Water resources and environment in Australia

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Australia is the driest inhabited continent in the world: the mean annual rainfall is only about 465 mm. The country has also one of the most variable climates in the world: tropical in the north to arid in the middle to temperate in the south, and still others (e.g. continental, oceanic). As a consequence, there is significant variability in hydrology and water resources (e.g. rainfall, streamflow) in both space and time: for instance, more than 80 % of the country gets an annual rainfall of <600 mm, but the tropical far north receives over 4,000 mm; and rainfall is generally more in winter than in summer, but it is the opposite in the far north. The extreme spatial and temporal variability in rainfall also contributes to frequent floods and droughts in different parts of the country: the 2010–2011 floods in the northeast state of Queensland (QLD) and the 2001–2009 drought (the Millennium Drought) in the southeast states of New South Wales (NSW), Victoria (VIC), and Tasmania (TAS) and also the Australian Capital Territory (ACT) are just two of the many recent examples.

Australia is an island continent, far away from much of the rest of the world. It is also home to some unique ecosystems and species. The Great Barrier Reef is the world's largest coral reef system, composed of over 2,900 individual reef systems and 900 islands stretching for over 2,600 km over an area of $\sim 344,000 \text{ km}^2$, located in the Coral Sea off the coast of QLD. Among the unique animal, bird, and plant

species are the kangaroo, the koala, the platypus, and the emu. Australia's distance from the rest of the world and its unique ecosystems put additional stress on the nation on various fronts. For instance, it becomes extra imperative to be self-sufficient in food production, rather than depending on imports from far off countries, to meet the nation's needs. Elimination of the potential spread of diseases from other countries, including through imports of food products, plants, and animals, is an absolute priority. These have contributed to, among others, significant exploitation of water resources and environment in the Murray–Darling Basin (MDB) over the past several decades.

All these observations clearly indicate that proper planning and management of Australia's water resources and environment is already at a critical stage. Looking at the projections of future population (if the current trend continues, the country's population is expected to reach 36 million by around 2050; see Australian Bureau of Statistics 2008) and anticipated impacts of climate change (increased temperature, reduced rainfall, increased frequency and intensity of floods and droughts; see CSIRO and Bureau of Meteorology 2007; Cleugh et al. 2011), this problem will become even far more vital and challenging. The relevant issues and questions to address are very many, including: (1) How can modeling and prediction of hydrologic processes be done better? (2) What are the impacts of climate change on water and environment? (3) Can the various water demands, including environmental flow requirements, be met adequately? (4) How does catchment landscape evolve? (5) In what ways a better understanding of floods and minimization of their risks be achieved? (6) What are the uncertainties in water allocation, and how to deal with them? (7) What is the role of information modeling in water resources? and (8) What are the challenges in managing waters shared across political boundaries?

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The current Special Issue compiles some important research activities that address the above issues, and others, associated with the water resources and environment in Australia. The issue consists of 11 papers, contributed by a total of 35 authors, from several universities/institutions/government organizations (and others) across Australia and elsewhere. The papers together cover a wide range of topics, study water and environmental issues in different regions/states (including the Murray–Darling Basin), analyze a variety of water and environmental data, develop and/or test different scientific concepts, employ a host of mathematical methods and measurement techniques, and offer important directions for the future. It is my hope that this compilation will form an important contribution to research on Australian water resources and environment.

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