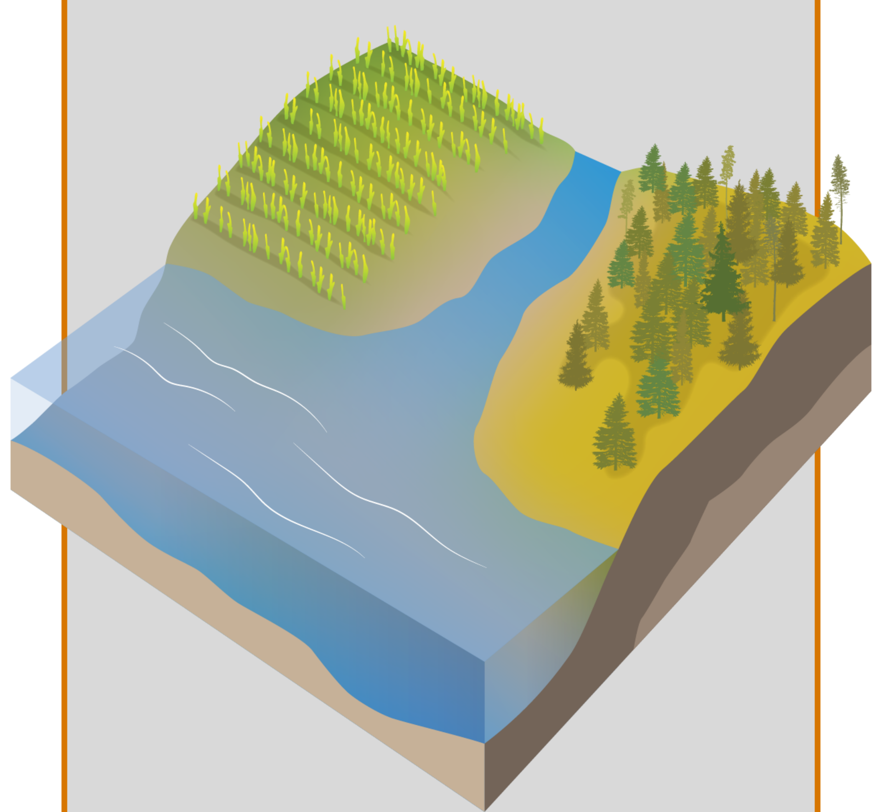
PREMIS: A multidisciplinary approach to understanding the terrestrial-aquatic interface

Pacific Northwest
NATIONAL LABORATORY



PREMIS

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

Stephanie Pennington
Benjamin Bond-Lamberty (PI)
Nate McDowell (PI)

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

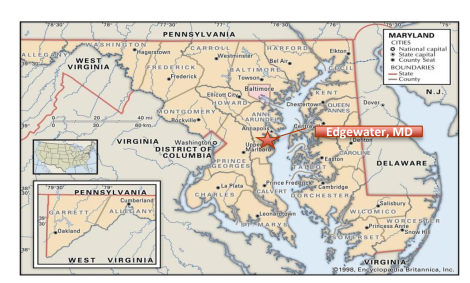
U.S. DEPARTMENT OF ENERGY BATTELLE
PNNL is operated by Battelle for the U.S. Department of Energy.

This project is part of a multi-disciplinary 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.

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 sap flow offers an observational approach, testing differences between lowland and upland trees

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

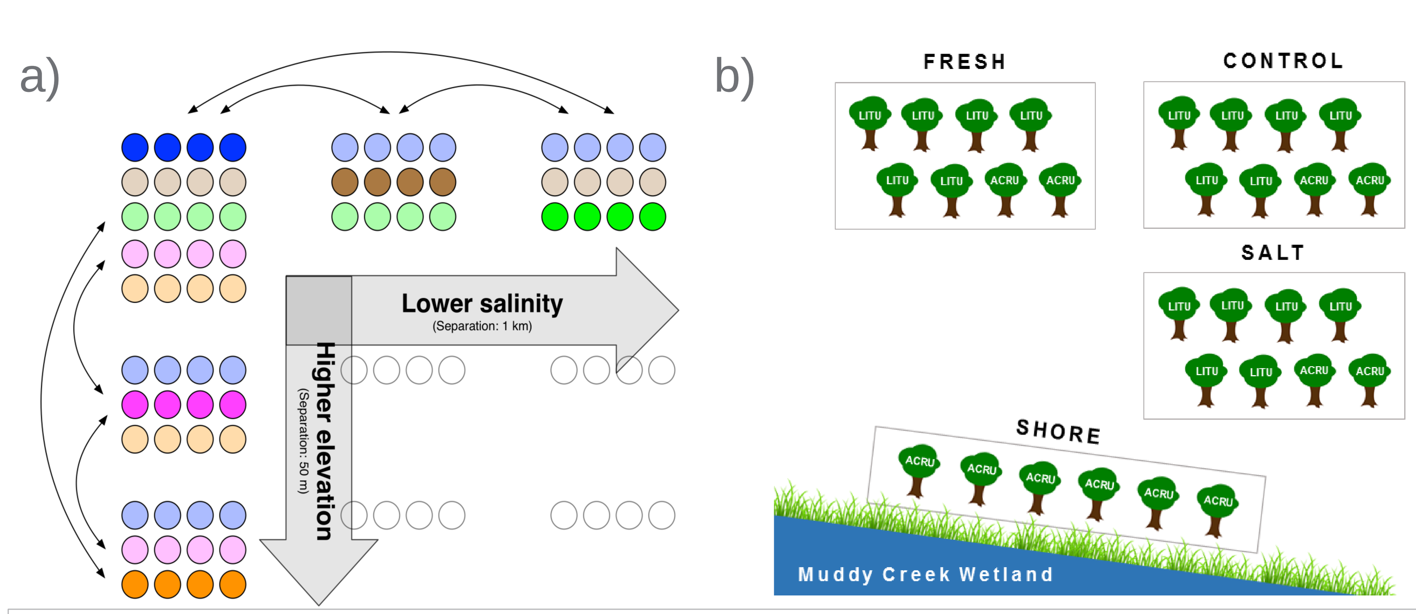


Figure 1. a) Transplant design for soil respiration measurements. Pairs of 4 were transplanted across salinity and elevation gradients. b) Graphic of the sap flux design. Fresh, control, and salt plots have sap flux sensors at 6 Tulip and 2 Red Maple trees, and the Shore plot containing 6 Red Maple trees.

https://github.com/PNNL-PREMIS
stephanie.pennington@pnnl.gov

(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) Benjamin Bond-Lamberty (PI) and Stephanie Pennington dig a soil core at SERC

Wenzhi Wang uses a pressure chamber to measure 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 pre-dawn and 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 flow sensors installed – measurements taken every 30 minutes

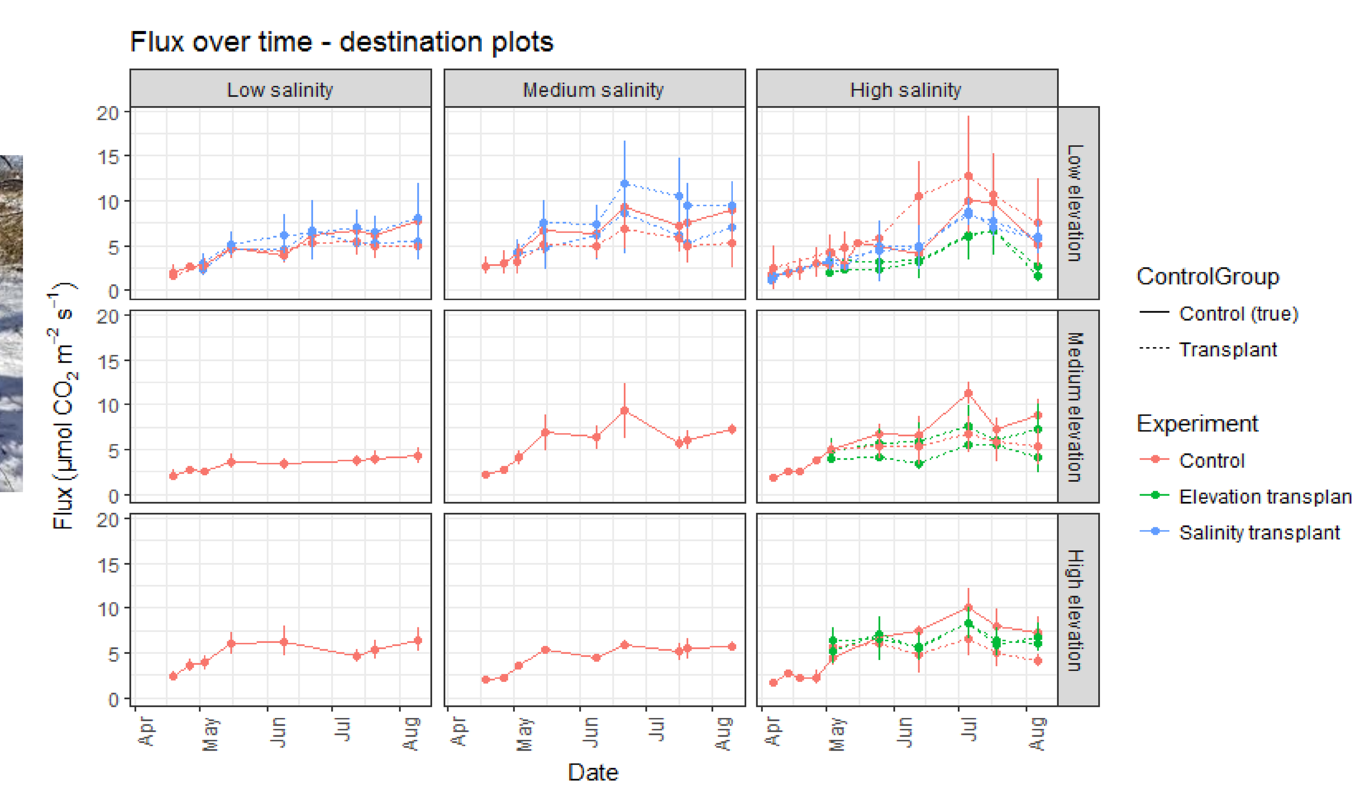


Figure 2. Mean CO_2 flux by sampling date and experiment; error bars show collar-to-collar variability (N=4). Large soil cores were transplanted along a natural salinity gradient (top row) and elevation gradient (right column).

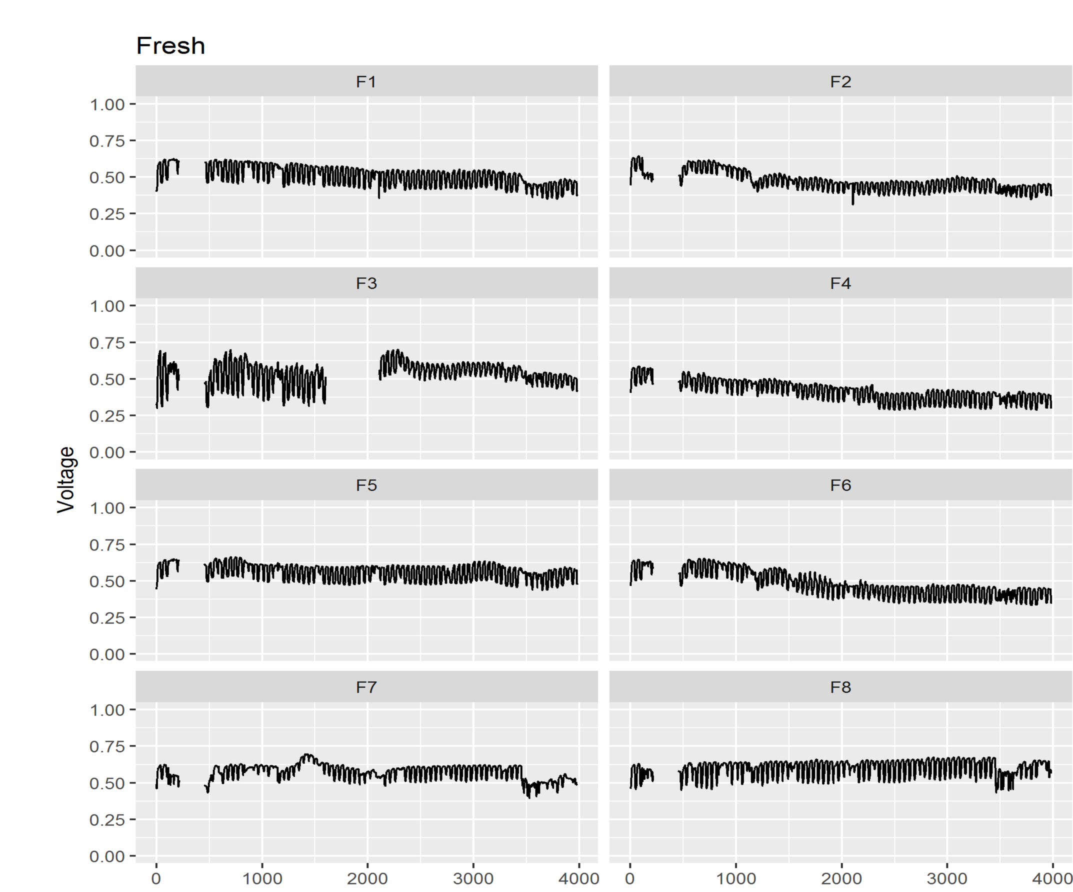


Figure 3. Raw sap flux data (in mV) showing daily variation from May to August, for eight different trees in one of the upland plots.

FUTURE WORK

- Analysis of tree distribution and spatial variability of soil respiration
- 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