Fine-resolution Global Climate Model for Water-Energy Nexus

U.S./China Clean Energy Research Center – Water/Energy Technologies (CERC-WET) Topic Area 4: Climate Impact Modeling, Methods, and Scenarios to Support Improved Energy and Water System Understanding


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Motivation

The goal is to improve meteorological inputs to regional analyses of water and energy resources through modeling and evaluation. The team used models to produce different sets of atmospheric and hydrological variables that will be subject to analyses of extremes, hydropower, groundwater, and impacts on power plants and electricity production for the recent historical record and future projection of next several decades.

Technological Challenges

The accuracy of inputs to regional hydrological and energy analyses is limited by large uncertainties across and within downscaling methods, and subject to additional uncertainty across the outputs of global climate models (GCMs). The primary challenge of downscaling is to convert conditions representing a large area into an accurate representation of finer spatial heterogeneity.

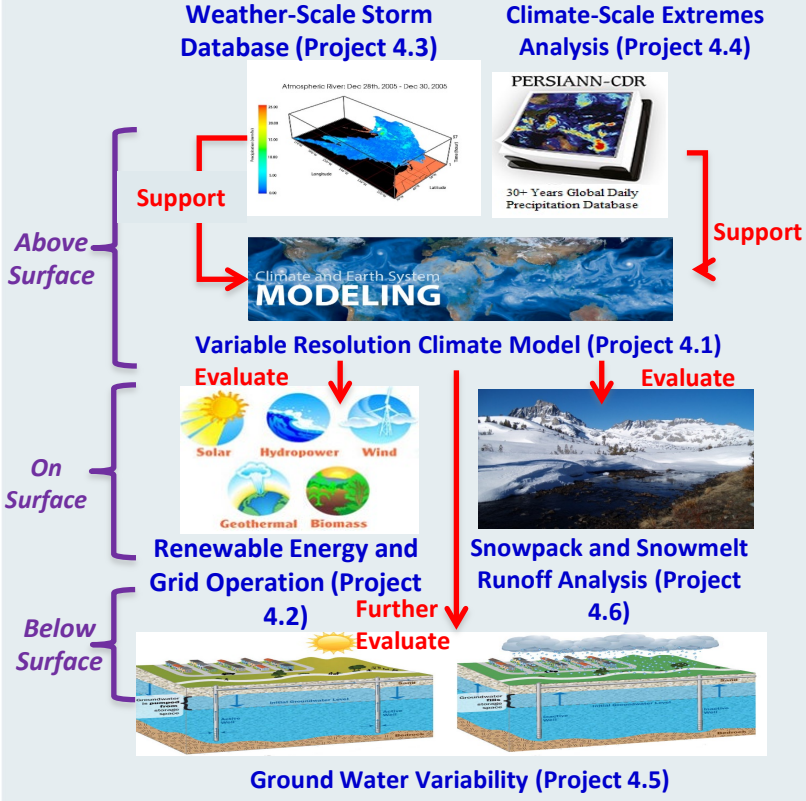

Figure 1. Structure of CERC-WET Topic 4 projects

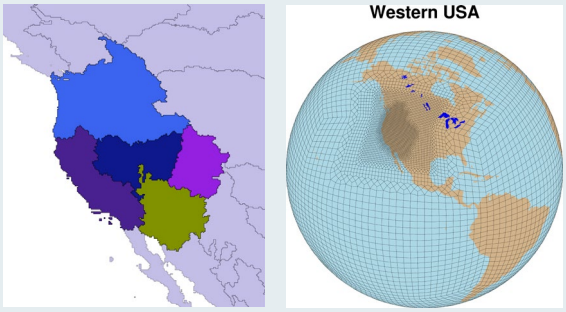

Figure 2. Map of the five major watersheds and 14 km resolution refinement grid in the western U.S.

Research

The effectiveness of a new, variable-resolution climate model is evaluated to provide fine-resolution outputs for the western U.S. and eastern China. We performed variable resolution CESM simulations with14 km resolution in the regions of interest for an historical (1970-2006) and a projection (2006-2050) period[1]. Simulations generally match well with reanalysis datasets (e.g., PRISM and PERSIANN-CDR) but with cold bias in the mountains and dry bias overall. Nonetheless, these precipitation outputs are more accurate than post-downscaled climate model data.

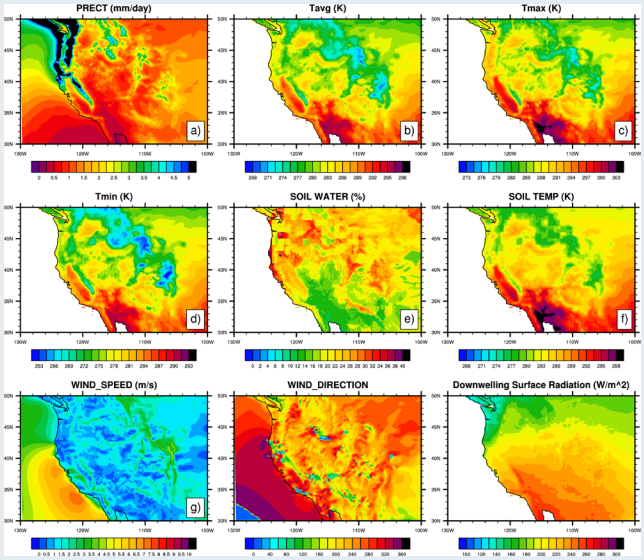

Figure 3. Annual climatological average of Selected hydroclimate variables outputs from VR-CESM simulation in the western U.S.