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Sources of error and uncertainties in palaeoflood reconstruction from dendrogeomorphological evidence

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Dendrogeomorphology is being used since three decades ago to estimate the order of magnitude of the paleoflood peak-flows; and since few years ago to compute palaeoflood discharges with more precision and detail. To this end hydraulic-hydrodynamic models, either 1D or 2D, have been calibrated using as observed references external dendrogeomorphic evidence (e.g. corrosion scarring). However, the palaeodischarges defined to date from this approach are potentially misleading since the flow behaviour due to the interference between trees and flow has not been considered. Trees cause an obstruction of water flow, drag forces and turbulence, which cause energy loss and result in water level variations. When the flow is subcritical a rise in water surface occurs upstream of the tree; whereas around the trunk there is a local decrease in the water surface. If supercritical flow occurs, the tree provokes a rise in water surface downstream of the tree, and local increase of the water surface around the trunk. With regard to this, in order to take in count these sources of uncertainties, we have calculated variations in water surface by applying an approach similar to the Yarnell equation. It is an empirical equation broadly applied to predict the change in water surface from just downstream of a given bridge to just upstream of the bridge. We have applied this equation to estimate the backwater rise as a result of the presence of trees on the river banks and floodplain, since hydraulic behaviour in this context is very similar to that empirically demonstrated for bridges. Here, we have estimated errors made in the palaeodischarges estimated so far. To this end, we have compared the existing deviations between palaeodischarges estimated from the standard dendrogeomorphic method and those derived from the approach proposed in this work. These findings do not invalidate the usefulness of dendrogeomorphology for assessing palaeodischarges, although they do show the need for correct characterization of backwater effects to guarantee reliability and minimize the uncertainties in the estimation.