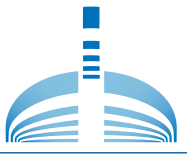


# ICE BITS



**SUMMER 2021**

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

## 2021-2031 Long Range Science and Long Range Drilling Technology Plans Updated

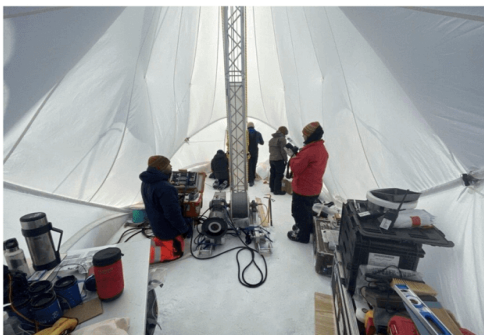
The U.S. Ice Drilling Program (IDP), in collaboration with its Science Advisory Board and with input from the research community, updated the Long Range Science Plan. The purpose of this plan is to articulate goals and make recommendations for the direction for U.S. ice coring and drilling science in a wide variety of areas of scientific inquiry and to make recommendations for the development of drilling technology, infrastructure, and logistical support needed to enable the science. A companion document, the Long Range Drilling Technology Plan, provides details about drills available through IDP. Both plans are revisited and revised as appropriate each spring. The Long Range Science Plan is available at <https://icedrill.org/long-range-science-plan>. The Long Range Drilling Technology Plan is available at <https://icedrill.org/long-range-drilling-technology-plan>.

If you envision the need for ice drilling for your project in the coming decade, **please make sure that the high-level articulation of your science is captured in the Long Range Science Plan.** If it isn't, send several sentences to [IceDrill@Dartmouth.edu](mailto:IceDrill@Dartmouth.edu) describing the science driver and the envisioned field date and location for your project, so that your plans are voiced in this planning document.

U.S. Ice Drilling Program  
LONG RANGE SCIENCE PLAN 2021-2031

### Ice Drilling Program Long Range Science Plan 2021-2031

Prepared by the U.S. Ice Drilling Program in collaboration with its  
Science Advisory Board and with input from the research community



June 30, 2021



Sponsor: National Science Foundation

Ice Drilling Program

### LONG RANGE DRILLING TECHNOLOGY PLAN



June 30, 2021



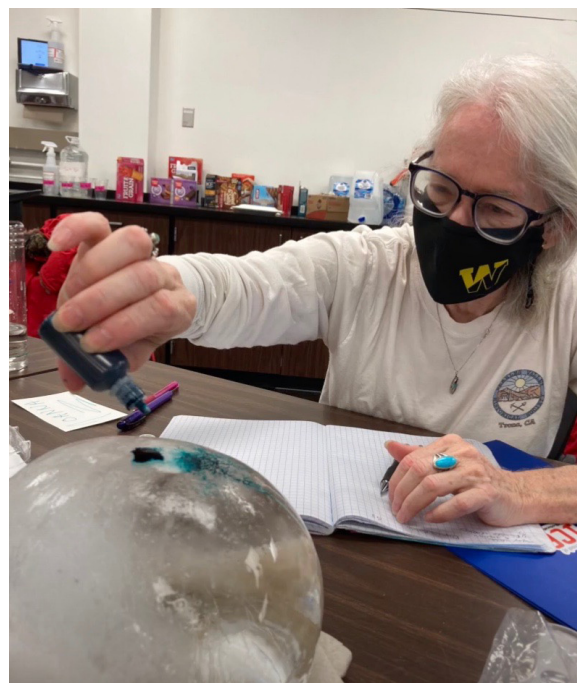
Sponsor: National Science Foundation

## Successful *School of Ice* Held at Oregon State University

IDP led another highly successful *School of Ice (SOI)* on July 31-August 4, 2021, at Oregon State University in partnership with Dr. Ed Brook. The SOI provides professional development workshops for faculty from minority-serving institutions, training participants to understand paleoclimate evidence derived from ice cores. It also provides participants with the opportunities and training to acquire the skills necessary to bring this exciting inquiry into new and existing Earth and environmental science classes on their campuses.

Eleven OSU researchers, an IDP engineer, and eight graduate students shared their research and expertise with this year's SOI participants. In addition, two educators led participants through hands-on inquiry labs that will be used in current and future courses back at their home institutions. Dr. Brook led two field trips related to course content. One trip was to the Oregon coast, where participants observed evidence of past sea level rise, ocean acidification, and fossil evidence of climate from 23 to 5 million years ago. A second field trip was to an overlook near Mt. Hood to observe evidence of the retreat of Elliott Glacier.

A highlights video from this year's SOI is available at <https://www.youtube.com/watch?v=INz3xm78zko>.



Learn more about SOI and other Ice Drilling Program education and outreach opportunities at <http://icedrill-education.org/school-of-ice/>.



*The School of Ice teaches hands-on, active learning inquiry-based labs to workshop participants.*



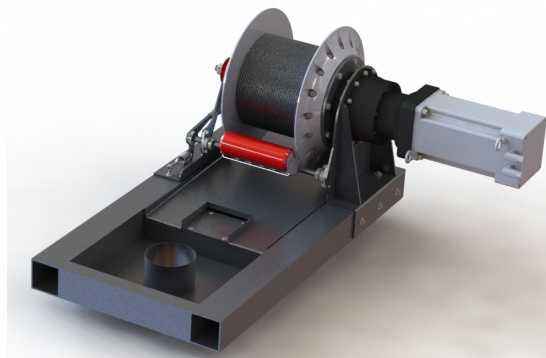
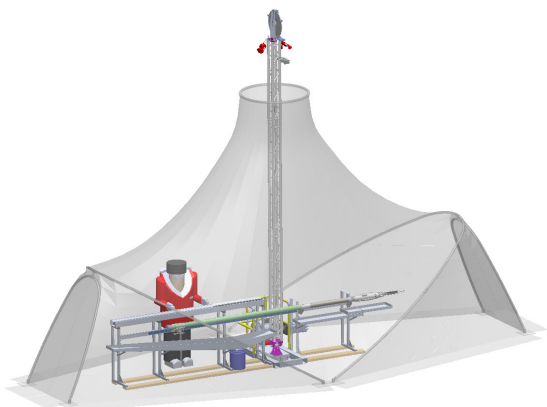


*A highly successful School of Ice (SOI) was held July 31-August 4, 2021, at Oregon State University in partnership with Dr. Ed Brook. The SOI provides professional development workshops for faculty from minority-serving institutions, training participants to understand paleoclimate evidence derived from ice cores.*



## 700 Drill Detailed Design Progress

Following NSF approval, IDP Engineers have now moved into the Detailed Design phase for the [700 Drill](#). The drill design is guided by and meets the [science requirements](#) identified by the research community. The small-diameter ice coring system will operate in a fluid-filled borehole to collect ice cores down to 700 m depth, all while minimizing logistics as much as possible. The 700 Drill will produce a 70 mm diameter core (potentially adapting to 64 mm in the future) and 88 mm diameter borehole, which will minimize the quantity (i.e., volume and weight) of drilling fluid and the number and weight of core boxes. IDP plans to hold an external design review with community scientists, ASC personnel, and the NSF in early PY 2022.



(left) Proposed layout of the 700 Drill inside of a modified MAST Tent. (right) 700 Drill winch drum, motor and base design. Credit: Grant Boeckmann

## Ice Core Early Career Researchers Workshop (ICECREW)

January 5-8, 2022

Salt Lake City, UT and Online

Sponsor: US Ice Drilling Program

Conveners: Jessica Badgley, Asmita Banerjee, T.J. Fudge, Bess Koffman, Summer Rupper, Katie Wendt

**Application Deadline: September 30, 2021**

Website: <https://icedrill.org/meetings/ice-core-early-career-researchers-workshop-icecrew>

The IDP-sponsored Ice Crew Early Career Researchers Workshop (ICECREW) is a professional development workshop for early-career researchers. This workshop was conceived by members of the IDP [Ice Core Working Group](#), and it will be held both **in-person and online January 5-8, 2022**, at the **University of Utah in Salt Lake City, UT**.

The workshop is free to attend. Travel stipends and childcare are available.

ICECREW is intended for early-career researchers whose work contributes to the drilling, processing, or interpretation of ice core data. The hope is to attract a diverse group of participants who may not have extensive experience working with ice core data.

Participants will connect with potential collaborators, learn about opportunities of future ice core drilling and research efforts, learn how to utilize resources available from past ice core projects, and engage in career development activities. Participants will also work together to develop two synthesis papers.

**Deadline for registration is September 30, 2021.** Participants must be affiliated with a U.S. institution to be eligible. Please see the [workshop website](#) for additional information.

## Presentations Available - *U.S. Science Traverses on the Greenland Ice Sheet: a Planning Workshop*

On June 11, 2021, the U.S. Ice Drilling Program and the Summit Science Coordination Office co-sponsored a U.S. science community planning workshop to identify and articulate U.S. science community interests for long-term planning of potential scientific traverses on the Greenland Ice Sheet. The interdisciplinary science community workshop identified future sites and traverse routes on the Greenland Ice Sheet where ground-based measurements and/or ice coring will be needed and the associated timeline over the coming decade for advancing science on multiple frontiers. The presentations from the workshop are available on the [workshop's website](#). In addition, workshop participants are currently working on a set of white papers that will also be available on the workshop's website.

## DISC Drill - Survey of Community Interest

The U.S. Ice Drilling Program is planning use of its drills for the coming decade. If you intend to submit a proposal to the NSF that would require use of the [DISC Drill](#), please send an email expressing your intent to [icedrill@dartmouth.edu](mailto:icedrill@dartmouth.edu) by **October 1**.

Deep drilling at [Hercules Dome](#) will be conducted using the [Foro 3000 Drill](#). A comparison of Foro 3000 Drill and DISC Drill capabilities and associated logistics requirements is [available online](#) and summarized in the table below.

Thank you for contributing to future planning for the U.S. Ice Drilling Program!

Drill System Parameter	DISC Drill		Foro 3000	
Core length (m)	3.2	4	2	3
Core diameter (mm)	122		98	
Replicate coring capability	Yes – active system		Passive system in development	
Time for setup/takedown (days)	71	71	28	24
Drilling days required to reach 2,800 m (days)	122	100	165	125
Number of seasons to reach 2,800 m [assuming 50 day field seasons]	3.9	3.4	3.9	3.1
Drill crew size (people)	10		7	
Core handlers/scientists (people)	7		4	
Drilling fluid required (drums) [53 gallons per drum]	385		210	
Power requirements at sea level (kW)	135		35	
Fuel requirements (gallons)	26,000	22,400	9,900	7,500
Core processing equipment (lbs.)	5,000		Included in cargo wt. & vol.	
Drill and core processing building	21,000lbs., 1,300 ft <sup>3</sup>		Included in cargo wt. & vol.	
Core storage area (below -20° C)	Required		Required	
Drill volume (cubes) [Includes MECC for DISC and Bicon shop for Foro 3K]	8,600		2,900	
Drill weight (lbs.) [Includes MECC for DISC and Bicon shop for Foro 3K]	136,300		40,500	
Drill fluid weight (lbs.) [Assuming 423 lbs. per drum]	162,900		88,900	
Diesel fuel weight (lbs.)	184,900	159,300	70,400	53,400
Ice Core weight (lbs.) [Heavy only on the way out]	72,200		46,500	
<b>Total weight (lbs.)</b>	<b>582,300</b>	<b>556,700</b>	<b>246,300</b>	<b>229,300</b>

*Comparison of DISC Drill and Foro 3000 Drill system parameters for a 2,800 meter deep ice coring project. More information comparing the Foro 3000 Drill and DISC Drill capabilities and associated logistics requirements is [available online](#).*

## Science Requirements: Replicate Coring for the Foro 3000 Drill

The [Foro 3000 Drill](#) is the deep ice coring drill that will be used for ice coring at [Hercules Dome](#), Antarctica. The IDP Science Advisory Board has identified the development of replicate coring capability for the Foro 3000 drill as a high priority in the IDP [Long Range Science Plan](#) 2020-2030; the first step in the process is the establishment of the IDP Science Requirements for Replicate Coring. When the Foro 3000 drill development was under consideration, a comparison of DISC versus Foro 3000 capability and logistics ([Johnson and Kippenhan, 2017](#)) indicated that a passive design for replicate coring would be advisable. A preliminary analysis ([Zeug, 2017](#)) found that a reliable approach using a whipstock in the parent borehole is feasible for retrieving replicate cores at specified depths from the parent borehole. There may be other approaches as well, but they must also fit within the overall goal of avoiding the electronic and mechanical complexity that would accompany a steerable drilling system, which is a more costly endeavor than is feasible now. From discussions organized by IDP with iterative discussions between representatives of the ice core science and borehole logging science communities and IDP staff, [science requirements for Replicate Coring Capability for the Foro 3000 Drill](#) have been established.

## Acknowledgment of IDP in Publications

If you receive any support from IDP, we kindly request that you acknowledge IDP in any resultant publications or articles with the following statement: “*We thank the U.S. Ice Drilling Program for support activities through NSF Cooperative Agreement 1836328.*” If you have any questions, please contact us at [IceDrill@Dartmouth.edu](mailto:IceDrill@Dartmouth.edu).

## 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](mailto:IceDrill@Dartmouth.edu).