

Non-floating Oil Spills: Structure and Outcomes

- Plenary talks (getting everyone on the same page)
 - ◆ Case Studies
 - ◆ Submerged Oil Overview
 - ◆ Biological Effects/Restoration

Non-floating Oil Spills: Structure and Outcomes

- Breakout Groups
 - ◆ Detection and Monitoring
 - ◆ Fate and Transport
 - ◆ Containment and Recovery
 - ◆ Effects and Restoration
 - ◆ Protection of Water Intakes

Non-floating Oil Spills: Structure and Outcomes

- Group Reports
 - ◆ Research Need
 - ◆ Objectives
 - ◆ Guidelines
 - ◆ Potential Impediments or Enhancements to Research
 - ◆ Application to the Decision-Making Process

Non-floating Oil Spills: Structure and Outcomes

- Workshop Report
 - ◆ **Tables** generated by each group
 - ◆ **Synthesis** into language for the preparation of study plans for future funding mechanisms or research proposals
 - ◆ Workshop **Summary** based on discussions at last plenary session

Submerged Oil Overview

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Response Challenges for Non-floating Oil Spills

- Detection of pooled oil on the bottom
- Detection/tracking of mobile oil suspended in the water column
- Predicting fate and transport of submerged oil
- Containment of oil on the bottom
- Containment of suspended oil

Response Challenges for Non-floating Oil Spills

- Protection of water intakes
- Submerged oil recovery
- Submerged oil injury assessment and resource restoration

Non-floating Oil Spills: Detection of Oil on the Bottom

- Needs for detection of pooled oil on the bottom
 - ◆ Thickness (generally “thin” 1-10 cm)
 - ◆ Dimension of oil accumulations
 - ◆ Patch size or percent cover in accumulation
 - ◆ Need to estimate volume/area

Non-floating Oil Spills: Detection of Oil on the Bottom

- Visible Surveys
 - ◆ Clear water only
 - ◆ Need diver validation/thickness measure
 - ◆ Rapid turnaround of results
 - ◆ Standard spill response method

Morris J. Berman, Puerto Rico



Lake Wabamum, Canada



Non-floating Oil Spills: Detection of Oil on the Bottom

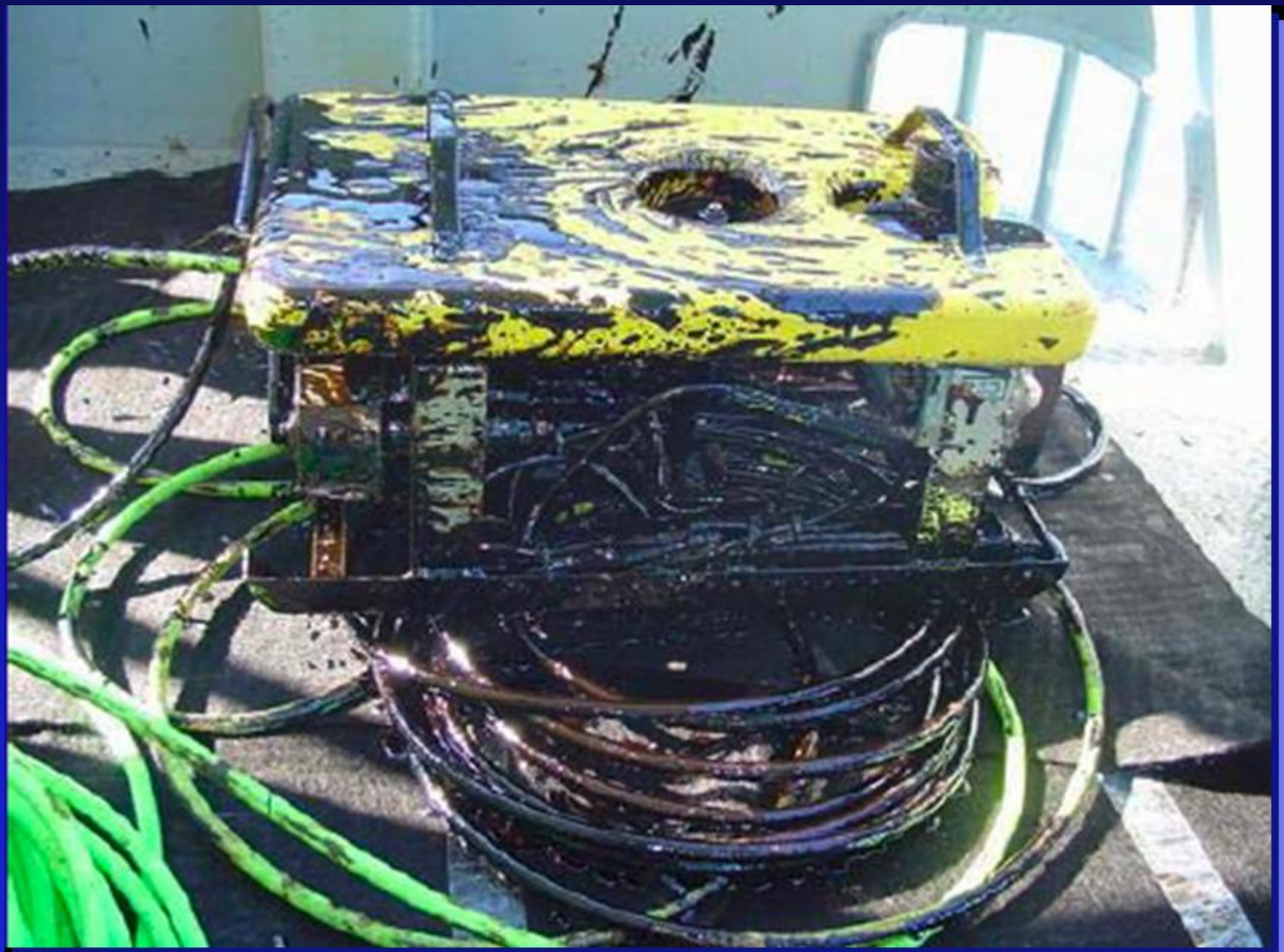
- Diver Observations/Video
 - ◆ Water visibility/depth/wx limits
 - ◆ Need divers anyway for validation
 - ◆ Low areal coverage/poor quantification
 - ◆ Contaminated diving expertise limited





Non-floating Oil Spills: Detection of Oil on the Bottom

- ROV Video/Photography
 - ◆ Water visibility/wx limits
 - ◆ Systems with good GPS tracking of ROV
 - ◆ Not much experience in response community on capabilities
 - ◆ Need rapid post-processing to produce useful products (georeferenced oil maps)



Non-floating Oil Spills: Detection of Oil on the Bottom

- Sorbent Drops

- ◆ Sorbent material attached to weights, dropped/dragged a short distance, then inspected for oil
- ◆ Embarrassingly crude but simple
- ◆ First used in 1984 at *Mobiloil* spill in Columbia River; latest in 2003 at *Athos 1*

Non-floating Oil Spills: Detection of Oil on the Bottom

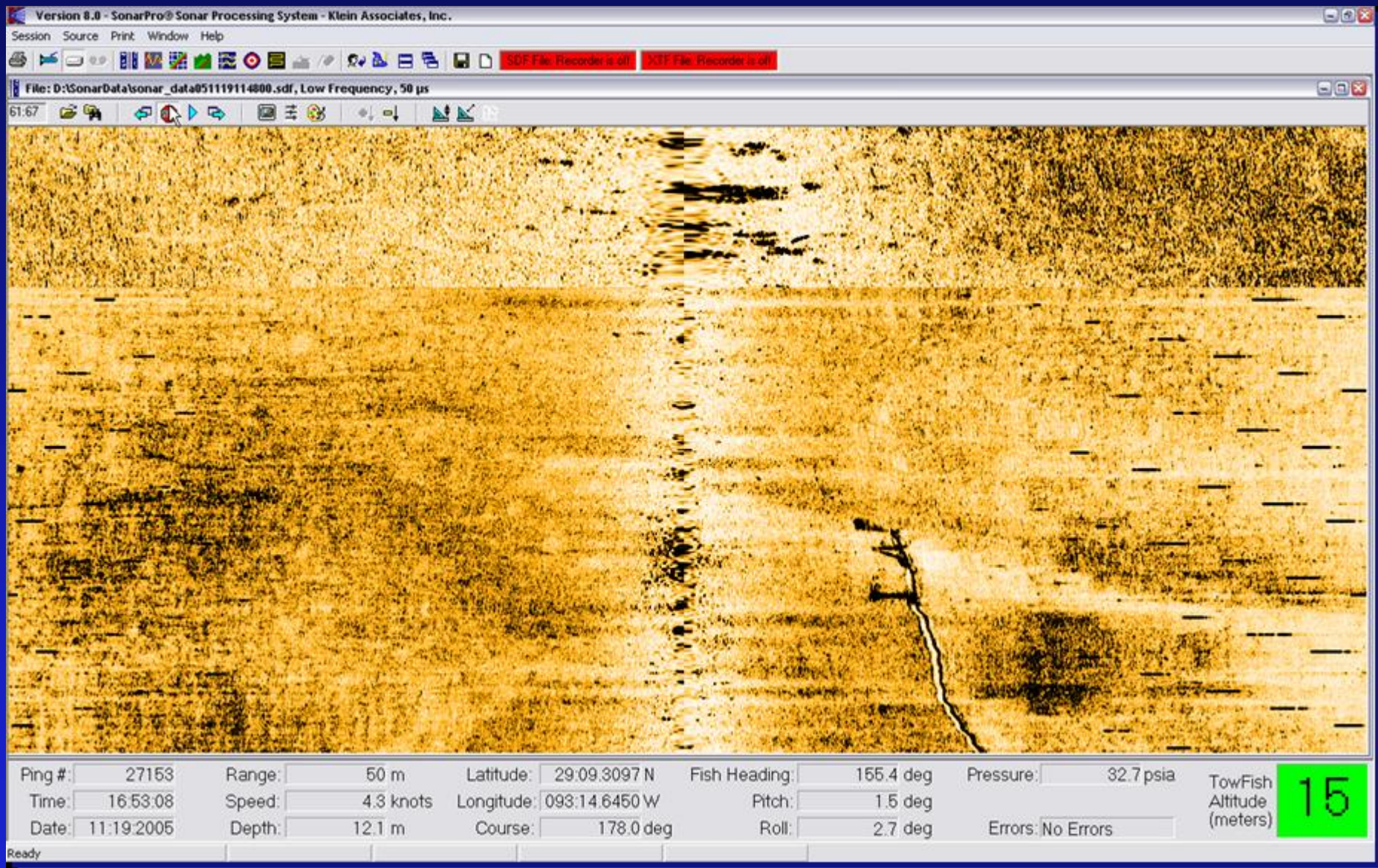
- Chain drags/V-SORs
 - ◆ Sorbent material attached to chains and dragged some distance, then inspected for oil
 - ◆ Used at many submerged oil spills as an initial search strategy
 - ◆ Provides data only on relative amounts of oil within drag area
 - ◆ Many limitations, but still useful



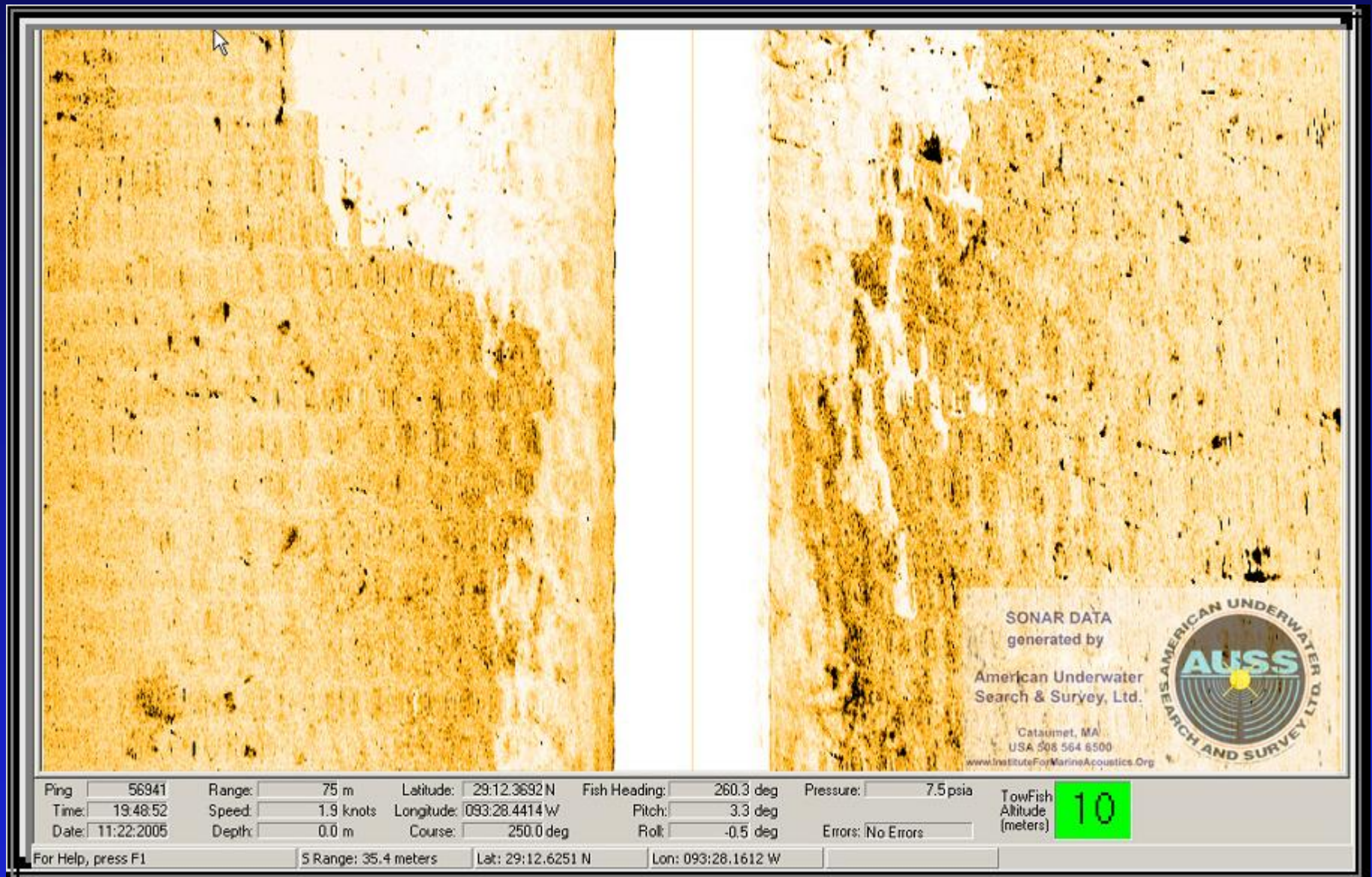
Non-floating Oil Spills: Detection of Oil on the Bottom

- Acoustic Systems
 - ◆ Lots of good capabilities (no water clarity limits, georeferenced, good areal coverage rates, 2D imagery, available technology)
 - ◆ Lots of limitations (detection limits for oil thickness, patch size; substrate effects; post-processing time; water depth; needs validation)
 - ◆ Little experience in response community

DBL 152 Debris Field and Trench



DBL 152 Oil Patch (?)



Non-floating Oil Spills: Detection of Oil on the Bottom

- Chemical Detection Systems
 - ◆ Only experience is with field fluorometers for oil in the water column
 - ◆ Potential technologies available
 - ◆ Effects of suspended oil (dissolved/particulate), physical processes/transport
 - ◆ Correlation of signal with amount of oil?

Non-floating Oil Spills: Detection of Mobile Oil

- Detection of mobile oil suspended in the water column
 - ◆ Can be dynamic/episodic at different time-scales
 - ◆ Can be along bottom/just under the surface
 - ◆ Desperate need for quantification of amount

Non-floating Oil Spills: Detection of Suspended Oil

- Stationary sorbent systems
 - ◆ Snare on ropes, in pots; on the bottom and in the water column
 - ◆ Uses readily available response materials
 - ◆ Provide good info on vertical distribution
 - ◆ No quantification or calibration of efficiency



Non-floating Oil Spills: Detection of Suspended Oil

- Trawled Systems
 - ◆ Mostly fish nets with snare
 - ◆ Used as recently as 2004 - Lake Wabamum
 - ◆ There are commercial oil recovery nets in the UK, never used in US
 - ◆ Better designs could be used for quantification

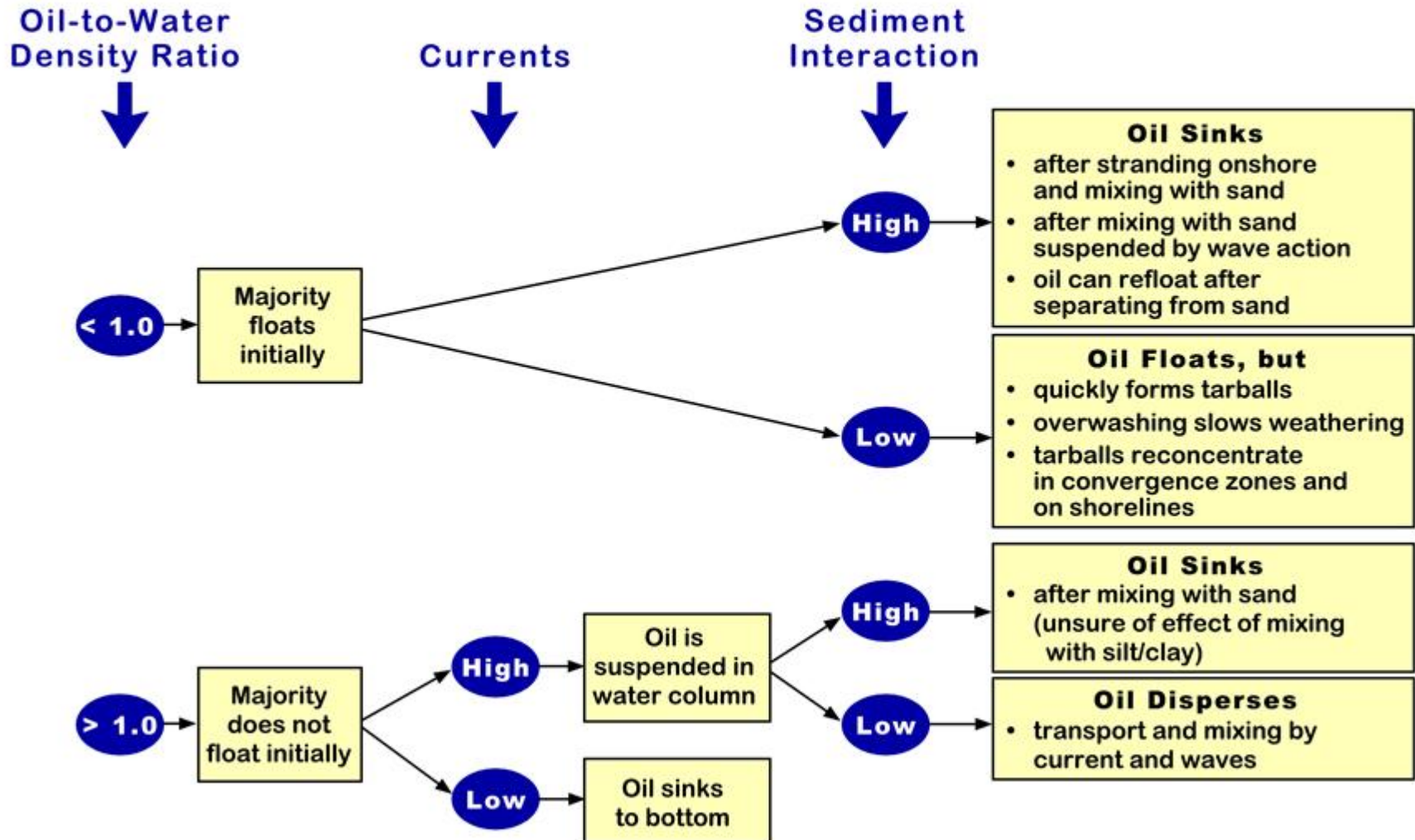
Non-floating Oil Spills: Detection of Suspended Oil

- Chemical Sensors
 - ◆ Only experience is with field fluorometry
 - ◆ Can sample different water depths
 - ◆ Need better understanding/calibration between dissolved and suspended oil
 - ◆ Fouling, contamination issues

Non-floating Oil Spills: Predicting Fate and Transport

- Processes that determine when oil submerges
- Oil/sediment interactions
- Processes that determine submerged oil movement
- Weathering of submerged oil
- Data gaps to provide better predictions

BEHAVIOR OF SPILLS OF HEAVY OILS



Non-floating Oil Spills: Protection of Intakes

- What are thresholds for different water uses and treatment systems (always “0”?)
- What detection methods are available?
- How do we communicate effectively with operators?
- Effective protection strategies

Non-floating Oil Spills: Containment/Protection of Intakes

- Filter fences
 - ◆ Geotextile fabric - Lake Wabamum
 - ◆ “Snare monster” - *Athos 1*
 - ◆ Silt curtains
- Air bubble curtains - Lake Wabamum
- Net booms

Non-floating Oil Spills: Oil Containment/Protection of Intakes

- Obvious need for improved technologies
- Need better site assessment/engineering design to improve effectiveness under typical current/flow conditions at intakes
- Need for systems to contain oil suspended during bottom oil recovery operations

Non-floating Oil Spills: Containment of Oil on Bottom

- Bottom booms, in theory
- Permeable barriers to allow water to pass but retain oil
- Bottom currents, oil resuspension processes are poorly understood
- Oil can re-suspended during high-energy events

Non-floating Oil Spills: Recovery of Oil on Bottom

- Diver directed pumping
 - ◆ Reduce water/increase oil recovery rates
 - ◆ Improve pumping rates
 - ◆ Improve oil pickup efficiency (sleds with larger vacuum units, hose management, oil concentration methods)

Athos 1 - Venezuela Crude Oil



Non-floating Oil Spills: Recovery of Oil on Bottom

- ROV directed pumping
 - ◆ Deeper water; diver safety
 - ◆ Reduce water/increase oil recovery rates
 - ◆ Improve pumping rates
 - ◆ Improve oil recovery

Non-floating Oil Spills: Recovery of Oil on Bottom

- Dredges
 - ◆ Appropriate types/dredge heads
 - ◆ Emergency modifications for oil recovery
 - ◆ Emergency permitting issues

Non-floating Oil Spills: Recovery of Oil on Bottom

- Decanting systems
 - ◆ Always *ad hoc*, under designed, and often fail, lots of trial and error
 - ◆ Need guidelines and calculation tools
 - ◆ Consider droplet size, flow rates, oil behavior (float or not)
 - ◆ Still need to use readily available materials

Morris J. Berman, Puerto Rico



Athos 1 Decanting - Oil Floated



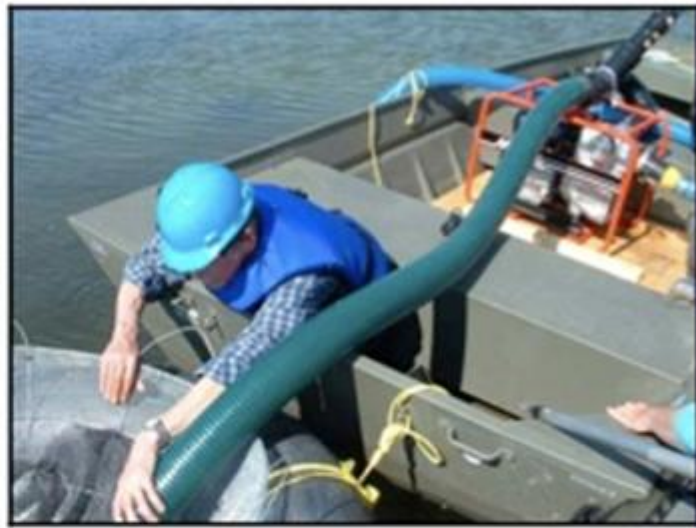
Athos 1 Decant “System”



Lake Wabumum - Tarball Recovery/Decanting



Photograph 1



Photograph 2



Non-floating Oil Spills:

Injury Assessment/Restoration

- What are likely effects based on exposure pathways (smothering, coating, low aquatic toxicity, ingestion)
- Biological assessment and monitoring approaches?
- Methods for scaling of injury?
- Restoration options?

Submerged Oil Summary

- Need new technologies for detecting, tracking, modeling, containing, protecting, recovering, decanting, assessing, restoring
- But, they need to be “emergency” ready
- Your charge next 1.5 days: Identify R&D projects to meet these needs