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Neural networks approach for raindrop size distribution and rainfall retrieval from polarimetric weather radar

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Meteorological and hydrological applications require quantitative precipitation estimates. Because of its spatial and temporal resolution as well as the extended coverage, weather radar is very suitable for such purposes. Nevertheless, rainfall rate estimate based on radar measurements is affected by a high degree of uncertainty due to space-time variability (from one rainfall event to another and within the same event) of raindrop size distribution (RSD). In the classical $Z - R$ technique the impact of the estimator on the physical variability of the RSD is large. The polarization diversity technique enables the use of combined algorithms which reduce the sensitivity to the variability of the RSD. In order to further reduce the dependence on microphysical variability of the observed event, Bringi et al. (2004) derived a new a Z–Rrelation for dual-polarized S-band radar data that is continuously varying in space and time as the storm microphysics evolves without the need for classifying the rain types a priori. This procedure is based on retrieving the raindrop size distribution parameters of a normalized gamma model using radar measurements of Z_H, Z_{DR}, and K_{DP}(Gorgucci et al. 2002; Bringi et al. 2002, 2003). The aim of this work is to provide a new three-steps procedure to retrieve the RSD parameters and estimate the rainfall rate. In the first step, the polarimetric variables (Z_H, Z_{DR}, K_{DP}) are used by means of a neural network technique to retrieve the RSD parameters. The reason of this choice is the wish to exploit the better capability of NNs to approximate complex functions such as those describing the relationships between the radar observables and the RSD parameters. In the second step, a Bayesian classification scheme is applied to discriminate between stratiform and convective regime from the estimated RSD pa-

rameters. Finally, the results of the classification are used to select a rain-regime tuned neural network algorithm to retrieve the rainfall rate. Numerical simulations are used to investigate the efficiency and accuracy of this approach. The simulator is based on a T-matrix solution technique, while precipitation is characterized with respect to shape, raindrop size distribution and orientation. A sensitivity analysis is performed in order to evaluate the expected errors of this method. Numerical results are discussed in order to evaluate the robustness of the proposed technique.

1 References

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