Geoscientific
Model Development

Discussions

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Interactive comment on "LAKE 2.0: a model for temperature, methane, carbon dioxide and oxygen dynamics in lakes" *by* Victor Stepanenko et al.

Anonymous Referee #1

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This paper presents 1D model for a lake, describing an evolution of horizontally averaged vertical distribution of water temperature, momentum, concentrations of oxygen, carbon dioxide and methane. It includes a module simulating heat and moisture processes in sediments, a module for a gas bubbles, and biogeochemistry modules for CO_2, CH_4 and O_2. The whole set of coupling modules, which makes LAKE 2.0 model, was tested against the Kuivajarvi Lake observations and showed a fair agreement. The paper presents a substantial advance in modeling of geophysical enclosed water bodies. The methods and assumptions are valid and clearly outlined. The interpretations and concentrations are properly supported by results.

The abstract does not provide a complete summary, but could be revised to include more results.

English is not my native language. Some sentences sound strange to me, but I cannot give an expertise.

I found the paper to be very interesting and well-written. The experimental set-up is well-conceived, and the analysis seems sound and comprehensive. The model simulations and configurations are well documented. I have no hesitation in recommending this manuscript to be published. I recommend to improve quality of plots, some of them look bad. I do have a couple of minor comments that the authors can address at their convenience.

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.

8-9. It is a good result, but not the only one and not the best one. I would suggest the authors to extend the list.

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.

45-46. It is not clear what does it mean. Please, omit or rephrase.

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.

68. Please, give more details about "certain physical processes" here.

90. "c" cannot be a specific heat because of conflict of units.

99. A(z) is an area (!) of horizontal cross-section, isn't it? Not a cross-section.

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.

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?

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".

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?

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?

600-620. Could you explain somehow the saw-shape methane concentration at the bottom in "reference" model results (Fig 9a)?

810. Good place to introduce BOD and SOD abbreviations, because of their further use.

861. "Wee" .

903. (and somewhere else) Change "U.Svensson" to "Svensson" or add initials to

others, for example, "G.L. Mellor and G.-H. Goudsmit" (914)

Figures 5-14. Poor quality of lines and text. I only have an idea what it is written in legends after multiple zoom.

Figure 13. Some lines are declared in legend but not available in plot.