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Editorial: Living with tropical storms in a changing climate

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Editorial on the Research Topic

Living with tropical storms in a changing climate

Tropical storms, including hurricanes, typhoons, cyclones, thunderstorms, and derechos are a major disturbance in many regions of the world. They can induce major changes to forest ecosystems, as well as affecting urban trees and forests, lead to fatalities and injuries, and have major economic impacts. By destroying standing trees, they also have a profound effect on standing biomass and carbon sequestration. Additionally, tree uprooting will modify the forest floor and edaphic characteristics, which will also influence ecosystem recovery and succession. With the changing climate, the severity and spatial and temporal occurrence of tropical storms is known to be changing and the effect on critically important tropical and sub-tropical forests is a major concern. Understanding tropical storm impact in the current and future climates requires close collaboration between many disciplines, including climatology, meteorology, mechanics, forestry, and ecology.

To date the major focus of studies into the impacts of wind damage to trees and forests for forest management has been in temperate and boreal forests. This is mainly due to the economic losses suffered by temperate forests in Europe, North America, and parts of Australasia from strong winds. Nevertheless, the ecological significance of wind damage to forests in both temperate and tropical areas has been known and studied for a long time including at least 50 years of studies of the ecological implications of hurricanes. In this special issue we have brought together papers that represent the state-of-the-art on the impact of tropical storms on natural, managed, and urban forests, the restoration of damaged forests, and research needs for the future.

One of the key requirements for understanding and mitigating wind damage from tropical storms is having computer-based models that can help to determine the key factors controlling the propensity of trees to be damaged by the wind. [Peterson and Cannon](#) report on a mechanistic model based on tree winching studies. The model showed that stand orientation and gaps in the forest were not particularly important but one of the most important factors controlling wind damage in forests

subjected to tropical storms is support from neighboring trees. This insight is confirmed by a recent paper looking at damage to a thinned forest stand in Japan from a typhoon (Kamimura et al., 2022).

A mechanistic model combined with a spatially explicit forest dynamics model was used to investigate the impact of wind on the structure and composition of a sub-tropical forest in Taiwan (Rau et al.). The results suggested that average canopy height and biomass decreased as wind disturbance strength increased. Importantly, above a certain wind speed threshold the values started to dramatically decline leading to a non-forested landscape. Such insight is increasingly important for understanding the probable response of natural forests to the changing climate and how to manage cultivated forests to reduce wind damage.

Wind damage is also critically important in urban forests. The level of destruction from tropical storms has important impacts on property damage, the risk to life, changes in the control of water runoff, as well as affecting the level of cooling and air pollution capture by urban trees. In Salisbury et al. the authors demonstrate the strong correlation between peak gust speed and remaining canopy coverage but also showed how local city policies and the retention of heritage trees can be of benefit in preserving canopy cover. More research on storm impacts on urban forests is clearly a priority.

Recovering from the damage caused by tropical storm damage can even be of concern in locations far removed from the tropical zone (Morimoto et al.). This is because tropical storms can move to high latitudes which is a phenomena that is becoming of increasing concern with the changing climate (Lee et al., 2020). In the paper of Morimoto et al. leaving retention trees on site after typhoon damage was demonstrated to be more effective at restoring a forest with the characteristics of a mature natural forest than replanting. This study demonstrates the need for careful long-term monitoring of managed forests following wind damage in order to devise effective strategies for mitigating their impacts.

The final paper by Heartsill-Scalley and López-Marrero makes the extremely important point that much of our knowledge of tropical storm damage is from studies in reserves and protected areas. Much less emphasis has been placed on damage from tropical storms in urban forests, coastal

forests, and in mixed-use landscapes. Studies in such forest types requires a much higher priority in order to extend our understanding of tropical storm impacts in these environments, which represent a significant proportion of the landscape affected by tropical storms and are often the types of forests with the most direct impact on people.

The quality and breadth of studies, while limited in number, has helped consolidate our existing knowledge on the impact of tropical storms on forests and trees. We hope that this special issue can provide a catalyst for continuing in depth research on tropical storm impacts in natural ecosystems, urban trees and managed forests, the mitigation of storm effects, and the management of forest recovery following damage. Such knowledge will become more and more important as the intensity and spatial extent of tropical storm impacts increases with our changing climate.

Author contributions

Y-YC drafted the first version. All authors contributed to the revised article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Kamimura, K., Nanko, K., Matsumoto, A., Ueno, S., Gardiner, J., and Gardiner, B. (2022). Tree dynamic response and survival in a category-5 tropical cyclone?: The case of super typhoon Trami. *Sci. Adv.* 8, eabm7891. doi: 10.1126/sciadv.abm7891

Lee, T., Knutson, T. R., Nakaegawa, T., Ying, M., and Cha, E. J. (2020). Third assessment on impacts of climate change on tropical cyclones in the Typhoon Committee Region Part I: Observed changes, detection and attribution. *Trop. Cyclone Res. Rev.* 9, 1–22. doi: 10.1016/j.tcr.2020.03.001