Nitrogen Oxide, Carbon Dioxide and Methane Emissions from Soil During Agro-Biofuel Production in São Paulo State, Brazil

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Brazil is the world’s largest producer of sugarcane, with an annual crop yield of over 470 x 106 metric tons in 2006-2007, planted in approximately 7 million ha. About half of sugarcane in Brazil is planted in the state of São Paulo, where sugarcane is the main agricultural product and contribute to about 27% of the state’s GDP.

With about half of the global ethanol production, Brazil is already the largest contributor in the international ethanol trade. Yet, production is predicted to continue to expand due to geopolitical instability in oil producing countries and an increasing commitment from developed countries to the Kyoto Protocol to reduce emissions of carbon dioxide and other greenhouse gases.

According to estimates from models and numerical analyses, Brazilian ethanol ranks among the best biofuels in terms of net energy produced for the amount of fossil fuel used in the production and, consequently, of CO₂ emitted. Also, sugarcane crops in Brazil grow with less nitrogen fertilizers than other biofuel crops, such as corn, which results in lower levels of nitrous oxide, a potent greenhouse gas, during the production of Brazilian ethanol. However, the lack of real measurements and actual data about emissions of greenhouse gases (GHG: N₂O, CO₂, CH₄) associated with the production of ethanol in Brazil hinders our capacity to properly quantify its effectiveness at reducing emissions of GHG. Studies estimates that soil emissions of GHG, which are not associated with the consumption of fossil fuels, account for more than 50% of the total emissions.

Meanwhile, in situ estimates of nitrous oxide (N-N₂O) emissions from fertilizer application in sugarcane fields in Brazil are in the order of 1%. If confirmed with further in situ measurements in a more comprehensive study, these low GHG emission can have important implications for the sugarcane industry in Brazil. In this project, we propose to determine in situ emission of GHG from soils, according methodology presented in Figure 1, planted with sugarcane in the state of São Paulo during its productive cycle to improve and expand existent estimates. In situ measurements of GHG in Brazilian sugarcane fields are practically non-existent, probably because N losses from fertilizers as N₂O (N-N₂O) are assumed to be insignificant in comparison to other losses, and because fossil fuel use during sugarcane production is low because much of the management practices in Brazil rely on manual labor. With eminent changes about to occur in the sugarcane ethanol industry in Brazil, these assumptions need to be revised and new data collected to guarantee the low emission.
According to estimates of GHG emissions generated from the burning of agricultural residues in Brazil since 1994, sugarcane accounted for about 97% of the emissions. However, the lack of field data and measurements from different systems of agricultural production create large uncertainties in emission calculations.

In this project, we expect to produce a complete assessment of GHG emissions from sugarcane crops in the state of São Paulo. By evaluating the variability of emissions as a function of management practices and climatic conditions, and soil types, however, by including different agroforestry milks in the state of São Paulo where sugarcane grows under different management practices, we can understand the complexity of representing the wide range of conditions for GHG emissions from sugarcane. By improving present emission predictions we can identify and validate soil emission models that can be used to estimate emissions of CH4 and N2O from sugarcane on CH4 emissions from sugarcane soils in São Paulo in order to improve and validate these models. Overall, we plan to produce reliable and realistic data on CH4 emissions from sugarcane soils in São Paulo, in order to improve and validate these models.

To calibrate and validate soil emission models, we plan to produce reliable and realistic data on CH4 emissions from sugarcane soils in São Paulo in order to improve and validate these models.