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ERA ACUTE – EXTENDING AN ENVIRONMENTAL RISK ASSESSMENT MODEL TO THE MARGINAL ICE ZONE

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ABSTRACT

ERA Acute is a globally applicable method and software tool for environmental risk assessment (ERA) of acute oil spills (Stephansen *et. al*, 2017a and 2017b; Libre *et al*, 2018), and is to be implemented as the new industry standard ERA methodology on the Norwegian Continental Shelf (NCS). This paper describes the proposed adaptation and further development of the established ERA Acute method to enhance the functionality for ERA of acute oil spills in the Marginal Ice Zone (MIZ).

Due to the highly dynamic nature of the MIZ, the pilot ERA Acute MIZ proposes to use high temporal resolution data on ice concentrations and presence of Valued Ecosystem Components (VECs) in newly developed functions to calculate impacts in the MIZ.

Based on literature and preliminary sensitivity tests; parameter values and risk functions have been proposed for the MIZ (ice concentrations in intervals between 10-80 %). The functions reflect that presence of ice reduces the available space for surface activities; foraging, diving, entering and exiting the water and concentrates the oil in the same space between ice floes. These

functions will now be further revised, tested and implemented in a software tool. This paper presents the proposed ERA Acute MIZ methodology.

INTRODUCTION

ERA Acute is developed as a globally applicable method and software tool for environmental risk assessments (ERAs) and is to be implemented as the new industry standard for the Norwegian Continental Shelf (NCS). The transitional zone between open ocean and sea ice (the marginal ice zone, MIZ) is a dynamic area with a high seasonal production of biomass which attracts high numbers of sea birds and marine mammals. Depending on proximity to the highly dynamic distribution of sea ice, accidental spills from petroleum activities may reach the MIZ, especially large or long-lasting accidental releases. A need has been expressed for improved methodologies and models for carrying out ERAs and Spill Impact Mitigations Analyses (SIMAs)/Net Environmental Benefit Analysis (NEBA) in Arctic areas (Aune *et al.*, 2018; Wenning et al., 2018), e.g. to better reflect the dynamic nature of the MIZ in ERA calculations.

Data with a high *temporal* resolution (here abbreviated HTR data) on relevant species' abundance are becoming available for an increasing number of species, through established and ongoing research projects (e.g. seabird data arising from the Marine Animal Ranging Assessment Model Barents Sea (MARAMBS) (http://marambs.dhigroup.com/). The temporal resolution may e.g. be one data set per day for a historical time series, based on quality modelling. ERA Acute also suggests using HTR ice concentration data to assess potential impact to the primary and secondary producers in the MIZ. It is important to note that using high quality HTR species distribution data and assessments are applicable for all areas but are particularly important for highly dynamic environments as the MIZ. Research about the MIZ ecosystem is reviewed in a number of reports, for example by Aune *et al.* (2017), von Quillfeldt e*t al.* (2017) and Aune *et al.* (2018). How oil is transported in ice and its fate are described by e.g. Afenyo *et al.* (2016b) and Nordam *et al.,* (2019), and toxicological experiments of oil spills in ice have been researched by e.g. Camus *et al.,* (2017) and Olsen *et al.* (2013).

This paper presents the proposed methodology for adapting ERA Acute impact calculations for use for spills that may reach the MIZ. The suggested approach is currently undergoing further work in a project supported by the Research Council of Norway, operating companies Equinor, Total, OMV, Wintershall-DEA, Lundin Energy and the Norwegian Oil and Gas Association (NOROG). The proposed methodology will be further tested, validated and calibrated and implemented into a software tool.

Basic concept of ERA Acute calculations

ERA Acute has been developed for the environmental compartments: Sea surface, water column, shoreline and sea floor. The compartments have a common basic impact calculation, however still reflecting the compartment-specific differences in impact mechanisms. ERA Acute uses a grid covering the analysis area, calculates impacts in all cells affected in a multitude of simulations, then summarizes and presents statistics of population losses, recovery times and risk matrices etc. Grid cell size should reflect the extent of the analysis area and the resolution of the input data. The basic ERA Acute impact function (Equation 1, Table 2) multiplies the probability for harmful oil exposure (p_{exp}) with the probability that the individual will die (p_{let}) and resource fraction present in the grid cell (N_{cell}). For further reading, ERA Acute methodology descriptions and reports are available at the NOROG website https://norskoljeoggass.no/miljo/mer-om-miljo/miljorisiko-og-miljorisikoanalyser2/era-akutt/.

ERA Acute provides different levels of detailing based on availability and distribution of biological resource data (e.g. sea birds or fish species). At the simplest level, no resource data are needed, and simple data are used at the intermediate level. At the most detailed level, the resource unit (N) is the fraction of the VEC population present in the cell for sea surface and water column, the length of coastal VEC type for shoreline, or area of sea floor habitat. This level will provide an impact assessment of the total fraction of the population lost or total shoreline or seafloor impacted. At this level of detail, recovery time is also calculated based on impact. Recovery functions are compartment-specific and unchanged for the MIZ and are therefore not discussed further in this paper. The data adaption (*N*-value) will directly affect the numerical value of the result and comparisons between compartments must be used with caution. HTR data are suitable for the most detailed impact calculations.

RESULT AND DISCUSSION - PROPOSED APPROACH

ERA Acute development for MIZ

Modelled HTR VEC distribution data with a daily resolution for specific time series are available for several species of seabirds and marine mammals, suitable for ERA modelling in areas both with and without presence of seasonal ice, providing the abundance parameter *N*. Several parameters used in the ERA Acute MIZ functions depend on the ice concentration. To represent the dynamic nature of the MIZ, HTR distributions of ice concentrations are proposed used to reflect the dynamic and high temporal and spatial variation in ice-infested areas. Each grid cell has a surface sea ice concentration (fraction of the area with ice cover, IceConc), which is used as input data to trigger calculations and parameter values. Ice concentrations between 10 % and 80 % trigger the MIZ-specific calculations. ERA Acute MIZ does not include areas with more than 80 % ice concentrations, and below 10 % the "normal" functions are used. How oil is transported within the ice is not a part of ERA Acute, as the model uses ODS as input, therefore it is important to use an ODS model that includes changed transport of oil in the presence of ice.

Ice concentration intervals

The degree of ice coverage, depending on the season, is correlated to certain features related to the behaviour of the ice itself, the spreading oil and presence of ice algae, phytoplankton and pelagic or sympagic zooplankton, and where they are in the seasonal bloom cycle.

10-30 % ice concentration: Very open pack (drift) ice is characterised by widely spaced ice floes, the spreading of oil is the same as in open water, not pushed under ice but present between floes. Upwelling of nutrients is highest in this zone and primary and secondary biological production is highest. This zone is on the outskirts of the MIZ and is assumed to have a low oil-retaining capacity.

30-60 % Ice concentration: Open pack/drift ice, with many leads and polynyas and ice floes are generally not in contact with one another. Ice concentration influences oil behaviour (DeCola *et al.*, 2009, Afenyo *et al.* 2016 a, b) and oil drifts with the ice at same velocity as ice. Oil is assumed to be partly pushed under the ice. The intensity of primary and secondary biological production is generally considered to be lower than for the 10-30% zone, roughly due to less light (phytoplankton) and less upwelling of nutrients, but higher than in 60-80%. The oil retaining capacity is proposed to be set to moderate during the spring melt or “summer neutral” and high in the autumn freeze-up or “winter neutral”.

60-80 % ice concentration: Close pack/drift ice where oil spreads between touching ice floes which contains and pushes it under the ice, where it could be encapsulated in a matter of days or hours (Afenyo *et al.* 2016b). The oil retaining capacity is assumed to be moderately high in the spring melt and high in the autumn freeze-up. Retention by encapsulation is used if in there is net ice formation, low retention if in net melting (or neutral). At this concentration the area is less biologically active with respect to primary planktonic production than in areas with lower ice concentrations, however the denser ice may be preferred by some marine mammals. There can be blooms of algae in larger leads and polynyas until august, which are important areas of biological production.

Above 80 %: In very close pack ice, the oil is assumed to be primarily trapped under the ice and is more likely to reside in the environment. This interval is currently considered outside the ODS modelling capabilities.

Seabirds and marine mammals in the MIZ

For surface VECs, abundance in the cell is given by the HTR VEC data with e.g. daily distributions. The general surface impact equation includes physiological (p_{phy}) and behavioral (p_{beh}) factors, exposure time (T_{exp}) and oil coverage (Cov_{ODS}) from ODS. The lethal fraction (N_{let}) is calculated by the basic (Equation 2, Table 2). For sea surface and water column VECs, lag- and restoration modelling are carried out according to the established general ERA Acute method but achieving a higher resolution in the range of recovery times by using HTR VEC data.

In the MIZ, the surface habitat has been divided into two major sub-compartments where exposure can occur; the open water surface between ice floes (SU) and the under-ice/water interface (UI). The elements are shown in Figure 1. For species that e.g. graze on sympagic fauna present under the ice, a practicable way to distribute the risk between these two sub-compartments was found to be to use a *weight factor* (WF_{IAI}) based on an *ice-associated index (IAI)* which is how associated the species is with the ice (LGL Ecological Research Associates Inc 2014a, 2014b).

At 10-30 % ice concentration an area concentration factor (AF) is proposed to be used which reduces the area available for surface activities and "compacts" the oil between floes. Equation 3 (Table 2) calculates the initial impact. AreaFactor (AF_{SU}) (Equation 4) in the MIZ is a function of the ice concentration (IceConc) in the cell, which modifies the probability of exposing the VEC when less surface area is available for swimming, diving etc., increasing the likelihood of exposure of the individual to oil when "crowded" together in less available surface water.

Between 30-80 % ice concentration*,* spreading of oil is affected by the presence of ice and oil is pushed under the ice following a linear increase between 30 and 80 %. The impact equations include partitioning between surface water (SU) and the under-ice surface (UI), modifying the two impact calculations by adding the exposure to oil under the ice for species with an IAI. The linearity assumption stems from the functions used in the ODS model OSCAR but may be subject to future revision. Above 80 % ice concentration, the oil is assumed to be trapped under the ice (Rusten *et al.*, 2014 citing Khelifa, 2010). Equation 5 is used to calculate the impact, Equation 6 and Equation 7 describe the partitioning (Table 2). Coverages from ODS are given as fraction of the whole grid cell area. In the ODS model OSCAR, output of film thickness and exposure time in grid cells with sea ice (> 30 %) will be larger than in grid cell with no sea ice. This is in line with what is observed in nature (e.g. Afenyo *et al.*, 2016a, 2016b). The effect in the ERA Acute calculations is an increase in the acute mortality for species present in grid cells with sea ice, due to higher probability that the thickness threshold for lethal effect is exceeded in OSCAR and longer exposure time of harmful oil (oil thicker than the lethal threshold thickness).

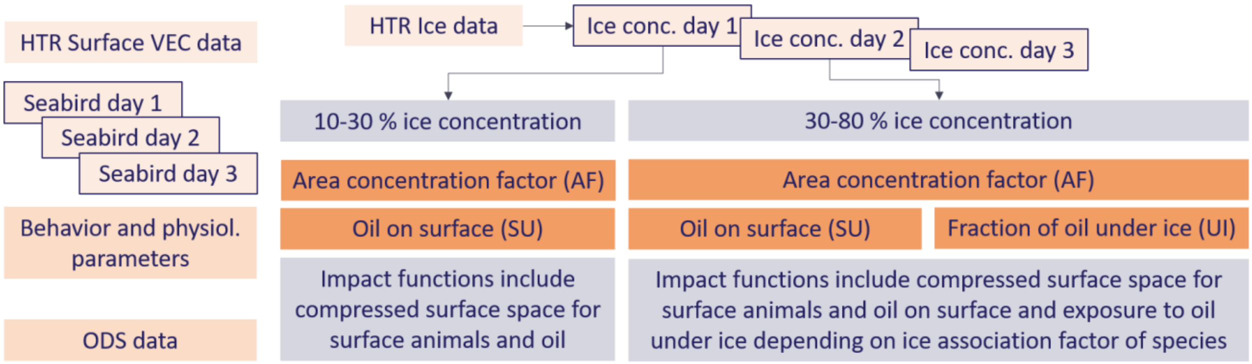

Figure 1. Basic principles of ERA Acute MIZ for the surface compartment.

Fish resources in the MIZ

Currently, no changes in the impact functions are proposed for fish egg/larvae resources due to presence of ice. Higher sensitivity settings can be used in ERA Acute when calculating lethality if a species requires it. Polar cod (*Boreogadus saida*) is mainly associated with the MIZ sea surface and under-ice sub-compartment and is the subject of further work.

Primary and Secondary Production in MIZ

The MIZ can be viewed as a specific “habitat VEC”, like a shoreline or seafloor community. As a parallel to this, we propose the primary and secondary producers in the MIZ to represent the general productivity of the MIZ. Four groups of primary and secondary producer-

VECs are included to represent the MIZ as a habitat: Pelagic phytoplankton, pelagic zooplankton, ice algae and sympagic zooplankton, which bloom in succession characteristic of the MIZ and are production drivers of the attractive foraging activity.

HTR data sets of ice concentrations are used, changing the parameters depending on ice concentrations and season (Table 1 and Figure 2 and 3). The goal has been to represent the dynamic nature of the MIZ moving north during the “melting season” and south during the “freezing season”. In ERA Acute MIZ, we propose to give each producer-VEC a set of parameters that are related to the bloom intensity in the period and ice concentration. The parameters are read from VEC-specific input (setup) files and the potential impact is calculated in each cell, depending on whether the VEC is pelagic (water column) or present under the ice, the season and ice concentration.

Proposed factors in Table 1 are preliminary for the Barents Sea, subject to ongoing testing and include consideration of the concentration interval zone and month. The dynamic nature is reflected by using the daily resolution ice concentration data. Equation 8 describes the impact calculations for sympagic plankton, and Equation 9 for pelagic plankton (Table 2). The Bloom Intensity Factor (BIF) is seasonal and ice-concentration-dependent and modifies abundance (N) for production VECs. Due to less light (phytoplankton) and less upwelling (all plankton) the higher ice concentration-zones have lower biomass production than at 10-30 % ice concentration and the production has different intensity throughout the summer season varying with the plankton group. BIF is proposed to have three levels: To include the whole area with potential impact to represent the peak of the bloom, we propose using *High* (e.g. between 1-2). Using *Low* (e.g. 0.5-1) will reduce the impact relative to the total area to represent a beginning or the end of the bloom. To eliminate the impact in months without primary and/or secondary production, e.g. representing overwintering, a baseline BIF may be used to give the area a low basic "value", when relevant. This is the subject of further development and testing and adjustment of months.

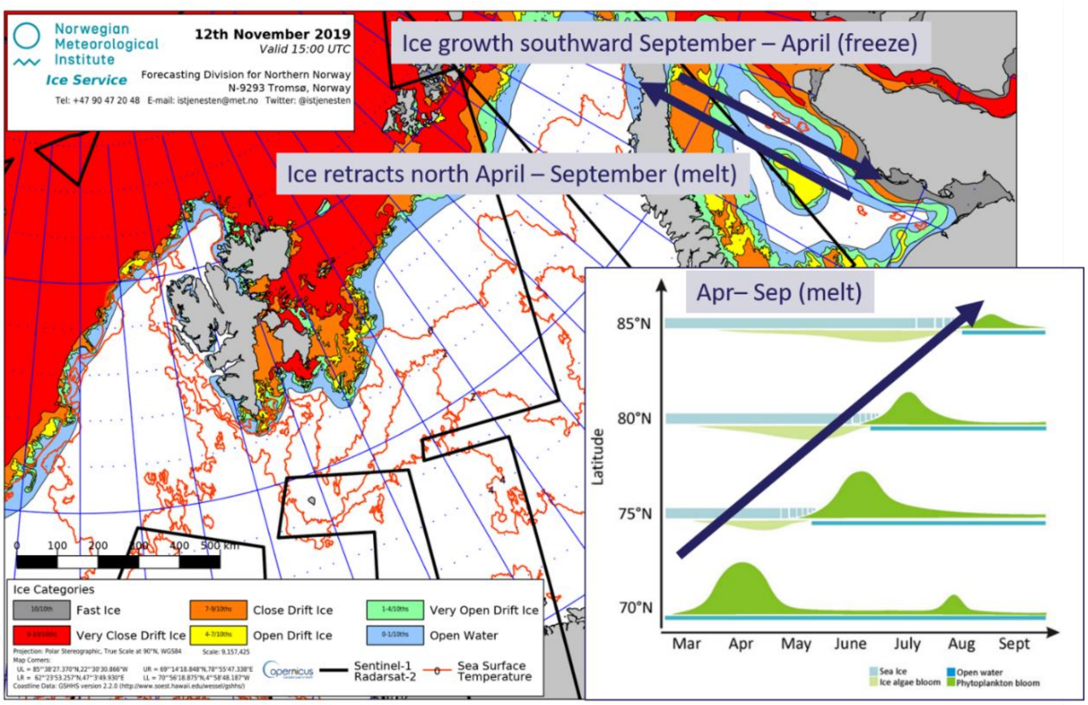

Figure 2. Principles of using georeferenced cell-based data on ice concentrations as input to drive the calculations in ERA Acute MIZ (Stephansen *et al.*, 2018). Bloom intensity illustration from Leu *et al.* (2011) and Falk-Petersen *et al.* (2007). Ice chart from https://cryo.met.no/en/latest-ice-charts for illustration purpose only.

Dynamics of the algal bloom succession and the general principle of the seasonal changes are outlined in Figure 2, showing an example of an ice concentration distribution data set and seasonal differences in the primary production regimes in the Northern European Arctic along a latitudinal gradient (the latter from Leu *et al.* (2011) and Falk-Petersen *et al.* (2007)). VECs with ice concentration-dependent seasonal properties, such as shifts in planktonic growth and bloom as the ice melts, will thereby move with the ice in the model. As the ice retracts north, the bloom moves with it, giving an earlier bloom in the southern parts than in the northern parts. This is due to the melting and breaking up of ice and is therefore correlated with the more open parts of the MIZ than the actual latitude, and we can utilize this to tie concentration intervals to the season at a level of detail sufficient for an intermediate level impact calculation. The geographic gradient is handled automatically by the model by using daily distributions of ice concentrations and the example parameters as shown in Table 1 to calculate an abundance analogue for the relevant ice concentration and season by matching with the date. The result is an impacted area.

For phytoplankton, the blooms are often viewed as being mainly present in open parts, with less production under the ice. However, under-ice blooms have been observed, and in a paper by Johnsen *et al.* (2018) it was suggested that phytoplankton blooms that were developed in open waters south of the ice edge were transported under the sea ice. In ERA Acute the phytoplankton are therefore “placed” in the whole water volume of the cell, also under ice. Thinning sea ice observed in later years means more light may penetrate, also changing the conditions for ice algae. The suggested parameter values representing the bloom intensities are subject to ongoing work on sensitivity testing and validation with the proposed functions.

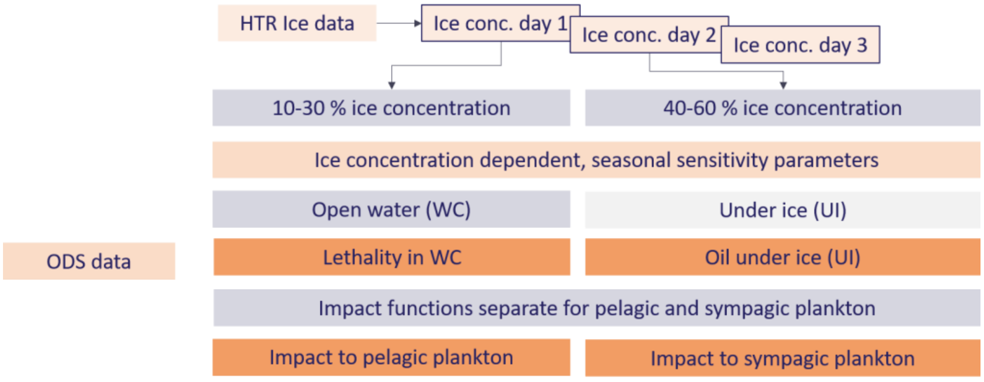

Figure 3. Basic elements of impact calculations for planktonic VECs.

Table 1. Summary overview of the preliminary example BIF values and monthly resolution to for weighting the impact, be tested for primary producer VECs considered in ERA Acute MIZ. Parameter values are under development for 60-80 %.

VEC: Ice algae								
Parameter	Value of BIF							
Ice concentration	10-30%				40-60 %			
BIF weighting	Low BIF	High BIF	End/low bloom BIF	No bloom Baseline BIF	Low BIF	High BIF	End/low bloom BIF	No bloom Baseline BIF
Months	Feb/Mar	Apr/ May	Jun	Jul-Jan	Mar/ Apr	May-Jun	Jul	Aug-Feb
Compartment	Surface under Ice							
Oil exposure:	Coverage under ice							
P_{let}, P_{beh}, P_{phy}	1							
VEC N-value	Area of VEC Ice Algae = Fraction of Cell Area with ice x cell area							
Pexp	1							
VEC: Phytoplankton								
Parameter	Value							
Ice concentration	10-30%				40-60 %			
BIF weighting	Low BIF	High BIF	Low BIF	Baseline BIF	Low BIF	High BIF	Low BIF	Baseline BIF
Months	May	Jun/ Jul	Aug/ Sep	Oct-Apr	Jun	Jul-Aug	Sep	October-May
Compartment	Water column							
ODS input:	See below:							
Plet	Lethal fraction directly based on Critical Body Residue (CBR) modelled in ODS or THC							
VEC N-value	Area of VEC Phytoplankton = Cell area							
Pexp	1							
VEC: Zooplankton (pelagic)								
Parameter	Value							
Ice concentration	10-30%				40-60 %			
BIF weighting	Low BIF	High BIF	Low BIF	Baseline BIF	Low BIF	High BIF	Low BIF	Baseline BIF
Months	Feb-Apr	May-Sep	Oct	Nov-Jan	Feb-Apr	May-Sep	Oct	Nov-Jan
Compartment	Water column							
Oil input:	See below:							
Plet	Lethal fraction directly based on Critical Body Residue (CBR) modelled in ODS or THC							
VEC N-value	Area of VEC pelagic Zooplankton = Cell area (utilise whole water column)							
Pexp	1							
VEC: Zooplankton (sympagic)								
Parameter	Value							
Ice concentration	10-30%				40-60 %			
BIF weighting	Low BIF	High BIF	Low BIF	Baseline BIF	Low BIF	High BIF	Low BIF	Baseline BIF
Months	Feb-Apr	May-Sep	Oct	Nov-Jan	Feb-Apr	May-Sep	Oct	Nov-Jan
Compartment	Under Ice (Ice-water interface)							
Oil input:	Coverage under ice (CovUI)							
P_{let}, P_{beh}, P_{phy}	1							
VEC N-value	Area of VEC Symp. Zooplankton = Ice concentration x Area of cell							
Pexp	1							

Potential Long-term impact-area (PLTIA)

For activities distant from the MIZ, oil from a potential spill may reach the MIZ after many days or weeks and in an emulsified and weathered state. Encapsulation, degradation and toxicity are the subject of research such as e.g. Camus *et al.* (2017), DeCola *et al.* (2006) and Afenyo *et al.* (2016), leaching of oil components were studied by e.g. Nahrgang *et al.* (2016) and Faksness & Brandvik (2008 a, b). The FateIce project includes improvements to ODS modelling of transport, spreading and weathering (Nordam *et. al.*, 2019). Oil transport in high ice concentrations, especially multi-year retention and oil under the ice, are currently not sufficiently modelled in ODS to be used to predict long-term effects in the proposed method for ERA Acute, but ODS modelling capabilities in ice are improving (Nordam *et. al.*, 2019).

For the MIZ habitat, oil retained in the ice could lead to prolonged exposure, potentially resulting in effects on ice algae or additional exposure for grazing animals. Oil that is trapped in ice could potentially move with the ice and may ultimately be released far from where the oil first reached the MIZ, i.e. in a different model grid cell from where the impact was calculated. The dynamics of oil encapsulation could be on a time scale of days and even hours (Afenyo *et al.*, 2016). Pending modelling of encapsulation and transport within multi-year ice, retention time of the oil in ice is not available. Restoration times of populations as such are also less relevant for VECs that have an annual bloom than for seabird and marine mammal populations.

Following discussions of oil drift modelling challenges in ice during the pilot study, we propose a simplified approach, subject to further potential development: From Figure 2 we see how we propose it would be possible to use the south-north/spring-summer melting phase connected to ice concentration and date, and vice versa for the freezing phase (adapted from Leu *et al.*, 2011).

In short, the principle is to assume that at higher ice concentrations and in periods of ***net freeze***, (i.e. there is more freezing than melting), the potential for pushing oil under the ice and encapsulating it, is higher than in areas with lower ice concentrations. In periods of ***net melt,*** we assume that oil is less likely to be retained in the environment in multi-year ice by encapsulation, hydrophobic oil has lower affinity to generally "wetter" ice (Øksenvåg *et al.*, 2019). Therefore, for a cell with a high ice concentration in the months where there is net ice formation, a higher oil Retention Factor (RF) could be used. Further research is needed to develop and propose robust RF-values. The area of the impacted cell is included in the "potential long-term impact area" (PLTIA) which is calculated from the oil coverage, RF and the cell area (Equation 10, Table 2). Each concentration interval has a potential for oil retention and long-term effects. The RF represents the potential exposure duration without a specific location and should be different in different regions of the Arctic, depending on the frequency of formation of multi-year ice. It could be compared to the Oil Holding Capacity (OHC) in the shoreline Environmental Sensitivity Index system (ESI) (NOAA, 2002), and the substrate-specific *sensitivity factor* (SF) modifying restoration time due to sequestration of oil used in ERA Acute for the *sea floor* compartment. However, e.g. with a RF=2, the area does not double in actual size, but the area counts twice with respect to potential *severity*. The impacted area in km^2 should be implemented as a separate endpoint factor and used as dimensionless and non-georeferenced PLTIA to avoid confusion, since the area is increased by the factor and the oil could move geographically with the ice to another cell. The purpose would be a simple screening of the potential for concern for long-term effect, not an accurate estimate of duration of impacts.

Table 2. Equations used in ERA Acute MIZ.

Basic impact calculation in a cell for a simulation for all compartments

Equation 1 $\mathrm{Imp}_{\mathrm{cell}} = \mathrm{p}_{\mathrm{exp}} \times \mathrm{p}_{\mathrm{let}} \times \mathrm{N}_{\mathrm{cell}}$

p_{exp}: probability for being exposed to oil above a harmful threshold, p_{let} probability that a given individual will die given exposure, N_{cell}: fraction-of-population equivalent in the cell.

Basic impact calculation in a cell for a simulation, for surface compartment (without ice) (non-daily data):

Equation 2 $N_{let} = [\mathrm{N_i} - \left(1 - (\mathrm{p_{beh}} \times \mathrm{Cov_{ODS,iT}} \times \mathrm{p_{phyT}})\right)^{\mathrm{T_{expiT}}} \times \mathrm{N_i}]_{\mathrm{Nlet,SU}})$

N_i in the cell *i* is given by the HTR VEC data. ($\mathrm{p_{phy}}$) and ($\mathrm{p_{beh}}$) are species-specific sensitivity factors, exposure time ($\mathrm{T_{exp}}$) and oil coverage ($\mathrm{Cov_{ODS}}$) are inputs from ODS.

Basic impact calculation in a cell (*i*) per day for a simulation, for surface compartment (10-30 % ice concentration (*IceConc, using daily ice distributions*)):

Equation 3 $N_{let-MIZ,i,1-30,date} = p_{beh} \times p_{phyT} \times N_{i_{date}} \times Cov_{ODS,iT} \times AF_{SU,MIZ,i,date}$

Equation 4 AreaFactor ($\mathrm{AF_{SU}}$) in the MIZ: Equation 1 $AF_{SU,MIZ,i,date} = \frac{1}{(1-IceConc,i,date)}$

Basic impact calculation in a cell for a simulation, for surface compartment (30-80 % ice concentration):

Equation 5 $N_{let-MIZ,i,>30} = \left(p_{beh} \times p_{phyT} \times N_{i_{date}} \times Cov_{SU,MIZ,iT} \times AF_{SU,MIZ,i,date}\right) + \left(p_{beh} \times p_{phyT} \times N_i \quad \times Cov_{UI,MIZ,i,date}\right) \times WF_{IAI,month})$

$\mathrm{Cov_{SU,MIZ,iT}}$ is coverage of oil at the water surface between ice floes, $\mathrm{Cov_{UI}}$ is coverage of oil under ice, calculated by the re-distribution of coverage of oil from the oil drift simulations between the remaining open sea surface and the area under the ice is given by:

Equation 6 $Cov_{UI,i,date} = (Cov_{ODS,iT,date} \times \frac{(IceConc,i,date-0.3)}{0.7})$

Equation 7 $Cov_{SU,MIZ,i,date} = Cov_{\,ODS,iT,date} - Cov_{\,UI,i,date}$

Basic impact calculation in a cell for a simulation, for planktonic species (30-80 % ice concentration):

Sympagic: Equation 8 $Imp_{Under-ice,i} = p_{beh} \times IceConc \times Cov_{UI,MIZ,iT} \times p_{phy} \times N_i \times BIF$

This equation is only valid if the IceConc> 30 % otherwise it will return 0 values.

Pelagic Equation 9 $Imp_{Pelagic,i} = p_{exp} \times p_{plet,WC} \times N_i \times BIF$

BIF is a seasonal and ice-concentration-dependent sensitivity factor which modifies abundance *N* for production VECs, denoting seasonal and ice-concentration-dependent differences in impact and where there are no behavior-related modifiers for the under-ice algae or zooplankton (p_{beh} = 1) as for seabirds and mammals.

Long-term impact factor area calculation (preliminary model)

Equation 10 $PLTIA = RF \times Cov_{ODS} \times cell\ area$

RF is the potential oil *retention factor* defined for a given ice concentration interval for a month, cell area is provided by the user in the setup.

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