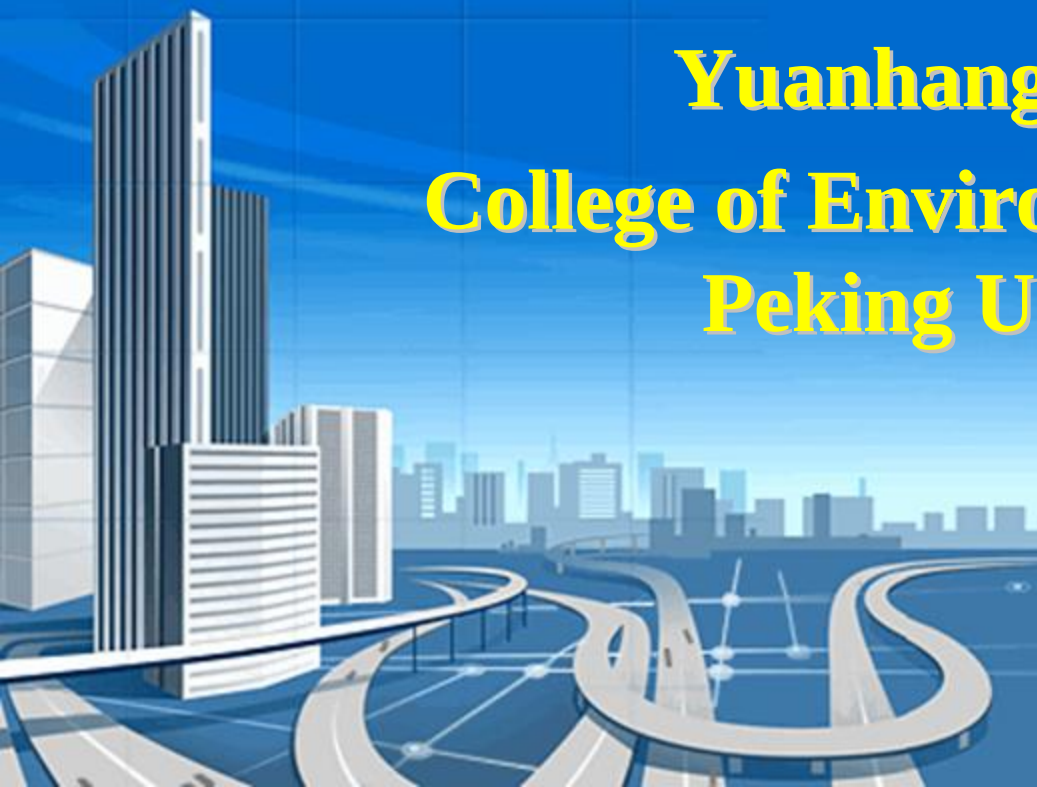
863 Major Project (2006-2010)
(Resource and Environmental Technology)

Progress of 3C-STAR projects

Yuanhang Zhang

College of Environ. Sci. & Eng.
Peking University



Vienna, Feb. 27, 2009

863 Major Project (2006-2010)
(Resource and Environmental Technology)

重点城市群大气复合污染综合防治技术与集成示范

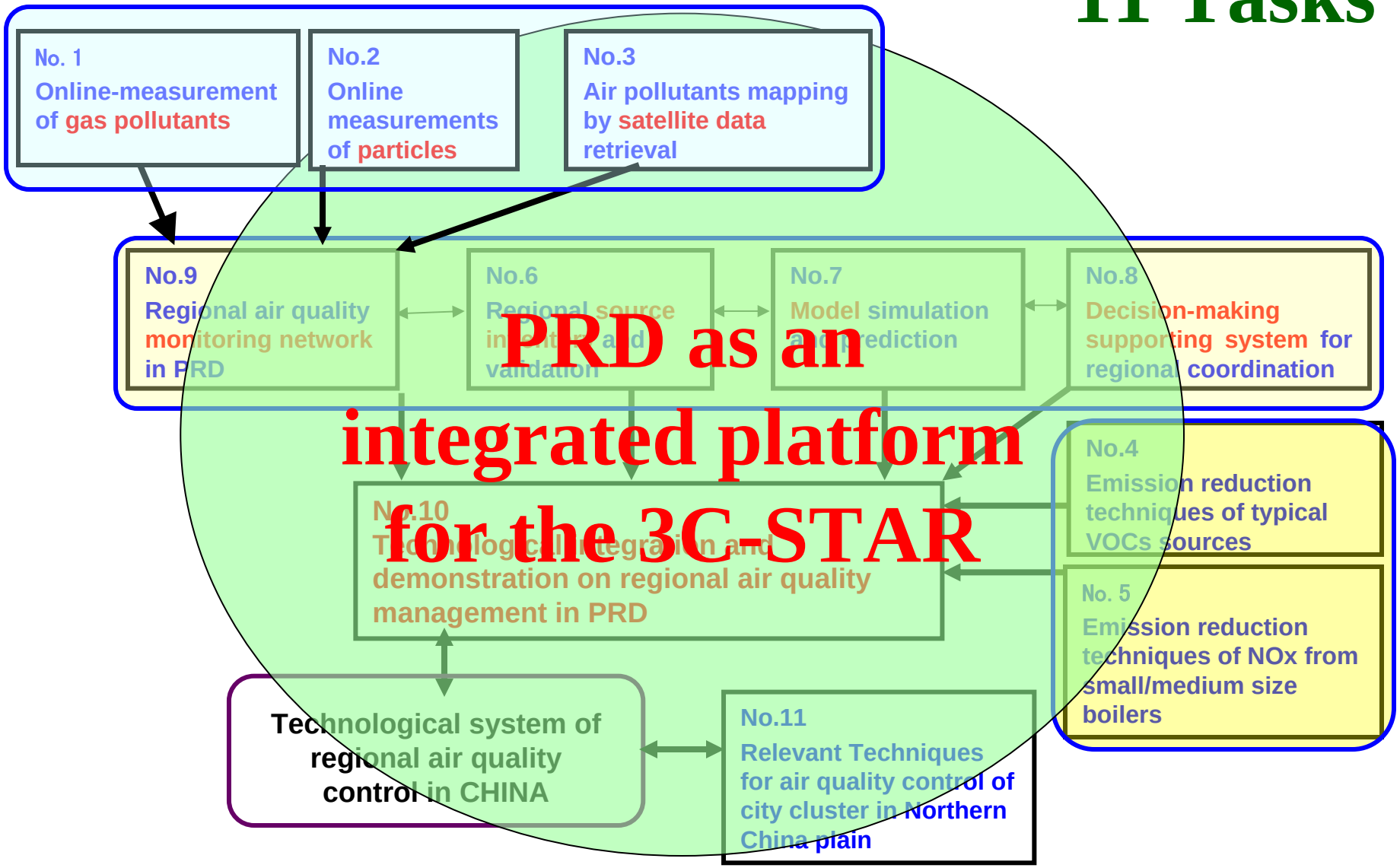
Synthesized Prevention Techniques for Air Pollution Complex and Integrated Demonstration in Key City-Cluster Region

3C-STAR

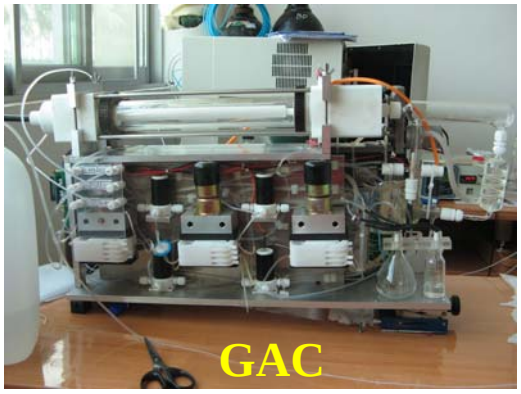
2006-2010

Framework of the 3C-STAR project:

11 Tasks



Equipments developed in the project

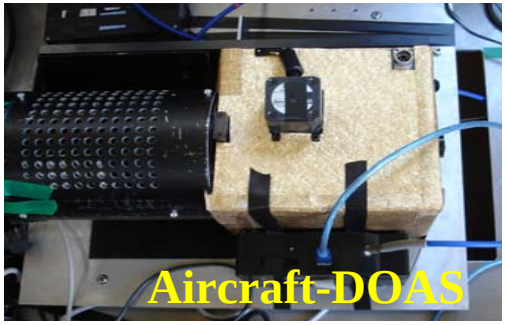

GAC


RCFP


GC-MS


PANs


NO, NO_2, NO_y analyzer


Aircraft-DOAS


Aircraft-FTIR


BC


Aerosol Sizer


Raman LIDAR

Mobile Van

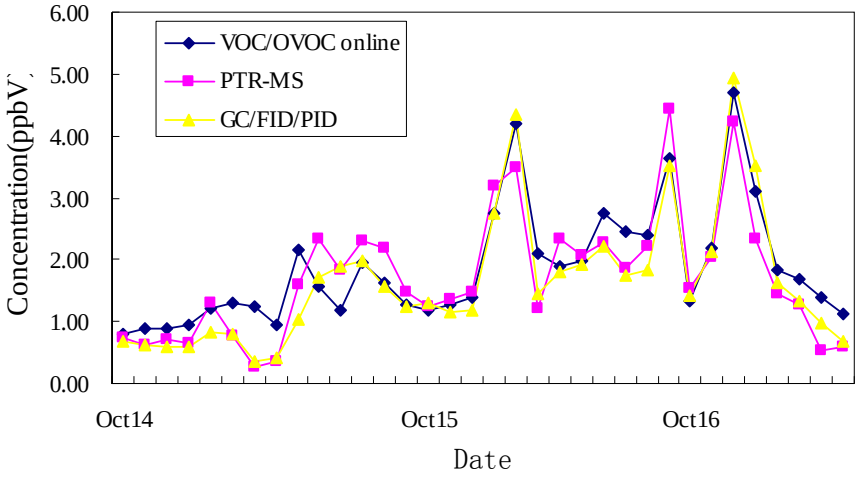
VOCs on-line by GC/FID/MS ~ Ram Lidar

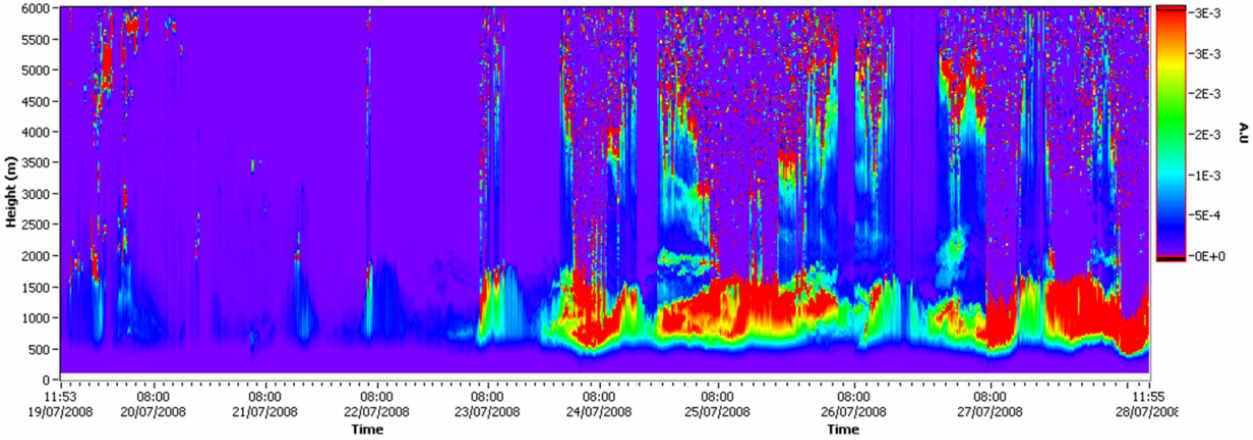
Species : ～100

resolution : ～1 hr

Alkane: 29; Alkene:11

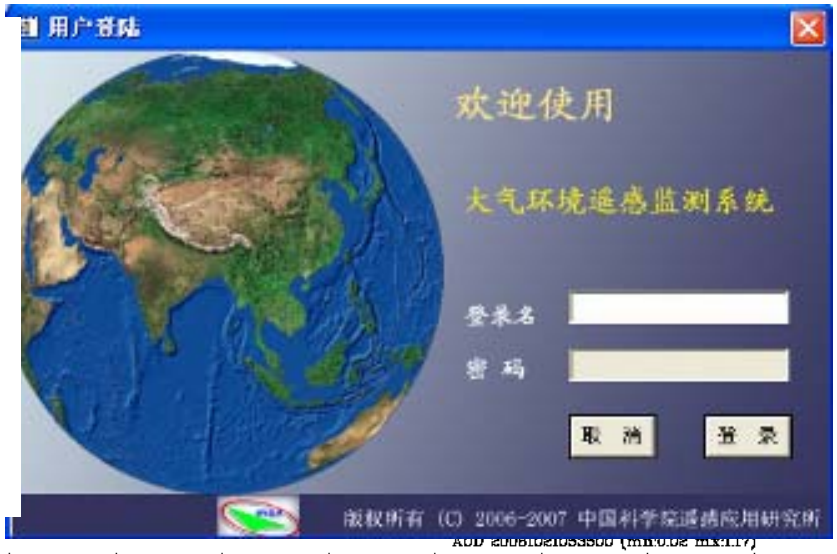
Aromatics: 16; OVOCs: 17

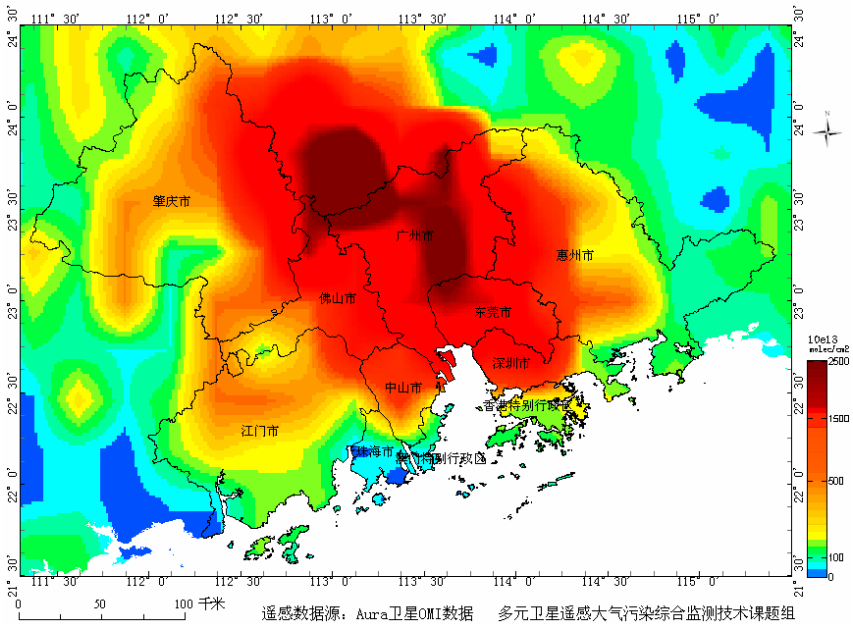




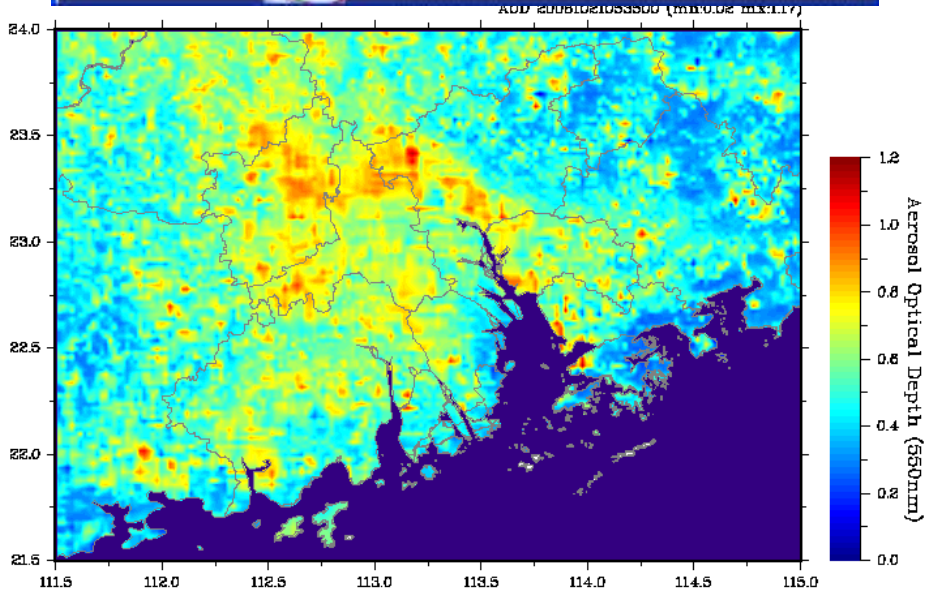
Stateline Remote Sensing

- **Retrieval Platform**
- **Validation**
- **AOD (surface light extinction ~ $PM_{2.5}$), NO_2, SO_2**



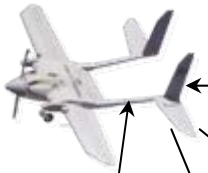


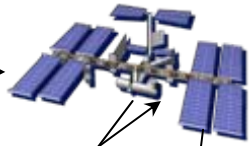
NO_2

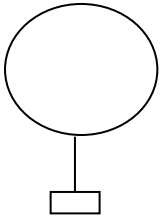


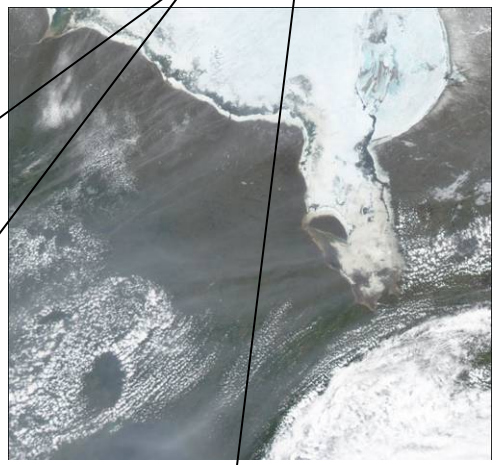
AOD

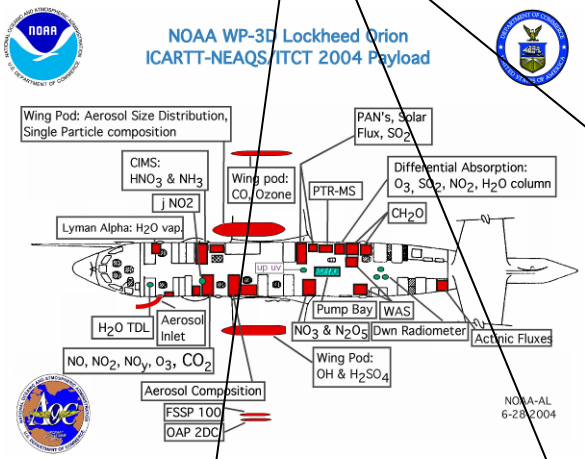
Measurement techniques

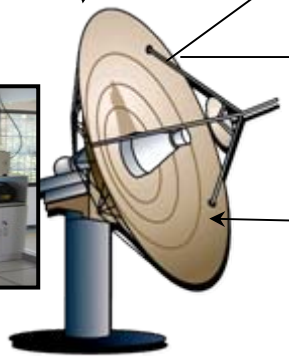


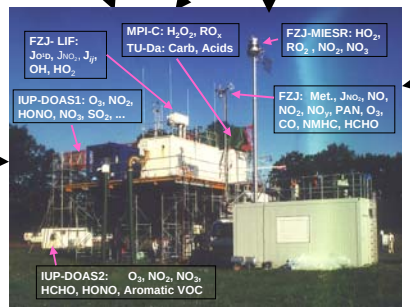






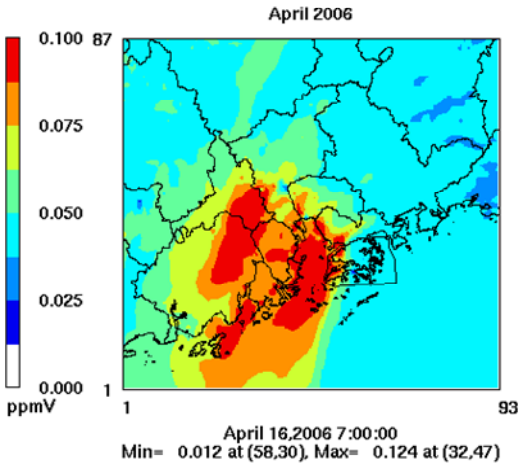




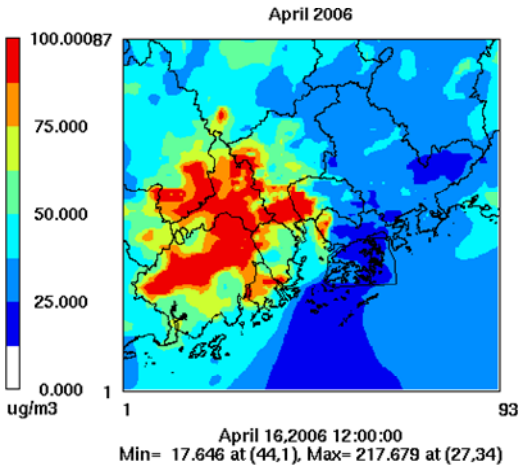


Regional air pollution by CMAQ

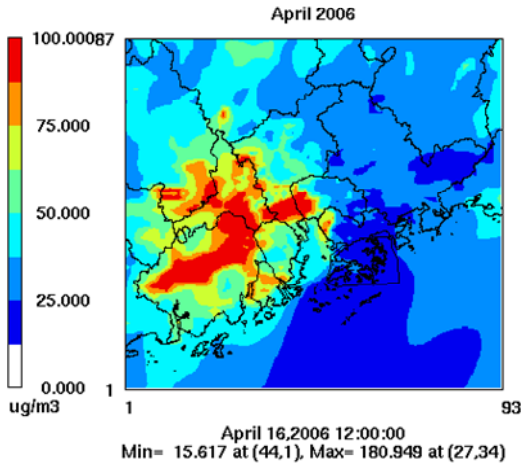
Surface OZONE in Pearl River Delta



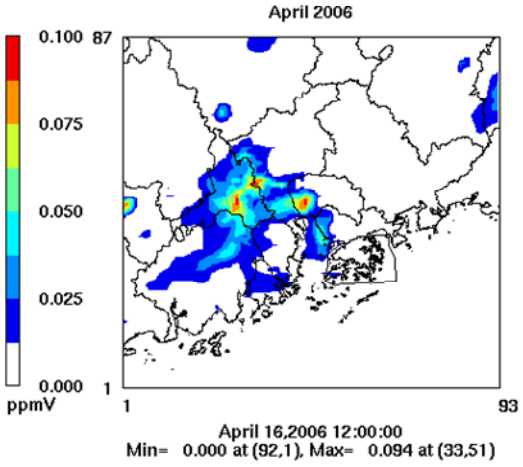
Surface PM10 in Pearl River Delta



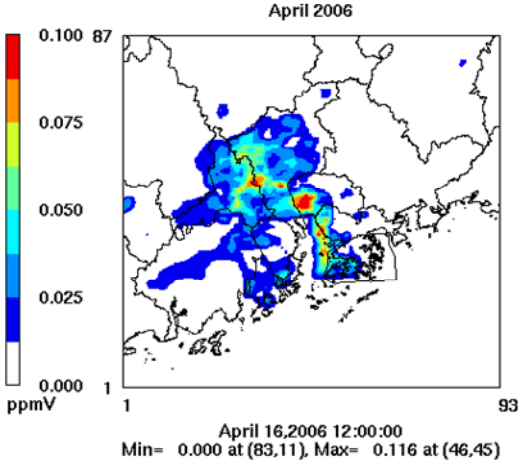
Surface PM25 in Pearl River Delta



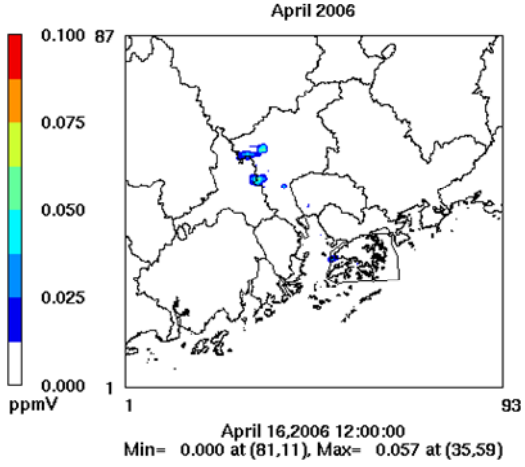
Surface SO2 in Pearl River Delta



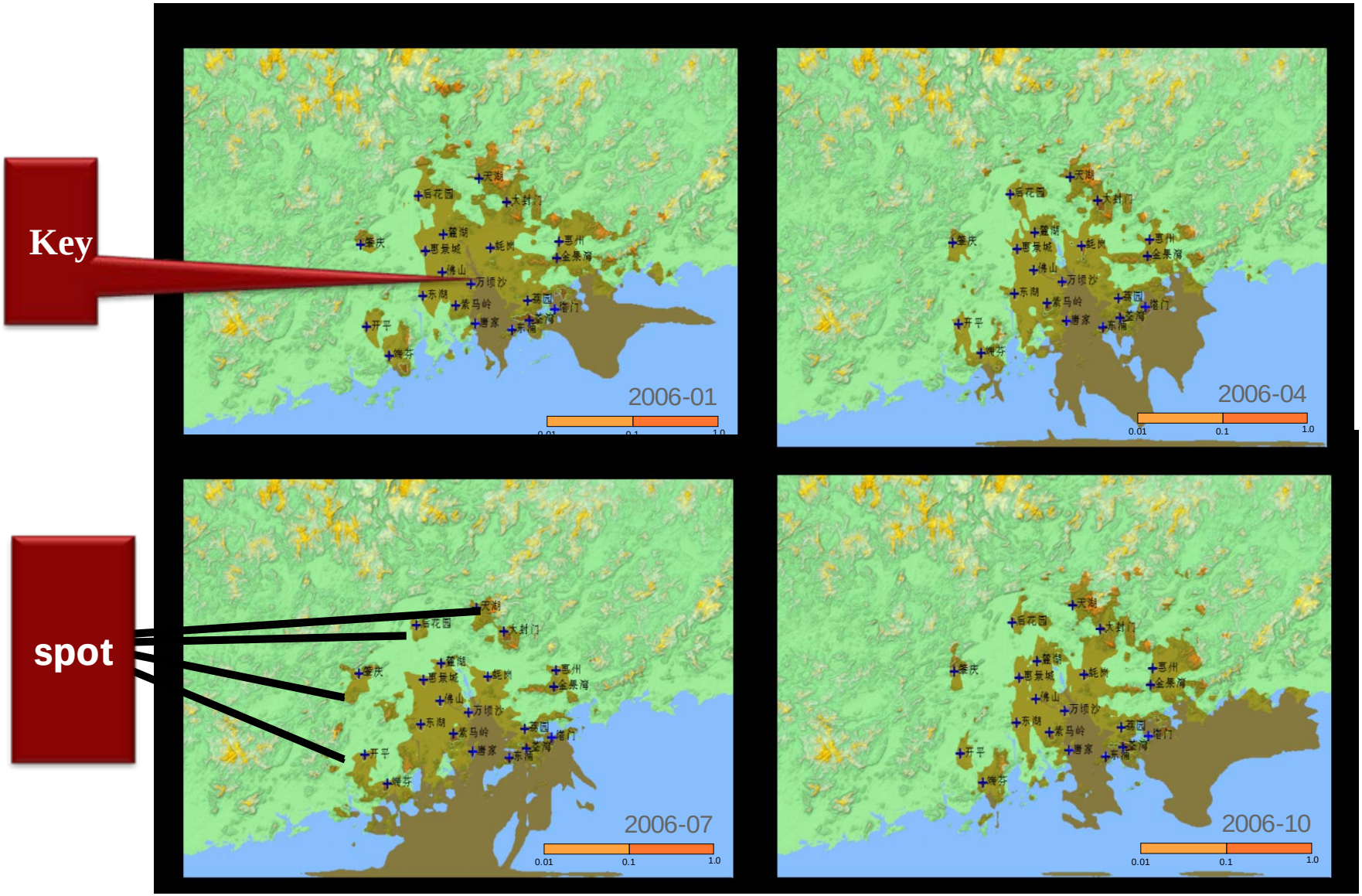
Surface NO2 in Pearl River Delta



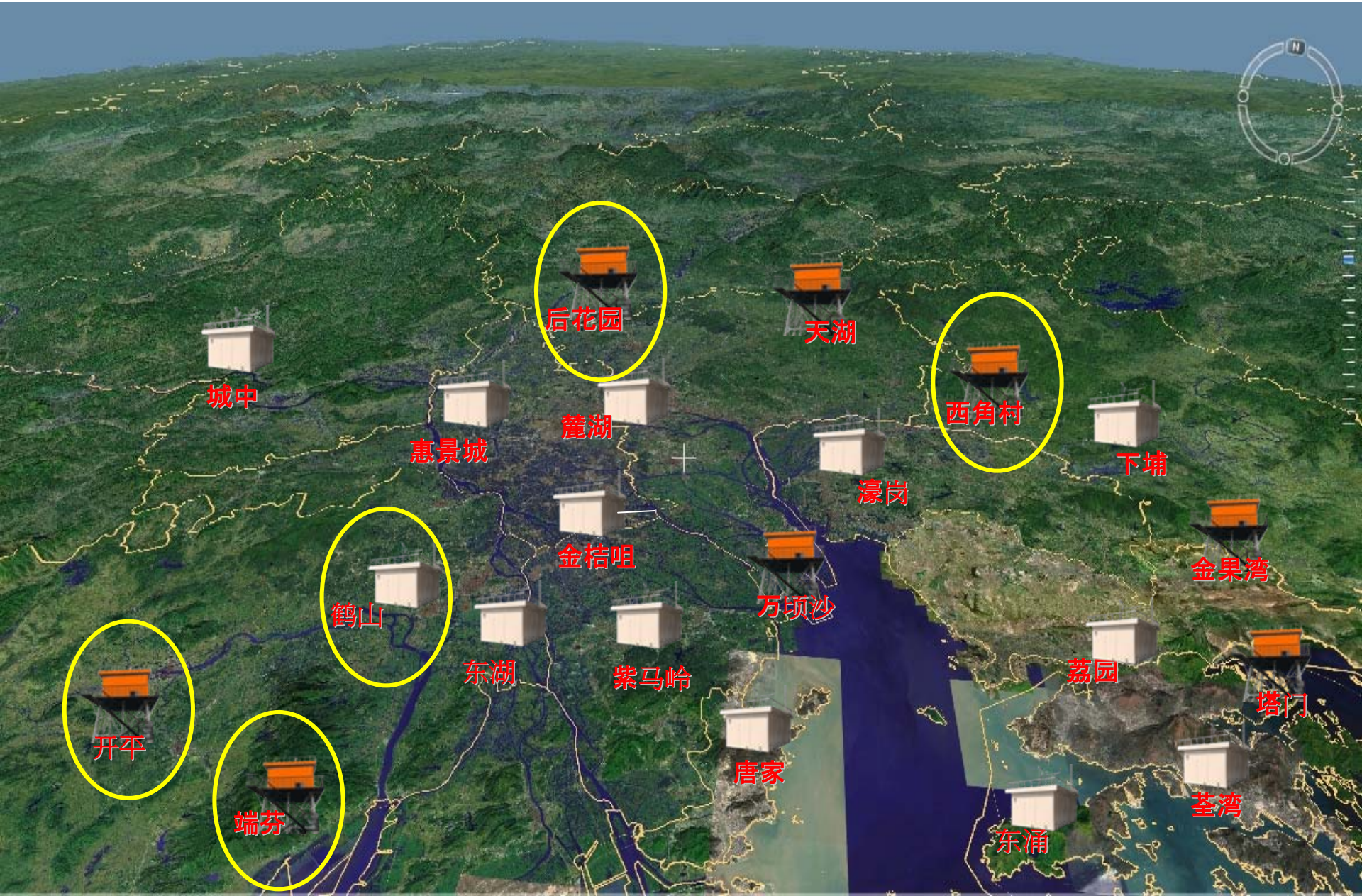
Surface NO in Pearl River Delta



Integrated footprints of 21 sites



Site Distribution in the Network



PRD air quality Ensemble forecasting Model System (PRD-EMS)

Goals: fully validated multi-scale and multi-pollutants regulated model

- Dynamic database
- 4-D Var data assimilation
- Karman Filter

Data assimilation

Diagnostic model for regional transport

- 3-D regional models CMAQ
- Chemical model
- Smart tagged source apportion

multi-scale regulated model

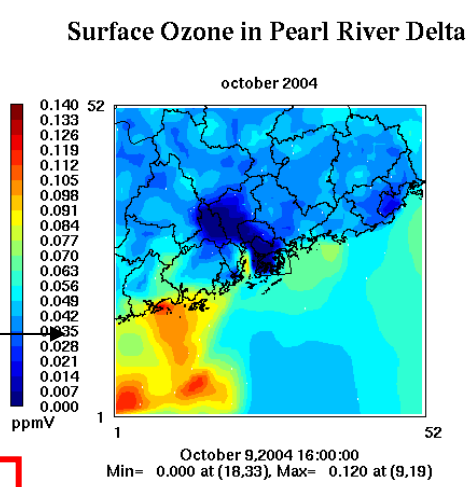
- OBM model
- Inverse modeling

- Supporting model
- Uncertainty analysis
- Manual for the forecasting

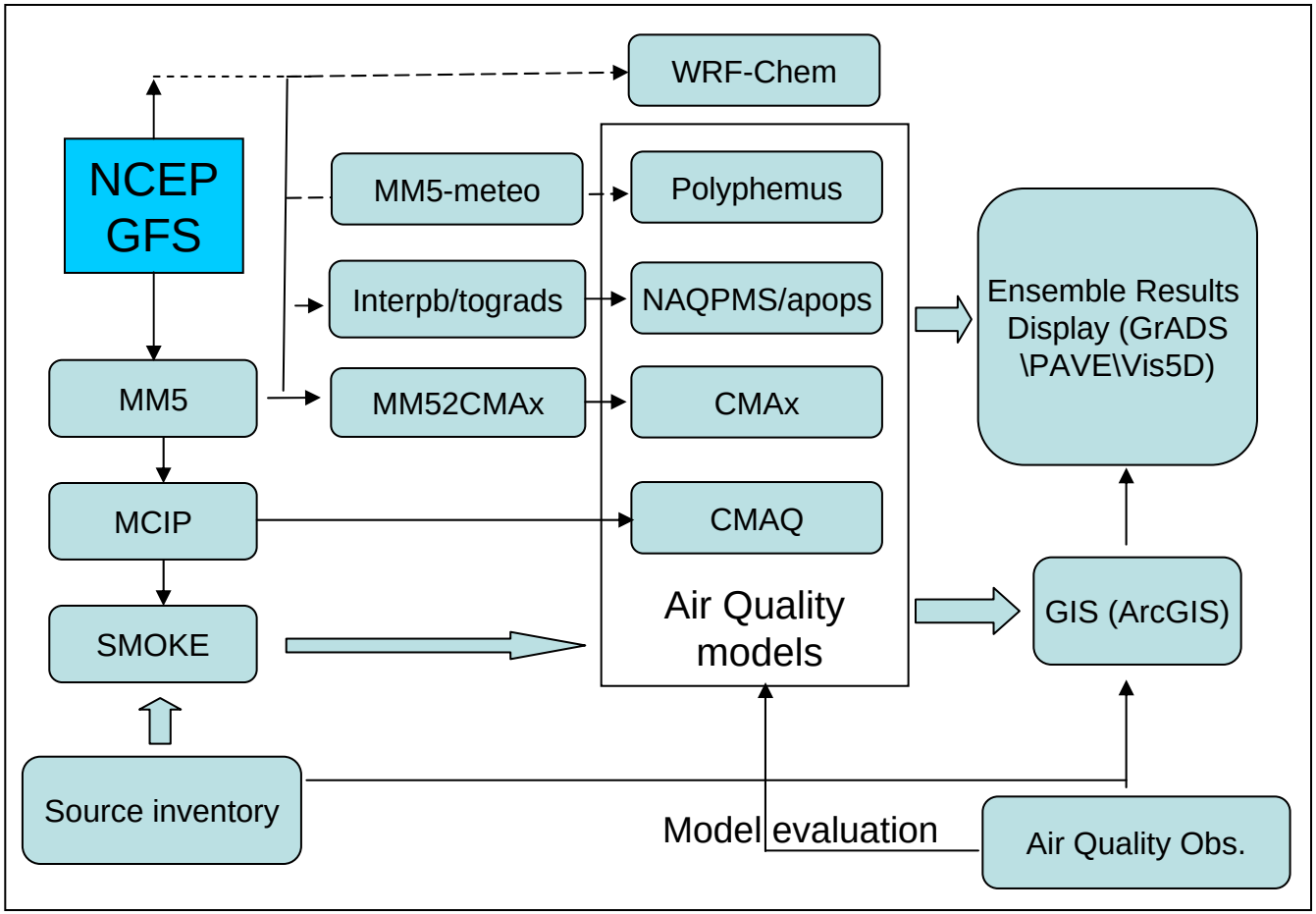
Ensemble forecasting

- Data platform for model intercomparison
- Validation of models
- Function testing of the models

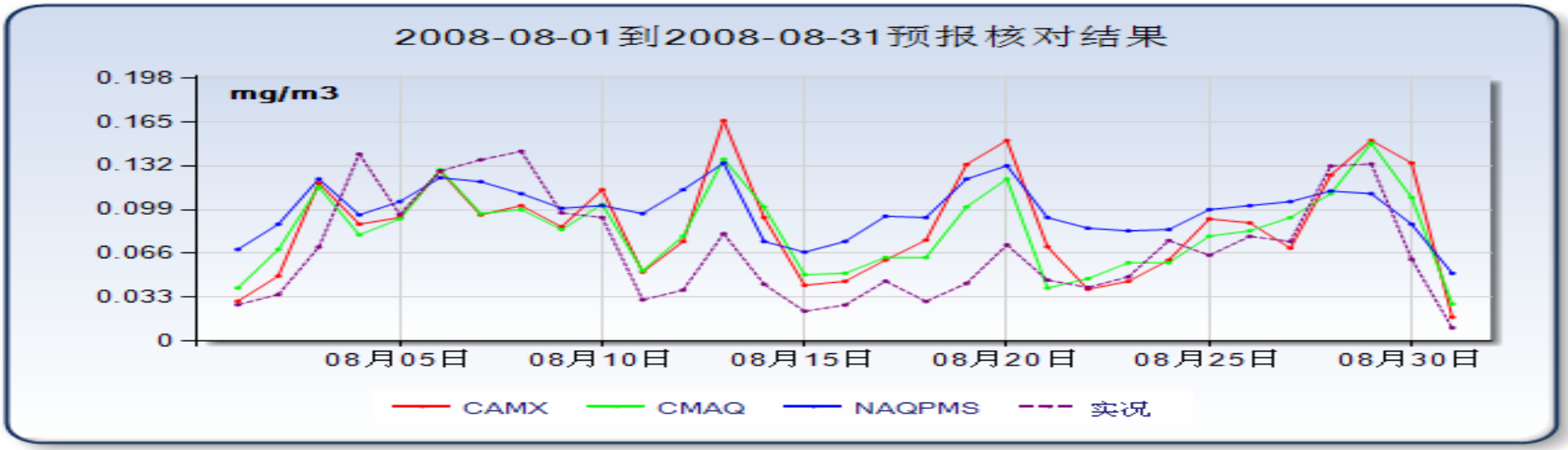
Visualization

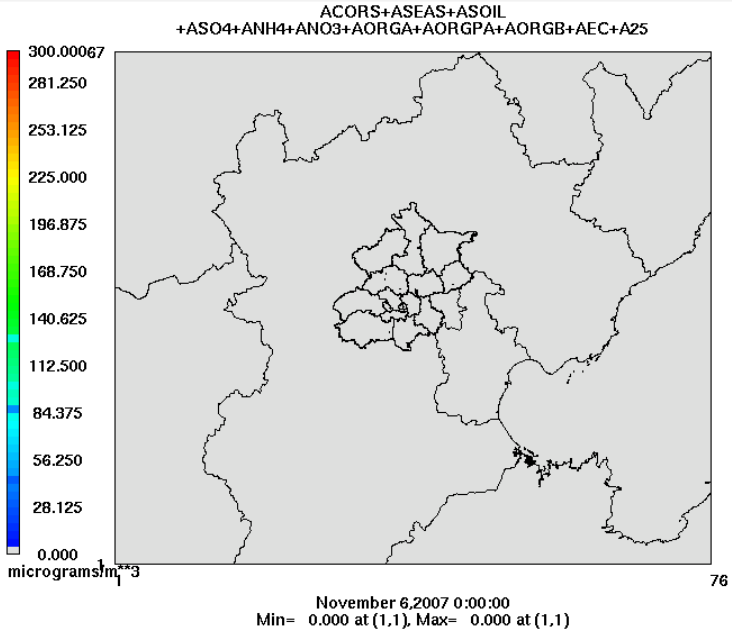


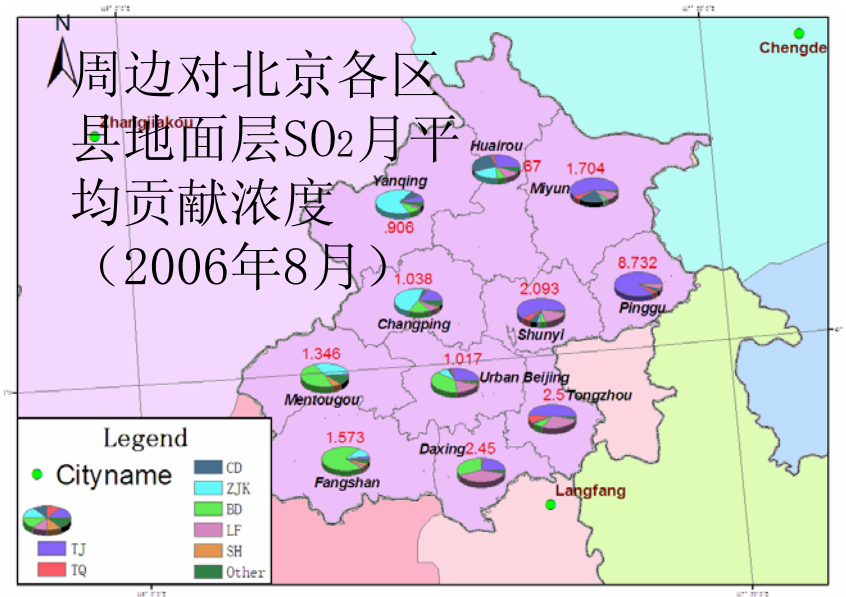
Ensemble Air Quality system Framework



Application of EMS to Beijing Olympic Game







Ground based regional air quality monitoring and ensemble forecasting system

Feedbacks (setting standards and assess achievements)

Region

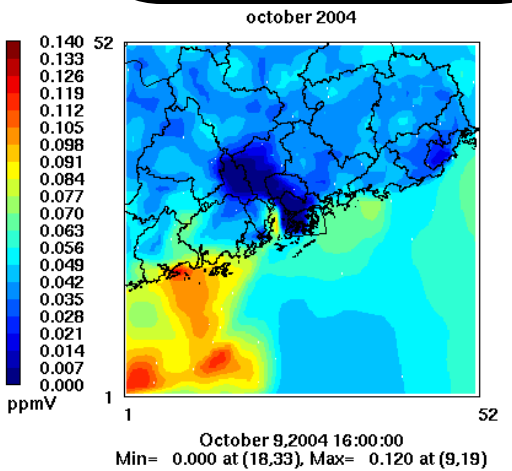
Super sites (1-2 st.)
+ monit. st. (many)

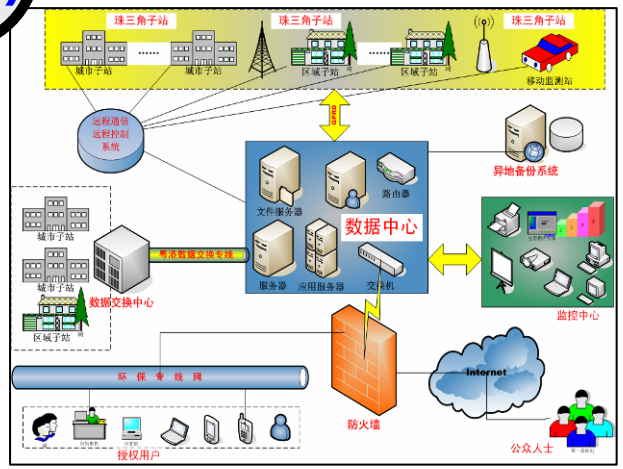
Prediction by PRD-EMS

policy

Industry

Information on observations and model calculations





863 Major Project (2006-2010)
(Resource and Environmental Technology)

Action Plan for
3C-STAR2008 PRD Campaign
(October-November)

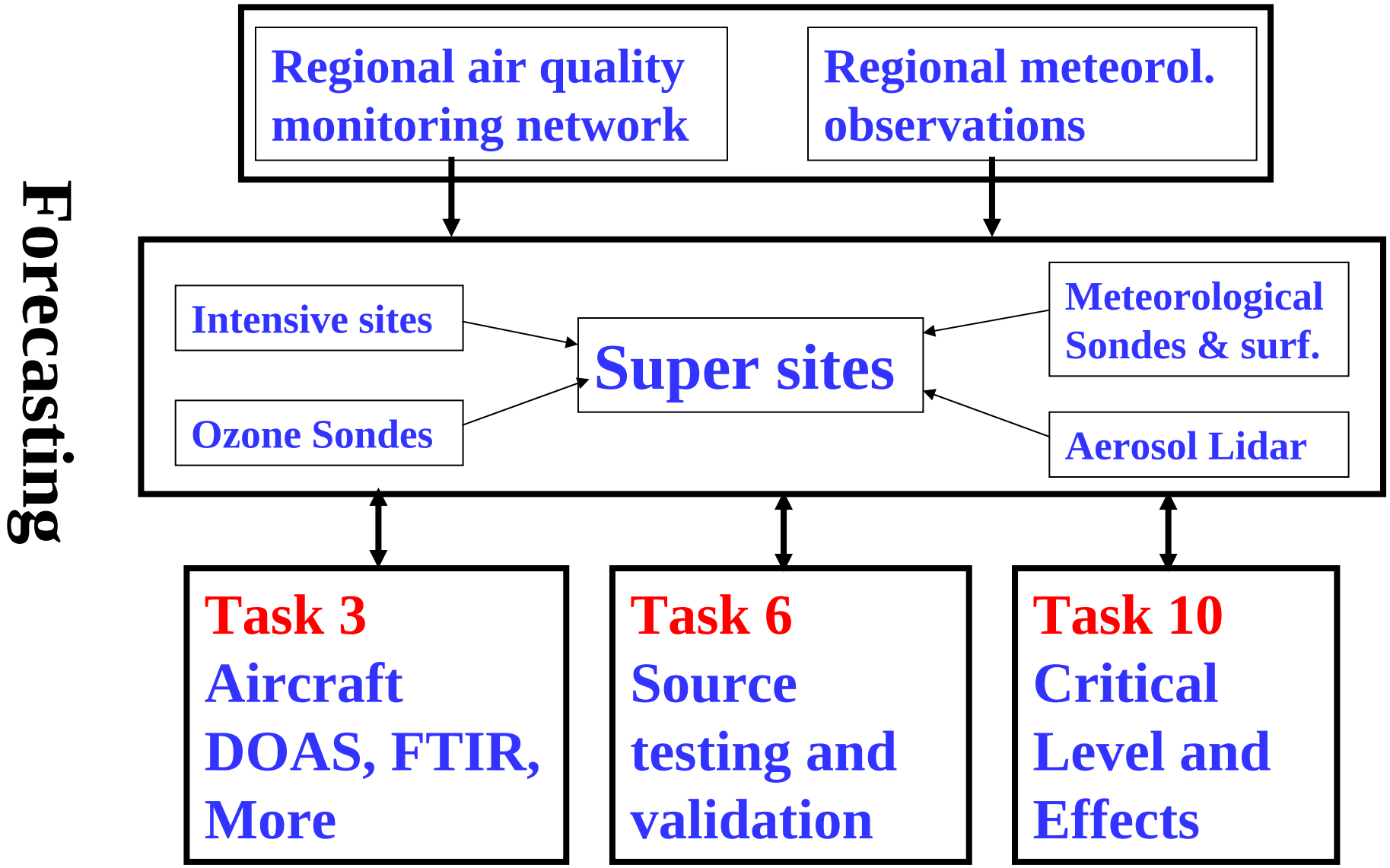
Participating institutes

1. PKU: Peking University;
2. GDEMC: Guangdong provincial Environmental Monitoring Center
3. CRAES: Chinese Research Academy of Environmental Sciences
4. AIOFM: Anhui institute of Optical and Fine Mechanics, CAS
5. IAP: Institute of Atmospheric Physics, CAS
6. ITMM: Guangzhou Institute of Tropical and Marine Meteorology;
7. IRSA: Institute of Remote Sensing Application, CAS
8. ZSU: Zhongshan University,
9. BIU: Beijing Industrial University
10. JU: Jinan University
11. RCEC: Research Center for Environmental Changes, Taiwan
12. GIST: Gwangju Institute of Science and Technology, Korea
13. TAMU: Texas A&M University, USA
14. FZJ: Juelich Research Center, Germany
15. NIES: National Institute of Environmental Studies, Japan

Sciences Questions

1. Performance of various measurement techniques and QA/QC in PRD? How to conduct the validation and inter-comparison?
2. What is characteristics of boundary meteorological processes? How to evaluate the influence of land/sea breeze to air pollution in PRD?
3. What is O_3 formation mechanism in PRD? Are there general guidelines for policy makers regarding VOC- and NOx-based O_3 abatement strategies?
4. What is chemical, physical and optical properties of aerosol in PRD? How aerosol impact regional climate?
5. What is the extent of interactions between different spatial scales (city , city cluster, China to global)
6. How to define source-receptor relationship cross the cities of PRD? How to validate the S-R relationship

Strategy of the 3C-Star2008 PRD Campaign



3D measurements in the campaign

Parameters observed at Super Sites

Meteorology：

- T, W, RH (Ground and vertical)
- J (O1D), J (NO_2) and UV-A, UV-B

Gaseous chemistry

- NO, NO_2, NOy, O_3, SO_2, CO, CO_2 (TECO)
- HNO_3, HNO_2, HCl, NH_3 (GAC)
- PAN (GC in-situ)
- VOCs（GC-FID in-situ and Canisters)
- Oxy-Organics (PTR-MS)
- HCHO (DOAS)
- HNO_2 (LP-DOAS, LOPAP)
- H_2SO_4
- H_2O_2 (HPLC in-situ)
- O_3 sounding

Closure measurement for O_3 production

Closure measurement for aerosol radiative forcing

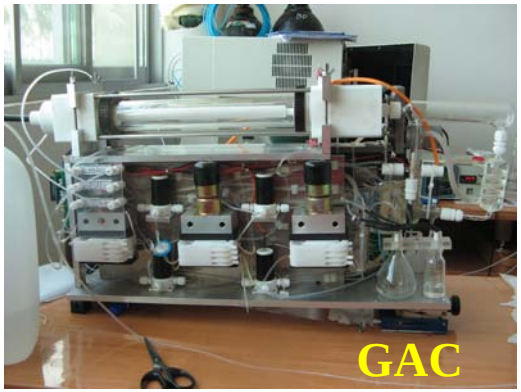
Aerosol chemistry

- Mass loading of $PM_{2.5}$ (TEOM)
- Chemical speciation of $PM_{2.5}$ and size distribution (sampler)
- EC/OC (Sunset in-situ)
- EC (SP2)
- Aerosol water soluble Ions and WSOC, (GAC)
- Chemical composition of particle size distribution (AMS)

Aerosol physical and optical properties

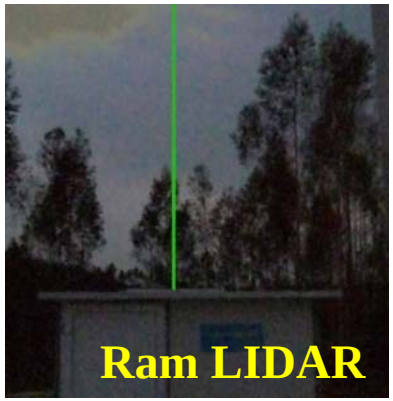
- Dry number distribution (DMPS/APS)
- Light scattering and absorption (Nephelometer, MAAP)
- Total light extinction coefficient
- AOD (CEMEL)
- Aerosol vertical profile (LIDAR)

Equipments developed in the project


GAC


VOCs on-line


PANs

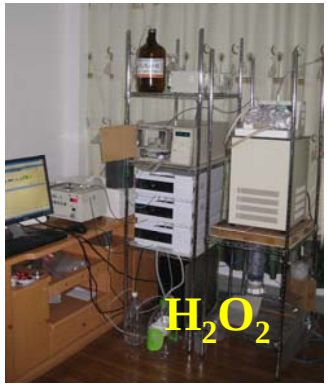

Ram LIDAR


Aerosol sizer

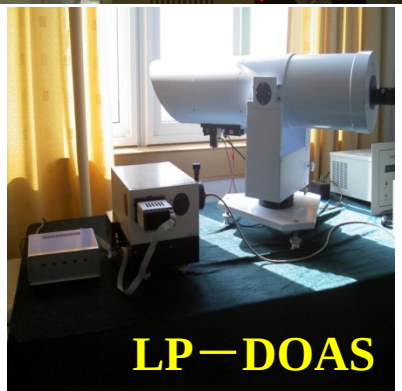

BC

Developed in project

Developed by institutes


H_2O_2

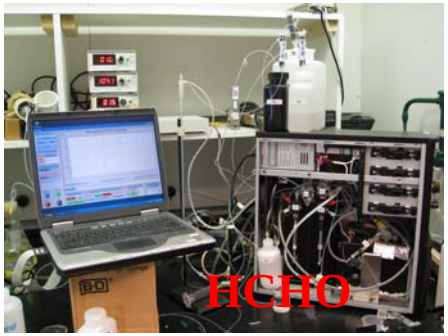

MANA

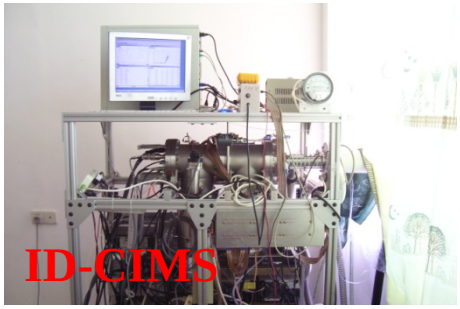

LP－DOAS

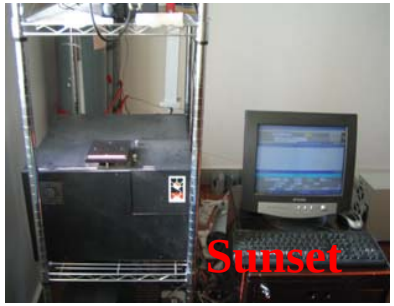

Mobile Van


Mobile DOAS

Equipments applied in the projects

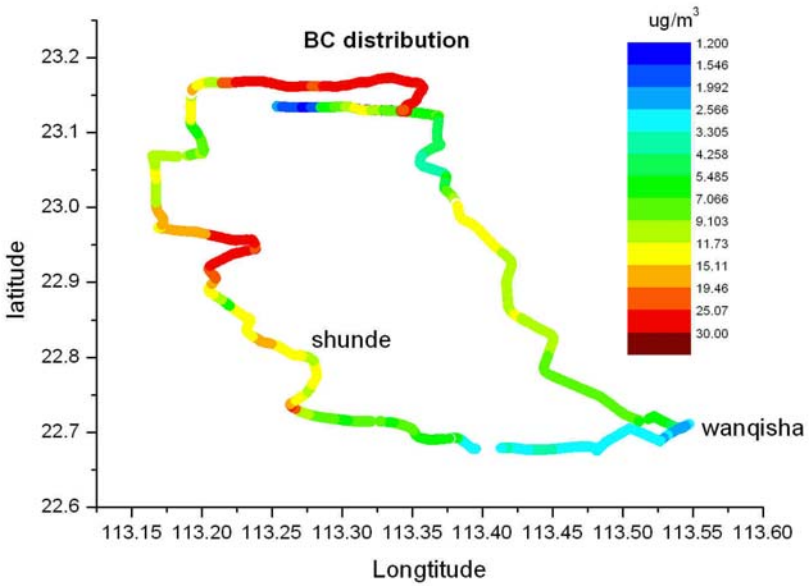




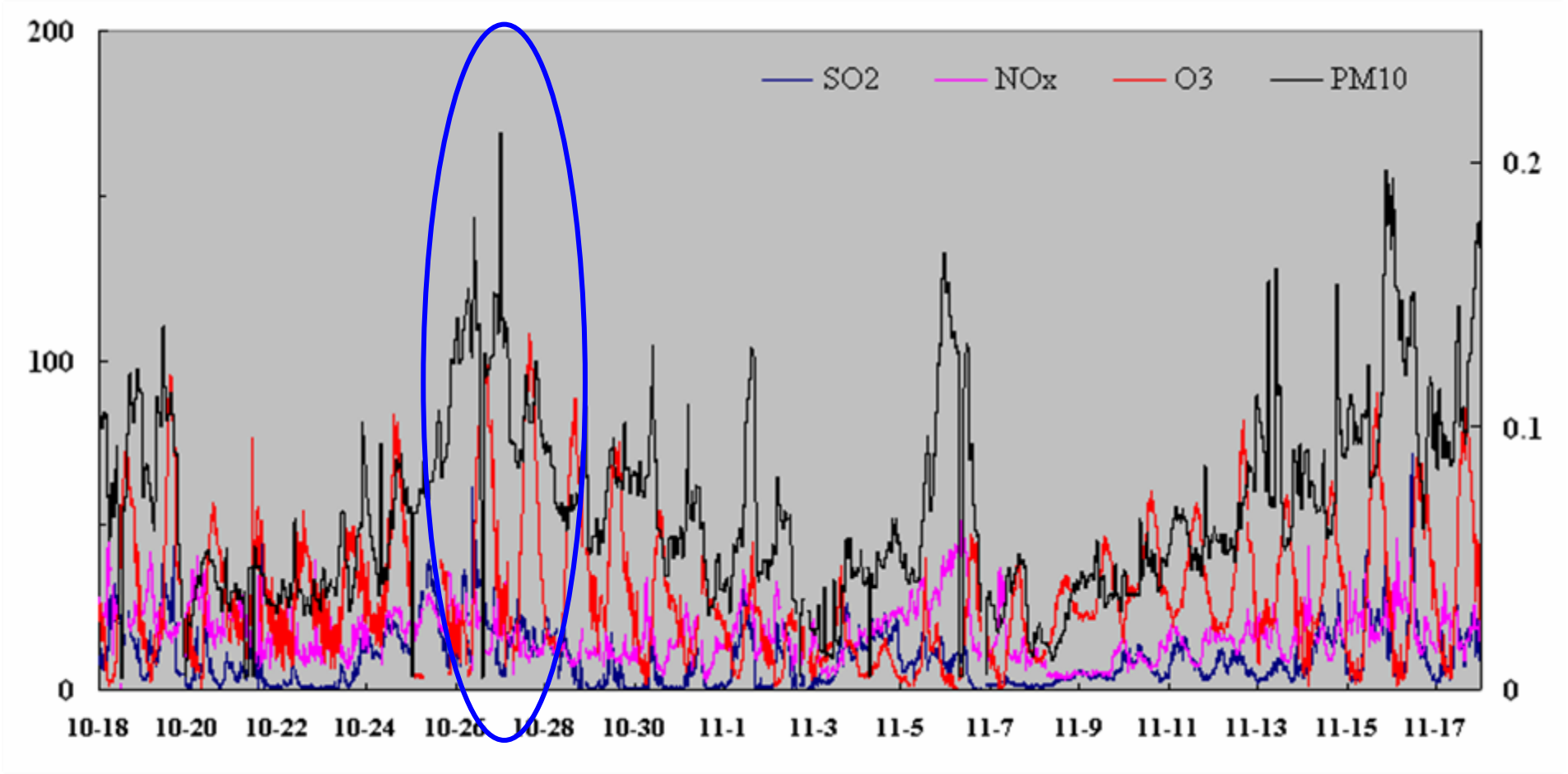


Pollution mapping by Mobile Van

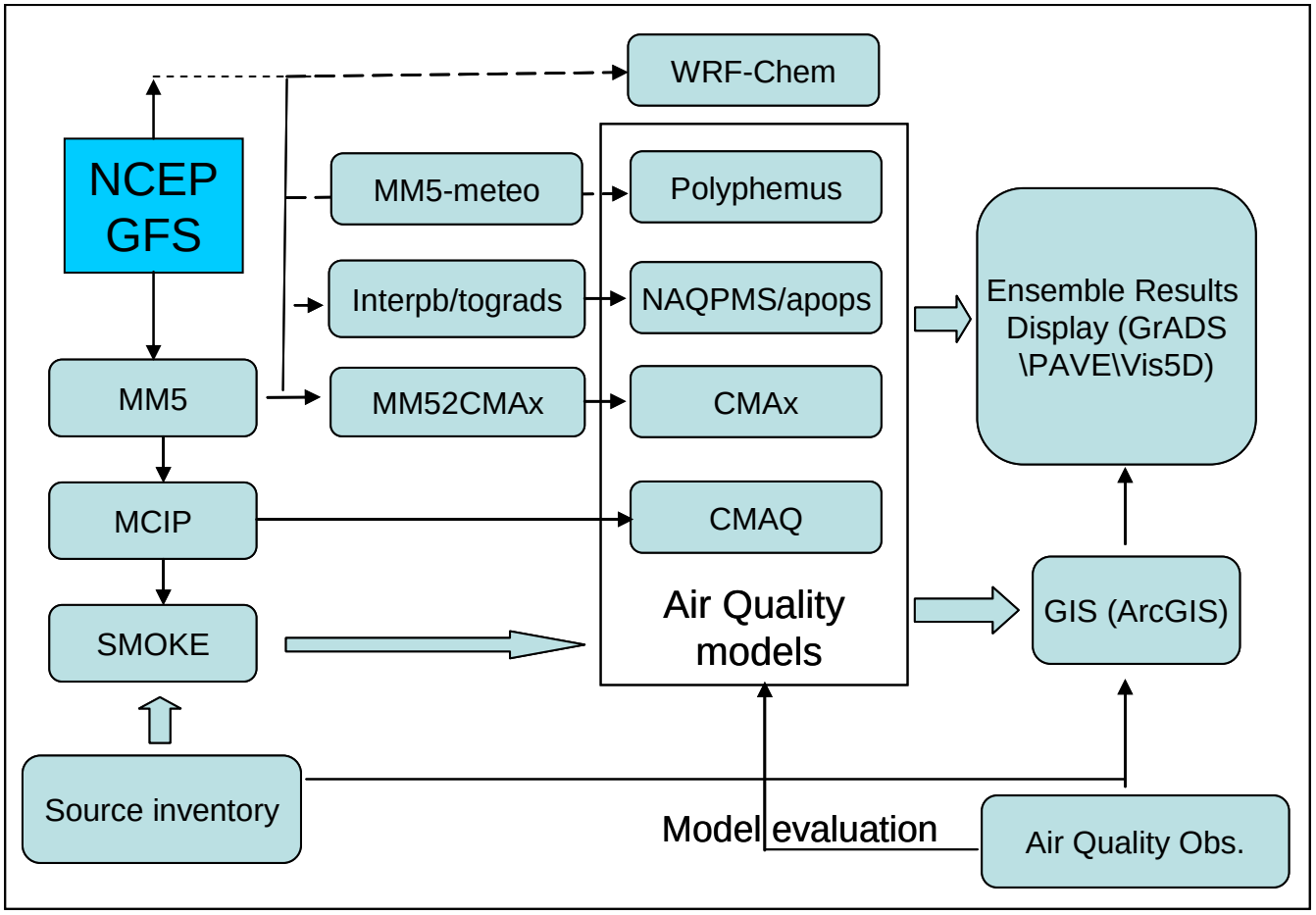
- TECO: SO_2, NOx, O_3, CO
- PTR-MS: VOCs
- GRIMM: aerosol number
- MAAP



Concentrations of O_3, SO_2, NO_x and PM_{10} at super-site



In-situ Forecasting



- **Weather forecasting (ITMM)**
- **Air quality forecasting (IAP, PKU)**

Meteorological Forecasting

广东省气象台（2008年） 10月24日11时发布 预报员：张 东

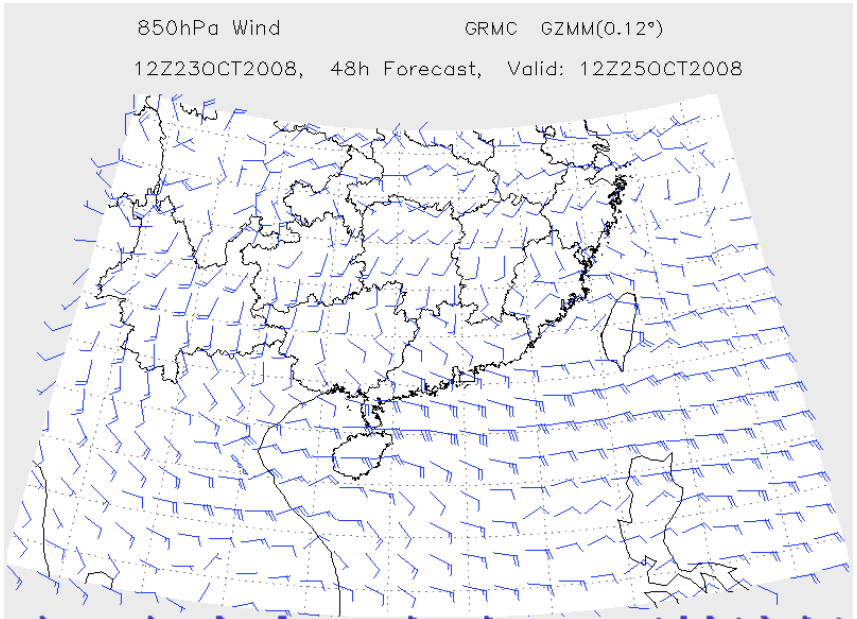
广东省陆地天气预报 天气形势分析： 500百帕三天内我省受强盛的带状副高控制，副高脊线后 期略有北抬。850百帕未来三天我省主要受偏东风场影响。地面冷高压中心东 移南压，我省受冷高压脊控制，26日有弱冷空气补充影响我省。

天气趋势预测： 今晚到明天白天，全省多云。明晚到27日，全省晴到多云。

主要城市天气预报： 今晚到明天白天：

广州：多云，22到29度；
佛山：多云，22到30度；
中山、深圳：多云间晴，23到29度；
东莞：多云间晴，22到30度；
珠海：多云间晴，23到28度；
惠州：多云间晴，22到29度；
清远：多云，21到29度；
肇庆：多云，21到30度；
江门：多云间晴，23到30度。

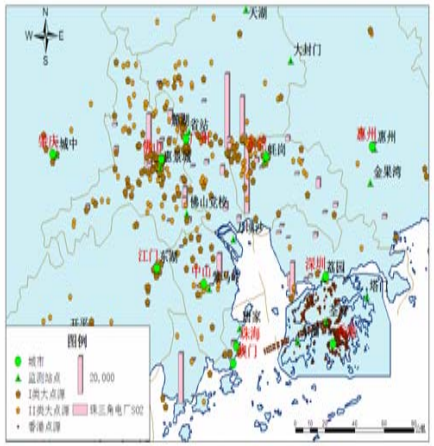
（资料来源：http://www.grmc.gov.cn/tqyb/cg_2.htm）



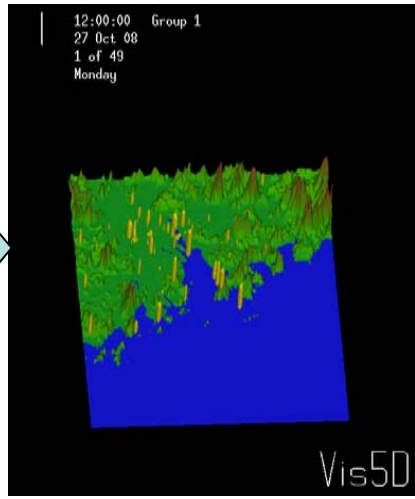
珠三角未来48小时850百帕流场变化（GRAPES）

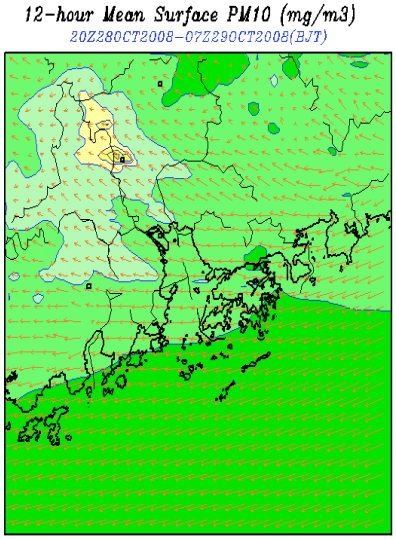
Application of EMS to PRD

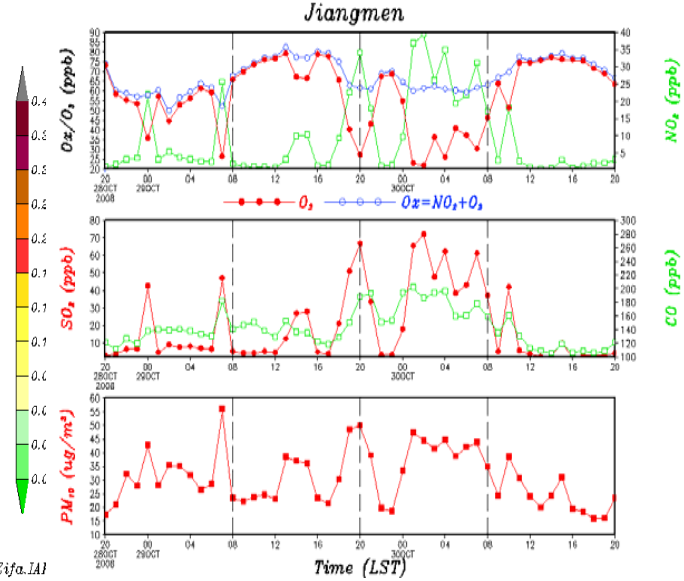
- Platform of PRD EMS
- Land-use retrieval from satellite data
- First version of emission data
- Forecasting trial

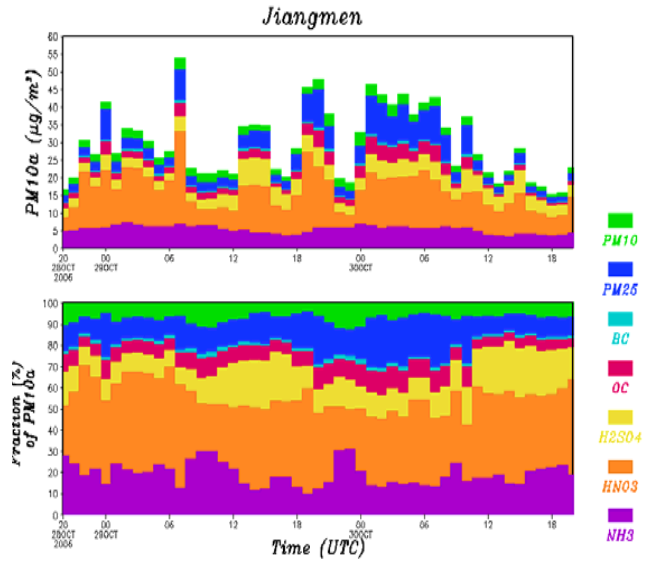


SMOKE模型



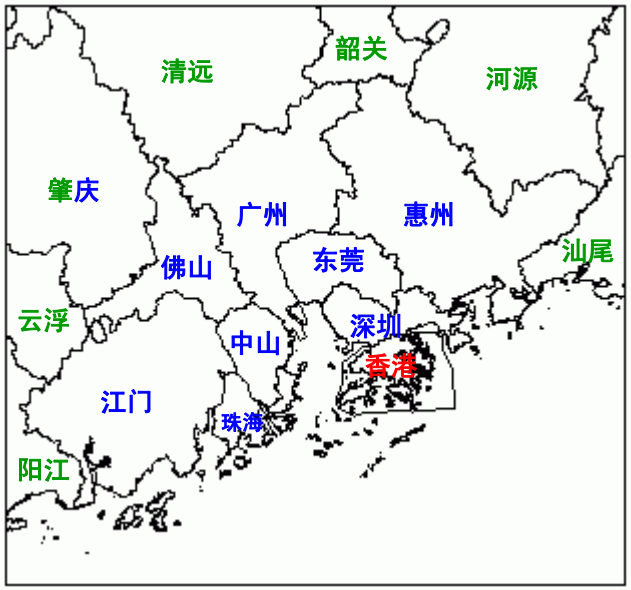


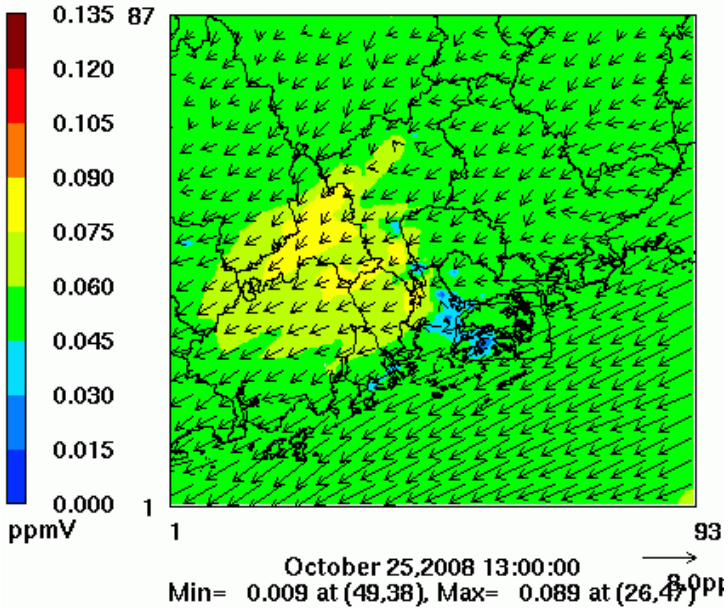


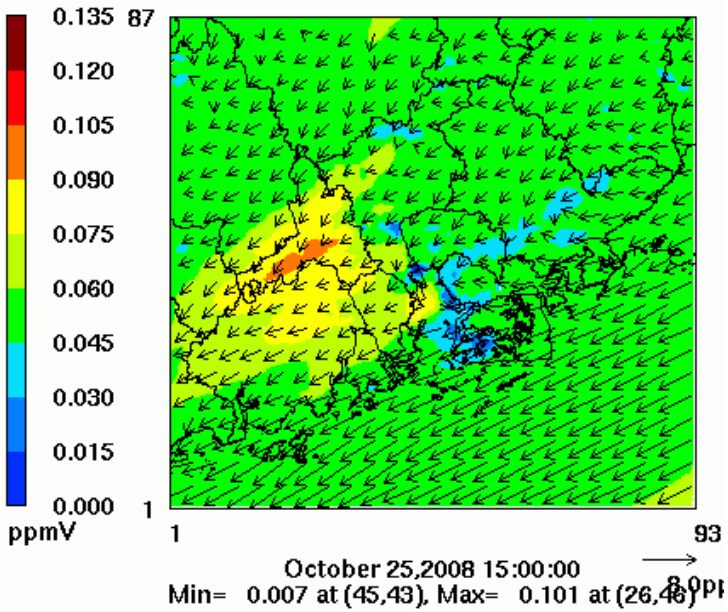


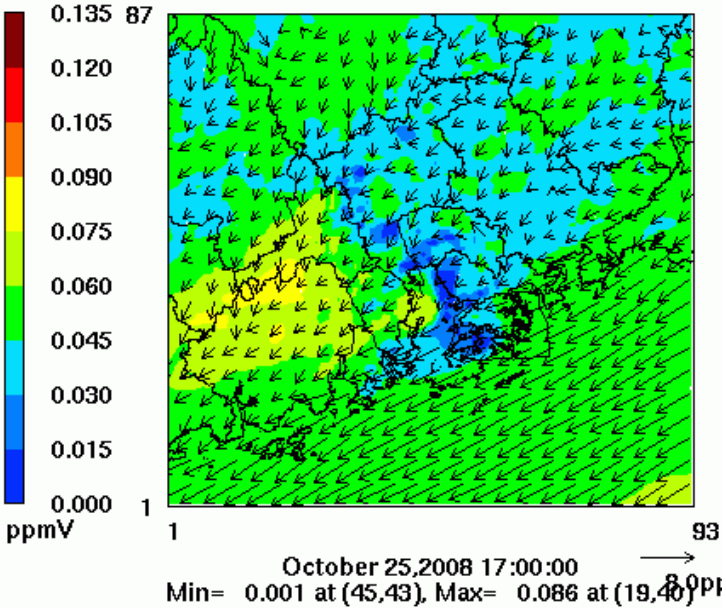
O_3 forecasted by CMAQ（2008-10-25）

(O_3: ppm; Wind speed: m/s)



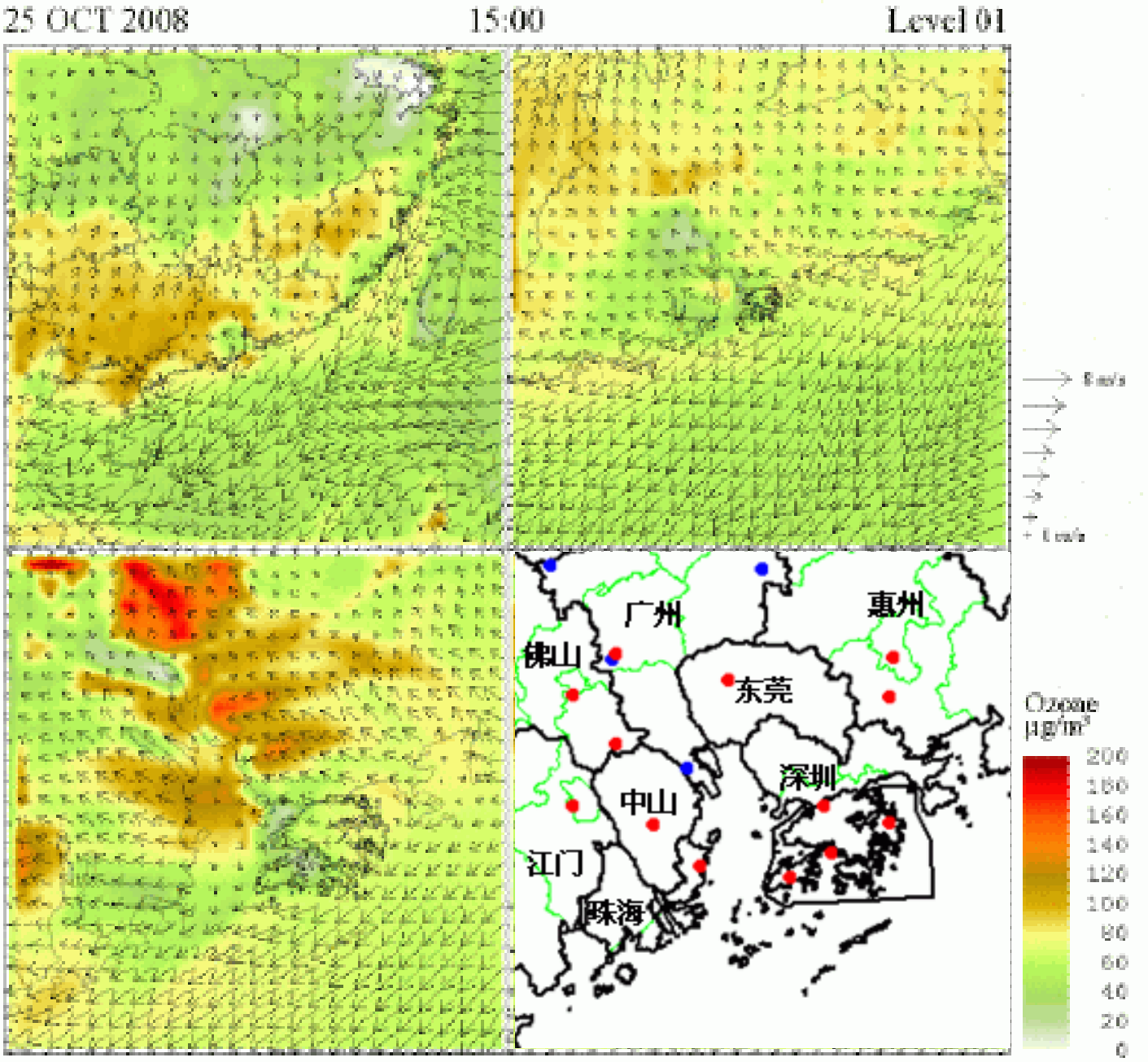






Air Quality Forecasting by HK EPB

Surface O_3



Air Pollution Forecasting in PRD

(2008-10-25)

Meteorological forecasting:

Cloudy mostly, dominant wind was Northeast with wind speed 2-4 m/s.

O_3 forecasting:

Likelihood of photochemical smog（hourly conc. > 0.20 mg/m^3 ）： High

The area with high O3: Concentration of 90-110ppb might be observed at Fushan, middle-north part of Jiangmen, Guangzhou, Pearl River estuary.

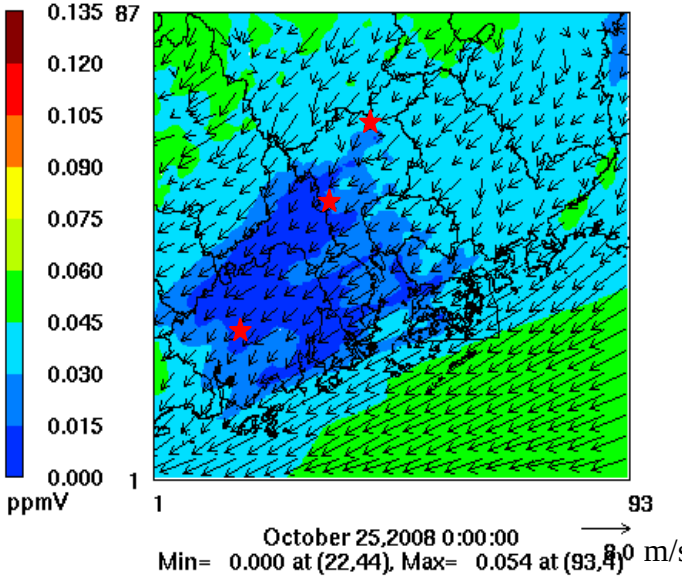
PM_{10}forecasting:

Likelihood of PM_{10} pollution (daily mean > 0.15 mg/m^3): Low

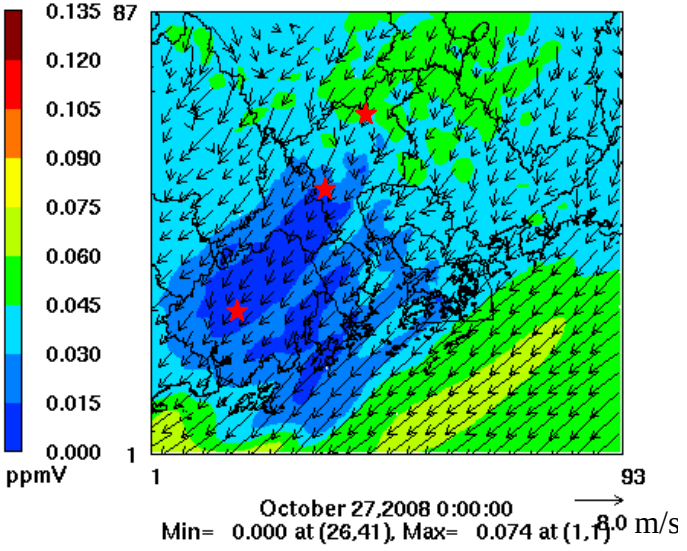
The area with high concentration: PM10 concentration will be elevated in late evening, concentration of 0.15mg/m^3 could be observed at some parts of Guangzhou and Fushan.

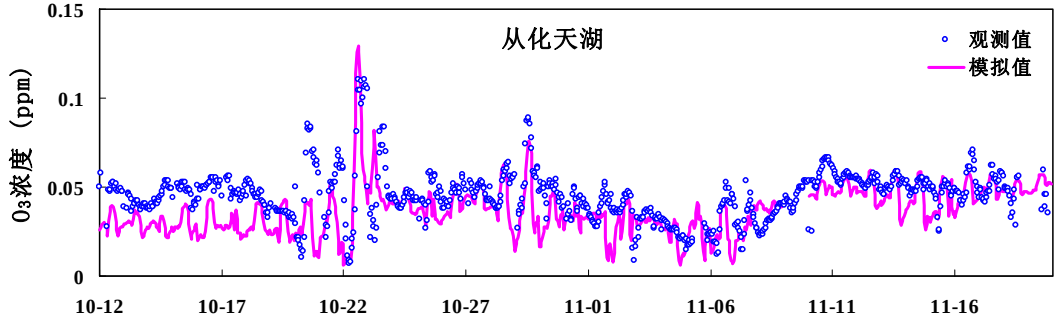
Comparison of observation and CMAQ forecasting

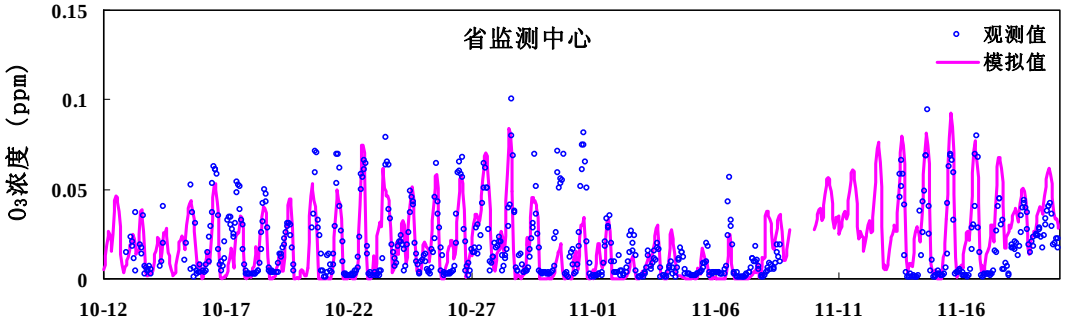
10月25日

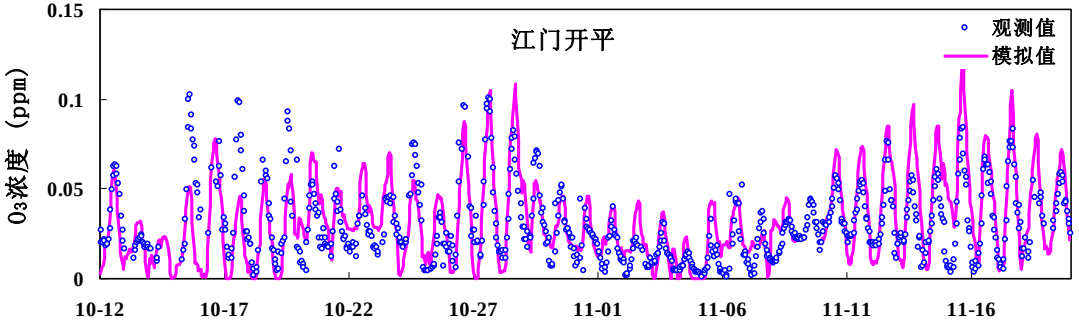


10月27日










谢谢！