

Supplementary information

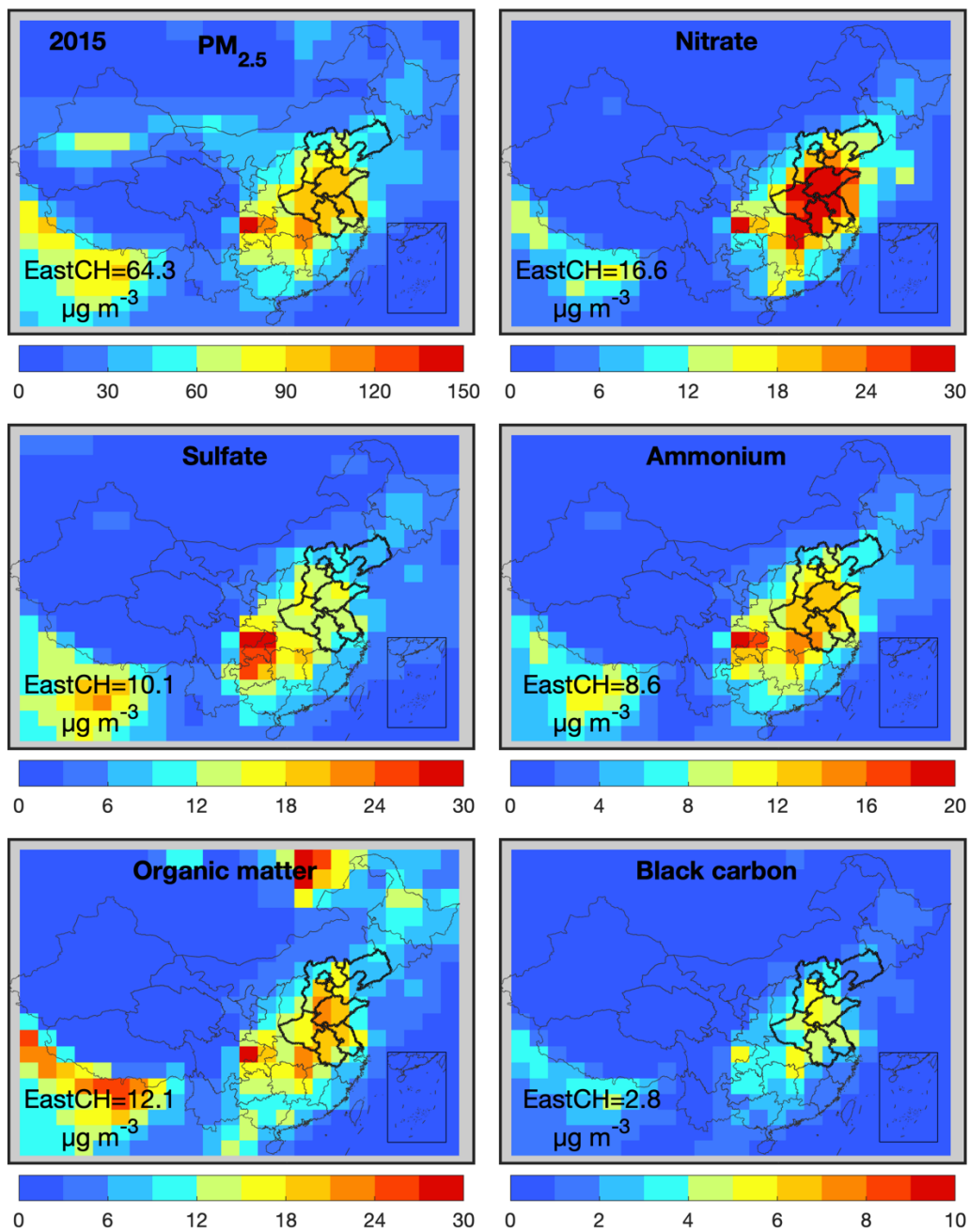


Figure S1. Annual mean total and compositional PM_{2.5} concentrations in China at a resolution of 2° x 2.5°. Spatial distributions of PM_{2.5} and composition concentrations are simulated by the GEOS-Chem model for 2015 January, April, July and October with a resolution of 2° x 2.5°. We regard the mean of the four months as annual mean. Thick black lines outline the eastern China discussed in this work. Text in the bottom left corner of each map refers to mean concentrations ($\mu\text{g m}^{-3}$) over the eastern China.

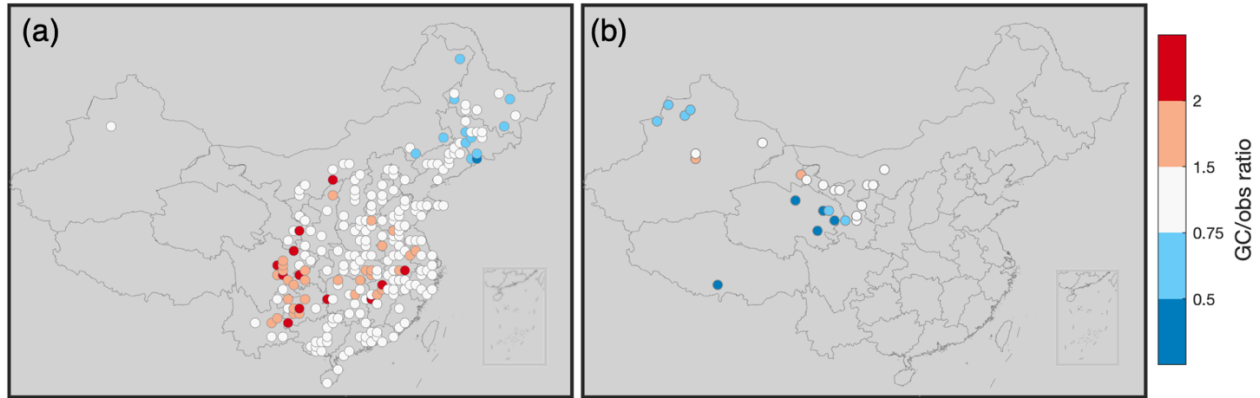


Figure S2. The spatial distribution of simulated and observed 2015 mean $PM_{2.5}$ concentration ratios at (a) anthropogenic pollutant dominated sites and (b) natural pollutant dominated sites. The simulated concentration at each measurement site represents the $0.5^\circ \times 0.625^\circ$ grid cell covering that site.

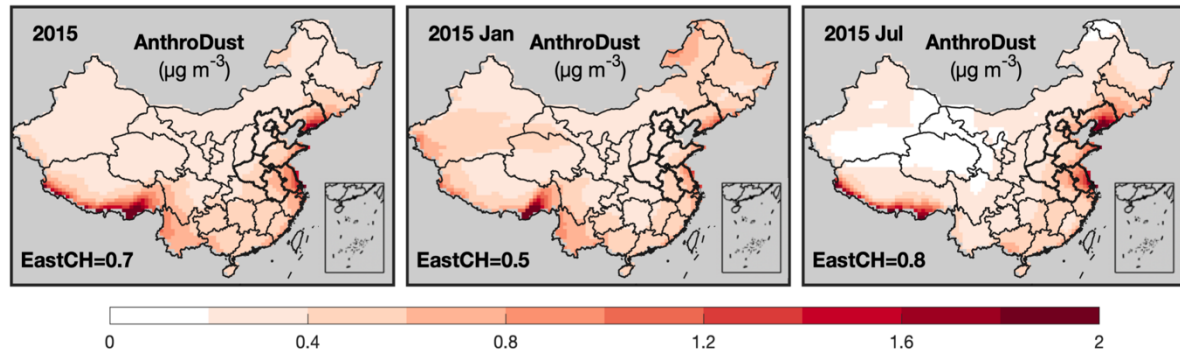


Figure S3. Annual mean contributions of foreign anthropogenic dust emissions to China in 2015 as simulated by the GEOS-Chem model. Thick black lines outline the eastern China discussed in this work. Text in the bottom left corner of each panel refers to mean concentrations ($\mu\text{g m}^{-3}$) over the eastern China contributed by foreign anthropogenic emissions.

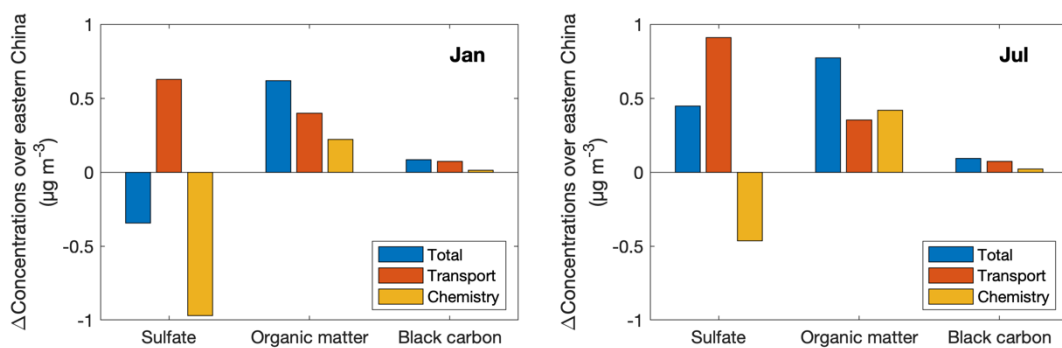


Figure S4. Contributions of foreign anthropogenic emissions to sulfate, organic matter and black carbon concentrations in January and July over the eastern China. Total concentrations contributions by foreign anthropogenic emissions are split into contributions from direct transport and chemical interactions according to the legend.

TableS1. Observations of PM_{2.5} composition concentrations from the literature. Concentrations are all in the unit of $\mu\text{g m}^{-3}$. NaN indicates a lack of record from the literature.

| Province or municipality | City | Latitude (°) | Longitude (°) | Start Time | Duration (months) | Sulfate | Nitrate | Ammonium | Organic aerosol | Black carbon | References |
|--------------------------|-----------|--------------|---------------|------------|-------------------|---------|---------|----------|-----------------|--------------|--------------|
| Beijing | Beijing | 39.59 | 116.21 | 2014.10 | 1 | 11.3 | 28.56 | 10.76 | 13.92 | 1.91 | Xu (2019) |
| Beijing | Beijing | 39.59 | 116.21 | 2014.1 | 1 | 9.96 | 11.43 | 5.13 | 22.04 | 6.27 | Li (2019) |
| Beijing | Beijing | 40.02 | 116.28 | 2014.1 | 1 | 22.61 | 24.41 | 4.5 | 44.84 | 16.03 | Li (2019) |
| Beijing | Beijing | 39.90 | 116.40 | 2014.1 | 2 | 54.21 | 65.66 | 10.82 | 31.04 | 7.86 | Li (2019) |
| Beijing | Beijing | 39.90 | 116.40 | 2014.1 | 1 | 9.6 | 12.1 | 6.7 | 47.585 | 9.475 | Gao (2018) |
| Beijing | Beijing | 39.90 | 116.40 | 2014.4 | 1 | 10.7 | 10.7 | 11.4 | 22.105 | 6.217 | Gao (2018) |
| Beijing | Beijing | 39.90 | 116.40 | 2014.7 | 1 | 25.6 | 25.6 | 14.1 | 14.872 | 5.329 | Gao (2018) |
| Beijing | Beijing | 39.90 | 116.40 | 2014.10 | 1 | 21.1 | 45.5 | 13.9 | 32.245 | 6.032 | Gao (2018) |
| Chongqing | Chongqing | 30.39 | 108.37 | 2014.1 | 1 | NaN | NaN | NaN | 13.263 | 2.41 | Huang (2018) |
| Chongqing | Chongqing | 30.39 | 108.37 | 2014.4 | 1 | NaN | NaN | NaN | 10.934 | 2.73 | Huang (2018) |
| Gansu | Xigu | 36.1 | 103.62 | 2014.4 | 1 | 5.2 | 2.2 | 1.4 | 11.8 | 4.7 | Wang (2016) |
| Gansu | Xigu | 36.1 | 103.62 | 2014.10 | 1 | 9 | 11.3 | 6.5 | 17.2 | 8.5 | Wang (2016) |
| Guangdong | Guangzhou | 23.07 | 113.15 | 2014.1 | 1 | 9.8 | 5.5 | 4.8 | 11.6 | 5 | Tao (2017) |
| Guangdong | Guangzhou | 23.07 | 113.15 | 2014.4 | 1 | 7 | 2.1 | 3.2 | 7.4 | 2.2 | Tao (2017) |
| Guangdong | Guangzhou | 23.07 | 113.21 | 2014.9 | 1 | 11.4 | 1 | 4.4 | 7.9 | 3.6 | Tao (2017) |
| Guangdong | Guangzhou | 23.07 | 113.15 | 2014.10 | 1 | 12.6 | 2.4 | 5.1 | 10.3 | 3.1 | Tao (2017) |
| Hainan | Haikou | 19.32 | 110.10 | 2015.1 | 9 | NaN | NaN | NaN | 5.6 | 2.5 | Tao (2017) |
| Hebei | Baoding | 38.87 | 115.47 | 2014.1 | 1 | 25.3 | 25.3 | 17.1 | 124.924 | 16.973 | Gao (2018) |
| Hebei | Baoding | 38.87 | 115.47 | 2014.1 | 1 | 10.6 | 10.6 | 9.3 | 17.691 | 3.394 | Gao (2018) |
| Hebei | Baoding | 38.87 | 115.47 | 2014.7 | 1 | 13.1 | 13.1 | 8.3 | 23.156 | 0.915 | Gao (2018) |
| Hebei | Baoding | 38.87 | 115.47 | 2014.10 | 1 | 32.4 | 32.4 | 16.5 | 38.942 | 8.772 | Gao (2018) |
| Henan | Zhengzhou | 34.8 | 113.5167 | 2014.12 | 2 | NaN | NaN | NaN | 25 | 5 | Wang (2017) |
| Henan | Zhengzhou | 34.48 | 113.31 | 2014.6 | 1 | NaN | NaN | NaN | 7.2 | 3.3 | Jiang (2018) |
| Henan | Zhengzhou | 34.48 | 113.31 | 2014.12 | 1 | NaN | NaN | NaN | 36.6 | 17.5 | Jiang (2018) |
| Hubei | Wuhan | 30.5728 | 114.4062 | 2014.1 | 12 | 16.78 | 11.28 | 9.67 | NaN | NaN | Huang (2016) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.4 | 1 | 17.2 | 8 | 11.1 | 7.7 | 4.9 | Ma (2019) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.6 | 1 | 15.6 | 9 | 6.9 | 16.2 | 6.7 | Ma (2019) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.12 | 1 | 14.7 | 14.9 | 7.9 | 16.4 | 6.4 | Ma (2019) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.4 | 1 | 15.1 | 6.3 | 5.3 | 4.6 | 3.4 | Ma (2019) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.6 | 1 | 14.1 | 7.9 | 6 | 13 | 5 | Ma (2019) |
| Hunan | Xiangtan | 27.48 | 112.55 | 2016.12 | 1 | 13.9 | 14.6 | 8.3 | 16.1 | 5.9 | Ma (2019) |
| Jiangsu | Nanjing | 32.03 | 118.46 | 2014.1 | 1 | 3.46 | 5.81 | 4.26 | 18.2 | 6.93 | Kong (2015) |
| Jiangsu | Nanjing | 32.03 | 118.46 | 2014.1 | 1 | 7.74 | 5.27 | 4.81 | 9.38 | 3.12 | Kong (2015) |
| Jiangsu | Nanjing | 32.03 | 118.46 | 2014.2 | 1 | 4.05 | 6.59 | 5.33 | 8.95 | 2.96 | Kong (2015) |
| Shaanxi | Xi'an | 34.17 | 108.93 | 2014.12 | 12 | 13.96 | 15.14 | 7.51 | 19.22 | 1.57 | Dai (2018) |

| | | | | | | | | | | | |
|----------|----------------|-------|--------|---------|----|-------|-------|------|-------|-------|--------------|
| Shaanxi | Xi'an | 34.17 | 108.93 | 2014.12 | 12 | 16.01 | 17.48 | 8.94 | 19.47 | 1.91 | Dai (2018) |
| Shaanxi | Xi'an | 34.15 | 108.55 | 2014.12 | 12 | 15.33 | 17.42 | 8.7 | 19.57 | 1.79 | Dai (2018) |
| Shaanxi | Xi'an | 34.15 | 108.54 | 2014.12 | 12 | 16 | 17.34 | 8.67 | 19.94 | 2.25 | Dai (2018) |
| Shaanxi | Xi'an | 34.09 | 108.55 | 2014.12 | 12 | 15.42 | 16.79 | 8.9 | 19.55 | 1.68 | Dai (2018) |
| Shaanxi | Xi'an Bohai | 34.2 | 108.56 | 2014.12 | 12 | 12.31 | 12.78 | 6.7 | 12.85 | 1.3 | Dai (2018) |
| Shandong | Island | 38.24 | 120.55 | 2015.4 | 3 | 13.31 | 6.92 | 4.98 | 5.79 | 2.24 | Zong (2018) |
| Shanghai | Shanghai | 31.3 | 121.5 | 2014.1 | 3 | 11.7 | 13.9 | 7.8 | NaN | NaN | Tao (2016) |
| Sichuan | Chengdu | 30.65 | 104.03 | 2014.10 | 1 | 10.5 | 9.3 | 6.9 | 10.4 | 3 | Wang (2018) |
| Sichuan | Chengdu | 30.65 | 104.03 | 2015.1 | 1 | 16.4 | 17.5 | 12.7 | 19.7 | 6.3 | Wang (2018) |
| Sichuan | Chengdu | 30.65 | 104.03 | 2015.4 | 1 | 8.3 | 5.9 | 5.1 | 6.3 | 2.7 | Wang (2018) |
| Sichuan | Chengdu | 30.65 | 104.03 | 2015.7 | 1 | 9.7 | 3.9 | 4.2 | 7.4 | 2.5 | Wang (2018) |
| Sichuan | Chongqing | 29.37 | 106.3 | 2015.1 | 1 | 17.5 | 15.8 | 11.3 | 24.2 | 5.9 | Wang (2018) |
| Tianjin | Tianjin | 39.06 | 117.1 | 2014.1 | 3 | 22.1 | 8.7 | 7.7 | 16.4 | 3.8 | Cao (2012) |
| Tianjin | Tianjin | 39.06 | 117.1 | 2014.7 | 3 | 32.5 | 25.5 | 22.2 | 43 | 8.9 | Cao (2012) |
| Tianjin | Tianjin | 39.06 | 117.1 | 2014.10 | 3 | 12.8 | 9.9 | 8.2 | 16.1 | 4.187 | Gao (2018) |
| Zhejiang | Ninbo | 29.8 | 121.56 | 2014.1 | 3 | 8.1 | 10.6 | 5 | NaN | NaN | Xu (2017) |
| Zhejiang | Ninbo | 29.86 | 121.52 | 2014.1 | 3 | 10.7 | 10.3 | 9.4 | NaN | NaN | Xu (2017) |
| Zhejiang | NaN | 30.18 | 119.44 | 2014.1 | 3 | 20.5 | 14.7 | 9.4 | 11.9 | 3.1 | Zhang (2017) |
| Zhejiang | NaN | 30.18 | 119.44 | 2014.4 | 3 | 18.5 | 7.1 | 5.8 | 10.3 | 2.6 | Zhang (2017) |
| Zhejiang | NaN | 30.18 | 119.44 | 2014.7 | 3 | 10.5 | 1.4 | 1.9 | 7.2 | 1.6 | Zhang (2017) |
| Zhejiang | NaN | 30.18 | 119.44 | 2014.1 | 3 | 15.9 | 11.7 | 4.9 | 13.8 | 3.4 | Zhang (2017) |

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