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Flood spatial coherence, triggers, and performance in hydrological simulations: large-sample evaluation of four streamflow-calibrated models

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Supplementary Material

Model illustrations

We provide illustrations of the model structures used in this work. Model schematics summarize the model states and fluxes. Schematics and equations use model-specific names as they are used in the model code. For clarity, these descriptions enforce that fluxes are shown in lower case and states in upper case. The model diagrams are based on:

- Snow17/SAC-SMA: analysis of the model's description (National Weather Service NOAA, 2002): https://www.nws.noaa.gov/oh/hrl/general/chps/Models/Sacramento_Soil_Moisture_Accounting.pdf and source code.
- TUW HBV: analysis of the model's source code (Viglione and Parajka, 2020).
- VIC: descriptions of VIC in Melsen et al. (2018); Melsen and Guse (2019) and on analysis of the v4.1.2h source code (https://github.com/UW-Hydro/VIC/releases/tag/VIC.4.1.2.h).
- mHM: analysis of the model's source code (https://git.ufz.de/mhm/mhm/-/tree/5.7) and a diagram provided in (Kumar et al., 2010).

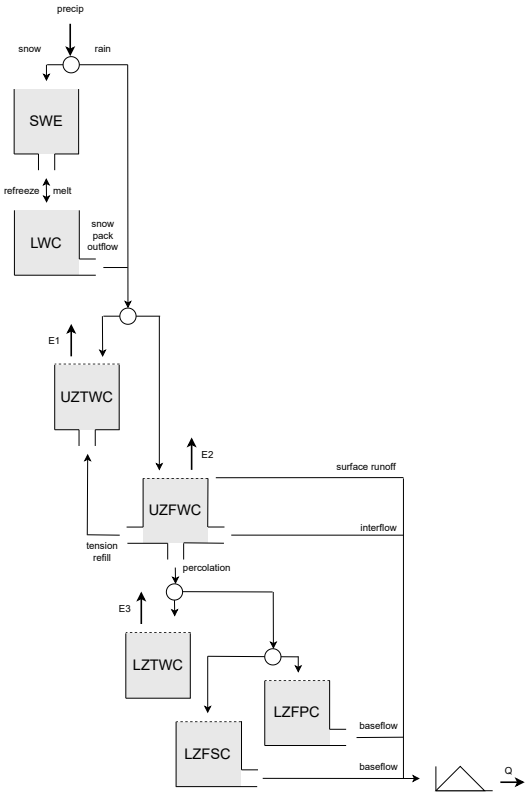

Figure 1. Structure of the Snow17/SAC-SMA model. Fluxes: precipitation (precip), snow, rain, snowmelt (melt), refreeze, snowpack outflow, evapotranspiration (E1, E2, and E3), tension refill, surface runoff, interflow percolation, baseflow, simulated discharge (Q). States: snow-water-equivalent (SWE), liquid water content (LWC), upper zone tension water contents (UZTWC), upper zone free water contents (UZFWC), lower zone tension water contents (LZTWC), lower zone free primary contents (LZFPC), lower zone free supplemental contents (LZFSC).

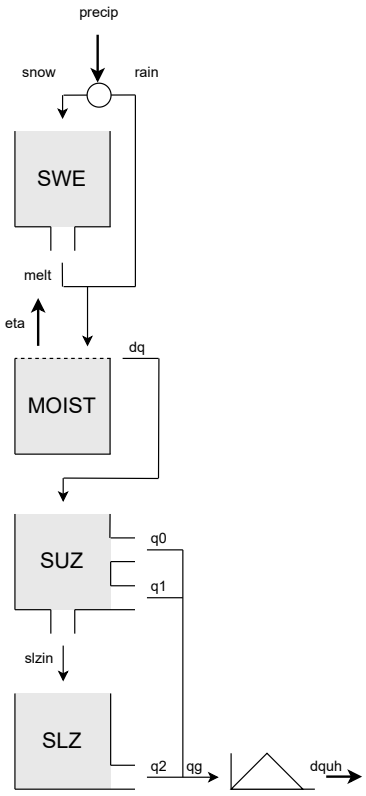

Figure 2. Structure of the TUW HBV model. Fluxes: precipitation (precip), snow, rain, snowmelt (melt), actual evapotranspiration (eta), runoff (dq), surface runoff (q0), subsurface runoff (q1), baseflow (q2), simulated runoff (qg), simulated discharge (dquh), input from upper to lower storage (slzin). States: snow-water-equivalent (SWE), soil moisture (MOIST), upper storage zone (SUZ), lower storage zone (SLZ).

VIC

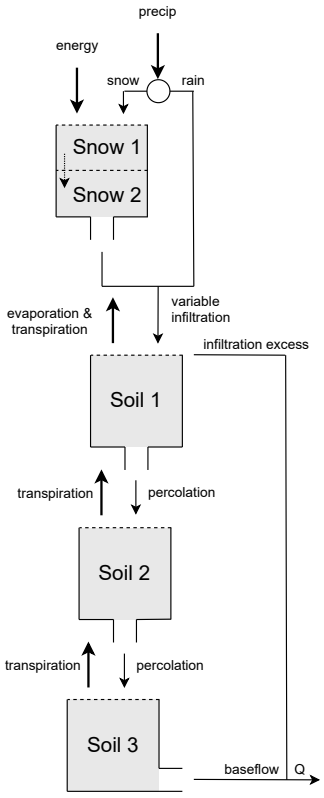

Figure 3. Fluxes: precipitation (precip), energy, snow, rain, variable infiltration, evaporation and transpiration, infiltration excess, baseflow, percolation, transpiration, simulated runoff (Q). Storage: snow layer 1 (Snow 1), snow layer 2 (Snow 2), soil layer 1 (Soil 1), soil layer 2 (Soil 2), soil layer 3 (Soil 3).

15 **mHM**

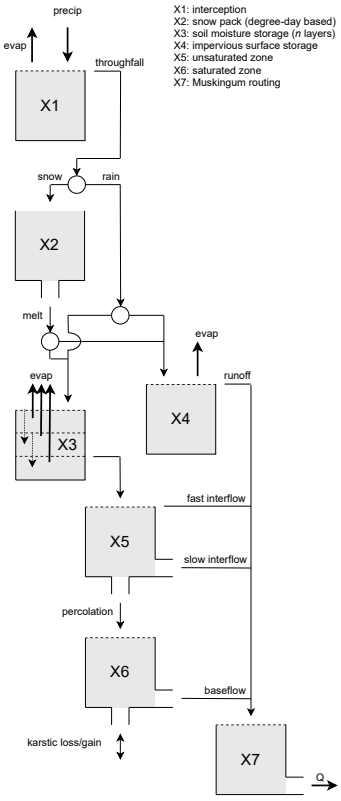

Figure 4. Fluxes: precipitation (precip), evapotranspiration (evap), throughfall, snow, rain, snowmelt (melt), runoff, fast interflow, slow interflow, percolation, baseflow, karstic loss/gain, simulated discharge (Q). Storage: Interception storage (X1), snow pack (X2), soil moisture storage (X3), impervious surface storage (X4), unsaturated zone (X5), saturated zone (X6), routing (X7).

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