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Special Topic: Climate Change Impacts and Adaptation

Perspectives on the impacts of climate change and their adaptation

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The pressing impacts of climate change and the imperative for adaptation strategies emphasize the immediate necessity for proactive global measures. These challenges encompass the enhancement of climate modeling, the development of sector-tailored strategies, and the implementation of adaptation measures. Addressing these issues necessitates worldwide collaborations, sustainable practices, technological innovations, and effective policies aimed at mitigating greenhouse gas emissions while adapting to changing climate. This special topic features five thoughtfully selected papers to explore the impacts of climate change concerning urban, watershed, ocean and power systems, as well as the desired adaptation responses.

Drought has profoundly affected global societies, ecosystems, and economies in past decades. In the context of global changes, the emergence of meteorological drought has the potential to exacerbate hydrological drought, thereby significantly impacting both water security and sustainable development. Wang *et al.* [1] developed a Random-Forest-Copula-Factorial analysis method for predicting drought under climate change and analyzing the effects of multiple factors and their interactions on propagation probabilities in the Aral Sea Basin. The projected future drought propagation probability, influenced primarily by mean climate conditions, catchment characteristics and human activities, is expected to surpass historical levels. This trend includes a lower probability in spring due to increased snow meltwater, while the highest probability occurs in autumn owing to reservoir operation.

Ensuring the precision of hydrological forecasting under climate change is pivotal for proactive adaptation strategies, ensuring effective risk management. Fan [2] developed a Bayesian Model Averaging (BMA)-based ensemble modeling system to forecast annual maximum flood rates and associated 3-day maximum flood volumes for the River Thames in the UK, using downscaled high-resolution climate projections from the latest general circulation models. Multiple hydrological models were also integrated into the modeling framework, which significantly enhanced the precision of hydrological forecasting, evidenced by its robust performance in the validation. The forecast of daily flood events and 3-day flood volumes across different scenarios presented a potential intensification. This study provided crucial insights into the potential impacts of future climate change on flood occurrences, helping stakeholders make informed decisions for effective mitigation and adaptation strategies.

Climate change is altering the ocean's ability to buffer human impacts, exacerbating challenges for the marine industry. Cao *et al.* [3] conducted a review outlining the effects of climate change on crucial marine industrial sectors. They emphasized the critical role of advanced petroleum microbiology in supporting sustainable development. Additionally, they provided valuable insights into the promising research prospects for maximizing the potential of this approach. Microbial-enhanced oil recovery and bioremediation of oily wastes are green pathways for oil recovery and pollution mitigation, marking a new era in petroleum microbiology. This evolution can lead to various technological breakthroughs to comprehensively benefit the marine environment and economic growth.

Nature-based low-impact development (LID) technologies, such as bioretention cells, green roofs and permeable pavements, hold significant value in effectively managing urban stormwater under changing climate. Zhang and Valeo [4] reviewed the function and performance of low-impact development technologies at different scales in future climates. Statistical downscaling methods were commonly employed to simulate precipitation, yet this approach might not align the scale adequately to model LID. To explore the ramifications of scale when modeling LID, a case study of a large catchment on Vancouver Island in Canada is provided, using the Shannon diversity index. The index is used to quantify the information loss in representing geographic spatial information. In particular, they reveal the importance of accurately representing slopes in estimating peak flow. This is crucial for reliable flood projections and the implementation of LID strategies.

The far-reaching consequences of climate change span across various sectors, posing significant challenges, especially for nations like China. Wang *et al.* [5] conducted a thorough analysis of climate change impacts on China's electricity, agriculture and industry sectors, collectively responsible for over 80% of the country's greenhouse gas emissions. Furthermore, the strategies implemented within these sectors were reviewed and potential improvements were explored. Future research inquiries incorporating local geographical features and population distribution in the electricity sector; bridging experimental data with practical production in the agricultural sector; leveraging advanced modeling and simulation techniques to analyze mitigation measures and policy scenarios in the industrial sector. This review shed light on climate change practices and provided evidence-based insights for formulating effective policies across various sectors in China.

This focused issue will help contribute to the advancement of research on climate-change impact and adaptation. The profound insights and perspectives shared here are meant to inspire fresh thinking and drive progress in our capability to tackle a variety of climate-related challenges. We would also like to extend our gratitude to the authors, reviewers and editorial staff for their support and contributions.

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