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Atmospheric Measurement Techniques Discussions

Interactive comment on "Relative drifts and biases between six ozone limb satellite measurements from the last decade" *by* N. Rahpoe et al.

Anonymous Referee #1

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This paper performs an analysis in order to derive the relative biases and drifts between six satellite ozone data sets. The analysis is performed via a regression of difference profiles of coincident measurements between instruments. The paper goes on to categorize the various biases and drifts between the different instruments (depending upon which instrument is considered the reference instrument) as well as the statistical significance of the results. A cursory comparison to analogous work is also made. Overall, this paper presents a wealth of data along with some higher level conclusions regarding the stability of the different data sets. However, I do have a few questions/concerns regarding this paper.

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Discussion Paper

1 Major Corrections:

Why is Eqn. 1 written as $\delta_i(z) = 2(x_c - x_r)/(X_c + X_r)$? Firstly, I imagine you really mean x_{ci} and x_{ri} instead of x_c and x_r for proper notation. Secondly, however, why do you use average profiles X_c and X_r instead of the actual profiles for that coincident pair (x_{ci} and x_{ri})? Dividing by the overall average (instead of the instantaneous average) skews the fractional difference and biases the drift term if the data itself has a trend. The equation should really be: $\delta_i(z) = 2(x_{ci} - x_{ri})/(x_{ci} + x_{ri})$. To better illustrate this point, imagine you have two datasets: a reference instrument 'A' and a second instrument 'B' that always measures the value for 'A' but lower by 10%. Now imagine that the ozone values are increasing with time at a rate of 2% per decade. If one were to compute the δ's using the correct equation and regress, one would find a bias term of approximately -10% and a drift term of 0%. However, if one were to use the equation in the paper, one would find δ's with a slightly smaller negative value at the beginning of the period and a slightly larger negative value at the end of the period and the regression analysis would create a bias of approximately -10% and a drift of approximately -0.2% per decade. This crude example illustrates how not using the instantaneous mean biases the drift term. The same is true of the seasonal cycle. While this is generally less important since the results of the seasonal cycle are not analyzed in this work, any bias in the seasonal sampling of the locations of coincident pairs could alias into the drift term.

Is an autocorrelation correction considered in your regression model? If not, the reported uncertainties will be biased low. If so, how is it applied and how are data gaps accounted for?

Page 3706, Line 24: "Most probably, this is due to diurnal ozone variations." What are the diurnal sampling characteristics of each instrument? Are there biases in the observed diurnal cycle of each instrument? Is there a bias in the difference of the local solar times of coincident pairs? This is mentioned again on page 3709, line 08 as a

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reason for drifts. However, additional analysis is required before identifying this as the definitive cause.

2 Minor Corrections:

Page 3701, Line 11: “The vertical resolution of GOMOS is 2 below 30 km and 3 above 40 km . . .” I assume you mean 2 km below 30 km and 3 km above 40 km.

Page 3701, Line 14: “The outliers and invalid data have been removed by using the data recommendations.” Reference?

Section 2: Is data filtering applied to the different data sets? If so, where do these filtering criteria come from?

Section 2: What is the natural measurement of each instrument (e.g., number density on altitude or VMR on pressure)? This is listed for some but not all of the instruments used. How are non-conforming data sets converted to the same units?

It seems as though the regression model is applied separately for each altitude and latitude band. However, Section 3 does not specifically mention that the regression is applied in separate latitude bands or what those bands are. This should be added to the paper.

The legends for Figures 1-3 get in the way of the data. This should be cleaned up. Additionally, I would recommend removing the boxes around legend items.

The size of the text for Figure 4 is too small and will be very difficult to see in a final paper format.

The size of the text for Figures 5-10 is also too small. I also think that the figures will be very difficult to read in final paper format. However, given the information content the authors wish to display, I do not know if there is a better way to do this. Additionally,

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while the uncertainties in the various biases and drifts are important, perhaps a plot showing the significance level would be more appropriate since this is what the authors talk about in the results more than the actual values of the uncertainties. It would also make it easier for the reader to immediately see what results are and are not statistically significant.

3 Grammatical Corrections:

Page 3704, Line 10: “SD” should be expanded to “standard deviation”

Page 3706, Line 07: The “3” in the parenthesis should read as “Fig. 3”

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 3697, 2015.