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Estimation of Specific Differential Phase in Melting Layer from C-Band Radar Measurements during the RELAMPAGO Experiment

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Extended Abstract

Remote sensing of Electrification, Lightning, And Mesoscale/microscale Processes with Adaptive Ground Observations (RELAMPAGO) field campaign has been conducted in the lee of the Andes Mountains in central Argentina. The lee of the Andes Mountains in central Argentina region is known for its high impact weather and some of the intense convective systems in the world. The intense events occur in terms of large hail (and the frequency of occurrences) and extreme lightning activities. However, the observations needed for the study of the convective events are scarce; this has been addressed during the RELAMPAGO experiment by performing various ground-based and airborne measurements. The repeated storms in this region have been sampled during the RELAMPAGO field campaign to study science questions related to the deep convective initiation, severe-weather generation, and various stages of storm development [1].

As part of the experimental setup for RELAMPAGO, various instruments like Doppler dual-polarization C-band radars, mobile weather stations, lightning instruments, microwave radiometers and radio soundings were deployed. The observations from these instruments have been used to characterize the various phases of convective environments, kinematic and microphysical evolution of clouds and precipitation. In addition to this, the Doppler dual polarization C-band radars polarimetric measurements will be used to further analyze the utility of C-band radars for strong convection and severe weather studies. Among the network of radars deployed during the campaign, CSU-CHIVO is of particular interest in this research. CSU-CHIVO is a research radar from Colorado State University, that was sent to Argentina during RELAMPAGO. It was located South of Cordoba city and East of the Andes foothills. The polarimetric products from the radar i.e., reflectivity factor Z_H, differential phase shift φ_{DP}, differential reflectivity Z_{DR}, correlation coefficient ρ_{HV} and specific differential phase K_{DP} will be used to estimate amount of precipitation during weather events, the shape, size, type of the hydrometeors as well as identifying melting layer (ML) and giant hail [2]. This measurements information on precipitation microphysics of the region will also be used to improve parameterizations of numerical weather prediction models.

The C-band radar polarimetric observations will be statistically analyzed to interpret various microphysical processes affecting ML signatures including surface rainfall. Melting layer is usually marked by increased Z_H, Z_{DR}, and K_{DP} because of the higher refractive index of water compared to ice, while melting results in reduction in ρ_{HV} because of the significant particle diversity [3]. This variability of Z_H and ρ_{HV} in ML is used to determine the vertical extent of the melting layer which will be presented and discussed. In addition to that, the values of K_{DP} in the melting layer will be estimated by first estimating differential phase shift φ_{DP} after removing the effect of back scatter differential phase. The estimated differential phase is then used for determining K_{DP} using a Kalman filtering technique [2, 3] so as to make sure that K_{DP} is estimated independent of other polarimetric variables from the radar. The vertical variation of estimated K_{DP} in the ML will also be estimated and presented.

References

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