Atmos. Chem. Phys. Discuss., 8, S10105–S10108, 2008
www.atmos-chem-phys-discuss.net/8/S10105/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Statistical analysis of non-methane hydrocarbon variability at a European background location (Jungfraujoch, Switzerland)" *by* V. A. Lanz et al.

Anonymous Referee #1

Received and published: 24 December 2008

General Comments

The manuscript by Lanz et. al addresses presents an eight year volatile organic compound (VOC) data set from Jungfraujoch in Switzerland that is analyzed using a factor analysis method to characterize source(s) and source regions for air masses encountered at this site. The manuscript addresses relevant scientific questions that are appropriate for ACP and presents an impressive long-term VOC data set from a remote, high-altitude site centrally located in Europe. While the authors have used a factor analysis of 10 hydrocarbons and halocarbons to determine the source types and provided a reasonable argument for using 4 factors, my main concern is that 4 factors do

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not adequately describe their observations; they should consider incorporating other gases that may elucidate the i) confounding problem with overlapping gases in multiple factors and ii) no single grouping of gases presented can succinctly delineate each factor/source type.

For example, similar distributions of the same chlorinated compounds are present in factors 2 and 4 while factors 1 and 3 have similar hydrocarbon distributions. Is it possible to attribute factor 1 to combustion alone by including gases such as ethyne and CO? Also, while factor 4 contains a larger fraction of trichloroethene, are other short-lived halocarbon data available to further substantiate this difference?

Another important point that must be considered is that this paper appears to focus solely on anthropogenic emissions; no biogenic compounds/emissions were considered. In studying the background levels of tracers, wouldn't biogenic emissions be important at this particular site? Thus, the title is misleading.

Moreover, it is surprising that no factor exhibits biogenic or terrestrial contributions - one would expect this to be persistent and likely contribute (especially during the summer months), if not make up an additional factor describing the sources and source regions. Also, were any marine tracers measured that may provide additional insight on air mass transport and processing? Furthermore, the C2 and C3 NMHCs would be useful to include because they may help to better delineate each factor/source type. Isoprene and its oxidation products, methyl vinyl ketone and methacrolein, could be used to constrain air mass processing and transport times during summer months. Also, other pairs of gases such as acetone and propane could provide insight on source regions, air mass processing and transport times. In my opinion, to accurately assess each of the factors, the authors should seriously consider including additional gases - most manuscripts that I have read carrying out similar types of analyses use a larger, more comprehensive suite of compounds to constrain each factor/source type.

Because the authors use the benzene/toluene ratio to determine the relative photo-

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chemical age of air masses, it would prove useful for the authors to examine a recent manuscript by M. L. White et al. currently in ACPD regarding a biogenic source of toluene in the rural northeastern US. If a biogenic source of toluene is persistent, this would affect the photochemical age determinations used in the paper - even though they are only referred to as "relative". This air mass age indicator should be used with caution, especially at a site like theirs.

Here is the citation for the manuscript:

M. L. White et al. (2008), Are biogenic emissions a significant source of summertime atmospheric toluene in rural Northeastern United States?, Atmos. Chem. Phys. Discuss., 8, 12283-12311.

Following suite, the authors bring about an interesting point that should be addressed more comprehensively. For L20 on P19536 the authors state that "Toluene, on the other hand, does not show a distinct seasonal variation". Benzene is in Factor 1 and Factor 1 is most dominant in winter, which means there could be a large amount of toluene from anthropogenic emissions. The fact that there is little seasonal variation in toluene year-round (Figure 4) indicates that there is likely to be an equally important contribution from vegetation to toluene in the warm season. This is an interesting point that the authors should expand upon.

Additionally, while not necessary, it would be useful to have a figure displaying the time series of the data in addition to the time series of the factor contributions.

Specific Comments

P19528, L6: Reviese "Variabilities in the NMHC series were modeled by factor analysis." to "Variabilities in the NMHC TIME series DATA SET were modeled by factor analysis."

P19529, L2: Begin sentence with "therefore" to read "Therefore, Jungfraujoch is a..."

P19529, L16: Replace "due to" with "because of"

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P19529, L24: Should read either "positively constrained" or "positive constraint"

P19530, L2-5: Revise this sentence, very awkward as written.

P19530, L19: Do not start sentence with "Due to", should say something more like "As a result of" or "Because of"

P19530, L23: "measurement" should be "measurements"

P19531, L19: "species" should be replaced with "gases" or "compounds"

P19531, L28: "is determined" should be replaced with "has been measured"

P19533, L3: Doesn't "non-negative" just mean "positive" values? If so, then why not just say so?

P19533, L10: As written, the following does not make sense, please revise: "As we measured distant to anthropogenic NMHC sources, the factor profiles F can not be directly related to emission profiles."

Specifically, what are "distant to anthropogenic NMHC sources"?

P19536, L4-6: The "overwhelming toluene peak" from "local sources" could be of biogenic origin - please consider looking in to this.

P19536, L26: As written, this says the "trichloromethane:benzene ratio" - should be "trichloroethene"

P19541, L22: Please quantify or specifically define what "nice agreement" is in this case.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19527, 2008.

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