Atmos. Chem. Phys. Discuss., 14, C7144–C7148, 2014
www.atmos-chem-phys-discuss.net/14/C7144/2014/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Top-down estimates of European $CH_4$ and $N_2O$ emissions based on four different inverse models" *by* P. Bergamaschi et al.

**P. Bergamaschi et al.**

peter.bergamaschi@jrc.ec.europa.eu

Received and published: 17 September 2014

**reply to Anonymous Referee 2**

We thank the referee for her/his overall very positive evaluation of the manuscript. We have included our replies to the specific comments of the referee below.

**Specific comments:**

*Abstract, line 1: I don't think it's appropriate to describe the models as "independent". There are several shared components between the different inversions (e.g. three models use some variety of ECMWF met fields).*

We will leave out 'independent' (also in the first sentence of the conclusions).

*Page 15687, line 17: should this be ". . . such as European CH4, . . ."*

This will be updated as suggested by the referee.

*Page 15691, line 9: were there any specific reasons why LMDZ-4DVAR "S2" inversions weren't performed? If so, could you provide reasons, otherwise, perhaps this should say that they "weren't available for this analysis".*

We will rephrase this as suggested by the reviewer.

*Page 15691, line 16: give a justification for the use of daytime/nighttime measurements.*

For the stations in the boundary layer the daytime measurements were used when measurements (and model simulations) are usually representative of large regions and much less affected by local emissions. In contrast, for the mountain sites night-time measurements were used to avoid the potential influence of upslope transport on the measurements, which is frequently observed at mountain stations during daytime. This will be included in the revised manuscript.

*Section 3.2 (and results/conclusions): There are many "subjective" choices that have been made throughout this section. For example, correlation length scales, a priori uncertainties, model representation errors, etc. In some cases these appear to differ markedly, for example, the apparent maximum representation error of 1ppm for TM5-4DVAR, but only 30ppb for TM3-STILT. It would seem to me that these choices could explain a relatively large fraction of the observed discrepancies between the models. Perhaps the discussion in the results or conclusions could be expanded slightly to highlight this, in addition to model systematic errors, etc (and suggest ways forward?)?*

For several models the dependence of inversion results on specific settings are described elsewhere (e.g. for TM5-4VAR in [Bergamaschi et al., 2010] (CH4) and [Corazza et al., 2011] (N2O) and for NAME-INV in [Manning et al., 2011]). From the available sensitivity experiments, the preliminary conclusion at this stage is that the specific settings of the individual models can explain only a smaller fraction of the



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inter-model differences observed in this study. Nevertheless, we agree with the referee that further, more comprehensive sensitivity experiments would be useful.

*Page 15692, line 22: Why was this "relaxed" constraint not also needed for methane? Aren't there similar "hot-spots" for CH4 (e.g. the polish coal mines that are mentioned elsewhere)?*

The same 'relaxed' constraint was actually also applied for S2-CH4. This should be correctly described in the sentence ("In the 'free inversions' S2-CH4 and S2-N2O, smaller correlation scale lengths of 50 km, and larger uncertainties of 500% per grid cell and month are used to give the inversion enough freedom to retrieve regional hot spots") .

*Page 15693, line 28: I think this should be "off-diagonal", rather than "extra-diagonal".*

This will be replaced as suggested by the referee.

*Page 15694, line 3: these are only "estimates of transport errors", which are actually unknown.*

This will be updated.

*Page 15694, Line 6: where have the methyl chloroform observations been obtained from? A reference should be given.*

Methyl chloroform observations have been obtained from AGAGE [Prinn et al., 2005] and by NOAA/ESRL [Montzka et al., 2000, 2011]. This is the same data set as used in [Pison et al., 2013]. The reference will be added.

*Page 15699, line 5: ". . .due to fewer models BEING available"?*

This will be updated.

*Page 15701, Line 17: "commonly" instead of "standardly"?*

This refers to the 'standard' EDGAR release products (which does not include the uncertainty estimates)



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