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Central European afforested pine stand carbon exchange in the contexts of climate change

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Even though there have been several studies concerning the carbon cycle or the net CO_2 exchange between coniferous forests (both temperate and boreal) and the atmosphere, little is known about carbon dioxide dynamics in afforested pine areas in central part of Europe. Since January 2008 we have carried out continuous measurements of net ecosystem exchange (NEE) between a 62-year-old afforested pine stand near the town of Tuczno in north-western Poland, using the open-path eddy-covariance system. The site is incorporated into the international Fluxnet network (PL-Tcz). The pine stands of similar age and structure are both the most representative forest types and the most effective sinks in terms of CO_2 in Poland. Our analysis indicated that the stand was a very productive forest, which has sequestered 32.25 t of carbon dioxide per ha within 5 years (2008-2009 and 2011-2013). The climatic conditions during this period represented mostly warm part of temperature-precipitation combinations (i.e. warm dry, warm wet, cold dry, cold wet conditions as compared to multiyear means). The average annual net ecosystem production (NEP) during this period was equal to 645 g C m-2 and ranging from 765 to 494 g C m-2 in 2009 and 2012 respectively. We assumed that interannual variations in total NEP among investigated years were mainly resulted from ecosystem photosynthesis (GEP), since deliverables from the 5-years-mean GEP value were much higher than that of respiration (R). The annual NEP decreasing tendency was found and it was more likely determined by weather conditions than stand ageing - decreasing spring temperature seemed to be the main reason. If this trend will continue in the future the productivity of investigated afforested pine stand will most probably decrease, although further studies are needed to investigate the response of such ecosystem to climatic conditions from cooler and drier part of temperature-precipitation combinations.