

# Evaporation Measurements from Two Contrasting Arctic Lakes



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## Introduction - Northern Lakes:

Are a ubiquitous part of the landscape : over a 100 x 100-km area surrounding the study sites, there are 3,727 lakes with an area > 5,000 m<sup>2</sup>, representing 28% of the land area.

Play an important role in the energy, water, and carbon cycles at the local to regional scale.

Occur at a broad spectrum of size, shape, and volume distributions across vast areas and latitudinal gradients.

Are undergoing rapid environmental change (e.g. ice cover duration change; thaw subsidence and rapid drainage).

## Objectives

How does the magnitude and controls of lake evaporation vary across this spatial and morphological gradient?

Compare/contrast two different small lakes: round and shallow vs. long and deep; northern and southern, to help address this question.

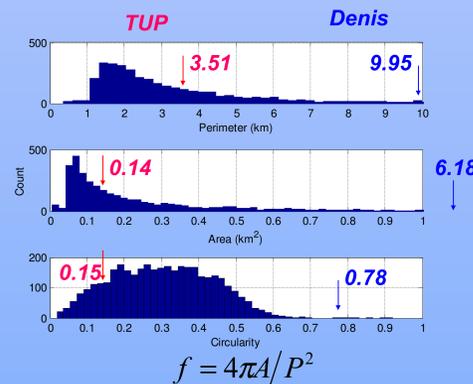


Fig 1. Histograms of lake perimeter, area, and circularity (circle = 1) for all lakes > 5,000 m<sup>2</sup> in the 100 x 100-km study region.

## Methods

Eddy covariance (sonic anemometer and krypton).

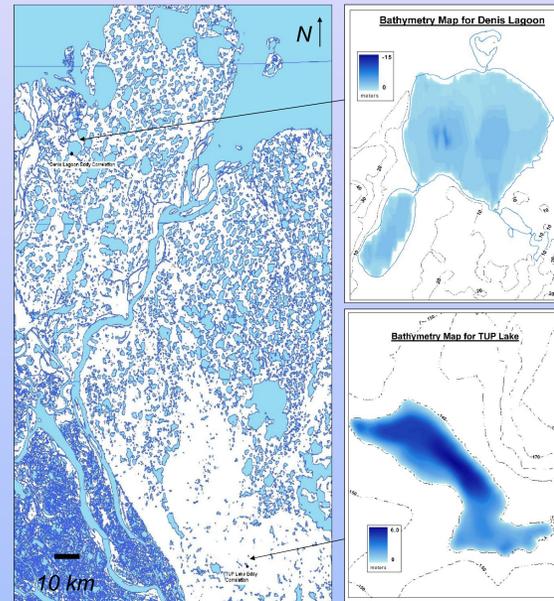
Standard suite of corrections.

Ancillary radiation and meteorological measurements.

2005, 2006, 2007 ice-free measurements; 30-min means.



## Study Sites



### Denis Lagoon

Typical in flat, permafrost terrain.

Round (3.0 by 2.7 km); shallow (1 m); circularity 0.78; surface area 6.18 km<sup>2</sup>.

### TUP Lake

Typical in Shield terrain

Long (778 m); narrow (163 m); deep (6 m); circularity 0.15; surface area 0.14 km<sup>2</sup>.

## Results

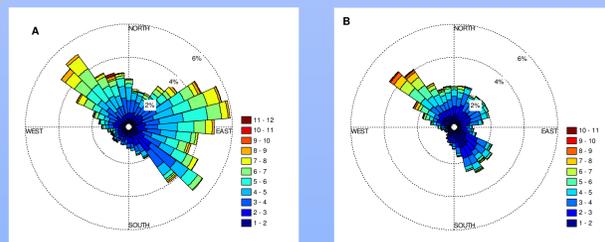


Fig 2. Wind direction frequency and speed (m s<sup>-1</sup>) for Denis Lagoon (A) and TUP lake (B) for all data (2005, 2006, 2007). Greater frequency of east winds at Denis Lagoon compared to prevailing NW winds at TUP lake.

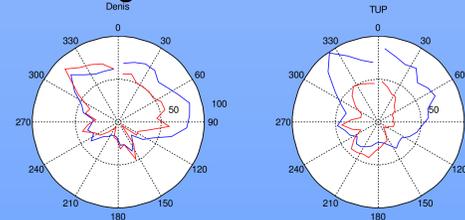


Fig. 3. Latent (blue) and sensible (red) heat fluxes (W m<sup>-2</sup>) as a function of wind direction for all data. We can “see” the lake with the larger latent heat ~325-100 degrees (Denis: 48% of the data; TUP: 27%); only these data were used in the subsequent analysis.

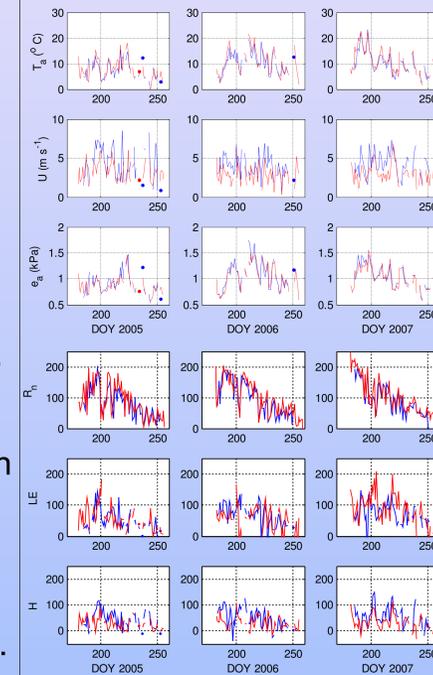


Fig 4. 24-hr mean general meteorological conditions (air temperature, wind speed, atmospheric vapor pressure) for Denis (blue) and TUP (red).

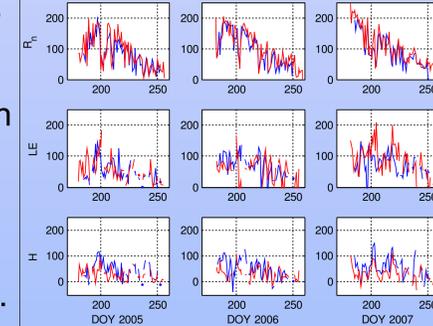


Fig 5. 24-hr mean energy balance components (net radiation, latent and sensible heat; W m<sup>-2</sup>) for Denis (blue) and TUP (red).

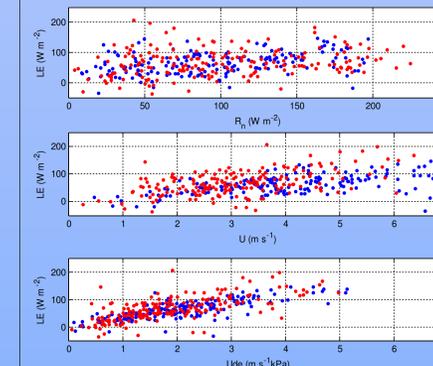


Fig 6. Controls on the 24-hr mean latent heat flux from Denis (blue) and TUP (red): net radiation; horizontal wind speed; product of horizontal wind speed and the difference between water surface and atmospheric vapor pressure.

## Conclusions

Except for wind speed and direction, met. conditions and net radiation were indistinguishable at both sites despite 90 km N-S separation.

Although low correlation between *LE* between sites, the best predictor of *LE* was *Ude* at both sites.

Despite differences in location, size, shape, and depth, nearly identical evaporative water losses (Fig 7).

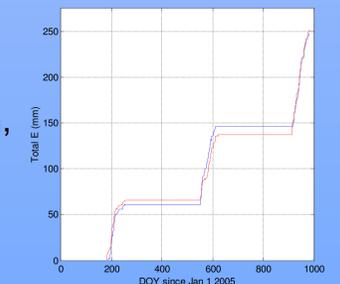


Fig 7. After three years, the total evaporative water losses were 249 (Denis-blue) and 251 mm (TUP-red).