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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the use of the correction factor with Japanese ozonesonde data" *by* G. A. Morris et al.

Anonymous Referee #2

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General Remarks:

The paper deals with the use of a correction factor (CF) that multiplies vertical ozone sonde concentration profile data so that the vertical columns computed agree with column measurements from co-located ground-based measurement. The authors constrain their study on vertical ozone profile data obtained with the KC79 and KC 96 ozone sonde types that have been deployed at four long term sounding stations (Sapporo, Tsukuba, Kagoshima and Naha) in the Japanese network over the periods 1990-1996 and 1997-2009, respectively. Applying CF may improve stratospheric parts of the profiles but can have also a degrading effect in other parts of the profile. The use of CFs, i.e. linearly scaling of vertical ozone sonde profiles, is a very controverse methodology in "correcting" ozone sonde data in general and certainly also in case of KC79/96

ozone sonde data. In this context the present study is a very valuable contribution in the discussion on the use of CFs and their impact on the quality of ozone sonde data and the long term trends derived from them. Although, the present study is based on a comprehensive analysis, discussion and conclusions drawn, my major critics deals with the methodology followed in chapter 2 and chapter 3. Here the paper lacks on structure and clarity. My critics focus on the fact why the authors still analyse the use of a CF based on the residual ozone column estimations by applying the constant mixing ratio (CMR) method instead of deriving residuals from satellite observations (e.g. McPeters et al., 1997, 2007). The CMR-method assumes a residual column with constant mixing ratio equal to the measured values at the top of the sonde profile. This assumption is quite outdated now, as satellite observations have shown that the ozone mixing ratio declines above about 35 km altititude. At this point the present manuscript needs substantial improvement before publication in ACP (see my specific remarks).

Specific Remarks

Abstract

Generally okay, just revisions are needed corresponding the changes made in the paper based on my comments listed below.

1 Introduction

Authors should more and clearly distinguish between the here used KC79/96 ozone sonde types and other existing types of ozone sondes such as the ECC-type that is used world wide by more than 90% of operational sounding stations or the BM-type. KC79/96 sondes have their own specific characteristics which can be very different from ECC or BM. The reader should be aware of this from the very beginning that any conclusions drawn are only applicable on KC79/96 ozone sonde data.

From historical perspective more correct is that the BM-type was first developed then CI and finally in 1969 the ECC (see WMO, 2011).

2 Column measurements

This chapter is rather long, not well structurized and the methodology followed should be improved: a.) The comparison with satellites (TOMS and OMI should be moved to the end of the chapter). b.) The chapter should start with clear definitions of CF and including the two approaches of determining the residuals (constant mixing ratio =CMR or satellite climatology=SC) and discuss briefly the pros and cons. c.) Then present time series of CF determined with CMR method and relative deviation of it when using SC-method. d.) In addition Figure 2 gives a good quantitification of the differences between both, CMR and SC ,methods. The simple CMR assumption is actually not true, on the contrary it is well know from literature, for example SPARC-IOC-GAW 1998 assessment, that above about Z=35 km the ozone mixing ratio is even declining such that CMR-residuals certainly tends to be overestimated. e.) Therefore Figure 3 should be extended with curves presenting also the CFs based on SC-residuals in order to show in how far these have any altitude dependence on bursting point criteria or not. f.) Knowing that CFs based on CMR-method will tend to be lower than CF's based on SC-method. This is certainly the case with KC79/96 sonde types which both tend to measure more ozone in the upper part of the profile (See e.g. JOSIE 1996/2000 and BESOS 2004 results) such that residuals estimated with CMR get even more enhanced. g.) At present it is not clear in how far the results presented in the Figures 4 and 5 may be biased by the criterion of only using data with Zburst >= 32 km. Questions remain in how far CFs based on SC method show a similar behavior or less sensitive to this criterion. The statistics presented in Table 4 & 5 and discussed extensively at pages 15605/6 are these still relevant when one would apply CF's based on SC method or getting different?. h.) These questions should be addressed by the authors before they start to discuss the impact on any ozone trend. i.) After this the comparison with TOMS and OMI satellites (Figure 1 and Table 3) should be presented and discussed.

3 Surface measurements

The comparsion can be only made in a qualitative way. To compare near suface ozone measurements made on different locations is difficult and certainly not straight forward as has been done in the present study because the origin of airmasses at the sounding and co-located surface site can be very different and strongly influenced by local pollution. The Japanese surface measurements reported here are therefore not only dealing with ozone but with the sum of all oxidative (i.e. odd oxygen = O3 + NO2 + NO3 etc) compounds. Near surface OX measurements can have at least significant NO2 contributions of 5-10 ppbv or even more depending on strength of nearby pollution. Hereby emitted NO reacts with O3 into NO2 that reacts with OH into HNO3 that acts as a net O3 sink in polluted and urbanized regions. Quantitative comparisons of O3-sonde measurements with OX surface measurements are meaningless: Figure 5 can only give qualitative indications about the shift towards 0 line when no CF applied. Table 6 should be omitted.

4 Sapporo ozone sonde intercomparison

This comparison is most powerfull comparsion because it shows clearly the key issues on the use of CF and its impact on the different parts of ozonesonde profile. However, here should also be discussed the differences between CF based on CMR and SC-method respectively.

Additional comparisons with other vertical ozone profiling instruments (Lidar, Micro-Wave) that are available at Tsukuba would increase statistics and are certainly very valuable for the paper.

5 Conclusions and recommendations These should be revised and streamlined based on my comments made before.

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