TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC STEM Experience Report

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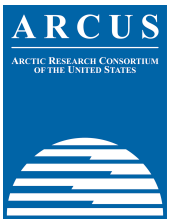
Operation IceBridge Antarctica

PolarTREC Expedition Page
https://www.polartrec.com/expeditions/operation-icebridge-arctic



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The Revitalizing Power of Teacher-Researcher Collaboration

The nature of science is continually moving us forward; from a fresh set of findings we rush ahead excitedly to the next batch of questions. From this continual pursuit, new ideas, methods and instruments are designed by scientists and technicians at a rapid pace, in turn yielding new data. As science teachers, we need to be part of this effort, to be inspired by it, learn from it and figure out how to share it with our students and the public. As we continue to learn about the world through newly developed instruments and data collection techniques, developed since we attended university, we grow enormously as educators. Because the data is deep and wide, it is nearly impossible to jump into it without a guide. Despite our best intentions to bring real data to our students, too many of us find it just too challenging to find accessible data, understand it and then translate it for our students. Working directly with scientists in the field allows us to wade in and become immersed in a complex study with the assurance of collegial support. We then return to our students as mini-experts, filled with first hand accounts of life in the field, deeper understanding of the science, and fresh data to play with. Teachers need experiences like this because we may have lost touch with the science we fell in love in the first place. By gaining first hand experience, we are reinvigorated to keep teaching and learning.

Summary of the Science

NASA's Operation IceBridge is a mission to study the changing Earth at the poles. Through the use of a suite of sophisticated remote sensing instruments, scientists are seeing the ice change in both the Northern and Southern polar regions in different ways. The team returns every year to gather more data, through which they can keep track of how ice thickness and extent is changing from year to year. Bridging the gap between ICESat (2003-2009) and the upcoming launch of ICESat-2, this airborne mission gathers detailed data flying at low elevations over polar ice measuring its characteristics with radars, lasers and a gravimeter.

Flying out of Presidente Carlos Ibáñez International Airport in Punta Arenas, Chile in a DC-8 aircraft, the NASA team flew for 10-12 hours each day. The instrument package aboard the DC-8 included a digital mapping system, 2 ATM Laser Altimeters, Infrared Imager, MCoRDS Radar Sounder, CReSIS Snow Radar, Ku-band Radar Altimeter, Ka-band Radar Altimeter and a Gravimeter. The DC-8 flew 23 missions during its seven-week field season measuring ice surface elevation, ice thickness and extent of land ice (including 2 flights over the South Pole), numerous ice shelves and sea ice.

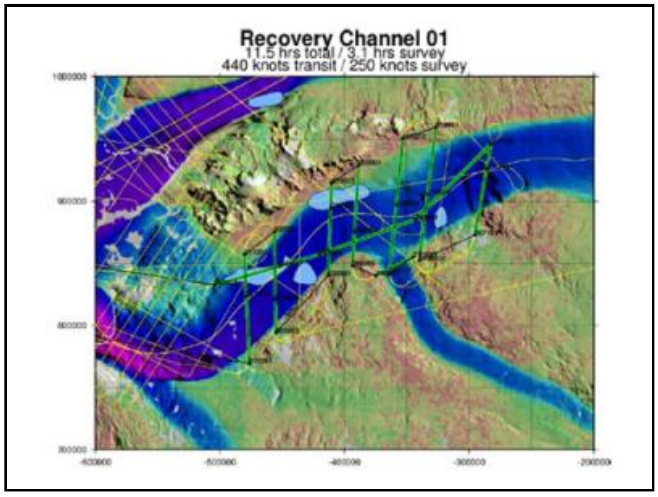
On board, we had 20-40 people, including the principal investigator scientists (Dr. Nathan Kurtz and Dr. Joe McGregor), several engineers and technicians from NASA and from various universities, many of whom had built or operated the instruments, data handlers, safety techs, pilots, navigators

The edge of an ice shelf. Photo by Maggie Kane

and an assortment of visitors (Chilean teachers, Chilean Air Force personnel, artists, dignitaries from the American embassy, personnel from NASA, and me).

Glaciers and ice shelves of special interest to the team along the West Antarctic coast included Pine Island Glacier, Getz ice shelf and Thwaites Glacier. One far reaching question concerned the “Cork in the bottle” concept, which asks whether the melting of ice shelves that effectively buttress feeding glaciers will lead to fast glacial advances once removed. By studying the thickness of the ice shelves, scientists can see how rapidly the ice is melting. This data allows climate modeling to take buttressing ice shelf thickness into account when calculating the rate of change. Another area of special interest along the eastern peninsula was the Larsen Ice Shelf, the collapsed Larsen B shelf and the glaciers behind it, including Crane, Jorum, Flask and Leppard Glaciers. Similar to the West Antarctic glaciers, scientists are measuring flow rates on and inside these glaciers. A major rift in the Larsen C shelf was measured as well, which soon became front page news around the world.

Scientists were also interested in the recent data that suggests the sea ice extent around Antarctica had increased in 2015-16. Speaking to Dr. Kurtz and NASA’s John Sonntag, the speculation related to changed wind patterns and atmospheric circulation, possible changes to the Antarctic oscillation and/or ozone hole correlations, changes in snow cover on sea ice leading to changes in insulation value, possibility of colder, less dense surface waters due to ice shelf melt, powerful La Nina events and/or natural variability. By surveying the sea ice each year, the data will help tell the story of what is happening.



Glacial flow rates are mapped. Image courtesy of NASA

Linking PolarTREC to my Classroom and Community

My students made great use of my PolarTREC journal entries. Students were assigned to read them daily and send me questions. Scribbling their questions in my notebook before takeoff, I was able to talk to the scientists and technicians onboard to get really in-depth answers from them, which I typed up and emailed back to my individual students. While I knew I would ask them to keep up through my journals, I had not anticipated the power of these communications. In many cases, the

The rift in the Larsen C shelf. Photo by Maggie Kane

responses were a full page or more. After this, I asked them to create follow-up questions, and again, answered those with help from the scientists and technicians. This became a very robust learning method and ideal for high school age students. My students (grade 9-12) participated in a Polar Connect event, and every student grades 3-8 got two or more visits from me after I returned. I gave a presentation about the experience and shared a dataset, showing how they could graph some of it. Additionally, 5 classrooms connected to the team airborne as they worked over Greenland the subsequent spring. I was fortunate to connect to many other schools through the NASA Connect programs, including schools in Colorado, Rhode Island, New York, Wyoming, Oregon and Arizona. I was also able to give numerous in-person presentations in Chile, Colorado and New York since the expedition.

Expectations and Outcomes

Prior to the expedition, I made a list of 3 things I expected to learn during my experience. Now I can reflect on those expectations and report the outcomes:

1. How is the data collected and what do the different instruments do?
   This was a strong focus of my work onboard, and I was able to talk to the different instrument technicians and learn how their instruments collected data. While my understanding is certainly at a basic level, I gained insight into how the different instruments collected different parts of the story.
2. How were transects chosen and how does the plane fly the same path each year?
   I was able to learn about some of the basic navigation tools and how the plane could travel the same path each year. Navigation became an area of interest of mine and I have written a lesson about it.
3. What are the trends in the data? While I have a basic understanding of trends, I still have yet to solidify a quantitative understanding of the long-term data. This is largely due to the enormity and power of the data sets and the savvy it takes to navigate them with purpose and clarity. I have been working with National Snow and Ice Data Center

Holding my 6th grade flags as we cross the South Pole! Photo by Maggie Kane

(NSIDC) data sets quite a bit this spring, but am still a novice with lots to learn to compare annual data sets.

Prior to my field experience, I outlined three things I hoped to teach better or differently. These are outlined below. Again, some growth was made in all areas:

1. Climate science: My climate change teaching “tool kit” tripled in size after the expedition! While I was able to lean on many resources prior to the field work during my fall classroom expedition on Slip-Sliding-Away: Glaciers and Climate Science with my Earth science students, the field experience brought huge credibility and fresh, first hand data to my students. They were able to work with data similar to that collected while I was on board (there is a 6mo. turnaround for the data, so we didn’t have this year’s data available) and see the glaciers for themselves through the data.
2. Atmospheric chemistry: My chemistry students had just completed a classroom expedition on atmospheric pollutants, ozone and air quality in Denver. Heading to Antarctica allowed me to teach them about greenhouse gasses with real relevance and give them a stronger connection between atmospheric pollutants like NOx and CO2. They also were able to learn about how we use isotope data from connection to ice core data. I found that Antarctica could fit into many parts of my various curriculums.
3. Using technology to play with real data: Using technology to play with large data sets is still evolving and challenging, but as I get more time to play with the data, I am sure to be able to use it more effectively within lesson plans. I hope to work with a scientist or graduate student who can teach me how to manipulate and display the data better.

Continued Outreach

Over the past few months, I have reached 1353 people at schools and through public and professional presentations.

I have been very fortunate to continue to be part of building a network of PolarTREC teachers working toward a common outreach goal. After presenting at NSTA in Los Angeles last March, several alum came together to design an abstract for an AGU session. That is now been accepted and I am currently working with our co-conveners.

I hope in the future, to be able to collaborate with the Operation IceBridge team and with the other PolarTREC teachers who participate with OIB. I would also like to continue to learn through playing with the NSIDC data. Working with a scientist or graduate student to learn

Students at Liceo Maria Auxiliadora, Punta Arenas, Chile. Photo by Maggie Kane

ways to use and show the data would be very helpful and is the largest gap I have at this point. I have seen wonderful displays of the data but have no idea how to generate good displays myself, and have had no luck getting the help I need thus far. This will be an area of focus for me in the coming months. Through the process of writing lessons and presenting at professional meetings, I will be able to reach more teachers and help them reach their students.