Evidence and causes of groundwater level fluctuations in a semiconfined mediterranean coastal aquifer. The ocean tide effect

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ABSTRACT

Coastal aquifers are complex because of the combined influences of marine oscillations and landward groundwater forces. The piezometric level is affected by these natural processes, each of which has its own cyclicity and range, resulting in a complex sequence of water level. This paper reports a field study that was conducted from May 2012 to July 2013, monitoring salinity using electrical conductivity (EC) measurements and groundwater levels in a coastal detrital aquifer in Almería (SE Spain). The monitoring wells used were installed near the top of the tidal zone on the beach front. Data on tidal level and the significant wave height were collected by the National Oceanographic Administration. The major objective of this study is to analyse the groundwater level fluctuations affected by rainfall, tides and waves, and to determine their implications on seawater intrusion dynamics.

Infiltration of precipitation is the most common and immediate cause of groundwater level rise. The study period was particularly dry and during this period the rise in groundwater level was approximately 25-30 cm, not identifying a seasonal cyclicity. Sea level fluctuations due to tidal action have had a clear influence on groundwater level. The maximum amplitude of sea level variations due to tides was 40 cm, causing groundwater level variations up to 15 cm. Tide-induced groundwater fluctuations were modeled using the analytical solution for unconfined coastal aquifers proposed by Li et al. (2000). To establish the degree of confinement in the studied aquifer the analytical solution proposed by Jiao and Tang (1999) has also been used. Respect to the influence of waves, there is a clear correlation between maximum wave height and the peaks corresponding to water table elevation. The main conclusion arrived at in this work is the greatest effect of precipitation on piezometric level, followed by the wave action, while tidal cycles caused variations of smaller amplitude in the piezometric logs. All these oscillations affect the position of the fresh water-seawater interface. The attenuation of tidal amplitude at the monitoring wells compared to the simulations calculated reveals certain differences, and this is due to the semiconfined nature of the aquifer. Groundwater conductivity and temperature are also seen to change with respect to the phase of the tides, with a symmetrical lag similar to that of water level in the well.

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