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Numerical simulation of extreme PM$_{2.5}$ pollution in China in winter 2013 by regional air quality model
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Studies on PM$_{2.5}$ observations in China have been gradually conducted since 2000 and have shown substantially high PM$_{2.5}$ concentrations in urban areas in the country. China faced extreme PM$_{2.5}$ pollution also in winter 2013, which was widely reported in mass media and attracted much public attention. In this study, the Community Multiscale Air Quality model (CMAQ) v5.0.1 driven by the Weather Research and Forecasting model (WRF) v3.4.1 was utilized to simulate the extreme PM$_{2.5}$ pollution.

The WRF/CMAQ modelling system was run for the period from 1 January to 5 February 2013 in the simulation domain covering East Asia. The model generally reproduced PM$_{2.5}$ concentrations in China (Fig. 1) with the existing emission data, including the INTEX-B emission data in the year 2006. Therefore, the extreme PM$_{2.5}$ pollution seems to be mainly attributed to meteorological conditions rather than emission increases in the past several years. In addition, the model simulated PM$_{2.5}$ concentrations in Japan (Fig. 2) as well as China, indicating that the model well captured characteristics of the PM$_{2.5}$ pollutions in both areas on the windward and leeward sides in East Asia. Note that the model still needs to be revised for better representation of individual PM$_{2.5}$ components.

The INTEX-B emission data have four sectors: power generation, industry, residential and transportation. Contributions of emissions from the four sectors in China to PM$_{2.5}$ concentration were estimated by conducting zero-out emission sensitivity runs. The residential sector had the highest contribution rate, followed by the industrial, power generation and transportation (Fig. 3). Therefore, the extreme PM$_{2.5}$ pollution may be also attributed to large primary PM$_{2.5}$ emissions from combustion for heating in cold regions in China.
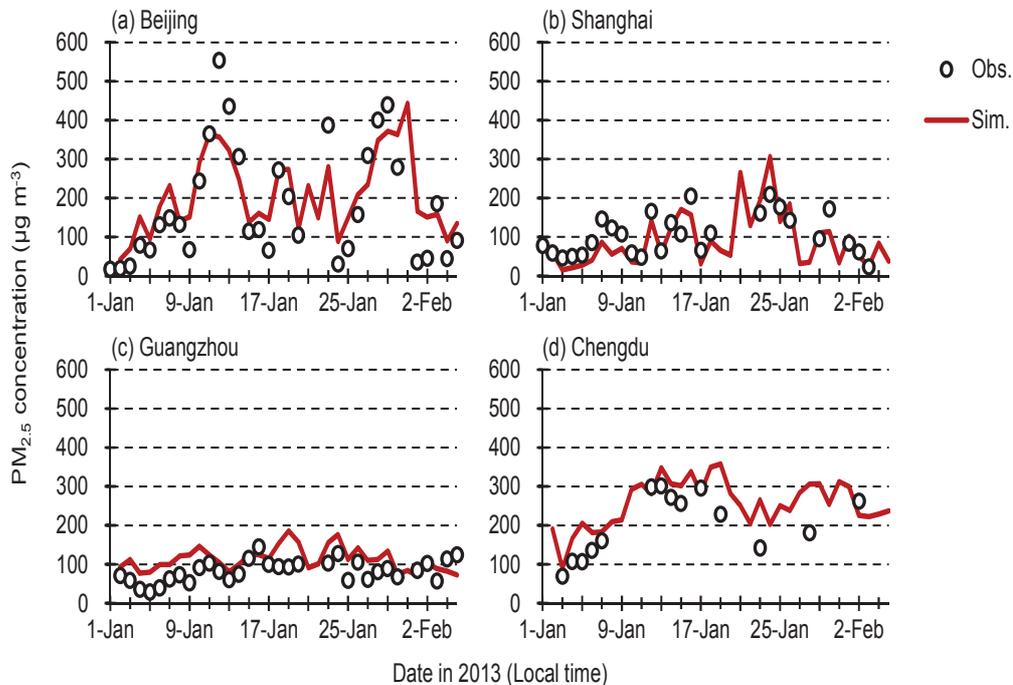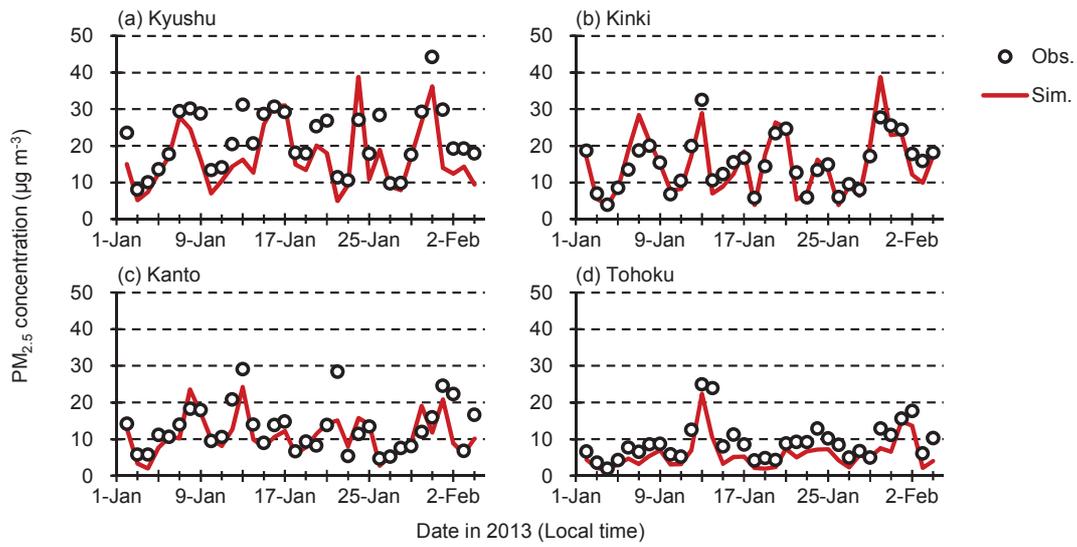

Fig. 1 Daily PM$_{2.5}$ concentrations in China

Fig. 2 Regional mean daily PM$_{2.5}$ concentrations in Japan
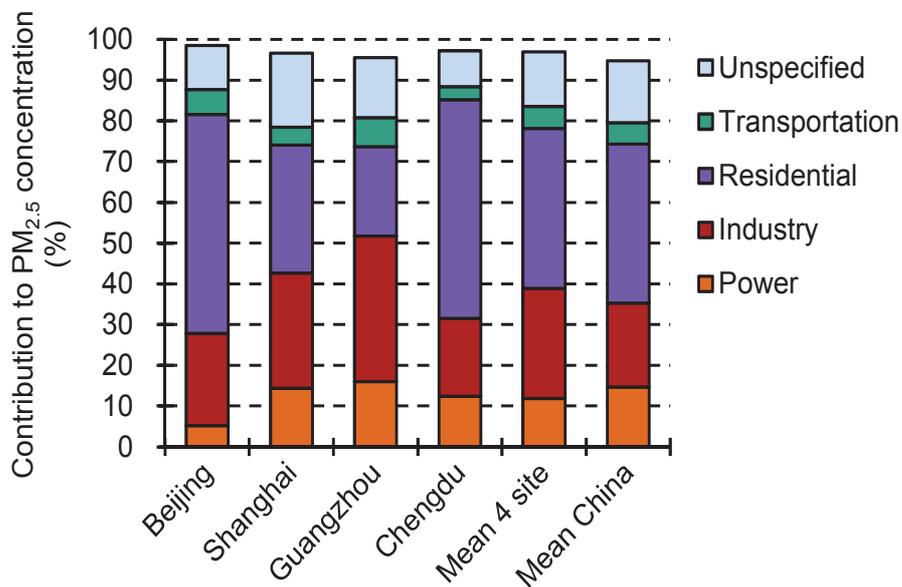

Fig. 3 Contribution of emissions by sector to PM$_{2.5}$ concentration in China

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