



Assessment of chloride natural background levels by applying statistical approaches. Analyses of European coastal aquifers in different environments

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ABSTRACT

Estimated natural background levels (NBLs) are needed to assess groundwater chemical status according to the EU Groundwater Directive. They are commonly derived for different substances by applying statistical methodologies. Due to the complexity of the sea water intrusion process, some of those methods do not always provide appropriate assessment of chloride NBLs. This paper analyzes the applicability of different NBL estimation methods in five EU coastal aquifers with significant differences in available datasets and hydrogeological settings. A sensitivity analysis of results to different constraints was performed to remove samples with anthropogenic impacts. A novel statistical approach combining different methods to identify the range of chloride NBLs is proposed. In all pilots the estimated NBLs were below 85 mg/L and fitted well with previous studies and expert judgment, except Campina del Faro aquifer (the maximum being 167.5 mg/L). Although this approach is more time consuming, it provides a more robust solution.

1. Introduction

The prerequisite for appropriate assessment of anthropogenic impacts on groundwater quality and the advance of young potentially contaminated groundwater in aquifer systems (Hinsby et al., 2001) is identification of natural groundwater composition by establishment of natural background levels (NBLs) (Hinsby et al., 2008; Li et al., 2021; Menafoglio et al., 2021) and fingerprinting sources of contamination or elevated concentrations (Knudsen et al., 2021). This study defines NBL as “the concentration of substance or the value of an indicator in a body of groundwater corresponding to no, or only very minor, anthropogenic

alterations to undisturbed conditions” according to the EU Groundwater Directive (GWD; EC, 2006). Even though the term “background” does not always have a coherent meaning across the studies (De Caro et al., 2017; Edmunds and Shand, 2008), the definition provided by Matschullat et al. (2000) as “relative measure to distinguish between natural and anthropogenically influenced concentrations” refers well to the general interpretation of the term.

As stated by Apello and Postma (2005), chemical composition of groundwater is a result of all the processes between water, minerals and gasses it has been in contact from recharge to discharge areas. Such natural factors as climate, rainfall composition and frequency,

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