# Methylmercury hotspots and cycling across a High Arctic freshwater sub-catchment

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## Introduction

- Methylmercury (MeHg) is a toxin that bioaccumulates and biomagnifies through food webs [1]
- Some Arctic **freshwater ecosystems** produce MeHg, with most production occurring *in situ* [1] as a result of microbial activity in sediments[2,3]
- There is a lack of understanding of the fate of MeHg as it is **transported downstream**[4,5] and how it varies **seasonally**[6]
- Arctic climate change has potential to alter MeHg cycling in these systems

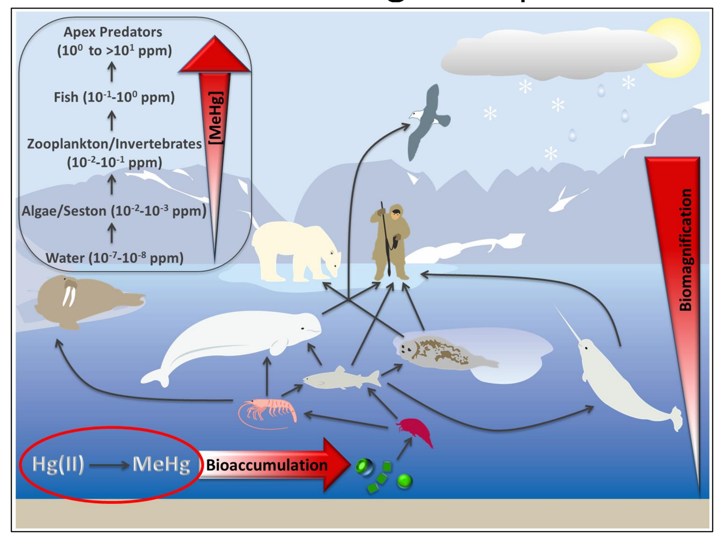


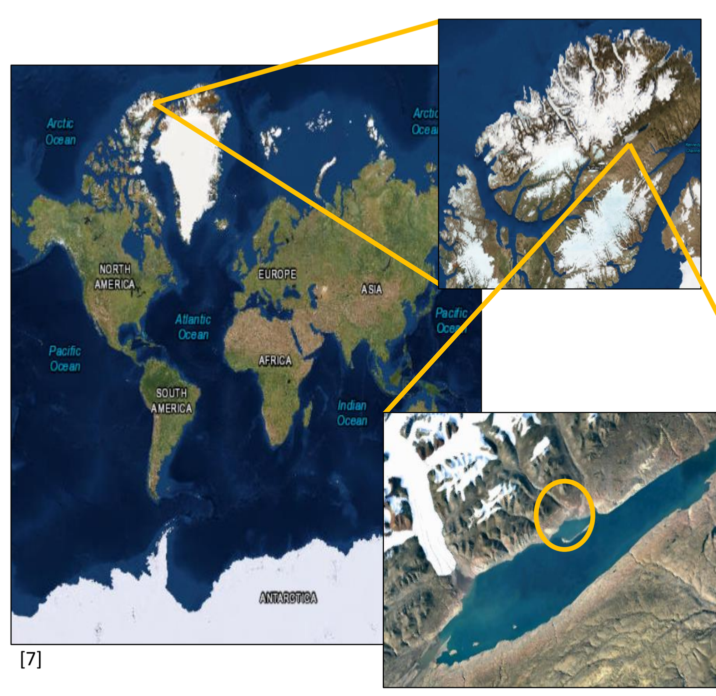

Figure 1. Mercury cycling in Arctic aquatic systems

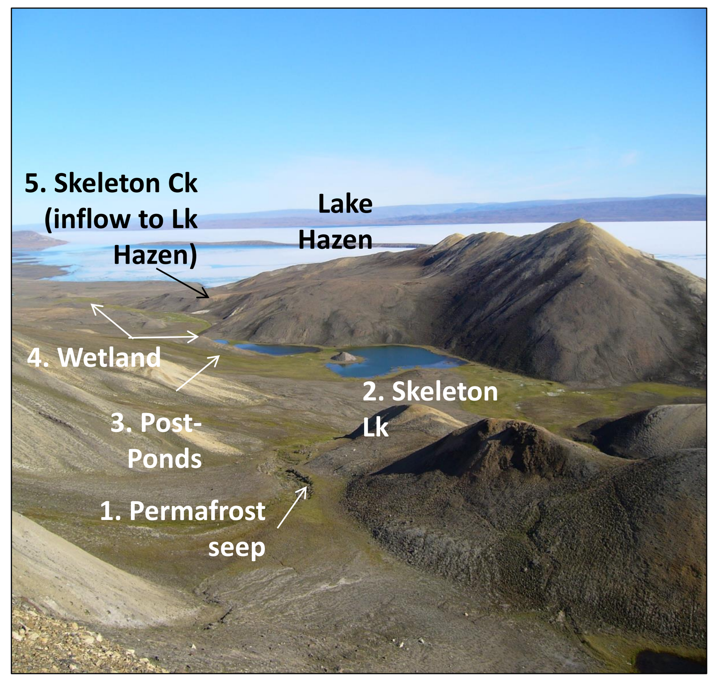
### Objectives:

To identify where MeHg is being produced and degraded along a freshwater sub-catchment and to identify how these processes vary seasonally

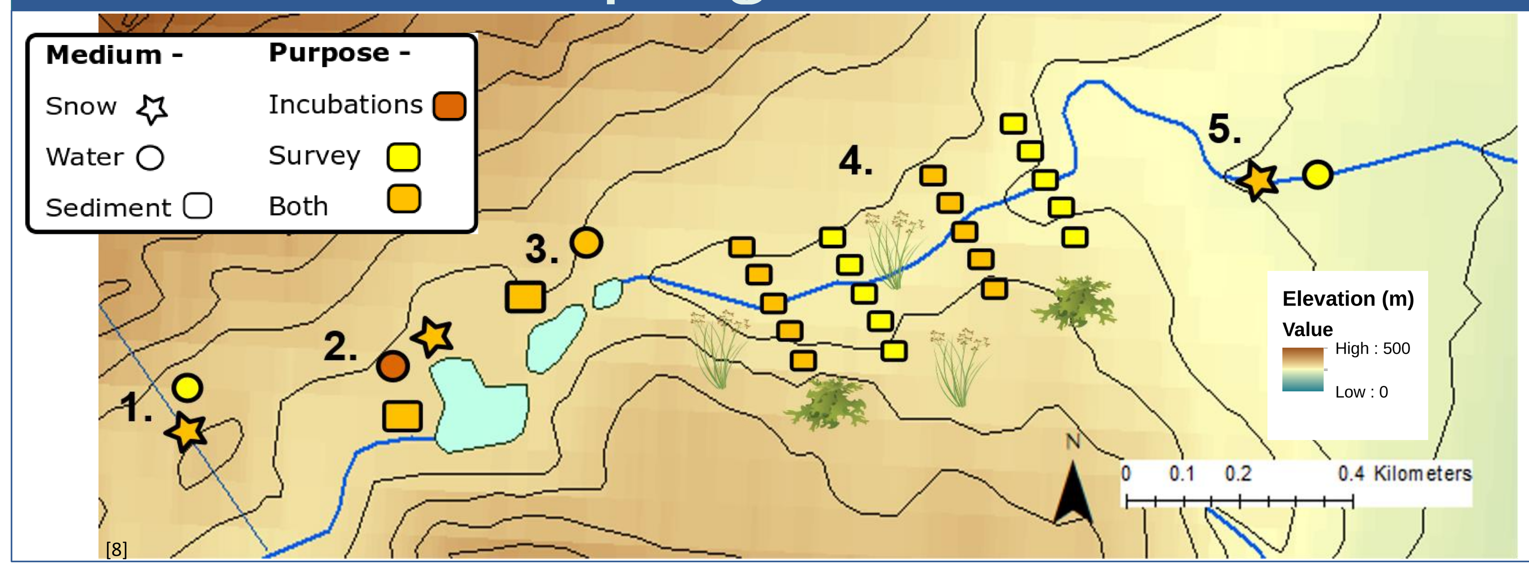
## Study Area

- A freshwater sub-catchment of Lake Hazen, Quttinirpaaq National Park, Ellesmere Island, Nunavut
- The Skeleton Lake continuum allows for samples to be taken as water travels into Lake Hazen passing through a lake, two wetland ponds, a wetland and a tundra creek channel




## Sampling Schematic




## Methods

**Using Stable Hg isotope tracers to investigate methylation potential:**

- Incubations of lake/pond water, lake/pond sediments, wetland soils, snowpack and snow melt samples were conducted shortly before melt, during the **ice-covered** period and the **ice-free**, productive period to explore the fate of MeHg as it is transported through the Skeleton Lake sub-catchment
- Inorganic **$^{198}$Hg and Me$^{199}$Hg** were injected into sample media at predetermined concentrations to track short-term methylation and demethylation potential, respectively[9,10]

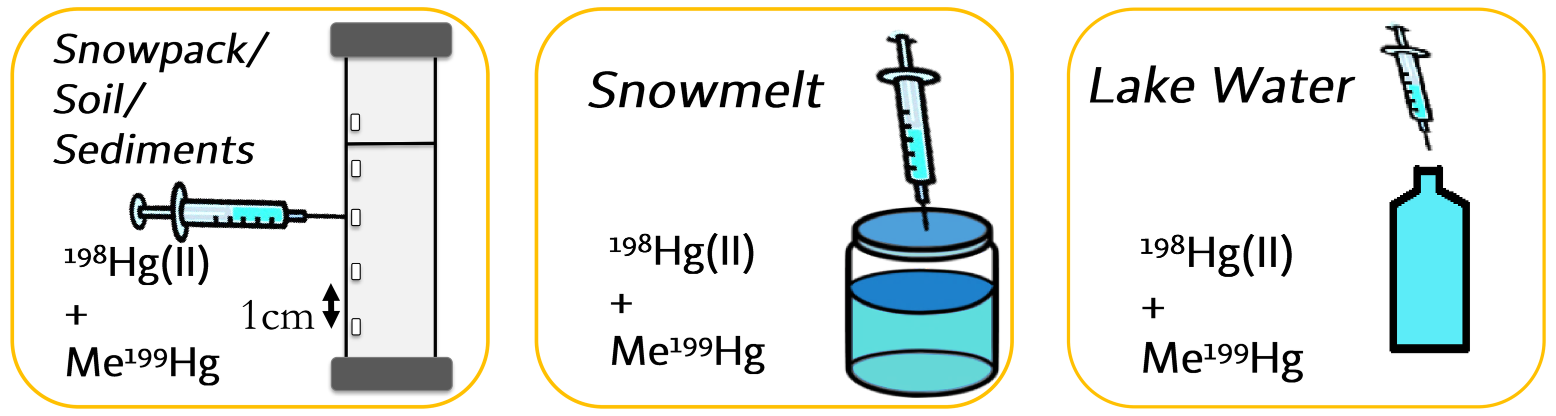



Figure 2. Illustrations of stable Hg isotope injection methods

**Spatiotemporal Hg & MeHg Survey:**

- Wetland soil cores were taken in summer 2016 along multiple transects perpendicular to water flow to examine saturation gradient
- Snow & snow melt samples were taken in spring 2017
- %MeHg obtained from soils, water, snow and melt will be used as a proxy for longer-term methylation potential[11]

## Results – High levels of MeHg in Spring

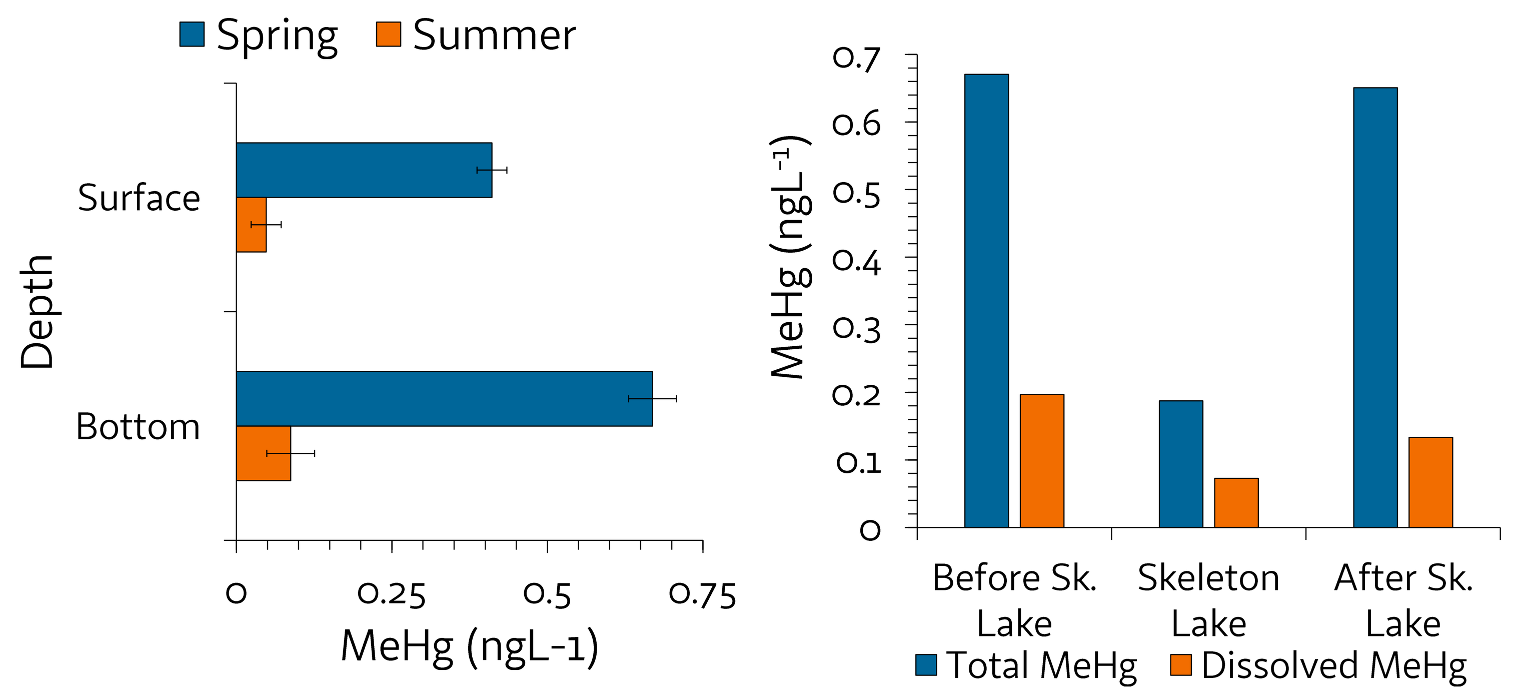



Figure 3. Total MeHg concentrations (ngL$^{-1}$) in Skeleton Lake water during ice-covered and ice-free period

Figure 4. MeHg concentrations (ngL$^{-1}$) in snowpack along Skeleton Continuum, May 2017

## Results – Spatial Variation

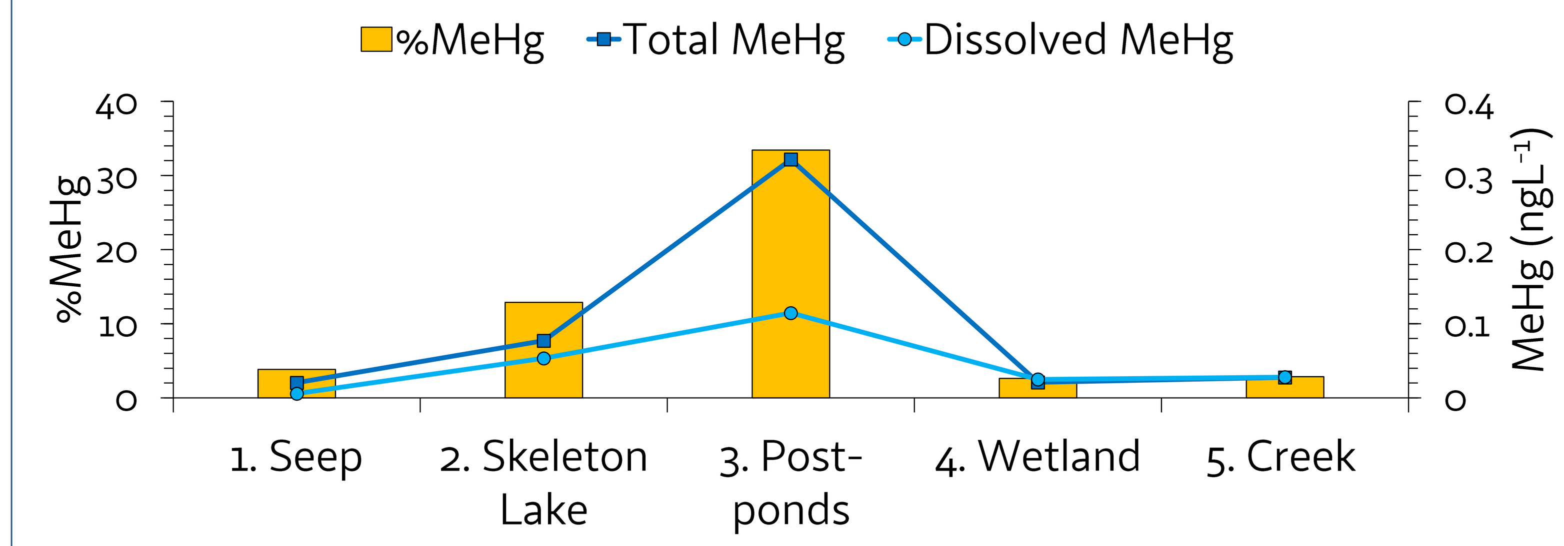



Figure 5. MeHg variation in water throughout the Skeleton Lake Sub-catchment in 2016

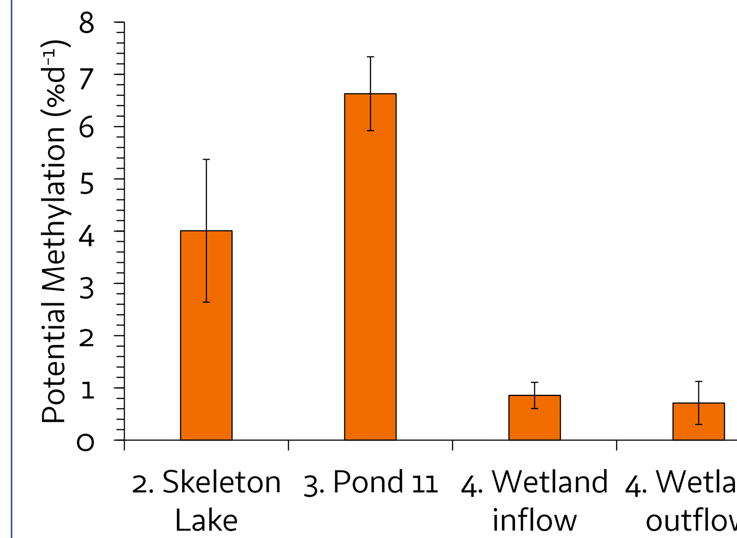



Figure 6. Potential methylation in Skeleton Continuum, Summer 2016

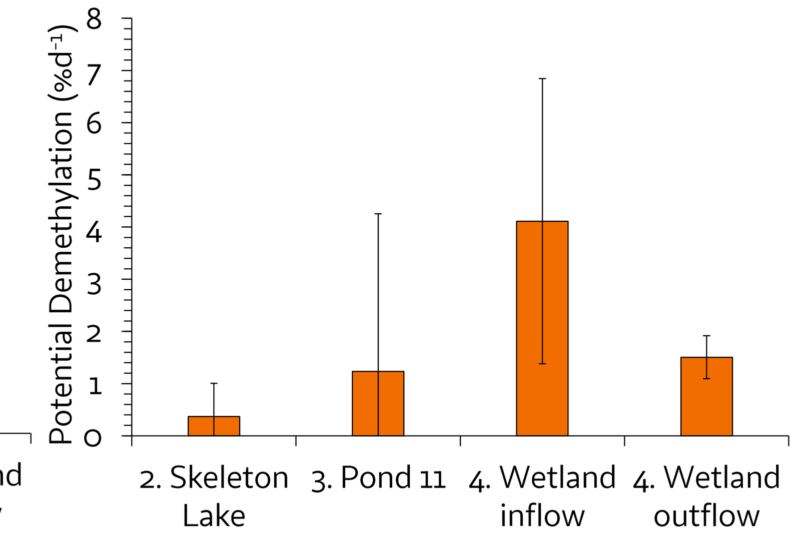



Figure 7. Potential demethylation in Skeleton Continuum, Summer 2016

## Discussion

- Preliminary spring results show that snow (0.53 ngL$^{-1}$) and Sk. Lake bottom water (0.56ngL$^{-1}$) have elevated MeHg concentrations before/during melt
- Spring methylation experiments in the water column/snow will shed light on observed seasonal patterns
- Skeleton Lake and Pond 11 sediments both act as hotspots for methylation, providing MeHg to the downstream wetland
- Potential demethylation in wetland soils is significantly higher when compared pond/lake sediments, establishing that there is potential for the wetland to act as a sink of MeHg through demethylation in soils
- Additionally, MeHg in the water flowing into the wetland is largely particulate bound, suggesting that sorption of MeHg onto soil organic matter may play a role in decreased MeHg concentrations[4]
- System MeHg & DOC concentrations have a significant positive regression ($p=0.03$, $R^2=0.22$)

## Future Steps

- Mechanisms driving changes in %MeHg can be elucidated by exploring the fate of MeHg as it is transported downstream
- Analysis of snowpack, snowmelt and snow particulate matter will provide an understanding of the origin of MeHg in snowpack and how it is transported and transformed during accumulation and melt
- Comparison of ice-free and ice-covered periods will aid in identifying how climate change may alter MeHg cycling in the Arctic

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