Understanding heat extremes in Sub-Saharan Africa: Projected changes in UNESCO Biosphere Reserves

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We explore the changes in climate extremes (heat stress, temperature and precipitation) as projected by the Sixth phase of the Coupled Model Intercomparison Project (CMIP6) multi-model ensemble under the ‘business as usual scenario’ (ssp585) for global warming levels from 1.0°C to 3.0°C, relative to pre-industrial levels in Sub-Saharan Africa. We focus on the 86 UNESCO-designated Biosphere Reserves located in sub-Saharan Africa, a region highly vulnerable to climate change, spanning monsoon, wet, dry and Mediterranean climate regions. Projected changes of temperature indices are significant at all warming levels across the five climate classes of Sub-Saharan Africa. Notably, absolute heat extreme indices are projected to increase more strongly than global mean temperature in monsoon and dry climate regions.

We found the strongest health risk to heat stress in the two monsoon and the rainy climate regions, and the lowest in the Mediterranean climate region. High risk of heat stress emerges at a global warming of 1.5°C in the northern hemisphere (NH) monsoon region, whereas only above a global warming level of 3°C in the SH monsoon and rainy climate regions. We find that limiting global mean temperature below 2.0°C reduces by a half the exposure to high levels of heat stress in the population in and around the Biosphere Reserves in Sub-Saharan Africa.

Finally, we investigated processes that might explain the differences in the regions. The NH monsoon class reaches high heat stress risks earlier, already at a global warming of 1.0°C, due to the compounding effects of temperature and humidity, as temperatures start from a warmer baseline and occur jointly with a significant increase in precipitation. While the rainy climate region also exceeds high risk thresholds, values of the different heat stress indices are highest overall in the SH monsoon region. Since the latter is a region projected to experience an intense drying, this suggests that the strong increase in heat extremes is caused by an amplification of land warming through land-atmosphere feedbacks.