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The simulation and preliminary evaluation of Jiangsu air pollution by using WRF/CMAQ model in 2014 winter

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Outline

- Background
- Introduction
- WRF-CMAQ model
- Observation and analysis
- Model and data
- Result
- Next work

Background

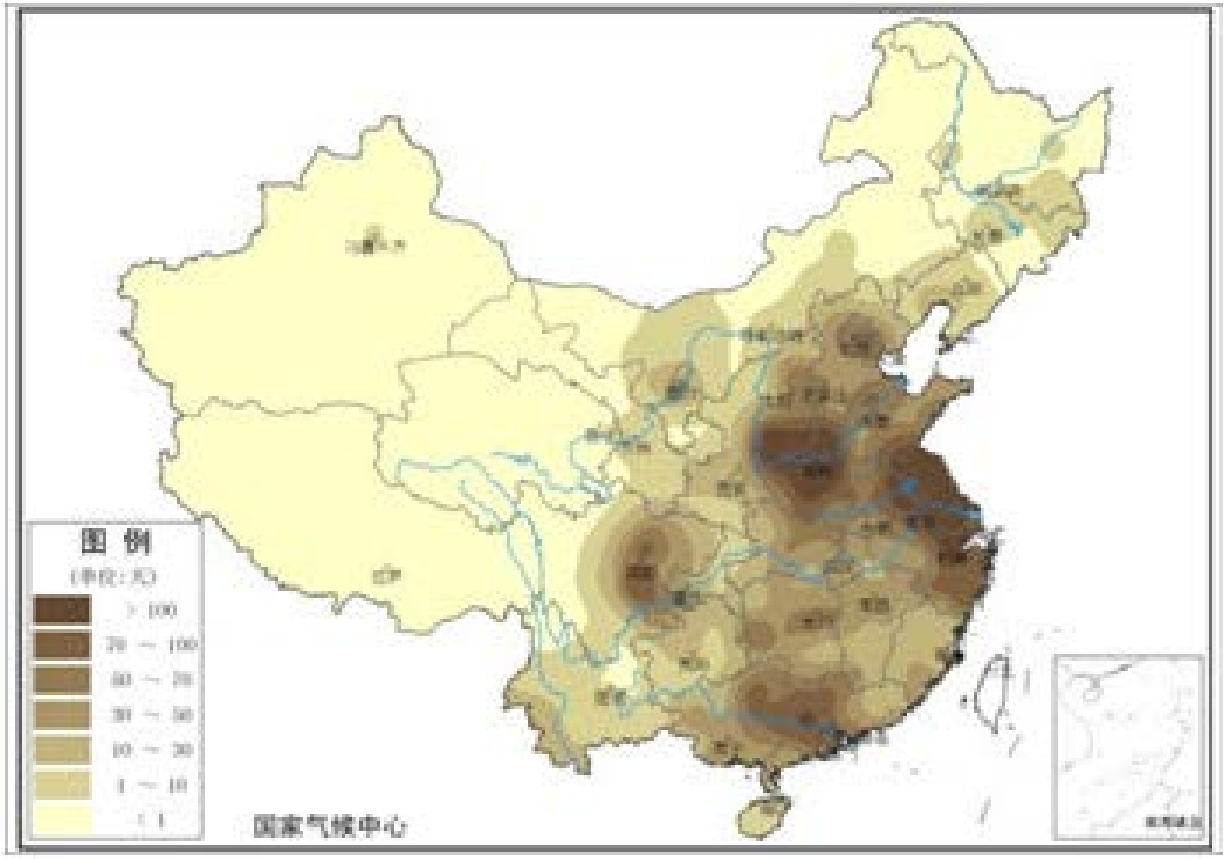


Fig1. China daily haze in 2013(来自《2013年中国环境状况公报》)

Introduction

- Air pollution has been a serious problem especially in eastern China .Such as January of 2013 witnessed the most frequent and serious episodes of heavy haze to date.

- WRF/CMAQ is the most common numerical model, and use the newest emission source(0.25*0.25) from Tsinghua University.

- Now we use WRF/CMAQ model to investigate the temporal and spatial variations of pollutant, and the effect of different urban canopy parameterization schemes and PBL schemes will be analyzed further.

WRF-CMAQ model

- WRF(Weather Forecasting and Research Model)
- CMAQ (Community Multiscale Air Quality Modeling System)

Table1

	Jiangsu Province
time	2014.12-2015.2
Center latitude	**119.0° E 33° N**
Domain resolution	**9km,3km**
vertical stratification	**27 sigma level**
horizontal grid	**300×200、200×200**

Observation and analysis

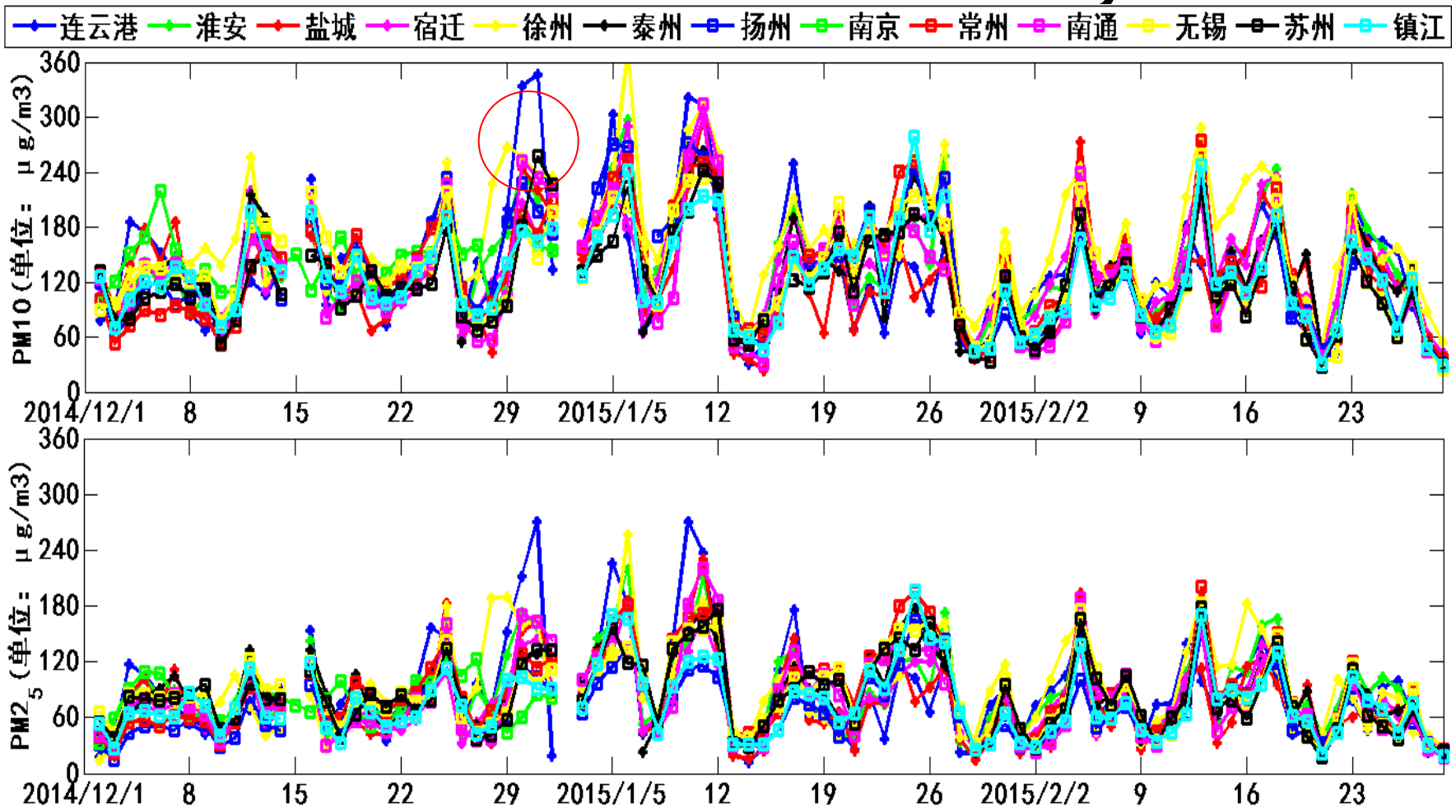


Fig2a. Observed hourly average concentrations of PM10 and PM2.5 at cities in Jiangsu Province from Dec2014 to Feb2015.

Observation and analysis

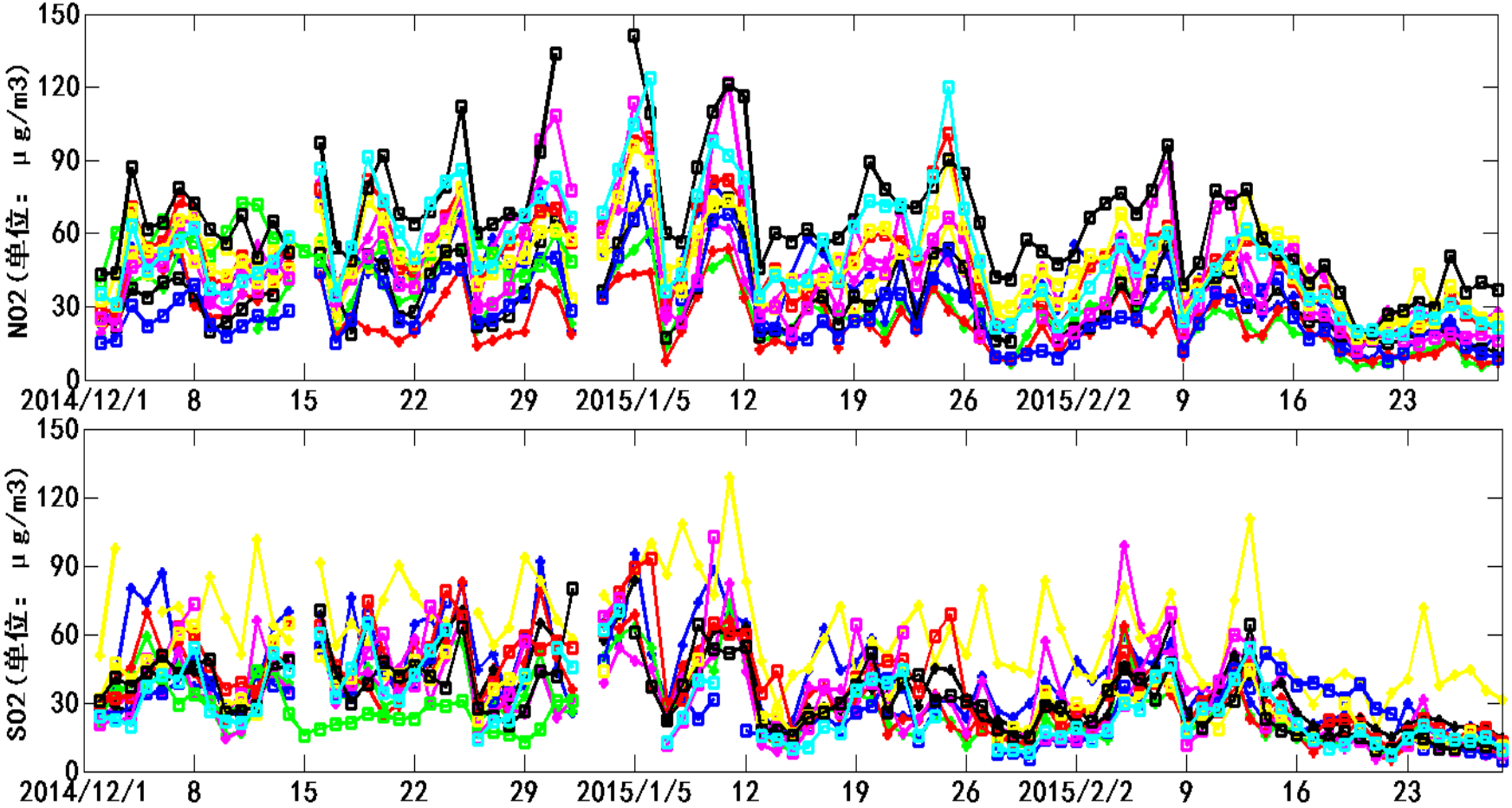


Fig2b. Observed hourly average concentrations of NO2 and SO2 at cities in Jiangsu Province from Dec2014 to Feb2015.

Observation and analysis

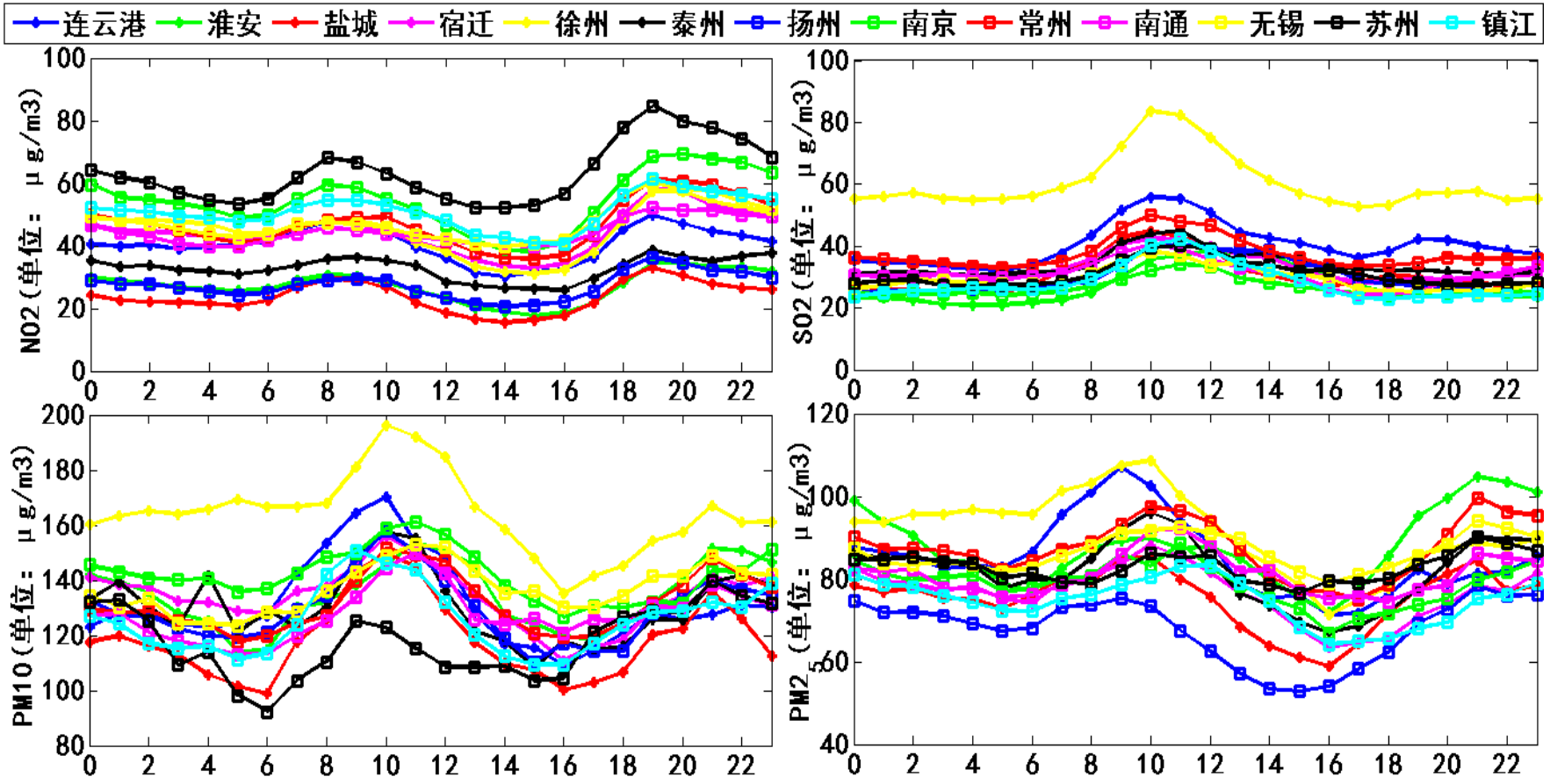


Fig3. Observed diurnal variation in Jiangsu Province from Dec2014 to Feb2015.

Observation and analysis

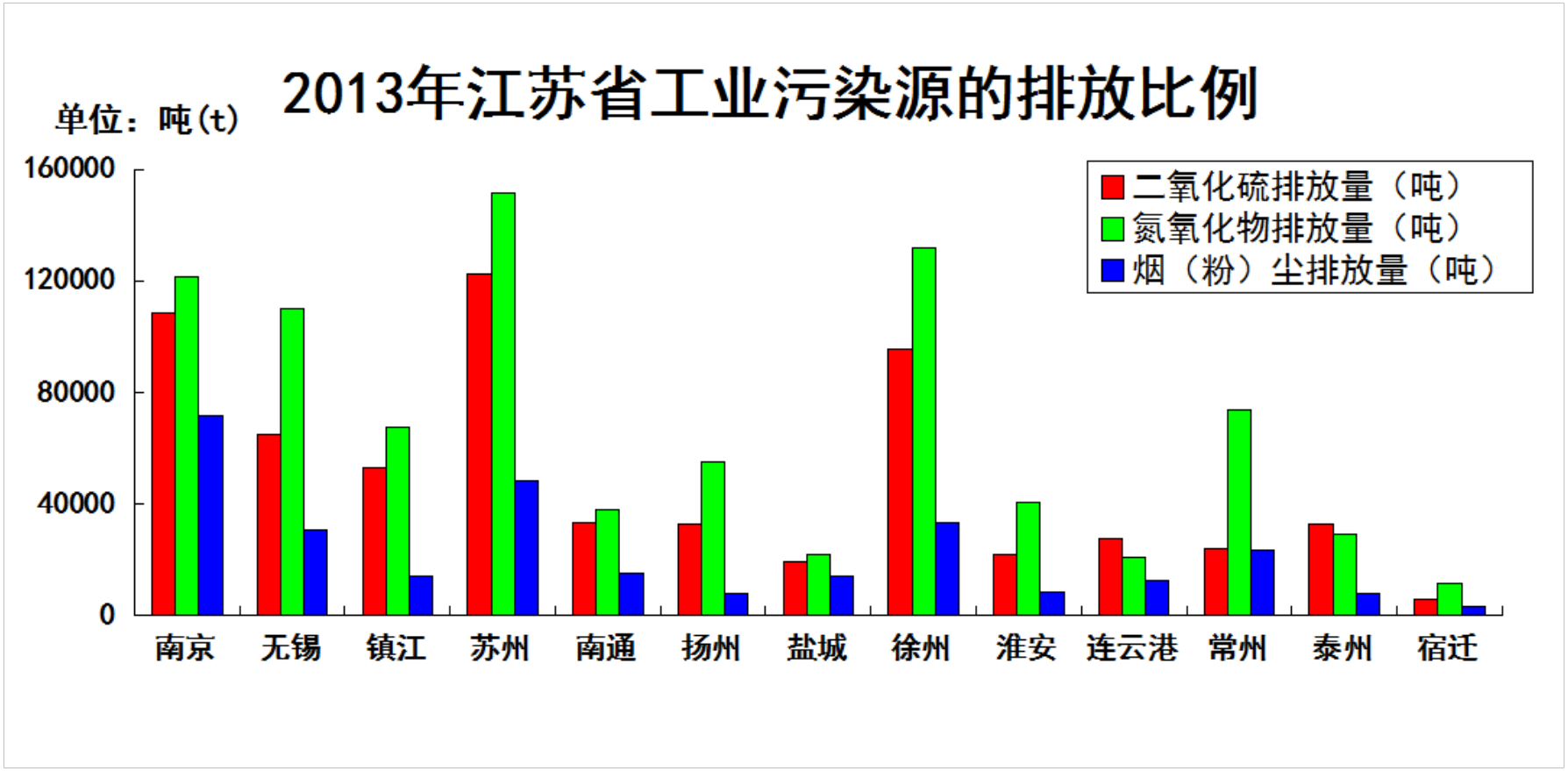


Fig4

Model and data

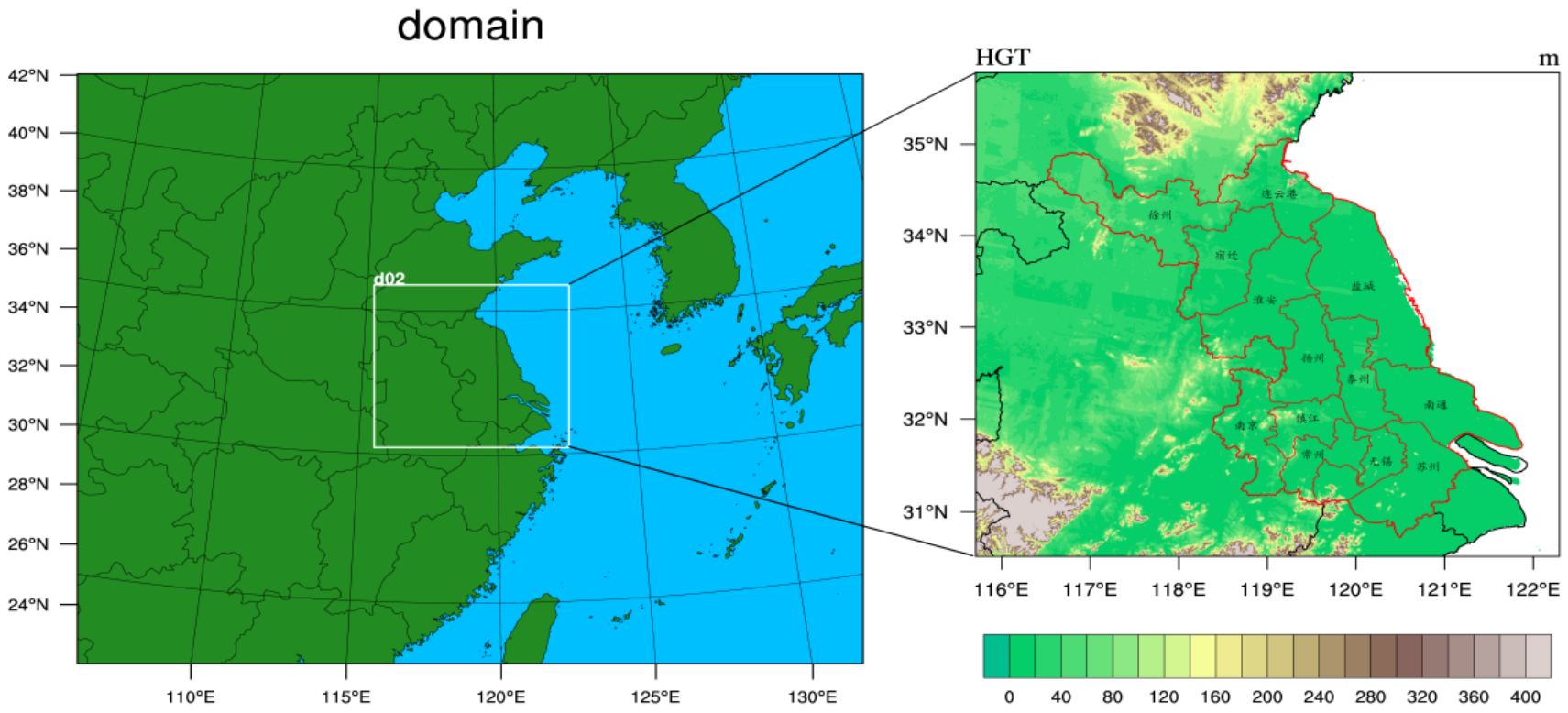


Fig5 .Two nested modeling domains and the inner area of terrain height

Model and data

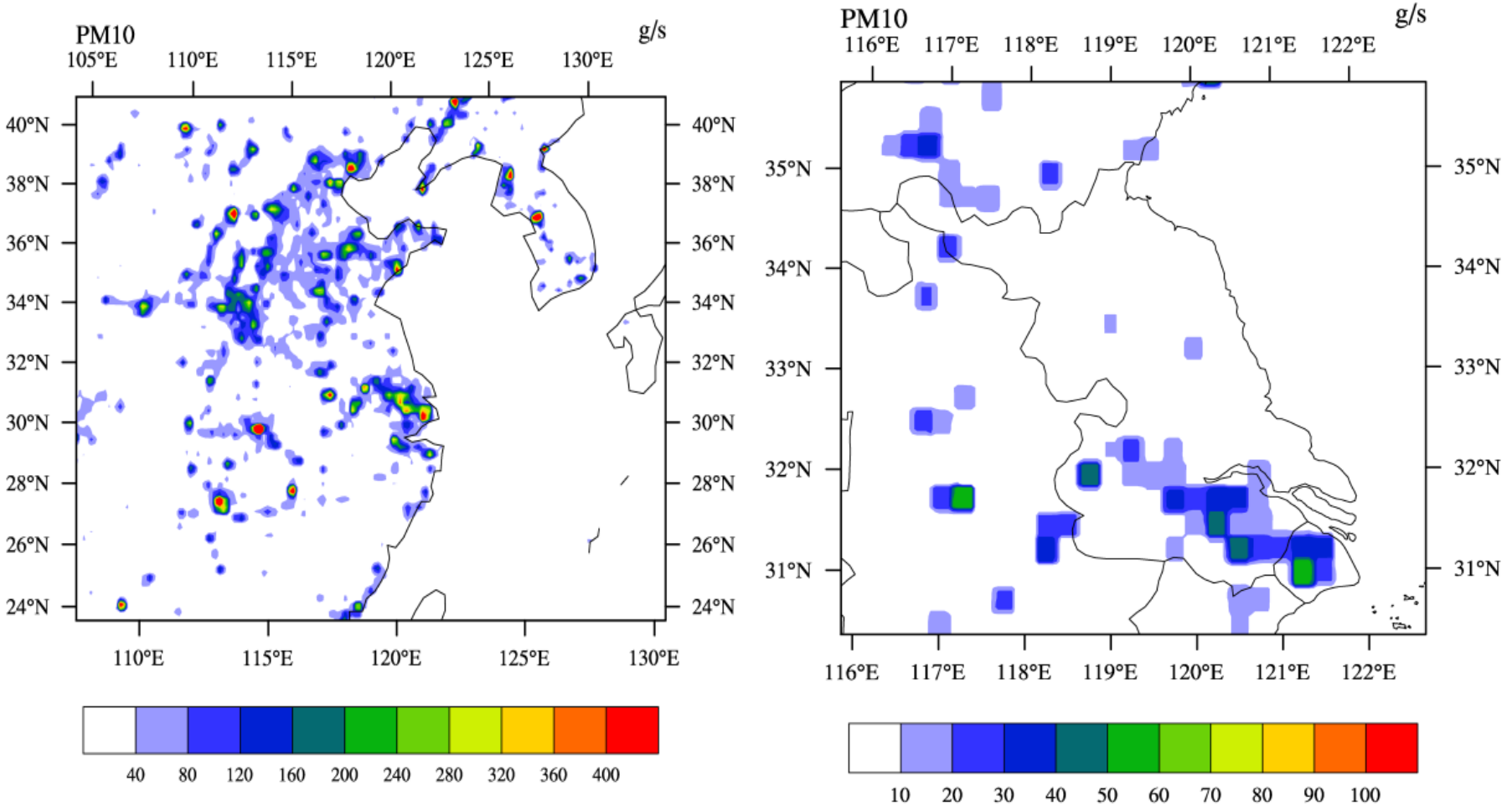


Fig6.Two nested modeling domains and primary PM10 emission rates from Tsinghua University

Model and data

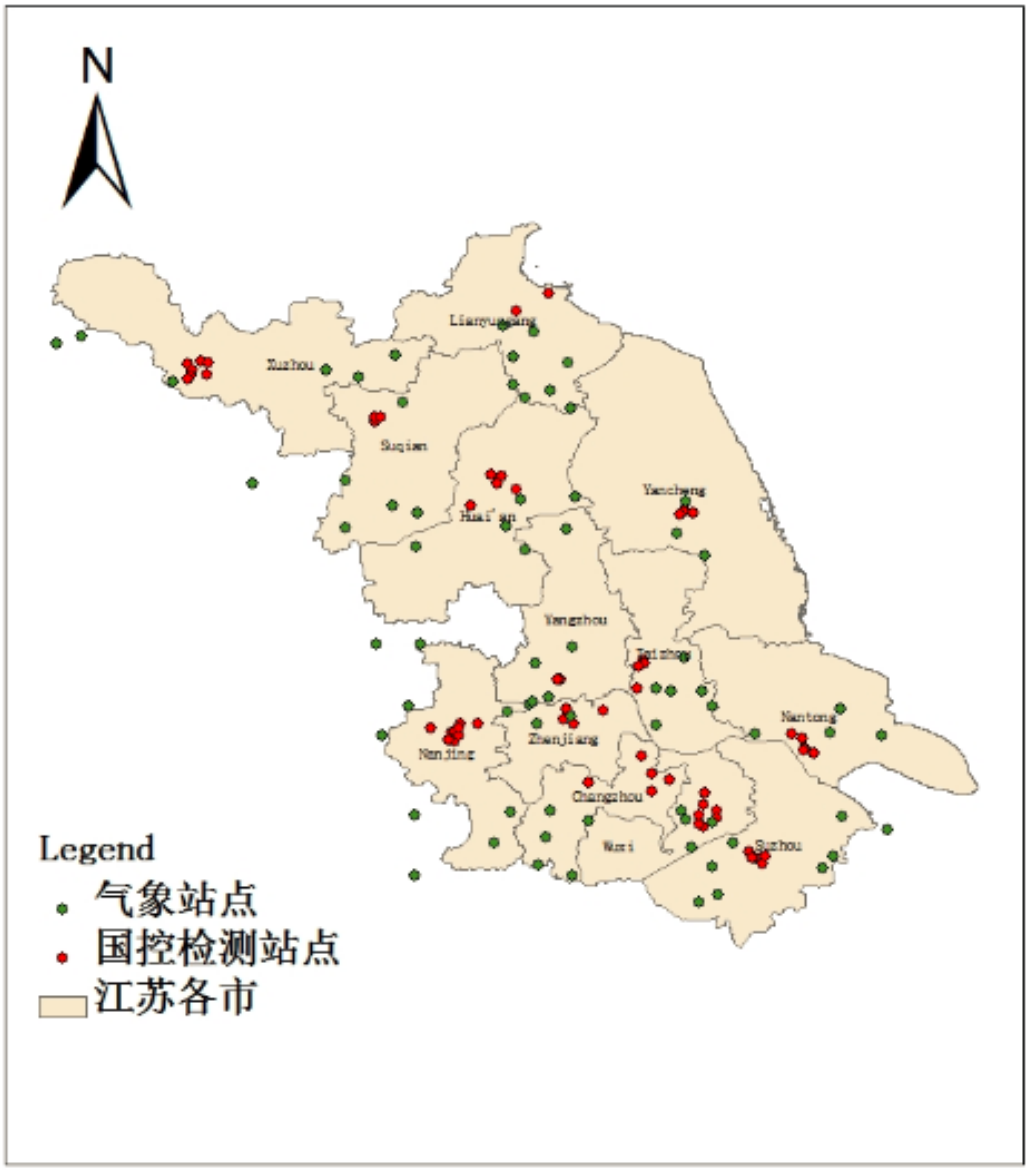


Fig7.Observation sites for meteorological (green) and pollution(red) in Jiangsu Province.

	T2		U10			T2		U10	
	R	RMSE	R	RMSE		R	RMSE	R	RMSE
丰县	0.9292	1.7247	0.5311	1.3031	仪征	0.9190	1.8946	0.7121	1.2574
沛县	0.9254	1.8148	0.4706	1.3578	兴化	0.8876	2.2139	0.6091	1.1509
邳州	0.9337	1.8845	0.6877	1.1184	江都	0.9196	1.8303	0.6910	1.1138
徐州	0.9268	1.6929	0.6625	1.2155	扬州	0.9220	1.7302	0.7174	1.1496
新沂	0.9356	1.5679	0.6474	1.1586	泰州	0.9341	1.5651	0.6413	1.2833
东海	0.9439	1.5027	0.5758	1.4375	扬中	0.9353	1.3856	0.5530	1.3854
沭阳	0.9429	1.3877	0.6844	1.1029	泰兴	0.9272	1.4439	0.5681	1.3197
赣榆	0.9144	1.7204	0.5683	1.3688	姜堰	0.9352	1.3558	0.5739	1.2785
西连岛	0.7599	2.4892	0.4807	3.7956	东台	0.9073	1.9945	0.5651	1.3154
连云港	0.9228	1.7753	0.6590	1.3898	丹徒	0.9294	1.5577	0.5984	1.3742
响水	0.9381	1.5058	0.5443	1.3603	海安	0.9412	1.3359	0.5063	1.3080
燕尾港	0.8976	1.6809	0.3940	2.2879	如皋	0.9196	1.7878	0.4777	1.3711
灌云	0.9336	1.7763	0.6014	1.2532	靖江	0.9347	1.3514	0.5851	1.2480
灌南	0.9380	1.4924	0.6778	1.1190	南通	0.9368	1.4378	0.4318	1.5983
滨海	0.9453	1.4425	0.5086	1.3837	如东	0.9423	1.3660	0.3352	1.5070
睢宁	0.9438	1.6471	0.5894	1.4938	吕泗	0.9308	1.3501	0.4716	1.7146
宿豫	0.9345	1.4843	0.6176	1.3399	通州	0.9381	1.3757	0.4246	1.3766
泗阳	0.9357	1.3907	0.6390	1.4600	启东	0.9103	2.1123	0.4036	1.4405
泗洪	0.9318	1.6188	0.6685	1.2517	高淳	0.9309	1.6099	0.8092	1.2040
盱眙	0.9344	1.4442	0.6663	1.4057	溧水	0.9401	1.4125	0.7681	1.4892
洪泽	0.7129	3.3394	0.4755	1.9505	丹阳	0.9359	1.4310	0.6281	1.3168
涟水	0.9393	1.4722	0.5486	1.3151	金坛	0.9324	1.6284	0.6246	1.3300
淮安	0.9411	1.9001	0.6347	1.2673	常州	0.9421	1.3206	0.6182	1.2932
阜宁	0.9500	1.2865	0.5799	1.2910	句容	0.9372	1.5518	0.7189	1.2683
楚州	0.9372	1.4888	0.6727	1.1906	溧阳	0.9096	1.7202	0.7499	1.2634
建湖	0.9397	1.4194	0.5223	1.3233	宜兴	0.8424	2.6627	0.5681	1.5417
金湖	0.9439	1.5327	0.7467	1.1392	吴中	0.7925	2.3202	0.5220	1.7378
宝应	0.9340	1.4721	0.6677	1.1600	江阴	0.7632	2.7730	0.4341	1.9428
射阳	0.9363	1.5649	0.5980	1.6154	常熟	0.9429	1.2782	0.4473	1.3934
盐城	0.9510	1.2355	0.6748	1.2116	张家港	0.9209	1.6128	0.5567	1.1090
大丰	0.9347	1.5663	0.5235	1.3795	无锡	0.7053	3.0491	0.5139	1.8622
六合	0.9313	1.7631	0.7372	1.1290	昆山	0.9366	1.3807	0.4899	1.5163
浦口	0.9248	1.5273	0.6013	1.4736	东山	0.7877	2.4059	0.5790	1.7288
南京	0.9356	1.4848	0.6801	1.4044	吴江	0.7468	2.6267	0.4589	2.0169
邗江	0.9275	1.6207	0.7112	1.1292	海门	0.9434	1.4822	0.5961	1.2541
高邮	0.9297	1.4267	0.6524	1.1863	太仓	0.9406	1.5170	0.6038	1.2950

Result

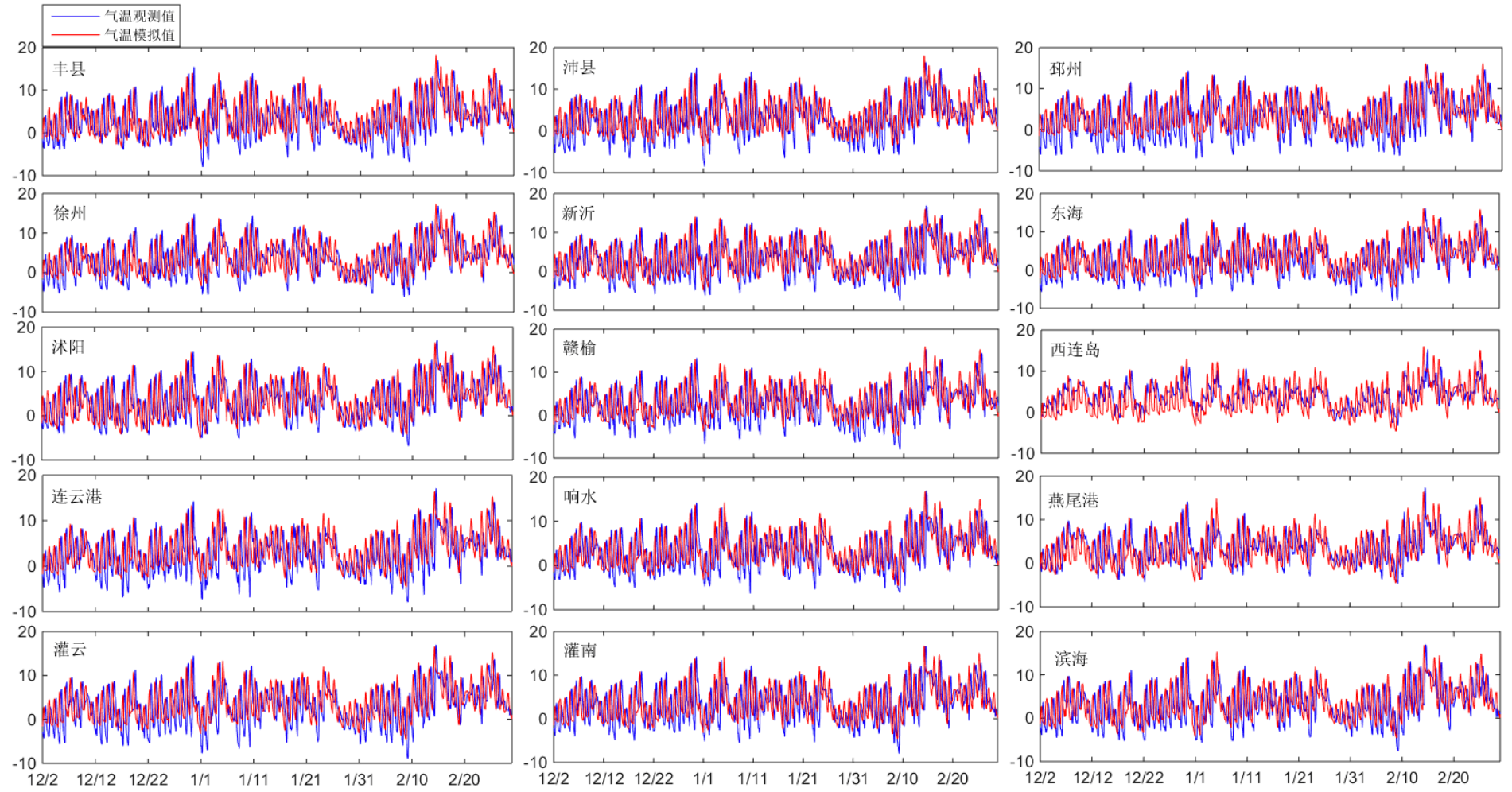
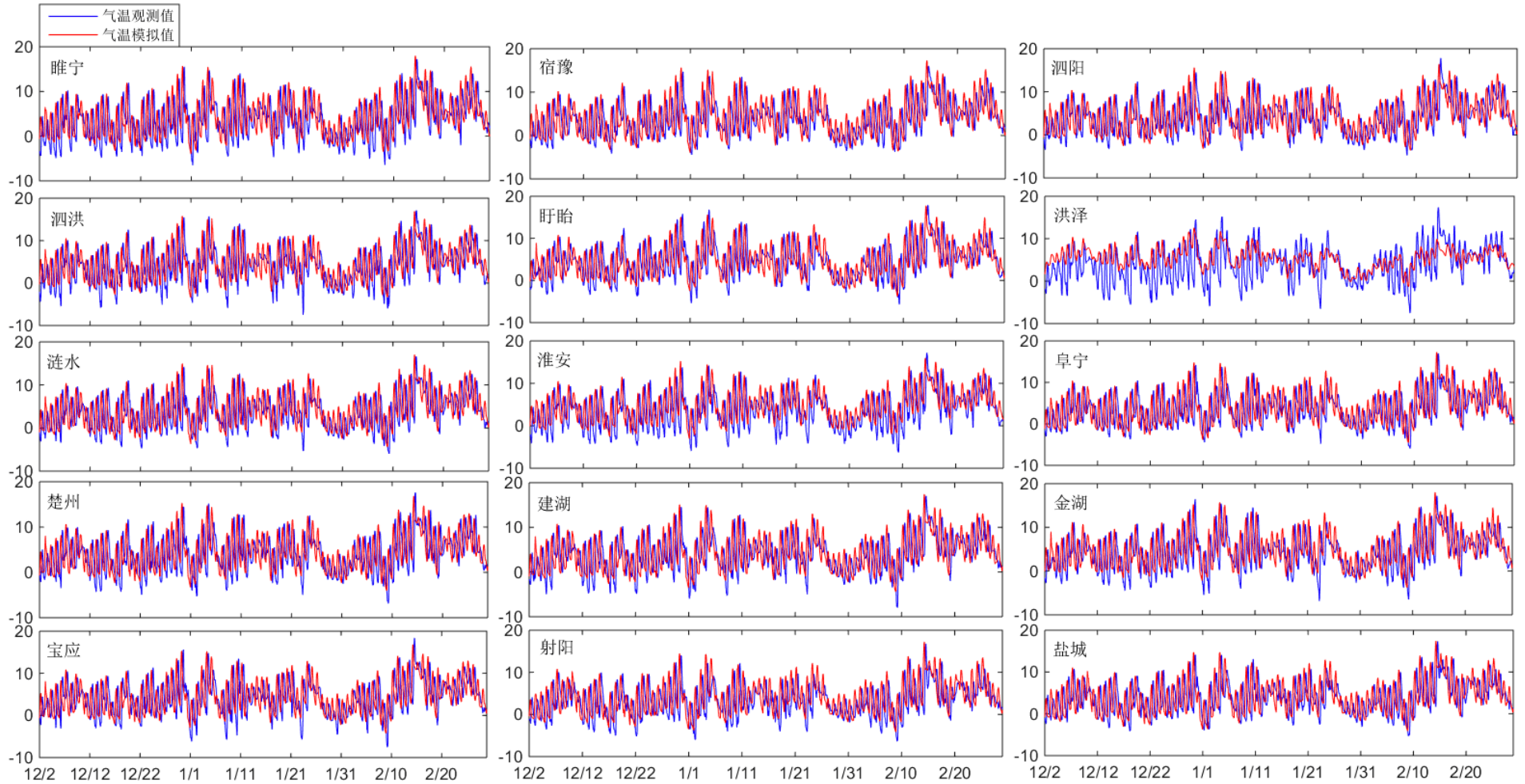


Fig8.Observed(blue) and simulated(red) of temperature at 72 sites in Jiangsu Province from Dec2014 to Feb2015.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盱眙
洪泽
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阜宁
楚州
建湖
金湖
宝应
射阳
盐城
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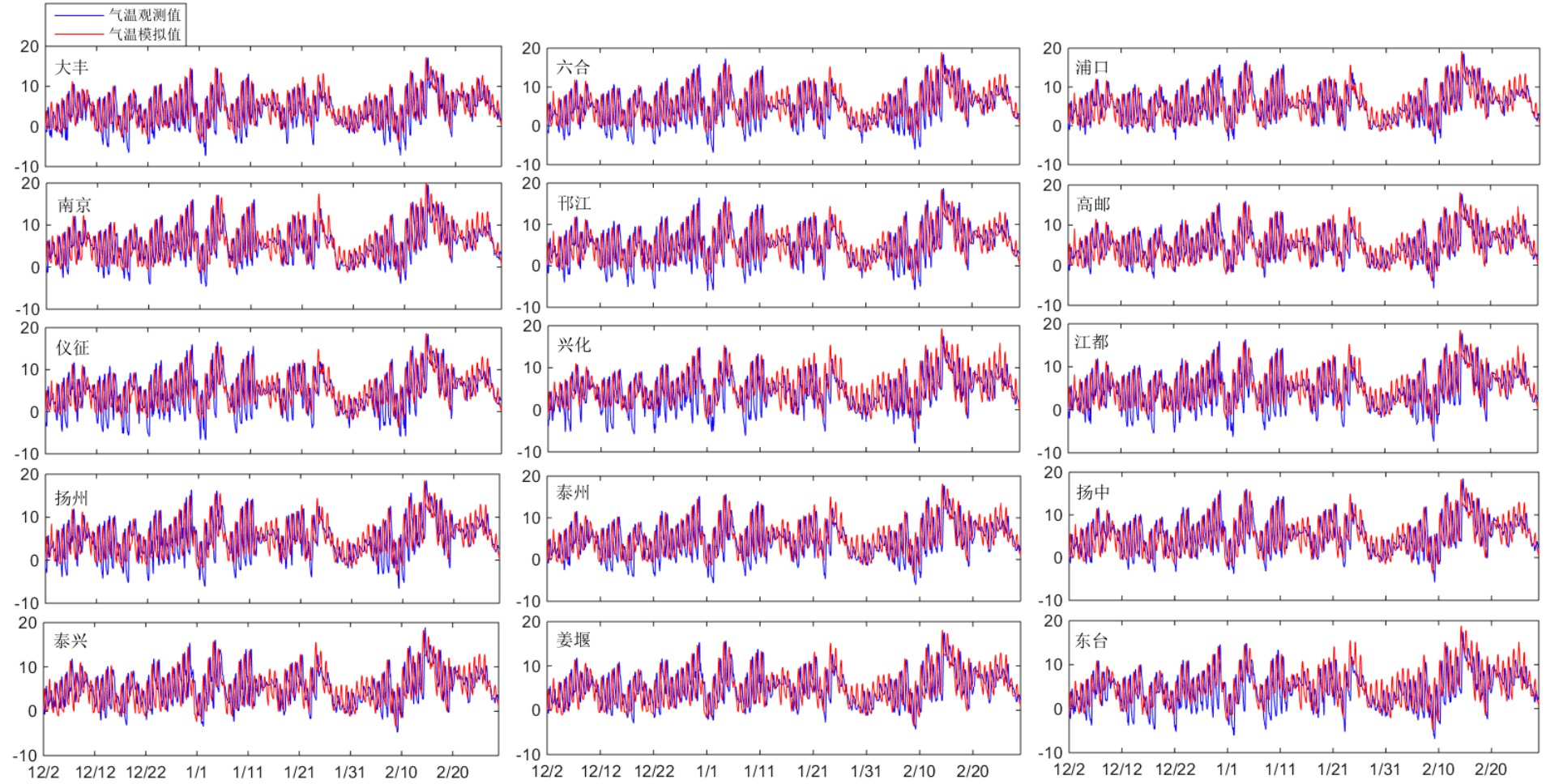
2/20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江都
扬州
泰州
扬中
泰兴
姜堰
东台
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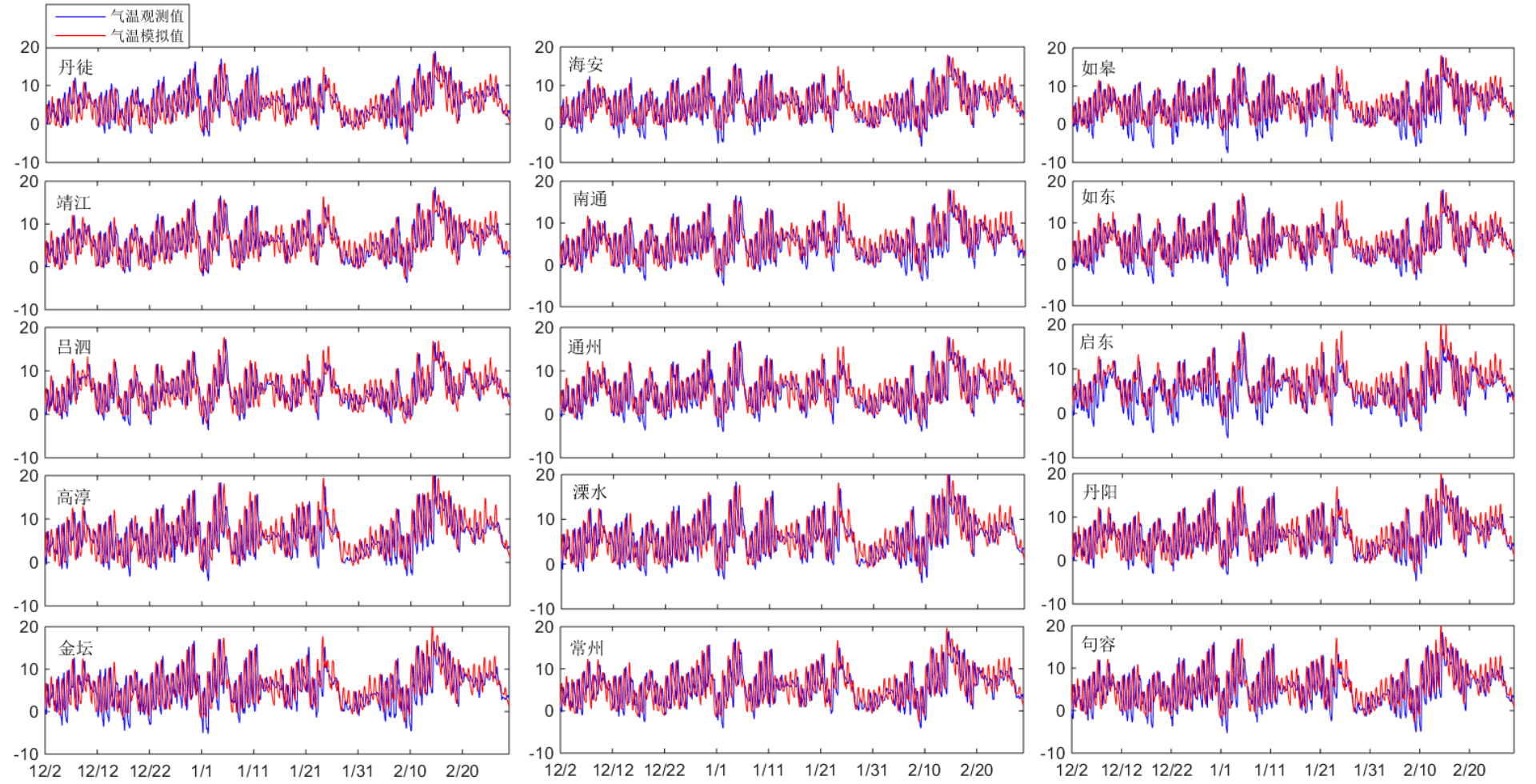
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高淳
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金坛
常州
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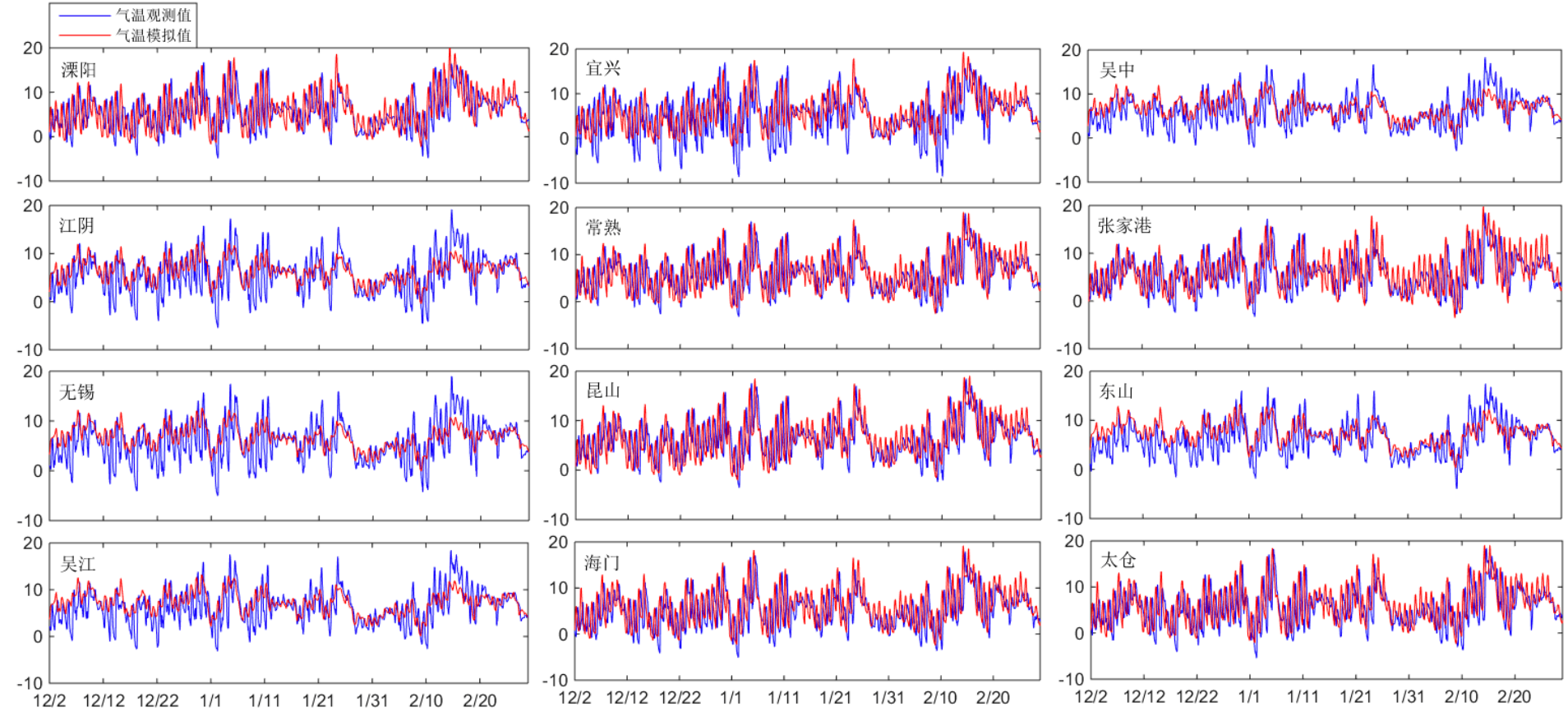
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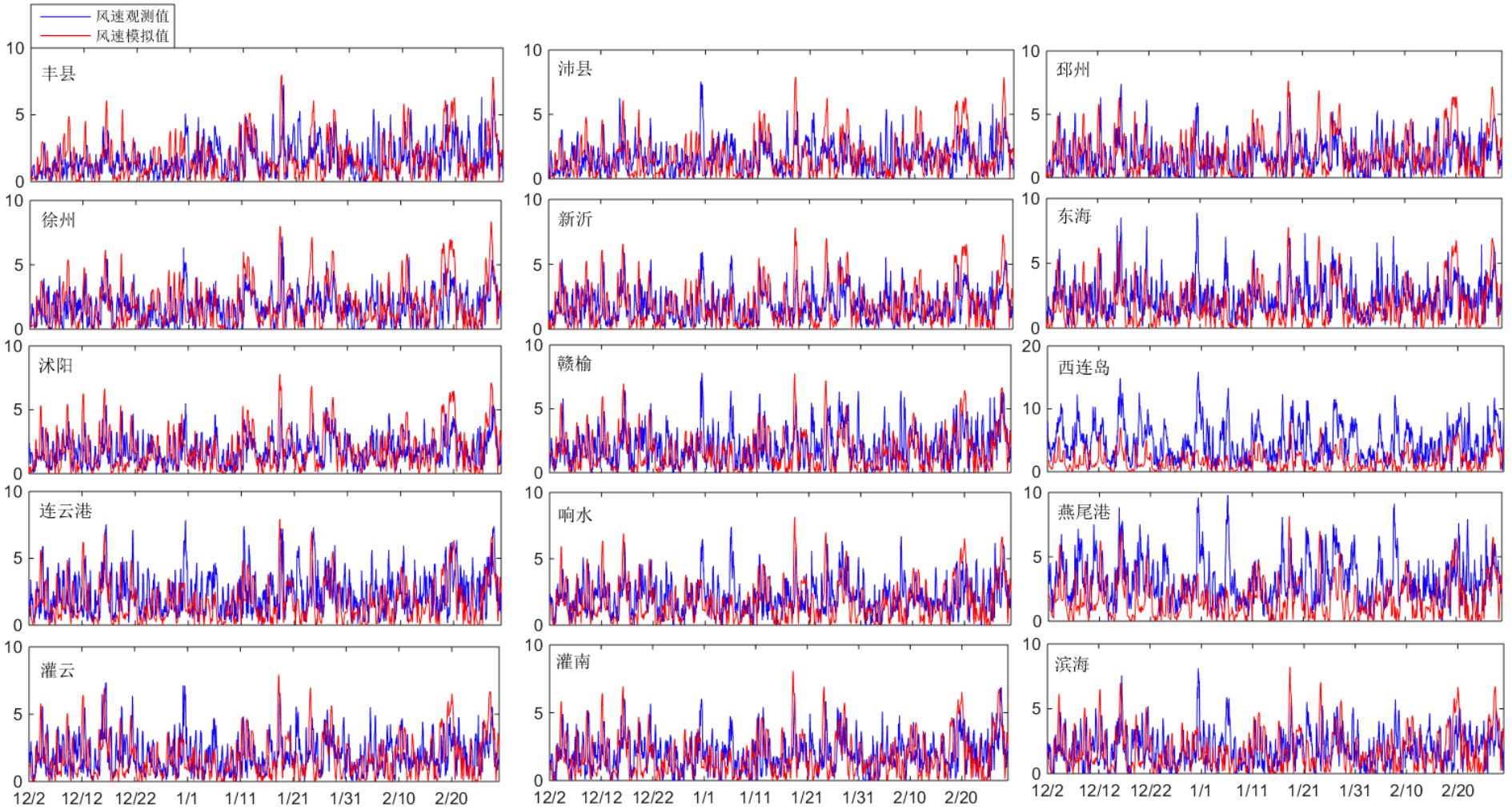
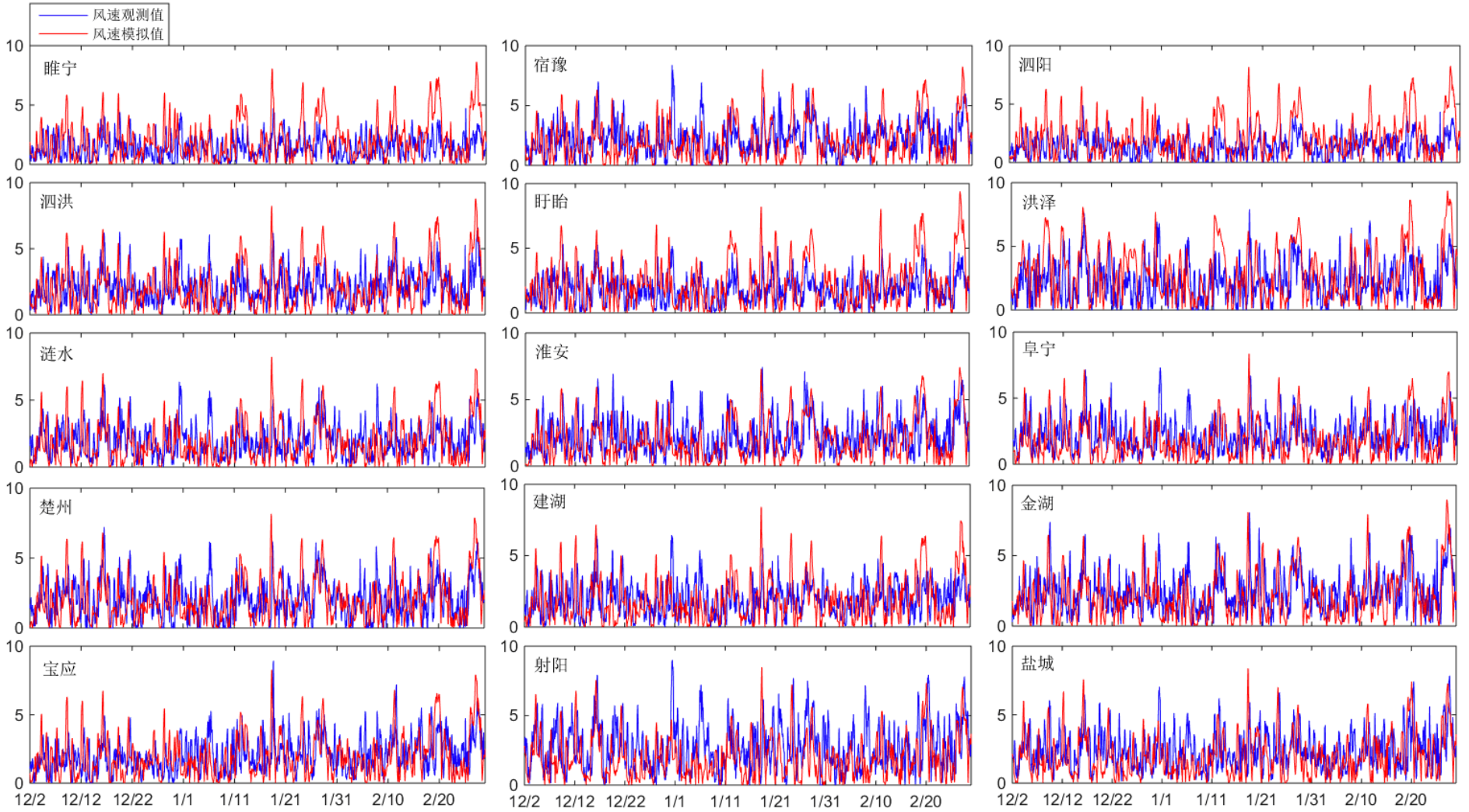


- Fig9.Observed(blue) and simulated(red) of wind speed at 72 sites in Jiangsu Province from Dec2014 to Feb2015.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淮安
阜宁
楚州
建湖
金湖
宝应
射阳
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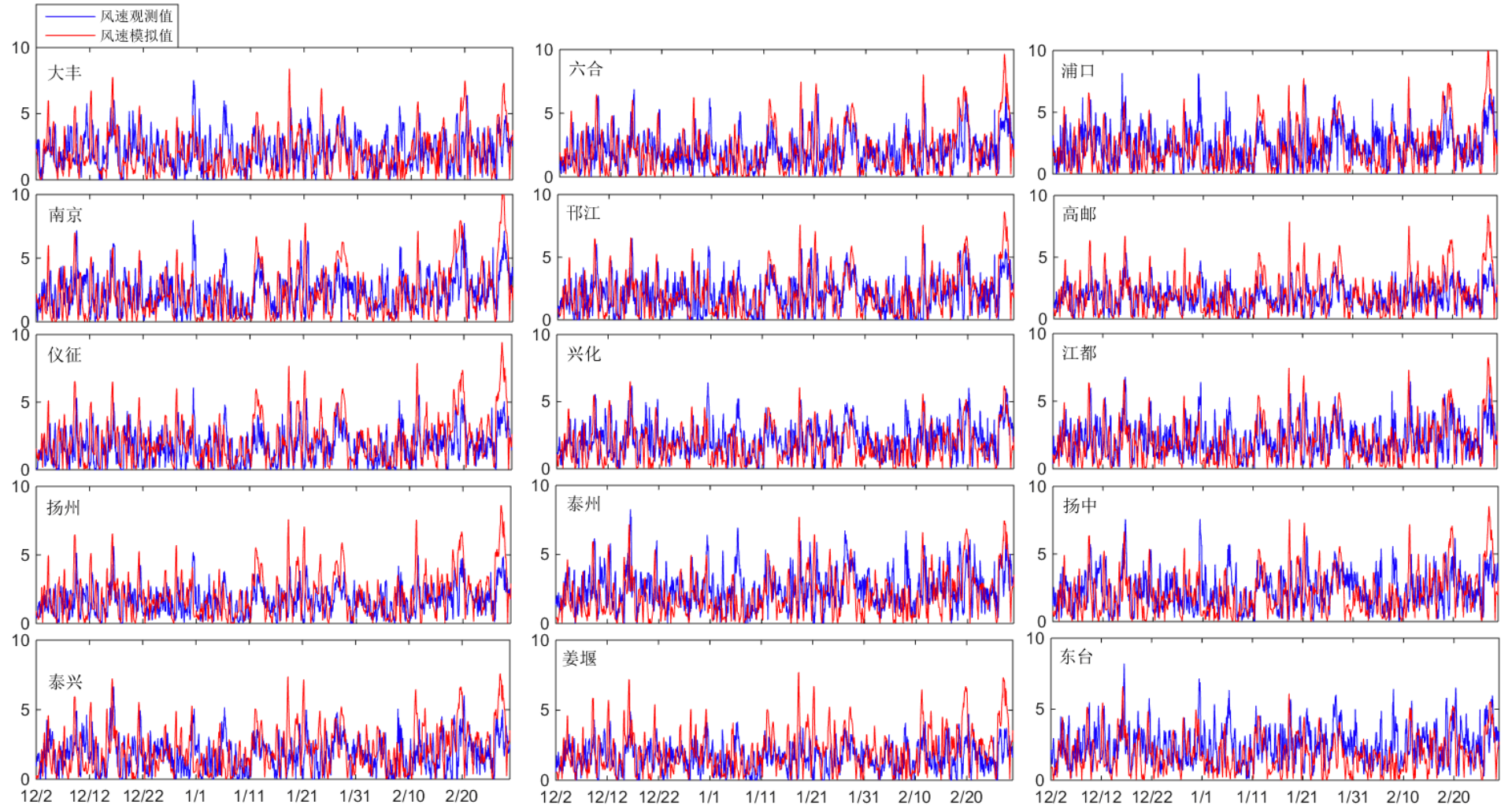
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泰州
姜堰
浦口
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江都
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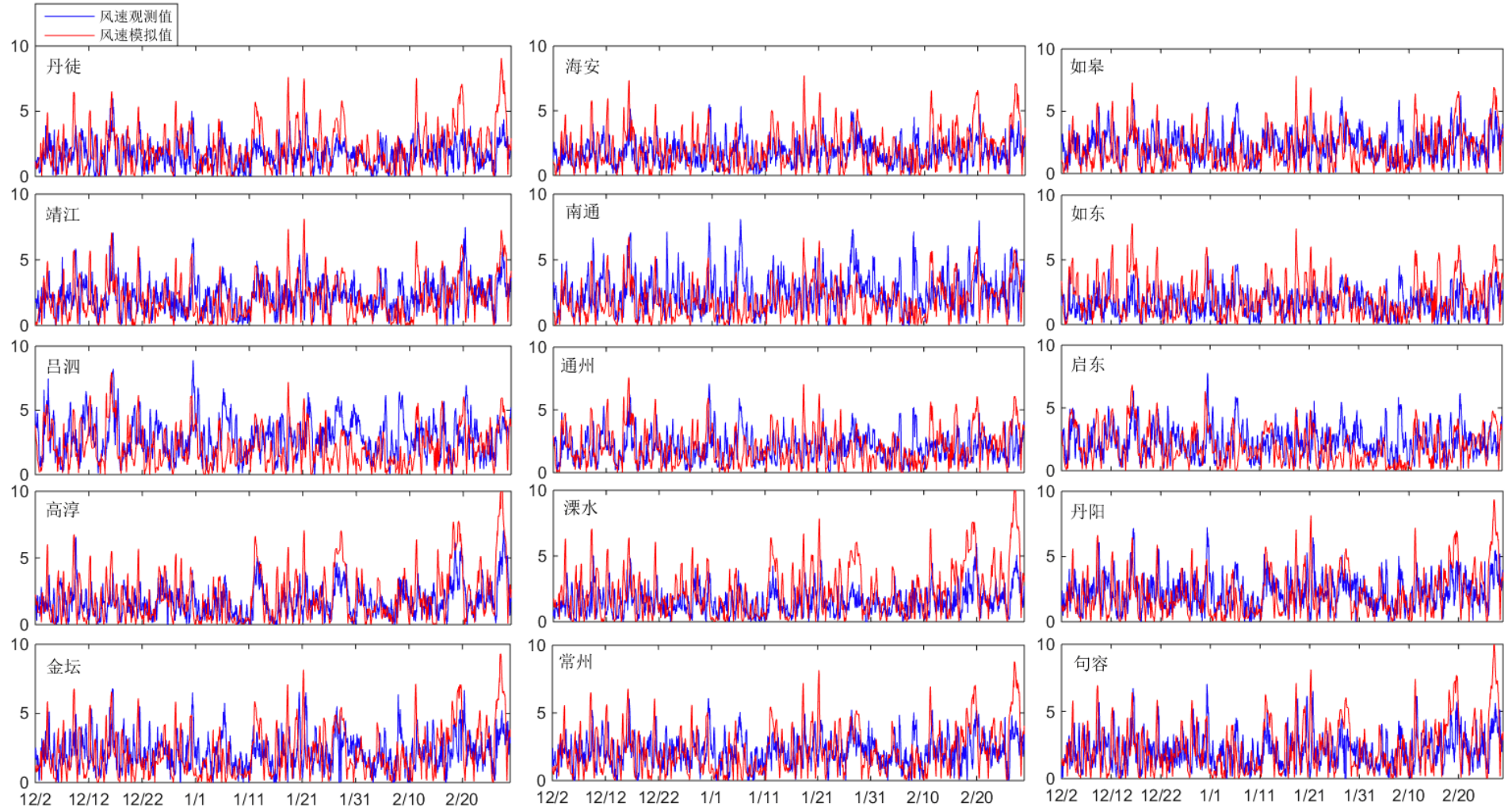
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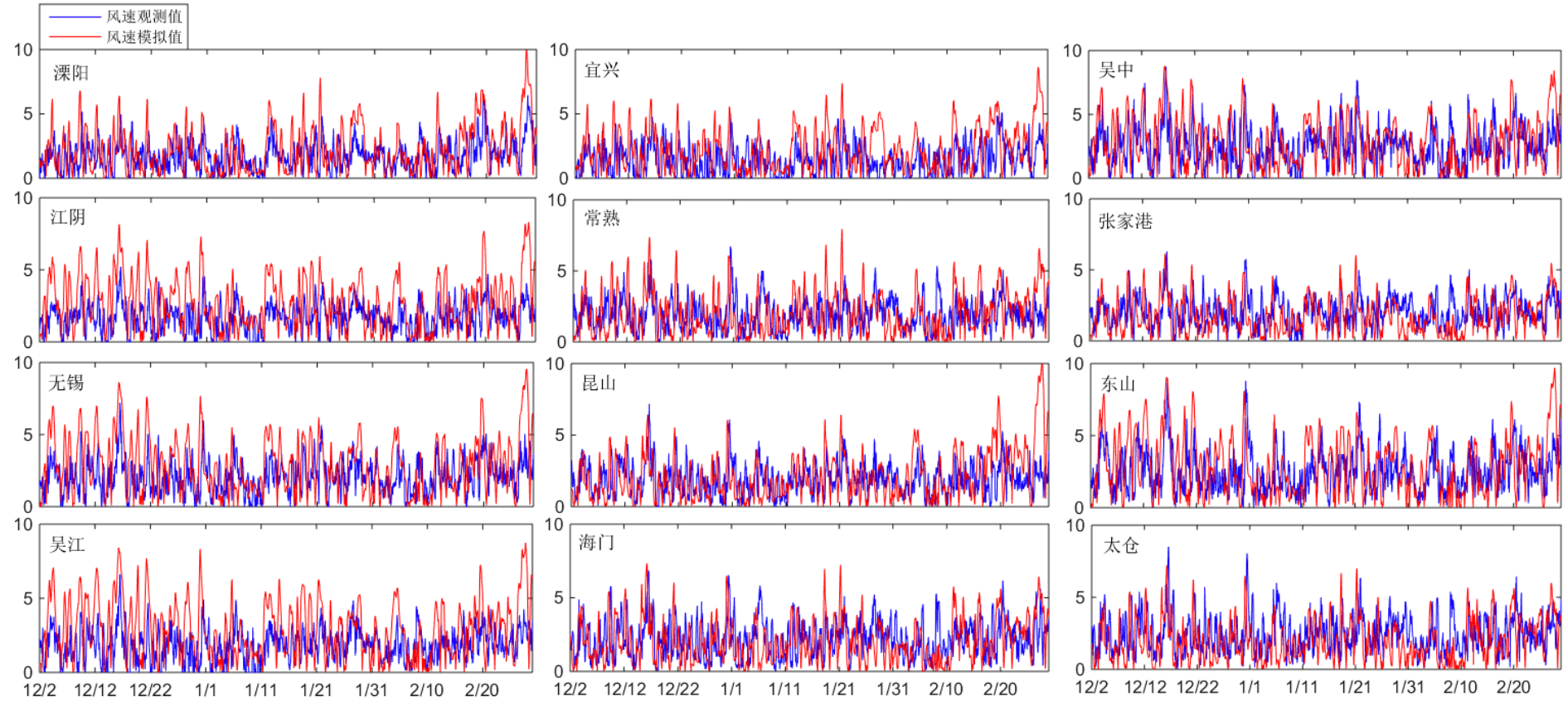
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PM10

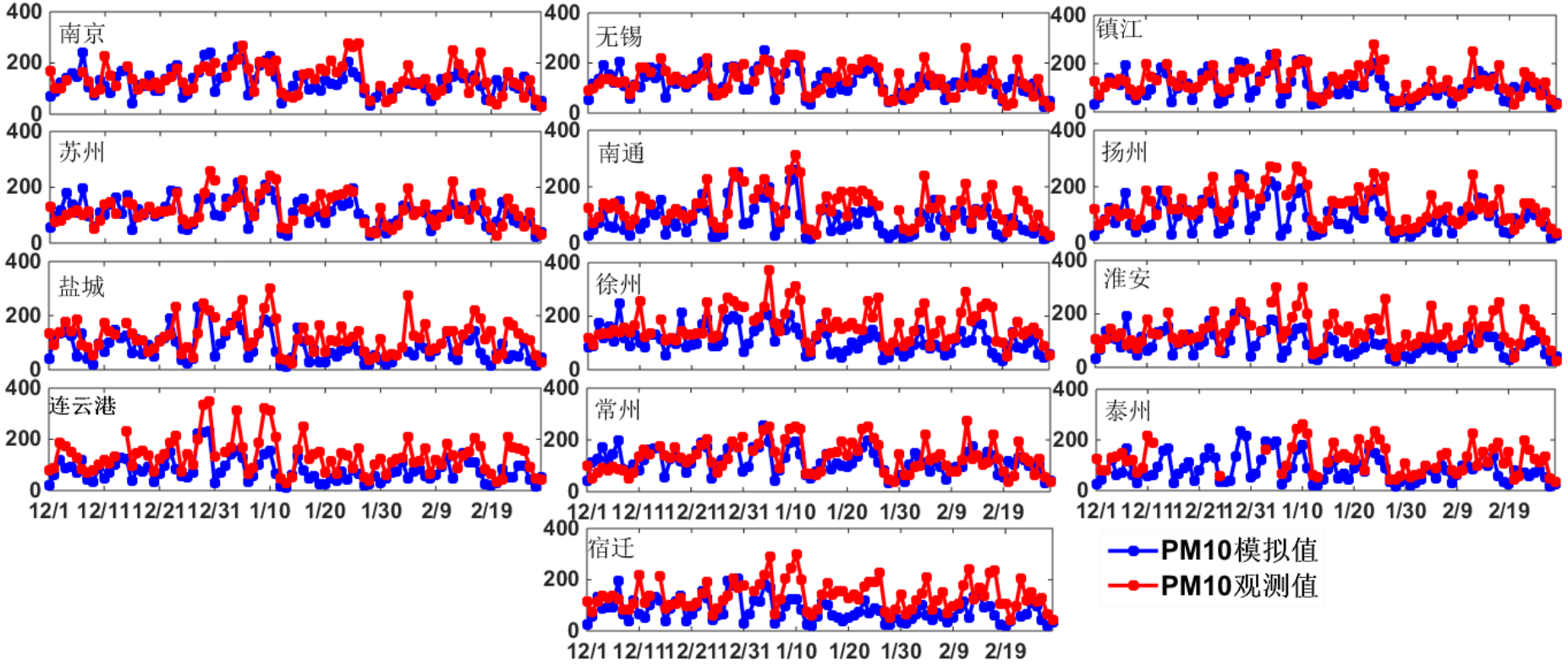

Fig10.Observed(blue) and simulated(red) daily average concentrations of PM10 at cities in Jiangsu Province from Dec2014 to Feb2015.

PM2.5

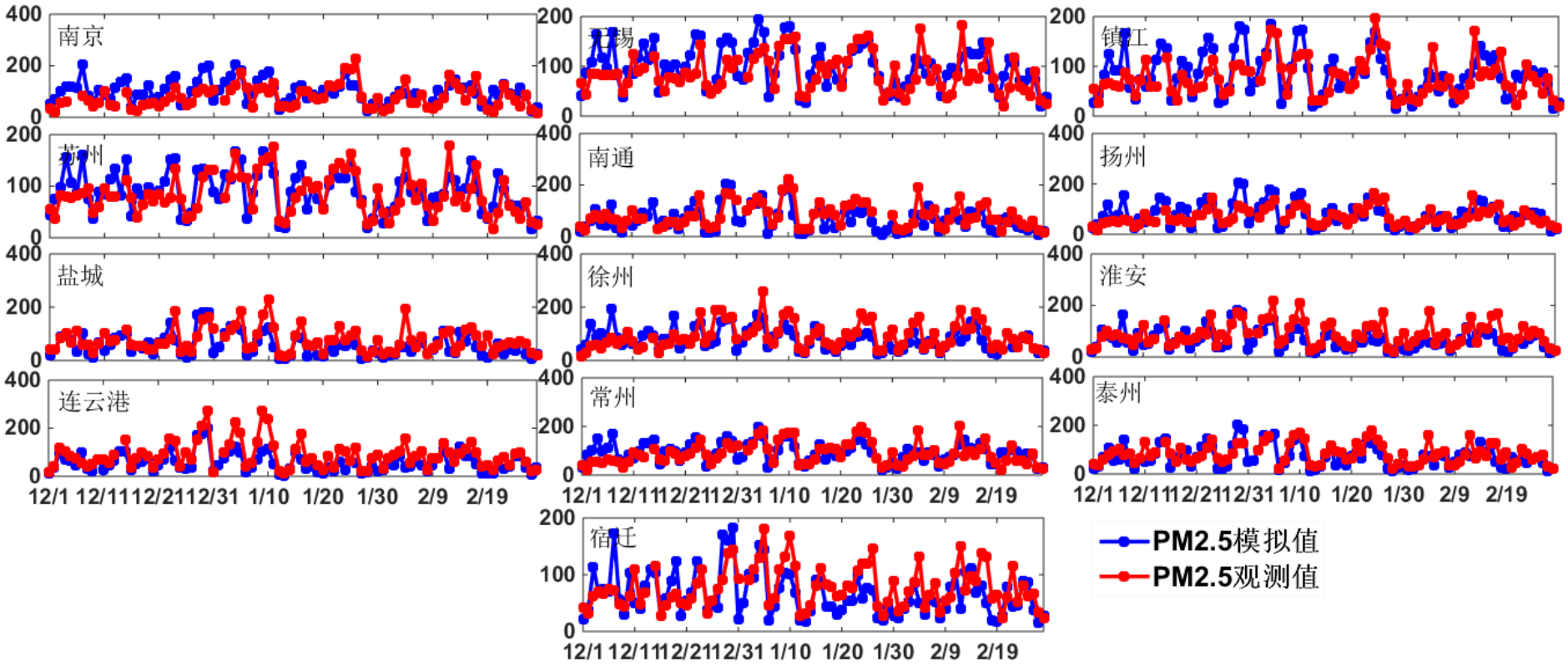

Fig11.Observed(blue) and simulated(red) daily average concentrations of PM10 at cities in Jiangsu Province from Dec2014 to Feb2015.

SO2

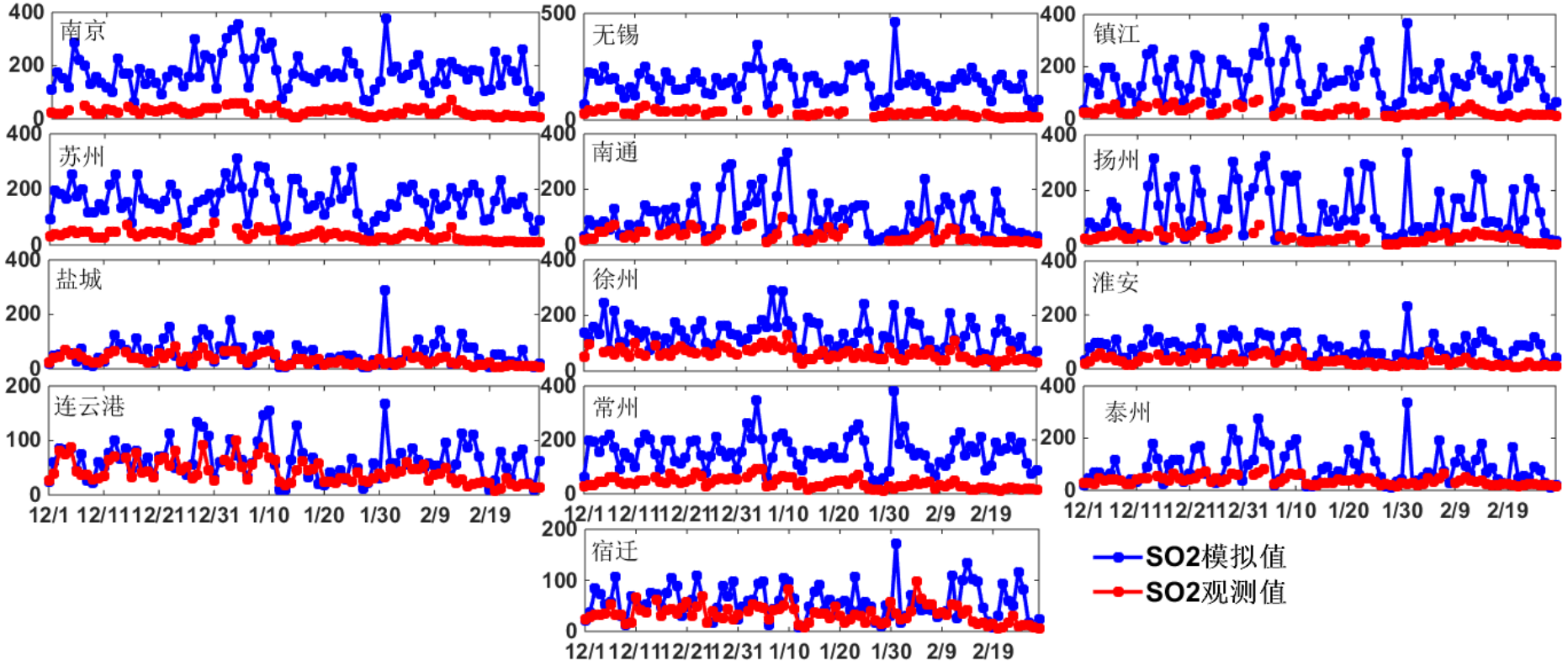

Fig12.Observed(blue) and simulated(red) daily average concentrations of SO2 at cities in Jiangsu Province from Dec2014 to Feb2015.

NO2

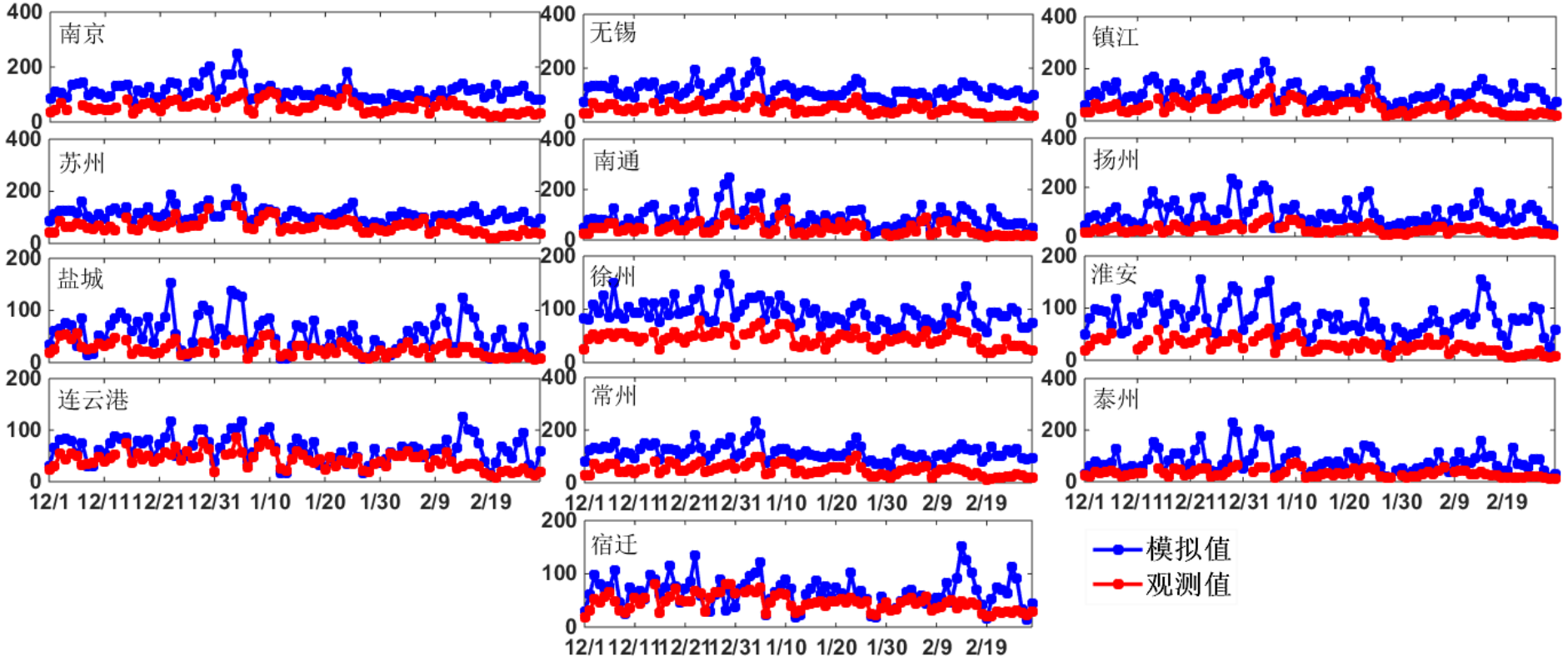

Fig13.Observed(blue) and simulated(red) daily average concentrations of NO2 at cities in Jiangsu Province from Dec2014 to Feb2015.

Table3

	R		RMSE	
	NO2	SO2	NO2	SO2
南京	0.4119	0.3379	56.0780	125.6490
镇江	0.5148	0.4359	56.9084	104.7404
苏州	0.3902	0.2848	46.6611	112.2833
南通	0.6170	0.5330	46.4631	62.3827
无锡	0.6471	0.1555	53.5956	36.2992
扬州	0.5147	0.3011	65.3751	90.1499
盐城	0.2730	0.4648	32.3045	36.1364
徐州	0.3672	0.5638	42.9646	63.4048
淮安	0.5117	0.4656	46.2899	44.5247
连云港	0.4169	0.5155	26.7151	28.7314
常州	0.5411	0.3890	62.6423	102.7762
泰州	0.5475	0.4747	47.8021	57.2040
宿迁	0.3147	0.3723	28.9844	30.1378

Next work

- Deeply analyze the reasons for the differences of simulation and observation currently.
- Adjust the intensity of emission source.
- Further study of the effect of different urban canopy parameterization schemes and PBL schemes for WRF/CMAQ model.

THANK YOU