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Groundwater and global hydrological change – current challenges and new insight

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As the world's largest accessible store of freshwater, groundwater plays a critical role in enabling communities to adapt to freshwater shortages derived from low or variable precipitation and high freshwater demand. As highlighted by the IPCC in 2001 (TAR) and 2007 (AR4), our knowledge of how groundwater systems respond to changes in climate and abstraction remains severely limited. Although new diagnostic tools such as the global aquifer map (WHYMAP) and satellite monitoring of changes in total water storage under the Gravity Recovery and Climate Experiment (GRACE) have recently been developed, their deployment is greatly constrained by a dearth of reliable and sustained observations of groundwater systems. Land-surface models (LSMs) embedded in General Circulation Models and offline macro-scale hydrological models continue to employ simplistic characterisations of groundwater systems due, in part, to the absence of global or continental-scale datasets to test or tune these models. Structural modelling challenges such as long response times of some groundwater systems to hydrological change and substantial uncertainty in projections of precipitation and evapotranspiration persist. New insight regarding the relationship between global hydrological change and groundwater systems including the impacts of intensive abstraction for irrigation on groundwater storage and changing rainfall intensity on groundwater recharge, have recently been developed from basin-scale studies where reliable groundwater observations exist. These studies provide a compelling case for the expansion of groundwater monitoring networks and compilation of a global groundwater archive (IGRAC), comparable to that to other components of the hydrological system (e.g. WMO, GRDC, WGMS), to improve understanding and management of the groundwater system under global hydrological change.