Comparing WRF-GHG Model with the in-situ Measurement

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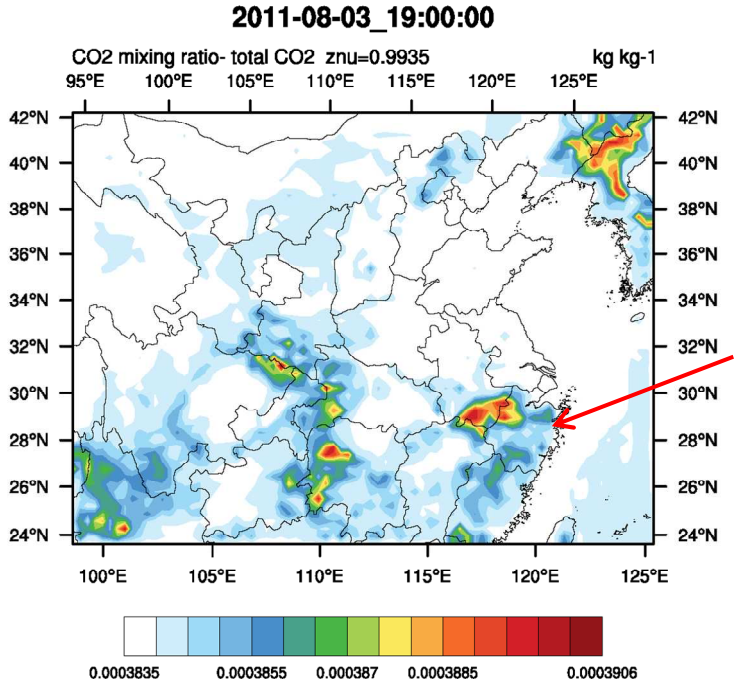
Outline

- Problems with previous version
- Major updates in current model
- Results and discussion
- Summary
- On-going Work

Problems with previous version

- We found there is no obvious high-value (hot-spot) in the urban region. The reason is the emissions did not match with map or exiting unreasonable value.
- The incomplete IC/BC (e.g., co2_fuel, which is very important in simulation) maybe underestimated CO2 concentrations.

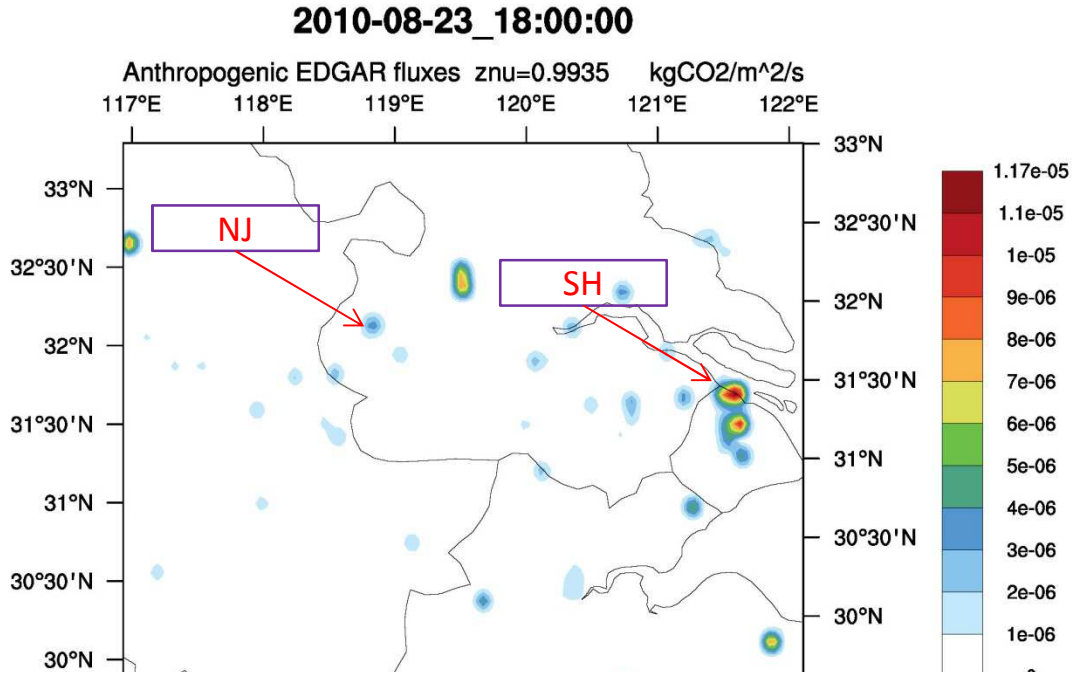


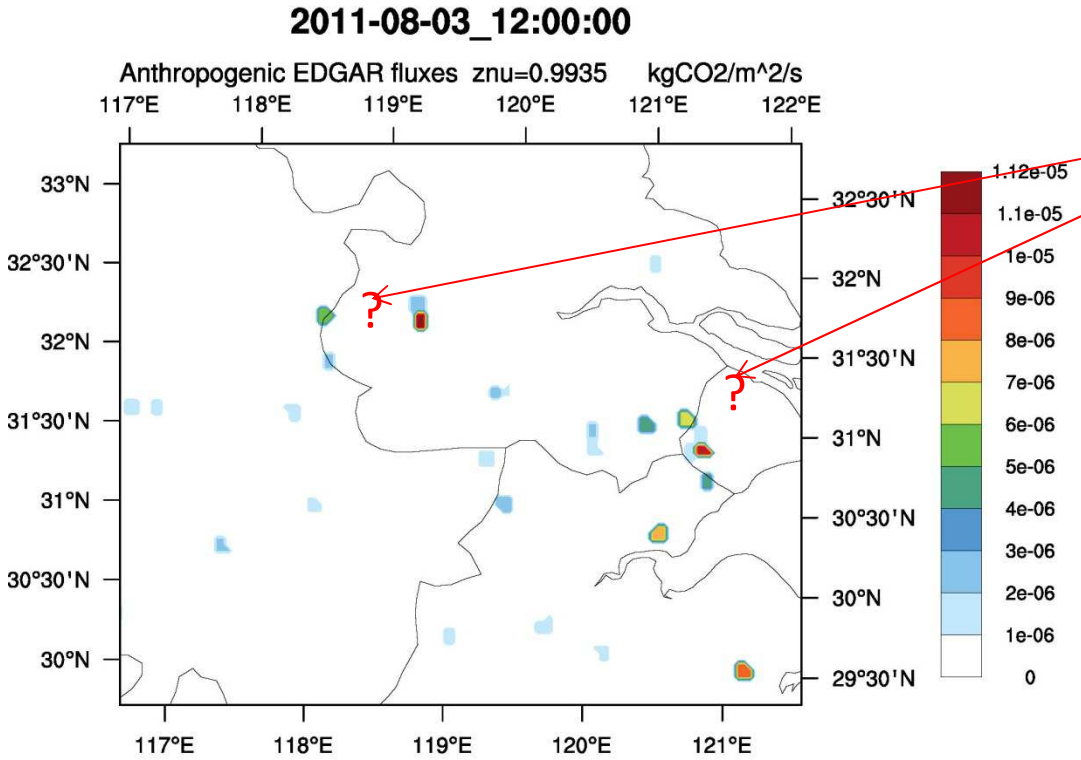
It should be higher value than vicinity in Shanghai based on the measured. However, the value in urban came to pretty lower.

Major updates in the current model

- Employ TM5 output (see Carbon-Tracker[1]) for CO2/CH4 IC/BC processing. (geos-chem for initiaion in early version)
- Write matlab program[2] to auto-generate all IC/BC
- Update edgar4.2 anthropogenic emissions

[1]. CarbonTracker - CT2011 - http://esrl.noaa.gov/gmd/ccgg/carbontracker/index.html
[2]. The code includs vprm_init.m, read_wrf_dom.m, interp_edgar42_to_wrf.m, tm5_to_wrf.m, wrf_ic/bc.m, and so on.





EDGARv4.2 Anthrop. Fluxes
Base year: 2008 Resolution: 1˚ x 1˚

Current emissions
Monthly updated

Where is the emission?

Old emissions

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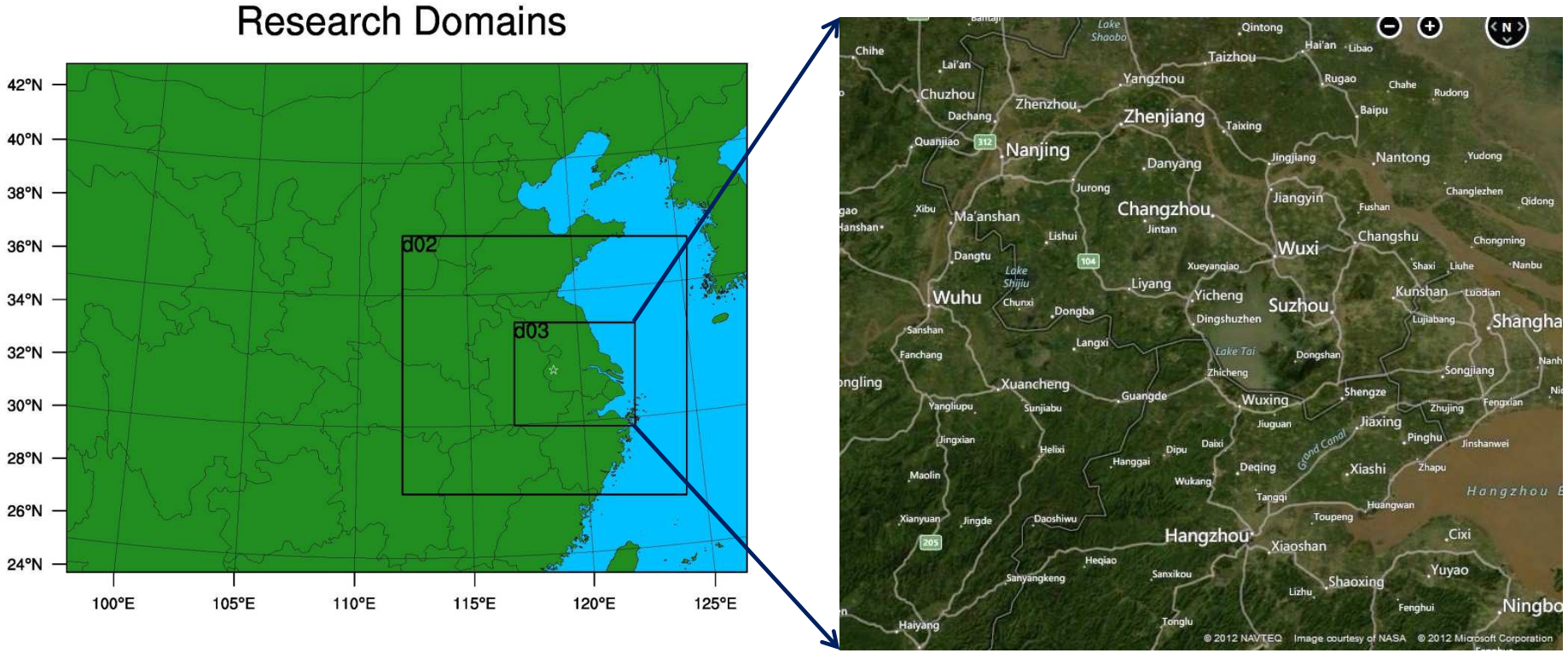
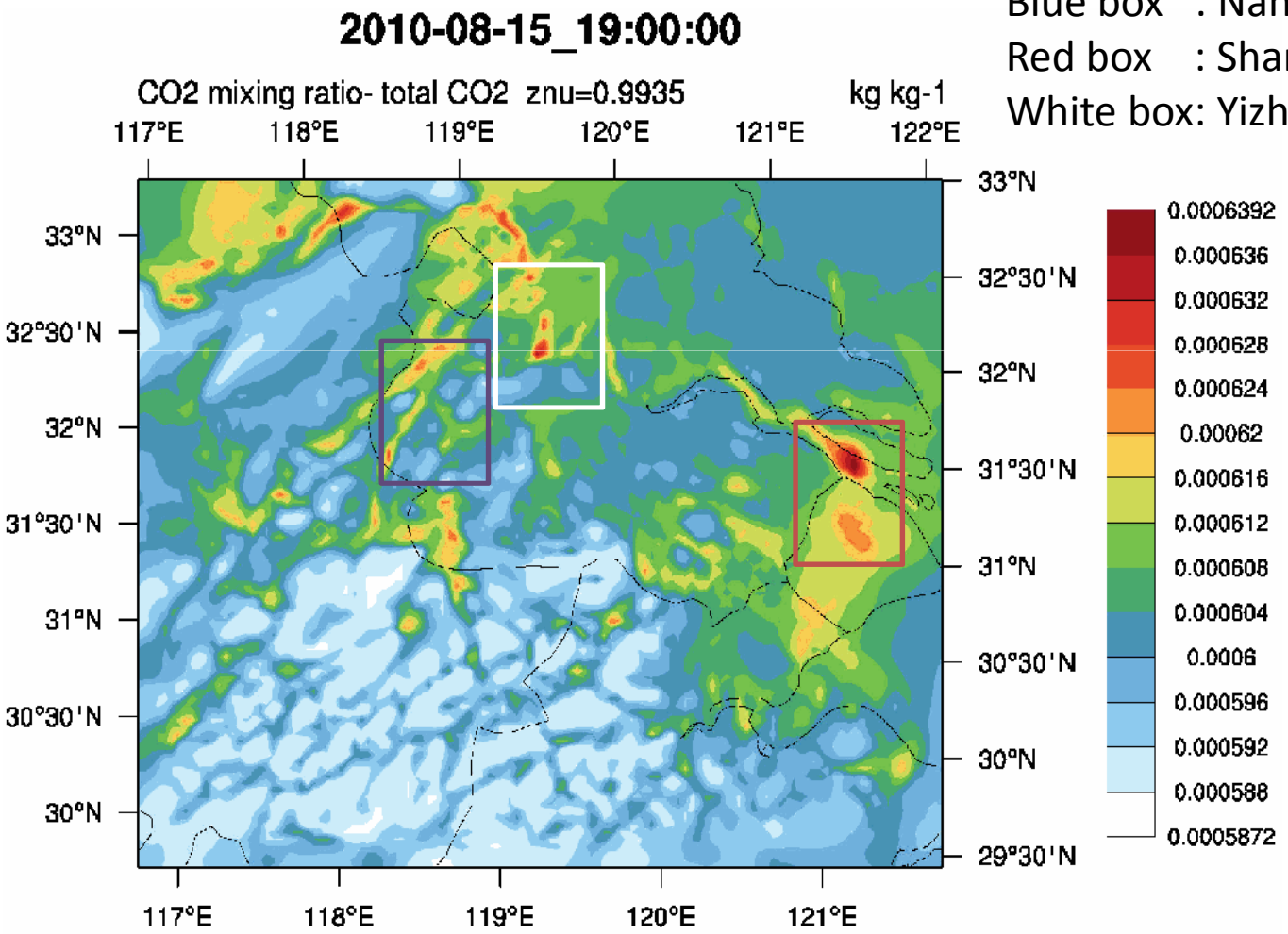
Simulation Region



WRF-GHG Configuration

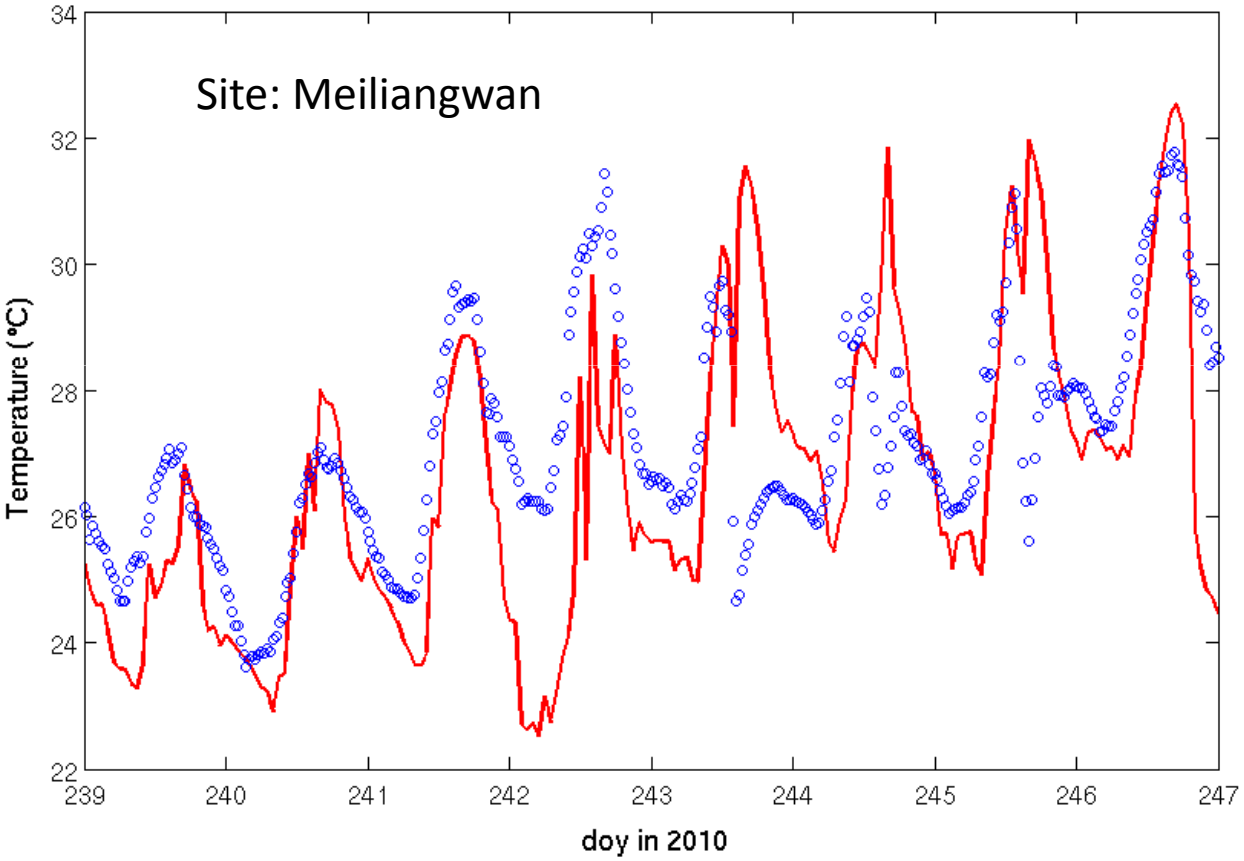
Nested domains	36km × 12km × 4 km
Met input field	NCEP FNL 1°×1°
Microphysics Options	WSM3, WSM5
SFC options	Monin-Obukhov, unified Noah, single-layer UCM
Urban	no urban physics
PBL options	Mellor-Yamada-Janjic (Eta) TKE scheme
CO2_1 = "CO2 mixing ratio- total CO2“	IC/BC
CO2_2 = "CO2 mixing ratio- VPRM CO2"	IC/BC
CO2_3 = "CO2 mixing ratio- fossil fuel CO2"	IC/BC
CO2_4 = "CO2 mixing ratio- biomass burning fluxes"	IC/BC
CO2_B = "CO2 mixing ratio- background" ;	IC/BC
FL_ANTCO2 = “Anthropogenic emissions of CO2”	Used in current simulation
FL_ANTCH4 = “Anthropogenic emissions of CH4”	Used in current simulation
FL_ANTCO = “Anthropogenic emissions of CO”	Used in current simulation

Temporal-spatial Variation of CO_2 Concentration



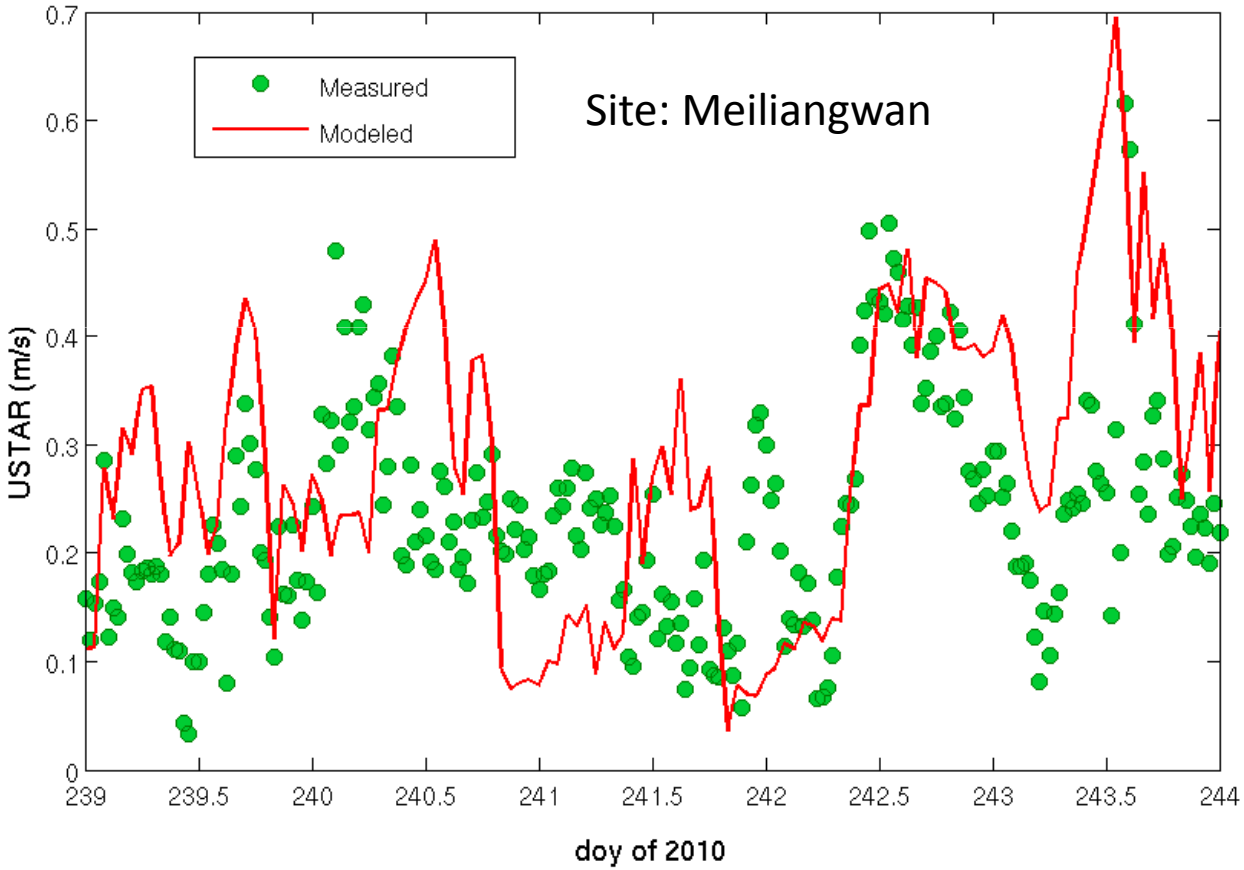
Blue box : Nanjing
Red box : Shanghai
White box: Yizheng industry

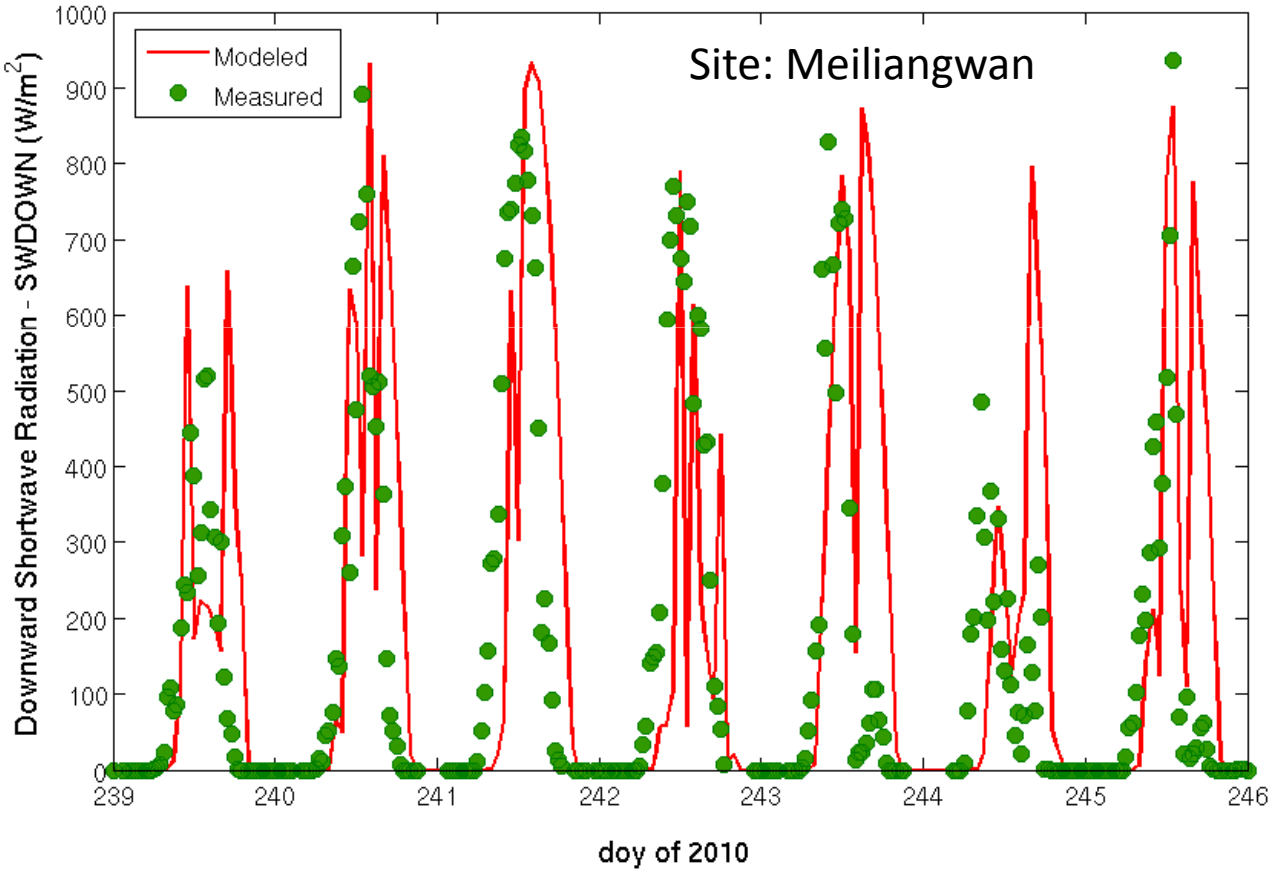
Results and discussion

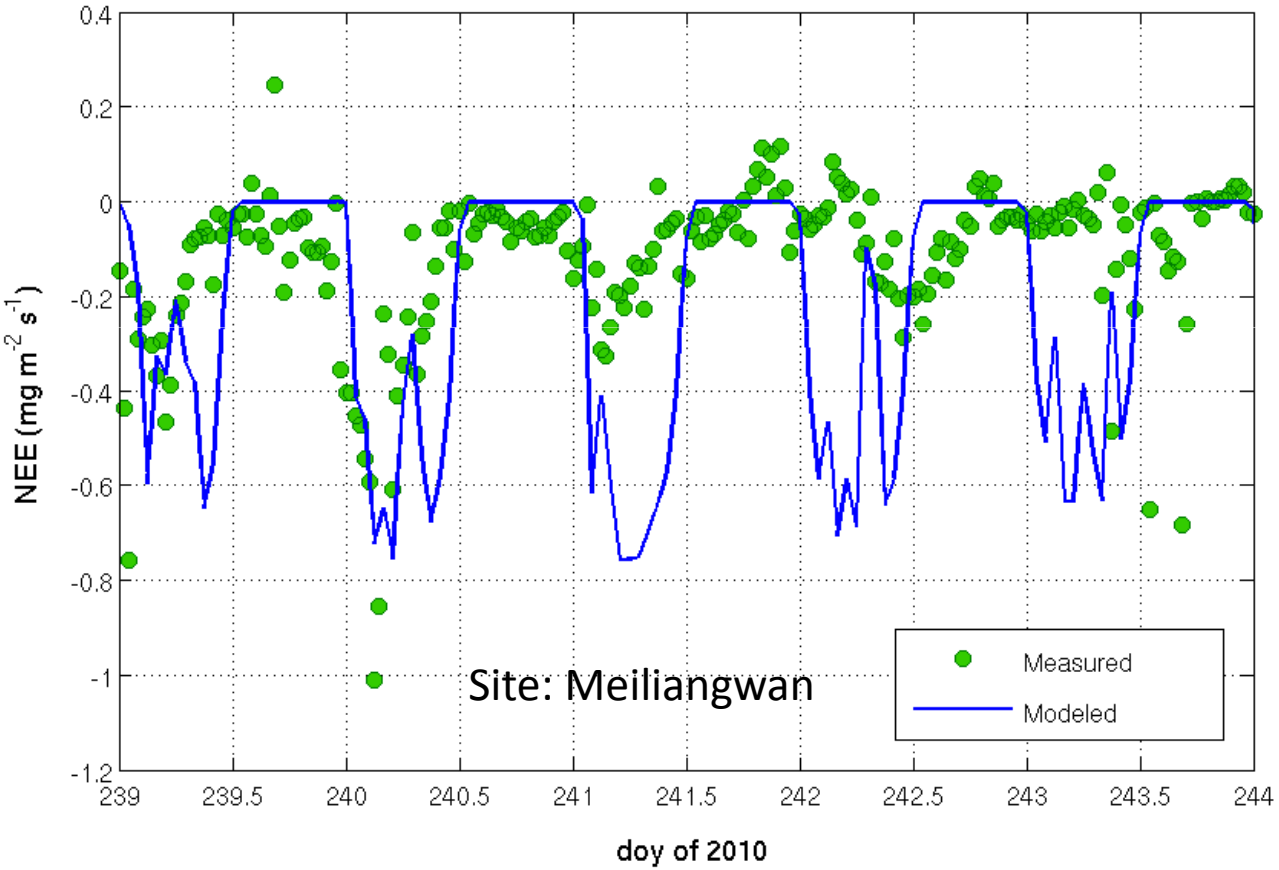


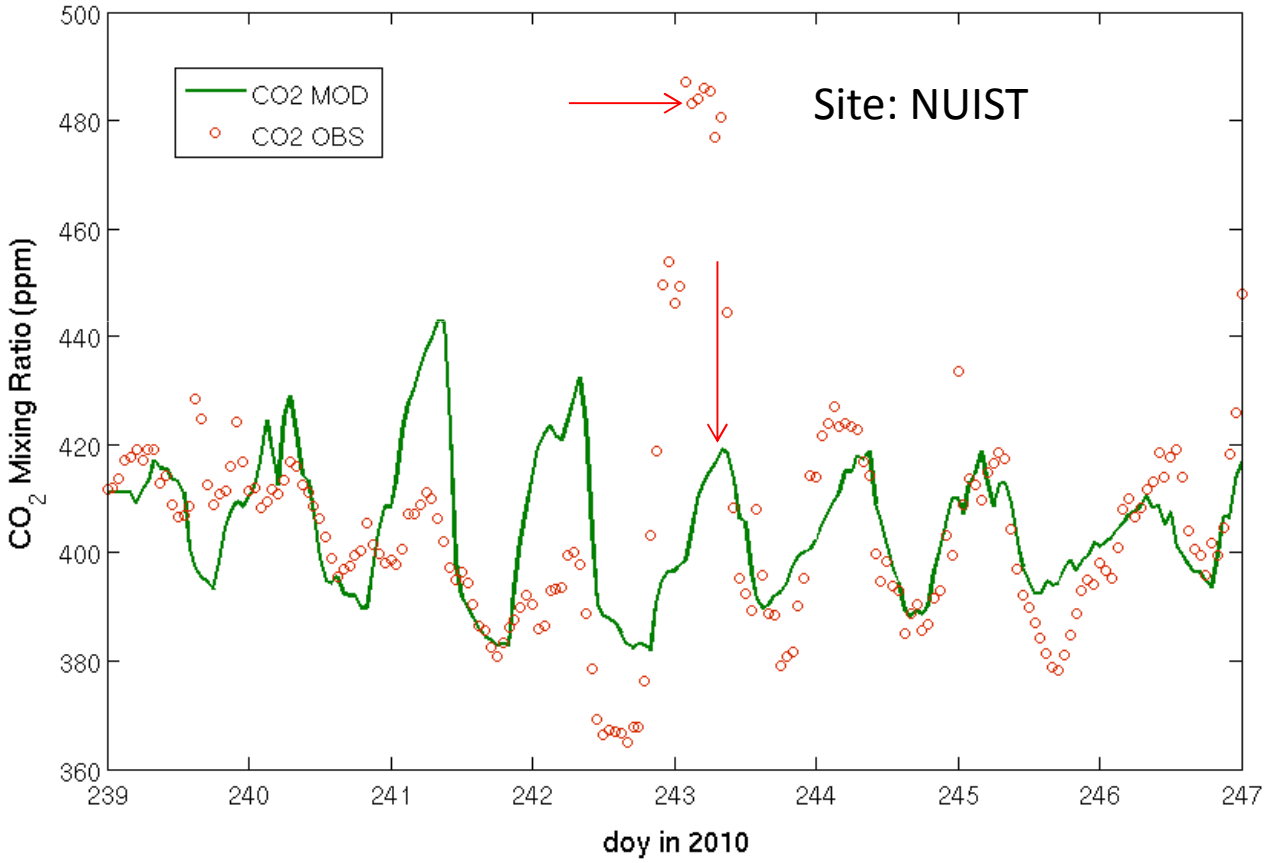
Linear model Poly1:
f(x) = p1*x + p2
Coefficients (with 95% confidence bounds):
p1 = -15.69 (-18.02, -13.36)
p2 = 816 (755.9, 876.2)

Goodness of fit:
SSE: 1489
R-square: 0.7959
Adjusted R-square: 0.7916
RMSE: 5.628


Measured
Modeled
Site: Meiliangwan
USTAR (m/s)
doy of 2010
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
239
239.5
240
240.5
241
241.5
242
242.5
243
243.5
244


Site: Meiliangwan
Modeled
Measured
Downward Shortwave Radiation - SWDOWN (W/m^2)
doy of 2010
1000
900
800
700
600
500
400
300
200
100
0
239
240
241
242
243
244
245
246


0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
NEE (mg m-2 s-1)
239
239.5
240
240.5
241
241.5
242
242.5
243
243.5
244
doy of 2010
Site: Meiliangwan
Measured
Modeled



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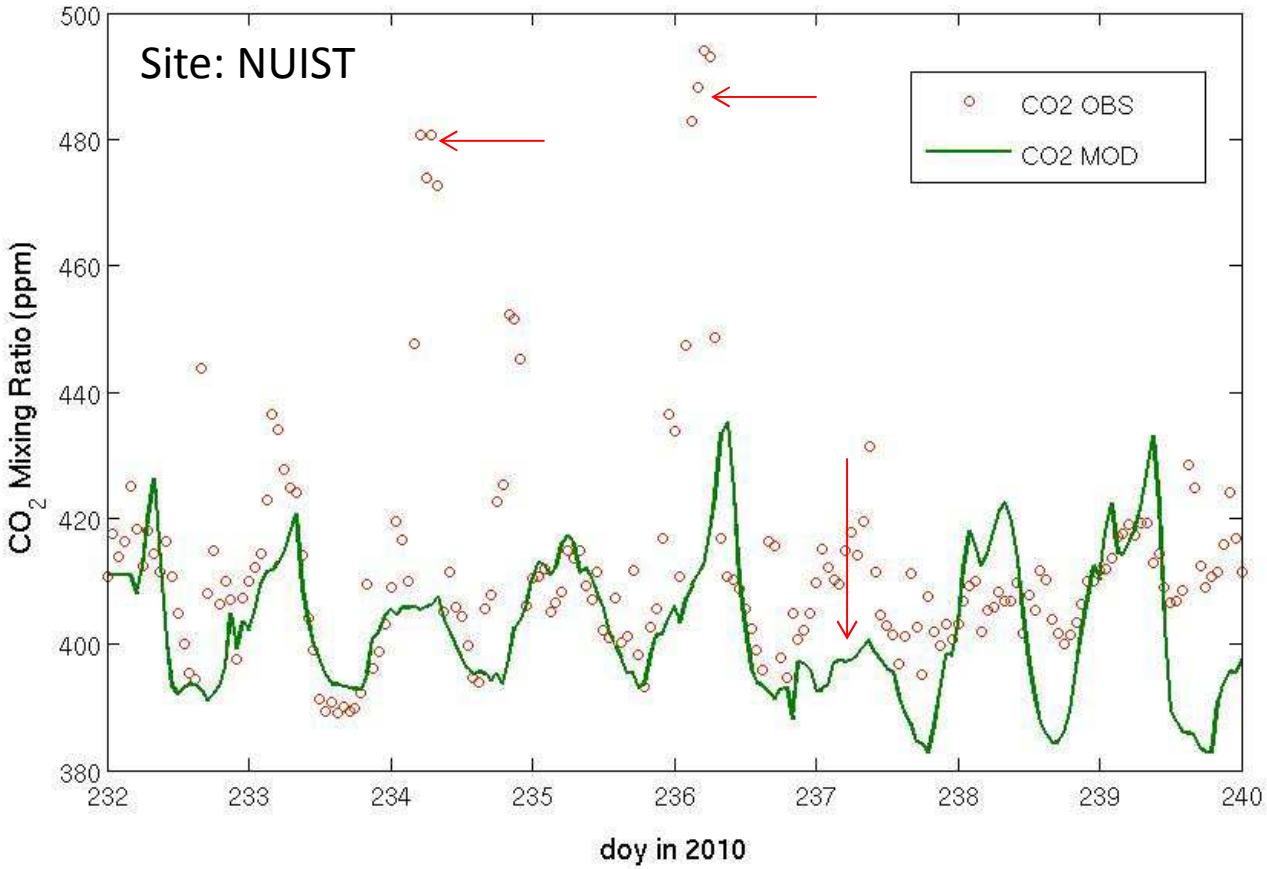
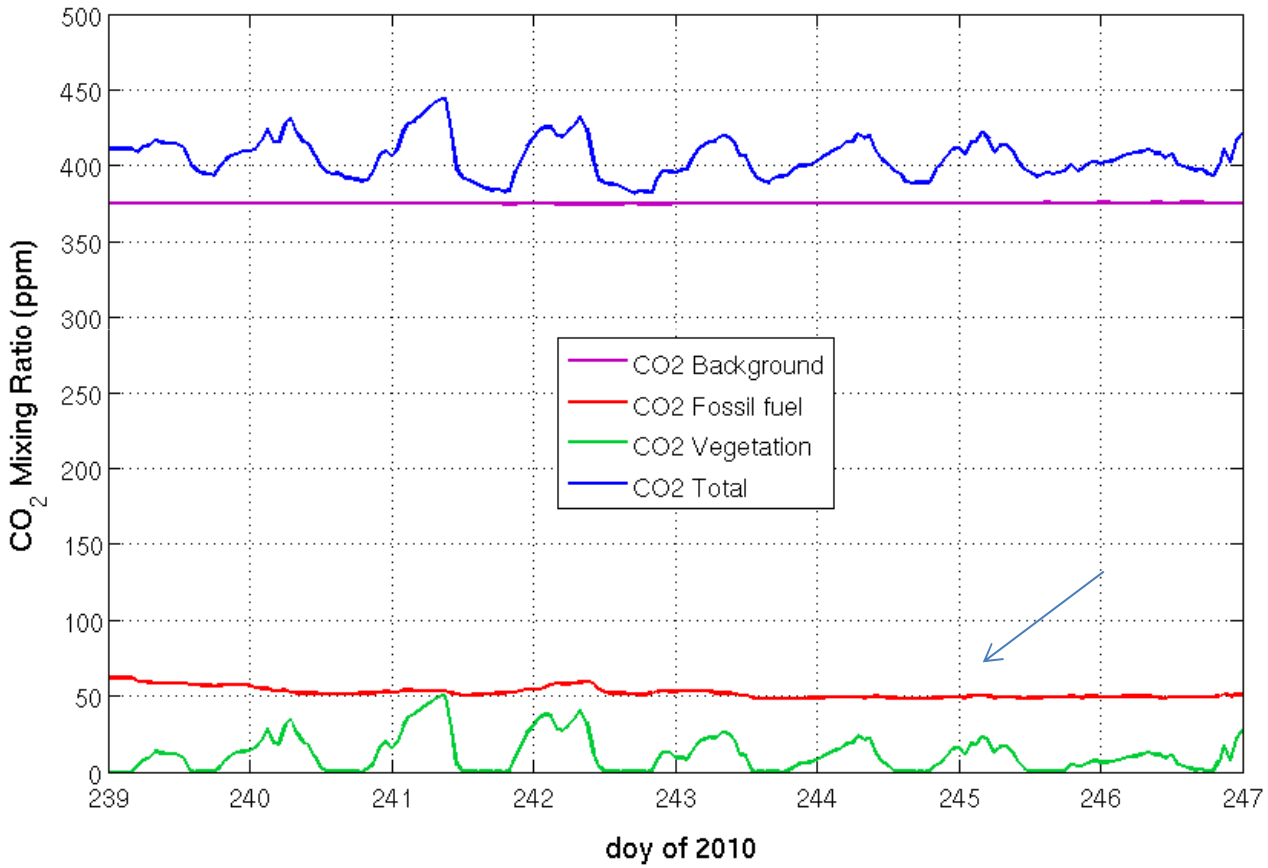

Site: NUIST
CO2 OBS
CO2 MOD
CO2 Mixing Ratio (ppm)
500
480
460
440
420
400
380
232
233
234
235
236
237
238
239
240
doy in 2010


500
450
400
350
300
250
200
150
100
50
0
239
240
241
242
243
244
245
246
247
CO_2 Mixing Ratio (ppm)
doy of 2010
CO2 Background
CO2 Fossil fuel
CO2 Vegetation
CO2 Total

Summary

- The meteorological fields reproduced well.
- The differences between simulation and measurement possibly caused by uncertainty of both WRF-GHG and the field measured data.
- Because of no high resolution emission, the impact of fossil fuel on CO_2 is not clear.

On-going Work

- Go on comparing model with the measurement in different site.
- To test CH_4 simulation.

Thanks.
Any question?