Oil Spill Modeling for Improved Response to Arctic Maritime Spills: The Path Forward (AMSM)

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Introduction

Maritime shipping and natural resource development activities in the Arctic are projected to increase, resulting in a higher probability of more frequent and/or larger oil spills. In an Arctic spill response, fate and trajectory modeling and decision-making must be done quickly, while addressing unique complications (e.g., ice, equipment availability, international waters). The increasing risk emphasizes the need to identify the state-of-the-art models available, Arctic specific capabilities, and potential for integration.

The AMSM project findings will support emergency response providers and relevant government officials in the event of an Arctic maritime oil spill and provide guidance for development of oil and ice modeling tools to improve prediction and communication of outputs.

Methods

- Phase 1: Formation of Project Core Advisory Team
- Phase 2: Define Needs / Questions Addressed by Response Models
- Phase 3: 3-Day Workshop on Arctic Maritime Spill Response Modeling
- Phase 4: Working Groups on Oil & Ice Interactions, Visualization & Uncertainty, and Technologies
- Phase 5: Virtual Workshop and Stakeholder Working Sessions
- Phase 6: Creation of Final Knowledge Product

Outcomes / Results

Improving Communication:

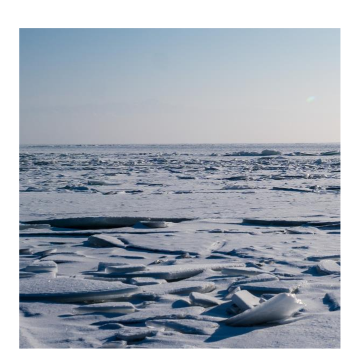
- Improved communication between oil spill modelers, ice modelers, and satellite-based ice observation systems by identifying:

Similarities, challenges & unique features of each model	Impacts of ice on response tactics & technology applications
Role of local & indigenous knowledge in response planning	New algorithm developments for predicting oil & ice interactions

- Compiled resource describing state-of-the-art ice and oil spill response models available in the U.S. and internationally.

Technology / Data Needs for Arctic Spill Response:

- Compiled list of new and existing technologies for observing oil and ice.
- Determined technology applicability and limitations for two spill scenarios:



Large Vessel Spill of Combinations of Oil in the Shoulder Season

Pipeline Spill Under Landfast Ice

- Established dialog between oil spill modelers and ice data providers to improve ice data availability during spills.
  - Ice data is not typically provided on response timescales (24 - 48 hours) or spatial scales (~ 1 kilometer).
  - Discussed methods to increase frequency of ice data products during active spill.

References

Manning, J.; Verfaillie, M.; Barker, C.; Berg, C.; MacFadyen, A.; Donnellan, M.; Everett, M.; Graham, C.; Roe, J.; Kinner, N. Responder Needs Addressed by Arctic Maritime Oil Spill Modeling. J. Mar. Sci. Eng. 2021, 9, 201. https://doi.org/10.3390/jmse9020201.

Outcomes / Results

Visualization & Uncertainty of Model Outputs:

- Responders recommended changes to model outputs/visuals to improve understanding.
- Created Confidence Estimates of Oil Model Inputs and Outputs (CEOMIO) Table to identify and communicate:
  - Sources of uncertainty
  - Qualitative confidence levels on scenario-specific basis
  - Input data gaps and quality issues

Conclusions

- The AMSM Project improved:
  - Preparedness for Arctic emergency response
  - Communication between key stakeholders
  - Integration of ice data into response modeling
  - Understanding of the state-of-the-art models available
  - Identification of data gaps and technology needs
- Proposed future research:
  - Determine exact ice data needed for oil spill modeling
  - Create and validate code to transfer ice data inputs into the General NOAA Operational Modeling Environment
  - Conduct tabletop exercise to practice data communication

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