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Ocean Science
Discussions

Interactive comment on "High-resolution under-water laser spectrometer sensing provides new insights to methane distribution at an Arctic seepage site" *by* Pär Jansson et al.

Anonymous Referee #1

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General Comments: As pointed out by the authors this is a FIRST, and hopefully the instrumentation described will enable a new era of high-quality data to be gathered for ocean and climate studies. The authors can document and quantify both the temporal and spatial heterogeneity of CH4 concentrations in the water column. That such heterogeneity exists is not new, but that it can be quantitatively studied is new. So far technology has limited researchers to either discrete sampling or use of sensors with long response times both making it practically impossible to describe the heterogeneities described in the present study. Coarse data allows for coarse models and budgets. This becomes evident in the data analysis presented. Although the data is high resolution, general applicability of the method for inventory (budgets) studies requires a large

amount of auxiliary data (current, CTD, TS, background/reference measurements). But this is the everyday challenge of the oceanographer (and modeller). The data will allow for substantial discussions within the modelling community. Hopefully, in the future we will see sensors with similar characteristics to that of the "MILS" fitted to groups/swarms of AUV's that can do concurrent sampling and monitoring of larger regions. This could enable true high-resolution characterization of a region of interest and enable high resolution modelling of CH4 dispersion dynamics. Such data will need to be collected in order to be able to use "bottom up" studies to build confidence in "top down" data and models used for inventory monitoring at the ocean and climate scales.

Specific comments: Page 5 L114-117: Where was the pump inlet located? This is not described in the paper nor in Grilli et al. 2018. A schematic is provided of the membrane assembly in SI3 of Grilli et al. 2018.

Page 6 L121-129: Regarding the position correction. A cylinder of height and width of the MILS probe was used. The assembly in Figure 1b show that the CTD, Battery and commercial CH4 sensor is far from symmetric, and the drag of these side mounted addons should probably have been accounted for in the position correction. These addons could also lead to a wobbling and rotation of the assembly. Was this monitored by onboard IMU sensors (inertial measurement unit)?

Section 3.1 Water properties It is not clear from the text that the current information is derived from data obtained simultaneously with the CH4 measurements. This is however stated in Jansson (2019) Figure 8b. When interpreting the inclination of the flairs is flair inclination perpendicular to the ship motion taken into account?

There can of course be unknown sources of the CH4, but there is mention of WSC meandering, and negligible tidal effects. Have typical eddy sizes been characterized? The time between transect lines 1 and 5 are by rough estimation 12 hrs i.e. roughly one tidal period. The whole cruise was two tidal periods. What is the direction of the tidal flow in this region? Both eddy size and tidal currents could result in noticeable

advection over a 12-hr period.

Page 13 L267: with the given speed of the cruise and the response time of the instrument (15 sec), spatial resolution is of the order 10m. However, how does the instrument obtain a measurement? Is it by continuous flow at a given flow rate over the membrane, or does it work in a batch mode with discrete samples passed over the membrane unit?

Page 13 L280: What is the reasoning behind scaling up the flair by 40%? Can the authors justify this quantitatively?

Technical corrections: Page 4 – L62-75 A map/graphic could be included for illustration if authors have access to graphical assistance. Page 4 – L80 and L95-97: purely cosmetic but I like it when lists come in the same order, e.g. temp, salinity and concentration. Page 7 – L150-180: I feel that the presentation in paragraphs 2.5 and 2.6 could benefit from a graphic illustrating the computational domains. I believe that this will aid the reader in understanding and conceptualizing the differences between the two methods better.

Figure 2: Second line: it should read "Gibbs seawater package". In the last line: the mean bubble rise velocity is 23 cm s-1, could you provide the mean bubble size as well?

Figure 7: The figure would be much easier to read if it was in colour.

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