

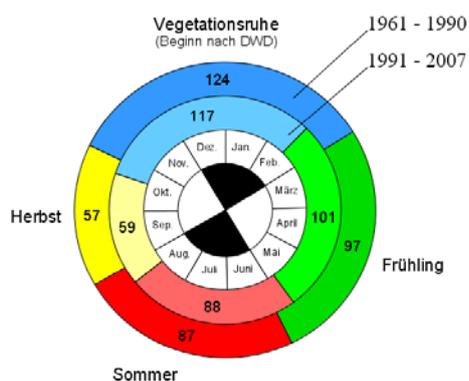
Climate change and plant phenology in Hesse

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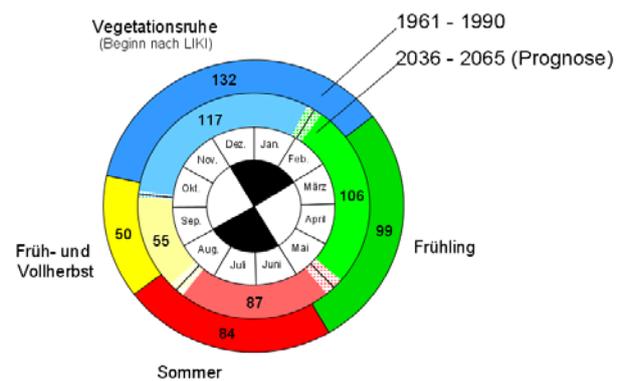
The climate in the state of Hesse has changed during the investigation period (1951-2007) as could be illustrated using e.g. the air temperature data of the meteorological station Gießen. In Gießen, the 30-year averages of air temperature have risen and exceed those of the climate normal period 1961-1990 nowadays by about 0.5 °C.

In this study phenological data for a large variety of crops, fruit plants as well as wild plants have been analysed. Phenological data originating from 170 stations in Hesse were collected during the period 1951-2007. The results of this analysis clearly demonstrate that plant development has responded to the climatic change in Hesse. Over the last 47 years temporal shifts in plant development ranged over +0.5 and -4.9 days/decade on average. Those trends have been most evident since the beginning of the 1990s. The spring phases responded notably to the higher temperatures during the winter months and started much earlier. However, the earlier beginning of the phenological phases tended to decline during the annual cycle. Possibly as a result of mild weather conditions, the autumn phase was even delayed in one region.

Plant responses, such as the length of the vegetation period and the leaf senescence of common oak did show considerable regional variation. While in some areas the vegetation period was longer, in others, e.g. in the region Oberes Weserbergland, it remained unchanged. However, in the Taunus area and the Lahntal area it became even shorter. Also, the length of the agricultural vegetation period defined as the time interval between the beginning of flowering of goat willow and leaf senescence of common oak according to LIKI (Länderinitiative für einen länderübergreifenden Kernindikatorersatz) extended in all regions of Hesse except for the Taunus area, where a small shortening occurred.



phenological clock with observed beginning of phenological seasons in Hesse



phenological clock with observed and predicted beginning of phenological seasons in the area Marburg-Gießener-Lahntal

(Frühling = spring, Sommer = summer, Herbst = autumn, Vegetationsruhe (Winter) = dormant period, Früh- und Vollherbst = early and full autumn, Spätherbst und Vegetationsruhe = late autumn and dormant period)

The observed changes in the plant development are predicted to continue in the future. In the Marburg-Gießener-Lahntal phenological seasons already have arrived early by up to 13 days during the last two decades and our regionalized phenological model based on the temperature data of the meteorological station Gießen predicts that they will further come early by up to 8 days until the middle of this century. Between 2036 and 2065, spring will commence on

February 2nd on average. Likewise, lengthening of the vegetation period and particularly the earlier beginning of the vegetation period will go on in the future. An extension of the model to other regions in Hesse (Geisenheim, Eschwege, Frankfurt) did resemble the trends found for the Marburg-Gießener-Lahntal.

However, the earlier onset of the vegetation period together with an earlier flowering bears dangers for fruit-growing. Despite climate warming the risk of late frost events during flowering leading to frost damage is likely to remain present in the future.