



# Update from the Ice Drilling Program Office

Mary Albert IDPO Executive Director March 2017





### Vision



To enable scientific discoveries about changes in environment and climate, using evidence from glaciers and ice sheets, to inform environmental policy.

## Mission

To conduct integrated planning for the ice drilling science and technology communities, and to provide drilling technology and operational support that will enable the community to advance the frontiers of science.





### Ice Drilling Program Office NSF Cooperative Agreement







### Ice Drilling Program Office Science Advisory Board







### Ice Drilling Program Office Science Advisory Board



Jim White (UC Boulder), Chair Ryan Bay (UC Berkeley) Ed Brook (OSU), Past Chair Jill Mikucki (UTK) Erich Osterberg (Dartmouth) Slawek Tulaczyk (UC Santa Cruz) Paul Winberry (CWU) Eric Wolff (Cambridge)



### Ice Drilling Program Office Long Range Science Plan



U.S. Ice Drilling Program

Long Range Science Plan 2016-2026



Prepared by the Ice Drilling Program Office in collaboration with its Science Advisory Board with input from the research community



Input to the plan comes from the SAB, the Working Groups, community members, and IDPO.

Prioritization of the drilling technology in the plan is established by the SAB.



### Ice Drilling Program Office Working Groups







## Ice Drilling Program Office Community planning workshops





#### Outcome: White papers on

- Ice Shelves & Ice Streams: Thwaites Glacier Region
- Ross Ice Shelf and Ice Streams
- Subglacial Aquatic Environments
- Antarctic Continental Interior



### Ice Drilling Program Office Community planning workshops





Outcome: science drivers, target locations, & timelines for the next decade included in the IDPO Long Range Science Plan 2016-2026





### IDPO-IDDO Community Outreach



#### IDPO-led AGU Town Halls:

# Scientific Drilling in the Polar Regions

Participation: IPICS, IDPO-IDDO, RAID, WISSARD, NSF



#### Ice Drilling Program Office Long Range Science Plan: Multiple Fields of Science



**U.S. Ice Drilling Program** 

#### Long Range Science Plan 2016-2026



Prepared by the Ice Drilling Program Office in collaboration with its Science Advisory Board with input from the research community

June 30, 2016



- Climate Change
- Ice Dynamics and Glacial History
- Subglacial Geology, Sediments & Ecosystems
- Ice as a Scientific Observatory





# **IDPO-IDDO** Integrated Science & Technology Planning



Ice Drilling Design and Operations Long Range Drilling Technology Plan



Prepared by the loe Drilling Design and Operations group in collaboration with the Ice Drilling Program Office

June 30, 2016



Science planning drives drill tech planning, development, and use. www.lcedrill.org



#### **IDPO-IDDO**



#### Annual Program Plan PY 2017

August 2016

Ice Drilling Program Office Ice Drilling Design and Operations

(IDPO - IDDO)

IDPO Load Institution Dartsouth

IDPO Parmer Initiations University of New Hompshire

U.S. Ice Drilling Program Long Range Science Plan 2016-2026



Prepared to the lost Brilling Program Diffice in collaboration with its Toleron Address Search with regul from the manuch community



Ice Drilling Design and Operations Long Range Drilling Technology Plan lune 10 2016

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# Ice Drilling Program Office IDPO Science Requirements for New or Upgraded Drilling Tech



lee Drilling Program Office

#### IDPO Science Requirements: RAM Drill

#### Background

The IDPO long Range Science Pair 2018 identified science grads for los drilling that spanned a solar range of science targets. For field projects with limited legislical support where peoplysical information is needed, an agits, scientist-spectrose, then hale drill is needed to rapidly service hales in film to depths of approximately 20180 m depths. Prior discussions improved by IDPO with iterative discussions texwers (DPO, scientist), and (DDO put), the following on the science recommends for the drill.

#### Scientific Requirements

1. The Drill should preduce helps in first for a 20 pm numbral help discreter in the top 30 000 m of a wide variety of first types; industing cas in lifest Artanctics or Greenland. A minimum help discreter of 7.5 cm is needed, in order to help jobs a cartridge of 5.5 cm discreter and 224.5 mm large the better of a help that is 200 m deep. The system may industrie realize the setup with/compressor subsystems to advect to active the second to alther only the top 40 m, or to drill to 100 m deep. The system rank top the top 40 m, or to drill to 100 m deep. The system cart you top the top 40 m, or to drill to 100 m deep.

 The goal for the shifting rate should be to produce 15 ten-sentimeter standard rates to 200 in depth in 8 hours or less of shifting inst industing shift transport time between size). The langest asseptable shifting time per 200 m hale is 80 minutes.

 The drift should have stand-alone capability for operation at small field campo at remain shes: with no heavy equipment.

4. The shift should be operative in cold antident temperatures down to (30%(5%),3%) and whether of up to 25 brands. The first and up are expected to be fraues.

5. Online depth should be available during drilling.

8. The modules for transport shall be sized appropriately to be easily handled by 2 people with loading assist equipment provided with the drill. The goal for the test system weight with annual packaging is to be less than approximately 4.000 %.

7. The dirit checks be very famil particle, with the skills, to be based over rough terrain. It is a goal that the 48 m system should be toward ideally by a single proxymobile, and the 186 m system based by arrestal assemblies or by a Tudier.

1. If towing the 40 m pattern by a single provinciale is not achievable, then a modular pattern is

Science requirements completed:

- Portable firn coring drill (<100 m)</li>
- RAM drill (update)
- Ramara drill

#### Science requirements in prep for:

- Agile ice coring drill (400-900 m)
- Foro 3000 drill
- Clean scalable hot water drill
- Winch simulator

#### http://www.icedrill.org/equipment/development.shtml



#### National Academy Report Priority for US Antarctic Science



A Strategic Vision for NSF Investments in

Antarctic and Southern Ocean Research



Box I. The Committee's Evaluation Criteria The committee developed criteria to evaluate research ideas gathered through the community engagement process:

- Compelling science
- Potential for societal impact
- Time-sensitive in nature
- Readiness/feasibility
- Key area for U.S./NSF leadership

Additional factors considered:

- Partnership potential
- Impacts on program balance



Figure 1. The mass of the Antarctic ice sheet declined by 92 billion tons per year from 2003 to 2014. The color scale indicates change in land ice mass (equivalent to centimeters of



#### NSF – NERC Joint Program in Antarctica



Thwaites: The Future of Thwaites Glacier and its **Contribution to Sea-level Rise** 

PROGRAM SOLICITATION NSF 17-505



Directorate for Deceptences Overal Poor Programs

Natural Environment Research Council

Fult Proposal Deadline(s) (size by 5 p.m. submitter's local time).

Makeh 61, 2017

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised NOF Proposal & Award Policies & Procedures Guide (PAPPG) (MSF 17-1), MSF anticipates release of the PAPPG in the Fall of 2016 and 4 will be effective for propriate submitted, or due, or or after January 30, 2017. Please be advised that propries who spt to submit prior to January 30, 2017, must also fallow the guidelines contained in MSF 17-1.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Theoles. The Future of Theoles Olacier and its Contribution to Sala-level Rise

**Synopsis of Program** 

Considerable uncertainty remains in projections of future callices from West Antanctica. Reducing this uncertainty is an international priority that was twoently underscored by the Scientific Committee on Antarctic Research in its Short and there are not And a second sec

# Arctic research policy from the Interagency Arctic Research Policy Committee



National Science Foundation	Department of Transportation
Department of Agriculture	Environmental Protection Agency
Department of Commerce	Marine Mammal Commission
Department of Defense	National Aeronautics and Space Administration
Department of Energy	Office of Management and Budget
Department of Health and Human Services	Office of Science and Technology Policy
Department of Homeland Security	Smithsonian Institution
Department of State	U.S. Arctic Research Commission
Department of the Interior	

#### Policy drivers:

- 1) Enhance the well-bring of Arctic residents,
- 2) Advance stewardship of the Arctic environment,
- 3) Strengthen regional and national security,
- 4) Improve understanding of the arctic as a component of planet Earth



Interagency Arctic Research Policy Committee U.S. Arctic Research Plan 2017-2021 Research Goals









#### Outlook

# Ice drilling technologies are key to enabling science both in the Arctic and Antarctic

- Near-term and long-term high priority U.S. science requires ice drilling
- Logistics realities require increasingly agile field equipment
- Funding realities requires increasingly an agile & resilient ice drilling program



#### Funding realities creates challenges & opportunities for resilience

### **IDPO-IDDO**

#### Balance between field support & tech development

Eos, Transactions, American Geophysical Union, Vol. 91, No. 39, 28 September 2010, Pages 345-346

#### A New Paradigm for Ice Core Drilling

The search for answers to questions about the changing climate has created an urgent need to discover past climate signatures archived in glaciers and ice sheets, and to understand current ice sheet behavior. Recognizing that US scientific productivity in this area depends upon a mechanism for ensuring continuity and international cooperation in ice coring and drilling efforts, along with the availability of appropriate drills, drilling expertise, and innovations in drilling technology, the US. National Science Foundation they have community support, are inc in the next version of the science play which is updated yearly in the spring.

To request specific drilling services tists must download a support request from the IDPO/IDDO Web site (http:// .icedrill.org/scientists/scientists.shtml) out, and submit it at least 4 weeks in advance of any given research propos date if the proposal is for the use of a ing drill, and at least 6 weeks in advan the proposal involves the development achieve their science objectives. SAB composition is representative of the varied areas of science in those research communities.



By design, IDPO-IDDO has used our CA funding to balance field support with tech development. When NSF funded less field science, IDPO-IDDO has created the new technology identified in the IDPO Long Range Science Plan, that fosters new science.

#### **IDPO-IDDO**



#### Program Management Performance on Major NSF Drill Development Projects

Project	Results	Progress!	
ICDS DISC Drill (2003-2008)	Significant external overrun	2011 Review Comments <i>"From gut-feel project management" to</i> <i>" a IDPO-IDDO owned projected management system that is consistent with NSF and industri best practices".</i>	
ICDS Wissard Project (2009- 2011)	Significant external overrun, project competed by another organization		
IDPO-IDDO Intermediate Depth Drill (IDD) (2011-2014)	On-schedule, no external overrun but required funds from lower priority projects		
IDPO-IDDO Agile Sub-Ice Geological (ASIG) Drill (2014 – Present)	On-budget, on-schedule (through North American Test)		
Rapid Access Ice Drill (RAID) (2012 concept 2014 – present)	On-budget, on-schedule (through shipment)		

Ice Drilling Design and Operations

### IDPO-IDDO Example: ASIG Drill



By design, IDPO-IDDO has used our CA funding to balance field support with tech development. When NSF funded less field science, IDPO-IDDO has created the new technology identified in the IDPO Long Range Science Plan, that fosters new science.



#### IDPO-IDDO



Challenge: reduce costs for NSF science budgets

Before: IDDO driller salary costs were charged to the science program

Now: IDDO driller salary costs come from our existing NSF Cooperative Agreement

This relieves stress on science projects but decreases our CA funds available for development projects.

## IDPO-IDDO Opportunity: Seek tech development funds through proposals



*Example – pending proposal*: Collaborative Proposal for ScHWD Mikucki, Albert, Mullilgan



Funding for new technology development projects will need to come from successful peer-reviewed proposals. We are cautiously optimistic.

### IDPO Education & Public Outreach



#### Strategic Goals

- Improve grades 7-12 educator teaching and learning of ice science climate concepts. *IDPO live* & web-based workshops for NSTA, NOAA, PEI, AMS
- Increase public appreciation for and understanding of ice science research discoveries to inform their decisions. *Presentations at community meetings, museums, national media possibilities*
- Build a sustainable community of IDPO graduate students, scientists and engineers engaged in education and outreach. AGU GIFT events, NOAA & NSTA webinars









### IDPO Education & Public Outreach



#### Strategic Goals (cont'd)

- Actively pursue collaborations and funding to develop high impact education and outreach products. *Partnership with Golden Apple summer institute, NOAA climate series, AMS*
- Encourage minority participation in STEM activities using ice science as the vehicle. *Led School of Ice for faculty at minority-serving institutions in Denver 2016 and in Hanover NH 2017, in collaboration with AMS.*









# Much more info at: www.lcedrill.org





#### News and Announcements

#### 22 June 2016

RAID science workshop - Sept 21, 2016, La Jola

Science Workshop for Research with the Rapid Access ice Drill

#### 15 June 2016

#### Spring 2016 Ice Bits Newsletter Now Available

The SPRING 2016 quarterly update of IDPO and IDDO activities is now available.

#### For Scientists

Information and resources for the ice drilling science and technology communities

- Field Support for NSF Proposals
- · Field Support for non-NSF Proposals
- Eield Project Support Requirements Form
- End-of-Season Project Support Eval Form







# Status of action on SAB Priorities from 2016-2026 Long Range Science Plan



# Ice Drilling Program Office 2016 Priority Drilling Technology Needs



#### Priority 1 (needed next year):

- Maintain existing agile equipment.
- Evaluate DISC vs IDD possibilities for Hercules Dome
- Repair, modify or acquire a very lightweight highly-portable drill for shallow ice coring to 100 m.
- Build a second Blue Ice Drill
- Create a conceptual design and cost estimate for adapting an agile coring drill to minimize logistical requirement for the drill, shelter, and fluid plan for ice coring up to ~ 700 m
- Develop and build the Lake Ice Drill for 5" holes thru 6 m of dirty ice
- Adapt or construct an agile shot-hole drill capable of drilling fifteen 10 cm diameter holes per day up to 100 m deep in both East and West Antarctica. This may include consideration of a RAM drill upgrade, or other means.



# Ice Drilling Program Office Priority Drilling Technology Needs

U.S. Ice Onling Program Long Range Science Plan 2016-2020





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- **Develop IDPO Science Requirements for**, and design and build, winch simulators.
- Evaluate practicality of acquiring WISSARD Drill system and operating it under IDDO.
- Develop IDPO Science Requirements for modular clean access capability for the Scalable Hot Water Access Drill for depths less than 1,000 m<sup>2</sup>.
- Develop IDPO Science Requirements and a conceptual plan for a hot water drill, with modular clean access add-on, capable of creating access holes in ice depths of 2,500 m or greater for deeper targets (i.e. sites around Thwaites, interior sedimentary basins).
- Conduct Antarctic field trials of the Rapid Access Ice Drill (RAID)<sup>1</sup>.

<sup>1</sup> This development is happening with DOSECC Exploration Services, LLC.

<sup>2</sup> The IDDO Conceptual Study for the ScHWD found that scalable capability deeper than 1,000 m would require different components that are not practical for use between 50-1,000 m.



## Ice Drilling Program Office Priority Drilling Technology Needs

U.S. Ios Orilling Program Long Range Science Plan 2016-202





- Provide a cost estimate and conceptual design for adapting the existing Intermediate Depth Drill and infrastructure to minimize logistical requirement for the drill, shelter and fluid plan for ice coring to approximately 600-800 m, if weight and cube estimates indicate this should go forward.
- Evaluate if the agile shot-hole drill design could be used, and is desired, for 15 cm diameter boreholes (up to 220m, xx per day) for radio neutrino detectors as well.
- Build a Scalable Hot Water Access drill for creating access holes in ice from 50 m up to approximately 1,000 m depth<sup>2</sup> with modular potential to be used for clean access.
- Upgrade the electrothermal drill to allow for coring to 300 m through temperate and poly-thermal firn and ice. The drill needs to be agile and light weight (transportable by helicopter).
- Continue to evaluate options for new drilling fluids.



## Ice Drilling Program Office Priority Drilling Technology Needs

U.S. to Orilling Program Long Range Science Plan 2016-2026



#### **Priority 3 (needed within the next 3 - 5 years):**

- Investigate rapid hole qualifier (temperature and caliper) for RAID boreholes
- Investigate potential of in situ probes for englacial and subglacial observations and sampling.
- Investigate potential for improved and more efficient site selection for ice core drilling projects.







#### Thank you, IDPO Science Advisory Board, for your service to IDPO-IDDO and to the community!

Thank you, NSF, for your continued support!