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Non-stationary relationships between decadal water storage changes over Australia and climate variability of the El Niño Southern Oscillation and Indian Ocean Dipole

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Large-scale ocean-atmosphere interactions are hypothesized as the main drivers of water variations over the Australian continent. This study examines the relative contributions of the large-scale ocean-atmospheric processes in different time-scale variations of terrestrial water storage (TWS) over Australia. The aim is to determine whether the role of main climatic phenomena such as the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) on water resources as appears to be a stationary relationship. The main analyses were performed on three decades (1982-2012) of: (i) TWS changes over Australia from the World Wide Water Resources Assessment (W3RA) hydrological model, and (ii) statistically reconstructed TWS changes from the Gravity Recovery And Climate Experiment (GRACE) products. Reconstructions were derived by applying low-degree autoregressive models to relate basin averaged TWS changes, over the nine major river drainage basins of Australia, to input values of precipitation minus evaporation as well as the ENSO and IOD indices. Our results indicate that both intra-annual and seasonal simulation and forecast of TWS water storage changes associated with ENSO cycles have increased during the last two decades of 1990 to 2010. The contribution of IOD to seasonal simulation and forecasts of TWS appears to have increased over the last decade. The long-term influence of IOD in TWS changes, however, appears to have decreased slightly. Our results demonstrate non-stationary behaviour of TWS in terms of variability and predictability due to the ENSO and IOD phenomena.
Keywords: Australia; ENSO and IOD in Water Storage; Reconstruction; Non-stationary Impact