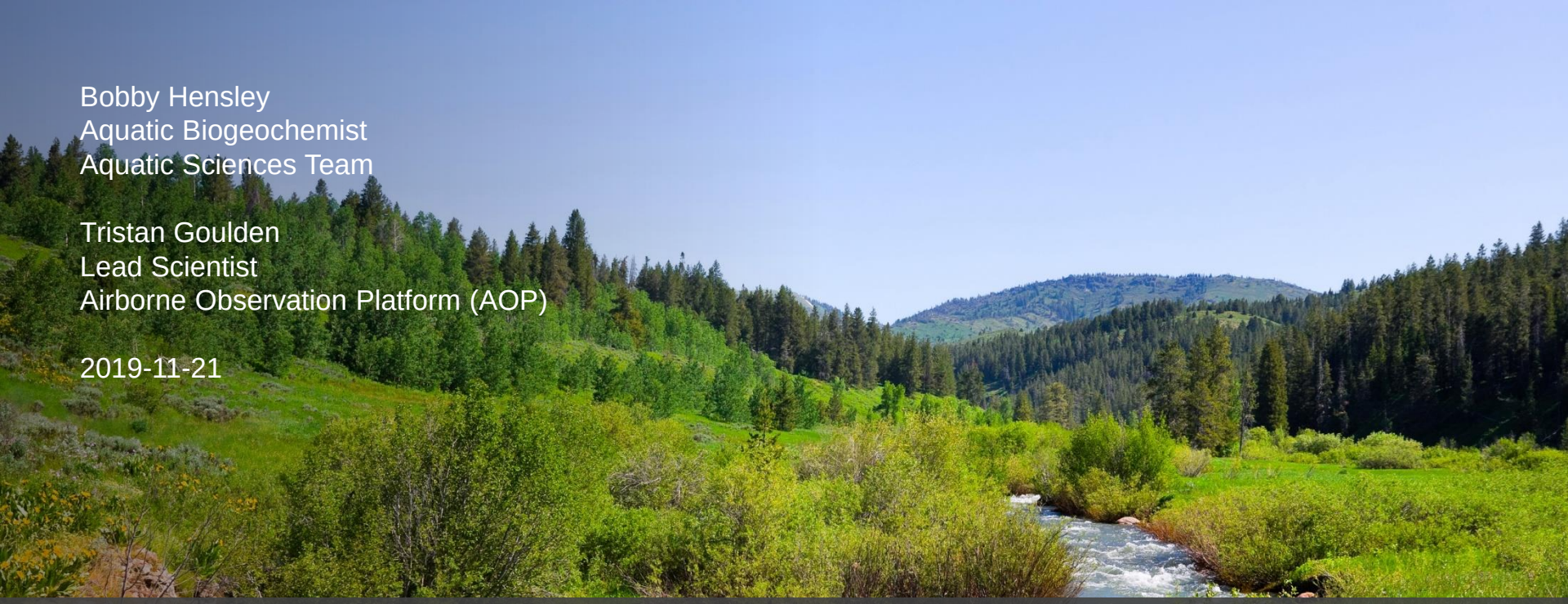


Bobby Hensley
Aquatic Biogeochemist
Aquatic Sciences Team

Tristan Goulden
Lead Scientist
Airborne Observation Platform (AOP)

2019-11-21

GEO AquaWatch Webinar

Overview of NEON AIS and AOP programs

National Ecological Observatory Network

A project sponsored by the National Science Foundation and proudly operated by Battelle

neon
National Ecological Observatory Network

BATTELLE

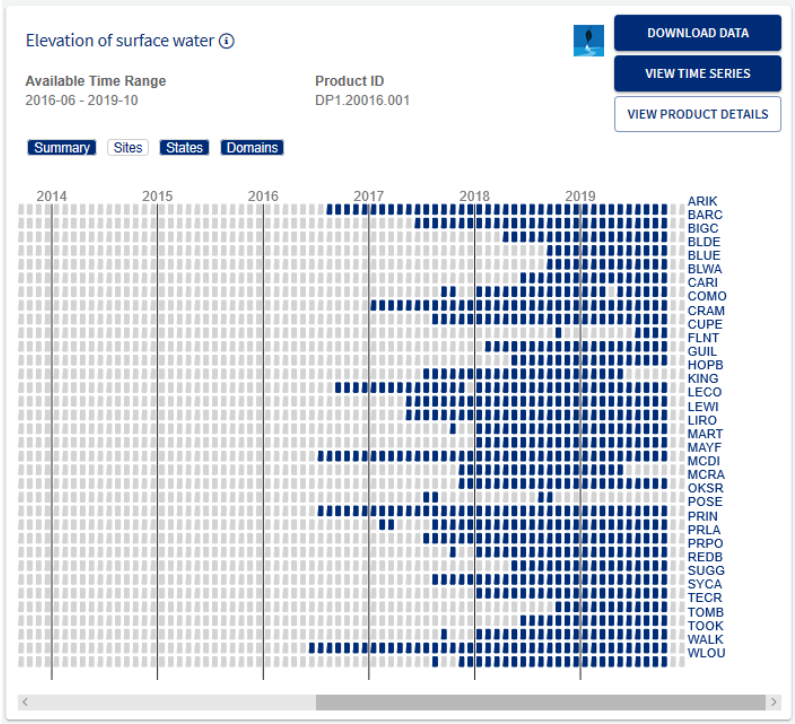
What is NEON?

- The National Ecological Observatory Network
  - Funded by the National Science Foundation and operated by Battelle
- Network of 81 field sites
  - 47 terrestrial and 34 aquatic
- Over 170 data products
- Planned 30-year life
  - Measure long-term change
- Provide open-access data
  - https://www.youtube.com/watch?v=IybNnE2vMBU
  - https://www.youtube.com/watch?v=3bIH_r6HUuA


35
30
25
20
15
10
5
0
95
90
85
80
75

Where can I access NEON data?

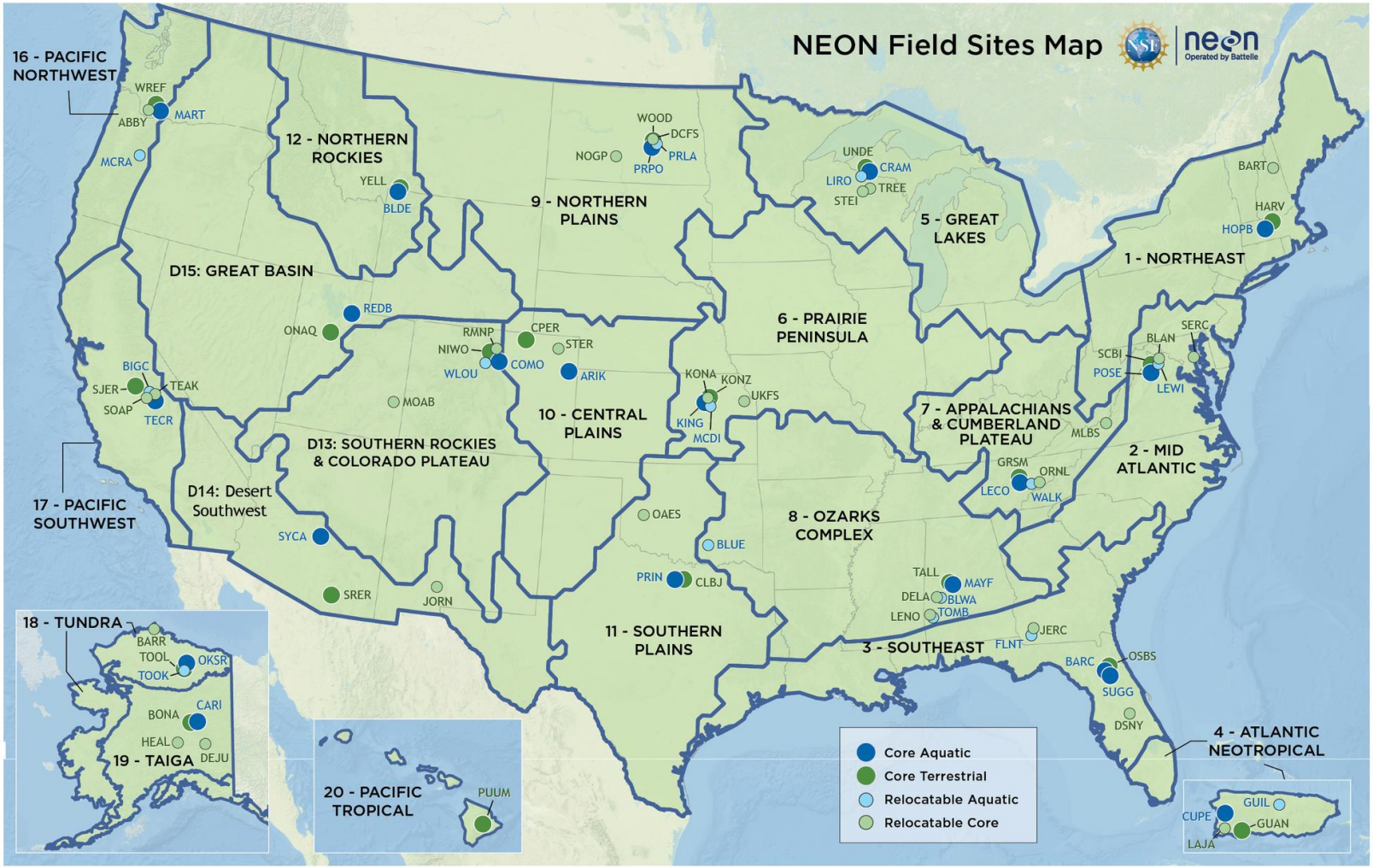
- Directly from NEON Data Portal
  - https://data.neonscience.org/home
  - Curated by product > site > month
  - Product details contain relevant protocols and documentation
  - Expanded package includes data QA/QC metrics
- Loaded into R using neonUtilities package
  - https://www.neonscience.org/neonDataStackR
- Direct access through NEON API
  - https://data.neonscience.org/data-api



Summary of Aquatic Sites

- 34 freshwater aquatic field sites
  - 24 wadeable streams
  - 3 rivers
  - 7 lakes
- 20 “core” sites
  - 1 per Domain (2 in D03, none in D20)
  - Remain for 30-year life of observatory
- 14 “relocatable” sites
  - Provide comparison or test specific questions
  - May move in response to user needs

Location of Aquatic Sites

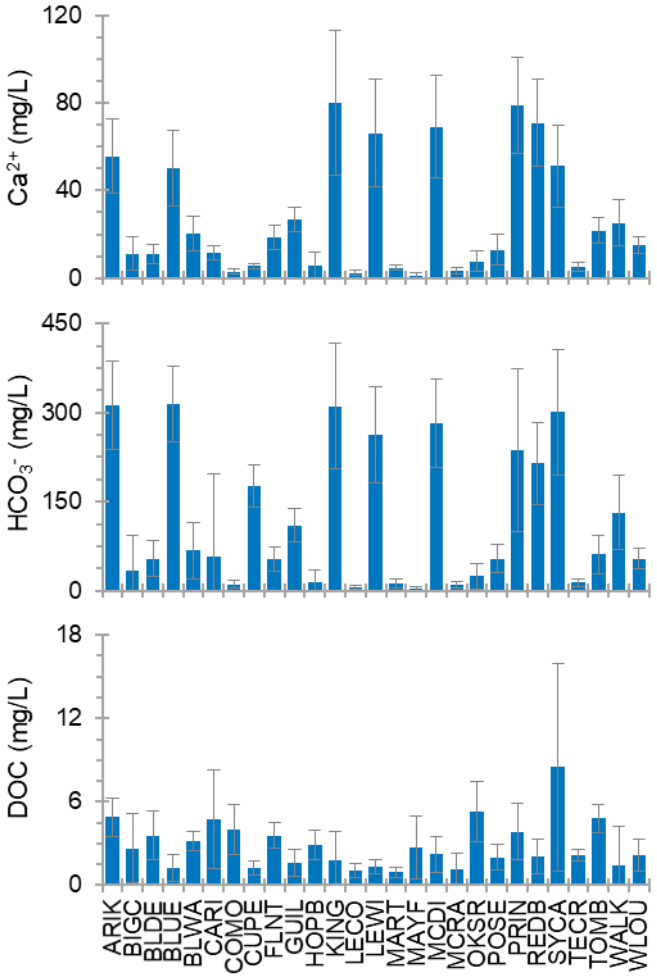


Observational Sampling (AOS)

- Physical
  - Bathymetry and morphology
  - Discharge
- Biological
  - Fish
  - Invertebrates
  - Aquatic plants and algae
- Geochemical
  - Sediment
  - **Water chemistry**

Water Chemistry Grab Sampling

- Both surface water and groundwater
- Typically performed bi-weekly
- Major Cations and Metals
  - Na^{+}, Ca^{2+}, Mg^{2+}, K^{+}, Fe^{2+}, Mn^{2+}
- Major Anions
  - HCO_3^{-}, Cl^{-}, SO_4^{2-}, Fl^{-}, Br^{-}
- Nutrients and Carbon
  - NO_3^{-}, NO_2^{-}, NH_4^{+}, TKN, TN, OrthoP, TP,
- Other
  - pH, SpC, DIC, DOC, TOC, TSS, TDS, UV_{250}, UV_{284}



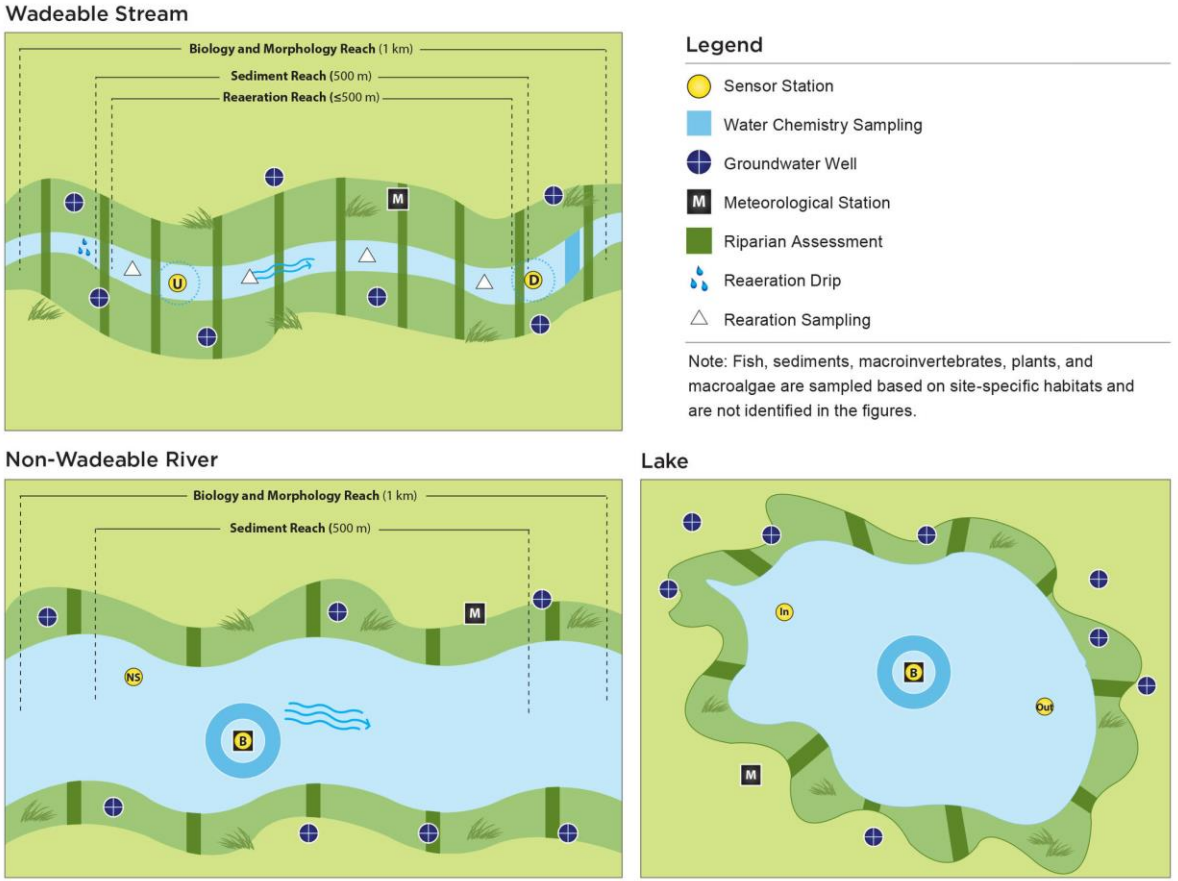
Instrument Sampling (AIS)

- Sensor locations vary by site type.

		Streams		Rivers		Lakes		
	Automated Instrument Measurements	Upstream (U)	Downstream (D)	Buoy (B)	Near Shore (NS)	Buoy (B)	Inlet (In)	Outlet (Out)
	PAR at water surface	✓	✓	✓	⊘	✓	⊘	⊘
	PAR below water surface	⊘	⊘	✓	✓	✓	✓	✓
	Elevation of surface water (pressure transducer based)	✓	✓	⊘	✓	⊘	✓	✓
	Temperature in surface water	✓	✓	⊘	⊘	⊘	⊘	⊘
	Temperature at specific depth in surface water (depths vary by site)	⊘	⊘	✓	⊘	✓	⊘	⊘
	Water quality: specific conductivity, chlorophyll a, dissolved oxygen content, pH, turbidity, and fluorescent dissolved organic matter (fDOM)	✓ (no fDOM)	✓	✓	⊘	✓	⊘	⊘
	Nitrate in surface water	⊘	✓	✓	⊘	✓	⊘	⊘
	Groundwater wells: specific conductivity, water temperature, elevation of groundwater	✓ Up to 8 per field site						
M	Meteorological measurements: wind speed and direction, air temperature, barometric pressure, relative humidity, shortwave radiation, and photosynthetically active radiation (PAR)	✓ One on bank		✓ One on bank, One on buoy		✓ One on bank, One on buoy		

Site Layouts

- Streams
  - Upstream (HOR.101)
  - Downstream (HOR.102)
- Rivers
  - Buoy (HOR.103)
  - Near-shore (HOR.101)
- Lakes
  - Buoy (HOR.103)
  - Inlet (HOR.130)
  - Outlet (HOR.140)



Surface Water Quality (DP1.20288)

- Measured using YSI EXO2 multiparameter sonde
  - Sampling frequency: 1 min
- Conductivity (µS/cm)
- Optical DO (mg/L & % saturation)
- pH
- Chlorophyll (µg/L)
- Turbidity (FNU)
- FDOM (QSU)
  - Only at downstream location (HOR.102)

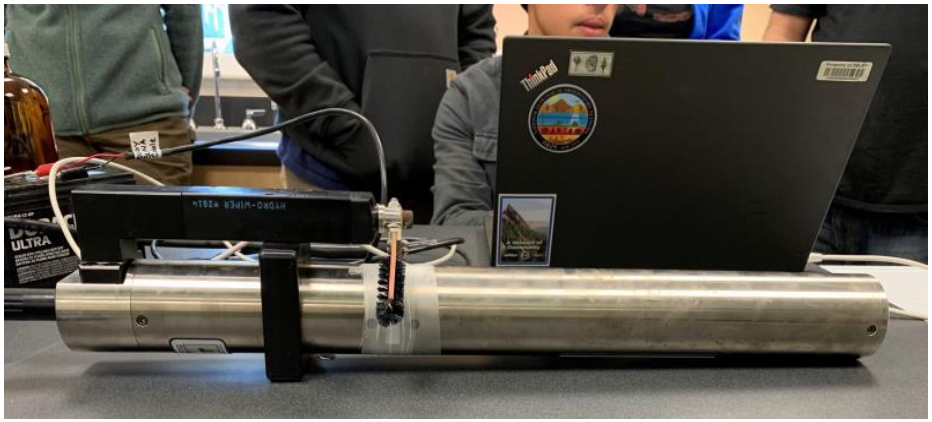
Nitrate in Surface Water (DP1.20033)

- Measured using SeaBird SUNA V2.
  - Sampling frequency: 15 min (avg 10 measurement burst)
  - Only at downstream location (HOR.102)

Data Quality

- Both sensors are equipped with automated wipers
- Sensors cleaned every 2 weeks
  - Pre- and post-cleaning measurements in DI are recorded

- Sensors calibrated monthly
  - Pre- and post-calibration measurements in DI are recorded



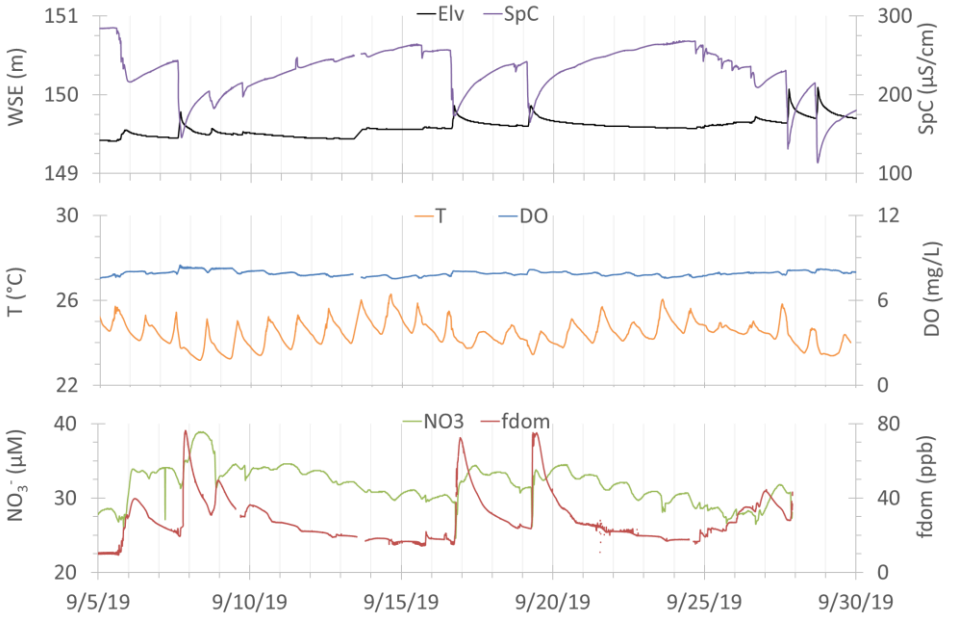
- NEON does not perform any drift correction
  - Necessary data is provided to users so they can perform if desired

Data Quality

- Anomalous measurements flagged
  - Null and Gap tests – Are there missing data?
  - Range test – Are values within plausible range?
  - Step test – Is change between sequential values plausible?
  - Persistence test – Do values change or are they “stuck”?
- De-spiking
  - Uses median absolute deviation to identify outliers
- Science Review
  - Were calibrations valid? Did Field Ops report any issues?
- All measurements receive a final Quality Score

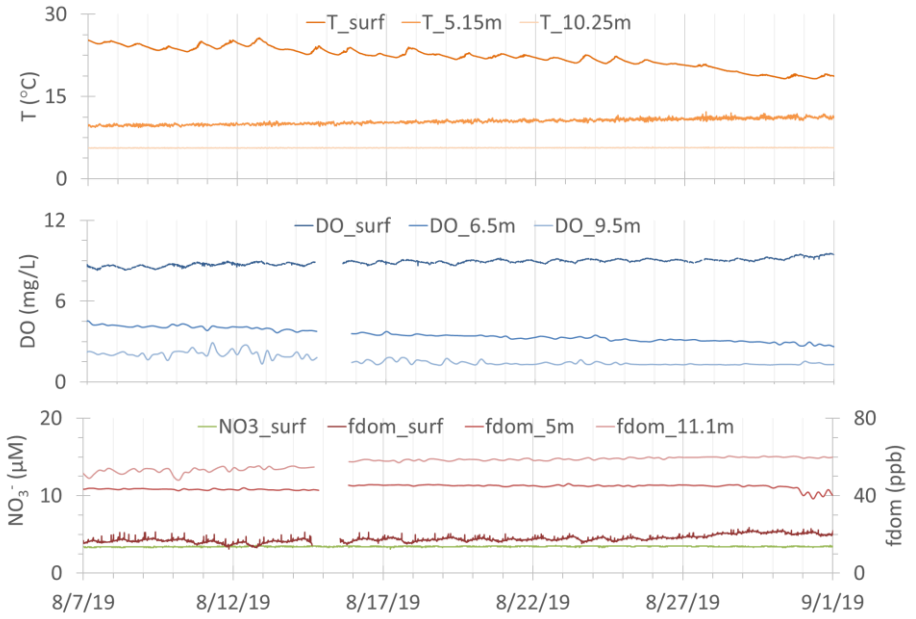
Rio Cupeyes (D04 Atlantic Neotropical)

- Drains 4.6 km^2 of old growth tropical wet forest in Bosque Estatal de Maricao of southwest Puerto Rico
- Average annual temperature is 25°C
- Annual precipitation is 1168 mm



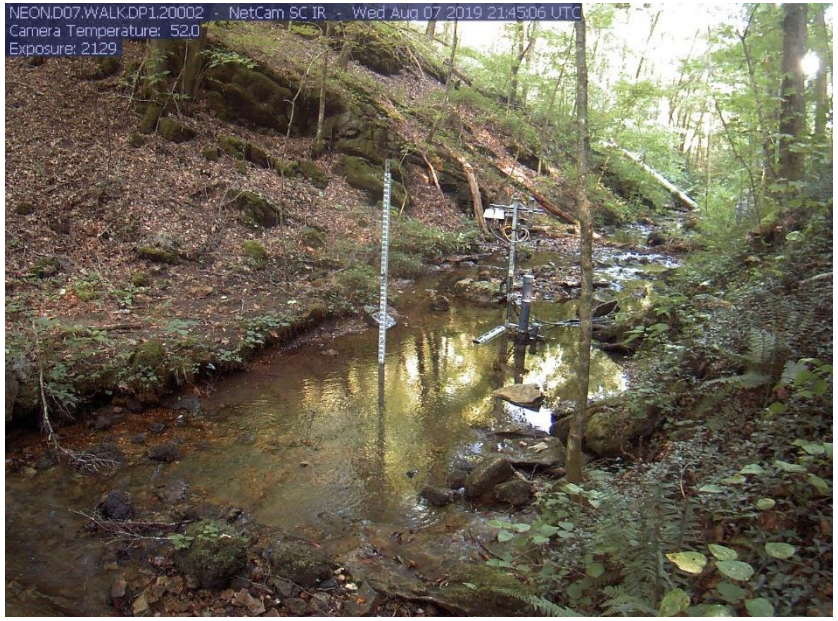
Crampton Lake (D05 Great Lakes)

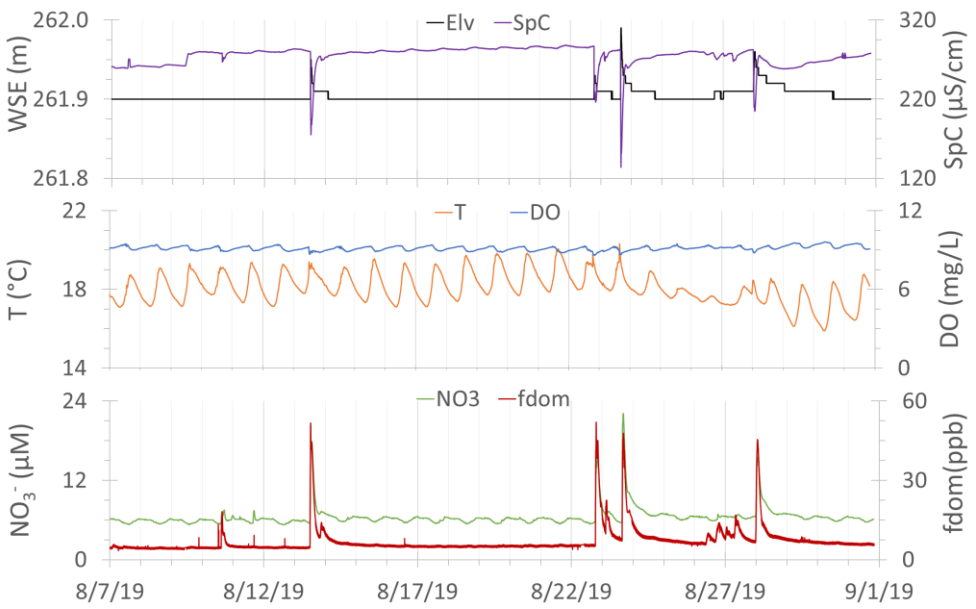
- 26 ha, 17.5 m deep, stratified, oligotrophic, seepage lake surrounded by hardwood forests in northern Wisconsin
- Average annual temperature is 3°C
- Annual precipitation is 854 mm



Walker Branch (D07 Appalachians)

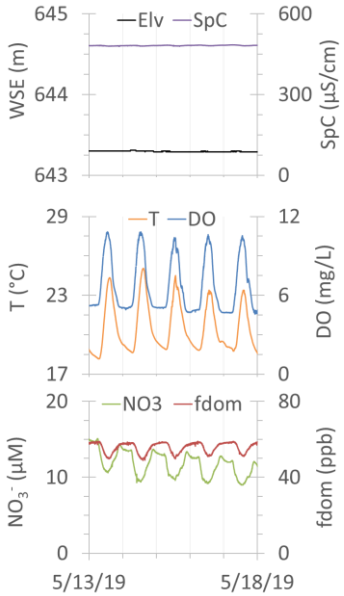
- Drains 1.8 km^2 of deciduous forest in the Oak Ridge Reservation in eastern Tennessee
- Average annual temperature is 15°C
- Annual precipitation is 1222 mm

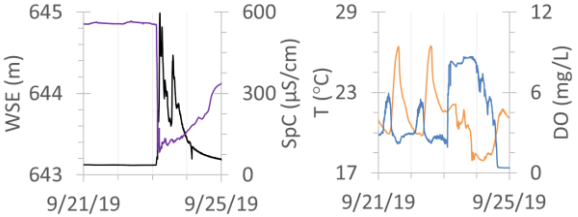




Sycamore Creek (D14 Desert Southwest)

- Drains 273 km^2 of Sonoran Desert scrub in the Tonto National Forest of southern Arizona.
- Average annual temperature is 21°C
- Annual precipitation is 350 mm





Caribou Creek (D18 Taiga)

- Drains 31 km^2 of boreal forest and wetlands in central Alaska.
- Average annual temperature is -1°C
- Annual precipitation is 399 mm