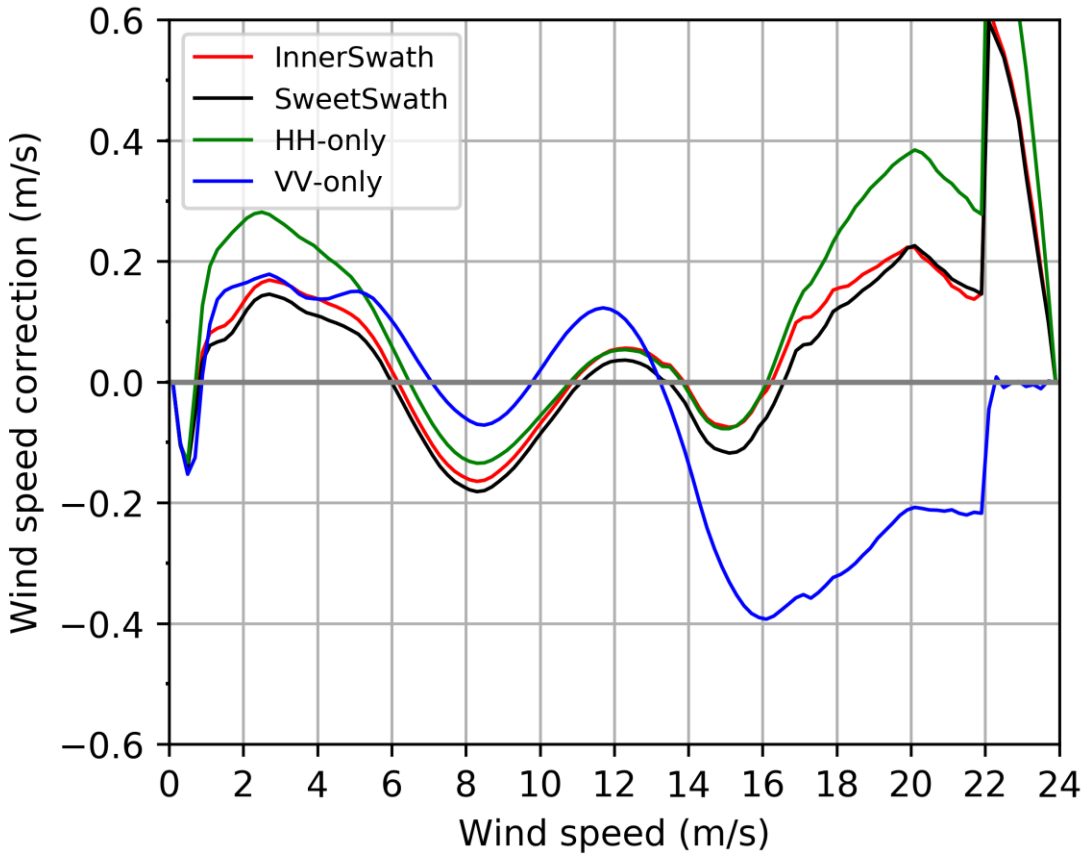


referring to NWP winds!



Wind speeds

NSCAT-4DS for SCATSAT



VV QC ratio = 86.16%

HH QC ratio = 89.92%

- **What has to be done?**

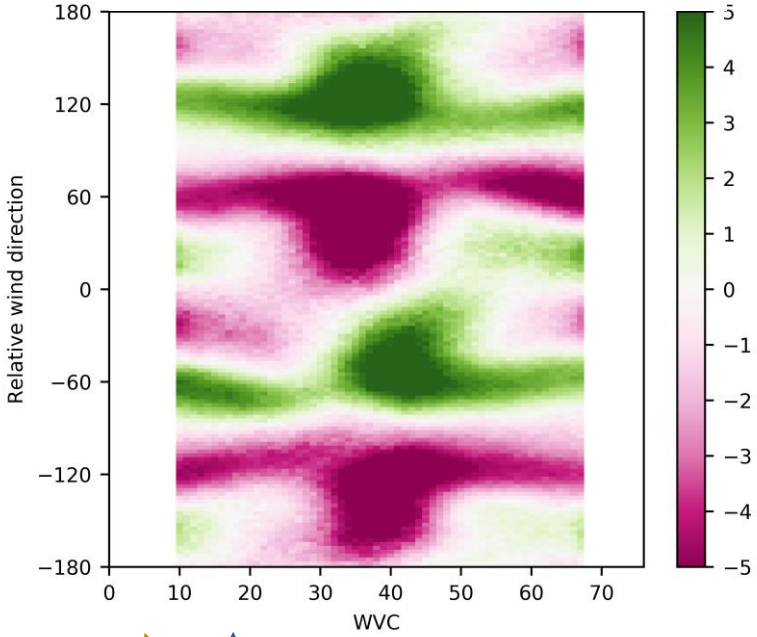
wind direction retrieval preference

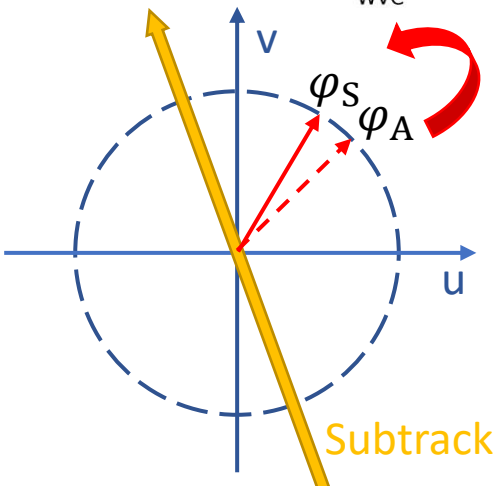
Wind directions

SCATSAT^{N4D} comparing to ASCAT-B winds

RMS of wind direction difference

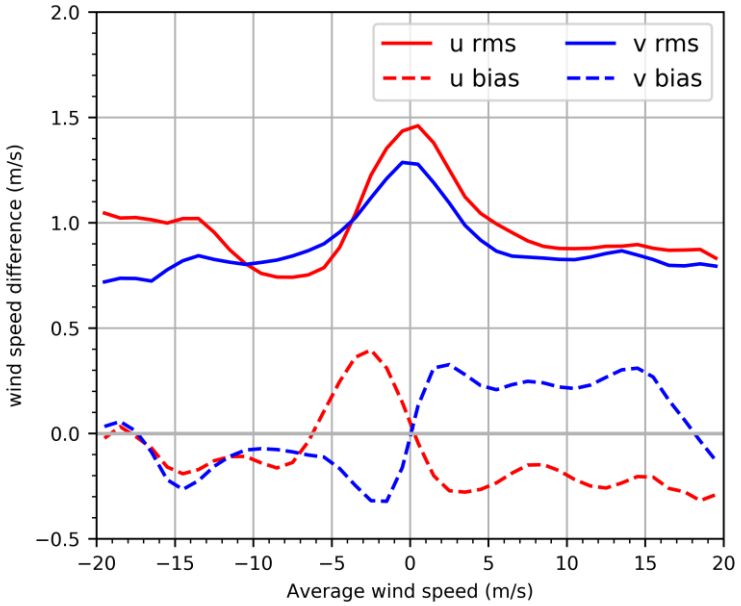
$\Delta\varphi = \varphi_S - \varphi_A$





Bias and RMS of wind components

$\Delta u = u_S - u_A$, $\Delta v = v_S - v_A$



$u > 0$: $\Delta u < 0$

$v > 0$: $\Delta v > 0$

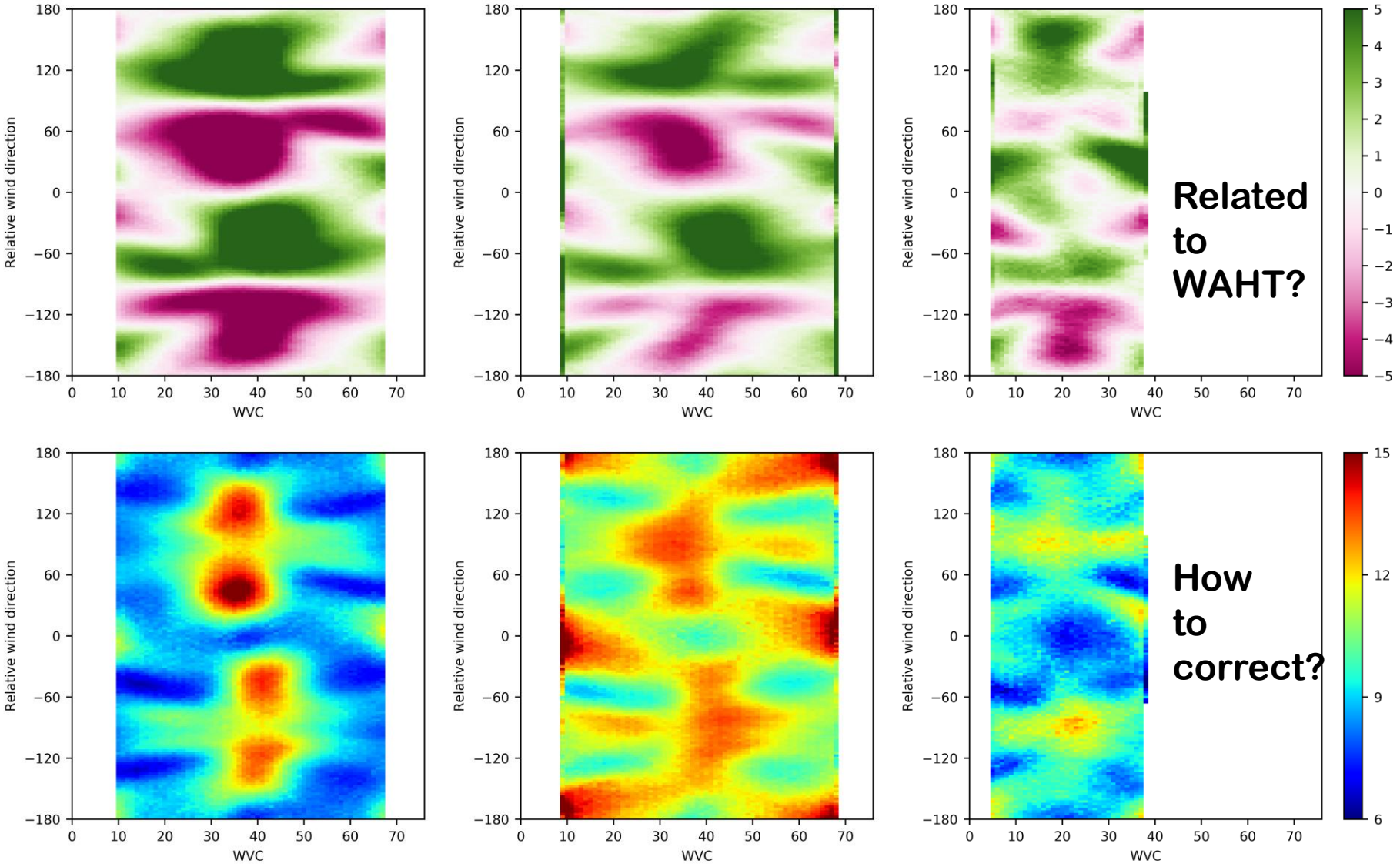
Wind Direction Retrieval Preference:

A tend to be closer to the nadir!

Wind directions

The **preferences** are produced by wind inversion algorithm (Bayesian approach), ambiguities removal method (2DVAR), or by GMF errors?

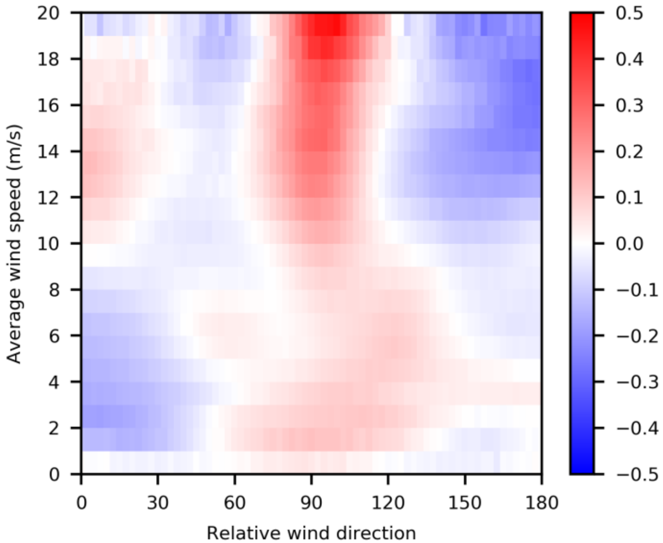
SCATSCAT, ECMWF_Operational | **QuikSCAT, ECMWF_ERA** | **RapidSCAT, ECMWF_ERA**



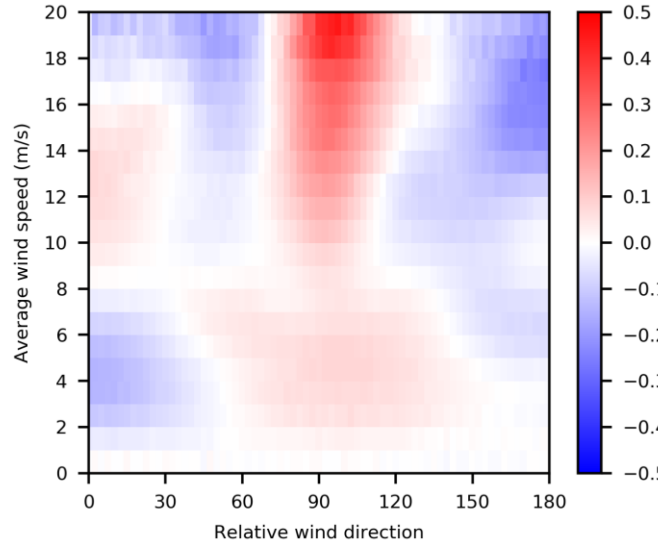

Thank you for your attention!

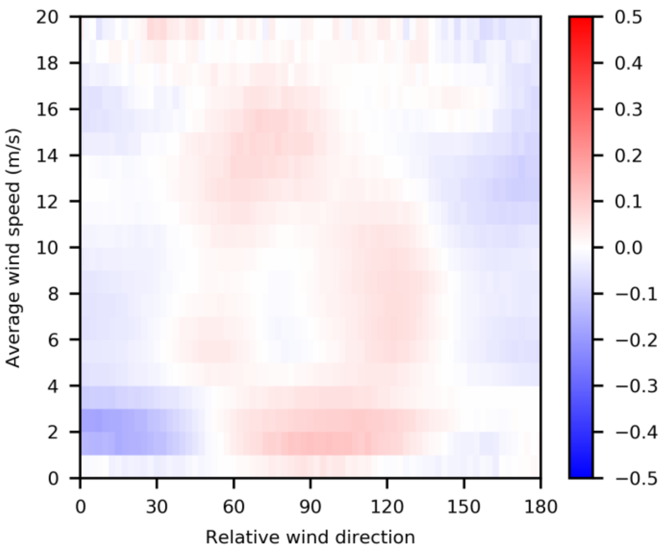
Wind directions

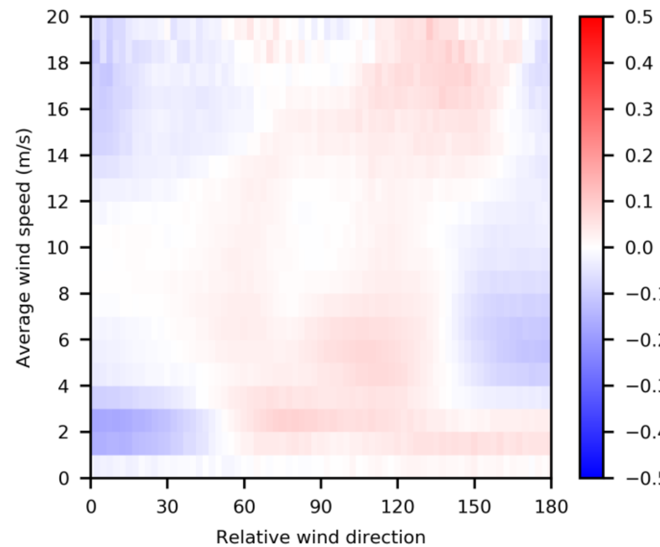
N4 - ASCAT-B



NWP

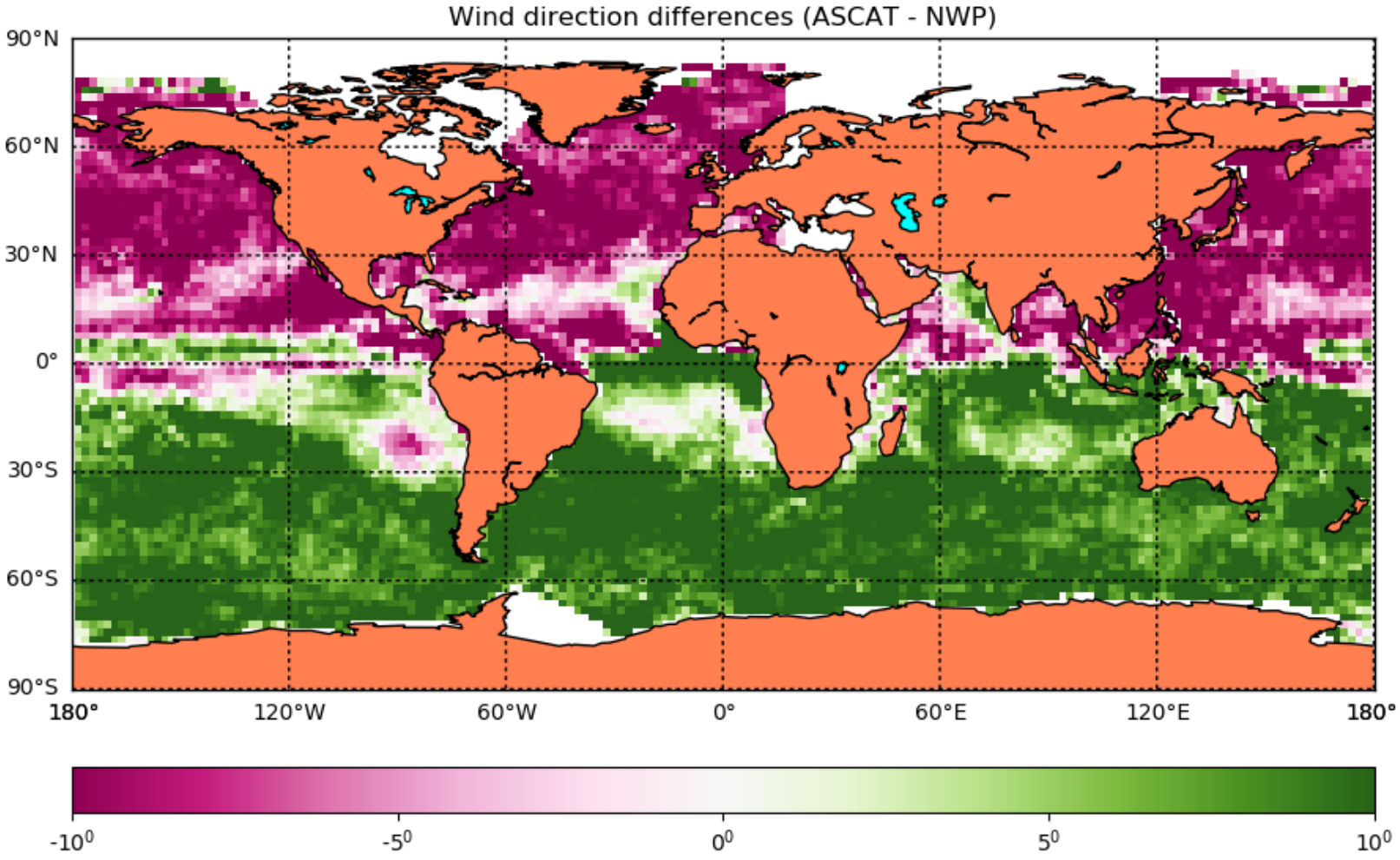






Wind directions

Using ASCAT winds as reference is a better choice in this study!



❑ Wind Modifiers:

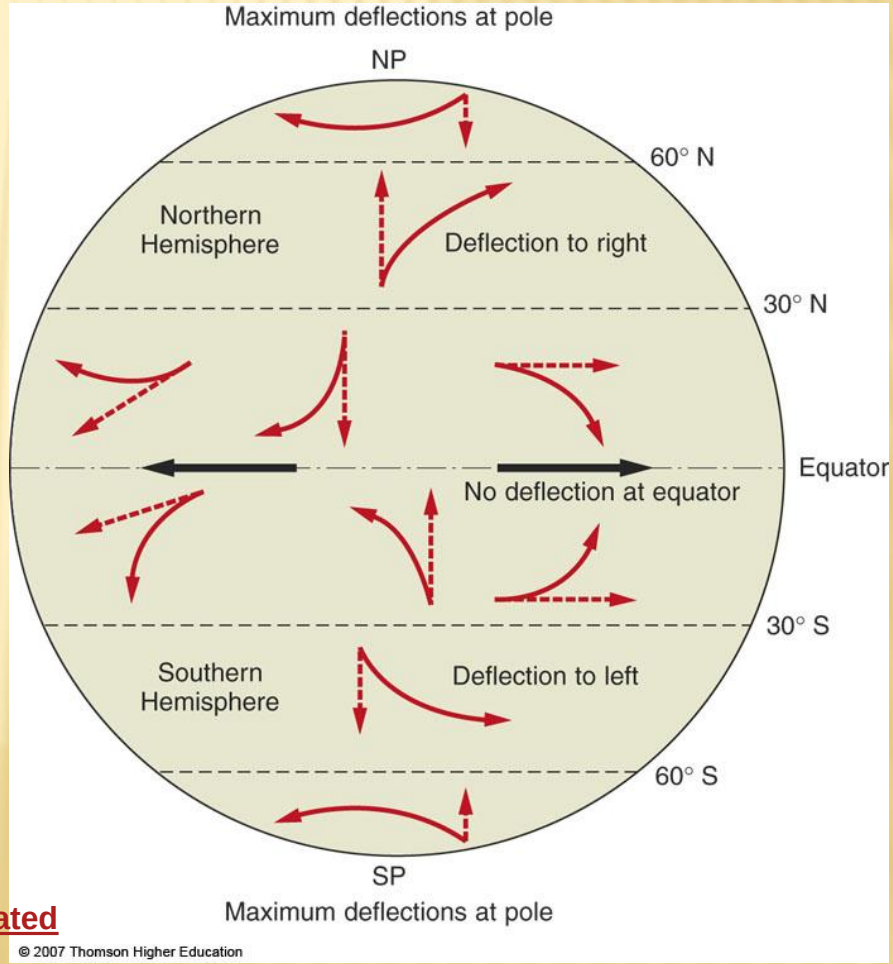
- **Surface Friction (effective up to about 1000 m above the surface – reduces wind speed)**

- **The Coriolis Effect and Wind – deflection due to rotation (Fig. 5.6)**

The Coriolis Effect

Deflection of winds and ocean currents to the right in the northern hemisphere and to the left in the southern hemisphere

Caused by earth's rotation below



Coriolis Effect
http://www.youtube.com/watch?v=mcPs_OdQOYU&feature=related