Atmos. Chem. Phys. Discuss., 7, S3452–S3454, 2007
www.atmos-chem-phys-discuss.net/7/S3452/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "What do ^{14}CO measurements tell us about OH?" *by* M. C. Krol et al.

Anonymous Referee #2

Received and published: 26 July 2007

1. Maarten Krol and colleagues build upon previous work in which an estimated atmospheric 14CO source by cosmic radiation and surface measurements are used to derive large-scale concentrations of OH, being the main 14CO sink. The reaction of 14CO with OH is pressure dependent, and to compute a realistic spatial-temporal atmospheric 14CO distribution they used the chemistry-transport model TM5. Krol et al ultimately aim at using the observations to optimise the 14CO distribution and derive global OH fields. As an intermediate step, the present manuscript studies the sensitivity of 14CO measurements to the area around the stations, reflecting the OH concentration during 14CO transport to the station.

Since 14CO concentrations near the surface are very low, measurements are elaborate and difficult so that only few measurement stations are available. One key question

is to what extent the small number of available observations constrains the 14CO distribution sufficiently well to derive OH fields. Since the 14CO source has a maximum near the extra-tropical tropopause, the computed distribution is sensitive to how well the model reproduces stratosphere-troposphere exchange. Furthermore, the 14CO method is sensitive to the fraction of 14C recycled through the biosphere, which must be corrected for, while the spatial information about OH is limited by the transport and lifetime of 14CO, typically a few months, so that especially at high OH concentrations the signal is regional rather than global.

I find the manuscript very interesting, suited for ACP and have only relatively minor comments. If the points below are addressed adequately the manuscript will be acceptable for publication.

2. The TM5 model is a suitable tool to address the issue and a state-of-the-art 14CO source function has been applied. One potential problem that should be discussed in more detail is that the model resolution is rather coarse, being downgraded from 1°/L60 to ˜5°/L25, and especially the representation of stratosphere-troposphere exchange (STE) may be problematic. Coarse grid models typically overestimate STE and this could disperse the 14CO too rapidly from the source region.

3. The abstract is difficult to read and is not very appealing for non-experts in inverse modelling. I suggest deleting the sentence “For our sensitivity calculationsĚ computational advantagesĚ” Especially the last 3 sentences are unclear; please reformulate. Constrain “local” OH? I don’t think so. Possibly “regional” OH, but your method will not replace direct measurements of local OH.

4. Section 2.2 presents the forward model calculations, showing that in middle and high latitudes the model underestimates 14CO compared to observations, whereas the agreement for the tropics is very good. It is conceivable that the 14CO source is underestimated, as stated on p.8. Does this mean that OH during transport into the tropics is too low, hence compensating errors, and leading to good agreement for

ACPD

7, S3452–S3454, 2007

Samoa and Mauna Loa?

5. The use of the adjoint TM5 model to study the sensitivity of 14CO measurements to OH concentrations is a clever application. I am confused though by the remark on p.9 that an adjoint code has been constructed for the two-way nested zoom model. If this is so, why are you not using the zoom algorithm for the regions around the measurement stations? If you do not want to generate the 1° resolution meteorological fields, please do not bring up the two-way zooming option.

6. Figure 3 of adOH is not very informative. I recommend using a 2D lat-lon plot with colour coding to represent the surface adOH field. You may want to use similar coordinates as in figure 4 to prevent misrepresentation of the polar regions.

7. Section 3.2, p.11: What do you mean with “A normal procedureĚ?

8. p.16 mentions “The high local sensitivityĚ” and “...determined locallyĚ”. I propose “regional sensitivityĚ” and “Ědetermined regionallyĚ” to avoid the impression of comparability with in situ measurements.

9. Discussion and conclusions: I recommend adding to section 4 a recommendation about the desirability of additional stations needed to constrain OH in inverse modelling. Even though further studies will be needed to estimate the number and exact location of stations, you have already demonstrated in which regions additional measurements would be useful. Considering the critical issue of 14CO transport modelling, I furthermore suggest discussing the importance of the model grid resolution.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 10405, 2007.

ACPD

7, S3452–S3454, 2007

Interactive Comment