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Effects of soil tillage on carbon dioxide emissions from agricultural soils

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Facing the current climate change discussion the question how to reduce sources and to enhance sinks of greenhouse gases is of increasing interest. In Europe croplands are significant CO2 sources, mainly due to agricultural management. As tillage is supposed to increase carbon dioxide emissions from soils and to reduce soil organic carbon content adapted management strategies could reduce CO2 emissions and enhance carbon sequestration in soils. In order to assess the impact of soil management on CO2 emissions and carbon dynamics of cropland a research project of three years duration has been started in 2007. Five agricultural fields in Austria (Lower Austria and Styria) where long-term experiments with different tillage treatments are performed have been chosen as study sites. They differ in soil texture, slope and climatic conditions. Three different tillage systems are investigated: Conventional tillage (CT), reduced tillage (RT) and no-tillage (NT). RT and NT use cover crops during the winter period. Each tillage system is replicated three times per site. The study comprises measurements of soil CO2 flux in intervals of about one week in order to estimate its annual course, but also in relation to management events. The measurements are performed using a portable soil respiration system which consists of an infrared gas analyzer combined with a non-steady-state through-flow chamber. Concurrent soil temperature and soil water content are measured. In addition, soil samples are taken for chemical analyses and microbiological investigations. In most cases lower soil CO2 fluxes were observed for NT plots than for RT and CT plots. Especially directly after tillage emissions were high compared to NT. Generally, it has to be stated that

data of CO2 flux measurements showed high spatial variation even within one site, because soil respiration depends on various factors, e. g. temperature, moisture, pH-value, substrate amount and vegetation activity. Calculated carbon losses from April to November 2007 for different NT plots were 4 - 35 % lower than for CT. However, for RT no general trend could be observed: Compared to CT carbon losses for the different RT plots ranged between a reduction of 16 % and an increase of 28 %.