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Editorial

Rainfall Erosivity in Soil Erosion Processes

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Abstract: Regional studies on the erosive power of rainfall patterns are still limited and the actual impacts that may follow on erosional and sedimentation processes are poorly understood. Given the several interrelated challenges of environmental management, it is also not always unclear what is relevant for the development of adaptive and integrated approaches facilitating sustainable water resource management. This editorial introduces the Special Issue entitled "Rainfall Erosivity in Soil Erosion Processes", which offers options to fill some of these gaps. Three studies performed in China and Central Asia (by Duulatov et al., *Water* **2019**, *11*, 897, Xu et al., **2019**, *11*, 2429, Gu et al. **2020**, *12*, 200) show that the erosion potential of rainfall is increasing in this region, driving social, economic, and environmental consequences. In the same region (the Weibei Plateau in China), Fu et al. (*Water* **2019**, *11*, 1514) assessed the effect of raindrop energy on the splash distance and particle size distribution of aggregate splash erosion. In the Mediterranean, updated estimates of current and future rainfall erosivity for Greece are provided by Vantas et al. (*Water* **2020**, *12*, 687), while Diodato and Bellocchi (*Water* **2019**, *11*, 2306) reconstructed and investigated seasonal net erosion in an Italian catchment using parsimonious modelling. Then, this Special Issue includes two technologically oriented articles by Ricks at al. The first (*Water* **2019**, *11*, 2386) evaluated a large-scale rainfall simulator design to simulate rainfall with characteristics similar to natural rainfall. The data provided contribute to the information that may be useful for the government's decision making when considering landscape changes caused by variations in the intensity of a rainfall event. The second article (*Water* **2020**, *12*, 515) illustrated a laboratory-scale test of mulching methods to protect against the discharge of sediment-laden stormwater from active construction sites (e.g., highway construction projects).

Keywords: erosion control; mulching; net soil erosion; raindrop energy; rainfall erosivity; runoff; sediment yield

1. Introduction

Rainfall erosivity is a major driver of sediment and nutrient losses worldwide, which may leave farmers vulnerable to crop failures and lead to unstable equilibrium states in landscapes [1,2]. The exposure of the Earth's surface to aggressive rainfall is a key factor controlling the water erosion in terrestrial ecosystems [3] and other damaging hydrological events, such as floods and flash floods [4]. The occurrence of hydrological extremes and the associated sediment loss during rainfall events are central features in the global climate system because worldwide variations in temperature and precipitation patterns produce corresponding changes in the development of natural hazards [5]. It is also assumed that extreme storms and rainfall-runoff erosivity are becoming more frequent due to climate change [6]. Highly vulnerable areas may result in catastrophic regime shifts connected with the occurrence of damaging hydrological events [7]. This explains the continuing interest of scientists and engineers in the hydrological response of landscapes. This interest ranges from a basic understanding of processes to prediction under changing conditions, driven by a greater recognition of the cost (both financial and environmental) of neglecting the hydroclimatic forcing factors in relation to soil conservation systems and land-use planning. This Special Issue is an overview of the research and implications for environmental monitoring and policymaking, and encourages further methodological development.

2. Special Issue Overview

The special issue of Water entitled "Rainfall Erosivity in Soil Erosion Processes" publishes eight articles that provide insights into challenges of hydrology and emerging issues at the interface with other related sciences like geomorphology.

The Special Issue contains four articles with a focus on hydrological hazards across China and Central Asia, dealing with: (1) spatiotemporal patterns of rainfall erosivity (Gu et al. [8]), (2) the explanatory power of peak rainfall amounts on sediment yield (Xu et al. [9]), (3) climate-change-induced rainfall erosivity (Duulatov et al. [10]), and (4) rainfall energy-induced soil splash erosion (Fu et al. [11]). The Tibetan Plateau (the focus of Gu et al. [8]), the most active geological belt in China, is not only being affected by the melting of glaciers and other ice formations but also by heavy precipitations that provoke widespread soil loss. These conditions may increase the risk of soil erosion. Especially in spring, rainfall erosivity has been significantly increasing from the 1980s. The southeastern region, where severe soil erosion restricts the development of agriculture and animal husbandry, requires the sustained attention of scientists. The study performed by Xu et al. [9] on the Shixia watershed, in the northeast of the upper reaches of Miyun reservoir in Beijing (China), is about how rainfall morphology affects runoff and soil loss, which is important to deepen the understanding of catchment hydrology and provide support for water and soil resource management. This contribution is worthy because the researches on rainfall affecting runoff and sediment yield rarely analyze impacts from the point of view of rain peak morphology. Fu et al. [11] clarified the effect of raindrop energy on the splash distance and particle size distribution of aggregate splash erosion and introduced a modelling approach to predict splash erosion in the Loess Plateau (central China). Duulatov et al. [10] estimated the potential influence of climate change on erosivity precipitations over Central Asia. In recent years, climatic conditions in Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) have changed owing to the reduction in glacier areas, accompanied by a shortage of water for irrigation, degraded natural vegetation covers, erosion processes and salinization, and a decreasing productive capacity of irrigated lands. The authors' predictions indicate that Kyrgyzstan and Tajikistan are expected to be the most affected countries from changes in rainfall patterns, especially from the increase in rainfall erosivity.

Two papers addressed specific topics in the Mediterranean region, where desertification is a serious issue that could be aggravated by rainfall-driven soil erosion. This was highlighted for Greece by Vantas et al. [12], while Diodato and Bellocchi [13] advocated a parsimonious modelling approach for the reconstruction of past erosion data, with an application to a small Mediterranean basin, whose dynamics are analysed in response to climate variability and land-use changes.

Finally, the topics addressed in two studies developed in Alabama (US) by Ricks et al. [14,15] are interesting and challenging in equal measure, and with a high degree of novelty that decision makers may find motivating and engaging. The methods used are high-tech (e.g., adding soil-specific polyacrylamide to erosion-control practices for a greater erosion control), supported by an adequately described mathematical background, and combined with application for construction sites apart from soil erosion itself, the transported sediments being carriers of contaminant factors as well.

3. Conclusions

Water, which is a precious resource for ecosystems, can also turn into a land-disturbing factor due to the erosive force of rainfall, expressed as storm erosivity. Hydrological extremes alter soil structure, triggering erosion, but the ecological consequences of shifts in precipitation extremes and characteristics due to climate change (e.g., nutrient loss and carbon balance) are often poorly understood. The widespread availability of high-temporal resolution rainfall records for large areas and the development of climate models have opened new opportunities for using methods for large scale planning and hazard prevention. This Special Issue raises awareness of the crucial role of hydrological extremes, though the limitations of the body of articles it publishes should be highlighted. It is important that it takes part in sketching the future of two regions particularly sensitive to hydrological changes (i.e., the Mediterranean and Central Asia with China), but there is still a lack of established studies in several regions of the world. Then, this Special Issue does not consider in full measure the extent to which population density, infrastructures, plant density, and other factors influence the occurrence of hydrological damages. The approaches and data resources that this Special Issue introduces are thus expected to promote future research and encourage the consideration of a wide array of scientific sources and possible methods for delivering decision support in various contexts.

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