

# Sensitivity of Simulated Severe PM<sub>2.5</sub> Pollution to WRF-CMAQ Model Configurations

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## Introduction

- Results of air quality simulations vary with model configuration changes.
- Sensitivity analyses on the variation provide important information for improvement of air quality model performance.
- This study focused on the impact of WRF-CMAQ configurations to PM<sub>2.5</sub> simulation in the severe pollution episode in China in January 2013.

## Model Setup

### • Baseline Simulation

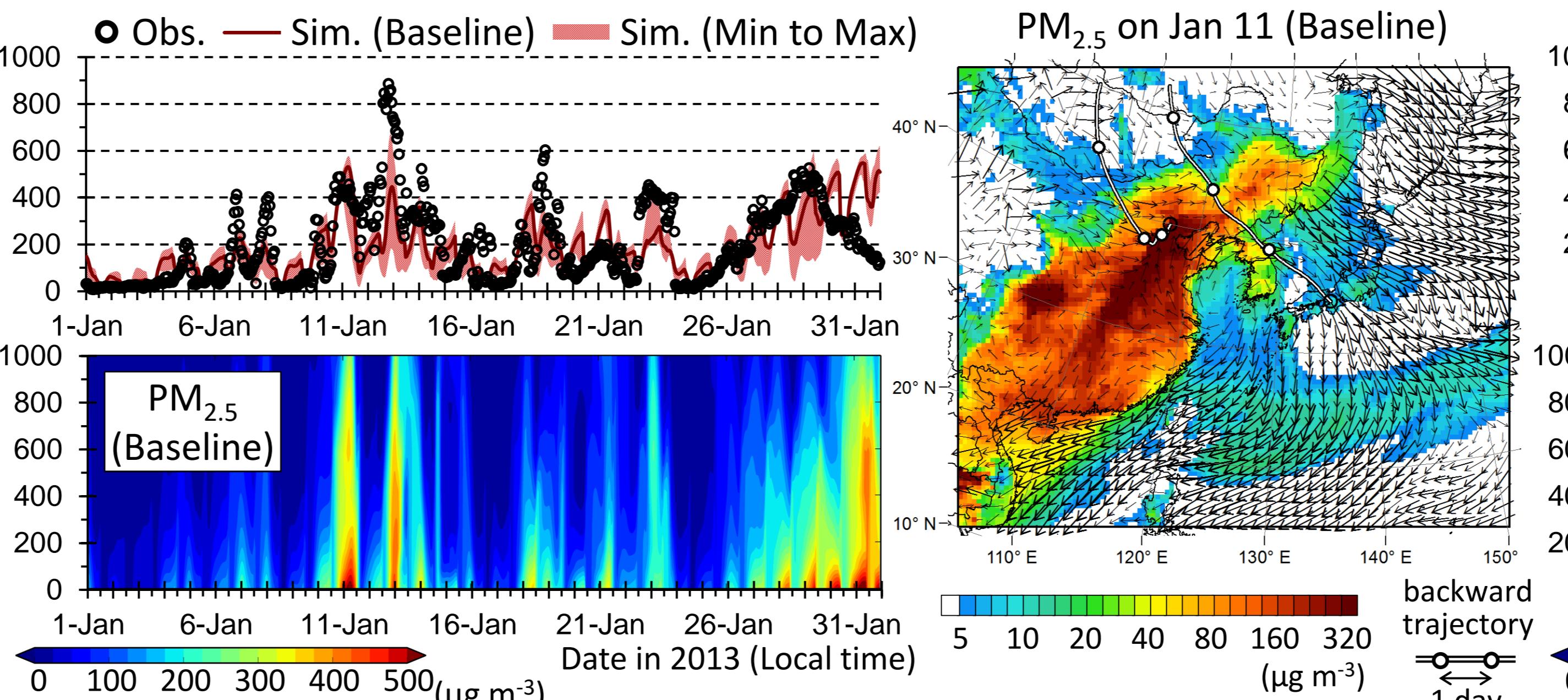
Configurations	
Model	Offline WRF v3.4-CMAQ v5.0.2
Period	January 2013 with spin-up in December 2012
Domain	East Asia, 45-km grid, 130x110 (WRF), 120x100 (CMAQ) 30 layers (up to 100 hPa, 1st layer height = <b>50 m</b> )
Topography/Landuse	30-sec USGS/30-sec USGS & 100-m MLIT-GIAJ
Analysis Data	NCEP FNL, JMA MSM-GPV, NCEP/NOAA RTG_SST_HR
WRF Physics	FDDA: $G_{t,q,uv} = 3.0 \times 10^{-4} \text{ s}^{-1}$ <b>ACM2 PBL, PX LSM</b> , Kain-Fritsch, Morrison, RRTMG
Boundary Conc.	MOZART-4/GEOSS
Emission Data	<b>INTEX-B, REAS (NH<sub>3</sub>), ARCTAS</b> , Japanese Inventories, Natural Emissions
CMAQ Chemistry	<b>CB05</b> & AERO6 with Aqueous chemistry

### • Sensitivity Analyses

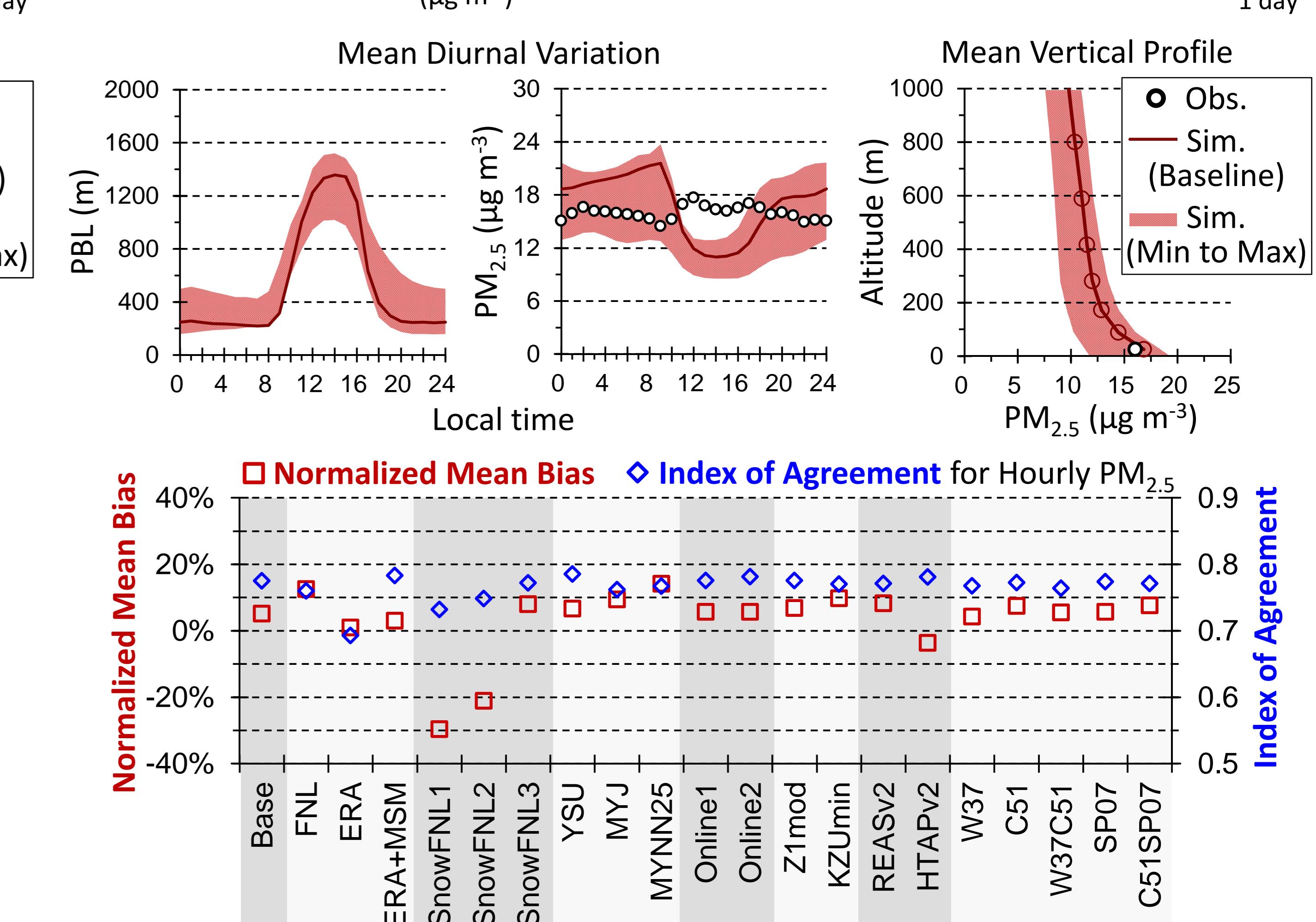
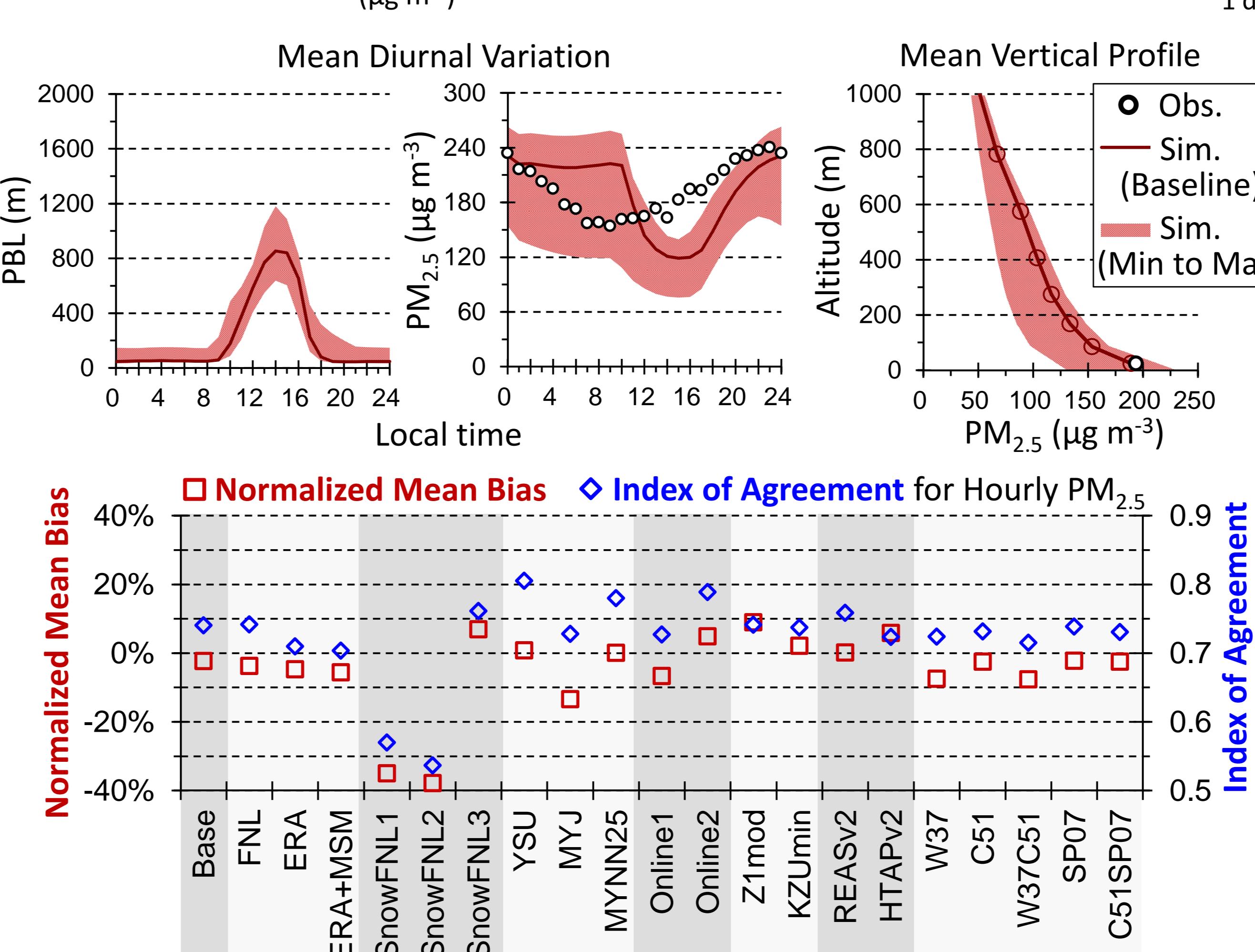
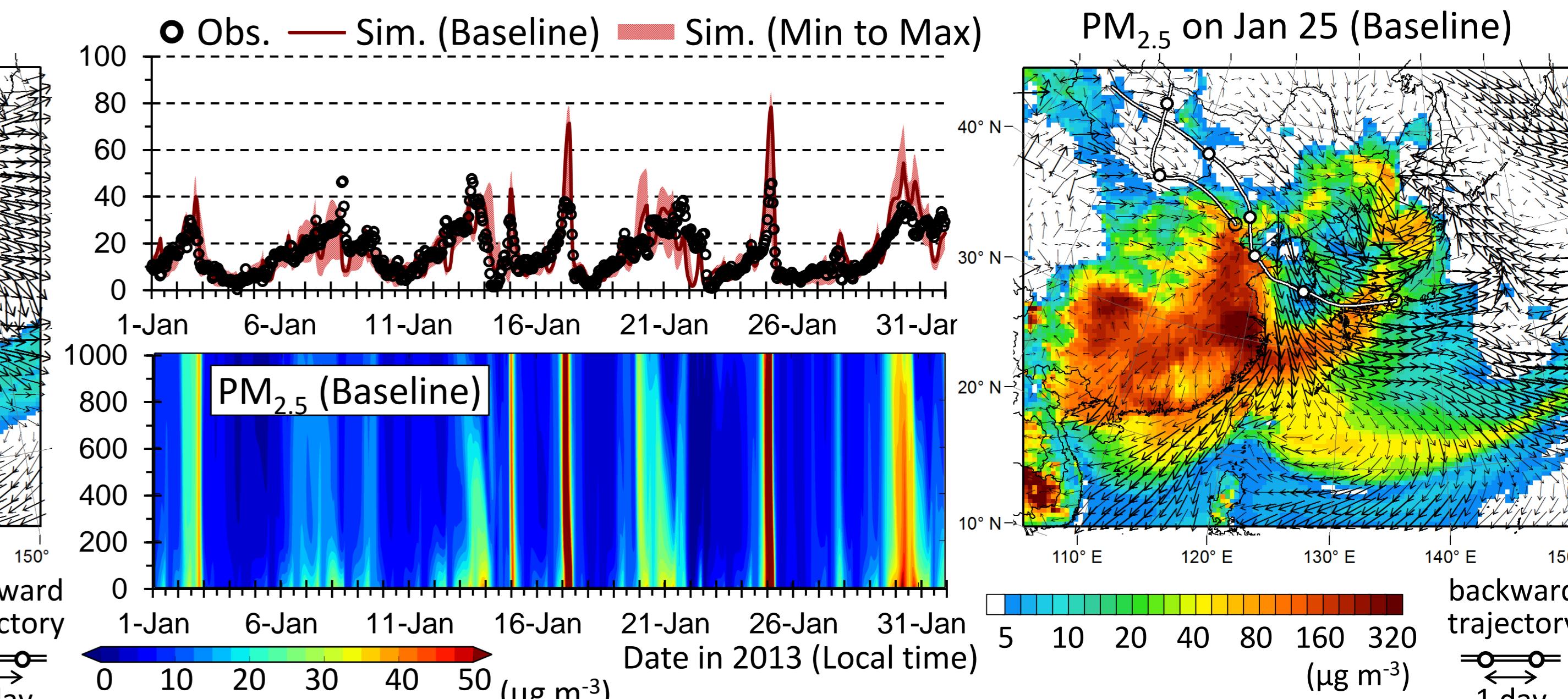
Configurations	
FNL	NCEP FNL
ERA	ECMWF ERA-Interim
ERA+MSM	ECMWF ERA-Interim & JMA MSM
SnowFNL1	Snow update from FNL, Soil Nudging, No FDDA within PBL
SnowFNL2	Snow update from FNL, No FDDA within PBL
SnowFNL3	Snow update from FNL
YSU	YSU PBL & Noah LSM
MYJ	MYJ PBL & Noah LSM
MYNN25	MYNN25 PBL & Noah LSM
Online1	1-way online WRF-CMAQ (without met-chem feedback)
Online2	2-way online WRF-CMAQ (with met-chem feedback)
Z1mod	1st layer height = 35 m
KZUmin	Change KZmin in urban from 0.5 to 0.01 $\text{m}^2 \text{ s}^{-1}$
REASv2	REAS v2 for anthropogenic emissions in the Asian Continent
HTAPv2	HTAP v2 for anthropogenic emissions in the Asian Continent
W37	WRF v3.7, CMAQ v5.0.2, CB05
C51	WRF v3.4, CMAQ v5.1, CB05
W37C51	WRF v3.7, CMAQ v5.1, CB05
SP07	WRF v3.4, CMAQ v5.0.2, SAPRC07tc
C51SP07	WRF v3.4, CMAQ v5.1, SAPRC07tc

## Results

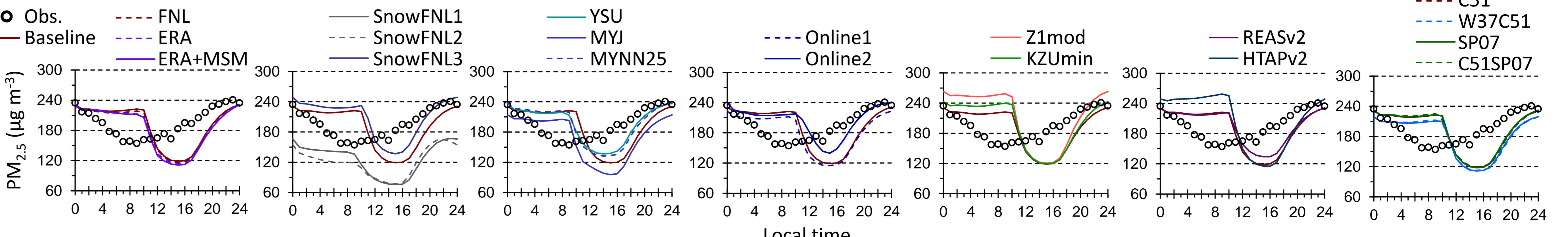
### • Model Performance at Beijing, China (39.95°N, 116.47°E)



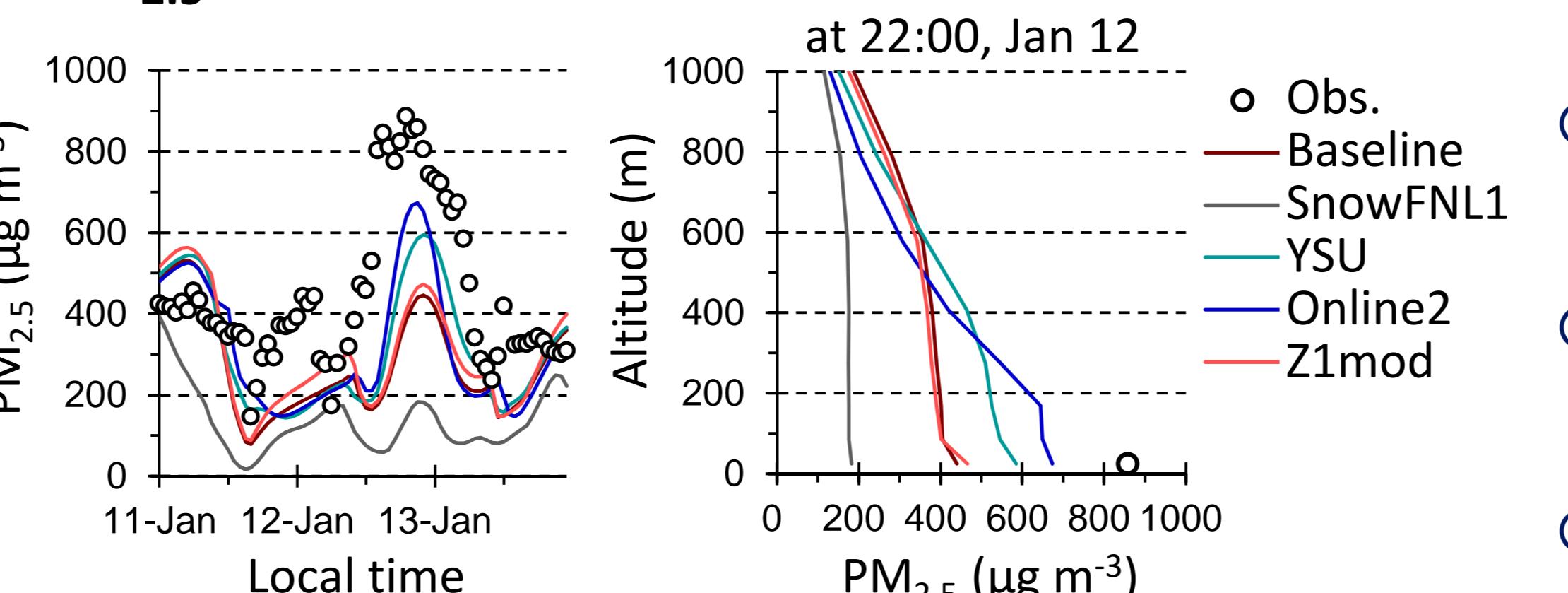
### • Model Performance at Osaka, Japan (34.68°N, 135.54°E)



### • Mean Diurnal Variation of PM<sub>2.5</sub> at Beijing



### • PM<sub>2.5</sub> at Beijing on January 12, 2013



## Summary

- Simulated PM<sub>2.5</sub> in Beijing with heavy local pollution is more sensitive to model configurations than that in Osaka affected by long-range-transport.
- Meteorology-chemistry feedback has larger impacts than the other configuration changes, particularly during severe local pollution.
- FDDA within PBL substantially influences ground-level PM<sub>2.5</sub> simulation.