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Influence of oceanic tides on the piezometric levels of the detritic aquifer of Doñana National Park (Spain)

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Doñana National Park is located in the SW of Spain. This Park is considered one of the most valuable wetlands in Europe. It is formed by an intricate net of marshlands and phreatic lagoons covering an area of 270 km2. It extends along the coast between the estuaries of the Guadalquivir and Tinto rivers. The main aquifer of the Park is Almonte-Marismas which covers 2640 km2 of the south western part of the lower Guadalquivir basin. It is composed of Miocene and Quaternary sediments: silt, sand and gravel. The alluvial deposits of fine materials located in SW are partially covered by eolian sands, while in the central plain they are covered by estuary and marshland silt and clay containing some sand and gravel, with a total thickness of up to 100 m. The depth of the eolian sands varies from over 100 m at the coast to approximately 10 m at the northern edge of the region. Groundwater predominantly circulates from the north-east to the south and then east before discharging to the Atlantic Ocean or north into the La Rocina stream, the main permanent tributary to the marshland.
18 piezometers with hourly data have been studied to establish the influence of oceanic tides. These piezometers are located on the eolian sands. The distance of piezometers to coast line ranges from 3km to 1km. The depth of the piezometer filters varies from 1m to 140m. The aim of this paper is to apply a spectral analysis in order to determine the presence and statistical significance of cycles from piezometric head measurements.
It has been taken into account cycles than show more than 95% of confidence level. In the most cases piezometric heads show cycles related to oceanic tides and moon cycles, but some piezometers show less influence or, even, neither. In general, the clearest influence of oceanic tides is present in piezometers with the filters close to surface. Only one piezometer shows both daily and monthly influence with its filter between 1m and 2m depth. The groundwater flow in this area is quite complex, as shown in the results of this study. In this sense, this area presents high vulnerability to groundwater exploitation.