Geophysical Research Abstracts
Vol. 16, EGU2014-11549, 2014
EGU General Assembly 2014

Nitrous oxide emissions from drained and undrained loamy soils in Central France.

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Artificial drainage is extensively used in cropped areas to decrease soil hydromorphy. Soil drainage class is considered as a possible factor controlling nitrous oxide (N_2O) emissions (Bouwman et al, 2002). Nevertheless, artificial drainage may have contrasting effects on N_2O emissions depending on climatic conditions (Colbourn et al, 1987; Venterea et al, 2008). By decreasing anoxic periods in soils, artificial drainage could reduce N_2O production by denitrification but it could also limit the reduction of N_2O into N_2. The objective of this study was to assess the effect of drainage on N_2O emissions and to provide a better understanding of the control of emissions by soil factors in both situations.

N_2O emissions were measured in Central France on 4 tile-drained and 4 undrained loamy plots, all located in a rural area of 10 km^2. 2 drained and 2 undrained plots were studied from December 2010 to June 2011 and 2 others drained and undrained plots were studied from November 2012 to June 2013. Fluxes were measured monthly before spring fertilizations and then weekly until the end of the measurement period. The closed chamber method (with 5 replicates per plot) was used and gas analysis was made by gas chromatography (ECD detector) during the first year and by the SPIRIT QCL spectrometer (Guimbaud et al., 2011) during the second year. Ancillary variables such as soil temperature, mineral nitrogen, water filled pore space (WFPS) in the top layer and groundwater table level were also measured.

Undrained soils presented much larger emissions and higher soil water content than drained ones. WFPS ranged from 16 to 82.6% on drained plots and 14 to 100% on undrained plots. On average, WFPS was 9% smaller on drained soils. The mean daily N_2O flux on drained soils (3.6 g N. $N_2O.ha^{-1}.d^{-1}$) was significantly smaller (T test, p=0.003) than on undrained ones (29.1 g N. $N_2O.ha^{-1}.d^{-1}$). Significant emissions were measured in nearly saturated conditions on undrained plots. The response of N_2O emission to soil WFPS was observed to be affected by the artificial drainage. This study suggests that artificial drainage in the investigated site may have decreased N_2O emissions. In addition, different soil control functions have to be considered for drained and undrained soils for model implementation related to soil N_2O emission processes.

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Acknowledgments : This work was supported by the Région CENTRE, the Fonds Européen de Développement Régional (FEDER) and INRA through the SPATIOFLUX Project, and by the Labex Voltaire (ANR-10-LABX-100-01).