In April 2012, over 55 lakes in northern Alaska were instrumented for CALON, a project designed to monitor physical and geochemical processes in Arctic permafrost lakes. Ten observation nodes along two ~200 km latitudinal transects from the Arctic Ocean to the Brooks Range foothills at each node, six representative lakes of differing size and depth were instrumented to collect field measurements on lake physiochemistry, lake surface and terrestrial-climate, lake water and permafrost temperature.

Data are downloaded from lakes and met stations in August, and proximal lakes are sampled, and discrete samples and measurements of geochemical and biogeochemical parameters in April and August, including dissolved organic carbon and total dissolved nitrogen for spring (April, under ice) and summer (August) in three years. The bars are averages and the error bars are the standard deviation. The lakes are organized from north to south (approximately).

Figure 5. Dissolved organic carbon and total dissolved nitrogen for spring (April, under ice) and summer (August) in three years. The bars are averages and the error bars are the standard deviation. The lakes are organized from north to south (approximately).

Want to learn more about CALON at AGU? ENSC-0562: Asakrston et al., Carbon cycling-climate change feedback of thawing permafrost in Arctic Alaska: Monitoring methane emissions. Moscone South Poster Hall, Wednesday AM ED430-0880: Elsner et al., Twelve Years of Interviews with the Inupiaq people of Arctic Alaska. Report from a Community Workshop. Moscone South Poster Hall, Thursday PM C21C-0754: Arp et al., Ice regime and melt-out timing cause emergent hydrologic responses among Arctic lakes. Moscone South Poster Hall, Tuesday AM

### Overview

- About half of the Arctic Coastal Plain (ACP) of Alaska is thermokarst lakes and drained lakes over permafrost (Figure 1).
- In April 2012, over 55 lakes in northern Alaska were instrumented for CALON, a project designed to monitor physical and geochemical processes in Arctic permafrost lakes.
- Ten observation nodes along two ~200 km latitudinal transects from the Arctic Ocean to the Brooks Range foothills. At each node, six representative lakes of differing size and depth were instrumented to collect field measurements on lake physiochemistry, lake surface and terrestrial-climate, lake water and permafrost temperature.
- Each April, temperature and depth sensors are deployed through the ice, and water samples are collected.
- Data are downloaded from lakes and met stations in August, including dissolved organic carbon and total dissolved nitrogen for spring (April, under ice) and summer (August) in three years. The bars are averages and the error bars are the standard deviation. The lakes are organized from north to south (approximately).

#### Figure 1. Location of monitoring nodes in two transects; each hub has a terrestrial met station – Six lakes are monitored at each hub, with basic instrumentation at all lakes and enhanced instrumentation at two lakes per hub. At Barrow, Atqasuk and Toolik, intensive instrumental at “Focus Lakes” measures water and energy balance throughout summer.

#### Figure 2. Winter severity is expressed by sum of monthly Freezing Degree Days for all nodes. Ice thickness and snow depth also shown as average for all six lakes. Winter generally warmed during the 3rd 3 years, and ice thickness declined. Winter 2014–15 slightly reversed this trend. Early snowfall in January explains some of the interannual and inter-site variability.

- Temperature, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity, b) air temperature, c) incoming solar radiation, and d) relative humidity.

- Analysis of water samples from August shows that there is little interannual variation in lake water chemistry for ten concentration, pH, and specific conductivity. Proximal lakes tend to have similar chemical signatures, but there are large variations across the study region. Although regional factors have some influence, local factors appear to largely control water chemistry. Lakes with suspected through lakes do not demonstrate a distinct chemical signature compared to nearby lakes (labeled in figures) lacking a through ice.

- Figure 6. Illustration of the large interannual variability among study years (2012–2015) for Ekalakak Lake (Barrow, Alaska). Shown are the 4-year mean, maximum, and minimum values of daily mean a) surface water temperature, b) air temperature, c) incoming solar radiation, and d) relative humidity, as measured from a data buoy deployed in the middle of the lake. Note the wide range of values among years, particularly early in the summer, immediately after ice-off. Water temperature is notably less variable than air temperature, due to thermal inertia and competing influences from other climatic factors, but both thermal regimes show a similar seasonal cycle. The large interannual variability illustrated here highlights the need for continued, long-term monitoring to detect climate-related trends in lake dynamics and hydrologic drivers.

- Figure 7. Above: Snow depth derived from satellite imagery across latitudinal bands. Snow depth generally decreases from east to west across all three bands. However, there is a slight increase in snow depth near the coast of the Arctic Ocean. Below: A remote time-lapse camera network has been in operation since 2011 and is being used to make seasonal and annual observations of lake ice and water column. Near-real-time observations are available on the TLO webpage between April and November.

- Time-Lapse Camera Observations

- Figure 8. Application of a thermal equilibrium steady-state model developed by J.R. Mackey suggests a link between under ice lake hydrology and thermal forcing. Analysis of water samples from August shows that there is little interannual variation in lake water chemistry for ten concentration, pH, and specific conductivity. Proximal lakes tend to have similar chemical signatures, but there are large variations across the study region. Although regional factors have some influence, local factors appear to largely control water chemistry. Lakes with suspected through lakes do not demonstrate a distinct chemical signature compared to nearby lakes (labeled in figures) lacking a through ice.

- Figure 4. Correlations of chromophoric dissolved organic carbon (CDOM) at 340, 380, 440, and 500 nm, in lakes during both August and April along CALON transects for the years 2012, 2013, and 2014. The mean (open circle, median (horizontal line)), standard deviation (boxes), and total range (whiskers) for each sample population are shown.

- CDOM absorption is higher during April compared to August, likely resulting from lower rates of photodegradation and bacterial decomposition during winter months. Similarly, most major elements and carbon concentrations are found to be slightly lower during April compared to August, likely resulting from the presence of higher concentrations of nutrients (e.g., NO3–) in the water column. However, there is still present on the lakes during April light transmission through the lake ice seems to be sufficient for primary production to take place in these lake ecosystems.

- On 20 August 2015, a workshop was held in Barrow to present and summarize highlights and findings of 12 years of research on native knowledge and landscape processes in Arctic Alaska. We do this by interviewing the people of the villages on the North Slope, and have talked to elders and hunters from Barrow, Atqasuk, and smaller villages. Q&A Team member Chris Cuomo talking to Thomas Richard, who was showing her the location of a drained thaw lake. (R) Phyllis Alqikok, one of the oldest residents of Atqasuk Pass, describing her family’s epic journey from Barter Island in Canada to Atqasuk Pass by boat, dog sled, and on foot.

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### Final Results from the Circumarctic Lakes Observation Network (CALON) Project

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At the workshop, Eisner, Cuomo and Project leader Ken Hinkel presented Mrs. Lollie Hoppin, our long-time community liaison, with a Certificate of Appreciation for her invaluable help, advice, and support.

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We hope that future iterations of CALON will include the entire Pan-Arctic, please contact us if you would like to be involved!