

## Reply to reviewer #3

We thank anonymous reviewer #3 for his/her additional comments on our revised draft. The review comments by anonymous reviewer #3 are numbered and repeated below *in italic letters*, followed by our answers. In the re-revised draft with corrections (supplement file), **red text** are the revisions suggested by reviewers #3.

<<Reviewer #3>>

<3-1> *The authors have been very responsive to the reviewers' concerns in preparing their revised manuscript. I have only one additional issue that I still think requires attention:*

Thank you for your very positive assessment of our response.

<3-2> *Discussion of seasonality still needs improving to have it more accurately reflect what is presented in Figure 8. Figure 8 shows seasonal changes at Rik that are hardly outside the uncertainty bars displayed, and the discussion at one point focuses on substantial increases from March to May that aren't outside the uncertainties displayed in Figure 8. Results for only a few months (Dec, Jan, Feb) appear outside 1-sigma s.d. This then leads to the extended discussion of the possibility that emissions (and their transport) are responsible for the summertime elevations.*

Perhaps we need to clarify the meaning of the 1-sigma s.d. in Figure 8. The 1-sigma s.d. in Figure 8 represents the year-to-year variability for each month, not the uncertainty of the measurements. The text was modified to “with large year-to-year variability (+/- 15-20%) for each month” to more clearly explain that the 1-sigma s.d. represent the variability among different years, not the measurement uncertainties. Although the standard deviations of mean values overlap with zero line in many months in Figure 8, the standard errors of mean values are much smaller by a factor of 3 to 4. It indicates the mean seasonal cycle is outside the uncertainties. We also modified the sentence for the cause of the spring-summer peak to “the peaks at Rikubetsu during spring-summer were affected by enhancements due to atmospheric transport from a region emitting HFC-23”.

<3-3> *Results at Ochiishi are only somewhat useful to the reader at this point, but could be made much more informative. This is because they haven't been presented with respect to the seasonality they suggest. Why not a simple analysis of the seasonality there to see if it approaches +/-10%,*

as may be suggested at Rik if uncertainties in retrievals there are ignored? If Ochiishi ground-based results don't show a seasonality like is observed in the total column, the authors could still argue that perhaps Ochiishi isn't seeing the total column incursion of emissions from the east.

We analyzed hourly Ochiishi HFC-23 data for the open data period between 2006 and 2010, and took a detrended monthly mean, which is shown in Figure 3-1 below. Each year's data are plotted in dotted lines, while the average is thick green line with 1 $\sigma$  standard deviation in broken purple line. As you notice, the ground-based Ochiishi data also show peaks during spring-summer months in May, June, and July. This supports our FTIR analysis which has elevated values between April to July as shown in Figure 8.

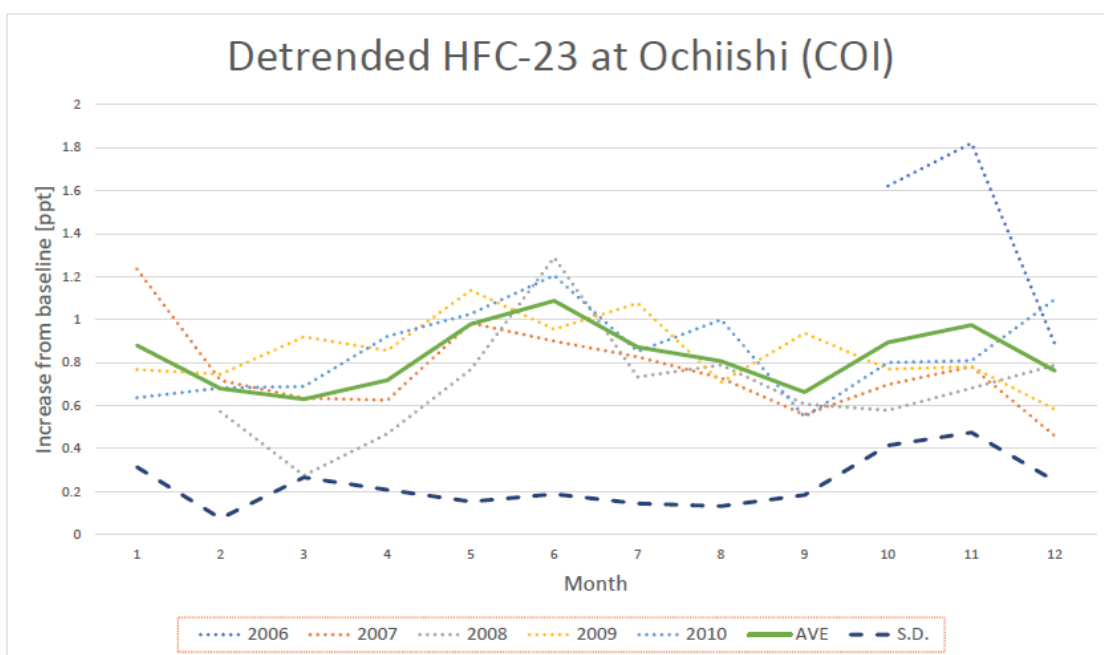


Figure 3-1. Detrended monthly mean HFC-23 data at Ochiishi between 2006 and 2010.

<3-4> At Syowa, it is argued fairly strongly that seasonality is not present. In retrieved info, despite a mean seasonal variability apparent in Figure 8 that is quite similar to Rik in most months, and visible uncertainties that appear to be smaller than at Rik, on average. But at Syowa in Figure 8, results aren't shown for all months (Jan, Feb, Jun appear to be missing), and uncertainties are not apparent for many other months. Perhaps there aren't enough data to describe the seasonality at Syowa? Some clarifications and reconsiderations are warranted.

We added January 2008 HFC-23 data (which was not used in the analysis in the previous draft due to a technical issue) for Syowa Station in the analysis, and Figures 2, 5, 6, 7, 8 were modified. In the new Figure 8, data for February and June are still missing, and there are no 1-sigma s.d.

bars in January, May, July, and August because there is only one year monthly average data available. Nevertheless, seasonal variation is not so apparent in the case of Syowa Station. This point is modified in the text in Section 5.2 to “At Syowa Station, where there are no observations in February and June and only one year of observations for January, May, July, and August, ...”. We also improved the caption of Figure 8 accordingly.