POLAR TREC

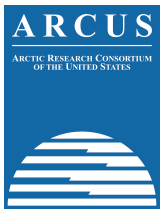
TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC STEM Experience Report

Lauren Neitzke Adamo

Sliding Glaciers

PolarTREC Expedition Page
https://www.polartrec.com/expeditions/sliding-glaciers



This program is supported by the National Science Foundation under award 1345146. Any opinions, findings, and conclusions or recommendations expressed by this program are those of the PIs and coordinating team and do not necessarily reflect the views of the National Science Foundation.

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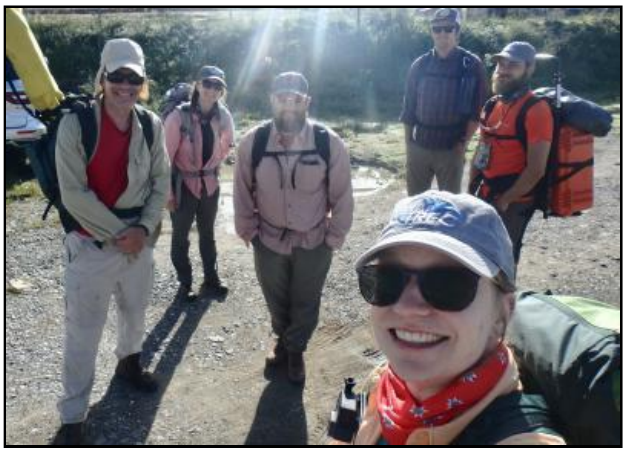
The Science of the PolarTREC “Sliding Glaciers” Expedition

PolarTREC (Teachers and Researchers Exploring and Collaborating) is a program in which educators from the United States, both formal and informal (i.e. educators in museums, science centers, etc.) spend 3-6 weeks participating in hands-on field research experiences in the polar regions. The goal of PolarTREC is to invigorate polar science education and understanding by bringing educators and polar researchers together. As part of the *Sliding Glaciers* PolarTREC team, I spent 24 days in the Swiss Alps working with researchers doing drone-based aerial photography of former glacier beds that will be used to help develop better sliding laws for glaciers, which will improve modeling of their dynamics. Even though this field site is not located in a polar region, the work done here will improve models of ice sheet flow relevant to polar regions.



The entire sliding glaciers team packed up and ready to head out into the field to conduct the drone survey.

Scientists have observed that rates of glacier flow in Greenland and Antarctica are locally increasing in response to warming of the atmosphere and oceans. Although the various feedbacks between warming and glacier flow are complex, all glaciers are sensitive to the basal drag exerted on the boundary between the bottom of the ice and the underlying geology (i.e. sediments or bedrock). Basal drag is affected by the type of material beneath the ice and the shape of the underlying surface. These factors dictate the “sliding law”: the relationship between slip velocity and basal drag required for modeling ice sheets. Modeling studies indicate that estimates of future sea-level rise are highly sensitive to the sliding law chosen.Therefore, improving sliding laws and better constraining their uncertainty are high priorities in the broader effort to assess sea-level rise over the next century.

Although this research has three phases, only the first requires field work. The work involves measuring at decimeter-scale resolution the topography of bedrock surfaces recently exposed by glacier recession over areas of 0.1-1.0 km2. These actual former glacier beds, rather than idealizations usually used in studies of sliding, will be used to model the relationship between sliding speed and basal drag and thereby determine applicable sliding laws.

Phase 1 was completed during the summers of 2017 and 2018 when team members traveled to Castleguard Glacier in Banff National Park in Alberta, Canada (2017) and the Valais Canton of Switzerland (the focus of this PolarTREC project). Whereas in 2017 the team at Castleguard Glacier used ground-based LiDAR, which required 5 days to complete measurements at one location, in 2018 we were able to survey exposed bedrock at nine glaciers in

Switzerland over the course of 18 days through the use of drone-based aerial photography. Structure-from-motion processing of the photography allows high-resolution digital elevation models to be produced. Phase 2 and 3 will be conducted over the next few years as the scientists perform various laboratory experiments and build computer models to test and evaluate the range of sliding behavior that can occur at the boundary between the ice and underlying rock and sediment. Results of these experiments and models will be used to create new sliding laws rooted in experimental and field data.

PolarTREC Teacher, Dr. Lauren Neitzke Adamo, holding the drone that was used in the "Sliding Glaciers" project to create the high-resolution surveys of the glacial forefields in Switzerland. (Photo by Jacob Woodward).

Summary of Experiences in the Field

PolarTREC Teacher, Dr. Lauren Neitzke Adamo, taking striation measurements in the glacial forefield by the Allalin glacier. (Photo by Lucas Zoet).

As a geologist myself, I am not new to field work or participating in scientific research. However, what was new to me was doing this type of work with an audience. Over the years, I have discussed my work and field experiences amongst family, friends, and colleagues. These conversations have ranged from avid curiosity to polite interest, but there were very few times when I felt that people were actively engaged with my work during these talks. The months leading up to this trip were filled with conversations with anyone who would listen about my upcoming expedition. I spoke about the exciting places in the Alps we would be hiking to, how we would be using the latest drone technology for the surveys, and how they could follow along with me through my journals, on social media, and my live stream event. I just hoped my efforts would yield a few followers.

Once I began to connect with the public during the expedition, I witnessed something amazing happen. There is something truly magical about being able to follow and "travel along" with someone on a scientific expedition like this. Not only were people reading my journals and social media posts, but they were eagerly anticipating my next update. I wrote and shared about the science, day-to-day life in the field, the challenges our team faced, my successes, and my failures. This makeshift, virtual, scientific community rallied behind me and the team as we continued our grueling daily treks into the mountains. I even witnessed the self-proclaimed "bad at science" individuals asking pointed questions and wanting to know more about the science and geology of our expedition and the study area. And it has not stopped. Weeks after returning

from the field, I am still constantly asked by friends, colleagues, and acquaintances to explain one thing or another.

PolarTREC Teacher, Dr. Lauren Neitzke Adamo, hiking across the glacial ice on the Rhône Glacier in Switzerland. (Photo by Lucas Zoet).

As a researcher, I think this type of lasting connection and continued enthusiasm from the public is something all outreach and education programs should strive for. As an educator, my love and enthusiasm for polar science and research has been rekindled. I am filled with a new determination to merge the researcher and educator in me as I seek out and create new polar education programs for years to come.

Linking PolarTREC to the Community

As an informal science educator, my primary audience will be the visitors to the Rutgers University Geology Museum (RUGM). Our visitors range in age from pre-school to adult, so I am planning a wide range of activities and events so that I can impact as many age groups as possible. However, all of the education and outreach will focus on the following three content areas.

1. Polar Science Basics- Introduce students and audiences to general information about Antarctica and the Arctic (i.e. differences in ecosystems, some of the major issues facing each of these areas, etc.).
2. Climate Change and Ice Sheet/Glacier Recession- Cover the basics of climate change science and illustrate the effects on the environment through visualization of the amount of glacier recession in the Swiss Alps.
3. Technology- Focus on the advanced technology and methods that were used for this research and others like it, especially the use of drones in environmental research and the construction of 3D models.
4. Sliding Laws- Develop potential activities and materials to explain the science behind the Sliding Laws that govern glacier flow.

PolarTREC Teacher, Dr. Lauren Neitzke Adamo, holding an example of one of the community "glacier flags" that various school and special interest groups made prior to the expedition. Each flag was

These content areas will be addressed through school visits, public lectures, the development of hands-on learning activities, journaling, social media posts, and the creation of temporary and/or permanent exhibits at the RUGM. Prior to the expedition in August 2018, I was able to visit several elementary, middle, and high schools around New Jersey that allowed me to bring some of the excitement of this cutting edge polar research into the classroom. Many of these classrooms, and some additional special interest groups, created "Glacier Flags" that traveled with me into the mountains of Switzerland. These will be returned to each of the groups over the next few

photographed in the field and returned to the groups for display. (Photo by Neal Iverson)

months as I visit them again. Additional schools and talks with other special interest groups will also be scheduled throughout the 2018-2019 academic year.

Through the use of my personal and RUGM social media accounts on Facebook and Instagram, I was able to connect with a large community of people prior to and during the PolarTREC expedition. To date, my PolarTREC Sliding Glaciers posts have reached thousands of people with over 25,000 individual interactions with the content posted. I will continue to use social media as I develop further polar science programing at the RUGM and through collaborations with local schools, libraries, and special interest groups.

Continued Outreach and Education

As the Director of the RUGM and a Professor/Researcher at Rutgers University, I have unlimited opportunities to present PolarTREC and polar science content to my audiences. Rutgers University is home to many top-notch climate scientists, and I plan to forge new collaborations between these researchers as well as connect with researchers and educators through the Polar Educators International network. These connections will be utilized to help plan "polar" and "technology" themed events at the RUGM, like our Annual Open House and Late Night at the Museum events. Additionally, I will work with the RUGM staff to develop possible temporary and permanent exhibits centered around climate change, glacial recession, and polar science topics.

PolarTREC Teacher, Dr. Lauren Neitzke Adamo, discussing polar science and explaining the items in an "Extreme Cold Weather" kit to a group of 4th grade students in New Jersey. (Photo by Memorial Elementary School Staff)

To encourage audiences outside of the RUGM to study and engage in polar science and climate change, I plan to develop materials and lesson plans for a "patch program". The aim of this program would be to encourage more elementary and middle school-aged Boy Scout and Girl Scout troops to start climate change discussions and investigations. The program would include all the necessary instructions and resources so that facilitators could run them on their own without guidance from a climate change expert. A checklist would also be included of various tasks and explorations that groups could conduct to earn their "patch". Although similar to official boy scout and girl scout badge programs, this "patch" program could be conducted by any interested party. Once complete, this program will also be introduced into the RUGM programming offered to visitors.

I envision a continually evolving process for my PolarTREC education and outreach initiatives. There is no end date in sight as I continue to collaborate with local schools, libraries, boy scouts, girls scouts, other PolarTREC alumni, and adult special interest groups. Ultimately, I would like to seek out grant opportunities that would allow me to design and run a range of polar-themed outreach and education programs that combine geoscience education and research with teaching in an informal educational setting.