WoodFlow Project: Integrated Management of Large Wood in Rivers

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INTRODUCTION

Floods are one of the most significant natural hazard, causing important social damages and economic losses worldwide. It is well known that rivers do not only carry clear water during floods, but especially in mountain areas, significant volumes of sediment (both suspended and bedload), and in forested basins, large amounts of instream wood can be also transported. The transport and deposition of wood material may result in a reduction of the cross-sectional area, triggering a backwater effect with inundation of the adjacent valley floor, together with aggradation, avulsion or scouring processes that ultimately cause civil- and infrastructures (i.e., embankment, bridge) damage. Thus, large wood transport increases flood hazard and risk, as witnessed during the last flood events in the Alpine region. In contrast, instream wood plays an important role in supporting the biodiversity and ecosystem function directly and indirectly. On the one hand by influencing the form and sedimentary structure of rivers and floodplains, affecting sediment sorting and providing a wide variety of habitats, on the other hand instream wood serves as well as a food source for many organisms. Therefore, the analysis of the processes involved in the instream wood dynamics (i.e., wood recruitment from hillslopes and fluvial corridor, transport and deposition) is of high interest to preserve the fluvial ecosystem and to mitigate potential wood-related hazards. The WoodFlow project, supported by the Swiss Federal Office for the Environment (FOEN), aims towards an integrated management approach. The project has a duration of 3.5 years (09.2015 – 03.2019) and will lead to improved knowledge and new methods to analyse instream wood dynamics in rivers in mountainous areas. This contribution presents an overview of the project and some relevant preliminary results.

WOODFLOW PROJECT OBJECTIVES, ACTIVITIES AND EXPECTED RESULTS

The main objectives to be investigated and the planned activities within the project are divided in three main blocks:

*Block 1 focuses on the analysis of recruitment processes and estimation of wood loads: the main processes responsible for controlling the amount of wood within a stream reach will be identified, exploring driving variables (climate, forest stand and morphological factors) and input processes (landslides, debris flows, snow avalanches, bank erosion). Data collected during previous flood events in Switzerland build the basis for these investigations (e.g., Steeb et al., 2017). Potential and effective wood load will be estimated with empirical, process-based and physically-based approaches. The goal here is to test and refine existing empirical equations (e.g., Rickenmann, 1997) to reveal trends in wood loading. The process-based approach will estimate wood volumes based on GIS data and results will be compared to the actual wood export occurrence of past flood events. This approach will be combined and compared with the method proposed by Ruiz-Villanueva et al. (2014a) who used a regional scenario on multi-criteria evaluation and fuzzy logic principles approach based on GIS to estimate potential wood load. Further, the role of vegetation patterns and their effects on recruitment process are analysed. To better characterize the potential wood load, new remote sensing tools will be tested with the objective to periodically obtain a detailed map of the vegetation structure (dimension, position and trees species). The fundamental dynamics of the recruitment processes such as bank erosion and bank/slope failure will be analysed on the basis of physically-based numerical models in which the mechanical effects of vegetation (root reinforcement, flow resistance, and wind-load) are implemented with state-of-the-art methods (Schwarz et al., 2015; Cohen and Schwarz 2017).

*Block 2 focuses on the entrainment, transport and deposition of wood in rivers and aims to understand the processes involved in the wood dynamics, how wood pieces evolve when transported (i.e., breakdown), their travel distance and to recognize and predict potential depositional areas. The transport of wood in rivers will be numerically simulated using the recently developed Iber-Wood model (Ruiz-Villanueva et al., 2014b). In Block 2, the monitoring of wood fluxes in rivers is also being carried out. In addition to field surveys and remote sensed data (gathered using UAVs), monitoring of wood transport in rivers using existing and installing new video cameras is an important activity. To complement this monitoring network, home videos in which wood-laden flows have been recorded are being analysed. The video post processing results are providing quantitative information about this type of multiphase flows.

*Block 3 focuses on the wood-related hazards and risks. The objectives are to analyze the potential impacts of large wood accumulations on local scour and backwater rise, identify critical cross-sections, and derive countermeasures. Physical and numerical modelling will be applied to evaluate the potential large wood blocking probability at a bridge pier depending on: (1) wood dimensions; (2) single logs, rootstocks and wood clusters; (3) flow characteristics, and (4) pier characteristics. The results will allow for an estimation of the blocking probability at bridge piers and can be used as a hazard evaluation tool prior to a flood event. In addition, the effect of coarse material (large wood) and fine material (e.g., branches, leaves) on backwater rise is being investigated (Schalko et al., 2016).

WoodFlow focuses on the integrated management of instream wood dynamics in mountain and foothill rivers and is directed towards an effective reduction of instream wood-related hazards and risks while maintaining the enhancement of fluvial ecosystems. Results will improve the understanding about the processes associated with instream wood and will contribute to the development of a federal management strategy that will help to evaluate and modify established prevention concepts.

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