Calibration of a distributed rainfall-runoff model for the validation of rainfall forecasts based on lightning data

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FLASH project propose the use of lightning data to improve nowcasts and forecasts of intense rainfall events in the Mediterranean region. These rainfall forecasts can improve real-time forecasts of flash floods and supply short term warnings of the risk of flash floods. The final objective of FLASH project is the validation of improved rainfall forecasts, developed by different algorithms, procedures and products, by the use of hydrological models. A physically-based rainfall-runoff model can be used to encode all the available information through the calibration process, which is critical to represent the basin behaviour correctly. This calibrated model can be used to quantify the improvement of a rainfall forecast based on lightning data.

There are many uncertainties linked to the result of a deterministic rainfall-runoff model, which can not be taken into account by traditional calibration and its fixed set of model parameter values. Otherwise, a probabilistic calibration methodology has been developed to achieve the probability density functions that best represent the variability of each model parameter. A set of synthetic hydrographs have been calculated by repetitive simulations of the rainfall-runoff model from Monte Carlo simulations over the feasible space of each parameter. Objective functions have quantified errors between synthetic and observed hydrographs. Probability density functions for every parameter have been estimated from the solutions that minimize all the selected objective functions at the same time. This probabilistic calibration takes into account the uncertainties in the estimation of initial basin state, measurements of rainfall and discharge and forecast of future rainfall.

The proposed probabilistic calibration methodology has been applied to the RIBS distributed rainfall-runoff model, and will be applied to different Mediterranean river basins in Catalonia to validate the results of FLASH project.