

The background of the slide is a photograph of a vast, flat, icy landscape, likely a frozen sea or a large ice field. The ice is broken up into numerous small, irregular floes, creating a textured surface. The sky is dark and overcast, with some light breaking through the clouds near the horizon. The overall color palette is dominated by blues and greys, with the red text providing a sharp contrast.

Ice Loads on Offshore Structures

Garry W. Timco

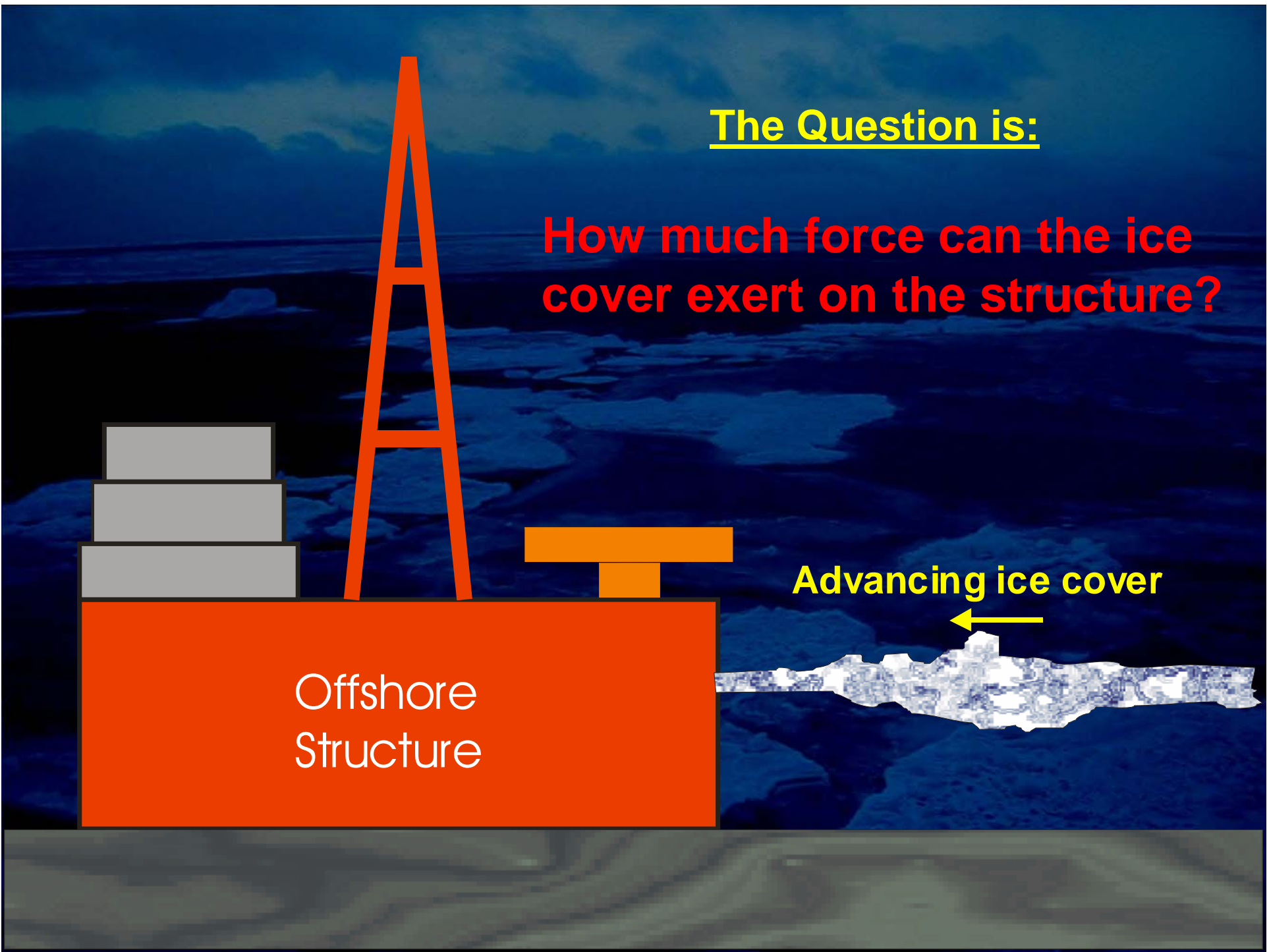
Canadian Hydraulics Centre

National Research Council of Canada

Ottawa, Ont. K1A 0R6

The Question is:

How much force can the ice cover exert on the structure?



Offshore
Structure

Advancing ice cover

The Force depends upon:

Ice Thickness

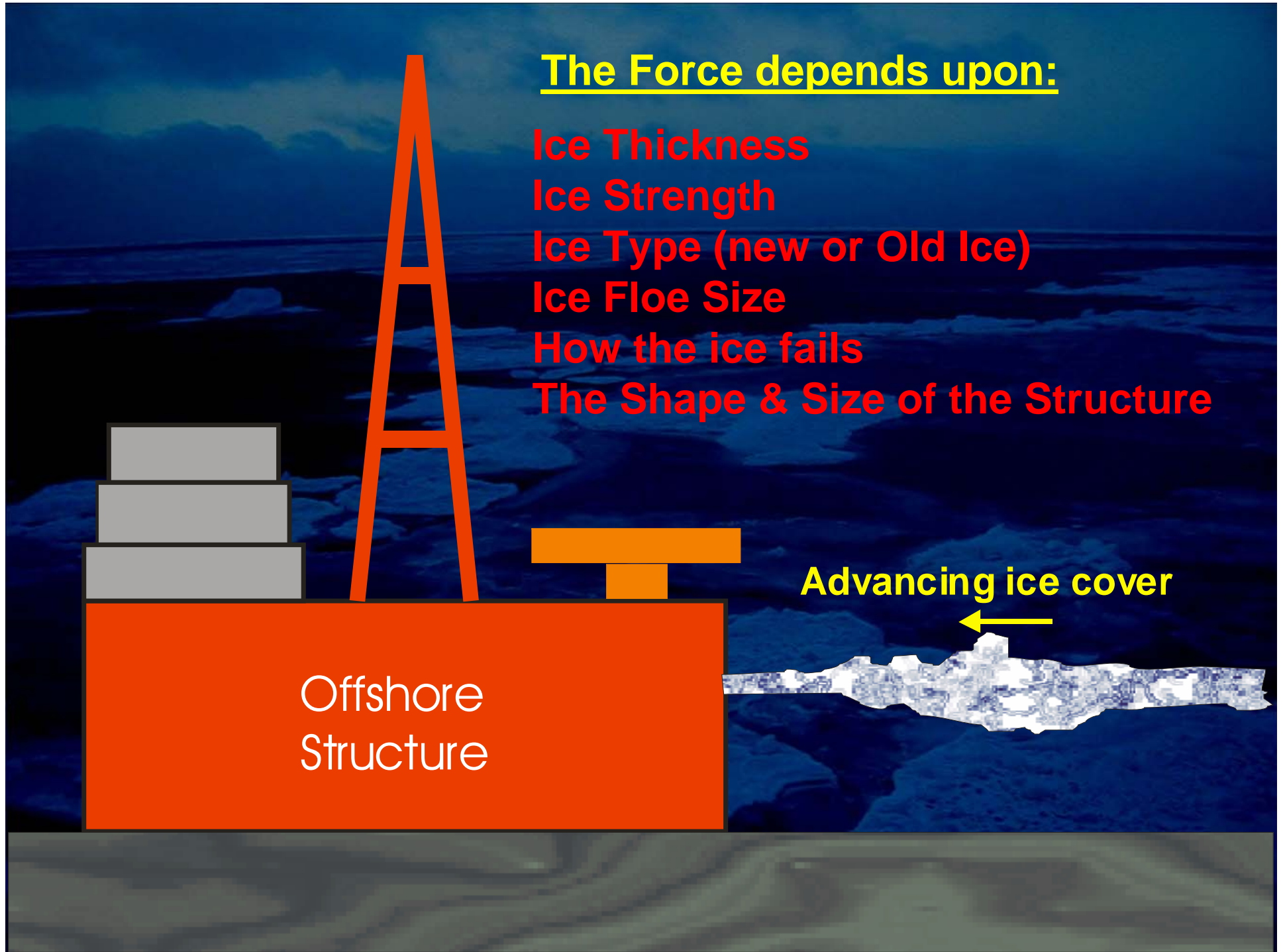
Ice Strength

Ice Type (new or Old Ice)

Ice Floe Size

How the ice fails

The Shape & Size of the Structure



Offshore
Structure

Advancing ice cover

How Do We Learn about Ice Forces

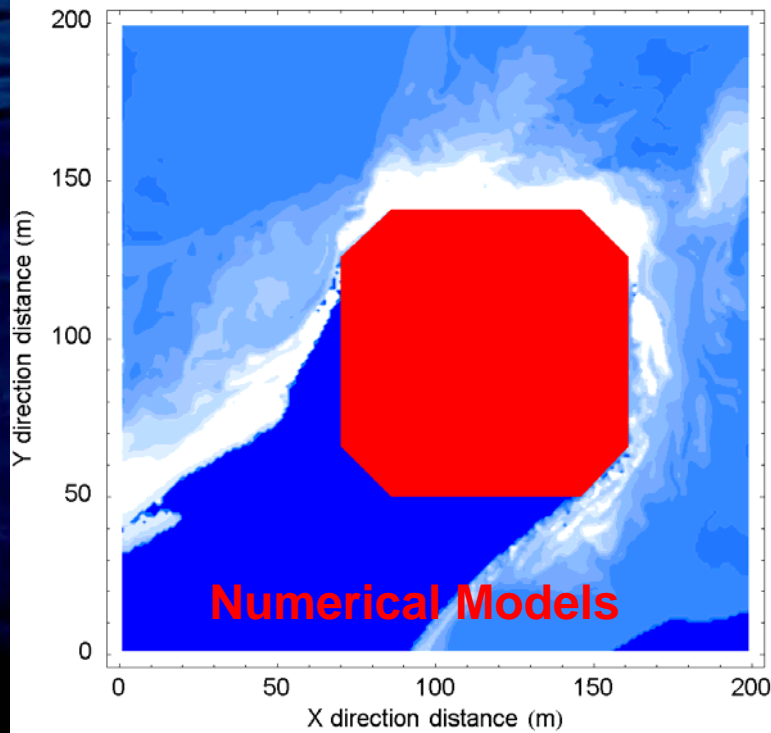
Field measurements of thickness and strength



Field measurements of ice forces



Run_07

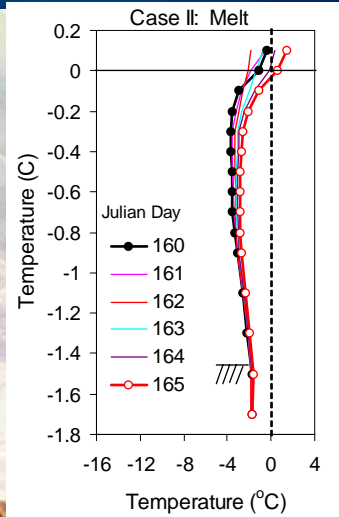


Laboratory experiments

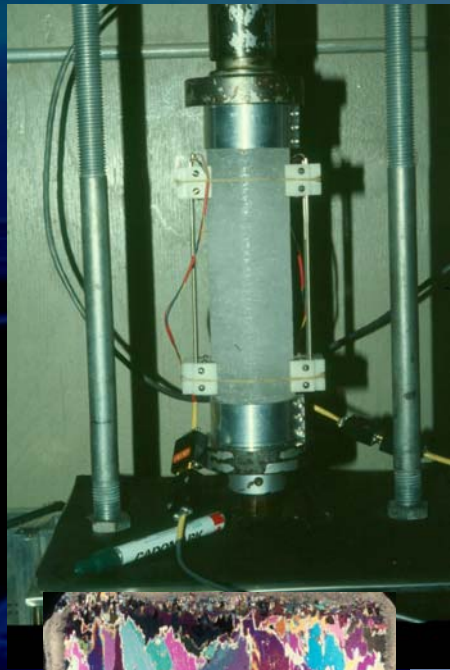


Sharing Information

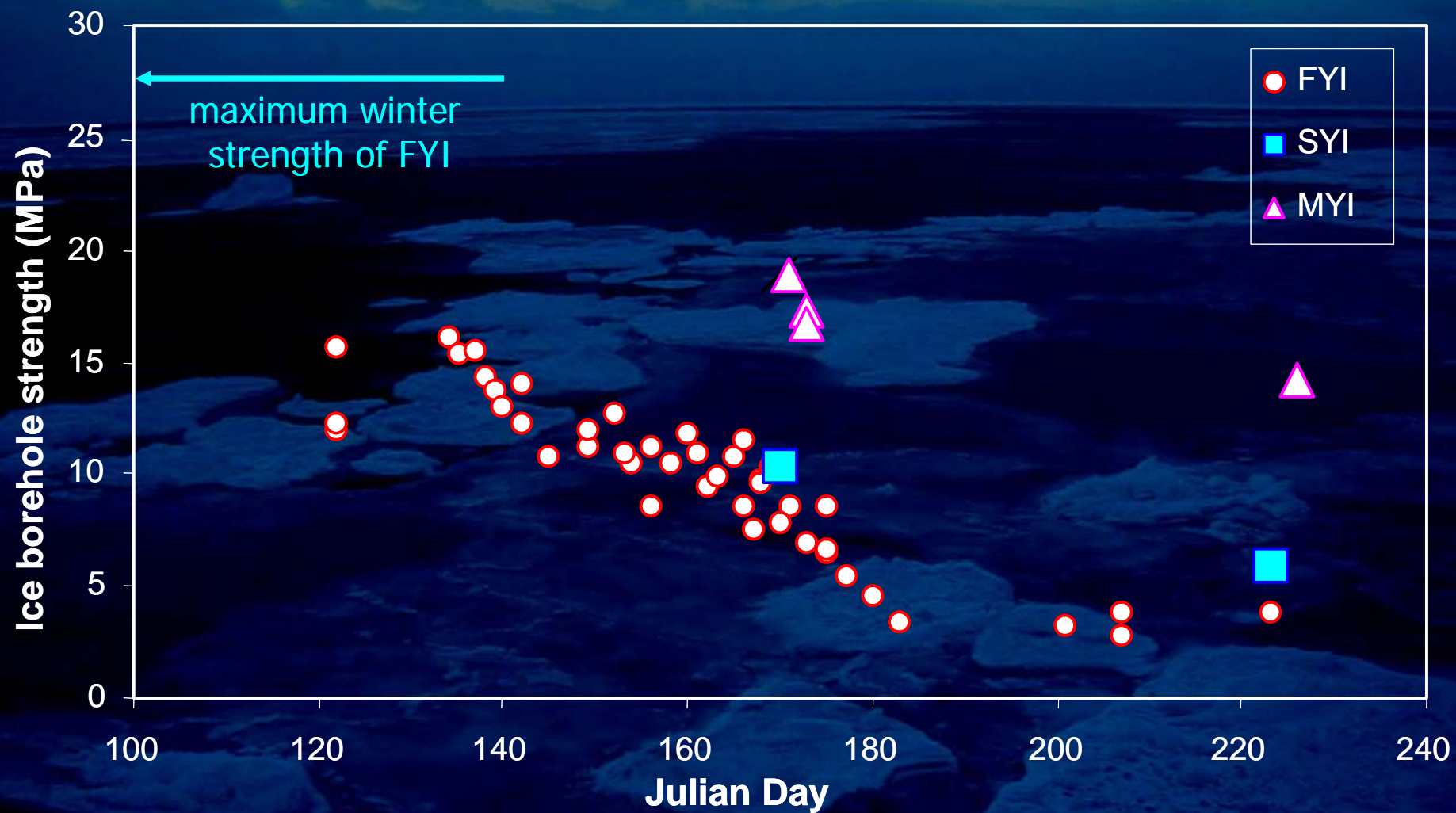
Field Measurements of Thickness, Salinity & Temperature



Field Measurements of Ice Strength



Field Measurements of Ice Strength



April

May

Jun

July

Aug

Field Measurements of Ice Loads



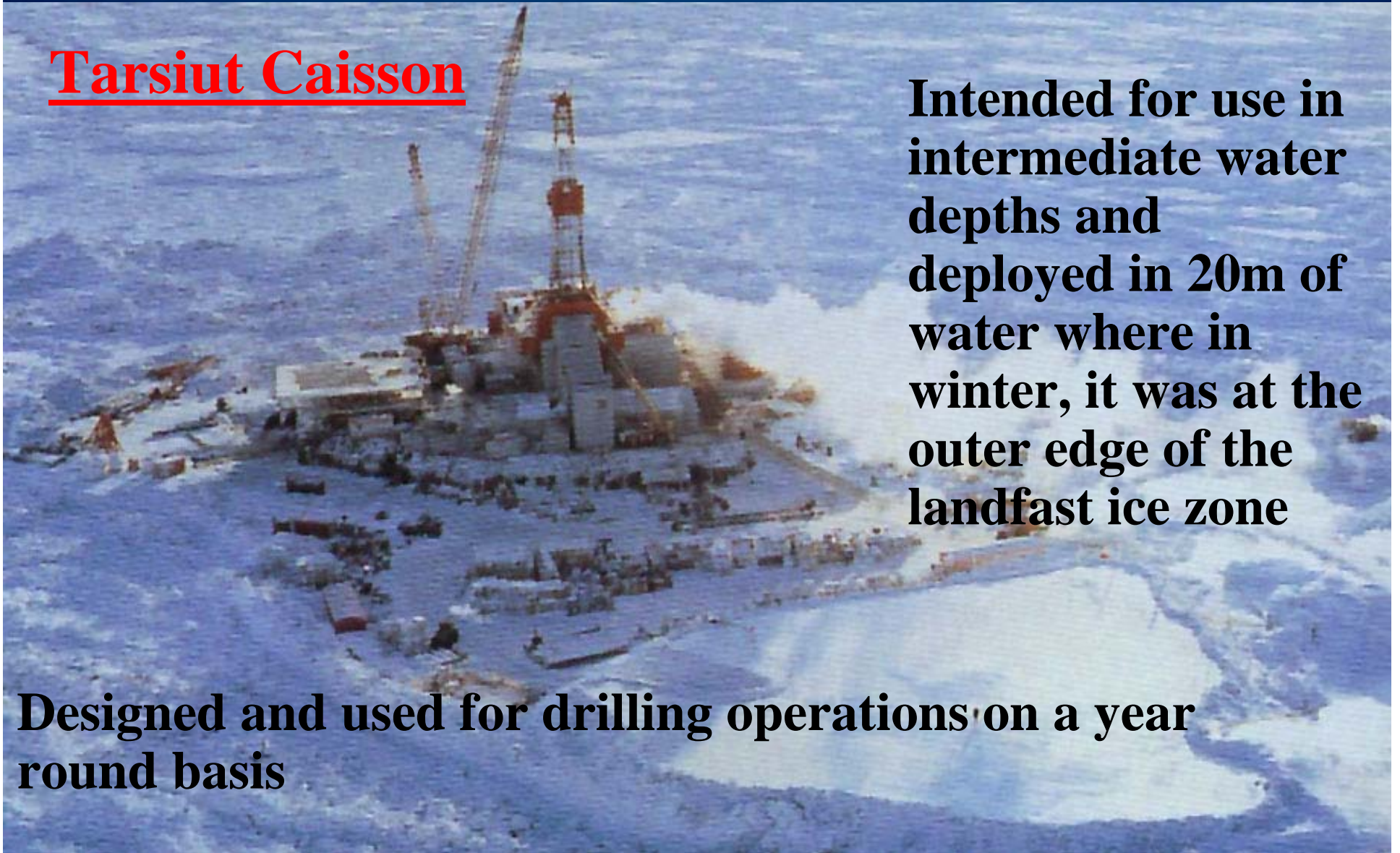
Industry/Government sponsored research

Field Measurements of Ice Loads

Tarsiut Caisson

Intended for use in intermediate water depths and deployed in 20m of water where in winter, it was at the outer edge of the landfast ice zone

Designed and used for drilling operations on a year round basis



Field Measurements of Ice Loads

Esso Caisson Retained Island (CRI)

Intended for use in intermediate water depths, and deployed at locations ranging from 12m to 25m in depth, which were also in landfast ice in winter

Designed for year round operations, but only used during freeze-up and winter ice conditions

Imperial Esso



Field Measurements of Ice Loads

Intended for use in intermediate to deeper water areas (10m to 40m), in both pack ice and landfast ice conditions

Designed and used for operations on a year round basis

SSDC



**Drilled 6 wells
2 in Canadian Beaufort**

Dome Petroleum - Canmar

Field Measurements of Ice Loads

Molikpaq

Originally intended for use in the deeper water areas (20m to 40m) in moving pack ice and open water situations, but has also worked in landfast ice (12m)

Designed and used for year round operations

Gulf Canada Resources Ltd.

Field Measurements of Ice Loads

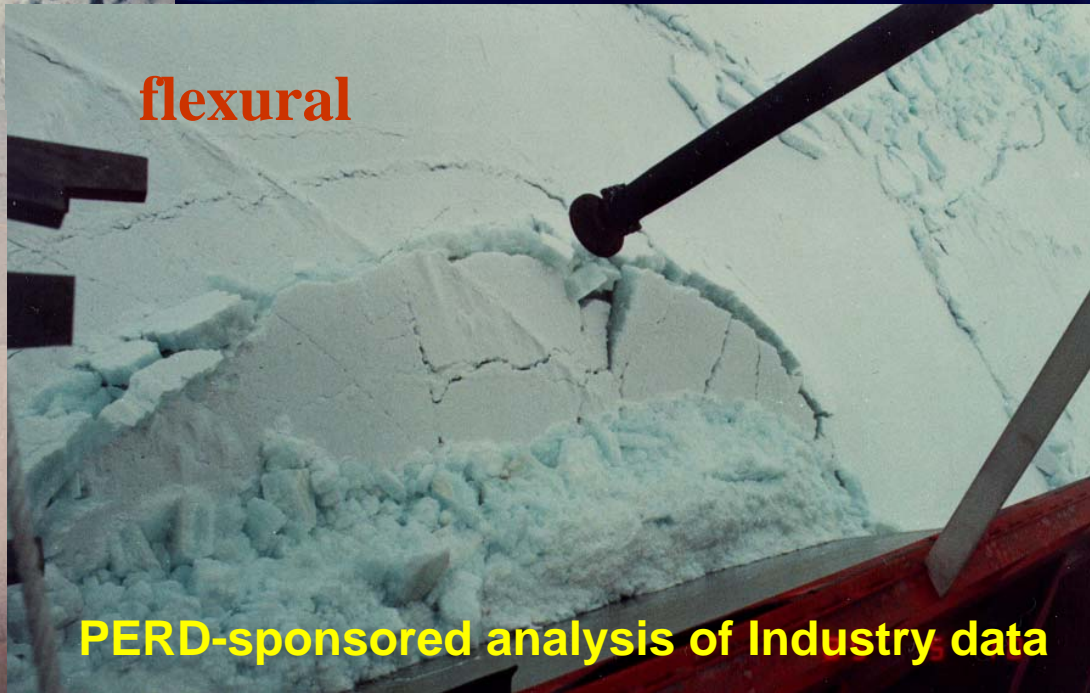
Information on Ice Loads
and Ice Failure Modes



crushing



mixed-mode



flexural

PERD-sponsored analysis of Industry data

Field Observations & Measurements



Laboratory Experiments of Ice Loads

Ice Tank at NRC Ottawa

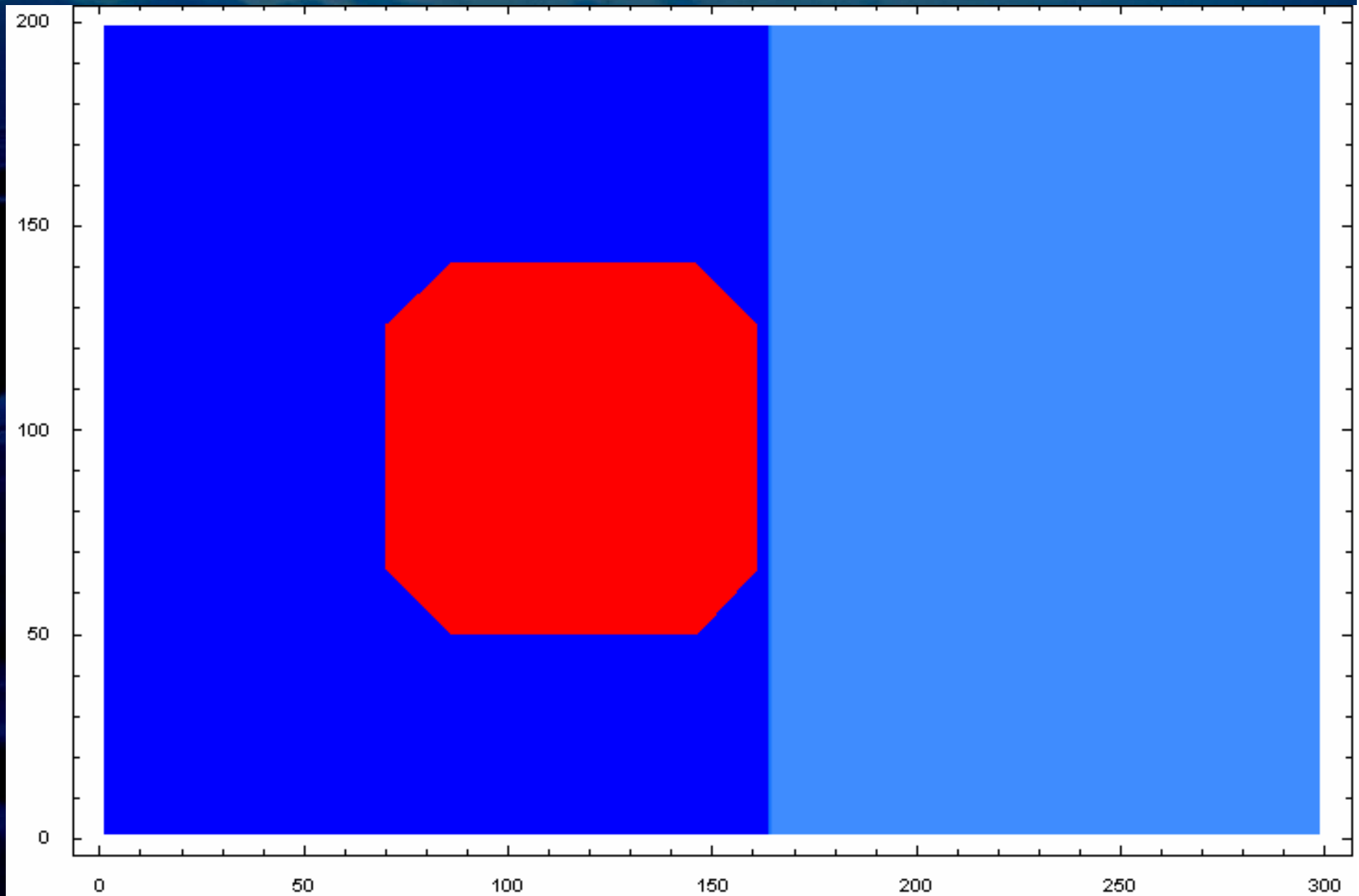


Model Test of the Molikpaq

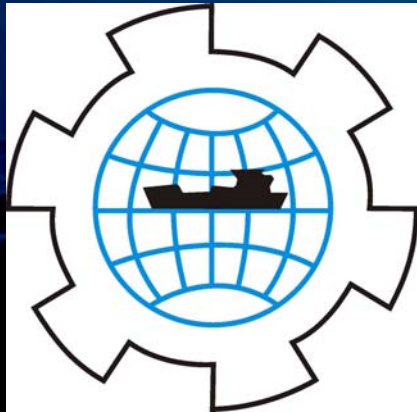
Model Tests on Sloping Structure



Numerical Modelling of Ice-Structure Interaction



Sharing Information



**International
Conferences**



Sweden



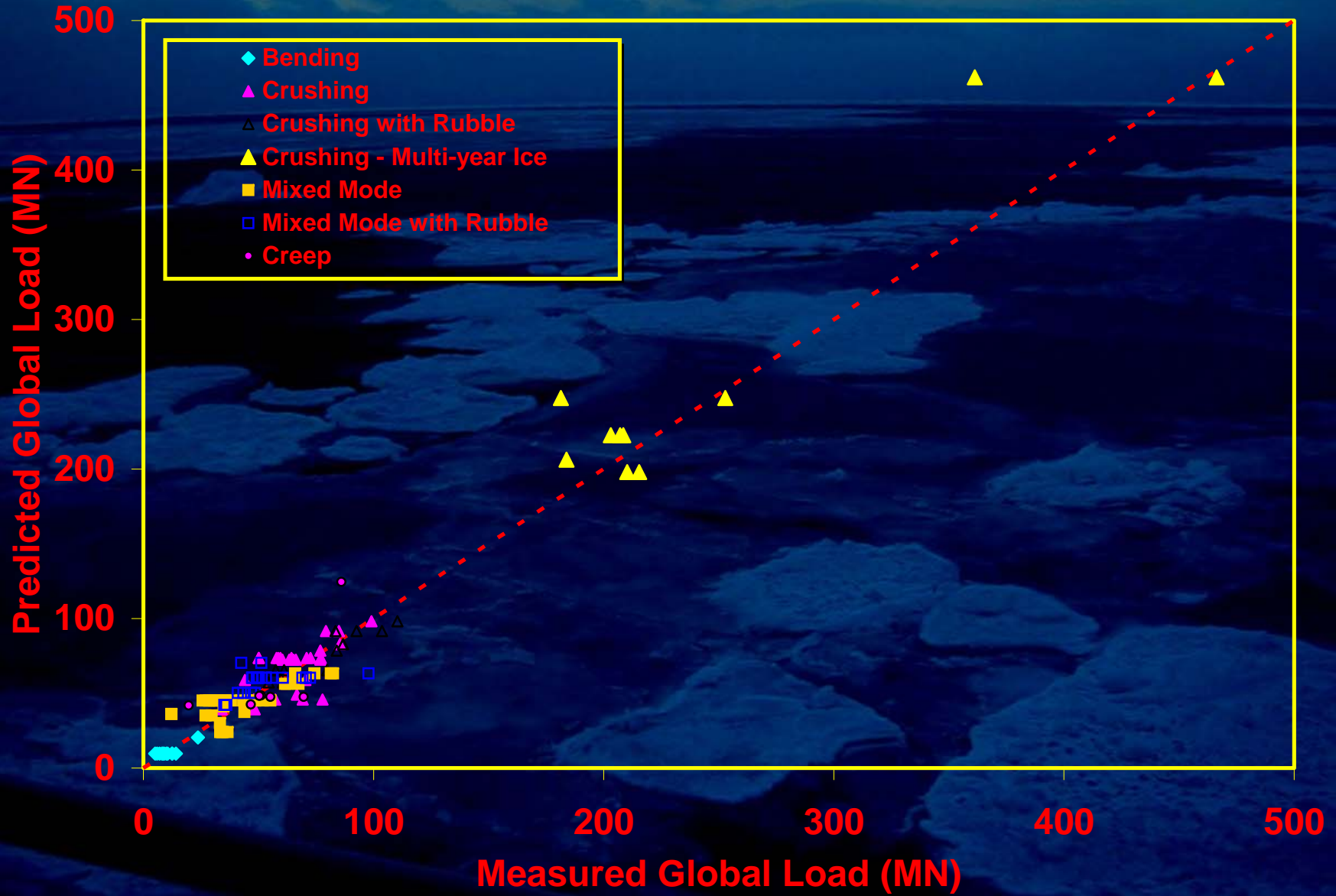
China

International Collaboration

Distribution of Results:

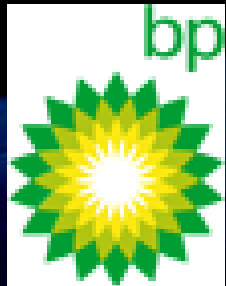
**CHC Website – www.chc.nrc.ca
Libraries – NRC, Aurora College, Etc.**

Predicting Ice Loads

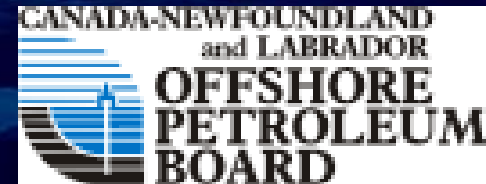


Who Uses this Information?

Industry & Consultants (world-wide operations)

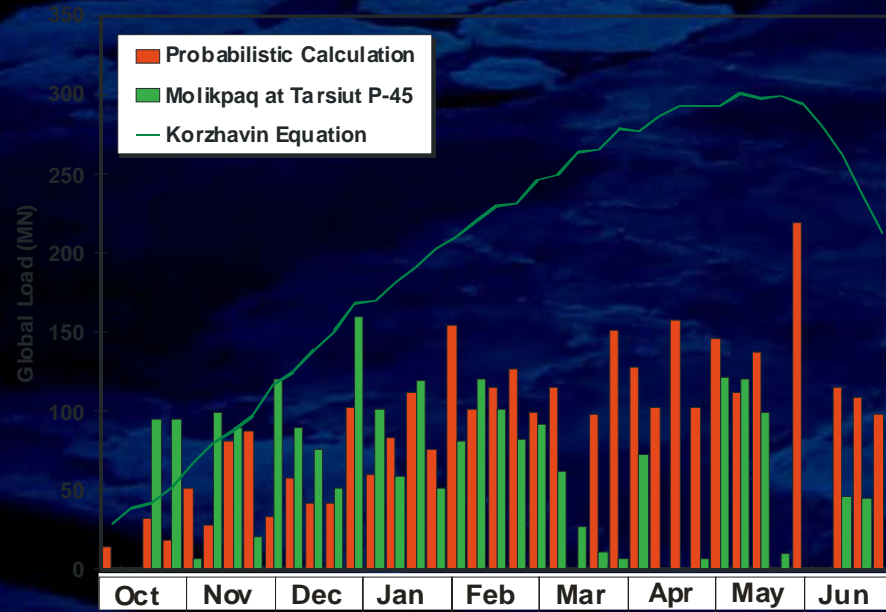


Regulators



Future Research

Profiling Rubble Fields



Ice Thickness Measurements

Summary

Knowledge of ice loads is very important to ensure safe design of offshore structures. This ensures safety of both personnel and the environment.

Considerable effort has been spent in understanding ice loads using:

- Field measurements
- Laboratory measurements
- Numerical models
- Sharing international knowledge
- Application of knowledge in different regions

PERD-sponsored research has provided a good understanding of ice loads

Ice load information is being used in Canadian & International Codes

Further research is required for understanding Old ice, ice rubble, and in developing probabilistic models for site-specific conditions