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Embedding a high resolution regional ocean model of the North-East Pacific in a coupled Global Climate Model

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This is a study of the regional atmosphere-ocean interactions, and the global ramifications, that result from a more accurate treatment of eastern boundary coastal upwelling regions in a fully coupled global multi-scale climate model. The nested Regional Climate Model (nRCM) has been implemented in the Community Climate System Model (CCSM) framework. Here the Regional Ocean Modeling System (ROMS) is used for an inner ocean nest, which receives (one-way) forcing from the global Parallel Ocean Program (POP) model. The sea surface temperature from ROMS and POP is merged and sent to the CCSM coupler to interact with the global Community Atmosphere Model (CAM), as well as the ice and land models. A pair of 150 year simulations have been performed: one a control case with the standard CCSM (version 3.1) global model, and another using the nRCM framework, with the ROMS domain covering the north-east Pacific. Regionally, the inclusion of ROMS leads to a large impact. Upwelling is enhanced in a narrow 10-20km strip next to the California/Oregon coast in the nRCM, introducing a cool sea surface temperature anomaly of 1-2^{o}C in an area where climate models typically have warm biases. The sea level pressure is also affected, with a subtropical high anomaly all year round, and a deepening of the Aluetian low in winter and spring. There are also more distant responses, including an anomalous southward cross-equatorial flow and southward shift of the ITCZ in the Pacific, and a large scale warming of the North Atlantic. However, the limitation of one-way forcing in the ocean adversely affects the spreading, and the magnitude, of the response. Thus current research is to implement a simple two-way interaction between the ocean models. If available, new results from the nRCM incorporated into the latest Community Earth System Modeling framework (CESM), will be shown. Eventually the nRCM will be used to explore the evolution of upwelling regions under projected climate change scenarios, including ecosystem and biogeochemical models.