(60-240329-A) **The Evolution of Atmospheric Observatories at Appalachian State University Into a World Leader in Long-term Measurements for Aerosol-cloud-climate Research**

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The collocated NOAA FAN, NASA AERONET, and NASA MPLNET sites at Appalachian State University (APP) are home to one of the two most comprehensive long-term (up to 15 years) continuous datasets of aerosol optical and microphysical properties in the U.S., in addition to engaging nearly 100 students in atmospheric research training. The APP datasets have been used in numerous regional and global studies of aerosol direct radiative effect, particle water uptake, $PM_{2.5}$, and to validate satellite-retrieved aerosol optical depth over mountainous terrain. Major instrumentation and air sampling upgrades, facilitated by two recent National Science Foundation grants, are positioning APP as a world leader in integrated studies of aerosol-cloud-climate interactions, aerosol chemistry, and microphysics. The new instruments include (1) Aerodyne Aerosol Chemical Speciation Monitor; (2) TSI Scanning Mobility Particle Sizer (SMPS); (3) Droplet Measurement Technologies DMT-100 Cloud Condensation Nuclei Counter; and (4) Magee Scientific A33 Aethelometer. An upgraded aerosol humidity conditioning system will expand the capability of existing aerosol humidified light scattering measurements to study hysteresis effects.

This presentation will focus on the integrated aerosol-cloud-chemistry studies facilitated by the new and existing instrumentation. Integrated measurements from specific air quality measurements will also be presented, including the 2023 Canadian wildfires, which impacted air quality over much of the U.S. Mid-visible aerosol optical depth at APP ranged from 0.5-1.5 during these episodes, including July 17-18. Much of the aerosol impacting APP was above the boundary layer (Fig.1), Mid-visible scattering coefficients exceeded 400 Mm^{-1} with high single-scattering albedo (~0.95) and a shift to larger accumulation mode particles during the smoke episode (Fig.2). Column averaged and vertically resolved aerosol measurements are necessary to determine the representativeness of the near-surface measurements of long-distance smoke transported to the region.

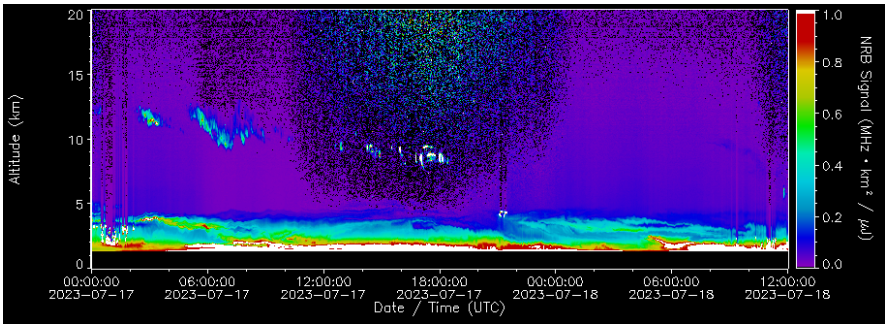

Figure 1. Aerosol normalized relative backscatter measured by micro-pulsed lidar at APP during Canadian wildfire smoke transport episode on July 17-18, 2023.

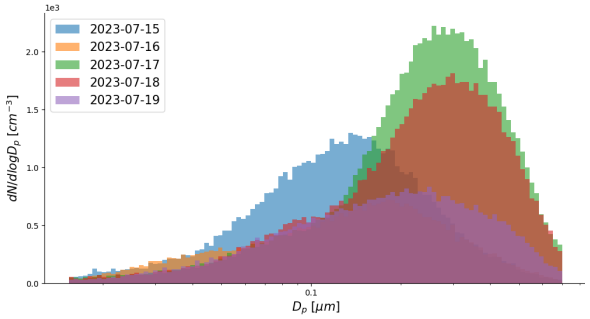

Figure 2. Daily averaged particle number size distributions measured at APP during Canadian wildfire smoke transport on July 17-18, 2023 and surrounding days.