

Simulating a DYNAMO case: sensitivity to lateral boundary conditions, SST forcing, and cumulus scheme's modifications

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Regional numerical models struggle with an accurate representation of the Madden Julian oscillation in cases of study. Results from regional model simulations are often highly dependent upon physical parameterization, especially to planetary boundary layer, cumulus and shallow cumulus schemes, due to the wide range of closures and assumptions. Modifications of entrainment rates in the Tiedkte cumulus scheme appear to improve MJO simulations in global models. These changes are applied to the WRF model for the second MJO event during DYNAMO.

The initial conditions, the lateral boundary conditions, and bottom or SST forcing also play an important role in the success of the MJO simulation. However, the scientific community has not yet reached a consensus regarding whether or not the MJO structure for a particular case of study benefits from having updated versus constant sea surface temperatures or from constant versus time-dependent lateral boundary forcing, especially for the convection.

In order to isolate the individual responses to each one of these factors, real simulations of an MJO case of study during DYNAMO are shown in which the MJO initiation and development is influenced by the lateral boundary conditions, sea surface temperature forcing, and modifications of the cumulus scheme. The simulations were performed within a regional domain over the Indian Ocean using the WRF model. Three cumulus schemes with different combinations of planetary boundary layer and radiation schemes were tested for a total of 28 simulations.

How well the model represents the MJO precipitation and dynamical fields is quantified by a case-specific MJO index. This index is based on the propagation speed, phase and strength of the MJO. The results are compared with observations, reanalysis data, and ECMWF forecasts from the DYNAMO field campaign.