

***Interactive comment on “Formic acid above the
Jungfrauoch during 1985–2007: observed
variability, seasonality, but no long-term
background evolution” by R. Zander et al.***

Anonymous Referee #2

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General Comments:

This paper presents a new 22-year data set for formic acid total vertical columns over the Jungfrauoch, as determined from solar absorption spectroscopy measurements. The analyses have implemented the newest spectroscopic line intensities for formic acid and the authors have made a thorough comparison of their results to previous measurements. The seasonal and diurnal variations in formic acid have been investigated using this data set and no statistically significant long term trend was observed.

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This work is definitely appropriate for publication in ACP after revisions to address the comments below. This paper provides a detailed description of this new data set and a very thorough review of the earlier in situ and remote sensing observations of formic acid. Both are a useful contribution to the scientific literature.

Specific Comments:

Pages 14779-14780. Section 4 describes the retrieval details for the formic acid analyses. However, I found that this part did not include any discussion of the sensitivity and the information content of the retrieval. I recommend this be added to the paper to give the reader a clearer understanding of the data product. Also, it would be instructive to include a few more details (or a reference or two) on the error analysis methods.

Page 14781, Lines 14-15. Were specific criteria used for eliminating outliers? If so, this should be described. With the density of points in Figure 2, it was difficult to see these example points to figure out the criteria used.

Page 14783, Lines 16-21. It would be helpful if the authors could provide an uncertainty estimate for their values obtained from the fits of the AM and PM data for each month range for this part of the discussion.

Page 14784, Lines 23-26. It was a bit unclear which of the previous references this information was taken from. It should be rephrased to make it clearer.

Page 14796, Lines 27-29. The Hartmann et al. (1989) results seem not to be included in Table 4. Is there a specific reason to omit this work from the tabulation?

Page 14810, Table 4. Here it was nice to see all of the formic acid results presented together. However, it was unclear what uncertainties were presented in the table. The authors should be clear in specifying if these are 1-sigma standard deviations, fitting errors etc. It would be helpful if the location of the MIPAS-B2 flight was listed here and in the text. It was not clear to me what "partim." refers to in the PEM-west and SCISAT row entries. Also, should the Jungfrauoch comparisons with the PEM flights be listed

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with the 2-7 or 7-12 km results?

Technical Corrections:

Page 14772, Line 6; Page 14780, Line 5; Page 14786, Line 15. The paper uses two numbers for the total number of days included in the dataset. It appears that at first there were 1537 days and this was reduced to 1501 days after filtering based on the quality of the spectral fitting. I think that a consistent number should be used to describe the dataset used in the analyses while providing the details of how many spectra were not of suitable quality.

Page 14776, Line 26. The word stratospheric is repeated twice in this sentence.

Page 14776, Line 22; Page 14797, Line 10; Page 14810, last line of table. A consistent acronym should be used for SCISAT.

Page 14777, Lines 14-15 and 22. Dashes should be removed when commas are used.

Page 14778, Line 13. An "and" is missing between final two citations.

Page 14779, Lines 17 and 27. Two and six should be used instead of 2 and 6.

Page 14780, Line 26. Suggest "...in Fig. 2a, while Fig. 2b...".

Page 14782, Line 4; Page 14784, Line 22; Page 14787, Line 26. The quarterly averages are defined explicitly always for J-J-A and sometimes for N-D-J but never for S-O-N. This should be done consistently through the paper.

Page 14783, Line 17. Suggest "shown" instead of "featured".

Page 14785, Line 6. Suggest "obtained" instead of "performed".

Page 14772, Line 9; Page 14785, Line 17; Page 14785, Line 17; Page 14810, Table 4. Use "time-coincident" rather than "timely".

Page 14786, Lines 16-18. Suggest rephrasing for clarity. "... has allowed various aspects of the free tropospheric loading of formic acid (HCOOH) to be characterized
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above the ...".

Page 14786, Line 23. "two-step" rather than "two-steps".

Page 14788, Line 8-10. I am not sure what is really meant in this statement by "re-actualized". It should be made clearer.

Page 14788, Line 17. should be "...to achieve optimal complementarity...".

Page 14790, Line 6. Here "trough" should be "through".

Page 14791, Line 1 and 23. Minimum and maximum should not be abbreviated here to be consistent with the rest of the paper.

Page 14791, Lines 11-15. The measurement method should be mentioned to ensure that the reader is clear on the technique being discussed.

Page 14791, Line 19. Should this be "chaotic" rather than "cahotic"?

Page 1472, Line 29. Acronym PEM should be defined at first usage.

Page 14793, Line 6. "cruise" rather than "cruse".

Page 14794, Lines 8-11; Page 14797, Lines 3-5. These statements should include a reference to the Jungfraujoch location to be clearer to the reader.

Page 14794, Lines 15-19. The location of the MIPAS-B2 measurements should be included in the discussion here.

Page 14795, Line 5. Acronym SONEX should be defined when it is used first.

Page 14795, Line 20. There should not be a space between the \pm and 17.

Page 14796, Line 8. "February" rather than "Februar".

Page 14813, Last line of caption for Fig. 3. Should this only refer to Sec. 5?

Page 14815, Table 1. "a priori" should not have any italicized letters.

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