

Interactive comment on “Carbon monoxide mixing ratios over Oklahoma between 2002 and 2009 retrieved from Atmospheric Emitted Radiance Interferometer spectra” by L. Yurganov et al.

Anonymous Referee #2

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CO mixing ratios over Oklahoma between 2002 and 2009 are derived from AERI spectra. The retrieval is improved rel. to earlier versions, the errors of the retrieval method are analyzed, and the AERI results are compared to aircraft, ground-based, and satellite measurements. A geophysical discussion on diurnal and annual cycles in the boundary layer is given. The paper is well written and should be published after revision.

Points of criticism

1. An important result of this work is that the AERI CO retrieval is strongly affected by water vapor cross sensitivity. This has been recently shown even for the CO retrieval

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from high resolution ground-based solar FTIR spectra. Please make reference to the following work: Sussmann, R., and T. Borsdorff (2007), Technical Note: Interference errors in infrared remote sounding of the atmosphere, *Atmos. Chem. Phys.*, 7, 3537–3557.

2. In an attempt to minimize water vapor interference, the authors use PWV retrieved by WMV because they assume this to be a good proxy for true PWV. However, using “true” values in the forward model is no guarantee to get rid of interference errors: spectroscopy of interfering water lines is never perfect and even using true PWV, spectral residuals are present in the vicinity of the target (CO) lines causing an interference effect. This effect can be reduced by jointly retrieving H₂O rather than fixing it to a “true” value that is not consistent with the measured spectrum given spectroscopy errors. Jointly retrieving water vapor helps to reduce the water vapor residuals, while possibly getting slightly unphysical retrieval results for PWV, which is no problem because PWV is not the target of the retrieval. We suggest that this possibility shall be investigated for further, possibly significant, improvement of the AERI CO retrieval. See Sussmann and Borsdorff (2007) for details.

3. The following sentence should be removed from the abstract. "Essentially, the new algorithm retrieves a CO mixing ratio that is determined by the convolution of the a priori profile (assumed to be constant with altitude), the true profile, and the averaging kernel which maximizes near the surface." (abstract, l 5 – 10) The convolution of the true profile with the averaging kernel matrix is a linear approximation of the retrieval but not a description of the retrieval itself.

4. There is a difference of about 12% between the AERI v2 retrieved profile and the “true profile” convolved with the averaging kernel in Fig. 2. This means that the averaging kernel is not able to sufficiently describe the actual retrieval. The averaging kernel overestimates the sensitivity of the AERI v2 algorithm. The reason for this should be explained in detail. The same difference is found in Fig. 8. Possibly this inadequate averaging kernel results from the influence of water vapor errors on the CO retrievals.

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This would be in line with the fact that negative bias in Fig. 8 is higher with the AERI v1 retrieval (as mentioned in the text).

Technical corrections

5. "contibuting" -> contributing (Introduction, p 1265, l 27)
6. The label for the averaging kernel line is missing in the legend of Fig. 2. This figure can be enlarged when the legend is placed into the right corner of the plot area.
7. The vertical distance of the x-axis description in Figs. 3a and 3b differs
8. Enlarge Fig. 6

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