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Climate impacts on biomass production in belgium

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In order to simulate the impact of climate on biomass production of agricultural crops, a regional approach commensurate with the spatial scale of regional climate models is needed. There is a trade-off between the resolution of meteorological information incorporated and accuracy of predicting biomass production. Accuracy should be maximised, whilst unwarranted precision or over-fitting should be avoided in order to ensure reliability. Uncertainties tend to increase with both temporal (extreme events) and spatial resolution (local changes).

Observed weather and yield data (1960-2008) across Belgium are explored for extreme weather events or yield occurrences. Based on detrending analysis, years with yield residuals below the 10th percentile or above the 90th percentile were defined as extreme. Regional observations at province level and simulations are used to assess the magnitude and spatial extent of the impact of changes in the mean and variability of temperature, rainfall, humidity and bio-meteorological indices that reflect heat stress, drought and water logging. The spread in indices, particularly in those containing soil moisture in the algorithm can be explained by seasonal spatio-temporal patterns of rainfall further enhanced by an effect on temperature. The unfavourable weather conditions during the growth season may be further aggravated by the physical environment.

A comparison of meteorological indices for two climate periods (0: 1960-1987, 1: 1988-2008) during the growing season of arable crops showed significant differences between yields, meteorological variables and bio-meteorological indices: vapour pressure deficit, dry growing days, wet growing days, favourable temperatures, evapotranspiration and the minimum temperature. The bio-meteorological indices appear to reflect the long-term meteorological variability or climate condition. Correlations between yield residuals and meteorological variables demonstrate the importance of the vegetation water balance, the maximum of Tmax, soil moisture conditions and average rainfall. The majority of the latter meteorological variables as well as the yield residuals are not significantly different between the two climate periods and appear to capture short-term meteorological conditions or inter-season weather variability. The variability in climate sensitive indices or variables is shown to be significantly different between the two periods.

Based on analysis of observed biomass production and weather data and with the help of a process-based dynamic vegetation model (REGCROP) trade-offs between spatial extent, temporal resolution and meteorological variables or indices are explored for biomass production of agricultural crops in different regions in Belgium.