Identifying the evolving human imprint on heat wave trends over Mexico and the United States

Ivonne García Martínez*†[1] and Massimo Bollasina[2]

[1]Centro de Investigación Científica y de Educación Superior de Ensenada – Carretera Tijuana-Ensenada 3918, Zona Playitas, 22860, Ensenada, Baja California, Mexico
[2]The University of Edinburgh – King's Buildings, Alexander Crum Brown Road, Edinburgh, EH9 3FF, United Kingdom

Abstract

Changes in frequency, duration and intensity of compound, daytime, and nighttime heat waves (HWs) over Mexico and the United States (U.S.) during the second half of the 20th-century are investigated using the Community Earth System Model Large Ensemble (CESM-LE). The individual role of anthropogenic aerosols, greenhouse gases (GHGs) and internal variability are identified and contrasted by means of the CESM-LE single forcing experiments during two periods: 1950-1975, when North American aerosol emissions peaked, and 1980-2005, when aerosol emissions declined. A strong anthropogenic imprint on the changes is found. During 1950-1975, aerosols, via both aerosol-radiation and aerosol-cloud interactions, dominate the decreasing trends in compound HWs over central U.S., the daytime HWs in most of the domain and the nighttime HWs over Mexico. Conversely, all three HW types are considerably more frequent, longer-lasting and more intense throughout the domain in the 1980-2005 period. The results show that GHGs play a major role in generating these increases, via the associated widespread warming and subsequent circulation adjustments. The contribution of internal variability is large during 1950-1975 (over 60% in most areas), and considerably reduced later on. This work highlights the importance of using distinct HW definitions to properly identify the more recurrent HW type in each region, their associated forcing factors, and the interplay between external forcing and internal variability.

Keywords: heat waves, anthropogenic aerosols, greenhouse gases, internal variability, large ensemble

*Speaker
†Corresponding author: ivonne.m.garcia.martinez@gmail.com