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Fine-grained data assimilation algorithm with uncertainty assessment in variational modeling technology

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We consider an approach to data-assimilation schemes design based on introduction of the special control functions into the structure of the model equations to take into account various uncertainties. In the presence of measurement data this augmented model is treated with variation technique for the functional describing the misfit between measured and calculated values with the introduced control functions as the quantities to be minimized in the phase space of the augmented model state functions. Due to uncertainty, the weak-constraint variational principle is formulated. Then a discrete analogue of the variational principle functional is constructed by means of decomposition, splitting and finite–volume methods. From the stationary conditions for the variational principle functionals the systems of direct and adjoint equations as well as the uncertainty equations are obtained [1, 2]. In general case the systems can be solved iteratively with some conditions imposed to the parameters.

As the splitting schemes is used, we propose to assimilate all available data at one model time step but on the corresponding splitting stages by means of direct algorithms without iterations. The approach can be called fine-grained data-assimilation. Such versions of algorithms are cost-effective, easy to be parallelized and may be useful for integrated models of atmospheric dynamics and chemistry.

In the case of convection-diffusion stage and one time step analysis window the multidimensional model can be further decomposed with the splitting technique to a set of one-dimensional models. Each resulting one-dimensional fragment has the form of three diagonal block-matrix linear problem that can be solved with the matrix sweep method [3]. In the case of assimilation windows longer than one time step the result of fine-grained algorithm analysis can be used as initial guess.

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References:

1. V. V. Penenko. Variational methods of data assimilation and inverse problems for studying the atmosphere, ocean, and environment // Numerical Analysis and Applications, 2009, V. 2, No 4, 341-351.

2. V. Penenko, A.Baklanov, E. Tsvetova and A. Mahura. Direct and Inverse Problems in a Variational Concept of Environmental Modeling // Pure Appl. Geophys . DOI: 10.1007/s00024-011-0380-5, (2012) 169: 447-465.

3. A. Penenko. Some theoretical and applied aspects of sequential variational data assimilation // Comp. tech. v.11, Part 2, (2006) 35-40 (In Russian).