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Is climate change responsible for a stagnation of the carbon input into agricultural soils of southeast Germany?

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In agricultural soils, the formation of soil organic matter (SOM) largely depends on the carbon (C) input by crop residues and rhizodeposition which is thus of decisive importance for the management and prediction of soil organic carbon (SOC) stocks in cropland and grassland. However, there is a remarkable lack of reliable, crop-specific C input data. We used a plant C allocation approach to estimate the C input of major crops and grassland into agricultural soils of Bavaria in southeast Germany. Historic and recent plant C allocation coefficients were estimated and C inputs were calculated for a 60-year period (1951-2010) using long-term agricultural statistics. The results revealed substantial increases of the C input by 100 to 150% in the last 60 years. This increase was related to linear yield increases until 1995 despite significant changes of plant C allocation. However, from 1995 onwards, crop yields and C inputs stagnated. This could be related to a decline of nitrogen fertilization in Bavaria induced by the introduction of the common agricultural policy of the EU. Moreover, increased temperature and solar radiation and increased occurrence of droughts in the course of climate change may be responsible for C input stagnation. Temperatures above the optimum of crops shorten the length of the growing season and reduce the assimilation rate. In Bavaria, a distinct increase of the mean annual temperature of 1.4 °C between 1951 and 2010 indicated an increased probability of high temperature extremes. The temperature increase may have also accelerated the development of crops as it was indicated by a shortened period from shoot to yellow ripeness of winter wheat. In view of the stagnation of yields and C inputs of most crops since 1995, we assume only slightly changes of the C input in the future. A further stagnation of the C input will probably result in a future decrease of SOC in agricultural soils of Bavaria as the ongoing temperature increase will lead to an enhanced mineralization of SOM. This is in contrast to several modeling studies which predict an increase of SOC in agricultural soils of Europe due to an expected increase of the C input.