Controls on coupled nitrogen and carbon cycles of watersheds across eco-regions

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Rationale:

- Carbon retention and assimilation by vegetation is limited by nitrogen availability, which means that their biogeochemical cycles are often tightly coupled.

- Environmental conditions like climate (temperature, precipitation & storm frequencecy & intensity), plant characteristics (C:N ratios) and disturbance legacies affect both carbon and nitrogen cycles at a watershed level.

- Comparing both nitrogen and carbon fluxes across different eco-regions has been complicated in the absence of consistent data.

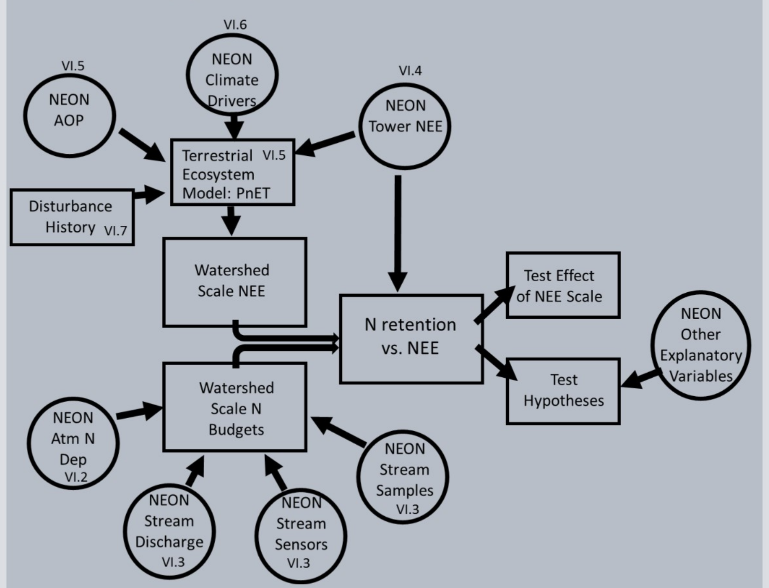
Research question:

How tightly are C and N cycles coupled across eco-regions and how is this coupling affected by environmental conditions and legacies of past disturbance?

Preliminary objective:

How consistent are nitrogen inputs from neon data with input rates from the national atmospheric deposition program (NADP)?

General approach:



Sites:

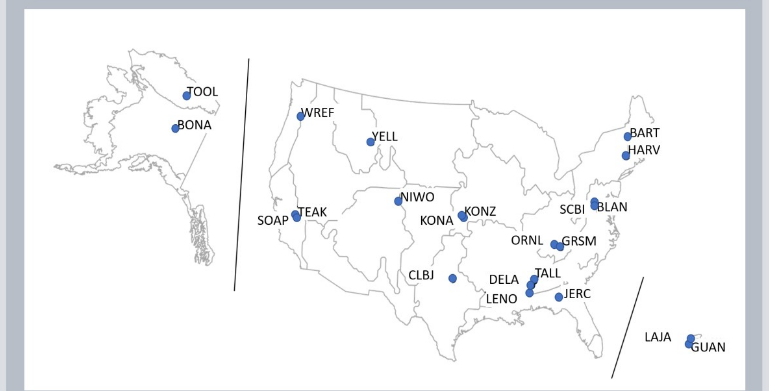


Figure 1: Terrestrial sites included in the project Only 17 sites out of the 22 shown here were included in the preliminary results because of incomplete data.

Methods:

General approach:
- Calculate N mass balance (N deposition vs stream outputs)

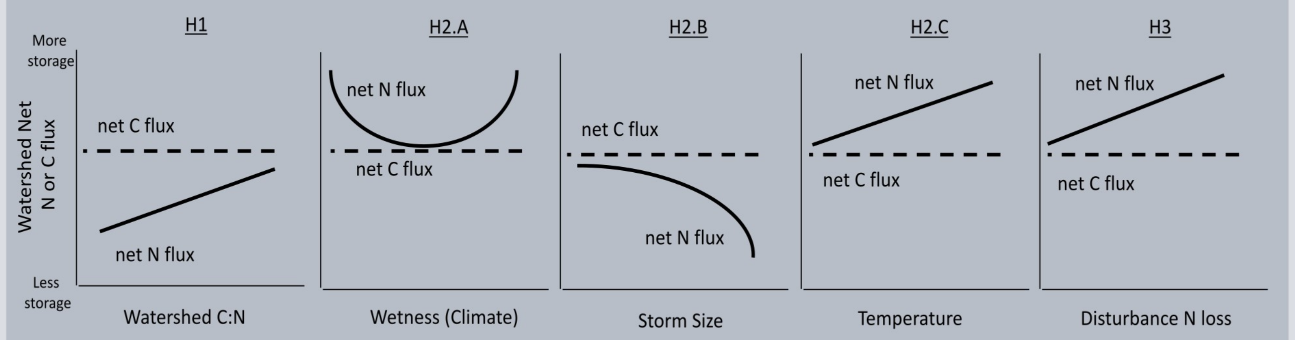
- Using a terrestrial ecosystem model (PnET), calculate NEE (C flux) for each watershed by scaling up eddy flux tower NEE results.

- Test hypotheses on environmental controls on C & N fluxes using a multiple linear regression model.

Methods - preliminary results:
- Calculate annual nitrogen flux for each neon site based on percipitation volume and bi-weekly chemical analysis of precipiation (NO3 & NH4)

- Annual flux rates for 2019 were adjusted for the number of days in the year that had chemical data (see Table 1).

Hypotheses:



Preliminary results:

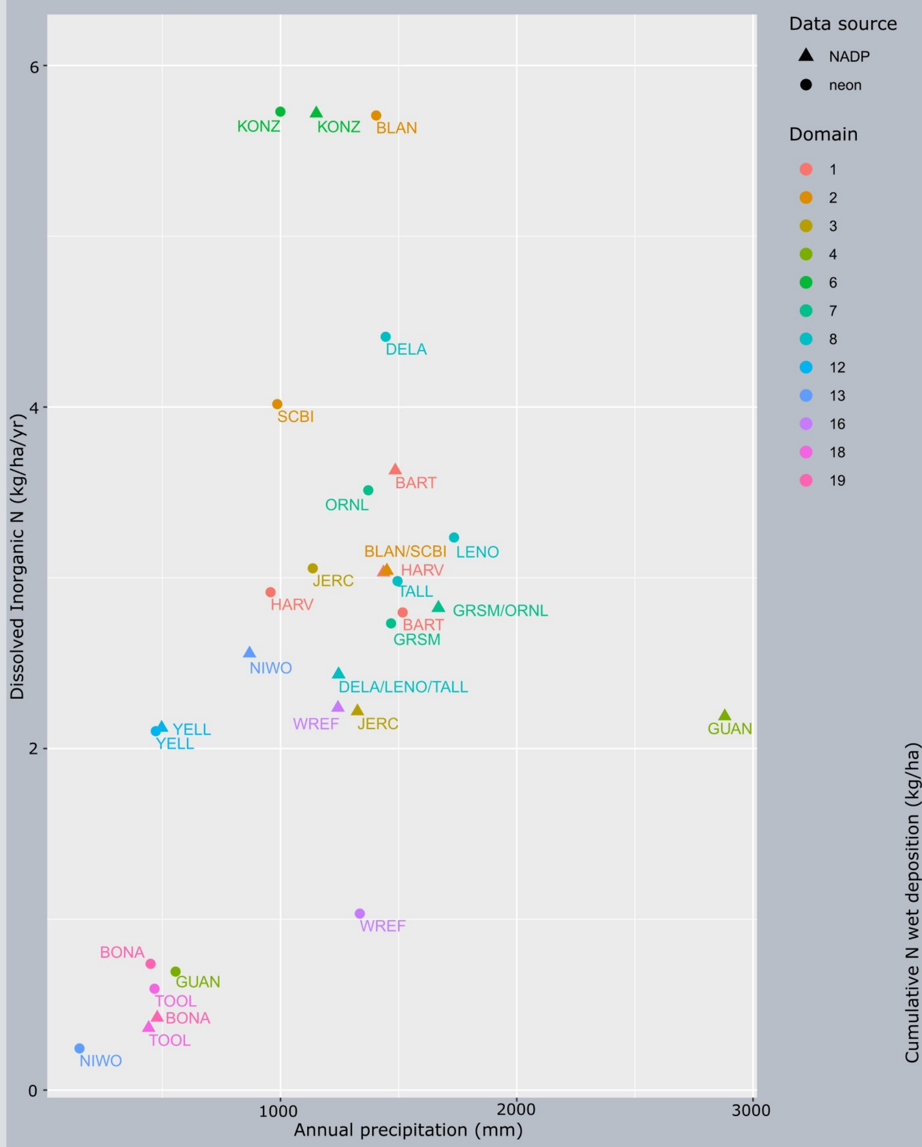


Figure 2: Annual rate of dissolved inorganic Nitrogen deposition in 2019 at 17 NEON sites and the nearest NADP site compared to annual precipitation. Data are normalized to the number of days that had data within the calendar year for each site (NEON Min: 147 days (BONA), NEON Max: 348 days (TALL), NADP Min: 363 days, NADP Max: 364 days). Three NADP sites (AL10, TN11, and VA28) were compared to multiple NEON sites. ▲

Table 1: Number of days with data records in 2019 and 2020* used to calculate nitrogen inputs for NEON and NADP sites. *2020 data was retrieved in November 2020 and, consequently, does not include November and December 2020.

NEON site	NEON 2019 wet deposition (days)	NEON 2020* wet deposition (days)	NADP site	NADP 2019 wet deposition (days)
BART	275	111	NH02	364
HARV	282	116	MA08	363
BLAN	238	48	VA28	364
SCBI	226	48	VA28	364
JERC	303	76	FL14	364
GUAN	234	0	PR20	363
KONZ	254	111	KS31	363
GRSM	212	112	TN11	364
ORNL	224	118	TN11	364
DELA	296	64	AL10	364
LENO	267	29	AL10	364
TALL	348	68	AL10	364
YELL	169	85	WY08	364
NIWO	266	97	CO90	363
WREF	272	83	WA98	364
TOOL	183	0	AK96	364
BONA	147	46	AK01	364

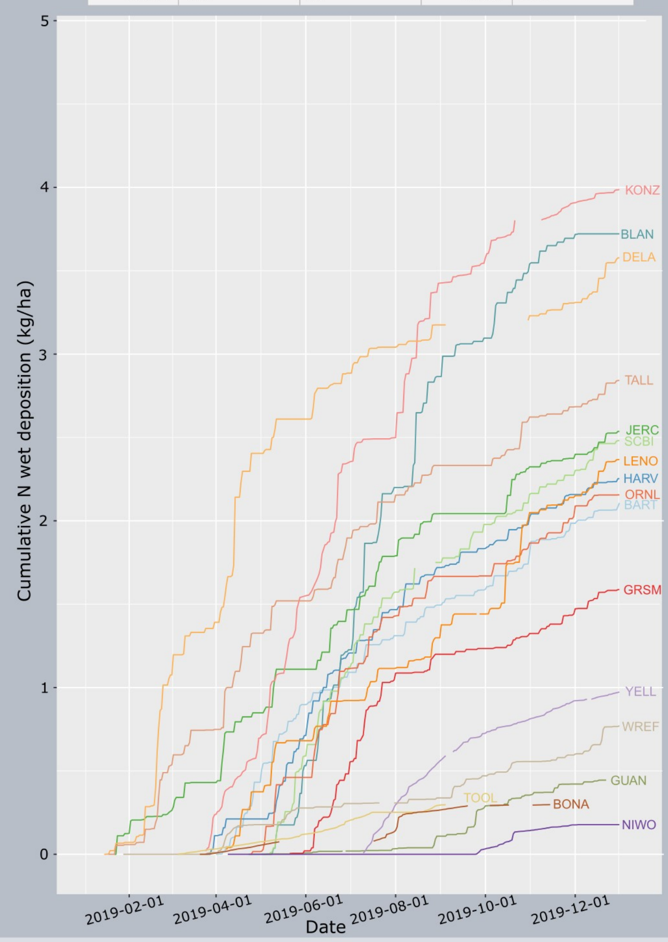


Figure 3: Cumulative dissolved nitrogen inputs at 17 NEON sites in 2019. Gaps represent missing data (precipitation volume or chemical deposition). ▶

Conclusions:

- The neon data resembles NADP data pretty closely when you consider the days for which we have data

- For most sites, nitrogen deposition is largely related to total precipitation volume and longitude.

- Data gaps have a strong effect on annual nitrogen deposition results (see data for GUAN NEON vs NADP)

- Important seasonal differences in inputs likely amplify the problems associated with data gaps.

Next steps:

- Calculate the N mass balance with stream outputs, which could also help smooth out the data gaps, depending on data availability.

- Calculate watershed NEE using PnET to scale up eddy flux tower data.

- Test hypotheses on environmental controls on C & N fluxes using linear regression models.

- Gap filling for 2019 and, eventually, 2020.

- Quantify uncertainty for deposition and stream outputs.

References:

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