

Interactive comment on “How sensitive are modeled contemporary subsea permafrost thaw and thickness of the methane clathrates stability zone in Eurasian Arctic to assumptions on Pleistocene glacial cycles?” by Valentina V. Malakhova and Alexey V. Eliseev

Anonymous Referee #1

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The paper presents a sensitivity study of the HSZ to details of sea level change and the consequent incursion and retreat of shelf sea inundation over the continental East Siberian Continental shelf. The shallow seas are exposed to the cold atmosphere for longer and hence form a deep permafrost layer. Depths at which the permafrost melts during each interglacial result in temporary hydrate stability zones, and I would presume low reservoirs of hydrates. The message is that time lags in ablation of the hydrate stability zone suggest that release of hydrate is a long process, and the timescale

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of anthropogenic warming is comparatively short. The paper is poorly written, the logic is hard to follow. The paper fails to present the science-driven issue – what is currently understood and why is this particular study advancing the field. What is expected of the study and how does it achieve its ends. Clearly this is associated with the initial conditions of anthropogenic climate change and the rate of future emissions such as described in the papers below. All these papers make use of a sediment model for the HSZ to the model itself is not unique. The authors do recognise this and so do not use much text to describe it. Even though it may not be the best model available, it is adequate for the task to which it is applied – namely a sensitivity study. Kretschmer, K., A. Biastoch, L. Rüpke, and E. Burwicz (2015), Modeling the fate of methane hydrates under global warming. *Global Biogeochem. Cycles*, 29, 610–625. doi: 10.1002/2014GB005011. Marín-Moreno, H., T. A. Minshull, G. K. Westbrook, B. Sinha, and S. Sarkar (2013), The response of methane hydrate beneath the seabed offshore Svalbard to ocean warming during the next three centuries, *Geophys. Res. Lett.*, 40, 5159–5163, doi:10.1002/grl.50985. The paper is rather too qualitative in that it does not attempt to quantify the uncertainties associated with the timing of the ocean inundations. It could perhaps use a metric of the volume of the HSZ as a function of the phase of the inundation. The writing of the paper still retains Russian phraseology with missing English definite article ('the') and indefinite articles ('a' and 'an'). I have suggested some changes for the introduction below, but the issue of confused logic and linguistics is common throughout, and would require major effort to provide corrections.

Detailed comments This title needs to be shortened. Perhaps - "The stability of contemporary Eurasian Arctic methane hydrates to Pleistocene glacial cycles". NOTE: you use 'hydrates' in the abstract and HSZ throughout so the title should use the same nomenclature Page 1. Line 1-8. The abstract needs to start with a sentence of context. What is the scientific question being addressed and why is this important? i.e. "Why should I read this paper?" Line 1-2. Single-point simulations with a model, describing the thermal state of subsea sediments driven by the forcing constructed from ice core



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data, show that the impact of the initial sediment conditions is lost after \sim 100 kyr. Line 3-5. The timings of continental shelf exposure during oceanic regressions, and flooding during transgressions, are important for the representation of the sediment thermal state and hydrate stability zone (HSZ). Line 11. Replace 'in last' with 'over the last' Line 12. Replace "is not known with a sufficient certainty" with "is not well known" or otherwise you need to quantify "sufficient certainty" Line 13. Rather than addressing a "controversy" it might be better if the paper were presented as "reducing uncertainty", rather than about taking sides in a controversy. I thus suggest replacing "there are controversial claims about origins" with "there is uncertainty about the origins" Line 17. I suggest "The uncertainty in the driver of methane release has important implication for the release rate from hydrates over the coming centuries (O'Connor et al., 2010)" Line 19. I suggest "Understanding may be improved, in principle, by means of" page-1 Line 20 to page 2 Line2. I suggest "Such modelling contains its own uncertainties associated with its parameterisations (e.g.) as explored by Eliseev et al (2015), and initial state originating from sea level changes during glacial cycles."

Page 2. Line 3. Replace "assumptions" with "approximations" Line 4. 'Obviously' is redundant, start with "The timing of the regressions and transgressions depends on the contemporary shelf depth" Lines 7-11. Poorly posed. I suggest "Previous studies either assume instantaneous exposition and flooding over the entire shelf (Portnov et al., 2014; Razumov et al., 2014), or that the permafrost, formed during the last glaciations, persists up to the present (Denisov et al., 2011; Anisimov et al., 2012). Line 12. Suggest "The impact of such approximations on the presence of the hydrate stability zone (HSZ), the region of the subsea sediments in which hydrates are thermodynamically stable, regardless of their presence or not, is still unexplored. With this purpose we undertake a series of one-dimensional simulations using a model describing the thermal state of subsea sediments."

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