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Testing different approaches to evaluate groundwater vulnerability to climate change

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Today, the impacts of climate change to the groundwater resources started to be quite well described for quantitative aspects and hydrogeological risk assessment. Some studies, such as EXPLORE2070, allowed highlighting the importance of climate change on, groundwater recharge reduction in some parts of the French territory, a change in recharge seasonality or the elevation of the sea water level. If the estimation of the climate change impact is possible based climatic scenarios proposed by the IPCC for aquifers for hydrogeological models exist, it remains difficult and delicate for sectors without models. The evaluation of climate change impact is more difficult knowing that a reduction of efficient rainfall will be variable impact from one aquifer to another. Thus, analysing the sensibility of aquifers to climate changes needs to take into account different hydrogeological parameters. Multiples methodological approaches can be envisaged.

The first approach developed was based on the use of IDPR (infiltration capacity), possible overflowing and drying areas, density of intermittent rivers, thickness of the unsaturated zone and hydrogeological dynamic (captive, free aquifer, cumulative effect, inertia,…). Mapping the groundwater vulnerability to climate change was then constructed using GIS multicriteria data treatment. Two calculations were carried out; a typology of aquifer comportment following two scenarios and the establishment of the vulnerability map combining the typology and the mean aquifer recharge.

Other methods, such as the use of drought resistance indicators can also be relevant for climate change impact evaluation. This indicator is based on three criteria i) half-decay time of water levels, ii) index of development and persistence of water network (IDPR) and iii) size of the aquifer system as, together with the thickness, determine the importance of its inertia. Mapping the drought resistance could be useful for example to look at the resilience of aquifer systems (capacity of the system to come back to a normal status) after severe drought episodes, one of the effects of climate change being more intense drought periods.

Confronting the different methods is a good way to evaluate uncertainties and to find new directions for investigations.

Keywords: groundwater, drought resistance, vulnerability, climate change.