Analysis of RapidScat Mid-Swath Directional Discontinuity

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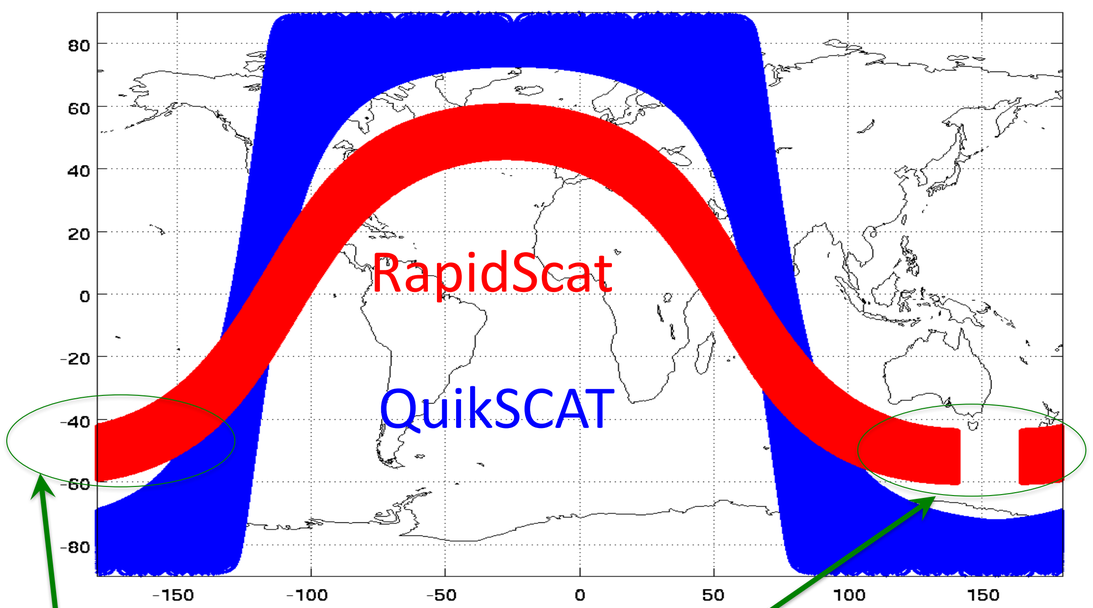
Status of RapidScat Climate Data Product: The RapidScat climate quality (whole footprint) data product has three shortcomings that we are currently striving to improve.

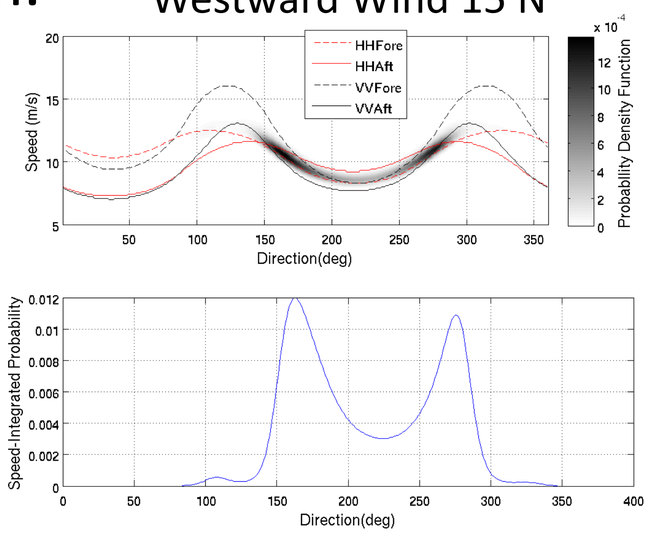
1. There is often a discontinuity in wind direction at the center of the swath. While we first thought this likely to be a software bug, we have recently determined that is in fact a result of errors in the geophysical model function (GMF) and differences in the RapidScat orbit as compared to QuikSCAT. To correct this problem, our colleagues at Remote Sensing Systems are revising the GMF using RapidScat data. We address this problem in this poster presentation.
2. The second shortcoming is that the rain flag is degraded for the roughly half of the RapidScat mission in which the receiver gain was reduced due to an instrument anomaly (low SNR mode). Low SNR mode lasted from August 14, 2015 until the end of the RapidScat mission on August 19, 2016 with a few short time reversions to nominal gain. During low SNR mode, accurate brightness temperatures could not be produced adversely impacting rain detection accuracy. To overcome this issue we are adding a radiometer rate mask produced from collocated microwave radiometer data. We describe how the new rain mask and associated rain detection bits can be used to quality control the RapidScat wind data. (See poster RapidScat Radiometer Collocations – A New RapidScat Dataset, Alex Wineteer, Lucrezia Ricciardulli, Bryan Stiles, Alex Fore)
3. Finally we have revised the calibration of QuikSCAT during calendar years 2015-2016 due to observed variation in the echo-centering in frequency likely caused by spacecraft attitude control errors. This revision effects the absolute calibration of RapidScat by increasing the VV polarization backscatter by 0.15 dB. The HH calibration is unchanged. (See poster RapidScat Recalibration and Reprocessing Status, Alexander Fore, Bryan Stiles, Alexander Wineteer, and Ernesto Rodriguez)

Directional errors at the center of the swath are worse when the radar look vector is parallel to the wind. This happens more frequently for RapidScat, due to eastward motion of the ISS over the southern ocean.

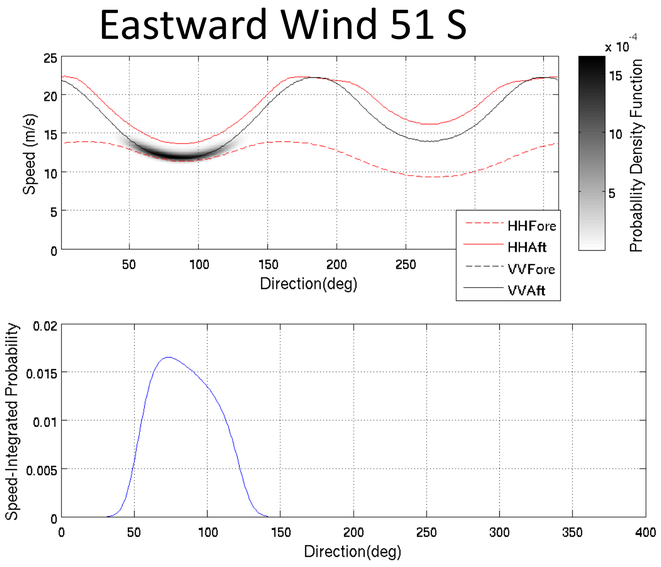


At nadir there are only two look directions, 180 degrees apart.

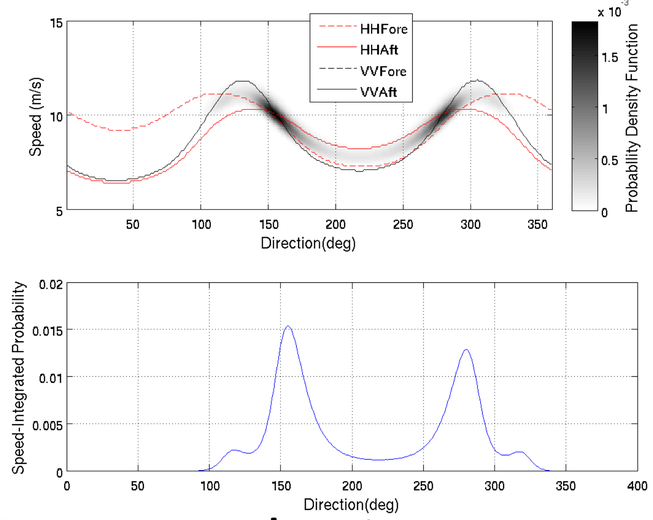
Westward Wind 15 N



Eastward Wind 51 S



Southeastward Wind 19 S



PDFs for three RapidScat nadir wind cells

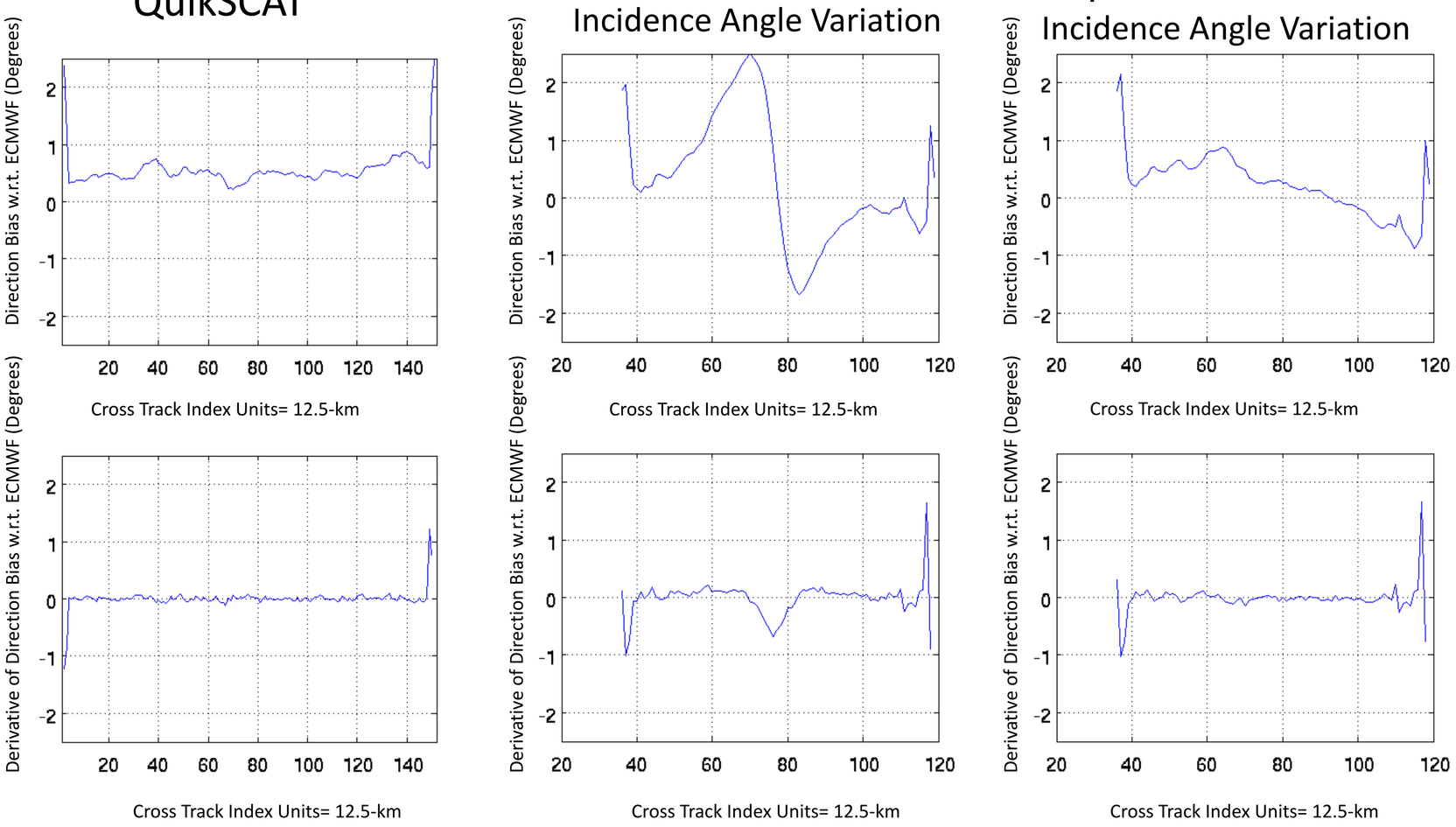
1. Eastward Wind at 51 S latitude.
   - Wind parallel to look vector
   - Solution curves for different looks close together for wide range of directions.
   - Large plateau in PDF, poor directional performance
2. Westward Wind at 15 N latitude.
   - RapidScat performance better for east/east winds near equator because swath is no longer east/west
   - Two distinct narrower ambiguities.
3. Southeastward Wind at 19 S latitude.
   - Winds nearly perpendicular to swath lead to better performance in the nadir wind cell.
   - Similar to QuikSCAT viewing geometry for east/west winds.

Errors in incidence angle dependency of GMF are also important sources of systematic directional error for RapidSCAT.

QuikSCAT

RapidSCAT Nominal Incidence Angle Variation

RapidSCAT 115% Incidence Angle Variation



Probability Density Function (log scale) of direction jump in center of swath