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Understanding of Regional Air Pollution over China using CMAQ, Part II. Process Analysis and Sensitivity of Ozone and Particulate Matter to Precursor Emissions

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1. Characteristics of the sites included in the process analysis

Beijing, Shanghai, and Guangzhou are three largest cities located in the center of 3 developed areas (Bohai Economic Circle area (BEC) encompassing Beijing, Tianjin and Shandong province; Yangtze River Delta (YRD) in the eastern provinces of Zhejiang, Jiangsu, Fujian, and Shanghai, and the Pearl River Delta (PRD) in Guangdong province), which represents typical urban air quality in China. Chengdu, located at the Sichuan Basin, is featured as the heavily-polluted area due to its basin topography and stable atmospheric condition that traps air pollutants in the basin. Jinan located in the North China Plain is one of most-polluted cities with high SO_2 emissions in China. Mt. Tai is the highest point over the North China Plain, which is an ideal site to study air pollutant transport. Xiaoping, located in Fujian province, is a rural site selected by the China National Environmental Monitoring Centre and by the Acid Deposition Monitoring Network in East Asia (EANET) and has been designated as a nature-protected area in China. Waliguan is the first in-land Global Atmosphere Watch (GAW) baseline station around the world, located at the top of Mt. Waliguan (3810 m above sea level) in the northeastern edge of the Tibetan plateau in the southwestern China.

2. Integrated process contributions to the formation of SO_4^{2-}, NO_3^-, and SOA in the PBL

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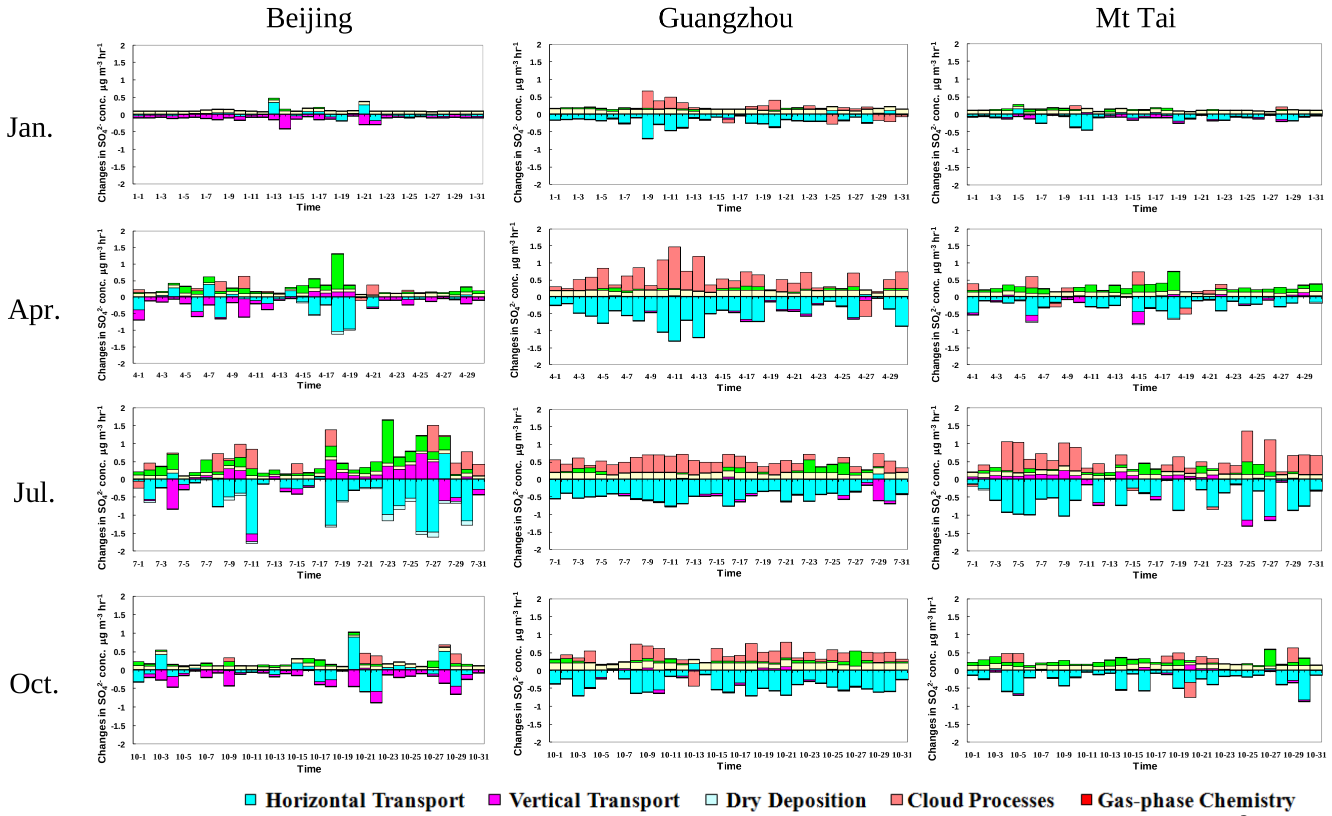

Fig. S-1. Daily-mean hourly contributions of individual processes to the mass concentrations of SO_4^{2-} in the PBL (0-2.9 km) at 3 sites (Beijing, Guangzhou, and Mt.Tai) in China in 2008.

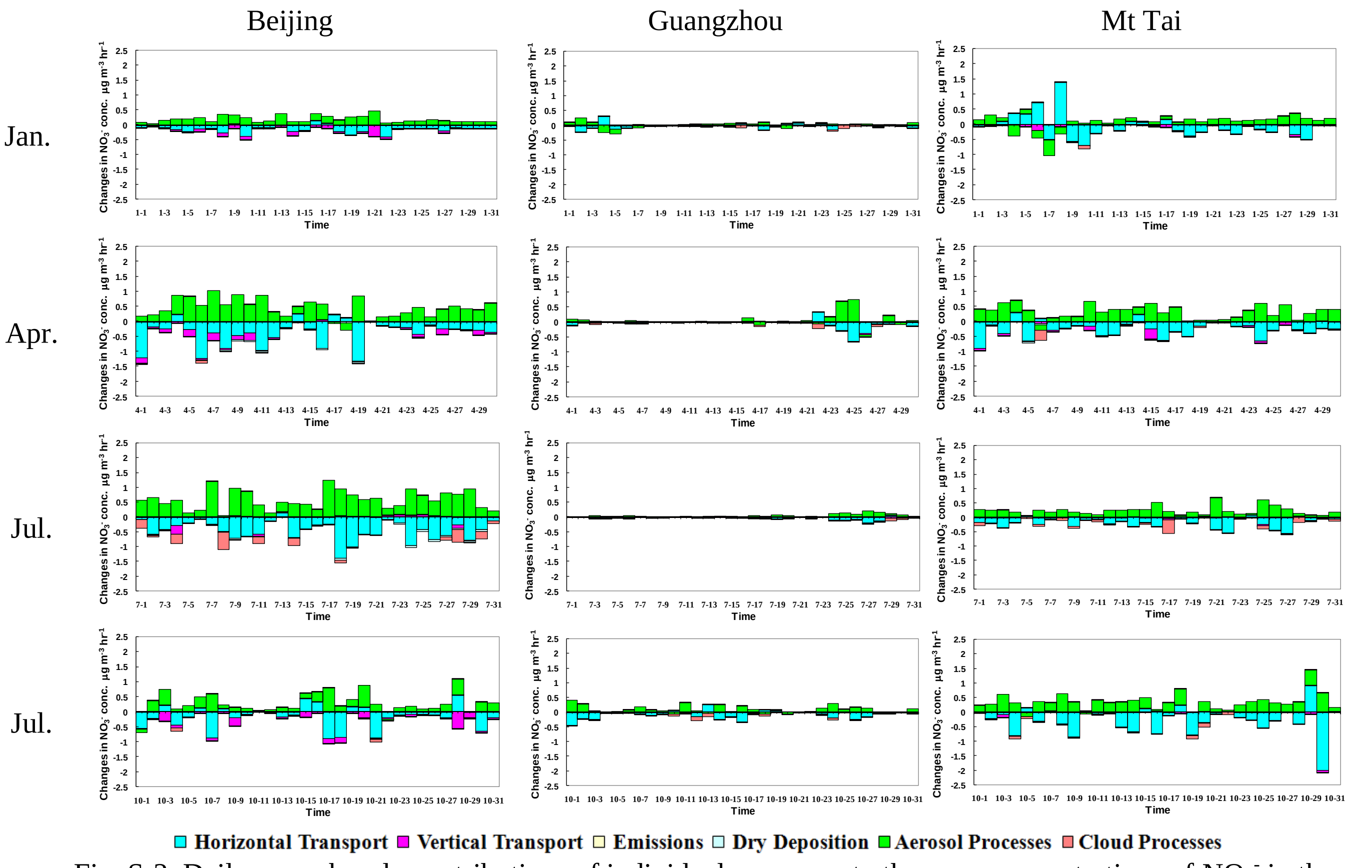

Fig. S-2. Daily-mean hourly contributions of individual processes to the mass concentrations of NO_3^- in the PBL (0-2.9 km) at 3 sites (Beijing, Guangzhou, and Mt. Tai) in China in 2008.

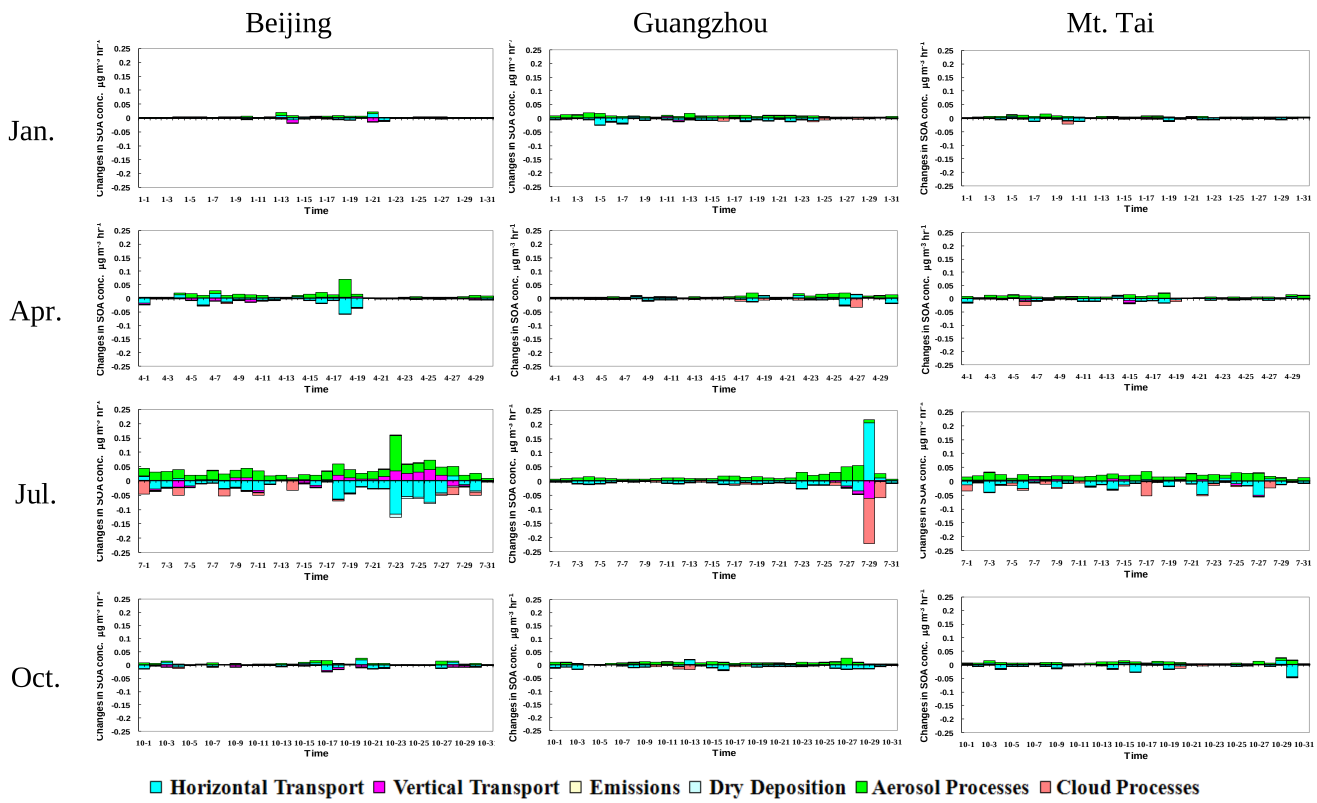

Fig. S-3 Daily-mean hourly contributions of individual processes to the mass concentrations of SOA in the PBL (0-2.9 km) at 3 sites (Beijing, Guangzhou, and Mt.Tai) in China in 2008.

3. Major processes of O_3 and PM_{10} in the PBL at two sites.

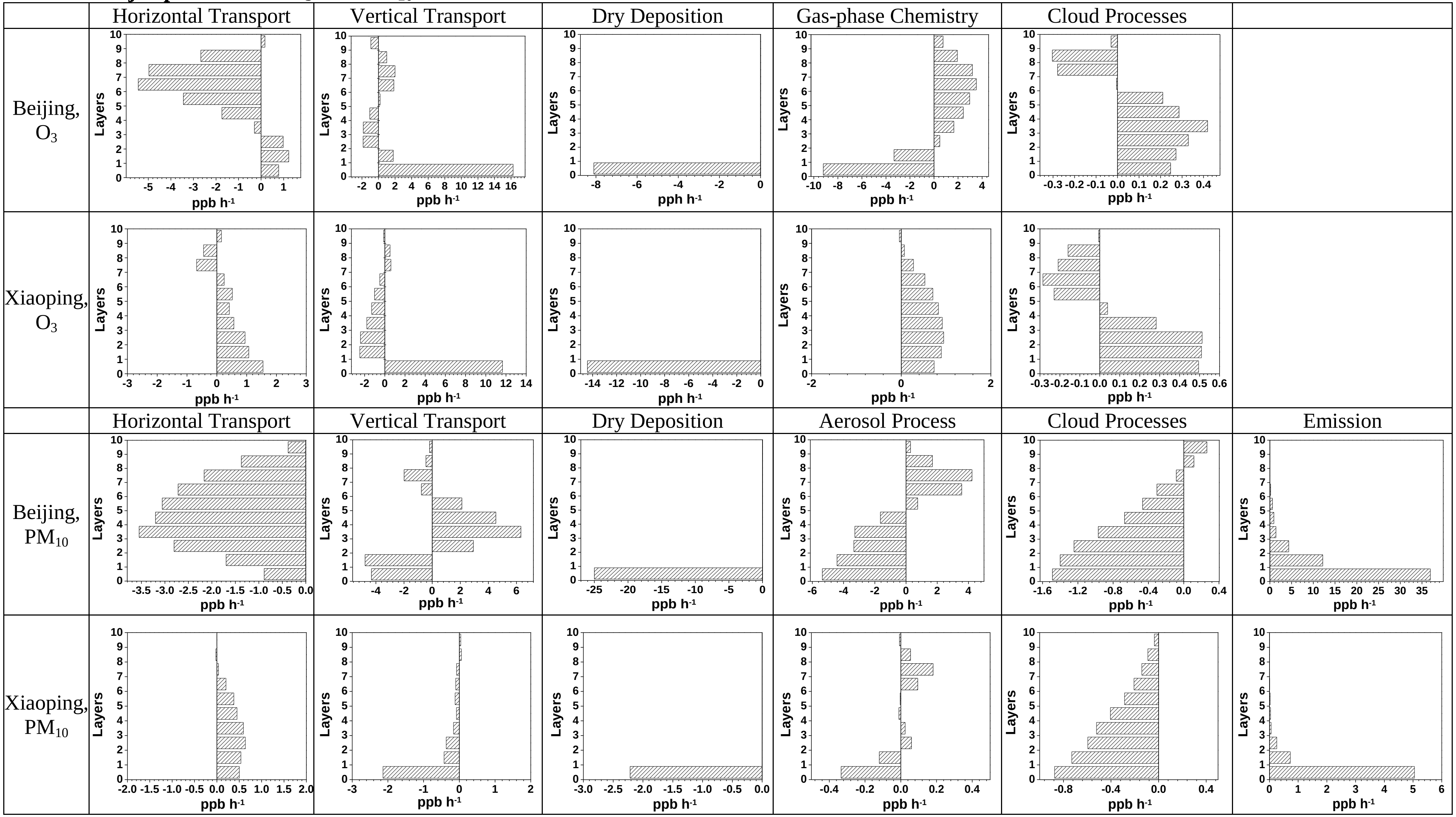

Fig. S-4. Monthly-mean hourly contributions of individual processes to the concentrations of O_3 and PM_{10} at different layers at the Beijing and Xiaoping sites in China in Jul. 2008 (The heights of layers 1-10 are: surface-36m, 36-72 m, 72-145 m, 145-295 m, 295-445 m, 445-675 m, 675-1070 m, 1070-1570 m, 1570-2090 m, and 2090-2950 m, respectively).

4. Process analysis products in the surface layer at eight sites

Total O_x production and OH chain length | OH reacted with AVOC and BVOC

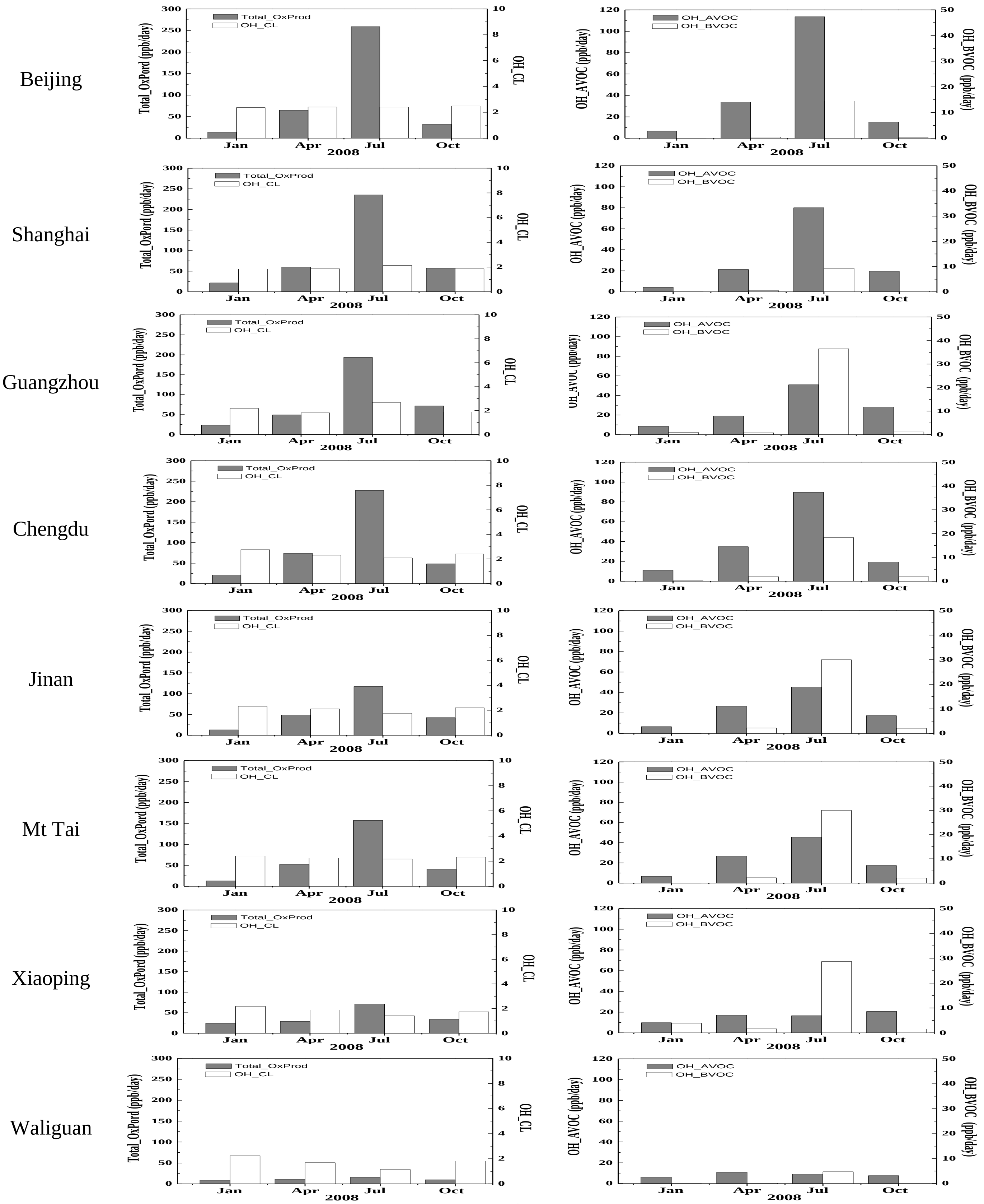

Fig. S-5. Monthly-mean total O_x production rate (ppb day^{-1}), OH chain length (dimensionless), and amounts of OH reacted with AVOCs and BVOCs (ppb day^{-1}) in 2008.

5. Sensitivity results

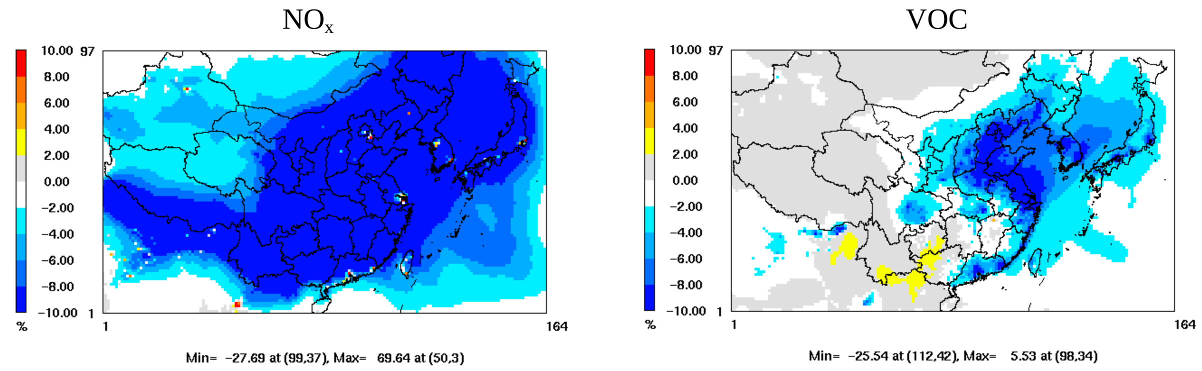

Fig. S-6. The monthly-mean percentage differences of hourly O_3 between the CMAQ simulations with a 50% domain-wide reduction of NO_x or AVOCs emissions and the baseline simulation in July 2008.

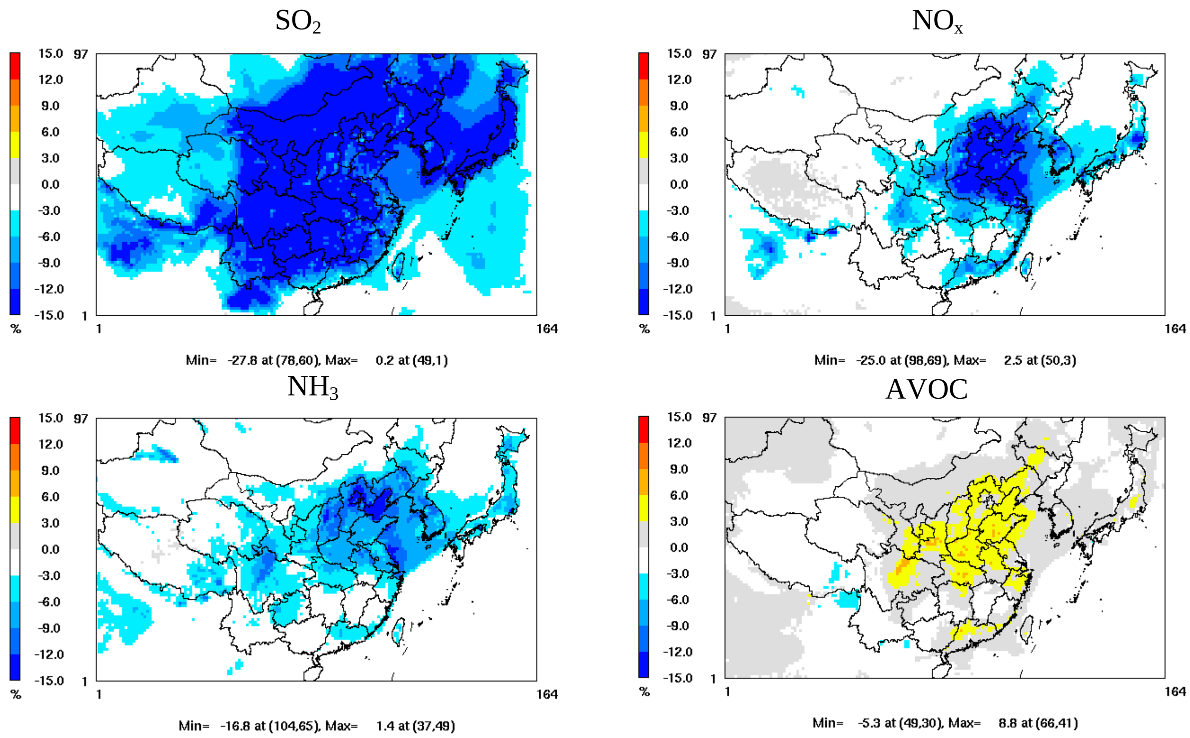

Fig. S-7. The monthly-mean absolute differences of hourly PM_{10} between the CMAQ simulations with a 50% domain-wide reduction of SO_2, or NO_x, or NH_3, or AVOCs emissions and the baseline simulation in July 2008.