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Editorial

Introduction to the Special Issue on Climate Change and Geosciences

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With increasing interdisciplinarity, more studies are examining environmental problems from an integrated perspective. This is apparent in the geological sciences and physical geography, which incorporate various disciplinary approaches, including biology, pedology, hydrology, geomorphology, and climatology. This Special Issue of *Geosciences* is comprised of studies relevant to the biosphere, atmosphere, and hydrosphere, with terrestrial systems also considered. This Issue takes a geoscience perspective, embracing both geology (Earth science) and physical geography.

Research in these fields is increasingly applied, investigating human impacts on the natural environment and the consequences of environmental change on human systems and resources, including food and water supply. Indeed, the Anthropocene is an increasingly recognized epoch that arguably commenced with the onset of agriculture and accelerated with industrialization over the last few centuries and decades [1]. Evidence of human impacts on the biosphere in terms of pollution and waste, nuclear testing, modification of landscapes, and so on (cf. [2]) has been accumulating and cannot be ignored in environmental change and landscape studies. The human impact on geomorphological features and processes is already evident, although it varies in degree spatially and between geomorphic domains [3]. The engineering of rivers, for example, affects geomorphological evolution [4] through changes in channel morphology and connectivity and flow ranges [5] and altered sediment deposition [6].

Although climate change also has natural causes, recent climatic change during the Anthropocene is overwhelmingly attributable to human activities (e.g., greenhouse emissions from industry causing global warming), as expressed by the concept of anthropogenic climate change [7]. Humans are effective agents of environmental change, as for instance evident through global warming, and we are increasingly capable of impacting the global environment. This environmental change threatens a state shift in the Earth's biosphere that jeopardizes human welfare as well as causing the extinction of many species [8].

Some have argued that continued and increasing engineering of Earth processes and ecosystems is necessary to support economic prosperity that would bring interest in and capability for effective conservation. However, this is a dangerous gamble, since on the other hand societal instability and ecological disruption could drive economic decline, leaving populations even more vulnerable to rapid shifts in Earth processes, including climate, natural resource depletion, and loss of ecosystem services [9,10]. In any case, better appreciation of the geological and geographical facts is indispensable for informed decision-making at levels from local to global.

Addressing anthropogenic climate change in landscape and management geoscience contexts is the subject of papers included in this Special Issue. This Special Issue presents relevant geoscience and physical geography research on humans impacting natural landscapes and the development of "human landscapes." This research agenda is central to studies of Anthropocene human impacts on the environment and of human-environment landscape interactions that have been pursued as part of applied geomorphology, including environmental geomorphology, since the 1970s and 1980s (e.g., [11,12]). A developing part of this subfield has been urban geomorphology (e.g., [13]), bringing geoscience tools to the city setting, where human interactions and impacts on landscapes are concentrated and focal.

Interactions between the biosphere, atmosphere, and hydrosphere are considered in this Special Issue from various integrated systems approaches. Dynamic Earth systems driven by climate change are studied in the eight (six research and two review) papers, which contribute to an array of subtopics: watershed hydrology, groundwater supply, crater lakes, and paleolimnology (review) as well as woody crops, fire regimes (review), and the Abrahamic religions. The specific contributions are as follows:

- Increased rainfall during storms directly affects stormwater runoff in urbanizing watersheds in coastal Beaufort County (South Carolina, USA), as assessed by runoff modeling showing increased runoff volume and rate [14]. Importantly, in all cases, the impacts attributable to climate change were greater than those resulting directly from urban development.
- Using satellite imagery in remote arid areas in the Al Ain region (UAE) to monitor the water budget, it was possible to identify a decreasing trend of the average annual recharge, leading to deleting water stores [15].
- Action to mitigate climate change impacts requires well-substantiated (evidence-based) inputs from scientists to inform decision-makers, in particular including religious leaders and activist groups [16].
- Long-term monitoring of groundwater is required to warn of water shortages. Shallow groundwater resources (e.g., unconfined aquifers) can be suited to stock-grazing and horticulture. Local groundwater salinity levels were found to be affected by a nearby waste dump site, which is exemplary of spreading environmental impacts around remote communities in Argentina [17].
- A crater lake in north-central Tanzania (Lake Basotu) examined through satellite imagery is shown to be in decline due to local agricultural practices and soil erosion causing sedimentation, increasing its sensitivity to climatic fluctuations [18].
- Woody biomass increment of hybrid aspen clones examined through dendrochronology is most affected by moisture stress, rather than temperature stressors [19].
- Fire activity at lower elevations and lower latitudes does not increase significantly in hotter and drier conditions. Climate is not the sole controlling factor and vegetation response is an important consideration in fuel-limited environments. Human impacts can also affect the landscape propensity for burning through altering vegetation distribution and trajectories [20].
- Paleoliminological research has documented anthropogenic effects in lacustrine environments since the onset of industrialization and increasing through the "Great Acceleration." This has resulted in long-term global change associated with biodiversity loss, the spread of invasive species, pollution, etc., tracked through lake sediments as a means to investigate past environmental change. The paleolimnological approach can, therefore, be used to inform mitigation and adaptation measures in response to climate change [21].

The resulting compilation was more hydrosphere-focused than originally anticipated, with terrestrial systems and the biosphere also receiving attention. These papers examine human-environment interactions within the Anthropocene from a long-term perspective and take into consideration the sustainability of these interactions and environments. The human impact is focal in these papers, from a variety of disciplinary viewpoints. Finally, the need and potential for science to inform decision-making and leadership is demonstrated.

Conflicts of Interest: The authors declare no conflict of interest.

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