Small scale Ocean Processes and Climate

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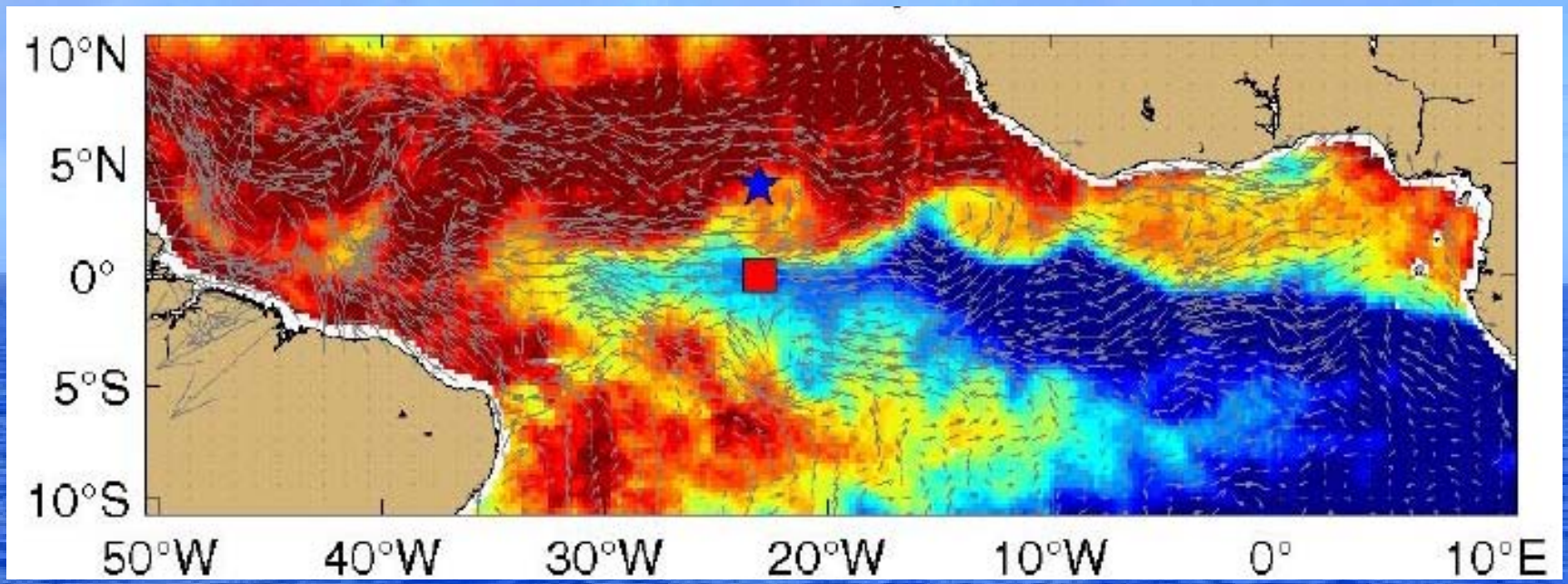
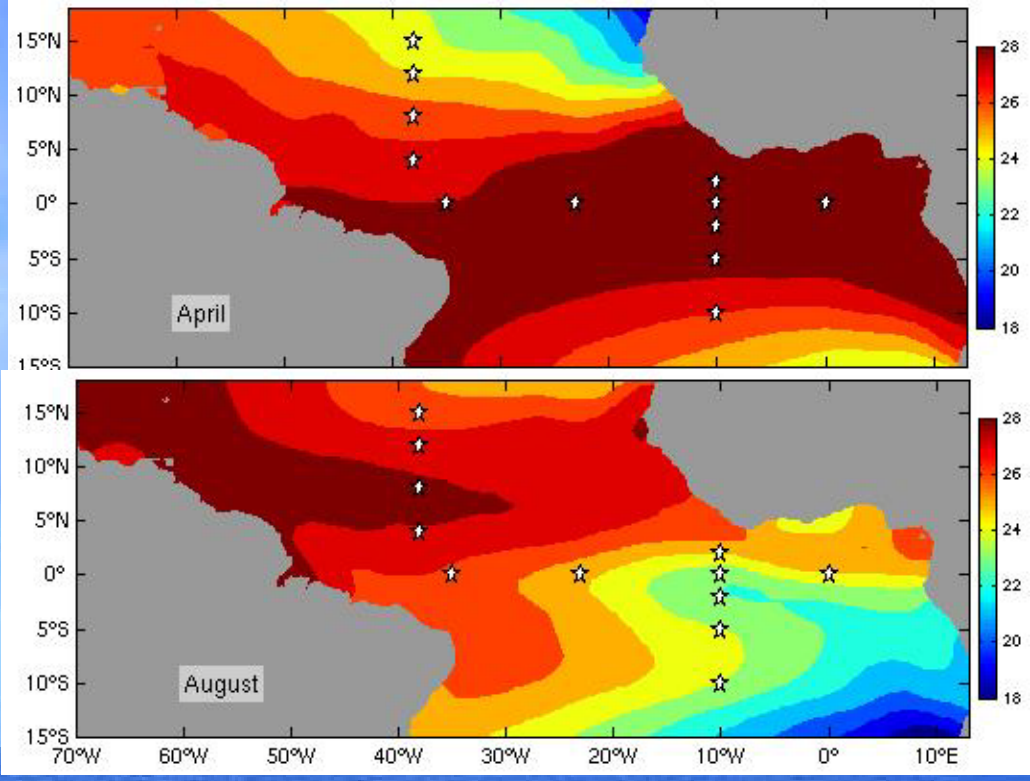


NOAA/AOML review

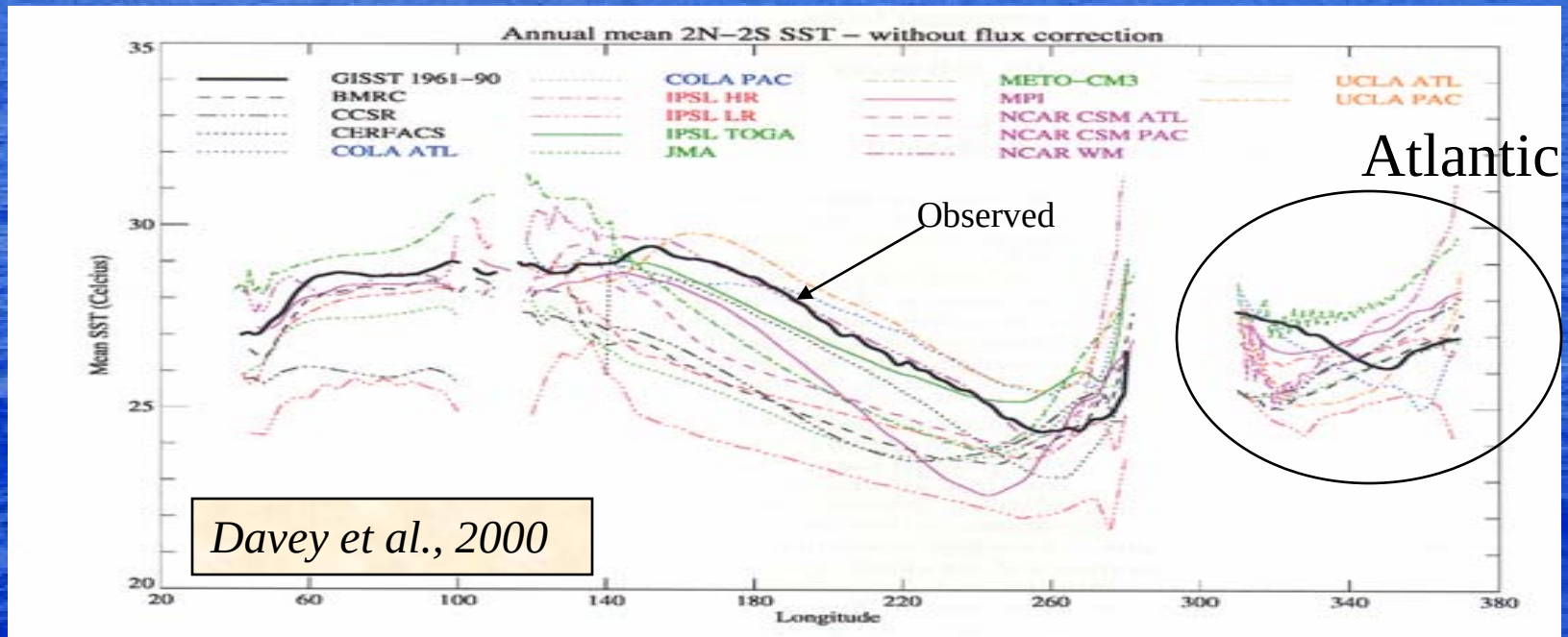
18—20 March 2008

Tropical Atlantic SST

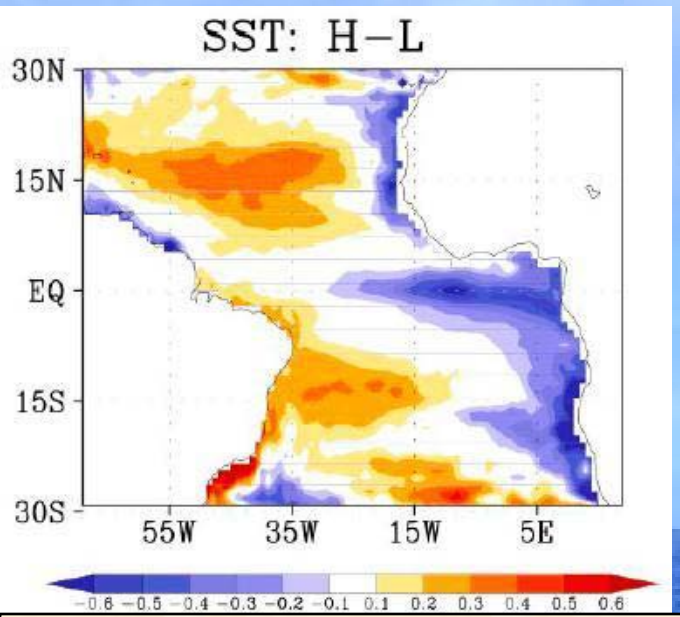
SST distribution (observed):



Coupled model equatorial SST:

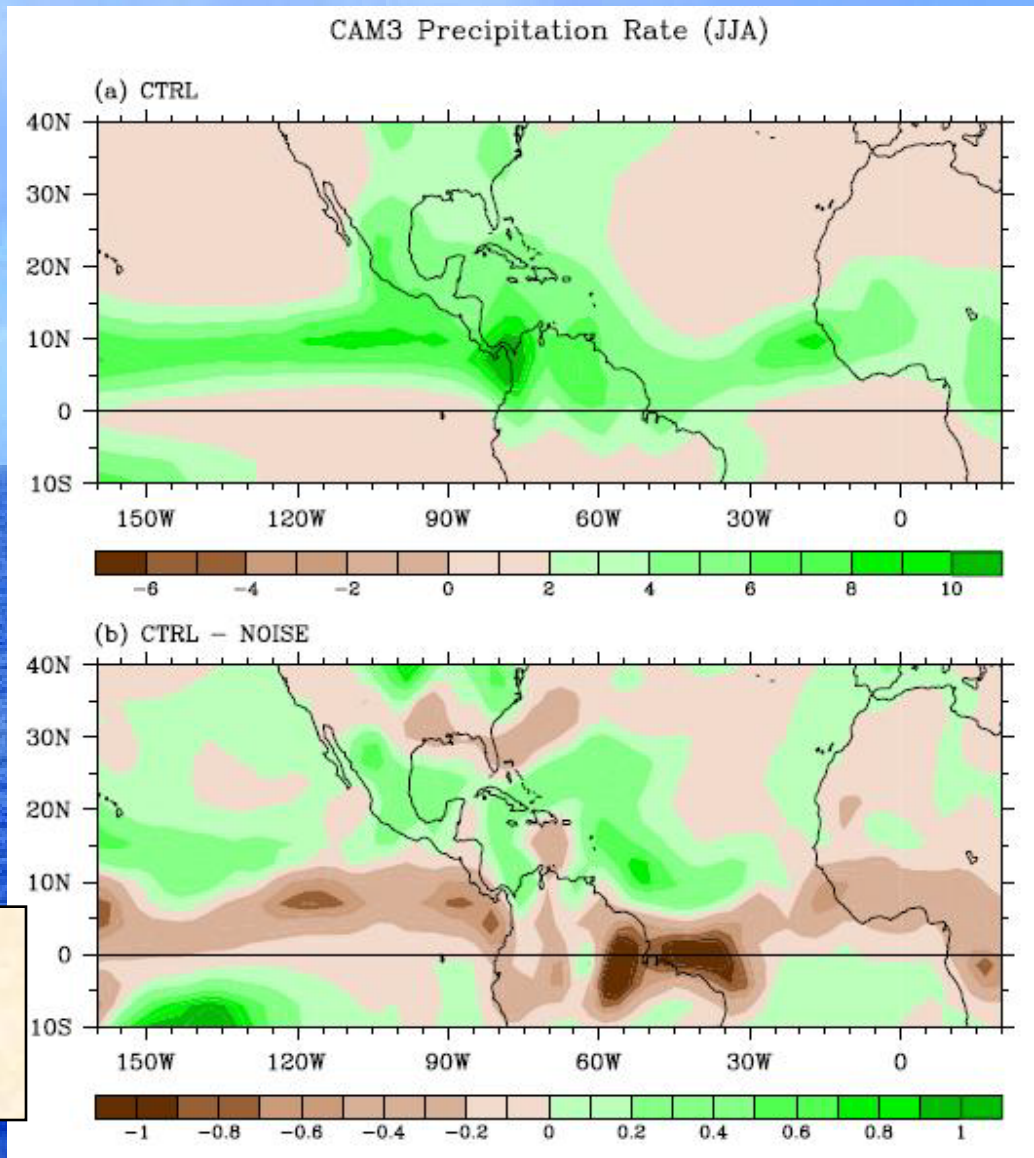


Ocean mesoscale matters!



Effects of high ocean resolution in coupled simulation of SST: Diffusion vs. eddy fluxes *(Seo et al., 2006)*

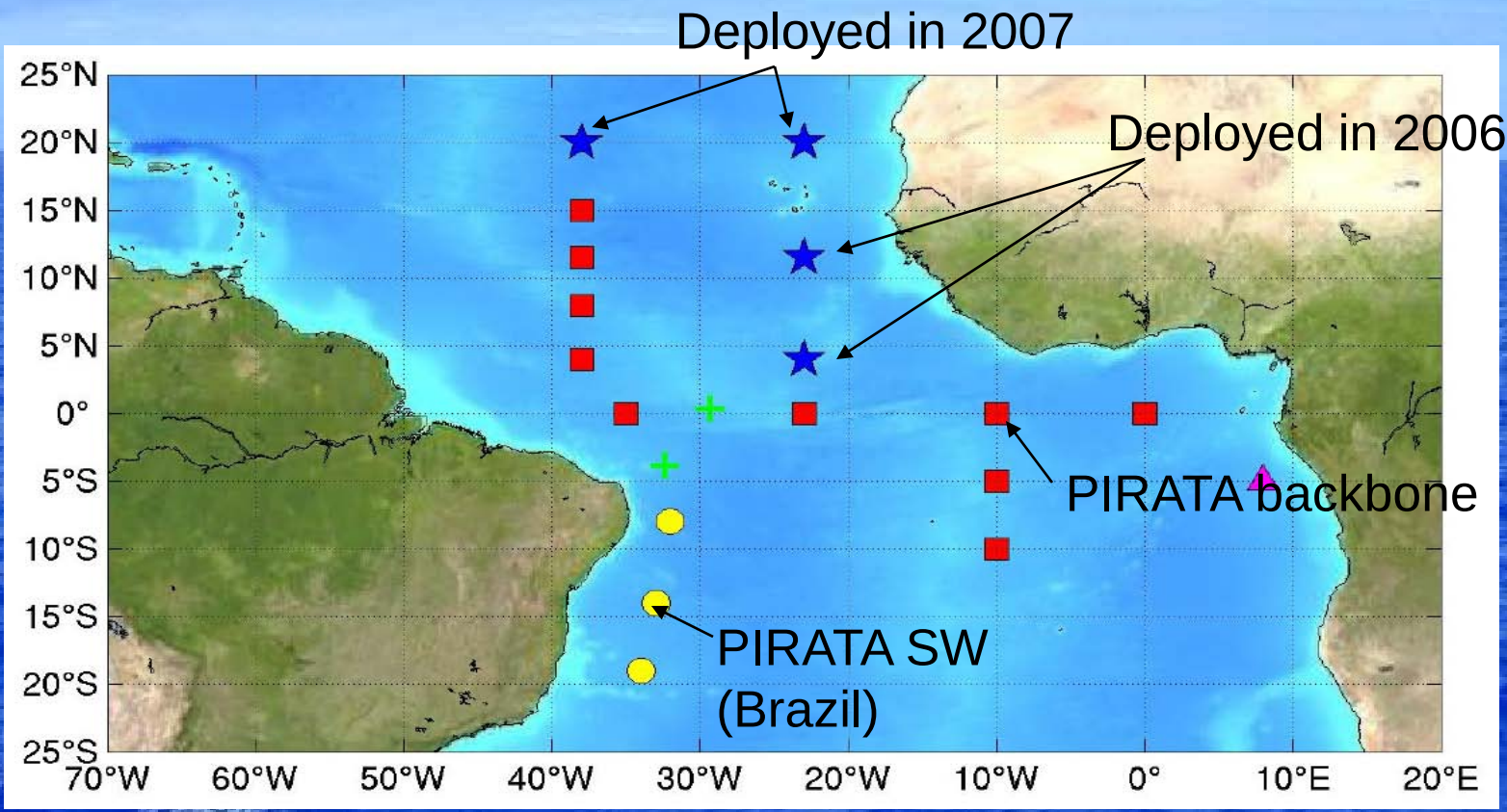
Right: effect of small-scale SST anomalies on rainfall *(figure courtesy Sang-ki Lee, AOML)*



PIRATA Northeast Extension (PNE)

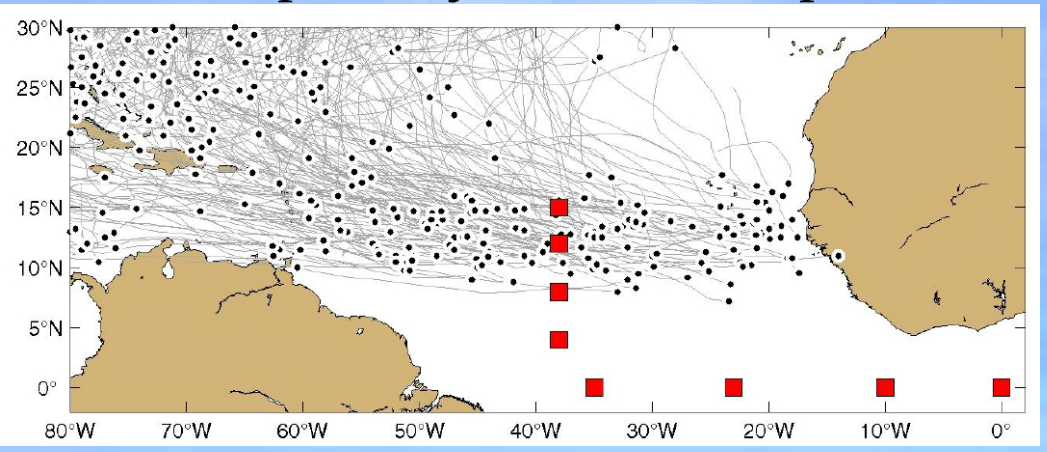
PNE: joint **AOML** and **PMEL** project that extends the PIRATA array into the northern and northeastern Tropical Atlantic. **ESRL**, **NESDIS**, Univ. Miami, Howard Univ. also collecting data during cruises.

AOML PIs: Rick Lumpkin, Claudia Schmid and Chris Meinen

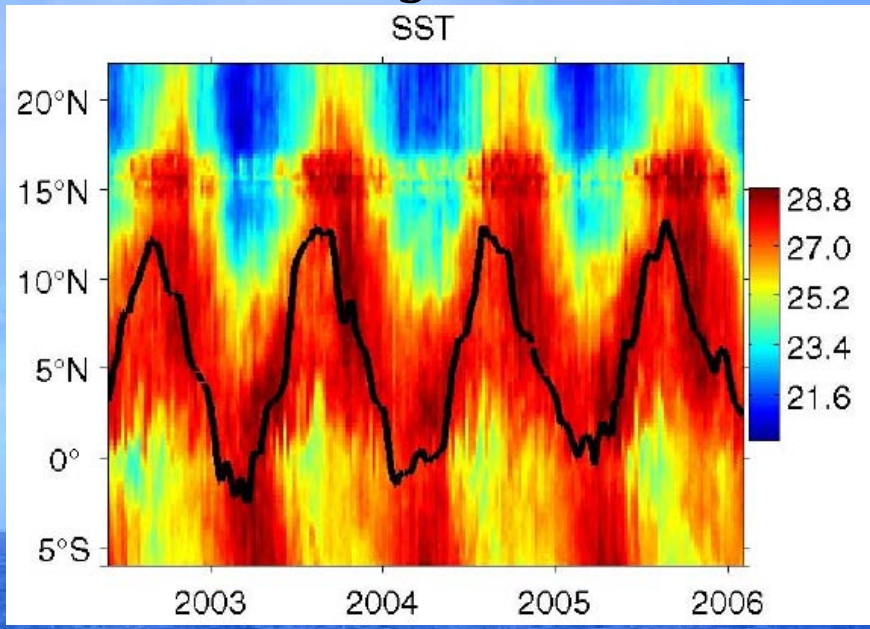


Purpose of PNE

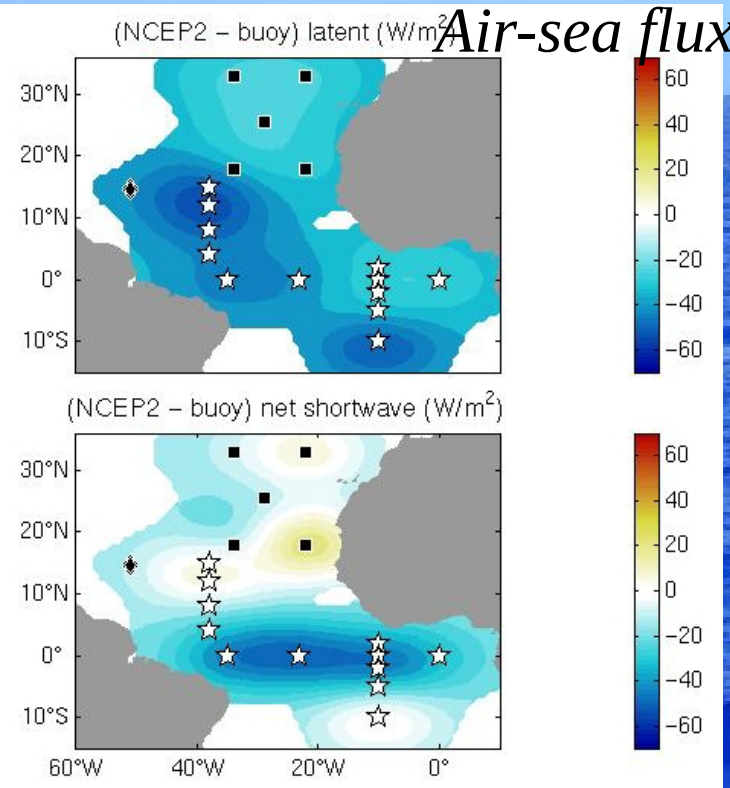
Tropical cyclone development



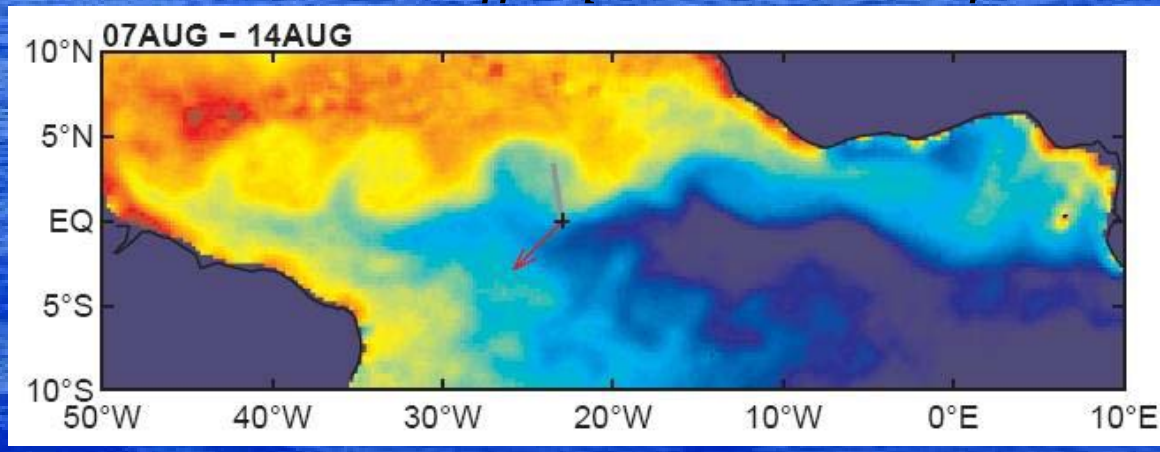
ITCZ migration



Air-sea fluxes

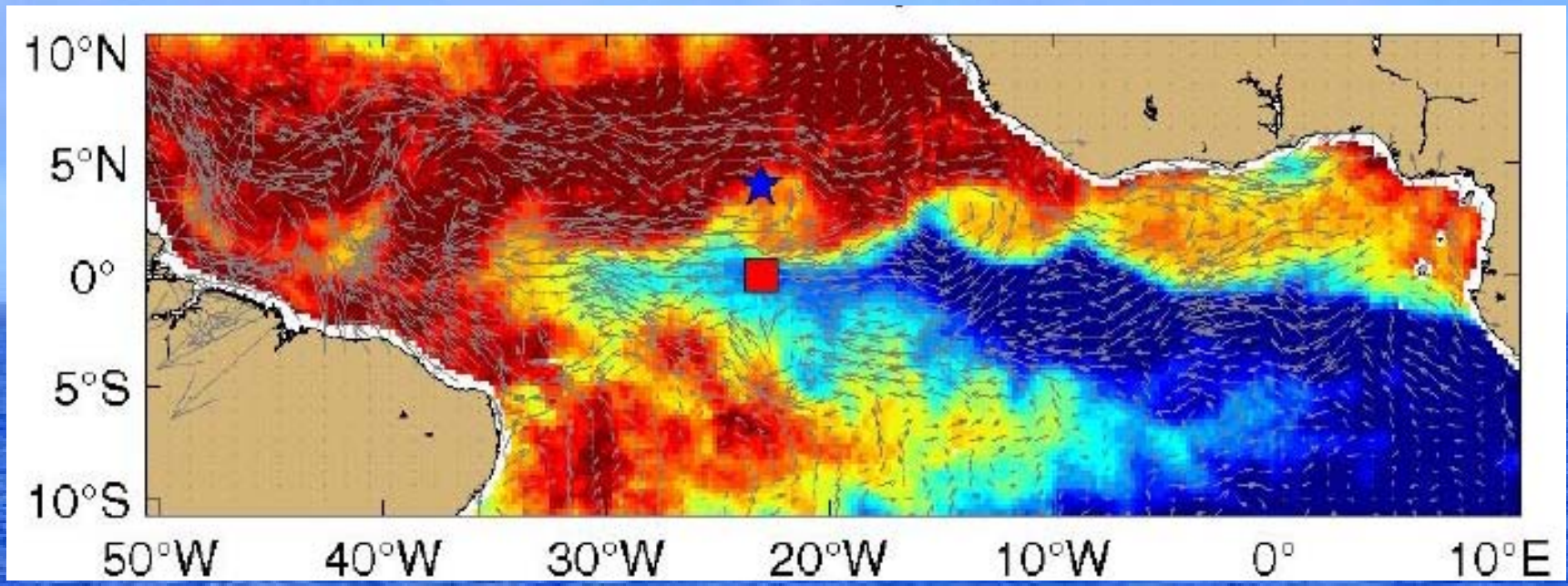


Off-equatorial role of TIWs



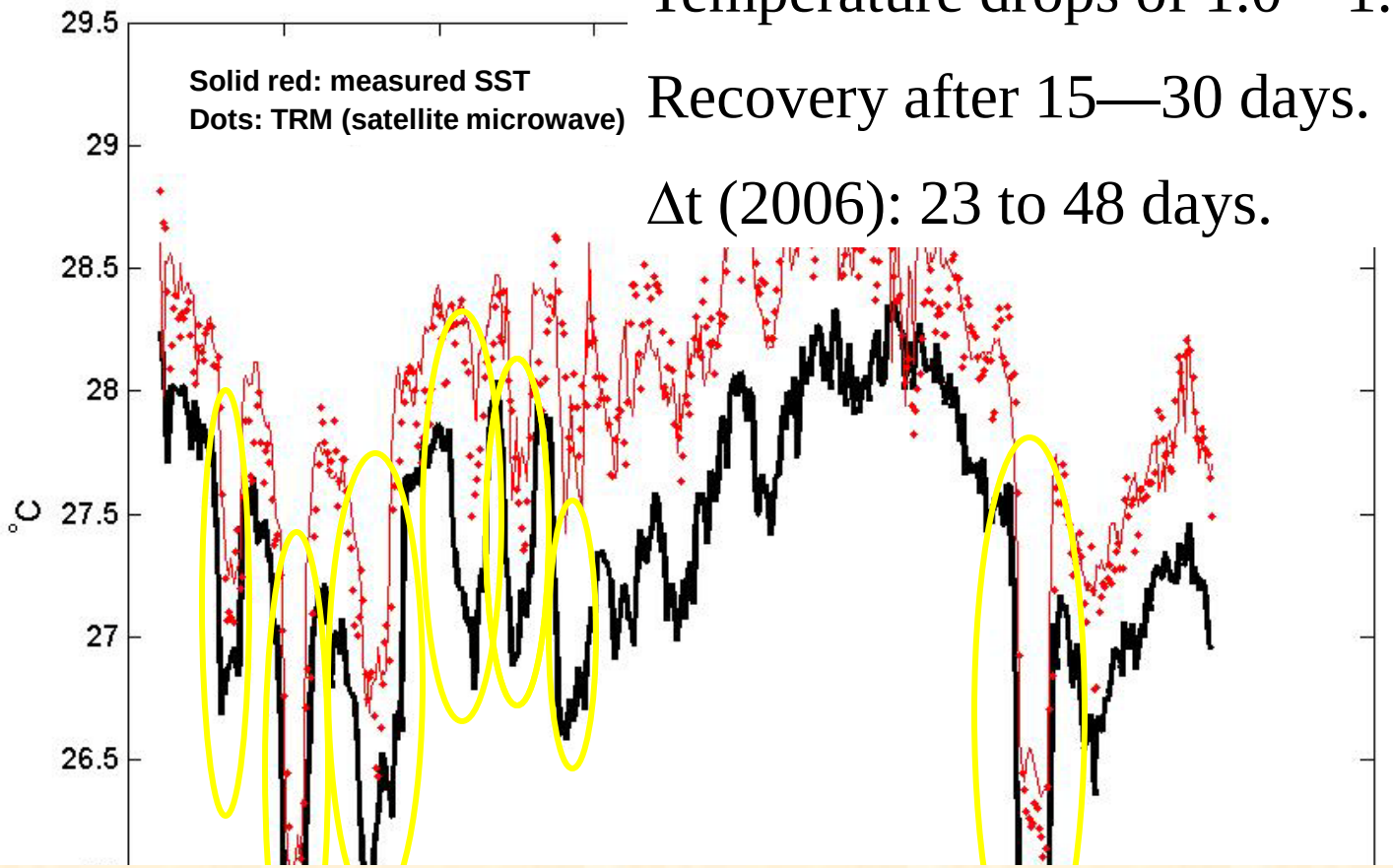
4 N, 23 W mooring

11 June 2006-present



Work by Rick Lumpkin (AOML) in collaboration with Mike McPhaden and Greg Foltz (PMEL).

Heat budget at 4N, 23W



Temperature drops of 1.0—1.7 C.

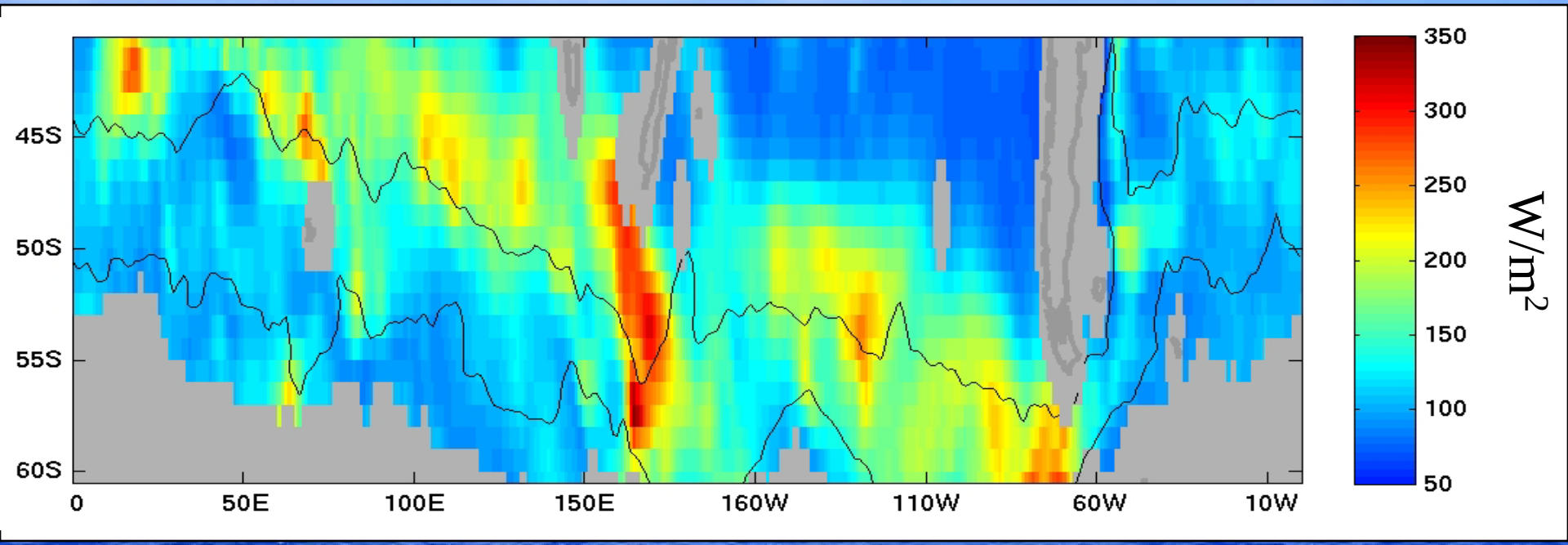
Recovery after 15—30 days.

Δt (2006): 23 to 48 days.

Tropical Instability Wave-driven heat advection of ~500 W/m^2 dominates intraseasonal variations.

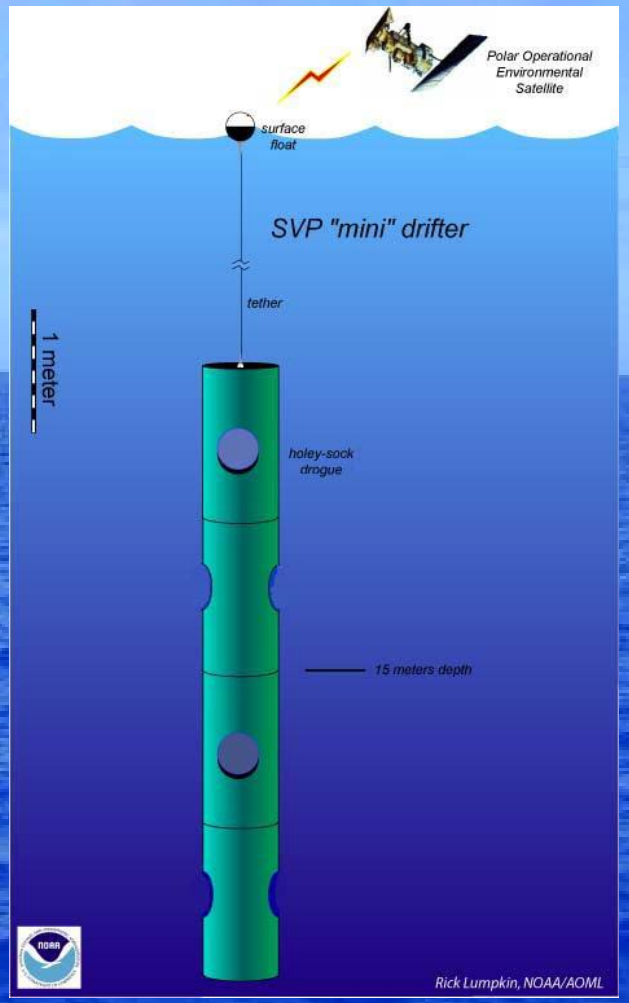
Weak seasonal cycle: delicate balance of latent loss, shortwave gain, and shortwave penetration associated with ITCZ migration.

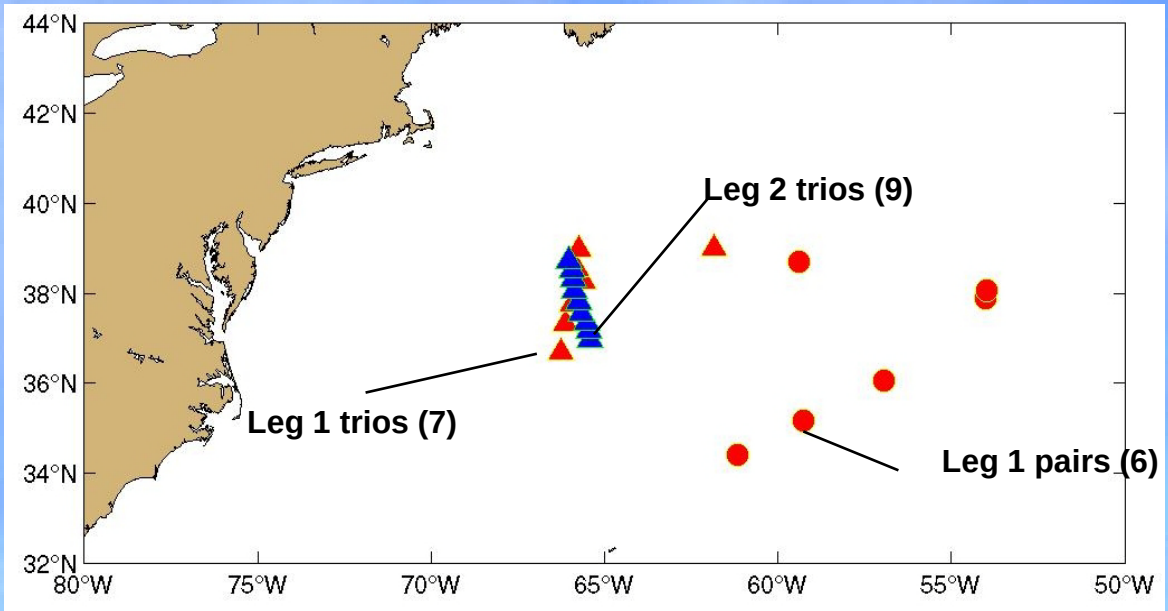
High latitudes: ocean heat budget estimates



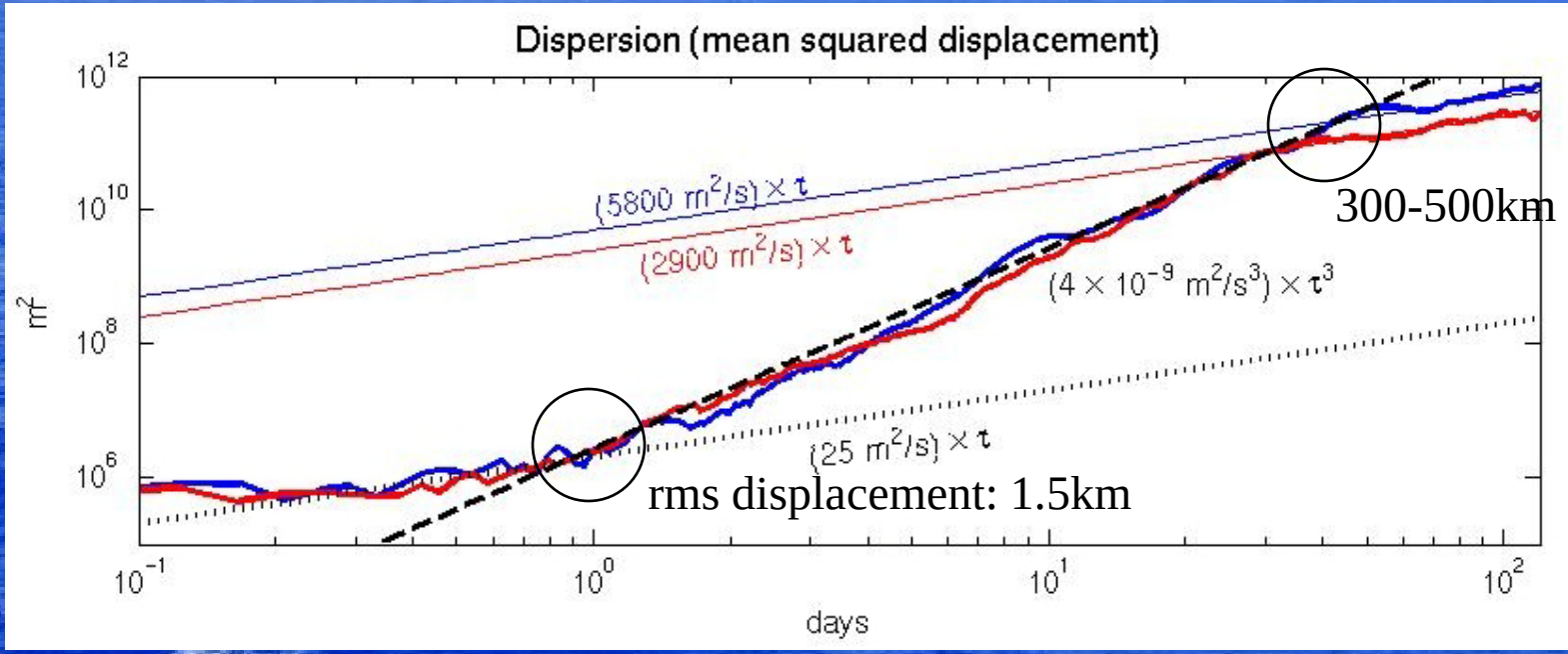
RMS imbalance in estimated heat budget of Southern Ocean, using satellite observations and Argo floats.
LARGE imbalances in formation region of SAMW.
Figure courtesy Shenfu Dong (AOML)

Ocean dispersion from meters to hundreds of kilometers (CLIMODE, Feb. 2007)



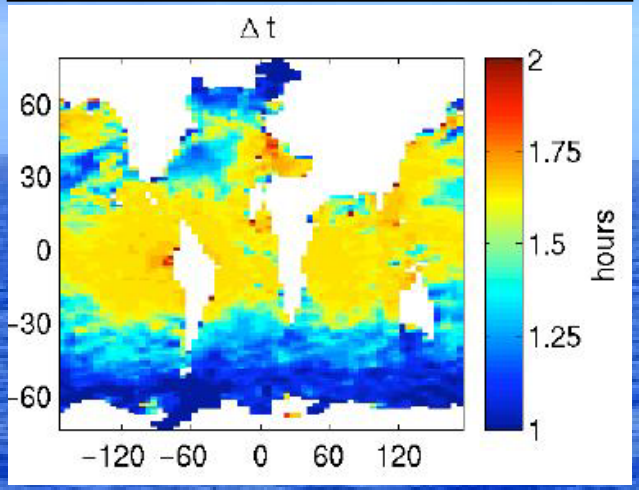


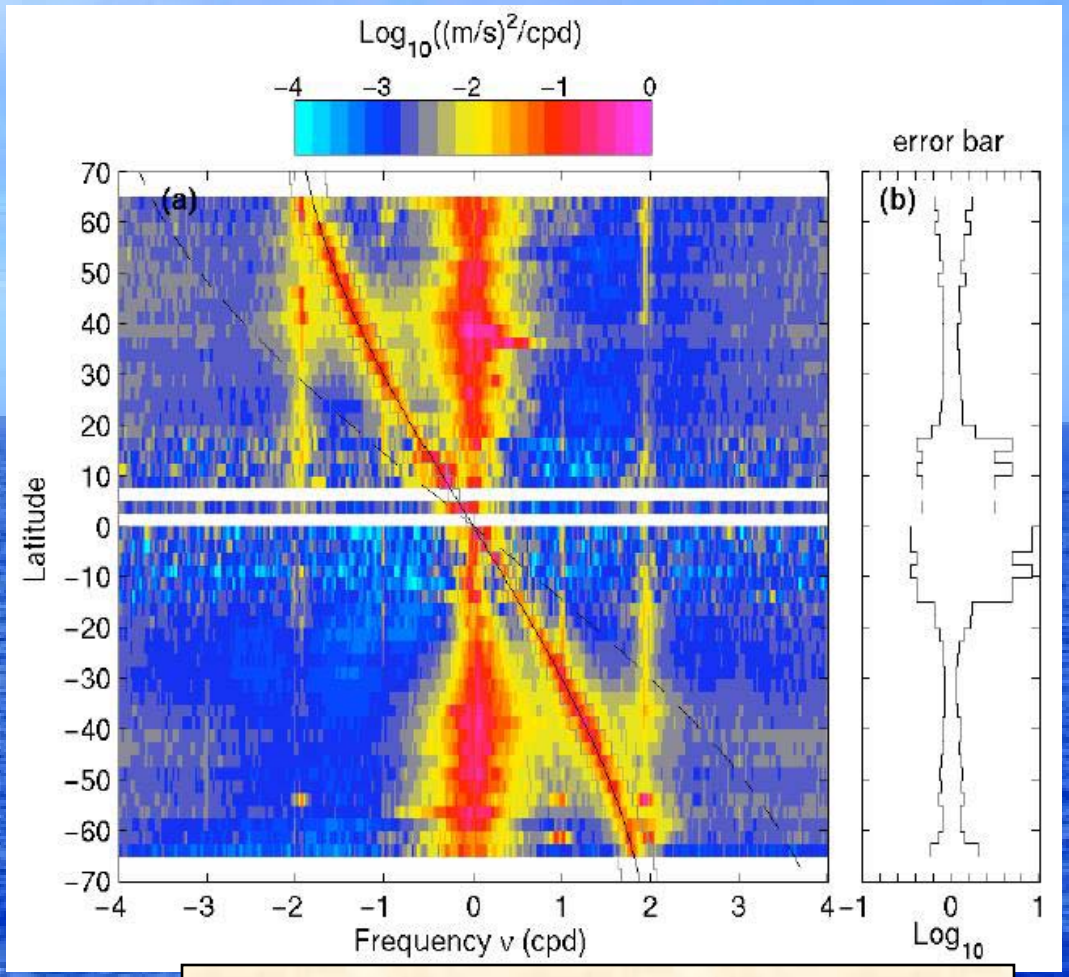
54 drifter pairs with initial separation less than 500 meters



High frequencies, small scales

Resolution of drifter data since 2005 (multisatellite)



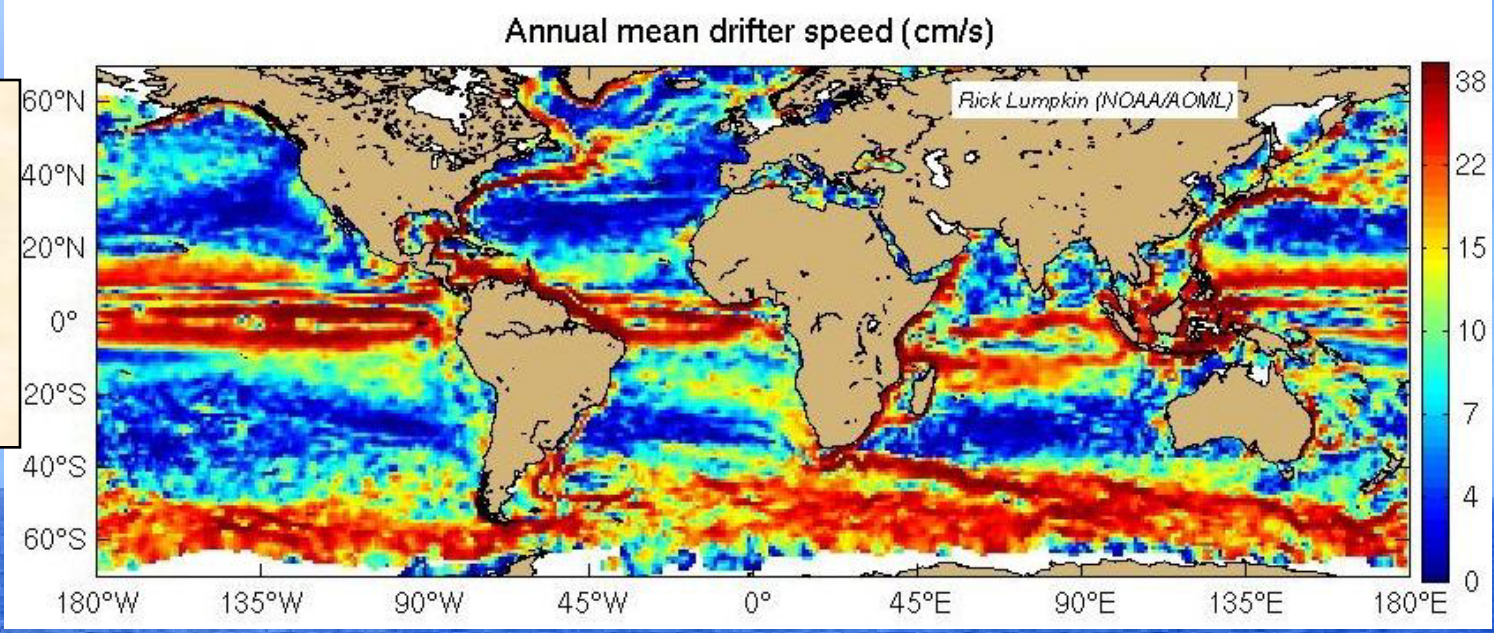


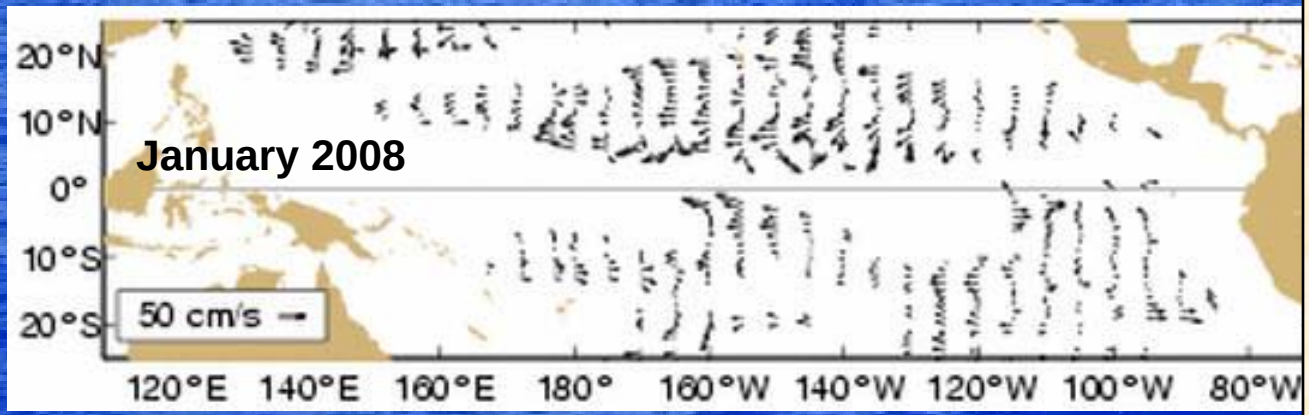
Elipot and Lumpkin, 2008

Transformational Research

- Currents and current anomalies from drifters

Monthly 1 climatology of surface currents (available at AOML web page)

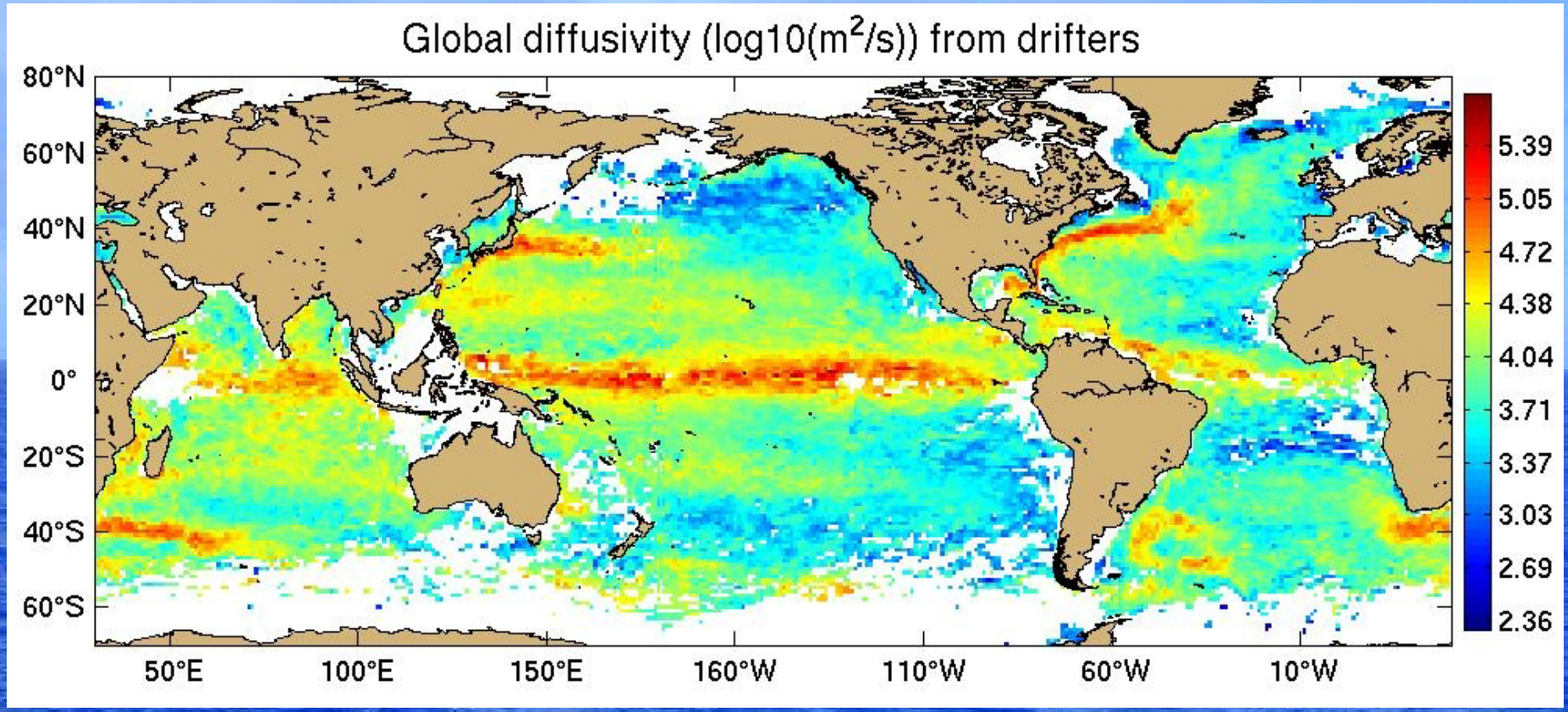




Surface current anomalies from drifters in Pacific (figure and discussion generated at AOML and published in NOAA/CDC Monthly Climate Diagnostics Bulletin)

Transformational Research

- Global effective diffusivities



- Product under development at AOML.
- Diffusion needed to simulate observed eddies in a coupled model, or in any non-eddy-resolving simulation.

Conclusions and the future

Mesoscale (and smaller scale) processes have significant climate impacts on ocean-atmosphere coupling, heat budgets, air-sea fluxes, and ocean transports.

Researchers at AOML are examining and quantifying these impacts in various regions, using in-situ and remote observations and modeling efforts.

Future work: sea surface salinity budgets and transports are also heavily influenced by mesoscale features. Salinity variations can have a large impact on overturning rates, water mass formation, and energy conversion estimates. Components of the Ocean Observing System will be used in conjunction with future satellite missions to revolutionize our knowledge of these effects.