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Analysis of seawater flow through optical fiber

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The relation between sea and coastal aquifer is very important to the human populations living in coastal areas. The interrelation involves the submarine ground water discharge of relatively fresh water to the sea and the intrusion of sea water into the aquifer, which impairs the quality of ground water.
The main process in seawater intrusion is managed by fluid-density effects which control the displacement of saline water. The underlain salinity acts as the restoring force, while hydrodynamic dispersion and convection lead to a mixing and vertical displacement of the brine. Because of this, a good definition of this saltwater-freshwater interface is needed what is intimately joined to the study of the movements (velocity fields) of fresh and salt water. As it is well known, the flow of salt water studied in seawater intrusion in stationary state, is nearly null or very low. However, in the rest of cases, this flux can be very important, so it is necessary its study to a better comprehension of this process. One possible manner of carry out this analysis is through the data from optical fiber.
So, to research the distribution and velocity of the fresh and saltwater in the aquifer, a fiber optic system (OF) has been installed in Argentona (Baix Maresme, Catalonia). The main objective is to obtain the distributed temperature measurements (OF-DTS) and made progress in the interpretation of the dynamic processes of water.
For some applications, the optical fiber acts as a passive temperature sensor but in our case, the technique Heated Active Fiber Optic will be used. This is based on the thermal response of the ground as a heat emission source is introduced. The thermal properties of the soil, dependent variables of soil water content, will make a specific temperature distribution around the cable. From the analyzed data we will deduce the velocity field, the real objective of our problem.
To simulate this phenomenon and the coupled transport and flow problem, dominant in seawater intrusion, a finite element code in C ++ language will be developed. Finally, the information obtained numerically with our code will be checked with the field information.