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An assessment of extreme Temperature Events and its impact on Wildlife Plant Phenology

Jonatan Siegmund and Reik Donner
Potsdam Insitute for Climate Impact Research, Telegraphenberg A 31, 14473 Potsdam, Germany

Besides gradual changes of the mean behaviour of climate variables,
global climate change results in higher frequencies and intensities of extreme climate events. Especially heat waves struck Central Europe during
the last decade and are predicted to do so even more frequently during
the 21st century. The impact of these extreme events on the ecologically
important flowering dates of wildlife plant species is not yet known precisely, although the temporal displacement or even absolute failure of
flowering may lead to the disturbance of sensitive ecological equlibria.
In this study, we systematically investigate the impact of extreme warm
monthly mean temperature on various wildlife plant flowering dates dur-
ing the time period of 1951-2014 for 52 German regions using the Plant
Phenology dataset of the German Weather Service. The impact of extremes is quantified using the coincidence analysis, a method to detect
non-random simultaneous appearences of events in two time series. We
calculate cumulative coincidence rates between both time series for time-
lags between 0 and 16 months in both directions. Our results underline the importance of the temperature of the flowering month regarding
extreme events and indicate long-term-dependencies between extremely
high temperatures and very early plant flowering dates with a time-lag
of almost one year. On the other hand, the disparity between the re-
sults of temperature-phenology and phenology-temperature coincidence
rates indicate, that extremely warm temperatures only cause very early
flowering dates under certain conditions, leading to the notion of conditional
coincidence. Taken together, our findings support the hypothesis, that
more and stronger extreme temperature events have the potential to sus-
tainably disturb mid latitude ecosystems.