Unprecedented risk of spring frost damage in Switzerland and Germany in 2017

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Spring frosts are feared by farmers, fruit growers, and wine growers as they can cause significant damage to crops when they occur during the development of the plants. In the second half of April 2017, following a very warm period that had caused premature vegetation growth, a cold air mass from the Arctic penetrated central and western Europe, causing severe damage to natural and cultivated vegetation over broad areas. Here, we analyze how exceptional this event was in Switzerland and Germany in relation to the accumulated growing degree days (GDD), used as a proxy for plant phenology advancement. Although this damaging frost was not the latest on record in terms of calendar days, our results show that it was, in some regions, unprecedented in relation to the accumulated warmth during the preceding period, at least since the beginning of instrumental temperature records (1864). Our results also highlight how global warming has considerably increased the number of days with mean temperature above 5 °C in late winter and early spring, especially since 1970 (+ 16.8 ± 4.7 °C days decade^{-1}). However, in spite of earlier spring phenology due to climate warming, our results suggest that the risk of damaging frost events to vegetation has remained unchanged over the last 150 years in lowlands of Switzerland and Germany, due to the concurring earlier occurrence of the last potentially damaging frosts (about $-$ 20 days since 1864). Our analyses reveal therefore that the April 2017 damaging frost was a true outlier in terms of risk of frost damage to plants.