Comparison of subvisual cirrus occurrences measured with lidars in Tarawa and Biak

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Subvisual cirrus clouds (SVCs), which are defined as cirrus with an optical thickness less than 0.03 (Sassen and Cho, 1992), generally exist at a height of around 17 km in the tropical tropopause layer (TTL) and SVCs play an important role in controlling radiation and water vapor content in the TTL. Boehm and Verlinde (2000) was a first paper to analyze lidar and radiosonde data and concluded that the SVCs were generated by negative temperature anomalies induced by Kelvin waves. Comstock et al. (2002) analyzed the same data over 7 months, including the month analyzed by Boehm and Verlinde (2000). They concluded that high cirrus with a cloud base zb above 15 km high did not coincide with negative temperature anomalies as often as found by Boehm and Verlinde (2000). Iwasaki et al. (2004) and Matsuura (2005) analyzed ship-borne lidar data and their studies were in agreement with Comstock et al. (2002). Though evaluation of their hypothesis is needed, extensive observations and analyses of SVCs with lidars and radiosondes have been performed by many researchers.

In order to research characteristics of SVCs, Soundings of Ozone and Water in the Equatorial Region/Pacific Mission (SOWER) group installed lidars in Tarawa (1^oN, 173^oE), Kiribati and Biak (0^oN, 136^oE), Indonesia, and the other Japanese science groups installed lidars in Kototabang (0^oN, 100^oE). Hence joint lidar researches are possible over thousands km. In addition, SOWER group implemented water vapor and ozone soundings as presented by companion papers in the same session of this conference.

Tarawa lidar has been installed on December 2005 and worked continuously except power failure. The Nd:YAG laser whose transmitted energy is 20 mJ per pulse at a wavelength of 532 nm and 10 Hz pulse repetition rate is used. Lidar return is received by a telescope of which diameter is 20 cm, then it is measured with two photomultiplier tubes (PMTs), where we observe two polarization at 532 nm. We set the laser to transmit beams for 5 minutes and cool down for 10 minutes then fire again in order to save a lifetime of a flashlamp which induces a laser pulse; hence each data is averaged for 5 minutes. Besides, we also set the vertical resolution to be 6 m. The time and vertical resolutions are variable by a laptop computer.

The summary of the lidar status is as follows. The highest SNR was measured till March 17 in 2006 where the sensitivity at 532 nm was about $3*10^{-7}$ [1/m/str] at the TTL. Relatively higher SNR was measured before August 14. However, there were 39 blackouts and 27 low SNR at night before the August 14. Since plastic parts which hold a secondary mirror in the telescope were melted and the mirror was contaminated by the smoke due to direct sunshine measured around the equinox, the sensitivity was changed on March. The reason of SNR reduction on August is not known. The low SNR at night was induced by dew on a skylight. In order for a fair comparison of annual lidar data, we have to modify the data with high SNR to be lower SNR; hence, we make lidar returns weak and add random noise.

We focus to report an analysis method of the annual lidar data in Tarawa in order for a fair comparison of all lidar data in 2006. We then examine a correlation of subvisual cirrus occurrences between Tarawa and Biak lidar data.