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GHGs balance in a land use change process from grassland to short rotation coppice of poplar

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At present one of the fastest spreading renewable energy sources are bioenergy cultivations. Millions of hectares of traditional crops all over the Europe are expected to be converted in energy crops in the near future, in order to produce green energy and contrast global warming. Last year, in the context of the GHG-Europe FP7 project we set up an experiment to verify the effects on the green-house gases balance of a land use change from traditional agriculture to short rotation coppice of poplar clones in central Italy. CO_2 fluxes measured during the last growing season through three Eddy Covariance masts – two on poplar plantations of different ages and one over a reference site (grassland) – have been analysed. We also monitored CO_2, CH4 and N2O fluxes from soil measured using chambers in order to better understand the contribution of other GHGs.

The two poplar plantations showed a similar uptake of Carbon, 368 g C m-2 year-1 and 358 g C m-2 year-1, while the grassland absorbed 220 g C m-2 year-1 during the same period. Soil respiration in average was higher for the youngest plantation of poplar and for the grassland, lower for the oldest one, where soil is undisturbed from more time. In all the sites we measured low emissions during the winter (between 80 and 150 mg CO_2 m-2 h-1), progressively higher in the spring and early summer with growing temperatures (up to 650 mg CO_2 m-2 h-1), quite low during the summer because of a strong drought, while the highest values were recorded in September (ca. 1100 mg CO_2 m-2 h-1 in the grassland and youngest poplar) after important rain events. Fluxes of N2O and CH4 from soil are very low: little absorption of CH4 in the grassland (values between 0 and -18.75 μg m-2 h-1), with peak after fertilization; in the SRC little absorption or emission with no clear seasonal pattern. Insignificant fluxes of N2O in all crops (even in the grassland after fertilization).

The carbon fluxes measured are strongly related to the particular climatic conditions of the last season: irrigation in the plantation resulted not to be enough for the summer drought, which conditioned NEE and soil respiration, and due to the drought condition the farmer decided to avoid fertilization in the SRC.

Emissions related to different management practices (plowing, sowing, harvesting, irrigation, fertilization, grazing) were also taken into account in order to achieve a complete balance of GHGs.