Ice-fishing for iButton Data

I was strolling over the frozen surface of
at Goddard Space Flight Center testing a
sock configuration for my upcoming excu
Lake Placid (the site of HOW 2004). My
hypothesis was that layering two pair of t
socks would provide more insulative cozi
than one thick pair. It was also a treat to
to explore areas usually off limits to pede
traffic due to the limited surface tension c
water.

As I approached a small island (about 10 meters across) in the middle of the frozen pond, I saw a plump brown furry critter making his way toward the ice's edge, apparently annoyed with the heavy boot stomps of my approach. At the edge, he quietly slipped from the island and disappeared. I saw as I drew closer that there was a hole in the ice at the island's edge, which acted as a trap door for the subsurface commuter.

I walked around to the other side and found a cleari
brush to step off the ice onto snow-covered terra firm
not occur to me that the ice might be thinner nearer
island's edge until my foot went through into the icy
water. Luckily, my other foot had already made land
was able to pull myself up before sinking below the l
my waterproof boot. On the island, I saw several ex
of gnawed tree stumps and fallen trees, which told m
exactly what type of critter my semi-aquatic semi-co
was.

This new access to the undersurface gave me an idea that quickly had me looking for a safer direction off the island and back to the lab. I collected five iButton Thermochrons, programmed them to sample every 15 minutes, grabbed a role of packing tape, and returned quickly to what I will call Castor Island.

Back on the island, I found a meter lengt with good flexibility and strength. Somet sure my island's namesake would return left it lying about. I cleared the plug of ic over from my boot's plunge and determin the depth at the island's edge was about centimeters. I wrapped one Thermochro and secured it to the end of the branch. attached another at 40 centimeters from of the branch and another at 50 centimet Having constructed my simple multi-leve temperature probe I gently set it in place probe tip sensor on the pond bed, the se sensor just below the water's surface, ar third dangling in the open air just above t surface.


The fourth and fifth Thermochrons I placed in the snow pack. One I pushed down to the ground (about 5 centimeters), and one just below the snow surface. To install them I simply pushed my finger into the snow to make a hole, dropped the sensor in, and covered the whole with some loose hoar. I felt quite a bit like a farmer, sowing my sensors to later reap interesting data. It would have to wait for tomorrow to see if I had a green thumb for such things.

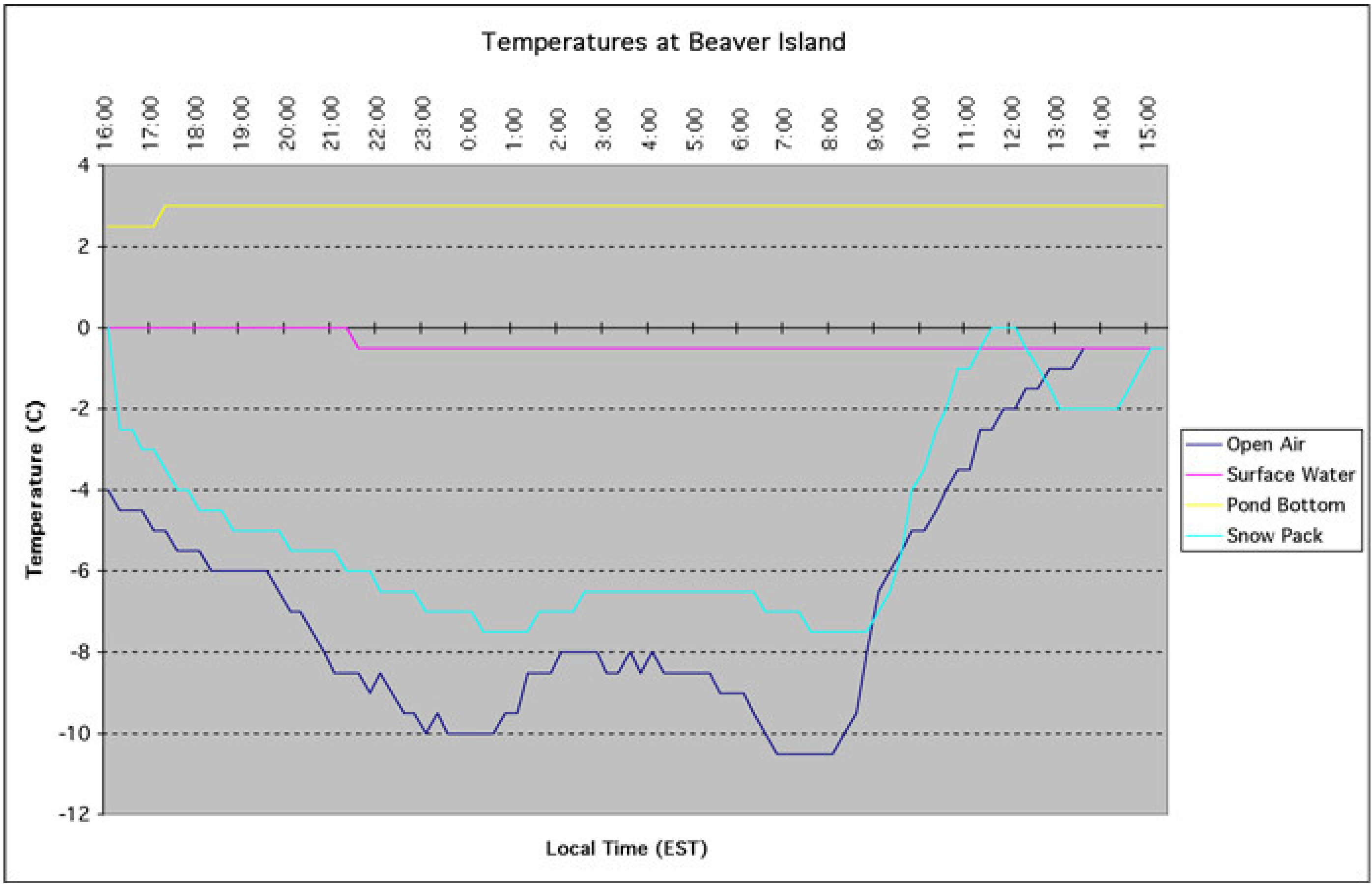
It took a lot of discipline the next day to wait for the proper hour to retrieve the sensors. I wanted to make sure I had a 24-hour cycle. Actually, I would have left them in place for a few days but the temperature was rising and I was not sure if I would have a solid surface to walk on for much longer.

I waited and retrieved the Thermochrons without event, save two. One, the ice had frozen over the surface of my hole; I had to break through again. Two, I discovered that if you bury an iButton in the snow, it is not very easy to find. I eventually found only one. Perhaps when the snow melts I will be able to find it, data intact, and then have one more point for my analysis. For now, I will content myself with one time series from the bottom of the pond, one from the top, one from the open air, and one from the snow pack.

I brought the sensor stick inside intact so
measure the separation between the ser
to be sure I knew which sensors were wh
cut the sensors free and took notes to la
the sensor positions.

With all four sensors still recording I performed three additional measurements. First, I put them into the freezer, which should be sub-zero. Next, I put them in a cup of steaming hot water. Finally, I put them in a cup of ice water. I left them in each location for at least 15 minutes to assure I got at least one data point for each. These points will allow me to co-calibrate the sensors and also calculate and absolute calibration offset. In addition, the definite spikes in the data which I knew correlated in time allowed me to time shift the data from each sensor to assure each related correctly to the same time.

The retrieved data for the 24 hours following the placement of the sensors are presented in the following graph:



This is a good illustration against the careless use of scientific data in decision-making. If one were trapped out in the cold and had this data, he may conclude that the warmest place to rest is at the bottom of the pond. This is a true fact actually, but this would hardly 'feel' the warmest. Notice that the snow pack temperature is warmer than the open air, especially at night. So if one were to stop for a nap it would probably be best to wrap up in a nice blanket of snow first.

The resolution of the sensors is .5 degrees (C). Thus, a shift of one half degree could represent a much smaller temperature shift and real temperature shifts of less than that value may not be registered. This fact will be ignored for the general discussion but should be taken into account when doing a deeper analysis.

The temperature at the bottom of the pond remains stable throughout. There is evidence that the colder surface water mixed with the warmer bottom water while breaking through the ice and implanting the sensor probe. The temperature stabilized after about one hour and then remained unchanged.

The temperature at the lake surface began at a steady 0 degrees (C). This is the predicted and logical result owing to the ice mass at that level. After several hours, the temperature drops .5 degrees (C) and remains stable for the rest of the data collection period. This is because the water froze over, obviously enveloping the sensor, and the temperature was able to drop. Presumably, the ice surface temperature could drop even further if the ice were thicker, providing more insulation between the cold air and the ice/water junction.

Both the open air and the snow pack tem display dramatic diurnal variation. The temperature of the snow pack remains a average of almost 2 degrees (C) warmer air temperature. There is an evident lag transmission of the air temperature to the of the snow pack of about 2 hours. A de snow pack would exhibit a greater lag in temperature peaks and slower and thus temperature variability.

One interesting feature is the quick rise i temperature shortly after sunrise, even o the temperature under the snow pack for time. This is followed by a dramatic rise snow pack temperature much higher tha expected, right up to 0 degrees (C). This be due to direct sunlight penetrating the pack and beginning a melting process bu also be a side effect of the possible effec described in the following paragraph.

The open-air temperature rises rapidly a stabilizes at the temperature of the surfa (or surface ice in this case). Judging fro that the snow pack temperature drops lo the recorded air temperature it is probab the open-air temperature is somehow co review of the picture of the sensors in pla reveals that the open-air sensor is in con the snow, which is most likely affecting th temperature reading.

The results provide interesting and predictable results. A better location for the open-air sensor (or an addition sensor) should be used. The diurnal variation could be better studied if the snow pack sensor were always in the shade. Some interesting data could be gathered if I could convince my furry semi-companion to carry a Thermochron to his dam and bring it back in a couple of days. I will work on this one.

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