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Characteristics and direct radiative effect of mid-latitude continental aerosols: the ARM case

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Abstract. A multi-year field measurement analysis of the characteristics and direct radiative effect of aerosols at the Southern Great Plains (SGP) central facility of the Atmospheric Radiation Measurement (ARM) Program is presented. Inter-annual mean and standard deviation of submicrometer scattering fraction (at 550 nm) and Ångström exponent å (450 nm, 700 nm) at the mid-latitude continental site are indicative of the scattering dominance of fine mode aerosol particles, being 0.84±0.03 and 2.25±0.09, respectively. We attribute the diurnal variation of submicron aerosol concentration to coagulation, photochemistry and the evolution of the boundary layer. Precipitation does not seem to play a role in the observed afternoon maximum in aerosol concentration. Submicron aerosol mass at the site peaks in the summer (12.1±6.7μg m^{-3}), with the summer value being twice that in the winter. Of the chemically analyzed ionic components (which exclude carbonaceous aerosols), $SO_4^{=}$ and NH_4^{+} constitute the dominant species at the SGP seasonally, contributing 23-30% and 9-12% of the submicron aerosol mass, respectively. Although a minor species, there is a notable rise in NO_3^{-} mass fraction in winter. We contrast the optical properties of dust and smoke haze. The single scattering albedo ω_0 shows the most remarkable distinction between the two aerosol constituents. We also present aircraft measurements of vertical profiles of aerosol optical properties at the site. Annually, the lowest 1.2 km contributes 70% to the column total light scattering coefficient. Column-averaged and surface annual mean values of hemispheric backscatter fraction (at 550 nm), ω_0 (at 550 nm) and å (450 nm, 700 nm) agree to within 5% in 2001. Aerosols produce a net cooling (most pronounced in the spring) at the ARM site

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