Centre d'Études Nordiques

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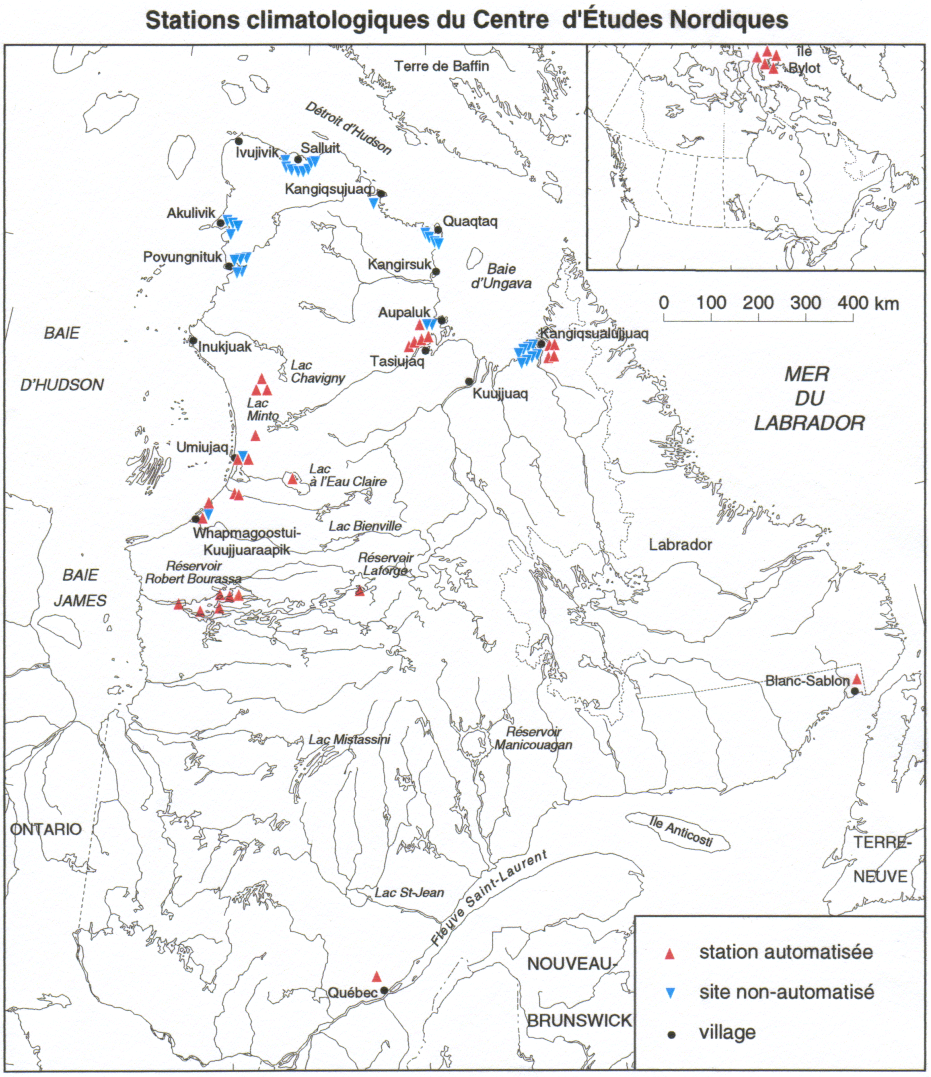
I will just give a few examples of our work. This is a map of Northern Quebec, and you have a glimpse here of what our network looks like. All of the red triangles are sites with dataloggers. Many of them measure air temperature only, with some also having thermistor cables for ground temperature. Most of these sites are now part of the GTNet-P network. One site is also a CALM site. There are approximately 30 blue triangle sites along the coast and in small villages with temperature cables that were installed during the airport construction program from 1979 to 1994. The cables go as deep as 20 m, in various surficial materials (bedrock, till, marine sediments).



The sites are scattered over a very large area, with a very large climatic gradient. We have arctic conditions, subarctic conditions. Marine conditions, continental conditions, continuous permafrost , discontinuous permafrost, with the tree line going through the middle.

As an example, at our station near Kangiqsujuaq we have four thermistor cables, all connected to Campbell CR-10 dataloggers with a multiplexer. The weatherproof container is mounted with a VHF antenna on a tower built from supplies that are readily obtainable from local hardware stores. The newest sites have radio-transmission of the data via modem. When the sites are not too far from the villages, we can transmit the data to the local meteorological station at the airport in the village. The station itself is linked to the university, so that data is obtained directly. We now have sites operating this way around the Hydro Quebec reservoir (James bay) In that kind of terrain, we can transmit data over 200 km. One site recently stopped transmitting, so we are sending a technician to the site to identify the problem, allowing us to minimize the length of the time without data.

Some sites also have the Campbell snowdepth recorder linked to the dataloggers. It measures the distance from the sensor to the snow surface, so once it is calibrated you know the snow thickness.

The village of Salluit, the northern-most village in Quebec has a mean annual air temperature of about –9.8^{o}C. It is built on very sensitive, ice-rich marine sediments. During construction of the airport, we installed a several thermistor cables: one in a depression, one in bedrock, two under the runway, and one in the village in the marine sediments. We haven't had sufficient funding to keep up monitoring at theses sites.

Data from these cables, published in a paper in 1995, shows that this area was experiencing cooling. In fact, the whole region including Baffin Island, the arctic section of northern Quebec and the Labrador coast were experiencing a slight cooling while the rest of Canada was warming.

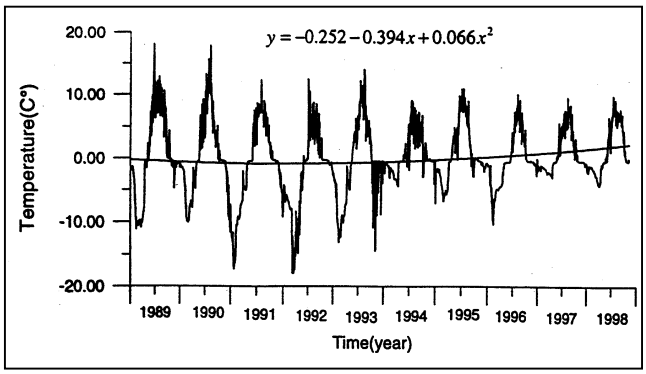
The Sheldrake site is our CALM site, a southern site near the treeline.

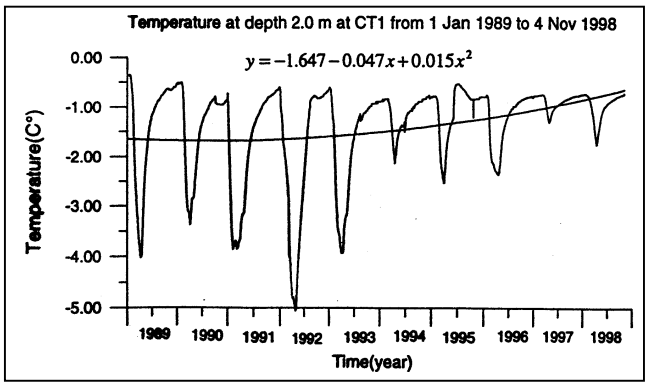
(slide) This is a cross section of another palsa in this area, showing the peat, and the underlying marine clay with ice lenses. The holes in this palsa are approximately 2 meters apart. I want to use this picture to introduce an idea for monitoring in the future. We intend to monitor not only how the changing climate affects the surface parameters for this site, but also its internal composition. We want to investigate how the internal changes along the transect affect not only the surface configuration, but also the geophysical and geotechnical properties of the permafrost. Tomorrow, Michel Fortier will tells us more about the geophysical aspects of this work.

I now want to show you a few examples of data that have been collected from our network. I don't want to spend too much time on this, since I think that these

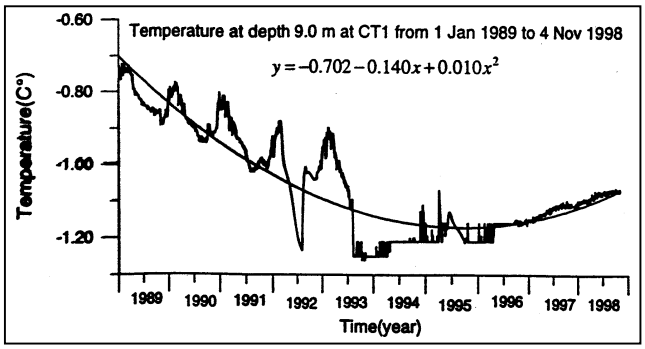
presentations complement one another. I agree with the previous speaker about the enormous impact that the help of northern residents can have on our research.

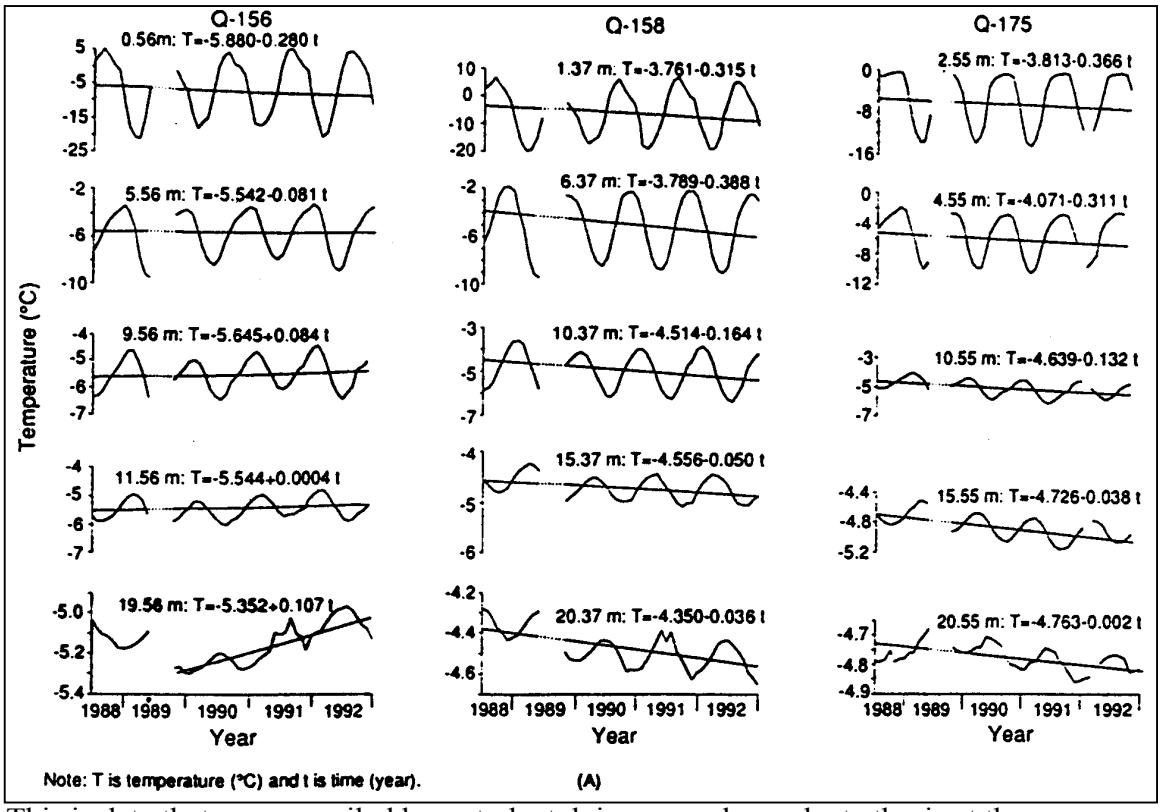
This is data from Kangiqsujuaq. This shows the cooling trend that I mentioned previously. If you look at the surface record, and put a curve through the data, there seems to be a change in slope around 1992-93. At 2 meters depth, you can see that after a really cold year (winter 1991-92 and summer 1992, which was the Pinatubo year, which was felt in the high arctic in eastern Canada) there has been a warming trend. At 9 meters we can see the trend after 1993. Perhaps the climate has changed: perhaps a fluctuation, perhaps a step-change like what we've seen in the Mackenzie area.





We have technical problems from time to time. We occasionally have to change dataloggers, and from time to time we get glitches in the data.





This is data that was compiled by a student doing an undergraduate thesis at the Sheldrake site. This is the air temperature recorded at the station, together with the Met station data for Kuujjuarapik Station (south) and the Inukjuak Station. Sheldrake and Kuujjuarapik are south of tree line, while Inukjuak is north of tree line. Even though Inujuak is closer to the site, the difference from the site data is a little bit larger. Quality control is another issue that we have to deal with the network. It's very important to constantly check the data for accuracy by these comparisons. With a network, it's possible to do an independent check on accuracy. Comparisons can be with high quality meteorological stations, or with two or three stations of your own.

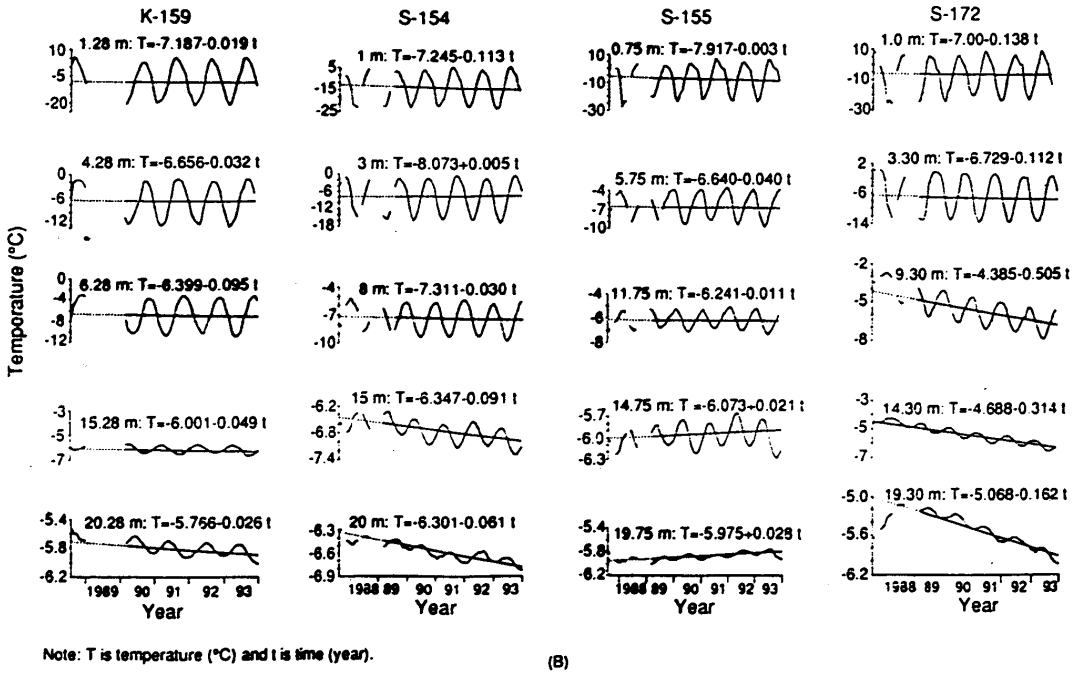


FIGURE 4. Temperature trends at five selected depths for the 20 m cables: (A) for Quaqtaq and (B) for Kangiqsujuaq and Salluit. Note that initial warming in Q-175 and S-172 is due to readjustment of the thermal profile following embankment construction.

This is ground temperature data at 2 meters for the same site and the same period. Even though there was no trend evident in the air temperature, the ground temperature shows a warming trend since the winter of 1991-92, due to site conditions and other factors.

1 to 3 are unpublished temperature data from a thermistor cable in Kangiqsujuaq.
4 and 5 are from Allard, Wang and Pilon 1995, Arctic and Alpine Research vol 27 pp 157-166.