PROJECTING THE EFFECT OF CLIMATE-CHANGE-INDUCED INCREASES IN EXTREME RAINFALL ON RESIDENTIAL PROPERTY DAMAGES

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SUMMARY HAIKU

Flood and landslip loss
will increase with climate change.
Costs will flow with rain.

INTRODUCTION

New Zealand's public insurer, the Earthquake Commission (EQC), provides insurance for some weather-related damages to residential property.

We use past detailed insurance claims data together with climate projections in order to project future monetary losses from damages caused by extreme events under different climate change scenarios.

Weather-related hazards have already cost the EQC 450 million (in 2017 NZ$) since the year 2000. We aim to answer two questions: What are the expected future monetary liabilities of the EQC, given future climate projections? And, how much more will the EQC have to pay in the future because of anthropogenic-induced climate change?

THE EARTHQUAKE COMISSION

In spite of its name, the EQC also insures some weather risk. Specifically, it covers residential land damage caused by a storm or a flood, and both residential building and land damage caused by rainfall-induced landslips. (Since 2019, it no longer covers building contents.)

In order to access this insurance, homeowners need to have private fire insurance and pay a flat yearly premium as a compulsory addendum to the private insurance. Between 2000 and 2019, the EQC's cover for residential buildings provided the first NZ$ 100,000 of the replacement value for each insured dwelling. Damages above this amount were covered by the private insurer. No premium is charged for the land cover, and the EQC land cover cap is set at the land's assessed market value.

DATA AND METHODS

We conduct our investigation using a longitudinal dataset of all individual EQC insurance claims and extreme rainfall events aggregated to the grid/year level. We first estimate the empirical relationship between extreme rainfall events and the EQC's weather-related insurance claims based on a complete dataset of all claims. We analyse 8,394 fully-documented claims lodged to the EQC between 2000 and 2017, totalling NZ$180,404,945.

We then use this estimated relationship, together with climate projections based on future greenhouse gas (GHG) concentration scenarios from six different dynamically downscaled Regional Climate Models, to predict the impact of future extreme rainfall events on EQC liabilities for different time horizons up to the year 2100, for the whole of New Zealand.

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EXTREME PRECIPITATION, EXPOSURE AND VULNERABILITY

The historical rainfall data we use are an 18-year time series (2000-2017) of observed daily rainfall, available for 5km by 5km grid cells and produced by NIWA.

We define extreme events based on the 95th, 98th, and 99th percentiles of the historical precipitation distribution for one day of accumulated precipitation. The percentile thresholds are defined separately for each grid cell. In order to account for antecedent conditions that might lead to damage, we also calculate the same thresholds for percentiles for up to five days of accumulated precipitation. Only wet days are considered in the percentile calculations, and we perform these calculations for inhabited grids only.

We take into account the geophysical characteristics associated with each residential building to capture the extent of exposure and vulnerability to extreme rainfall for each grid-cell observation.

CLIMATE MODELS

We use a suite of six climate models, one each from the UK, Norway, and China and three from the USA. The models are dynamically downscaled with NIWA's regional climate models, and then further semi-empirically downscaled to the 5km horizontal grid.

The six different representations of the climate have been built up to reflect the past climate (1971-2005) and future climate under the different greenhouse gas emissions scenarios (RCPs 2.6, 4.5, 6.0, 8.5) and periods (2006-2100). The projection of future losses is done for all RCP scenarios in 20-year time slices for all percentiles and days of accumulated precipitation, and for all climate models. This gives us 360 forecasts for each 20-year time slice.

We project future losses assuming no changes in exposure (e.g. number and value of residential buildings) or vulnerability (e.g. construction materials).

RESULTS

Climate change, the expected increase in intensity and frequency of extreme weather-related events, is likely to translate into higher damages and thus an additional financial liability for the EQC. The percent change between projected and past damages, the climate change signal, rises from an increase of between 7% and 8% in 2020-40 to an increase of between 9% and 25% in 2080-2100, depending on the GHG concentration scenario.

Overall, liabilities will increase more if future GHG emissions are higher (i.e. higher RCPs). The climate signal for the low emissions scenario (RCP 2.6) is smaller, and actually decreases toward the end of the century, when GHG concentrations in the atmosphere are assumed to decrease. The same, but to a lesser extent, is observed in RCP 4.5. In contrast, the time profile of the highest-emissions RCP 8.5 is much steeper, with the climate signal more than doubling between 2020-2040 and 2080-2100.

The increase we have projected in the public insurer's liabilities can also inform private insurers and regulators, and policymakers who are assessing the future performance of both the public and private insurers covering weather-related risks in the face of climatic change.

CAVEATS

Some important caveats to this work include:

- 60% of the total claims between 2000-2017 could not be used for the regression analyses and thus for our projections, due to incomplete documentation.
- The future damage functions of extreme rainfall events may be different from the current ones.
- Our predictions about future climate change costs assume constant exposure and vulnerability over time, which may be violated by processes such as population growth, land use planning, construction of protective infrastructure, and improvements in construction technology or practices.
- Rainfall-induced landslip hazard maps are not yet available, so landslip risk was inferred from geophysical factors.
- Our definition of extremes is based on a short 20-year time series and only few simulations in a non-stationary system.

SUMMARY

We project future insured damages from extreme rainfall events associated with future projected climatic change. Our research shows that EQC should plan for future payouts for weather-related damage to be between 7% and 26% higher than current payouts. The predicted adverse impacts vary over time and space.

New Zealand's population and its residential building stock value has been steadily growing over the past few decades and both are projected to continue to increase. This suggests that future liabilities may be higher than what we predict.

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