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Soil nitrous oxide emissions from winter wheat cropland at landscape scale

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An improved understanding of how variables such as soil type, water content or temperature, interact to control N_2O emissions at the landform scale is needed for scaling up emissions to regional/national scales. In this study, N_2O emissions were measured along three sloping sites (1.6 - 2.1%) cropped to winter wheat within a 10-km^2 area in Central France by non steady-state chamber technique. The objectives were to measure N_2O emissions at the shoulder and foot-slope landform positions and to identify the factors controlling their variations. Fluxes of N_2O ranged from 0 to 0.11 mg N m^{-2} h^{-1}, increased exponentially with soil mineral nitrogen (N) concentrations (r^2 = 0.57, $p < 0.001$) and correlated with soil denitrification potential rate. The soil mineral N content explained 31% ($p < 0.05$) of the variations in N_2O fluxes when the Water-Filled Pore Space (WFPS) was <60% and 87% ($p < 0.001$) when WFPS was >60%. Landform positions had a significant, but not consistent effect upon N_2O fluxes with greater emission in the foot-slope position at only one of the three sites. The differences in WFPS between shoulder and foot-slope positions correlated linearly with the differences in N_2O fluxes (r^2 = 0.47, $p < 0.001$). While soil water content could not explain a large proportion of the variation in N_2O fluxes, it modulated the effect of soil mineral N content. Our results therefore suggest that in this agricultural landscape, the spatial variations in N_2O emission were regulated by the influence of hydrological processes on soil aeration and denitrification intensity.