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PERSPECTIVE

The spatial distribution of extreme climate events, another climate inequity for the world’s most vulnerable people

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Abstract

Does the climate change signal emerge equally from internal climate variability across the globe? If not, are there particular locations where temperature extremes might disproportionately affect specific populations? The letter by Harrington et al. (2016 Environ. Res. Lett. 11 055007) argues that people living in low latitude countries, which contain the majority of the world’s poorest people, are—and will continue to be—disproportionately affected by increases in temperature extremes. Due to differences in expertise of climate scientists, and climate impact and adaptation scientists, few climate extreme event analyses are spatially disaggregated and linked to local populations’ socio-economic characteristics. The research presented in this letter begins to bridge this gap by providing evidence of inequitable spatial impacts from climate extremes on the world’s poorest people.

Main response

It is well understood that the impacts of climate change most severely affect the world’s most vulnerable people (Olsson et al. 2014). People who, in the main, are least responsible for causing the changes in climate that we are currently experiencing. With the vast bulk of current warming being caused by historic emissions created by the EU and the US in the last 150 years (Hansen and Sato 2016), it is unsurprising that the nations which have not significantly contributed to the world’s cumulative carbon dioxide emissions are keen that the nations which did, take full responsibility to make meaningful emission reductions—and provide support to the most affected countries to adapt to the inevitable impacts (Peters et al. 2015).

The concerns of inter-generational and intra-generational equity are now mainstream topics in discussions about climate justice (Wood 1995, Thomas and Twyman 2005). The letter by Harrington et al. (2016) opens a new area of research in climate equity, that of spatial equity: in particular, those countries located in low latitudes which are likely to be more significantly impacted by extreme events due to climate change than those in higher latitudes. Further work on this topic is needed, but these initial findings reinforce the need for richer countries to take on the responsibility for their contribution to climate change by paying for the social, environmental and cultural costs being felt by poorer countries.

Recent climate change research highlights the importance of understanding the impacts of extreme events (Seneviratne et al. 2014), for example, changes in temperature extremes, which may lead to hotter, longer or more frequent heatwaves, rather than just considering average temperature changes on population health (Haines et al. 2006). For this reason, it is important to be able to identify the emergence of extreme event signals from internal variability.

Harrington et al.’s (2016) letter addresses this question: whether the lower internal variability found at lower latitudes (enabling the enhancement of a signal-to-noise ratio) in comparison to higher latitudes results in large increases in the frequency of extreme daily temperatures. Specifically, the analysis explores the evidence for regional-scale spatial heterogeneity of the time-evolution of extreme temperature exceedances using a direct comparison with the accumulation of simulated cumulative carbon dioxide emissions. This approach has been made possible by recent progress in near-linear correlations between...
cumulative carbon dioxide emissions with corresponding global temperature anomalies.

This analysis uses a probability ratio (PR) to examine differences in the pre-industrial control period and the likelihood of exceedance in a more recent time step. The result can be interpreted as the increased likelihood of an extreme temperature threshold being exceeded—in comparison to a more recent time period which does not have human activity. The analysis is carried out using models from CMIP5 and RCPs for 2006–2100 running 30 year interval windows, with an extreme of the 99.9th percentile based on 200 years of pre-industrial simulations. The focus is on specific PR thresholds that are exceeded at a single grid scale, unlike previous analyses which considered global averages or large regions. This finer grain analysis allows the linkage of the emergent changes in PR to specific characteristics of the populated regions of the world. To account for regional variation, purchasing power parity (PPP) was used to compare economic development.

Harrington et al (2016) found that by considering the spatial distribution of cumulative emissions of PR emergence (CEPRE) for each PR threshold (2, 10 and 50) using RCP8.5, less cumulative emissions are required for the continual exceedance of those PR threshold for lower latitude countries (generally larger, poorer populations), compared to higher latitudes countries (generally smaller, richer populations). Combining these findings with PPP and demographic characteristics in these two broad regional groupings, they found that there are increasingly large CEPRE between the ‘richer’ versus the ‘poorer’ populations.

The analysis concludes by finding that daily temperature extremes more frequently affect those who have contributed the least to the current climate change, and have the least human and capital resources to carry out adaptation activities. The significance of these results directly relates to the time horizons available to implement pro-active adaptation policy in poorer nations, with the poorer socio-economic quintiles having a significantly higher exposure to the emergence of daily extreme temperatures.

A limitation of the paper is that this analysis hides the significant intra-national inequality, national PPP is a very blunt tool for economic comparison, useful to take a snapshot of a nation’s overall relative purchasing power, but it does little to indicate the relative levels of wealth/poverty within that nation. To further explore this issue, Gini coefficients might be a useful metric of inequality to consider. In addition, given that almost 90% of the world’s population lives in the northern hemisphere, the break down of population into ‘high’ and ‘low’ latitudes is a little misleading, as in reality virtually no significant population exists in the southern ‘high’ latitude grouping. Meanwhile in the northern ‘high’ latitude group, significant intra-country inequality exists, for example the well-documented impacts of climate change on Indigenous people living in the Arctic (ACIA 2004).

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