Title:

Target journal: Limnology & Oceanography Letters or Biogeochemistry Letters

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Background:

* The majority of global lakes are north of 45 deg. N latitude {Verpoorter:2014dk} and freeze during the winter
* Extended freezing periods can decouple lakes from their catchments and ice cover influences the physical environment of lakes with consequences for the biology and chemistry of these environments
* Although studies focused on under ice dynamics are limited, a few recent studies suggest that nitrogen is actively cycled despite low temperatures and limited light availability:
  + {Powers:2017bn} found that ice duration was positively correlated with nitrate accumulation in northern oligotrophic and mesotrophic lakes, and that nitrification likely generated the majority of the nitrate
  + {Cavaliere:2018cb} found that winter and summer rates of denitrification did not differ in 9 Canadian lakes with a broad range of DIN concentrations
* These studies suggest that N cycling during winter months may influence N availability in the biologically productive summer months
* While N cycling under ice may influence in-lake winter N dynamics, melt events reconnect frozen lakes to their catchments and hydrologic forcing (and primary productivity?) could potentially modulate this winter signal and influence spring water column N concentrations and speciation
  + The extent to which melt events influence in-lake N dynamics depends on:
    - melt event provenance and severity
    - lake-watershed physical configurations (lake area, lake : catchment area ratio)
    - biological productivity

Value/contribution of this study:

* These lakes are eutrophic and hyper-eutrophic systems, whereas Powers et al. studies were in oligotrophic-mesotrophic lakes, but Cavaliere & Baulch (2018) included a few lakes with elevated DIN concentrations
* Time series includes under ice time series during both frozen and thawing periods, the latter of which are challenging data to collect and may be rare
  + First comparison: the frozen period for two years (2014 & 2015) for Missisquoi Bay, in which the years differed in freeze severity (i.e., 2014 = slower ice growth, more mid-winter freeze-thaw cycles & 2015 = persistent subfreezing temperatures)
  + Second comparison: the 2015 freeze and thaw dynamics for two lakes: Missisquoi Bay (eutrophic, low lake : catchment area) and Shelburne Pond (hypereutrophic, greater lake : catchment area)
  + Comparison of interannual variability of
* Builds on {Joung:2017ko} by including DIN data