Exploring radiance vertical profiles to investigate atmospheric aerosol stratification by combining measurements and modeling

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Abstract
Knowledge about the factors that determine atmospheric aerosol stratification is essential to understand the partioning of radiant energy in the Earth's atmosphere, which in turn would enable improvements in the accuracy of weather and climate model predictions. Vertical soundings, using ground-based, airborne and satellite-borne lidar systems, complemented by in-situ measurements of aerosol profiles using instruments on airborne platforms, have been the most commonly used techniques to investigate the vertical distribution of atmospheric aerosols. The results obtained using these techniques are not consistent, which implies that available knowledge on vertical profiles of atmospheric aerosols is not yet conclusive. Therefore, there is a need to develop and test different investigation techniques to study the vertical stratification of atmospheric aerosols. In this article, we present profiles of scattered spectral radiances for different viewing, relative azimuth and solar zenith angles, in an atmosphere with different aerosol loading. Further, we propose and discuss a method to retrieve vertical distributions of aerosol properties in the troposphere from profiles of radiance measured by the Cloud Absorption Radiometer aboard a South African Weather Service research aircraft—the Aerocommander 690A—over Skukuza, South Africa, in June 2005.

Keywords: aerosol; atmospheric aerosols; measurements; modeling; profiles; stratification; vertical profiles; vertical stratification; radiance; radiance profiles.