IKAAĠVIK SIKUKUN

Photo by Sarah Betcher
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KOTZEBUE
IKAAĠVIK SIKUKUN

Spring 2020 newsletter 3: Bridging science & Indigenous communities to study sea ice change in Kotzebue Sound

Ikaaġvik Sikukun—Ice bridges

The frozen environment around Kotzebue Sound is changing. Ocean water is warmer, with less sea ice and more open water. Ikaaġvik Sikukun—Iñupiaq for ice bridges—is a research project in Kotzebue, Alaska that connects the community with scientists to understand how sea ice, ocean physics and marine mammals are changing in the Sound. The science is guided by an Elders Advisory Council and documented through several short films. This newsletter shares the results of Ikaaġvik Sikukun's measurements on and under the ice.

Ikaaġvik Sikukun began in 2017 and is expected to finish in 2021. This year, the team is focusing on processing data and interpreting results along with the Elders Advisory Council. Due to coronavirus, all in-person meetings in Kotzebue were canceled to ensure the health and safety of the community.

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Learn more!

To learn more about Ikaaġvik Sikukun visit us online at www.ikaagviksikukun.org or email questions/comments to ikaagvik_all_pis@lists.ldeo.columbia.edu.

Support

Ikaaġvik Sikukun thanks the Gordon and Betty Moore Foundation for funding and Selawik National Wildlife Refuge for logistical support.

Participants

NATIVE VILLAGE OF KOTZEBUE
KOTZEBUE IRA

UAF UNIVERSITY OF ALASKA FAIRBANKS

Lamont-Doherty Earth Observatory
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LATITUDE

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On ice measurements

How do snow depth and sea ice thickness change throughout the year? Does the river channel impact ice thickness?

Measuring sea ice & snow

Ikaaġvik Sikukun measured snow depth and sea ice thickness in Kotzebue Sound. These measurements help explain how, when and why ice grows and melts. The Elders Advisory Council helped choose the two sites: 1) a high-current site in the channel where the Noatak and Kobuk rivers merge and flow out of the Sound, and 2) a low-current site at the edge of the channel in a small bay. Comparing the two sites may help explain how currents and river water impact sea ice growth and melt.

Who measures ice & snow?

The Kotzebue Sound snow depth and sea ice thickness sites were initially set up in January 2018 by graduate students **Kate Turner** and **Carson Witte** and project leader **Alex Whiting**. Each year the site is set up in January when the sea ice is stable. Gauges are removed before break-up in late April or early May. In spring 2018, Elder Advisor **Bobby Schaeffer** and Alex recorded the data. Since January 2019, Kotzebue's **Vince Schaeffer** took over measurements. Although field work ended for Ikaagvik Sikukun in 2019, these measurements continued in 2020 through a partnership with the Alaska Arctic Observatory & Knowledge Hub.

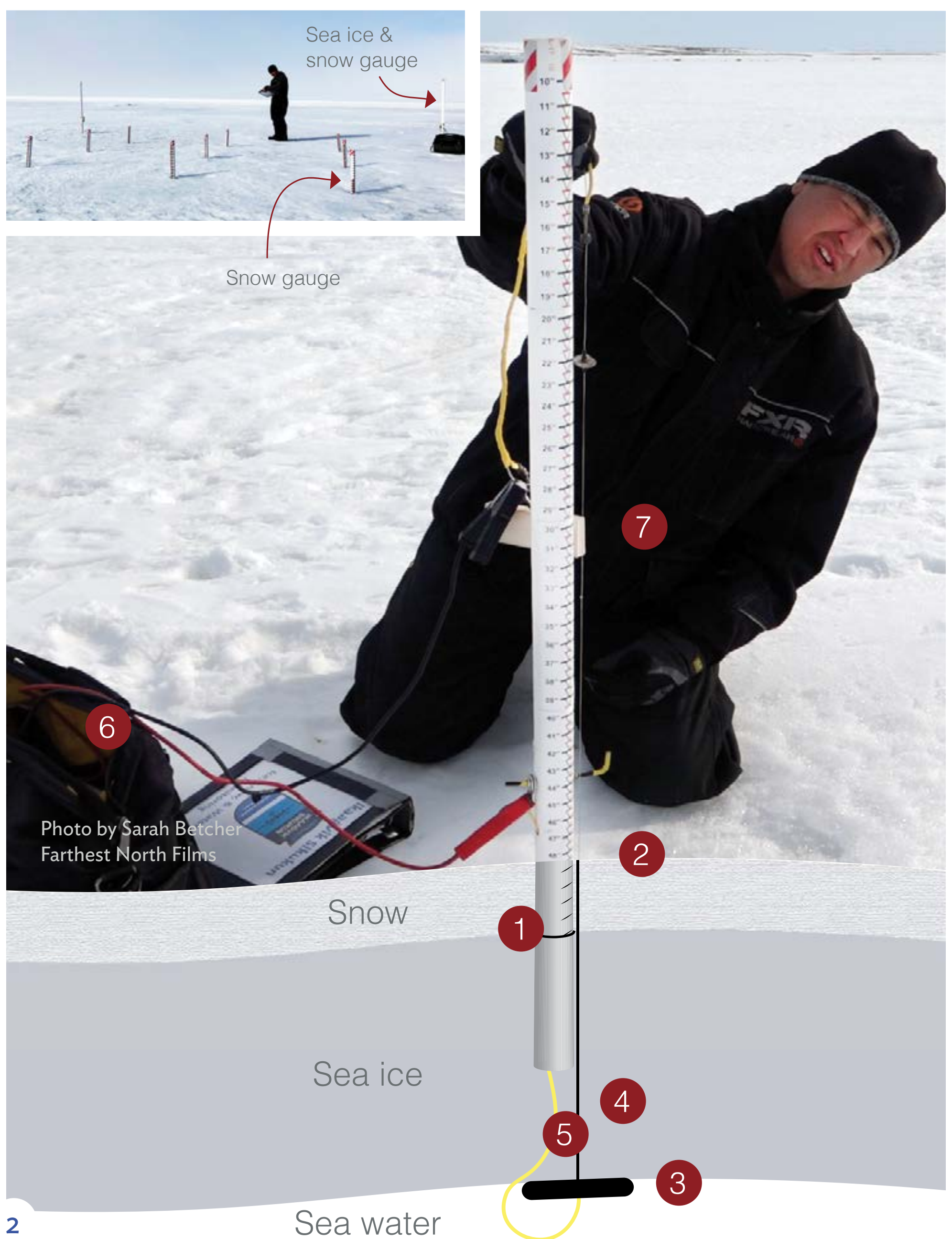


Photo by Sarah Betcher
Farthest North Films

What did we measure?

Each week from January to May snow and ice measurements were taken at the channel and bay sites. Sites had 4 gauges for measuring both snow depth and ice thickness, and 9 more to measure only snow depth.

This diagram shows how the snow depth and ice thickness was measured. Data on **page 3** came from these measurements.

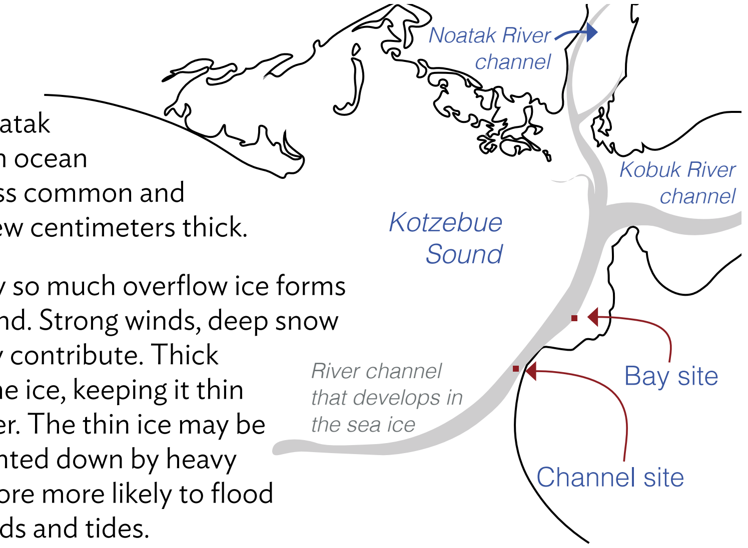
1. Marks the "zero point" at the **ice surface** when the gauge was frozen in place in January.
2. The **gauge markings** are used to measure snow and ice depth.
3. **Steel weight** sitting under the ice.
4. **Steel cable** runs from the steel weight to the top of the gauge.
5. **Copper wire** can be connected to a car battery. Doing so heats up the steel cable, melting the ice so the cable can move. Vince pulls the cable until the steel weight rests on the ice's bottom.
6. **Car battery** connects to the copper wire at the positive end and the steel cable at the negative end.
7. Once the cable is pulled tight, ice thickness is measured by seeing where the **wooden handle** hits the gauge markings.

Overflow on sea ice

Sometimes the weight of the snow, along with wind and strong incoming tides, pushes the sea ice down and seawater from below floods the surface. On rivers, this flooding is often called "overflow." Flooded sea ice can impact wildlife such as seal pups, if their lairs no longer provide a warm place to dry off.

In 2019, flooded snow from overflow was common in the Sound (see photo below). When this overflow refroze it made up 50% of the total sea ice thickness. Local residents often find overflow near the channel and the mouth of the Noatak River. In the open ocean overflow ice is less common and typically only a few centimeters thick.

It is not clear why so much overflow ice forms in Kotzebue Sound. Strong winds, deep snow and thin ice likely contribute. Thick snow insulates the ice, keeping it thin throughout winter. The thin ice may be more easily weighted down by heavy snow, and therefore more likely to flood under strong winds and tides.



Overflow photo by Sarah Betcher
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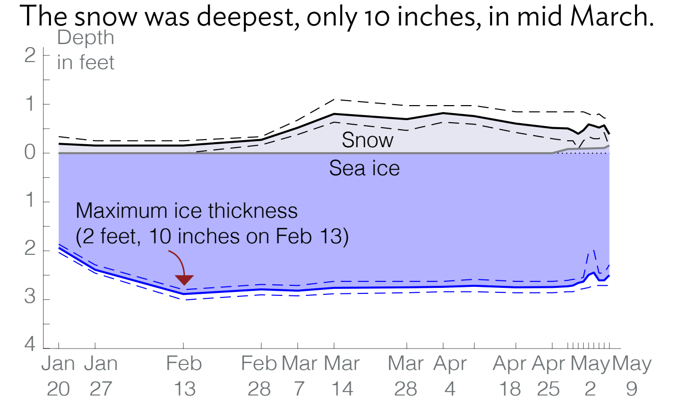
Check out the data

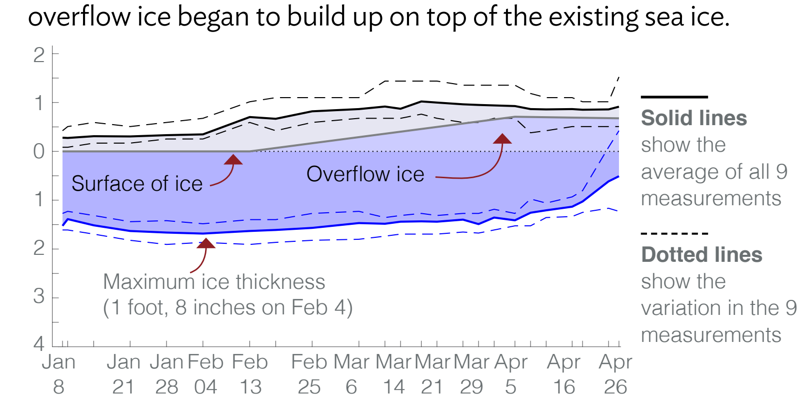
2018 channel site

There was little snow in 2018 and considerable ice grew in January. It stopped growing relatively early, reaching its maximum in mid February. The snow was deepest, only 10 inches, in mid March.



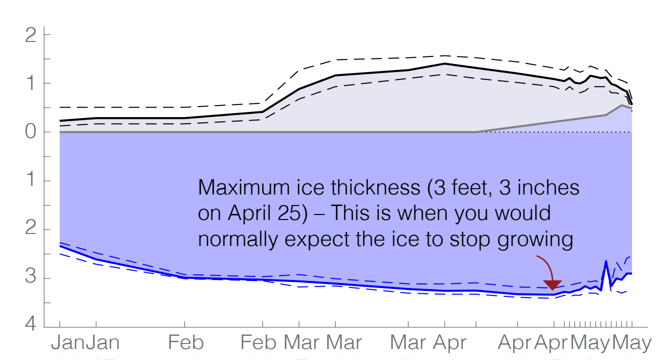
2019 channel site

Ice was over a foot thinner in 2019 than in 2018. Deeper snow and strong winds/tides likely contributed to the thinner ice. By the middle to end of February, overflow ice began to build up on top of the existing sea ice.



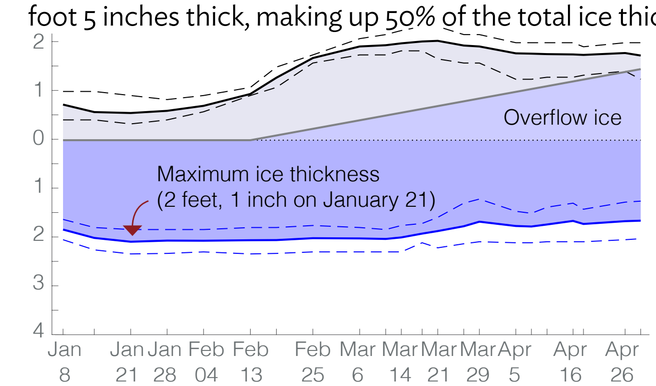
2018 bay site

Without strong currents to erode ice from below, Bay ice was about 5 in thicker than channel ice. Ice grew until late April. Snow was also deeper (1 ft 5 in) at the Bay site.



2019 bay site

Bay site ice stopped growing three months earlier than usual and was over a foot thinner than 2018. Strong southerly winds and deep February snow pushed the surface of the ice down, causing overflow. By winter's end overflow was ~1 foot 5 inches thick, making up 50% of the total ice thickness.



Three consistent patterns emerged. Bay site ice was thicker than in the channel where the current was stronger. Strong winds and thin ice in 2019 caused more flooding so thick overflow ice formed. Ice stopped growing earlier in the winter than expected (ice typically continues growing until mid to late April), which suggests that heat from the ocean limits ice growth.

Under ice measurements

How do currents and saltiness impact how sea ice grows and melts?
Which seasons are most impacted by ocean water compared to river water?

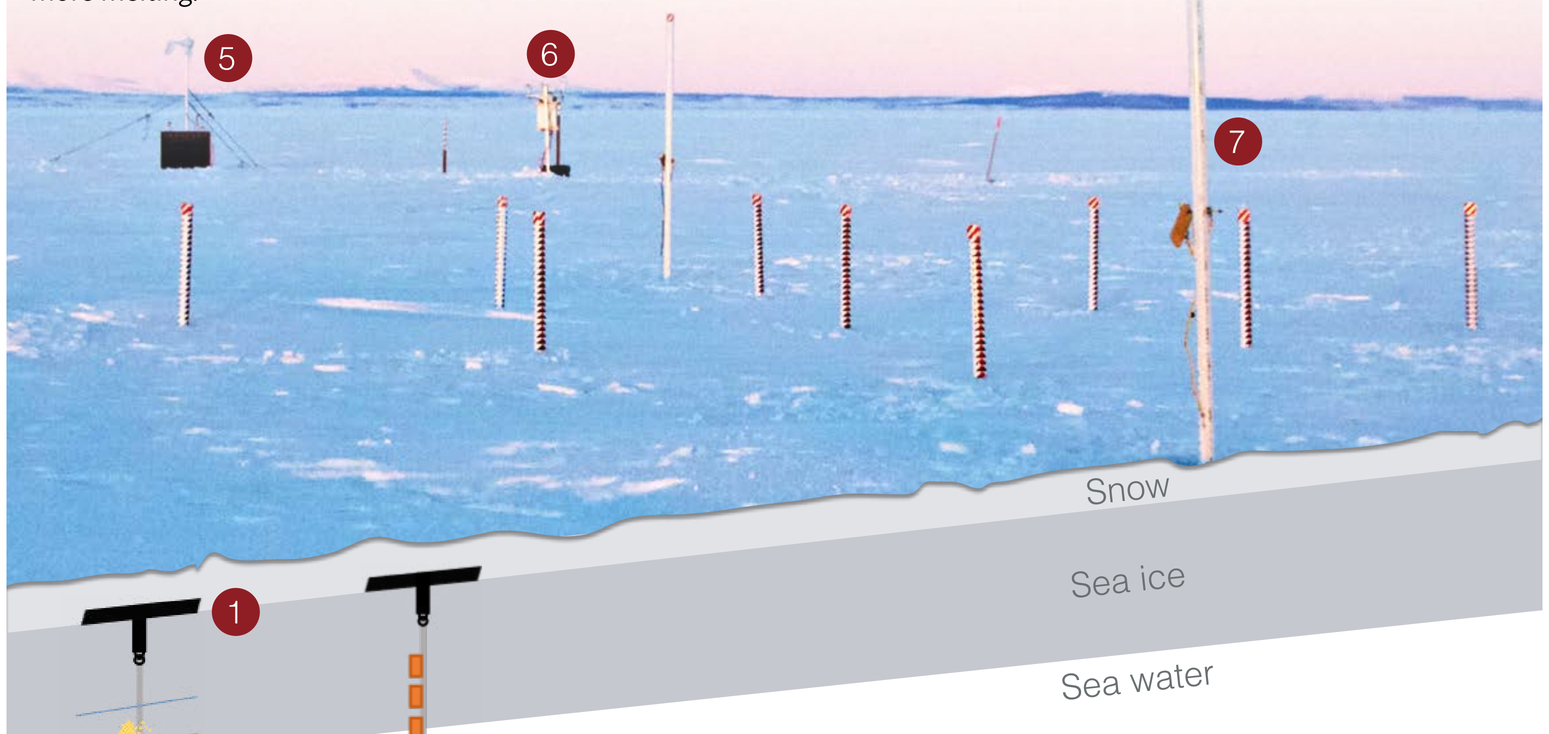
What happens under the ice?

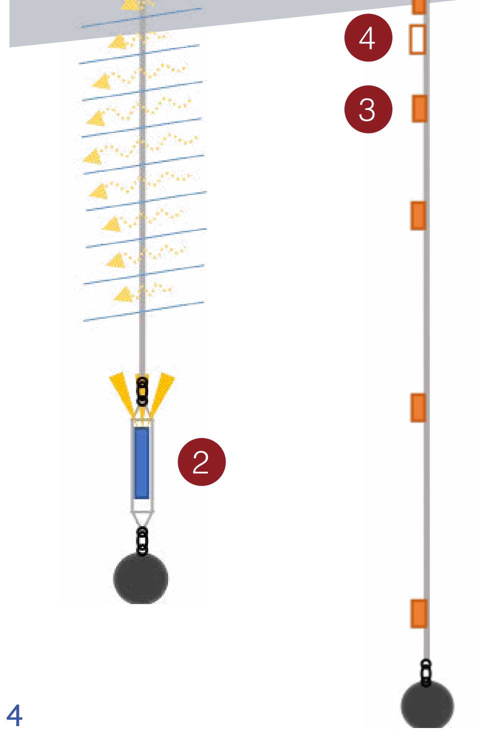
To understand how sea ice forms and melts in Kotzebue Sound Ikaaġvik Sikukun, graduate student **Carson Witte** and project leader **Christopher Zappa** used specialized science instruments to explore the interactions between three forces:

Salty ocean water. Saltier water is usually further from its freezing point so it can cause more melting.

River channel. As the river water moves out of the Sound, its current can erode away sea ice.

Heating and cooling. Driven by the sun (or lack of sun in winter) and by the water too.





What did we measure?

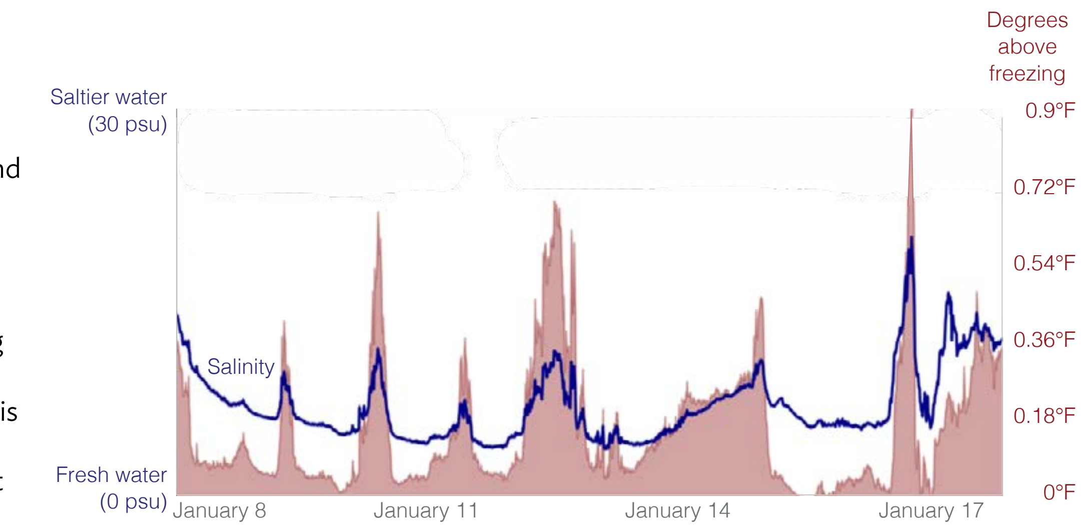
Under ice measurements were taken with sensors at the channel site only. These sensors remained in the ice all winter. In spring they were retrieved and the data stored within was downloaded. Data at the top of **page 5** came from these sensors.

1. This "T" braces against the ice keeping the under ice sensors, which are attached to a string with a weight at the bottom, in place.
2. This sensor uses pulses of sound to measure the current at different depths.
3. The orange sensors on this string measure the temperature.
4. The white sensor measures both the salinity and the temperature.
5. This windmill and solar panel provided power to the instruments throughout the winter.
6. This weather station sits on top of the ice, measuring the effects of air temperature, humidity, wind and sunlight on the growth and melt of the ice. The difference between how much heat the sun gives off and how much the ice reflects back, tells us how much melting happens directly from the sun.
7. These are the snow and ice gauges discussed on **page 2**.

Check out the data

Ocean — most impact in winter

As expected, water moving north into Kotzebue Sound was usually saltier, and water moving south out of Kotzebue Sound was usually fresher. Ikaaġvik Sikukun temperature and salinity sensors showed that peaks in salinity, meaning that ocean water was moving into the Sound, usually happened simultaneously with warmer water. This means that in winter, the ocean brings heat into Kotzebue Sound. Movement of ocean water into the Sound usually was driven by wind.



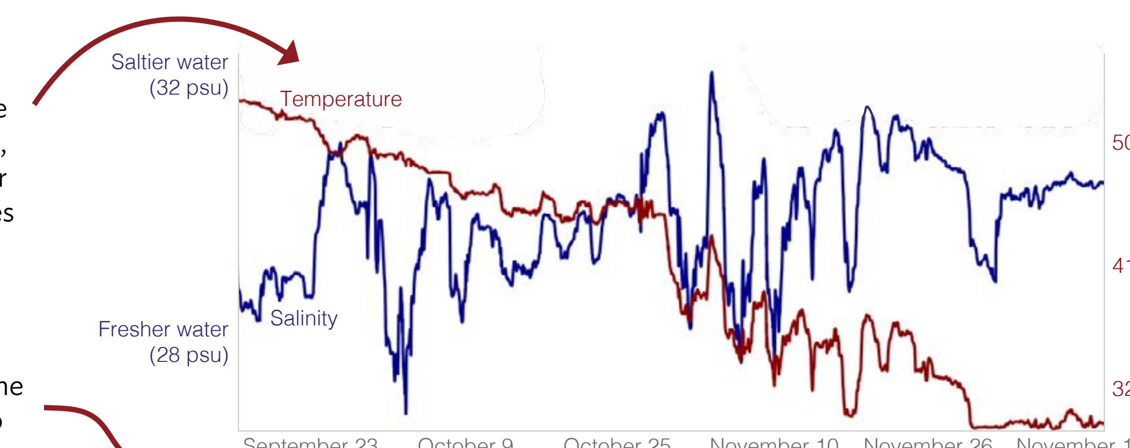
psu = Practical Salinity Unit, a measure of how salty water is.

River channel — most impact in spring & fall

On **page 2 and 3** we learned from the "on ice measurements" that sea ice is thinner in the middle of the river channel. The "under ice measurements" (**page 4 and 5**) revealed that the ocean was the biggest contributor of heat in winter (which also helps explain why the ice on **page 3** stopped growing so early). However, all these sensors were only in place during winter. To understand what happens during freeze-up and break-up, a mooring was tethered to the seafloor near the mouth of the Sound for two years. This instrument, which is pictured in the photo to the right, measures salinity and temperature year-around. The data are shown below.

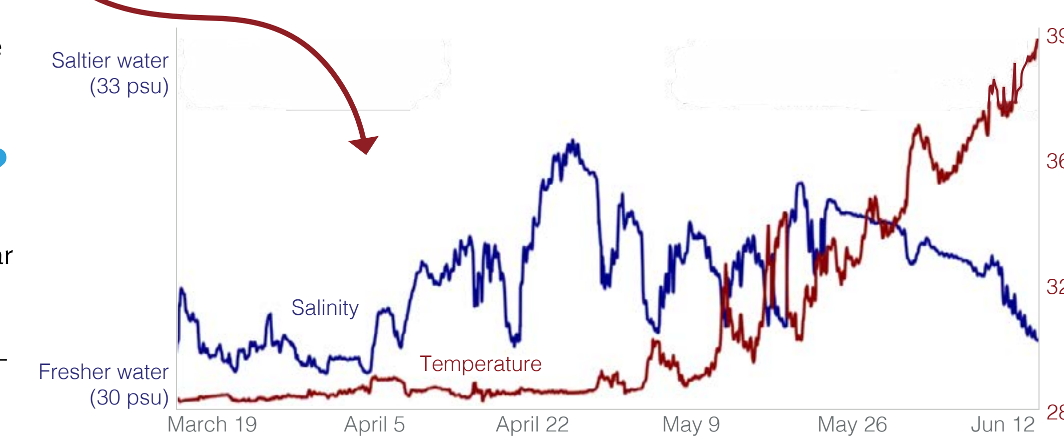
Fall

In fall, the river is cooler than the seawater in the Sound. The cool, fresh river water drives the water temperature down and promotes freeze-up of Kotzebue Sound.



Spring

In spring, the opposite is true. The relatively shallow river warms up faster than the deeper Sound. As the rivers flow into the Sound the channel raises the water temperature and drives break-up.

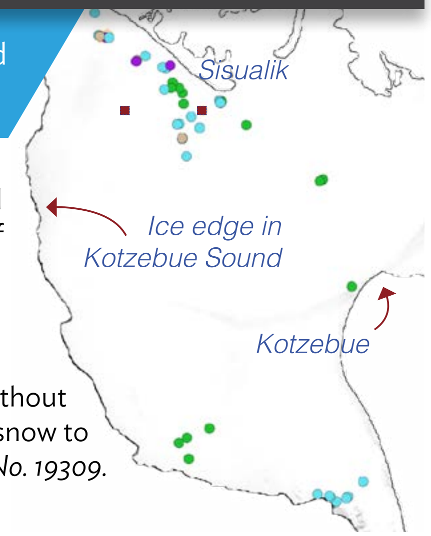


Why does it matter?

These data show that the Kobuk and Noatak rivers control how sea ice near Kotzebue forms in fall and breaks up in spring. This means that one way to anticipate when freeze-up and break-up will occur is by monitoring river temperatures upstream.

Seal habitat surveys

What kind of ice and snow features do ringed seals need to build pupping lairs and breathing holes in Kotzebue Sound?



Female ringed seals birth pups in snow covered lairs built into snowdrifts on the downwind side of pressure ridges. The pups are covered in white, woolly hair for the first few weeks of their life while they build blubber. Well-built lairs keep pups safe, warm and dry.

Jessie Lindsay is an Ikaağvik Sikukun graduate student studying seals and their habitat in Kotzebue Sound. Jessie, along with project leaders **Donna Hauser** and **Andy Mahoney,** measured snow and ice characteristics at seal lairs and breathing holes compared to ice without any seal structures. These surveys help explain how rough the ice needs to be in order for snow to accumulate deep enough for seal lairs. *All seal research was conducted under NMFS Permit No. 19309.*

Finding seals

It can be hard to find seals, seal lairs and their breathing holes. In 2018 and 2019, Ikaağvik Sikukun used a combination of snowmachine expeditions, led by the Elders Advisory Council; surveys with unmanned aerial vehicles (commonly known as drones) equipped with thermal cameras; and an airplane to follow the drone and photograph seals from the air.

Lairs found during on-ice surveys were in 12.5 inches of snow on average. They were usually in snow drifts associated with rougher ice. It is possible that some lairs were in marginal habitat. For example, one lair was in 10.8 inches of snow. The actual lair was 8 inches tall with only about an inch of snow over top.

Breathing holes usually were on smoother ice with an average 7.9 inches of snow.

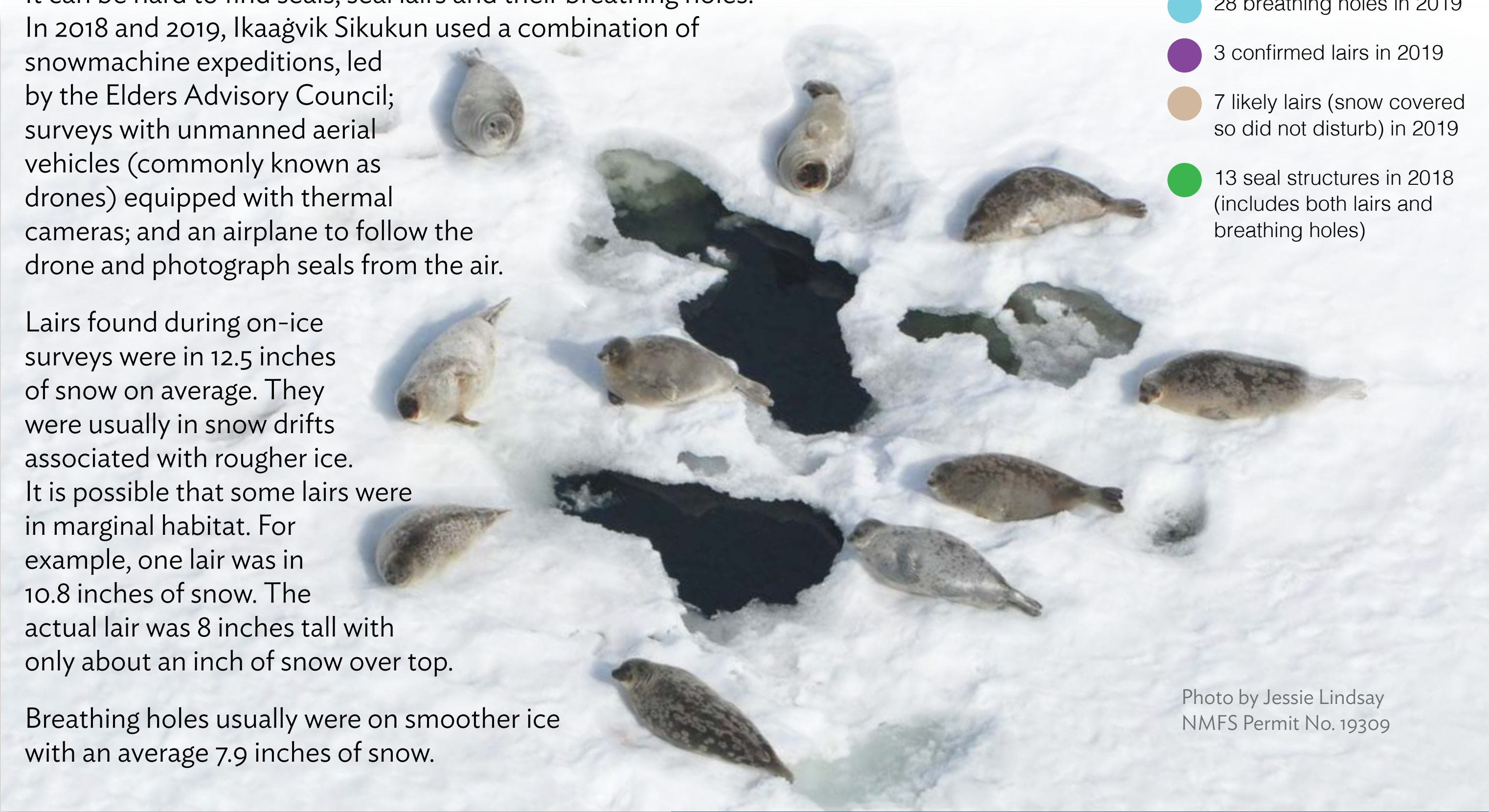


Photo by Jessie Lindsay
NMFS Permit No. 19309

Photo by Jessie Lindsay
NMFS Permit No. 19309

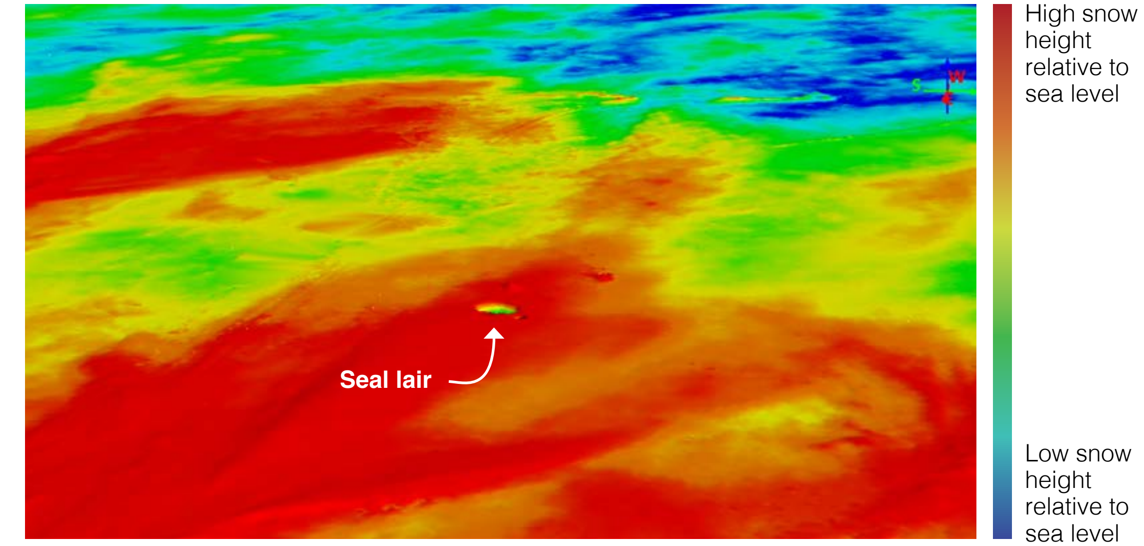
Flooded seal lairs

On **page 3** we saw that at times deep overflow occurs in Kotzebue Sound. The seal surveys found two flooded seal lairs in 2018 and one in 2019. The picture on the left shows a collapsed lair with liquid water covering the floor. Lairs provide a safe place for pups to dry off after they get out of the water. This is especially important when pups are first born because they rely on fluffy fur rather than blubber to keep them warm. Wet fur is not as warm as dry fur.

Help us understand if flooded lairs are normal in Kotzebue Sound. How often do you find seal lairs with water in them? Send your insights to ikaagvik_all_pis@lists.ldeo.columbia.edu.

Check out the data

Photo by Sarah Betcher
Farthest North Films



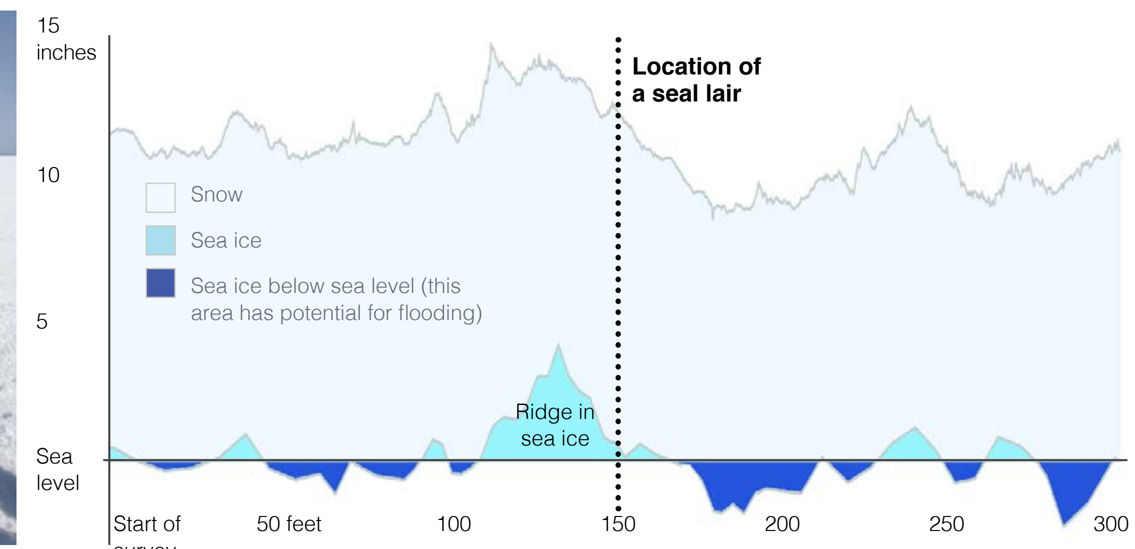
Lasers for snow roughness

This 3D model was created by surveying a 200 x 200 meter area with a laser. The red shows where the snow was higher relative to sea level. A collapsed seal lair is visible in the center of the image. The lair is in a drift with deeper snow. The laser only shows what happens on the snow's surface. It doesn't reveal the structure of the ice hidden beneath. To learn what kind of ice features seals need, Ikaağvik Sikukun used a magnaprobe.

Magnaprobe for ice roughness

A magnaprobe is a pointy rod with a basket (like a ski pole) at the base. When the rod is pushed into the snow to the ice, the basket slides up resting on top of the snow. Each time this is done the person holding the rod presses a button. Doing so records the snow depth while simultaneously taking a GPS location. Merging the laser 3D model with the snow depth from the magnaprobe tells us where the ice is rough and snow drifts accumulate.

Photo by Donna Hauser



Searching a larger area with UAVs

The seal habitat surveys were used as anchor points for unmanned aerial vehicle (UAV) surveys. The detailed measurements at seal structures helped the team understand what to look for in UAV footage. Since UAVs can quickly survey a much larger area than a person on foot, this combination allowed Ikaağvik Sikukun to look for seals across much larger portions of the landfast ice in Kotzebue Sound. The Ikaağvik Sikukun fall 2019 newsletter covered the UAV work more fully. Read about it at **https://bit.ly/3oFXBkS**.

Ikaaġvik Sikukun on YouTube

Watch a video

Filmmaker Sarah Betcher captured each aspect of Ikaaġvik Sikukun from the first conversations with the Elders Advisory Council, to the on-the-ground and in-the-air measurements in Kotzebue Sound. Much of the science discussed in this newsletter was turned into short videos on YouTube. A feature length film will be released at the end of the project.

To learn more about :

On ice measurements, watch Ice Mass Balance
https://youtu.be/CY_WuP1bcfc

Seal habitat surveys, watch Laser Scanner & Magnaprobe
https://youtu.be/ZbVvYAyFCNw

Explore all project videos by searching for Ikaaġvik Sikukun on YouTube.


Photo by Bjorn Olson

Meet the Elders Advisory Council

Ikaaġvik Sikukun's Elders Advisory Council grew up on the sea ice and waters of Kotzebue Sound hunting, fishing, learning from their Elders, and observing the environment and character of the Sound.


Roswell Schaeffer Sr.
Kotzebue Elder


Cyrus Harris
Sisualik Elder


Bobby Schaeffer
Kotzebue Elder


John Goodwin
Kotzebue Elder

Meet the researchers


Vince Schaeffer
Collects snow, ice and ocean data


Carson Witte
Studies air-sea-ice interactions

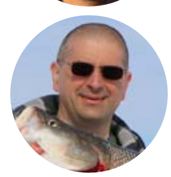

Nathan Laxague
Studies air-sea-ice interactions


Jessie Lindsay
Studies ringed seal lairs & habitat

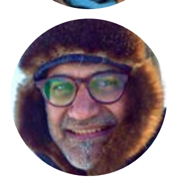
Meet the project leaders

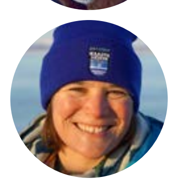

Chris Zappa
Studies air-sea-ice interactions


Andy Mahoney
Studies sea ice & impacts to humans


Alex Whiting
Native Village of Kotzebue Environmental Director


Sarah Betcher
Documentary filmmaker


Ajit Subramaniam
Studies remote sensing and marine ecosystems


Donna Hauser
Studies marine mammal ecology

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