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Modeling Nitrous Oxide emissions in grass and grass-legume pastures in the western Brazilian Amazon

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Introduction

Mineral nitrogen (N) dynamics in soil and the exchange of N gaseous in the interface soil-atmosphere are intimately associated with animal manure in pastures. According to soil inorganic-N pools and the site studied, forest or pasture, and pastures age the soil inorganic-N pools of ammonium and nitrate can be similar in the forest or ammonium dominated in the pasture. Also annual average net nitrification rates at soil surface in forest can be higher than in pasture suggesting a higher potential for nitrate-N losses either through leaching or gaseous emissions from intact forests compared with established pastures (NEILL et al., 1995). To Melillo et al. (2001) nitrous oxide (N_2O) emissions from the newly created pasture (5.0 kg N_2O-N ha^{-1} yr^{-1}) were about two and one half times the forest emissions (9.0 kg N_2O-N ha^{-1} yr^{-1}) during the first 2 years and N_2O fluxes from pastures older than 3 years (1.4 kg N_2O-N ha^{-1} yr^{-1}) were on average about one third lower than fluxes from uncut forest (9.0 kg N_2O-N ha^{-1} yr^{-1}). One of the best predictor of N_2O flux from soil is the magnitude of the nitrate pool in the soil surface (VERCHOT et al., 1999, MELILLO et al., 2001). The N_2O emissions can be measured from samples from the field by gas chromatograph or estimated by process-based models. Denitrification-Decomposition (DNDC) model simulates carbon and nitrogen biogeochemical cycles occurring in agricultural systems (GILTRAP et al., 2010). Here we presented N_2O emissions simulated by DNDC model from grass (> 30 years old) and grass-legume pastures (> 4 years old after grass > 30 years old) and from soil of a native forest in the western Brazilian Amazon.

Material and Methods

The study was conducted to predict the soil N_2O emissions by DNDC in a Ultisol under a pure *Brachiaria humidicola* (Rendle) Scheick pasture (G) and a mixed pasture of *B. humidicola* and *Arachis pintoi* Krapov. & W. C. Greg cv. BRS Mandobi (GL), both without fertilization. A native forest (NF) classified as Bamboo open+dense, on the same soil type, was the reference. The experiment was stablished in 2011 at the Guaxupé farm (68° 05' W, 9° 57' S, 200 m a.s.l) in Rio Branco, state of Acre, Brazil. Deforestation of the experimental area occurred in 1981. Soil sampling was carried in G, in the GL, and in the NF, on the same soil type in 2014 Feb-Dec. and 2015 Jan-July in the 0-0.10 and 0.10-0.20 m layers. Soil analyses were according to Pecus network protocols and results and meteorological data were inputs to DNDC to predict N_2O emissions (LI et al., 1994) in the same period 2014 Feb-Dec. and 2015 Jan-July.

Results and Conclusions

Average N_2O emission in 166 days followed the order: pure pasture (35.8 µg N m^{-2} h^{-1}) > native forest (28.2 µg N m^{-2} h^{-1}) > mixed pasture (27.2 µg N m^{-2} h^{-1}). N_2O emissions were lowest in the season's transitions wet-dry and dry-wet and highest in the wet and dry characteristics seasons of the Brazilian Amazon.

N_2O emissions were correlated with water-filled pore space (WFPS 0-0.10 m) and soil temperature (0-0.1. m) in NF, G and GL ($P < 0.05$) and were no correlated with soil nitrate-N contents.

Annual N_2O emission was 3.13 kg N ha^{-1} yr^{-1} in G, 2.47 kg N ha^{-1} yr^{-1} in NF and 2.38 kg N ha^{-1} yr^{-1} in GL. The annual N_2O flux simulated is in the range fluxes tabulated by Verchot et al. (1999) to N_2O fluxes in the humid tropical forests (0.3 to 6.7 kg N ha^{-1} yr^{-1}) and according to Meurer et al. (2016) to pastures.

Total predicted N_2O flux in the assessed period was 4.6 kg N ha^{-1} in G, 3.0 kg N ha^{-1} in NF and 2.7 kg N ha^{-1} in GL (Figure 1) and are higher than the reported by Melillo et al. (2001) for old pastures but are in the range reported by Meuer et al. (2016).

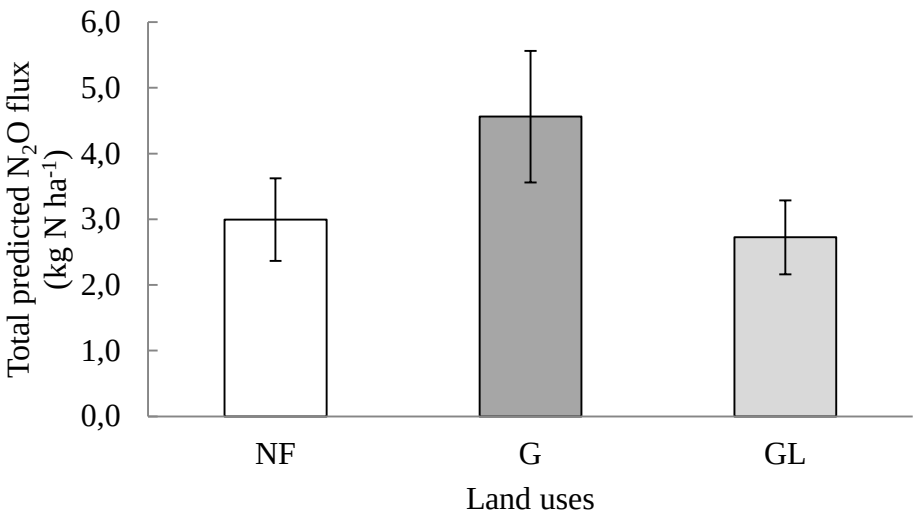

Figure 1. Total predicted N_2O flux at the Guaxupé farm, Acre State, Brazil. NF = native forest. G = single pasture of *Brachiaria humidicola* and GL = mixed pasture of *B. humidicola* with *Arachis pintoi* cv BRS Mandobi. Values are mean of 38 simulations of the soil parameters that were the inputs to DNDC. Bars are standard deviation.

Although in the range of N_2O fluxes measured across the Brazilian Amazon, the N_2O fluxes estimated by DNDC in this study should be treated with caution, as the fields' results to N_2O emissions are not yet available to comparison with simulated fluxes.

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