



Role of Soil Moisture vs. Recent Climate Change for the 2010 Heat Wave in Western Russia

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Extreme event attribution statements are often conditional on increased greenhouse gas concentrations or a particular ocean state, but not on other physical factors of the climate system. Here we extend the classical framework and assess the influence of soil moisture on a heat wave to obtain a physical attribution statement. In particular, we test the role of soil-moisture-temperature feedbacks which have been shown to be generally relevant for the build-up of exceptionally high temperatures. As a case study we investigate the severe 2010 heat wave in western Russia, which was previously found to be influenced by anthropogenic climate change. We quantify the relative role of climate change and that of soil moisture-temperature feedbacks with the event attribution framework and analyze ensemble simulations to distinguish the effect of climate change and the 2010 soil moisture conditions for annual maximum temperatures.

We find that climate change from 1960 to 2000 alone has approximately tripled the risk of a severe heat wave in western Russia. The combined effect of climate change and the dry 2010 soil moisture yields a 13 times higher heat wave risk. We conclude that internal climate variability causing the dry 2010 soil moisture conditions formed the basis for this extreme heatwave.