Meteorological Observations in SPURS

James Edson

University of Connecticut

Tom Farrar & Al Plueddemann

Woods Hole Oceanographic Institution

Miami SPUR Meeting

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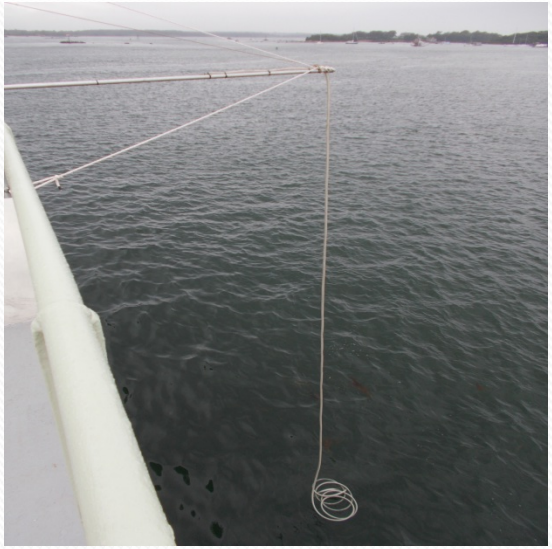
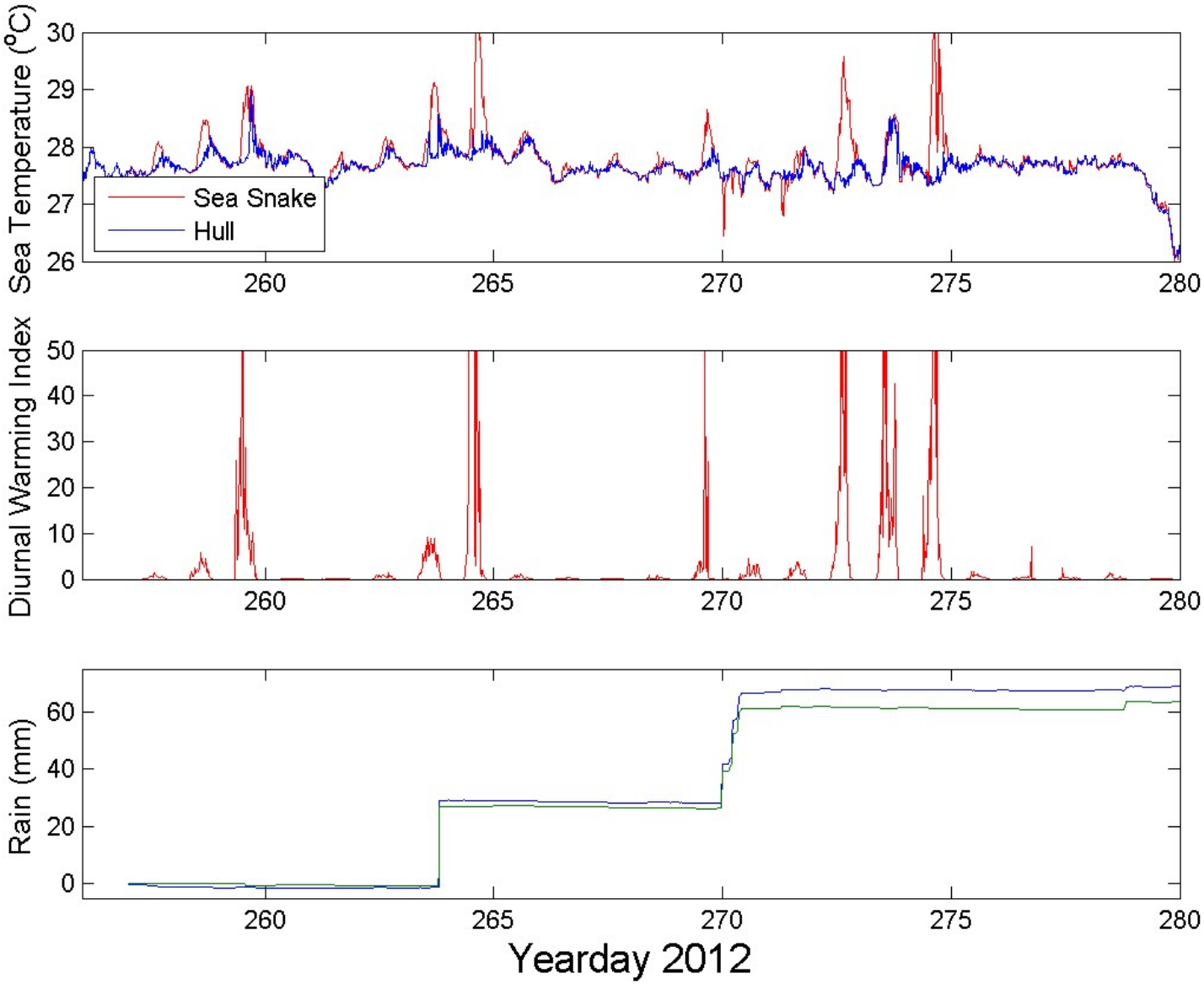
Knorr Met Systems

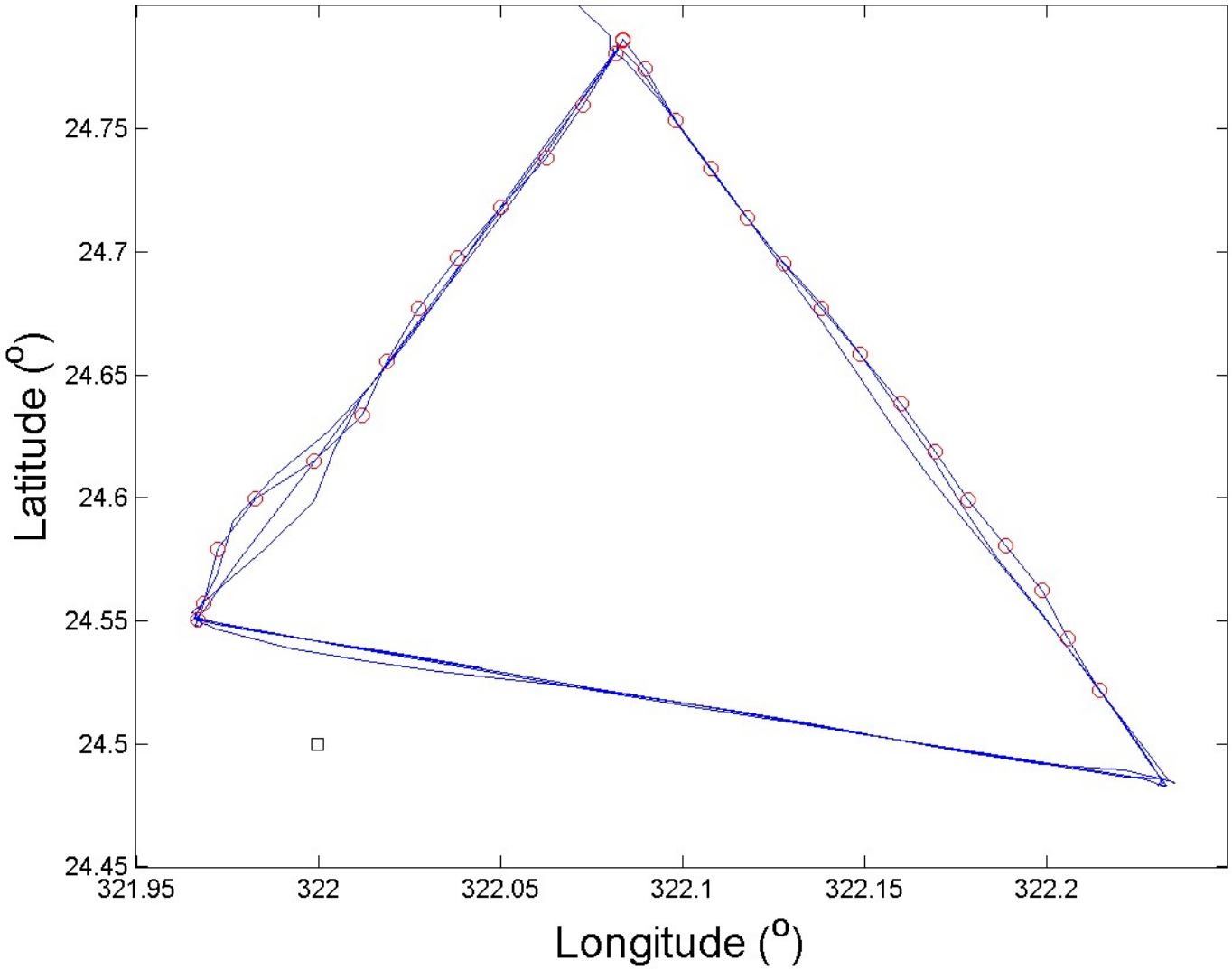


- Direct covariance flux system.
- 2 open path LI-7500 hygrometers
- 1 aspirated RH/T sensors
- 2 naturally aspirated RH/T sensor
- GPS compass
- Downwelling solar and IR sensors
- 2 Self-siphoning rain gauge
- Sea-snake

Sea Temperature & Rain



Cruise Track



Flux Definitions

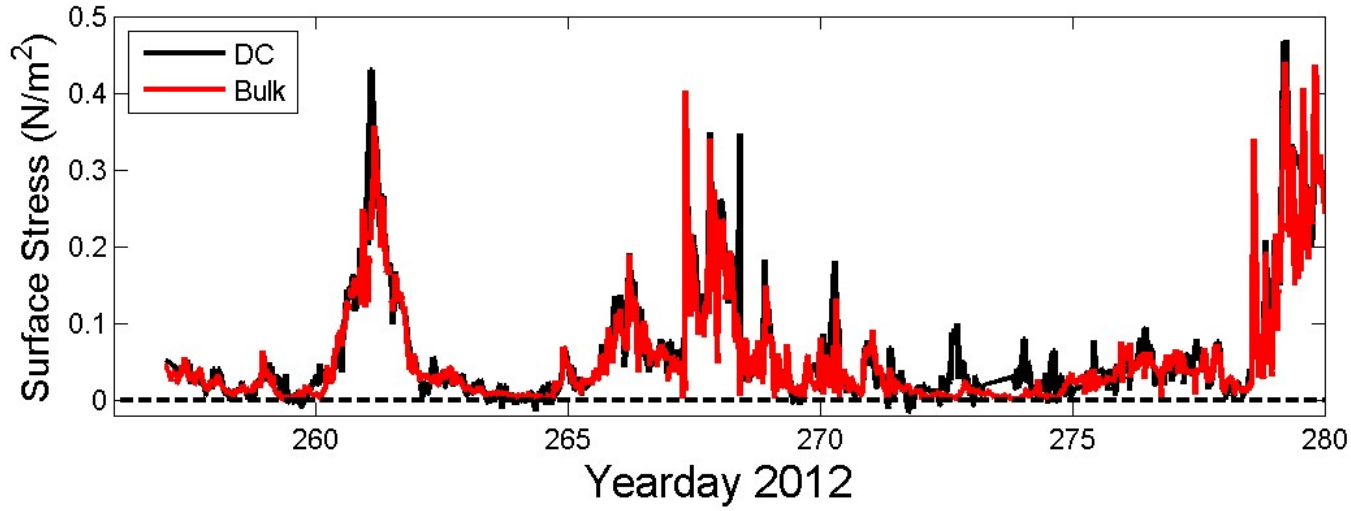
Momentum Flux: $$\rho_a \overline{uw} = \rho_a C_D S_r \Delta U_r$$

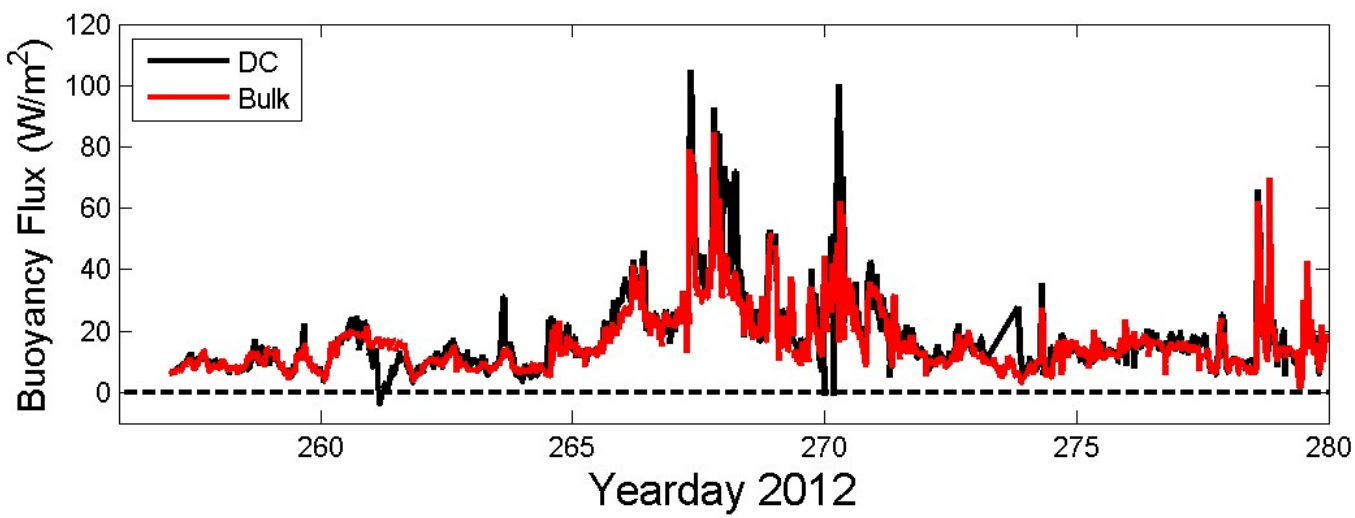
Buoyancy Flux: $$\rho_a c_p \overline{wT_v} = \rho_a c_p \left(\overline{wT} + 0.61 \overline{T}\,\overline{wq} \right)$$

Latent Heat Flux: $$\rho_a L_v \overline{wq} = \rho_a L_v C_E S_r \Delta Q$$

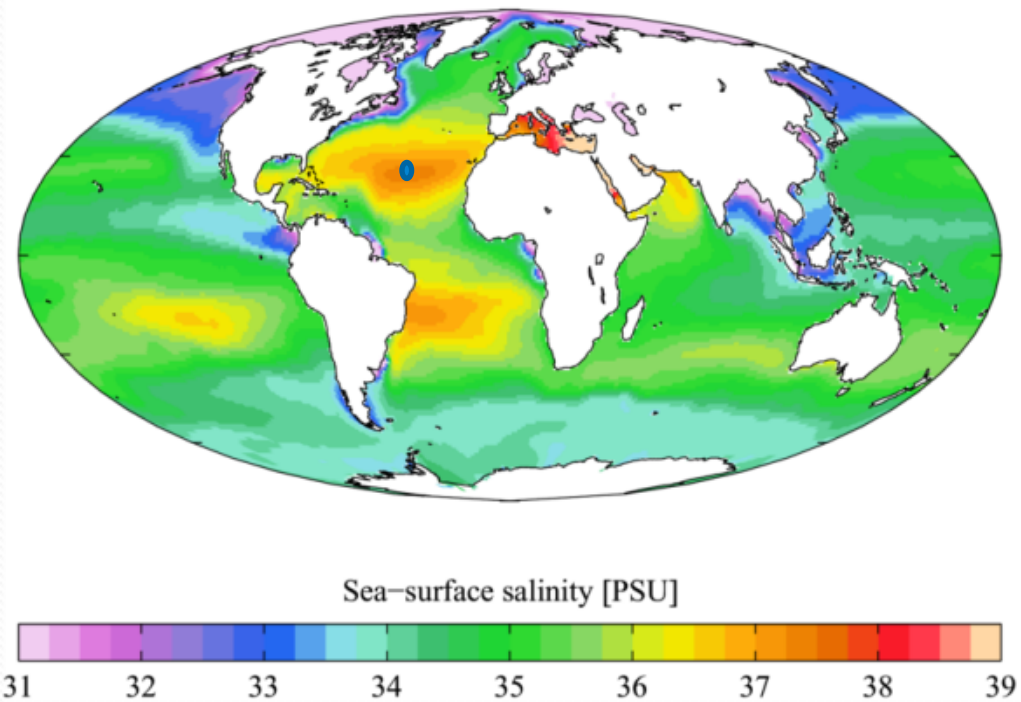
Sensible Heat Flux: $$\rho_a c_p \overline{wT} = \rho_a c_p C_H S_r \Delta \Theta$$

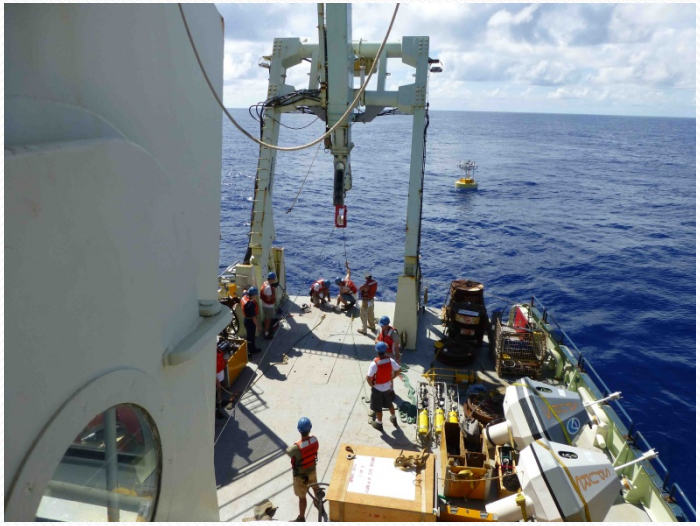
SPURS Direct Covariance Fluxes





Salinity Processes in the Upper Ocean Regional Study (SPURS).





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Drag Coefficient Formula

- COARE Algorithm

$$C_D(z/z_o, z/L) = \frac{-\overline{uw}}{\Delta U S_r} = \left(\frac{\kappa}{\ln(z/z_o) - \boxed{\psi_m(z/L)}} \right)^2$$

Atmospheric Stability

$$C_{DN}(z/z_o) = \frac{-\overline{uw}}{\Delta U_N \boxed{G}} = \left(\frac{\kappa}{\ln(z/\boxed{z_o})} \right)^2$$

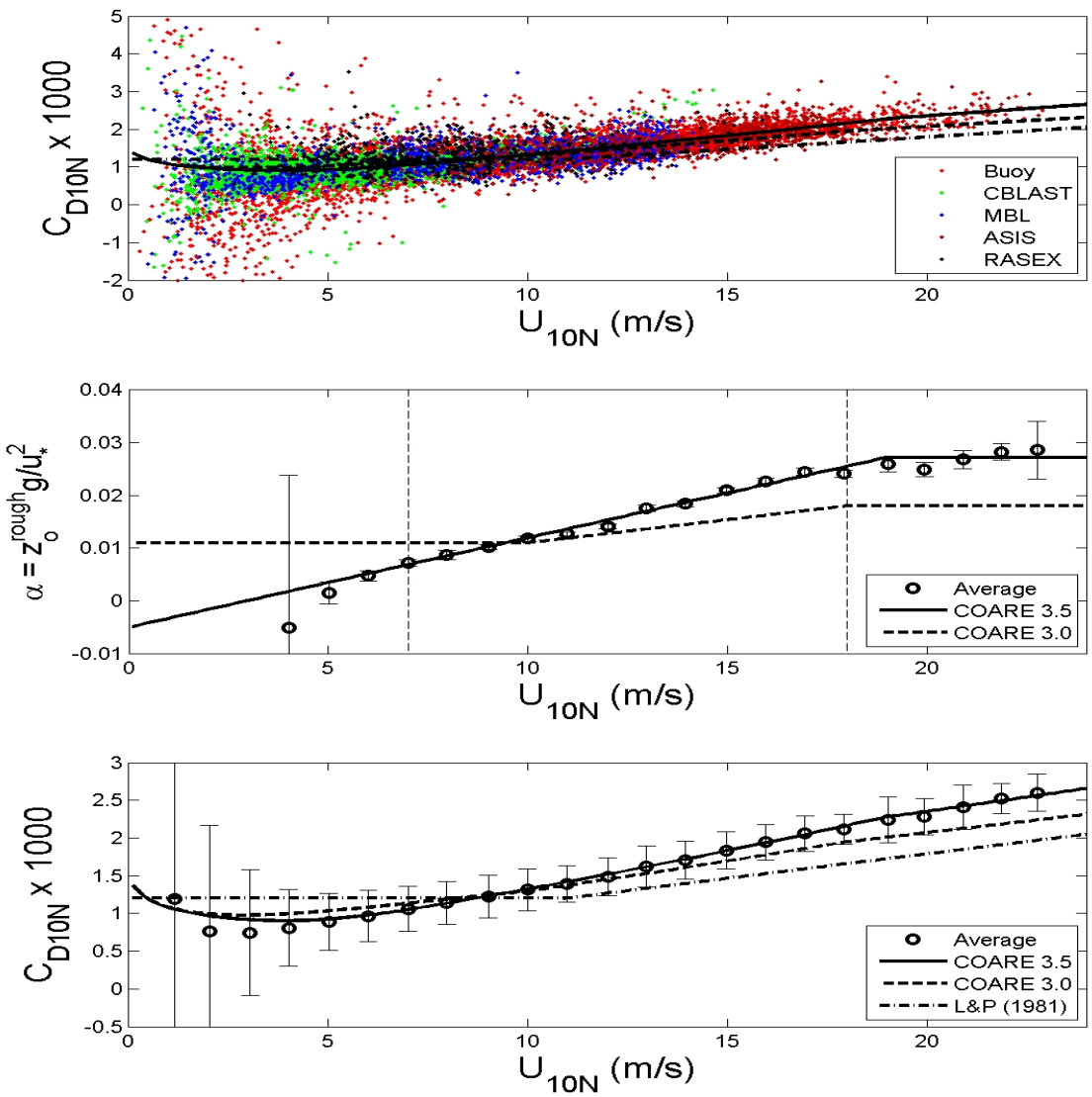
Surface Roughness

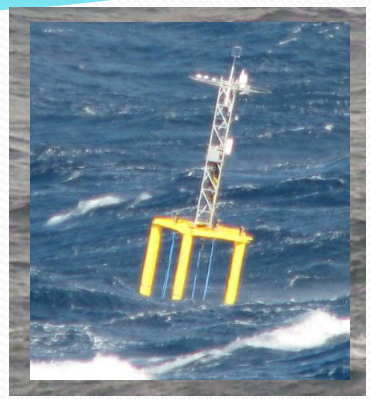
- COARE parameterizes the roughness length as:

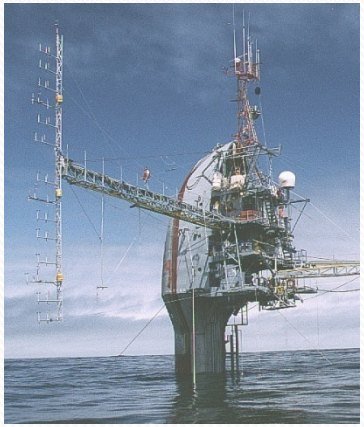
$$z_o = \alpha \frac{\nu}{u_*} + \boxed{\beta(U_{10})} \frac{u_*^2}{g}$$

Charnock Parameter

Roughness Length & Drag Coefficients

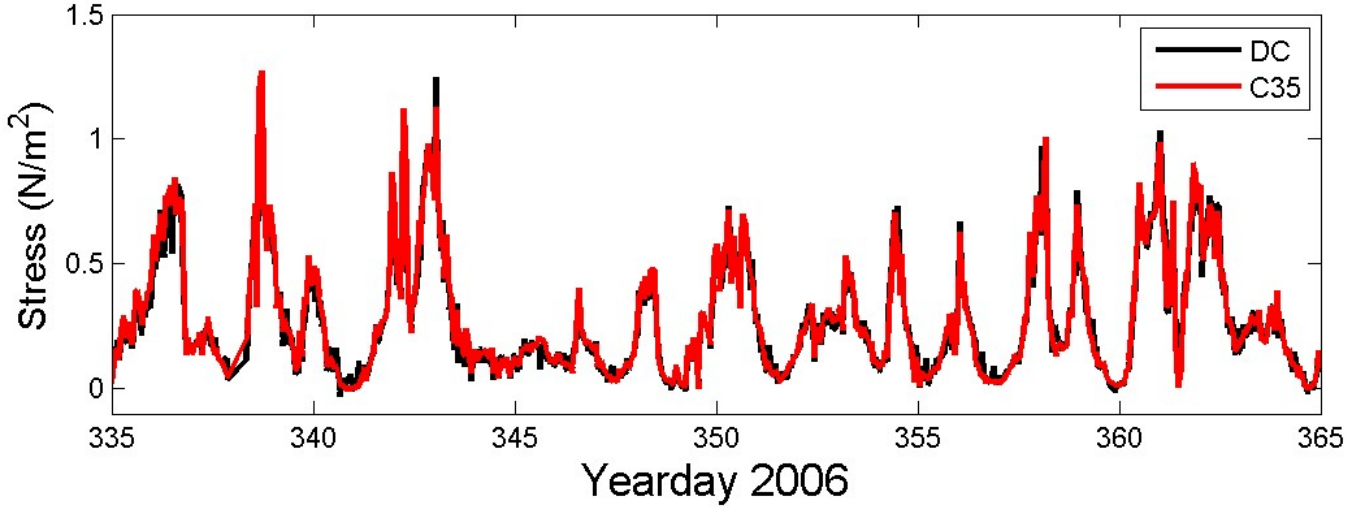


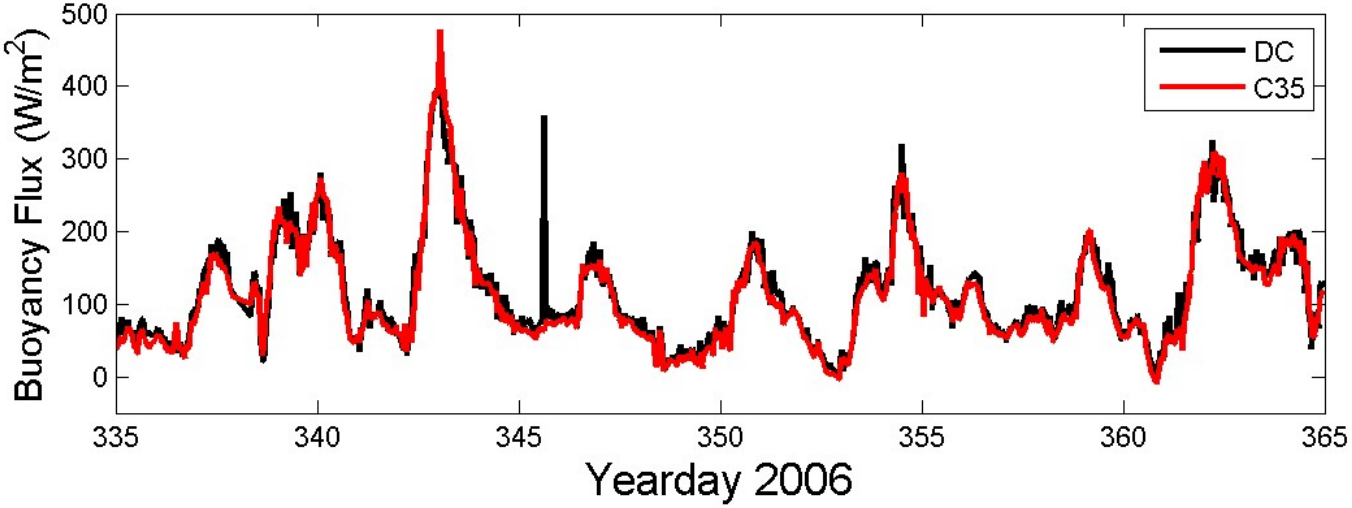




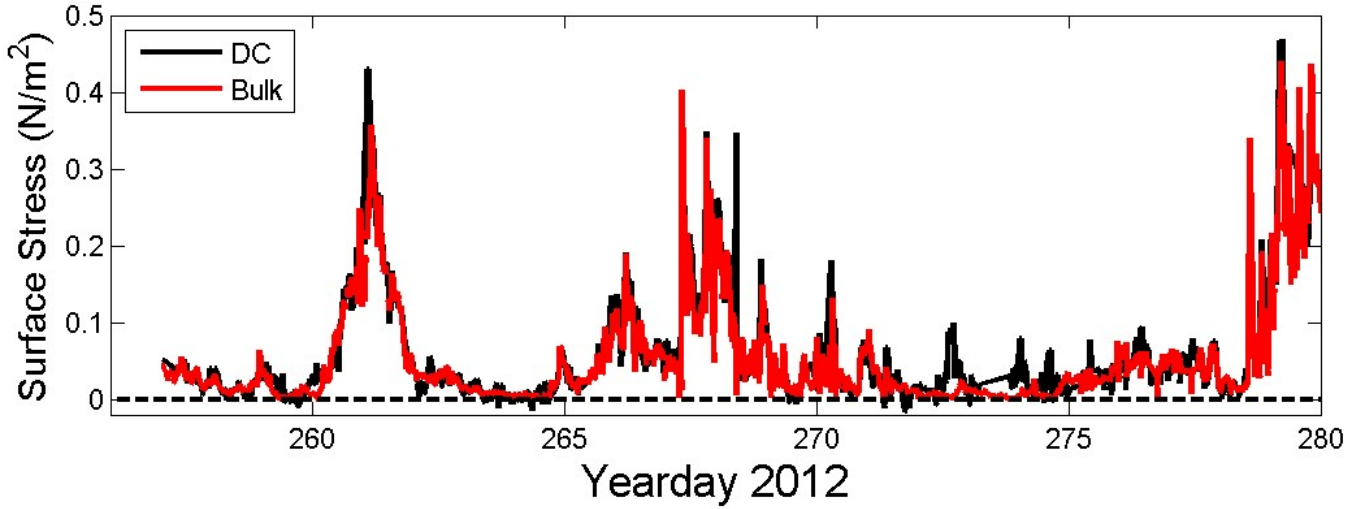
DC Fluxes from a Buoy and Spar

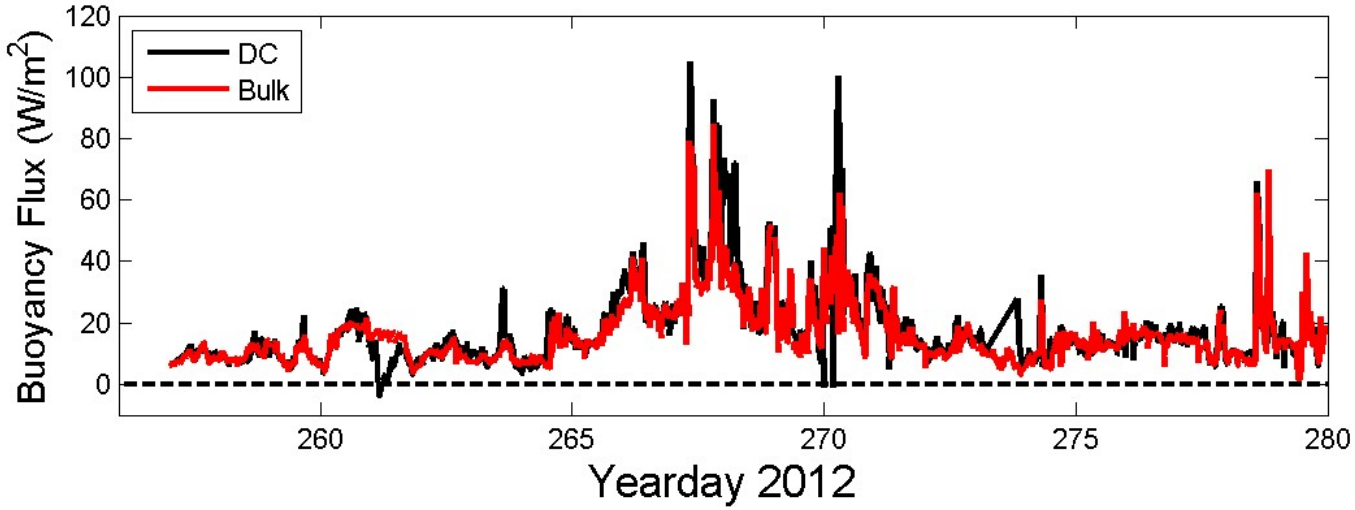
CLIMODE Direct Covariance Fluxes



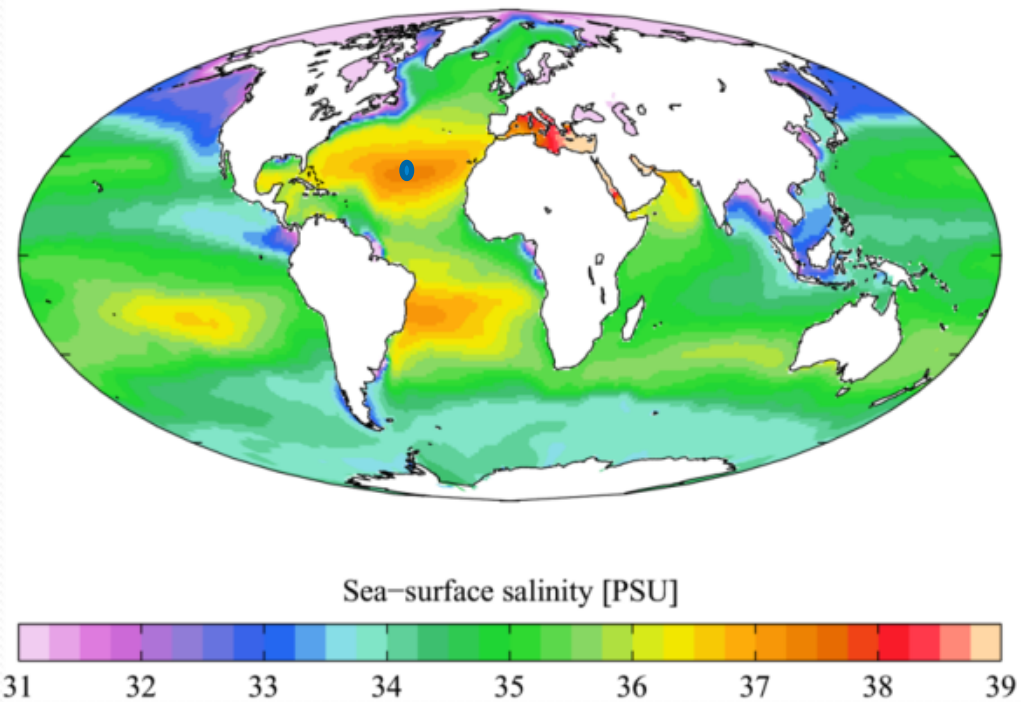


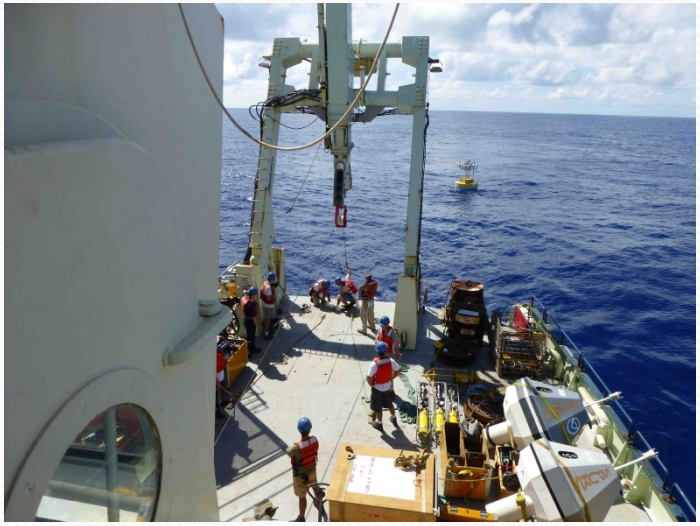
SPURS Direct Covariance Fluxes





Salinity Processes in the Upper Ocean Regional Study (SPURS).





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Sensible Heat Flux: $$\rho_a c_p \overline{wT} = \rho_a c_p C_H S_r \Delta \Theta$$

Dalton Number Formula

- COARE Algorithm

$$C_E(z/z_{oq}, z/L) = -\frac{\overline{wq}}{\Delta Q S_r} = C_D^{1/2}\left(\frac{\kappa}{\ln(z/z_{oq}) - \boxed{\psi_q(z/L)}}\right)$$

Atmospheric Stability

$$C_{EN}(z/z_{oq}) = -\frac{\overline{wq}}{\Delta Q_N \Delta U_N \boxed{G}} = C_{DN}^{1/2}\left(\frac{\kappa}{\ln(z/\boxed{z_{oq}})}\right)$$

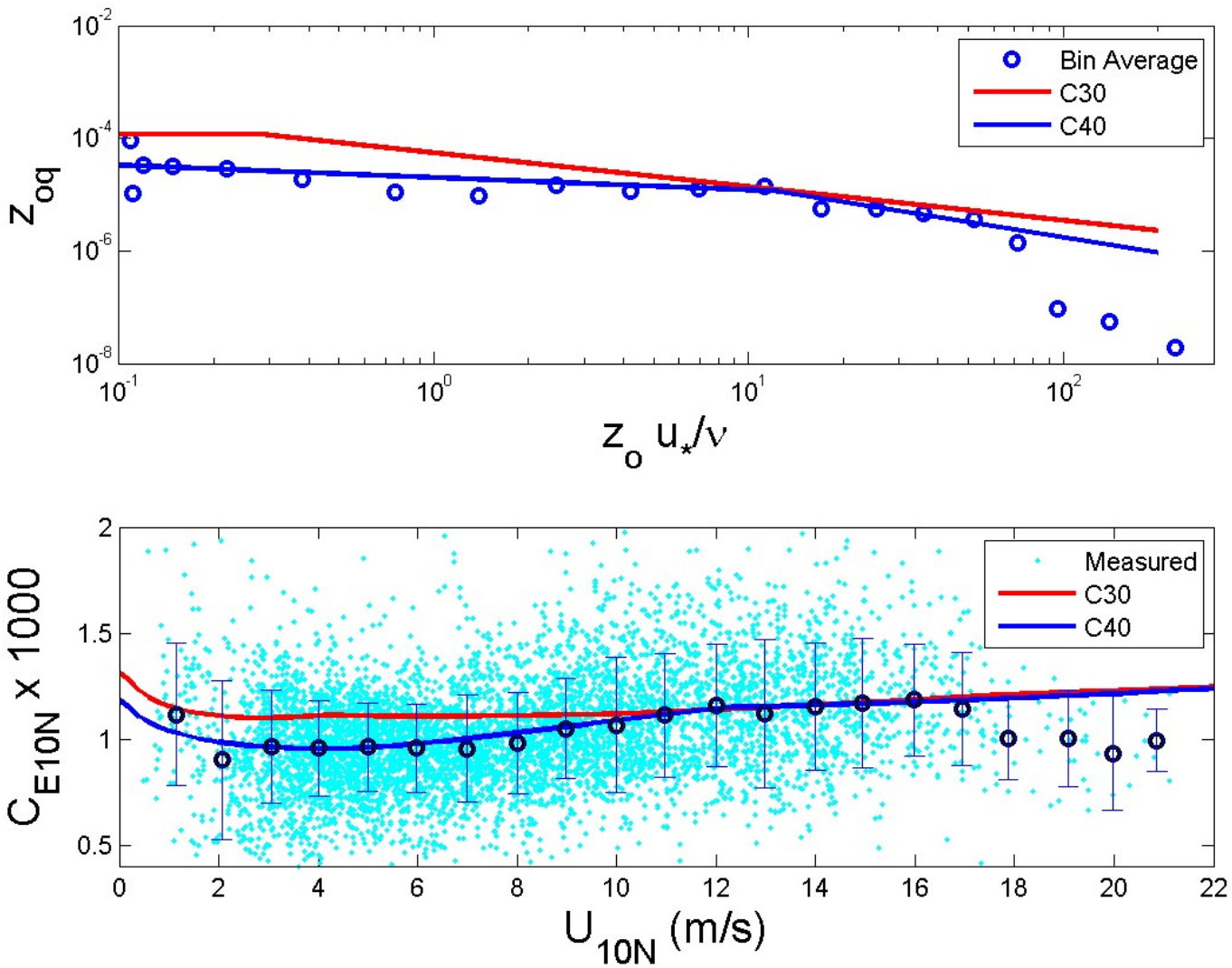
Moisture Roughness

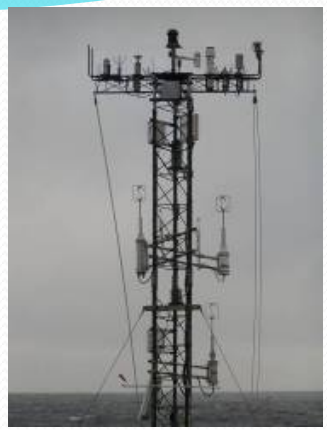
- COARE parameterizes the moisture roughness length as:

$$z_{oq} = f\left(\frac{z_o u_*}{\nu}\right)$$

As a function of the roughness Reynolds number

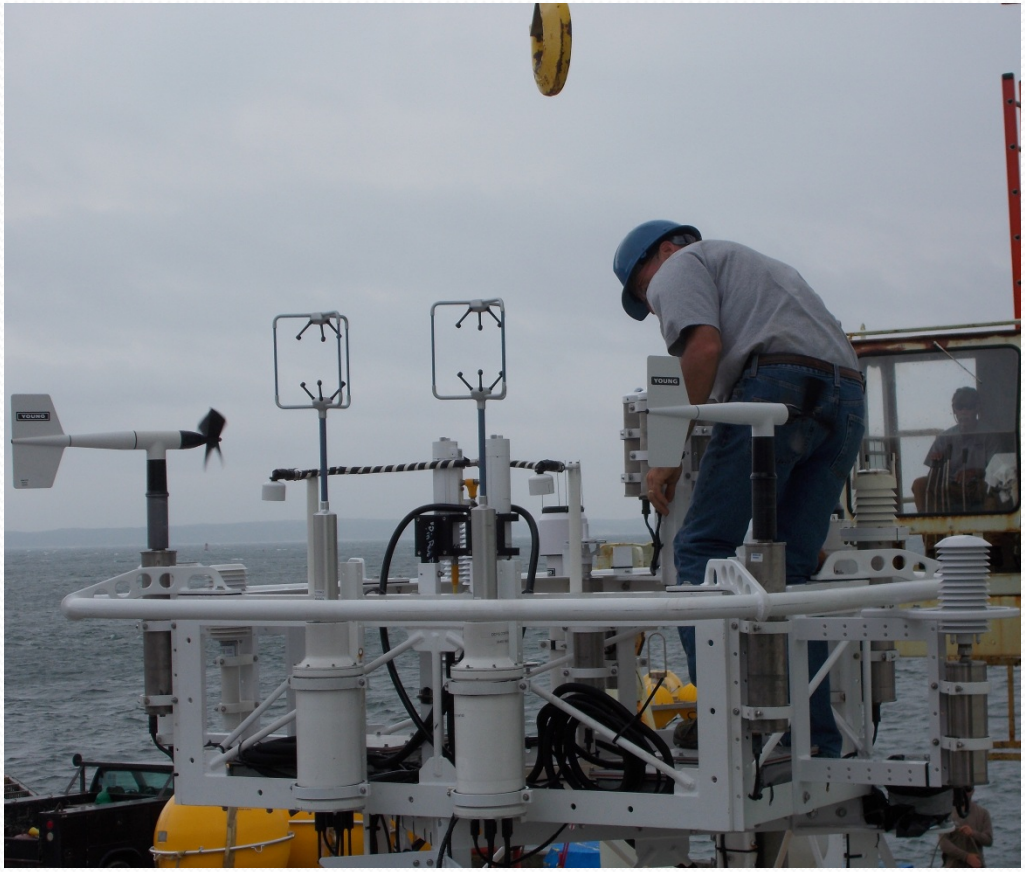
Moisture Roughness Length & Dalton Number



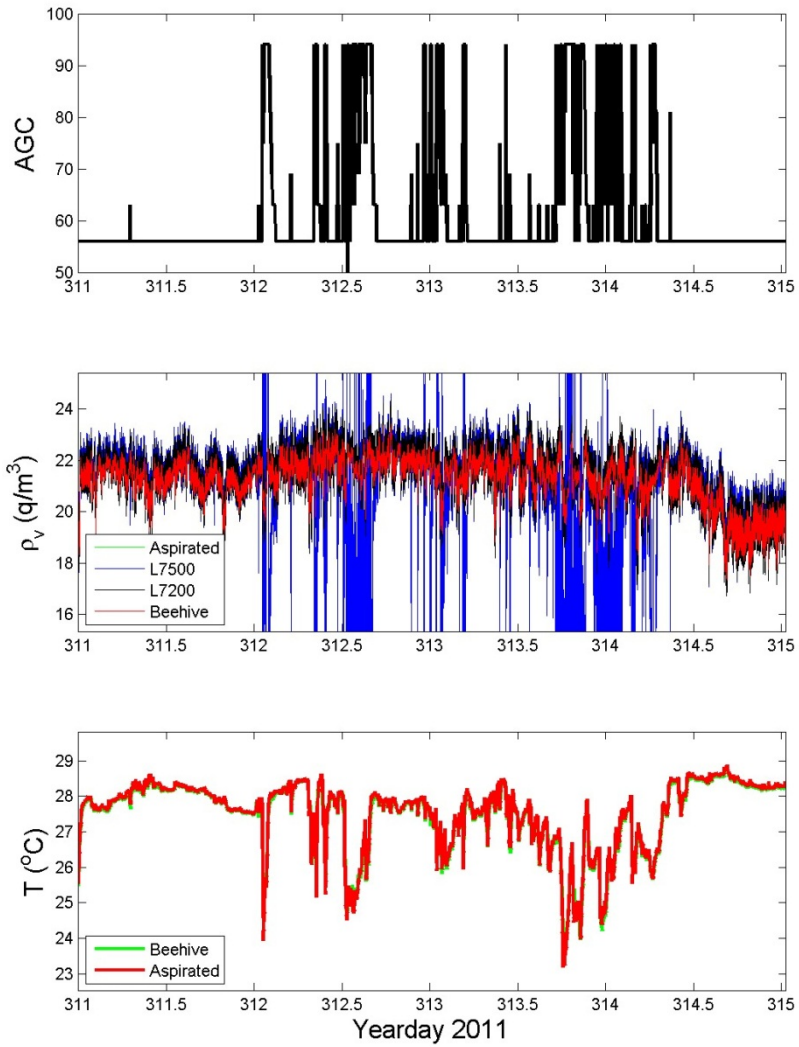


Salinity Processes in the Upper Ocean Regional Study (SPURS).

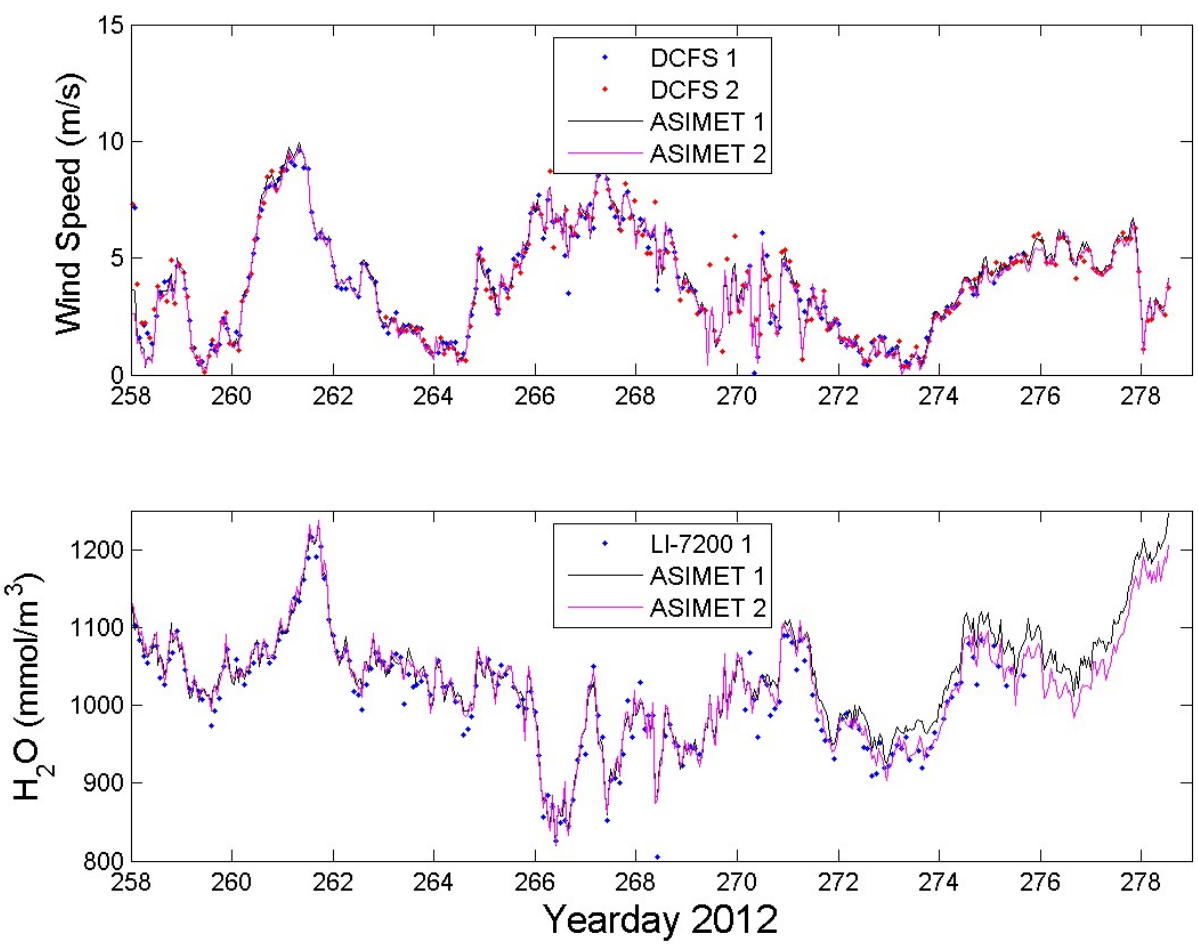
- 2 DCFS
  - Sonic Anemometers
  - Sonic Thermometers
  - MotionPakII AMU
  - Compass
- 2 LI-7200
  - Closed-Path IRGA
  - Blower

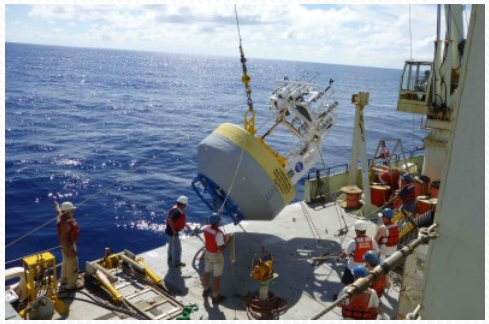


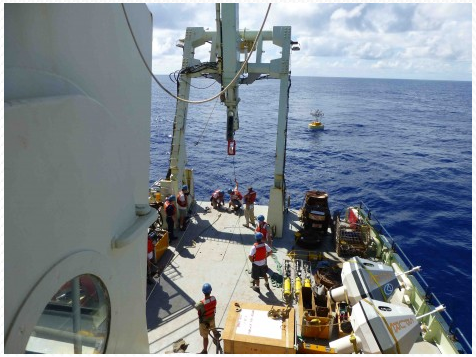
Humidity Flux in Rain

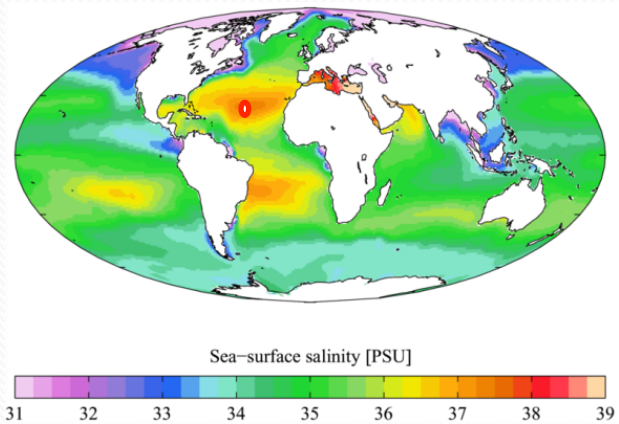


SPURS DCFS/LI-7200

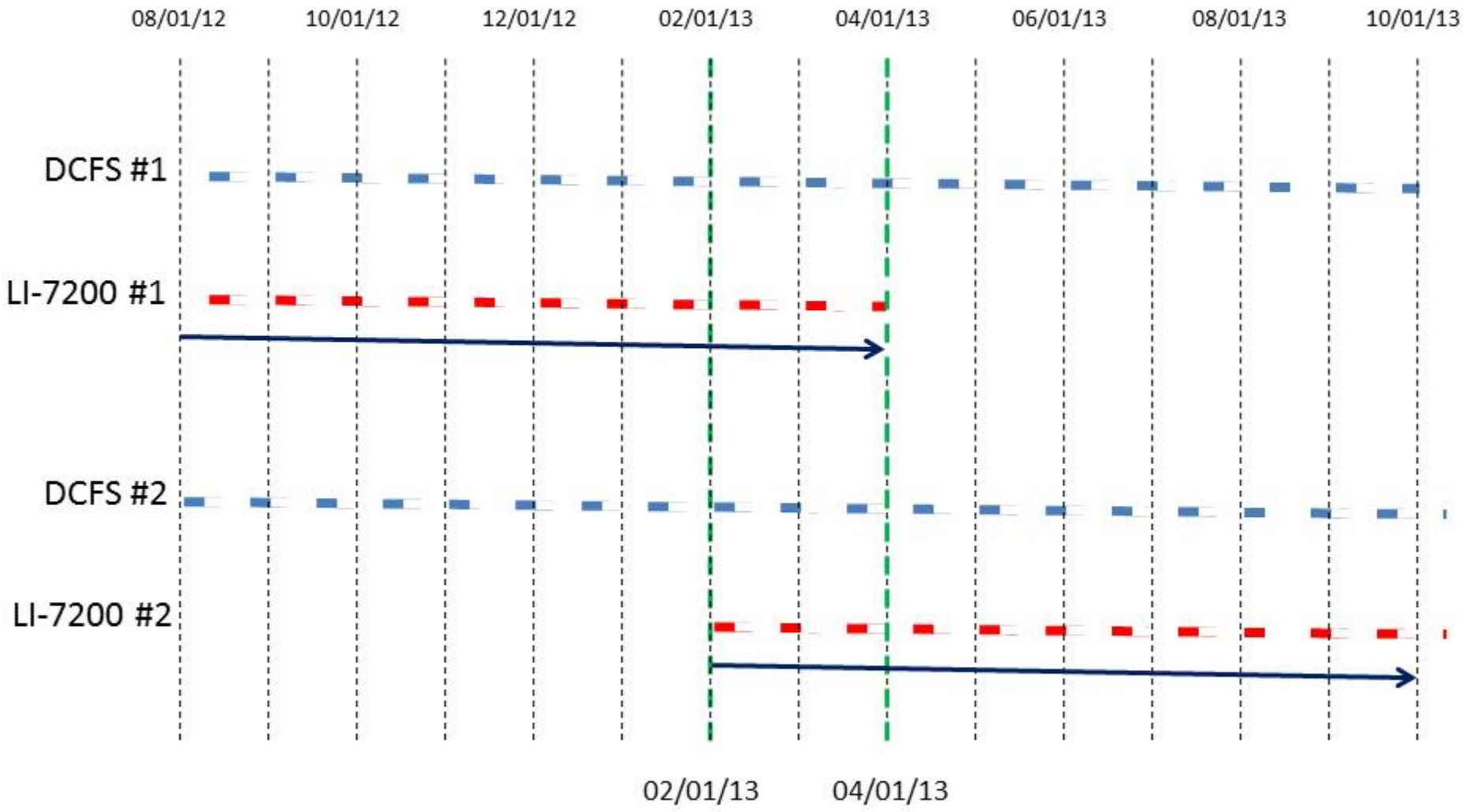




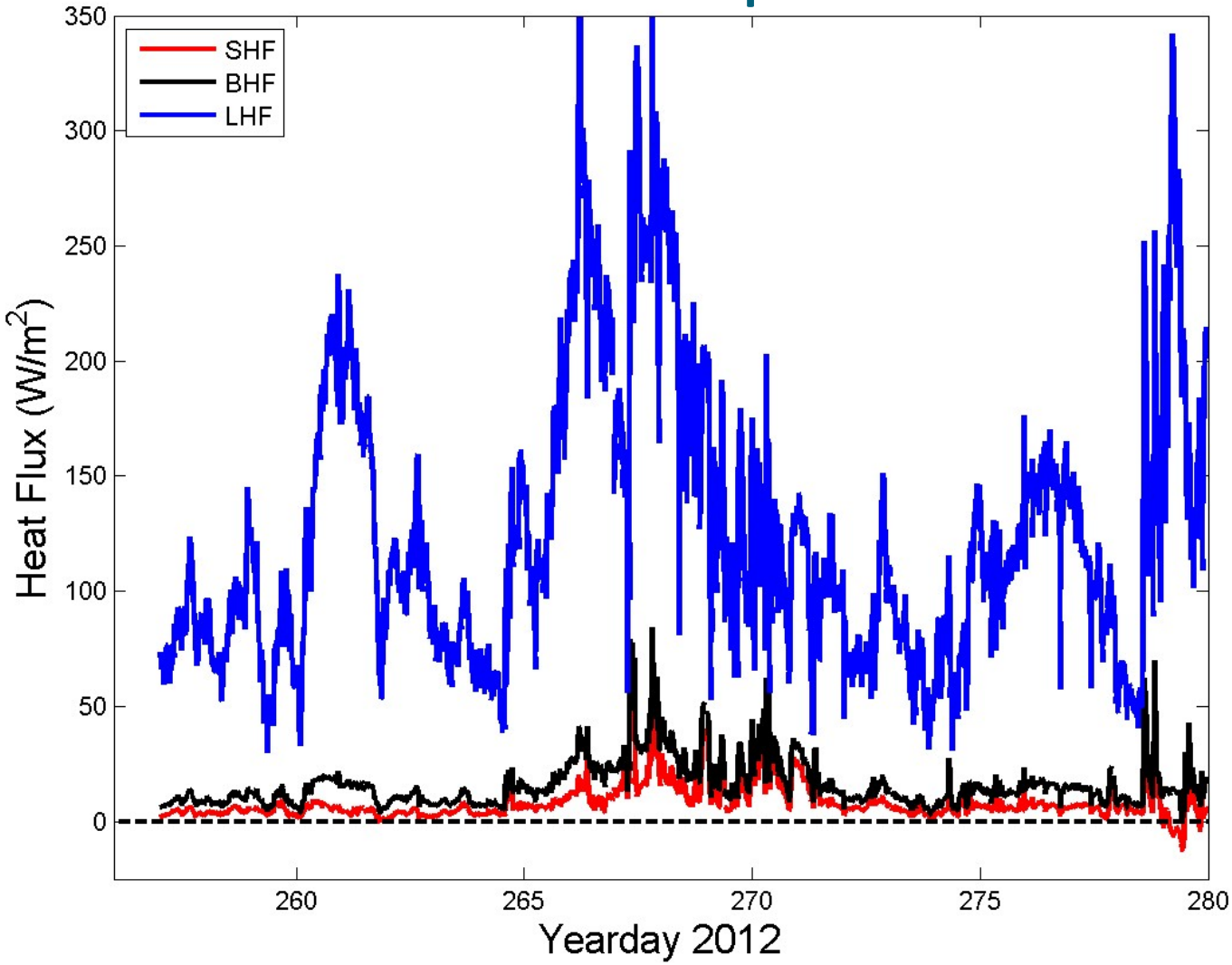




SPURS Sampling Strategy



SPURS Heat Flux Comparison



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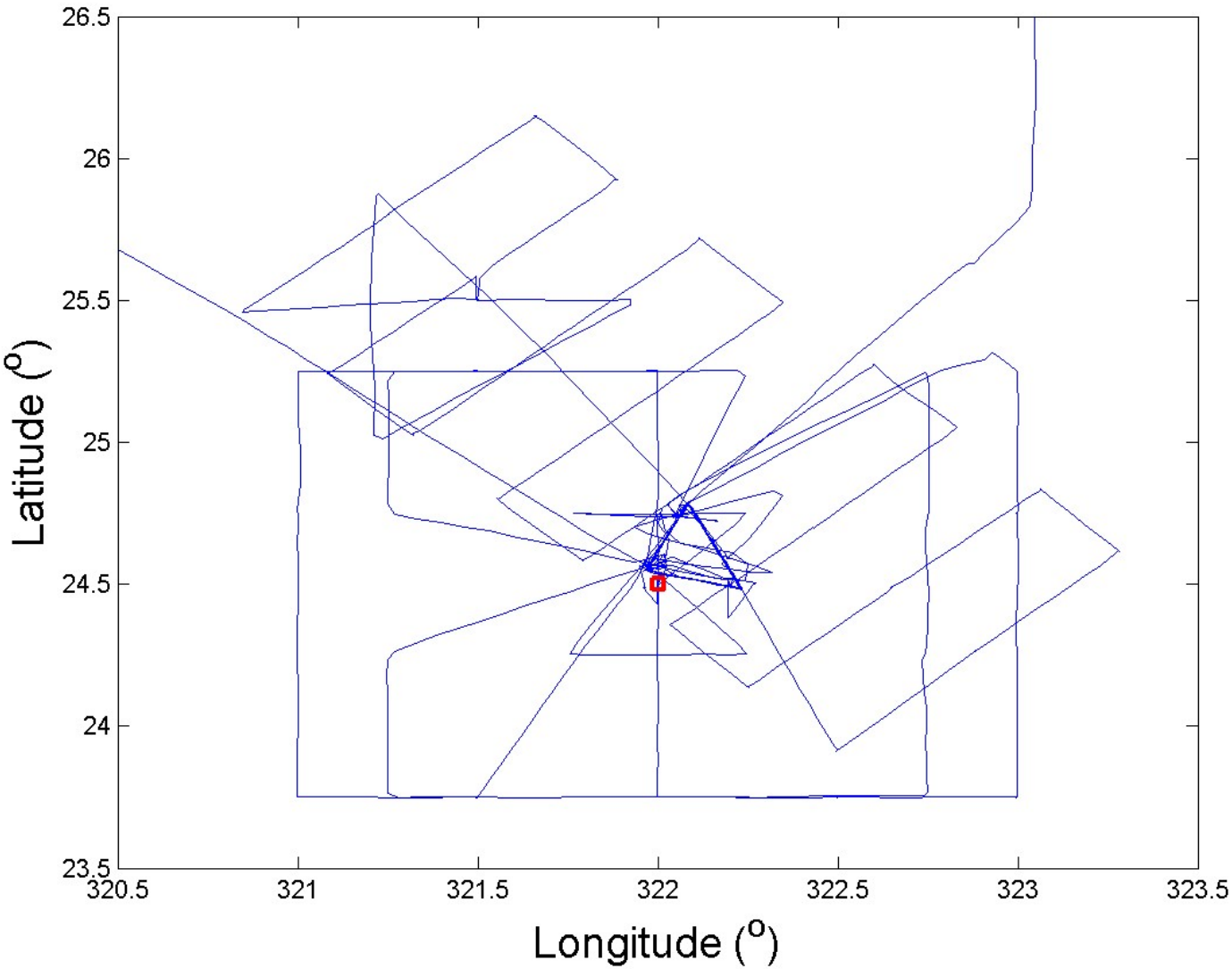
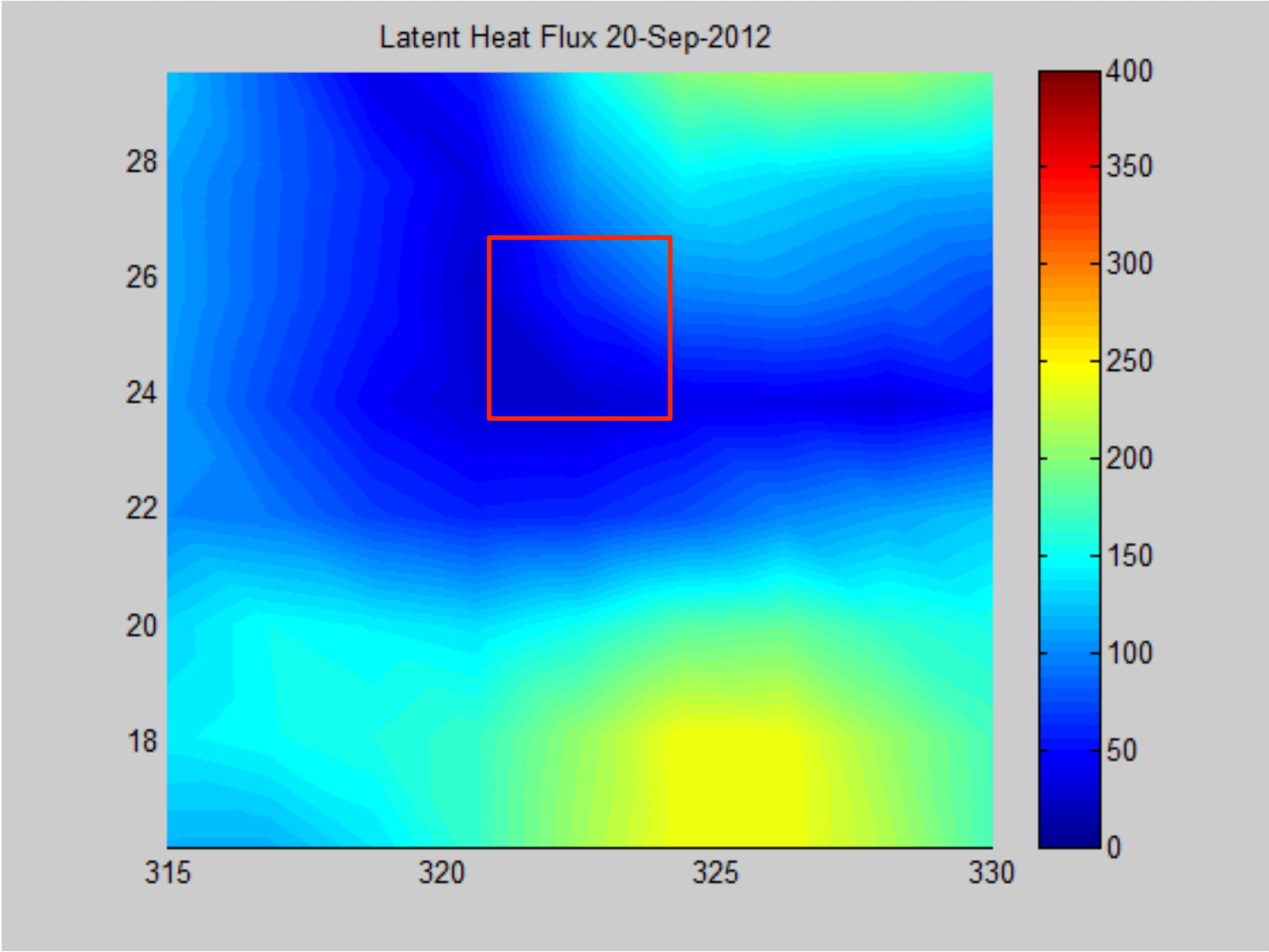
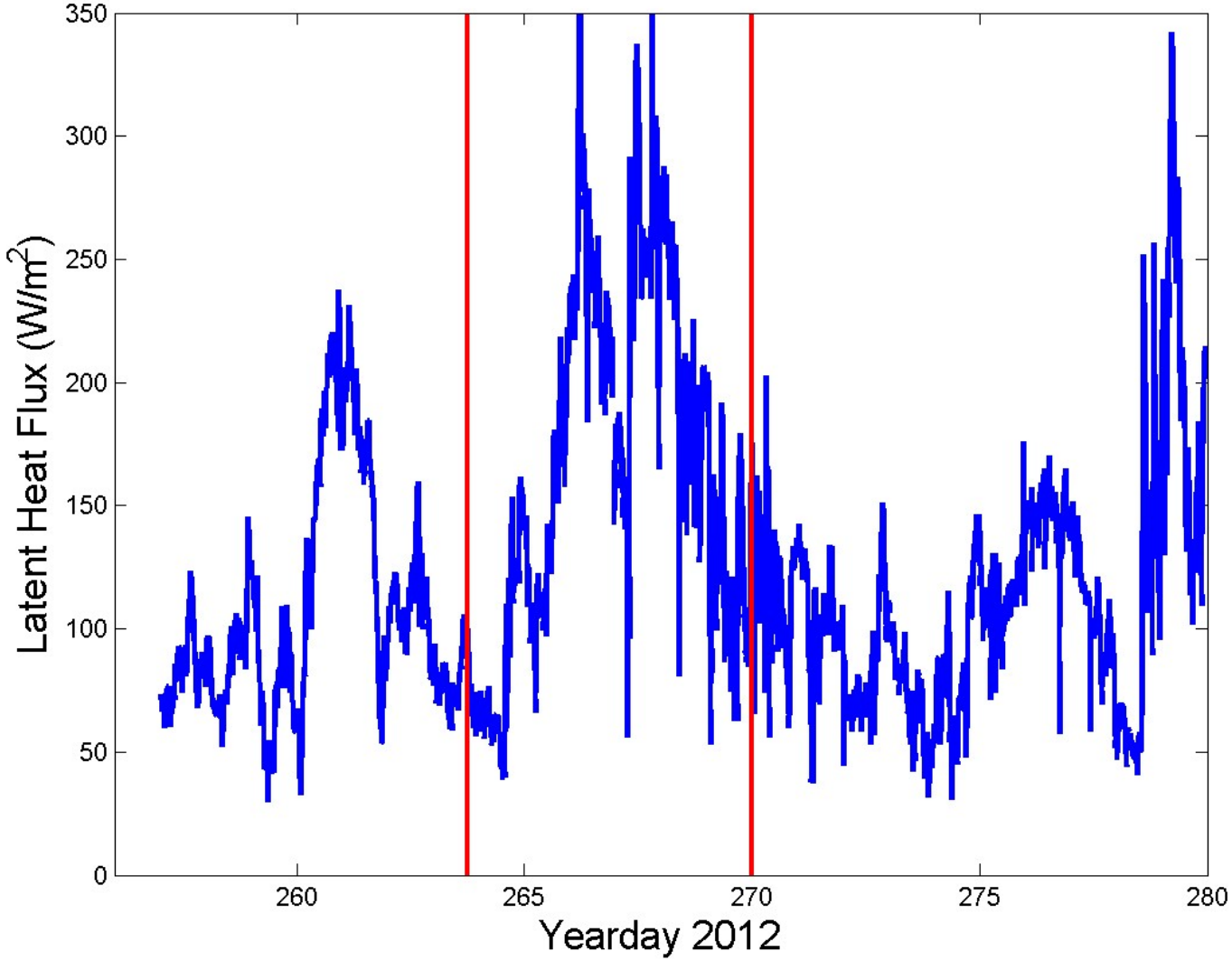
Cruise Track



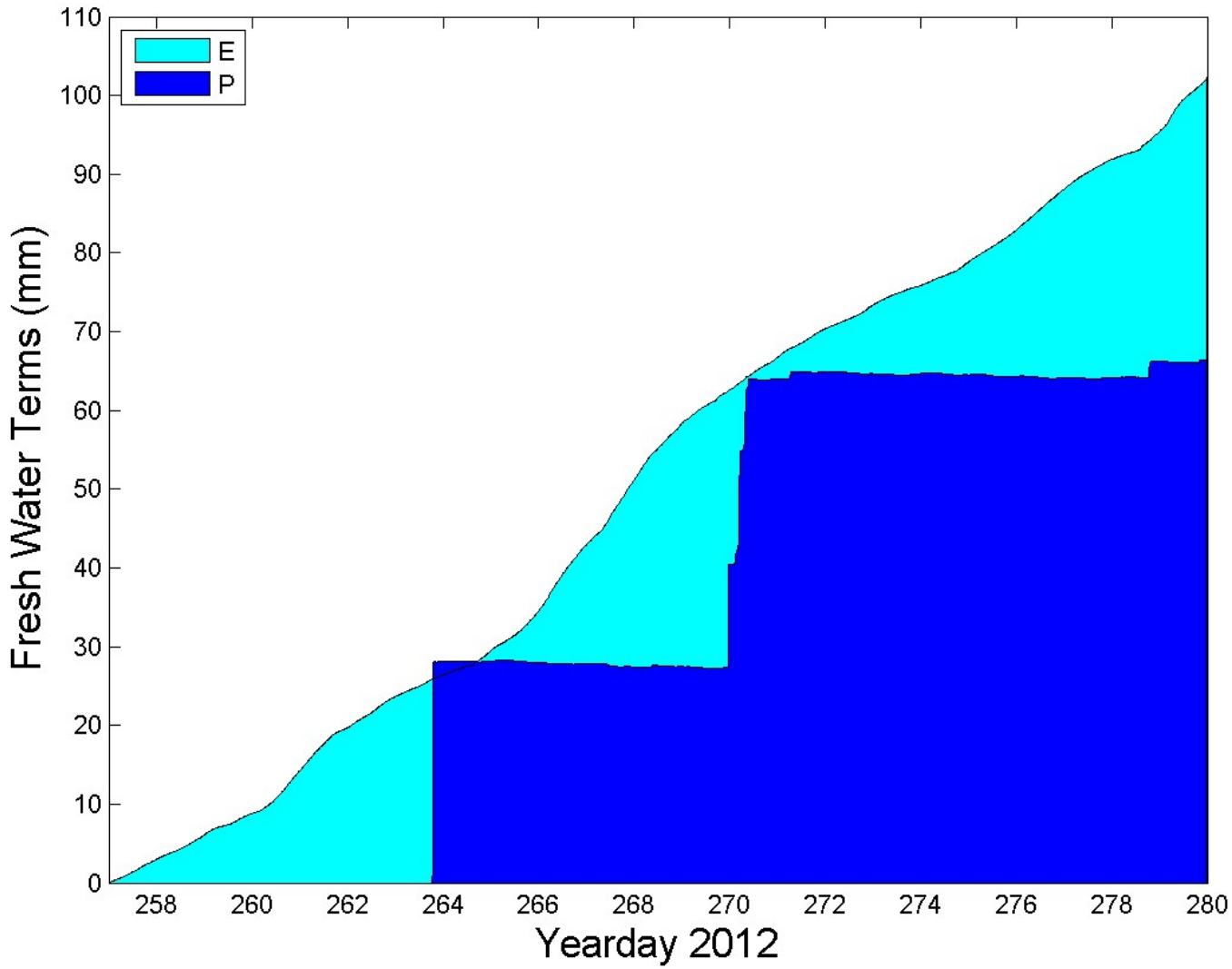
WRF Latent Heat Flux



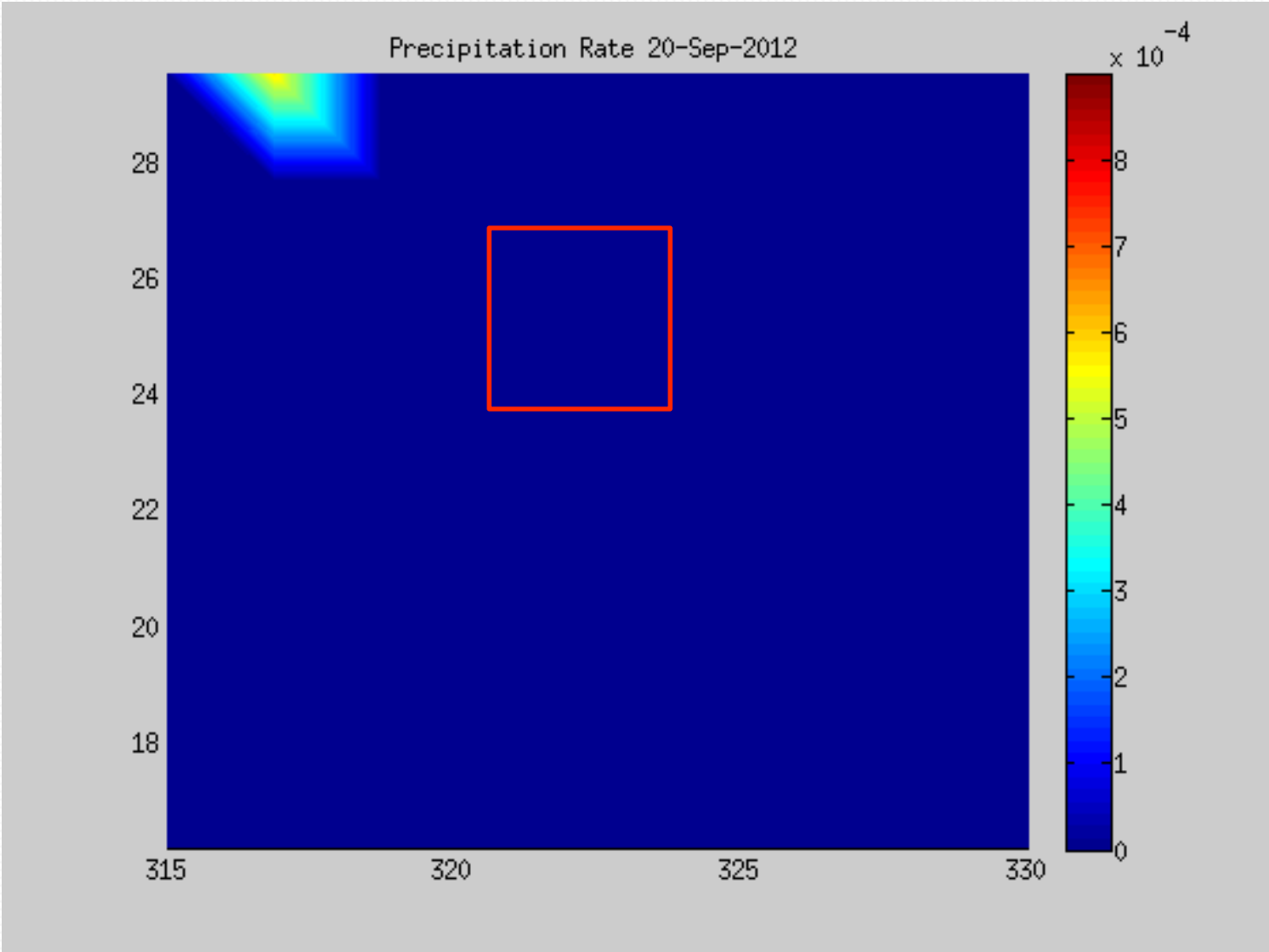
SPURS Latent Heat Fluxes



SPURS Accumulated Precipitation and Evaporation



WRF Precipitation



Summary

- High quality shipboard meteorological measurements were collected during the September cruise.
- These measurements include direct covariance momentum, heat and mass fluxes; radiative fluxes.
- Theses will be quality controlled and data set of means and fluxes will be made available for participants.
- The central mooring was successfully deployed with 2 direct covariance flux systems capable of measuring momentum, heat and mass fluxes.
- The telemetered data indicate that the buoy system continues to operate as expected.
- The ultimate goal of this effort is to improve surface heat flux parameterizations using in COARE and by numerical models.
- We are investigating the use of WRF to test the sensitivity of the model to these parameterizations, and to provide better regional estimates of P-E.