A Computational App for a Proper Evaluation of the Irrigation Effect Over the Aquifers

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Abstract

A correct design and control of the irrigation cycles is very important for the correct and efficient grow of the crops. It is well known that a correct design of the irrigation cycles increases its efficiency and reduces the amount of water required. An important objective in the agricultural industry is to design an optimal irrigation plan depending on the requirements of the crop. The irrigation cycles have effect over the quality and quantity of water. It becomes more relevant in these areas of the world where the amount of water is limited. Nowadays, several scientists are involved in different research whose objectives are focus on find alternative sources of water that can be used to the irrigation. One idea is to reuse human waste water [1]. This concept is based on the pollutant removal effect of the sun, the soil and the plants itself. However, it requires an important control of the polluted water evolution in the subsurface.
Numerical modeling is an important tool to help engineers and scientists to design structures, simulate experiments, etc. In the context of this study, it can be used as a proper design of irrigation structures. It serves also to evaluate the propagation of the pollutants or nutrients available in the irrigation water through the subsurface.
We present an useful app designed in COMSOL Multiphysics® that simulates the effects of different irrigation cycles over the soil saturation. It also can simulate the evolution of the pollutants dissolved in the water through the subsurface attending to its degradation. The application solves Richard's equation to obtain the groundwater flow field, the saturation and the advection diffusion equation to simulate the movement of the pollutants or nutrients. The model is prepared to evaluate the evolution of the dissolved elements involved in the organic matter degradation chain.
The app is fully parametrized. Regarding to the geometry is up to the user to select the extension of the modeled area, the extension and location of the irrigation areas, etc. The app also considers different materials for the subsurface. Once the geometry is generated, the app allows the user to assign the properties of the materials such as the permeability or the porosity and introduce the irrigation planning which is read from an external file. Finally, the initial concentration of the different species is assigned together with the composition of the irrigation water.
The app is prepared to show several types of plots such as 2D slices that shows the evolution of the saturation, the plumb, etc. It shows also the evolution of the groundwater level and water saturation in the observation points.
The possibility of generated custom apps with COMSOL Multiphysics® allow the user to generate general models such as the one presented here that can be applied for different

crops and areas.

References
[1] Hussain I.; L. Raschid; M. A. Hanjra; F. Marikar; W. van der Hoek. 2002. Wastewater use in agriculture: Review of impacts and methodological issues in valuing impacts. Working Paper 37. Colombo, Sri Lanka: International Water Management Institute.

Figures used in the abstract

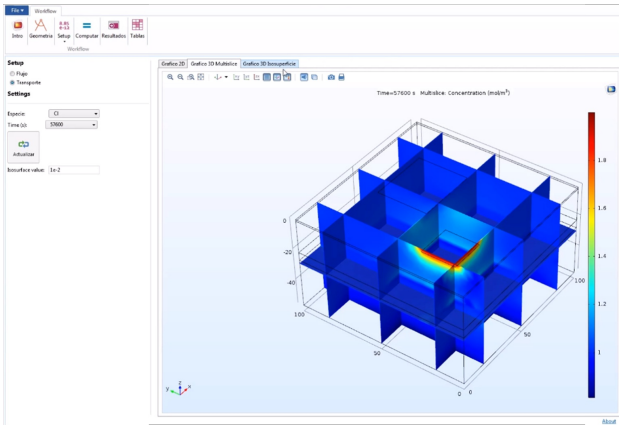

Figure 1: Screenshot of the computational app showing the chloride evolution in the aquifer.