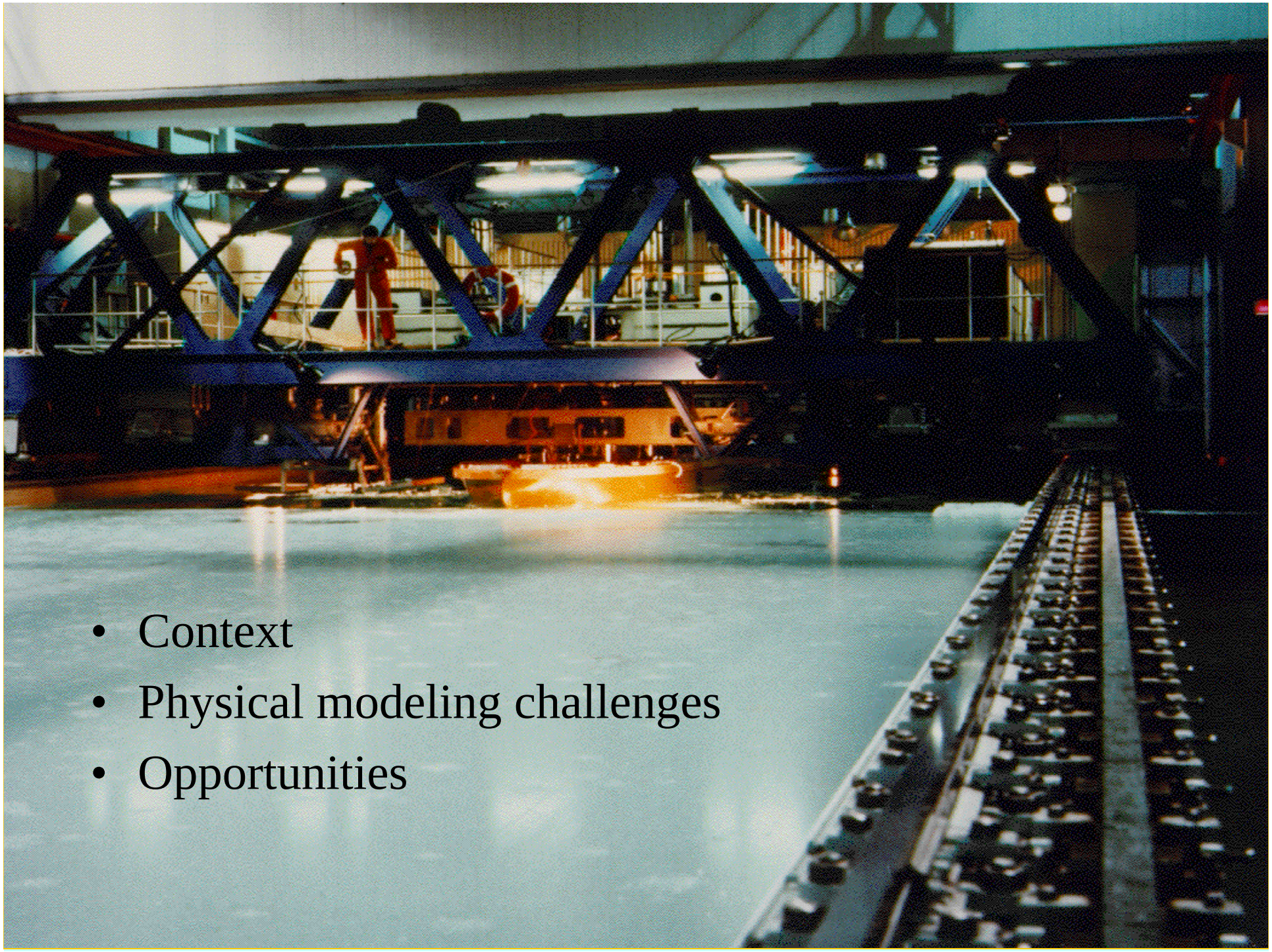
Model Testing in Ice: View Forward

F. Mary Williams

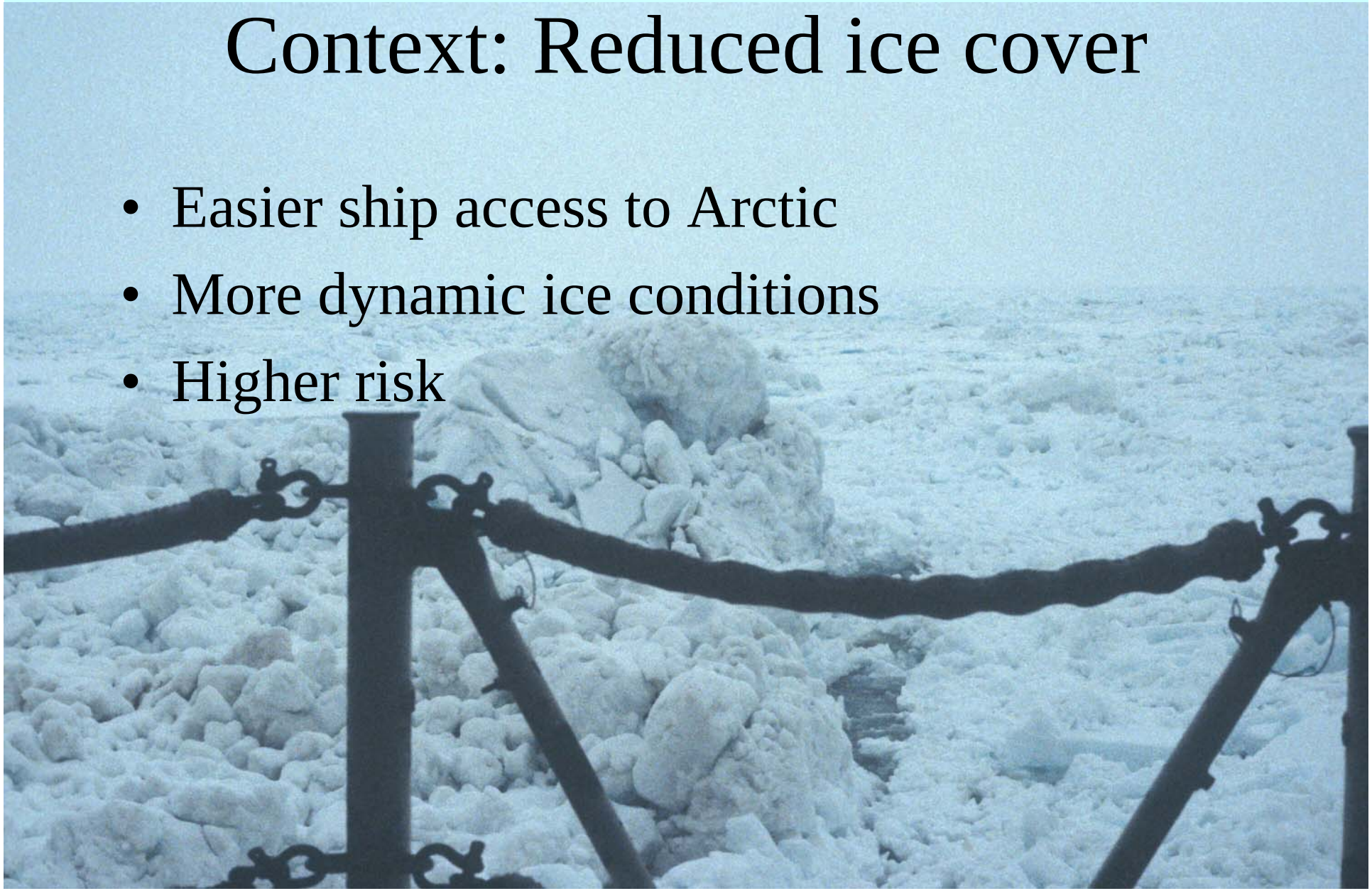
NRC - Institute for Ocean Technology

Canada

NRC-CNRC


• Context
• Physical modeling challenges
• Opportunities

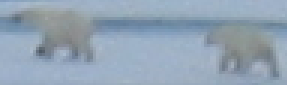
Context: Reduced ice cover



- Easier ship access to Arctic
- More dynamic ice conditions
- Higher risk

Dynamic environment

Context: Fragile Environment



- Ecosystem depends on the ice
- Arctic influence on global ocean systems
- Restrictions by national & aboriginal states
- Corporate responsibility
- Low risk tolerance

Context: Energy Market

- High price of oil promotes investment & exploration
- High cost of fuel promotes efficient operations

Physical Modeling in Ice

Continuous & discrete processes

Multiple modeling constraints

NOT A TOW TANK WITH ICE

Mature Technologies

- Ship resistance in level ice
- Ship propulsion in level ice
  - Power prediction – different methods
  - Loads on propellers – different definitions
- Mean global load on structure
- Model ice production
  - No common standard

Modeling Challenges - 1

- Failure modes
  - Ride up or pile up?
  - Floe splitting or rubbling?
  - Piece size
- Ice pressure distribution
  - Structure integrity – local ice pressures
  - Turning moments – pressure along ice line

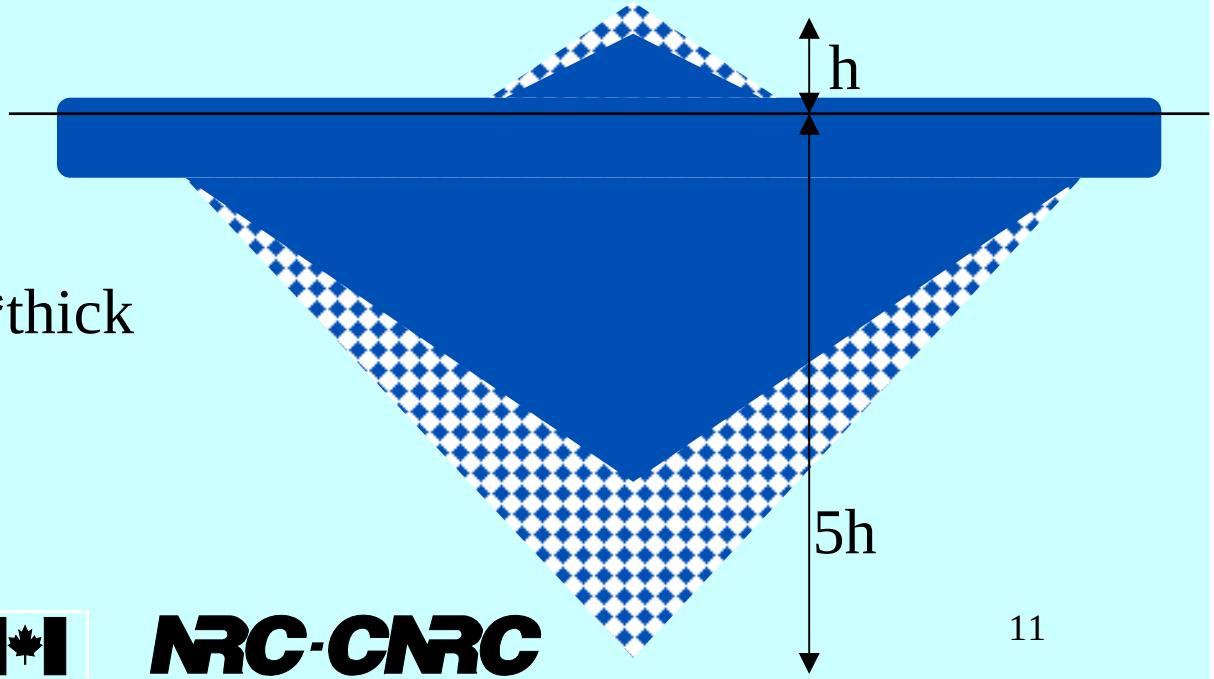
Modeling Challenges - 2

- Load dynamics
  - IIV – ice equivalent of VIV
  - Slender structures (jack-ups)
  - Wide structures (Molipak)
  - Moored structures
- Podded propulsion in ice

Modeling Challenges - 3

Continuous/discontinuous ice

- Pack ice => concentration 6/10 to 10/10
- Rubble (brash) => concentration 10/10 to 30/10
- Ridges => h > 3*thick



Other craft

- Fishing vessels
- Life boats
- Submarines
- Helicopters

Opportunities

- Predictive capability @ low risk
- First test for math models
  - FEM
  - DEM
- Unique capacity to deal with multi-phase
- Attractive to client => dynamic & visual

Summary

- Opportunities for ice tanks
- Role for ITTC
  - Collaboration on technology development
  - Common standards