Geophysical Research Abstracts
Vol. 15, EGU2013-8395, 2013
EGU General Assembly 2013

Impact of past and future climate variability and extreme events on carbon loss in European arable agriculture

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Predictions of climate models suggest an increase in climate variability and an increased probability in the occurrence of extreme weather events during this century. The expected increase in variability of meteorological variables such as temperature and precipitation will impact the productive functions as well as the ecosystem services agricultural systems provide, including the storage of soil organic carbon. Here we use a methodology and specifically tailored climate datasets that were developed in the EU FP7 CARBO-Extreme project to analyze the effect of increased climate variability on long term soil organic carbon sequestration, erosion and crop production in Europe.

We quantified the changing impact of extreme events on carbon dynamics and soil organic carbon loss from agricultural soil cultivated with wheat, barley, maize and rye in Europe for the period from 1900-2100. In separate simulations we specifically address the potential losses of soil carbon associated with erosion. We further characterized the effect of CO_2 fertilization on crop growth.

Preliminary results indicate a growing contribution of extreme weather generally lowering biomass production and crop yields in Europe, albeit with regional variations. This decrease will lead to a relatively lower input of organic matter into the soil and generally lower soil organic carbon stocks. Yet, in areas characterized by relatively drier conditions the decomposition of organic material and thus heterotrophic transpiration is reduced which can result in a net accumulation of soil organic matter. Finally, we attempted to identify the cropland area susceptible to increased carbon loss due to climate extremes by unraveling the relative contribution of the combined spatial fingerprint of physiographic characteristics and climate extremes over Europe.