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Mass retrieval and a posteriori error analysis using non-linear inverse modelling techniques applied to atmospheric tracers

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An account on recent progress in the inverse modelling of pollutants with first order chemistry (tracers, radionuclides, etc.) is given. The methods, which are variational and whose general principles have been presented in earlier EGU assemblies, are fundamentally nonlinear. They are meant to perform efficiently on the reconstruction of sources of accidental type (typically ETEX, Chernobyl.) In this report, the emphasis is put on two recent developments:

- The problem of finding the total released mass through nonlinear methods is first studied. Because the positivity of sources is taken into account, a non-zero prior mass scale appears in the background term. The cost function has a non-quadratic dependence on this parameter. This rules out many known parameter estimation techniques, when one has to choose this parameter prior to the inversion.
- A posterior analysis of the retrieved source and retrieved errors is then conducted. It generalises well-known data assimilation results that make use of the Hessian of the cost function. Closely related is the second order sensitivity analysis on the source and retrieved errors, of special significance for inverse modelling.