Atmos. Chem. Phys. Discuss., 3, S1873–S1875, 2003
www.atmos-chem-phys.org/acpd/3/S1873/

Atmospheric Chemistry and Physics Discussions

Interactive Comment

Interactive comment on "Optimizing CO_2 observing networks in the presence of model error: results from TransCom 3" *by* P. J. Rayner

C. Rödenbeck (Referee)

christian.roedenbeck@bgc-jena.mpg.de

Received and published: 11 November 2003

In the context of estimating CO2 surface exchange fluxes based on atmospheric measurements at a set of discrete sites by inversion of atmospheric transport, the paper considers the optimization of the observing network, using a genetic algorithm. Extending existing studies, the optimality criterion is not only based on the a-posteriori variance but also on the spread of results from a range of different transport models. Under this extended criterion, a more diverse network is found to be optimal. This result is interpreted as the effect that the optimal network tries to average out the model spread. The inclusion of insensitive 'null' stations gives a means to check whether an observing network is information-saturated. Particular observing sites are considered in more detail, showing their effect on reducing a-posteriori variance on the one hand, but increasing model spread on the other. Besides the particular results found

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

for the specific inversion set-up chosen, the study discusses their generality for other inversions.

General comments:

The study provides interesting information relevant for a wider class of inversions. The presented methods can be useful both in selecting available data for inverse calculations, and assessment of potential new sampling locations. Scope and methods are explained in a clear and concise way. The paper should be published in Atmospheric Chemistry and Phyics after minor revisions.

Specific comments:

1) I fully accept that the 'between uncertainty' (defined in Eq (2) as the empirical standard deviation of flux estimates across the ensemble of transport models) is an appropriate measure of the model spread for the given purpose. It should be kept in mind, however, that the ensemble of models is by far not a stochastic sample (in particular, not a Gaussian around some truth). As a practical consequence, some different weighting of 'within' and 'between' uncertainties in the 'total' uncertainty seems to be as justified as the equal weighting chosen here. It might be interesting to discuss this a bit, as this weighting would probably shift the threshold in the balance between selecting a site in order to constrain fluxes and rejecting it in order to reduce model spread. Moreover, a remark should be made that errors common to all models will not be taken into account by the optimized network. Such common errors are very likely to exist and to be significant.

2) I like the style of the paper, yet there are a few places that might become even better accessible to readers outside the field:

- The three cases of optimization, termed 'within' etc., should be explicitly defined, e.g. by explicitly stating the link between the different measures of uncertainty on the one hand, and the metric (and the score) used in the genetic algorithm on the other hand.

- The members of the population are said to be defined by a set of integers. It should be explained what the values of these integers mean.

- It seems that the effect of taking an observing site n times means an enhanced quality requirement for that site (reduction of required data uncertainty by $1/\sqrt{n}$). This should be explained in the methods section.

3) The given discussion of robustness of the TransCom3 annual mean estimates specifically referres to the choice of the optimal observing network, not however to the various other aspects of an inverse calculation. To avoid confusion to readers outside the inversion community, this qualification should also be added in the abstract, as any present-day CO2 inversion results (or at least certain features thereof) are of limited robustness with respect to many of the choices that have to be made.

Technical corrections:

In the captions to Figs. 1 and 2, top and bottom panels are referred to by (a) and (b) which is however not defined in the graphics.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 5185, 2003.