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How does our ignorance of rainfall affect the uncertainty of hydrological computations?

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Precipitation is an essential input to hydrological studies, fundamental for water balance studies, for hydrological simulation and forecasting. Since precipitation can be spatially and temporally variable, the configuration of the raingauge network can have a major impact on the accuracy of hydrological computations.

Hydrological good sense tells us that the less we know about catchment rainfall, the more uncertain our hydrological computations will be. Quantifying this trend, i.e. the sensitivity of our computations to the design of the rainfall measurement network is essential in a context of increasing requests and decreasing finance. We keep hearing about the need to "rationalize" observation networks. However, this rationalization, which often means a reduction of network density, can deteriorate our rainfall knowledge and can particularly increase the hydrological computation uncertainties.

We evaluate here on a large set of French catchments the impact of the rain gauge density and rain gauge network configuration on the uncertainty of several hydrological computations, based on the GR4J daily rainfall–runoff model [Perrin et al., 2003]. Four hydrological applications are considered: (i) daily runoff simulation, (ii) long-term average streamflow assessment, (iii) high-flow quantiles assessment, and (iv) low-flow quantiles assessment.

Perrin, C., C. Michel, and V. Andréassian (2003), Improvement of a parsimonious model for streamflow simulation, Journal of Hydrology, 279(1-4), 275-289, doi: 10.1016/s0022-1694(03)00225-7.