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How much do modeled tropical cyclone impacts depend on the hazard set choice?

Simona Meiler^{1,2}, Kerry Emanuel³, and David N. Bresch^{1,2}

¹ETH Zurich, Institute for Environmental Decisions, Department of Environmental Systems Science, Switzerland (simona.meiler@usys.ethz.ch)

²Federal Office of Meteorology and Climatology MeteoSwiss, Switzerland

³Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

Tropical cyclones (TC) cause devastating damage to infrastructure and are a concerning threat to human life. Records of historical TCs are very limited and therefore the data to study impacts of this natural hazard remain sparse. The generation of synthetic storm tracks is an important tool to overcome this spatial and temporal limitation.

We perform the first global model intercomparisons of different synthetic TC track sets. We use the CLIMADA (CLIMate ADAPtation, Aznar-Siguan and Bresch, 2019) platform, which integrates hazard, exposure, and vulnerability data, to compute TC risk and to quantify socio-economic impacts for different storm track sets. Our comparison shows how the selection of a TC track set might affect the estimated damage and which dataset is suitable to answer what type of research question. Specifically, we provide a qualitative overview of the different TC model types, we compare damage by return period and perform a global sensitivity analysis for selected TC damage model parameters.

We contrast the following sources of tropical cyclone tracks: i) observed storms from IBTrACS (Knapp et al., 2010), ii) probabilistic events obtained from historical ones by a direct random-walk process (Kleppek et al., 2008), synthetic tracks from coupled statistical-dynamical models iii) from Emanuel et al. (2006, 2008), and iv) CHAZ (Lee et al., 2018), and v) synthetic tracks from a fully statistical model, STORM (Bloemendaal et al., 2020). We find that the choice of event set becomes more important when studying tail events, basins with smaller historical event sets or small areas. In these cases we discover modelled losses to vary by more than an order of magnitude. This variance can partly be explained by the varying distribution of hazard intensities at landfall between event sets.