

# QuikSCAT-based Evaluation of CMIP3 & CMIP5 models

*Tong Lee, Duane Waliser, Frank Li, and Michelle Gierach  
Jet Propulsion Laboratory, California Institute of Technology*

**CMIP:** Coupled Model Intercomparison Project under the World Climate Research Program in support of IPCC

**CMIP3:** for the Fourth Assessment Report (AR4) of IPCC (2007)

**CMIP5:** for the Fifth Assessment Report (AR5) of IPCC (2013)

## Motivation:

- Does CMIP5 improve upon CMIP3 relative to observations?
- How does the consistency (or diversity) among models change from CMIP3 to CMIP5?
- Lack of evaluation of CMIP models using global ocean surface wind stress observations.

## Analysis focus:

Annual mean & seasonal cycle in the late 20<sup>th</sup> century, background state that are important to simulated climate variability and to climate change projection.

# Observations and CMIP Models

## Observations:

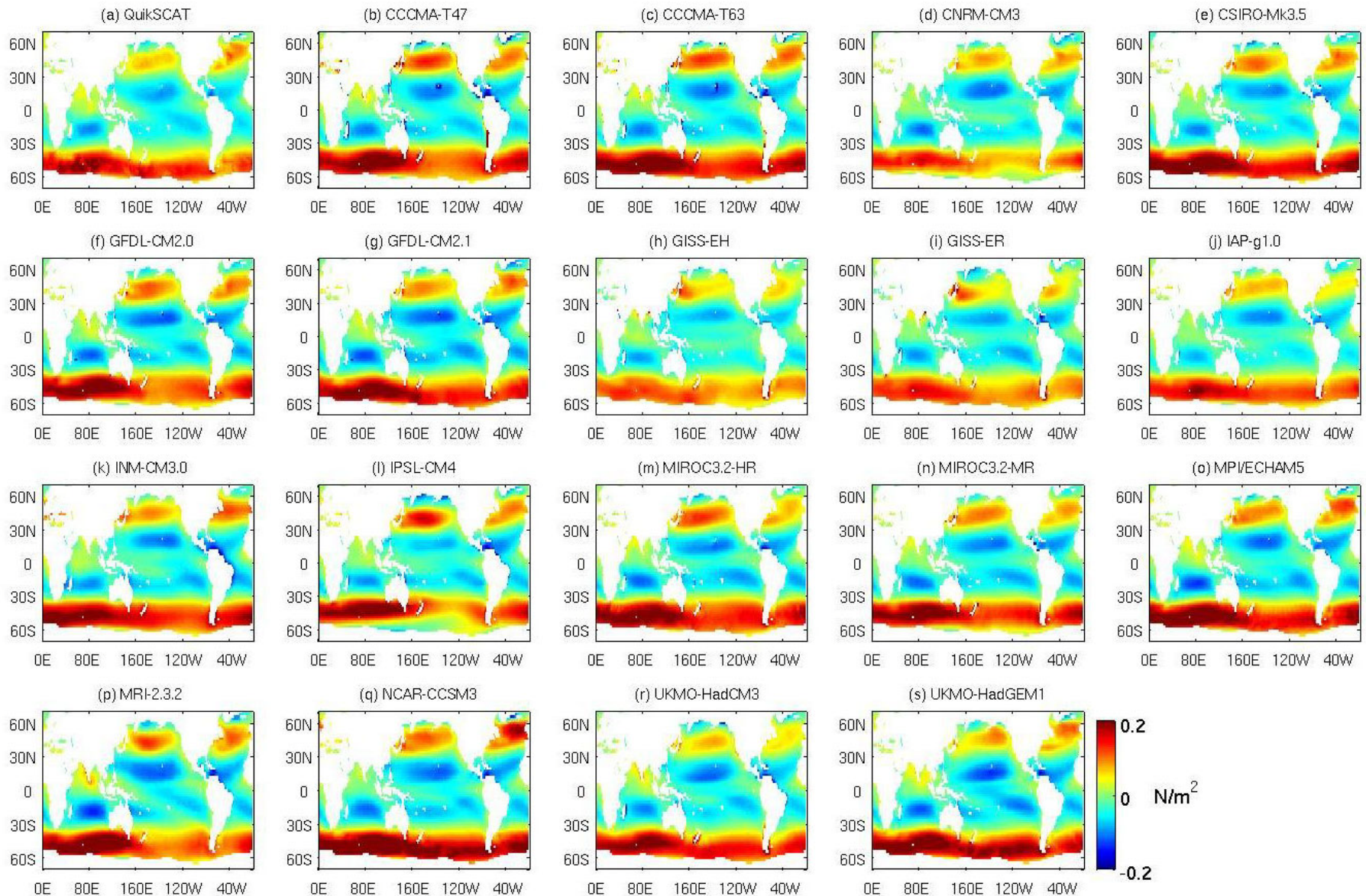
Scatterometer Climatology of Ocean Winds (SCOW) based on QuikSCAT data (1999-2007). Risien and Chelton (2008).

<http://cioss.coas.oregonstate.edu/scow/>

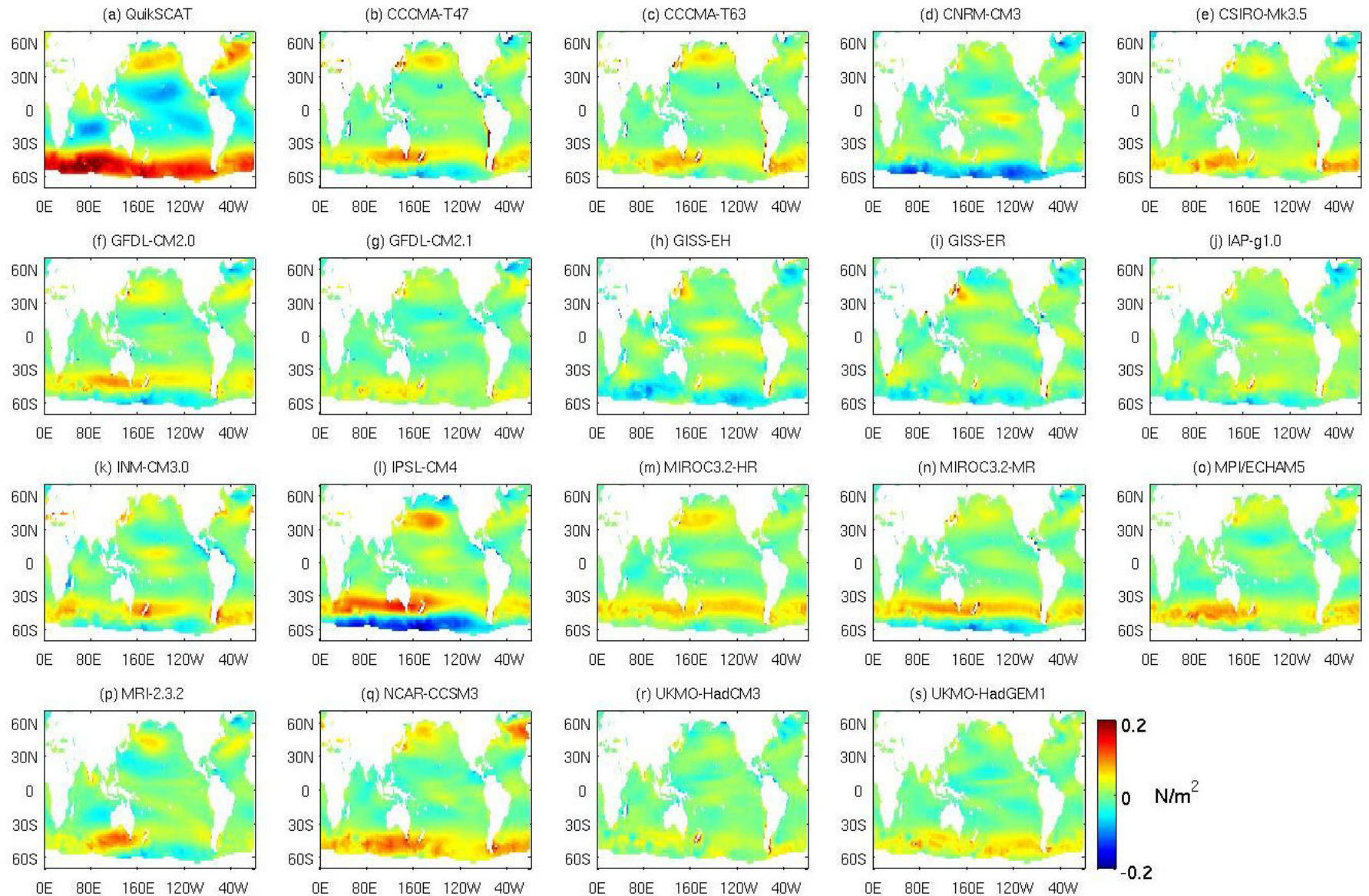
## CMIP Models:

18 CMIP3 and 11 CMIP5 models from 12 different countries, 1970-1999 climatology (most do not have complete QuikSCAT period)

# QuikSCAT & CMIP3 annual mean zonal wind stress



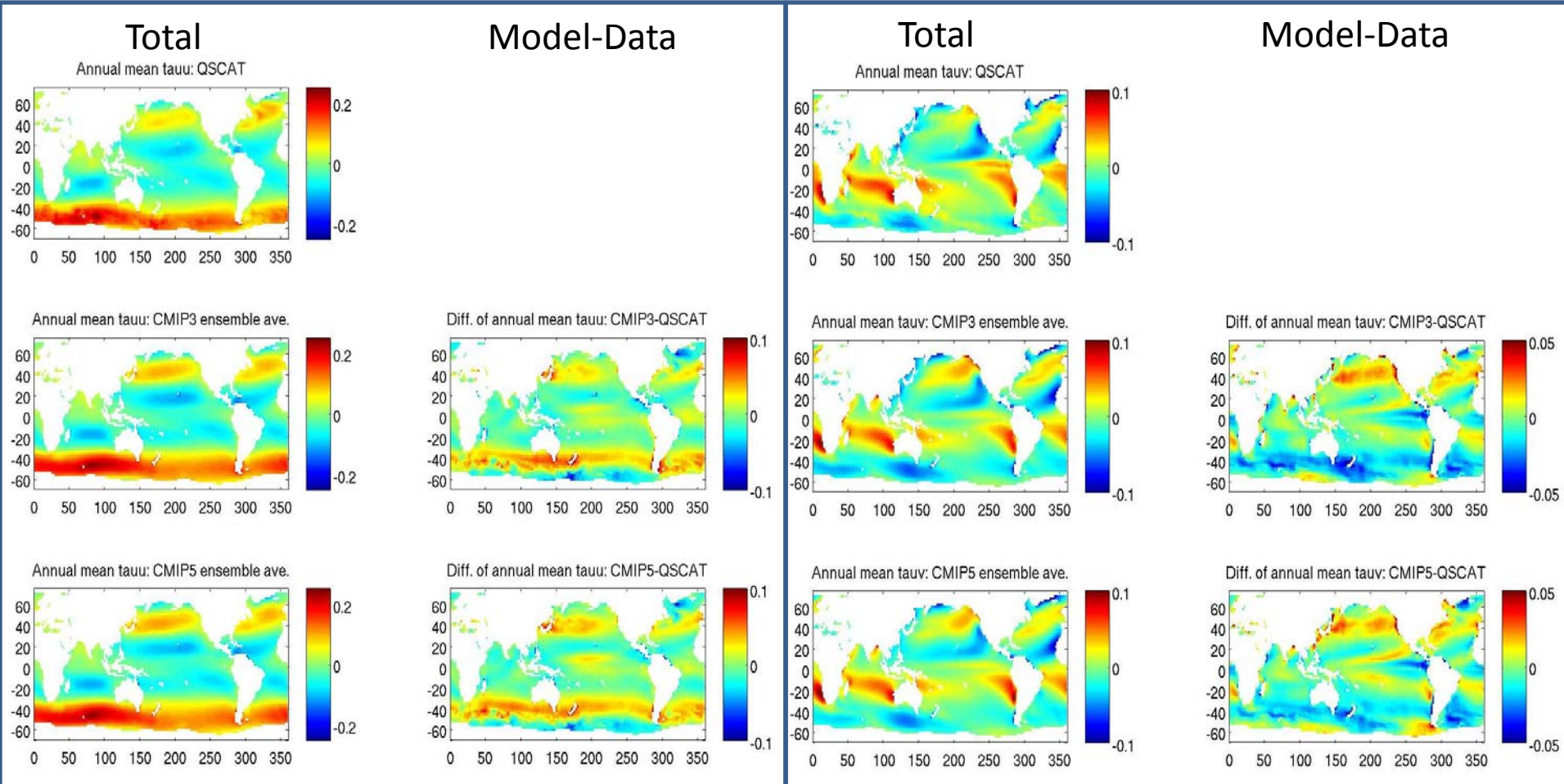
# QuikSCAT & CMIP3-QuikSCAT annual mean zonal wind stress



# QuikSCAT, CMIP3 and CMIP5 ensemble averages, and model-data differences: very similar between CMIP3 & CMIP5

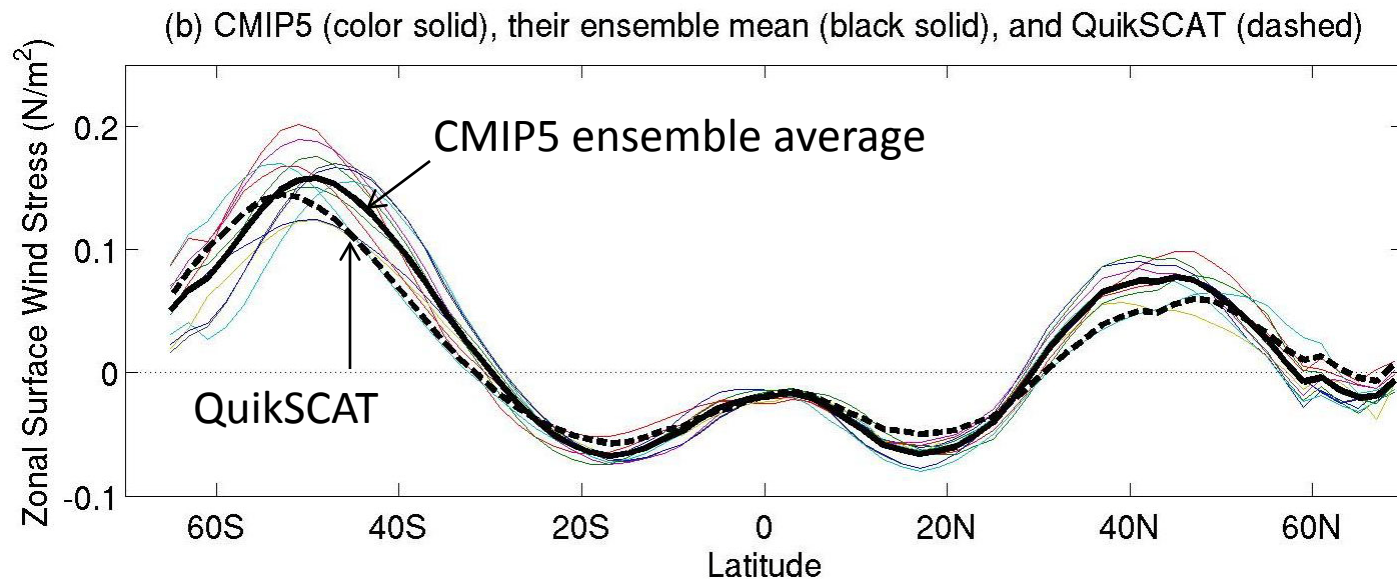
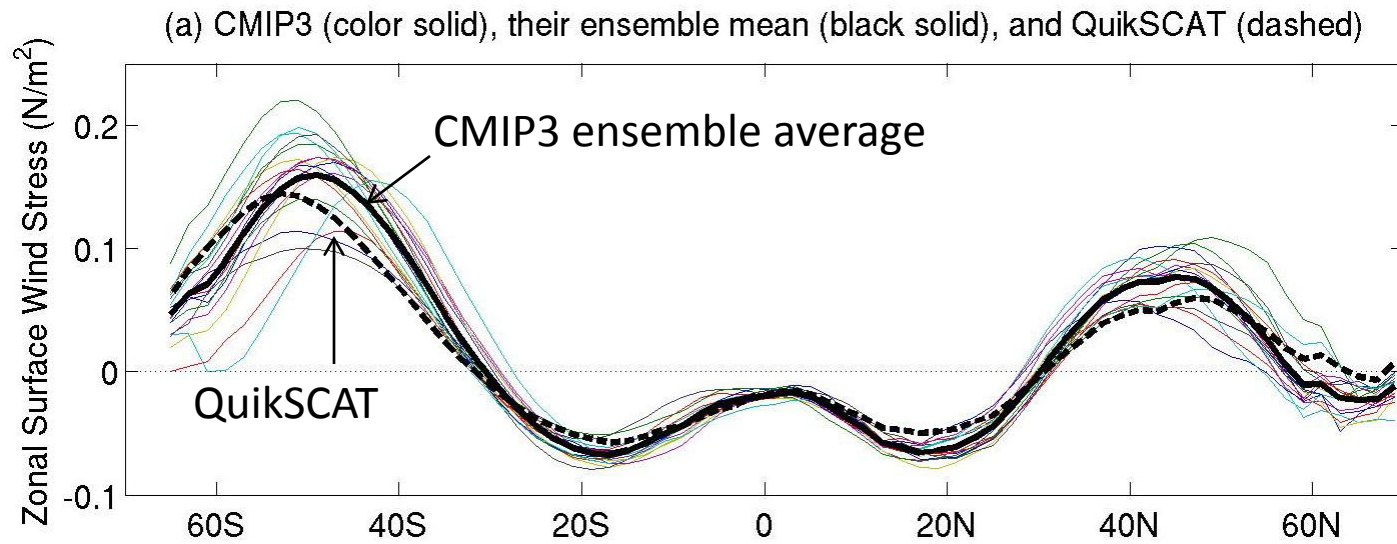
Zonal

Meridional

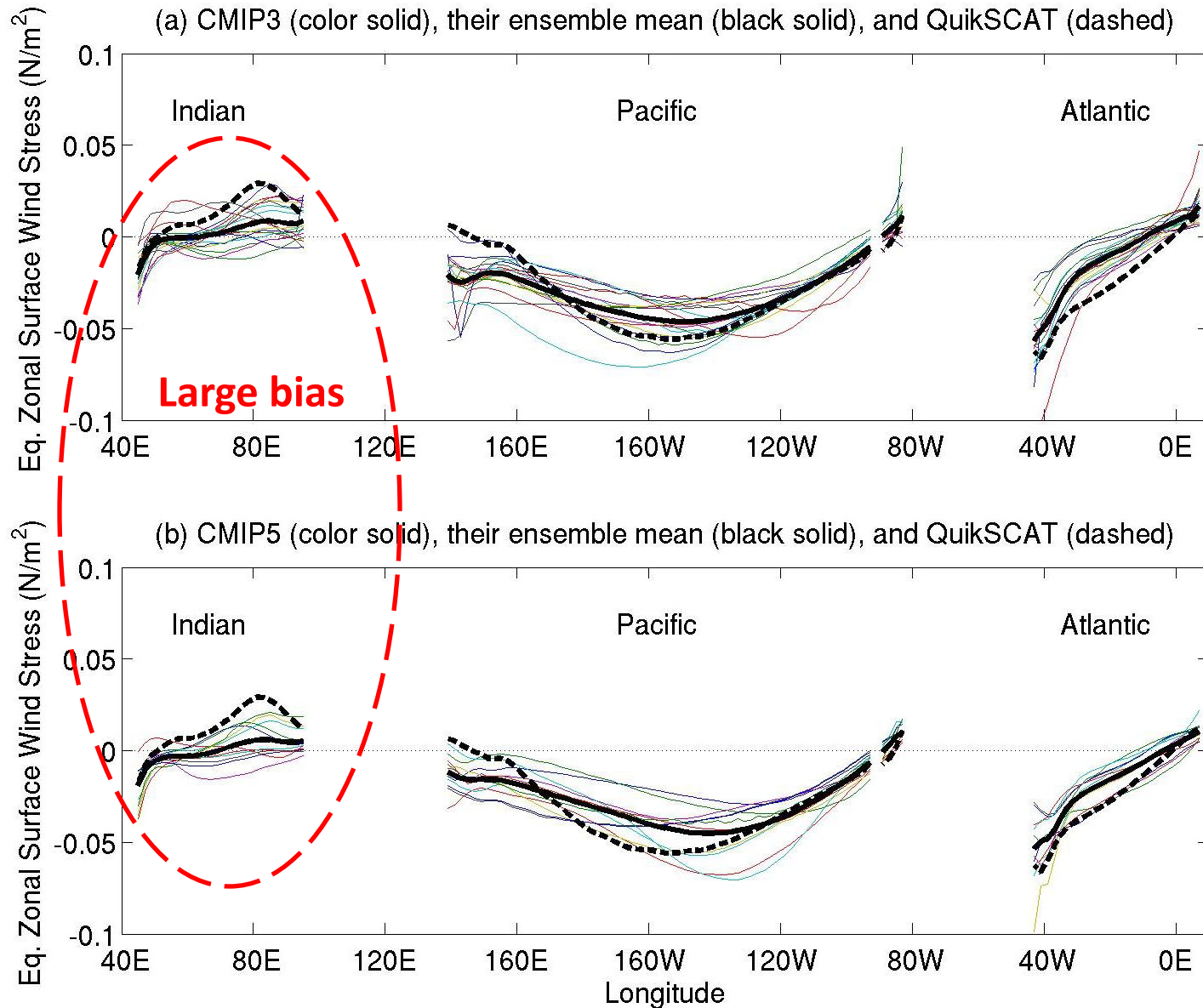


**CMIP models' mid-latitude westerly wind stress too strong**

# Zonally averaged zonal wind stress as a function of latitude: similar bias of CMIP3 & CMIP5 relative to QuikSCAT



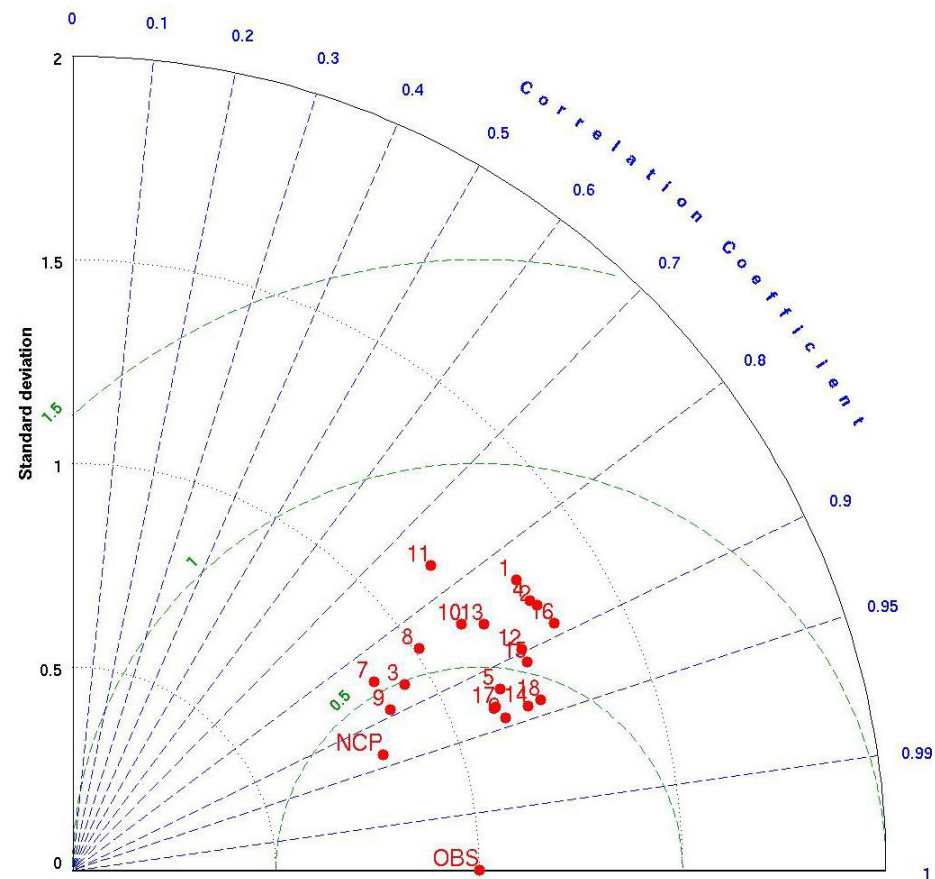
# Equatorial zonal wind stress (2°S-2°N average): Similar bias between CMIP3 & CMIP5 relative to QuikSCAT



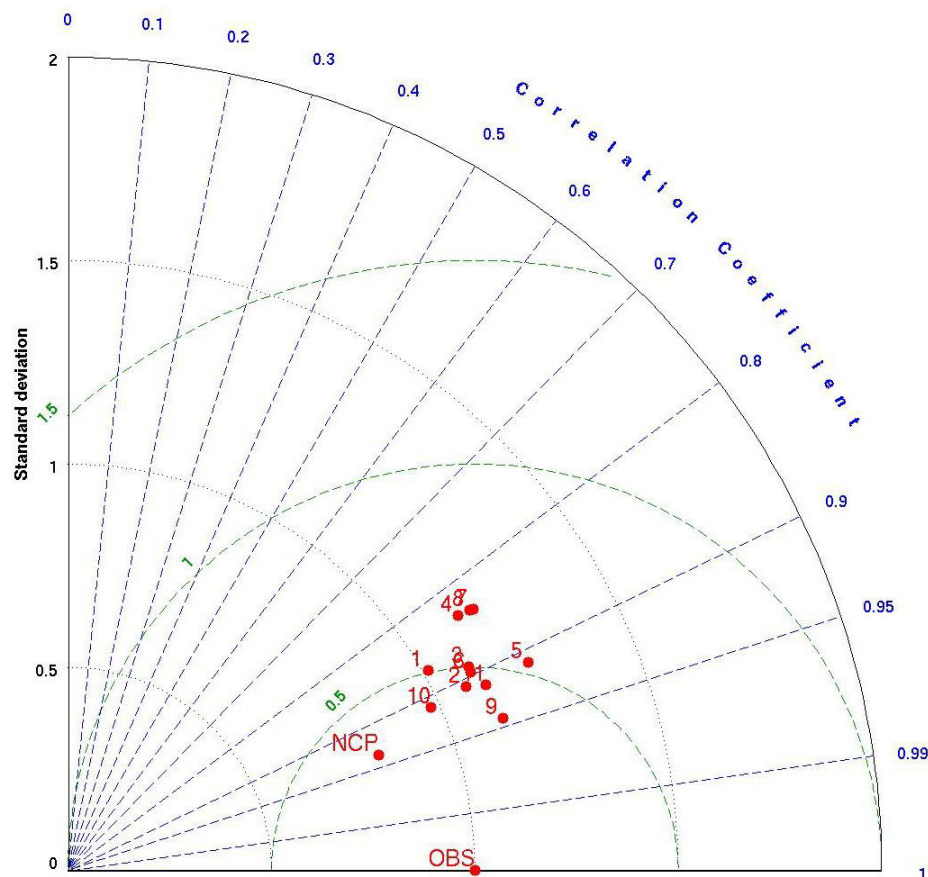


# Taylor Diagrams for annual mean spatial structure: CMIP3 & CMIP5 have similar spatial std. dev., correlation with observations, & distance from observations

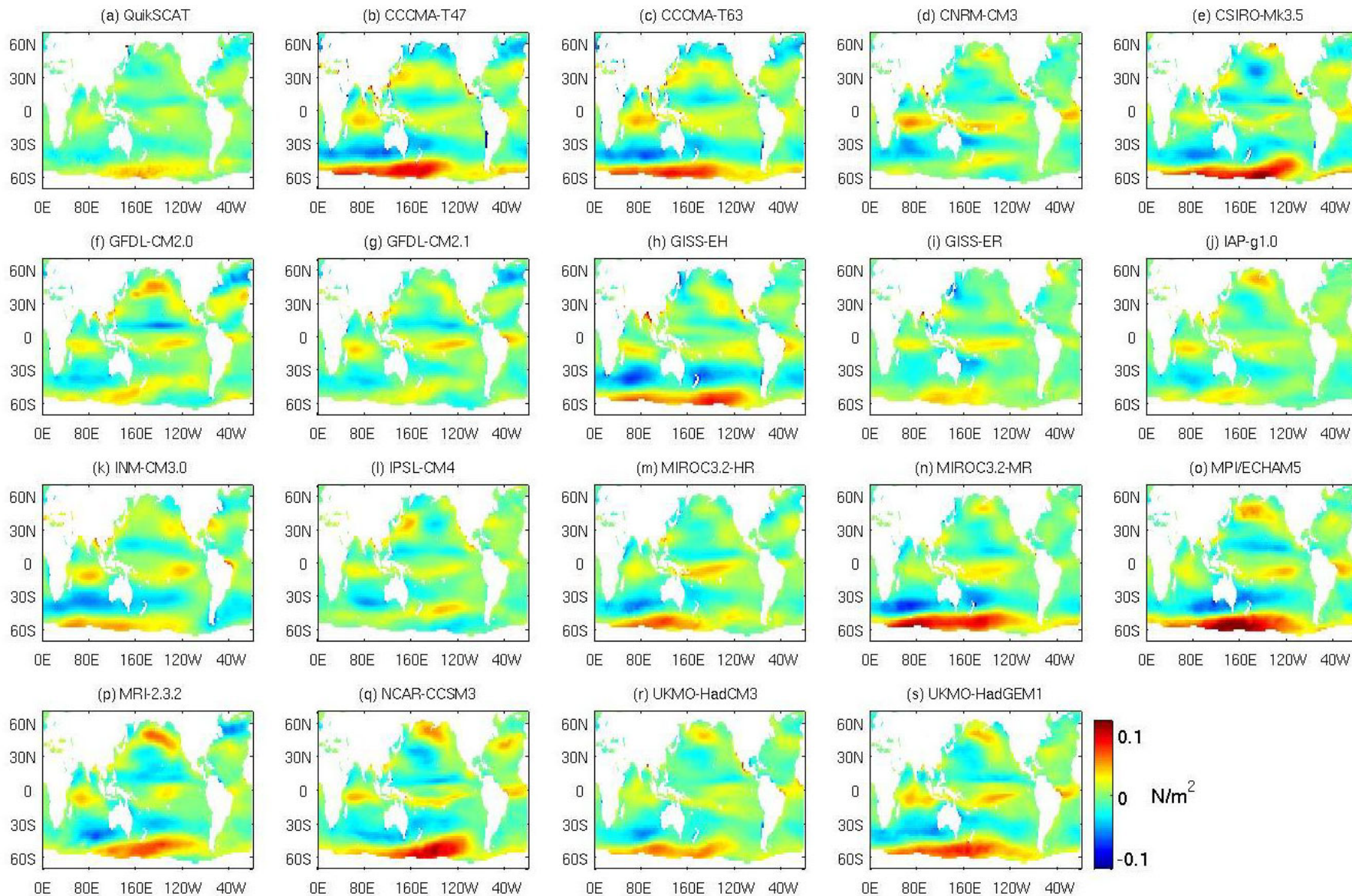
## CMIP3



## CMIP5

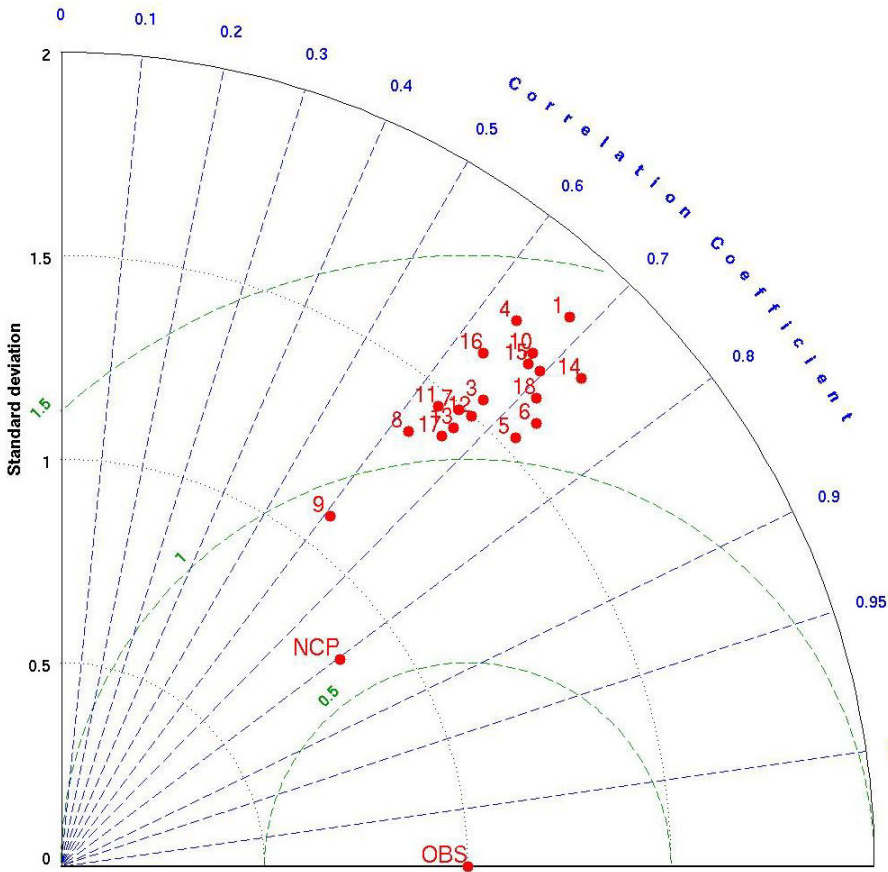


# Example of seasonal anomaly (April): CMIP models tend to have too large seasonal anomalies

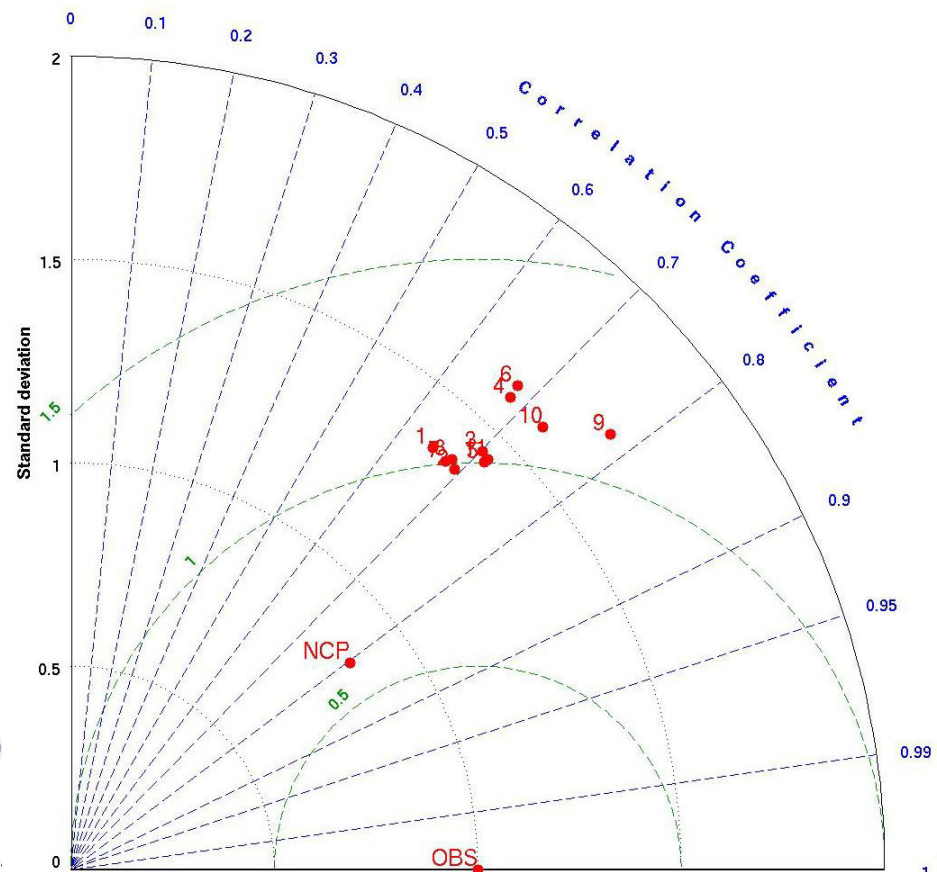


# Taylor Diagrams for seasonal (temporal) variability averaged over the global ocean: CMIP models' seasonal cycle too large

## CMIP3



## CMIP5



# Summary

- **CMIP3 & CMIP5 annual mean and seasonal cycle of ocean surface wind stress are very similar.**
- **CMIP models have too large a seasonal cycle.**
- **Lack of obvious improvement relative to QuikSCAT data.**

## **More details:**

- **CMIP models' mid-latitude westerlies too strong.**
- **Equatorial zonal wind stress too weak in Atlantic and Indian Ocean.**