A COUPLED OCEAN-ATMOSPHERE DOWNSCALED CLIMATE PROJECTION FOR THE PENINSULAR FLORIDA REGION

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A downscaled projection over the Peninsular Florida (PF) region is conducted with a Regional Climate Model (RCM) at 10km grid spacing that incorporates interactive coupling between the atmosphere and ocean components of the climate system. This is first such application of a coupled ocean-atmosphere model for climate projection over the PF region. The RCM is shown to display reasonable fidelity in simulating the mean current climate and exhibits higher variability both in the ocean and in the atmosphere than the large-scale global model (Community Climate System Model version 4 [CCSM4]), which is used to drive the RCM. There are several features of the regional climate that RCM displays as an improvement over CCSM4: upper ocean thermal stratification, surface eddy kinetic energy of the ocean, volume flux through the Yucatan Channel, and terrestrial rainfall over PF. The projected mean hydroclimatic change over the period 2041-2060 relative to 1986-2005 over PF shows significant difference between RCM and CCSM4, with the RCM becoming significantly drier and CCSM4 moderately wetter. Furthermore, over the ocean surface, especially over the West Florida Shelf (WFS), RCM displays a wetter and a warmer surface climate compared to the CCSM4 simulation.

Our analysis of the model output indicates that owing to far improved resolution of ocean bathymetry in the RCM relative to CCSM4, the response in projected changes in surface heat flux, clouds, upper ocean circulations and upper ocean stratification especially over the shallower parts of the ocean around PF respond differently. This contrast is most apparent between WFS and PF in the RCM simulation, which suggests that a future warm climate would likely produce more rain over WFS at the expense of corresponding reduction over PF, contrary to the absence of any such gradient in the CCSM4 simulation. Furthermore, in the RCM simulation, the warming of the sub-surface ocean in the future climate is owed to the combined influence of excess atmospheric heat flux directed towards the ocean from the atmosphere and the advective heat flux convergence with the relative slowing of the Loop Current in the future climate. The study demonstrates that such RCMs with coupled ocean-atmosphere interactions are necessary to downscale the global climate models to project the surface hydro-climate over regions like PF that have mesoscale features in the ocean, which can influence the terrestrial climate.