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Beyond Temperatures: An Econometrically-Estimated Damage Function of 21st Century Climate Impacts using Extreme Climate Indicators

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Quantifying the climate impacts onto economic outcomes is crucial to inform policy decisions. Projections of climate damages using Integrated Assessment Models (IAMs) predominantly rely on damage functions with little grounding in empirical evidence. In turn, empirical studies of climate impacts frequently use highly aggregated and simplified climate measures, such as country-averaged annual average temperatures, possibly masking much of the sub-annual extreme weather events that greatly affect society. Here we estimate the impact of climate onto economic growth using a large set of candidate climate variables ranging from droughts to extreme precipitation in a global panel dataset. Using econometric model selection methods robust to outlying observations, we identify relevant climate variables without a-priori imposing their inclusion in the model. Results suggest that economic impacts are more accurately described by extreme climate indicators than commonly used temperature measures. We further show that the explanatory power of climate variables for economic growth remains considerable even when socio-economic control variables are introduced. We project future climate impacts onto economic growth using SSP scenarios and CMIP5 projections to construct an empirically-derived climate damage function based on the identified relevant extreme climate variables. The empirical damage function can significantly increase the accuracy of IAM damage projections, and the use of more specific climate indicators can improve regionally specific adaptation plans guiding policy on targeted levels of warming.