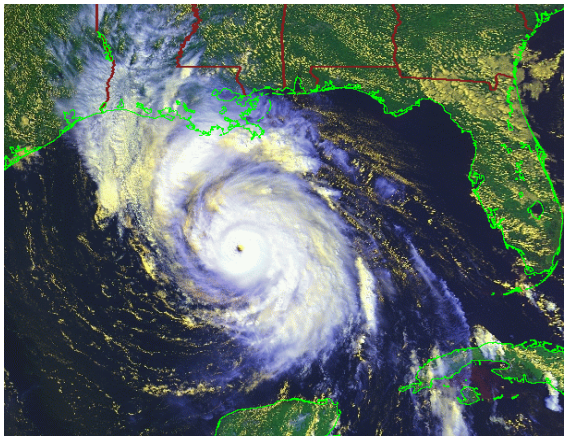
Systematically Merged Atlantic Regional Temperature and Salinity (SMARTS) Climatology: Application to Hurricane Earl



Pat Meyers, Lynn K. "Nick" Shay, Jodi Brewster, Benjamin Jaimes

Goal: Using satellite, in situ data and models to examine the ocean's role in intensity changes (Its more than just SST).

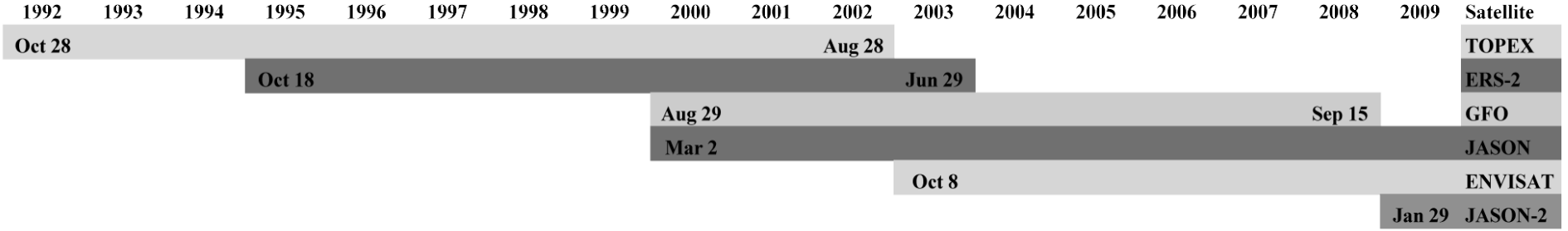
RSMAS

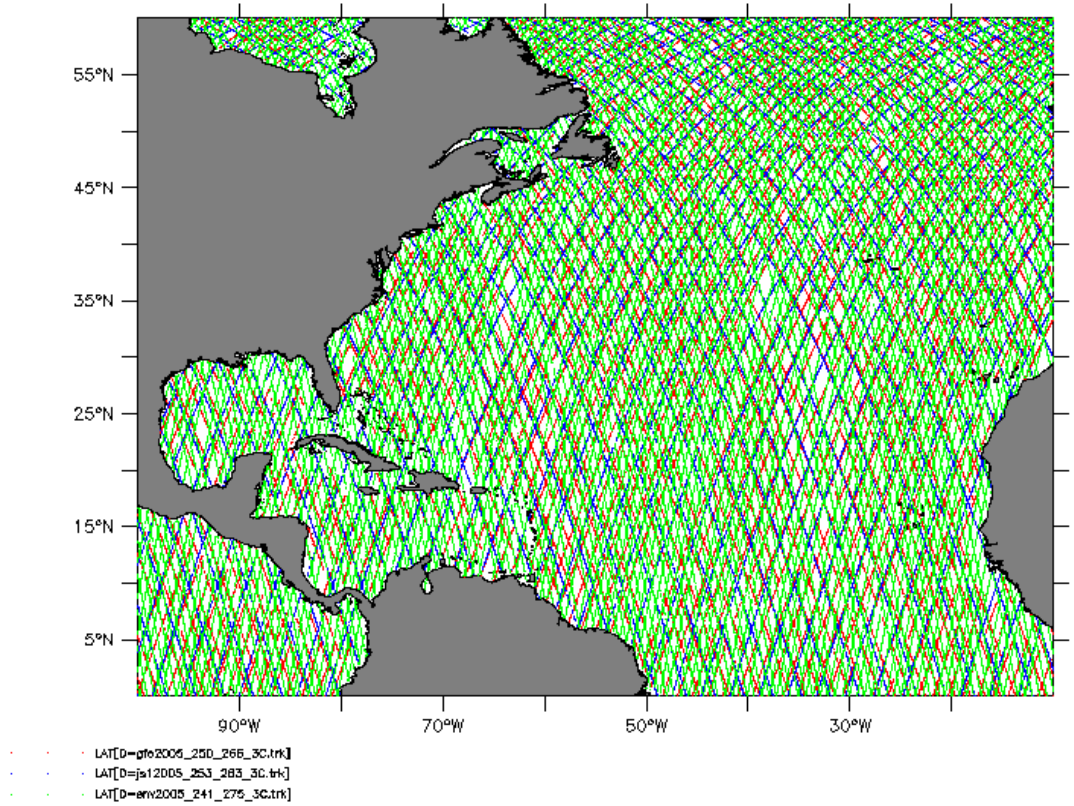
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

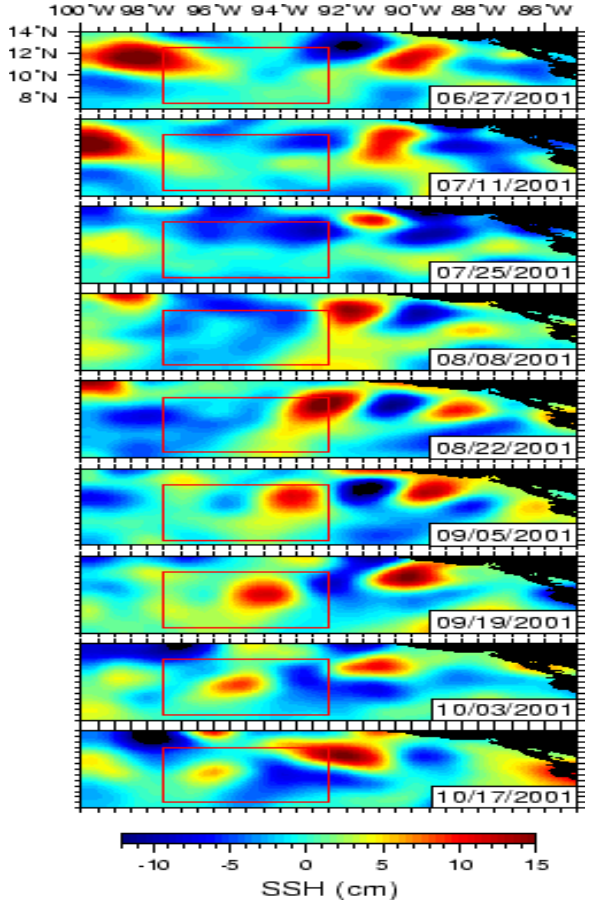
NASA

HURRICANE FORECASTERS ARE PREDICTING A HALF-DOZEN CATEGORY TWO'S, SEVERAL CATEGORY FOUR'S, AND FOR THE FIRST TIME EVER...
NEWS
THE TIMES-PICAYUNE © 2010
A CATEGORY 10-W40.
NEWS

Satellite Altimetry Availability Since 1992





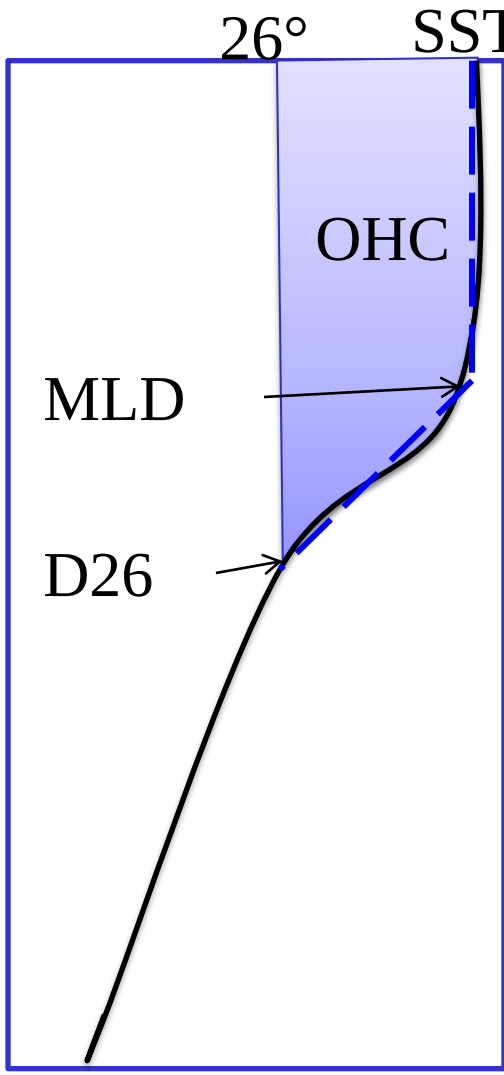


Motivation and Background

- Minimum sea surface temperature threshold for hurricane formation: SST >26ºC (Palmen, 1948)
- Leipper (1972) introduced Ocean Heat Content
  - Integrated thermal energy from surface to 26º isotherm

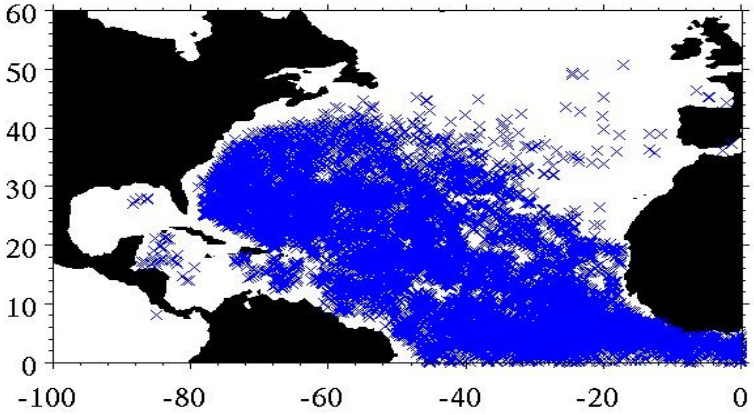
$$OHC = c_p \rho \int_{D26}^{\eta} (T_z - 26°) dz$$

- Empirical approach to estimate OHC from satellite altimetry (Shay and Brewster, 2010)
- Ocean thermal structure is important feedback mechanism (Chang and Anthes, 1978)
- Warm core eddies inhibit mixing and provide deep energy source for hurricanes (Shay et al., 2000; Jaimes and Shay, 2009)

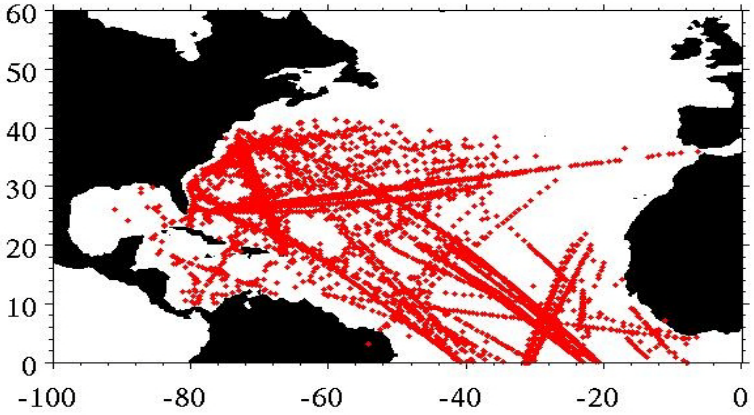


ARGO, XBT, AXBT, Mooring:
44,000 Profiles From 98-09 (Meyers et al., 2010)

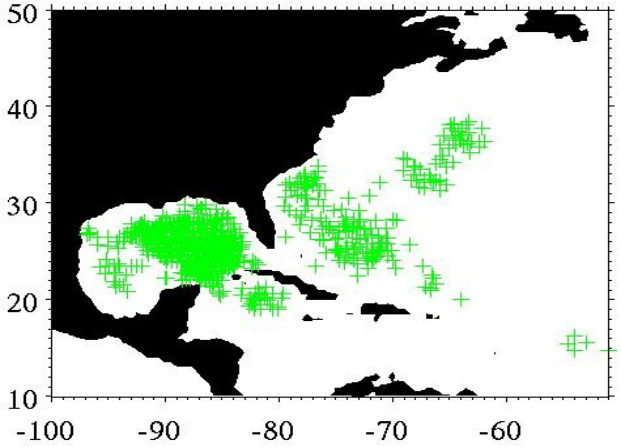
Argo Soundings
profiles: 19,697
(2000-2009)



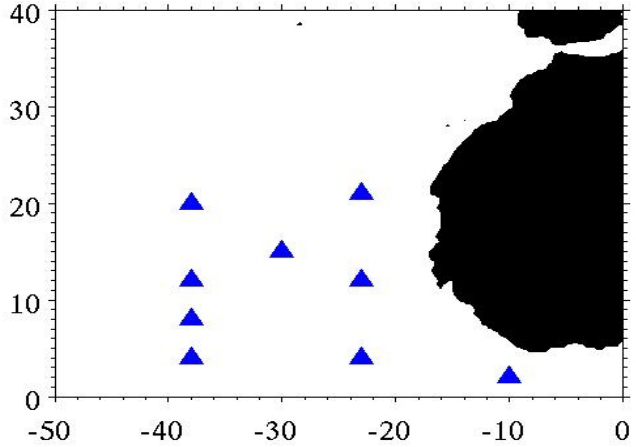
XBT Soundings
profiles: 10,722
(2000-2009)



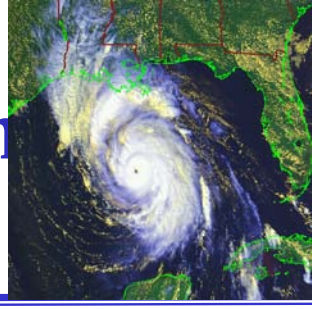
AXBT Soundings
profiles: 1,022
(1998-2009)



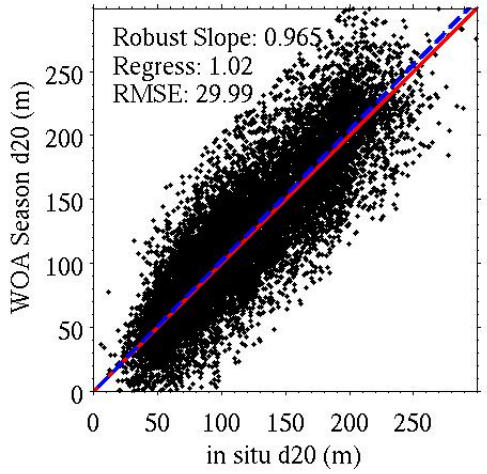
Pirata Mooring Profiles
profiles: 13,116
(1998-2009)

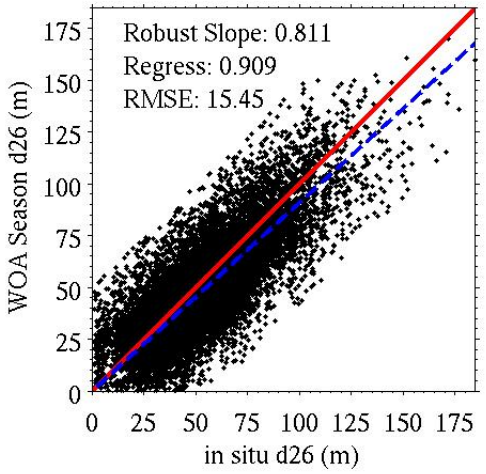


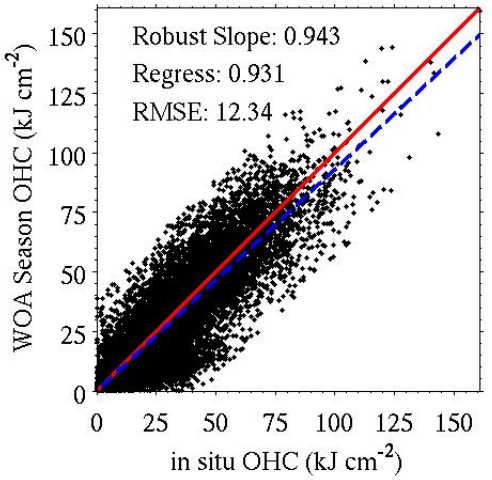
Hurricane Season Climatology Comparison
Float Data

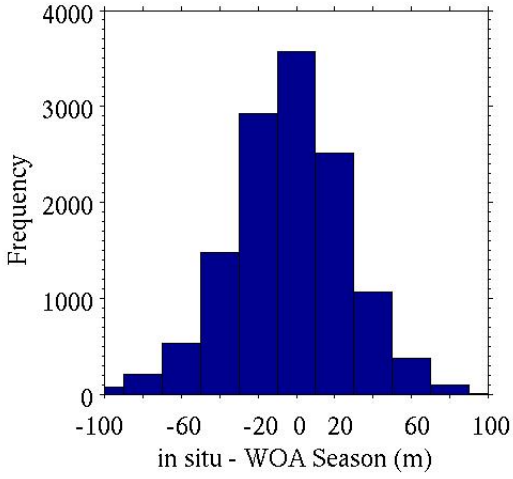


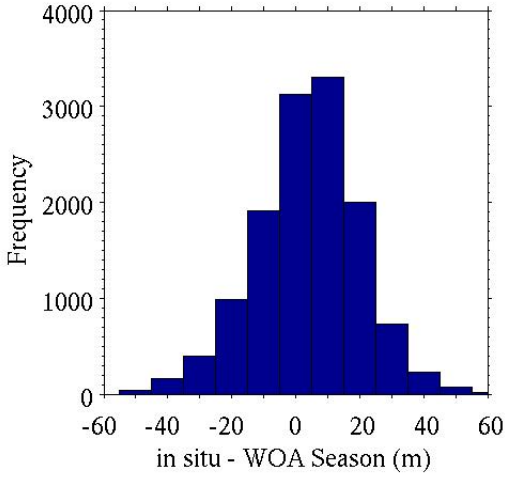
ARGO: 12830 profiles

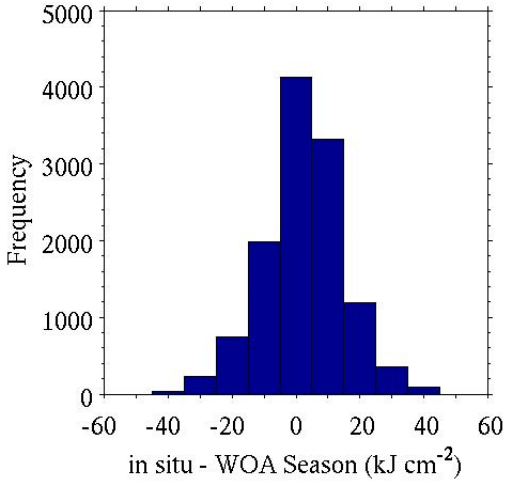






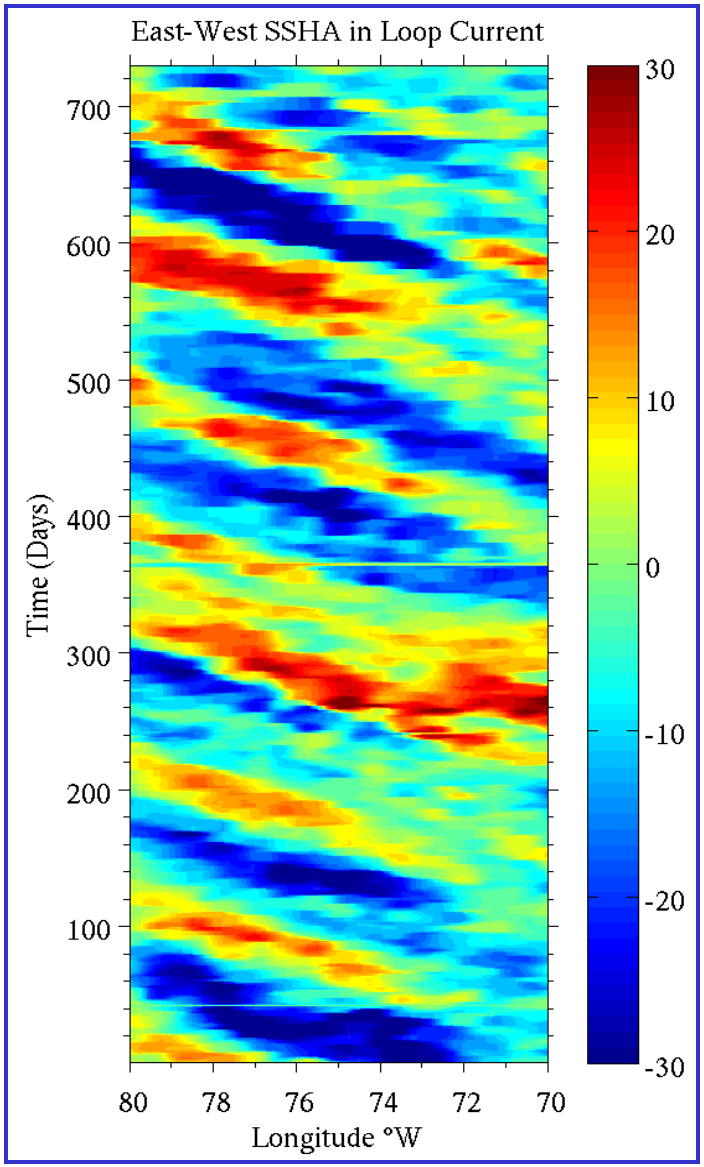






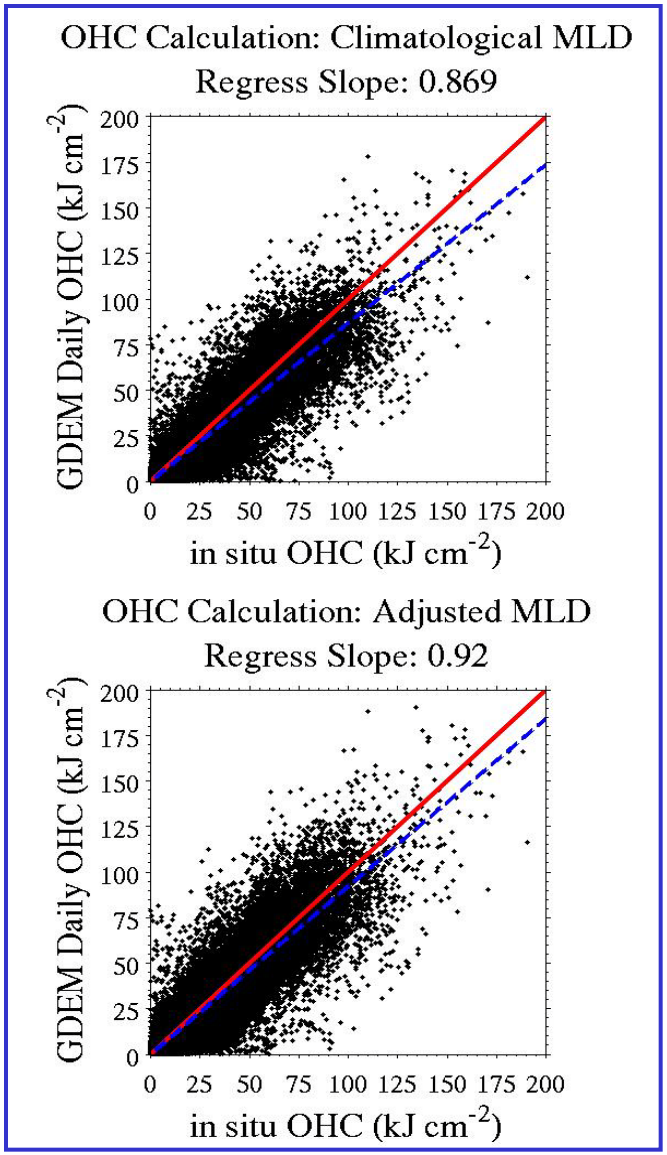
Drift Velocity Adjustment

- Previous OA used constant drift velocity over entire Atlantic Basin
- Examination of non-drifted Sea Surface Height Anomalies (SSHA) showed spatially varying drift velocities
- Adjustments led to small changes in the location of features

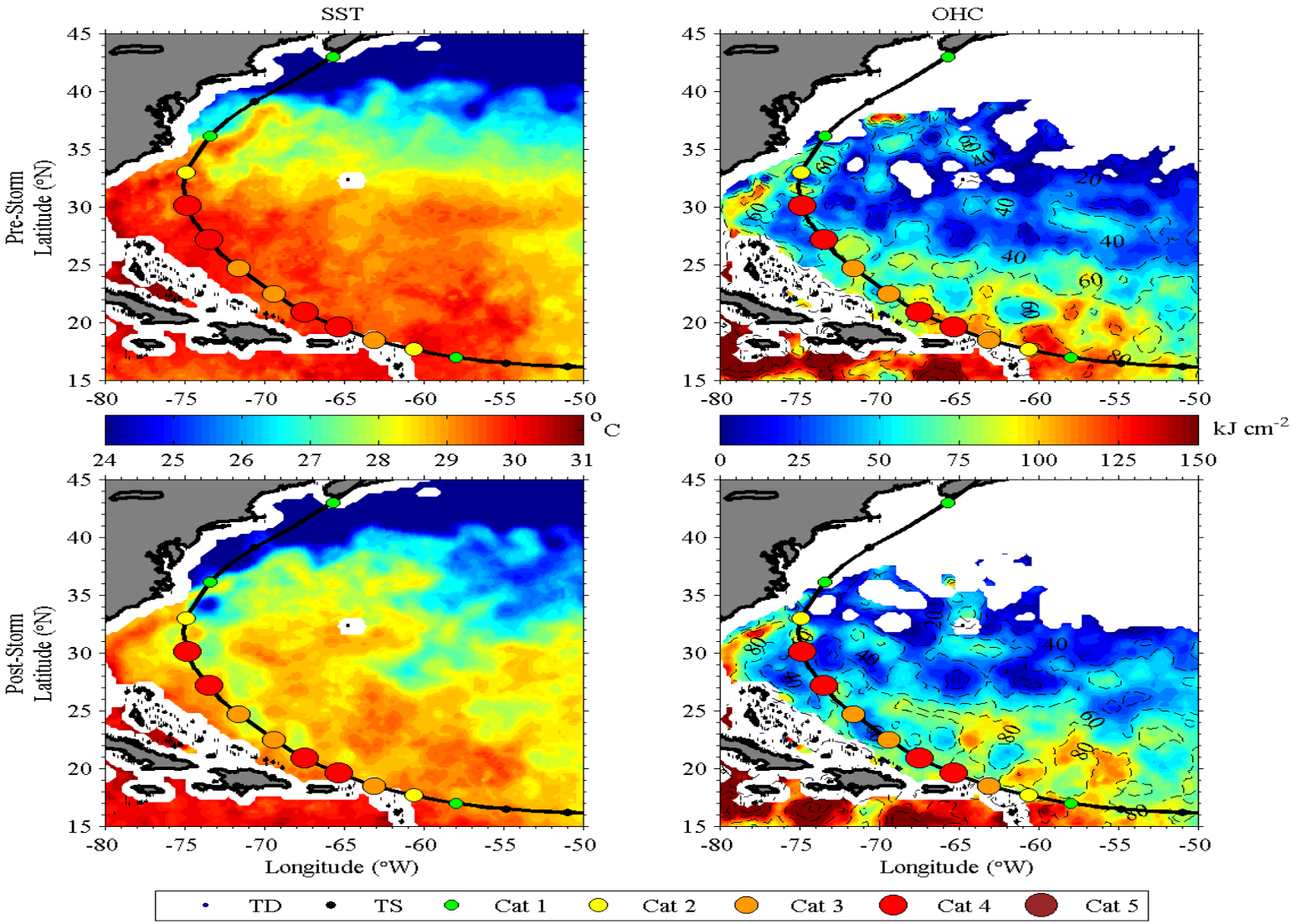


Satellite-Estimated MLD Consideration

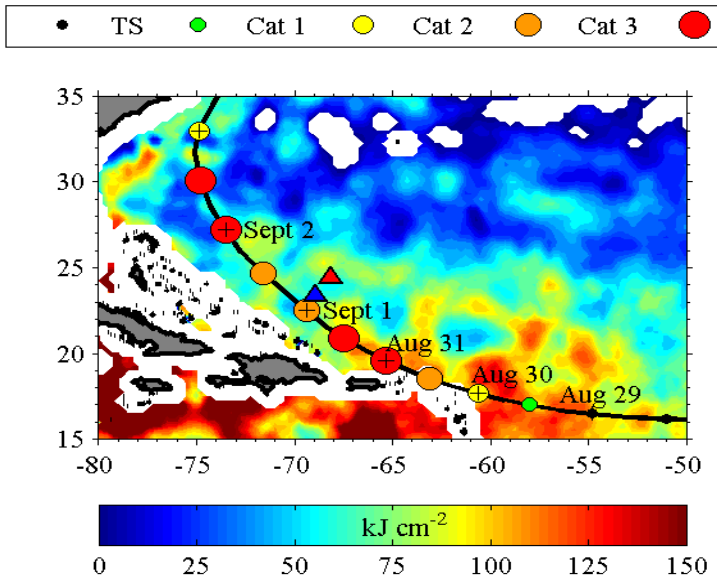
- Improvement to OHC regression slope. More realistic variability
- Decreased accuracy after strong wind-forcing events (entrainment)
- Most useful during hurricane season when there is more variability of MLD

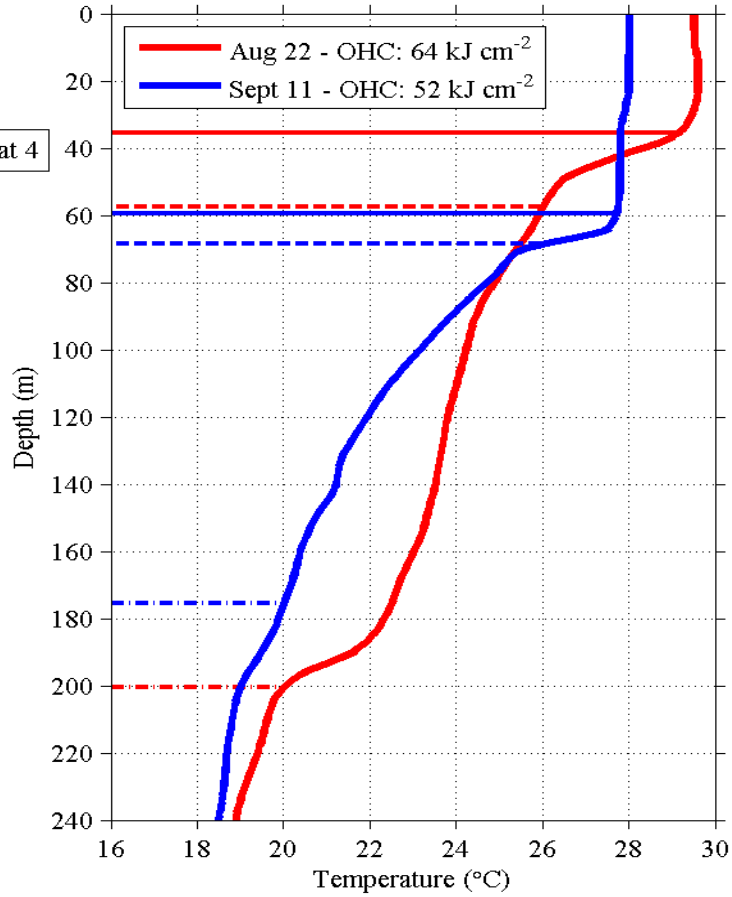


Hurricane Earl (2010): SST (TMI) and OHC (Jason, Envisat Altimeters)

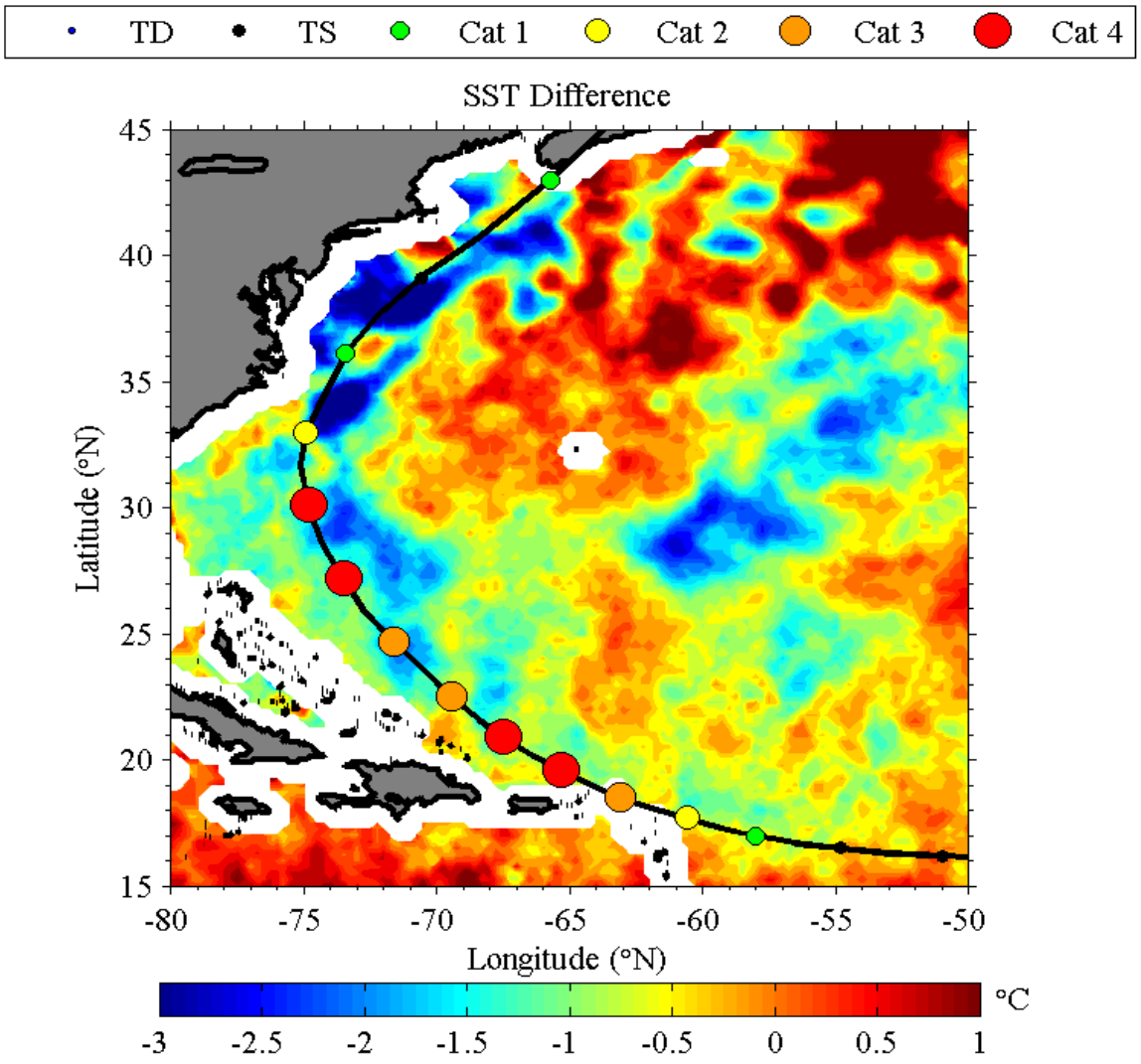


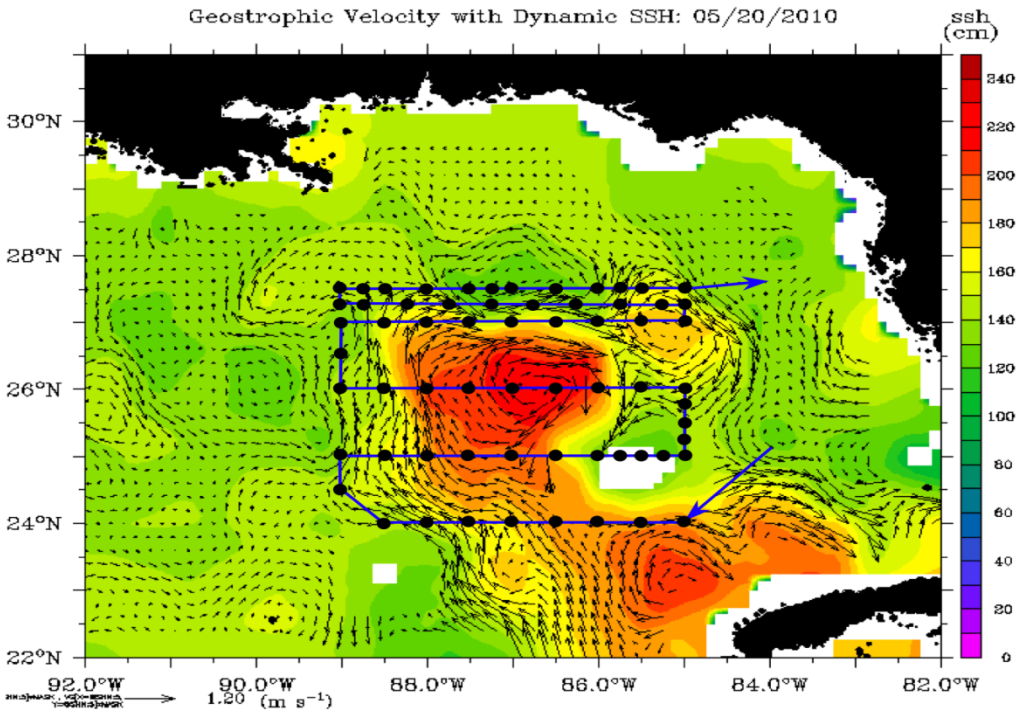
Hurricane Earl (2010): satellite and ARGO Float Measurements

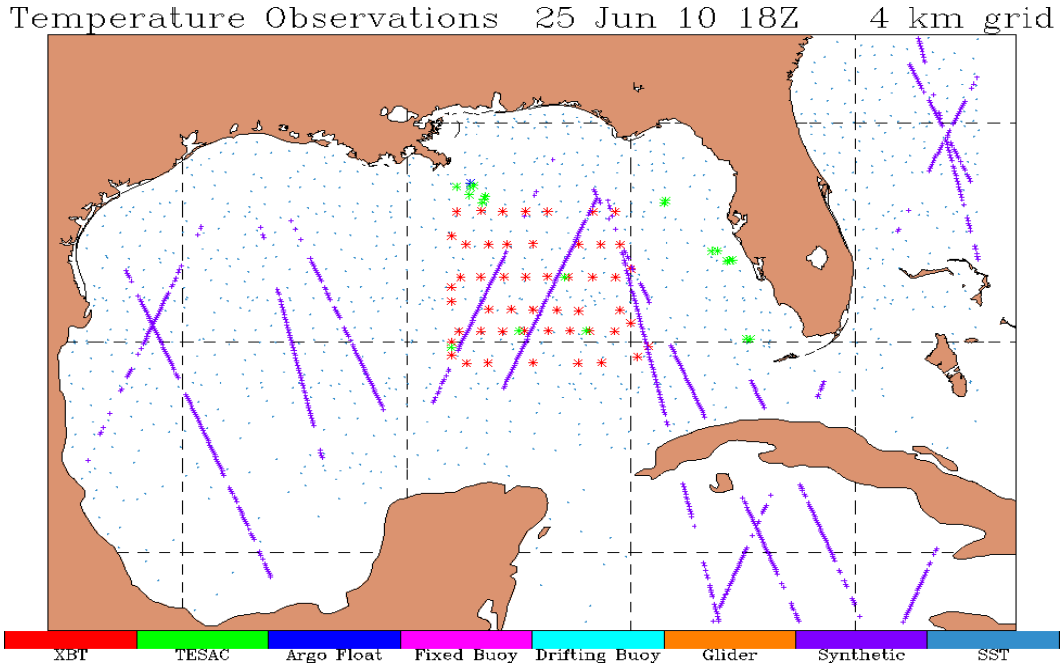




Hurricane Earl SST Differences (2010)



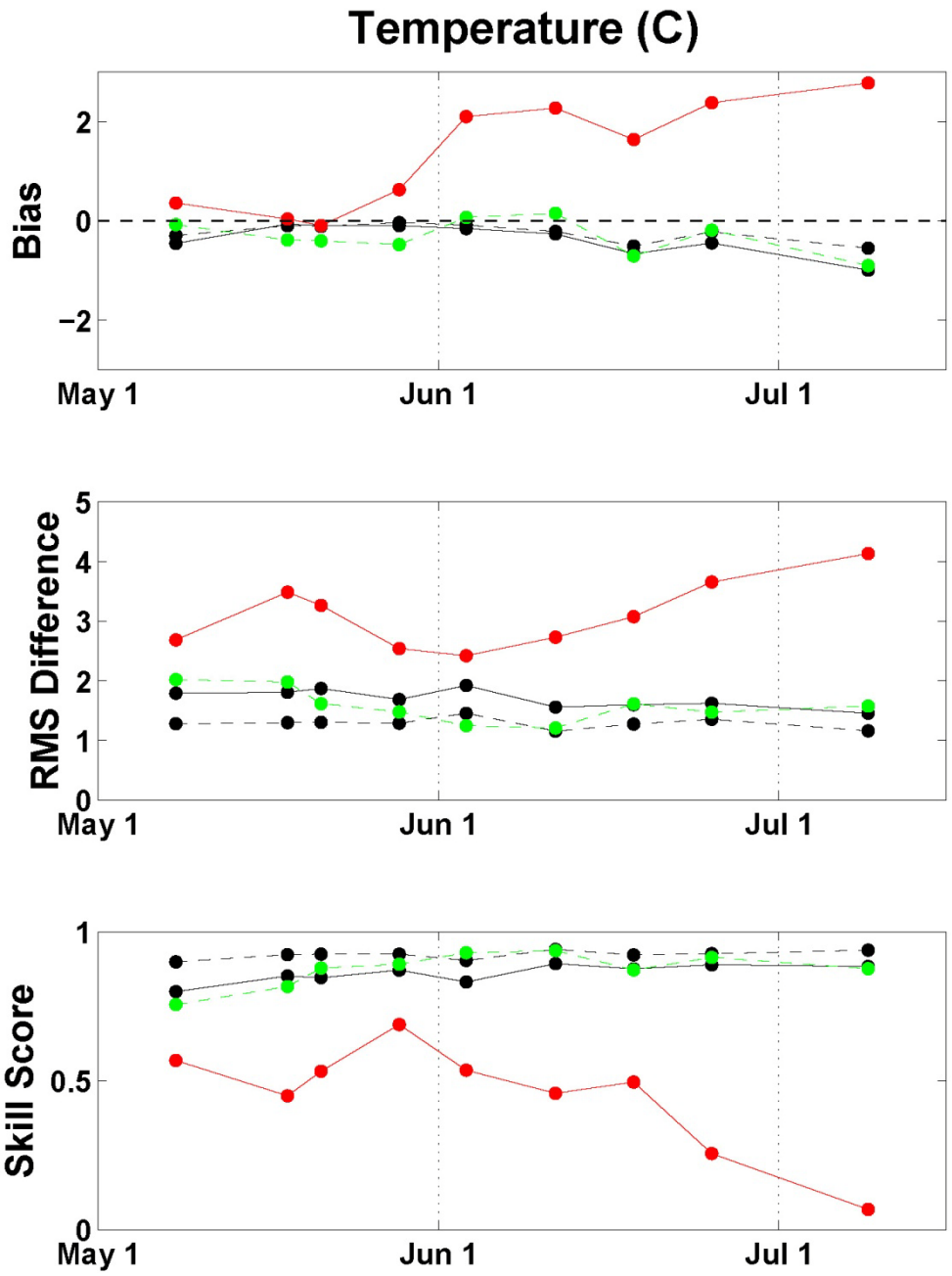




Deep Water Horizon Oil Spill Grid Spanning From 24 to 28N using AXBTs, AXCTDs and AXCPs (from Early May 2010).

Assimilated altimeter data and AXBTs into an ocean models for trajectory forecasts.

(Shay et al, PNAS, 2011 Submitted)



Evaluation of Four HYCOM Nowcasts

MODELS:

Navy 0.04-degree GOM HYCOM

Navy 0.08-degree global HYCOM

NCEP/EMC RTOFS

Solid lines – No P3 assimilation

Dashed lines – With P3 assimilation

This evaluation compares temperature from all AXBT profiles over the depth range from 30 to 360 m

Conclusions & Summary

- Extensive in-situ temperature profile data used to evaluate GDEMv3.0 and WOA01 regionally and seasonally
- Determined feature drift velocities along altimetry (Jason1,2) tracks to incorporate in objective analysis
- MLD algorithm a more uniform deepening rather than changing stratification improves OHC by ~4 to 7%.
- Approach is being successfully transitioned to NESDIS for Global Real Time Product (NASA, NSF, NOAA)
- Application of OHC to RI in Earl and Karl….Use HYCOM in uncoupled and coupled states.
- Assess fluxes from GPS sondes/ DAWN (momentum flux?)….SSTs from any research flights?