Geophysical Research Abstracts, Vol. 8, 09026, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09026

Modelling re-analysis of the Chernobyl accident: model evaluation and source apportionment

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The work presents the re-analysis of the radioactive pollution dispersion after the Chernobyl accident using the Finnish Emergency Modelling System SILAM forced by several meteorological drivers: ECMWF ERA-40 re-analysis and different versions of regional NWP model HIRLAM. Two sets of simulations are considered: (i) forward runs using all available to-date information about the source terms and air concentration and deposition measurements for the verification purposes, and (ii) inverse problem solution (source apportionment) via variational data assimilation (4D-VAR), which took into account the information about observed concentrations. Utilization of deposition measurements for the source apportionment task was complicated due to practical absence of the time dimension in these data.

The results of the simulations showed that SILAM system driven by the state-of-art meteorological models can quite well reproduce even such a complicated phenomena – including some of its peculiar characteristics, such as location of the maximum deposition area in eastern Sweden, bifurcation in the pollution pattern over Ukraine, double-appearance of the radioactive cloud over the southern Finland, etc.

It was also shown that the key pre-requisite for approaching the inverse problem is a sufficient number of observation sites and their temporal resolution. This was also demonstrated previously on an example of source apportionment problem constructed on the basis of ETEX experiment, where the density and quality of observations enabled for successful determination of both place and time of the source of tracer .