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Rainfall estimation in the context of post-event flash flood analysis

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Due to their spatial coverage and space-time resolution, operational weather radar networks offer unprecedented opportunities for the observation of flash flood generating storms. However, the radar rainfall estimation quality highly depends on the relative locations of the event and the radar(s). A mountainous environment obviously adds to the complexity of the radar quantitative precipitation estimation (QPE).

A pragmatic methodology is proposed to take the best benefit of the existing rainfall observations (radar and raingauge networks):

1) A precise documentation of the radar characteristics (location, parameters, operating protocol, data archives and processing) needs first to be established. The radar(s) detection domain can then be characterized using the "hydrologic visibility" concepts (Pellarin et al. J Hydrometeor 3(5) 539-555 2002): this procedure is aimed at determining ground clutter, screening effects and the theoretical error of the rainrate estimation for the various elevation angles. This calculation requires a digitized terrain model of the region, knowledge of the radar parameters and a climatology of the vertical profile of reflectivity (VPR).

2) Rather dense raingauge observations (operational, amateur) are usually available at the event time scale while few raingauge time series exist at the hydrologic time steps. Such raingauge datasets need to be critically analysed; a geostatistical approach is proposed for this task.

3) The radar data re-processing can then be considered with the following 3 steps:

a) special care needs to be paid to ground clutter which has a dramatic impact of radar QPE. Dry-weather maps and long-term radar rainfall accumulation maps may help in this task. Horizontal interpolation is recommended for filling in the affected pixels.

b) the eventual radar bias (due to calibration error and/or unsuited Z-R relationship) and the average event VPR can then be estimated using a procedure based on the spatialization of the raingauge/radar ratios calculated at the event time scale.

c) Knowing the calibration error, the screening effects and the average VPR, reflectivity data can be reprocessed and eventually combined on the vertical to produce new rain amounts at ground level.

4) We propose to reserve the existing raingauge time series for an assessment of the radar QPE and their error structure using again a geostatistical approach.

Such a procedure, strictly valid for non-attenuated frequencies, will be illustrated with the radar datasets collected during the Aude 1999, Gard 2002 and Slovenia 2007 rain events of interest in the HYDRATE project.