A Quantitative Analysis of Convective Mass Flux Parameterizations Using Direct Observations from DYNAMO

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The 2011 DYNAMO investigation of the Madden Julian Oscillation (MJO) included an elaborate, multiplatform observation field study with ships, islands, and aircraft in the Indian Ocean. The R/V *Revelle* was a primary platform for surface-based near-surface, boundary-layer, cloud, and precipitation observations. We have used selected data from DYNANO to investigate convective mass flux approximations form the core of must cumulus parameterizations (see Lappen and Randall, 'Toward a Unified Parameterization of the Boundary Layer and Moist Convection', Parts I, II, and III) including application to *shallow convection,* which has historically been neglected because of the observational difficulty – conventional scanning precipitation radars are not suitable for non- or weakly-precipitating clouds.

The analysis used two unique NOAA ship-based remote sensors: the 94-GHz cloud Doppler radar and the Doppler lidar – but also drawing on other sources of data (microwave radiometer, ceilometer, surface fluxes, rawinsondes, and the C-band radar). The time series of *radar in-cloud* turbulence profiles were combined with time series of *lidar clear-air* turbulence profiles. This allows direct observations of updraft/downdraft structure with sufficient time/space resolution to measure profiles of convective velocity distributions with the shallow convective cloud explicitly partitioned in the time series. Characterization of the convective mass flux profiles will then allow us to address directly the role of shallow convection in the transport of moisture from the boundary layer into the lower troposphere.