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Interannual variability of CO2 fluxes and yield by a winter wheat crop (Triticum aestivum L.)

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In this study, two winter wheat (Triticum aestivum L.) cropping seasons were compared at the Lonzée (Belgium) experimental site. The site, crop management, sowing and harvest dates were similar on the two years. The main difference between the seasons was due to to climate conditions. Continuous eddy-covariance fluxes, leaf scale photosynthesis measurements and crop development monitoring were performed during the whole vegetation periods. Globally, the two years were characterised by a higher than normal air temperature (9.9 °C and 11.9 °C respectively against 9.4 °C for standard) and lower than normal rainfalls (595.1 mm and 675.1 mm respectively against 772 mm for standard). In addition, the second season (2006-2007) was characterised by an exceptionally mild winter, dry and hot conditions in April and by humid and cloudy conditions during the last vegetation phases. These particular conditions induced earlier growth stages and the comparison of global fluxes gives contrasting results: gross primary productivity (GPP) was larger in 2007 but, on the contrary, net primary productivity (NPP) and crop productivity were lower on this year. The bad yields could be explained, on one hand by the drought in April 2007 that induced abnormally small flag leaves, on the other hand by cloudy and humid conditions from end May to harvest, that induced an assimilation reduction due to low radiation and favoured disease development. The simultaneous higher GPP and lower NPP and productivity in 2006-2007 raise the question of carbon allocation. It suggests that the excess carbon assimilated in 2006-2007 was not stored in grain or straw and thus that it would have been stored in the roots or in vegetation parts that decompose before the harvest. Further biomass measurements (and especially root biomass) are necessary to confirm this hypothesis.