Tropical Ocean Water Budgets and Model Diagnostics as Derived from Satellite Data

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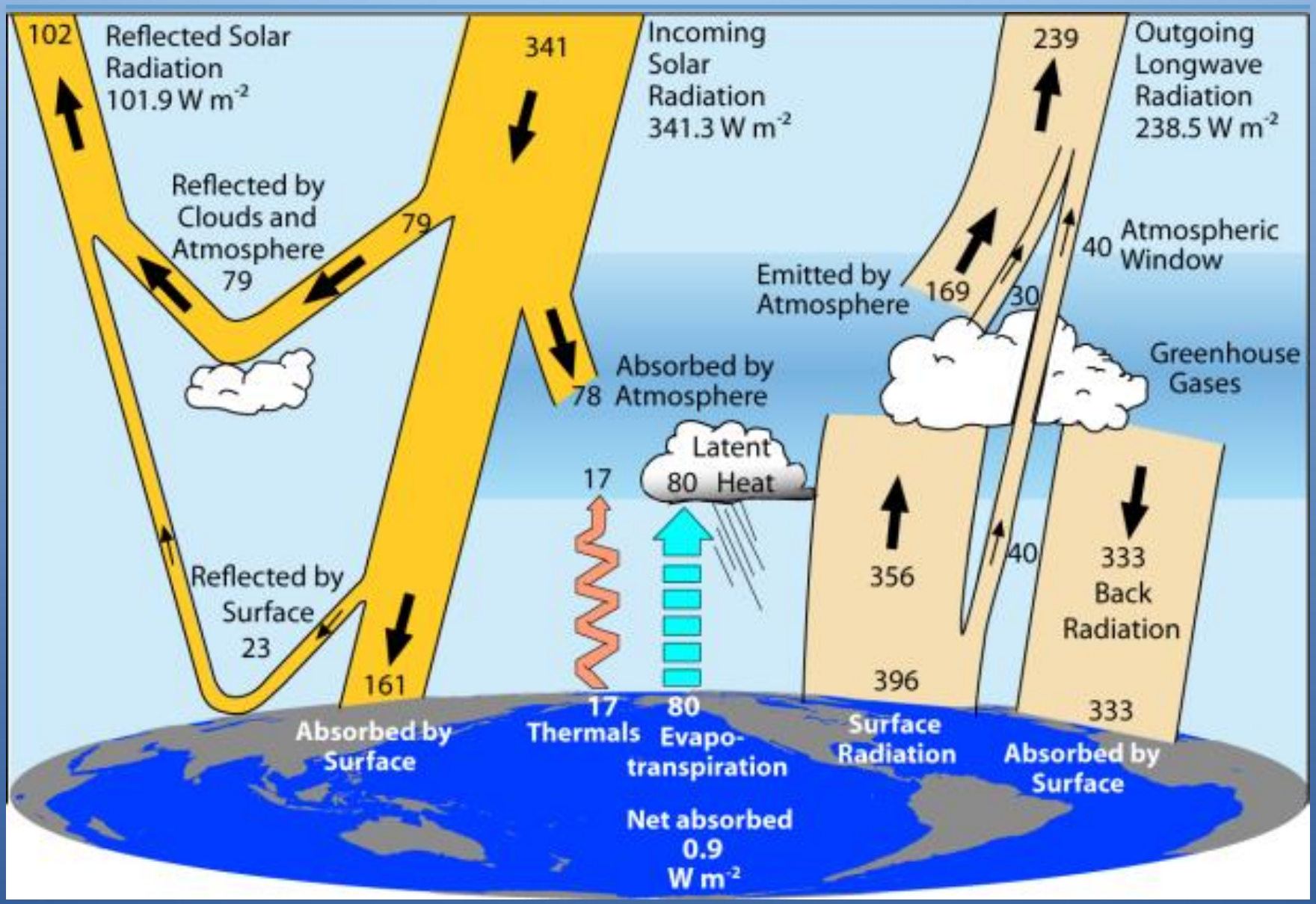
with Help from GEWEX Data and Assessments Panel

Global Water and Energy Budgets

(from Trenberth, Fasullo and Kiehl, 2009, BAMS)



Multi-Year Average Radiation

	All Sky			All Sky			All Sky
	$LW\uparrow$	$LW\downarrow$	LW_{net}	$SW\uparrow$	$SW\downarrow$	SW_{net}	Sfc_{net}
Trenberth et al., 2009	396.0	333.0	-63.0	23.0	184.0	161.0	98.0
GEWEX SRB (1/84 – 12/07)	396.5	343.9	-52.6	22.0	188.6	166.6	114.0
ISCCP FD (1985 – 2004)	395.6	344.7	-50.9	23.2	188.9	165.7	114.9
CERES (Ed 2 Avg) (2000 – 2005)	398.0	342.0	-56.0	23.1	188.9	165.8	109.8
A-Train (2006 – 2009)	398.0	347.2	-50.8	20.8	189.0	168.2	117.4

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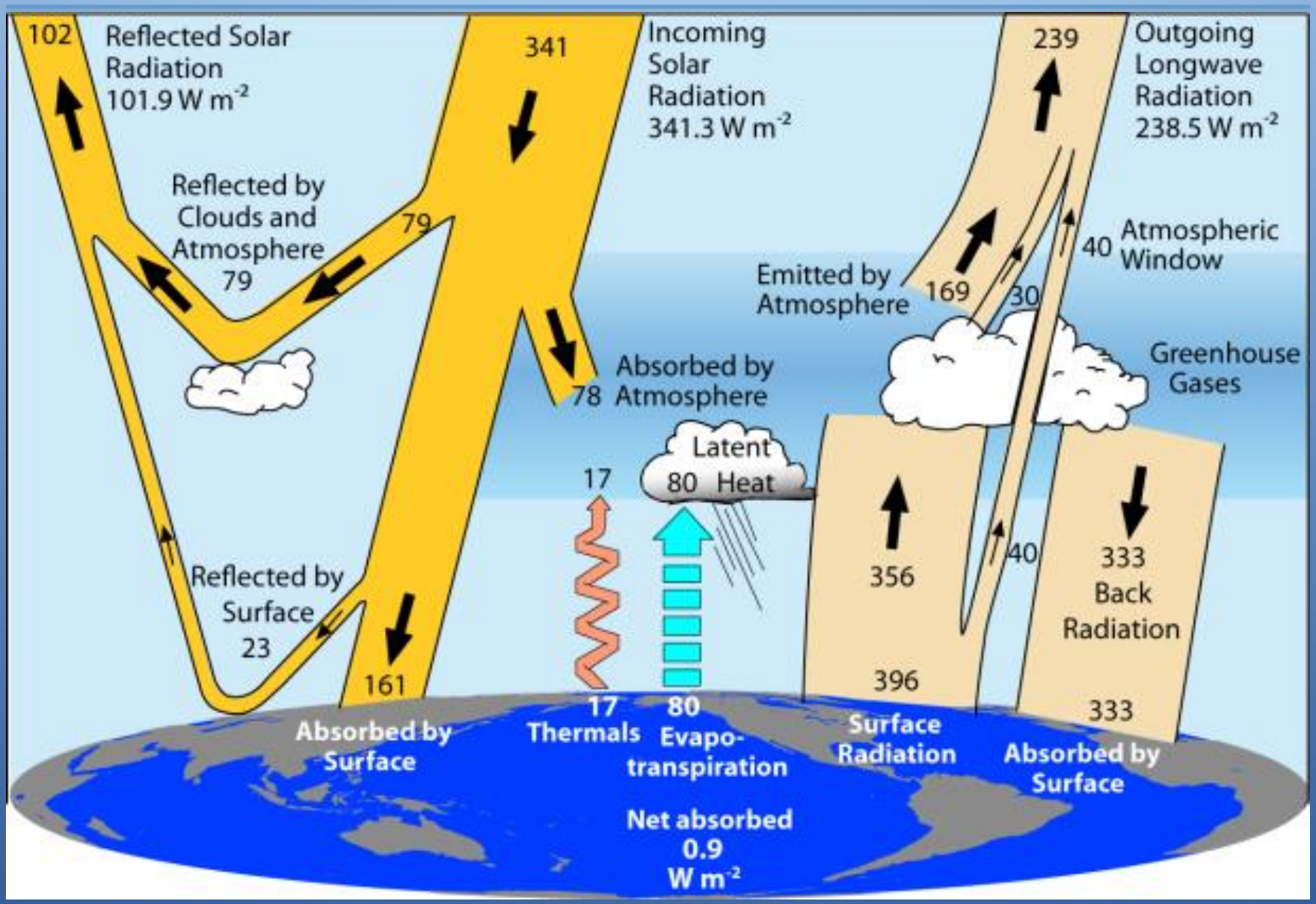
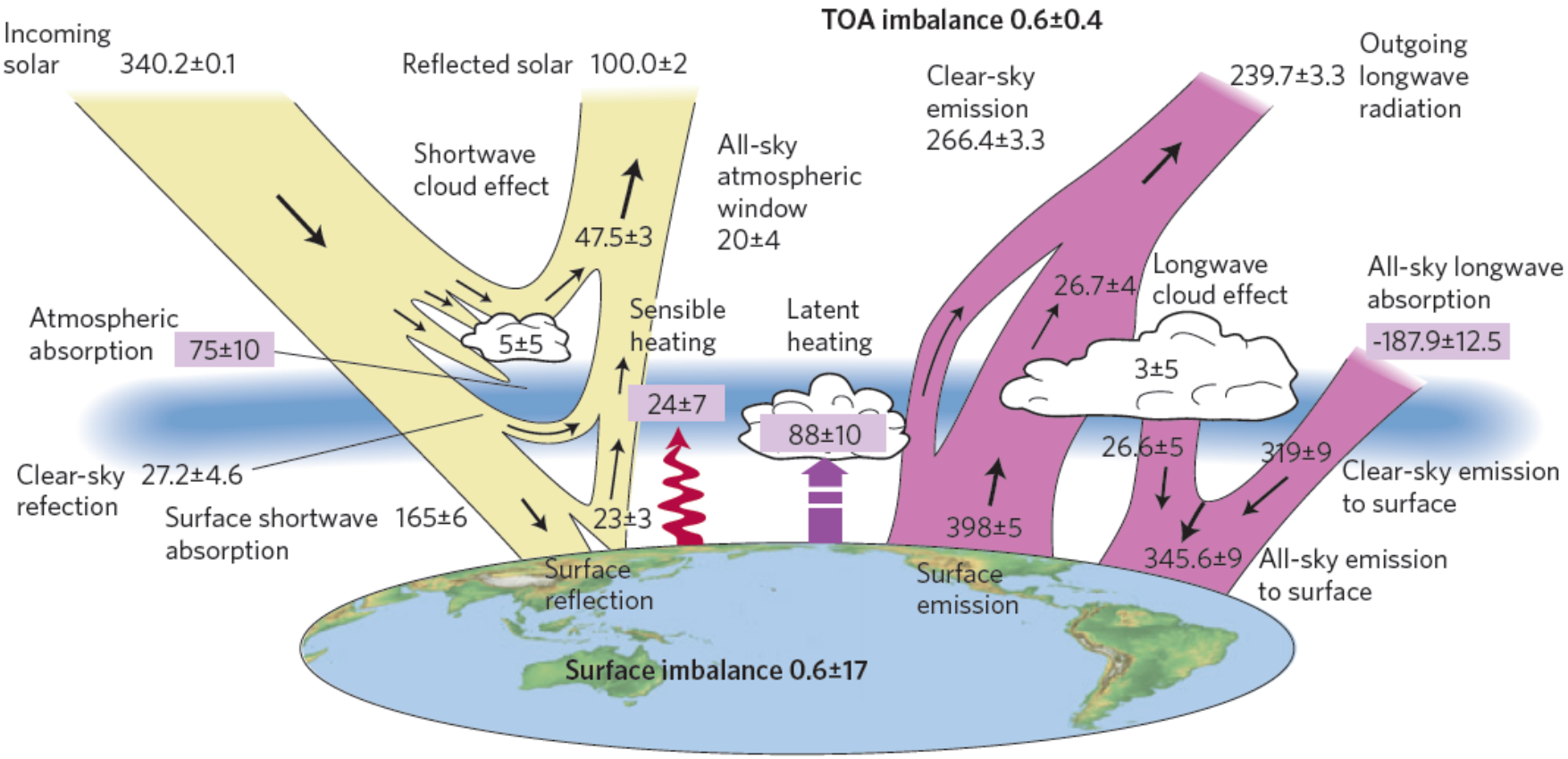


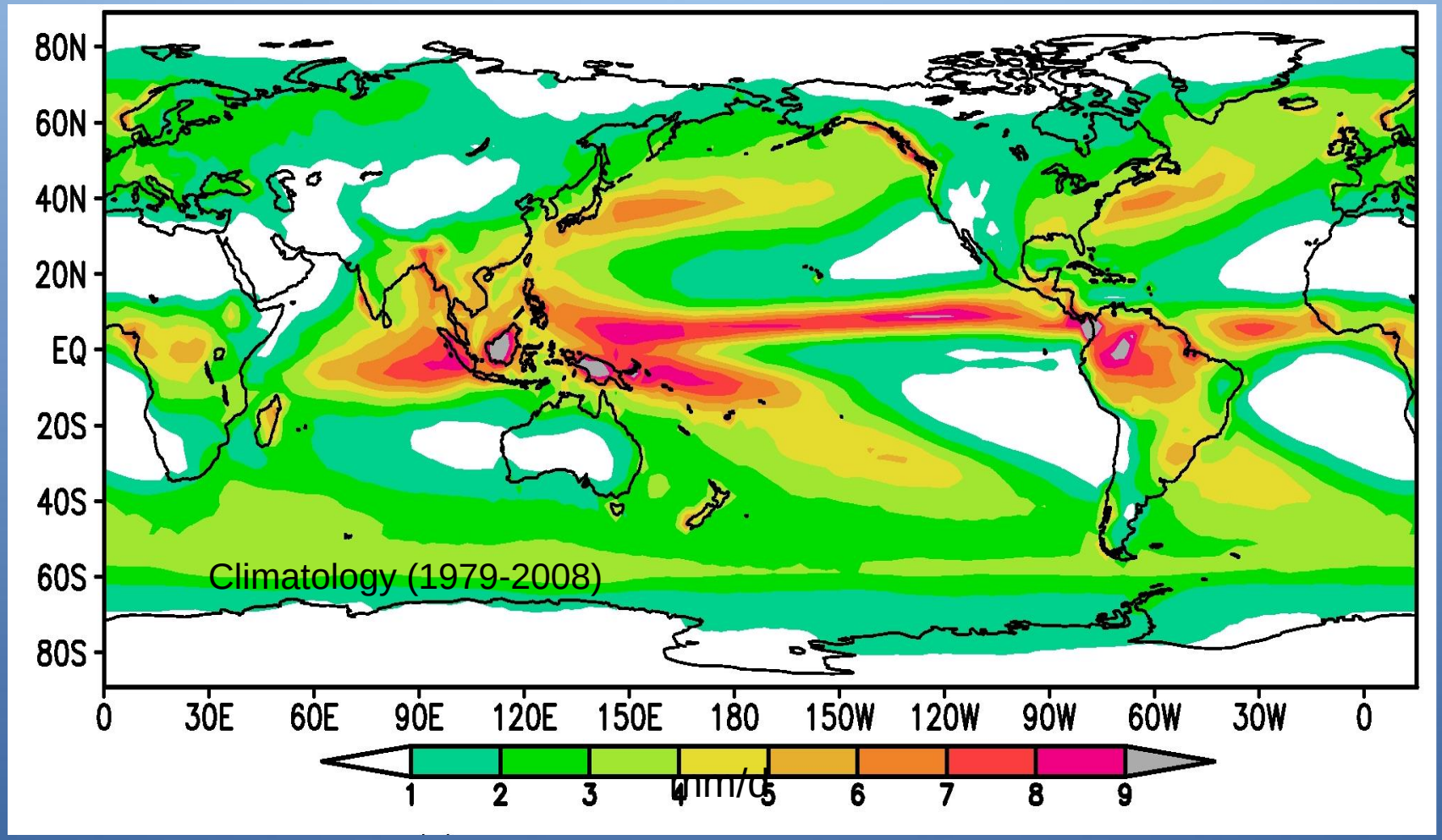
Global Energy Budget Closure

Stephens et al (2012, Nature GeoScience, 23 September 2012)



Global Precipitation Climatology Project (GPCP)

Robert Adler, U. of Maryland-College Park, USA



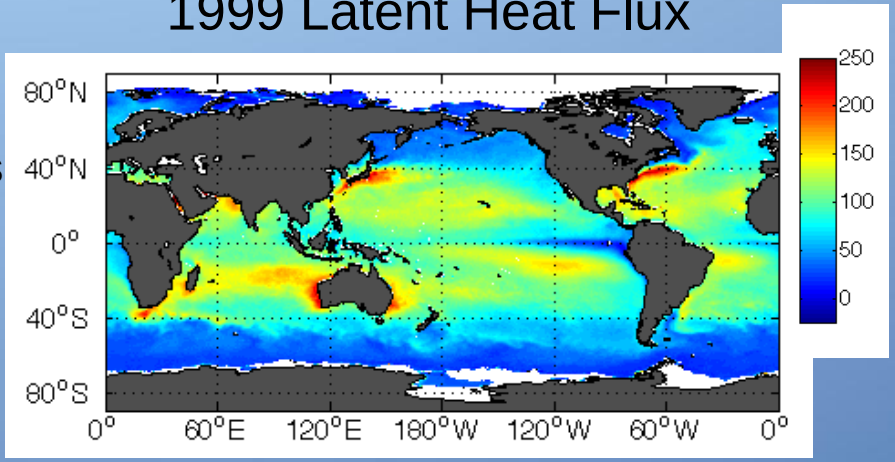
GPCP mean is2.64 mm/day corresponding to 76 W/m² ± 7 W/m²

SeaFlux

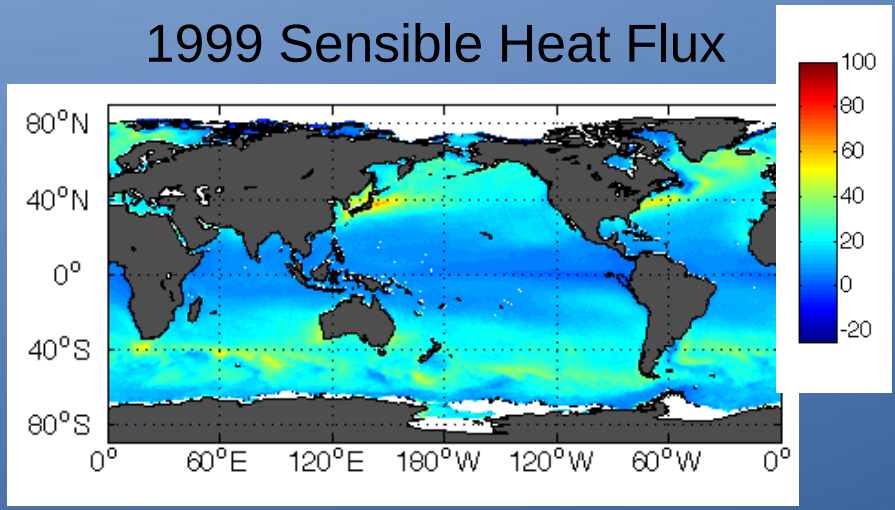
Carol Anne Clayson , Woods Hole Oceanographic Institution

- **Near-surface air temperature and humidity**
  - Roberts et al. (2010) neural net technique
  - SSM/I only from CSU brightness temperatures (thus only covers 1997 - 2006 in Version 1.0)
  - Gap-filling methodology -- use of MERRA variability – 3 hour
- **Winds**
  - Uses CCMP winds (cross-calibrated SSM/I, AMSR-E, TMI, QuikSCAT, SeaWinds)
  - Gap-filling methodology -- use of MERRA variability – 3 hour
- **SST**
  - Pre-dawn based on Reynolds OISST
  - Diurnal curve from new parameterization
  - Needs peak solar radiation, precipitation
- **Uses neural net version of COARE**
- **Available at http://seaflux.org**

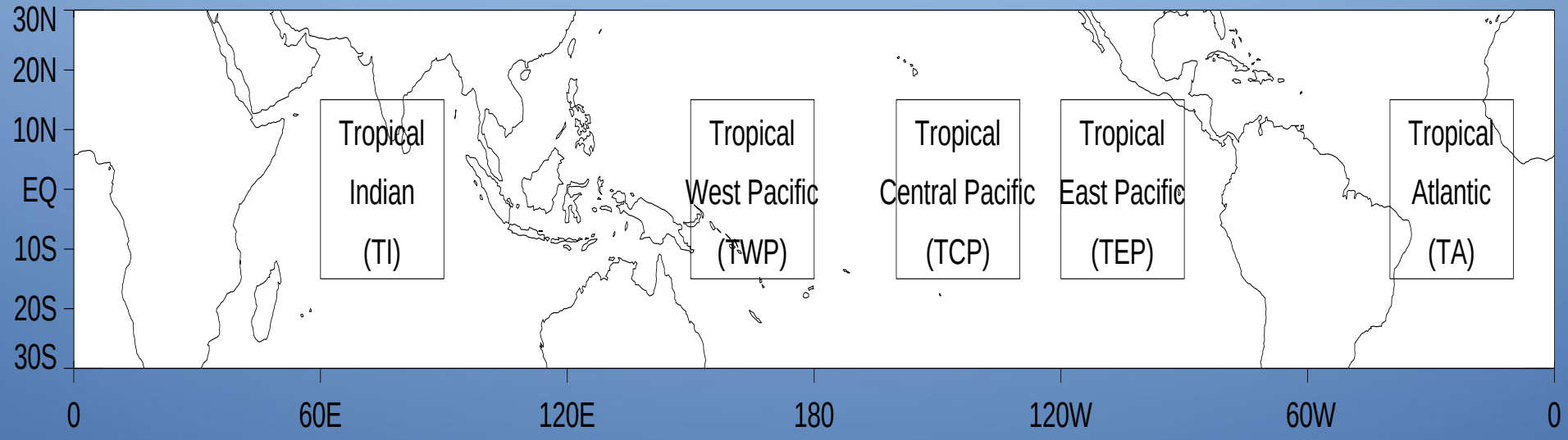
1999 Latent Heat Flux



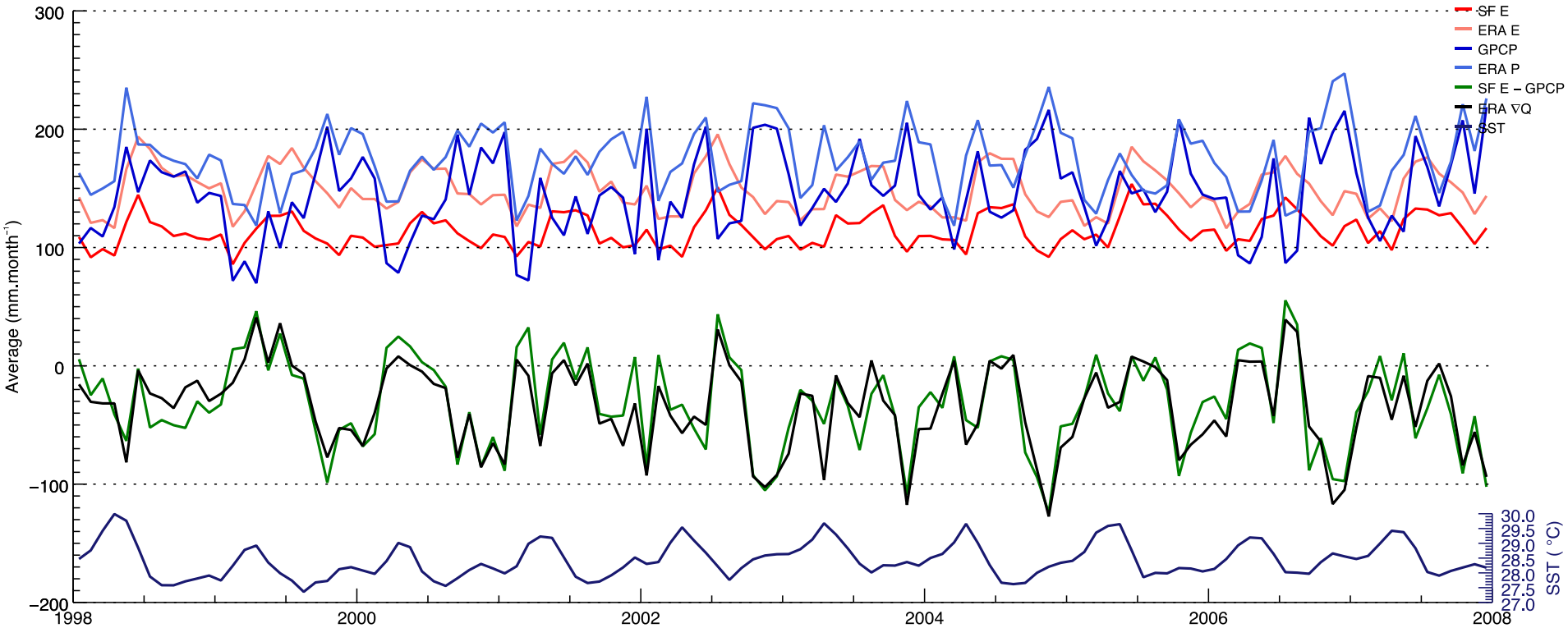
1999 Sensible Heat Flux



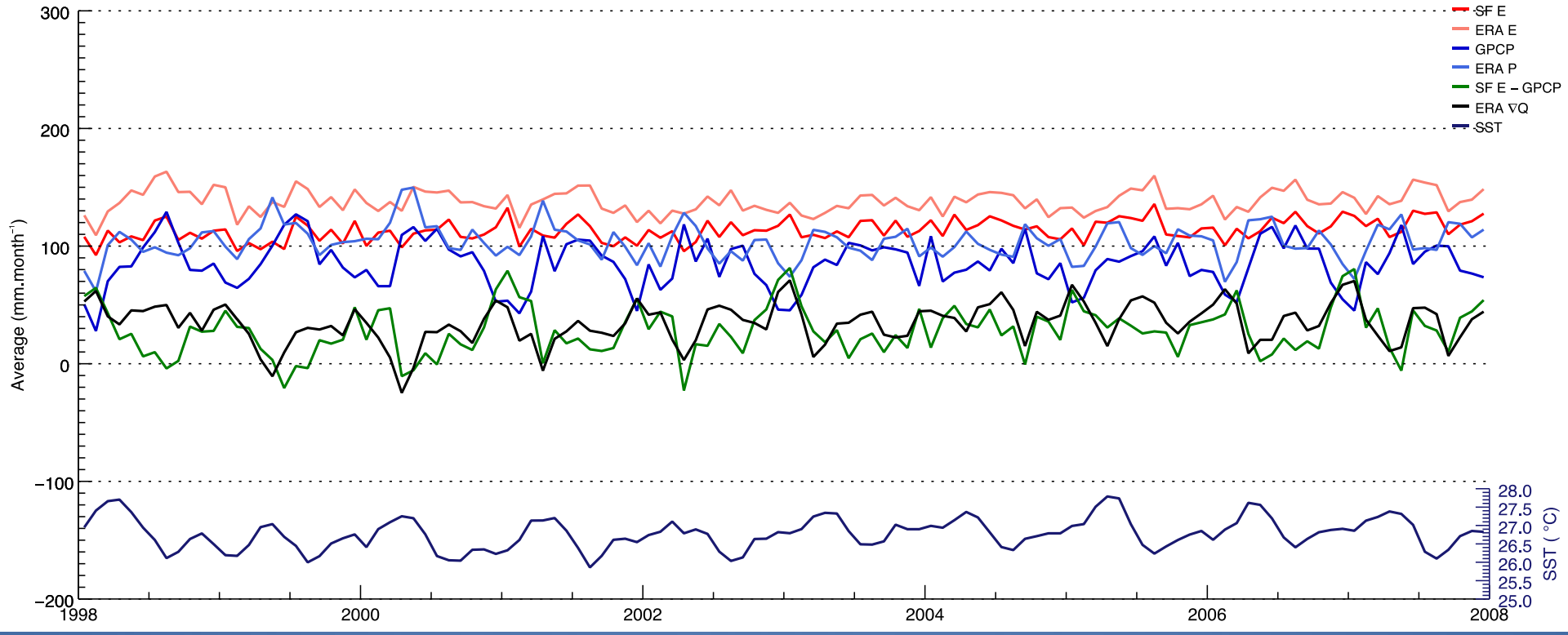
Open Ocean Domains



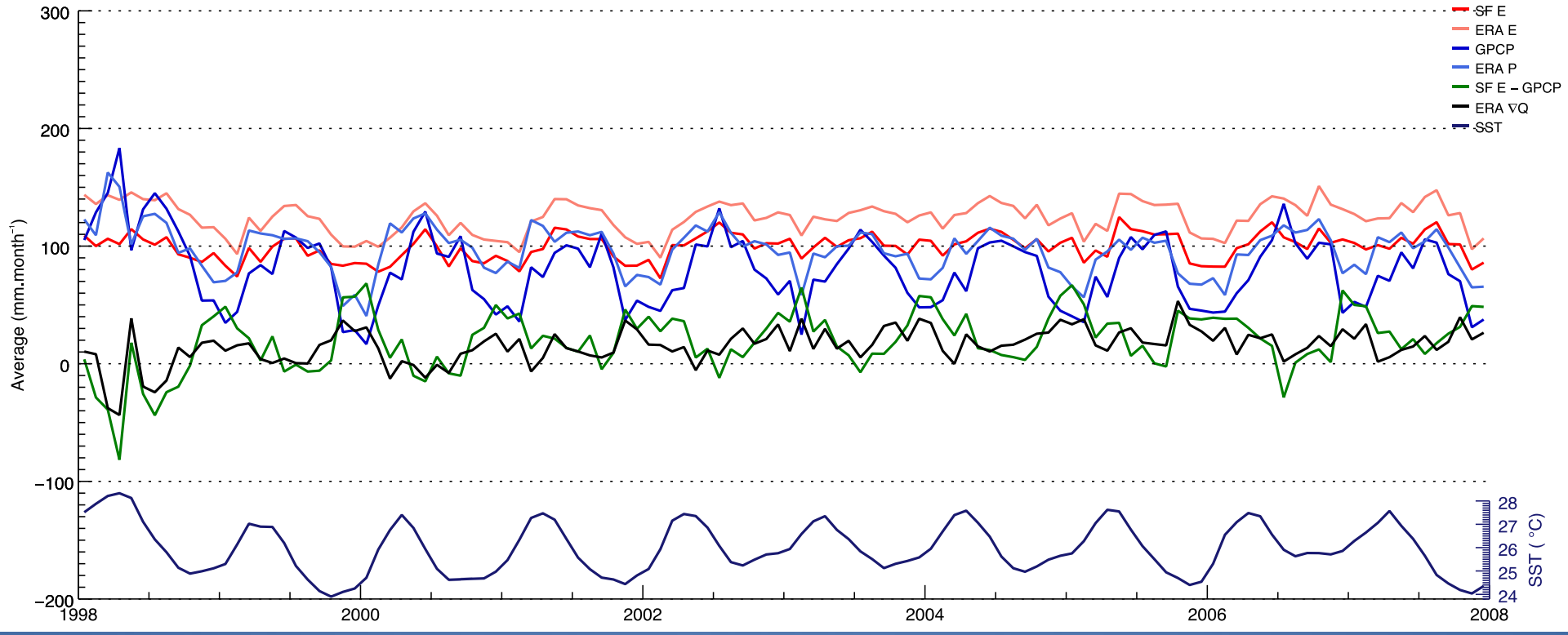
E, P and Div(Q) for Tropical Indian Ocean



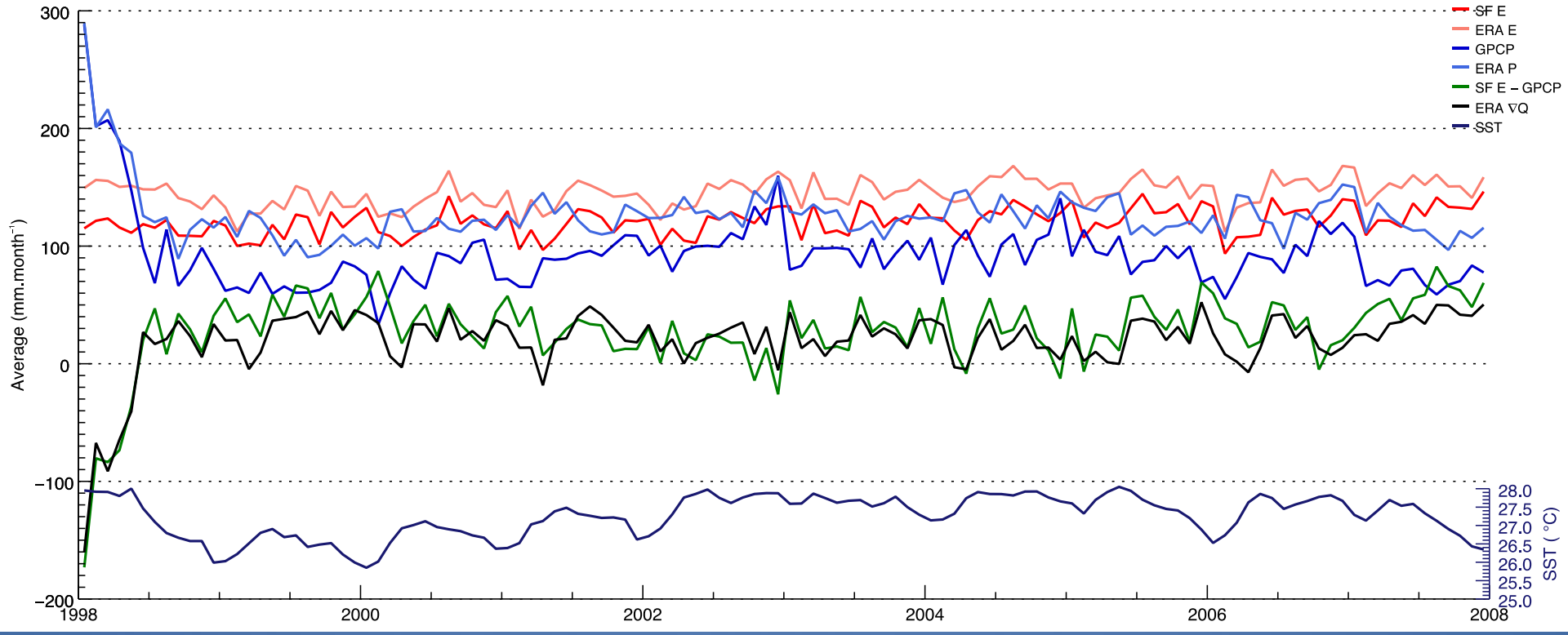
E, P and Div(Q) for Tropical Atlantic



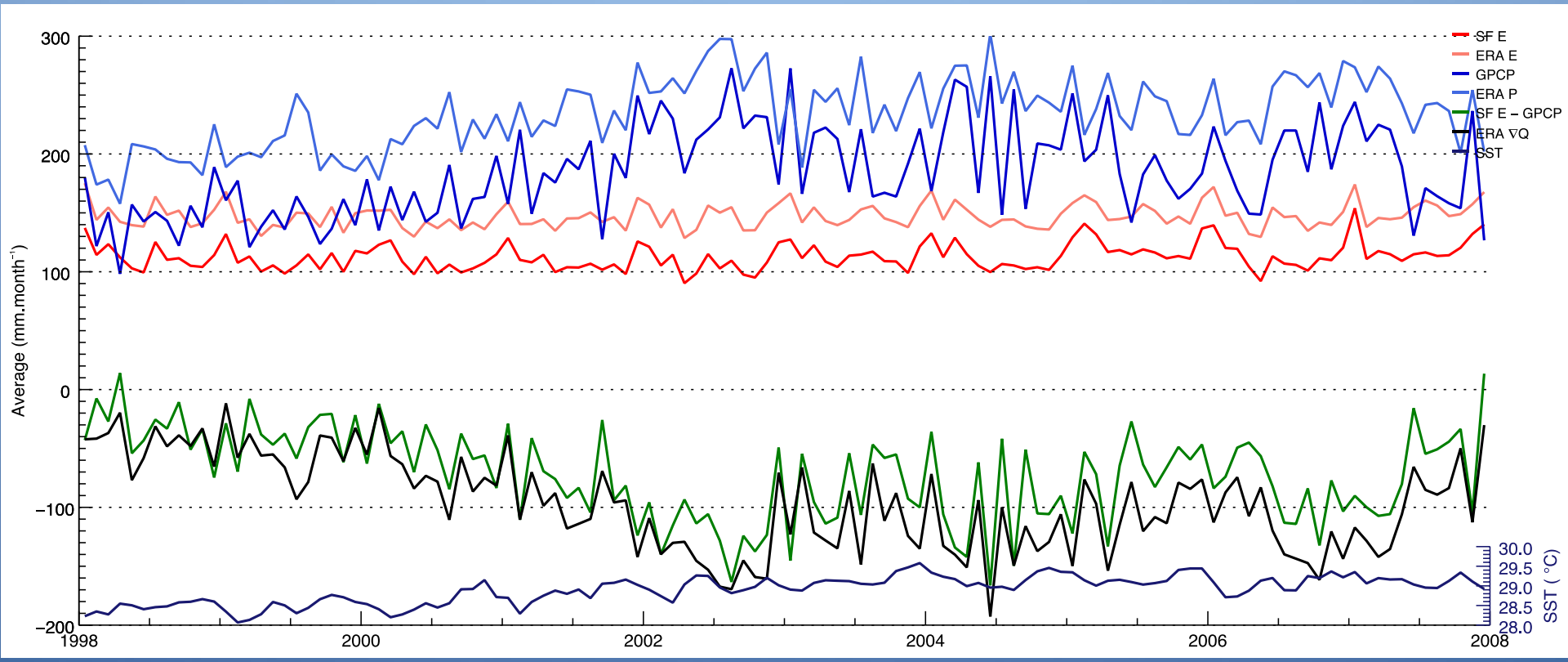
E, P and Div(Q) for Tropical East Pacific



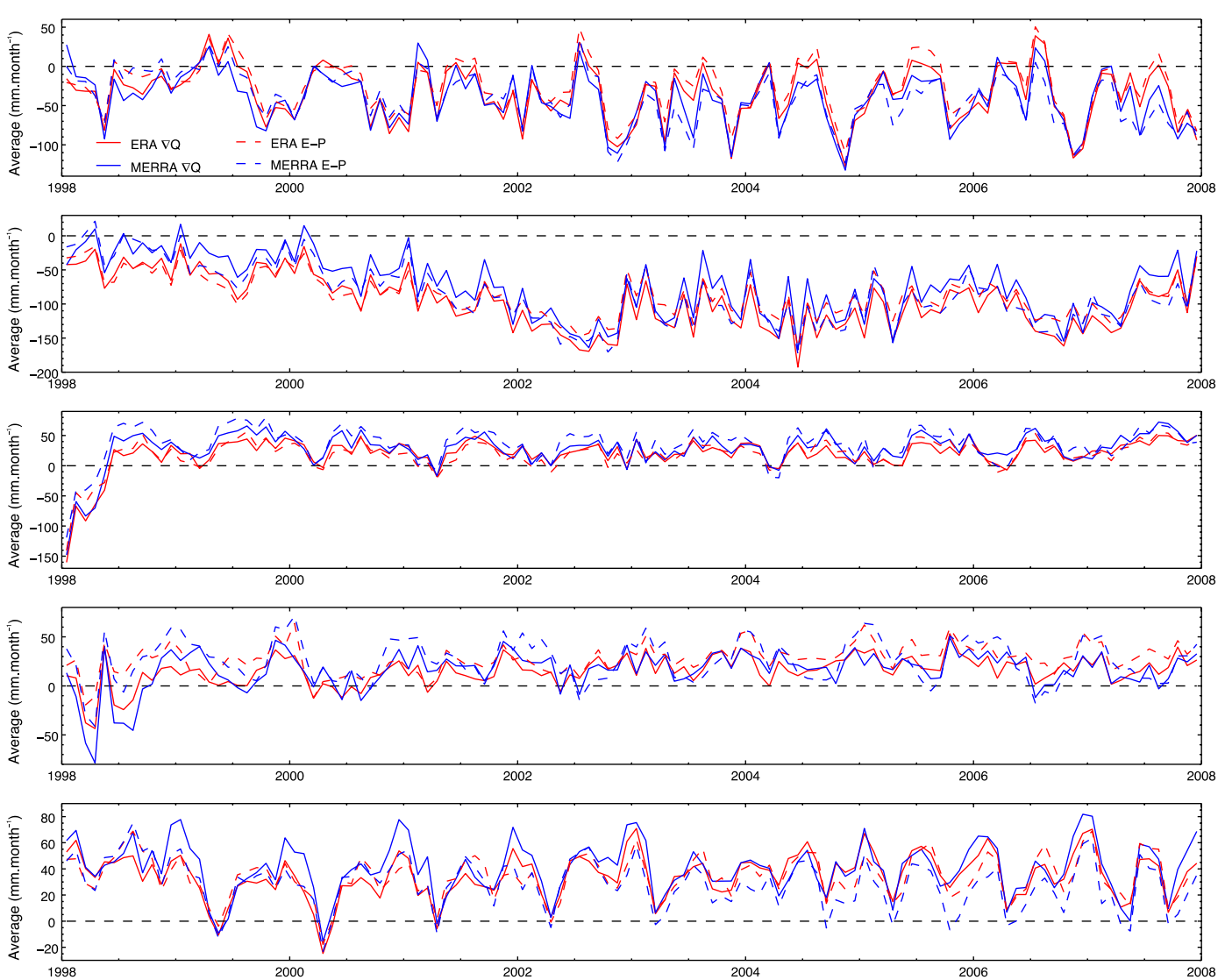
E, P and Div(Q) for Tropical Central Pacific



E, P and Div(Q) for Tropical West Pacific

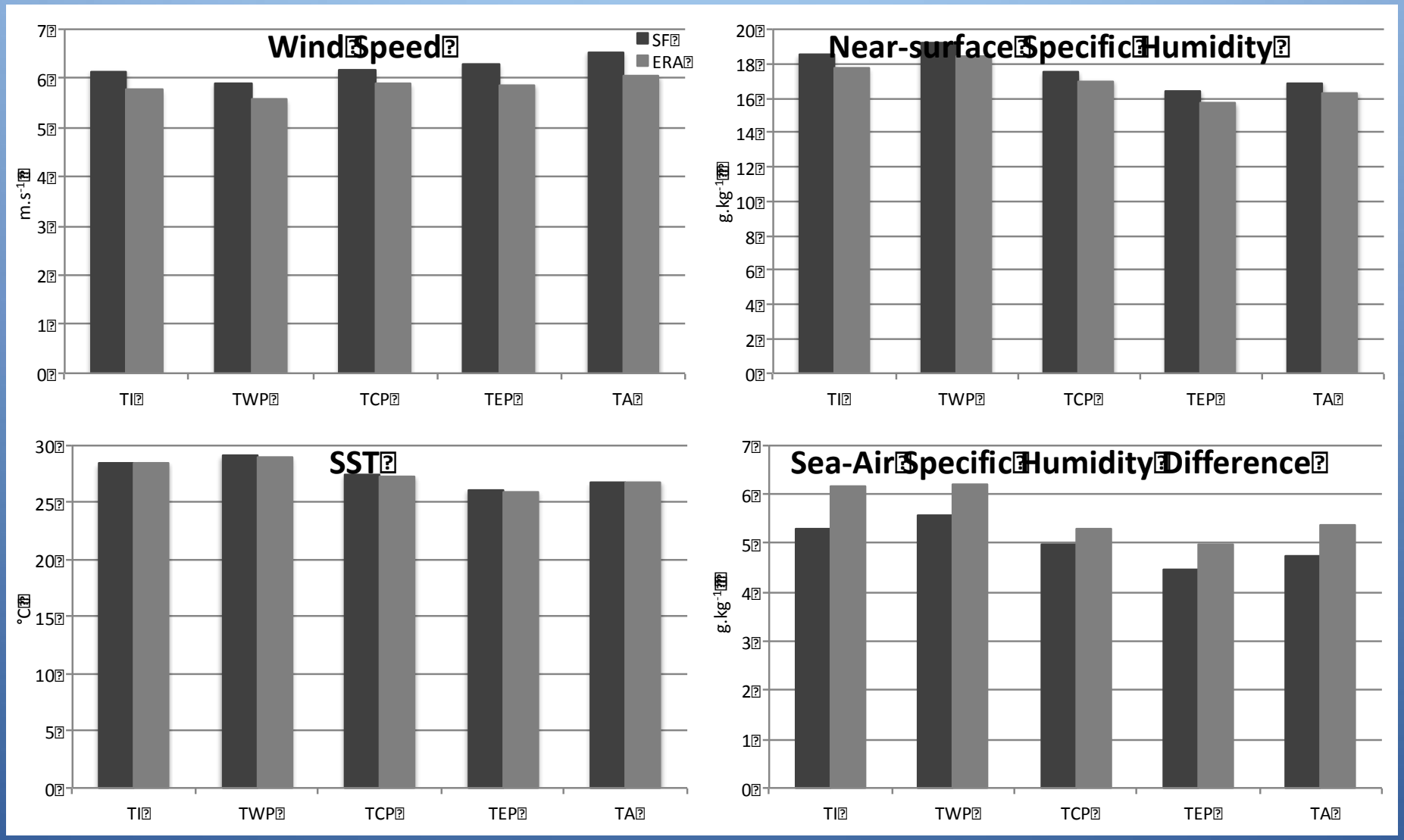


Water budgets from Reanalysis



The Bulk Parameterization

$$E = r_a C_q u_x \left(q_0 - q_a\right)$$



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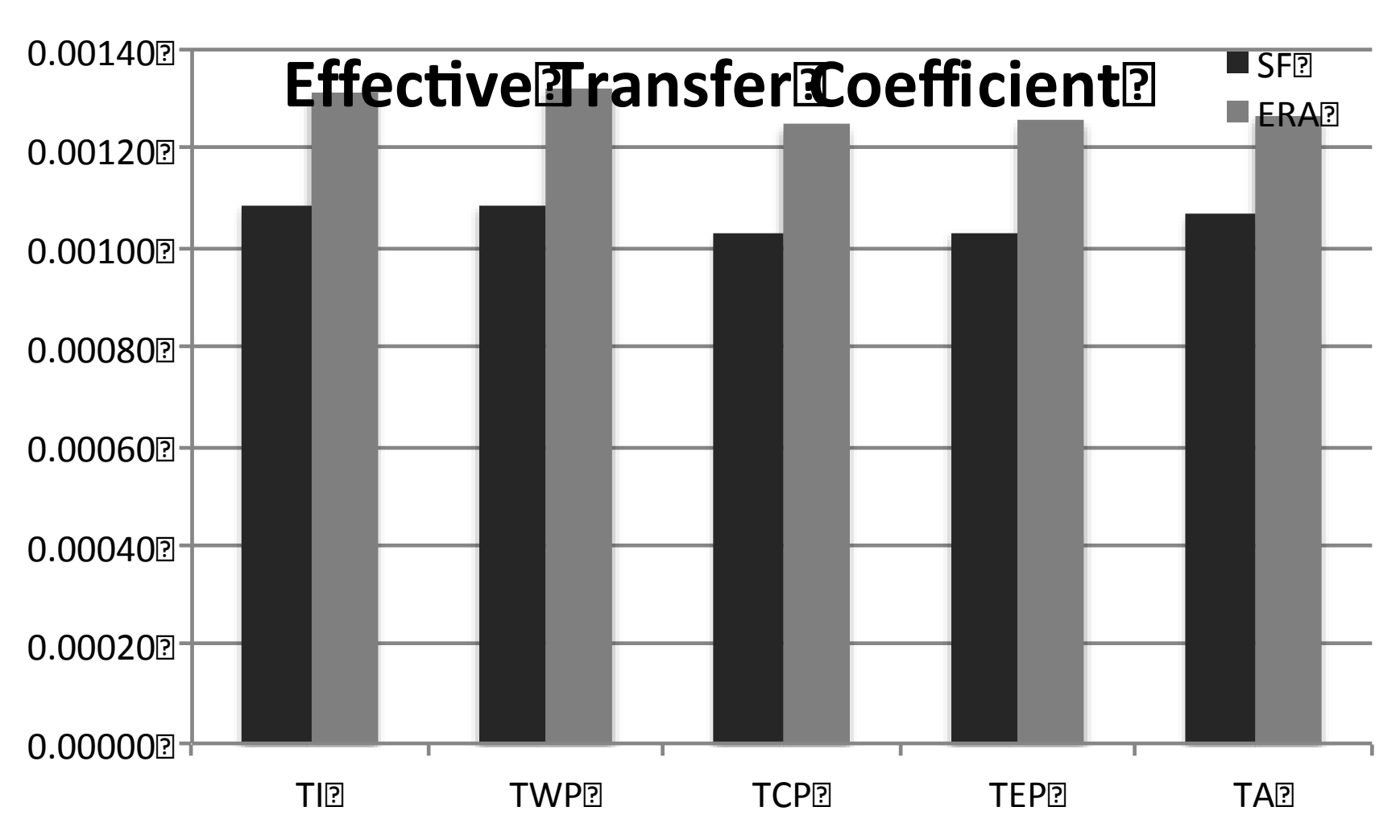

Summary

- Water is in balance over tropical oceans
- A trend is evident in West Pacific that is not seen in other basins. Therefore not a satellite trend but a natural change.
- Global models require too much evaporation and therefore Precipitation to balance water. Extra precipitation is in the form of excess drizzle.