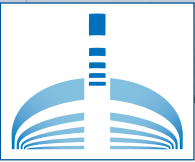


ICE BITS



FALL 2019

Quarterly update of U.S Ice Drilling Program (IDP) activities

Connect with IDP at the 2019 AGU Fall Meeting!

The Ice Drilling Program (IDP) is trying something different this year at AGU. Rather than holding a Town Hall meeting like we have done in the past, this year we will have a booth at the 2019 AGU Fall Meeting! We are hoping that the booth will allow more face time and interaction with everyone, especially early-career scientists. So please stop by our booth and learn about how to obtain drilling support from IDP, the various outreach support that we can provide, and much more! We'll be at [booth 312](#) during the week.

You can also catch Louise Huffman, IDP's Director of Education and Public Outreach, at the following AGU activities:

**AGU
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Talk	ED24A-01 Bridging the Gap Between Ice Core Researchers and Non-Science Audiences: Lessons Learned from a Powerful Model (Invited) Louise Huffman, Dartmouth College, Tuesday, 10 December 2019, 16:05 – 16:19, Moscone South – 215, L2 https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/497757
Poster	ED21D-1061 Polar Educators International: Creative Ways to Connect Field Research to Global Audiences from Classrooms to the General Public Louise Huffman, Dartmouth College and Betsy Wilkening, University of Arizona, Tuesday, 10 December 2019, 08:00 – 12:20, Moscone South – Poster Hall https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/561718
Session Convener	ED34B Climate Literacy: Moving Broad Audiences from Knowledge to Action I , Wednesday, 11 December 2019, 16:00 – 18:00, Moscone South – 215, L2 https://agu.confex.com/agu/fm19/meetingapp.cgi/Session/88629
Session Convener	ED31D Climate Literacy: Moving Broad Audiences from Knowledge to Action II Posters , Wednesday, 11 December 2019, 08:00 – 12:20, Moscone South – Poster Hall https://agu.confex.com/agu/fm19/meetingapp.cgi/Session/88628
Session Convener	ED54B Climate Literacy: Preparing the Future Climate Workforce Through Higher Education: Engaging Students at Minority-Serving Institutions in STEM-Successful Approaches I , Friday, 13 December 2019, 16:00 – 18:00, Moscone South – 215, L2 https://agu.confex.com/agu/fm19/meetingapp.cgi/Session/88640
Session Convener	ED51C Climate Literacy: Preparing the Future Climate Workforce Through Higher Education and Engaging Students at Minority-Serving Institutions in STEM-Successful Approaches II Posters , Friday, 13 December 2019, 08:00 – 12:20, Moscone South – Poster Hall https://agu.confex.com/agu/fm19/meetingapp.cgi/Session/82503

2019 Arctic Field Season Support Completed

IDP successfully supported five projects during the 2019 Arctic field season.

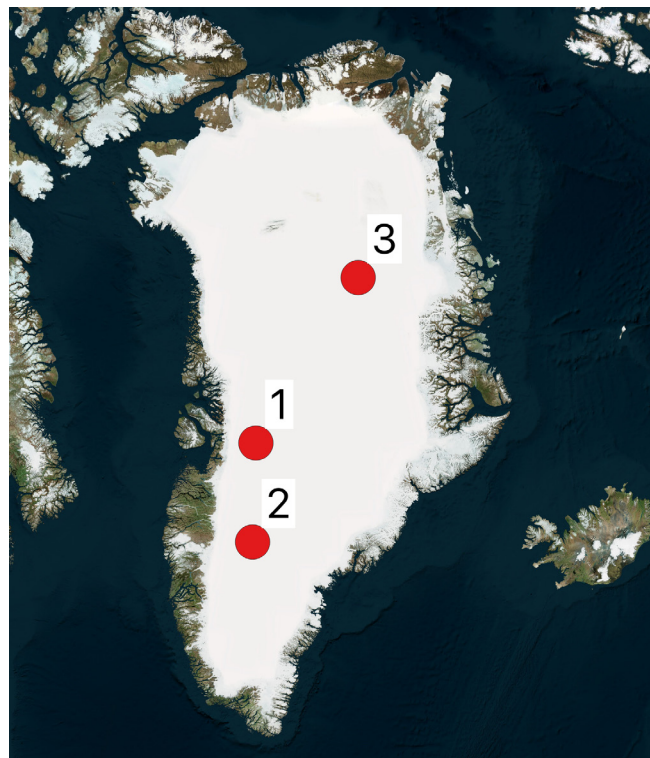
(1) The *Collaborative Research: Quantifying Heat/Mass Structure and Fluxes Through the Full Thickness of Greenland's Percolation Zone* project (PIs Harper and Humphrey; NSF awards 1717241 and 1717939) collected shallow firn cores in western Greenland using an IDDO hand auger and Sidewinder kit. The shallow cores were used to quantify firn density and provided access for temperature logging of the shallow firn thickness. The goal of the multiyear project is to use a combination of shallow and deep cores/boreholes to quantify the structure, thermal state, and heat fluxes through the full thickness of the firn column across a transect spanning western Greenland's percolation zone. The researchers are using their own hot water drill to drill the deep (up to 100 meters) boreholes.

(2) The *Collaborative Research: Refreezing in the Firn of the Greenland Ice Sheet: Spatiotemporal Variability and Implications for Ice Sheet Mass Balance* project (PIs Rennermalm, Tedesco, and Hock; NSF awards 1604058, 1603331, 1603815) used an IDDO hand auger and Sidewinder kit for a third season in Greenland. During the multiyear project, the researchers collected several shallow firn cores from the southwestern sector of the Greenland Ice Sheet to investigate the stratigraphy, density, temperature, and liquid water content of the firn cover and its spatial and temporal variations.

(3) The *Partnerships for Polar Science Education and Outreach in Greenland (JSEP) and Antarctica (JASE)* project (PI Virginia; NSF award 1748137) encompasses two NSF-sponsored polar-focused programs – the Joint Science Education Project (JSEP) and the Joint Antarctic School Expedition (JASE) – that provide significant opportunities for training the next generation of STEM professionals and for polar-science outreach. JSEP, a project of the Joint Committee, was initiated in 2007 to educate students and teachers from Greenland, Denmark, and the U.S. The program brings US students together with Danish and Greenlandic students in Greenland where the group spends three weeks studying the causes and consequences of Arctic environmental change. As part of the JSEP program, an IDDO hand auger was used to expose the students to firn science (observing stratigraphic, density, and temperature changes with depth) at EastGRIP. JASE, a project in collaboration with the Chilean Antarctic Institute (INACH), takes U.S. students to Antarctica to work alongside Chilean students and examine Antarctica's rapidly changing ecosystems.

(4) The *EAGER: Exploration of the Denali Basal Ice Core Archive* project (PI Kreutz; NSF award 1806422) returned to their 2013 ice core drill site and used the Stampfli Drill to collect a 50-meter long core from the summit plateau of Mount Hunter, Alaska. The researchers used a solar power system to power the Stampfli Drill during collection of the first ~45 meters of core when the sun was shining; the last 5 meters were collected during cloudy conditions, which required use of a generator to power the drill. The objective of the research is to understand the recent and past changes in summer temperature, snow accumulation, atmospheric circulation, and pollution in the context of the last 2000 years of natural variability in the North Pacific. In 2013 the researchers collected twin 208-meter long ice cores to bedrock from the same location (see *Ice Bits* 2013 Summer). This season's 50-meter long core will be used to update the climate record from 2013 to 2019 and help aid in the interpretation of the deeper ice.

(5) The *Electrothermal Drill Testing with the Juneau Icefield Research Program* project (Ice Drilling Program) successfully field tested new



Map of Greenland showing 2019 Arctic field season locations. The numbers shown on the maps correspond to the project numbers in the text.



Map of Alaska showing 2019 Arctic field season locations. The numbers shown on the maps correspond to the project numbers in the text.

modifications to the Thermal Drill. In late July and early August 2019, IDP Mechanical Engineer Grant Boeckmann, IDP Field Support Manager Anna de Vitry, and IDP contractor and Warehouse Manager Jim Koehler traveled to Juneau, AK, for a beneficial testing opportunity with the Juneau Icefield Research Program (JIRP). Utilizing the well-established logistics of the JIRP program, the IDP team was able to test new Thermal Drill modifications including a new 300-meter drill cable, a prototype ethanol delivery mechanism, and new heat rings. The IDP team successfully reached 294 meters and was able to refine operating procedures for the equipment.

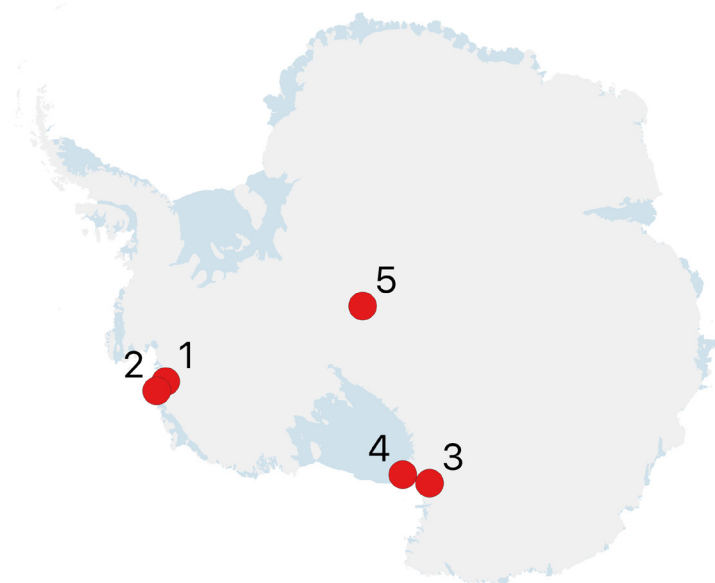
Field Support to Antarctic 2019-2020 Projects

IDP is providing support to the following projects during the 2019-2020 Antarctic field season:

(1) The *Geological History Constraints on the Magnitude of Grounding Line Retreat in the Thwaites Glacier System* project (PIs Goehring, Balco, Hall, Campbell; C-443-M; NSF award 1738989) contributes to the joint initiative launched by the U.S. National Science Foundation (NSF) and the U.K. Natural Environment Research Council (NERC) to substantially improve decadal and longer-term projections of ice loss and sea-level rise originating from Thwaites Glacier in West Antarctica. The goal of the project is to obtain geological evidence from the Thwaites-Pine Island Glacier system that will show whether glaciers were less extensive than they are at present, and, if so, when. The project will utilize the Badger-Eclipse Drill and Winkie Drill to obtain subglacial bedrock from sites where ice thickness is dynamically linked to grounding-line position in the Thwaites system (specifically in the Hudson Mountains). Observation of significant cosmogenic-nuclide concentrations in these samples would provide direct, unambiguous evidence for past episodes of thinning linked to grounding-line retreat as well as constraints on their timing and duration.

(2) The *Thwaites-Amundsen Regional Survey and Network (TARSAN) integrating atmosphere-ice-ocean processes affecting the sub-ice- shelf environment* project (PI Pettit; C-445-M/N; NSF award 1738992) contributes to the joint initiative launched by the U.S. National Science Foundation (NSF) and the U.K. Natural Environment Research Council (NERC) to substantially improve decadal and longer-term projections of ice loss and sea-level rise originating from Thwaites Glacier in West Antarctica. Thwaites and neighboring glaciers in the Amundsen Sea Embayment are rapidly losing mass in response to recent climate warming and related changes in ocean circulation. The processes driving the loss appear to be warmer ocean circulation and changes in the width and flow speed of the glacier, but a better understanding of these changes is needed to refine predictions of how the glacier will evolve. One highly sensitive process is the transitional flow of glacier ice from land onto the ocean to become a floating ice shelf. This flow of ice from grounded to floating is affected by changes in air temperature and snowfall at the surface; the speed and thickness of ice feeding it from upstream; and the ocean temperature, salinity, bathymetry, and currents that the ice flows into. The project team will gather new measurements of each of these local environmental conditions so that it can better predict how future changes in air, ocean, or the ice will affect the loss of ice to the ocean in this region. The project will use a 400-meter winch with tower and sheave from the 4-Inch Drill as an instrument installation winch to lower instruments into hot water-drilled boreholes on the Dotson Ice Shelf to measure ocean water properties at locations where warm Circumpolar Deep Water reaches the Thwaites grounding line.

(3) The *Collaborative Research: Snapshots of Early and mid-Pleistocene Climate and Atmospheric Composition from the Allan Hills Blue Ice Area* project (PIs Higgins, Brook, Severinghaus, Mayewski; I-165-M; NSF award 1744993, 1745006, 1744832 and 1745007) will collect new ice cores from the Allan Hills Blue Ice Area. Bubbles of ancient air trapped in ice cores have been used to directly



Map of Antarctica showing 2019-2020 Antarctic field season locations. The numbers shown on the maps correspond to the project numbers in the text.

reconstruct atmospheric composition, and its links to Antarctic and global climate, over the last 800,000 years. Previous field expeditions to the Allan Hills Blue Ice Area, Antarctica, have recovered ice cores that extend as far back as 2.7 million years. These ice cores extend direct observations of atmospheric carbon dioxide and methane concentrations and indirect records of Antarctic climate into a period of Earth's climate history that represents a plausible geologic analogue to future anthropogenic climate change. Through this project, the team will return to the Allan Hills Blue Ice Area to recover additional ice cores that date to 2 million years or older. The new Foro 400 Drill and Blue Ice Drill will be used to recover the ice cores. The climate records developed from these ice cores will provide new insights into the chemical composition of the atmosphere and Antarctic climate during times of comparable or even greater warmth than the present day.

(4) The *Phase 2 Development of a Rapid Access Ice Drilling (RAID) Platform for Research in Antarctica* project (PI Goodge; D-551-M, D-552-M; NSF award 1419935) will initiate its third Antarctic Field Trial (AFT3) of the RAID drill system – to collect ice and rock samples from a deep ice sheet near Minna Bluff. The RAID drilling system will be put through a complete set of drilling trials, including augering firn, setting a borehole packer, drilling about 600 meters of grounded ice, and obtain samples of ice and rock cores at depth (by wireline rotary coring). All components of the drilling system will be tested and evaluated. The 4-Inch Drill will be used to make 2-3 meters of smooth-walled borehole just below the firn-ice transition, at a depth of approximately 70 meters, to field test the setting of the borehole packer. The Intermediate Depth Logging Winch will be used to field test a borehole dust logger in selected boreholes produced this season at Minna Bluff.

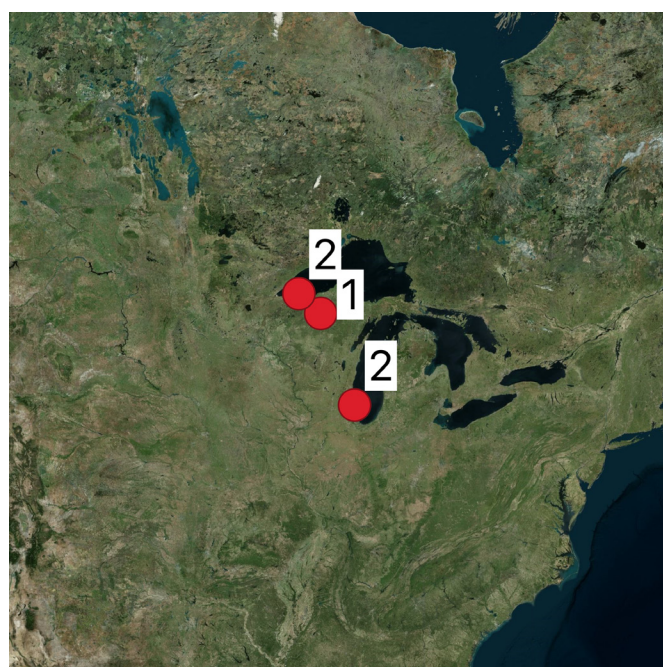
(5) The *Management and Operations of the IceCube Neutrino Observatory 2016-2021* project (PIs Halzen and Hanson; A-333-S; NSF award 1600823) will utilize the Intermediate Depth Logging Winch to lower a series of optical+UV and radio sensor packages into the South Pole Ice Core (SPICEcore) borehole to the full depth of the hole (1751 m). The science goals include measurements of the radio absorption length of the ice from 100-1000MHz, radio birefringence in the ice, and ice index of refraction, all measured as a function of depth and ice temperature. The science team is interested in the optical scattering, absorption lengths, and luminescence as a function of depth and optical wavelength from the visible into the ultraviolet.

Field Support to Northern Hemisphere Winter/Spring 2019-2020 Projects

IDP is providing support to the following Northern Hemisphere projects during the 2019-2020 winter/spring field season:

(1) The *SG: The Ecosystem Ecology of Lake Ice Loss in North-Temperate Lakes* project (PI Dugan; NSF award 1856224) advances the growing field of winter limnology by using long-term data collected on northern lakes in Wisconsin in conjunction with a snow-removal experiment to look at under-ice algae and the implications for ice-loss on spring algae blooms. Using an IDDO Hand Auger, the researchers will collect lake ice cores through an ice thickness of up to one meter to study the biogeochemistry and habitat of lake ice.

(2) The *Collaborative Research: Sediment Transport Mechanisms and Geomorphic Processes Associated with Shore Ice along Cold Climate Coastlines* project (PIs Zoet and Theuerkauf; NSF award 1916179 and 1950101) will test the hypothesis that limited or variable shore ice cover, when compared to consistent shore ice cover, results in enhanced storm-induced coastal erosion and damage to coastal infrastructure. Cold climate coastlines



Map of North America showing Winter/Spring 2019-2020 field season locations. The numbers shown on the maps correspond to the project numbers in the text.

are highly vulnerable to reduced winter ice cover in response to climate change. The dynamics of how reduced ice cover influences coastal evolution is poorly understood which inhibits accurate forecasting of future coastal response in cold climates. Researchers on this project hope to improve our understanding of how sediment interacts with shore ice as well as the resulting coastal landscape change. The first part of the project involves laboratory experiments aimed at studying the physics of sediment and ice interactions. The second part of the project will gather field measurements that use the laboratory measurements as a basis to investigate how cold climate coastlines naturally respond to the shore ice. Using a SIPRE Hand Auger, the researchers will collect ice core samples of 1-3 meters in length on Lake Michigan and Lake Superior to inspect debris entrained within the ice for comparison with the laboratory experiments. This research will result in a model that will help explain how reduced and variable winter shore ice cover alters the coastal landscape, which will help coastal managers proactively plan for future climate change impacts.

International Partnerships in Ice Core Sciences 3rd Open Science Conference – Ice Core Science at the three Poles

18-23 October 2020

Crans-Montana, Switzerland

Europe/Zurich timezone

<https://indico.psi.ch/event/6697/>

Email: ipics@psi.ch to be on meeting mailing list

The third Open Science Conference (OSC) of the International Partnerships in Ice Core Sciences (IPICS) will be held from 18-23 October 2020 in Crans-Montana, Switzerland. The objective of the conference is to present, discuss and put into perspective the most recent results of past and current ice core drilling projects. The theme of the third OSC is *Ice Core Science at the three Poles*. As in previous IPICS OSCs, part of the conference is a one-day early career scientists workshop on 18 October organized by Ice Core Young Scientists (ICYS).

Important Dates

1 January 2020: Abstract submission opens; Registration opens; Travel support applications open

30 April 2020: Deadline for abstract submission and travel support applications

1 June 2020: Abstract confirmation

1 July 2020: Early-bird registration closes

1 August 2020: Program online

1 September 2020: Online registration closes

18 October 2020: Ice Core Young Scientists (ICYS) workshop

19-23 October 2020: IPICS 2020 3rd Open Science Conference

For more information, please visit the conference web site at <https://indico.psi.ch/event/6697/>.



International Partnerships in Ice Core Sciences 3rd Open Science Conference



Ice Core Science at the three Poles



Save the Date!

IDP Ice Core Working Group Community Planning Workshop April 2-3, 2020

Information on the location and agenda will be forthcoming — stay tuned!!

Ice Drilling Support for NSF Polar Proposals

If you are preparing a National Science Foundation (NSF) proposal that includes any kind of support from IDP, you must include a Letter of Support from IDP in the proposal.

Researchers are asked to provide IDP with a detailed support request three weeks prior to the date the Letter of Support is required. **Early submissions are strongly encouraged.**

Although there are no proposal deadlines for the Antarctic Research and Arctic Research solicitations, NSF advises researchers to submit proposals 18 months in advance of their potential deployment date.

For further information on requesting IDP support, visit our website at <https://icedrill.org/requesting-field-support> or contact us at IceDrill@Dartmouth.edu.