

Interactive comment on “Modeling the impediment of methane ebullition bubbles by seasonal lake ice” by S. Greene et al.

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1. Since diffusion rate in the air is much greater than that in water, the rate limiting process is diffusion of methane in water in air-water exchange. The diffusion rates of dissolved gases in water strongly depend on wind velocity. The effective thickness of diffusion layer in Eq.(1) in this manuscript might be change in wind velocity. Generally, since it is too difficult to measure the thickness of diffusion layer or to measure the concentration distributions of gases in the thin layer, the gas transfer coefficients k are empirically determined as proportional coefficients to the difference of bulk concentrations (chemical potentials) between air and water. Many values were proposed for CO₂ exchange between air and ocean (Nightingale and Liss, 2003). I believe (Sasaki et al., 2010) that the air-lake transfer coefficient of CO₂ proposed by Cole and Caraco (1998)

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is applicable to such small and shallow lakes in this manuscript, though the conversion of value for CO₂ to that for CH₄ is needed using Schmidt number. In this equation, the wave effect by wind (bubble formation with wave breaking) is evaluated weaker. I would like to ask authors to consider the wind effect on lake to air diffusive flux of methane in the future.

Nightingale P.D. and Liss P.S. (2003), Gases in seawater, in *The Oceans and Marine Geochemistry*, ed H. Elderfield, Vol 6 of *A Treatise on Geochemistry* (eds Holland and Turekian) Ch 3, 49 – 82.

Cole, J. J., and N. F. Caraco (1998), Atmospheric exchange of carbon dioxide in a low-wind oligotrophic lake measured by the addition of SF₆, *Limnol. Oceanogr.*, 43, 647–656.

Sasaki, M., et al. (2010), Air-lake exchange of methane during the open water season in Syowa Oasis, East Antarctica., *J. Geophys. Res.*, 115, D16313, doi:10.1029/2010JD013822.

2. There are no dissolved oxygen concentrations (DO) of water column during the ice-covered season in this manuscript. When an oligotrophic lake is capped by ice cover, DO is supersaturated because of biological activity (perhaps, photosynthesis of mosses and algae at the bottom of lake) (Yoshida, et al., 1975). If similar phenomenon commonly occurs in seasonal ice-covered shallow lakes, the supersaturated DO must accelerate the methanotrophy of dissolved methane during the ice-covered season analyzed by Eq.(6) in this manuscript.

Yoshida, Y., T. Torii, S. Nakaya and K. Moriwaki (1975), *A Limnological Study of Some Lakes in the Antarctic*, The Royal Society of New Zealand, Wellington, 311-320.

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