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Discussions
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Interactive comment on "Microbial activity, methane production, and carbon storage in Early Holocene North Sea peats" *by* Tanya J. R. Lippmann et al.

Anonymous Referee #2

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Note from reviewer: I do not have expertise in the experimental elements of this manuscript, thus my critique of microbial activity, gene sequencing and methane production is limited. General comments This manuscript documents a significant carbon store in the North Sea during the last glacial-interglacial transition, with experiments to understand the precise microbial activity and methane production/potential. The authors use gene-based sequencing to understand the microbial community structure and to explore the role and potential of peat microbial communities in carbon (methane) cycling. A key contribution of this work is quantifying these peats via observations/measurements and incubation experiments to determine the carbon storage potential with implications for better understanding the role of peat deposits in the

global carbon budget. This manuscript is well written and contributes important knowledge for better understating the role of buried peats in the carbon cycle. Two overall suggestions (1) keep discussion and result separate. For example, "capped by either shallow marine clay or sands" should perhaps move the 'shallow marine' interpretation to the discussion section. There are countless other examples of discussion embedded into the results section, for example starting at L477-L484. This would help with the organization of the manuscript. Also (2) perhaps place more emphasis on the global implications of this work for the carbon budget ie. How much does this change our estimates of carbon stores? What are the potentials for this carbon to be released in the future? Are there any other regions where a similar peat has been deposited? Specific comments L70 – "ice sheets reaching as far south as the Doggerbank area were subjected to strong glacio-isostatic adjustment" – ice sheets were subject to GIA? Or the earth was subject to GIA? please clarify. L95 – "task of measuring CH4 stores remains challenging" – why is this the case? L145 – why were these sites chosen for microbial sequencing? This is unclear. Do they provide good spatial coverage that is representative of the region? L213 – same as above. why were these particular sites chosen for microbial sequencing? This is unclear. L325-327 – this mixture of high/low sampling resolution and high/low taxonomic resolution is interesting. Perhaps an extra line on why this technique was chosen? L391 – " the thickness of the peat layer does not appear to play a determining role in CH4 concentrations, as both thick and thin peat layers harboured both high and low CH4 concentrations" – this is an interesting finding of this work, with implications for carbon modelling of paleo-peatlands. Is it possible to show this graphically? A quick plot showing thickness vs. CH4 concentration? L420 – The header suggests that this section will contain information on plant macrofossil communities, but there is no such information here. L489 – given the high spatial variability in peat thickness, I would expect to see (large?) errors on this estimate. What uncertainties were incorporated into this calculation and how do they impact the resulting error? L614 – what is meant by "from a similar period"? is this referring strictly to the time interval, or the sequence of events (SL rise) that would cause these peats to

be buried? Fig. 1 – Does the 3rd panel "North Sea basin" refer to present-day conditions? It might be worth clarifying. Fig. 1 caption – "The distribution of tsites within this sampling area" – sites?