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A parsimonious water balance model for runoff assessment in mountainous basins.

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Water uses and many economic activities of the piedmont regions rely on the abundant water resources of the European Alps. The stability of flow seasonality is a key element for some water uses and depends on factors that control runoff regimes at the catchment scale. Runoff regime prediction, however, represents a challenging topic because of the effects of the complex topography and the large precipitation variability, accompanied by scarce measurement points. Moreover snow accumulation and snow melt are dominant, but largely unknown, mechanisms in the hydrologic cycle of mountainous basins, influencing the timing and the volumes of the runoff.
In this work we present a simple and parsimonious water balance model developed to reproduce the main features of the runoff regime of small mountainous basins. The model works on a monthly scale and partitions precipitation into snow and rainfall depending on temperature values, which also regulate evapotranspiration. Runoff is calculated as the sum of two different contributions: net precipitation (total rainfall minus actual evapotranspiration) and snowmelt, modeled with a “degree-month” approach. We first investigate the effects of different physical catchment descriptions (lumped vs distributed) and the possibility of describing the day-by-day temperature variability within the month using a simple statistical formulation. A procedure to take into account the problem of the precipitation undercacth is also proposed.
The ability of the model to reproduce the river regime is tested in various river basins of Northern Italy by comparing observed and simulated runoff. The results are also compared with those obtained by two statistically based procedures for river regime regionalization. The parsimonious parameterization and the limited input information required by the model allows its application in ungauged basins, not only for water resources and regime investigation but also for the evaluation of the impact of climate non stationarities.