

Atmos. Meas. Tech. Discuss., referee comment RC2  
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## Comment on amt-2022-298

Anonymous Referee #2

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Referee comment on "Comparison of atmospheric CO, CO<sub>2</sub> and CH<sub>4</sub> measurements at Schneefernerhaus and the mountain ridge at Zugspitze" by Antje Hoheisel et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-298-RC2>, 2022

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This work by Hoheisel et al., provides a very interesting analysis of the impact of local pollution events to the continuous time series of CO<sub>2</sub>, CH<sub>4</sub> and CO at the ZSF station (which is a Global Station within WMO/GAW and a class-2 ICOS atmospheric site). The work takes advantage by an interesting experiment consisting in implementing a long sampling line from ZSF to the overlooking mountain ridge (300 m higher) and by the huge routinely work by the station manager in manually flagging raw data. I really appreciate this paper because it sheds light on the potential impacts to atmospheric observations from different sources of local contamination (e.g. air outflow from near tunnels, local human activity related with station maintenance and touristic activity, possible system leakages). This analysis clearly shows how, besides the uncertainty related to the analytical measurement techniques, other contributions can increase the total measurement uncertainty.

I recommend publication after that some points (mostly minor) have been further discussed/stressed.

As a general comment, I would recommend the authors to provide specific recommendations to the user of the ZSF dataset. As an instance, can potential users (still) use the daytime data from 2002 to 2014 in front of the possible impact of a potential leak in the sampling system? Can you provide recommendation for the fitness of this dataset for specific purposes (e.g. trend calculation, use in inversion modeling, model validation, etc etc)? Similar recommendation should be mirrored in distribution databases like the WDCGG. As concerning the ZSF dataset in the WDCGG, it is not completely clear to me if the data available by the WDCGG are the ZSF QC or the ZSF with local pollution (with suitable flags). A clarification to potential users can be really useful.

In the following, some specific points that should be considered by the authors for their revision are reported.

## ABSTRACT:

Line 2: please provide the geographical location of Zugspitze

Line 11: please, be more specific: what anthropogenic sources?

## INTRODUCTION

Line 17-18: please provide references for the cited stations. Among the continental mountain site also Mt. Cimone (active since 1979 can be cited).

Line 28: please specify GAW acronym

## EXPERIMENTAL SET-UP

Please, can you provide more description about the management of the calibration and target gas injections? Looking to the setup reported in figure A1, it seems that they are simultaneously sampled by all the three instruments. Is it correct? Did you intercompare the instrument when simultaneously sampling ambient air from the ZSF inlet?

How the air inlet at ZGR is designed? Is it equipped with heater, rainguard, filters?

Line 94: specify the inner diameter, I think it is more important than the o.d.

Line 95: "a part of the air flow is dried using the same drying system as the ..", Why only "a part"? I cannot see an overflow before the cold trap (figure A1).

Line 98: if the residence time is 6':40", why was the data shifted by 6 minutes and not 7 minutes? Do you monitor the flow stability over the time?

Line 101 – 104. All this section need a more robust explanation and discussion. How did you assess the offset of 5.2 ppb (which is rather large, indeed)? Did you perform an instrument characterization for the impact of the water vapor influence (e.g. <https://doi.org/10.5194/amt-5-2555-2012>)? The impact of the not efficient water vapor correction must change as a function of the water vapor levels. Why did you not apply a correction function based on the actual water vapor value? How the overall measurement uncertainty was affected by using this fix offset? The same points are valid for the offsets related with the pump within the flow path. Which was the reason of the artifacts by the 2 pumps? Did you note any impact on CO<sub>2</sub> and CH<sub>4</sub>? All these points should be clarified in the text.

## CALIBRATION

In general, how often the NOAA calibration gases have been reassigned? How stable were the target gas measurements? Are you able to provide a quantification of the uncertainty based on the target gas results? Please, provide a better description of the calibration strategy (how many cycles, injection duration ...). Providing these information will represent a valuable source of info for interested readers.

## RESULTS AND DISCUSSION

Line 166: I would expect that very local pollution events like those related with the use of snowblower were traced better by NO peaks (rather than NO<sub>2</sub>). Can you comment on this?

Line 172: which kind of specific tests have been performed? Are you able to completely rule out the possibility of icing on the sampling inlet affecting the sampling efficiency? Please, explain more.

Line 177: this is an interesting experiment. How did you measure the direction of the flow inside the tunnel? I would suggest to change Figure 4 with an example from the experiment in Nov 2020 showing the CH<sub>4</sub> near the tunnel entrance with simultaneous measurements at ZSF. Did the CO<sub>2</sub> vary during the inverse CH<sub>4</sub> peaks?

Line 205: from a user perspective, it is interesting to know the relationship between the

local pollution event flagged in this work with the flags reported in the WDCGG datasets (e.g. Valid (background): 1, Valid (background): U, Invalid: N, Valid (background): O, Invalid: K, Valid (background): R, Invalid: H, Invalid: 3, see <https://gaw.kishou.go.jp/search/file/0071-6031-1001-01-01-9999>).

Line 213: how long the intercomparison was?

Line 231: please correct "ppb".

Figure 7: please explain what the error bars represent.

Line 242: I suppose that also thermal valley and slope winds play a role. This should be cited.

Line 244: this is actually not true. For CH<sub>4</sub> and CO the seasonal peaks are occurring in spring (March-May). During the summer a relative minimum is evident likely due to lower combustion emissions (for CO) and enhanced OH removal (for CO and CH<sub>4</sub>).

Line 258: I think that the higher deviation during winter daytime (when vertical transport from the PBL is minimized) can be a point towards local influences.

Line 279 – 284. I'm confused. Figure C2 reported a significant deviations between weekday and weekend also in 2002-2007. Why is not this evident in Figure C1?

The presence of a leakage in the sampling system in the period 2002-2014 can potentially have impact on the trend calculation and (considering that the impact is exceeding 1 ppm during daytime hours) on utilization of this dataset for inversion experiments (even if modelers are usually taking night-time data from mountain sites) or model validation. I would like to see recommendation to users about the use of this earlier ZSF dataset. These recommendation should be also provided in the national/international database using these data.

CONCLUSIONS:

Line 298: "baseline" should be used instead of "background"

## APPENDIX C:

Line 326: how the 31-day moving window was defined? Did you perform sensitivity tests changing the length of the time window?