42nd IAH CONGRESS

THE INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS
HYDROGEOLOGY: BACK TO THE FUTURE!

time left
days

Rome, Italy
13-18 September 2015

Main Topics

GROUNDWATER, FOOD AND HEALTH

How to give good drinking water to rural, poor populations? How to manage GW in these areas, and prevent water contamination? How to prevent the transfer of contamination from GW to crops, and safeguard human health? How to guarantee and improve the quality of food through GW quality and footprint? How to give answers in an integrated scientific and Civil Society Organizations approach?

SUSTAINABLE USE OF GROUNDWATER

How to achieve sustainable use of GW? How sustainable use of GW is linked to climate change and GW quality? How to manage GW in tunnels, mining and excavations? How to manage aquifer recharge and storage? How to extract and use GW heat?

GROUNDWATER FLOW SYSTEMS BEHAVIOUR

How to investigate mineral (medicinal) and thermal GW systems? How to solve the open questions in karst hydrogeology? How to study the effect of the aquitards on GW flow? How to investigate porous and fractured aquifers, from local to regional scale?

URBAN AND CONTAMINANT HYDROGEOLOGY

How to study the hydrogeological behaviour of aquifer systems in urban and industrial areas? How to evaluate the impacts of contamination sources, and analyse/simulate the transport of contaminants in different media? What are the emerging contaminants? What are the forensic approaches in GW contamination?

GROUND / SURFACE WATER: AN INTEGRATED VIEW

How to manage and use surface- and ground-water in an integrated perspective? How to study the ecohydrology and functionality of GDE?

GROUNDWATER GOVERNANCE AND POLICY

How to link science and policy in GW governance? What are the main issues concerning transboundary aquifers? How to use Decision Support Systems in GW governance? Can we couple hydrologic and economic modelling to manage GW?

GROUNDWATER MANAGEMENT IN COASTAL AREAS

How to quantify submarine GW discharge in coastal areas? How to study and manage coastal GW resources? Does GW influence marine ecosystems? Do “freshwater” aquifer reserves exist beneath the seabed?

NEW TOOLS AND NEW FRONTIERS

How to be innovative in GW testing and modelling? Can molecular biology tools be used in GW studies? How to be innovative when using tracer and isotope methods, or geophysical investigations in hydrogeological studies?

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LINKS

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Sessions

Sessions Index

T1 – GROUNDWATER, FOOD AND HEALTH

S1.1 Developing groundwater for water security in rural communities: the role of science, government, and civil society.
Convenors: Alan MacDonald (British Geological Survey, United Kingdom) and Viviana Re (Ca' Foscari University of Venice, Italy – National Engineering School of Sfax, Tunisia)
In many rural parts of the world (particularly in low income countries) access to groundwater provides the only realistic option for a sustainable safe drinking water supply and can markedly increase local water security. The new Sustainable Development Goals (SDGs) will call for universal coverage for safe drinking water, and a step change towards household connection. However, developing and managing these groundwater supplies can involve many challenges, such as: siting boreholes and wells in low productivity aquifers; testing for and dealing with poor water chemistry, managing groundwater with weak or absent regulation, contamination from onsite sanitation, and issues of ongoing maintenance and non-functionality. This session seeks to: (1) discuss the contribution that groundwater supplies can make to local water security; (2) the current and future challenges of increasing rural groundwater supply; and (3) the opportunities of working together with civil society. Case studies of successful or unsuccessful projects are welcome.

S1.2 Food production, human health and wellness: the role of groundwater
Convenors: Loredana Musmeci (Istituto Superiore di Sanità, Italy) and Luca Lucentini (Istituto Superiore di Sanità, Italy).
Chemical, radiological or microbiological contamination of water stored in aquifers, may seriously impact human health. Groundwater is widely used as source of drinking water, food preparation, irrigation of food crops and animal husbandry, as well as for recreational purposes. Some groundwater pollutants are of great concern for health, including heavy metals (e.g. arsenic, cadmium, chromium, lead, selenium), fluoride, nitrates, radon, specific microorganism.
Risk analysis is the key strategy to assess the groundwater pollution potential, to adequately protect aquifers, to establish control measures, with the aim of preventing, mitigating or managing negative effects of unsuitable groundwater uses on health and economy.

S1.3 Sustainability of groundwater use: how water footprint assessment can help?
Convenors: Water Footprint Network and Water Observatory of the Botín Foundation
Co-convenor: Aurélien Dumont (UNESCO-IHP)
This session welcomes studies that have specifically considered an aquifer or have highlighted groundwater among the sources of water consumed (blue and green WF) and contaminated (grey

WF), both under the 'production perspective' (water management in a delineated area) or under the 'consumption perspective', related with supply chain management. The session will also address the methodological challenges through practical positive and negative examples for every step of a Water Footprint Assessment – accounting, sustainability assessment, and response formulation for a sustainable, fair and efficient use of groundwater resources. It will particularly consider, but will not be limited to, food supply chains

S1.4 Health impacts of groundwater contamination and sanitary risk assessment
Convenor: Paul Dylan Hynds (School of Engineering, Dublin Institute of Technology, Ireland)
Current estimates indicate that waterborne enteric diseases account for 4.1% of the DALY global burden of disease, resulting in 1.8 million deaths annually, at least one third of which are derived from contaminated groundwater systems (WHO, 2014). Numerous studies have demonstrated a link between domestic groundwater sources and the occurrence of human enteric infection. However, significant data and method-based uncertainties remain with respect to enteric disease estimation and pathogen source/pathway assessment for future groundwater management. This conference session will encompass outbreak investigations, cohort studies and quantitative microbial risk assessments of enteric infections from groundwater sources, in addition to sanitary assessments of pathogen sources and contaminant pathways. Accordingly, the session will provide an overview of the current state of knowledge, thus providing a starting point for the development of improved health impact and sanitary assessment, in order to safeguard future generations of groundwater users.

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T2 – GROUNDWATER FLOW SYSTEMS BEHAVIOUR

S2.1 Novel experimental and modelling approaches for the characterisation of karst systems *(coordinated by IAH "Karst" Commission)*
Convenor: Nico Goldscheider (Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany)
Karst aquifers form by chemical dissolution of carbonate rock and can be described as a network of hydraulically-connected conduits embedded in a fissured rock matrix and interacting with this matrix. Flow in the conduits is often fast and turbulent, while laminar flow and intermediate storage can be observed in the matrix. Because of this hydraulic heterogeneity, karst aquifers behave different than porous media, and they require specifically adapted investigation methods. This session deals with novel experimental and modelling approaches for the characterization of karst aquifer systems at all scales, from laboratory scale to catchment scale, and from conceptual and schematic models for improved process understanding to regional karst aquifer models for improved water resources management. Presentations combining experimental methods and modelling are particularly encouraged. Although the focus of this session is on novel methods, practical applications of experimental and modeling approaches are equally welcome.

S2.2 Characterization of anthropogenic impacts on groundwater in karst *(coordinated by IAH "Karst" Commission)*
Convenor: Neven Kresic (AMEC Environment and Infrastructure, Inc., USA)
The main goal of this session is to raise awareness of the unique vulnerability of karst water resources to various anthropogenic impacts and actions needed to protect karst groundwater users and groundwater-dependent ecosystems. The session aims at linking scientists, engineering, management, and regulatory communities interested in both the well-established and innovative tolls for characterization of these impacts. We also welcome presentations on the monitoring approaches for various related physical and chemical parameters, general and specific impacts indicators, and techniques of their quantitative analyses.

S.2.3 Mineral and thermal waters: hydrogeology, hydrogeochemistry and sustainable management *(coordinated by the IAH Commission on "Mineral and Thermal Waters" – CMWT)*
Convenors: Jim Lamoreaux, Werner Balderer and Adam Porowski (IAH Commission on Mineral and Thermal Waters)
Hydrogeologists, hydrogeochemists, engineers and representatives of the industrial sector dealing with mineral and thermal water resources are welcome to participate. Oral presentations and posters regarding recent research, achievements and new discoveries in the field of mineral and thermal waters from around the world will be solicited. Presenters will be invited to publish their papers in a special issue of the international journals Carbonates & Evaporites or Sustainable Water Resource Management or, as an alternative, as a book in the Environmental Earth Science Series.

S2.4 Hydrogeology of fractured rocks: progress in understanding of flow and mass transport
Convenor: John M Sharp (University of Texas, Austin, USA)
Fractured rock systems cover over 20% of the Earth's land surface and underlie shallow sedimentary deposits and sedimentary basins. This session will address critical issues in fractured rock system

hydrogeology. Presentations on geological controls (and evolution) of fractured rock systems, system characterization, water resource availability and sustainability, contamination and remediation, new investigation methods (geologic, hydraulic, chemical, biological, and geophysical), interactions with overlying and adjacent sedimentary systems, and applications to waste disposal, geothermal systems, engineering geology, and mineral/petroleum resources are welcome. The session will build upon and extend recent IAH Conferences in the Czech Republic and France.

S2.5 Hydrogeology of aquitards: flow and transport
Convenor: Beth Parker (G360, University of Guelph, ON, Canada), co-convenor: Jessica Meyer (G360, University of Guelph, Canada)
As global demand for energy, minerals and fresh water increases so does our impact and reliance on groundwater. Predictions of groundwater flow and contaminant behavior are very sensitive to the physical, chemical and microbiological characteristics of lower permeability units, typically underemphasized or ignored in hydrogeology education, research and practice. This is changing rapidly due to societal interests in unconventional oil/gas and geothermal energy extraction, deep repositories for nuclear waste and carbon dioxide sequestration and land use and climate change impacts to the hydrologic system and groundwater. This session invites presentations regarding new advances and insights into the characteristics of clayey and rock aquitards.

S2.6 Natural geologic barriers as repositories of hazardous wastes
Convener: Christine Stumpp (Helmholtz Zentrum München, Neuherberg, Germany)
Deep or low permeable geologic formations are used as repositories of hazardous wastes minimizing their release into the environment. The protection of such geological formations strongly depends on the isolating properties. Therefore, siting waste repositories requires a thorough analysis of the groundwater flow and contaminant transport. This session invites presentations investigating the permeability and transport processes in natural geologic barriers. In particular contributions are welcome using environmental tracer approaches, analysis of geochemical reactions within barriers, mathematical modeling and geophysical methods

S2.7 Discharge area: a fingerprint of groundwater flow conditions *(coordinated by the IAH Commission on "Regional Flow")*
Convenor: Judit Mádl-Szonyi (Eotvos Lorand University, Hungary)
In most hydrogeological studies the focus is placed on understanding the amount and distribution of recharge to aquifers based on the water balance approach, a lumped-parameter model. As opposed, the theory of regional groundwater flow systems with recharge, throughflow and discharge regimes, offers an alternative better suited for distributed-parameter modelling and isotopic tracer interpretation. We invite papers that emphasize the quantitative understanding of flow systems and their fingerprint, thus shifting focus from recharge to discharge, and to its economical and practical importance such as wetland ecology, soil salinization, ore deposition, surface water interaction etc.

S2.8 Analysis of groundwater flow systems during no recharge periods
Convenors: Walter Dragoni (University of Perugia, Italy) and Ognjen Bonacci (University of Split, Croatia)
During no recharge periods, flow of groundwater systems depends largely on the physical characteristics of the aquifers and their hydrogeological setup. Therefore, in line of principle, these characteristics could be inferred from an appropriate interpretation of the depletion process. Depletion curves interpretation methods were developed between the late 1800s and the 1970-80s, with few original advances in more recent years: the session aims to discuss the state of the art of the detection, interpretation and use of depletion processes. Works considering springs and groundwater systems in general (darcian and non-darcian) are expected. Results of theoretical research and case studies are welcomed.

S2.9 Effect of groundwater chemistry on permeability
Convenor: Lucio Di matteo (University of Perugia, Italy)
The behavior of clay materials hosted in aquifers, in natural barriers and in soils is deeply affected by physical and chemical characteristics of pore-fluids. Specific interactions occur at particle level as consequence of changes in pore-fluid composition; this can modifies the permeability and porosity, affecting both recharge processes and flow in the groundwater systems. This can have a strong impact on water management practice. The session aims to present and to discuss theoretical research and case studies, at different scale, from laboratory to the field. Integrated studies are also expected on different soils and pore fluid composition, taking into account both well-established and innovative tools..

S2.10 Mitigation of impacts due to groundwater depletion
Convenor: Giuseppe Sappa (Sapienza University of Rome, Italy)
Excessive Groundwater depletion, due to different factors, affects major regions in North and Central Africa, Middle East, South and Central Asia, North America, Australia and some other localized areas, all over the world. Climate change is one of the most important factors, causing excessive groundwater depletion, but it isn't the only one. This session is aimed to discuss case-histories of excessive groundwater depletion, due to different factors, referring to technical approaches, like

artificial recharge or other solutions, applied to groundwater management, in the aim to mitigate the effects of these factors on groundwater resources.

S2.11 Earthquakes and groundwater: before, during, after
Convenor: Shemin Ge (Colorado University, USA)
Earthquakes and groundwater interact at various temporal and spatial scales. Examples of such interactions include groundwater-level and water-chemistry fluctuated before, during, and after earthquakes, reservoir induced seismicity, and fluid injection induced seismicity related to production of geothermal and unconventional oil and gas. As activities in reservoir building and unconventional energy production around the globe show no signs of abating, continued efforts are called for to better understand the mechanisms of earthquake-groundwater interactions and to potentially help mitigate seismic hazards. This session encourages and provides a forum for exchange of research advances on this topic in the form of case studies, numerical modeling, field and experiments. Studies including human and social-economic dimensions are also welcome.

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T3 – SUSTAINABLE USE OF GROUNDWATER RESOURCES

S3.1 Sustainable yield in groundwater systems: from conceptual model to field experiences
Convenor: Paolo Fabbri (University of Padova, Italy)
The sustainable yield of a groundwater system is that proportion of the recharge that can be extracted without compromising the integrity of the water source and the ecosystems. In some regions management of groundwater systems to the sustainable yield, considering the hydrological, ecological, socioeconomic, technological, cultural, institutional and legal aspects of groundwater utilization, is one of the main objectives. In many places in the world some groundwater supplies are severely depleted because of high levels of water extraction. This session aims to compare people that approach conceptually and experimentally that problem, but also case study are welcome.

S3.2 Climate change and groundwater availability: a call for adaptation *(coordinated by IAH Commission on Groundwater and Climate Change)*
Convenor: Richard Taylor (University College London, United Kingdom)
Groundwater can play a central role in enabling communities to adapt to climate variability and change. There is consequently growing interest in the use of groundwater to address both climate-driven variability in freshwater resources and increased agricultural, domestic and industrial freshwater demands. This session seeks to: (1) define specific advances in knowledge of relationship among groundwater, climate, and adaptation; (2) identify critical knowledge gaps; and (3) promote inter-disciplinary collaborations as well as data and knowledge exchanges.

S3.3 Aquifer recharge assessment and storage management: quantity and quality issues *(coordinated by IAH Commission on Managing Aquifer Recharge)*
Convenor: Peter Dillon (CSIRO, Australia)
Co-convenor: Rudy Rossetto (Scuola Superiore S. Anna, Pisa, Italy)
Historically aquifers have sustained human water needs during droughts and in recent times techniques to enhance recharge and improve groundwater quality have been developed. Managed aquifer recharge (MAR) with all types of waters, in a variety of aquifers, using a range of methods is efficiently increasing the resilience of some future water supplies. MAR accompanied by monitoring, laboratory and modelling studies is also pushing the boundaries of knowledge of groundwater biogeochemical and hydrodynamic processes, that affect for example; fate of viruses in aquifers, metal mobilisation, clogging, and recoverability of banked water. Telling field applications and research papers are sought.

S3.4 Combacting over-extraction: artificial recharge and aquifer engineering regulation
Convenor: Dave Kreamer (University of Nevada, Las Vegas, USA)
Managed Aquifer Recharge and engineering augmentation of groundwater supply have been important hydrogeological techniques for ameliorating the effects of groundwater withdrawal. Artificial recharge projects have, in many cases, successfully helped to provide sustainable groundwater use, improve water quality, combat saline water intrusion, block subsurface contaminant plumes, and restore the natural function of groundwater/ surface water interactions which are important human and ecological considerations. This session seeks to investigate the state-of-the-art techniques of managed aquifer recharge and engineering intervention, the varying legal and regulatory framework for implementing these systems, and examples with lessons learned from past attempts to manage aquifer replenishment.

S3.5-Managing Aquifer Recharge as a solution to water scarcity and drought in Mediterranean and MENA regions
Convenor: Ralf Klingbeil (United Nations ESCWA, Lebanon) (to be confirmed)
Co-convenor: Enrique Fernandez Escalante (TRAGSA – Spain)

Managed Aquifer Recharge (MAR) and Aquifer Storage and Recovery (ASR) can be suitable approaches for intermediate storage of water to overcome supply shortages in times of water scarcity and drought. Passive infiltration systems or active injection wells require substantive technical knowledge adapted to the local circumstances. Beside hydrogeological, scientific or technical challenges; to ensure longer term sustainability of MAR and ASR schemes integrated assessments are required that also address socio-economic and legislative and regulatory issues. Integrative approaches to MAR / ASR from the Mediterranean and Middle East North Africa regions shall offer a platform for regional exchange and cooperation.

S3.6 Water supply in karst regions: challenges and solutions *(coordinated by IAH "Karst" Commission)*
Convenor: Zoran Stevanovic (University of Belgrade, Serbia)
The karstic waters are widely utilized as a source of drinking water supply and around 20% of the global population largely depends on karstic groundwater. Many countries utilize karstic springs simply because there are no other alternatives, but in many others, awareness of their importance and the good water quality they provide is a principal factor for such a decision. It is known that the karst environment is not always friendly: the unstable flow and great variation of the discharge of the karstic springs, salt water intrusion, delineation of sanitary protection zones, insurance of ecological flows, are just some of the challenges that need appropriate solutions from water managers and engineers.

S3.7 Groundwater salinity increase due to irrigation return flow
Convenor: Lucila Candela (Technical University of Catalonia, Spain)
Assessment of groundwater salinity from irrigation return flow requires understanding of processes controlling the release, movement and retention of solutes in the aquifer media. This session aims to review state-of-the-art on physico-chemical processes, uncertainties in measurement data and modeling and case studies. Contributions focusing, but not limited to the following topics are welcome: observed patterns and trends, irrigation management strategies, modeling to quantify processes, as well mitigation measures and the cost effectiveness of these measures. Interdisciplinary studies that bridge salinity occurrence and other problems of particular relevance (microcontaminants, irrigation with non-conventional water, effect on aquifer parameters, etc.) are also invited.

S3.8 Groundwater protection and management in tunnels and underground works
Convenor: Marco Tallini (University of L'Aquila, Italy)
Taking into account groundwater quantity and quality is a key-point in the tunnels and underground works boring, which are increasingly spread worldwide in the megacities, in the classical mining areas or in areas where human activities overexploit groundwater and significantly reduce its quality. The session goal is devoted to the latest state of the art of the current and innovative approaches to analyze the groundwater protection and management techniques, including groundwater monitoring and modeling for the evaluation of different scenarios, which can be considered in the different stages of boring or in the long term life of subsurface works.

S3.9 Extraction and utilization of underground heat: from low enthalpy to high temperature sources
Convenor: Peter Szucs (University of Miskolc, Hungary)
There are more and more geothermal projects on a worldwide scale dealing with the extraction and utilization of underground heat to fulfill the energy demand. The application of heat pumps, the direct use of thermal water from low and medium enthalpy reservoirs, or electricity production from geothermal power plants are getting more and more widespread all over the world. The quantity and quality of the groundwater resources can be influenced during the different activities causing for example overproduction, thermal breakthrough or hydraulic fracturing, etc. The main objective of this special session is to attract presentations from different fields to give good design, operation or management examples how innovative and scientific solutions can support sustainable use of groundwater resources in low, medium or even high enthalpy subsurface environments.

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T4 – URBAN AND CONTAMINANT HYDROGEOLOGY

S4.1 The consequence of urban sprawl on groundwater resources
Convenor: Marco Masetti (University of Milan, Italy)
Urban sprawl may threaten both the quality and quantity of groundwater because of the strong influence of changes in land use type, both in space and in time. The session is focused on the occurrence of hydrogeological impacts such as: a) the correlations between urban sprawl and the occurrence of different contaminants in groundwater, (b) the characterization of negative impacts of sprawl on groundwater flow and recharge and its role in land subsidence and salinization, (c) the findings of new solutions and perspectives in prevention and/or mitigation of the impact of urban

sprawl on groundwater quantity and quality

S4.2 Methods in urban hydrogeology
Convenor: Ken Howard (University of Toronto Scarborough, Canada)
This session will deal with all issues related to groundwater in the urban and peri-urban environment. Abstracts are invited on topics that range from water quality (e.g. pollutant source characterisation and contaminant transport) to water quantity (e.g. aquifer recharge mechanisms and the role of urban "karst"). Presentations dealing with aquifer protection, urban groundwater management and urban water governance are also welcomed

S4.3 The challenges of source apportionment and managing contamination at complex field sites
Convenor: Hans Richnow (Helmholtz Centre for Environmental Research, Leipzig, Germany)
This session will focus on various techniques for characterizing source of contaminants a complex field sites for assessing origin and time of contamination events. Complex industrial and urbanized field sites may have multiple contamination events reflecting the history of industrialization of the region. The elucidation of the contamination history is often important for asserting polluters. On one hand, the composition of contaminants for the delineation of contamination events is challenging since natural attenuation processes modify the spectrum of contaminants. On the other hand, natural attenuation is an important sink for contaminants thus quantification of these processes is important for managing contaminated sites.
We will discuss concepts and strategies base on chemical and isotope analysis for tracing the origin and source of contaminants as well as characterizing their fate at complex field sites in areas with an industrial history. This session aims to bring together scientists in the field of hydrology, microbiology, geochemistry from industry and academia to promote an interdisciplinary interaction from different perspectives related to research and future challenges of source identification and sinks of pollutants at contaminated areas. This should foster the discussion on managing contamination at contaminated complex field sites.

S4.4 Emerging organic contaminants in groundwater: sources, occurrence and fate
Convenor: Dan J. Lapworth (British Geological Survey, United Kingdom)
Globally, a diverse array of synthetic organic compounds are manufactured in large quantities and used for a range of purposes including food production, health care and hydraulic fracturing. Emerging contaminants (ECs) are compounds previously not considered or known to be significant in groundwater, but which are now being detected, and have the potential to cause adverse ecological or human health effects. In the last decade there has been a growing interest in their occurrence, fate in groundwater and potential toxicity. We welcome papers that explore ECs in groundwater including those focused on EC occurrence and fate at the transient groundwater-surface water interface as well as novel methods for monitoring and prioritising ECs.

S4.5 Effects of aquifer heterogeneities on contaminant transport: integrated experimental and modelling approaches
Convenor: Aldo Fiori (University of Rome III, Italy)
The understanding and modeling of flow and transport processes in heterogeneous porous formations have challenged the research community for more than three decades. The matter has generated a significant debate on the principal mechanisms that control transport and the best strategies to represent them. A parallel debate has emerged regarding the development of novel and effective techniques for the aquifer characterization. The above problems have encouraged researchers to develop novel characterization techniques, suitable geostatistical and inverse methods for describing and modeling the heterogeneous subsurface environment, as well as innovative modeling approaches. In this session, we seek for contributions from scientists active in the field of contaminant transport in heterogeneous aquifers, such as to provide a wide view on the recent developments in this area.

S4.6 Impacts of non- point contamination sources on groundwater
Convenor: Dave Rudolph (University of Waterloo, Canada)
Co-convenors: Will Robertson (University of Waterloo, Canada) and Ramon Aravena (University of Waterloo, Canada)
The impacts of non-point sources of contamination on the water quality of groundwater supplies and the health of ecosystems are being observed globally and remain as a challenging issue to resolve. Rural sources including agricultural management and urban sources including road deicers and lawn amendments have resulted in both acute and chronic water contamination problems. This session will focus on emerging techniques for characterizing non-point source impacts through the use of novel tracing techniques, field investigation programs and modeling tools with an emphasis on documented field cases. Research related to BMP strategies and potential remedial approaches will also be emphasized.

S4.7 Groundwater remediation: the never ending conflict between pump&treat and in situ treatment
Convenor: Neil Thomson (University of Waterloo, Canada)

Efficient and effective groundwater remediation methods are required to protect human and ecosystem health, and are necessary for urban intensification. If brownfield sites are remediated, redeveloped and returned to productive use, they can generate significant economic, environmental, and social benefits. The development and critical assessment of remediation technologies for various geologic environments and contaminant conditions is an ongoing struggle and often pump & treat is selected over in situ technologies. This session provides a forum for the general remediation community to present novel methods and performance results related to in situ groundwater remediation technologies as a contrast to pump & treat.

S4.8 Sustainable technologies for groundwater remediation: in situ strategies for plume containment and source zone removal *(coordinated by CERI Sapienza)*
Convenor: Marco Petrangeli Papini (Sapienza University of Rome, Italy)
Groundwater contamination by NAPL (Non Aqueous Phase Fluid) represents one of the most difficult problem to be faced in the management of contaminated sites. The chemical and physical properties of these substances make it necessary to formulate appropriate remediation strategies to ensure an effective removal of the source and the long term management of the contamination plume. In situ technologies based on the integration of physical-chemical, biological and hydrogeological processes are required for a sustainable solution of the problem. The session will consider works from the laboratory to the field scale focused on the development of in situ processes in the long term management perspective.

S4.9 Mine dewatering and water quality
Convenor: Wendy Timms (University of New South Wales, Australia)
Dewatering of open pits and underground mining operations is critical for safe and efficient operations. Mining deeper and in more challenging environments has implications for design of dewatering, management of aquifer interactions and water quality. This session will include papers on hydraulic and hydrogeochemical aspects of dewatering and associated issues such as aquifer re-injection, subsidence and stability, natural and engineered barriers to groundwater flow, long term water quality issues in mine voids, and minimizing risk of unacceptable impacts on water resources.

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T5 – GROUND/SURFACE WATER: AN INTEGRATED VIEW

S5.1 Interaction between aquifers, rivers, lakes and estuaries: Flow and Transport
Convenor: Klaus Hinsby (Geological Survey of Denmark and Greenland, Denmark)
Understanding and quantifying the interactions between groundwater and surface water in terms of water, solute and colloid or pathogen transport is of increasing importance for sustainable water resources management and protection of both drinking water resources and groundwater dependent or associated aquatic ecosystems. This session invites presentations on physical, chemical and ecological measurements and monitoring of interactions between aquifers and both fresh and marine surface water bodies, as well as integrated groundwater-surface water modelling and submarine groundwater discharge, including application of isotopes and other tracers for improved understanding of flow and transport in and interactions between groundwater and surface water.

S5.2 Integrated surface and groundwater management
Convenor: Miquel Salgot (University of Barcelona, Spain)
At the basin scale, surface and groundwater should be fully related in terms of natural flow and resources management. Overexploitation leads to a lack of connexion between rivers and its aquifers with the subsequent destruction of the natural management of water resources. The tendencies on basin research and management try to re-establish this connexion as well as aquifer recharge by using conventional and non-conventional water resources. Special focus is put on reclaimed and runoff water use for recharge and on the use of aquifer treatment and recovery techniques (ASR, MAR). Studies integrating natural flow, extraction, discharge, reclamation, reuse and demand management are considered as paramount for all basins.

S5.3 Ecohydrology and ecological modelling of groundwater dependent ecosystems *(coordinated by IAH Network "Groundwater and Ecosystems")*
Convenor: Marco Cantonati (Museo delle Scienze di Trento, Italy)
One of the main challenges for humankind is providing sufficient-quality water to a still-rapidly-increasing population. This frequently involves groundwater dependent ecosystems (GDE). The paramount importance of providing solutions to the "water crisis" lets other issues stay in the background, or being totally disregarded. One of these is the recently-quantified relevance of GDE for the conservation of freshwater biodiversity, that is a relevant proportion of global diversity. The application of ecohydrological principles and the ecological modelling of GDE is thus urgent and necessary for a sustainable use of GDE, and to exploit the potential of their biota for quality and integrity assessments.

S5.4 Hydrogeological indicators for Groundwater Dependent Ecosystems functionality
Convenor: Luis Ribeiro (CVRM-IST, Portugal)
In a hydrogeological framework several practical and technically robust tools are currently used to identify GDEs at local and regional scales. Groundwater recharge and discharge are key issues to well-understand the interaction with the ecosystems and their temporal variability. The identification of hydrogeological scale can be a useful indicator of ecosystem dependence as well the type of aquifer (porous, karstic or fractured) as they influence the magnitude of groundwater levels changes. A toolbox with hydrogeological indicators to proper characterize the functionality of GDE should also include topographical and geomorphologic parameters.

S5.5 Karst aquifers and ecosystems *(coordinated by IAH "Karst" Commission)*
Convenor: Natasa Ravbar (Karst Research Institute, Slovenia)
Karst aquifers offer a great range of economic assets, provide unique habitats and valuable ecosystem services. Owing to their particular nature, these environments are highly susceptible to destruction. Any interference is likely to have irreversible impacts and disturb the natural balance of the elements (e.g. water, soil, flora and fauna) and processes (e.g. corrosion, CO2 sequestration, energy flux) that constitute them. The session aims for better understanding of the highly fragile karst environments and addressing challenges of their protection. We are looking forward to receiving contributions that share experiences and case studies from karst areas worldwide presenting a multi-disciplinary approach to finding solutions to concrete problems, and/or discuss new methodologies and techniques.

S5.6 Natural and human induced Impacts on Groundwater Dependent Ecosystems *(coordinated by IAH Network "Groundwater and Ecosystems")*
Convenor: Bjorn Klove (University of Oulu, Finland)
Aquifers and groundwater-dependent ecosystems (GDE) are facing increasing pressure from water consumption, irrigation and climate change. Pollution, land use and loss of habitats is a threat for these valuable systems with unique biodiversity. In arid and semiarid regions groundwater level drawdown, reduced river flow has had sever impacts on lakes and wetlands. While ecosystems suffer from reduced flow, impacts of climate change and nitrate pollution in major aquifers is also a threat to GDEs that has not been well understood. There is an urgent need to better understand the impact of natural and human induced Impacts on GDEs

S5.7 Long term impacts of climate on groundwater: scenarios and challenges
Convenor: Francesco Fiorillo (University of Sannio, Italy)
Groundwater resources are strictly connected to local climate conditions, hydrogeological features as well. Climate is the main factor controlling recharges processes, which strongly depend on the temperature and rainfall distribution during the hydrological year. These climate variables have also a typical inter-annual cyclicity, which controls the groundwater levels at long-term scale. Deviations from mean values of climate variables induce modifications on recharge processes, and have direct consequences on groundwater level fluctuations. The session is focused on these aspects, included the effect of the worldwide observed temperature increase, and on the modification of the rainfall temporal distribution. Studies carried out on daily, monthly or annual scale analysis are welcome, and future scenarios or challenges on the groundwater resource are also particularly suitable.

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T6 – GROUNDWATER GOVERNANCE AND POLICY

S6.1 How to link Science and Policy in groundwater governance?
Convenor: Shaminder Puri (Secretary General of IAH, United Kingdom)
'Out of sight and out of mind', and often categorised as 'too difficult' to understand, groundwater remains an enigma to most. Except where there are significant water supply interests, policy-makers, practitioners and researchers alike continue to ignore groundwater. Surface waters represent 'outcrops of groundwater' where groundwater is a significant pathway for pollutant fluxes from the land, but how do we explain this better to policy-makers preparing long-term plans? How can we explain the 4-dimensional aspects of complex catchment systems to the stakeholder community? This session welcomes case-studies that explore how groundwater can be dealt with in River Basin Planning through innovative ways to inform and educate those who need to know.

S6.2 Science/Policy interface: the role of groundwater in river basin management plans
Convenor: to be announced

S6.3 Putting governance of transboundary aquifers into practice; where the hydrogeological and legal meet *(coordinated by IAH Commission on Transboundary Aquifer)*
Convenor: Neno Kukuric (UNESCO IGRAC)
In recent years considerable progress has been made on mapping and assessment of transboundary aquifers as well as international law relevant to transboundary aquifers – raising global awareness on the need for transboundary groundwater governance. However, there remains a need to ground these advancements at a practical scale and to further induce cooperation on groundwater [illegible]

governance. Often the challenge is how to move beyond predominantly geologically defined aquifers (sometime very large in area) and global conventions to this practical scale. Therefore we invite presentations from all those grappling with hydrogeological and/or legal challenges in transboundary aquifer governance.

S6.4 Development of decision support systems for sustainable groundwater management
Convenor: Mohamed Bazza (FAO Land and Water Division, Rome, Italy)
The topic is focused on innovations in research and operations models as well as practical experiences in applying them in real time situations, for the purpose of serving as decision support systems (DSS) for the sustainable management of groundwater. Research in the areas concerned with groundwater, such as cognitive science, economics and technology, cover the principles, concepts and theories of DSS per se; whereas operations are concerned with the methods, tools and techniques in management and cover such areas as data acquisition, social arrangements, economics, communication, information technology, etc., as they relate to groundwater management.

S6.5 The implementation of EU and international water regulatory schemes: experiences and perspectives
Convenor: Elisabetta Preziosi (IRSA, National Research Council, Italy)
Sustainable water management requires suitable policy tools able to meet both environmental and social objectives for the future generations. As for Europe the Water Framework Directive (2000/60/EC) has established an ecosystem-based approach for water policy and water resource management and protection. In this session we aim to bring together scientists, policymakers, governmental agencies and practitioners in order to discuss the advances in water resources management to inform water policy and governance for a sustainable development. Presentations are invited on themes ranging from the implementation of current water regulations or recommended best practices, integrated water resources management, use and sharing of trans-boundary waters, conflict management and negotiations of water resources and examples of hydrogeological science based policymaking. Field monitoring and modelling studies that help to underpin water policy are also strongly encouraged as well as experiments on stakeholder engagement and decision support tools development.

S6.6 Methods for assessing natural background and threshold values in groundwater
Convenor: **Teresa Condesso De Melo (Instituto Superior Tecnico, Portugal)**
Pressures on groundwater quality are increasing mainly as a result of human activity. The assessment of groundwater chemical status often requires the derivation of groundwater natural background levels (NBLs) and threshold values (TVs). NBLs form the basis for defining the natural properties of groundwater derived from atmospheric or geological sources and for distinguishing natural phenomena from human impacts. TVs for the *protection* of groundwater dependent *ecosystems* and human health are derived for pollutants and related to the pressures identified as putting groundwater bodies at risk. The challenge nowadays is on the development of the most appropriate methodologies to calculate NBLs and TVs which may require the selection and use of both chemical and biological indicators and tracers.

S6.7 Updating the paradigm of vulnerability of aquifers
Convenor: **Alain Dassargues (University of Liège, Belgium)**
The public's growing awareness of groundwater quality and quantity issues lead to many risk analysis linked, among others, to the aquifer quality/quantity state, to drinking water well protection, to the groundwater dependent ecosystems (wetlands, springs, streams). In this context of applied hydrogeology for decision makers, terms as 'vulnerability of aquifers' or 'vulnerability of groundwater' are used with various meanings. Vulnerability of what? the whole aquifer? the saturated zone? a production well?... Vulnerability with regards to which kind of stress/pressure or hazard? Unclear definitions have lead indeed to far more confusion in the different ways of building vulnerability indexes/indicators and maps with unfortunately a large degree of empiricism and subjectivity.
The focus of this session is clearly to provide clear definitions, new ideas and techniques, and a forum of discussion about new vulnerability mapping techniques that conciliate scientific rigorous approaches giving more emphasis on processes-based methods, and the need of clarity for decision makers.

S6.8 Governance and management of groundwater in areas susceptible to desertification
Convenor: Pier Paolo Roggero (University of Sassari, Italy)
Groundwater is key resource in desertification vulnerable areas. The United Nation Convention to Combat Desertification (UNCCD) does not explicitly mention groundwater as relevant to desertification but recognizes it in the site-specific complex relationships between watershed processes, ecosystem services, human impacts on hydrological processes. This reveals a weak link between the scientific community of hydrogeologists and the networks of scientific communities contributing to the implementation and development of the UNCCD. This session opens a new space for dialogue between hydrogeologists and scientific networks such as Desertnet international, that will provide new opportunities for interdisciplinary research and innovation.

S6.9 Advances in coupled hydrologic and economic m 附件 1- 11 **odwater and**

S6.9 Advances in coupled hydrologic and economic modelling of groundwater and conjunctive use systems

Convenor: Manuel Pulido-Velazquez (Polytechnic of València, Spain)

The complexity of groundwater management requires methods for the integration of technical, economic, environmental, legal and social issues within a framework that allows for the development of efficient, equitable and sustainable groundwater use strategies. Combining economic concepts and performance indicators with the modelling of the hydrologic and water use system (hydro-economic models) can provide results and insights more directly relevant for water management decisions and policies. This session aims to provide a forum for discussing advances in groundwater economics and groundwater and conjunctive use hydroeconomic models and their relevance in the design of water and land use management strategies.

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T7 – GROUNDWATER MANAGEMENT IN COASTAL AREAS

S7.1 Submarine groundwater discharge: quantification and ecological impacts

Convenor: Philippe Van Cappellen (University of Waterloo, ON, Canada)

Submarine groundwater discharge (SGD) and associated material fluxes form an important link between land and sea. In many coastal areas nutrient delivery by SGD rivals or even exceeds that by rivers and atmospheric deposition. The past decades have seen major advances in our ability to quantify SGD and, as a result, we are now in a much better position to assess the impacts of SGD on coastal ecosystems. In this session, we welcome experimental and theoretical studies that address the hydrological, biogeochemical, environmental and socio-ecological aspects of SGD in coastal marine environments, as well as inland seas and large lakes.

S7.2 Exploitation of submarine springs: challenges and technical solutions

Convener: **Matt Charette (Woods Hole Oceanographic Institution, USA)**

In arid regions, local fishermen have reported the occurrence of submarine freshwater springs for centuries, yet few municipalities have attempted offshore fresh or usable water exploration. This is mainly due to the relatively high cost of exploration/production and the assumption that limited volumes of freshwater make this potential resource economically unfeasible. In the last decade, advancements in oceanography and earth sciences, refinement of exploration and production tools, as well as the reported significant freshwater producible from submarine freshwater springs in various parts of the globe have considerably improved the feasibility of this resource making offshore exploration a challenge rather than a high risk venture.

S7.3 Salt water intrusion: processes, investigation methods and monitoring

Convenor: Maurizio Polemio (IRPI, National Research Council, Italy)

To guarantee sustainable use of groundwater resources in a future climate under the risk of saltwater intrusion we need a better understanding of processes, development of investigation methods and improving the efficiency of spatial monitoring systems. We need to improve our knowledge from the borehole or site scale to the aquifer or regional scale: the session is so focused on any kind of innovative approach or useful practical experience concerning processes under the effect of saltwater intrusion, the survey approaches and the large scale and/or long-duration monitoring.

S7.4 Management of coastal groundwater resources: drought, tsunami and anthropic pressures *(coordinated by IAH Network "Coastal Aquifer Dynamics and Coastal Zone Management")*

Convenor: Giovanni Barrocu (University of Cagliari, Italy)

In coastal areas, as the transition zones between land and sea, the fragile interface equilibrium between fresh, brackish, and salt water is generally jeopardized by (1) natural processes such as floods, tsunamis, subsidence, and sea-level variations, and (2) human actions like freshwater overexploitation, drainage, land reclamation, and pollution, so that it may be strongly affected by droughts, conditioning aquifer recharge. Therefore, all water resources should be managed in an integrated way, considering (1) local hydrogeological characteristics, and (2) quantity and quality demands for different purposes, so as to grant a real sustainable economic development for present inhabitants and future generations.

S7.5 Impacts of projected sea- level rise on coastal groundwater resources

Convenor: Yoseph Yechieli (Geological Survey of Israel).

Co-convenor: Gualbert Oude Essink (Deltares, The Netherland)

Absolute sea level has risen in the last decades at many places throughout the world and is expected to rise in the next century. The effect of this rise is site dependent (e.g. coastal topography, permeability of aquifers and more). This rise is thought to be a result of climate change, which is by itself another important factor in the response of aquifers to sea level rise. While some analytical and numerical (1D, 2D, 3D) modelling efforts have been done, very little field data is available due to the relatively slow rise and the difficulty in obtaining such data in shor[illegible] no possible

relatively slow rise and the difficulty in obtaining such data in short monitoring time. One possible solution is to study these processes near (saline) lakes or inland seas whose variations can be several orders faster than near the ocean. This session intend to deal with analytical and numerical modelling effort as well as field work that try to quantify salinization and related processes near seas, (saline) lakes or inland seas worldwide. Lessens from past (palaeo) events of sea level changes can also be presented in this session.

S7.6 Freshwater aquifer reserves beneath the seabed
Convenors: Ghislain De Marsily (University of Paris VI, France) and Vincent Post (Flinders University, Australia)
Recent studies (e.g. Post et al, 2013) have shown that in coastal areas there may be important freshwater reserves in aquifers beneath the seabed. One of the assumptions used to explain this observation is that these aquifers were recharged when the continental shelves became exposed when sea levels were lower during the glaciations of the Pleistocene. When the sea level rose, this freshwater remained in the aquifers and are now beneath the seabed. Some of the important questions about these potential reserves are around the salinity of this water, their extent and the volume of water they contain, and what exploitation methods could be used to recover the freshwater. Current scientific challenges include the development of observation methods, age dating, and modelling approaches to better understand the genesis and preservation of the offshore freshwater reserves.
Reference:
V.E.A. Post, J. Groen, H. Kooi, M. Person, S. Ge, W. M. Edmunds (2013) Offshore fresh groundwater reserves as a global phenomenon. *Nature*, Vol. 504, 5.12.2013, doi:10.1038/nature12858.

S7.7 Integrated Coastal Zone Management (ICZM) protocols: hydrogeology, the big absentee
Convenor: Dolores Fidelibus (Politechnic of Bari, Italy)
Even though a specific reference to coastal aquifers is included in Article 5 'Objectives of ICZM', groundwater is a big absentee in practical applications of ICMZ protocols. It is a long time that the community of hydrogeologists emphasizes that such protocols do not competently address groundwater topics, sometimes completely forgetting the close relationship among inland groundwater, submarine groundwater discharge, and marine environment, as well as the consequences of disruption of freshwater/seawater equilibrium. The session encourages submissions from different areas of hydrology, hydrogeology, land planning and marine sciences that address issues related to a correct integration of groundwater facets within protocols of integrated coastal zone management.

S7.8 Groundwater quality issues in coastal aquifers: Improving our understanding through measurements and modelling
Convenor: Henning Prommer (University of Western Australia).
In many countries the groundwater quality of coastal aquifers is severely stressed by a wide range of anthropogenic influences, mostly associated with a particularly dense population and a wide variety of industrial activities. Understanding the current state and the future evolution of groundwater quality in coastal aquifers relies on the robust analysis of the typically complex flow patterns, which coincide with steep geochemical gradients. For this session we seek contributions that report innovative methods for characterising and analysing coastal groundwater systems, including numerical modelling studies of variable density flow and of reactive transport processes under variable density conditions.

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T8 – NEW TOOLS AND NEW FRONTIERS

S8.1 Advances in modelling and model- related issues
Convenor: Jesus Carrera (IDAEA-CSIC, Barcelona, Spain)
Co-convenor: Andrea Zanini (University of Parma, Italy)
The session addressing advanced groundwater modeling issues. These include, but are not restricted to: stochastics (uncertainty, upscaling, mixing), inverse problem (calibration, data assimilation, Kalman filtering, etc), and hydro-thermal-mechanical and chemical coupled models (subsidence, CO2 storage, fracking, enhanced geothermal systems, etc). Presentations are welcome on model concepts, numerical methods and actual applications. If a minimum critical mass is achieved, we will decide on the possibility of preparing a special issue for a specialized journal.

S8.2 Molecular biology tools in groundwater studies: the „omics" revolution
Convenor: Károly Marialigeti (Eotvos Lorand University, Hungary)
Co-convenor: Antonio Bucci (University of Molise, Italy)
Groundwater is a manifold resource, a medium for biogec

Groundwater is a manifold resource, a medium for biogeochemical processes, an extreme environment, and a biodiversity hotspot. Using culture based standard techniques the autochthonous microbes and processes remain hidden. Cultivation independent technologies resulting large datasets (array techniques, NGS, proteome, etc.) combined with in-situ, even single cell metabolic studies, biomarker use etc. and bioinformatic analysis can give a molecular level understanding of groundwater processes even at high-resolution spatial and temporal scales. Studies are welcome which use "omics" and other molecular tools to unravel the community composition, metabolism and other functions of the groundwater ecosystem and having geochemical consequences.

S8.3 New advancement in using compound-specific isotope analysis (CSIA) to investigate organic contaminants
Convenor: Orphan Shouakar-Stash (University of Waterloo, ON, Canada)
The session aims to provide a forum for presenting new advancements in analytical methodologies for CSIA as well as presenting research outcomes from laboratory experiments and field site investigations. In recent years, CSIA have seen a remarkable growth in end-user acceptance and consequently an increase in the applications of CSIA in field sites studies. The advancements in the analytical capabilities of CSIA and the recent outcomes from dual CSIA laboratory experiments showed how CSIA is a powerful tool in investigating sources of organic contaminants, understanding their fates and studying transformation mechanisms.

S8.4 Tracer and isotope hydrology (joint sessions with the International Commission on Tracers of the IAHS)
Convenor: Piotr Maloszewski (Helmholtz Center Munich, Germany and AGH University Krakow, Poland)
Tracers are widely used to characterize groundwater flow paths, estimate system parameters and/or for understanding and quantifying of groundwater bioremediation. The characteristic isotopic signature of many pollutants and the changes in isotopic composition during specific biological, chemical, and physical processes may yield unique information on the origin of pollutants and on their fate in soil and groundwater. This session will be focused on two following topics: i) Estimation of water origin, water flow-paths and groundwater dynamics in heterogeneous groundwater systems by use of tracers and mathematical modelling; ii) Understanding and estimating of pollutant transport and bioremediation processes using isotope methods.

S8.5 Hydrogeophysics, remote sensing, and radar technologies: innovative tools and recent development
Convenor: Giorgio Cassiani (University of Padova, Italy)
The characterization of the subsurface from a hydrological viewpoint requires that the system's structure, hydraulic parameters and main boundary conditions be identified. This makes hydrology and hydrogeology data-hungry disciplines. In face of this need, traditional investigation methods are generally insufficient or inadequate, as they provide data with limited spatial and temporal coverage and resolution. This session aims at presenting innovative, non- or minimally-invasive exploration techniques, that can provide spatially-extensive and time-intensive data. This wealth of information shall be used, in conjunction with traditional data, to build, calibrate and validate physical-mathematical models describing the hydrological dynamics under investigation.

S8.6 Energy Resources and Groundwater: the Water-Energy Nexus
Convenor: John E. Doherty (Flinders University of South Australia)
Fuel for the making of energy, and energy itself in the form of heat, are extracted from the subsurface. This is not new. However recent energy industry developments, such as those associated with extraction of unconvential gas, have the potential to place groundwater systems that support other industries, and provide water for domestic use, at risk. Inference of risk, and the design of appropriate adaptive management strategies for mitigation of risk, poses new challenges to groundwater monitoring and modelling. This session focusses on those challenges.

S8.7 Hydrogeological mapping for sustainable management, protection, evaluation and valorization of groundwater resources *(coordinated by ISPRA Italy)*
Convenor: Willy Struckmeier (German Federal Institute for Geosciences and Natural Resources)
Co-convenor: Lucio Martarelli (ISPRA, Italy).
Hydrogeological Maps are excellent tools for both, the visualization of data and the communication between groundwater experts, engineers, executives or with the public often having a rather poor understanding of the hydrogeological facts. The value of maps is high, as they portray very condensed information at one sight about the groundwater situation in the geographic context. They easily allow comparison with the neighborhood and help identifying inconsistencies in the data.
Digital tools such as Geographic Information Systems (GIS) allow using the maps within the process of data collection and analysis, but also help producing tailor-made maps for various purposes. The session deals with concepts of and findings from hydrogeological maps and their application

S8.8 Conventional and water- free fracking: role of carbon dioxide and consequences on groundwater

Convenor: to be announced

S8.9 Advances in public domain groundwater flow and transport modelling
Convenors: Tullia Bonomi (University of Milan-Bicocca, Italy) and **Daniel Feinstein (U.S. Geological Survey, USA)**
Co-convenor: Jacopo Borsi (TEA Sistemi SpA, Pisa, Italy)
The last several years have seen many enhancements of the widely-used USGS code MODFLOW and related flow and transport programs. Much of the progress has come from partnerships between the USGS and researchers in the private sector. Advances include an unstructured finite-difference version of MODFLOW allowing targeted grid refinement, a NEWTON-RAPHSON solver allowing stable treatment of dry cells, new options for simulation of transport, groundwater/surface interactions, optimized management, and fracture flow, as well as codes built around MODFLOW which integrate groundwater, surface-water, surficial and farming processes. Other public domain codes which solve groundwater flow and transport processes by finite difference, finite element or analytic element techniques (e.g., SUTRA, TOUGH2, GFLOW, HYDROGEOSPHERE) have also seen important advances. Contributions to the session are encouraged which feature applications of recently released versions and extensions of MODFLOW and/or other public domain groundwater codes, or, alternatively, which describe enhancements still in development.

S8.10 New strategies and tools in groundwater monitoring
Convenor: Craig Simmons (Flinders University of South Australia)
The development and application of more efficient and effective methods of monitoring and measuring groundwater will improve our ability to understand, characterise and manage groundwater. Challenges and opportunities include, but are not limited to, measurement of groundwater processes at increased spatial and temporal resolution; integration of numerous and emerging tools and techniques (e.g., hydraulic, geological, geochemical, environmental tracers, geophysical, remote sensing, ecological, climate data – amongst others) as the basis for both robust characterisation and assessment of groundwater systems and in recognition of the increasing interdisciplinarity of water and environmental issues; reducing uncertainty in groundwater analyses by acquisition of appropriate data at appropriate scales; understanding and quantifying the benefit-cost trade-offs in monitoring and data acquisition; integrating measurement and modelling as the basis for quantitative analysis. This session discusses new strategies and tools for monitoring, characterising and modelling groundwater systems. Fundamental advances through to applied case studies in which new tools, strategies and approaches are developed, demonstrated, integrated and applied will be presented.

S8.11 Nanotechnology and groundwater: threats and promises
Convenor: John Tellam (University of Birmingham, United Kingdom)
Nanotechnology applications continue to proliferate across a very wide range of human activities, from clothing to food production, energy storage to paper manufacture, electronics to medications. Two major issues of relevance to groundwater are: What is the contaminant potential of engineered nanomaterials? and What hydrogeological uses could nanomaterials be put to? Session 8.11 invites contributions on any topic relevant to these issues, including: the transport and fate of manufactured nanoparticles (including particle-particle, particle-surface, and particle-solute interactions, and role of nanoparticles in groundwater contamination); manufactured nanoparticle toxicity (including to indigenous microbes); application of nanotechnology in hydrogeological investigation; and application of nanotechnology in remediation.

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