ERMS: Task 2: Non-toxic thresholds

Background

The goal of the ERMS program is to develop an integrated risk assessment model to enable the companies to quantify environmental risk from drilling discharges. The work is built on the present Environmental Impact Factor (EIF) being used for produced water (with DREAM) discharges that covers risk calculation in the water column. The new model development will also include risk assessment of the environmental compartment “bottom sediments”. The EIF for produced water is based on the main principles of risk and hazard assessment as described in the EU-TGD, based upon the PEC/PNEC approach. This approach was also decided to be followed in development of the EIF for drilling discharges. A schematic presentation of the PEC/PNEC approach within the EIF produced water, is given in Figure 1.

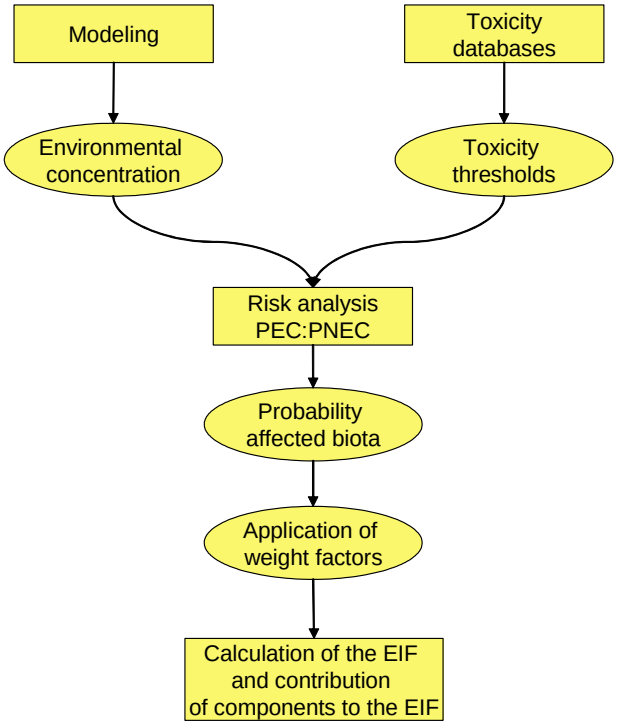

Figure 1. Schematic overview of the steps included in calculation of the EIF for produced water discharge.

The PEC (Predicted Environmental Concentration) is an estimate of the expected concentration of a chemical to which the biota will be exposed during and after the discharge of that chemical. The PNEC (Predicted No Effect Concentration) is the concentration below which it is not likely that adverse effects on the biota of a particular environmental compartment will occur. The ratio of the PEC and the PNEC indicates the likelihood of the occurrence of adverse effects. In this task toxicity contribution to the risk both in water column and in bottom sediments has been focused on.

For drilling discharges toxicity might not be the only important stressor. Non-toxic stressors, including burial by cuttings and mud particles, oxygen depletion caused by

additional oxygen demand from biodegradable substances and changes in grain size, are part of an integrated measure of the overall probability of damage in the sediments.

Objective

The objective of this task was to derive thresholds for non-toxic disturbances related to drilling discharges. The approach should be in accordance to relevant environmental international regulations (EU-TGD, EC, 2003) for the water column and the sediments. The following stressors are evaluated:

- Suspended matter in the water column
- Burial of benthic organisms by cuttings and mud particles
- Change in sediment structure expressed in a change in the median grain size
- Change in the sediment quality by a change in oxygen content of the sediment

The "PNECs" for suspended matter and burial are based on laboratory exposure tests. PNECs are derived using both the assessment factor approach and the SSD (species sensitivity distributions) approach. The latter gave more realistic results compared to natural background concentrations.

The "PNEC" for changes in grain sizes is based on the grain size preference of North and Norwegian sea species. This information is available from monitoring studies.

The determination of the "PNEC" for changes in the oxygen concentration in sediment is less straight forward. It is assumed that there is a linear relationship between the Redox potential and the oxygen content. Monitoring data is used to derive a relationship between the change in redox potential and the change in species diversity. The 'PNEC' for oxygen is based on the layer thickness of the oxygenated sediment (mm).

Research needs

1. In ERMS the presence of suspended matter in the water column is indicated as a stressor to aquatic biota. The stress function included in the EIF for drilling discharges is based on direct effects on mainly filter feeders. Secondary effects (e.g. caused by a reduction of light penetration) might as well lead to effects on phytoplankton development. These effects might have consequences higher in the food chain. Studies to assess the importance of these secondary effects could be of interest especially for arctic or tropic systems.

2. Burial, oxygen depletion and change in grain size are included in the EIF for drilling discharges. At the moment these stressors are assumed to be independent. This is however an oversimplification of reality. Experiments with these three stressors could lead to a set of weighting factors indicating the relative importance of the stressors.

3. The effects on biota as a result of the change of oxygen content in the sediment are not very well documented. Experiments with non-toxic, biodegradable substances could lead to more knowledge on the effects of these substances.