

Regions without historical records threatened by tropical cyclones in the future

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INTRODUCTION

Tropical cyclones are responsible for the greatest meteorological catastrophes, leading to substantial economic costs for the nations affected. For instance, in the USA, insured losses exceeded 480 billion U.S. dollars over the last decade (NOAA National Centers for Environmental Information U.S., 2022). In Jamaica, the annual average damages caused by tropical cyclones are estimated at 0.5%, with periodic losses reaching almost 10% of the Gross Domestic Product (Adam & Bevan, 2020).

The future of tropical cyclones is a matter of concern and extensive study, with focus on their climatology, intensity and frequency. Projections indicate less frequent but more intense tropical cyclones (Chand et al., 2022), which aligns with what has been observed in the recent years. For example, in 2013, super-typhoon Haiyan in the Philippines caused more than 6,000 deaths and \$15 billion in damages (NDRRMC, 2013).

It is also known that, as consequence of expanding tropics, tropical cyclones are shifting poleward. However, the changes in tracks have not been analysed from an impact and risk perspective. Our hypothesis is that atypical tracks can cause more damage due to the lack of adaptation to these extreme events in these areas. A case in point is the atypical track of tropical cyclone Kenneth, which struck areas of Mozambique where previous tropical cyclones had not, resulting in 45 casualties and \$100 million in damage (Mawren et al., 2020). Another example is the Herimin storm in 2022, which nearly impacted the Canary Islands in Spain, a region with no historical records of tropical cyclones.

This study aims to identify regions exposed to hazards induced by tropical cyclones under climate change that were not recorded in the historical period.

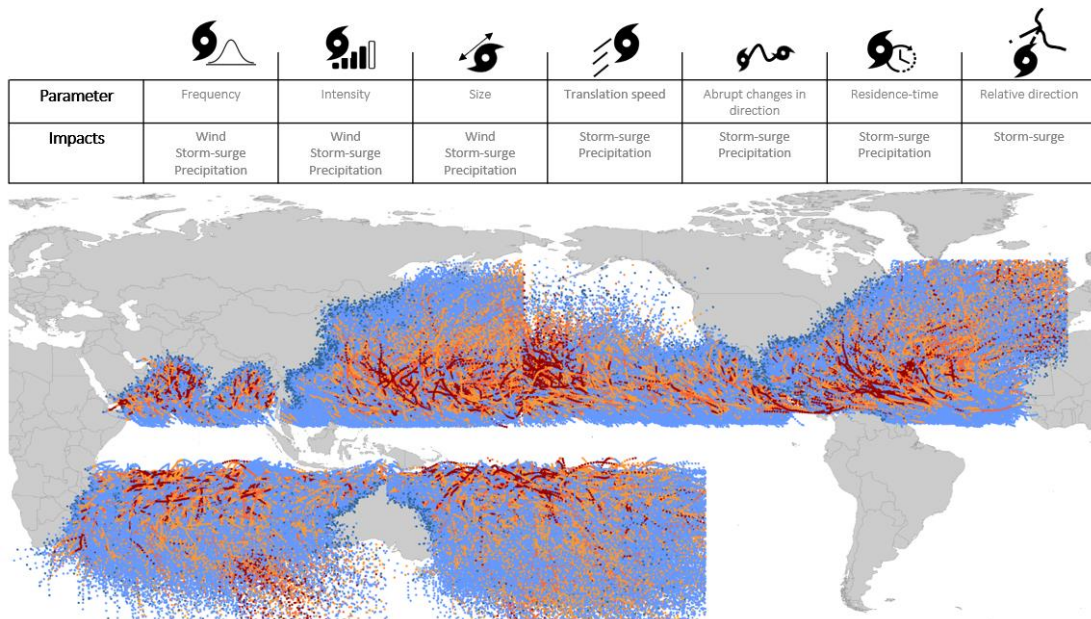


Figure 1 - 100 years of synthetic tropical cyclones for the climatology from 1980 to 2017.

METHODS

For this purpose, we have analysed the characteristics of tropical cyclones under two climatology periods: a baseline climate (1980-2017) and a future high-emission climate scenario, the Shared Socioeconomic Pathway SSP8.5 (2015-2050). We have analysed the characteristics of synthetic tracks generated with

a model based on STORM (Bloemendaal et al., 2020, 2022). To evaluate the uncertainty, we have analysed four Global Climate Models (CMCC, CNRM, EC-Earth and HadGEM3). We have examined frequency and intensity, as well as other parameters of tropical cyclones that are critical for coastal impacts (precipitation, storm surge and winds). These parameters include

size, translation speed, abrupt changes in direction, residence time in front of the coast, and relative direction to the shoreline.

Based on the empirical distribution of these parameters, we have identified critical infrastructure, population, and coastal ecosystem exposure to future tropical cyclones, that were not affected during the historical period. It should be noted that we assume the exposure indicators are the same in the future and the historical period, as our goal is to assess shifts in hazards driven by climate change.

RESULTS

This study identifies regions that will experience an increase in exposure to tropical cyclones in the future. This is a critical step in preparing adaptation strategies for future extreme events. It involves considering not only hazards that have occurred locally in historical periods but new threats arising from the displacement of these storms.

REFERENCES

Adam, Bevan (2020): Tropical cyclones and post-disaster reconstruction of public infrastructure in developing countries. *Economic Modelling*, vol. 93, pp. 82-99.

Bloemendaal, De Moel, Martinez, Muis, Haigh, Van Der Wiel, Haarsma, Ward, Roberts, Dullaart, Aerts (2022): A globally consistent local-scale assessment of future tropical cyclone risk. *Science Advance*, vol. 8, eabm8438.

Bloemendaal, Haigh, de Moel, Muis, Haarsma, Aerts. (2020): Generation of a global synthetic tropical cyclone hazard dataset using STORM. *Scientific Data*, vol. 7, 40.

Chand, Walsh, Camargo, Kossin, Tory, Wehner, Chan, Klotzbach, Dowdy, Bell, Ramsay, Murakami (2022): Declining tropical cyclone frequency under global warming. *Nature Climate Change*, vol. 12, pp.655-661.

National Disaster Risk Reduction and Management Center (2013): Final Report Effects of Typhoon YOLANDA (HAIYAN) 06-09NOV2013. Quezon City, Philippines.

NOAA National Centers for Environmental Information U.S. (2022): Billion-Dollar Weather and Climate Disasters. <https://www.ncei.noaa.gov/access/billions/>.