Predicting the impact of anthropogenic climate change on physical and biogeochemical processes in the northern Gulf of Mexico

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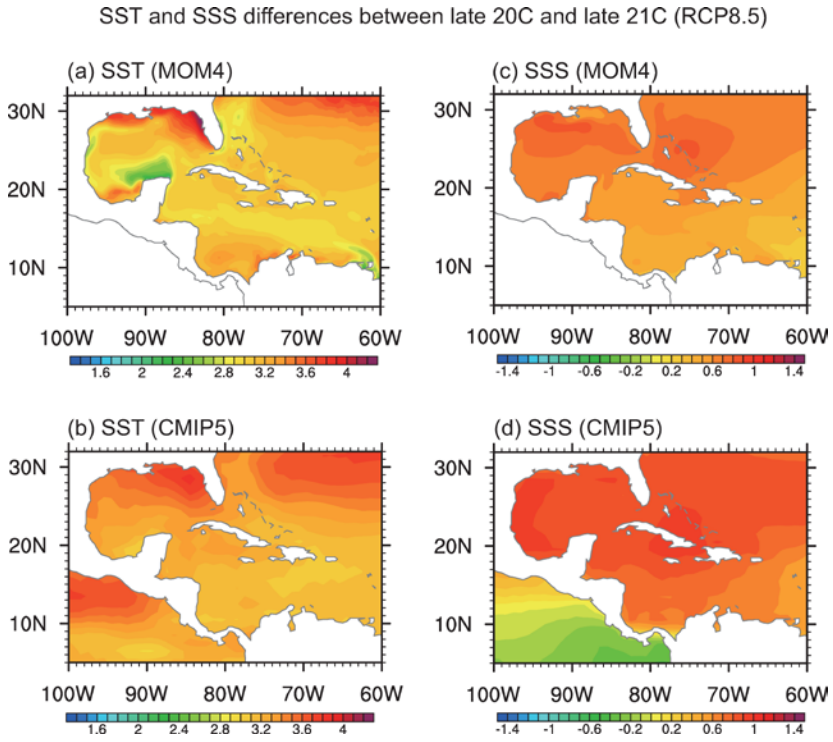
Recent studies examined the potential impact of anthropogenic greenhouse warming on the Intra-Americas Sea (IAS, Caribbean Sea and Gulf of Mexico) by downscaling the Coupled Model Intercomparison Project phase-5 (CMIP5) model simulations under historical and future CO_2 emission scenarios using an eddy-resolving resolution regional ocean model. The simulated volume transport by the western boundary current system in the IAS, including the Caribbean Current, Yucatan Current and Loop Current, reduced by 20-25% during the 21st century, consistent with a similar rate of reduction in the Atlantic Meridional Overturning Circulation. The projected weakening of the ocean circulation in the Gulf of Mexico (GoM) suggests that the shallow (≤ 180 m) northern shelf of the GoM may experience lower rates of upwelling from deep cool water onto the shelf and toward the coast. Consistent with this hypothesis, the downscaled model predicts an intense warming over the northern shelf of the GoM especially during boreal summer. This warming trend can have several implications for the region, which borders the US states of Texas, Louisiana, Mississippi, Alabama and Florida. For one, this may increase the chance for hurricane intensification during landfall in the northern and eastern Gulf. The warming may also have a deleterious impact upon one of the richest fishing grounds in the US, exposing marine life living in the northern Gulf of Mexico shelf regions, such as fish, shrimp, marine mammals, and turtles as well as coral reefs and sponges, to increasing frequency of thermal stress and hypoxia. The main objective of this project is to provide a range of realistic scenarios of future environmental changes in the region for the research community and fisheries resource managers. To achieve that goal, this project aims to use a high-resolution regional ocean-biogeochemistry model to downscale the CMIP5 model projection of the carbon and biogeochemical parameters along the northern GoM for the 21st century.



SST differences in the IAS between the late 21st century (2090 ~ 2098) and late 20th century (1990 ~ 1998) during the boreal summer months of ASO obtained from (a) the downscaled MOM4.1 simulation and (b) the weighted ensemble of 18 CMIP5 models simulations. Annual mean SSS difference in the IAS between the late 21st century and late 20th century obtained from (c) the downscaled MOM4.1 simulation and (d) the weighted ensemble of 18 CMIP5 models simulations. The units for temperature and salinity are °C and psu.