Geophysical Research Abstracts
Vol. 17, EGU2015-3033, 2015
EGU General Assembly 2015

Analytical source term optimization for radioactive releases with approximate knowledge of nuclide ratios

Radek Hofman (1), Petra Seibert (1,2), Ivan Kovalets (3), and Spyros Andronopoulos (4)

(1) University of Vienna, Vienna, Austria (hofman.radek@gmail.com), (2) University of Natural Resources and Life Sciences (BOKU), Vienna, Austria (petra.seibert@univie.ac.at), (3) Ukrainian Center of Environmental and Water Projects, Kiev, Ukraine (ivkov084@gmail.com), (4) National Center for Scientific Research Demokritos, Athens, Greece (sandron@ipta.demokritos.gr)

We are concerned with source term retrieval in the case of an accident in a nuclear power with off-site consequences. The goal is to optimize atmospheric dispersion model inputs using inverse modeling of gamma dose rate measurements (instantaneous or time-integrated). These are the most abundant type of measurements provided by various radiation monitoring networks across Europe and available continuously in near-real time. Usually, a source term of an accidental release comprises of a mixture of nuclides. Unfortunately, gamma dose rate measurements do not provide a direct information on the source term composition; however, physical properties of respective nuclides (deposition properties, decay half-life) can yield some insight. In the method presented, we assume that nuclide ratios are known at least approximately, e.g. from nuclide specific observations or reactor inventory and assumptions on the accident type. The source term can be in multiple phases, each being characterized by constant nuclide ratios.

The method is an extension of a well-established source term inversion approach based on the optimization of an objective function (minimization of a cost function). This function has two quadratic terms: mismatch between model and measurements weighted by an observation error covariance matrix and the deviation of the solution from a first guess weighted by the first-guess error covariance matrix. For simplicity, both error covariance matrices are approximated as diagonal. Analytical minimization of the cost function leads to a liner system of equations. Possible negative parts of the solution are iteratively removed by the means of first guess error variance reduction.

Nuclide ratios enter the problem in the form of additional linear equations, where the deviations from prescribed ratios are weighted by factors; the corresponding error variance allows us to control how strongly we want to impose the prescribed ratios. This introduces some freedom into the problem so that the nuclide release rates can accommodate to both measurements (and their errors) and prescribed ratios.

The method will be demonstrated on synthetic data generated by Lagrangian particle dispersion model DIPCOT.

This research is supported by EU FP7 project PREPARE: Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe (contract no. 323287).