ANNUAL TARGET:

FY09: Provide improved climate simulations on subcontinental, regional, and large watershed scales, with an emphasis on improved simulation of precipitation

Q1: Set up protocol and metrics for model-observation comparison

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1. Introduction

Climate model simulations are routinely and extensively compared with available observations. This serves to identify the relative strengths and weakness of different models or newer model versions, and ultimately contributes to building confidence in the reliability of simulations of past, present and future climate. Employing a broad spectrum of model diagnostics reveals model deficiencies, and sometimes provides insight into the root cause of model errors. Increasingly, models are being tested at regional scales – well known to be a much tougher test of model performance than traditional larger scale diagnostics.

The Community Climate System Model (CCSM) is a Coupled Ocean-Atmosphere General Circulation Model (OAGCM) sponsored by the National Science Foundation (NSF) and the U.S. Department of Energy (DOE). It is administratively maintained by the Climate and Global Dynamics Division (CGD) at the National Center for Atmospheric Research (NCAR). Simulations performed with the third major release of the model – CCSM3 – have been extensively evaluated (e.g., Collins et al., 2006), and are included in hundreds[1] of multi-model studies highlighted in the Fourth Assessment (AR4) of the Intergovernmental Panel on Climate Change (IPCC).

CCSM model developers are currently in the late stages of defining the next version of the community model, CCSM4. In the months ahead, it is expected that the first CCSM4 control runs will be performed. Using metrics of model performance, these initial CCSM4 experiments will be compared against previous model versions in an effort to quantify model improvements with an emphasis on simulated precipitation on regional spatial scales.

2. Model Evaluation Protocol

Model Simulations

Standard 20-year "present day" control simulations will provide the benchmarks. The CCSM3.0 used in the IPCC AR4 provides a benchmark simulation. The impacts of a finite volume dynamical core on regional precipitation will be examined by evaluating a revised version of CCSM3 (Bala et al., 2008). As the first control runs of CCSM4 become available, the regional precipitation evaluation will be revisited to document

[1] http://www-pcmdi.llnl.gov/ipcc/subproject_publications.php

changes in model performance. If available during this fiscal year, a higher resolution control run of CCSM4 will also be examined.

Variables and Observational Data

Emphasis will be on simulated precipitation, but surface air temperature will also be used to evaluate the CCSM simulations. For precipitation, the Global Precipitation Climatology Project (GPCP, e.g., Alder et al., 2004) will be used as the primary reference data. To provide a measure of observational uncertainty, an alternate precipitation data set (CMAP, Xie and Arkin, 1997) will also be used. The *CRUTEM3* surface (2 meter) temperature, prepared as a collaborative product of the Met Office Hadley Centre and the Climatic Research Unit at the University of East Anglia, will be used for temperature evaluation over land.

Analysis Domain

For consistency with previous research, sub-continental and regional scales will be evaluated in the domains defined in Chapter 11 (Regional Climate Projections) of the AR4 (IPCC, 2007). This includes multiple domains in Africa, Europe, Asia, North America, Central and South America, Australia and New Zealand, Polar regions, and small islands. Large watersheds will be determined by the configuration of the Community Land Model (CLM), the land-component of CCSM.

Model Performance Metrics

Many of the established climate model metrics used to quantify performance at large scales can also be applied at the regional level, relying on simple statistical measures such as the correlation, variance, and root-mean-square error (e.g., Taylor, 2001, Gleckler et al., 2008). Traditionally, metrics have emphasized the mean climate, but variability metrics have been gaining increasing attention. Model agreement with the spatial structure of precipitation data sets will be quantified at regional scales, as will as the amplitude of variability on monthly to inter-annual time scales. Distilling model performance down to a diverse collection of simple metrics in this way will provide an examination of the relative performance of simulated precipitation at regional scales in different versions of CCSM.

3. References

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