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Groundwater temperature patterns in the freshwater-saltwater contact zone in coastal aquifers. The Motril-Salobreña Aquifer (SE Spain)

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The groundwater temperature in the freshwater-saltwater contact zones shows a characteristic pattern completely different from that monitored in other parts of the coastal aquifers. The temperature-depth profiles of seven wells in the Motril-Salobreña aquifer (southern Spain) were used as a basis for a comparative analysis involving various parameters to determine their relations and factors influencing the different trends. The temperature profiles show a shallow belt of variable temperature (up to 5 ºC) that can reach depths in the groundwater ranging from 15 m to 45 m. There is an influence of ambient temperature on all the profiles, with a lag time of two to five months. Furthermore, there is a clear influence of the Guadalfeo River (the main source of recharge to the aquifer) reflected in a decrease in temperature coinciding with peak flow rates in the river and the highest water tables in the aquifer during the springtime when the river flow derives mainly from snowmelt from Sierra Nevada. In the autumn, there are secondary peaks in river flow rates due to rainfall, and the river temperature is higher than in spring. In this case, the groundwater temperature rises. This influence fades with distance from the river. In the summer, when the river is dry, the temperature profiles are straight, with no effect on groundwater temperature.

Three of the wells, the closest ones to the coastal line, are exception. However, as there is no clear coincidence between temperature valleys and peaks in the river flow rate, making it difficult to establish a relation between the groundwater temperatures and the river recharge in these two cases. Instead, we must recur to a discharge-zone flow pattern, typical of the freshwater-saltwater contact in a coastal aquifer (Glover, 1959), that generates vertical upward fluxes due to the density contrast when is reaching the saline wedge. In this case is even more pronounced due to the fact that the Motril-Salobreña aquifer has quite a high horizontal hydraulic gradient, which in turn causes an equally large vertical hydraulic gradient in the discharge zone. These vertical flows hinder the mixing of water from surface recharge with existing aquifer water. This model is based on the presence of artesian wells in sectors close to the coastline, indicating a significant discharge zone of freshwater into the sea.