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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Seasonal and diurnal variations of net ecosystem CO₂ exchange over Songnen meadow steppe in northeastern China

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Key words: *Leymus chinensis*, Songnen meadow steppe, eddy covariance, carbon flux, net ecosystem CO₂ exchange

Introduction Carbon dioxide is the key factor to determine the degree of global climate change. In China, the studies on the role of terrestrial ecosystems in the sequestration of carbon have been limited to the typical steppe located in central Mongolia and Inner Mongolia, whereas for the meadow steppe, is still vacant. This paper is the first time to present results of continuous measurements of net ecosystem CO₂ exchange (NEE) above the Songnen meadow steppe in northeastern China using the eddy covariance technique. Our specific objectives were to: (1) to describe the characteristics in variations of net ecosystem CO₂ exchange (NEE) on diurnal and seasonal scales; (2) to quantify the magnitude of a source or sink for atmospheric CO₂.

Materials and methods The measurements were performed in the Pasture Ecology Research Station of Northeast Normal University, which located in Changling, Jilin Province of China (123°44'E, 44°40'N, 167m a.s.l.). To evaluate the carbon sequestration of Songnen meadow steppe, which characterized by a large-scale pattern of meadow and alkali-saline patches, an open-path EC flux measurement tower was established in May 2007 as a member of the US-China Carbon Consortium (USCCC) for a long-term monitoring of turbulent fluxes of CO₂, water vapor and energy (123°30'E, 44°35'N, 171m a.s.l.).

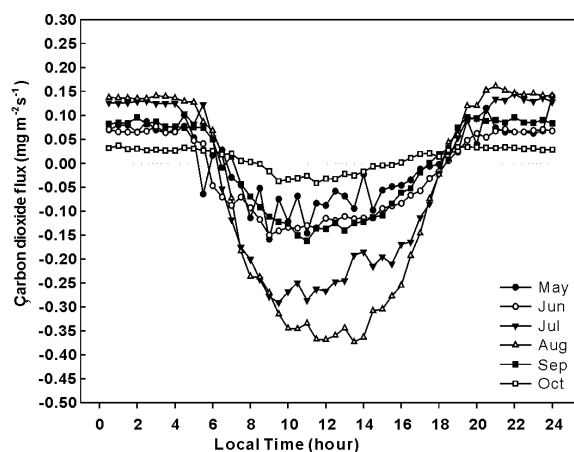


Figure 1 The monthly-average diurnal variations of CO₂ fluxes over Songnen meadow steppe during the growing season in 2007.

Results and discussion Apparently in Figure 1, the carbon assimilation was lower in the initial phase of growing season, which caused NEE in the daytime near the size of NEE at night. The rapidly growth of *Leymus chinensis* was respect to rising temperature and soil moisture. From June, NEE in the daytime started to increase and maintained a fairly higher than that at night for a long time until back to balance in September subsequently. An average CO₂ uptake reached a maximum of $-0.37 \text{ mg CO}_2 \text{ m}^{-2} \text{ s}^{-1}$, which can be seen in August when aboveground biomass peaked and higher than the steppe in Inner Mongolia ($-0.29 \text{ mg CO}_2 \text{ m}^{-2} \text{ s}^{-1}$, Zhang et al., 2007). The Songnen meadow steppe acted as a net sink of atmospheric CO₂ and sequestered 87.73 g C m^{-2} during the growing season in 2007.

Conclusions The diurnal amplitude of net ecosystem CO₂ exchange (NEE) over Songnen meadow steppe varied substantially within the peak growing season, and there was a marked seasonal trend that NEE was regulated by the temperature and amount of precipitation. Firstly given the importance of Songnen meadow steppe as a terrestrial carbon store and argument concerning its carbon sink strength, this study will help to reduce uncertainties in carbon accounting for eastern Eurasia steppe.

References

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