Suspended sediment dynamics in Alpine rivers: insights from two recent measuring stations on the Adda and Brembo rivers

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Introduction: This analysis is conceived within the context of the "Progetto Dighe 2014-2016", which is focused on providing a scientific support to the Regional Environmental Protection Agency as to the use of water resources and the safe management of dams and reservoirs. Within this context, the presented analysis aims at providing an insight and an understanding on the dynamics of suspended solids during flood events. The purpose is to mimic these natural dynamics during sediment flushing from reservoir, so that the impact on the downstream ecosystems is mitigated. In order to investigate different types of sediment transport dynamics, two watershed were selected: the upper Adda River (measuring station at S. Giacomo di Teglio (359 m a.s.l.), characterised by a highly regulated nivo-glacial regime) and the Brembo River at Ponte Briolo (228 m a.s.l.), which features a nivo-pluvial regime and a lower degree of flow alteration by hydropower uses.

Methods: As said above, the research goal is the characterization of suspended sediment dynamics (concentrations, durations, hysteresis loops) during relatively important runoff events, which are due to summer/autumn rainfalls or spring rain-on-snow events.. Observations of water stage and suspended sediment concentration (SSC) are derived from two real time monitoring stations equipped with a turbidimeter, a water stage and a thermometer; in addition samples are collected manually and analysed in a laboratory in order to obtain calibration curves. Moreover, Imhoff cones are collected during flood events. Additional data such as precipitation, snowcover and air temperature are used to characterize the meteorological and hydrological conditions for each event. By a sinoptic ensemble of these data, the response of each watershed to a given precipitation event is investigated. The connection between sediment source areas and the stream network is investigated also taking into acconut th effect of snow cover, ice and/or snow melt on sediment production. So far, 10 months of data have been collected, and thus results are already available for several precipitation events. The characterization of these events will allow us to build a conceptual model that will support a decision making tool for the management of flushing operations.

Results: Preliminary results referring to turbidity-SSC calibration curves and water-sediment hysteresis loops are available. Interestingly, calibration curves show a clear dependency on the season, and for some events a clear hysteretic cycle is evident for the Brembo River (Figure 1). The trend is less evident in the data collected along the Adda River, probably because of the higher degree of flow alteration.

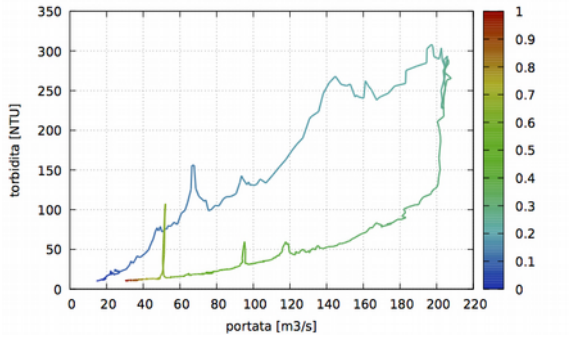

Fig. 1: *Hysteresis loop for an event in the Brembo River.*

Discussion: The preliminary results highlight the relevance of the turbidimeter calibration issue, often overlooked. In fact, the continuous monitoring is based on indirect optical measures, and an accurate conversion into SSC depends on several factors such as the number of the samples, and sediments size and colour, which in turn vary over seasons and even during events in complex catchments as those of the Alps. A large number of good-quality samples, taken over a wide range of SSC and for different events from spring to autumn can surely increase the robustness of the subsequent analysis. Indeed, such an intense sampling activity could be supported by automatic pump samplers where possible, and in any case should be accounted for by river agencies when planning the installation of new monitoring stations.

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