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CO2 fluxes exchanged by a 4-year crop rotation cycle.

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This study analyses carbon fluxes exchanged by a production crop during a four year cycle. Between 2004 and 2008, the successive crops were sugar beet, winter wheat, potato and again winter wheat.

Eddy covariance, automatic and manual soil chamber, leaf diffusion and biomass measurements were performed continuously in order to obtain the daily and seasonal Net Ecosystem Exchange (NEE), Gross Primary Productivity (GPP), Total Ecosystem Respiration (TER), Net Primary Productivity (NPP), Autotrophic Respiration, Heterotrophic Respiration and Net Biome Production (NBP).

The whole cycle budget showed that NEE was negative and the rotation behaved as a sink of 1.59 kgC m-2 over the 4-year rotation. However, if exports were deducted from the budget, the crop would become a small source of 0.22 (+/- 0.14) kgC m-2, which also suggests that the crop soil carbon content decreased. This could partly be explained by the crop management, as neither farmyard manure nor slurry had been applied to the crop for more than 10 years and as cereal straw had been systematically exported for livestock. This result is also strongly dependent on climate: the fluxes were subjected to a large inter-annual variability due to differences between crops but also to climate variability. In particular, the mild winter and the dry spring underwent in 2007 induced an increase of the biomass fraction that returned to the soil, at the expense of harvested biomass. If 2007 had been a 'normal' year, the carbon emission by the crop rotation would have been twice as great. This is analysed more in detail in a companion presentation (Dufranne et al., this session).

The impacts of some farmer interventions were quantified. In particular, the impact of ploughing was found to be limited both in intensity (1 to 2 micromol m-2 s-1) and duration (not more than 1 day).

Seasonal budgets showed that, during cropping periods, the TER/GPP ratio varied between 40 and 60% and that TER was dominated mainly by the autotrophic component (65% of TER and more). Autotrophic respiration was closely related to GPP during the growth period.

The main causes of uncertainty with these results were due to biomass samplings and eddy covariance measurements (mainly, uncertainties about the u* threshold determination).