ELEMENTAL CYCLES OF BOREAL ECOSYSTEMS

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How (and why) are elemental cycles coupled?

McGuire et al. 2018
How (and why) are elemental cycles coupled?
How do cycles of biologically significant elements change in response to short- and long-term changes in climate and disturbance regimes?
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High-frequency (15-minute) data from instream sensors:
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High-frequency (15-minute) data from instream sensors:

- temperature
- conductivity
- dissolved oxygen
- turbidity
- nitrate
- dissolved organic matter
Biogeochemical responses to climate and disturbance

C2
Low permafrost

C3
High permafrost

C4
Med permafrost

P6
Med permafrost
Burned 2004
Biogeochemical responses to climate and disturbance
Biogeochemical responses to climate and disturbance

Dissolved organic matter

period (days)

calendar date

wavelet power levels
Biogeochemical responses to climate and disturbance
How can we detect and predict ecological regime changes in the boreal forest?

Johnstone et al. 2010
How can we detect and predict ecological regime changes in the boreal forest?

Stream chemistry as indicator of ecological state of catchment?

Johnstone et al. 2010
Ecological regime shifts

- Quantify the stability of ecosystems in response to fire, permafrost thaw, & climate
- Evaluate proximity of catchments to a change in ecological state due to intensification of the disturbance regime
Ecological regime shifts

Early warnings of state change

Increased:
- Variance
- Autocorrelation
- Skewness
- Kurtosis
- Biomodality

![Graphs showing ecological regime shifts with early warning signs.](image)
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