A review of the potential to establish a global, operational river monitoring based on Sentinel-3 water surface elevation observations

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Operational river monitoring from Sentinel-3 radar altimetry

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In the last decades, the collection of discharge observations has declined worldwide, with increasing delays and restrictions on data access [5]. Alternative methods to provide essential high quality, baseline observations to support water management include exploiting remote sensing observations. In recent years, there has been a large and successful effort in extracting and processing radar altimetry observations over inland water bodies, including rivers, resulting in global, publically accessible water surface elevation databases (e.g. [1, 4]).

The European Space Agency (ESA) mission Sentinel-3 is a multi-instrument mission carrying a radar altimeter operating in high-resolution Synthetic Aperture Radar (SAR) mode. Mission objectives include providing public operational inland water surface elevation data. ESA launched the first satellite, Sentinel-3A, in February 2016 and plan to launch Sentinel-3B in 2018. Sentinel-3A has a revisit time of 27 days with a ground track separation of 104 km. The two-satellite configuration reduces the ground track separation to 52 km for the same revisit time. By intersecting the ground tracks with the 98 largest river lines, we obtain 2940 and 5898 so-called virtual stations (VS) for the one- and two-satellite constellation, corresponding to roughly one VS every 44 km river on average. We estimate 305 VS in the Amazon River basin alone, with an increase to 590 VS once both satellites are operational as shown for the downstream basin in Figure 1. This will provide a unique opportunity to establish a global satellite-based monitoring network driven by operational, high-resolution Sentinel-3 water surface elevation observations.

Several studies have used various complementary observations to establish satellite-based gauging stations. For instance, [3] established satellite-based gauging stations for the Zambezi river using on-ground bathymetry, water depth and velocity measurements to develop a stage-discharge curve at Envisat VS, however on-ground measurements are often tedious and the study area must be accessible. [2] used numerical discharge simulations to approximate river bed properties for the Amazon River and extract rating curves for Envisat radar altimetry data. In this case, the accuracy of the discharge estimates was highly limited by input data quality and simulated discharge errors. Thus, Sentinel-3 water surface elevation observations have the potential to bridge a critical gap in global river discharge observations but an effective approach is needed to establish rating curves for the Sentinel-3 VS.

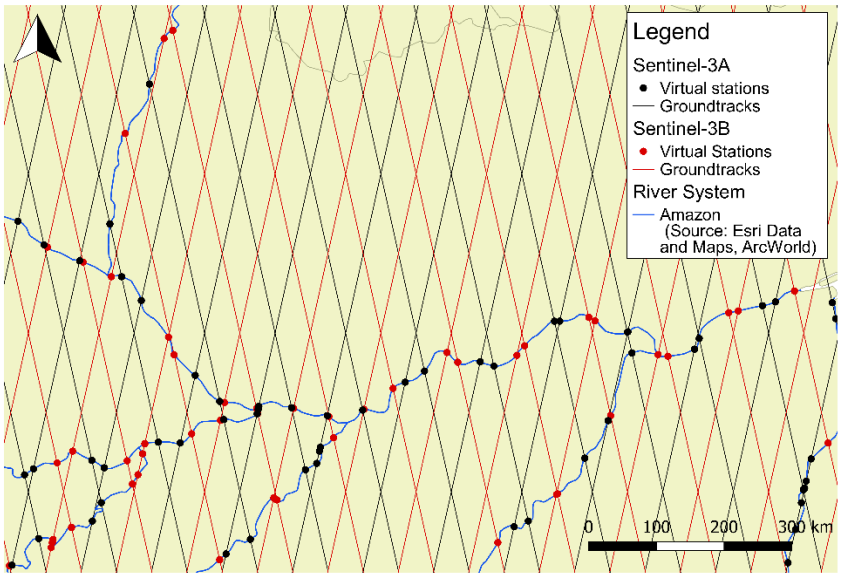

Figure 1 Sentinel-3A and B ground tracks and virtual stations in the downstream Amazon river system.

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