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Coupling meteorological and hydrological models for river discharge forecasting. Part II: A case study about hydropower generation management

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In a companion contribution, a method for the downscaling of precipitation fields from general circulation models to the river catchment scale is proposed. The analysis approach outlined there is now tested in a case study, where precipitation forecasts are used in an application related to power production. The Vallarsa catchment has an area of approx. 50 km^2 and corresponds to a mountain region with altitude ranging from 585 to 2230 m, with average annual precipitation of about 1100 mm. Runoff is captured by two distinct reservoirs (Speccheri, 800 m a.s.l., with a volume of approx 10^7 m^3, and Busa, 585 m a.s.l. and $5{\cdot}10^5$ m^3), both serving the same hydropower plant located in Ala (Trento). The water collected in the Busa small reservoir is lifted by pumps to the larger basin of Speccheri and then channeled to the power plant for production. The society managing the plant sells power on the italian electricity market in hours of peak energy consumption during the day, and buys energy in the nighttime to supply water pumps at the Busa basin. Quantitative forecasts of rainfall and discharge in the tributaries of the two reservoirs are needed in order to plan dam operations with a two-days advance, minimizing the dam spillover and the loss of water resource. The downscaling approach cited above is applied to provide an estimation of the expected rainfall, and is proved to minimize the mean error in the precipitation estimate, although some shortcomings remain in the exact quantitification of the rainfall peaks. A semi-distributed surface runoff model is then used to estimate the river discharge at the inlets in the Speccheri and Busa reservoirs. Particular attention is devoted to modeling the snowmelt contribution to runoff, which is particularly relevant during springtime. As an alternative to physically based hydrological models we explore the feasibility of an Artificial Neural Network approach to relate the reservoir level directly to the rainfall forecast.