

Interactive comment on “Long-term evolution and seasonal modulation of methanol above Jungfrauoch (46.5 N, 8.0 E): optimisation of the retrieval strategy, comparison with model simulations and independent observations” by W. Bader et al.

Anonymous Referee #2

Received and published: 6 June 2014

This paper describes a dataset of methanol measurements obtained from an FTIR instrument at Jungfrauoch in Switzerland covering the 1995 to 2012 period. This is an interesting and important analysis, as there are few long time series of methanol, and there are still large uncertainties in its sources and sinks. The paper presents a nice balance of a detailed description of the methods used and some insight into seasonal variability of methanol at this location. By using two spectral windows rather

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than one the authors have been able to increase the typical Degrees of Freedom for Signal (DOFS) from 1.0 to 1.8, thus allowing for characterization of not just the total column but also partial columns.

The paper fits very well into the topics covered by Atmospheric Measurement and Technology. It is interesting and well organized, though slightly unclear in some spots. It should be accepted with the minor issues listed below addressed.

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Line 17: combined with

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Line 20: Is the solar signal really significant for these ground based IR measurements? Could the authors estimate the error incurred in CH₃OH if the solar signal is ignored?

Line 28: Please explain in the text what a synthetic spectrum at 6.1 mK means.

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Line 13: Is the 98% absorption for O₃ reported in the “1037” window along a nadir or slant path? If it is a nadir path, then I would expect that along the long slant paths used for these observations that this window would become entirely opaque. Since evidently reasonable CH₃OH retrievals are obtained, this does not happen. Could the authors explain? Is this due to the sufficient spectral points located between the O₃ lines to allow for detection of the broad CH₃OH feature? If so, the authors could highlight the importance of the high spectral resolution of the FTIR used.

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Line 12: The total estimated error is frequently written (Worden et al., 2004) as the sum of smoothing errors, measurement errors (due to spectral noise) and finally systematic and random errors due to uncertainties in both fixed parameters (such as spectral properties) and parameters that change from observation to observation but are not

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retrieved (e.g., temperature). The authors have calculated systematic and random errors (as shown in Table 1), but it is not clear which, if any, were included in the total error estimate shown in Figure 2. I believe they should all be included, but am willing to see counter arguments.

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Lines 1-6: This discussion on the evaluation of the uncertainties in the O3 line parameters is confusing. It appears that since a 10% uncertainty in the O3 line (intensities??, please clarify) leads to poor O3 (please confirm) retrievals, then 10% is too high an estimate, and 5% was chosen instead, but 5% does not appear in Table 1.

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Line 1: do not

Line 23: which showed substantially

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Line 17: considered sufficiently

Line 25: The sentence starting with "Even" needs to be broken up and rewritten, it uses "respectively" too many times.

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Line 15: Where is it shown that the IMAGES model fails to reproduce the observed diurnal variation?

Line 25: In Fig. 6

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Line 4: Neither of the IMAGES

Line 10: You cannot state that the seasonal amplitude of the in situ measurements ap-

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pears to be significantly lower than the signal from the FTS, as there are no in situ data in June and July, when the summer peak occurs. I do not agree with this statement.

Line 14: Sentence starting with "Indeed is too long and cumbersome.

Line 25: Is there an inconsistency here? How can the methanol variability be underestimated by IMAGES if the seasonal cycle is not significantly different: similar peak to peak variability and insignificant fractional difference; in the text it says -6 and +1, but Figure 7 shows much greater values for March and April.

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The authors may want to suggest that this dataset be used as a validation set for satellite data.

Figures: In general I am not sure the pink background makes for clarity. I will leave it to the editor to decide.

Figure 1: Hard to see, needs to be larger.

Figure 5: What are the three blue lines?

Reference for review:

Worden, J., Kulawik, S. S., Shephard, M. W., Clough, S. A., Worden, H., Bowman, K., and Goldman, A.: Predicted errors of tropospheric emission spectrometer nadir retrievals from spectral window selection, *J. Geophys. Res.*, 109, D09308, doi:10.1029/2004JD004522, 2004.

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