

Title: Dataset associated with “An Improved Rescaling Algorithm for Estimating Groundwater Depletion Rates using the GRACE Satellite”

Abstract: The Gravity Recovery And Climate Experiments (GRACE) satellite mission has been instrumental in estimating large-scale groundwater storage changes across the globe. GRACE observations include significant errors, so pre-processing is normally required before the data are used. In particular, the regional observations of terrestrial water storage anomalies (TWSA) are usually filtered to reduce the effects of measurement errors and then rescaled to reduce the unintended impacts of the filtering. The rescaling is typically selected to maximize the Nash-Sutcliffe Efficiency (NSE) between the rescaled filtered TWSA and original TWSA from large-scale hydrologic models that represent an incomplete water budget. The objectives of this study are (1) to evaluate the use of NSE in the current GRACE rescaling methodology, (2) develop an improved methodology that incorporates a complete regional water budget, and (3) examine the impacts of the rescaling methodology on regional assessments of groundwater depletion. To evaluate the use of NSE as a performance metric, we implement an analytical solution to improve the relative variability between the filtered and original TWSA series. Improved relative variability produces more reliable estimates when comparing the results to TWSA estimates from global positioning systems (GPS) for the Sacramento and San Joaquin River basins (containing Central Valley) in California. Rescaling with the complete regional water budget based on observed hydrological fluxes results in a larger scale factor (3.18) than the scale factor from the large-scale hydrologic model outputs (1.97), and the new TWSA results are more consistent with those from GPS. The larger scale factor also suggests that regional groundwater depletion is more severe than previously estimated.

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Format of data files - .txt

Location where data were collected – Sacramento and San Joaquin river basins, California

Time period which data were collected – 2006-01-2010-12

File Information

Dataset_1.txt: Filtered GRACE TWSA

Dataset_2.txt: Rescaled filtered GRACE TWSA

Dataset_3.txt: Filtered and original unfiltered GLDAS TWSA

Dataset_4.txt: Changes in water storage from complete water balance

Dataset_5.txt: GPS TWSA

Dataset_6.txt: Groundwater storage anomalies

Variable Information

Dataset_1.txt

- Calendar year (YYYY)
- Calendar month (MM)
- Filtered GRACE TWSA (mm) (total water storage anomalies obtained from University of Colorado, Boulder GRACE data portal)

Dataset_2.txt

- Calendar year (YYYY)
- Calendar month (MM)
- Filtered GRACE TWSA rescaled using scale factor $k_{\alpha=r, GLDAS}$ (mm)
- Filtered GRACE TWSA rescaled using scale factor $k_{\alpha=1, GLDAS}$ (mm)
- Filtered GRACE TWSA rescaled using scale factor $k_{\alpha=r, CWB}$ (mm)
- Filtered GRACE TWSA rescaled using scale factor $k_{\alpha=1, CWB}$ (mm)

Dataset_3.txt

- Calendar year (YYYY)
- Calendar month (MM)
- GLDAS TWSA (mm) (GLDAS-based total water storage anomalies obtained from University of Colorado, Boulder GRACE data portal)
- Filtered GLDAS TWSA (mm) (GLDAS-based filtered total water storage anomalies obtained from University of Colorado, Boulder GRACE data portal)

Dataset_4.txt

- Calendar year (YYYY)
- Calendar month (MM)
- Changes in water storage from complete water balance (mm/month) (estimated from regional precipitation and evapotranspiration, and exiting streamflows)

Dataset_5.txt

- Calendar year (YYYY)
- Calendar month (MM)
- GPS TWSA (mm) (total water storage anomalies obtained from NASA's Jet Propulsion Laboratory)

Dataset_6.txt

- Calendar year (YYYY)
- Calendar month (MM)
- Groundwater storage anomalies estimated from GRACE TWSA rescaled with $k_{\alpha=r, GLDAS}$ (mm)
- Groundwater storage anomalies estimated from GRACE TWSA rescaled with $k_{\alpha=1, CWB}$ (mm)

Data sources

GRACE and GLDAS TWSA were obtained from University of Colorado, Boulder GRACE data portal - <http://geoid.colorado.edu/grace/>

GPS TWSA was obtained from NASA's Jet Propulsion Laboratory data portal – <sideshow.jpl.nasa.gov>

Precipitation data obtained from the Oregon State University PRISM Website:
PRISM Climate Group, Oregon State University, <http://prism.oregonstate.edu>

Evapotranspiration data obtained from the online Data Pool Terra MODIS product, courtesy of the NASA EOSDIS Land Processes Distributed Active Archive Center (LP DAAC), USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota, <https://lpdaac.usgs.gov/tools/data-pool/>

Discharge data obtained from United States Geological Survey Website:

U.S. Geological Survey, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), at URL <http://waterdata.usgs.gov/nwis/>. DOI: <http://dx.doi.org/10.5066/F7P55KJN>

Soil moisture and Snow water equivalent data obtained from output of Global Land Data Assimilation System (GLDAS) simulations available at <https://disc.gsfc.nasa.gov/datasets?keywords=GLDAS>. These datasets were used to estimate groundwater storage anomalies available in Dataset_6.txt.

Surface water storage data obtained from California Data Exchange Center available at <https://cdec.water.ca.gov/reservoir.html>. This data was used to estimate groundwater storage anomalies available in Dataset_6.txt.