On the Right Track for Tropical Clouds

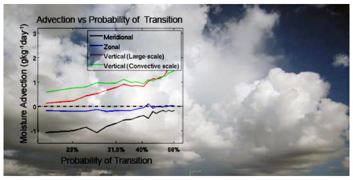
Research Highlight

Researchers at Pacific Northwest National Laboratory and collaborators are hot on the trail of a large and lumbering atmospheric wave. Originating in the tropics, the intra-seasonal force wields influence on weather patterns around the world. Using high-resolution regional modeling along with field data, the scientists found that the frequency of the wave's shallow-to-deep convective cloud transitions is sensitive to moisture buildup in the mid-troposphere and a large-scale lifting in the atmosphere. Simultaneous forces—the lifting and a decline in large-scale drying—result in moisture buildup leading to the initiation of the Madden-Julian Oscillation (MJO).

PNNL researchers and a collaborator from the Indian Institute of Technology used observations from the 2011 ARM MJO Investigation Experiment (AMIE)/Dynamics of the Madden-Julian Oscillation (DYNAMO) field campaigns over the Indian Ocean. For this study, they used the Weather Research and Forecasting (WRF) model, a high-resolution regional model to track the processes that lead to the rapid, shallow-to-deep convective cloud transitions associated with the initiation and propagation of the MJO. They tracked several thousand model-simulated clouds throughout the clouds' lifetime and considered various environmental factors that determine whether the clouds become deep.

The field campaign data used in their research are available at National Center for Atmospheric Research's (NCAR's) Earth Observing Laboratory's DYNAMO Data Catalogue and at the ARM Data Archive under Gan Island, Maldives.

Cracking the code of the MJO will mean better prediction of severe winter storms for the U.S. West Coast, the summer monsoon in the U.S. Southwest, Pacific hurricanes and perhaps even the El Niño weather event. The MJO is a complex, large-scale and slow-moving tropical intra-seasonal atmospheric wave with far-reaching impacts on weather patterns around the world. Understanding and modeling its initiation and propagation are two of the long-standing challenges in climate science. This research, using integrated data from field campaigns and high-resolution modeling, is providing insight into this important atmospheric enigma.



Large-scale vertical lifting and the decline of mid-level drying by equator-ward horizontal advection are found to be the primary mechanisms of moistening that lead to the initiation and propagation of MJO deep convection.

Reference(s)

Hagos SM, Z Feng, K Landu, and L charles. 2014. "Advection, moistening, and shallow-to-deep convection transitions during the initiation and propagation of Madden-Julian Oscillation." Journal of Advances in Earth System Modeling, 6, 938-949.

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Cloud-Aerosol-Precipitation Interactions