

Recent developments in exploitation of data assimilation in early and late phase of radiation accident

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The paper gives a comprehensive summary on developments achieved in years 2006-2009 in exploitation of the data assimilation (DA) in the field of radiation protection. Radiation accident followed by an aerial release of radionuclides into the environment has the two successive phases: the early and the late phase [3]. In order to ensure efficiency of introduced countermeasures it is necessary to predict spatio-temporal distribution of the released radionuclides and its evolution. DA is the optimal way how to exploit information from both the measured radiological data and expert-selected (modeled) prior knowledge to obtain reliable estimates of radiation situation. The palette of available DA methods spans from the simple ones bases on pure interpolation to the advanced Bayesian methods [1]. We apply the Bayesian methodology for assimilation in both the phases.

In the early phase, movement of radioactive cloud over the terrain is modeled [8]. During this process, measurements available from the Early warning network of the CR are used for correction of selected initial conditions (magnitude of release, meteorological conditions etc.) entering used atmospheric dispersion model in the form of prior distributions [10]. The developed method based on particle filters [2] gives us assimilated (improved) estimate of the radiation situation on terrain and a way how to easily extend the estimate to prediction on an arbitrary time horizon.

In the late phase, propagation of radionuclides deposited on terrain through the environment is modeled. This phase lasts until the radiation levels resume to background values. We use linearized model of radionuclides removing due to radioactive and environmental decay processes and a parametrized form of model error covariance structure [6] for estimation of radiation situation on terrain in time horizon of several month or years [9]. The developed DA methodology is based on marginalized particle filter [5].

Specific DA algorithms are tested on scenarios simulating different reactor accidents in a power plant. The objective is to integrate DA subsystem into the decision support system HARP localized for the conditions of the CR [7]. This work is supported by grants GAČR 102/07/1596 and MŠMT 1M0572.

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