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Custom built respiration chambers for CO_2 fluxes assessment in headwater streams

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Recent large-scale estimations of CO_2 fluxes suggest that water bodies play an important role in carbon dioxide emissions; however, these estimates fail to consider the heterogeneities of degassing rates and the actual extent of water-air interfaces. The reasons can be found in the difficulty of mapping the smaller headwater streams and the heterogeneities of the physical and biochemical processes that control CO_2 generation and transfer.
Here we developed and built a small floating respiration chamber using an Arduino board connected to a low-power CO_2, temperature and relative humidity sensor and a barometric pressure sensor; the chamber is specifically designed to properly create a sealed air volume above the very shallow and narrow headwater streams, where water velocities are high and the riverbed is very bumpy. This chamber allows the simultaneous measurement of CO_2 concentration in both atmosphere and water via the headspace method, along with degasification rates that can be estimated from the dynamics of CO_2 concentration in the chamber volume. We tested this new sensor system in a small alpine catchment in northern Italy, showing that it might represent a valid -and cheap- alternative to the state-of-the-art techniques that involve the use of tracer gases and very expensive pCO_2 sensors.