

Interactive comment on “Annual variation and global distribution of strato-mesospheric carbon monoxide measured by ground-based Fourier Transform Infrared spectrometry” by V. Velazco et al.

Anonymous Referee #1

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This paper presents long-term time series of strato-mesospheric CO retrieved from ground-based Fourier Transform Spectrometer spectra measured at 6 different sites at different latitudes. These time-series are compared to the results of a global 2-dim chemical transport model and in general a good agreement is found. Furthermore, the authors discuss latitudinal differences in the observed seasonal cycle and they highlight a feature observed in late summer at high-latitude, which they call the ‘summer bulge’.

General Comments: Long-term measurements of strato-mesospheric CO are certainly of interest to the readers of ACP. However, the overall intention of the authors is some-

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what unclear. On the one hand the description of the instrumentation and retrieval is way to short for a data paper. On the other hand, the scientific discussion of the datasets itself is very superficial. I believe that this manuscript can be a valuable contribution and should be published in ACP, if thoroughly rewritten any my criticisms and comments are taken into account.

My major criticisms are:

The presented study is poorly motivated. What is the intension of this study, what are the open scientific questions and how does this study contribute to solve them?

The authors do not put their results in context to other studies. The results and conclusions sections do not mention any other publication of middle atmospheric CO. The discussion of the results should make clear what is verification of existing knowledge and what are new findings. Also, please discuss how your results compare to other studies, e.g. the ones mentioned in the introduction or from the list of additional references given later.

The instrument section does not provide sufficient information about the used instruments and retrieval techniques. At a minimum you should add some information about the spectral range, spectral resolution and signal-to-noise. Also you should make clear that these instruments are Fourier Transform Spectrometers that they measure direct sunlight from the ground. Regarding the retrieval, you should mention that you use the optimal estimation technique and give some information about the used a priori constraint (a priori profiles and covariance). How many vertical levels have been used? Also, it would helpful to explicitly mention the microwindows and the interfering gases.

Finally, the authors have to include error bars and an error discussion. Please provide errors for your retrieved CO columns and discuss the different error components. How large are the smoothing errors or the noise errors? What are the potential biases due to uncertainty in spectroscopy?

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Specific comments:

p. 7123: Discussion of figure 1. For some cases, the kernel for the 18km to 85 km is not perfect... What is the cause for these differences? For which cases do you get a kernel close to unity? Please include such a case in Figure 1 as well.

p. 7124: Discussion of Figure2. Does each of the blue dots represent an individual measurement? What is the reason for the small amount of datapoints, e.g., there is only a single datapoint for spring 2004 from Ny Alesund. I feel that it is an overstatement to argue that model and measurements agrees very well for northern high-latitude. There is only a small number of datapoints from the Ny Alesund site and the comparison for the Kiruna site shows significant differences. For Arrival Height, the authors claim that the winter maximum is higher in the model. However, the FTIR instrument does not provide any measurements in winter and the observed discrepancies could also be explained by a phase shift. Bremen and Lauder comparison: What do you mean by \check{E} lesser values over Lauder. Lesser than the observations or lesser than for Bremen? Also you argue that the comparison with the model is very good for both places. I would argue that the model constantly overpredicts the Lauder observations and that it underpredicts the 2003 observations at Bremen. In summary, the comparison between model and measurement should be done more carefully and more quantitative, e.g. correlation plots would nicely reveal potential biases. Also without any information about errors, it is difficult to assess if the measured and the modeled results agree well or not.

p. 7125: From the average curves shown in Figure 4, the authors argue again that the maximum CO is larger in the Arctic compared to the Antarctic. Only Kiruna provides measurement of the peak CO values. For all other sites, measurements are only available for spring and fall and I do not believe that you can make this statement.

Technical comments:

p. 7119: The title is very misleading. The authors do not present a global distribution,

but only measurements at 6 different sites (e.g. no tropical site).

p. 7120: Comparison with different model scenarios... -> Comparison with two model scenarios

p. 7120: ...larger seasonal variation than anywhere... variation in what ?

p. 7121: ...Farmer et al. (1980); Zander et al., (1981)... change order of references

p. 7122: ...(see also Rinsland et al.(1998). -> ...(see also Rinsland et al.(1998)).

p. 7122: ... developed by Hase (2000) -> Hase (2002)

p. 7122: A detailed description and comparison of both retrievals are shown in .. -> A detailed description and comparison of both retrieval algorithms is shown in

p. 7123: ...extending from -85.3S to 85.3N... -> I assume that the model extents from -90S to 90N and the given values are centers of grid-points?

p. 7124: ... Arrival heights station... -> Arrival Heights station

p. 7125: Note that Kiruna is often at the edge of the polar vortex. Do you mean the wintery polar vortex? If so, how does this affect the summer bulge ?

p. 7126: The Lauder data do not show the very high values of strato-mesospheric CO. -> to what do you refer here ??

p. 7126: Figure 6 shows that the tropospheric CO₂ does not influence the strato-mesospheric CO. -> Isn't this already clear from the averaging kernel shown in Figure 1?

p. 7128: Dupuy et al. reference: Strato.mesospheric... -> Strato-mesospheric...

p. 7130: Figure1 looks very stretched

p. 7132: Figure 3: Please increase the distance between the panels so that the x10¹⁶ does not print on the next panel

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p. 7133: On my print-out, it looks like you have used different fonts in the legend. The larger number of data points make the thin line with symbols just look like a thick line. Maybe you want to use a consistent to display the data from the 4 different sites.

p. 7135: Figure 6: Please increase the distance between the panels so that the $x10^{18}$ does not print on the next panel

Additional References you might want to include:

Lopez-Valverde et al., GRL, Vol 20, No 12, 1993

Lopez-Valverde et al., JGR, Vol 101, No D6, 1996

Aellig et al., JGR, Vol 100, No D7, 1995

Allen et al., J. Atmos. Sci., Vol 56, 1999

Dupuy et al., GRL, Vol 31, 2004

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