Quantification of P-E and Air-Sea Exchange during SPURS-2

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To study the fate of fresh water (Precipitation) in the Intertropical Convergence Zone (ITCZ)

- Cruise dates: August – September 2016
  September – November 2017
- WHOI Buoy Mooring at 10°N, 125°W
- Atmosphere and ocean observations
- Other resources deployed as well
Ship-board Meteorology

- **Met Mast**
  - 2 DCFS/Licors
  - Optical Rain Gauge (ORG)
  - 2 Aspirated RH/T
  - 1 Shielded RH/T
  - Pyranometer (Solar radiation)
  - Pyrgeometer (IR radiation)

- **O2 Deck**
  - 2 Self-Siphoning Rain Gauges
  - 5 Read & Dump Rain Gauges
  - 2 Pressure Sensors

- **Sea Snake (Near Surface $T_{sea}$)**

- **Fantail**
  - 2-axis Sonic
  - Pyranometer (Solar radiation)
  - Pyrgeometer (IR radiation)
  - 2 Self-Siphoning Rain Gauges
  - 1 Shielded RH/T
Ship-board Meteorology
Ship versus Buoy Comparisons
Median Monthly Precipitation Rate for GPCP (1996-2016)
Gaussian Curve Fit to Precipitation along 125 W for September

$$y = \frac{1}{\sigma \sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$
Buoy Precipitation

Latitude

Sep      Oct      Nov     Dec
         Jan      Feb     Mar      Apr     May      Jun       Jul      Aug     Sep      Oct

20
15
10
5
0
-5
Salinity (SMAP), E-P (SeaFlux – GPCP), and Divergence (ASCAT)

\[
\frac{\partial W}{\partial t} + \frac{\partial (uW)}{\partial x} + \frac{\partial (vW)}{\partial y} = E - P
\]

We are within a factor of ~3 of closing the moisture budget using remotely sensed surface winds only.
Validation and Utilization of MERRA-2 over the SPURS Region

Research Objectives

- To improve our understanding of the processes that control the exchange of momentum, heat and mass across the air-sea interface.
- To develop platform and systems that directly measure the momentum, sensible heat and latent heat fluxes.
- To improve parameterization of these fluxes for use in numerical models and process studies.

Momentum Flux: \[ \tau_0 = \rho_a u w \approx \rho_a C_D S_r \Delta U \]
Latent Heat Flux: \[ Q_E = \rho_a L_v w q \approx \rho_a L_v C_E S_r \Delta Q \]
Sensible Heat Flux: \[ Q_H = \rho_a c_p a w T \approx \rho_a c_p a C_H S_r \Delta \Theta \]
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Transfer Coefficients

Momentum Flux: \( C_D = \frac{\overline{uw}}{S_r \Delta U} \)

Latent Heat Flux: \( C_E = \frac{\overline{wq}}{S_r \Delta Q} \)

Sensible Heat Flux: \( C_H = \frac{\overline{wT}}{S_r \Delta \Theta} \)
Neutral Dalton & Stanton Number
Upper ocean mixing processes and air-sea flux feedbacks

- Comparison of mixing models with buoy, ship observations
- Evaluation of fluxes and changes through freshwater lenses – time scale of recovery at various depths
- Similarities in local effects and recovery seen with similar variations in precipitation amounts, wind speed
Summary

- Meteorological and near surface data was successfully collected on board the R/V Revelle during the fall 2016 and 2017 field campaigns.
- The WHOI buoy was successfully deployed and recovered with a DCFS and LI-7500 systems capable of measuring momentum, heat and mass fluxes.
- The LI-7500 ran for approximate 5.5 months, while the DCFS ran 8.5 months.
- Analysis and cross-calibration of these systems is well underway and we are sharing the met data and readme files with SPURS PIs.
- To do list includes:
  - Analysis of R/V Revelle DCFS flux system
  - Computation of significant wave height and period (when on station)
  - Inclusion of OSPRE and salinity snake data in Met data file.
- We plan to use these measurements with remotely sensed data and MERRA-2 reanalysis to provide better regional estimates of P-E.
- We plan to use all our buoy-based measurements to improve our heat flux parameterization.