Database for Hydrological Time Series over Inland Waters (DAHITI)

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Results
For the estimation of the water level time series we use altimeter data from all available altimeter missions. Figure 1 shows all altimeter missions since 1985. All data are cross-calibrated in advance to remove the range bias between the missions allowing to use all missions as a single altimeter system.

Data

Motivation
Since many years satellite altimetry is becoming increasingly important for hydrology. The fact, that satellite altimetry, originally designed for open ocean application, can also contribute reliable results over inland waters helps to understand the water cycle of the system earth and makes altimetry to a very useful sensor for hydrology. In this poster, we present the new "Database for Hydrological Time Series of Inland Waters“ (DAHITI). This database provides water level time series for lakes, rivers, reservoirs, and wetlands from multi-mission satellite altimetry which are computed by a Kalman Filter approach.

Methodology
The methodology applied for DAHITI includes new approaches for outlier detection [Support Vector Regression (SVR)] (Burges, 1998) and estimation of water level time series by a Kalman Filter approach. The work flow is divided in a "Preprocessing" and an "Estimation" step.

1. Extraction of Data
For each water body, all necessary altimeter data such as position, satellite height, range, geophysical corrections, time, and waveforms are extracted from OpenADB.

2. Classification of Waveforms
This option allows us to classify waveforms into three classes ("linear brown", "linear exponential", "single peak") using the method of "Support Vector Machine (SVM)", (Schwaeke et al., 2012)

3. Retracking of Waveforms
This option allows us to retrack waveforms after the classification step in order to estimate improved ranges. Every class is assigned to one retracking algorithm.

4. Calculation of Final Heights
The final heights are estimated considering original or retracted ranges, geophysical corrections, good, and corrections for relative range biases between different missions.

5. Calculation of Standard Deviations
After estimating the final heights, along track standard deviation is computed.

6. Reject Outliers
In the last preprocessing step outliers are rejected. Hereby we use criteria such as location, max. standard deviation, height limits, along track Support Vector Regression (SVR), SVR for whole missions, waveform classes from classification.

7. Read Data from Preprocessing Step
For the estimation of the water level time series we extract parameters such as longitude, latitude, time, height, and standard deviation.

8. Create Grid from Mask
A spatial grid is derived from a land/water mask which is necessary for the the Kalman filtering step.

9. Kalman Filtering
For the estimation of the water level time series we apply Kalman filtering with time-dependent altimeter measurements as input data. In addition, errors in the altimeter data are considered by using the standard deviations of the heights. The Kalman filter enables us to compute values of water level heights for every epoch and every grid node over the water body. In our case we make a forward and backward Kalman filtering to consider the water level height evolution before and after the current epoch. For more details see Schwaeke and Bosch (2012).

10. Estimation of the Final Time Series
For every step a mean height of all grid nodes is estimated considering an error limit.

Validation
For validation we compare in-situ data with time series from satellite altimetry and estimate correlation and RMS.

Discussion / Outlook
DAHITI provides time series of inland waters for hydrological applications.

- A new strategy using Support Vector Regression for outlier detection and a Kalman Filter approach for the estimation of water level time series leads to reliable time series which show high correlation and RMS with gauges.
- In future, DAHITI will be extended to smaller water bodies where an improved classification and retracking strategy is necessary to archive reliable time series.
- In order to achieve this, we will implement and investigate additional retrackers and extend the number of waveform classes.

References:
- Schwaeke C., Kaul T., Bosch W.: Classifying Radar Echoes of Envisat Altimeter Data for an Optimised Retracking. 6th Coastal Altimetry Workshop, Rio de Janeiro, Brazil, 2012/08/02

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