



## **Statistical separation and forecast of water storage patterns over West Asia using GRACE data and climate indicators**

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Recent studies indicate that large parts of West Asia, specifically the arid Middle East region, exhibited a rapid loss of freshwater reserves during the past decade. A reliable estimation of large scale terrestrial water storage (TWS) and groundwater storage (GWS) changes and the ability of forecasting them, with respect to climate variability and change, are therefore essential for West Asia. This study first implemented a least squares inversion approach to separate the Gravity Recovery and Climate Experiment (GRACE)-derived total water storage products over West Asia. Time series of separated terrestrial water and groundwater storage changes were then generated over the region, covering the period of 2003 to 2013. Forecasting scenarios were generated to predict TWS and GWS changes by applying low-degree autoregressive models which relate basin averaged TWS and GWS changes to input values of precipitation and evaporation as well as the North Atlantic Oscillation index as the remote controller of the region's climate. Dry, normal, and wet scenarios were designed to forecast West Asia's TWS and GWS variations over the period of 2013 to 2015. Our separated results over 2003 to 2013 indicated a decline in TWS and GW over the Middle East. A strong correlation was found between the NAO index and variability of water storage over West Asia, specifically during the period of 2005 to 2008. Dry forecasting scenarios indicated continuous GWS decline over the northwest part of Iran, entire Iraq and Syria, which have been already facing challenges of limited water resources.

**Key words:** Forecasting GRACE-TWS; Groundwater; Signal Separation; Middle East