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Regional Arctic Climate Model (RACM): Overview and selected results

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Global climate models have relatively limited skill in representing the current and past state of the Arctic, which undermines their predictions of future arctic climate change. Some of the most significant problems include sea ice area and thickness distribution, northward fluxes of heat and moisture, export of freshwater into the North Atlantic and the evolution of cryosphere components. Such errors arise from many sources including inadequate representation of polar climate processes and coarse model resolution. On the other hand, the majority of existing regional higher resolution Arctic models do not account for important sea-ice-atmosphere feedbacks. They either simulate the atmospheric state using simplified lower boundary conditions for sea ice and ocean or predict sea ice-ocean variability using prescribed atmospheric forcing. However, many of these processes and feedbacks impose critical controls on both regional Arctic and on global climate variability and their realistic representation requires dedicated high-resolution modeling studies to improve climate predictions. One way to address these shortcomings is through the use of an Arctic-focused regional climate system model, which allows for increased spatial resolution, improved model physics optimized for polar regions, retrospective simulations and the use of "perfect" lateral boundary conditions. We have developed a regional Arctic climate system model (RACM) that couples existing off-the-shelf atmosphere, ocean, sea ice, and land component models. The atmospheric model used in RACM is a version of the National Center for Atmospheric Research (NCAR) Weather Research and Forecasting (WRF) model that has been optimized for polar regions. The ocean and sea ice models are the same as those used in the NCAR Community Climate System Model (CCSM3), although used on a regional domain: the Los Alamos National Laboratory POP ocean model and CICE sea ice model. Land surface processes, snow cover and hydrology are represented by the Variable Infiltration Capacity (VIC) model. These four climate system component models are coupled using the NCAR CCSM coupler CPL7. The simulation domain of RACM covers the entire pan-Arctic region and includes all sea ice covered regions in the Northern Hemisphere and all terrestrial drainage basins that flow into the Arctic Ocean. This poster will provide an update on the current status of RACM, show some results from fully coupled simulations, and present plans for future RACM development that will include ice sheet modeling and dynamic vegetation.