

AUTOMATING SURFACE WATER DETECTION FOR RIVERS

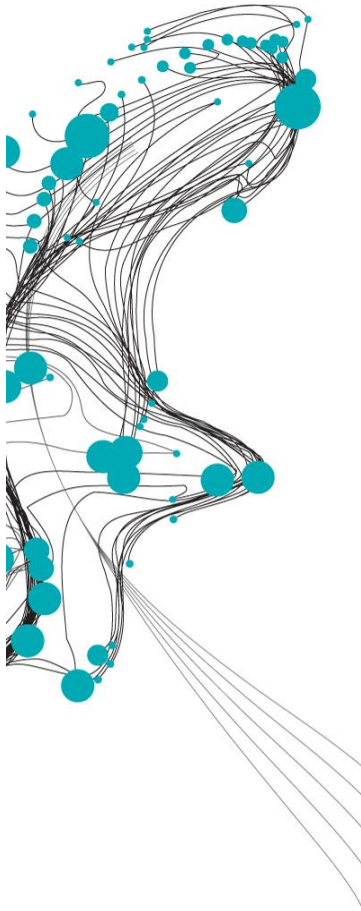
THE ESTIMATION OF THE GEOMETRY OF RIVERS BASED ON OPTICAL EARTH OBSERVATION SENSORS

This thesis studies the extent to which the geometry of rivers around the globe can be determined in an automated manner, based on openly available optical Earth Observational (EO) satellite sensors. Knowledge of the course of a river allows for the bathymetry to be estimated. Currently, the course of a river, at any given point in time, is derived by means of visual inspection based on geographical maps, which may be time-consuming. Automating this process can therefore be highly beneficial. The utilization of remote sensing technology is investigated to observe the dynamics of rivers at frequent time intervals. Google Earth Engine is adopted for the analysis, interpretation and manipulation of multispectral satellite data.

In order to detect surface water within a multispectral satellite image, water indices are utilized, followed by a Height Above Nearest Drainage map and an image thresholding approach (Otsu's method). To estimate the bounds of a river under cloudy circumstances, multiple historical images are sampled to generate a composite, representing the water occurrence of a river over time. Historical images are weighted based on the date they were sampled, in order to reduce the impact of varying surface water widths over time. The composite is used to estimate segments of a river that were initially unknown due to the presence of clouds. The resulting surface water mask is subsequently converted to a smooth river polygon. River widths are derived based on a Euclidian distance map and a centerline, followed by a pruning procedure.

The approach has been validated based on two river polygons provided by Rijkswaterstaat, representing a segment of the Meuse and the Rhine. The estimated geometries based on EO satellite images were found to be highly similar to the river polygons provided by Rijkswaterstaat. Furthermore, a comparison towards a recently build database consisting of global river widths from Landsat imagery (GRWL; Allen and Pavelsky, 2018) revealed clear similarities.

Although the estimation of the geometry of rivers in a more or less automated manner was found to be achievable, its global applicability remains limited to a local scale. Computations in GEE were found to be too resource-demanding, limiting the maximum size of a river polygon that can be generated. Furthermore, the estimation of the geometry of a river is found to be limited to rivers that are at least three to four times wider than the corresponding satellite's spatial resolution in order to obtain usable results.



Joost Thissen

Graduation Date:
8 February 2019

Graduation committee:
University of Twente
Prof. Dr. S. J. M. H. Hulscher
Ir. A. Bomers
Ir. K. D. Berends

Deltares
Dr. Ir. M. F. M. Yossef
Ir. J. S. de Jong

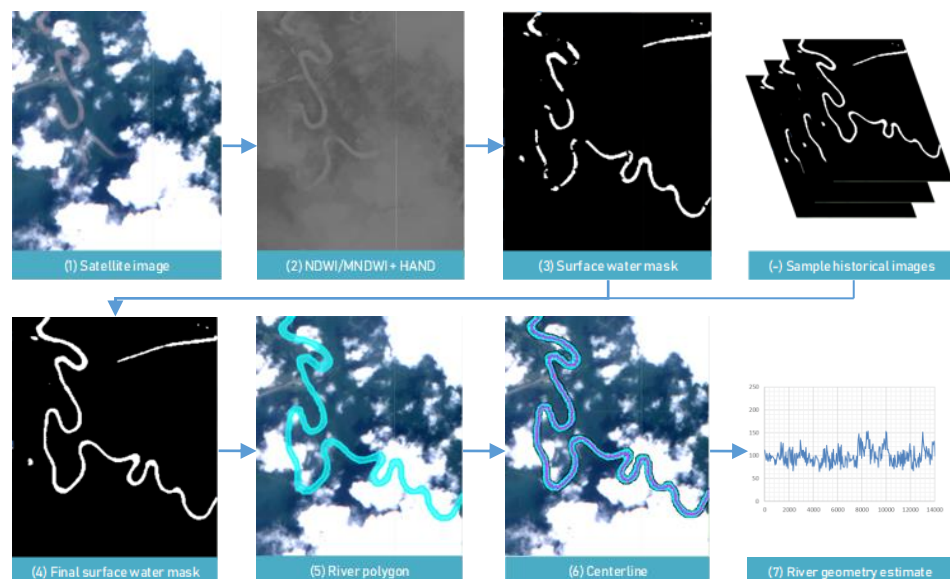


Figure 1: The estimation of the geometry of a river under cloudy conditions—Trinity River, Texas, USA (example)

Allen and Pavelsky (2018) Global Extent of Rivers and Streams. Science. <https://doi.org/10.1126/science.aat0636>