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A 3D numerical groundwater model for sustainable groundwater management of the coastal aquifer system of the Arborea plain, Sardinia (Italy)

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Coastal areas around the Mediterranean basin concentrate population, multi-sector economic activities and agricultural activities. This induces an important need in fresh water and high solicitation of coastal aquifers, which can lead to salt water intrusion. This issue, added to contaminated surface water percolating towards the aquifer, and along with climate change show the urge for innovative groundwater management, especially in coastal areas. The PRIMA Sustain-COAST European project aims at exploring innovative governance for sustainable coastal groundwater management and pollution reduction in the context of a changing climate by involving researchers, local populations, water stakeholders and policy makers.

The Arborea plain in Sardinia (Italy) is characterized by an intense agricultural activity based on dairy cattle farming (approximately 31.000 livestock units in the district). The area, reclaimed from a lagoon in the 1920s, is intensely used for fodder crops to feed the cattle. Thus, an important drainage network has been developed to maintain the soil in suitable conditions for agriculture. Heterogeneous nitrates contamination of the aquifer system has been highlighted through soil sampling and groundwater monitoring in the Arborea plain in previous studies and the zone is classified as a Nitrates Vulnerable Zone (following Directive 91/676/CEE). The hydrogeology of the study site is characterized by two main aquifers: the upper one, unconfined, hosted in a sandy unit (SHU), separated from the second aquifer, hosted in an alluvial formation (AHU), by lagoon deposits aquitard.

In the present study, we show the individual work steps to get from the existing 3D hydrogeological model to a 3D numerical groundwater model using the interactive finite-element simulation system Feflow 7.4. The developed partially unstructured steady-state flow model takes into account the recharge of the aquifer system by surface water, the drainage and irrigation network and the seasonal variation of water volumes drained and spread on the land. Also accounted for are water pumped by farms for technical use and livestock, groundwater flow between the different units and interactions with seawater. Results show the influence of

groundwater management, especially for agricultural activities, and interaction with surface water, which is highly impacted by anthropic networks (irrigation and drainage). Ongoing research is aimed at quantifying the spatio-temporal distribution of nitrate in the SHU aquifer under transient groundwater flow conditions to compare different water management, climate change and contamination scenarios.

References

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