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Seasonal nitrous oxide emissions from cropland in eastern Canada measured using tunable diode laser flux gradients between 1996 and 2005 - Comparison with DNDC predictions.

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The atmospheric concentration of nitrous oxide (N2O) increased from a pre-industrial level of 270 ppbv to more than 320 ppbv nowadays. The expansion of agricultural land and the increase of N fertilization usage are considered to be the main driving factors over the period. The global warming potential of N2O is about 300 times that of CO2. Globally agriculture is responsible for 60% of anthropogenic N2O emissions (about 2.8 Gt CO2e), while in Canada, the contribution of the agricultural sector has been estimated to be 70% (34 Mt CO2e) in 2007. The annual Canadian emissions of N2O following application of synthetic fertilizer are estimated to be 8 Mt CO2e, varying between 0.1 to 2% of the applied N rate. Nitrous oxide emissions from cropland in temperate climate are largely event driven, following rainfall occurrence after fertilizer application and following snowmelt for northern regions (e.g., in Eastern Canada). The average emissions during the snowmelt period vary considerably, reflecting the influence of many controlling factors, associated with climate and fertilizer management practices. In this presentation, we investigate the influence of these factors on the seasonal nitrous oxide emissions, using field-scale measurements carried out in Eastern Ontario (Canada) between 1996 and 2005 and predictions from the Denitrification-Decomposition (DNDC) model. The tower-based N2O flux measuring system was equipped with a close-path single-pass tunable diode laser (TDL) (TGA100, Campbell Scientific Inc., Logan, UT) for measuring N2O gradients and a sonic anemometer (several models were used over the period) to compute the eddy diffusivity coefficient. The flux-gradient towers were located in an experimental farm south of Ottawa and measurements carried out in fields planted with corn, spring, wheat, soybean, and canola, for the main N2O emission periods following spring thaw and N fertilization. Daytime and nighttime fluxes were QC/QA and gap-filled separately. The DNDC model, which consists of four interacting submodels that predict daily and annual emissions from agricultural soils, was calibrated for Canadian conditions and used to derive direct N2O emissions estimates. N2O emissions after snowmelt varied from 1 to more than 3 kg N2O-N ha-1 while those following synthetic fertilizer application ranged between 0.5 and 2.5 kg N2O-N ha-1 for synthetic N application rates of 40-160 kg N ha-1.