

Faraday Discussions
Supplemental Information
PM_{2.5} Pollution in China's Guanzhong Basin and US's San Joaquin Valley Mega-Regions

John G. Watson^{1,2,3}
Junji Cao^{2,4}
Xiaoliang Wang^{1,3}
Judith C. Chow^{1,2,3}

¹*Division of Atmospheric Sciences, Desert Research Institute, Reno, Nevada, USA*

²*State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment,
Chinese Academy of Sciences, Xi'an, China*

³*Graduate Faculty, University of Nevada, Reno Nevada, USA*

⁴*Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China*

Introduction

Table S1 summarizes and compares emission reduction measures for the SJV and GZB. Figure S1 compares monthly 24-hour PM_{2.5} distributions at urban-scale¹ monitors in the western (Baoji), middle (Xi'an) and eastern (Linfen) portions of the GZB, indicating that wintertime levels experience the highest concentrations. Data were acquired by Berman² from hourly beta attenuation measurements at GZB compliance sites. Figure S1 data are only available for parts of 2014 through 2016. Figure S2 shows analogous 24-hour PM_{2.5} distributions in the southern (Bakersfield), middle (Fresno), and northern (Modesto) portions of the SJV, also with the highest concentrations occurring during the winter months. Data were obtained from the U.S.EPA³ compliance data base. Federal Reference Method (FRM)⁴ filter samples were gravimetrically⁵ analyzed for SJV measurements.

In Figures S1 and S2, the 25th and 75th quartiles (bottoms and tops of boxes), minimum and maximum (lower and upper ends of whiskers), and “outliers” denoted by circles (values over or under 1.5 times the difference between the 75th and 25th quartile). The winter season includes December and January and February of the following year; spring is March, April, and May; summer is June, July, and August; and fall is September, October, and November for each year.

References

1. J. C. Chow, J. P. Engelbrecht, J. G. Watson, W. E. Wilson, N. H. Frank and T. Zhu, *Chemosphere*, 2002, **49**, 961-978.
2. L. Berman, *National AQI Observations (2014-05 to 2016-12)*, Harvard Dataverse, Cambridge, MA, 2017. <https://doi.org/10.7910/DVN/QDX6L8>
<https://dataverse.harvard.edu/dataverse/beijing-air>
3. U.S.EPA, *Pre-generated data files*, U.S. Environmental Protection Agency, Research Triangle Park, NC, 2020. https://aqs.epa.gov/aqsweb/airdata/download_files.html
4. U.S.EPA, *List of designated reference and equivalent methods*, U.S. Environmental Protection Agency, Research Triangle Park, NC, 2020. https://www.epa.gov/sites/production/files/2019-08/documents/designated_reference_and-equivalent_methods.pdf
5. J. G. Watson, R. J. Tropp, S. D. Kohl, X. L. Wang and J. C. Chow, *Aerosol Science and Engineering*, 2017, **1**, 193-205.

Table S1. Clean air actions in China and central California, USA

Source Sectors	Control Measures	
	China (Target Year)	Central California, USA
Industry	<ul style="list-style-type: none"> • Eliminate small (<20 gigawatts) coal-fired boilers (2025) • Purify raw coal and implement flue-gas desulfurization (install SO₂ scrubbers) • Achieve emission limits for industry boilers, coking, iron and steel, and cement (2030) 	<ul style="list-style-type: none"> • Install oxides of nitrogen scrubbers in southern SJV oil field steam generator • Substitute natural gas for crude oil combustion in steam generators
Transportation	<ul style="list-style-type: none"> • Comply with China VI emissions standards for on-road gasoline and diesel vehicles including heavy duty vehicles (2025) • Implement China V (Euro 5) for off-road vehicles (2030) • Average diesel fuel sulfur content <10 ppmw (starting 2017) • Optimize traffic management 	<ul style="list-style-type: none"> • Eliminate leaded gasoline • Provide subsidies to replace old with newer engines • Replace diesel irrigation pumps with electric and propane pumps • Reduce sulfur content to <15 ppmw maximum, (<~7 ppmw average) for on- and off-road gasoline and diesel fuels Enforced by periodic testing and penalties • Stricter emission standards for on- and off-road diesel engines
Agriculture	<ul style="list-style-type: none"> • Improved farming policies and technologies (factsanddetails.com), no specifics • Guidance on chemical pesticide and fertilizer use • Improved methods for prescribed agricultural burning 	<ul style="list-style-type: none"> • Improve livestock management practices to reduce volatile organic compounds (VOCs) and ammonia (NH₃) emissions • Controlled field burns of crop residues
Residential	<ul style="list-style-type: none"> • Ban domestic coal burning for heating and cooking in rural villages (2030) 	<ul style="list-style-type: none"> • Replace old wood burning appliances with certified stoves
Fugitive Dust	<ul style="list-style-type: none"> • Street cleaning with water spray in urban city centers 	<ul style="list-style-type: none"> • Implement fugitive dust suppression rules for construction, paved and unpaved roads, and agricultural/food/mineral processing

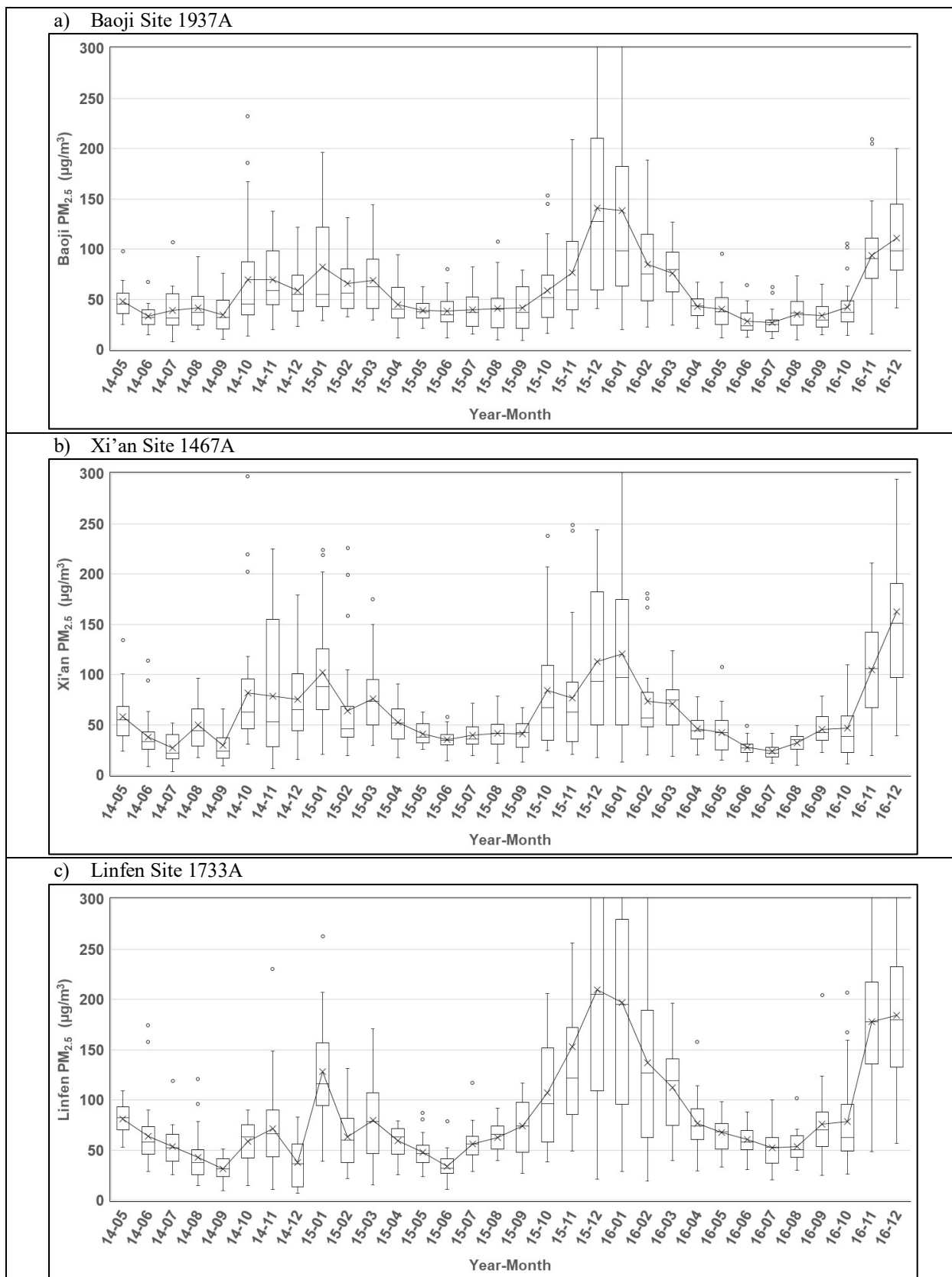


Figure S1 Monthly 24-hour PM_{2.5} distributions at GZB monitoring sites ² from 2014 to 2016.

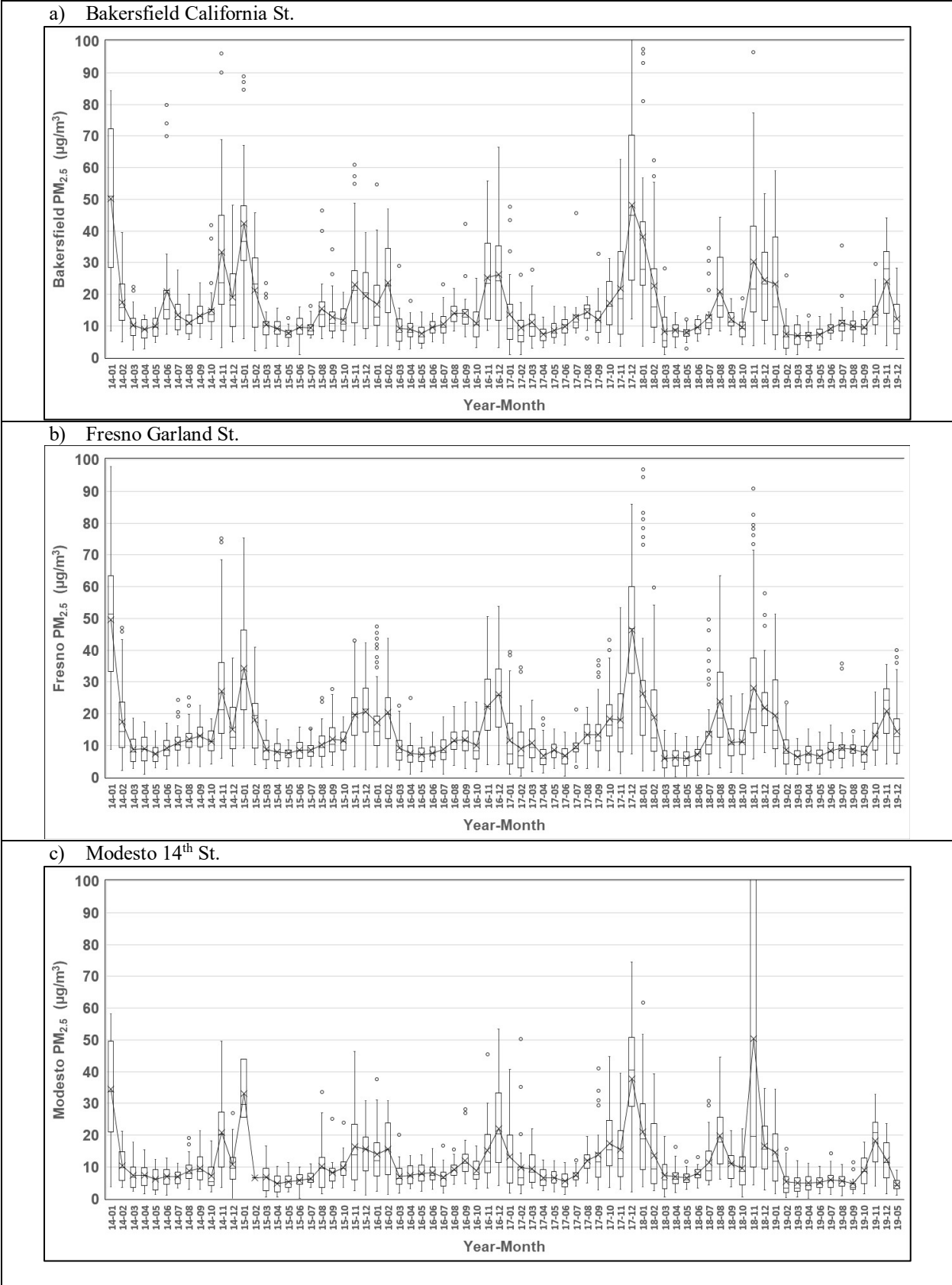


Figure S2 Monthly 24-hour PM_{2.5} distributions at SJV monitoring sites from 2014 to 2016.