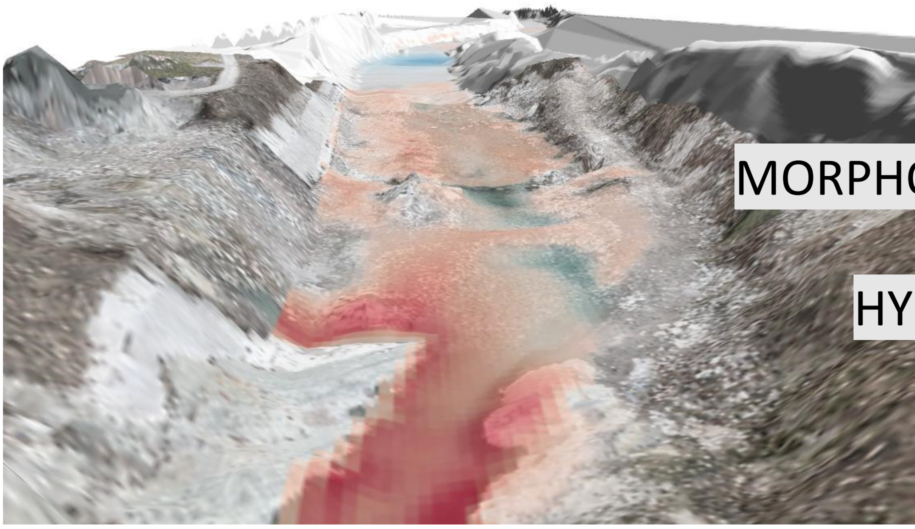

MORPHODYNAMIC 2D MODEL FOR MITIGATION OF HYDROGEOLOGICAL RISK

CORDEVOLE RIVER - PONTE MAS

SEDICO - BL (ITALY)

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INTRODUCTION

In October 2018, the “Vaia” storm affected a large part of north eastern Italy’s mountain area. The main damages were caused by strong winds that produced large windthrows, but significant disturbances were also observed along the rivers network. During the event, a rainfall amount of 330 mm was recorded corresponding approximately to 28% of average annual precipitation.
These conditions caused a massive runoff in the Cordevole River, with its 850 km^2, dolomitic catchment located in the Agordino district of Veneto Region, favouring an intense erosive activity. This work presents a first characterization of the effects induced in the Ponte Mas area by using a morphodynamical 2D model.
This location became the symbol of the event across Italy as the left bank of the river eroded deeply causing the failure of the above retaining wall and the consequent collapse of buildings and roads.

MODEL INFO

In order to analyse the dynamic of the occurred bank collapse, the 2D morphodynamical model BASEMENT v.2 was implemented. The domain covers an area of about 30 ha. About 64'500 triangular elements were defined for the discretization of geometry and elevation, with a maximum surface of 5 m^2 in the riverbed areas and of 20 m^2 in the out of bank flooded areas. The site presented a complex morphology, since a natural canyon with outcropping rocks forming a contraction which induced helicoidal velocities near the banks. The hydraulic jump between upstream and downstream of the bridge determines a rather abrupt rise in the water surface, establishing an area of strong erosion followed by a deposition area.

The study assumed a single-grain bedload transport (mean grain diameter: 25mm) derived from the granulometric analysis and a boundary equilibrium conditions. Different grain sizes were also applied in order to complete a sensitivity analysis of the results in relation to the single-grain parametrization. During the event, the peak of water discharge has been estimated in about 1 000 m^3/s while it is assessed in about 1 400 m^3/s for a recurrence interval RI=100 years. Both cases were implemented.

PROJECT DESCRIPTION

Studio API (Feltre, Italy) supported the design group in defining urgent interventions for restoring the functionality of the retaining wall in the left river bank. Several options were examined with the model in order to identify the best solution. The project – designed in 2018 and realized in 2019 – consisted of restoring the retaining wall with tieback and foundation piles. A new arched threshold was added to stabilize the riverbed. In particular, the depth of the erosion estimated by the model was taken as reference to design the height of the piles. Following an intense atmospheric event on 4-6 December 2020, strong erosive action was established on the left bank, which caused the partial collapse of the riprap. This event allowed additional calibrations of the model, defining further upgrade interventions, still ongoing.

RESULTS

The results obtained with the model application were essentially two. First, the model exactly reproduced what happened during both the VAIA storm and the December 2020 event, better explaining the dynamics that led to the bank collapse. Second, the model gave useful indications to the design of hydraulic and structural countermeasures. Specifically, the model facilitated the assessment of the excavation behind the retaining wall, supporting the design of the new works.

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