Specific comments on the manuscript by

S. Greene, K. M. Walter Anthony, D. Archer, A. Sepulveda-Jauregui, and K. Martinez-Cruz
“Modeling the impediment of methane ebullition bubbles by seasonal lake ice”

from Victor Stepanenko (Lomonosov Moscow State University)

p.10864, l.19 Reference to (IPCC, 2013) is not relevant to an estimate of 35% contribution of lakes in global natural surface methane emissions. Fig.6.2 at p. 474 of (IPCC, 2013) gives us an upper estimate of 25% for freshwaters, i.e. for lakes, rivers and reservoirs.
p.10866, l.8-10 This goal is very broad and formally involved numerous processes in a lake, that are not covered (and can hardly be) by the paper.
p.10864-10866 The authors give a traditional view on the origin of methane in lakes (via organics decomposition in anoxic environment), but there is evidence for other important sources of methane in lacustrine systems (see, e.g. Tang et al., 2014, http://www.aslo.org/lo/toc/vol_59/issue_1/0275.html)
p.10868, l.2-7 Not clear, how the interpolation of water level using atmospheric precipitation was done during the ice-period.
p.10870, l.18-20, It is not clear, why 30-day averaging was needed to perform three times. Single 30-day averaging smooths time series considerably. Moreover, was it checked that three-times smoothing didn't change significantly the annual (seasonal) accumulated fluxes?
p.10873, l.16-17, It is appropriate to mention the method for footprint estimation.
Section 2.2.10. Since the bottom diffusive flux of methane is usually very variable across the lake bottom, with much higher values on shallow sediments, more details should be given on how the diffusive flux was measured in Vault Lake: the number of replicates, the location of measurements, etc. Moreover, as the temperature in shallow sediments undergo profound annual cycle, the annual cycle of diffusive methane flux there is also significant. So, assuming constant rate of methane release from sediments for all the study period may cause considerable errors.
p.10875, l.16 Equation (3) does not come from (2) if z_w = z_s = 0.
p.10876, l.14-15 “...the amount of released...” → probably, should be “...the amount of methane released...”
p.10877, l.22 Avoid referring to gas bubbles below the ice as to “air bubbles”, as their composition is very different from that of air.
p.10880, l.2 (Lofton et al., 2013) reference is missing in bibliography.
p.10880, l.6-9 Including vertical methane and O_2 concentration gradient would have had significant effect on the water-column-top methane concentration had hence on its emission to the atmosphere via diffusion and during “ice flooding” events.
p.10881, l.6-9 Did this CH_4 concentration behaviour occurred before ice-melt? Explicitly mentioning it in this part of text would clarify for the reader that this top-water-column methane accumulated before ice-melt.
p.10881, l.12-16 To my opinion this is a weak point in the methodological part of the study and might affect results significantly. First, the diffusive methane flux to the atmosphere largely depends on the turbulent state of the lake mixed-layer and the near surface atmospheric layer. Thus, instead of using two constants in (1), D_{CH_4} and \delta_{eff}, in many studies wind-dependent exchange coefficient is used (Cole & Caraco, 1998) or more sophisticated parameterizations (MacIntyre et al., 2010)(Heiskanen et al., 2014). And second, using the same summer CH_4 concentration in 2011 and 1012 may also impose significant errors in emission rate to the atmosphere. The authors should provide estimates on how these approximations affect the results that are of the main focus in the paper.
p.10882, l.20-25 These two sentences cause two confusions. First, for C seep sites 85% vs. 72% CH_4 contribution to bubble composition in fresh and encapsulated bubbles, respectively, is called significant difference. However, the very similar difference for B-type bubbles in the next sentence

is called “not significant” (83% vs. 72%). I can guess, that it is due to large standard deviation in the second case (83% +- 12%), but for the C seep bubbles standard deviation is not given. And second confusion is caused by the difference between methane concentration in two B-type encapsulated bubbles (72% and 14%), whereas no comment is given on such large difference.
p.10885, l.10-11, I would remove “either by seep ebullition or diffusion”, or rephrase appropriately, because it may be understood by a reader from this sentence, that for both methane transport modes the fraction of methane consumed by methanotrophs is the same.

Cole, J. J., & Caraco, N. F. (1998). Atmospheric exchange of carbon dioxide in a low-wind oligotrophic lake measured by the addition of SF6. *Li*, *43*(4), 647–656. doi:10.4319/lo.1998.43.4.0647

Heiskanen, J. J., Mammarella, I., Haapanala, S., Pumpanen, J., Vesala, T., MacIntyre, S., & Ojala, A. (2014). Effects of cooling and internal wave motions on gas transfer coefficients in a boreal lake. *Tellus B*, *66*. doi:10.3402/tellusb.v66.22827

MacIntyre, S., Jonsson, A., Jansson, M., Aberg, J., Turney, D. E., & Miller, S. D. (2010). Buoyancy flux, turbulence, and the gas transfer coefficient in a stratified lake. *Geophysical Research Letters*, *37*(24), n/a–n/a. doi:10.1029/2010GL044164