QuikSCAT-based Evaluation of CMIP3 & CMIP5 models

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**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 20th century, background state that are important to simulated climate variability and to climate change projection.
Observations and CMIP Models

**Observations:**


**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

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

(a) CMIP3 (color solid), their ensemble mean (black solid), and QuikSCAT (dashed)

(b) CMIP5 (color solid), their ensemble mean (black solid), and QuikSCAT (dashed)
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
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.