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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intercomparison of NO_2, O_4, O_3 and HCHO slant column measurements by MAX-DOAS and zenith-sky UV-Visible spectrometers during the CINDI-2 campaign" *by* Karin Kreher et al.

Anonymous Referee #2

Received and published: 20 August 2019

This manuscript is a well written and extensive intercomparison between UV-Visible spectrometers during a field study with a highly refined strategy. The work demonstrates very good agreement between slant column densities of the gases mentioned in the title during the campaign. These efforts are necessary for understanding agreement between instruments and for use in subsequent profile retrievals and satellite validation. The work is clearly relevant to Atmospheric Measurement Techniques and I recommend that it be published with minor revisions. Below are general and then specific comments.

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Discussion paper

General comment:

The manuscript goes through extensive procedures that were designed to synchronize measurements to be of the same volume of air at the same time. This synchronization has been improved as compared to the prior campaign, and results are improved. This result indicates that there are significant variations in the actual slant column densities at the same elevation angles if viewed at even slightly different times. The result is not surprising for short-lived pollution gases that probably have a variety of nearby sources, but it indicates that subsequent inversions to vertical concentration profiles and vertical column densities may have challenges due to variations in the vertical concentration profile that occur during the measurement profile. This point is discussed on page 12, lines 21-31, but is not given as much importance as is necessary for this finding. On the other hand, it seems that this point may be the origin of the "conclusion" on lines 13-14 of page 17 that the design "was not fully adequate for profile inversion experiments". This conclusion should be removed or reworded because the present work does not show inversion experiments and thus cannot conclude on them. If the point was meant to be that variability in space and time is observed, then that is a conclusion. Please make clear both the important point of variability in time and space and discuss relevance for inversions, but do not conclude about inversions that are not shown here.

Specific comments:

Page 3, line 34. It should be discussed here that when the instruments that measure profiles sequentially at un-synchronized field studies (as they will typically be used after CINDI-2) that the variability during the profile will affect profile inversions. Potentially the Boesch et al. (2018) AMT paper could be cited.

Page 4, line 24. The Apituley et al. manuscript to be submitted to AMT is really important to the present publication. Is this manuscript submitted? If it is not submitted by the time of this manuscript being decided upon, details should be added here.

Page 5, lines 9-10. The suggestion for future studies should be in the discussion rather than here. Potentially giving an indication to "see section N.M" would be appropriate.

Page 6, line 31. Please give the approximate solar zenith angles of these UTC cutoffs so that they can be more easily translated to other work.

Page 7, line 14. The text says "atmospheric noise", but this effect is not noise but variability given later analysis. Reword.

Page 10, lines 23-29. It may be appropriate to note that retrievals using a zenith reference spectrum within the same elevation sequence (rather than a fixed noon reference) often reduces difficulty in fitting, and thus more instruments could get useful HCHO data if other analysis methods were used.

Page 12, line 24. The word "noise" is used, but this effect is not noise, but rather "variability" due to viewing different airmasses (in time or space).

Page 12, line 39. Replace "keeps larger" with "remains larger".

Page 13, line 16. Change "dependency" to "dependence".

Figure 7 needs a color/symbol key

Table A1. The reference to Vandaele et al. (1998) is not in the references. The paper that I believe is cited seems to indicate the spectrum is at 294K rather than 298K. Please clarify this citation and temperature. This citation and temperature occur in other appendices. Please assure that all sources are fully cited in these appendix tables.

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