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Discussions

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Interactive comment on "Assessing the potential for non-turbulent methane escape from the East Siberian Arctic Shelf" *by* Matteo Puglini et al.

Anonymous Referee #1

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Dear Editor, I read the manuscript by Puglini et al. you asked me to review for Biogeosciences. Hopefully, there are other reviewers that know more about modeling than I do, because I feel not 100% confident about judging part of this manuscript. Despite this (partly) mismatch, I found the manuscript well-outlined, clear and an overall pleasure to read. The manuscript focuses on non-turbulent methane escape from the East Siberian Arctic Shelf and evaluates the main physical and biogeochemical controls (for example organic matter quality, sedimentation rate, AOM rate...) on the efficiency of the biofilter that regulate non-turbulent methane emission. The authors conducted a comprehensive steady state sensitivity study through a of two baseline scenarios, active and passive case. Since the manuscript does not comprise the methane escape by bubble ebullition, a conclusion for overall gas escape on the East Siberian Arctic

Shelf cannot be ruled out but still, this is a very interesting contribution for the scientific community interested in this area and in methane related processes.

The manuscript address relevant scientific questions within the scope of Biogeosciences, and it present an interesting modelling approach to quantity the non-turbulent methane escape from the East Siberian Arctic Shelf. The conclusions are substantial, and the scientific methods and assumptions valid although a bit more technical while describing the modelling parameters. The results clearly support the the interpretations and conclusions of the manuscript. The manuscript cites the relevant paper then the number and quality of references seem to be appropriate. I have only few comments and I therefore suggest to accept this manuscript after moderate revisions.

General comments: The abstract is very long and contains too many information. Suggest to re-write it in a more concise way. The same comment is valid for the chapter 3.3.1 Window of opportunities, here there are interesting observations, but sometimes slightly verbose. The authors indicate that the active sediments are influenced by Âńa deep methane sourceÂż. then at the end of the paper they define that the deep methane source is ca 3 m below the seafloor, which is not exactly very deep. Would, it be possible to find another term instead of "deep"? In any case, this has to be better defined at the beginning of the manuscript. Specific comments: Page 2 Lines 17-18: "Under these conditions, permafrost aggraded on the shelf and was subsequently submersed when rising sea level flooded the shelf during the Holocene sea transgression (12 and 5 kyr BP)". Reference is needed.

Page 2 Line 19: explain what is "gas hydrate"

Page 2 Lines 29-30: "The increasing influx of warmer Atlantic water into the Arctic Ocean - the so-called Atlantification . . .". This term need to be explained and relevant papers need to be cited. In both "Zhang et al., 1998; Biastoch et al., 2011" the term Atlantification is not mentioned. Page 2 Line 2: what destabilize gas hydrate? Pressure changes or temperature increase? Or what? Page 4 Line 6: which are the "changes

in environmental conditions" mentioned here? Page 4 Line 12: for methane emissions and fractures, it might be useful to read a recently published paper in Biogeosciences "Yao et al., 2019". Biogeosciences, 16, 2221–2232, 2019

Rage 4 Line 19: What are the "passive and active sediments"? although there is some explanation later in the manuscript, these concepts need to be explained here, as soon as they are mentioned in the text. Page 6 Line 15: what about the anaerobic oxidation of methane? Page 9 Line 10: why the authors have assumed both baseline scenarios a water depth of 30 m when the average water depth of the ESAS is âĹij45 m (data from James et al., 2016)? Page 9 Line 28: is the trawling in the area affecting gas hydrate stability also? Is the gas hydrate close to the seafloor? Where is the real sediment depth? Which is the thickness of the sediments that is affected by trawling? Few cm or maybe 1 meter? Page 17 Line 13: "rapidely". To be corrected Page 23 lines 26-29: Would it be possible to better explain this concept here? I found very difficult to follow the reasoning here and related gas saturation concentration with precipitation of authigenic carbonate. Page 24 Line 28: Lena river and Moustakh Island in the Buor-Khaya Gulf need to be included in Figures and captions. As a general rule, all the locations that are mentioned in the main text need to be reported in location maps and relative captions. Page 26 Lines 16-17: The authors indicate that Additional physical reworking such as ice scouring or dredging, or the absence of bioirrigation, which is known to be patchy in Arctic sediments could even further reduce estimated methane effluxÂż. I would assume that these processes might enhance the methane fluxes instead since they remobilize sediments. More elaboration is needed here. Page 26 Line 25 ′: "Artic's". To be corrected Page 26 Line 26: How does it happen that "increasing sedimentation rates occur through coastal erosion"? please clarify. Page 28 Lines 33-34: "we show that methane from deep sources (ca. 3 m) reaches the sediment water interface within 7 to 20 years." A comment on the fact that 3 meters is considered deep has been previously reported. Page 29 Line 29: wording Âńwhich is in turn is determined". Chapter 3.3.1 this chapter is not very well organized and it is difficult to follow. Page 33 Lines 25-26: ÂńOn the ESAS, AOM is a transport-limited process

and transport parameters thus exert an important control on the efficiency of the AOM biofilter and, thus, on methane efflux". Please rewrite in a more clear way. Page 33 line27: what does "sedimentation and active fluid flow" in brackets mean respect the advective transport?