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Comparison of hydrologic response between a conceptual and a travel time distribution model for a snow-covered alpine catchment using Alpine3D

Francesco Comola (1), Michael Lehning (1), Mathias Bavay (2), Raphaël Mutzner (3), Bettina Schaefli (4), Andrea Rinaldo (4), and Marc Parlange (3)

(1) CRYOS Lab., École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland (francesco.comola@epfl.ch), (2) WSL Institute for Snow and Avalanche Research, SLF Davos, Davos, Switzerland, (3) EFLUM Lab., École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, (4) ECHO Lab., École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Fully distributed models of alpine catchment surface processes typically use the geomorphological information provided by digital maps for describing the dynamics of rain, snow, soil and vegetation with much detail. Physically based hydrological models would also require a detailed description of the sub-surface characteristics, which is hardly available. With the increased use of detailed and highly distributed models of surface transport the lack of adequate treatment of sub-surface processes becomes the serious bottle neck.

In the past, conceptual hydrological models have been widely applied also for mountain catchments. Their parameters, however, require careful calibration since they do not generally have any direct physical meaning. This motivates the testing of a spatially-explicit hydrologic response model based on geomorphologic travel time distributions, in connection with the detailed description of alpine surface processes as provided by Alpine3D. Moreover, mountain basins are generally characterized by shallow soil layers and the runoff response is highly influenced by the significant topographical gradients, which may favour travel time distribution approaches based on geomorphological information.

In this contribution we present the comparison between the conceptual snowmelt/rainfall-runoff model currently implemented in Alpine3D and the spatially-explicit hydrological response model. In particular we characterize the response during snowmelt, considering patchy snow covers in the Dischma and Val Ferret catchments (Grisons and Valais, Switzerland). We show that the spatially-explicit hydrological response model, which explicitly accounts for geomorphologic travel time distributions reacts adequately to spatially varying water input from melting snow. We conclude that a spatially-explicit hydrological model presents an interesting new avenue for the simulation of the hydrologic response of mountain catchments with Alpine3D.