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Trace gas and energy exchange above a pine afforestation: past, present and future research

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Forests are among the most important elements of the Earth's biosphere, providing In the context of global climate change forest plays an important role as a sink of CO_2, besides providing other ecological advantages such as favourable habitat for plant and animal species. Changes in the global environment are likely to severely affect the functioning of forest ecosystems. The direction and intensity of these changes can be assessed by the analysis of mass and energy fluxes exchanged between the forest canopy and the atmosphere.
Water vapour (H_2O) and carbon dioxide (CO_2) fluxes were measured using the eddy covariance (EC) method in order to obtain long-term data series. Measurements started in January 2008 and continue until today. The EC tower was established within a 56 year and 24 m tall scots pine (pinus sylvestris L.), located nearby the town of Tuczno (North-West Poland). This forest is representative for the large areas that are under the management of one national company (State Forests National Forest Holding). It has been hypothesized that this type of forest (same stand age and structure) are responsible for the major net uptake of atmospheric CO_2 in Poland. Annual sequestration during the first two years of measurements was shown to be as high as (702 g C·m-2 in 2008 and 747 g C·m-2 in 2009. However, less carbon was sequestered during the years 2010 and 2011, 546gC·m-2 and 592 gC·m-2, respectively.
During the upcoming years we aim at answering the following question: which variables, meteorological or air quality, determine the annual variance of net ecosystem productivity (NEP)? Therefore the existing EC tower was additionally instrumented with devices measuring basic meteorological parameters (solar radiation, air and soil temperature, precipitation). Research will further be extended by studying the hydrology, nutrient cycling and soil properties in order to derive a combined knowledge on forest ecosystem functioning in Poland.