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Characterizing the regional particulate pollution around the two Chinese mega-cities Guangzhou and Beijing: Aerosol optical property measurements

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The extinction of solar radiation by aerosol particles is of great importance for the Earth's radiative balance and climate. The optical properties of atmospheric aerosols are, however, highly variable and not well characterized. Aerosol optical properties were measured in two locations in China. The first site was in a rural area approximately 60 km northwest of the mega-city Guangzhou in south China and was part of the "Program of Regional Integrated Experiments of Air Quality over the Pearl River Delta" intensive campaign in July 2006 (PRIDE-PRD2006). The second site was a suburban site approximately 40 km south of Beijing and was part of "Campaigns of Air Quality Research in Beijing" (CAREBeijing-2006) in August 2006. Both sites were designed to measure the regional pollution around these mega-cities.

Prior to the aerosol optical measurements, the sampled air was dried to below 40% RH (generally 20-40% RH). Two instruments were used to measure light absorption and scattering by aerosol particles. Aerosol scattering coefficients at 450 nm, 550 nm, and 700 nm were determined with a TSI three-wavelength nephelometer. Aerosol absorp-

tion coefficients at 532 nm were measured with a DRI Photoacoustic Spectrometer, which in contrast to other widely used absorption instruments, does not suffer from artifacts due to filter-particle interactions.

In both 30-day measurement campaigns, a variety of different types of air masses and meteorological conditions were encountered. In PRIDE-PRD2006 this included high pollution events from local biomass burning. Compared to the Guangzhou optical data, the trends in Beijing were less episodic, with lower maximum values, but higher average values. In PRIDE-PRD2006 the average scattering coefficient (550 nm) was 151 Mm^{-1} and the maximum was 1900 Mm^{-1}. Comparatively, the average scattering coefficient (550 nm) for CAREBeijing was 333 Mm^{-1} and the maximum was 1440 Mm^{-1}. Similar trends were noted for the aerosol absorption coefficient. The average single scattering albedo for both campaigns was $\sim$0.83 (at 532 nm); however, there were many instances where significantly lower single scattering albedo values were measured (as low as $\sim$0.5).

Strong diurnal cycles were seen in both campaigns for the scattering and absorption coefficients, and the single scattering albedo. In PRIDE-PRD2006 these cycles can be explained through the formation of a stable nocturnal boundary layer with continued nocturnal surface emissions into this shallow layer, followed by the daytime break-up of this layer and its mixing with the overlying residual layer due to convective mixing induced by solar irradiation. No evidence was found for significant production of secondary aerosol, in spite of the highly photochemically active environment of this measurement site.

These measurement results suggest that local and regional aerosol emissions have a large impact on the aerosol pollution and radiative balance of both the Pearl River Delta and Beijing regions.

Reference

Garland, RM et al., “Aerosol optical properties in a rural environment near the mega-city Guangzhou, China: Implications for regional air pollution and radiative forcing” to be submitted to Atmospheric Chemistry and Physics, 2008.