Future Changes in Earth’s Hydrological Cycle

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Overview and Summary

Analyzing the Earth’s hydrological cycle requires the use of many tools and techniques. Here, we employ the CESM (Community Earth System Model) suite of models and scenarios to evaluate precipitation, evaporation-precipitation (E-P), and moisture transport. We find that increasing horizontal resolution affects transient moisture transport, in part, by resolving tropical cyclones.

Testing Timeslice Approach for CCSM4/CAM4

Does CAM4 reproduce the climate of CCSM4 when forced with CCSM4 sea surface temperatures? CAM4 forced with CCSM4 sea surface temperatures is able to produce a surface climate which compares very closely to the fully coupled climate simulation. Precipitation and E-P, key metrics when studying Earth’s hydrological cycle, are shown in the panels to the right. The furthermore panels show observations. The model is able to produce spatial precipitation and evaporation patterns that compare to observations. The CESM (CCSM4) standard one degree resolution was used for this analysis.

Moisture Transport

A breakdown of CAM4 moisture transport for the half degree resolution is shown in the leftmost panel. Comparison to the two degree resolution for transient eddies (center panel) shows increased transport with higher resolution. The ability to resolve tropical cyclones with the half degree model contributes to these changes. The precipitable water panel illustrates cyclones off both coasts of Australia as well as one off the Southeast Asian coast.

Future Climate Changes (RCP8.5 Scenario)

Changes in annual precipitation patterns and E-P from the RCP8.5 future climate scenario (years 2081-2100) are shown in panels to the right. Using the standard CCSM4 one degree model, subtropical Pacific Ocean desert areas get drier as do the South Indian and South Atlantic basins. Over land, the U.S. Southwest states show continued drying as the Southeast states continue to moisten. Running the model at higher resolution would be beneficial for the evaluation of regional effects. A CCSM4 half degree fully coupled 20th Century simulation as well as an RCP8.5 scenario are in progress.