Climate change induced carbon competition: bioenergy versus soil organic matter reproduction - an indicator based assessment

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For the region of Central Germany global change scenarios predict a growing risk of declining amounts of soil organic matter (SOM). The production of bioenergy is one strategy to counteract the growing anthropogenic CO2-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. We will present a methodology for the large-scale 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. With the carbon demand index (CDI) and the capacity index (CAP) two indicators have been developed that enable the identification of hot spots of high carbon demand for SOM reproduction due to climate change and the usage of bioenergy. Due to the low data requirements, the indicators are widely applicable and transferable. 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%-40%) of fresh organic carbon from biomass for SOM production on the current level. The analysis reveals that bioenergy carbon demand is not evenly distributed over the study region and is showing some regional

clustering. There is no significant correlation between matter demand for bioenergy and carbon amount required for SOM reproduction. However, the analysis identifies certain hot spots of high carbon demand where high capacity of biogas production may conflict with rising demand for biomass to mitigate climate change effects on SOM storage.