Xiguan
Dong
Department of Hydrology and Atmospheric Sciences, University of Arizona, Tucson,
Oral
Mesoscale Convective Systems (MCSs) morphologically consist of a convective precipitating portion and a non-precipitating anvil canopy. MCS precipitation is important to the atmospheric hydrologic cycle because of heavy precipitation in convective cores (CC) and widespread precipitation in stratiform rain (SR) regions. Both global and regional atmospheric models exhibit persistent biases in MCS initiation location and timing, stratiform area and precipitation fraction, and anvil coverage (AC), as well as MCS organization, in part due to a lack of comprehensive observations and retrievals. The central United States is most prone to MCSs where MCSs contribute between 30% and 70% of warm-season rainfall. Clouds and precipitation from MCSs are key components in the energy and hydrological cycles of the climate system. Understanding the transition process from cloud to precipitation in MCSs is a highly desired goal, however, there are few studies to quantitatively investigate the relationships between MCSs' cloud microphysical properties and precipitation.
To investigate the MCSs' cloud and precipitation properties and their transition processes over the CONUS, Professor Dong's group at the University of Arizona has collected and analyzed three long-term high-resolution observational datasets during the period 2010-2012. They are geostationary satellite infrared brightness temperature, NEXRAD radar reflectivity from the GridRad dataset (hourly, 0.02 o x 0.02 o spatial and 1-km vertical resolutions), and hourly Stage IV multisensor precipitation dataset. Based on this comprehensive dataset, Tian et al. (2020) tracked the MCSs, classified each MCS into three regions (CC, SR, AC), then applied the retrieval method of Tian et al. (2016) to generate a 4D database of the ice cloud water content and path (IWC, IWP) for MCS SR and thick AC regions. These datasets and results have been used to evaluate the NOAA WRF simulated MCS's cloud and precipitation properties and their transition processes under different synoptic patterns (extratropical cycle and subtropical ridge) and MCS stages (genesis, mature, and decay stages) in the study of Wang et al. (2019). Wang et al. (2019) used the self-organizing map (SOM) to objectively identify synoptic patterns for the tracked MCSs over the Southern and Northern Great Plains (SGP/NGP) during the warm season (April-September), 2007-2014. They found two dominant synoptic patterns over these two regions: extratropical cycle dominates during April-May but subtropical ridge is dominant pattern from June to September over both SGP and NGP. These comprehensive datasets and results will provide an observational benchmark for the science community to evaluate model simulations and validate satellite precipitation products.
Presentation file
Dong-dod-2023.pdf
YouTube link
View recording
Meeting homepage
DoD Cloud Post-Processing and Verification Workshop