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Editorial

Physical Geography and Environmental Sustainability

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Received: 21 November 2017; Accepted: 22 November 2017; Published: 28 November 2017

Abstract: In this introduction to the Special Issue on Physical Geography and Environmental Sustainability, the links between a variety of physical landscapes located throughout the world and long-term wellbeing are considered from a systems approach. Twelve papers were published as part of this call, with half from Asia, especially China. They represent a contribution across topographic landscapes, from mountainous to estuarine, and cover models as well as case studies encompassing landscape and environmental changes. Remotely sensed data, statistical analysis, and GIS were often incorporated in the work, and this particularly conveys the importance of spatial analysis on inputs by physical geographers in sustainability research. Furthermore, scale variations from the local to global are presented as part of a geographical contribution. The connectedness of environments to humans and the reverse (of humans adapting to environmental change) is evident in several of the papers where human impacts and adaptation are concerned. Finally, the last paper provides a comprehensive summary of the potential contribution that physical geographers can make to environmental sustainability from a multidisciplinary approach.

Keywords: sustainable (agricultural) development; invasive species; vegetation (land-use/) cover change; soil organic carbon (SOC); cruise ship waste management; soil crust development; treeline; coastal communities; estuarine flood-risk; syndisciplinary/multidisciplinary research

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1. Introduction to the Special Issue

The role of physical geographers in ensuring the attainment of sustainability in a variety of Earth environments and systems at a multitude of scales is critical. This Special Issue calls on the expertise of physical geographers, including geomorphologists, climatologists, and so on, to consider the future of geosystems in a variety of settings and locations throughout the world. Accordingly, a diversity of landscapes are approached from an integrated systems point-of-view. The key aim was to contemplate sustainability from the perspective of physical geographers, who focus on environmental problems and their solutions. Keywords for the submissions included: physical environments; geosystems; climate change/global warming; landscape change/environmental change; climate change adaptation; environmental resources; and human–environment interactions. There was a total of 12 papers that were ultimately accepted for publication, including research articles, a case report, and review-style paper that are briefly outlined next.

2. Summary of Papers

Published papers as part of this Special Issue have addressed the following:

1. Earth observation by way of five online tools and initiatives, including enviroGRIDS in the Black Sea catchment for data-sharing; Google Earth Engine for big-data processing; application processing interfaces allowing for new uses of data and models; the Berkeley Ecoinformatics Engine; and collaborative mapping tools (Seasketch/MarineMap and InVEST software that facilitate the engagement of different stakeholders. These tools support sustainable development

through evidence brought by physical geography that is coupled with socioeconomic information ([1] case report).

2. Wetland mapping of Rwanda's Akagera Complex Wetland using remote sensing and GIS, with Landsat data between 1987 and 2015 (acquired in 5-year intervals) deployed in a DEM at 30-m resolution. The data reveal that 30% of the surface area is composed of waterbodies and that floodplain and swamp forest appear in smaller proportions. Waterbodies have been subject to instability associated with invasive species and certain lakes (Mihindi, Ihema, Hago, Kivumba) have shown evidence of shrinking ([2] article).
3. In the Nanxiong Basin, China, both natural climate change and human activities are driving vegetation cover change. This was quantified using statistical methods and GIS to information from the past two decades, between 2000 and 2015. Most variations where a significant cover change occurred were attributable to human impacts, particularly due to industrialization and urbanization. On the other hand, the plantation and enclosed forest policy worked to ensure a noticeable recovery in vegetation in the study area during this period ([3] article).
4. Remote sensing and GIS provided the means to examine the spatiotemporal dynamics of estimated soil organic carbon (SOC) in the Sanjiang Plain, China. The findings indicate that cropland increased between 1992 and 2012, with dry farmland converted to paddy fields. The SOC storage of cropland in the top 1 m of soil increased from 1220 to 1290 Tg·C due to increased cropland area. Agricultural reclamation from natural land-use also had a significant effect, with SOC values that are consistent with the movement direction of paddy fields ([4] article).
5. In the Baltic Sea area, the cruise ship industry is examined in terms of its waste management at cruising ports, with four ports (Copenhagen, Helsinki, Stockholm, Tallinn) selected for this study. Using statistics and interview data, based on 12 interviews with port managers and decision-makers, the study calls for a standardized environmental legislation that is based on coherent measurement systems in order to encourage transparent environmental monitoring while also maintaining the competitiveness of these ports. The authors suggest focusing on specific waste types (waste specialization) and setting specific waste-discharge fractions as well as working towards spatial network collaboration ([5] article).
6. Soil crust development and its impacts on underlying soil properties was investigated based on research executed in 2016 in the Hobq Desert of Inner Mongolia, North China. Soil samples up to 30 cm in depth made up soil crust samples from five areas entailing different stages of development. The physicochemical properties of samples indicated a gradual increase in these properties: thickness, water content, macro-aggregate (>250 μm) content, organic matter content, microbial biomass, and enzyme activities along the soil crust development gradient, with only soil bulk density of soil crusts experiencing a decrease. Amelioration effects were noted for physicochemical and biological properties below algal and moss crusts in comparison to the physical crust; these were concentrated in the upper horizons (top 12 cm) and quickly diminished deeper down the soil column ([6] article).
7. As part of what has been called "syndisciplinary" research, it is advocated that factors influencing treeline (physiognomy, spatial patterns, dynamics) at the local to regional scales should have priority in investigations of the response to climate change of the treeline. Heat dependency influences the treeline position at global scale, but this changes regionally to locally due to variations in physiognomy, diversity, spatial and temporal features, and heterogeneity ([7] article).
8. Nonpoint source pollution affected by crop production was examined using a case study of the Heilongjiang land reclamation area in China. This area produces 80% of water pollution due to fertilizer application. Nitrogen loss used to decouple nonpoint source pollution from crop production showed a weak decoupling frequency, but this was not steady in 2001–2012; this was true for rice production, although it was not steady over time, except for the Suihua branch ([8] article).

9. By integrating multiresolution remote sensing and topographic and field-based datasets to examine the Mu Us Sandy Land in northern China, this paper quantifies change in land-use/cover change (LUCC) between 1965 and 2015. Land-use change occurred in three stages, during the Great Cultural Revolution, economic modernization, and the Great Ecological Project. National policies affected land use during these different periods, with cultivated land increasing in the first (Great Cultural Revolution); vegetation coverage, but also cultivated and artificial surfaces, also increased in the second stage (of economic modernization); and cultivated land as well as unused land decreased in the final stage (of the Great Ecological Project), when woodland and spare vegetation increased through the implementation of the Grain for Green Project, although there was more increased cultivation once more and reduced woodland and spare vegetation by the end of this phase, so that artificial surfaces in grasslands areas led to encroachment ([9] article).
10. With the impact of major storms upon the Atlantic coast of Canada leading to much physical damage as well as socioeconomic impacts, communities composed of aging populations are vulnerable to the effects of climate and environmental changes. Based on interviews completed in 2011–2012, this study examines the impacts of the 2010 winter storms in Atlantic Canada, conveying the physical as well as socioecological impacts in 10 coastal communities located in three Canadian provinces (Québec, New Brunswick, Prince Edward Island). Semi-structured interviews convey physical changes that are triggered by coastal erosion due to high-wave impact and storm surge flooding the coastline. Without government support, these rural communities cannot build large-scale flood protection, so that development should be controlled and relocation also encouraged, instead of any further building at the coast. Furthermore, emergency planning requires more work, with concerted short- and long-term responses necessary by government in order to promote sustainability ([10] article).
11. Morphological changes triggered by climate change (e.g., extreme precipitation, sea-level rise, etc.) in estuaries can enhance the flood risk. A case study of the flood-prone Shetzu Peninsula in Taipei City, Taiwan, examines flood resilience. Retailers' resilience thinking was considered, including any adaptive knowledge, skills, and networks. As a basic industry, the retail sector underwent a location quotient analysis; however, other assessments (e.g., interactive visualization modelling, consumption intensity mapping, etc.) are also relevant to consider. Semi-structured interviews held to explore the resilience thinking of 15 key retailers identified weather-related risks and adaptation plans. Urban resilience introduced as an adaptation intervention could help to manage climate change impacts ([11] article).
12. In this final paper, physical geographers are examined in terms of their potential contribution to sustainability research. In a systematic review of three physical geography journals (*Geogr. Ann. A*, *Phys. Geogr.*, *Prog. Phys. Geogr.*), results convey that physical geographers are active in sustainability research. They are engaging from a spatial perspective, contributing their understanding of human–environment interactions as well as studying the impacts of environmental change through an understanding of the natural world, notions of process and systems, and a range of methodological work. In short, physical geographers have an immense potential value in participating as part of multidisciplinary teams ([12] article—review style).

3. Conclusions

Several themes have emerged from the papers that have been published in this Special Issue on Physical Geography and Environmental Sustainability. First, a variety of landscapes are represented, indicating the breadth of coverage where physical geographical research is concerned. As noted by [12], physical geographers are engaging with sustainability research from a range of locations, representing the natural world as well as the processes involved in a systems framework. Here, there are studies, including a few case studies and a case report, that examine agricultural fertilizers as contributing to nonpoint source pollution in China and flood resilience thinking in the retail sector of Taipei City, Taiwan. In both cases, these studies exemplify (not only the case study approach that can be expected in the contemporary physical geography tradition, but also a holistic approach, where humans and environments are considered as interacting in integrated systems that entail processes and track and denote change at various scales. Multidisciplinary teams, encompassing physical geographers, operate at the local-to-regional scale, as for example: to examine rural coastal communities in Atlantic Canada as well as treeline change in Colordo, USA and elsewhere; but, which can also transfer research to other scales, such as at the national level, as in China, and address temporal change as well as cross-spatial change.

These papers convey the breadth of geographical scale and integration as well as scope. In addition to the more established perspectives within physical geography, of spatial-temporal, holistic or integrated, and scale-based approaches, is an emergence now into adaptation research within sustainability (also noted by [12]), including urban sustainability (e.g., [11]). Moreover, because of the interdisciplinary perspective that is created by having several sub-disciplinary fields within physical geography, including geomorphologists, climatologists, soil scientists, biogeographers, and hydrologists, it is possible to include a breadth of research studies and expertise that stretches beyond most environmental disciplines. The papers in this Special Issue, for instance, have entailed soil science (e.g., [4,6]) as well as landscape change (e.g., [3,9]) and impacts due to climate change, including flooding (e.g., [10,11]). A variety of methodological approaches are incorporated here, with spatial technology (remote sensing, GIS, etc.) included in several studies (e.g., [1–4]), serving to portray the role of technology on data compilation and analysis in geographical research. Data visualization is evident in paper [11] for modelling and, earlier in the Special Issue, [1] explores data-sharing based on data acquired from Earth observation.

Due to urbanization and its impact on land-use, several studies here have also examined land-use and land-cover changes (e.g., [1,2]) through mapping. So, urban environments are increasingly being addressed by physical geographers, as for instance geomorphologists as part of urban geomorphology [13,14] or what has been a growing "human geomorphology" (e.g., [15]). Such a development stems from human–environment interactions that is also evident in some of the papers comprising this Special Issue. This acknowledges the impact of climate as well as humans in modifying landscapes, portraying the importance of a breadth of factors contributing to landscape and environmental changes that physical geographers are well-capable of encapsulating in their work. This is well-placed within the auspice of Anthropocene research that has gained in popularity recently (e.g., [16]) and conveys the capacity of physical geographers to embrace contemporary trends in research, thus joining the bandwagon of research waves that currently includes sustainability and has recently emerged from climate change research.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Lehmann, A.; Chaplin-Kramer, R.; Lacayo, M.; Giuliani, G.; Thau, D.; Koy, K.; Goldberg, G.; Sharp, R., Jr. Lifting the information barriers to address sustainability challenges with data from physical geography and Earth observation. *Sustainability* **2017**, *9*, 858. [CrossRef]
2. Ndayisaba, F.; Nahayo, L.; Guo, H.; Bao, A.; Kayiranga, A.; Karamage, F.; Nyesheja, E.M. Mapping and monitoring the Akagera Wetland in Rwanda. *Sustainability* **2017**, *9*, 174. [CrossRef]
3. Yan, L.; He, R.; Kašanin-Grubin, M.; Luo, G.; Peng, H.; Qiu, J. The dynamic change of vegetation cover and associated driving forces in Nanxiong Basin, China. *Sustainability* **2017**, *9*, 443. [CrossRef]
4. Man, W.; Yu, H.; Li, L.; Liu, M.; Mao, D.; Ren, C.; Wang, Z.; Jia, M.; Miao, Z.; Lu, C.; et al. Spatial expansion and soil organic carbon storage changes of croplands in the Sanjiang Plain, China. *Sustainability* **2017**, *9*, 563. [CrossRef]
5. Svaetichin, I.; Inkinen, T. Port waste management in the Baltic Sea area: A four port study on the legal requirements, processes and collaboration. *Sustainability* **2017**, *9*, 699. [CrossRef]
6. Niu, J.; Yang, K.; Tang, Z.; Wang, Y. Relationships between soil crust development and soil properties in the desert region of North China. *Sustainability* **2017**, *9*, 725. [CrossRef]
7. Holtmeier, F.-K.; Broll, G. Treelines—Approaches at different scales. *Sustainability* **2017**, *9*, 808. [CrossRef]

8. Yang, Q.; Liu, J.; Zhang, Y. Decoupling agricultural nonpoint source pollution from crop production: A case study of Heilongjiang land reclamation area, China. *Sustainability* **2017**, *9*, 1024. [CrossRef]
9. Li, S.; Wang, T.; Yan, C. Assessing the role of policies on land-use/cover change from 1965 to 2015 in the Mu Us Sandy Land, northern China. *Sustainability* **2017**, *9*, 1164. [CrossRef]
10. Vasseur, L.; Thornbush, M.; Plante, S. Climatic and environmental changes affecting communities in Atlantic Canada. *Sustainability* **2017**, *9*, 1293. [CrossRef]
11. Chiang, Y.-C.; Ling, T.-Y. Exploring flood resilience thinking in the retail sector under climate change: A case study of an estuarine region of Taipei City. *Sustainability* **2017**, *9*, 1650. [CrossRef]
12. Day, T. The contribution of physical geographers to sustainability research. *Sustainability* **2017**, *9*, 1851. [CrossRef]
13. Thornbush, M.J. Geography, urban geomorphology and sustainability. *Area* **2015**, *47*, 350–353. [CrossRef]
14. Thornbush, M.J.; Allen, C.D. *Urban Geomorphology: Landforms and Processes in Cities*; Elsevier: Oxford, UK, 2018; in press.
15. Gregory, K.J. The human role in changing river channels. *Geomorphology* **2006**, *79*, 172–191. [CrossRef]
16. Brown, A.G.; Tooth, S.; Bullard, J.E.; Thomas, D.S.G.; Chiverrell, R.C.; Plater, A.J.; Murton, J.; Thorndycraft, V.R.; Tarolli, P.; Rose, J.; et al. The geomorphology of the Anthropocene: Emergence, status and implications. *Earth Surf. Proc. Landf.* **2017**, *42*, 71–90. [CrossRef]