Geophysical Research Abstracts
Vol. 20, EGU2018-11025, 2018
EGU General Assembly 2018

Emergent Extremes in the Downwelling Radiation at the Earth's Surface

William Collins and the CASCADE Team

Lawrence Berkeley National Laboratory, Climate & Ecosystem Sciences Division, Berkeley, California, United States (wdcollins@lbl.gov)

Climate change is demonstrably altering the frequency, severity, and character of extreme weather phenomena including heat waves, droughts, and severe storms. These alterations follow from the interactions among several systematic trends in climatic parameters, including surface and atmospheric temperatures, increased atmospheric humidity, and alterations in the thermal stratification of the troposphere. Early modeling studies of the anthropogenic greenhouse effect indicate that these trends will also alter the mean radiation fields throughout the climate system, for example the downwelling longwave flux at the Earth's surface.

To date, however, the effects of climate change on the statistics of extreme downwelling shortwave and longwave radiation at the Earth's surface have yet to empirically determined. For instance, while we expect that heatwaves accompanied by abrupt increases in atmospheric humidity should result in large, transient excursions in the downwelling longwave flux, this has yet to be conclusively and systematically demonstrated from observations. Since these radiative extremes could substantially amplify the harmful effects of the extreme phenomena that generate them, for example by reducing the capacity of urban centers to cool, such a demonstration is urgently needed.

In this paper, we analyze the extreme statistics of the downwelling radiation at the Earth's surface in the recent past and show these statistics are changing. We analyze the 1 to 3-minute observations of the radiation collected from among the 59 stations in the Baseline Surface Radiation Network (BSRN). BSRN is a project of the Global Energy and Water Cycle Experiment (GEWEX) under the auspices the World Climate Research Programme. The ultra-high temporal frequency of these measurements provides superb statistics on the rare extreme values in the downwelling shortwave and longwave fluxes and also enables the detection of changes in these fluxes in response to highly transient meteorological extremes. We fit these data using Generalized Extreme Value (GEV) distributions and quantify how the location, shape, and scale parameters governing these distributions are changing with time. We conclude by discussing the implications of our findings for the near-term evolution of the Earth's surface radiation budget.