The Madden-Julian Oscillation (MJO) is among the most important sources of predictability at subseasonal time scales. It modulates the statistics of tropical cyclones across multiple ocean basins during summer and can alter the mid-latitude circulation resulting in substantial pattern changes and in some cases leading to extreme events. The MJO has also been shown to affect the reliability of weather forecasts over Europe and weekly precipitation amounts over poorly irrigated areas such as India during the monsoon. Benefits resulting from reliable operational forecasts of the MJO cannot be over-emphasized. Thus far, even a theoretical explanation of the MJO has been elusive due to the lack of comprehensive observations. An international field campaign CINDY2011 was designed to aid this issue. The Dynamics of the MJO (DYNAMO) was the US component of this campaign.

The Climate Program Office of NOAA funded NOAA/CPC and the University of Maryland-ESSIC to provide operational monitoring and forecast support to the campaign. A series of MJO events occurred during DYNAMO making it a very successful observational campaign. In this paper we present a synthesis of experience gained on understanding the MJO using data from the NCEP coupled and uncoupled model forecasts and DYNAMO observations. We first compare the evolution of observed large scale Outgoing Longwave Radiation (OLR) for each of the DYNAMO MJO events to the evolution of forecast OLR. We show that for each of these events the GFS was systematically suppressing near equatorial convection as the enhanced convective phase of the MJO was propagating from the western to the eastern Indian Ocean. This equatorial suppression of convection was leading to an unrealistically subduing of the forecast MJO. We then try to shed light on this forecast behavior by focusing on differences between DYNAMO station observations and GFS forecasts. We finally compare forecast skill between the uncoupled GFS and coupled CFS during DYNAMO and explore hypotheses on the importance of air – sea interaction on the evolution of MJO. We conclude with a list of challenges to address in order to improve future subseasonal forecasting systems.