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A novel classification rainfall type using a clustering approach in the tropical Andes.

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Information on the vertical profile of rainfall is important to improve our knowledge about microphysical processes that govern the formation of the hydrometeors. In addition, the vertical profile helps improving the quantitative precipitation estimation from scanning weather radars and may be useful to improve the parameterization of cloud microphysical processes in numerical models. Usually, rainfall types (e.g, stratiform and convective) are defined by using some rainfall characteristics of its vertical profile such as intensity and velocity. Furthermore, certain thresholds for these variables need to be defined to separate the rainfall classes. However, studies about the vertical profile of rainfall showed that the vertical variability of rainfall highly depends on the local climate and the study area. In consequence, these thresholds are a constraining factor for the rainfall class definitions because they cannot be generalized. Besides, the identification of thresholds can become too subjective and, thus, influence the identification of rainfall types. In regions of complex topography such as the Tropical Andes, rainfall vertical profile studies are very scarce and they show that rainfall classification has similar drawbacks such as the identification of thresholds. Thus, this study aims to develop a new methodology for rainfall events classification by using a data-driven clustering approach based on the k-means algorithm that allows accounting for the similarities of rainfall characteristics (e.g., duration, intensity, drop size distribution) of each rainfall type. The study was carried out using data retrieved from a K-band Doppler Micro Rain Radar (MRR) that records rainfall characteristics such as rainfall intensity, drop velocity, reflectivity profile, drop size distribution (DSD), and liquid water content (LWC). The MRR was located in the tropical Andes, at 2600 m a.s.l., in the city of Cuenca, Ecuador. Three years of data were available for the study with a temporal resolution of 1 minute. First, the rainfall events were identified by using three criteria: minimum inter-event, minimum total accumulation, and minimum duration. Then, by using the k-means approach, several iterations with different number of clusters each were evaluated and consequently, three representative rainfall classes were found. These classes showed certain transitions (e.g., for rainfall intensity, velocity and drop size distribution) that separated the rainfall classes. The distributions of these rainfall event characteristics were compared with those found in the literature. This novel classification provided new insights about the variability of the rainfall in this tropical mountain setting and how its characteristics revealed distinctive patterns of the rainfall processes. Finally, since the rain types were identified by a data-

driven method, it ensured an objective separation of the rainfall events. Thus, the application of this method in other sites will allow contrasting previous findings regarding the suitability of the tailor-used thresholds for rainfall classification.