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Dynamical downscaling of historical climate over CORDEX Central America domain with a regional ocean-atmosphere coupled model

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The climate in Mexico and the Central America region is influenced by a multitude of physical factors that include oceanic conditions from both Pacific and Atlantic sides, and atmospheric conditions over the large land masses of North and South America continents. These factors together with important ocean-atmosphere coupled processes occurring in the region result in a climatic system that represent a great challenge for both global and regional climate modeling. To identify the added value that regional climate models may introduce in the representation of the climate of this region and to understand the role of the ocean-atmosphere coupling, we explore a set of coupled and uncoupled present-time regional climate model (RCM) simulations forced by both reanalysis and global model data. When compared with the driving global model, both coupled and uncoupled simulations improve the representation of the regional climate, including a significant reduction of the summer rainfall bias that partly results from a misrepresentation of the Caribbean Low-Level Jet (CLLJ). This improvement is a consequence a better representation of the moisture flux convergence resulting from a higher horizontal resolution of the regional model. Further improvements in the representation of the spatial pattern of the CLLJ are obtained in the coupled configuration, which also reduce the warm bias in the Northeastern tropical Pacific that characterizes the driving fields of the coupled global climate model. Despite the high resolution and the coupling, the regional modal do not improve the cold sea surface temperature (SSTs) bias that characterize the Caribbean region in the global model. These colder SSTs have both positive and negative effects: on one hand, they strengthened the North Atlantic subtropical high (NASH), which improved the representation of the moisture influx over Central America; On the other hand, the colder SSTs suppressed surface evaporation and favored the weakening of the local interannual variability in the SST. Like for the CLLJ, we found a significant improvement in the representation of the Mid Summer Drought in the regional coupled configuration. Overall, this configuration showed good performance in the representation of the rainfall over the land areas and the large-scale circulation over the whole domain.