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Inverse modelling for mercury dispersion over Europe

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A sensitivity analysis for mercury over Europe is performed. Building on the tools developed for this analysis, data assimilation methods are used to improve the forcing conditions on the dispersion model.

The approach, based on adjoint techniques, goes beyond the widely used source-receptor method. Since an area limited domain is used, the boundary conditions must be taken into account carefully. In such a domain, a local gaseous mercury measurement depends on the ground emissions and re-emissions, but also on the incoming mercury from domain boundaries and on the initial content of the domain. Sensitivities to those inputs are computed through adjoint techniques, using the numerical transport model POLAIR3D. Examples of sensitivity maps are provided for EMEP mercury stations.

Elemental gaseous mercury life-time being of order one year, global or hemispherical models are usually preferred to study its dispersion, while area-limited models depend on boundary conditions to a large extend. Going beyond the sensitivity analysis, data assimilation of mercury based on adjoint solutions can help determine relevant boundary conditions for area-limited models of mercury transport. These ideas are tested with POLAIR3D simulations.