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The Dischma river mystery: why does my snow hydrological model not work here ?

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During recent model development for hydrologic prediction in high Alpine areas, we noticed that a relatively simple snow hydrological model (SEHR-ECHO model) shows a surprising divergence from observed discharge over prolonged periods of time (several years) for the high Alpine Dischma catchment (Swiss Alps). We started a detailed data analysis including downstream discharge observations, the meteorological observations and a qualitative assessment of snow cover maps during these years (showing no particularly extreme patterns during these years). We also completed, a series of re-calibration experiments and a detailed comparison to the simulation results from other similar hydrological models and from a physics-based snow model (Alpine3D). All models use their own description of the precipitation and temperature input fields that are derived from a similar set of meteorological stations. The simple models compute snow melt from air temperature alone and use similar hydrologic process descriptions.

All three simple models show a similar divergence from observed discharge data, especially during summer months. A comparison to discharge simulations from the model Alpine3D shows that this physics-based model is able to reproduce the observed discharge relatively well during these summer periods. It shows, in exchange, a surprising divergence from observed discharge during early spring, when the calibrated simple models fit the observed data well.

These results might point towards a misfit of the simple models to potentially wrong discharge observations during early spring or indicate that the physics-based model has problems reproducing snowmelt-induced discharge during this period. In conclusion, the question remains to date unanswered what might cause the departure of the simple snow model simulations from the observed discharge data. We look forward to the discussion with modellers and experimentalists to collect new ideas on how to resolve this mystery.