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Impact of extreme events on the carbon cycle of cropland in Europe

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Extreme weather events will increase in frequency in future and will affect the carbon cycle. To get a better understanding of these impacts the CarboExtreme project investigates these effects on different land uses. As part of this project the study presented here focuses on droughts and heat waves and their impact on cropland in Europe. Net primary production (NPP) and net ecosystem exchange (NEE) are simulated for 1901-2100; results from two periods (1971-2000 and 2071-2100) are presented here. The simulation results of 2003 are used as a reference for a "dry" year, based on several publications that describe a spatially wide-spread drought in Central Europe for this year. The simulations are performed with the process-based model DailyDayCent. Beside the impact of weather conditions, the carbon cycle of croplands is strongly affected by management (e.g. crop rotation, tillage, fertilizer), which is difficult to simulate or predict. To consider these effects, data from the NitroEurope project are aggregated to the spatial and temporal scale of CarboExtreme. Additionally, two approaches are taken to isolate the impact of the climate from the impact of management: First, crop (wheat) and management are assumed to be constant over time (not in space); second, varying crop rotations are considered, with variable management practice. The results show the impact of droughts on the European level, as well as general effects of climate change on NPP and NEE. The simulation results for wheat show the highest values of NPP in Central Europe and low values in the South-West and the North of Europe for the control period 1971-2000. This distribution is similar for the second period (2071-2100), but increased (up to 100 gC per square meter). The comparison with the "dry" year 2003 shows a strong decrease of the productivity in Central Europe, but small impacts in the East, North and South-West of Europe. The pattern for NEEs is similar and shows the croplands as a small source of carbon (except Northern Europe), which increases in the second period (2071-2100).