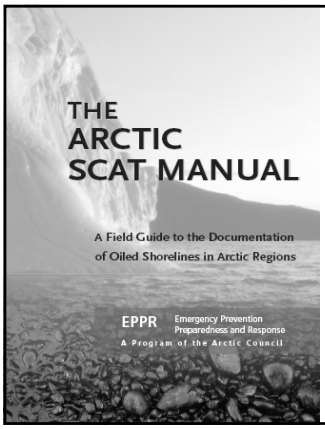
Shore Zone Topics

- Arctic “SCAT”
- Great Lakes Shore Ice
- Shore Operations in Ice

Anchorage 23 April 2010



funded by

The Arctic Council

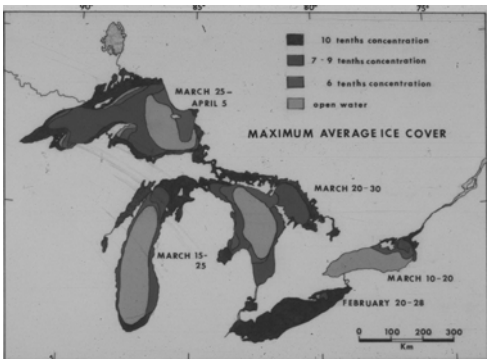
Snow and Terminology

snow	**SNW**
frozen swash	**FSW**
frozen spray	**FSP**
ice foot	**IFT**
ice-push ridge	**IPR**
grounded floes	**GFL**
glacier ice	**GLC**

frozen swash **FSW**

frozen spray **FSP**

“Ice Volcanoes”

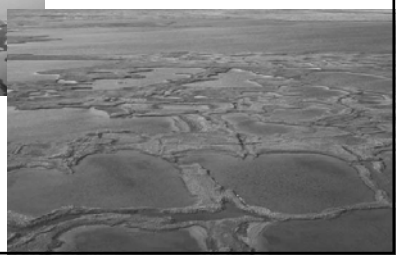


Arctic Shore Types

- inundated low-lying tundra
- tundra cliffs (ice rich and ice poor)

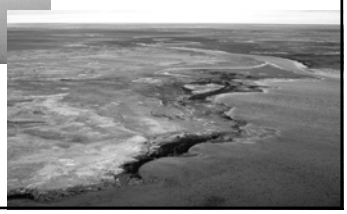
In the US, not found outside of Alaska

Inundated Low-lying Tundra



Ice-Rich Tundra Cliffs

Peat Shoreline



Shoreline Response Operations

Oil in Snow

Oil in broken ice in rivers

Oil in shorefast ice

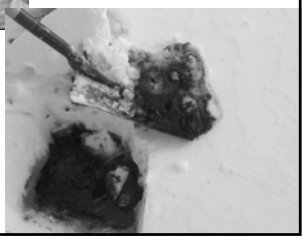
Oil under ice in rivers

SNOW

Tactic	Oil Type				
	Volatile	Light	Medium	Heavy	Solid
Natural Recovery	✓	✓	o		
Flooding	✓	✓	✓		
Low Pressure Ambient Wash	✓	✓	✓		
Low Pressure Warm Wash					
High Pressure Ambient Wash					
High Pressure Warm Wash					
Steam cleaning					
Sand Blasting					
Manual	o	o	o	o	o
Vacuums	o	✓	✓		
Mechanical	o	o	✓	✓	✓
Vegetation Cutting					
Passive Sorbents	o	o	o		
Mixing-wet	✓	✓	✓	o	
Mixing-dry					
Sediment Relocation	✓	✓	✓	o	
Burning	✓	✓	✓	o	
Dispersants					
Shoreline Cleaners					
Solidifiers					
Bioremediation					

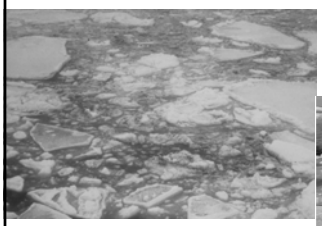
Snow with Crude Oil

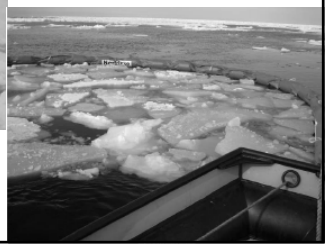
Snow with Diesel



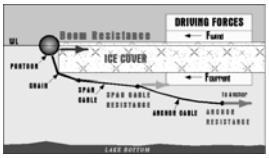
Snow Melters

Oil in Rivers and Broken Ice





Ice Booms



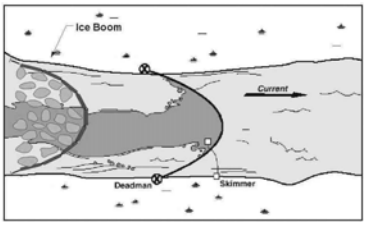
Lake Erie

~ 6.5 km long

Lac St. Pierre

~ 2.5 km long – 22 spans

Concept to Utilize Ice Booms During Response



Abdelnour et al. 2000

Oil on shorefast ice

SHORE ICE

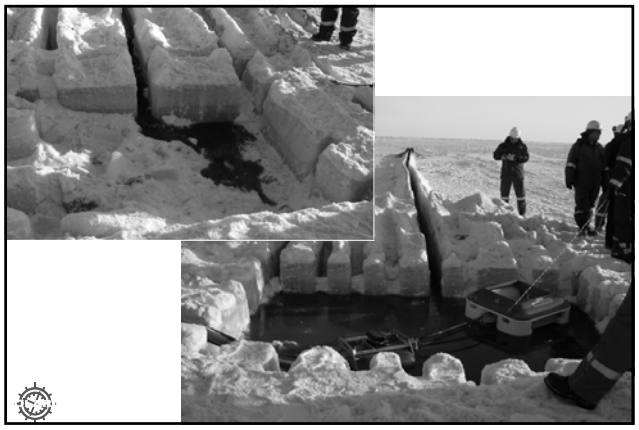
Tactic	Oil Type				
	Volatile	Light	Medium	Heavy	Solid
Natural Recovery	✓	✓	o		
Flooding	✓	✓	o		
Low Pressure Ambient Wash	✓	✓	✓	o	
Low Pressure Warm Wash			✓	o	
High Pressure Ambient Wash				o	
High Pressure Warm Wash					
Steam cleaning					
Sand Blasting					
Manual	o	o	o	o	o
Vacuums	o	✓	✓		
Mechanical	✓	✓	✓	✓	✓
Vegetation Cutting					
Passive Sorbents	o	o	o		
Mixing-wet					
Mixing-dry					
Sediment Relocation					
Burning	✓	✓	✓	o	
Dispersants					
Shoreline Cleaners					
Solidifiers					
Bioremediation					

Havre St. Pierre – Bunker C

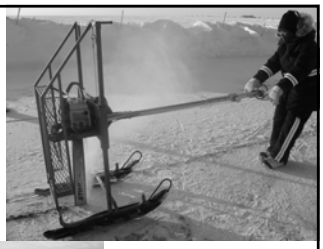
M/V Saraband spill - 1998

Some oil was recovered from the broken ice around the vessel more than 1400 tons of ice removed

Oil under Ice in Rivers



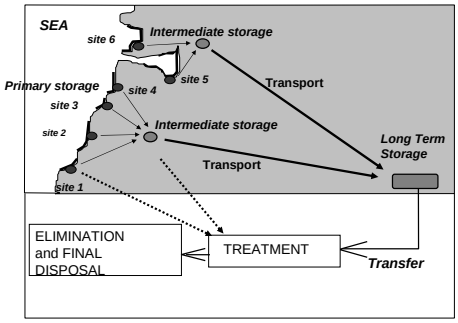
Chain Saw Frames



Barrier in Ice Slot

Waste Transfer

Typical Model



Model Must be Modified for Remote Area Operations

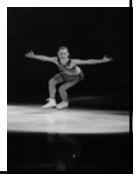
- No roads
- Transfers will be either by
  - tracked vehicle,
  - boat (barge, landing craft), or
  - helicopter.

Winter Challenges

- Short days
- Cold stress
- More support required
- Oil may be hard to detect in snow or under ice
- Ice is dynamic
- Oil weathers more slowly (especially evaporation)

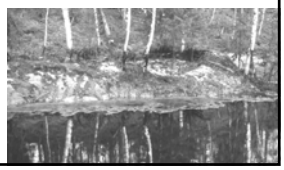
Winter Positives

- Emulsification retarded
- Evaporation retarded (may be a negative)
- Ice minimizes spreading on water
- Snow slows spreading
- Cold lowers viscosity – slows spreading
- Can recover 100% of oil spilled on ice !
- Can travel on smooth ice



Winter Strategies

- Spreading and transport minimized so recover before remobilized during spring thaw
- Potential operational impacts lower in winter



Summary

Key factors in dealing with winter and ice or snow:

- Cannot just "cut and paste" summer procedures to cold or winter operations
- Requires a different set of strategies, tactics, and methods for containment and recovery
- Requires a different approach to safety, support and logistics

Summary

Need to consider and plan for a range of scenarios:

- Oil and **snow** on land or on ice
- Oil **buried or penetrated in snow** on land or ice
- Oil on **shorelines** or river banks with snow and/or ice
- Oil **on solid ice** - rivers and ocean
- Oil **under solid ice** - rivers and ocean
- Oil **in broken ice** – rivers and oceans