1.085 Sensitivity study for satellite observation of the lowermost tropospheric ozone using three different wavelength ranges, UV, TIR, and microwave.

Early Career Scientist

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Abstract:

Tropospheric ozone, one of the most harmful pollutants, has been increasing globally over few decades. Satellite measurement has an advantage of global monitoring coverage but also has a difficulty to obtain the amount of the lowermost tropospheric ozone. There are attempts to improve the vertical resolution of tropospheric ozone profile by combining the space-based measurements with different spectral ranges at ultraviolet (UV) and thermal infrared (TIR) such as Aura/OMI and TES or MetOp/GOME-2 and IASI. Our idea to further increase the sensitivity of the tropospheric ozone is adding microwave (MW) measurements to UV and TIR measurements. We simulated the sensitivities to the vertical distribution of the tropospheric ozone based on the optimal estimation method.

The degree of freedom for signal (DFS, i.e., how detail the vertical distribution of ozone is constrained), the pressure of maximum sensitivity, reduction rate of error from the a priori error, and the averaging kernel matrix were calculated using radiative transfer models. The DFS value was increased by 96, 23, and 30% in the upper troposphere (UT), middle troposphere (MT), and lowermost troposphere (LMT), respectively by adding the MW measurements to the UV and TIR ones. The MW measurement increased the DFS value of the LMT ozone; nevertheless, the MW measurement alone has no sensitivity to the LMT ozone. Adding the MW measurement made the pressure of maximum sensitivity value for the LMT ozone closer to the surface. These results indicate that the constraints on the UT and MT ozone, which are explicitly introduced by the MW measurements, attribute to the derivation of better information of the LMT ozone. The results of this study are applicable to the upcoming air-quality monitoring missions, APOLLO, GMAP-Asia, uvSCOPE and the NICT air-pollution prediction project.