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Sensitivity to climate change of snowmelt recharge in a mediterranean volcanic aquifer

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When compared to other terms of the surface hydrologic balance, snow cover dynamics is quite often the slower one. Fluctuations in snow dynamics may be then strongly coupled to those aquifers that get substantial recharge from snowmelt. On the other side, is expected to have a dramatic impact on snowfall, especially in regions with strong climate gradients such as the Mediterranean area. We analyze here the current and projected dynamics of the phreatic volcanic aquifer of Mount Amiata, in central Italy. Higher elevations of the recharge zone, around 1,700 meters, experience about 30% of precipitation in the form of snow, and snowmelt is found to contribute to more than 50% of recharge. The vicinity to a temperate sea enhances the interannual variation of precipitation in general and snowfall in particular. The characteristics of the aquifer are such that percolation/seepage to/from deeper layers may be considered negligible in the aquifer mass balance. A continuous belt of peripheral springs, located where the $$$$ bedrock intersects the surface, account for the whole aquifer discharge with a good approximation. The most important ones, such as the S.Fiora spring with about 0.6 m3/s average discharge, have been continuously monitored for more than two decades and provide a very good measure of the groundwater response to surface hydrologic variability. All these aspects make the Amiata aquifer a perfect candidate for assessing the sensitivity of groundwater dynamics and recharge to climate fluctuations. This sensitivity is here assessed, as usual in many climate change studies, calibrating a physically-based model first to reproduce the current climate both in terms of average and main temporal variations, then applying climate change scenarios eventually downscaled to match the required model resolution. The coupled surface-aquifer model MOBIDIC is used at 100m and 1 day resolution, so that very fine details of the system can be evaluated, such as the flow in the hydrographic network and the discharge from single springs. Due to the importance of the snowmelt in the case study, the snow dynamics module has been calibrated using a long series of snow extent estimates from Landsat imagery.