Scientists explain the impacts of aerosol radiative forcing

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A hazy day (Dec. 28, 2017) and a clean day (Jan 11, 2018) in Wushan, Guangzhou. Credit: B.R. Mai

Aerosols are colloids of tiny solid or liquid particles suspended in the atmosphere. Their diameters typically range between 0.001 and 100 µm. Aerosols are recognized as a major factor influencing global and regional climate change owing to their ability to scatter and absorb solar radiation. Indirectly, they modulate Earth's energy balance by altering cloud properties—in particular, cloud droplet size—by serving as cloud condensation nuclei, which further influence the cloud fraction, height and lifetime. All these aspects result in modification of the planetary albedo and hydrological cycle. Some important environmental issues, such as haze, acid rain and tropospheric ozone pollution, are also closely correlated with aerosol pollution.

Dr. Boru MAI and Professor Xuejiao DENG from China Meteorological Administration and Professor Zhanqing LI from the University of Maryland analyzed seven years (2006-12) of Cimel sunphotometer data collected at Panyu, the main atmospheric composition monitoring station in the Pearl River Delta (PRD) region of China. The study revealed aerosol optical properties and direct radiative effects on surface irradiance. The researchers found that during the dry season (October to February), about 90 percent of aerosols in the PRD region were dominated by fine-mode strongly absorbing particles, with an Ångström exponent (AE) = 1.35, single scattering albedo (SSA) = 0.86, and aerosol optical depth (AOD) = 0.52. Fine-mode strongly scattering particles constituted about 9.5 percent, with AE = 1.3, SSA = 0.96, and AOD = 0.65. High contents of fine-mode aerosol loading significantly influence the radiation exchange between Earth's surface and atmospheric system.

The study was published in *Advances in Atmospheric Sciences*. The researchers also found that over 2006-12, the mean diurnal shortwave direct radiative forcing caused by aerosols at the surface, inside the atmosphere (FATM), and at the top of the atmosphere steadily declined over time, with the decrease in FATM being significant. Moreover, the SSA increased from 0.87 in 2006 to 0.91 in 2012. These findings may be attributable to the drastic measures taken to reduce emissions, especially absorbing aerosols, over the past decade by the transformation of the region's economy. Relevant research will be carried out in future to dig deeper into these issues.

Optical properties and radiative impacts of absorbing particles can be used to improve the accuracy of inversion algorithms for satellite-based aerosol retrievals in the PRD region and to better constrain the climatic effect of aerosols in climate models.

More information: Boru Mai et al, Aerosol optical properties and radiative impacts in the Pearl River Delta region of China during the dry season, *Advances in Atmospheric Sciences* (2018). [DOI: 10.1007/s00376-017-7092-4](https://dx.doi.org/10.1007/s00376-017-7092-4)

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