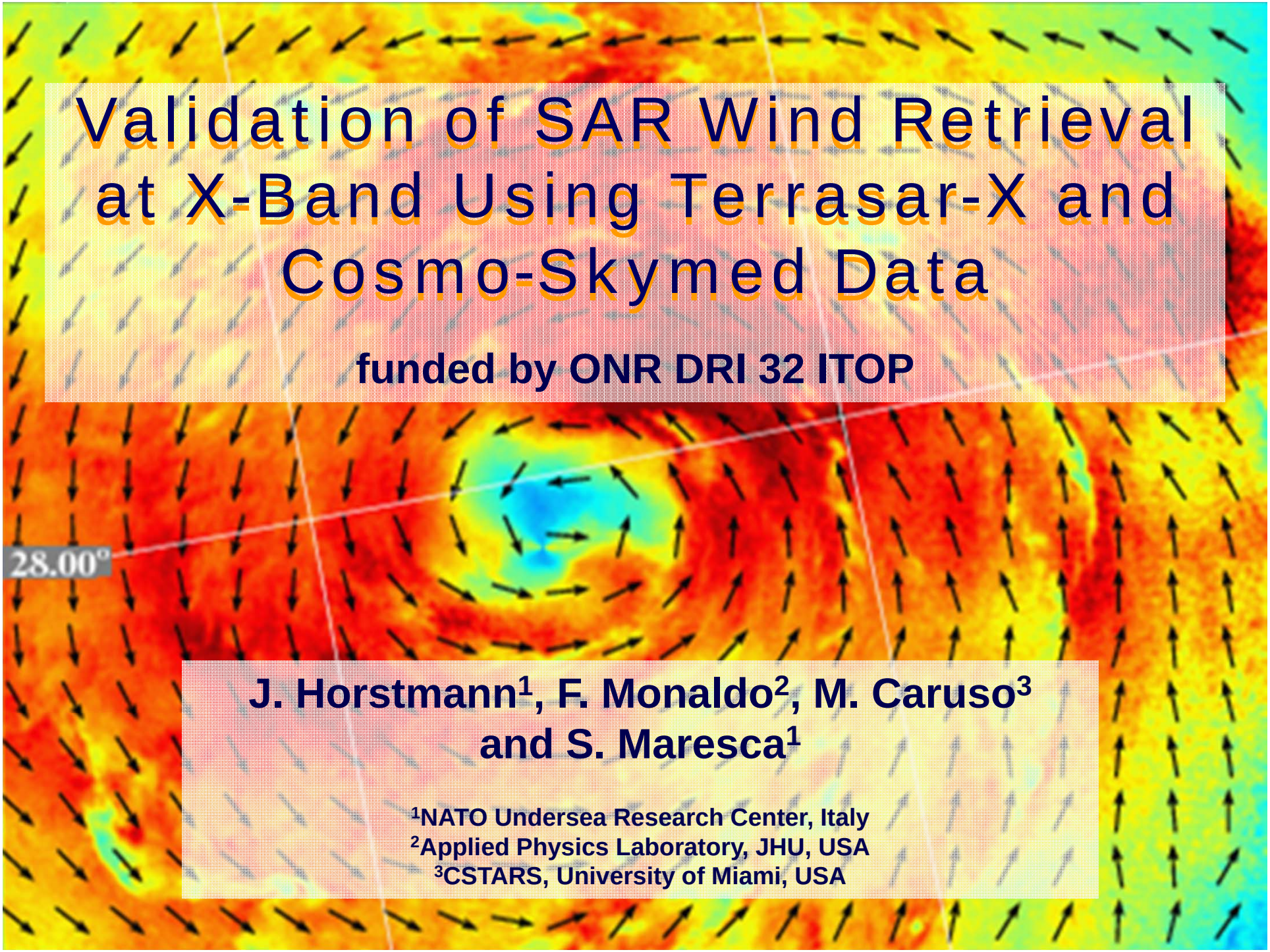


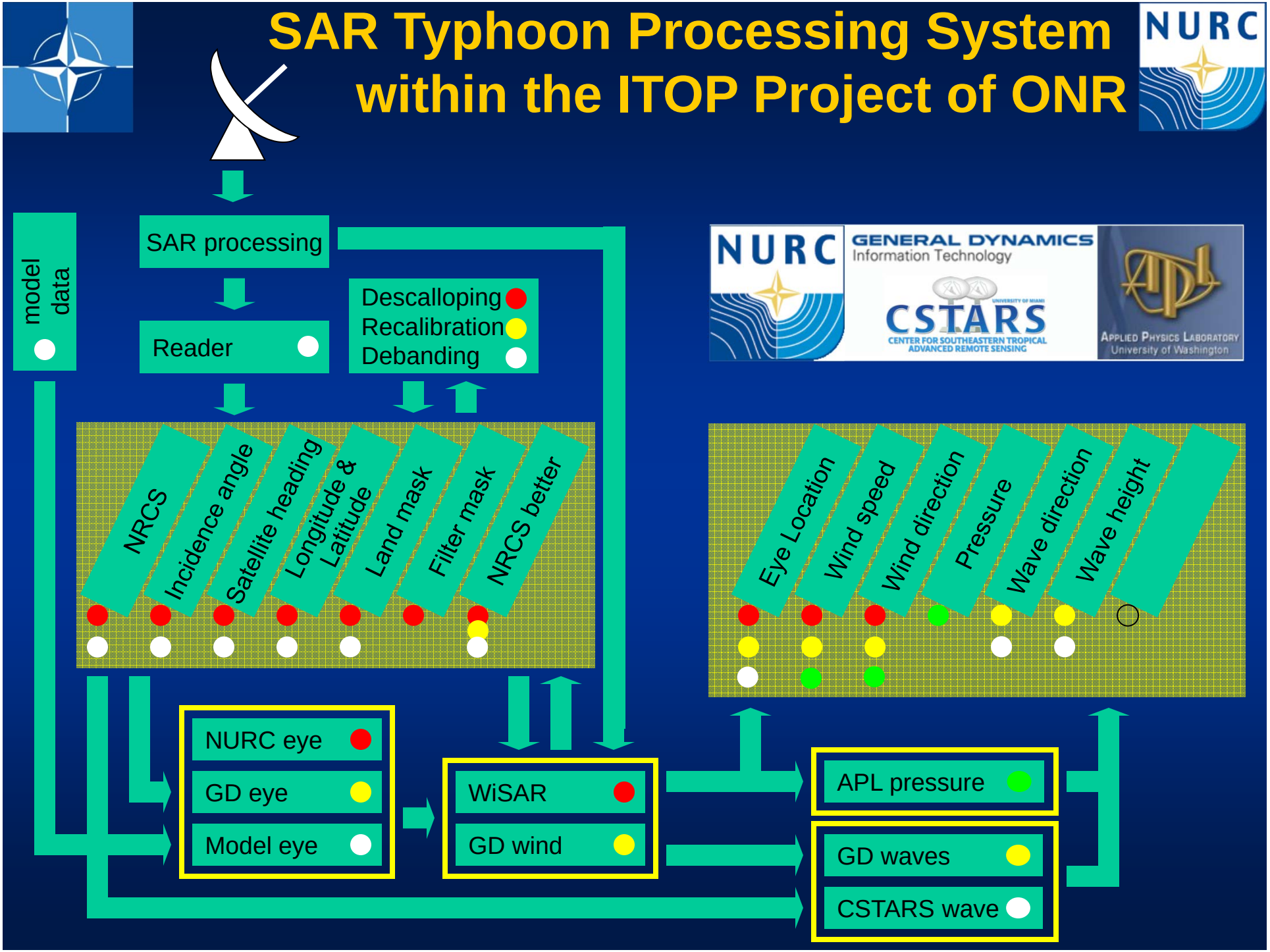
Validation of SAR Wind Retrieval at X-Band Using Terrasar-X and Cosmo-Skymed Data

funded by ONR DRI 32 ITOP

J. Horstmann[1], F. Monaldo[2], M. Caruso[3] and S. Maresca[1]

[1]NATO Undersea Research Center, Italy
[2]Applied Physics Laboratory, JHU, USA
[3]CSTARS, University of Miami, USA

SAR Typhoon Processing System within the ITOP Project of ONR



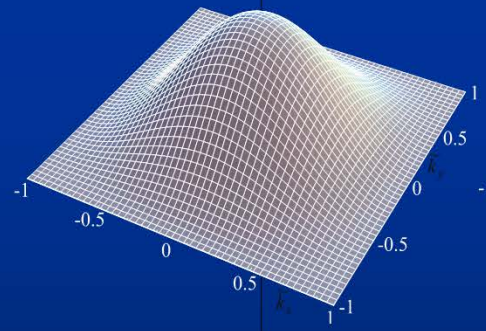
General Approach for Ocean SAR Wind Field Retrieval (WiSAR)

Local Gradient Method

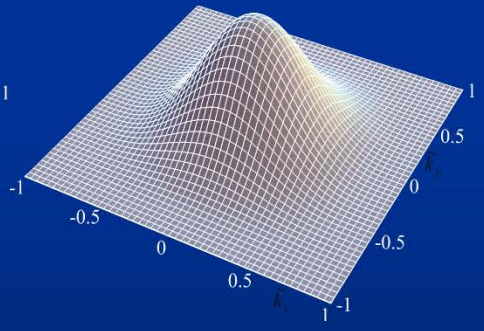
$(B^2B^4_{xy})^3$ → Sobel → $(B^2B^4_{xy})$ → Φ

Binomial filter

2 dim. B^2 Filter



2 dim. B^4 Filter



Optimized Sobel-Filter

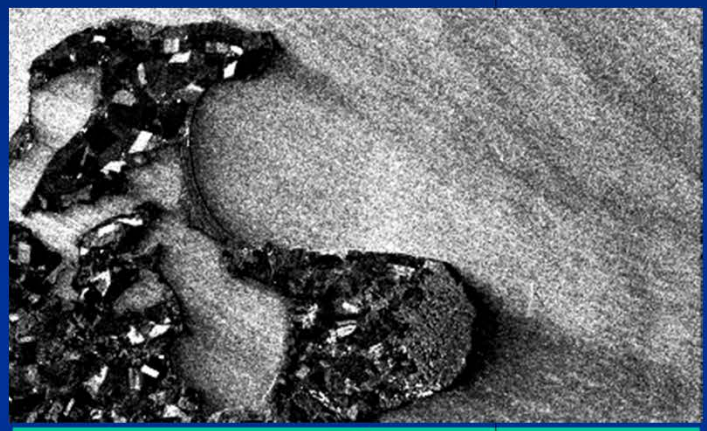
3	0	–3
10	0	–10
3	0	–3

→

3	10	3
0	0	0
–3	–10	–3

→

Geophysical Model Function



$$\sigma_0^{pol} = a(\theta)u^{\gamma(\theta)}[1 + b(\theta)\cos\phi + c(\theta)\cos(2\phi)]$$

Φ θ u_{10}

GMF for C-, X- and L-band

σ_o

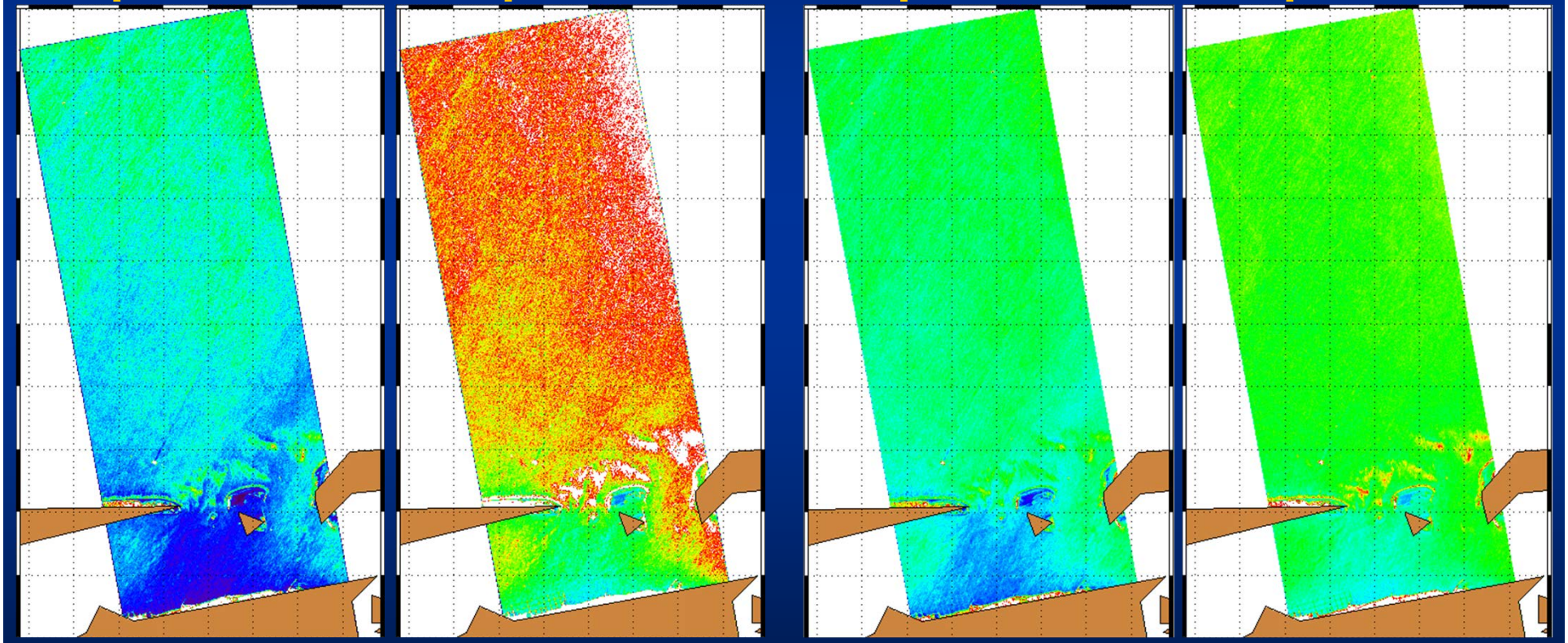
XMOD Retrieved Wind Speeds

Theoretical XMOD

VV-pol **HH-pol**

Empirical XMOD

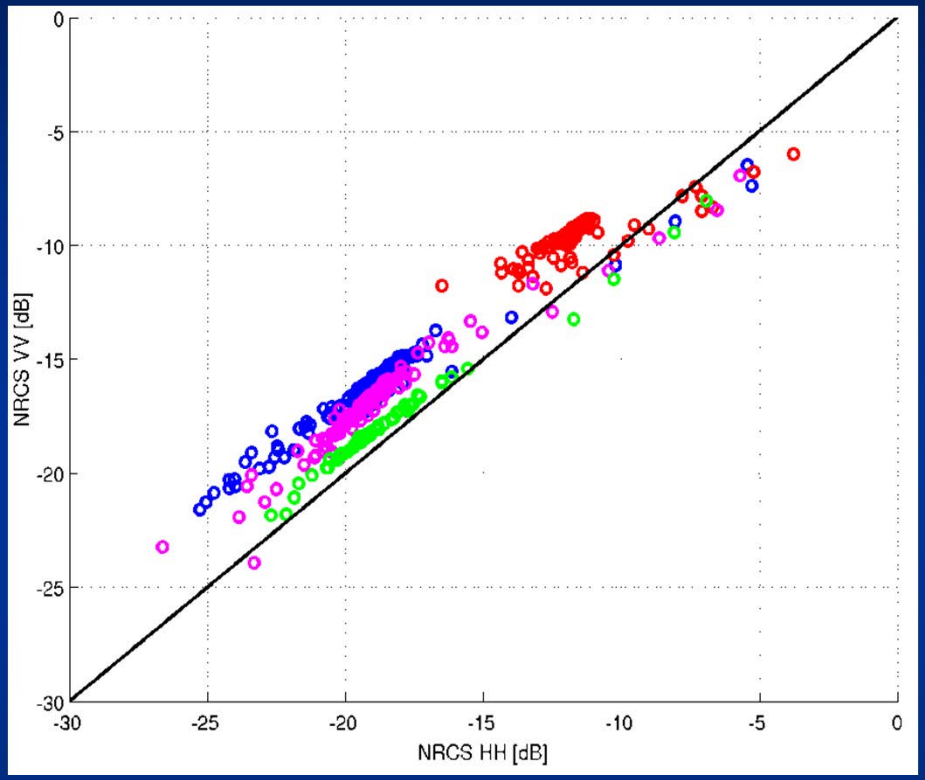
VV-pol **HH-pol**

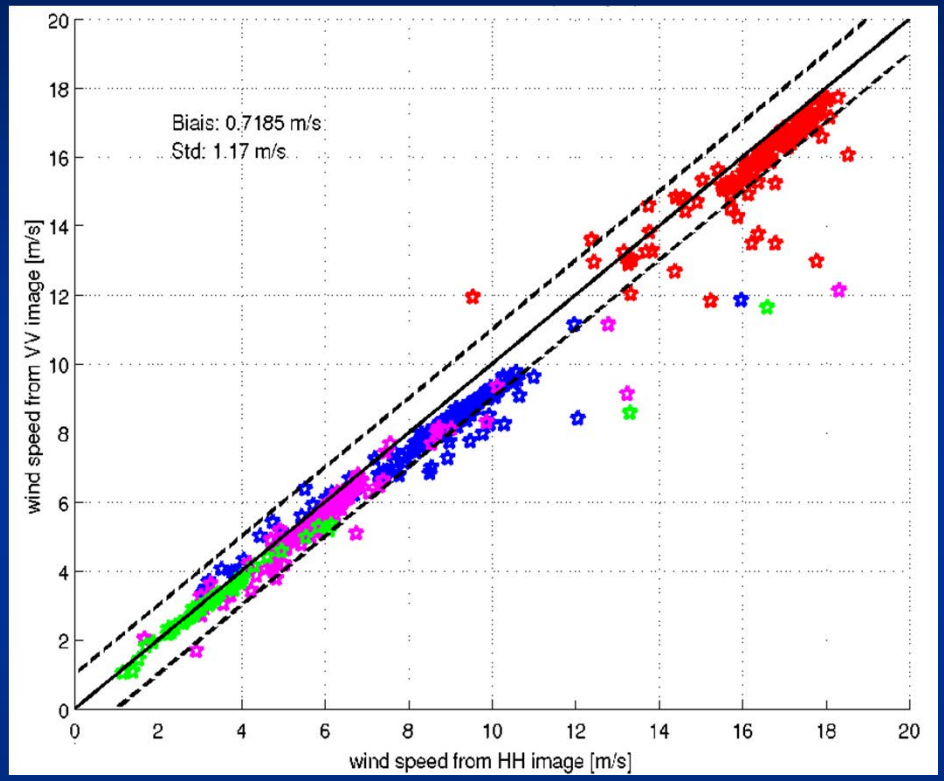


Wind speed [m/s]

0 **22.5**

Consistency Check of Emperical XMOD using TerraSAR-X in Dual Pol



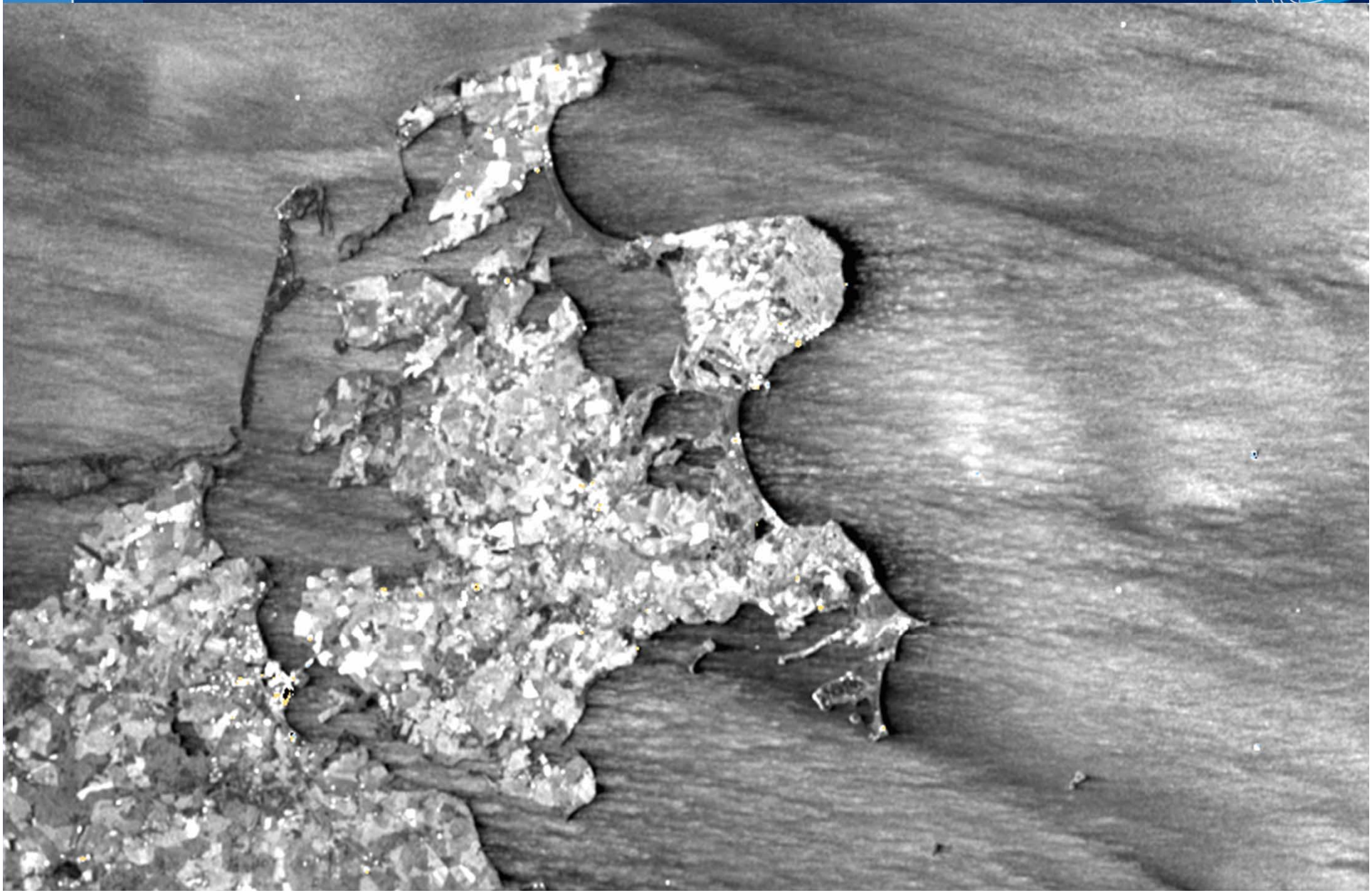


As expected
HH NRCS < VV NRCS

Good agreement between HH and VV pol retrieved wind speeds

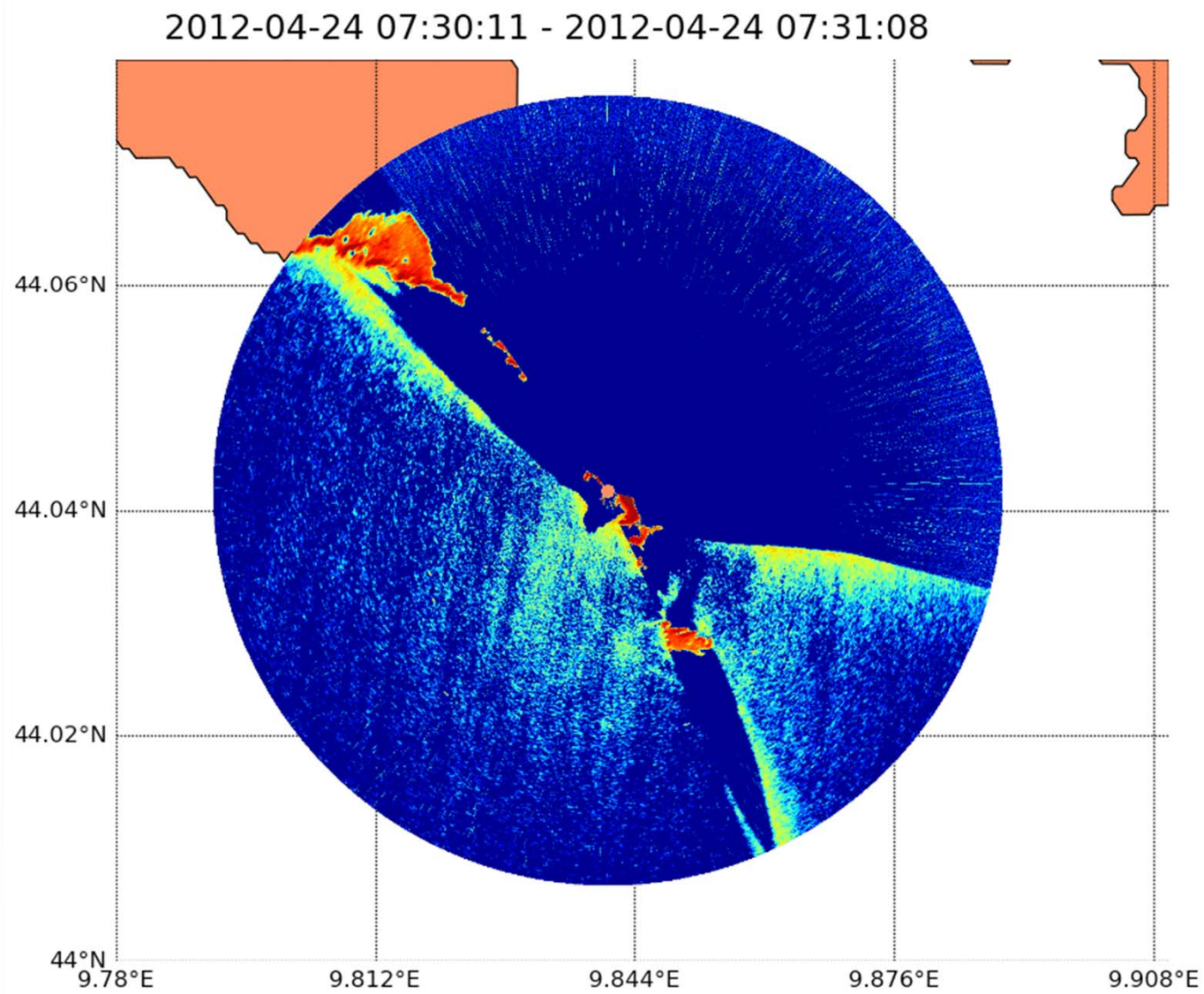
⇒ Consistency in the empirical XMOD

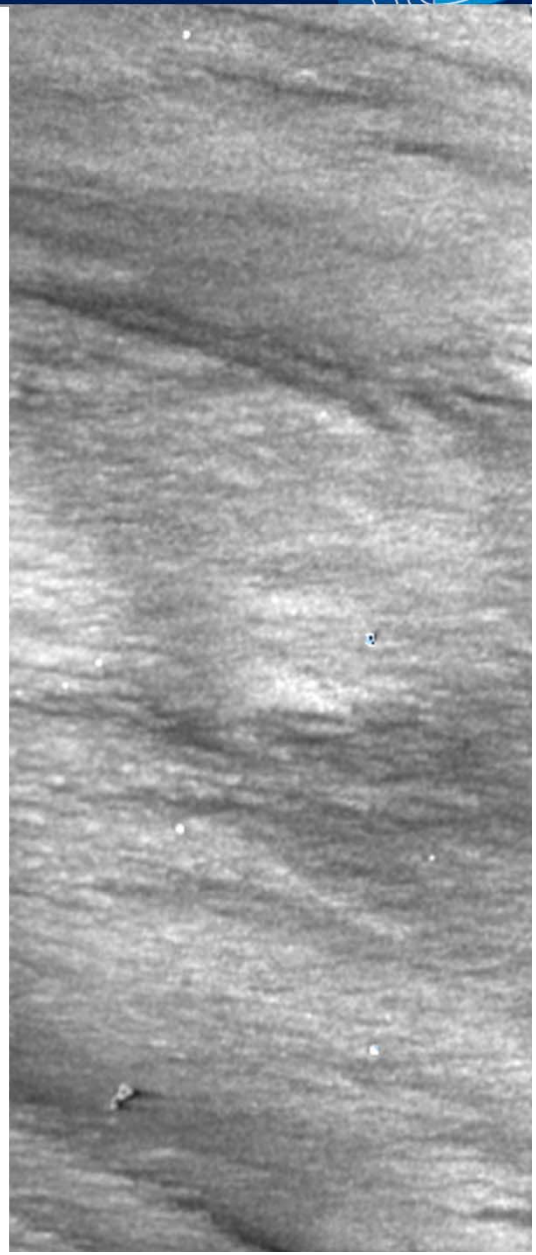
Wind Induced Streaks for Wind Direction Retrieval



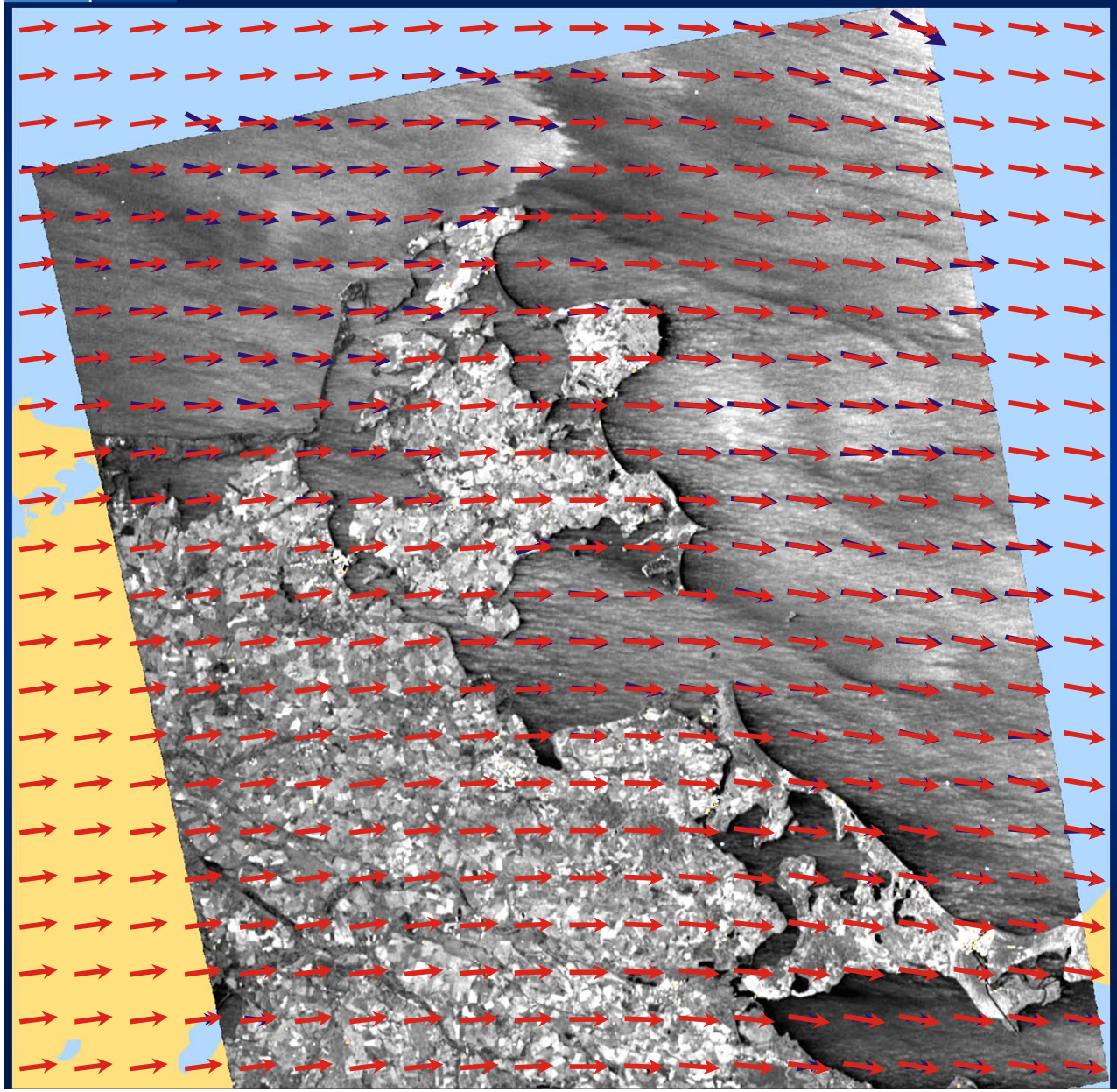
Wind Induced Streaks for Wind Direction Retrieval

X-band Marine Radar Observed Wind Streaks





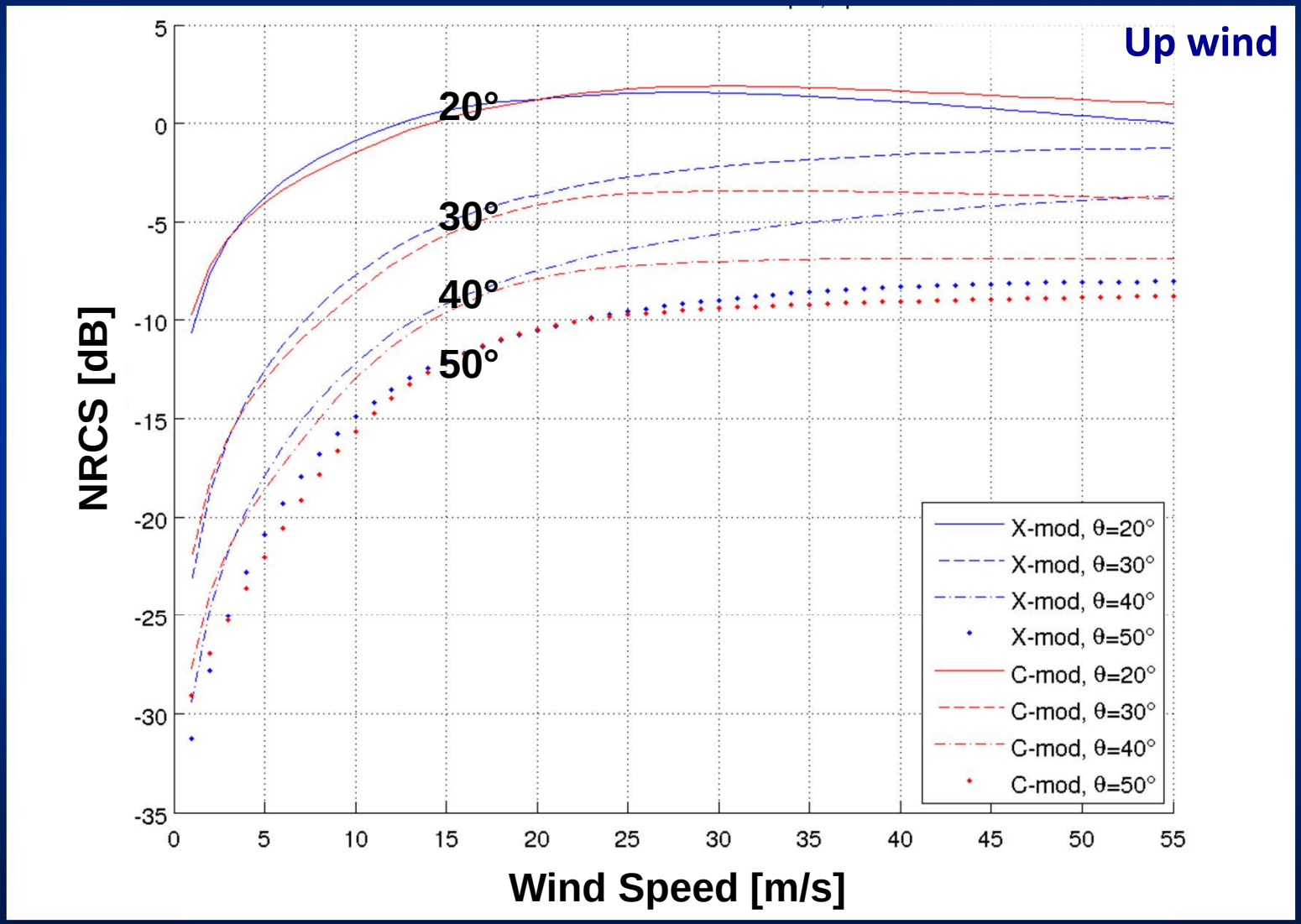
TerraSAR X Retrieved Wind Directions



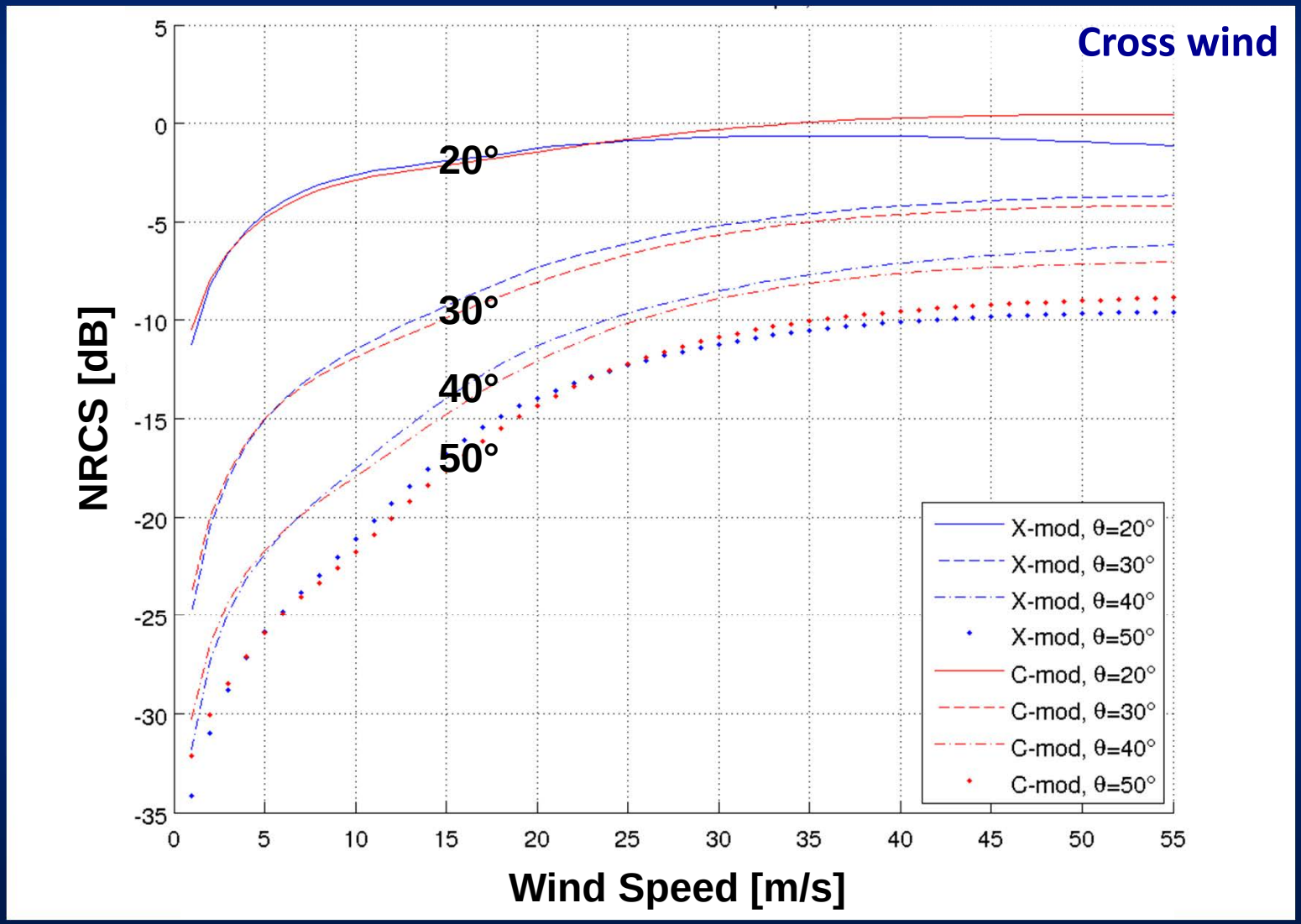
5 km resolution

WiSAR
DWD model

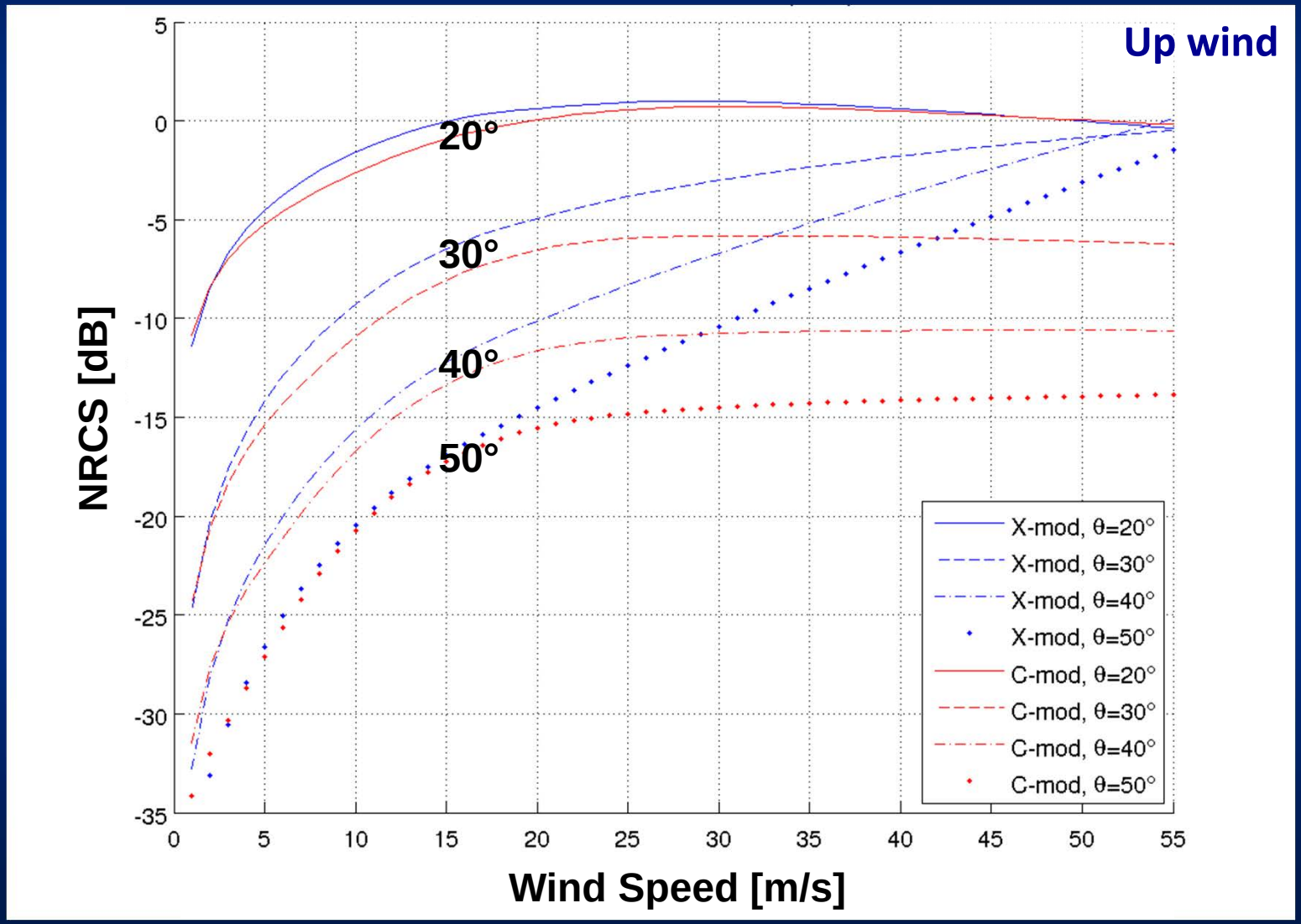
Comparison of X-band to C-band GMF for VV Polarization



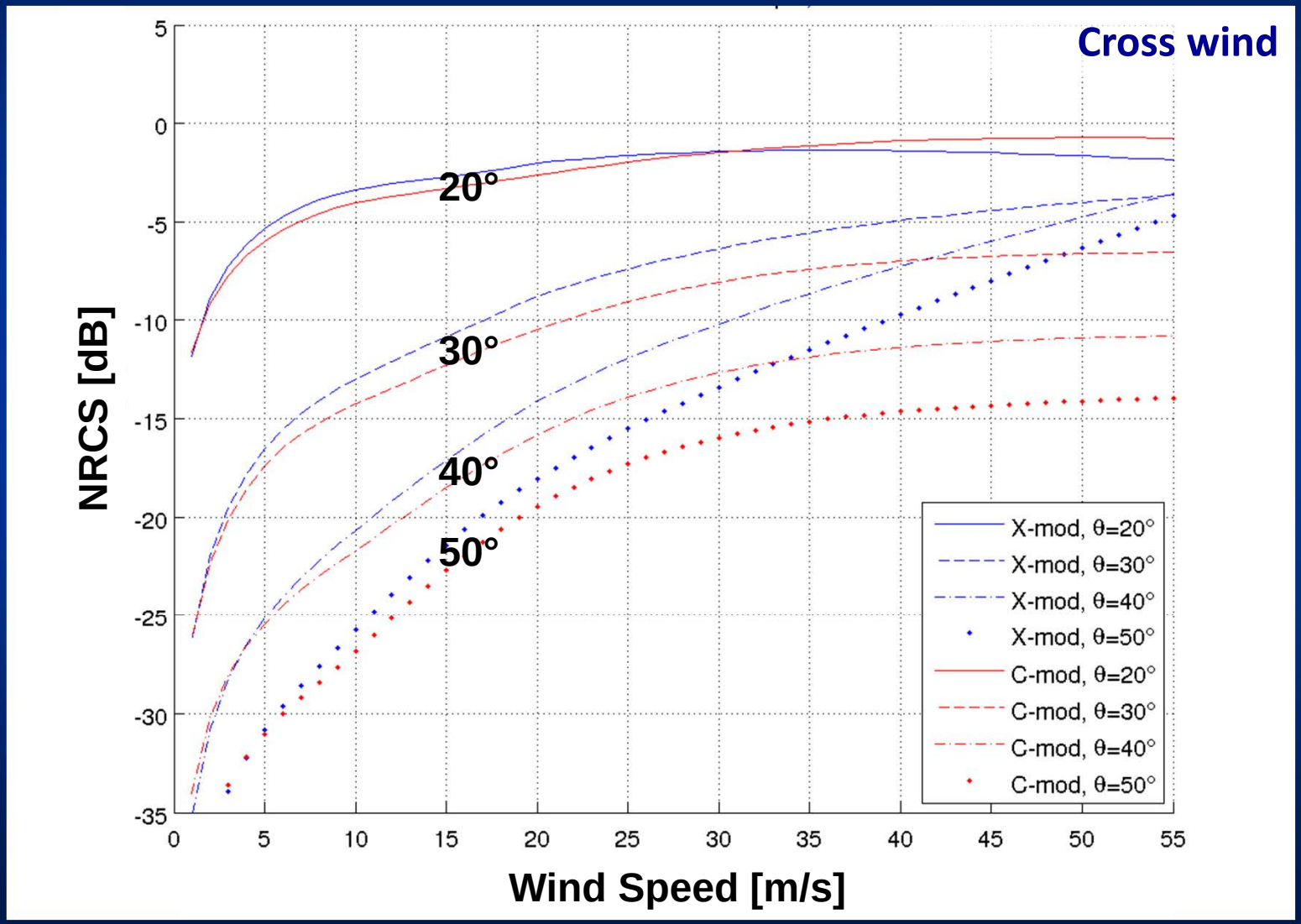
Comparison of X-band to C-band GMF for VV Polarization



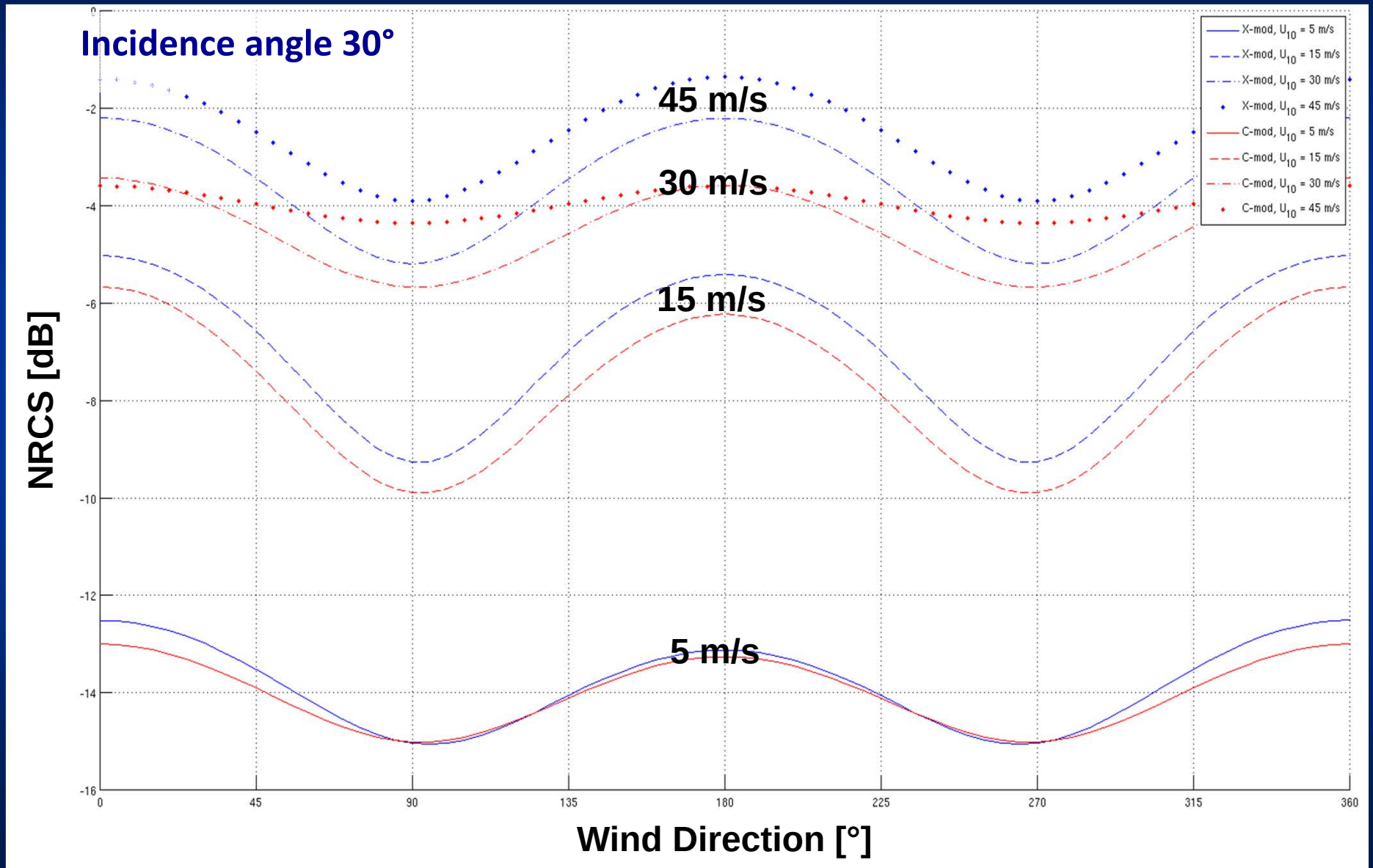
Comparison of X-band to C-band GMF for HH Polarization



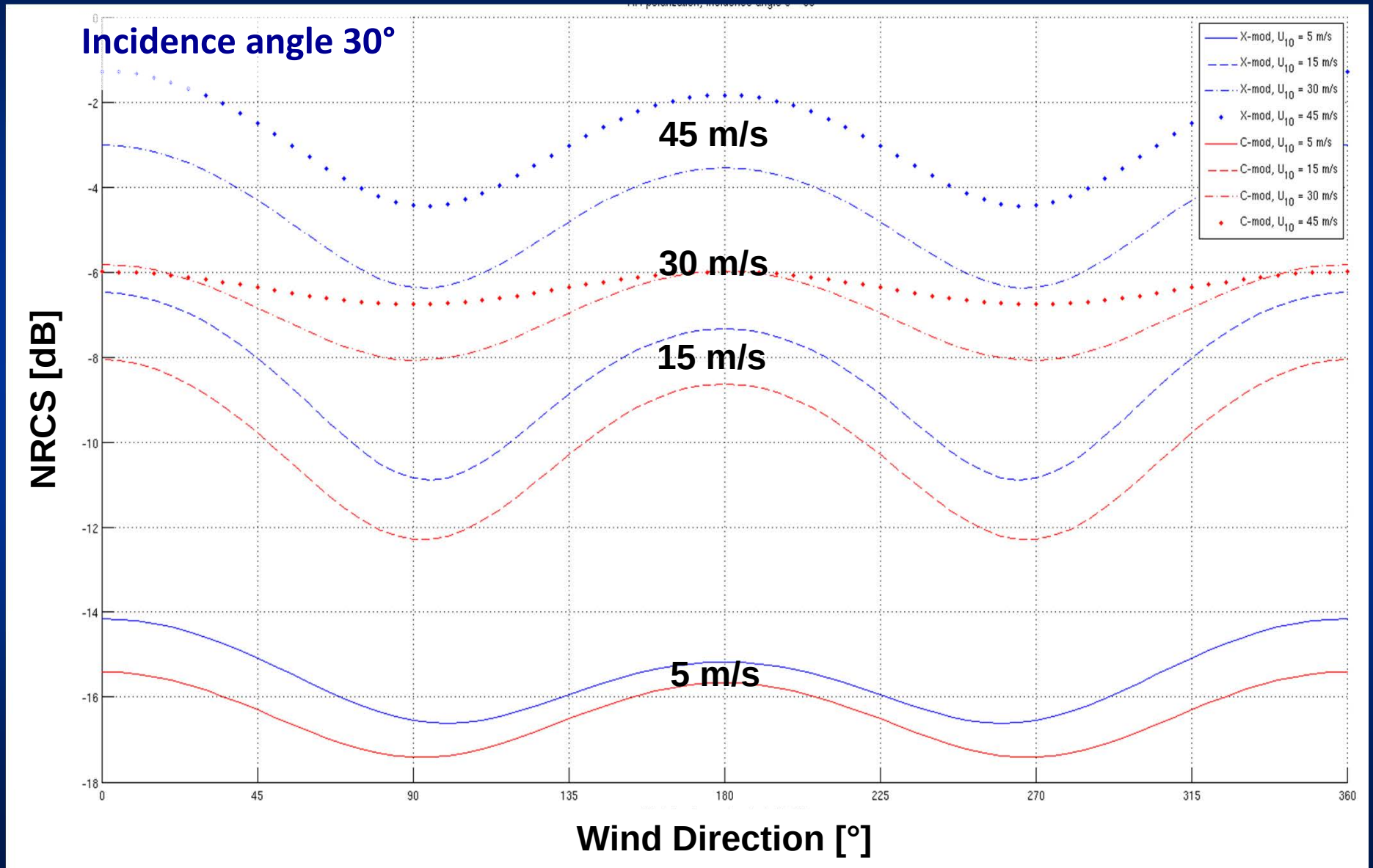
Comparison of X-band to C-band GMF for HH Polarization



Comparison of X-band to C-band GMF for VV Polarization

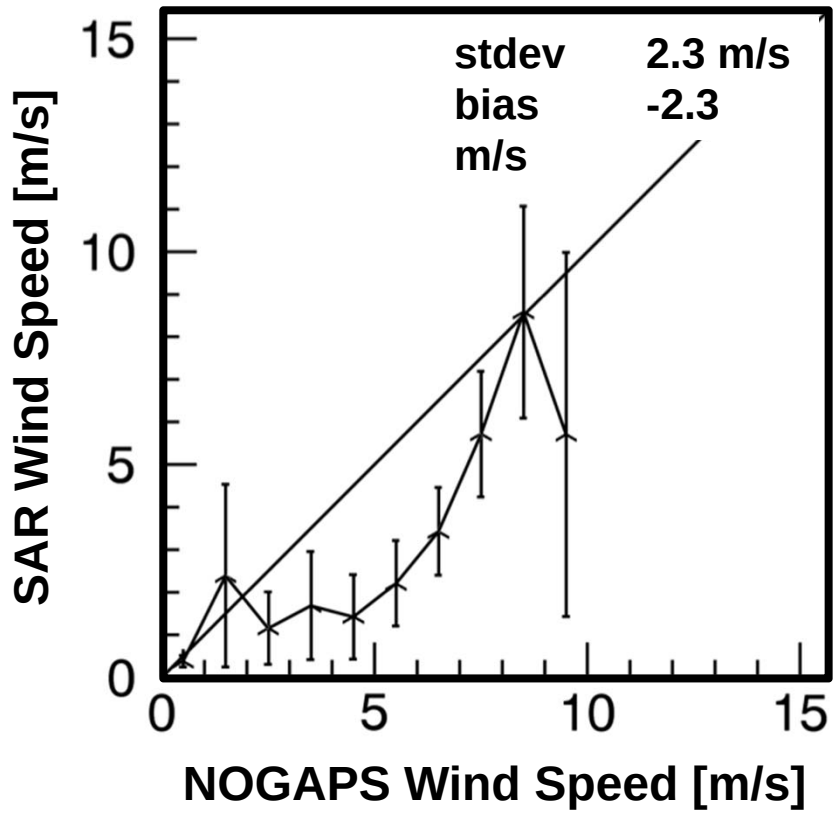


Comparison of X-band to C-band GMF for HH Polarization

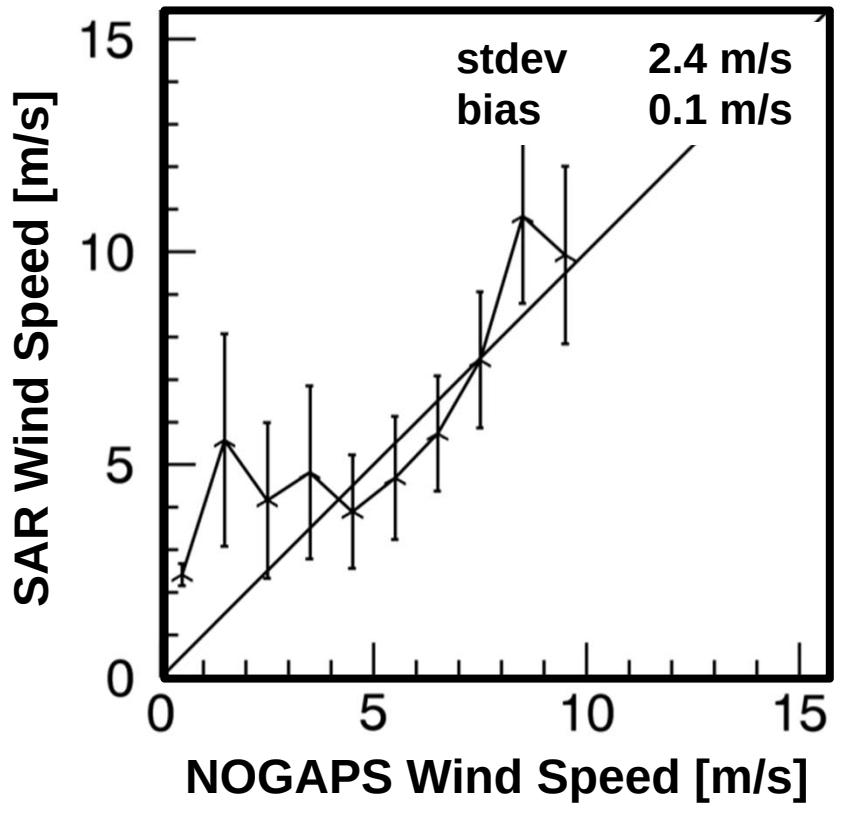


Comparison of Cosmo-SkyMed to NOGAPS wind Speeds

Uncorrected NRCS

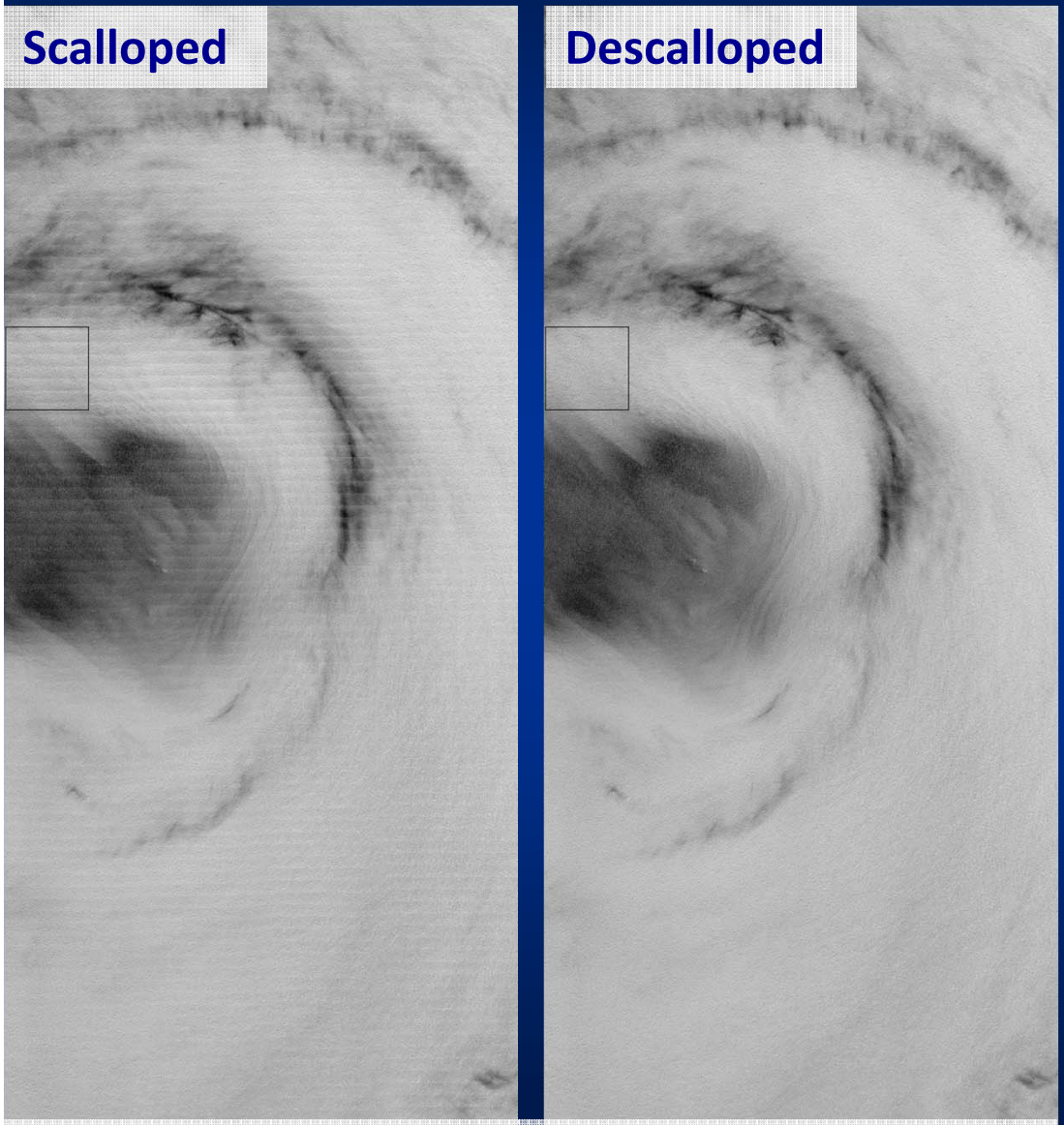


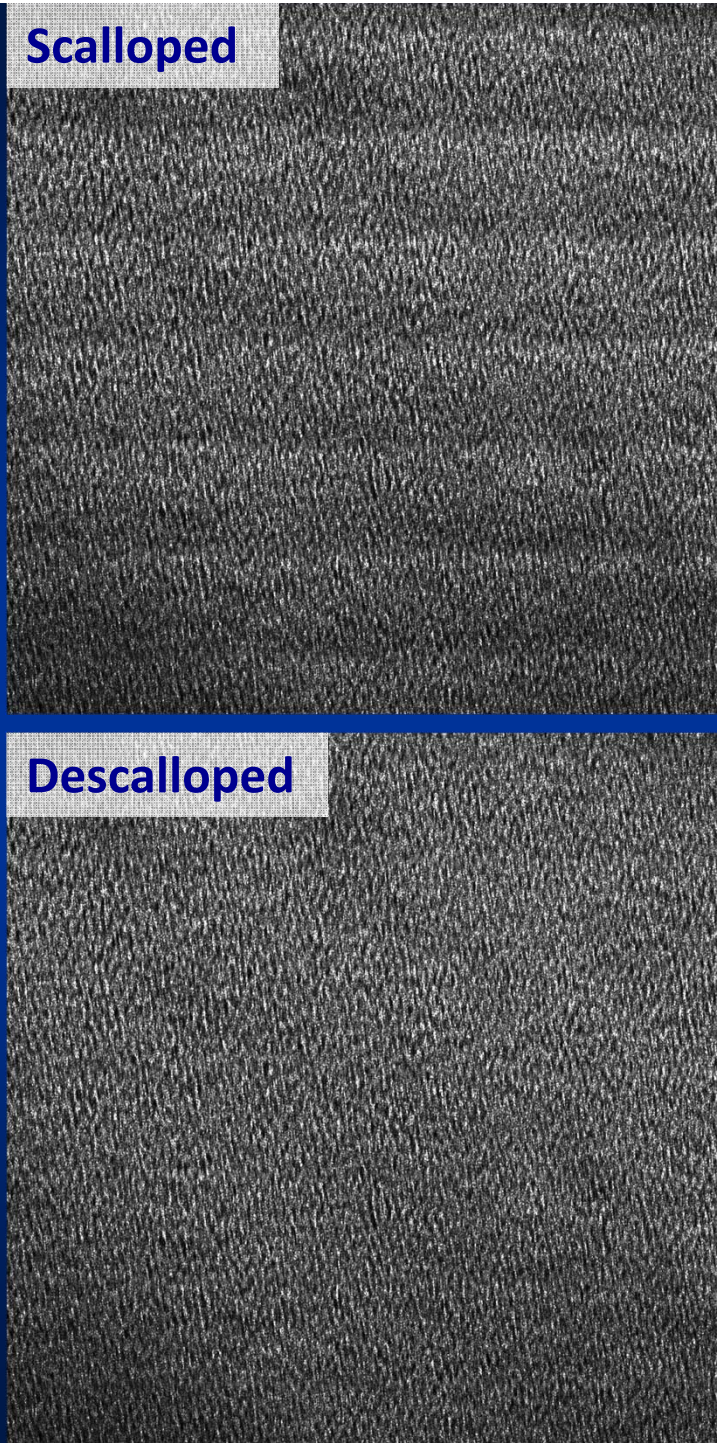
Correction to NRCS



36 Cosmo-SkyMed VV-pol imagery
compared on a 25 km grid (782 co-locations)

Removal of Scalloping TerraSAR-X image

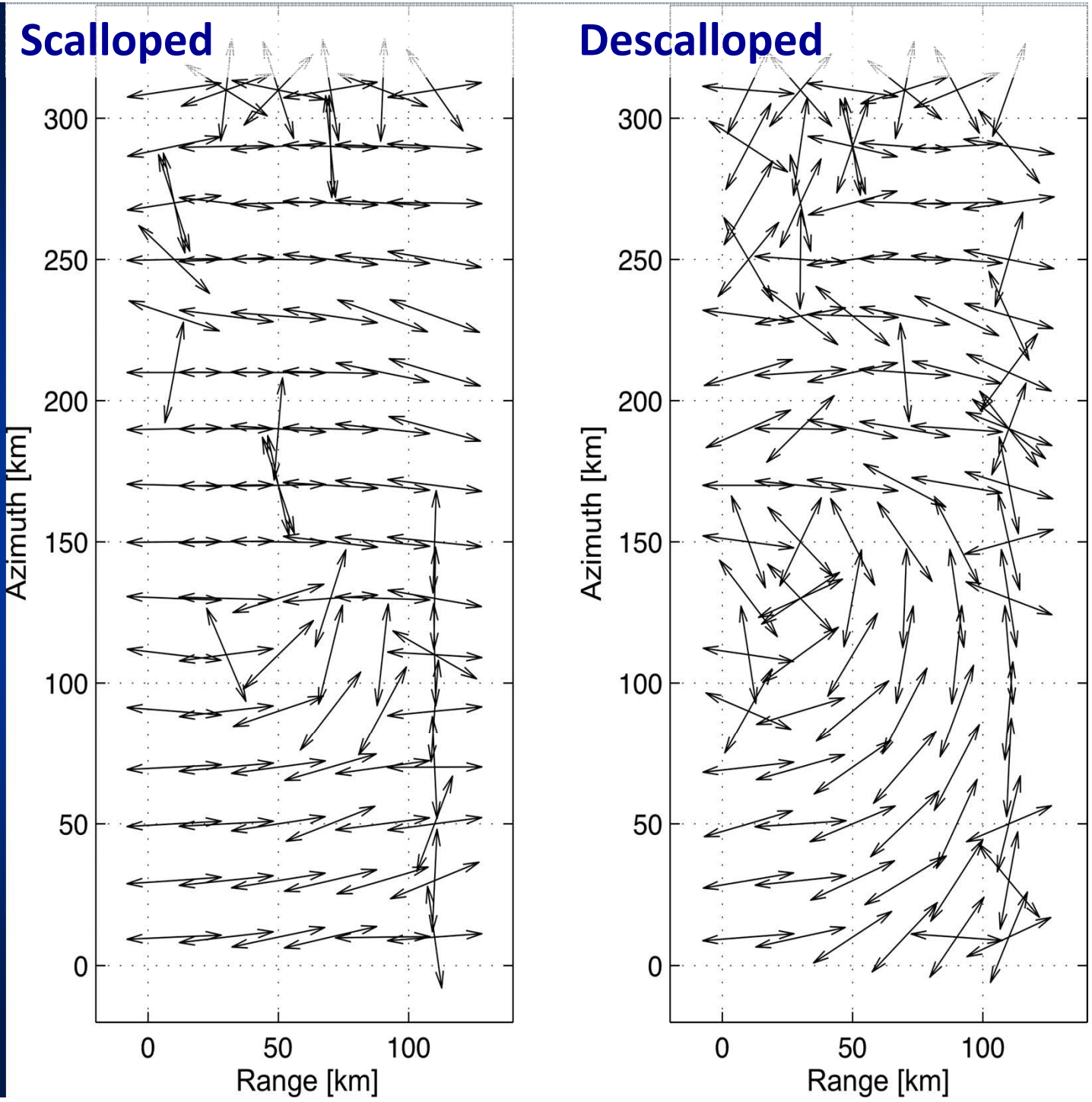




Romeiser et al., submitted to TGARS 2012

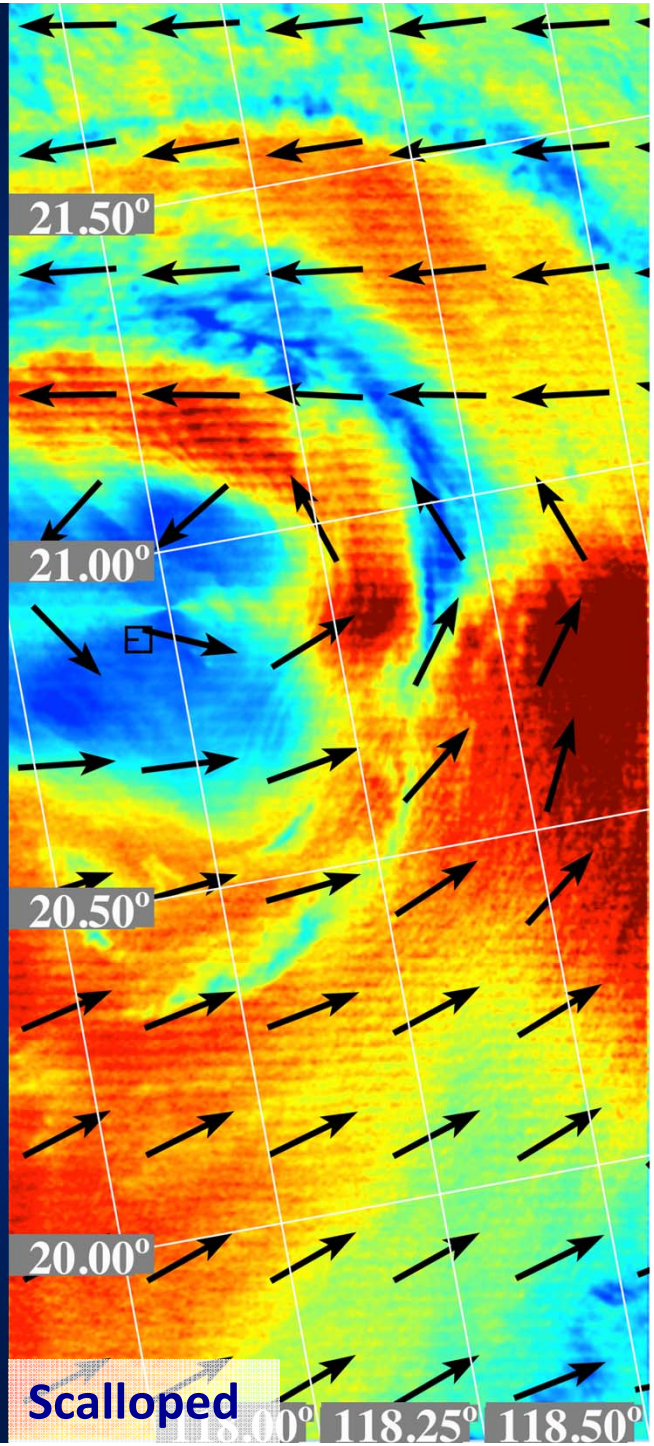
Wind Directions

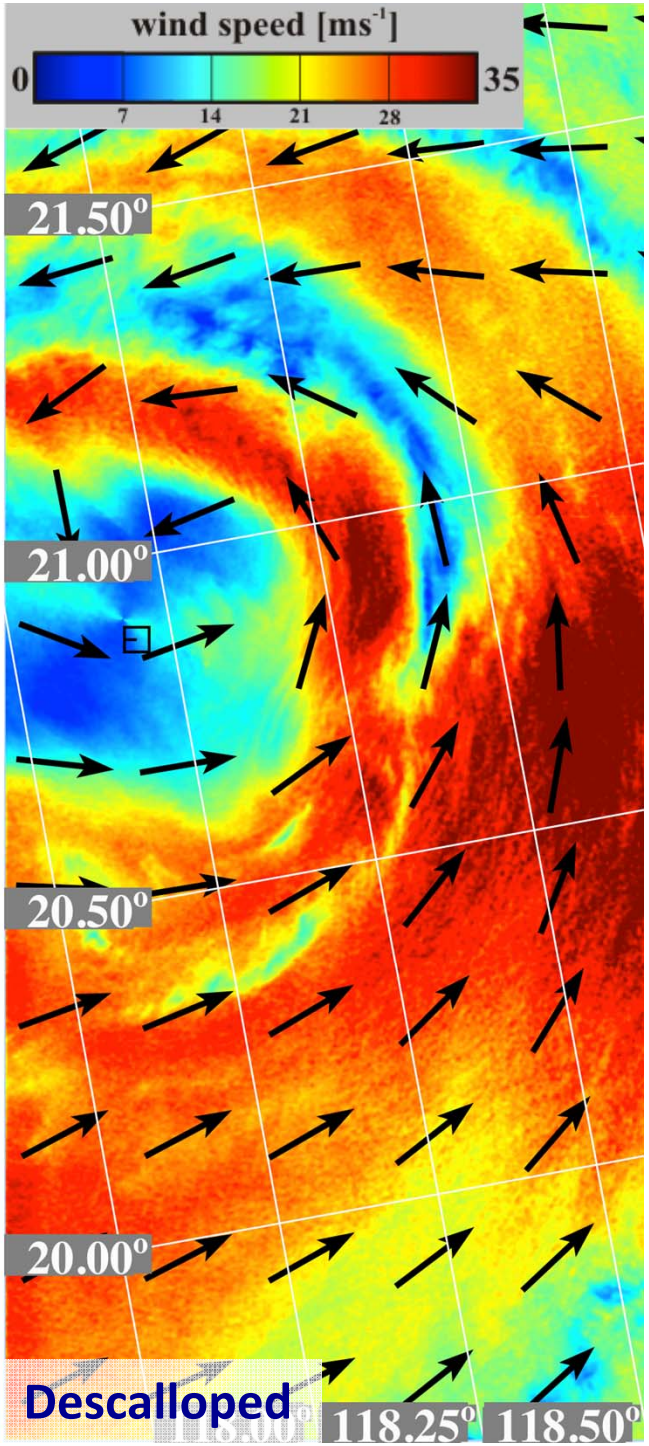
21. Oct 2010
22:05 UTC



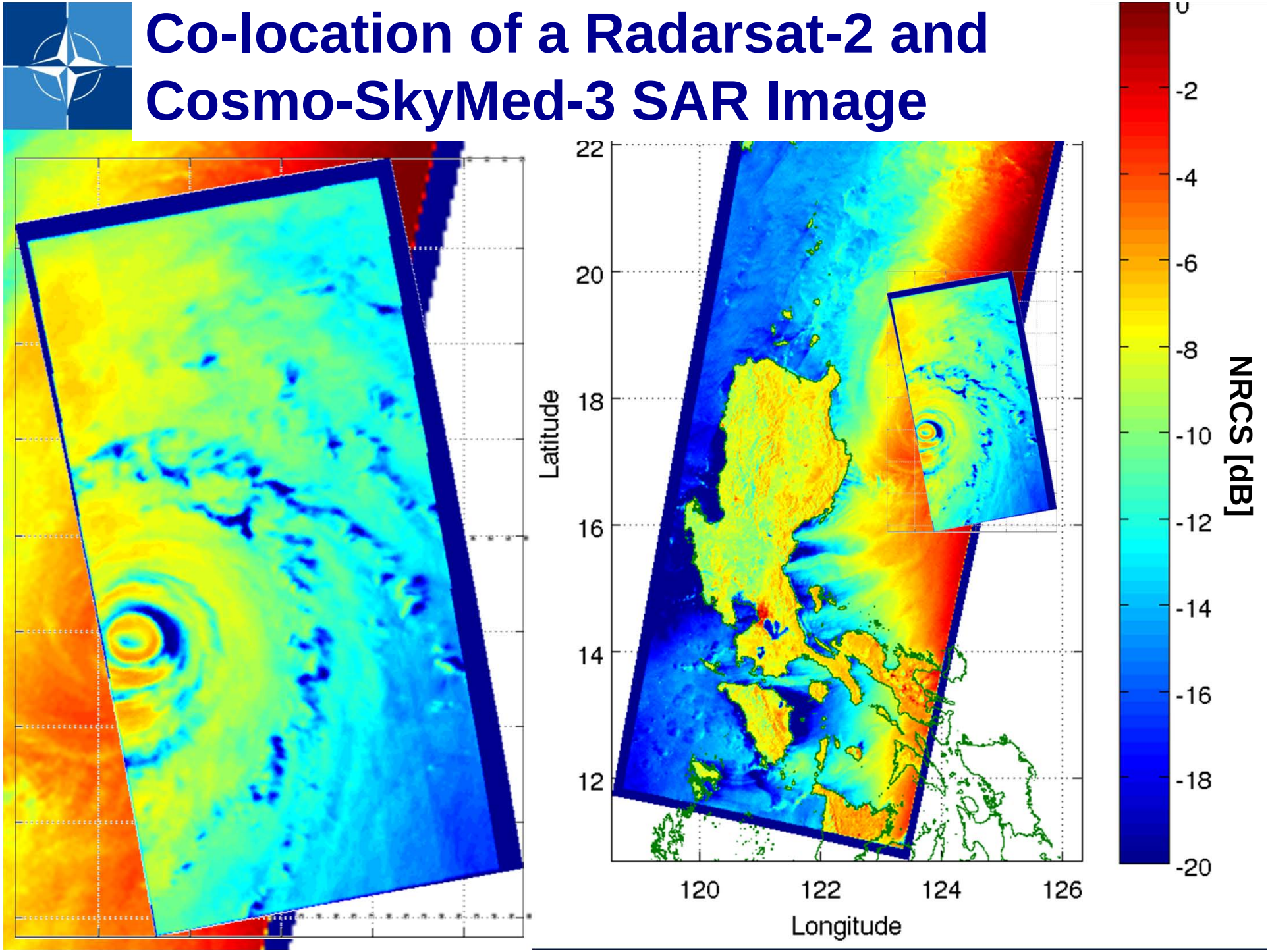
TerraSAR-X Wind Field

21. Oct 2010
22:05 UTC

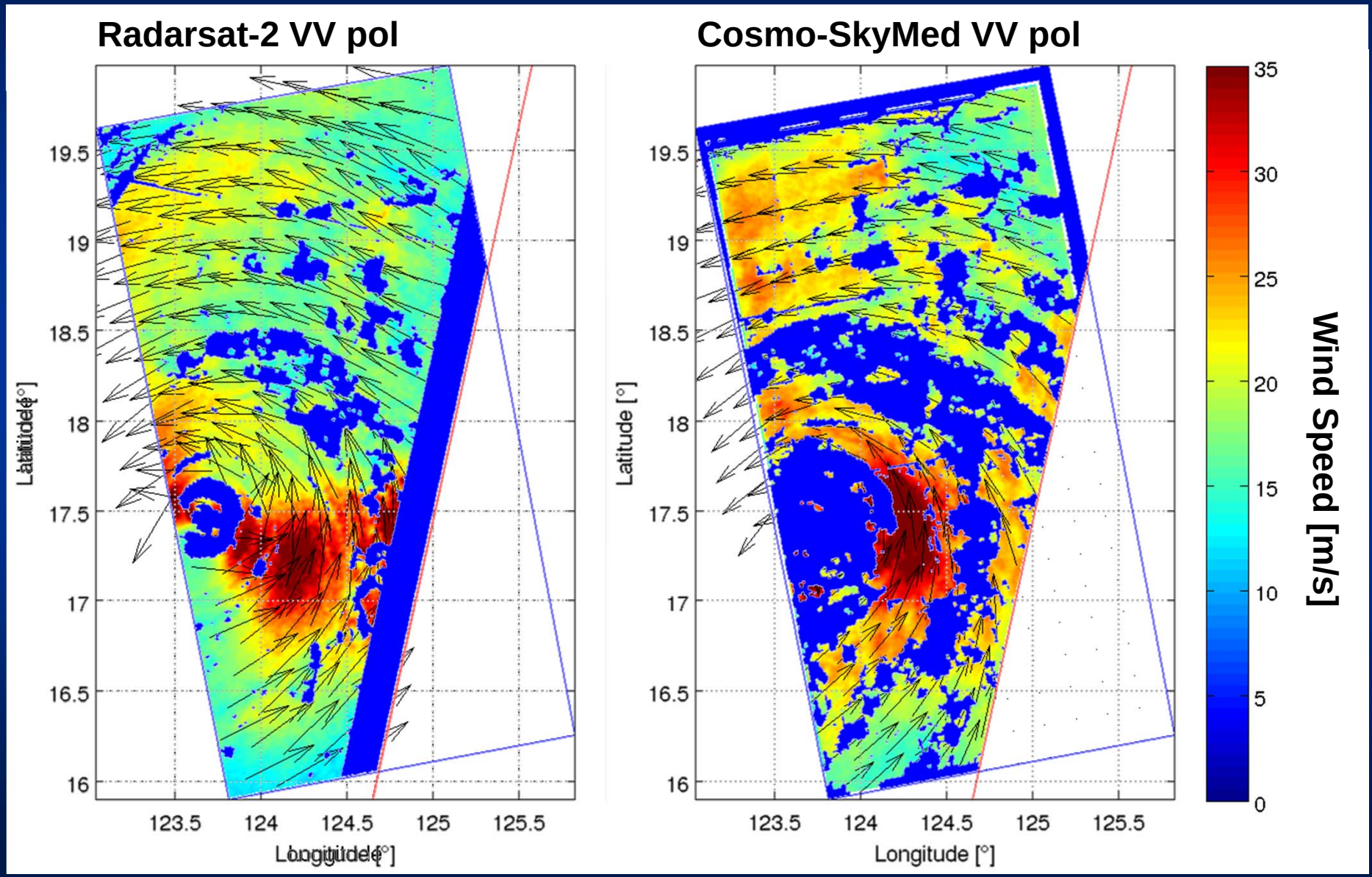




Co-location of a Radarsat-2 and Cosmo-SkyMed-3 SAR Image

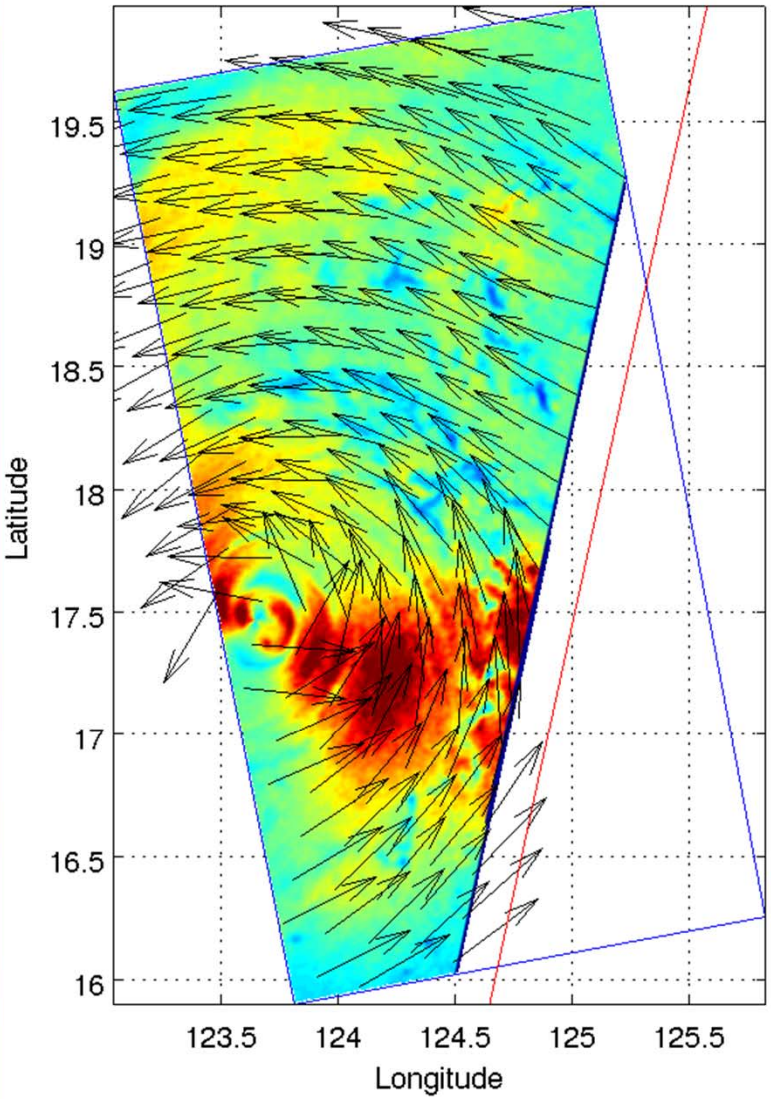


Comparison of C-band and X-band SAR Under Typhoon Conditions

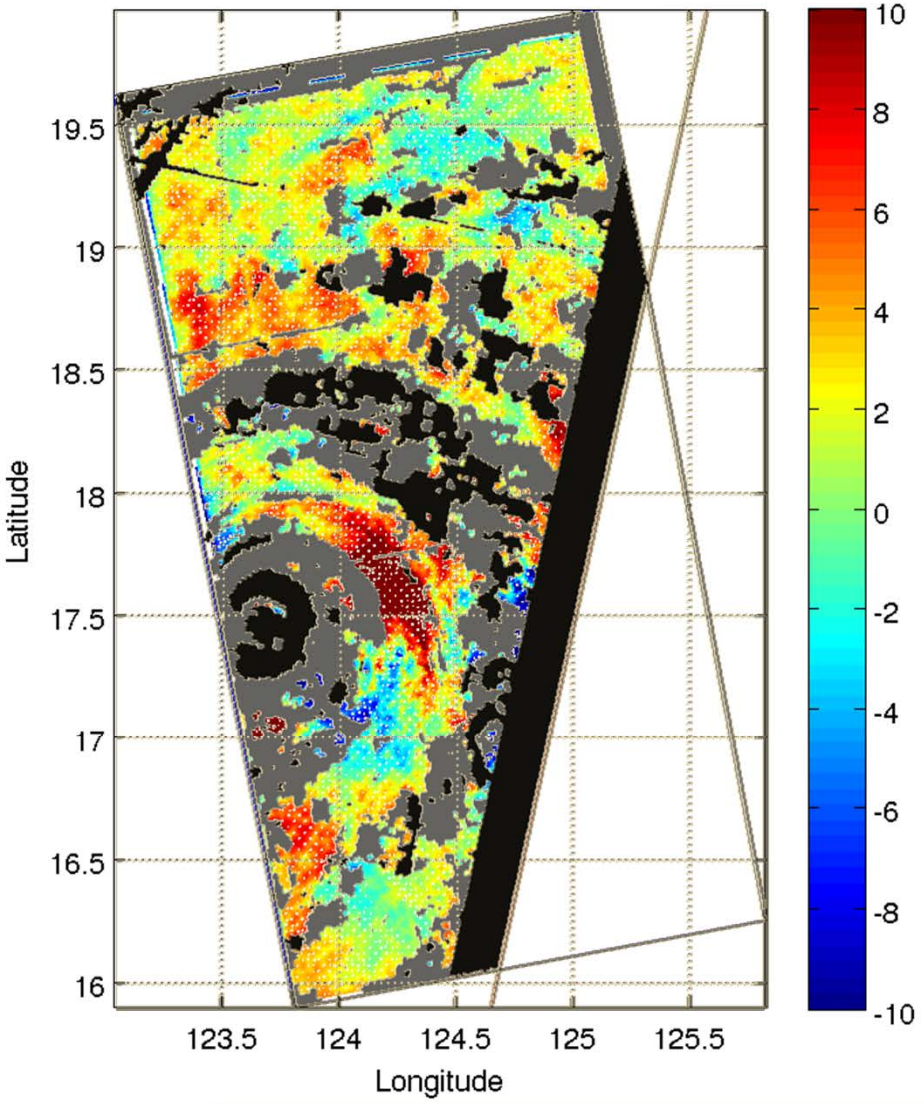


Comparison of C-band and X-band SAR Under Typhoon Conditions

Radarsat-2 VV pol

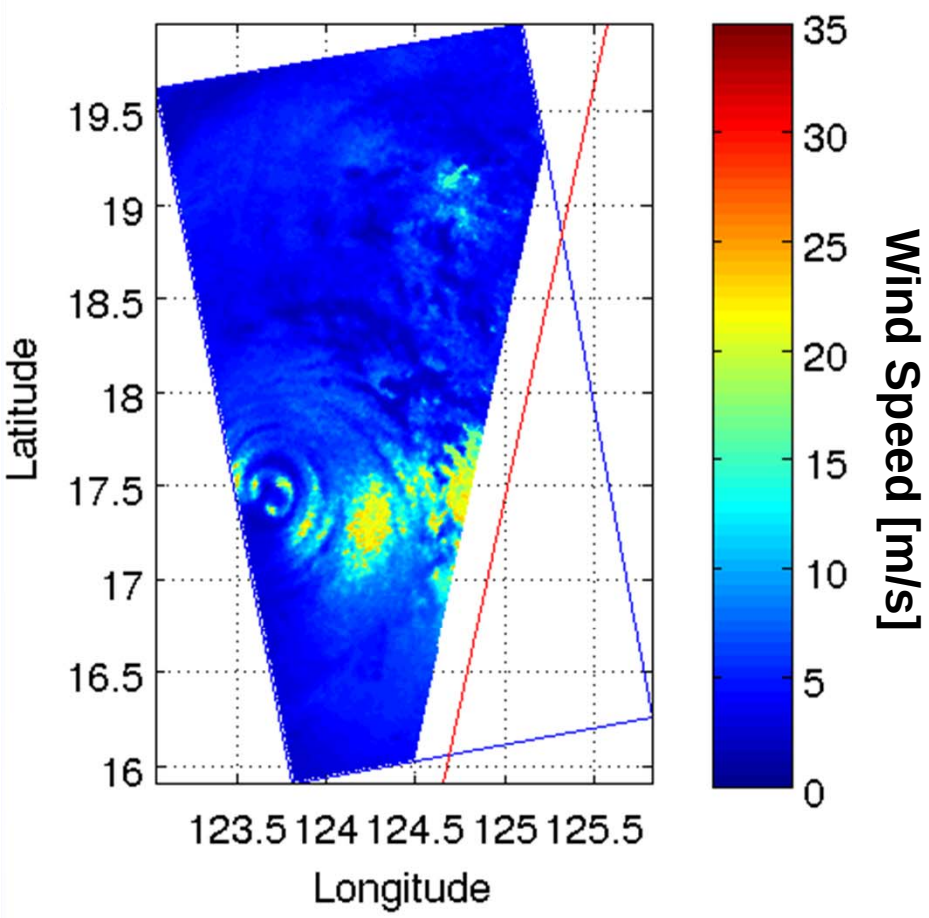


Cosmo - RSAT

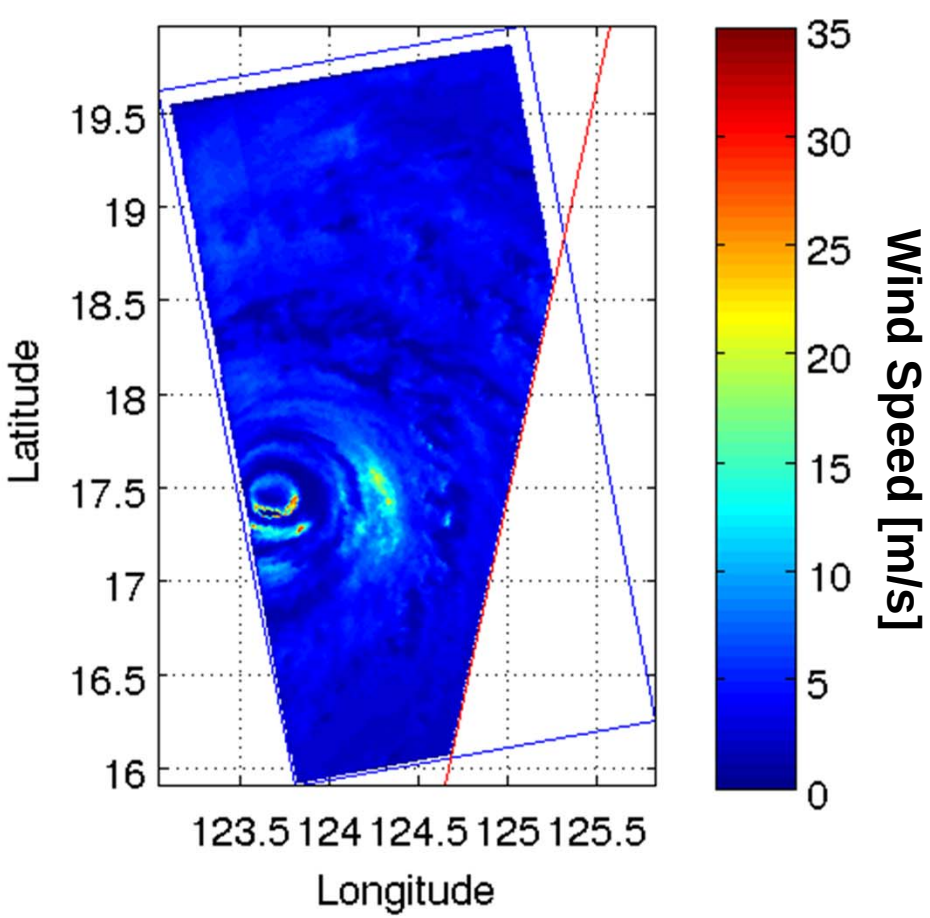


Estimated Wind Speed Uncertainty Assuming a ±0.5 dB NRCS Error

Radarsat-2 VV pol

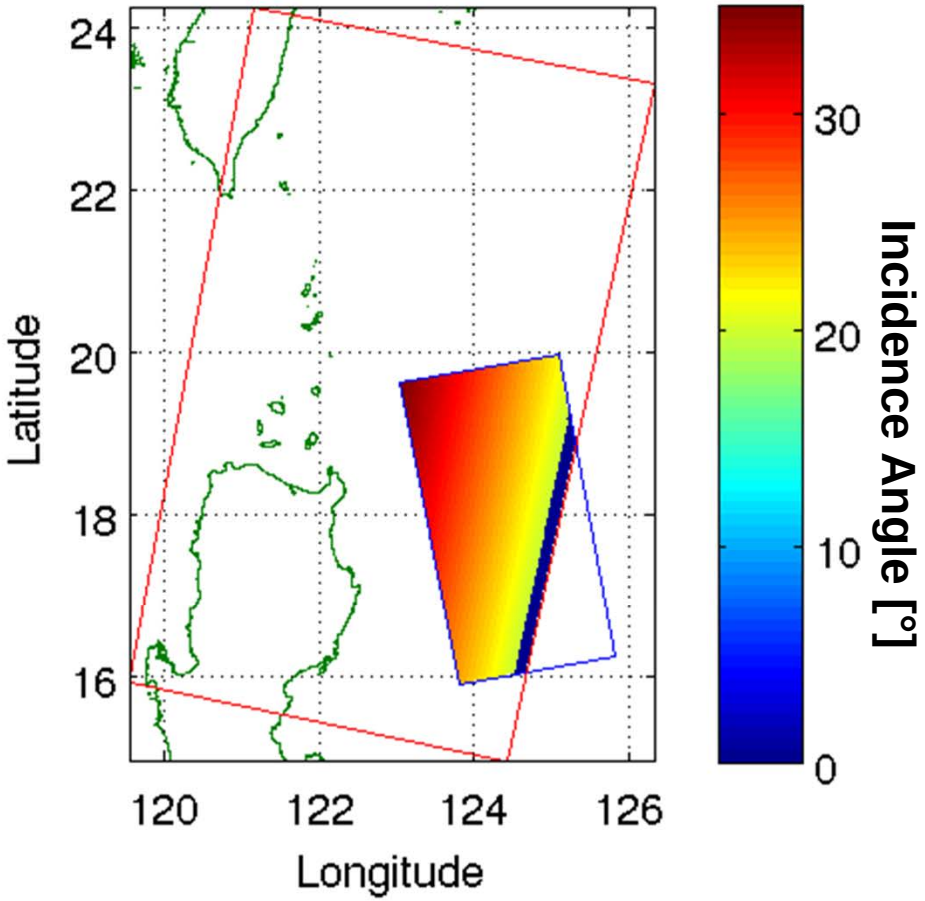


Cosmo-SkyMed VV pol

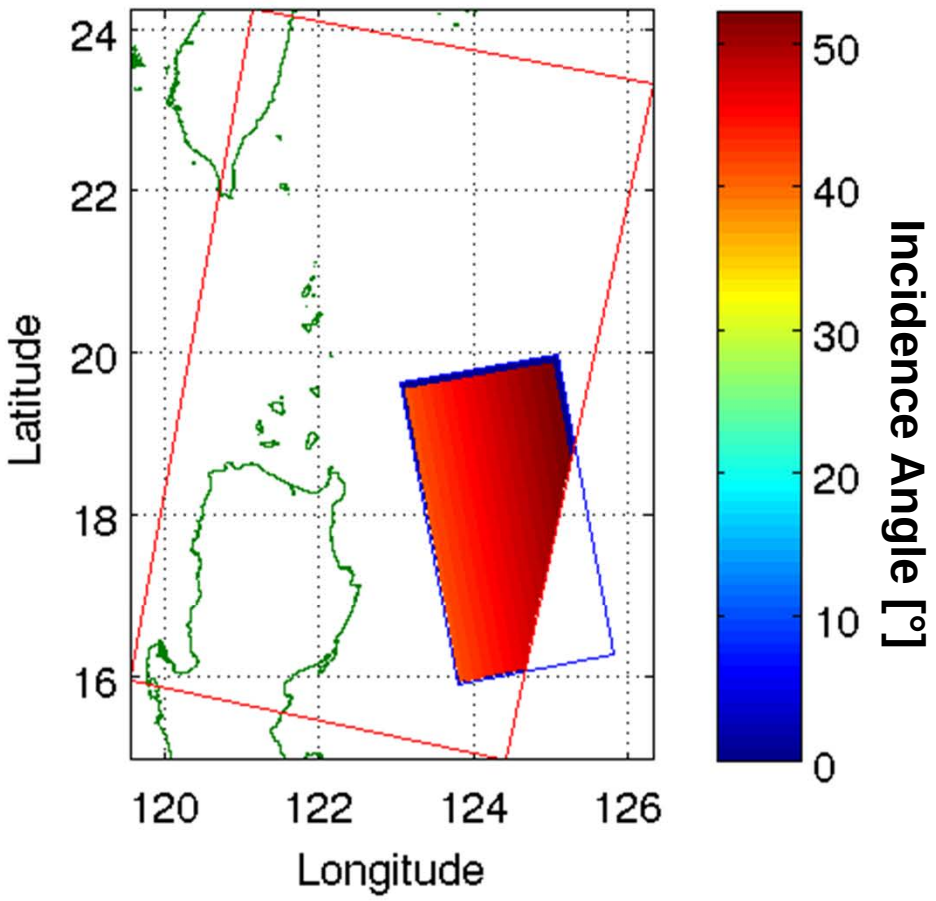


Incidence Angles

Radarsat-2 VV pol



Cosmo-SkyMed VV pol



Imaging of Rain at X-Band

Imaging of Rain at X-Band