戦略目標３: 北極域における自然環境の変化が人間社会に与える影響の評価

サブ課題３

北極海における油流出事故のリスク評価および対策・対応の検討

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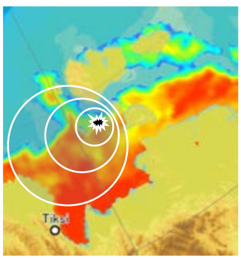
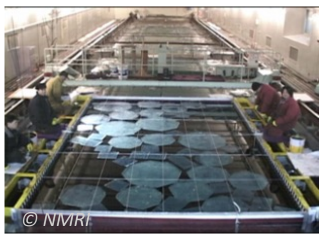
このサブ課題の概要

調査

- 先行研究／調査
- 事故事例
- 対応策

氷海域における油流出問題





モデル

- 氷ー油の形態
- 水ー氷ー油での油拡散
- 入力データ整備

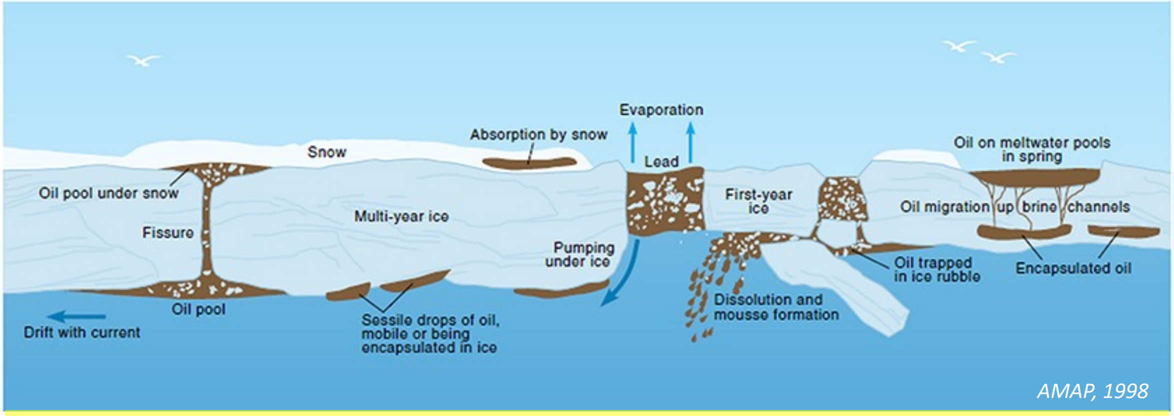
他のArCS II課題との連携

検証

- モデルの合理性
- 対応策の有効性
- シミュレーション

模型実験の活用

氷中油流出対応の困難さ



氷と油の混合形態には様々あり、回収など対応の困難さに繋がっている。

Questions

1. どの様な資機材や回収方法があるか？　また、その実効性は？
2. 拡散・風化を予測する場合の合理的なモデルとは？
3. 最終的なリスクは？　また、有効な備えとは？

このサブ課題の概要

分野	計画	内容
モデル	油流出現象への影響を考慮した、海氷運動モデルの整備及びデータ取得。	東大モデルを整備し実行環境を整えた。現在、コード最適化中。
調査	油流出範囲に関する先行研究の調査とArCS研究との比較検討により、シーズ・ニーズ・マトリクスの作成。特にpack ice環境下での知見の積み上げ。	ACのEEPRによるCircumpolar Oil Spill Response Viability Analysisの報告書をベースに調査した。
検証	既存の氷中油回収手段のレビューと改善点の検討。	

- Arctic Councilは、防災に関するWGにおいて北極海における油流出対処法の実効性解析を行い、2017年に報告書を公表した。現場でとり得る対処法は、海氷含め、気象・海象等の環境要因によって異なると考えられる。本報告書では、Arctic Marine Assessment Programme（AMAP）を参照しながら10年間の環境データに基づく解析を行い、様々な対処法を海域別に評価している。
- この課題では、北極海航路の商業利用との関連性の観点から本レポートをレビューし、さらに蓋然性を高める拡張を検討する。また、ArCS IIでの成果として期待される高精度な環境データや流出油の漂流予測計算によって、本報告書における評価の精度や価値を向上させる可能性について検討する。

タンカー起源の油流出事故

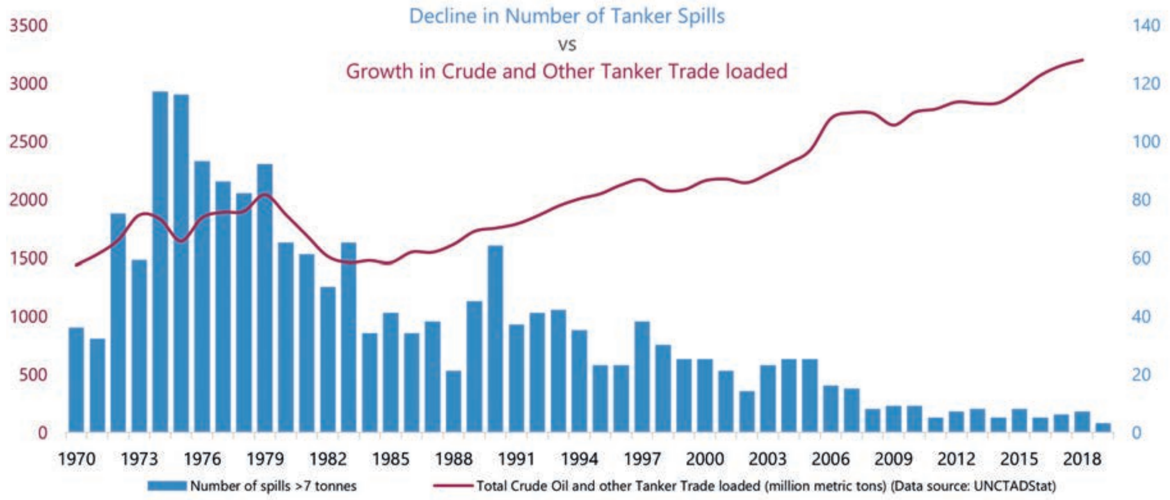


Figure 9: Decline in number of tanker spills vs growth in crude and other tanker trade loaded 1970-2019 (UNCTADstat information not yet available for 2020)

流通量の増加に対し、漏出量は減少している。

タンカー起源の油流出事故

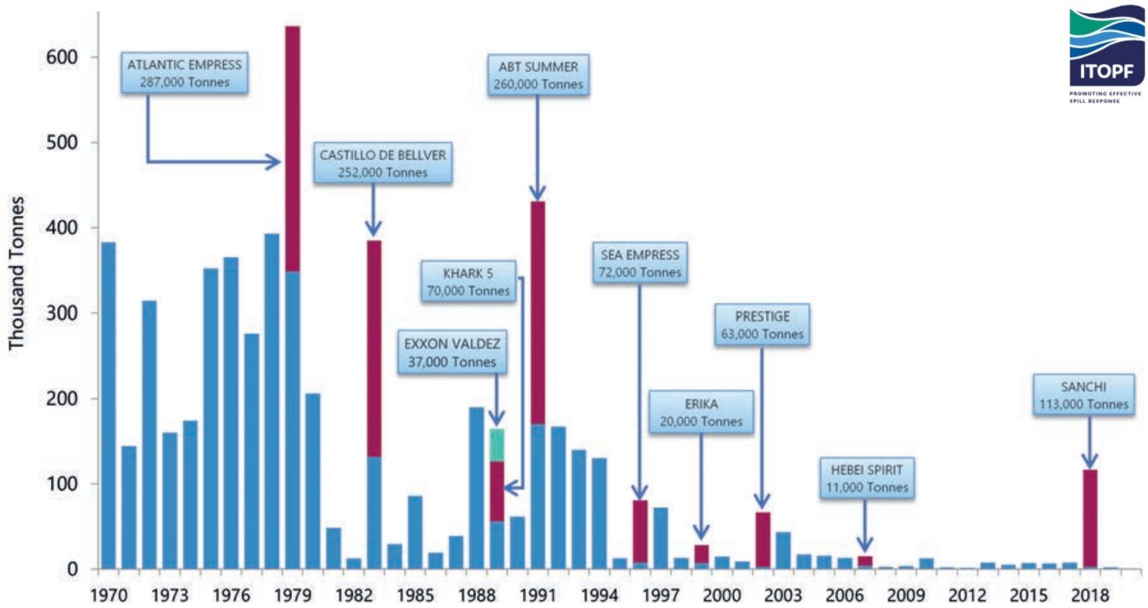


Figure 8: Quantities of oil spilt 7 tonnes and over (rounded to nearest thousand), 1970-2020

事故によって流出量が大きく異なる。

Arctic Challenge for Sustainability II

タンカー起源の油流出事故

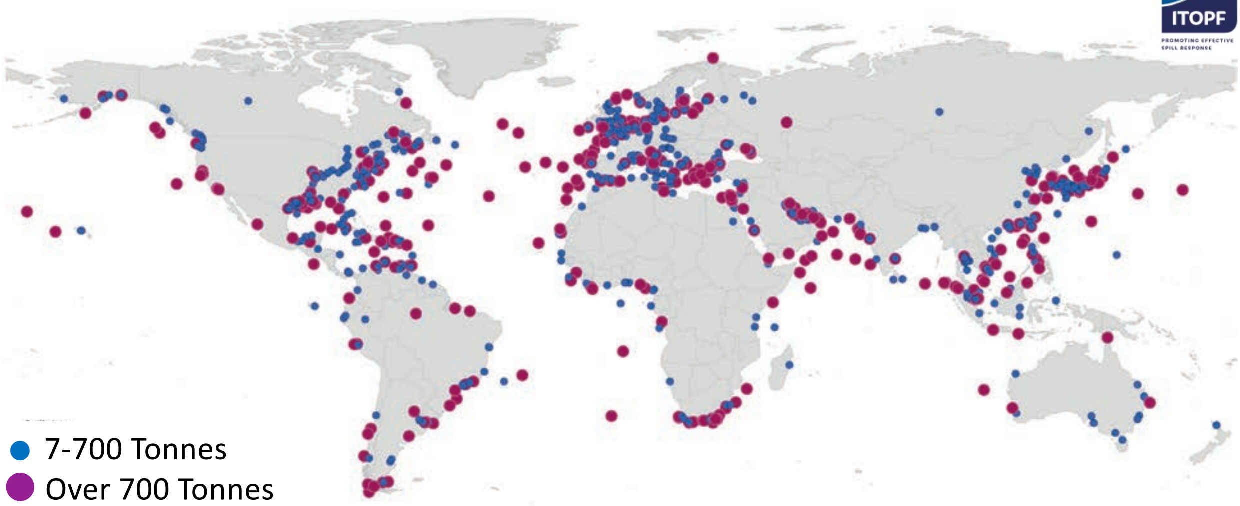


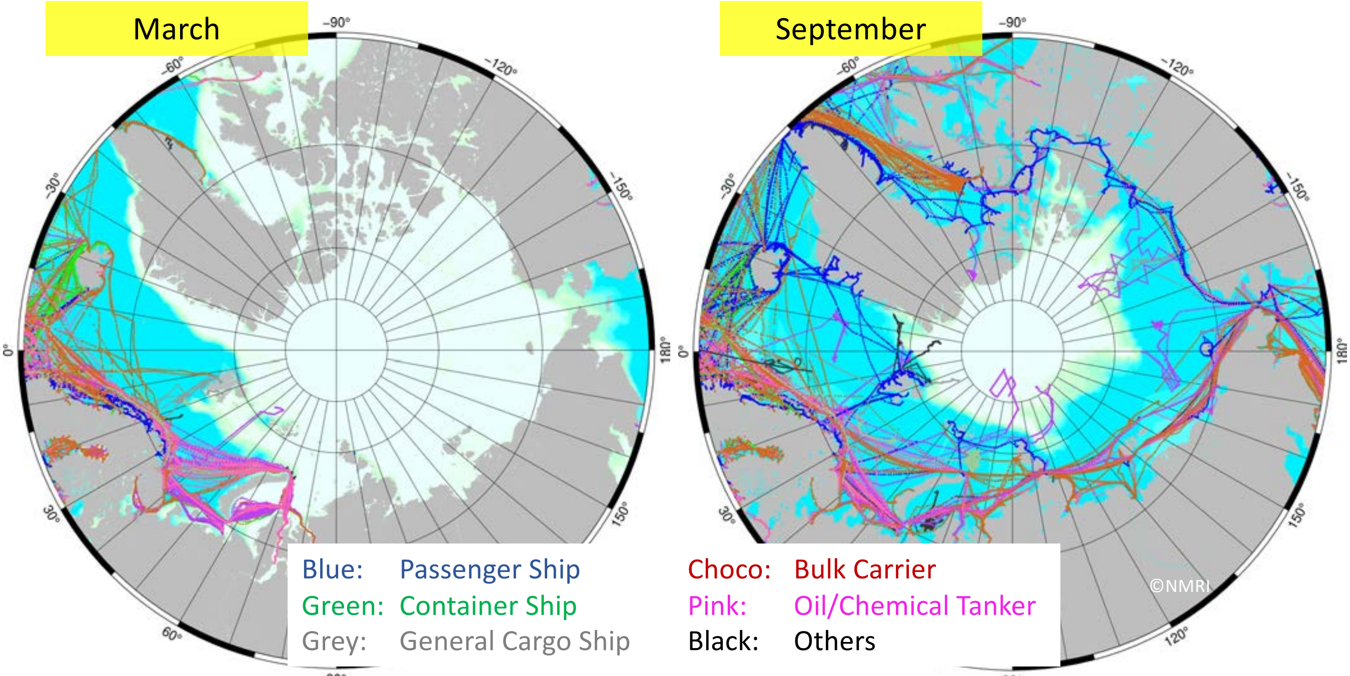
Figure 3: Map of spills (>7 tonnes) from 1970-2020 (All rights reserved © ITOPF)

ここ30年では北極圏ではほとんど見られていない。

Arctic Challenge for Sustainability II

2019年の北極海における通航

Data Source: Satellite AIS Provided by exactEarth/IJS



夏場の海氷減少により、タンカーを含め通航が活発化している。

Report by EPPR for Emergency 2017

EPPR : Emergency Preparedness, Prevention and Response (WG)

Co-led by Norway / US / Denmark

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Circumpolar Oil Spill Response Viability Analysis: Technical Report

This report exists in two versions, print and digital (PDF).
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Cover photograph
Expedition cruise in between icebergs Disko Bay, Greenland
Peter Prokosch
http://www.grida.no/resour

DNV·GL
nuka
BSEE Bureau of Safety and Environmental Enforcement
Norwegian Ministry of Foreign Affairs
NORWEGIAN COASTAL ADMINISTRATION
DEFENCE COMMAND DENMARK

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Report by EPPR for Emergency 2017

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CIRCUMPOLAR OIL SPILL RESPONSE VIABILITY ANALYSIS

Technical report

BUREAU OF SAFETY AND ENVIRONMENTAL ENFORCEMENT

Study funding was provided by the Norwegian Coastal Administration and the U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement, Oil Spill Preparedness Division, Washington, DC under Contract Number E17PC00002. EPPR´s project co-leads have been Norway, USA, and Denmark.

Report No.: 9, Rev. 1
Document No.: 110B3A5N-9
Date: 2017-03-07

Photo: Jan Kenneth Aarsund

Project name:	Circumpolar Oil Spill Response Viability Analysis	DNV GL AS Oil & Gas Environmental Risk Management P.O. Box 300 1322 Høvik Norway Tel: +47 67 57 99 00 NO 945 748 931 MVA
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Customer contact:	CO Herma Banks/COR Steven Pearson	
Date of issue:	2017-03-07	
Project No.:	PP155730	
Organization unit:	Environmental Risk Management	
Report No.:	9, Rev. 1	
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Objective:The analysis estimates how often different type of oil spill systems could be deployed in the Arctic based on defined operational limits and a comparing these to a hindcast of metocean data.

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目的：北極でどのような対応がとられているか、またその稼働限界について、
気象海象データによるハインドキャストで分析する。

解析対象エリア – AMAP Study Area

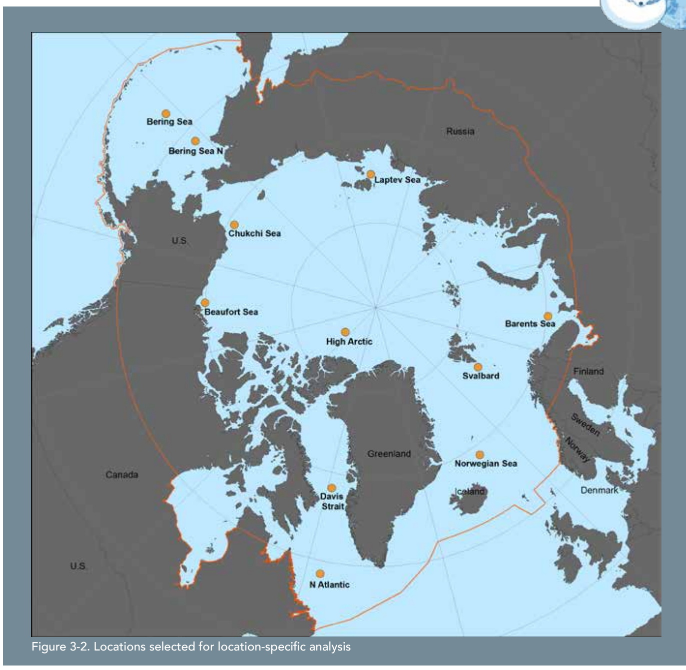

Figure 3-2. Locations selected for location-specific analysis

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Geospatial analysis
- Considering operational limits
- Red/Yellow/Green indication

Response Viability Index
- Mapping for each system
- Scoring and averaged monthly

Location-specific analysis
- 29,443 cells and 11 sites
- Cycle graphics

Sensitivity analysis
- Metocean dataset
- Except ice data

対応システムの分析

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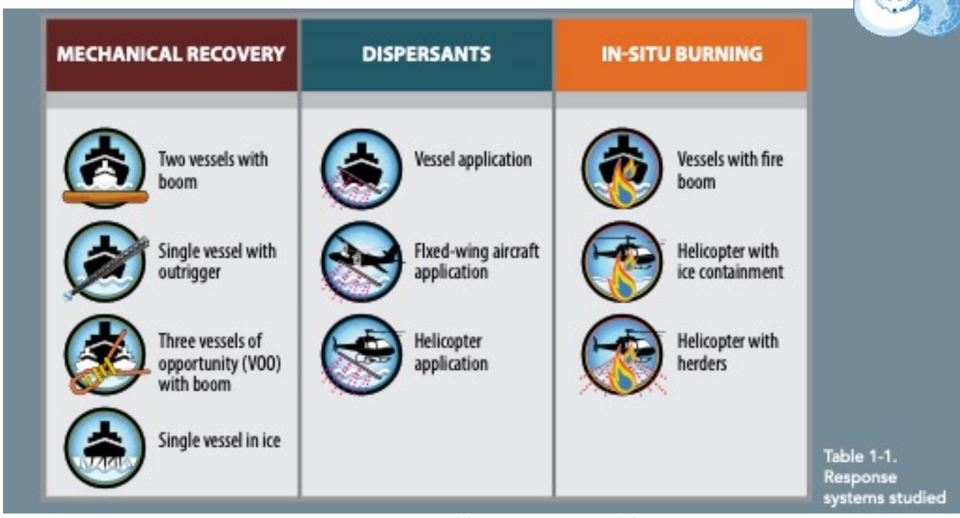


Table 1-1. Response systems studied

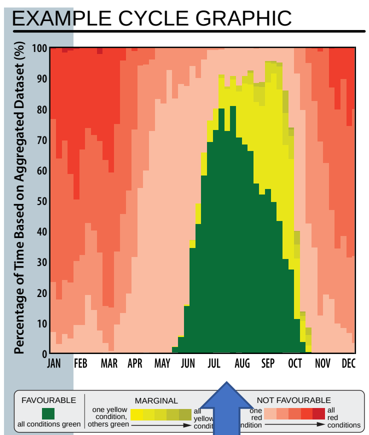


Table 3-2. Response viability categories

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

分析におけるインプットとアウトプット

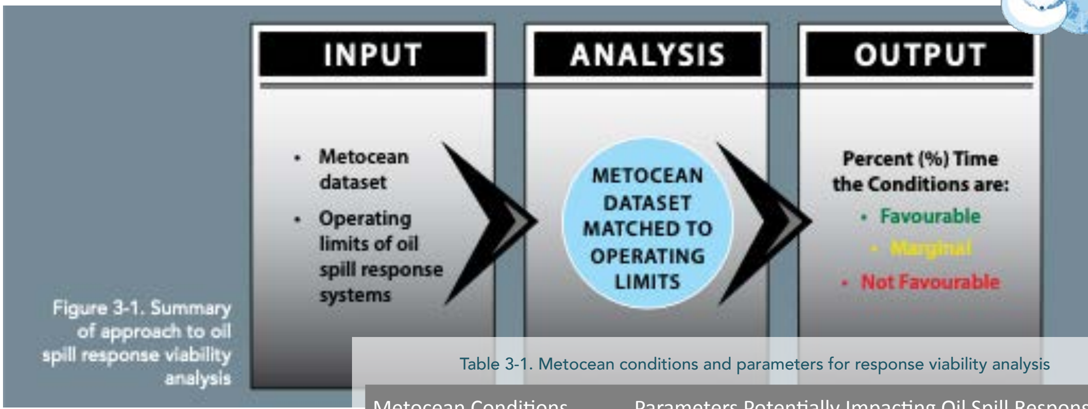


Figure 3-1. Summary of approach to oil spill response viability analysis

Table 3-1. Metocean conditions and parameters for response viability analysis

Metocean Conditions	Parameters Potentially Impacting Oil Spill Response
Wind	Wind speed (m/s)
Sea state (waves)	Significant wave height (m) Average wave period (s)
Sea ice	Ice coverage (%)
Air and sea temperature	Air temperature (°C) Superstructure icing (cm/hr)* Wind chill (w/m^2)
Visibility	Daylight/darkness Horizontal visibility (m) Cloud ceiling (m)**

* included for vessels, not aircraft
** not included in quantitative analysis due to lack of data

使用データセット

Table 4-2. Parameters and data sources used in viability analysis

SOURCE	PARAMETER	UNIT	SPACE RESOLUTION	TIME RESOLUTION	TYPE OF DATA
MET Norway (ERA-Interim)	Wind speed at 10 meters above sea surface	m/s	Approximately 0.5 ° x 0.5 ° (ERA Interim)		Modelled/ hindcast
	Significant wave height	m	Interpolated to:	Every 6 hours 10 years of data (2006-2015)	
	Air temperature at 2 meters above sea surface	˚C	25 km x 25 km		
	Water temperature at sea surface	˚C			
	(There is no wave data when the ice concentration > 30 %)				
MET Norway	Horizontal visibility	m	25 x 25 km	Every 6 hours	Calculated based on air temperature and dew point temperature
NSIDC	Ice concentration	%	25 x 25 km	Daily 10 years of data (2006 – 2015)	Satellite Imagery Processed by DNV GL
DNV GL	Daylight (including civil twilight) and darkness	Yes/no	25 x 25 km	Every 6 hours	Calculated based on position as described in Section 4.3.2
DNV GL	Structural icing	cm/hr	25 x 25 km	Every 6 hours	Calculated based on wind speed, air temperature, and water temperature as described 4.3.3
DNV GL	Wind chill	˚C	25 x 25 km	Every 6 hours	Calculated based on wind speed and air temperature as described 4.3.4

手法的に予測が不可能

解像度の改善余地がある

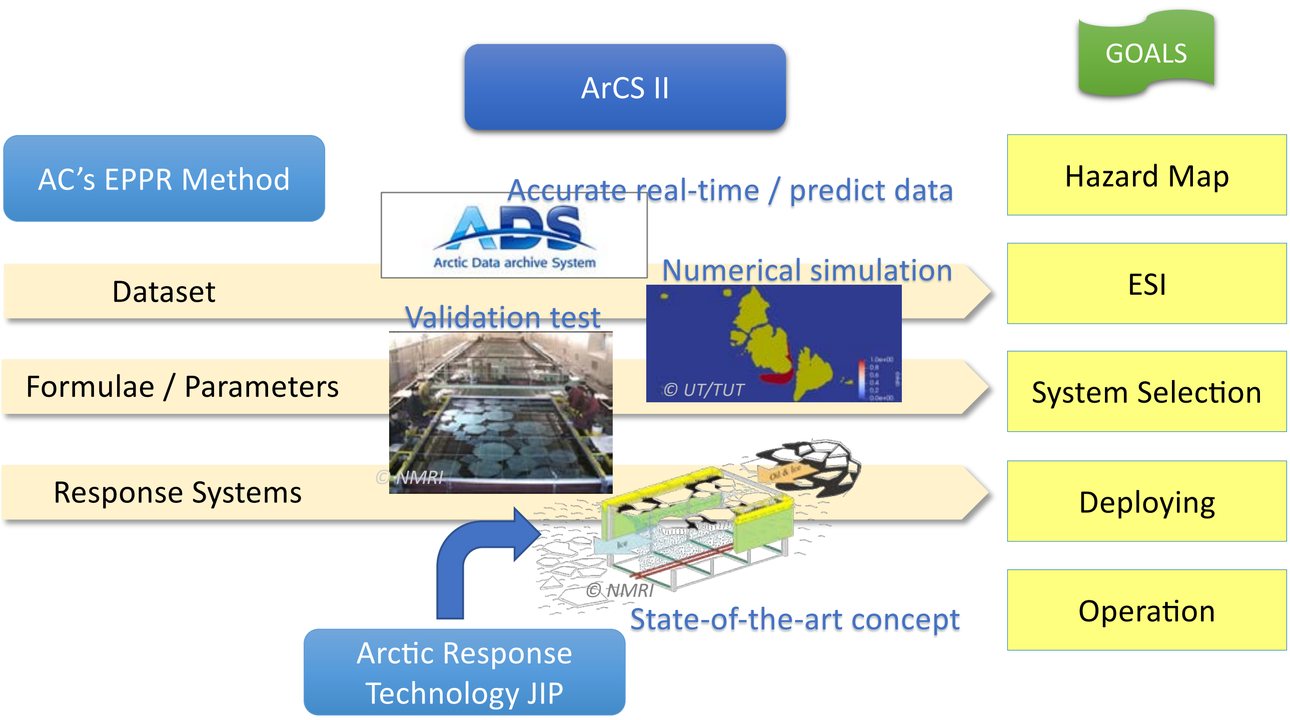
実効性や効率を非考慮

ArCS II全体で改善が可能

COSRVAをより実効的に実施するには

1. 気象海象データの高解像度化
   - ✓ 25 x 25 kmのメッシュをさらに微細化し、局所的な解像度を上げる。
2. 予測計算を可能にすること
   - ✓ 気象海象及び油変動の予測計算手法を適用する。
3. より広範な油回収システムの分析
   - ✓ 参考例：“Arctic Oil Spill Response Technology Joint Industry Programme.”
4. 評価関数の定式化やパラメータを改善
   - ✓ 水槽実験や数値モデルによってブラックボックスの中身を定量化する。
5. 対応資機材ごとの実効性や効率を検証
   - ✓ より実用的な評価軸を付与する。

Action Plan 2021-



ご清聴ありがとうございました。