Modeling GHG Flux Under Different Land Management In Central Ohio

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INTRODUCTION

- Because of large uncertainties in assessing terrestrial carbon-cycle–climate feedbacks over the coming decades (Heimann & Reichstein 2008), monitoring and modeling of the mechanism of greenhouse gas (GHG) emissions are highly relevant. Such assessment is required for different soil types, land use, geological regions and, climatic zones (Kudeyarov & Kurganova 1998).
- Smith et al. (1997) compared the performance of nine soil models using long-term experimental data, and reported the challenges of simulating soil moisture that varies widely both temporally and spatially.
- Land use is one of the important controls which determine the variability in soil temperature and moisture regimes.
- Though most models require a number of parameters for an accurate simulation of soil microclimate; simple, process-based and user-friendly model to describe the differences of land uses are also required.
- The temperature dependency of in situ GHG flux has been studied partly for more accurate prediction of annual GHG emission using soil temperature, which is relatively easy to monitor, and for the better understanding of terrestrial feedback of GHG emission under the changing climate. Lloyd and Taylor (1994) concluded that the relationship between CO_2 flux and temperature can be accurately presented by an Arrhenius equation where the effective activation energy (Ea) for CO_2 flux varies inversely with temperature.
- Compared to the temperature dependency, the contribution of soil moisture on GHG flux is not so conspicuous because increasing soil temperature is accompanied by decreasing soil moisture (Davidson et al. 1998). The latter is, however, the second most important variable for predicting ecosystem respiration in semi-arid region, because it strongly influences the physiological activity of vegetation and soil microbes (Qi & Xu 2001).

OBJECTIVES

Principal objectives of this study are to:

(1) determine the dependency of GHG flux under corn on soil temperature and moisture regimes, and

(2) simulate the soil temperature and moisture data using routinely measured meteorological data.

MATERIALS & METHODS

- Measurements of soil temperature (ST; 0-5 and 5-10 cm), volumetric soil water content (VWC; 0-5, 5-10, 15-20 and 25-30 cm) and GHG flux were conducted for no-till (NT) and chisel plow (T) treatments with tile drainage (D) and without drainage (ND). These measurements were made at the Waterman Farm of The Ohio State University, Columbus, Ohio (N 40° 1' 4.04", W 83° 2' 35.08"). (Fig.1)
- These measurements were made on an ongoing field experiment initiated in 1994 on a Crosby (fine, mixed, mesic, Aeric Ochraqualf) silt loam soil. The mean annual precipitation of the site is 1016 mm and mean annual air temperature is 11.8 C° (USDA-NRCS, 2006).

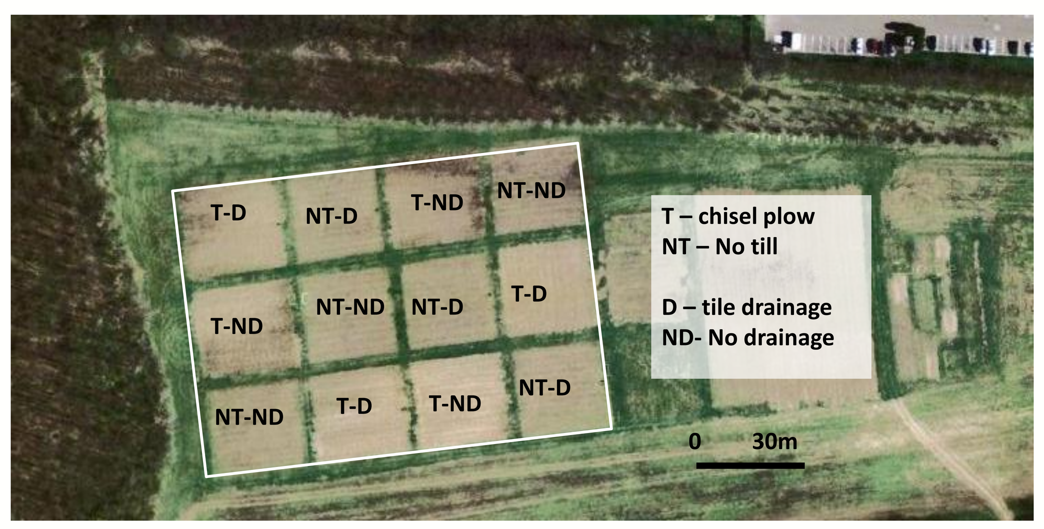

Fig.1 Experimental site

- Each plot was 27.4 x 27.4 m, and the plots were separated by a 6.1 m drive way on all sides.
- Tillage treatments consisted of : (i) fall chisel plowing to a depth of about 0.2 m, and spring disking to prepare the seedbed for planting, and (ii) the NT plots which were undisturbed either before or after the establishment of the experiment.
- Subsurface drainage was installed in some plots in the spring of 1994 using perforated corrugated plastic tubing (Sullivan, 1997).
- The site is under continuous corn (Zea mays L.) since the establishment of the experiment.
- Gas samples were periodically taken from closed chambers installed in each treatment (Fig.2) and methane, carbon dioxide and nitrous oxide concentrations in the gas samples were measured using a gas chromatography.

Fig.2 Gas sampling

- Calculated GHG flux at each site is correlated with ST and VWC using regression analysis.
- Measured ST and VWC are simulated by a simple process-based model with the meteorological data.

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