Multisensor and Multimodel Monitoring and Investigation of Air Pollution

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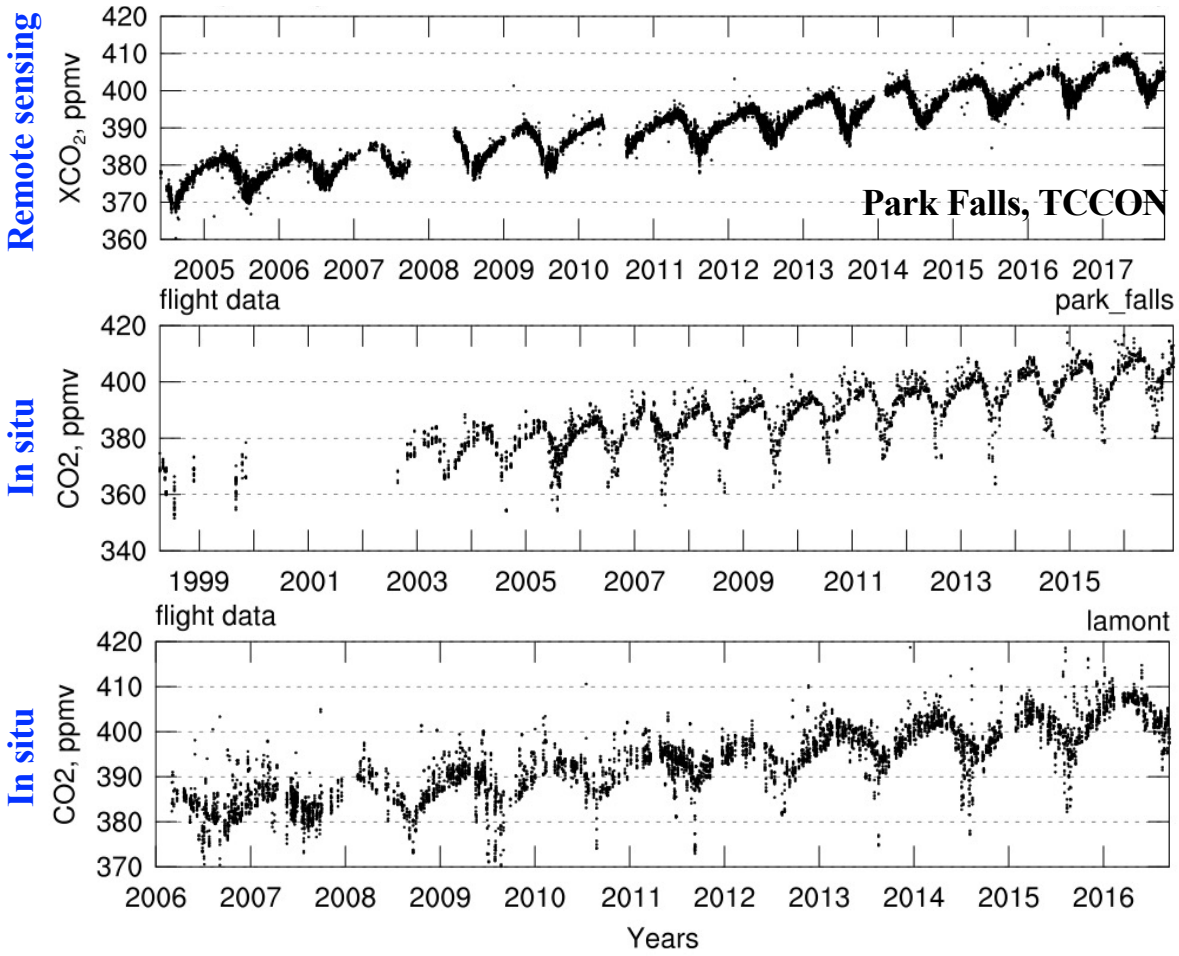
https://cpaess.ucar.edu/sites/default/files/meetings/2021/documents/agenda-and-abstracts-april-24-2021.pdf

1. 3D WRF-CO_2 simulation
2. Multi-Model investigation of Haze Pollution

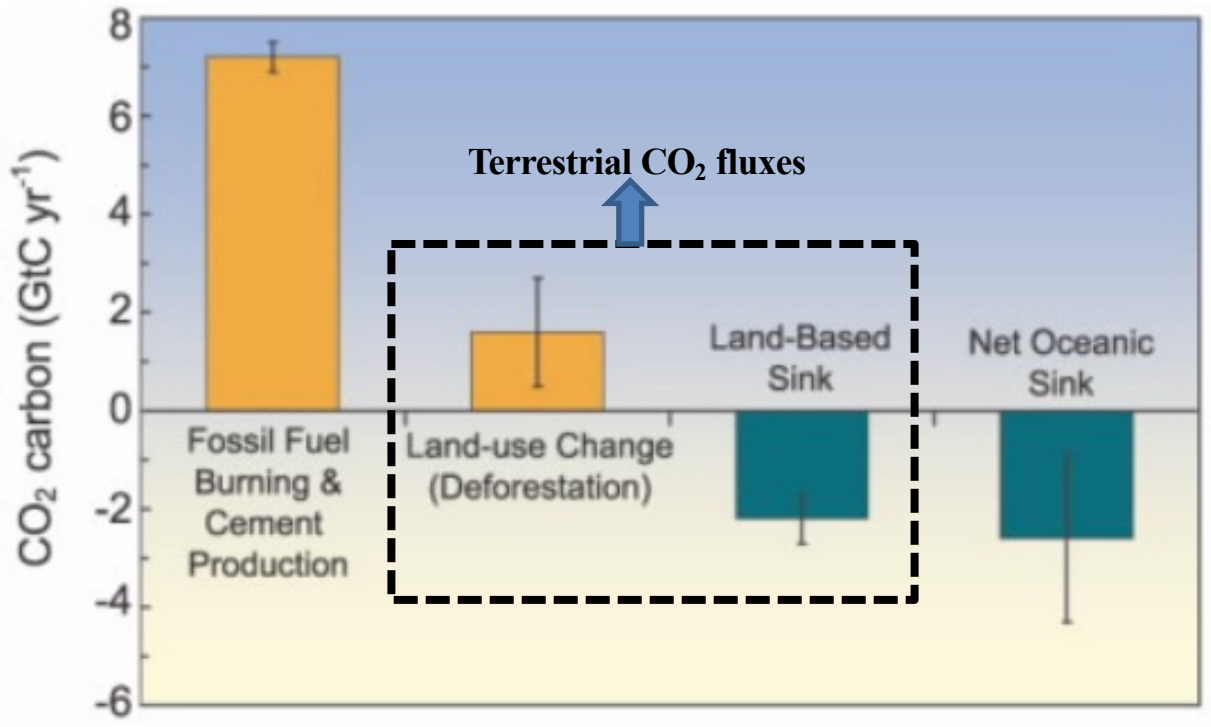
CO_2-induced global warming?

Trend of CO_2



Global warming controversial? Look at CO_2 trend!!

Global CO_2 sources and sinks



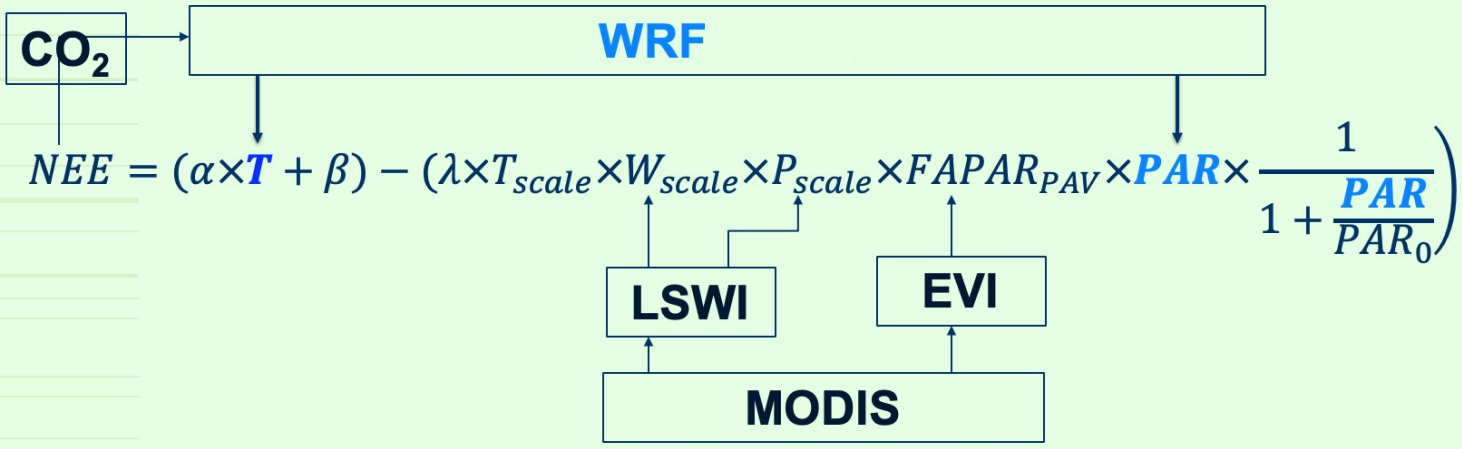
IPCC (2007)

Uncertainties of terrestrial CO_2 fluxes are large

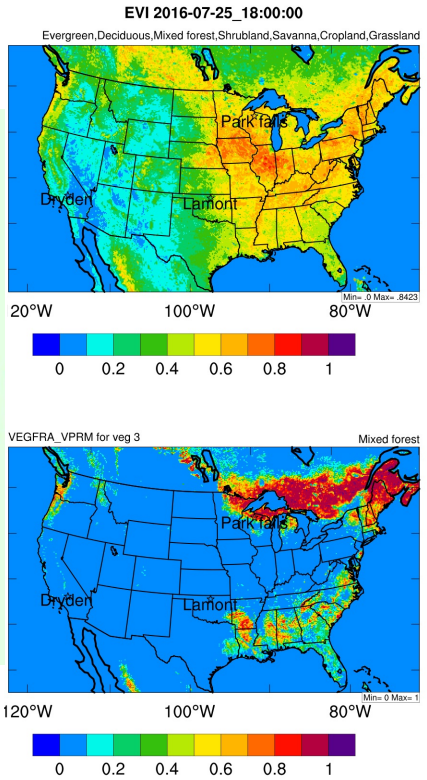
Weather-biosphere online-coupled WRF-VPRM

- Vegetation Photosynthesis and Respiration Model (VPRM) (Xiao et al., 2004; Mahadevan et al., 2008; Ahmadov et al., 2007)

WRF-VPRM system

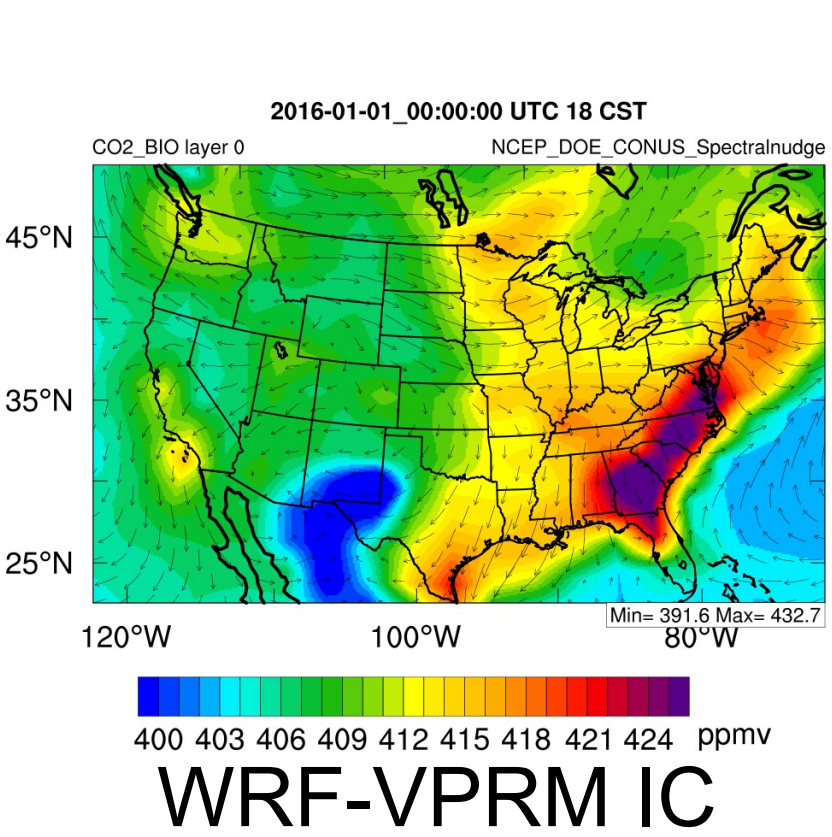


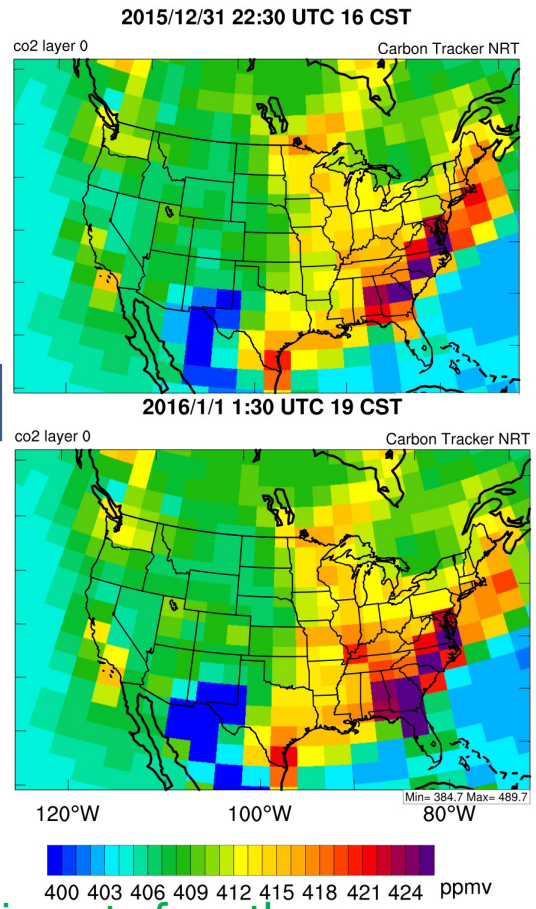
α, β, λ, PAR_0 need flux data calibration



More details in Hu et al., 2020, JAMES

Downscaling in 2016 from CarbonTracker

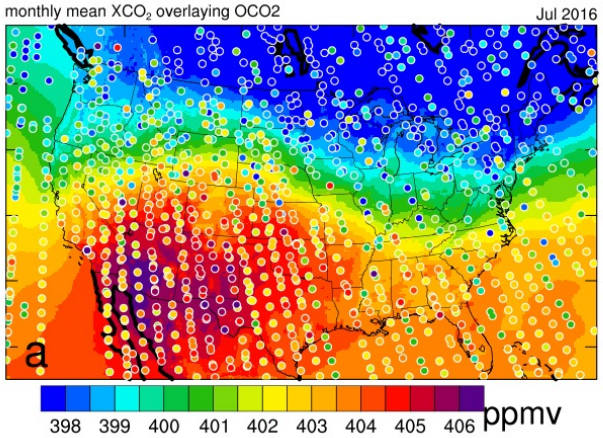


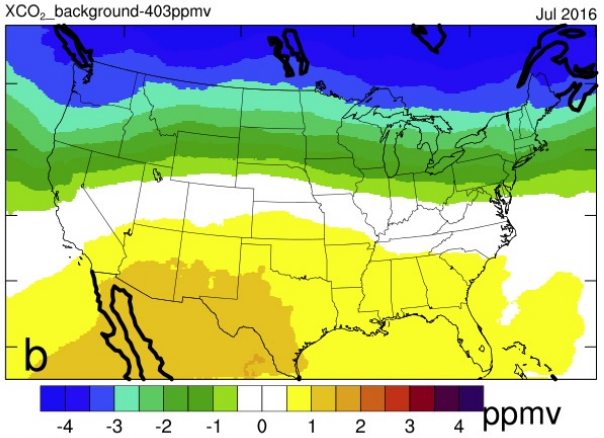


Point 1: both IC/BC are time dependent
Point 2: resolution of WRF-VPRM is much higher, adequate to investigate impact of weather

Compare with OCO-2; individual contributions

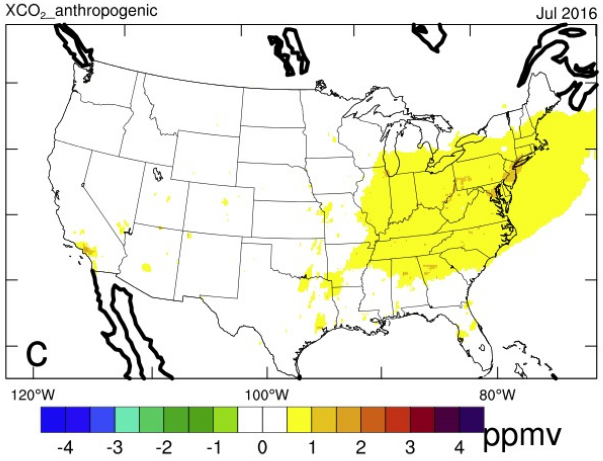
Total

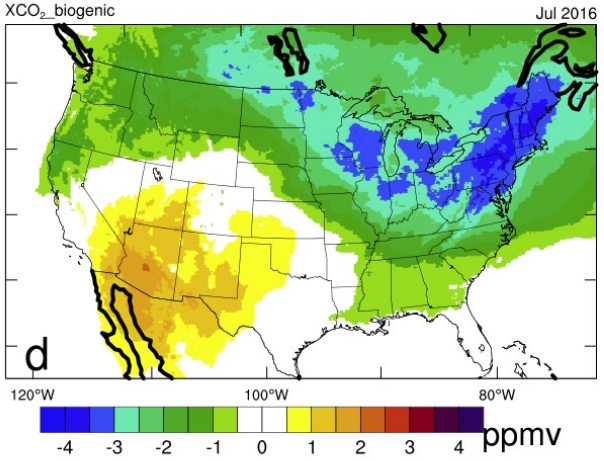




Background

Anthropogenic





Biogenic

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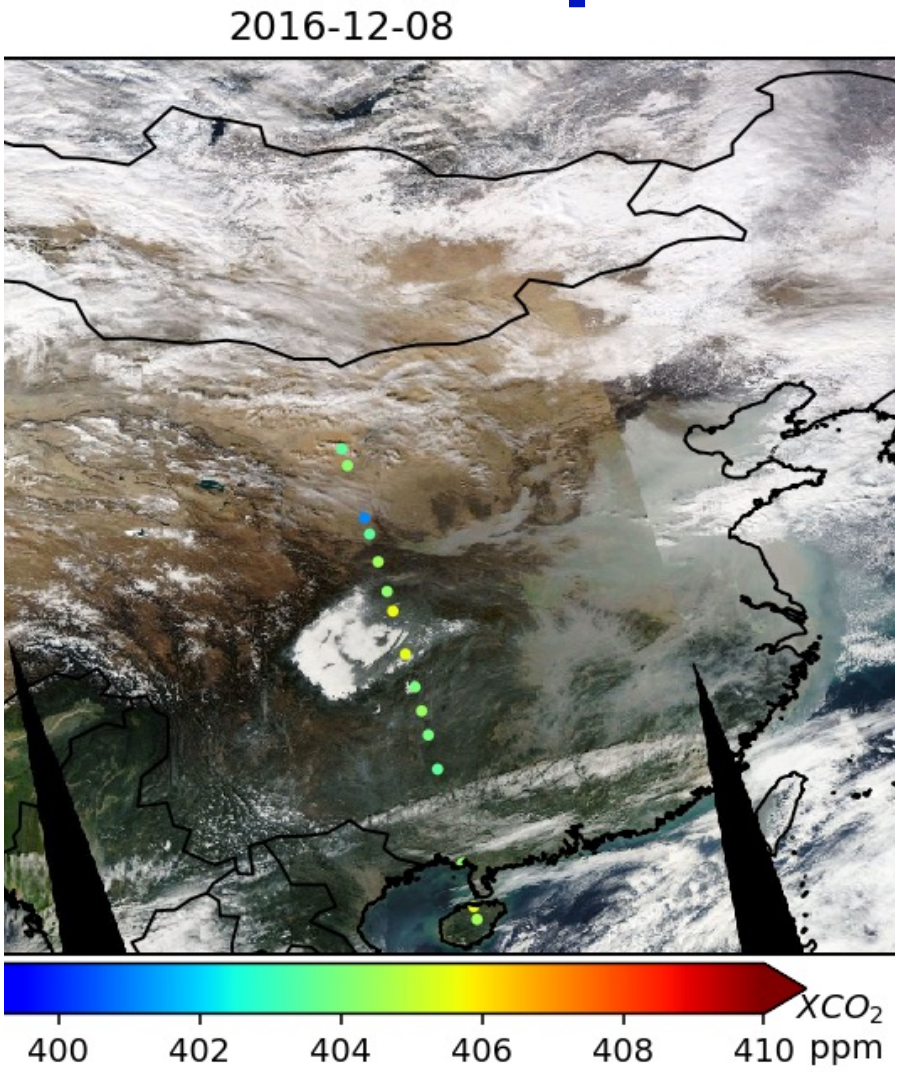
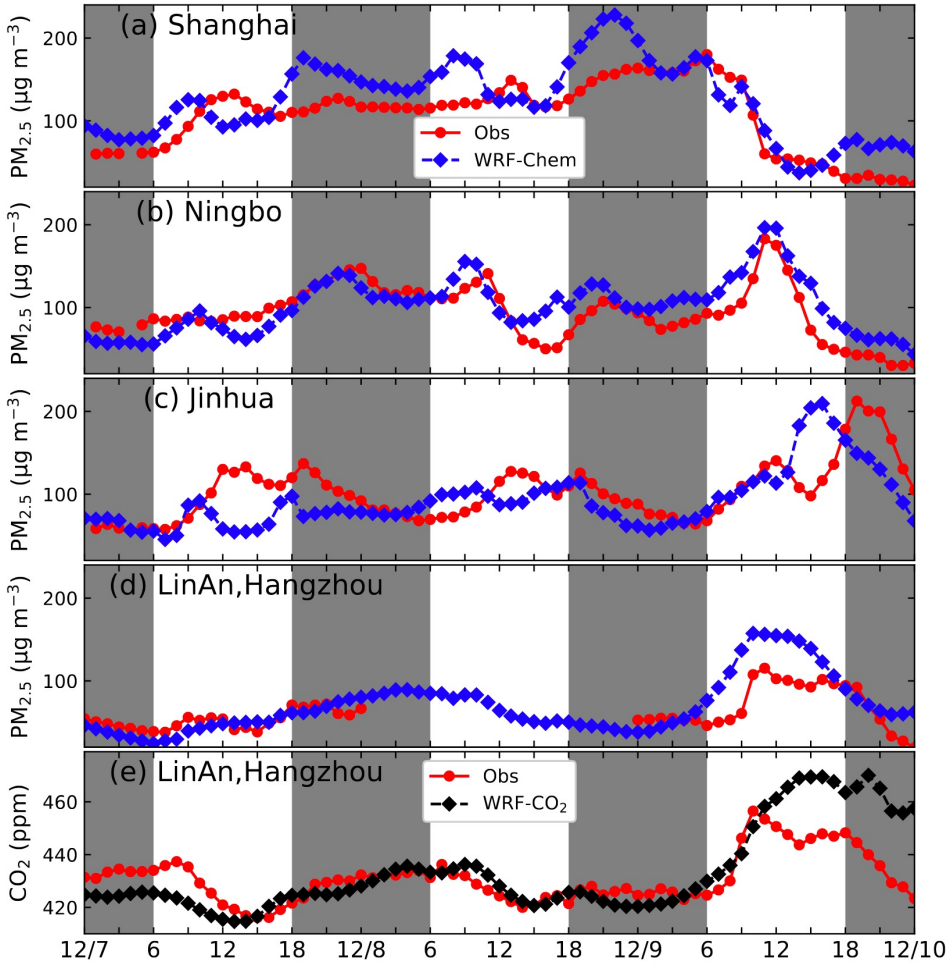
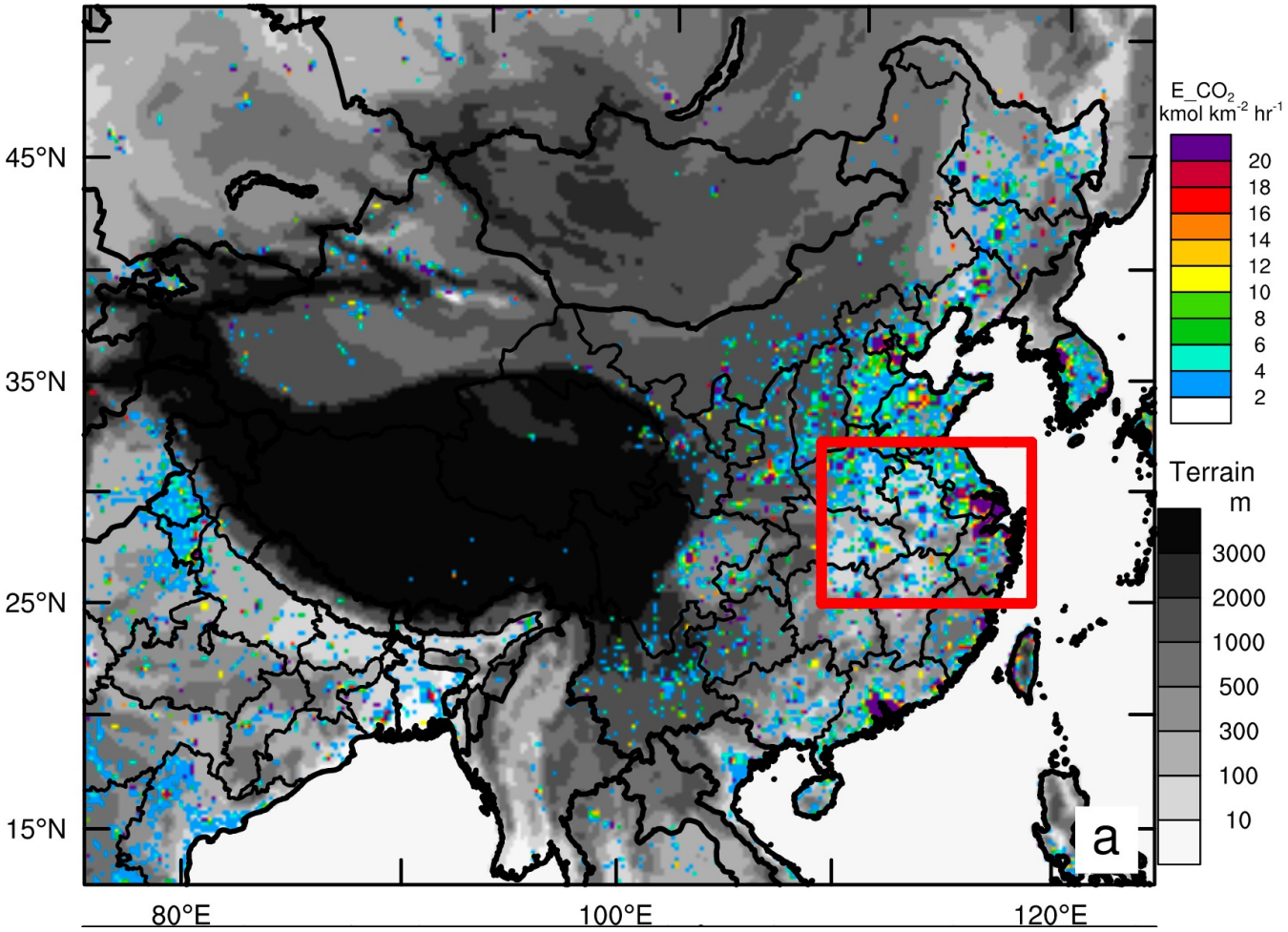
Haze pollution in China





Heaviest haze pollution in China in 2016

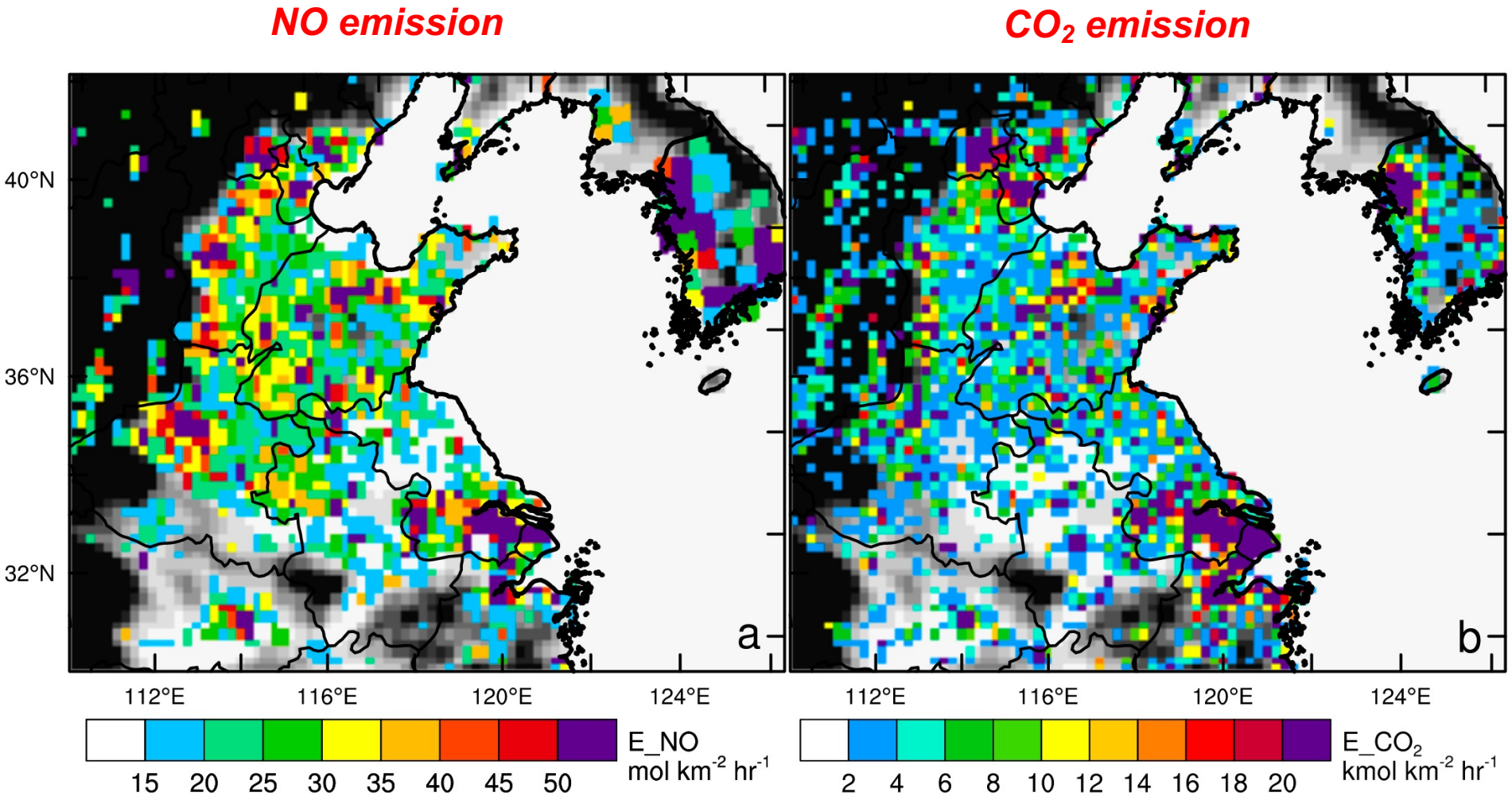
A Multi-Model Multi-Sensor approach



WRF-Chem
&
WRF-CO_2

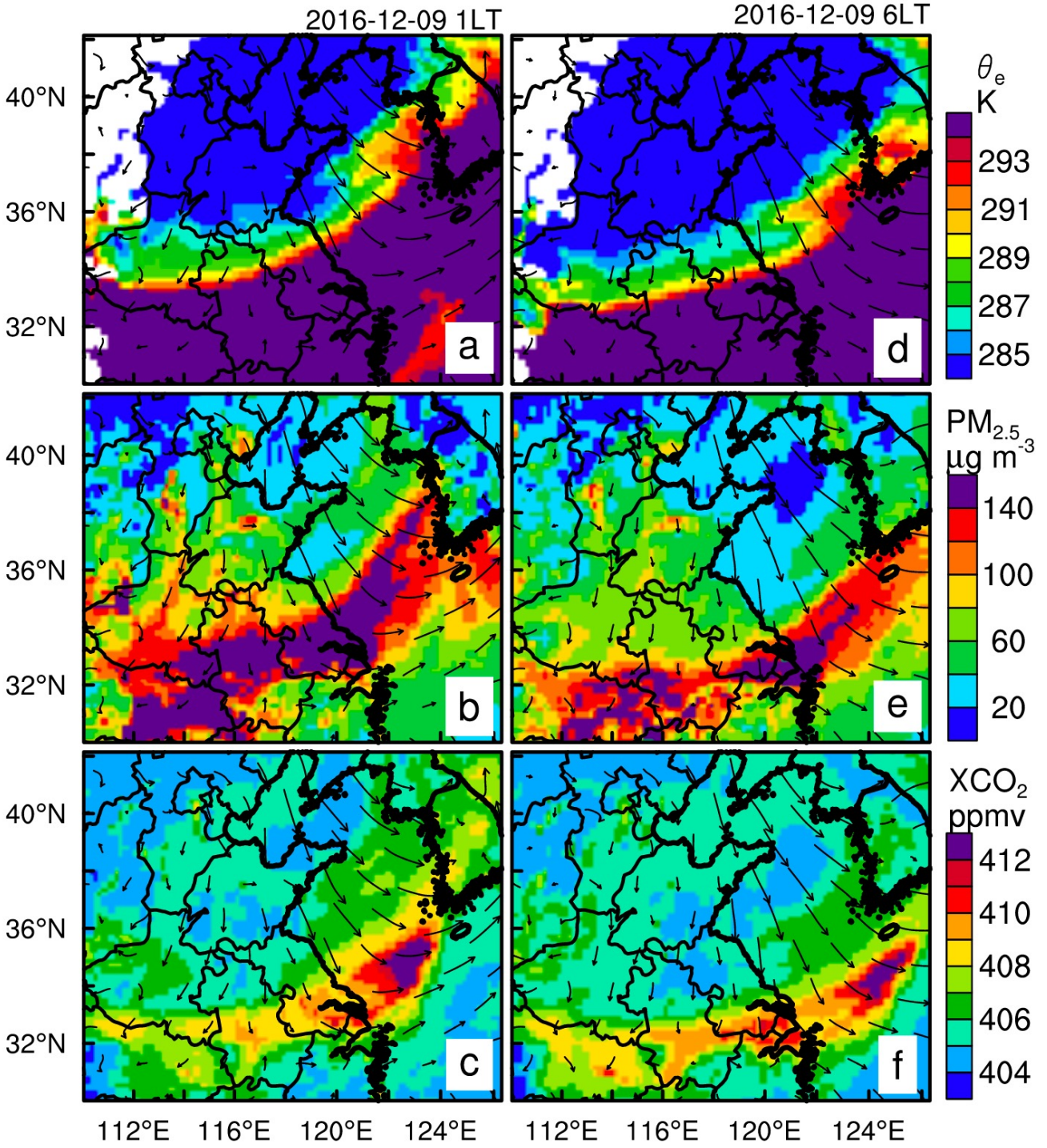
Hu, X.-M., et al., 2020: Multi-sensor and multi-model monitoring and investigation of a wintertime air pollution event ahead of a cold front over eastern China. J. Geophy. Res., 10.1029/2020JD033538.

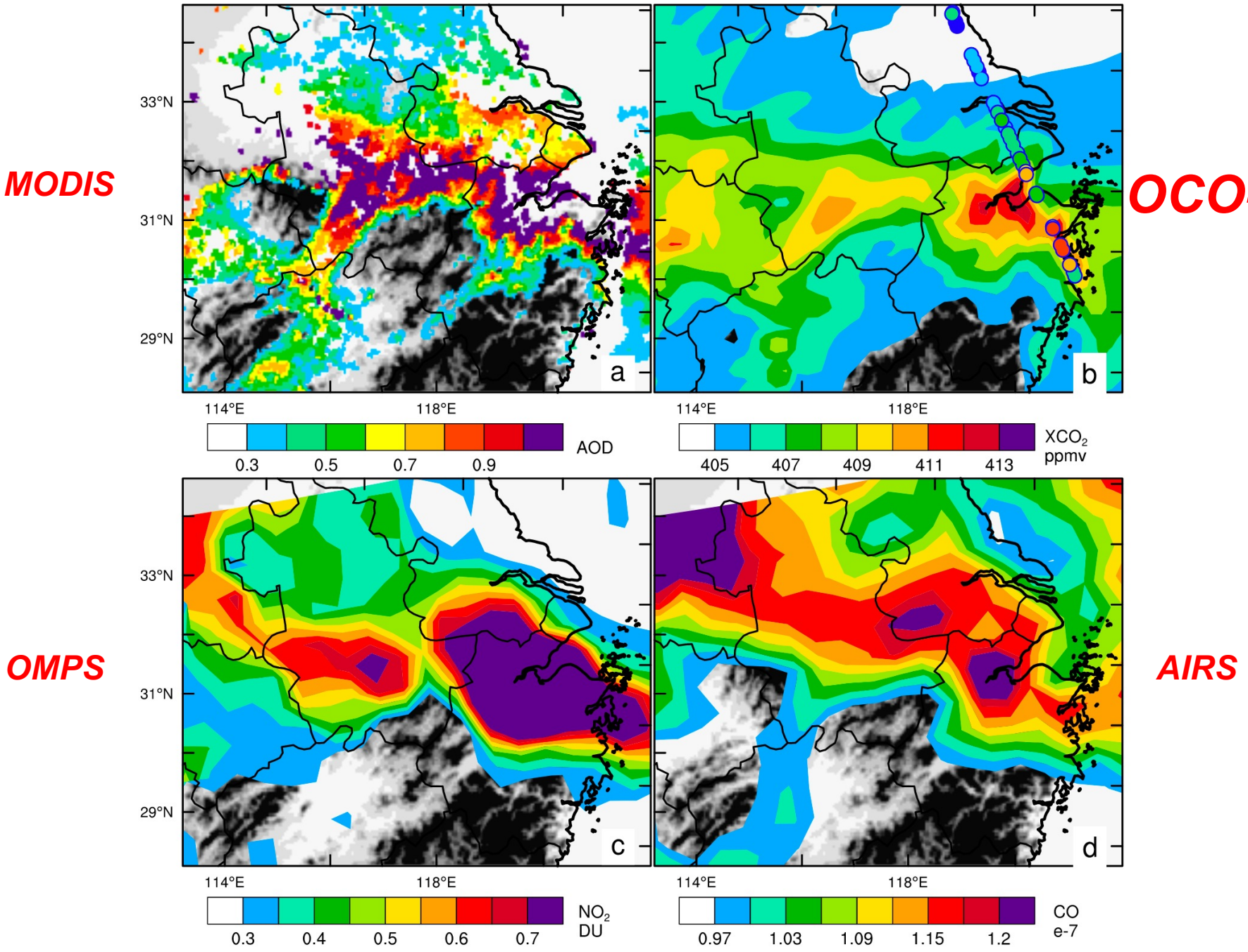
Emissions for WRF-Chem & WRF-CO_2



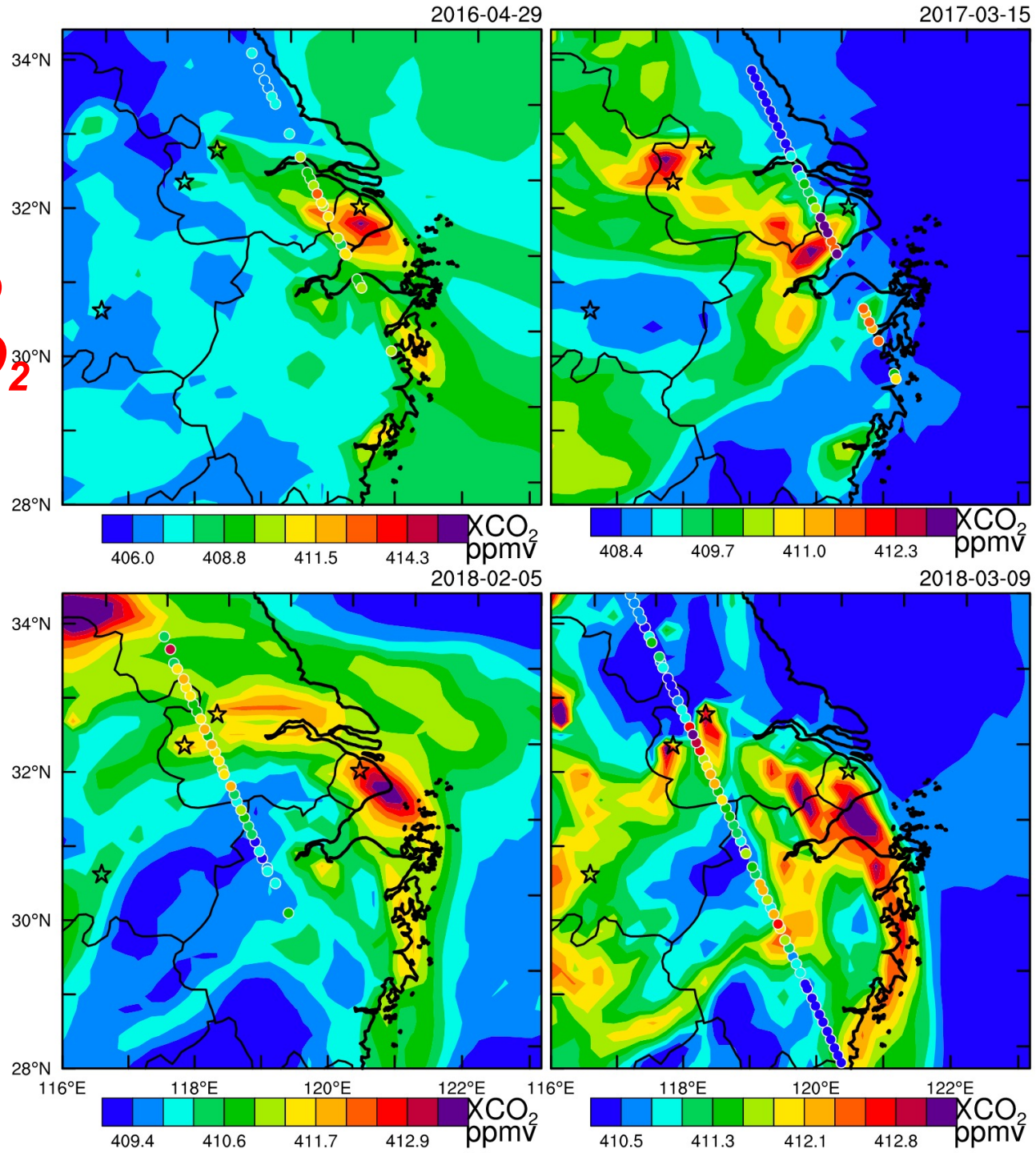
CO_2 is co-emitted with other pollutants (or precursors)

CO_2 and pollutants Accumulated ahead of the cold front




MODIS
OCO-2
OMPS
AIRS
33°N
31°N
29°N
114°E
118°E
a
b
c
d
AOD
0.3
0.5
0.7
0.9
XCO2
ppmv
405
407
409
411
413
NO2
DU
0.3
0.4
0.5
0.6
0.7
CO
e-7
0.97
1.03
1.09
1.15
1.2

Using OCO-2 to detect other CO_2 plumes



Conclusions

1. **WRF-CO_2 system is further developed at Univ. Oklahoma by coupling with global model and improving terrestrial parameterization.**

2. **A severe haze pollution at the leading edge of a cold front in China on Dec. 9, 2016 is examined using multi-sensors and multi-models, including WRF-Chem and WRF-CO_2.**

3. **Satellite-retrieved column-averaged CO_2 data can be used to monitor air pollution events collectively with other in situ and remote-sensing instruments.**

References

1. **Hu, X.-M.**, S. Crowell, et al. (2020), Dynamical Downscaling of CO_2 in 2016 over the contiguous United States using WRF-VPRM, a weather-biosphere-online-coupled model, *J. Adv. Modeling Earth Systems*, 10.1029/2019MS001875.
2. Li, X., **Hu, X.-M.**, Cai, C. et al. (2020), Terrestrial CO_2 Fluxes, Concentrations, Sources and Budget in Northeast China: Observational and Modeling Studies, *J. Geophys. Res.-Atmospheres*, 10.1029/2019JD031686.
3. **Hu, X.-M.**, J. Hu, L. Gao, C. Cai, Y. Jiang, M. Xue, T. Zhao, and S. M. R. Crowell, 2020: Multi-sensor and Multi-model Monitoring and Investigation of a Wintertime Air Pollution Event Ahead of a Cold Front over Eastern China. *J. Geophys. Res.-Atmospheres*, 10.1029/2020JD033538.
4. **Hu, X.-M.**,Gourdji, S. M., Davis, K. J., Wang, Q., Zhang, Y., Xue, M., . . . Crowell, S. M. R. (2021). Implementation of improved parameterization of terrestrial flux in WRF-VPRM improves the simulation of nighttime CO2 peaks and a daytime CO2 band ahead of a cold front. *J. Geophys. Res.-Atmospheres*, e2020JD034362. 10.1029/2020JD034362.