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Fully-coupled fine-resolution CCSM simulations: A prototype and advancements.

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A suite of fully coupled multi-decadal global simulations using the Community Earth System Model (CESM) framework is underway using coarse (standard climate model resolution) and fine-resolution (weather-scale and largely eddy resolving) components whose goal is to explore the effects of component resolution and the choice of initial state. These simulations build on a prototype 20-year fully coupled global CCSM simulation whose grid resolutions were 0.1-degree for the ocean and ice, and 0.25-degree for the atmospheric and land components. The component models were the Los Alamos Parallel Ocean Program 2.0 (POP2.0) and CICE4.0, and the Community Atmospheric Model 3.5 (CAM3.5) and the Community Land Model 3 (CLM3). The finite volume dynamical core was used in CAM3.5. The model realistically developed intense category 4 tropical cyclones and the resulting upper ocean response. Also, the model realistically reproduced the structure and pathways of explicitly resolved Agulhas ocean eddies, the main constituent of the upper limb of the Atlantic meridional overturning circulation. However, the Polar atmospheric vortices were excessively contracted and intensified, producing cold sea surface temperature biases and excessive ice cover in the Northern Hemisphere. Here we compare these results with those from CCSM simulations using a Eulerian Spectral dynamical core with either T341 or T85 spectral wavenumber truncations and 0.1-degree ocean/ice components. Additionally we explore the impact of using ocean/ice states from an equivalent forced global 0.1-degree ice/ocean model and from the prototype CCSM simulation as initial conditions for these follow-on simulations.