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# Inverse modelling of methane and carbon monoxide emissions together with 3D-formaldehyde production from satellite measurements.

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Satellites nowadays provide measurements for various atmospheric constituents with a lower accuracy than for the ground stations but a remarkable spatiotemporal coverage. These data can now be combined in sophisticated inversion systems that take the impact of the chemistry of the lower atmosphere into account.

In order to improve our knowledge of the emissions of greenhouse gases and of their precursors at the global scale, we have developed a system for the inversion of the emission fluxes and 3D-production of the gases involved in the oxidation chain of methane ($CH_4$), in particular formaldehyde (HCHO) and carbon monoxide (CO), reacting with hydroxyl radicals (OH).

The interactions between these molecules are modelled based on a simplified version of the module of atmospheric chemistry INCA implemented in the atmospheric transport model LMDz, guided by the winds of the ECMWF analyses. The inversion scheme is based on Bayesian inference: a variational system, developed at LSCE from the ECMWF four-dimensional variational system (4D-Var), has been adapted for this.

We present here the results of the inversion for global surface fluxes of CO and $CH_4$ and global 3D-concentration fields of HCHO, obtained with observations from MOPITT for CO, from SCIAMACHY for $CH_4$ and from OMI for HCHO (plus surface data for methyl-chloroform to constrain OH concentrations) on months August to December of the year 2004, a period during which all three satellites were operational. We compare these results to what can be obtained with surface data only.