Overview Presentation

US Coast Guard Arctic Response Workshop

Anchorage

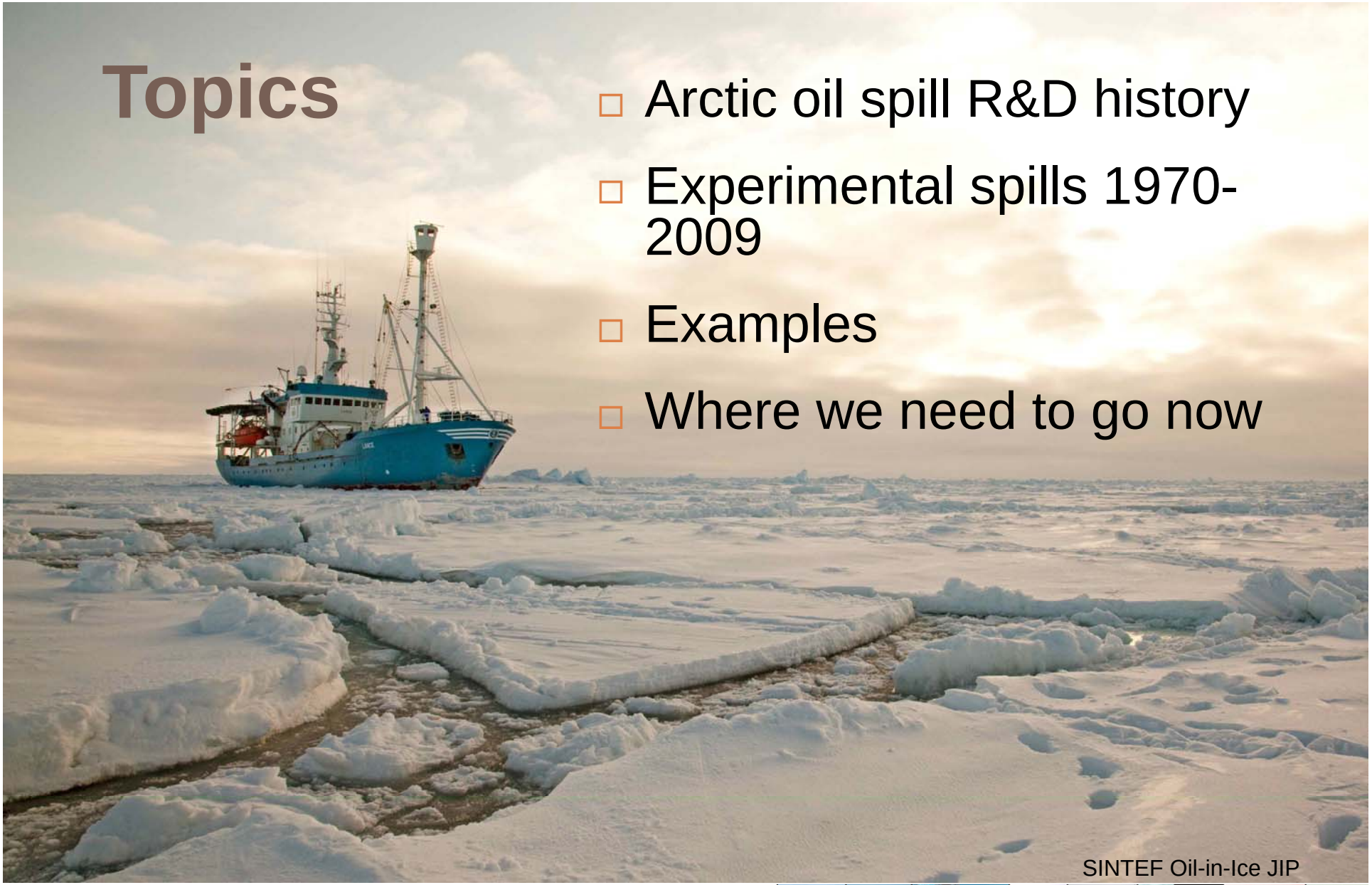
April 23, 2010

Experiences with Experimental Spills

David Dickins – DF Dickins Associates

Topics

- Arctic oil spill R&D history
- Experimental spills 1970-2009
- Examples
- Where we need to go now



SINTEF Oil-in-Ice JIP

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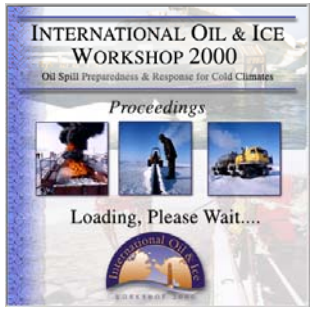
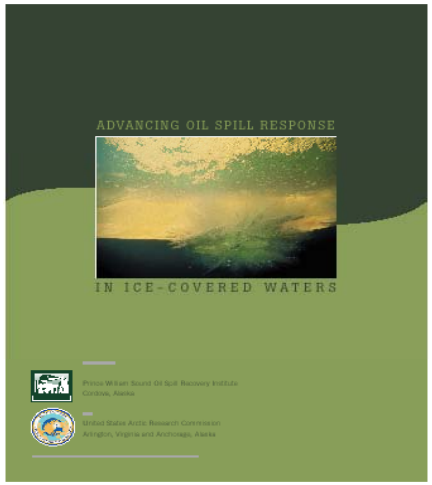
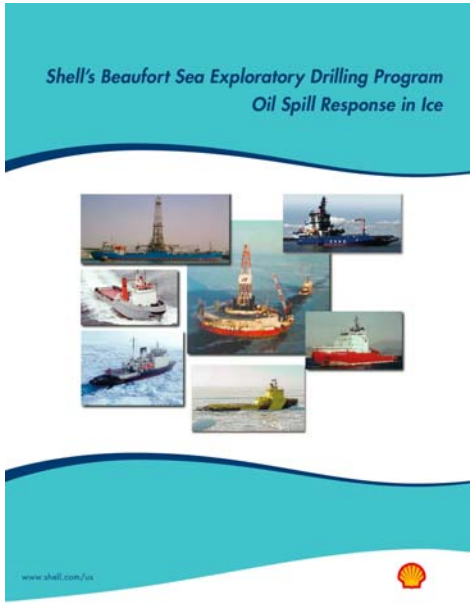
Information Sources





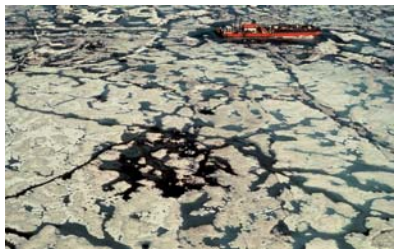


- **SINTEF Oil-in-Ice JIP 2007-09**
- **International Oil and Ice Workshop: Anchorage 2007 – Dickins/SL Ross**
- ***Oil Spills in Ice Discussion Paper*: Dickins-Vaudrey-Ross 2000**
- **2001 Seminar on Spills in Ice: Finnish Environment Institute, Helsinki 2003**
- ***Advancing Oil Spill Response in Ice Covered Waters*: DF Dickins for OSRI-US Arctic Research Commission 2004**
- **Development of New Oil Spill Response Concepts in Ice: SINTEF-HSVA 2005 (EU ARCOP)**
- **International Oil and Ice Workshop: Anchorage 2000 - Dickins/ACS**
- **Environment Canada AMOP 1979---**
- **Alaska Clean Seas Technical Manual**
- **+++ many thousands of pages more!!**

Arctic Oil Spill Research – Brief History

Ohmsett Photo - Dickins

Owens and Belore (2004)



Dickins and Buist 1980

SINTEF 2006

SL Ross and DF Dickins 2002

- Crude oil spills under solid ice in Canada 1974/79/81; Norway – Svalbard 2006
- Baffin Island Oil Spill Project 1981
- Svalbard oil in sediments 1997/98
- Experimental spills in broken ice in Canada (1986) and Norway (1993 and 2008/09)
- Accidental spills in ice: E.g. *Kurdistan*, Buzzards Bay, *Antonio Gramsci, Saraband*
- Tank/basin testing: E.g. Ohmsett (New Jersey), CRREL (USA), HSVA (Hamburg), NRC (Ottawa), ACS Wave Tank (Prudhoe Bay), SL Ross lab (Ottawa), SINTEF (Trondheim)

Known Experimental Spills in the Arctic and/or Ice

Project	Year	Contact/Author	Location	Environment	Total Size/#spills	Clean-up
Behavior of Oil Spills in the Arctic	1970	USCG - Glaeser	Chukchi	on and under fast ice	1-2 bbl/5 spills	Burning
Interaction of Crude Oil with Arctic Sea Ice	1975	Dickins	Cdn Beaufort	under fast ice	340 bbl/9 spills	Burning & Mechanical
Oil Behavior Under MY Ice	1978-82	ESRF - Comfort	Cdn High Arctic	under old ice	11 bbl/single spil	None
Oil and Gas Under Sea Ice	1979/80	Dickins & Buist	Cdn Beaufort	under fast ice	116 bbl/3 spills	Burning
Oil behavior in fast ice	1979-83	Allen & Nelson	US Beaufort	on and under fast ice	multiple spills 5 to 288 gal	Burning
Baffin Island Oilspill - BIOS	1981	Env Canada - Owens, Sergy, Dickins et al.	Cdn E Arctic - Pond Inlet	shorelines	190 bbl/2 main spills	Dispersants & Natural
Emulsions in Ice	1982	COOSRA - Potter, Dickins, Buist	Cdn Beaufort	under fast ice	100 gal/2 spills	Burning
Exp Spills of Crude Oil in Pack Ice	**1986**	**ESRF - Buist & Dickins**	**Cdn East Coast - NS**	**between floes and in leads in pack ice**	**18 bbl/3 spills**	**Burning**
Beaufort Sea Dispersant Trial	1987	ESRF - Swiss	Cdn Beaufort	open water	50 gal	Dispersants
Spitsbergen Test Burn	1988	Allen	Svalbard	open water	500 gal	Burning
Marginal Ice Zone Experiment	**1993**	**SINTEF - Singsaas, Brandvik, Daling**	**Barents Sea - 75°N**	**between floes and in leads in pack ice**	**164 bbl**	**None**
Svalbard Exp. Spill	2006	Dickins, SINTEF, UNIS, Boise State	Svalbard	under fast ice	21 bbl	Burning
In-situ treatment oiled sediments	1997/98	Env Canada - SINTEF, Exxon - Sergy, Owens +	Svalbard	shorelines	105 bbl/3 sites	Bioremed.
Oil in Ice Field Experiment 08	**2008**	**SINTEF JIP**	**Barents Sea - 78°N**	**in openings within pack ice**	**5 bbl/2 spills**	**Burning**
Oil in Ice Field Experiment 09	**2009**	**SINTEF JIP**	**Barents Sea - 78°N**	**between floes in pack ice**	**110 bbl/5 main spills**	**Burning, Dispersants**

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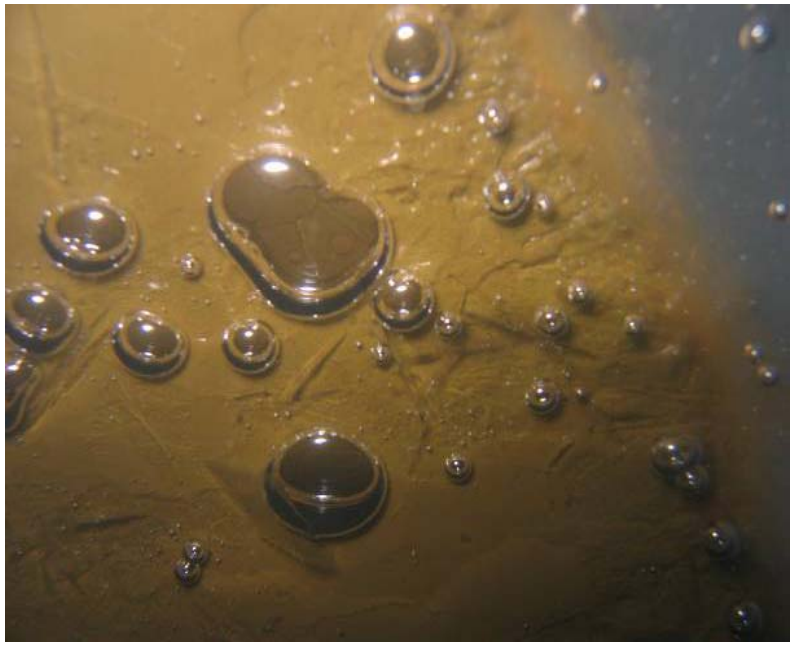
Learning through Experimental Spills

BIOS 1981 Photo: D. Dickins

SL Ross and DF Dickins 1986

Balaena Bay 1974/75

Encapsulation



Confined oil under ice with new crystals forming within 24 hours Photo: P.J. Brandvik 2006

Oil Encapsulated in ice during an experimental spill In Alaska. Photo: A. Allen

Migration

Oil coming through first year ice - Balaena Bay, Beaufort Sea spring 1975

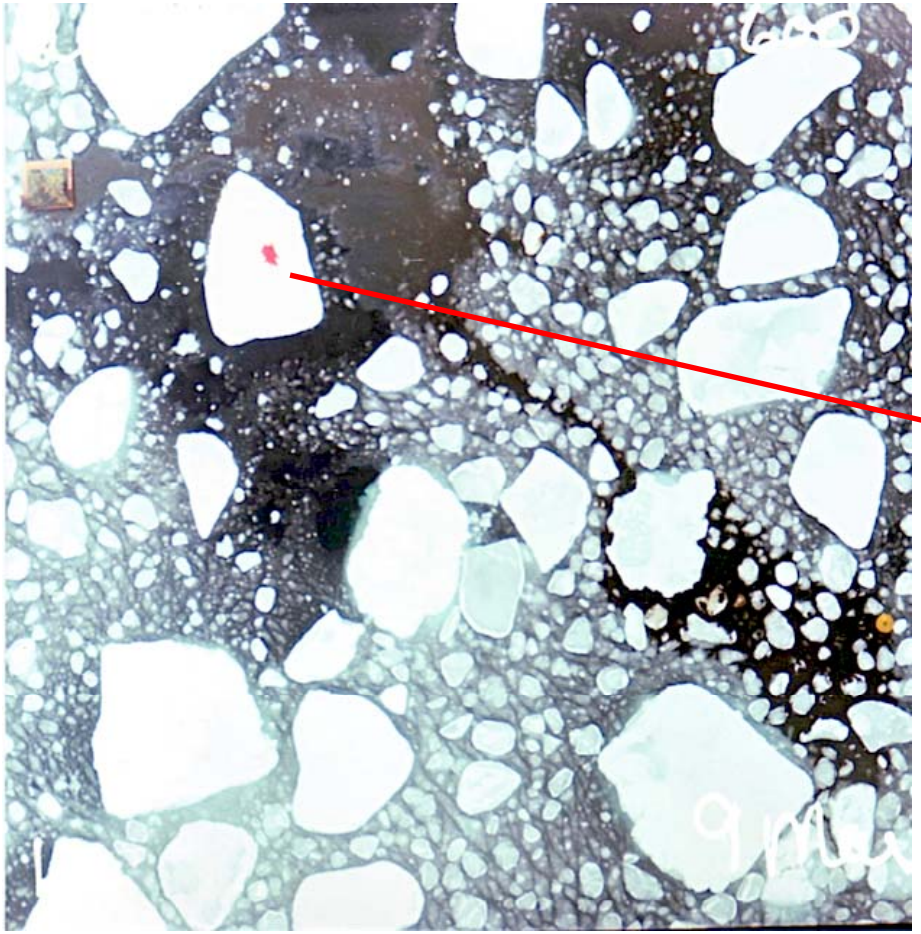
Experimental spills of crude oil in pack ice – off Cape Breton, Nova Scotia 1986

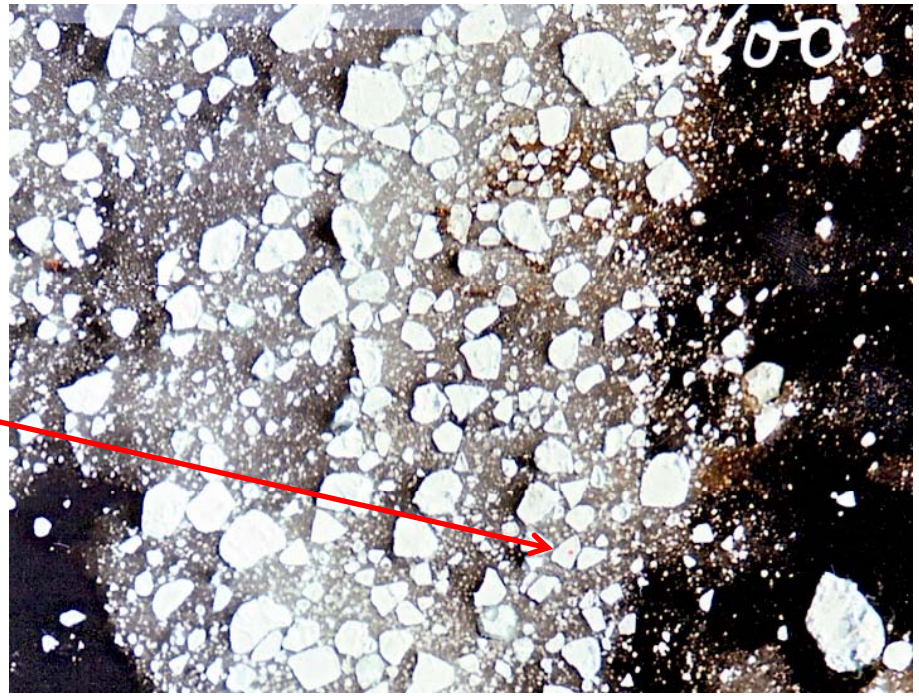
R. Belore 1986

D. Dickins

- 3 spills 6 bbl each
- Followed over several days
- Ice conditions ranging from 4-6/10 small floes and ocean swell near ice margin to leads in 7-8/10 ice
- Presence of slush key factor in oil behavior
- 0.86 s.g. crude remained close to surface
- No observed emulsification
- Limited spreading
- Effective burning (80% plus)
- Results used as basis for simple spreading relationship in pack ice

1986 Cape Breton Trials off Nova Scotia





Cape Breton 1986 from 600 ft and 3400 ft (R. Belore)

First experimental spills in pack ice followed 7 years later in Norway. No further significant spills in pack ice from 1993-2010 in spite of the priority now assigned to the issue of spills in broken ice.

Norwegian Marginal Ice Zone Experiment - 1993

Photos: SINTEF
I. Singsaas

- Single spill 163 bbl, 45 km inside ice edge in 9/10 starting concentration
- Followed for one week
- Similar API to 1986 CAD spill (0.85)
- Low wave energy
- Insignificant transport of oil particles under floes validating 1986 findings
- Key findings
  - Sensitivity of oil spreading and film thickness to ice concentration (10 cm to 1 cm in 45 min, constant for 4 days then to 1 mm in 24 hours as ice went from 8/10 to 7/10
  - 2-5% of total volume adhered to perimeter of ice floes
  - High potential for ISB - not carried out
  - Mechanical Rope mop deployment hampered by influence of vessel opening up the ice cover (as in 86)

Experimental spill under ice at Svea, Svalbard 2006

Photos: SINTEF

In-situ Burning of a 3400 liter crude oil weathered for 2 months (27% evaporated). 96% efficiency.

Summary

- Much of our present understanding of oil behavior in ice and the trade-offs involved in applying different response tools in a range of oil and ice conditions is derived directly from a small number of experimental spills carried out over the past 40 years.
- Laboratory experiments and tank tests can continue to advance our knowledge base and capabilities to some degree but ultimately there is no substitute for going out in the field and learning first-hand in a real ice environment.
- We need to lend our full support to any efforts by government and industry to launch a new series of offshore field trials with oil and ice in North America.