ECMWF and GFS Forecasts During DYNAMO: Model Representation of Multiscale Variability and MJO Initiation

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One of the main goals of DYNAMO is to improve prediction of the Madden-Julian Oscillation (MJO), especially during initiation. Successfully predicting the MJO may lead to improved prediction of downstream weather systems, including tropical cyclones, droughts, floods, and heat waves. Currently, it is not know whether the predictability of the MJO is ultimately determined by error growth from smaller scale or basin-scale and planetary-scale processes.

The main objective of this study is to better understand global model prediction of MJO by examining the ECMWF and GFS model forecasts during DYNAMO. The performance of the model predictions of multiscale variability in MJO is quantified by comparing with observations. Specifically both model forecasts and observations are analyzed using a spatial 2-D Lanczos filter. Three spatial scales are considered: Mesoscale (< 500 km), large-scale (1000-2500 km), and basin-scale (>2500 km). Basin scale represents the overall large-scale MJO. The model forecast errors are then compared with baseline "persistence forecasts," in which the model initialization is used at all forecast times, instead of the actual model forecasts. The variables used to determine the forecast errors include zonal winds at 850 hPa and 200 hPa and rainfall. The model can be said to lose predictability when the forecast error grows comparable to the persistence errors. In that case, the model is not providing additional skill. Because error growth depends on scale, the predictability limit depends on the scale of the phenomenon of interest.

Overall, the ECMWF forecasts had smaller forecast errors than the GFS forecasts at corresponding lead times. At the mesoscale, predictatability was lost quickly, while some degree of large-scale and basin-scale predictability is maintained through 15 days, especially in ECMWF.