2016

Tower-based greenhouse gas fluxes in a restored tidal freshwater wetland: A shared resource for research and teaching.

Ellen J. Stuart-Haëntjens
Virginia Commonwealth University, goodrichstej@mymail.vcu.edu

Scott C. Neubauer
Virginia Commonwealth University, sneubauer@vcu.edu

Christopher M. Gough
Virginia Commonwealth University, cmgough@vcu.edu

Tower-based greenhouse gas fluxes in a restored tidal freshwater wetland: A shared resource for research and teaching

Ellen J. Stuart-Haëntjens, Scott C. Neubauer, Christopher M. Gough

Virginia Commonwealth University, Integrative Life Sciences, Department of Biology, Box 842012, 1000 W. Cary Street, Richmond, VA 23284-2012

I. Background

- Wetlands store large amounts of carbon (C) in both biomass and soils, playing a crucial role in offsetting greenhouse gas (GHG) emissions; however, they also account for 30% of the global yearly CH_4 emissions.
- Human disturbance has led to the decline of natural wetlands throughout the United States, with a corresponding increase in created and restored wetlands.

► The Rice Rivers flux tower (yellow triangle) and solar panel locations (yellow dot) are near the eastern bank in the northern tidal portion of the VCU Rice Rivers Center wetland. The flux footprint (the area where the majority of the fluxes originate from) is outlined in a yellow semi-circle, with dominant winds (and therefore the bulk of the fluxes) coming from the west. (Left)

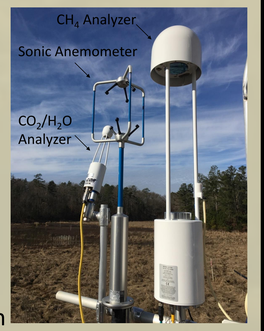
- Studies characterizing biogeochemical processes in restored wetlands, particularly those that are both tidal and freshwater, are lacking in the literature but essential for informing science-based carbon management.
- Quantifying the uptake and loss of CO_2 and CH_4 at the ecosystem (i.e., > hectare) scale is essential to evaluating whether and why restored wetlands exert a net warming or cooling influence.

▼ Driving the pilings

►Tower and solar panel set up

II. Technology

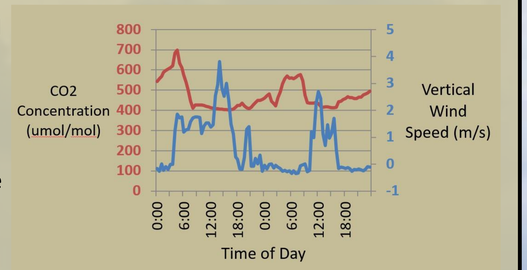
- Eddy flux technology continuously measures ecosystem scale CH_4 and CO_2 flux exchange between wetland and atmosphere at high frequencies.
- Unlike the traditional chamber method of measurement, this technology captures multiple landscape features within the wetland such as the grasses, mudflats, and Kimages Creek.



►The set up of LI-COR eddy flux instrumentation on the tower in the Rice Rivers Center restored wetland.

III. Preliminary Data

► Figure 1. Data collected by the flux tower showing variations in vertical wind speed and CO_2 concentrations at 6 m above the wetland surface two days in December 2015.



CO_2 concentrations were high above the wetland surface at night because low wind permitted heavier greenhouse gases to pool. When winds increased during the daytime, concentrations decreased as CO_2 mixed with air depleted in carbon dioxide.

IV. Data products

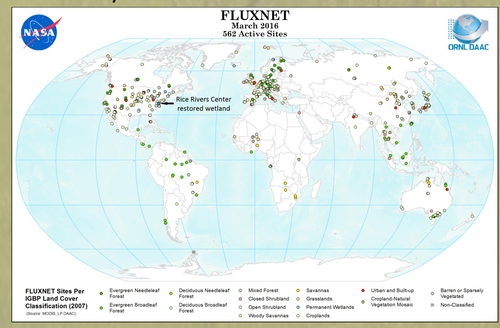
Table 1. Data provided by the instruments on and around the flux tower. All data will be available for those interested in collaboration or using it for teaching purposes.

Data Product	Instrument
CO_2 Concentration and Flux	LI-7500RS Open Path CO_2/H_2O Analyzer
CH_4 Concentration and Flux	LI-7700 Open Path CH_4 Analyzer
Water Vapor Concentration and H_2O Flux	LI-7500RS Open Path CO_2/H_2O Analyzer
Vertical and Horizontal Wind Speed	Sonic Anemometer
Air Temperature	Humidity and Temperature Probe
Humidity	Humidity and Temperature Probe
Soil Moisture	Soil Moisture Probe
Soil Temperature	Soil Temperature Sensor
Precipitation	Tipping Bucket Rain Gauge
Light (PAR)	Quantum Sensor LI-190R
Global Solar Radiation	Pyranometer LI-200R
Net Radiation	Single-Channel Net Radiometer

To request data please contact: Ellen Stuart-Haëntjens
Email: goodrichstej@vcu.edu

V. Data access and distribution

- Tower data will be available to VCU faculty, staff, and students
  - Raw data and calculated fluxes available for research purposes
  - Real-time remote tower data for classroom/outreach use through FluxSuite
- Tower data will be available to external researchers, increasing the visibility of the Rice Rivers Center
  - VAFlux – informal statewide network
  - Ameriflux and Fluxnet: National/international networks of flux towers, where permanent freshwater wetlands are under-represented



VI. Future Work

- Has function recovered in the restored wetland? Contrast CO_2 and CH_4 fluxes as well as soil C pools in the restored (Kimages Creek) and mature (Harris Creek) tidal forested wetlands.

Acknowledgements

This research was supported by a Rice Rivers Center Research Award and a VCU Life Sciences HEETF.

Rice Rivers Center