Regional urban groundwater body risk assessment of contaminants using remotely sensed multi-resolution land-cover data

Okke BATELAAN[1,2,4], Juliette DUJARDIN[2,3] & Pierre JAMIN[5]
Imtiaz BASHIR[2], Frank CANTERS[3], Alain DASSARGUES[5,4] & Serge BROUYÈRE[5]

[1] *School of the Environment, Flinders University, Adelaide, Australia*
E-mail: Okke.Batelaan@flinders.edu.au
[2] *Department of Hydrology and Hydraulic Engineering, Vrije Universiteit Brussel, Brussels, Belgium*
[3] *Cartography and GIS Research Group, Dep. of Geography, Vrije Universiteit Brussel, Brussels, Belgium*
[4] *Department of Earth and Environmental Sciences, KU Leuven, Heverlee, Belgium*
[5] *Department ArGEnCo, Hydrogeology Unit and Aquapôle, University of Liège, Sart Tilman, Belgium*

KEY WORDS - urban recharge modeling, sub-pixel classification, contaminant flux estimation, risk assessment methods

ABSTRACT
Contaminated sites are often the result of past relatively anarchic economical and industrial development. The last decades stakeholders are more aware of the risks posed by these sites. Within the Frac-Weco project an integrated framework for the assessment, at regional scale, of the risks posed by these contaminated sites on water resources and ecosystems has been developed. The methodology is based on the calculation of contaminant fluxes reaching the receptors providing a way of estimating the level of exposure/degradation of these receptors at the groundwater body scale.

The most important contamination problems at regional scale are located around old urban and industrialized areas. The land-cover distribution in these zones is of prime importance because it determines the spatial variation of groundwater recharge, which is the main vector of contaminant leaching from soil surface to groundwater. To obtain detailed information about land cover for groundwater recharge modeling, a stratified satellite image classification approach was adopted combining land-cover mapping at pixel level for the studied area as a whole with sub-pixel estimation of imperviousness within built-up zones. The obtained land-cover data is used as an input in the WetSpass model to simulate groundwater recharge at high resolution in spatially complex urban areas. In the next step the simulated groundwater recharge is used as an input in a regional scale groundwater flow and transport model simulating contaminant dispersion through the aquifer. Modeling results are further used to calculate a quality index for the whole groundwater body based on threshold values defined specifically for each contaminant.

The approach proposed has been applied on the RWM073 groundwater body corresponding to the alluvial deposits of the Meuse River, Liège (Belgium). The high-resolution groundwater recharge estimations obtained by integrating remote sensing in the modeling procedure allow a better identification of the potential sources of contaminants and enable a proper quantification of total fluxes of contaminants from brownfields into the groundwater. The developed framework for regional risk assessment results in a global quality indicator for the groundwater body which can be used as input for decision-making.