Tailoring groundwater quality monitoring to vulnerability: a GIS procedure for network design

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Abstract Monitoring networks aiming to assess the state of groundwater quality and detect or predict changes could increase in efficiency when fitted to vulnerability and pollution risk assessment. The main purpose of this paper is to describe a methodology aiming at integrating aquifers vulnerability and actual levels of groundwater pollution in the monitoring network design. In this study carried out in a pilot area in central Italy, several factors such as hydrogeological setting, groundwater vulnerability, and natural and anthropogenic contamination levels were analyzed and used in designing a network tailored to the monitoring objectives, namely, surveying the evolution of groundwater quality relating to natural conditions as well as to polluting processes active in the area. Due to the absence of an aquifer vulnerability map for the whole area, a proximate evaluation of it was performed through a geographic information system (GIS) methodology, leading to the so called “susceptibility to groundwater quality degradation”. The latter was used as a basis for the network density assessment, while water points were ranked by several factors including discharge, actual contamination levels, maintenance conditions, and accessibility for periodical sampling in order to select the most appropriate to the network. Two different GIS procedures were implemented which combine vulnerability conditions and water points suitability, producing two slightly different networks of 50 monitoring points selected out of the 121 candidate wells and springs. The results are compared with a “manual” selection of the points. The applied GIS procedures resulted capable to select the requested number of water points from the initial set, evaluating the most confident ones and an appropriate density. Moreover, it is worth underlining that the second procedure (point distance analysis [PDA]) is technically faster and simpler to be performed than the first one (GRID+PDA).

Keywords Monitoring network · Groundwater quality · Aquifer vulnerability · GIS · Central Italy

Introduction

Monitoring of chemical and quantitative status of groundwater and aquifer vulnerability assessment are jointly considered by the national acts promulgated by European Member States in relation to the Water Framework Directive (WFD) 2000/60/EC (European Communities 2000) and its “daughter” Groundwater Directive (GWDD) 2006/118/EC (European Communities 2006). However, these activities are usually conducted...