Geophysical Research Abstracts
Vol. 16, EGU2014-3328, 2014
EGU General Assembly 2014


# Modelling groundwater seepage zones in an unconfined aquifer with MODFLOW: different approaches

Bertrand Leterme (1) and Matej Gedeon (2)
(1) SCK-CEN, Belgium (bertrand.leterme@sckcen.be), (2) SCK-CEN, Belgium (matej.gedeon@sckcen.be)

In areas where groundwater level occurs close to surface topography, the discharge of groundwater flow to the ground surface (or seepage) can be an important aspect of catchment hydrological cycle. It is also associated with valuable zones from an ecological point of view, often having a permanent shallow water table and constant lithotrophic water quality (Batelaan et al., 2003).

In the present study, we try to implement a correct representation of this seepage process in a MODFLOW-HYDRUS coupled model for a small catchment (18.6 $km^2$) of north-east Belgium. We started from an exisiting transient groundwater model of the unconfined aquifer in the study area (Gedeon and Mallants, 2009) discretized in 50x50 m cells. As the model did not account for seepage, hydraulic heads were simulated above the surface topography in certain zones.

In the coupled MODFLOW-HYDRUS setup, transient boundary conditions (potential evapotranspiration and precipitation) are used to calculate the recharge with the HYDRUS package (Seo et al., 2007) for MODFLOW-2000 (Harbaugh et al., 2000). Coupling HYDRUS to MODFLOW involves the definition of a number of zones based on similarity in estimated groundwater depth, soil type and land cover.

Concerning simulation of seepage, several existing packages are tested, including the DRAIN package (as in Reeve et al., 2006), the SPF package (from VSF Process; Thoms et al., 2006) and the PBC package (Post, 2011). Alternatively to the HYDRUS package for MODFLOW, the UZF package (Niswonger et al., 2006) for the simulation of recharge (and seepage) is also tested.

When applicable, the parameterization of drain conductance in the top layer is critical and is investigated in relation to the soil hydraulic conductivity values used for the unsaturated zone (HYDRUS). Furthermore, stability issues are discussed, and where successful model runs are obtained, simulation results are compared with observed groundwater levels from a piezometric network. Spatial and temporal variability of the seepage zones is obtained and can be compared against seepage indicators such as soil maps or types of plant habitat.

References

Batelaan, O., De Smedt, F., Triest, L., 2003. Regional groundwater discharge: phreatophyte mapping, groundwater modelling and impact analysis of land-use change. Journal of Hydrology 275, 86-108.
Gedeon, M., Mallants, D., 2009. Local-scale transient groundwater flow calculations. Project near surface disposal of category A waste at Dessel, NIRAS/ONDRAF, 74 p.
Harbaugh, A.W., Banta, E.R., Hill, M.C., McDonald, M.G., 2000. MODFLOW-2000, the U.S. Geological Survey modular ground-water model user guide to modularization concepts and the ground-water flow process. USGS, Denver, CO.
Niswonger, R.G., Prudic, D.E., Regan, R.S., 2006. Documentation of the Unsaturated-Zone Flow (UZF1) package for modeling unsaturated flow between the land surface and the water table with MODFLOW-2005. Techniques and Methods 6-A19, USGS, Denver, CO.
Post, V.E.A., 2011. A new package for simulating periodic boundary conditions in MODFLOW and SEAWAT. Computers & Geosciences 37, 1843-1849.
Reeve, A.S., Evensen, R., Glaser, P.H., Siegel, D.I., Rosenberry, D., 2006. Flow path oscillations in transient ground-water simulations of large peatland systems. Journal of Hydrology 316, 313-324.
Seo, H.S., Šimůnek, J., Poeter, E.P., 2007. Documentation of the HYDRUS Package for MODFLOW-2000, the

U.S. Geological Survey Modular Ground-Water Model. Colorado School of Mines, Golden, CO.
Thoms, R.B., Johnson, R.L., Healy, R.W., 2006. User's guide to the Variably Saturated Flow (VSF) Process for MODFLOW. U.S. Geological Survey Techniques and Methods 6-A18, p. 58.