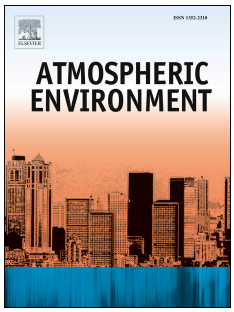
Accepted Manuscript



Aerosol optical properties and radiative effects: Assessment of urban aerosols in central China using 10-year observations

Ming Zhang, Yingying Ma, Wei Gong, Boming Liu, Yifan Shi, ZhongYong Chen

PII: S1352-2310(18)30194-8

DOI: 10.1016/j.atmosenv.2018.03.040

Reference: AEA 15910

To appear in: *Atmospheric Environment*

Received Date: 4 October 2017

Revised Date: 22 February 2018

Accepted Date: 20 March 2018

Please cite this article as: Zhang, M., Ma, Y., Gong, W., Liu, B., Shi, Y., Chen, Z., Aerosol optical properties and radiative effects: Assessment of urban aerosols in central China using 10-year observations, *Atmospheric Environment* (2018), doi: 10.1016/j.atmosenv.2018.03.040.

Aerosol optical properties and radiative effects: Assessment of urban aerosols in central China using 10-year observations

Ming Zhang[a], Yingying Ma[a, b], Wei Gong[a, b], Boming Liu[a], Yifan Shi[a] and ZhongYong Chen[c]

[a] State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan, Hubei Province, China

[b] Collaborative Innovation Center for Geospatial Technology, Wuhan, Hubei Province, China

[c] Hubei Provincial Meteorological Bureau, Wuhan, Hubei Province, China

Key words:

Aerosol optical properties; Aerosol radiative effects; haze; Wuhan; central China

Abstract

Poor air quality episodes are common in central China. Here, based on 10 years of ground-based sun-photometric observations, aerosol optical and radiative forcing characteristics were analyzed in Wuhan, the biggest metropolis in central China. Aerosol optical depth (AOD) in the last decade declined significantly, while the Ångström exponent (AE) showed slight growth. Single scattering albedo (SSA) at 440 nm reached the lowest value (0.87) in winter and highest value (0.93) in summer. Aerosol parameters derived from sun-photometric observations were used as input in a radiative transfer model to calculate aerosol radiative forcing (ARF) on the surface in ultraviolet (UV), visible (VIS), near-infrared (NIR), and shortwave (SW) spectra. ARF_{SW} sustained decreases (the absolute values) over the last 10 years. In terms of seasonal variability, due to the increases in multiple scattering effects and attenuation of the transmitted radiation as AOD increased, ARF in summer displayed the largest value (-73.94 W/m^2). After eliminating the influence of aerosol loading, the maximum aerosol radiative forcing efficiency in SW range ($ARFE_{SW}$) achieved a value of -64.5 W/m^2/AOD in April. The ARFE change in each sub-interval spectrum was related to the change in SSA and effective radius of fine mode particles (Refff), that is, ARFE increased with the decreases in SSA and Refff. The smallest contribution of $ARFE_{NIR}$ to $ARFE_{SW}$ was 34.11% under strong absorbing and fine particle conditions, and opposite results were found for the VIS range, whose values were always over 51.82%. Finally, due to the serious air pollution and frequency of haze day, aerosol characteristics in haze and clear days were analyzed. The percentage of $ARFE_{NIR}$ increased from 35.71% on clear-air days to 37.63% during haze periods, while both the percentage of $ARFE_{UV}$ and $ARFE_{NIR}$ in $ARFE_{SW}$ kept decreasing. The results of