PRELIMINARY RESULTS OF COMPARISON BETWEEN KC OZONESONDE AND UV OZONE DIAL

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ABSTRACT

Tropospheric ozone profiles simultaneously measured with both KC ozonesondes and a UV ozone DIAL are compared. Preliminary results for 21 cases suggest that the KC ozonesondes tend to underestimate ozone density about 20% compared to the ozone DIAL, which is consistent with one previously reported. In addition, the ozone profiles obtained from the DIAL have some fine structures that are not seen in the profiles from the KC ozonesondes. The cause of this difference, presumably related to their vertical resolutions, is not completely understood.

1. INTRODUCTION

Japan Meteorological Agency operationally conducts ozonesonde observation at three observation sites in Japan. Carbon-iodine type chemical ozonesondes (hereafter cited as KC ozonesondes) are used [1]. This type of ozonesondes consists of carbon and platinum electrodes soaked in potassium bromide reaction liquid.

Shibata et al. compared KC ozonesonde data with DIAL data and pointed out the underestimation of tropospheric ozone density obtained from the KC ozonesondes [2]. In BESOS (Balloon Experiment on Standards for Ozone Sondes) campaign [3], about 20% underestimation compared to UV photometer data is confirmed in KC ozonesonde data [4]. Fig. 1 depicts a result of comparison with the UV photometer. In this figure we cannot see the detail of the lower tropospheric ozone profile. Further comparison with the KC ozonesondes and the DIAL in the troposphere has not been reported so a lot.

We have developed a UV ozone DIAL, with which the variation of tropospheric ozone is observed continuously. In order to clarify the relationship between both data further, comparison between KC ozonesonde and UV ozone DIAL data is in progress. Here we report the preliminary results obtained.

2. METHODOLOGY

Simultaneous measurements are performed in Tsukuba (Tateno). Ozonesonde observation is conducted at the Aerological Observatory that is on almost the same site as the Meteorological Research Institute. DIAL observations were carried out around the same time as the operational ozonesonde measurements at 0600 UTC every Wednesday. Comparisons are implemented for 21 cases from November 2004 to February 2006.

Ozone profiles were observed using a three wavelength UV ozone DIAL which utilizes an Nd:YAG laser (FHG: 266 nm) and a single path Raman cell filled with carbon dioxide [5]. Three wavelengths produced are 276 nm, 287 nm, and 299 nm as the first to third Stokes lines of the stimulated Raman scattering. This DIAL instrument

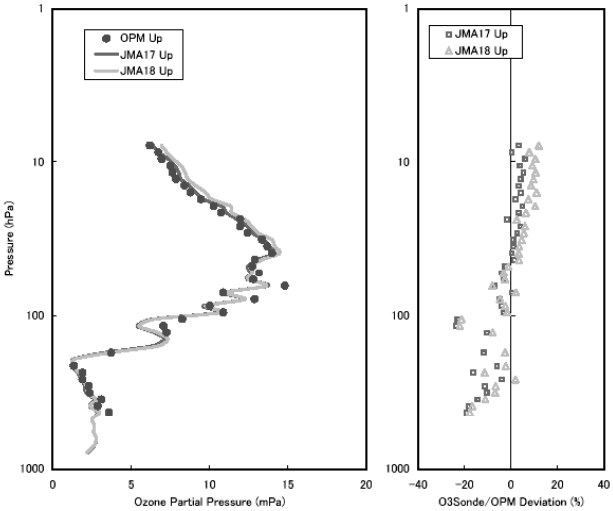

Fig. 1. Comparison between the KC ozonesondes (JMA17 and JMA18) and the UV photometer (OPM) conducted in BESOS campaign, 2003 [4].

can measure ozone density in the entire troposphere up to about 10 km within 30 minutes. The vertical resolution is about 100 m and the precision is better than 10% in the troposphere. The precision of KC ozonesondes is about 10%.

3. RESULTS AND DISCUSSION

An example of comparison between KC ozonesonde and DIAL data is shown in Fig. 2. These data were obtained on January 14, 2005. One-sigma statistical error bars for the DIAL are included in the figure. There seems to exist significant difference between two data. Fig. 3 depicts a scatter plot of the ozone density measured by the DIAL versus that by the KC ozonesondes. A regression line and a correlation coefficient are also shown in the figure. In this example ozone density measured by the KC ozonesondes are 24% smaller than that by the DIAL. Many other examples showed that the KC ozonesondes typically measured ozone density about 20% smaller than the DIAL. This result is consistent with one previously reported.

As a cause of underestimation of the tropospheric ozone density in the KC ozonesondes it is pointed out that ozone is destroyed by impurities around the path leading to the reaction cell. Measures to avoid underestimation in the KC ozonesondes are in progress.

Another feature in the Fig. 2 is fine structures in the DIAL ozone profile that are not found for the KC ozonesondes. It is not confirmed whether the fine structure actually exists or is caused by error. However, some continuous DIAL measurements seem to indicate

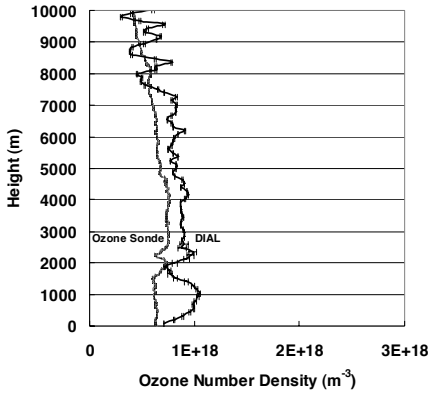

Fig. 2. An example of comparison between the KC ozonesonde and DIAL data on January 14, 2005.

significant temporal variation in the fine structure [5]. The cause of the difference between the KC ozonesonde and DIAL data is presumably related to their vertical resolutions. In the case of ozonesondes the vertical resolution is mainly related to its time response, whereas in DIAL it is related to different factors, that is, range gate width, received photon number per range gate, and fitting method. These factors should be examined further to address whether or not the fine structure actually exists.

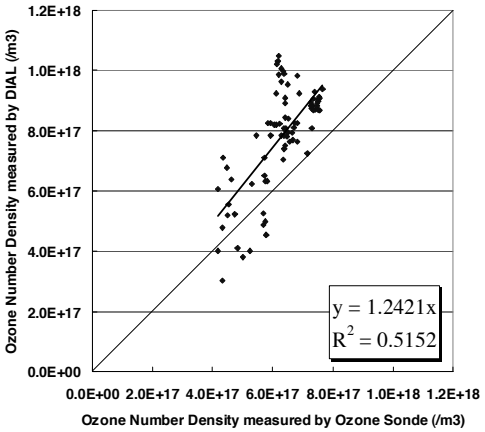

Fig. 3. Scatter plot of the ozone density measured by the DIAL versus that by the KC ozonesondes on January 14, 2005.

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