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

Jonatan Siegmund and Reik Donner
Potsdam Institute 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 equilibria.

In this study, we systematically investigate the impact of extreme warm monthly mean temperature on various wildlife plant flowering dates during 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 results 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 sustainably disturb mid latitude ecosystems.