Workshop 02

Extreme event attribution

Erich Fischer[1] & Thomas Frölicher[2,3]

1 Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland
2 Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland
3 Oeschger Centre for Climate Change Research, University of Bern, Switzerland

In recent years, numerous extreme and record-breaking weather or climate events have occurred over land and ocean, some of which have caused severe adverse impacts on organisms, ecosystem services, infrastructure, and resulted in casualties. When such high-impactful events occur, the question arises whether their frequency, intensity or duration was influenced by human-induced climate change or if the event was simply caused by natural climate variations. The process of answering this question is known as 'Extreme event attribution'.

Extreme event attribution is a growing field in climate sciences. It tries to determine to what extent anthropogenic climate change has influenced the probability or intensity of individual events or classes of events. In recent years, various methods have been developed to assess the impact of global warming on extreme events, resulting in numerous attribution studies (see, for example, https://www.worldweatherattribution.org). These studies generally follow four steps: (1) Defining the event by establishing its spatial and temporal characteristics and variables to be analyzed. (2) Quantifying the frequency and intensity of the extreme event based on observations. (3) Evaluating climate model output against observation-based data. (4) Using statistics and climate model output to attribute characteristics of the extreme event to human-caused climate change.

This hands-on workshop aims to review the current state of extreme weather attribution science and then to attribute recent land-based heatwaves, drought events and marine heatwaves to human-caused climate change. Each group will attribute a different extreme event using observations, reanalysis data and climate model output. We will also discuss the challenges in attributing certain events, discuss different attribution approaches and provide guidance for communicating attribution results to the public and other scientists.

Key references

General overview about attribution of extreme weather and climate-related events
https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wcc.380
https://nap.nationalacademies.org/catalog/21852/attribution-of-extreme-weather-events-in-the-context-of-climate-change

Step-by-step guide for event attribution as developed by the World Attribution group:
https://ascmo.copernicus.org/articles/6/177/2020/
https://link.springer.com/article/10.1007/s10584-021-03071-7

Marine heatwaves under global warming and potential impacts on marine ecosystems:
https://www.nature.com/articles/s41586-018-0383-9

Examples of attribution studies
https://www.worldweatherattribution.org
https://iopscience.iop.org/article/10.1088/1748-9326/aba3d4
https://www.nature.com/articles/s41467-024-48280-7

Examples of alternative attribution approaches:
https://wcd.copernicus.org/articles/2/971/2021/
https://www.nature.com/articles/s41467-019-09729-2
https://www.pnas.org/doi/full/10.1073/pnas.2112087118
https://esd.copernicus.org/articles/11/855/2020/

Requirements: Laptop