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Biophysical controls on CO₂ evasion from Arctic inland waters

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TitleBiophysical controls on CO₂ evasion from Arctic inland waters**Abstract**

CO₂ evasion to the atmosphere from inland waters is a major component of the global carbon (C) cycle. Yet spatial patterns of CO₂ evasion and the sources of C that fuel evasion remain poorly understood. In this thesis, I use detailed measurements of biological and physical drivers of CO₂ evasion to assess how C is transformed and evaded from inland waters in the Arctic (Northern Scandinavia and Alaska). I found that lake size was a master variable controlling lake CO₂ evasion in an Arctic catchment and that large lakes play a major role at the landscape scale. In stream networks, I found that catchment topography shapes patterns of CO₂ evasion by dictating unique domains with high lateral inputs of C, other domains where biological processes were dominant, and domains where physical forces promoted degassing to the atmosphere. Together, these topographically driven domains created a strong spatial heterogeneity that biases regional and global estimates of CO₂ evasion. Further, I found that photosynthetic activity in Arctic streams can produce a large change in CO₂ concentrations from night to day, and as a result CO₂ evasion is up to 45% higher during night than day. The magnitude of the diel change in CO₂ was also affected by the turbulence of the stream and photo-chemical production of CO₂. Overall, this thesis offers important insights to better understand landscape patterns of CO₂ evasion from inland waters, and suggests that stream metabolic processes largely determine the fate of the C delivered from Arctic soils.

Keywords

Inland waters, carbon dioxide, organic carbon, inorganic carbon, arctic, CO₂ evasion, DOC, DIC, streams, metabolism, oxygen

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