The extreme warmth of the Central European spring in 2018 and its effects on fruit ripening phenology in Austria – a 251 year perspective

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The extreme warmth of the Central European spring in 2018

In this work the phenological entry dates of three fruit ripening phases during the extreme spring of 2018 were related to the phenological record since 1946 and the instrumental period since 1768 in Austria (Figure 1). The comparison with the instrumental period since 1768 was accomplished via multiple regression with preseason temperature (temperatures before the phenological event) as independent variable.

The exceptional warmth of spring and early summer of 2018 caused the earliest beginning of fruit ripening dates in Austria since 1946 of black elder and red currant, the second earliest of apricot, as well as the shortest period between the beginning of flowering and fruit ripening for all three species (same as 1956 for red currant). These phenological extreme events of the 2018 spring correspond to the highest Austrian preseason April/May/June temperature average since 1768.

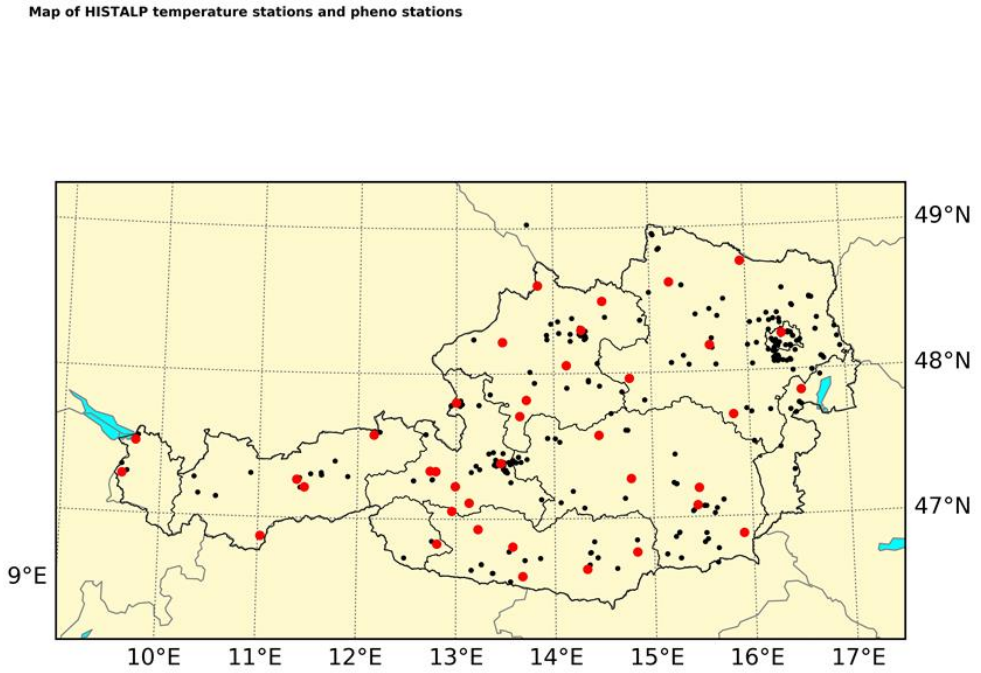

Figure 1: Map of HISTALP stations (red dots) and phenological observations (black dots), which were used to calculate the 2018 average Austrian entry dates of black elder, red currant and apricot beginning of flowering and beginning of fruit ripening.

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In order to put the spring of 2018 into a long term perspective, the above mentioned phenological time series were extended back to 1768 by the much longer homogenised HISTALP temperature time series. This was achieved by multiple regression driven by preseason mean monthly temperatures. In order to accommodate for the uncertainty of the regression model, the lower (5%) and upper (95%) bounds of the confidence intervals were added to the reconstructed time series. Even when considering the lower bounds, the 2018 entry date of black elder beginning of fruit ripening remains the earliest since 1768. The 2018 entry date of apricot comes fourth (after 1811, 1794, 1797 and same as 1822) and that of red currant third (after 1811 and 1794, Figure 2, next page). In order to evaluate the phenological variability since 1970 a 11 year moving average and a 41 year moving trend were calculated for the combined time series consisting of the modelled (from 1768 to 1945) and observed (from 1946 – 2018) sections. Neither the level of the 11 year averages nor the level of the 41 year trend values since 1970 have occurred during any other period since 1768.

These results contribute to the discussion of the temperature sensitivity of phenological phases. In spite of the unprecedented spring and early summer temperature level our phenological data do not indicate that lower bounds of the time period between flowering and fruit ripening have yet been reached. The fruit ripening phenology of the mid latitudes is still sensitive enough to faithfully record temperature trends and extreme events supplementing the instrumental record.

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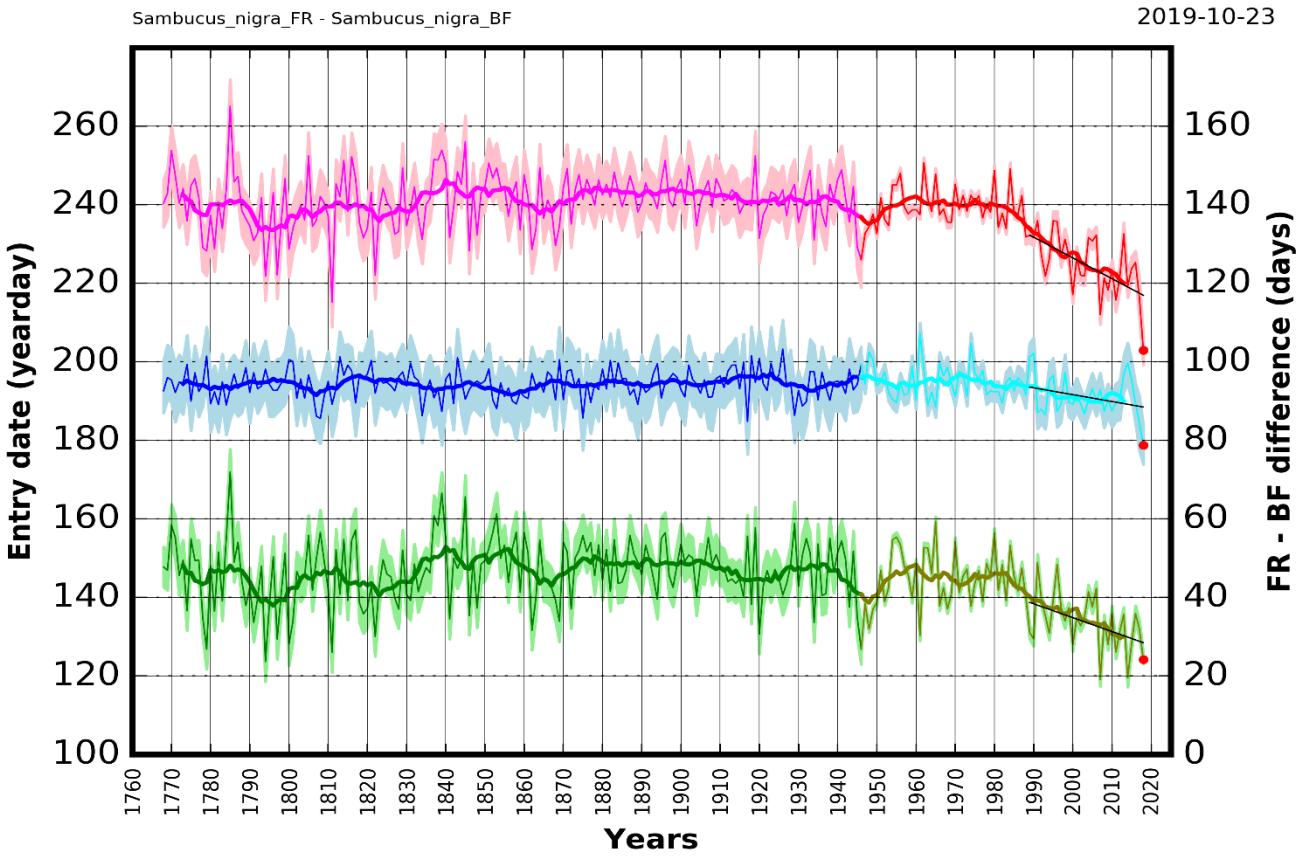

*Figure 2. Time series of black elder: "beginning of flowering" (BF, modelled section green and observed section olive green) and "beginning of fruit ripening" (FR, modelled section magenta and observed section red, left y - axis) and difference time series FR – BF (modelled section blue and observed section cyan, right y - axis). The light coloured area around the lines is the 90% confidence interval of the MLR model respectively of the Austrian average entry date. Thick lines are 11 year moving averages. The 2018 values are marked with a red dot. The black lines represent the trends from 1989 – 2018, which are: BF **-0.34** days/year, FR **-0.51** days/year and for FR – BF -0.17 days/year, trend values are bold if significant according to Mann-Kendall trend test at 95%.*

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