Multi-mode characterization of total columnar aerosols over China based on SONET ground-based remote sensing measurements since 2010

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Aerosol is an important component of the terrestrial atmosphere and plays a key role in the determination of global climate change, visibility, and human health. With the rapid development of the economy and human expansion, fine particulate matter is the most important air pollutant in many developing countries. However, the observation sites of Aerosol Robotic Network and Sky Radiometer Network are still very rare and are distributed unevenly over China. Sun-Sky Radiometer Observation Network (SONET, www.sonet.ac.cn) is a ground-based radiometer network with the extension of multiwavelength polarization measurement capability to provide long-term columnar atmospheric aerosol properties over China [1], which is a necessary remedy to an important lack of total columnar atmospheric aerosols over China. There are 16 sites located in typical regions of China, including urban, rural, desert, coastal, basin, mountain, and plateau areas, and the data have been obtained since 2010. The absolute aerosol optical thickness uncertainty can be less than about 0.01–0.02. In this study, we employ a new remote sensing method [2,3] to separate the characteristic peaks of atmospheric columnar aerosol volume particle size distribution (VPSD) and retrieve the complex refractive index (CRI) from the SONET observation over China from 2010–2016. It has been found that the aerosol VPSD can be decomposed into four characteristic peaks, including the fine, sub-fine (SF), sub-coarse (SC), and coarse modes, while CRIs can be separated into fine and coarse modes with CRI errors less than about 0.046 (real part) and 0.003 (imaginary part). The results show the mean central radii of the peaks in the fine, SF, SC, and coarse modes are around 0.15, 0.33, 1.86, and 3.30 μm, respectively. In general, the aerosols are complex and highly varying both in time and geographically. The SF mode is the major one in the eastern region in China. The absorption by aerosol in the eastern region is stronger than in the western region with the larger imaginary part of the CRI, while the scattering is weaker.

References

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