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Global assessment of coastal aquifer state and its vulnerability respect to Sea Water Intrusion. Application to several Mediterranean Coastal Aquifers.

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In this research we propose a method for a global assessment of coastal aquifer state and its vulnerability to Sea Water Intrusion (SWI). It is based on two indices, the MART index, which summarize the global significance of the SWI phenomenon, and the L_GALDIT for a lumped assessment of the vulnerability to SWI. Both of them can be useful as a tool to assess coastal groundwater bodies in risk of not achieving good status in accordance with the Water Framework Directive (WFD, 2000) and to identify possible management alternative to reduce existing impacts. They can be obtained even from a reduced number of data (in the MART case only depend on the geometry and available aquifer state data) with simple calculations, which have been implemented in a general GIS tool that can be easily applied to other case studies.

The MART index in an aquifer is related with the total mass of chloride in the aquifer due to sea water intrusion and can be obtained by simple linear operations of volume and concentrations that can be deduced from a schematic conceptual cross-section approach (orthogonal to the shore line) defined to summarize the intrusion volume in the aquifer. At a certain historical time, this representative aquifer cross-section can be defined in a systhematic way from the aquifer geometry, the specific yield, and the hydraulic head and chloride concentration fields that can be deduced from the available information by using appropriate interpolation methods. Following the proposed procedure we will finally obtain a summary of the historical significance of the SWI in an aquifer at different spatial resolution: 3D salinity concentration maps, 2D representative conceptual cross-section of intrusion and the MART lumped significance index. The historical evolution of the MART can be employed to perform a global assessment of the resilience and trends of global significance of the SWI in an aquifer. It can be useful to compare the significance of intrusion problems in different groundwater bodies and temporal periods. Some assumptions and hypothesis assumed in this analysis of the significance of SWI were also applied in a previous research work, the SITE index (Ballesteros et al., 2016).

Finally, we have also obtained vulnerability maps to SWI by applying the GALDIT method (Chachadi and Lobo-Ferreria, 2007). As in the analysis of the significance, we propose to apply an analogous procedure to summarize the vulnerability of the aquifer to SWI at different spatial scale: 2D vulnerability maps, 2D representative conceptual cross-section of the vulnerability and a global vulnerability index (L_GALDIT). The historical evolution of the L_GALDIT could be also employed to perform a global assessment of the resilience and trends of the global vulnerability of the SWI in an aquifer. While MART index is calculated using only physical variables, L_GALDIT employs weighted qualitative characteristics based on expert criteria. It can be useful to combine both MART and L_GALDIT indices in order to obtain a general knowledge of SWI in an aquifer.

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