Atmos. Meas. Tech. Discuss., 6, C2996–C3000, 2013
www.atmos-meas-tech-discuss.net/6/C2996/2013/

Atmospheric Measurement Techniques
Discussions

Interactive comment on "Propagation of radiosonde pressure sensor errors to ozonesonde measurements" *by* R. M. Stauffer et al.

M. Shiotani

shiotani@rish.kyoto-u.ac.jp

Received and published: 21 October 2013

(This is prepared under discussion with Y. Inai, M. Fujiwara, and F. Hasebe.)

We found that the first part of this paper about pressure offsets statically calculated for various types of radiosondes shows very interesting results and conveys an important message to radiosonde user community particularly for the stratosphere. However, we suspect that the latter part about estimation affecting on ozonesonde measurements is somewhat misleading in view of the altitude coordinate when they make a comparison.

We are interested in a vertical profile of ozone mixing ratios along a specific vertical coordinate such as in geopotential height or geometric height. In the following we consider the three cases for ozone profiles to make our discussion clear.

If we use a radiosonde with a pressure sensor, but without a GPS sensor, we will get an ozone profile in ozone mixing ratio using the pressure sensor data and geopotential height using the pressure sensor data. This is what we usually get from a conventional ozonesonde system with a pressure-sensor-type radiosonde. Hereafter we call this Profile A.

If we use a radiosonde with a GPS sensor, but without a pressure sensor, we will get an ozone profile in ozone mixing ratio using the GPS geometric height data which is converted to pressure, and geopotential height using the GPS data. This may be thought as the "true" profile, since GPS measurements are known to have much smaller uncertainty particularly in the stratosphere (Nash et al., 2011). Hereafter we call this Profile B.

If we can conduct a dual-launch of the above two types of radiosondes each of which has a pressure sensor and a GPS sensor, respectively, we can get various ozone profiles. One example is that in ozone mixing ratio using the pressure sensor data, and geopotential height using the GPS data. Hereafter we call this Profile C.

What we really need to know as ozonesonde users is the differences between the "true" profile with a GPS sensor and the observed profile with a conventional pressure sensor. This should be based on a comparison between Profile A and Profile B. However, results shown in this paper seem to be based on the comparison between Profile B and Profile C.

In the following we would like to make these points clear using examples of ozone profiles calculated for Profiles A, B, and C. The data we used here is based on those used for Fig. 2 in Stauffer et al. (kindly provided by Ryan Stauffer), and figures presented in Fig. 1 are focused in the stratosphere with a coordinate system in geometric height.

First we discuss profiles in ozone partial pressure (the upper left (UL) figure). We suppose this is basically similar to Fig. 10 B in Stauffer et al. The radiosonde type for this measurement is Vaisala RS80, and Inai et al. (2009) found that it has a pressure bias ∼ -0.5% and a resulting altitude bias ∼ +300 m. The altitude shift seen in this figure is rather larger than that estimated by Inai et al (2009), but we clearly see the difference between Profile A and Profile B; Profile C is the same as Profile B, so the two profiles are overlapped.

If we calculate ozone mixing ratios for Profiles A, B, and C, we get the upper right (UR) figure. For this calculation we need to consider two factors: one is a shift of the altitude coordinate for Profile A (blue) and a pressure bias for calculating ozone mixing ratios. For Profile C (black) a pressure bias is only taken into account, but for Profile A we need to calculate ozone mixing ratios using an ozone partial pressure profile as shifted in Fig. UL.

The difference between Profile A – Profile B (blue) and Profile C – Profile B (black) are shown in the lower left (LL) figure. As we easily expect from Fig. UL, the differences between Profile A and Profile B change sign around the maximum of ozone partial pressure. Also ozone profiles usually include small scale variations owing to small scale atmospheric waves such as gravity waves, so we see vertical variations in the difference between Profile A – Profile B (blue). On the other hand, the difference between Profile C – Profile B (black) only shows one side and smooth bias with increasing height. For this specific model (Vaisala RS80), an effect from the pressure bias seems to cancel out that from the altitude shift in some sense.

From these results we suppose that the comparison shown in this paper is a case for the difference between Profile B and profile C, which is not what we want to know as ozonesonde users who really want to know the difference between profile A and Profile B. Using an ozonesonde system with a conventional radiosonde and a GPS sensor, such as used in this study, we can use coincident ozone data with pressure information calculated from GPS height information to calculate ozone mixing ratios correctly. However, people are still using an ozonesonde system with a conventional radiosonde without GPS, and the situation is similar to those ozonesonde measurements that were done in the past. In these cases, we need to know the difference between profile A

without GPS and Profile B with GPS. These are points of our comments.

References: Inai, Y., F. Hasebe, K. Shimizu, and M. Fujiwara (2009).Correction of radiosonde pressure and temperature measurements using simultaneous GPS height data. Scientific Online Letters on the Atmosphere (SOLA), 2009, Vol. 5, 109âĂŠ112, doi:10.2151/sola.2009âĂŠ028. https://www.jstage.jst.go.jp/article/sola/5/0/5_0_109/_article

Nash, J., T. Oakley, H. Vömel, and LI Wei, 2011: WMO Intercomparison of high quality radiosonde observing systems Yangjiang, China, 12 July – 3 August 2010. World Meteorological Organization Instruments and Observing Methods, Report IOM-107, WMO/TD-No. 1580. http://www.wmo.int/pages/prog/www/IMOP/publications-IOM-series.html

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 7771, 2013.

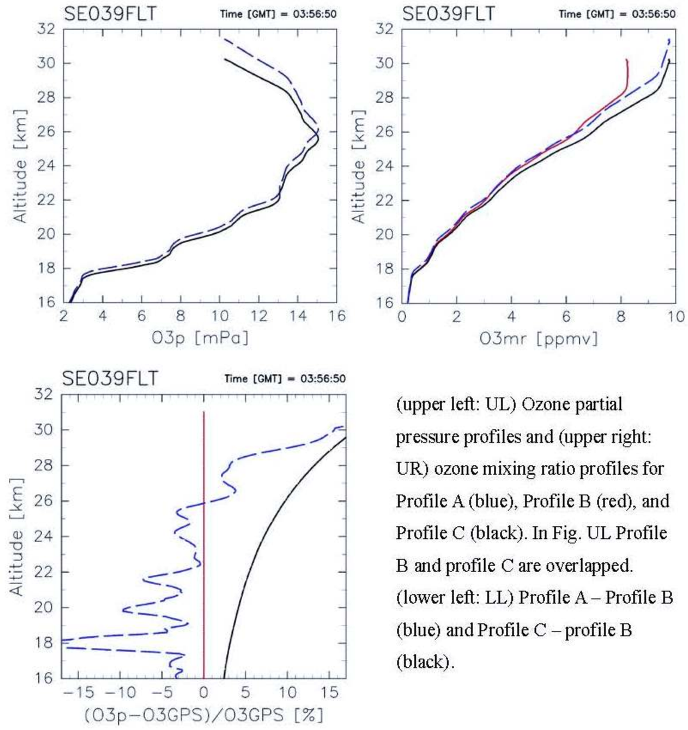

Fig. 1. (upper left: UL) Ozone partial pressure profiles and (upper right: UR) ozone mixing ratio profiles for Profile A (blue), Profile B (red), and Profile C (black). In Fig. UL Profile B and profile C are