

Interactive comment on “A discussion on the determination of atmospheric OH and its trends” by P. Jöckel et al.

M. Krol

m.krol@phys.uu.nl

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1. Introduction

The article of Jöckel et al. focusses on the determination of global $\langle k.OH \rangle$, which is defined as:

$$\langle k.OH \rangle := -\frac{dM/dt}{M(t)}. \quad (1)$$

The main problem is the determination of the global tracer mass M and its rate of change dM/dt from measurements that are taken at a small number of stations. The number of stations should be limited since the costs that are involved in the collection and analysis of the samples are huge. Here, I will address the role of models. Models

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can provide additional information concerning the expected variability at measurement stations. This information can and should be exploited. In another comment, I will propose a strategy for a Computer Aided Gedanken Experiment (CAGE).

2. Role of Models

Jöckel et al. calculate M and dM/dt by taking a weighted average of the concentrations that are monitored at several measurement stations (their equation 2). In their study this monitoring is done by calculating the station concentrations with a transport model, in which the tracer was released and transported. Since the transport model uses 'observed' meteorology (i.e. output from a weather prediction model), the meteorological variability at the measurement stations is in principle modeled. This meteorological variability will be reflected in simulated tracer concentrations. What is the variability that is expected? For a tracer like Methyl Chloroform (MCF) the main sinks (OH) are located in the tropics and sub-tropics. This means that at a mid-latitude stations like Mace Head, southerly winds will be associated with low mixing ratios, while northerly winds will bring higher mixing ratios. Here it is assumed that there are no significant emissions of the tracer. If the modeled time-series at several measurement stations are integrated to a global mean burden M (see their equation 2), the meteorological variability at the stations will be reflected in M and dM/dt . For this reason, the inferred $\langle k.OH \rangle$ will also be noisy, as shown in their figures 1 and 2. In fact, it seems unwise to aim at monthly $\langle k.OH \rangle$ values because of meteorological variability. Yearly averaged $\langle k.OH \rangle$ values deviate only 2% from the 'true' values, because the variability cancels out when averaged over longer periods. In contrast, Prinn et al. (2001) showed large uncertainties in their yearly OH values that were derived from MCF measurements. A large part of these uncertainties is caused by the fact that their model is not able to simulate the interannual variability that is present in the ALE/GAGE/AGAGE

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time series. In a recent paper, we show (Krol and Lelieveld, 2002) that a consistent MCF inversion is achieved if $\langle k.OH \rangle$ is determined in 3- to 5-yearly periods, whereas hemispheric and yearly estimates are much more noisy. Again, the model that was used employed climatological wind fields and is not able to simulate interannual variability. In conclusion, monthly and yearly estimates of $\langle k.OH \rangle$ are uncertain because of the meteorological variability at measurement stations. This holds for the procedure outlined by Jöckel et al. and also for inversions that employ climatological transport.

A new generation of transport models now uses 'observed' meteorology to drive the transport. Note that the 'pseudo-measurements' that were used by Jöckel et al. were also calculated with such a model. In my experience, these models are much better suited than 'climatological' models to simulate the variability of MCF-like tracers. By scaling the OH fields in such models, $\langle k.OH \rangle$ can in principle be determined without the aforementioned climatological noise. This information from models can and should be used in a tracer release experiment.

What information about the OH level and distribution can we obtain from the release of a MCF-like tracer? Can we obtain hemispheric OH estimates? Can we obtain trends in OH? How many stations do we need and what should be their location? To answer these questions, the proposed Computer Aided Gedanken Experiment (CAGE) can be very useful. However, the CAGE presented by Jöckel et al. uses only a very simple 'model' to aggregate the station concentrations to a global mean. In another comment, I propose an alternative strategy.

3. references

Krol, M. and J. Lelieveld, Can the variability in OH be deduced from measurements of 1,1,1-trichloroethane (methyl chloroform)?, J. Geophys. Res., accepted for publication.