Final Report for NYWRRI Award # 64750-1110807

GREENHOUSE GAS PRODUCTION AS POLLUTION TRADE-OFFS IN NEW YORK WETLANDS AND SOURCE WATER STREAMS

Start / End dates: 03/13-12/14 (with no cost extension)

Principal Investigator: P. Vidon.

Objectives:

As indicated in last year's report the objectives of this project were 1) to determine total N_2O, CO_2, and CH_4 fluxes (positive or negative) in streams and wetlands in relation to greenhouse (GHG) fluxes in the surrounding landscape, both seasonally, and during key hydrological events, and 2) to determine the variables driving GHG dynamics in streams and wetlands (e.g. stream flow, water table depth, oxidation-reduction potential, temperature, nutrient concentration).

With this research, we also intended to determine to what extent streams and wetlands in forested NY source watersheds are "hot spots" of GHG production in the landscape (in relation to their surrounding upland environment) and which variable(s) (e.g. climate, nutrient availability) drive(s) GHG dynamics (CO_2, N_2O, CH_4) in these systems.

Activity Report

As of today, all fieldwork has been completed, and two masters' theses partially supported by this research were completed or are near completion. Several manuscripts are currently in preparation based on the work supported by this project. Although data analysis is on going, some preliminary conclusions are noteworthy and are therefore included in this report.

In general, our data indicate that headwater stream water was hyper-saturated for CO_2, N_2O and CH_4 gases. For instance, in summer 2014, a mean CO_2 concentration of 88.25 µmol/L (1520.5 µatm), a mean CH_4 concentration of 1.16 µmol/L (554 µatm) and a mean N_2O concentration of 0.02 µmol/L (µatm) were observed in the stream. These are 5.8, 432, and 2.3 times in excess of atmospheric equilibrium, respectively.

Especially high values of dissolved CH_4 were found in mucky and wet riparian sites and in the pools with fine textured bed sediments relative to other locations. CH_4 was strongly negatively related to DO, while N_2O was strongly positively to NO_3^- and negatively related to NH_4^+.

When fluxes at the soil or water interface with the atmosphere are measured, average CO_2 fluxes ranged from 0.15-2.54 $gC/m^2/day$, with higher fluxes occurring at headwater sites. Average CH_4 fluxes ranged from -0.05 to 768 $mgC/m^2/day$ with negative flux values occurring at some of the upland sites. On the contrary, lowland and wetland sites were the largest contributors of CH_4 to the atmosphere.

When the relative contribution of each GHG is expressed in CO_2 equivalent, we find that CO2 is the main proponent of CO2eq flux at all areas of the landscape except for the wetland, where CH4 contributes >80% of the positive CO2eq flux.

On a seasonal basis, summer, spring, autumn, and winter accounted for 40%, 24%, 27%, and 9% of the net annual flux, respectively.

Graduate and Undergraduate Student Training (2 Graduate Students, 2 Undergraduate Students)

Conference Presentations

Vidon, P., J. Gomez, S. Serchan, C. Beier, M. Mitchell, J. Gross, 2014. Greenhouse gases dynamics in forest soils, and the role of forests at regulating climate. Huntington Lecture Series – Adirondack Interpretive Center, Newcomb, NY, July 2014.

Gomez, J., P. Vidon, M. Mitchell, C. Beier, J. Gross, 2014. Soil-atmosphere CO_2, CH_4, and N_2O fluxes across time and space in a forested watershed. SUNY-ESF Spotlight on Research 2014 Conference, Syracuse, NY, April, 2014.

Serchan, S., Vidon, P., 2013. Greenhouse gas dynamics in streams located within forested landscapes of the US Northeast. ASA, CSSA and SSSA Annual meeting, Tampa, FL, November 2013.

Gomez, J.*, Vidon, P., Mitchell, M., Beier, C., Gross, J.*, 2013. Geomorphic influence and hydrologic controls on greenhouse gas fluxes at the soil-atmosphere interface in northern forests. ASA, CSSA and SSSA Annual meeting, Tampa, FL, November 2013.

Gomez, J., P. Vidon, M. Mitchell, C. Beier, J. Gross, 2013. Geomorphic influence and hydrologic controls on greenhouse gas fluxes at the soil-atmosphere interface in northern forests. 2013 CNY Earth Science Student Symposium. Syracuse, NY, April 2013.

Serchan, S., P. Vidon, 2013. Greenhouse gas dynamics in streams located within forested landscapes of the US Northeast. 2013 CNY Earth Science Student Symposium. Syracuse, NY, April 2013.

Thesis partially supported by work conducted under this award

Satish Serchan. Target graduation: Summer 2014. Title: TBD

Joshua Gomez. MS thesis. Title: Soil-atmosphere carbon dioxide, methane, and nitrous oxide fluxes across time and space in a forested watershed. Spring 2014

Peer Reviewed Publications

Four publications are in preparation and will be submitted in 2014/2015.