Preface

Climate change and rapid population growth pose a serious threat to global water availability, which result in changing the water cycle, sea level, and rainfall variability, and thus crop production and the frequency and scale of floods and droughts. The water cycle operates across all scales, from the global to the smallest stream catchment, and involves the movement of water in terms of precipitation, evaporation, transpiration, vapour transport, surface runoff, subsurface return flow and groundwater flow. Accurate knowledge and accounting of various hydrological processes (evapotranspiration, rainfall, runoff, and seepage, etc.) and different factors (land-use changes) affecting these hydrological processes, both spatially and temporally, is of paramount importance. The spatial scales considered can vary from pixel to continent. Ground-based measuring and monitoring techniques have very limited ability to capture the spatial and temporal variation of different hydrological variables at regional and continental scales.

Recent, state-of-the-art advances in measuring hydrological variability by means of satellite gravimetric techniques such as the Gravity Recovery and Climate Experiment (GRACE) mission, other remote sensing platforms (TRMM, Landsat and MODIS), and ground-based methods have provided a great potential to estimate spatio-temporal surface water balance, spatially-averaged water budgets, hydrodynamics, hydrological processes, and characterization of groundwater systems in gauged and ungauged basins at regional and global scales. New satellites, such as GRACE, SMOS, and METOP, are starting to generate hydrological parameters that have large potential for water managers in data sparse environments. Sensors such as radar altimeters, primarily designed for ocean or ice studies, are now used for monitoring continental waters. Optical-thermal satellites (Landsat and MODIS) have been extensively used for estimation of vegetation health parameters and actual evapotranspiration from various land-use classes over the past two decades. Finally, the “Predictions in Ungauged Basins” initiative (PUB) is focusing on remote sensing models and estimates of spatially-averaged water budget components across scales and beyond catchment boundaries. In parallel, advances in ground-based measurement techniques, such as distributed temperature sensing, geological weighing lysimeters (gwl), and geophysical surveys are finding their way into research and practice for characterizing the hydrological parameters by more efficient means.

To bring together the broad interest of specialists on the subjects of satellite gravimetry, remote sensing and ground-based methods in multi-scale hydrology and water resources management over the full range of terrestrial spatial scales from pixel to continent, a joint symposium (J-H01) entitled: *GRACE, other remote sensing platforms and ground-based methods for estimating multi-scale surface water budgets, groundwater system characterization and hydrological processes* was held during the 25th General Assembly of the International Union of Geodesy and Geophysics (IUGG), *Earth on the Edge: Science for a Sustainable Planet*, in Melbourne, Australia, from 28 June to 7 July 2011. The joint symposium was led by the International Association of Hydrological Sciences (IAHS) with other IUGG Associations including the International Association of Geodesy (IAG) and International Association of Meteorology and Atmospheric Sciences (IAMAS). This IAHS publication contains 30 peer-reviewed papers from different disciplines to provide a review on the state-of-the-art on one or more aspects of GRACE, Remote Sensing and Hydrological Models for understanding of multi-scale hydrological processes. The papers have been

organized into three general categories: GRACE Application, Satellite Application, and Hydrological Application.

The editors are grateful to the symposium participants for their scientific contributions, which together form an impressive volume on the topic of state of the art application of remote sensing and ground-based methods for multi-scale hydrology. We also thank symposium participants for their prompt submission of manuscripts and adherence to a tight publication schedule. Penny Perrins and Cate Gardner at IAHS Press are graciously thanked for their tireless effort in preparing the papers for publication. Lastly, the editors thank Dr Tamara Jackson for an English review and editing of the accepted papers, Mr Josh Sixsmith for preparing the front page picture, Mr Kaleem Ullah for help in session planning and Pierre Hubert (Secretary General of IAHS) for coordinating the joint symposia details.

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