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Fine particulate matter ($PM_{2.5}$) trends in China, 2013–2018: separating contributions from anthropogenic emissions and meteorology

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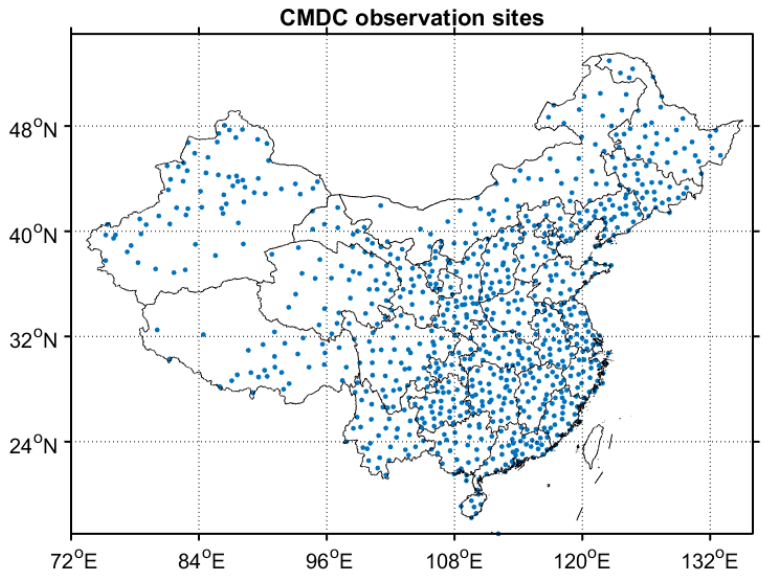

Figure S1 Distribution of meteorological observation sites archived in the Surface Daily Climate Dataset (V3.0) from the China National Meteorological Information Center (CNMIC; http://data.cma.cn/).

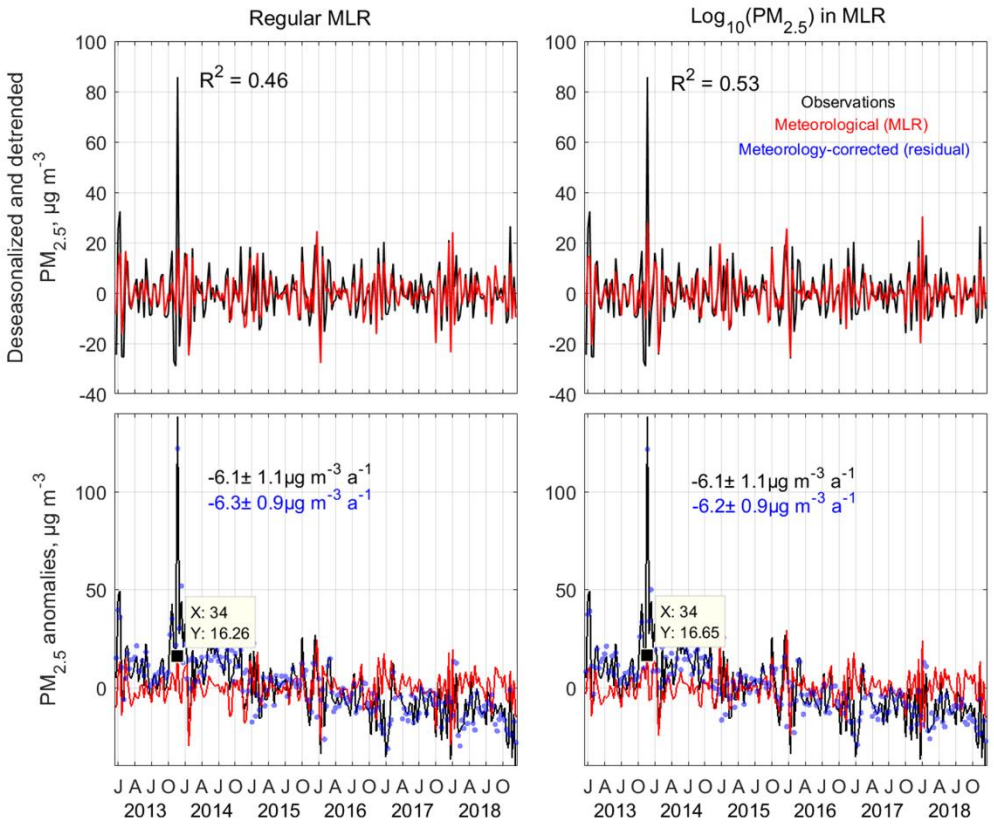

Figure S2 Top panels: Observed and MLR model fitted deseasonalized and detrended $PM_{2.5}$ over YRD for 'regular MLR' (left; MLR used in this study) and for relating $\log_{10}(PM_{2.5})$ to meteorological variables in MLR (right). Bottom panels: Observed and MLR model fitted $PM_{2.5}$ anomalies over YRD for 'regular MLR' (left) and for relating $\log_{10}(PM_{2.5})$ to meteorological variables in MLR (right). We take the logarithm of $PM_{2.5}$ to reduce the influence of extreme values. The top panels confirm the unfavorable meteorological conditions in December 2013 over YRD.

Note: As the 'regular MLR' performs better overall correlations for our study region, and the improvement over YRD does not change the conclusion, we adopted the 'regular MLR' in our main text.

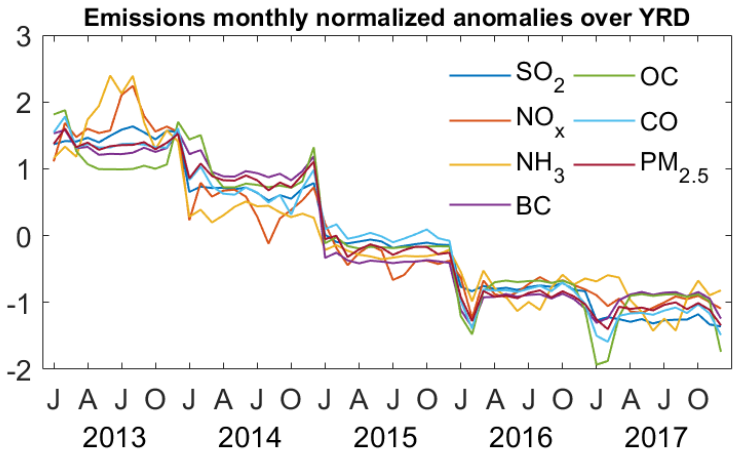

Figure S3 Monthly normalized anomalies of SO_2, NO_x, NH_3, BC, OC, CO, and primary $PM_{2.5}$ emission intensities from the Multi-resolution Emission Inventory for China (MEIC; http://www.meicmodel.org). January 2017 has anomalously low OC, CO and primary $PM_{2.5}$ emission intensities compared with previous years at the same month.

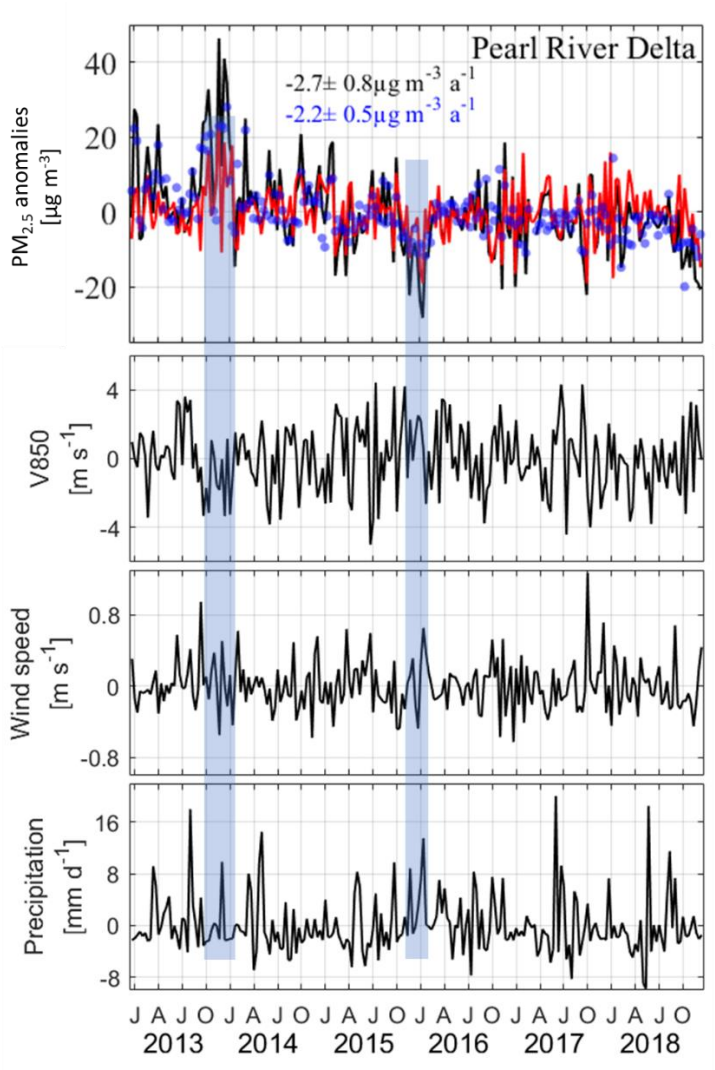

Figure S4 Time series of 2013-2018 10-day mean anomalies for $PM_{2.5}$ (same as the PRD panel in Figure 6), 850 hPa meridional wind velocity (V850), wind speed, and precipitation over PRD. The high $PM_{2.5}$ in autumn 2013 to winter 2013-2014 are associated with anomalously low V850. The low $PM_{2.5}$ in Dec. 2015 and early Jan. 2016 are associated with anomalously high V850, high wind speed, and more precipitation.

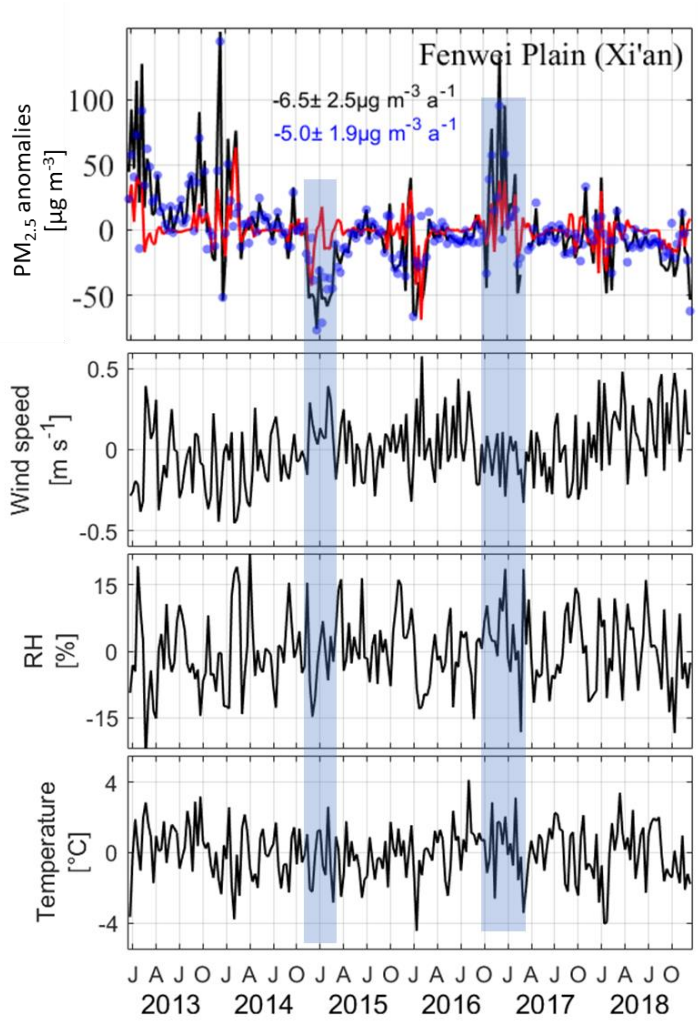

Figure S5 Time series of 2013-2018 10-day mean anomalies for $PM_{2.5}$ (same as the FWP panel in Figure 6), wind speed, RH, and temperature over FWP. The low $PM_{2.5}$ in winter 2014-2015 are associated with anomalously high wind speed, low RH, and low temperature. The several high peaks from Nov. 2016- Feb. 2017 in FWP are associated with anomalously low wind speed, high RH and high temperature.

Table S1 Meteorological variables included in the final MLR models.

Regions / Seasons	BTH	YRD	PRD	SCB	FWP (Xi'an)
Winter	PRECIP(-) RH(+) TEM(+) V850(+)	WIN(-) TEM(+)	WIN(-) RH(-) V850(-)	WIN(-) RH(-) TEM(+) V850(+)	WIN(-) V850(+)
Spring	PRECIP(-) RH(+) TEM(+) V850(+)	TEM(+)	WIN(-) TEM(+) V850(-)	WIN(-) RH(-) TEM(+)	PRECIP(-) RH(+)
Summer	WIN(-) V850(+)	WIN(-) PRECIP(-)	WIN(-) RH(-) V850(-)	WIN(-) RH(-) V850(+/-)	PRECIP(-)
Autumn	RH(+) TEM(+) V850(+)	WIN(-) TEM(+)	WIN(-) RH(-)	WIN(-) RH(-)	WIN(-) TEM(+)

Note: The signs in brackets indicate the sign of their correlations to $PM_{2.5}$. Variables in red are variables selected by most of the grids in a region. For each grid, at most 3 meteorological variables were retained in the final MLR model after the stepwise selection procedure. The final meteorological variables in the MLR show regional consistency with occasionally heterogeneity. Only variables appear in at least 2 grids are listed.