Session: C36 Poster: Th33A

Progress in American monsoon research: Investigation of microphysical processes occurring in convection during NAME

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To address questions regarding microphysical processes occurring in the core North American Monsoon region, data from NCAR's S-band polarimetric Doppler radar (S-Pol), deployed during the North American Monsoon Experiment (NAME), were used to investigate microphysical processes in convection. A cell identification and tracking algorithm was applied to the data to locate and track convective elements, classified as isolated cells or cells embedded within organized systems. We were particularly interested in studying microphysical evolution as a function of topography. An example of intense, isolated convection over the low terrain highlighted a deep, isolated cell with precipitation-sized ice extending to 15 km AGL. A ZDR column indicated the lofting of supercooled water above the melting level and subsequent freezing, producing hail embryos. Similar features were observed in an isolated cell over the western slopes, highlighting the combined roles of collision-coalescence and melting precipitation-sized ice for producing intense rainfall, similar to convection observed in other regions of the tropics and mid-latitudes. Despite previous observations of weaker and shallower cells over the Sierra Madre Occidental (SMO), this analysis revealed the potential for accretional processes to also play an important role in producing intense rainfall over these higher elevations. In addition, reduced warm-cloud depths, increased ice mass slightly above the melting level, and a narrower distribution of drop sizes suggested a reduced role of warm-rain processes over the SMO compared to intense cells over the lower terrain. Despite a greater frequency of isolated convection during NAME, organized systems were responsible for 75% of total rainfall in the radar domain. Similar to isolated cells, both warm-rain and ice-based processes played important roles in producing intense rainfall in organized features. Although similarities existed between isolated cells and cells embedded within MCSs, organized cells were typically deeper and contained more ice, which melted and contributed to the development of mesoscale convective outflow boundaries. As convection organized along the western slopes, these boundaries spread over the lower terrain, converging with larger scale upslope flow, thus allowing for new convective initiation and propagation of systems toward the coast. Once over lower elevations, additional warm-cloud depth aided in the generation of intense, long-lasting rainfall, and allowed for continued ice production, which, along with the development of rear inflow in the trailing stratiform region, led to further development of convective outflow. Similar processes were observed in other mountainous regions characterized by heavy rainfall. A comparison with convection occurring during the Terrain-influenced Monsoon Rainfall Experiment (TiMREX) will also be presented to provide a more general analysis of orographic precipitation during monsoons.