

Interactive comment on “Mathematical modelling of positive carbon-climate feedback: permafrost lake methane emission case” by I. A. Sudakov and S. A. Vakulenko

Anonymous Referee #2

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This manuscript presents an approach to theoretical modelling of methane emission from Siberian lakes. The main assumption is that lakes are shallow, which is in contrast with some other work on this topic. The focus is on positive feedback where methane-induced increase in global warming speeds up methane emission. The research is very well motivated and authors stress their "new approach to the problem". However, they could better identify what is new by a direct comparison(s) to other approaches; the relevant discussion in section 5 has no references. The paper does not mention important previous work on modelling of thaw-lake growth and methane emission that can be found using a quick Google search.

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I have tried to follow the mathematical part of this work. I must say that it is cluttered with typos and inconsistencies, which make it confusing and often difficult to follow. It appears that the manuscript was prepared in a hurry without much consideration. This is a shame as the work is potentially very interesting to the community. Below I mention just a few (of many) points that should be clarified.

The language is not precise and there are grammar errors.

There is no consistency in indicating the dependence of different variables on x, y, z , and t , to better distinguish variables from parameters.

On page 240, how can $\tanh(x/\epsilon)$ be a solution to (9)? It does not depend on z .

What is "the case C" mentioned on pages 241-242?

The same variable S is used in (15) and (17) in relation to different quantities. What is more, S is also used to denote the total lake area later in the paper.

Above (16), "Delta s " should be "Delta S ".

Please explain how a differential equation for the lake-radius growth (18) can be a form of an algebraic equation (16).

On page 243 there are references to equations (20) and (21) which should clearly point to some other equations.

At the end of the first paragraph on page 244, the deterministic case is $dR/dt = \delta - \kappa/R$, where $\kappa = \kappa(x, y, z, t)$ according to (16). This is in odds with equation (19) where $R/dt = \delta - \mu/R$, where μ is a constant. Why?

Why is the Pareto law coefficient k referred to as feedback coefficient on page page 249? I thought the feedback coefficient was denoted with γ .

What is different in figures 2-4: k or γ ? I cannot see any "true Armageddon" in figure 4. In fact, the temperature at 500 years is noticeably lower than in figure 3.

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Also, (rather unclear) captions claim that there is less methane in the presence of lake influence? The lake area should have units of meter squared, not meter.

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