Geophysical Research Abstracts
Vol. 14, EGU2012-10517-1, 2012
EGU General Assembly 2012

Carbon and Nitrogen dynamics in forest soils depending on light conditions and tree species

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Climate change mitigation actions under the Kyoto Protocol apply among other decreases of CO_2-emissions and/or increases of carbon (C) stocks. As soils represent the second biggest C-reservoir on Earth, an exact estimation of the stocks and reliable knowledge on C-dynamics in forest soils is of high importance. Anyhow, here, the accurate GHG-accounting, emission reductions and increase in C stocks is hampered due to lack of reliable data and solid statistical methods for the factors which influence C-sequestration in and its release from these systems.
In spite of good progress in the scientific research, these factors are numerous and diverse in their interactions. This work focuses on influence of the economically relevant tree species - Picea abies, Fagus sylvatica and Quercus spp. - and light conditions on forest floor and mineral soil C and N dynamics in forest soils. Spruce monocultures have been widely used management practices in central European forests during the past century. Such stands are in lower altitudes and on heavy and water logged soils unstable and prone to disturbances, especially to windthrows. We hypothesize that windthrow areas loose C & N and that the establishment of the previous nutrient stocks is, if at all, only possible to be reached over the longer periods of time. We research also how the increased OM depletion affects the change of C & N stocks in forest floor vs. mineral soil. Conversion of such secondary spruce monocultures to site adequate beech and oak forests may enable higher stocks allocated predominantly as stable organic carbon and as plant available nitrogen.
For this purpose sites at 300-700m altitude with planosols were chosen in the region of the Northern Alpine Foothills. A false chronosequence approach was used in order to evaluate the impacts of the tree species and change in light conditions on dynamic of C & N in the forest floor and mineral soil, over the period 0-100 (for oak 120 y.) years.
The C- and N-pools were estimated for different compartments over the available age classes. The sampling of humus and surface vegetation was done using 30x30 and 50x50cm frame. It was distinguished between following fractions: fine/coarse roots (</> than 2mm), woody debris (dead wood, branches, cones and acorns), living vegetation (ground vegetation and its roots), litter (leaves fresh and decomposed coarse organic layer) and humus (more than 30% of fine organic matter). C and N stocks in mineral soil were assessed for the 10, 30 and 60cm depth. Furthermore, the influence of solar radiation on humus and mineral soil C and N was evaluated using the GSF (global site factor) estimated with hemispherical photography. The photographs were taken on each sampling point using the 180° viewing angle looking upward into the canopy.
As expected, the solar energy strongly influences the occurrence of herbaceous layer in spruce and oak stands. Furthermore, beech and oak chronosequences display positive (although not strong) correlation between the light factor and C & N accumulation in the humus fractions. In the beech chronosequence, good correlation with light conditions in stands is only found in the sum of all forest floor compartments (litter, woody debris and humus). On the contrary, with exception of spruce ($r = 0.391^{**}$ for the 10cm depth) no significant correlation was found with the mineral soil C for the three observed depths.