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Towards a Climate Data Record of Ocean Vector Winds: The New RSS ASCAT

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Outline:

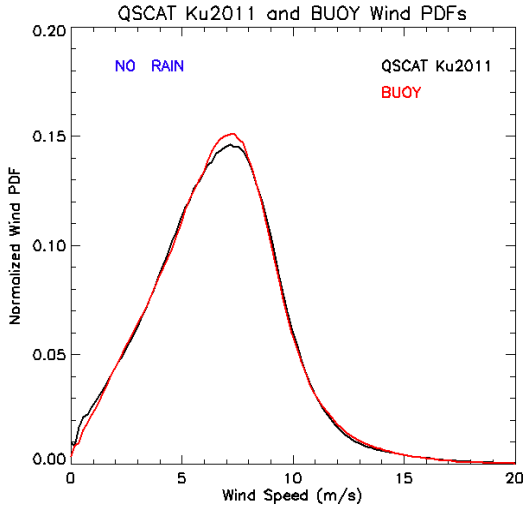
- Scatterometers intercalibration strategy
- New RSS ASCAT (C-2013 GMF)
- Validation: Wind speed and direction
- Consistency of ASCAT/QuikSCAT wind timeseries
- Rain impact on C-band ASCAT
- Sample Storms

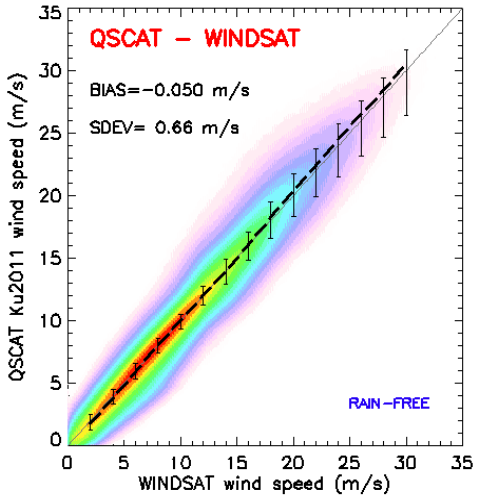
Acknowledgements
This work is supported by NASA Physical Oceanography, Ocean Vector Wind Science Team.

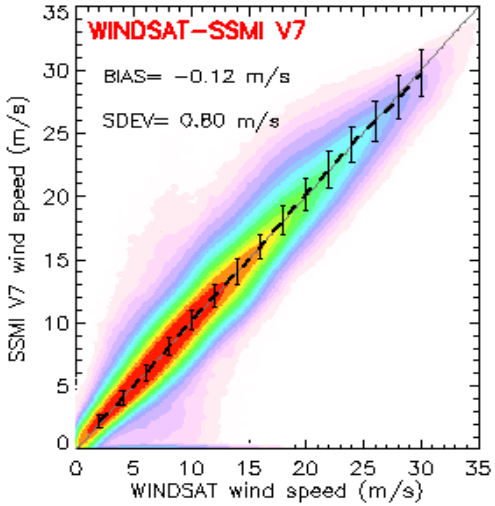
Presented at the IOVWST meeting
Kona, Hawaii, May 2013

Consistency between ASCAT and QuikSCAT

Our strategy for achieving consistency between ASCAT and QuikSCAT at all wind speeds is to adopt similar calibration and methodology for the GMF and the wind algorithm for the two scatterometers.







In 2011, a new QuikSCAT GMF Ku-2011 was developed to improve high wind speed retrievals between 20-30 m/s (presented at IOVWST 2011, Annapolis; available online). WindSat was used as ground truth for high winds and to rain-flag the QuikSCAT sigma0. WindSat is part of our intercalibrated V7 winds, which include retrievals from SSM/I and SSMIS. The V7 wind products can be considered our scatterometer calibration reference.

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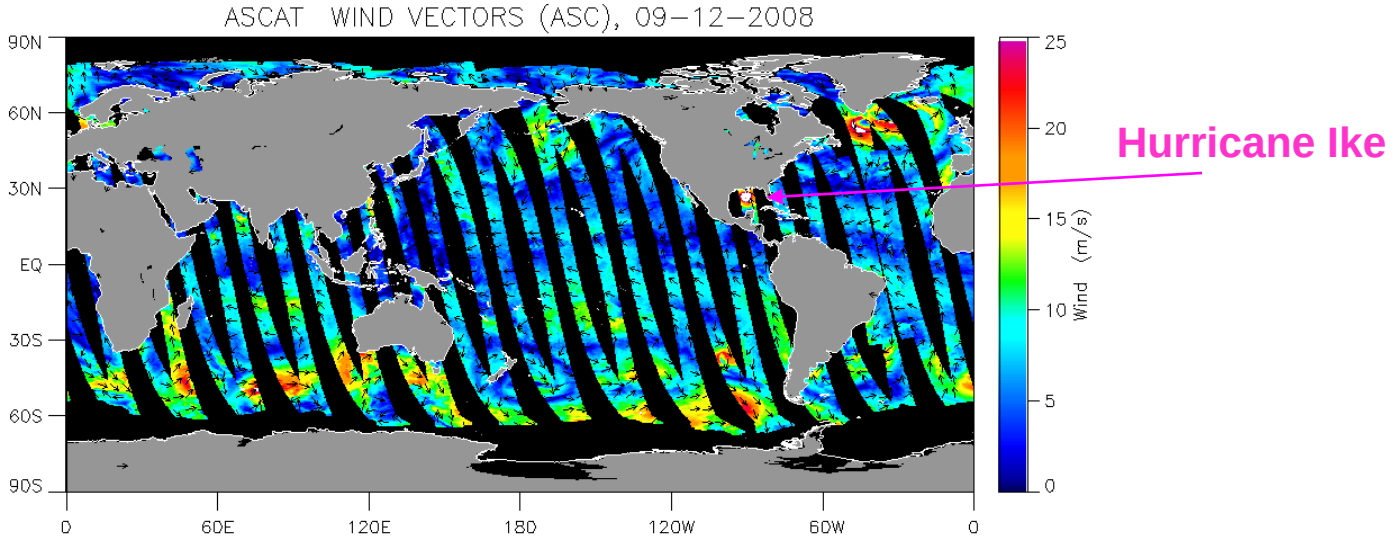
New RSS ASCAT, GMF C-2013 (C-band)



- To develop the new ASCAT GMF we used 4 years of ASCAT sigma0 colocated with SSMI and WindSat wind speeds (120-min), and CCMP wind directions. SSMI was also used to rain-flag ASCAT sigma0. Details of the GMF were presented at the IOVWST meeting in Utrecht, June 2012 (available online). ASCAT L1B files kindly provided by EUMETSAT.
- To keep the methodology as close as possible to QuikSCAT, we developed an ASCAT wind algorithm similar to the QuikSCAT one, with the added complexity of a viewing geometry with multiple incidence angles.
- The new ASCAT C-2013 winds will be available soon at www.remss.com.

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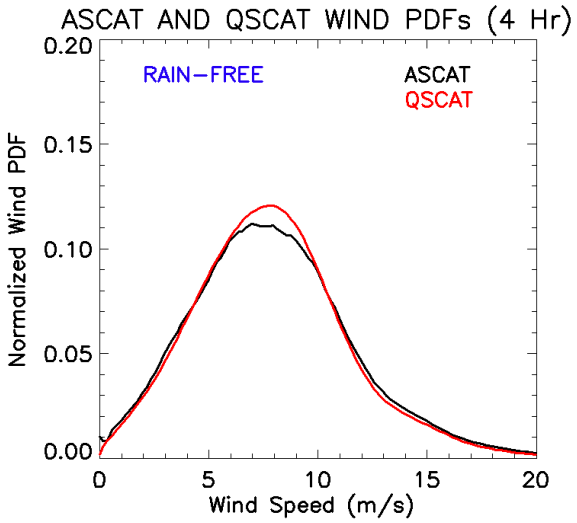
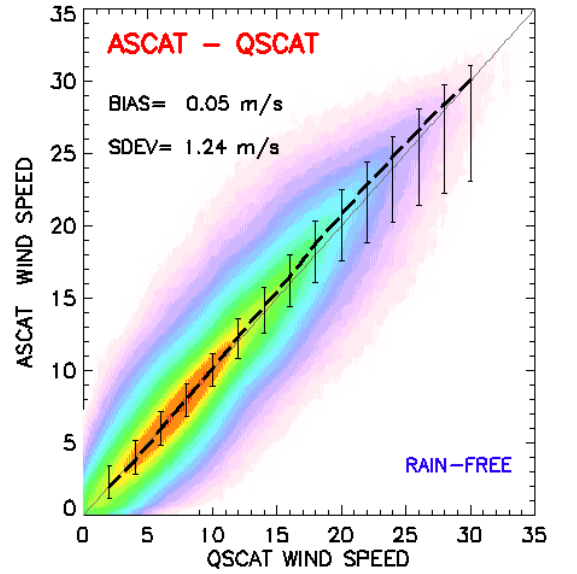
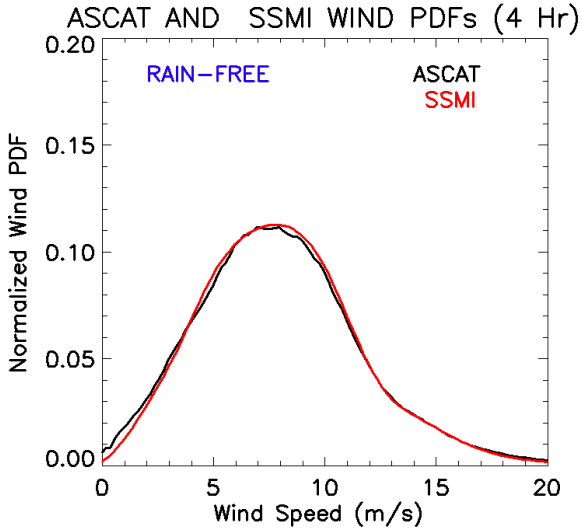
ASCAT Wind Speed PDFs Validation

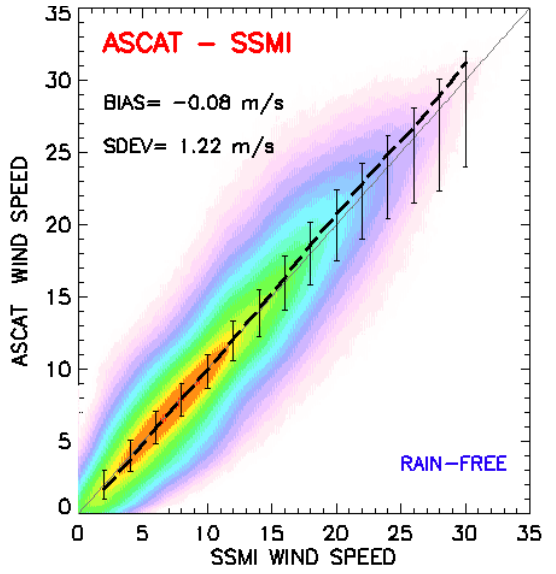
QSCAT



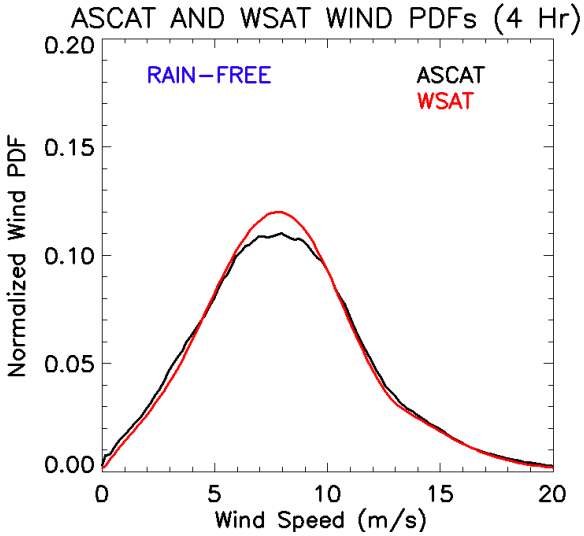


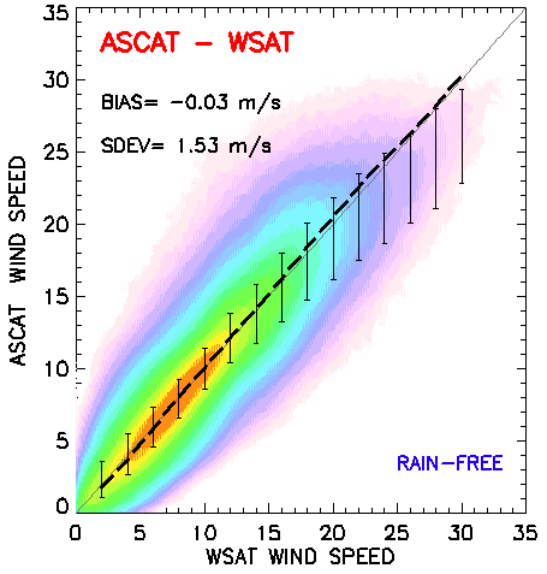
SSMI





WINDSAT





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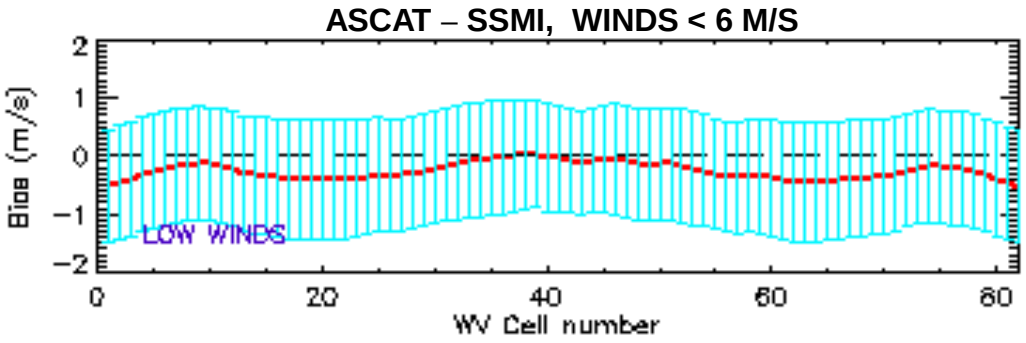
ASCAT Across-track Bias

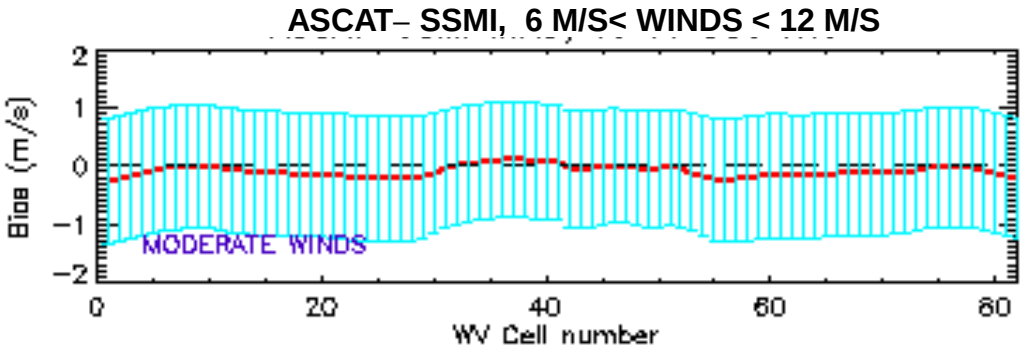
Left scan ← → Right scan

Low winds



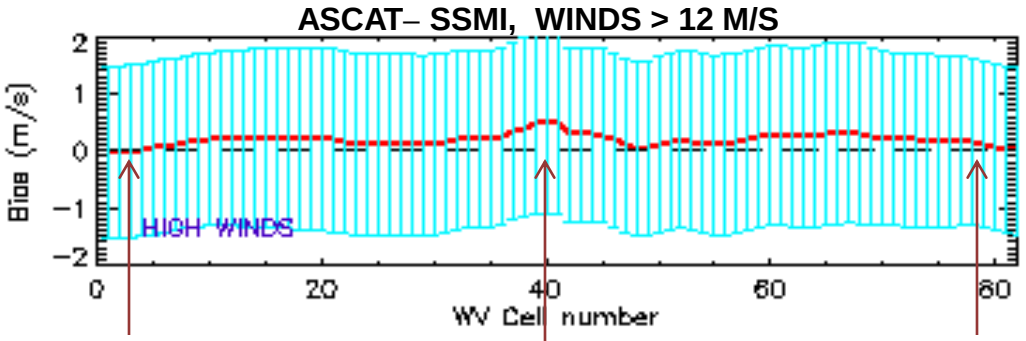
Small bias at High incidence angles (outside edge of the scans).

Moderate winds



No significant across-track bias for winds greater than 6 m/s

High winds



High incidence angles | Low incidence angles | High incidence angles

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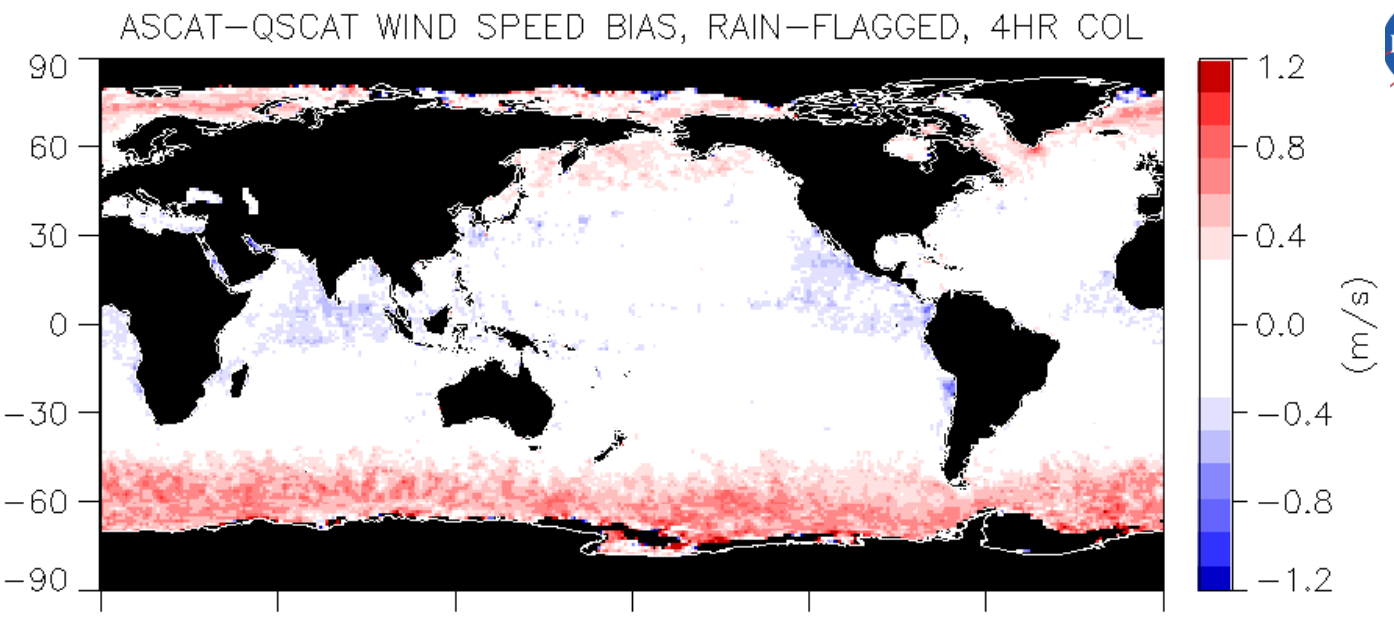
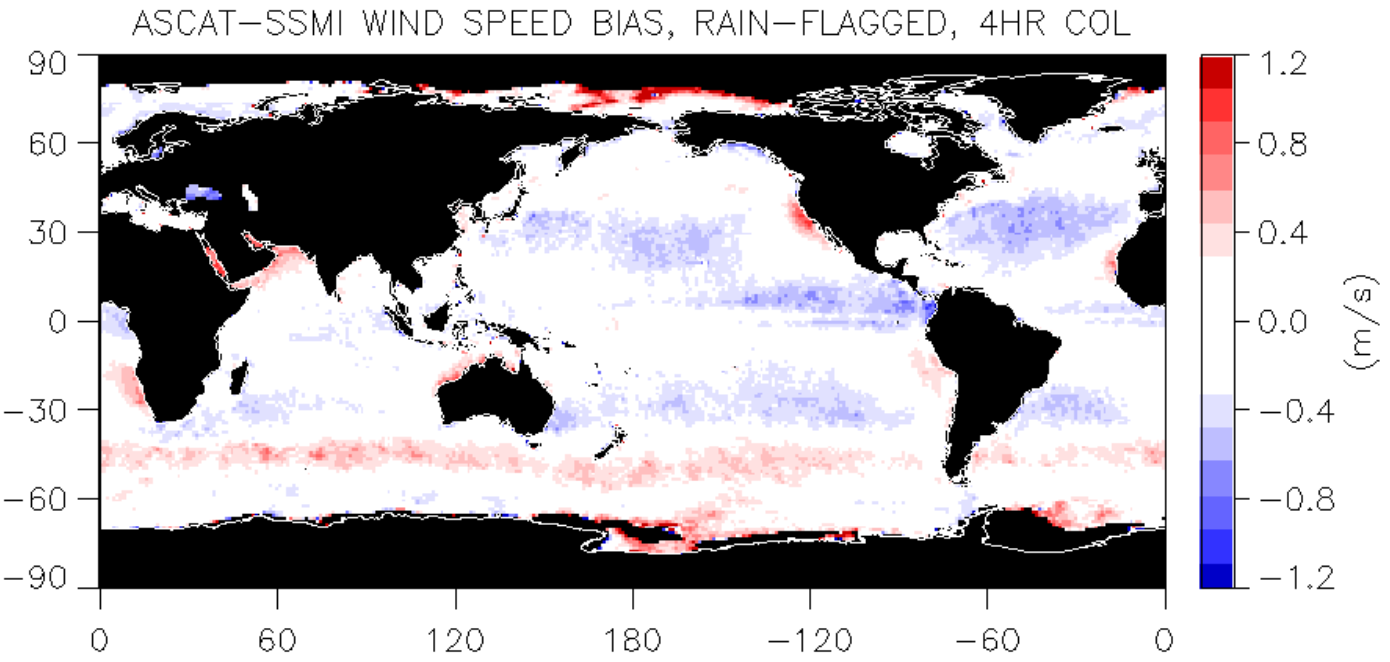
ASCAT BIAS GLOBAL MAPS

ASCAT-QSCAT



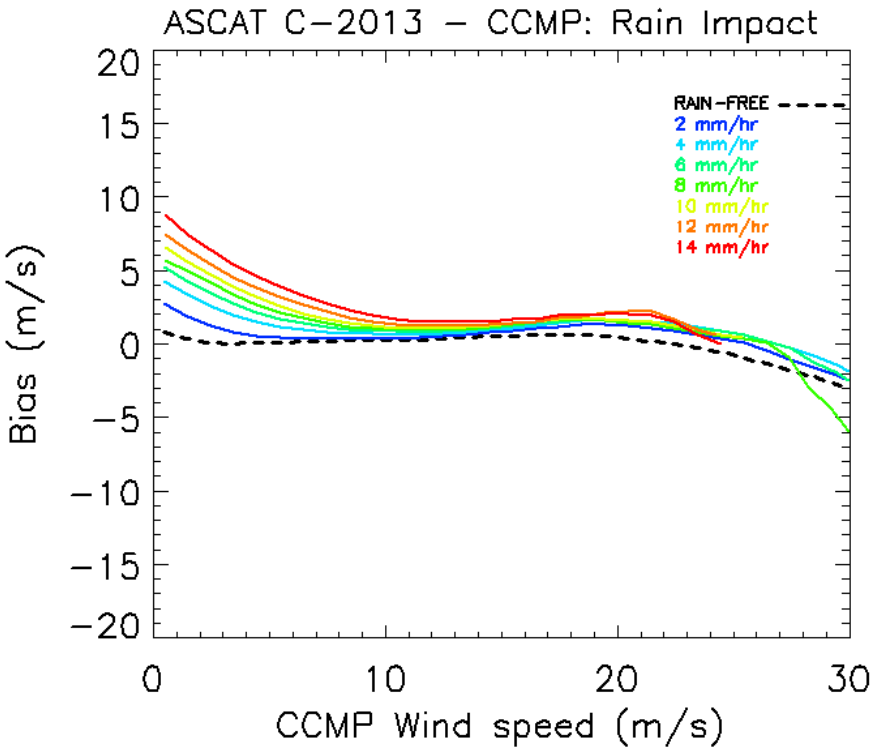
ASCAT-SSMI



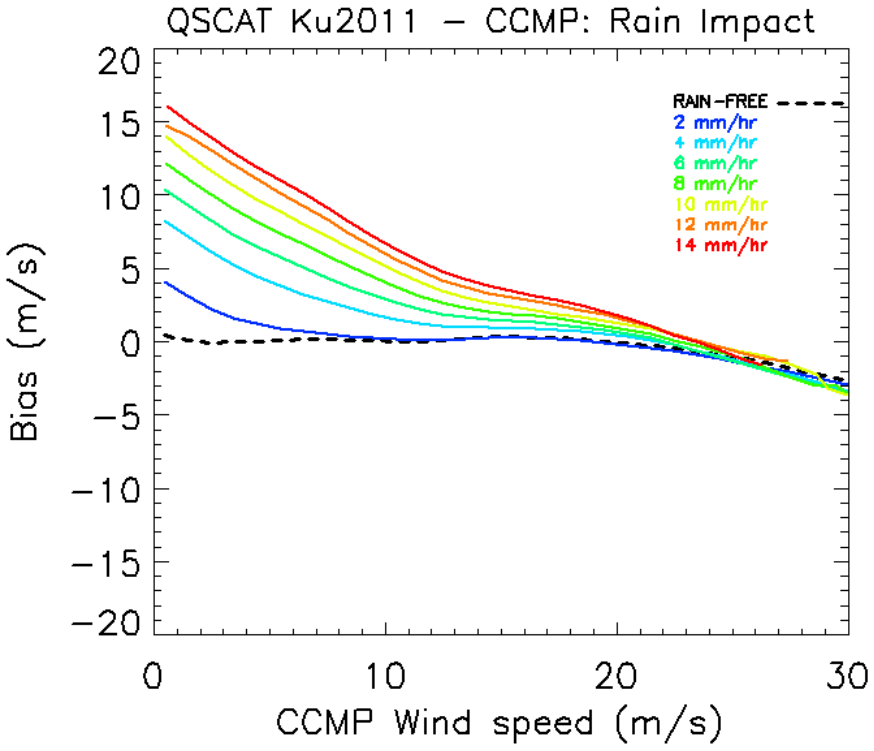
Rain impact at C-band and Ku-band

- GMFs were designed to be for rain-free retrievals
- We used QSCAT and ASCAT wind retrievals in rain to determine the statistics of the rain impact
- Bias is proportional to rain intensity; QSCAT (Ku-band) more affected then ASCAT

ASCAT (C-band)



QuikSCAT (Ku-band)



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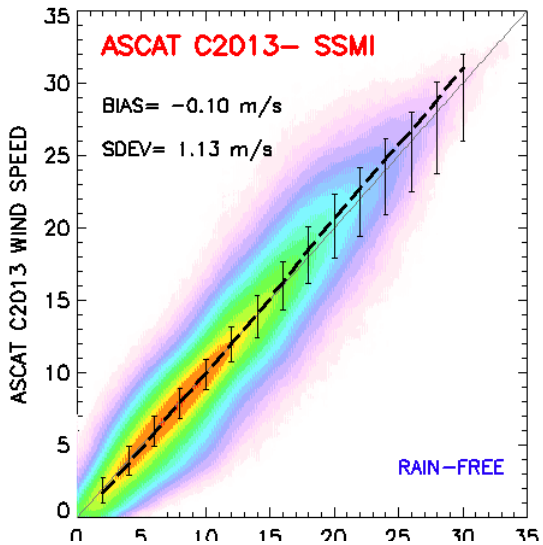
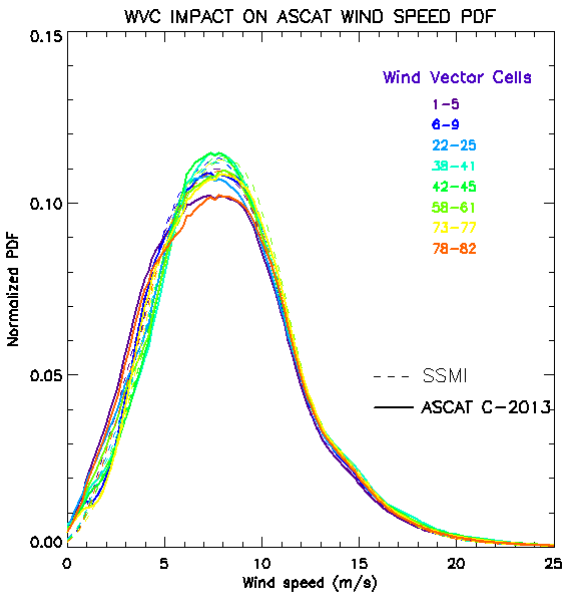
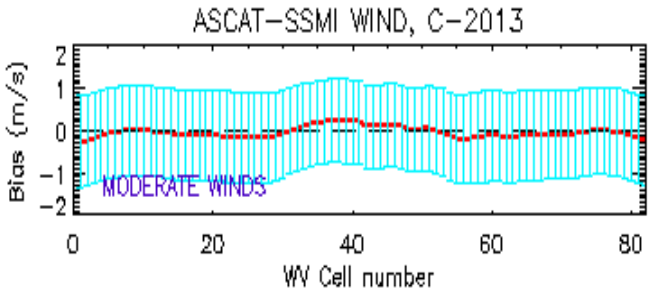
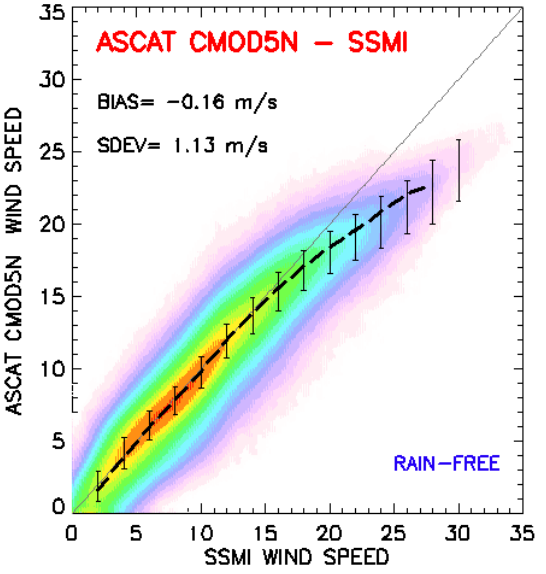
Impact of CMOD5n GMF in RSS ASCAT wind algorithm

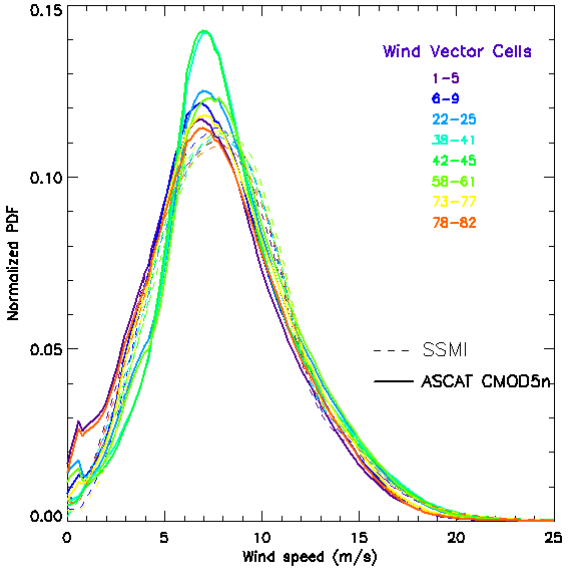




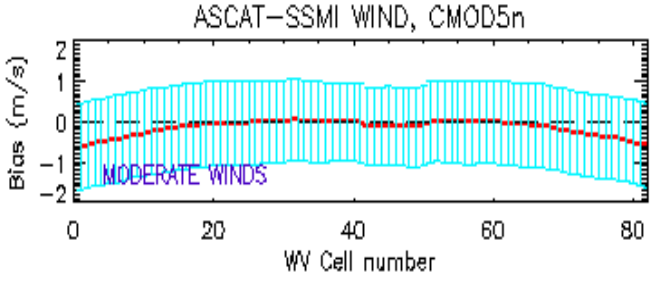
GMF: RSS C-2013



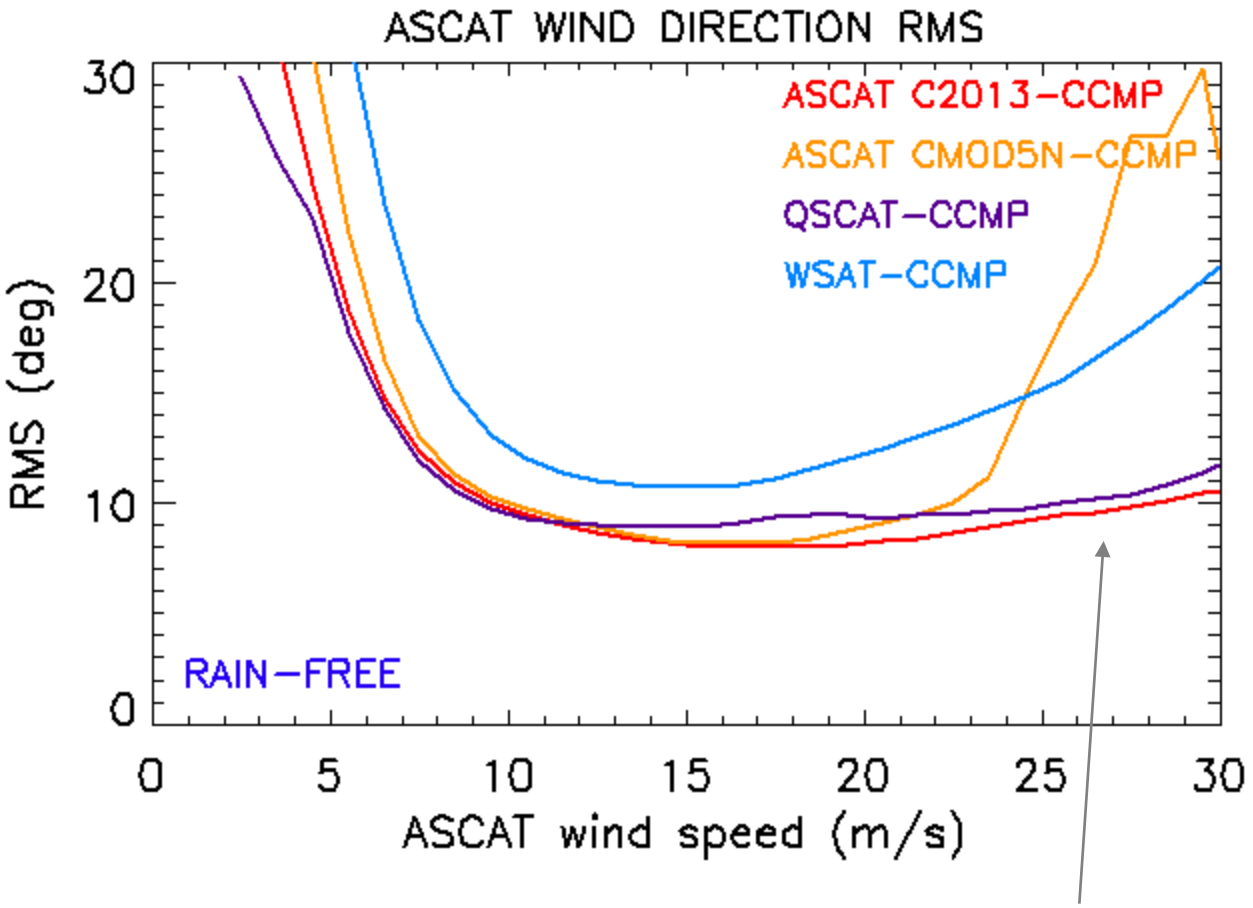




GMF: KNMI CMOD5N



ASCAT Wind Direction Validation



With a properly designed GMF it is possible to have very good retrievals of wind direction at high winds, and for C-band even in hurricanes under heavy rain (more later…)

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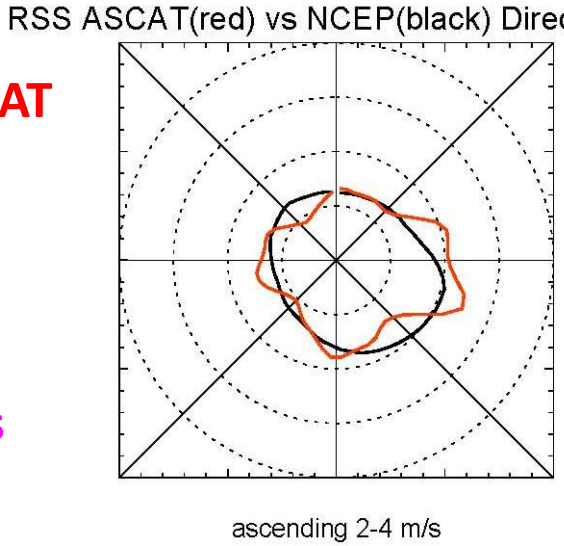
Wind direction histograms: Ebuchi plots

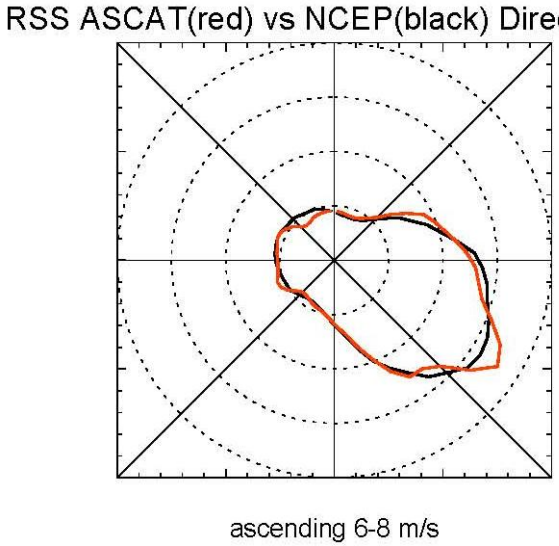
RSS ASCAT

NCEP

2-4 m/s



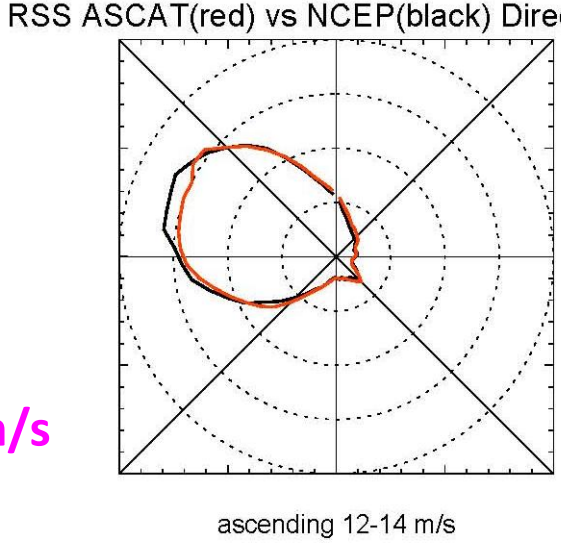
ascending 2-4 m/s



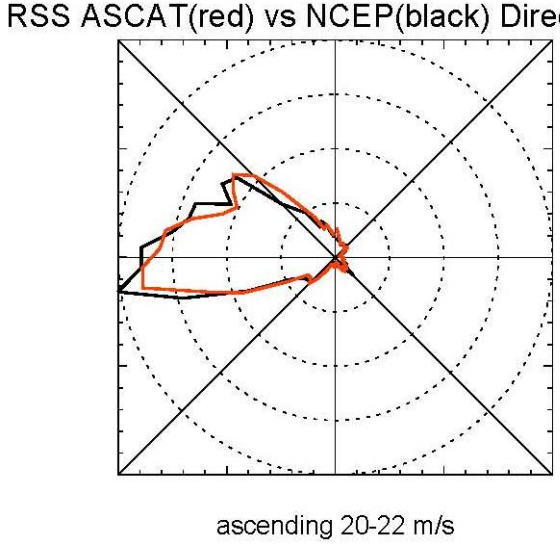
ascending 6-8 m/s

6-8 m/s

12-14 m/s



ascending 12-14 m/s



ascending 20-22 m/s

20-22 m/s

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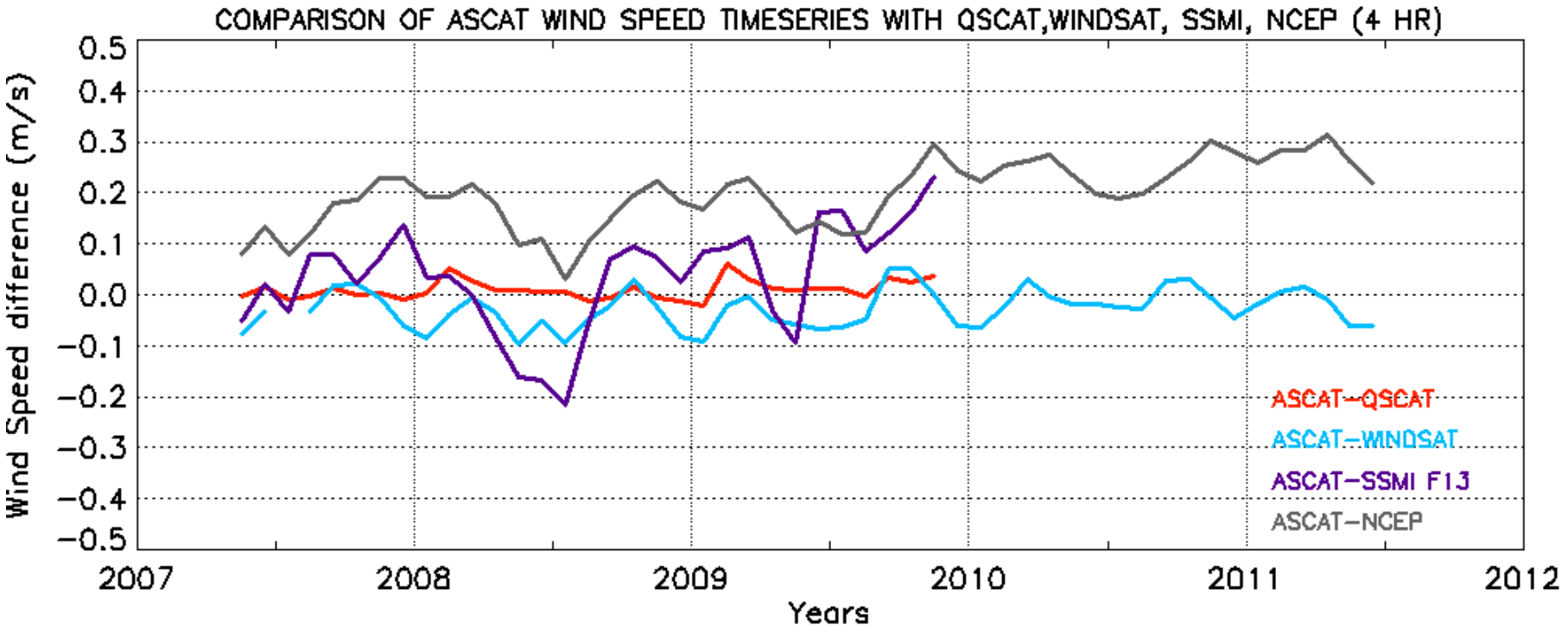
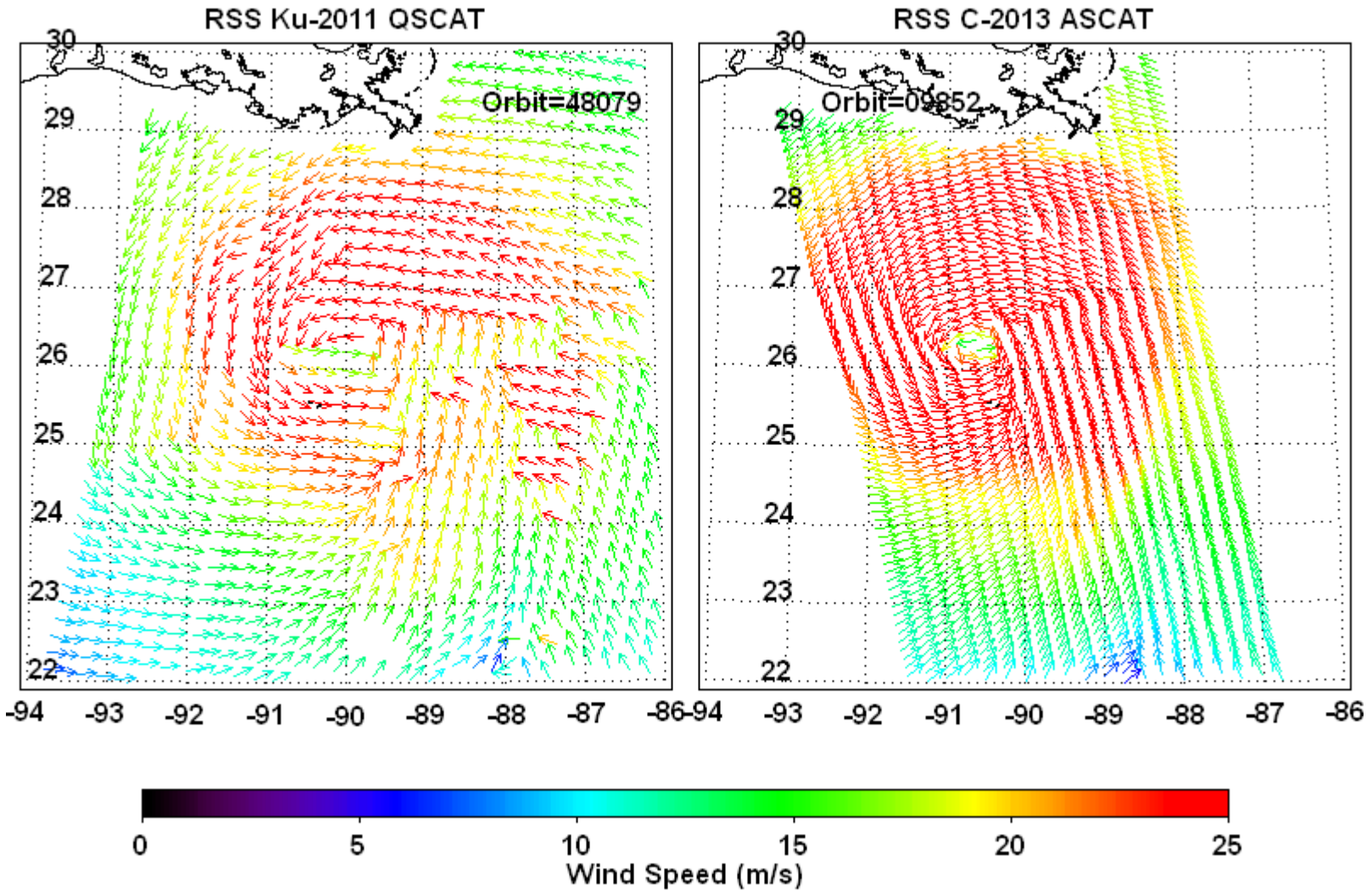
COMPARISON OF WIND ANOMALY TIMESERIES



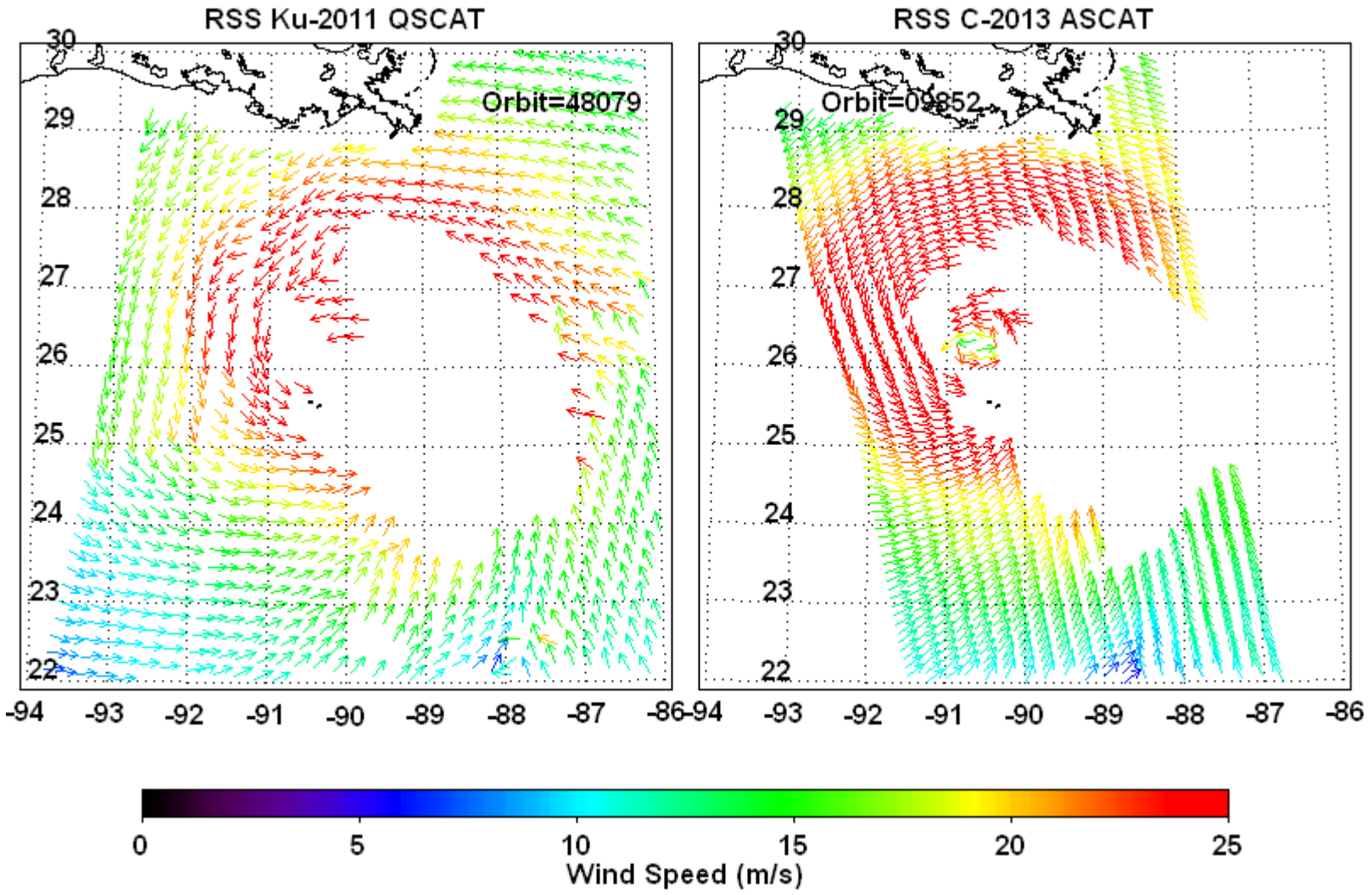
ASCAT-QSCAT GLOBAL WIND ANOMALY TIMESERIES IS VERY STABLE

Note: Here we compare ASCAT to SSMI F13 instead of F16, because F16 local observation time during this period drifted in time. F13 observing times was very stable, and corresponded to WindSat and QSCAT observing times (6pm/6am).

Hurricane Ike, Sep 11, 2009, 24:00 UT, all retrievals



Hurricane Ike, Sep 11, 2009, 24 UT, retrievals with intense rain (> 15 mm/hr) flagged



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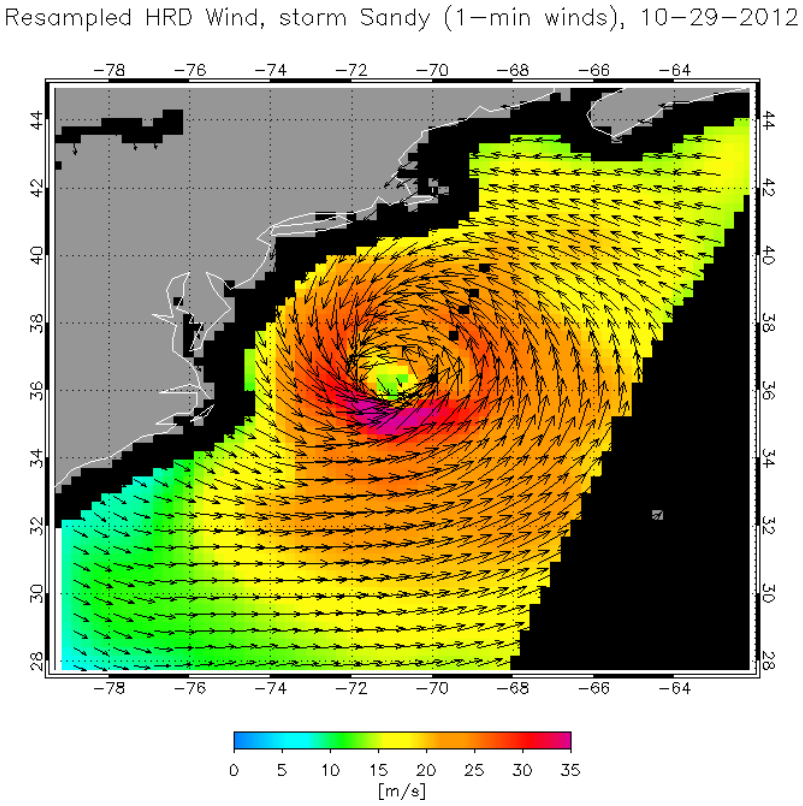
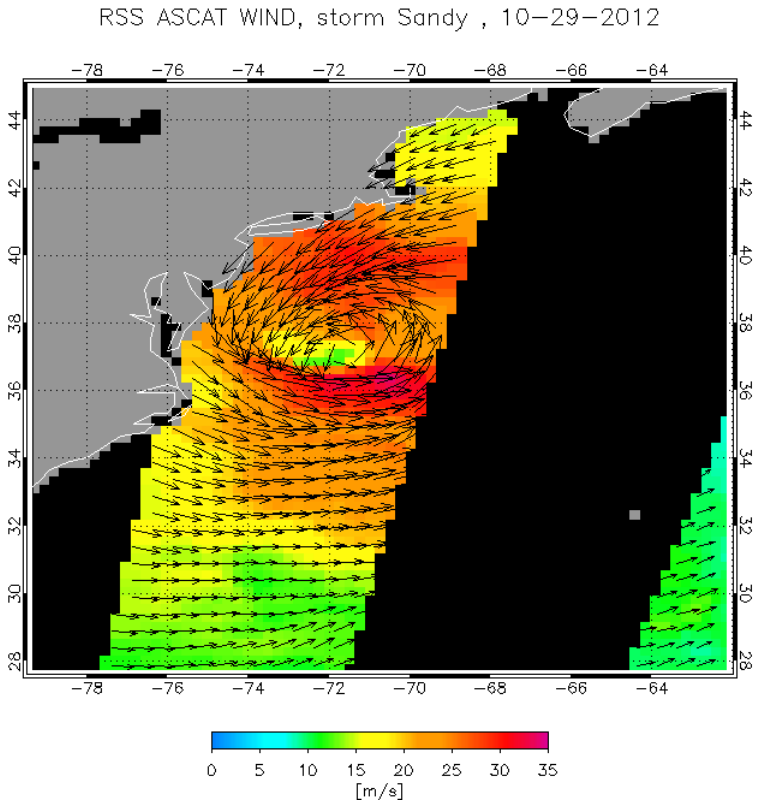
STORM SANDY: VECTOR WINDS

HRD Winds, Oct 29
10:30 UTC



Maximum 1-min winds: 39 m/s
Maximum 10-min winds: 34.6 m/s
NWS reported winds (touchdown): 35-40 m/s

RSS ASCAT Winds, Oct 29
14:20 UTC



Maximum RSS ASCAT winds: 34 m/s

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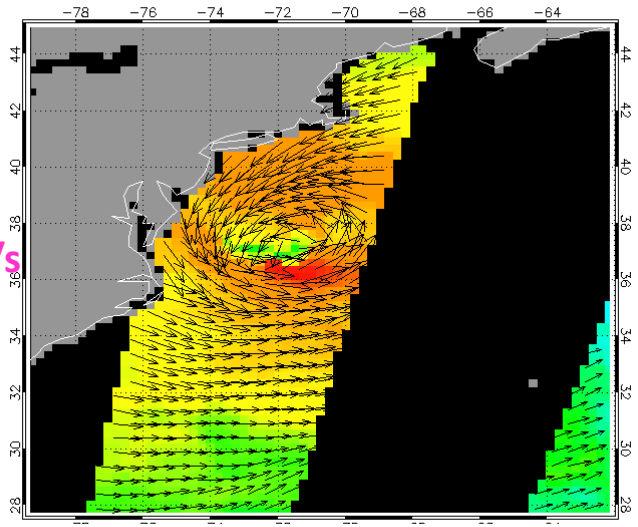
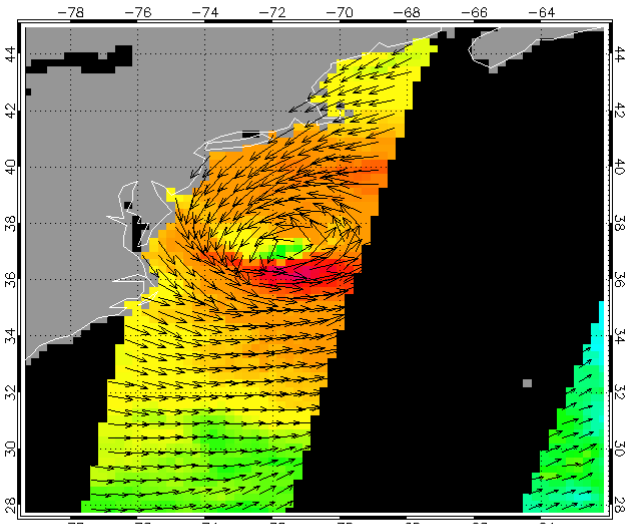
KNMI ASCAT WIND, storm Sandy , 10–29–2012



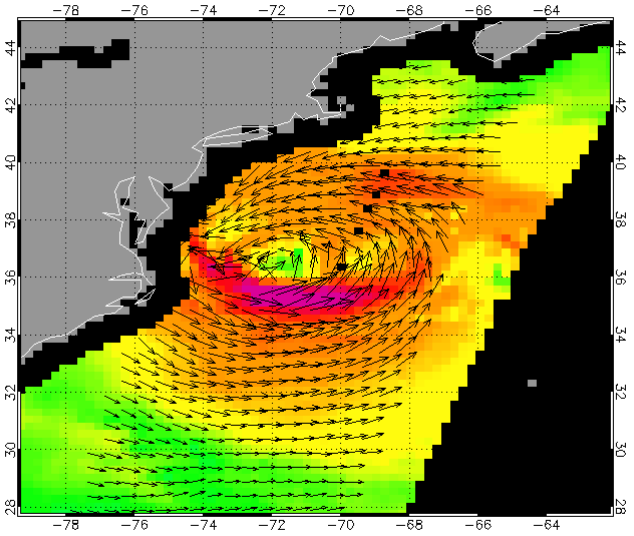
NOAA ASCAT WIND, storm Sandy , 10–29–2012



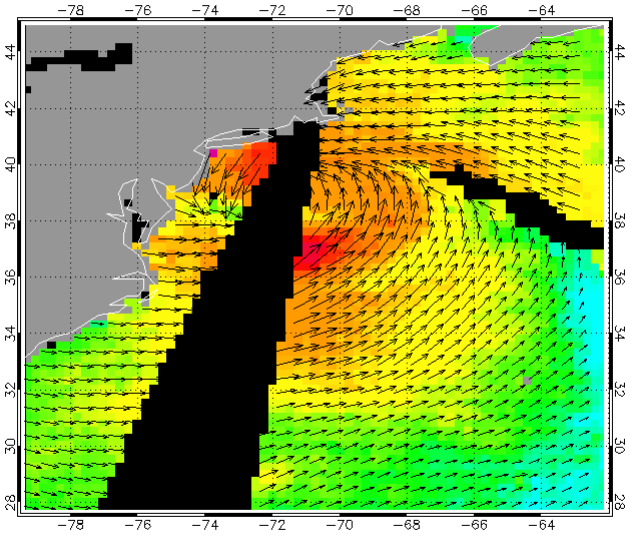
KNMI ASCAT
14:20 UTC
Max=30.4 m/s

NOAA ASCAT
14:20 UTC
Max=34.0 m/s

WindSat All–weather Wind, storm Sandy 10–29–2012



NOAA OSCAT WIND, storm Sandy , 10–29–2012



WINDSAT
11:24 UTC
Max=42 m/s

NOAA OSCAT
16:30 UTC
Max=32.6 m/s

Aknowledgments: ASCAT and OSCAT data kindly provided by Paul Chang, at NOAA/NESDIS/STAR

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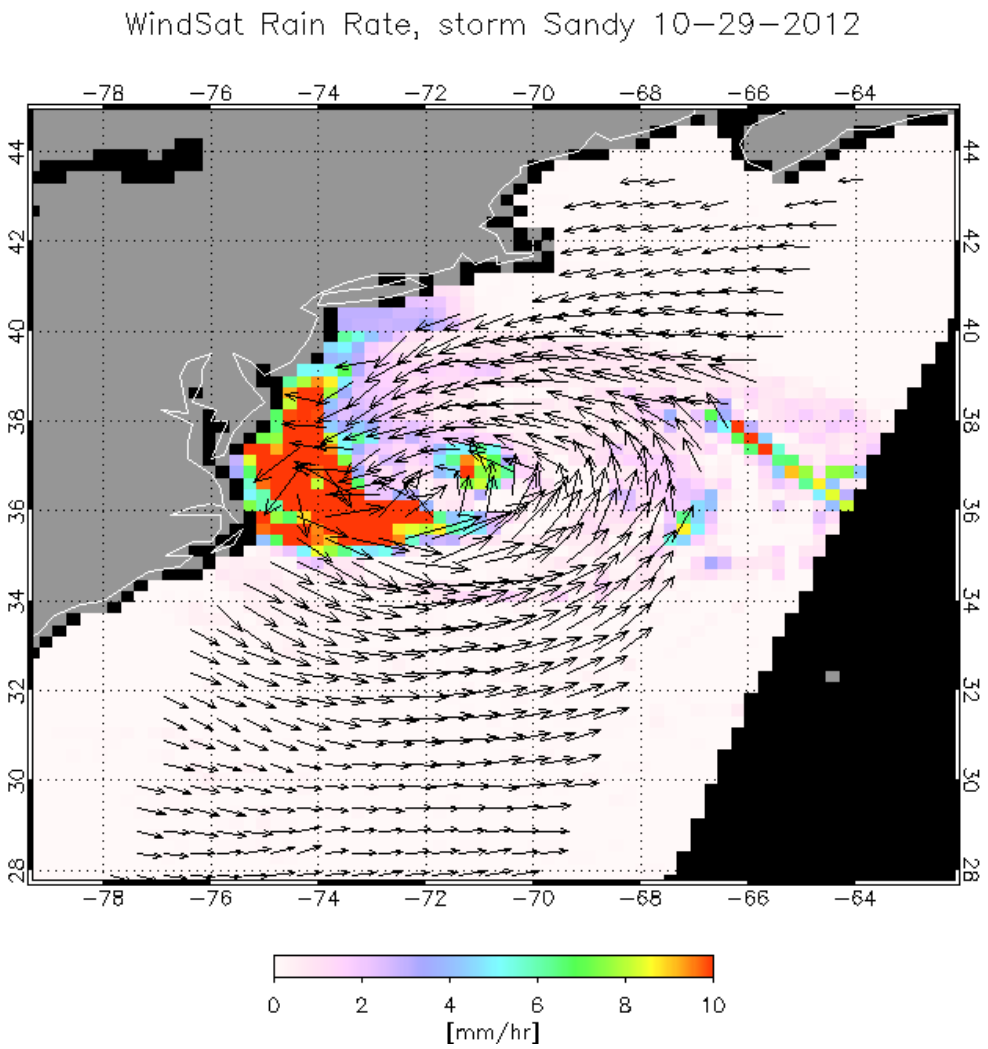
STORM SANDY : RAIN RATES OBSERVED BY WINDSAT



Summary and Conclusions:

- Long term goal: integrate observations from multiple scatterometers into a Climate Data Record (CDR).
- New QuikSCAT Ku-2011 released in 2011 with improved high winds
- Developed ASCAT GMF (C-2013) and processed winds (2007- July 2011) with an algorithm similar to QuikSCAT
- Performed an extensive validation of RSS ASCAT versus wind database.
- Comparison of RSS ASCAT and QuikSCAT shows very good agreement.
- In the two and half years of QuikSCAT/ASCAT overlapping, the timeseries of their wind anomalies are stable and well within a 0.1 m/s margin required for climate studies.
- Very good ASCAT wind direction retrievals at all wind speeds.
- ASCAT winds affected by positive rain bias at low wind speeds (rain rate dependent).
- Very good RSS ASCAT wind retrievals in storms
- RSS ASCAT winds will be released in summer 2013 (www.remss.com); later will be reprocessed to reflect adjustments in ASCAT sigma0 calibration (for climate).
- Additional scatterometers will be added to the timeseries following the same methodology (ERS, OSCAT, …)

EXTRA SLIDES

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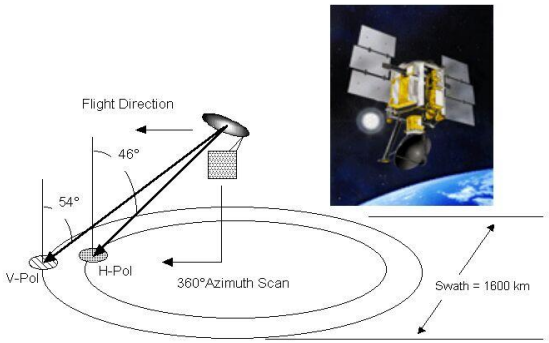
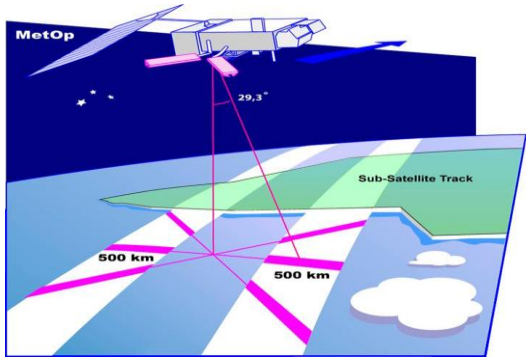
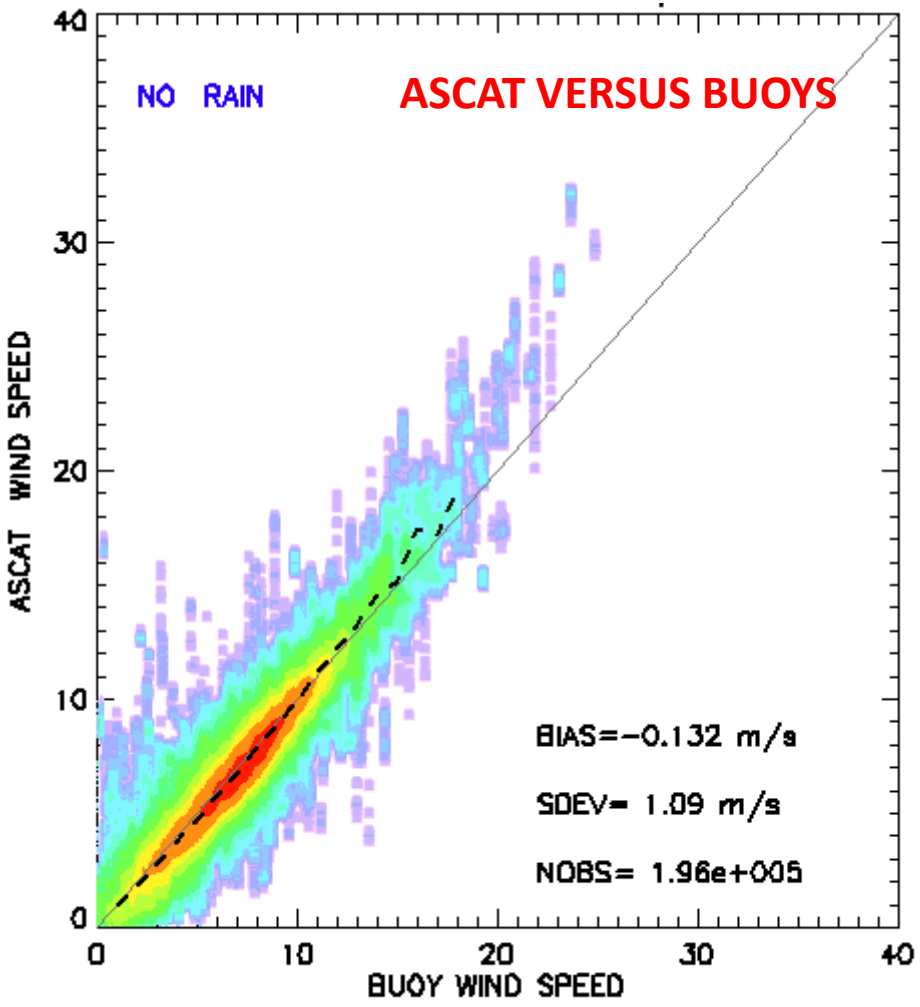
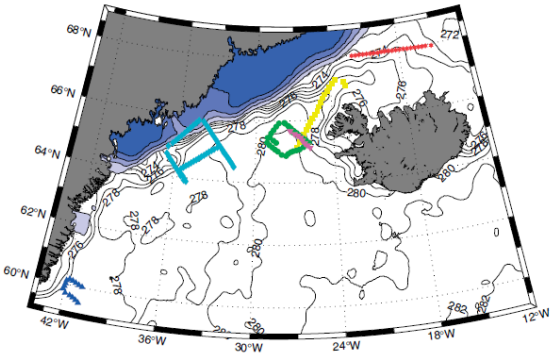
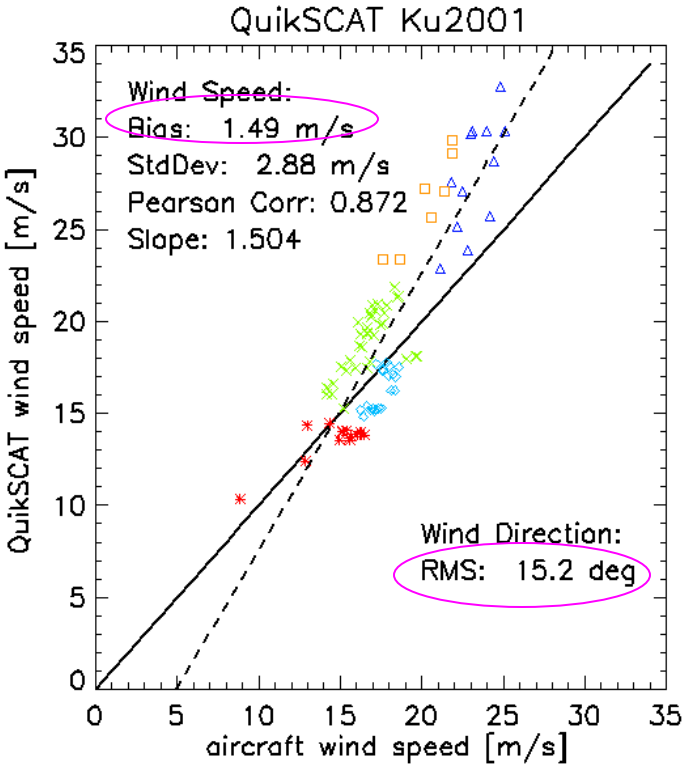
QuikSCAT		ASCAT
		
Conical scanning	Geometry	3 beam antennae
V-Pol and H-Pol	Polarization	V-Pol
13.4 GHz (Ku-band)	Frequency	5.2 GHz (C-band)
6:00am	LTAN	9:30pm
46º (H); 54º (V)	Incidence angle	variable: 25º-65º
1600 Km	Swath	2 swaths of 500 Km
12.5 (25) Km	Sampling (Resolution)	12.5 (25) Km
1999-2009	Time period	2007-current

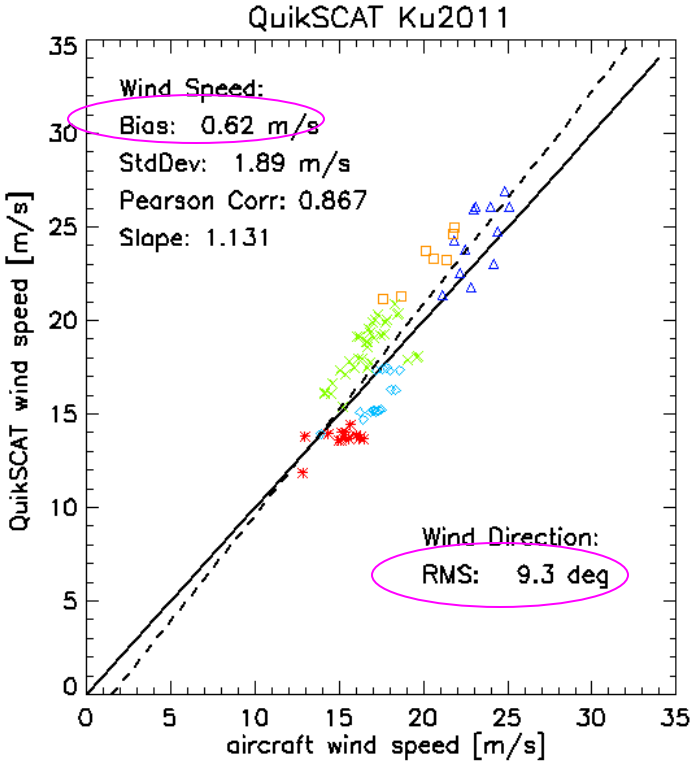

NO RAIN
ASCAT VERSUS BUOYS
ASCAT WIND SPEED
BUOY WIND SPEED
BIAS=-0.132 m/s
SDEV= 1.09 m/s
NOBS= 1.96e+005
0
10
20
30
40

HIGH WINDS VALIDATION: AIRCRAFT

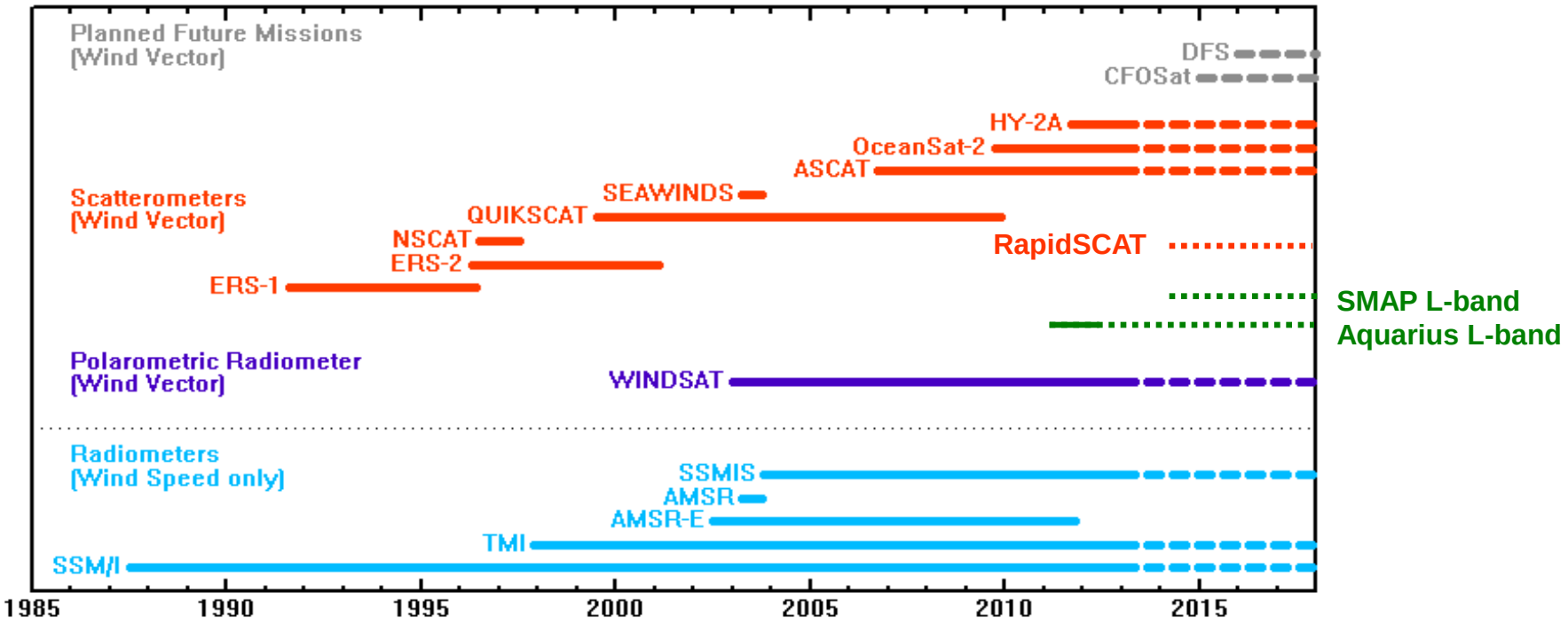


Aircraft turbulent probe observations taken during the Greenland Flow Distortion Experiment (GFDex), Feb and Mar 2007 (Renfrew et al, QJRMS 2009).





Ocean Vector Wind Missions



1. **Goal: After QuikSCAT, continue the OVW time series using ASCAT**
2. **Long-term goal: produce an intercalibrated climate-quality data record starting with ERS (Wind Vector) in 1991, and with SSMI in 1987 for wind speed.**
3. **Use QSCAT as backbone. QSCAT was reprocessed using the new GMF, Ku-2011, developed to improve high wind speeds retrievals.**
4. **Using QSCAT methodology, we developed ASCAT GMF and RSS ASCAT Winds**