MMM SEMINAR SERIES

TROPICAL CYCLOGENESIS AND ITS RELATION TO INTERACTIONS BETWEEN AFRICAN EASTERLY WAVES AND MESOSCALE CONVECTIVE SYSTEMS

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Tropical cyclogenesis remains a challenging research topic, in part due to the limited understanding of the interactions between the mesoscale processes and the TC-seedling synoptic-scale vortex. The interactions between African easterly waves (AEWs) and mesoscale convective systems (MCSs) over Africa and east Atlantic and how they pertain to the formation of TCs are documented. First, an algorithm that objectively tracks MCSs over Africa is developed to analyze the morphology and climatology of these systems over Africa. It is shown that realistic MCS propagation over Africa is attained when the tracker accounts for the African Easterly Jet (AEJ) mean background flow in which the MCSs propagate on.

With an MCS dataset in place, a 5-year climatology AEW-MCS dataset is developed to perform a wave-relative analysis of AEW-MCS systems over Africa and over the Main Development Region. It is found that the MCSs of developing AEW-MCS systems (those that develop into TCs) are more likely to be in phase with and propagate at the same speed as the AEW trough. In contrast, the MCSs of non-developing AEW-MCS systems are more likely to be positioned south of the AEW trough and do not necessarily propagate at the same speed. In addition, it is found that developing AEWs over West Africa are associated with a larger number of Convective Cloud Clusters (CCCs; squall line-type systems) than non-developing AEWs. Over West Africa, the fraction of extremely large MCS areas associated with developing AEWs is larger than for non-developing AEWs. These findings support the notion that both the position of moisture and latent heating relative to the AEW trough are essential for cyclogenesis.

At the synoptic-scale, significant differences between developing AEWs and non-developing AEWs were identified that could be key in understanding tropical cyclogenesis likelihood. Developing AEWs exhibit stronger Shamal wind, northerly flow, West African monsoon flow and zonal Somali jet when compared to non-developing AEWs. These synoptic features experienced by developing AEWs are linked to a strong monsoon trough over Africa. It is proposed that these large-scale features identified for developing AEWs can be key predictors of AEW intensity and tropical cyclogenesis.

Finally, a high-resolution and convective-permitting of a developing AEW simulation is used to evaluate the role of mesoscale processes in the growth and intensification of an AEW that undergoes tropical cyclogenesis. This is done through a wave-relative moisture budget analysis.

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For Zoom information, please contact Nancy Sue Kerner nskerner@ucar.edu
Seminar will also be live webcast https://operations.ucar.edu/live-mmm