

Climate Applications of Ocean Surface Vector Winds

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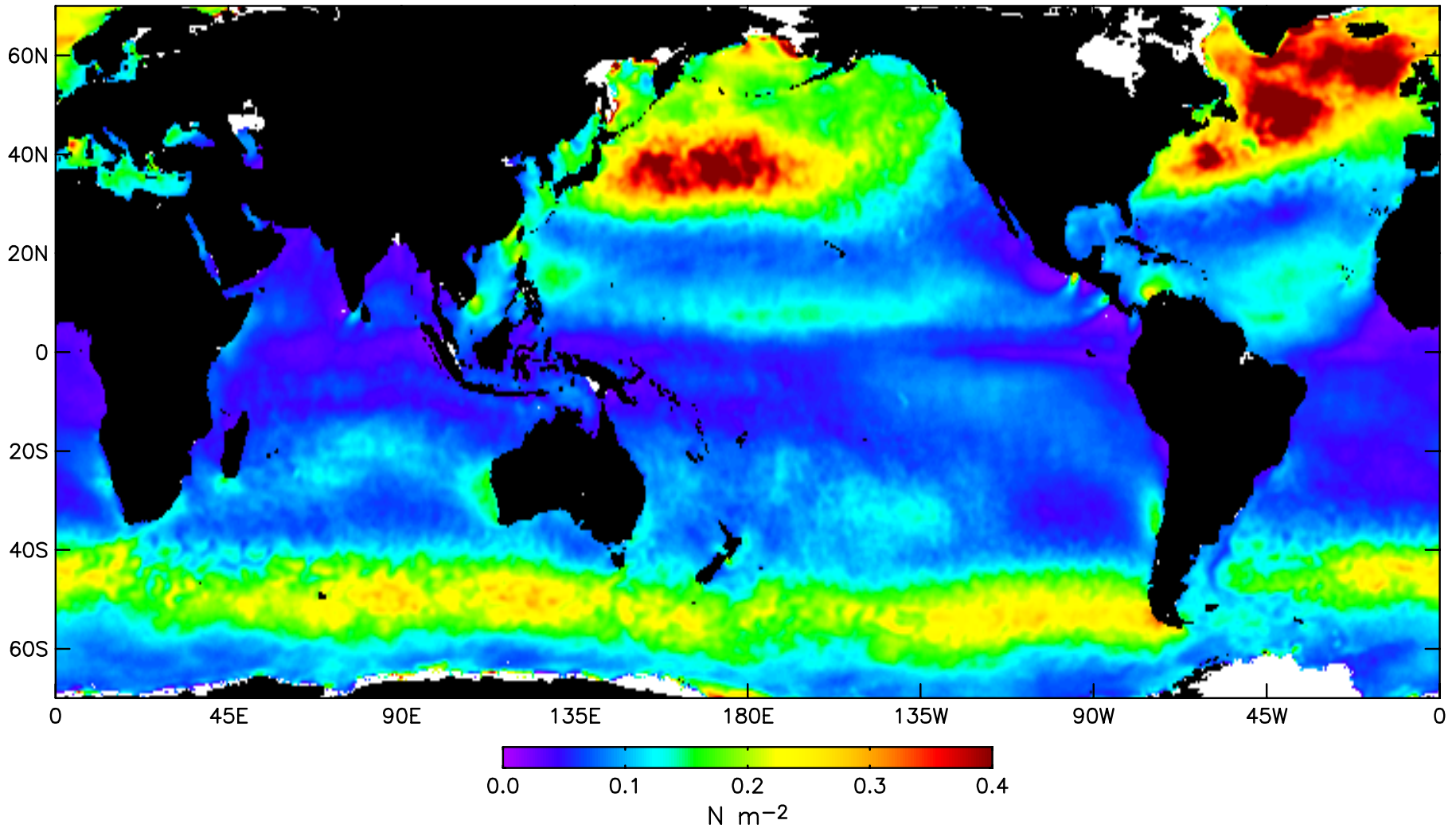
Issues:

- *Accuracy*
- *Spatial Resolution*
- *Global Coverage*
- *Continuity of Data Record*
- *Length of Data Record*

2-Month Average Wind Stress Magnitude

QuikSCAT, January–February 2003

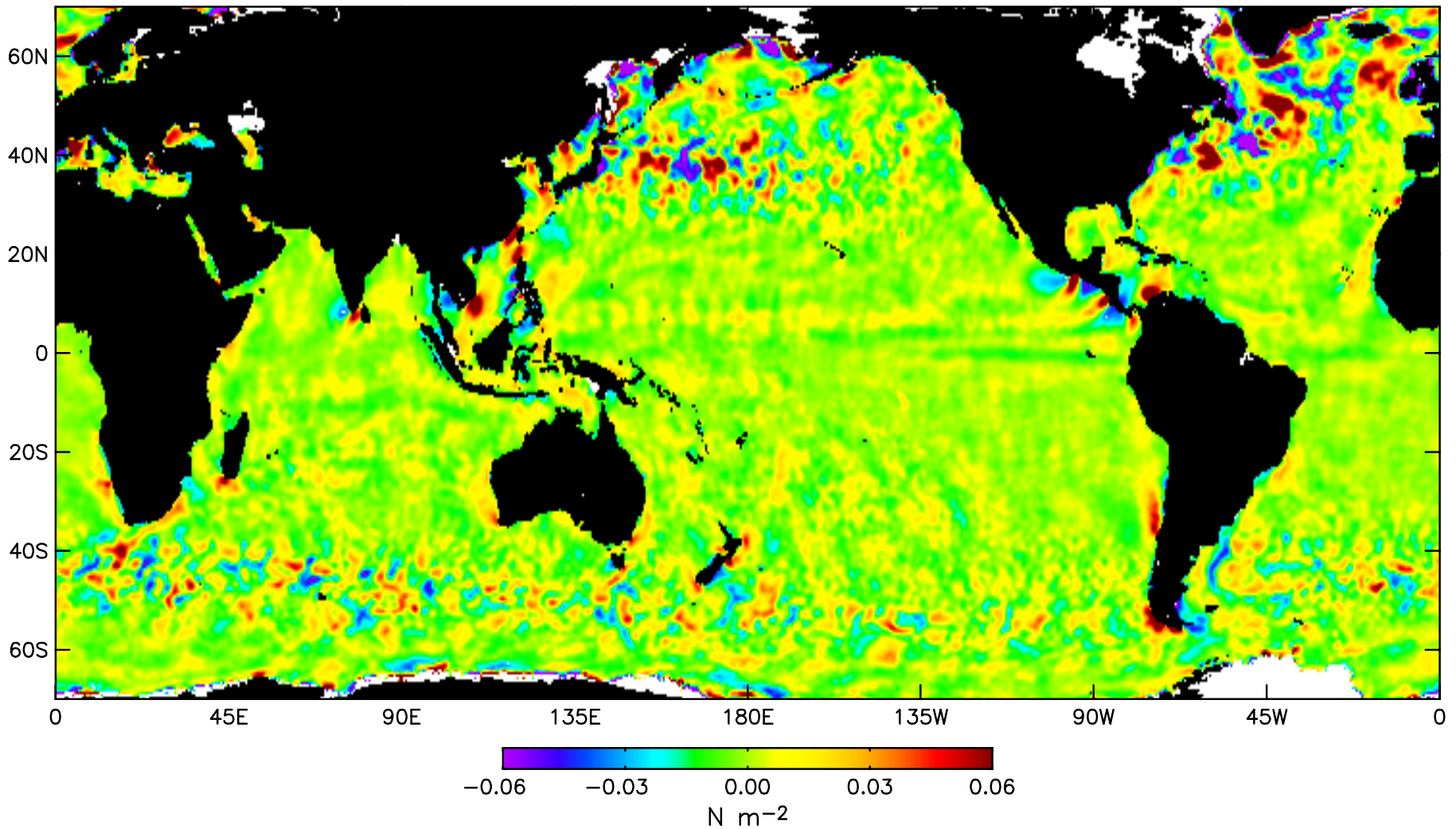
Wind Stress



2-Month Average Wind Stress Magnitude (Spatially High-Pass Filtered)

QuikSCAT, January–February 2003

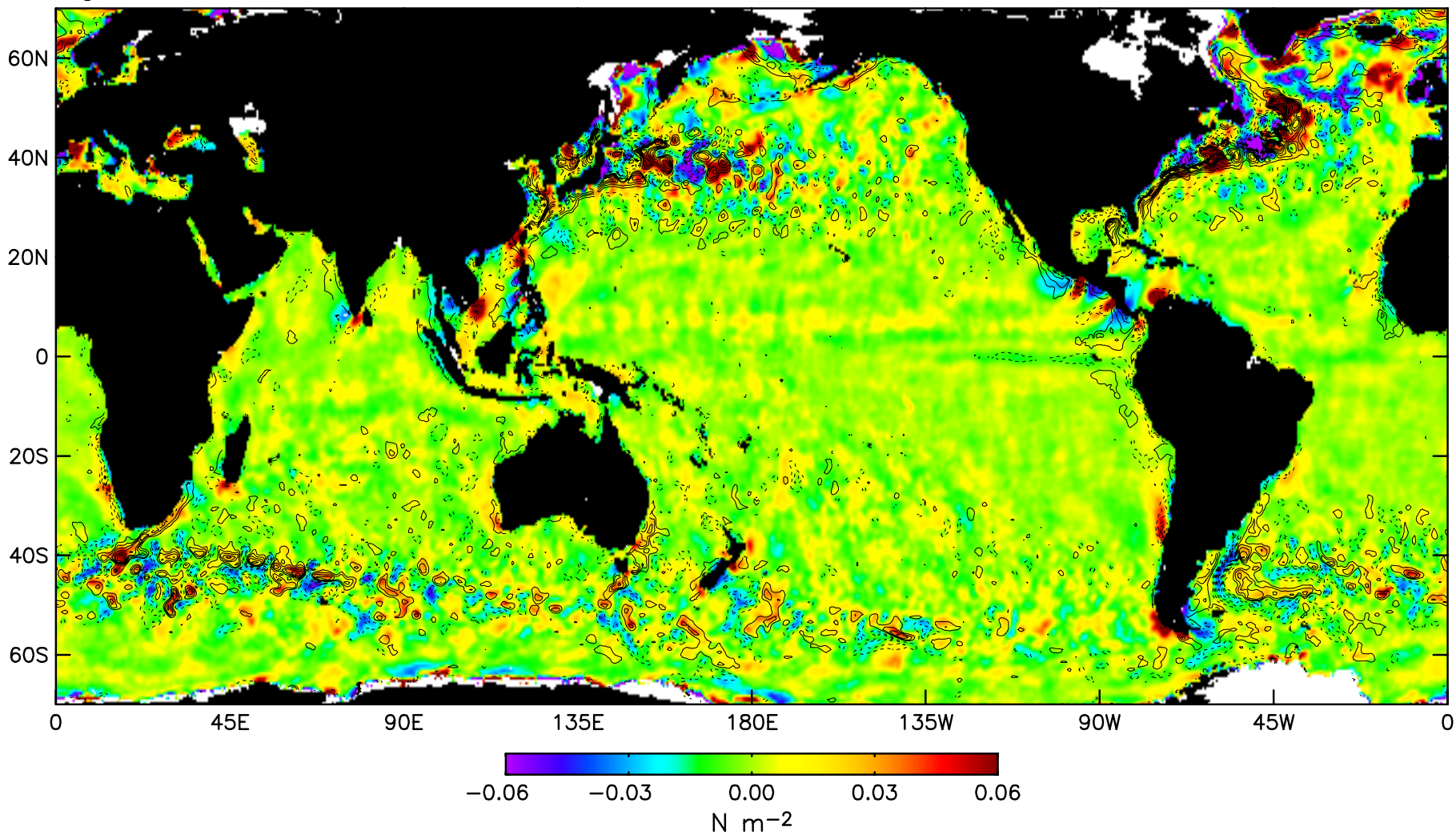
High Pass Filtered Wind Stress



2-Month Average Wind Stress Magnitude and SST (Spatially High-Pass Filtered)

QuikSCAT, January–February 2003

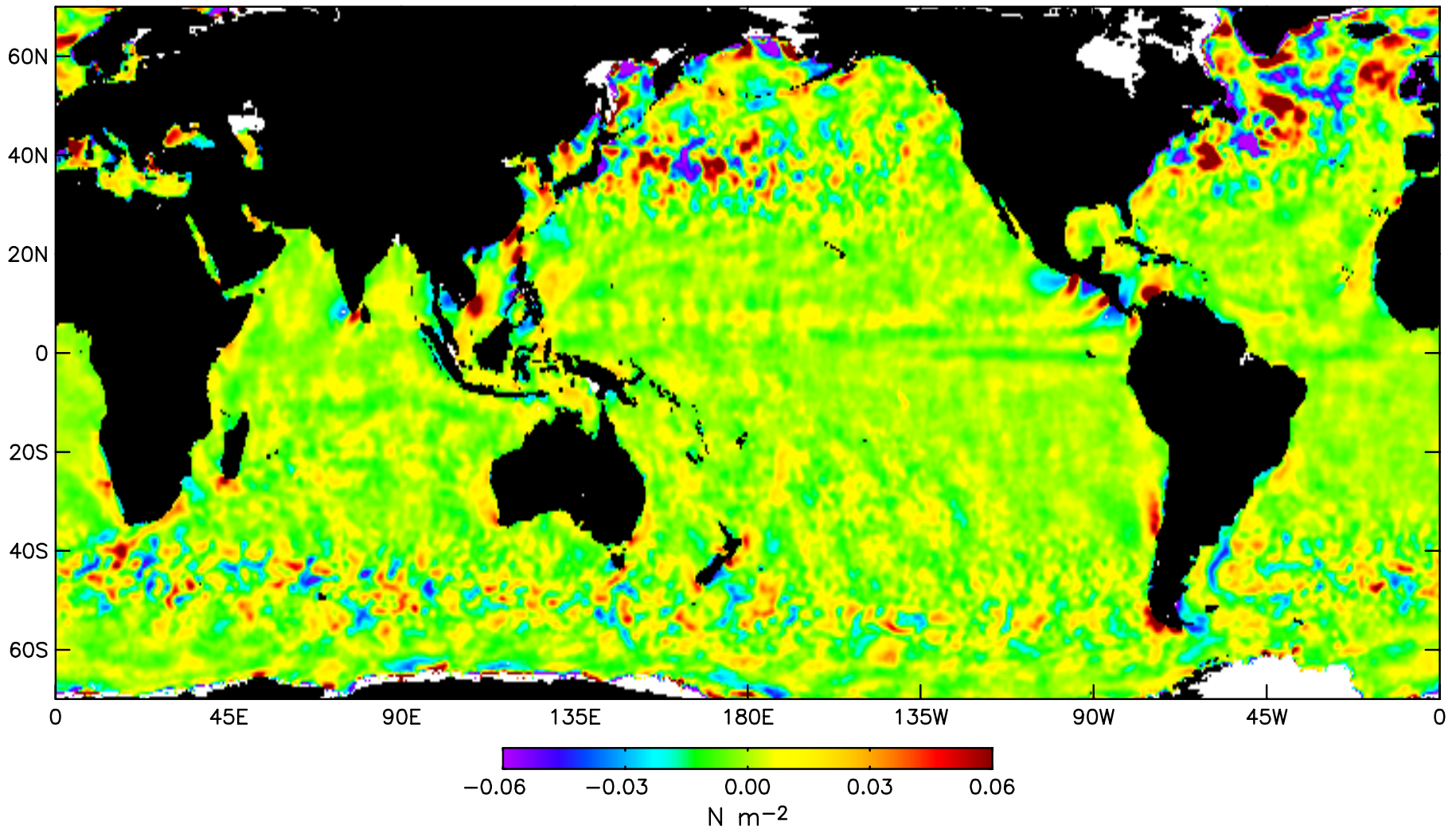
High Pass Filtered Wind Stress and SST



2-Month Average Wind Stress Magnitude (Spatially High-Pass Filtered)

QuikSCAT, January–February 2003

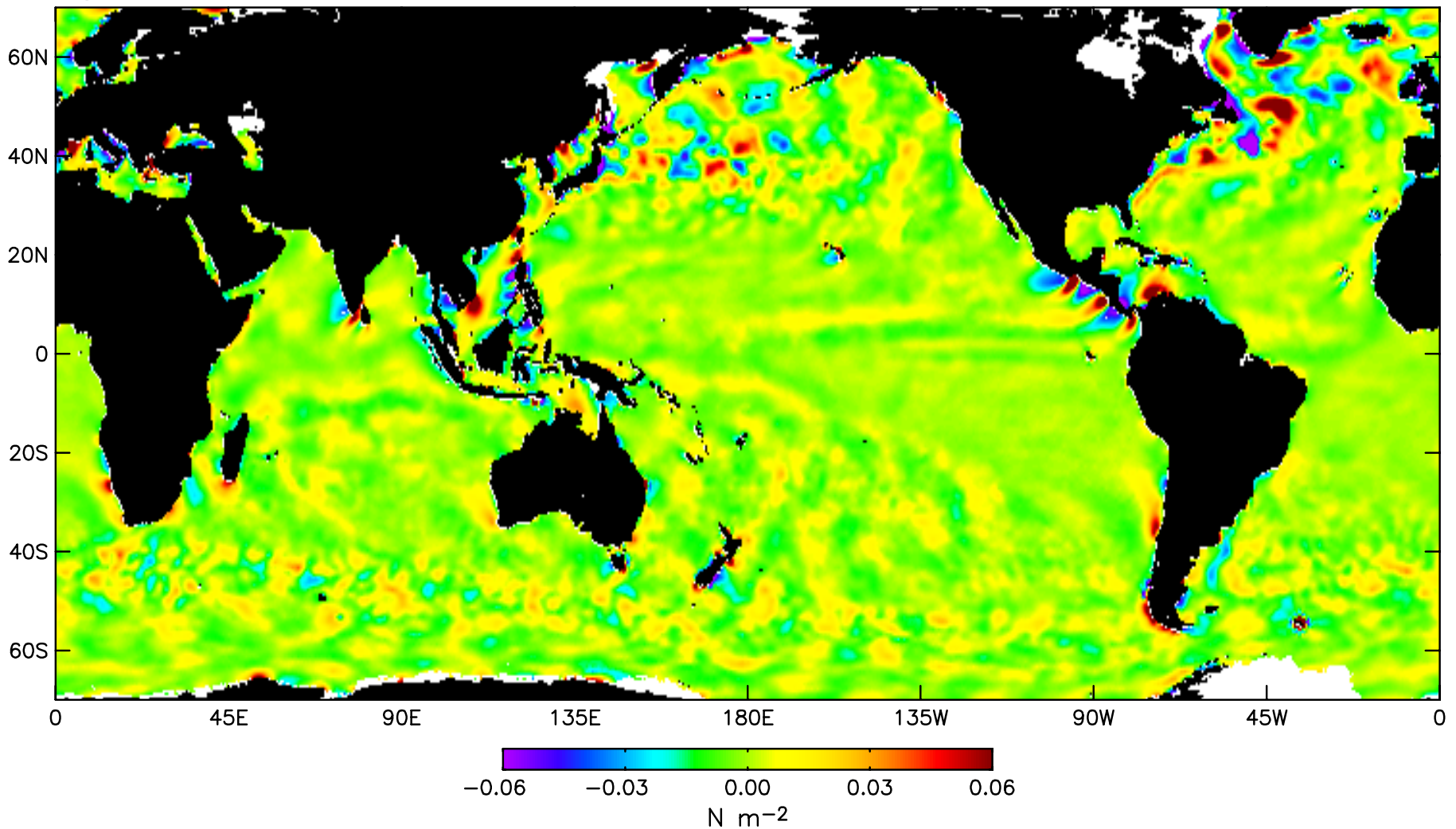
High Pass Filtered Wind Stress



2-Month Average Wind Stress Magnitude (Spatially High-Pass Filtered)

ECMWF, January–February 2003

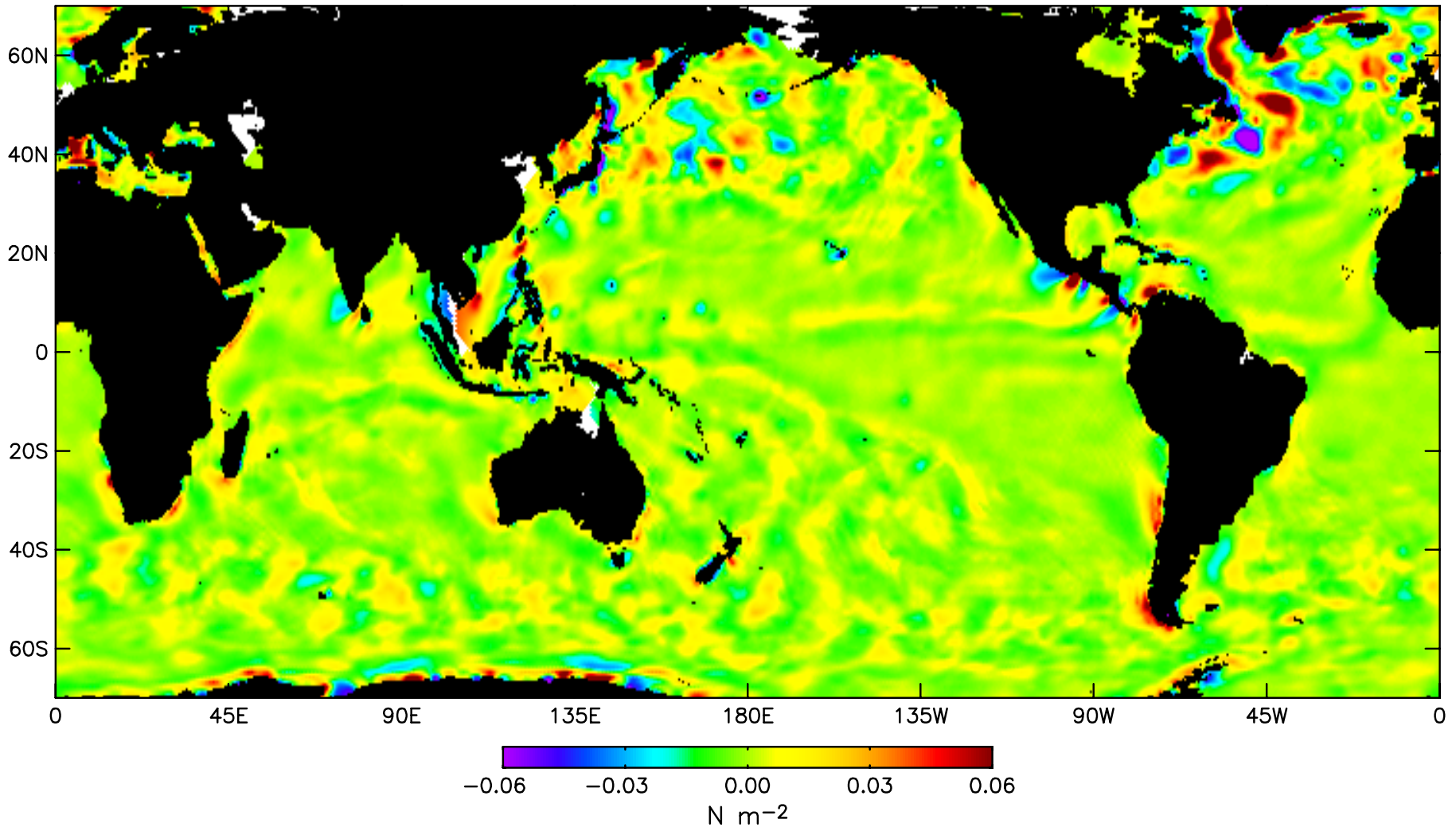
High Pass Filtered Wind Stress



2-Month Average Wind Stress Magnitude (Spatially High-Pass Filtered)

NCEP, January–February 2003

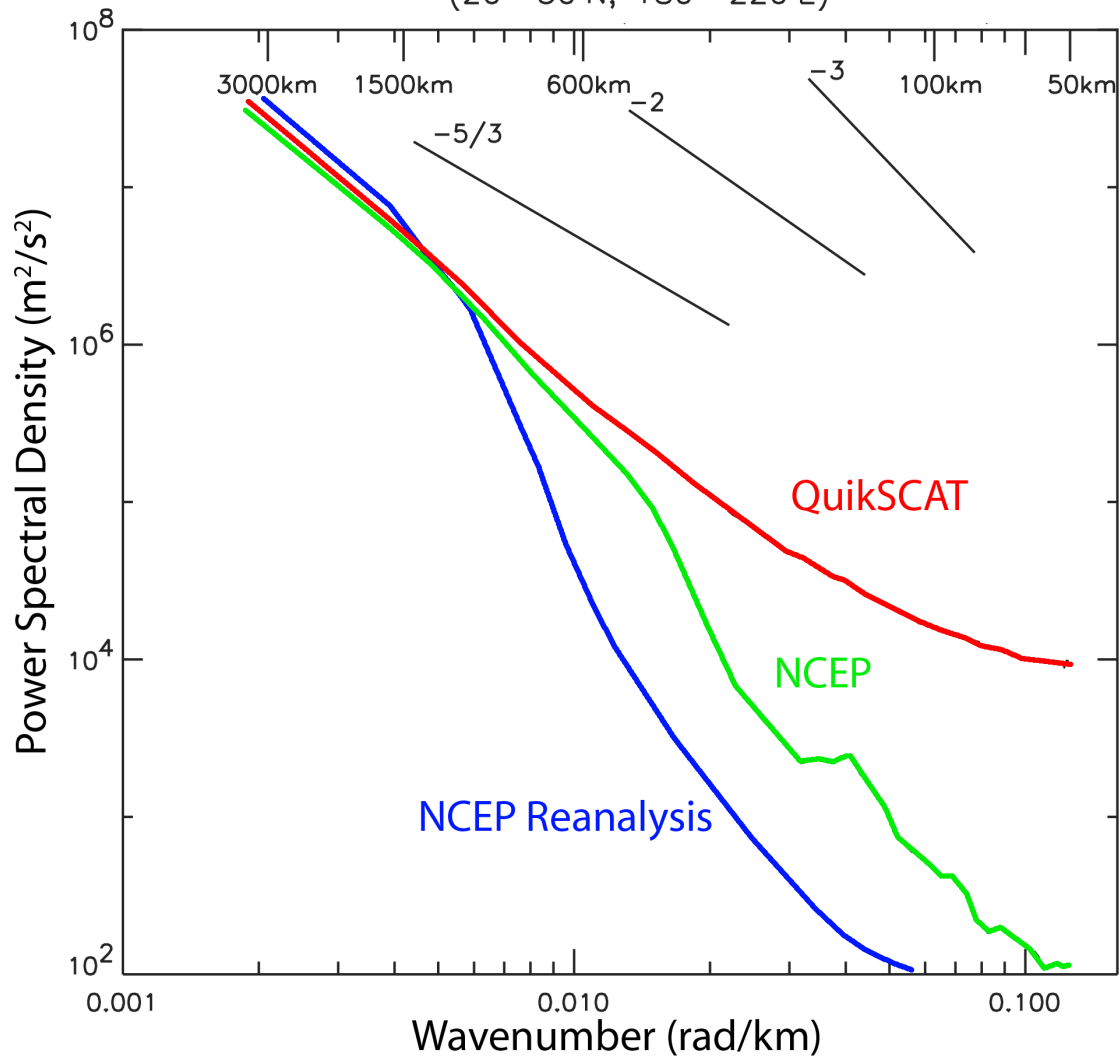
High Pass Filtered Wind Stress



Wavenumber Spectra of Zonal Wind

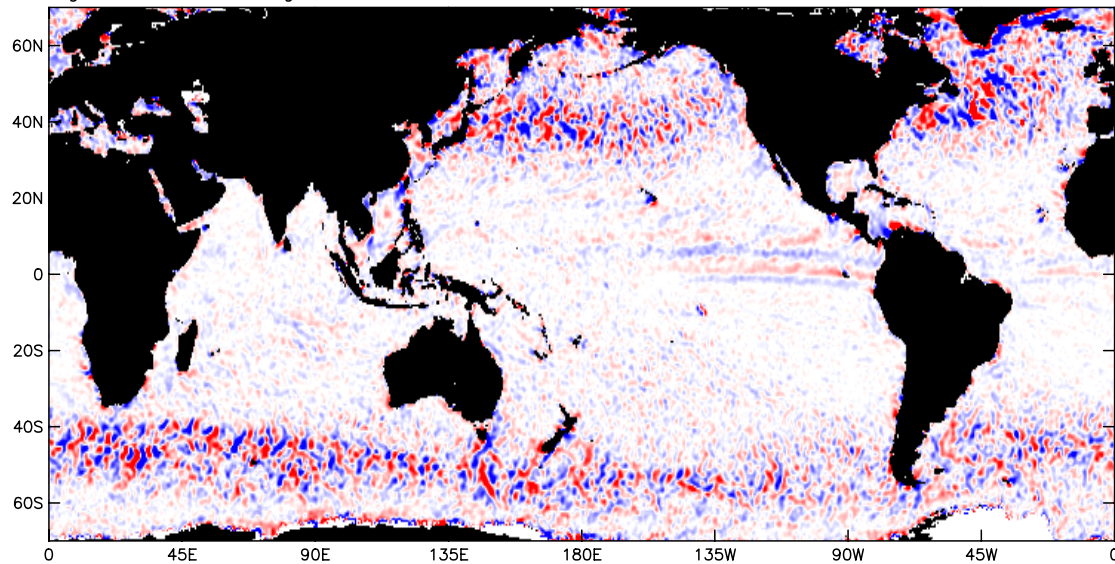
January - December 2000

(20°–50°N, 180°–220°E)

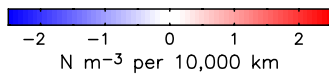
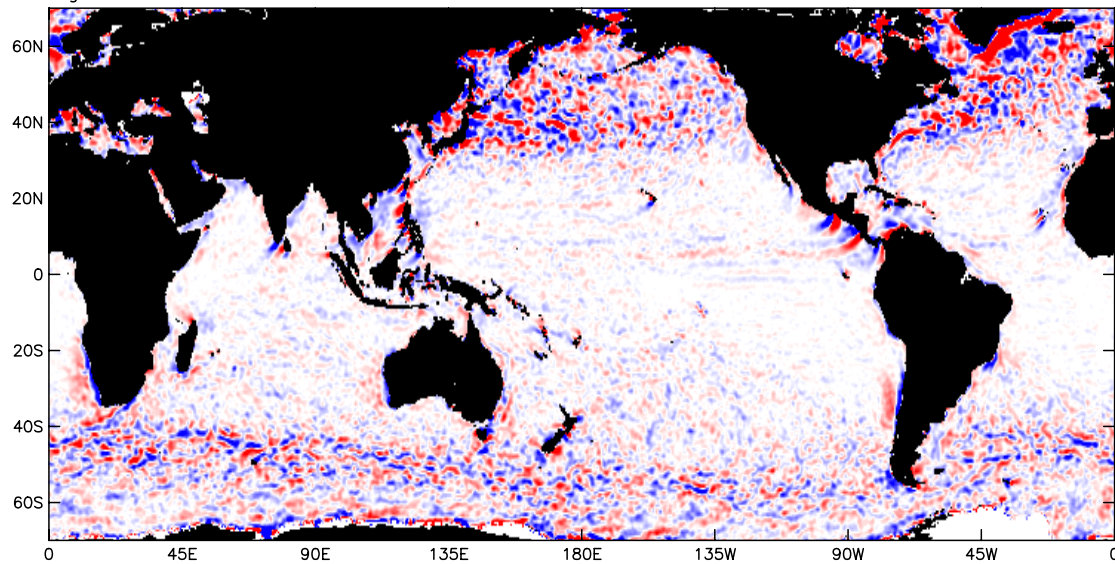


QuikSCAT, November 2002 – February 2003

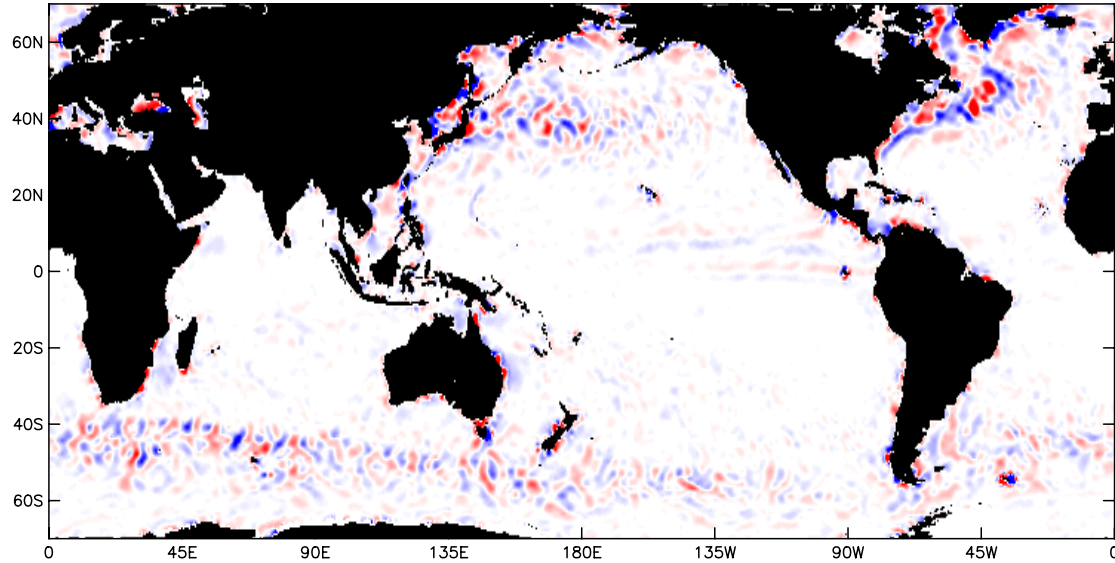
High Pass Filtered Divergence



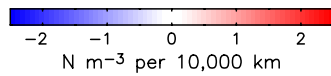
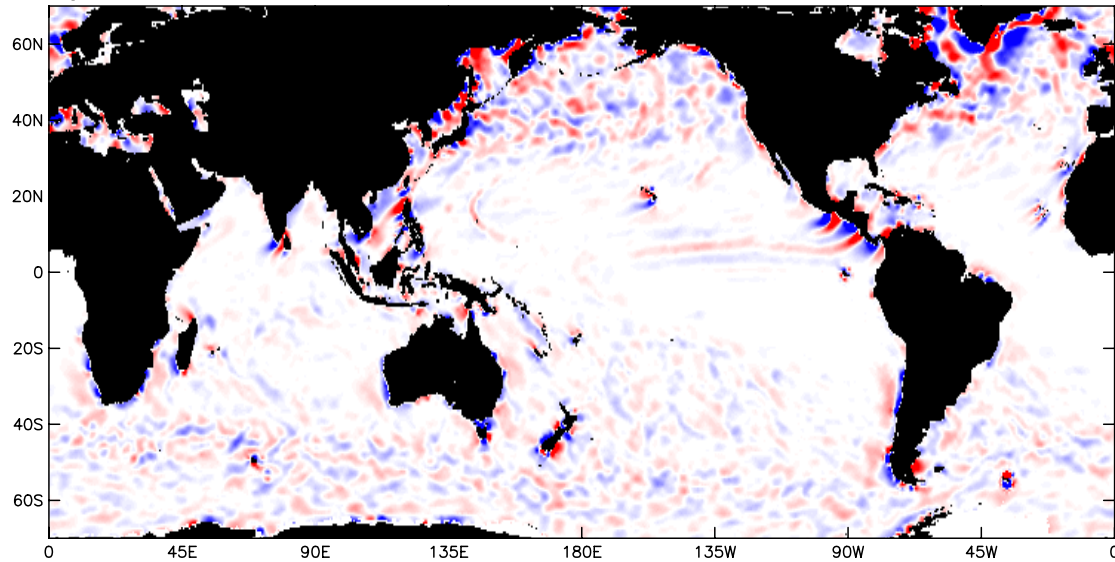
High Pass Filtered Curl



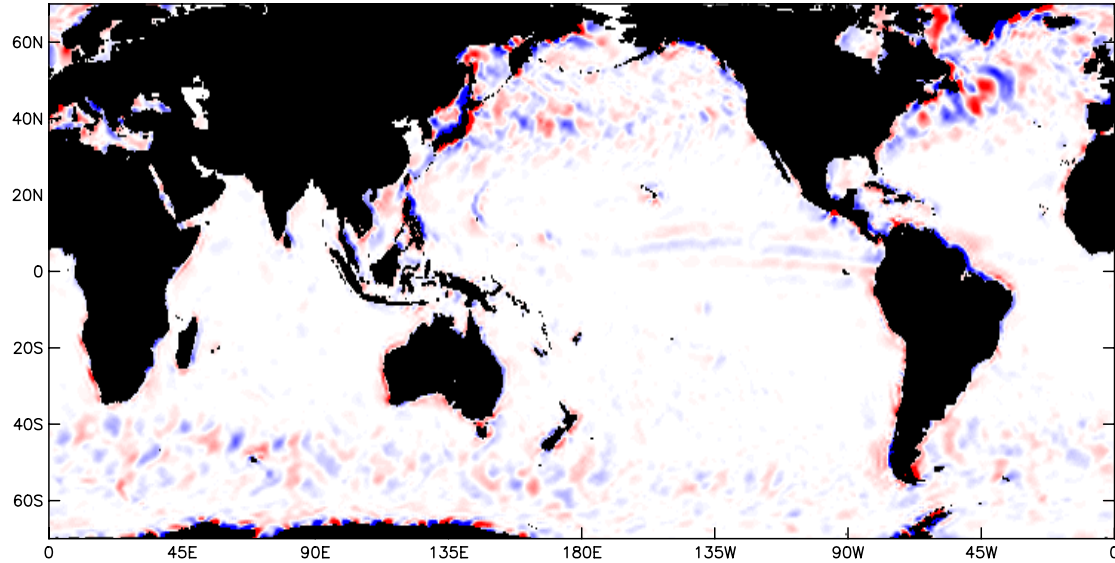
High Pass Filtered Divergence



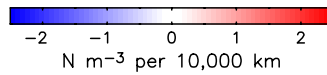
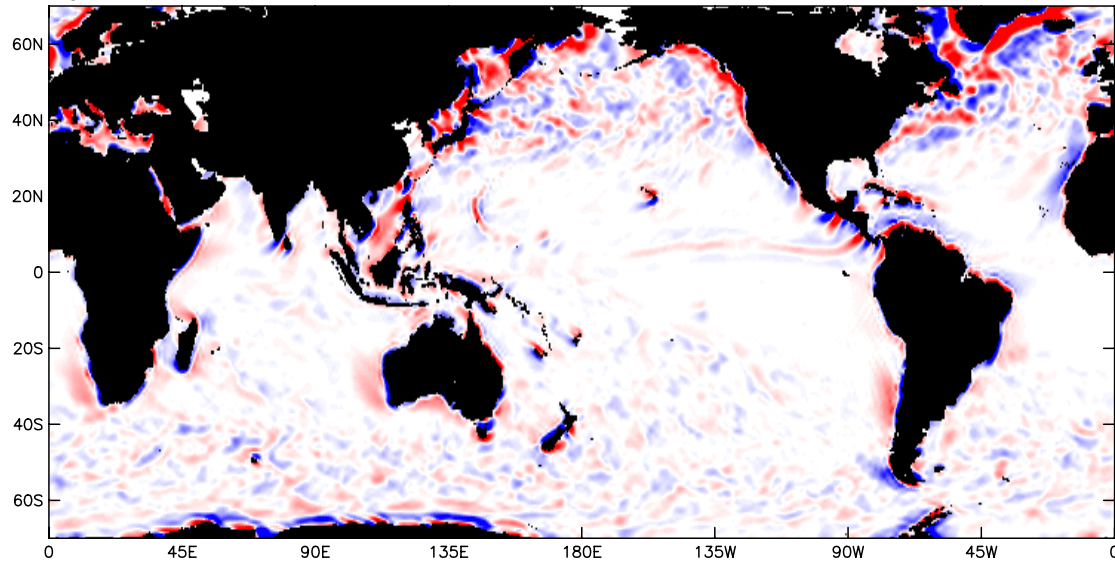
High Pass Filtered Curl



High Pass Filtered Divergence



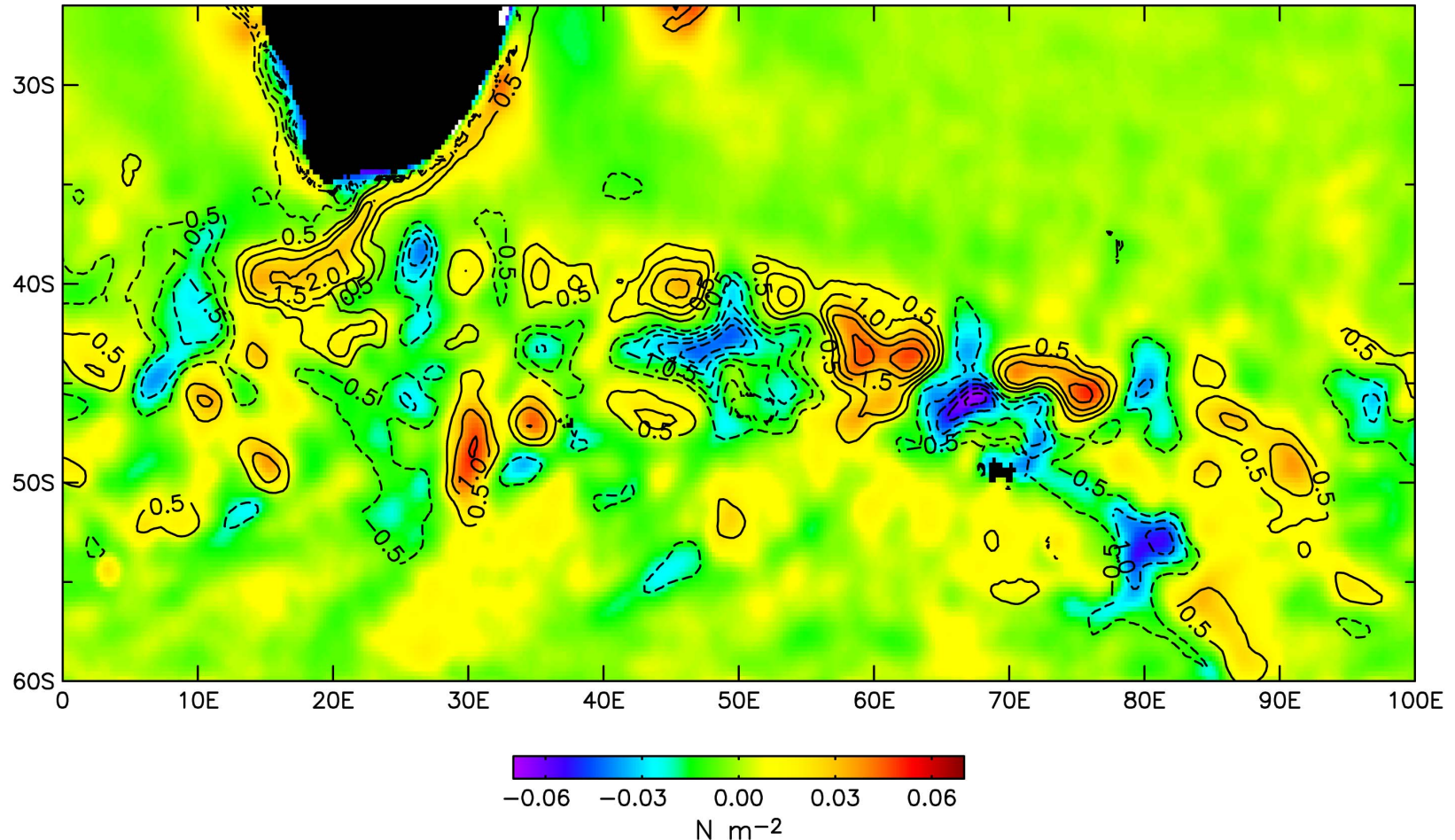
High Pass Filtered Curl



South Indian Ocean Region

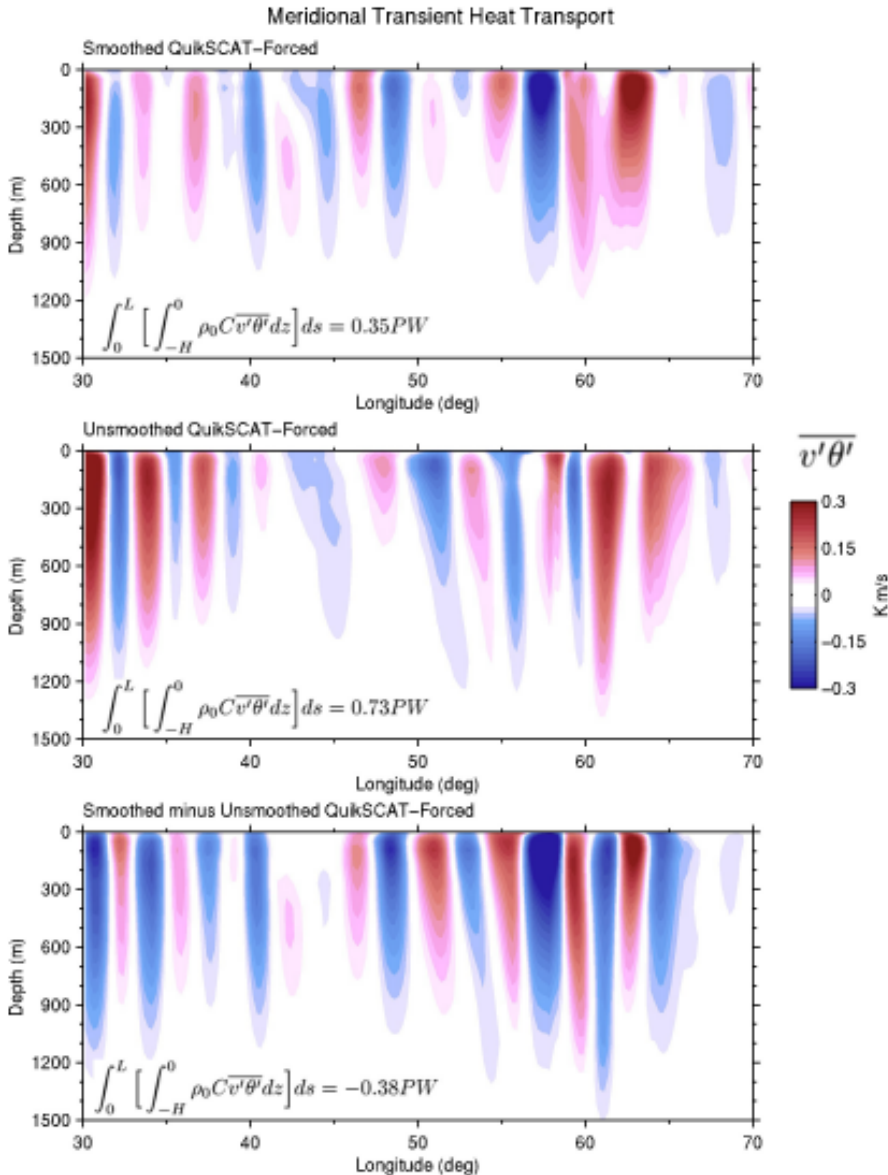
Filtered 2-Year Average QuikSCAT Wind Stress Magnitude
and AMSR Sea Surface Temperature Contours

August 2002 - July 2004



Meridional Eddy Heat Transport in the South Indian Ocean

(O'Neill et al., 2006)

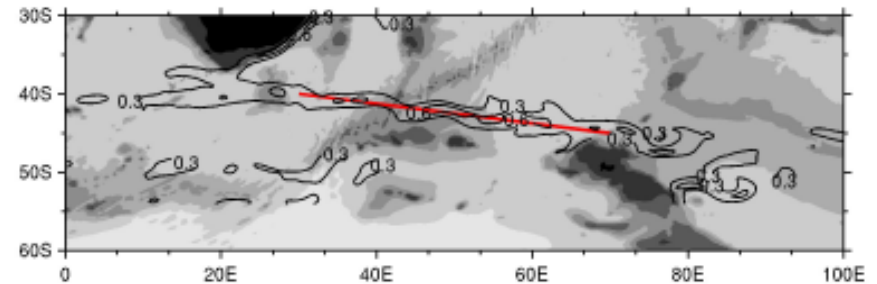


The MOM2 model was forced with 4-year average QuikSCAT winds in two ways:

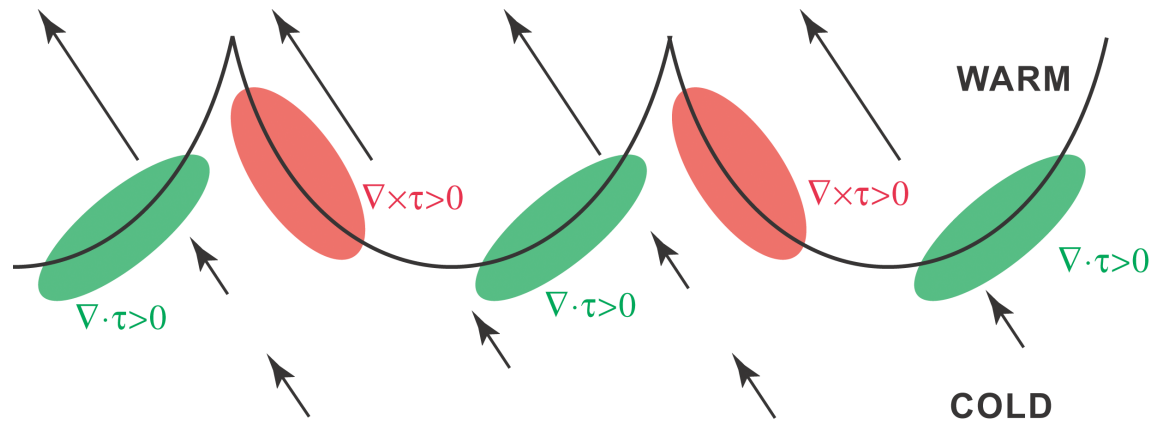
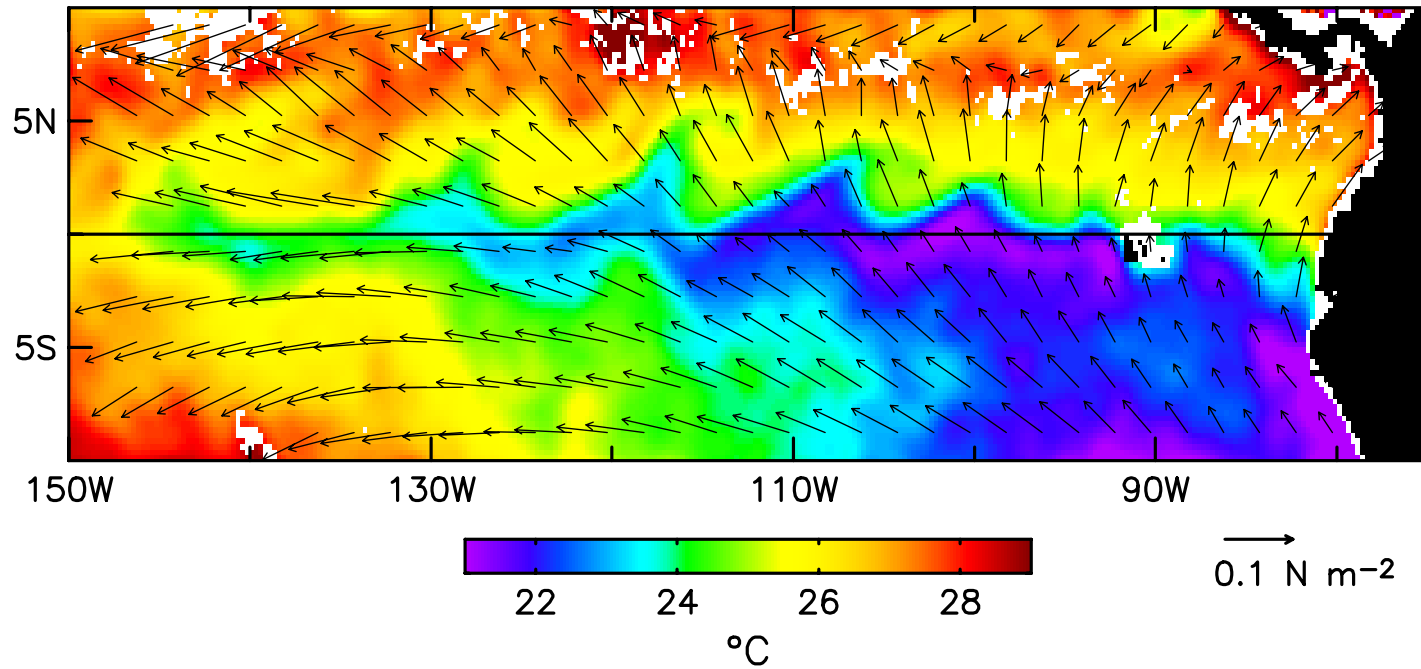
- Raw 25-km QuikSCAT wind stress
- QuikSCAT wind stress spatially smoothed to retain only the large scales that are resolved by the NCEP global forecast model.

Result:

The meridional heat transport is twice as strong in the model forced by the unsmoothed QuikSCAT wind stress field.

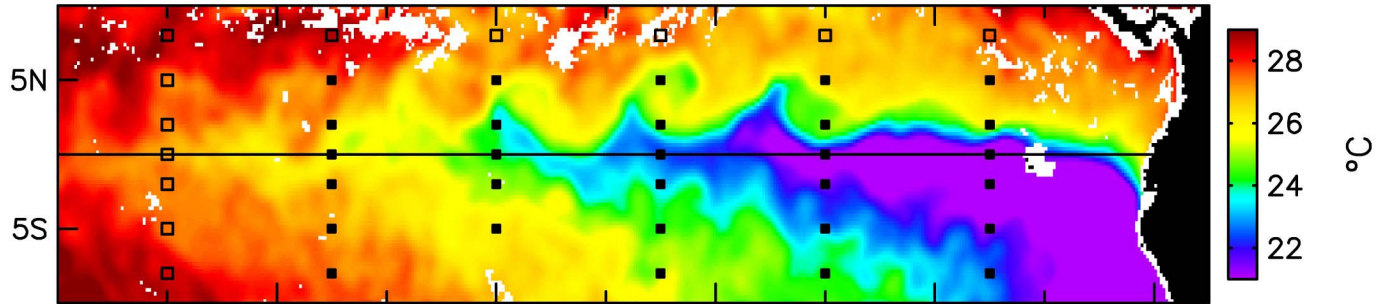


Wind Stress Vectors and SST, 12 December 2001

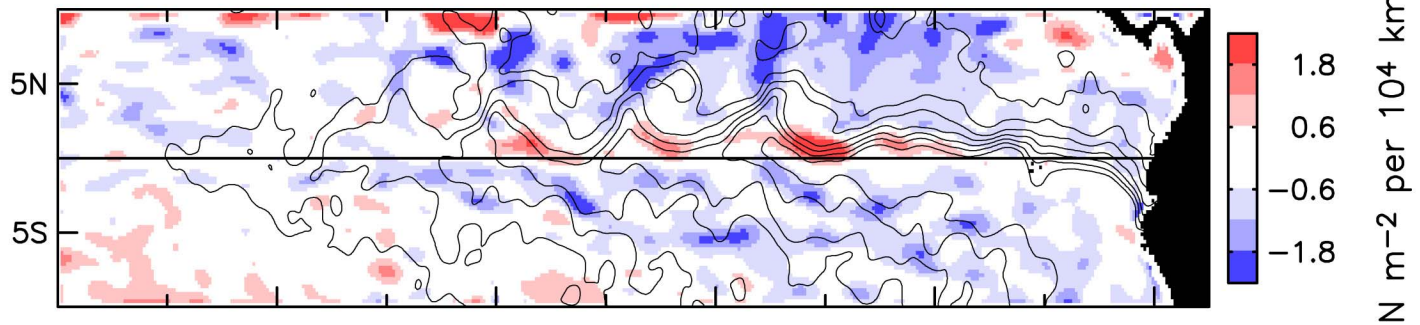


2-4 September 1999

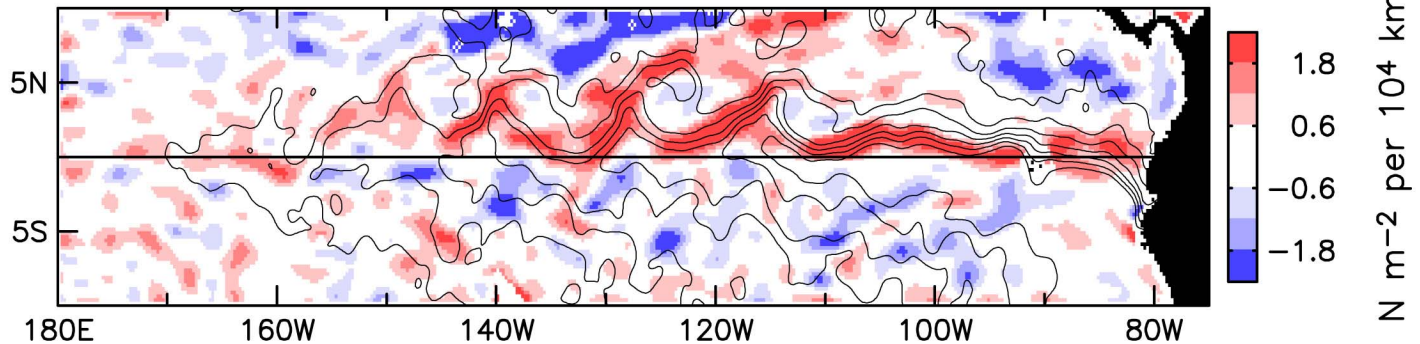
TMI Sea Surface Temperature



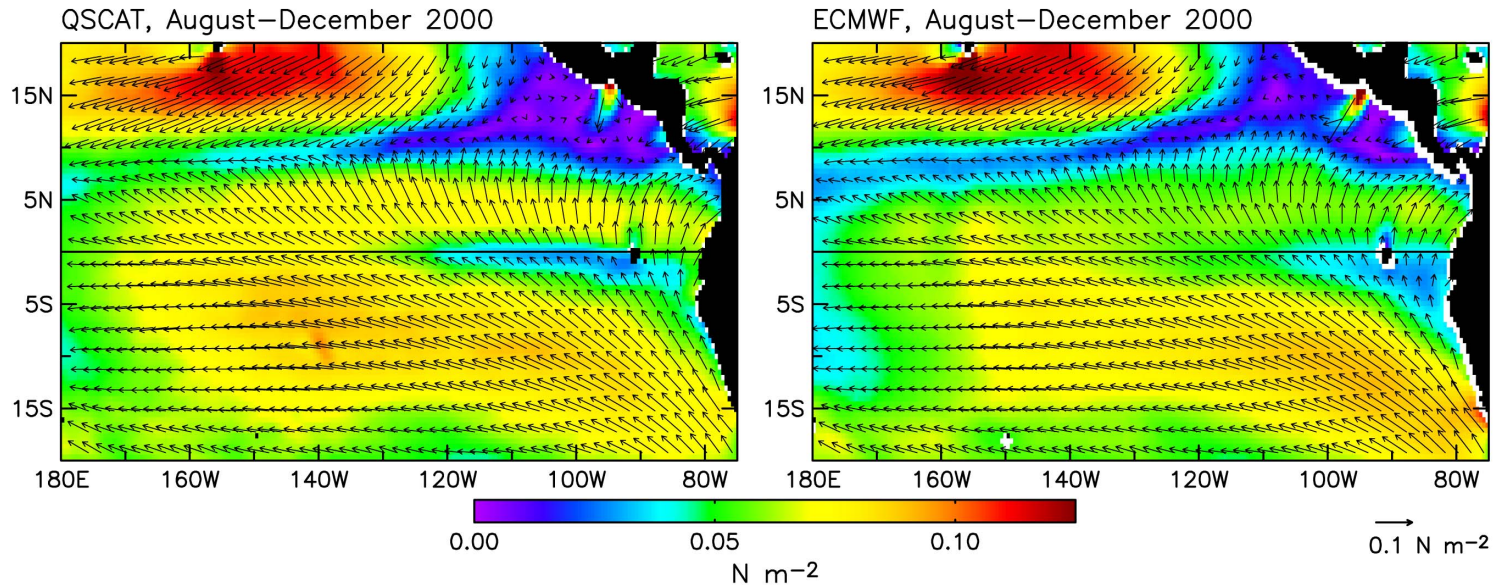
QuikSCAT Wind Stress Curl with SST Overlaid



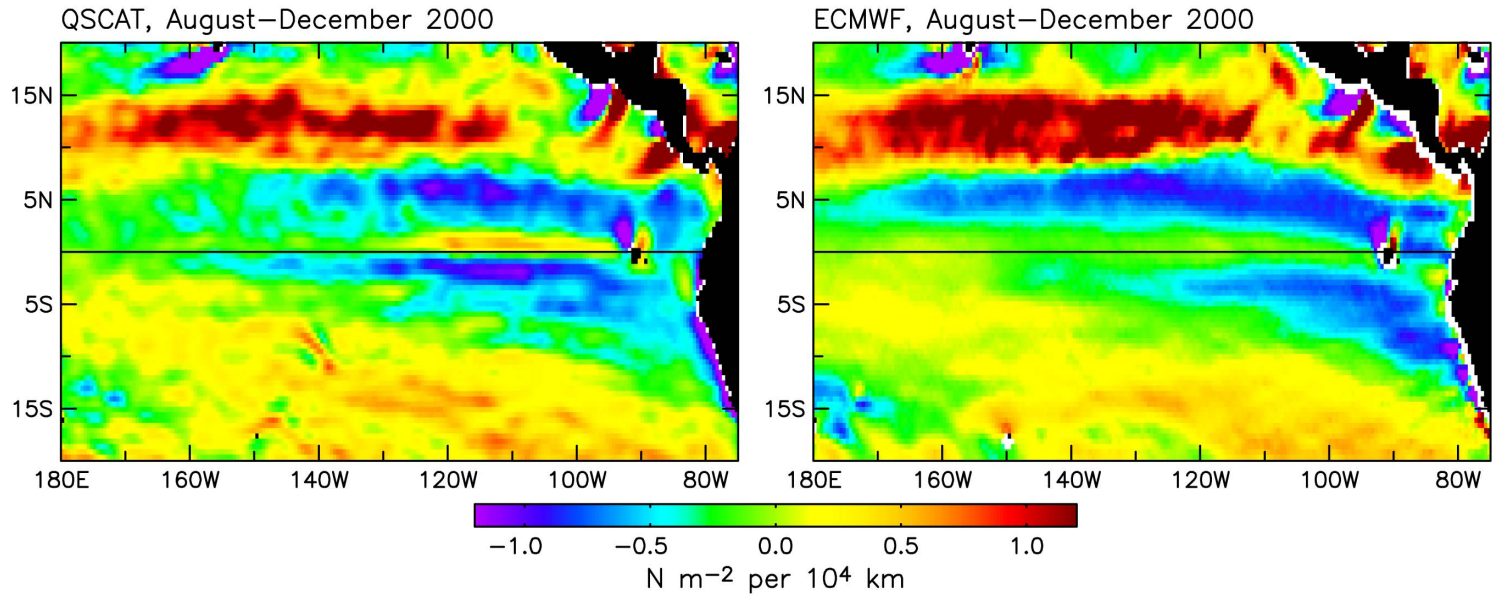
QuikSCAT Wind Stress Divergence with SST Overlaid



Wind Stress



Wind Stress Curl



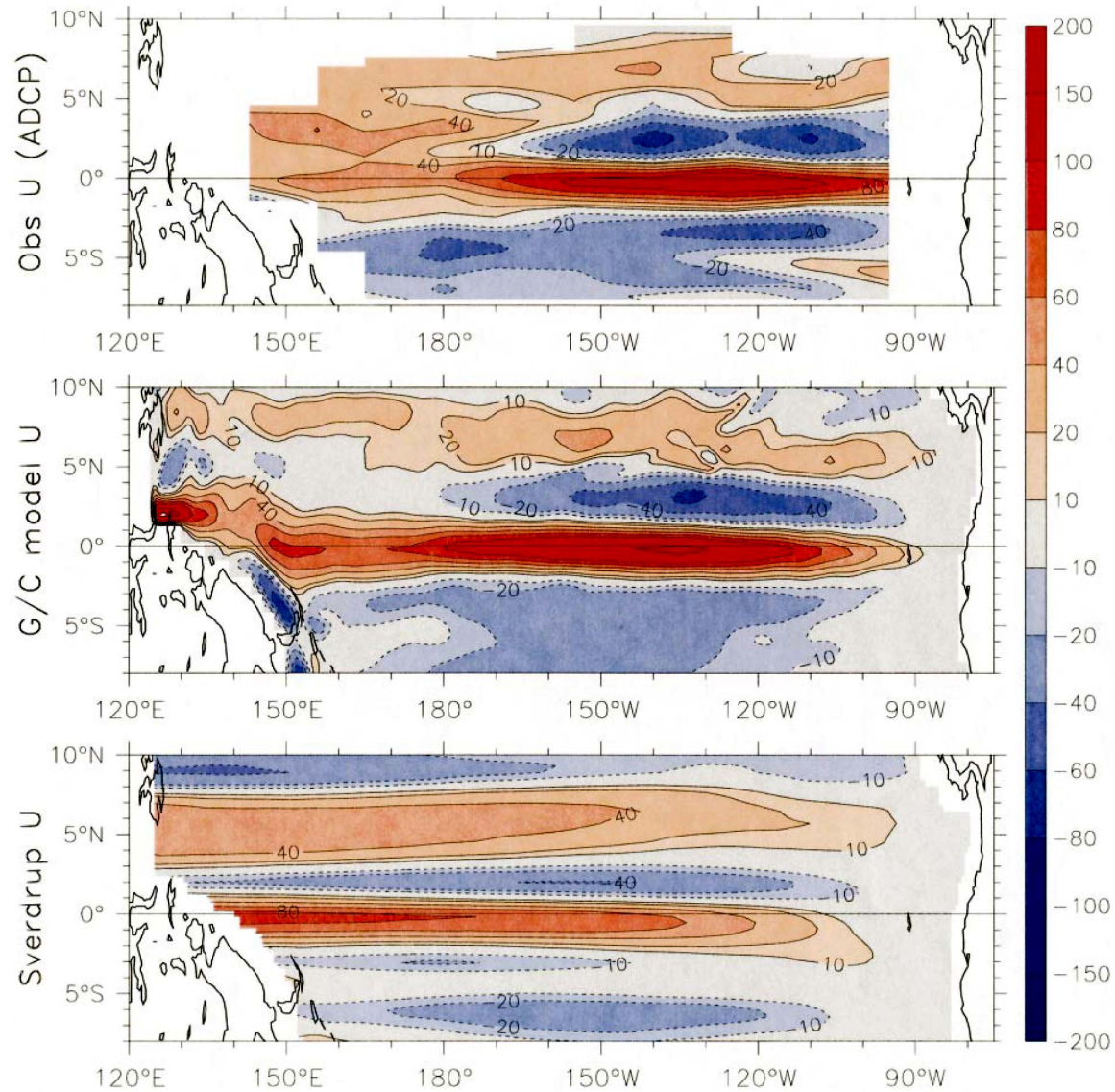
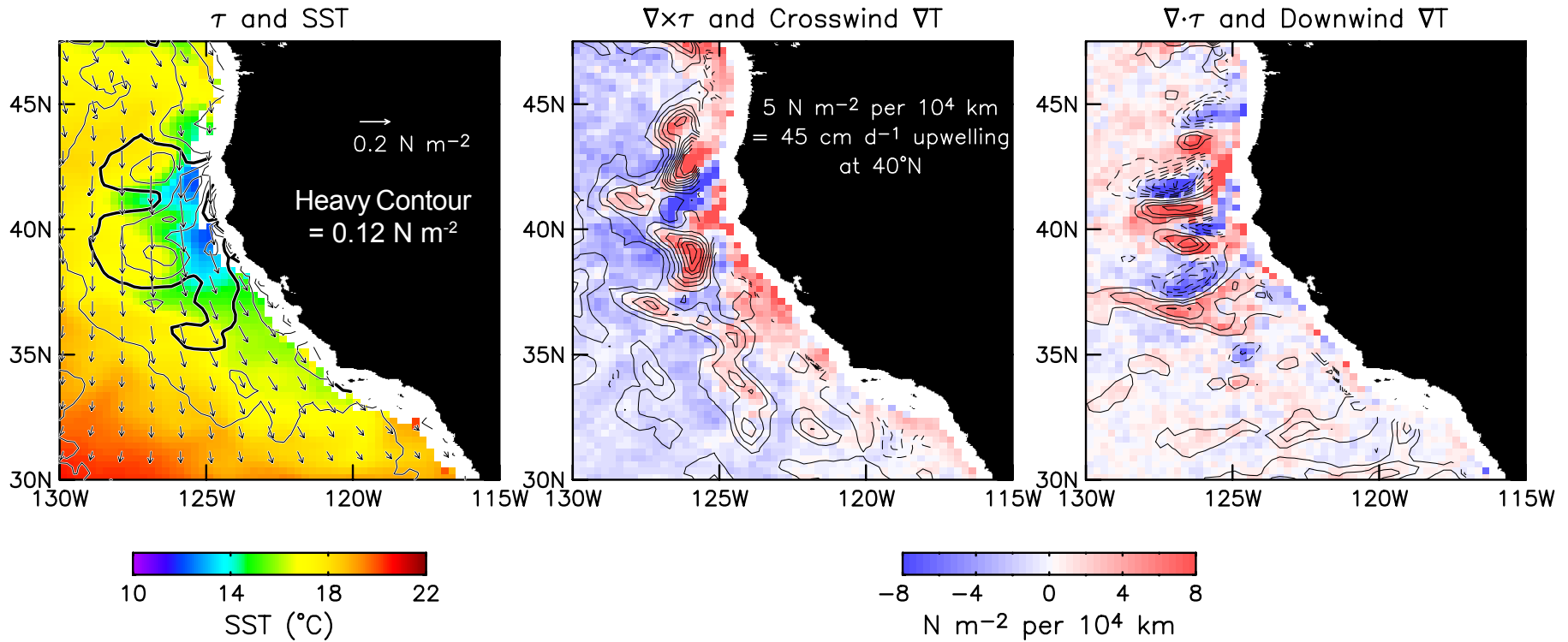
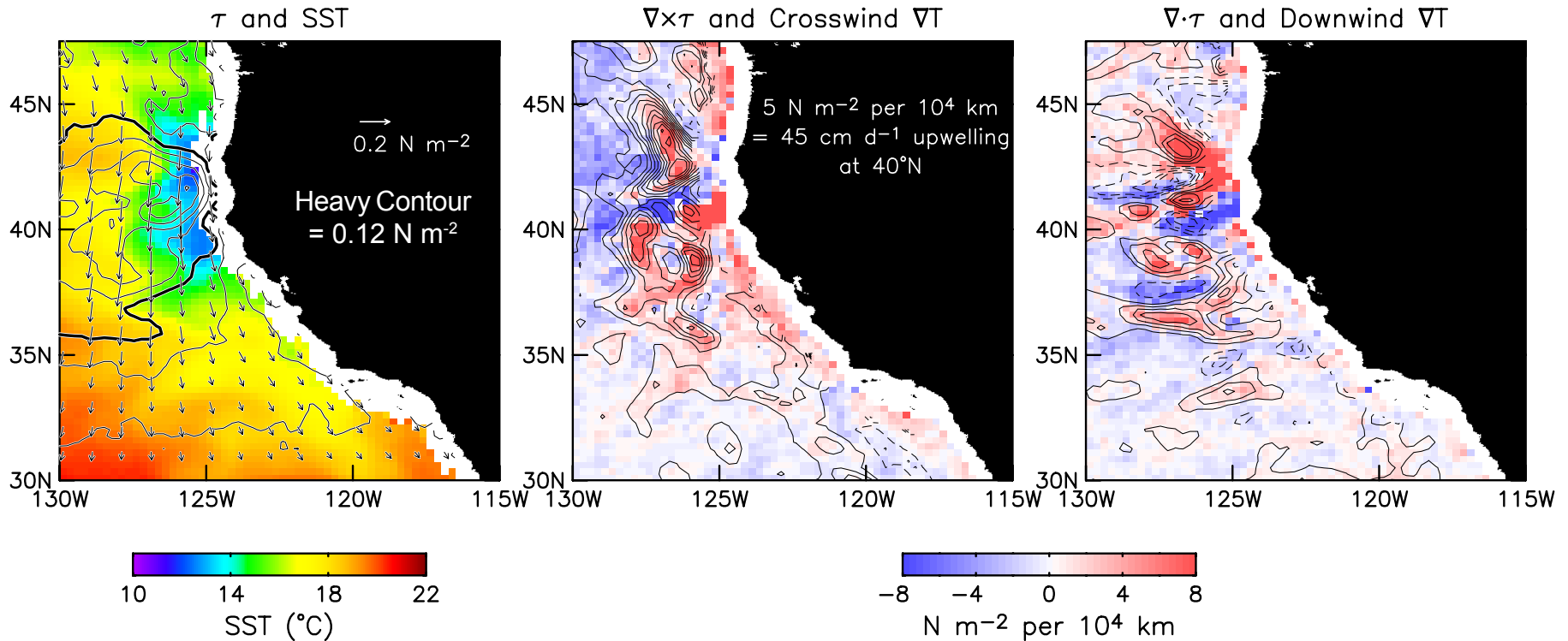


FIG. 3. Vertically integrated zonal transport/unit width ($\text{m}^2 \text{s}^{-1}$) from (top) ADCP observations, (middle) model, and (bottom) the Sverdrup balance [Eq. (5)]. Red colors indicate eastward transport, blue colors westward. The colored area in the top panel shows areas sampled by ADCP observations. Observed and model transports are integrated from the bottom of the ADCP sampling and the model, respectively; about 400 m in each case.

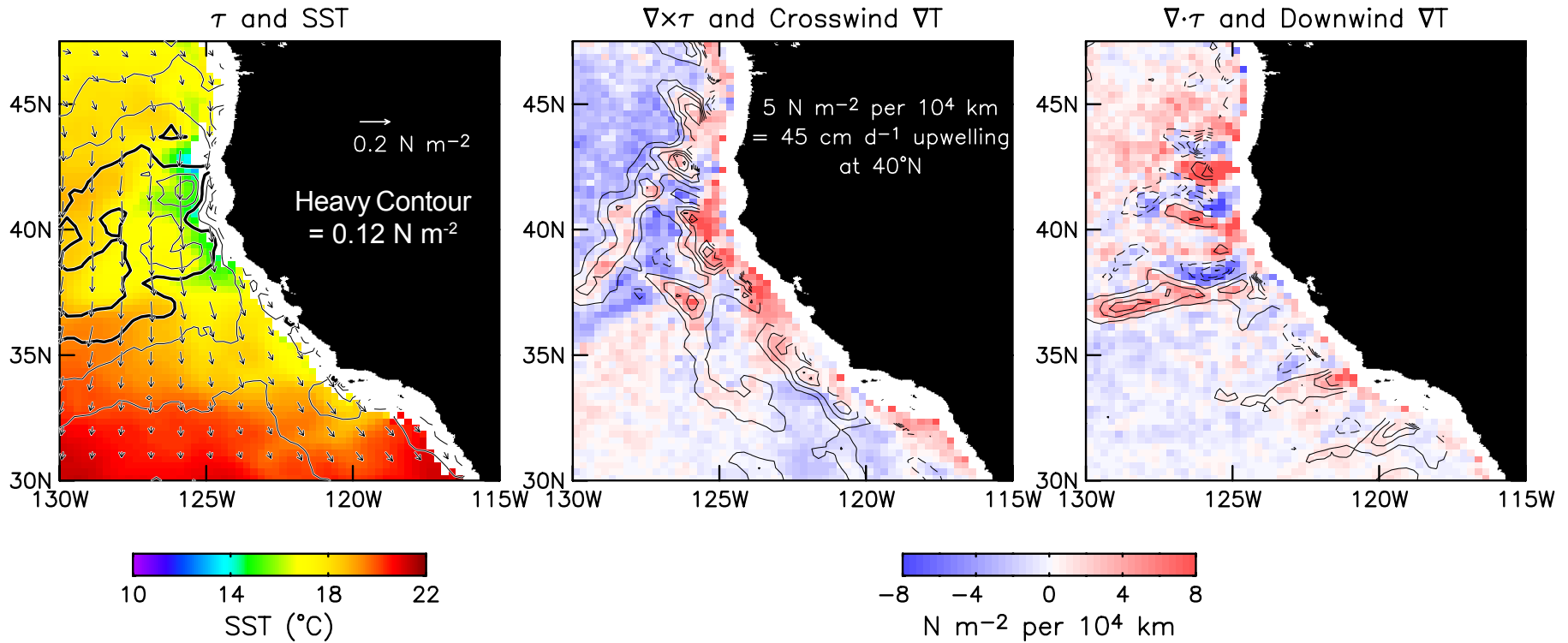
29-Day Average QuikSCAT Wind Stress Field Centered on 18 August 2002



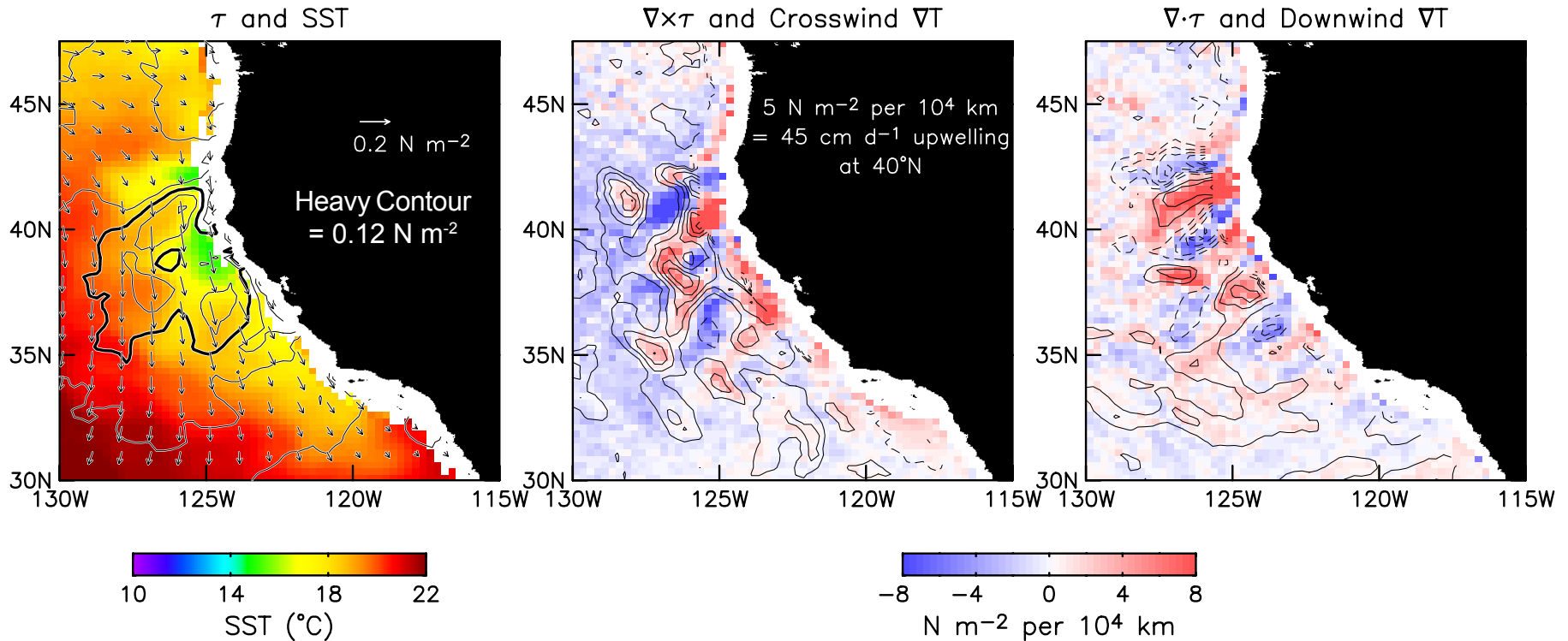
29-Day Average QuikSCAT Wind Stress Field Centered on 29 September 2002



29-Day Average QuikSCAT Wind Stress Field Centered on 14 September 2003

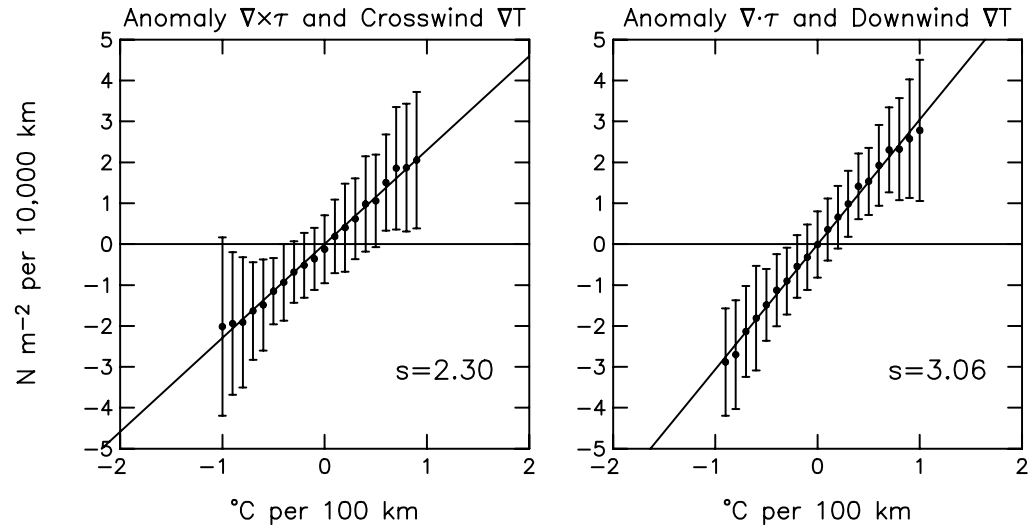


29-Day Average QuikSCAT Wind Stress Field Centered on 5 September 2004

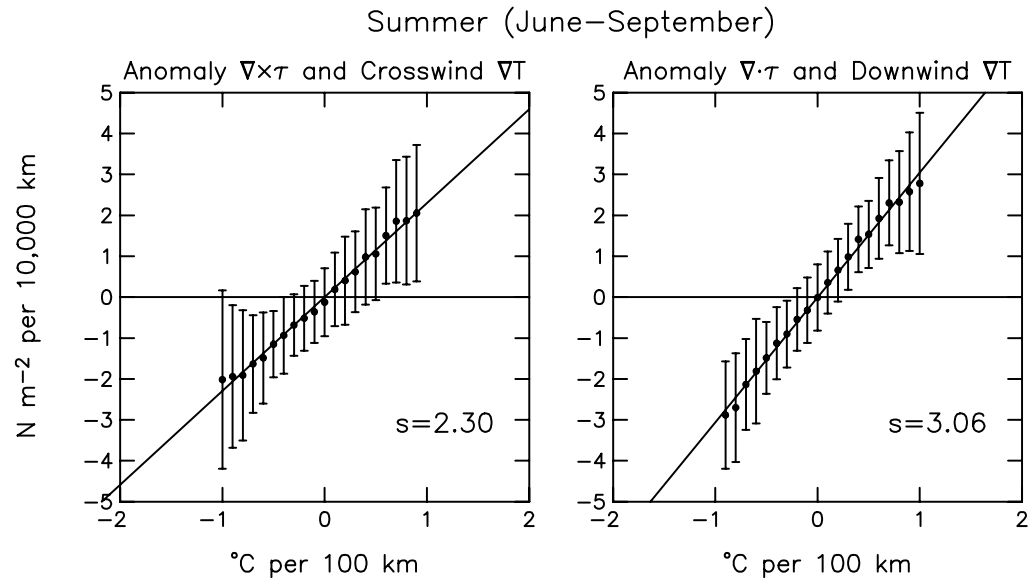


QuikSCAT and AMSR

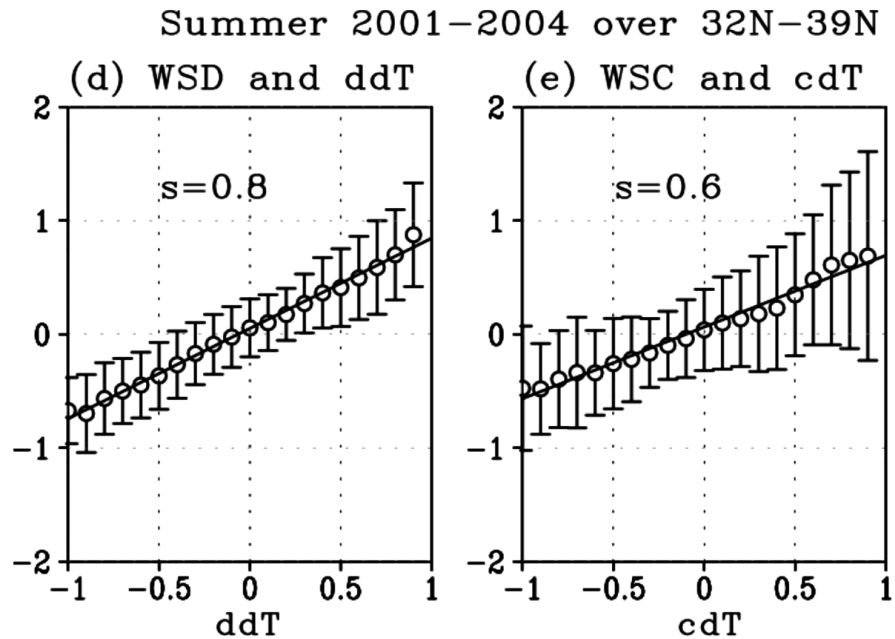
Summer (June–September)



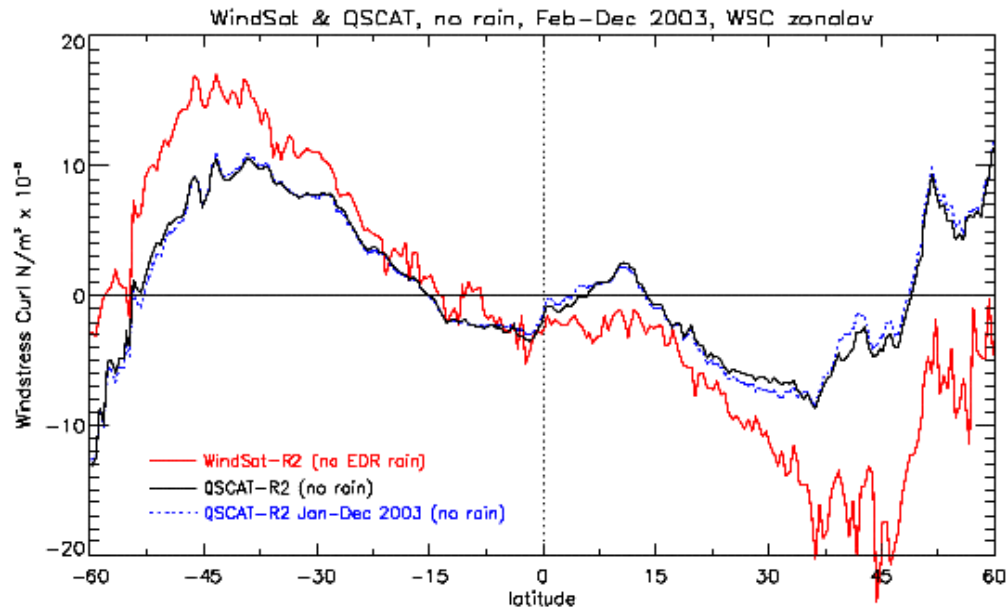
QuikSCAT and AMSR



Scripps Coupled Ocean- Atmosphere Regional Model (Seo *et al.*, 2006)



QuikSCAT vs. WindSat Global Zonally Averaged Wind Stress Curl (11-month average, February - December 2003)



Conclusions

- QuikSCAT has established a 7-year data record that reveals previously unknown persistent and pervasive SST-induced small-scale structure in the surface wind field.
 - *This small-scale structure is poorly represented in all other wind datasets.*
- The QuikSCAT data record is only now approaching a length that is useful for climate research applications.
 - *How can the continuity of this data record be maintained?*
- QuikSCAT data are nonetheless proving to be extremely useful for assessing the accuracy and resolution limitations of operational forecast models, climate models, and coupled ocean-atmosphere models.
- QuikSCAT data are beginning to be analyzed to investigate climate variability in both the atmosphere and the ocean:
 - *Is there a link between SST and atmospheric variability above the boundary layer?*
 - *What are the feedback effects of SST-induced small-scale variability in the wind stress field on the ocean circulation?*
- Analyses conducted to date expose serious concerns about the utility of passive polarimetric measurements of surface winds for research applications.