Carbon Dioxide Evasion from Large Tropical Rivers: Measurements from the Amazon and Mekong River Basins

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Context: Richey et al. (2002) estimated that 0.5-0.7 Ci yr⁻¹ is evade as CO₂ from rivers and wetlands of the Amazon basin, which is an order of magnitude greater than fluvial export of organic carbon to the ocean. We currently have ongoing field campaigns to measure gas flux, CO₂ concentrations, and many associated environmental parameters in both the Amazon basin and throughout Southeast Asia. These projects share the goal of refining estimates of the net contribution of humic tropical regions to the global carbon cycle by quantifying the magnitude of carbon fluxes in rivers.

Abstract: We measured air-water fluxes of carbon dioxide (CO₂) in marine environments at a variety of spatial scales in two of the ten largest river systems in the world: the Amazon and the Mekong. Fluxes of carbon dioxide were quantified using a floating chamber equipped with a fan and an air pump to circulate the air within the chamber and through a portable infrared gas analyzer to measure CO₂ concentration continuously as it is evacuated within the chamber. In addition, data were collected at all sites for dissolved inorganic carbon, dissolved oxygen concentration and saturation, water temperature, weather conditions (wind speed, air temperature, and relative humidity), and, in part of the field campaign in the Amazon, dissolved organic carbon (DOC) concentration and suspended sediment load. Preliminary results suggest that previously published estimates of basin-wide CO₂ outgassing in the Amazon rivers and Mekong rivers are too low, and that different ecological dynamics within the rivers and the surrounding forests, different geological settings, and different land-use regimes may lead to substantially different CO₂ evasion rates for these two large tropical river systems.

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<tr>
<th>River</th>
<th>pCO₂ (µatm) Mainstem</th>
<th>pCO₂ (µatm) River</th>
<th>pCO₂ (µatm) Maine</th>
<th>DOC (µmol kg⁻¹) Mainstem</th>
<th>DOC (µmol kg⁻¹) River</th>
<th>DOC (µmol kg⁻¹) Maine</th>
<th>Turbidity (NTU) Mainstem</th>
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Other methods. In a comparison with boat-based eddy covariance (EC), in cooperation with Dr. Scott Miller, UC Irvine, we observed broad congruence between values and the larger footprint of EC measurements. It is not possible to use EC in profiling methods to measure fluxes over many river and lake environments in the Amazon without contamination from terrestrial algae.

Conclusions:
- Flux measurements made with modified floating chambers agree with other methods and will generate meaningful estimates of CO₂ evasion and transfer velocities in tropical rivers.
- Gas transfer velocity values, and thus flux estimates, in Richey et al. (2002) were conservative, emphasizing the ecologic importance of CO₂ evasion from Amazonian waters.
- Gas transfer velocity and fluxes are consistent with the estimates from the Amazon and Mekong river systems, suggesting that our results may be applied to modeling carbon fluxes in other important global river systems.

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References: