Plinius Conference Abstracts,
Vol. 11, Plinius11-203, 2009
11th Plinius Conference on Mediterranean Storms

Representing radar QPE and QPF uncertainties using radar ensembles

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In the last years, new comprehension of the physics underlying the radar measurements as well as new technological advancements have allowed radar community to propose better algorithms and methodologies and significant advancements have been achieved in improving Quantitative Precipitation Estimates (QPE) and Quantitative Precipitation forecasting (QPF) by radar. Thus the study of the 2D uncertainties field associated to these estimates has become an important subject, specially to enhance the use of radar QPE and QPF in hydrological studies, as well as in providing a reference for satellite precipitations measurements.

In this context the use of radar-based rainfall ensembles (i.e. equiprobable rainfall field scenarios generated to be compatible with the observations/forecasts and with the inferred structure of the uncertainties) has been seen as an extremely interesting tool to represent their associated uncertainties.

The generation of such radar ensembles requires first the full characterization of the 3D field of associated uncertainties (2D spatial plus temporal), since rainfall estimates show an error structure highly correlated in space and time.

A full methodology to deal with this kind of radar-based rainfall ensembles is presented. Given a rainfall event, the 2D uncertainty fields associated to the radar estimates are defined for every time step using a benchmark, or reference field, based on the best available estimate of the rainfall field. This benchmark is built using an advanced non parametric interpolation of a dense raingauge network able to use the spatial structure provided by the radar observations, and is confined to the region in which this combination could be taken as a reference measurement (Velasco-Forero et al. 2008, doi:10.1016/j.advwatres.2008.10.004). Then the spatial and temporal structures of these uncertainty fields are characterized and a methodology to generate consistent multiple realisations of them is used to generate the radar-based rainfall ensembles scenarios. This methodology, based on the improvement of the "String of Beads" model (Pegram and Clothier, 2001, doi:10.1016/S0022-1694(00)00373-5), is designed to preserve their main characteristics, such as anisotropy and the temporal variations of their spatial correlation.

The discussion of the results on an illustrative case study and their potential interest in hydrological applications is also discussed.