Adding observed Weather Regimes to climate simulations of MJOs - ENSO

1. Adding weather regimes observed by (TRMM+QSCAT) to the coupling of the Indian Ocean with the atmosphere ---> impact on MJOs.

2. Adding western Pacific warm pool regimes to improve ENSO forecasts.

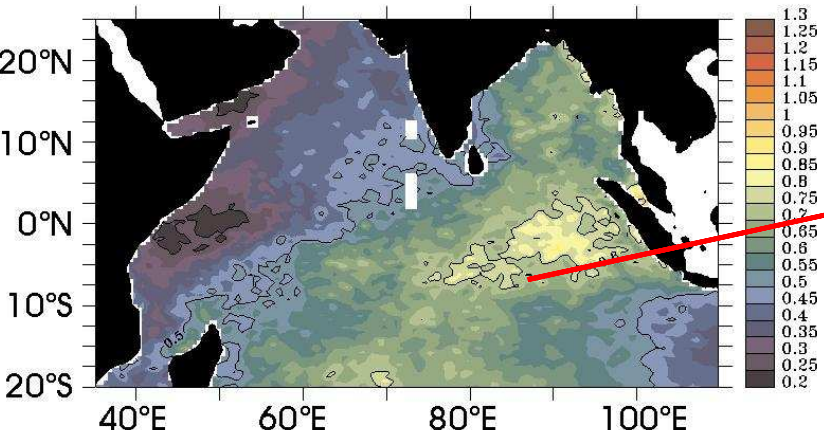
3. Success only with initial conditions of model forced by FSU ship winds:

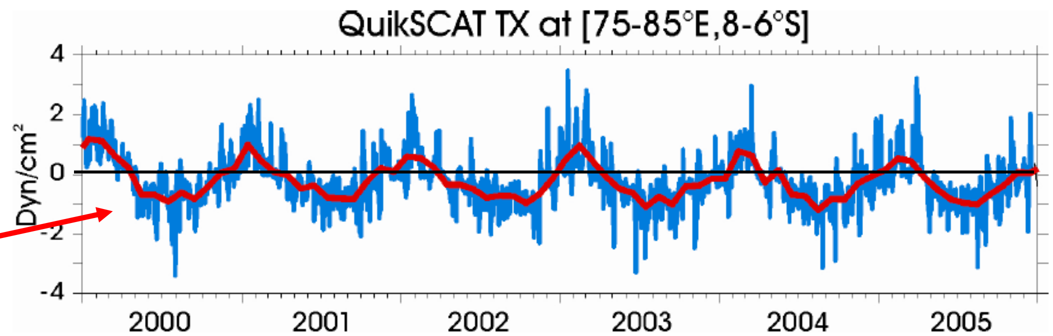
    * systematic failure with NCEP, ECMWF, ERS…see Footnote

    * failure if ocean is initialized with QSCAT.

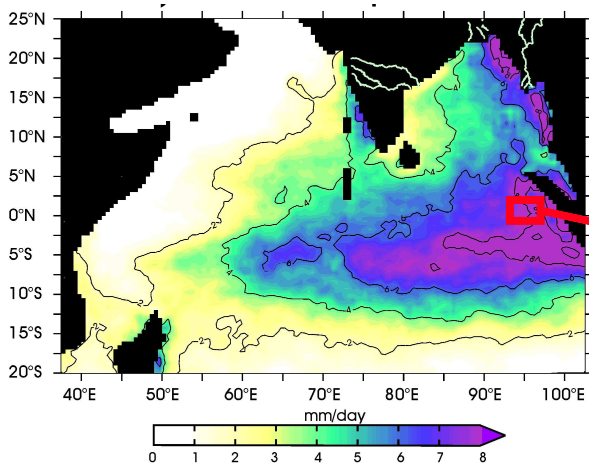
OVWST, Seattle, Nov 2008, Perigaud + Dureau (JPL) + Illig (IRD) + Cassou (CNRS)

Climate Change in the Tropics induced by Indian Weather events

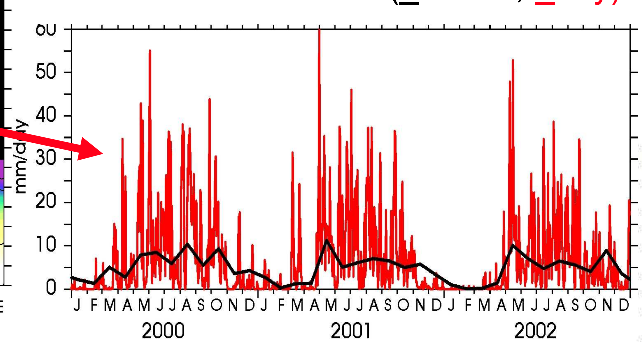




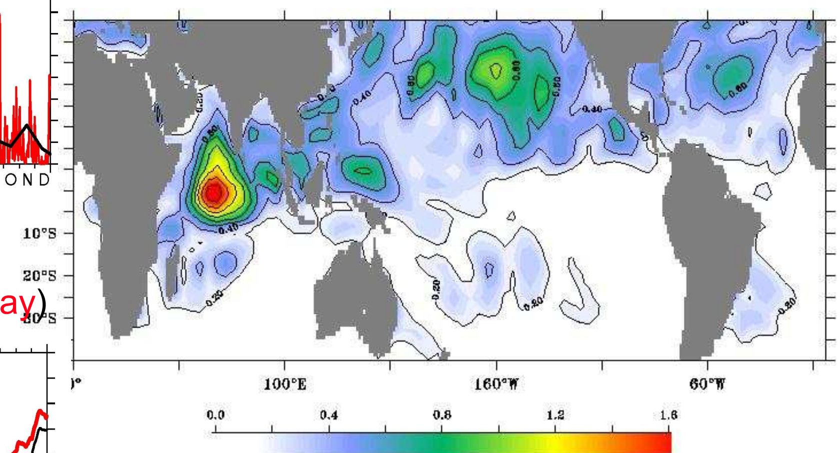
Quikscat winds and TRMM rain submonthly fluctuations

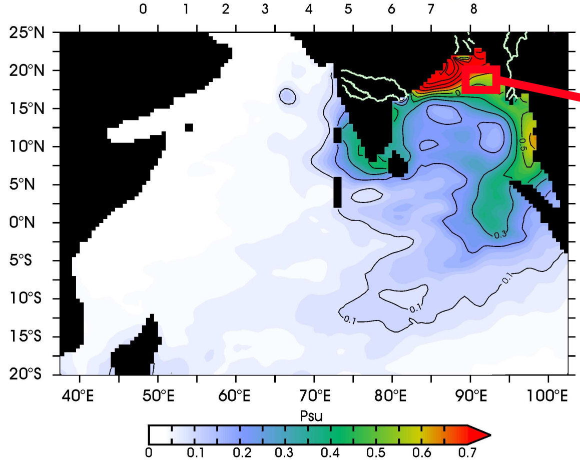


TRMM Rain data(_month, _day)

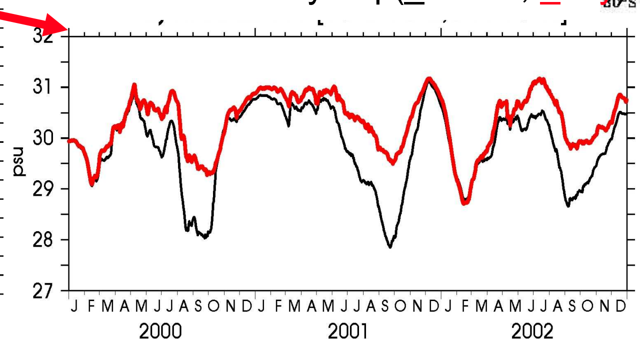


change the SSS, SL, SST,
and model rain



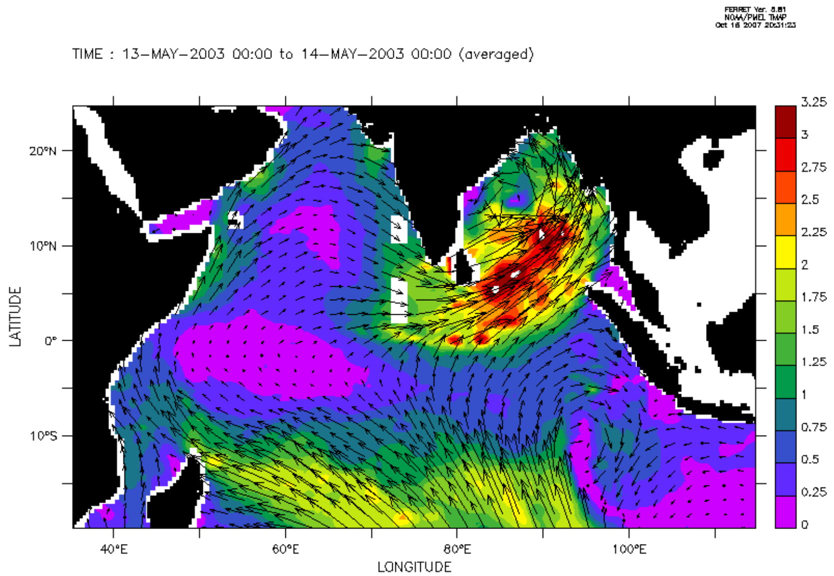


Model Salinity Exp(_month, _day)

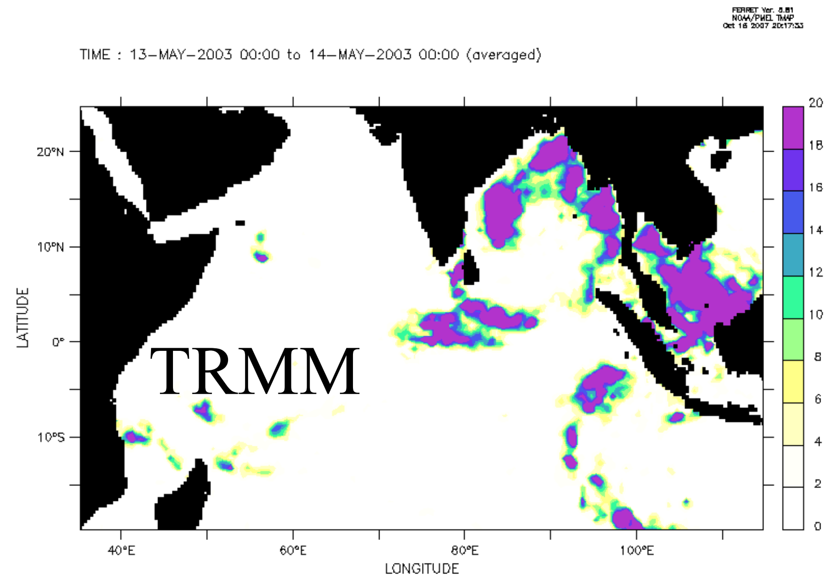


Intraseasonal-to-interannual climate changes simulated by the Indian Ocean/Atmos/Land model.

Indian Cyclone 10-19 May 2003

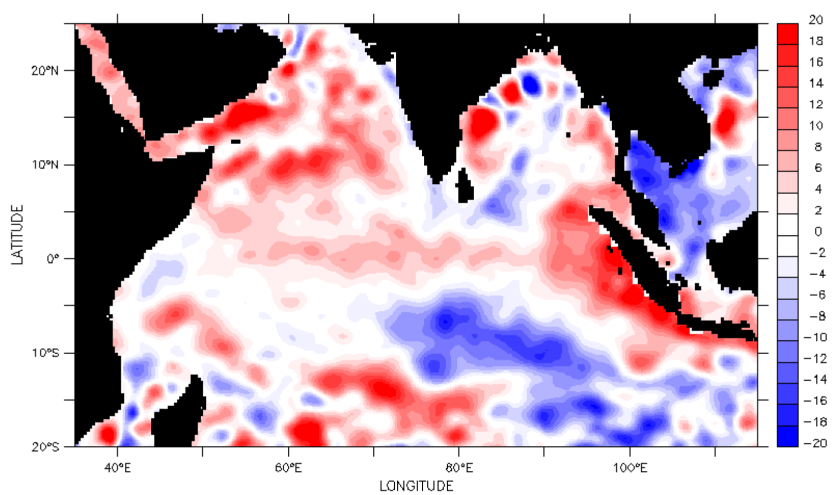


QuikSCAT



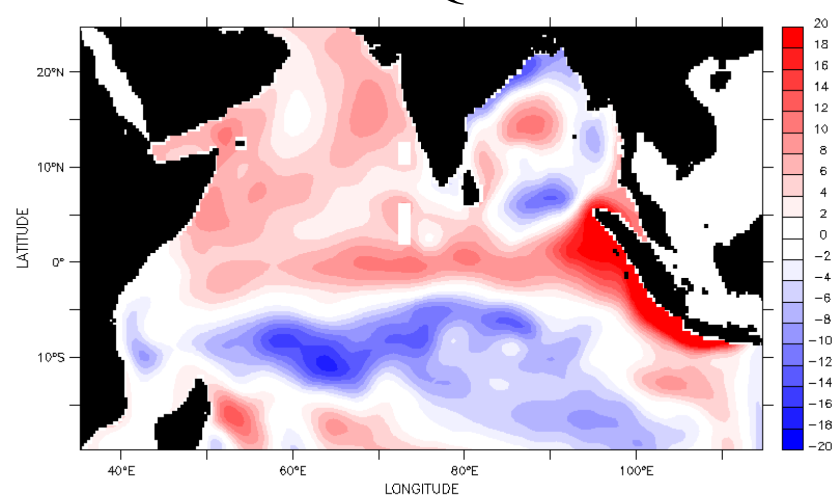
TRMM

SL TOPEX



SL TPJE

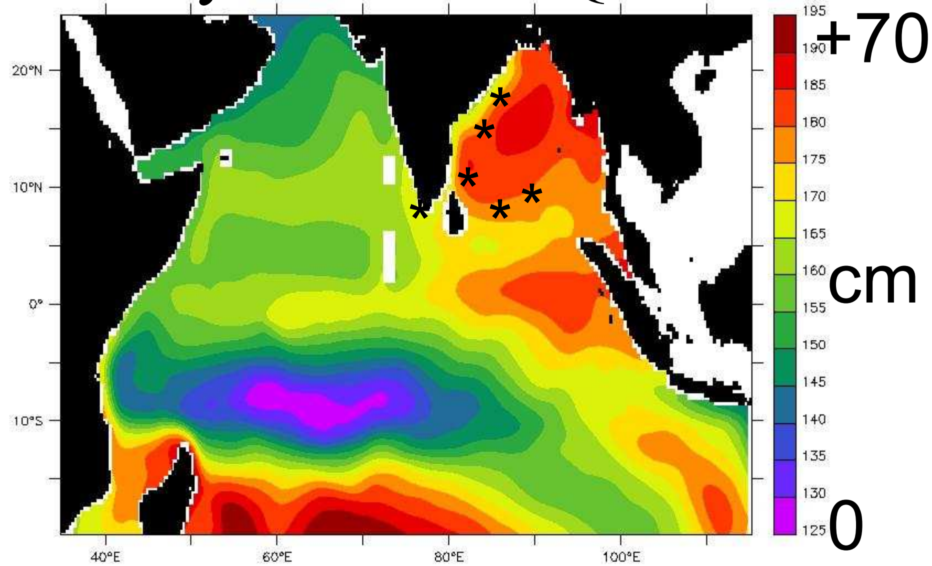
SL QSCAT



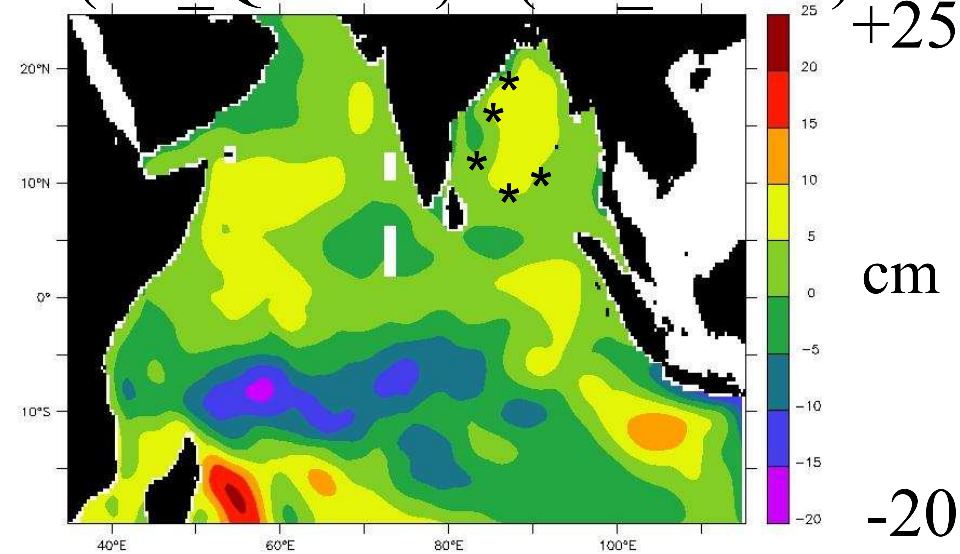
SL: RunQSCAT

Model Sea Level driven by QuikSCAT or by NCEP averaged on 3 days of a Bengal cyclone

2-5 May 2003 from QSCAT



(SL_QSCAT) - (SL_NCEP)



Cyclone index over the Bay of Bengal:

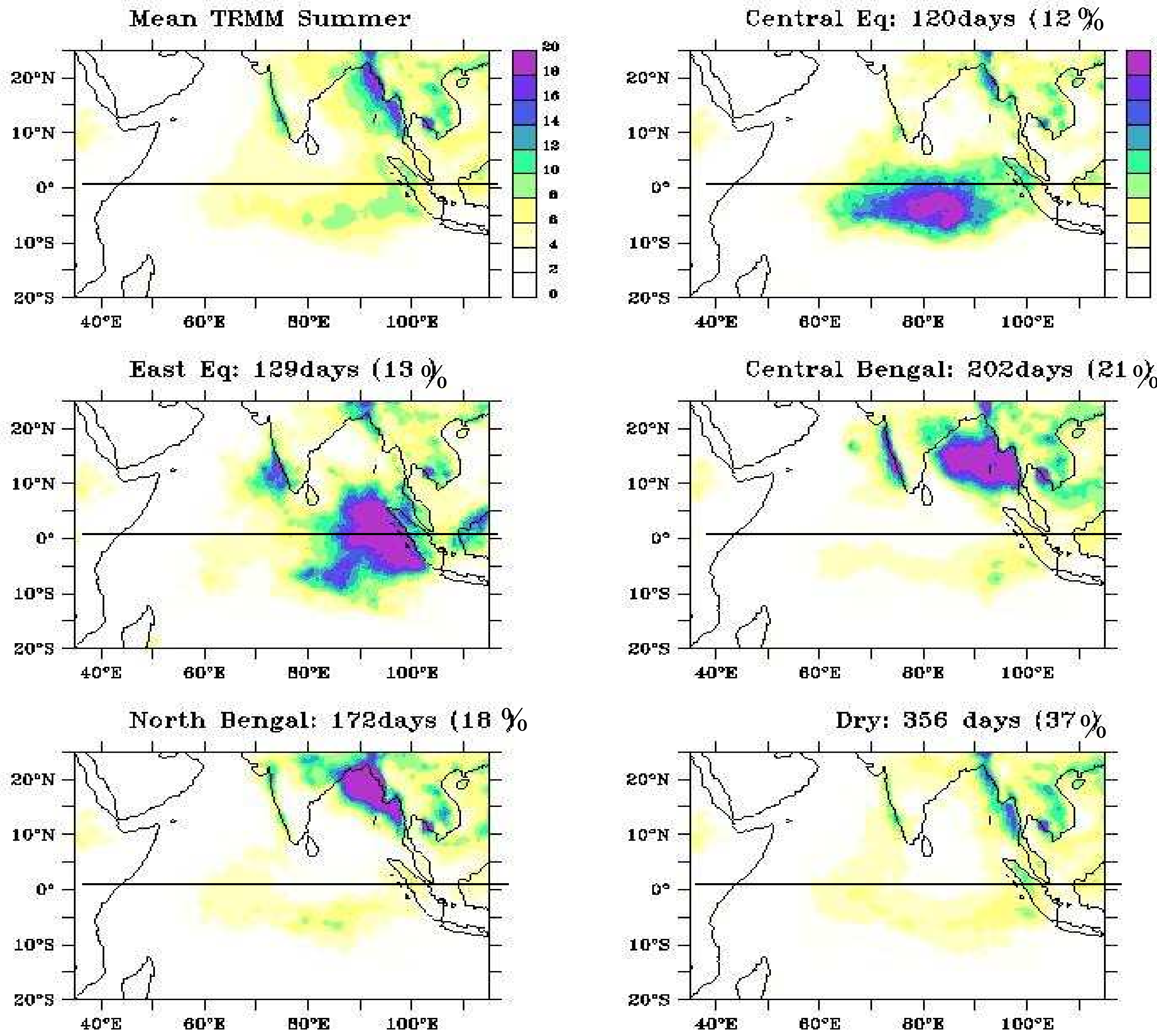
Depending on the forcing, the index differs by O(+8cm)

= - 1.0 psu change of Salt content or

= + 3.2 ºC change of heat content in the upper 100m ocean.

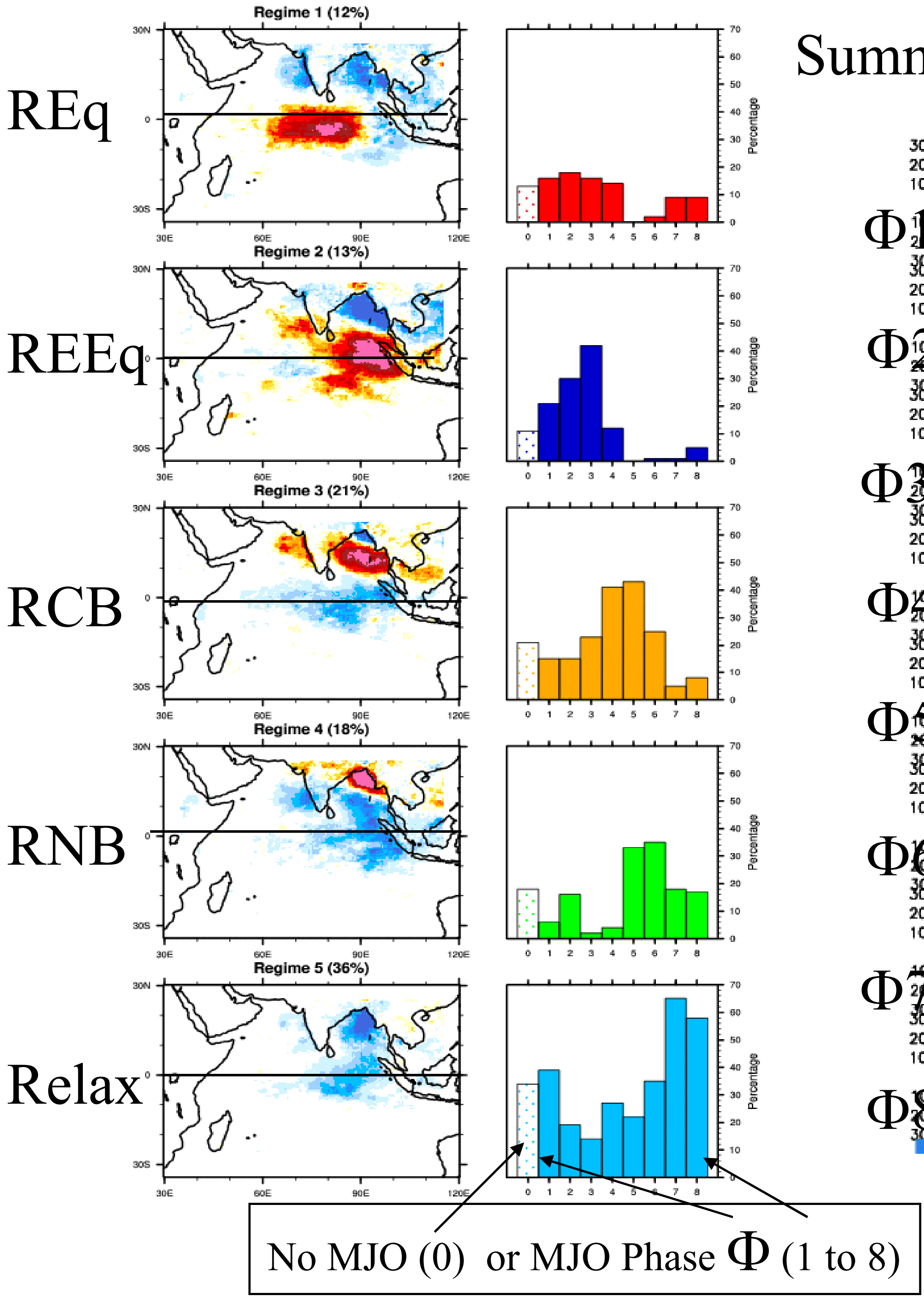
BIG difference!

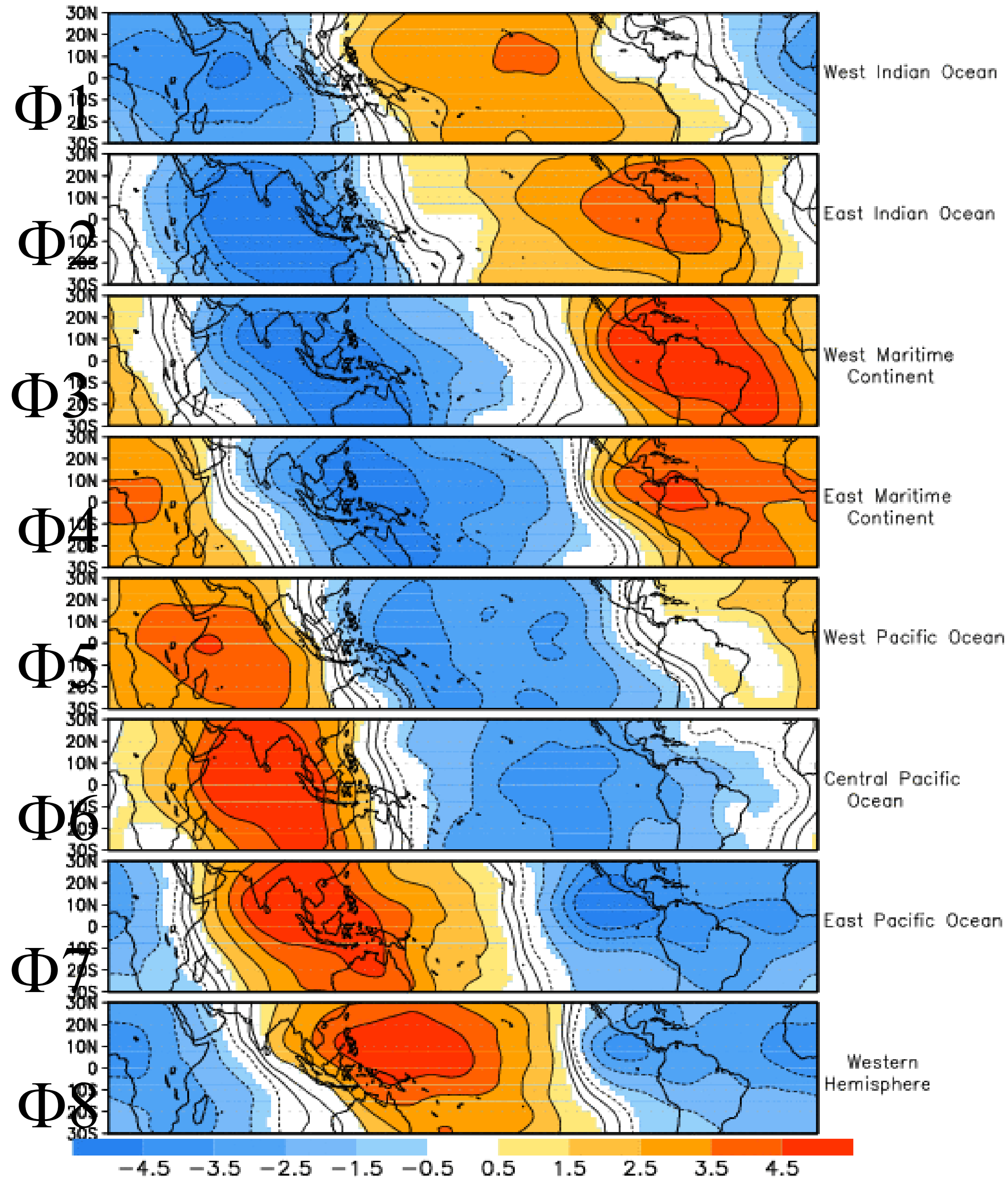
LARGE scale wind stress vectors matter for hurricane no less than local winds.



All regimes have 3-to-5 day time of persistence.

Summer weather regimes and MJOs





Part 2: Application to ENSO forecasts

QSCAT wind stress vector regimes in the Indian and Western Pacific Warm pool (west of the dateline) are added to an ENSO model because:

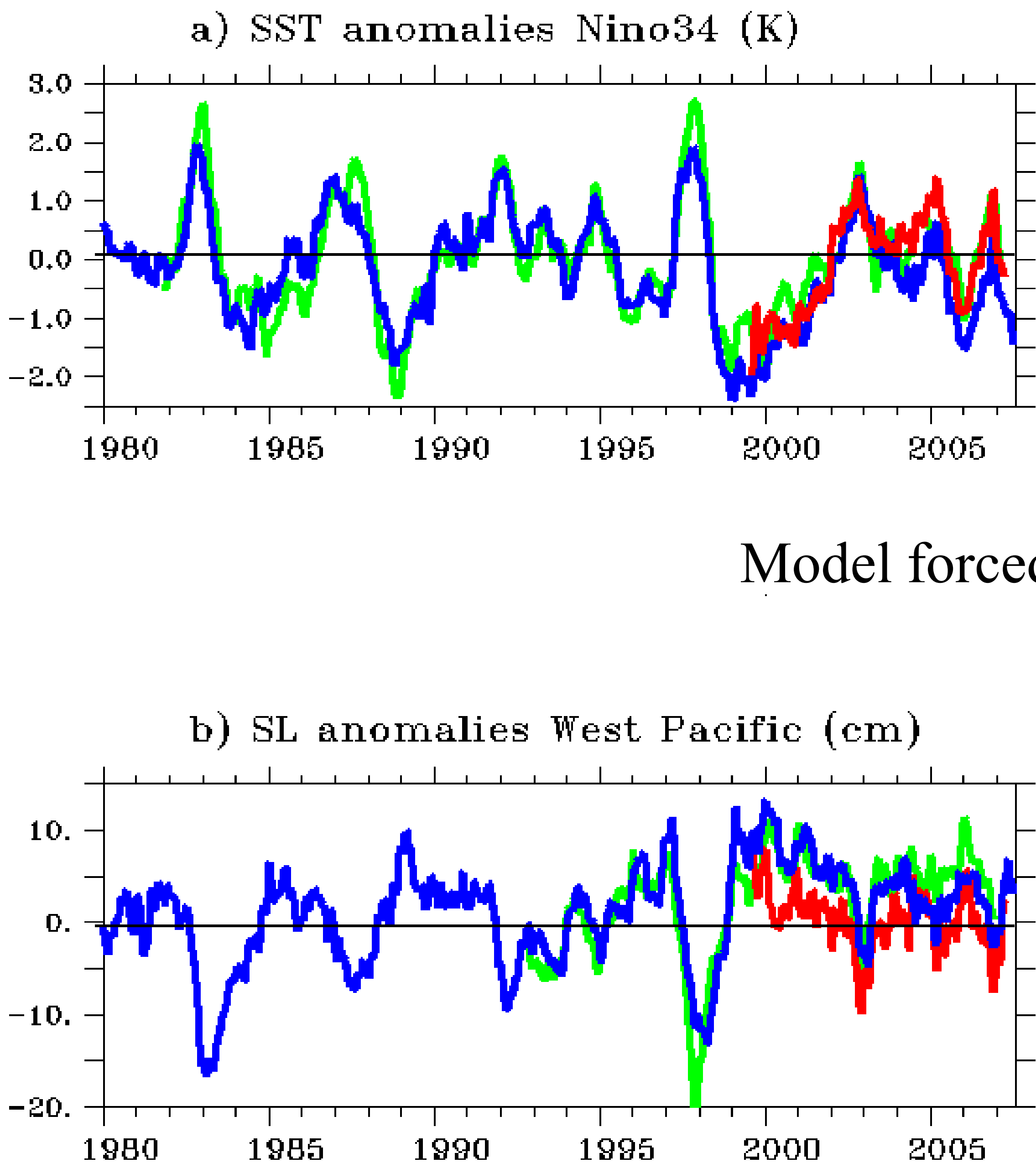
* Coupled models have NO skill in simulating the occurrence of weather events like they are observed.

* Coupled models can have skill in simulating intraseasonnal-to-interannual fluctuations.

*Predictive skill depends on the quality of model parameterization and on the quality of initial conditions.

See Perigaud and co-authors 1996, 1997, 1999, 2000abc, and 2002.

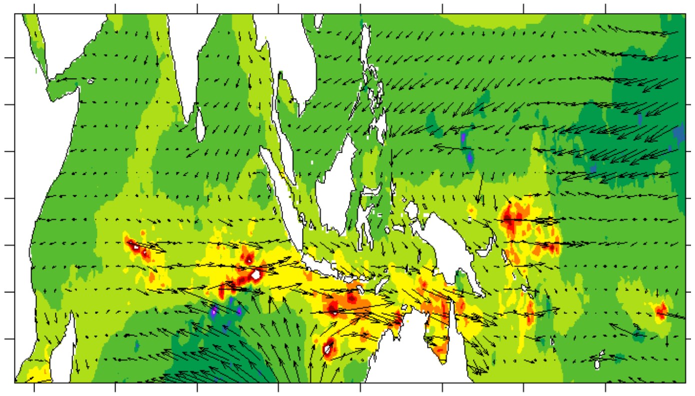
Tropical Pacific **ENSO** model: initialisation since 1961 validated with data



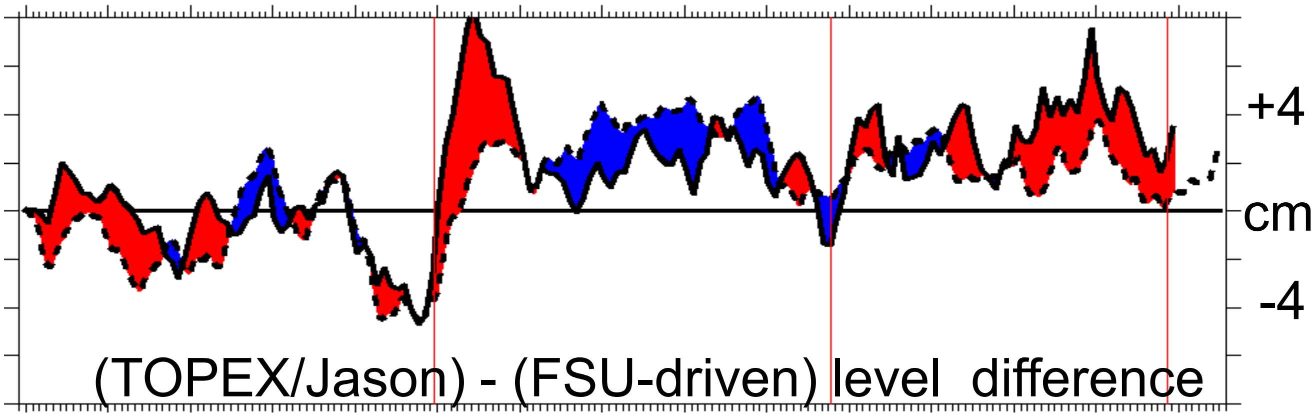
Model forced by FSU or by QSCAT

Wind Burst, Ocean charge and ENSO

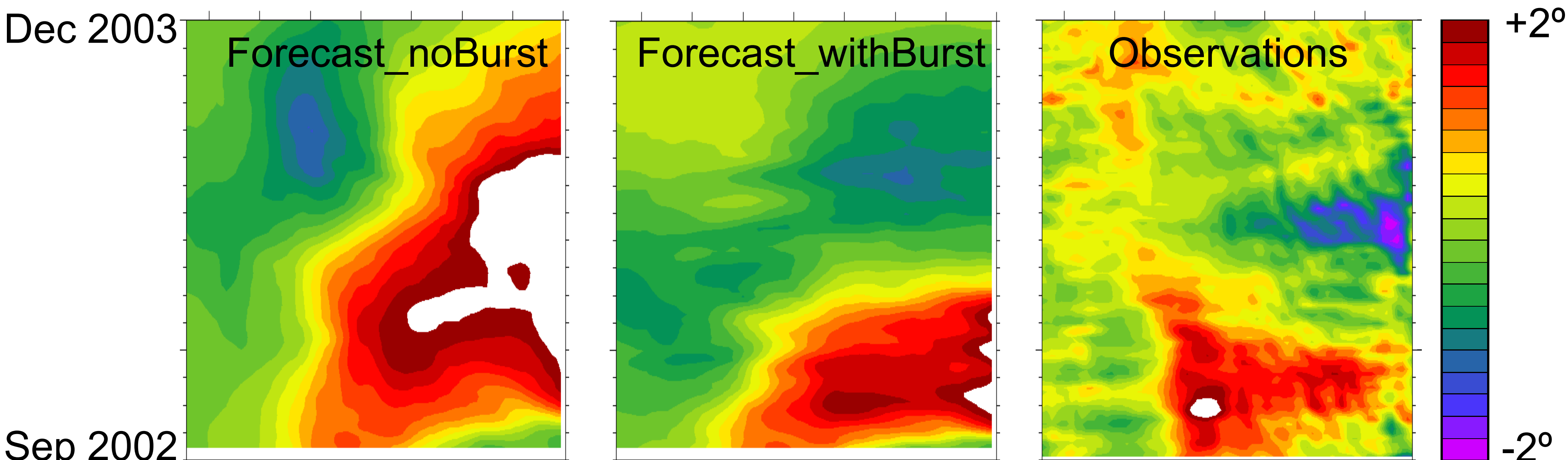
QSCAT Burst 25 Feb 2003



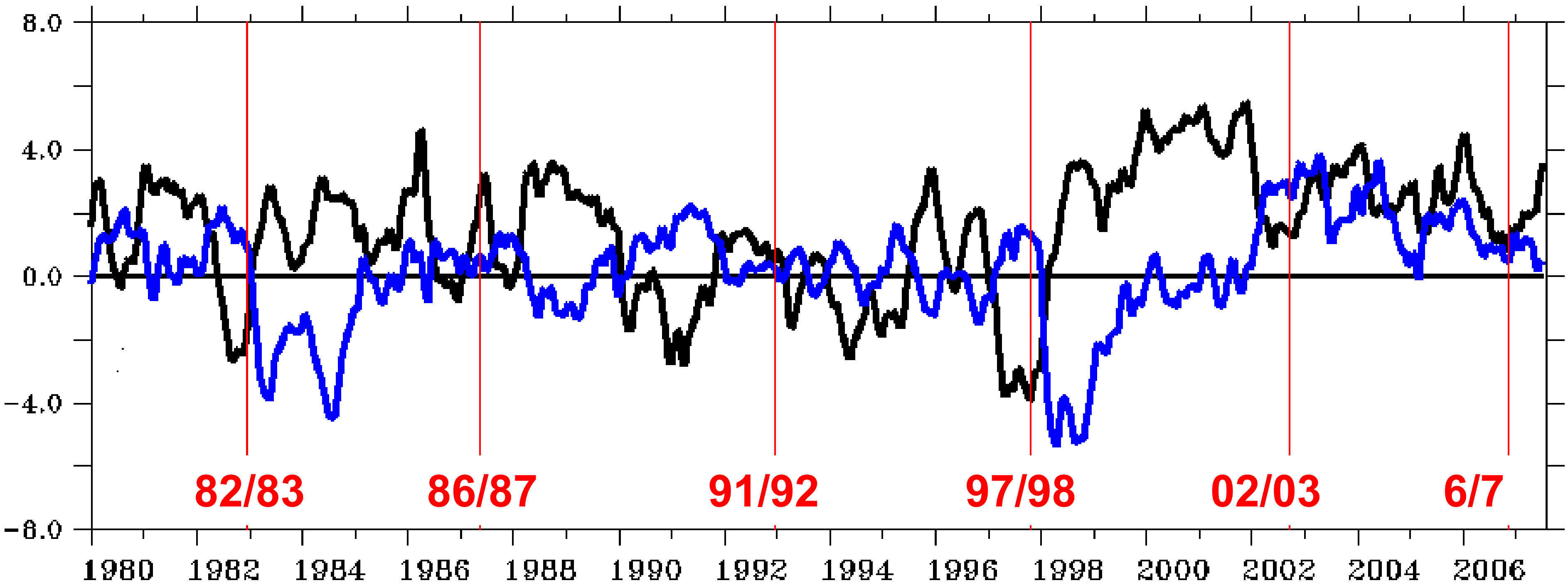
1992-to-2007 Tropical Pacific Ocean re(dis)charge



SST predicted or observed along the equatorial Pacific for 15 months since Sep 2002

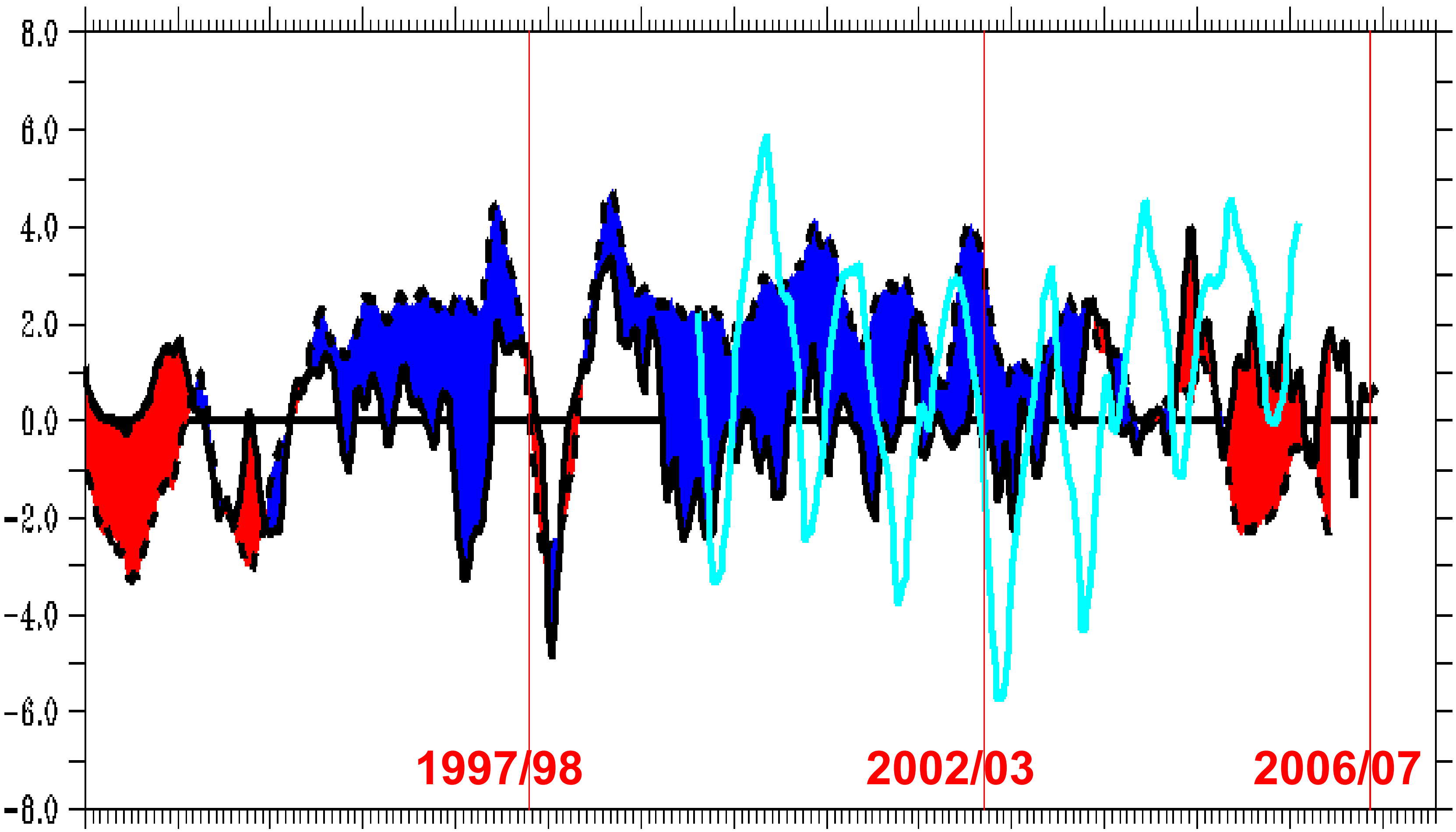


North and South Tropical Pacific Sea Level time series driven by FSU winds



Since 1992, we have been using TPJ sea level difference with the level simulated by Model_FSU to monitor the changes due to the mass inflow/outflow across the Pacific and across the Indian ocean lateral boundaries (see Florenchie and Perigaud, 2001).

Sea Level (*cm*) from Model_QSCAT, or Model _FSU (---), or Data (—)

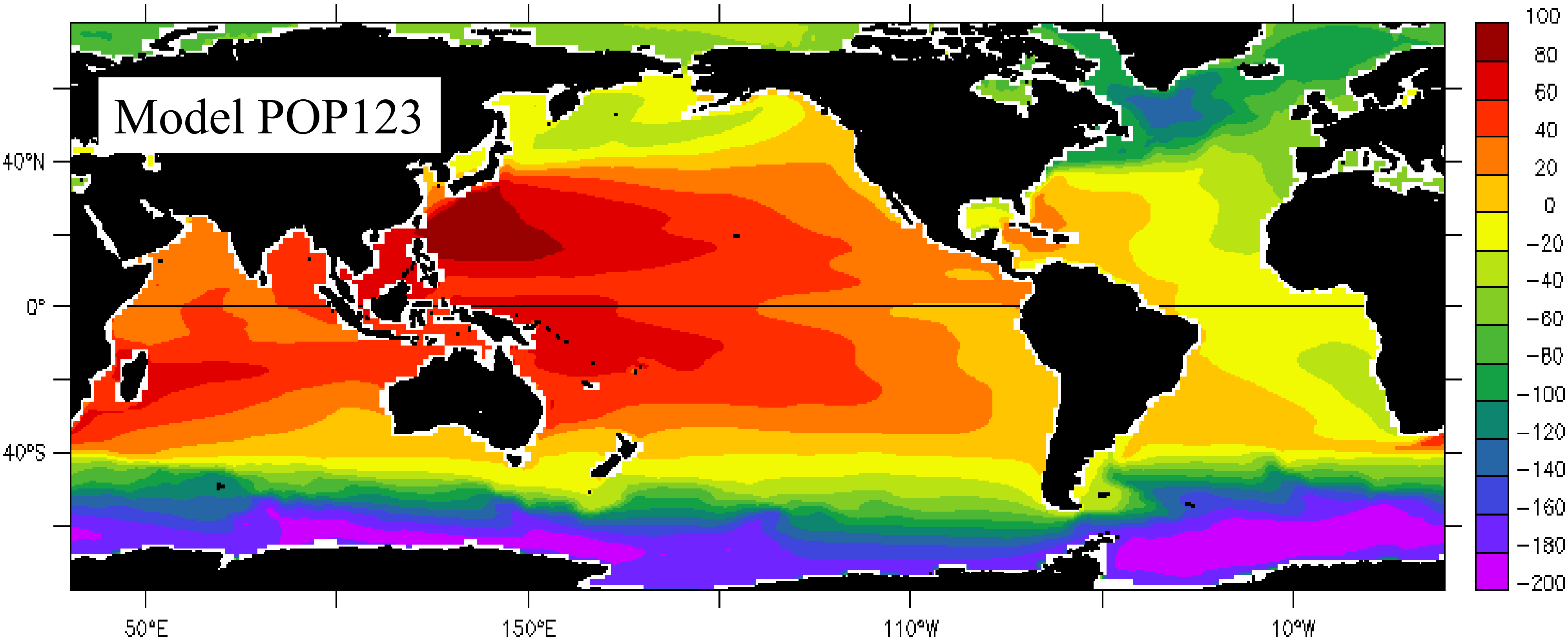


The "seasons"driven by QSCAT are larger than the "seasonal+interannual + multiyear" changes monitored by (TPJdata - SL_*FSU*).

The Indo-Pacific mass exchanges driven from QSCAT is incompatible with those driven by FSU. This cannot be because of our model errors.

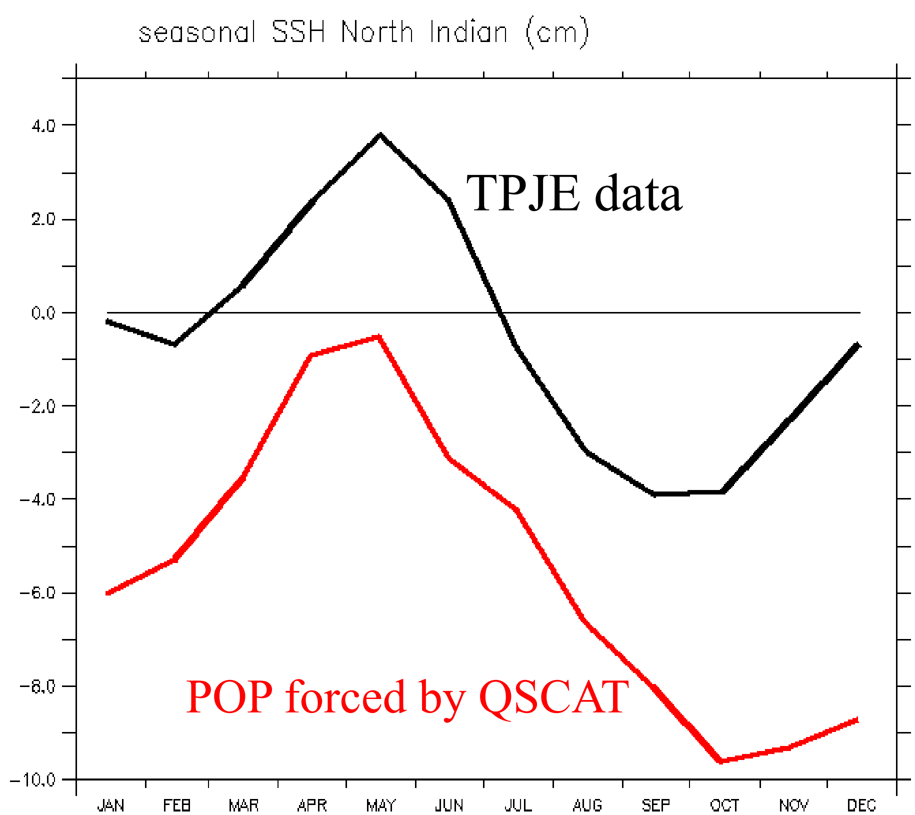
===> Check with other ocean models, i.e. ECCO or POP.

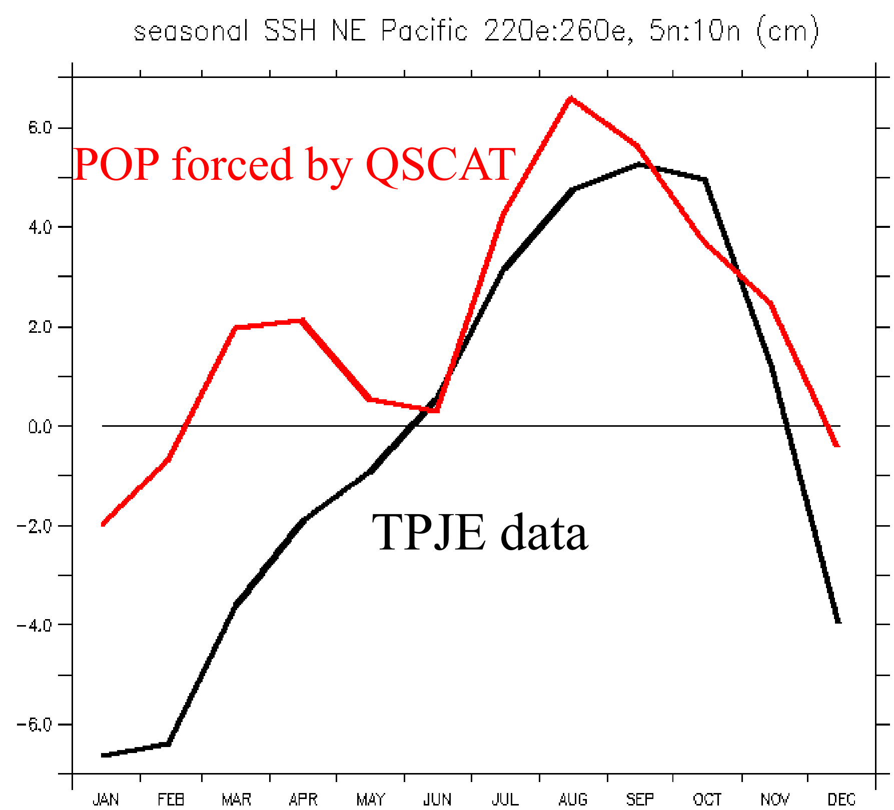
2000:2004 mean SL forced by QuikSCAT climatology
POP model after 123 years spin up



Curtosy of W. Large, S. Yeager, M. Jochum, NCAR CSM, Sep 2008

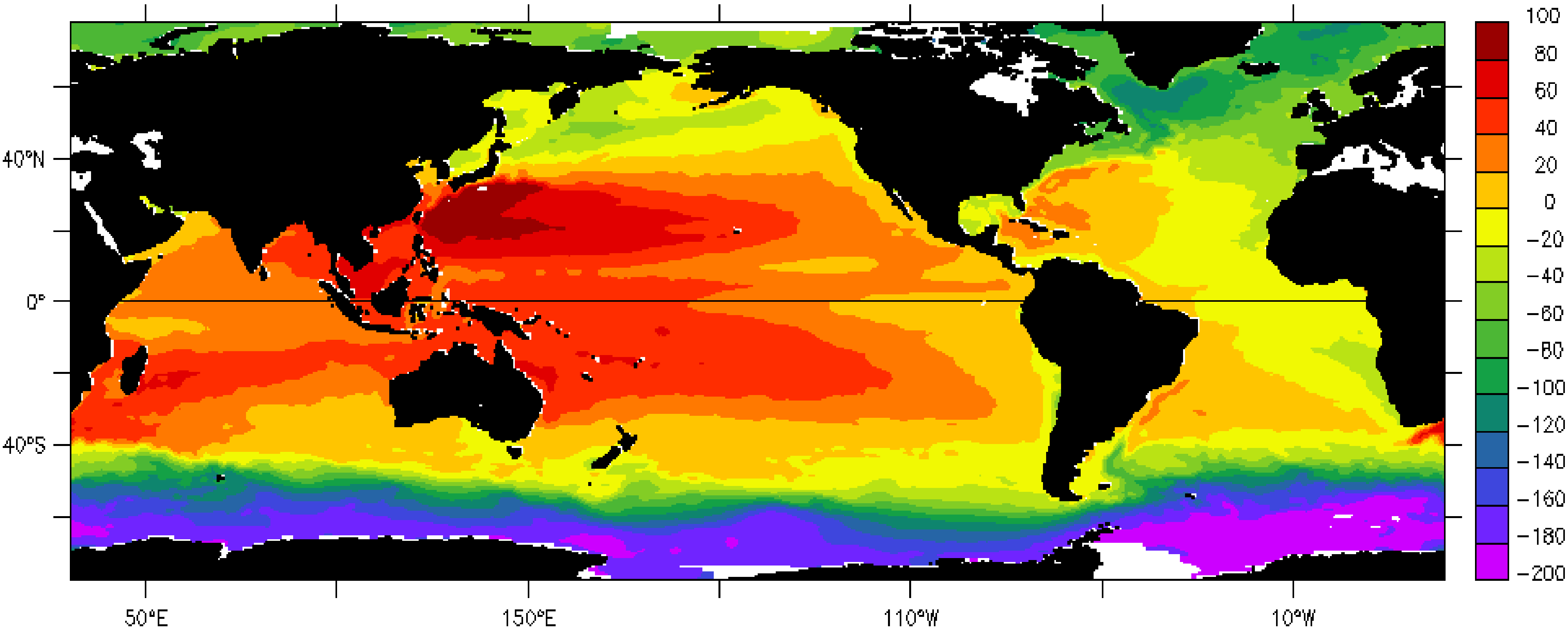
Comparison Sea Level forced by OSCAT (POPmodel) with TPJE





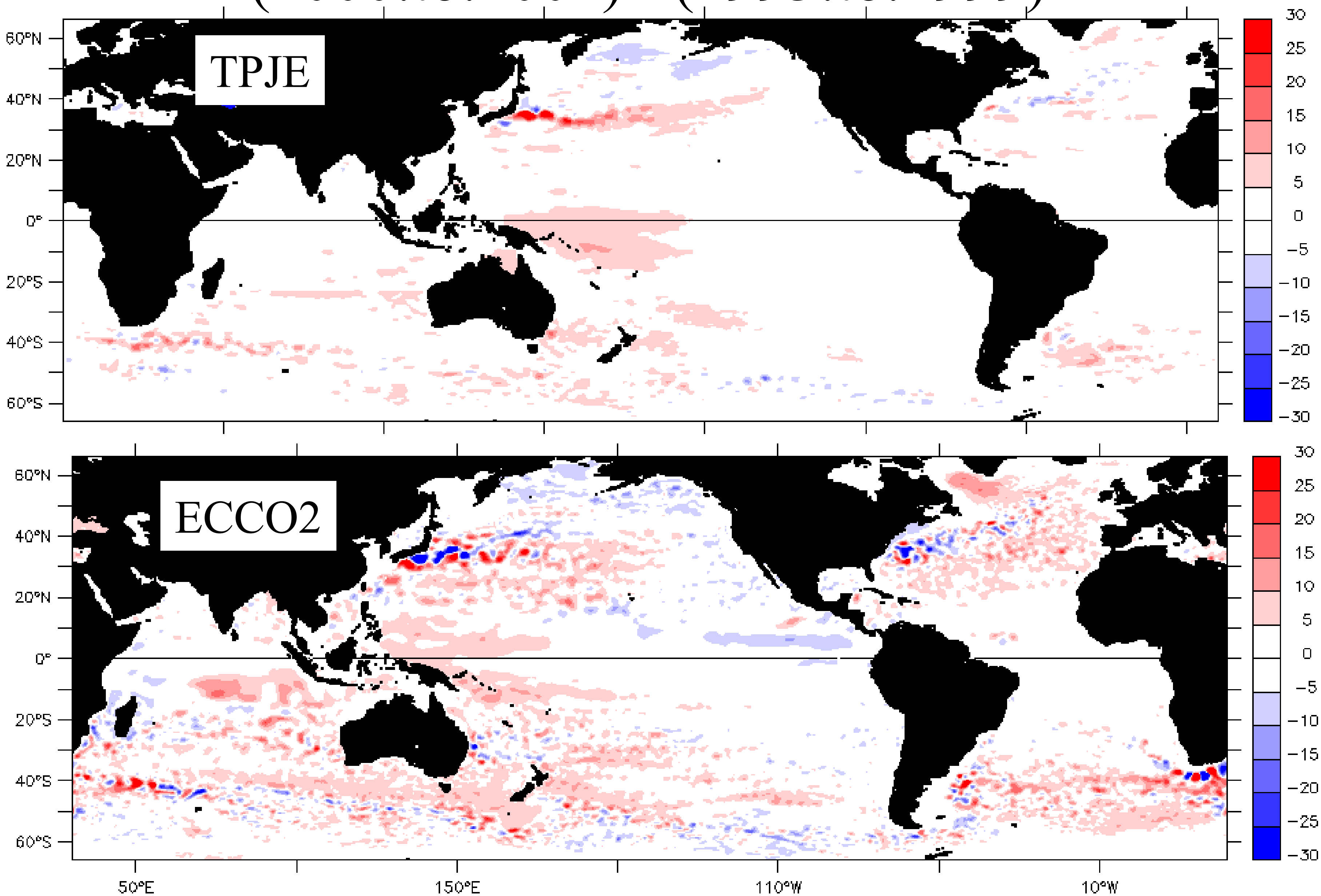
For both model and data, time series are relative to the mean sea surface averaged between 20S and 20N. Model-data misfit cannot be due to model Errors. Misfit is well explained by errors in QSCAT reported to OVWST in Portland and Amsterdam and in extra slides after the conclusion of this ppt.

2000:2004 averaged SL from data



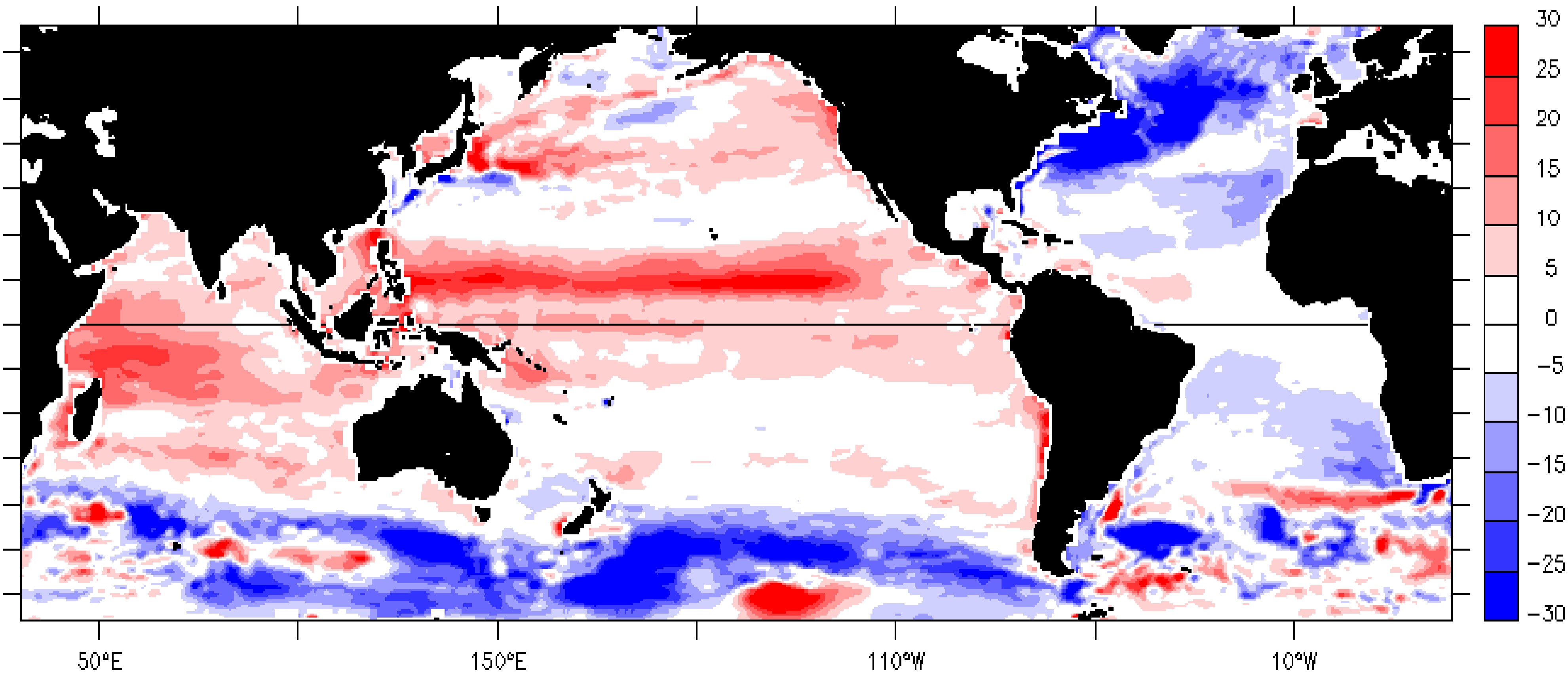
Data from Rio et al., 2005 + TPJ adjust (1993:1999) ---> (2000:2004)
Data from Maximenko and Niiler, 2005 (1993:2002) ----> (2000:2004)

Observed and Model Time averaged SL change (2000:to:2004) - (1993:to:1999)



ECCO2 exp here is forced by ECMWF, no TPJE assimilation after 2001.

2000:2004 averaged SL difference: BalanceQSCAT - Data



This signal is VERY BIG.
It corresponds to a change of Earth’s oblateness which is incompatible with the observed range of LOD variations.

Conclusion and Perspectives

1) Adding weather rain and wind events to the ocean/atmosphere coupling feeds the 60 day resonance of the Indian ocean which contributes to generate atmospheric MJOs that propagate around the Planet.

2) Adding wind bursts to the coupling of the Pacific warm pool can significantly improve the intraseasonal to interannual forecasts.

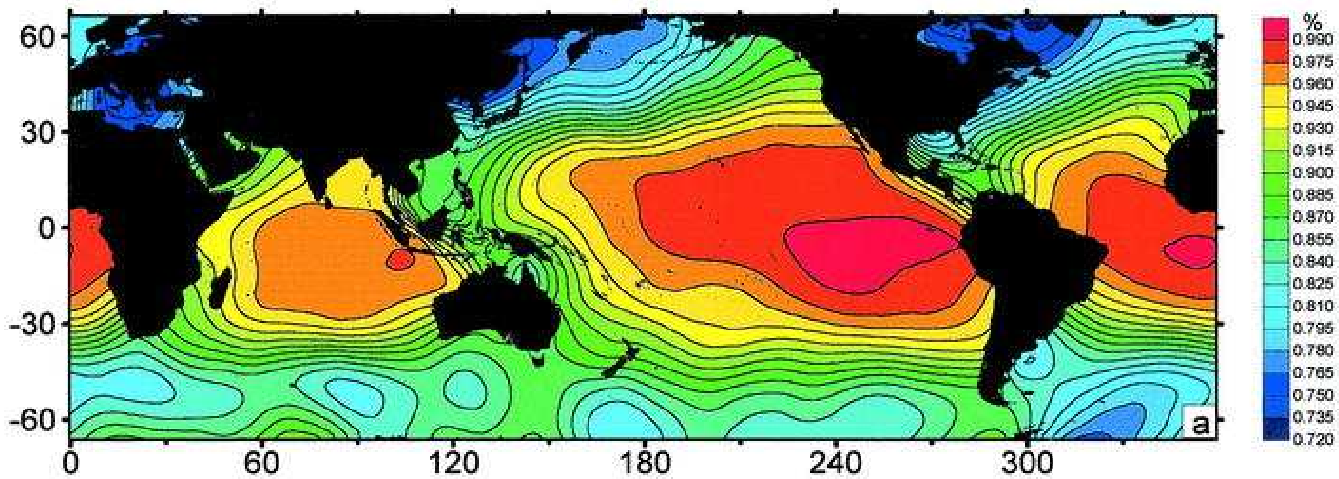
BUT

these results are obtained when the ocean is forced by FSU ship pseudo-stress vectors and monitored by TPJ data since 1992. Failure when QSCAT is used for monitoring of large scale wind-driven sea level.

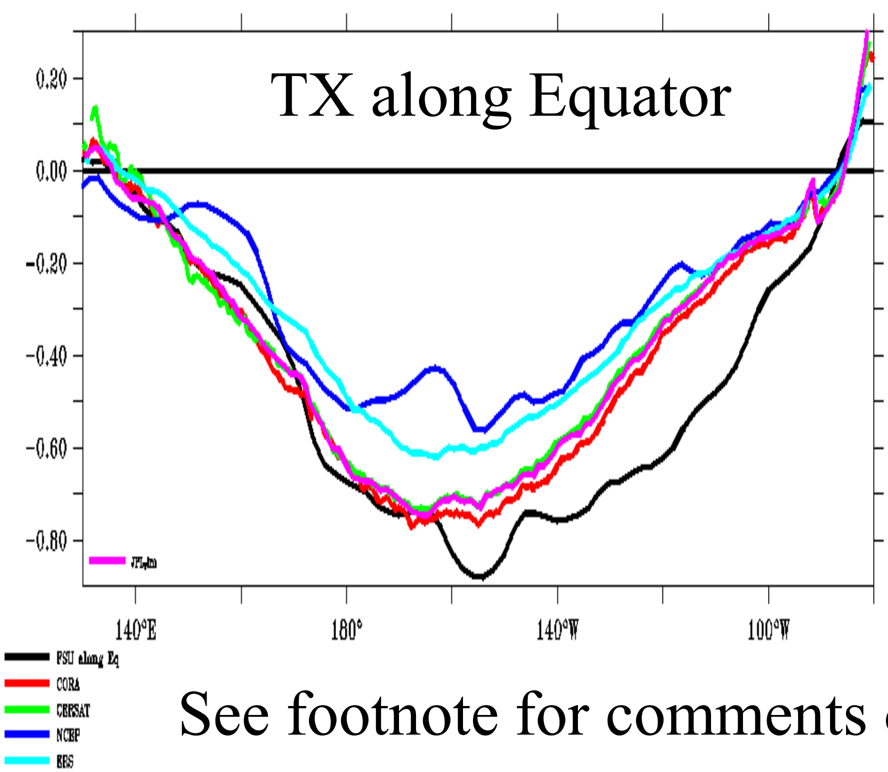
3) The sea level forced by QSCAT wind stress climatology is in disagreement with TPJ basin-wide budgets.

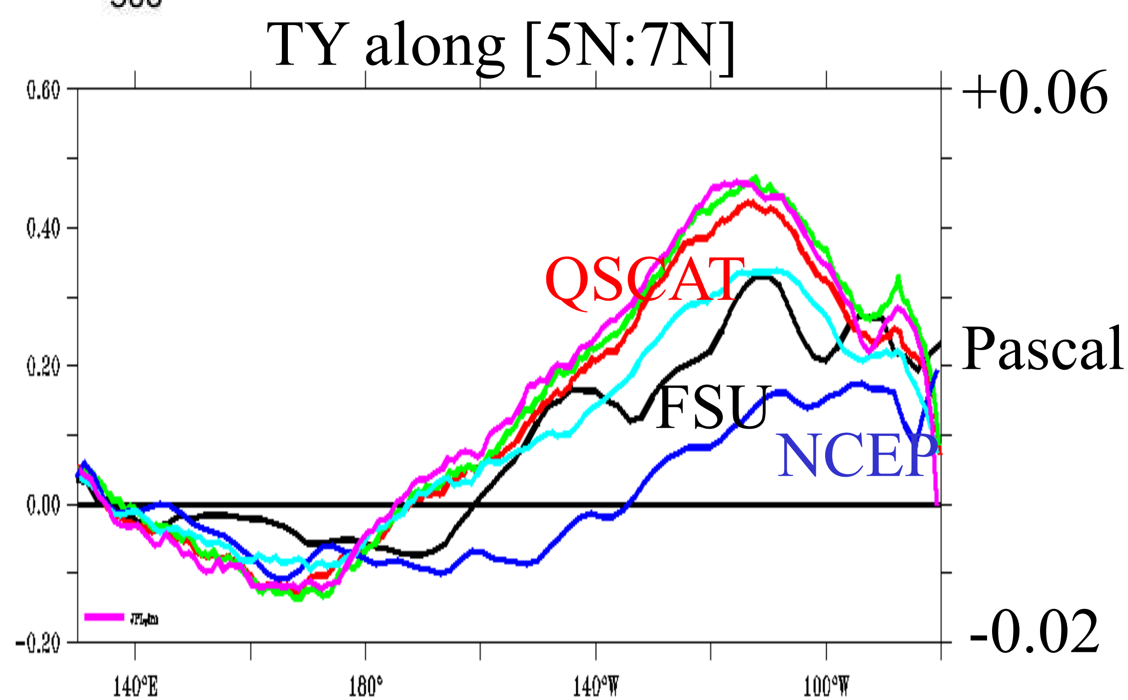
See manyOVWWork.doc

Basin-wide torques due to swell in the tropics



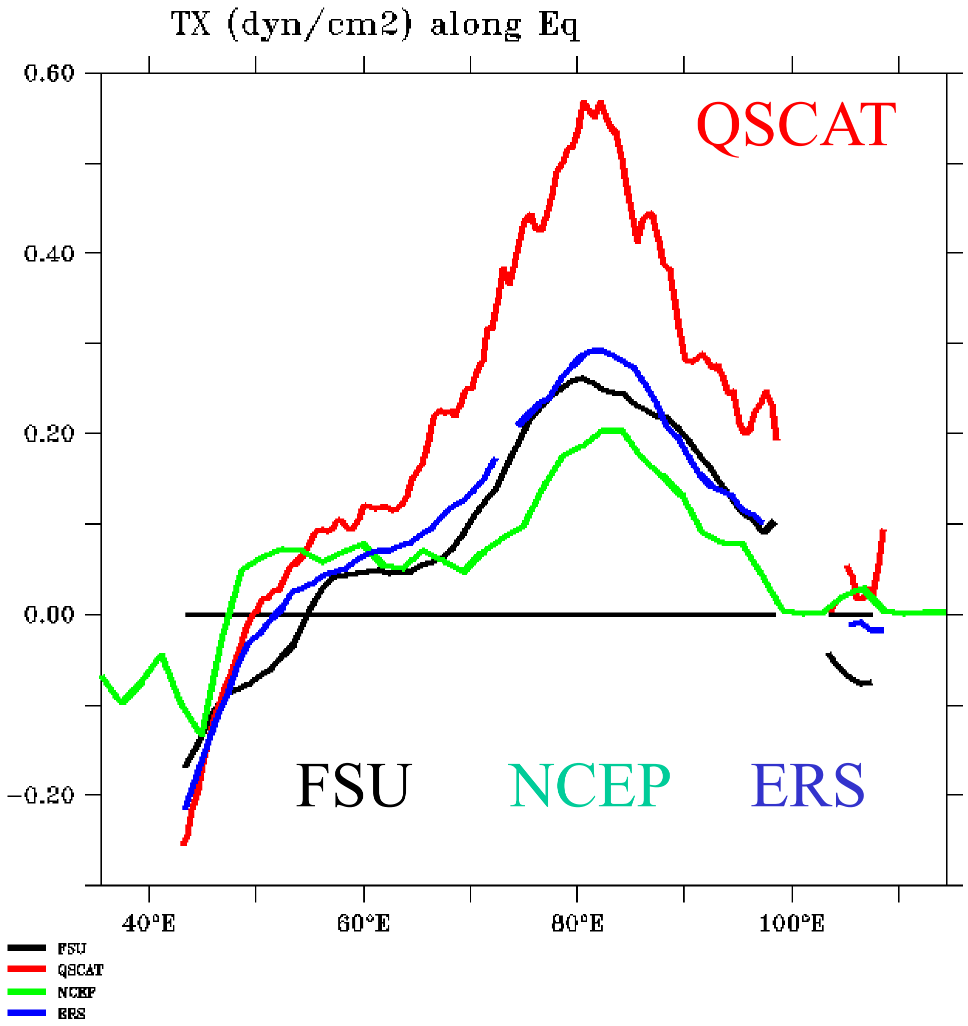
We should not drive Ocean models with scat data that include the torques due to swell or Wind waves.

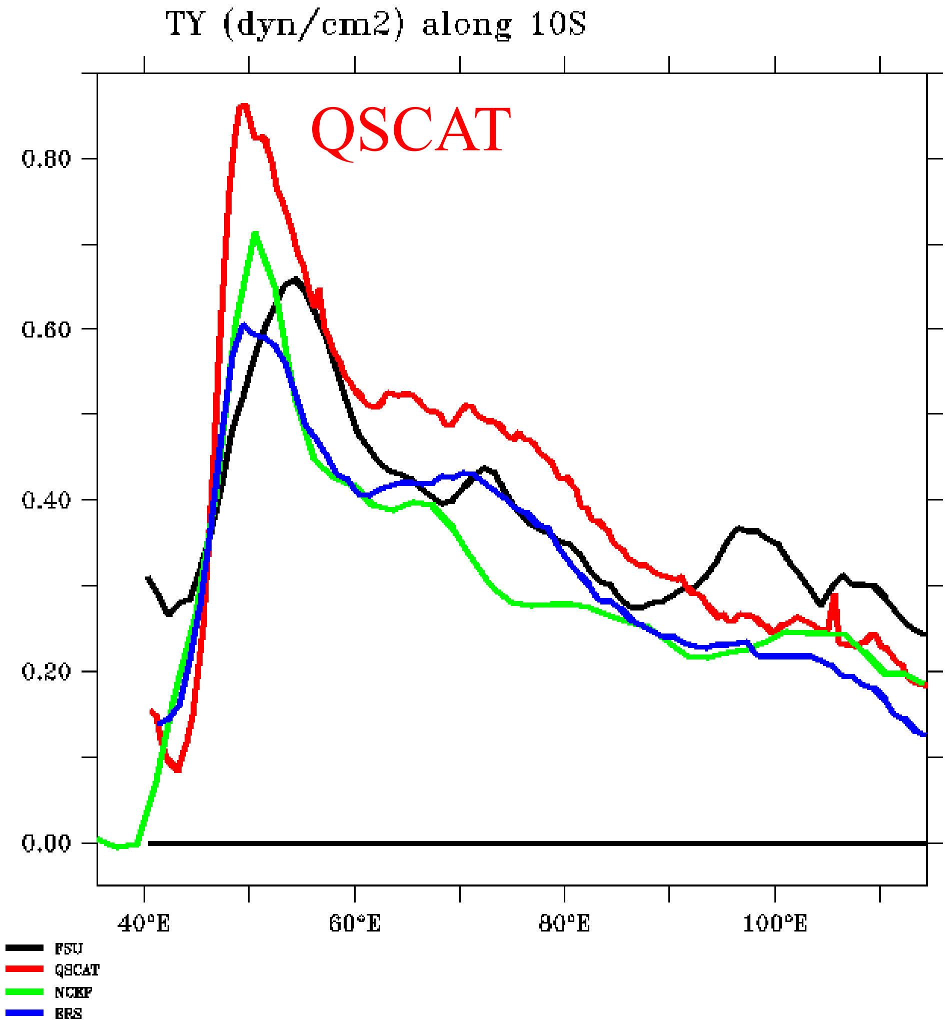




See footnote for comments on QSCAT, ERS, FSU ship wind data,

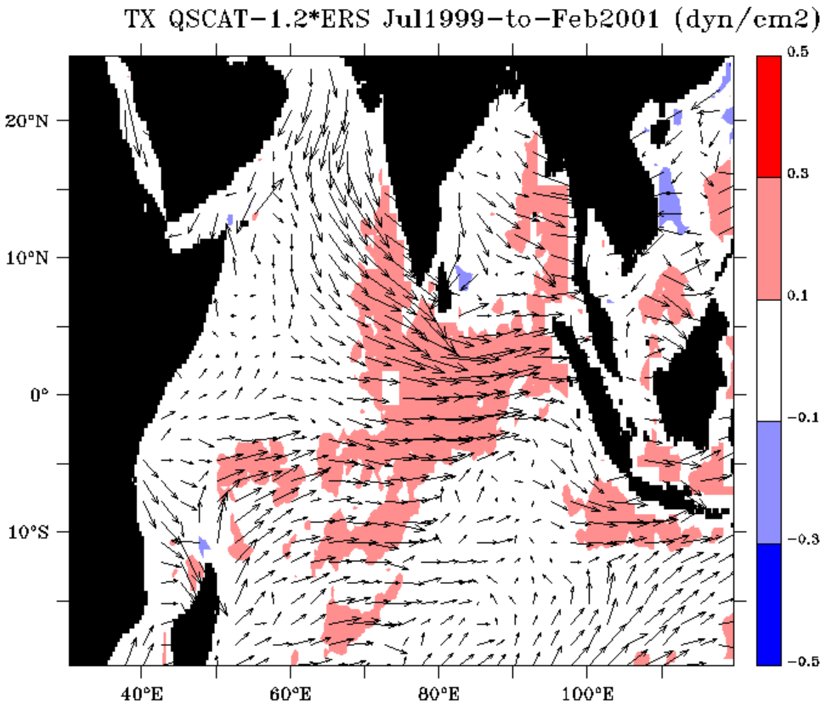
Mean 1999-2001 TX and TY Indian Ocean



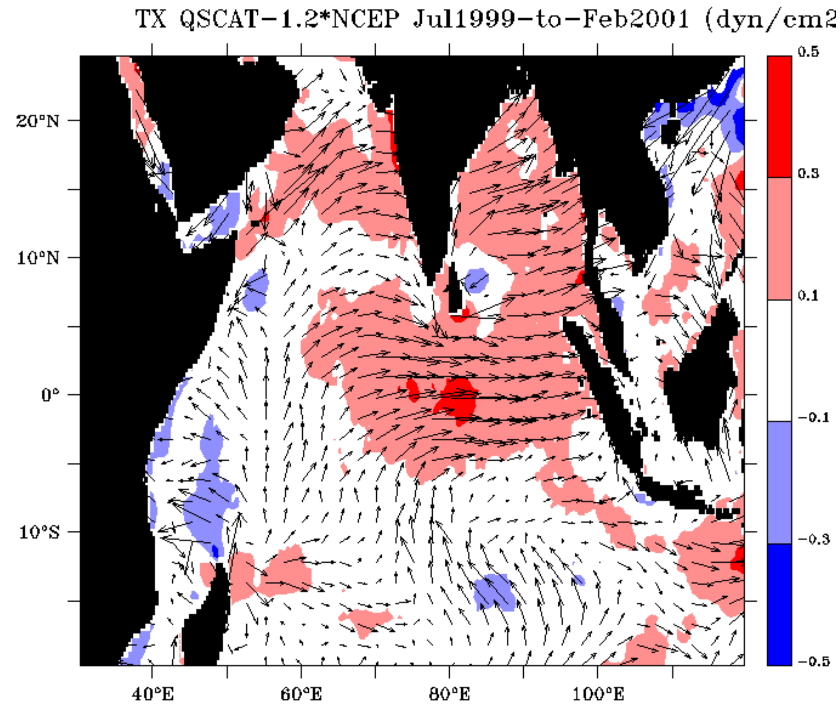


Differences in (TX,TY) averages over 1999-2001

QSCAT - ERS



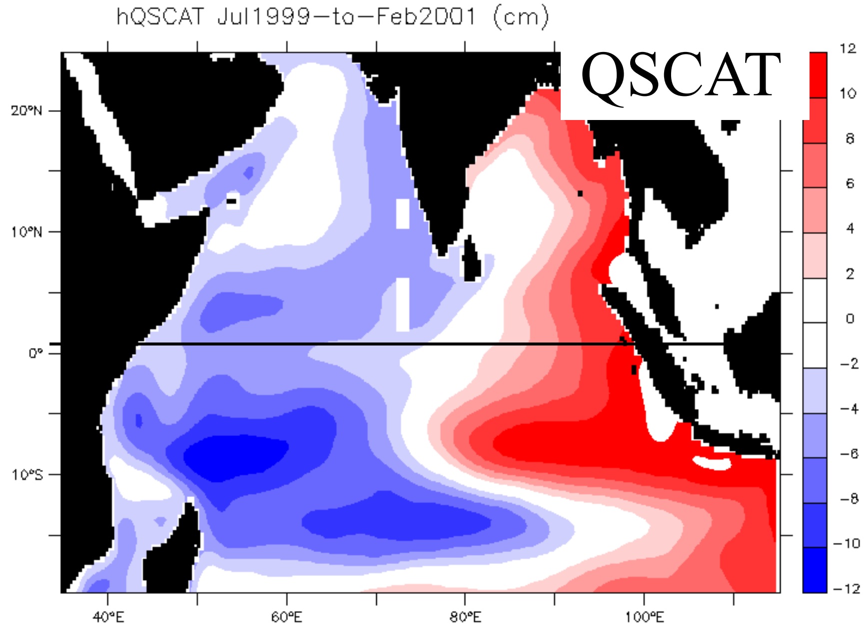
QSCAT - NCEP

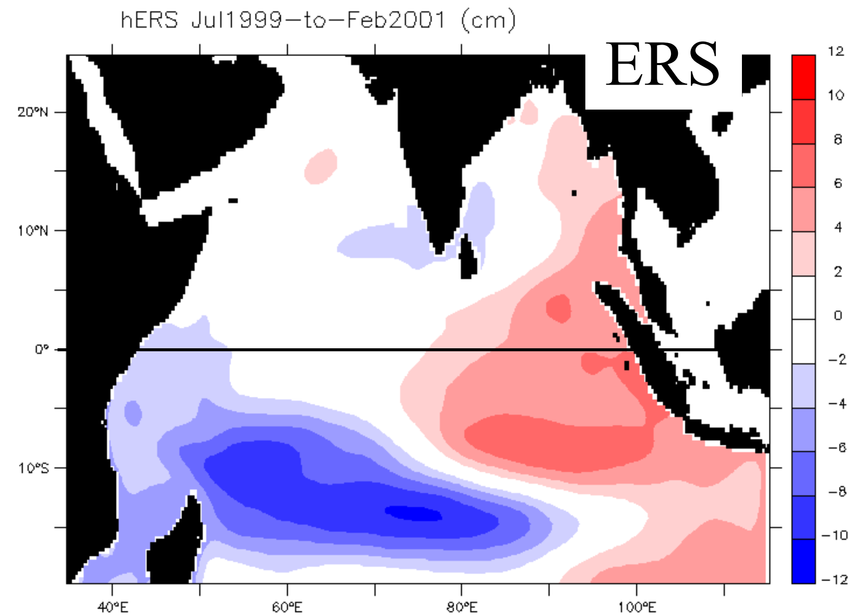


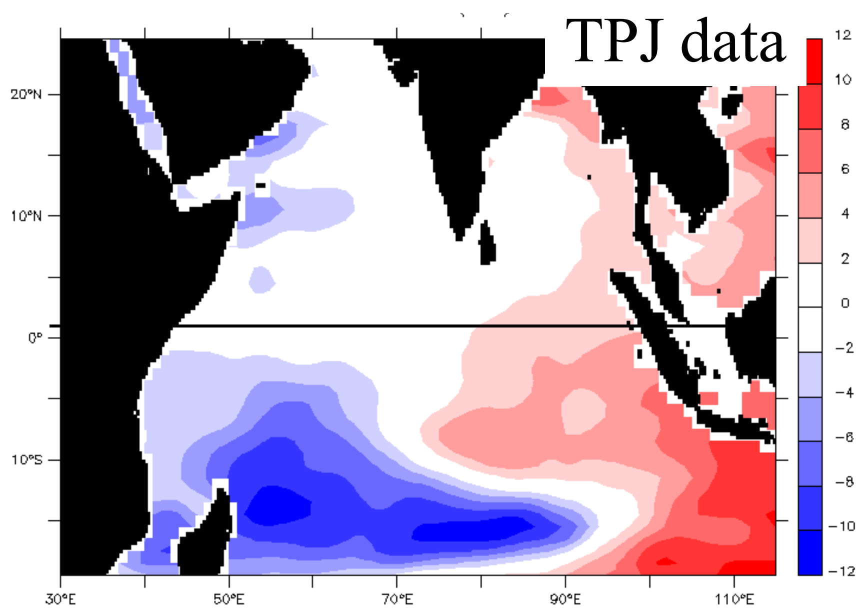
QSCAT difference with ERA40 and QSCAT difference with FSU have similar patterns with amplitude similarly as large as the above.

Difference TX intensity in color, unit is Pascal, diff (TX,TY) in vector.

Indian Ocean Sea Level forced by QSCAT or ERS



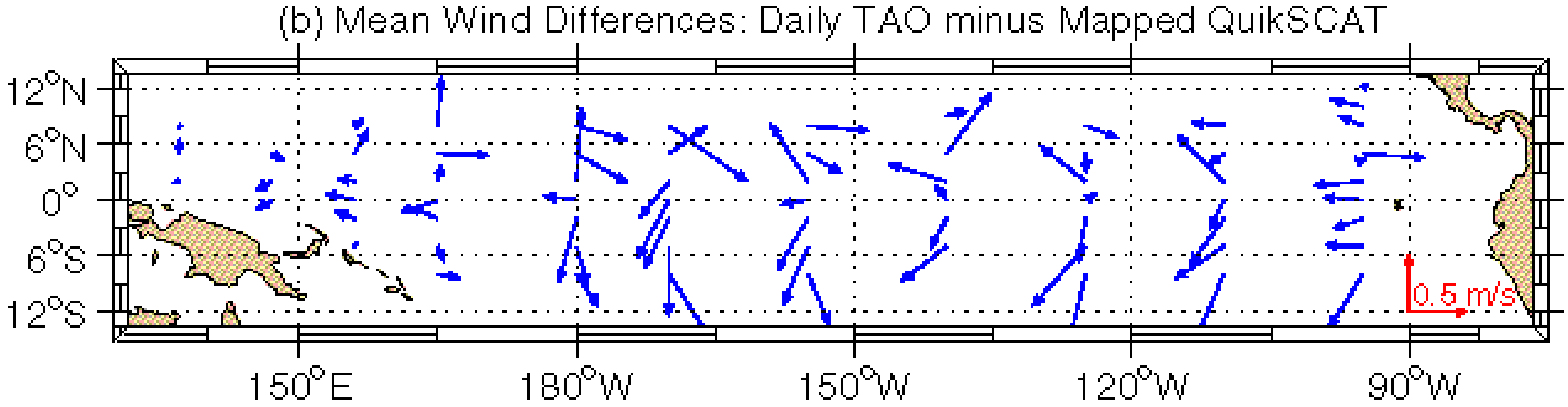




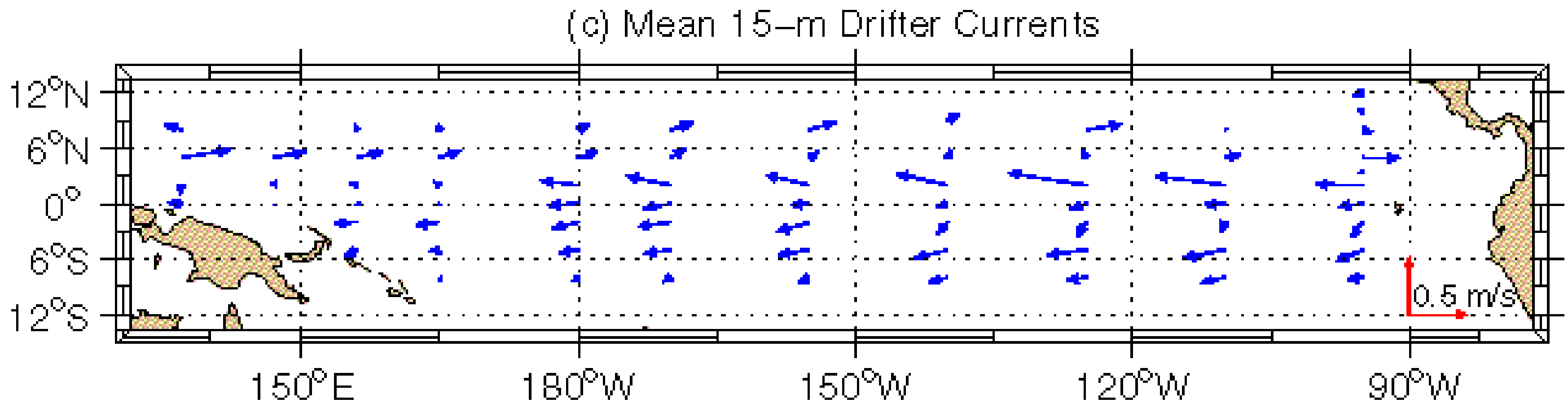
The misfit with TPJ is bigger for the model forced by QSCAT than for the model forced by ERS.

The misfit is consistent with the discrepancy between QSCAT and all other wind stress vectors.

TAO winds - QSCAT winds: mean differences



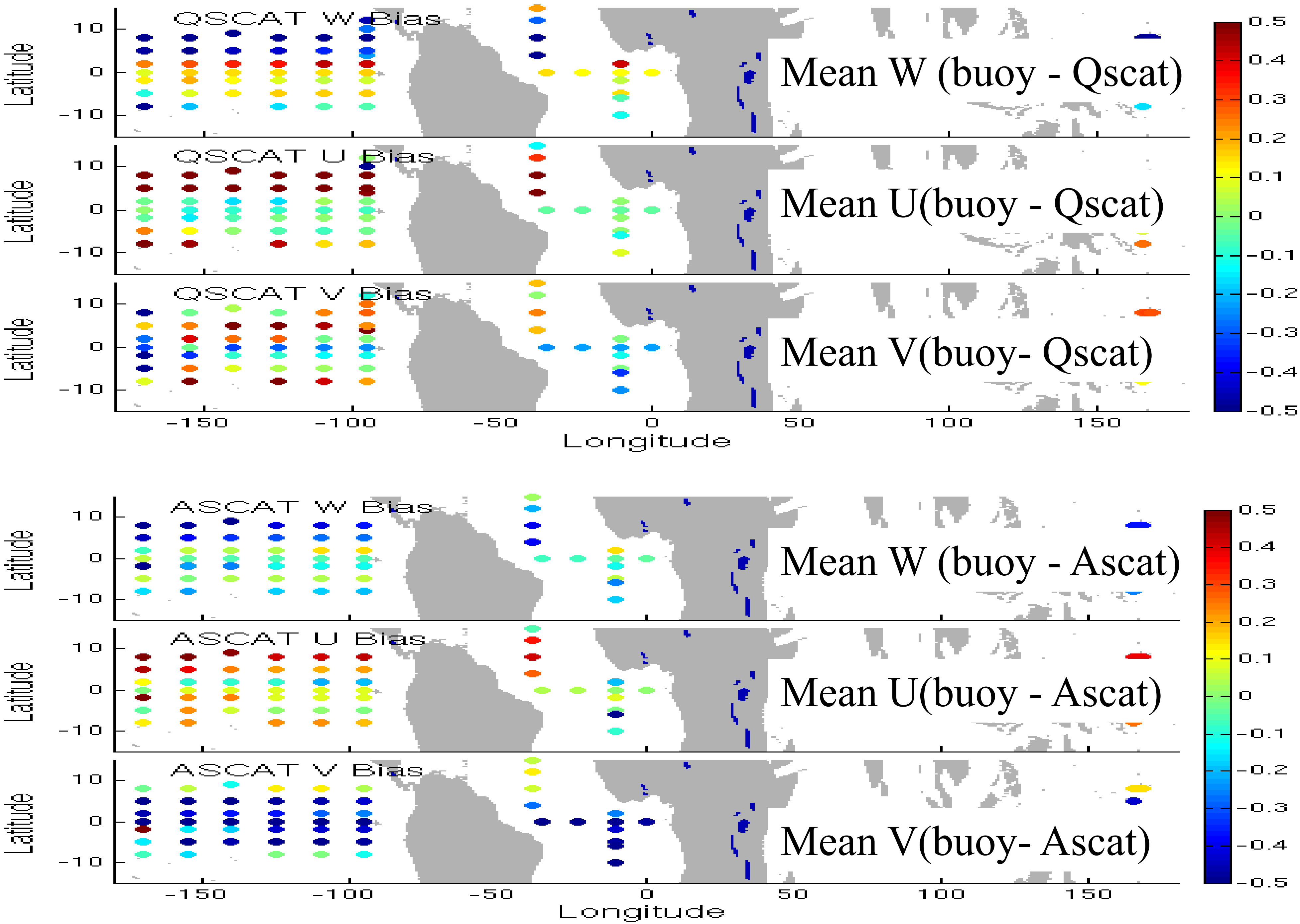
Mean Currents from Drifters



Current estimates from (TAO-QSCAT) are much more divergent (120ºW) and much more curly (160ºW) than currents observed with drifters.

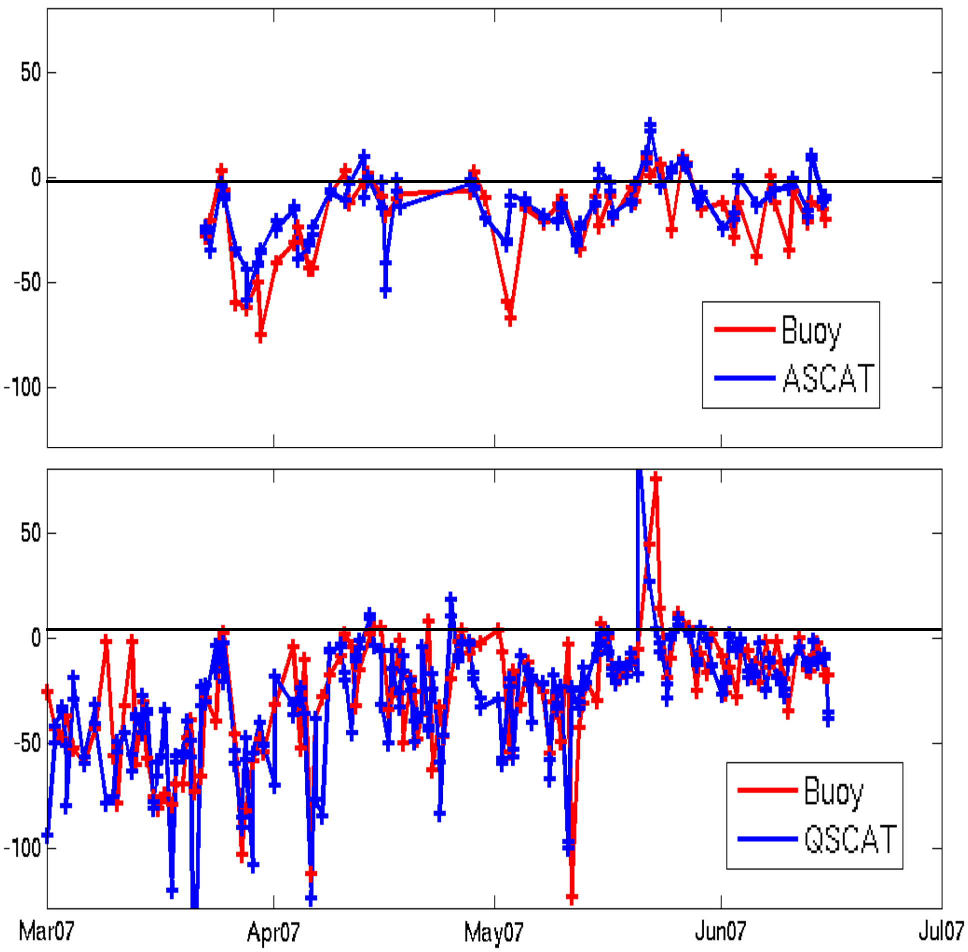
From Kelly et al, 2006

QSCAT and ASCAT collocated with buoys (10mn)



QSCAT or ASCAT collocated with TAO

Zonal WU 5N, 125W



Meridional WV 5N, 125W