

Implementation of Solute Return Flow from Irrigation into a Numerical Finite Element Code

Ellen Milnes, Centre d'hydrogéologie, Université de Neuchâtel, CH-2007- Neuchâtel
Email : ellen.milnes@unine.ch

Philippe Renard, Centre d'hydrogéologie, Université de Neuchâtel, CH-2007- Neuchâtel
Email : philippe.renard@unine.ch (corresponding author)

In coastal aquifers which are exploited for agricultural purposes, salinisation by salt recycling from irrigation is superimposed on the effects of seawater intrusion. Water quality degradation of irrigation pumping wells caused by seawater intrusion enhances salinisation by irrigation, as the extracted solute mass is recycled and is not withdrawn from the system. The mass conservation formulation that is usually applied to transport simulations in seawater intrusion settings neglects solute mass return flow from irrigation and therefore yields 'best-case' results. In this study we implement the process of solute recycling from irrigation into the numerical model by converting the cumulated extracted solute mass at the end of each time-step of each well boundary condition into a source term which corresponds to the respective irrigated surface. The transformation of the cumulated solute mass signal into a source term signal is done by means of the advection-dispersion equation solution for a concentration-step boundary condition. The source term is thus modified at each time-step. Only saturated media is simulated and therefore some parameters of the unsaturated zone can only be considered in the course of the transformation of the out-going solute mass signal at the well boundary conditions into entering solute mass signals (e.g. depth to water table and dispersion). The advantage of introducing the solute return flow into a numerical model is that the salinity distribution, particularly in the low concentration range can be better simulated. The impact of the heterogeneous aquifer characteristics on the salinity distribution can also be evaluated and the relative importance of salinisation by seawater intrusion versus solute mass recycling can be evaluated.