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The discontinuous Galerkin method for coupling a 1D river model to a 2D shallow water one

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Compared to deltas, lakes and estuaries, rivers generally are characterized by their natural downstream flow that can often be dealt with adequately by having recourse to 1D models. The cross-section integrated Saint-Venant equations are widely used in river modeling and engineering applications. In order to ensure the mass conservation the conservative form of the equations is preferred. In this case, the flux and source terms may be formulated in several ways. It is seen, however, that not all of them lead to stable and accurate numerical results. The choice of the convenient unknown and intermediate variables allows getting an optimal stability with fewer numerical adjustments. Furthermore, in a realistic domain, two different issues should be carefully dealt with, namely the relative paucity of geometric data points and the connection to larger water bodies (delta, lakes ...). Regarding the data interpolation, the reference level for data definition and interpolation is generalized along the river instead of associating a local reference frame to each cross-section, allowing to obtain a smooth, stable source term. As for the connection to a 2D model, a boundary-connected coupling based on flux continuity is adopted. The aforementioned modules are implemented in the framework of a discontinuous Galerkin finite-element model, i.e., the Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM, www.slim-ocean.be). Validation is performed by running the model in idealized configurations. Then, the river-lakes-delta continuum of the Mahakam River (Borneo, Indonesia) is modeled and validation is based on measured water level.