PEKING UNIVERSITY

Neural Network Prediction of Pollutant Emissions from Open Burning of Crop residues and Application to Air Quality Forecasts in Southern China

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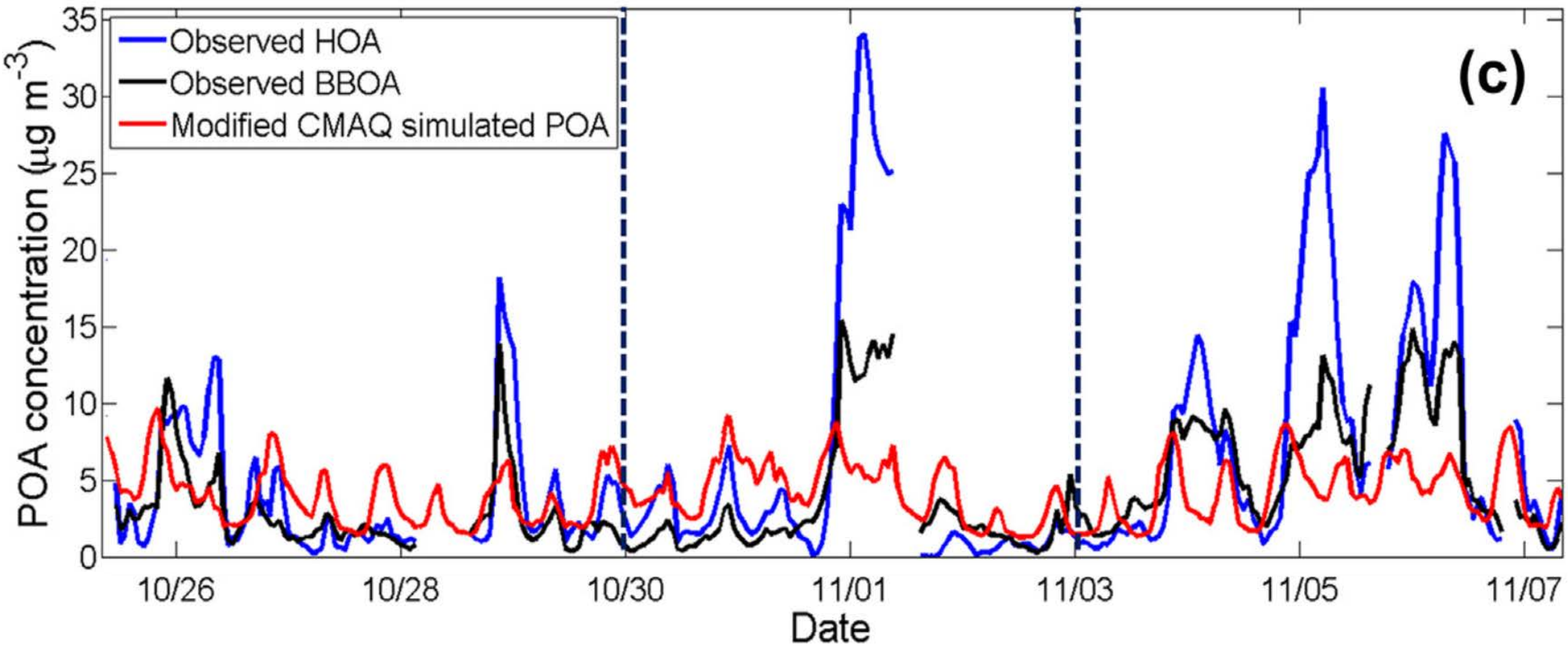
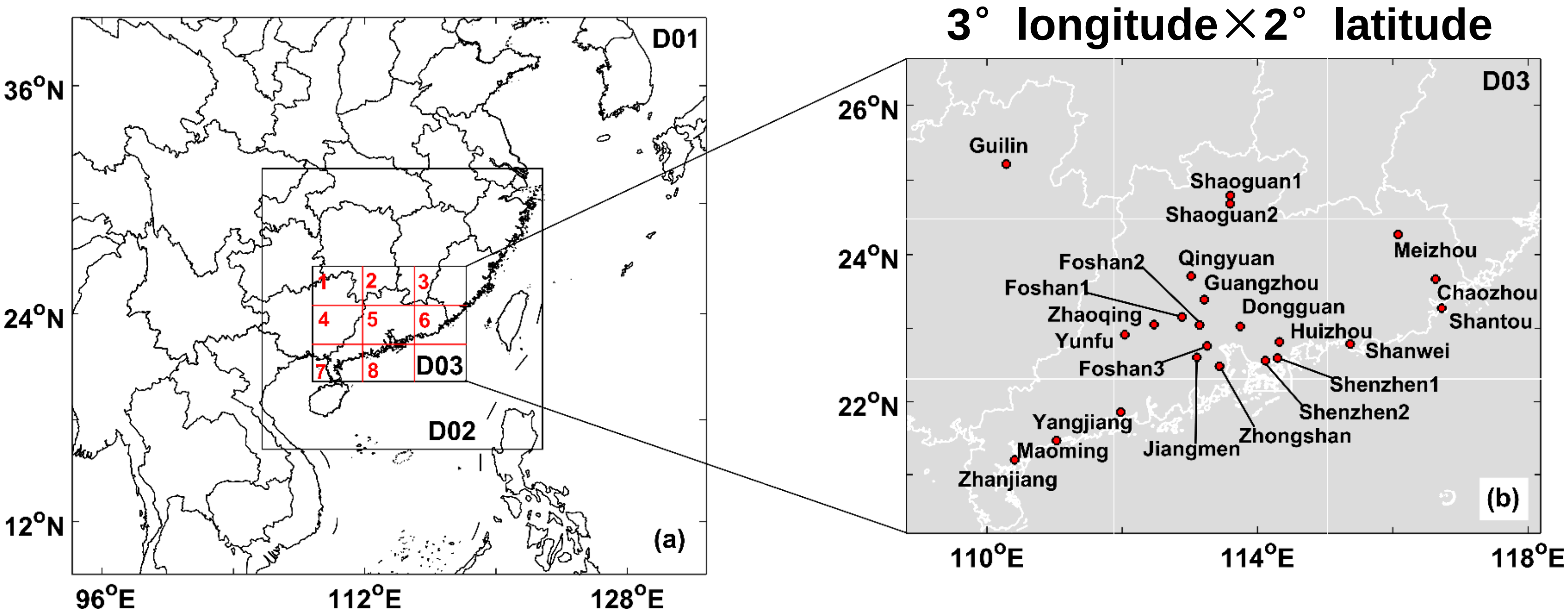
Open burning of crop residues is human-modulated interaction between air quality and meteorology



Shenzhen observations (Aerosol Mass Spectrometry, He et al. 2011)

Modified CMAQ (Li, Fu* et al., 2013)

Question 1: How do we use the BPNNs to obtain the daily-variable biomass burning emissions?



BPNN models

FINN (Fire Inventory)

$$E_{m,n,d}(x,y) = \overline{FINN\_E}_{m,n}(x,y) \cdot \left[\frac{FC_{n,d}}{\overline{FC_n}}\right]$$

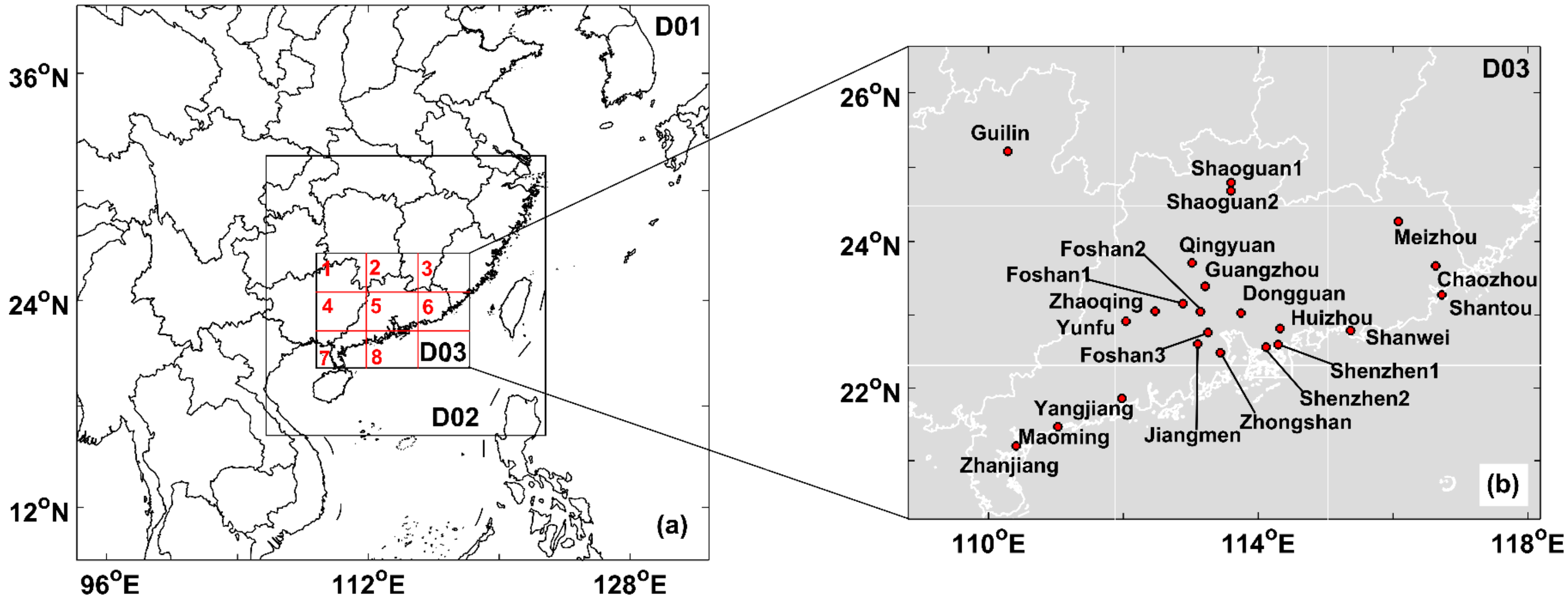
Scale factors

MODIS fire observations

m^{th} specie
n^{th} box
d^{th} day in January

Question 2: What are the impacts of daily crop residue burning emissions on air quality?

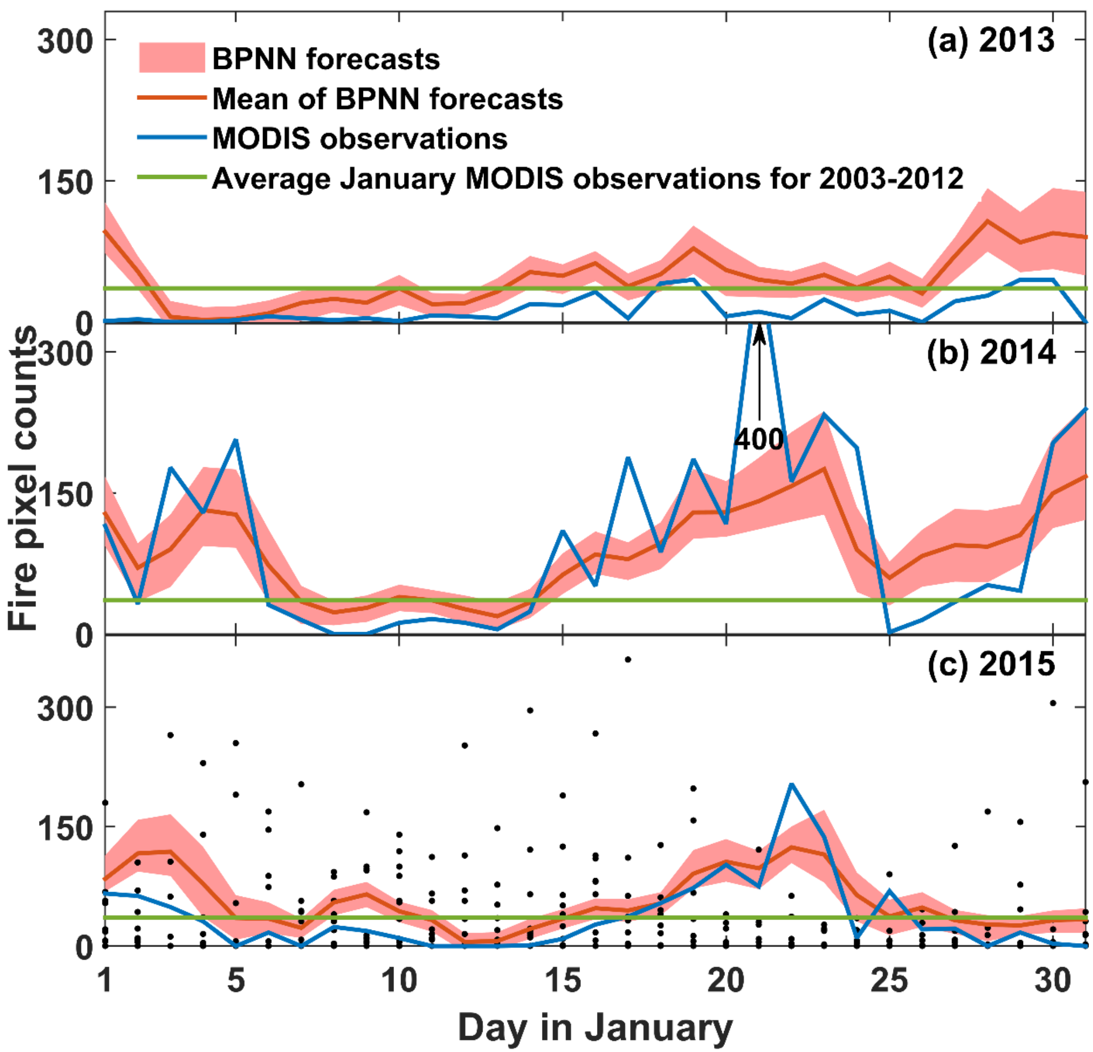
The nested domain in our WRF-Chem simulations



Design of sensitivity simulations

Case	FINN_2014	BPNN_2014	FINN_MEAN	NO_BB
Model version	WRF-Chem v3.6.1			
Simulated period	2014.01.01 00:00 – 2014.01.31 00:00 (UTC)			
Biomass burning emission (D03)	FINNv1.5 in January, 2014	Forecasted biomass burning emissions in January, 2014	Climatological January mean FINNv1.5 (2003-2012)	No

The interannual change and daily variability of fire counts can be forecasted by BPNN ensembles



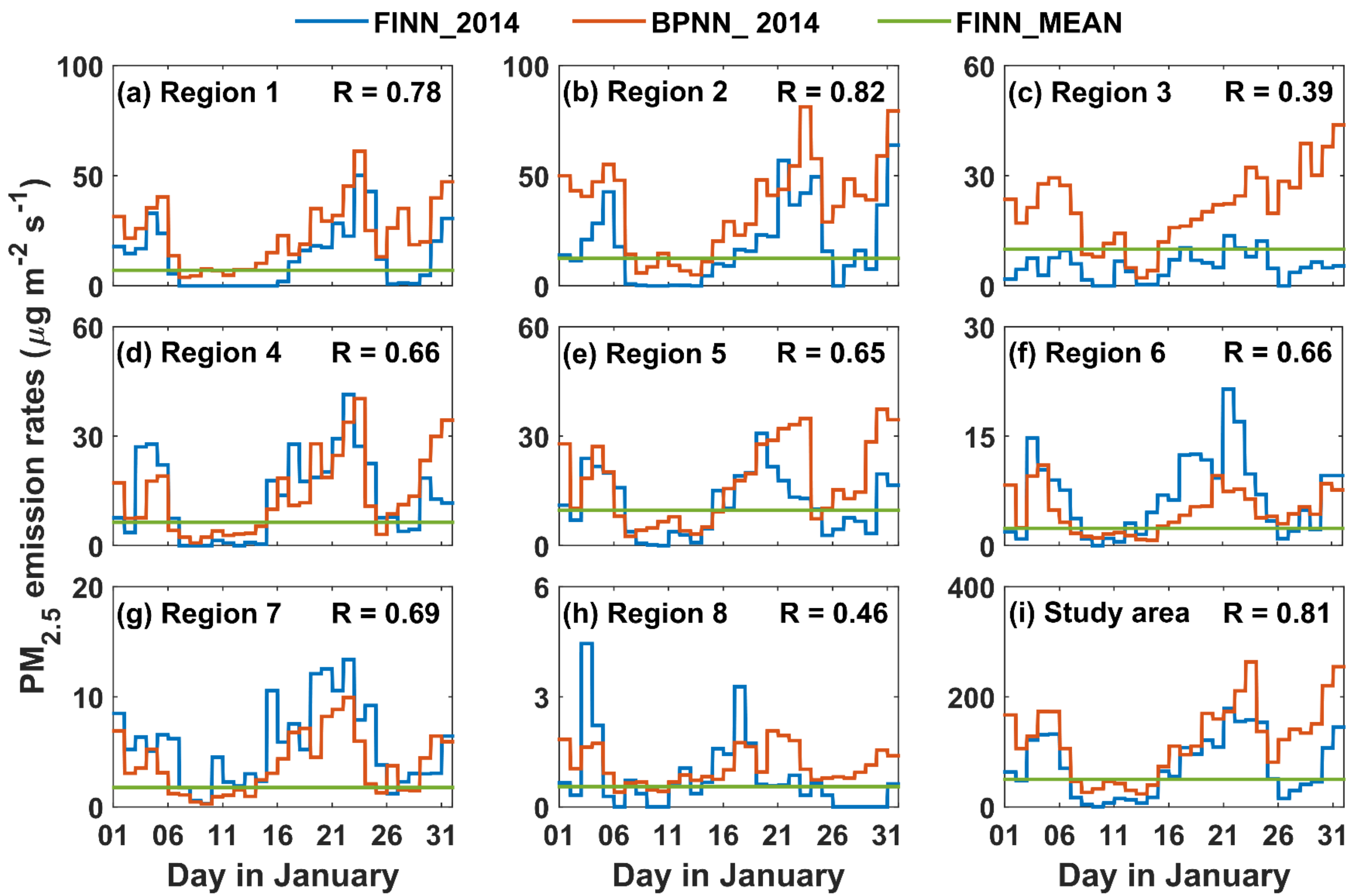
- MODIS-observed fire counts
- Forecasted fire counts using the BPNN ensembles
- Climatological January mean fire counts from MODIS
- MODIS-observed daily fire counts from 2003 to 2012

	OBS MEAN	BPNN MEAN	R	RMSE
2013	13	46	0.60	40.0
2014	100	89	0.77	68.6
2015	37	56	0.80	33.3

Interannual variation

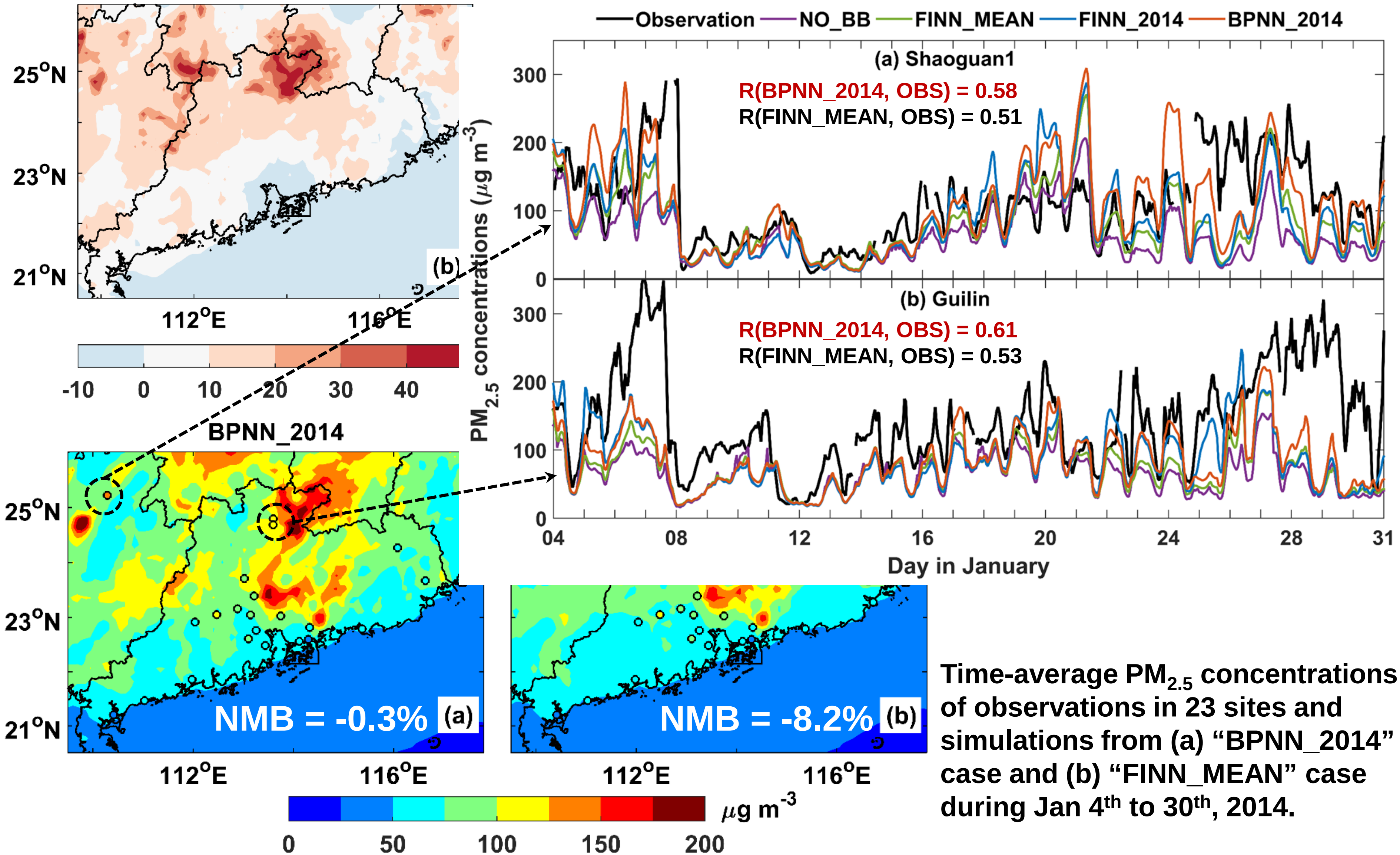
Day-to-day variability

BPNNs reproduced the temporal variability of $PM_{2.5}$ emission rates from biomass burning



The time series of $PM_{2.5}$ emission rates in January given by FINN (FINN_2014), forecasted by our BPNN ensembles (BPNN_2014) and climatological January mean FINN (FINN_MEAN)

The daily-variable emissions lead to improvements in the forecasts of $PM_{2.5}$ concentrations



Time-average $PM_{2.5}$ concentrations of observations in 23 sites and simulations from (a) "BPNN_2014" case and (b) "FINN_MEAN" case during Jan 4th to 30th, 2014.

Take home messages

- **Open burning of crop residue is a <u>human-modulated</u> interaction between air quality and meteorology.**

- **We used BPNN models to forecast the daily variable emissions of open crop residues burning with an accuracy over 70%.**

- **Our forecasted daily-variable emissions led to improvements in the forecasts of $PM_{2.5}$ concentrations in Southern China.**