Use of multi-sources 10-years quantitative precipitation estimation re-analyses in a lumped rainfall-runoff model

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For hydrological applications (e.g. flood forecasting), radar technology should provide both a mean to follow the spatial dynamics of rainfall fields and a quantitative evaluation of precipitation depths. Indeed, meteorological radar provides spatially distributed rainfall depths that are potentially more informative than traditional ground rain gauge networks that only give point rainfall estimate. Over the last years, many studies have focused on the assessment of radar-based precipitation data for simulating stream flows through a hydrological model. However, the assessment of the operational value of radar rainfall estimates remains difficult because of the continuous and rapid evolution of radar technology. Moreover, most studies focuses on limited set of « selected » events and study areas of limited extent, which makes their conclusions difficult to generalize.

In that context, Météo-France (the French national weather service), in close relationship with several French hydrology labs, launched a national collaborative project with the objective of producing a 10-year reference database of Quantitative Precipitation Estimations (QPE). The objective is to make use optimally at any time of all the available information (radars, hourly and daily rain gauges, satellite data, model freezing level heights, etc) to obtain the best possible surface precipitation estimation. The resulting data base, will consist of hourly, 1km² gridded QPE and associated estimation uncertainties over the entire French territory. This will represent a common reference for hydrologists useful for various applications such as the calibration of the hydrological model parameters, the assessment of the the added value of high space-time resolution input for hydrological models, etc.

The multi-source QPE re-analysis requires automated procedures of radar data processing and of combination of all available data sources, in particular combination of radar data with rain gauge network. First, a methodology for automated identification and treatment of radar measurement artefacts (ground clutter, partial beam blocking, clear air echoes, anthropogenic targets, bright band, etc.) was developed and tested. This initial step is particularly important when re-analysing old radar products, which were not corrected from many error sources. Secondly, methodologies for combination with daily and hourly rain gauges data were tested and then applied in order to optimally benefit from all information sources. Thirdly, an effort was made to produce quality data over each precipitation pixel.

Then, these QPE (data value and data quality) are used as input in a lumped rainfall-runoff model. Taking into account spatialized input in a lumped model is not straightforward: many tries are processed, from very simple use (mean areal precipitation over area of catchment) to more complex ones. An evaluation of each tries is computed at each stage with a hydrological viewpoint: best performances are awarded to solutions given the best streamflows simulation.