Influence of the sea level oscillations on groundwater temperature and salinity in the coastal Motril-Salobreña Aquifer

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ABSTRACT

Continuous records of electrical conductivity (EC), temperature and groundwater head were acquired from a long perforated borehole, situated 300 meters from the coast, to analyze the dynamic behaviour of the freshwater-saltwater contact in the detrital Motril-Salobreña aquifer (Southern Spain). The borehole penetrates 250 m into the unconfined aquifer and allows the water enter at the different depths of 39 m, 86 m, 132 m and 236 m. Temperature-pressure sensors were installed at the first two depths and temperature-EC-pressure sensors at 132 m and 236 m depth, to collect hourly measurements.

This work aims to determine the differences between hydraulic head fluctuations and temperature and EC fluctuations due to the influence of tidal oscillations, comparing collected data during 1-year period. Spectral analysis was carried out to prove the existence of diurnal and semidiurnal frequencies, as well as lower frequency peak related to spring and neap tides, whose signal is less visible. The response of the groundwater to the sea tide is better observed at a depth of 132 meters, where different time-lags for semidiurnal frequency were detected between tidal fluctuations and EC and temperature fluctuations. Temperature and EC fluctuate almost synchronized with a mean time-lag of approximately 8 and 9 hours, respectively, relative to the tide. However, groundwater head reacts faster to sea level fluctuations and it is estimated a mean time-lag of 2 hours relative to the tide, which means there is a difference of approximately 6 and 7 hours between temperature and EC fluctuations and groundwater head fluctuations. The previous time-lag values were obtained employing the maximum peaks of the oscillation for the analysis; nevertheless, if the minimum peaks are used, these values are slightly higher. Both for temperature and for EC, there is a small variation in the wavelength of the crests and the throughs of the oscillations considering that the average of periods of the maximum value are shorter than the average of periods of the minimum values.

At a depth of 236 meters, all these time-lags are shorter than those calculated for a depth of 132 meters. Peak-to-peak average amplitudes also vary with depth, from 0.04ºC (-132 m) to 0.03ºC (-236 m) in temperature time series, and from 3800 µS/cm (-132 m) to 380 µS/cm (-236 m) in EC time series. Temperature oscillations can not be interpreted in a clear way from collected data at a depth of 39 m, while at a depth of 86 m, the oscillations are more evident but not enough to detect the main peaks regularly. These variations in the temperature and EC oscillations may be due to different lithological composition of the aquifer and the depth where data was obtained.