Harmonized Sentinel-1 SAR Global River geometry and Inundation database

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Satellite-based observations on river geometries are sporadic in time, space, or both. Most satellite-based surface water maps, river widths, water surface elevations (WSE), slopes, and bathymetry are asynchronized in time and space. The current configuration of satellites such as Sentinel-6 measured the WSE but is missing the river width, slopes, and depths.
To advance hydrological sciences research, there is a need to produce a harmonized time series of river geometry data of non-SWOT satellites in partnership with the upcoming SWOT mission. The SWOT satellite will measure river width, height, and slope but missing river depth measurements in space and time. Further, none of these current satellites measure the WSE, river width, and slopes synchronously. In this work, we use the Sentinel-1 SAR satellite data archive from 2015 to the present to create a global river width and surface water database at the reach scale. A modified version of the Sentinel SAR surface water classification algorithm from ASF is used to quantify the surface water extent on the stream approximately every six days (at the equator) at 10m spatial resolution globally. This 10m water mask is fed into a workflow to quantify the river widths, surface water inundations, slopes, and synthetic bathymetry in SWORD (SWOT River Database) stream networks.
A Satellite HAND is used to address the cloud obscured surface water observations using a trained machine learning algorithm. We use WSE derived from the Global Water Monitor from NASA GSFC, Hydroweb from LEGOS, and ICESat-2 to harmonize the WSE observation. And Landsat-8/9 and Sentinel-2 water observations to fill the gaps in the Sentinel-1 SAR database. We use Congo River Basin as a test case where we have more than 500 radar altimetry-based WSE, continuous series of Sentinel-1, ICESat-2, Landsat-8/9, and Sentinel-2 observations. A Congo River hydrologic model is used to generate the streamflow discharge. The satellite observed river reaches are assimilated with the stream flows computed by the routing models. And the downstream reaches in the river network without satellite observations get optimized for discharge/river geometry at each observation cycle. Our final product is a harmonized river geometry dataset (reach's water extent, WSE, slope, synthetic bathymetry) for Congo Basin's SWORD reaches.