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# Possible climate change impacts on agriculture and viticulture in Luxembourg – the benefit of ensemble-based regional climate change projections

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Agriculture and viticulture are still of importance for Luxembourg's economy (Central Europe). Hence, the impacts of possible changes in future regional climate on agriculture, especially on insect vermin communities, and on viticulture have frequently been investigated and discussed during recent years.
Here we present results of three studies assessing projected regional climate change effects. They are primarily based on a regional climate model (RCM) ensemble from the FP6 ENSEMBLES project. We focus on changes in air temperature and precipitation and the impacts of these variables on
a) the cabbage stem weevil (C. pallidactylus), one of the most severe pest species in winter oilseed rape in Luxembourg and
b) possible changes in the cultivation of grapevine varieties in Remich, the centre of Luxembourg's vine cultivation, situated in the valley of the Moselle River.
In both investigations different RCMs, covering the period from 1961 to 2100 (SRES A1B emission scenario), with a spatial resolution of 25 km, are used. To reduce systematic biases in the RCM-derived daily time-series of air temperature and precipitation, different bias correction schemes are applied. Due to the ensemble approach, a better quantification of the uncertainties in the projections and in the derived parameters is possible.
In general the multi-model annual mean air temperatures are projected to rise by 3.1°C between the control time-span (1961 to 1990) and the far future (2069 to 2098) and significantly shifts towards dryer summers and wetter winters are detected.
To assess the migration of cabbage stem weevils from their overwintering habitats to oilseed rape crops, several threshold-based statistical models were chosen and combined with the RCM projections. An earlier onset as well as a prolongation of the possible emergence and the main migration time spans is detected for the near (2021 to 2050) and far (2069 to 2098) future. For the stage of stem elongation of oilseed rape, an earlier onset of 3.0 days per decade is projected, while for the emergence of C. pallidactylus a shift towards an earlier onset between 3.0 and 3.3 days per decade is expected (all values referring to the far future period). The main migration period of the weevil to the field may start 2.0 days earlier per decade under future climate conditions and the time span of possible migration is prolonged for about 30 days.
For the region of Remich more than 30 years of phenological observations of grape-vine and corresponding meteorological measurements are available. The impact of changes in air temperature on grape-vine varieties is analysed with the Huglin Index, which classifies different grape varieties according to their minimal thermal requirements. Trend analyses of ten-year time slices outlined statistically significant trends towards the possibility to cultivate grape varieties with higher thermal requirements in the future. Higher temperatures will possibly lead to increased sugar contents and less acidity of the vine. Furthermore, the frost risk for grape-vine under future climate conditions is discussed.