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Impact of bio-energy production and climate change on soil organic matter reproduction in Central Germany

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For the region of Central Germany global change scenarios lead to the prediction of a growing risk of declining amounts of soil organic matter (SOM). The production of bioenergy is one strategy to counteract the growing anthropogenic CO_2-emissions. Both issues have a close connection: SOM is one important base of soil productivity and requires a steady reproduction flux. Bioenergy production requires productive soils and partly consumes plant biomass carbon thus reducing the available amount for SOM reproduction. This study delivers a methodology for the identification of areas with possible conflicts between bioenergy production and SOM reproduction based on i) the prediction of climate change impact on SOM reproduction and ii) an analysis of the regional distribution of biogas plants. The proposed algorithm is applied for the region of Central Germany as a pilot region.

The quantification of climate change impact was based on regionalized climate data from the IPCC scenarios A1B, A2 and B1 as prognosis for 2001 – 2100 in relation to the retrospective C20 data for 1961-2000 calculations. For downscaling we used the regional climate models REMO and WETTREG, the latter with 3 different subsets for wet, normal and moist conditions. For all resulting datasets the annual sum of rainfall and the average of air temperature were calculated.

Soil impact is represented by means of the top soil texture that has been taken from the German soil map (BUEK1000; scale 1:1,000,000). The map shows 71 different soil mapping units in the study area. Each soil unit has been assigned a characteristic soil profile (“Leitprofil”) where soil texture was derived by using the guidelines for soil mapping (KA4).

Results indicate a growing demand (10%-30%) of fresh organic carbon for SOM production. The analysis reveals that bioenergy carbon demand is not evenly distributed over the study region.

There is no significant correlation between matter demand for bioenergy and carbon amount required SOM reproduction but the analysis lead to the identification of certain hot spots where measures are required to maintain sustainability for SOM reproduction. Thus, while being away from the worst case scenario (positive correlation between both carbon sinks) there is still room for development toward a negative correlation which would be the ideal solution.