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On the relationship between Polarimetric Radio Occultation observables and water content for convective systems at different life stages

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Accurate prediction and modeling of heavy precipitation events remains an issue due to gaps in our understanding of the physical processes underlying them. Such gaps arise from the limited number of good quality observations that constrain the thermodynamic parameters (e.g. temperature, moisture, etc.) within heavy precipitation, since the observations of some space-based sensors are degraded in the presence of thick clouds.

The Global Navigation Satellite System (GNSS) Polarimetric Radio Occultation (PRO) technique was recently created to overcome some of these limitations, by providing vertical profiles of temperature, pressure, and water vapor, along with vertical information about hydrometeors (i.e. raindrops, snow, ice crystals, etc), simultaneously. It represents an enhancement of the standard radio occultation technique, that consists on tracking the signals emitted by GPS satellites from a low Earth orbit satellite occulting behind the Earth's horizon. These signals cross lower and denser layers of the atmosphere as the occultation advances. The augmentation that the polarimetry provides consists on collecting these signals using two linearly and orthogonal polarized antennas (H and V), instead of the circularly polarized one used in the standard technique. Comparing the phase of the signals received at the two antenna ports, we can infer the presence of hydrometeors along the ray paths. Polarimetric Radio Occulation technique is being proved aboard the PAZ satellite, in an experiment led by the Institut de Ciències de l'Espai (ICE-CSIC,IEEC), in collaboration with NOAA, UCAR and NASA/Jet Propulsion Laboratory, operating since 2018. These profiles are obtained globally, through all kinds of clouds and over all kinds of surfaces. Such characteristics are rather unique in the current observing system.

For this study, mesoscale convective systems (MCS) are particularly of interest. Given the characteristics of the observational technique and the targeted systems, it is relatively easy to find collocated measurements. Therefore, we can study the nature of the vertical structure of the hydrometeors within the cloud structure of MCS, depending on their life stage (e.g. initiation, maturity, decay) and relative position (e.g. leading vs trailing), with the help of geostationary

infrared imagery. Unique insights obtained with the new PRO technique will be presented.