Editorial/Preface: Advances in water resources and water networks management under climate change conditions, seeking for efficiency

This Special Issue of *Journal of Water Supply: Research and Technology – AQUA* includes a collection of papers initially presented at the *2nd EWaS International Conference 'Efficient & Sustainable Water Systems toward Worth Living Development'*. The conference was held on June 1–4, 2016, in Platanias/Chania, Crete, Greece (http://www.ewas2.tuc.gr/). The conference was co-organized by the University of Thessaly/Civil Engineering Department and the Technical University of Crete/School of Environmental Engineering. The EWaS series of conferences started in Thessaloniki in 2013.

The 2nd EWaS International Conference highlighted the need to improve the efficiency and sustainability of water resources systems, threatened by the climate change conditions the whole world is experiencing today, leading to water scarcity and water intermittent supply. At the same time, it is estimated that almost 40% of Europe's available drinking water is being wasted through real (physical) losses occurring along the water supply and distribution networks. This makes the water scarcity threat even more intense. Thus, advances in water resources and water networks management under climate change conditions are needed, seeking for efficiency. Efficient management of water resources and water networks asks for advanced tools and strategies for their analysis, monitoring, planning and operation. Such tools and techniques are presented by the papers included in this Special Issue. More specifically:

The paper by Colombani *et al.* (2017) deals with the impact of climate variability on the salinization of the coastal wetland-aquifer system of the Po Delta, Italy. To understand the hydrological processes occurring within the specific system, the contribution of both evaporation and anthropogenic factors to groundwater salinization was assessed. A time series (2002–2015) of monthly average climatic data and a temperature-salinity dataset were used in three adjacent saline-brackish lagoons to identify the actual evaporation patterns and predict future trends using artificial neural networks (ANN). Moreover, the use of groundwater and surface water equivalent freshwater heads, along with the geological architecture, allowed the fluctuation of lagoon salinities to be linked with the degree of hydraulic connection between wetland and aquifer system. The results show that the less a lagoon is hydraulically connected with the aquifer, the higher is the salinity peak that could be reached at the end of the summer period. ANN forecasts highlight that in the near future this behavior will be the rule rather than the exception. The presented methodology could help water managers to better understand the processes of the surface/groundwater continuum in coastal lagoonal environments, and to put in place prevention and/or mitigation measures to avoid water resources deterioration. Finally, this study points out that the shallow lagoon water quality could be negatively affected by climate variability due to increased evaporation rates; this key point must be explicitly taken into account when modelling the future scenarios of water resources management in coastal areas.

The paper by Psomas *et al.* (2017) attempts to assess future water supply and demand in a water-stressed catchment after environmental restrictions on abstractions. The Ali Efenti catchment studied is a rural upstream sub-catchment of the Pinios river basin in central Greece. The average annual precipitation in this sub-catchment is relatively higher and groundwater recharge is relatively faster than in the other parts of the river basin. Still, seasonal water shortages occur due to the rapid increase of water abstractions in the summer months, mainly for crop irrigation. In the near future (2015–2030), the gap between water supply and demand is expected to deteriorate, considering the impacts of climate and socio-economic change. The adoption of environmental restrictions on water abstractions, which is a measure foreseen in the local river basin management plan, could decrease water stress substantially from 19.2% to 13.9%. However, this would require enormous (26%) cuts in the current water abstractions during June–September, lowering water demand coverage from 86% to 68%. Optimal combinations of measures, from an economic and environmental perspective, will need to be designed to bridge the gap between water supply and demand and restore water

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demand coverage to satisfactory levels. Hydrologic and water resources management modelling has been implemented using the Water Evaluation And Planning system (WEAP), which is a conceptual model based on water balances.

The paper by Brančić & Nešković (2007) deals with local groundwater supply systems for remote settlements, which is a big issue for Serbia, where most of the local water supply systems are developed and maintained by the local communities and are in bad shape. Based on national strategy, this issue should be resolved by building regional systems using artificial reservoirs. The paper presents case studies from three areas in Serbia in order to offer an alternative to regional water supply with the development of autonomous groundwater supply systems in remote settlements, especially in cases when water supply from surface water inevitably leads to deterioration in quality and quantity of the resource. The research included monitoring of regime parameters and multiple chemical analyses in order to determine stability of the resource, in both a qualitative and a quantitative sense, as well as other important factors for the development of a water supply system. The paper concluded that, if properly and continuously monitored and developed by public water utilities, these autonomous groundwater systems would be able to provide the required amount of quality resource for water supply of remote settlements where needed.

The paper by Kaur *et al.* (2017) deals with the source apportionment of nitrogen in Estonian rivers. The statistical model MESAW was used to estimate the diffuse unit-area source emission coefficients of nitrogen in Estonian rivers. The input data included monitored riverine loads, point sources and land use categories from a total of 50 rivers/catchment areas. Two independent studies were conducted: the estimation of emission coefficients for the whole of Estonia and for a smaller study area near Tallinn. The results from both cases showed that drained peat soils were the highest diffuse source contributor in unit-area loads. The results show that the unit-area loads from drained peat soils were up to 2.3 times higher than from arable land. Moreover, a comparison of emission coefficients for the whole of Estonia and for the Tallinn catchment area indicated that coefficients can vary significantly between sources and single years. Additional detailed studies and monitoring are needed to support these conclusions.

The paper by Biela *et al.* (2017) focused on monitoring the effectiveness of advanced sorption materials for removing selected metals from water. There are a number of ways to remove heavy metals from water. Sorption on granular media based on iron oxides and hydroxides is currently the most used option. The experiment was carried out using sorption materials GEH, CFH 0818, CFH 12 and Bayoxide, which are primarily designed to remove arsenic from water. Four columns with an inner diameter of 4.4 cm were prepared for the purpose of the experiment. The thickness of the filtration media was 62 cm on average. Nickel, iron and manganese pollution was simulated in a laboratory. The efficacy of metals removal by four selected sorption materials was compared. During the experiment, the flow rate was set to reach the required retention time of 2.5, 7 and 15 minutes. It was found that the nickel concentration was reduced according to Regulation No. 252/2004 setting the limit value even after the shortest retention time (2.5 mins). Longer retention time had no significant effect on nickel removal. The measurements also proved that all sorption materials have the ability to remove iron and manganese from water. Bayoxide sorption material achieved the best results in nickel, iron and manganese removal from water.

The paper by Kanakoudis *et al.* (2017) deals with the policy recommendation for drinking water supply cross-border networking in the Adriatic region. Cross-border water resources and drinking water supply management are among the basic concerns for almost all Adriatic Sea countries. Adopting immediate measures, such as developing common methodologies, tools and techniques addressing water quality and quantity issues, water losses and pricing policies, is a top priority. An approach to facing these challenges to efficient and effective cross-border water supply and resources management was developed through the cooperation of several organizations and stakeholders involved in the Drinkadria project. The paper discusses its specific objectives and outputs linked to: (a) promotion of sustainable provision of drinking water, by setting joint cross-border recommendations on drinking water resources management, a common code of good practices for water utilities towards reduced water losses and non-sustainable uses; (b) undertaking of innovative technologies, through the implementation of pilot actions; and (c) stimulating capacity building, through the development of a

regional network of water supply experts. The relevant pilot actions aim at improving water supply and groundwater management, while the use of analytical tools for water losses reduction is the road path for sustainable water supply. Eventually, measurable results support decision makers in the adaptation of effective and efficient policies.

The paper by Agathokleous & Christodoulou (2017) deals with the component-holistic condition assessment of water distribution networks (WDNs). The paper presents an expanded methodology for imprinting the condition of an urban WDN. Even though the majority of past research efforts related to WDNs deal with water mains, only a small number of research studies have considered house connections in the analysis, and very few researchers have examined how the failure of pipe fittings affects the network performance. Rehabilitation actions in a WDN related to any part of it, whether it is a pipe or a fitting, have a direct effect on the condition of the whole system. Moreover, in the overall cost of repairing a leakage, the cost of the failed unit is very small compared with the cost of the work to detect, localize and restore the problem. Thus, the effect of the fittings on the network's rehabilitation cost is equally important as that of the pipelines. Therefore, a mathematical model simulating the overall WDN condition and targeting asset management of WDNs, which includes not only water mains data but also those of fittings and house connections, is closer to reflecting the actual condition of the network.

The paper by Patelis *et al.* (2017) focuses on combining pressure management (PM) and energy recovery benefits in a water distribution system installing pumps working as turbines (PATs). Gravity can play a beneficial role in certain WDNs, although in several cases high nodal pressures occur. Excessive pressure may lead to several negative effects regarding the network's operation and life. Thus, water utilities are convinced to implement PM policies. Instead of just 'destroying' energy using conventional measures, there are other PM options, like installing PATs, which can recover energy at the same time. Hydro-turbines are widely used in small water energy production plants producing electricity utilizing the water's kinetic energy. PATs are micro-turbines (compared with the usual ones) used exactly in reverse mode to the ordinary pumps. Installing a PAT aims to not only produce energy but also keep the pressure of the downstream pipe to a desired level. Pressure reducing valves (PRVs) are able to decrease pressure too, thus also reducing water losses. This study attempts to exploit every possibility of replacing a PRV with a PAT and check a PAT's ability to reduce pressure to acceptable levels as well as to produce a significant amount of energy. Kozani's (Greece) WDN is used as the case study. Various scenarios were checked, utilizing the network's calibrated hydraulic model with intriguing results.

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