Surface Water Storage and Groundwater Storage from Satellite Data in the Northern East-African Rift Region (https://doi.org/10.5880/GFZ.1.3.2024.001)

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1. Licence

2. Citation

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Table of contents

3. Data Description

The data set provides surface water storage (SWS) and groundwater storage (GWS) data for the Northern East African Rift region.

SWS is estimated from a combination of lake water levels observed with satellite altimetry and water surface area derived from the water occurrence maps. The truncated pyramid formula estimates water volume change from these two data sets. The volume change is then converted to surface water storage and uniformly distributed over the lake surface, leading to SWS. To match the spatial resolution of SWS with the spatial resolution of terrestrial water storage (TWS), the resulting maps are spatially Gaussian filtered, half-width 250km.

TWS, as observed with the GRACE and GRACE-FO satellite mission, monitors the sum of changes in the water storage compartments SWS, GWS, snow and ice, and root-zone soil moisture (RZSM). Thus, to estimate GWS for this data set, the water storage compartments are subtracted from TWS. Here, we neglect snow and ice.

The temporal coverage of the data is from April 2020 to May 2023.

3.1. Surface Water Storage Data

The following provides an overview of the processing steps leading to the SWS data. Details of the processing are provided in Boergens et al. (2024).

3.1.1. Water Level Data

The water level time series are based on satellite altimetry. They are freely available from the Database for Hydrological Time Series of Inland Waters web portal (DAHITI, https://dahiti.dgfi.tum.de,). The details of the data processing are provided in Schwatke et al.(2015) .

The time series length varies between September 1992 and September 2023, depending on the available data. The temporal resolution depends on the number of altimeter crossings and the repeat cycle of the used mission and can vary between a few days and about a month.

3.1.2. Water Surface Data

To assess the water surface area of the lakes, we analysed the Global Surface Water Occurrence maps provided by Pekel et al. (2016) via the Global Surface Water Explorer (https://global-surface-water.appspot.com/). The data set is based on 36 years (1984-2020) of global remote sensing observations of water surfaces, classified to a water occurrence probability for each pixel. From these Water occurrence maps we estimate the empirical cumulative distribution function with which the area of the lake can be matched to any water level.

3.1.3. Surface Water Storage Data

The water volume change between two water level (WL_i-1 and WL_i) and water surface area (WSA_i-1 and WSA_i) observations can be calculated with the truncated pyramid formula (Abileah et al., 2011).

For the time series of lake volume changes relative to the first time-step, all time steps are cumulated. Following, the volume [km^3] is converted in lake storage [Gt].

The time series of lake storage for each lake are interpolated to common time steps and the storage change is equally distributed over the lake surface. Following the resulting SWS maps are spatially filtered with a Gaussian filter, half-width 250km.

3.2. Groundwater Storage Data

GWS data is estimated from a combination of TWS with SWS and RZSM. TWS is provided by Boergens et al. (2020). RSZM is taken from the Global Gravity-based Groundwater Product (G3P, Güntner et al., 2024).

4. File description

4.1. File inventory

Folder structure, file list and file content included in data publication of surface water storage and groundwater storage data for the Northern East African Rift (NEAR):

The zip file contains two folders, “time series” and “maps” and this document.

- “time series” contains three subfolders
    - “surface_area” contains 10 *.txt files containing time series data in ASCII format of the water surface area of the lakes of the NEAR region (see section 4.2 for the naming convention).
    - “volume” contains each 10 *.txt files containing time series data in ASCII format of the water volume change of the lakes of the NEAR region (see section 4.2 for the naming convention).
    - “water_levels” contain each 11 *.txt files containing time series data in ASCII format of the water level of the lakes of the NEAR region and of the Victoria Nile River (see section 4.2 for the naming convention).
- “maps” contain two *.nc files for gridded data sets of surface water storage and groundwater storage (see section 4.2 for the naming convention).

4.2. File naming convention

2024_001_Boergens_Schwatke_NEAR_SWS_GWS_data-description.pdf: This document

2024-001_Boergens_Schwatke_NEAR_SWS_waterlevel_*[waterbodyname]*.txt: ASCII file of time series of water levels of *waterbodyname*

2024-001_Boergens_Schwatke_NEAR_SWS_area_*[waterbodyname]*.txt: ASCII file of time series of water surface area of *waterbodyname*

2024-001_Boergens_Schwatke_NEAR_SWS_volume_*[waterbodyname]*.txt: ASCII file of time series of water volume changes of *waterbodyname*

2024_001_Boergens_Schwatke_NEAR_SWS_gridded_1.0_degree_Gauss_250km.nc: NetCDF file of gridded and filtered surface water storage

2024_001_Boergens_Schwatke_NEAR_GWS_gridded_1.0_degree_Gauss_250km.nc: NetCDF file of gridded groundwater storage

4.3. Description of data tables

2024_001_Boergens_Schwatke_NEAR_SWS_waterlevel_*[waterbodyname]*.txt

Contains the altimetric water level observations provided by the DAHITI (dahiti.tum.de) data portal for the lakes in the Northern East-African Rift.

Column header	unit	Description
date	[yyyy-mm-dd]	Date of observation
water level from altimetry	[m] normal heights	Observed water levels given in normal heights
error	[m]	Internal error of the DAHITI processing

2024_001_Boergens_Schwatke_NEAR_SWS_area_*[waterbodyname]*.txt

Contains the water surface area estimated from water occurrence maps for the lakes in the Northern East-African Rift.

Column header	unit	Description
date	[yyyy-mm-dd]	Date of observation
area	[km^2]	Water surface area
uncertainty	[km^2]	Estimated uncertainty of water surface area

2024_001_Boergens_Schwatke_NEAR_SWS_volume_*[waterbodyname]*.txt

Contains the water volume changes estimated from water level and water surface area for the lakes in the Northern East-African Rift.

Column header	unit	Description
date	[yyyy-mm-dd]	Date of observation
volume	[km^3]	Water volume changes wrt. first observation
uncertainty	[km^2]	Estimated uncertainty of water volume changes

2024_001_Boergens_Schwatke_NEAR_SWS_gridded_1.0_degree_Gauss_250km.nc

Contains the gridded and filtered surface water storage (SWS) changes for the lakes in the Northern East-African Rift. Filtered with spatial Gaussian filter, half-width 250km.

Column header	unit	Description
time	[dd] days since 2002-4-14	Date of observation
lon	[DD.dddd] degrees East	Longitude in WGS84 in decimal degrees
lat	[DD.dddd] degrees North	Latitude in WGS84 in decimal degrees
sws	[mm]	surface water storage from altimetry and water occurence maps

2024_001_Boergens_Schwatke_NEAR_GWS_gridded_1.0_degree_Gauss_250km.nc

Contains the gridded and filtered surface water storage (SWS) changes for the lakes in the Northern East-African Rift. Filtered with spatial Gaussian filter, half-width 250km.

Column header	unit	Description
time	[dd] days since 2002-4-14	Date of observation
lon	[DD.dddd] degrees East	Longitude in WGS84 in decimal degrees
lat	[DD.dddd] degrees North	Latitude in WGS84 in decimal degrees
gws	[mm]	groundwater storage from TWS - SWS - RZSM

5. References

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