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Using groundwater levels survey, chemical analyses and isotopic data for estimating the groundwater flow and the relative contributions of different carbonate aquifers and surface waters: an example from southern Italy

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In the evaluation of aquifer resources, the calculation of groundwater balance by means the definition of the incoming water (recharge) and the outgoing water (discharge) is crucial. The water balance equation is generally easy, but the definition of some of the incoming/outgoing water such as evapotranspiration, subsurface aquifer discharge and others, need specific estimations by empirical formulae, approximations and different surveying methods.
Moreover, the knowledge of the aquifer geometry, in terms of size and shape, is critical to evaluate in detail the volume of groundwater stored. Finally, the definition of all the parameters of the balance can indicate the groundwater flowpath, that cannot be assessed otherwise, due to the high depth of the groundwater table and the consequent absence of groundwater monitoring points.
The case study (> 250 km2) concerns the Mt. Maggiore and Mt. Tifata carbonate mountains, located in the southern part of the Italian peninsula. The hydrogeology in this area is relevant, due to the presence of well fields for drinking water supply, with a pumping rate sometimes very close to the mean recharge.
The area is characterised by a Mediterranean pluviometric regime with a single winter maximum (in November) and a dry summer (min in August). The average rainfall ranges between 1350 mm/y and 1050 mm/y. The temperatures range near the coast between 9°C in January and 25 °C in July, while, on the mountain relief, an average of 3 °C in winter and of about 20 °C in summer.
The total groundwater resources have been evaluated in about 150 Mm3/y.
The greater uncertainties in the groundwater resources evaluation are in the definition of the recharge area and the aquifers geometry and connections with the Volturno river, flowing between the two mountains. To face with these problems the hydrogeological study included groundwater levels survey in the surrounding plains, chemical and isotope (hydrogen and oxygen stable isotopes) analyses of groundwater and surface waters.