Controls on greenhouse gas production in streams across a land use gradient

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Background

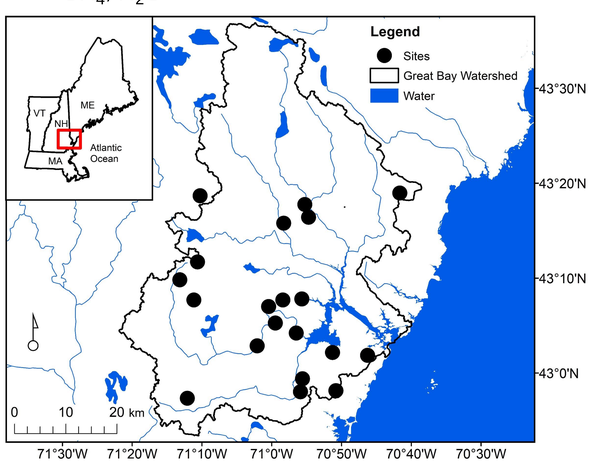
- Fluvial ecosystems can be quantitatively significant sources of CH_4 and N_2O
- Collective emissions may offset terrestrial carbon sink
- Considerable uncertainty remains in regional and global estimates of greenhouse gas (GHG) emissions from streams
- Controls on GHG concentrations (water chemistry, sediment characteristics) are poorly understood

- **What controls spatial and temporal variability in CH_4 and N_2O across streams of varying land use?**

Methods

Monthly sampling at 20 sites

- Surface water
  - DOC, TDN, NO_3^-, NH_4^+, PO_4^{3-}, cations & anions
- Dissolved gas
  - CH_4, N_2O



Results

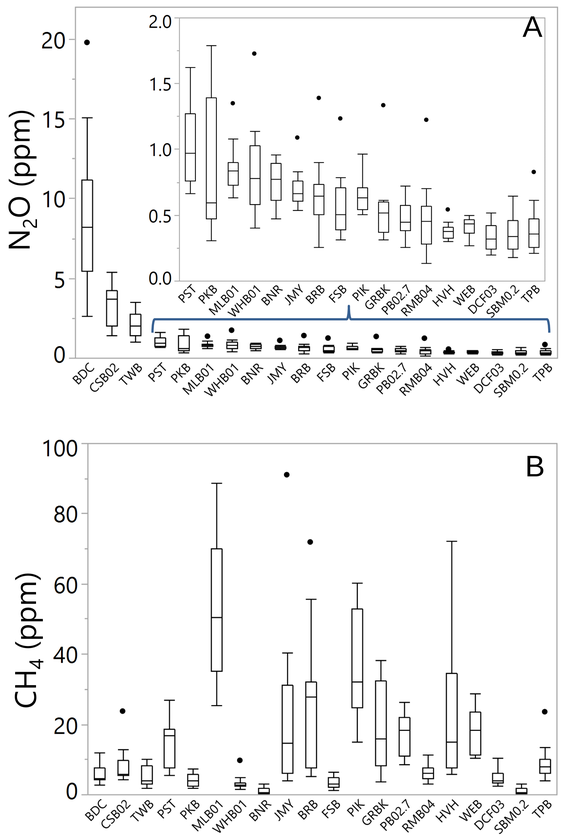


Figure 1. Boxplot panels represent N_2O (A) and CH_4 (B) concentrations across 12 months at 20 sites. Ordered by decreasing N_2O concentration.

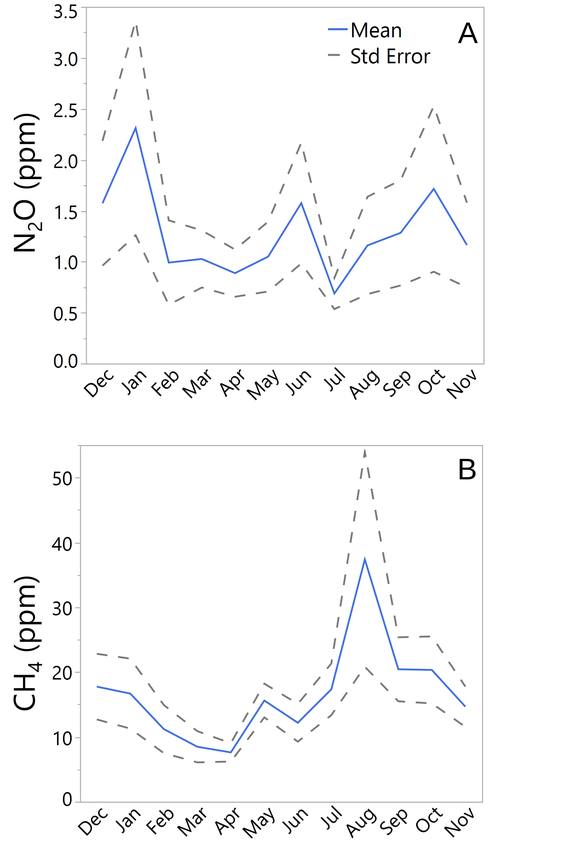


Figure 2. Mean N_2O (A) and CH_4 (B) concentrations across 20 sites over time. The dashed line represents standard error.

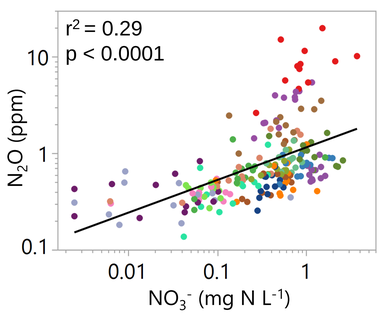


Figure 3. Linear regression between N_2O and NO_3^- concentrations across sites.

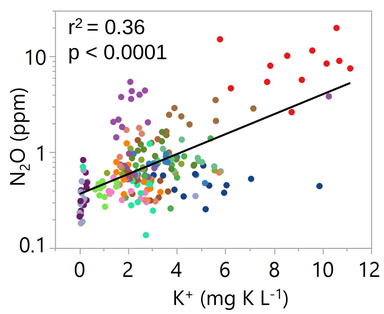


Figure 4. Linear regression between N_2O and K^+ concentrations across sites.

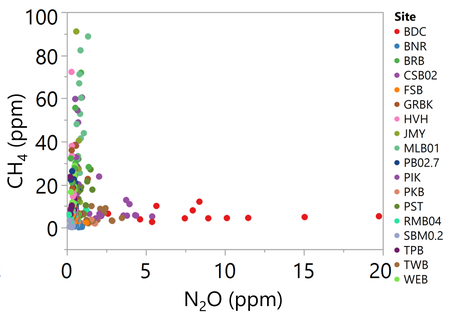


Figure 5. Relationship between CH_4 and N_2O concentrations across sites.

Conclusions

- Differences in seasonal patterns of CH_4 and N_2O concentrations
- Variability of CH_4 concentrations unexplained by a single predictor variable
- Elevated NO_3^- concentrations result in higher concentrations of N_2O
- Influence of K^+ on N_2O?
  - Reduction of NO to N_2O catalyzed by K[1]
  - K increases N reductase enzyme activity[2,3]

Emerging Questions

- What role do sediment characteristics play in greenhouse gas production?
- At low N_2O concentrations, what controls the variability in CH_4?
- Does potassium play a role in N_2O dynamics?

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References

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