MONITORING GROUNDWATER STORAGE CHANGES IN TEXAS USING GRAVITY RECOVERY AND CLIMATE EXPERIMENT (GRACE) DATA

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The twin satellite system, Gravity Recovery and Climate Experiment (GRACE) [1], can be one such 'robust and cost-effective' approach to monitor the dynamics of groundwater storage variations. GRACE is very unique in its features as a remote sensing platform. It provides large-scale coverage, good temporal resolution (monthly) for groundwater management and is suited for sensing the complete vertical profile of water cycle storage as snow, glacier, surface water, soil moisture, biomass and groundwater [2]. The GRACE data can provide monthly scale water storage anomalies which are the estimates of the changes in terrestrial water storage (TWS) over a specific region. GRACE has already demonstrated its potential to monitor groundwater storage changes (GWS) and estimate groundwater depletion such as in India [3,4], High Plain Aquifer, USA [5,6], Central Valley, USA [7,8], Mississippi River Basin, USA [9], Illinois, USA [10], North China [11], Western Jilin, China [12] and Ethiopia [13]. GRACE data has also been used to estimate groundwater storage changes in the poorly monitored regions from seasonal to annual scales [14].

Fig. 1 illustrates monthly TWS storage anomalies in terms of Equivalent Water Height (EWH) and monthly soil moisture storage anomalies obtained from several GLDAS-1 hydrologic models over the state of Texas. The groundwater storage anomalies can be estimated by subtracting the soil moisture storage anomalies from GRACE TWS anomalies. The extreme drought in 2011 can be clearly seen from all of the time series. It should be noted that, however, TWS has not been recovered to its previous stage after the 2011 drought. Figure 2 shows the long-term (2003 – 2014) annual trend of TWS changes over Texas. It can be clearly seen that the northern and southeastern Texas (around Houston) has been experiencing depletion of TWS.

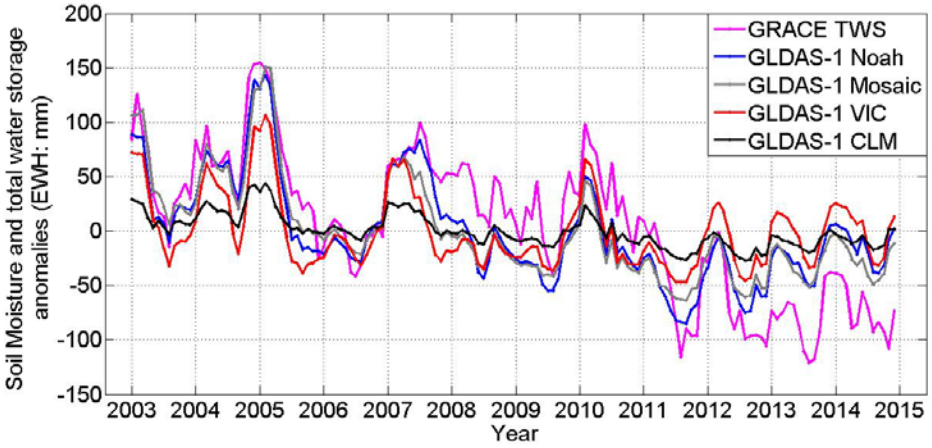

Fig. 1. Time series of GRACE TWS anomalies and soil moisture anomalies from several GLDAS-1 hydrologic models.

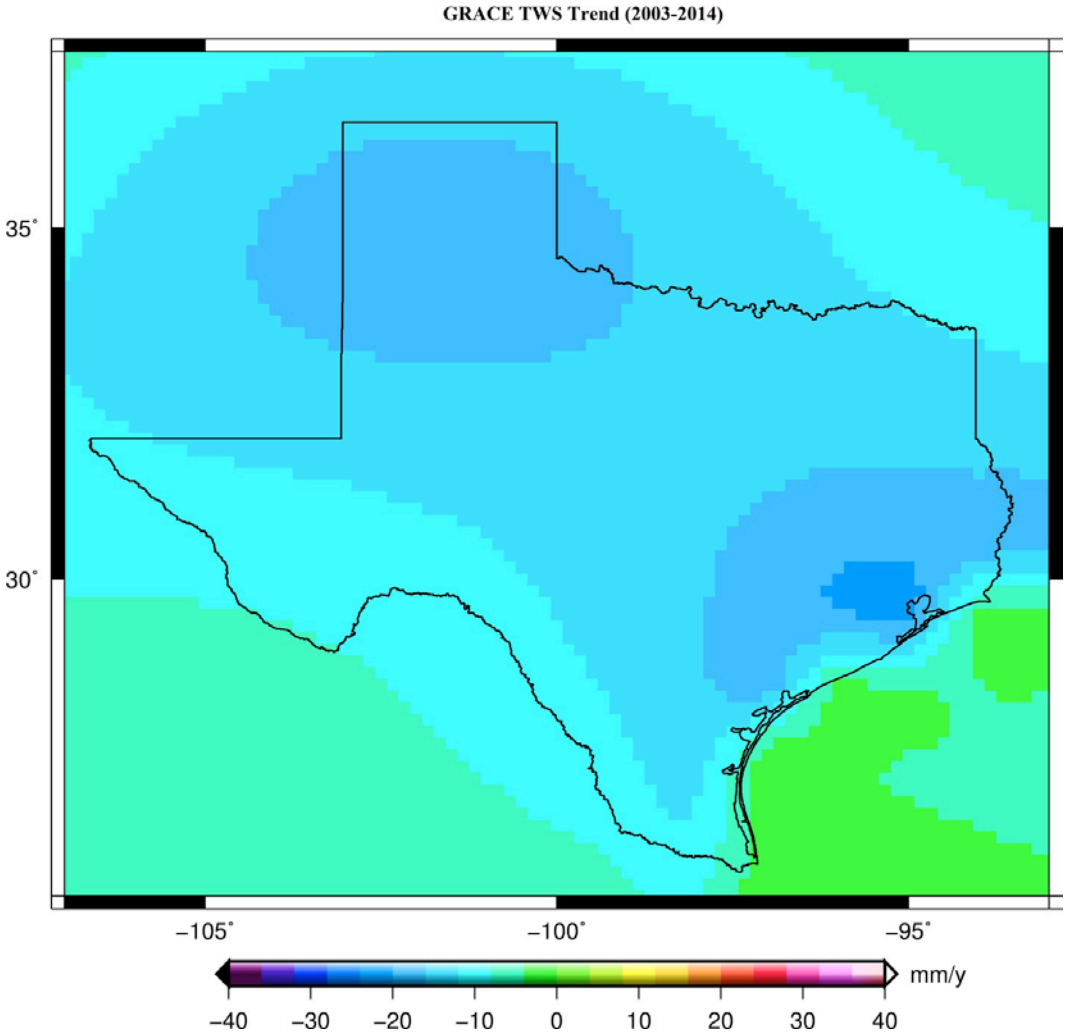

Fig. 2. Long-term (2003 – 2014) linear trend (mm/year) of GRACE TWS anomalies over the state of Texas.

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