Geophysical Research Abstracts
Vol. 19, EGU2017-14427, 2017
EGU General Assembly 2017

Historical deforestation increased the risk of heat extremes in northern mid-latitudes

Quentin Lejeune (1), Edouard Davin (1), Lukas Gudmundsson (1), Johannes Winckler (2), and Sonia Seneviratne (1)

(1) ETH Zürich, Institute for Atmospheric and Climate Science, Zürich, Switzerland , (2) Max Planck Institute for Meteorology, Hamburg, Germany

During the industrial period, large areas in the world have experienced a reduction in forest cover and an expansion of agricultural areas. Some modelling studies showed that this has significantly affected the intensity of temperature extremes through changes in biophysical land surface properties (Christidis et al. 2013, Pitman et al. 2012), however they exhibit a low level of agreement about its overall climate impact. Besides, even if they generally point toward an albedo-induced cooling over deforested mid-latitudes, this does not align with recent observational evidence suggesting that deforestation has a local daytime warming effect, especially in summer (Lee et al. 2011).
Here, for the first time we intend to constrain CMIP5 models with observations in order to assess the contribution of historical deforestation to changes in the risk of warm extreme events. To do so, we have selected five models from the CMIP5 ensemble that can reproduce the observed local warming effect of deforestation during daytime in summer.
Our results indicate that deforestation played a primary role in the evolution of hot extremes since preindustrial time. We quantify that a decrease in tree cover by at least 15% locally increased the intensity of the 99th percentile of daily maximum temperature (corresponding to the 3-4 hottest days of the year) by 0.6°C over northern mid-latitudes, accounting for 30-40% of their total warming. Moreover, it amplified the increase in their frequency due to the greenhouse gas forcing by 30%. Our results imply that land-cover changes need to be considered when studying past and future changes in heat extremes, in particular for regional-scale detection and attribution purposes.

References:
Christidis, N., P. A. Stott, G. C. Hegerl, and R. A. Betts, The role of land use change in the recent warming of daily extreme temperatures (2013), Geophysical Research Letters, 40, 589-594
Pitman, A. J., et al., Effects of land cover change on temperature and rainfall extremes in multi-model ensemble simulations (2012), Earth System Dynamics, 3, 213-231
Lee, X., et al., Observed increase in local cooling effect of deforestation at higher latitudes (2011), Nature, 479, 384-387