28PC8 # DIAL MEASUREMENT OF VERTICAL OZONE PROFILES IN THE TROPOSPHERE CONTAINING AEROSOL LAYERS WITH STRONG BACKSCATTER GRADIENTS

Vladimir A. Kovalev

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
P.O. Box 93478, Las Vegas, NV 89193-3478, U.S.A.
Phone: (702)-798-3246 FAX: (702)-798-2692
E-MAIL: AMDVXK@vegas1.las.epa.gov

Airborne differential absorption lidar (DIAL) appears to be the most promising remote sensing tool for studies of ozone in the lower troposphere. However owing to the finite wavelength separation between the off and on lines used in the DIAL technique for determining constituent concentrations, substantial errors can be introduced by differential aerosol backscatter and extinction between these wavelengths. The conventional technique for aerosol corrections of the DIAL ozone data is usually acceptable when the data are obtained in atmospheres lacking turbid layers with large backscattering gradients. For ozone measurements made in a turbid troposphere, especially for areas containing large gradients of aerosol distributions, the correction technique is often not effective due to the high sensitivity of the data to assumed atmospheric characteristics chosen a priori. For this atmospheric situation, it is not possible to obtain a significant improvement in the accuracy of the range-resolved ozone measurement by implementing the differential backscatter corrections.

In this report, a technique is presented for determining the approximate ozone concentration profiles in turbid atmospheres where the lidar signal is influenced by localized spatial variations in aerosol backscattering.[1] The aerosol extinction-coefficient profile measured at a reference wavelength is used to estimate the likely errors in the ozone-concentration backscatter correction term caused by uncertainty in the spectral dependency of the aerosol extinction, aerosol backscatter-to-extinction ratio, etc. This estimate makes it possible to determine the appropriate boundaries of the uncertainty in the DIAL solution for the specific atmospheric situation.

In order to facilitate the separation of the regular (subjected to differentiation) component of the ratio of the off and on DIAL signals from random noise, an auxiliary function is introduced; the function is obtained by transforming the ratio of the off and on DIAL signals. The approximate ozone-concentration profile is found as the sum of two constituents: i) the auxiliary function, and ii) the derivative of the logarithm of an analytical approximation of this function. The logarithm of the ratio of the original-to-approximated auxiliary functions is used to determine whether the approximation is reasonable, and to demarcate atmospheric layering where a strong aerosol backscattering gradient can result in an unacceptably large error in the measured ozone concentration. Preliminary ozone data obtained using this method suggest a significant improvement over the conventional approach.

References

1. V.A.Kovalev et al., "DIAL measurement of vertical ozone profiles in the troposphere containing aerosol layers with strong backscatter gradients," submitted to Applied Optics.