Geophysical Research Abstracts
Vol. 20, EGU2018-5439, 2018
EGU General Assembly 2018

Future climate risk: The challenge of compound events

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Floods, wildfires, heat waves and droughts often result from a combination of interacting physical processes across multiple spatial and temporal scales. The combination of physical processes (climate drivers) leading to a significant impact is referred to as a “compound event”. Traditional risk assessment methods typically only consider one driver/variable at a time and ignore the effects of multiple climate drivers, potentially leading to underestimation of risk as drivers of extreme events are often spatially and/or temporally dependent. However, many major catastrophes bear the hallmark of being caused by compound events. For instance, the extraordinary event in Russia in summer 2010, which killed more than 50,000 people and damaged large parts of Russian crops, involved the co-occurrence of the four dependent hazards: drought, heat, fire, and air pollution.
Here we show how a better understanding of the nature of compound events may improve projections of potential impacts with direct benefits to society. While efforts to understand single drivers of extreme events need to continue, a refocusing of activity towards compound events would help bridge the gap between the climate science and impact modelling communities. Thus, the notion of compound events serves as a link between climate scientists, engineers, social scientists, impact modelers and decision-makers, who need to work closely together to understand these complex events. Identifying hazards and linking them to circumstances where relevant drivers act jointly allows for climate projections to be more directly related to impacts than traditional univariate approaches. This will change our way of querying climate model outputs and create new approaches for model evaluation and impact assessment. We present examples of how compound events can be integrated into climate extremes analysis and impact assessment methods, and make recommendations for future research directions. This will ultimately yield better-informed assessments of hazards, and allow for improved risk analysis, projection and decision-making.