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Paleo-flood discharge reconstruction in a highly dynamic tropical catchment using hydraulic modelling and dendrogeomorphic techniques

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Torrential floods are a frequent hazard in the General River in Costa Rica, and have caused disasters along its floodplain, for the last time during the 2017 rainy season. Coping with future flood disasters requires an understanding of the frequency and magnitude of flood events. However, as in many areas in Costa Rica and Central America, the General River Basin is characterized by scarce systematic data on past floods and peak discharges. In this study, we apply paleohydrological methods based on tree-ring series to extend the observations of past extreme flood events in two high-gradient mountain streams. We use two-dimensional hydraulic modelling based on highly-resolved (0.3 m) digital surface and elevation models (High Resolution UAV Photogrametry) to estimate the flood magnitude of past events. To this end, we gather a unique spatiotemporal dataset of scarred trees, which can be used as paleostage indicators. A total of 90 scarred trees have been analyzed with dendrogeomorphic techniques. This information allowed us (i) to investigate the potential of tropical tree species for dendrogeomorphic studies, (ii) the effect of variability in geomorphic tree positions on peak discharge reconstructions, and (iii) the impact of reconstructed events on the results of flood frequencies. Results suggest that trees growing in straight stream reaches or in the inner side of channel bends would be better candidates for peak discharge reconstructions than trees located on the outer side of channel bends or growing in overbank sections with dense vegetation cover. In addition, it had been seen that approximately every 10 years the impact of tropical cyclones affects this watershed. In that sense, our findings will be useful for the design of future strategies dealing with flood risks in the floodplains of the General basin providing potential to be used in other tropical catchments.