Comparing lidar and ceilometer backscattering measurements for the detection of aerosol layers in the PBL over São Paulo, Brazil

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Abstract: The Planetary Boundary Layer (PBL) is the lowest part of the troposphere and it is directly influenced by the Earth's surface and anthropogenic activities. The concentration of aerosol in the PBL is typically much higher than in the free troposphere. Given that most of the air pollution in the troposphere is capped by this layer, obtaining the PBL height (PBLH) and its evolution during the day can assist in monitoring and studying aerosol concentrations and properties and its impact on air quality.

Multi-instrument monitoring of the PBLH can assist in identifying the arrival of different air masses and tracking the evolution of aerosol layers during the day. Due to their lower cost, ceilometers can be powerful tools to enhance these measurements, although such an instrument has a few limitations when compared to lidars. The weaker laser light source used in ceilometers can limit the detection of aerosol layers to a few kilometers in height, depending on the presence and distribution of clouds and aerosols in the atmosphere. Given that some methods to estimate the PBLH need strong gradients in the concentration of aerosols to identify it correctly, the improper identification of the aerosol layers can become problematic for obtaining the PBLH.

We compared lidar and ceilometer data from two instruments located in the city of São Paulo, Brazil, approximately 15 km from each other. We found that, in clear sky conditions, it is possible to correctly identify aerosol layers in the PBL with data from both instruments. The presence of clouds, signal attenuation and noise can sometimes cause errors in the identification of aerosol layers, especially when using ceilometer data. We found that, despite not being co-located, both instruments show similar profiles, up to a few kilometers in height.

Keywords: planetary boundary layer; aerosols; lidar.

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