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Performance and sensitivity of a spatially distributed hydrological conceptual flood model with snow components.

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In France, flash floods are responsible for a significant proportion of damages caused by natural hazards, either human or material. Hence, advanced modeling tools are needed to perform effective predictions. However for mountainous catchments snow modeling components may be required to correctly simulate river discharge.

This contribution investigates the implementation and constrain of snow components in the spatially distributed SMASH* platform (Jay-Allemand et al. 2020). The goal is to upgrade model structure and spatially distributed calibration strategies for snow-influenced catchments, as well as to investigate parametric sensitivity and equifinality issues. First, the implementation of snow modules of varying complexity is addressed based on Cemaneige (Valery et al. 2010) in the spatially distributed framework. Next, tests are performed on a sample of 55 catchments in the French North Alps. Numerical experiments and global sensitivity analysis enable to determine pertinent combinations of flow components (including a slow flow one) and calibration parameters. Spatially uniform or distributed calibrations using a variational method (Jay-Allemand 2020) are performed and compared on the dataset, for different model structures and constrains. These tests show critical improvements in outlet discharge modeling by adding slow flow and snow modules, especially considering spatially varying parameters. Current and future works focus on testing and improving the constrains of snow modules and calibration strategy, as well as potential validation and multiobjective calibration with snow signatures gained from in situ or satellite data.

*SMASH: Spatially-distributed Modelling and ASsimilation for Hydrology, platform developped by INRAE-Hydris corp. for operational applications in the french flood forecast system VigicruesFlash