The authors are grateful to the anonymous referee for carefully reading the manuscript and proposing a number of valuable improvements to the text. They are addressed in the table below.

Referee's comment	Authors' response
3-5. I would recommend to omit this sentence or to rephrase, because: a) it is not a good idea to make reader to evaluate author's knowledge from the very beginning (from abstract), b) the "knowledge" is changing and future readers won't understand what it is about. If authors want to rephrase I would suggest to indicate what is exactly included in their general form of 1D diffusion-type equation.	The sentence is removed.
8-9. It is a good result, but not the only one and not the best one. I would suggest theauthors to extend the list.	*The abstract is extended by the following text:* "The model is validated vs. comprehensive observational dataset gathered at Kuivajarvi Lake (Southern Finland) demonstrating a fair agreement. The value of a key calibration constant, regulating the magnitude of methane production in sediments, corresponded well to that obtained from other two lakes. We demonstrated via surface seiche parameterization that the near-bottom turbulence induced by surface seiches is likely to significantly affect CH_4 accumulation there. Furthermore, our results suggest that a gas transfer through thermocline under intense internal seiche motions is a bottleneck in quantifying greenhouse gas dynamics in dimictic lakes, calling for further research."
25. I would recommend a brief outline of the models listed here, showing what are their advantages and disadvantages, what ideas were taken and what approaches were used and developed in presented model.	*This paragraph is rewritten as follows (amendments denoted by **bold**):* "Concomitantly with growing awareness of lakes significance for current and future climate change, few attempts have been made to develop lake models, incorporating thermodynamics, turbulence and biogeochemistry in order to simulate CH_4 and CO_2 in natural water bodies (Stepanenko et al., 2011; Kessler et al., 2012; Tan et al., 2015). study the response of lakes and their greenhouse gas emissions **to the** future climate change \ (Tan and Zhuang, 2015b) and **to assess the relevant feedbacks through** implementation of biogeochemical lake models into the Earth system models. **These lake models rely on well-established 1D thermodynamic and turbulence closure schemes, whereas**

	biogeochemical modules proposed are still not convincingly constrained on the data from sufficient number of lakes representing different regions. Moreover, physical schemes of lake models have to be reconsidered to match new requirements posed by biogeochemical modules, e.g. distinguishing between shallow and deep sediments, accurate treatment of hypolimnetic and thermocline mixing, etc. In the LAKE model version 2.0, presented here we address some of these questions and propose corresponding model improvements."
45-46. It is not clear what does it mean. Please, omit or rephrase.	*The whole paragraph is rewritten (amendments denoted by **bold**):* "The obstacles described above hinder development of mathematical model **from first principles**. Therefore, any lake greenhouse gas model would **inevitably** contain a number of empirical constants to be calibrated on an extensive dataset (Tan et al., 2015a), what is a usual practice in e.g. wetland CH_4 models models (Walter et al., 1996; Walter and Heimann, 2000; Wania et al., 2009; Melton et al., 2013). **As the calibration is often performed via formal optimization algorithms, the errors caused by inconsistent or incorrect mathematical formulations in the model are compensated by incorrect (but "optimal") values of calibration parameters (right result from compensating errors).**"
50-52. What kind of problems this model is supposed to solve? I think this is the key question in designing a model, but it is not answered here. 54-55. Why vertical turbulent flux through hypolimnion and metalimnion are of special concern? Please, explain. 55-56. What is going to be a development? What was wrong with LAKE? Please, describe a progress.	*This paragraph now has the form (amendments denoted by* **bold**): "This work aims at developing the lake model based on rigorous mathematical development feasible in framework of 1D approach, applied for thermodynamic, hydrodynamic and biogeochemical prognostic variables in unified manner. We avoid using procedures for formal optimization (calibration) of the model parameters, rather focusing on qualitative behaviour of the model and its sensitivity to selected uncertain processes and constants. **The choice of processes and comprehensiveness of their mathematical representation is made to target the fair model performance in: (i) lake thermodynamic regime (temperature profile, energy fluxes), (ii) O_2, CO_2, and CH_4 concentration distribution in the water**

	column and fluxes to the atmosphere, and (iii) vertical transport of water properties in order to ensure (i) and (ii). Vertical turbulent flux of dissolved gases through hypolimnion and metalimnion are of special concern in this work, **since CO_2 and CH_4 mostly originate in the hypolimnion, while the major interest for community is how much of these species evade to the atmosphere.** The lake model, developed here is based on LAKE model, that has been continuously advanced during last decade in Moscow State University (Stepanenko and Lykossov, 2005; Stepanenko et al., 2011) and was extensively validated in LakeMIP experiments (Stepanenko et al., 2010, 2013, 2014) in terms of lake temperature and energy fluxes. **The main development of LAKE 2.0 compared to LAKE includes biogechemical module, describing processes related to O_2, CO_2 and CH_4 dynamics, multiple columns of sediments (facilitating heat and gas exchange between water column and sediments at different depths) and surface seiche parameterization."**
68. Please, give more details about "certain physical processes" here.	*The new variant of the sentence:* "In Section 5, we analyze results of reference experiment as well as of sensitivity experiments, elucidating significance of vertical gas transport induced by surface and internal seiches. "
90. "c" cannot be a specific heat because of conflict of units.	*Equation (1) contained a typo, now it is corrected:* $$c\frac{\partial f}{\partial t} = -c\frac{\partial u_i f}{\partial x_i} - \frac{\partial F_i}{\partial x_i} + R_f(f, ...)$$
99. A(z) is an area (!) of horizontal cross-section, isn't it? Not a cross-section.	*Yes, corrected.*
99. Why diffusion and dissipation are slashed here. They are quite different processes. Kf is not a diffusion (neither a dissipation) but is used to parameterize diffusion, but parameterization of dissipation could not necessarily use it.	*Agree, this textblock is rewritten as follows:* "k_f the turbulent diffusivity (conductivity for temperature, viscosity for momentum) coefficient for variable f"
169-170. The above conditions (166-168) say nothing about gas concentrations, how could gas concentrations be affected by them and what are the conditions for gas concentrations?	*The paragraph is amended (changes marked by* **bold**): "**The same options hold for CH_4 concentration, as diffusion-type equations are solved in the water column and in each**

	sediment column for this property as well (see Sections 2.6.1 and 2.6.2). We found that the first option provides reasonable results for temperature and especially for **CH_4** concentrations (see below in the paper), whereas the second one needs calibration of parameters entering the flux-gradient relationship in the bottom boundary layer. The marginal heat flux is calculated using the same temperature (**CH_4 concentration**) and flux continuity condition, that is facilitated by the solution of vertical heat (**CH_4**) transfer in sediments below sloping bottom (see details in Section 2.5)."
284-286. Some sentences, like this one, attribute a model description to a specific lake study, but the aim of the paper is a model development. I would suggest to address the absence of methane production in model to a further development not to "the lake under study".	*The sentence is corrected to:* "Deep CH_4 production from old organics near the bottom of talik is included in the model (Stepanenko et al., 2011), but in Kuivajarvi Lake simulation presented here it is switched off because this lake is not a thermokarst one."
379-380. I was confused with the mixture of variables and their units here. What if to specify units somewhere else? They are all listed in "List of symbols" along with their units. Why not to omit units in text?	*All units in the text are omitted, except for where values of variables are given.*
383-384. It is not clear for me why argon is important when consider the bubble gases and water vapor is not. Could you explain, please?	*The paragraph in the corrected text (***bold** *denoting changes):* "Five gases are considered in a bubble: CH_4, CO_2, O_2, N_2 and Ar. Water vapour constitutes minor contribution to a bubble pressure, and therefore neglected. Indeed, the saturated vapour pressure at 20 C is 23.4 hPA that is 2% of atmospheric pressure. This is the upper estimate for water vapour pressure contribution in bubbles, as the pressure increases with depth, and saturation vapour pressure -- decreases, due to water temperature drop. **Similar estimates hold for Ar, though it is formally included in the bubble model.**"
600-620. Could you explain somehow the saw-shape methane concentration at the bottom in "reference" model results (Fig 9a)?	*The new paragraph is added here:* "The "SS-" experiment (Fig. 10) provides a clue for explanation of the saw-like pattern of CH_4 concentration in the reference model run (Fig. 9a). The closer joint inspection of Figs. 7a and 9a reveals that CH_4 drops near bottom coincide in time with O_2 jumps. Oxygen jumps are evidently caused by enhanced vertical mixing, as there are no oxygen sources at large depths. In

	contrast, such mixing events completely absent when surface seiches are switched off (Fig. 10). This leads us to a firm conclusion, that the variability of mixing and respective gases concentrations variations are caused by surface seiches intensified by increased wind forcing events.”
810. Good place to introduce BOD and SOD abbreviations, because of their further use.	*Agree, done.*
861. “Wee”.	*Corrected.*
903. (and somewhere else) Change “U.Svensson” to “Svensson” or add initials to others, for example, “G.L. Mellor and G.-H. Goudsmit” (914)	*Agree, initials are removed everywhere.*
Figures 5-14. Poor quality of lines and text. I only have an idea what it is written in legends after multiple zoom.	*All the figures are enlarged.*
Figure 13. Some lines are declared in legend but not available in plot.	*The legend is corrected accordingly.*