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Dynamic aspects of large woody debris in river channels

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Large Woody Debris (LWD) are an integral component of the fluvial environment. They represent an environmental resource, but without doubt they represent also a risk factor for the amplification that could give to the destructive power of a flood event. While countless intervention in river channels have reintroduced wood in rivers with restoration and banks protection aims, during several flash flood events LWD have had a great part in catastrophic consequences, pointing out the urgency of an adequate risk assessment procedure. At present wood dynamics in rivers is not systematically considered within the procedures for the elaboration of hazard maps resulting in loss of prediction accuracy and underestimation of hazard impacts. The assessment inconsistency comes from the complexity of the question: several aspects in wood processes are not yet well known and the superposition of different physical phenomena results in great difficulty to predict critical scenarios.
The presented research activity has been aimed to improve management skills for the assessment of the hydrologic risk associated to the presence of large woody debris in rivers, improving knowledge about LWD dynamic processes and proposing effective tools for monitoring and mapping river catchments vulnerability.
Utilizing critical review of the published works, field surveys and experimental investigations LWD damaging potential has been analysed to support the identification of the exposed sites and the redaction of hazard maps, taking into account that a comprehensive procedure has to involve: a) Identification of the critical cross sections; b) Evaluation of wood availability in the river catchment; c) Prediction of hazard scenarios through the estimation of water discharge, wood recruitment and entrainment, wood transport and destination.
Particularly, a survey sheets form for direct measurements has been implemented and tested in field to provide an investigation instruments for wood and river reach monitoring. The sheets have been settled down to answer to several information requests involved in all steps of a risk assessment procedure, and to provide useful indications for a better comprehension of the dynamics of wood in rivers.
Based on a critical analysis of the current state of the art an improved theoretical mechanistic model of LWD entrainment has been proposed and tested with flume experiments, considering this feature a crucial aspect in wood dynamics.
The entrainment condition is traditionally physically based on the stationary equilibrium of gravity, buoyancy, friction and hydrodynamic forces acting on the body partially submerged in a flow field. In this work no any force has been neglected a priori and an original interpretation of some aspects of the problem has been adduced taking cues from different disciplines
The proposed approach is able to provide a threshold parameter, showing relative small experimental scatter, and to discriminate between entrainment modes (sliding, rolling, floating).
The provided correlation, for each particular configuration of the debris (shape and orientation), establish the threshold value for the proposed entrainment criterion that allows determining, for a discharge with a certain recurrence interval, the probability of motion and the relative entrainment mode.