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Developing a phenological model for grapevine to assess future frost risk in Luxembourg

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Late frost damage represents a significant hazard to grape production in cool climate viticulture regions such as Luxembourg. The main aim of our study is to analyze the frequency of these events for the Luxembourg's winegrowing region in the future. Spring frost injuries on grape may occur when young green parts are exposed to air temperature below 0°C. The potential risk is determined by: (i) minimum air temperature conditions and the (ii) the timing of bud burst. Therefore, we developed and validated a model for budburst of the grapevine (*Vitis vinifera)* cultivar Rivaner, the most grown local variety, based on multi-annual data from 7 different sites across Europe and the US. An advantage of this approach is, that it could be applied to a wide range of climate conditions.

Higher spring temperatures were projected for the future and could lead to earlier dates of budburst as well as earlier dates of last frost events in the season. However, so far it is unknown if this will increase or decrease the risk of severe late frost damages for Luxembourg's winegrowing region. To address this question results of 10 regional climate change projections from the FP6 ENSEMBLES project (spatial resolution = 25km; A1B emission scenario) were combined with the new bud burst model. The use of a multi model ensemble of climate change projections allows for a better quantification of the uncertainties. A bias corrections scheme, based on local observations, was applied to the model output. Projected daily minimum air temperatures, up to 2098, were compared to the projected date of bud burst in order to quantify the future frost risk for Luxembourg.