Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AAS21-18 Room:313 Time:April 30 15:15-15:30

The impact of altitude mis-estimation caused by Vaisala RS80 pressure bias on ozone and temperature profile data

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Non-biased meteorological data are necessary for studies for detecting long-term climate change. Vaisala RS80 radiosonde is widely used for operational and scientific observations. It has been known, however, that the RS80 has pressure bias. The pressure bias affects height information of the profile in a traditional way where the geometric height (or geopotential height in some cases) is calculated from the hydrostatics equation. In addition, the pressure measurements affect the mixing ratio values of any chemical species because the calculation needs air pressure value. The RS80 pressure bias is estimated to be -0.3 $\pm$0.2 hPa, -0.4 $\pm$0.1 hPa, and -0.4 $\pm$0.1 hPa (1σ) at 20 km, 25 km, and 30 km, respectively from the observations using RS80 together with global positioning system (GPS) sensor in the Soundings of Ozone and Water in the Equatorial Region (SOWER) project during from December 2004 to January 2010. Since ozone mixing ratio and temperature are also measured simultaneously, the impact of the mis-estimated altitude on observed profiles of ozone and temperature was evaluated. The net biases of -1.3 $\pm$1.4%, -0.5 $\pm$0.7%, and 3.1 $\pm$1.9% (1σ) at 20 km, 25 km, and 30 km, respectively for ozone mixing ratio and that of -0.1 $\pm$0.2 K, -0.2 $\pm$0.3 K, and -0.4 $\pm$0.7 K (1σ) at 20 km, 25 km, and 30 km, respectively for temperature are estimated as impacts from RS80 pressure bias. Those ozone and temperature biases can result in artificial variation in the long-term meteorological records when there is a radiosonde change from or to RS80. Especially, sign-reversed biases of ozone and temperature appear as artificial variations when the instrument is changed from RS80 to non-pressure-biased radiosonde (for example GPS sonde).

Keywords: sonde observation, observational bias, stratospheric ozone, stratospheric temperature, stratospheric long-term variation