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A simplified approach to analyze the effectiveness of NO_2 and SO_2 emission reduction of coal-fired power plant from OMI retrievals

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Nitrogen oxides (NOX) and sulfur dioxide (SO_2) emissions from coal combustion, which is oxidized quickly in the atmosphere resulting in secondary aerosol formation and acid deposition, are the main resource causing China's regional fog-haze pollution. Extensive literature has estimated quantitatively the lifetimes and emissions of NO_2 and SO_2 for large point sources such as coal-fired power plants and cities using satellite measurements. However, rare of these methods is suitable for sources located in a heterogeneously polluted background.

In this work, we present a simplified emission effective radius extraction model for point source to study the NO_2 and SO_2 reduction trend in China with complex polluted sources. First, to find out the time range during which actual emissions could be derived from satellite observations, the spatial distribution characteristics of mean daily, monthly, seasonal and annual concentration of OMI NO_2 and SO_2 around a single power plant were analyzed and compared. Then, a 100 km $\times$ 100 km geographical grid with a 1 km step was established around the source and the mean concentration of all satellite pixels covered in each grid point is calculated by the area weight pixel-averaging approach. The emission effective radius is defined by the concentration gradient values near the power plant. Finally, the developed model is employed to investigate the characteristic and evolution of NO_2 and SO_2 emissions and verify the effectiveness of flue gas desulfurization (FGD) and selective catalytic reduction (SCR) devices applied in coal-fired power plants during the period of 10 years from 2006 to 2015.

It can be observed that the the spatial distribution pattern of NO_2 and SO_2 concentration in the vicinity of large coal-burning source was not only affected by the emission of coal-burning itself, but also closely related to the process of pollutant transmission and diffusion caused by meteorological factors in different seasons. Our proposed model can be used to identify the effective operation time of FGD and SCR equipped in coal-fired power plant.