ENS0 Diversity – data requirements

U.S. CLIVAR Summit 2013, Annapolis MD
POS breakout session

Workshop discussion on TAO-Triton, alternative array and/or measuring techniques (floats, gliders)

Consensus was that we need the TAO type array, we cannot afford to have any fewer measurements, in fact we need more
Description - Surface Composite SST patterns

- SODA
- CCSM4
- CCSM4-m

CT

WP
Surface forcing
Composite TAUX patterns

SODA

CCSM4
Taux

CCSM4-m

CT

WP
Subsurface – Dynamical processes
Composite thermocline depth (Z15)
Heat budget
(following Di Nezio et al. 2012)

\[ \rho_o c_p H \frac{\partial T}{\partial t} = Q_{ocn} + Q_F \]

\[ H = 65m \]

\[ T = \text{average temperature} \]

\[ Q_{ocn} = \text{ocean heat flux convergence} \]

\[ Q_F = \text{surface heat flux} \]

\[ Q_{adv} = Q_z + Q_m + Q_v \]

\[ Q_z = \rho c_p \int_{-H}^{0} u \frac{dT}{dx} dz \]

\[ Q_m = \rho c_p \int_{-H}^{0} v \frac{dT}{dy} dz \]

\[ Q_v = \rho c_p \int_{-H}^{0} w \frac{dT}{dz} dz \]
Ocean advection

Ocean convergence budget

Niño3

Niño3-m

Niño4

Niño4-m

Q (W/m²)

Lag (month)

Total

Zonal

Meridional

Vertical

Q (W/m²)

Lag (month)
Surface heat flux

Heat Flux budget

Niño3

Niño3-m

Niño4

Niño4-m

Lag (month)

Lag (month)

Q (W/m²)

Q (W/m²)

Net heat flux
Solar
Longwave
Latent
Sensible

Total
Solar
Latent
Longwave
Sensible
What is the Seasonal Foot Printing Mechanism (SFM)?

- **NPO in NDJ (-1)**
- **Winds & Heat Flux**
- **SST in FMA (0)**
- **Tropical Winds**
- **Feedback (e.g. WES)**
- **El Nino in NDJ(0)**

_Vimont et al. 2001, GRL; 2003a&b, J. Climate_
SLP Index SST/SLP composite DJF(0)-JJA(0)

NDJFM(-1/0) SLP Index (175W-140W, 10N-25N) Composites (Neg-Pos)

Correlation between SLPI and Niño3.4 SST Index in JFM(1) is 0.61 in nature (Anderson 2007) and 0.59 in the model (Deser et al., 2012)

NCEP Reanalysis

CCSM4
Wind Evaporation SST (WES) Feedback

- Trough west of warm SSTs
- Southwest winds to the southwest of the +SSTA oppose trades
- Anomalous latent heat flux into the ocean
- Warm SSTs
- southwest propagation of \(Q_{lh}\) & SST

\[
Q_{lh} \sim \rho c_e (u'(q'_s - q'_a) + u'(q_s - q_a))
\]

Theoretical underpinning WES: Chang et al., 1997; Xie 1997, 1999;
equatorward & westward propagation: Vimont 2010
h(m) Exp-Cntl 5-day Hövmoller: Western Boundary

Alexander et al. 2010
Observations needed

• Surface and Subsurface temperature data (SSH)
• Velocities
• Surface winds
• Surface heat fluxes