International Oil & Ice

WORKSHOP 2007

Sponsored by:

- U.S. Minerals Management Service (MMS)
- Alaska Clean Seas (ACS)
- Alaska Department of Environmental Conservation (ADEC)
- Cook Inlet Spill Prevention and Response Inc. (CISPRI)
- Prince William Sound Oil Spill Recovery Institute (OSRI)
- United States Coast Guard (USCG)

Organized by:

- SL Ross Environmental Research Ltd.
- DF Dickins Associates Ltd.

International Oil & Ice Workshop 2007

Background

Speaker Bios

Papers

Sponsors

Background

Learn about the workshop's origins, participants, goals and topics.

Speaker Bios

Broaden your knowledge of the key speakers.

Papers

Download any of the 21 presented papers.

Sponsors

Discover the players that help make the workshop possible.

Background

Over the past ten years, offshore petroleum exploration, development and transport in cold regions has expanded to include Alaska, the Canadian Beaufort Sea, Sakhalin Island, North Caspian Sea, Baltic, Norwegian Barents Sea, and the Russian Arctic. This period has also seen numerous important advances in our understanding of spill behavior and response in cold environments and ice, which is helping to expand the response-operating window for a number of diffrent strategies. The U.S. Minerals Management Service ahs been a leader in North America for much of this work, funding a wide range of projects, and making full use of the Ohmsett test facility in New Jersey. Organizations in Finland and Norway have led many research and development programs to design new recovery systems and better understand oil behavior and weathering in ice. In April 2000, Alaska Clean Seas together with 16 other government and industry sponsors, organized the highly successful first Internation Oil and Ice Workshop in Anchorage. That event attracted over 300 participants from around the world and was highly regarded as an opportunity to share the latest information in the field. Given the continued expansion in drilling activity and leasing interest in deep water Arctic areas, as well as rapidly increasing levels of tanker traffic in many ice-covered areas, 2007 is viewed by the sponsors as an opportune time to hold a second specialized workshop on the broad topic of oil spills in ice.

This workshop is designed to bring together an international audience with a common interest in advancing spill response in cold water and ice, and protecting the world's Arctic regions. The workshop goals are to:

- Share international advances in Arctic oil spill research and operations
- Guide future research and development programs towards priority areas of common interest.

The two-day technical program is made up of presentations by recognized experts on a wide range of key topics such as:

- International Arctic oil and gas developments
- Ice environments
- Ice-going vessel technology
- Remote sensing

- Enhancements to mechanical recovery systems
- Chemical herders in ice
- Cold-water dispersants
- Experimental spills
- Case studies
- Ongoing and future research programs

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Allen, Alan

Oil Spill Response Planning for Shell's Offshore Exploration Program in the Alaskan Beaufort Sea [PDF]

Baschek, Björn

Operational Multi-Sensor Oil Spill Surveillance Program [PDF]

Bradford, John H

Developments with Ground Penetrating Radar to Detect and Map Oil Trapped Under Ice [PDF]

Brandvik, Per Johan

Behaviour and Weathering of Oil Spills Under Arctic Conditions and Implications for Response [PDF]

Brigham, Dr. Lawson

A *New* Arctic Ocean ~ Responding to Marine Access Change at the Top of the World [PDF]

Brooks, Read Admiral Arthur E.

Buist, Ian

In Situ Burning for Oil Spills in Ice-Covered Waters [PDF]

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Using Herding Surfactants to Thicken Oil Slicks in Pack Ice for *In Situ* Burning [PDF]

Eicken, Hajo

Beaufort Sea - Ice Zones and Implications for Spill Scenarios [PDF]

Keller, Arturo A.

Oil Recovery with Novel Oleophilic Skimmer Surfaces under Cold Climate Conditions [PDF]

Kristoffersen, Bjørn

Environmental Strategies While Moving into a New and Challenging Oil and Gas Province - The Barents/Pechora/Kara Sea Areas [PDF]

Lampela, Kari

Baltic Approach to Oil Spill Recovery in Ice: Case Studies and Recent Development in Baltic Sea [PDF] States

Lee, Kenneth

Oil Mineral Aggregate Formation in Ice-Infested Waters [PPS]

Luthi, Randall B.

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Lessons Learned: On-Land, Cold-Weather Spill Response Clean-Up Operations [PDF]

Mullin, Joseph

Cold Water Dispersant Effectiveness Experiments Conducted at Ohmsett with Alaskan Crude Oils and Corexit 9500 and 9527 Dispersants [PDF]

Nedwed, Tim

ExxonMobil Research on Remotely Applied Response Options for Spills in Dynamic Ice [PDF]

Niini, Mikko

New Arctic Vessel and Icebreaking Technologies [PDF]

Owens, Ed

Shoreline Treatment in Arctic Environments [PDF]

Rytkönen, Jorma

Maritime Safety Development and Winter-time Demands for Shipping and Oil Spill Preparedness in the Baltic Sea environment [PDF]

Singsaas, Ivar

Recent Testing of Oil-in-Ice Skimmers [PDF]

Sørstrøm, Stein Erik

Joint Industry Arctic Oil Spill Research Program [PDF]

Ulmer, Frances

Weir, Laurie

The Integrated Tracking of Pollution Program (ISTOP) and Ice

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Joint Industry Arctic Oil Spill Research Program
Sørstrøm, Stein Erik

The Integrated Tracking of Pollution Program (ISTOP) and Ice Forecasting/Mapping Services in the Western Arctic
Weir, Laurie

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Speaker Bios

Alan A. Allen

Spiltec, Woodinville WA

David Dickins

DF Dickins Associates Ltd., La Jolla CA

Shell, together with its primary response contractors, ASRC Energy Services (AES) and Alaska Clean Seas (ACS), has developed one of the most comprehensive oil spill response programs ever assembled for an Arctic exploration program. For the remote possibility of a major spill, Shell has provided, on location, a highly trained response team and the best available cold-climate resources for an immediate response to contain, recover and/or eliminate as much oil as possible thereby minimizing environmental impacts. Because of the possibility of ice incursions during the open water period and the natural variability of the timing and duration of freeze-up, Shell's oil spill response strategies and tactics have been designed to cover a wide range of open water and ice conditions. In heavy ice concentrations (e.g., ice incursions in summer, new ice at freeze-up, or with drifting floes at break-up), Shell's high-volume, viscous-oil recovery systems would be supplemented with tactics involving the rapid and efficient elimination of oil with controlled burning. Established burn guidelines are in place to allow in situ burning to take place with scientifically monitored safeguards to protect responders, the environment and local populations.

Mr. Al Allen has over 38 years experience as a technical advisor and field supervisor involving hundreds of oil spills around the world. His assignments have spanned more than 65 countries, providing training and operational guidance for government and industry organizations in the use of mechanical cleanup, the application of chemical dispersants, and the use of controlled burning. Al has spent over 30 years working in Alaska and other cold climates managing oil spill cleanup operations, serving as an advisor to oil industry and regulatory organizations, and conducting offshore and onshore spill prevention, control and research programs.

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International Oil & Ice Workshop 2007

Speaker Bios

Dr. Björn Baschek

Federal Institute of Hydrology (BfG)
Koblenz Germany

Germany is using a combined system of aerial remote sensing and satellites for maritime surveillance and the detection of oil pollution: On behalf of the Federal Ministry of Transport, Building and Urban Affairs, the Central Command for Maritime Emergencies (CCME) coordinates the operational surveillance, the Federal Institute of Hydrology is the scientific consultant, and the Naval Air Wing 3 "Graf Zeppelin" operates the aircraft.

The talk will present in detail the multi-sensor system of the two "DO228" oil spill surveillance aircraft. As a long-range sensor for the localisation of a possible oil spill serves a side looking airborne radar (SLAR). The data of the extended near-range sensor system consisting of IR/UV scanner, microwave radiometer, laserfluorosensor and a camera system (e.g. FLIR) is processed by the on-board analysis to determine e.g. oil spill area, thickness, volume and type. Thus, also under adverse weather and light conditions detailed information can be provided for the support of oil spill combating.

Björn Baschek is a physicist who made his PhD in the field of radar remote sensing applied to meteorology. Since 2005 he is working at the German Federal Institute of Hydrology (BfG) within the Department Geoinformation and Remote Sensing. He is scientific advisor of the German oil spill surveillance project. This is including responsibility for the sensor system of the German surveillance aircraft as well as participation in the European satellite project MarCoast. He is member of the European Group of Experts on Satellite Monitoring and Assessment of Sea-based Oil Pollution (EGEMP).

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Speaker Bios

John H. Bradford

Center for Geophysical Investigation of the Shallow Subsurface
Boise State University - Boise, ID

Co-authors: Leah Steinbronn, Lee Liberty (Boise State), David Dickins (D.F. Dickins Associates Ltd.), Per Johan Brandvik (SINTEF)

Since 2004, we have undertaken a series of laboratory and field experiments to test hardware and develop analysis tools for the purpose of detecting crude oil spills on, within, and beneath sea ice using ground-penetrating radar (GPR). Notably, the experiments include 1) a set of small spills (49 - 188 l) within and beneath laboratory grown urea ice (~ 35 cm thick) conducted at the US Army's Cold Regions Research and Engineering Laboratory, and 2) a contained spill (3,400 l) under natural sea ice (~65 cm thick) conducted in the Svalbard Archipelago. In all cases, we successfully identified the location and spatial distribution of the majority of spilled oil. Oil film thicknesses under natural sea ice may vary from a few mm to 20 cm or more. GPR wavelengths at 500 MHz are on the order of 30 cm, therefore the target layers are typically less than the signal wavelength, placing the detection of oil films in the realm of thin bed analysis. When the thickness of a reflecting layer is less than the signal wavelength, the recorded waveform is actually the result of interference of waves reflected from the top and bottom of the layer. This interference causes amplitude, phase and frequency anomalies whose form depends on the thickness of the layers and the contrast in electric properties at the boundaries. Detecting oil films depends on differentiating the waveform anomalies from the background response. Our experimental results suggest that GPR coupled with thin bed analysis can be a valuable component of spill characterization and clean up. Ongoing work includes an extensive modeling effort to understand GPR response varying conditions such as ice and oil thicknesses, ice salinity and temperature.

John Bradford received BS (1994) degrees in both Physics and Engineering Physics from the University of Kansas and a PhD (1999) in geophysics at Rice University. From 1999 to 2001 he worked as a research scientist at the University of Wyoming. He is currently Director and Assistant Professor of Geophysics at the Center for Geophysical Investigation of the Shallow Subsurface at

Boise State University. His research interests include numerical modeling, imaging, and attribute analysis of wave-propagation based geophysical data.

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Speaker Bios

Per Johan Brandvik

SINTEF Marine Environmental Technology, Trondheim, Norway

The knowledge regarding weathering processes in Arctic oil spills with presence of ice is limited. Experimental studies have been performed in laboratories, but only to a limited degree in the field. This paper summarizes and compares results from field and laboratory experiments performed in North America and Norway from the mid seventies until today, with focus on the experience from newer experiments. Status and results from several ongoing projects will also be presented.

Several weathering properties for the oil spill in broken ice are strongly influenced by the low temperature, reduced oil spreading and reduced wave action caused by the high ice coverage. Reduced water uptake, viscosity, evaporation and pour point could extend the operational time window for several contingency methods compared to oil spills in open waters. This could open up for dispersant treatment and in-situ burning even after an extended period of weathering for an oil spill in broken ice.

The main author Dr. Brandvik has worked at SINTEF in Norway as a Research Scientist focusing on weathering processes in marine oil spills and their influence on operational oil spill contingency for over 20 years. In recent years he has especially focused on oil weathering and field experiments in Arctic areas. He has also worked as a associate professor at the Norwegian University of Science and Technology (NTNU) in Trondheim and presently holds an adjunct position at the University Center at Svalbard (UNIS).

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Speaker Bios

Dr. Lawson Brigham

Deputy Director US Arctic Research Commmission &
Alaska Office Director, Anchorage

Arctic sea ice is undergoing an extraordinary transformation that is creating a much more accessible Arctic Ocean. We are also witnessing new marine uses of the Arctic Ocean including expanded natural resource development, tourism, fishing and marine research. All of these uses will have profound implications for the Arctic and its indigenous communities. In addition, the current governance of the Arctic Ocean is complex and a patchwork of regulations and regimes implemented by each of the five nations surrounding the Central Arctic Ocean. In response to these factors, the Arctic Council has called for a comprehensive Arctic Marine Shipping Assessment (AMSA) under the Council's Protection of the Arctic Marine Environment Working Group (PAME). Canada, Finland, and the United States are the Lead Countries for AMSA. Ongoing are a data survey (to determine an estimated total number of ships in the Arctic Ocean for a given calendar year); development of scenarios or plausible futures to 2050; town hall meetings in Arctic communities; a review of the history & governance of Arctic marine transport; and, reviews on the social, environmental & economic impacts of expanded Arctic marine activity throughout the Arctic Ocean.

Dr. Lawson Brigham is Deputy Director & Alaska Office Director of the U.S. Arctic Research Commission in Anchorage. He is currently Chair of the Arctic Marine Shipping Assessment of the Arctic Council, an intergovernmental forum of the eight Arctic nations. A career U.S. Coast Guard officer he sailed aboard icebreakers on the Great Lakes and on expeditions to the Arctic and Antarctic. He has served as a researcher at Woods Hole Oceanographic Institution and the U.S. Naval War College, and as a faculty member of the Naval Postgraduate School in the Office of Naval Research Chair in Arctic Marine Science. Captain Brigham received his PhD in polar oceanography from Cambridge University in the United Kingdom and has spent more than three decades on research related to the Russian Arctic, ice navigation, and satellite remote sensing of the polar regions.

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Speaker Bios

Rear Admiral Arthur E. Brooks

Commander, Seventeenth Coast Guard District

Rear Admiral Brooks was commissioned as an Ensign upon graduation from the United States Coast Guard Academy in 1974. His first duty assignment was aboard the Coast Guard Cutter DEPENDABLE (WMEC 626), Panama City, Fla. where he served as Student Engineer and Deck Watch Officer. In addition to his Bachelor of Science degree from the U. S. Coast Guard Academy, he holds a Juris Doctor degree from the Marshall-Wythe School of Law, College of William & Mary, Williamsburg, Virginia. He was the Coast Guard Fellow in the Department of State's 39th Senior Seminar, National Foreign Affairs Training Center, Arlington, Va. and is a graduate of the Harvard University, Kennedy School of Government Senior Executive National and International Security Program.

Rear Admiral Brooks has served in a variety of surface operations, legal, command and staff assignments. Other afloat tours included Commanding Officer, USCGC POINT HARRIS (WPB 82376) in both Bodega Bay, Calif., and Apra Harbor, Guam, Mariana Islands; Executive Officer, USCGC CONFIDENCE (WMEC 619), Cape Canaveral, Fla.; and Commanding Officer, USCGC SENECA (WMEC 906), Boston Mass. Ashore tours included the Fifth CG District Operations Center, Portsmouth, Va.; Assistant Staff Legal Officer, Eleventh CG District, Long Beach, Calif.; Head, Department of Professional Development, U. S. Coast Guard Academy, New London, Conn.; Staff Legal Officer, U. S. Coast Guard Academy; Commandant of Cadets, Coast Guard Academy; Commander, Coast Guard Greater Antilles Section, San Juan, Puerto Rico; and Chief of Staff, Coast Guard Atlantic Area, Portsmouth, Va.

Rear Admiral Brooks' awards include three Legions of Merit, the Meritorious Service Medal with Operational Distinguishing Device, three Coast Guard Commendation Medals, Coast Guard Achievement Medal, and Commandant's Letter of Commendation Ribbon, three National Defense Service Medals, three Humanitarian Service Medals, three Coast Guard Sea Service Ribbons, Expert Rifleman Ribbon, and Pistol Expert Ribbon.

Speaker Bios

Ian Buist

SL Ross Environmental Research Ltd.
Ottawa, Ontario Canada

In situ burning is one of the few practical options for removing oil spilled in ice-covered waters. In many instances in situ burning, combined with surveillance and monitoring, may be the only response possible. As with all countermeasures in any environment, the suitability of burning a particular spill depends on the characteristics of the spilled oil and how the oil behaves in the particular ice conditions. There is an extensive body of knowledge concerning in situ burning of oil in ice situations, beginning with laboratory, tank and field studies in the mid-1970s in support of drilling in the Canadian Beaufort Sea. In situ burning research has been conducted primarily in Canada, Norway and the United States. This paper serves as a review of the subject, focusing on recent research results, summarizing the following topics:

- The basic requirements and processes involved with in situ burning;
- Trade-offs associated with burning in ice-covered waters;
- How oil spill behavior in various ice conditions controls in situ burning;
- The application of burning in various ice situations;
- In situ burning of oil spills in snow.

Ian Buist is one of Canada's leading experts on oil spill behavior and countermeasures and an acknowledged authority on in situ burning. For four years he was chief research engineer for Dome Petroleum Ltd. on oil spill prevention and control for their Beaufort Sea program. In this capacity Mr. Buist was involved in the development of several novel oil spill countermeasures techniques including air-deployable igniters, incinerators and fire resistant booms. He was also manager for several field experiments of oil spill behavior and countermeasures in the Beaufort Sea. Since joining SL Ross in 1983, Mr. Buist has developed oil recovery concepts for use in ice conditions, researched the use of chemicals to enhance spill control, analyzed the response needs of drilling and production operations in the Atlantic, Pacific and Arctic oceans, conducted numerous experiments to predict the behavior of various crude oils and study alternative countermeasures, and performed field and tank trials to evaluate oil spill behavior and response in open water and ice conditions.

Over the past twenty years Mr. Buist has been heavily involved in various projects related to in situ burning, and continues to be regarded as one of the world's leading authorities on the subject. Another of Mr. Buist's special areas of expertise is the mathematical modeling of oil spill processes. He has developed algoritms to describe oil spill behavior (spreading, dissolution, dispersion and emulsification), and in situ burning (of both slicks and surface blowout plumes).

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Speaker Bios

Ian Buist

SL Ross Environmental Research Ltd.
Ottawa, Ontario Canada

In situ burning is an oil spill response option particularly suited to remote ice-covered waters. The key to effective in situ burning is thick oil slicks. Concentrated pack ice can enable in situ burning by keeping slicks thick. In loose pack ice conditions oil spills can rapidly spread to become too thin to ignite. Fire booms can collect and keep slicks thick in open water; however, even light ice conditions make using booms challenging. A joint industry group recently completed a multi-year study to evaluate oil-herding surfactants as an alternative to booms for thickening slicks in light ice conditions to facilitate in situ burning.

Small-scale laboratory experiments were completed in 2004 and 2005 to examine the concept of using herding agents to thicken oil slicks among loose pack ice for the purpose of in situ burning. The encouraging results of the preliminary experiments prompted further meso-scale testing at the US Army Cold Regions Research and Engineering Laboratory (CRREL), the Ohmsett facility, and the Fire Training Grounds in Prudhoe Bay, AK.

The non-proprietary cold-water herder formulation used in these experiments proved effective in significantly contracting oil slicks in brash and slush ice concentrations of up to 70% ice coverage. Slicks in excess of 3 mm thick, the minimum required for ignition of weathered crude oil on water, were routinely achieved.

Slicks that were too thin to be ignited after spreading to equilibrium were thickened by applying herder, ignited, and burned equally well in both brash and slush ice conditions at air temperatures as low as -17 °C. The burn efficiencies measured for the herded slicks were only slightly less than the theoretical maximums achievable for equivalent-sized, mechanically contained slicks on open water.

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Speaker Bios

Hajo Eicken

University of Alaska Fairbanks

The Beaufort Sea ice cover exhibits a distinct zonation. Landfast ice lines the entire coastline during the ice season. Grounded ridges along the outer edge stabilize the landfast ice and separate it from recurring leads in the flaw zone. In recent years, Beaufort Sea ice has substantial thinned, with a northward retreat of the summer minimum ice edge. The ice regime of the coast and inner shelf has changed in a more complex fashion, with later freeze-up and higher winter temperatures. Maximum landfast ice extent has not changed significantly, but winter break-out events are increasingly common.

The presentation will conclude with a discussion of implications for oil-spill scenarios. Remote-sensing data reveals substantial local variations in key variables, such as onset of stable ice or break-up, with Prudhoe Bay exhibiting a particularly long, stable landfast ice season. There is some evidence that the deformation regime of the flaw zone and ice-seafloor interaction have changed over the past few decades. At the same time, multiyear ice occurrence in inshore waters has decreased significantly, although incursions of multiyear ice from the Northeast during the winter are still quite common.

Hajo Eicken is Professor of Geophysics at the University of Alaska Fairbanks (UAF). Before joining UAF, he was a senior scientist at the Alfred Wegener Institute where he led the research group for sea ice physics and remote sensing. Dr. Eicken's research interests include studies of the growth, evolution, and properties of sea ice in the Arctic and Antarctic. He is particularly interested in determining how microscopic and macroscopic properties affect larger-scale sea-ice processes and its role in the climate system. Dr. Eicken is serving on a number of scientific and technical committees. Currently he is heading an effort at UAF to enhance use of scientific data by a range of different stakeholders at the local and international level during the course of the International Polar Year.

Beautfort Sea-Ice Zones & Implications for Spill Scenarios

Hajo Eicken
Geophysical Institute
University of Alaska Fairbanks,
hajo.eicken@gi.alaska.edu

- Introduction: Zonation & operational windows
- Landfast ice, pack ice and the flaw zone
- Implications for oil-spill scenarios
- Conclusions

Beaufort Sea-Ice Zones & Implications for Spill Scenarios

- ***Introduction: Zonation & operational windows***
- Landfast ice, pack ice and the flaw zone
- Implications for oil-spill scenarios
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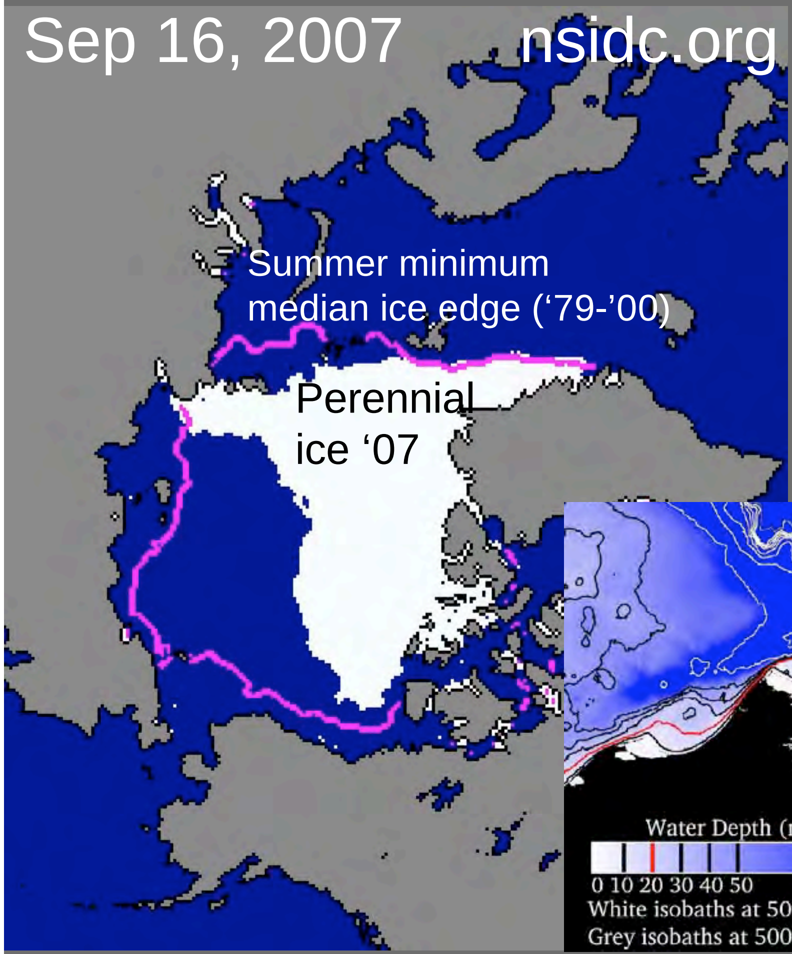
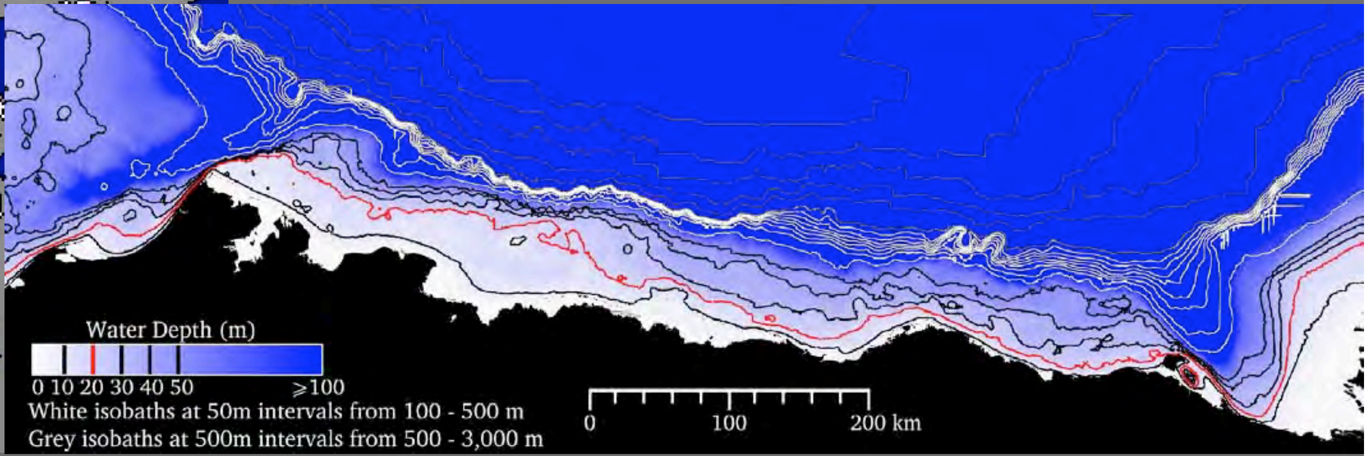
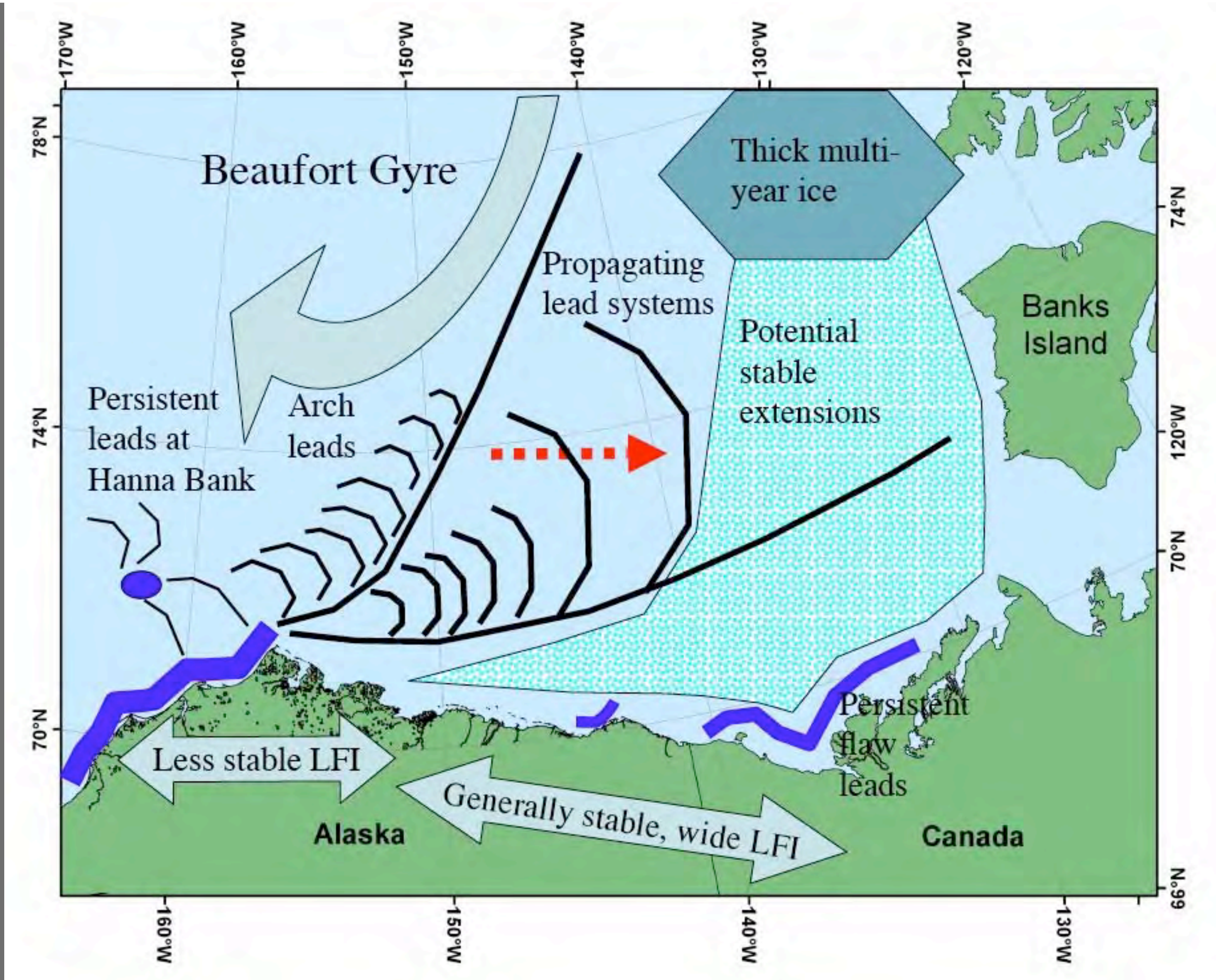
The Beaufort Sea ice cover in context

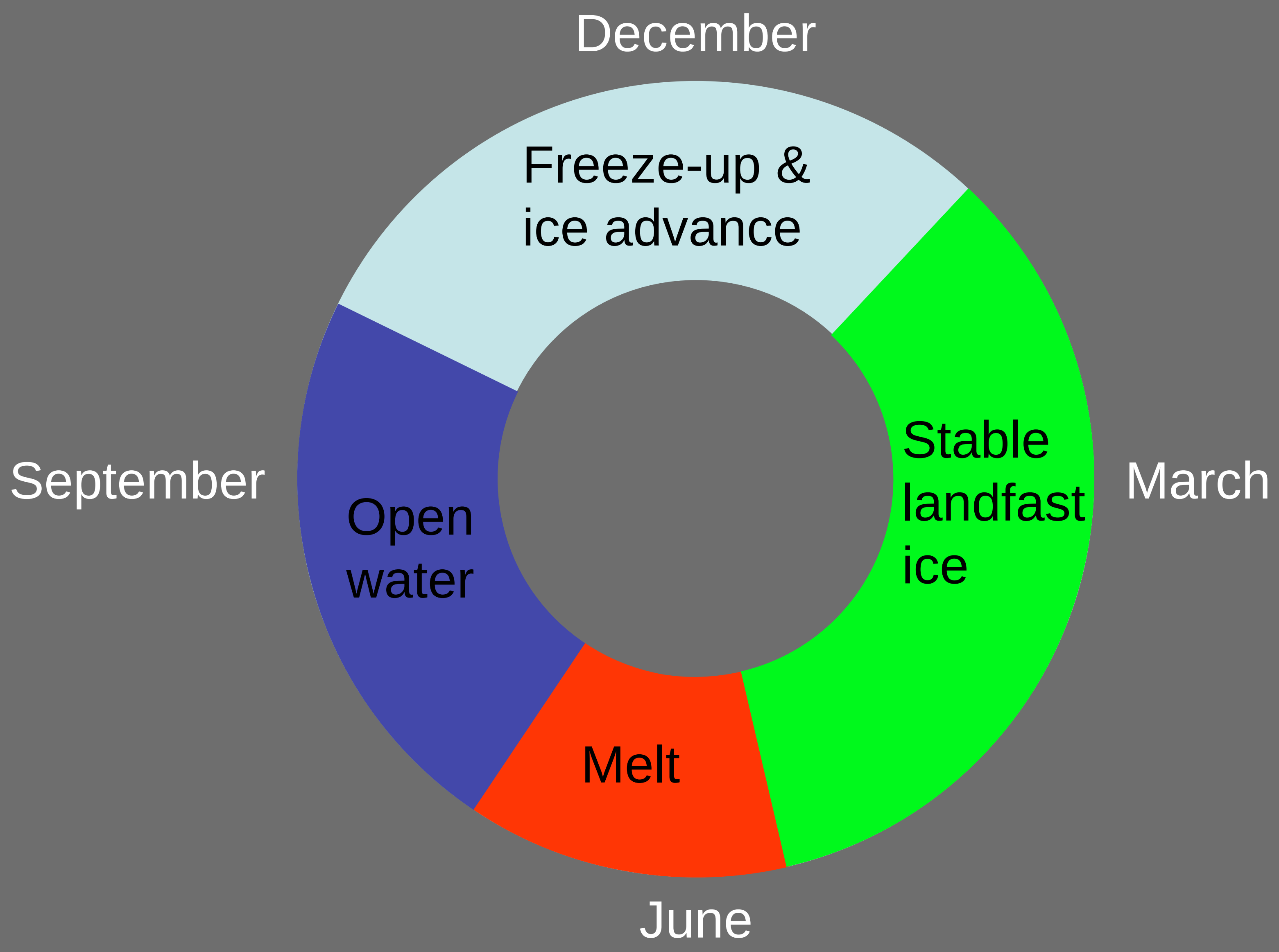


- Remote sensing and field based observations w/ support from MMS & NSF-IPY
- Source data from Mahoney, Cotter, Graves, Shapiro, Eicken (mms.gina.alaska.edu) & others as indicated

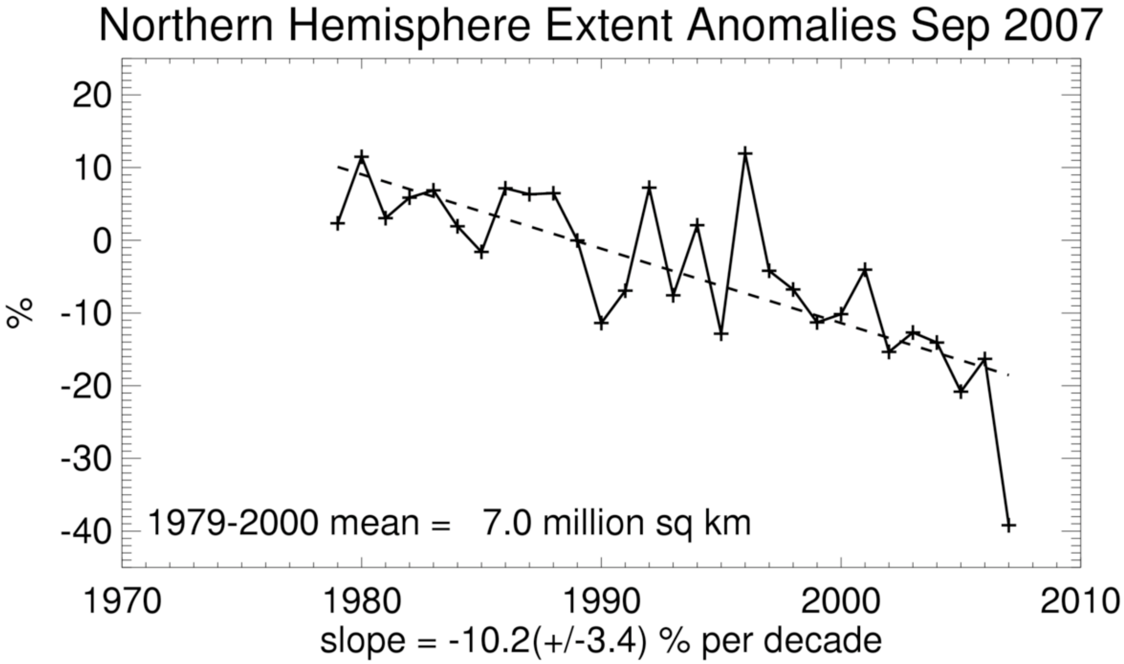



Beaufort Gyre
Thick multi-year ice
Propagating lead systems
Potential stable extensions
Banks Island
Persistent leads at Hanna Bank
Arch leads
Persistent flaw leads
Less stable LFI
Generally stable, wide LFI
Alaska
Canada
170°W
160°W
150°W
140°W
130°W
120°W
78°N
74°N
70°N
66°N

Annual sea-ice cycle & operational windows

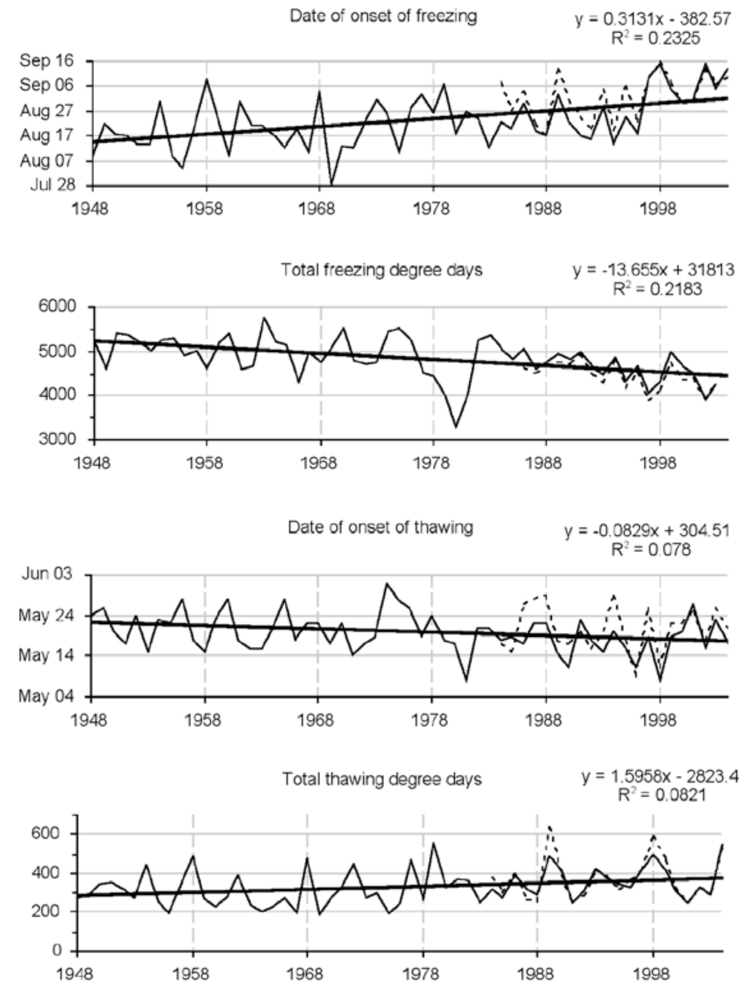


Minimum ice extent anomalies, onset of freezing/melt, freezing/thawing degree-days



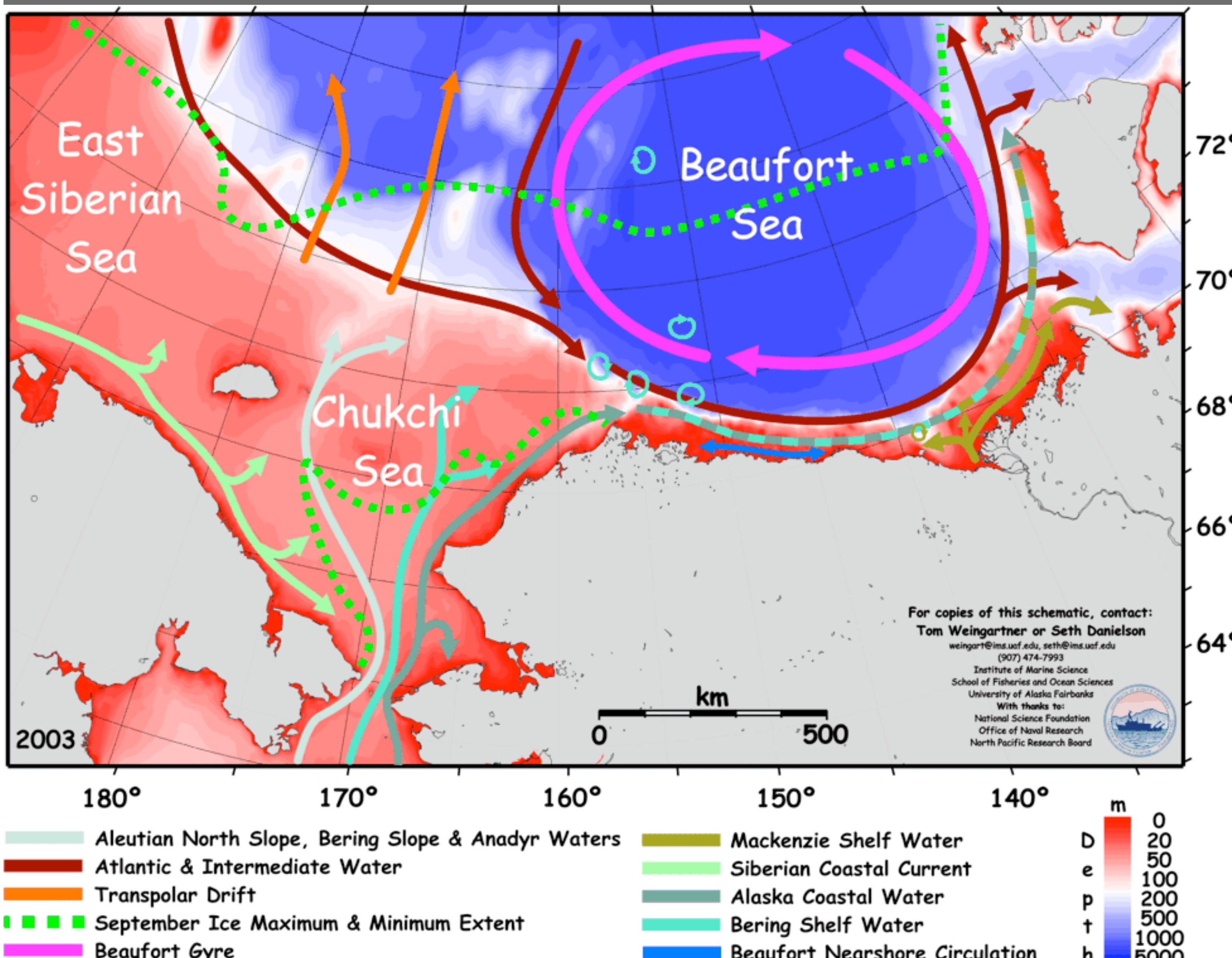
NSIDC (2007)

- Reduction in summer ice
- Beaufort/Chukchi: Earlier melt, reduced freezing degree-days



Mahoney et al. (2007)

The open water season

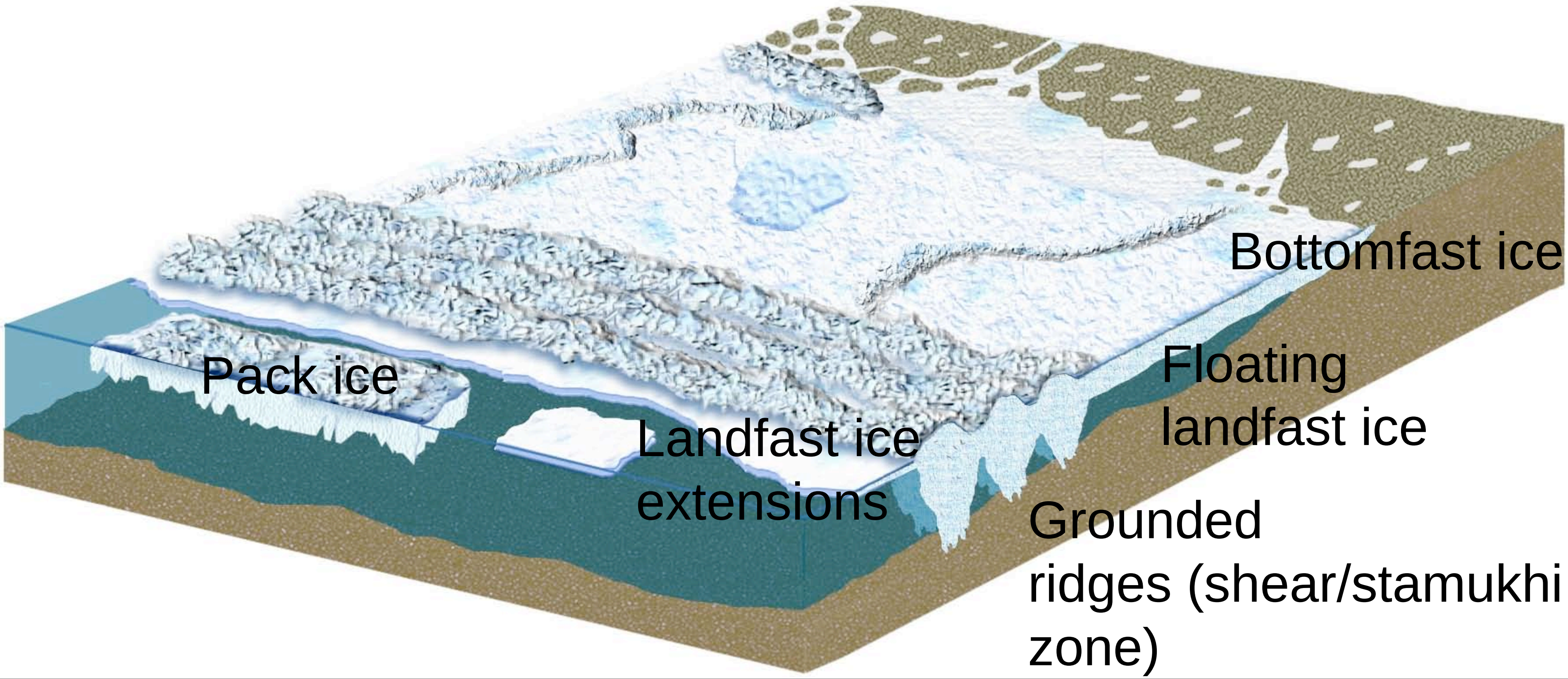


- Surface ocean circulation & potential open-water oil dispersal patterns (Weingartner & Danielson, www.ims.uaf.edu/beaufort/)
- Coastal current & nearshore circulation: Complicate ice drift & defor-mation patterns

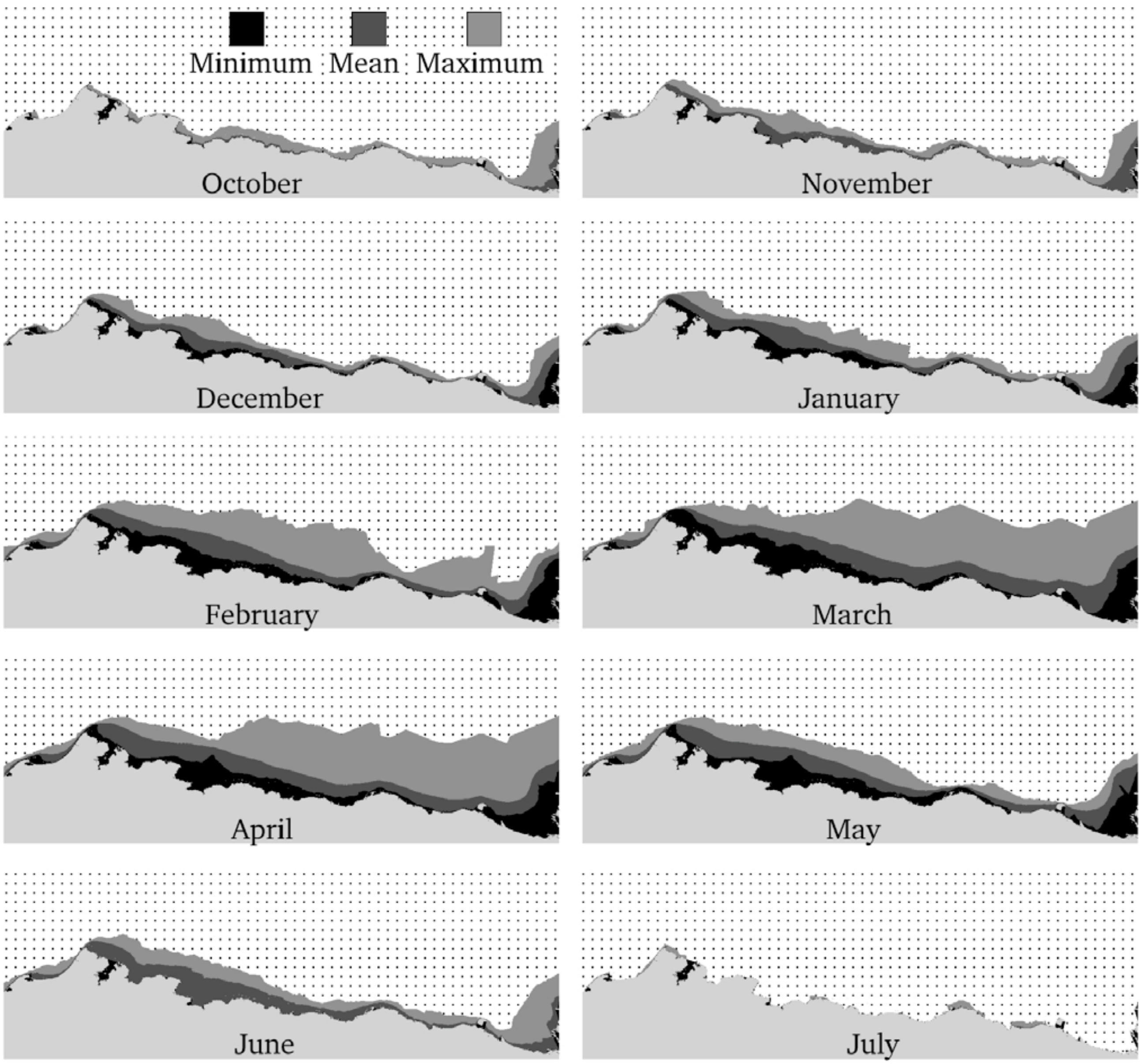
Beaufort Sea-Ice Zones
& Implications for Spill Scenarios

- Introduction: Zonation & operational windows
- ***Landfast ice, pack ice and the flaw zone***
- Implications for oil-spill scenarios
- Conclusions

Landfast ice zone



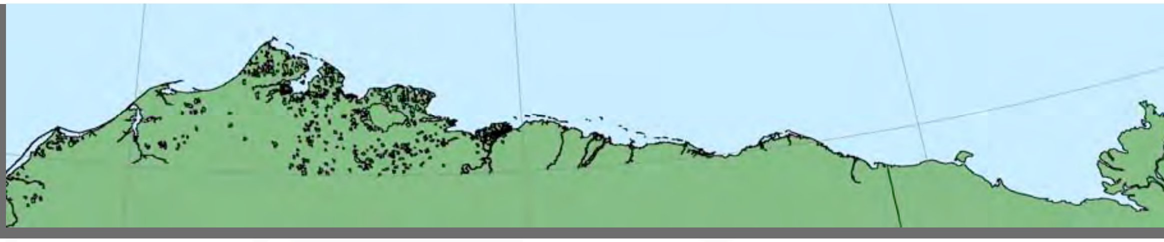
Seasonal cycle of landfast ice extent

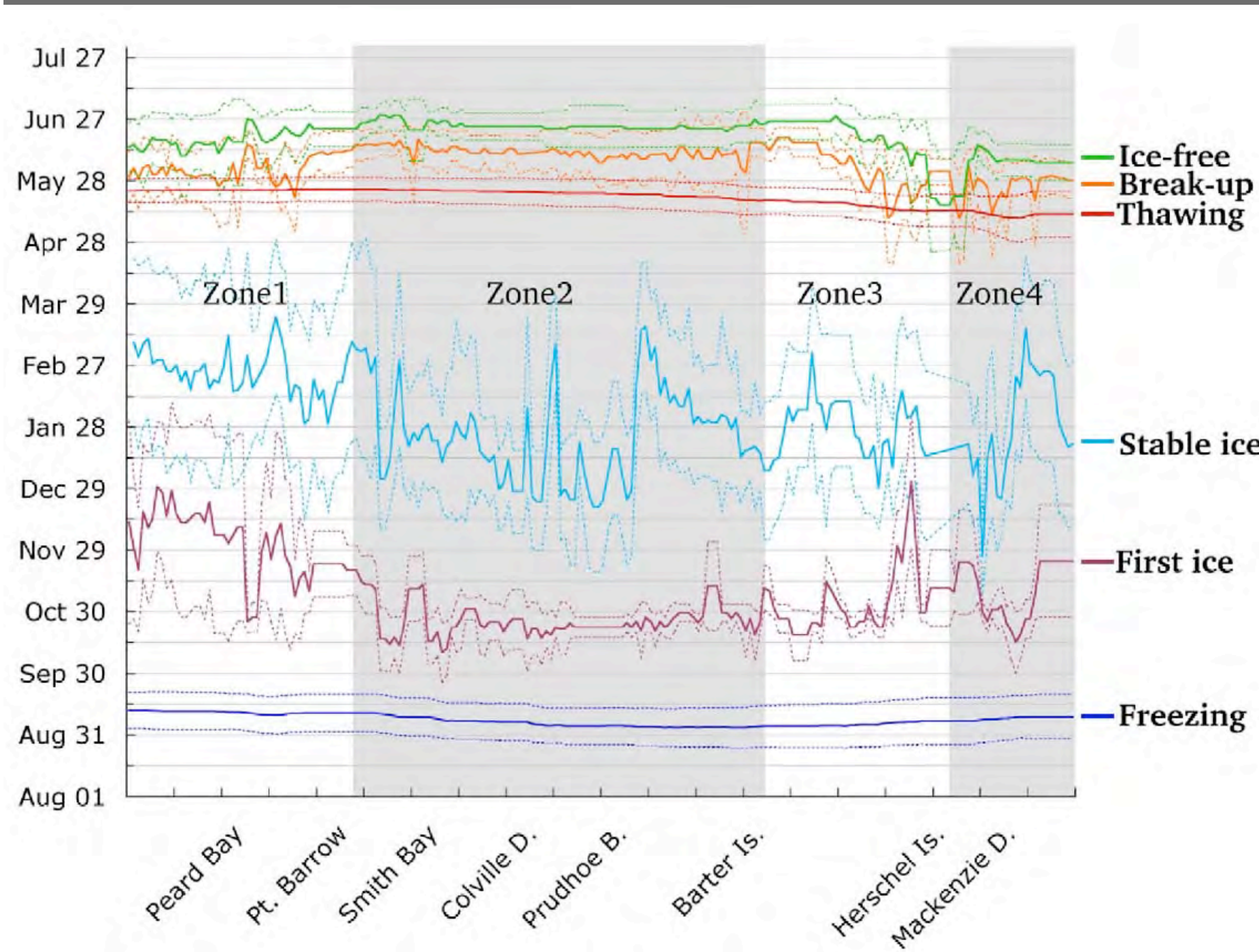


- Mean controlled by bathymetry
- Maximum controlled by pack/landfast ice interaction (stable extension)
- Minimum controlled by break-out events
- Iñupiaq ice experts: Break-outs much more frequent since early 1990s

		This study					Barry et al. (1979a)		
		Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**All zones**	**Central Chukchi**	**Central Beaufort**	
First Ice*	**Mean**	Dec 01	Oct 25	Nov 04	Nov 9	Nov 7	Early November	Mid October	**First continuous fast ice**
	σ’	31.8	9.6	11.4	17.5	16.4			
Stable Ice	**Mean**	Feb 23	Jan 22	Jan 28	Jan 27	Feb 01	Feb	Jan/Feb	**Stable ice inside of 15 m isobath**
	σ’	41.9	30.1	32.6	34.9	34.1			
Break up	**Mean**	Jun 04	Jun 11	Jun 04	May 26	Jun 06	Jun 10	Jun 30	**First openings and movement**
	σ’	13.9	14.2	13.7	12.6	14.6			
Ice Free	**Mean**	Jun 18	Jun 24	Jun 24	Jun 06	Jun 18	Jul 05	Aug 01	**Nearshore largely free of fast ice**
	σ’	12.7	8.4	12.6	10.2	10.4			

*1996-1998 omitted from analysis

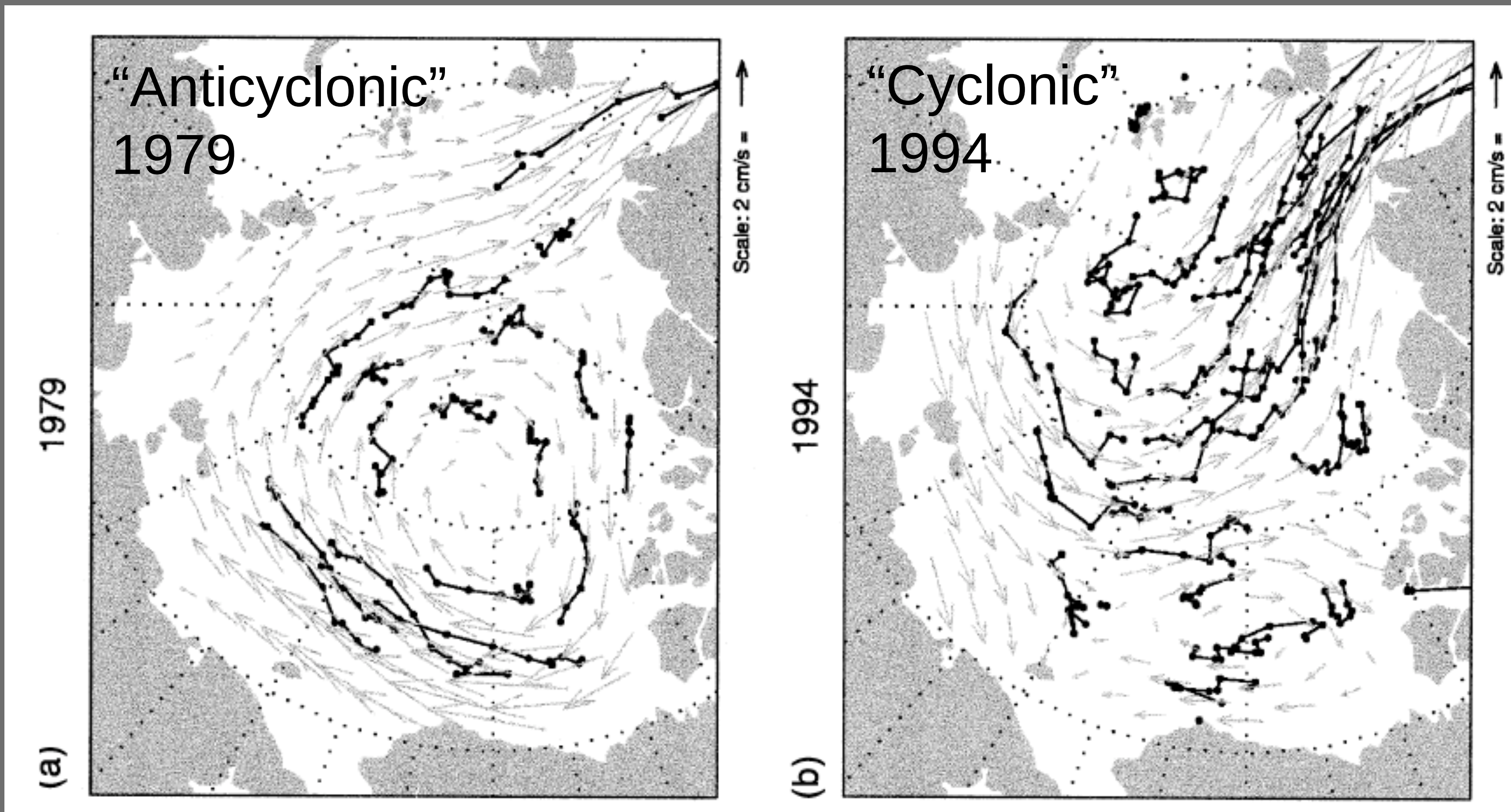




- Spatial and temporal variability in key seasonal events
- Early onset (e.g. Prudhoe Bay) vs. late onset (e.g., Point Barrow)
- Stable vs. variable ice regimes
- Importance of local conditions

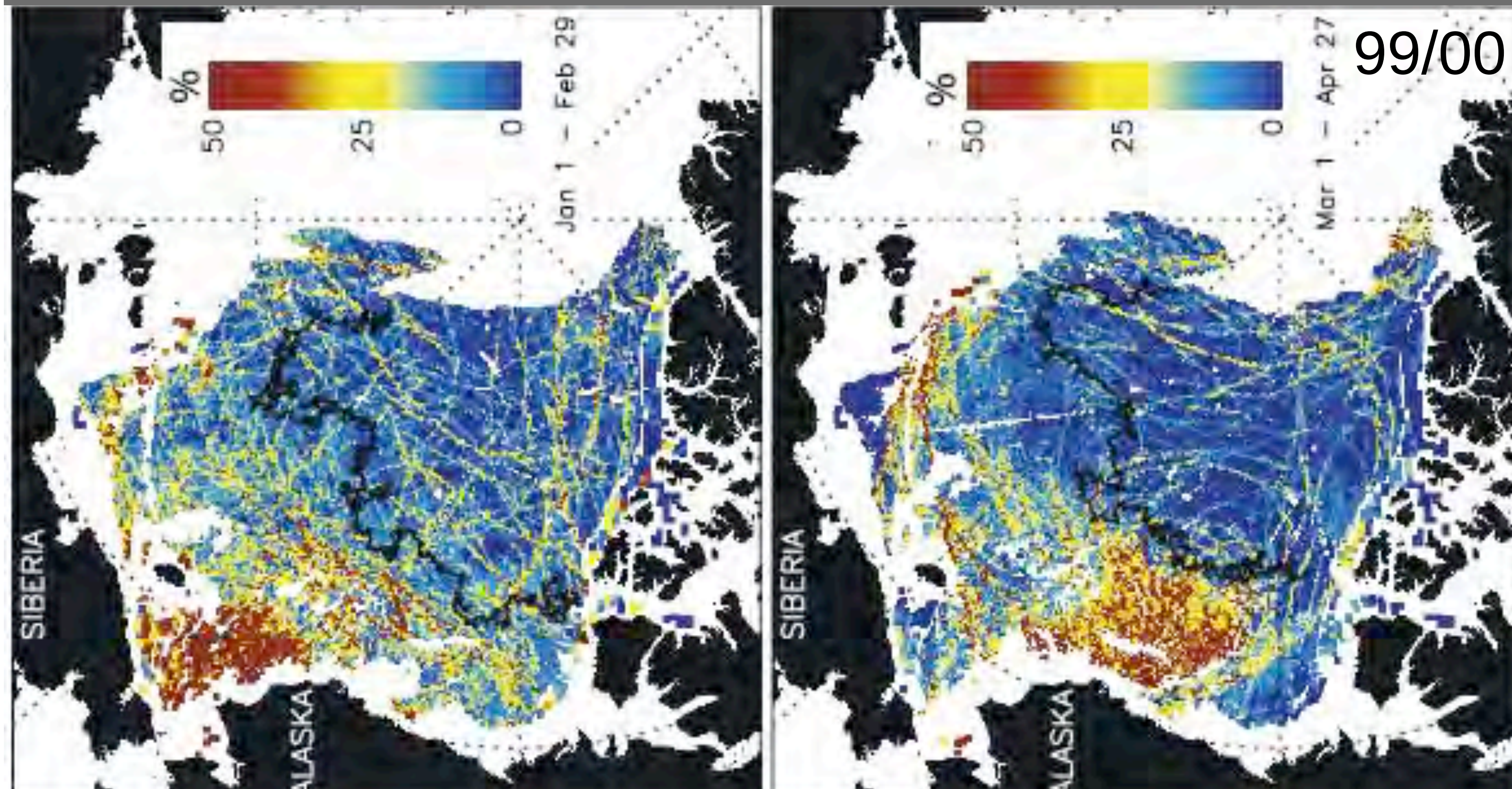
Pack-ice movement

- Lower atmospheric pressure favors "cyclonic" circulation:
  - Faster export of ice
  - Transpolar Drift expanded, Beaufort Gyre reduced in extent



Rigor et al. (2002)

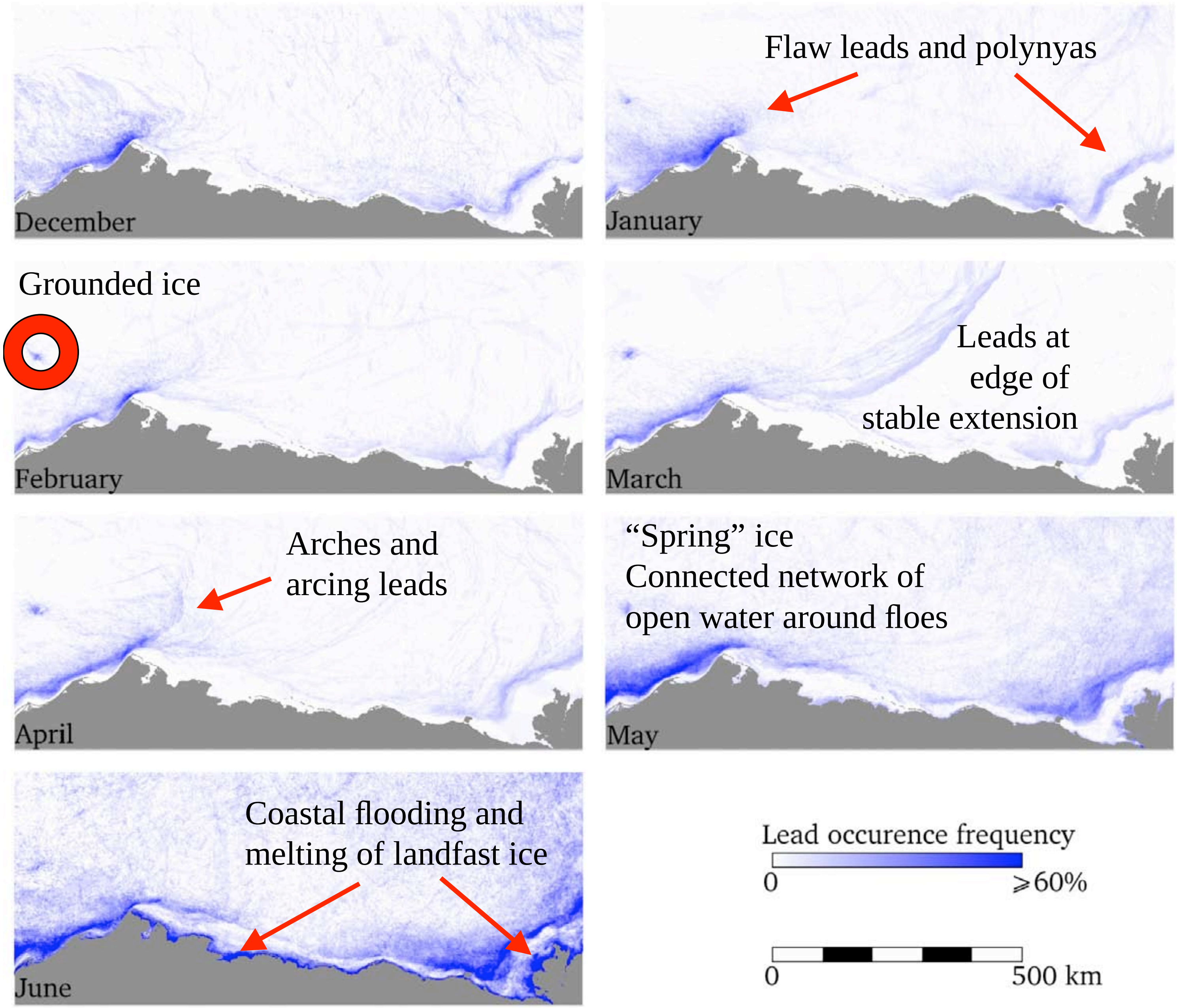
Divergence & shear between pack & landfast ice

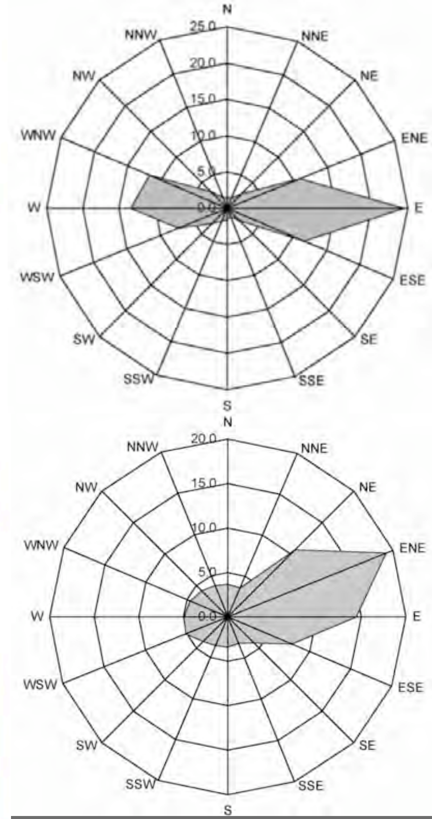


Kwok (2006)

- Time fraction that ice is “active”: div >0.02/day, shear >0.03/day
- Lack of data over shelves and in coastal regions

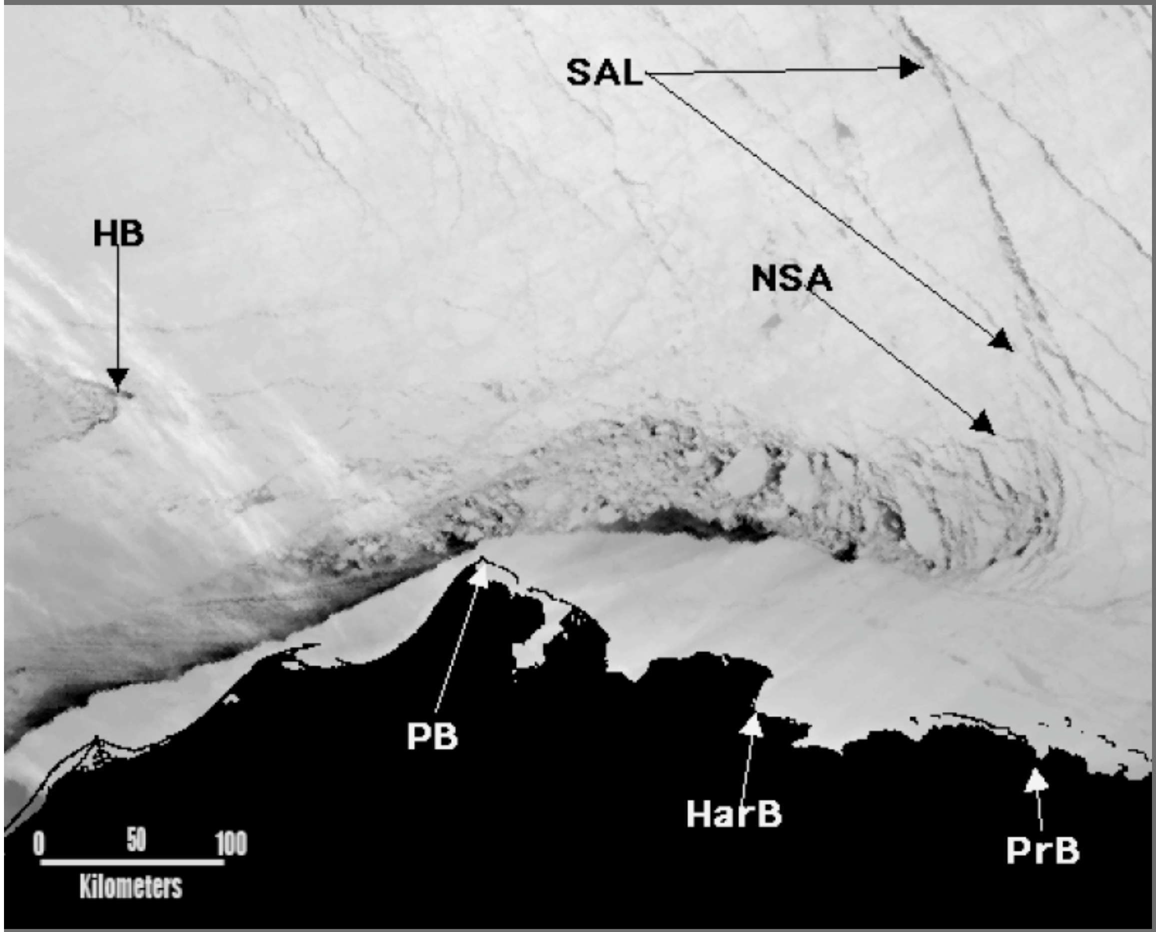
Lead occurrence patterns (1993-2004)





- Winds mostly from ENE (Barrow, 1971-2000) or E (Barter Island, 1971-1988)

The Flaw Zone

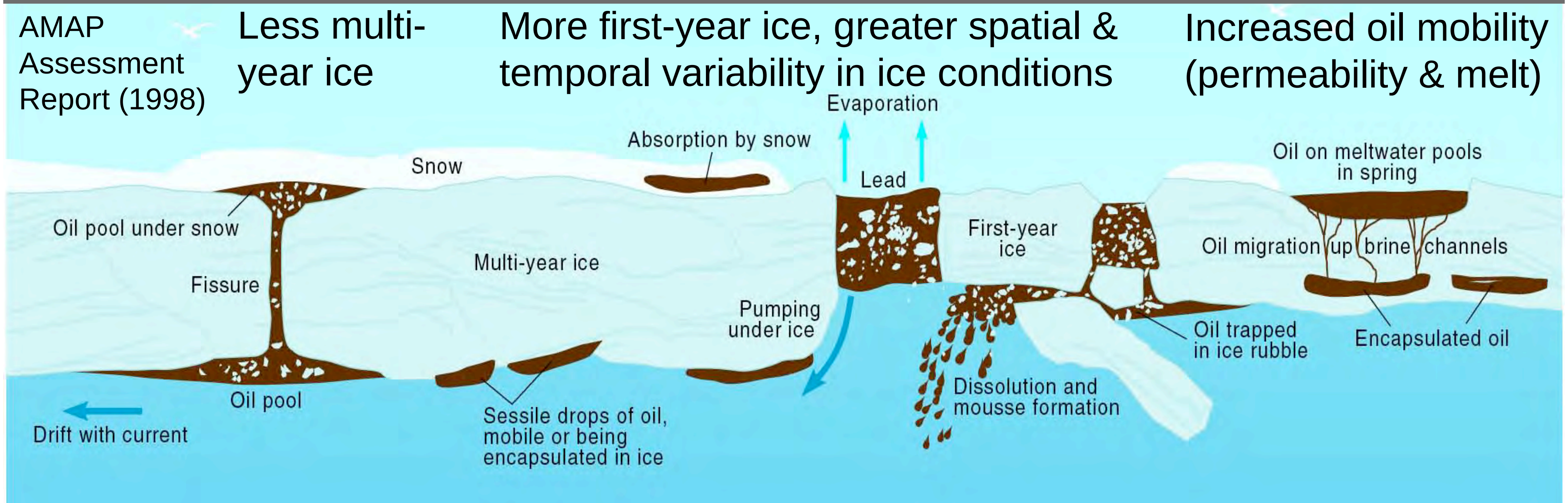


- Flaw zone:
  - few km to >100 km wide
  - Separates landfast from pack ice
  - Shear/rotation of floes, propagation of cracks
  - Few data on ice motion and deformation in flaw zone

Beaufort Sea-Ice Zones
& Implications for Spill Scenarios

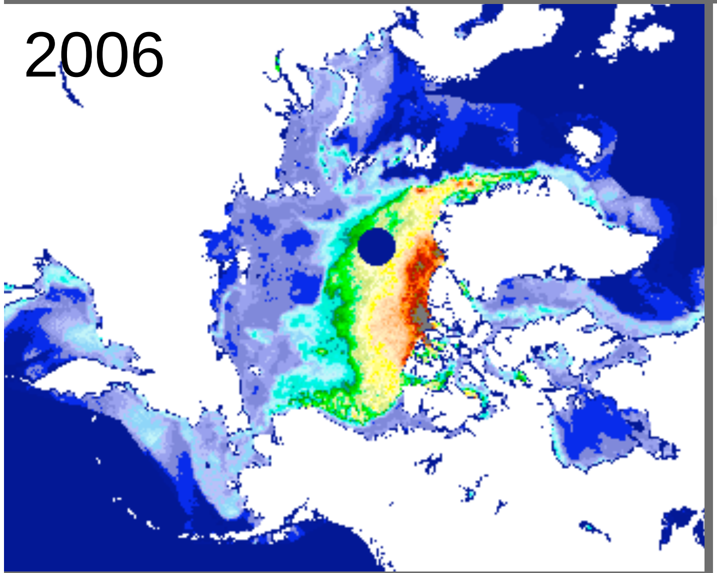
- Introduction: Zonation & operational windows
- Landfast ice, pack ice and the flaw zone
- ***Implications for oil-spill scenarios***
- Conclusions

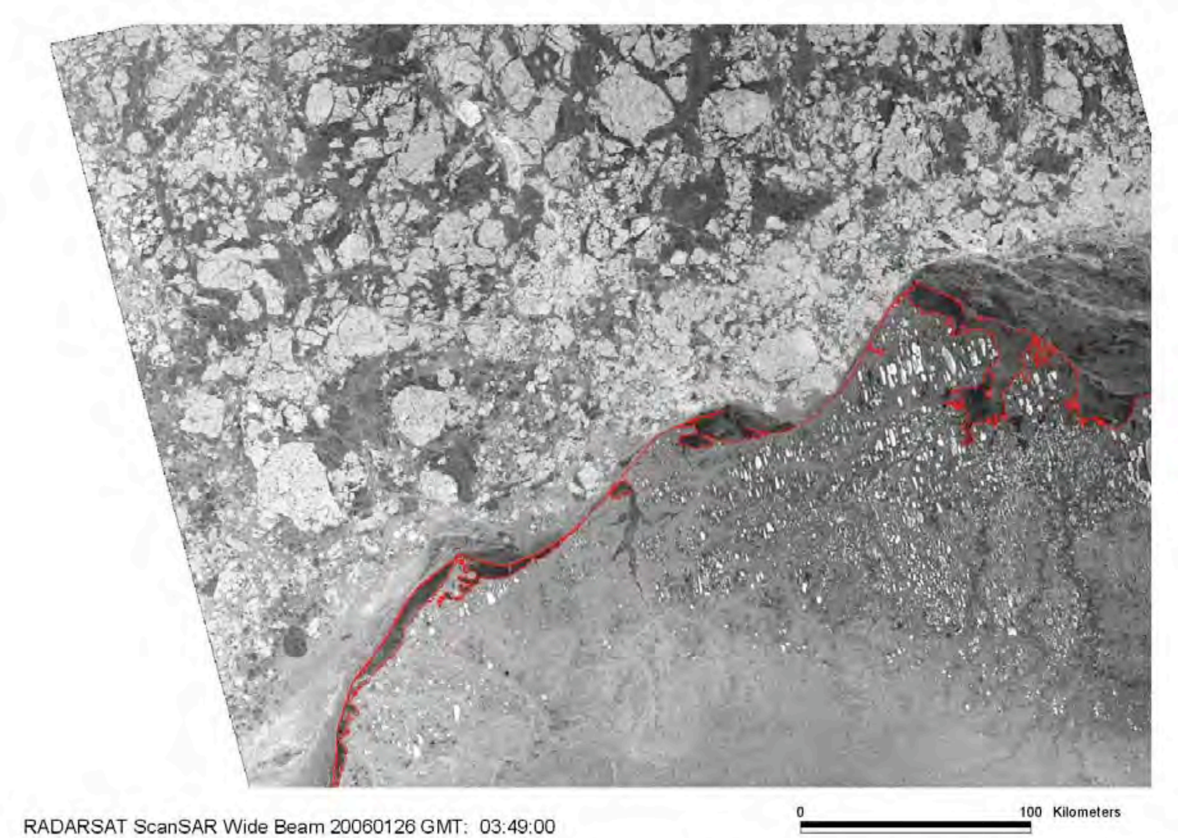
Movement & mobilization of oil in sea ice



- Release into open water and leads
- Trapping in rubble, rough ice & frazil (potential for sediment-oil interaction)
- Movement with drift ice vs. local confinement in landfast ice
- Upward percolation in spring: Earlier onset of warming & melt, more permeable ice cover?

Multi-year ice incursions

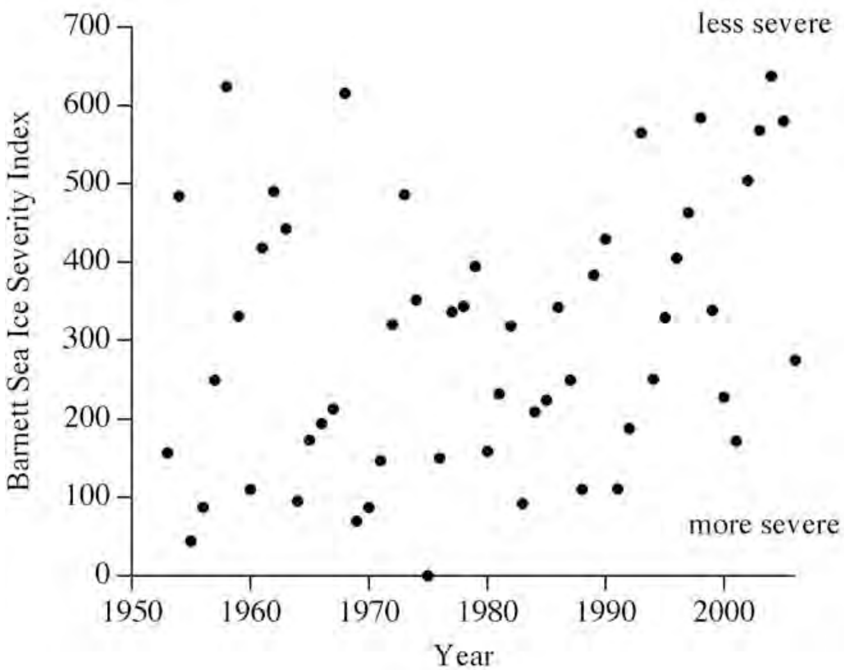


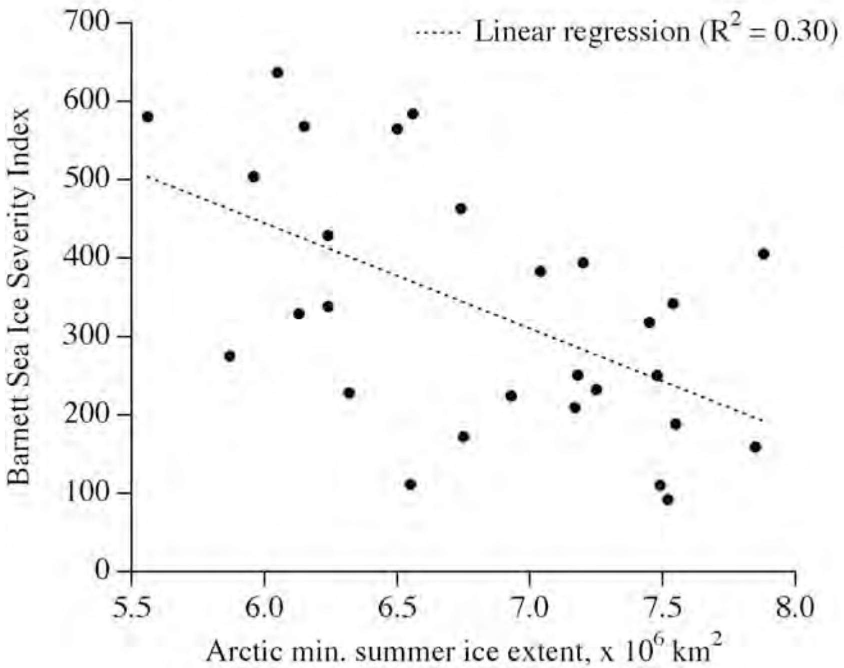


RADARSAT ScanSAR Wide Beam 20060126 GMT: 03:49:00

Source: Canadian Space Agency downlinked by the Alaska Satellite Facility. Processed by Allison Gaylord, Nuna Technologies.

- Reservoir of MY ice north of Canada: Delay of seasonal ice retreat, summer & winter ice hazard, variability in summer ice conditions over shelf

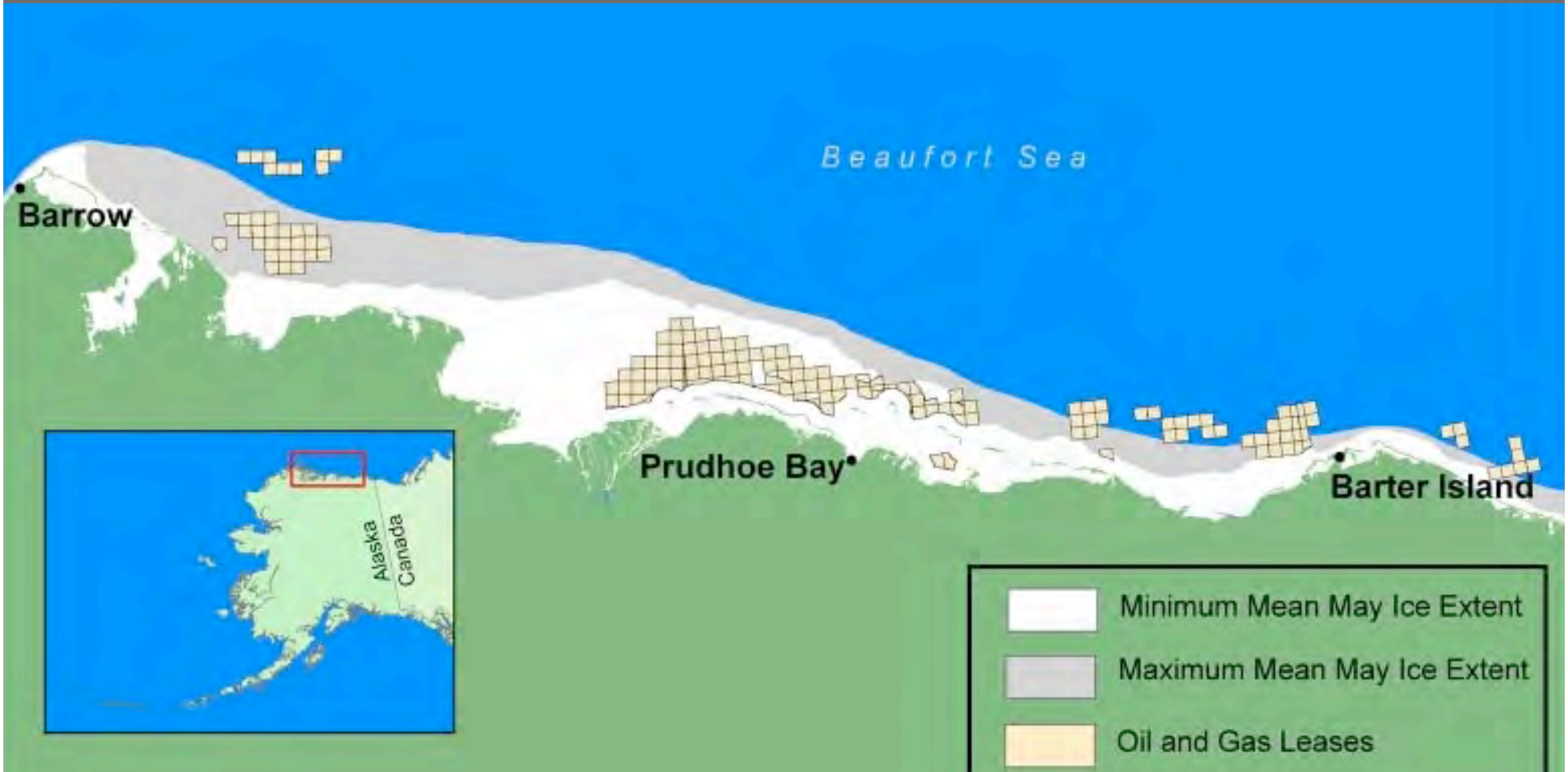




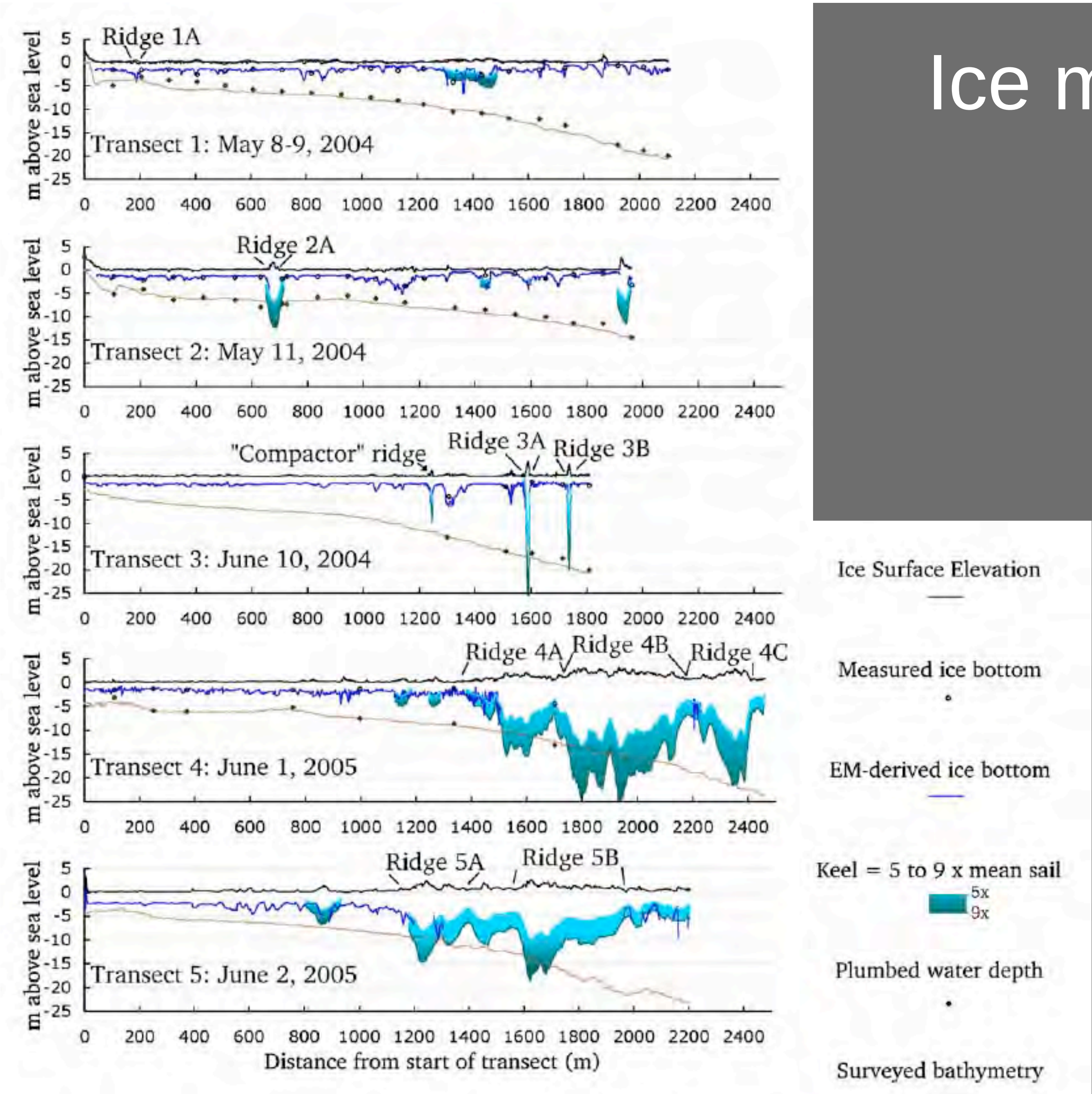
Summer ice variability: Regional ice regime vs. Arctic ice regime

- Length of Barrow-Prudhoe navigation season, severity of ice in coastal Chukchi-Beaufort Sea in August-September (computed by National Ice Center)
- Resolution/accuracy of remote sensing data
- Interannual & local variability
- Summer ice incursions

Lease areas in relation to ice conditions



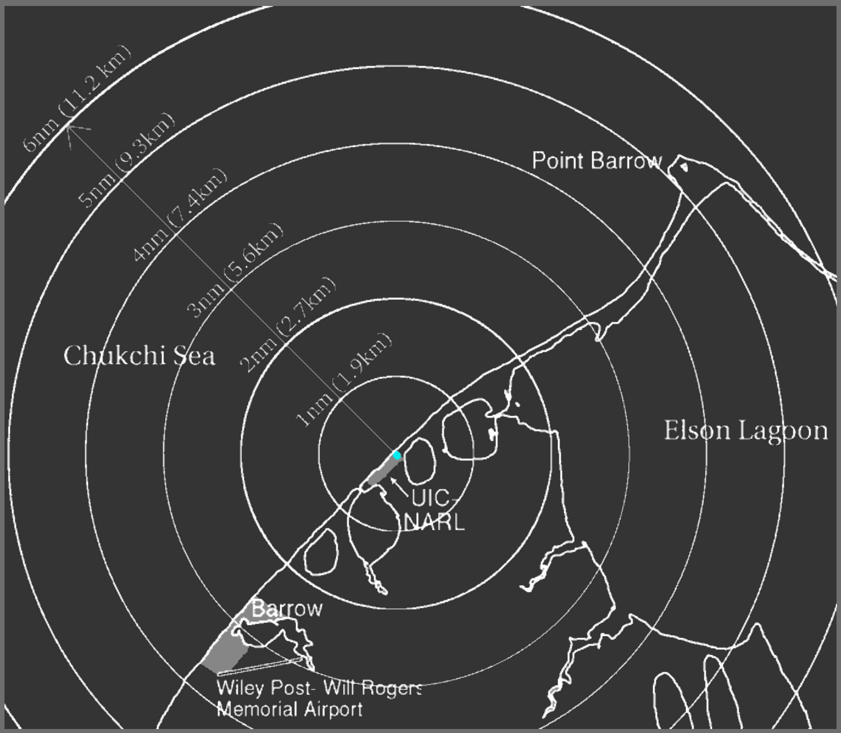
Lease sale data: MMS (2005)

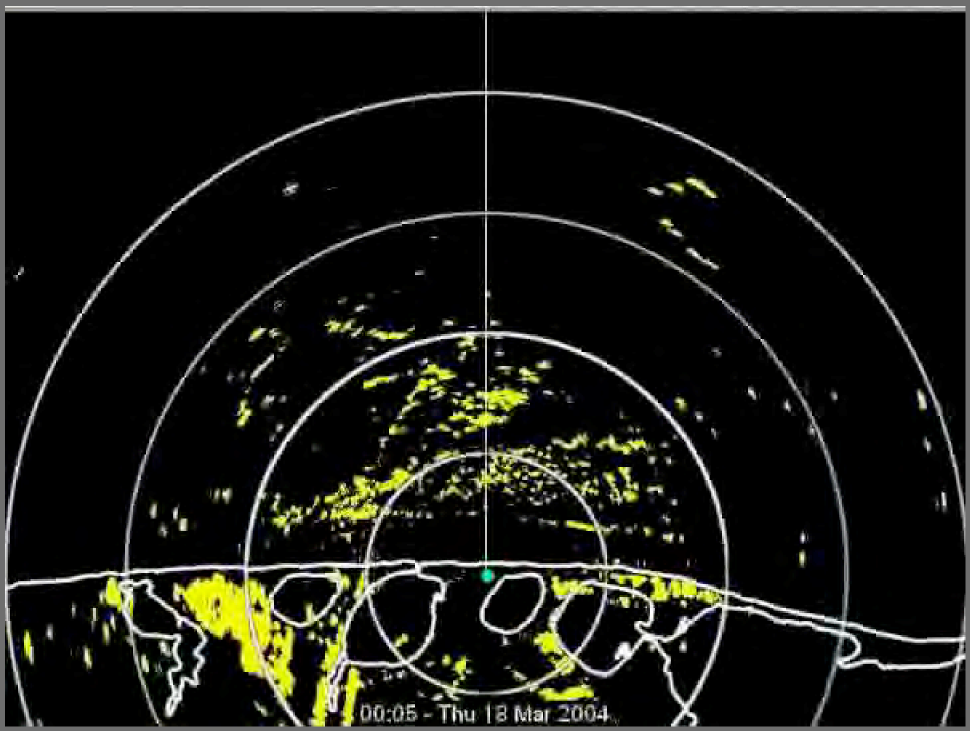


Ice morphology

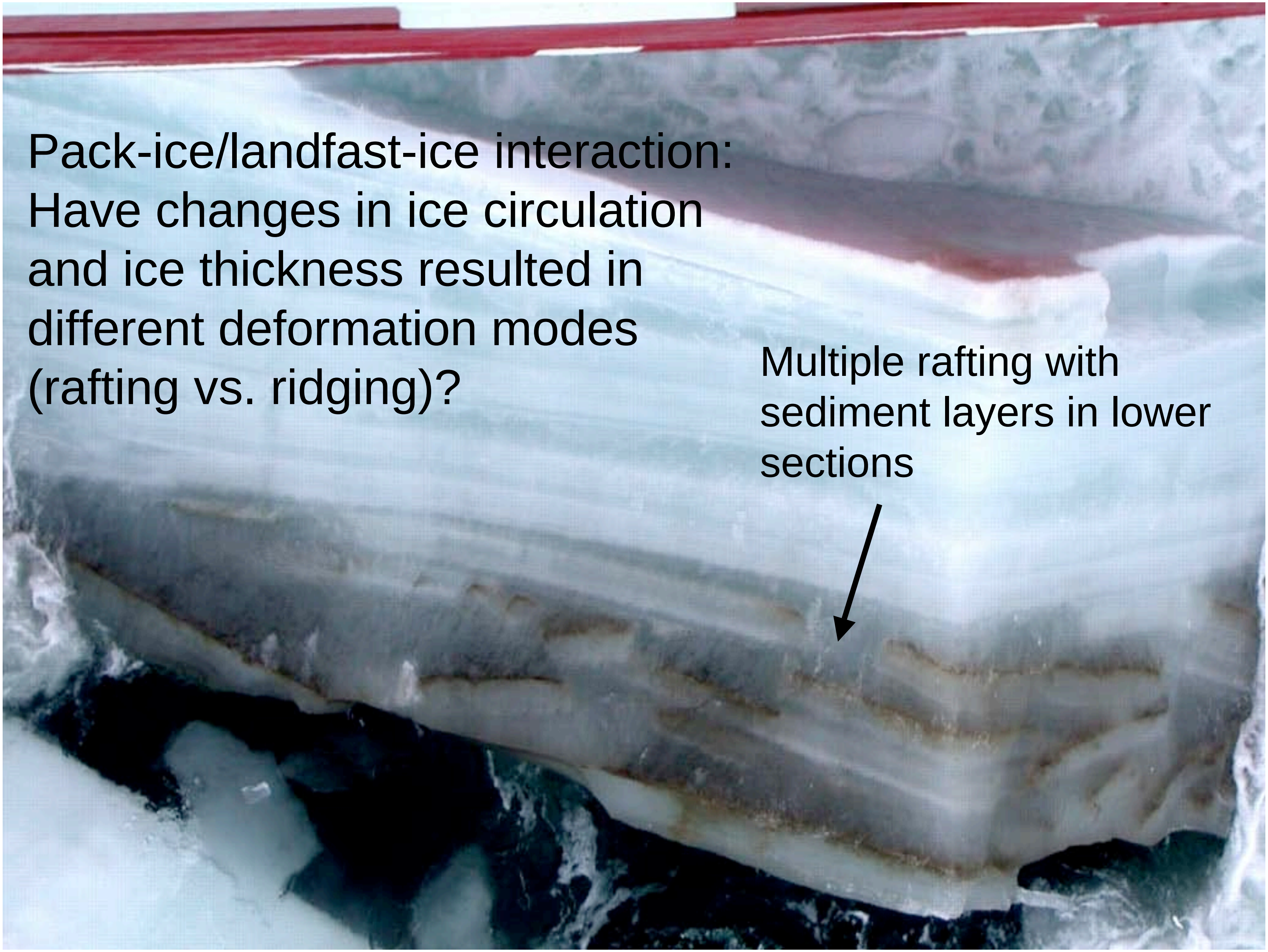
- Potential lack of grounded ridges as factor in reduced ice stability
- Impact of ice morphology on under-ice currents and potential oil dispersal

Dynamics of the flaw zone

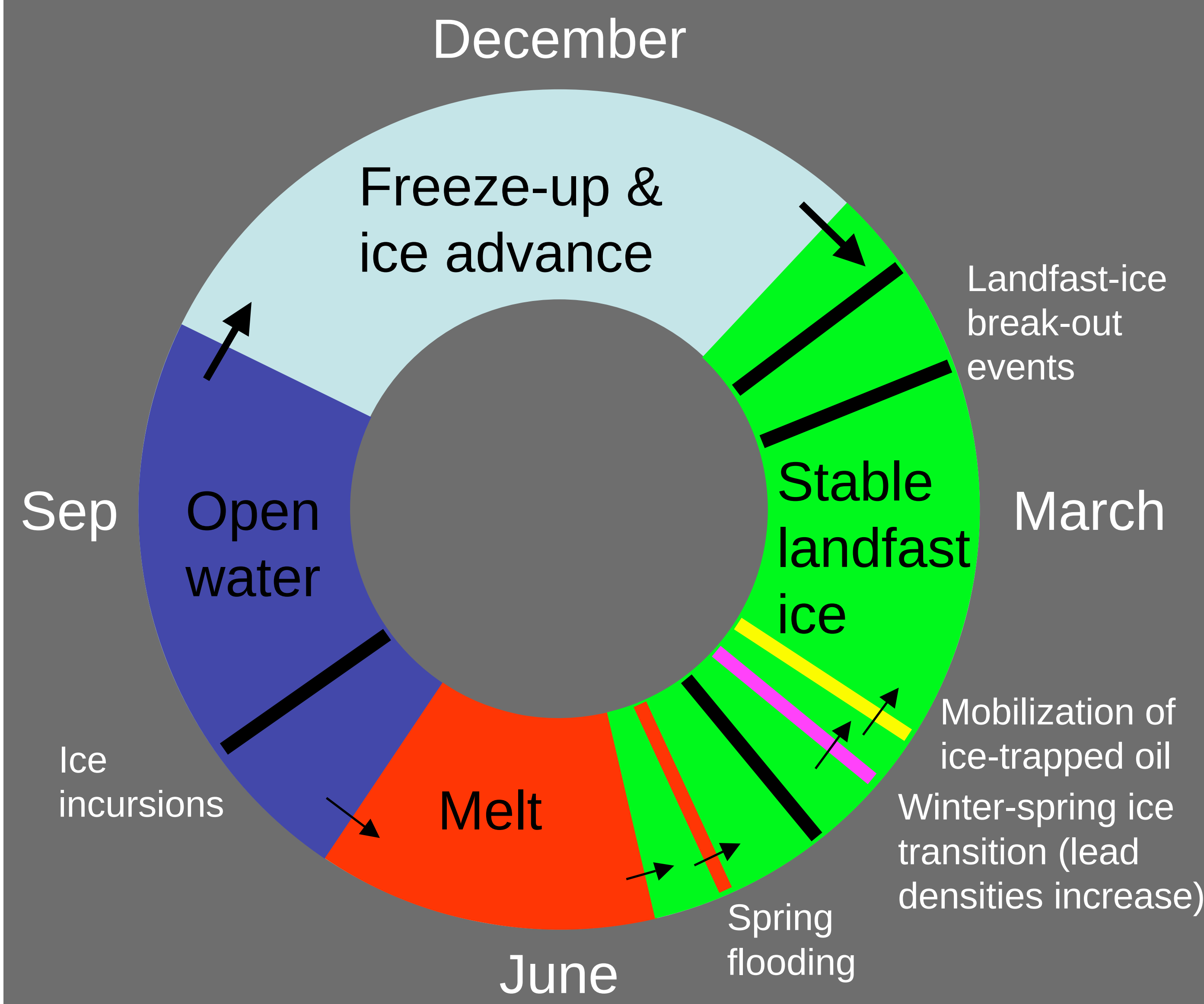




- Coastal marine radar at Barrow provides glimpse of key processes in flaw zone and landfast/pack-ice interaction
- More details in Mahoney et al. (CRST, 2007) & at www.gi.alaska.edu/snowice/sea-lake-ice/data.html


Pack-ice/landfast-ice interaction:
Have changes in ice circulation and ice thickness resulted in different deformation modes (rafting vs. ridging)?
Multiple rafting with sediment layers in lower sections

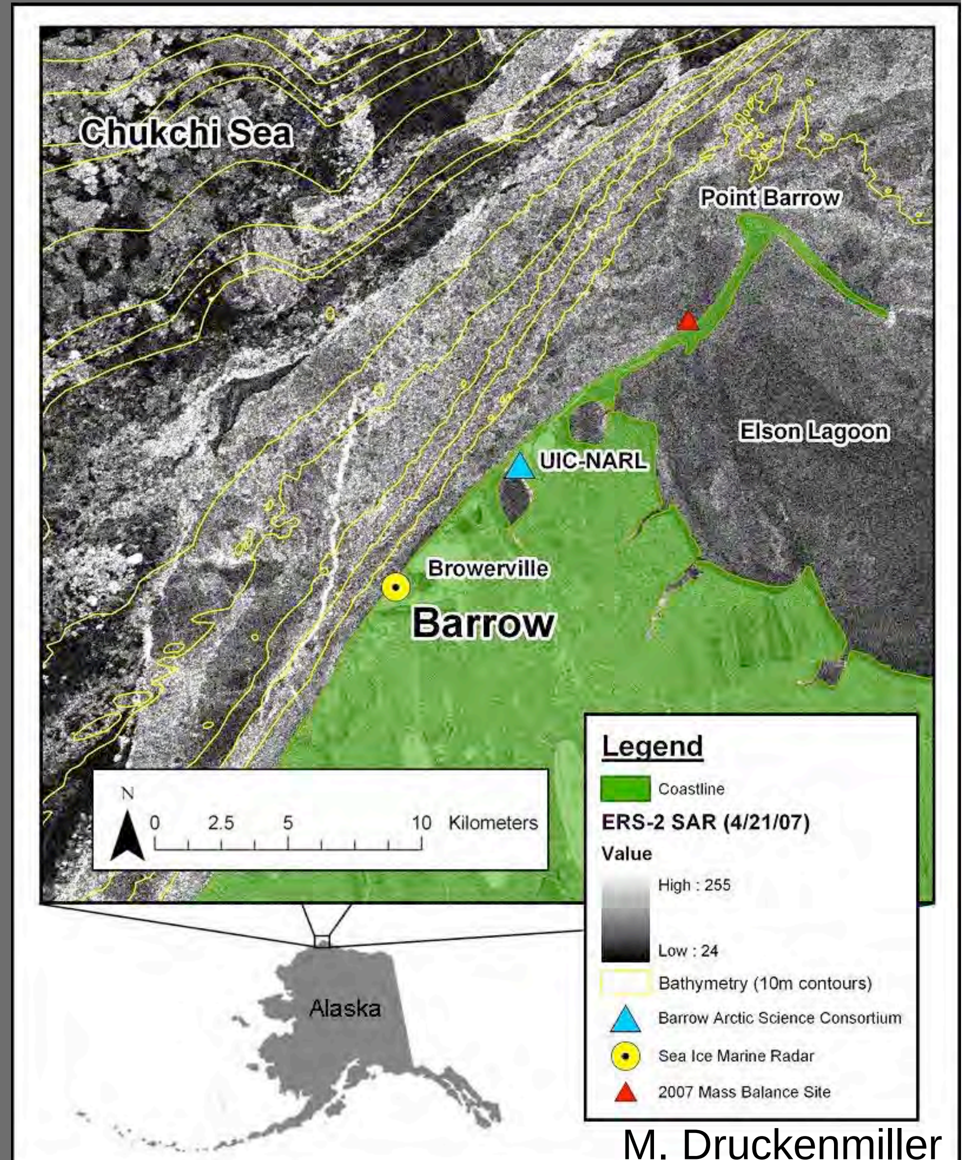
Annual sea-ice cycle & operational windows



- Open-water operations regime longer, potential for ice incursions
- Landfast-ice operations regime shorter, potential for break-outs
- Flaw-zone regime more variable in time & space
- Highly specific to particular location

The value of integrated sea-ice observations

- *Remote sensing* (km-scale): Ice extent and evolution
- *Coastal radar* (sub-km scale): Ice dynamics and evolution
- *EM thickness and DGPS topography* surveys (sub-km scale)
- *Ice mass-balance* site (10s m-scale): sealevel , water temperature, ice & snow thickness & temperature
- *Local ice observations* (J. Leavitt, A. Brower Sr. and others): Iñupiaq expertise & ice use, annual cycle
- Seasonal Ice Zone Observing Network (SIZONet) IPY Project



M. Druckenmiller

Conclusions

Data exchange meeting
Thursday 4-6pm
1007 W 3rd Ave, #100
Flyers & white paper outside meeting hall

- Open water season: longer, potential for ice incursions (ice detection)
- Landfast ice: extent little changed, less stable (lack of grounded ridges and stabilizing factors)
- Ice morphology & under-ice currents
- Flaw zone: Change in ice dynamics (rafting, sediment entrainment, break-outs)? Need for quantitative information
- Multi-year ice reservoir remains in Canadian Arctic
- Role of local expertise in integrated observations and spill response

Speaker Bios

Arturo A. Keller

Bren School of Environmental Science & Management
University of California Santa Barbara

Increasing oil exploration, production and transport in Arctic waters will increase the risk of an oil spill occurring in cold and ice-infested waters. The presence of ice crystals in oil emulsions affects the adhesion processes between an oil slick and the surface of an oleophilic skimmer and prevents oil from being efficiently recovered. The objective of this project was to perform a comprehensive analysis of the adhesion between oil or ice-in-oil mixtures and various surface patterns and materials, under cold climate conditions. This knowledge was then applied to improve existing mechanical response equipment. The novel recovery surfaces that proved to increase the recovery efficiency of a drum skimmer up to two times in warm waters were also successful in cold climate conditions. Based on the results of the laboratory tests at subfreezing conditions, we selected materials and surface patterns with the highest oil recovery potential under cold climate conditions, and performed field scale oil spill recovery tests with three different oils. This provided valuable information about the correlation between the laboratory tests and full-scale experiments. It also demonstrated the potential of the skimmer modifications under conditions similar to response operations. The field tests were very successful, with high rates of oil recovery under cold climates, with and without ice present. However, the presence of ice did decrease the overall rate of oil recovery to some extent.

Arturo Keller received M.S. and Ph.D. degrees in Civil and Environmental Engineering from Stanford University. He holds a B.S. in Chemical Engineering and a B.A. in Chemistry from Cornell University. Dr. Keller has more than 20 years of industrial experience in projects involving wastewater treatment, hazardous waste handling and management, pollution prevention and minimization, recycling and process modifications to reduce emissions. He is a Professor at the University of California in Santa Barbara.

Oil Recovery with Novel Oleophilic Skimmer Surfaces under Cold Climate Conditions

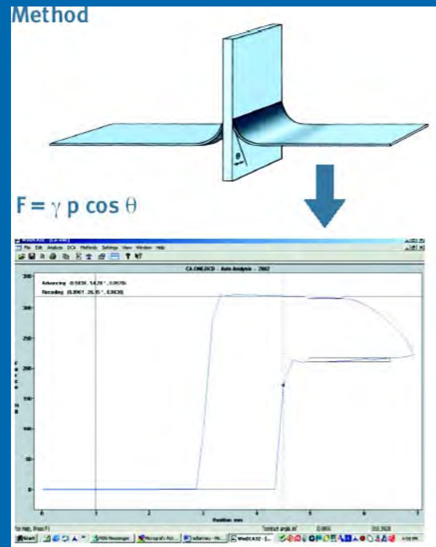
Arturo A. Keller & Kristin Clark

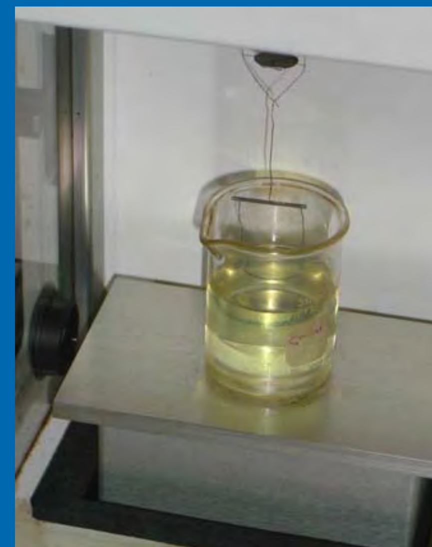
Bren School of Environmental Science & Management
University of California, Santa Barbara

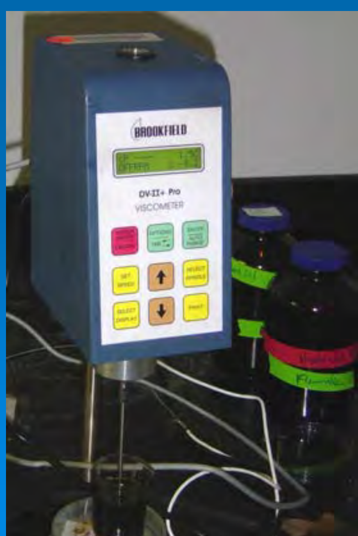
Objectives

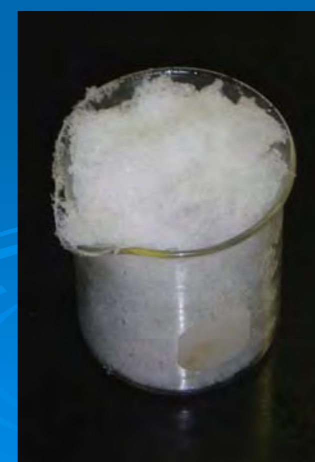
- Characterize properties that affect oil recovery in cold climates
- Perform full-scale test of novel drum recovery surfaces tailored for oil spill recovery under cold climate conditions
- Understand effect on recovery process of:
  - Cold temperature
  - Mixtures of slush ice and oil
  - Different drum geometries and surface materials
  - Skimmer operational conditions

Preliminary Lab Work

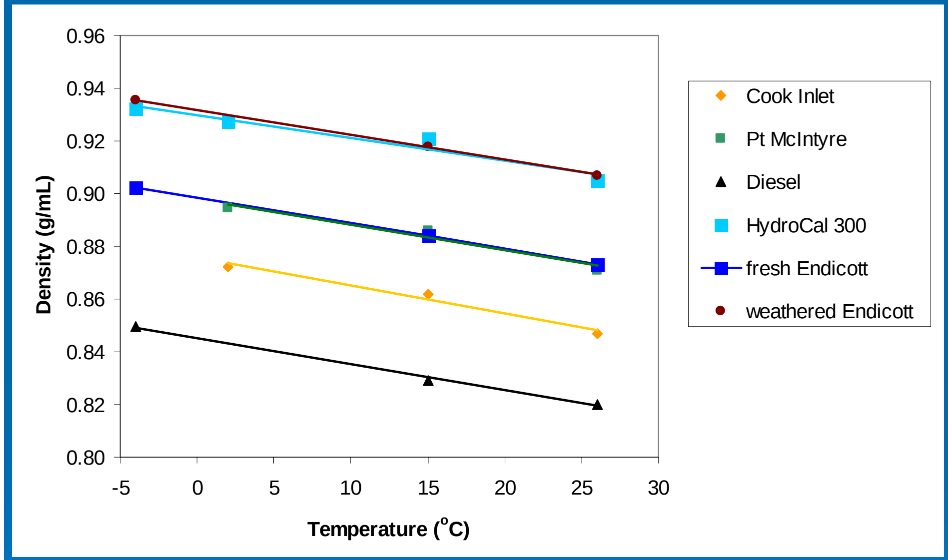


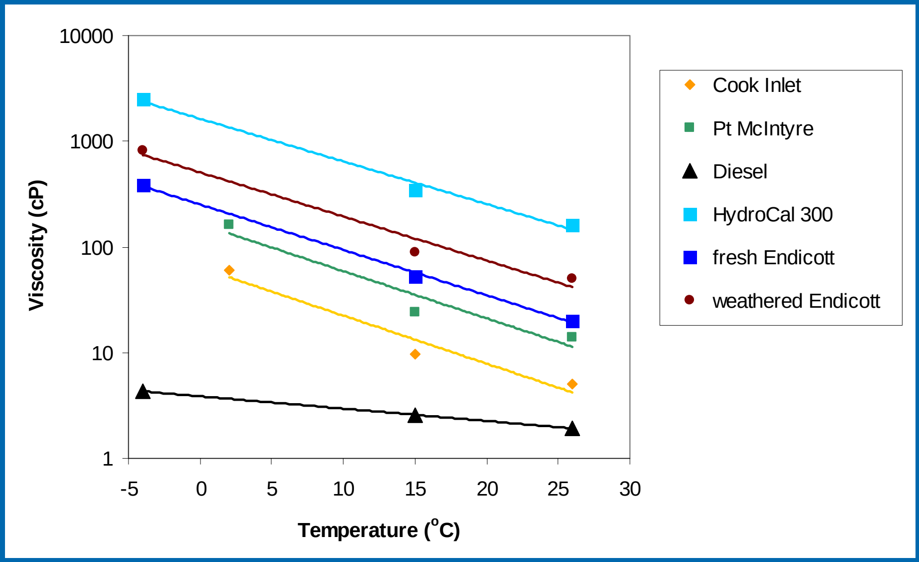


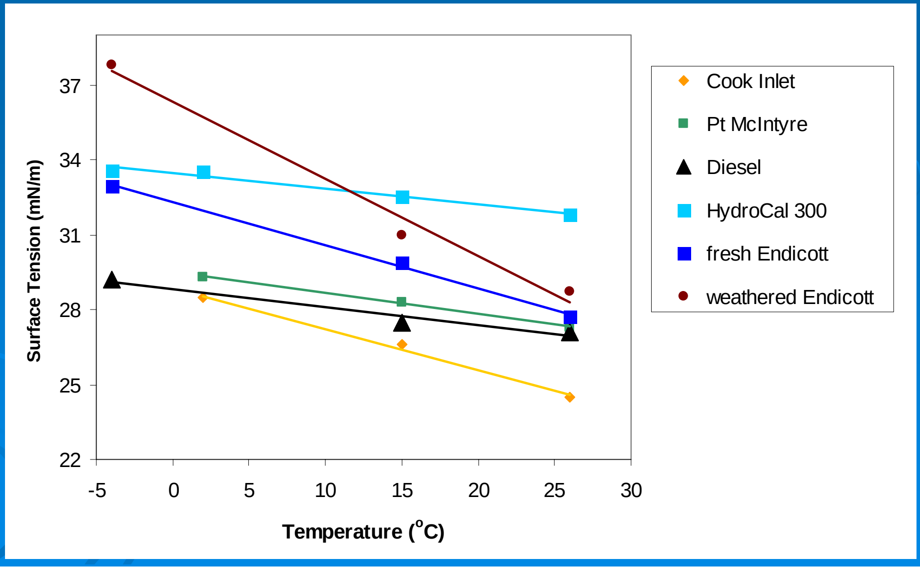




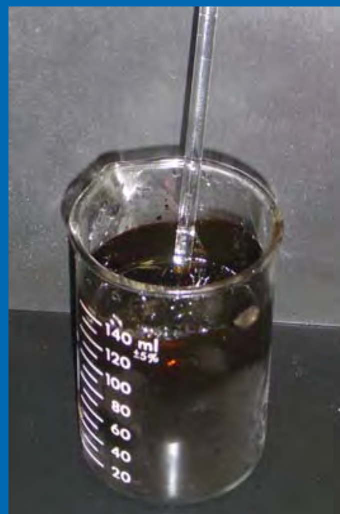
Physicochemical Properties







Oil & Ice Mixtures



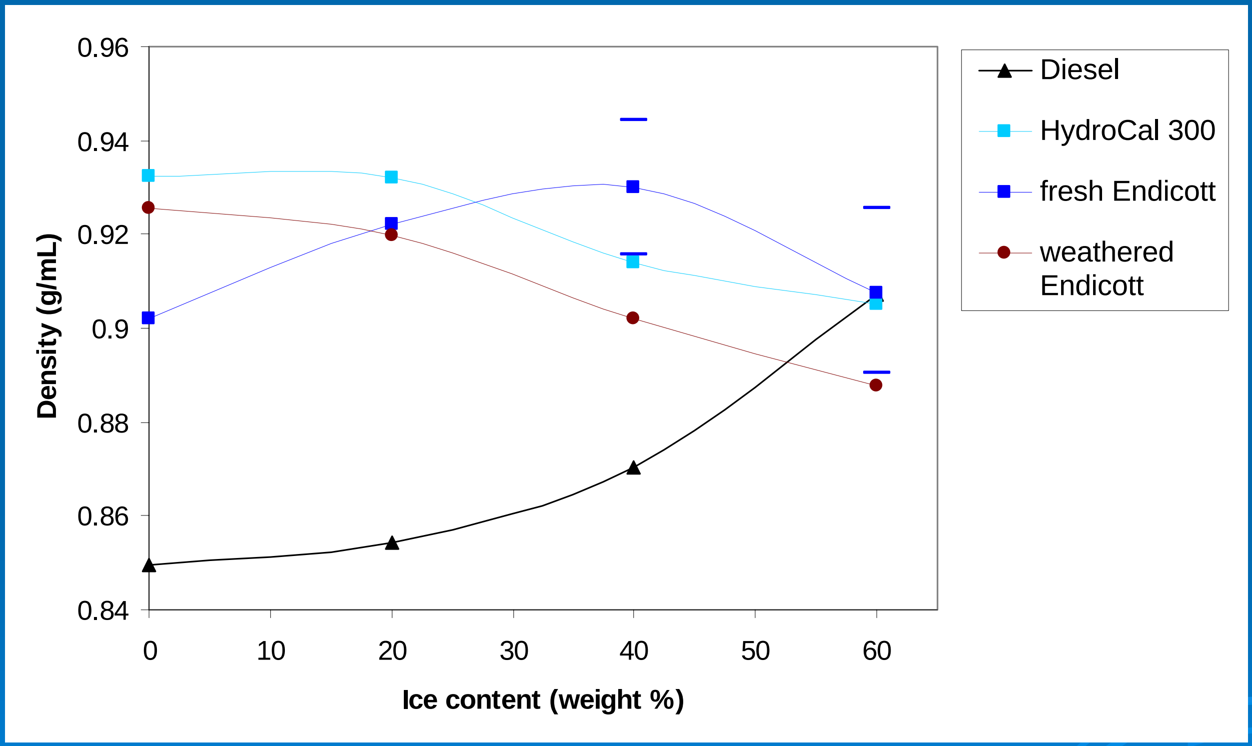
30% ice/fresh Endicott mixture

60% ice/ HydroCal 300 mixture

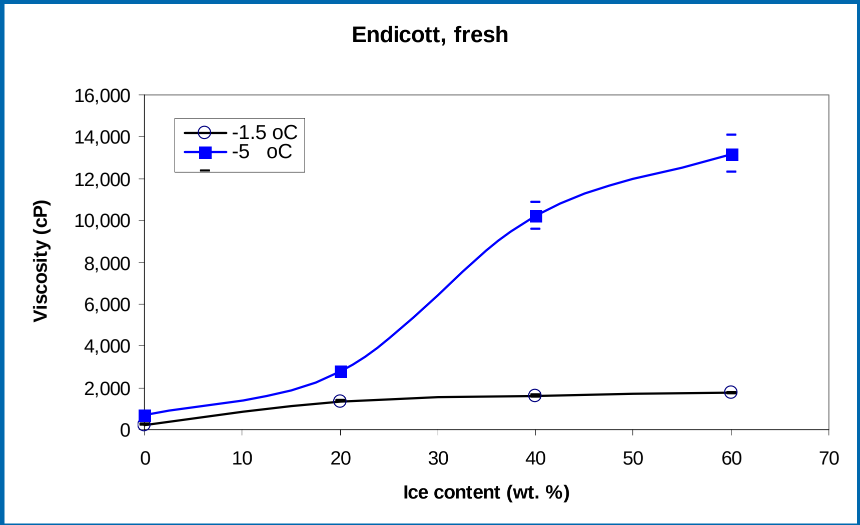
80% ice/fresh Endicott mixture

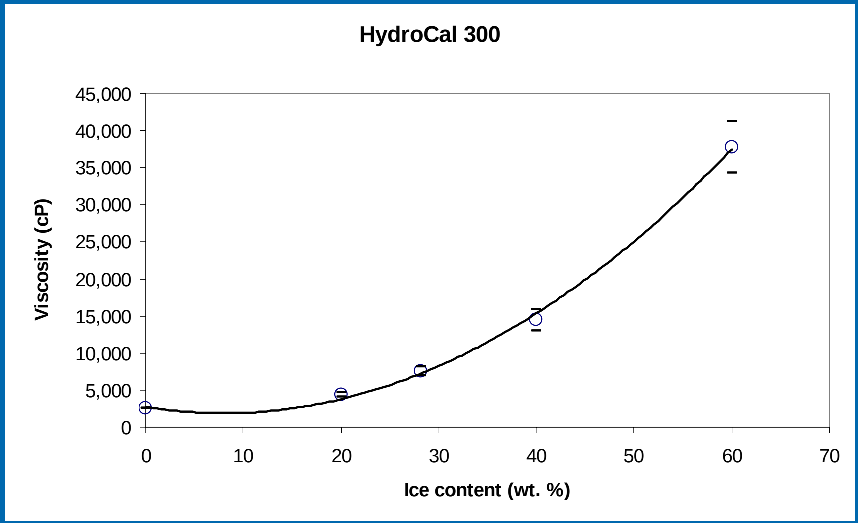
40% ice/diesel mixture

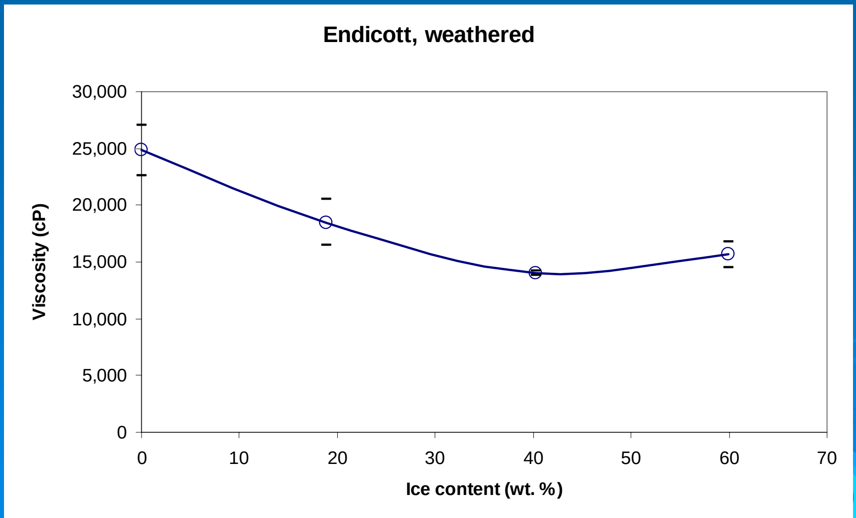
Oil & Ice Mixtures

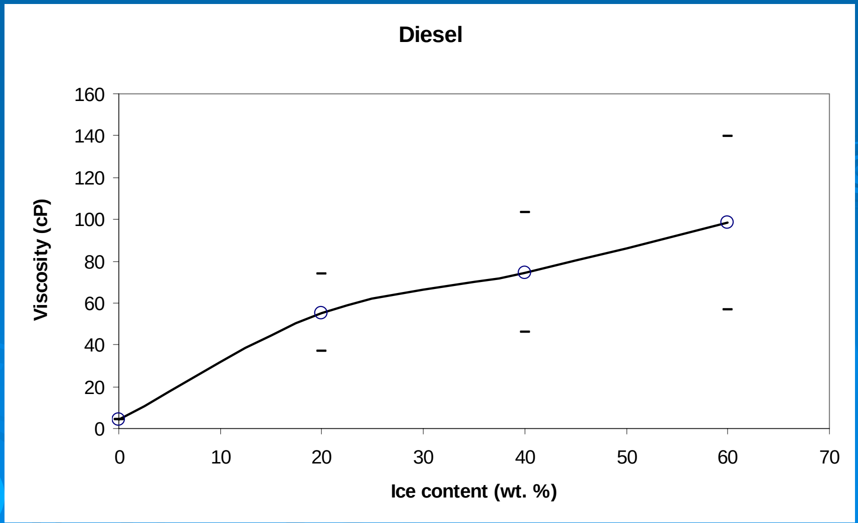


Oil & Ice Mixtures

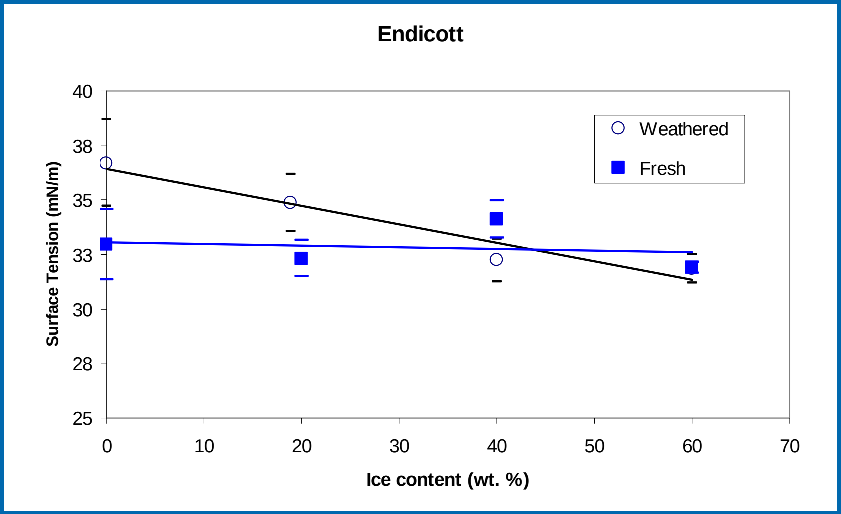


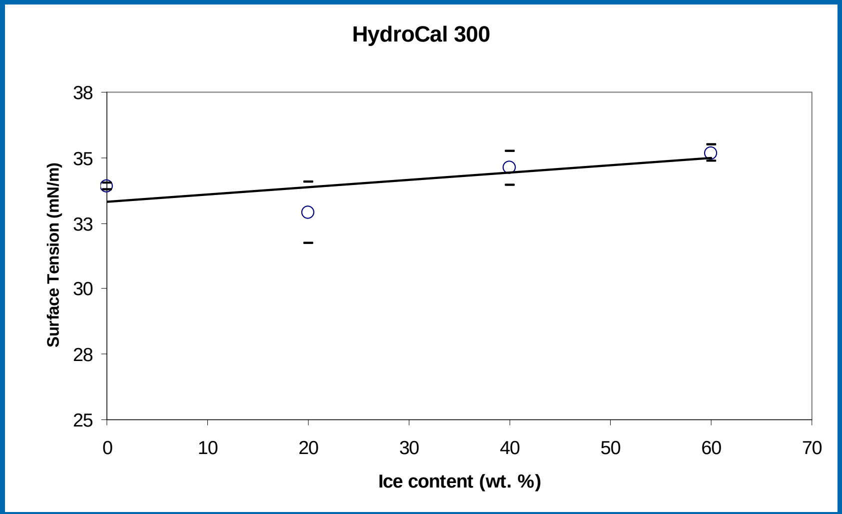


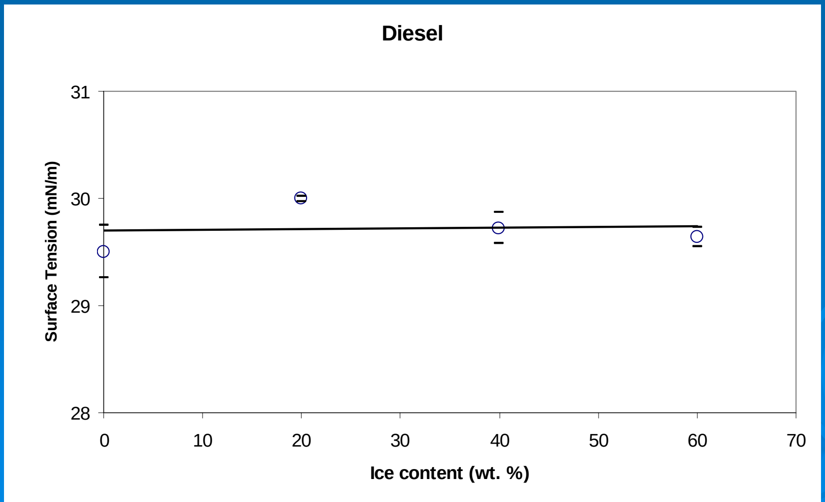




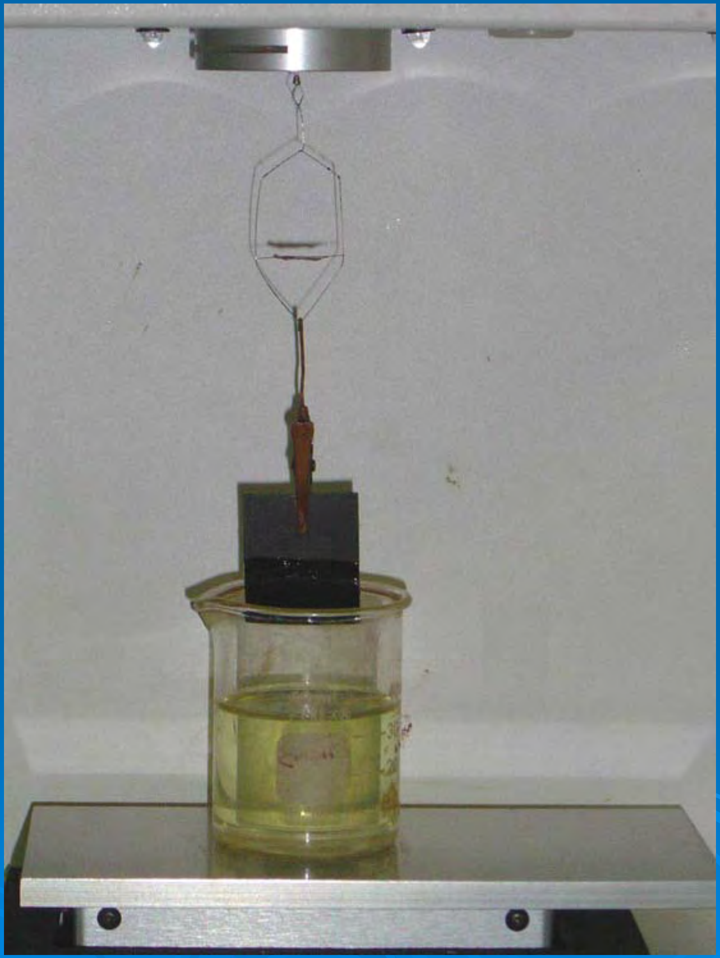
Oil & Ice Mixtures



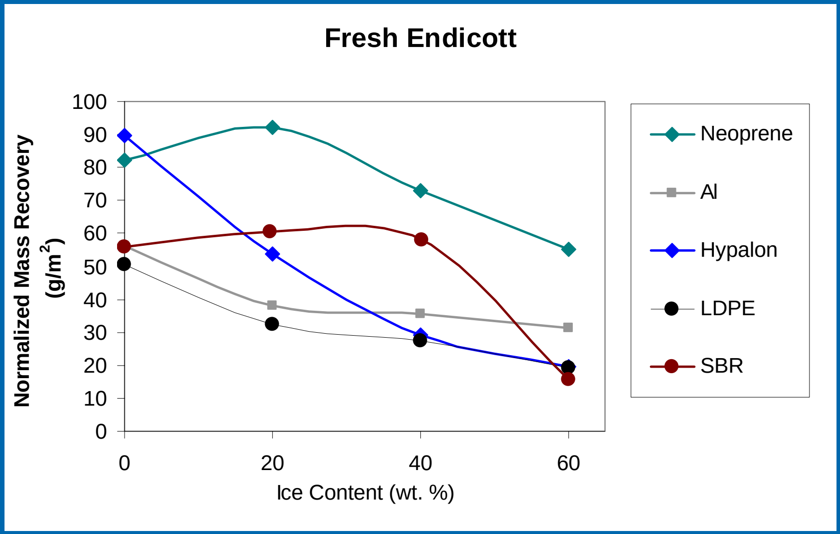


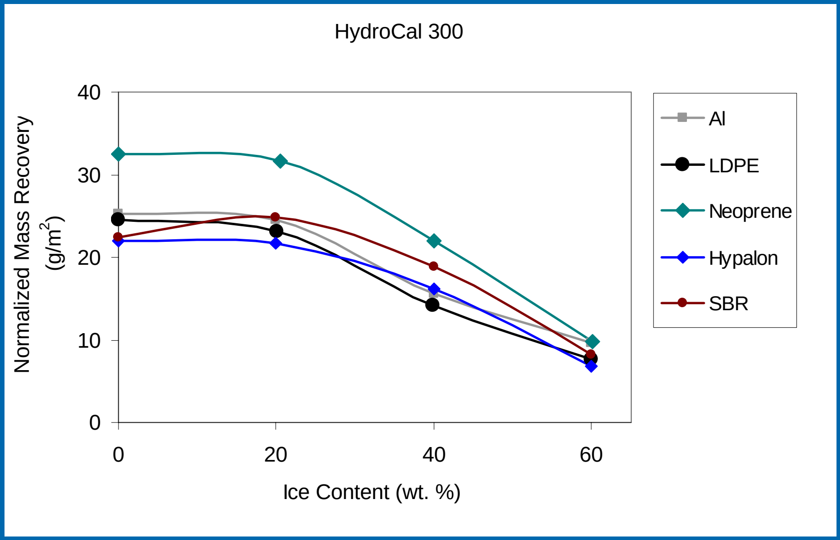


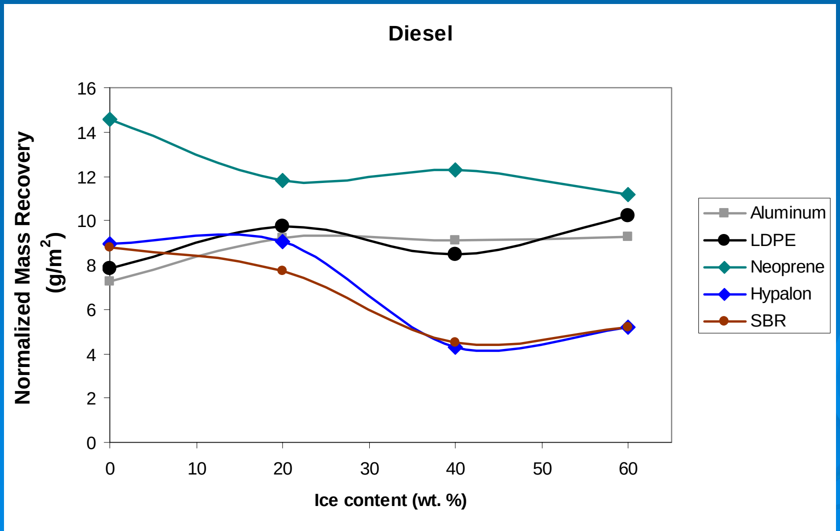
Oil Recovery



Oil & Ice Mixtures







Summary of Lab Work

- Expect much higher viscosities
- Ice/oil mixtures likely to separate for lighter oils
- For more viscous oils or higher % ice, expect oil coating ice, very high viscosity
- High recovery at lower temperatures (high viscosity => more adhesion)
  - Decreasing with increasing ice content
- Expect Neoprene to do better than others

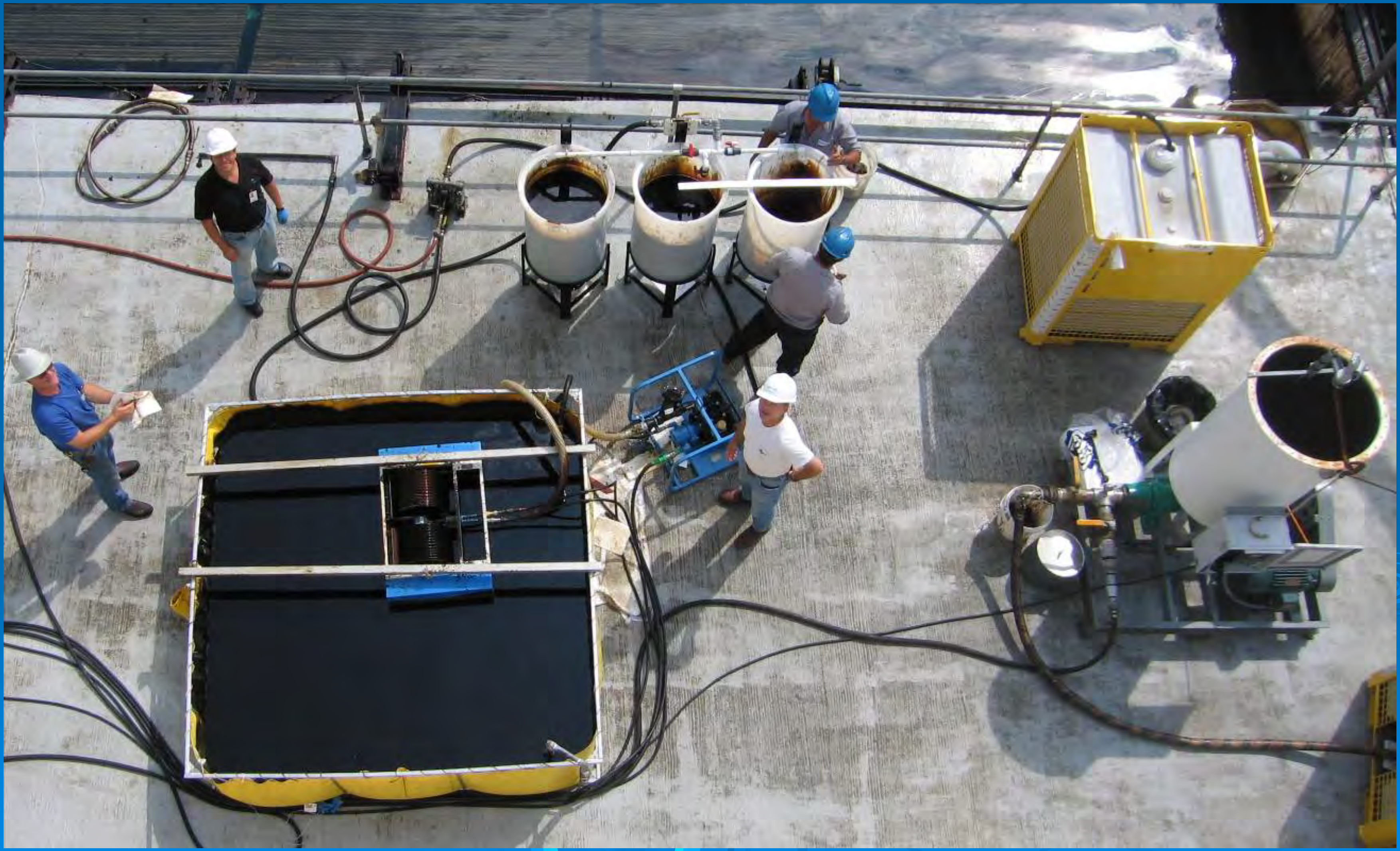
Field Test Variables

- Temperature:
  - -1 to -3 ^{o}C
- Oils:
  - Endicott, Hydrocal 300, Diesel
- Oil film thickness:
  - 20-30 mm
- Drum rotational speed:
  - 10-60 RPM
- Drum surfaces:
  - Aluminum, LDPE, Neoprene, Hypalon
- Drum geometries:
  - flat, 20^{o}, 30^{o} and 40^{o} nominal groove angles

Field Tests in Feb in NH

Cold Regions Research & Eng. Lab (Army Corps of Engineers, NH)

Ohmsett test tank



Full-scale skimmer

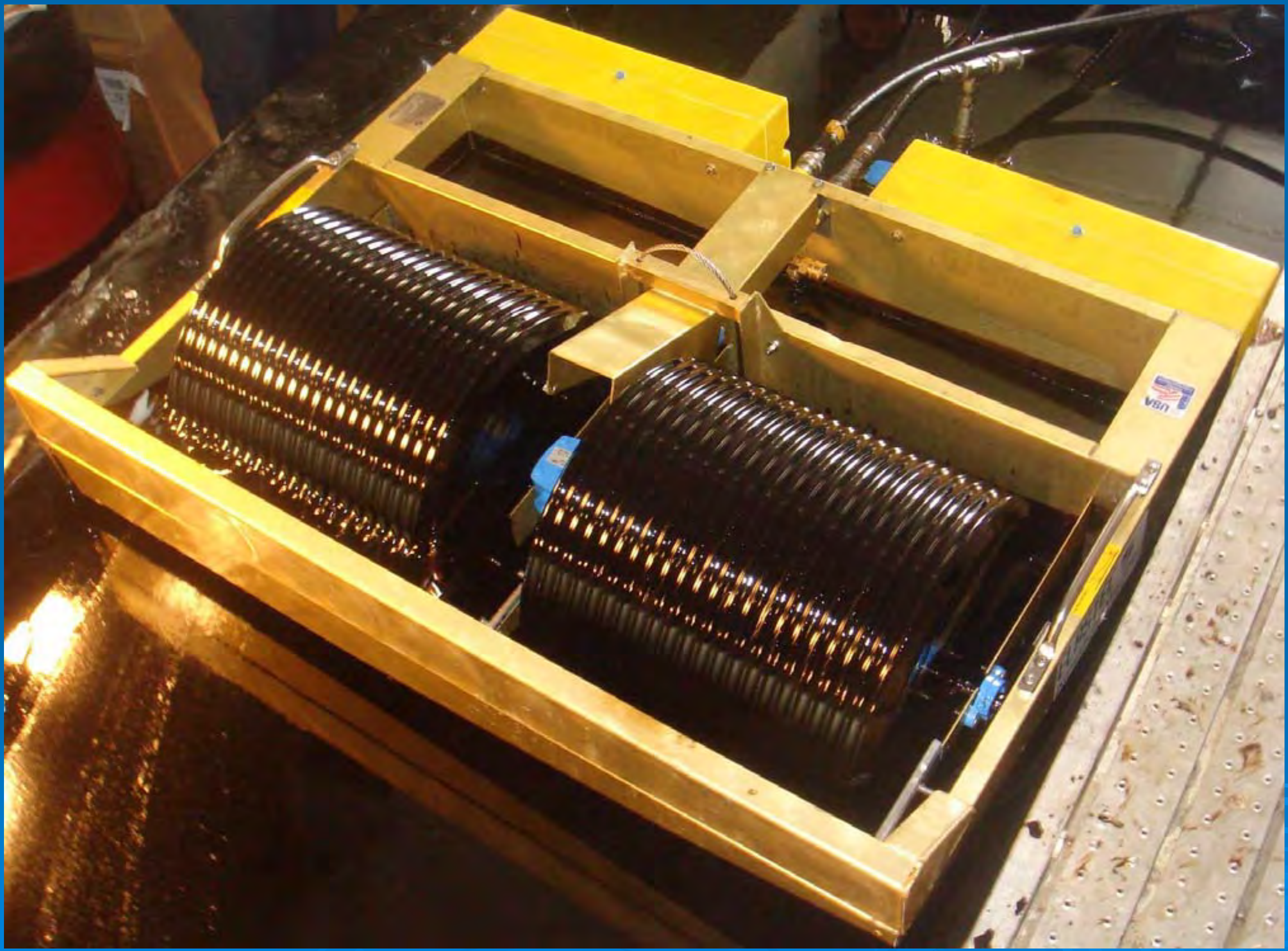
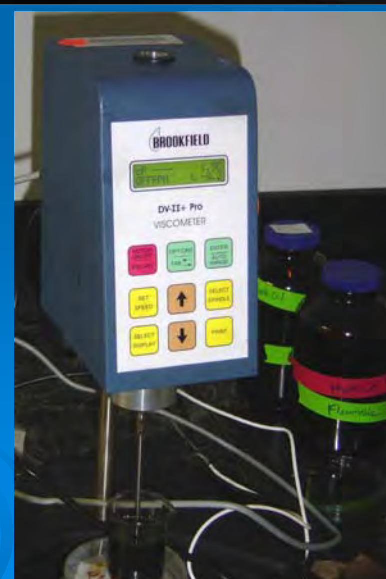


Photo courtesy of American Elastec, Inc.

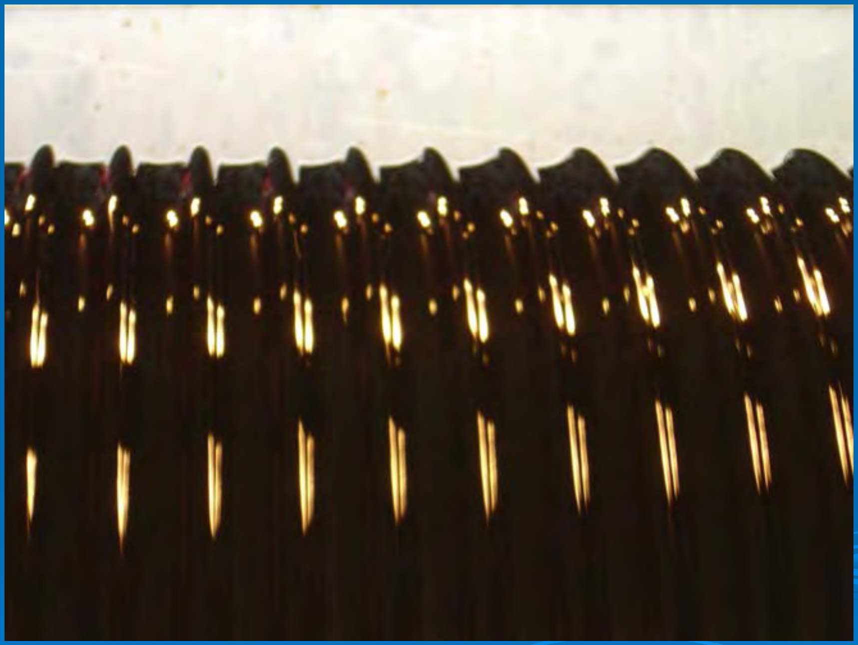
Minimax Skimmer

Photo courtesy of American Elastec, Inc.

Adding Ice

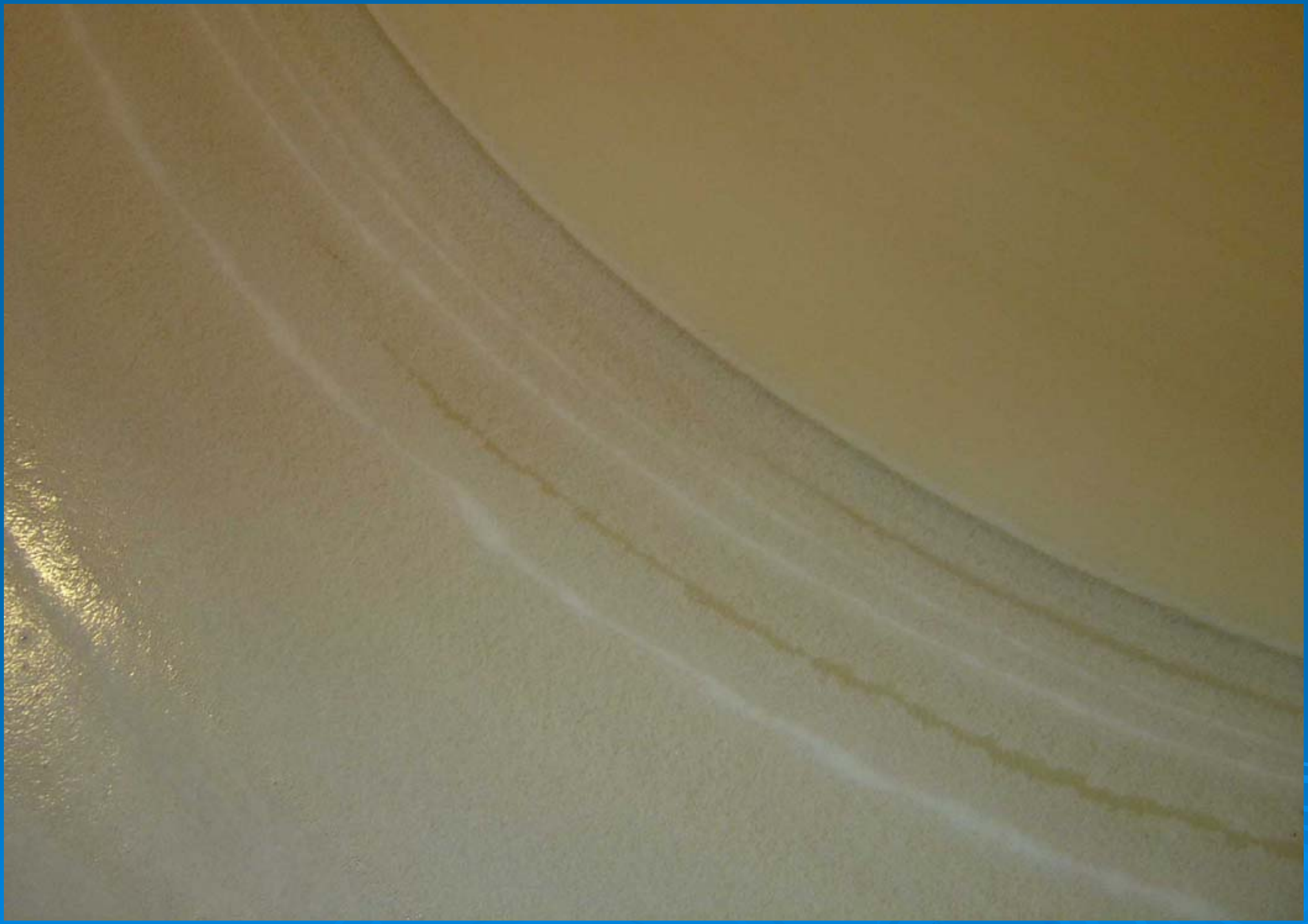


Endicott (fresh)

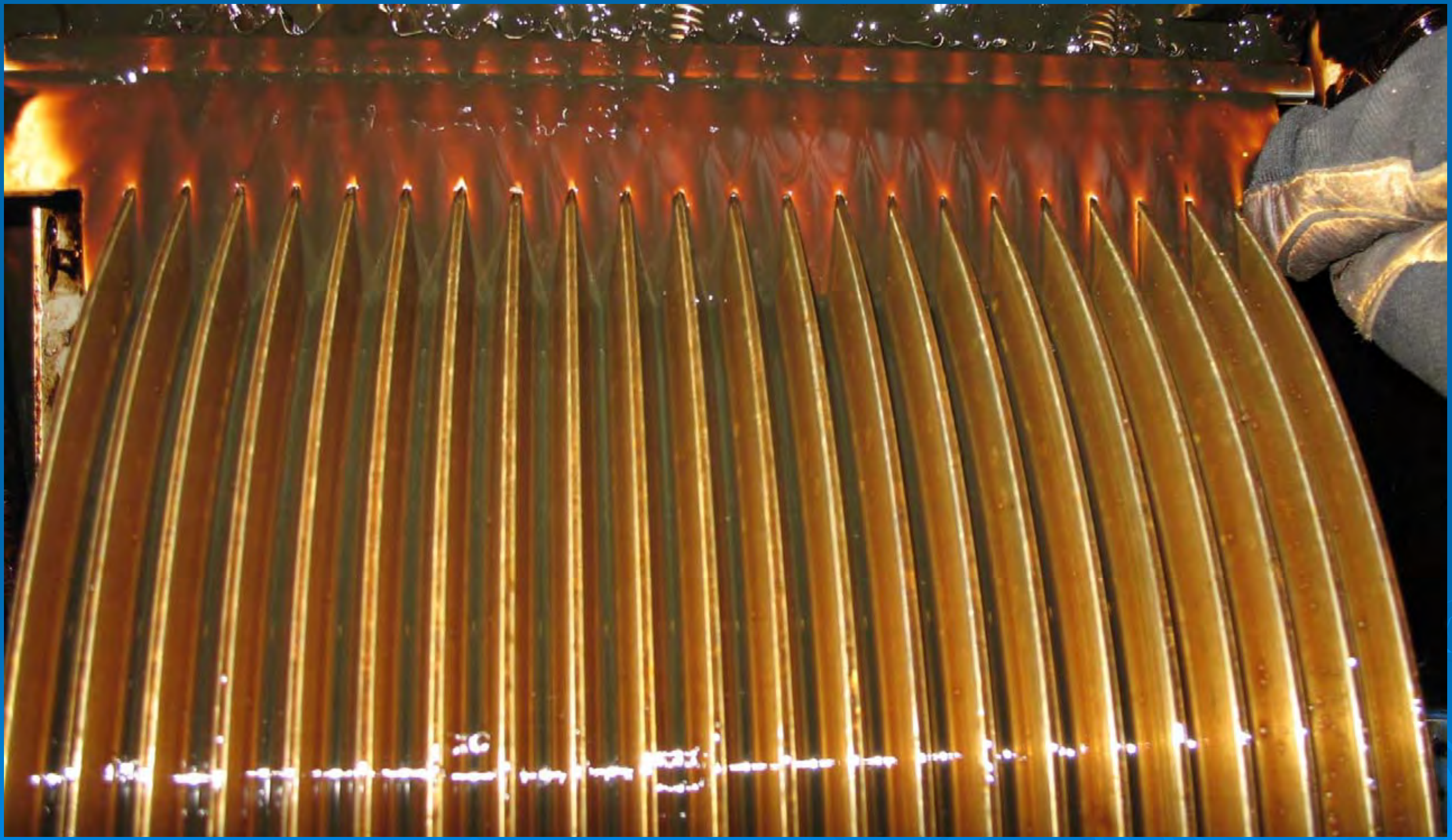


HydroCal 300

HydroCal 300

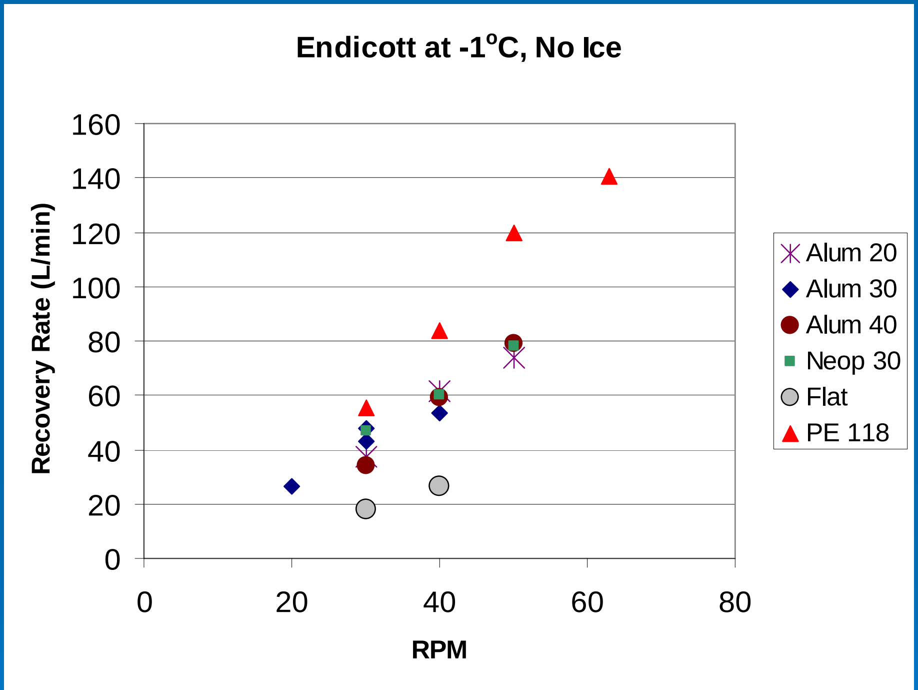


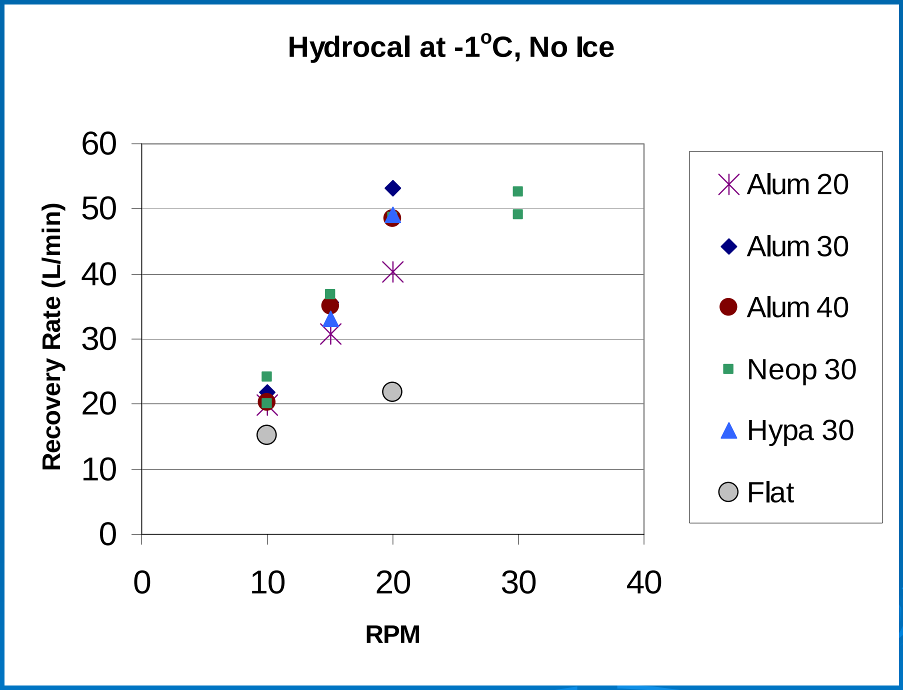
Diesel



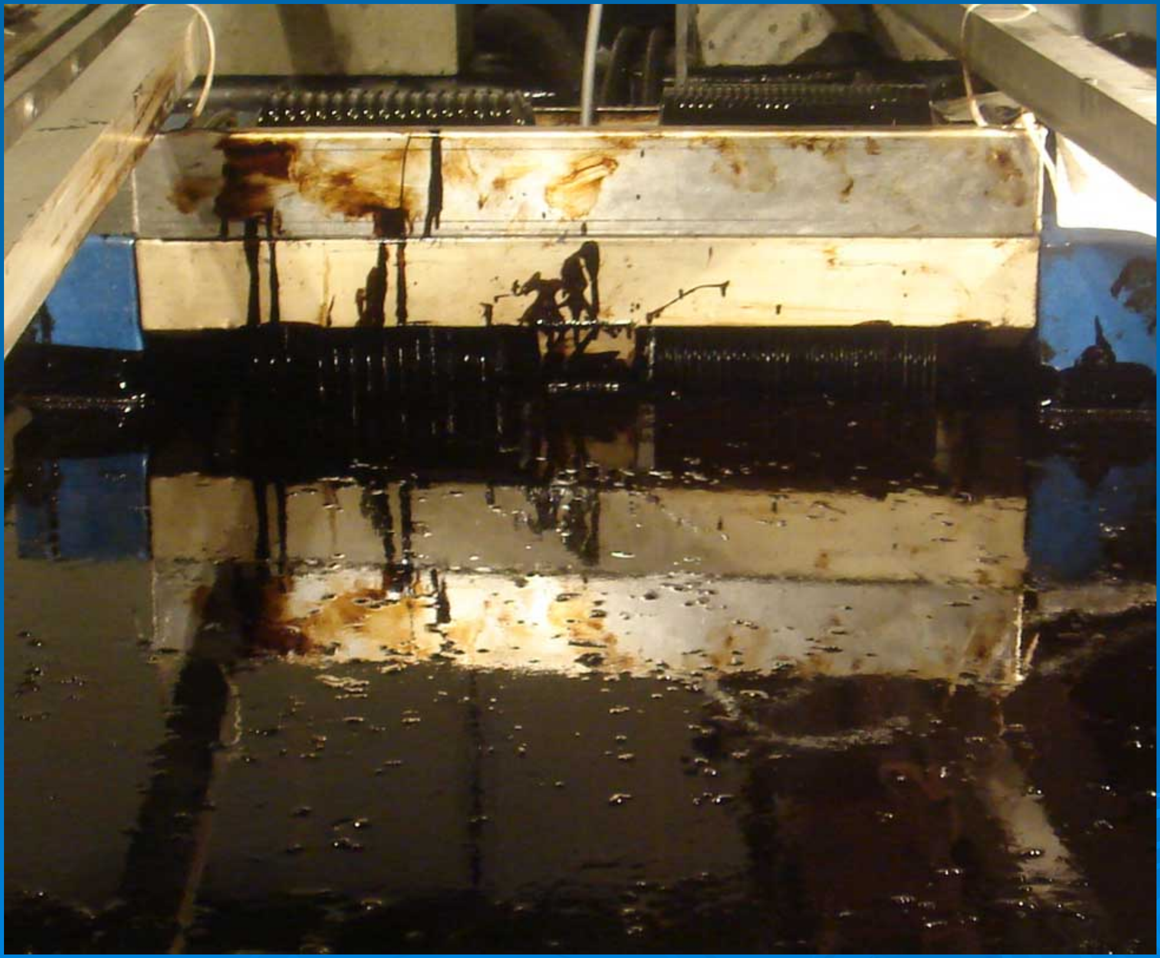
Flat drums

Oil Recovery w/o Ice





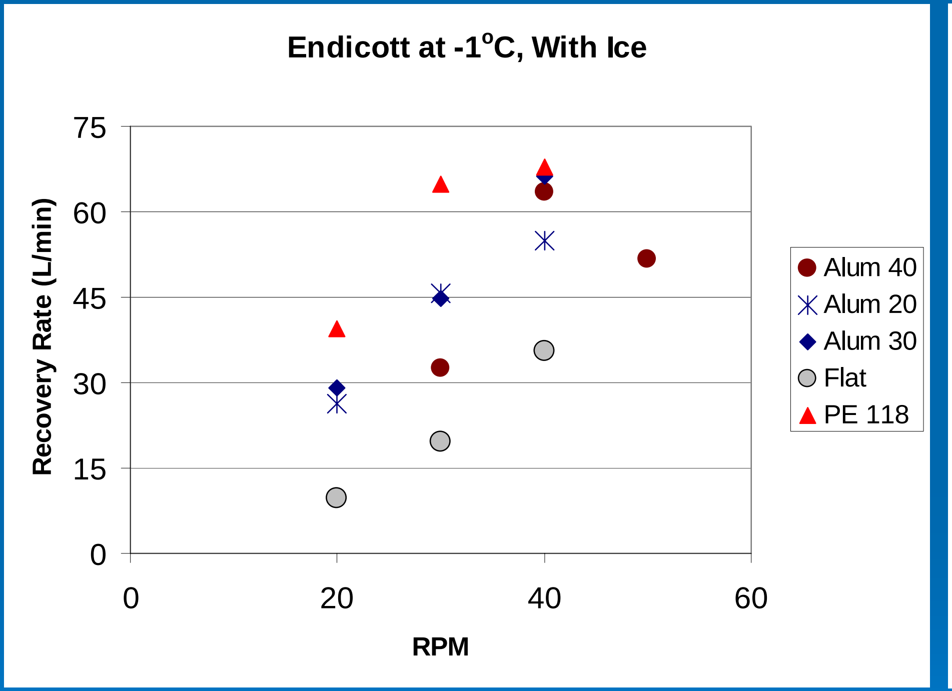
Endicott and 30% ice

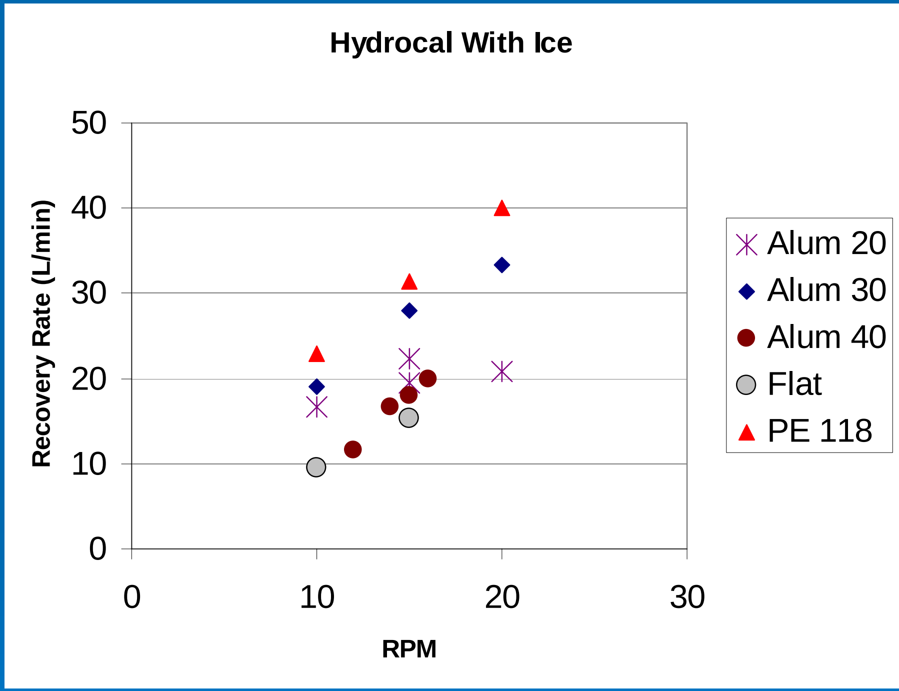


Minimal ice build-up

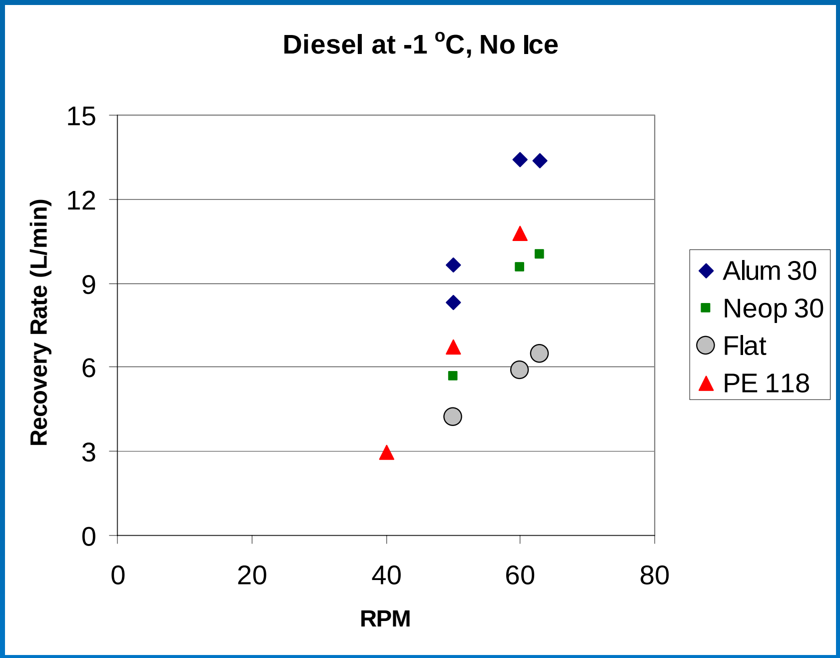
HydroCal 300 and 30% ice

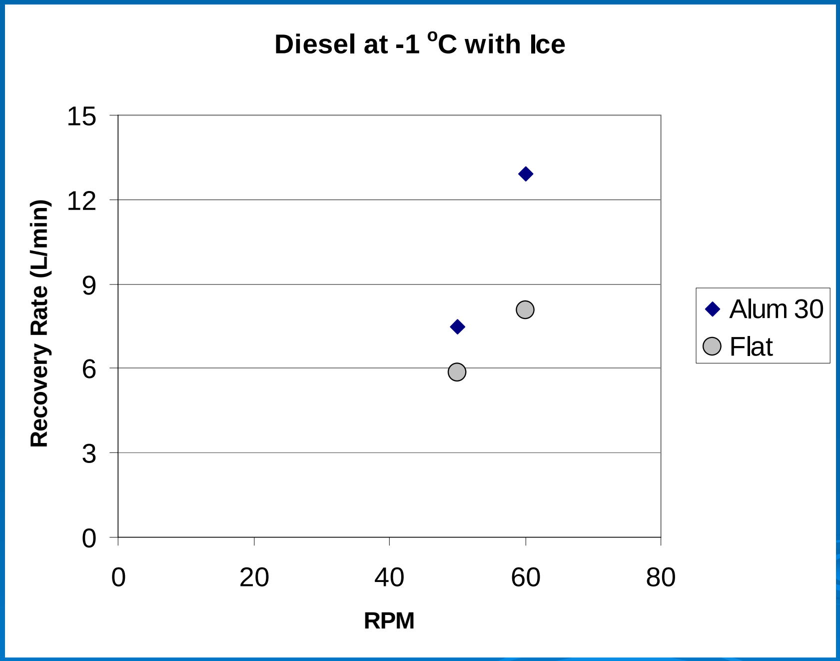
Oil Recovery with Ice





Diesel recovery





Conclusions

- High recovery rates for light to viscous oils under cold conditions
- Presence of ice (30% by weight) reduces oil recovery but recovery rate still quite acceptable
- No significant ice build-up behind skimmer for 25 mm slick thickness
- Water recovery was relatively low

Conclusions

- Groove angle and depth may be optimized for specific conditions
- Surface materials play secondary role
- Larger system can recover up to 300 L/min (80 gal/min) of Endicott or HydroCal
- Existing systems can be retrofitted to much more effective grooved drums

Acknowledgements

Projects funded by

U.S. Dept of Interior, Minerals Management Service

Oil Spill Recovery Institute at Prince William Sound Center

University of California Toxic Substances Research and Teaching Program

Support from

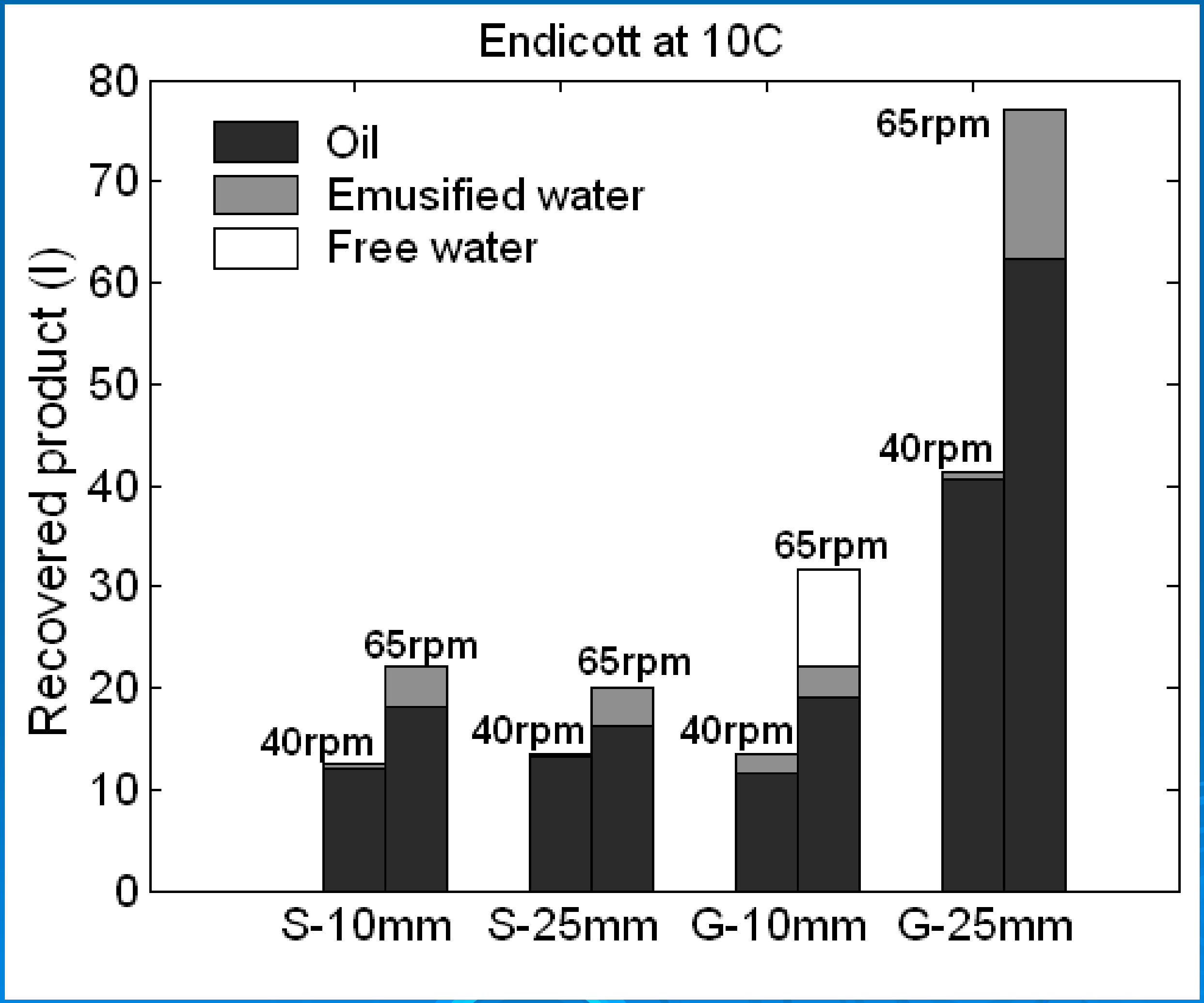
Army Corps of Engineers (CRREL Lab)

Ohmsett Facility & Mar Inc.

American Elastec, Inc.

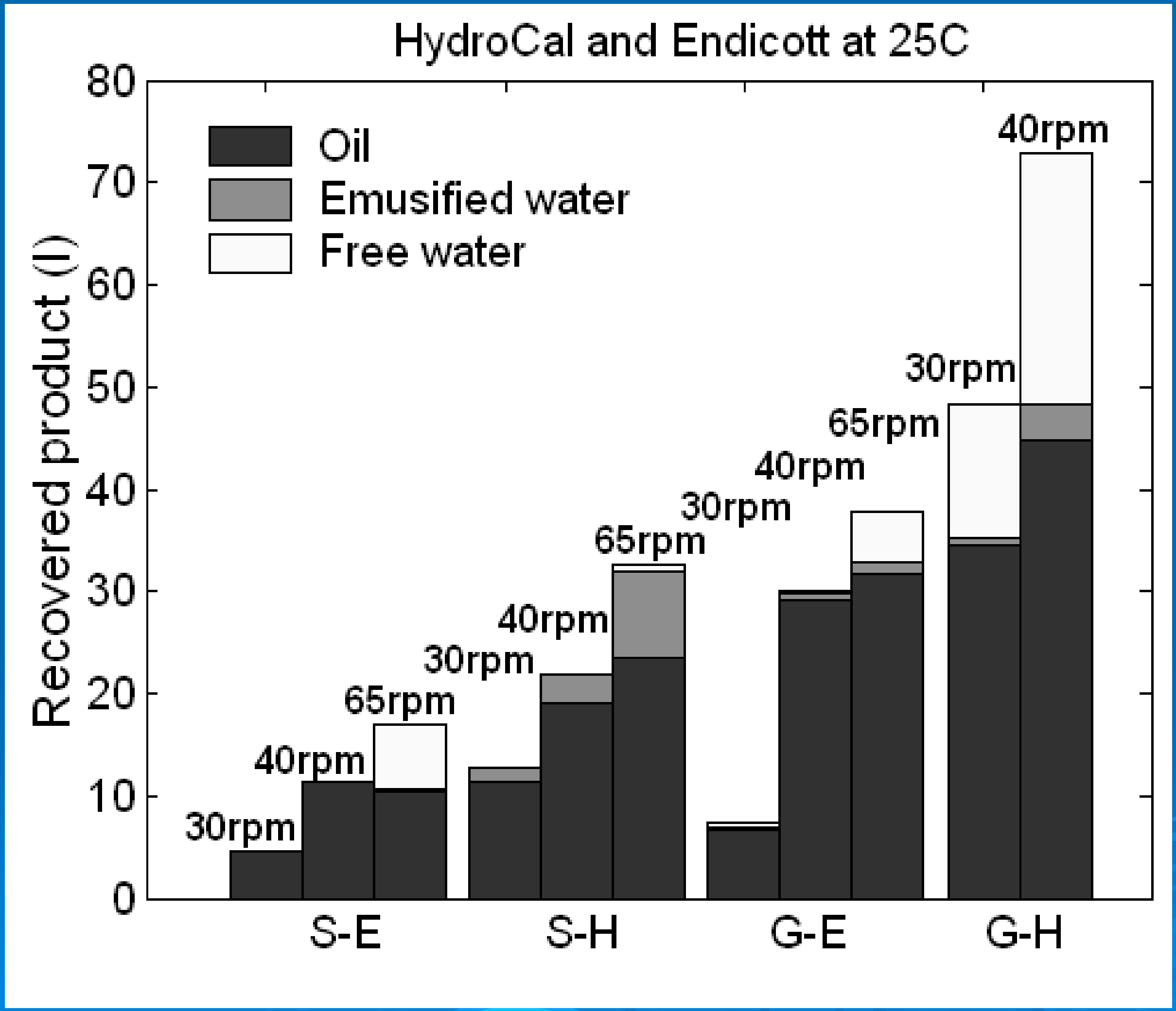
Questions ?

Sample test results at 10 ºC



Recovery in liters/min   3.785 L/min = 1 gal/min

Sample test results at 25 ºC



Recovery in liters/min 3.785 L/min = 1 gal/min

Speaker Bios

Bjørn Kristoffersen

Statoil Barents Region, Stavanger Norway

Statoil's environmental policy is funded on the ambition of zero harm to the environment and sustainable operations. This policy has a holistic approach and focus on conserving biodiversity, limiting emissions/discharges, limiting use of land/resources and involving stakeholders.

According to the title, the presentation is giving an overview of the environmental strategies necessary to meet the changing environment in the Barents Region. A large area, with proven reserves and exploration potential and with favourable location for the markets. With a basis on the Snhvit LNG development, Shtokman and other exploration/projects, this region is an important gateway to the Arctic. The environmental and socio-economic challenges of the Arctic require close co-operation between all stakeholders to ensure co-existence and sustainable technology. Statoil is committed to developing technology for operations anywhere in the Arctic within 2030, and our environmental policy is tailor made to support this. We have established an extensive co-operation program with authorities, research institutions, indigenous people organizations, fishery interests and others to meet our goals in the Barents Region. Our approach is risk based which means that we focus on identifying Best Available Technology to reduce the probability for accidents and we establish the best possible measures to reduce impact from any potential hazard.

Oil spill contingency in arctic waters is a condition for sustainable operations. This is reflected by the comprehensive program Statoil has initiated in the Barents Region, by building knowledge and contingency ability in close co-operation with regional interests in Norway and Russia.

Bjørn Kristoffersen is (as of September 2007) Vice President Environment of the Barents Region business area in Statoil International E&P. Statoil is an international oil company with interests in more than 30 countries. The company is partly owned by the Norwegian State and has developed world-class offshore operating competence throughout the development of the

Norwegian Continental Shelf, a harsh environment stretching from the North Sea to the Barents Sea. Statoil is merging with the Norwegian oil company Norsk Hydro on October 1st. Mr. Kristoffersen has been with Statoil for 23 years and has been involved in most project developments in Norway up to 1995 when he was posted in Azerbaijan as environmental manager for Azerbaijan International Operating Company. After four years in the Caspian region he has been with Statoil International E&P working in Brazil, Venezuela, Africa, Russia and other parts of the world. The latest three years he has been engaged with environmental challenges in the arctic region.

Note: Statoil merged with Norsk Hydro and from 1st October 2007 and the two companies are now known as StatoilHydro.

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Speaker Bios

Kari Lampela

Finnish Environment Institute (SYKE)
Helsinki, Finland

The Baltic Sea is one of the most heavily operated sea areas and maritime transport is expected to increase still. The increasing transport of oil and oil products is the most significant reason for this development. On account of the fact that Baltic Sea is already heavily polluted, avoidance of any extra pollution load to the sea is one of the main principles when choosing response methods. Northern and Eastern parts of the Baltic have ice every winter and about once in 30-40 years the whole sea area is covered by ice. Because about 80% of Finnish transport is by sea, continuous and safe sea traffic during the ice season is vital to Finland and to other Baltic Sea states. This paper gives an overview of the oil spill response policy adopted by Baltic Sea states mainly due to the work of the Baltic Sea Environment Protection Commission, HELCOM, concentrating on oil spill response in ice and cold conditions. There have been some minor accidental oil releases in ice during recent years, which aredescribed in the paper. Due to the greatly increased oil traffic especially in the Gulf of Finland, there is a great demand to develop new methods and equipments to collect oil in ice. Some of the latest developments, studies, new mechanical response units and response vessels are explained as well.

Mr. Lampela has over 40 years of experience in different governmental bodies in Finland. In addition to the overall management of the field of oil spill response Mr. Lampela is in charge of the related research and development work of the Finnish Environment Institute. He has provided leadership to a diverse team of scientists, bost domestic and international and his responsibilities include also extensive liaison with key governmental agencies and environmental groups around the Baltic Sea.

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Background

Speaker Bios

Papers

Sponsors

Speaker Bios

Kenneth Lee

Center for Offshore Oil and Gas Environmental Research
Bedford Institute of Oceanography, Fisheries and Oceans Canada
Dartmouth, Nova Scotia, Canada

Paper presented by: Martin Blouin
Canadian Coast Guard, Quebec, Canada

The promotion of Oil Mineral Aggregate (OMA) formation has been proposed as an oil spill countermeasure for oil spills in ice-infested waters. In a manner similar to that of chemical oil dispersants, this technique is based on the dispersion of oil from the surface into the water column; the premise being that resultant concentrations will be below the threshold limits that cause detrimental biological effects. Laboratory studies and field trials have shown that dispersed oil in association with mineral fines has an expanded oil-to-water surface area that will promote enhanced microbial degradation rates. Thus, spilled oil is not merely transported into the water column but effectively removed from the environment by natural processes. In terms of use in the Arctic, in situ methodologies may offer a major operational advantage, as there is no need for the physical removal and treatment of contaminated waste materials for treatment.

A collaborative field program between the Canadian Coast Guard and Fisheries and Oceans Canada has been initiated to provide fundamental scientific knowledge, field validation of response technologies, and training to oil spill responders. This presentation will describe our 2007-2008 project to be conducted in ice-infested waters of the St. Lawrence estuary prior to submission of a full-scale Arctic program.

Kenneth Lee received his B.Sc. degree in marine biology from Dalhousie University, followed by Masters and Doctoral degrees in limnology and microbiology from the University of Toronto. During his post-doctoral research studies in chemical oceanography with the Department of Fisheries and Oceans at the Institute of Ocean Sciences, Victoria, British Columbia Dr. Lee became interested in the development and validation of marine oil spill countermeasures. He has conducted research programs on chemical oil dispersants, natural attenuation, bioremediation, phytoremediation, and oil mineral aggregate formation. He is a lead researcher on the assessment of environmental impacts associated with offshore oil and gas exploration and production.

Dr. Lee is currently the Executive Director of the Department of Fisheries and Ocean's Centre for Offshore Oil and Gas Environmental Research (COOGER) based at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. This centre is responsible for the coordination of a national strategic program in environmental and oceanographic research of oil and gas activities as they relate to the Department of Fisheries and Oceans Canada mandate.

Speaker Bios

Randall B. Luthi

Director Minerals Management Service
U.S. Department of the Interior

Randall B. Luthi was appointed Director of the Minerals Management Service on July 23, 2007.

Luthi, a former speaker of the Wyoming State House of Representatives, is a rancher and attorney in private practice from Freedom, Wyoming. He previously served in the Department of the Interior and at the National Oceanic and Atmospheric Administration (NOAA).

Luthi is a partner in the Luthi and Voyles law firm in Thayne, Wyoming, and manages a cattle ranch in western Wyoming. He was first elected to the Wyoming House of Representatives in 1995, and served as speaker in 2005 and 2006.

He served in Washington in career positions as Senior Counselor for Environmental Regulations in NOAA's Office of General Counsel from 1990 to 1993, and as an attorney in the Department of the Interior Office of the Solicitor from 1986 to 1990.

Based on his work in the Wyoming legislature, Mr. Luthi developed an understanding of the importance of royalties paid to the federal government by companies producing energy on our public lands and waters. As Majority Leader and Speaker of the Wyoming House, Mr. Luthi was instrumental in formulation of state budgets which relied heavily upon royalties and severance taxes paid by energy companies developing federal leases. In addition, he was a legislative member of the Energy Council, which is an organization comprised of legislative representatives from energy producing states and provinces and private energy-related industries that meets quarterly to learn the latest in developments in energy related technology and to discuss energy policy.

In addition, Luthi worked as a legislative assistant in the office of U.S. Senator Alan K. Simpson of Wyoming. In this capacity, Luthi provided counsel on legal and legislative issues including oil and gas taxation.

Luthi graduated from the University of Wyoming in 1979 with a Bachelor of Science Degree in administration of justice, and earned a law degree from the University of Wyoming in 1982.

International Oil & Ice Workshop 2007

Speaker Bios

Lee Majors

Planning and Development Manager
Alaska Clean Seas
Pouch 340022
Prudhoe Bay, AK 99734-0022

Alaska Clean Seas (ACS) is the Oil Spill Recovery Organization for the North Slope of Alaska. Annually, ACS responds to over 300 reportable spills and many other spill events.

Presented will be an overview a few of the larger spill events over the last couple years. Emphasis will be placed on spill events in snow and ice, tactics utilized, and lessons learned. Included will be overview of the 2H pad and Drill Site 14 responses in 2005 plus the Gathering Center 2 pipeline spill response in 2006. The Gathering Center 2 pipeline response was the largest spill response ever on the North Slope of Alaska. These responses outline the tactics on land in snow and ice and extreme weather.

In 2005 and 2006, ACS conducted training and demonstrations on spill response tactics on overflood ice conditions. Tactics and lessons learned from these sessions will also be presented.

Lee Majors has over 20 years of spill response experience with ten years in the marine environmental field with the U.S. Coast Guard. The last seven years he has been the Planning and Development Manager for Alaska Clean Seas overseeing Oil Spill Response Research and Development, Spill Response Training, and Safety.

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Speaker Bios

Joseph Mullin

Joseph Mullin,
Minerals Management Service
Engineering and Research Branch
Herndon VA, USA

Co-authors: Randy Belore and Ken Trudel, SL Ross Environmental Research Ltd.

One myth in oil spill response is that "chemical dispersants do not work effectively in cold water." This is due to the general misconception that cold water inhibits dispersant effectiveness (DE) and the lack of experimental data to indicate otherwise. To address this issue, the U.S. Minerals Management Service (MMS) funded and conducted two series of dispersant experiments in very cold water at Ohmsett - The National Oil Spill Response Test facility, located in Leonardo, New Jersey from February-March 2006 and January-March 2007. Four Alaskan crude oils Alaska North Slope (ANS), Endicott, Northstar and Pt. McIntyre and two dispersants Corexit 9500 and Corexit 9527 were used in the test series. The crude oils were tested fresh, weathered by removal of light ends using air sparging and weathered by placing the oils in the tank in both breaking wave conditions and non-breaking wave conditions. Results from the 2006 and 2007 Ohmsett test series demonstrated that both Corexit 9500 and Corexit 9527 dispersants were more than 90% effective in dispersing the fresh and weathered crude oils tested. This verified the results from laboratory and small-scale experiments. MMS expects that results from these test series will assist government regulators and responders in making science based decisions on the use of dispersants as a response tool for oil spills in the Arctic. The results from the 2006 and 2007 Ohmsett dispersant effectiveness test series bust the myth that chemical dispersants are not effective in cold water.

Mr. Mullin is a Research Oceanographer with 34 years of scientific research and program management experience in the areas of marine science and oil spill response. He is responsible for developing, implementing and managing the U.S. Minerals Management Service's Nationwide Oil Spill Response Research Program.

Mr. Mullin has been closely involved in the development, testing and evaluation of various oil spill equipment and techniques including fire resistant booms, skimmers for broken ice conditions, in situ burning in various environments and cold water dispersant effectiveness. He has authored or co-authored 120 scientific papers, technical articles and peer-reviewed publications.

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Speaker Bios

Tim Nedwed, Ph.D., P.E.

ExxonMobil Upstream Research Company
Houston TX, USA

ExxonMobil Upstream Research Company (URC) has an internal oil-spill response research program designed to enhance capabilities in dynamic marine ice conditions. The research has focused on developing capabilities for large-scale spills using the remotely applied techniques of chemical dispersants and in-situ burning. These techniques may provide the necessary oil spill encounter rates in a challenging ice environment while keeping personnel safely away from potentially hazardous conditions.

Research findings indicate that dispersants are an option for spills in ice given adequate mixing conditions and the appropriate oil. To enhance capabilities, URC is developing a new dispersant gel that has a number of advantages. For conditions with inadequate ambient mixing, URC has developed a concept to utilize the prop wash of response vessels to supply the necessary energy to disperse chemically-treated oil. URC is developing a better understanding of the fate of oil after a marine spill particularly after dispersant treatment in low-energy conditions.

Regarding *in situ* burning, URC led the recently completed joint-industry research project evaluating the concept to extend in situ burning to lower ice conditions using chemical herders.

URC is beginning evaluation of a novel concept that utilizes a well known physical phenomenon to remotely map and detect oil spilled under ice.

This presentation summarizes key components of URC's oil-spill response research program.

Dr. Nedwed has a B.S. degree in chemical engineering and a Ph.D. in environmental engineering. He has worked for Exxon and ExxonMobil in the Upstream Research Company for 10 years and leads the oil spill response research program for the upstream portion of the corporation.

ExxonMobil Research on Remotely Applied Response Options for Spills in Dynamic Ice

ExxonMobil Upstream Research

International Oil and Ice Workshop

Anchorage, Alaska
October 10 -11, 2007

Sponsored by: ACS, Alaska DEC, Cook Inlet Spill Response Inc., Oil Spill Recovery Institute, USCG, U.S. MMS

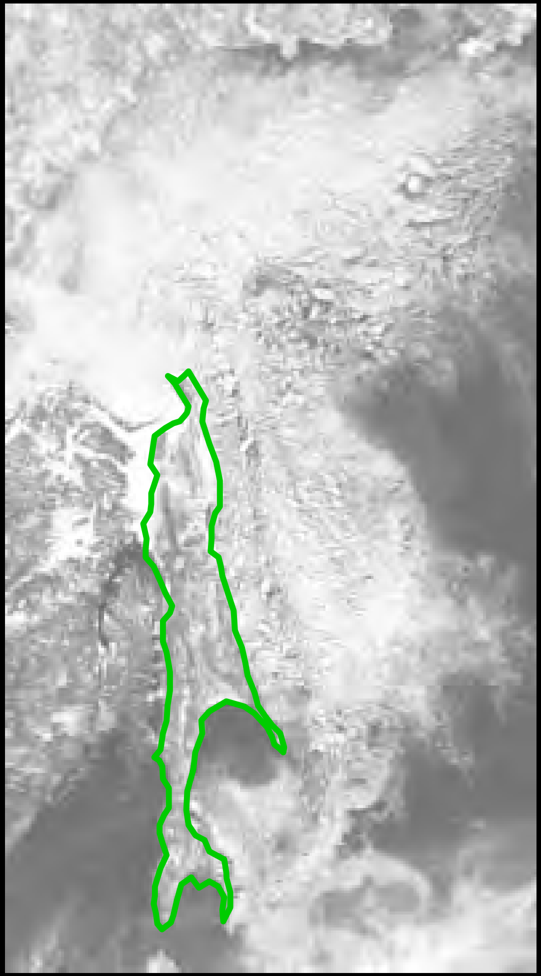
Organized by: S.L. Ross Environmental Research and DF Dickins and Associates

FESCO Sakhalin

Orlan Platform

Dekastrie SPM

Sakhalin Ice Conditions



AVHRR satellite image
April 7, 1999
Island length = 950 km

Sakhalin Tanker Trials

Sakhalin Ice Floe

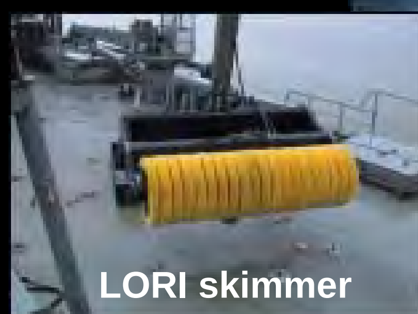
Why focus on "remotely applied" response options?

Four broad options for oil-spill response in both ice and open water

- Observation only
- Mechanical recovery
- In situ burning
- Dispersants

(In situ burning and Dispersants: remotely applied options)

Rope mop skimmer



LORI skimmer

Gulf of Finland spill cleanup with LORI skimmer

Mechanical response is challenged by ice

Background – Initial Research Focus

Dispersants

- Show that dispersants can work in ice
  - Ice motion enhanced dispersion
- Limitations: oil viscosity / mixing energy

In situ burning

- Ice can provide containment
  - Can burn in all ice conditions
  - Can burn emulsions
- Limitations: slick thickness / weathering

Chemical dispersion of oil in ice at OHMSETT—ice motion enhanced dispersion

2002 Tests studied limits to ISB in ice

1983 Test burn effective in concentrated ice

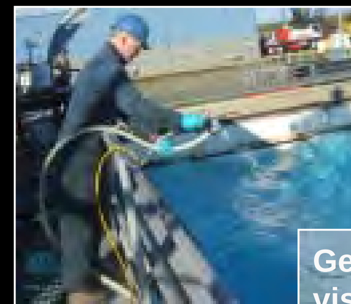
ExxonMobil Research on Remotely Applied Response Options for Spills in Dynamic Ice

ExxonMobil Upstream Research

New Dispersant Gel

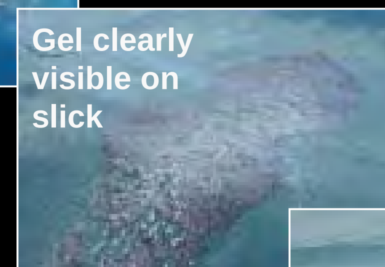
SL Ross Wave Tank

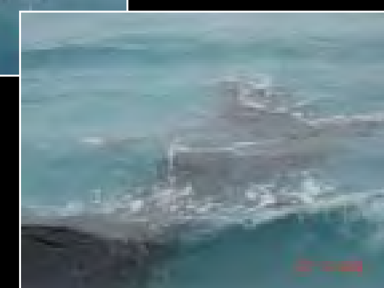
OHMSETT Wave Tank

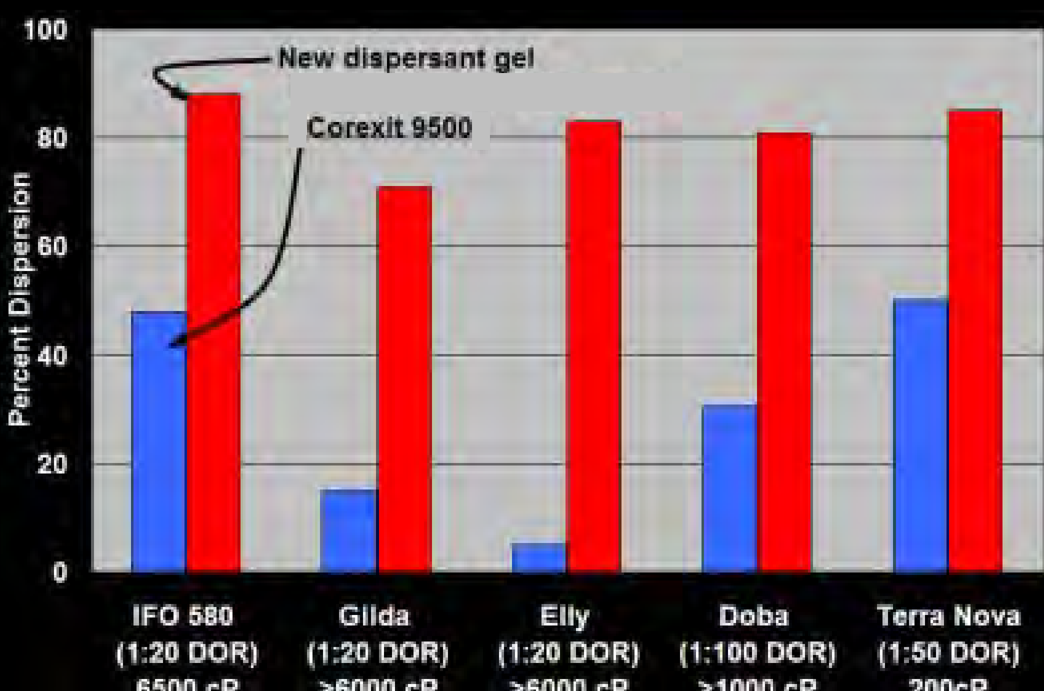


New formula

9500 immediately after application







Advantages

- May triple delivery capacity
- Allows dispersion of viscous oil
- Reduces spray drift
- Visible after application
- Buoyant, cohesive drops

New Dispersant Gel

New Formula Dispersed the Prestige Oil

C9500 New Gel

C9500 New Gel

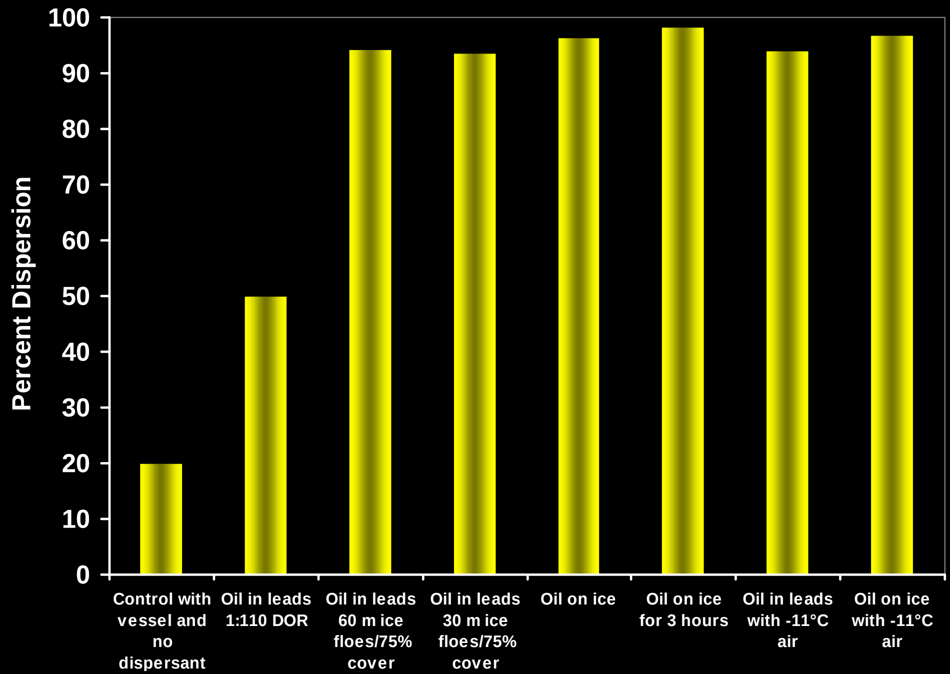
Icebreaker Enhanced Dispersion

Chemical Dispersion Enhanced by Icebreaker Prop Wash

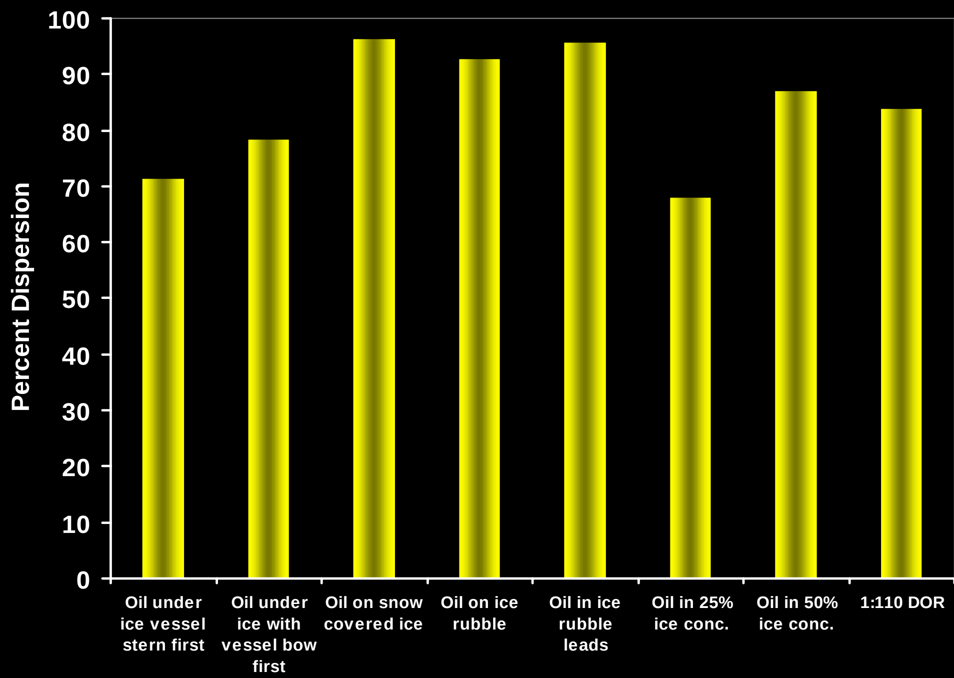
Azimuthal Stern Drive Icebreaker

Completed positive basin tests

URC-Funded Model Basin Test Results

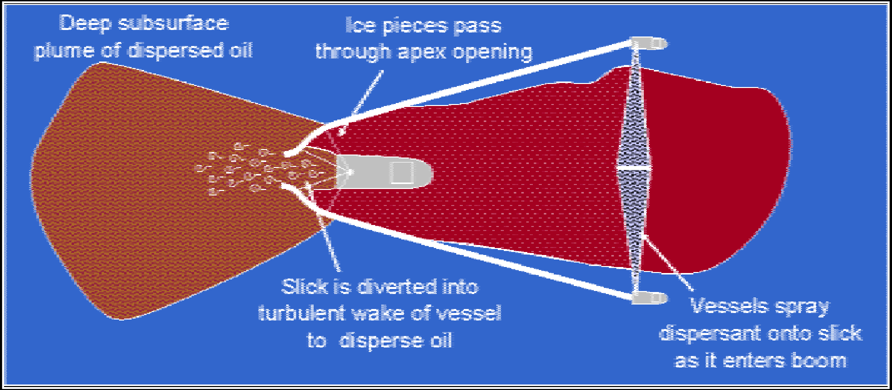


BP-Funded Model Basin Test Results

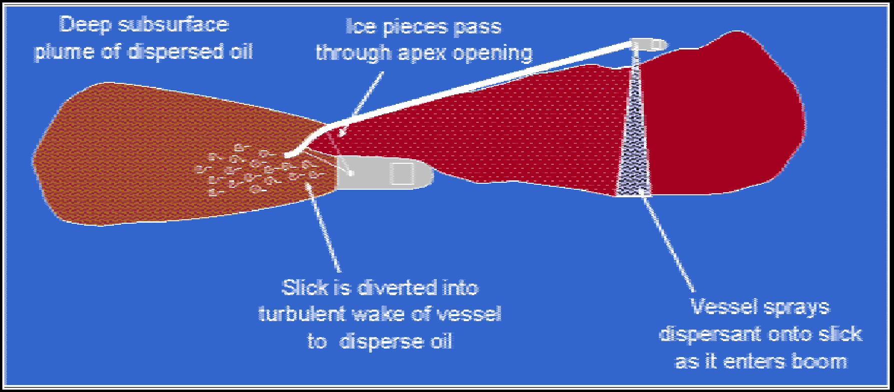


Diversion Boom Concept

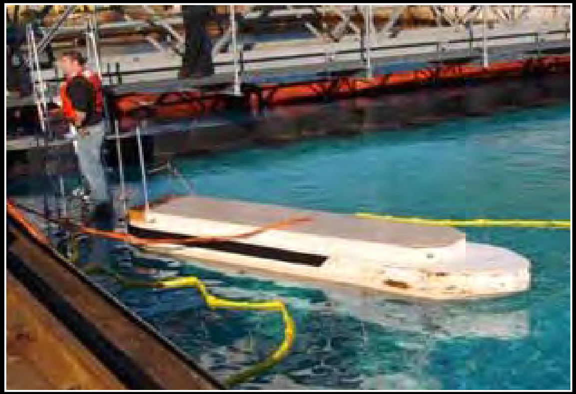
Extending the Prop-wash Concept to Vessels of Opportunity and Lower Ice / Open Water



Three Vessels of Opportunity and Two Booms



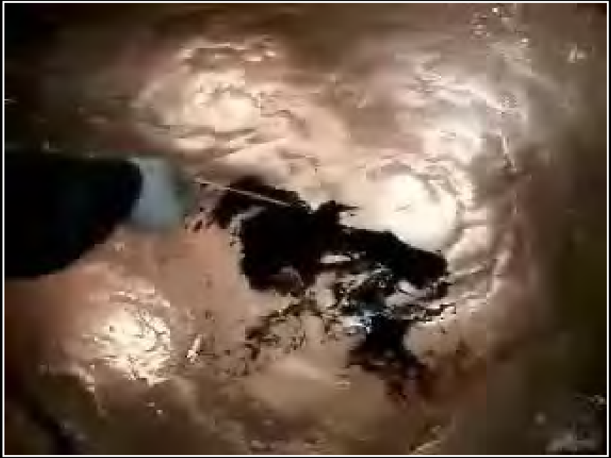
Two Vessels of Opportunity and One Boom

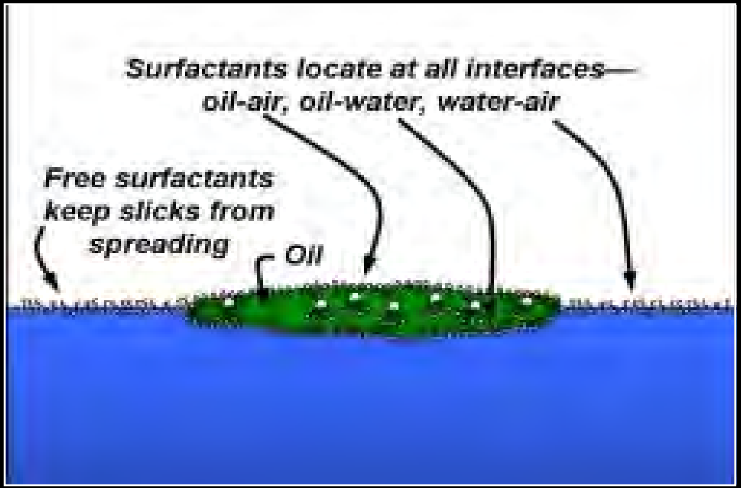


Completed basin tests using 1:25 scale workboat

Restricted Spreading Biases Dispersant Effectiveness Tests

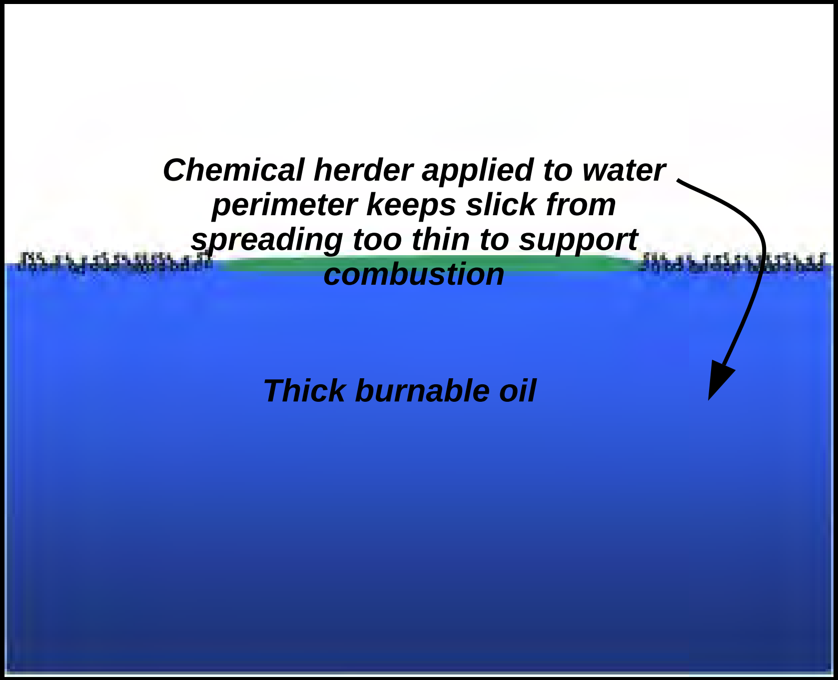
- Closed systems keep slicks from spreading
  - – Beaker and basin walls
  - – Oil containment systems
- Surfactants on water surface keep slicks from spreading
- Surfactants cover all surfaces after dispersant application
  - – Overspray onto adjacent water
  - – Migration from oil
- Restricted spreading increases the amount of energy required for dispersion
  - – Not an issue for conventional oils with adequate mixing
  - – Negatively biases dispersants effectiveness with
    - + Low energy conditions
    - + Viscous oils





In situ Burning Enhanced using Chemical Herders

- **Led joint-industry project evaluating herders**



Chemical herders may extend in situ burning to lower ice concentrations

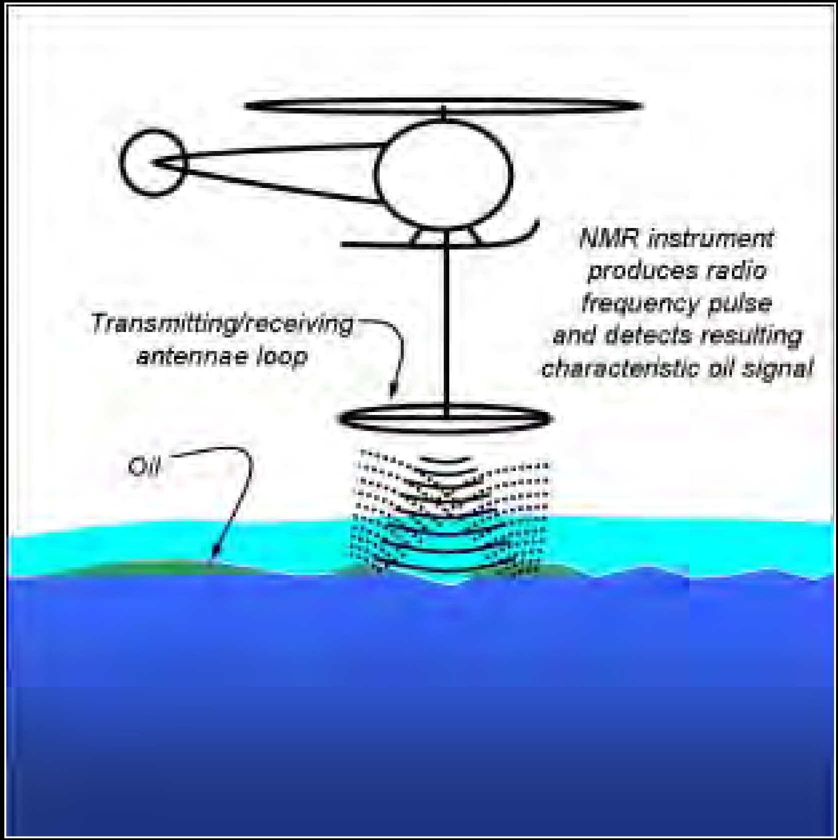
Enhance in situ burning using chemical herders

Lab-scale tests

Remote Sensing of Oil Under Ice

- **Enhancing remote detection of oil under ice is an important need**
- **NMR is the only technique to characterize water aquifers remotely**
- **Relatively simple instrument that utilizes Earth's magnetic field**
- **Ice is virtually invisible to the instrument**

Utilize nuclear magnetic resonance in the Earth's magnetic field



Summary

Our findings indicate

- *Dispersants work in ice given enough mixing energy*
- *EM's new dispersant gel allows more efficient use of dispersants—may triple capacity and allow treatment of cold/viscous oil*
- *ASD Ice breakers and EM's diversion-boom concept effectively supply mixing energy if needed*
- *Standard tests may bias dispersant effectiveness tests particularly for challenging conditions*
- *In-situ burning is effective if ice containment is sufficient*
- *Chemical herders extend in-situ burning to lower ice conditions*
- *New remote detection concept using NMR may close important gap*

The End

Speaker Bios

Mikko Niini

President, Aker Arctic Technology Inc
Helsinki, Finland

The paper describes the recent revolutionary improvements made in ship technology for operations in ice and describes the new possibilities available through the use of azimuthing thrusters in ice going vessels. In addition to describing the recent applications of such new technologies and especially the improvements in ship operations safety Mr. Niini will be discussing the possibilities of using such new technologies in new oil combating vessel designs and in combating operations.

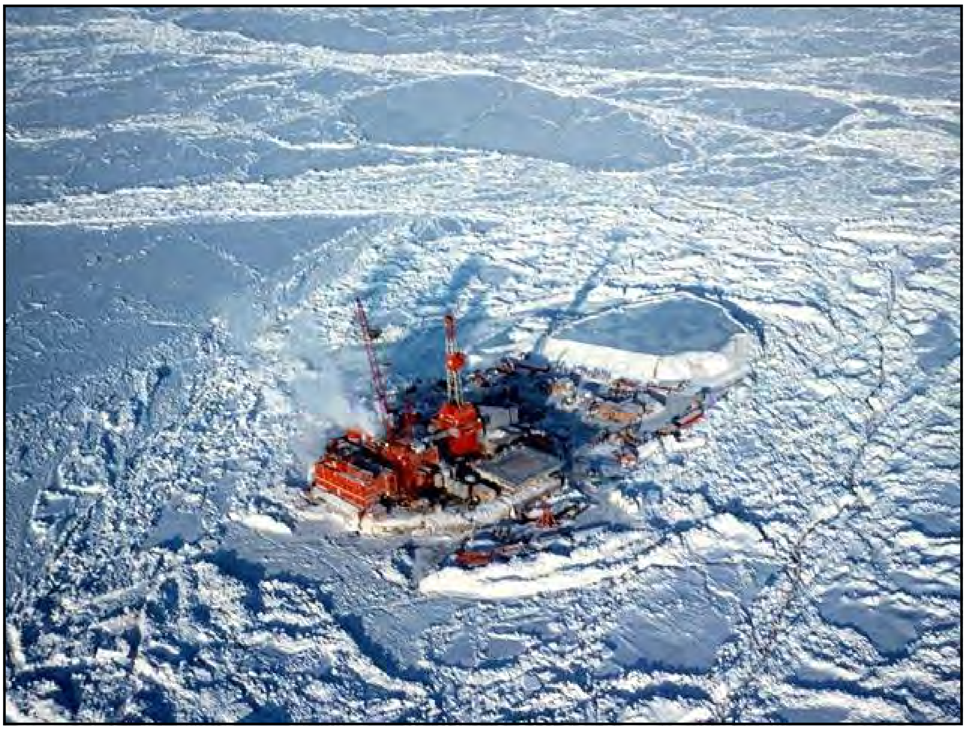
Mikko Niini, born 1946, graduated from Helsinki Technical University as a Naval Architect in 1970. While completing his studies Mikko joined Wärtsilä Helsinki Shipyard in 1970 for the "Manhattan" project and developed his thesis on the basis of the very first ice model tests in Finland. Since then Mr. Niini has held different positions within design, marketing, publicity and sales. After the merger of Wärtsilä and Valmet shipbuilding activities in 1986 he continued as Vice President, Marketing and Sales of Kvaerner Masa-Yards Inc. In recent years Mikko Niini has led Aker Yards (ex Kvaerner Masa-Yards) to be involved in oil and gas transport developments in North of Russia, Sakhalin and the Caspian Sea. The yard has been awarded contracts for the first icebreaker new building for the Sakhalin projects and for the world's first Arctic container vessel for OJSC Norilsk Nickel. In the beginning of 2005 Mikko Niini was appointed President of Aker Arctic, a newly established company for widening Aker's business scopes in the icy waters. Aker Arctic has already won two important design contracts, for the world's first Arctic shuttle tankers, two for ZAO Sevmorneftegaz/JSC Sovcomflot being built in St. Petersburg and another three for ZAO Naryanmarneftegaz/JSC Sovkomflot being built at Samsung in Korea. Currently Aker Arctic develops new solutions for oil combating in the Baltic Sea.

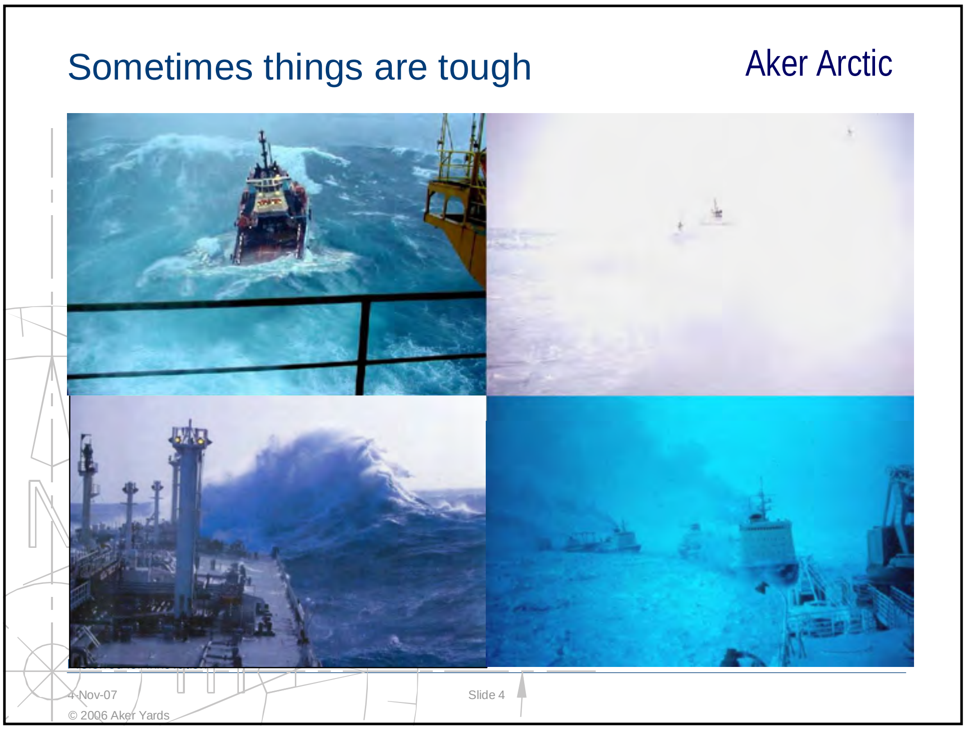
Aker Arctic

New Arctic Vessel and Icebreaking Technologies

Mikko Niini, President
Aker Arctic Technology Inc
International Oil & Ice Workshop
Anchorage 10.10.2007

Preferred for Innovation



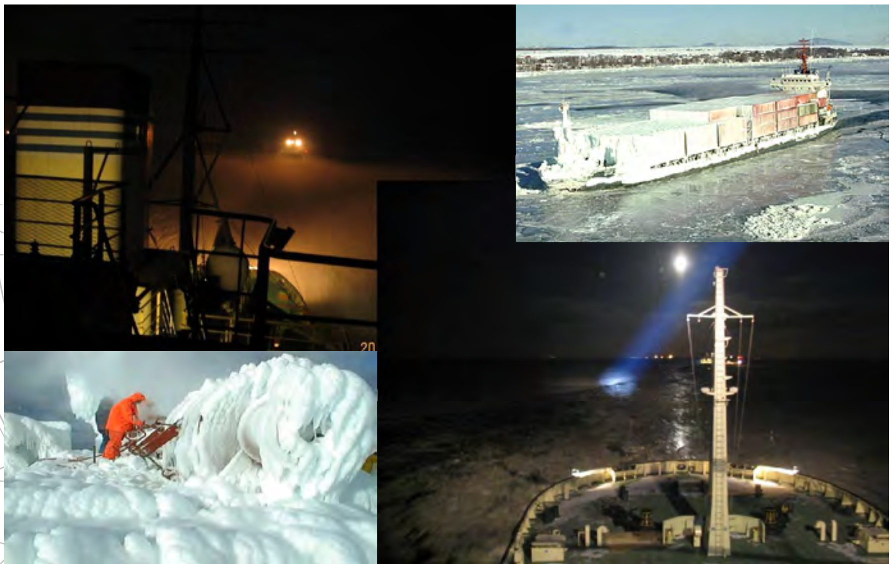

Sometimes things are tough
Aker Arctic
4-Nov-07
Slide 4
© 2006 Aker Yards

The challenge: harsh environments

Aker Arctic

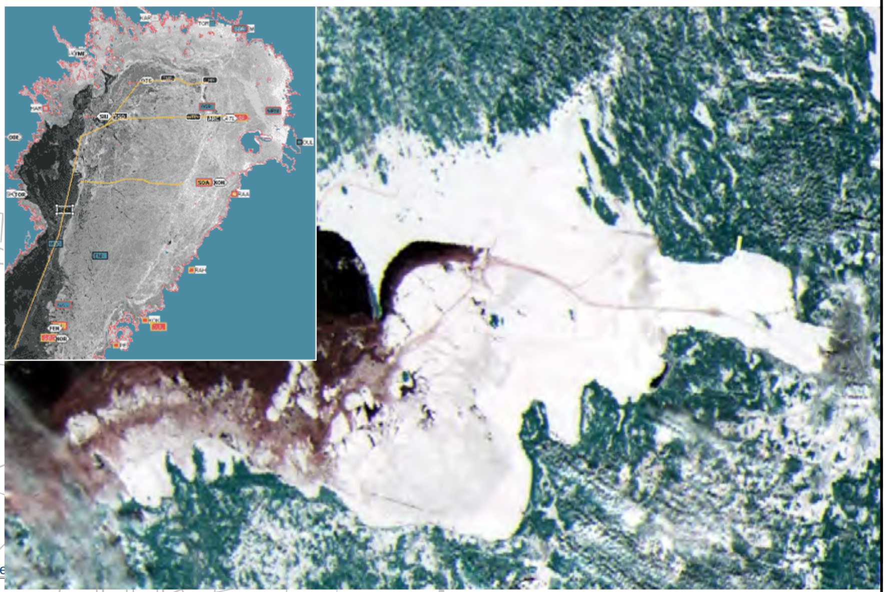
Winter is cold and dark

Aker Arctic



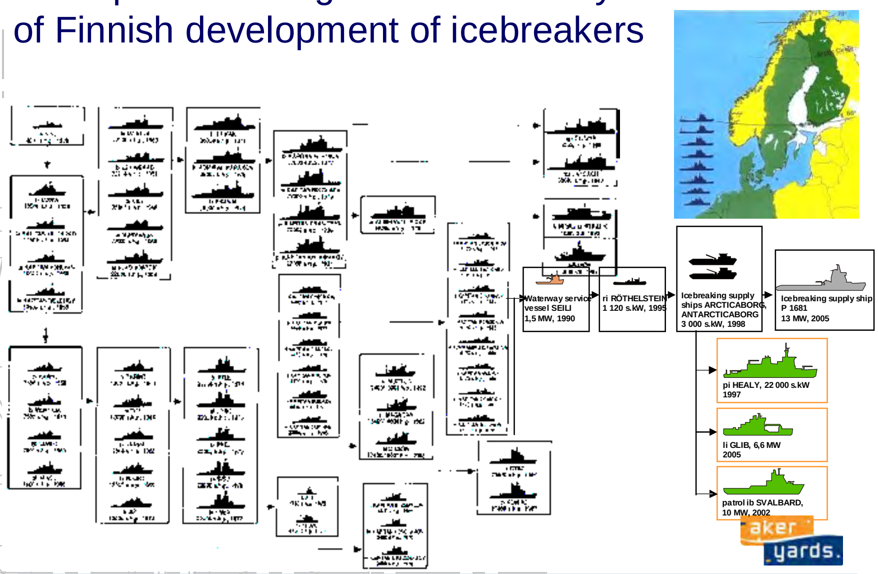
Baltic Sea- a freezing sea

Aker Arctic



Ice expertise background in the 50 years of Finnish development of icebreakers

Aker Arctic



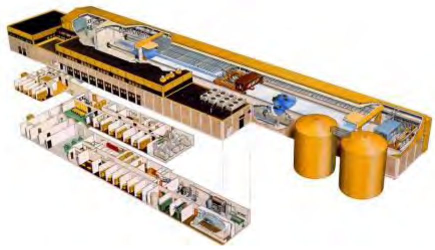
aker yards.

Aker Arctic

Idea for ice model tests raised by Exxon along the T/T ”Manhattan” experimental voyages to North Slope

Aker Arctic

35 years´ ice modelling experience



1954 1969 1982 1989 1991 2005

- 1954: Icebreaker ”Voima” delivered
- 1969: Project ”Manhattan”, Wärstilä Icebreaking Model Basin (WIMB) established
- 1982: Wärtsilä Arctic Research Center (WARC)
- 1989: Masa-Yards Arctic Research Center (MARC)
- 1991: Kvaerner Masa-Yards Arctic Technology Center (MARC)
- 2005: **Aker Arctic AARC**

Preferred for Innovation

aker yards.

Aker Arctic

We built the first polar icebreakers and opened the Northern Sea Route for year-round traffic in 1982

19 Arctic dry cargo ships

25 polar tankers

9 Polar icebreakers

2 Nuclear icebreakers

14 River icebreakers

aker yards.

Aker Arctic

Our Arctic experience includes design and construction of nuclear icebreakers

Multipurpose Icebreakers "Fennica", "Nordica" and "Botnica" from Aker Yards

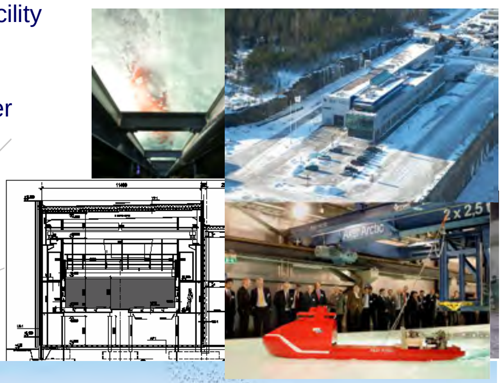
Aker Arctic

New facility constructed in 2005

New model testing facility opened in 2006

Aker Arctic

- A new third generation test facility erected in 2005,
- investment 10,3 Mill. €
- Beam increased to allow larger structures to be tested
- Glass bottom to improve observation
- Latest technology for freezing process
- Latest technology for data recording
- Best in the world



Aker Arctic Technology Inc – the global full service ice technology partner

Aker Arctic

- While restructuring Aker Yards operations, ice-related activity was separated from yards to an independent business unit, as a ”center of excellence”, to work globally
- Aker Arctic established and registered in 2005
- Equity 8 Mill. EUR
- AARC shareholders:

Aker Yards	62,5 %
ABB	12,5 %
Aker Kvaerner	12,5 %
Wärtsilä	12,5 %

- Board:
  - Oddvar Slettevold, chairman
  - Magne Håberg, Mikko Niini (AY)
  - Risto Neuvo (AKET), Lasse Mäkelin (ABB Marine), Jari Salo (Wärtsilä Propulsion)
- Turnover from 1,5 to 4,3 Mill. EUR (2006), further growth expected

Preferred for Innovation

Aker Arctic – today´s center of excellence specialises in tailored solutions for winter and Arctic operations

Aker Arctic

Field research
- Ice conditions
- Ice properties
- Route selection
- Design basis development

Concept development
- Basic design
- Feasibility studies
- Performance predictions
- Simulations

Testing in model and full scale
- Ships and structures
- Offloading operations
- Floaters
- Rescue and evacuation

Services include assistance to shipowners and shipyards building special vessels or offshore structures

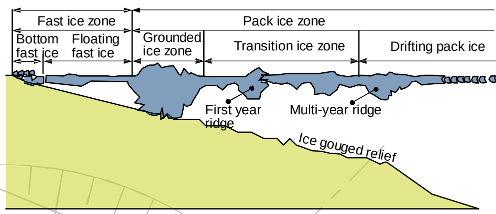
Aker Arctic

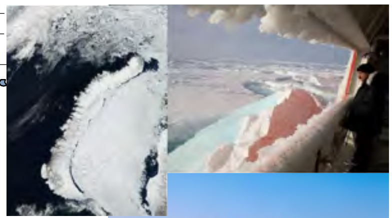
Project sales and project execution
- Tender packages, Basic designs
- Aker ARC standard designs
- Licence agreements
- Project executions
- Helsinki yard project design department merged with AARC
- Total staff 30 of which 25 naval architects

Ice navigation training

Aker Arctic

Field work has been continued





Sakhalin, Kara Sea, Spitzbergen, Greenland, Hudson Bay

Aker Arctic

Past experience and sufficient ice condition data available for reliable Design Basis

- Sakhalin, 1990/1991/1992/1997/1998/2007
- Barents Sea, 1991/1992/1993/2001/2005
- Pechora Sea, 1992/1993/1994/1998/1999
- Kara Sea, 1993/1995/2006/2007
- Ob Bay, 1995/1996/1998/2000
- Baltic,1994/1995/1996/1997/1998/2003
- Canada Arctic archipelago 2007
- ARCDEV 98, the EU-funded trial trip by M/T “Uikku” to Tambey in April 1998
- M/T “Uikku” Northern Sea Route passage as first foreign merchant vessel 1998

Preferred for Innovation

Full-scale experience, ships and ice conditions

§ BALTIC SEA, Scandinavia	100
§ LAKE SAIMAA, Finland	10
§ LAKE VÄNERN, Sweden	1
§ ARCTIC, Canada	12
§ ALASKA, USA	2
§ GREAT LAKES, USA	3
§ ANTARCTIC	5
§ ARCTIC, Russia	37
§ ARCTIC, Greenland, Spitzbergen	2
§ RIVERS, Russia	13
§ SAKHALIN, Russia	7
§ CASPIAN SEA, Kazakhstan	1

Picture: Aker Arctic DAS™ vessel "Pacific Endeavour" ice testing at Greenland

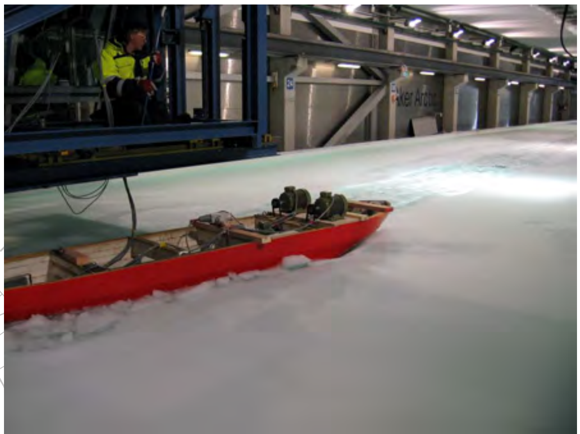
New challenges met recently

Aker Arctic

AKER ARCTIC PARTICIPATES IN RUSSIA´S PROGRAM FOR NEW NUCLEAR ICEBREAKERS - Record ice conditions created in the new AARC Technology Center

The new generation icebreaker is set to break 2.85 m thick level ice with the power of 60MW. The performance of the tests was very challenging. The scale of the Russian built models resulted to extreme ice thickness in the basin. However, it was noted that the thickness model ice thickness 84mm was reached with no difficulty even in summer outside temperatures. It was also noted that ice thickness well over 100 mm is reachable.

AARC is currently operating its third ice. Later this fall Aker Arctic will take on again new testing challenges as model tests in multiyear ice conditions will be simulated.



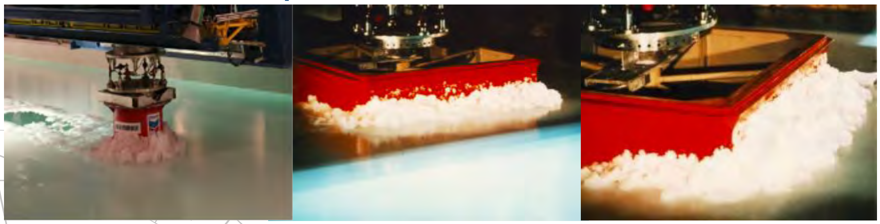
aker yards.

Preferred for Innovation

4-Nov-07

Aker Arctic

Offshore is an important part of Aker Arctic´s operations



Ice rubble formation on gravity based structures (D-6, Prirazlomnoye, SSDC) and a SPAR.

Aker Arctic

Future needs for ice model tests in offshore activities

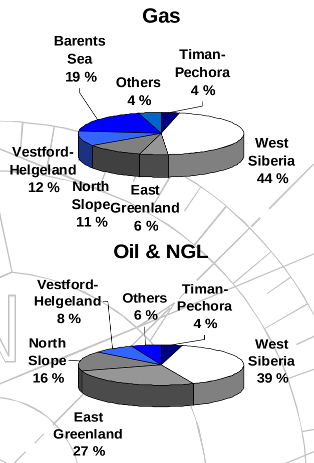
- The mission based approach in concept devevelopment call for model testing to set the performance requirements
- New types of activities in offshore operations lead to unkown phenomena, which need to be studied with model tests

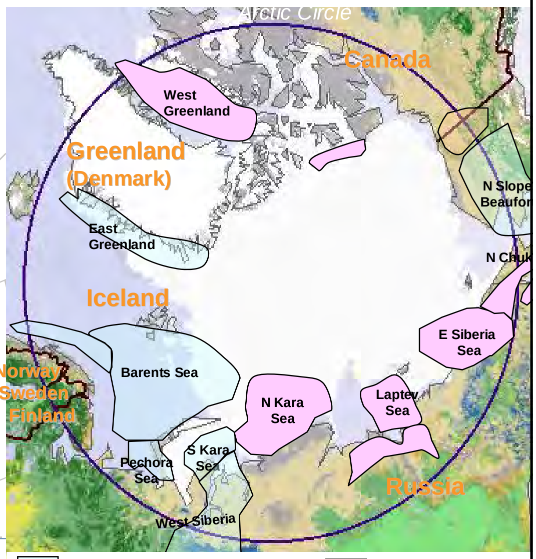
Preferred for Innovation

Aker Arctic

The opportunity
25% of world's undiscovered resource in the Arctic

*USGS study





Basin include in USGS study Basin excluded

Preferred for Innovation

4-Nov-07

Aker Arctic

While the market was "dead", important developments took place

- the recent developments for cost efficient Arctic navigation by Aker Arctic

Double Acting Supply Vessel

Oblique Icebreaker

Preferred for Innovation

4-Nov-07

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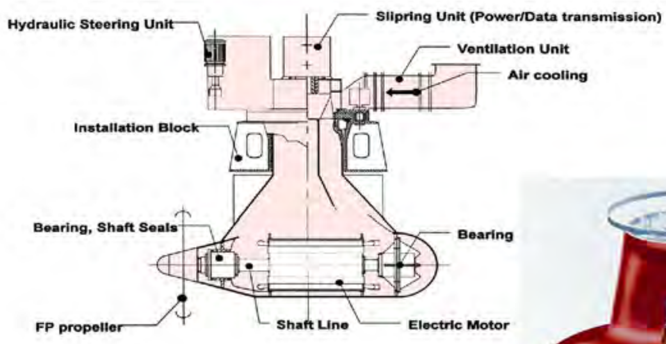
Electric propeller turning 360 degrees and to give full thrust to any direction

Aker Arctic



This turned out to become later Azipod®

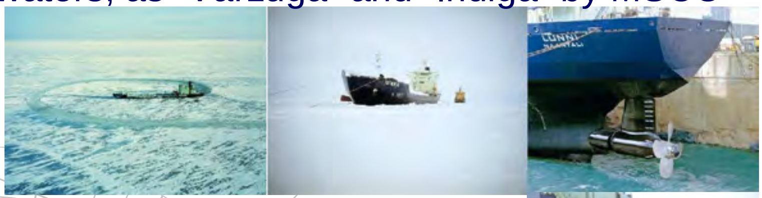
Preferred for Innovation

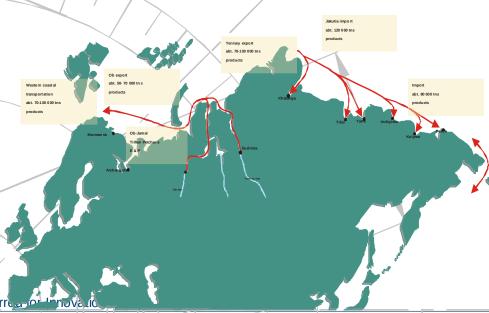
The new propulsion system development and the "Uikku" conversion in 1993

Aker Arctic

After 10 years of Arctic pioneering work “Uikku” and “Lunni” are today back in the Arctic waters, as “Varzuga” and “Indiga” by MSCO

Aker Arctic





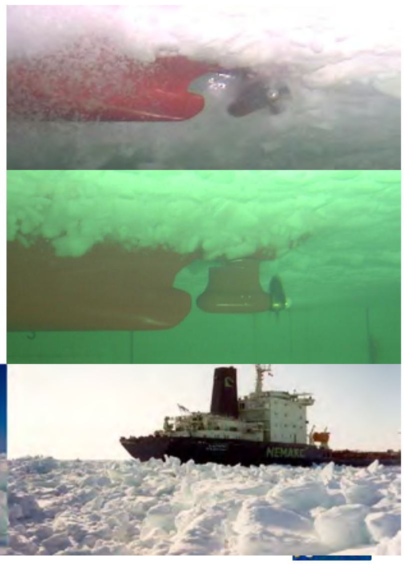
Today 15 years of Arctic experience for pod drives

aker yards.

Aker Arctic DAS™: Innovation by experience

Aker Arctic

- **Excellent performance**
- **Successful running backwards when moving ahead was impossible**
- **Learned a new way of operation**
- **Ridge destruction with the propeller**
- **Best performance in most difficult conditions**
- **Ice resistance down to 50 %**
- **Power requirements down to 60 %**

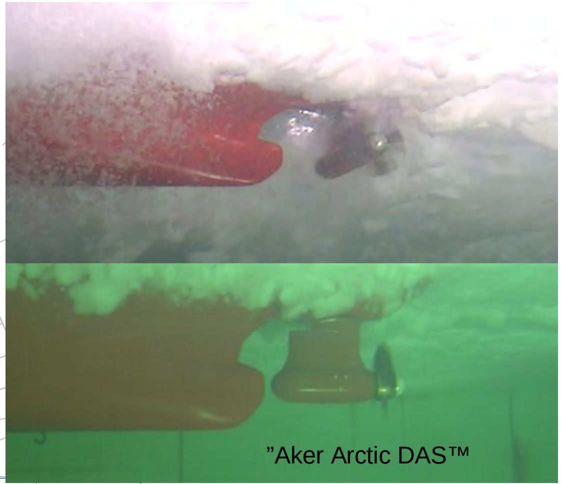


Aker Arctic

Learning by experience:
Propeller acts as a big pump to flush the hull

The idea of ”double-acting” vessels is based on azimuthing thrusters flushing the hull by the propeller stream.

In level ice, frozen channels, rubble fields and ridges the propeller flushses the lower ice pieces and ”eats up” the ice rubble.



Preferred for Innovation

Aker Arctic

First double-acting IBSSV´s in the North-Caspian, 9 years in service

The Wagenborg “Aker Arctic DAS™” double-acting" icebreaking supply vessels working for AGIP KCO (Kashagan East)

Main dimensions: 65 x 16,4 x 2,9 m

Power 2 x 1,6 MW

icebreaking capacity max. 1,0 m level ice

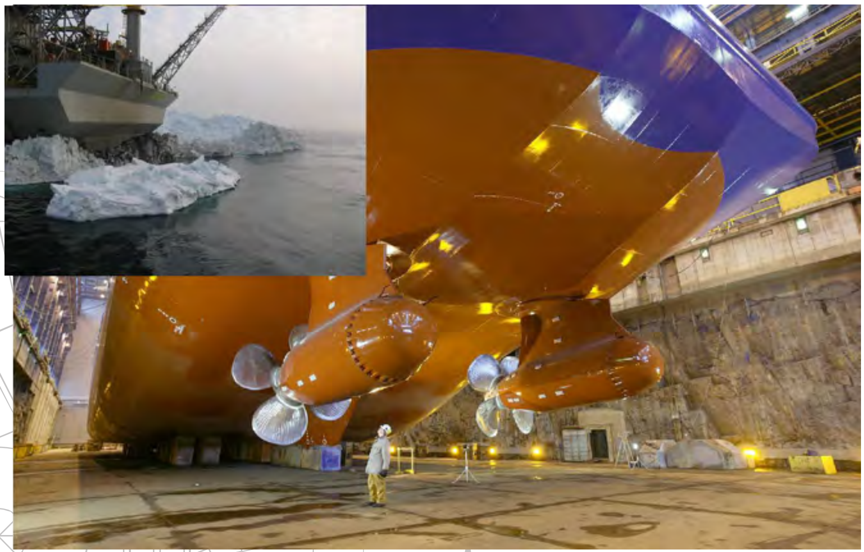
Penetration through grounded ridges


Aker Arctic
Excellent performance in any conditions
Aker Arctic DAS™
in Great Lakes by USCG
aker yards.
4-Nov-07
© 2006 Aker Yards
Slide 33


Aker leads the way for the maritime industry today
Aker Arctic
Norilsk Nickel 5 vessels
2006-2009
World´s first Arctic oil export systems:
Aker Yards´ DAS concept selected 2007/9
2 x 70 ktdw shuttles Admiralty/Gazprom
3 x 70 ktdw shuttles Samsung/LUKoil,COP
2 x 105 ktdw shuttles Sumitomo/Neste Oil
Sakhalin 1 & 2 projects, all new
icebreakers delivered by Aker Yards
Preferred for Innovation
4-Nov-07
© 2006 Aker Yards
Slide 34

Aker Arctic

”Double-acting” concept thoroughly selected by Exxon



Double-acting performance

Aker Arctic

FESCO SAKHALIN

- SUPPLY AND STAND-BY SUPPORT FOR ORLAN PLATFORM
- DNV ICEBREAKER ICE-10
- LOA = 99.9 m
- B =21.0 m
- T = 7.5 m
- DWT = 4 298 T
- GT = 6 882
- MCR = 17 400 kW
- 2 * 6 500 kW ABB Azipod

aker yards.

Preferred for Innovation

All Sakhalin newbuildings from Aker, all model tested by us

Aker Arctic

AY recently built Ice Classed OSV's

- Fesco Sakhalin
- Polar Pevek
- Pacific Endeavour
- Pacific Endurance
- Pacific Enterprise

Picture by Harald Valderhaug

Preferred for Innovation

Polar Pevek for De Kastri terminal

Aker Arctic

POLAR PEVEK

- TANKER ASSISTANCE IN THE DE-KASTRI TERMINAL
- DNV ICEBREAKER ICE-10
- LOA = 74.3 m
- B = 17.0 m
- T = 6.1 m
- DWT = 940 T
- GT = 3 396
- MCR = 11 000 kW
- 2 * ABB Azipod

Picture by Harald Valderhaug

aker yards.

Preferred for Innovation

Recent Ice Class OSV's

Aker Arctic

PACIFIC ENDEAVOUR

- FIRST OF THREE IB PSV´s FOR SAKHALIN 2 (SHELL)
- DNV ICEBREAKER ICE-10
- LOA = 91.5 m
- B = 19.0 m
- T = 8.2 m
- DWT = 4 482
- GT = 4 992
- MCR = 17 280 kW
- 2 * 7 000 kW RRM Aquamaster ARC 1.0

Picture from Swire Pacific Web-site

Another Aker Yards built icebreaker, tested in model scale and full scale by Aker Arctic in Greenland and Spitzbergen

Aker Arctic

- Three UT 758 IBPSV´s for Sakhalin 2 project
- Delivered in April-October 2006
- Built by Aker Yards AS, Søviknes and Langsten, Norway
- Two 7,5 MW mechanical azimuthing thrusters
- Aker Arctic DAS™

Prefe

Aker Arctic

Our ultimate goal: cost efficient volume transports in Arctic

Aker Arctic

”Tempera” commissioned in winter 2003

M/T Tempera now five years in service

Ice performance verified in practical work in the Primorsk export shuttle service.

Full scale trials in 2003:

§ level ice 80 cm at 5,0 kn

- broken channels 7 knots
- ice ridges (4 metres) at 3 knots
- maximum ridge penetration 13 metres (maximum) found in the region)

Preferred for Innovation

”Norilskiy Nickel” in Kara Sea, March 2006

Delivered after succesful ice trials on April 12th, 2006. Vessel currently in regular trade from Murmansk to Dudinka in the Kara Sea, proving her capability in year-round independent operation. Ice class LU7.

Aker Arctic

Proven ice performance lead to a contract for four more vessels under a licence from Aker Arctic

- Ice condition: level ice 1.5 m, strength 700-800kPa
  - Power: 13 MW
  - Speed Astern: 1.75 m/s (3,3 kn), Ahead 1.25 m/s (2,3 kn) (model tests: 1.02, 0.85 m/s)
- Power needed to break 1.5 m thick ice in 2 knots: Astern 8.5 MW, Ahead 11.5 M
- Speed in frozen Yenisey channel with 13 MW: Ahead 3.75 m/s (7.5 knots)
- Speed in unfrozen Yenisey channel with 13 MW: 4.5 m/s (9 knots)
- Speed in own 1.5 m thick unfrozen channel with 5 MW: Ahead 4.5 m/s (8.9kn), Astern 4.25m/s (8.5 kn)
- Speed in own 1.5 m thick unfrozen channel with 12 MW: Ahead 7 m/s (14.3kn)
- Average speed in frozen rubble field running astern for 5 miles was 1 knot (no chance to run ahead)

Preferred for Innovation

Aker Arctic

Aker Arctic transport solution already selected for two major Arctic oil projects - Prirazlomnoye

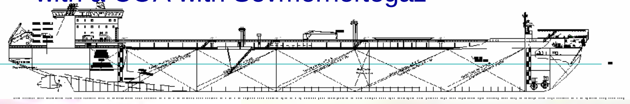
- **Width** 126 m
- **Length** 126 m
- **Height from the sea level** 120 m
  Weight(without hard ballast)110 000 t
  (with hard ballast) 506 000 t
- **Well slots** 40
- **Total caisson capacity** 159 890 m3
- **Oil Tank Capacity** 108 814 m3
- **Maximum daily production** 20 748 m3
  Staff 200 people
- **Stock replenishment period** 60 days
- **Life time** 25 years

aker yards.

Aker Arctic 70.000 tdw shuttle tankers for Pechora Sea

Aker Arctic

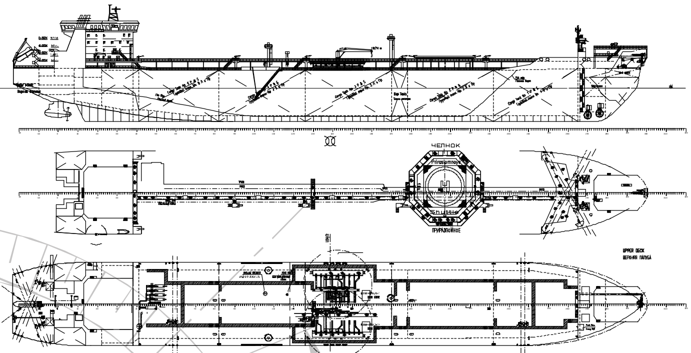
Prirazlomnoye; Admiralty yard, Owner Sovkomflot with a COA with Sevmorneftegaz



Aker Arctic contract for the Basic Design with Admiralty yard. Two ships to enter serviced in 2009

Prirazlomnoye Shuttle tanker

Aker Arctic



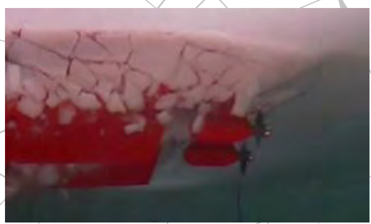
- Dual Class	Russian Register Lloyds Register
- Ice class	LU 6
- Length o.a.	258,75 m
- Beam	34,0 m
- Depth	20,8 m
- Draught	13,6 m
- Deadweight	70 000 t
- Proplusion power	17 MW

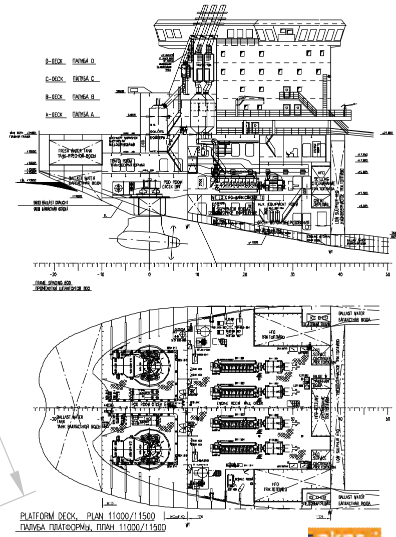
-Basic Design	AARC
- Builder	Admiralty Shipyard
- Owner	SOVCOMFLOT/SMNG
- Keel laying	Summer 2007
- Delivery	End 2009
- Icebreaking capability	1.2 m+0.2m snow, 3 kts

Prirazlomnoye Shuttle tanker, Machinery

Aker Arctic

- Diesel generator sets: 4 x 6525 kW
- Propulsion Azipods: 2 x 8,5 MW

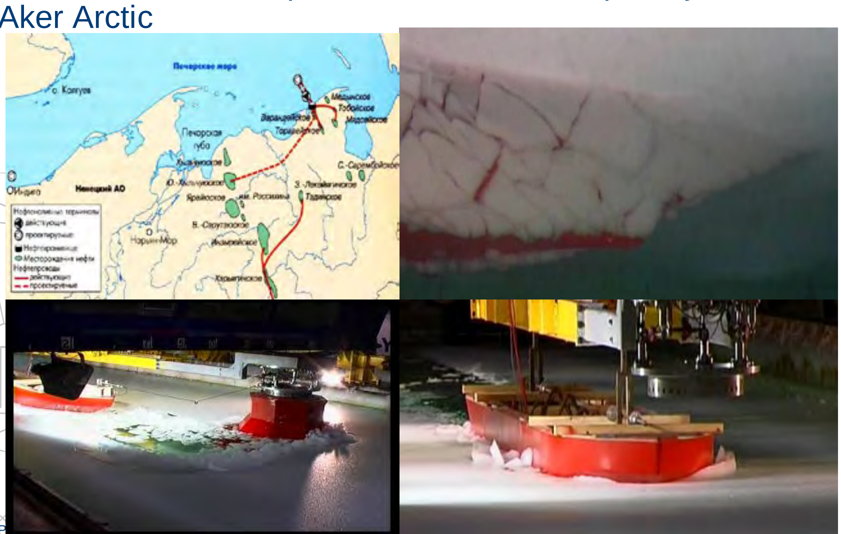




Preferred for Innovation

New solutions in Arctic oil exports systems: LUKOil/ConocoPhillips in Varandei, developed by Aker Arctic

Aker Arctic



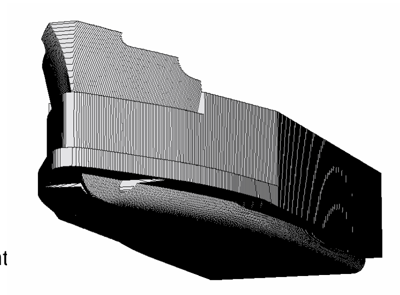
Sovcomflot contract for three 70.000 tdw vessels with Samsung, deliveries 2007-2009

Aker Arctic

- Another Aker Arctic DAS™ design concept
- World´s first marine Arctic Oil Export system
- In service December 2007
- Final design with twin 2 x 10 MW pod drives, ice class LU6
- Vessel unit price 138 M USD

Drilling ship leads the way to icy operations in Alaska

Aker Arctic



Shell has inititiated a drilling campaign in Alaska for 2007-2009 – the first since mid 1980´s. All the solutions developed and used for this Beaufort Sea operation are based on Aker Arctic´s engagement and solutions. Drillship " Frontier Discoverer" of Frontier Drilling USA Inc, Houston, is the first drilling vessel created for Arctic conditions.

Three of the icebreakers used for ice management in this drilling campaign are built by Aker Yards.

Multipurpose Icebreakers ”Fennica”and ”Nordica” will provide ice management for the Shell drilling campaign

Aker Arctic

4-Nov-07

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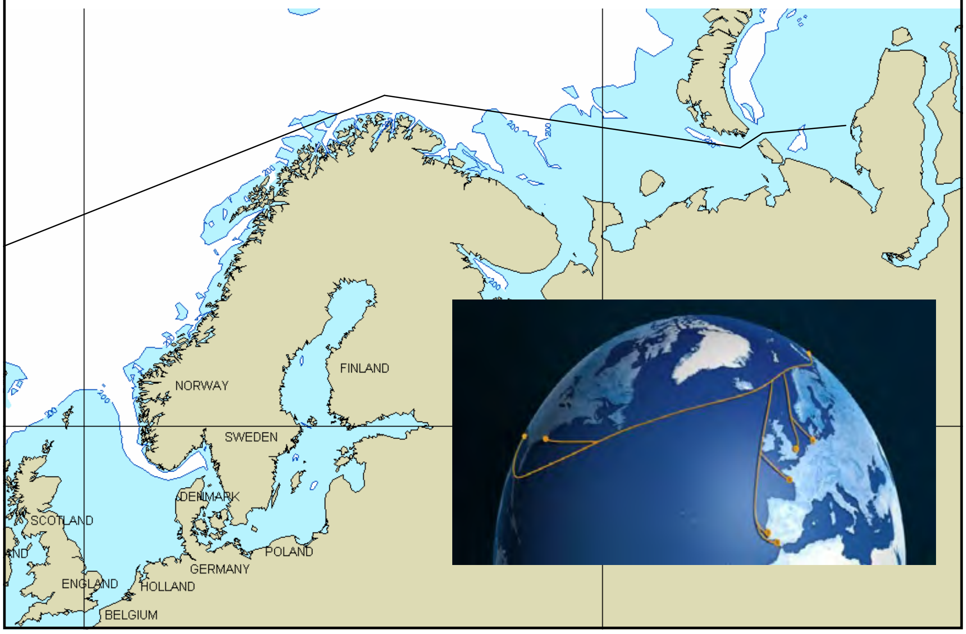
LNG transports from Yamal are possible

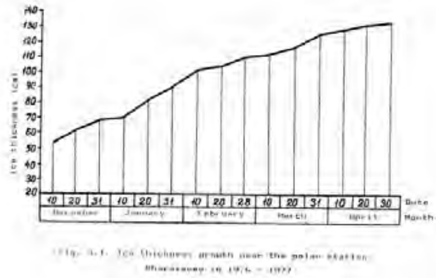
Aker Arctic

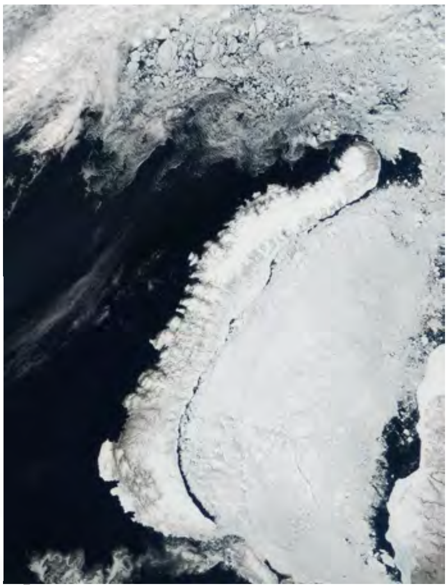


Kara Sea ice massif

Aker Arctic

Ice thickness at Kharasevey





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Aker Arctic LNG

Aker Arctic

Open water Mode:

The vessel will operate in the open water conditions as the normal tankers.

Podded propulsion provides good open water efficiency and easy arranagement of general spaces.

Ice operating Mode:

The vessel will operate stern ahead with pulling propellers.

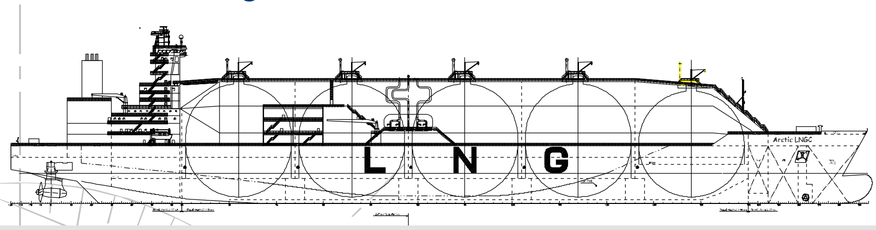
Very good ice breaking capability can be achieved with normal open water propulsion power.

Preferred for Innovation

4-Nov-07 Slide 56

Aker Arctic

Double Acting Arctic LNG



Main Dimensions

Loa	340 m
Lpp	324.90 m
Breadth, moulded	50.00 m
Depth	22.90 m
Design draught	12.00 m
Deadweight design	abt. 92,650 t
Scantling draught	12.7 m
Deadweight scantling	abt. 95,800 t
Gross tonnage	abt. 133,000
Cargo capacity	206,000 m3
Speed design draught	19.5 kn
Ice breaking performance @ 5 knots astern:1.5m / ahead:70cm	
Radius of action	abt.13,000 nm

Class

LR+100A1, Liquefied Gas Carrier, Ship Type 2G (Methane in independent tanks, Type B, Max. pressure 0.25 kg/cm2, Min. temperature -163°C) *IWS, +LMC, UMS, NAV1, IBS, SCM, LI, Ship Right (SDA, FDA, CM), ICC, TCM

Deep well pumps tanks 155 m.l.c	10 x 1,600 m3/h
Boil off rate	0.15%
Combined cargo heater/ vaporizer	
Inert gas/venting plant	
Bow thruster	abt. 2,000 kW

Machinery

diesel electric propulsion,
2 x Azipod: Output 2 x 18,000 kW

Diesel generator aggregates
dual fuel total abt. 46,000 kW
Fuel consuption 7.3t/h
Integrated automation system
Voltages for main consumers 11kV/6.6kV, 450/230V, 60Hz
Water/CO2/powder fire fighting system
Accommodation
Crew cabins incl. Pilot 49 pers.

Verified performance for Kara Sea

Aker Arctic

Level ice test results astern

170cm 4.9 knots

150cm 5.4 knot

Ridged ice astern

11-14m 0.8 knots

Heavy ice conditions can be penetrated with the same power level in the engines as are needed for the open water trade!

The real potential is in LNG trades with Arctic DAS carriers

Aker Arctic

Yamal – Europe/U.S. Gulf of Mexico

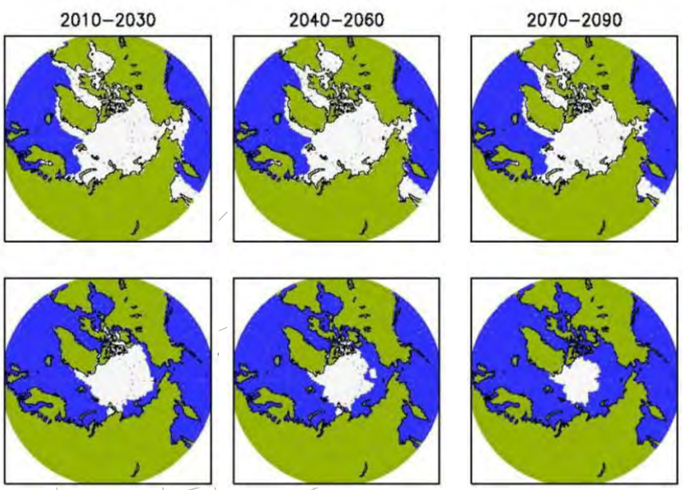
We have three major ongoing R & D projects:
-for developing large size Arctic pod drives, with CNIIMF, KSRI and RMRS
- for measuring thruster loads in order to find right dimesnioning basis in the future
- for developing contra rotating propeller solutions
-We are working also in projects related to LNG fuel and fuel cells in Arctic, and on ice induced vibrations and impacts to the gas containment system

Ice Coverage Predictions 2000-2100

Aker Arctic

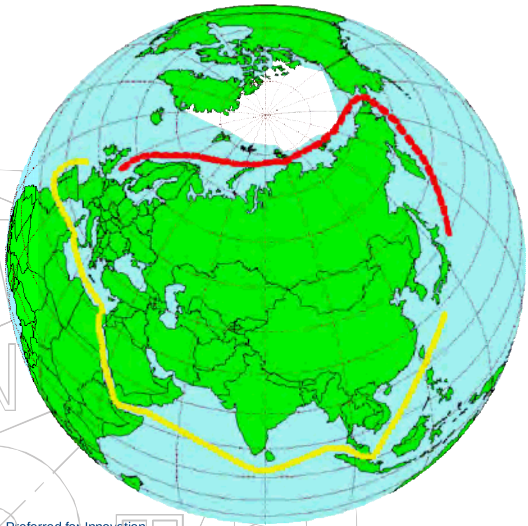
March

September



The Northern Sea Route (NSR) versus Suez Canal Route (SCR)

Aker Arctic



Hamburg - Yokohama

NSR = 6,920 sm

SCR = 11,430 sm

Preferred for Innovation

Study for the Instiutute of the North: Trans-polar Containership

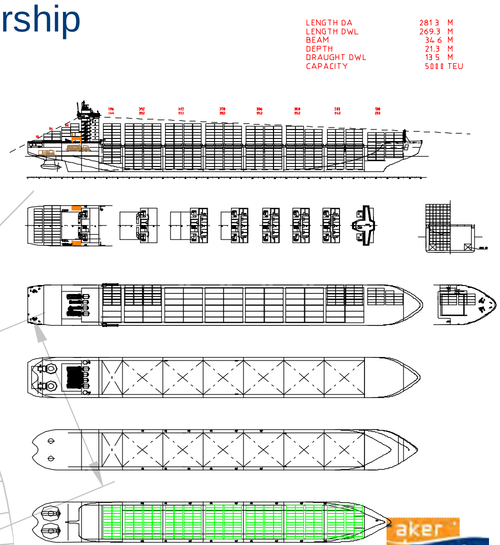
Aker Arctic

The "Norilskiy Nickel" experience has led one step closer to efficient trans-polar cargo liners in "economy-of-scale" sizes.

A feasibility study was conducted for US Government

2 x 17 MW pod drives,

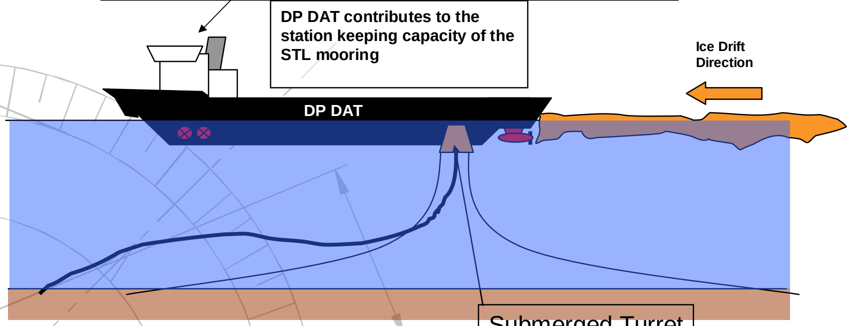
Transit time Alaska-Europe 11 days (summer), 20 days (winter)



Preferred for Innovation

Aker Arctic

Arctic Tanker Loading – one alterantive solution



Preferred for Innovation

Aker Arctic

The next need: Ice-going research vessel, capable of working in ice-covered waters

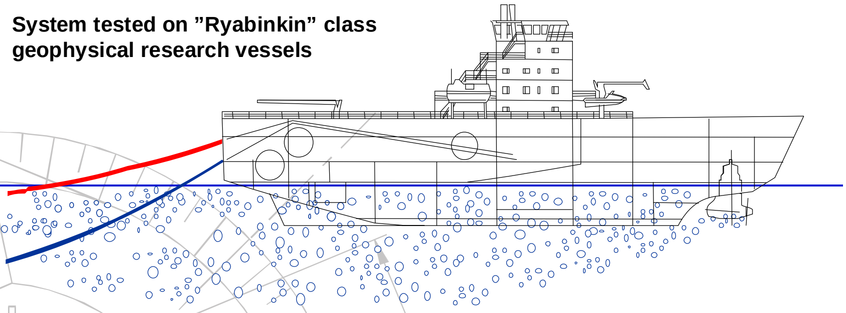
- bow thrusters secure the efficient and stable speed in ice conditions
- model test results confirm good propulsion efficiency for bow propellers
- no disturbing propulsion noises into the scientific system

- wide stern secures efficient seismic work
- hull form developed to leave a wide open channel behind the vessel
- no propellers to disturb the seismic work

Air bubbling used as noise barrier to isolate from propeller and ice breaking noise

Aker Arctic

System tested on "Ryabinkin" class geophysical research vessels

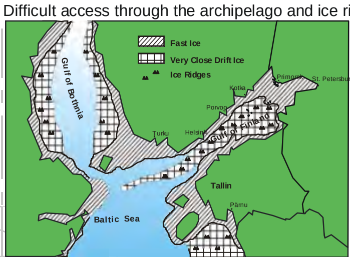


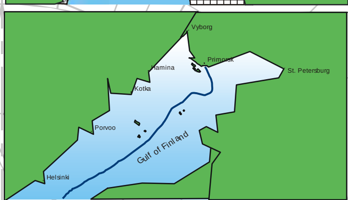
The Aker Arctic wide-stern seismic icebreaker with bow propulsion and an air bubbling noise barrier for work in Arctic environment. Aker Arctic has unique measurement data on underwater noise caused by e.g. the icebreaking itself. A related important study was conducted recently to an Owner wanting so far to be anonymeous.

Winter is our challenge in oil spill risks

Aker Arctic

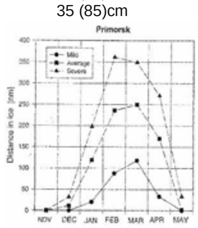
Difficult access through the archipelago and ice ridges

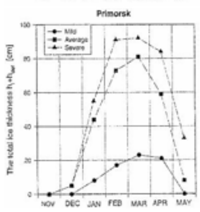




Gulf of Finland with the location of the Primorsk terminal and prevailing winter ice conditions.

	Average ice coverage (days)	Average (maximum) ice thickness
Primorsk	140	50 (90)cm
St. Petersburg	145	55 (90)cm
Porvoo	110	40 (89)cm
Tallin	90	35 (85)cm





A long-term statistical analysis of the ice conditions for the Primorsk terminal.

K.Riska

Port of Primorsk, 160 Mill tons/year

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IMO notified practice: Two icebreakers escorting minimum an IA ice class tanker

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Safe and reliable

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But sometimes only one is available

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.. or not any available, the whole convoy drifting on terms of the weakest

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Larger vessels are introduced, B-Maxes exceeding 200 000 tdw

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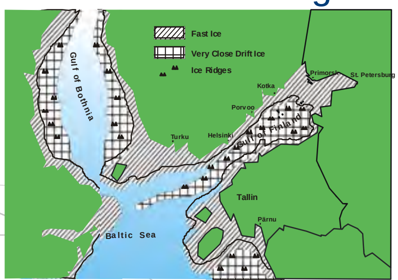
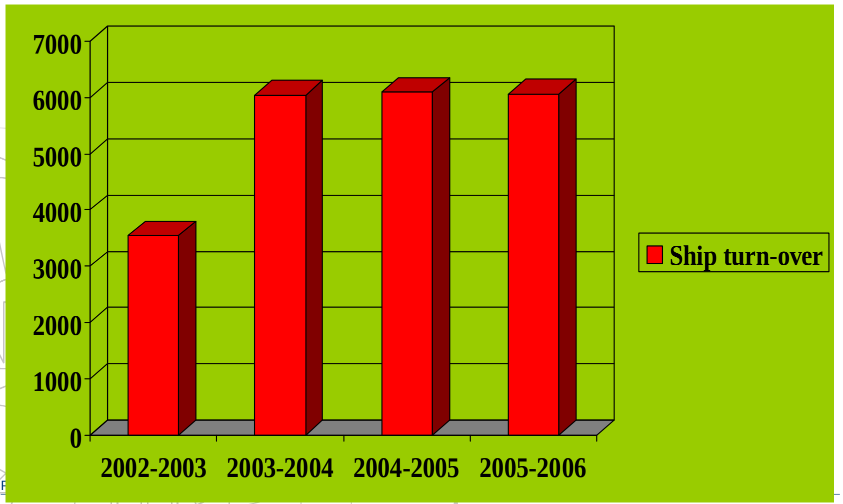


Total ship calls in Russian ports in the Gulf of Finland during winter navigations of 2002-2006

Aker Arctic



Number of port calls in Russian ports of Primorsk, Vyborg, Vysotsk and Ust – Luga during winter navigations of 2002 – 2006

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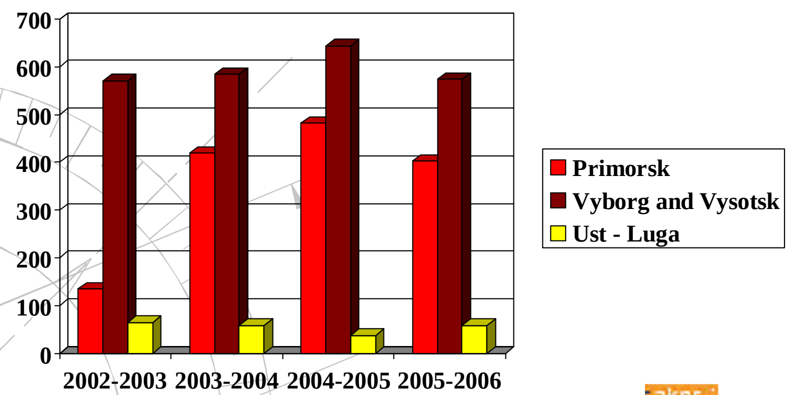

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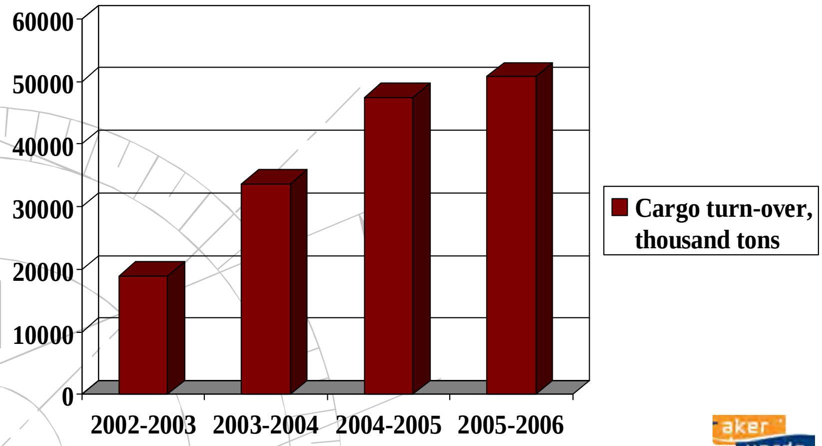
Total cargo turn-over of all Russian ports in the Gulf of Finland during winter navigations from 2002 to 2006



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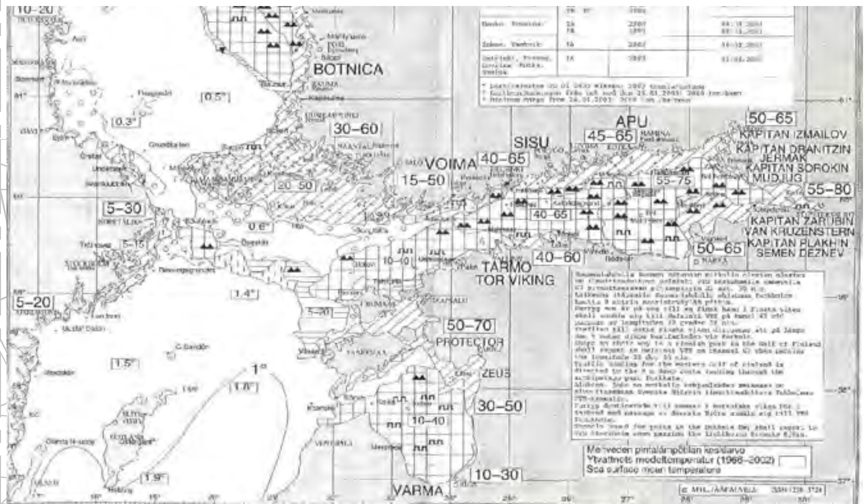
Gulf of Finland examples, February 2003



Shallow waters, many turns

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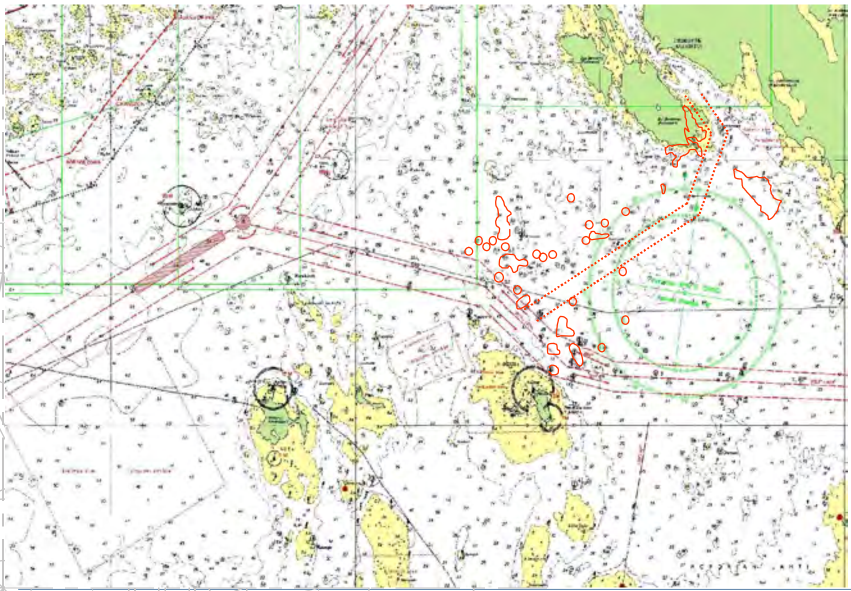

Oil spills, not if but when?

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Case ”Runner”, just fuel not cargo oil

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Typical platform, ORLAN in Sakhalin

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”FESCO SAKHALIN” for Sakhalin 1 (Exxon)

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Efficient dispersant management with azimuthing propulsion

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Oil combating icebreaker

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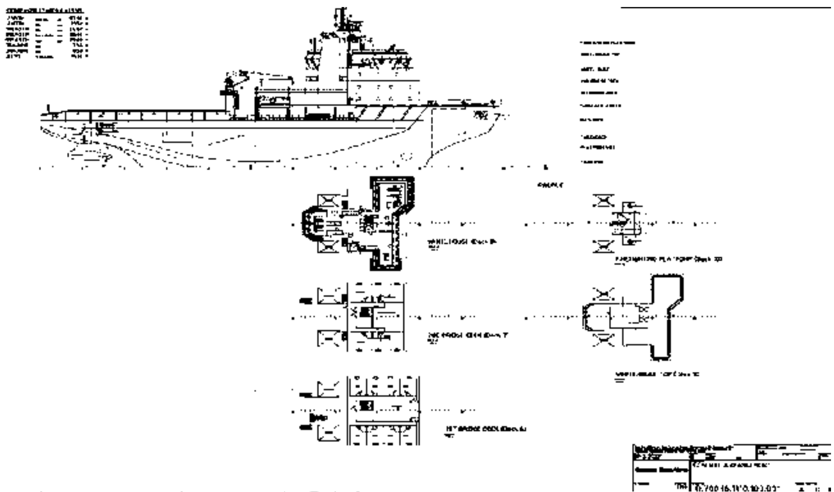

aker yards.

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Another innovation – the oblique oil combating icebreaker for wide tankers

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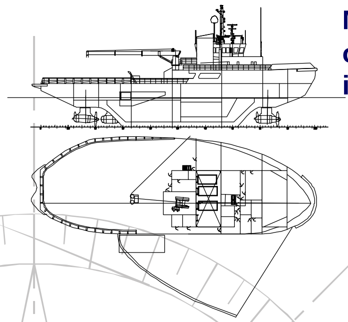
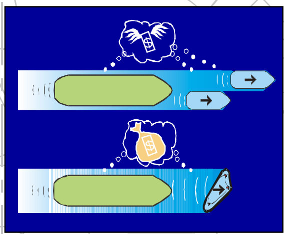


Multipurpose oil combating icebreakers (oblique)

- three functions in one small size hull
- icebreaking by the side

- one 40m wide channel, replaces two traditional icebreakers



- oil combating in heavy ice conditions (ice cleaning vibrator)
- excellent for escort towing

Excellent added performance values

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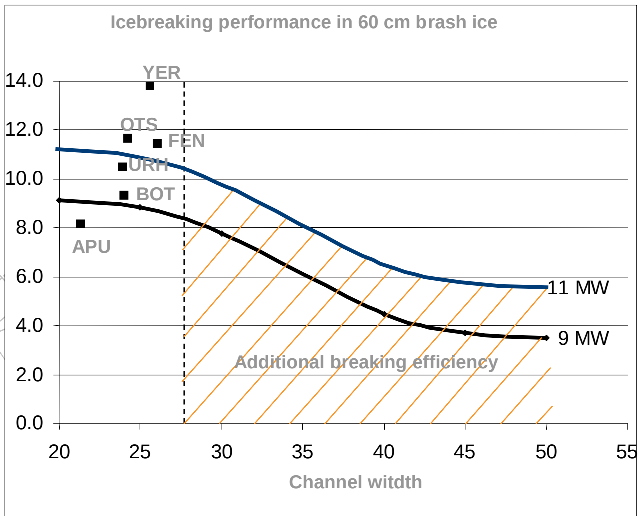

Why should a ship be symmetric?

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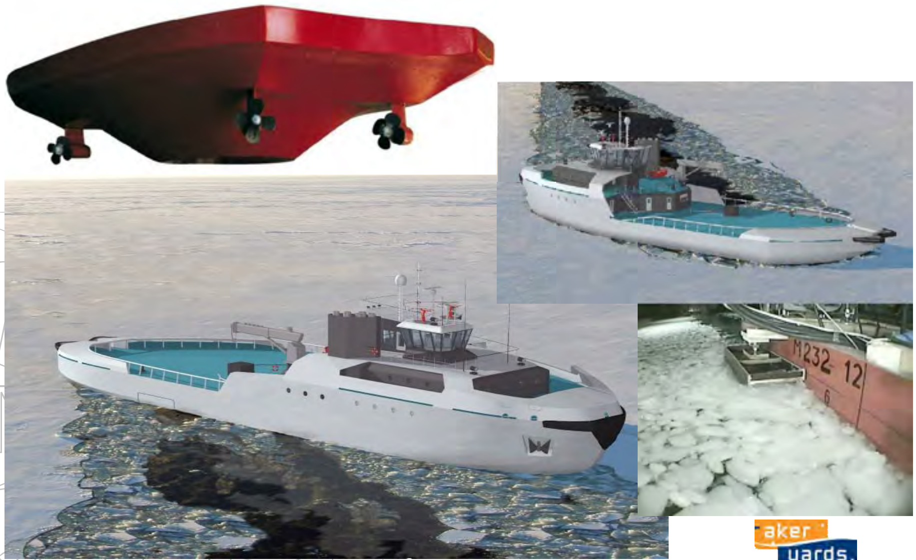

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New ice operation tools

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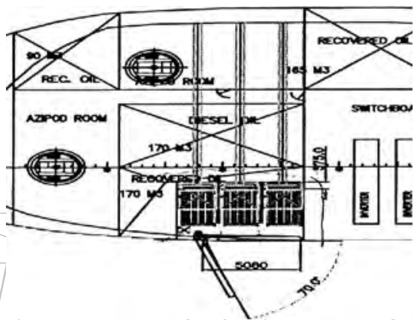

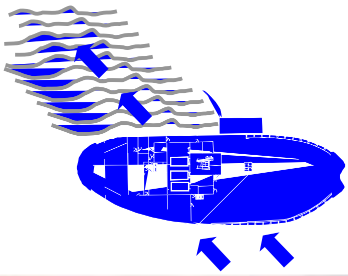

Icebreaking trimaran development for icebreaking and oil spill combat

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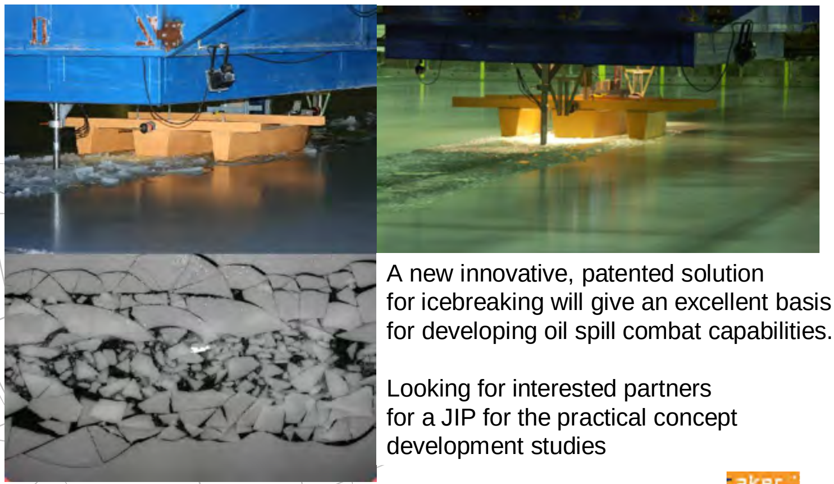

A new innovative, patented solution for icebreaking will give an excellent basis for developing oil spill combat capabilities.

Looking for interested partners for a JIP for the practical concept development studies

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Thank you!

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aker yards.

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aker yards.

Speaker Bios

Ed Owens

Polaris Applied Sciences Inc.
Bainbridge Island WA, USA

Shoreline operations in Arctic and subarctic environments involve an understanding of the fate and behavior of oil in snow and ice in order that decision makers can develop appropriate objectives and strategies for treatment or cleanup activities. The first part of the paper summarizes the results of a review of the "state-of-the-art" regarding the behavior of oil on ice and snow covered shorelines and the response options for cleanup or treatment. This review was undertaken, in part, as the basis for considering R&D options to redress gaps in our knowledge or technological deficiencies for response operations on shorelines with snow and ice.

Two key components of the decision process for Arctic regions are remote area logistics/operations and waste generation. The second part of this paper describes a current project to develop a Decision Guide and Job Aids for waste management in the Arctic. The volume of waste generated by the response activities is not controlled by the size of the spill, nor the location, but rather is a direct function of the response objectives and the response methods decisions made by the management team. It is important therefore to understand the decision process and to provide the decision makers with relevant information regarding waste generation, waste types, and waste volumes upon which they can set the response objectives.

Dr. Owens has 40 years experience in arctic and sub-arctic environments in the Canadian Arctic and on the Alaska North Slope. He has been involved with Sakhalin Island oil development and production projects since 1995 and with arctic oil spill response operations or oil spill experiments in Spitzbergen, Russia, and Canada. Dr. Owens focus is on shoreline operations and he has flown and mapped the arctic coasts of the Northwest Passage from Baffin Bay to Point Hope.

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Speaker Bios

Papers

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Jorma Rytkönen

Research Director
Kymenlaakso University of Applied Sciences, Finland
Merikotka Research Institute, Finland

Paper presented by: Kari Lampela, Finnish Environment Institute

Shipping has steadily increased around the Baltic Sea over the past decade. Around 2,000 sizeable ships are normally at sea at any time in the Baltic, including large oil tankers, ships carrying dangerous and potentially polluting cargoes, and many large passenger ferries. The Baltic Sea has some of the busiest shipping routes in the world.

The trend to increasing marine oil transport in the region started with the disintegration of the former Soviet Union. Russia lost parts of its Baltic ports to the surrounding States. These developments quickly led to new harbour and terminal developments such as: the Muuga oil terminal in Estonia, St. Petersburg oil terminal rehabilitation, and new terminals at Primorsk and Vysotsk in Russia. Oil transportation along the North-Eastern part of the Baltic Sea exceeded 100 million tons for the first time in 2004. New prognoses have estimated that at current crude oil price levels the total oil volume transported in only the Gulf of Finland may exceed 250 million tons before 2015.

High levels of tanker traffic in a sensitive and shallow sea require special procedures and safeguards to maintain safety. Winter vessel traffic creates special challenges to maintain schedules and reliability in all weather and ice conditions. This paper gives an overview of shipping statistics in the Baltic, the current level of accidents and the main actions taken to improve maritime safety, focusing on winter navigation. The safety-related actions of HELCOM, and latest joint activities in the area are briefly highlighted along with an introduction to the challenges of winter spill response.

Mr. Jorma Rytkönen is currently working as a research director of the Kymenlaakso Polytechnic University in Kotka, Finland. He has more than 20 years background in maritime R&D in the areas of maritime safety, environmental impacts, oil combating, mechanical recovery and oil bioremediation. Recently he has worked closely with the Baltic scientific community preparing a joint report on the risks of oil transportation in the Baltic and a manual for open sea monitoring of illegal oil discharges. He is also the research director of the MERIKOTKA Research Institute, a joint venture of four main Universities in Finland. The focus is on maritime safety, winter navigation and environmental protection.

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Speaker Bios

Ivar Singsaas and Per S. Daling

SINTEF Materials and Chemistry
Trondheim Norway

As part of the Joint Industry Program "Oil Spill Contingency for Arctic and Ice-covered waters" testing of a selection of oil recovery skimmers has been performed. The testing was performed in SINTEFs ice basin at low temperatures and in the presence of two different ice conditions. The selection of skimmers was made in cooperation with manufacturers. Totally six skimmers were tested, four brush drum skimmers, one brush belt skimmer and one drum skimmer equipped with lamellas.

As has been demonstrated in previous basin testing brush and brush drum skimmer has shown a high potential for recovery of oil in ice. However, equally important as the oil recovery principle is the ice processing capabilities of the skimmer. Two of the skimmers tested showed better ice processing capabilities than the others and gave promising results in the basin testing.

Ivar Singsaas is a Senior Research Scientist at SINTEF Materials and Chemistry, Marine Environmental Technology Department in Trondheim, Norway. He obtained his MSc from the University of Trondheim and has worked with oil spill contingency at SINTEF since 1991. Main scienfic areas are: weathering studies of oils, oil spill contingency analysis and planning, and oil spill response technology development.

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Speaker Bios

Stein Erik Sørstrøm

SINTEF Technology and Society
Trondheim, Norway

Stein Erik Sørstrøm has a Masters of Science degree from the University of Trondheim. He has spent 30 years in various roles related to environmental management including freshwater and wildlife management, oceanography, and environmental technology. Much of this time has been with SINTEF, the largest research and development organization in Norway and the fourth largest in Europe.

From 1997 to 2005 he worked in a private company within innovation and business development with focus on environmental technology, energy and environment (mainly in China), environmental monitoring, environmental consulting and project management. Since 2005 he has been Senior Adviser for SINTEF Division Technology and Society.

Stein Erik has been involved in oil spill R&D since 1978 and has broad experience in this field as project manager for a number of projects. Stein Erik is presently working for SINTEF Materials and Chemistry as Program Coordinator for the Joint Industry Program on Oil spill contingency for Arctic and ice covered waters.

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Speaker Bios

Frances Ulmer

Chancellor of the University of Alaska Anchorage

Prior to appointment as Chancellor of the University of Alaska Anchorage, Fran Ulmer served as the Director of University of Alaska Anchorage's Institute of Social and Economic Research. She brings to this position 30 years of experience of public policy in Alaska. Previously, she was a fellow at the Institute of Politics at Harvard University's Kennedy School of Government and a Distinguished Visiting Professor of Public Policy at the Institute of Social and Economic Research. In the early 1980s, Fran was the Mayor of Juneau, then a member of the Alaska House of Representatives (1986-1994) and in 1994, Fran became the first female Lieutenant Governor of Alaska. In that year, she was appointed to the North Pacific Anadromous Fish Commission by President Bill Clinton and served on this international board for 11 years, including as Chair, with representatives from Japan, Russia, Korea, Canada and the United States. Fran has participated in numerous panels, task forces, commissions and forums as a speaker, moderator and panelist to address the intersection of science, economics, politics and policy. Fran currently serves on the Board of Trustees of the National Parks Conservation Association, the Advisory Board of the Union of Concerned Scientists and the Alaska Nature Conservancy Board. Fran has a BA in political science and economics and a Law Degree from the University of Wisconsin.

Speaker Bios

Laurie Weir

Canadian Ice Service
Ottawa, Ontario Canada

The Canadian Ice Service's (CIS) operational program ISTOP (Integrated Satellite Tracking of Pollution) is design to effectively use SAR satellite imagery from Canada's Radarsat-1 as an aid in marine oil spill detection. The CIS has established research priorities that will help ensure that the ISTOP program will continue to play an effective role in the mitigation of marine oil pollution today and in the years to come. The program is a partnership between the Canadian Space Agency, Transport Canada, the Department of Fisheries and Oceans and Environment Canada.

The Canadian Ice Service (CIS) as part of the North American Ice Service (NAIS) provides ice charts, ice forecasting/ice drift models and imagery for the western arctic. This year CIS will be supporting a number of research initiatives in the Arctic as part of its contribution to the International Polar year. This information could provide a valuable resource in the event of a trans boundary spill in this region.

Laurie Weir graduated from Queen's University with an H BSc. Degree in Earth and Atmospheric Science. Her career includes:

- Meteorological technician- Atmospheric Environment Service, Cape Parry & Hay River NWT.
- Meteorological radar technician-Atmospheric Environment Service, Sudbury, ON
- Aviation Weather Analyst and Briefer-with the Meteorological Service of Canada, Toronto
- Ice Observer and Ice Analyst - Canadian Ice Service, Ottawa

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