Cottonwood Lake ice formations

How air and water temperature affect the creation of lake ice on Cottonwood Lake, Wasilla, Alaska

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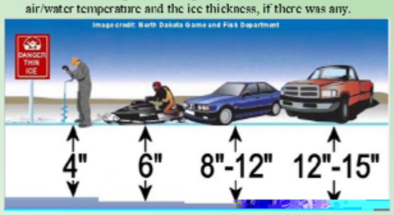
Introduction

Almost fifty people die of hypothermia and other ice and water related problems in Alaska, simply from misjudging the ice level on the water, or even not knowing how much ice there is. Most people in the Northern Hemisphere use primarily frozen rivers for transportation of goods, as well as for recreational uses. Many people do not recognize what hazards appear on dangerous levels of ice. For Alaskans, it is essential to know how to get an accurate reading of the ice level, and what is the safe level of it.

Our goal for this project is finding any relation between the temperature of the air and water around ice and the thickness of it. We wanted to find an easy method of checking the ice thickness for safe traversing, as well as the thickest place ice exists on an average lake. Our group wished to find the ratio of air/water temperature and the ice thickness, if there was any.



Materials and methods

In order to get complete, thorough results, we had to use effective and precise methods of getting the temperatures, as well as the ice thicknesses.

Using an ice auger, we would drill holes through the ice at pre-designated points on Cottonwood Lake, using a GPS, and record the thickness of the ice, as well as the temperature of the water below and the air above. Then, we would make a note of the wind speed and direction as well as the weather, ie: was it overcast, partly cloudy, or clear.

As we began our project, it was our intentions to visit the lake twice a week to collect data. However, we came to realize that once a week would be sufficient to get an accurate picture of the changes that were taking place.

Drilling and measuring lake ice on Cottonwood

Collecting data before Lake ice formed.

Cottonwood Lake Ice Data

DATE	TIME	SKY CONDITION	WIND SP.	AIR TEMP	WATER	ICE	N. DGRS	W. DGRS
10.14.07	1304 hrs	overcast	0 MPH	42.8 F	43.3 F	NO ICE	61.6002	149.3169
10.14.07	1310hrs	overcast	0 MPH	42.8 F	43.1 F	NO ICE	61.59996	149.3165
10.17.07	1500hrs	clear	0MPH	40.4 F	44.8 F	NO ICE	61.6002	149.3169
10.17.07	1505hrs	clear	0MPH	40.4 F	44.9 F	NO ICE	61.59996	149.3165
10.21.07	1510hrs	overcast	10MPH	35 F	39.5 F	TRACE	61.6002	149.3169
10.21.07	1515hrs	overcast	10MPH	35 F	39.6 F	TRACE	61.59996	149.3165
10.24.07	1500hrs	clear	0 MPH	38 F	41.2 F	NO ICE	61.6002	149.3169
10.25.07	1300 hrs	clear	0 MPH	18 FF	40.7 F	NO ICE	61.59996	149.3165
10.28.07	1120 hrs	clear	5MPH	17 F	38.3 F	TRACE	61.6002	149.3169
10.28.07	1120 hrs	clear	5 MPH	17 F	40.2 F	TRACE	61.59996	149.3165
10.31.07	1410 hrs	clear	0 MPH	41 F	38.0 F	1/8"	61.6002	149.3169
10.31.07	1410 hrs	clear	0 MPH	41 F	38.6 F	1/8"	61.59996	149.3165
11.4.07	1430hrs	overcast	8MPH	36 F	34.8 F	1/4"	61.6002	149.3169
11.4.07	1430hrs	overcast	8MPH	36 F	36.1 F	1/2"	61.59996	149.3165
11.11.07	1330 hrs	overcast	0 MPH	31 F	34.8 F	2 "	61.6002	149.3169
11.11.07	1330 hrs	overcast	0 MPH	31F	34.3 F	2"	61.59996	149.3165
11.16.07	1320 hrs	overcast	0 MPH	23 F	34.1 F	2"	61.6002	149.3169
11.16.07	1320 hrs	overcast	0 MPH	23 F	34.1 F	2"	61.59996	149.3165
11.25.07	1345 hrs	overcast	30 MPH	18 F	34.7 F	2"	61.6002	149.3169
11.25.07	1345 hrs	overcast	30 MPH	20 F	34.5 F	2"	61.59996	149.3165
12.2.07	1345hrs	overcast	40 MPH	19 F	34.9 F	4.5"	61.6002	149.3169
12.2.07	1345 hrs	overcast	40 MPH	19 F	34.7 F	4 "	61.59996	149.3165
12.9.07	1300 hrs	overcast	0 MPH	25 F	35 F	11"	61.6002	149.3169
12.9.07	1300 hrs	overcast	0 MPH	5 F	5 F	10.5"	61.59996	149.3165
12.22.07	1440 hrs	overcast	5 MPH	21 F	33.8 F	16"	61.6002	149.3169
12.25.07	1440 hrs	overcast	5 MPH	34 F	34.2 F	15.75"	61.59996	149.3165
1.13.08	1100 hrs	clear	0 MPH	11 F below	33.1 F	23 "	61.6002	149.3169
1.13.08	1300 hrs	clear	0 MPH	11 F below	33.0 F	23"	61.59996	149.3165

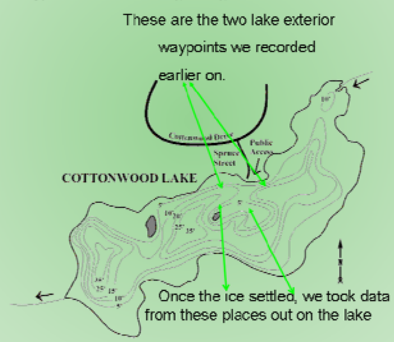
Results

During the first few months of the project, we immediately noticed the late arrivals of ice. This was disappointing, as we were unable to take data from the two water waypoints on the lake. However, this did give us ample opportunities to take more data on the surrounding waypoints on the lake exterior.

As more traces of ice began to be spotted, patterns began to occur. The water temperature would be below forty degrees, and the longer it was, the more ice became present.

After two months, it became apparent that the longer the water temperature was below forty, the more ice was there. Even though the air temperature kept dropping in congruence to the ice thickness, the water levels began leveling off. The ice would thicken, but the water would stay the same temperature.

The below figure is a replica of the Cottonwood Lake, and the waypoints we chose for data gathering.



So just what is ice?

Ice is created when water reaches a temperature of 32 degrees Fahrenheit, or 0 degrees Celsius. The low temperature forces the water molecules to slow, and join closer together, forming a frigid solid substance known as ice. The colder temperature of the water immediately below the ice cause that water to freeze, and build the ice up from below. Likewise, the snow and rain above the ice originally formed becomes colder, and adheres to the ice, making it larger on top.

Conclusions

Many people in Alaska depend on the use of the lakes and rivers during the winter months for recreation and transportation. It is imperative that use of the lakes and rivers start only after the ice is thick enough to be considered safe.

It was our intention to show that one could accurately predict the thickness of lake ice based on the air temperature. We believed that after the air reached a certain temperature (below freezing) and stayed at the level for a number of days it would cause the water temperature to continue to drop, therefore, causing the ice to form and grow thicker with time.

Our hypothesis was wrong. Even though the temperature of the air and water did affect the ice, it was impossible to predict how thick the ice was by using only those two variables. Most noticeably, the temperature of the water dropped to approximately 33 degrees and stayed at that temperature throughout our testing. Even then, the ice grew thicker with each visit to the lake.

In conclusion, the only reliable and safe method to gauge lake ice is to visit the site, drill a hole, and measure the ice.

Literature Cited

Please contact:
Project ALISON @http://www.gi.alaska.edu/alison for information on other lake ice projects in Alaska

National Weather Service NWS

Alaska Outdoor Journal

NOAA National Oceanic & Atmospheric Administration

Acknowledgements:

We would like to thank Mr. Merrill, our mentor,
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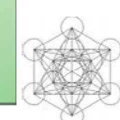
…And everyone who went out on the ice before us to make sure it was safe enough to walk on.



Courtesy of Google Images