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Zhidan Wen, Kaishan Song, Ying Zhao, Xiuliang Jin

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Carbon dioxide and methane supersaturation in lakes of semi-humid/semi-arid region, Northestern China

Zhidan Wen^a, Kaishan Song^{a,*}, Ying Zhao^{a, b}, Xiuliang Jin^a

^a Key Laboratory of Wetland Ecology and Environment, Northeast Institute of Geography and
Agroecology, Chinese Academy of Sciences, Changchun 130102, China

6 ^b University of Chinese Academy of Sciences, Beijing 100049, China

* Corresponding author. (E-mail address: songks@neigae.ac.cn; Address: Northeast Institute of
 Geography and Agroecology, Chinese Academy of Sciences, Changchun, China)

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Abstract Understanding concentrations of carbon dioxide (CO₂) and methane (CH₄) 10 11 in lakes is an important part of a comprehensive global carbon budget. We estimated data on the partial pressure of CO_2 (pCO₂) and CH_4 (pCH₄) from sampling with 95 12 lakes in semi-humid/semi-arid region of Northestern China during ice-free period. 13 14 Both pCO_2 and pCH_4 varied greatly among the study sites. $p(CO_2)$ values in these 15 lakes ranged from 21.9 to 30152.3 µatm (n=403), and 91% of lakes in this survey 16 were supersaturated with CO₂. $p(CH_4)$ values ranged from 12.6 to 139630.7 µatm 17 with all sites in this study of CH₄ sources to the atmosphere during the ice-free period. 18 The collected urban lakes samples exhibited higher pCO_2 and pCH_4 than wild lakes 19 samples. Either the mean value of $p(CO_2)$ or $p(CH_4)$ in saline waters is higher than in fresh waters. Correlation analysis implied that the partial pressure of the GHGs (CO₂ 20 21 and CH₄) showed statistically correlations with water environment indicators like pH, 22 dissolved organic carbon (DOC), total nitrogen (TN), total phosphorus (TP), and 23 chlorophyll a (Chla). However, the most of the relationships showed a high degree of 24 scatter, only pH might be used as the predictor of the gas partial pressure based on the result of this study (r_{pCO2} =-0.437, p<0.01, n=382; r_{pCH4} =-0.265, p< 0.01, n=400). 25 Furthermore, salinity could be a good predictor for $p(CO_2)$ and $p(CH_4)$ in 83 26 freshwater lakes in our study ($r_{pCO2}=0.365$, $r_{pCH4}=0.323$, p<0.01, n=348). The mean 27 CO_2 flux increased with the decreasing lake area size. The calculated annual areal 28 carbon emission rate is 560.2 g C m⁻² from 95 lakes in Northestern China. We could 29 not extrapolate carbon emission from these lakes to the boreal region or a wider scale 30 31 because of the change of environmental conditions.

32 Keywords: carbon dioxide, methane, carbon cycling, lakes

33 1. Introduction

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