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Challenges of Integrating Multiple Scatterometer Observations into a Climate Data Record: The Effect of Diurnal Variability

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Acknowledgements

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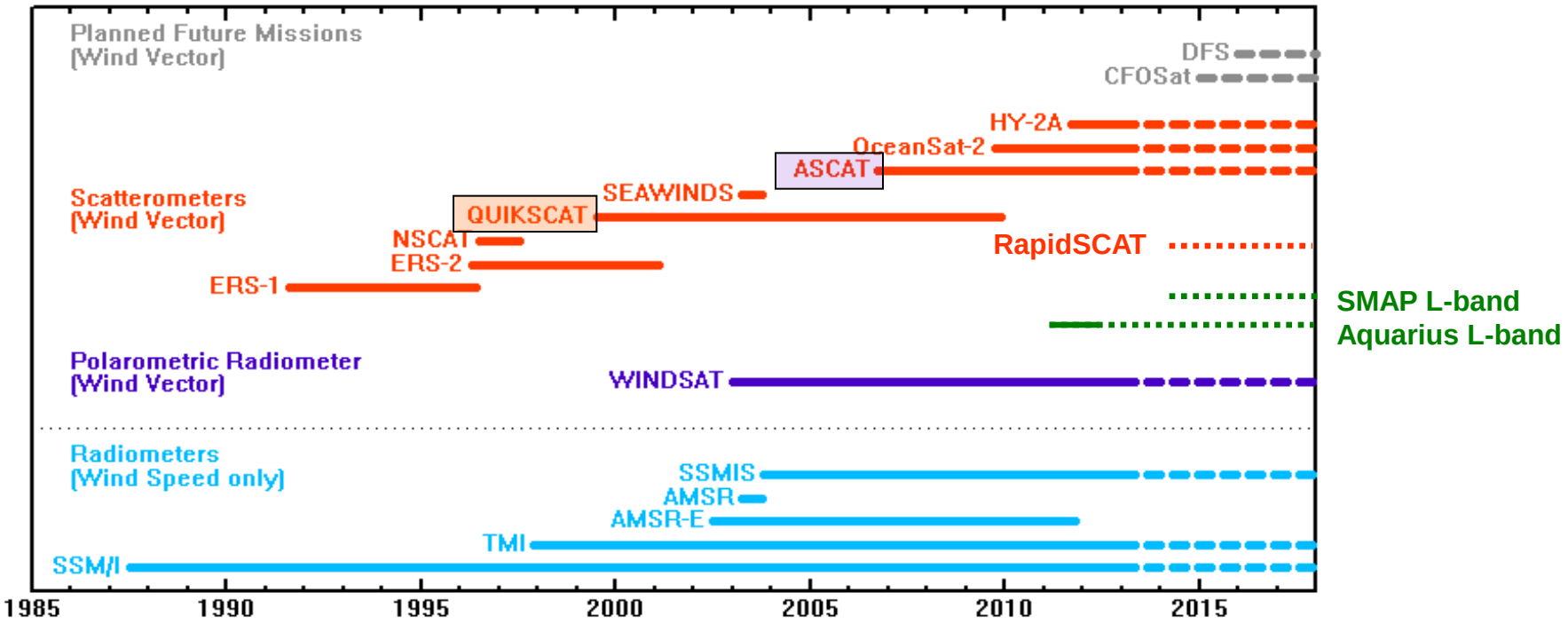
Presented at the IOVWST meeting Kona, Hawaii, May 2013

Ocean Vector Wind Missions



1. Goal: After QuikSCAT, continue the OVW time series using ASCAT
2. Use QSCAT as backbone. QSCAT was reprocessed using the new GMF, Ku-2011, developed to improve high wind speeds retrievals.
3. Using QSCAT methodology, we developed ASCAT GMF and RSS ASCAT Winds
4. 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.

➢ **When integrating in a CDR retrievals obtained at different times of the day, the diurnal variability has to be removed.**

IMPACT OF DIURNAL CYCLE

•ASCAT observations: 9:30pm (am) LT for ascending (descending)

•QuikSCAT observations: 6 pm (am) LT for descending (ascending)

•If there were no diurnal cycle on the surface winds, the average difference of the PM-AM at each location would be zero.

•Therefore regional biases in the PM-AM maps for ASCAT and QuikSCAT are indicative of the effects of diurnal variability of the ocean surface winds.

• Because of the different observing time, PM-AM regional biases for ASCAT and QuikSCAT might differ from each other. In this case, the diurnal variability signal should be removed from each of the dataset before integrating them into a Climate Data Record.

•Estimating the amplitude and phase of diurnal variability from current satellite observations presents some challenges. We looked for consistency in a combination of scatterometer and radiometer observations over few years, to separate a real diurnal variability from other sources of regional bias or noise. Information gathered from buoy data is also useful, but very limited in space.

•A complete understanding of the diurnal cycle will be provided by RapidSCAT (2014)

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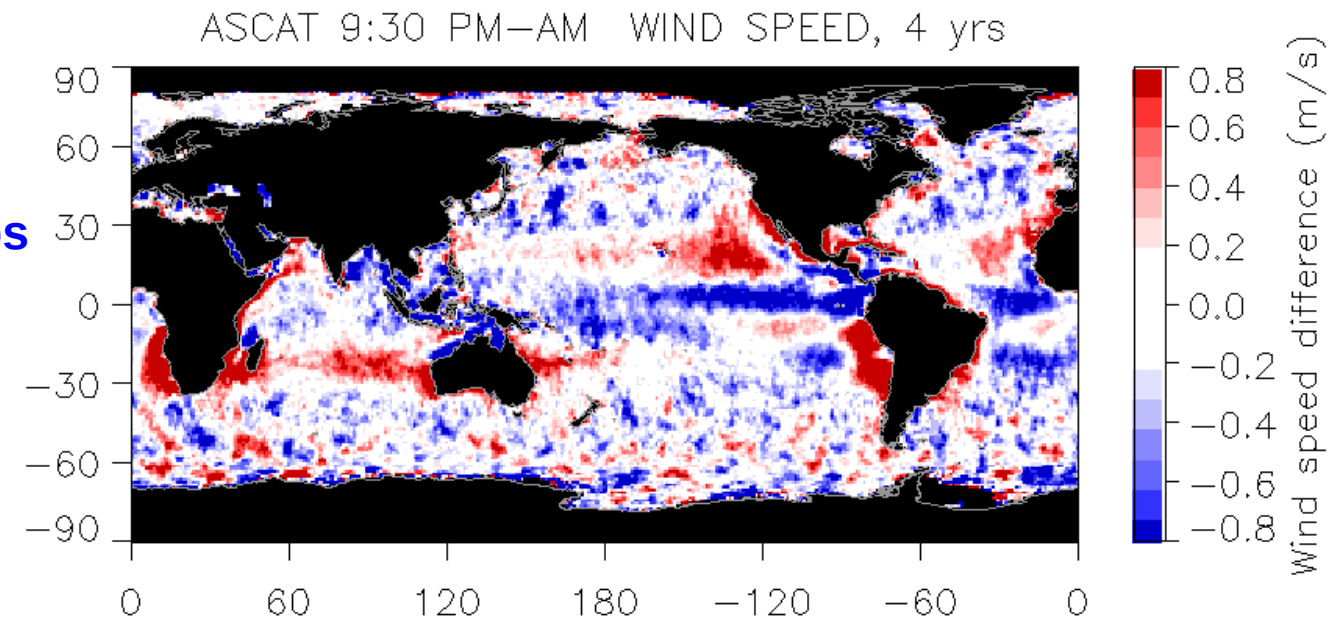
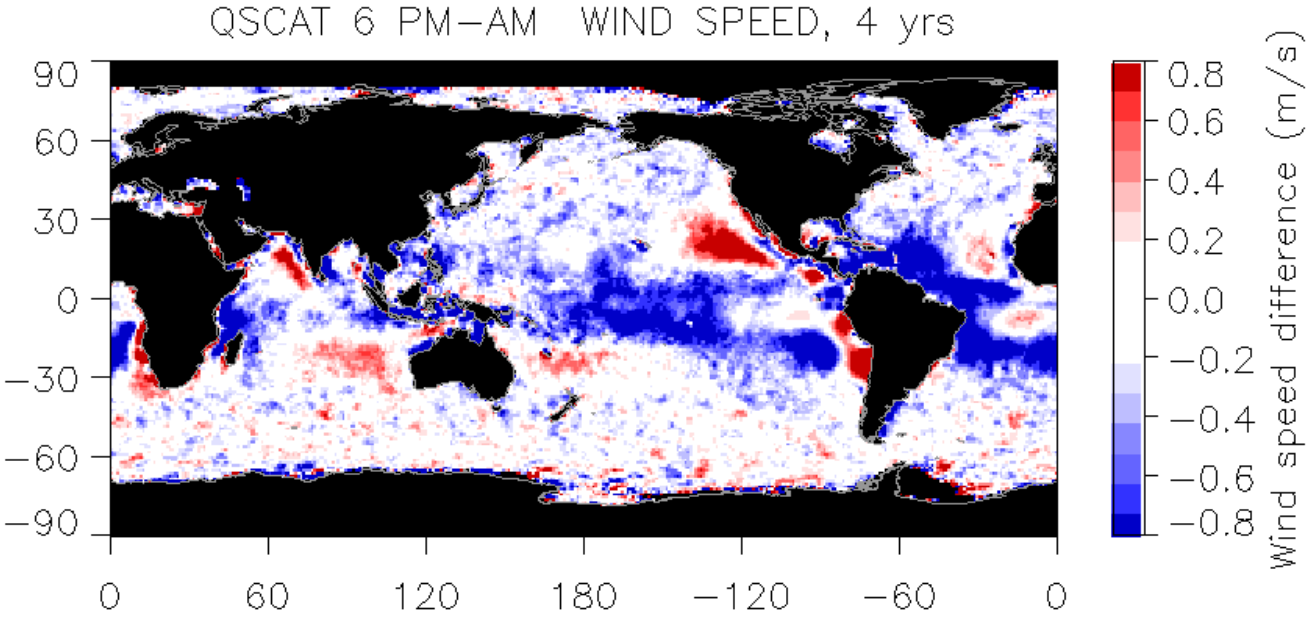
Wind Speed PM-AM Difference Maps

ASCAT
9:30 PM-AM



QSCAT
6 PM-AM



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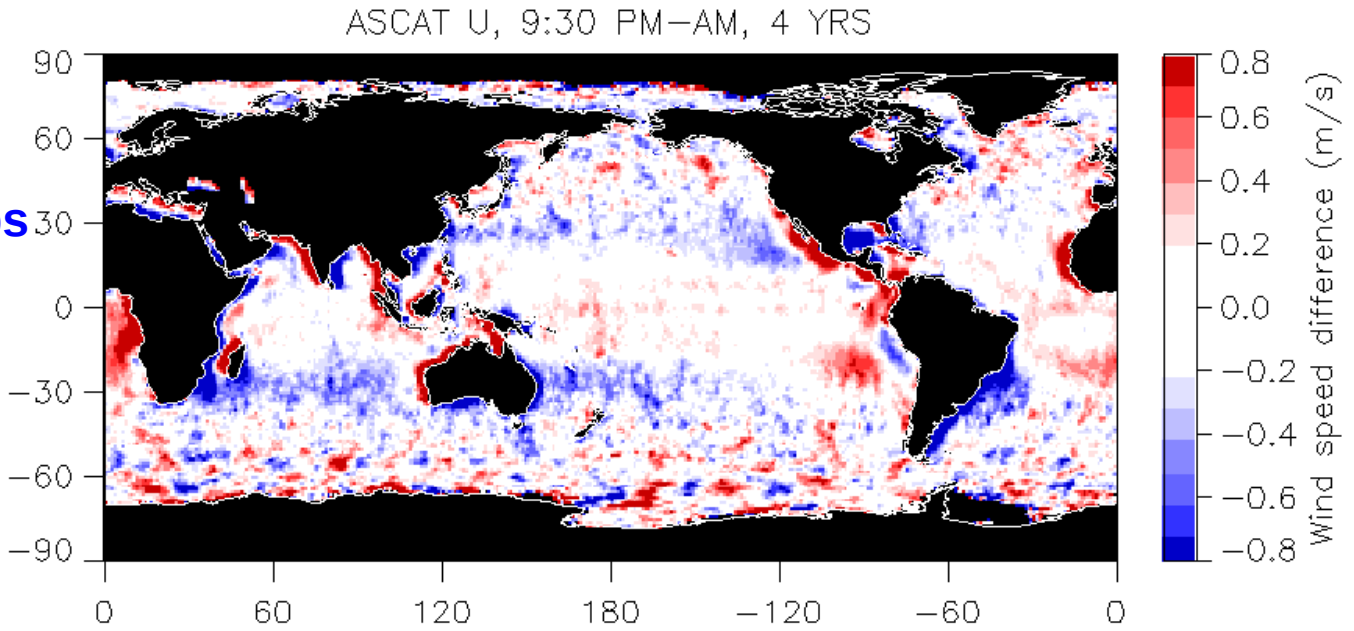
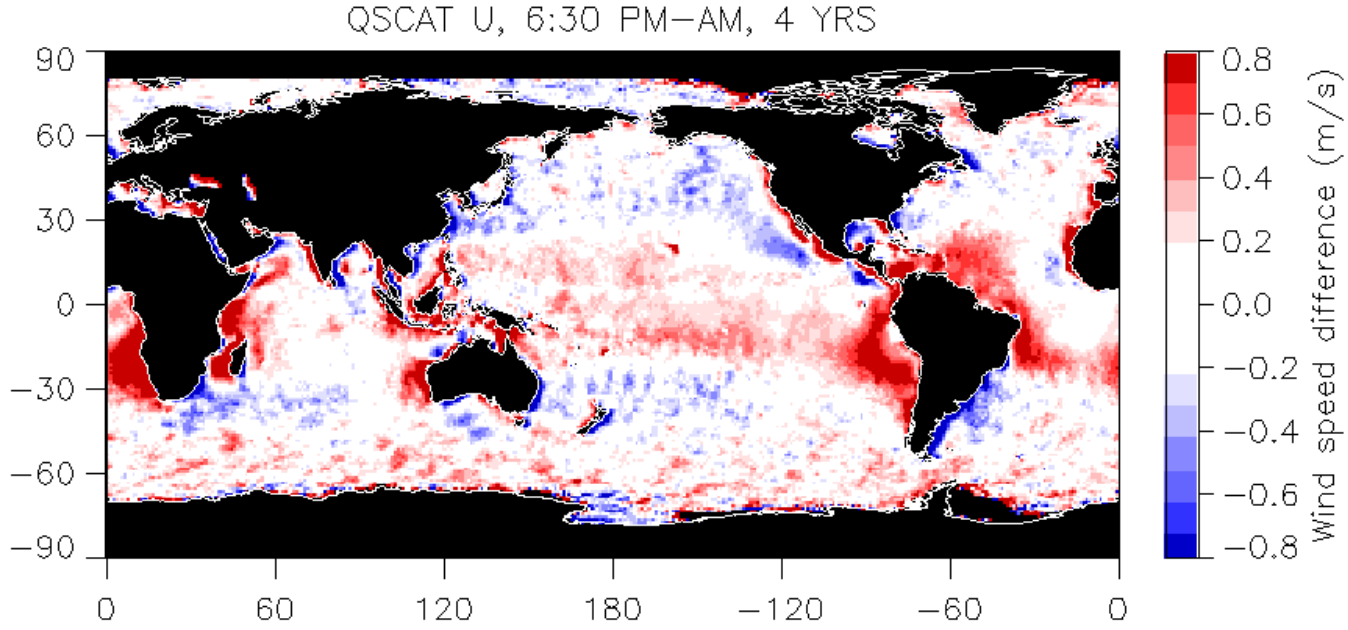
U component PM-AM Difference Maps

ASCAT
9:30 PM-AM



QSCAT
6 PM-AM



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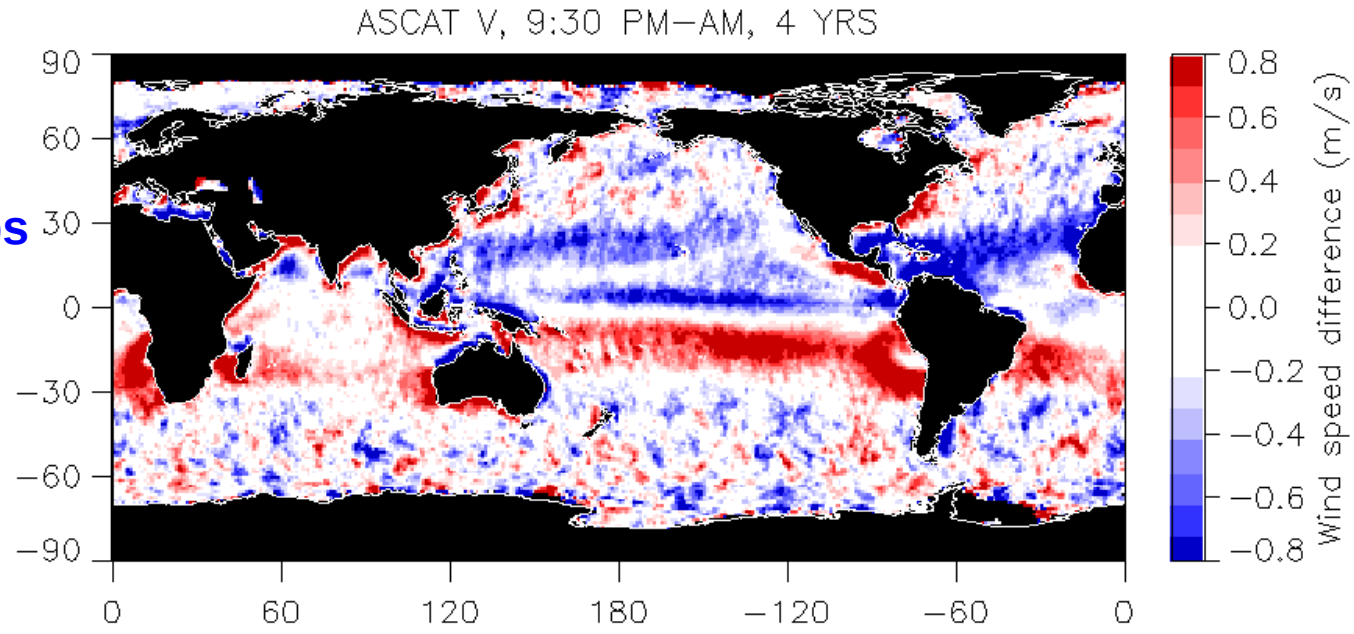
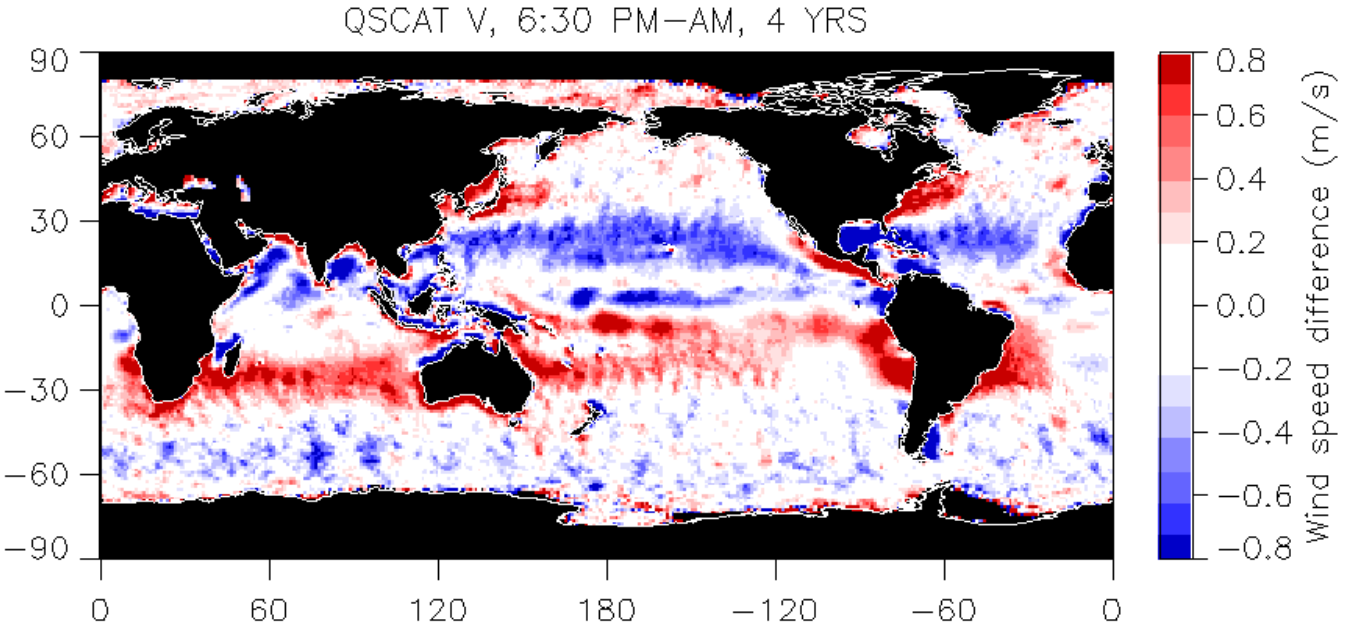
V component PM-AM Difference Maps

ASCAT
9:30 PM-AM



QSCAT
6 PM-AM



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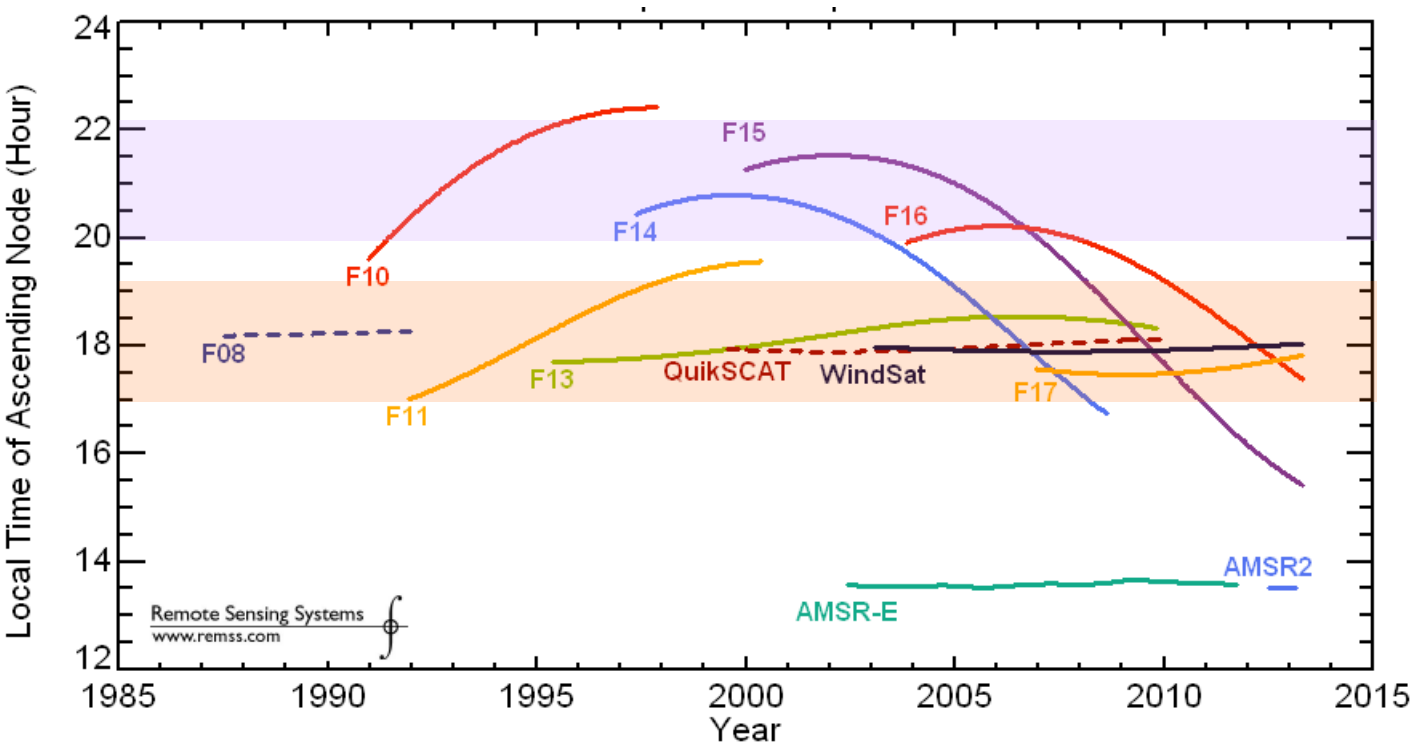
Our resources for understanding the diurnal cycle of winds

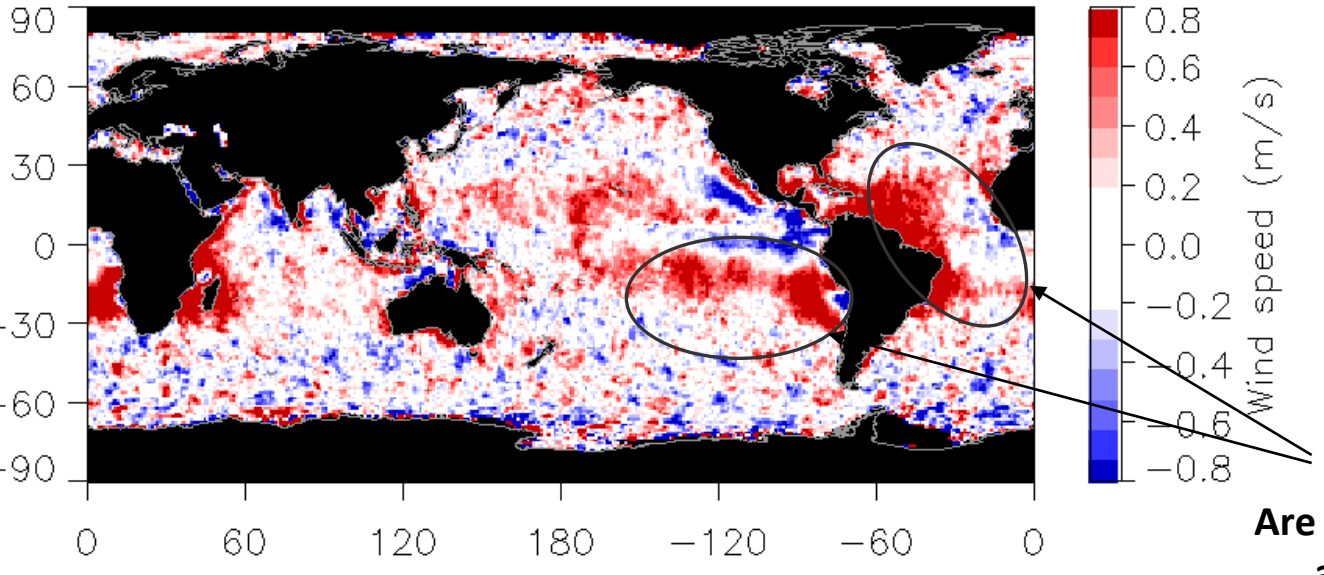
Scatterometers: ASCAT, QuikSCAT, (OSCAT not used here)
Radiometers: SSM/I (F8, F10, F11, F13. F14, F15,), SSMIS (F16, F17), AMSR-E, AMSR2, WindSat, TMI (LEO, precession over the diurnal cycle)
Reanalysis Models: NCEP, MERRA
Global Buoys



Scatterometers

ASCAT PM-AM
MINUS
QSCAT PM-AM

Observing time (LT)
ASCAT: 9:30
QSCAT: 6

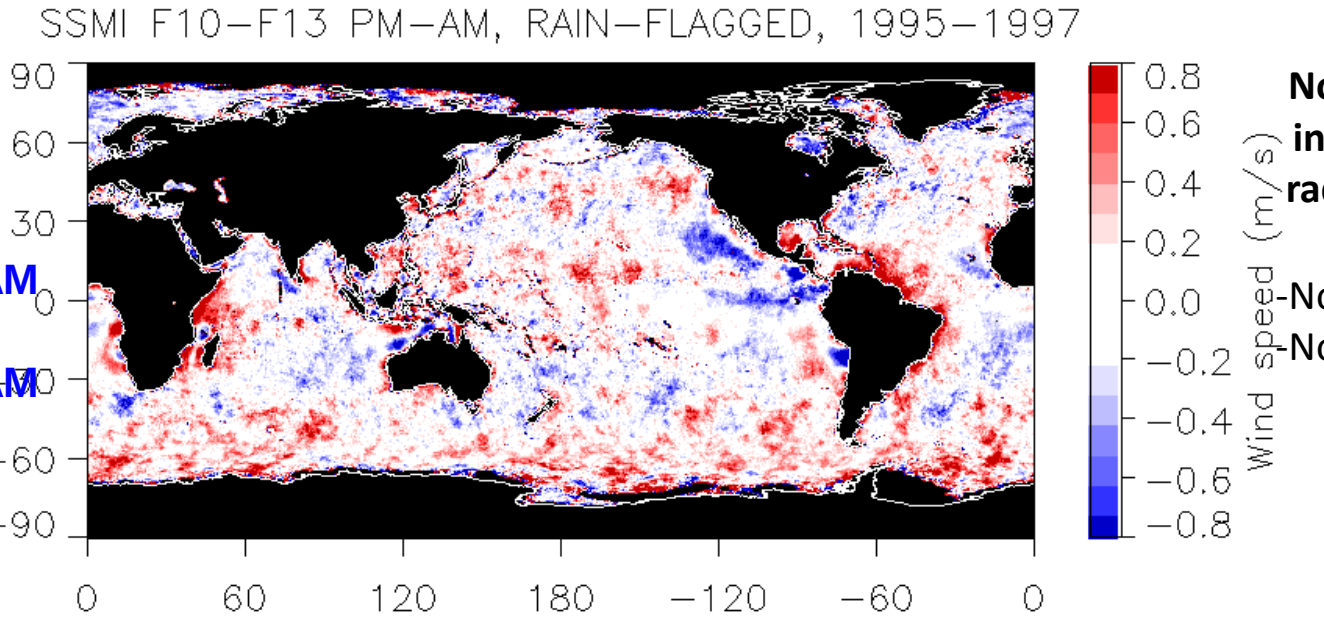


Are these really a diurnal signal? Not present in the SSMI radiometers

Radiometers

SSMI F10 PM-AM
MINUS
SSMI F13 PM-AM

Observing time (LT)
F10: 10
F13: 6

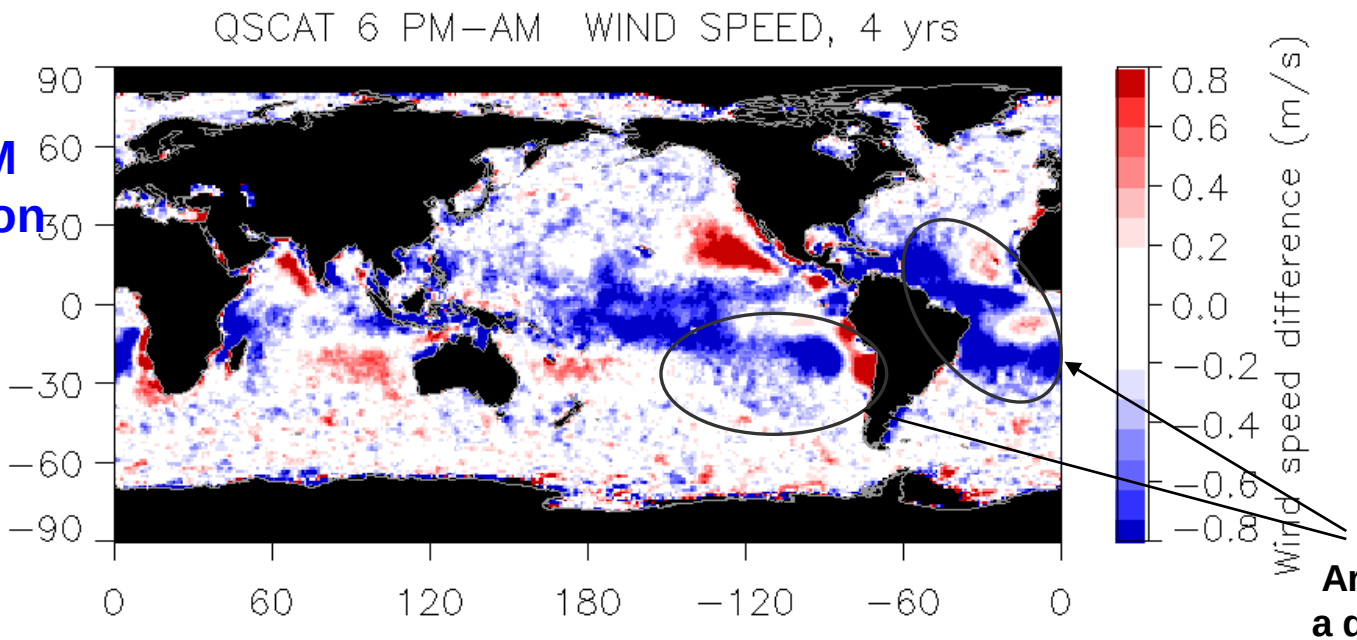


-Not rain
-Not scan edge

6 PM-AM Verification

QSCAT

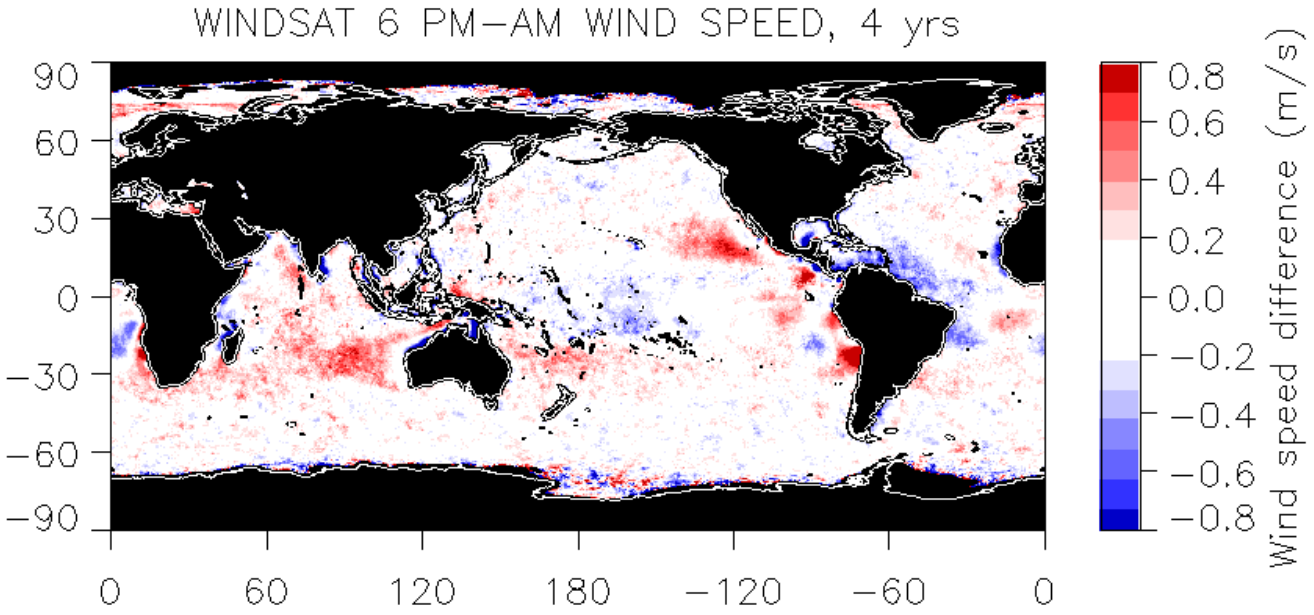
6 pm-am



Are these really a diurnal signal? Not present in WindSat radiometer

WindSat

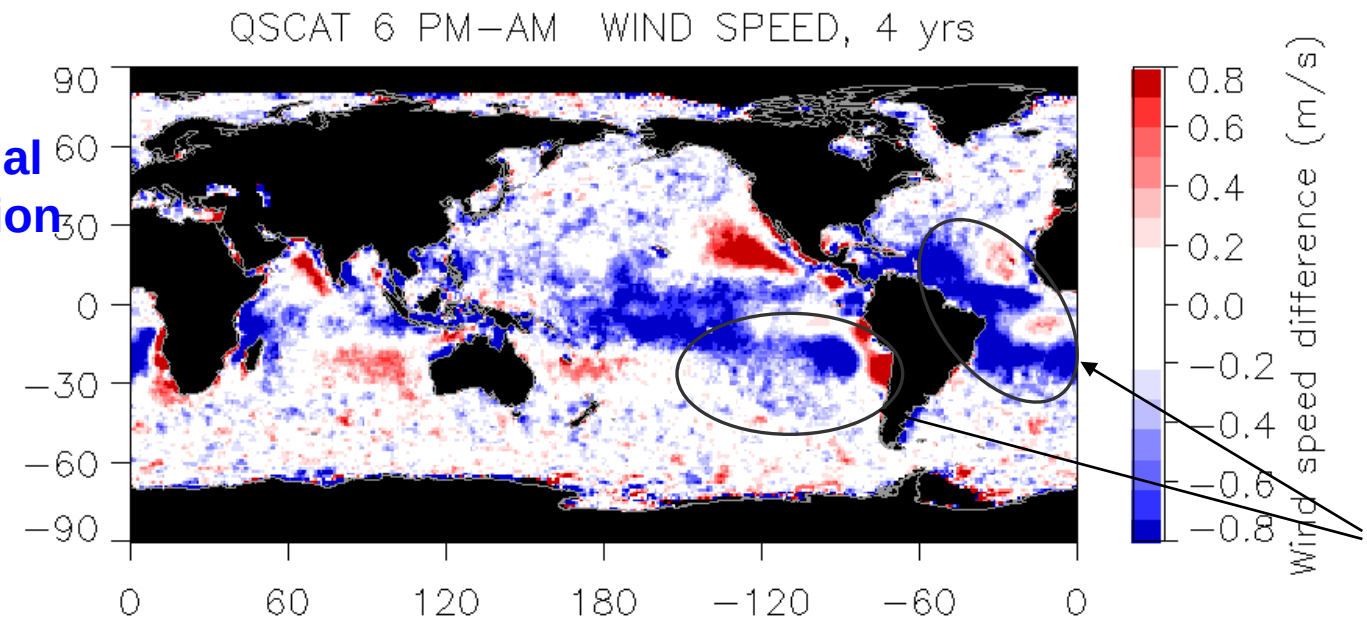
6 pm-am



Additional Verification

QSCAT

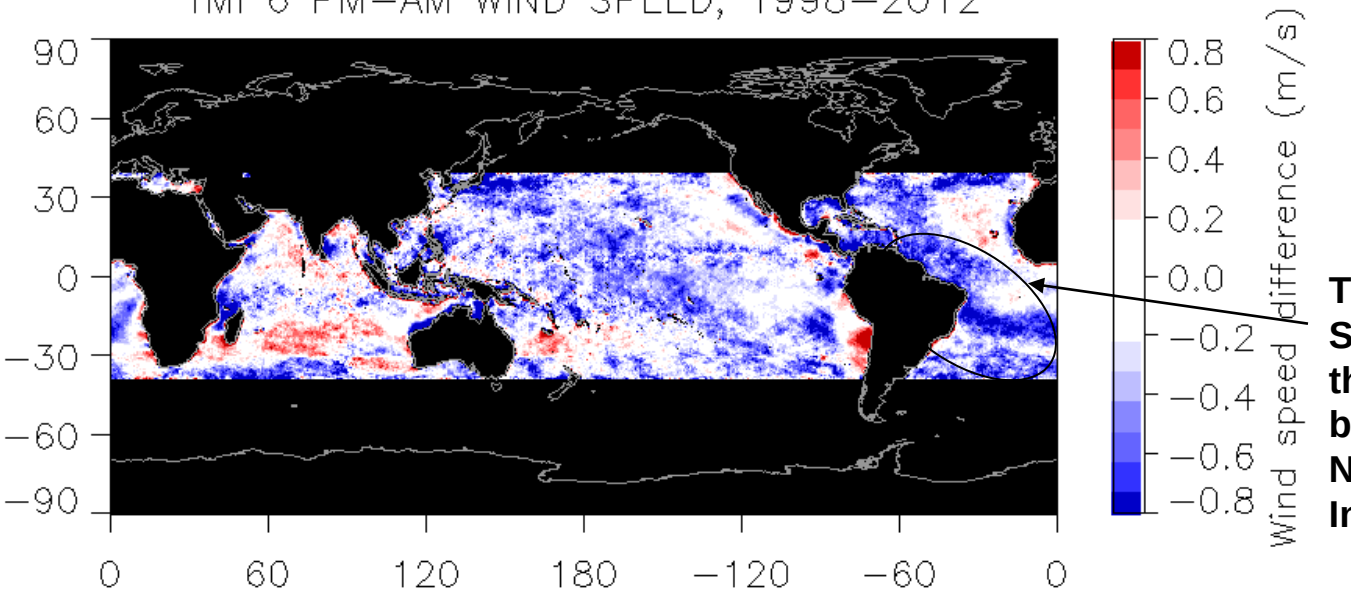
6 pm-am



Is this really a diurnal signal?

TMI

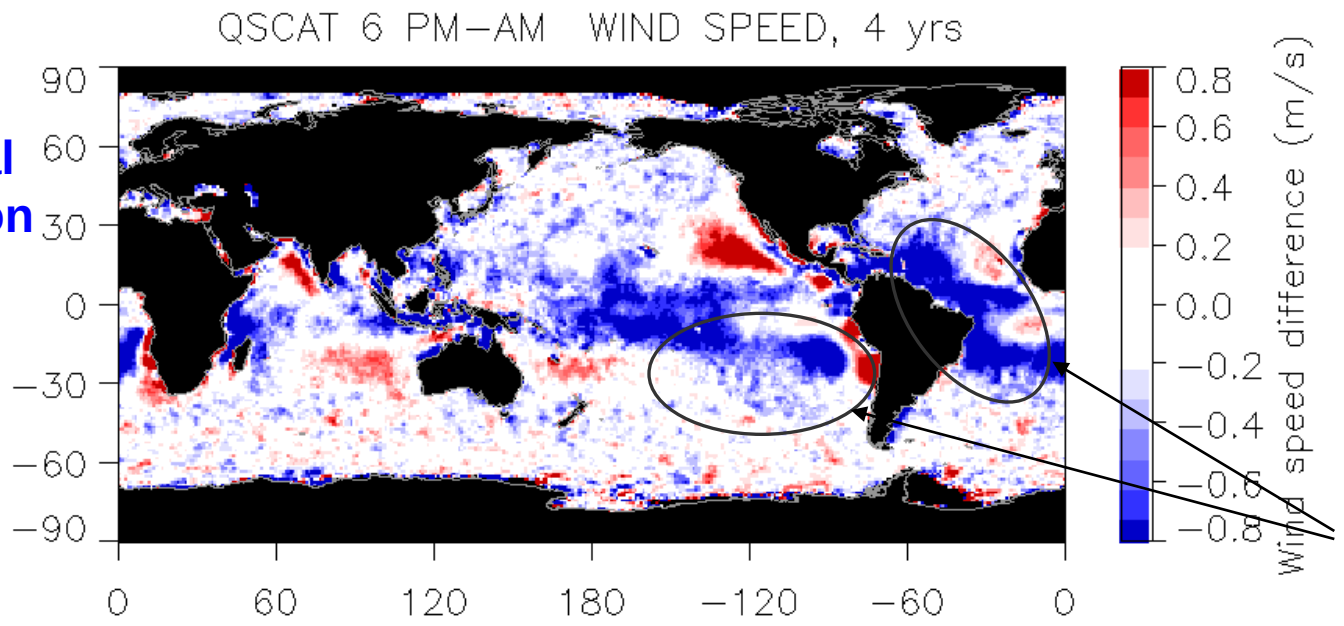
6 pm-am



TMI shows a Some signal in the Atlantic, but weaker. No much signal In Pacific

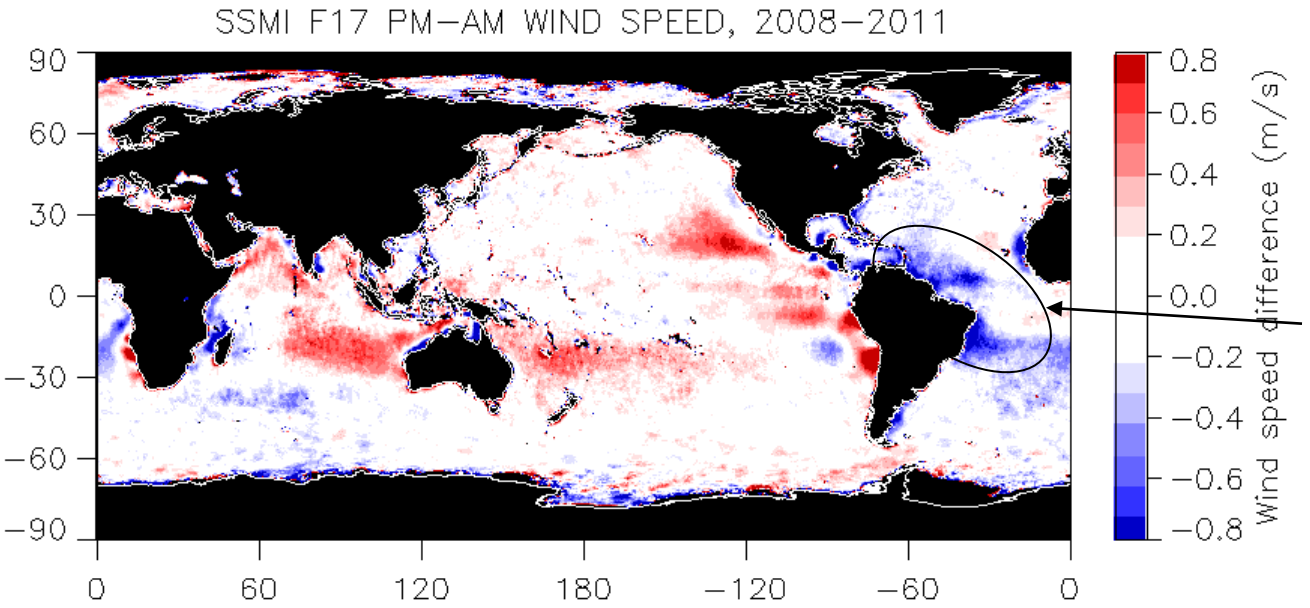
Additional Verification

QSCAT
6 pm-am



Is this really a diurnal signal?

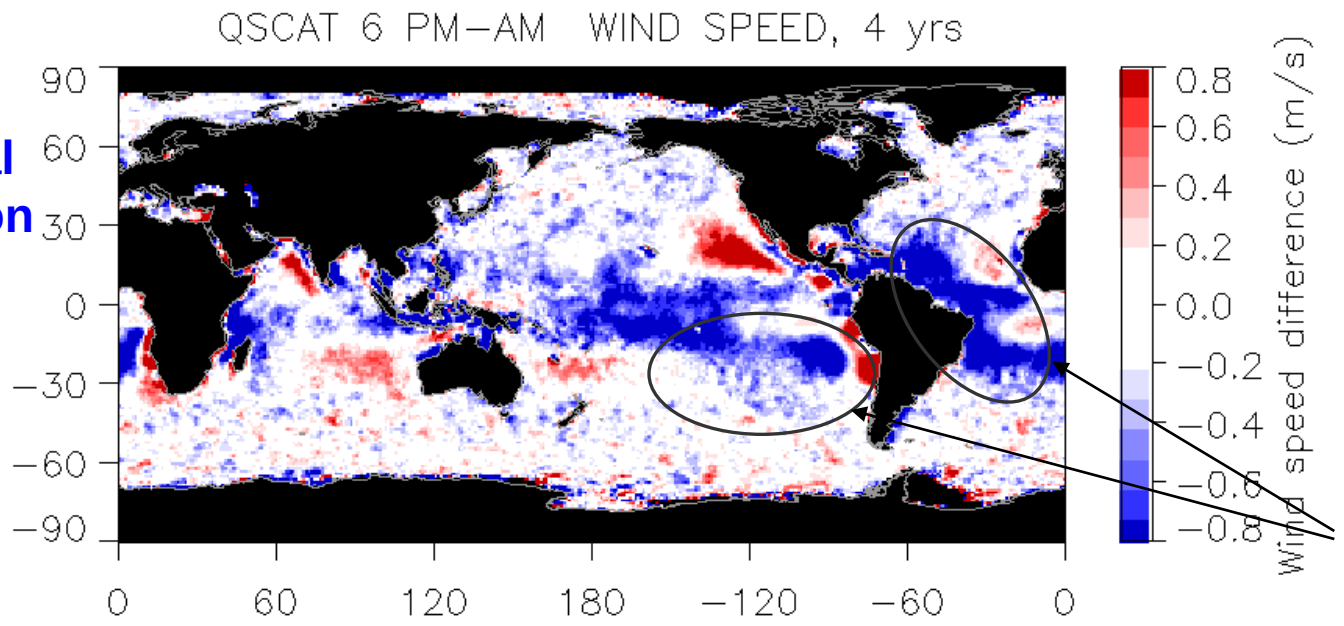
SSMI F17
6 pm-am



F17 shows a Some signal in the Atlantic, but weaker.

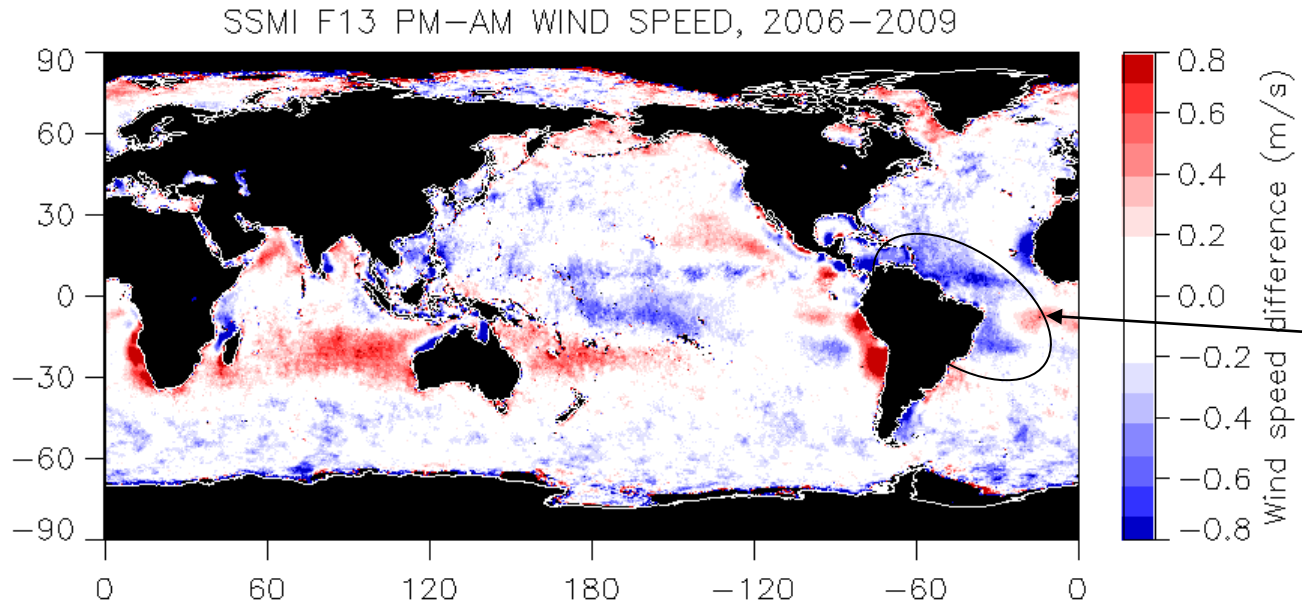
No signal in Pacific

Additional Verification



QSCAT:
6 pm-am

Is this really a diurnal signal?



SSMI F13
6 pm-am

F13 shows a Some signal in the Atlantic, but weaker.

Very weak signal in EQ Pacific

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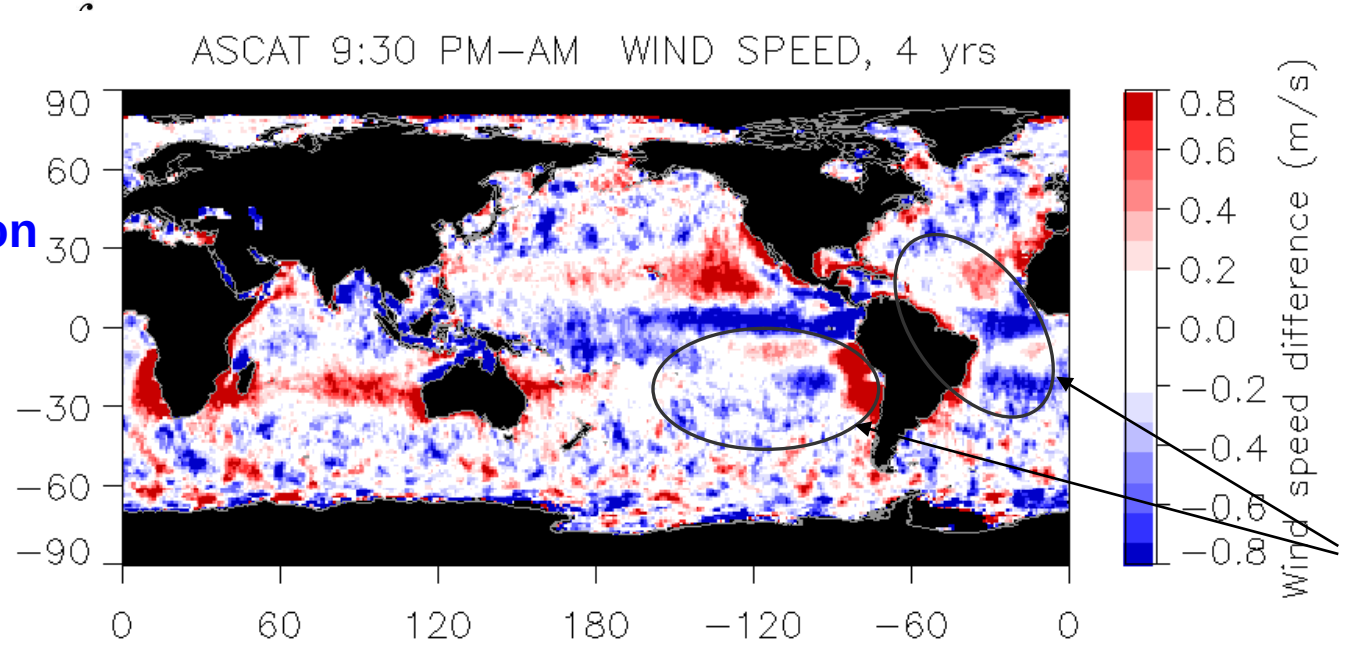
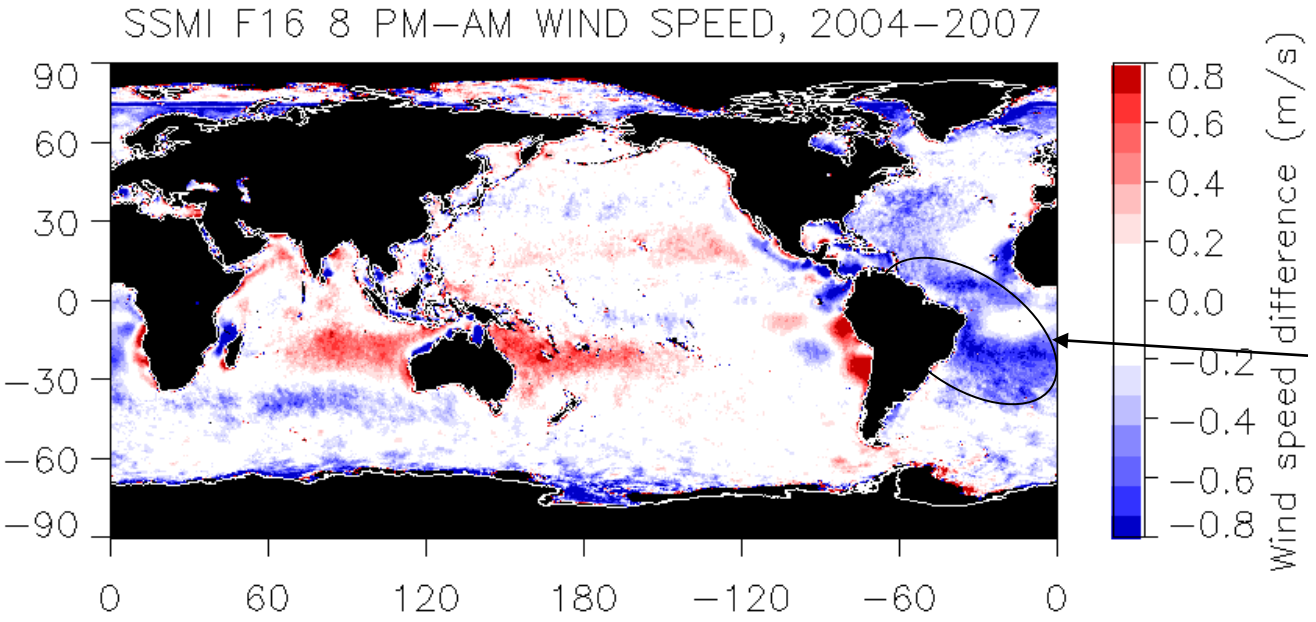
9 PM-AM Verification

ASCAT
9:30 pm-am



Is this really a diurnal signal?

SSMI F16
8pm-am



Good signal in the Atlantic F16, nothing In Pacific

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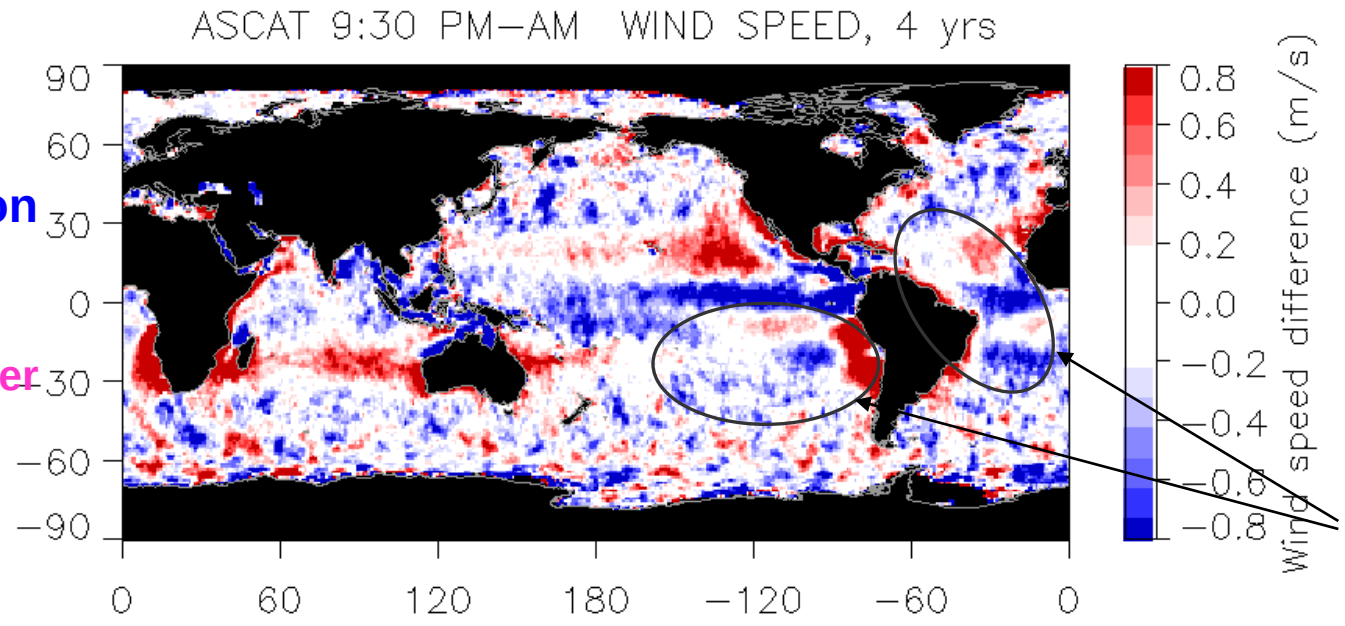
9 PM-AM Verification

Scatterometer

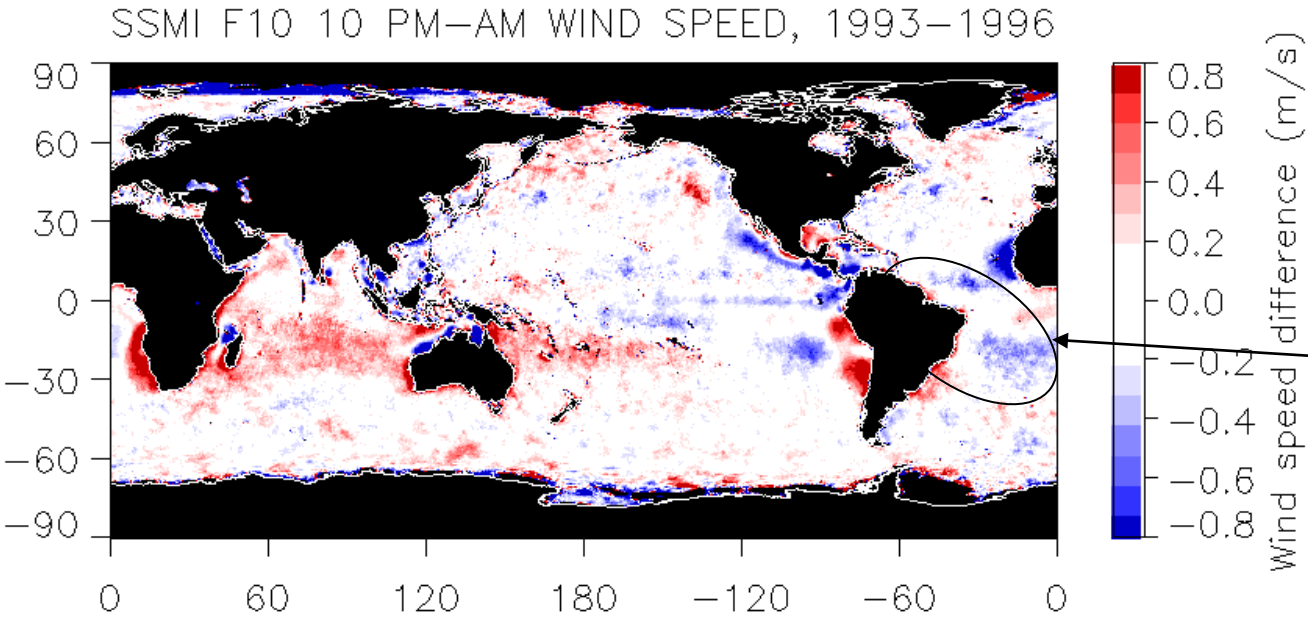
ASCAT:
9:30 pm-am



Is this really a diurnal signal?

Radiometer

SSMI F10:
10pm-am

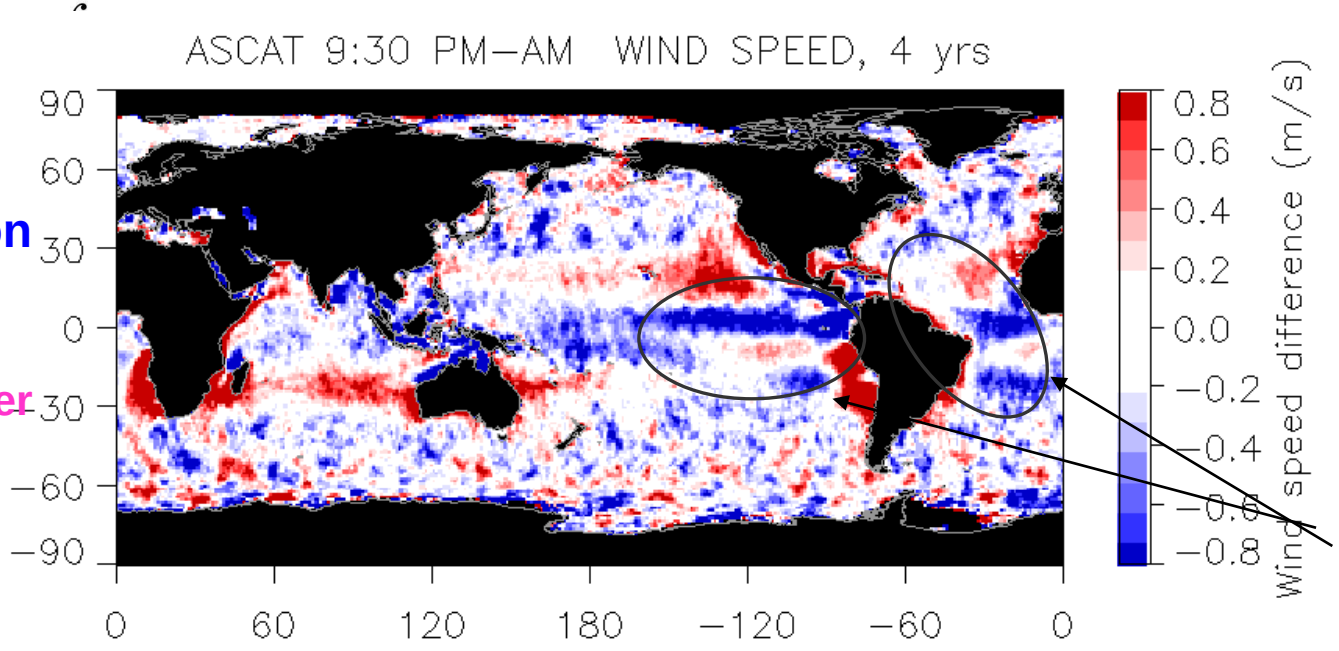


F08 shows a Some signal in the Atlantic, but weaker.

9 PM-AM Verification

Scatterometer

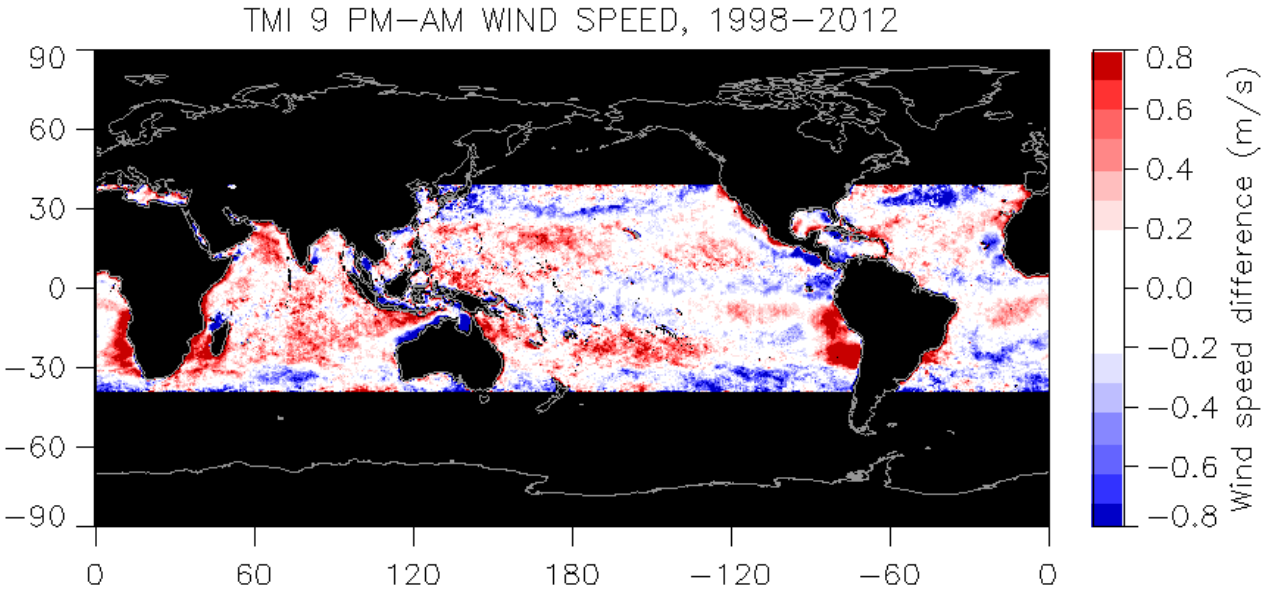
ASCAT:
9:30 pm-am



Is this really a diurnal signal?

Radiometer

TMI:
9 pm-am



Not much in TMI at 9pm-am !

A QUICK LOOK AT THE REANALYSES

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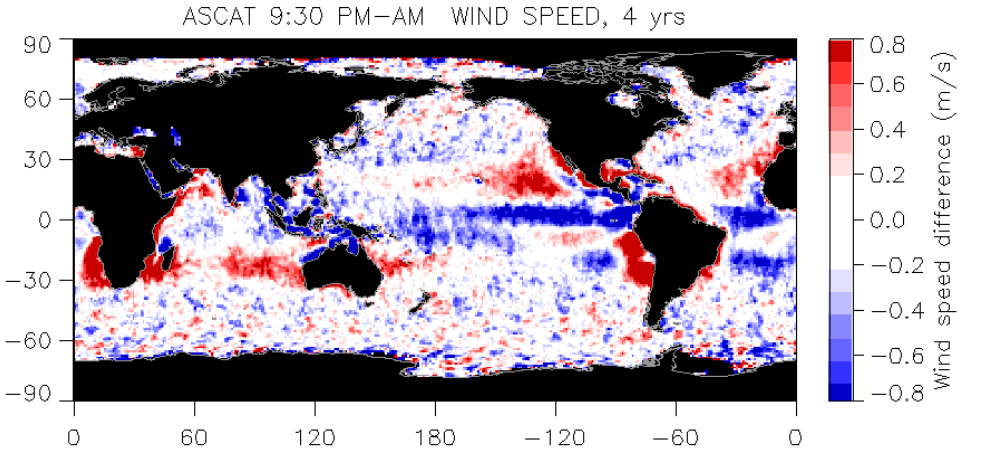
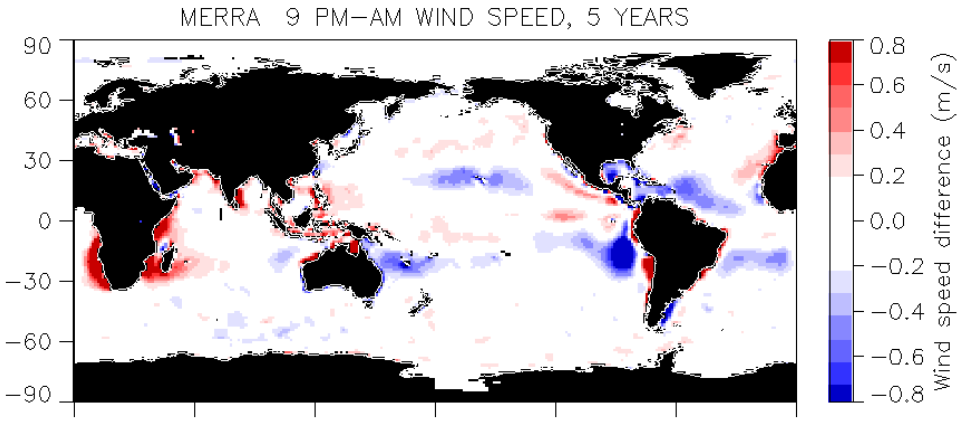
ASCAT

9:30 pm-am



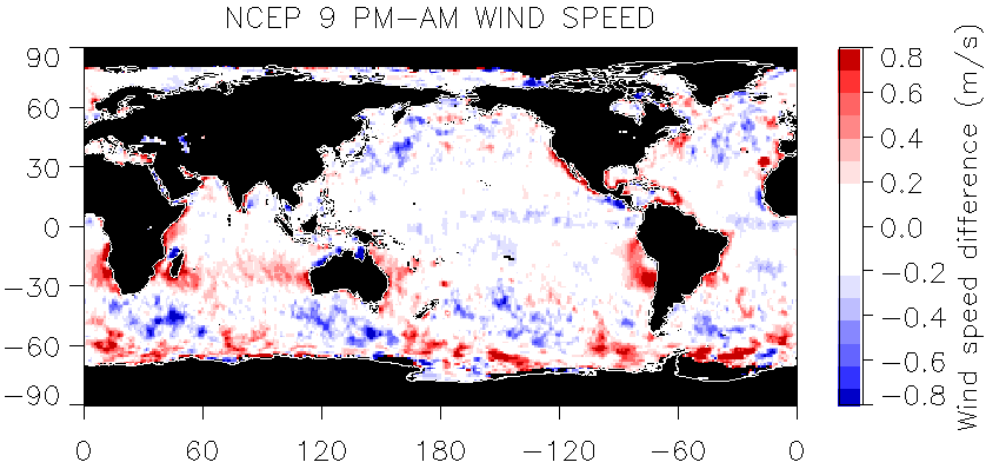
MERRA

9 pm-am



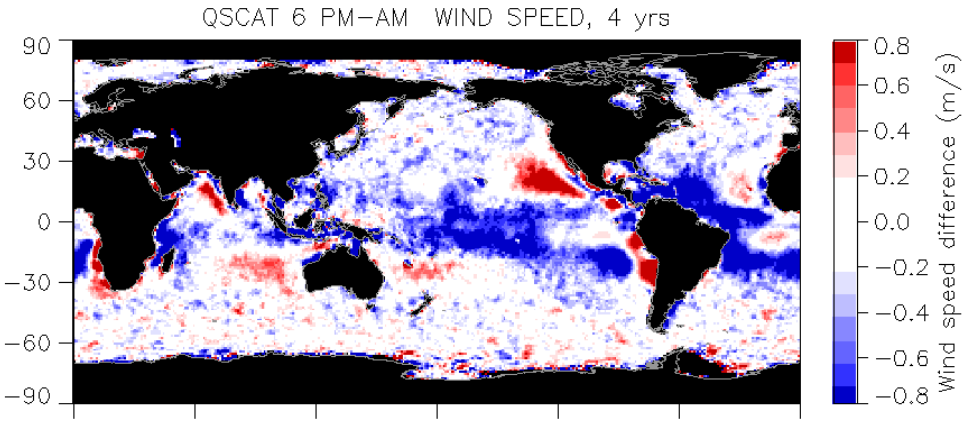
NCEP

9 pm-am



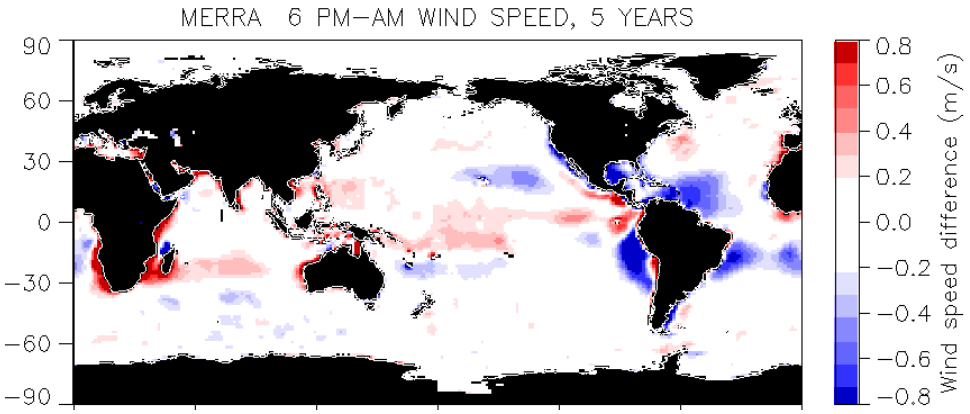
QSCAT

6 pm-am



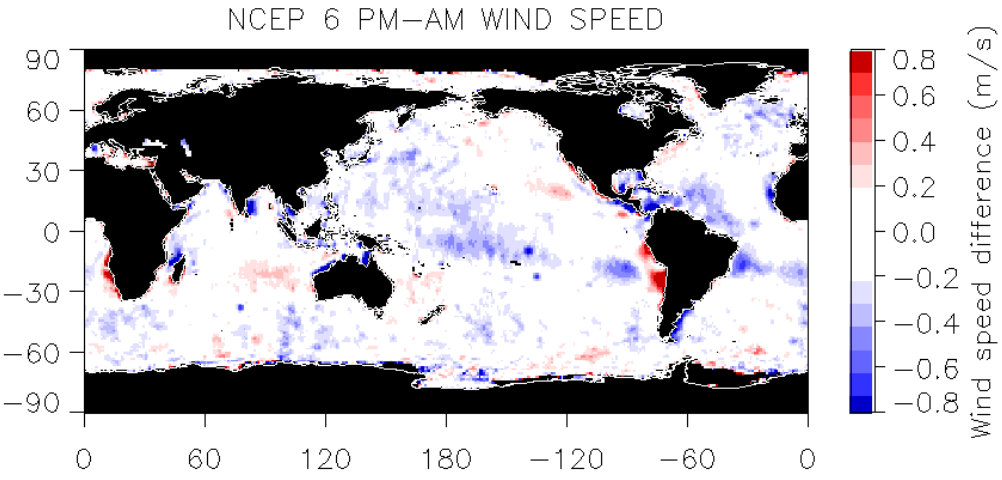
MERRA

6 pm-am

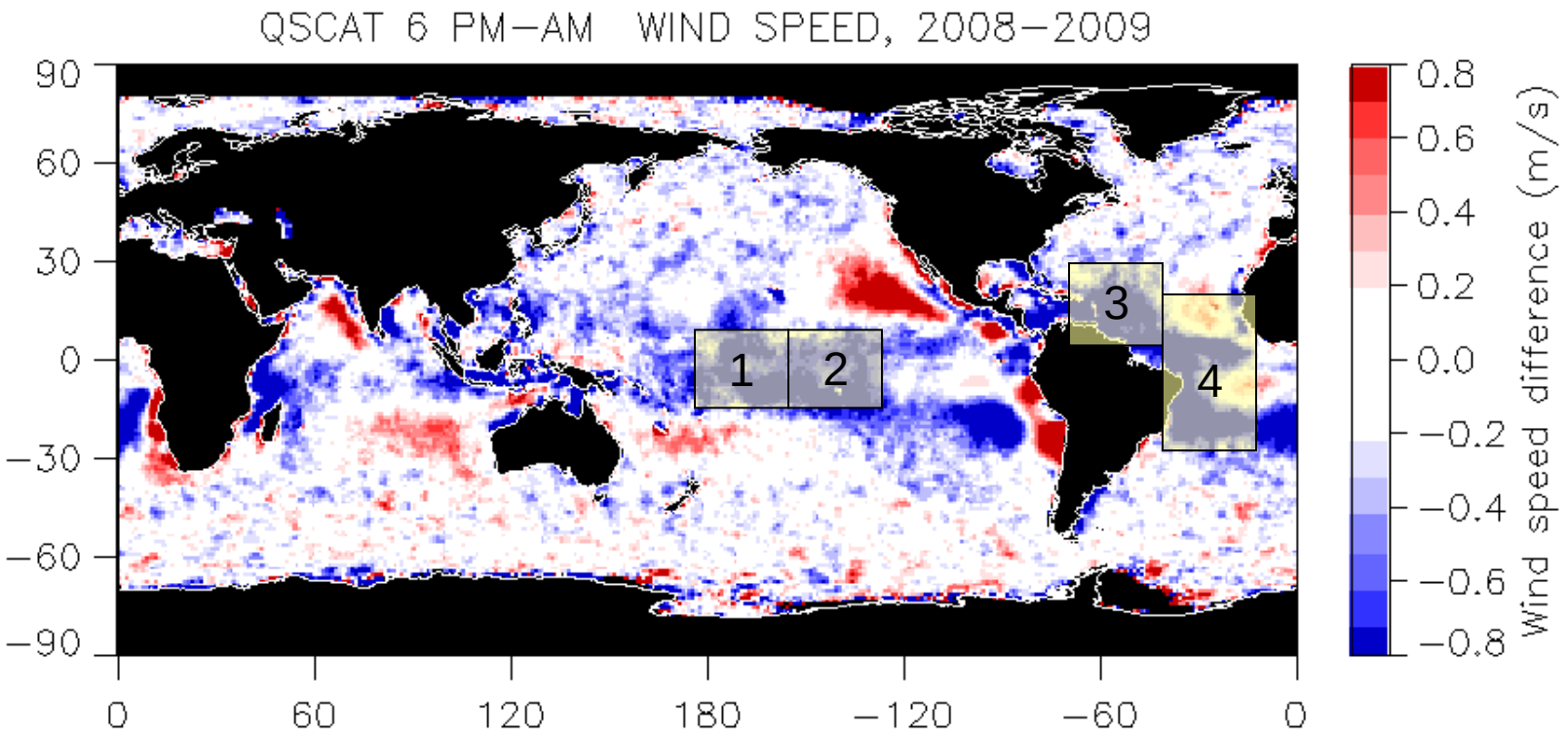


NCEP

6 pm-am

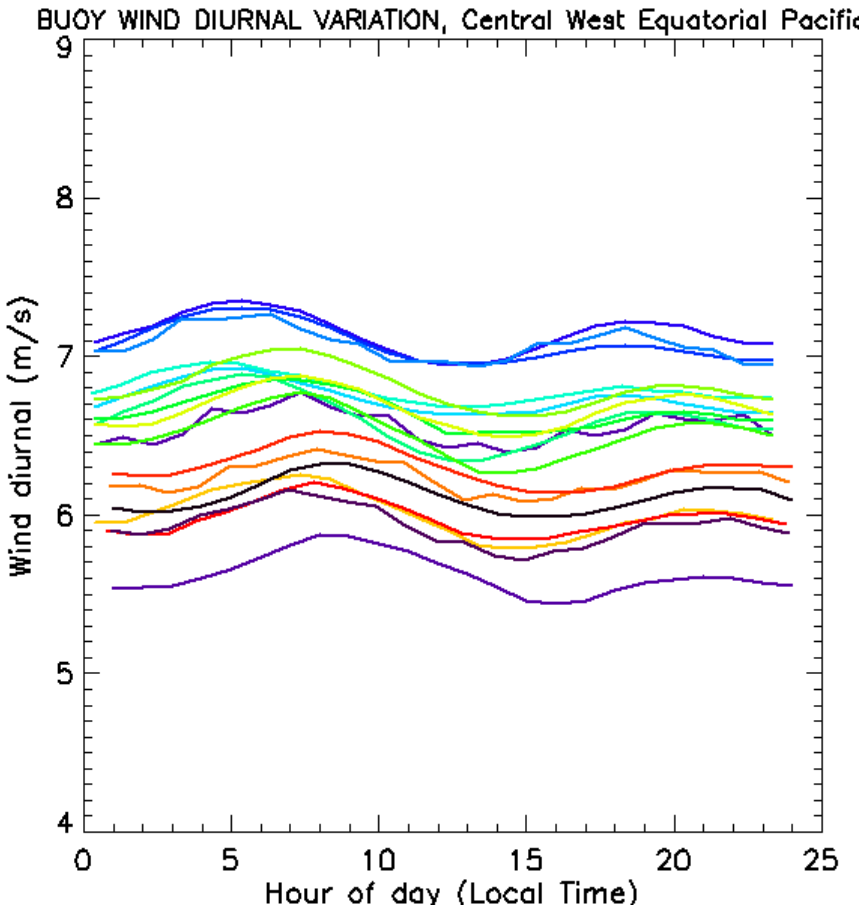


Comparison with buoys
Focus on 4 selected regions

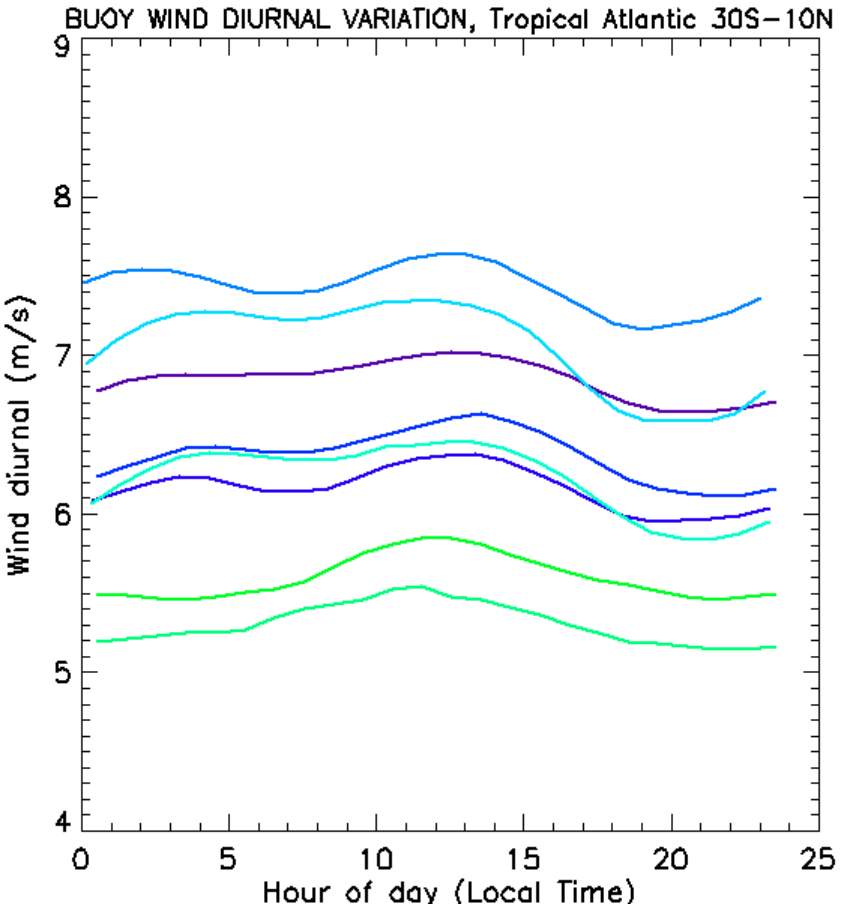


1= Central W EQ Pacific
2= Central E EQ Pacific
3= Caribbean
4= Tropical Atlantic

PACIFIC BUOYS, 15S-5N

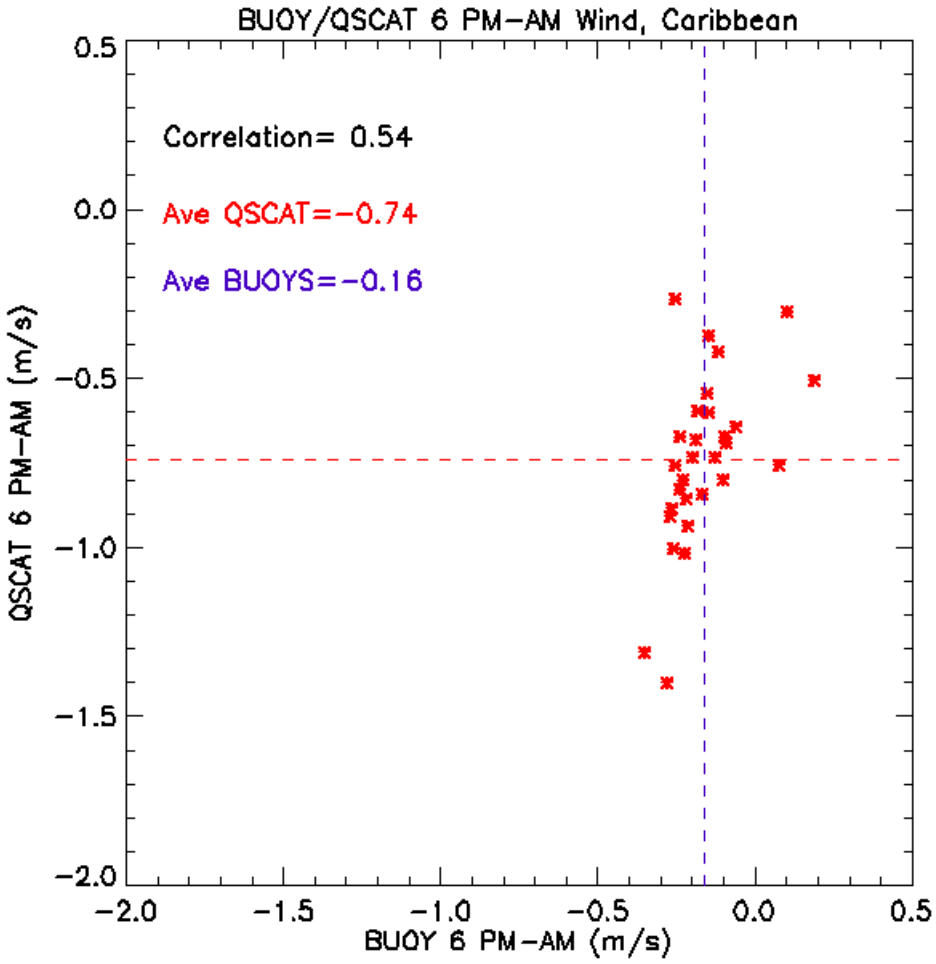


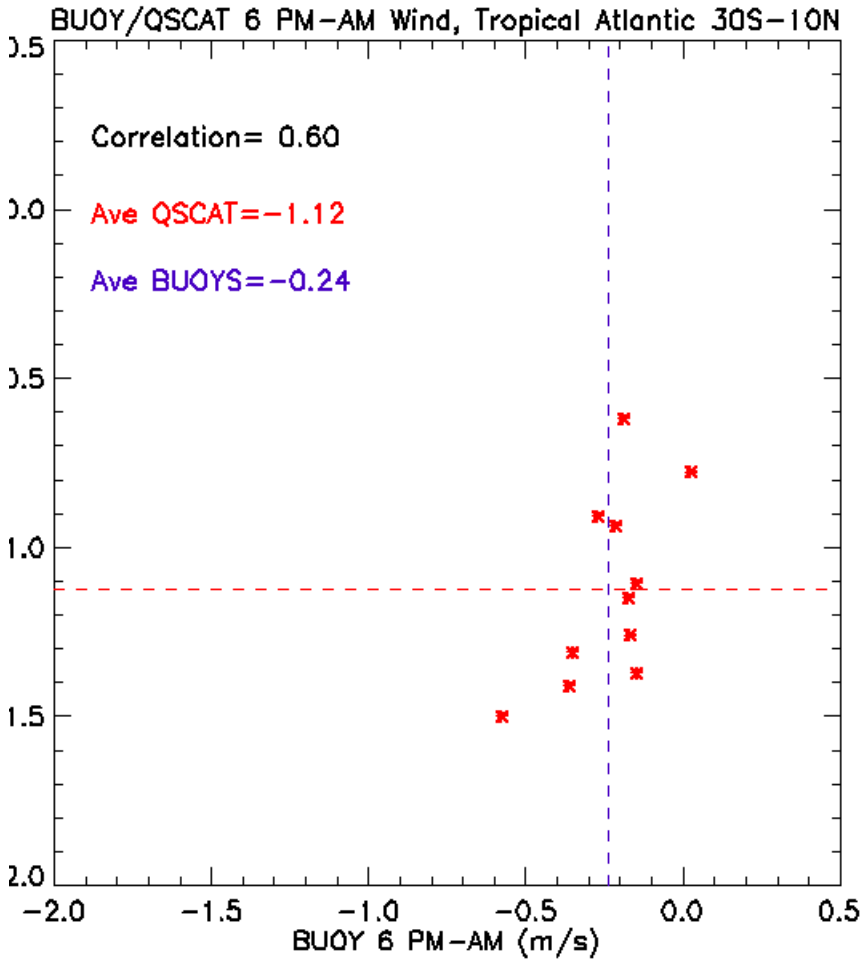
ATLANTIC BUOYS, 30S-10N



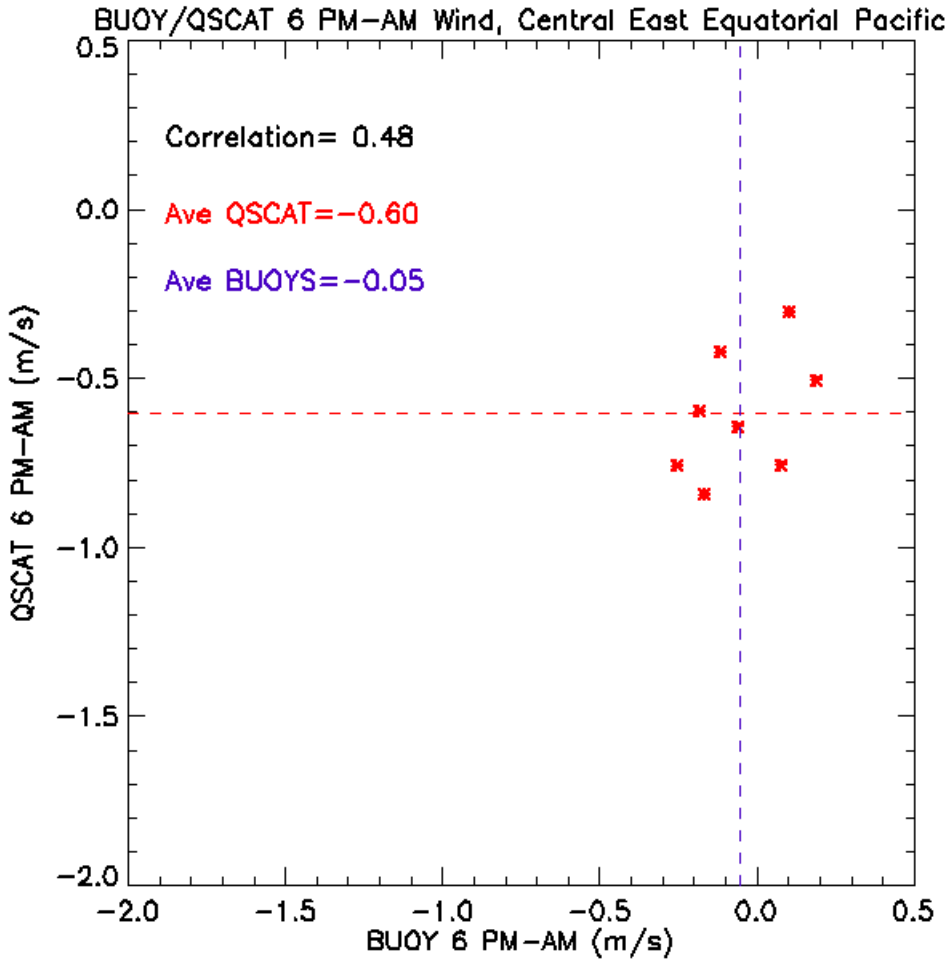
- The diurnal variations in the selected regions are consistent among buoys.
- There is a prominent semi-diurnal component, due to atmospheric thermal tides
- Itneresting paper about wind diurnal/semidiurnal: Ueyama and Deser, J. Climate, 2008.

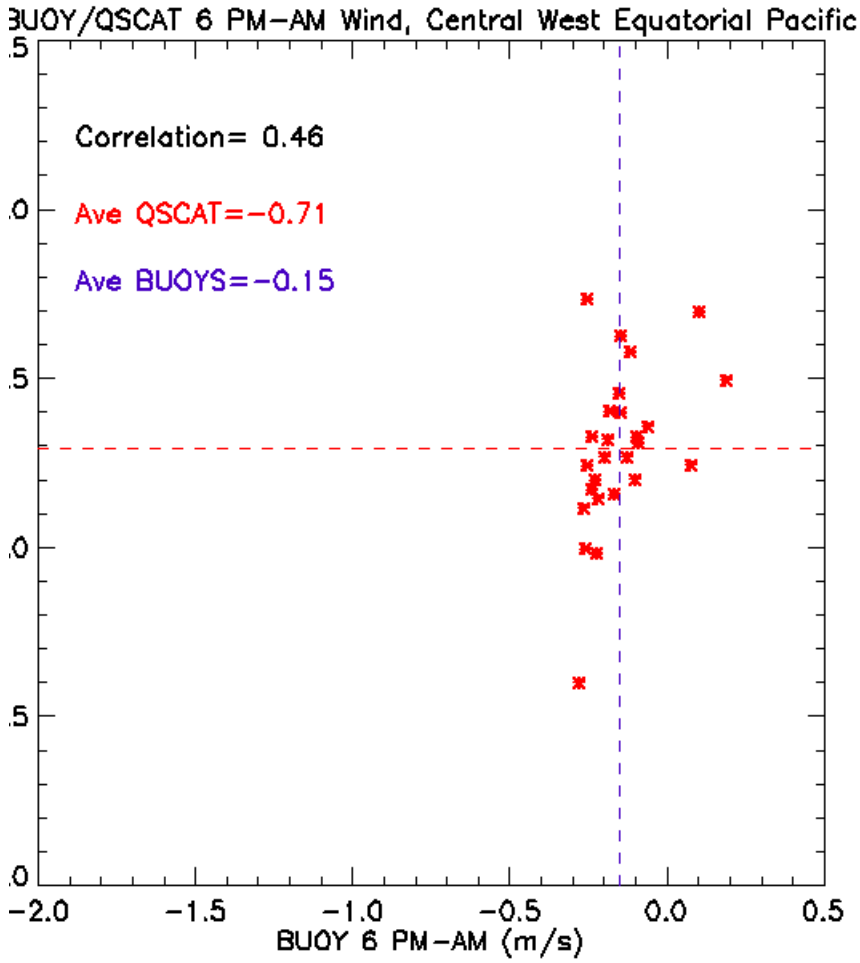
ATLANTIC BUOYS





EQUATORIAL PACIFIC BUOYS





Summary and Conclusions:

- Long term goal: integrate observations from multiple scatterometers into a Climate Data Record (CDR).

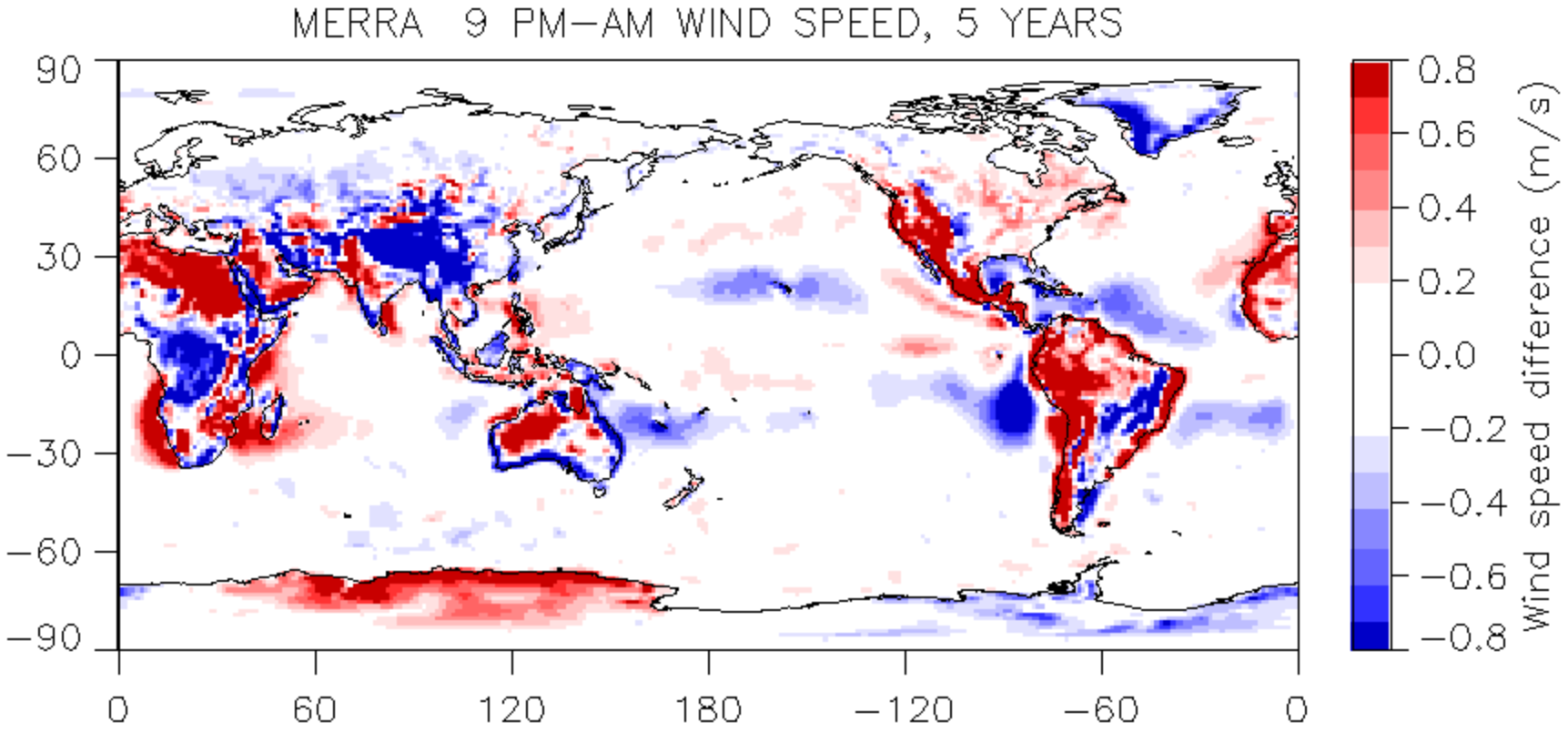
- Diurnal variability of the ocean surface winds needs to be removed from the ASCAT and QuikSCAT data before integrating them in a CDR. As of today, there is some uncertainty in the amplitude/phase of the diurnal.

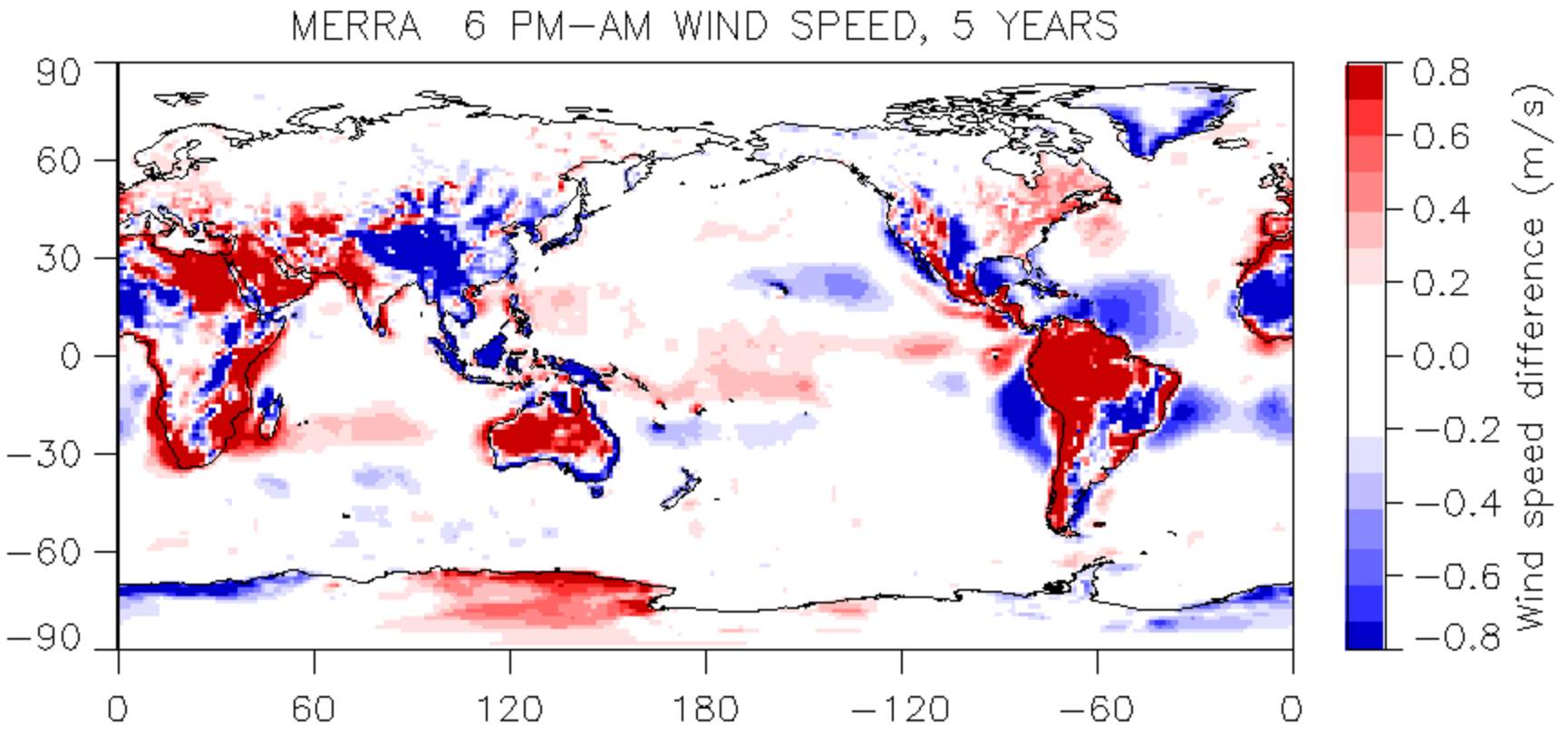
- Most of the PM-AM signals in the scatterometers are present in the radiometers (mostly at the ocean boundaries), except for some large signals in the open Pacific and Atlantic. Are these real or spurious? Buoys show weaker signals.

- A complete understanding of the diurnal cycle will be achieved with RapidSCAT (2014).

EXTRA SLIDES

Here we can see the effect of land on diurnal variations over the ocean, notice S Africa and S America




MERRA 6 PM–AM WIND SPEED, 5 YEARS
90
60
30
0
−30
−60
−90
0
60
120
180
−120
−60
0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
Wind speed difference (m/s)