

Black: referee's comments red: authors' answers

First, we want to thank the referee for the detailed analysis of our paper.

For the details, please look into the paper with keeping track of changes.

The manuscript “Ground-based FTIR retrievals of SF₆ at Réunion Island” by Minqiang Zhou et al. describes a 12-year time series of SF₆ column measurements in the troposphere and lowermost stratosphere. Given the scarce observation pool of SF₆ in general and its significance as a purely anthropogenic extremely long-lived greenhouse gas with a huge global warming potential, this is a very valuable data set. The authors derive an SF₆ trend from their own observations as well as a comparison with two satellite datasets and one set of near-surface in-situ observations in the tropics.

The manuscript is well written and describes the data sets and the retrieval parameters and error budgets for the SF₆ time series that were used in the study. To calculate trends from each dataset, a linear model with periodic (seasonal) components is applied. The resulting trend estimates are close but not identical. This is explained by different vertical and latitudinal coverage of the used datasets.

General comments:

1. One criticism that I have is the misuse of tense throughout the manuscript. Practically all of the text is written in present tense. However, the convention for scientific writing is that past tense should be used for reporting the authors' observations and results while present tense is reserved for well-known facts and cited results from the scientific literature. Please refer to guidelines on the internet such as <https://www.nature.com/scitable/topicpage/effective-writing-13815989>.

Corrected.

2. I also think that there should be a map that shows the locations of the ground based observations as well as the latitude bands covered by the satellites.

Added (see Figure 4).

3. Given the fact that the SF₆ spectral line is weak and the retrieval depends on the SMO observations for prior information, the significance of the derived trend(s) should be better scrutinized. Please have a look at the methods developed by Weatherhead et al., Factors affecting the detection of trends: Statistical considerations and applications to environmental data, *J. Geophys. Res.* 103, 17149- 17161, 1998, doi:10.1029/98JD00995. This has been the standard method for establishing trends in atmospheric components for years. Apply the method to your results as much as possible. At least, add some discussion on the significance of the trend you found based on the well-established Weatherhead et al. method.

The trend methodology in this study is same as the Basic Statistical Modeling in Weatherhead et al, 1998. I added this reference in the text.

Minor comments:

• p. 2, l. 34: “SMO” has only been defined in the abstract so far, which is not a good place for an acronym definition. Please re-define here at the first use in the main text.

Corrected.

• p. 3, l. 16: “. . . signal to noise (SNR).” → “. . . signal-to-noise ratio (SNR).”

Corrected.

• p. 3, l. 27: “. . . contains an extra weak H₂O absorption line . . .”? Do you mean “extra weak” as in “very weak” or as in “an additional weak line”?

I mean “an additional weak line”, corrected.

• p. 4, l. 25: what is the typical tropopause height at Maïdo? Is the 20 km range a fixed value or basically defined by the troposphere height?

The typical tropopause height at Maïdo is 16-17 km. Added in the text.

20 km range is a fixed value from the averaging kernel of the FTIR SF₆ retrieval.

• p. 5, Eqns. 2 & 3: do not use “retrieval parameter error” in an equation. Give it a proper mathematical symbol like ϵ_r or similar and provide a definition (“The retrieval parameter error ϵ_r is defined as . . .”). Then use the symbol in your equations.

Corrected.

• p. 6, l. 2: why did you chose 5%? Why not more or less? Where does your information on the error distribution of the SF₆ profile come from?

The SF₆ is constantly increasing during last two decades, with the annual growth of ~3.0%. As the SF₆ a priori profile is fixed and scaled to the in-situ measurement in the year of 2009, we assumed that there is no systematic error for 2009, but 3% for 2010 and 2008; 6% for 2011 and 2007; 9% for 2012; 12% for 2013; 15% for 2014 and 2004; 18% for 2016. After taking the number of measurements as the weighing function, the mean value is about 5%. Therefore, we apply 5% as the systematic uncertainty of SF₆.

• p. 6, l. 8: Do not use “retrieval parameter error” in italics. Use symbol or spell out in the same typeface as the rest of the text.

Corrected.

• p. 6, l. 13-21: most of the parameters and acronyms used here (zshift, ILS, Pseudo database) are defined somewhere around Sec. 2.1, about 3 pages further up in the manuscript. Could you please provide these definitions closer to the point in the manuscript where they are actually used for the first time?

Corrected.

• p. 8, l. 20: “. . . is about 0.4 years greater than . . .” → “. . . is about 0.4 years higher than . . .”

Corrected.

• p. 8, l. 24: “. . . has much more data points . . .” → “. . . has many more data points . . .”

Corrected.

• p. 8, l. 28: “. . . decreasing above tropopause, . . .” → “. . . decreasing above the tropopause, . . .”

Corrected.

• p. 10, l. 2: “. . . is not public available yet.” → “. . . are not publicly available yet.”

Corrected.

• p. 10, l. 5: “. . . are public available ftp://. . .” → “. . . are publicly available at ftp://. . .”

Corrected.

• p. 16, Fig. 2: please add a close-up view of the SF₆ line as it is not really visible in the spectral overview.

Added.