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Hydrometeor classification from a 2 dimensional video disdrometer

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Hydrometeor classification techniques aim at identifying the dominant hydrometeor type in a given observation volume or at a given time step, during precipitation. Such techniques are employed to interpret measurements from polarimetric weather radars, cloud lidars, and airborne particle imagers and their output is applied to risk assessment, air traffic control, and parametrization of numerical weather models.

In the present work we develop a hydrometeor classification approach designed for data collected by a ground instrument: the 2 dimensional video disdrometer (2DVD). The 2DVD provides fall velocity and 2D views of each particle falling in its sampling area, by means of two orthogonally oriented line scanning cameras. We summarize this large amount of information over time steps of 60 seconds by characterizing the statistical behavior of a set of shape, size and velocity descriptors calculated for each falling hydrometeor. This summarized information is the input for the classification algorithm, that therefore provides the dominant hydrometeor type during a given time step of precipitation.

8 dominant hydrometeor classes have been identified by visual inspection of data collected in different climatologies (Switzerland, France and Canada), namely: small particles, dendrites, columns, graupel, rimed particles, aggregates, melting snow and rain. 400 representative time steps have been manually selected and classified in one of these classes in order to build a training set for the classification algorithm. The employed classifier is a support vector machine (SVM), a supervised linear classification method trained and evaluated on subsets of the 400 time steps. The algorithm achieves accurate performances, with overall accuracy higher than 90% in global terms and higher than 84% in median for each of the 8 hydrometeor classes available. This is confirmed by the Cohen's Kappa score (or HSS), that takes into account the prediction by chance and is higher than 0.88 in global terms.

The classification of 2DVD data is of particular interest for future comparisons with retrievals obtained from other instruments (like polarimetric weather radars), and the present approach may be easily translated to other particle imaging systems, airborne or ground-based. Future improvements needs to be focused on improving the time resolution of the classification, ultimately achieving a particle by particle identification.