Sustainable resource management: water practice issues

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Abstract

The themed issue on “Sustainable resource management: water practice issues” includes a wide variety of original contributions in environmental hydrology, hydrogeology, thermal waters, mining hydrogeology, urban groundwater, hydrologic engineering, and water-related research and practice. This contribution summarises the scope of a selection of the studies presented mainly during the sessions on “general research on water” from the 1st and 2nd International Congress on Water Healing Spa and Life Quality—I and II Symposium Internacional de Termalismo y Calidad de Vida” (STCV)—, that took place in Ourense (Galicia, Spain) in 2015 and 2017. The special issue presents key studies and model regions in hydrology, groundwater and thermal water processes, exploration, abstraction, protection, and sustainable management of the water resources. The articles also contribute to the overall knowledge of hydrological systems under a climate variability framework and societal pressures. In addition, the importance of an ethos of long-term environmental sustainability, socio- and eco-responsibility, and ethics in water resource management is highlighted.

Keywords Environmental hydrogeology · Water resources · Sustainability · Climate change · Water practice · Geoethics

Introduction

The main scope of “general research on water” sessions from the 1st and 2nd International Congress on Water Healing Spa and Life Quality held in Ourense (Galicia, Spain) on 23–24 September 2015 and 20–21 September 2017 (details in Faílde-Garrido et al. 2015, 2017) was debate on the environmentally sustainable water issues related to the knowledge, management, use and protection of this dynamic, fragile but resilient natural resource with global importance. To achieve that major goal, water resource studies should be assessed from multidisciplinary, interdisciplinary, and trans-disciplinary approaches.

The international congress overlapped in time with Termatalia (International Fair of Thermal Tourism, Health and Welfare) in the charming city of Ourense in the Galicia region, NW Spain. Ourense is well known for its high thermal water potential and constitutes a key reference in the Iberian, European, and international framework. Use of the thermal water spring dates back at least to Roman times (e.g., Maraver 2006; Gómez-Pérez et al. 2017). Ourense is recognised as one of the main thermal cities of Europe (e.g., Termared 2011; Eurogeosurveys 2016). In the region, there are other well-known thermal towns and villages (e.g., Carvalho 1996; Carvalho and Chaminé 2015; Chaminé et al. 2015a, b; Juncosa-Rivera et al. 2017) such as Chaves, S. Pedro do Sul, Monção, Gerês (N Portugal) and Verín, Lugo, Lobios, Bande, Pregoixeiro (Galicia, Spain). The study, abstraction and use of water resources and thermal waters positively influence life quality of the society, contributing meaningfully to their health and well-being. The healing spa is a key sector with a relevant socioeconomic impact on health and wellness tourism (Peris-Ortiz and Álvarez-García 2015). In addition, these thermal spots were included in the European Route of Historic Thermal Towns, a certified international network of sustainable tourist destinations promoting the history and cultural heritage related to water (EHTTA 2017). Finally, the thermal waters journey in

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Europe spans time and space, rooted in a dialogue between cultures and civilization, particularly ancient Greeks, followed by Celts, Gauls, Romans, Byzantines, and Ottomans, and has influenced the development of major metropolis (e.g., Wittfogel 1956; LaMoreaux and Tanner 2003; Margat and van der Gun 2013; EHTTA 2017, Gómez-Pérez et al. 2017).

The “general research on water” sessions from the International Symposium on Healing Spa and Life Quality were co-chaired by the School of Engineering (ISEP, Porto) of the Polytechnic of Porto (Portugal) and the Campus of Water (Faculty of Sciences, Campus of Ourense) of the University of Vigo (Spain), Fig. 1. This event constitutes an opportunity to strengthen a long-standing cooperation between both academic and scientific institutions, as well as create new challenges and insights on water-related themes in the near future. An example is the recently created “Water, Sustainability and Development” doctoral programme led by the University of Vigo within partnership with the Polytechnic of Porto, among the other international institutions.

The “Sustainable resource management: water practice issues” volume

The motto of the thematic issue is an original contribution to bridging the gap between research, sustainable management, and practice in water resource studies. Approaches to dealing with the research–practice gap were stated by numerous researchers and practitioners in several fields, but progress in this subject has been slow and discontinuous (e.g., McIntyre 2005; Mallonee et al. 2006; Korthagen 2007). In addition, hydrologic investigations focused on research and practice must contribute to solving real-world problems and societal needs (e.g., Hunt and Doherty 2011; Simmons et al. 2012; Hileman et al. 2016; Irvine 2018). Finally, much more keen and well-balanced work needs to be done within this scope to decrease the real research–practice gap between academia, industry, and society. Fortunately, in current days, there is a decrease in the organisational, communicational, and cultural barriers related to global water issues, and an ethos and holistic approach is emerging based on a design that considers nature, integrated sustainable management,

Fig. 1 Overview during the sessions from the 1st and 2nd International Congress on Water Healing Spa and Life Quality (STCV'15 and STCV'17), Ourense, Spain (+ info: <http://campusdaauga.webs.uvigo.es/en/>)

eco-responsibility, socio-ecological analysis, and ethics (e.g., Leopold 1974, 1990; Llamas 1975, 2004; Biswas 1988; McHarg 1992; Custodio 2002; Llamas and Martínez-Santos 2005; Mays 2013; Petitta 2013; Chaminé 2015a, b; Hileman et al. 2016; WWI 2017; Abrunhosa et al. 2018). Nowadays, water resource issues are larger, interconnected, and more interdisciplinary and transdisciplinary, as well as affecting society and ecosystems in a changing earth system framework due to climate variability and societal pressures and/or conflicts (e.g., Gleeson et al. 2012; Mays 2013; Taylor et al. 2013; Foster and MacDonald 2014; Rockström et al. 2014; Braga et al. 2014; Chaminé et al. 2015a, b). Last but not least, hydrogeology deals with an invisible, dynamic, finite, and fragile, but resilient resource to be protected in a sustainable manner. Because of this, water data acquisition must be understood as a boots-on-the-ground science and practice driven with the integrative support of field and analytical methods, GIS mapping, geo-visualisation techniques, and modelling tools (Chaminé et al. 2013, 2015a, b). In summary, a sound and balanced interconnection is needed between academia and practice in integrated water resource management, guided by an ethos of long-term sustainability. In addition, the holistic remarks of water attributed to Luna Leopold are still topical (Hunt and Mine 2012, p. 5): “Water is the most critical resource issue of our lifetime and our children’s lifetime. The health of our waters is the principal measure of how we live on the land”. Tortajada and Biswas (2017) highlighted the fundamental issue focused on the quality of water not only as a human right but also, in a broader overview, as vital to all ecosystems.

This special issue on “Sustainable resource management: water practice issues” comprises a selection of papers that address these challenges in hydrological systems research and practice. The topics covered in this thematic issue illustrate a wide range of original contributions in sustainable water resources management (SWRM). The volume is of interest to all researchers and practitioners in the fields of hydrology, hydrogeology, water resources, hydrologic engineering, and water-related professions.

The large number of motivating articles range from case studies to systematic widespread investigations of water resources and encompass a variety of different hydrogeological topics and settings (e.g., hydrogeological, mapping, hydrogeochemistry, hydrodynamics, groundwater mining, isotopic hydrology, hydromineral resources, water management, hydrological engineering, urban groundwater, mountain hydrogeology, water technologies, hydro-economics, etc.). Some of the papers focussing on hydrology practice address engineering, technology, and planning aspects, while others look at the role of climate variability, environment, economics, and ecosystem issues. The challenges of sustainable water management are confirmed by the variety of contributions to this special issue (Fig. 2).

As shown in Table 1, the thematic issue has a core of 24 original papers and 1 editorial note gathering 98 authors from 48 academic, research and development institutions, or private companies from Europe (Portugal, Spain, United Kingdom, Germany, Norway), America (United States of America, Mexico, Argentina), Asia (Bangladesh), and Oceania (Australia). In addition, several academic and R&D institutions of Portugal (University of Azores, University of Lisbon, University of Porto, Polytechnic of Porto; Centre GeoBioTec—University of Aveiro, CIIMAR—Interdisciplinary Centre of Marine and Environmental Research, REQUIMTE—Chemistry and Technology Network Laboratory, INSA—National Health Institute Doutor Ricardo Jorge, C²TN—Centre of Nuclear Sciences and Technologies, CERENA—ISTI University of Lisbon, IDL—Institute D. Luis University of Lisbon, ICT—Institute of Earth Sciences, LABCARGAISEP—School of Engineering of Porto) and

Table 1 Some numbers in the themed issue on “Sustainable resource management: water practice issues”

Number of	Articles	Editorial	Authors	Institutions	Reviewers
	24	1	98	48	61

Fig. 2 Word cloud based on all keywords (a) and abstracts (b) of the thematic issue on “Sustainable resource management: water practice issues” (generated using <http://www.wordle.net/>)

Spain (Technical University of Catalonia, Technical University of Valencia, University Complutense of Madrid, University of Zaragoza, University of A Coruña, University of Vigo; Royal Academy of Sciences of Spain, EPHYSLAB—Environmental Physics Laboratory| University of Vigo) are well represented in the themed issue.

A last word of great appreciation for the outstanding input of over 60 anonymous reviewers in different stages of the peer-reviewed process (some of them were involved in two or three rounds) to achieve the high standards of Sustainable Water Resources Management from Springer, as well as all the editorial support from the Editors-in-Chief, associate editors, assistant editors, and production team of the journal.

There is a comprehensive range of purposes for sustainable water resource management (SWRM) as demonstrated in this themed issue (Fig. 3). Papers here address several approaches: (i) an interesting set of papers addressing studies in mining environment and water issues (Custodio et al. 2017a, b, c; Banks et al. 2017a, b) and key lessons learned in Spain on the sustainability of intensive groundwater development (Custodio et al. 2017a, b, c); (ii) the papers of Gómez-Pérez et al. (2017), Juncosa-Rivera et al. (2017), Marques et al. (2018), Afonso and Chaminé (2018), López et al. (2018), and Trota et al. (2018) are related mainly to spa technologies evolution, hydrogeochemistry and hydrogeological conceptual models of thermal waters, hydromineral resources, and geothermal systems; (iii) a valuable set of papers highlighting urban groundwater issues, including rural hydrogeology (Naves et al. 2017), sustainable water supply (Paris et al. 2017; Pérez et al. 2018), urban

groundwater ecotoxicology (Guimarães et al. 2018), and historical urban groundwater systems (Antunes and Gonçalves 2018; Afonso et al. 2018); (iv) papers stressing the importance and application of isotope tracers as tool for outlining sources (Bottrell et al. 2017; Fernandes et al. 2018), as well as key studies related to climate change and environmental impacts on groundwater resources (Pisani et al. 2017; Espinha Marques et al. 2017; Mansilha et al. 2017); (v) Monckton (2018) presents an economic analysis of impacts of coal seam water on agriculture; Areu-Rangel et al. (2017) discusses numerical modelling in dams related to a hydrological engineering framework, and Didar-UI Islam (2017) shows a study related to the treatment of different types of wastewater by electrocoagulation technology and pollutant removal.

Outlook

A major societal challenge is decreasing the gap between research and practice in sustainable water resource management, or at least creating a common ground with fewer barriers to solving real-world problems. It is important to build a balanced dialogue between scientists, engineers, stakeholders, decision makers, and end-users to generate reliable knowledge in design with nature, socio- and eco-responsibility, governance, and ethics. The characterisation, design, planning, monitoring, evaluation, and management of water resources must include integrative sustainable methodologies and nature-based solutions. Understanding the role of

Fig. 3 Main themes of the contributions to the journal Sustainable Water Resources Management Special Issue on “Sustainable resource management: water practice issues”

conceptual site models is essential to accurately assess hydrogeological systems and water resources (Chaminé et al. 2013, 2015a, b). That holistic approach contributes, definitively, to protecting the environment, biodiversity, and ground systems, particularly given the effects of climate variability and land-use change.

Sustainability comprises the interactions, interlinkages and impacts among numerous sectors, decisions, and technologies (e.g., UN-WCED 1987; Custodio 2002; Alley and Leake 2004; Guppy et al. 2018). Water is a fragile shared resource. Sustainable water management is a key component of development, which requires meeting the water demand for all the users without compromising the future supply. That approach needs the best management practices, encompassing ecological, environmental, ethics, and hydrologic integrity of the groundwater systems in a sustainable long-term perspective.

Future efforts should continue to focus on decreasing the gap between research and practice in sustainable water resource management within an ever-changing environment. Treating groundwater and surface water bodies as a single resource is a key approach for an integrated sustainable management. Water sustainability is the driving force for a balanced ethos in practice based on technical–scientific knowledge, eco-responsibility, and ethics.

We truly hope that this special issue can inspire talented students, scientists, engineers, and other water-related practitioners. Last but not least, we believe that the future editions of the “International Congress on Water” in Ourense are sure to constitute an interesting forum for discussion to strengthen the scientific and technical knowledge relationship between academia and practice in the field of water resources, thermal waters, and groundwater.

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