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Editorial

Fluvial Geomorphology and River Management

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This Special Issue deals with the role of fluvial geomorphology in landscape evolution and the impact of human activities on fluvial systems, which require river restoration and management. It is well-known that the fluvial environment system is one of the principal morphological landscapes of the world, and its processes greatly influence landscape modifications. The long-term geomorphological evolution of rivers is strictly controlled by the interplay of tectonic activity and climatic changes [1] and, close to coastal zones, sea-level oscillations also contribute to modifying this natural system [2]. Another geomorphic agent which contributes to the modification of river ecosystems is represented by anthropic activity which, historically, has increased the levels of modification of natural rivers [3]. Human pressure on fluvial systems, causing low to high levels of modification has led to an increase in river management relevance. In addition, the recent growth of global temperatures in the word has induced the relevant modification of fluvial discharges with high loss of life and infrastructures due to high-magnitude events. Studies on the change in magnitude and frequency of rainfalls and consequently on the fluvial discharges at different latitudes, together with the impact of human activities on river system have become a new frontier of research. This has led to a new perspective in approaching the study of fluvial environments, such as river restoration and management, requiring the merging of more than one set of expertise in that field. At present day, in fact, a comprehensive study on the river behaviour requires a new methodology in which the classical environmental analysis based on geomorphological and geological investigations needs to be integrated. This means that knowledge coming from water resources and flooding hazard management must involve experts of several disciplines, including geomorphology, ecology, engineering, and economy. In this way, studying the contribution of fluvial geomorphology through the analysis of fluvial landform changes, the measurement of geomorphic properties of catchment basins, and the impact of contaminant material and their diffusion in the fluvial system is useful. The Special Issue is addressed to researchers in fluvial geomorphology and river management who use new multidisciplinary approaches, combining field surveys and modelling elaboration to obtain original and innovative approaches in the development and management of a fluvial system. As a result, in this Special Issue there are almost five different research topics, made by contributors from different parts of the world. Research papers all deal with fluvial system behaviour in several, and sometimes vastly different, morphoclimatic regions. Indeed, in each of these regions, considering the changeable discharge of rivers, the approach of river management can be expressed in different ways.

The behaviour of Mediterranean fluvial systems was stressed with three distinct approaches by Bentivenga et al. [4] and Filocamo et al. [5] in southern Italy, and by Sánchez-Donoso et al. [6] in southern Spain. Concerning humid continental climatic zone areas, the papers of Heasley et al. [7], Zingaro et al. [8], and Heritage and Entwistle [9] analyse the fluvial systems of the UK under different point of views, whereas those of Szabó et al. [10] and Bihałowicz and Wierzbicki [11] address fluvial systems of central Europe in Hungary and Poland, respectively. The fluvial system in the humid tropical climate of Brazil was analysed by Marinho et al. [12], and that in the arid climate of Northern Ethiopia by Annys et al. [13]. Finally, the behaviour of sinuosity rivers in arid to humid climates of

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China was modelled by Xiao et al. [14] and the morphological evolution of the river channel and its restoration in the Yongding River was proposed by Li et al. [15].

The topics addressed by each paper are original, showing innovative and classic methods in the investigation of fluvial systems. An original approach is presented by Heasley et al. [7] who developed a typology of catchment control on river reaches, grouping multiple waterbody characteristics in setting types that are considered useful for decision-making in fluvial management. A machine learning technique allowed the authors to extract self-organism maps (SOMs) used in the identification of spatial distribution types, thus producing a map of waterbody typology of the England and Wales areas. The sediment connectivity analysis as a tool to investigate flood monitoring in fluvial catchments was proposed by Zingaro et al. [8]. They focus on the application of the flow connectivity index in the Severn River basin of the UK with the aim to test the efficiency of the approach concerning flooding episodes that periodically affect the area. The authors demonstrate a good understanding on the relationship between high sediment connectivity areas and high flooding areas by using quantitative analysis and visual interpretations of sediment flow connectivity index maps (a-SCI-maps) and flooding maps, thus suggesting the importance of the SCI index in flood-hazard evaluation and monitoring. The rise of interest in the pollution of the fluvial environment has led Szabó et al. [10] to study the distribution of heavy metals in fluvial sediment landforms and the associated risk of pollution in land managers and farms. They analyse point bars and swales landforms in the floodplain of the Tisza River located in North-East Hungary, utilizing sampled soils. The different concentrations of pollutants into fluvial forms are recognized in both the horizontal and vertical patterns. The authors demonstrate that, in the horizontal pattern of the floodplain, higher metal concentrations belonged to the swales, whereas in the vertical pattern higher metal concentrations are found in all layers of swales. The analysis of nitrogen pollution in fluvial channels led Xiao et al. [14] to investigate the relationships between river pollution distribution and river sinuosity through the implementation of river channel simulation models. They monitor the nitrogen reduction processes in rivers with different sinuosity values, thus confirming the existence of their positive correlation. A more elevated concentration of pollutant was measured in the concave bank of the sinuous river than the convex bank and a higher purification capacity was observed in the concave bank than the convex one. Moreover, they found high pollutant concentration in the upstream section than the downstream section of the convex bank. The role played by storage of sediment in fluvial systems led Marinho et al. [12] to research the temporal and spatial variability of water flows and total suspended sediment discharge in the Negro River, a left tributary of the Amazon River in the Anavilhanas Archipelago of Brasil. The authors demonstrated the existence of a sedimentary link between the Negro River and the Anavilhanas Archipelago. Despite its potentially high volume of water, the Negro River has low available power for fluvial work, such as erosion and the transport of suspended solids. They recognized the low power fluvial work of the Negro River because of the backwater effect induced by the Solimoes River, which favours the retention of sediment discharge in the Anavilhanas Archipelago. Finally, the authors analysed the impact of this process on the building of a hydroelectric dam in the area, considering the extreme climatic events. The building of a dam which blocks the river flow was another question debated by Annys et al. [13] that analysed the impact produced by a hydropower dam on river morphology and downstream hydrology as a consequence of climate changes under normal and extremely high water levels. The study area is located in the semi-arid environment of the Tekeze River of Northern Ethiopia. Based on the information coming from dam operation and management and from downstream field measurement, the authors recognized active riverbed narrowing as a consequence of the alteration of both the vegetation dynamics and the agricultural activities. In this way, the paper highlights the importance of optimising dam operation and management in order to safeguard downstream riparian users and ecosystems. The assessment of erosion and deposition balance, in association with channel switching in a channel, illustrates their implications for local and downstream flooding, which was

proposed by Heritage and Entwistle [9]. They investigated river channel behaviour in the Caldew River of the UK using lidar surveys. The authors analysed channelized fluvial reach placed in an incipient wandering system, which controls the interplay of erosion and deposition and suggests upstream naturalization of the fluvial system together with other natural flood management activities in order to decrease the flood risk in the fluvial downstream areas. The role of river management was discussed in a quantitative and qualitative analysis of rainfall and erosion/deposition dynamics in the coastal plain of the Ionian belt of southern Italy by Bentivenga et al. [4]. The work deals with the role played by either climatic change or human activities in triggering flooding events in this sector of the Mediterranean. The authors identify that the most recent flooding in the area was due to the failure of reclamation channels than the overflow of the main streams because of the high frequency of extreme rainfall events. A geomorphic approach was used by Sánchez-Donoso et al. [6] dealing with the question of the evaluation of a morphometric parameter measurement in upstream reaches of agricultural land catchments. They used remote sensing tools to measure the ridge to the head of the channel distance parameter in three catchments of the Iberian Pyrite Belt of Spain and found that two adopted methodologies are useful in the estimation of geomorphic reclamation projects. They argued that the two methods of Lidar data and orthoimages interpretation must be used in combination to reduce false results and may reveal some errors provided by a single method. Li et al. [15] addressed the morphological channel evolution of the Yonging River in China through a quantitative assessment of its spatial and temporal evolution. The authors explored the controlling factors responsible for channel variation in time and space, concluding that human activities controlled the channel behaviour in the past 54 years. Finally, based on the results, they proposed a set of ecological river restoration strategies and protection in the river. A discussion on the basic geomorphic concept of differential erosion was addressed by Bihałowicz and Wierzbicki [11] which applies the concept to fluvial patterns in the whole Poland territory. The authors observed that, in wide alluvial valleys, the main channel flows above more resistant rocks from the bedrock than the less resistant ones and proposed the application of a new and original concept of reversed "differential erosion". The geomorphological evolution of river valleys was analysed by Filocamo et al. [5], who use integrated geomorphological and chronostratigraphic analyses to reconstruct the Quaternary landscape evolution of the Calore and Volturno fluvial valleys, in Southern Italy. They discerned the role of tectonics, climate, and volcanic events in the fluvial valley's evolution, employing fluvial and alluvial fan deposits for their investigation. Moreover, they recognize the relevant role of Pleistocene tectonics in the genesis of the fluvial valleys and the dominant role of climate and land-use changes in the formation of fluvial terraces and alluvial fans, starting from 15 ka.

The Special Issue contains twelve research articles which cover many topics ranging from the management of fluvial reaches to flooding and pollution and the behaviour of fluvial erosion/deposition processes with climate changes. Moreover, the role of human activities has also become important, placing it as a new geomorphic agent in the modification of the fluvial system. The selected papers represent a further contribution to the comprehension of fluvial dynamics and how natural and anthropic activities can modify river systems. The hope is that the collected papers can contribute to an increase in interest in this important and vulnerable environment which is so fundamental for human life.

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