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Long term chronicles and near real time discharges estimates derived from satellite altimetry, hydrological modelling and remote sensing observations in ungauged basins

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Monitoring discharge in tropical and subtropical basins is challenging for several reasons, such as access difficulties, transboundary or geomorphological issues, lack of consistent in situ information. However, discharge information is critical for a sustainable water resource resource management and flood forecasting, especially in a climate change context.
In view to improve monitoring and forecasts in those basins, a method allowing to infer river discharges from satellite altimetry observations of water surface elevation (WSE) has been built. It relies on the MGB-IPH hydrological and hydrodynamic model set up using satellite data: precipitation estimates via GPM TAPEER, vegetation and soil parameters obtained from ESA GlobCover V2 and FAO/UNESCO World soil map respectively, and a digital elevation model (Bare Earth SRTM). The model is run on a temporal window where satellite altimetry time series are available.
At each crossing between an altimetry ground track and the river network it is possible to infer the parameters of a rating curve based on Manning-Strickler flow law from WSE observations and discharges forecasted by the MGB-IPH model. The probabilistic method allows to estimate uncertainties on the estimated rating curve parameters and discharges. The methodology is applied in several basins, sampling a large range of river channel morphologies, drained areas and hydro-climatic conditions: the Amazon basin, the Congo basin, the Niger basin, the Tsiribihina basin.
The methodology is validated by comparing the discharges inferred with the rating curves and WSE from satellite altimetry to i) in-situ discharges, where available and ii) modeled discharges, elsewhere. The results show the large degree of applicability of the method in different conditions, evidenced by high correlations between rated discharges and reference discharges. Such a rating curve dataset can be used for several applications such as climatic reanalysis in data sparse areas, by combining past (back to the mid 90's) and present altimetry missions. It is also helpful for real time monitoring of floods and droughts. In addition, side applications have been found to be possible due to the intrinsic properties encompassed in Manning's equation, such as estimating water depth in a channel for navigation or inferring river bathymetry for local and regional modelling purposes.