



## Identification of large-scale aquifer behavior across three decades of groundwater storage change in the western Mediterranean region

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The Mediterranean region is undergoing increasing climatic and anthropogenic pressures that challenge water security. Groundwater is a strategic resource for agriculture and water supply in the region, buffering climate change impacts. While previous studies have focused on specific aquifers' water budgets and trends at plot scales, regional dynamics remain unclear. One of the challenges for assessment is the uneven distribution of access to groundwater level monitoring data, as it's not centralized and publicly accessible in most Mediterranean countries. Here we present results that focused on analyzing the groundwater level trends in the countries with the most available groundwater level information: France, Portugal, and Spain. This study contributes to our understanding of groundwater dynamics under varying drivers and groundwater-depletion mitigation options.

As a system with 'memory,' analyzing decades of time series is essential to understand the changes, vulnerability, and resilience. For 1985-1994, 1995-2004, and 2005-2014, a trend analysis was performed on the groundwater levels for piezometers ( $n=844$ ) covering these periods with considerable completeness. We identified clusters of similar groundwater level developments and categorized them into nine aquifer archetypes, for example: stable water table depth, continued depletion, groundwater level recovery, and local gaining or depleting water levels occurring in each of the three decades. Furthermore, the influence of climate and geological variables on these temporal evolutions were analyzed. Overall, about a third of the studied piezometers showed trends in at least one of the periods. Increasing depths were observed more abundantly in the first period (1985-1994), while decreasing depths were more abundant in the last period.

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