

**Supplementary text to "A simple and cost-efficient automated floating chamber for continuous measurements of carbon dioxide gas flux on lakes" by Kenneth Thorø Martinsen, Theis Kragh and Kaj Sand-Jensen**

This supplementary text presents more detailed illustrations (Figure S1-S3) of the parts (Table S1) required to construct the automated floating chamber. We also present other potential considerations for further development or use.

The floating chamber (including the CO<sub>2</sub> mini-logger and battery supply) itself is described in detail in Bastviken et al. (2015). We use their design with the addition of two connectors, one in each side of the chamber: One inlet for the air-pump and one outlet for the long external tube for passive pressure equilibration (Figure S1). The connectors fit to pieces of 4/6 mm (inner/outer diameter) tubing and rubber O ring is used as sealing around the hole in the chamber side. The connectors and tubing connect the chamber's headspace with the external box (Figure S2) containing the air-pump, timer and battery (Figure S3).

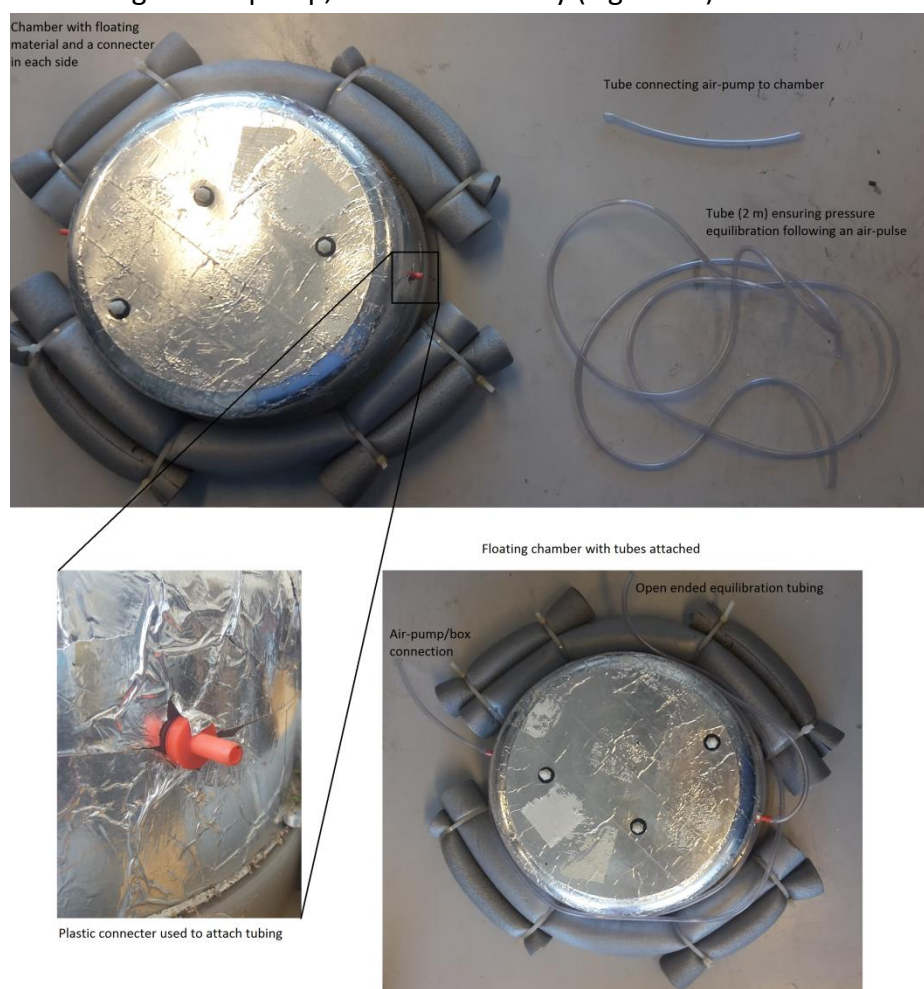


Figure S1: Figure showing the floating chamber and tubing used to connect the air-pump to the chamber's headspace and the long tube (4/6 inner/outer diameter) for equilibration.

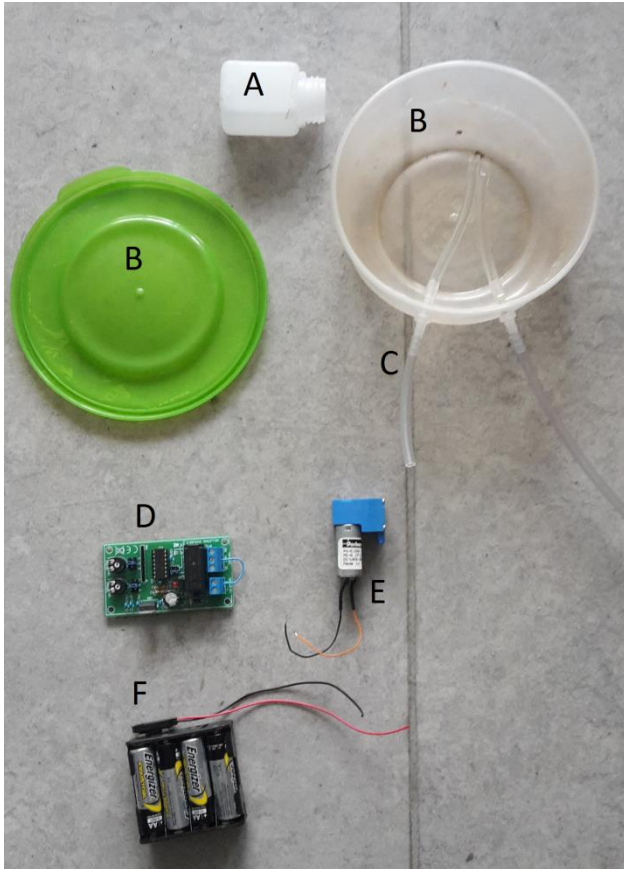


Figure S2: Figure showing the parts used to build the external box containing air-pump, battery and timer. Specifically a cover for the air-pump inlet (A), the plastic box and lid (B), the inlet and outlet for the air-pump with connectors through the box wall and tubing (C), the timer (D), air-pump with wires soldered (E) and example of a simple battery supply consisting of eight AA 1.5 V alkaline batteries in a casing with wires (F).

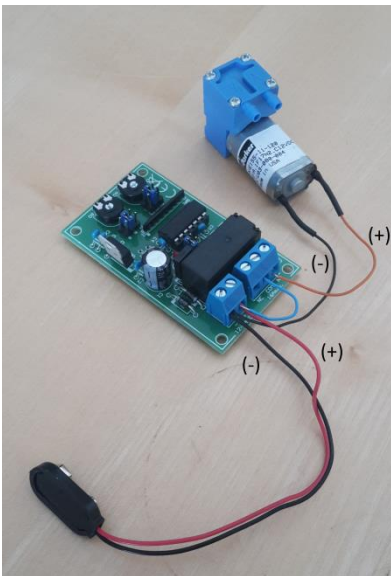


Figure S3: Close up of the timer and air-pump. The wire connections are also shown in Figure 1. The battery wiring used here fits the 8x1.5 V package (Figure S2) but other alternatives can be used. The timer comes with thorough instructions on assembly and operation.

Part:	Weight (grams):	Notes:
Air-pump Parker, USA, CTS series, PMDC, Product number: E155-11-120	45	Available in a range of different models varying power and voltage supply for example. Find supplier on <a href="http://www.parker.com">www.parker.com</a> , datasheet for available pumps: <a href="http://www.parker.com/Literature/Precision%20Fluidics/Miniature%20Diaphragm%20Pumps/CTS%20pump%20data%20sheet.pdf">http://www.parker.com/Literature/Precision%20Fluidics/Miniature%20Diaphragm%20Pumps/CTS%20pump%20data%20sheet.pdf</a>
Timer Velleman, Belgium, VM 188	42	<a href="https://www.velleman.eu/products/view/?id=408232">https://www.velleman.eu/products/view/?id=408232</a> . Available from different suppliers. This model comes in parts and needs to be soldered, good instructions on assembly and practical use are provided.
Power supply	212	Standard 1.5 V AA alkaline batteries used in the present examples, see text for further discussion of options. Battery casing and wire available in any electronics store, for example RS-components: <a href="http://www.rs-online.com">http://www.rs-online.com</a> .
Box	108	Waterproof plastic box, range of different options (design and size) available depending on choice of setup and design of flux chamber. Available in hardware stores.
Plastic tubing and connectors		Different types available. A rigid plastic tube is best for the equilibration tubing. The connectors are available with screw thread for easy installation and use of rubber to avoid chamber leakage. Available in hardware stores or laboratory suppliers.

Table S1: Table showing the parts from Figure S8 used to build the external box containing the air-pump along with the weight of each part (407 g in total) and notes/link to where they can be acquired.

Further considerations:

The proposed design of the automatic floating chamber would work well in a range of different conditions. However, a few case-specific options could be considered.

1. The air-pump is battery powered, making the available battery power a limitation on the deployment duration. We have used a battery package of eight standard 1.5 V AA batteries which are easily accessible. Flux measurements can then be made for 3-4 days using a 30/5 min pause/pulse cycle. This time period is determined by the duration of the air-pulse but may also be affected by the ambient temperature. This kind of setup has high mobility and

is sufficient for use at often visited sites. At remote or more permanent field sites a larger battery can be used. A large deep-cycle marine battery (12 V) would essentially remove the power limitations of the setup. These batteries are heavy, but could be placed on a nearby floating buoy or on the bank depending on the system. This would also reduce weight placed on the chamber. If placing the batteries on a separate floating chamber, the air-pump can also be moved removing any extra weight on the top of the floating chamber.

2. The air-pump pulse/pause intervals should be adjusted depending on the gas exchange velocity and available battery supply. This is done on the timer using a small screw driver.
3. We have found the air-pumps used here to be reliable in a range of conditions. However, the air-pump is the most expensive part. Very cheap alternative pumps exist (4-5 \$) with the same specifications. We have yet to try these out. But, with their price tag these modification would be very, very cheap. The same probably goes for the timer, but we have found the one used here easy to use and operate.

#### References:

Bastviken, D., Sundgren, I., Natchimuthu, S., Reyier, H., and Gålfalk, M.: Technical Note: Cost-efficient approaches to measure carbon dioxide (CO<sub>2</sub>) fluxes and concentrations in terrestrial and aquatic environments using mini loggers, *Biogeosciences*, 12, 3849-3859, 10.5194/bg-12-3849-2015, 2015.

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