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Quantifying the "chamber effect" in CO_2 flux measurements

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The significance of aquatic CO_2 emissions has received attention in recent years. For example annual aquatic emissions in the Amazon basin have been estimated as 500 Mt of carbon[1]. Methods for determining the flux rates include eddy covariance flux tower measurements, flux estimates calculated from partial pressure of CO_2 (pCO_2) in water and the use floating flux chambers connected to an infra-red gas analyser. The flux chamber method is often used because it is portable, cheaper and allows smaller scale measurements. It is also a direct method and hence avoids problems related to the estimation of the gas transfer coefficient that is required when fluxes are calculated from pCO_2. However, the use of a floating chamber may influence the flux measurements obtained. The chamber shields the water underneath from effects of wind which could lead to lower flux estimates. Wind increases the flux rate by i) causing waves which increase the surface area for efflux, and ii) removing CO_2 build up above the water surface, hence maintaining a higher concentration gradient. Many floating chambers have an underwater extension of the chamber below the float to ensure better seal to water surface and to prevent any ingress of atmospheric air when waves rock the chamber. This extension may cause additional turbulence in flowing water and hence lead to overestimation of flux rates. Some groups have also used a small fan in the chamber headspace to ensure thorough mixing of air in the chamber. This may create turbulence inside the chamber which could increase the flux rate. Here we present results on the effects of different chamber designs on the detected flux rates.

[1]Richey et al. 2002. Outgassing from Amazonian rivers and wetlands as a large tropical source of atmospheric CO_2. Nature 416: 617-620.