



Estimating seasonal and annual lake level changes of groundwater-fed lakes in northeastern Germany using RapidEye archive data

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Groundwater-fed lakes in northeastern Germany revealed massive fluctuations in their lake levels during the last decades. However, precise in situ lake level measurements were only recorded for a small numbers of lakes. In this study we evaluate the potential of multi-spectral images (RapidEye) to extract the evolution of former water-land-boundaries and estimate the variation in lake levels.

The main test area is lake Fürstenseer See near Neustrelitz in northeastern Germany. Lake Fürstenseer See is characterized by a significant increase of its lake level since 2010. This increase is observed by 37 RapidEye images recorded between 2009 and 2015. After the preprocessing of the RapidEye time series, we extracted the water-land-boundaries automatically using the NIR band and the normalized difference water index (NDWI). The corresponding lake levels were estimated by merging the water-land-boundary with a high-resolution digital elevation model (DEM) showing the terrain and the underwater topography of the lake. As the shore of lake Fürstenseer See is heterogeneous in topography and vegetation, we selected different subsets for the level reconstruction and evaluation. The evaluation of the method based on in situ gauged lake levels, DEM analyses and DGPS measurements in 2014.

RapidEye images enable the monitoring of seasonal and annual variations of lake level changes of lake Fürstenseer See, but the accuracy of the estimated levels strongly depends on the precision of the extracted water-land-boundary. In the RapidEye images the water-land-boundary is often covered by overhanging trees and dense reed. Thus, a shoreline subset with little or no vegetation as well as shallow topography are required for precise reconstruction of lake levels.