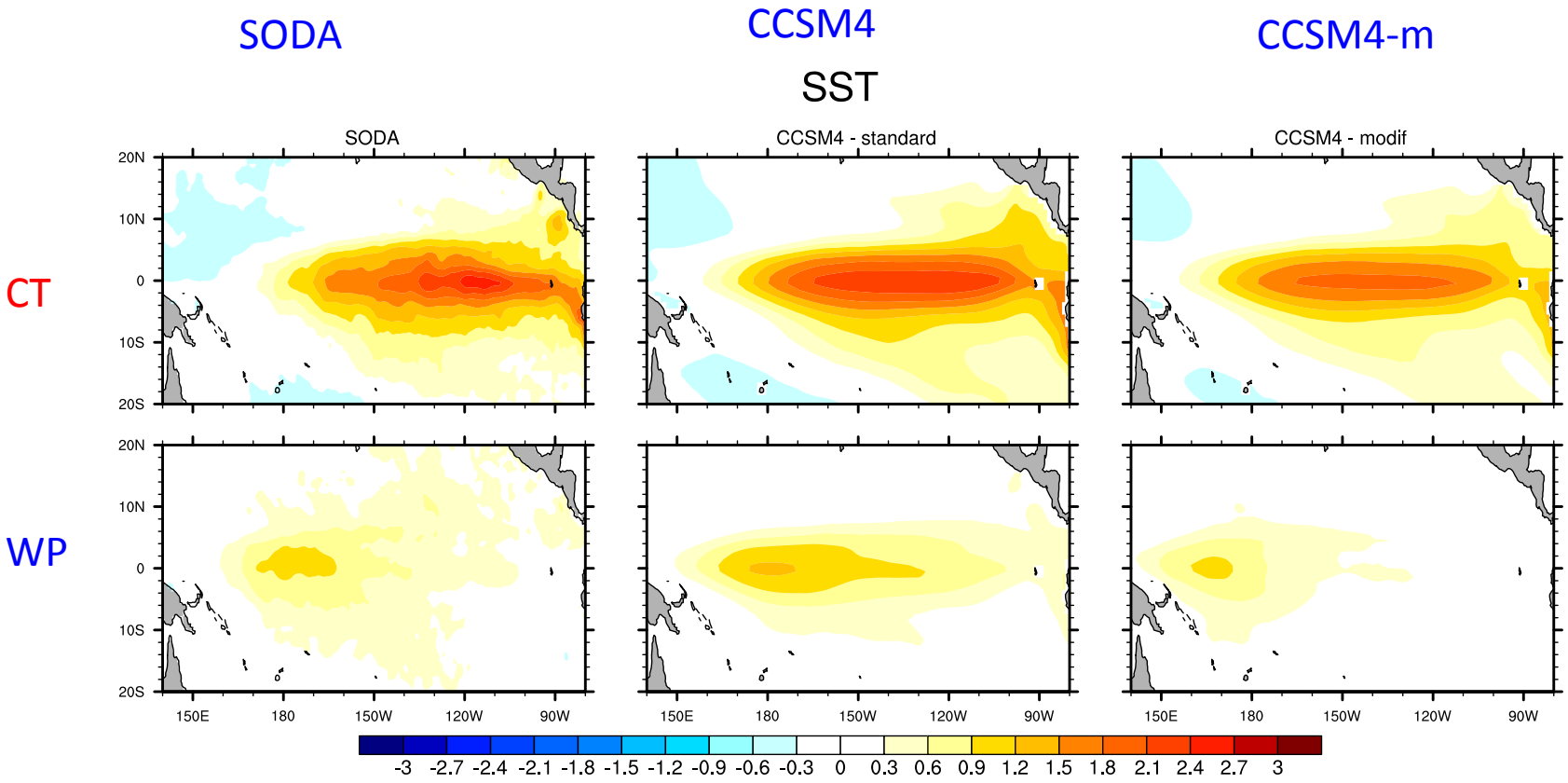
ENSO Diversity – data requirements

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

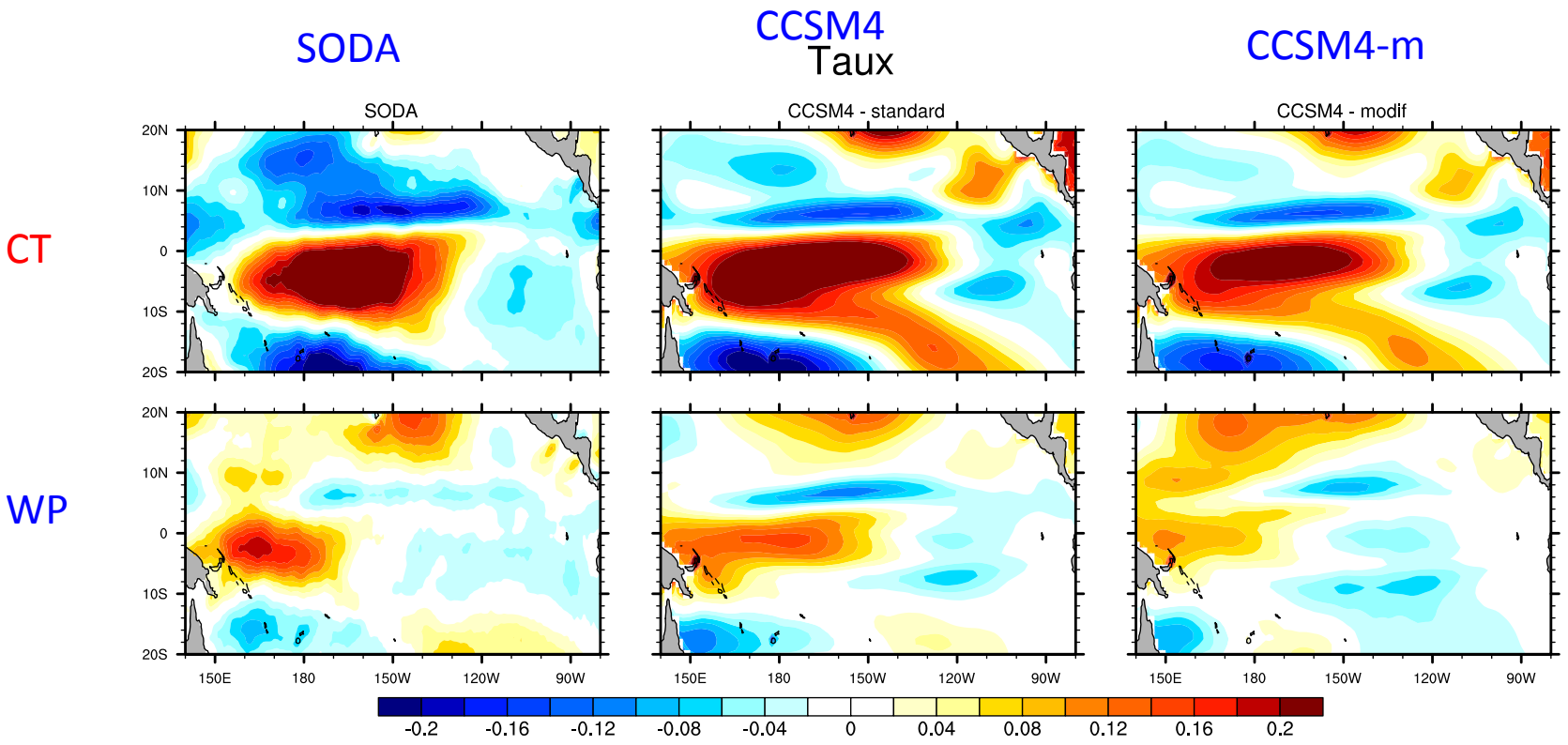
Workshop discussion on TAO-Triton, alternative array and/or measuring techniques (floats, gliders)

Consensus was that we need the TAO type array, we cannot afford to have any fewer measurements, in fact we need more

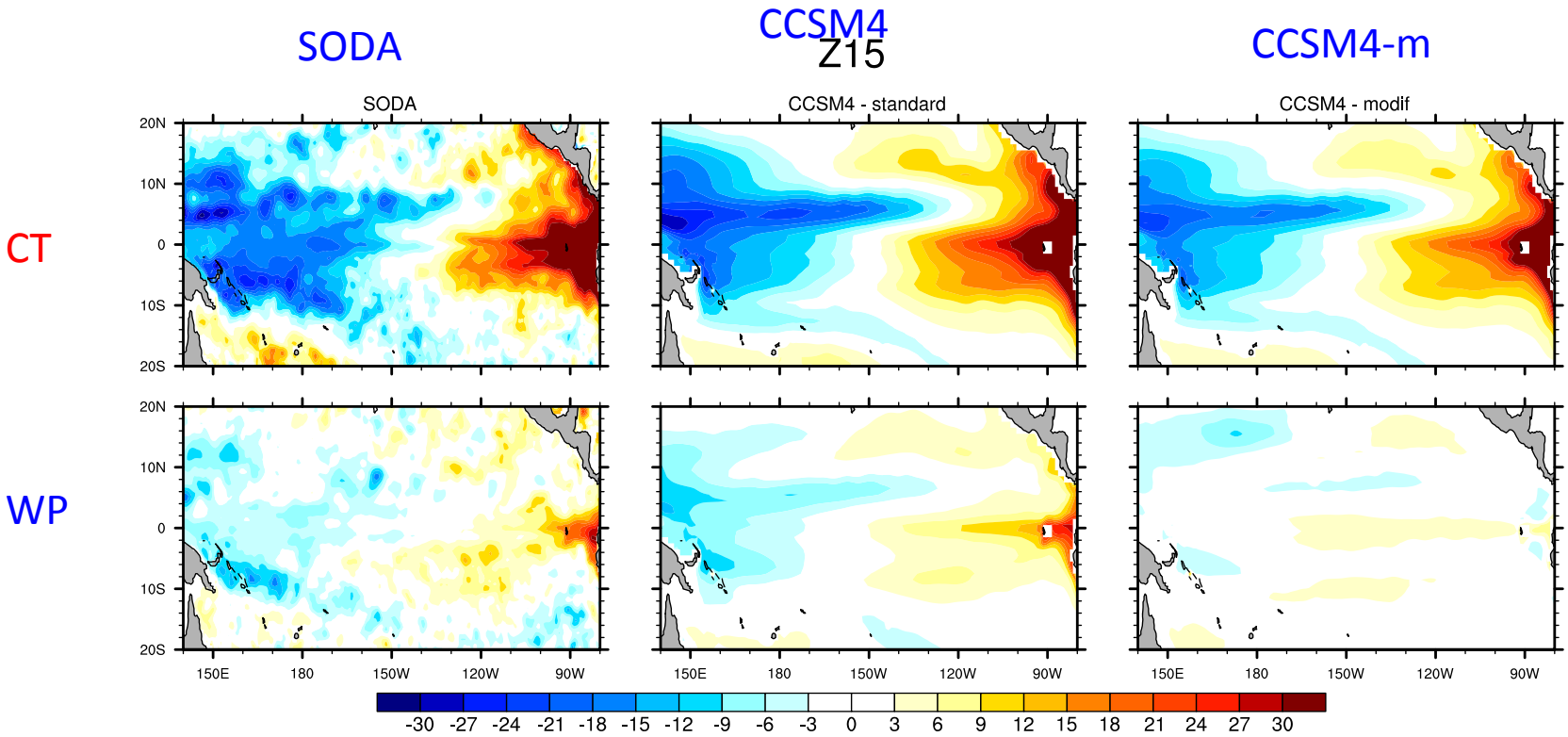
Description -Surface Composite SST patterns



Surface forcing
Composite TAUX patterns



Subsurface – Dynamical processes
Composite thermocline depth (Z15)



Heat budget

(following Di Nezio et al. 2012)

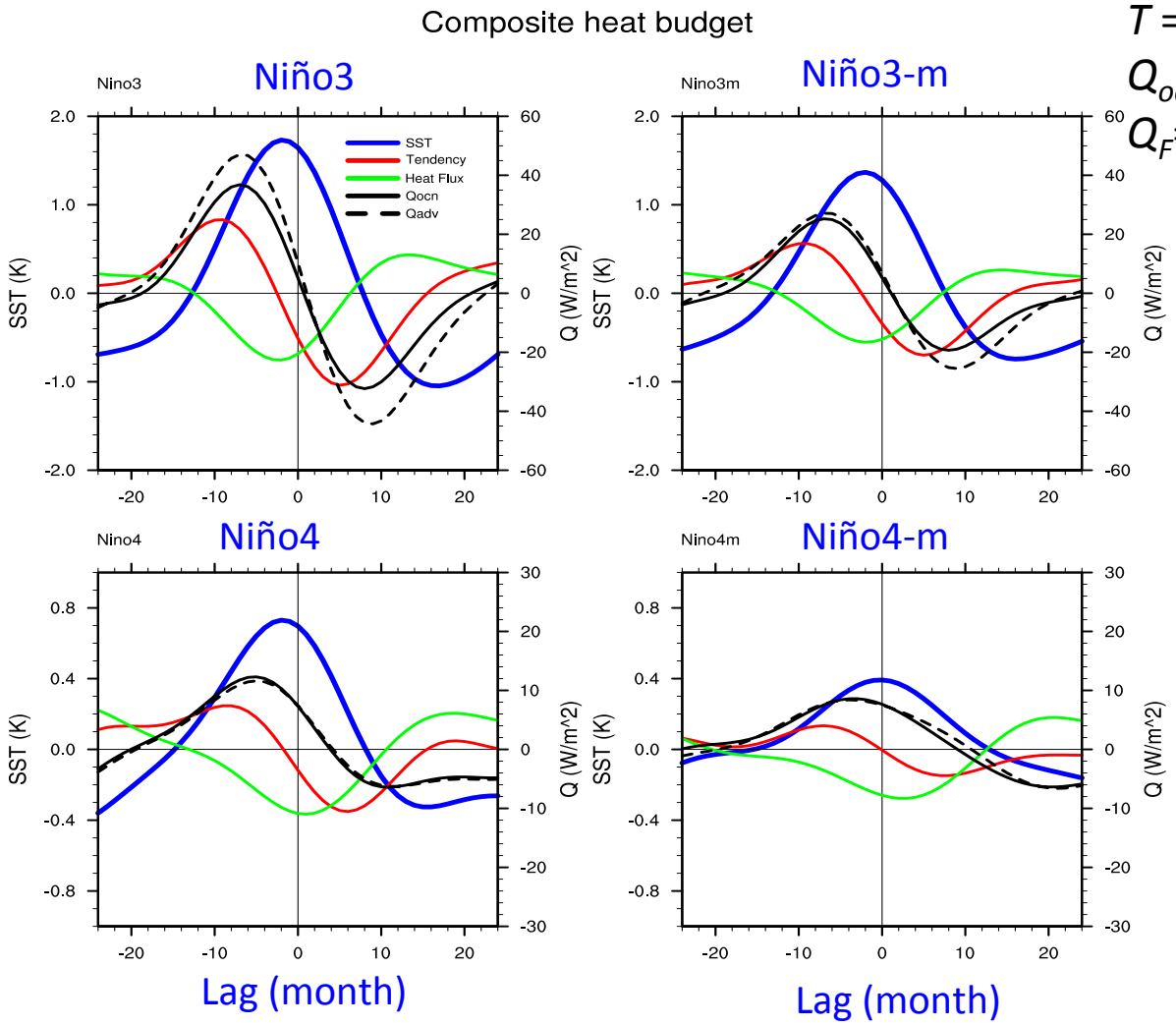
$$\rho_o c_p H \frac{\partial T}{\partial t} = Q_{ocn} + Q_F$$

$$H = 65m$$

T = average temperature

Q_{ocn} =ocean heat flux convergence

Q_F= surface heat flux



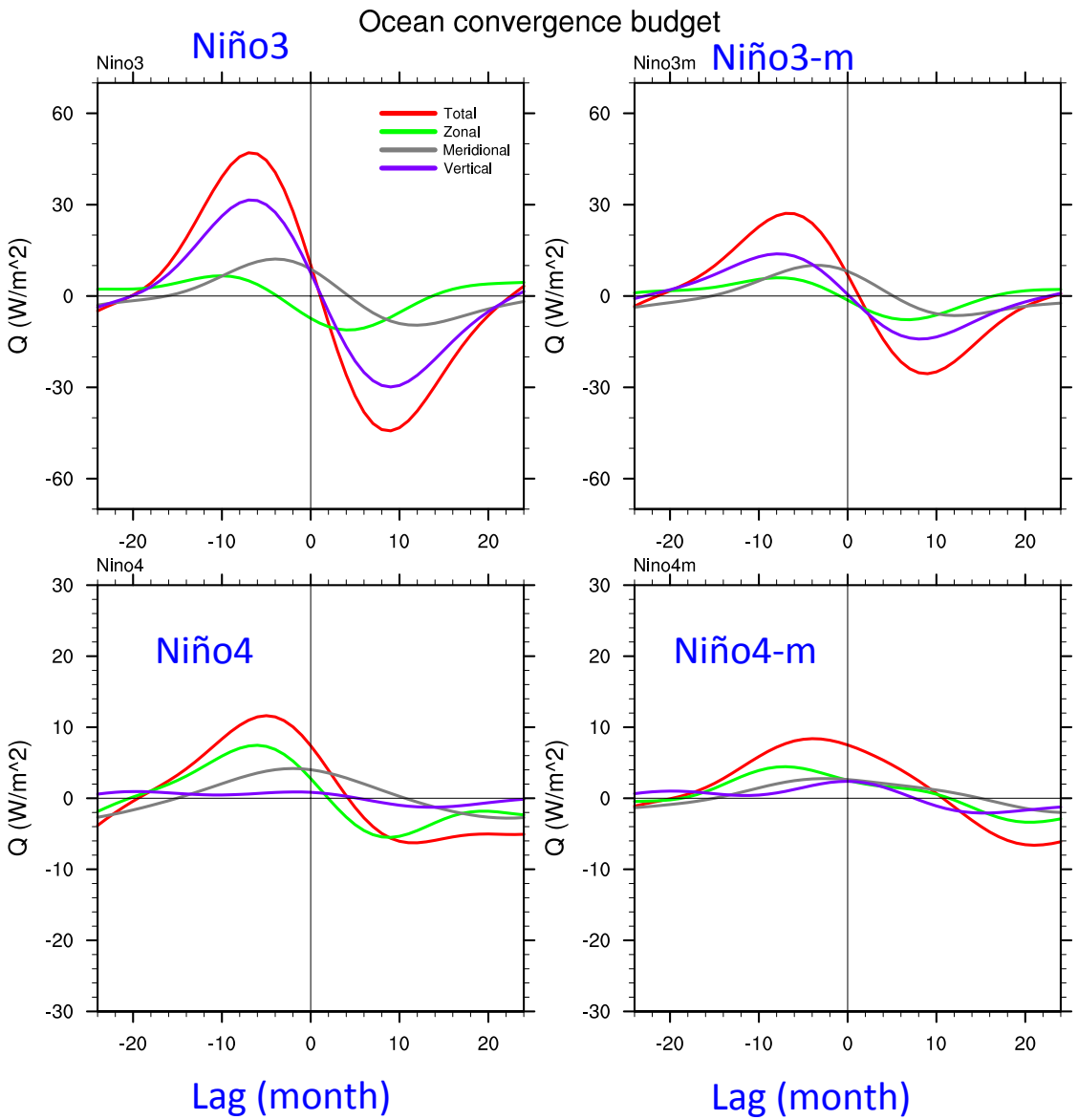
$$Q_{adv} = Q_z + Q_m + Q_v$$

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

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

$$Q_v = \rho c_p \int_{-H}^{0} w \frac{dT}{dz} dz$$

Ocean advection



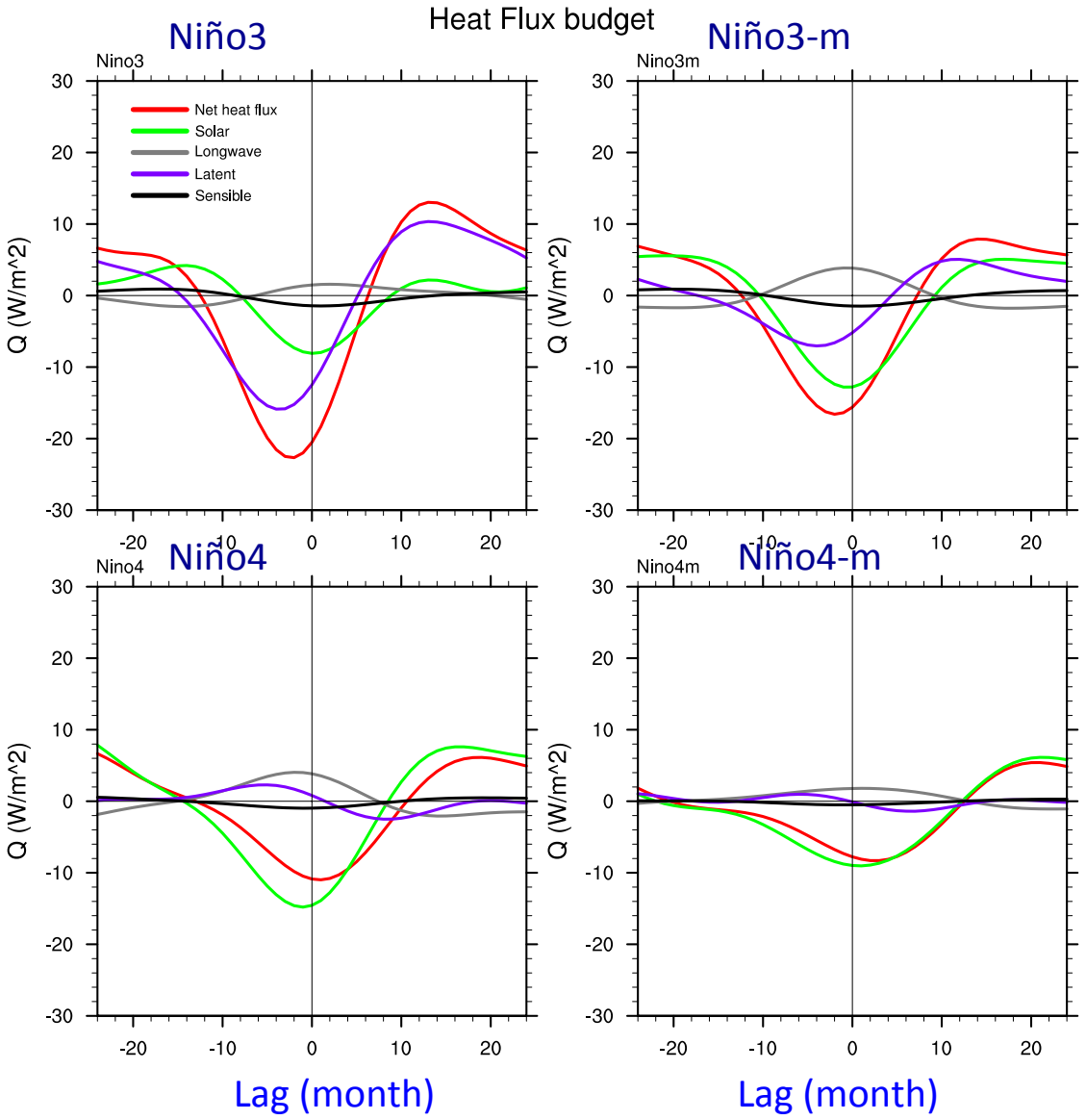
Total

Zonal

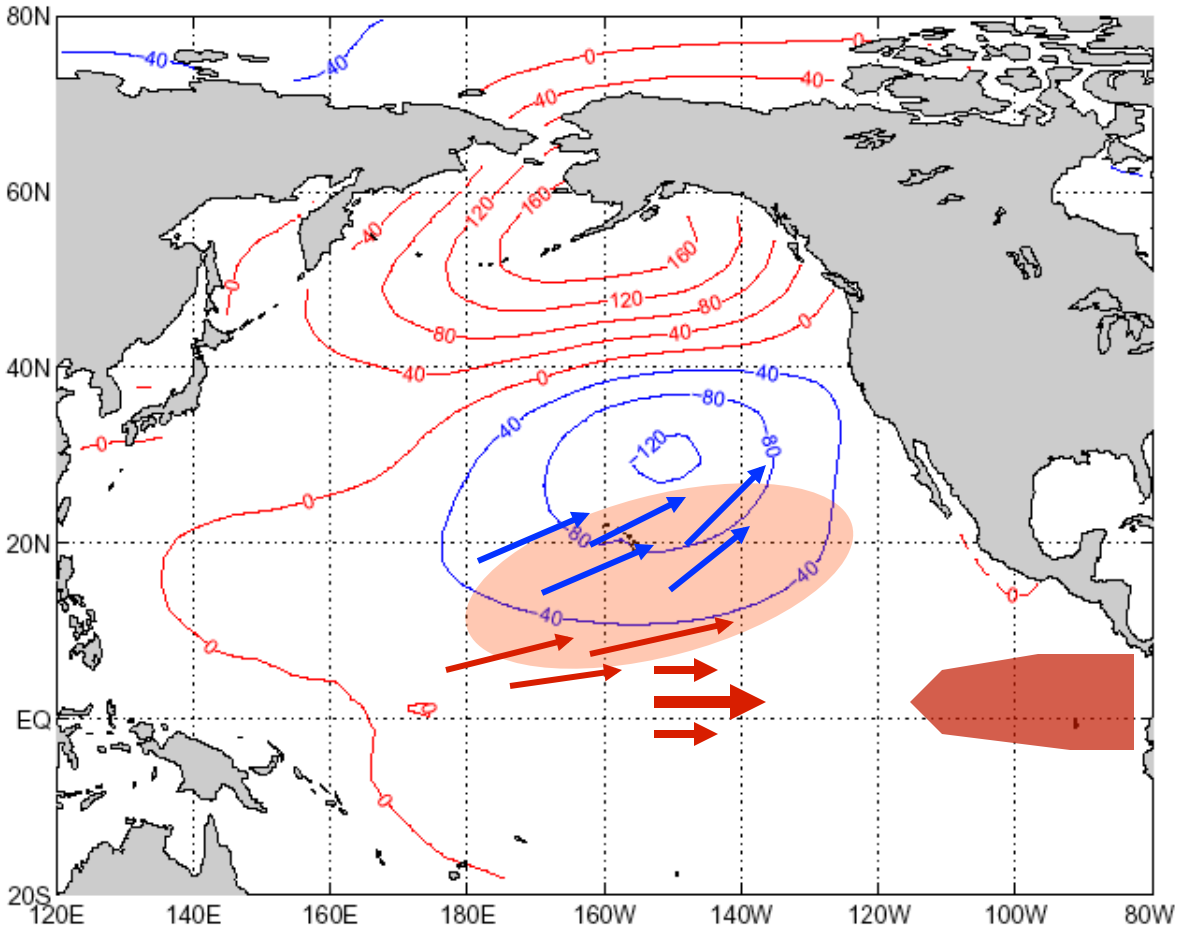
Meridional

Vertical

Surface heat flux



What is the Seasonal Foot Printing Mechanism (SFM)?



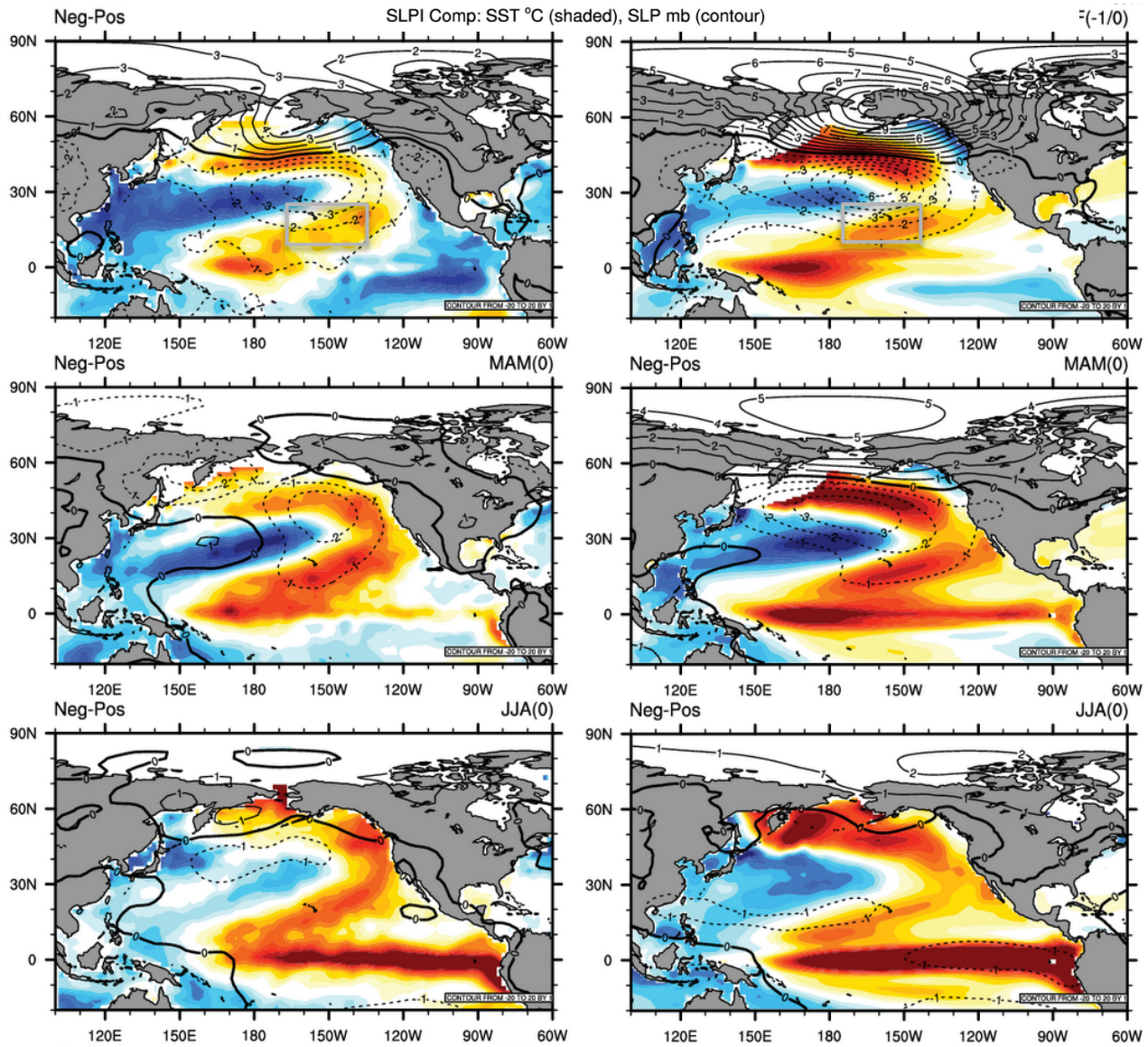
- NPO in NDJ (-1)
- ⇓
- Winds & Heat Flux
- ⇓
- SST in FMA (0)
- ⇓
- Tropical Winds
- Feedback (e.g. WES) JJAS(0)
- ⇓
- El Nino in NDJ(0)

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)

NCEP Reanalysis

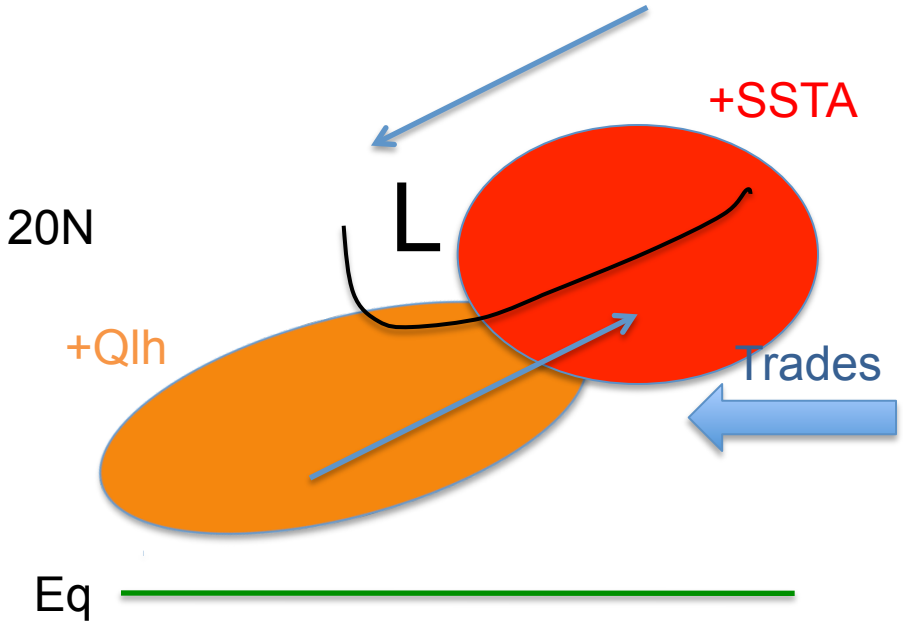


CCSM4

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

Wind Evaporation SST (WES) Feedback

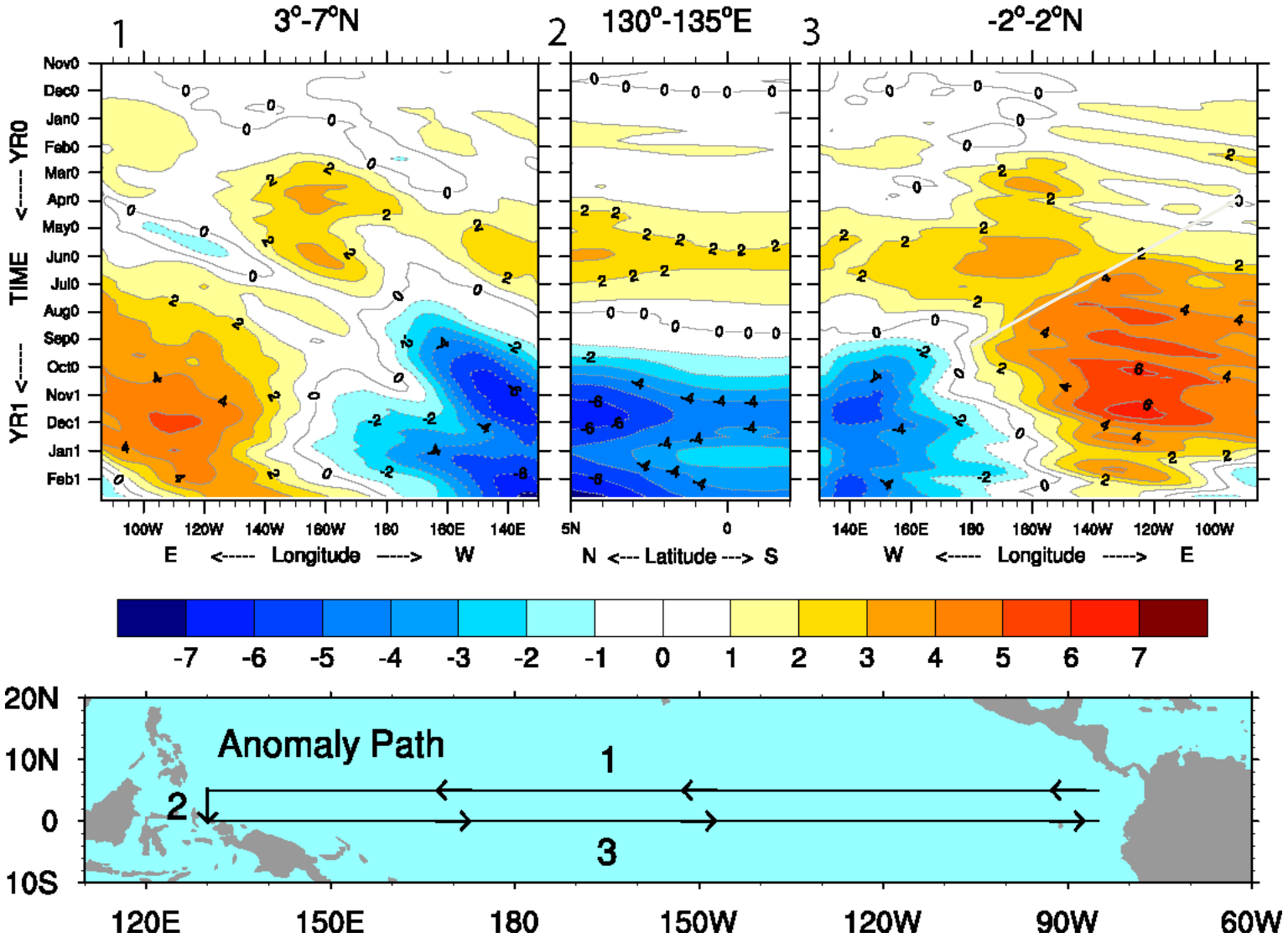


$$Q_{lh} \sim \rho c_e(\underline{u}(q'_s - q'_a) + \underline{u'}(\underline{q_s} - q_a))$$

- 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

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