


Editorial

New Technologies in Geo-Hazards Analysis, Hydrogeology and River Restoration

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Strong societal pressures are now seeking to restore balance to environments that have been destabilized by many years of poor practices in valley bottoms, geological subsoil and slopes. The task to put back into good order watersheds that are increasingly frequented and inhabited is enormous, but also subject to risks linked to the disharmony between societies and nature. The scientific community, whether from the hydro-geosciences or the social sciences, is very involved in these issues, which concern the analysis of geo-hazards, hydrogeology, and river restoration. This is helped by the global context: landslides are recurrent in the world, causing many serious events every year; groundwater is facing serious pollution problems (water quality), as well as serious scarcity problems, both in cities and in the countryside (water quantity); riverbeds have never been as much of an issue as they are today, as many countries want to reverse the centuries-old trend of damming and enclosing rivers by renaturation or rewilding, while limiting flood risk. The consideration of natural risks and their management on a watershed scale require a good understanding of not only physical but also human processes. More and more, populations are asked to give their opinion on how to manage their territory, which can influence the main orientations of the restoration works, whether it is about the slopes, the subsoil or the rivers. Solving major environmental issues requires technological development, which includes the renewal of conceptual approaches, development of new methods, and the formalization of new societal paradigms, fully embodying what the population living in the watersheds wants today and tomorrow.

This Special Issue intends to echo this state of ongoing research, concerned both with technical progress but also listening to societal expectations, by answering three questions: (i) What are the new concepts, methods and techniques (field measurements, geomatics, modeling, etc.) to better understand the functioning of slopes, subsoil waters and alluvial plains, separately and/or in combination? (ii) How can these new scientific contributions help to reduce the risk of floods, water shortages, pollution, and landslides in order to make environments more in line with sustainable-development expectations? (iii) How can these new technologies proposed by researchers be used and integrated by watershed managers to improve bio-hydro-morpho-ecological conditions and human/nature harmonization? A total of five papers (four research papers and one review paper) in various fields of geo-hazards analysis, including rockfall hazard, and river dynamics and restoration, perceived through field experience, image analysis and hydro-sediment modelling, are presented in this Special Issue. Concerning geohazard analysis, Ravanel et al. [1], in the glacial and torrential basin of Taconnaz (Mont-Blanc massif, France) dominating the Chamonix valley, highlight a new type of hazard with a rockfall triggered at c. 2700 m a.s.l. in November 2018. They studied the triggering conditions at the permafrost lower limit, the effects of the supra-glacial path on the flow patterns, and the fate of the scar and the deposit on torrential activity. The study of the triggering factors indicates glacial retreat as the probable main cause, assisted by the melting of ice lenses left by the permafrost disappearance. This event improves the understanding of cascading processes that increasingly impact Alpine areas in the context of climate change. Concerning river dynamics and restoration, Arfeuillère et al. [2] evaluate to what extent riprap removal may be an efficient restoration measure



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in terms of the reactivation of bank erosion and the replenishment of the local bedload in gravel-bed floodplain rivers with a sufficient amount of freedom space. In the Allier River (France), they conclude the removal of riprap is an effective measure for certain, but not all, channelized floodplain reaches. The geomorphological and sedimentary contexts are two criteria that should be considered when selecting sites for restoration. Rakotoarisoa et al. [3] propose to model the diachronic evolution of connectivity in small agricultural basins of Seine Maritime in the Parisian basin (France) using a multiagent system (MAS) and to develop synthetic indicators characterizing spatial links in the flow processes. The model outputs show that spatial connectivity has been steadily increasing over the past 70 years due to the enlargement of the parcel grid and the growth of runoff surfaces. Wahiduzzaman and Yeasmin [4] examine the shifting pattern of the Ganges-Padma River (Bangladesh) using satellite images taken between 1973 and 2016. They conclude that both the sinuosity ratio and the braiding index increased over time, exceeding the meandering threshold. Overall, the variation in the braiding index exceeds that of sinuosity. Duquesne and Carozza [5] focus on the interpretation and quantification of sedimentary processes in low-energy fluvial environments. They compare five methods of grain size data processing (statistic moments, textural analysis, multivariate statistics combining Principal Component Analysis and hierarchical cluster analysis, and CM image and end-member modeling analysis). The authors discuss their effectiveness in characterizing low-energy floodplain deposits in the downstream section of the Charente River (France). They conclude that the multivariate statistics approach and end-member modeling analysis present interesting results and allow the robust identification of sub-units. However, the results of the multivariate statistics depend on the choice of input variables and do not support non-zero values, while the second method, the most recent and most complex, needs to be developed further to clearly link the end-member classes to sedimentary processes.

Although submissions for this Special Issue have been closed, more in-depth research in the field of geo-hazards analysis, hydrogeology and river restoration continues to address the challenges we face today, such as maintaining biodiversity, water quality, sustainable regional development, reducing natural and technological risks in the context of climate change and global population growth.

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References

1. Ravanel, L.; Duvillard, P.-A.; Astrade, L.; Faug, T.; Deline, P.; Berthet, J.; Cathala, M.; Magnin, F.; Baratier, A.; Bodin, X. The Tacconnaz rockfall (Mont-Blanc Massif, European Alps) of November 2018: A complex and at-risk rockwall-glacier-torrent morphodynamic continuum. *Appl. Sci.* **2023**, *13*, 9716. [[CrossRef](#)]
2. Arfeuillère, A.; Steiger, J.; Gautier, E.; Petit, S.; Roussel, E.; Vautier, F.; Voldoire, O.; Saillard, J. Removal of riprap within channelized rivers: A solution for the restoration of lateral channel dynamics and bedload replenishment? *Appl. Sci.* **2023**, *13*, 2981. [[CrossRef](#)]
3. Rakotoarisoa, M.M.; Reulierand, R.; Delahaye, D. Agent-based modelling of the evolution of hydro-sedimentary connectivity: The case of flash floods on arable plateaus. *Appl. Sci.* **2023**, *13*, 2967. [[CrossRef](#)]
4. Wahiduzzaman, M.; Yeasmin, A. An observation of the changing trends of a river channel pattern in Bangladesh using satellite images. *Appl. Sci.* **2022**, *12*, 11604. [[CrossRef](#)]
5. Duquesne, A.; Carozza, J.-M. Improving grain size analysis to characterize sedimentary processes in a low-energy river: A case study of the Charente River (Southwest France). *Appl. Sci.* **2023**, *13*, 8061. [[CrossRef](#)]

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