The Cryosphere Discuss.,
doi:10.5194/tc-2016-156-AC1, 2017

The Cryosphere
Discussions
Open Access

Interactive comment on "Sonar Gas Flux Estimation by Bubble Insonification: Application to Methane Bubble Fluxes from the East Siberian Arctic Shelf Seabed" *by* Ira Leifer et al.

Ira Leifer et al.

ira.leifer@bubbleology.com

Received and published: 26 January 2017

Both reviewers suggested that the manuscript could use from structural re-organization and a thorough proof reading, as well as shortening. We agree and have very significantly improved the manuscript. Specifically, We moved details of the modeling to the methodology section, as well as the calibration. We also moved up and improved the study motivation. These two efforts improved the manuscripts. Prior to this, we went through the entire manuscript on a line by line basis to improve readability and add definitions.

While the concepts of bubble-bubble interactions described in equation 4 are key to the article's main point, the equation was a distraction that has been replaced by a short

discussion, given that there is no effort to apply the equation (and its main point is that our understanding is too poor to even attempt to do so).

From the point of view of sonar observations, the bubble differential equations of radius and mass change are now presented with a sentence or two describing each. These equations are important also for the bubble model.

Addressing also the comment of Reviewer 1 and Reviewer 2, a better explanation for the scoping study is now presented in the revised study motivation, which is earlier in the manuscript. Also, the bubble model description has been moved to earlier, and a better explanation of the role the bubble model plays in the analysis ties in the bubble behavior equations has been added. Additionally, the differential equation for bubble size has been added, which ties changes in mass flux to size – i.e., what sonar observes, including explanation of the terms.

New section titles all of which are correctly numbered.

The number of figures in the main manuscripts has been reduced by two.

Reviewer 1: We apologize for the lack of geographical information for Fig. 7, but this was part of the agreement necessary to have permission to release these data (a small subset of the overall data). These data were considered economically sensitive and we worked hard to be able to release even these data.

Figure 8 now is labeled properly, moreover, we also labeled all figures as to whether they are single or multiple beam sonar data on the figure for clarity.

Reviewer 2: Calibration is described as integration of all values in a depth window for both MBES and SBES.

bubble-bubble acoustical interaction in this paper is due to scattering, not as in Tang et al., from acoustic coupling due to the compressibility of the bubbles. In the latter case, this is only for very high bubble density, which is not important, agreed. In the former case scattering can occur over any distance.

Respectfully, I disagree that a detailed quantitative theoretical consideration is needed. Ghosting is a very common artifact in sonar data where the true plume ghosted as a nearby faint plume. If multiscattering can create ghosts outside the plume, it seems evident that it also occurs inside. More to the point, and we apologize if the structure of the paper confused the discussion, Figure 9 shows that sonar return does not linearly scale with volume - there are non-linear effects, which are discussed at length. We thus argue to other researchers to not consider sonar data at only one depth, but to consider sonar data at multiple depths. Initially, we started to try and in fact do a more detailed theoretical investigation, but after writing out the equations, we realized that the number of unknowns is so large as to make the study only relevant for a mathematical paper not the real world. This is part of why we have removed equation 4, which was a remnant of the earlier effort.

With respect to resonance, if one looks at typical minor bubble plume size distributions - none of these plumes were of a magnitude to be major, bubble size distributions fall off extremely rapidly, an order of magnitude in 20-30% size change, e.g., see Fig. 10. These are not broad size distribution plumes. Thus, unless resonance just happens to be at the peak, most of the signal is going to come from non-resonance bubbles. Moreover, as shown in Fig. 10, the size rapidly changes as the bubble rises, so if all the response was from resonance, why is there no such trend in the sonar return with height in either the seep bubbles or in the engineered plume bubbles in the data presented herein (Fig. 7)?

Fig. 6, has been relabeled, as sigma is not in db, and the text now explains that the figure is included because of its trend, not its absolute value. The caption clearly says integrated – other figures are average.

WRT applying the results of the numerical model, the explanation is not more clear, and is in its own paragraph on this volume correction factor.

Regarding the title, see note above about permission for release.

Technically, a histogram is a probability distribution (or density) function. We now have added this terminology to occurrence to be more correct.

We have expanded our review to include other references, including Veloso et al. Unfortunately, Muyakshin and Sauter is beyond a paywall, and since I (and also co-authors) have left our universities, getting articles behind paywalls is quite a challenge – and this paper is not available on researchgate. I am not comfortable citing an article unless I have read it.

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-156, 2016.