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Atlantic Hurricanes and Associated Insurance Loss Potentials in Future Climate Scenarios

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Atlantic tropical cyclone (TC) activity is a major source of substantial damage along the U.S. coastline and the Caribbean. The recent trend and the potential future changes of TC activity are currently under debate.

In this study climate model output is combined with a loss model of the Swiss Reinsurance Company to assess changes of potential losses of the end of the 21st century. We use time-slice experiments of two atmospheric general circulation models (AGCMs), the ECHAM5 model (MPI, Hamburg, Germany) and the MRI/JMA model (MRI, Tsukuba-city, Japan). For each model set up a control simulation for present day conditions and a scenario simulation for the period 2070-2100 (SRES A2 for ECHAM5 and A1B for MRI/JMA) are available. Both models are used with a high horizontal resolution which is suitable to resolve TCs. TCs are individually identified by our TC detection and tracking method.

The modeled tracks of TCs are evaluated by comparing the CTRL simulations with best track data. This comparison shows that the number of intense storms is still underestimated which could be traced back to the model resolution. In order to account for this underestimation, we apply a statistical calibration leading to a better representation of the TC intensities. The results of both models after the calibration show an increased number of major hurricanes in the scenario simulation, but the number of major hurricanes which make landfall is still underestimated in the MRI/JMA model.

Despite the biases, the simulated hurricanes for the present and the future are used as input for the loss model of the Swiss Reinsurance Company. This loss model estimate a probabilistic event set and combine this with average vulnerability curves for all risk types and locations. The resulting loss frequency curve for the MRI/JMA model shows that, e.g., a 10-yr event in the CTRL simulation will become an 80-yr event in the SCEN simulation, because of less frequent landfalls in the SCEN simulation, whereas the 10-yr event of the ECHAM5 CTRL simulation will become a 6-yr event in the future. On regional scale, e.g., single U.S. states, even stronger deviations between the different models are found. Overall, we show that a combination of current state-of-the-art models and loss models is possible, but the results still lacks robustness due to the high uncertainty of projected changes in hurricane strength, location and frequency.