Large-scale emergence of regional temperature variability by the end of the 21st century

Dirk Olonscheck*[1,2], Andrew P. Schurer[1], Lucie Luecke[1], and Gabriele C. Hegerl[1]

[1]University of Edinburgh – School of GeoSciences, Edinburgh EH9 3JW, United Kingdom
[2]Max Planck Institute for Meteorology – Bundesstraße 53, 20146 Hamburg, Germany

Abstract

The past and projected trajectory of global warming is well understood, but changes in temperature variability and associated extremes remain uncertain. Here we use the unprecedented opportunity to investigate changes in temperature variability with single-model initial-condition large ensembles from multiple models and contextualise these recent and future results with estimates from instrumental records, paleoclimate proxies, and model simulations of the past climate. We find that human-caused changes in internal year-to-year temperature variability are expected to emerge from the unforced range by the end of the 21st century across models forced with a strong global warming scenario. Different simulated changes in globally averaged temperature variability between models can be explained by a trade-off between strong increases in variability on tropical land and substantial decreases in high latitudes. This latitudinal pattern of temperature variability change is explained by loss of sea ice in high latitudes and changes in vegetation cover in the tropics. Instrumental records are broadly in line with this emerging pattern, but have data gaps in key regions. Paleoclimate proxy reconstructions support the simulated magnitude and distribution of temperature variability. The unprecedented changes in temperature variability strengthen the need for urgent climate mitigation to avoid substantial human-caused increases in tropical temperature variability and related heat extremes.

Keywords: climate variability, emergence, large ensembles, projections, paleoclimate

*Speaker