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A tentative 10-year sediment budget of the lower River Ebro (NE Iberian Peninsula)

A. Tena (1), R.J. Batalla (1,2), D. Vericat (2,3), and J.A. López-Tarazón (1)

(1) Department of Environment and Soil Sciences, University of Lleida, Lleida, Spain (alvaro.tena@macs.udl.cat / +34973702613), (2) Forestry and Technology Centre of Catalonia, Solsona, Spain, (3) Centre for Catchment and Coastal Research, Institute of Geography and Earth Sciences, Aberystwyth University, Wales

Dams in the Ebro basin alter flow regime and sediment transport of most rivers in the catchment. This fact, together with changes in land use, results in a sustained decrease of the sediment load since the beginning of the 20^{th} century, with special impact on the sediment load of the lower reaches of the river. The aim of this work is to develop a long-term suspended sediment budget for the river reach downstream the largest complex of dams in the basin (Mequinenza-Ribarroja-Flix, impounding around 1.7 km^3 of water). As a first step we have estimated the river's sediment load over a 10-year period based on turbidity and water discharge records continuously measured by the Ebro Water Authorities. Turbidity measurements have been calibrated by means of five-hundred manual water samples collected during all flow conditions (i.e. floods and low flows) between 2002 and 2008. Water samples have been collected 28 km downstream from the lowermost Flix Dam, at the Mora d'Ebre Monitoring Section (hereafter MEMS). Discharge at MEMS is estimated by routing the flow hydrographs from the Ascó gauging station, located 15 km upstream. Routing was based on the Muskingum method and supported by water depth and velocity measurements taken along a wide range of hydraulic conditions. The lack of supply of fine sediment from upstream is reflected in the low concentrations measured at MEMS, averaging 32 mg/l (maximum recorded $<$500 mg/l for an 8-year return period flood). These values represent ten times less than those measured upstream from the complex of dams. The average annual load attains 0.27×10^6 tonnes, a value that represents around 3% of the estimated load at the beginning of the 20^{th} century, when the basin was not regulated and agricultural uses were predominant in the catchment's headwaters. Progress in the construction of suspended sediment budgets is an essential element to inform current management and restoration actions in the river, with special interest to re-assess the design of flushing flows that is being implemented in the lower Ebro since 2002.

Keywords: sediment transport, dams, river regulation, land uses, River Ebro