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Sustainable management of groundwater exploitation using Monte Carlo simulation of seawater intrusion in the Korba aquifer (Tunisia)

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Worldwide, seawater intrusion and salinisation of coastal aquifers and soils is a major threat for food production. While the physico-chemical processes triggering the transport and accumulation of salts in these regions are relatively well known and well described by a set of partial differential equations, often it is extremely difficult to model accurately these phenomena because of the lack of an accurate data set. On one hand the physical parameters (porosity, permeability, dispersivity) that control groundwater flow are extremely variable in space within geological media and are only measured at some specific locations, on the other hand the forcing terms (pumping, precipitation, etc.) are often not measured directly in the field. The result is a high level of uncertainty. The problem is how to take rational decision toward sustainable water management in such a context ?

One possibility explored within this work is to run a large set of model simulations with stochastic parameters by means of the EGEE GRID infrastructure and to define robust and sustainable water management decisions based on probabilistic analysis of the resulting simulation outputs. This approach is currently being investigated in the Cape Bon peninsula, located 50 km South-East of Tunis, one of the most productive agricultural areas in Tunisia. In this plain the World Bank has shown that major water resources problem could occur in the next decade. One of the major sources of uncertainty in the Cap Bon aquifer system are the pumping rates and their time evolution. To investigate the impact of this source of uncertainty, first a geostatistical model of the spatial distribution of the pumping has been constructed and then the GRID has been used to run a 3D density-dependent groundwater flow and salt transport model in a Monte Carlo framework.

While these results are still preliminary, GRID computing paradigm offers clearly a huge potential within this field. One particularly interesting aspect offered by this methodology to Tunisian water managers, not having access to local computing technology, is to be able in a near future to run directly, via a web portal to the GRID, their groundwater flow simulation and uncertainty analysis. This option has not been tested yet and requires further development.

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