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Variable density flow modelling in coastal aquifers of Greece and Tunisia

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Physical-based models for groundwater flow and contaminant transport are compiled for 3 of the porous medium aquifer systems of MEDSAL'S pilot sites: Rhodope and Samos in Greece and Bouficha in Tynisia. Each of the three compiled models shares the same principles of salinization front geometry and evolution; that of a transition zone between fresh and salt water masses, through the adoption of the variable density flow approach. Two well-known and highly documented and scientifically justified modelling suites of codes that both offer numerical solutions, have been used for this exercise: the finite element code FEFLOW for Rhodope pilot and the coupled finite difference MODFLOW-SEAWAT suite for Samos and Bouficha pilots.

Despite the varying degree of sophistication and detail of the three compiled models, all performed satisfactory and successfully simulated the major evolution mechanisms that are dominant in each of the studied systems. All three models were capable to replicate the seawater intrusion and furthermore provide hints to identify the existence of additional mechanisms that affect the salt content evolution in the aquifer systems. Depending on the data availability and the capability to approximate the sources of salinity based on these, additional salinization processes could be represented to a higher or lower degree. In any case however, the existence of such mechanisms will become apparent either quantifying them, or through partial divergence of field data to modelled results.

A significant conclusion of the modelling exercise is that a single and complete simulation of complexed systems with multiple salinization mechanisms is not easy to be performed and requires considerable effort that needs to be based on data availability, detailed knowledge of the structure and evolution of the system, as well as, deciphering well the controlling mechanisms before attempting to compile the model.