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Interactive comment on "A guide for upper-air reference measurements" *by* F. Immler et al.

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We thank Larry Miloshevich for his review of our paper. He asked for the addition of a paragraph about the time-lag error which is an important source of uncertainty in radiosoundings. We agree with this point of view that was also raised by the second referee and have added an appropriate paragraph to our manuscript.

Even though the error caused by the time-lag might not fit well into the concepts of systematic or random error, it is certainly covered by the concept of measurement uncertainty that our manuscript is based upon and that we suggest for using within the GCOS reference upper-air network (GRUAN). At a given instance of the measurement, the time-lag of the instrument causes a bias which in magnitude and sign depends on the values the sensor has experienced earlier and the physical properties of the sensor.

This bias can be described mathematically and a correction can be implemented.

How to do this in detail goes beyond the scope of this paper and has been addressed in other publications. The important point we need to emphasize is that the uncertainty of this correction needs to be estimated and added to the overall uncertainty budget of the measurement.

In order to address the referees issue the following paragraph was inserted in section 3.3:

The finite sensor response time also causes bias when the value of the measurand is changing rapidly relative to the response time of the sensor. This occurs for example in humidity measurements in the troposphere with radiosondes, where rapid changes from humid to dry layers and vice versa can occur during the ascent. The polymer sensors utilized in most radiosondes are comparatively slow, in particular at cold temperatures, giving rise to the so-called 'time-lag error' [Miloshevich et al., 2004]. Again, this effect can be corrected but introduces additional uncertainty, e.g. due to limited knowledge of the time-lag constant (which is a function of temperature).

Also, in section 4.3.4 the following paragraph is introduced:

Another issue is the time-lag bias that was mentioned in section 3.3. The time-lag of the temperature sensor of the RS92 is of the order of less then a second over the entire temperature range [Vaisala, 2007]. The temperature during the ascent varies generally by less than a tenth of a degree in this time frame (along an adiabatic profile at a typical balloon ascent speed of 5 m/s the temperature gradient is 0.04 K/s). Therefore, it may be assumed that the bias caused by the time-lag of the temperature sensor can be neglected.

*R*eferences:

Miloshevich, L. M.; Paukkunen, A.; Vömel, H. & Oltmans, S. J. Development and Validation of a Time-Lag Correction for Vaisala Radiosonde Humidity Measurements, J. of Atmos. Oceanic Techn., 2004, vol. 21, issue 9, p. 1305

Vaisala Radiosonde RS92 Measurement Accuracy, Vaisala, 2007

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1807, 2010.