



NOAA/NESDIS High Wind C-Band Model Function and its Impact on the Detection of Hurricane Force Winds in Extratropical Storms

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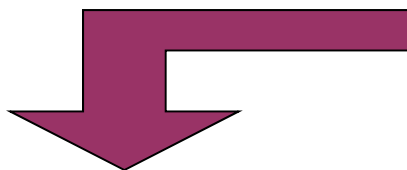
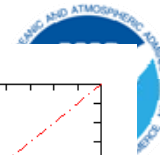
NOAA/NESDIS/STAR

Joseph Sienkiewicz

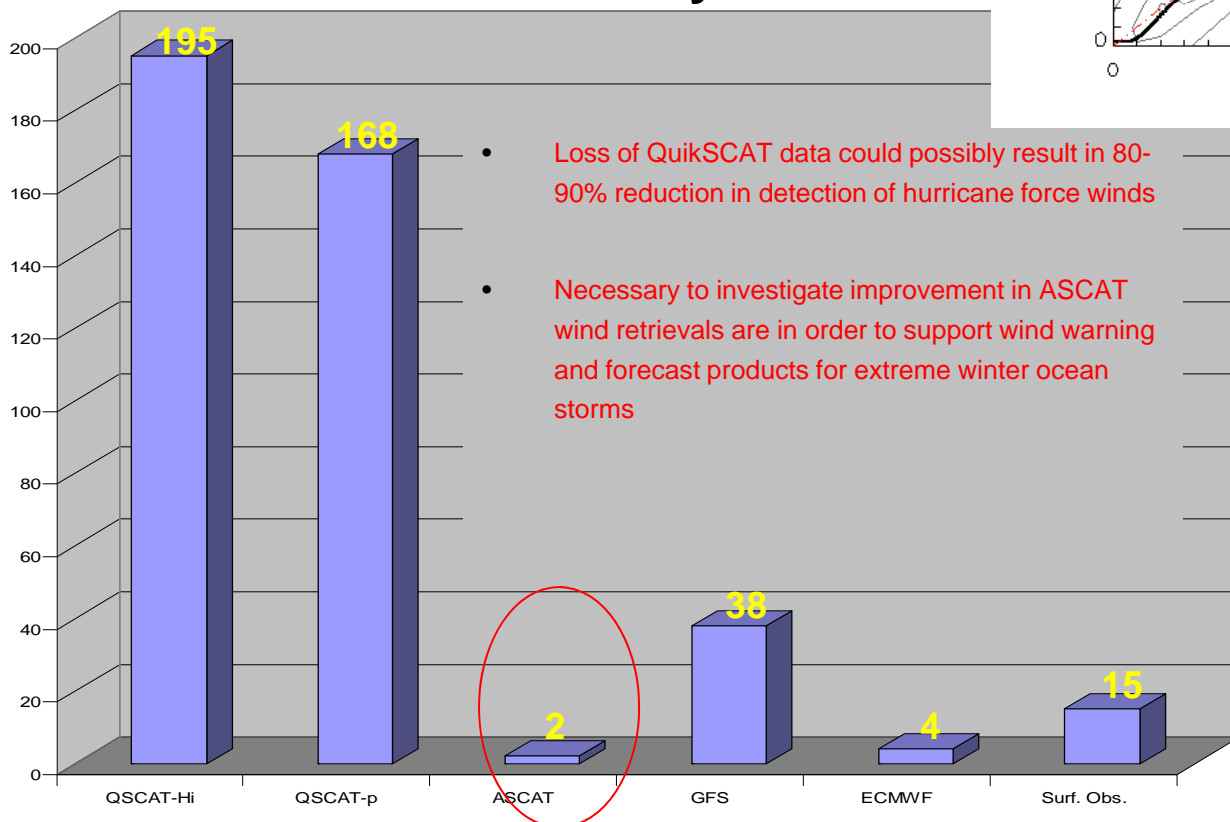
NOAA/NCEP/OPC



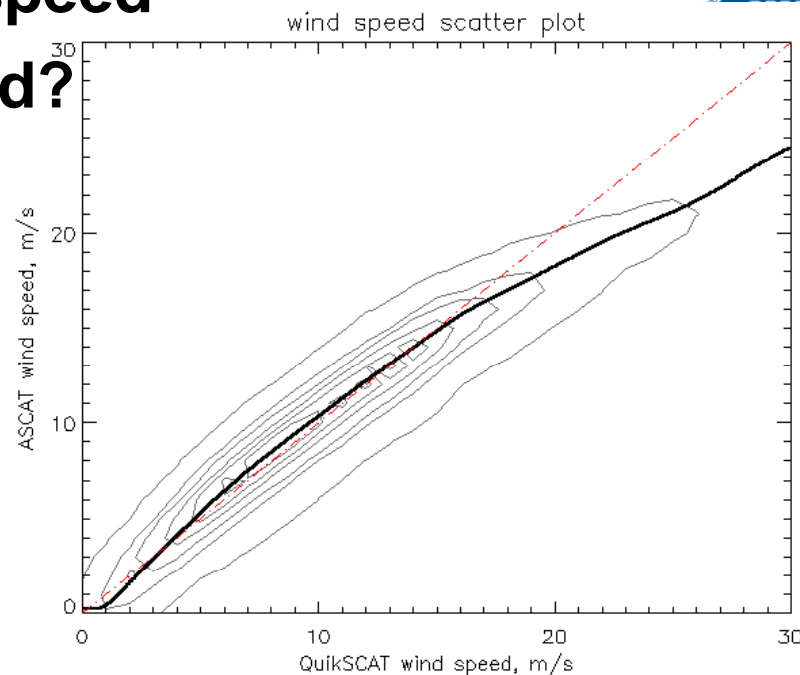
Can ASCAT high wind speed retrievals be improved?



Hurricane Force Observations Oct'07 ~ May'08



- Loss of QuikSCAT data could possibly result in 80-90% reduction in detection of hurricane force winds
- Necessary to investigate improvement in ASCAT wind retrievals are in order to support wind warning and forecast products for extreme winter ocean storms



- ASCAT underestimate high wind speeds in comparison to QuikSCAT
- Hurricane force wind detection from ASCAT is very rare



Study Approach

- Scatterometer wind retrievals are dependent on Geophysical Model Function (GMF) that relates backscatter to ocean surface wind fields
- The ASCAT operational GMF (CMOD5n) is written in harmonic terms:

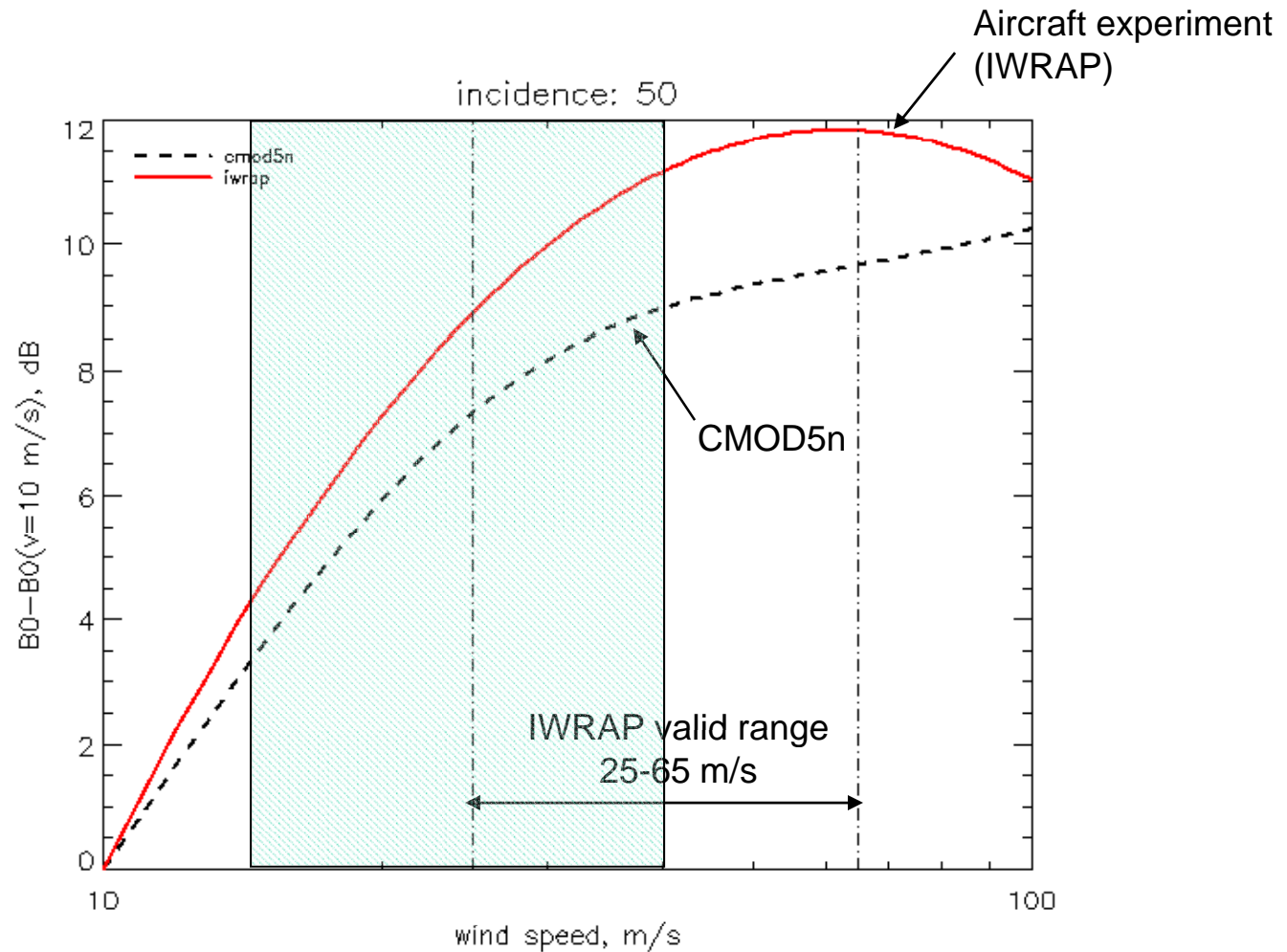
$$\sigma_0 = B_0(\nu, \theta) \cdot [1 + B_1(\nu, \theta) \cos \phi + B_2(\nu, \theta) \cos 2\phi]^{1.6}$$

Hersbach, et al., *J. Geophys. Res.* (2007)

- Assumption is that B_1 and B_2 are modeled correctly.
- ASCAT/QuikSCAT match-ups show B_0 is biased high at high wind speeds



C-Band V-Pol σ_0 dependence on wind speeds

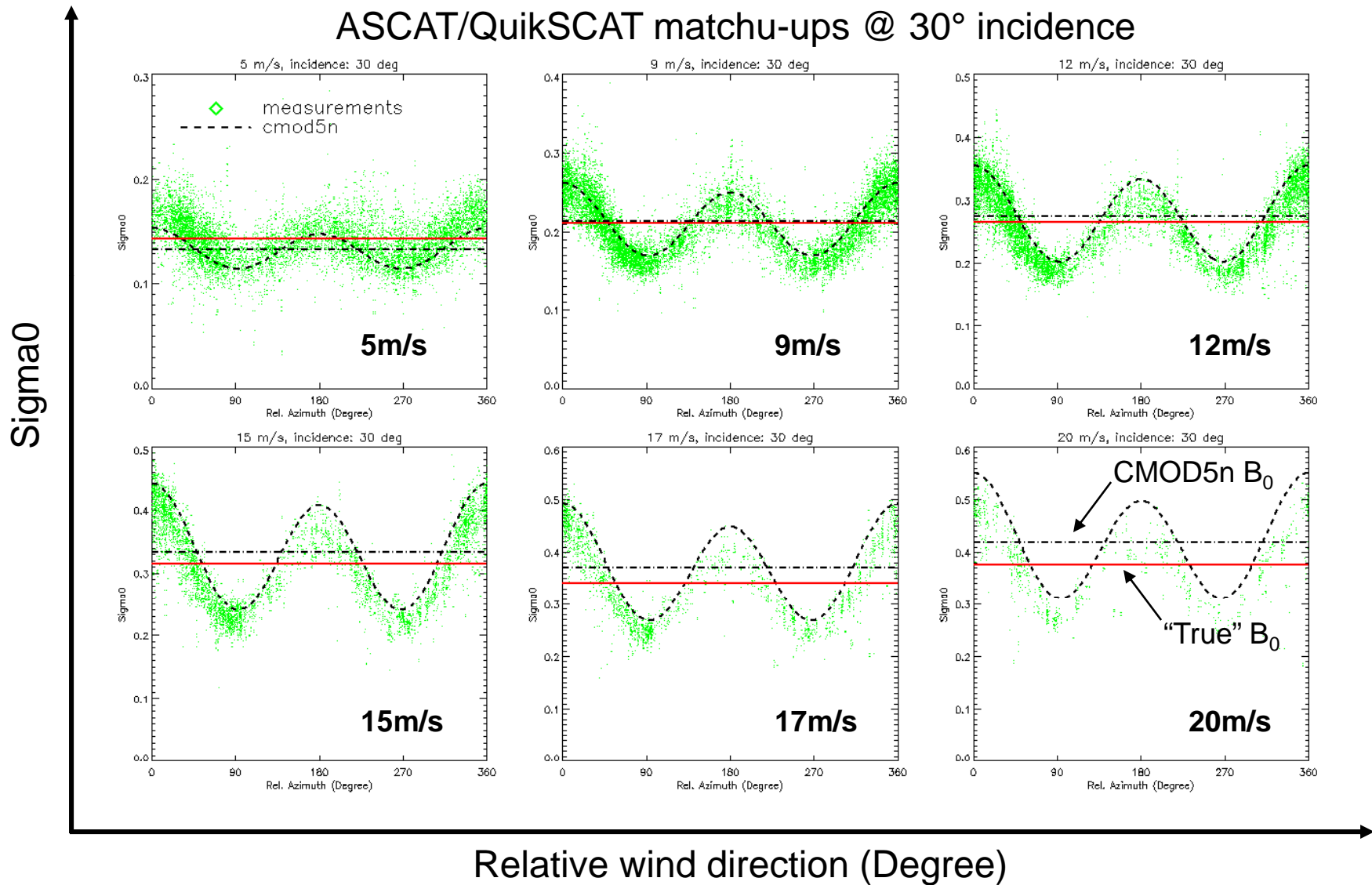




Measured and Model Sigma0 dependence on wind vector at 30 deg incidence



ASCAT/QuikSCAT matchu-ups @ 30° incidence





C-Band V-pol Saturation wind speeds

- IWRAP GMF is valid at 29°, 34°, 40° and 50° incidence and 25-65 m/s
- The B_0 is written in the form:

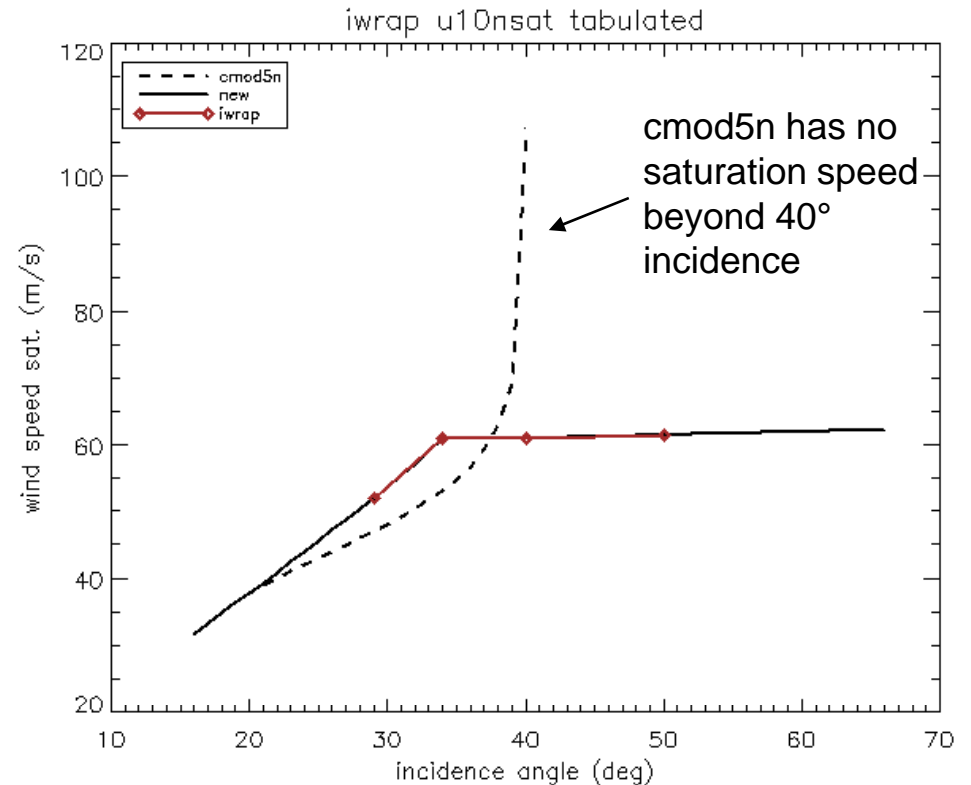
$$B_0 = 10 \cdot \left((\beta + \gamma_1 \log(U_{10N}) + \gamma_2 [\log(U_{10N})]^2) \right)$$

Fernandez, et al., *J. Geophys. Res.* (2006)

- U_{10Nsat} is defined as the wind speed where B_0 reaches its maximum value:

$$\left. \frac{\partial B_0}{\partial U_{10N}} \right|_{U_{10N} = U_{10Nsat}} = 0 = 10 \frac{-\gamma_1}{2\gamma_2}$$

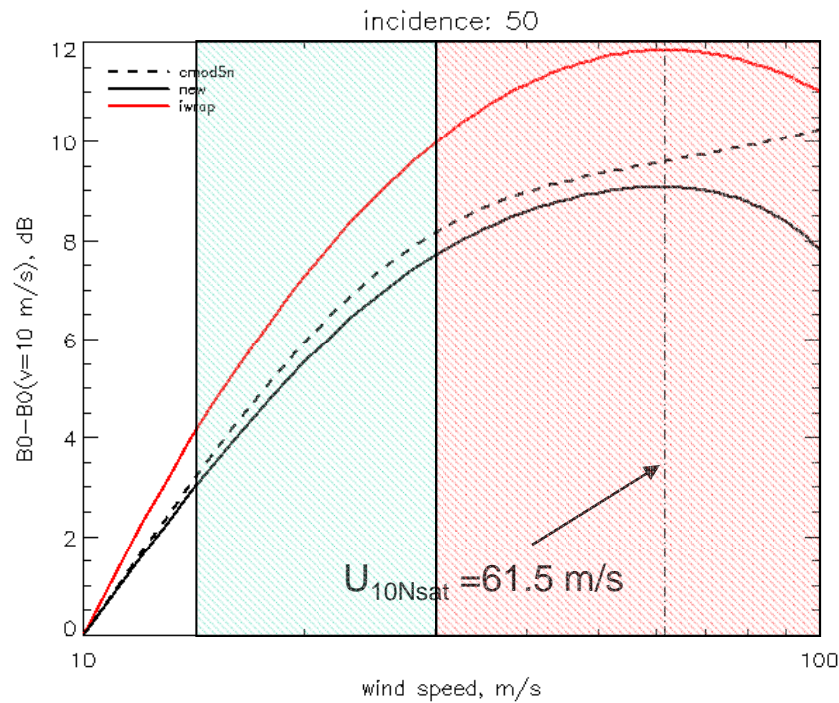
Fernandez, et al., *J. Geophys. Res.* (2006)



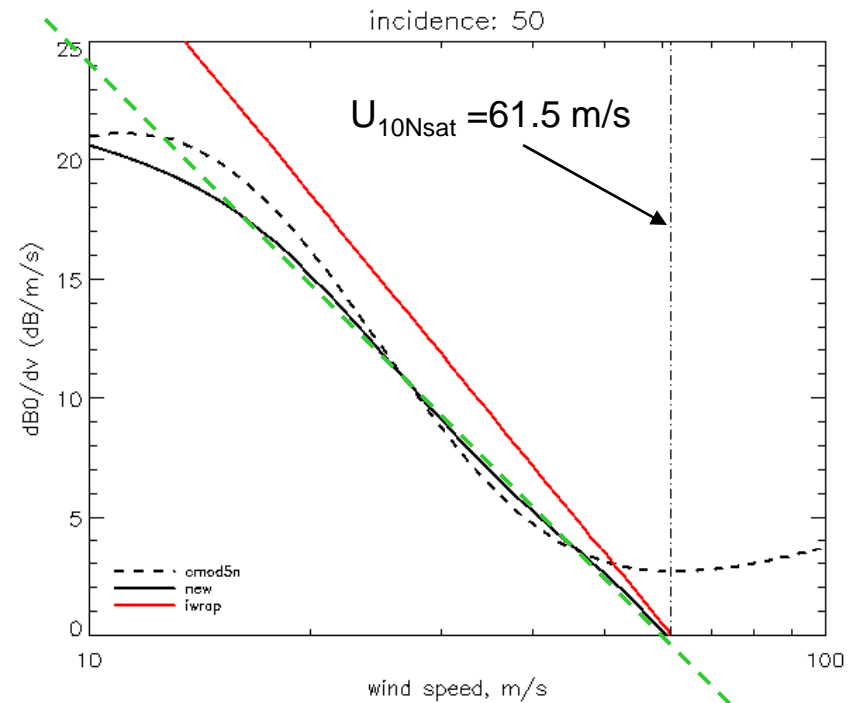


High wind speed B_0 ; Incidence: 50 deg

B_0 vs wind speed

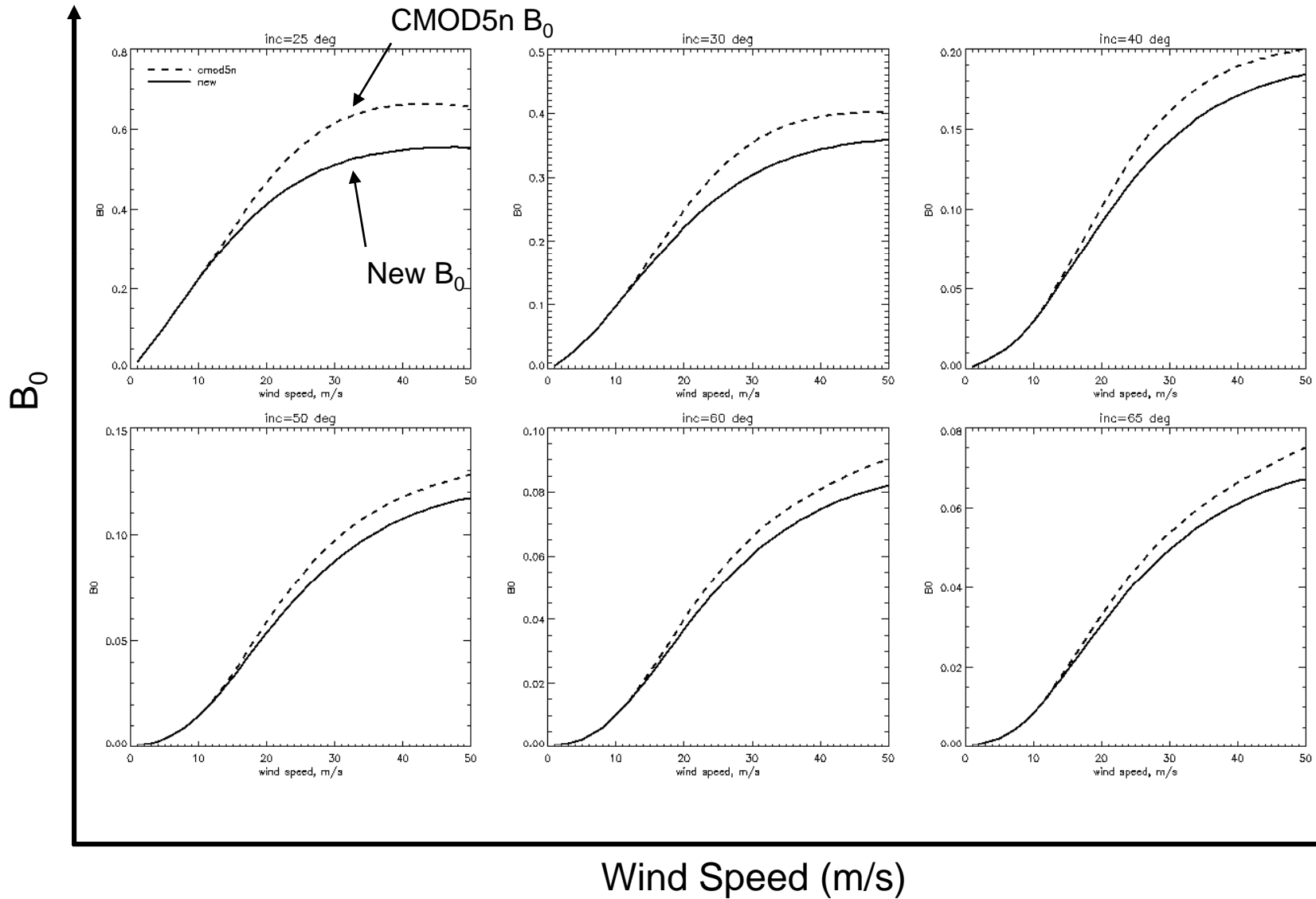


$\frac{\partial B_0}{\partial U_{10N}}$ vs wind speed



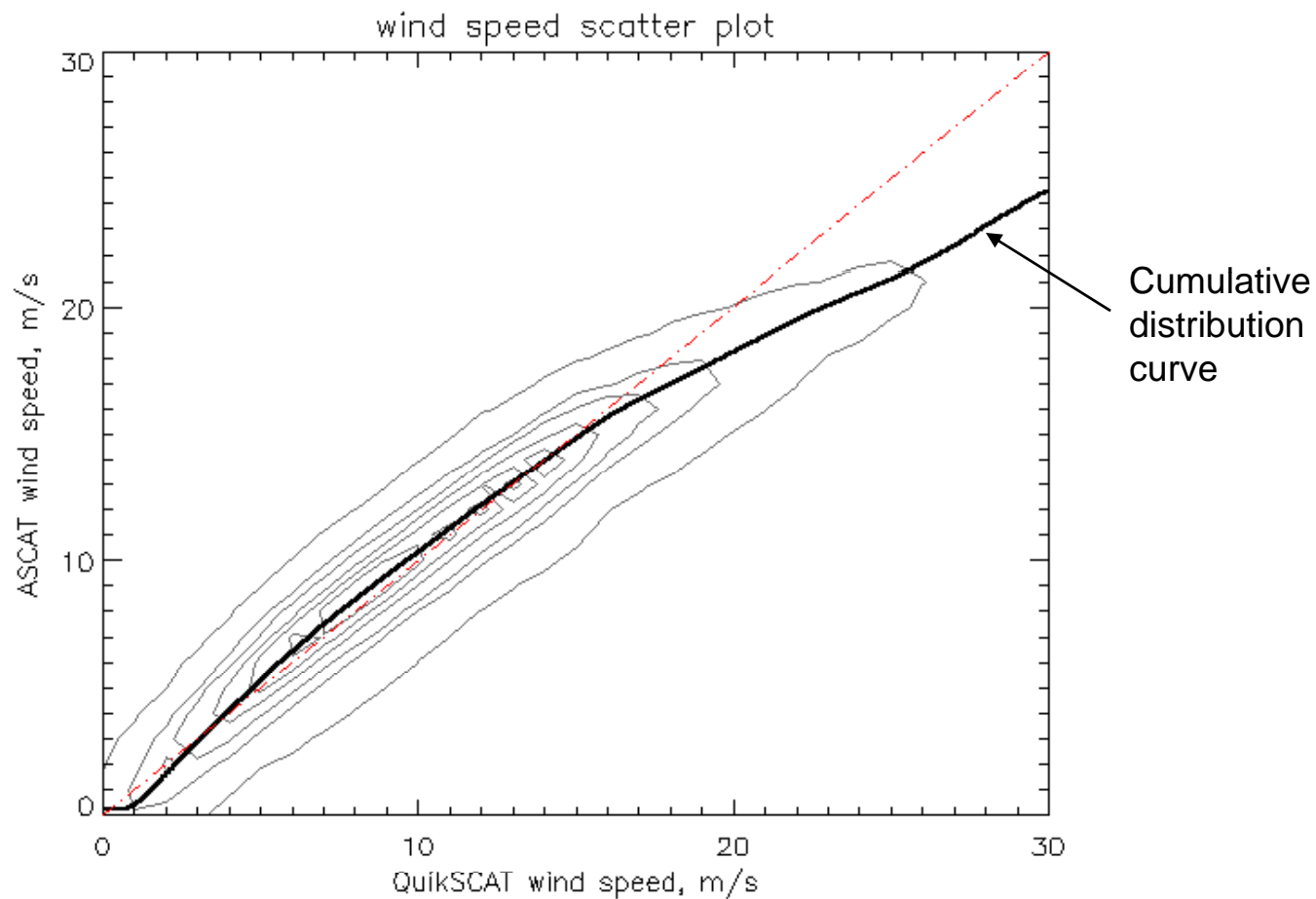


CMOD5n vs New B_0



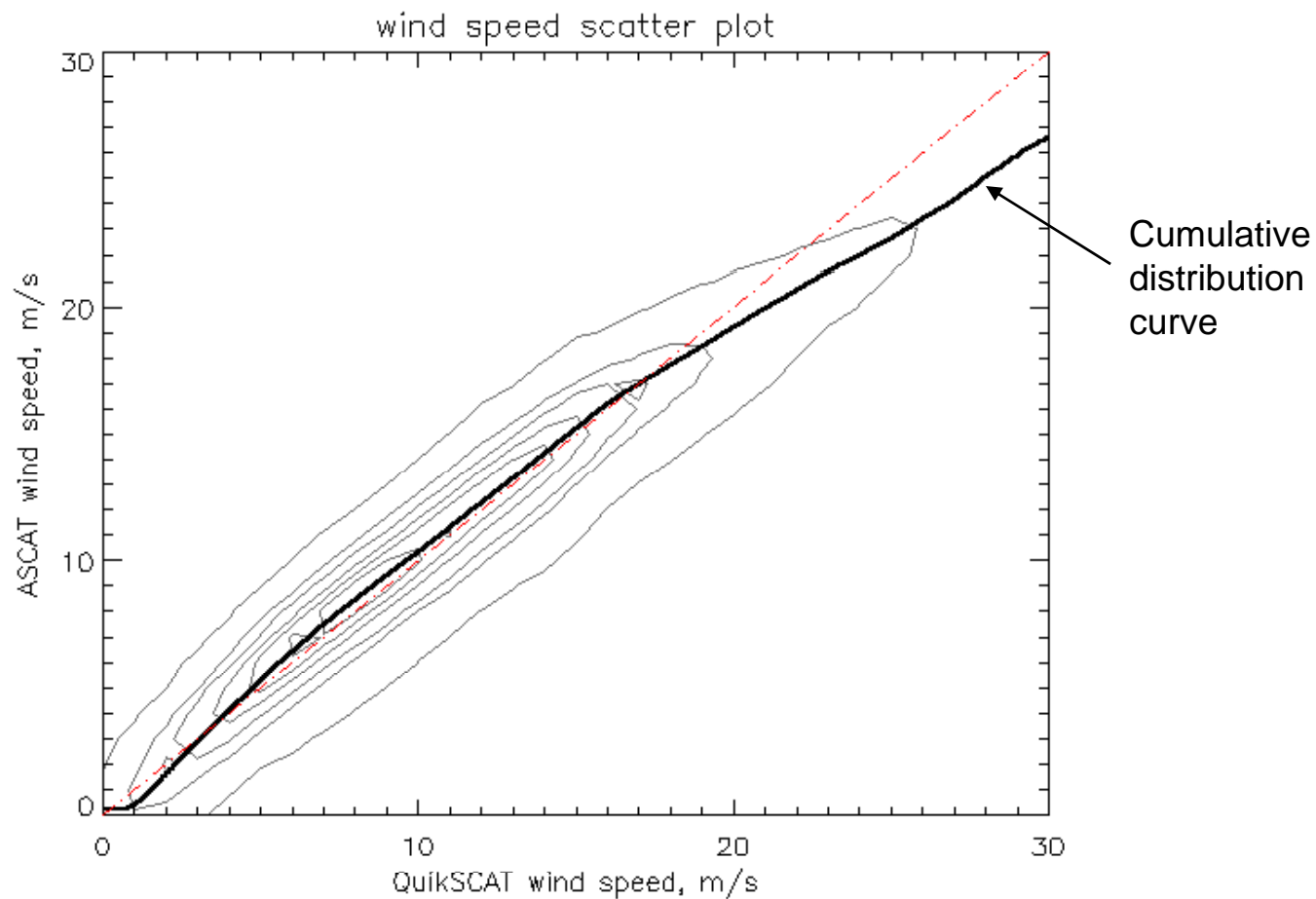


ASCAT vs QuikSCAT speed (before)



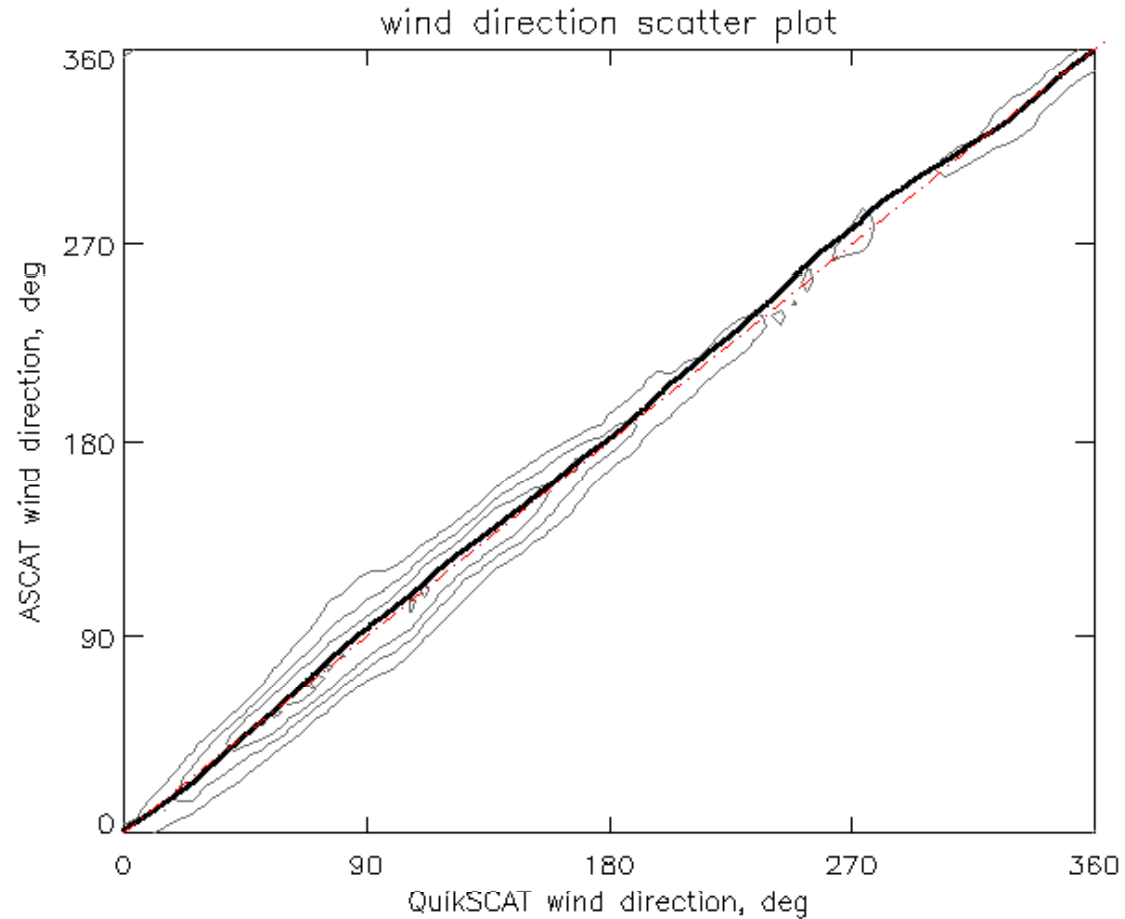


ASCAT vs QuikSCAT speed (after)



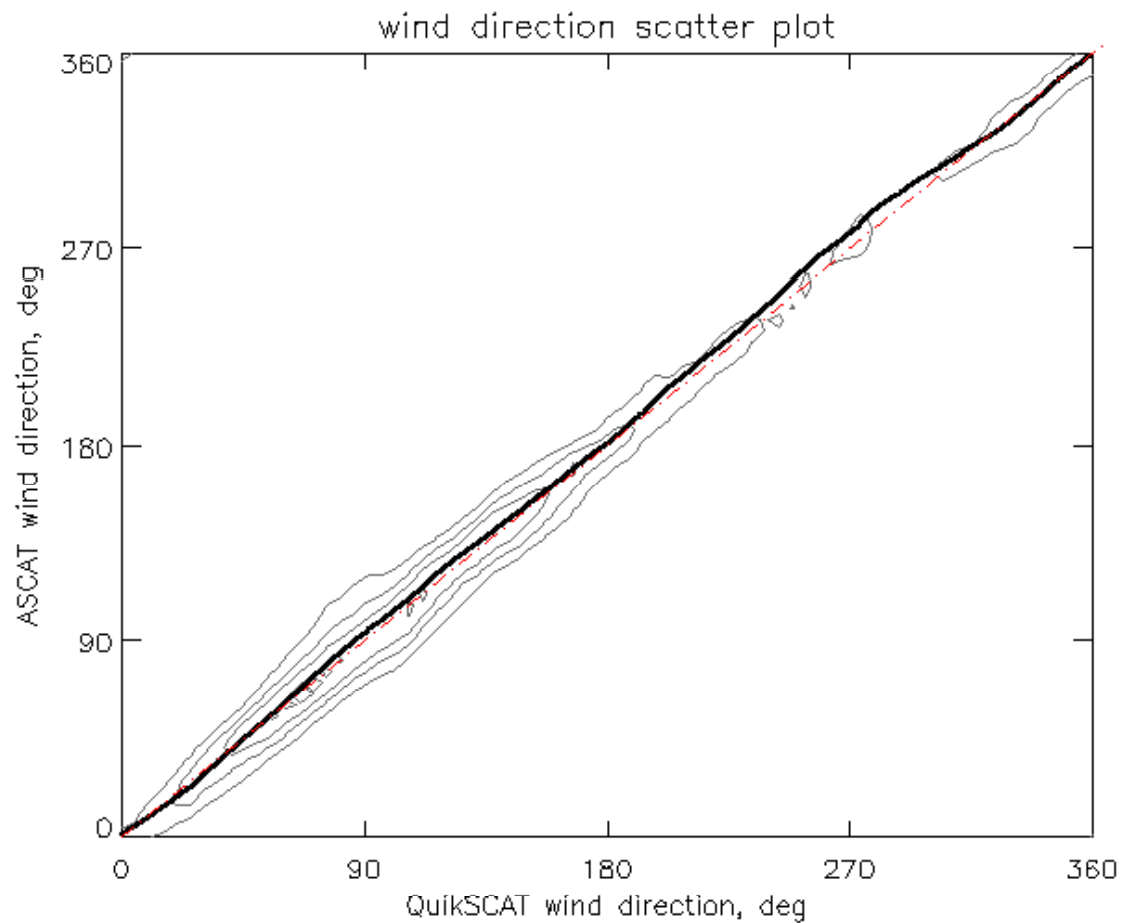


ASCAT vs QuikSCAT direction (before)



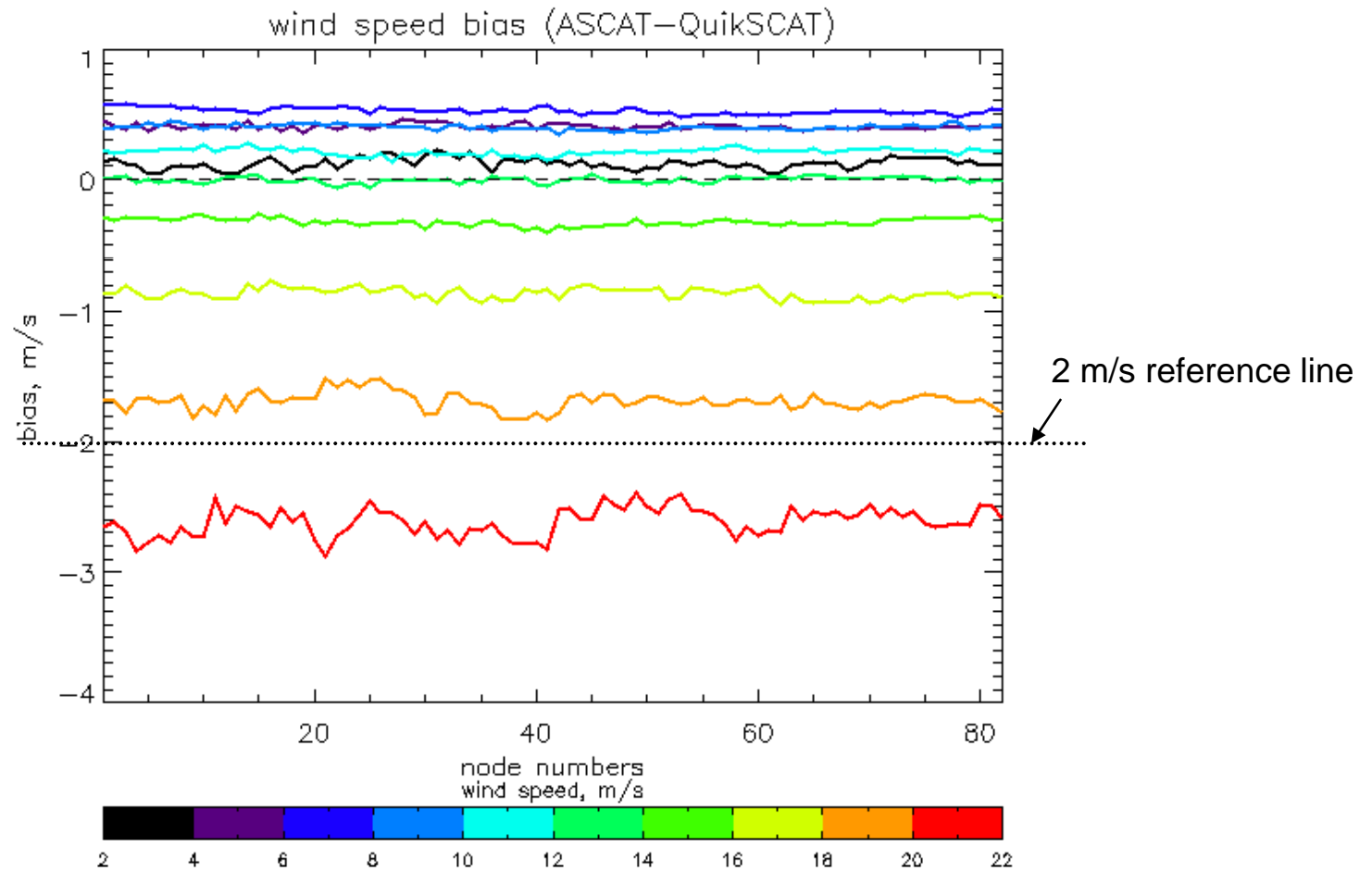


ASCAT vs QuikSCAT direction (after)



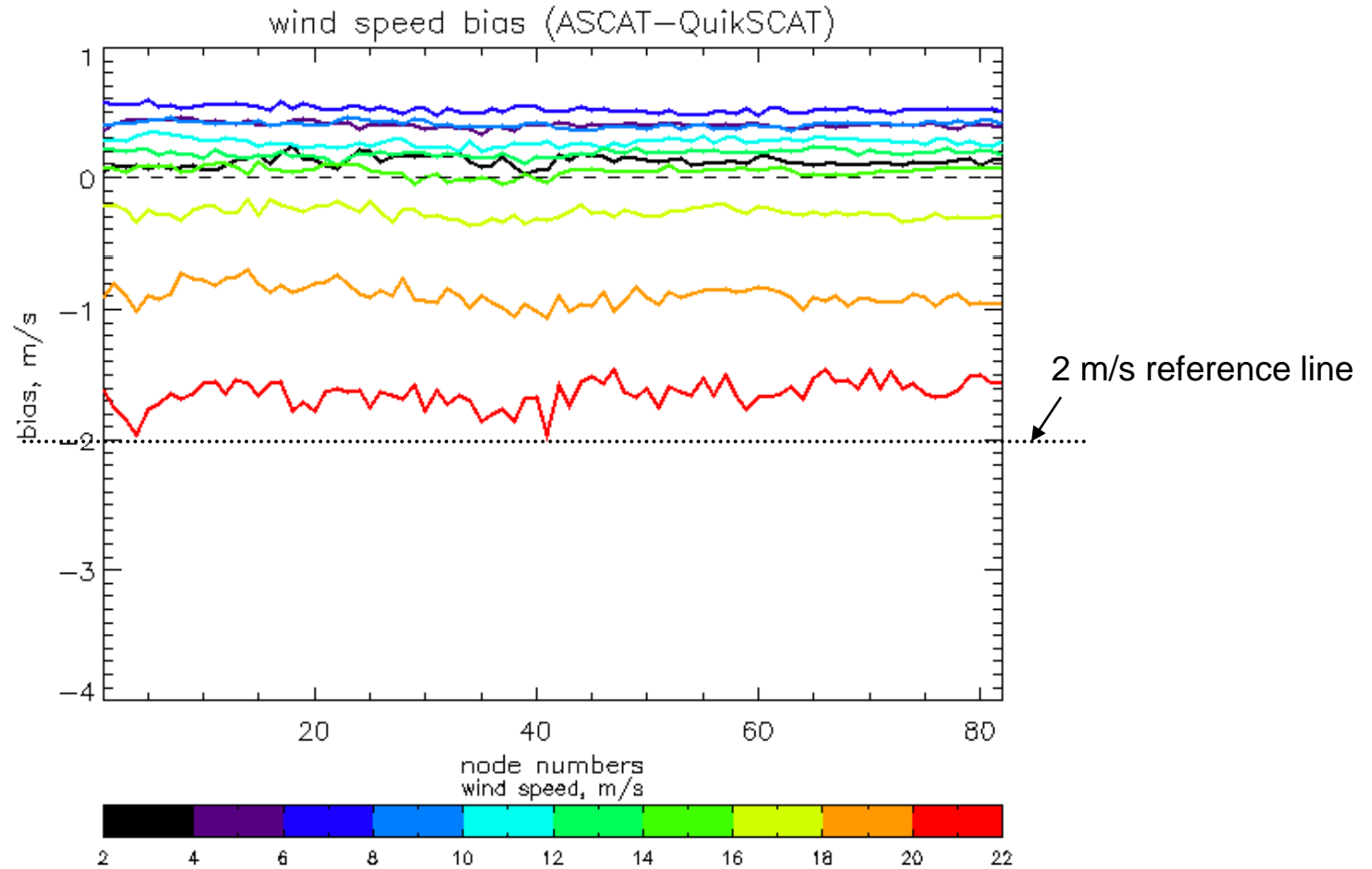


Across Swath Speed Biases (before)



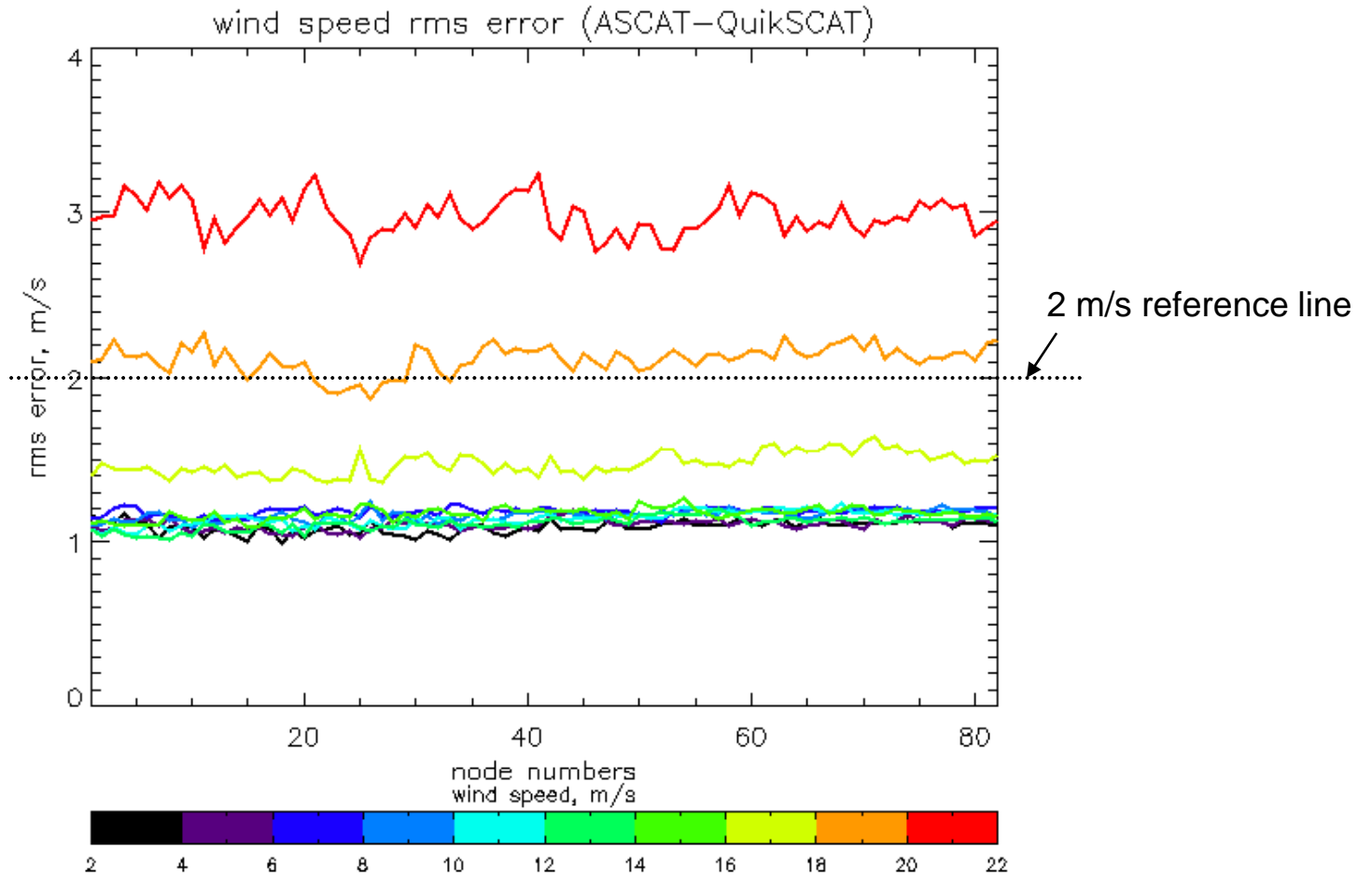


Across Swath Speed Biases (after)



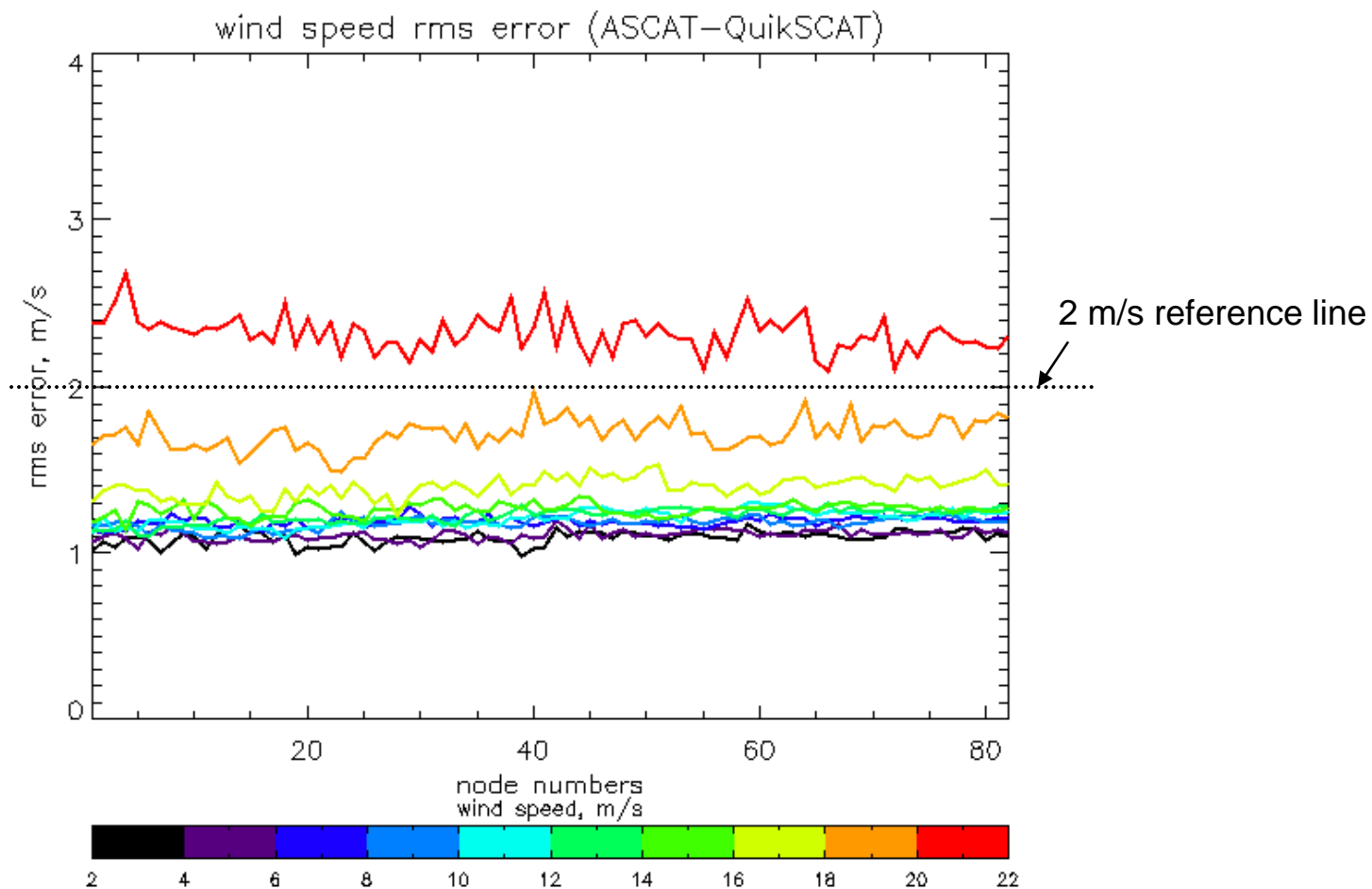


Across Swath Speed RMS errors (before)



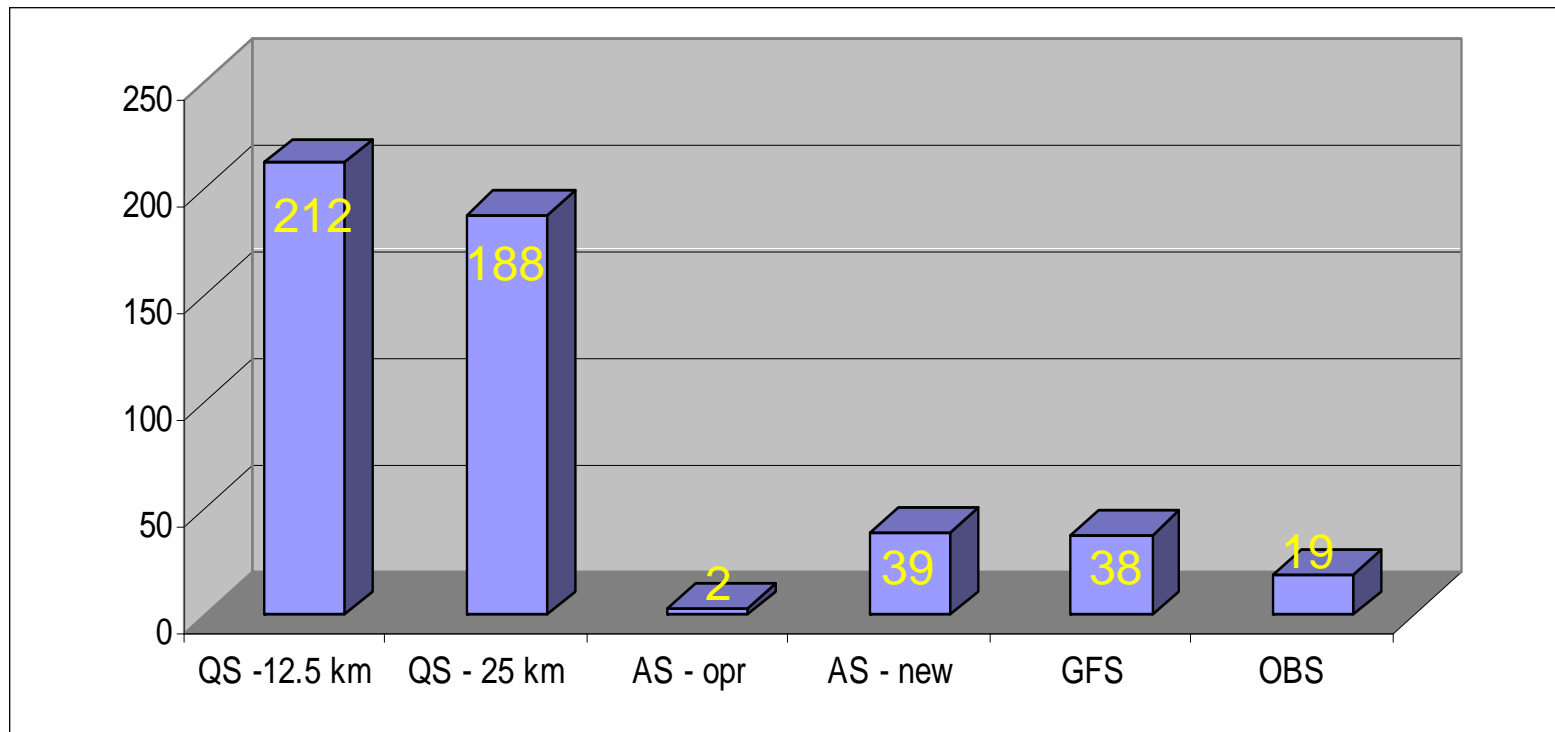


Across Swath Speed RMS errors (after)

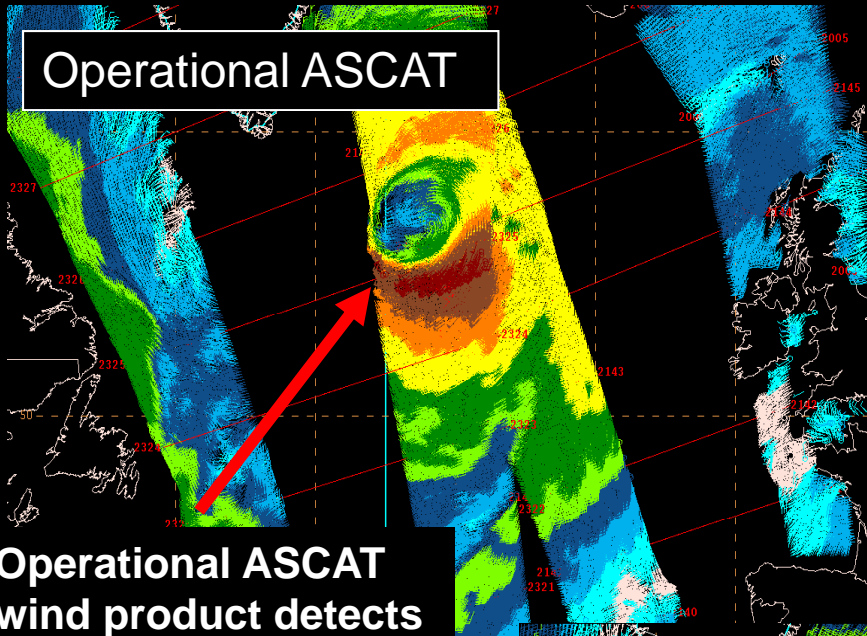




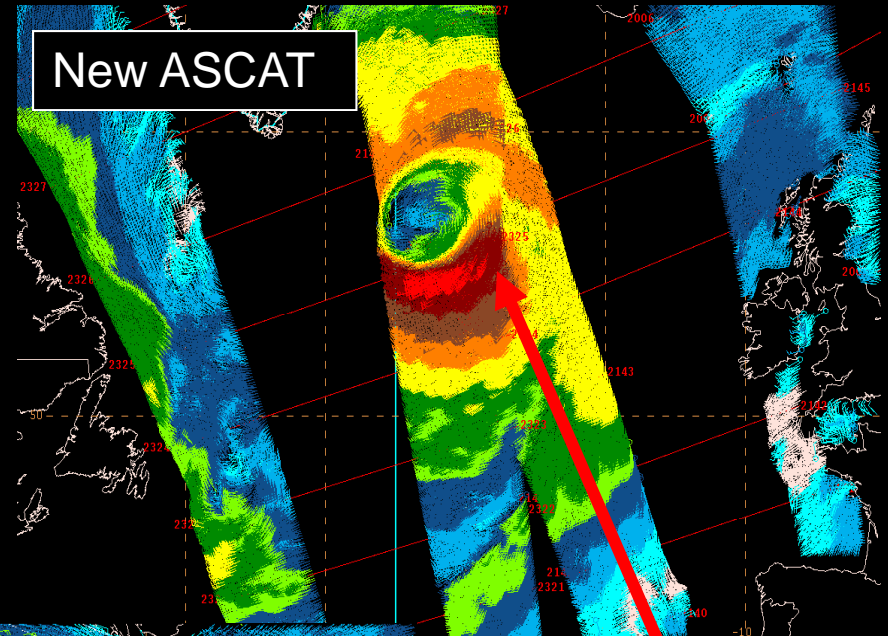
Hurricane Force Observations (Oct'07 ~ May'08)



North Atlantic Extratropical Storm Example

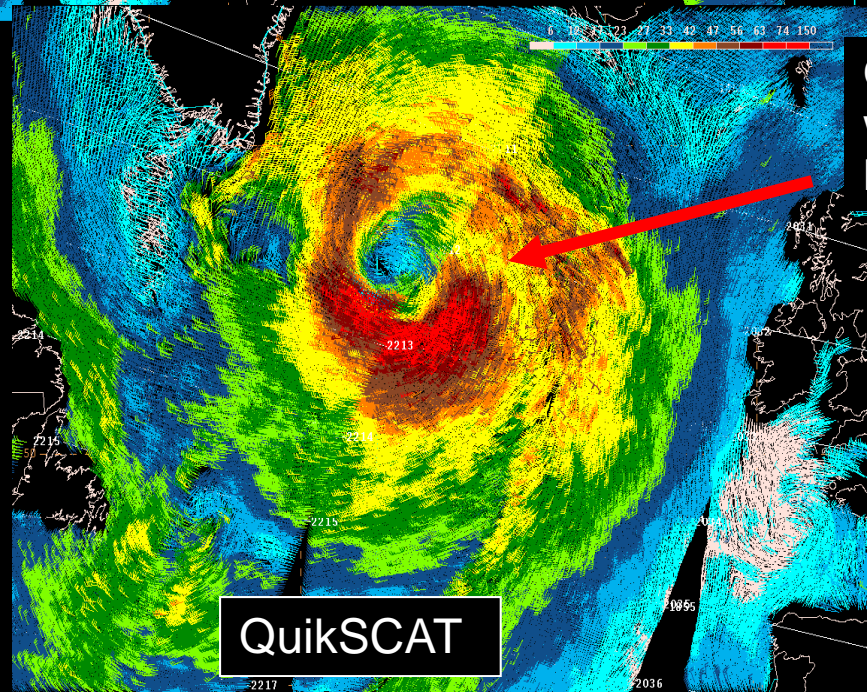


Operational ASCAT



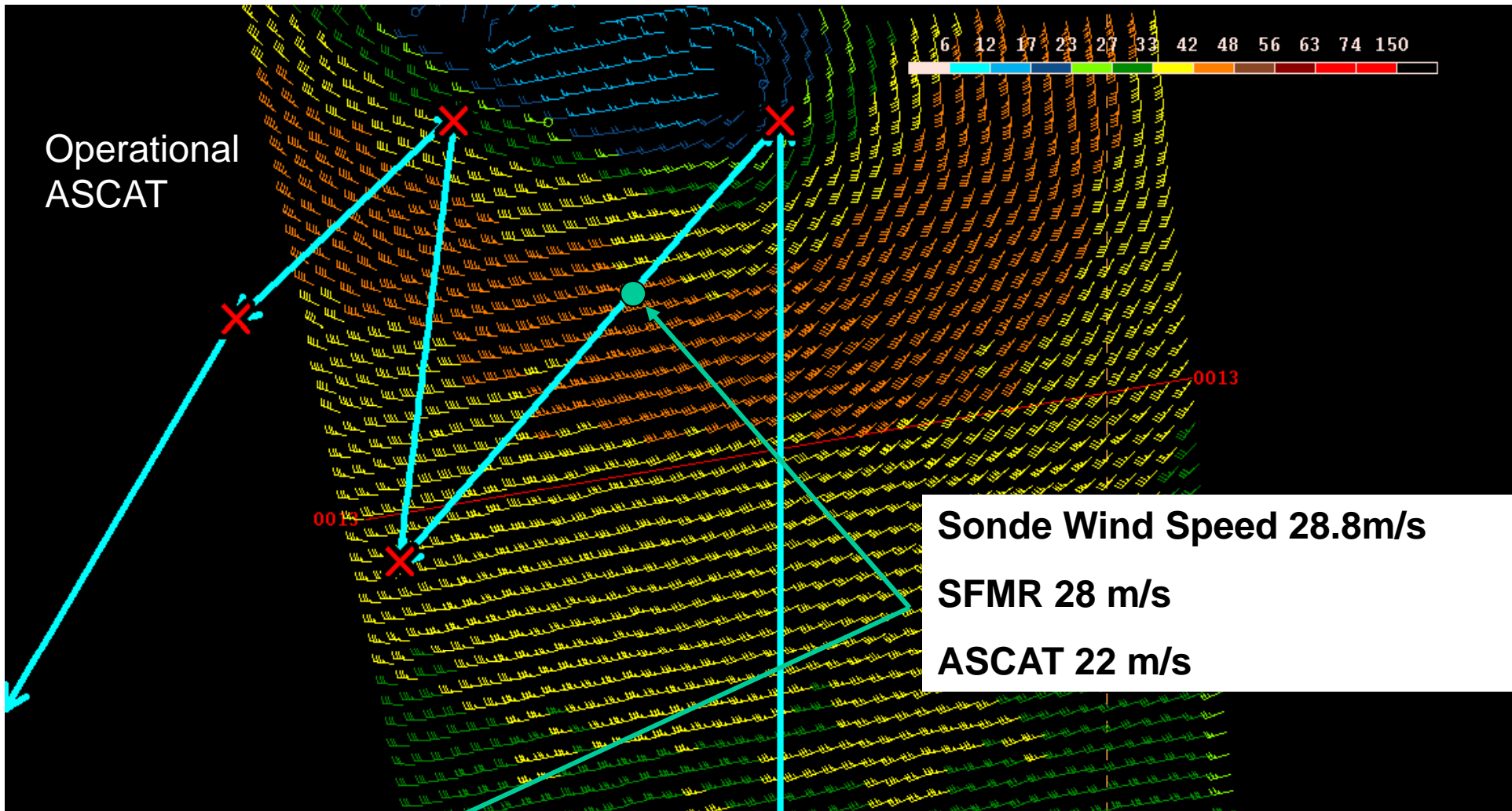
New ASCAT

**Operational ASCAT
wind product detects
STORM force wind.
One wind warning
category lower than
the actual winds.**

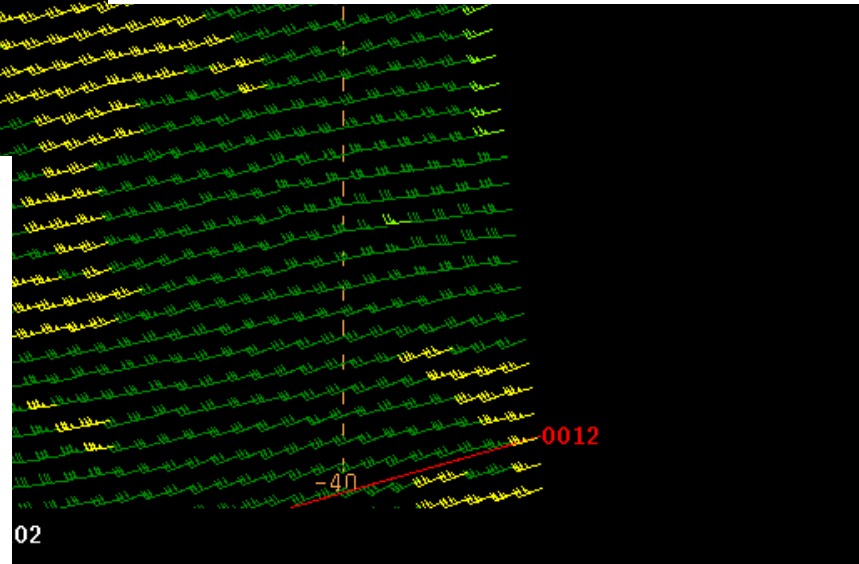
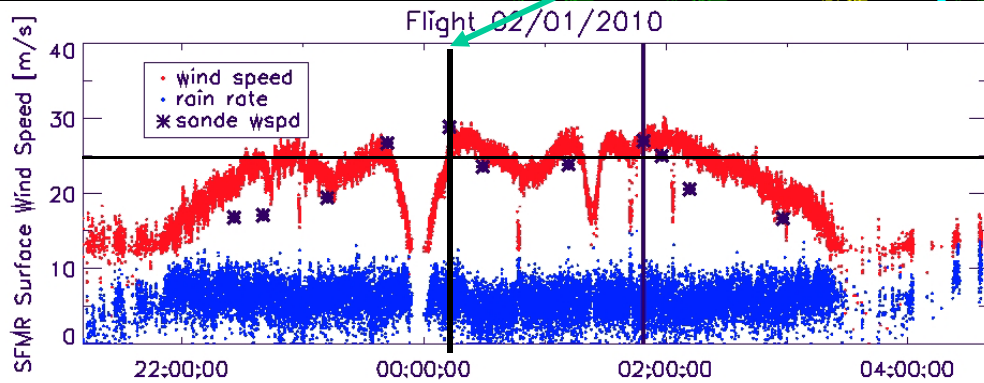


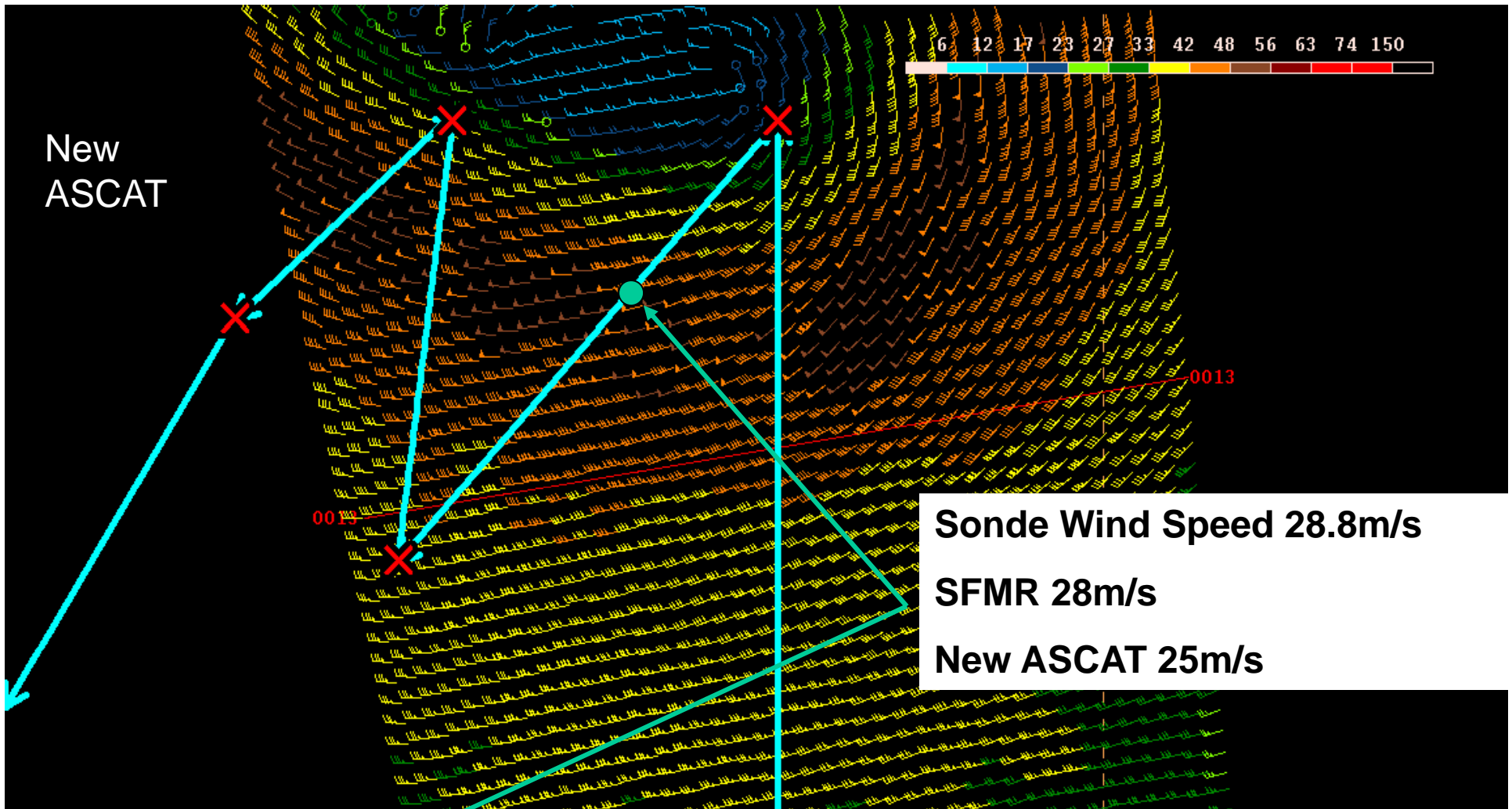
QuikSCAT

**QuikSCAT & New ASCAT
wind products detects
HF wind.**

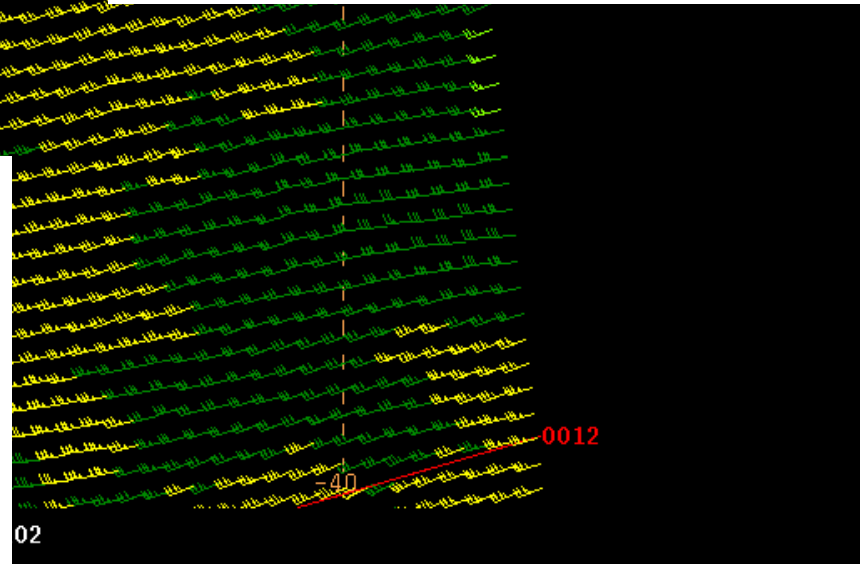
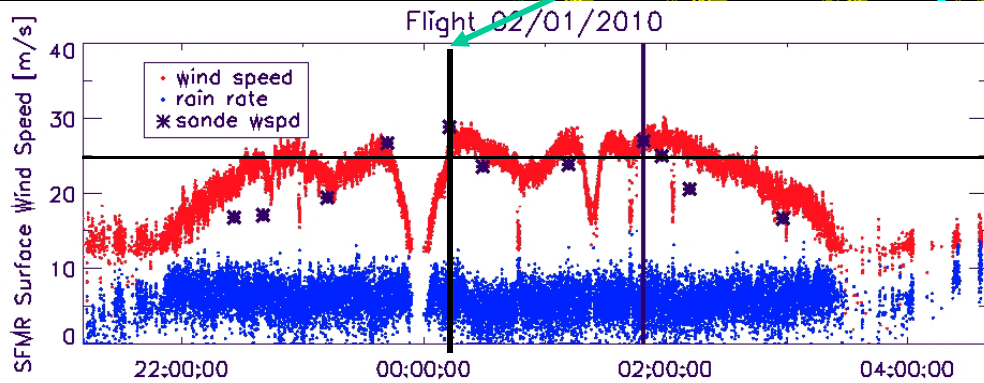


Sonde Wind Speed 28.8m/s
SFMR 28 m/s
ASCAT 22 m/s





Sonde Wind Speed 28.8m/s
 SFMR 28m/s
 New ASCAT 25m/s





Conclusions

- New ASCAT GMF was developed
 - B_0 was modified for high wind speeds
 - Matching IWRAP GMF high wind trend and correcting for observed B_0 biases
- New ASCAT high wind speed retrievals compare better to QuikSCAT
 - Bias and RMS wind speed errors are improved
 - New ASCAT wind speed retrievals are still biased low but resultant biases are smaller

Future Work:

- Determine new quality controls
- Transition new ASCAT product into operations