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The past is the key to the future: how the groundwater recharge to carbonate aquifer in central Italy has changed in recent decades

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Carbonate aquifers are important resources especially in mountainous regions because they are able to store huge quantities of groundwater in the humid periods and gradually release them during dry periods. Water quality is often excellent, hence they are regarded as strategic both for human consumption as well as for environmental uses. In many parts of the world this resources are largely exploited to supply large urban areas and possible negative effects of climate changes to their discharge is a great concern. The present study aims to analyze how the regimen of recharge to groundwater is affected by eventual non stationarity in temperature and precipitation during past decades. The case study (235 km2) is located in central Italy and feed the Nera river with an average discharge of about 3.3 m3/s. Daily data from 16 (7) stations monitoring precipitation (temperature) covering the area of interest over the period 1951-2013 were spatially homogenized by means of kriging at a 1 km2 resolution. The resulting daily maps were used to force a simple spatial distributed soil water budget model considering the local hydrogeological structure. The reconstructed daily recharge to the aquifer was then compared to the discharge of the groundwater system observed in the period 1991-1993 and 1996-2012 (discontinues measurements). Results show that minimum and maximum temperatures present a significant (95%) positive trend after the 1980, in acceleration after 1990 (+0.055 (+0.07)°C/yr for the maximum T; +0.03 (+0.06) °C/yr for the minimum T, for the periods 1980-2013 (1990-2013)); precipitation and recharge to the aquifer present a non-significant (95%) negative linear trend over the period 1951-2013 (-1.5 mm/yr and -3 Ls-1yr-1 respectively) without obvious changings points, indicating in first approximation a marginal impact of temperature non stationarity on the recharge. The decrease in the recharge to the aquifer, although not statistically significant, represents a reduction of 5.5% of the groundwater system discharge over the past 60 years.