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Methodology for prediction and estimation of consequences of possible atmospheric releases of hazardous matter: "Kursk" submarine study

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Abstract. There are objects with some periods of higher than normal levels of risk of accidental atmospheric releases (nuclear, chemical, biological, etc.). Such accidents or events may occur due to natural hazards, human errors, terror acts, and during transportation of waste or various operations at high risk. A methodology for risk assessment is suggested and it includes two approaches: 1) probabilistic analysis of possible atmospheric transport patterns using long-term trajectory and dispersion modelling, and 2) forecast and evaluation of possible contamination and consequences for the environment and population using operational dispersion modelling. The first approach could be applied during the preparation stage, and the second - during the operation stage. The suggested methodology is applied on an example of the most important phases (lifting, transportation, and decommissioning) of the ``Kursk" nuclear submarine operation.

It is found that the temporal variability of several probabilistic indicators (fast transport probability fields, maximum reaching distance, maximum possible impact zone, and average integral concentration of ^{137}Cs) showed that the fall of 2001 was the most appropriate time for the beginning of the operation. These indicators allowed to identify the hypothetically impacted geographical regions and territories. In cases of atmospheric transport toward the most populated areas, the forecasts of possible consequences during phases of the high and medium potential risk levels based on a unit hypothetical release (e.g. 1 Bq) are performed. The analysis showed that the possible deposition fractions of 10^{-11} (Bq/m^2) over the Kola Peninsula, and 10^{-12} - 10^{-13} (Bq/m^2) for the remote areas of the Scandinavia and Northwest Russia could be observed.

The suggested methodology may be used successfully for any potentially dangerous object involving risk of atmospheric release of hazardous materials of nuclear, chemical or biological nature.

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