The role of atmospheric dynamics in extreme wildfire activity in northeastern Siberia

Rebecca Scholten, Dim Coumou, Fei Luo, and Sander Veraverbeke

In the summer of 2020, extreme fires have raged in northeastern Siberia, many of them within the Arctic Circle burning in ecotonal larch forest and tundra ecosystems. This unprecedented increase in fire activity within the Arctic Circle has been linked to record-high temperatures measured in the region, as well as to high lightning activity.

In mid-latitudes, the pronounced and long-lasting heatwaves of the last decade have been linked to amplified Rossby waves connected with weak atmospheric circulation. These amplified waves tend to phase-lock in preferred positions and thereby lead to more persistent summer weather. Linkages between atmospheric teleconnections and boreal wildfires exist for some regions, yet the influence of wave dynamics on arctic-boreal wildfires is unknown. We explored relationships between wave dynamics, heatwaves, and the unprecedented fire activity in Siberia in 2020 to assess whether the recent surge in arctic-boreal fires in Siberia is driven by large-scale atmospheric dynamics.

We determined wave amplitudes as phase positions by applying fast Fourier transformation on weekly averaged mid- to high-latitudinal mean meridional wind velocities at the 250 mb level from ERA5 reanalysis data. Gridded percentage area burned between 2001 and 2020 was derived from the Moderate Resolution Imaging Spectrometer (MODIS) Burned Area product (MCD64A1). We then quantified the importance of Rossby wave patterns on fire activity clustered by latitude in eastern Siberia.