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DAHITI: Inland Water Levels from Space for Climate Studies

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1. Introduction

In this poster, we present the "Database for Hydrological Time Series of Inland Waters" (DAHITI) and the potential for climate studies. Satellite altimetry was designed for ocean applications. However, since several years, satellite altimetry is also used over inland water to estimate water level time series of lakes, rivers and wetlands. The resulting water level time series can help to understand the water cycle of system Earth and makes altimetry to a very useful instrument for hydrological applications.

2. About DAHITI

DAHITI has been operated by the Deutsches Geodätisches Forschungsinstitut der Technischen Universität München (DGFI-TUM) since 2013. Currently, the database contains more than 600 water level time series of lakes, reservoirs, rivers, and wetlands (see Figure 2). They are freely available via ***http://dahiti.tum.de*** for registered users. In general, DAHITI is targeted at all users who require water level time series and uncertainties for various hydrological applications.

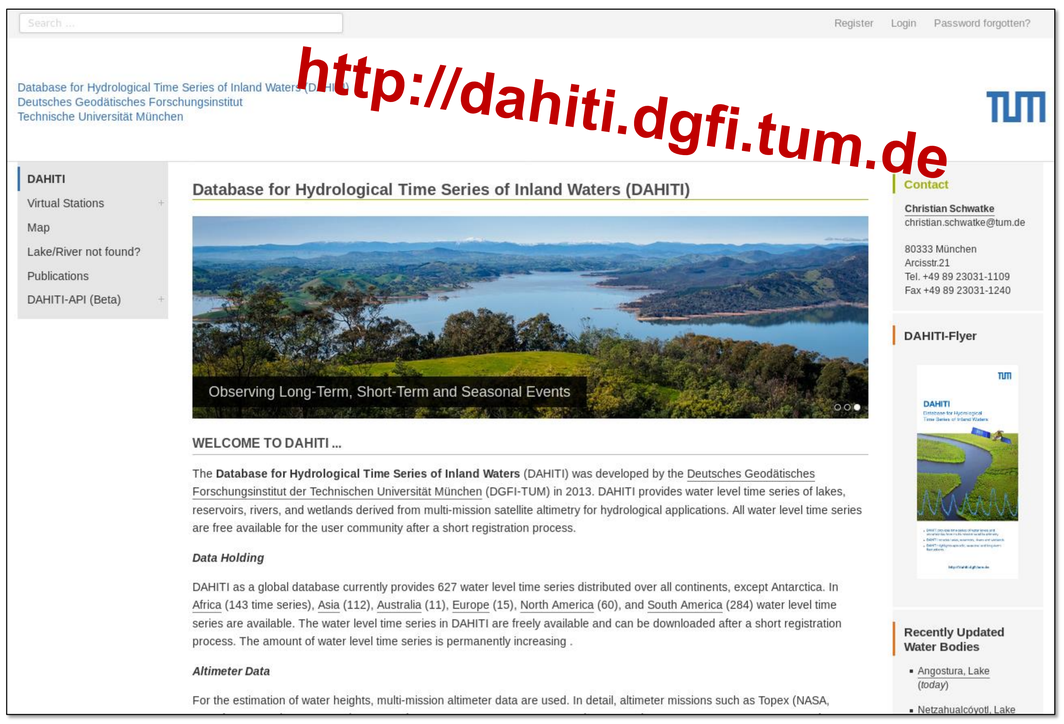

Figure 1: Homepage of the DAHITI (http://dahiti.dgfi.tum.de)

3. Data Holding

Currently, DAHITI provides 626 water level time series distributed over all continents, except Antarctica. The database comprises time series for Africa (143 time series), Asia (112), Australia (11), Europe (15), North America (61), and South America (284).

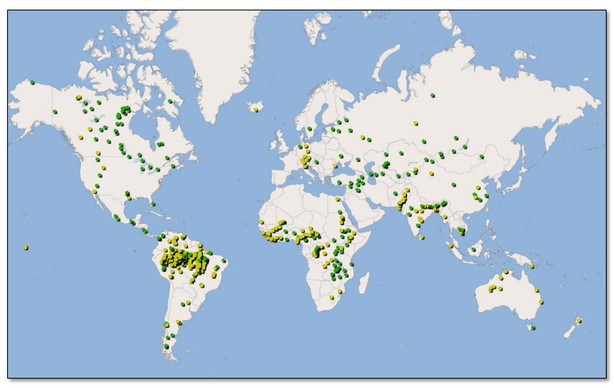

Figure 2: Available inland water bodies in DAHITI

4. DAHITI Approach

The DAHITI approach of estimating water level time series is based on intensive data screening, an extended outlier rejection, and a Kalman Filtering step. More details can be found in Schwatke et al, 2015.

All available altimeter missions (e.g Topex/Poseidon, Jason-1/-2/-3, Envisat, Saral, etc.) over the inland water body are combined in the DAHITI approach. This allows us to estimate consistent water level time series for lakes and rivers for more than 25 years.

5. Data Access

The DAHITI time series can be downloaded as ASCII file or directly via API from the DAHITI website.

The user has the possibility to select from the following types of data.

- *Normal heights (w.r.t. geoid)*
- *Ellipsoidal heights (w.r.t. WGS84)*
- *Variations around the mean value*

```
# DAHITI-ID       : 104
# Target name     : Urmia, Lake
# Continent       : Asia
# Country         : ir
# Longitude       : 45.4779
# Latitude        : 37.6011
# Software        : 5.0
# Download        : 2017-08-18 07:19:25
# ----------------------------------------
# column 1        : date [yyyy-mm-dd]
# column 2        : normal heights w.r.t. EIGEN-6C3stat [m]
# column 3        : error [m] (Kalman Filter, formal errors)
# ----------------------------------------
1992-09-28 1275.348 0.002
1992-11-16 1274.995 0.004
1992-12-16 1275.322 0.042
1993-01-05 1275.753 0.001
1993-01-15 1275.735 0.002
1993-01-25 1275.951 0.002
1993-02-04 1276.034 0.002
1993-02-14 1275.931 0.001
1993-03-05 1275.901 0.001
1993-03-15 1276.043 0.004
1993-04-14 1276.429 0.001
1993-04-24 1276.696 0.005
1993-05-14 1276.797 0.003
1993-05-24 1276.810 0.001
1993-06-03 1277.008 0.001
```

Figure 3: Downloaded water level time series

6. Selected Examples

6.1 Aral Sea

The Aral Sea is located in Central Asia (Kazakhstan, Uzbekistan). Over the last decades, the Aral Sea dried out and decomposed into several parts. Because of the different hydrological conditions, the water level changes vary in each of the basins. The major basin (east) lost about 10m of water height in the last 20 years and dried out completely whereas the water level in the western basin is still decreasing. However, the northern basin is regulated by a dam which leads to a nearly constant water level with seasonal variations for more than 25 years now.

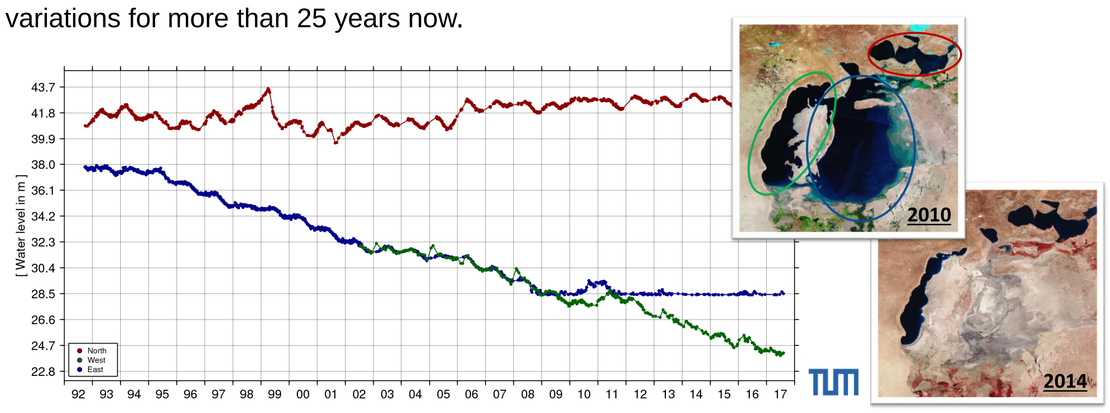

Figure 4: Water level time series of Aral Sea based on Topex, Envisat, Jason-1, Jason-2, Jason-3 and Saral/AltiKa altimeter data with additional Landsat-Image from 2010 and 2014 (Source: http://dahiti.dgfi.tum.de/81/, http://dahiti.dgfi.tum.de/82/, http://dahiti.dgfi.tum.de/83/, Google Earth Engine)

6.2 Lake Urmia

Lake Urmia is located in the Northwestern part of Iran and has an extent of about 5,500 km² and max depth of about 16m. Because of absent precipitation and dam construction, the water level of Lake Urmia has been decreasing about 8m since 1995.

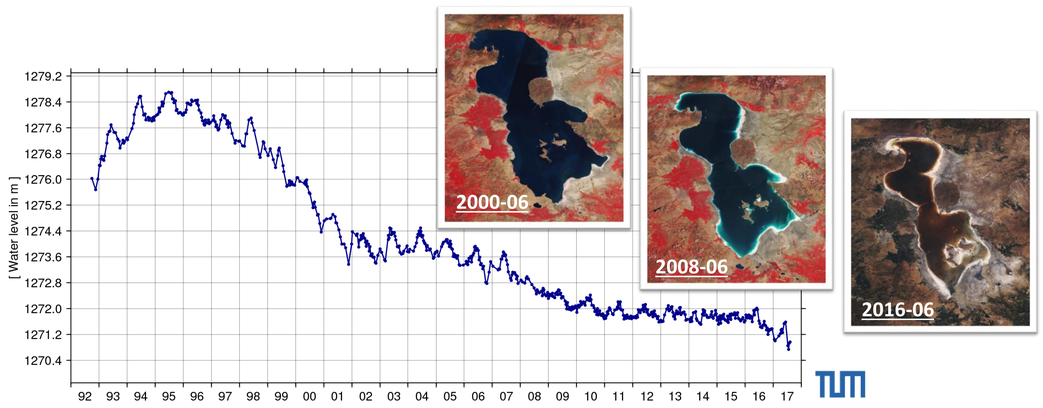

Figure 5: Water level time series of Lake Urmia based on Topex, Jason-1, Enivsat, Jason-2, and Jason-3 with additional Landsat-Image from 2000-06, 2008-06 and 2016-06 (Source: http://dahiti.dgfi.tum.de/104/ , Google Earth Engine)

6.3 Lake Chiquita

Lake Chiquita is the second largest lake of South America. It is located in the Northern part of Argentina and has a depth between 12m and 19m. The lake has few inflows, but no outflows. The water level decreased strongly by about 5m between 2003 and 2013. Since 2013, the water level is increasing again. The reason for the strong water level variations are the unsteady precipitation and evaporation over the last decades and water withdrawal from the Dulce River for irrigation purposes.

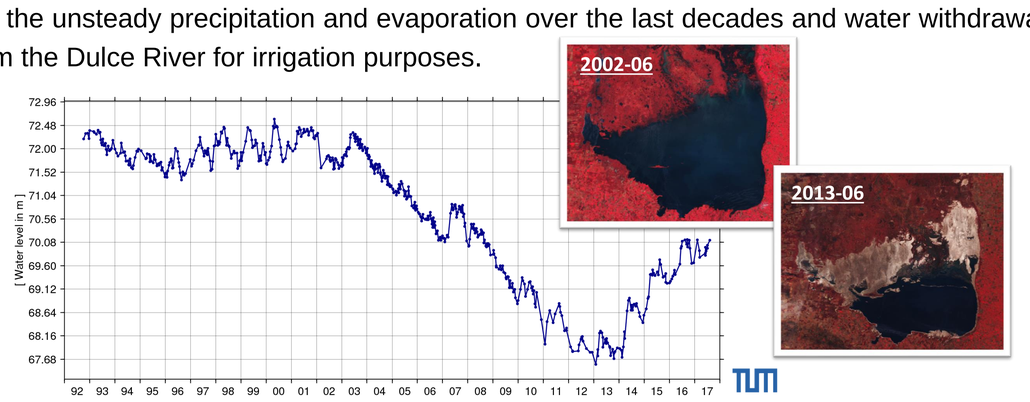

Figure 6: Water level time series of Lake Chiquita based on Topex, Jason-1, Jason-2, Jason-3 and Cryosat-2 with additional Landsat-Images from 2002-06 and 2013-06 (Source: http://dahiti.dgfi.tum.de/66/ , Google Earth Engine)

7. Conclusion

- Satellite altimetry is an outstanding measurement technique to capture long-term events up to 25 years of inland water bodies
- Signatures of extreme rain events, drought, climate change and human interferences can be traced
- Water level time series of DAHITI can be also used for other hydrological applications such as investigating seasonal or short-term events of lakes and rivers.

References

- *Schwatke C., Dettmering D., Bosch W., Seitz F.:* **DAHITI - An Innovative Approach for Estimating Water Level Time Series over Inland Waters using Multi-Mission Satellite Altimetry**. Hydrol. Earth Syst. Sci., 19, 4345-4364, doi:10.5194/hess-19-4345-2015, 2015

IAG Workshop: Satellite Geodesy for Climate Studies, Bonn, Germany, 19-21 September 2017