Geophysical Research Abstracts
Vol. 21, EGU2019-13643, 2019
EGU General Assembly 2019

Identifying key driving processes of recent heatwaves and droughts

Kathrin Wehrli, Benoît P. Guillod, Mathias Hauser, Matthieu Leclair, and Sonia I. Seneviratne
Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland (kathrin.wehrli@env.ethz.ch)

In a changing climate some extreme events, such as droughts and heatwaves, are made more likely and/or more intense. To assess their predictability and how they will change in the future it is crucial to improve our understanding of the processes that drive present-day extreme events. Besides climate change, the components of the climate system – in particular the land surface, atmospheric circulation and the ocean – and their interactions may play a key role in changing the odds for a particular event to occur.

This study aims to identify the role of the individual drivers for specific events of the recent decade, such as the 2015 European Heatwave and the 'Angry Summer' of 2012/13 in Australia. Simulations are performed with the Community Earth System Model (CESM) using nudging of horizontal wind and soil moisture prescription techniques to separate the contributions of atmospheric circulation and land surface conditions. Factorial experiments that force the model towards observations for one or several key components at a time allow us to identify how much of the observed anomaly of each event can be attributed to each driver. We demonstrate that the fully constrained model accurately reproduces how anomalous an event was, although with biases in the underlying model climatology. The atmospheric circulation is a key factor for all events examined and we identify events that are mainly driven by the atmosphere and global warming, while the role of the ocean is often smaller and highly uncertain. We demonstrate that soil moisture is another key driver: prescribing only the soil moisture state already explains a large fraction – up to 50% – of the event anomaly.

In summary, depending on the region of occurrence and the type of extreme, different factors are the dominant causes of an event. Both the atmospheric circulation and land surface state can be key drivers and when prescribing both components we can accurately represent the anomaly of heatwaves and droughts.