GRACE Final Conference

EOS-tool - Operative add-ons

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EOS-tool and operative add-ons

Operational Requirements Matrix

D5.4
Support tools for implementation of EOS

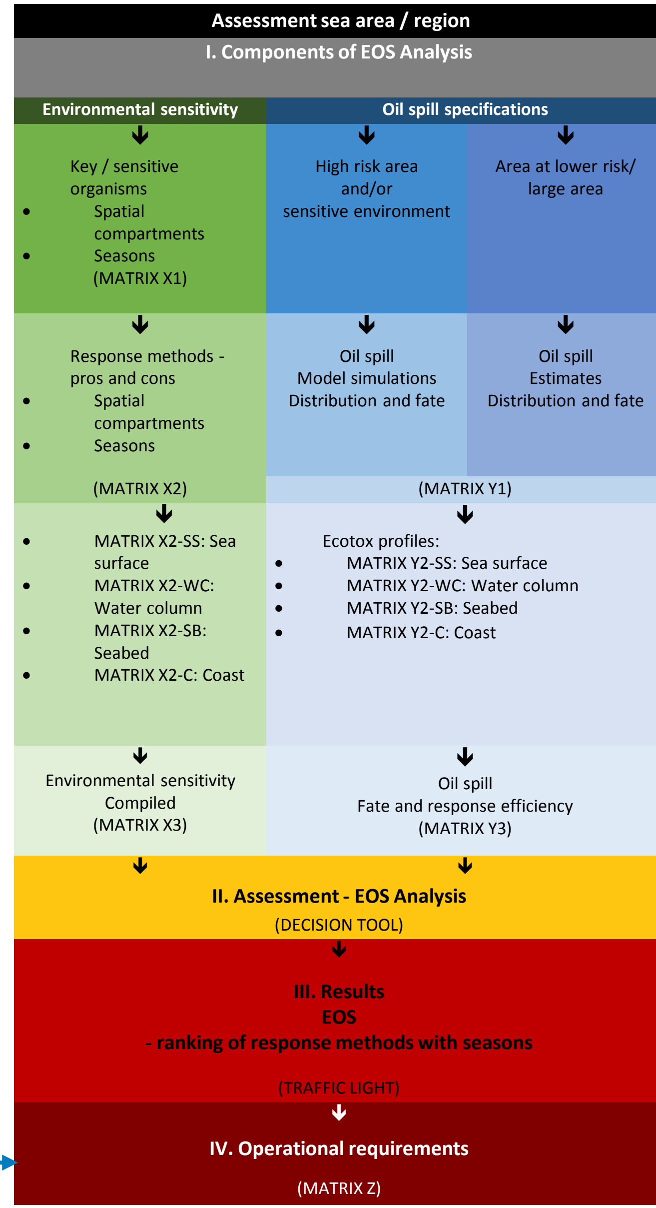
Oil-in-ice Code

D4.5
For facilitation of communication/documentation of oil in ice event characterisation

Oil spill risk assessment

D5.6 and D1.10
Oil spill risk assessment methodology for Arctic conditions and trial applications for two

Add-ons to EOS



D5.6 and D1.10

Oil spill risk assessment

D5.4

Matrix Z1:
General operational requirements
Matrix Z2:
Operational probability

D4.5

Oil-in-ice code

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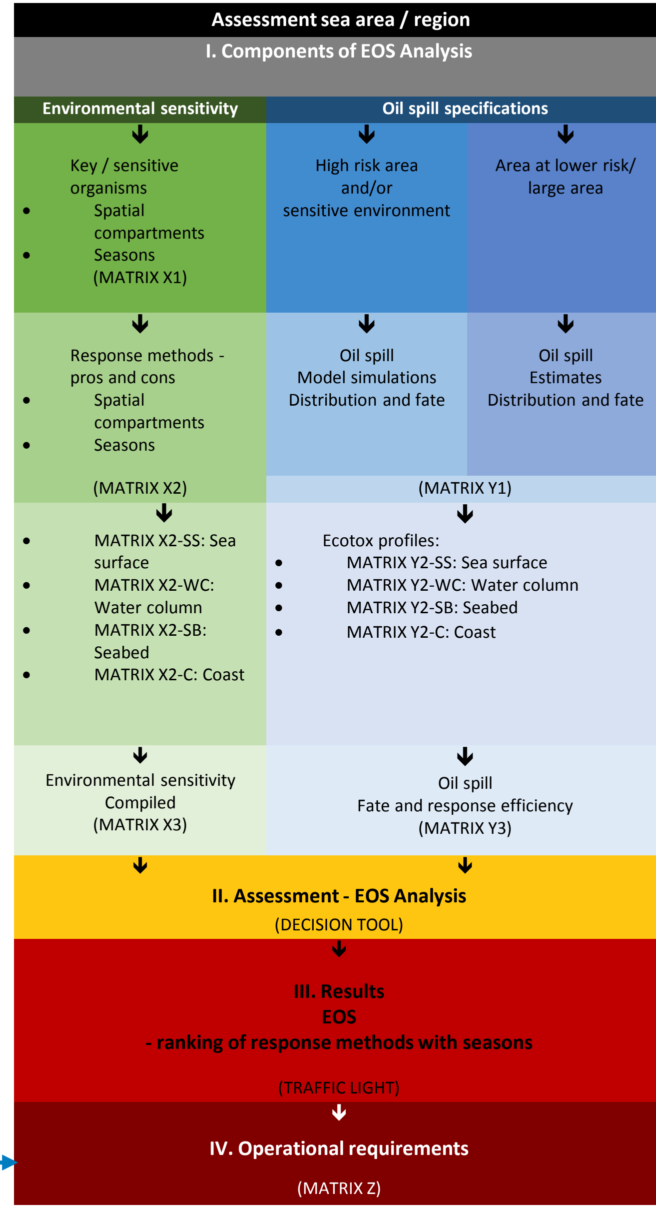
Add-ons to EOS



D5.6 and D1.10

Oil spill risk assessment

D5.4

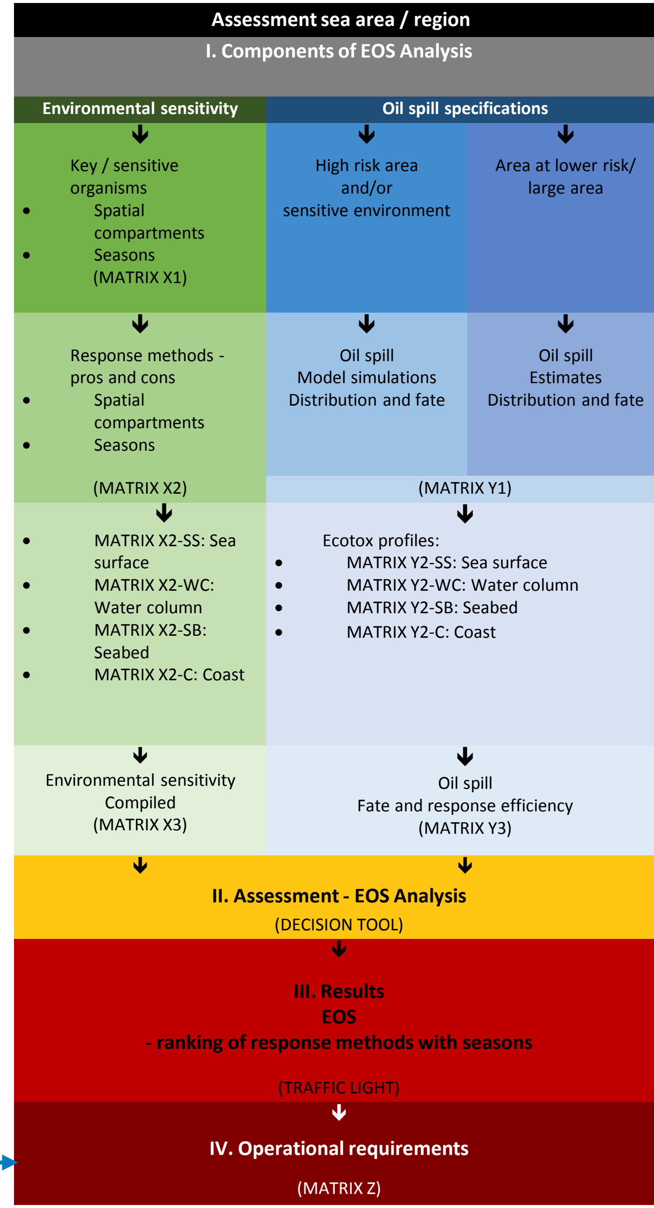
Matrix Z1:
General operational requirements
Matrix Z2:
Operational probability

SHALL WE?

D4.5

Oil-in-ice code

Add-ons to EOS



D5.6 and D1.10

Oil spill risk assessment

D5.4 – CAN WE?

Matrix Z1:
General operational requirements
Matrix Z2:
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D4.5

Oil-in-ice code

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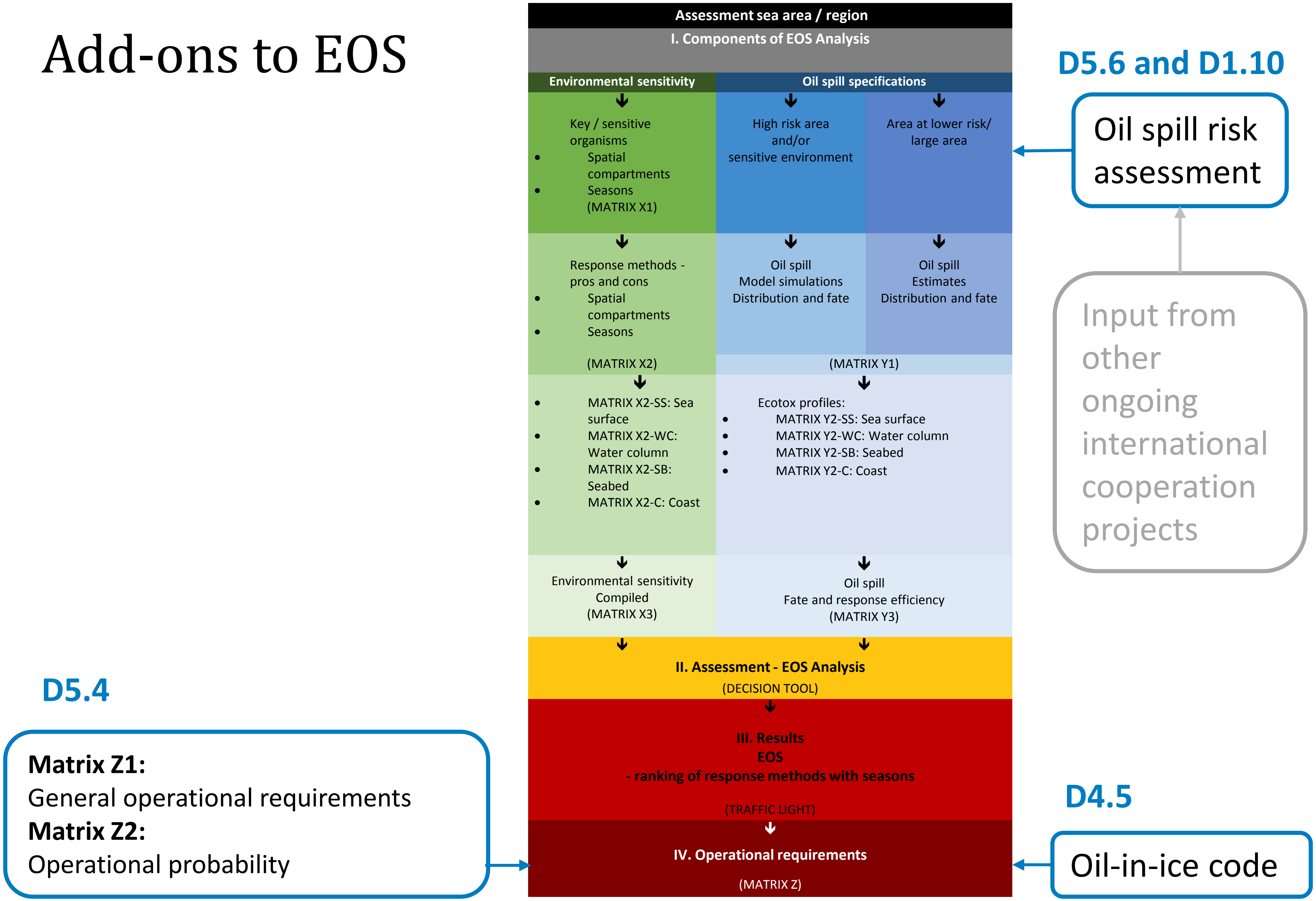
Add-ons to EOS



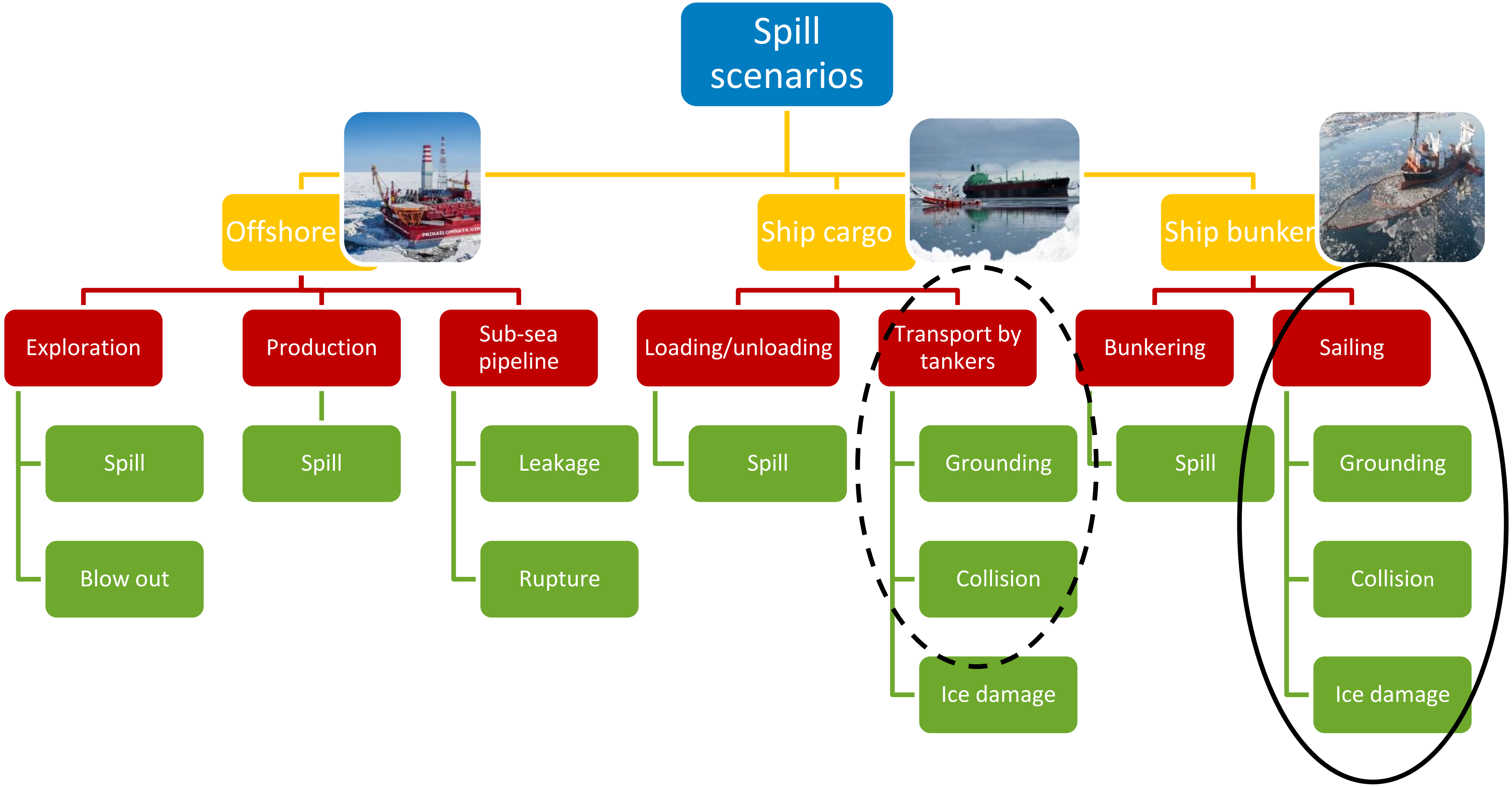
GRACE and oil spill risk assessment

Design of adequate integrated oil spill response actions and identification of environmental effects, needs input on:

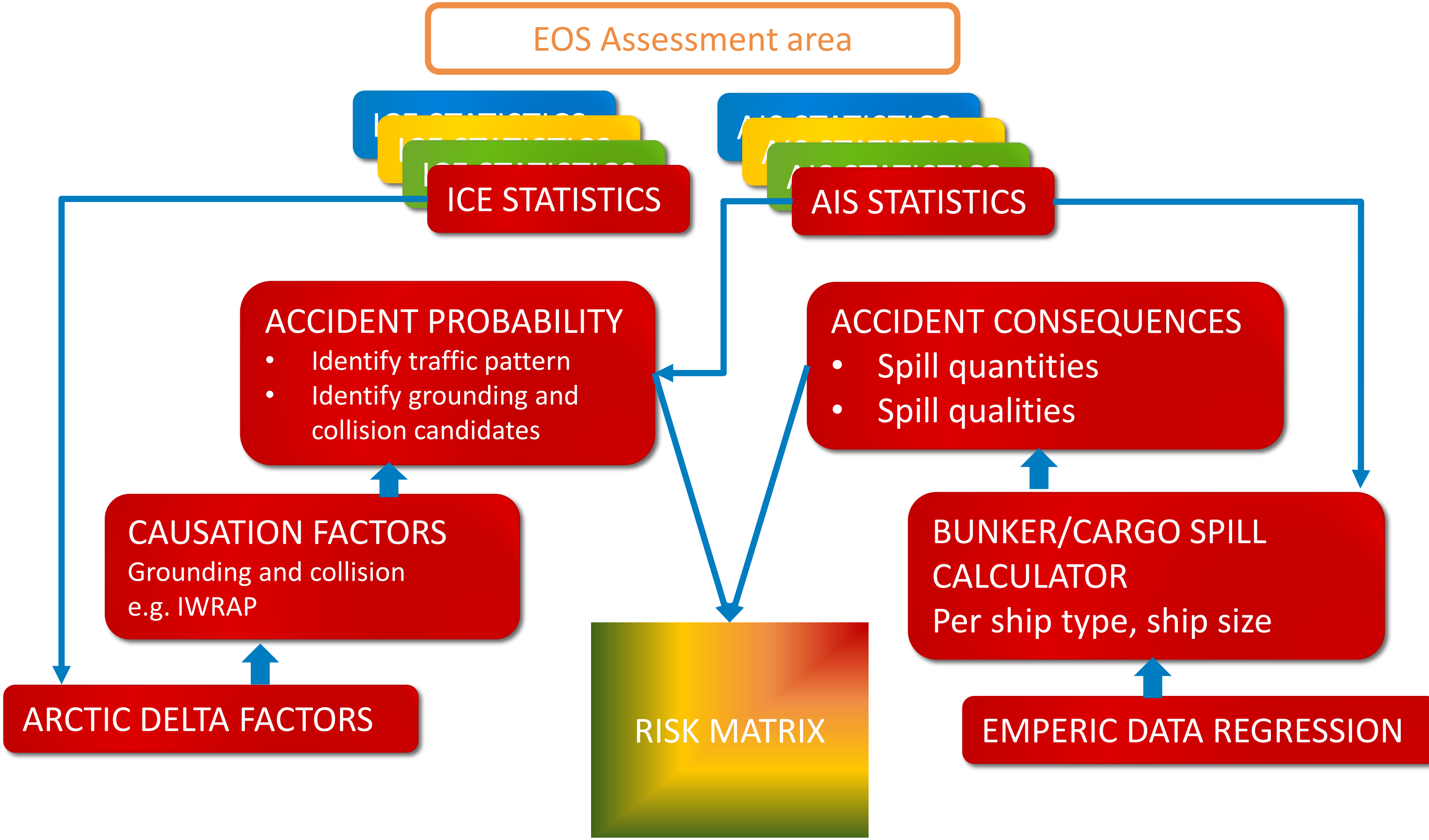
- Where?
- How often?
- What type of oil?
- How large oil spills may be excepted?

Spill risk assessment will provide answers

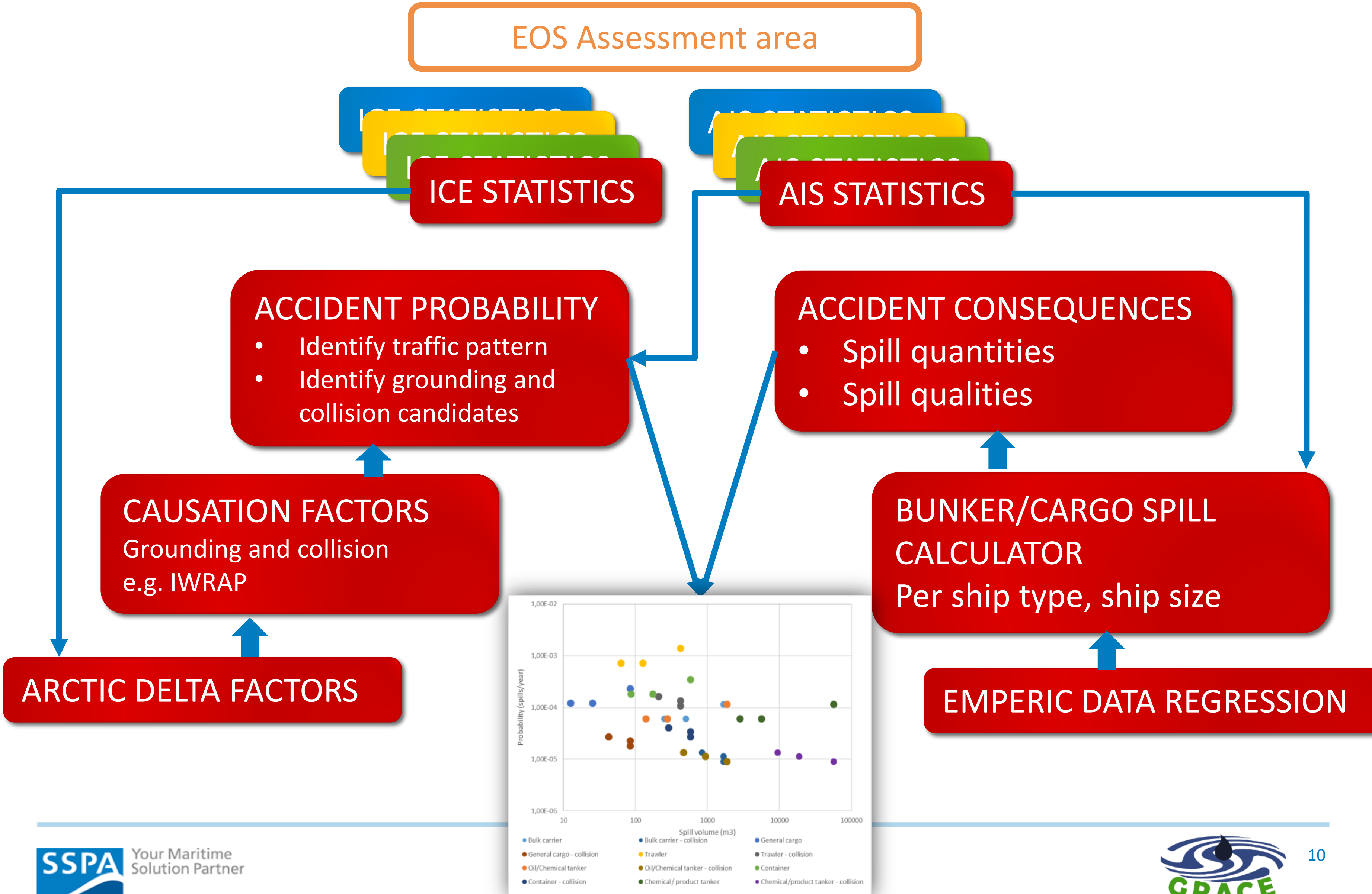
Hazid – Potential spill scenarios



Method for risk quantification



Method for risk quantification



Method for risk quantification

EOS Assessment area

ICE STATISTICS

AIS STATISTICS

ACCIDENT PROBABILITY
- Identify traffic pattern
- Identify grounding and collision candidates

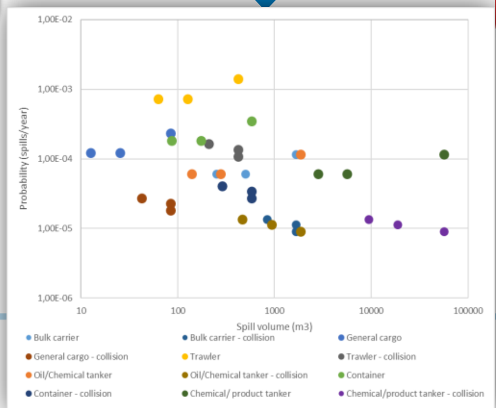
ACCIDENT CONSEQUENCES
- Spill quantities
- **Spill qualities**

CAUSATION FACTORS
Grounding and collision
e.g. IWRAP

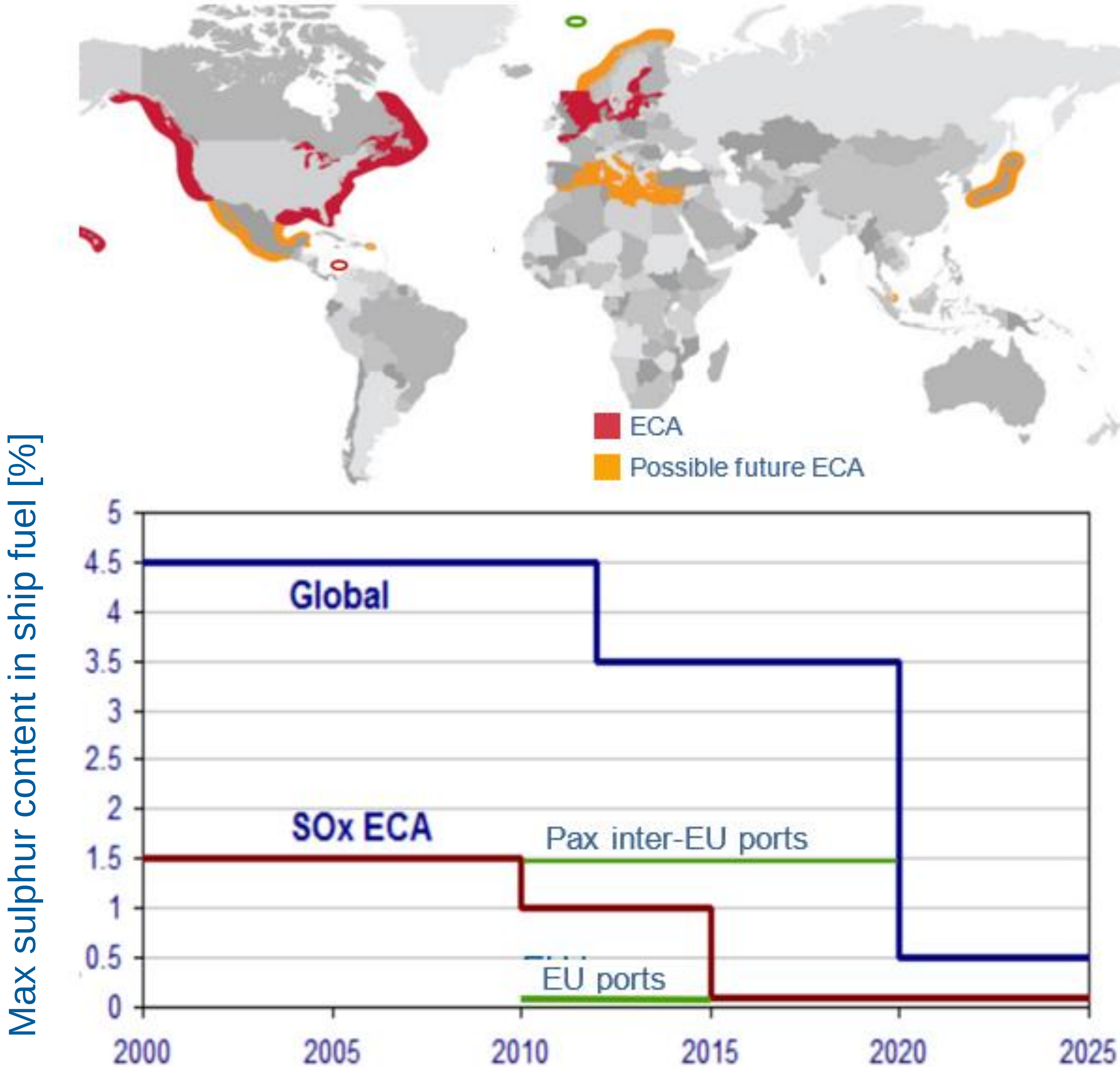
BUNKER/CARGO SPILL CALCULATOR
Per ship type, ship size

ARCTIC DELTA FACTORS

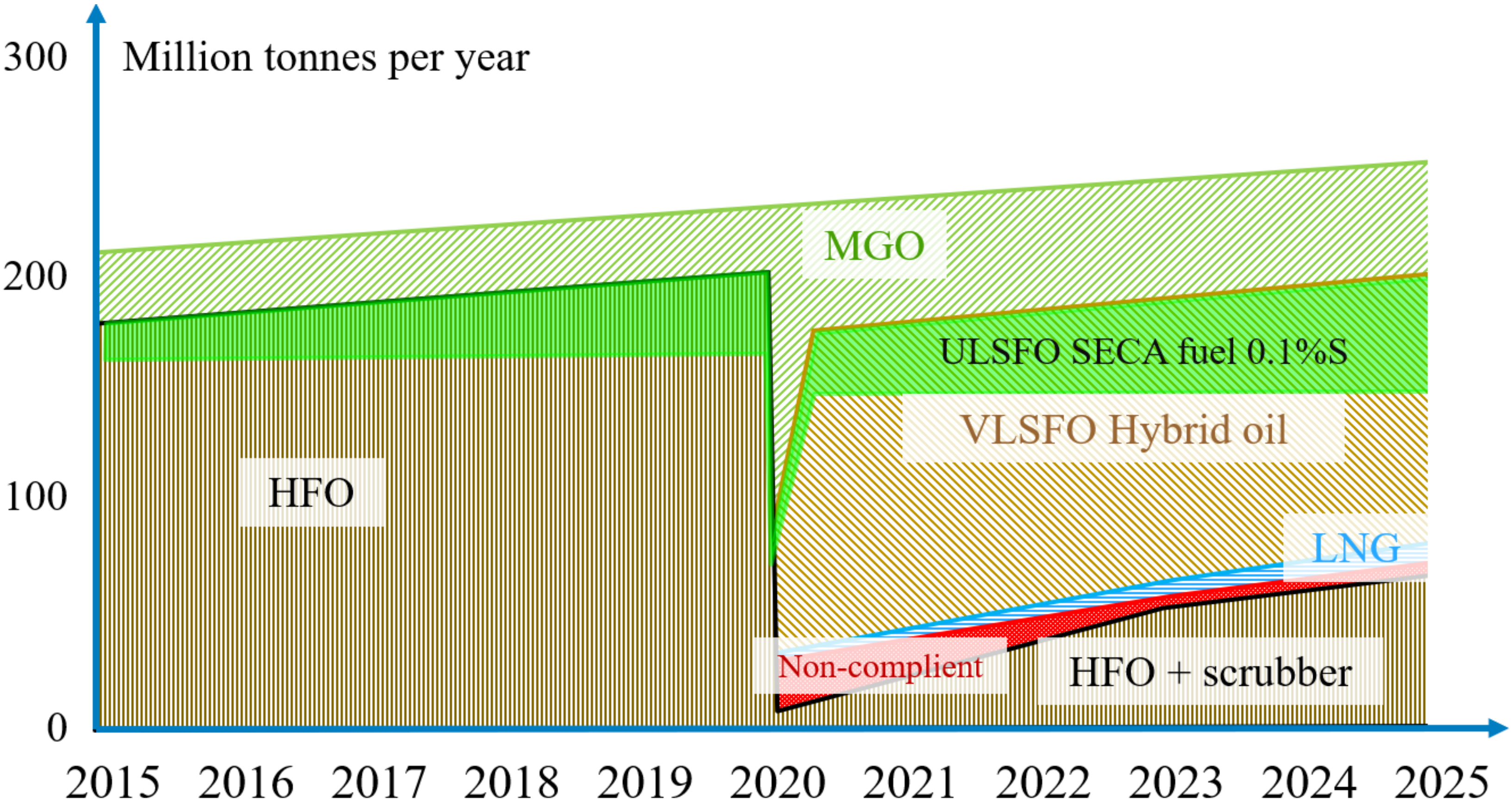
EMPERIC DATA REGRESSION



Ship fuel regulations SOx



Predicted future global demand for marine fuel and its possible distribution into different qualities



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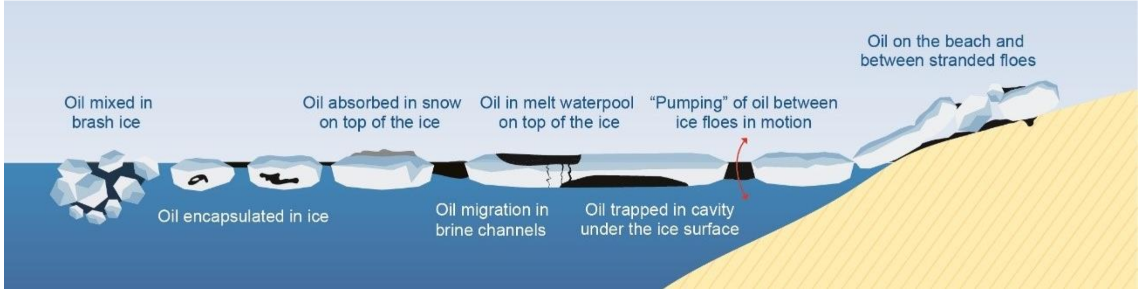
An unpleasant surprise and experience for oil spill responders

Difficulties to recover the ULSFO hybrid fuel oil by conventional skimmers

Will global introduction of VLSFO hybrid fuel oil change recovery capabilty world-wide?

Oil in Ice Code



Background

A designated oil in ice code is needed, in order to facilitate communication, documentation, planning of efficient response operations.

Aim

- A tool for facilitation of efficient communication between all professionals and stakeholders involved in oil spill issues related to sea ice.
- This group includes; planners and responders as well as researchers and environmental scientists evaluating potential consequences of oil spills and environmental risks associated with exploration of oil and gas in Arctic areas and increased shipping activities in ice-covered waters.
- The oil in ice code shall be simple and be based on established terminology.

Ice and oil properties and their influence on oil spill behavior in icy water

Characteristic environmental conditions

Freezing conditions
Ice type
ice coverage
air temperature
water temperature
water salinity

Weather conditions
wind velocity
wave height
perturbation
suspended sediments

Characteristic physical oil properties

Temp dependent
density
viscosity
surface tension
vapour pressure

Temp defined
solidification
flammability
distillation data

Fate and behaviour of spilt oil and its weathering processes properties

Areal distribution
drift/advection
spreading

Vertical distribution
evaporation
solution

Weathering effects
natural dispersion
emulsification

Long-term degradation
photo oxidation
biodegradation
sedimentation

Oil in Ice Code – Selected parameters

The oil in ice code includes 5 characteristic ice and oil parameters:

- Ice type
- Sea ice concentration
- Temperature
- Ice dynamics
- Oil classification

Oil in Ice Code –Selected parameters

The oil in ice code includes the following characteristic ice and oil parameters and classes:

- **Ice type**
- Sea ice concentration
- Temperature
- Ice dynamics
- Oil classification

0 = Ice free

1 = Slush < 2 cm

2 = Small brash < 40 cm

3 = Brash < 2m

4 = Floes < 6 m

5 = Large floes/pack ice ≥ 6 m

6 = Fast ice

Affects both how the oil interacts with the ice and what type of vessel and oil spill recovery equipment that is needed

Oil in Ice Code –Selected parameters

The oil in ice code includes the following characteristic ice and oil parameters and classes:

- Ice type
- **Sea ice concentration**
- Temperature
- Ice dynamics
- Oil classification

0 = ice free
1 ≤ 1/10 concentration (areal coverage)
2 ≤ 2/10
3 ≤ 3/10
4 ≤ 4/10
5 ≤ 5/10
6 ≤ 6/10
7 ≤ 7/10
8 ≤ 8/10
9 ≤ 9/10
10 > 9/10, including ridged pack ice ≥ 10/10

The sea ice concentration has a direct impact on drift and weathering characteristics and thus the choice of oil recovery method

Oil in Ice Code – Selected parameters

The oil in ice code includes the following characteristic ice and oil parameters and classes:

- Ice type
- Sea ice concentration
- **Temperature**
- Ice dynamics
- Oil classification

Essential external factor which influences all the processes that changes the oil properties and behaviour in water and in ice. Temperature is also important with respect to ice formation and development.

-	Freezing, temperatures below the freezing point of the water
0	Temperatures around the freezing point of the water
+	Melting, no risk of ice formation, above freezing point

Oil in Ice Code – Selected parameters

The oil in ice code includes the following characteristic ice and oil parameters and classes:

- Ice type
- Sea ice concentration
- Temperature
- **Ice dynamics**
- Oil classification

0 – Calm

1 – Moderate ice movements

2 – Severe ice movements

Affected by wind, current and waves. In addition, localisation and surrounding geographic affects the movements. The movements affects the choice of response technique.

Oil in Ice Code – Selected parameters

The oil in ice code includes the following characteristic ice and oil parameters and classes:

- Ice type
- Sea ice concentration
- Temperature
- Ice dynamic
- **Oil classification**

FE Floater/evaporator

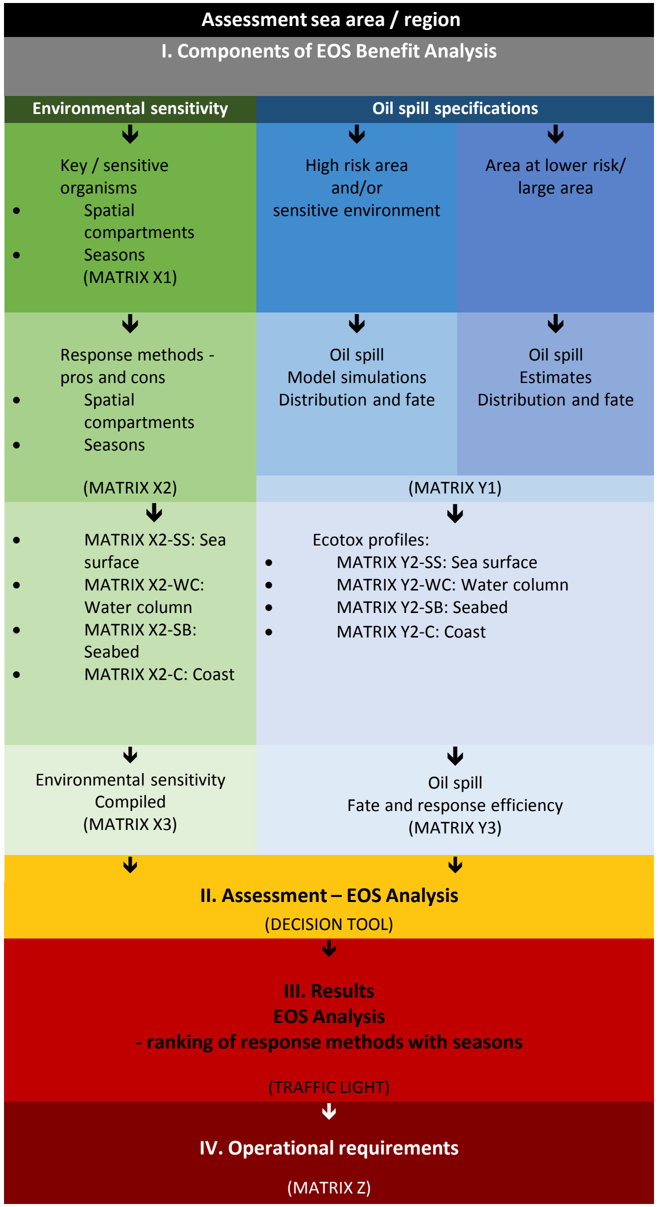
FED Floater/evaporator/dissolver

F Floater

FD Floater/dissolver

An important stage in choosing an appropriate response strategy for an oil spill is to predict the behaviour of the substance spilt at sea.

Add-ons to EOS



Operational Requirements Matrix

D5.4
Support tools for implementation of EOS

Matrix Z; Operational requirements provides an add-on to the EOS traffic light output; *shall we?*

Given a *specific area* and *specific design oil spill* (quantity and type), the EOS matrices will give traffic light indications/ranking for each of the 4 oil spill response methods; mechanical recovery, dispersion, in-situ burning (ISB) and do nothing.

The knowledge database Z on operational requirements will provide answers to the subsequent question; ***can we?***

MATRIX Z1

For each of the 4 OSR methods, MATRIX Z1 defines **general operational requirements** in terms of time, weather windows and ice conditions and identifies **needs for specific resource logistics** in terms of equipment, personnel and vehicles. In addition, the operational requirements vary depending on oil type. Matrix Z1 primarily refers to conditions in spatial compartments Sea surface 1 and Coast 4

Oil spill response method	Operational window			Resource logistics		
	Time window	Weather window	Ice conditions	Equipment	Personnel	Transport
Mechanical recovery	Medium 8-72 h	Moderate 0-9 m/s	<1/10	Booms, skimmers, storage	Intense	Dedicated vessels
Dispersion	Very short 2-8 h	Wide for airborne application	< 5/10	Dispersants, spraying equipment	Non intensive	Aircraft, boats
ISB	Short 6-24 h	Calm stable ≤ 8 m/s	0 – 8/10	Fire boom, herders, igniters	Non intensive	Boats
Do nothing	Long 0 - years	Only option for severe weather	0-10/10	monitoring	No urgent needs, but may call for intensive beach cleaning	Only for monitoring

MATRIX Z2

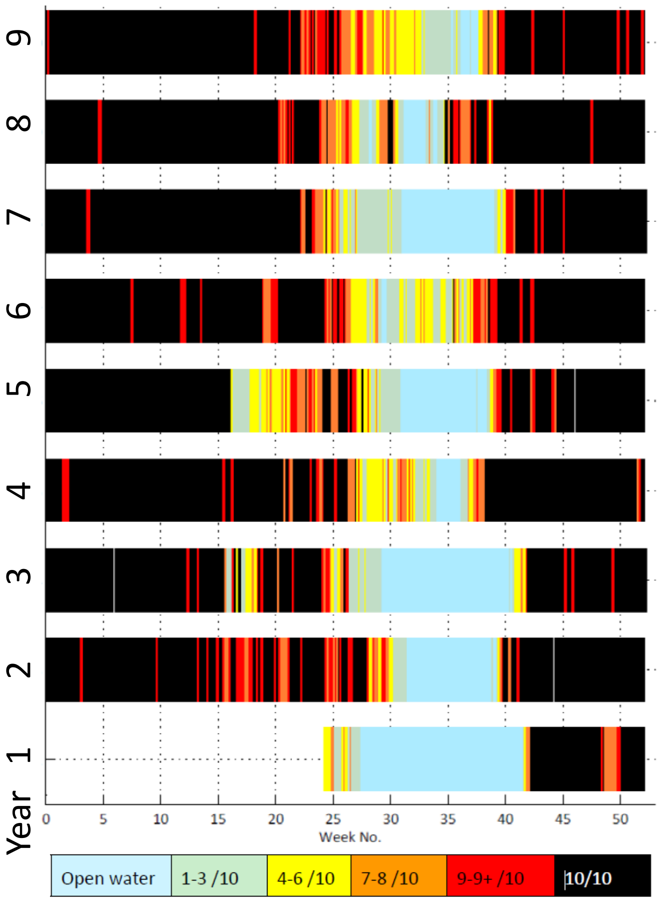
The variables defining weather and ice conditions cannot be accurately specified in absolute figures for a specific area and season, but may rather be described in terms of probability figures. Therefore, Matrix Z2 is outlined to calculate the **operational probability** for each OSR method and each season for a **specific oil spill scenario**.

Oil spill response method	Season	Operational window			Resource logistics						
		Oil specific time window	Probability weather window	Probability suitable ice conditions	Equipment		Personnel		Transport		Operational probability
		hours	p_{Ww}	p_{Ic}	Available E_{av}	Needed E_{ne}	Available P_{av}	Needed P_{ne}	Available T_{av}	Needed T_{ne}	$P(op) = p_{Ww} \times p_{Ic} \times \frac{E_{av}}{E_{ne}} \times \frac{P_{av}}{P_{ne}} \times \frac{T_{av}}{T_{ne}}$
Mechanical recovery	Spring										
	Summer										
	Autumn										
	Winter										
Dispersion	Spring										
	Summer										
	Autumn										
	Winter										
ISB	Spring										
	Summer										
	Autumn										
	Winter										
Do nothing	Spring										
	Summer										
	Autumn										
	Winter										

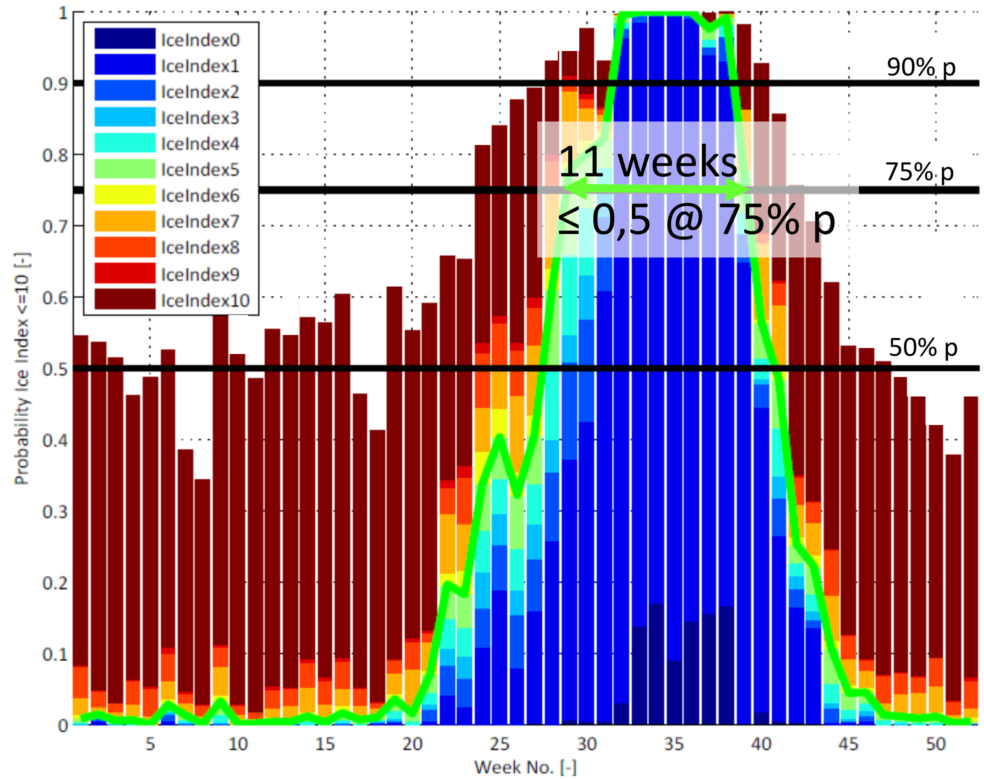
Probability of suitable ice conditions

Example on how metocean/ice statistics can be utilised to estimate credible <u>operational window</u> for spill response operations in ice infested areas and harsh weather conditions

Registered ice concentration at a site off Greenland per week during 9 years



Combined with NOAA egg code statistics on ice type, floe size, thickness + wind from ECMWF, an *ice severity index* is defined (1-10). The operational window for each RT is also defined by the in ice severity index. Assessment of statistics graphically defines expected operational season duration at a given probability confidence level.



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