Impact of river bathymetry on discharge modeling

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Remote sensing offers the possibility to estimate river flows globally. Discharge is included as one of the official products of the Surface Water and Ocean Topography (SWOT) satellite. It is calculated via different methodologies using the width and water surface elevation (wse) derived from the sensor[1]. One of such methodologies is SIC4DVar, which combines 1.5D hydraulic model SIC and a variant of the Four-Dimensional Variational data assimilation method. In this study, the impact of the cross-section definition is analyzed by comparing the assimilated discharge using cross-sections derived from: (1) SWOT-only width and wse, (2) high-resolution Lidar DEM, (3) MERIT Hydro DEM and (4) Copernicus DEM. The flowchart in Figure 1 illustrates the steps.
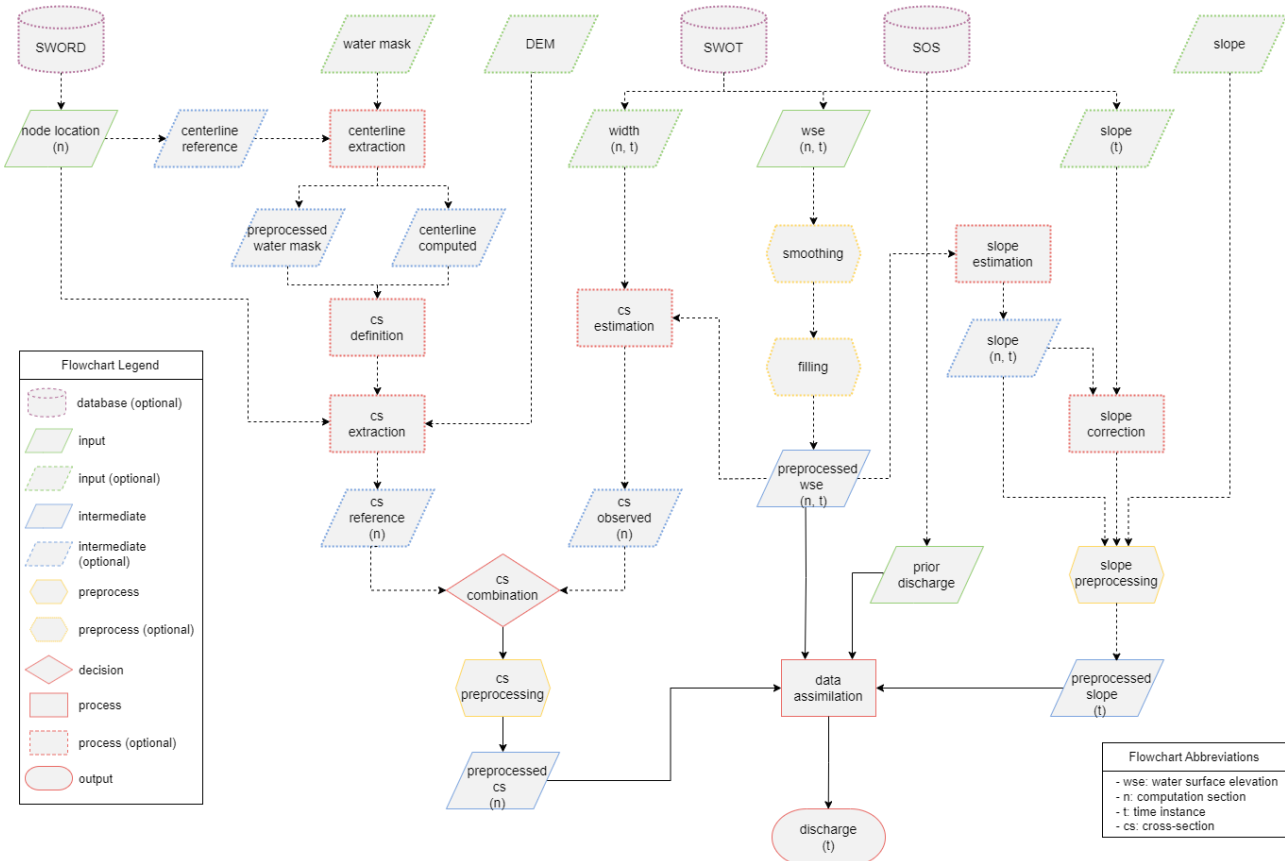

Figure 1: methodology flowchart

In SIC4DVar, water surface elevation is assimilated by changing the depth of the cross-sections and the roughness. Figure 2 shows the assimilated discharge for the different test cases. The temporal pattern is well captured by the different cross-sections, but the magnitude varies largely, up to 400 m3/s. The DEMs were treated in the same way, so the results of the Lidar also have modified cross-sections.

Reference

(1) Durand, M., Gleason, C. J., Garambois, P. A., Bjerklie, D., Smith, L. C., Roux, H., Rodriguez, E., Bates, P. D., Pavelsky, T. M., Monnier, J., Chen, X., di Baldassarre, G., Fiset, J. M., Flipo, N., Frasson, R. P. D. M., Fulton, J., Goutal, N., Hossain, F., Humphries, E., … Vilmin, L. (2016). An intercomparison of remote sensing river discharge estimation algorithms from measurements of river height, width, and slope. *Water Resources Research, 52*(6), 4527–4549.
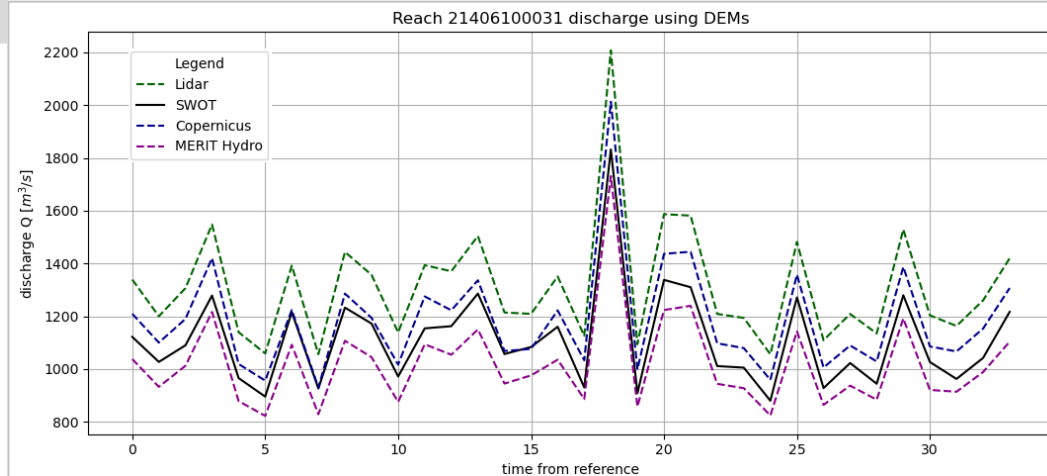
Figure 2: Simulated discharge