Combining of MASW and GPR imaging and hydrogeological surveys for the groundwater resource evaluation in a coastal urban area in southern Spain

Alcalá, F.J.
Martínez-Pagán, P.
Paz, M.C.
Navarro, M.
Pérez-Cuevas, J.
Domingo, F.

Abstract
This paper conceptualizes and evaluates the groundwater resource in a coastal urban area hydrologically influenced by peri-urban irrigation agriculture. Adra town in southern Spain was the case study chosen to evaluate the groundwater resource contributed from the northern steep urban sector (NSUS) to the southern flat urban sector (SFUS), which belongs to the Adra River Delta Groundwater Body (ARDGB). The methodology included (1) geological and hydrogeological data compilation; (2) thirteen Multichannel Analysis of SurfaceWaves (MASW), and eight Ground Penetrating Radar (GPR) profiles to define shallow geological structures and some hydrogeological features; (3) hydrogeological surveys for aquifer hydraulic definition; (4) conceptualization of the hydrogeological functioning; and (5) the NSUS groundwater resource evaluation. All findings were integrated to prepare a 1:5000 scale hydrogeological map and cross-sections. Ten hydrogeological formations were defined, four of them (Paleozoic weathered bedrock, Pleistocene littoral facies, Holocene colluvial, and anthropogenic filling) in the NSUS contributing to the SFUS. The NSUS groundwater discharge and recharge are, respectively, around 0.28Mm^3 $year^{-1}$ and 0.31Mm^3 $year^{-1}$, and the actual groundwater storage is around 0.47 Mm^3. The groundwater renewability is high enough to guarantee a durable small exploitation for specific current and future urban water uses which can alleviate the pressure on the ARDGB.

Author keywords
Adra town
Aquifer geometry
Ground penetrating radar
Groundwater resource evaluation
Hydrogeological map
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