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Flow Duration Curve (FDC) from remote sensing: potential of lifetime SWOT mission

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The SWOT (Surface Water and Ocean Topography) satellite mission is scheduled for launch in 2021 and will provide unprecedented bi-dimensional observations of rivers wider than 100m, providing water surface heights, width and slope. Based on these observations SWOT will enable the estimation of river discharge at global scale and in ungauged basins. This study considers SWOT lifetime (3 years) and tests the satellite potential for the estimation of Flow Duration Curve (FDC) in ungauged rivers. FDC illustrates the relationship between the frequency and magnitude of streamflow at given location and it is of interest for many hydrological problems related to hydropower generation, water allocation and habitat suitability, river and reservoir sedimentation, to cite a few.
The analysis focuses on a reach (∼140 km in length) of the middle-lower portion of the Po River, in Northern Italy, along which we considered SWOT overpasses (revolution time of nearly 21 days) during a period of 3 years. For each satellite overpass, discharge estimation is pursued considering different river stretches (5, 10 and 20 km) and using synthetic remotely sensed measurements derived from a numerical hydraulic model corrupted with minimal observational errors. FDCs obtained with synthetic observations are compared with those defined referring to daily discharge values recorded at different gauging stations along the studied reach.
The study confirms the potential of SWOT mission for the estimation of FDC in ungauged rivers, providing limited errors on the estimation of discharge quantiles: on average errors are lower than 20% of the observed values, while worst estimations are obtained for low flows, for which errors may rise to nearly 35%.