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Atmospheric Measurement Techniques Discussions

Interactive comment on "In-situ measurements of oxygen, carbon monoxide and greenhouse gases from Ochsenkopf tall tower in Germany" *by* R. L. Thompson et al.

R. Thompson

rthompson@bgc-jena.mpg.de

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P1253L5: The reason for wanting to reduce the residence time is to make the GC measurements more comparable with those of CO2 and O2, so that the co-variances of these species in time can be studied more effectively. We think there is likely also to be some integration of the signal (for the GC measured gases) during the time the air is resident in the air-lines, so that the variation over time is a little smoothed. Thus, to compare GC measurements with those of CO2 and O2, it is not just a simple lag that needs to be accounted for.

P1253L14: In 2008, we tested three KNF-N86 pumps for fractionation effects on

O2/N2. We found that the two of the KNF-86 pumps produced no significant artifacts in O2/N2, whereas one produced a positive offset of up to 15 per meg (while running). Because of the variation between pumps of the same model, we recommend that all pumps be tested before installation and if possible re-tested regularly. We think that certain pumps may develop leaks while running and thus cause fractionation regardless of the model type.

P1257L17: The Zero gas is a gas standard with atmospheric concentrations of CO2 and O2. It is used to recalculate the y-axis intercept point of our calibration curve and is thus called the 'zero'.

P1260L14: The flask sampling system and line are not shown in Fig. 2. The flask system is independent of the in-situ measurements and an inline MgCl2O4 trap is used to dry the air.

P1262L20: "daily trimmed mean values" means that we calculate the mean excluding the highest and lowest 25% of the values. If there are outliers in the data, the trimmed mean should give a more representative and robust estimate of the center of the body of the data.

P1263L20: Sirignano et al., 2008 present a very interesting study on the sensitivity of APO to changes in CO2 and O2 resulting from fossil fuel combustion. However, we think that a more pertinent reference here would be Keeling & Shertz, Nature, 358, 1992, which examines the in detail the main drivers of the O2 and CO2 seasonal cycles.

P1263L24: We think that the phase shift in APO between the Shetland Islands and Ochsenkopf if largely due to the time needed for this 'oceanic' signal to be transported in the atmosphere to Ochsenkopf. The APO maxima and minima at Ochsenkopf occur a few days later than at the Shetland Islands. The oceanic signal is much larger than the seasonality from fossil fuel combustion (Sirignano et al., 2008).

P1264L17: noted and 'for' has been removed

P1264L19: The trend and 4-harmonic curve was fitted to the O2/N2 data simultaneously using least-squares method. The trend and its uncertainty are presented in Table 3. The rate of decrease may be as much as 19.4 per meg/year but the mean value is 16.3 per meg/year. This means that the O2/N2 trend is about 12% (and may be up to 15% with the range of uncertainty) of the seasonal amplitude. For CO2, the trend is about 10% (and may be up to 13%) of the seasonal amplitude. The trend calculation is sensitive to the fact that there are inter-annual variations in the summer/winter maxima/minima. Therefore, a longer record is necessary to reduce the uncertainties on the trend calculations.

P1265L10: Unfortunately, we currently do not have the facility to measure C12/C13 isotope ratios of CH4. CH4 isotope analyses could help to identify the principle sources of the CH4 that we measure at Ochsenkopf, that is, to distinguish between 3 categories of CH4 emissions: fossil fuel, biomass burning and biogenic (e.g. from wetlands). However, it would not help us to distinguish whether the wetland contribution to CH4 was from the northern tundra regions or not. What would help, is to use an atmospheric transport model, as well, to ascertain in which regions fluxes are contributing to the observed change in CH4 at Ochsenkopf. As for the reviewer's specific question: Could such analyses be of help in demonstrating that indeed methane emissions from the high northern latitudes occurred? These methane emissions have already been measured directly using automated chambers (please see Mastepanov et al., Nature, 2008).

P1266L17: the influence of seasonal differences in atmospheric transport includes the changes in the planetary boundary layer height e.g. between summer and winter, which strongly modulates the mixing ratios of tracer gases in the boundary layer. This combined with seasonal changes in N2O emissions (especially those from soils) results in a different seasonality at continental stations compared with marine stations.

P1266L23: the uncertainty for trends at Ochsenkopf are given in Table 3. the uncertainty for those at the Shetland Islands have now been added in the text.

P1271L5-18: The O2:CO2 ratio changes during this event, from approximately 1.1 on 18-Sep to approximately 1.4 on 19-Sep-2006, confirming that indeed the main source of CO2 (and sink of O2) changed from a largely biosphere to largely fossil fuel combustion. This has now been added to the text and Fig. 8.

P1272L18: Please see reply at point (9)

P1272L27: we have modified the statement:

"The occasional diurnal variations in CH4, CO, and N2O occurred under very stable conditions, that is, at night-time, when there was no convective mixing and when a source was present in the near-field..."

to include a statement about the vertical gradient:

"The occasional diurnal variations in CH4, CO, and N2O occurred under very stable conditions, that is, at night-time, when there was little convective mixing. This resulted in significant accumulation in the nocturnal boundary layer, which during the day-time was mixed into the PBL. Occasions when the night-time increase was much stronger at the 23 m level than at 90 m most likely resulted from sources in the near-field (if the source was not local, then one would not expect to see a strong vertical gradient in concentration, between 23 and 90 m, as the air would be more mixed with advective transport).

Table 2: For O2, we have a greater number of poor samples with the flask sampling system as well as more frequent intervals of poor data with the in-situ measurement as compared with the other species. This in addition to the later start analyzing flask samples for O2/N2 (in Feb-2007 compared to Jun-2006 for the other species) explains why there are fewer O2 data points in the comparison. For the in-situ O2 measurement, the quality of the data was judged on the basis of the precision and accuracy of the

Target Tank measurement.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 1247, 2009.