Water availability evaluation for a sustainable management of groundwater resources in mountainous areas

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Groundwater resources in mountain areas is strategically important to maintain adequate water supply both for drinking supply and for other anthropogenic activities in many parts of the world (Somers & McKenzie, 2020). This resource is getting more and more important considering that water demand in mountain areas is growing, 1.4 billion people will depend critically on mountain runoff by 2050 (Viviroli et al., 2020) and it should help to better cope with future climate scenarios to satisfy the increasing demand for clean and safe water. Within this framework, a reliable quantitative estimation of the resources in the different groundwater bodies is necessary to support their management.

Two groundwater bodies (GWBs) of about 200 km² width each, respectively located in the central Alps and in the southern Apennines, have been studied to determine the availability of local water resources. Both the GWBs are mainly composed by carbonate rock masses, extensively karstified, hosting many springs constituting important sources of safe and clean water for the local districts. The areas differ for climatic, geomorphological, and land use - land cover conditions that affect water distributions within each area. Groundwater budgets of the selected GWBs were determined through hydrogeological approaches that make extensive use of data collected and managed by the local public authorities (Regional Environmental Offices and Agencies) and by the local water managers. Groundwater budgets were evaluated resolving the classical analytical solution where the inflows are equal to the outflows within each GWB, including the budget terms: precipitation, evapotranspiration, surface runoff and groundwater recharge/discharge. Groundwater budgets were carried out on a yearly basis for the period 2014 – 2018, including an extremely wet year (2014) and a severe dry year (2017), representing two opposite climate scenarios strongly influencing groundwater recharge and storage.

The application of different approaches for the evaluation of the single components of the groundwater budget allowed to: i) identify the parameters that mostly affect the evaluation of each single component; ii) determine the general uncertainty in the estimation of groundwater resources availability (i.e., groundwater recharge and storage); iii) evaluate the consistency of public datasets to estimate groundwater budget and iv) highlight the necessity and usefulness of implementing the public datasets to increase the reliability of the estimation of groundwater resources availability.

Somers L.D. & McKenzie J.M. (2020) - A review of groundwater in high mountain environments. WIREs Water, 7(6), e1475.

Viviroli D., Kummu M., Meybeck M., Kallio M. & Wada Y. (2020) - Increasing dependence of lowland population on mountain water resources. Nat. Sustain., 3, 917-928.