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Screening of sustainable groundwater sources for integration into a regional drought-prone water supply system

T. Y. Stigter[1], J. P. Monteiro[2], L. M. Nunes[2], J. Vieira[3], M. C. Cunha[3], L. Ribeiro[1], J. Nascimento[1], and H. Lucas[4]
[1]Geo-Systems Centre/CVRM, Instituto Superior Técnico, Lisbon, Portugal
[2]Geo-Systems Centre/CVRM, Universidade do Algarve, Faro, Portugal
[3]FCTUC – Departamento de Engenharia Civil, Coimbra, Portugal
[4]Águas do Algarve, Faro, Portugal

Abstract. This paper reports on the qualitative and quantitative screening of groundwater sources for integration into the public water supply system of the Algarve, Portugal. The results are employed in a decision support system currently under development for an integrated water resources management scheme in the region. Such a scheme is crucial for several reasons, including the extreme seasonal and annual variations in rainfall, the effect of climate change on more frequent and long-lasting droughts, the continuously increasing water demand and the high risk of a single-source water supply policy. The latter was revealed during the severe drought of 2004 and 2005, when surface reservoirs were depleted and the regional water demand could not be met, despite the drilling of emergency wells.

For screening and selection, quantitative criteria are based on aquifer properties and well yields, whereas qualitative criteria are defined by water quality indices. These reflect the well's degree of violation of drinking water standards for different sets of variables, including toxicity parameters, nitrate and chloride, iron and manganese and microbiological parameters. Results indicate the current availability of at least 1100 l s^{-1} of high quality groundwater (55% of the regional demand), requiring only disinfection (900 l s^{-1}) or basic treatment, prior to human consumption. These groundwater withdrawals are sustainable when compared to mean annual recharge, considering that at least 40% is preserved for ecological demands. A more accurate and comprehensive analysis of sustainability is performed with the help of steady-state and transient groundwater flow simulations, which account for aquifer geometry, boundary conditions, recharge and discharge rates, pumping activity and seasonality. They permit an advanced analysis of present and future scenarios and show that increasing water demands and decreasing rainfall will make the water supply system extremely vulnerable, with a high risk of groundwater salinization and ecosystem degradation.

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