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Integrating snowfall limit forecasts to improve hydrological modeling

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Flood forecasting in mountainous areas requires accurate partitioning between rain and snowfall; an incorrect snow/rainfall limit (on daily or sub-daily timescales) typically implies a significant over- (or under-)estimation of the source catchment areas contributing to runoff and infiltration. This study details the development of a snow/rainfall partitioning method which incorporates snowfall limit information from Limited Area Models (LAMs) to improve catchment-scale hydrological modeling. LAMs consider the vertical, humid, atmospheric structure including wet bulb temperature in their snowfall limit calculations. Such an approach is more physically-based than inferring snowfall limit estimates based on dry, ground temperature measurements, which is the standard procedure in most hydrological models. A case study involving complex topography in the Swiss Alps demonstrates the potential of the developed method with the integration of COSMO forecast re-analysis snowfall limit information. Such data and the new method are proven here to significantly improve runoff simulation, particularly in the spring when a large part of the catchment is close to saturation. Integrating LAM snowfall limits thereby provides good estimates of runoff contributing areas, with practical implications for operational hydrology in Alpine regions.