EGU23-17061, updated on 27 Apr 2024
https://doi.org/10.5194/egusphere-egu23-17061
EGU General Assembly 2023

Temporal variations of groundwater tables and implications forsubmarine groundwater discharge: a case study the Mediterranean Spanish coast

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Submarine groundwater discharge (SGD) has received increasing attention as it has been proven to be a fundamental hydrological process that supports many coastal biogeochemical cycles and, even more, social-ecological systems and their implications in saltwater intrusion dynamics. Fresh SGD (FSGD) is very dependent on climatology, whereby, in an analogous form as a river discharge, this event is tightly attached to the aquifer . This research aims to evaluate the impact of climate change on FSGD based on historical precipitation and groundwater level data and future climatic projections (precipitation and temperature).

The daily precipitation and potential evapotranspiration time series from the public source were recorded between January 1, 1996, and October 31, 2022, in Cabrils hydrometeorological station in Northeastern Spain, where the trend shows a brief decrease in the precipitation in the latest years. The Box-Ljung forecasting method with an autoregressive integrated moving average (ARIMA) model was used to predict the changes in precipitation for projected years. The ARIMA models, validated with 26 years of data (1996–2022), were used for predicting precipitation up to 2050. To estimate the effect on FSGD, piezometric data from the Argentona alluvial, close to the Cabrils station, was used. From the water table data, the hydraulic gradient can be defined and FSGD calculated based on Darcy's law.

Based on the precipitation series, recharge is calculated compared with groundwater historical levels of the aquifer in the coastal zone, estimating its effect on groundwater discharge. With the rise of extreme events due to global warming, we could face a change in FSGD dynamics in the years to come. With high precipitation events expected to be more frequent, FSGD may be more discontinuous and with higher peaks, with direct implications in saltwater intrusion dynamics and the coastal biogeochemical cycles.

Keywords: Submarine groundwater discharge, Aquifer recharge, Precipitation, Climate change, Extreme climate events.