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Ground-based remote sensing of aerosol optical properties and their radiative impacts in PRD region of China

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Aerosol direct effects on surface irradiance were explored by using 7 years' ground-based broadband and spectral radiation data at Panyu, the main site of atmospheric composition monitoring in Pearl River Delta (PRD) . Aerosol optical properties were derived from a Sun photometer, and the radiations were calculated by SBDART model. Results demonstrated that in dry seasons(from October to next February), the annual mean aerosol optical depth (AOD) at 550nm was 0.535, and more than 60% AOD was in a range of 0.2-0.6. Due to the fact that few dust taken place in PRD region, the course mode of weak or strong absorbing aerosol was negligible. However, the proportion of fine mode, weak radiation absorbing particle was about 9.52%, with the Angstrom exponent (α440/470) = 1.30, single scatter co-albedo (ω0) =0.04.Up to 90% of the aerosol was dominated by fine mode, strong absorbing particles, as given by mean α440/470 = 1.35, ω0 =0.14. Because of strong absorption, the variations in aerosol concentration significantly heated the air, and cooled down the surface. The annual mean shortwave direct radiation forcing at the surface (SFC), inside the atmosphere (ATM), and at the top of atmosphere (TOA) was -33.51$\pm$8.41, 27.29$\pm$7.19, -6.22$\pm$2.22 W/m^2, respectively. The strong absorbing aerosol not only changed the amount of global shortwave radiation reaching the surface, but also varied the proportion of diffuse and direct radiation. The annual mean reduction in global and direct radiation due to aerosol was -37.50$\pm$9.43 W/m^2 and -81.89$\pm$18.42 W/m^2 and aerosol caused 44.38$\pm$9.49 W/m^2 more diffuse radiation reaching the Earth's surface. Due to the significant radiation impacts of fine mode, strong absorbing particles, the properties of carbonaceous aerosols in PRD and their impacts on regional climate change should be further studied.

Key words: Aerosol; Optical properties; Radiation forcing; Pearl River Delta