

Trend analyses of aerosol optical thickness over Japan using long-term remote sensing observations and their evaluation

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Aerosols in the atmosphere are an important factor affecting the Earth's climate. However, their formation mechanism is complex, and especially in East Asia, rapid changes in emissions of their precursor gases are thought to be occurring in recent years, so that annual trends in aerosol levels have been poorly understood. In this study, we examined the trends in aerosol optical thickness (AOT) at 500nm over Japan using sky radiometer data acquired over a long time period at four sites in Japan (Chiba, Fukuejima Island, Cape Hedo, Miyakojima Island) under the framework of the SKYNET international ground-based observation network. To conduct quantitative trend analyses, sky radiometer measurements were evaluated by simultaneous observations with a CIMEL Sun photometer of NASA/AERONET and a PFR radiometer of WMO/GAW at Chiba in November-December 2015. The mean differences between the CIMEL sun photometer and sky radiometer and between the PFR radiometer and sky radiometer were 0.003 ± 0.006 and -0.007 ± 0.004 , respectively. Based on these results, we analyzed the annual trends of AOT at the four sites in Japan and found that AOT decreased at a rate of about $(0.005-0.02)/\text{year}$ (2-6%/year) on average in recent years. These trends were found to be consistent with those estimated from MODIS data. To understand the cause of the observed decreasing trends, an additional analysis was conducted using Angstrom exponent data. AOTs for smaller aerosol particles exhibited similar decreasing trends, suggesting that at least at Chiba the observed decreasing trends were due to reduction in domestic anthropogenic aerosols. On the other hand, analysis of MODIS AOT data over China showed decreasing trends, except for a limited area around the Shandong province, for 2009-2015. In this presentation, we will discuss in detail potential factors causing decreasing trends in AOT over Japan, with a consideration of impacts by such aerosol variations in China.

Keywords: Aerosol, Sky radiometer, CIMEL, PFR, MODIS