Model Biases in the Tropical / Equatorial Pacific Ocean

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- Biases in coarse resolution, CMIP-class, work-horse coupled climate models,
- Solutions from CMIP5 models

In comparison with available observations, representations of

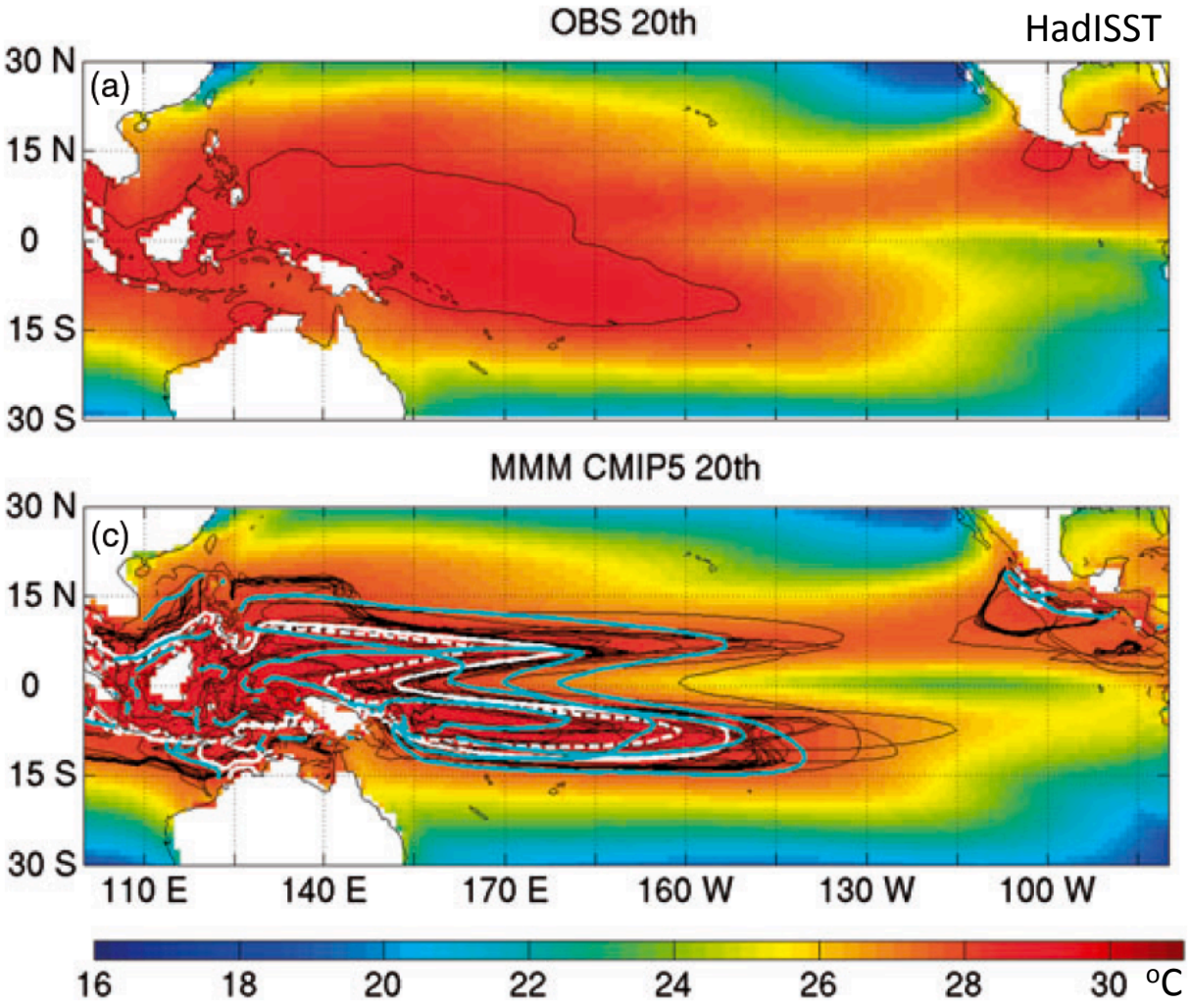
- Sea surface temperature (SST): mean and seasonal cycle
- El Nino – La Nina
- Thermocline, upper-ocean temperatures
- Currents
- Precipitation

Not covered:

Variability and modes of variability, e.g., PDV; Tropical instability waves; Salinity; Deep Pacific properties; Upwelling; Indonesian Throughflow representation and interactions; …

Minimal attribution of biases …

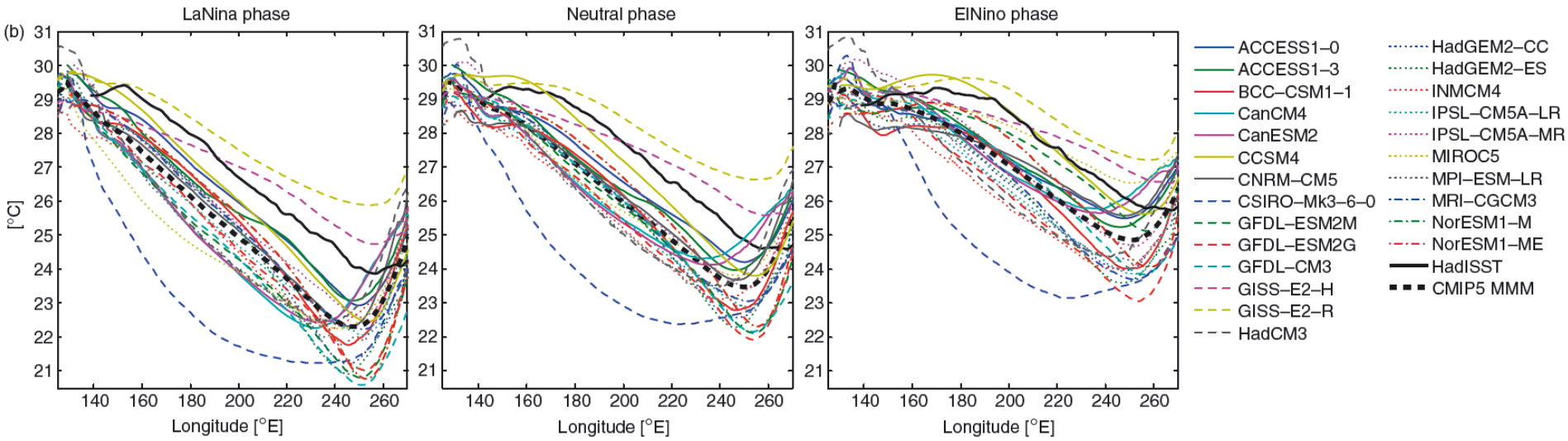
Mean SST (1980-1999)



Contour lines are for the 28.5°C isotherm
MMM: white lines

Grose et al. (2014, Int. J. Climatology)

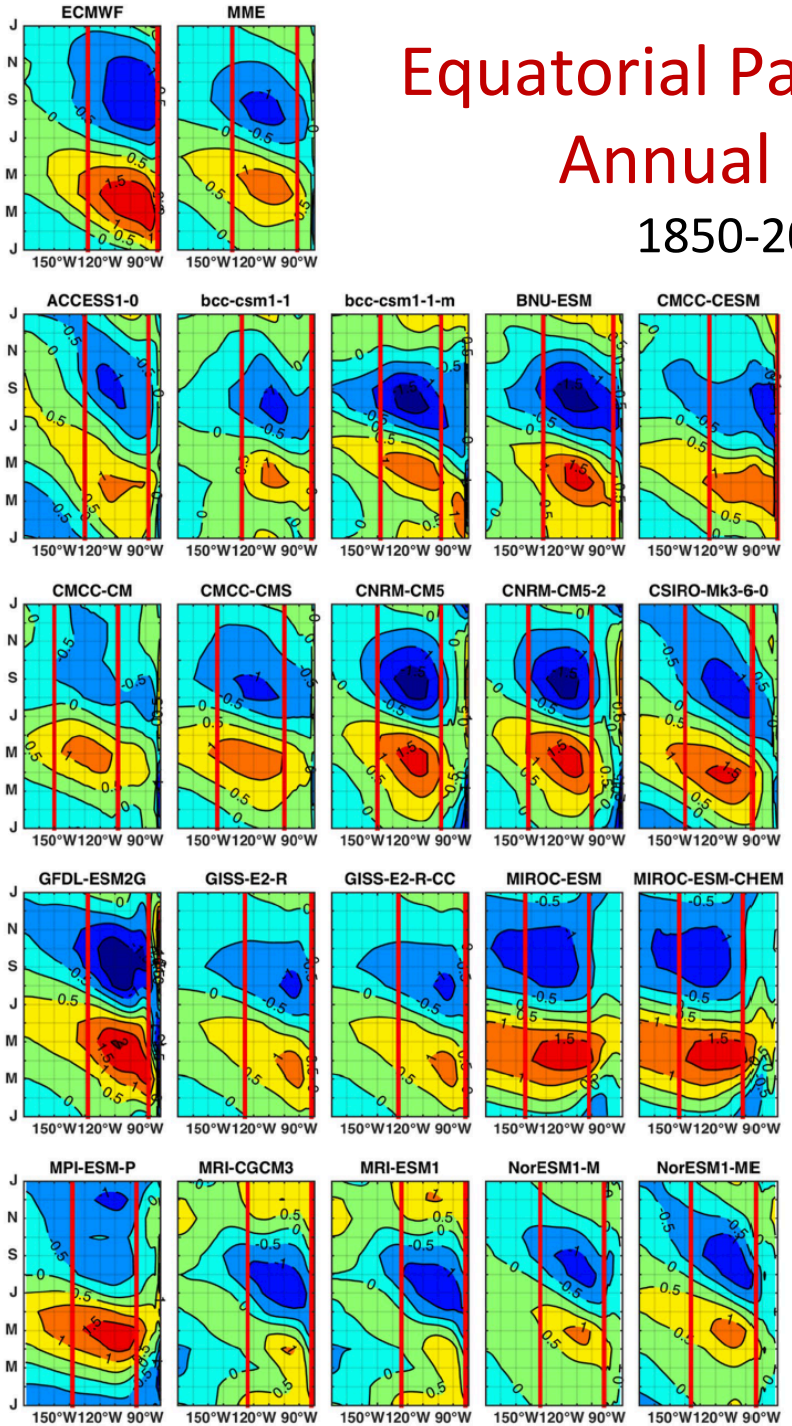
Equatorial Pacific SST from CMIP5 (1980-2005)



Grose et al. (2014, Int. J. Climatology)

Equatorial Pacific SST Climatological Annual Cycle from CMIP5

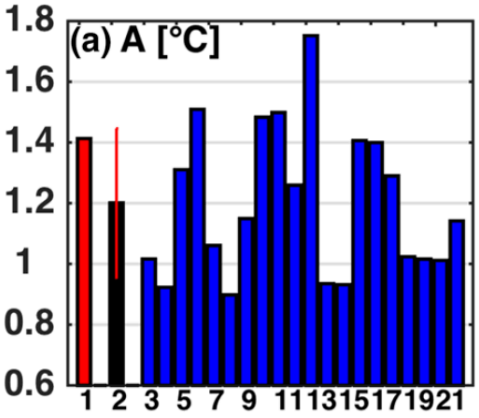
1850-2005; 6°S-6°N Average



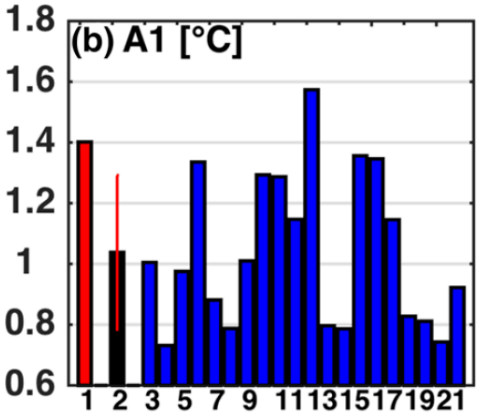
Chen and Jin (2017, Clim. Dyn.)

Equatorial Pacific SST Climatological Annual Cycle from CMIP5

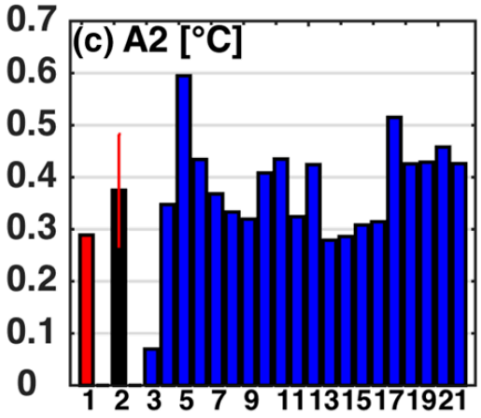
Total Amplitude

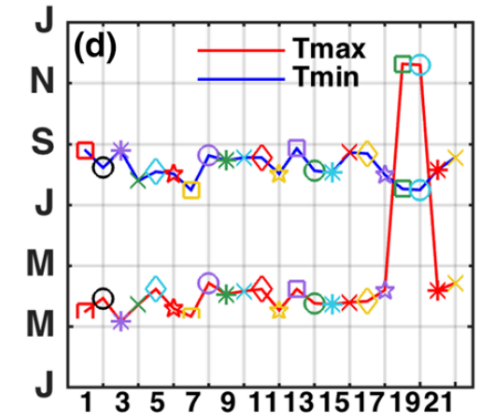


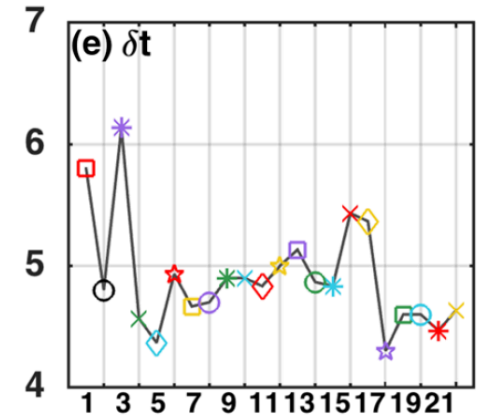
Annual Component



Semi-Annual Component





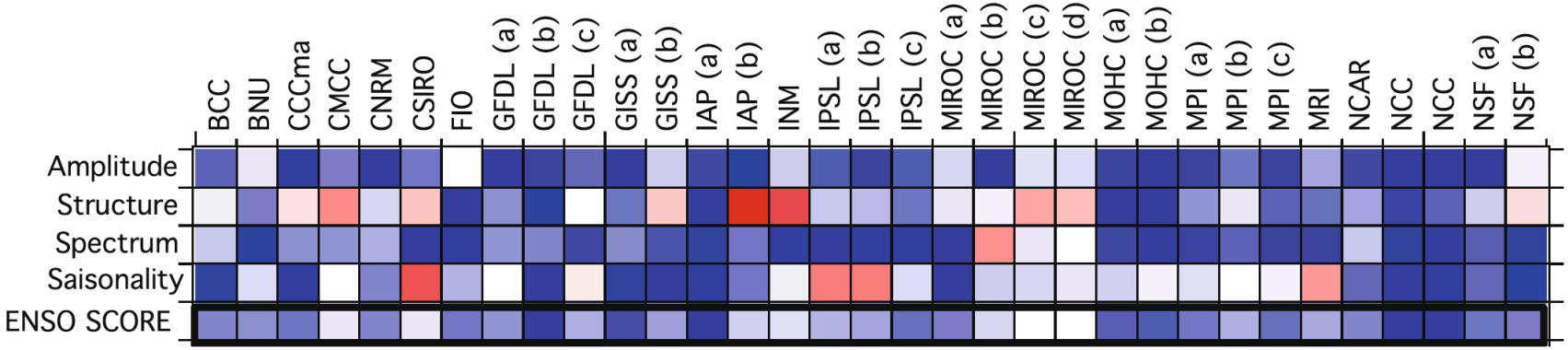


ECMWF reanalysis: Red column & red square

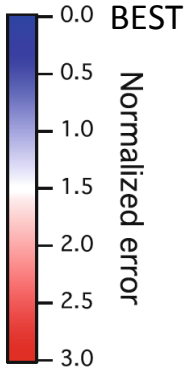
Multi Model Mean: black

Chen and Jin (2017, Clim. Dyn.)

El Nino Representations in CMIP5

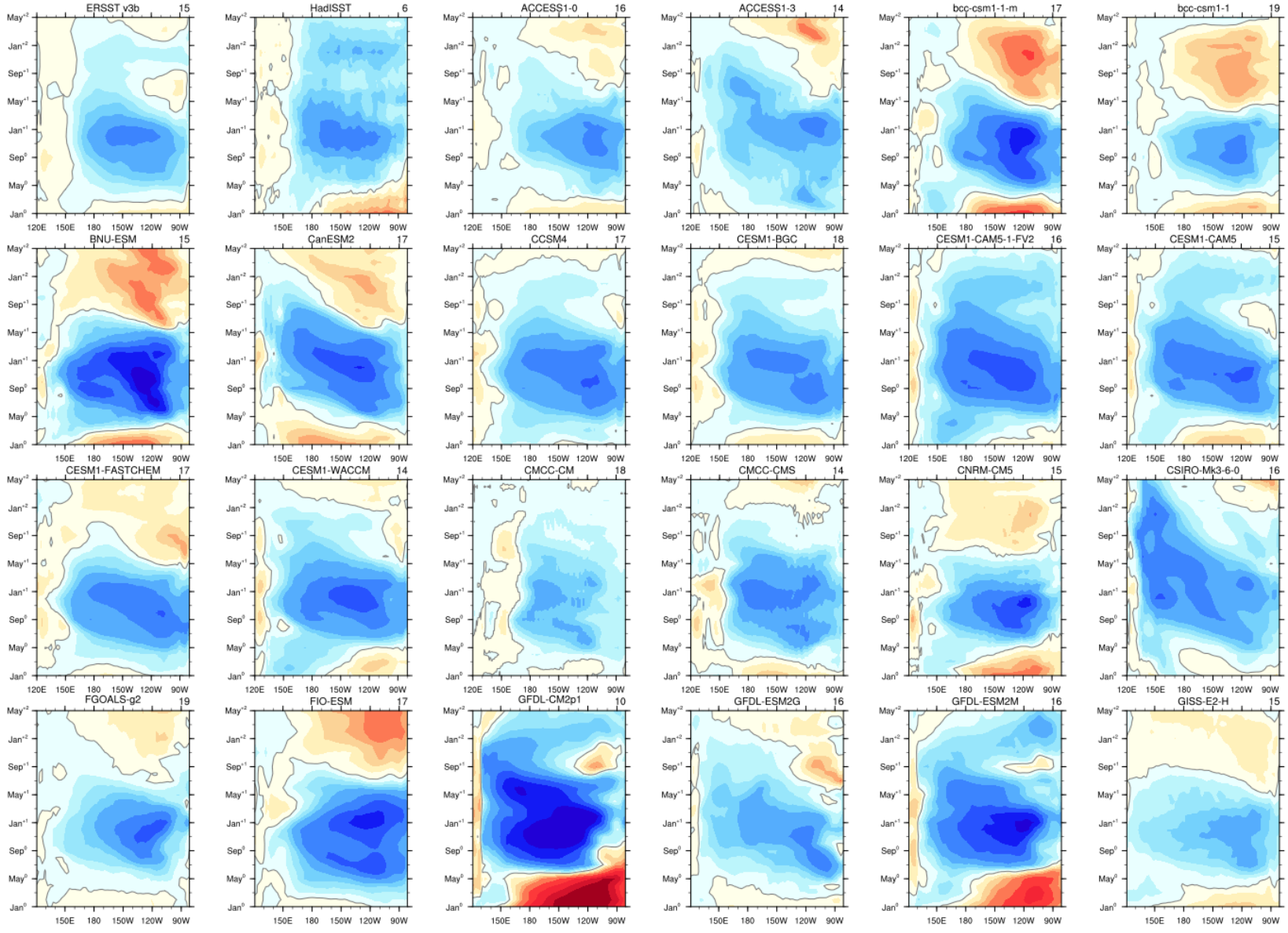


Amplitude: Nino 3 SST anomaly variability
Structure: % events peaking in Eastern Pacific
Spectrum: power (3-8 year) / power (1-3 year)
Seasonality: NDJ / MAM Nino 3 SST SD ratio



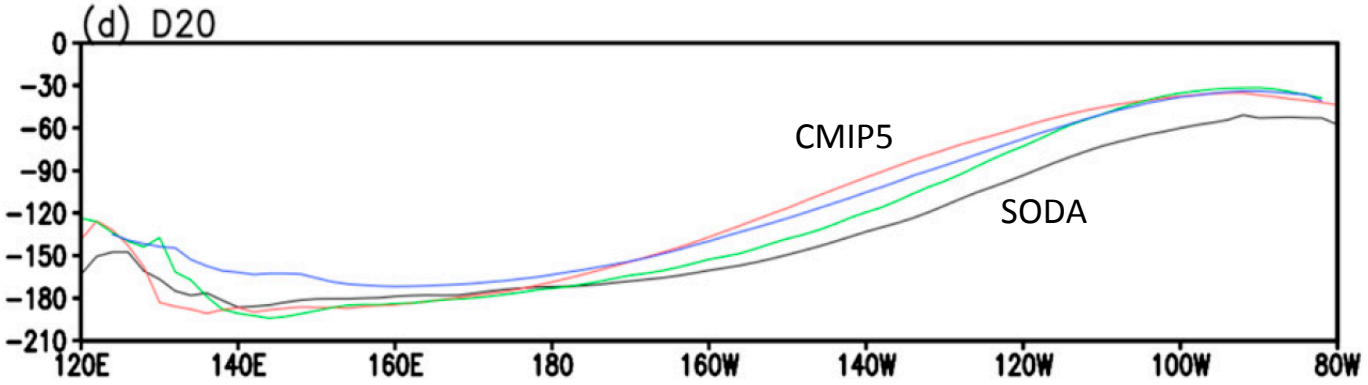
Bellenger et al. (2014, Clim. Dyn.)

La Nina Composites Time Evolution from CMIP5 (3°S-3°N)



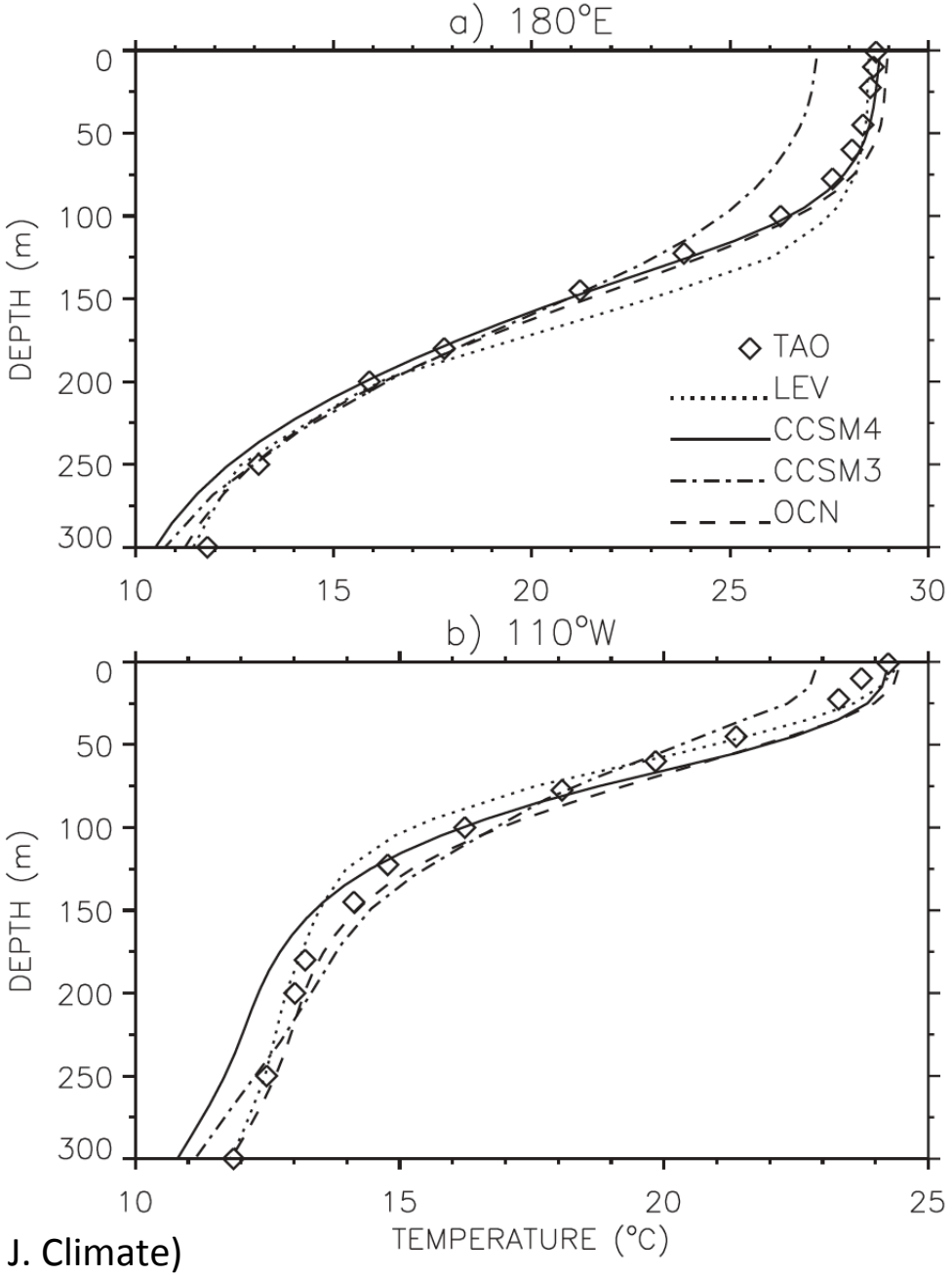
Adam Phillips

Depth of the 20°C Isotherm Along the Equatorial Pacific



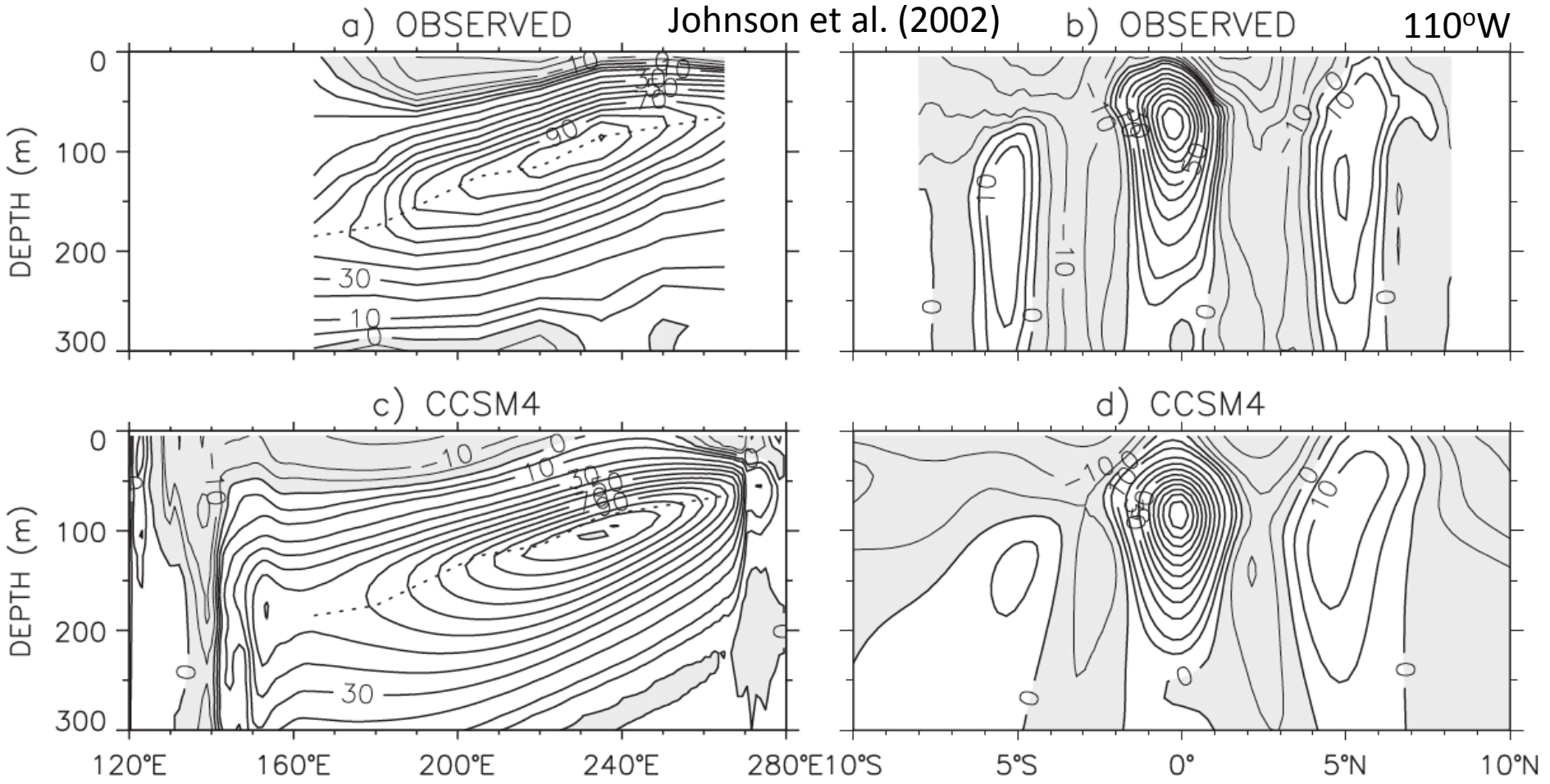
Li and Xie (2014, J. Climate)

Equatorial Pacific Temperatures



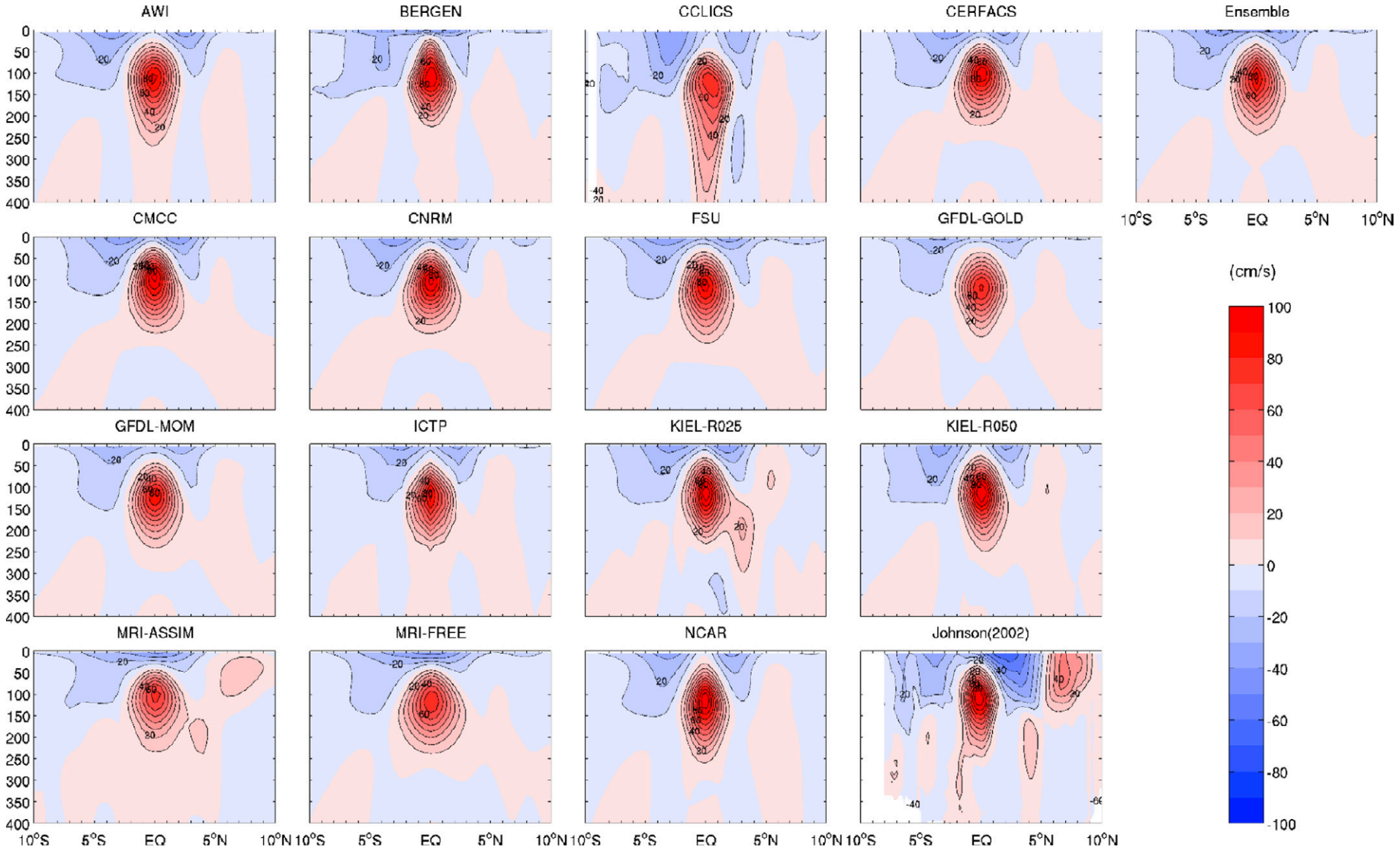
Danabasoglu et al. (2012, J. Climate)

Mean Zonal Velocity in the Pacific Ocean



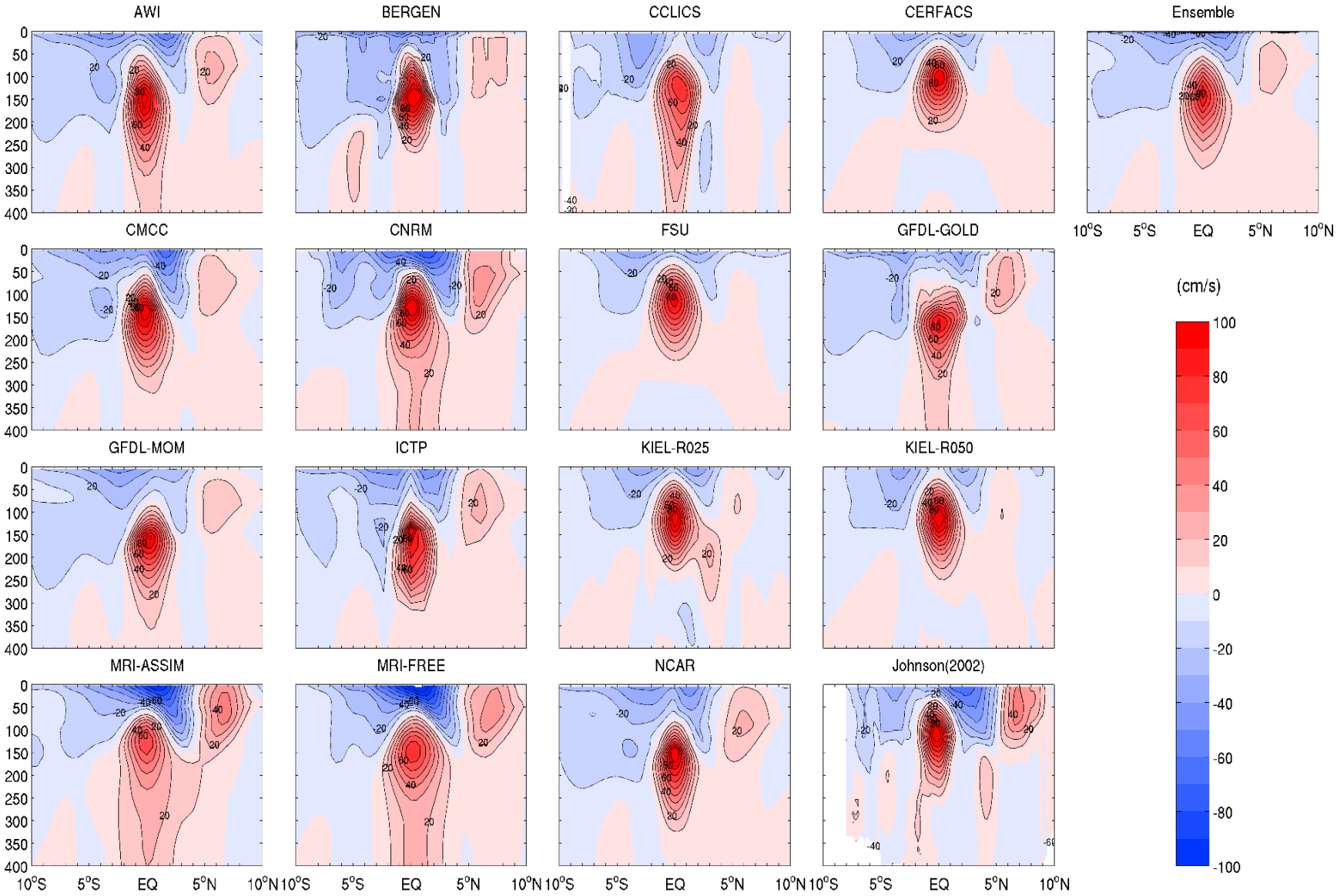
Danabasoglu et al. (2012, J. Climate)

Mean Zonal Velocity in the Pacific Ocean from CORE-II Simulations (140°W, 1986-2000)



Tseng et al. (2016, Ocean Modelling)

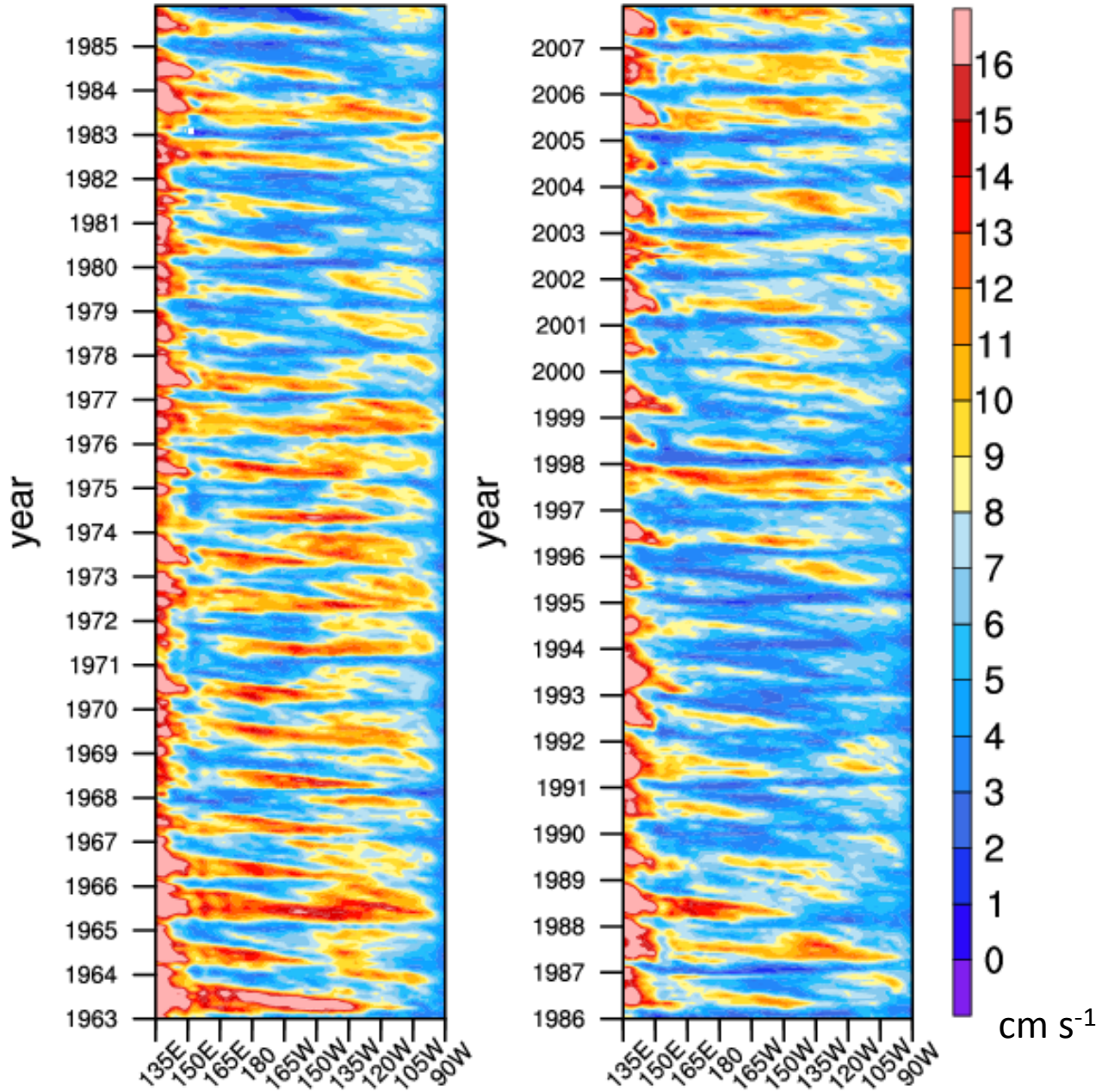
Mean Zonal Velocity in the Pacific Ocean from CORE-II Simulations (140°W, 1993-2007)



Tseng et al. (2016, Ocean Modelling)

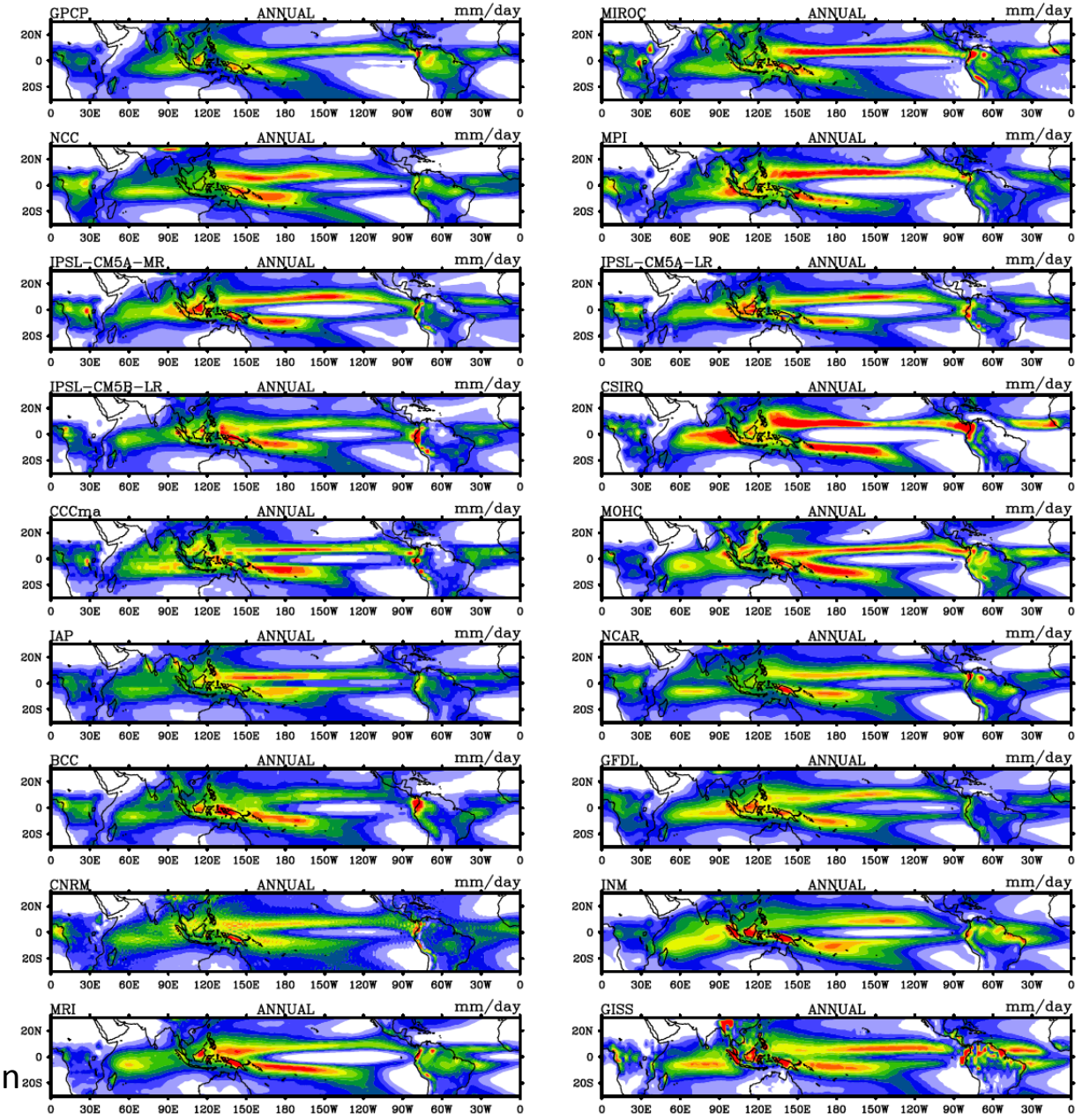
Zonal Velocity from POP2 CORE-II Simulations

2°-10°N,
0-400 m



Yuheng Tseng

Annual Precipitation from CMIP5 (1979-1999)



Oueslati and Bellon (2015, Clim. Dyn.)

Summary

- The majority of the tropical / Equatorial Pacific biases are persistent and likely linked to each other.
- They are usually attributed to deficiencies / biases in coupled model fluxes …… For example, zonal wind stress -> upwelling -> changes in SSTs -> convection and precipitation, etc. However, remains rather complex and inconclusive.
- As the modeling centers move from one CMIP to the next, there is often not enough time to go back and attempt to understand the origins of such biases.