Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04615, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04615
EGU General Assembly 2008

Non-Gaussian data assimilation for source-driven atmospheric transport: generalisations to nonlinear physics

M. Bocquet (1,2) and L. Wu (1,2)

(1) Université Paris-Est, CEREA joint laboratory ENPC / EDF R&D, (2) INRIA

Non-Gaussian data assimilation techniques have been previously proposed for inverse modelling of sources of atmospheric tracers. However the physics was assumed linear. Methods such as the maximum entropy on the mean [MEM] or based on exact Bayesian inference have been developed so as to take into account specifics of the problem (e.g. the positivity of the source field). They have been successfully validated on real dispersion events (ETEX, Chernobyl).

So far, these approaches made use of the Jacobian matrix: thanks to the linear physics assumption, the full model (often adjoint model trajectories) could be encoded in a matrix, prior to any optimisation.

Here, generalisations of these approaches (mainly MEM) to nonlinear physics are proposed. One rigorous generalisation still makes use (though iteratively) of the Jacobian matrix, and is similar to the representer technique. Although perfectly sound, this approach is expected to be very time consuming. Another generalisation which is not based on the Jacobian matrix (no prior model computation), but on the cost function gradient computation (in a fashion similar to 4D-Var) is also proposed. This way, a fully consistent and justified non-Gaussian assimilation scheme based on MEM, that easily copes with non-linear physics, can be defined. It relies on the retrieval of both the concentration field and the source field. Due to peculiar properties of the MEM approach such as convexity, simplifications occur when deriving the optimality equations from the base cost function.

Forgetting about the inverse modelling point of view, this generalisation rigorously identifies with a weakly constrained 4D-Var with a non-Gaussian implementation of model error (which is actually the source field).

Future plans are to apply and test these schemes on air quality problems: accidental release and photo-chemistry applications.