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Climate impacts on Flanders' fields

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During the past decade Belgium has experienced more monthly extremes than in any other decade since observations started in 1833. According to Global Circulation Model predictions, the frequency and magnitude of extreme weather events are likely to increase with climate change. Not only the frequency and magnitude of meteorological events but also their timing in relation to crop development and the physical environment will determine their impact.

The implications of extreme weather events are demonstrated for the year with the lowest yields in the past decade for winter wheat (2001), winter barley (2003), potatoes (2006) and sugar beet (1998) in the agricultural regions of Flanders. Water stress, both drought and flooding, and heat stress seem the major factors that influence arable yields in Flanders. The unfavourable weather conditions during the growth season may be further aggravated by the physical environment. A bad year for one arable crop is not necessarily a bad year for another arable crop such that diversification within one farm may be a good strategy to cope with weather variability.

Based on analysis of historical yield and weather data, a process-based dynamic vegetation model was designed to integrate the effects of crop management, weather and physical environment on crop growth. The model operates at a regional scale commensurate with regional climate models and capable of both capturing weather and climate variability impacts.

Pronounced yield losses mainly due to water shortages and heat stress occur for all climate change scenarios, to a lesser extent in the case of winter cereals on loam soils. Root crops such as potatoes and sugar beet will experience increased drought stress particularly when the probability rises that sensitive crop development stages coincide with dry spells. This may be aggravated when wet springs cause water logging in the field and delay planting dates. Despite lower summer precipitation predictions for the future climate in Belgium, winter cereal yield reductions due to drought stress will be smaller due to earlier maturity. On the contrary winter cereals may suffer from water logging in the field during early spring and from heat stress during flowering in early summer.

The results demonstrate that observed yield patterns contain substantial information on the impact of weather and climate variability on yields. This knowledge was used to design a dynamic vegetation model and simulate yields for four arable crops in Flanders under scenarios of climate change.