

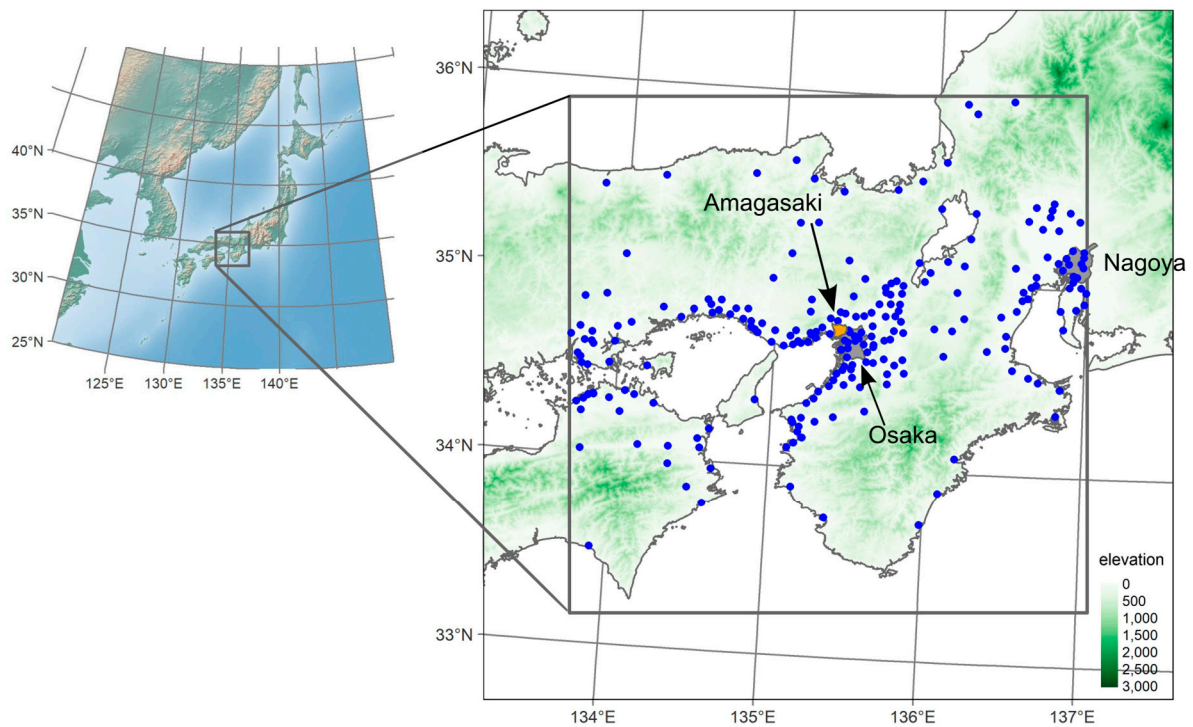
# Supplementary material: Predicting Daily PM<sub>2.5</sub> Exposure with Spatially Invariant Accuracy Using Co-existing Pollutant Concentrations as Predictors

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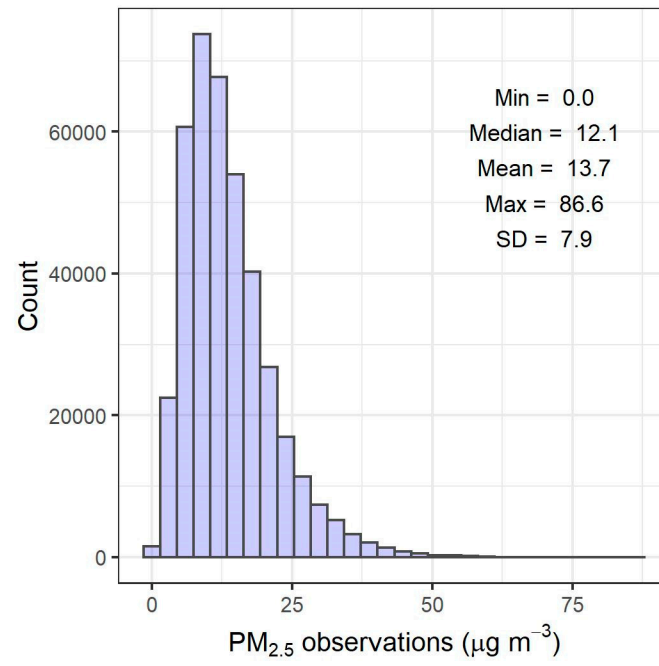
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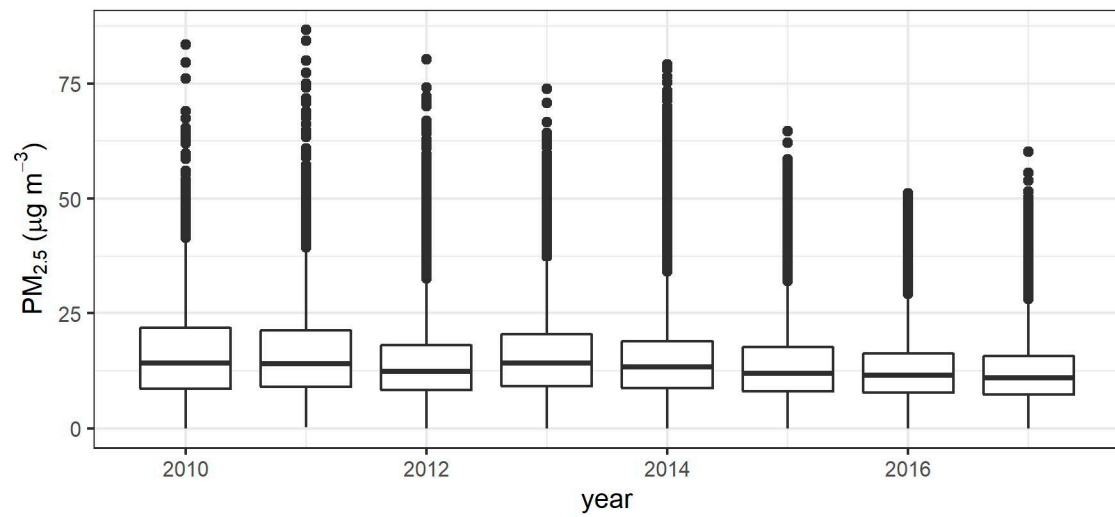
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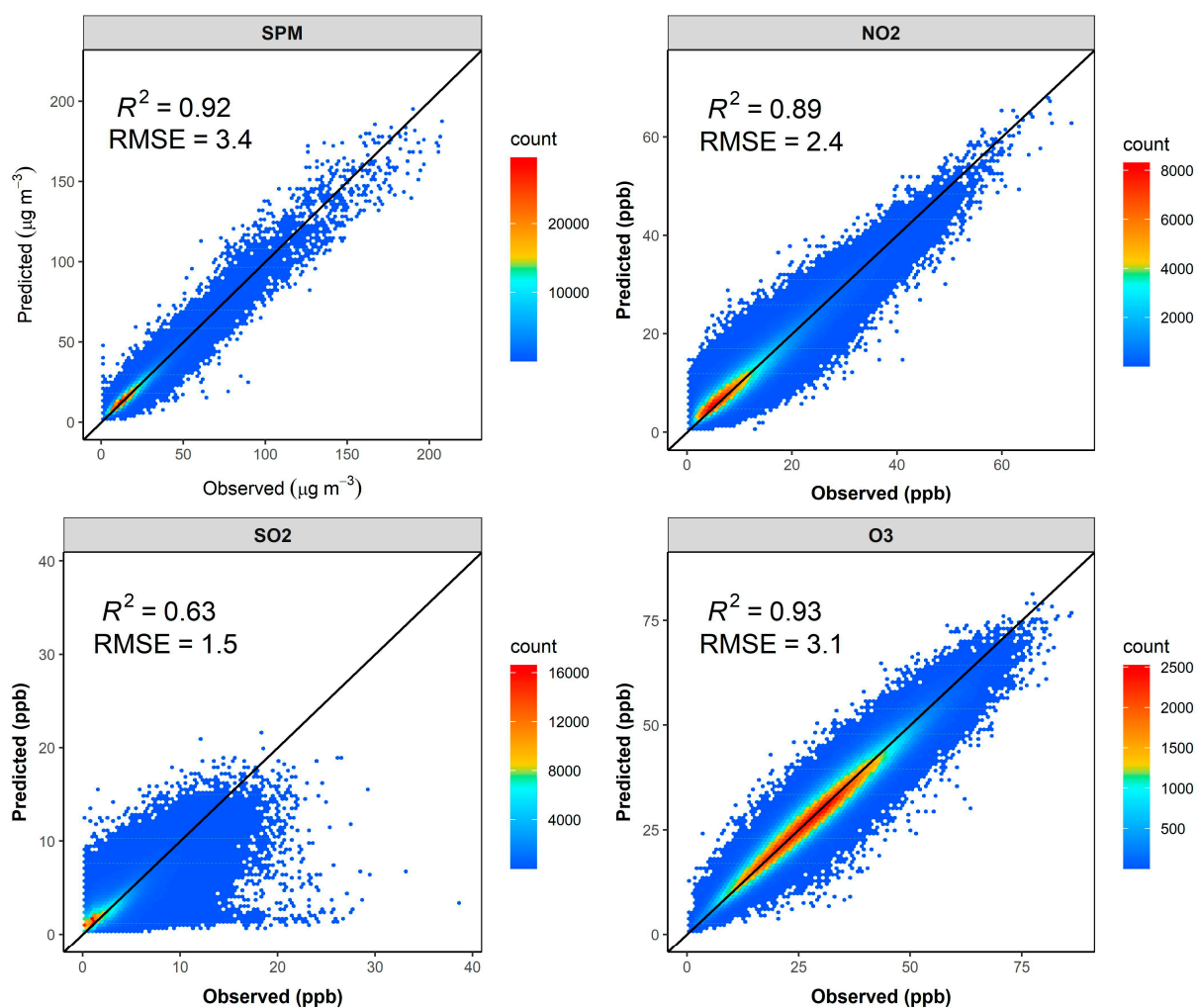
**Figure S1.** Study area. The blue dots represent the monitoring locations. The inner rectangle represents the modeling and prediction areas. The colored area indicates Amagasaki. The shaded areas indicate Osaka and Nagoya.



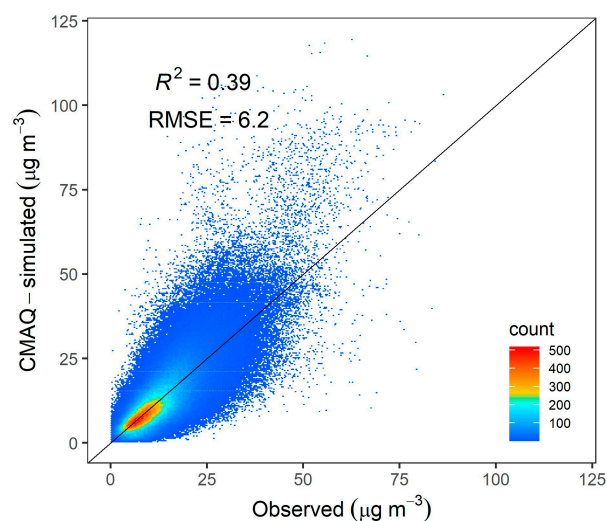
**Figure S2.** Histograms of the daily PM<sub>2.5</sub> observations used in this study. Unit is  $\mu\text{g m}^{-3}$ .



**Figure S3.** Boxplot of the daily PM<sub>2.5</sub> observations used in this study. Unit is  $\mu\text{g m}^{-3}$ .



**Figure S4.** Validation results of ordinary kriging for co-existing pollutants obtained by 5-fold cross-validation via ordinary kriging to obtain model predictors. Red represents higher point density and blue represents lower density. The lines in each panel represent a 1:1 line.



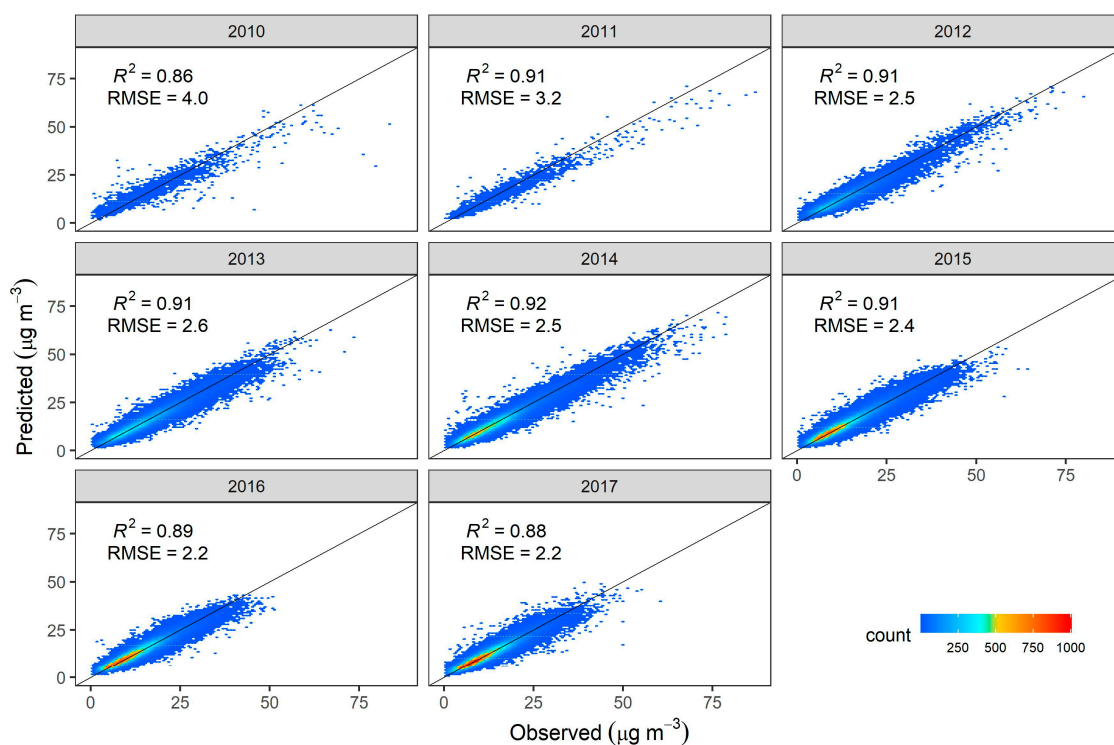
**Figure S5.** Scatter plots of the CMAQ-simulated and observed daily PM<sub>2.5</sub> concentrations in the study area from 2010 to 2017.

**Table S1.** Predictors used in this study.

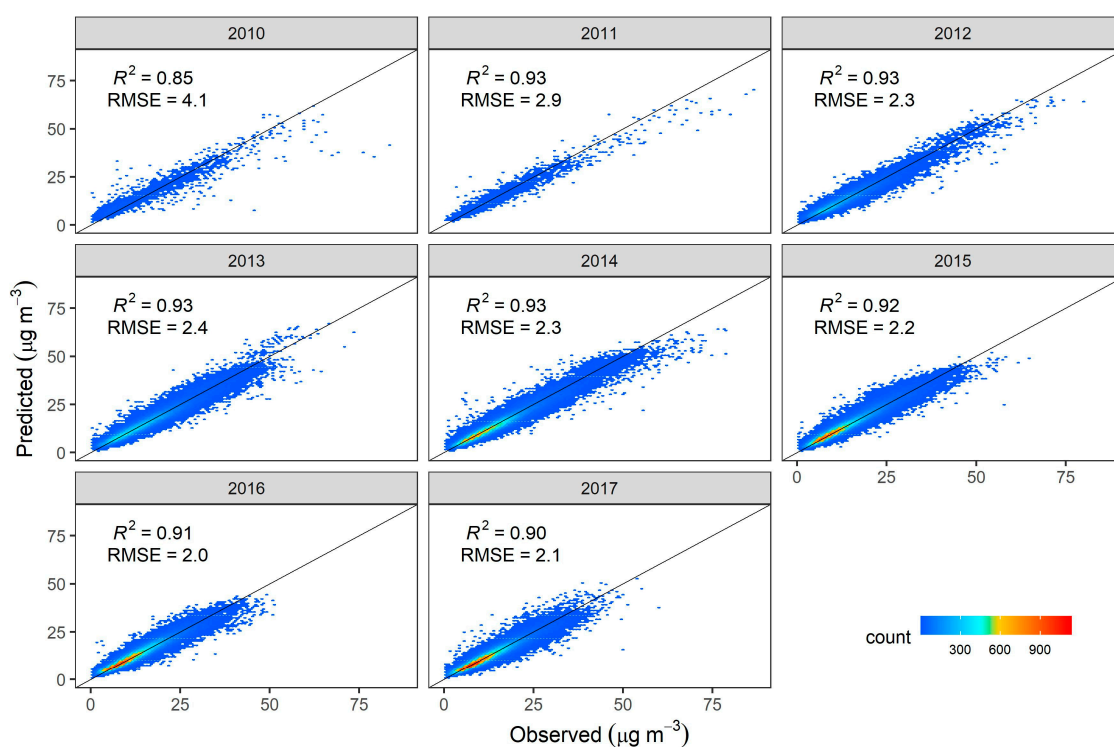
Variables	Temporal Resolution	Units
Kriged SPM	Daily	$\mu\text{g m}^{-3}$
Kriged NO <sub>2</sub>	Daily	ppb
Kriged O <sub>3</sub>	Daily	ppb
Kriged SO <sub>2</sub>	Daily	ppb
CMAQ PM <sub>2.5</sub>	Daily	$\mu\text{g m}^{-3}$
WRF temperature	Daily	K
WRF precipitation	Daily	mm h <sup>-1</sup>
WRF relative humidity	Daily	%
WRF wind speed	Daily	m s <sup>-1</sup>
WRF PBL	Daily	m
Built-up area ration	Constant	unitless
Green area ratio	Constant	unitless
Agricultural area ratio	Constant	unitless
Large PM <sub>2.5</sub> point sources	Monthly	kg km <sup>-2</sup> day <sup>-1</sup>
Primary road length	Constant	km
Highway road length	Constant	km
Distance to primary road	Constant	km
Distance to highway	Constant	km
Elevation	Constant	m
Population	Constant	number

**Table S2.** Data sources.

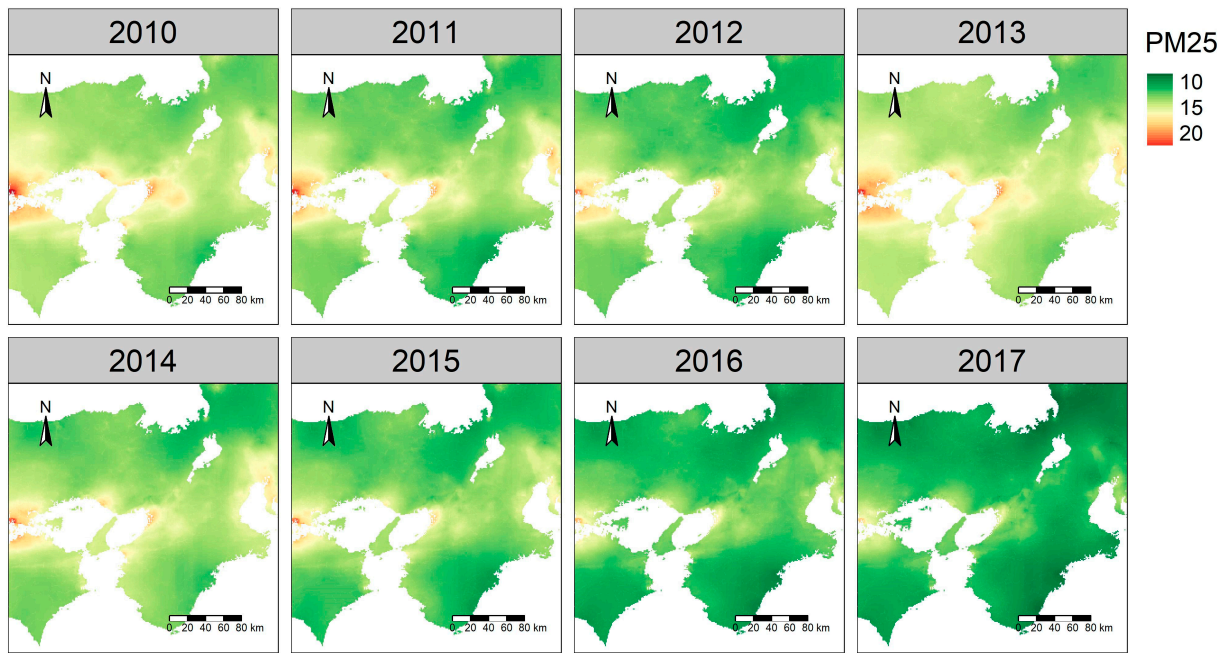
Predictor	Data Source	Period	Source
<b>Air quality monitoring network data</b>	Ministry of Environment, Japan	2010–2017	<a href="http://www.nies.go.jp/igreen/">http://www.nies.go.jp/igreen/</a>
<b>Land use data</b>	National Land Numerical Information Data	2014	<a href="http://nlftp.mlit.go.jp/ksj/">http://nlftp.mlit.go.jp/ksj/</a>
<b>Elevation</b>			
<b>Emission from large point sources</b>	EAGrid2010-Japan	2010	<a href="https://doi.org/10.11298/taiki.49.117">https://doi.org/10.11298/taiki.49.117</a>
<b>Road network data</b>	OpenStreetMap	2015	<a href="https://www.openstreetmap.org">https://www.openstreetmap.org</a>
<b>Population</b>	National Census	2010	<a href="http://e-stat.go.jp/SG2/eStat-GIS/page/download.html">http://e-stat.go.jp/SG2/eStat-GIS/page/download.html</a>



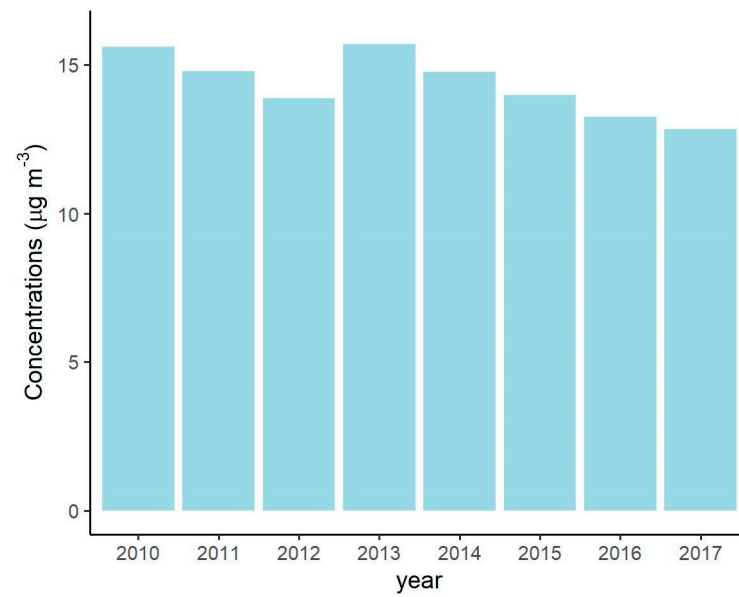
**Figure S6.** Scatter plots of the observed and predicted concentrations obtained by spatial cross-validation summarized by year. Red represents higher point density and blue represents lower density. The lines in each panel represent a 1:1 line.



**Figure S7.** Scatter plots of the observed and predicted concentrations obtained by temporal cross-validation summarized by year. Red represents higher point density and blue represents lower density. The lines in each panel represent a 1:1 line.



**Figure S8.** Annual prediction maps obtained by aggregating the daily predictions for the study period in each year.



**Figure S9.** Temporal trend of PM<sub>2.5</sub> components in Amagasaki. The annual values were obtained by averaging the daily predictions for each year in Amagasaki.