Field data and numerical simulation of a fresh water lens below a small island with a strong tidal regime

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ABSTRACT

Small (diameter < 1 km) islands have important ecological values, which are largely dependent on the presence of fresh groundwater. Yet they are often poorly investigated from a hydrogeologic point of view. Temporally-variable boundary conditions such as groundwater recharge and tidal fluctuations have been shown to exert an important control on the shape of the fresh water lens and width of the transition zone between fresh and saline groundwater (Underwood *et al*., 1992). This study aims to elucidate the controls of these temporally-variable boundary conditions on the development of the interface between fresh and saline groundwater and the volume of fresh water below a small island in the Ria de Aveiro Lagoon in Portugal.

Field data, including multi-electrode resistivity measurements, reveal that the semi-diurnal tide drives the oscillatory movement of the interface between fresh-and saline groundwater. Data from multi-level observation wells show that the interface resembles the shape of an error function, suggesting that dispersive mixing due to the continuous tidal forcing is an important process. A numerical groundwater model was developed to simulate transient groundwater flow and solute transport under variable-density conditions. The objective of the model was to gain a better conceptual understanding of the flow and salinity patterns beneath the island. An adapted version of SEAWAT version 4 (Langevin *et al*., 2007) was used to take into account the effect of tidal variations and a moving shoreline on a sloping beach. The model reveals the complicated nature of the groundwater flow pattern beneath the island and the potential role of mixed-convective flow related to the outflow of fresh groundwater beneath the sloping beach face.

REFERENCES

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