ICE BITS

FALL 2018

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

AGU Town Hall 2018: Scientific Drilling in the Polar Regions

The U.S. Ice Drilling Program (IDP) will hold the AGU Town Hall on *Scientific Drilling in the Polar Regions* on Tuesday, December 11, at the Marriott Marquis room Independence E from 12:30-13:30. The meeting is convened by Mary Albert with co-convenor John Goodge. In addition, at this Town Hall a representative of the International Glaciological Society will present the IGS Richardson Medal to Dr. Julie Palais.

Abstract: Ice sheets, glaciers, and the underlying bedrock, sediment and permafrost hold crucial evidence of past climate, ice sheet dynamics, and cratonic geology. National and international collaboration for drilling in the remote polar regions requires strategic coordination between science, technology, and logistics. This meeting will provide the research community with updates on IDP, IPICS, RAID, and SALSA drilling initiatives. Opportunities for community involvement will be showcased, and input from the audience will be solicited.

Date: Tuesday, 11 December 2018
Time: 12:30 - 13:30
Location: Marriott Marquis - Independence E
AGU meeting website: https://agu.confex.com/agu/fm18/meetingapp.cgi/Session/56028
For additional information: please contact Mary Albert (Mary.R.Albert@dartmouth.edu)

2018 Arctic Field Season Support Completed

IDP successfully supported seven projects during the 2018 Arctic field season.

(1) The *Genetic, Phylogenetic and Functional Microbial Diversity in Permanently Frozen Aquatic Sediments Over Geological Time* project (PI Vishnivetskaya; NSF award #1442262) successfully collected shallow permafrost cores in Svalbard using an IDP SIPRE hand auger and a new Stihl BT121 power head. This was the first permafrost coring utilizing equipment in the IDP inventory. The permafrost cores will be used to investigate whether microbes embedded in permafrost are extinct, representing ancient terrestrial surface or marine communities preserved through time, or actively living communities that have been evolving since being buried.

(2) The *Refreezing in the Firn of the Greenland Ice Sheet* project (PI Rennermalm; NSF award #1604058) collected several shallow firn cores from the southwestern sector of the Greenland Ice Sheet using an IDP hand auger and Sidewinder kit. The firn cores will be used to investigate the stratigraphy, density, temperature, and liquid water content of the firn cover and its spatial and temporal variations.

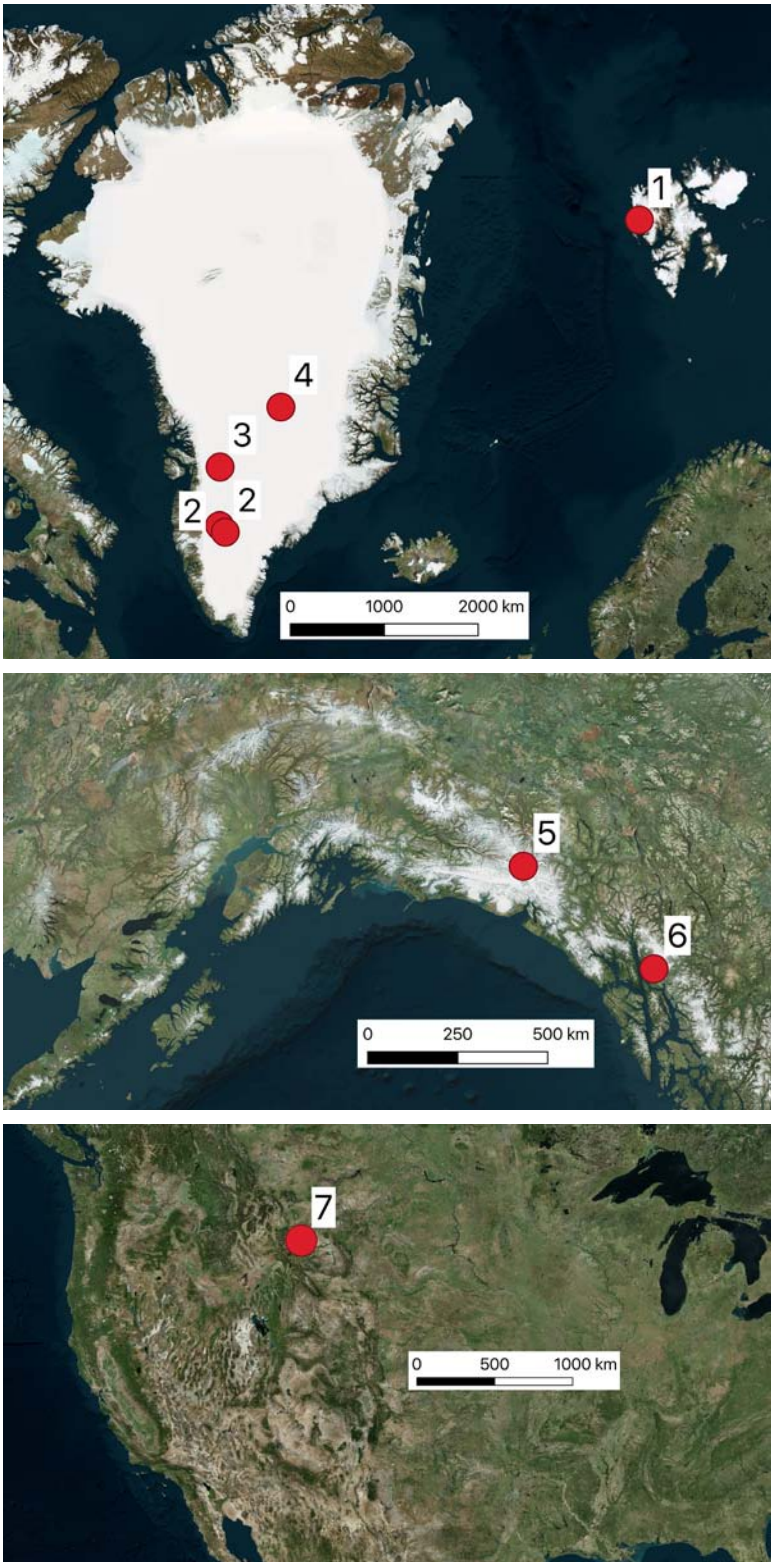
(3) The *Quantifying Heat/Mass Structure and Fluxes through the Full Thickness of Greenland's Percolation Zone* project (PI Harper; NSF award #1717241) collected two shallow firn cores in western Greenland using an IDP hand auger and Sidewinder kit. The shallow cores were used to quantify firn density 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.

(4) The *Wireless Analysis Tool for Subsurface Observation of Northern-ice-sheets (WATSON)* project (PI Bhartia; NASA PSTAR) successfully utilized the IDP Geovision borehole camera to inspect an existing borehole drilled by IDP during the 2017 Arctic field season near Summit Station, Greenland. The researchers intend to utilize the borehole during the 2019 field season. The objective of the project is to develop an ice drill integrated with a deep-UV fluorescence analytical instrument, with the ultimate goal of deploying the drill/instrument to Mars. The immediate project is conducting tests of the drill/instrument at planetary analog sites in Greenland.

(5) The *Geophysical Reconnaissance to Expand Ice Core Hydroclimate Reconstructions in the Northeast Pacific* project (PI Kreutz; NSF award #1502783) successfully operated IDP's new 2-Inch Stampfli Drill at the researchers' Divide Camp in the St. Elias Mountains, Yukon Territory, Canada. One firn core was collected to 20 meters and a second firn core to 10 meters depth. Weather and flight operations hampered the researchers' ability to experiment further with the new drill, however, the recovered core met their scientific needs and the researchers provided IDP with valuable feedback on the equipment. The researchers have maintained automatic weather stations at the Divide Camp since 2002, which represents an unprecedented observational record of snow accumulation and associated weather conditions in this glaciated region. The researchers plan to calibrate the firn core-based snow accumulation, temperature, and hydroclimate signals to the automatic weather station data.

(6) The *Measuring Snow Compaction on Ice Sheets* project (PI Kingslake; Columbia University internal funding) collected six shallow cores from the Juneau Ice Field using an IDP hand auger and Sidewinder kit. The goal of the project is to develop a new capability to rapidly measure the density and rate of densification of firn using ApRES (autonomous phase-sensitive radio-echo sounder). The researchers are using firn-density profiles and records of ice lens developed from the cores to compare to ApRES-derived densities.



Map of Greenland and Svalbard (top), Alaska and Canada (middle) and the United States (bottom) showing 2018 Arctic field season locations. The numbers shown on the map correspond to the project numbers in the text.

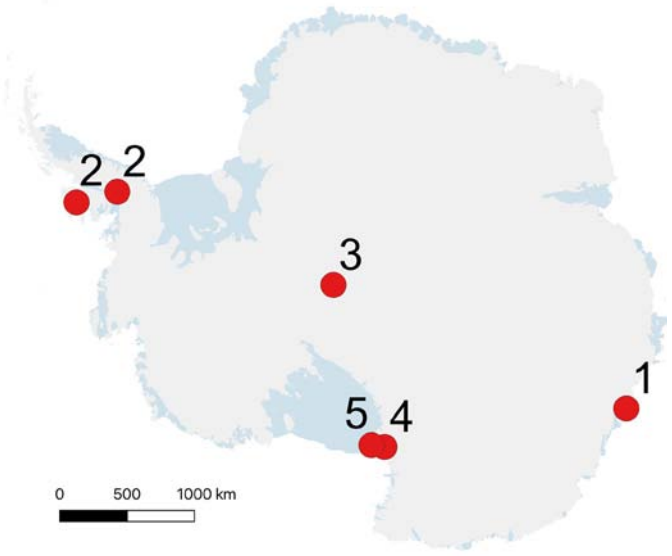
(7) The *Reconstructing Ancient Human and Ecosystem Responses to Holocene Climate Conditions* projected (PI McWethy; NSF award

#1832486) utilized the Prairie Dog drill system and a PI-supplied hand auger to recover firn/ice cores from the Beartooth ice patches in Montana over Labor Day weekend. The drive shaft to the Prairie Dog drill broke during drilling preventing retrieval of cores to the full depth desired. The researchers were successful, however, in recovering 8.5 meters of newly accumulated snow/firn since their last visit to the ice patches in 2016. The researchers are studying the ice patches to better understand past climatic conditions and human use of high elevations in the northern Rocky Mountains prior to the arrival of Europeans.

Field Support to Antarctic 2018-2019 Projects

IDP is providing support to the following projects during the 2018-2019 Antarctic field season:

(1) The *Reconstructing Carbon-14 of Atmospheric Carbon Monoxide from Law Dome, Antarctica, to Constrain Long-Term Hydroxyl Radical Variability* project (PI Petrenko; I-160-M) will sample firn air and shallow ice to a depth of about 233 meters at the Law Dome high-accumulation coastal site in East Antarctica. The goal of the project is to obtain measurements of paleo-atmospheric carbon-14 of carbon monoxide back to the 1800s when reactive trace gas emissions from human activity were minimal. These measurements will help to constrain changes in the oxidizing capacity of the atmosphere during the industrial period. The Badger-Eclipse Drill will be used to create the borehole for the firn air sampling. The 4-Inch Drill and Blue Ice Drill - Deep will be used to collect the ice core samples.



Map of Antarctica showing 2018-2019 Antarctic field season locations. The numbers shown on the map correspond to the project numbers in the text.

(2) The *Antarctic Firn Aquifers: Extent, Characteristics, and Comparison with Greenland Occurrences* project (PI Scambos; I-344-E) will investigate areas in the Antarctic Peninsula where water from summer melting of snow drains down into the deeper snow (firn) and remains as a water-flooded snow layer throughout the Antarctic winter. These zones are called firn aquifers. The project aims to confirm indications from satellite data that these areas exist on the Wilkins Ice Shelf and the George VI Ice Shelf coast. Persistent water in the upper layers of an ice shelf can destabilize the ice shelf and cause it to fracture and disintegrate or, on a non-floating ice sheet, can cause it to flow faster by draining to the bottom of the ice and reducing the friction between bedrock and glacier. Using the IDP Hand Auger, the fieldwork is centered on shallow ice-core drilling to ~60 meters depth at the southern Wilkins Ice Shelf and the southern George VI Ice Shelf. In addition to drilling one or two cores at each of the sites, researchers will conduct ground-penetrating-radar surveys of the area around the cores to determine the varying depth and extent of the aquifers. They will also install AMIGOS (Automated Meteorology–Ice–Geophysics Observing System) stations at each site with a sensor array that will measure weather, snow temperature and accumulation, and melt-season duration and intensity. As part of the ice coring, the researchers will also measure snow density and temperature in recovered ice.

(3) The *Radio and Optical Measurements of Glacial Ice Properties Using the SPICEcore Borehole* project (PIs Halzen and Hanson; A-333-S) 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 meters). The science goals of this IceCube project 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.

(4) The *McMurdo Dry Valleys Long-Term Ecological Research (MCM-LTER) Program* is an interdisciplinary and multidisciplinary study of the aquatic and terrestrial ecosystems in an ice-free region of Antarctica. The MCM-LTER has studied Dry Valleys ecosystems since 1993 and observed their responses to climate variations over time. Landscape connectivity, such as streams connecting

glaciers to lakes, and lake level rise connecting upland soils, is recognized to be influenced by climate and geological drivers. Researchers hypothesize that increased ecological connectivity within the Dry Valleys will amplify exchange of biota, energy, and matter, homogenizing ecosystem structure and functioning. During the MCM-LTER program, researchers will examine how climate variation alters connectivity among landscape units, and how biota (species, populations, and communities) are connected across this heterogeneous landscape, using state-of-the-art science tools and methods, including ongoing and expanded automated sensor networks, analysis of seasonal satellite imagery, biogeochemical analyses, and next-generation sequencing. Researchers (PI Doran; C-511-M) will utilize the Sediment Laden Lake Ice Drill to make holes in the permanent lake ice of the Dry Valleys for access to deployed equipment and melting out cables in the ice.

(5) The *Phase 2 Development of a Rapid Access Ice Drilling (RAID) Platform for Research in Antarctica* project (PIs Goodge and Severinghaus; D-552-M) will conduct system updates, maintenance, and functional tests of a new drill head and cutting tool for the RAID platform. Upon request by the PIs, IDP is deploying one engineer to serve as the team leader for the maintenance season.

Subglacial Access Science Planning Workshop: March 29-30, 2019

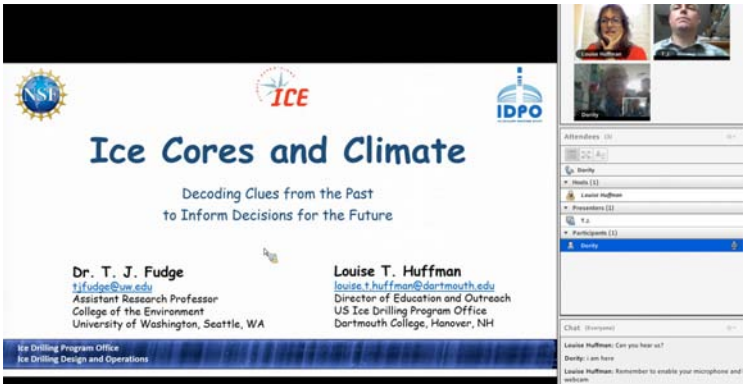
Save the date! The U.S. Ice Drilling Program Subglacial Access Working Group (IDP-SAWG) will hold a community planning workshop on March 29-30, 2019 at the Washington Dulles Marriott Suites Worldgate hotel in Herndon, Virginia. The meeting will be all day on Friday March 29, and Saturday morning March 30. Another announcement will come out in mid-December with additional details.

Please pre-register for the meeting by following the instructions on the workshop website, https://icedrill.org/subglacial-access-science-planning-workshop-2019. After we receive your pre-registration, we will send you additional details of meeting logistics and agenda.

Description: Scientific discoveries achieved from evidence within, and beneath the Arctic and Antarctic ice sheets and temperate glaciers are critical to society today, but they are not achieved without significant advance planning. The U.S. Ice Drilling Program (IDP) will sponsor an interdisciplinary ice community workshop to identify future Arctic and Antarctic drilling sites for subglacial science, the ice drilling technology that is needed, and the timeline over the coming decade for advancing subglacial science on multiple frontiers. The outcome of the workshop will be white papers describing community endeavors with associated timelines that will become part of the updated U.S. Ice Drilling Program Long Range Science Plan https://icedrill.org/about/resources.shtml#scienceplan .

Education and Outreach Update

On November 15, 2018, Education and Outreach Director, Louise Huffman, hosted a webinar featuring Dr. T. J. Fudge (University of Washington) who presented ice core science information to 6th grade students in Nevada. Students were thoroughly engaged and asked questions for almost half an hour during and after the presentation. Dr. Fudge's time and dedication to outreach are especially appreciated given that he departed the following week for two months of field research at Hercules Dome, Antarctica.



Screenshot of the November 15, 2018, webinar to 6th grade students in Nevada.

Applications for the *School of Ice* to be held in Denver, CO, June 23-26, 2019, are available at https://goo.gl/ZGe7sv or contact Louise Huffman at louise.t.huffman@dartmouth.edu.

Ice Drilling Support for NSF Polar Proposals

The NSF Antarctic Research program will now accept proposals at any time for solicitation ANT 18-530, and the NSF Arctic Research Opportunities program will accept proposals at any time for solicitation ARC 16-595.

Scientists who are proposing NSF research that will require ice coring or ice drilling should request field support from IDP by downloading the form for drilling support from https://icedrill.org/scientists/scientists.shtml. Scientists who seek to include IDP education and outreach activities associated with U.S. ice coring or drilling science projects should follow the directions on getting "Outreach Support for Scientists" from https://icedrill.org/scientists/outreach_support.shtml.

Scientists should send support requests to Icedrill@Dartmouth.edu at least 3 weeks before the target date for submitting your NSF proposal. Early submissions are strongly encouraged.

For further information on requesting IDP support, visit our website at http://www.icedrill.org/scientists/scientists.shtml or contact us at IceDrill@Dartmouth.edu .