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Seasonal evolution of IOD and its sensitivity to the mean state in the HiGEM High Resolution Coupled Climate Model

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The Indian Ocean Dipole (IOD) is a major mode climate variability over the tropical Indian Ocean and surrounding region. Understanding the seasonal evolution of the IOD and its interaction with ENSO events is vital for the study of climate variability over the tropical Indian Ocean and surrounding land masses.
Examination of the seasonal evolution of positive IOD events in HiGEM shows a delay in its initiation and termination with respect to an observed positive IOD composite. In the HiGEM positive IOD composite, SST anomalies in the eastern equatorial Indian Ocean (EEIO) are colder and extend further west associated with excessive easterly winds over the equatorial Indian Ocean when compared with its observed counterpart. We suspect these biases are due to biases in model mean state. To investigate the sensitivity of the seasonal evolution of the IOD to the representation of the mean state, coupled ensemble experiments have been conducted for selected positive IOD and neutral years chosen from a long control integration of the model. These experiments have been repeated for the chosen positive IOD and neutral years by applying a monthly varying correction to the ocean windstress over the equatorial Indian Ocean, in order to attempt to reduced the coupled bias. By comparing the difference between positive IOD and neutral year experiments with and without applying corrections, we note that in the windstress corrected integration the strength of the cold SST anomaly in the EEIO is reduced considerably, while the integration without windstress correction showed similar biases to the HiGEM positive IOD composite event generated from the long control run. This leads to more realistic looking initiation and termination in the windstress corrected run. In uncorrected runs, the equatorial easterly windstress during boreal autumn (SON) can upwell cold subsurface waters very easily as the EEIO thermocline during this season is overly shallow in the model. This will establish a stronger Bjerknes feedback in the model, which is itself stronger during positive IOD events. This feedback is one of the reasons for the colder EEIO SST anomalies and stronger easterly windstress anomalies in HiGEM during a positive IOD event. From the two ensemble experiments, it is also noted that ENSO SST anomalies play an important role in the predictability of east-west SST gradient along the equatorial Indian Ocean.