Geophysical Research Abstracts
Vol. 20, EGU2018-7291-1, 2018
EGU General Assembly 2018

An influence of reforestation techniques following windthrow on forest's carbon balance

Janusz Olejnik (1,2), Klaudia Ziemblinska (1), and Marek Urbaniak (1)

(1) Poznan University of Life Sciences, Meteorology, Poznań, Poland (klaudiaziem@wp.pl), (2) Department of Matter and Energy Fluxes, Global Change Research Centre, AS CR, v.v.i. Belidla 986/4a, 603 00 Brno, Czech Republic

Apart from climate, soil and local site conditions, the net carbon (C) balance of forest ecosystem is driven by the occurrence of natural and anthropogenic disturbances. Among them extreme wind events are the most common natural hazards in Europe. Even though windthrow is one of the greatest threats to forests, the assessments of the impact of wind damages on ecosystem's C balance remain scarce. This is primarily the case due to the technical and logistical difficulties involved in setting up CO_2 flux measurements in areas following windthrow, resulting in only few existing measuring stations globally. Considering the fact, that reforestation practices commonly used in some European countries at windthrow areas, are at some point similar to those used in clearcuts, there is a question of their impact on long-term forest's C balance. We thus used the opportunity of windthrow caused by a tornado that occurred in July 2012 in northwest Poland to answer the question of the role of forest management in reducing C loss from windthrow.
In this study, we aimed at providing information to close the current knowledge gap of the long-term C dynamics of a windthrow area, with a special focus on addressing the question: which of the two different reforestation methods - conventional (I- uprooted stumps extracted and ploughing) or non-conventional (II- all stumps left on the site and shallow soil ripping) results in the lowest C losses to the atmosphere. Carbon dioxide (CO_2) fluxes were measured by the eddy covariance (EC) technique for four continuous years during 2013-2016 over two reforested Scots pine stands („TlenI" and „TlenII" sites). We hypothesized that net C losses from the conventionally restored site would exceed those from the non-conventionally reforested area, since the biggest impact on NEP totals would be due to ploughing in conventional reforestation (TlenI). Prior to the tornado, both investigated areas comprised homogeneous Scots pine stands at the age of 76-86 years on average, with similar soil and habitat conditions.
Obtained results indicate that both sites became significant carbon (C) sources after the windthrow (up to 575 $gCm^{-2}y^{-1}$). However, the TlenI (conventional technique) lost over 30% less C than TlenII during the 2015-2016 observation period when fluxes at both sites were measured simultaneously. Moreover, in contrast to existing knowledge, ploughing as done at TlenI, did not substantially increase CO_2 emission, as compared to the TlenII site, where the soil was only locally ripped. Using simple linear models, we have also estimated that the net carbon emission decrease at TlenI was few times faster than at TlenII windthrow area which means, that C neutrality at conventionally managed site will most probably be reached after 5-6 years from being damaged by wind, while under the non-conventional treatment it can take even 18-20 years. To sum up, these unique studies led to the conclusion that the currently widely applied conventional reforestation technique in wind-disturbed Polish forest is more effective in decreasing C losses than a technique that leaves stumps to decompose and avoids ploughing.