Including ASCAT in OAFlux Global Vector Wind Analysis (1987 – present)

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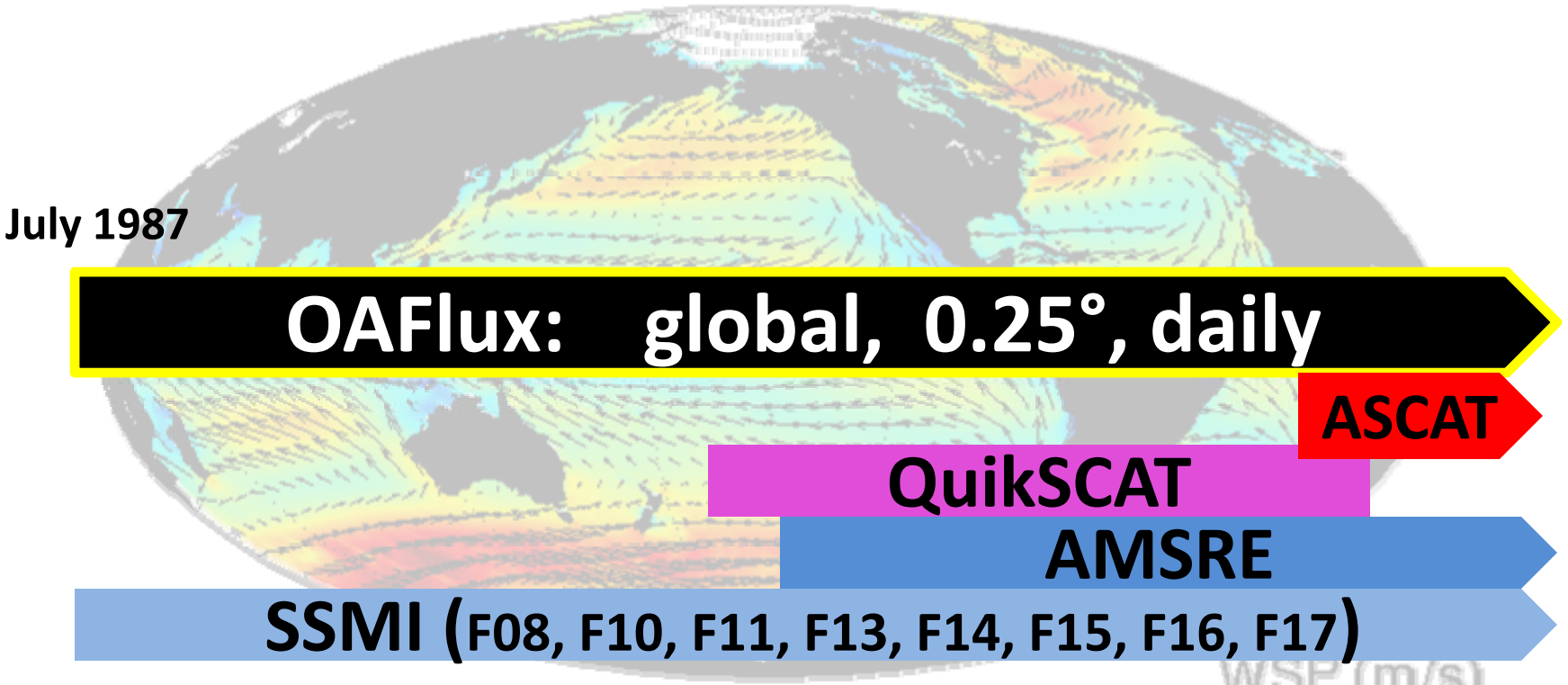
with programming support from Dr. Xiangze Jin

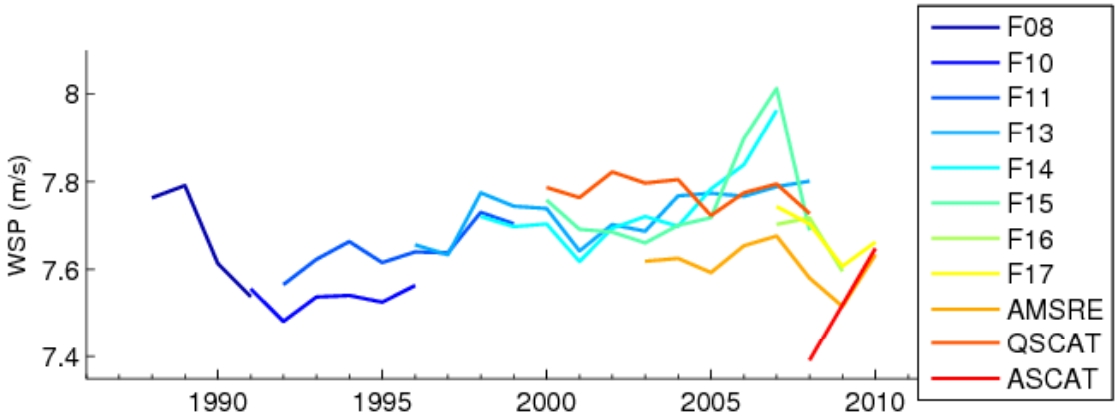


International ocean vector winds science team meeting, Annapolis. Maryland 9-11, 2011

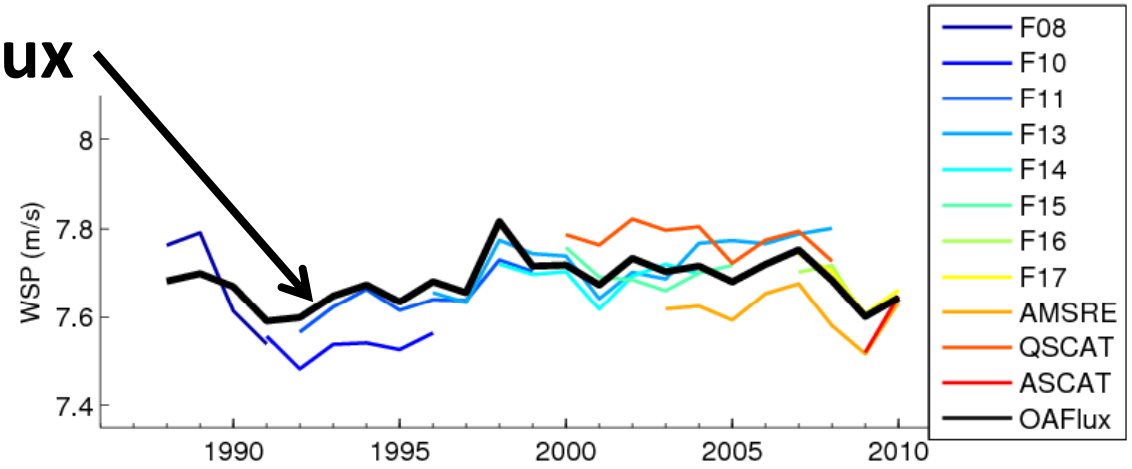
OAFlux Global Vector Wind Analysis

Aiming at a consistent ocean vector wind time series that best characterizes the ocean wind retrievals during the satellite era

Wind speed retrievals from radiometers and scatterometers



OAFlux



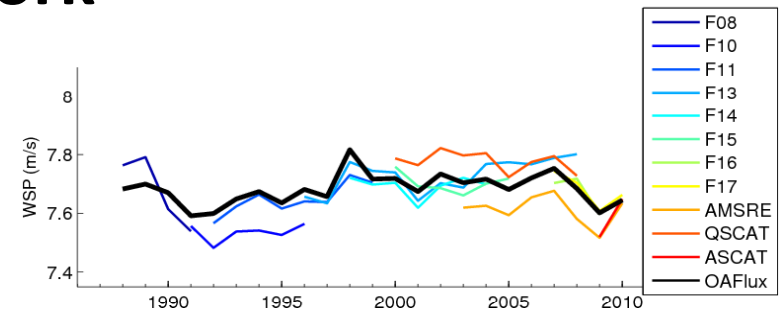
SSMI, AMSRE, and QuikSCAT are downloaded from http://www.ssmi.com

ASCAT is from http://podaac.jpl.nasa.gov

OAFlux synthesis framework

Reference:

Yu, L., and X. Jin, 2011: Satellite-based global ocean vector wind analysis: synergizing microwave radiometers and scatterometers.



Strategy:

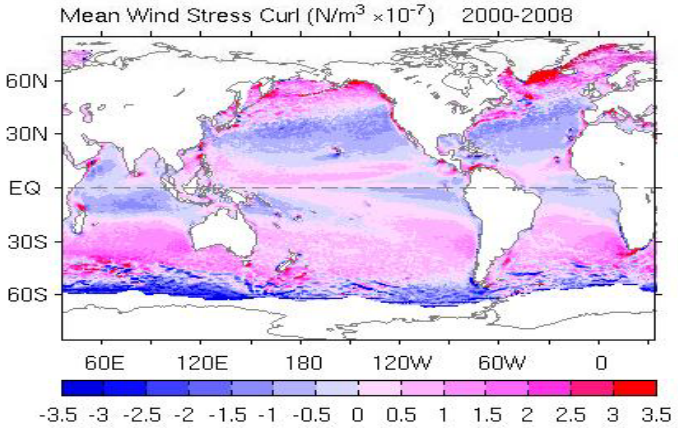
- NWP wind directions used as initial guess if scatteometers are not available.

Methodology:

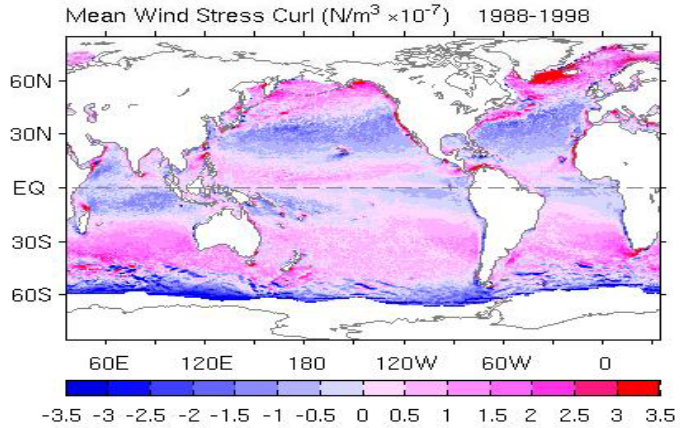
- Objectively analysis based on variational minimization method (data assimilation approach)
- Cost function for the objective analysis:

$$F = \sum_k \alpha_k (u_{ana} - u_{o,k})^2 + \sum_k \alpha_k (v_{ana} - v_{o,k})^2 + \sum_m \beta_m (\sqrt{u_{ana}^2 + v_{ana}^2} - w_{o,m})^2 + Dyn(vort, div)$$

QuikSCAT (2000 – 2008)



Before QuikSCAT (1988-1998)

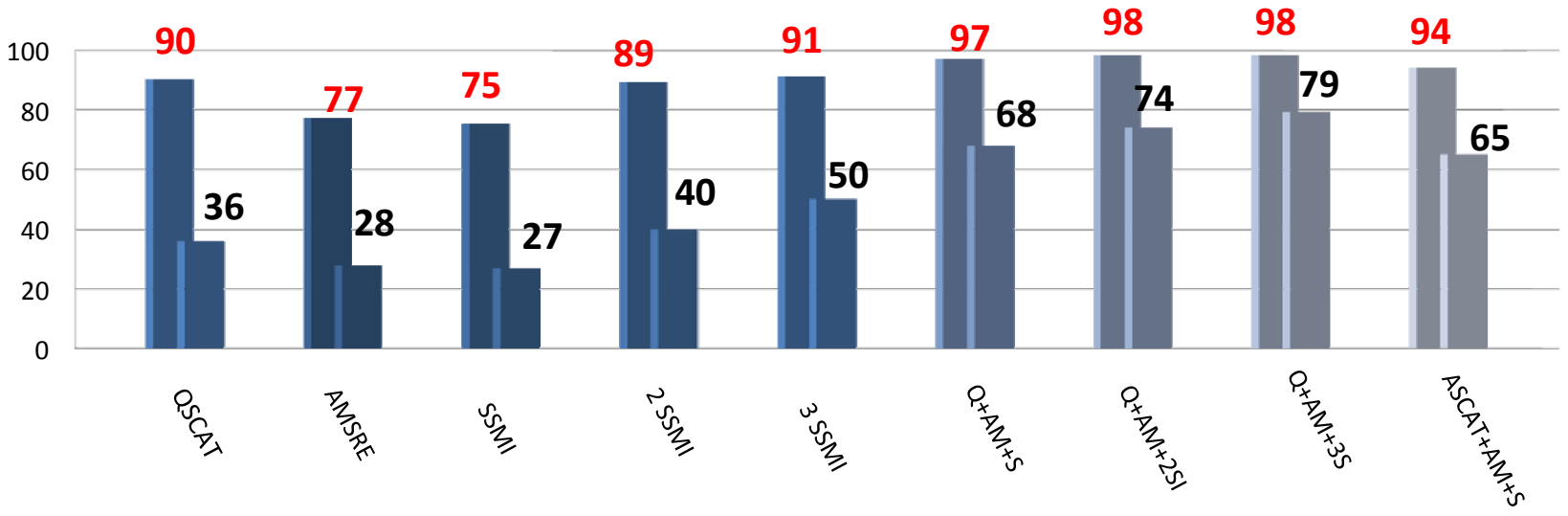


Why daily?

Daily resolution is chosen to ensure maximum satellite coverage on daily basis

→ stability of the time series for climate analysis.

Global coverage: Daily versus 6-hourly

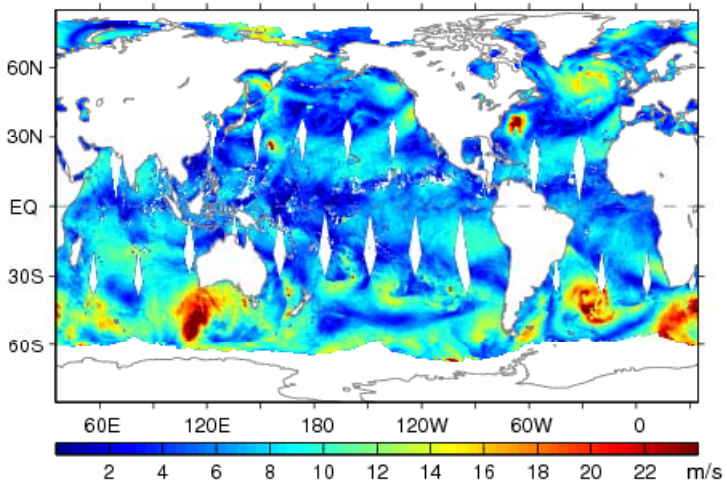


Constructing daily wind fields: QuikSCAT vs ASCAT

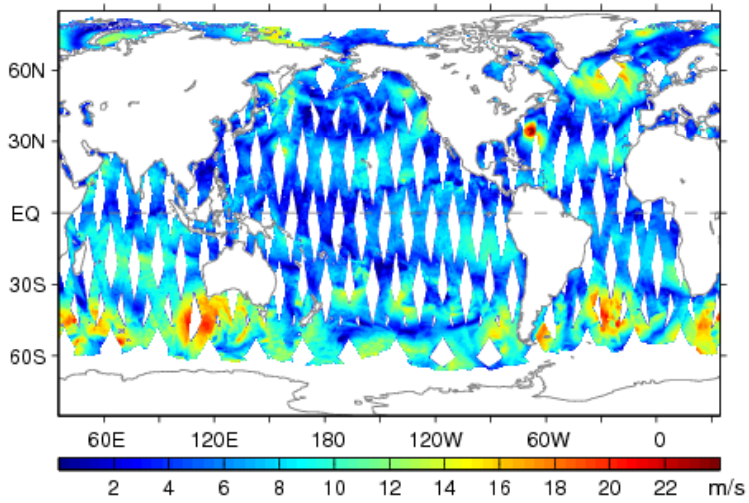
08/22/2009
Daily mean

Retrievals

QuikSCAT (85% coverage)

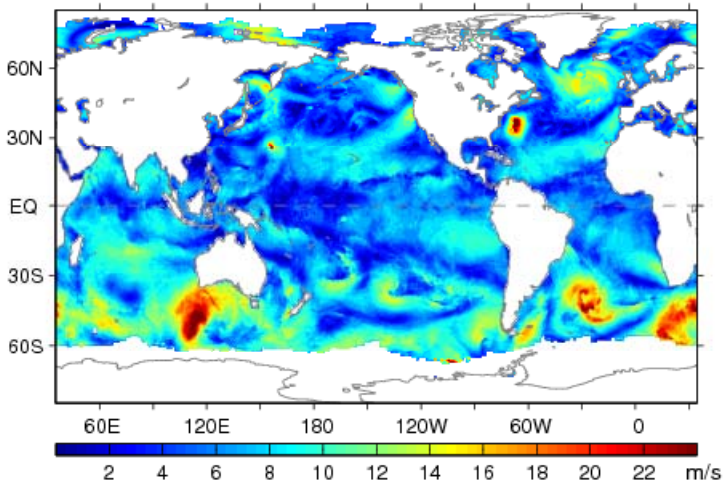


ASCAT (65% coverage)

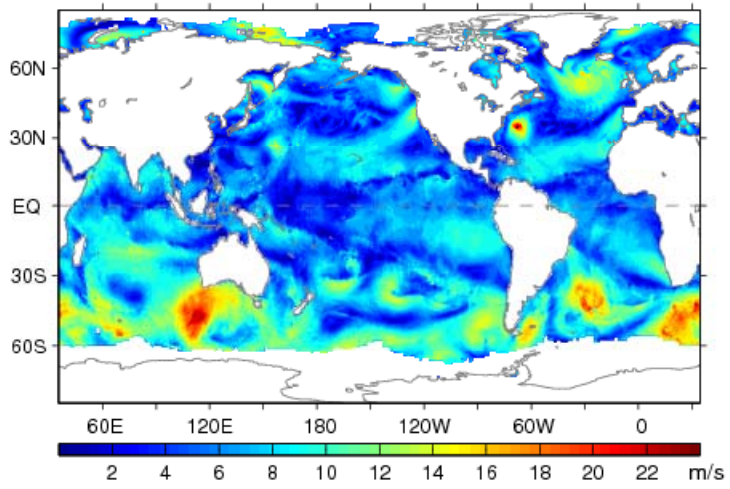


OAFlux synthesis

OAFlux (**QuikSCAT** + SSMI+AMSRE)

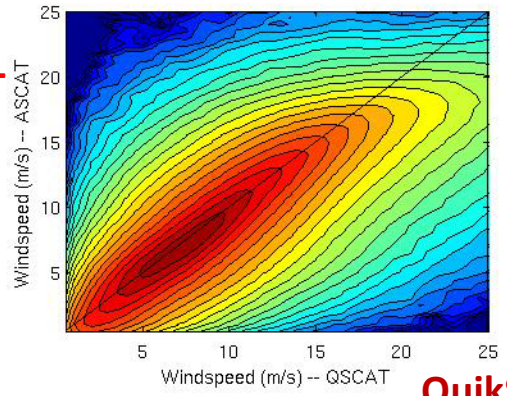


OAFlux (**ASCAT** +SSMI+AMSRE)



ASCAT versus QuikSCAT:

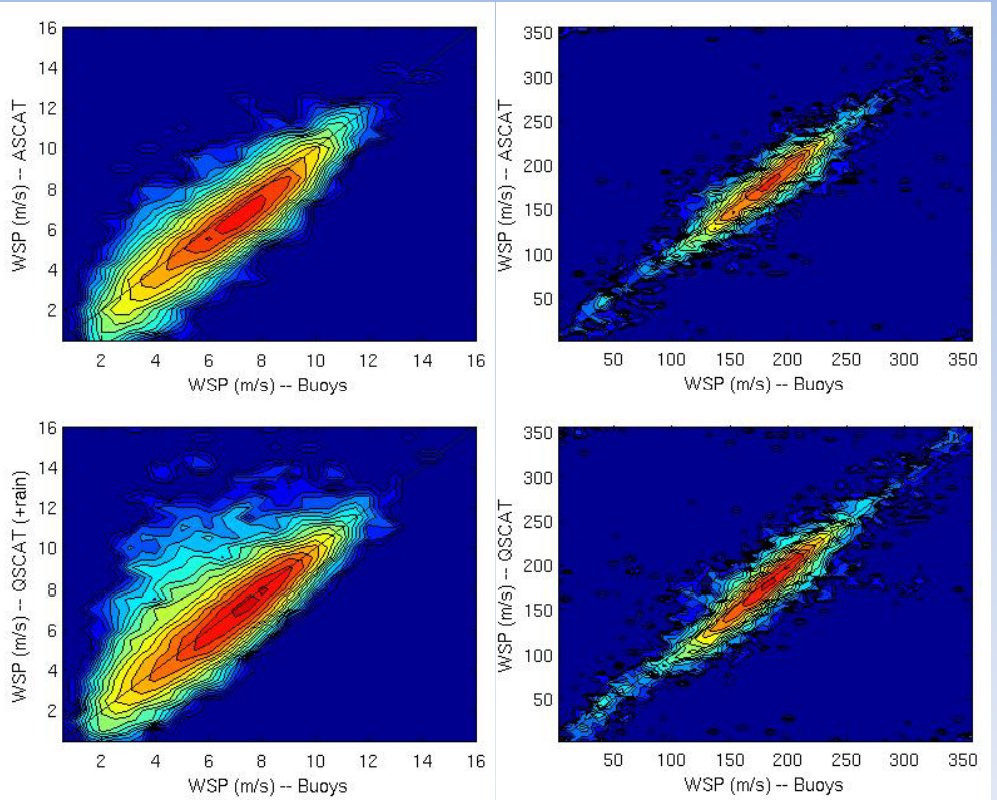
ASCAT are weaker,
particularly at high winds



Global collocation
2008

Comparison with buoys

wind speed **wind direction**



ASCAT vs Buoys

Total 9174 pairs (2008)

DIFF(WSP) = - 0.37 m/s
STD (WSP) = 1.03 m/s
DIFF(DIR) = -2.79 deg
STD (DIR) = 26.86 deg

QSCAT vs Buoys

Total 12759 pairs (2008)

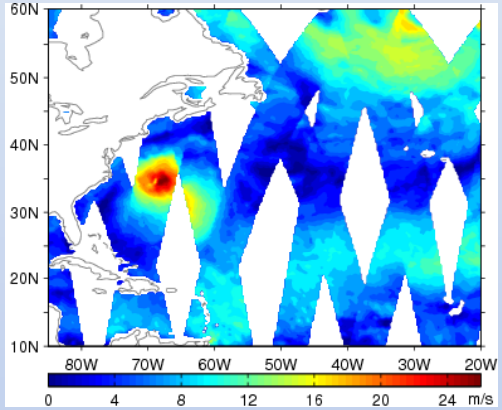
DIFF(WSP) = 0.08 m/s
STD (WSP) = 1.25 m/s
DIFF(DIR) = -2.97 deg
STD (DIR) = 27.54 deg

DIFF = Satellite – Buoys

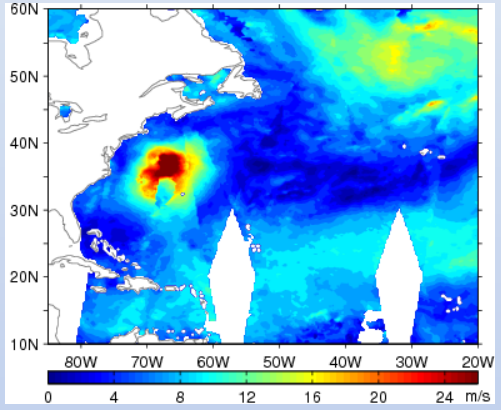
Buoys=RAMA +TAO +
PIRATA + WHOTS + KEO

A close look on Hurricane Bill: 8-22-2009

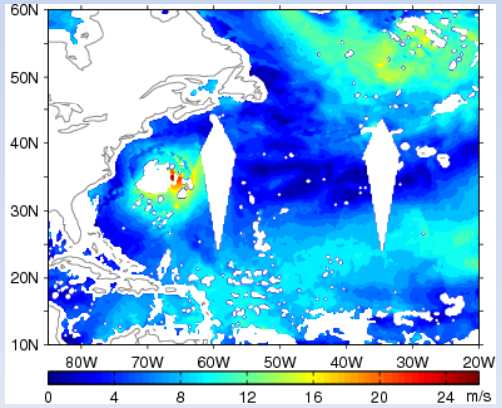
ASCAT
01:41 UTC (ascending)
14:02 UTC (descending) max=27m/s



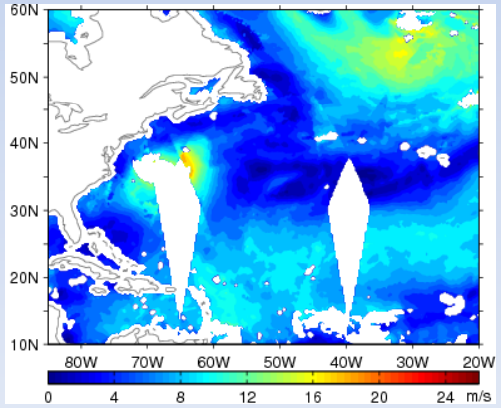
QuikSCAT
10: 36 UTC (ascending)
22:54 UTC (descending) max=50m/s



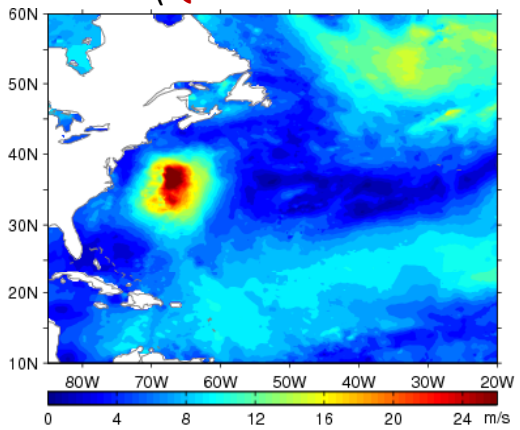
AMSRE
06:54 UTC (descending)
17:54 UTC (ascending)



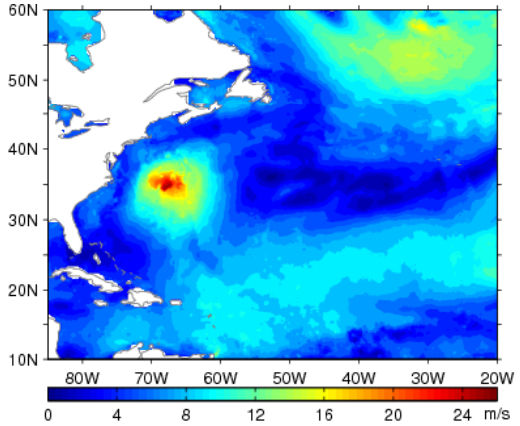
SSMI 17
11:00 UTC (descending)
20:42 UTC (ascending)



OAFlux (QSCAT + SSMI + AMSRE)



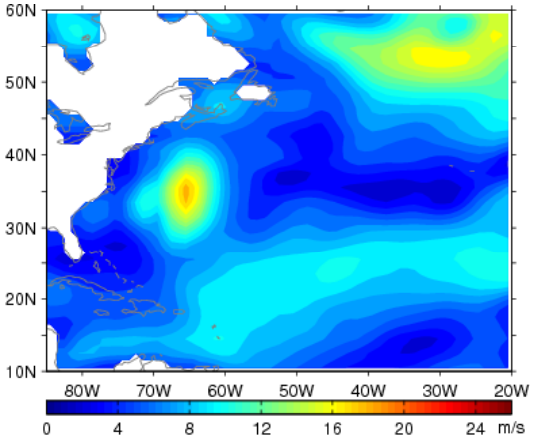
OAFlux (ASCAT + SSMI + AMSRE)



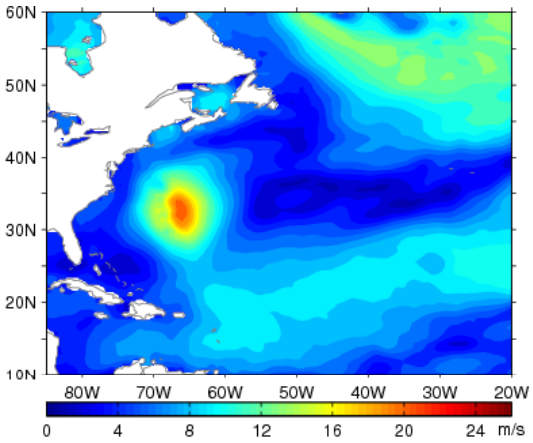
NWP fields vs OAFlux

NWP vectors are used as initial conditions when there is no scatterometer observation.

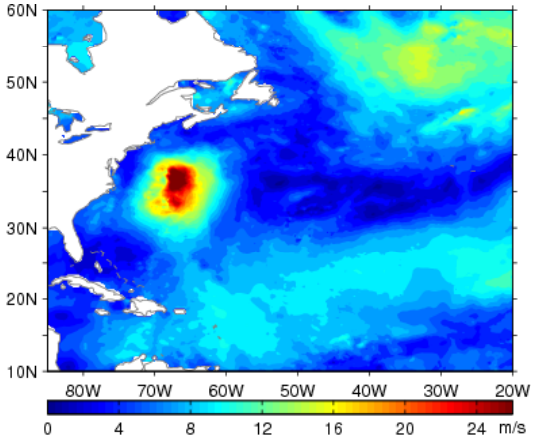
NCEP

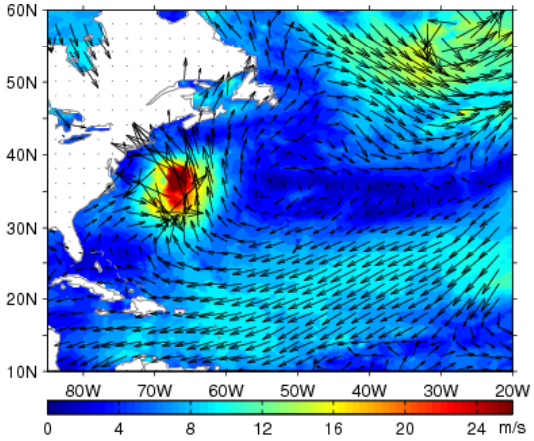


ERA interim

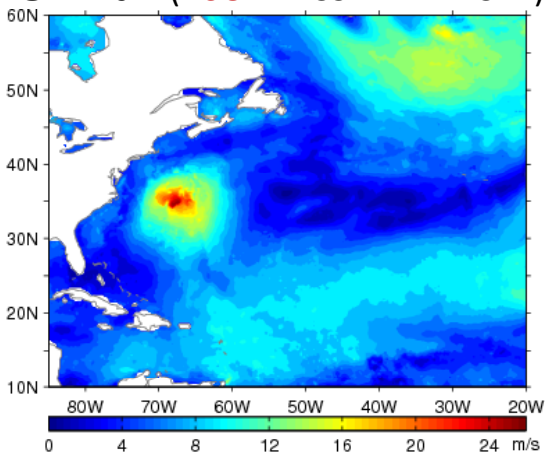


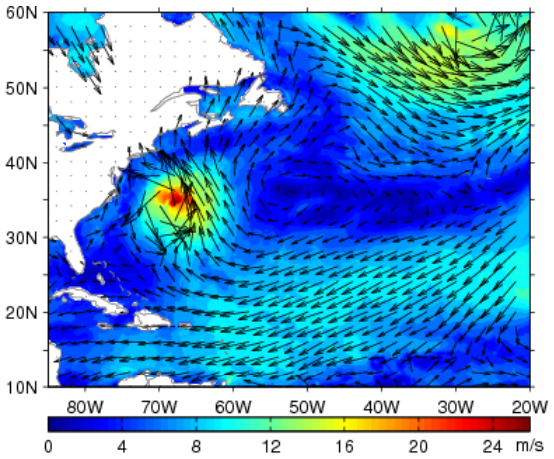
OAFlux (**QSCAT** + SSMI + AMSRE)





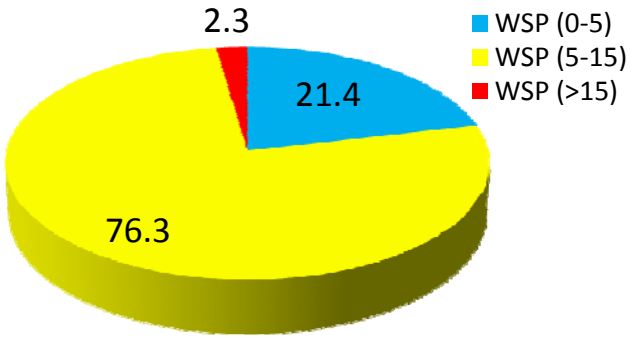
OAFlux (**ASCAT** + SSMI + AMSRE)

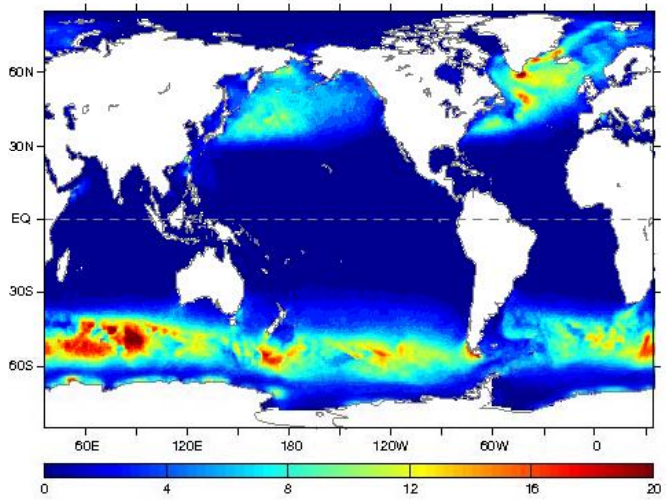


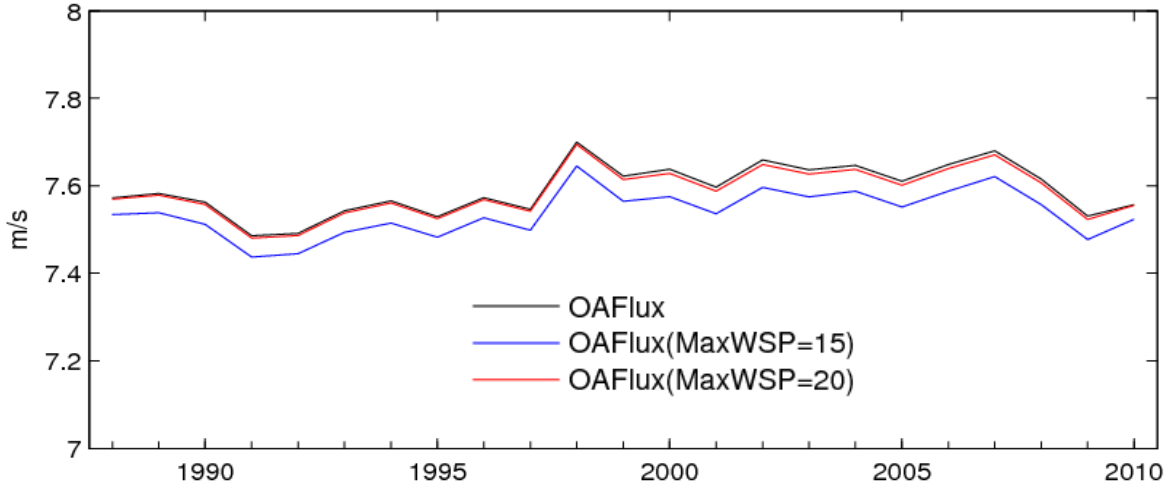


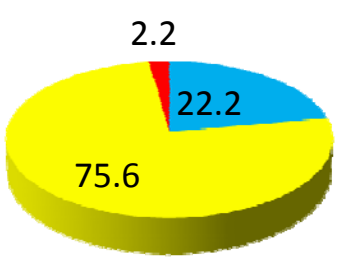
Influence of high winds on OAFlux time series

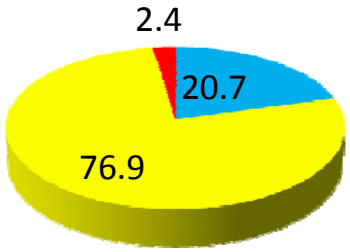
Percentage of low, moderate, and high winds



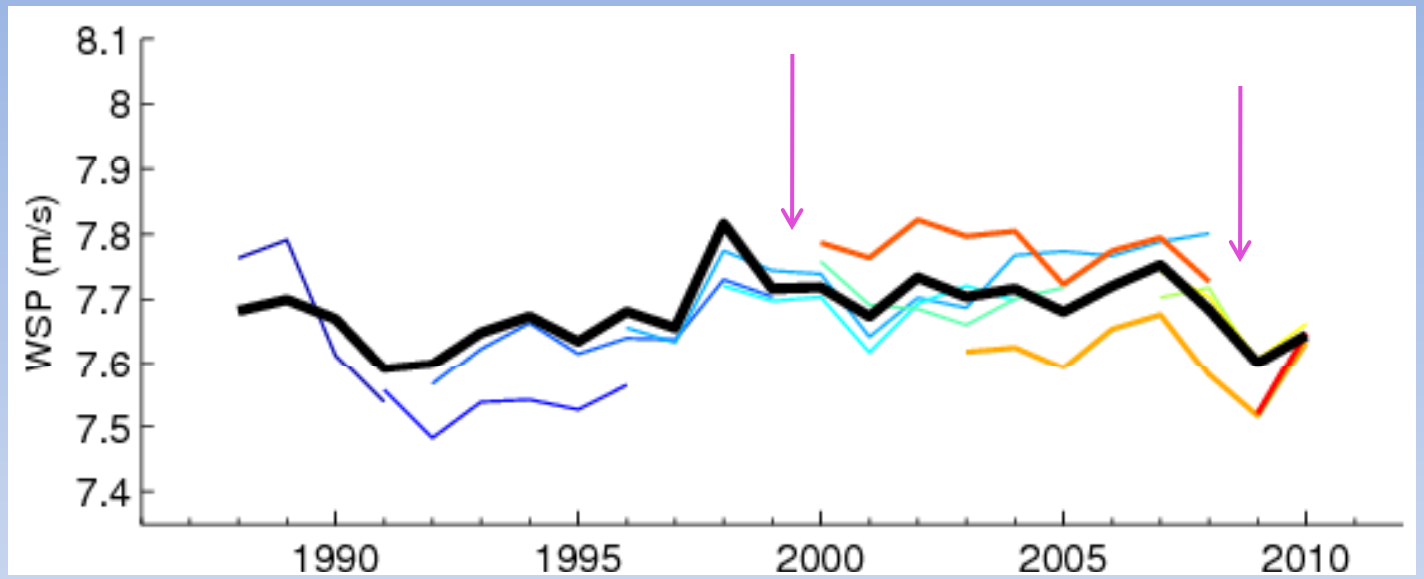


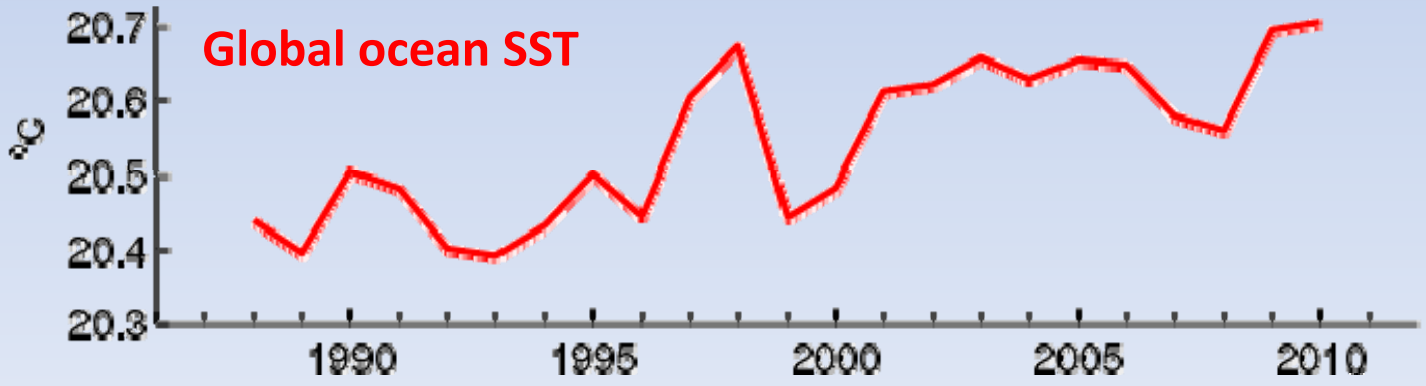




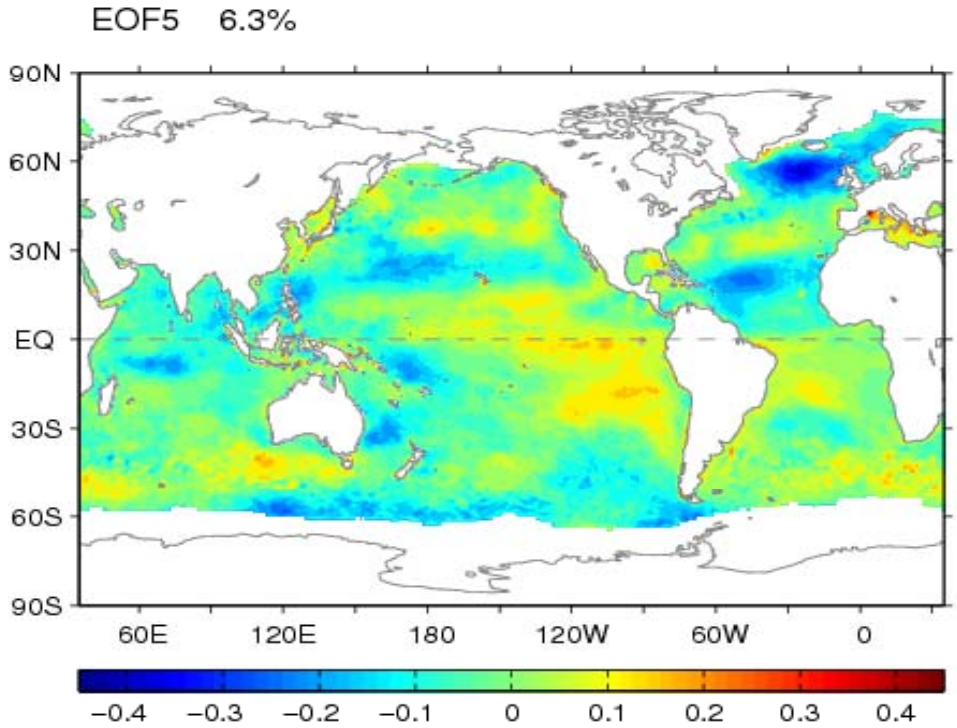


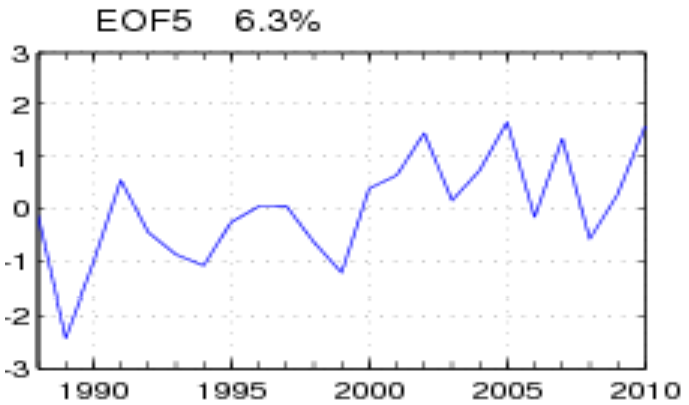
Wind and SST


WSP (m/s)
8.1
8
7.9
7.8
7.7
7.6
7.5
7.4
1990
1995
2000
2005
2010


Global ocean SST
°C
20.7
20.6
20.5
20.4
20.3
1990
1995
2000
2005
2010

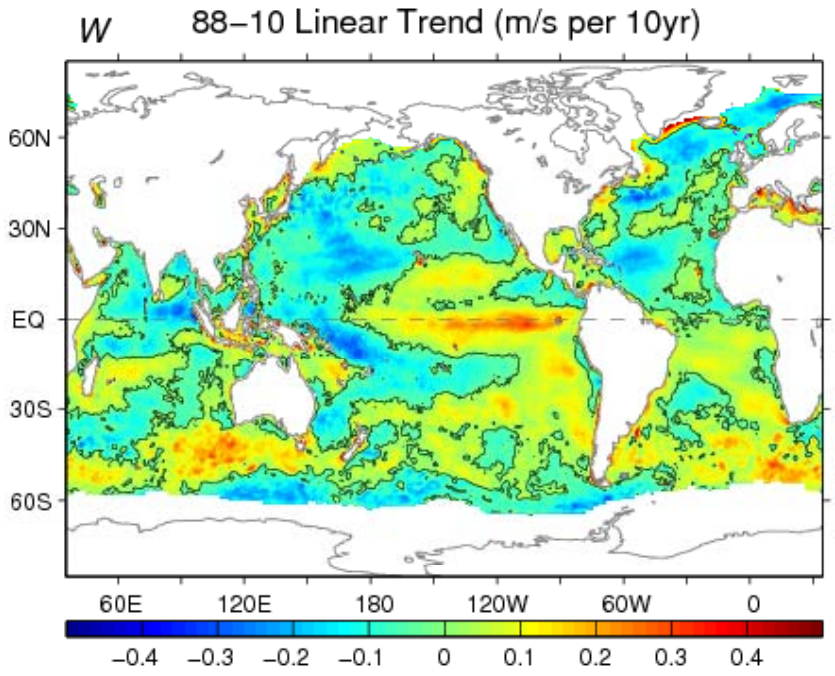
EOF mode of Trend



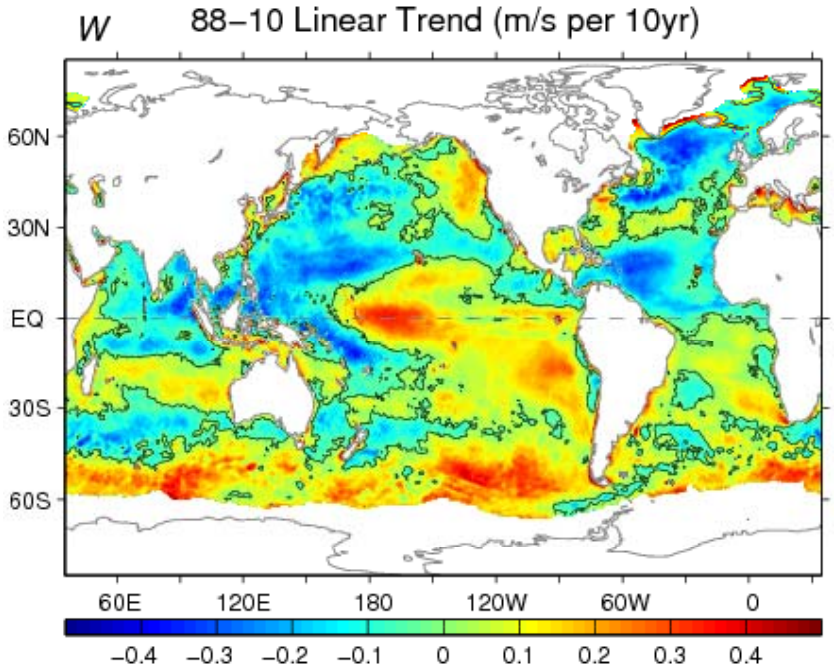


Linear trends in wind speed

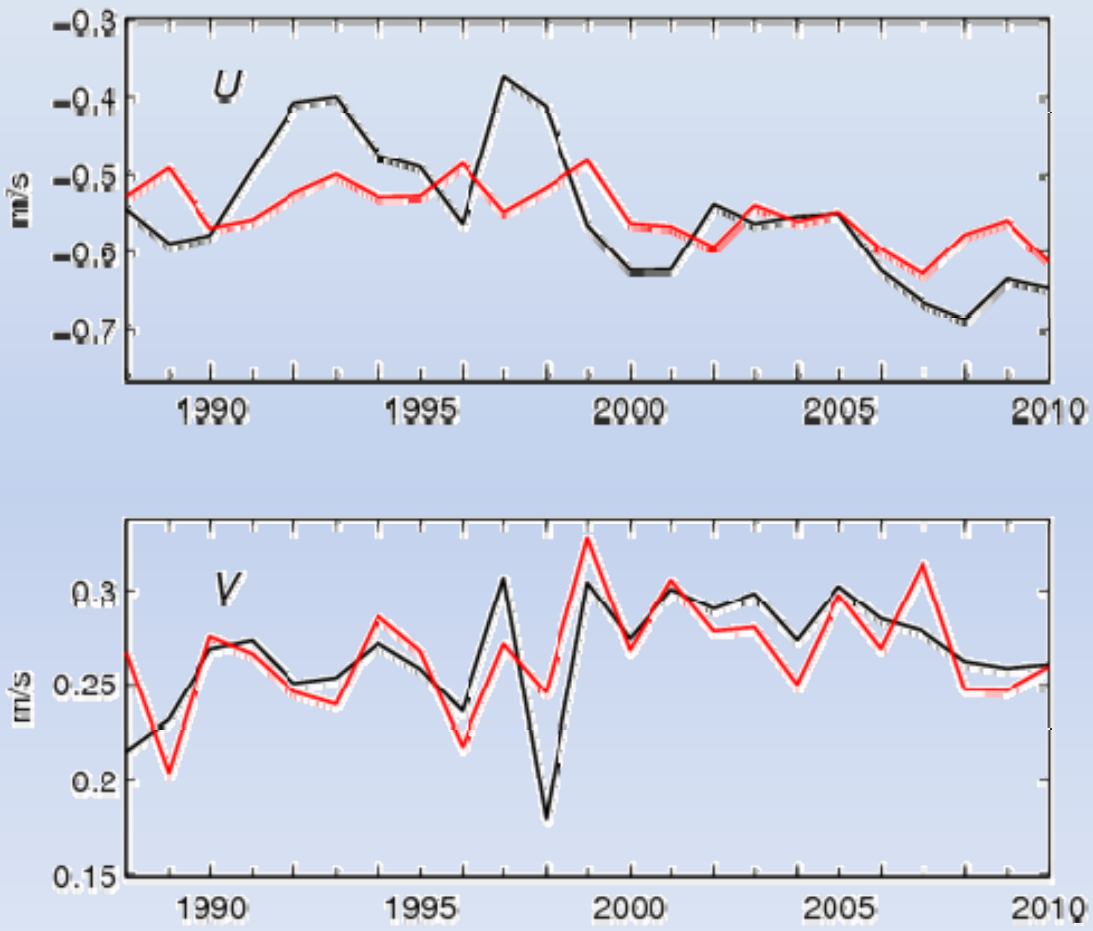
After removing 3 EOF modes (40.5% of variance)



Original time series



Time series of (U,V)

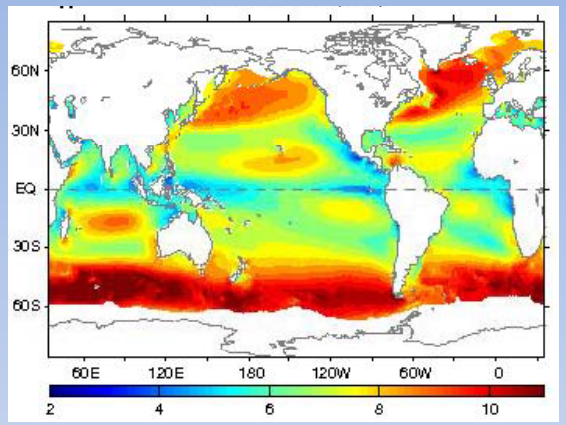


Original time series

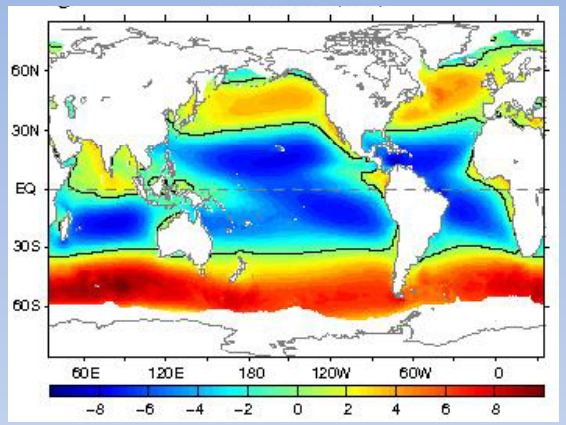
3 EOF modes removed (46.5% variance)

The changing ocean winds as seen from satellites (1988-2010)

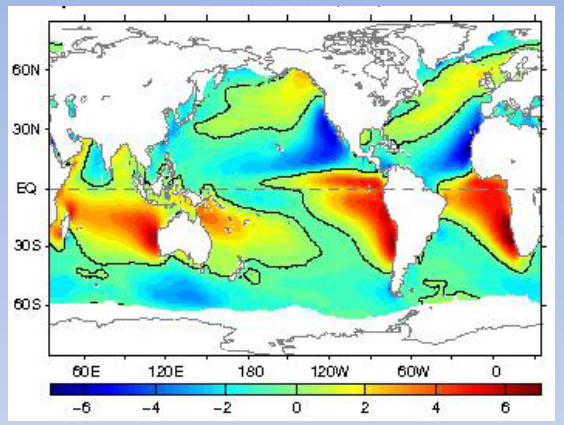
WS Mean



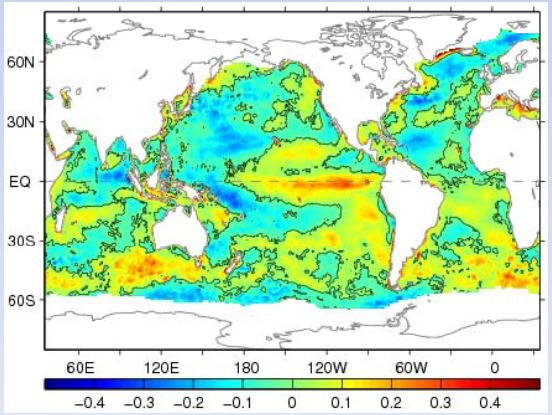
U Mean



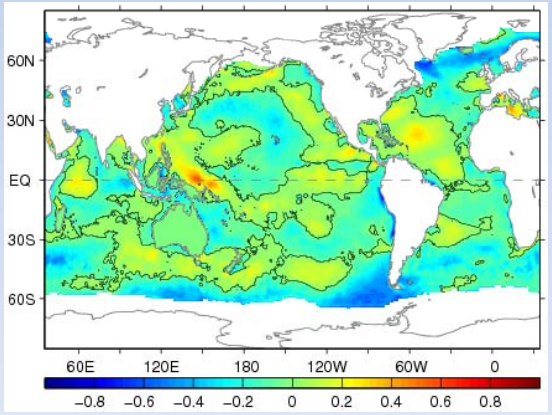
V Mean



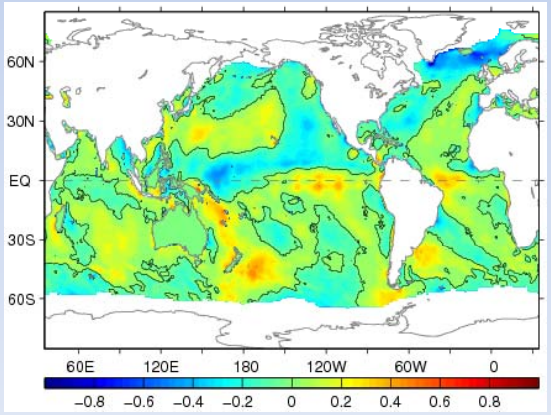
WS trend



V trend



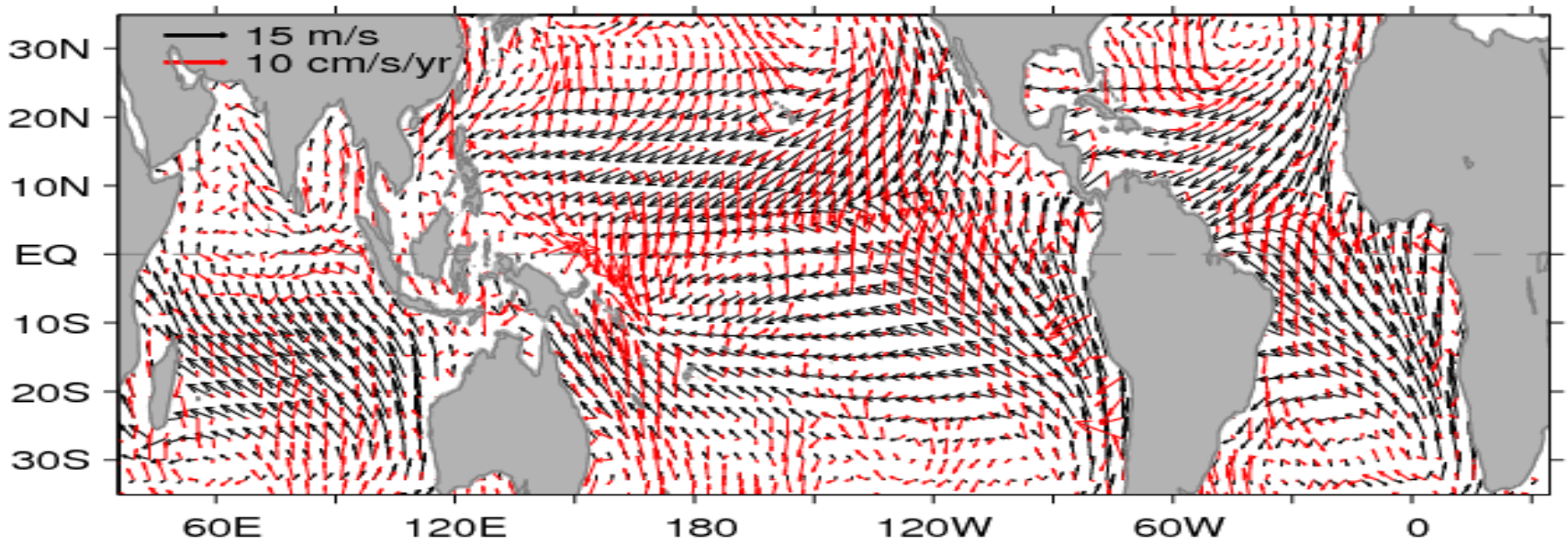
V trend



Reference

Yu, L., 2011: Strengthening of global ocean-surface winds as ocean warms. Deep Se Research II Special Issue on "*Satellite Oceanography and Climate Change*"

Mean and trend vectors



Summary

- We have developed objective synthesis framework that fills data gaps in ASCAT to provide complete description of global daily vector wind fields.
- We now have time series of global 0.25^{o}, daily ocean vector winds from 1987 onward that best characterizes SSMI, AMSRE, and QuikSCAT, and ASCAT.
- ASCAT high winds (>15m/s) are weaker than QuikSCAT high winds. On annual mean basis, high winds account only ~2.5% of global winds, which we found do not influence the global annual-mean time series.
- Low-frequency variations are observed in time series of wind speed and components, showing that global mean wind speed has increased. ENSO signals should be removed before studying long-term changes.
- Ocean vector winds affect virtually every detail of the oceanic role in climate change. A consistent time series would be important for many applications. We are working on a public release of OAFlux wind datasets in near future.

For more information on WHOI OAFlux project and products, visit the project website: http://oaflux.whoi.edu