MEASUREMENTS OF CO_2 FLUXES OVER TWO DIFFERENT UNDERLYING SURFACES IN AN AGRICULTURAL LANDSCAPE IN CHINA

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ABSTRACT

In order to better understand the regional climate change, it is necessary to quantify the CO_2 flux over agricultural landscapes. CO_2 fluxes were collected directly by using eddy covariance over two different underlying surfaces (i.e., a rice paddy, and a mixed crop surface) in an agricultural landscape in the central China over two periods of 40 days in 2001 and 2002 respectively, in which significant plant growth occurred. Results show (1) that daytime absorption of CO_2 flux by the rice paddy gradually increased but nighttime release of CO_2 flux by the rice paddy did not; (2) that, for both rice paddy and mixed crop surface, daytime absorption of CO_2 significantly increased after rain events, but nighttime release of CO_2 almost did not change; and (3) that maximum diurnally daytime absorption of CO_2 reached 6 g m^{-2} h^{-1} over rice paddy and 2.8 g m^{-2} h^{-1} over the mixed crop surface respectively.

INTRODUCTION

The direct and indirect effects of increasing atmospheric CO_2 may have profound implications for the structure and function of plant communities. Vegetation, in turn, plays a crucial role in the global carbon balance. Agricultural ecosystem is one of the most widespread vegetation types in the world and therefore is a significant component of the earth's climate system. Many researchers have reported the direct measurements of surface energy components and CO_2 flux over homogenous crop surfaces [e.g., *Gao et al.*, 2003]. Unlike most of the prior studies, the present work attempts to inter-compare CO_2 fluxes measured over two different agricultural surfaces which locate in the same climate region.

MATERIALS AND METHODS

The first experiment was made from June 10 to July 20, 2001 at a rice paddy ($32^0$30'N, $119^0$07'W) in the main agricultural ecosystem of China. Soil at the experimental site was predominantly clay loam. The site was flat, homogeneous, approximately 600 m × 600 m, and surrounded by similar rice fields. The second experiment was carried out at a conventional meteorological site ($31^0$41'N, $117^0$08'E) in the main agricultural ecosystem of China during the period from 10 June to 20 July 20, 2002. Soil at the experimental site was predominantly clay loam. The site surface was mixed crop, and consisted of grass (10%), bean (15%), corn (15%), and rice (60%) around. The predominant wind direction was south-east during the period of the experiment.

The instruments used in two experiments are same. A three-dimensional ultrasonic anemometer (CSAT3, Campbell Scientific Inc.) was used to measure the means and standard deviations of the wind velocity components (i.e., u, v and w); a Krypton hygrometer (KH20, Campbell Scientific Inc.) was used to measure the mean and standard deviation of water vapor density; and a fine-wire thermocouple (FW05) was used to measure the mean and standard deviation of air temperature. These sensors were installed at 4.0 m above the ground surface. All signals for the sensors were recorded at a sampling rate of 20 Hz and were averaged over 30 min periods. Webb *et al.* [1980] corrections were used for CO_2 flux. Following Moore [1986], we corrected eddy covariance values for the effects of path length averaging of the sonic anemometer and the gas analyzer, and for spatial separation of sensors. We use the following equation to reliably estimate CO_2 flux:

$$F_{CO2} = \overline{w'c'}, \quad (1)$$

where F_{CO2} is CO_2 flux (mg m^{-2} s^{-1}), c' is the fluctuation in the concentration of CO_2 (mg m^{-3}).

RESULTS

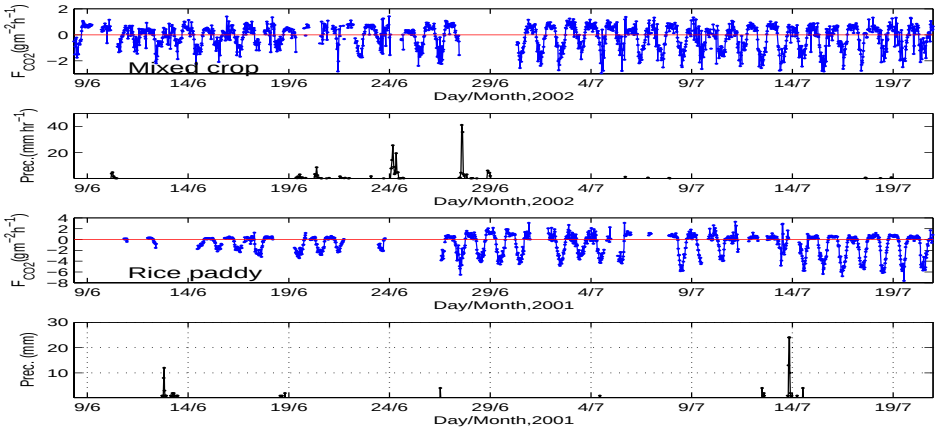

Figure 1 shows the time series of F_{CO2} and precipitation collected at our two sites. Significant plant growth occurred during these two 40-day periods. We find that: (1) daytime absorption of CO_2 flux by the rice paddy gradually increased but nighttime release of CO_2 flux by the rice paddy did not; (2) for both rice paddy and mixed crop surface, daytime absorption of CO_2 significantly increased after rain events, but nighttime release of CO_2 almost did not change; and (3) maximum diurnally daytime absorption of CO_2 reached 6 g m^{-2} h^{-1} over rice paddy and 2.8 g m^{-2} h^{-1} over the mixed crop surface respectively.

CONCLUSION

We have inter-compared CO_2 fluxes by using the data collected at two sites. Although both of these two sites located in the same climate region, a significant difference of CO_2 fluxes exists between two sites because of the land cover difference.

REFERENCES

Gao. Z., L. Bian and X. Zhou (2003), Measurements of Turbulent Transfer in the Near-surface Layer over a Rice Paddy in China, *J. Geophys. Res. 108(D13)*, 4387, dio: 10.1029/2002JD002779.