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Tracking log transport and deposition during a 20-year flood in a wide mountain river

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Distance of large wood transport during floods and conditions for wood deposition in wide mountain rivers are still insufficiently recognised. Tracking logs tagged with radio transmitters was used to investigate differences in depositional conditions and the length of log displacement during a 20-year flood between channel reaches of different morphology in the Czarny Dunajec River, Polish Carpathians. During a rising limb of the flood, logs were placed into the river at the beginning of an incised reach, close to the beginning of a channelized reach, and 1 km upstream from the beginning of a wide, multi-thread reach. The incised, channelized, and multi-thread reaches retained 12.5%, 33%, and 94% of tagged logs introduced to these reaches, and all the logs retained in the multi-thread reach were deposited in its upstream half. Significant differences in the length of displacement existed between the logs delivered to the river at the three locations, with logs placed into the river at the beginning of the incised reach moved the longest distances and those delivered just upstream from the multi-thread reach the shortest ones. One-fourth of the logs were deposited in a low-flow channel or on channel margin, one-fifth on the floodplain and more than half on gravel bars. After the flood, river cross-sections with deposited logs and a set of cross-sections without wood deposits were surveyed to collect data for one-dimensional modelling of hydraulic conditions at the flood peak. The cross-sections with deposited logs were typified by significantly greater flow width and flow area, and significantly smaller mean flow depth, mean velocity, Froude number, mean bed shear stress and unit stream power. Principal component analysis of the hydraulic parameters in the analysed cross-sections grouped the two types of cross-sections in distinct clusters, indicating that multi-thread cross-sections differed in hydraulic parameters from all the other cross-sections. The experiment confirmed findings from the previous wood inventory and numerical modelling of wood transport and deposition in the river, indicating that in a wide mountain river wood can be transported long distances in a narrow, single-thread channel, whereas it is preferentially deposited in a wide, multi-thread channel. The hydraulic modelling provided a physical justification for the observed differences in wood behaviour between the distinct channel morphologies.

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