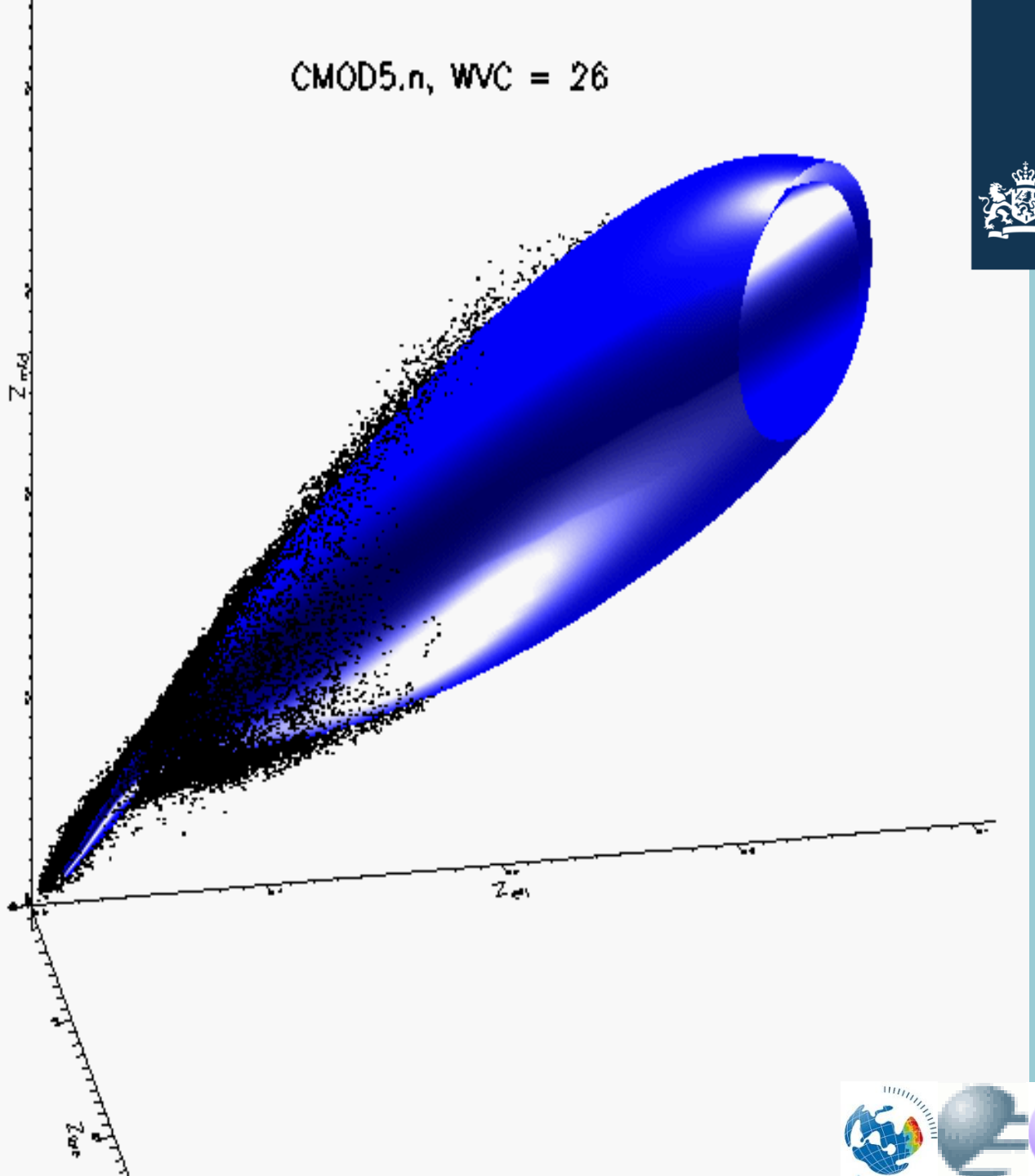


Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

New GMFs

Ad Stoffelen

Jeroen Verspeek

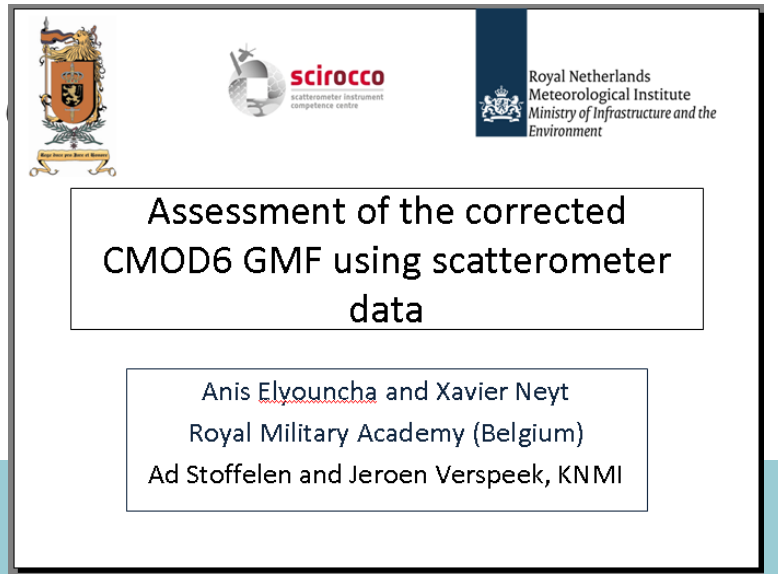
Lucrezia Ricciardulli, RSS

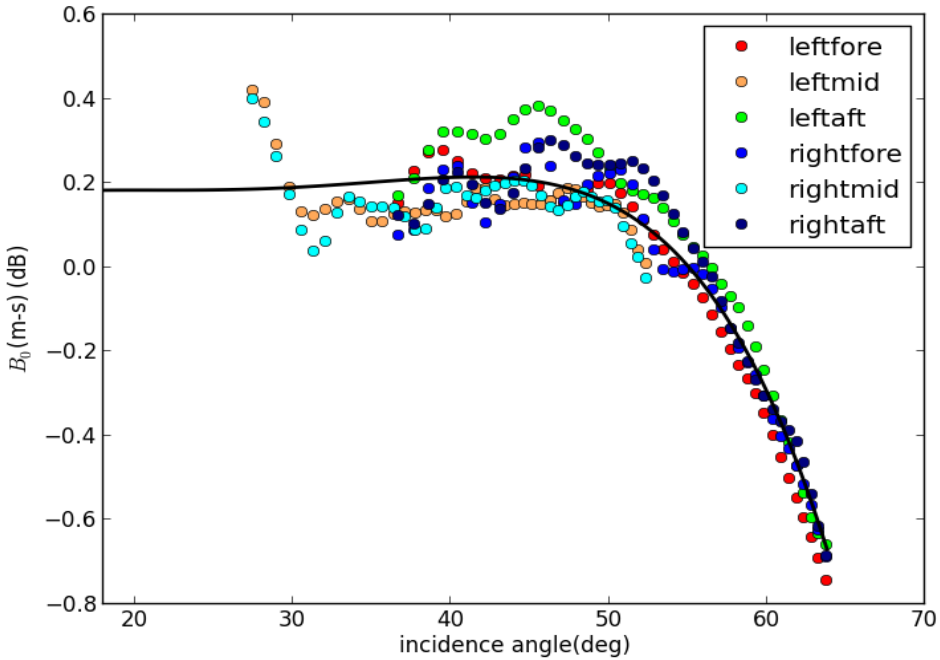
scat@knmi.nl

From ASCAT to ERS – CMOD6

- Assumption: ASCAT (well calibrated) reference
  - Absolute linear calibration (transponders)
- Incidence-angle dependent bias, attributed to the GMF
  - CMOD5n developed for ERS, not validated at high incidence angles
- Beam-dependent bias, attributed to instrument calibration
- To account for ERS incidences, CMOD5na as in Verspeek et al., 2012, is corrected to become CMOD6, see below

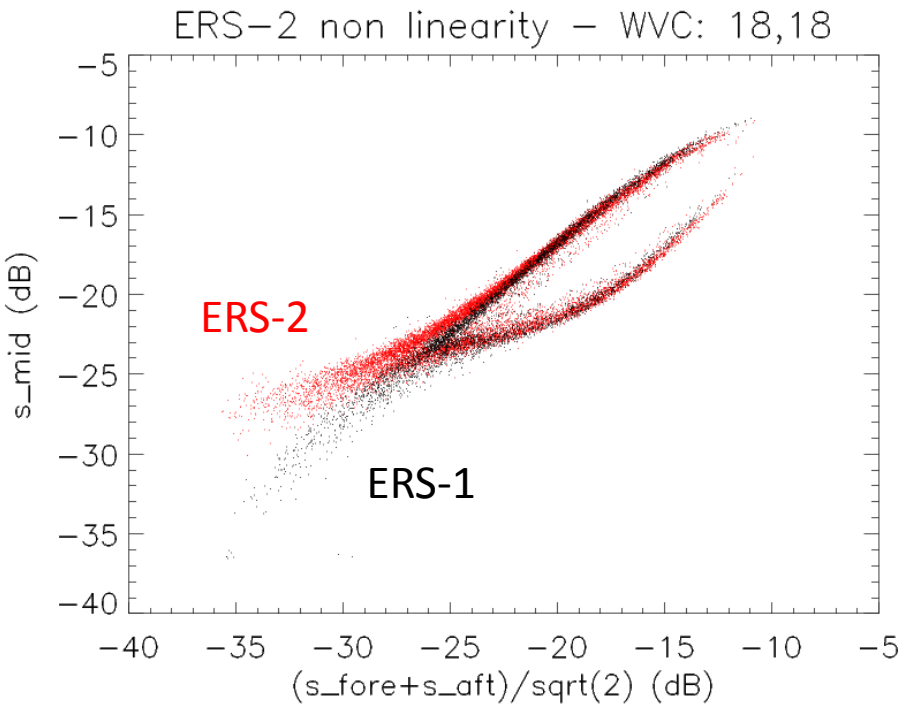
Correction of CMOD5n

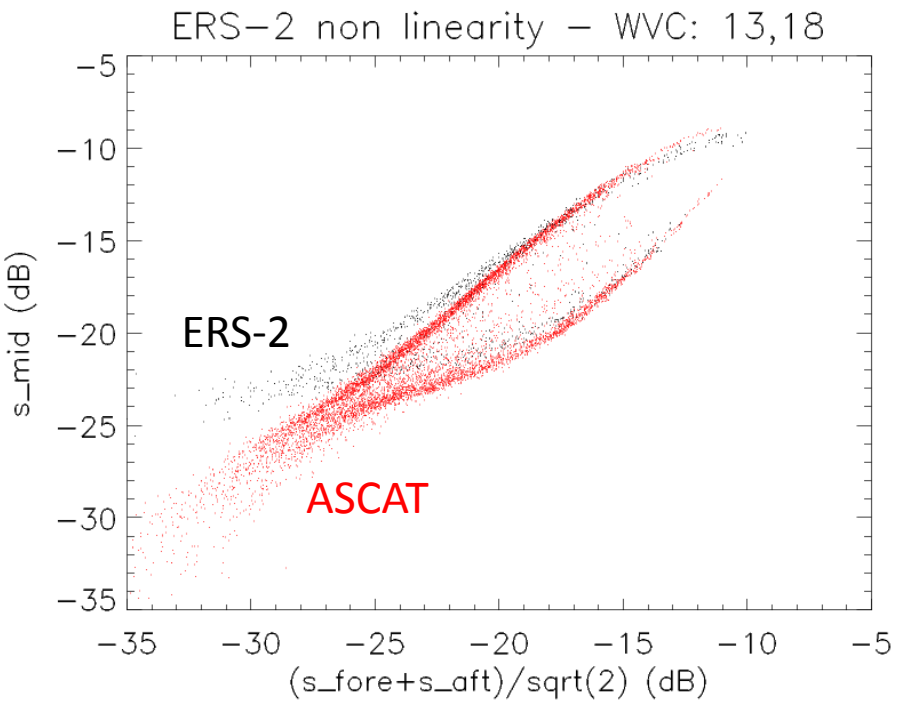


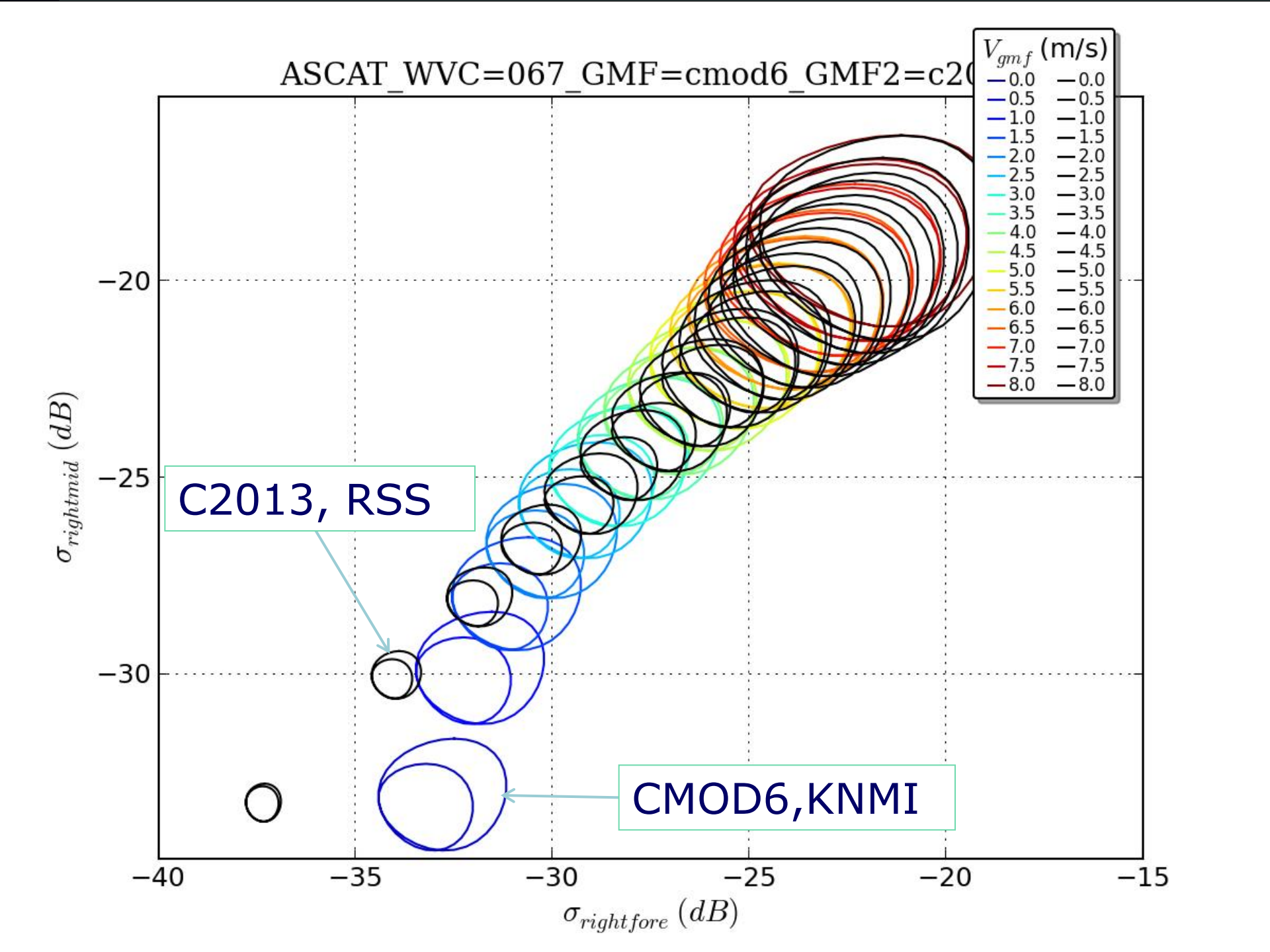


ERS1=ERS2=ASCAT?

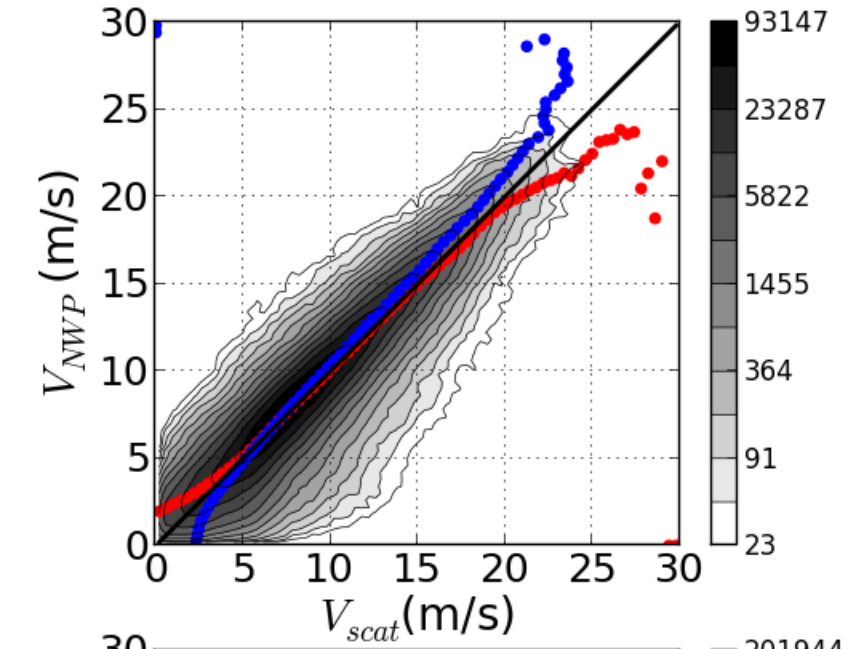
- ERS-2 non-linearity
  - At low incidence angles (low backscatter)
  - Impact on CMOD5, as this is ERS heritage

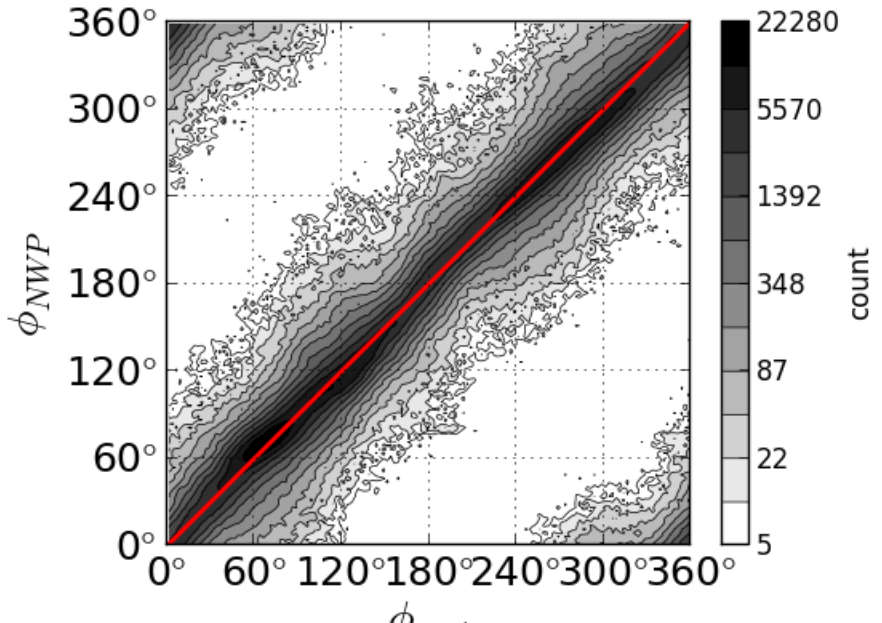


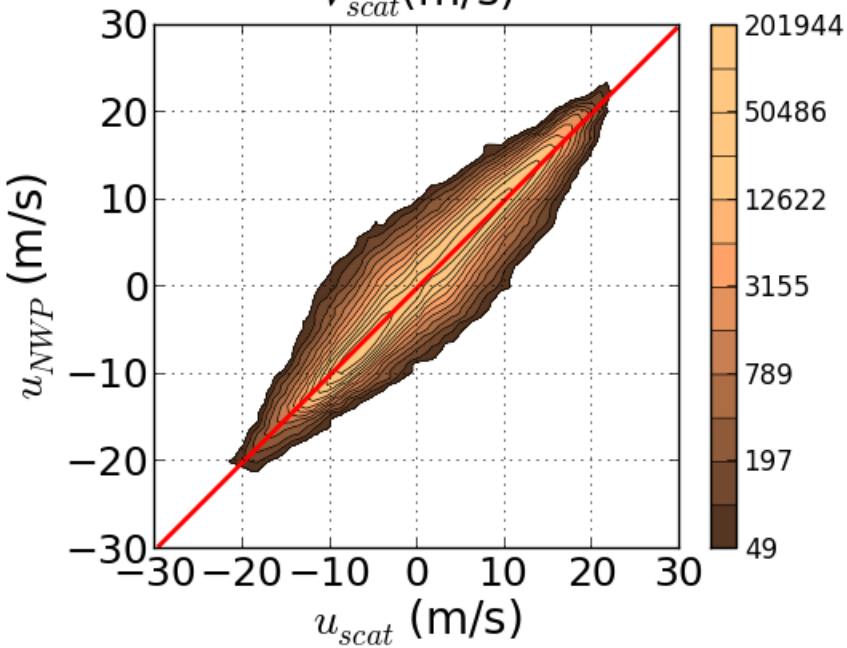


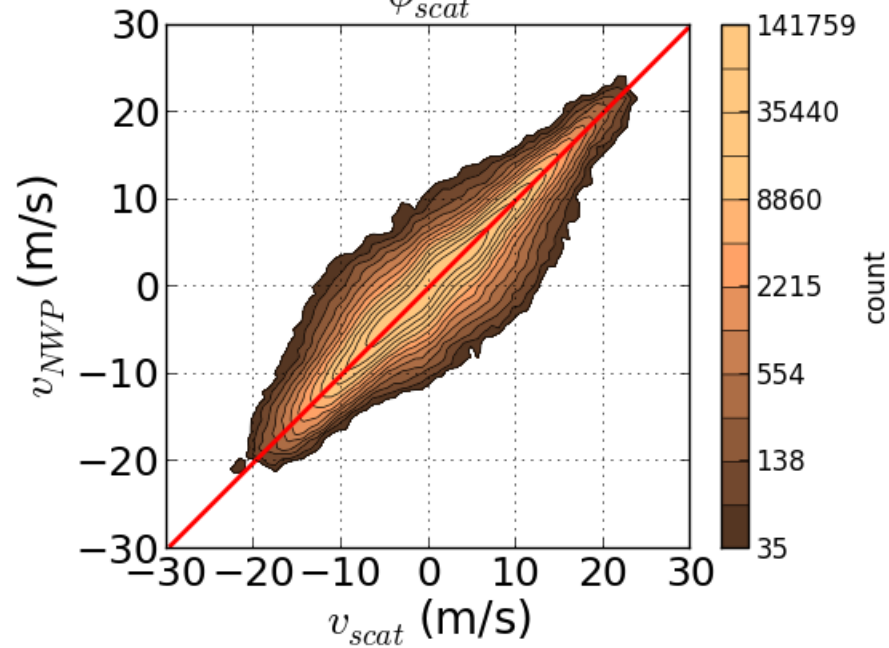

ASCAT_WVC=067_GMF=cmod6_GMF2=c2
V_{gmf} (m/s)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
C2013, RSS
CMOD6,KNMI
$\sigma_{rightmid}$ (dB)
$\sigma_{rightfore}$ (dB)
−20
−25
−30
−40
−35
−30
−25
−20
−15

CMOD7


V_{NWP} (m/s)
V_{scat}(m/s)
93147
23287
5822
1455
364
91
23


ϕ_{NWP}
ϕ_{scat}
count
22280
5570
1392
348
87
22
5


u_{NWP} (m/s)
u_{scat} (m/s)
201944
50486
12622
3155
789
197
49


v_{NWP} (m/s)
v_{scat} (m/s)
count
141759
35440
8860
2215
554
138
35

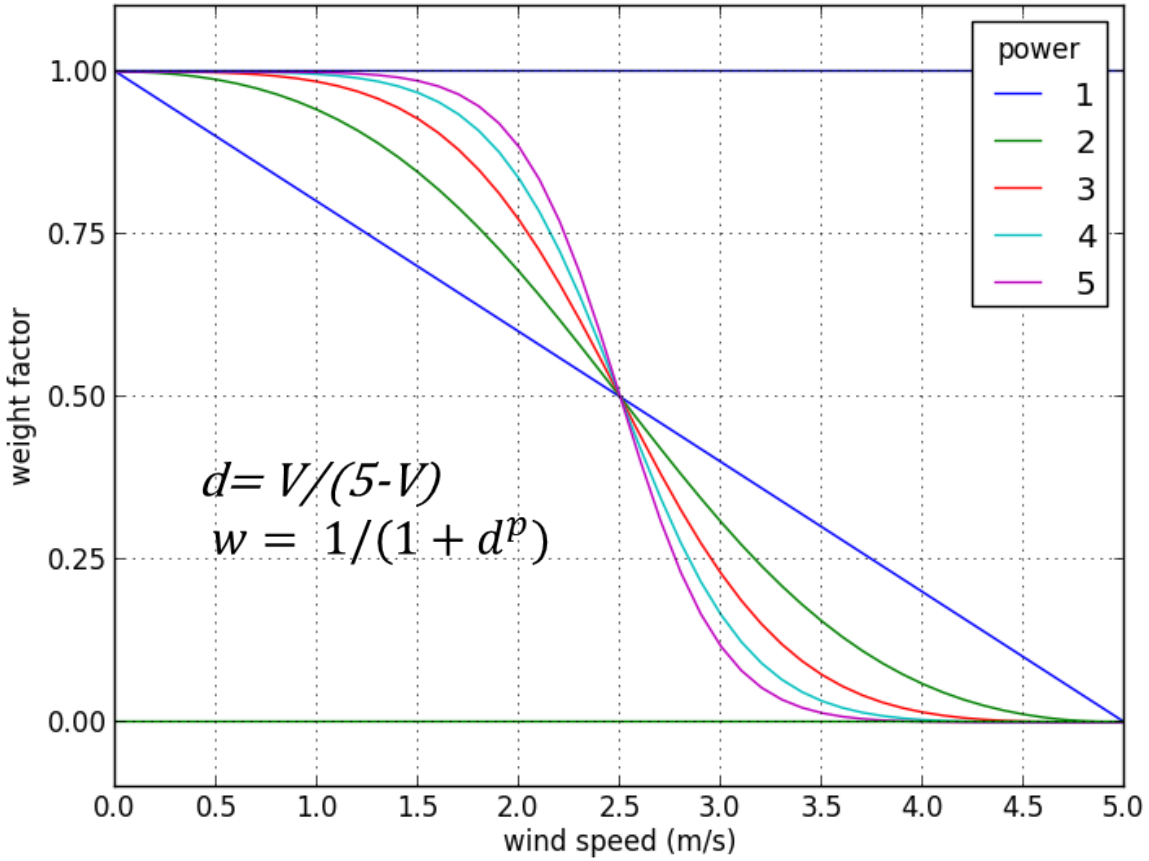
CMOD6+C2013=CMOD7

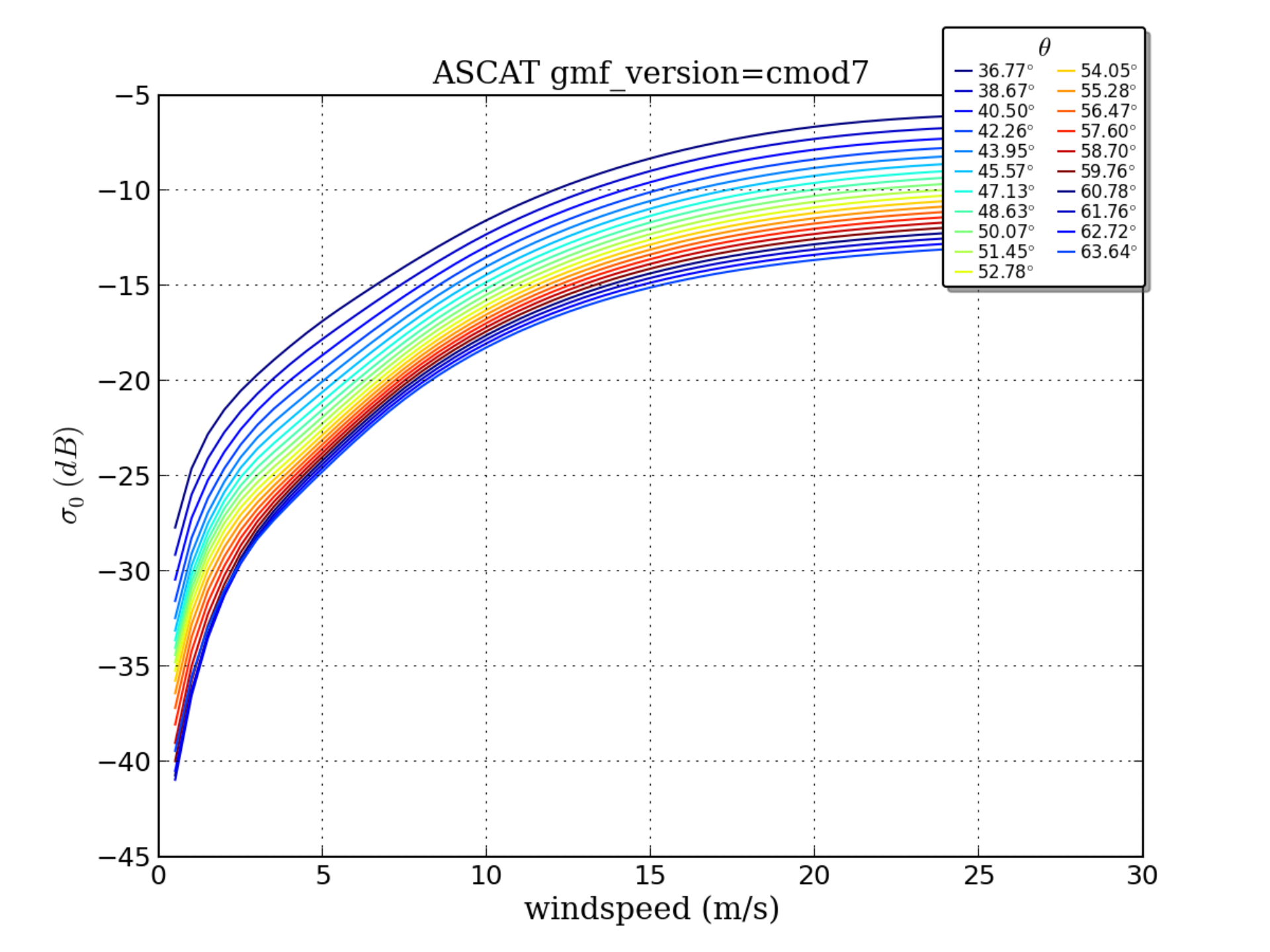
- Adapt dimension C2013 table to dimensions of AWDP GMF table

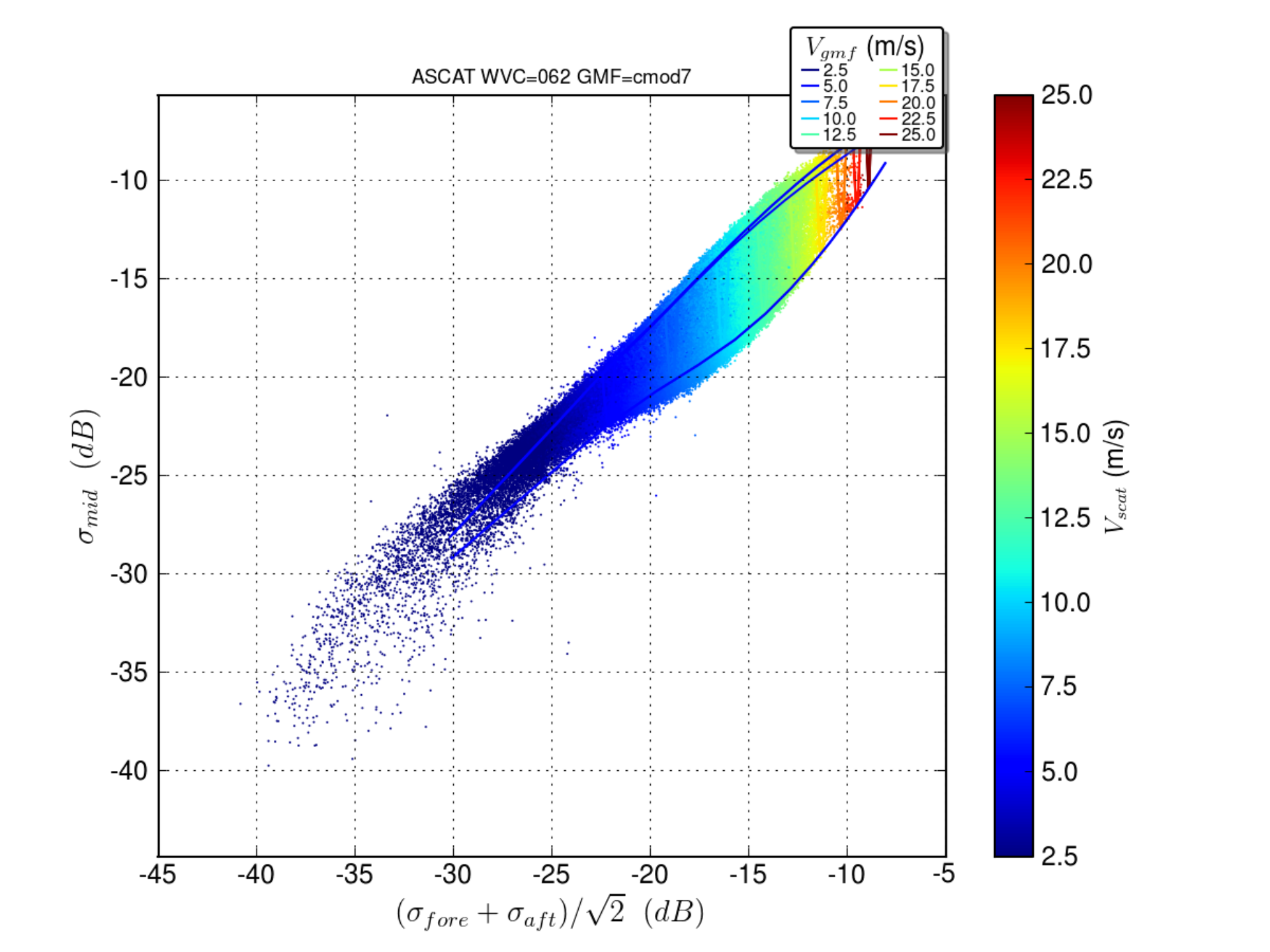
```
# c2013 original from Ricciardulli with VV and derivatives:
# LUT properties for gmf_c2013_t1.dat:
#=======================================
# wind min/max = 0.-70. (step 0.2) [m/s] --> 351 pts
# dir min/max = 0-180 (step 2.0) [deg]   -->  91 pts
# inc min/max = 16-66 (step 0.5) [deg]   --> 101 pts
#=======================================

c-vv2.dat:
#=======================================
# wind min/max = 0.2-50. (step 0.2) [m/s] --> 250 pts
# dir min/max = 0-180 (step 2.5) [deg]   -->  73 pts
# inc min/max = 16-66 (step 1) [deg]   --> 51 pts
#=======================================
```

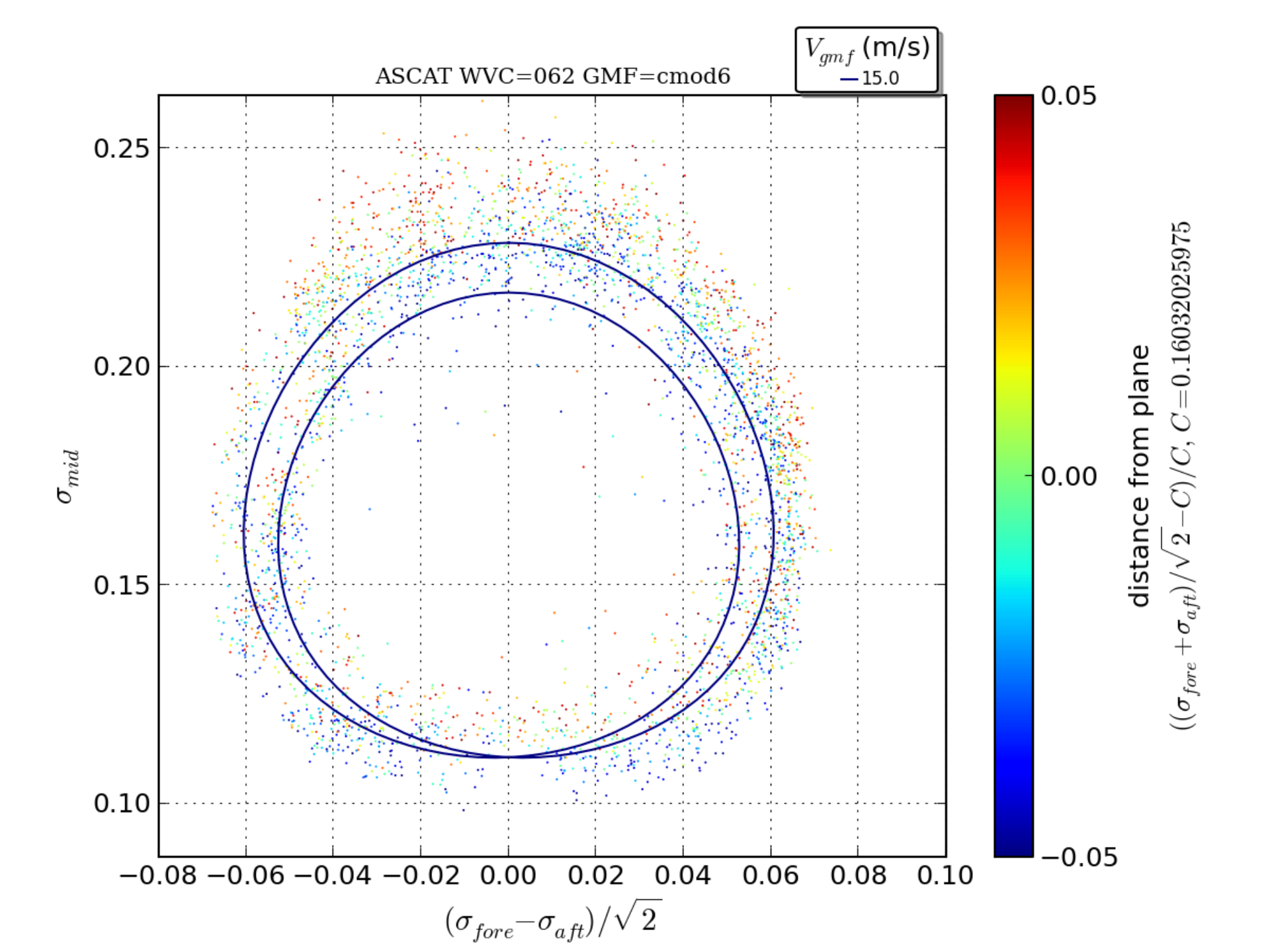
- Use CMOD6 for V>=5 m/s
- Interpolate between V=0 m/s and V=5 m/s

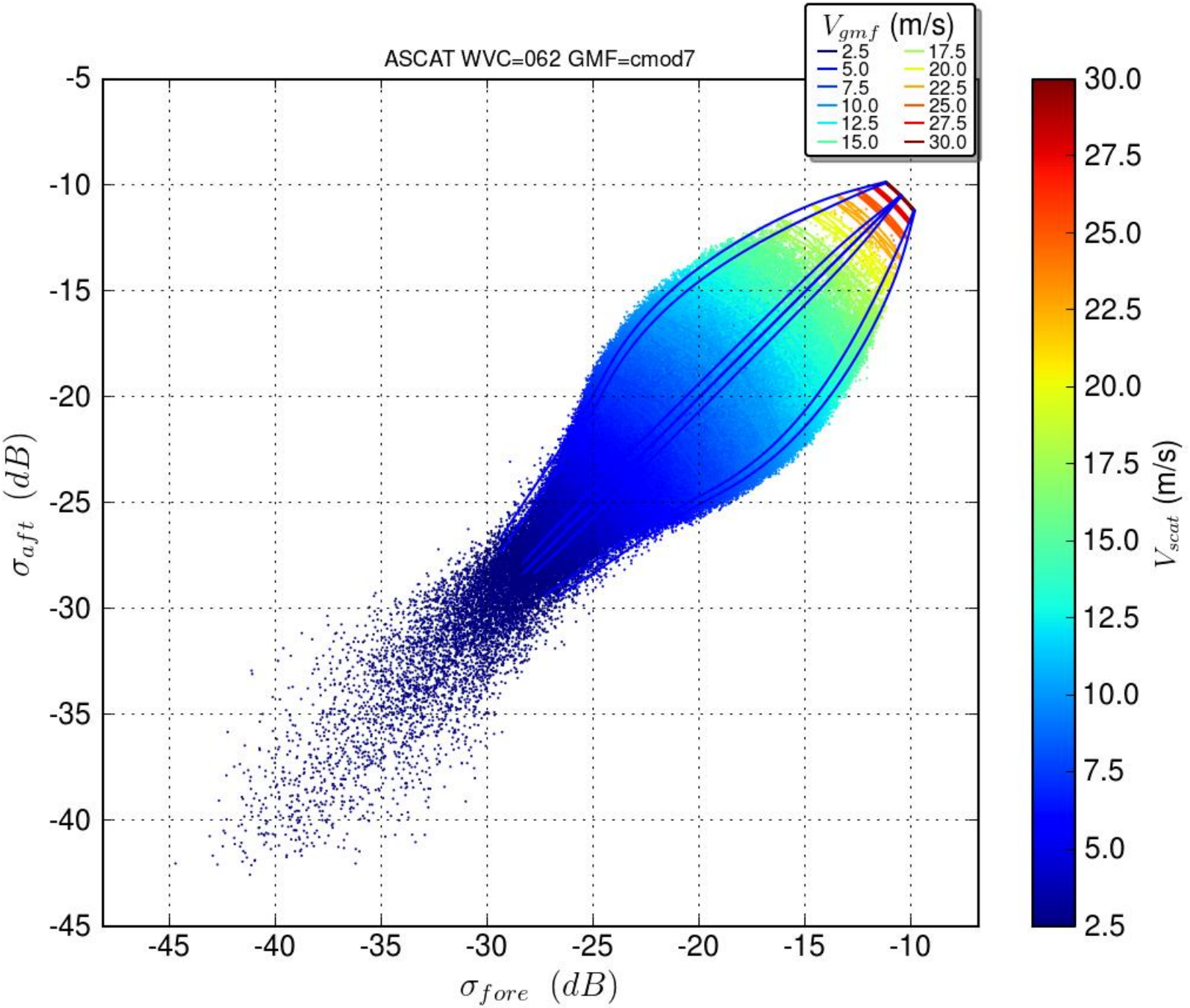
Interpolation weight function



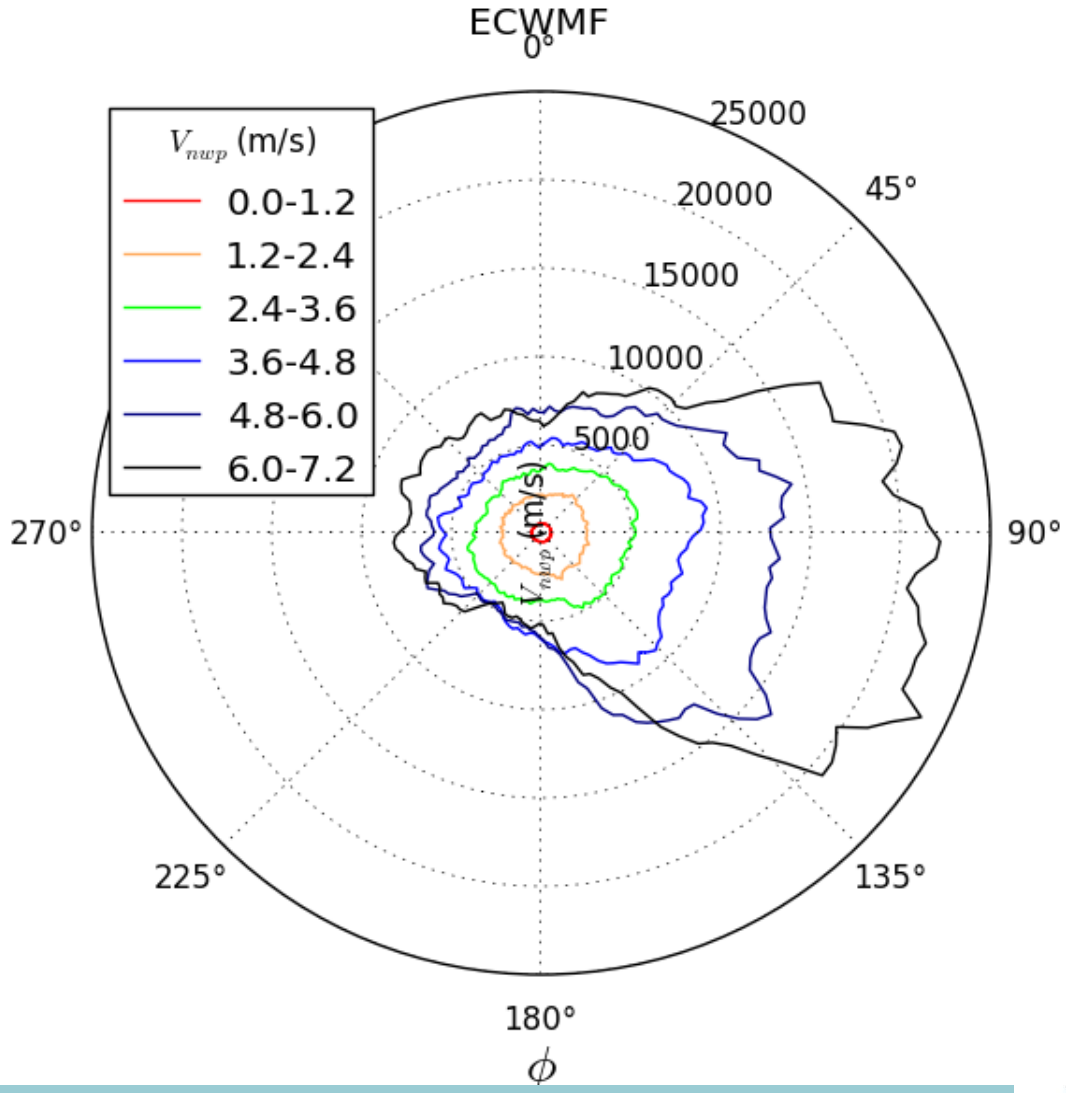

ASCAT gmf_version=cmod7
θ
36.77°
38.67°
40.50°
42.26°
43.95°
45.57°
47.13°
48.63°
50.07°
51.45°
52.78°
54.05°
55.28°
56.47°
57.60°
58.70°
59.76°
60.78°
61.76°
62.72°
63.64°
−5
−10
−15
−20
−25
−30
−35
−40
−45
σ0 (dB)
0
5
10
15
20
25
30
windspeed (m/s)


ASCAT WVC=062 GMF=cmod7
V_{gmf} (m/s)
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
σ_{mid} (dB)
$(\sigma_{fore} + \sigma_{aft})/\sqrt{2}$ (dB)
-10
-15
-20
-25
-30
-35
-40
-45
-5
V_{scat} (m/s)

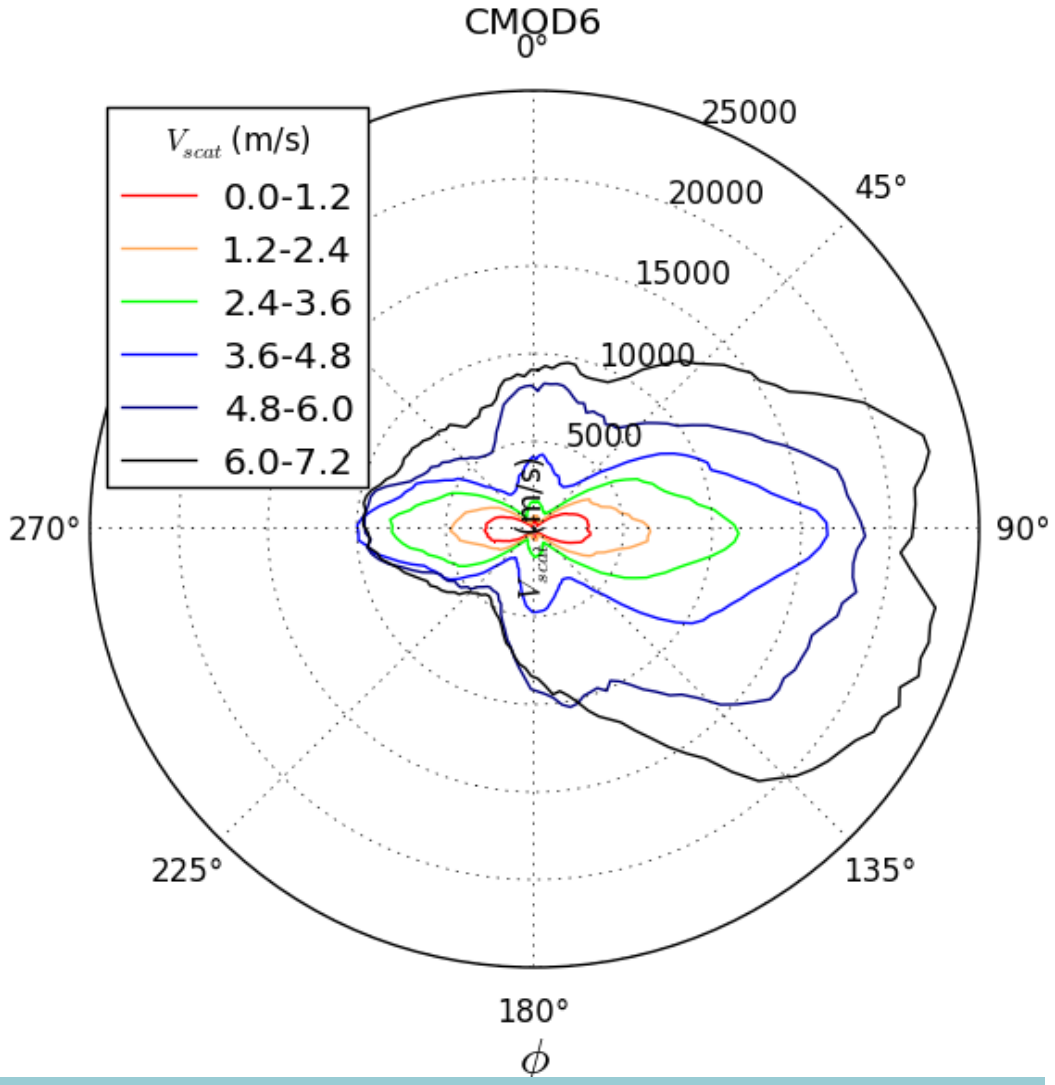

ASCAT WVC=062 GMF=cmod6
V_{gmf} (m/s)
15.0
0.25
0.20
0.15
0.10
σ_{mid}
−0.08 −0.06 −0.04 −0.02 0.00 0.02 0.04 0.06 0.08 0.10
$(\sigma_{fore}-\sigma_{aft})/\sqrt{2}$
0.05
0.00
−0.05
distance from plane
$((\sigma_{fore}+\sigma_{aft})/\sqrt{2}-C)/C$, $C=0.16032025975$


ASCAT WVC=062 GMF=cmod7
V_{gmf} (m/s)
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
-5
-10
-15
-20
-25
-30
-35
-40
-45
σ_{aft} (dB)
-45
-40
-35
-30
-25
-20
-15
-10
σ_{fore} (dB)
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
V_{scat} (m/s)

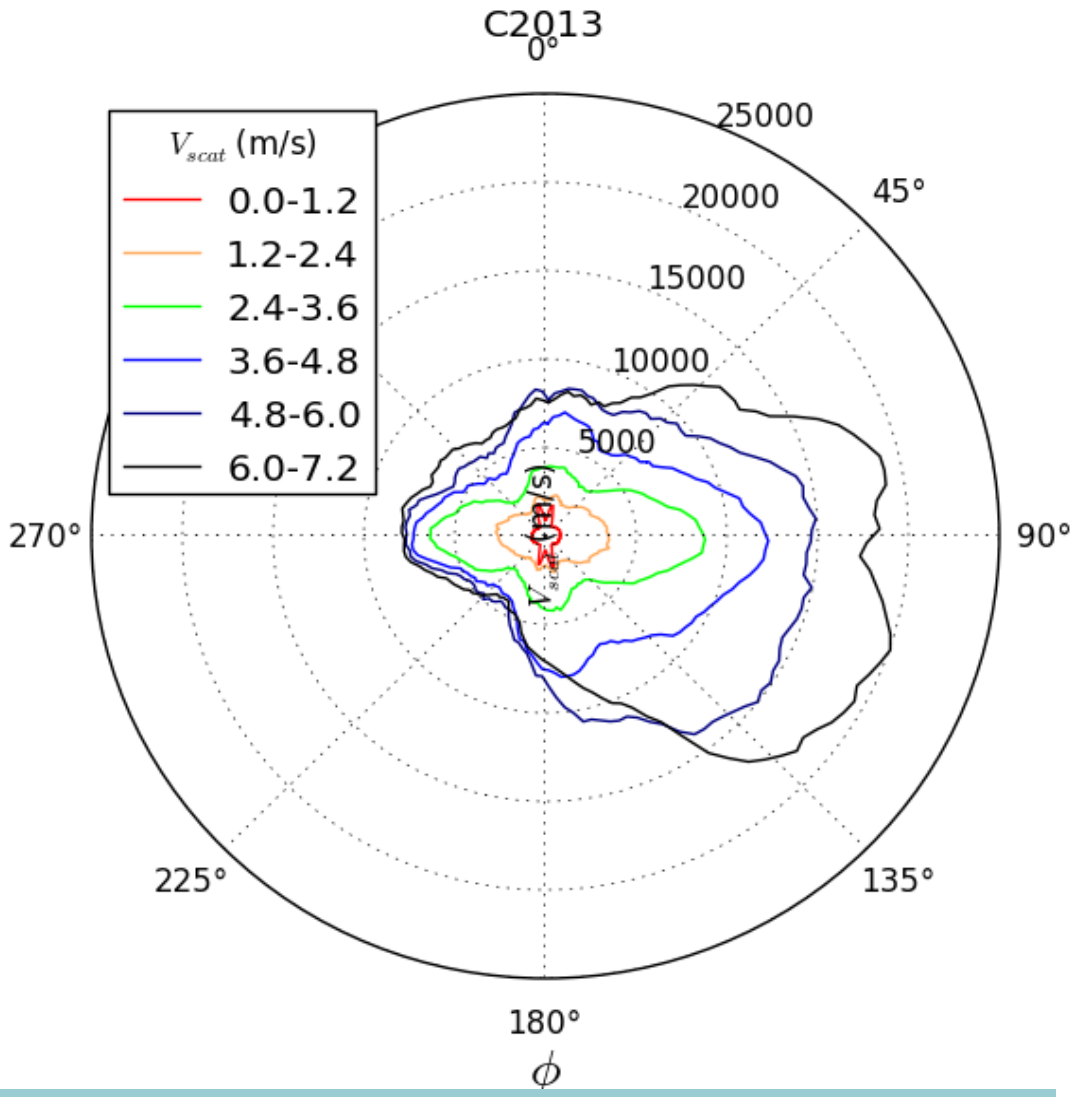
Ebuchi plots - ECMWF



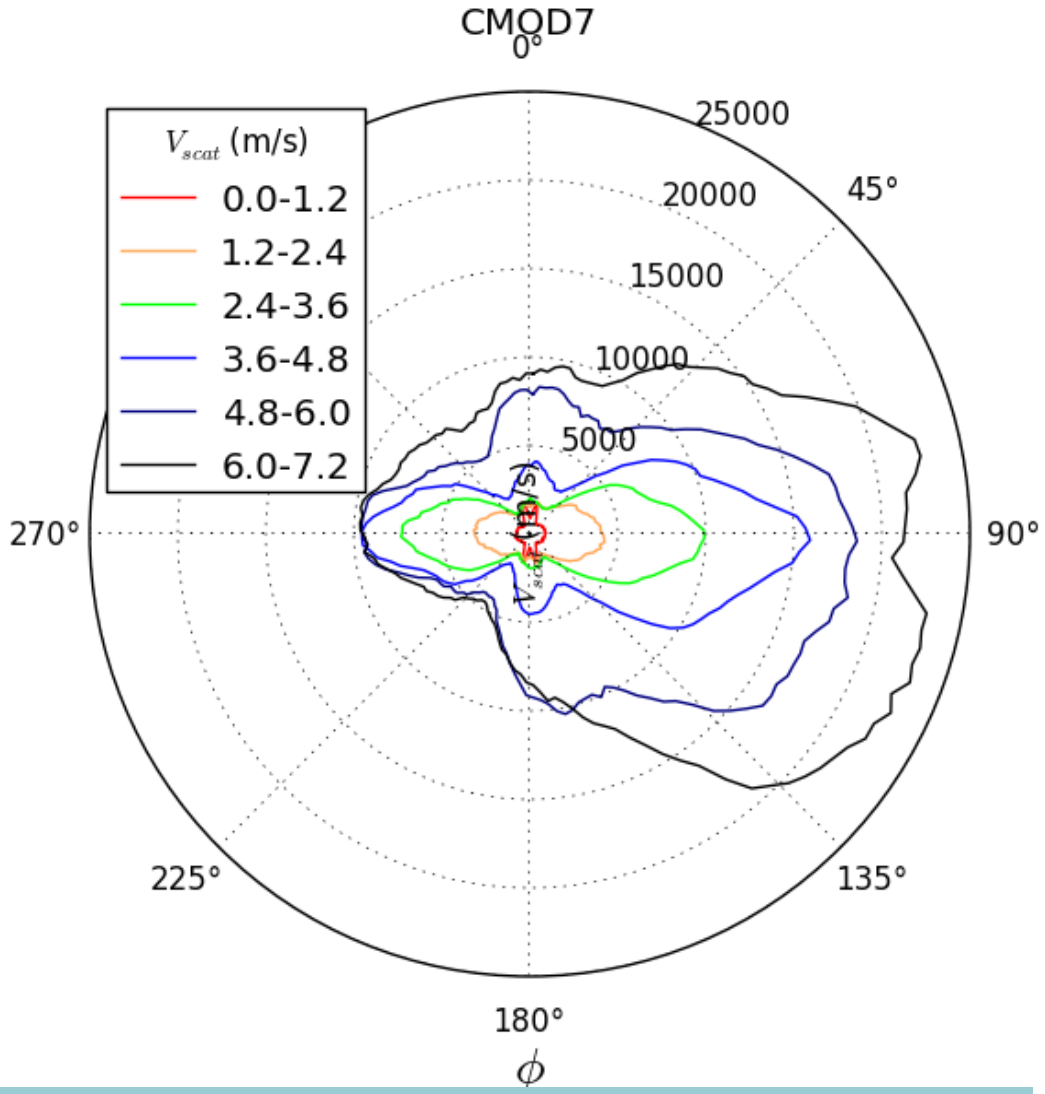
CMOD6

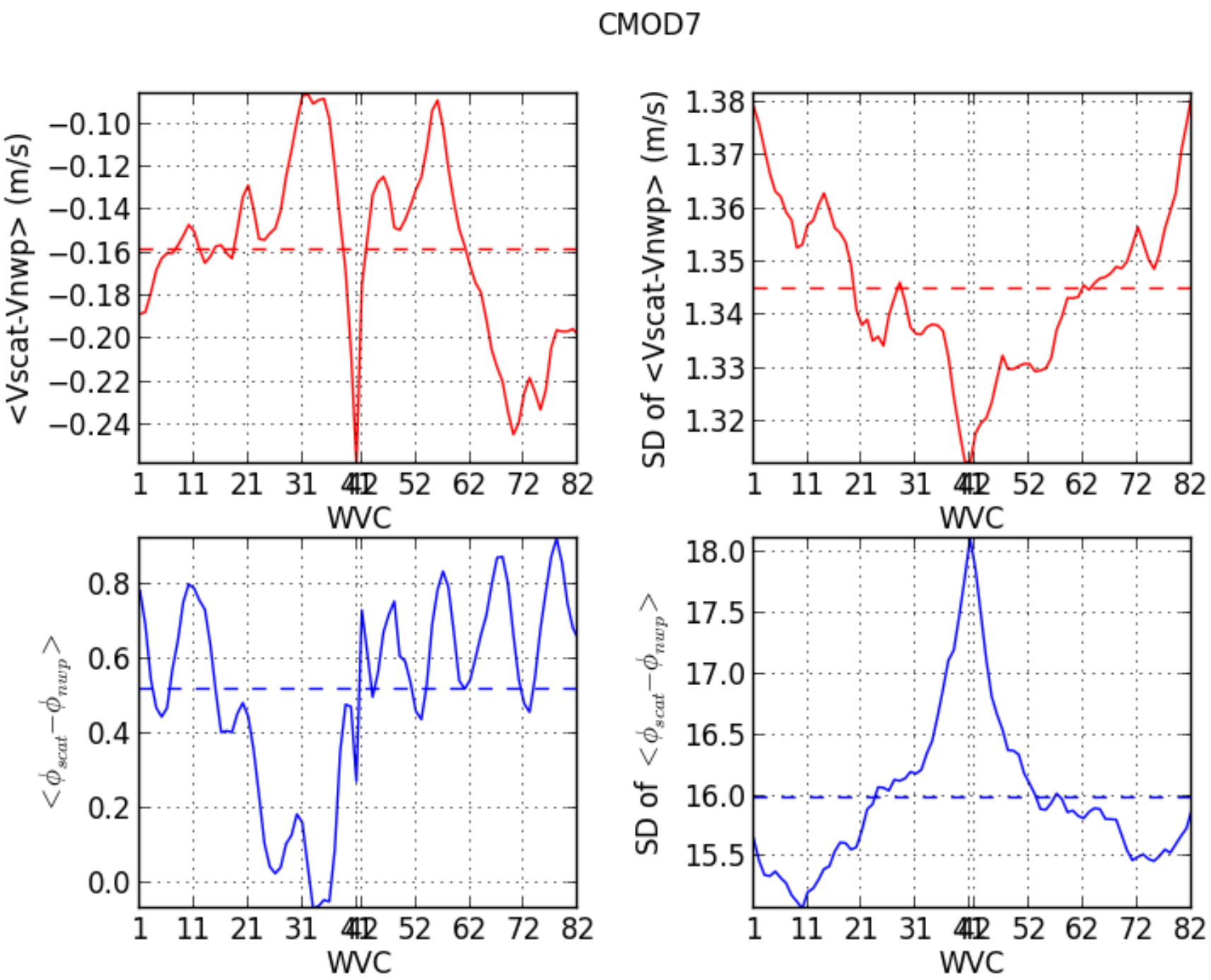

CMOD6
0°
25000
20000
15000
10000
5000
45°
90°
135°
180°
225°
270°
ϕ
V_{scat} (m/s)
0.0-1.2
1.2-2.4
2.4-3.6
3.6-4.8
4.8-6.0
6.0-7.2

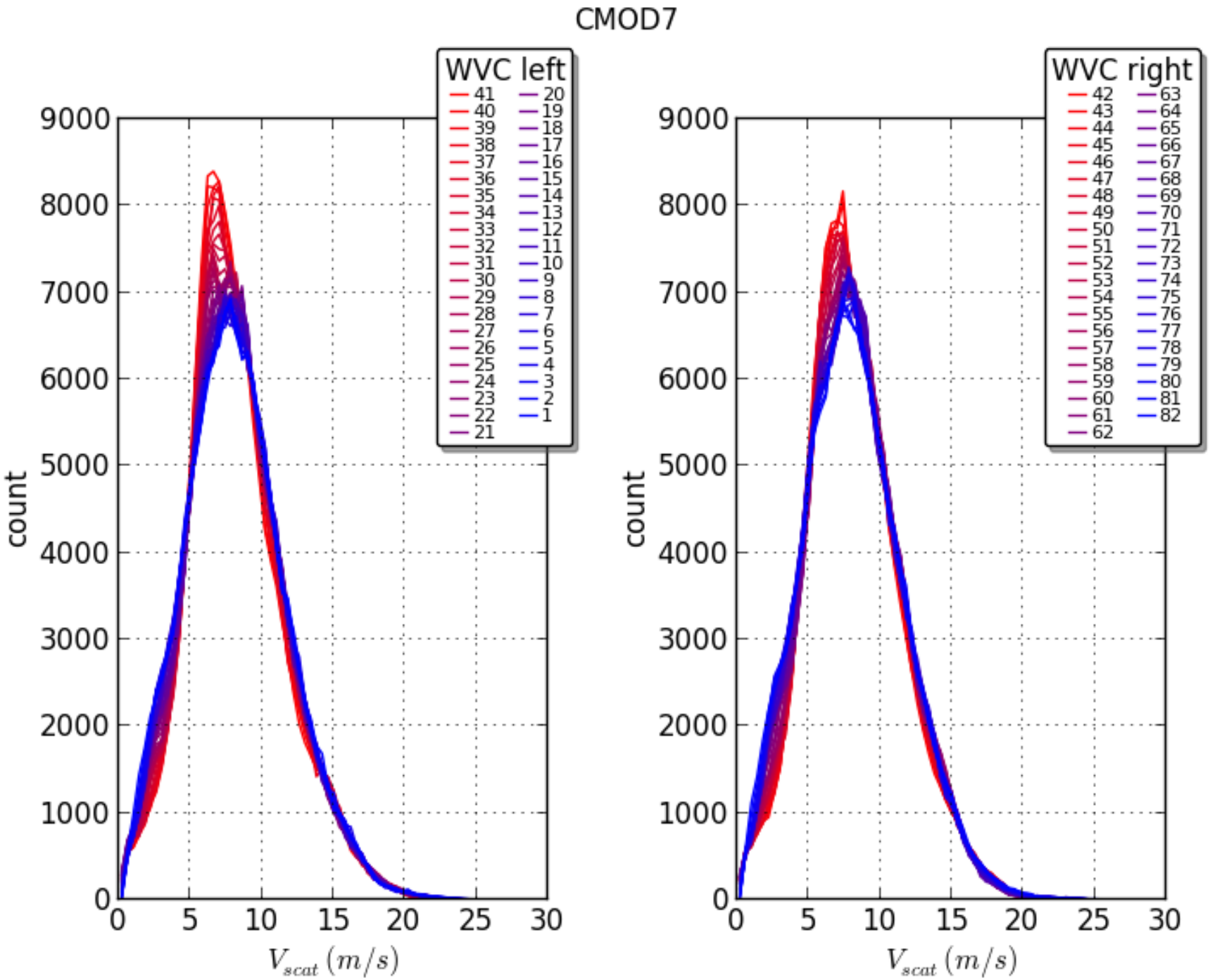
C2013


C2013
0°
45°
90°
135°
180°
225°
270°
25000
20000
15000
10000
5000
V_{scat} (m/s)
0.0-1.2
1.2-2.4
2.4-3.6
3.6-4.8
4.8-6.0
6.0-7.2
ϕ

CMOD7 (trial)


CMOD7
0°
45°
90°
135°
180°
225°
270°
25000
20000
15000
10000
5000
V_{scat} (m/s)
0.0-1.2
1.2-2.4
2.4-3.6
3.6-4.8
4.8-6.0
6.0-7.2
V_{scat} (m/s)
ϕ


CMOD7
<Vscat-Vnwp> (m/s)
−0.10
−0.12
−0.14
−0.16
−0.18
−0.20
−0.22
−0.24
1 11 21 31 41 52 62 72 82
WVC
SD of <Vscat-Vnwp> (m/s)
1.38
1.37
1.36
1.35
1.34
1.33
1.32
1 11 21 31 41 52 62 72 82
WVC
$<\phi_{scat}-\phi_{nwp}>$
0.8
0.6
0.4
0.2
0.0
1 11 21 31 41 52 62 72 82
WVC
SD of $<\phi_{scat}-\phi_{nwp}>$
18.0
17.5
17.0
16.5
16.0
15.5
1 11 21 31 41 52 62 72 82
WVC

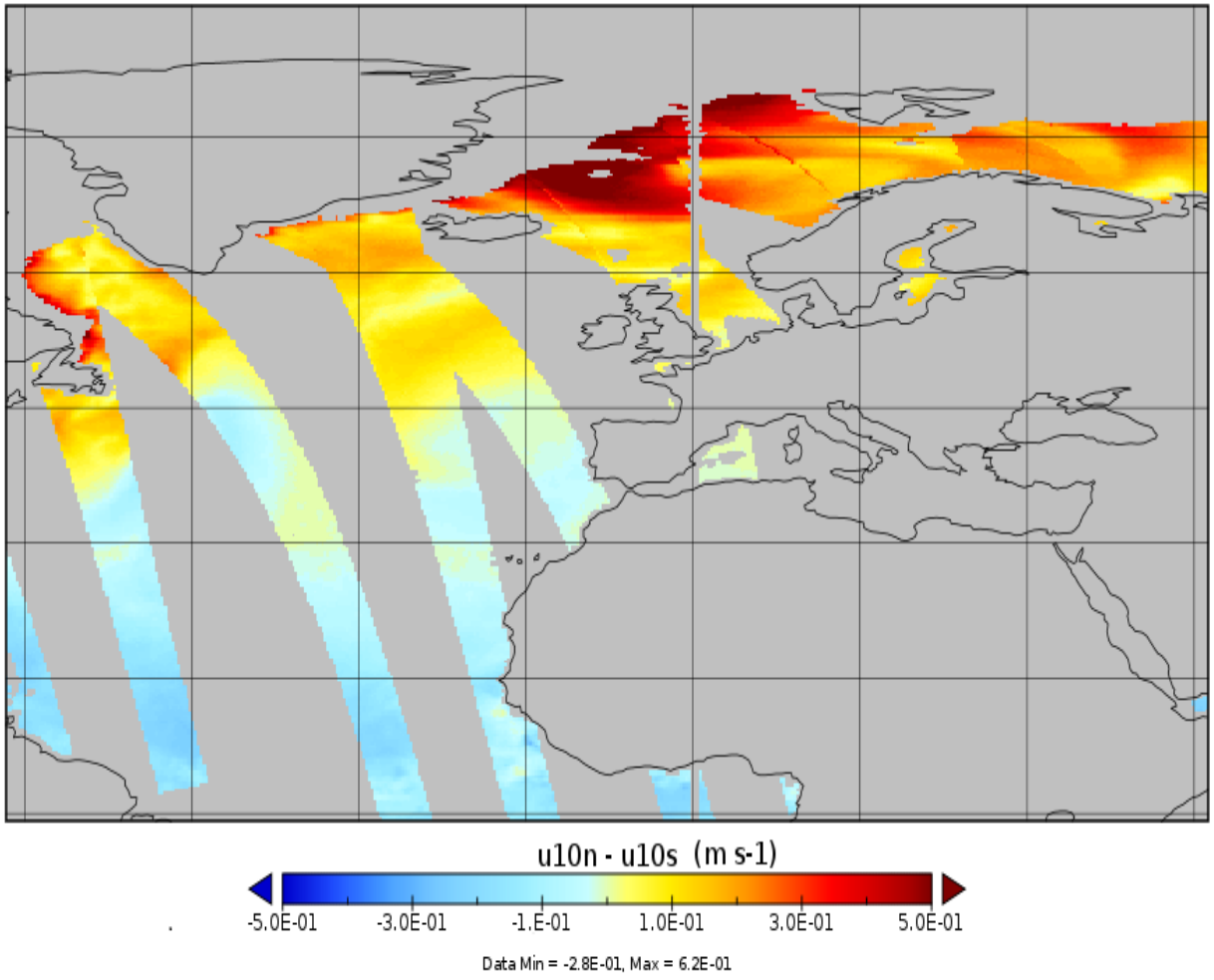

CMOD7
WVC left
41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
WVC right
42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62
63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82
count
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0 5 10 15 20 25 30
$V_{scat}\,(m/s)$

Stress-equivalent Winds, U10S

Equivalent neutral winds, $\boldsymbol{u}_{10N}$, depend only on $\boldsymbol{u}_{*}$, surface roughness and the presence of ocean currents and were used for backscatter geophysical model functions (GMFs)

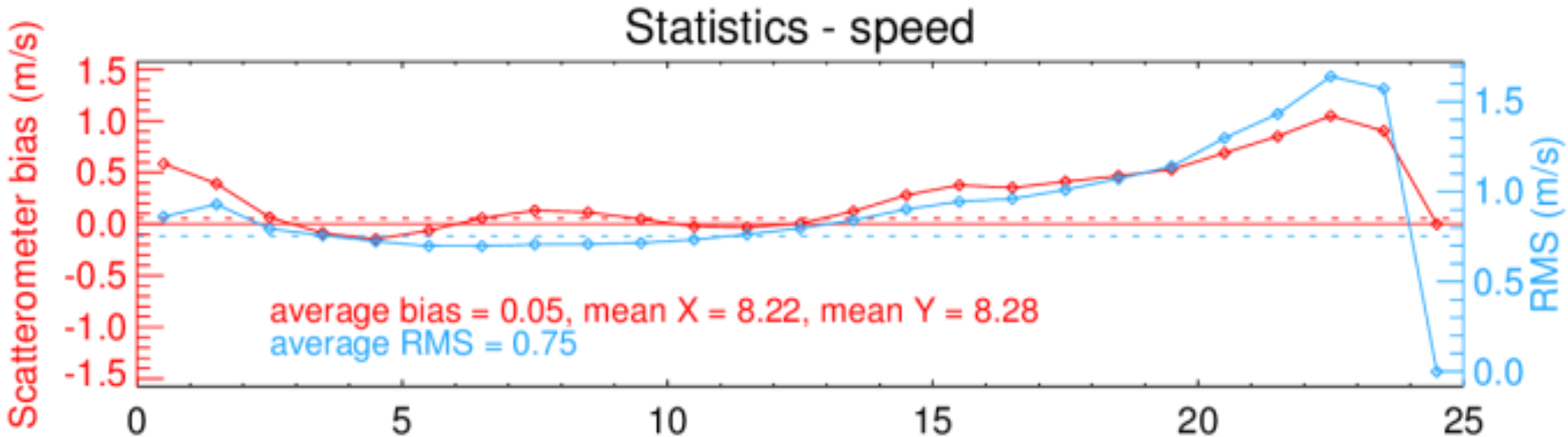
Stress-equivalent wind, $\boldsymbol{u}_{10S} = \sqrt{\rho_{air}} \cdot \boldsymbol{u}_{10N} / \sqrt{\rho_{ref}}$ is a better input for backscatter GMFs

Implemented in MyO FO v5 and under evaluation in the IOVWST



Rapidscat vs ASCAT

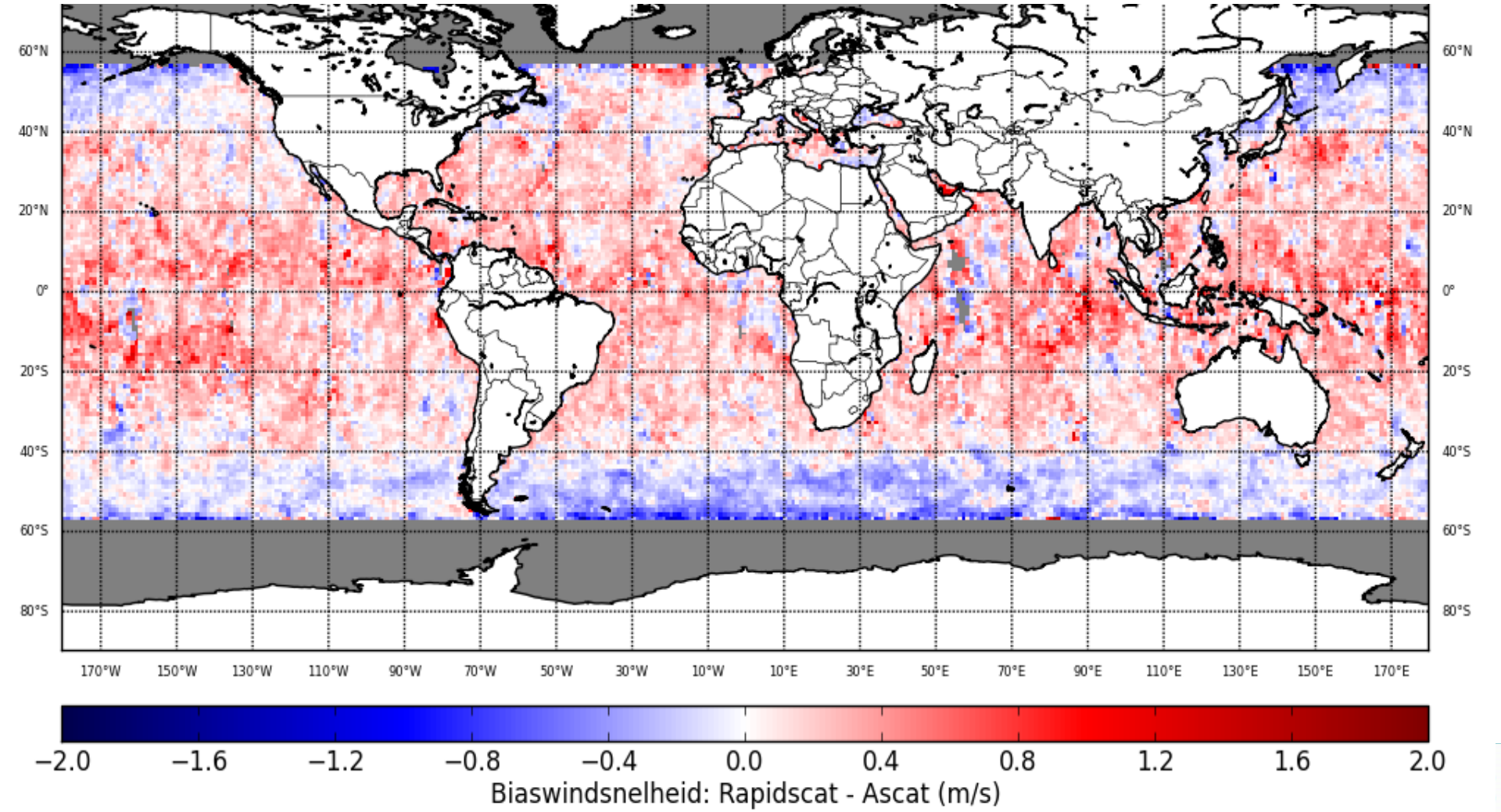
- November thru March, < 30 min, < 25 km & closest
- Good comparison, but different speed scale and QC
- High latitude winds are different; due to speed scale?
- RSCAT NSCAT4 winds higher at low and high end (vs CMOD6)
- Low ASCAT winds too often rejected (need CMOD7?)
- Accepted data appear generally good, but many rejected winds appear close to the diagonal, which calls for RSCAT QC improvements
- Further in-depth analysis needed



Rapidscat vs ASCAT

all swaths

November thru March, < 30 min, < 25 km & closest



Conclusions

- C2013 biased for winds > 15 m/s with respect to moored buoy winds (and ECMWF winds)
- C2013 shows improved winds for V<5 m/s, since based on ASCAT
- CMOD7 uses CMOD6 for V >=**x** m/s and mix of CMOD6 and C2013 for V<**x** m/s
- First trial CMOD7 interpolation between C2013 and CMOD6 works well; use C2015?
- Wind statistics of CMOD7 vs WVC will be improved by PDF matching
- U10S
- Account for surface tension to explain C and Ku band differences?