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A new variational multi-specie inverse system to optimize sources and sinks of greenhouse gases and their precursors.

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Today, accurate but uneven observations of trace gas are available at a series of surface stations. Some constituents such as methane and carbon monoxide start to be observed by satellite, with a lower accuracy than for the ground stations but a remarkable spatiotemporal coverage. The optimal exploitation of these types of information requires their combination in elaborate inversion systems because the chemistry of the lower atmosphere couples the variations of the greenhouse gas concentrations.

We have developed a varational multispecies inverse system to optimize sources and sinks of major trace gases of the methane oxidation chain (methane, formaldehyde, carbon monoxide, molecular hydrogen). The interactions between these molecules are established by a simplified version of the full chemistry model 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 four-dimensional variational system (4D-Var), developed at LSCE from the ECMWF weather forecast system, has been adapted for this. We present here the first results of inversions for global surface fluxes CH4 and CO of year 2004, obtained with available surface and satellite data.