Reply to the interactive comments made by anonymous referee #1 on "Marine mammal tracks from two-hydrophone acoustic recordings made with a glider" by Elizabeth T. Küsel et al.

Referee # 1:
The paper is interesting as it offers a report on the use of gliders for performing acoustic surveys to detect and study marine mammals. The specific case present an interesting option based on a low cost recorder rather than custom complex dedicated electronics. However the paper appears more as a basic tech report than a scientific paper. The findings have no scientific relevance for marine biology and the authors show little expertise in the description of detected biological sounds.

Authors' response:
The main point of the manuscript was to evaluate the use of a glider fitted with two hydrophones for marine mammal population density estimation studies. Most population density estimation studies have been done with data from fixed sensors, either single sensors or hydrophone arrays. Detection, classification, and sometimes tracking and localization are inherent components of population density estimation from passive acoustics. The intent was to show what extra information or constraints a glider with two phones would provide to such studies and ultimately to adapt the existing density estimation methodology from fixed sensors to moving platforms. We also note that the described experiment was opportunistic and by no means designed as a density estimation experiment. We are making sure those points are stressed and clear in the manuscript. Finally, since Ocean Science is carrying a special issue about the experiment and the use of gliders, we thought that would be the most appropriate venue to submit our manuscript.

Referee # 1:
The findings have no scientific relevance for marine biology and the authors show little expertise in the description of detected biological sounds. Dolphin clicks and sperm whale clicks are well known now. The figures don't show the characteristics of detected events in detail, e.g. to clearly show the differences among artifacts and real signals, or to show the multi paths underlined in the text.

Authors' response:
Since, as the reviewer points outs, dolphin and sperm whale clicks are well known, we did not think it was necessary to present a detailed description of those. Moreover, as stated above, the purpose of the study was not to simply detect and classify marine mammal sounds. However, more or better figures could be easily included to show some characteristics of the recorded data outlined in the text.

Referee # 1:
The multi paths in recording biosonar clicks is well known and the multi paths can be positively used to improve the localization of sperm whales. Surface multi paths are generated by the sea surface, but often also the sea bottom generates reflections of sperm

whale clicks. With a flat sea surface reflected clicks show phase inversion, described in the text as mirror images.

Authors' response:
Multipath occurrence, of any underwater signal will depend on the geographic location, water column structure, and depth of source. In the case of marine mammal calls we don't know where they are, neither in depth nor distance from the recording sensor. Multipath can sometimes be used to aid in localizing whales. However, in order to automatically distinguish multipath in the recorded data, highly specialized algorithms are necessary. Another option is for a human analyst to manually check the data, which can be a time-consuming task. For density estimation studies, detectors of simple characterization are preferred. Therefore, the use of complex algorithms for selecting only direct arrivals was beyond the scope of this work. Our intent was not to localize animals; being able to resolve tracks is sufficient and less time-consuming for density estimation purposes. The term "mirror image" was used to describe the pattern observed in the estimated tracks shown on the bottom plot of Figure 8. We hence assumed they were likely caused by multipath, which upon visual inspection of the corresponding data proved to be true.

Referee # 1:
Advantages/disadvantages of the use of a glider are not presented.

Authors' response:
The last paragraph of the introduction lists some advantages and disadvantages of working with gliders for marine mammal studies.

Referee # 1:
Which is the impact of flow noise? How the change in depth influences the recording? Which types of noises are made by the glider itself, e.g. when it changes its asset?

Authors' response:
The sources of noise from a Slocum glider were well characterized by Kristy Moore in her thesis dissertation in 2007. Flow noise was shown to possibly affect frequencies up to 2 kHz, on a 20 kHz sampling frequency system. As we were mostly concerned with higher frequencies, flow noise was deemed not important for our application. Other noise types made by the glider include fin steering, movement of the battery, volume piston, and air pump. These are however, discrete events that do not interfere with the overall acoustic recordings and can be easily distinguished. A note about the flow and other glider noises, including the above-mentioned reference, is being added to the manuscript for completeness.
Glider depth changes would influence the recordings, again depending on the environment (bathymetry and sound speed profile) and the location of the source (whale). Transmission loss and ray calculations are being made with the local bathymetry and sound speed profile recorded by the glider at the same time the acoustic recordings were made. Such information will be added to manuscript to highlight the acoustic environment.

Referee # 1:
Is the quality of the recorder well suited to the task? Authors write about clicks with energy content increasing with frequency. Most dolphins do produce clicks with peaks above 40 kHz and up to 100 kHz and more. Recording them at close range may result in very high frequency levels that may saturate the hydrophone, its preamplifiers and even the recorder input. Also to consider the resonance of the ceramics in the hydrophones and the possible aliasing effect induced by the intrinsic a-a filters of the recorder that may "reflect" the acoustic energy above Nyquist down to the recorded range.

Authors' response:
We do believe the quality of the recorder was well suited to the task given its high sampling frequency (96 kHz), good bit resolution, and low self-noise. It should be kept in mind that no specific species were initially targeted and that the experiment was opportunistic. While we do understand that 96 kHz sampling frequency may not be enough to capture all frequencies of, for example, dolphin clicks, it is still enough to detect dolphins, potentially classify some of them, and detect other whale species such as sperm whales.

Referee # 1:
A minor point concerns the choice of the recorder. A minor point concerns the choice of the recorder. External batteries have been used. Other pocket recorders have less noise and require much less power than the Tascam. Some can run for 48 hours on their two internal AA batteries. The recorder is called "voice recorder" but it should be called "music recorder".

Authors' response:
The choice of the recorder was made due to its good specifications and our limited budget. The TASCAM offered an inexpensive option with good resolution and high sampling frequency (96 kHz). As shown in Figure 1 (b) of the manuscript only the main board of the original product was used. The plastic cover (which took unnecessary space inside the glider's science bay) was removed, therefore external batteries had to be used to power the device. In its original configuration, the TASCAM took two AA batteries and recorded sounds by default at 44.1 kHz at 16-bit resolution. Therefore, in order to record at 96 kHz and 16-bit resolution we found that we needed 8 AA batteries to power the unit in order to record for 24 hours. Due to its construction, the TASCAM did not allow recordings past 24 hours. A noise assessment of the TASCAM was made when it was first acquired. It showed higher self-noise at lower frequencies (< 1 kHz), but not deemed sufficiently high to consider it a problem. Research for off-the-shelf recorders at the time (2013-2014) indicated that the TASCAM offered the highest sampling frequency, while other pocket recorders had sampling frequencies only up to 44.1~48 kHz.