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Heat stress indicators in CMIP6: Estimating future trends and exceedances of critical physiological thresholds

Clemens Schwingshackl, Jana Sillmann, Marit Sandstad, and Kristin Aunan

CICERO, Oslo, Norway (clemens.schwingshackl@cicero.oslo.no)

Global warming is leading to increased heat stress in many regions around the world. An extensive number of heat stress indicators has been developed to measure the associated impacts on human health. Here we calculate eight heat stress indicators for global climate models participating in the Coupled Model Intercomparison Project phase 6 (CMIP6) and compare their future trends and exceedances of critical physiological thresholds with particular focus on highly populated regions. The heat stress indicators are selected to represent a range of different applications, such as extreme heat events, heat-related losses in worker productivity, heat warnings, and heat-related morbidity and mortality. Projections of the analyzed heat stress indicators reveal that they increase significantly in all considered regions as function of global mean temperature. Moreover, heat stress indicators reveal a substantial spread ranging from trends close to the rate of global mean temperature up to an amplification of more than a factor of two. Consistently, exceedances of critical physiological thresholds are strongly increasing globally, including in several densely populated regions, but also show substantial spread across the selected heat stress indicators. Additionally, the indicators with the highest exceedance vary for different threshold levels, suggesting that the large indicator spread is associated both to differences in trend magnitude and threshold levels. The usage of heat stress indicators that are suitable for each specific application is thus crucial for reliably assessing impacts of future heat stress, while inappropriate indicators might lead to substantial biases.