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Evaluating the Moisture-Mode Theory of the MJO against ECMWF IFS Reforecast for DYNAMO

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The recently developed MJO theory based on "moisture mode" thinking is built upon the weak temperature gradient approximation. In this approximation, effects of convective latent heating and drying are balanced by vertical transport of temperature and moisture by vertical motions associated with convective heating. As a consequence of this balance, cloud-radiation interaction plays a central role in convective instability for the development of precipitation peaks of the MJO. This role of cloud-radiation interaction requires the ratio of radiative heating vs. convective heating to be at least 20%. These and other aspects of the moisture-mode MJO theory are evaluated using a reforecast product for DYNAMO by the ECMWF Integrated Forecast System (IFS). Forecasts of total and radiative heating (Q1 and Qr) and total drying (Q2) are first validated against those estimated from in situ DYNAMO and satellite observations. The key aspects of the moisture-mode MJO theory are examined at various longitudinal sectors of the Indian Ocean where strong MJO events were observed during DYNAMO, and also over the Pacific Ocean where there were no MJO heating signals during DYNAMO. The results show that while cloud radiation may explain the majority of the moisture tendency associated with the MJO by inducing vertical transport of moisture, its ratio to convective heating is above 20% only during the convective decay phase of the MJO. In addition, cloud radiation appears to play a similar role in the large-scale non-MJO convection. These and other preliminary results suggest room for the refinement of the moisture-mode theory of the MJO.