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A probabilistic ecological risk model for Arctic marine oil spills

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Abstract

A model that can evaluate the ecological risk posed to the Arctic marine ecosystem is presented in this paper. The proposed model is aimed at evaluating the risk of an accidental oil release. The model incorporates a release and dispersion model, fate and transport model, and ecotoxicological modelling. Uncertainties in the proposed model and data are addressed through a probabilistic framework implemented using a fugacity model to estimate the exposure concentration in the different media that are in contact with oil. This is the focus of this paper. The 95th percentile of Predicted Exposure Concentration ($PEC_{95\%}$) is compared with the 5th percentile of the Predicted No Effect Concentration ($PNEC_{5\%}$) to produce a Risk Quotient (RQ) profile, which indicates the level of risk posed to the Arctic marine ecosystem. The application of the proposed model is illustrated through a case study. The RQ obtained is useful for making decisions on the management of safety for Arctic marine ecosystems, such as setting operational goals to prevent accidents and for designing emergency preparedness plans. The uniqueness of this work in comparison to earlier studies is that, the methodology takes into account all the significant component models needed to address a potential oil spill in a probabilistic way and demonstrated in an Arctic setting. This study also shows that the methodology is useful as a first step to decision making in the absence of data on accidental releases in the Arctic marine waters.

Keywords: Arctic, Ecology Risk, Oil Spill, Pollution, Risk Assessment

1. Introduction

Increased potential for oil and gas exploration, as well as shipping through the Arctic, [36] has prompted governments of Arctic countries, the International Maritime Organization

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