# What climate change means for reinsurance

The frequency of major hurricanes has been increasing at a rate of up to 15% per decade over the last 40 years, a recent scientific study concludes. In other words, we should expect to see extreme events like hurricane Dorian in 2019 more frequently in the future. **Allianz Re**'s **Dr Bastian Johann Manz** gives an expert view.

There is a complex relationship between hurricanes and climate change. Despite the complexity and uncertainty surrounding the climate change impact on hurricanes, there are already lessons for reinsurers in relation to managing future hurricane risks.

The formation and intensification of hurricanes, or more generically tropical cyclones, are fuelled by high sea surface temperatures. Under a warming climate, rising sea surface temperatures may extend the hurricane season – the last six seasons all started early. Similarly, a poleward shift of cyclone activity has been observed in recent decades, predominantly over the Pacific. In the future, the reach of tropical cyclones may extend to the fringes of historical domains and beyond.

## Unknown impacts on hurricane intensity

One of the most uncertain impacts of climate change is the projected change in hurricane intensity. When accounting for the technological advances in monitoring storms, the historical record shows no trend in tropical cyclones frequency on a global level. The aforementioned increase in major storms is offset by a reduction in weak to moderate storms.

This trend is expected to continue into the future with category 4-5 events becoming more frequent, possibly at a rate of 25 to 30% per 1°C of global warming. This is an important aspect for insurance, as major tropical cyclones result in disproportionately higher losses – if there's landfall.

Whether to expect changes in landfall frequency perhaps remains the most unknown. Some research suggests that the very conditions that favour high activity in the tropics are linked to wind shear along the US coastline, causing hurricanes to re-curve into the North Atlantic earlier. Consequently, more category 4-5 events would not necessarily translate into subsequent landfalls.

Researchers are far more confident about changes in what are termed 'secondary' perils: Storm surge and cyclone-induced flooding. As sea-levels rise, the storm surge associated with a particular tropical cyclone will be higher relative to land. In addition, as the wind speeds of major tropical cyclones are expected to increase, so would the storm surge generated by such events.

A warmer atmosphere has a higher moisture content, resulting in more rainfall, approximately 7% per 1°C of warming. In addition to rising rainfall rates, local rainfall accumulations are also affected by the forward motion of hurricanes. Reductions in the propagation speed by over 10% have been recorded globally over recent decades with even higher rates over the North Atlantic.

In slower moving storms rainfall accumulates in the same location rather than being distributed along the storm's path as it advances. Recent iconic examples are hurricanes Harvey (2017) in Houston and Dorian (2019) in the Bahamas, both stalling just after landfall with rainfall accumulations of approximately one metre.

When a hurricane affects a city, flooding is also amplified by the urban landscape. Tall buildings create a drag effect, funnelling warm air from the surface into the atmosphere, producing more cloud and further precipitation. Once the water hits the ground, impervious concrete surfaces prevent infiltration into the ground and increase runoff. Researchers in the US have estimated that urbanisation increased Harvey's flood risk 21-fold, while other studies attributed 15-40% of the event's rainfall to global warming.

## Limited (historical) data

Altogether, and unlike other weather-related hazards like drought, heatwaves or extreme precipitation, the impacts of climate change on hurricanes are complex and often opposing. A recent report by the World Meteorological Organization analysed the views of leading scientists and concluded that while there is consensus that climate change is likely a driving factor in many of these processes, definitive detection and attribution of historical trends to climate change as well as future projections remain uncertain.

The reasons for this are, on the one hand, limited historical records with consistent observations only available in the satellite-era (approximately since 1980). For context, it would require 60 years to detect a 10% increase in category 4-5 hurricane frequency.

However, climate trends are further occluded by natural climate variability, which modulates hurricane activity on time-scales of months to years and is often as poorly understood as climate change. On the other hand, in the past the granularity of climate models has been insufficient to appropriately capture the physical processes affecting wind fields and rainfall patterns.

Typically, climate models have simulated a much lower historical tropical cyclone frequency than was observed. However, initial runs of a 1km global climate model by the European Centre for Medium-Range Weather Forecasting indicate that technological advances will help address these limitations in the coming years.

## Risk mitigation

Given the many open questions surrounding the climate change impact on hurricanes, it can be tempting to wait and see. However, hurricane risk will change, that is certain and there are some steps (re) insurers can take to prepare today. Apart from the outlined changes in hurricane activity, to date the driver for increasing catastrophe losses more widely can be found in socio-economic developments, not climate change.

Worldwide coastal populations, such as Miami which doubled in population size in the last 40 years, continue to grow, exposing more people to cyclone risk. The increasing concentration and value of assets will further exacerbate tropical cyclone losses.

As exemplified by hurricane Harvey the natural hazards themselves are amplified through human processes such as urbanisation and land use change. Therefore, accurate location and exposure data of insured objects is key to adequately assess risk. Allianz has developed a global set of high-resolution hazard maps down to a scale of 5m to enable adequate pricing for individual risks globally. Further layers reflecting the change in flood risk under projected climate change scenarios have been derived based on global climate model runs.

In quantifying changes in risk, catastrophe models are, by design, well-suited to account for severity and frequency changes. As a result, they remain an appropriate tool to translate climate model outputs into risk metrics.

To acknowledge the complexity of loss dynamics, catastrophe models need to account for the interacting and compounding effects of storm surge, surface and river flooding alongside extreme winds. Incorporating emission pathways, climate model simulations and multi-peril interactions, in addition to natural variability, will present decision-makers with a larger wealth of data but also greater uncertainty.

Consuming and managing this uncertainty across the insurance value chain, from improved risk selection in underwriting to portfolio diversification, will be an additional challenge of climate change. By contrast, historical hazard and claims data, while undoubtedly of high value, will increasingly become less indicative of future catastrophe losses. In the future, risk models will be increasingly more informed by climate model simulations to complement the backward-looking view of claims.

## In a broader sense

The mitigation of climate change impacts remains a task for society global. Insurers can incentivise prevention measures from the scale of individual policyholders to regional and national scales through partnerships with different levels of government and non-governmental organisations. By advising on building guidelines and planning as well as investing in open-access hazard tools, insurance can drive adaptation and resilience. Crucially, insurance can provide the risk transfer that is required for many risk mitigation and adaptation measures to come to fruition.

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