Predictability and Model Verification of the Water and Energy Cycles: Linking Local, Regional and Global Scales

Principal Investigator: Duane Waliser

Science issue: Quantify our simulation and prediction capabilities of the water cycle and estimates of its predictability, considering regional to global scales.

Approach: Examine climate simulations and hindcast/forecast data sets from global models.

Satellite-based data: GPCP, CMAP, AIRS, ISCCP, GLDAS, OAFlux, TRMM, SSMI

Models: NOAA CFS, NASA GEOS-5, CMIP-3/IPCC

Analyses: NCEP, ECMWF

Study Period: 1979 and later for simulations and weather/short-term climate forecasts, 20th and 21st century for CMIP3/IPCC

NOTE: The late arrival of GEOS5 products has driven effort into other synergistic studies on the water cycle and climate variability (e.g, MJO).

Project status:

•Year 1 (past) –[1]Waliser et al 2007 examines the model-data and model-model agreement in the global water cycle in the climate model simulations assessed in the IPCC FAR. [2]Jiang et al 2007 quantifies empirical forecast skill of MJO precipitation.

•Year 2 (current) – [3]Examine NCEP CFS forecast fidelity and predictability of modeled water cycle terms. [4]Quantify water cycle associated with MJO from space-based observations.

•Year 3 (next): Explore prediction and predictability questions with GEOS5 and modeled global water cycle fideltiy with MERRA.

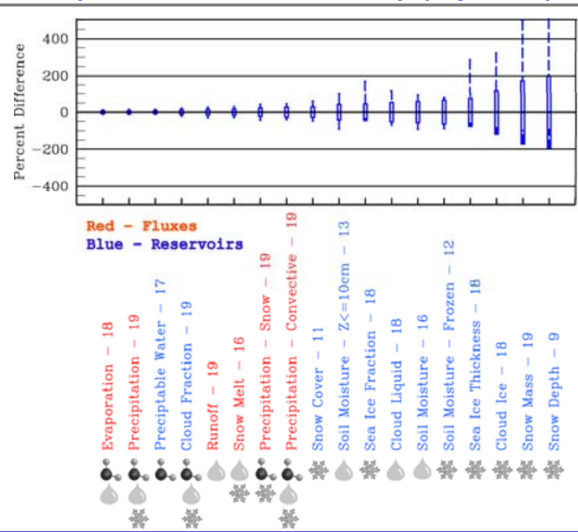
[1]Waliser, D. E., K. Seo, S. Schubert, E. Njoku, 2007: Global Water Cycle Agreement in IPCC AR4 Model Simulations, Geoph. Res. Let., 34, L16705, doi:10.1029/2007GL030675.

[2]Jiang, X., D.E. Waliser, M. Wheeler, C. Jones, S. Schubert, M.I. Lee, 2007: Assessing the Skill of an All-season Statistical Forecast Model for the Madden-Julian Oscillation, Mon. Wea. Rev., In Press.

[3]Jiang, X., D.E. Waliser, H.L. Pan, H. van den Dool, S. Schubert, 2008: Internannual prediction skill and predictability of the global water cycle in the NCEP Coupled Forecast System. J. Climate, In Preparation.

[4]Waliser, D. E., B. J. Tian, M. J. Schwartz, X. Xie, W. T. Liu, and E. J. Fetzer, 2008: The hydrological cycle of the Madden-Julian Oscillation: An estimate from satellite observations. Geophys. Res. Lett., In Preparation.

- Water Cycle quantities are ordered left -> right in increasing uncertainty.
- Fluxes (red) show better agreement than reservoirs (blue).
- Vapor ( ) and Liquid ( ) show better agreement than Frozen ( ) water.
- Taking the above into consideration, it can be seen that quantities that have robust observational constraints, in many cases from satellite, tend to exhibit less model uncertainty.
- The most uncertain water cycle components (e.g., snow, ice, cloud mass) represent key climate feedbacks.



Model-to-model agreement in globally-averaged, annual mean values of hydrological quantities from 1970-1994 of the 20th century AOGCM simulations assessed in the IPCC AR4.. Quantities are ordered in increasing model disagreement using the standard deviation. Horizontal labels consist of the variable name and the number of model contributions included. Font color indicates whether the water cycle component is a flux (red) or reservoir (blue). In addition, model variables are labeled with icons indicating whether the variable is associated with vapor (molecule), liquid (drop) and/or ice (snowflake).

NEWS linkages:

Contributes to NASA-MAP Subseasonal Project: PI S. Schubert.

Collaborate with W. Olson and W.K. Tao on MJO and Latent Heating Retrievals

Collaborate with T. Liu on MJO and Moisture Convergence Retrievals

Discussions with A. Schlosser and M. Bosilovich NEWS “core” projects….

Collaborate with H. Pan and H. van den Dool – NCEP CFS model forecast skill and predictability

Collaborate with GMAO - GEOS-5/MERRA simulation fidelity of the global water cycle

D. Waliser, Updated: June 11, 2008