



Quasi-real time estimation of intense rainfall rates from weather radar

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Rainfall intensity estimation from radar is known to be prone to different sources of uncertainty, both in the detection and in the processing phase. These sources of uncertainty are especially relevant when severe rainfall rates are considered, thus calling for the adoption of advanced methods for the estimation of the rainfall rate from radar observations.

We introduce a quasi-real time procedure for the adaptive estimation of the coefficients of the Z-R relation that links radar reflectivity to rainfall rate. The proposed quasi-real time calibration can grant Z-R relationships consistent with the evolution of the event while the use of a spatially adaptive approach makes the technique amenable to be applied in large areas with complex orography. The aim is to define a simple and operative methodology suitable for a systematic and possibly unsupervised application, capable to reconstruct the whole spectrum of intensities occurred during an intense rainfall event.

We propose to readjust the power-law equation commonly used to transform reflectivity to rainfall intensity at each time step, calibrating its parameters by means of Z-R pairs collected in the time proximity of the considered instant. Z-R data are filtered with a reflectivity threshold, which varies in time, in order to discriminate between the presence and absence of rainfall. For every location, the spatial calibration domain is limited to the rain gauges belonging to a neighbourhood. Z-R coefficients are estimated for each location and each time step by minimizing the standard deviation between observed and estimated rainfall, through a non-linear procedure.

The case study includes a set of 16 severe rainfall events occurred in the north-west of Italy. The technique outperforms the classical estimation methods for most of the analysed events and shows significant potential for operational uses. The determination coefficient undergoes up to 30% improvements and the BIAS values are reduced, for stratiform events, up to 80% of the values obtained with the classical non-adaptive Z-R relations.