

Reply to Comments from Anonymous Referee #3 on “Long-term measurements of aerosols and carbon monoxide at the ZOTTO tall tower to characterize polluted and pristine air in the Siberian Taiga” by X.Chi et al.

We appreciate the effort of Anonymous Referee #3 to provide very useful comments on our manuscript. Recognizing that such comments help to further improve the quality of the published manuscripts, we considered each comment carefully. In almost all cases, we made the suggested revisions. Below, we answer the comments point by point. For clarity, we reproduce the referee comments in *bold italic* style.

Anonymous Referee #3 general comments:

This is a fine manuscript. It describes and discusses results from long-term measurements (over 4 years) of aerosols and carbon monoxide at a site in Central Siberia. Although part of the data set was already discussed in earlier publications, there is definitely more than enough new material (both in terms of data and interpretation) in the present manuscript. The interpretation of the data is clear, thorough, and overall quite convincing. The manuscript is definitely worthy of publication in ACP. I have only minor comment.

Anonymous Referee #3 Specific comments:

1. Page 18,369, lines 1-2: Does the larger summer single scattering albedo at ZOTTO than at SMEAR II (0.96 versus 0.91) imply that the secondary aerosol formation during summertime is much stronger at ZOTTO than at SMEAR II? If so, is there any evidence for this? Is there no alternative explanation possible? Could it not be that there is a higher impact from biomass burning aerosols in summer at the SMEAR II site than at ZOTTO?

We cannot compare secondary aerosol formation between two different sites based on single scattering albedo data alone. For both, aerosol scattering coefficient and absorption coefficient, we observed lower summer average values at ZOTTO site than at SMEAR II, suggesting that SOA formation at ZOTTO is smaller than at SMEAR or that there is less anthropogenic SOA at ZOTTO (or both). The larger summer single scattering albedo at ZOTTO is mainly due to the much lower absorption coefficient in relation to the scattering coefficient at ZOTTO in comparison to SMEAR II, i.e. our average summer scattering and absorption coefficients are $12.9 \pm 12.3 \text{ Mm}^{-1}$, and $0.32 \pm 0.39 \text{ Mm}^{-1}$ at ZOTTO, while they were $17 \pm 13 \text{ Mm}^{-1}$, and $1.4 \pm 1.2 \text{ Mm}^{-1}$ at SMEAR II site. Indeed, this may suggest that SMEAR II is influenced by more anthropogenic pollution or biomass burning aerosols in summer than ZOTTO. However, while we did not intend to compare the secondary aerosol formation from both sites, the large seasonal difference is still a clear indicator for seasonal source variability at the ZOTTO site.

To avoid misunderstandings, we change the sentence to: “In contrast, our average value in summer (0.96) is higher than their summer values (0.91), suggesting a lower impact of anthropogenic sources at ZOTTO than at SMEAR II. The relatively high difference between summer and winter values is indicating a strong secondary aerosol formation during summertime at ZOTTO.”

2. Page 18,369, line 23: The time series for CO in Fig. 1 shows data up to July

2011. In both the Abstract and the Introduction it says that this manuscript presents and discusses data up to December 2010. Were the CO data of the period December 2010 to July 2011 included when calculating medians, ranges, averages, and standard deviations for CO in this manuscript? This should be clarified.

This manuscript actually presents and discusses data up to December 2011. The time (December 2010) mentioned in the abstract, introduction and summary and conclusion is wrong. The time (December 2011) mentioned in results and discussion is correct. These mistakes will be changed in the final revised version. In Figure 1, indeed, the time series for CO ends in June 2011. Due to technical problems with our CO monitor, no CO data is available after July 2011. We will clarify this in the section 2.2.4.

3. Page 18,372, line 1: CH₄ is mentioned here and also on several occasions further on, but it is unclear where the CH₄ data come from or how they were obtained. There is nothing said about methane in the section "Measurements and methods".

Thanks, an additional section 2.2.5 ("other measurements") will be added in the final revision, which will briefly present measurement methods for CH₄ and meteorological data (e.g., temperature).

4. Page 18,372, lines 15-16: A literature reference is needed for the statement in this Sentence.

We agree. In the revised manuscript, the sentence is changed to "For example, the MATCH-MPIC model (Model of Atmospheric Transport and Chemistry - Max Planck Institute for Chemistry version, Lawrence et al., 2003) suggests that on some winter days (e.g., 14 and 16 Jan. 2010) as much as 50 ppb CO at ZOTTO may originate from Europe (MATCH-MPIC, 2012)". Two literature citations are added to the reference list.

5. Page 18,415, Fig. 12: It should be indicated what the units (and scale) are in the ordinate for the monoterpene emissions.

Figure 12b was changed accordingly in the revised manuscript.

6. Problems with references:

p. 18,348, l. 26: "Zhang et al. (2011b)" is not in the reference list. There are two "Zhang et al. (2011)" references in that list, but it is unclear to which of the two the authors make reference here.

Zhang, F. is Zhang et al. (2011a) and Zhang, X.L. is Zhang et al. (2011b). This will be clarified in the revised manuscript.

p. 18,360, lines 23 and 25: "Ruckstuhl et al. (2010)" is not in the reference list. There is "Ruckstuhl et al. (2012)" in that list, to which no reference is made within the text.

Ruckstuhl et al. (2012) is the corresponding final paper in AMT. Ruckstuhl et al. (2010) is the AMTD paper. Therefore, both "Ruckstuhl et al., (2010)" in p.18,360 are changed to "Ruckstuhl et al. (2012)" in the revised manuscript.

p. 18,360, l. 24: "Zhang et al. (2011a)" is not in the reference list. There are two "Zhang et al. (2011)" references in that list, but it unclear to which of the two the authors make reference here.

Zhang, F. is Zhang et al. (2011a) and Zhang, X.L. is Zhang et al. (2011b). This will be clarified in the revised manuscript.

7. Technical and other minor corrections:

p. 18,346, l. 6: Based on what is written on p. 18,352, l. 23, "90" should be replaced by "89".

This is a mistake, 90 will be changed to 89 in the revised manuscript

p. 18,352, l. 2: Replace "are given" by "is given".

Corrected as suggested.

p. 18,353, l. 27: Replace "referred as" by "referred to as".

Done.

p. 18,354, l. 12: Replace "0.17, 0.26" by "0.17, and 0.26".

The text is corrected as written.

p. 18,358, l. 14: Replace "distributions" by "distribution".

Corrected as suggested.

p. 18,361, l. 16: Replace "Anthropogenic" by "anthropogenic".

The text is corrected as written.

p. 18,363, l. 11: Replace "Gunthe et al., (2009)" by "Gunthe et al. (2009)".

Done.

p. 18,366, l. 29: Replace "inter quartile" by "interquartile".

Changed as suggested.

p. 18,368, l. 20: Replace "are somewhat" by "is somewhat".

Corrected as suggested.

p. 18,369, l. 1: Replace "summer values" by "summer value".

The text is corrected as written.

p. 18,369, l. 6: Replace "0.77-.89" by "0.77-0.89".

Done.

p. 18,371, l. 1: Replace "concentrations" by "concentration".

Changed as suggested.

p. 18,371, l. 24: Replace “foot print” by “footprint”.

Corrected as suggested.

p. 18,377, l. 8: Replace “to other” by “to that at other”.

Corrected as suggested.

p. 18,377, lines 17-18: There is something wrong here, i.e., with “due to a diurnal errcycle suggests that”. The latter should likely be replaced by “due to a diurnal cycle in the local emission sources and photochemical processes. In our case, the long growth cycle suggests that”, like was written in the previous version of this manuscript.

Indeed, one line was deleted by mistake here. Text is corrected as suggested in the revised version.

p. 18,380, l. 22: Replace “because they have” by “because the VOCs have”.

Changed as suggested.

p. 18,381, l. 22: Replace “Fig. 13a” by “Fig. 13”.

Corrected as suggested.

p. 18,384, lines 26-27: These two lines should be deleted.

The lines are deleted in the revised version.

p. 18,399, first line of heading of Table 1: Replace “ranges” by “range” and “deviations” by “deviation”.

Corrected as suggested.

p. 18,400, third line of heading of Table 2: Replace “Dec 2011” by “Dec 2010”. Or should it perhaps be “July 2011”? (See my comment 2 above).

The text “Dec 2011” is not changed here; the reason was given in the reply for comment 2.

p. 18,402, first line of heading of Table 4: Replace “Median and ranges” by either “Medians and ranges” or “Median and range”.

The text is replaced by “Median and range”.

p. 18,406, last line of caption of Fig. 3: Replace “December 2011” by “December 2010”.

The text “Dec 2011” is not changed here; the reason was given in the reply for comment 2.

p. 18,408, second line of caption of Fig. 5: Replace “aerosols size” by “aerosol size”.

Corrected as suggested.

p. 18,415, second line of caption of Fig. 12: Replace “temperature solid” by “temperature; solid”.

Done.