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Integration of Sentinel-1 and Sentinel-2 Datasets for River Discharge Estimation

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Rivers are corridors of freshwater that provide vital services for sustainable development and ecosystem functioning. Moreover, increase in frequency and severity of droughts and floods due to climatic change necessitates innovative and reliable techniques enabling continuous monitoring of river discharge to effectively manage risk. Since ground-based flow gauging stations are difficult to install and maintain, especially in remote regions, remote sensing methodologies have gained attention over the last decades.

In this study, we integrate Sentinel-1 Synthetic Aperture Radar (SAR) data and Sentinel-2 optical data to make best use of their advantages, namely, observation capability on cloudy-days and higher spatio-temporal resolutions, respectively. In our methodology, we first identify the water surface area at selected river reaches where flow observations are also available. The conceptual framework for computing water surface areas within the specified study boundaries entails the utilization of water indices, specifically the Normalized Difference Water Index (NDWI) and Modified Normalized Water Index (MNDWI), for Sentinel-2 and histogram-based backscattering intensity thresholding for the Sentinel-1 platform. Later, we establish relationships between the computed surface water areas and corresponding flow measurements. The Google Earth Engine (GEE) platform serves as the operational foundation for executing the methodology. We validate the satellite-based discharge estimations using observed in-situ discharge data obtained from three selected USGS gauging stations along the Mississippi River, USA. According to our preliminary results, the coefficient of determination values between estimated and observed discharge datasets range between 0.49-0.79, 0.44-0.77 and 0.49-0.74 for the studied river reaches. The methodology is being tested for other river reaches along the globe to test and improve its river discharge estimation accuracy.

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