Ranking of oil spill cleanup system effectiveness in Arctic conditions

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CONTEXT

Diminishing Arctic sea ice opens shipping routes

Increased shipping

Shipping accident

Oil spill risk

Mechanical recovery

Dispersant application

In-situ burning

OBJECTIVES & IMPORTANCE

Research Objective

Develop a preference learning-based modeling framework to rank the effectiveness of selected oil spill cleanup technologies

Importance:

- Data-driven ranking of technologies, less dependent on experts' opinion
- Useful for Arctic harsh conditions

METHODOLOGY

Influential Factors for Cleanup Operations

Environmental

Cold temperature, Ice presence and continuity, Low visibility, Wave height, Wind Speed

Oil Properties

Slick thickness, Slick continuity, Type

Other Arctic conditions

Remoteness, Community density

Viable Cleanup Response Systems in the Arctic

Mechanical

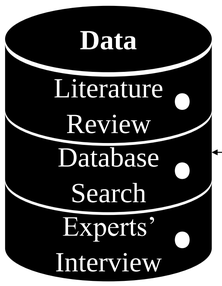
(1) Two vessels with boom, (2) Single vessel with outrigger (3) Three vessels of Opportunity with boom (4) Single vessel in ice

Chemical

(5) Vessel application (6) Fixed-wing aircraft application (7) Helicopter application

Burning

(8) Vessel with fire boom (9) Helicopter with ice containment (10) Helicopter with herders



DST Modeling

Preference Learning: a semi-supervised Gaussian Utility function

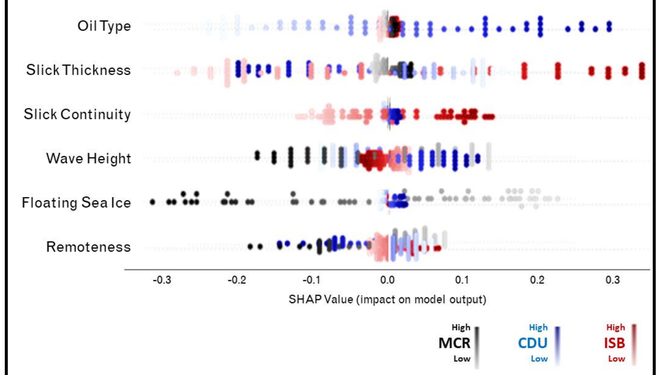
$$\mathcal{P}(f) = \frac{1}{(2\pi)^{n/2}|\Sigma|^{1/2}} \exp(-\frac{1}{2} f^T \Sigma^{-1} f)$$

Statistical Evaluation

- Response Effectiveness
- Compare the proposed model with Fuzzy TOPSIS

Ranking response systems

COMPUTATIONAL ANALYSIS



A **summary plot** illustrates influence of each factors on the model output; colors represent effectiveness of different response operations

ENGAGEMENT

Through end-user engagement and involvement of industry experts, the societal relevance and usefulness of research objectives and results will be ensured.

Transport Canada

Canadian Coast Guard

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