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Quantification of Global Primary Emissions of PM2.5, PM10, and TSP from Combustion and Industrial Process Sources

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Emission quantification of primary particulate matter (PM) is essential for assessment of its related climate and health impacts. To reduce uncertainty associated with global emissions of TSP, PM10 and PM2.5, we compiled data with high spatial ($0.1^{\circ}\times0.1^{\circ}$) and sectorial (77 primary sources) resolutions for 2007 based on a newly released global fuel data product (PKU-FUEL-2007), and an emission factor database including emission factors measured recently in developing countries. Total emissions for TSP, PM10 and PM2.5 were estimated to be 162 (123–224), 99 (80–130), and 78 (64–101) Tg, respectively. Our estimates for developing countries are higher than those previously reported. Spatial bias associated with large countries could be reduced by using sub-national fuel consumption data. Despite the fact that most industrial and transport sources locate in urban areas, residential fuel consumptions are quite different between rural and urban areas, especially in developing countries. As a result, per person annual primary PM emission in rural areas are much higher than those in urban areas. Further, this difference in developed countries (12 and 2.8 kg PM2.5 for rural and urban areas) is larger than that in developing countries (8.4 and 4.6 kg PM2.5 for rural and urban areas). Additionally, we looked at temporal trends from 1960 to 2009 at country-scale resolution. Although total emissions are still increasing in developing countries, their intensities in terms of gross domestic production or energy consumption have decreased. PM emitted in developed countries is finer owing to a larger contribution from non-industrial sources, and use of abatement technologies. In contrast, countries like China, with strong industry emissions and limited abatement facilities, emit coarser PM. The health impacts of PM are intensified in hotspots and cities owing to covariance of sources and receptors. Although urbanization reduces the per person emission, overall health impacts related to these emissions are heightened because of aggregation effects.