Effects of anthropic changes on the propagation of the Gleno dam break in the Valle Camonica floodplain

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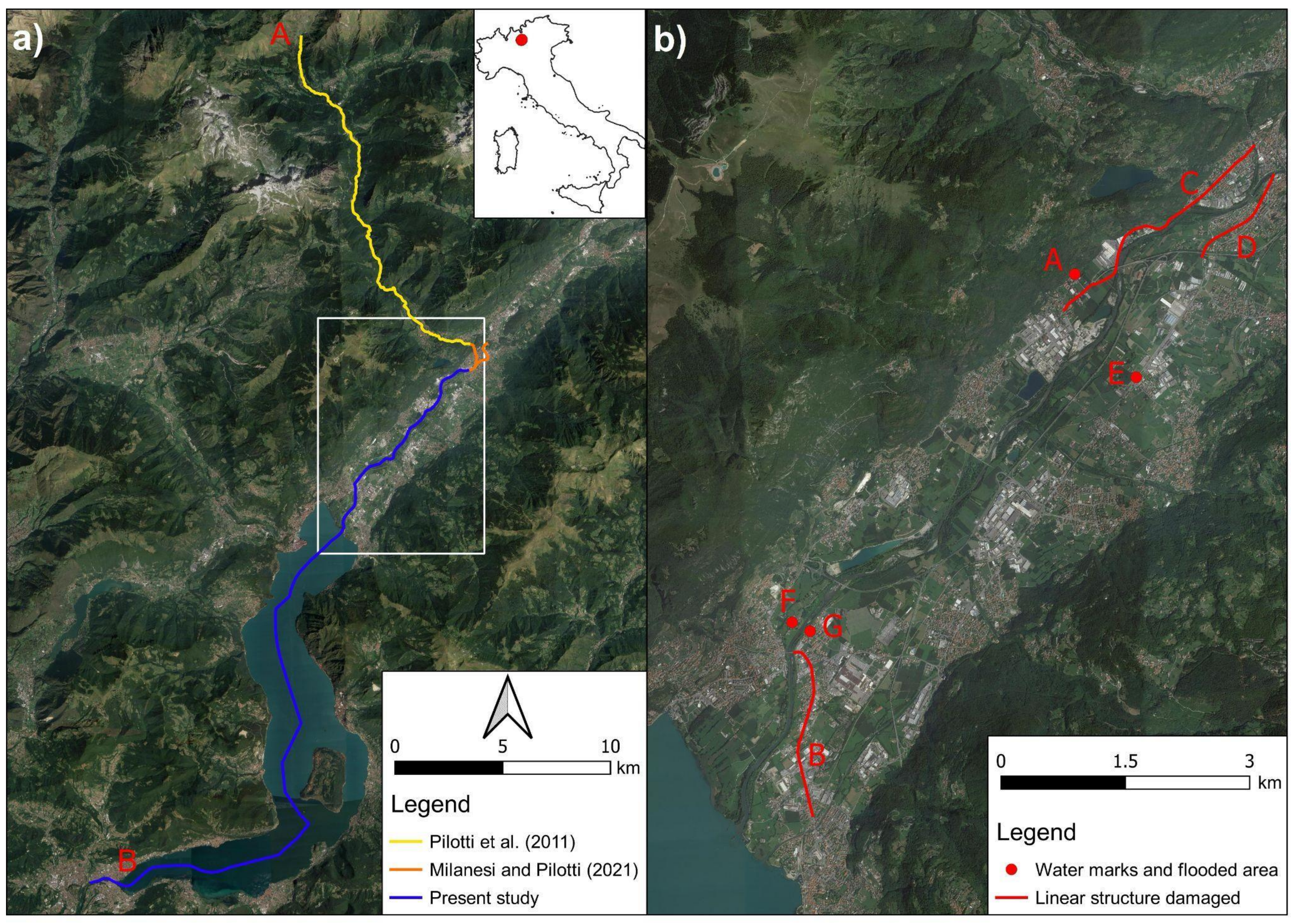

Figure 1. a) Satellite view of the study area highlighting the two reaches (respectively, yellow and orange lines) studied by Pilotti et al. (2011) and Milanesi and Pilotti (2021); the blue line shows the reach studied in this contribution. Points A and B show respectively, the location where the dam break occurred as well as the place where the limnograph was recorded. b) Satellite view of Valle Camonica, between the hamlet of Corna and the Iseo lake, highlighting the historical information derived from damage compensations and the description of the event from the newspapers.

1. INTRODUCTION

On the morning of December 1, 1923, the Gleno Dam located in Valle di Scalve (northern Italy) suddenly collapsed a few days after the first reservoir filling, releasing almost 4.5 million of m^3 of water. The consequent inundation caused havoc along the downstream valley and a death tool of at least 356 people.

The hydraulics of this event has been recently explored in a set of papers, A first work [5] focused on the reconstruction of the failure of the dam and the propagation of the dam break wave throughout the steep alpine valley as far as the alluvional fan of Corna. In a following work [4] the authors studied the propagation of the dam break wave on the alluvional fan around Corna, at the foothill of the alpine valley. In this contribution, we investigate the propagation of the flood wave from Corna, where the computed hydrograph from previous investigation provides the upstream boundary condition, as far as the Lake Iseo outlet in Sarnico. In the middle, the flood crossed 10 km of a wide pre-alpine floodplain that has been deeply modified over the last century and a 23 km stretch of a deep prealpine lake.

2. THE PROPAGATION OF THE WAVE ALONG FLOODPLAIN AND THROUGH THE LAKE

The simulation was accomplished by using HEC-RAS 2D [2] The observation of the floodplain provided by high-quality aerial synoptic photographic survey of 1944 compared to the present satellite images showed the transition from an agricultural based area to an industrial and heavy urbanized one suggesting on one hand different type of roughness values for the valley, on the other hand radical changes occurred to the bathymetry. Important structures, such as levees and road embankments, that locally changed the bathymetry in a way capable of limiting the flooding areas were removed in order to fully replicate the historical topography [7].

The upstream boundary condition for the flood propagation was provided by a previous study [4]. The maximum extent of the computed flooding well matches the only recorded water mark and the historical information available. A 30 m mesh was used in order to model the lake response to the incoming flood wave. To our knowledge this marks one of the first case of application of HEC-RAS 2D to the problem of flood propagation through a deep lake. A measured historical hydrograph recorded the level change in the lake due to the flood and was used to validate the overall modelling chain.

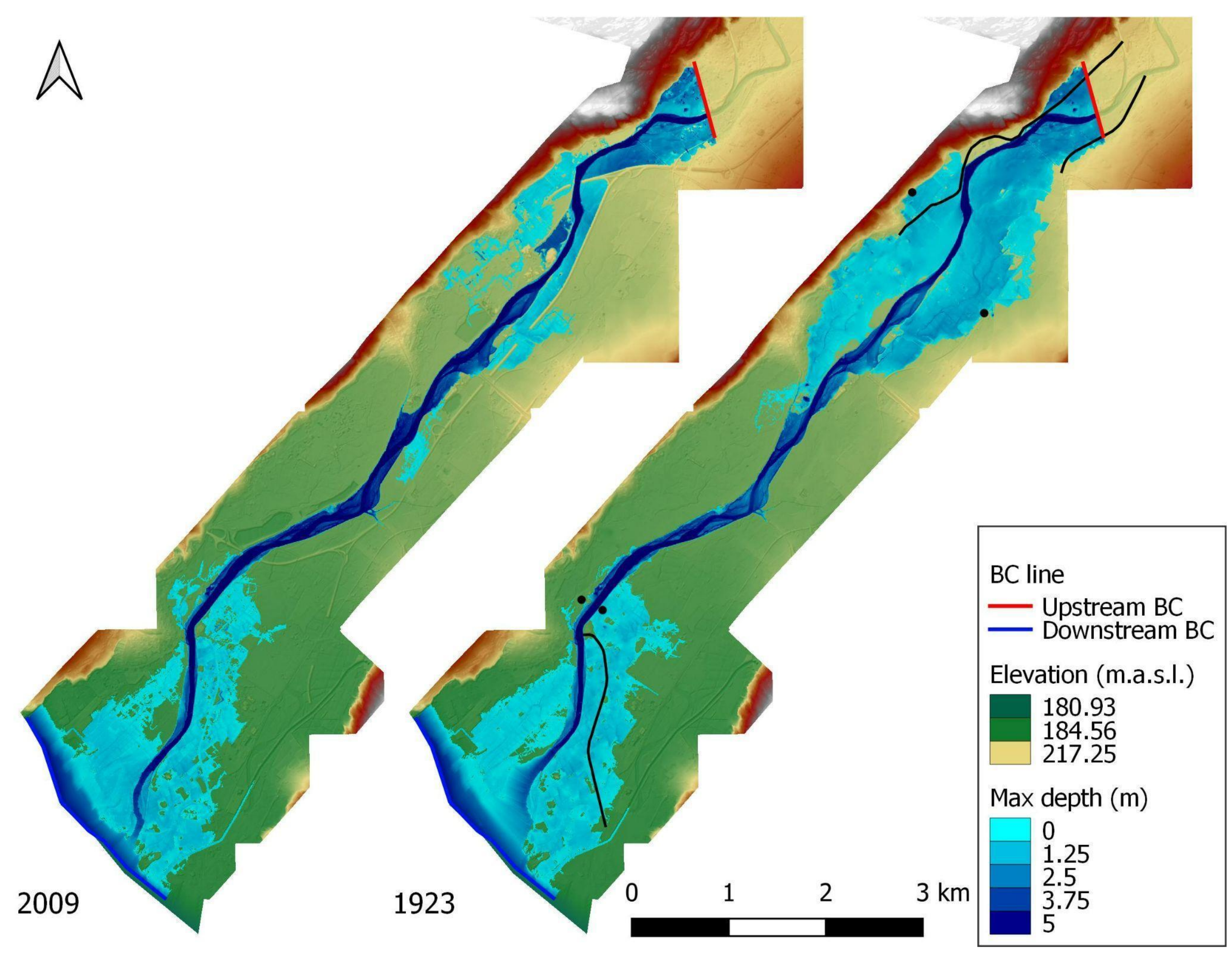

Figure 2. HEC-RAS inundation maps: DEM_A (left), DEM_B (right). The solid black lines reported on the right map show the location of roads where the presence of the water is documented, as shown in Figure 1b.

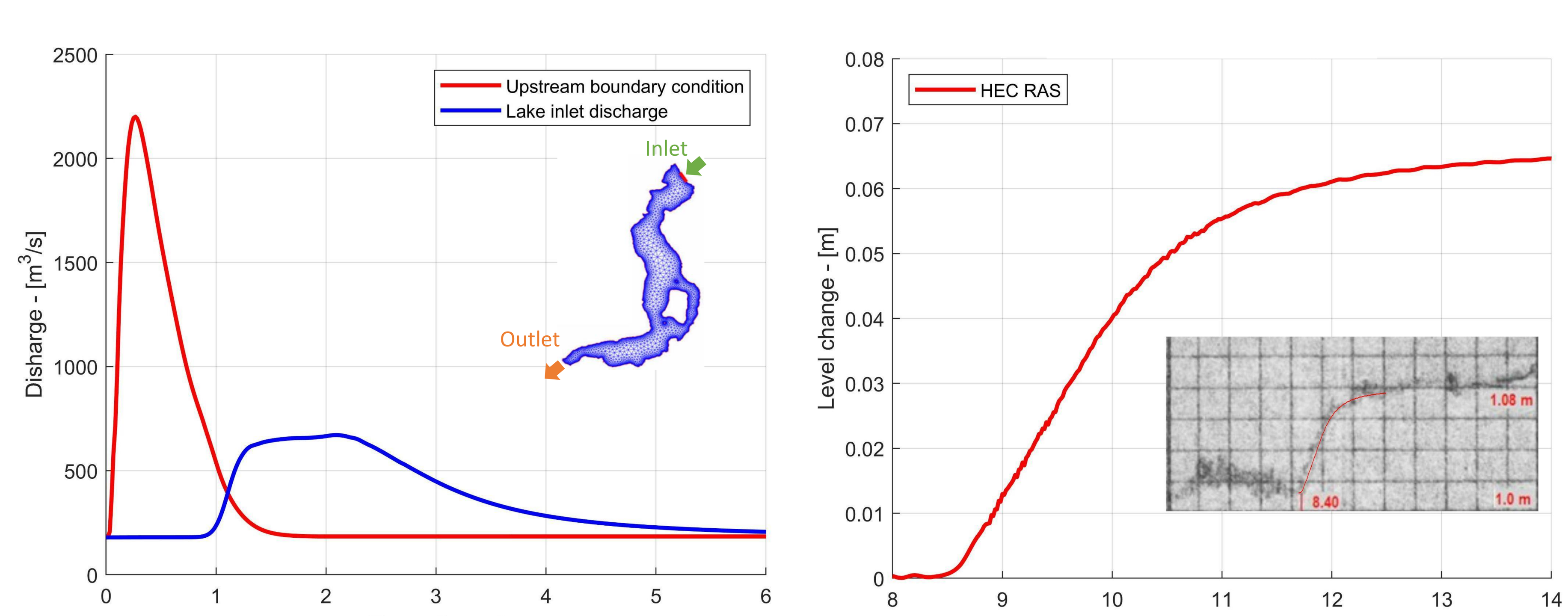

Figure 3. On the left, computed flow hydrograph of the Oglio river at the entrance of Lake Iseo. On the right, comparison between the computed water level change at Sarnico and measured limnograph.

3. CONCLUSION

The study of the propagation of the flood following the Gleno dam break in Valle Camonica provides the opportunity of observing the effects of a flood with relatively small volume but high return period peak. It also provides the opportunity to study the effects of 100 years of anthropic changes on the flood extent. In spite of the significative reduction of the hazard, the present situation of Valle Camonica paradoxically suggests that the residual risk is now much higher than 100 years ago due to the increase in exposure on the flooded areas.

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