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1 **Black carbon and wavelength-dependent aerosol absorption in** 2 **the North China Plain based on two-year aethalometer** 3 **measurements**

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10 **Abstract.** Light-absorbing components of atmospheric aerosols have gained particular
11 attention in recent years due to their climatic and environmental effects. Based on two-year
12 measurements of aerosol absorption at seven wavelengths, aerosol absorption properties and
13 black carbon (BC) were investigated in the North China Plain (NCP), one of the most densely
14 populated and polluted regions in the world. Aerosol absorption was stronger in fall and the
15 heating season (from November to March) than in spring and summer at all seven
16 wavelengths. Similar spectral dependence of aerosol absorption was observed in non-heating
17 seasons despite substantially strong absorption in fall. With an average absorption Angström
18 exponent (α) of 1.36 in non-heating seasons, freshly emitted BC from local fossil fuel burning
19 was thought to be the major component of light-absorbing aerosols. In the heating season,
20 strong ultraviolet absorption led to an average α of 1.81, clearly indicating the importance of
21 non-BC light-absorbing components, which were possibly from coal burning for domestic
22 heating and aging processes on a regional scale. Diurnally, the variation of BC mass
23 concentrations experienced a double-peak pattern with a higher level at night throughout the
24 year. However, the diurnal cycle of α in the heating season was distinctly different from that
25 in non-heating seasons. α peaked in the late afternoon in non-heating seasons with
26 concomitantly observed low valley in BC mass concentrations. In contrast, α peaked around
27 the midnight in the heating season and lowered down during the daytime. The relationship of
28 aerosol absorption and winds in non-heating seasons also differed from that in the heating
29 season. BC mass concentrations declined while α increased with increasing wind speed in
30 non-heating seasons, which suggested elevated non-BC light absorbers in transported aged
31 aerosols. No apparent dependence of α on wind speed was found in the heating season,
32 probably due to well mixed regional pollution. Pollution episodes were mostly encountered
33 under low winds and had a low level of α , implying aerosol absorption should be largely

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