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The full GHG balance of croplands under seven-year rotation scheme and conventional tillage practices in Poland

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Greenhouse gases fluxes were measured with chambers on the selected plots of the experimental arable station of Poznan University of Life Sciences in Brody (52o26'N, 16o18'E), Poland. This is a long term experiment, where the same crops are cultivated under the same fertilization treatment schemes (eleven combinations) since 1957. At the blocks of the full 7-year rotation, there are cultivated in permanent rotation: winter wheat ->winter rye -> potato ->spring barley -> triticale and alfalfa (till the second year). GHG fluxes have been measured on plots with the same fertilization level (Nmin-90kg, K2O-120 kg/ha, P2O5-60 kg/ha and Ca), which is very close to the average amount of mineral fertilization applied in western Poland. No catch crops were cultivated between the main crops. The soil was classified as Albic Luviosols according to FAO 2006 classification.
CO_2 fluxes have been measured monthly since March 2011, while N2O and CH4 fluxes since March 2012 (weekly) and measurements were continued till October 2013. CO_2 fluxes were measured with dynamic chambers, while N2O and CH4 fluxes were measured with both static and dynamic chambers approaches (using LOSGATOS gas analyser). Carbon net ecosystem exchange (NEE) and ecosystem respiration (Reco) have been modelled for the entire period based on the measured fluxes (different management treatments were included in the model), while N2O and CH4 fluxes were linearly interpolated between campaigns.
Taking into account the accumulation periods between 15th of October and 14th of October of the next year the cumulated NEE was negative only in case of alfalfa, winter rye and winter wheat, reaching in average -3.5 tCO_2-C ha-1 for alfalfa and winter rye fields and around -0.4 tCO_2-C ha-1 for winter wheat in seasons 2011-2012 and 2012-2013. While, cumulated NEE for spring crops (potato and spring barley) was positive for the same periods and reached in average 1.1 tCO_2-C ha-1 and 2.5 tCO_2-C ha-1 for spring barley and potatoes, respectively. The fields with spring crops have positive NEE, and hence negative climatic impact, because by more than half of the year the soil was bared and no catch crops were cultivated between main crops.
For the entire 12-months period the highest N2O emission rates were recorded at plots of winter wheat and winter rye and reached 2.2 kgN2O-N ha-1 and 2.0 kgN2O-N ha-1, respectively. At plots of alfalfa and potatoes the emission rates were close to 1.5 kgN2O-N ha-1, while at spring barley plots the emission did not exceed 1.1 kgN2O-N ha-1. At the same time, the yearly CH4 uptake reached from -0.9 kgCH4-C ha-1 at plots of alfalfa, -1.5 kgCH4-C ha-1 at plots of winter wheat to around -1.7 kgCH4-C ha-1 at winter rye, potato and spring barley plots.