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"A novel isotopically-based conceptual model of the Mt. Amiata aquifer (Central Italy)": new insights on recharge mechanisms, hydrodynamics and resilience to climate changes".

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Groundwater bodies are important water supplies since they represent the safest and most reliable sources for drinking water. They are also regarded as reliable "climatic archives", being able to "store" information on climate variability at both local and global climate conditions. The shallow aquifer hosted in the Mt. Amiata volcanics (Quaternary) represents the most important freshwater reservoir of southern Tuscany (central Italy), currently providing nearly 37•10̂6 m3 of drinkable water to the inhabitants of both Southern Tuscany and Northern Lazio regions. Although hydrogeological and geochemical studies have been carried out in the last decades, this groundwater system is still poorly constrained and, thus, deserves to be further investigated in detail.
The present work has a two-fold purpose aimed at: (i) reviewing the isotopic features characterizing the meteoric recharge over the area and (ii) tuning the circulation model in of the Mt. Amiata aquifer. Additional goals are to: (i) evaluate the response of this groundwater systems to climate changes, and ii) provide useful hints to the local authorities for future water management actions addressed at protecting this resource.
Previous data were combined with those acquired with a network consisting of 8 different rain gauges (passive samplers) deployed from January 2017 to December 2018, over the Mt. Amiata area installed at different altitudes: between about 300 (foothills) and 1,700 m a.s.l. (mountain summit). The rainfall levels were monthly or bi-monthly measured along with the flow rates of selected springs. Rainfall and spring waters were collected for stable isotopic determinations (oxygen, deuterium) and tritium analyses and compared to those obtained from between December 2010 and January 2012 in same sites. In 2017 a significant decrease of precipitation with respect to those of 2011 and 2018 occurred and the overall aquifer yield was recognized to slightly diminish over a similar time span. Rainfall showed significant stable isotopic variations on the (stable) isotopic signature, the heaviest values being measured in 2017. In addition, the tritium values determined at the summit of Mt. Amiata and related to the first three months of year 2018, were sensibly lower than those recorded in 2011. Isotopically, a good agreement between rainfall vs. groundwater system was observed, suggesting that the aquifer can be used as a proxy for local climate changes. Eventually, three main hydrogeological patterns within the shallow Mt. Amiata aquifer were suggested, each one characterized by short-, medium- or long-term travel times, respectively, and a novel equation for a local meteoric water line was computed.