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Controlling factors of nitrous oxide (N2O) emissions at the field-scale in an agricultural slope

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Agricultural practices widely contribute to the atmospheric nitrous oxide (N2O) concentration increase and are the major source of N2O which account for 24% of the global annual emission (IPCC, 2007). Soil nitrification and denitrification are the microbial processes responsible for the production of N2O, which also depends on soil characteristics and management. Besides their control by various factors, such as climate, soil conditions and management (content of NO3- and NH4+, soil water content, presence of degradable organic material…), the role of topography is less known although it can play an important role on N2O emissions (Izaurralde et al., 2004). Due to the scarcity of data on N2O direct vs. indirect emission rate from agriculture in the Seine Basin (Garnier et al., 2009), one of the objectives of the study conducted here was to determine the N2O emission rates of the various land use representative for the Seine Basin, in order to better assess the direct N2O emissions, and to explore controlling factor such as meteorology, topography, soil properties and crop successions. The main objective of this study was at the same time to characterize N2O fluxes variability along a transect from an agricultural plateau to a river and to analyze the influence of landscape position on these emissions.

We conducted this study in the Orgeval catchment (Seine basin, France; between 48°47' and 48°55' N, and 03°00' and 03°55' E) from May 2008 to August 2009 on two agricultural fields cropped with wheat, barley, oats, corn. N2O fluxes were monitored from weekly to bimonthly using static manual chambers placed along the chosen transect in five different landscape positions from the plateau to the River.

This study has shown that soil moisture (expressed as Water Filled Pore Space) and NO3- soil concentrations explained most of the N2O flux variability during the sampling period. Most of N2O was emitted directly after N fertilization application during a relatively short period of one month.

Landscape position strongly affected cumulative N2O emissions which were more than three times higher in footslope position (annual budget of 4 kg N-N2O ha-1 yr-1) than in shoulder (1.1 kg N-N2O ha-1 yr-1) or slope positions (1.1 and 1.2 kg N-N2O ha-1 yr-1), where soil water contents were higher (mean 68.4% WFPS in footslope position whereas mean WFPS were 50.4 and 60.5% in slope positions and 58% in shoulder position). N2O emissions were relatively low (0.5 kg N-N2O ha-1 yr-1) and did not show much annual variation in unfertilized riparian buffer.

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