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BOOK OF ABSTRACTS

Strategies to mitigate the phenomenon of groundwater depletion in the Mediterranean region

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Introduction

Groundwater is a primary source of drinking water for almost two billion people worldwide (Gleeson et al., 2010). Moreover, it is critically important for energy, food security, human health and ecosystems (Gleeson et al., 2015). Yet, depletion of groundwater reserves is a common phenomenon in both humid and semi-arid regions of the world. Although non-sustainable groundwater exploitation has been documented on both regional and global scales (Gleeson et al., 2012), specific spatiotemporal characteristics need to be further studied and quantified. The phenomenon of groundwater depletion occurs when extraction from an aquifer exceeds the recharge, with the extent of the depletion effects being also determined by the aquifer type. A number of research challenges prevail, the most significant being the quantification of factors triggering groundwater depletion. Inevitably, depletion leads to increased pumping costs and the reduction of groundwater discharge to streams, springs and wetlands affecting ecosystems (Sophocleous, 2000). Additionally, lowered water tables induce groundwater flow, which can lead to salinization by seawater intrusion in coastal aquifers (Konikow and Kendy, 2005). Eventually, groundwater depletion can even lead to dry wells. The main cause of groundwater depletion is the excessive extraction for irrigation especially in cases where an aquifer is only replenished in a slow manner, while climate change could potentially exacerbate the phenomenon in some regions (Weider and Boutt, 2010). Global food production has increased dramatically since 1970 due to advances in well-drilling equipment and electrical pumping, and a large number of wells has been operated in a largely unregulated manner, often replacing surface-water resources. Accordingly, in some areas, groundwater levels have declined at rates even exceeding 1 m per year. On the other hand, climate-related changes might also influence recharge rates and aggravate groundwater depletion as recharge rates are influenced by the distribution and seasonality of snow coverage as well as drought events. Within this study a detailed analysis of hydrogeological, hydrological and climatological data was obtained in order to quantify groundwater depletion develop a software to optimize hydropower generation and managed aquifer recharge.

Materials and methods

In the framework of this study was selected three case studies in Greece and one in Italy. The case studies include the coastal aquifer in Anthemountas and Marathonas basin, the inland basin of Mouriki and Campania region in Italy (Figure 1). In all sites field and laboratory measurements was obtained including water level measurements, physicochemical analysis of surface and groundwater samples, water flow measurements and UAV mapping. Climatological data were collected from meteorological station and satellites in order to project hydrological balance and groundwater recharge variation. All available data were used for the simulation of surface-groundwater interaction in the hydrosystems using ArcSWAT. future climate data, for the period from 2030 to 2040, were automatically generated using the SWAT weather generator considering RCP 4.5 scenario. The final step was the development of a simulation model for hydropower generation and Managed Aquifer Recharge. The model is solved by the harmony search algorithm and the whole process is organized in Python language.

Results and concluding remarks

In the coastal aquifers of Greece, groundwater depletion phenomenon is continuously exaggerated due to overexploitation. Future scenarios project increasing of evapotranspiration amounts and decline of groundwater recharge in the coastal aquifers. In the inland aquifer of Mouriki basin and in the mountainous part of Campania region there are no significant variation in the hydrological components. The simulation scenarios for dam operation and MAR application clearly showed increasing trend of groundwater table, while energy production is not neglectable. Groundwater mis-management constitute the main driver for groundwater depletion. The use of small dams as mini-scale hydropower facilities can provide clean energy production, reduce CO_2 emissions and lead to an economically feasible and eco-friendly strategy against groundwater depletion. Nevertheless, the inversion of groundwater depletion requires holistic and versatile approaches including detailed monitoring, use of treated wastewater, crop type changes and awareness raising of local community and end users.

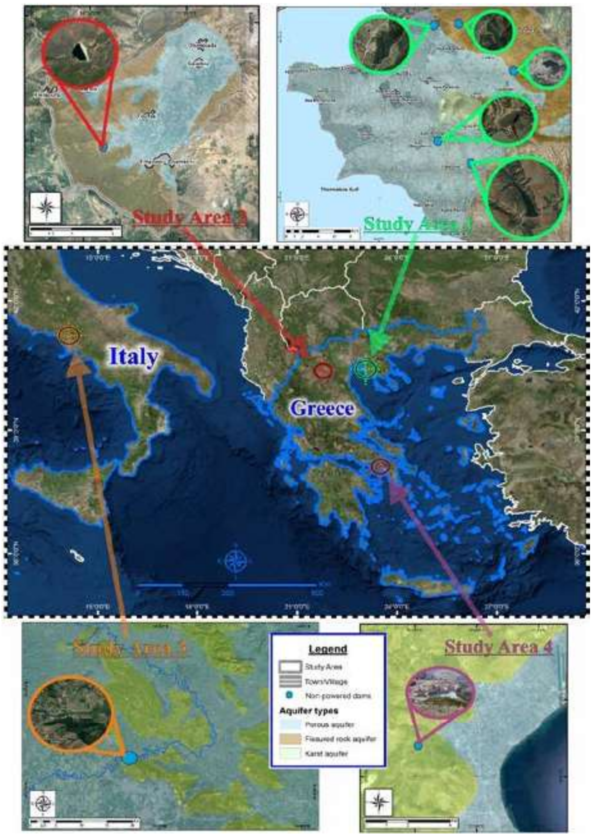

Figure 1 Study areas and non-powered Dams.

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