

Enhancing stochastic variability in natural catastrophe models: application to tropical cyclone risks in Australia

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Abstract. Natural catastrophe risk is increasing globally as climate change alters weather patterns and the population continues to grow. Catastrophe (CAT) models are commonly used in the insurance industry to evaluate and manage natural catastrophe risks. Broadly speaking, CAT models combine historical data and knowledge from diverse fields such as physics and engineering, and probabilistic (typically i.i.d) resampling techniques are then commonly used to simulate thousands of years of possible events. Based on these events, monetary loss outputs are in turn produced by combining hazard, exposure and vulnerability components within the model. This paper re-explores some of (simplistic) probabilistic assumptions typically utilised by CAT models in the literature, and proposes alternative, more sophisticated probabilistic assumptions inspired by findings in the climate science literature as well as industry observations. Examples include allowing for fluctuations in natural hazard behaviour to be conditional on random changes in a climate modulator over time, as well as evaluating the possible impacts on damage resulting from consecutive events. These alternative probabilistic assumptions are calibrated and implemented in an open-source global climate model CLIMADA, and applied to analyse tropical cyclone risk in Australia.