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The Seasonal and Temporal Evolution of Isolated Deep Convection over the Amazon Rainforest

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Deep convective clouds (DCCs) redistribute energy and moisture in Earth's atmosphere and can lead to hazardous weather events. Their occurrence and intensity depend on environmental conditions with the potential for aerosol invigoration. However, isolating the aerosol effects remains challenging due to limited observations of DCCs in different environmental conditions and lifecycle stages. This study examines the seasonal and temporal evolution of isolated DCCs sampled by the Atmospheric Radiation Measurement (ARM) Mobile Facility (MAO) near Manaus, Brazil during GoAmazon 2014/15. The Tracking and Object-Based Analysis of Clouds (*tobac*) algorithm was used for Lagrangian tracking of DCCs with radar reflectivity (Z) > 30 dBZ from the Sistema de Proteção da Amazônia Manaus S-band radar to estimate the lifecycle stages of DCCs sampled by an ARM Radar Wind Profiler (RWP) at MAO.

Vertical profiles of Z and unique vertical velocity (w) estimates within DCC cores from the RWP were used to examine key kinematic properties like updraft/downdraft strength and mass flux (MF). DCCs within 20 km of MAO with lifetime > 36 mins had an average Z, velocity (V) and area (A) of 42.5 dBZ, 8.7 m s^{-1}, and 56.2 km^2, respectively. DCC lifetimes were divided into the developing, mature, and dissipating stages of convection. V increased with lifetime while Z, A, and rain rate (R) increased from the developing to the mature stage before decreasing till the dissipating stage. The mature stage had the strongest convection with the strongest updrafts and the highest Z and net MF across lifecycle stages. Developing DCCs had the weakest convection with the lowest Z and weaker updrafts above the melting layer.

DCCs were most frequently observed during the wet season but the dry season had the strongest, fastest moving, largest, and most isolated DCCs. Due to stronger updrafts above the melting layer, developing DCCs were stronger during the dry season with the highest upward MF across lifecycle stages. Mature and dissipating DCCs were stronger during the wet season with stronger updrafts aloft. As a result, stronger convection was observed with greater upward MF during the first (second) half of DCC lifetime during the dry (wet) season.

Keywords: deep convection, clouds, Lagrangian tracking