Title: Need for "Climate-Coupled Catastrophe" ™ (C3™) Models – A Novel Modeling Approach for Climate Risk Analytics

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The increasing frequency and severity of extreme weather events, driven by climate change, pose significant challenges for the insurance and reinsurance sectors. To account for the complex dynamics of a rapidly changing climate, CoreLogic introduced a novel modeling approach that coupled Climate and Catastrophe Models to quantify current and future natural hazard risk. The CoreLogic's "Climate-Coupled Catastrophe models"™ (C3™ Models), integrate current and future high resolution climate data to develop high-definition stochastic event sets that represent the frequency and severity distributions of expected future climate scenarios. By coupling climate models with catastrophe modeling techniques, we aim to provide a more robust framework for understanding and predicting the impacts of all natural hazard events. Here we present our C3™ modeling approach, adaptation modeling and findings for the North Atlantic Hurricane peril. Our approach involves refining existing CAT model to incorporate the latest downscaled climate data. For this, we first downscale CMIP6 General Circulation Models' data using different downscaling techniques (incl. *dynamical*, and *hybrid* downscaling). Later, from this downscaled data, we built hurricane stochastic event sets for different Shared Socioeconomic Pathways (SSPs; defined in IPCC Sixth Assessment Report) and time horizons (2030, 2040, and 2050). Finally, these future hurricane wind hazard data were combined with future vulnerability and financial modules to estimate average annual losses (AALs), probable-maximum losses and tail-value-at-risk at structure-level for all the structures in the U.S. Further, we evaluated the effectiveness of various building adaptation strategies against hurricane wind. These strategies include modeling various structure characteristics including enhanced roof-to-wall connections, wall-to-Floor-to-Foundation Anchorage, improved shutters, and improved design code and enforcing of the code.

We found that, for coastal U.S. (Gulf of Mexico and East Coast), under SSP5-8.5, in 2050, the hurricane wind related average annual losses would increase by 50%. Our results also show that, under our full mitigation and adaptation scenario, we see on an average a 40% and 45% decrease in average annual losses from hurricane wind in the state of Florida and across the U.S Gulf and East coast. Further, we present here multiple levels of adaptations efforts and their efficacy. Here we further discuss the challenges of integrating climate science into catastrophe models. Overall, our findings highlight the spatial heterogeneity in future hurricane hazard and thus associated losses. This further underscore the importance of developing "climate-coupled models" ™ as a transformative tool in the future of risk management, providing a more comprehensive and dynamic approach to assessing and mitigating climate-driven risks.

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