MORPHODYNAMICAL 2D MODELLING FOR THE ANALYSIS OF THE MOBILISATION AND PROPAGATION OF A VOLUME OF GRAVEL FED INTO THE ISARCO RIVER DOWNSTREAM THE FORTEZZA DAM

ISARCO RIVER, NAZ SCIAVES / VARNA (BZ), ITALY

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INTRODUCTION

The Fortezza dam, as well as all the major dikes, represents a hydraulic disconnection of the river: it interrupts both transport of sediments and mobility of fishes. The lack of sediments downstream the dam is an unfavourable condition of the watercourse, as it fosters erosion processes along the riverbed and the riverbanks. At the same time, it results in a poor biological quality of the river, as sediments and deposition areas represent the habitat for fishes and other aquatic species. In order to improve the overall quality of the Isarco River downstream the Fortezza dam, from both the morphodynamical and biological point of view, the dam managing company planned to take around 5000 m^3 of gravel from the basin upstream the Fortezza dam and feed it downstream into the river. Our work aimed to simulate the mobilisation and propagation of this volume of sediments along the first 5 km of river reach by using a morphodynamical 2D model.

MODEL INFO

The 2D morphodynamical model BASEMENT v.3 was exploited to simulate the mobilisation and propagation of the volume of gravel that is planned to be fed into the Isarco River. The domain covers a length of around 5.3 km of the river reach and an area of about 1.32 km^2. The calculation mesh was created with about 98500 triangular elements, with a maximum surface of 8 m^2 in the riverbed and riverbank areas and 40 km^2 in the floodplain areas. Along the river reach, between the inflow and outflow sections, 4 additional control sections were assigned in order to print output data at the specified sections. As downstream the dam there is actually no solid transport, only a liquid hydrograph was set as inflow boundary condition. The volume of around 5500 m^3 of gravel was distributed on an area of the riverbed of about 6900 m^2 with a depth of about 0.80 m. This area was then set as erodible with a fixed bed elevation equal to the thickness of the layer. Since the simulation aimed at understanding the propagation of the volume of gravel fed in the river, the whole downstream reach was set as non-erodible. The study assumed a single-grain bedload transport. The mean grain diameter was derived from the granulometry of the material that is planned to be fed in the river (mean grain diameter: 18 mm). The simulations were performed considering ordinary flood events with a return period ranging from 1 to 5 years, as the aim of the study was to understand the effects of frequent events on the volume of gravel. The peak water discharge was estimated through the statistical analysis of the time series of hourly measured outflow discharges at the Fortezza dam since 2010. The estimated peak water discharge was equal to 110 m^3/s. Extraordinary flood events (return period of 200 years) were also simulated to verify the effect of the additional amount of sediments on the hydraulic hazard.

RESULTS

The simulations allowed to observe the evolution over time of the mobilisation and propagation of the volume of gravel fed in the river along the modelled reach during ordinary flood events. The model gave useful indications about the sectors of the river where sediments mostly tend to deposit. Finally, the output data from the 4 assigned control sections and the outflow section allowed to estimate the sedimentographs flowing out of the sections and calculate the balance between the volume of sediments fed into the river, the volume of gravel deposited within the domain and the volume flowing out of the domain.

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