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Design of adaptation actions to compensate the hydrological impact of the river regulation by dams on the Ebro Delta (Spain): combining modeling and field work.

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River regulation by dams for both flood control and water storage has allowed to decrease both uncertainty and risks associated to extreme hydrological events. However, the alteration of the natural river flow regime and the detraction of high water volumes usually lead to significant effects downstream on the morphology, water quality, ecological status of water… and this is particularly relevant in the transitional waters since the sea level rise poses an additional threat on such conditions.
The Ebro River, in northeastern Spain, is one of the highly regulated rivers in Spain with the dams located in the mainstream. Besides an estimated decrease of a 30% of the freshwater inputs, the sediment delivery to the final delta in the Mediterranean has dramatically been decreased up to a 99%, with environmental risks associated to the reduction of the emerged areas from the loss of sediment supply, the impact on the subsidence dynamics, and the sea level rise. The Ebro Delta suffers a mean regression of 10 m per year, and the persistence of macrophyte development in the final reach of the river due to the low water mean flow regime.
The project LIFE EBRO-ADMICLIM (ENV/ES/001182), coordinated by the IRTA in Catalonia (Spain), puts forwards pilot actions for adaptation to and mitigation of climate change in the Ebro Delta. An integrated approach is proposed for managing water, sediment and habitats (rice fields and wetlands), with the multiple aim of optimizing ground elevation, reducing coastal erosion, increasing the accumulation (sequestration) of carbon in the soil, reducing emissions of greenhouse gases (GHG), and improving water quality. This work presents the pilot actions included in the project to mitigate the loss of water flow and sediment supply to the delta. Sediment injections at different points upstream have been designed to calibrate and validate a sediment transport model coupled to a 2D-hydrodinamic model of the river. The combination of an a-priori approach theoretical modeling with the pilot field actions leads to an efficient design of these injections, an estimation of their efficiency, the calibration of the flow and sediment transport model for the simulation of different options of regular recirculation of sediments from the dams' tails, and the identification of thresholds for their operationality. The use of physical approaches for modeling the hydrological impacts of dam regulation provides an efficient tool for the design of field work and potential adaption actions.