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Temporal variability of CO_2 and N2O emissions in an agricultural long-term field trial regarding effects of different management practices and extreme weather effects

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In order to achieve a reduction of greenhouse gas emissions, modern agronomic management practices need to be established. Therefore, to assess the effect of different farming practices on greenhouse gas emissions, reliable data are required. The experiment covers and compares main aspects of agricultural management for a better implementation of sustainable land use. The focus lies on the determination and interpretation of greenhouse gas emissions, where the effects of diverse tillage systems and fertilisation practices of an integrated farming system as well as the impacts of extreme weather conditions are observed. In addition, with analysis of the alterable biological, physical and chemical soil properties a link between the impact of different management systems on greenhouse gas emissions and the observed cycle of matter in the soil, especially the nitrogen and carbon cycle, is enabled.

Measurements have been carried out on long-term field trials at the Research Farm Scheyern located in a Tertiary hilly landscape approximately 40 km north of Munich (South Germany). The long-term integrated farming system trial was started in 1992. Since then parcels of land (each around 0.2-0.4 ha) with a particular interior plot set-up have been conducted with the same crop rotation, tillage and fertilisation practice referring to integrated farming management. Thus, the management impacts on the soil of more than 20 years have been examined.

Fluxes of CH4, N2O and CO_2 have been monitored since 2007 for the integrated farming system trial using an automated system which consists of chambers (0.4 m2 area) with a motor-driven lid, an automated gas sampling unit, an on-line gas chromatographic analysis system, and a control and data logging unit. Precipitation and temperature data have been observed for the experimental field to include weather effects.

The main outcomes are the analysis of temporal and spatial dynamics of greenhouse gas emissions influenced by management practice events (i.a. fertilisation, crop incorporation and tillage) and weather effects (drying-rewetting, freezing-thawing, intense rainfall and dry periods) and the creation of impact studies comparing the management practices (minimum tillage vs conventional tillage; high vs low fertilisation). Physical, chemical and biological soil properties (i.a. texture, mineral nitrogen, soil organic carbon and microbial biomass) have been examined in short time intervals to aggregate the parameters and processes influencing the greenhouse gas emissions and to build a linkage between soil organic matter and greenhouse gas emissions. Moreover, with the collected soil and agronomic data (harvest, tillage and fertilisation practices) the study contributes to a process quantification supporting modelling approaches.