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Modeling the effects of low flow on wood transport in the Piave River

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In low flow conditions, wood transport is limited but still important. In addition, low flows are significant to stress a numerical model of Large Wood (LW) transport and to assess its capacity in simulating LW displacement or non-displacement. The solver ORSA2D_WT was employed and tested to improve the knowledge related to these thresholds (moving vs not moving). The software couples the solution of the 2D Shallow Water Equations to a dynamic Discrete Element Model that computes the hydrodynamic forces to calculate LW transport. To assess whether ORSA2D_WT can cope with the infrequent mobilization of LW in low flow conditions, it is applied to a reach of the Piave River (North-East Italy), where the wood budget was already investigated. Field data about LW position, mobilization, shape, size and orientation, flow conditions and morphological changes were collected.

The critical aspects that affect the model performance and that deserve an in-depth analysis are the wood-riverbed interaction and the log shape representation in the model. ORSA2D_WT works in fixed-bed conditions, computing a 2D force balance to determine wood entrainment. It considers only cylindrical forms or jams composed by cylindrical elements, whose relevant hydrodynamic parameters are the longitudinal cross-section and the hydrodynamic coefficients, that depend also on the log orientation to the flow.

Regarding wood-riverbed interaction, bed friction plays a significant role compared to the forces that trigger wood motion. This is especially true in low flow conditions when floatation is less important than rolling/sliding. The local erosion that occurs nearby wood pieces likely influences wood mobilization, as well as the presence of roots and/or branches.

To assess if the model schematizations are sufficiently accurate for low flow conditions and to overcome the model limitations, the friction and hydrodynamic coefficients are suitably corrected. In particular, the influence of the local water level on the friction coefficient is investigated, and the hydrodynamic coefficients are modified to include different LW shapes. The modified model is calibrated with the data available for one sub-reach and then applied to a different sub-reach, to assess its performance.