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Drought and flood monitoring and connection to climate variability in Pearl River Basin, Southern China using GRACE data

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Drought and flood occur frequently in the Pearl River Basin (PRB), leading to severe damage and economic losses. For better basin-scale water resources management, this study investigates drought and flood and connection to climate variability in PRB using the total terrestrial water storage (TWS) data from the Gravity Recovery And Climate Experiment (GRACE) satellites. Water storage deficit (WSD) and WSD index (WSDI) are used to characterize drought in PRB. A total of nine drought events are identified during the study period 2003-2014. The period 2003-2006 experienced the most serious drought with a duration of 34 months and WSD (or total severity) of over 1200 mm. WSDI is comparable to self-calibrated Palmer Drought Severity Index (scPDSI) in timing with a correlation of 0.80. Overall, WSDI has higher magnitude than the scPDSI throughout the study period. Flood is characterized by a flood potential index (FPI) which is calculated using TWS anomaly and precipitation. The FPI peaked in June 2008 when the flood was the most serious with the largest rainfall and discharge. Strong correlation is found between FPI and rainfall/discharge in all the four seasons indicating the joint control of flood by rainfall and discharge. This study analyzes the relationship between drought, flood and four climate indices (i.e. El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), Indian Ocean Dipole (IOD) and North Atlantic Oscillation (NAO)). Different drought events were related to different climate indices. The severe drought during 2003-2005 was triggered by a warm PDO phase. The 2009-2010 drought was jointly influenced by the warm phase of the three indices: ENSO (i.e. El Niño), IOD and PDO. The severe drought in 2011 was related to the cool phase of both PDO and ENSO (i.e. La Nina). The flood in 2008 was mainly induced by the cool PDO phase with the combined effect from IOD and NAO.