Development and Application of a High-Resolution Global MCS Database using Feature Tracking on Satellite Data

Zhe Feng, Jingyu Wang, Samson Hagos, Ruby Leung, Karthik Balaguru
Pacific Northwest National Laboratory

Mesoscale convective systems (MCSs) play a crucial role in the hydrologic cycle and energy redistribution in the climate system. Oceanic MCSs in the tropics are particularly important because they are long-lived and can grow to tremendous horizontal extent. Through precipitation as well as generation of wind gusts, they can interact with the ocean surface to modulate surface fluxes. Air-sea interactions associated with MCSs over the tropical oceans have not been systematically quantified due to lack of a coherent high-resolution MCS database.

In this pilot study, we developed a new algorithm to track long-lived and intense MCSs using the NASA Global Merged IR brightness temperature (T_b) and NASA GPM IMERG precipitation feature (PF) dataset. The two datasets combined could potentially provide MCS identification with 4 km and 30 min spatiotemporal resolution globally. We compared MCSs identified using T_b+PF dataset against an independent MCS database constructed using the Next-Generation Radar (NEXRAD) 3-D radar network data in the United States over 3 warm seasons. The NEXRAD radar-based MCS database is considered ground truth in this study. MCS frequency, spatial distribution, lifetime and temporal evolution from satellite data compare very well with NEXRAD MCS database, demonstrating the ability of the satellite dataset to accurately identify long-lived and intense MCSs. We apply this algorithm to track MCSs over tropical Indian Ocean, the Maritime Continent and West Pacific warm pool. MCS characteristics such as frequency, lifetime, intensity and propagation speeds will be compared between these regions. Applications of the MCS database for air-sea interactions, SST variability, and feedback on intra-seasonal oscillations such as the MJO will be discussed.