Robust change in population exposure to heat stress risk with increasing global warming.

Nicolas Freychet1, Gabriele C. Hegerl1, Natalie S. Lord2, Eunice Lo2, Matthew Collins3, and Dann Mitchell2

1University of Edinburgh, School of Geosciences, Edinburgh, UK (nicolas.freychet@ed.ac.uk)
2University of Bristol, Bristol, UK
3University of Exeter, Exeter, UK

There is no uniform definition of heat waves and many climate indices can be derived from the surface temperature. When considering the impact of heat on human health, heat stress needs to be considered. Several indicators of heat stress have are commonly used, such as the Heat Index (HI), the Wet-Bulb Globe Temperature (WBGT) or the Wet-Bulb Temperature (Tw), all take into account the temperature and humidity. Each of these indices can be computed from non-linear empirical formula but they all use different scales which make results difficult to compare. Here we performed a comparative study using these 3 indices by defining corresponding levels of heat stress between the different metrics. We analyzed where sever, dangerous and deadly heat stress hazards will become more frequent, using climate model projections from CMIP6, and where the choice of the index makes a difference. For each index, we use a filtering techniques to remove models that cannot reproduce realistic extreme values during the current period (using a set of 4 different reanalyses as a reference). Following, we translated this risk in terms of country exposure and vulnerability, using population and GDP growth scenario.

We show that South and East Asia and Middle-East, as previously pointed out by many studies, are highly exposed to heat stress hazards. But more vulnerable countries with less resources for mitigation are also highlighted such as West Africa and Central and South America. For all these regions, about 20 to more than 50% of the population would be exposed to sever heat stress each year no matter the heat stress index chosen. European countries and USA will also be exposed several time per year to conditions of similar heat stress level than the 2003 heat wave. When going to more extreme hazards, especially when considering the “survivability threshold” of 35°C for Tw, different indices lead to more discrepancies in the results but similar regions can be identified as the most vulnerable.