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Variational data assimilation algorithms at the splitting stages of an atmospheric chemistry transport and transformation model

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In the development of the concept of environmental forecasting and design using the models and observations [1], a variational data assimilation algorithm for atmospheric chemistry transport and transformation models is presented. Modern nonlinear atmospheric chemistry transport and transformation models require input parameters like emission sources, initial and boundary conditions, etc. In the applications, this information usually is not fully available and can be complemented by the data assimilation algorithms and the available concentration measurements. The algorithm is based on the splitting scheme and quasi-independent solution of the linked inverse problems for the separate splitting stages of the model with the shared measurement data. The uncertainty (control) function is introduced into the transport and transformation model source term (which can be interpreted as the reconstructed emission rate) to provide flexibility to adjust to data. The control function is evaluated on a sequence of time intervals as the constrained minimum of the cost functional, combining the control function norms with the norm of the misfit between available measurement data and its model-simulated analogue. Data assimilation on the linear transport stage is carried out with a direct algorithm without iterations [2]. The iterative algorithms are applied to the nonlinear inverse source problem on the transformation stage [3, 4]. The algorithm was applied in the realistic urban air quality evaluation scenarios [1].

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