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Interactive comment on "Gaseous mercury distribution in the upper troposphere and lower stratosphere observed onboard the CARIBIC passenger aircraft" *by* F. Slemr et al.

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Dr. D. Jaffe

We thank Dr. D. Jaffe for his appreciation of our work. He raises three questions concerning the tests with soda lime trap, the comparison of our measurements with those reported by Talbot et al. (2007a), and the destruction rate calculations using SF6 concentrations.

1. Work with soda lime trap: The soda lime traps were flushed by zero air for 24 hours to reduce the blanks to below the detection limit. By injections of known amounts of elemental mercury their transmission was found to be 100%. Despite of these precautions we had problems with contamination. At the beginning of almost each flight higher

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mercury concentrations were observed for about 30 min by the channel with soda lime trap than the one without. In the monthly sequence of four successive flights, this initial contamination decreased from the first to the fourth flight. This and the fact that the sampling pump is running only above an altitude level of about 5000 m makes a contamination at the airport unlikely. The observed contamination seems to originate from a slow diffusion of mercury from the bulk of the material. Despite of these problems the mercury concentrations downstream of the soda lime trap reached zero values during several sections of several flights, mostly in the stratosphere, suggesting that all mercury measured by the channel without a trap was present as RGM. In summary, we agree that the soda lime trap should be replaced by a better method, such as e.g. KCl trap described by Swartzendruber et al. (2008). We are currently working without any trap but are planning to repeat the experiments with the KCl trap mentioned above.

2. Despite the similar inlet systems Talbot et al. (2007a) report their data as elemental gaseous mercury (GEM) whereas we report our data as close to total gaseous mercury (TGM), i.e. GEM and most of the reactive gaseous mercury (RGM). We think that these statements are both correct and that their apparent contradiction can be reconciled by the different air humidity. The CARIBIC aircraft flies at an altitude of 9 – 11 km in air with a dew point of -40oC and less. For about 96 % of the samples the water content is below 500 ppm. Only for about 2 % of the CARIBIC samples the water content exceeds 1000 ppm. The measurements made by Talbot cover altitudes up to ~7 km with much higher humidity. Thus the conditions of our measurements are similar to those made in Antarctica for which Temme et al. (2003a) demonstrated that RGM passed through the inlet system whereas those of Talbot et al. (2007a) are similar to that encountered at ground stations outside of polar regions for which substantial losses of RGM in inlet tubing were reported. The tenacity of water layers will probably cause a delayed and gradual switch from a zero transmission of RGM in a humid air to a higher transmission in dry air. Consequently, during the short flights at varying and lower altitudes the water memory effect of the inlet tubing may never allow RGM to pass.

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3. Almost all trace gases with a lifetime on the order of 0.1 – 10 yr with sources predominantly in the troposphere or in the stratosphere show pronounced gradients in the lowermost stratosphere: decreasing concentrations with increasing altitude for CO and other gases with sources in the troposphere and increasing concentration of O3 with its major source in the stratosphere. Plots of O3 vs CO show a linear relationship resulting from the mixing of tropospheric and stratospheric air (Zahn et al., 2002). To each air parcel in the lower stratosphere a spectrum of residence times after leaving the troposphere can be attributed. To calculate the average residence time we used SF6, a substance with an atmospheric lifetime on the order of 6000 yr, whose concentration increased by 0.230 ppt yr-1 during the last decade (Stiller et al., 2008). As SF6 is almost inert both in the troposphere and stratosphere, its gradient in the lowermost stratosphere is given solely by mixing and its concentration can be used to determine the average stratospheric residence time of the air parcel. The calculated depletion rate would represent a net rate in case that a reverse process occurs simultaneously. The absence of zero TGM concentrations suggests that a reverse process might exist. We are not aware of other inherent assumptions. But we would like to note that our calculation of the depletion rate is only a first approximation because of the limitations mentioned in the text. We hope that the improved precision of the SF6 analyses and additional data from the flights made after March 2007 will provide better information about the depletion rate, its variability and the parameters governing it.

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