Comparative Analysis of Aerosol Layer Heights: PACE vs. MPLNET Surface-Based Lidars

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Aerosol layer heights play a crucial role in understanding atmospheric dynamics, air quality, and climate change. With the escalation of North American wildfire frequency and intensity, understanding their role in climate forcing and pollutant distribution is a growing need. Furthermore, long-range transport of biomass burning pollutants can significantly impact air quality by acting as reservoirs for ozone, ozone-precursors, and harmful aerosols; while dust transport can alter the Earth's radiation balance, affecting climate patterns and contributing to regional temperature variations and changes in precipitation dynamics. This study focuses on a comparative analysis of the aerosol layer height products from OCI, SPEXOne, and HARP-2 instruments aboard PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) satellite with ground-based aerosol lidars like the Micro-Pulse Lidar Network (MPLNET) across the United States. While ground-based lidar systems provide detailed vertical aerosol structures absent in PACE observations, satellite instruments offer spatial coverage unattainable by point-source lidar observations. We compare aerosol layer height data collected from both instruments during various time periods and co-location (overpass) over various geographic locations in the United States to assess their agreement and identify discrepancies. Additionally, we investigate the factors that influence the observed differences, especially multiple aerosol layers, aerosol type (dust and smoke), and complex surface terrain. Our findings contribute to improving the understanding of aerosol vertical distribution and advance the integration of satellite and ground-based lidar observations for synergistic atmospheric sensing.

References

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