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Overview of convection initiation events during the RELAMPAGO-CACTI project

James Marquis (1), Jim Wilson (2), and Adam Varble (3)
(1) University of Colorado - Boulder, (2) NCAR, (3) Pacific Northwest National Lab

Northern Argentina frequently contains mesoscale ingredients for warm season deep moist convection that are generally analogous to the central and high-plains regions of the United States. Orographic circulations associated with the Andes Mountains and shorter neighboring ranges, such as the Sierras de Cordoba, frequently trigger moist convection when these background mesoscale conditions are favorable. Among other objectives, the RELAMPAGO-CACTI field project aimed to collect observations in northern Argentina characterizing boundary layer and free-tropospheric environments associated with the diurnal initiation of strong and long-lived storms, weak and short-lived storms, and events in which storms did not initiate when otherwise forecasted by convection-allowing models.

During 7 convection initiation (CI) missions, a combination of 4 mobile Doppler on Wheels (DOW) radars and 4 stationary C-band and Ka-/X-band radars from CSU and ARM-DOE were deployed to collect multi-Doppler winds and single-Doppler RHI observations within forecasted CI regions, typically surrounding the highest topography associated with the Sierras de Cordoba mountain range. During each 6-8-hour deployment, hourly radiosonde launches were performed by 6 mobile teams, each separated by distances of 30-50 km, yielding very high spatial and temporal mesoscale resolution of vertical profiles of instability, moisture, and shear within the forecasted CI region. Furthermore, the CACTI G-1 aircraft flew cloud-penetrating transects, collecting in situ state variables and aerosol information in cumuli prior to their development into deep convection. There were 3 cases in which widespread CI occurred within the observing domain, 3 cases with CI of isolated storms, and 2 cases of CI-failure. Only 2 cases yielded intense and/or long-lasting storms near or in the observing domain.

RELAMPAGO-CACTI observations will be used to relate cloud-scale processes of CI success and failure to the surrounding mesoscale environment. We seek to understand the roles of shear upon entrainment within growing congestus, as well as boundary layer and lower-tropospheric controls upon the initial width and frequency of thermals comprising growing convective updrafts. Preliminary analysis presented herein will involve: an overview of CI cases, multi-case comparison of environmental soundings collected during the CI stages of strong vs. weak convective storms, and possible CI failure mechanisms. For example, at least one of the well-observed (and inaccurately-forecasted) CI failure events occurred despite persistent low-level moisture advection, substantial surface-based CAPE, and virtually eliminated surface-based CIN throughout the observing period.