

Interactive comment on “Atmospheric observation-based global SF₆ emissions – comparison of top-down and bottom-up estimates” by I. Levin et al.

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I read the paper with interests, and the global total emissions are found to be suitable for global scale chemistry-transport model (CTM) simulation of atmospheric SF₆. To check whether the estimated emission trends and variability are in better agreement with the observation compared to those in EDGAR4.0 database, I simulated SF₆ concentration using an atmospheric general circulation model (AGCM) based CTM (ACTM; Patra et al., 2009). The ACTM transport set up is identical to Patra et al. (2009) and run for the period of 1988-2008. Two SF₆ emission scenarios are used here: 1. based on EDGAR (2009) for the period of 1988-2005 (extrapolated for 2006-2008 pe-

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riod using 2004 to 2005 emission increase rate), and 2. the EDGAR (2009) emission distributions for each year scaled using global emissions, as estimated by Levin et al (2009).

The model observation comparisons for the period 1990-2008 are shown in Fig. 1a for two selected sites with longest measurement record of atmospheric SF₆ (top panel), namely, Cape Grim, Australia (CGO) and Alert, Greenland (ALT). In the bottom panel (Fig. 1b), comparison of SF₆ growth rates are shown. Note here that the ACTM estimated growth rates are obtained by subtracting the concentrations 12-months apart, i.e., the growth rate on 1 July 2000 is the difference between monthly-mean concentrations in December and January of 2000, which different from the digital filtering technique employed by Levin et al. (2009).

While the simulation using EDGAR (2009) emissions fairly reproduce the SF₆ growth rate over the period of 1990 and 2008, systematic over- and under-estimations are found prior to 1993 and post-2000 (Fig. 1b). These systematic differences in growth rate are not seen when the EDGAR (2009) emissions are scaled to Levin et al. (2009) global totals. However, the latter seems to under-estimate growth rate during the post-2006 years.

Over the 1990-2008 period, the ACTM simulated concentrations attained slightly lower values (6.13 and 6.23 ppt for two emission cases) than the observed concentration of 6.38 ppt at CGO. It is difficult to ascertain whether this overall under-estimation is caused by model transport error with the help of single CTM simulation, but hopefully will be better addressed in a multi-CTM framework as proposed in TransCom-CH₄ (Patra et al., 2009a).

The other issue that remains uncertain is how to estimate regional emissions or emission trends using presently available measurement network. While this paper is a fine contribution to this field of research, future work should be directed towards reducing the uncertainties in regional emission estimations.

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References

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Figure captions

Figure 1: Timeseries of SF₆ concentrations (a; top panel) and growth rates (b; bottom panel) as measured by Levin et al. (2009) and ACTM (Patra et al., 2009) at two sites, namely Alert (ALT; 82.5°N, 62.5°W) and Cape Grim (CGO; 40.7°S, 144.7°E). Note that the error bars representing measurement uncertainties (~0.02 ppt) are mostly smaller than the symbol size. The ACTM simulation cases using EDGAR (2009) emission and

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that corrected using Levin et al. (2009) global trends are denoted by ACTM/EDGAR4 and ACTM/EDGAR4/Levin, respectively.

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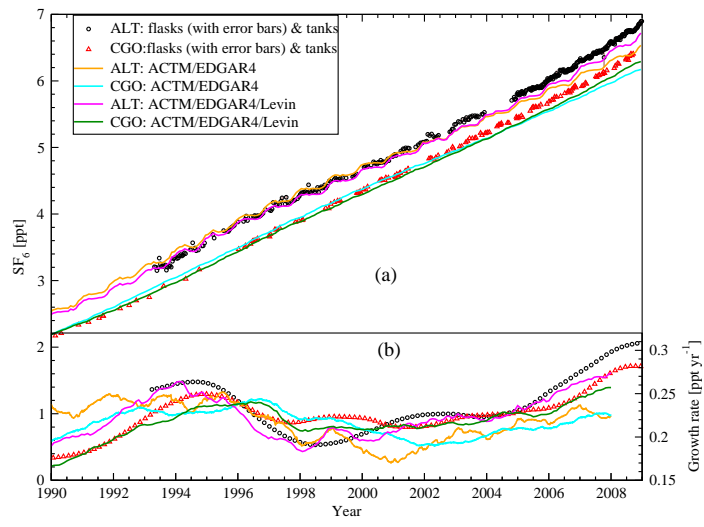


Fig. 1.

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