**Introduction**

**Ice algae**
- 1º pulse of spring photosynthetic production
  - Supports Arctic food-web
  - Produce essential fatty acids
  - Poly-unsaturated (PUFA)
  - Saturated

**Light & Nutrient Limited**
- "Light & Nutrients:" Lipids & Protein

**Diatoms**
- Class Bacillariophyceae
- Encased in silica frustule
- Pennate & Centric

**Fourier Transform Infrared (FTIR) Spectrochemical Analysis**
- Measures biomolecular (biomass) composition
  - PUFA
  - Total Lipids (CH$_2$CH$_3$)
  - Proteins (Amide I)
  - Silica (Si-O)

**Tidal straits hypothesis**
- Shallow, narrow water ways
- Increased water column mixing, Therefore: increased nutrient flux

**GOAL:** Determine the influence of light & nutrient availability on biomass composition of individual Arctic diatom cells compared to bulk-community biomass & species composition

I. Use FTIR to examine biomass composition (PUFA, total lipids, & protein), in individual cells of different diatom taxa; compare to bulk algal community

II. Compare FTIR-derived biomass to bulk measurements (e.g. Chl a, organic C & N, etc.), & taxonomic composition

III. Relate changes in biomass to nutrient fluxes, location in tidal strait & penetration depth in bottom fine structure of sea ice

**Field Work & Sample Collection**

- Finlasyon Islands, Dease Strait, near Cambridge Bay, NU, CA
- 26 April to 12 May 2017

**Fine Structure**
- Sites #: 1 – 4
  - Thin Snow Cover (< 8 cm)
  - Bottom: 0-2, 2-5, & 5-10 cm
  - Cells filtered onto a poly-carbonate filter
  - Store @ -80°C; prep on dry ice

**Transmission Mode FTIR – Individual Biomass**
- Light passes through sample + substrate, BaF$_2$
- Wavelengths = vibrational energies of functional groups are absorbed
- IR spectrum:
  - Processed in MATLAB™

**Biomolecular Analysis**
- Agilent Cary 670 IR Spectrometer & 620 IR Microscope:
  - Global Light Source
  - 64 x 64 pixel FPA detector
  - 15x (0.62NA) optics
  - 1.1 x 1.1 µm$^2$ pixel (projection)

**Sample Preparation for PUFA - Lights Out!!**
- Filters sectioned in dark
- Cells released onto a BaF$_2$ windows, with Milli-Q water (4 µl drop)
- I.D. taxa under light microscope with red light filter (650 nm)
- Samples dried in desiccant chamber overnight (~12 hrs), in dark
- Analysed next day, in darkened room

**Finding PUFA**
- PUFA Band: 3006 cm$^{-1}$ (red arrow)
- Low T + 650nm filter & dark room prevents photo-oxidation of PUFA
- Navicula genus has been observed to have the greatest quantity of PUFA

**Preliminary Results**

**Nitzschia frigida**
- Light = constant
- Lipids increase (site 1 to 4)
  - Variability between ice sections
  - Proteins decrease (site 1 to 4)
- Ratio Pattern
  - Normalizes lipids & proteins across all sites
  - Reflects increased nutrient stress, with high lipid & low protein
  - Greater, further from site 1

**Bulk-Community Biomass Composition Analysis**
- Attenuated Total Reflectance (FTIR-ATR)
  - Light passes through crystal in contact with sample
  - Creates an evanescent wave, penetrates sample by few microns

**Next Steps...**

**Acknowledgments**

This work was supported by funding the Northern Scientific Training Program (NSTP) to Mundy, NSERC operating grants to CAO and NSERC-Polar Knowledge Canada (CKANC) is thanked for in-kind logistical support. Special thanks are extended to the Dalvakinak Hunters and Trappers Organization and residents of Cambridge Bay for their support of the ICE-CAMS field program. This is a contribution to the programs of NSERC, Antartic, Arctic Science Partnership and the Canada Excellence Research Chair unit at CEOS.