Progress in OVW for climate monitoring

1. ERS, QSCAT, ASCAT data do not agree.
   Today's L2B or L3 products monitor winds that are associated with climate changes that are not consistent with what we know.

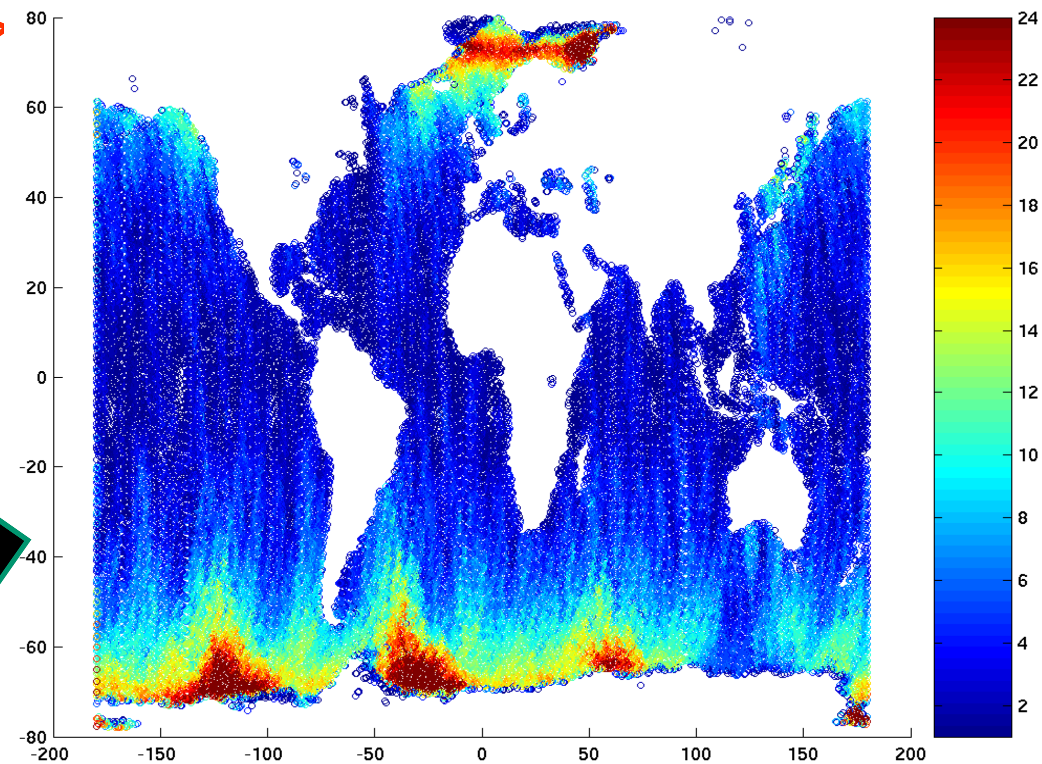
2. Error Source= OUR choice: sigma0 are converted in (speed, dir) of winds,
   * Pseudo-stress vectors (m^2/s^2) have directions that differ from winds.
   * In terms of energy, because water is 1000 denser than air, oceans' displacements (ripples, waves, currents…) are not negligible relative to atmospheric displacements.

3. Towards new cal/val metrics:
   Ocean Vector Wind WORK during Δt in (kg * m^2/s^2) to be monitored from time_0 to time_0 + n*Δt where Δt = ~1 week (or 10 days).

ASCAT/QuikSCAT collocated data

Max Spatial Separation = 50km
Max Temporal Separation = 4h.

14% data are within 1 hour
and 25 km.

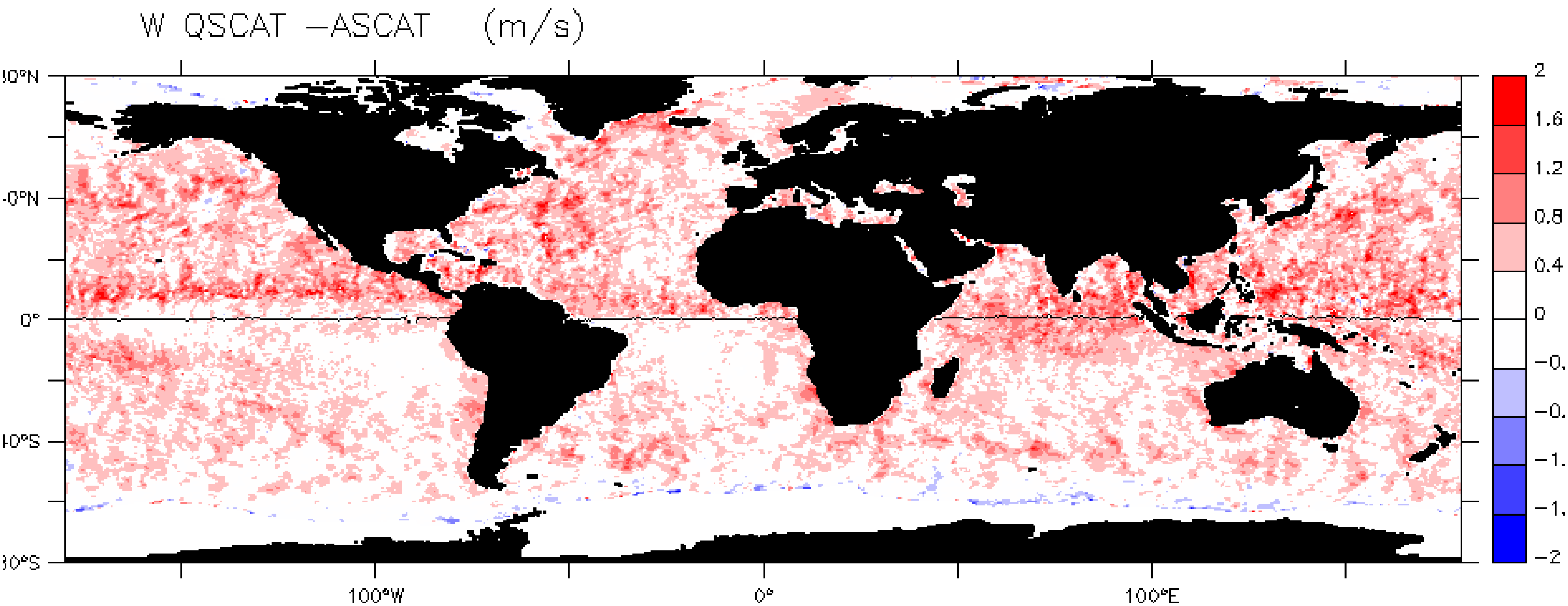


During 2 months, collocation provides
~11M data on the globe
(~1M in the tropics).

See Bentamy (2008a; 2008b).

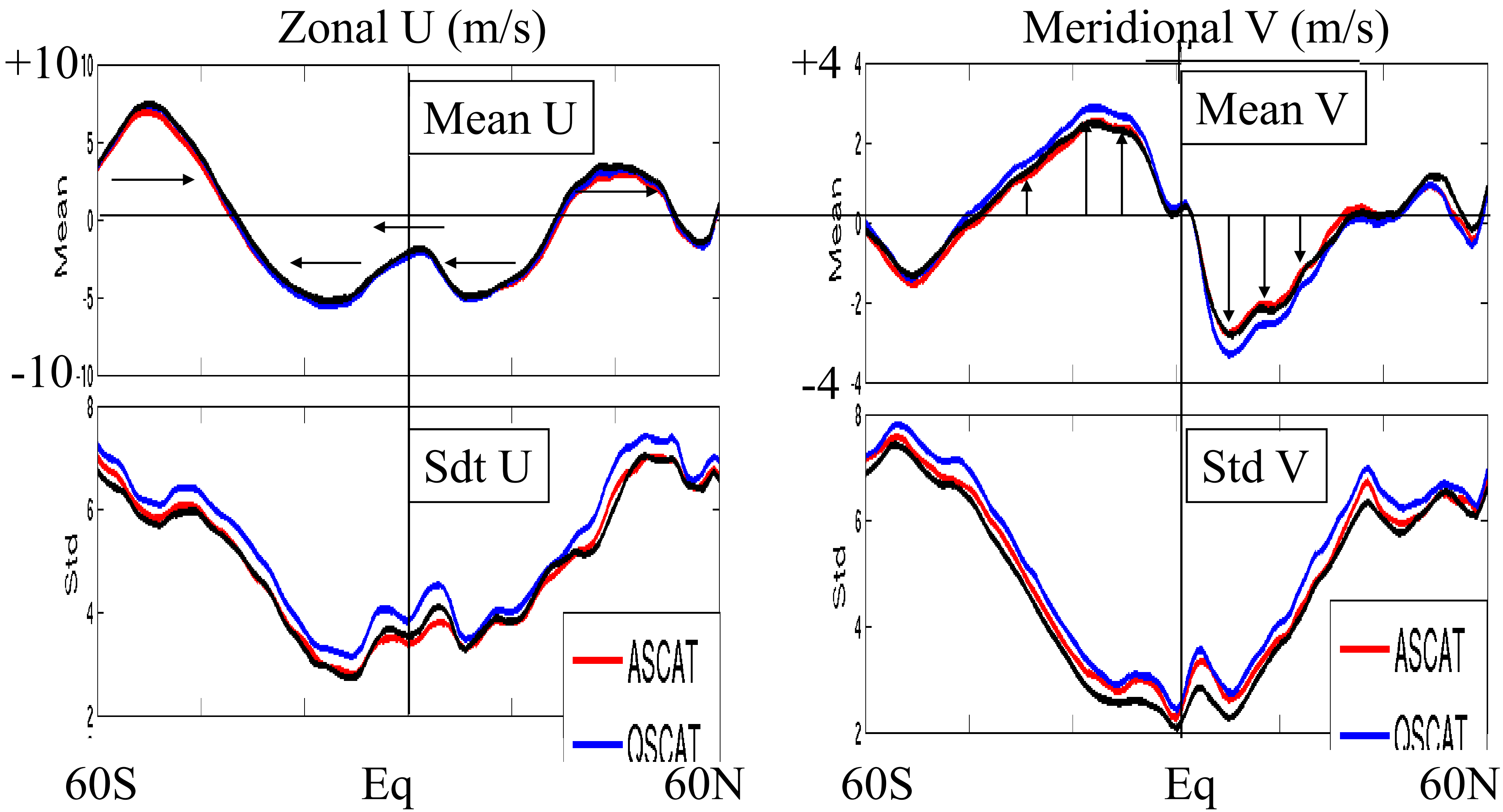
Results next slides come from collocation during "11 months" (since Oct 07).

Time averaged difference in wind speed W: QSCAT - ASCAT



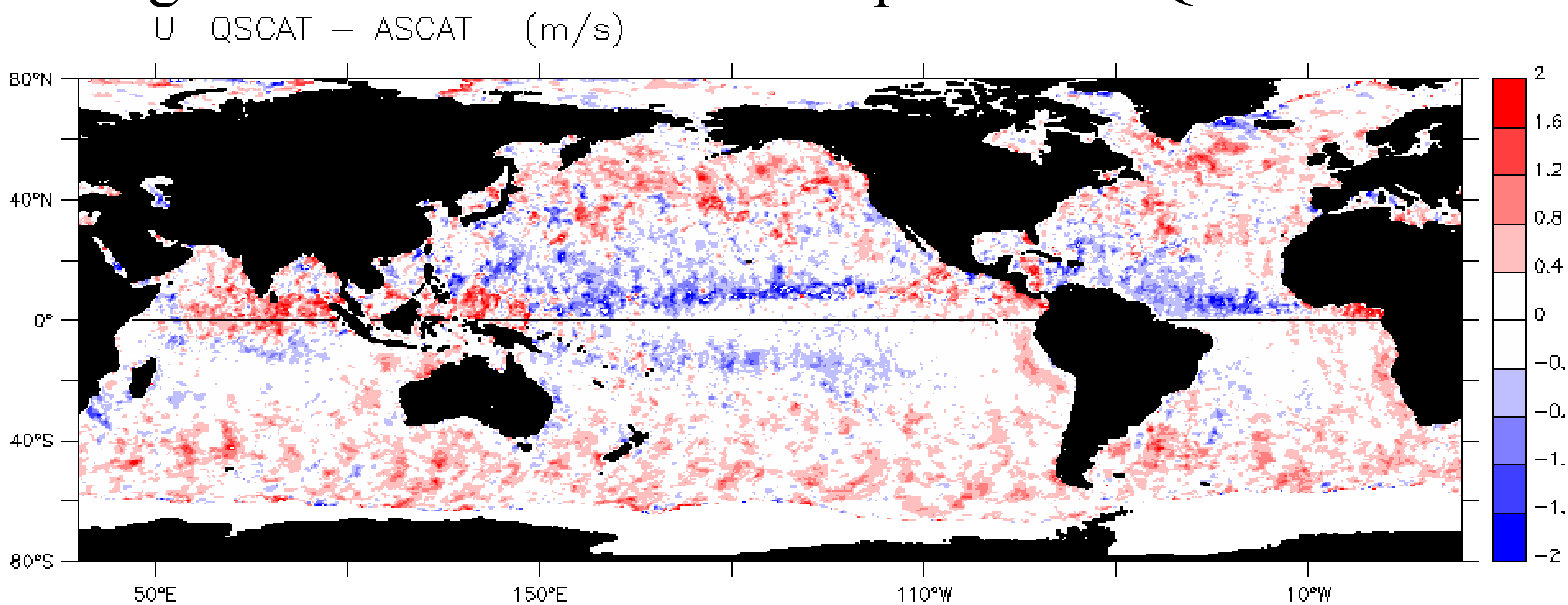
QSCAT stronger than ASCAT everywhere. See footnote

QuikSCAT ASCAT ECMWF collocated winds as a function of latitude



QuikSCAT: Mean and Variance are stronger at all latitudes for V and for U. See Footnote.

Time-averaged difference in zonal component U: QSCAT - ASCAT

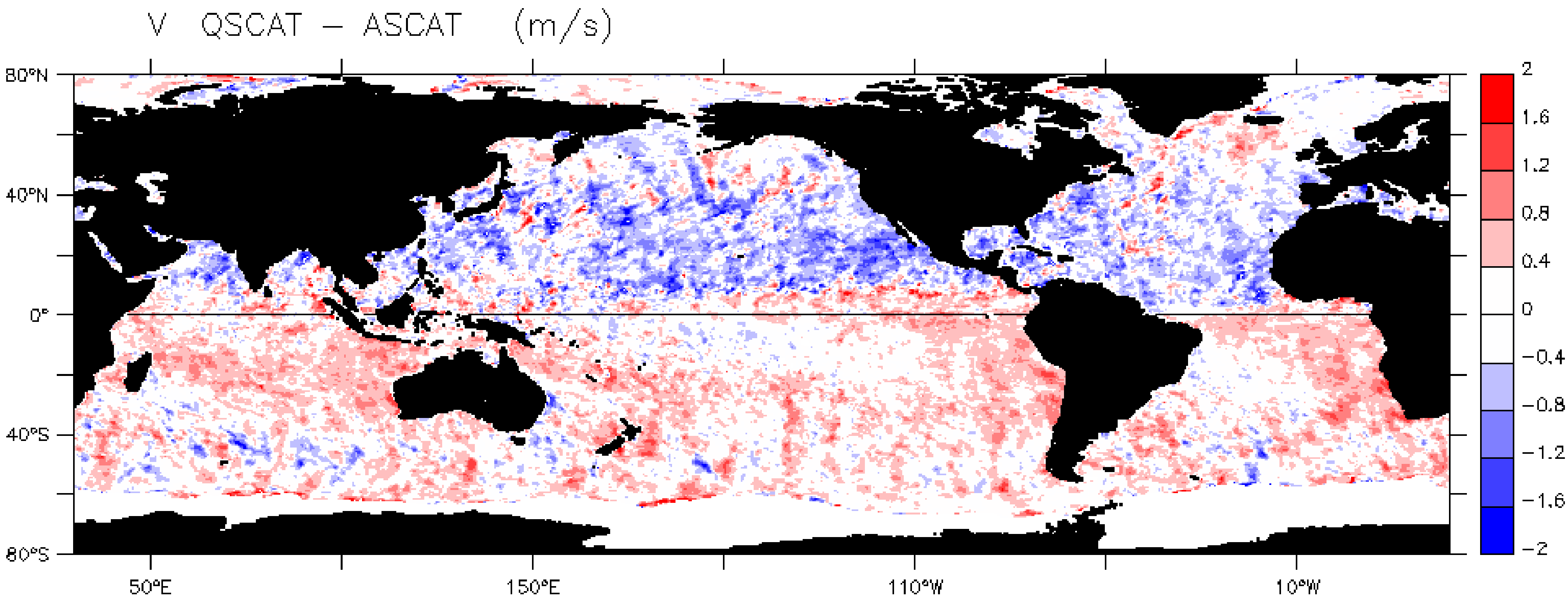


ACC, Indian Ocean, North Pac and North Atlantic where winds and oceans flow eastward: QSCAT stronger eastward than ASCAT.

Tropical Pacific and Atlantic where winds and oceans flow westward, QSCAT stronger westward than ASCAT..

In the tropics, note that the discrepancy is not ITCZ/SPCZ rain signature.

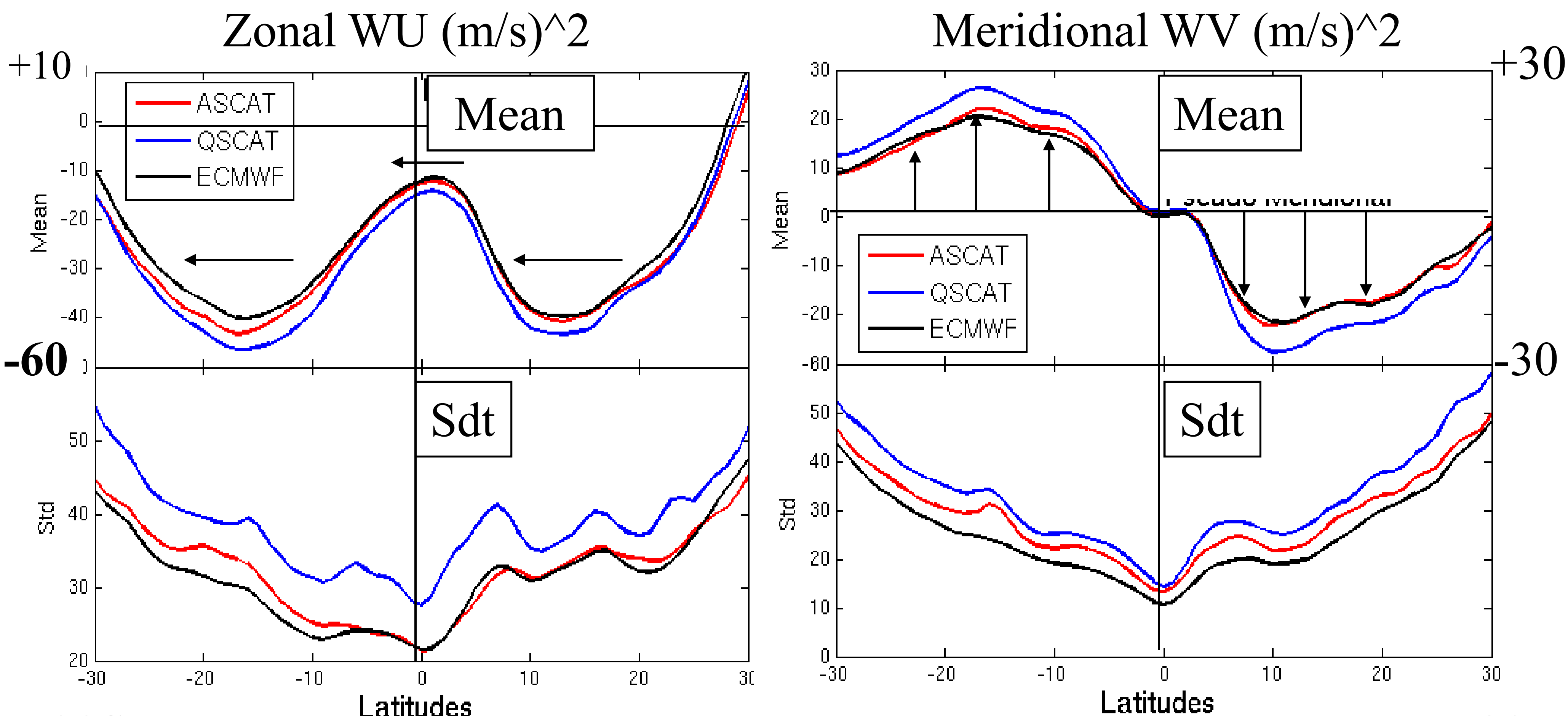
Time averaged difference in meridional component V: QSCAT - ASCAT



QSCAT is more convergent towards the “equator” than ASCAT.

QuikSCAT ASCAT ECMWF collocated pseudo-stress

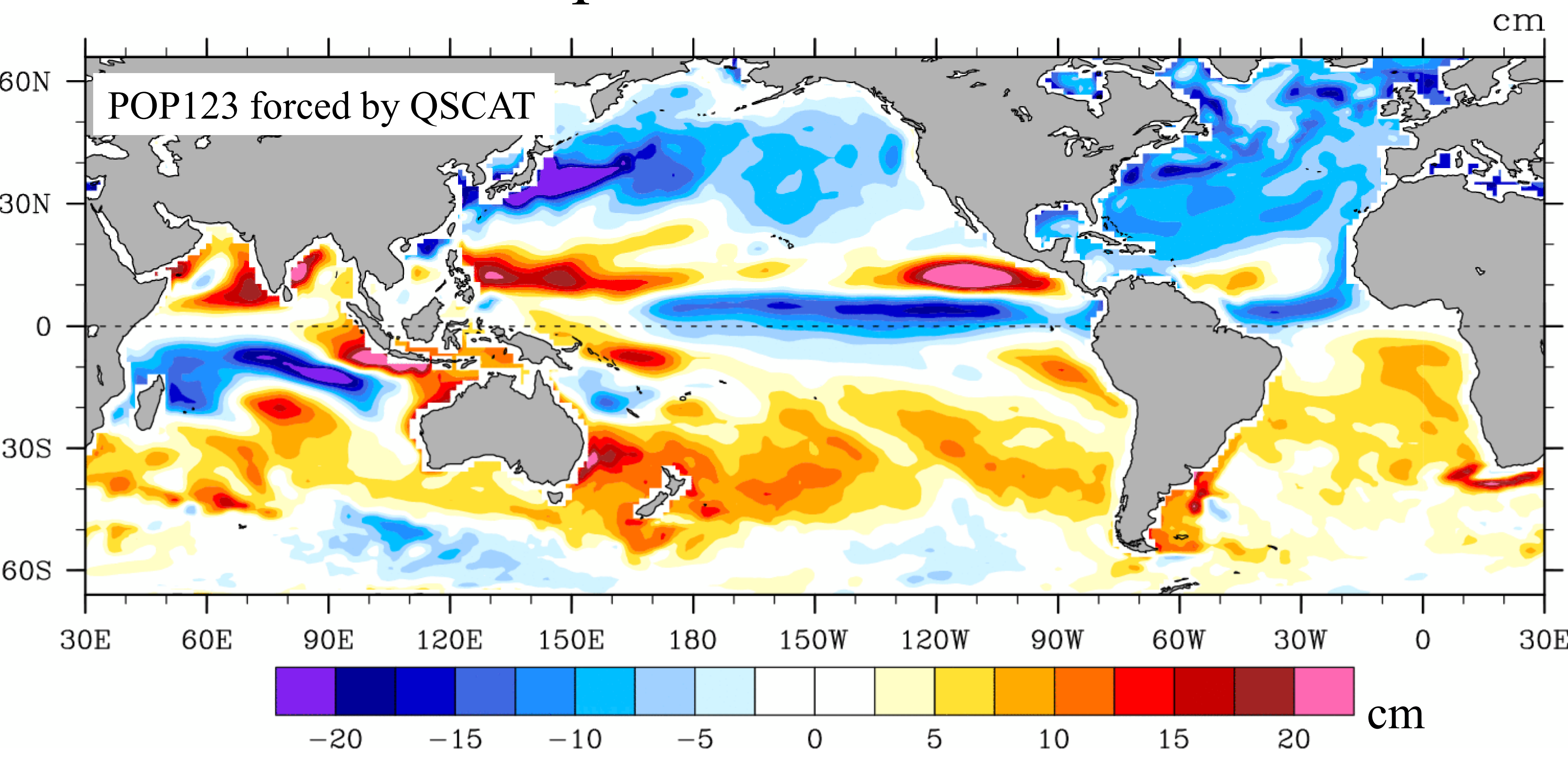
Zonally averaged values as a function of latitude



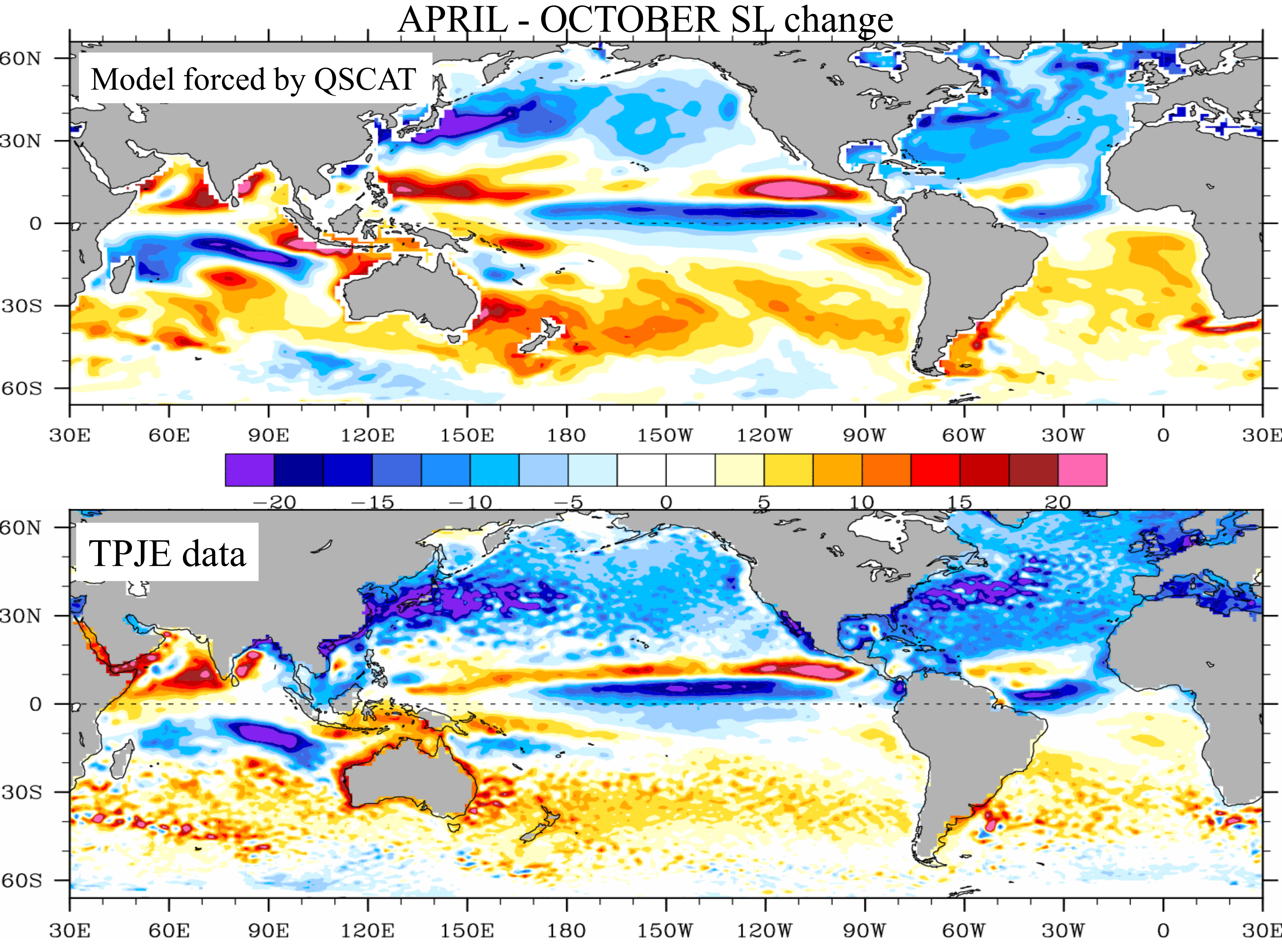
QSCAT: stronger trade winds and equatorial convergence than others.
ASCAT retrievals agree with ECMWF whereas they SHOULD differ because the (ocean+waves+swell) detected by ASCAT are not in ECMWF.
However, QSCAT differs TOO MUCH from the truth.

Seasonal Sea Level change simulated by POP forced by QSCAT

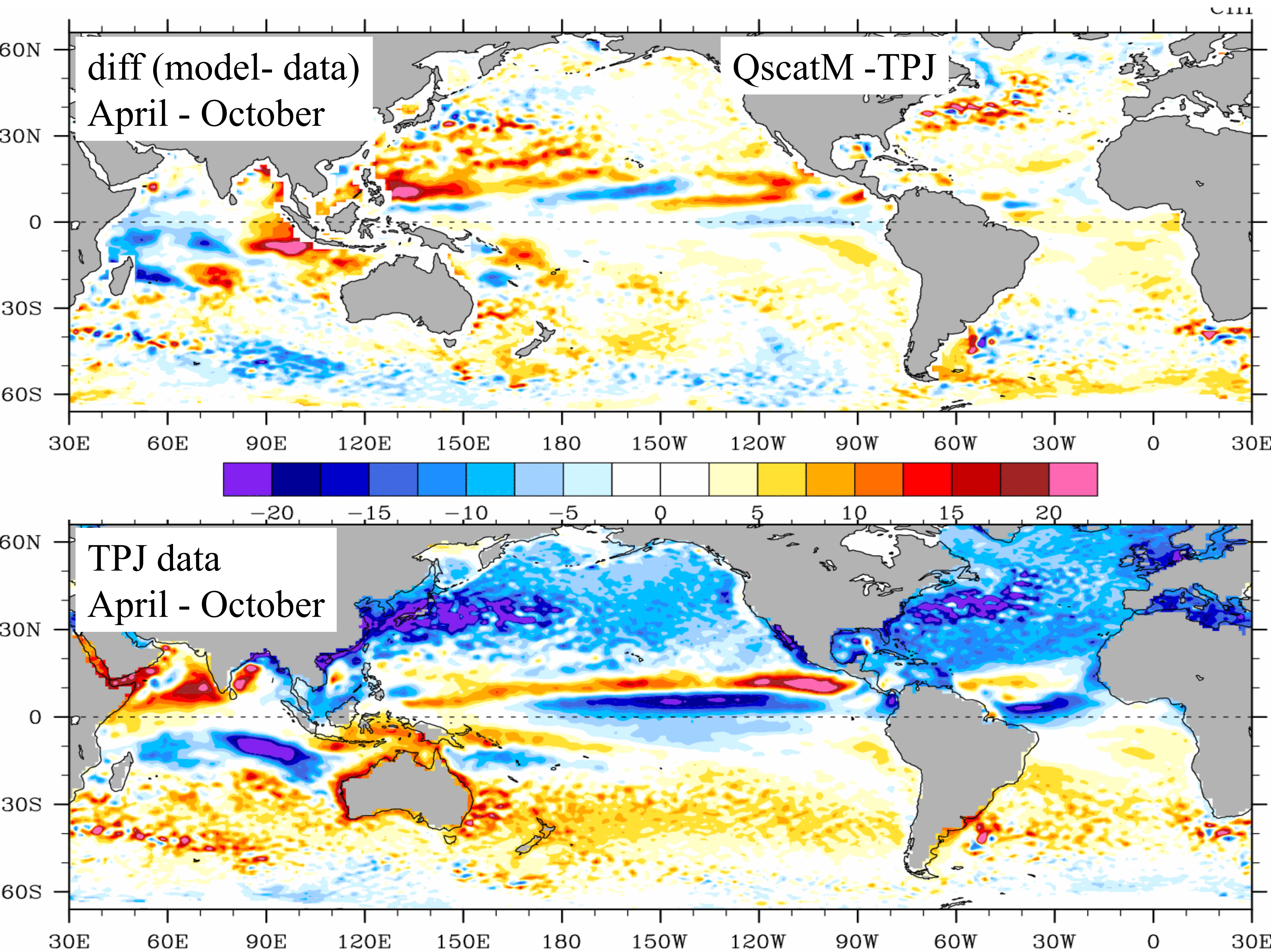
April - October



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

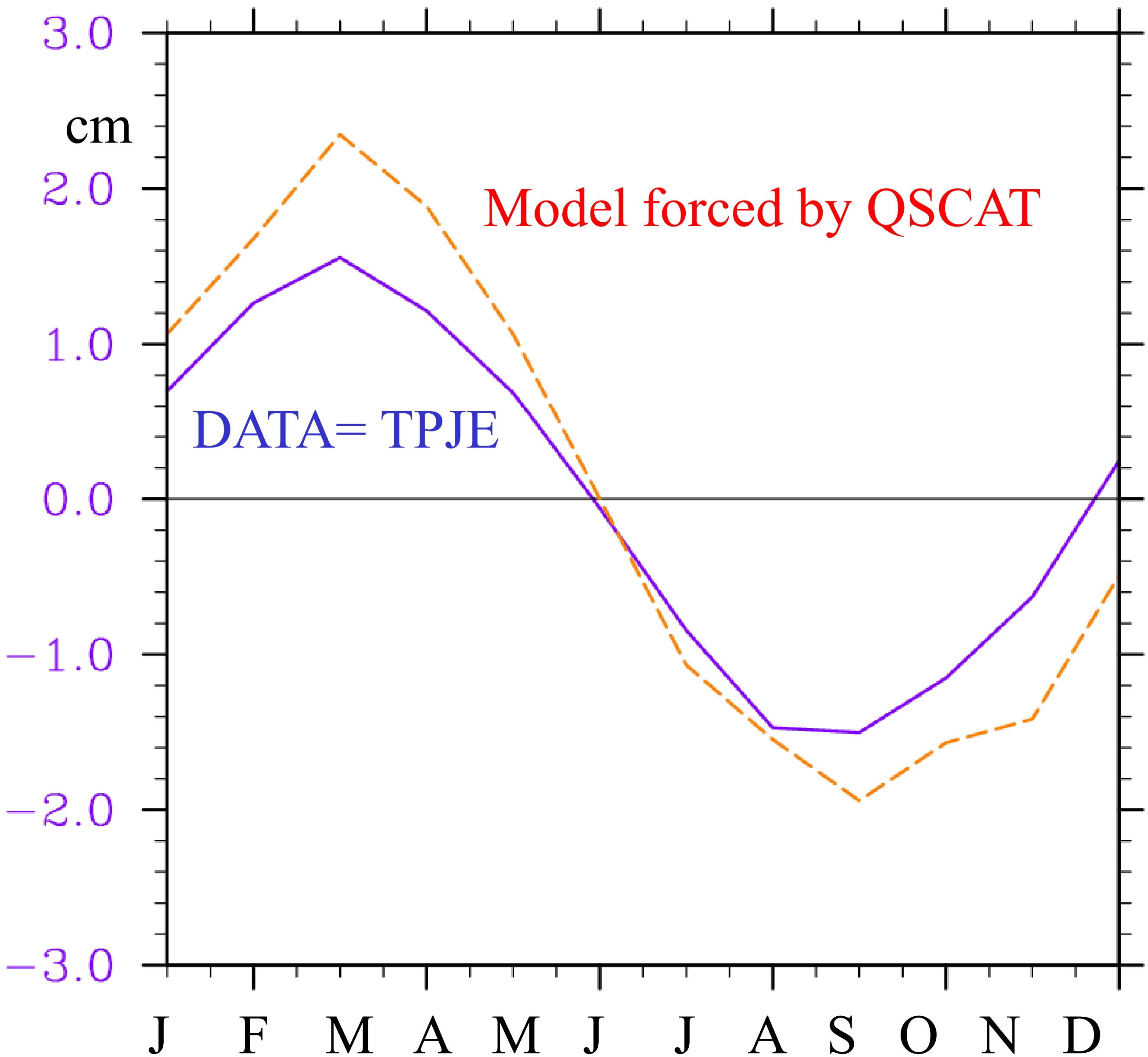


APRIL - OCTOBER SL change
Model forced by QSCAT
TPJE data
60N
30N
0
30S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
30E
−20
−15
−10
−5
0
5
10
15
20



diff (model- data)
April - October
QscatM -TPJ
cm
60N
30N
0
30S
60S
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
30E
−20
−15
−10
−5
0
5
10
15
20
TPJ data
April - October

Seasonal Sea Level signal averaged in the SOUTH

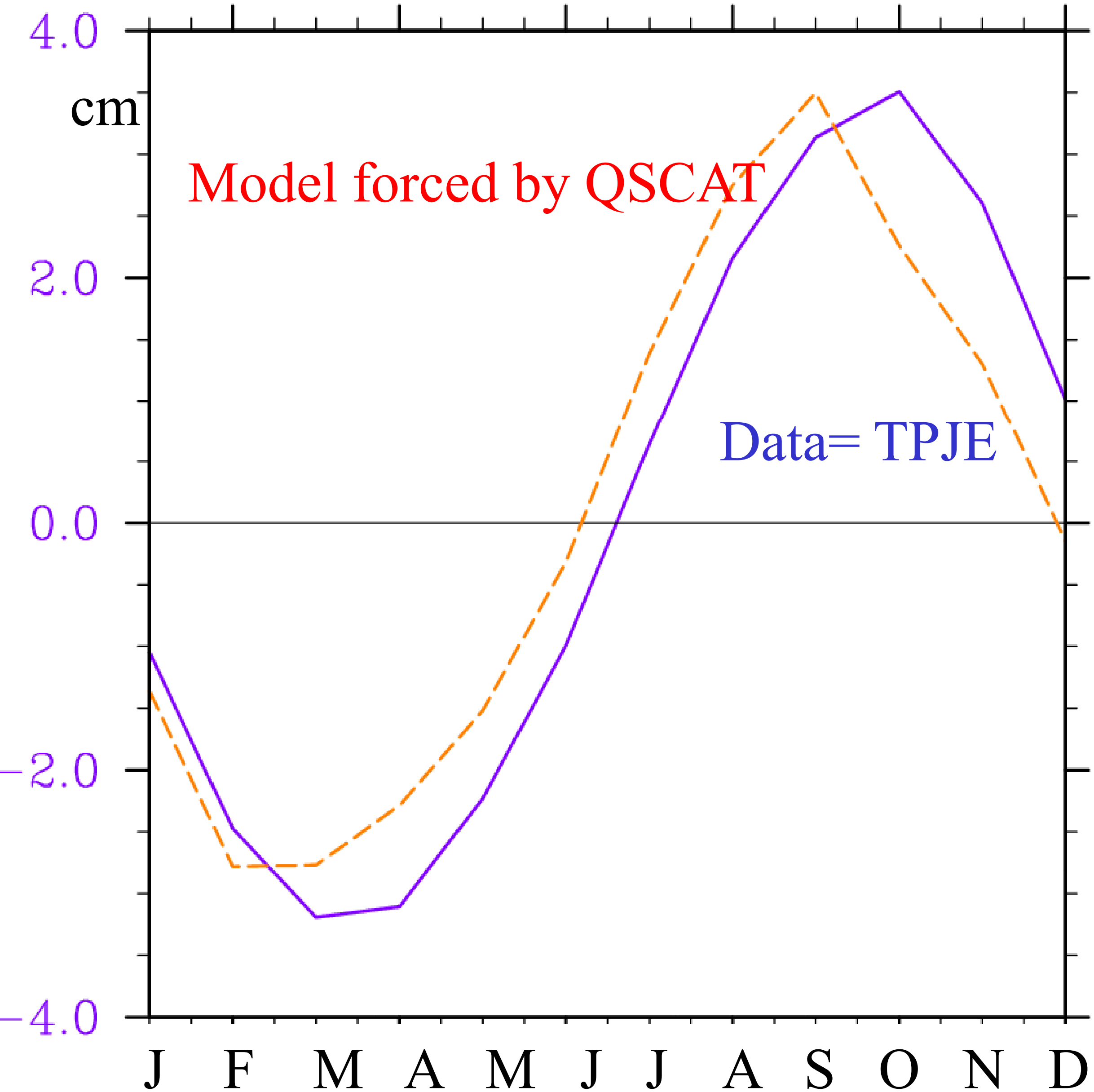


QSCAT drives seasonal SL changes in the South that are 50% bigger than observations.

Don't forget that TPJE data monitor planetary averaged SL budgets with ~2mm/year accuracy.

Could this be due to errors in POP model?

Seasonal Sea Level signal averaged in the North

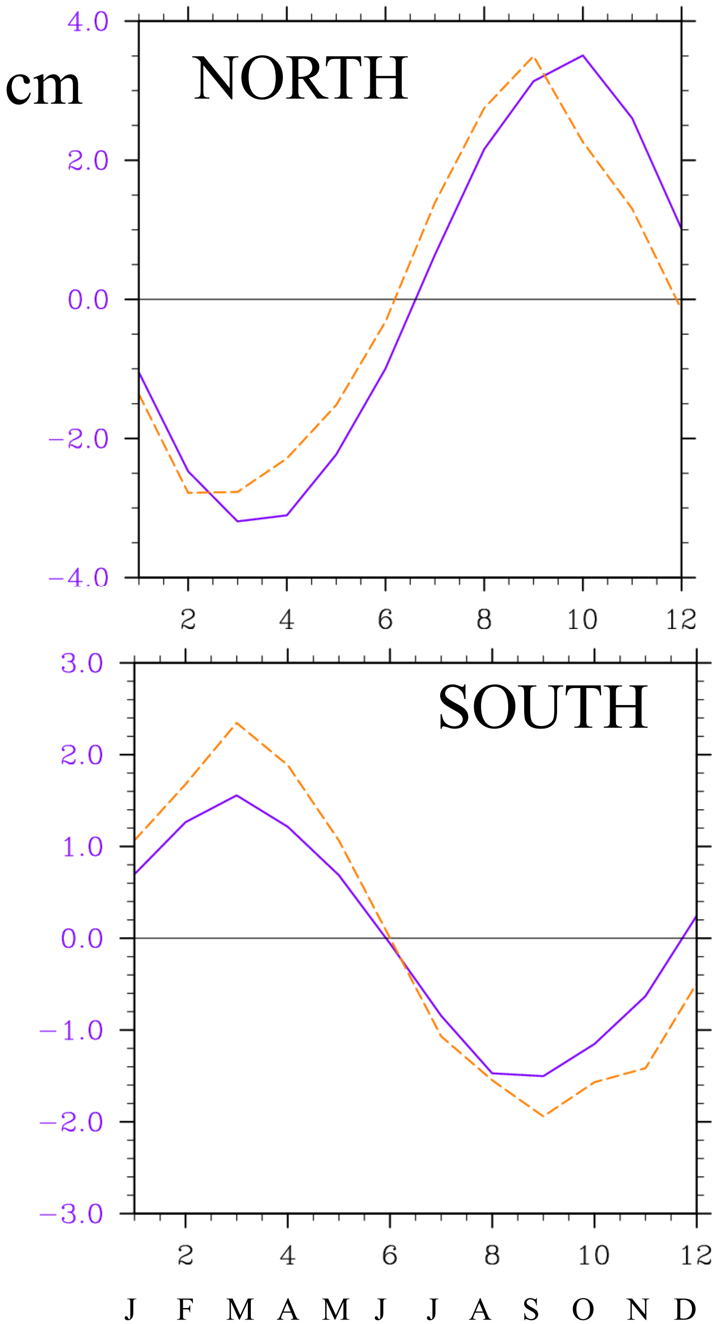


In the North, it is not the amplitude that differs from TPJE data, but the timing of the seasons driven by QuikSCAT.

Waves and swell DO differ in the North and in the South, and modelers DO need to take into account the effet of (wave+swell) in the drag used to couple OA.

However, it is unlikely that errors in POP model friction is the dominant error source here because….next slide…

Seasonal discrepancy between TPJE and model forced by QSCAT



The timing of the seasons driven by QSCAT in the North is erroneous BECAUSE North Pacific waters are rushed into the South Indian Ocean with ITF increased more than normal all year long and more than ever during summer Monsoon, consistently with overestimated amplitude in the South.
All year long, waves generated around Antarctica more than waves generate in the North high lats transform into swell that propagate equatorward and cross the equator in the Tropical swell pools.

Both QSCAT and ASCAT overestimate the northward cross-equatorial signal in the eastern swell pool (see buoy and ADCP comparison).

Conclusion and Perspectives

1) Today's estimates of *SCAT products:
QSCAT have a stronger amplitude everywhere and a stronger equatorial convergence in the subtropics. QSCAT seasonal and 5-year averaged biases are so strong that they violate what has been so far observed and simulated in ocean/climate changes.

2) Choosing to convert QSCAT sigma0 into energy vectors + learning how slopes of (waves +swell) modify the ripple scattering of the energy depending on the rotating or fixed antenna beam of the radar can correct part of today's flaws in the estimated wind directions and magnitudes…. There is so much hope that DFS will allow to construct a GMF for monitoring ocean/climate!…. Go Go GO!!!… Launch DFS!!!

3) Possible new cal/val metrics: OVW Work zonal, meridional and vertical.

Ocean Vector Wind Work

In addition to converting *scatt sigma0 L2A values into L2B winds if people want to continue to do so, we can ask agencies to convert sigma0 into OVWWork on each Wind Vector Cell (WVC) surface, taking advantage of the specific spatio-temporal distribution of each WVC for each specific satellite orbit…. possibly using future optimal (x,y,t) combinations of *scatt and rain satellites constellation. But first:

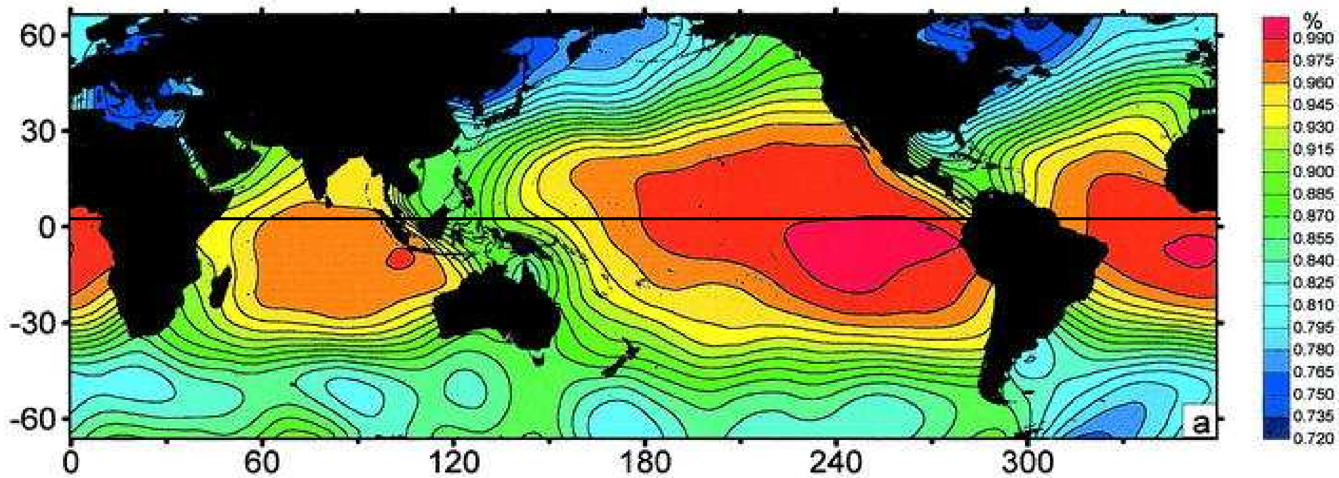
individual *scatts (ERS1, ERS2, NSCAT, QSCAT, SW2, ASCAT) have to be calibrated using Planetary-averaged OVWwork amount accumulated every week (or 10 days?), and using independent geodesy + Grace + altimetry + atmos SLP + SSMI water content to validate such planetary OVW budgets. The 2 horizontal components of OVWWork are:

OVWWork_x = TX * Surface_WVC * U_ocean * dt (1)

OVWWork_y = TY * Surface_WVC * V_ocean * dt (2)

We also need to compute the vertical OVWWork_z that goes into rising locally generated wind waves. Swell does NOT belong to OVWWork_z.

Swell pools in the 3 tropics



Swells generated by winds around Antarctica reach and cross the equator 3 to 4 days after.

Uncertainty of bulk: (Ua - Uoc - 0.8 Uorb) = u*/k log[(z - 0.8 H)/z0]
+ Uncertainty Uorbital wind waves and swell (model+wind).

We want to avoid bulk formulae as much as possible to monitor climate.

Wind waves and swell slopes may affect the energy backscattered by the ripples measured by the radar. They possibly affect our way of estimating Wind? Waves? Currents? Stress? directions depending on whether our detection tools has a fixed or a rotating geometry .