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ERA Acute: Implementation of a New Method for Environmental Risk Assessment of Acute Offshore Oil Spills

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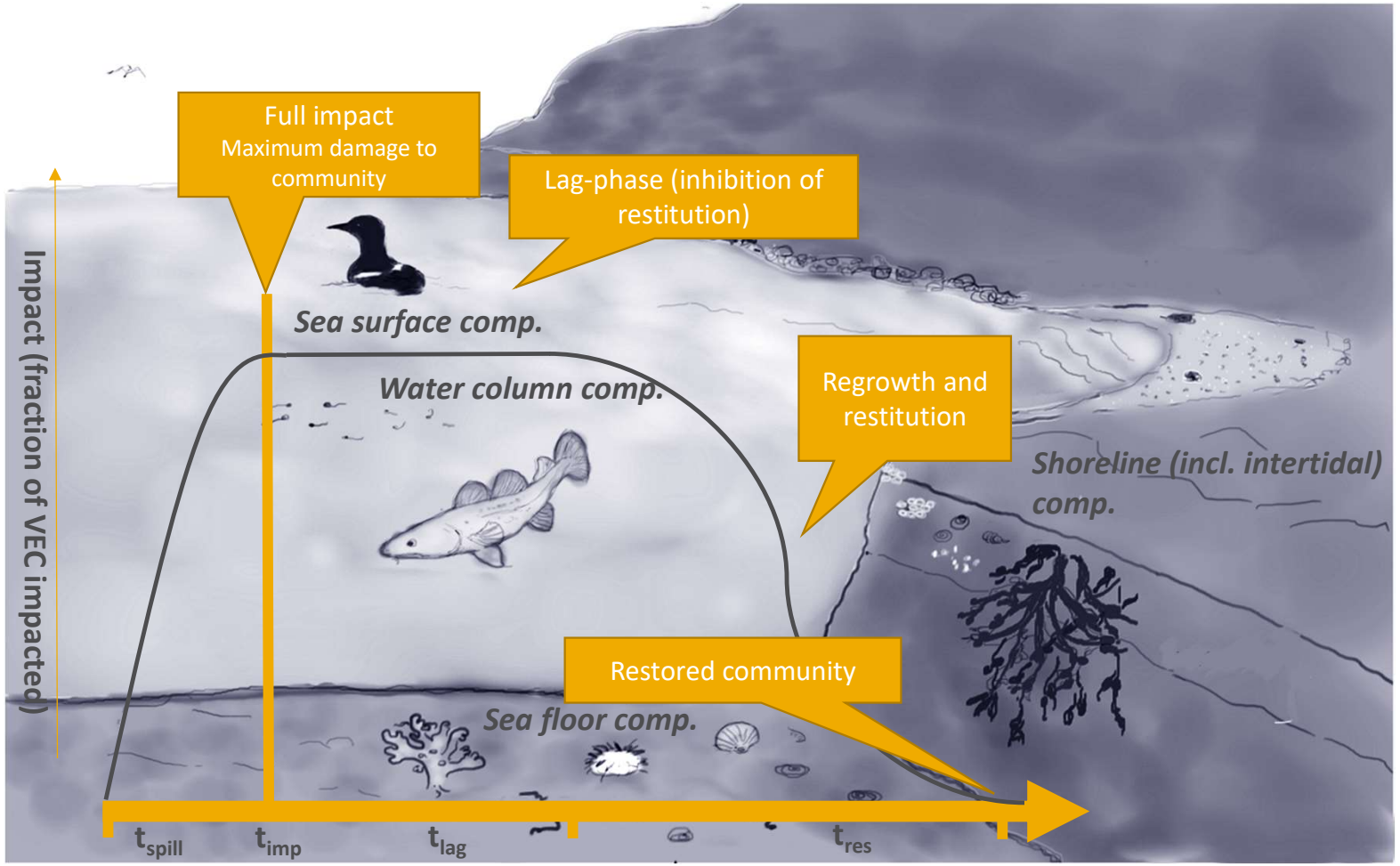
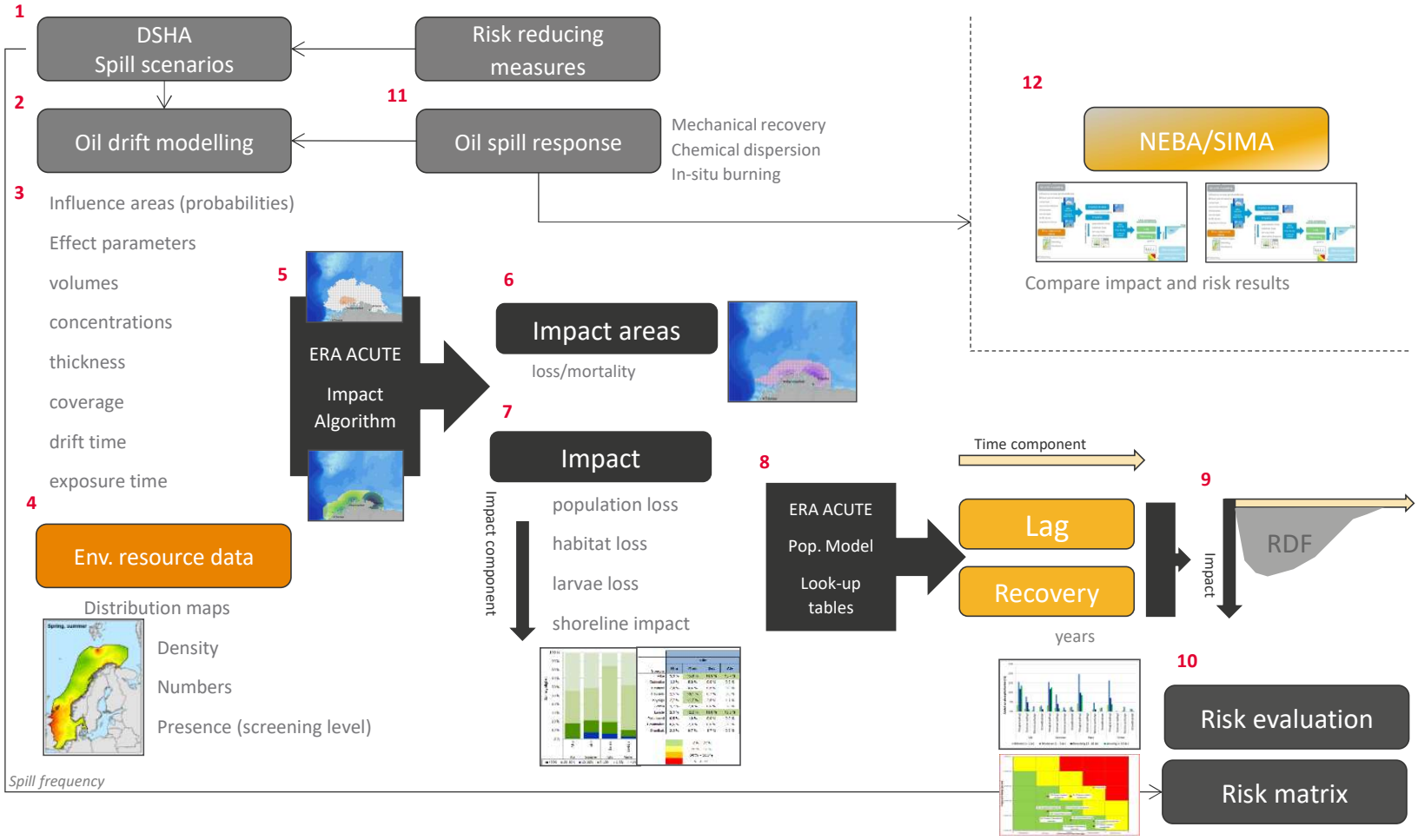
ERA Acute: The need for a standardized methodology to assess oil spill environmental risk

Environmental risk assessment (ERA) process is carried out to ensure Environmental risk acceptability of offshore installations and operations. The need for a standardized methodology and software tool able to carry out easily and reliably ERA with the potential for international recognition led to the development of the ERA Acute methodology and software tool.

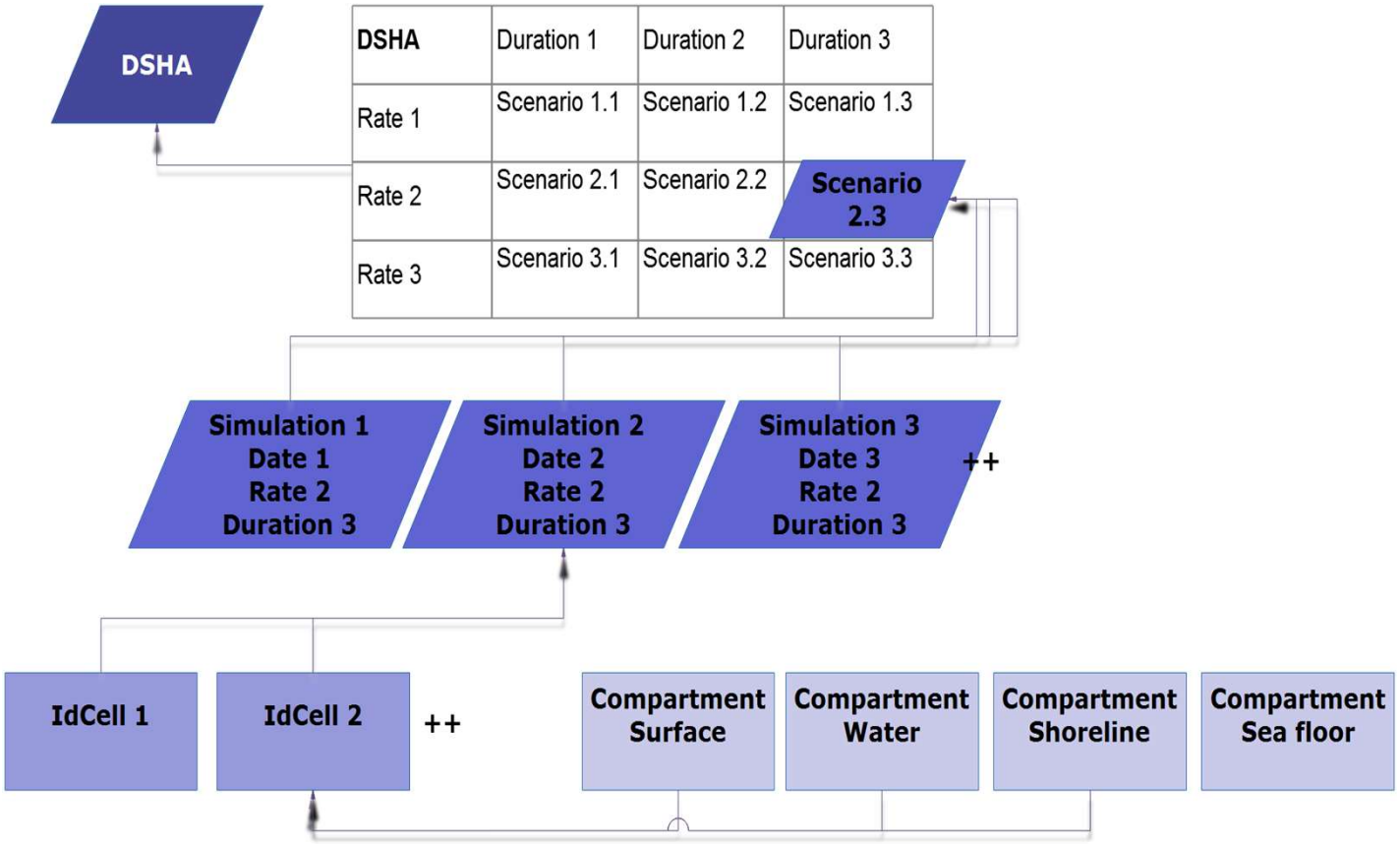
Impact and time factors in ERA ACUTE



Overview of ERA Acute applications



Defined situation of hazard and accident



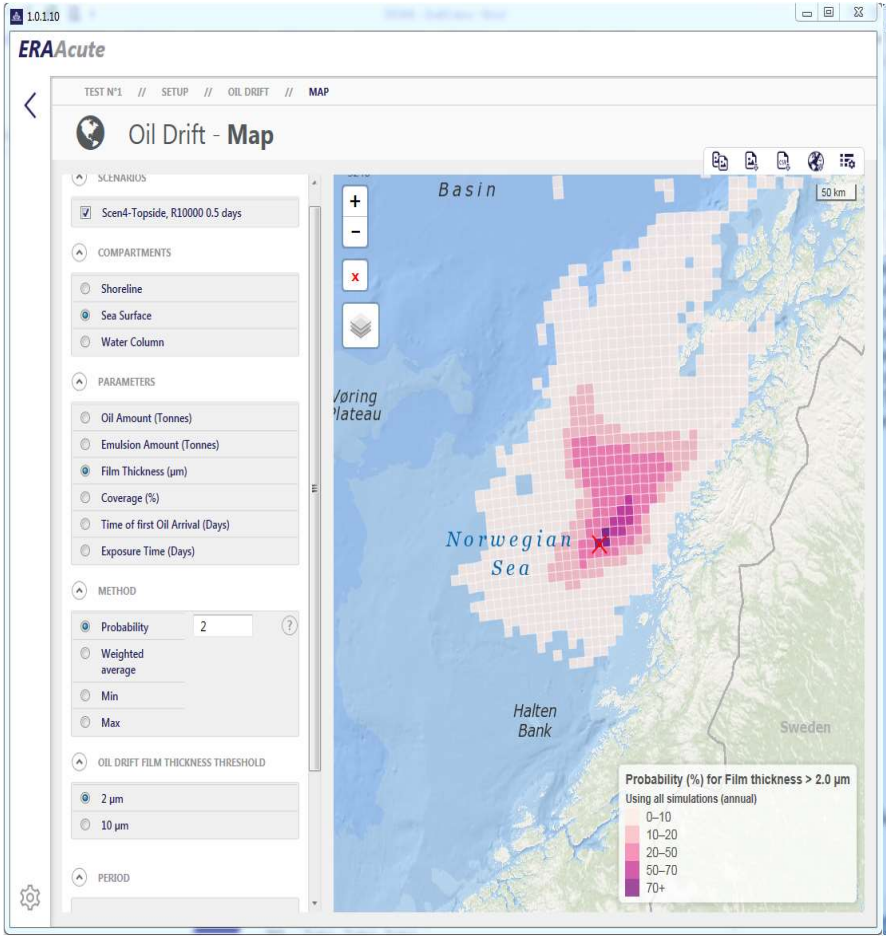
Example of Surface compartment

Surface species impact calculation: Three main wildlife groups: Birds, Mammals, Reptiles

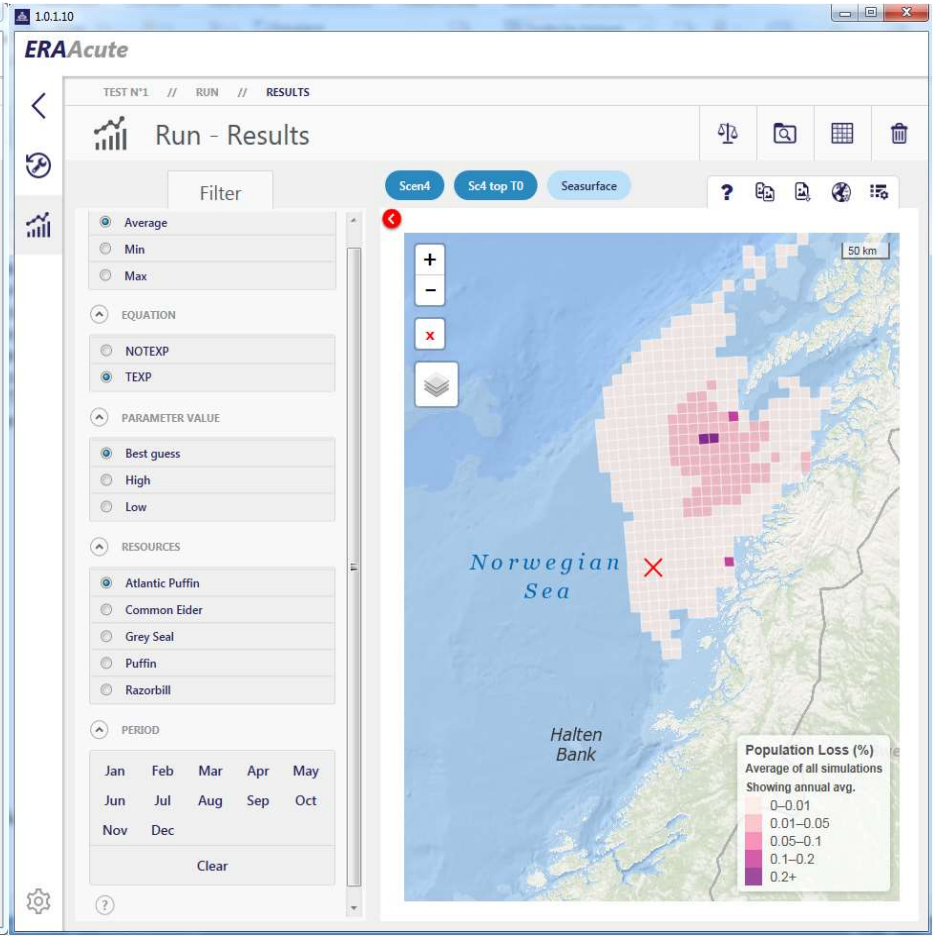
$$N_{let} = \sum_{i=1}^{n} N_i - \left(1 - p_{beh} \times Cov_{TH} \times p_{phy}\right)^{T_{exp_{TH}}} \times N_i$$

- N_{let}: Number of individuals (or fraction) killed in a grid cell (impact)
- Ni: Number of individuals (or fraction) in a grid cell
- P_{beh}: Behavioural factor (WG or species specific)
- P_{phy}: Physiological factor (WG or species specific)
- Cov_{TH}: Percentage area covered with harmful oil in grid cell
- T_{expTH} : Time with harmful oil in grid cell
- *Harmful oil = Oil film thickness > Threshold thickness (TH). Different THs for birds and mammals/reptiles*

Surface species: Example of ERA Acute impact calculation

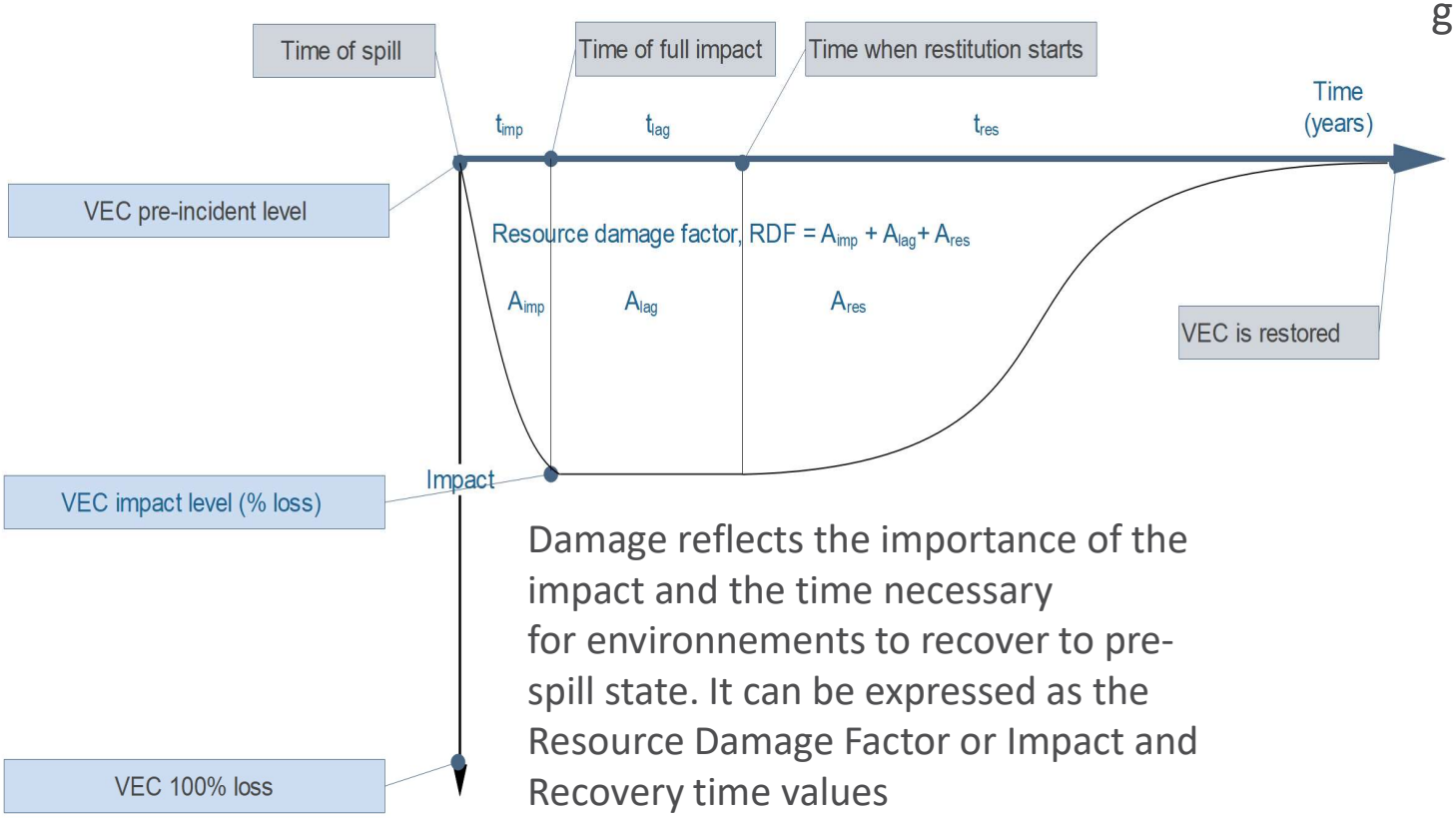


probability to have oil film thickness > 2 µm



Atlantic Puffins population loss

From impact to damage calculation



Damage reflects the importance of the impact and the time necessary for environnements to recover to pre-spill state. It can be expressed as the Resource Damage Factor or Impact and Recovery time values

For surface species restitution time is calculated througth a discrete logistic growth model:

$$N_{t+1} = \frac{N_t R}{1 + (aN_t)^b}$$

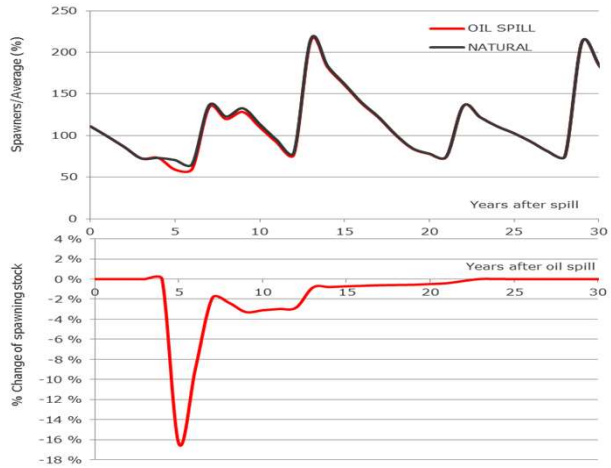
- N_t is the population size at time t
- R = the fundamental net reproductive rate.
- a = (R-1)/K, where K is the carrying capacity
- b = a factor determining the density dependence type.

For shoreline, water column and sea floor Similar damage parameters are calculated through specific approaches for each compartment

- Shoreline:

Exposure calculation against Toxicity threshold and use of NOAA Environment sensitivity index and look up table for recovery time for invertebrates, vegetation and wetlands.

$$T_r\ (mm) = {Vr(m^3)} \Big/ L_r\ (km) \times \frac{TR\ (m)}{\sin(\tan(sl_r) \times PF}$$



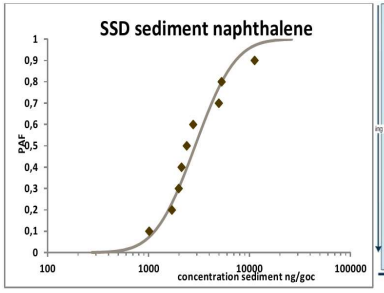
Years after spill	Reduction >1%
0	0.0 %
1	0.0 %
2	0.0 %
3	0.0 %
4	0.0 %
5	-16.4 %
6	-8.9 %
7	-1.9 %
8	-2.4 %
9	-3.3 %
10	-3.1 %
11	-3.0 %
12	-2.8 %
13	0.0 %
14	0.0 %
15	0.0 %
16	0.0 %
17	0.0 %
18	0.0 %
SUM	-41.7%

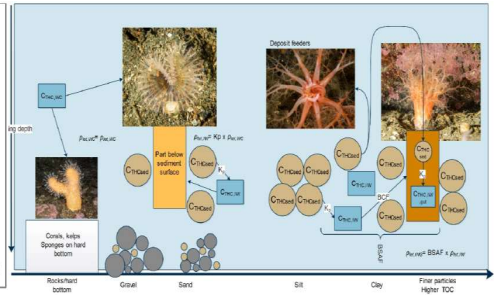
- Water Column:

Recovery time and RDF are calculated by comparison of modelled undisturbed fish stock from year to year with disturbed case by the oil spill impact on fish larvae.

- Sea Floor:

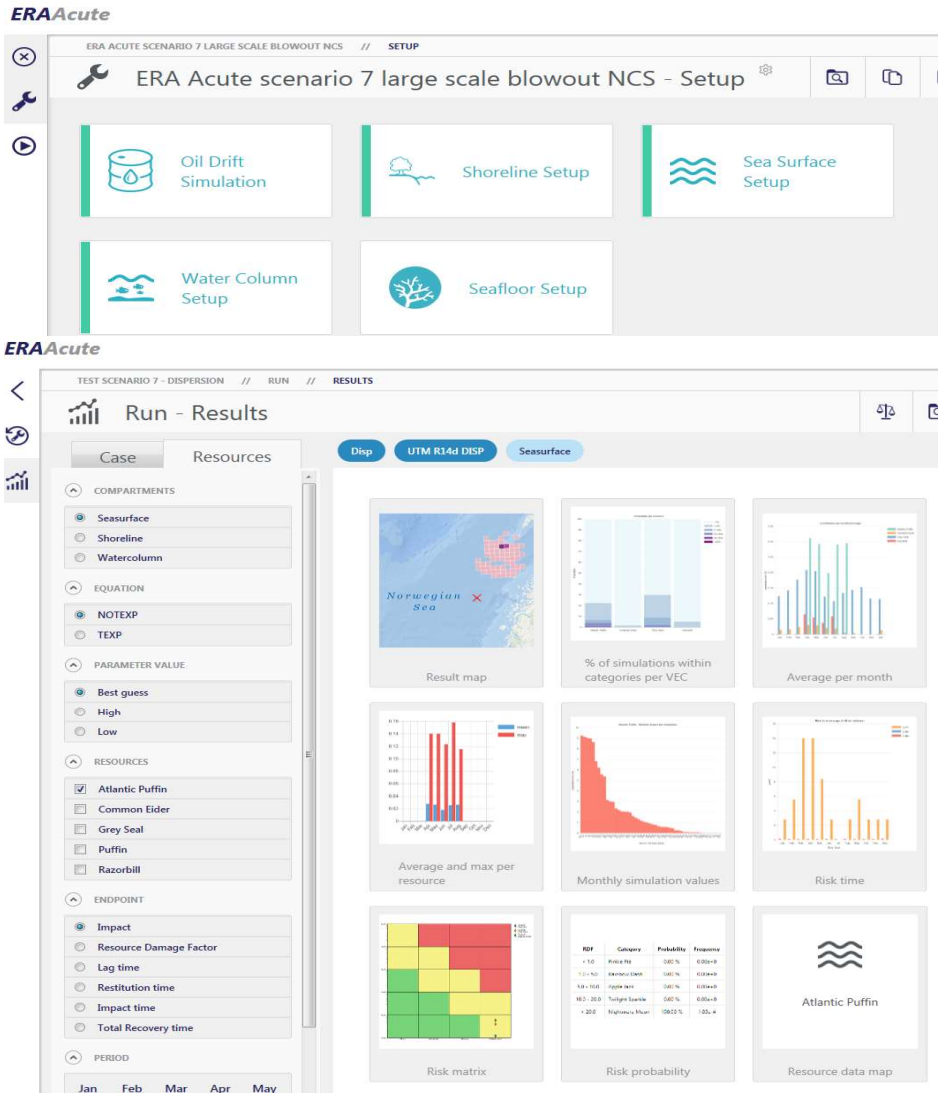
Calculation of potentially affected fraction for sediment species and exposure through different organisms feeding modes.
Recovery time are estimated from exposure decay with time of pollutants in sediments and look up table for hard bottom species such as sponges and coral.





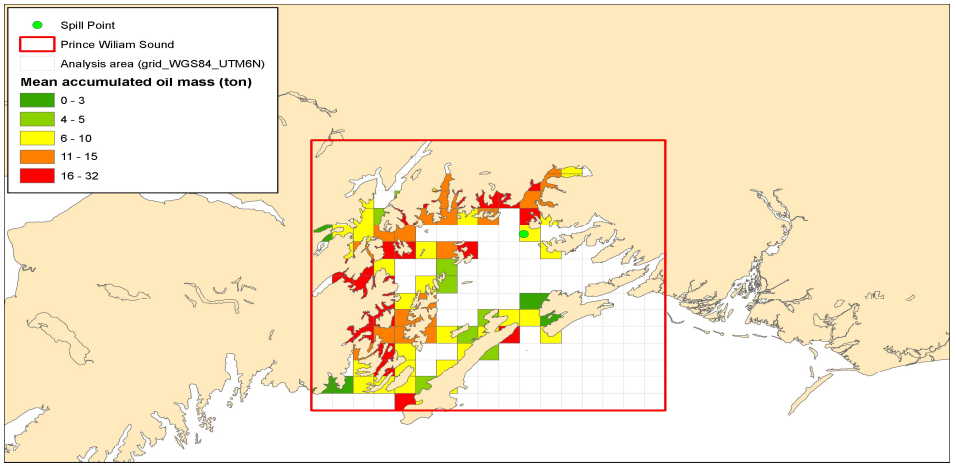
ERA ACUTE SOFTWARE TOOL POTENTIAL

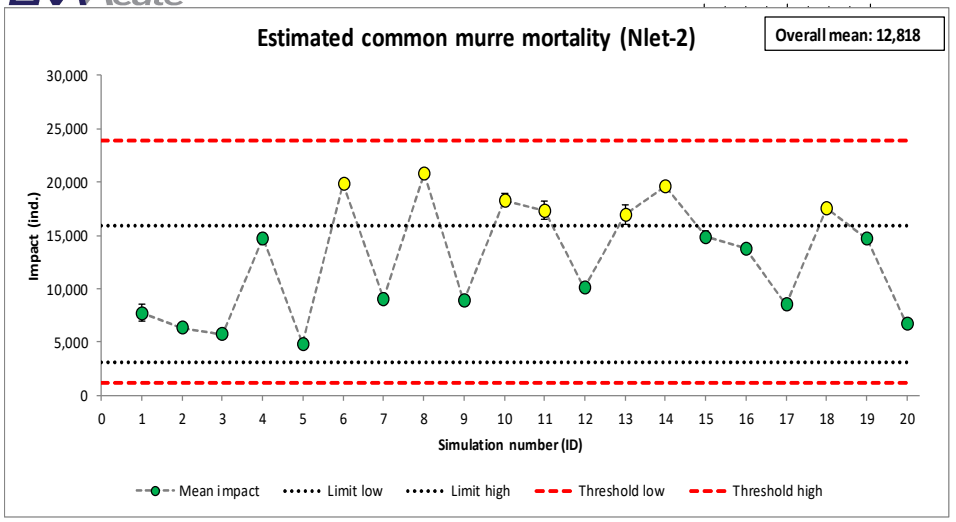
- Offers simple approache: level A for risk screening purposes that can be used with limited input data for impact calculation.
- Level B offers damage calculations through detailed impact and recovery time estimation for each environment compartment.
- Results are displayed as graphs and maps and also contain risk management tool options like the Risk matrix and the comparison tool as input to NEBA and SIMA.



Validation against field data for Deepwater horizon and Exxon valdez spill incident

- Reconstructed field data from observation of spill effects and satellite data have been carried out.
- Stochastic Oil drift simulations were done in the same windows of time as for the spill incidents.
- ERA Acute calculations were done on that basis and compared with field data.
- Results lies in the boundaries of observed variability of impact and damages reported from observations





Conclusion

- ERA Acute provides a scientifically robust methodology implemented in an easy to use software tool to assess environmental risks for offshore installations and operations
- It is in line with Industry IPIECA/IOGP 2013 guidelines on ERA
- Can be applied worldwide
- It is a transparent and standardized approach in a stepwise fashion thus allowing to carry out early risk detection with a minimal amount of data and further assess damage and risk at a second level of detailed calculation of impact and recovery time of environment
- Validation against field data shows good agreement.
- Risk results can be displayed on Risk matrix application and compared between different response and risk reduction measures options through a comparison tool in support of NEBA and SIMA
- Based on this results ERA Acute is considered to become a standard for ERA applied to Norwegian Continental Shelf

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