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Suspended Sediment Dynamics in a Highly Regulated River: The Lower Ebro (NE Iberian Peninsula)

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The River Ebro has one of the largest basins in the Iberian Peninsula. Altogether, 190 dams impound around 2/3 of the mean annual runoff. The largest complex of dams is located in the lowermost part of the basin, 115 km upstream from the Delta. Mequinenza, Riba-roja and Flix reservoirs own a capacity of 1.7 km3, and retain, on average, up to 90% of the suspended load. Sediment transport has been monitored upstream and downstream the dams in several periods since 1998. In this work we present a preliminary description of the sediment dynamics observed during contrasted hydrological years: (i) low-magnitude years characterized by frequent small floods, and (ii) high-magnitude years characterized by less frequent large (winter) floods. During low-magnitude periods suspended sediment concentrations (hereafter SSCs) tend to be lower than during high-magnitude years, in which sediment transport is more active. Under baseline conditions SSCs rarely reach values higher than 400 mg/l, while during larger floods SSCs of up to 1.5 g/l have been obtained. During high magnitude years the seasonal variation of the SSCs shows anticlockwise hysteresis, reflecting a progressive increment of the supply and availability of fine sediment from upstream reaches and tributaries. Mean SSC during winter is almost an order of magnitude higher than in summer, reflecting a more generalised contribution of sediment from the entire basin. Poorly-looped clockwise hysteresis or even no hysteresis loops are obtained during low magnitude years. This pattern reflects a progressive decrease of sediment availability in the basin, although SSCs during these seasons are relatively similar. Comparable dynamics have been observed downstream from the dams, although SSCs is one order of magnitude lower, reflecting the role of the dams in trapping sediment. The long-term sediment disequilibrium observed in the Ebro river downstream dams underline the need of restoring the geomorphic integrity of its fluvial and deltaic system. All information related to sediment transport dynamics is essential to inform restoration programmes and achieve the objectives established in the River Basin Management Plan that is already being elaborated.