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A Simulation for detecting lower tropospheric O3 with Vis-UV simultaneous observation of solar scattering spectra

Sho Otake[1*], Kazuyuki Kita[1], Hitoshi Irie[2]

[1]Graduate school of science,Ibaraki Univ., [2]JAMSTEC

Accompanying with the industrial development in China and other countries, the transboundary pollution from this area to surrounding areas is becoming a significant environmental problem. A geostationary satellite observation of atmospheric pollutants such as ozone (O3) is effective for monitoring the transboundary pollution, and JAXA starts the feasibility studies of the geostationary observation. Although the ozone measurement from satellite is mainly utilizes the O 3 absorption of solar UV, this UV measurement of O3 from a geostationary satellite is less sensitive to the lower tropospheric ozone in the midlatitude areas because of effective scattering of solar UV. On the contrary, the measurement using the visible absorption by O3 has the sensitivity to the lower tropospheric O3 similar to those in the above atmosphere. Therefore, the lower tropospheric O3 amount may be evaluated from the difference of O3 slant column densities derived from simultaneous UV and Vis measurement of solar scattering spectra from the geostationary satellite. The purpose of this study is to establish a technique to this evaluation with computer simulations as well as simulation observation of UV-Vis simultaneous measurement of solar scattering spectra from a mountain top.
First, we estimated errors in the derived lower tropospheric O3 from the observational errors in slant column densities obtained from UV and Vis measurements. We calculated the slant column densities from the UV and Visible measurements and air mass factors for the both wavelengths with a simulating program, SCIATRAN (Rozonov et al., 2005), by assuming the vertical profiles of temperature, pressure, ozone and aerosol as climatology values. We also calculated them in the case that the surface ozone is increased by 100 ppbv. If the observational errors in the slant column densities from the UV and Vis measurement are 0.5% and 1%, respectively, the tropospheric O3 amount lower than an altitude of 3 km can be evaluated with an error of 50% from a geostationary observation. For the simulating observation from a mountain top, we also did the similar simulation. If the errors in the slant column densities from the UV and Vis measurement are 0.5% and 3%, respectively, the tropospheric O3 in the boundary layer can be evaluated with an error of 35% - 85%.

Keywords: tropospheric ozone, remote sensing