THE ARCTIC OIL SPILL RESPONSE TECHNOLOGY

JOINT INDUSTRY PROGRAM

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COLLABORATION AMONG NINE COMPANIES

- International research programme
- Builds upon decades of R&D in arctic oil spill response
- Brings together experts across industry, academia and independent research centres
- Research integrity through technical review and public dissemination of results

Six areas of research:

- Dispersants
- Environmental Effects
- In Situ Burning (ISB)
- Mechanical Recovery
- Trajectory Modelling
- Remote Sensing

ACHIEVEMENTS TO DATE

9 reports now completed:

In Situ Burning (ISB)

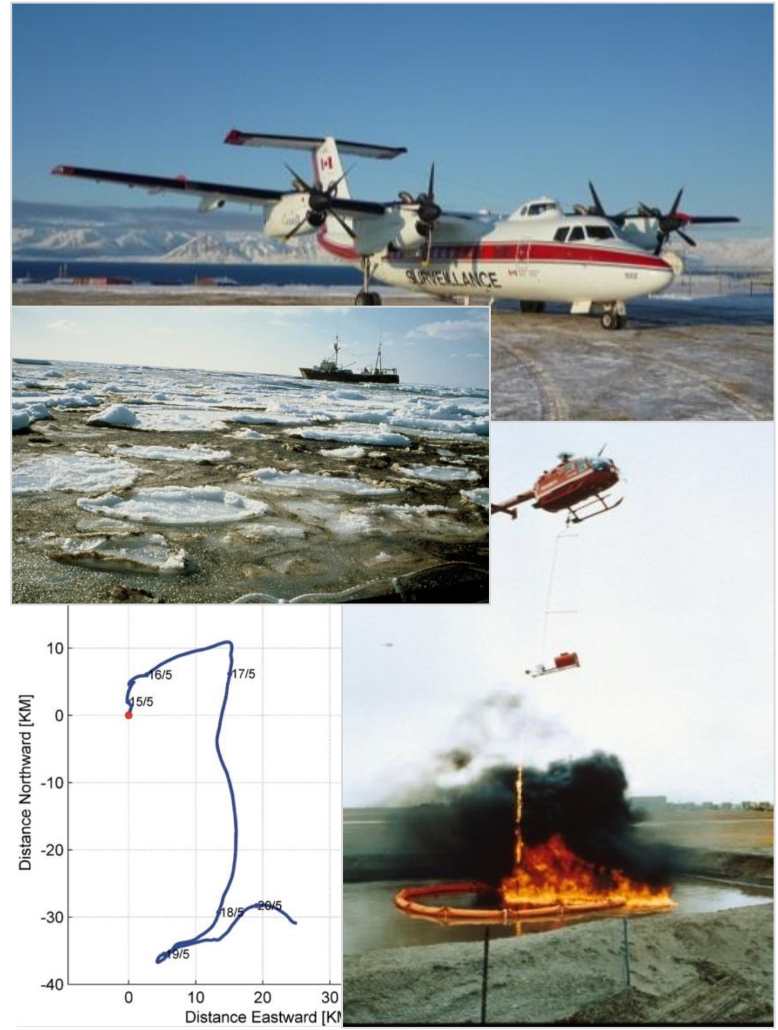
- **State of Knowledge**
- **Technology Summary and Lessons from Key Experiments**
- **Status of Regulation in Arctic and Sub-arctic Countries**

Dispersants

- **Fate of Dispersed Oil Under Ice**
- **State of Knowledge of Dispersant Testing Under Realistic Conditions**
- **Status of Regulations and Outreach Opportunities**
- **Inter-Basin Calibration**

Remote Sensing

- **Surface Remote Sensing**
- **Subsea Remote Sensing**



Photos: J. Mullin; Transport Canada; DF Dickins

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

A CLOSER LOOK AT THE PROJECTS

Dispersants

2) Dispersant testing under realistic conditions

- **AIM: To define the operational limits of chemical dispersants and mineral fines in arctic marine waters**
  - **State of Knowledge, Summary of Existing Regulations, and Inter Basin Calibration tasks are complete and reports on JIP website**
  - **Dispersant effectiveness experiments initiated at research facilities in Canada, France, and Norway**
  - **75 dispersant and 45 oil mineral aggregate experiments will be conducted, using 5 crude and fuel oils and 4 dispersants**
  - **The crude and fuel oils will be weathered and tested with 2 levels of ice coverage, 2 dispersant-to-oil ratios, 3 salinity levels, and with three energy levels (low, high and propeller wash)**
  - **Research experiments on the use of polyethylene blocks to improve dispersant effectiveness test repeatability are also being conducted**

Photos: SINTEF

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS


SINTEF Flume Tank


Dispersant Application


Removing Barrier After 18-Hours of Weathering


Initial Testing at Low Energy

A CLOSER LOOK AT THE PROJECTS

Environmental impacts

AIM: To improve the knowledge base for conducting arctic Net Environmental Benefit Analysis (NEBA)

- **The comprehensive Phase 1 review and NEBA tool is complete**
- **Phase 2 research will address research activities to improve and advance Arctic NEBA's**
- **Four research projects underway**
- **Akvaplan-niva received permit from Governor of Svalbard to install 20 mesocosm at Svea, Norway and conduct the experiments**
- **Initial 8 mesocosm to be installed in sea ice in January 2015 and will remain until June 2015**

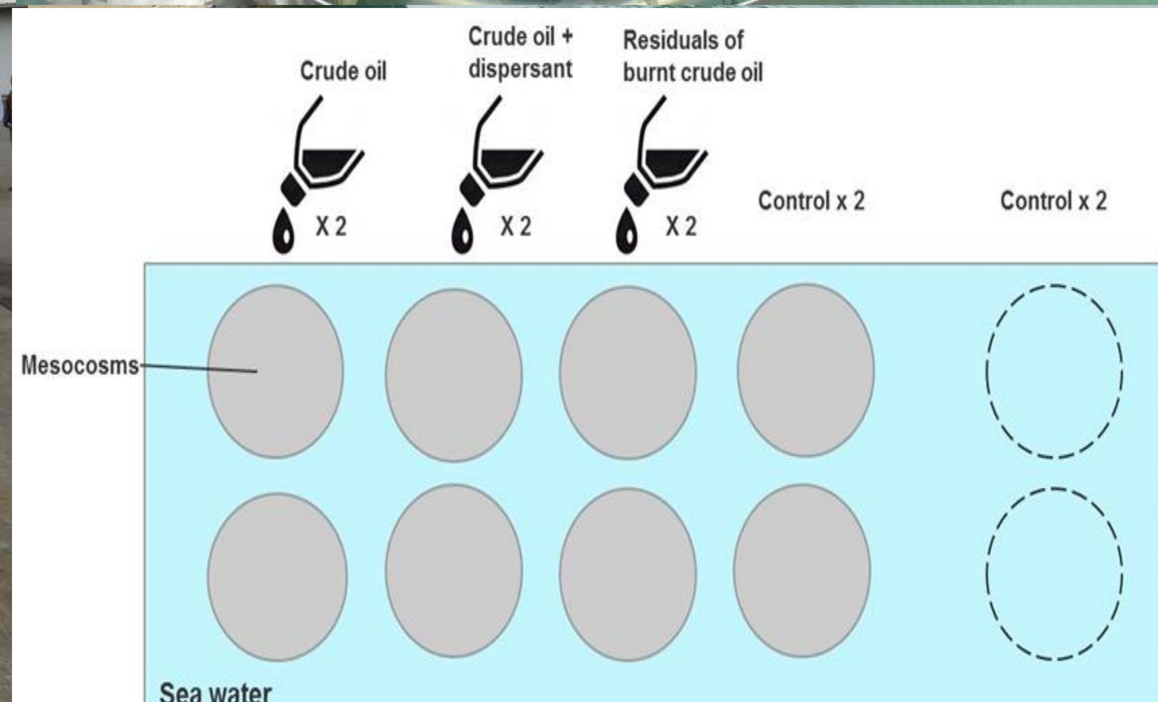
Photo: Caspian International Seal Survey

Photo: SINTEF

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

Mesocosms to be Employed in the Svea, Norway Field Campaign. Length: 3 m, Diameter: 1.6 m, Weight: 325Kg

Mesocosm Buoyancy Testing at Cedre



A CLOSER LOOK AT THE PROJECTS

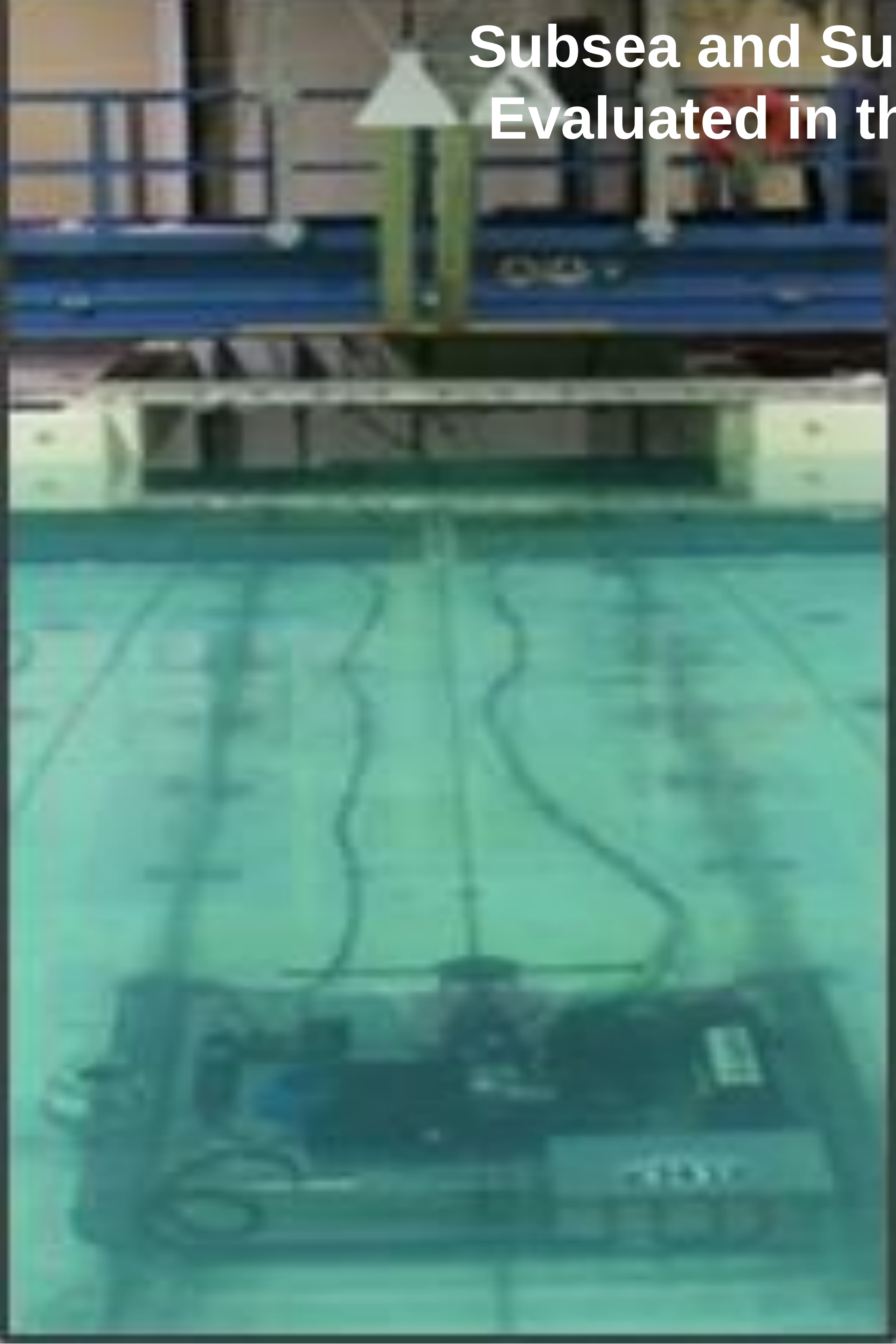
Remote sensing

AIM: To advance oil spill remote sensing and mapping capabilities to locate oil on, encapsulated in and under ice

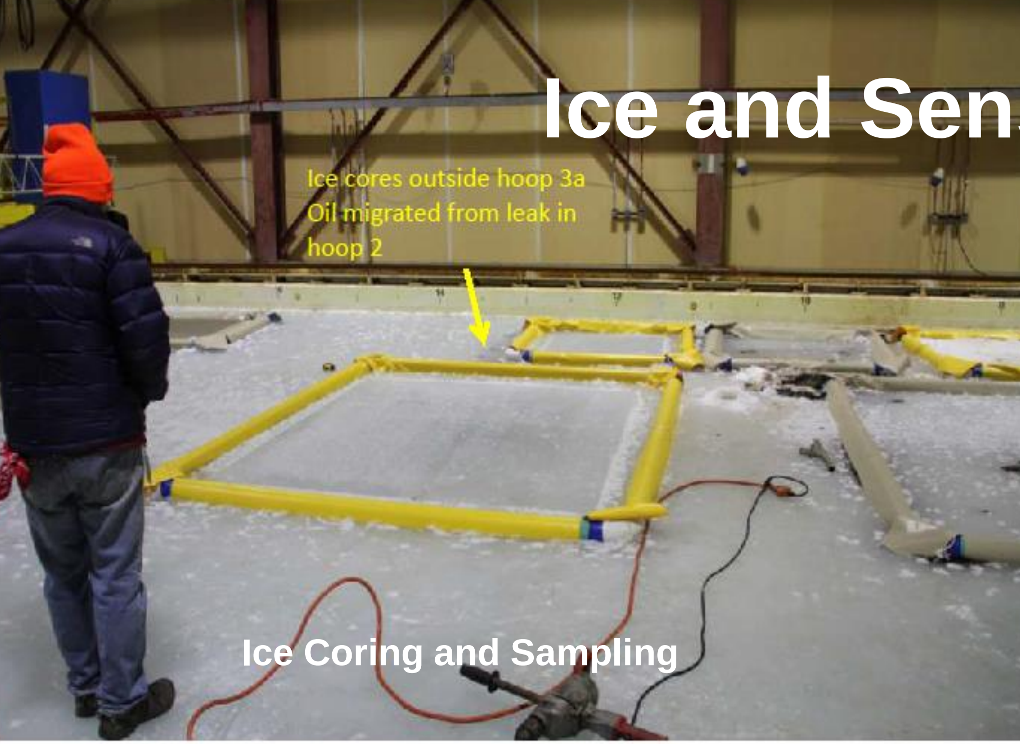
- **Phase 1 complete is complete and the surface/subsea reports are available on the JIP website**
- **Phase 2 experiments are being conducted at the U.S. Army Corps of Engineers-Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH**
- **Prince William Sound Oil Spill Recovery Institute is the contractor to conduct phase 2 research program**

Photo: Transport Canada

Subsea and Surface Sensors Being Evaluated in the CRREL Test Tank

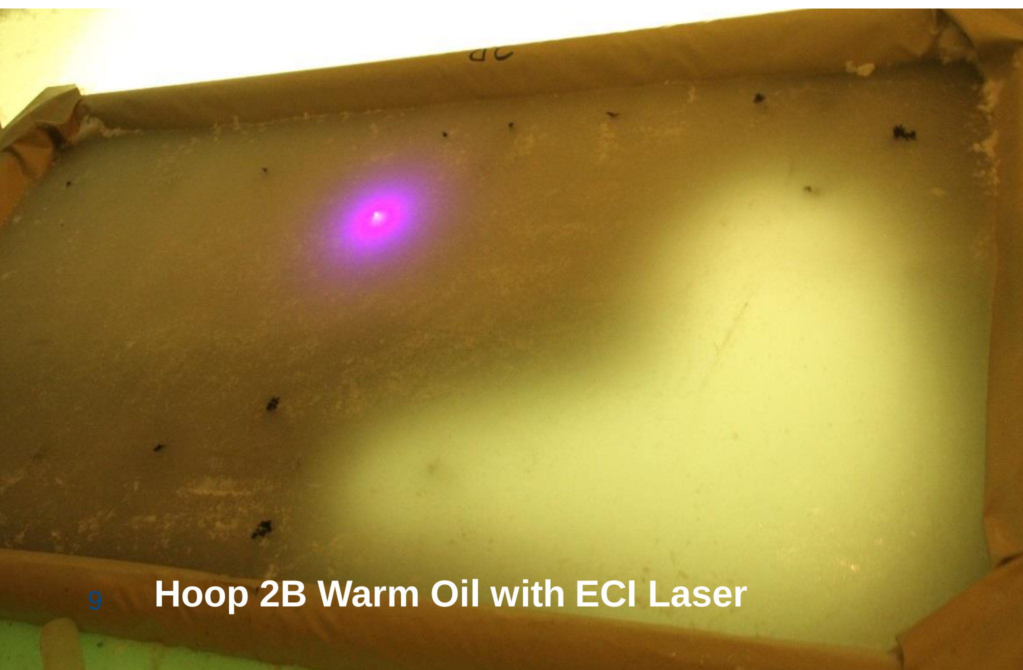


Ice and Sensor Sampling



Ice Coring and Sampling


View of Test Hoops from CRREL Cam


Hoop 2B Warm Oil with ECI Laser


Hoop 2B After Warm Oil Injection

A CLOSER LOOK AT THE PROJECTS

In situ burning

Chemical herders

AIM: To advance the knowledge of chemical herder fate, effects and performance to expand the operational utility of in situ burning as an arctic oil spill response tool

- **Laboratory, small and large scale basin experiments are being conducted in Canada, Denmark, and USA**
  - **Physical fate of the herder during burning and combustion products being emitted**
  - **Acute and chronic toxicity and bioaccumulation of chemical herders on arctic copepods**
  - **Biodegradation of herders in arctic conditions**
- **Windows-of-Opportunity for Herders**
- **Impacts of Herder Monolayer on Birds**

ISB with 90% efficiency after herding

ARCTIC RESPONSE TECHNOLOGY OIL SPILL PREPAREDNESS

A CLOSER LOOK AT THE PROJECTS

Field research using chemical herders to advance in situ burning

AIM: Validate the operational feasibility of an aerial herder/burn response strategy using both manned and remote controlled helicopters

- **Construction of a large, above ground, fully lined, temporary test basin 90m x 90m was successfully completed in Fairbanks, Alaska**
- **Field releases with ANS crude oil (200 liters ~ 1 barrel) using a variety of delivery platforms to spray herders and then ignite the herded slick**
- **Conduct helicopter testing to confirm the suitability of the aerial herder delivery system and spray pattern**
- **Evaluate the feasibility of robotic helicopter technology (UAVs) to apply herders and igniters**

Photo: J. Mullin

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

Completed Test Basin
View from East Corner to North Corner

Initial Liner Placement

Iceberg Formation Experiments in Test Tank

WHAT'S NEXT?

- Permitted field studies using in situ mesocosm to measure the exposure potential, sensitivity and resiliency of sea ice and the sea surface micro layer will be conducted January-June 2015 at Svea, Norway
- Field experiments will be conducted in March-April 2015 in Fairbanks, Alaska to validate the operational feasibility of an aerial herder/burn response strategy using both manned and remote controlled helicopters
- Flume tank studies in the UK and field research at Svea, Norway to collect data for dispersant modelling project
- Research has been initiated to develop a new sea ice model that will be tested, evaluated and validated. Results will be integrated into established oil spill trajectory models
- A new project to improve aerial ignition systems for using in situ burning as an arctic oil spill response tool will be initiated in 1Q/2015.

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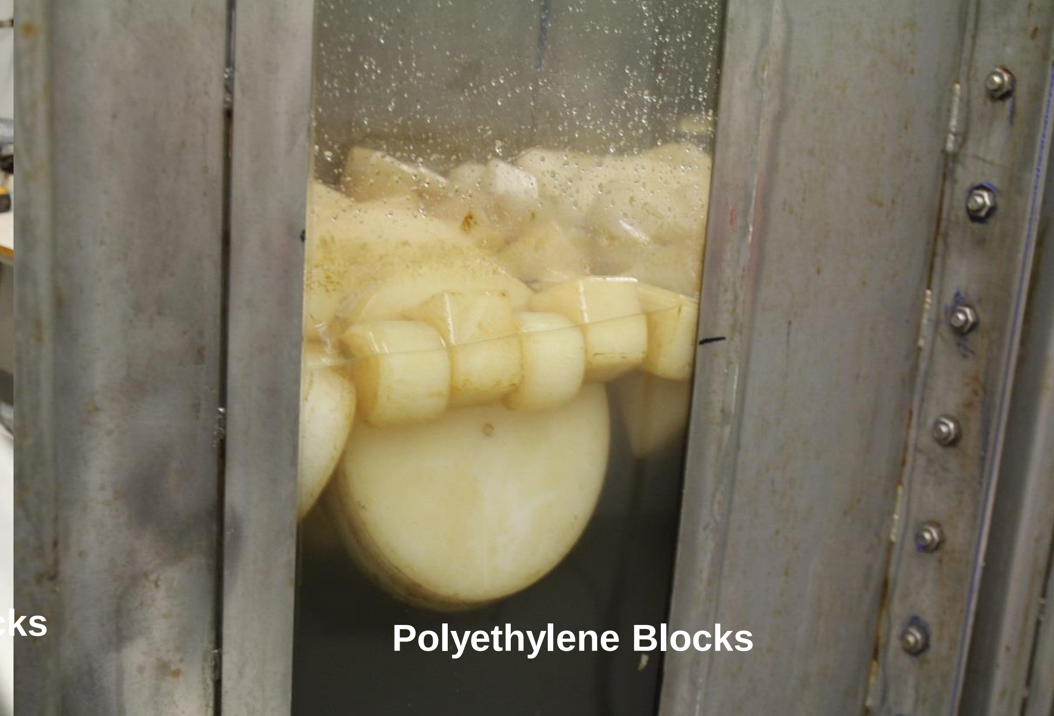
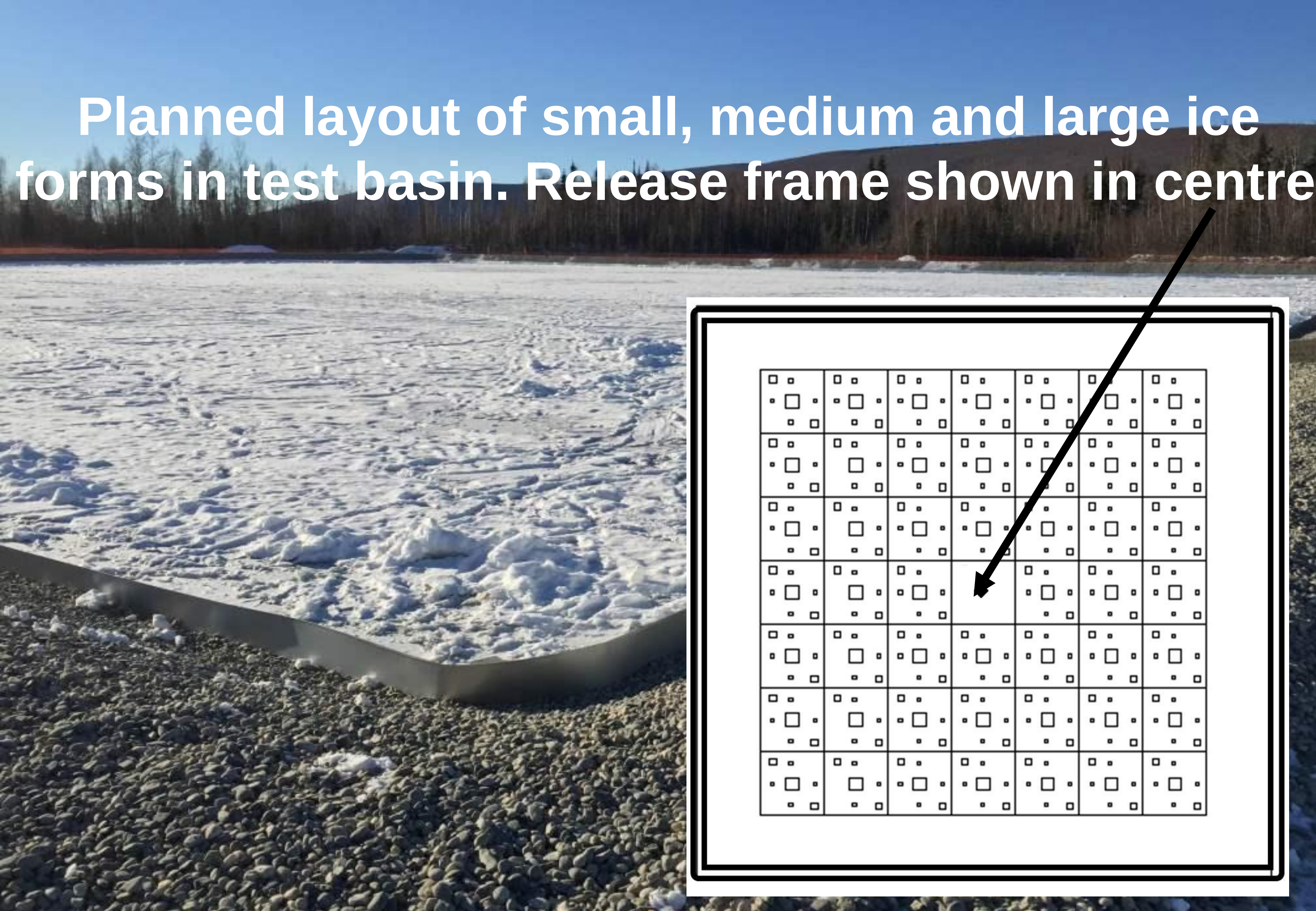
Visit the programme website at: www.arcticresponsetechnology.org


Tank Experiments at High Energy with Polyethylene Blocks


Polyethylene Blocks


Tank Experiments at High Energy with Ice


Ice Blocks


Planned layout of small, medium and large ice forms in test basin. Release frame shown in centre