Geophysical Research Abstracts
Vol. 17, EGU2015-11771, 2015
EGU General Assembly 2015

The effect on increased harvest residue extraction on forest soil carbon stocks

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The demand and potential for increasing the use of bioenergy from harvest residues in Sweden are large. Commercial forest residues such as tops, branches and stumps, can be left at the harvest site to gradually decompose and contribute to the soil organic carbon (SOC) turnover, or it can be collected for energy purposes as means to mitigate climate changes. The climate mitigation potential of using logging residues (tree tops and branches) for bioenergy has been debated mostly due to that harvest residue and stump extraction negatively affect SOC accumulation. The Swedish forest management system Hugin and the decomposition model Q were used to estimate the carbon stock changes in the Swedish forests at a national level. Several extraction scenarios were branches and tops and stumps are removed from the forest were simulated. In all scenarios the short term effects on SOC were greater than the long term effects. The main reason for this is because the extraction potential decreases with time. The decrease in SOC accumulation was largest for stump extraction, with 0.15 Mg C ha -1 y loss on average over a 100-year simulation period which was equivalent to an energy supply of 25 TWh. Despite the negative effects of soil carbon changes by extracting harvest residues, the study presented here, show that the extraction and use of harvest residues in the energy system results in a positive effect on reducing carbon emissions to the atmosphere when substituting coal with the extracted biomass.
The uncertainties of decomposition of woody organic matter in the context of extraction of harvest residues will also be highlighted. First by showing that the choice of decomposition model is important in assessing the SOC changes since the models differ in process approach. Therefore, a comparison of the decomposition functions of the Q model and Yasso07 will be presented. Secondly by presenting how the stump extraction is associated with soil disturbance. A sensitivity analysis of the parameters in the Q model that regulates this kind of disturbance effect will be made to illustrate how soil disturbance might affect the decomposition of organic matter.