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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 data) for given flash-flood cases:
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(s) can then be characterized using the "hydrologic visibility" concepts (Pellarin et al. J Hydrometeor 3(5) 539-555 2002).
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) A number of identifications can be implemented prior to the radar data re-processing:
a) Special care needs to be paid to (residual) ground clutter which has a dramatic impact of radar QPE. Dry-weather maps and rainfall accumulation maps may help in this task.
b) Various sources of power losses such as screening, wet radome, attenuation in rain need to be identified and quantified. It will be shown that mountain returns can be used to quantify attenuation effects at C-band.
c) Radar volume data is required to characterize the vertical profile of reflectivity (VPR), eventually conditioned on rain type (convective, widespread). When such data is not available, knowledge of the 0°C isotherm and the scanning protocol may help detecting bright-band contaminations that critically affect radar QPE.
d) With conventional radar technology, the radar calibration accuracy and the relevance of the Z-R relationship can only be assessed with external data (raingauges here). Ways for characterizing the equifinality structure and optimal parameters will be presented.
Such a procedure will be illustrated and assessed with the radar and raingauge datasets collected during the Aude 1999, Gard 2002 and Slovenia 2007 rain events of interest in the HYDRATE project.