U.S. Arctic Ocean Oil Spill Response Gap Analysis
BSEE Project #1022

Nuka Research

Other studies

- **Prince William Sound (2006-2008)**
- **Canadian Beaufort and Davis Strait (2011)**
- **Northern British Columbia (2012)**
- **Aleutian Islands (2014)**
- **Barents Sea (2014)**
- **Greenland (2015)**
- **Circumpolar Arctic (2017)**
- Gulf of Mexico (in process – BSEE project)

Terminology

Response GAP Analysis

- How often could you expect environmental conditions to **preclude** response to an oil spill at a given location?

Response VIABILITY Analysis

- How often could you expect environmental conditions to **favor** response to an oil spill at a given location?

Simple Methodology

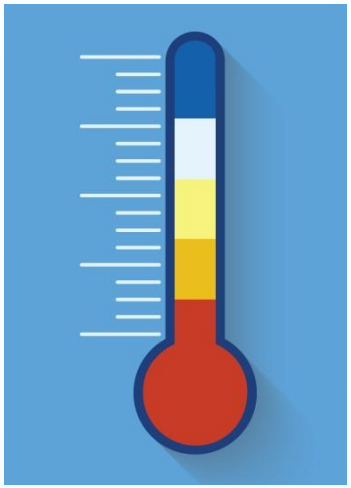
- Hindcast technique
- Assemble dataset of met-ocean conditions
- Establish environmental limits for technique, tactic, equipment
- Compare limits to dataset
- Report results as %
  - Viable
  - Marginal
  - Not Favorable

Categories

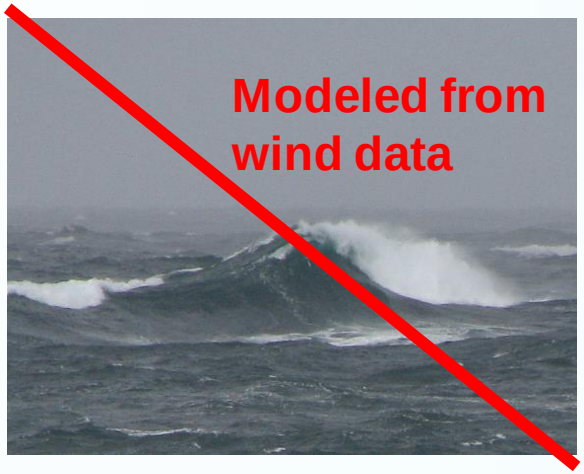
G	**Generally favourable conditions in which the tactic could be expected to be deployed safely and operate as intended.**
Y	Conditions are marginal, such that the tactic could be deployed but operations may be challenged or compromised.
R	Conditions are not favourable, so the tactic would typically not be used due to the impact of metocean conditions on safety or equipment function.

Met-ocean Conditions

Wind speed, chill, vessel icing



Air temperature, water temperature, dew point

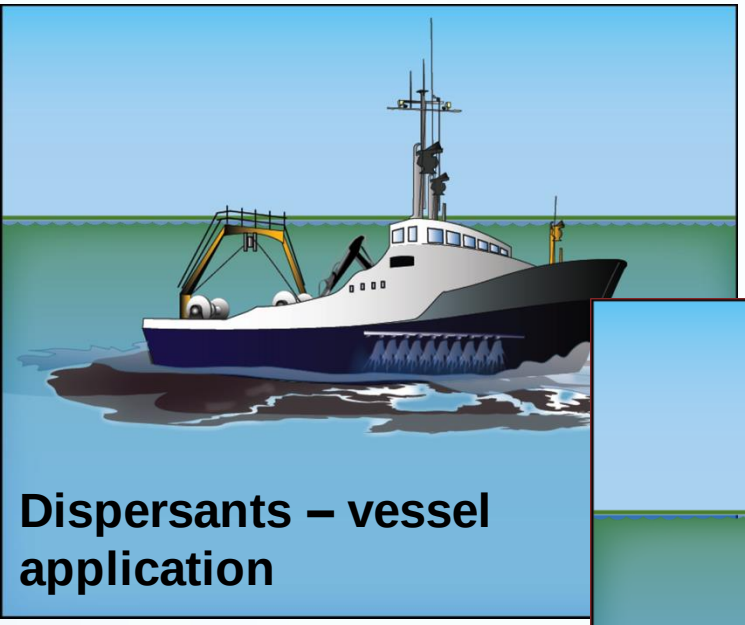


Wave height, steepness

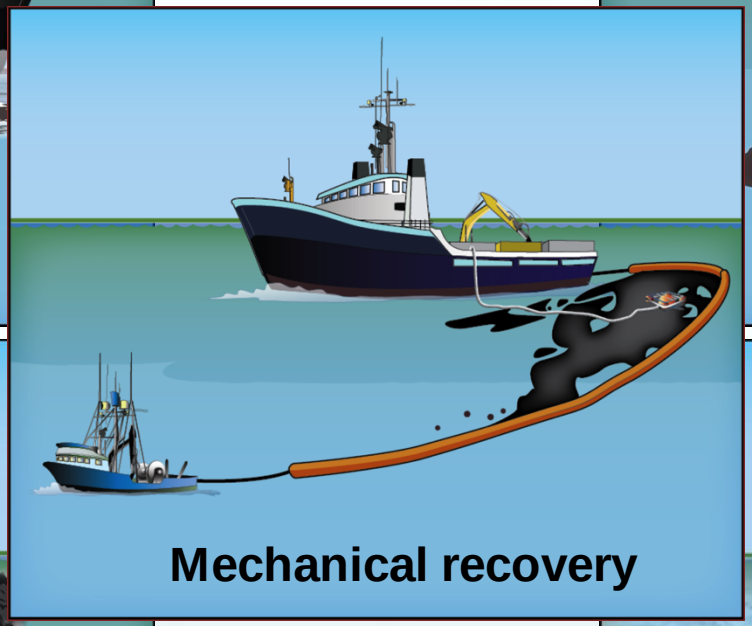
Visibility, horizontal, ceiling, daylight/darkness

Sea ice coverage

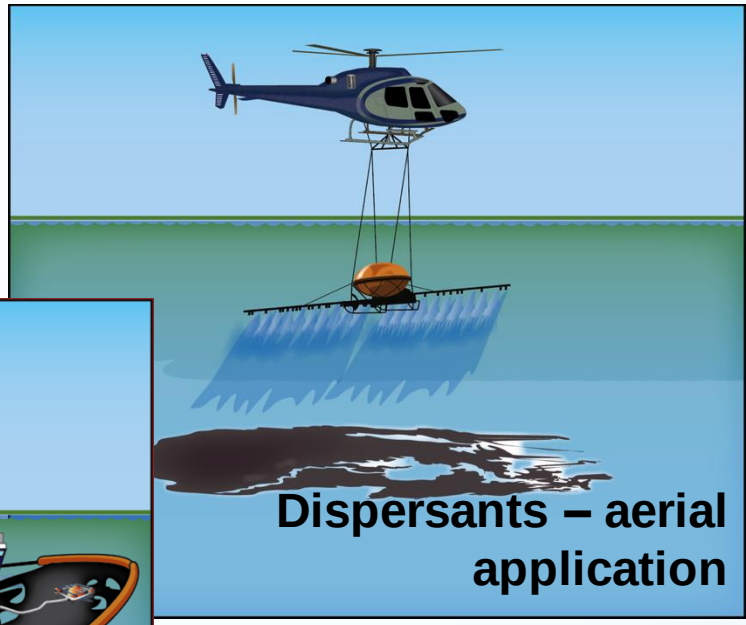
Inputs: Response Systems



Dispersants – vessel application



Mechanical recovery

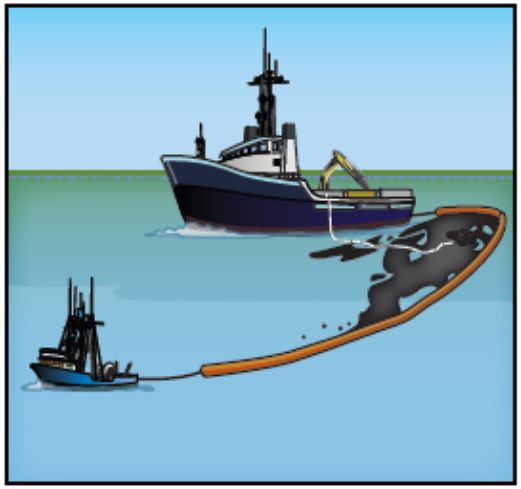


Dispersants – aerial application

In-situ burning – vessel ignition

In-situ burning – aerial ignition

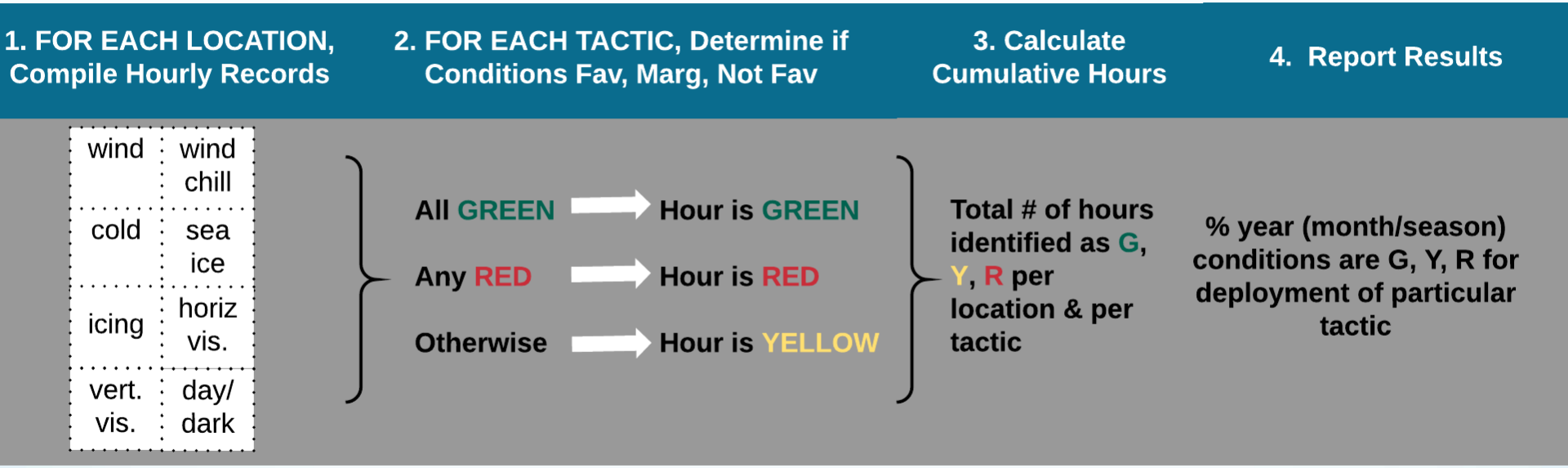
System Limits



SYSTEM COMPONENTS	BASELINE SPECIFICATIONS
Vessel platform	1 ea. 75 m offshore response vessel 1 ea. 20 m vessel of opportunity to tow boom
Containment system	Boom suited for > 2 m rough seas
Skimming system	High volume oleophilic skimmer suited for > 2 m rough seas
Primary storage	Onboard response vessel
Other components	Detection technology (such as aerial observation or FLIR) to detect and track oil

SYSTEM LIMITS – METRIC	FAVOURABLE	MARGINAL		NOT FAVOURABLE
	Upper Boundary	Lower Boundary	Upper Boundary	Lower Boundary
Wind m/s	≤ 11	11	18	≥ 18
Wind wave height m	≤ 1.8	1.8	3.0	≥ 3.0
Sea ice coverage %	≤ 10	10	30	≥ 30
Air temperature °C	≥ -5	-5	-18	≤ -18
Wind chill temp. °C	≥ -31.7	-31.7	-37.2	≤ -37.2
Structural icing cm/hr	< 0.7	0.7	2.0	> 2.0
Light conditions (day/dark)	Daylight	Darkness		
Horizontal visibility km	≥ 0.9	0.9	0.2	≤ 0.2
Vertical visibility m	≥ 152	152	10	≤10

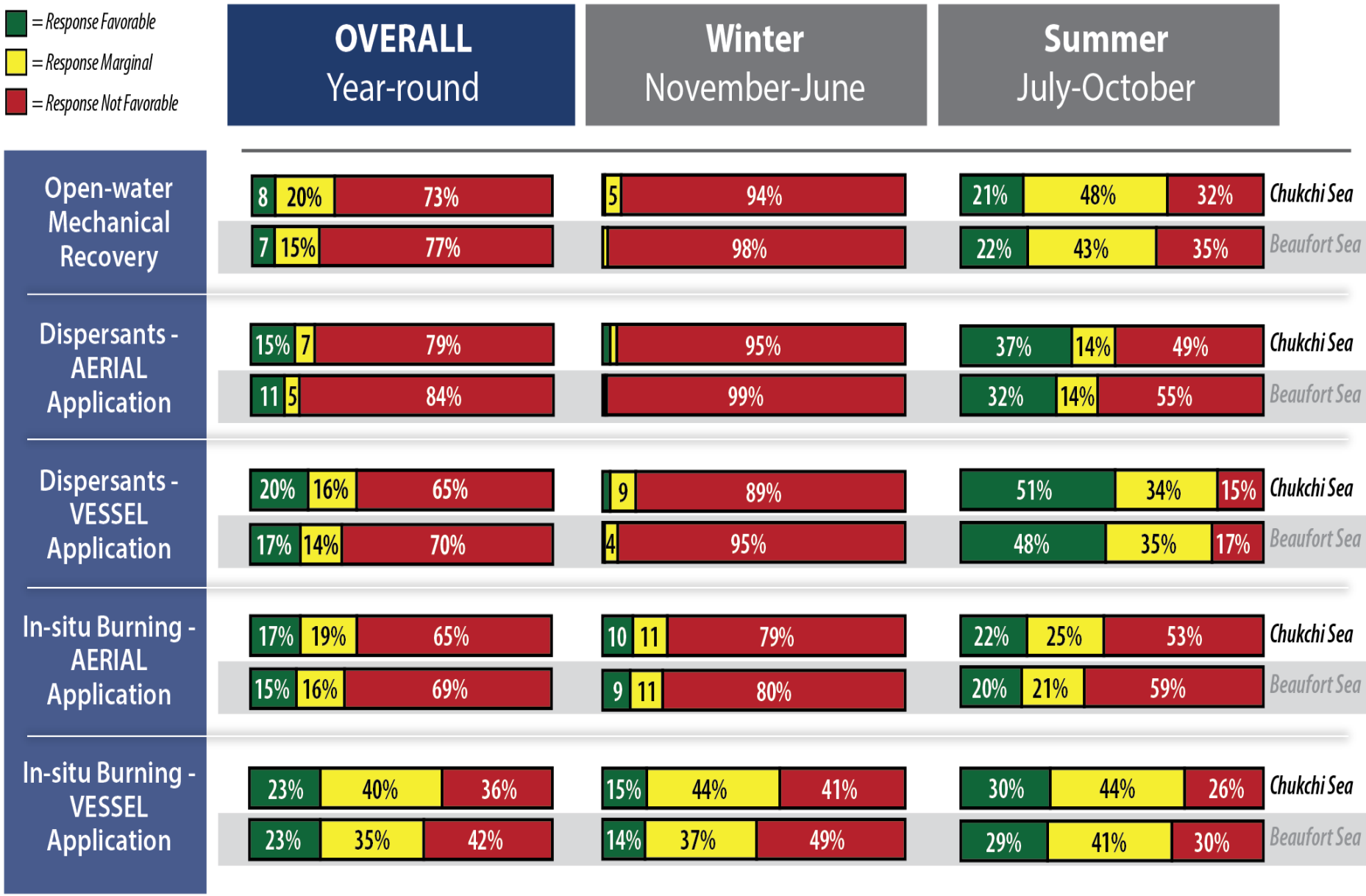
Methodology



= Response Favorable

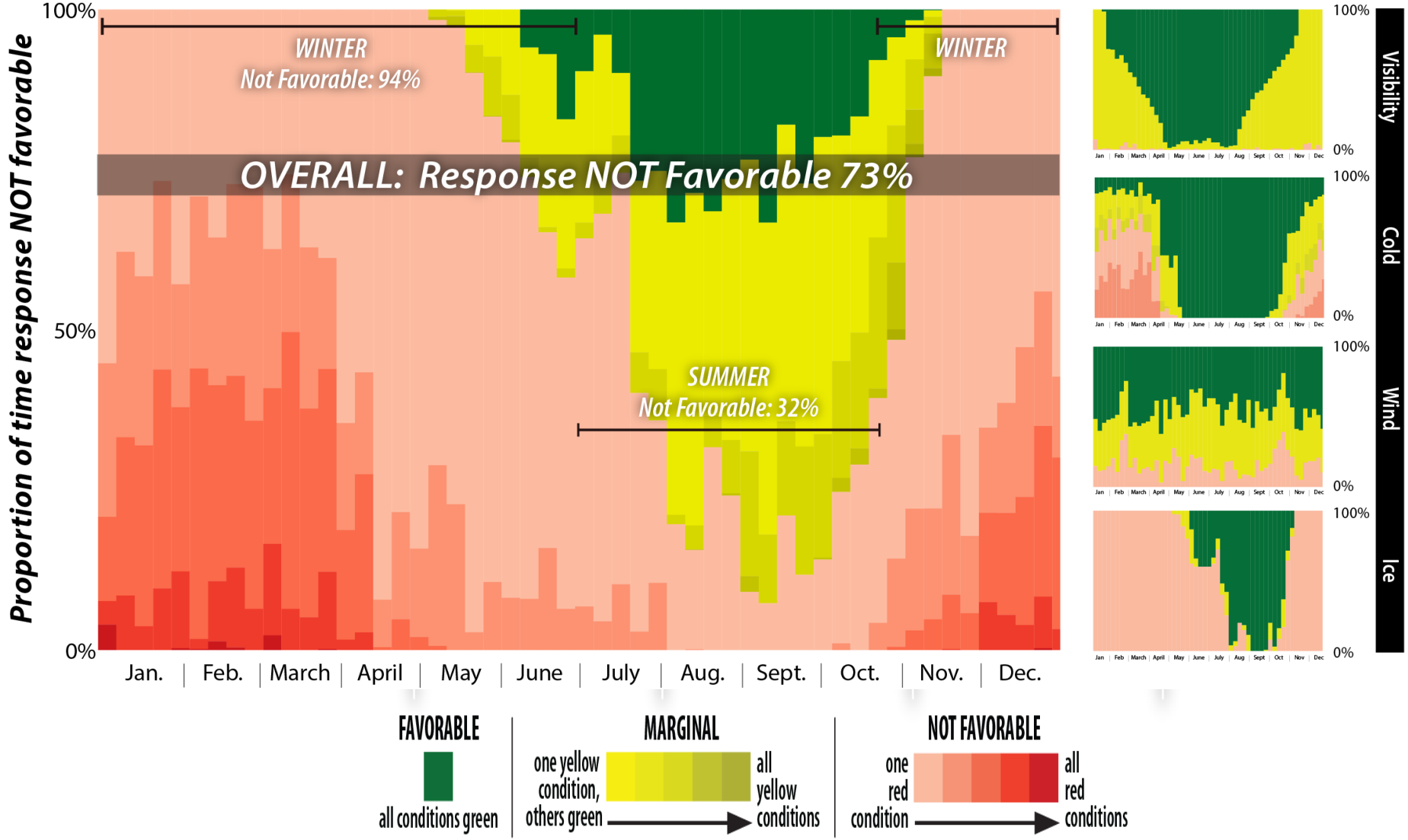
= Response Marginal

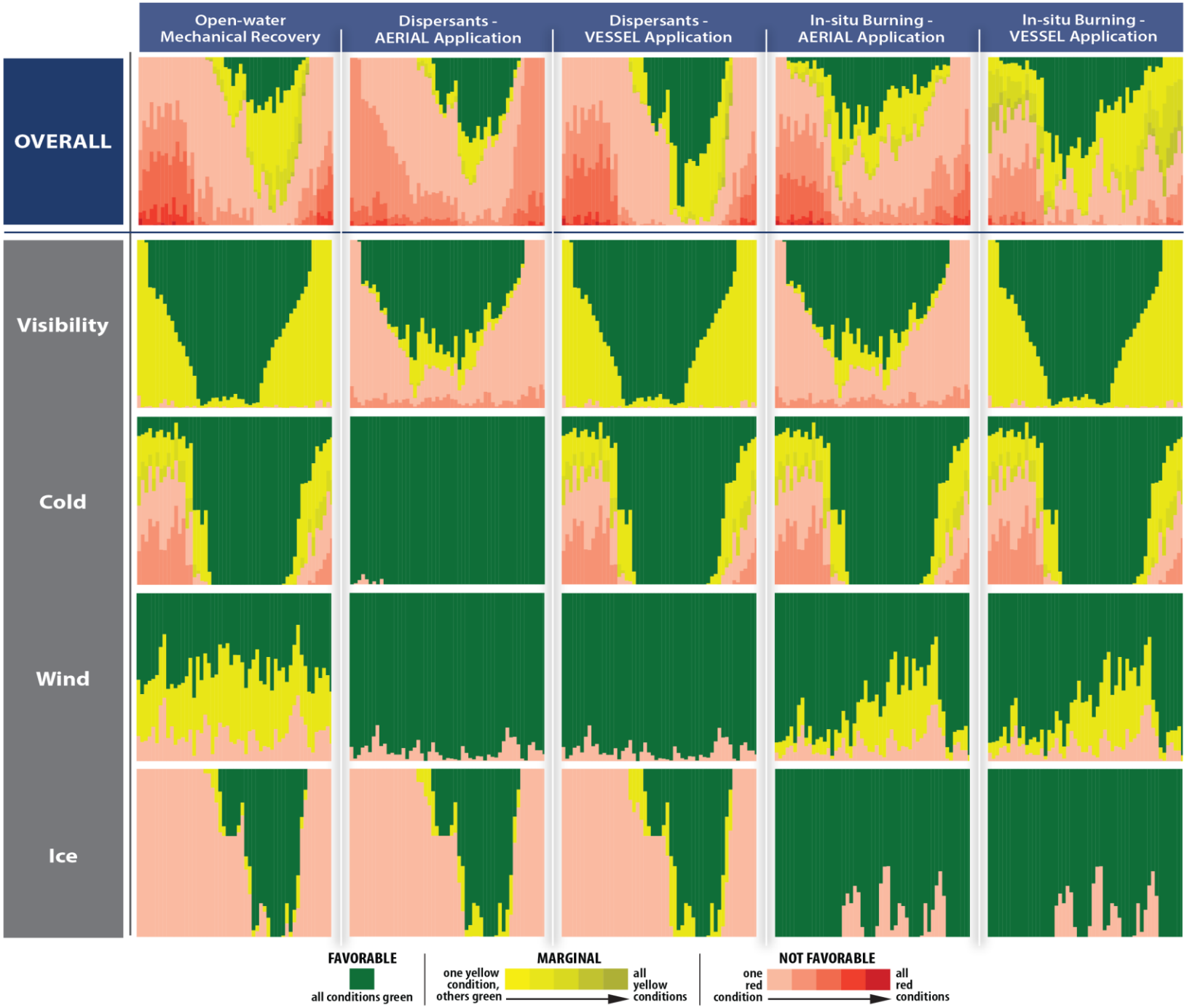
= Response Not Favorable



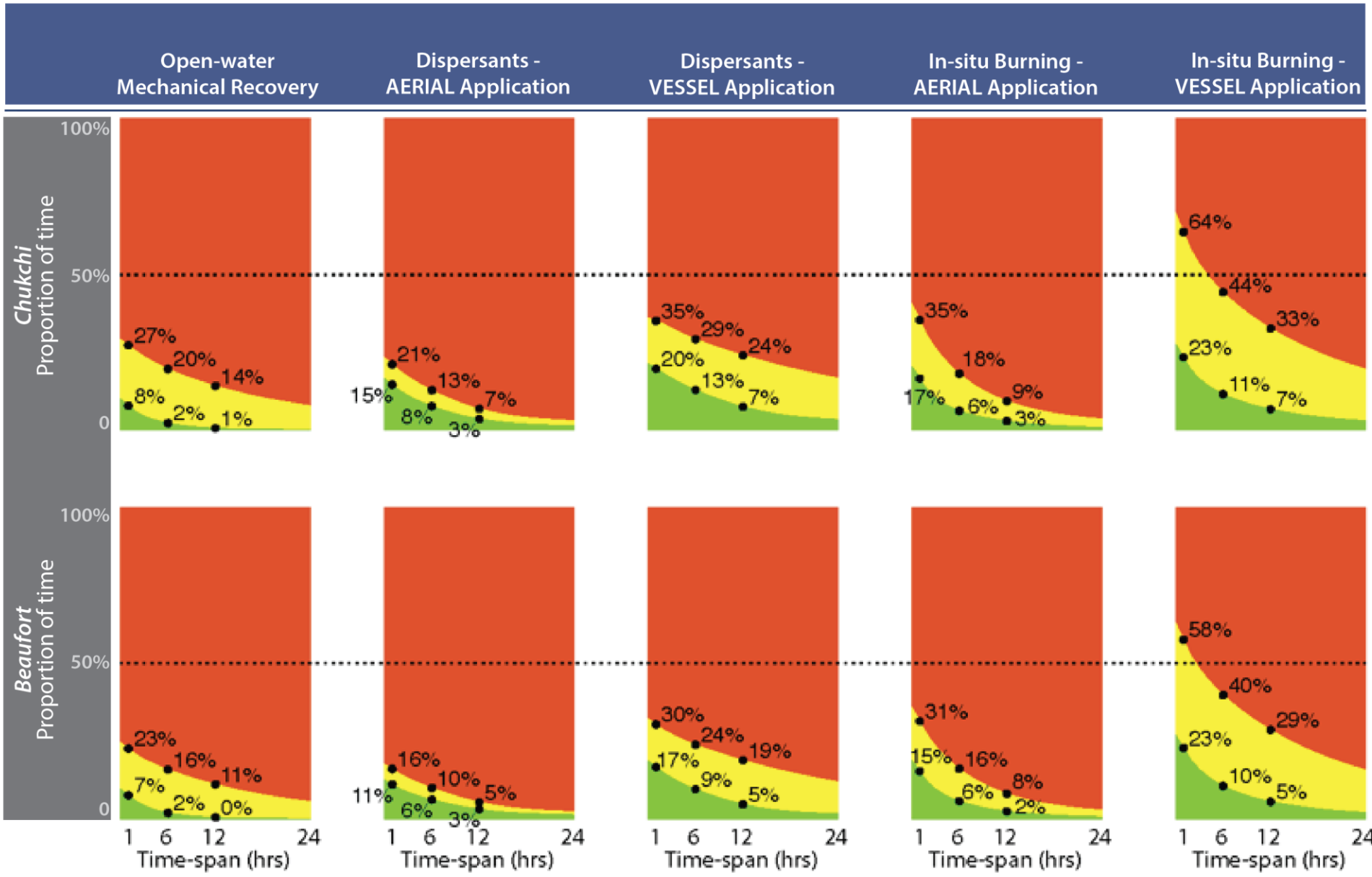
Open-water Mechanical Recovery

Chukchi Sea Location

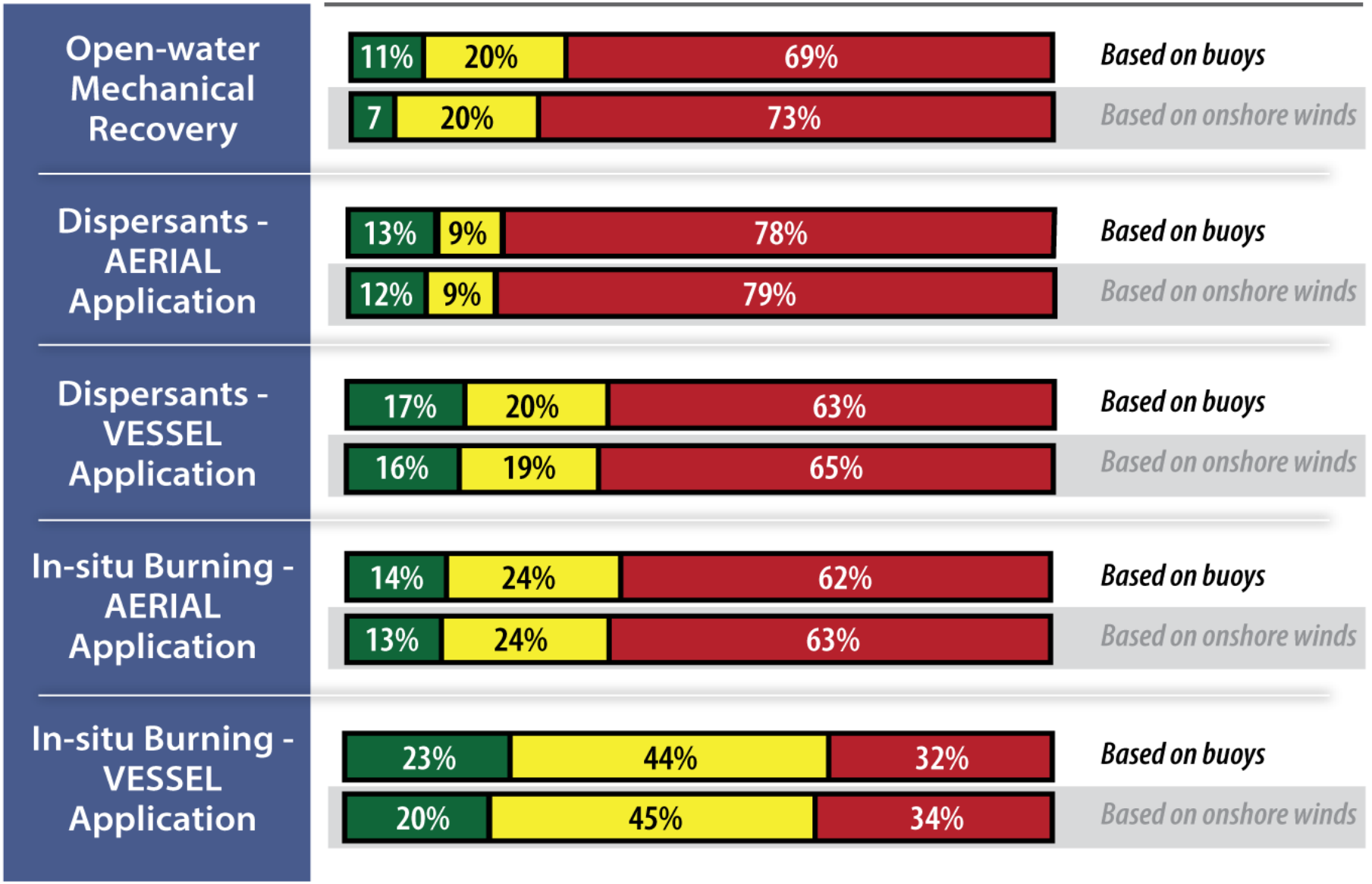



Open-water Mechanical Recovery
Dispersants - AERIAL Application
Dispersants - VESSEL Application
In-situ Burning - AERIAL Application
In-situ Burning - VESSEL Application
OVERALL
Visibility
Cold
Wind
Ice
FAVORABLE
all conditions green
MARGINAL
one yellow condition, others green
all yellow conditions
NOT FAVORABLE
one red condition
all red conditions

Time-window sensitivity



Modeled vs buoy waves – results comparable



Applying results

- Test planning assumptions
- Consider tactic selection
- Explore seasonal variations
- Identify best “bang for the buck” improvements

Limitations

- Predict likelihood of an oil spill
- Predict outcome of a response
- Consider consequences of a spill to the environment or people
- Predict the *effectiveness* of a response
- Assess oil type
- Assess logistics needs or equipment availability

Conclusion

- Mid-range ice concentration was not as common as expected (observations concentrated above 80% or below 20%).
  - Implications to “broken ice” system planning
- Different plans needed for different seasons
- Ability to sustain a response is much different than ability to mount a response (based on weather alone)
- Different inputs would influence results

Recommendations

- Better documentation of response limits
  - Protocol
  - Sea trials
- Better data on environmental conditions
  - Observational vs. modeled
- Incorporate additional tactics and support functions
  - SMART, storage and transfer, tracking and surveillance
  - Logistics, supply chain
- Look at operational time periods


Thank you
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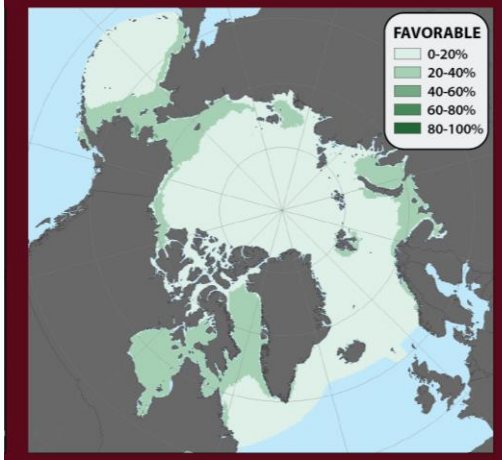

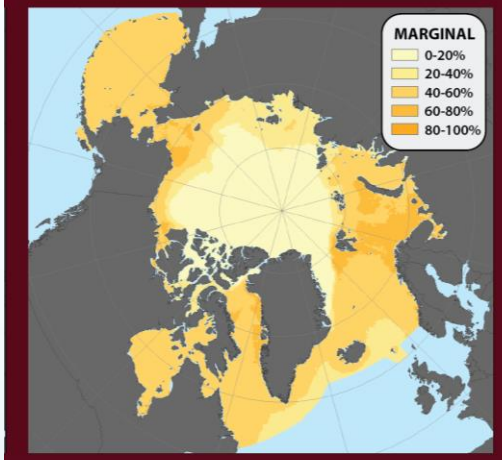

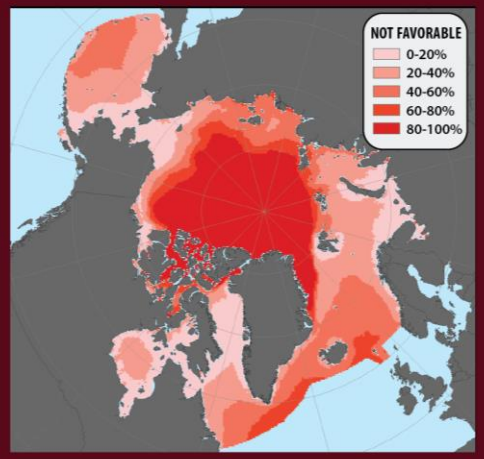

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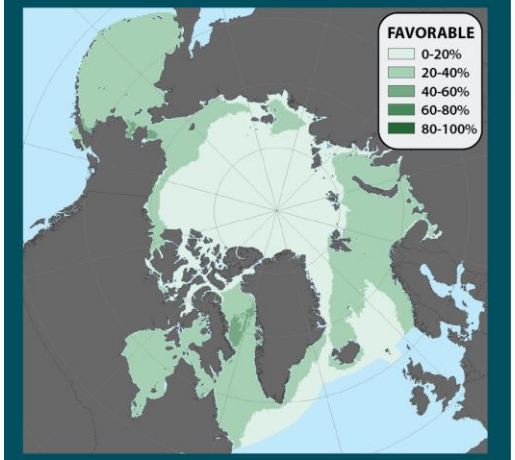

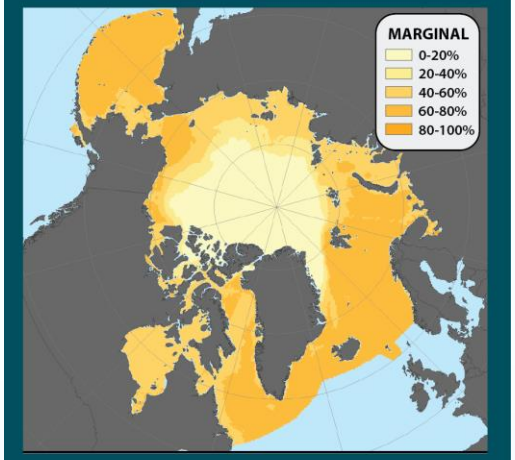

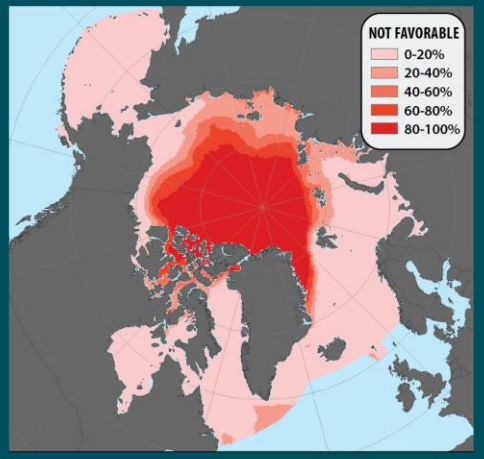

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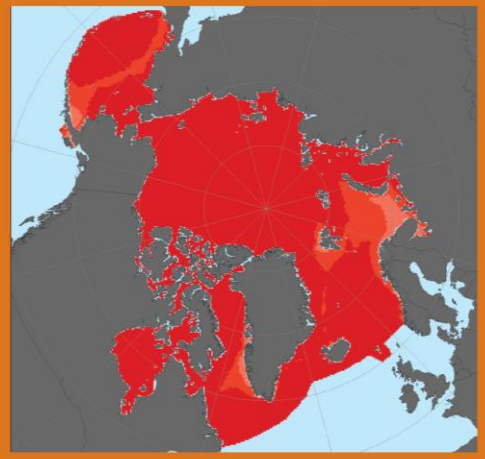

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preliminary results