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Investigating the influence of Boundary Layer Dynamics on Aerosol Optical Properties Using Ceilometer and Cimel Sun Photometer.

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Monitoring atmospheric conditions is crucial for understanding the behaviour of aerosols, which directly impact air quality, climate, and satellite-based remote sensing applications. In this study, we focus on the atmospheric boundary layer (ABL), which regulates the dispersion, transport, and transformation of aerosols. Ceilometers, which measure the height of the boundary layer by detecting the backscatter of laser pulses, are used to observe ABL dynamics, including variations in boundary layer height (BLH), aerosol stratification, and vertical mixing. The Cimel Sun Photometer, a ground-based instrument that measures aerosol optical depth (AOD) and radiative properties of aerosols through direct sunlight measurements, is employed to provide insights into columnar aerosol loading, size distribution, and optical properties. This study examines the correlation between ABL height, as measured by the ceilometer, and AOD trends from the Cimel Sun Photometer over Pretoria, a region with high pollution sources such as industrial areas and significant seasonal changes. By integrating these datasets, we assess how fluctuations in BLH influence aerosol concentration and optical properties across different seasons (summer, autumn, and winter). This research contributes to improving air quality assessments, validating aerosol models, and enhancing the parameterisation of aerosol dynamics in climate models

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