Geophysical Research Abstracts
Vol. 14, EGU2012-4665-2, 2012
EGU General Assembly 2012

An approach to improve precipitation estimation to model the water budget in Alpine catchments

E. Mair (1), G. Bertoldi (1), S. Della Chiesa (1,2), G. Niedrist (1,2), L. Egarter Vigl (1), U. Tappeiner (1,2)

(1) Institute for the Alpine Environment, EURAC Research, Bolzano, Italy (giacomo.bertoldi@eurac.edu, 00390 471055399), (2) Institute of Ecology, University of Innsbruck, Sternwartestraße 15, A 6020 Innsbruck, Austria.

Accurate quantification of precipitation is still one of the major sources of uncertainty in quantifying the water budget of Alpine catchments. In fact, besides increasing data availability, usually most of the stations are located in the bottom of the valleys, while, at high elevations, rain gauge accuracy is limited by snow and wind, with strong underestimation of the total precipitation. Similar problems exist for snow measurement devices.

In this contribution we present a novel empirical approach to improve precipitation estimation using rain gauge data, snow height and standard meteorological observations, and we evaluate the improvements in estimating the water budget of the Mazia Valley (100 km^2 - Central Alps - South Tyrol, Italy). In fact, due to the screening effect of the surrounding mountains (mostly glaciated, maximum elevation: 3750 m a.s.l.) this valley has a relatively dry cold continental climate with strong precipitation gradients.

In the framework of the projects “Klimawandel” and “HydroAlp”, 17 monitoring stations were installed to measure standard micrometeorological variables, vegetation properties and soil moisture.

For a correct climate analysis, a distinction between snow and rainfall is necessary. Due to energy limitations in remote alpine areas no heated rain gauges were installed. However, four stations are equipped with snow height sensors, from which snow data can be retrieved. For other stations the calculation of the snow water equivalent was more complicated because of the lack of snow height sensors.

In the empirical approach, for every registered precipitation data record snow height change was reviewed and compared to air temperature and relative humidity, as well as to the calculated wet bulb temperature, in order to distinguish between rainfall and snowfall events. Also the global solar radiation was controlled to identify melt water production coming from accumulated snow on the top of the unheated rain gauges. With a formula for the snow density depending on air temperature and wind speed the water equivalent of the fallen snow was calculated, and added to the precipitation data series. Analyses were carried out for the hydrological years 2009-10 and 2010-11.

Simulations of the water cycle with different precipitation input scenarios were carried out with the physically based eco-hydrological model GEOtop. When only rain gauges information was used as input, a strong underestimation of snowmelt runoff occurred, while the proposed approach showed a significant improvement in model performance.
Results show how it is crucial to include the information on snow depth, wind speed and air temperature coming from high elevation stations in order to correctly predict the amount and the seasonality of runoff production in Alpine catchments.