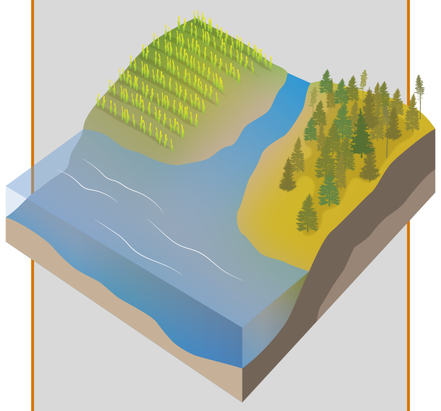
PREMIS: A multidisciplinary approach to understanding the terrestrial-aquatic interface

This project is part of a collaborative effort to understand terrestrial-aquatic interface (TAI) ecosystems stressed by climate change. Monitoring sap flux and greenhouse gas fluxes offers a way to quantify the stability and resilience of terrestrial ecosystems in a changing environment.



PREMIS

PRedicting **E**cosystem Resilience through **M**ulticscale and **I**ntegrative **S**cience

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Ben Bond-Lamberty (PI)
Nate McDowell (PI)

We thank Pat Megonigal and the entire staff of SERC for their support of this research. For more information, please see http://serc.si.edu

U.S. DEPARTMENT OF ENERGY BATTELLE
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MOTIVATION

- The TAI may be especially vulnerable to global changes such as sea level rise and extreme weather conditions
- Transplanting soil cores allows us to manipulate the environment to simulate environmental changes
- Monitoring transpiration in trees via sap flow offers insight into the impact of seawater on plant health

APPROACH

- LOCATION:
  - Smithsonian Environmental Research Center – coastal forest on a tributary of Chesapeake Bay in Edgewater, Maryland
- DESIGN:
  - 124 transplanted soil cores (40 cm diameter, 20 cm depth) along natural salinity and elevation gradients, including true and disturbance controls
  - 30 trees with Granier-type sap flux sensors

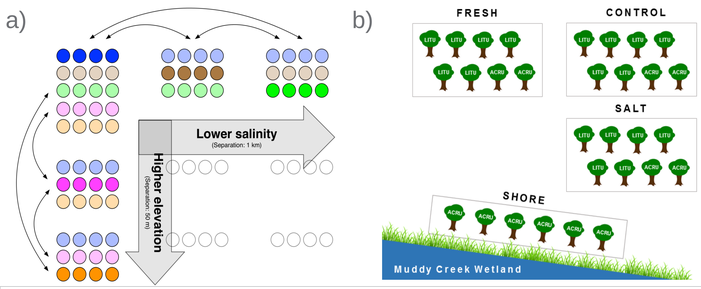

Figure 1. a) Transplant design for soil respiration measurements. Pairs of 4 were transplanted across salinity and elevation gradients. b) Graphic of the sap flux design. Fresh, control, and salt plots have sap flux sensors at 6 Tulip and 2 Red Maple trees, and the Shore plot containing 6 Red Maple trees.

https://github.com/PNNL-PREMIS
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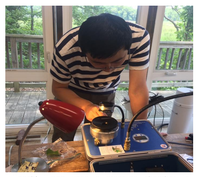
(left to right) Nick Ward (PI), Vanessa Bailey (PI), and James Stegen (PI) sample the soil at GCREW


(left to right) Stephanie Pennington and Mercedes Horn pose with a soil core


(left to right) Ben Bond-Lamberty (PI) and Stephanie Pennington dig a soil core at SERC


Wenzhi Wang uses a pressure chamber to measure the water potential of a Tulip Poplar leaf


Stephanie Pennington installs a sap flux sensor in a Tulip Poplar tree


Nate McDowell (PI) measures photosynthesis of mid-day leaf samples


Uzay Sezen uses a crossbow to gather leaf samples from high canopies

PROGRESS + RESULTS TO DATE

- Weather stations installed at each salinity gradient
- Wells installed containing conductivity meters
- All soil collars installed – measurements taken every 7-10 days
- All sap flux sensors installed – measurements taken every 30 minutes

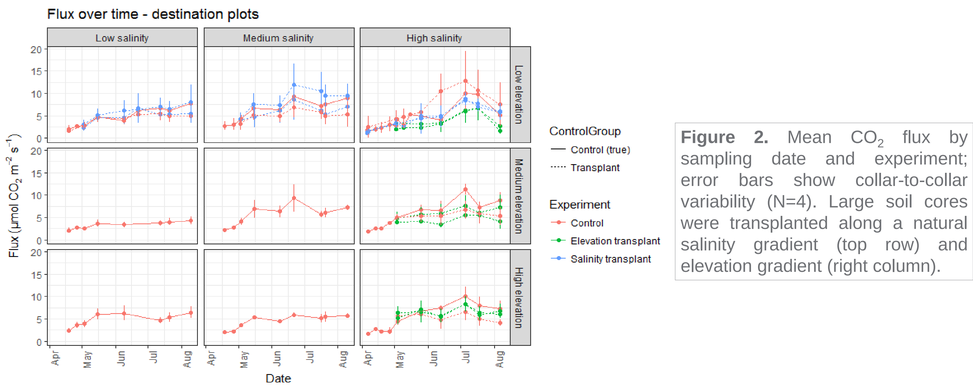
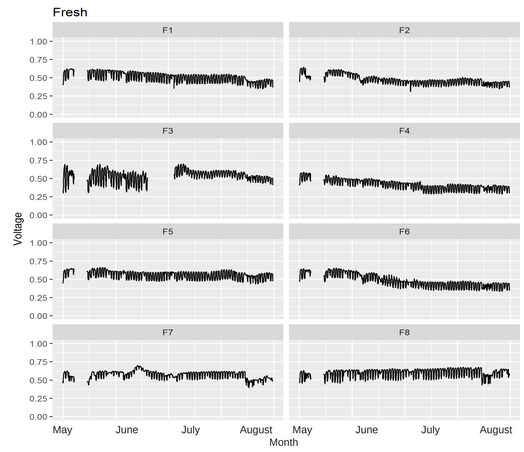


Figure 2. Mean CO_2 flux by sampling date and experiment; error bars show collar-to-collar variability (N=4). Large soil cores were transplanted along a natural salinity gradient (top row) and elevation gradient (right column).

Figure 3. Raw sap flux data (in mV) showing daily variation from May to August, for eight different trees in one of the upland plots.



FUTURE WORK

- Analysis of tree distribution and spatial variability of soil respiration
- Quantify sap flow response to saltwater and freshwater treatment
- Install continuous soil respiration monitoring system around sap flow trees
- Integrated analysis of salinity and disturbance effects on both plant water and soil CO_2 fluxes