CO₂ Flux From Grassland Headwater Streams

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Introduction

The University of Kansas Water Resources Laboratory Flume system simulates a simplified headwater stream environment. The flume has a recirculating water system with a constant head of water of supply of water that feeds to a 0.75 m × 1.2 m channel. Diffusing CO₂ into the water reservoir system supplies a suitable amount of supersaturated groundwater, and precise measurements of discharge are allowed in the controlled environment

Artificial Stream(Flume)

The chamber-based flux method provides an accurate measure of CO₂ efflux from grassland headwater streams. We used the water reservoir system to supply a suitable amount of CO₂ to the flume. Precise measurements of discharge were allowed in the controlled environment.

Results: Flux & Gas Transfer Coefficients

The chamber-based flux measurements in the figure below(flat within a measurable error) estimate the flume-based flux measurements. Further trials are needed to confirm the initial trend displayed in the above results. The results of laboratory experiments indicate that the floating chamber method may provide an accurate and robust mean of measuring flux in a headwater stream environment. This measurement technique could prove a crucial component to determining the impact of headwater streams and shallow groundwater in the global carbon cycle.

Results: Alkalinity, CO₂ Degassing, or both?

We can assume that pH changes are induced by flux of CO₂ into or out of the flume water. Alkalinity(HCO₃⁻) remains constant throughout the study and does not change over the CO₂ length of the flume. The assumption of CO₂ in the chamber is that calcite and all other minerals are under saturated (due to it being treated water).

Conclusions

Further trials are needed to confirm the initial trend displayed in the above results. The results of laboratory experiments indicate that the floating chamber method may provide an accurate and robust mean of measuring flux in a headwater stream environment. This measurement technique could prove a crucial component to determining the impact of headwater streams and shallow groundwater in the global carbon cycle.

Future Research

• Further comparison using gas transfer coefficients to normalize the data is needed. To do this we need to account for atmospheric CO₂ changes that occur over the duration of the experiment that affect the degassing rate for the flume water.
• More in flume testing at different velocities, and with different chamber designs is needed. In particular, testing of chamber based measurement systems may prove a crucial component to determining the impact of headwater streams and shallow groundwater in the global carbon cycle.
• All of the floating chamber based measurement systems demonstrated an exponential decay phase with a strong correlation(R² < 0.85) as the concentration in the chamber increased over time. This is due to degassing from the CO₂ length of the flume. Using the equation from Alin et al.(2013) we calculate a chamber-based flux for each trial. The slopes did not correlate well to increases in flume velocity.

References

Datry, T., Poisson, M., Geniez, P., 2007), and requires several years of study to determine the rate of change.