DEVELOPPING A PHYSICALLY BASED GROUNDWATER VULNERABILITY CONCEPT IN A "DPSIR" FRAMEWORK

J. BEAUJEAN [1,2], S. BROUYERE [1], J.-M. LEMIEUX [3], R. THERRIEN [3] and A. DASSARGUES [1]

[1]: Hydrogeology & Environmental Geology, Geo3 Group, ArGEnCo Department, Aquapole, B-52/3, Université de Liège, B-4000 Liège, Belgium, e-mails: jean.beaujean@ulg.ac.be alain.dassargues@ulg.ac.be
[2]: now at Applied Geophysics, Geo3 Group, ArGEnCo Department, Université de Liège, Liège, Belgium.
[3]: Département de Géologie et de Génie Géologique, Université Laval, 1065 avenue de la Médecine, Québec, Canada.

Abstract

A general physically based method is presented to assess vulnerability of groundwater to external pressures with respect to quality and/or quantity issues. In the vulnerability assessments, many scientific authors agree nowadays that 'physically based' methods must be preferred to traditional approaches based on empirical overlay and index methods where physical attributes are often mixed with implicitly embedded conventional priorities. Results from one or another of these last methods can consequently be very dissimilar for a given case study and decision makers are losing confidence in these tools.

A methodology is proposed to reframe the groundwater vulnerability assessment in a Pressure-State-Impact causal chain that is familiar to decision makers. The DPSIR framework, for describing interactions between society and the environment, defines a chain of Drivers that exert Pressures on the State of a given resource, such as water, which then generates an Impact that will require an appropriate Response (Kristensen, 2004).

The concept of groundwater vulnerability assessment considered here is based on the calculation of sensitivity coefficients for a user-defined groundwater state for which several physically-based indicators are proposed. These sensitivity coefficients reflect the easiness with which the groundwater state transmits pressures into impacts. They are grouped into a vulnerability matrix of pressures and impacts that quantify vulnerability for every combination of causal links identified in the DPSIR chain. For that reason, the sensitivity coefficients are converted to vulnerability, using the concept of 'falling below a given threshold', which is commonly used in socioeconomic sciences (Luers et al. 2003).

Outside the careful selection of the sensitivity analysis method that can significantly influence the computational effort (Beaujean *et al.*, 2013), emphasis will be given to the illustration of the general methodology on a simple case (of an alluvial aquifer with concerns related to water supply) demonstrating the potential use of this general and physically based vulnerability assessment method.

While the methodology is general, the choice of causal chains has to be made prior to the calculation. The vulnerability is also related to a damaged state and is related to the 'distance' between the current state and a given threshold. This choice is arbitrary such that the vulnerability is sensitive to the choice of the threshold. The framework is general and, when applied to water, can include states that are not limited to quality such as, for example, water quantity and availability.

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