Geophysical Research Abstracts
Vol. 16, EGU2014-9958, 2014
EGU General Assembly 2014

Plant biodiversity and soil nitrogen and carbon pools changes as a result of nitrogen deposition at permanent pine plots in Central Russia

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We present results of analysis of increased rates of atmospheric nitrogen deposition observed in Central Russia between 1960 and 2010, and dealt with air pollution by NO_x, on a biodiversity and main pools of C and N in pine forests of Moscow region, Russia. Shifts in nitrogen availability of three pine plots have been analyzed using presence/absence records on dynamics of understory plant communities (chronosequence consisting of four surveys from 1959-61 up to 2003) and a set of specialist plant species as bioindicators of soil richness. Atmospheric N loads received by ecosystems in 1950-1960 were estimated equal 5-7 kg ha-1 yr-1 with N-NH4 prevalence. In 1975-1990, NO_x were more severe air contaminants that increased the N loads up to 15-20 kg ha-1 yr-1. Because of the economic decline of soon after 1990, general air pollution and the N deposition rates in Moscow region reduced, but a short time later started to increase again. We assume that those changes might be caused by atmospheric N input rates and to examine this assumption (i) analyze of species composition in understory has been done using Ellenberg indicator values and Tsyganov interval ecological scales developed for European Russia, and (ii) modeling of dynamics of main C and N pools in forest have been additionally carried out using EFIMOD and ROMUL models. Two nitrogen deposition scenarios have been simulated: (i) the steady background rate of N deposition equal to the one in the middle of last century, and (ii) the real ambient level of N depositions in last 50 yrs. Results have confirmed changes of understory species composition sustaining an eutrophication have been revealed in all plots. Number of specialists which mark rich soil conditions increases from 1950 and reaches maximum at 1990 for all plots. There is a difference between sample plots. Increasing number of specialists for rich conditions is very expressed for the richest mixed pine-lime stand and mixed pine-oak stand. Number of indicators of rich conditions for these plots reaches maximum in 1990 year with maximum level of nitrogen deposition. For more poor in nitrogen sparse pine-rowan stand plot number of indicators of rich conditions increases until last survey in 2003 year. Model simulations show a response of main C and N pools on nitrogen surplus in the second scenario. Besides the NPP growth and increased C stock in the stand biomass and soil, both labile N compounds in soil and total N pool in simulated ecosystem have been shown to increase. But, similar ecosystem effects have not been found in scenario when N deposition rates were low. N saturation of studied pine ecosystems dealt with the prolonged income of 10-15 kg N ha-1 yr-1 is presently manifested by shifts in the diversity of understory plant communities.