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The impact of different management techniques on carbon balance of a pine stand after windthrow

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Forest ecosystems cover approximately 1/3 of the global land area (and 29.8% in Poland). Since forests are constantly exposed to various types of disturbances - both natural and anthropogenic such as fires, wind, insects outbreaks or clear cuts – it is important to investigate the impact of such damages on the carbon dynamics. This becomes even more important due to the fact that future climate change will most likely result in a higher frequency and intensity of extreme climatic events. Even though wind damages cause large disturbances to forests only few places in the world exist where continuous measurements of carbon exchange (CO_2) in windthrown sites are carried out. Besides the opportunity to assess the carbon dynamics following wind disturbance, there is an additional possibility of evaluating differences in post windthrow forest management practices.

To fill this knowledge gap we set up two measuring stations in north-western Poland in the 500ha area of pine forest damaged by tornado in July 2012, to assess the impact of such disturbance on CO_2 and H_2O exchange by use of Eddy Covariance (EC) technique (Tlen I and Tlen II). Both sites are characterized by similar climatic as well as soil conditions and are located 3km from each other.

While at the site Tlen I all biomass (coarse and fine woody debris were collected together with stumps) was removed and ploughed thereafter, at Tlen II only trunks and main branches were taken out from the site without ploughing. Total harvested biomass per hectare, as derived from local forest inventory, were almost 18 % higher at Tlen I than Tlen II site (where uprooted stumps were left to decompose).

First analysis of the eddy covariance data shows that both sites are significant carbon sources. Emissions of carbon dioxide from the non-ploughed site (Tlen II) are higher than from the ploughed site (Tlen I). Both sites released more than 8.1 t of CO_2 per ha during a three month time period (mid July to mid August 2014) after being prepared for reforestation as described above . Future analysis and continuation of the measurements will help to answer the following remaining questions: How does the carbon flux change in time at both sites? When does either system reach a compensation point (NEP0)? How large are the differences in CO_2 loss between both sites? Which management technique appears to be more “carbon friendly” (less CO_2 released to the atmosphere per decade). If these questions are answered they will allow to adapt current post-windthrow management activities and provide potential mitigation abilities in disturbed forest ecosystems.