Ice Drilling Science Community Workshop

Ice Drilling Program Office

Herndon, VA

April 2011

www.icedrill.org

IDPO-IDDO
Vision and Mission

Vision

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

Mission

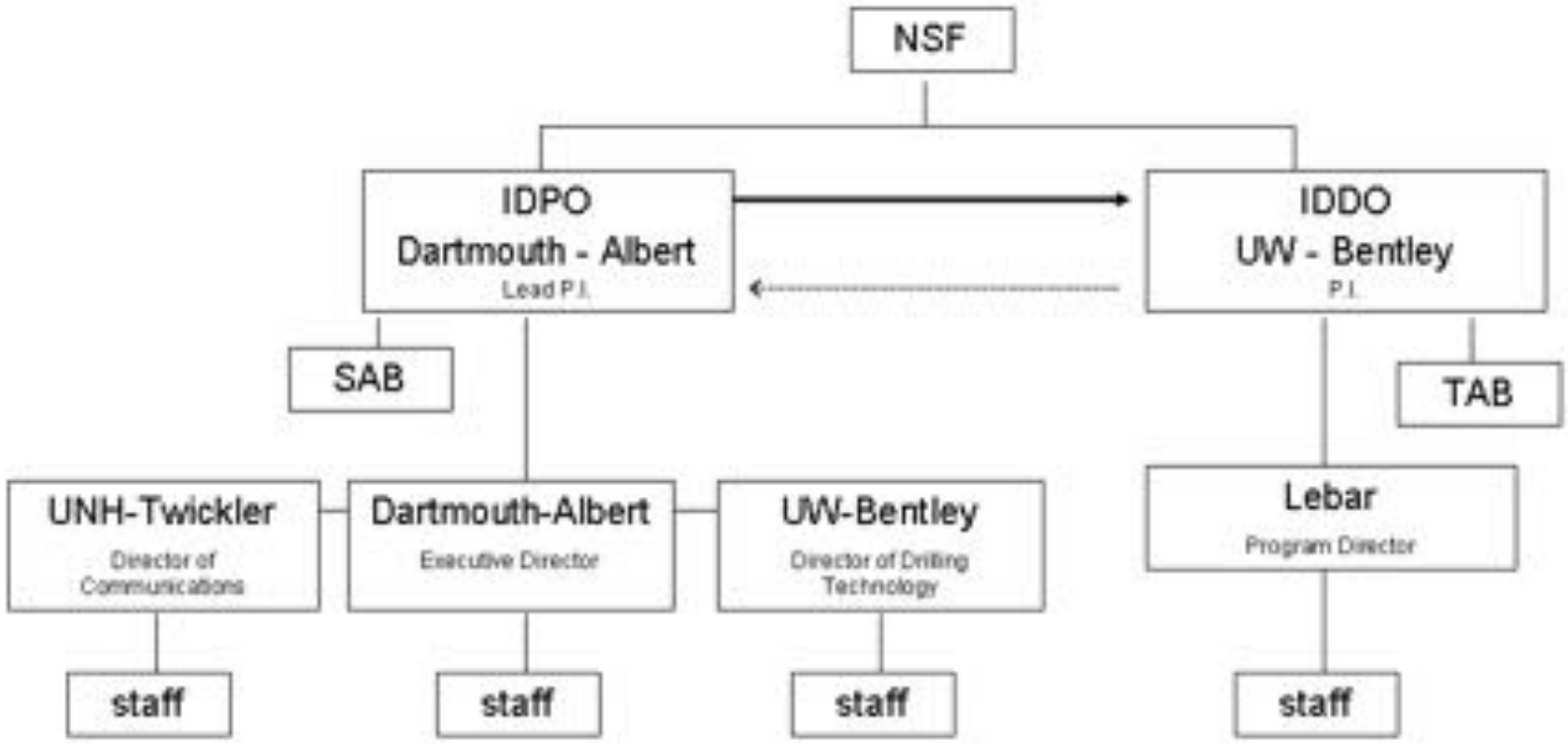
To conduct integrated planning for the ice drilling science and technology communities and to provide drilling technology and operational support that will enable the community to advance the frontiers of climate and environmental science.

Workshop Goals

- Share ideas for future science targets needing ice drilling
- Form interdisciplinary teams to address problems with like drilling needs
- Each team writes a short white paper that presents an overview of the science, and identifies the approximate site location, field years, and drill needed
- If a new drill will be needed, the team identifies draft science requirements of the drill

IDPO & SAB will use the information to update the Long Range Science Plan, and get the ball rolling on plans for drill development, so that it will be read when needed by the science.

Organization: IDPO-IDDO



Advisory Committee:
IDPO Science Advisory Board

Purpose:

- Represent the scientific community to IDPO and convey IDPO & SAB actions back to the community
- Identify emerging scientific developments that will impact use of existing and future drilling technology
- Maintain & update the IDPO Long Range Science Plan
- Contribute to 10-yr planning matrix in the Science Plan
- Review IDPO & IDDO activities and responsiveness to community needs

Membership:

- Science experts in the range of sciences that utilize ice coring and drilling technology

Advisory Committee:
IDPO Science Advisory Board

Howard Conway (Chair), Univ. Washington – ice dynamics
Ed Brook, Oregon State – IPICS U.S. Co-Chair
Dorthe Dahl-Jensen, Danish Ctr Ice & Climate – EUROPICS
Karl Kreutz, U. Maine – Chair, Ice Core Working Group
Gary Clow, USGS – Chair, Borehole Logging Working Group
Sridhar Anandakrishnan, Penn State – geophysics
Ryan Bay, Berkeley – physics
Jill Mikucki, Dartmouth – cryomicrobiology
Ross Powell, U. Illinois – subglacial processes
Eric Saltzman, UC Irvine – ice cores

IDPO Planning Example

- The Long Range Science Plan and Technology Plan are coordinated & they guide the IDPO-IDDO Annual Plan
- Community is involved in planning via AGU Town Hall, SAB, web input on science plan annually in May, community workshop
- Example Intermediate Drill: Community need is articulated in Long Range Science Plan, IDPO gets broad community input on science requirements and addresses timing/budget issues & int'l collaboration; IDDO is conducting the feasibility study now. We anticipate using some of the IDDO baseline funding for 2012 to start the engineering

SAB-recommended logistical principles

- Planning for drilling technology needs to consider the cost and availability of logistics, beginning with the earliest stages of planning and continuing as decisions are made throughout the engineering design and fabrication process.
- Science requirements need to be balanced by consideration of logistical issues including weight, size, costs and time frame for development. All factors need to be clearly defined at the initial stage of planning, and changes during the engineering design and fabrication process should be reassessed by the IDPO;
- Drills and accompanying technology for a specific project should be developed with consideration of potential use in future possible projects. They should be versatile and adaptable.

Long Range Science Plan Categories

- Climate
- Ice Dynamics and Glacial History
- Sub-Ice Environment
- Ice as a Scientific Observatory

Long Range Science Planning Matrix

- Climate

	2010				2011				2012				2013				2014				2015				2016				2017				2018			
Climate	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
~ 200 yr investigations																																				
Hand auger/sidewinder		x	x	x	x	x	x	x	x	x	x			x	x			x	x																	
Prairie Dog drill		x	x	x	x	x	x	x	x																											
Thermal coring drill		x	x																																	
2k array																																				
badger/eclipse drill		b	b	b	b	b	b																													
4-inch drill		4	4			4	4																													
40k Network																																				
40k-WAIS Divide																																				
DISC drill - coring				D	D																															
borehole logging at WAIS								L			L				L					L	L															
replicate coring conceptual design																																				
replicate c. engineering	x	x	x	x																																
replicate c. prototype & lab tests			x	x	x																															
replicate c. fabrication				x	x	x																														
replicate coring at WAIS-D							D	D			D	D																								
40k - Roosevelt Island																																				
NZ drill - coring				N	N																															
Acquisition planning -intermediate drill																																				
establish science requirements			x	x																																
int drill feasibility & cost estimate					x	x	x	x																												
int drill design/adaptation								x	x	x																										
int drill fabrication								x	x	x	x	x																								

Long Range Science Planning Matrix

- Ice Dynamics and Glacial History

	2010				2011				2012				2013				2014				2015				2016				2017				2018			
Ice Dynamics & History	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Development - hot water access drill																																				
subglac hot water drill development	x	x	x	x	x	x	x	x	x	x	x	x																								
Development - mech rapid access drill																																				
establish science requirements					x	x	x																													
conceptual design									x	x	x	x	x																							
engineering											x	x	x	x	x																					
prototype & lab tests													x	x	x	x																				
fabrication														x	x	x	x																			
Bed conditions																																				
Geothermal flux																																				
Ice properties affecting flow																																				
Tracers of flow history (layering)																																				
Paleo ice elevation & topography																																				
Sub-ice shelf mass balance																																				
WISSARD													x	x				x	x																	
Grounding zone processes																																				
WISSARD													x	x				x	x																	

Long Range Science Planning Matrix

- Sub-Ice Environment

	2010				2011				2012				2013				2014				2015				2016				2017				2018			
Sub-Ice Environment	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Sedimentary record																																				
Microbial ecosystems & biogeochem																																				
WISSARD													x	x			x	x																		
Geologic& tectonic history																																				
Subglacial lakes & hydrology																																				
WISSARD													x	x			x	x																		

Long Range Science Planning Matrix

- Ice as a Scientific Observatory

	2010				2011				2012				2013				2014				2015				2016				2017				2018			
Ice as a Scientific Observatory	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Ice - a platform for planetary science																																				
Observations from existing boreholes																																				
Conceptual design for borehole repair						x																														
Assessment of existing boreholes						x																														
Borehole repair							x	x																												
Siple Dome																																				
Borehole logging													L	L																						

Workshop Goals

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- Form interdisciplinary teams to address problems with like drilling needs
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Questions?

Advisory Committee:
IDDO Technical Advisory Board

Purpose:

- Meet yearly to discuss 5-yr/Long Range Drilling Technology Plan and respond to technical issues raised by IDDO staff
- Review and give TAB approval to the Drilling Technology Plan
- Provide additional input to, or serve on other technical review panes for IDDO as requested by IDDO

Membership:

- Four overseas original members
- In early 2011 Hideaki Motoyama from Japan joined the TAB

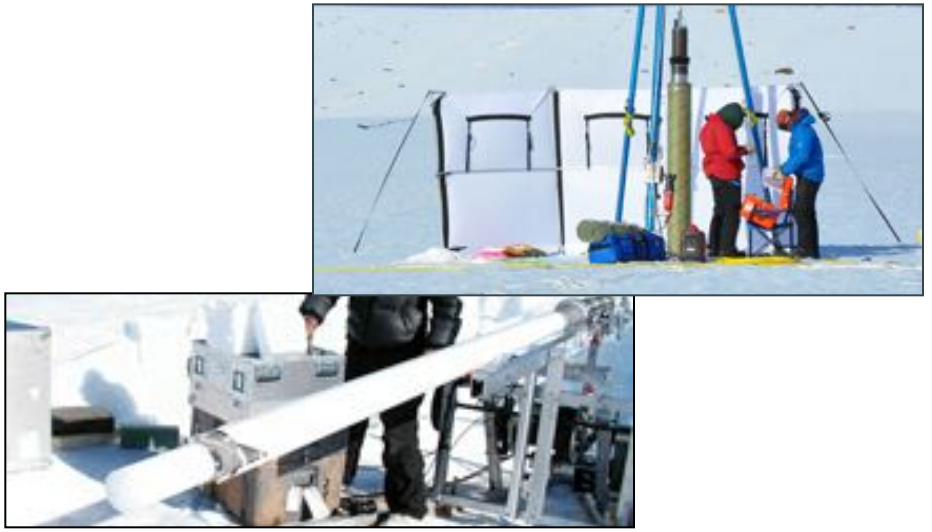
Upcoming meeting in April 2011 will include as guests two drilling engineers from China

IDPO Planning Examples

- The Long Range Science, Technology Plans are coordinated & they guide the IDPO-IDDO Annual Plan
- Community is involved in planning – SAB, web input on science plan, AGU Town hall, community workshop
- Results: Intermediate Drill – Community-voiced need articulated in Long Range Science Plan, IDPO coordinating science requirements, timing/budget issues & int'l collaboration, IDDO conducting feasibility study now. Anticipate baseline funding for 2012 to start design

Drilling Support Examples

- WAIS-D deep core: excellent core quality, timing on track, deepest U.S. core ever, 3331 meters
- Good results with agile drilling for smaller community projects
- Innovative new drilling technology

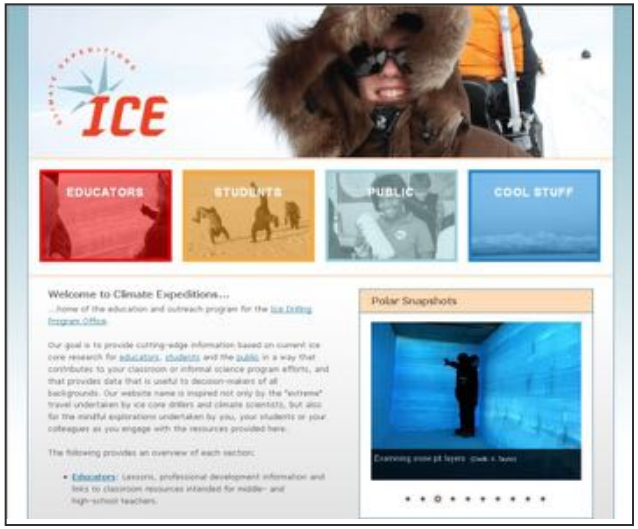


Communication Examples

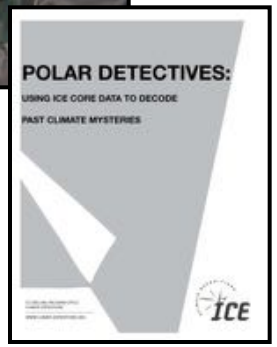
- Engaging and useful web site *Icedrill.org*
- Quarterly newsletter *Ice Bits*
- *Icedrill.news* listserv announcements
- IDPO and IDDO Presentations / interactions at community meetings (WAIS-D, ICWG, State of the Arctic, Chapman Subglacial)

Education & Outreach Examples

- Broadening public exposure to science, e.g. U.S. Science Festival
- Creating new education web site *Climate-Expeditions.org*
- Developing outreach skills in graduate students
- Building scientist collaborations for curriculum and outreach
- Delivering teacher workshops



NSTA National Science Teachers Association



SAB-recommended drilling investments

The SAB identifies the following as high-priority investments urgently needed in the coming one to five years for the drilling technology to enable scientific discovery (the following are not prioritized):

- Maintain quality agile coring/drilling capability
- Obtain two logging winches: 1 km and 4 km, with first priority on 1 km
- Develop replicate coring capability
- Purchase or construct an agile intermediate-depth ice coring drill
- Develop a design for rapid access through ice sheets with a narrow hole
- Identify needed upgrades to the DISC drill for use in East Antarctica
- Develop a design for clean access through the ice sheet with a hole large enough to deploy subglacial rovers
- Identify an appropriate drilling fluid to be utilized at in situ temperatures below -30C.