VARIATIONAL DATA ASSIMILATION IN A TRANSPORT MODEL

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Abstract
A variational algorithm for data assimilation is considered. It is based on the minimization of a certain quadratic functional of the prediction quality and the solution of the adjoint problem. Numerical model experiments demonstrating the potentialities of this approach, and prospects of its application for solving practical problems, have been carried out.
Keywords : Models, Black Sea, Pollution, Radionuclides, Surface Waters.

The need to conduct monitoring and prediction of the Black Sea ecological state requires the elaboration of methods for identifying the sources of pollution. A methodology to solve such problem may be based on minimization of a quadratic functional of prediction quality, characterizing the deviation of the model estimates from the observed data. The functional minimum is found under the proviso that the model estimates are defined as a solution of an equation of passive impurity transport. This approach is based on the realization of direct and adjoint models of the process being investigated. In this method, the solution of the adjoint problem is the influence function. Information agreement between the model and the measurements is attained by variation of the input parameters provided by the extremum of the prediction quality functional. The form of the latter depends on the modeling objectives. Computations of the required function through the solution of the adjoint problem, yields a possibility to solve numerous practical problems, including an estimation of the influence of the different initial field areas and of the model coefficient, on the model prediction.

Computations aiming at the reconstruction of the initial field have been performed using the variational algorithms. Data on ^{137}Cs for the Black Sea area for May - June 1986 were used as measurements of passive impurity. Figures 1,2 shows the model field of concentration (Fig. 1) compared with initial one (Fig. 2) with its maximum at the Caucasian coast, where just after the Chernobyl accident intensive rains have fallen. The model was integrated for 40 days.

Different aspects of the application of variational methods for data assimilation in modeling the passive impurity propagation are considered.

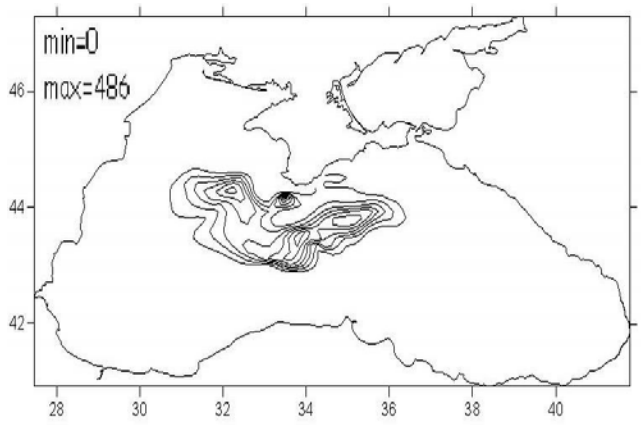

Fig. 1. Modelled field of ^{137}Cs concentration (Bk/m^3).

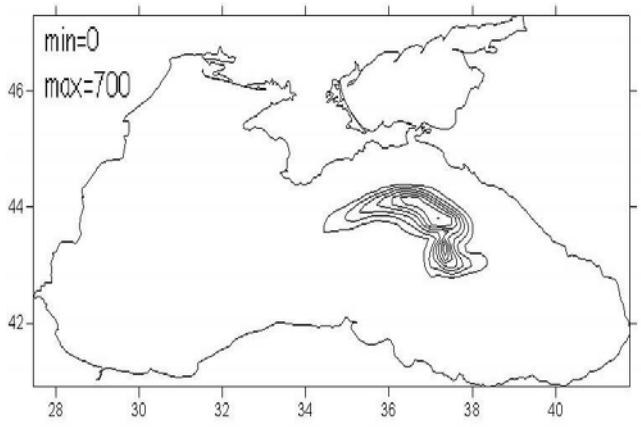

Fig. 2. Reconstructed initial field of ^{137}Cs concentration (Bk/m^3).

References
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