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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "A discussion on the determination of atmospheric OH and its trends" *by* P. Jöckel et al.

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## 1. CAGE: what should be done?

In an earlier comment, I argued that the interpretation of measurements should be done with a model using 'observed' meteorology. However, the same model is used in a CAGE to simulate the tracer release and the subsequent transport. As a result, the simulated 'pseudo-measurements' will be identical to the model results. How can we still learn from such an exercise? I propose to focus on model processes that are uncertain and to investigate how these processes affect the simulations and the derived $< k.OH >$ values. Some examples of the relevant processes and model parameters:

- The hemispheric gradient of OH





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- Stratospheric removal, uptake in the ocean and by the terrestial biosphere
- Transport by sub-grid-scale convection
- NCEP versus ECMWF wind fields
- Model resolution and advection scheme
- Seasonal OH variations
- Sampling strategy: number of stations, column measurements

The aim of these CAGEs would be to quantify how model errors and uncertainties are translated in artificial variations in derived $< k.OH >$ values. A concrete example:

1. pseudo-measurements are calculated at several stations
2. as a first guess in the inversion, the hemispheric ratio of OH is reversed
3. the OH field is re-optimized using the pseudo-measurements and inverse modeling techniques

In the best case, the original OH field (i.e. the OH field that was used to generate the 'pseudo-measurements') is obtained from the inverse procedure. This is not guaranteed, however, since the state of the model (e.g. more OH on the Northern hemisphere) has been translated in the atmospheric concentrations at only a few measurement stations. This means that a lot of information about the model state has been thrown away. With these numerical experiments, much can be learned concerning the optimal placement of measurement stations. Note that this approach differs from the approach described by Jöckel et al.. In that approach the global mean tracer mass is determined as accurate as possible from the station-weighted sum. In the approach proposed



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here, the positions of the stations can be optimized such that they, for instance, allow for an accurate determination of the hemispheric OH ratio.

From the experimental point of view, it would be very important to quantify the following processes that need to be incorporated in the models:

- The rate constant of the tracer+OH reaction, including its temperature dependence
- Photolysis rate (in the stratosphere)
- Uptake by water surfaces, soils, and biosphere

Of course, the uncertainties in these processes should be minimized. In order to quantify the exchange with the stratosphere, it would be advantageous to emit two or more tracers with different lifetimes.

The decline of MCF that is currently observed at the AGAGE stations and at a number of other sites is a well-suited test case for the models. Moreover, if a complete phase out of MCF will be achieved in the near future and if natural emissions turn out to be insignificant, the measured atmospheric decay of MCF can be used to obtain $< k.OH >$. From earlier studies we learned that processes like emissions, transport to the stratosphere, and uptake by water surfaces should be modeled correctly to estimate $< k.OH >$ without systematic errors.



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