IAHS2017-268
IAHS Scientific Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Modeling of the water flow and nitrogen transport in variably saturated soil

Abdellatif Maslouhi and Rachid Karra
Ibn Toufail university, physics, Morocco (rachid.karra@gmail.com)

Groundwater reserves are important exploitable water resources. Unfortunately, the intensive agriculture practiced today, requires the use of fertilizers and pesticides in large quantities and sometimes, in an uncontrolled way which significantly reduces the quality of groundwater. Nitrate contamination in irrigation groundwater is a serious world-wide problem. The M'nasra zone (North-West of Morocco) well known for its intensive agricultural activities is threatened by nitrogen pollution. In this study, we used a new mathematical formulation to predict spatial and temporal distribution of water and nitrate in unsaturated-saturated zones which are regarded as a single continuum. A numerical model (Freefem ++ code) was developed to study the water flow and nitrogen dynamics in variably saturated soil. The chosen numerical approach has the advantage of generating self-adaptive meshes very interesting for the study of transfers in singular areas, particularly at the capillary fringe. The nitrogen transformations in the soil were simplified using parameters that can be calculated from easily measured chemical soil properties or obtained from the literature. In this study, we show the interest of modeling various chemical, physical and biological processes that influence the fate of nitrogen in the agricultural soils for evaluating the groundwater contamination by nitrates. The nitrogen simulation shows that in the saturated zone, the flow is mostly loaded by the nitrate and the ammonium nitrogen NH_4+-N has an insignificant effect on the solute transport in the aquifer. The validity of the model is proved by the excellent agreement between simulated and experimental data measured in the laboratory-scale physical model. In general, the numerical model constitutes a rapid tool to predict with an excellent precision the water flow and the reactive solute evolution in groundwater. It is concluded that the developed model is a rigorous, practical and useful forecasting tool, which can be used to simulate the transport of nitrogen in groundwater systems. It can also be used to design remedial systems such as bioremediation trenches.