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Can high resolution climate simulations with the Community Atmospheric Model (CAM) offer a new perspective on 21st century mitigation scenarios ?

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Present-day climate simulations using the Community Atmosphere Model (CAM) show that some aspects of the simulated climate are improved in response to increased horizontal resolution (Bacmeister et al, 2014). Increased resolution allows us to explicitly resolve tropical cyclones (TC) and study TC statistics. Present-day climate simulation with CAM5 at 25 km captures TC statistics reasonably well, suggesting that CAM5 is a good candidate to look at these storm statistics in a changing climate. Other features of the present-day simulation with CAM5 at 25km also clearly improve due to better representation of topography or better simulation of regional circulations. This is the case for the Summer Indian Monsoon and the wintertime precipitation over the Southeast United States. Despite these improvements, it is important to note that some aspects of the simulation do not improve and even deteriorate. For instance, the double ITCZ is exacerbated and large biases in summertime precipitation over the central US remain.

Because the high resolution simulation is more realistic in terms of reproducing intense storms and fields strongly influenced by the topography or regional circulation, they offer a new perspective to look at these aspects for the twenty-first-century representative concentration pathway (RCP). A major objective for running these higher resolution RCP scenario experiments is to provide more detailed information as to the difference in mitigation cost between scenarios.

Here we examine time-slice simulations of the end of the 20th and 21st centuries (using the RCP4.5 and RCP8.5 scenarios). We use 20-year uncoupled simulations with CAM5 at 25 km using prescribed sea surface temperatures (SSTs) and sea-ice extent. For the 20th century run, prescribed SSTs and sea-ice are coming from observations. For the 21st century, SSTs and sea-ice are extracted from RCP fully coupled runs at lower resolution and are corrected by the present-day model bias. We assess how the TC statistics, Indian monsoon and Southeast US precipitation change as the global climate changes. We discuss the differences between the RCP scenarios and the eventual benefits and costs of the RCP4.5 compared to RCP8.5. Such information should prove invaluable in determining how linear (or otherwise) mitigation costs increase between the two RCP scenarios examined here.

Reference: J Bacmeister, M F Wehner, R B Neale, A Gettelman, C Hannay, P H Lauritzen, J M Caron and J E Truesdale (2014). Exploratory High-Resolution Climate Simulations using the Community Atmosphere Model (CAM). Accepted for publication in J. of Climate ; doi: http://dx.doi.org/10.1175/JCLI-D-13-00387.1