Intercomparison of two regional chemistry models: WRF-Chem and CMAQ

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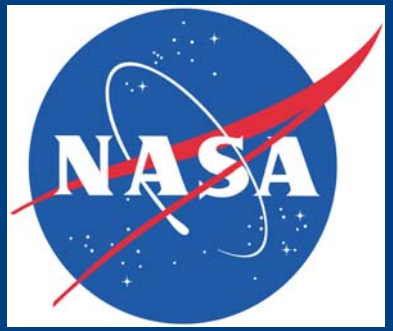

Current Research Projects

Project	Model(s)	Year(s)
HTAP + MICS-Asia (EA)	WRF +CMAQ + MOZART; WRF/Chem + MOZART	2001
Regional inflow / outflow (EA + NA)	WRF/Chem + CAM-Chem	2005, 2006
O_3 sensitivity to climate (NA)	WRF + CMAQ	2002 +
Hg sensitivity to climate (NA)	WRF + CMAQ	2003, 2004
Energy strategies for climate & AQ (NA)	WRF + CMAQ	2002 +

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Motivating questions

- Challenging problem: complex processes occurring at global to local scales, and their strong coupling across scales
- Recent developments: coupling regional and global CTMs
- CMAQ: initially developed for regulatory purpose in the US, for which ground-level ozone is the greatest concern
- WRF-Chem: the coupled climate-chemistry model to address scientific questions

Motivating questions (2)

By comparing WRF-Chem and CMAQ …

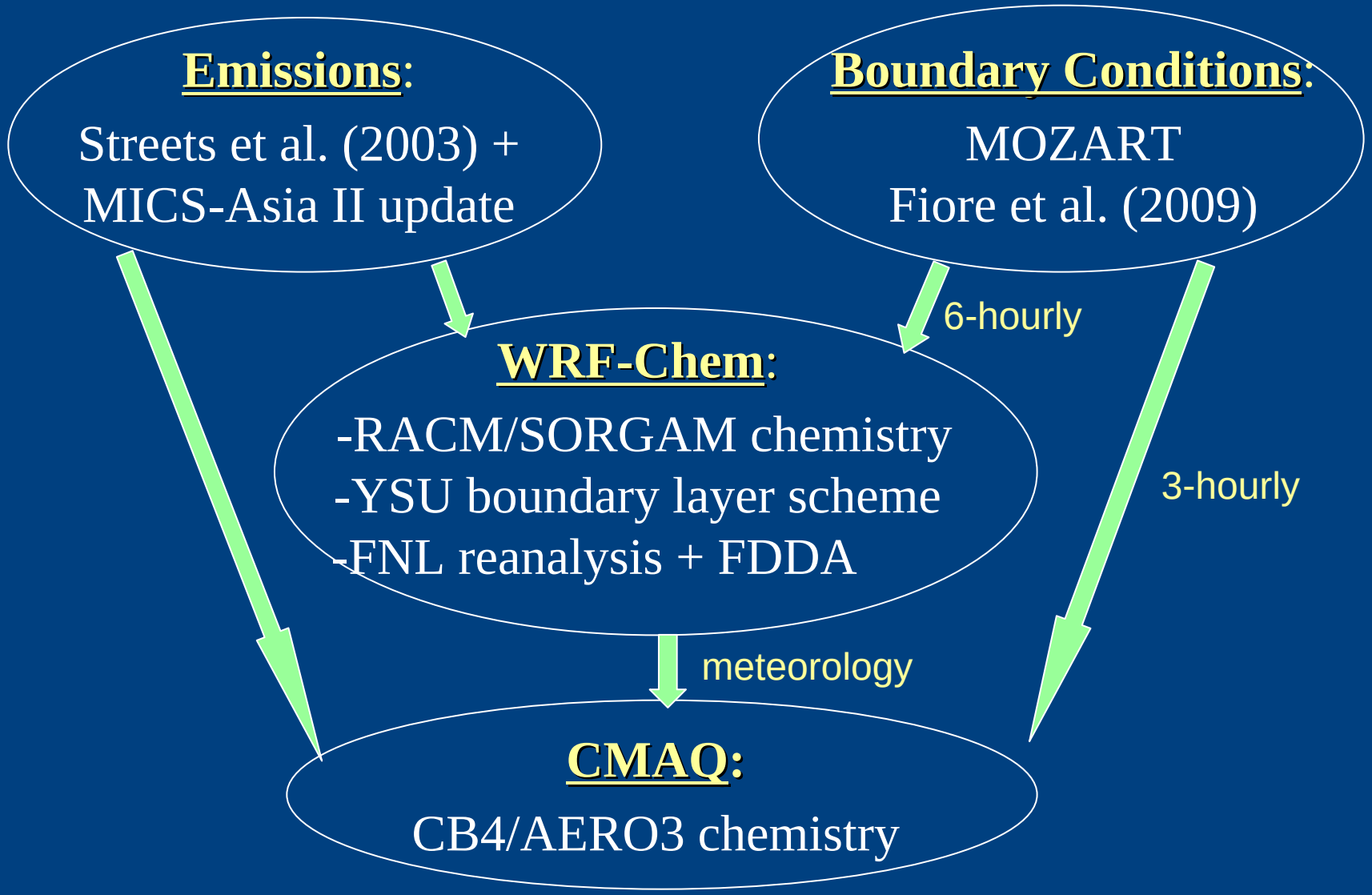
- identify physical and chemical processes missing in the model, or poorly parameterized processes

By comparing WRF-Chem and MOZART …

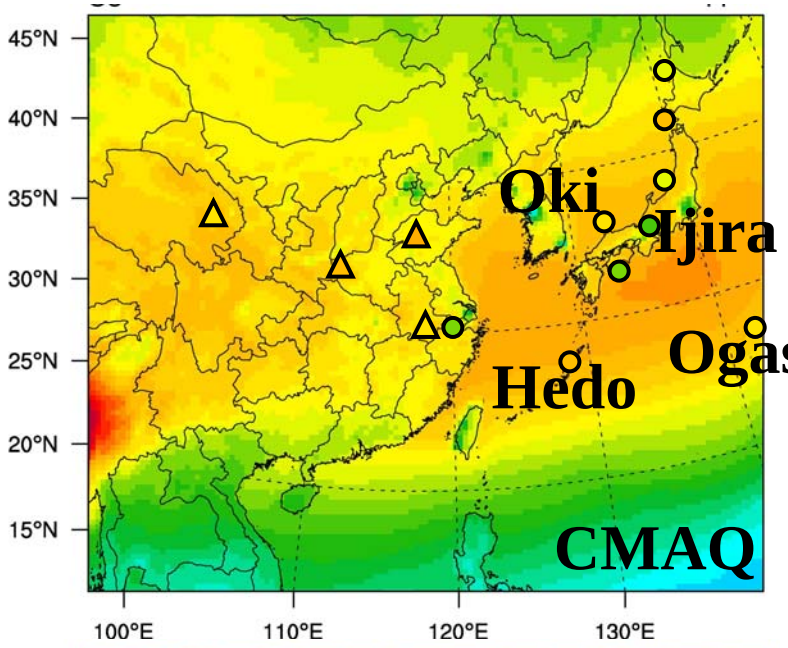
- What regional processes can explain the differences between regional and global models?

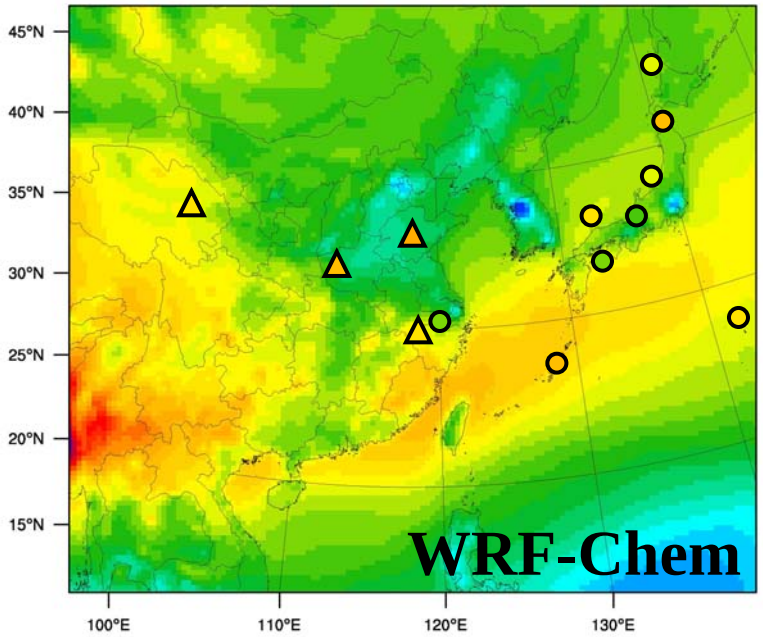
Intercomparison Framework

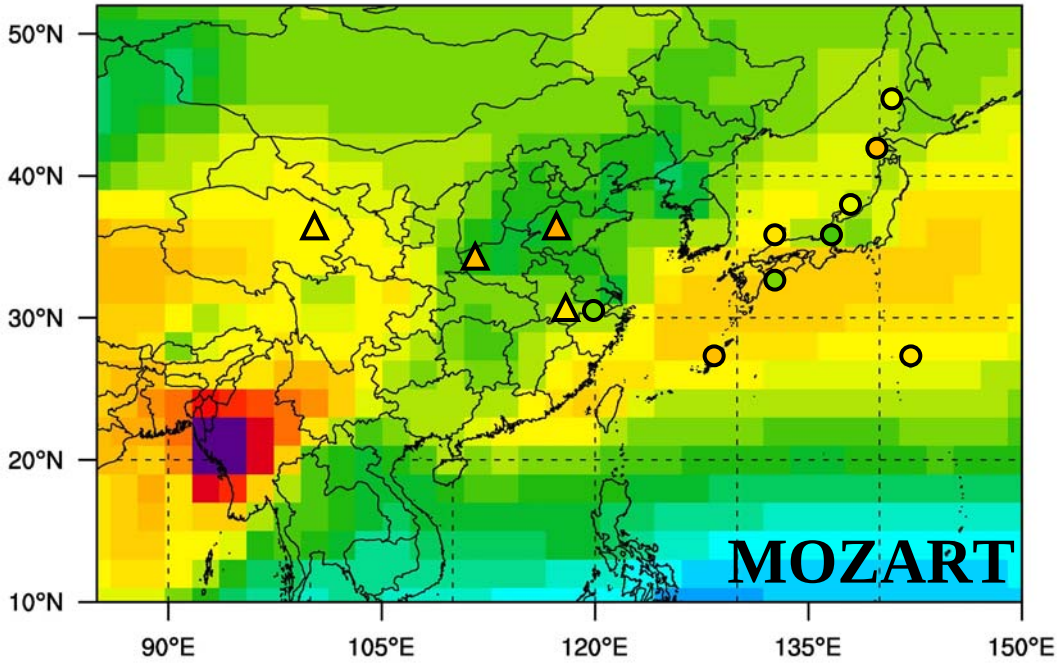
36x36 km, 30 layers (20 m depth of first layer), 2001



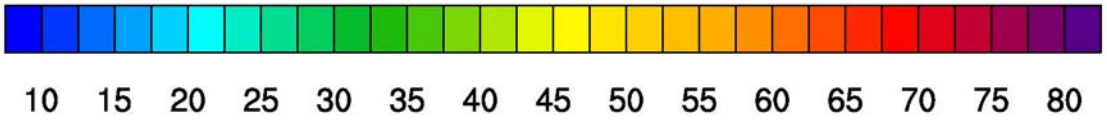
Surface Ozone in March 2001



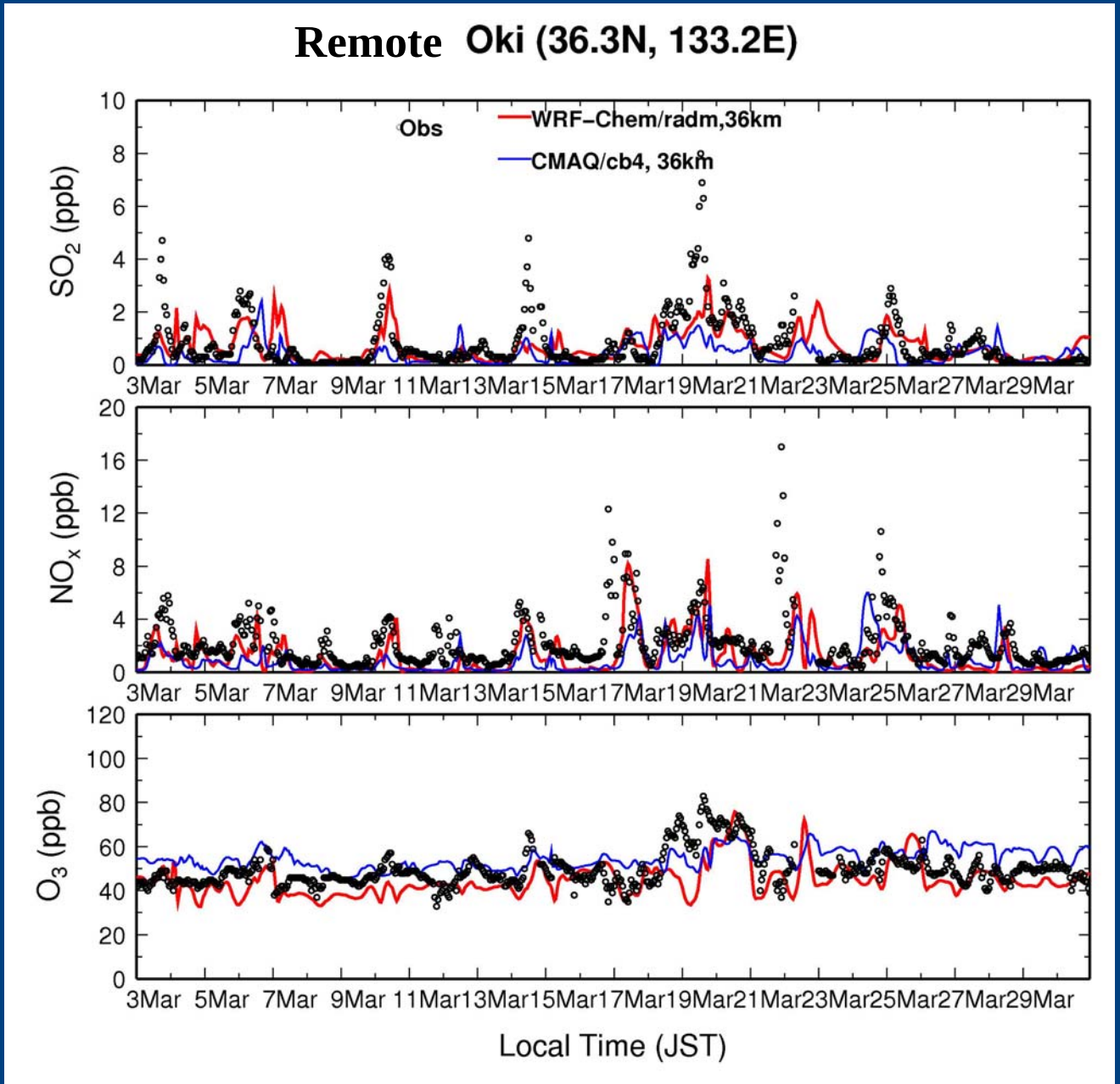


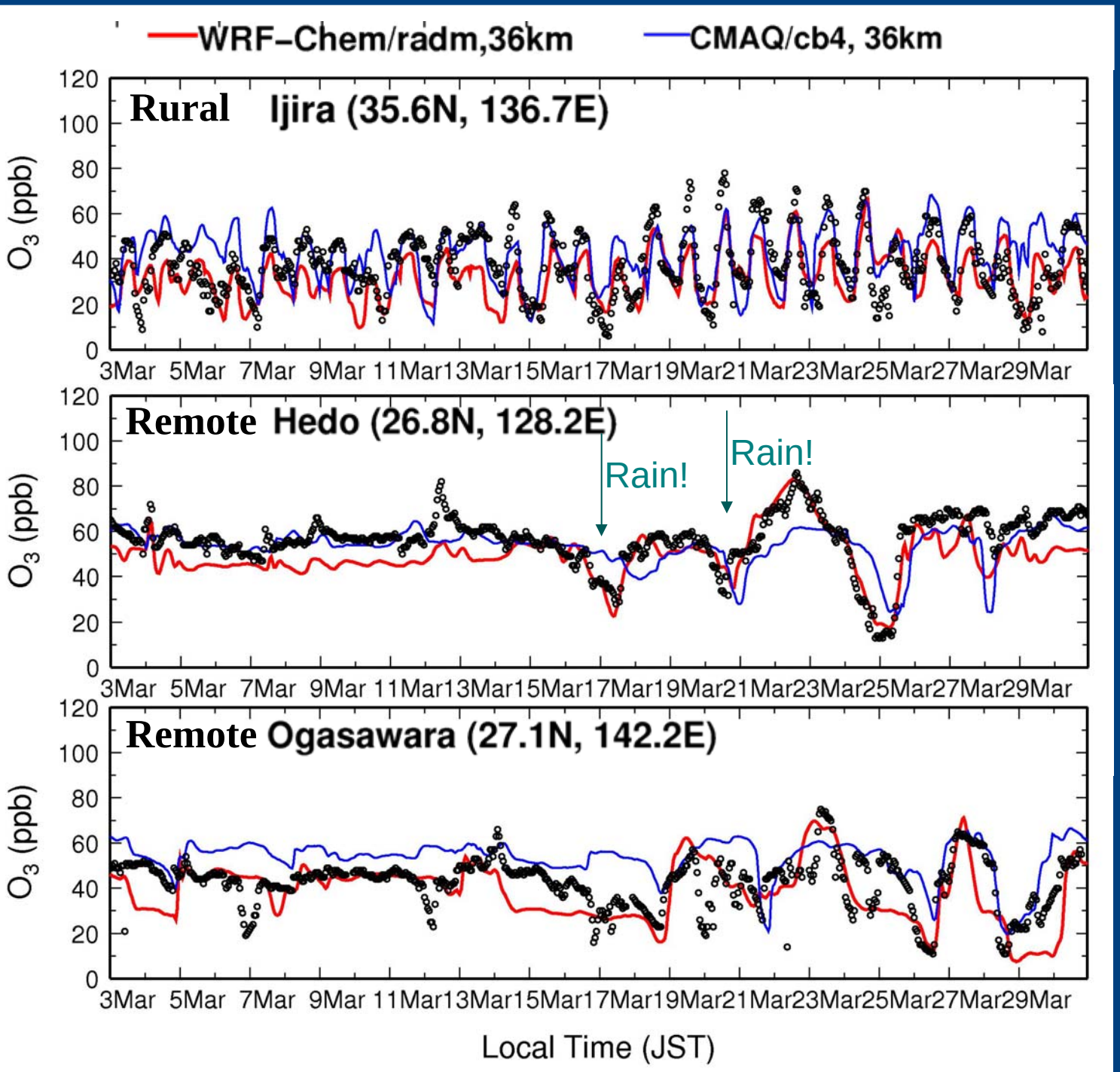


Obs. data: EANET(2001), Want T. et al. (2001), Li et al. (2007)

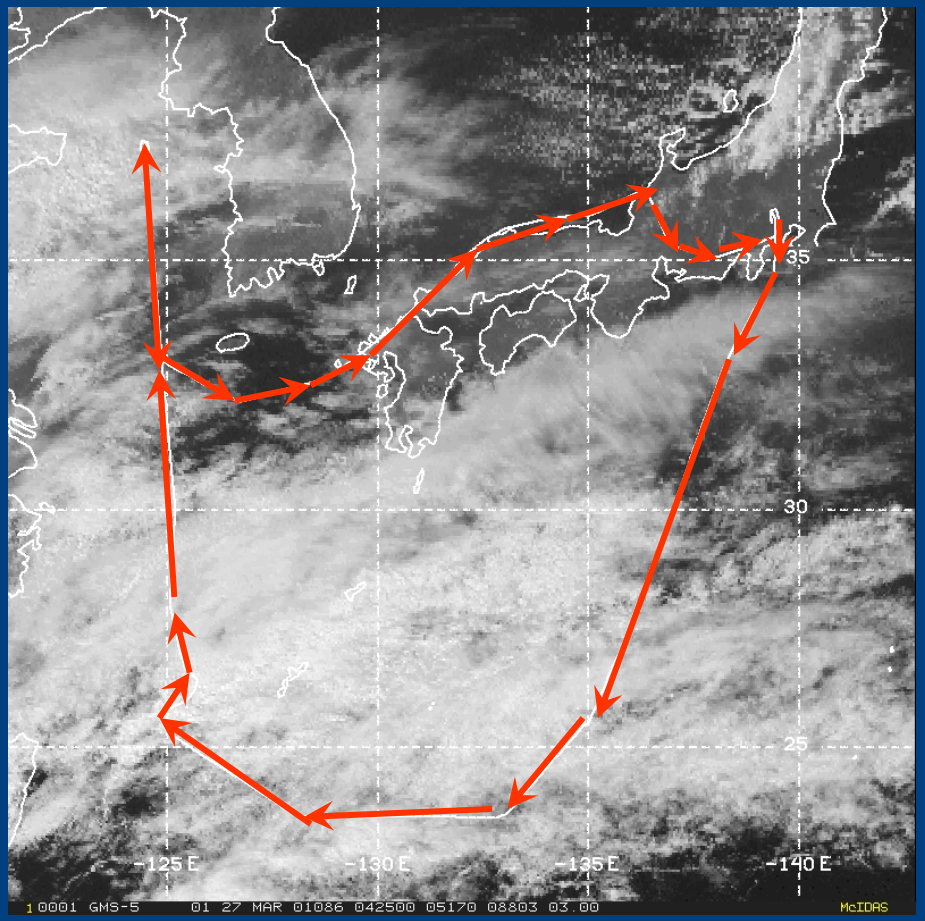


Evaluation with EANET measurements



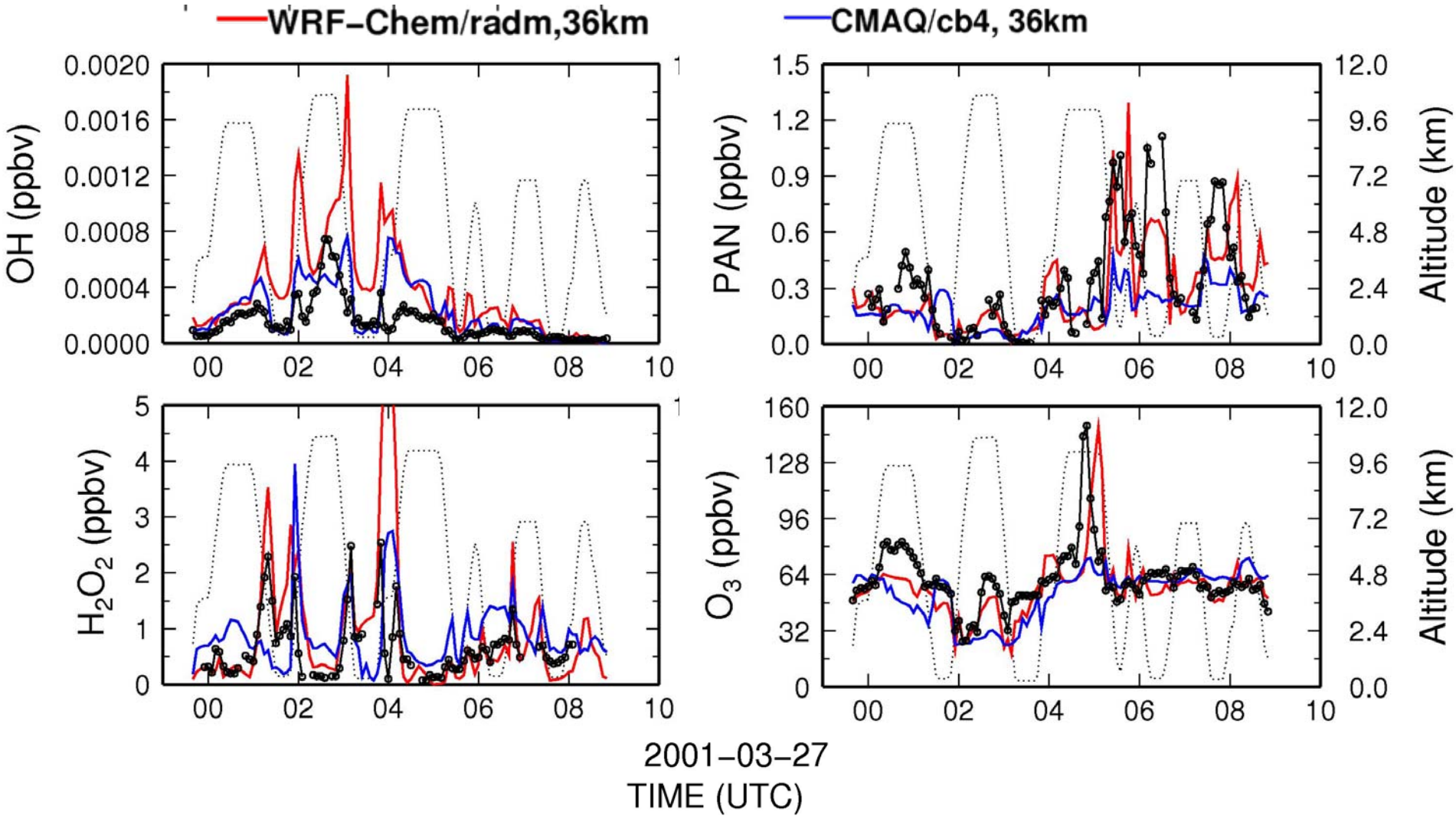

WRF–Chem/radm,36km
CMAQ/cb4, 36km
Rural Ijira (35.6N, 136.7E)
Remote Hedo (26.8N, 128.2E)
Rain!
Rain!
Remote Ogasawara (27.1N, 142.2E)
O3 (ppb)
0
20
40
60
80
100
120
3Mar 5Mar 7Mar 9Mar 11Mar13Mar15Mar17Mar19Mar21Mar23Mar25Mar27Mar29Mar
Local Time (JST)

Compared with TRACE-P aircraft measurements



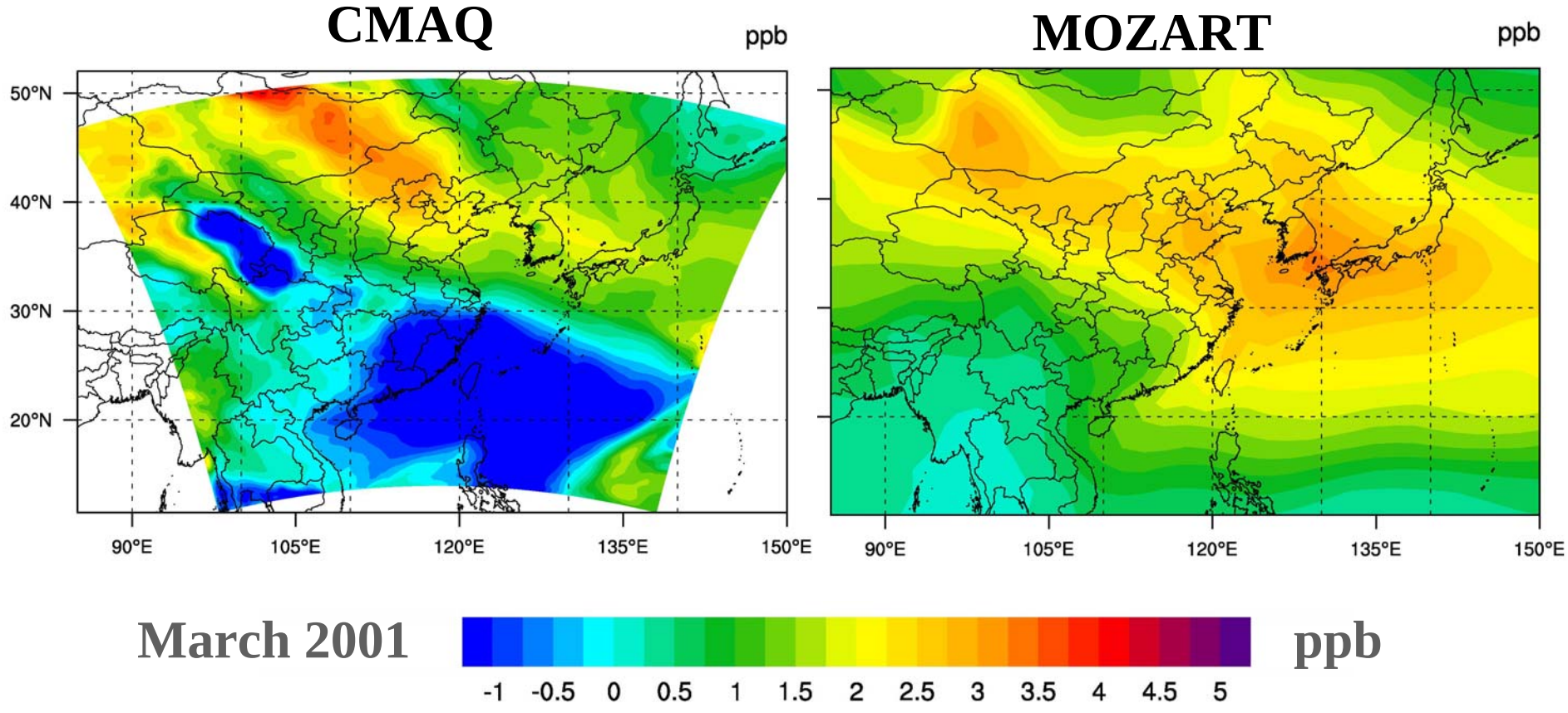
DC8 Flight 15 on March 27, 2001:
Convective Outflow and Stratospheric Influence

TRACE-P DC8 Flight 15



Ozone in Asia: European Enhancement

Surface

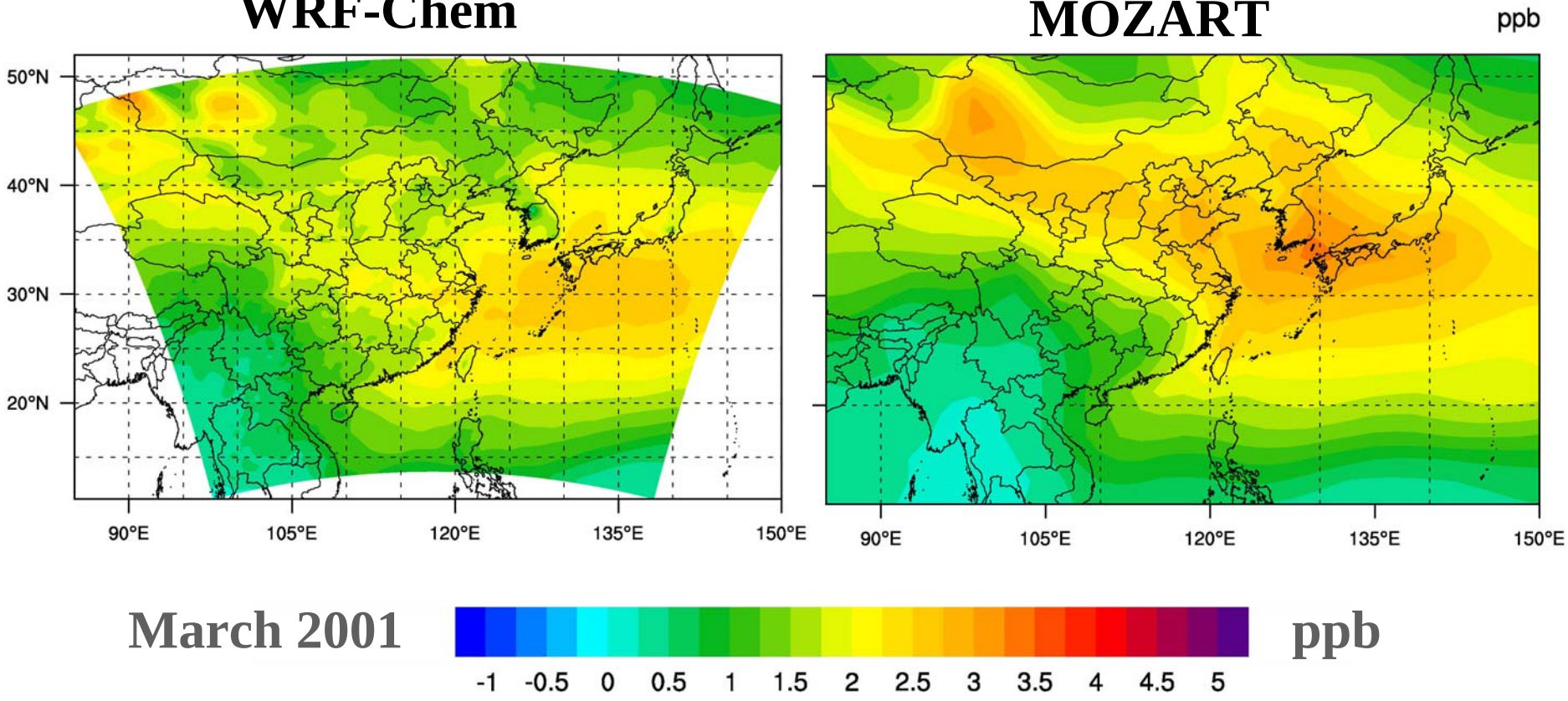


Ozone in Asia: European Enhancement

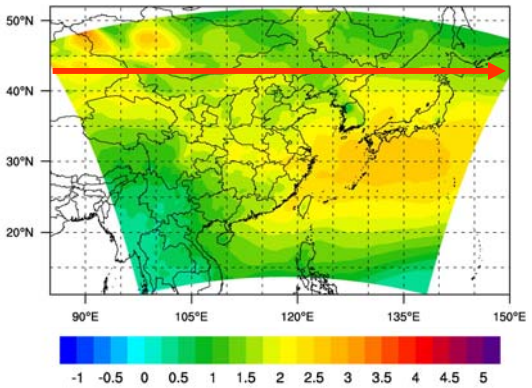
Surface

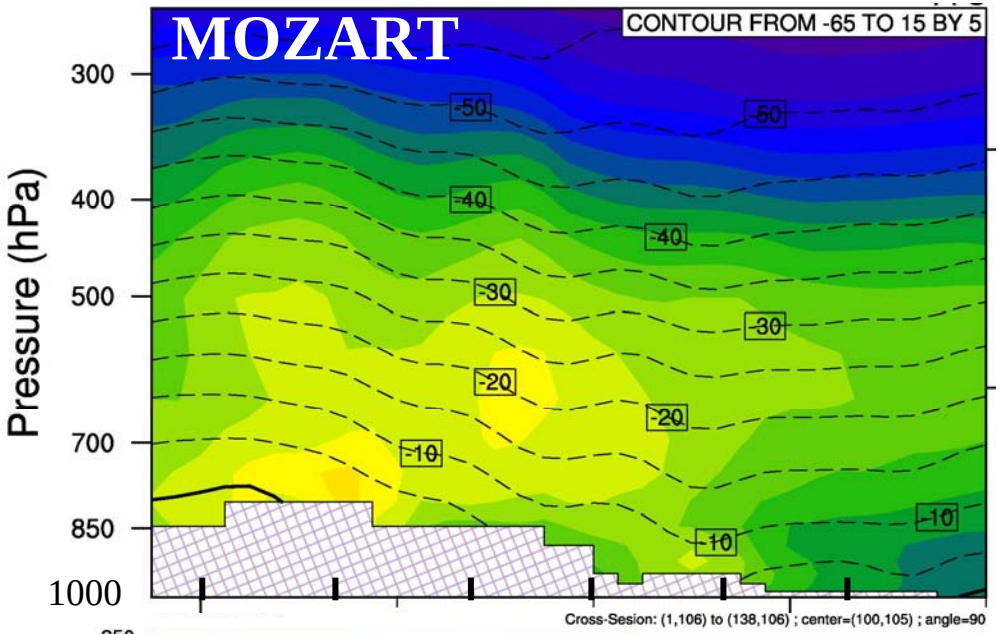
WRF-Chem

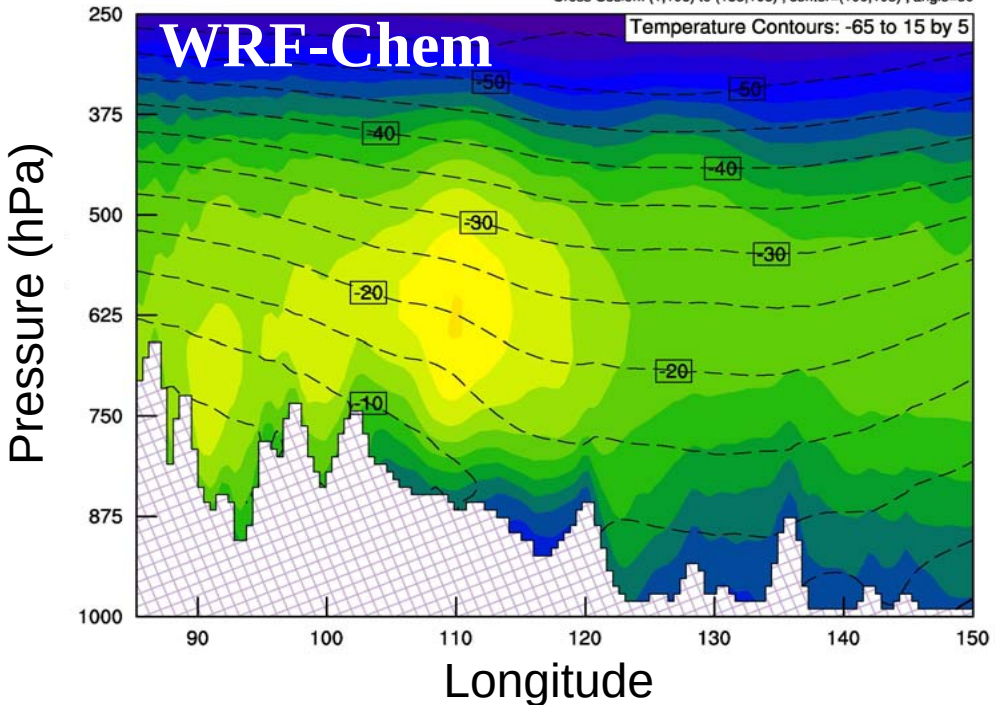
MOZART

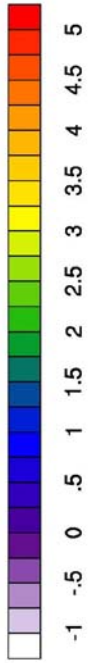


EU Enhancement (cross section at 43° N)

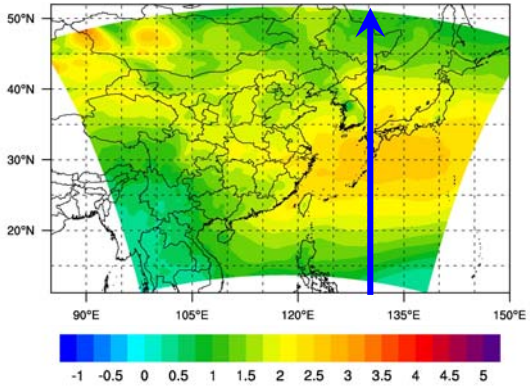


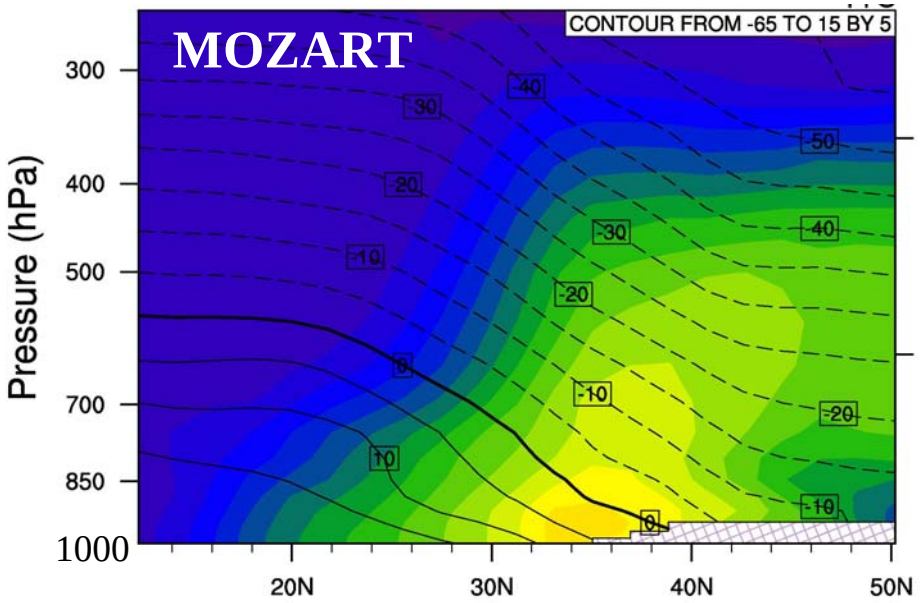


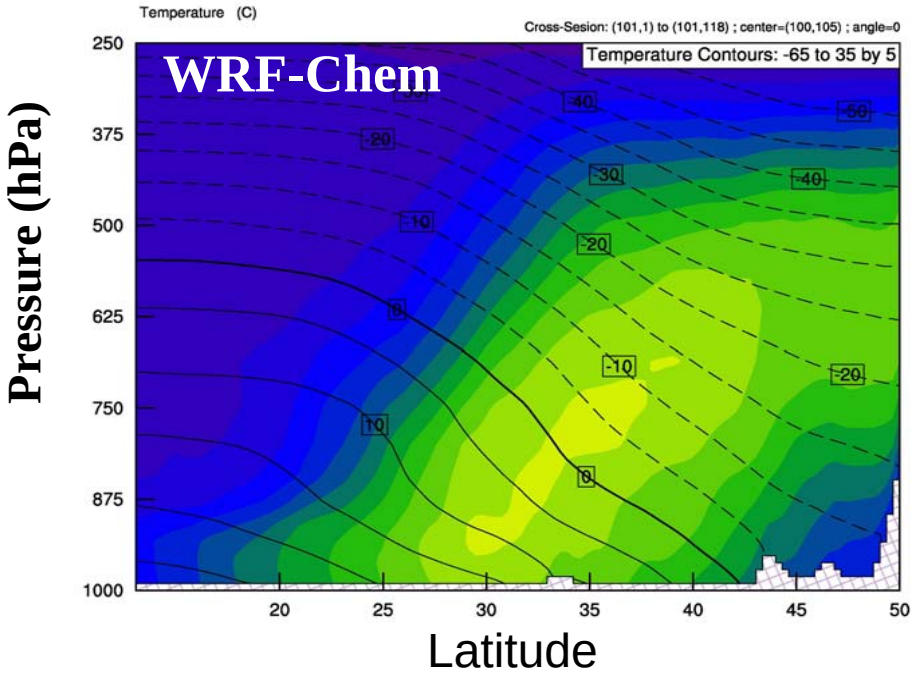




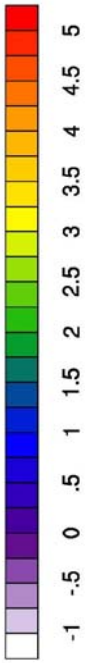
EU Enhancement (cross section at 130° E)







O_3 (ppb)



Conclusions and future plans

- CMAQ and WRF-Chem show similar ability in reproducing the variations of ground-level ozone from EANET
- WRF-Chem better captures vertical profiles of major species from a TRACEP flight sample, which is intended to examine convective transport and stratospheric influence
- Current version of CMAQ might not be well suited for examining the exchange between the surface and the free troposphere
- Regional model WRF-Chem and global model MOZART show similar pattern for EU enhancement of ozone in Asia, but WRF-Chem exhibits fine scale variations reflecting the impacts of regional processes such as urban titration, land-sea breeze, and topographical circulation

Thank You!

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