Using MACC-II Global Boundary Conditions

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Rutherford Appleton Laboratory, UK

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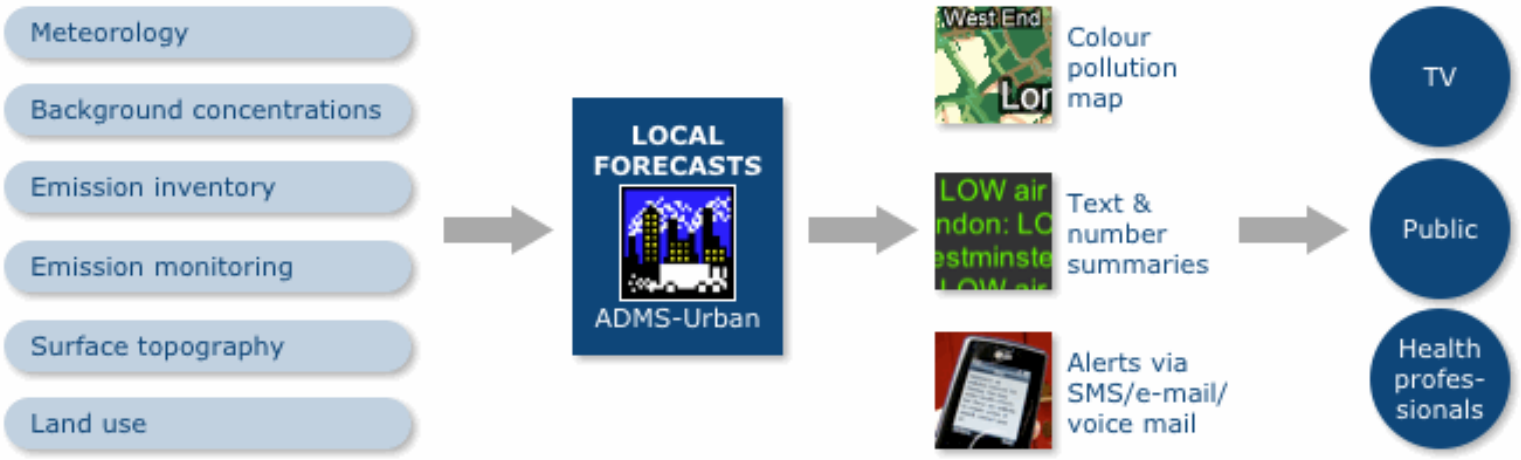
What is CERC?

- CERC is a privately-owned company, founded in 1985
- CERC carries out software design and development, consultancy, training and research in all aspects of local air quality
- 3 directors, 23 staff
  - 11 software developers
  - 7 air quality consultants
  - 5 admin/IT
- Offices in Cambridge, UK

CERC Software

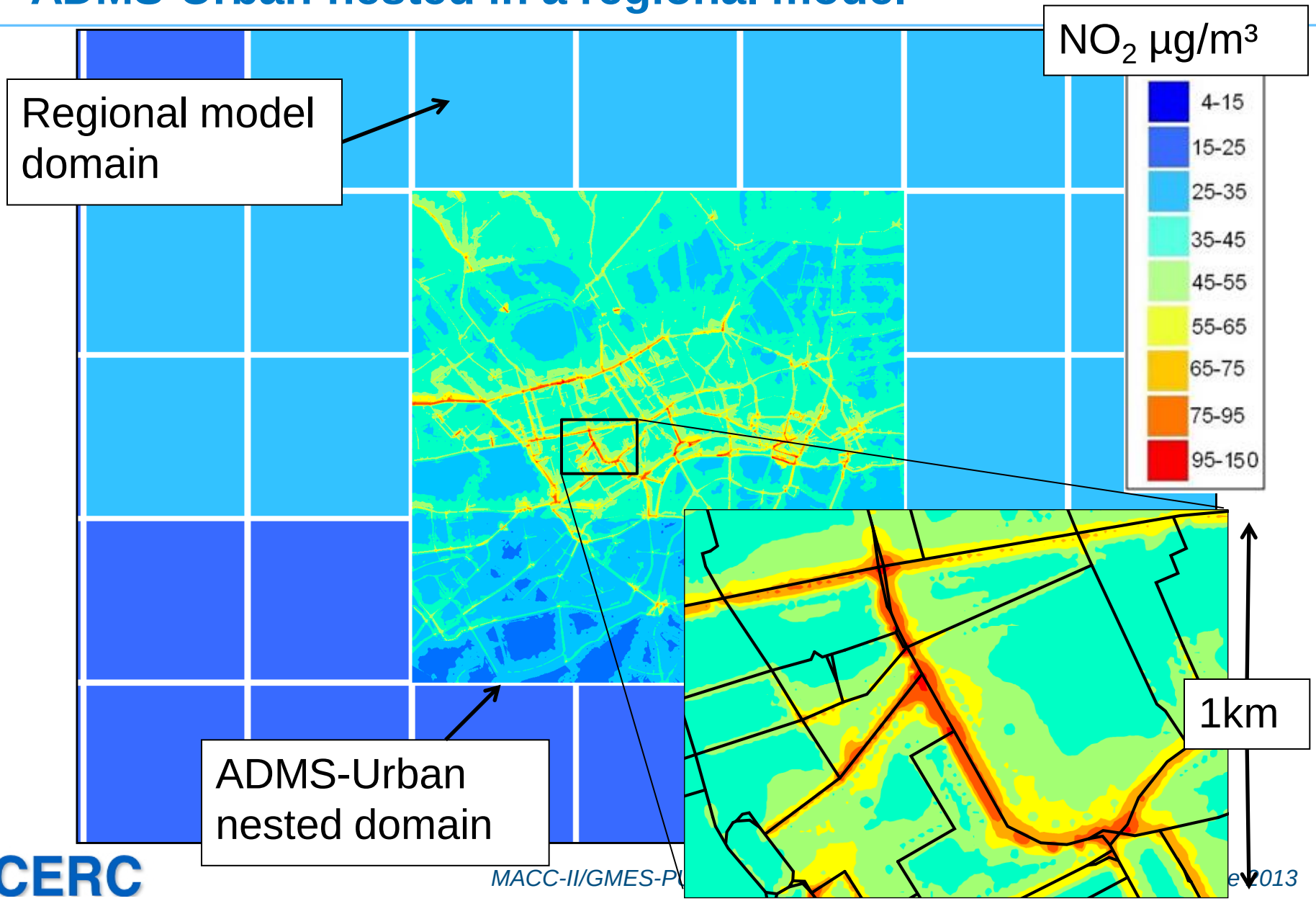
 ADMS 5	• Models dispersion of industrial emissions for permit applications and environmental impact assessments
 ADMS-Urban	• Comprehensive street-scale modelling system for managing urban air quality for planning and air quality assessments.
 ADMS-Roads	• Simplified version of ADMS-Urban for modelling road traffic and some industrial sources
 ADMS-Airport	• Extension of ADMS-Urban for managing air quality at airports
 EMIT	• Emissions inventory database software for toxic emissions and greenhouse gases
 FLOWSTAR	• Model of flow over complex terrain
 ADMSSTAR	• Advanced software for modelling short-term accidental releases
 ADMS-Screen	• Simple single source screening model for industrial emissions
 GASTAR	• Dense gas dispersion model
 Run Manager	• Software for distributing CERC model runs across networks

Air quality forecasting at CERC: ADMS-Forecast



- System delivers street-scale air quality forecasts for a city as maps and alerts
- In operation at CERC to deliver the *air*TEXT service for London
- CERC installed the system at *Barcelona Regionale* to deliver forecasts for Barcelona

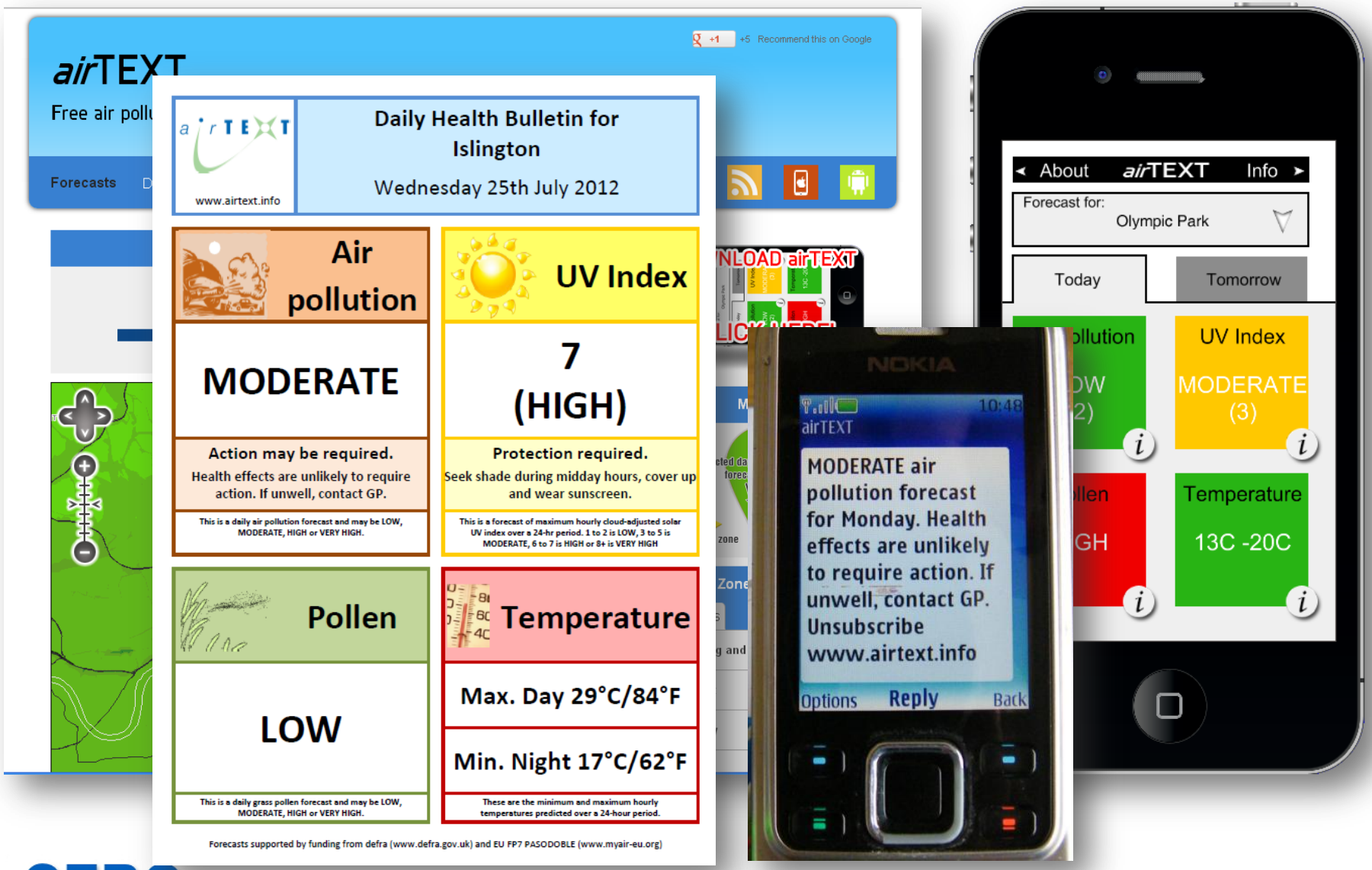
ADMS-Urban nested in a regional model



*air*TEXT

- *air*TEXT is the **air quality forecasting service for London**, operated by CERC on behalf of the *air*TEXT consortium, a group of organisations including UK Environment Agency, Health Protection Agency, Greater London Authority (GLA) and all Greater London local authorities
- *air*TEXT provides free air quality alerts direct to over 7000 subscribers
- *air*TEXT was initially developed in 2007 under ESA-funded PROMOTE, and supported by further funding from FP7 PASODOBLE, UK National Government (DEFRA), the GLA and all the Greater London Local Authorities

*air*TEXT products



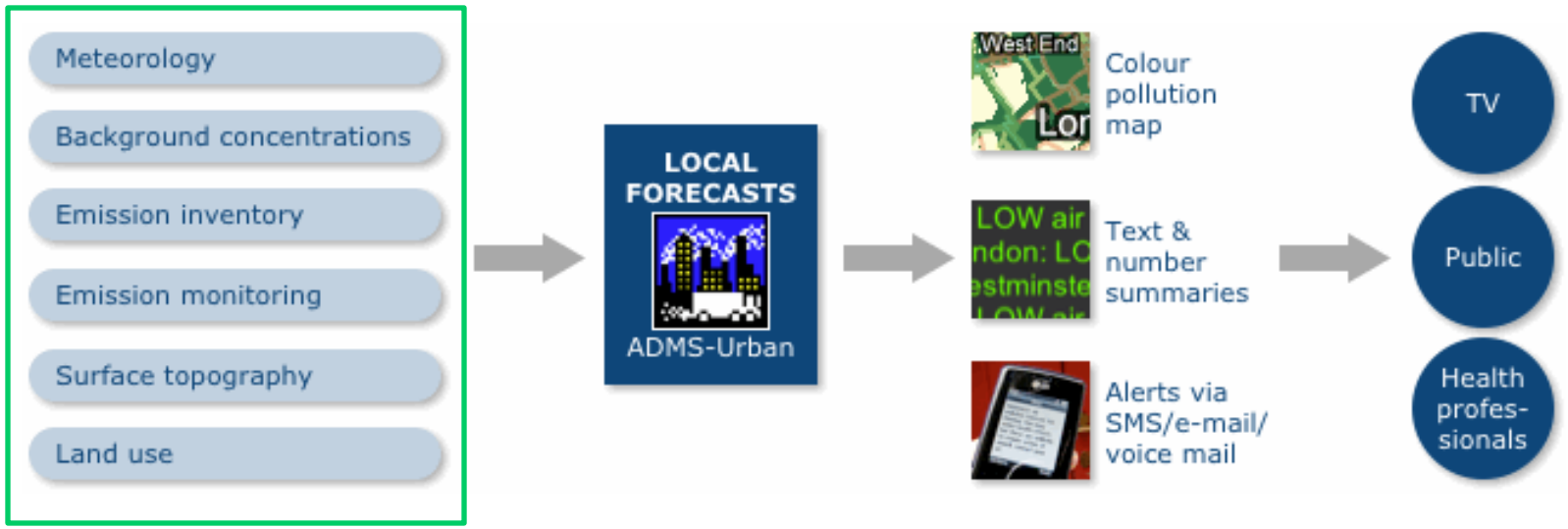
CERC in China

- CERC China based in Beijing
- ADMS-Urban and ADMS-EIA (special version of ADMS-Urban) approved for use in China by Chinese authorities
- Both models have a Chinese language GUI
- Around 100 institutes across China use ADMS-Urban or ADMS-EIA

Forecasting air quality in Beijing

- In August 2012, CERC and CERC China were jointly awarded the contract to provide Beijing Municipal Environmental Monitoring Centre (BMEMC) with an air quality forecasting system
- In September 2012 a team from CERC and CERC China installed the forecasting system at BMEMC and delivered a week-long training course in ADMS-Urban, EMIT and the other components of the system

Input data for Beijing system



- Meteorology: MM5 met forecasts performed by Chinese Academy of Science
- Background concentrations: ***MACC global product***
- Emission Inventory: local inventory being compiled by BMEMC

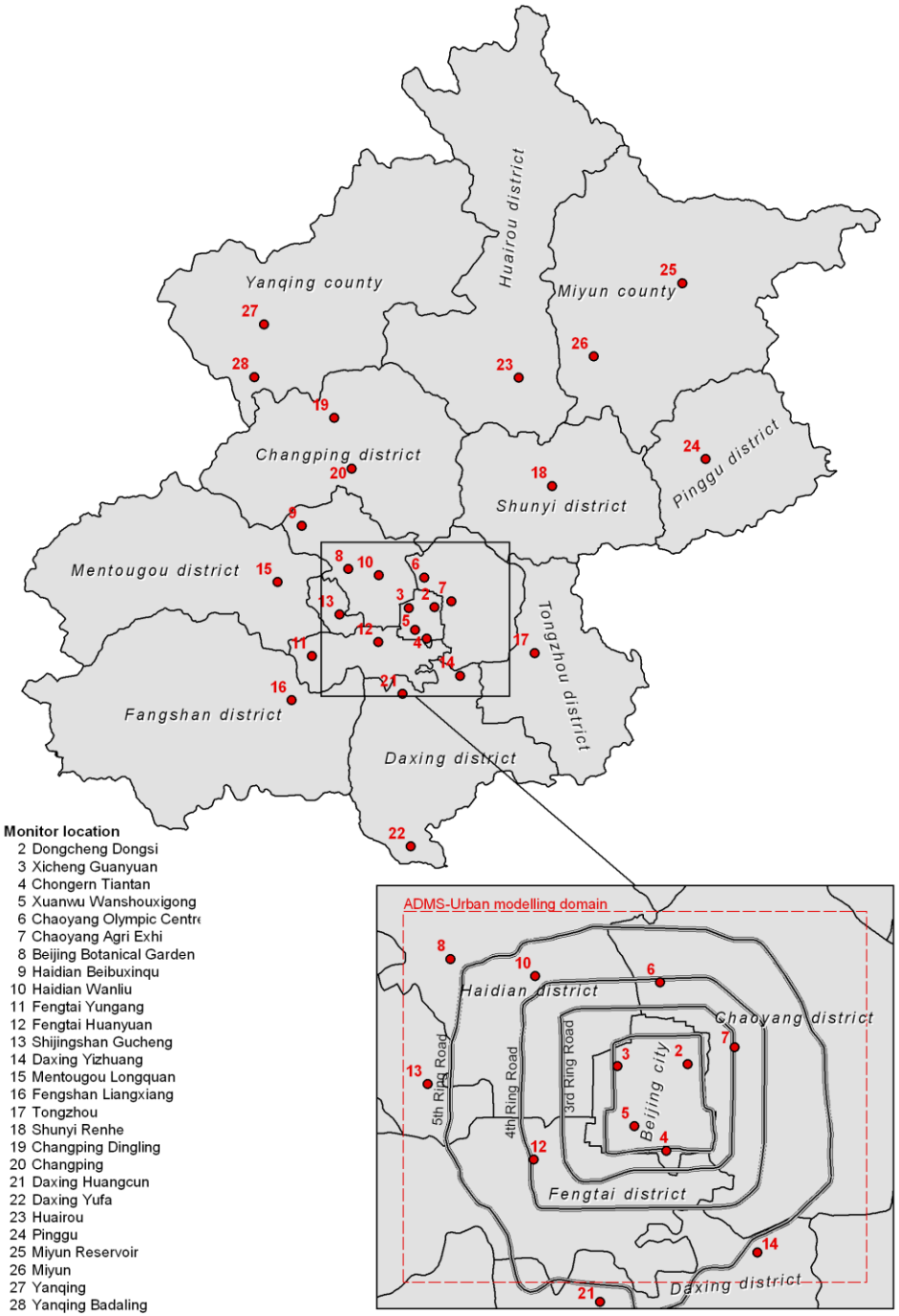
Using MACC-II global product as background

- Beijing system uses the MACC-II web coverage service (WCS) to extract data for the Beijing region

This system in our experience is quick and efficient, allowing us to only download the data we require

- Beijing has a latitude of 39.9° and a longitude of 116.4°
- Beijing system requests MACC-II data for longitude from 115° to 117° and latitude from 39° to 41°, a region covering the region of the Beijing monitoring sites operated by BMEMC
- This WCS request returns 4 MACC-II data points
- Validation of NO_2, PM_{10} and SO_2 for the period 23rd June to 9th October 2012
- 4 monitoring stations chosen from 28 available to be nearest representative sites (background)

Beijing monitoring sites operated by BMEMC



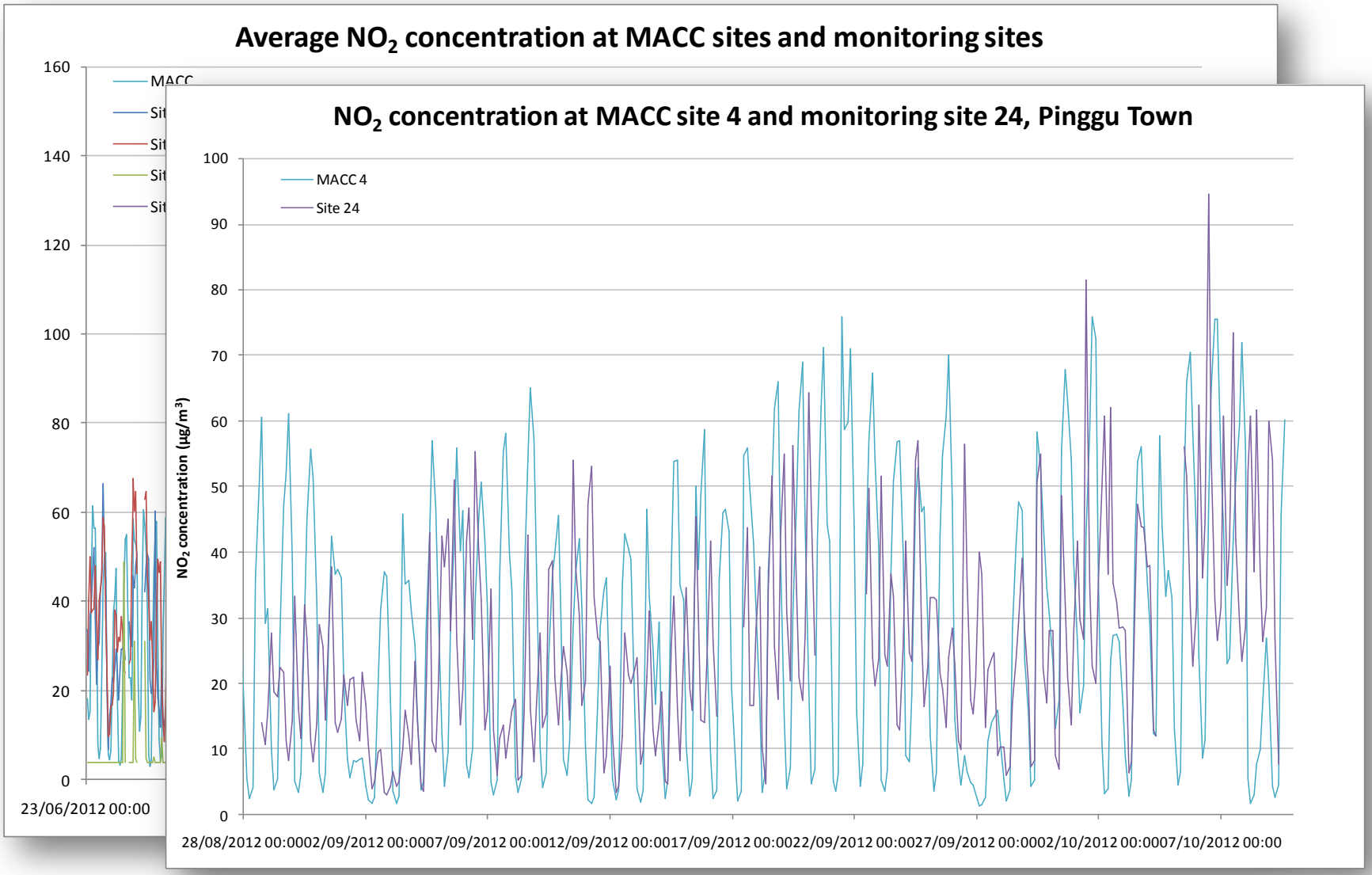
Monitor location

2 Dongcheng Dongsi
3 Xicheng Guanyuan
4 Chongern Tiantan
5 Xuanwu Wanshouxigong
6 Chaoyang Olympic Centre
7 Chaoyang Agri Exhi
8 Beijing Botanical Garden
9 Haidian Beibuxinqu
10 Haidian Wanliu
11 Fengtai Yungang
12 Fengtai Huanyuan
13 Shijingshan Gucheng
14 Daxing Yizhuang
15 Mentougou Longquan
16 Fengshan Liangxiang
17 Tongzhou
18 Shunyi Renhe
19 Changping Dingling
20 Changping
21 Daxing Huangcun
22 Daxing Yufa
23 Huairou
24 Pinggu
25 Miyun Reservoir
26 Miyun
27 Yanqing
28 Yanqing Badaling

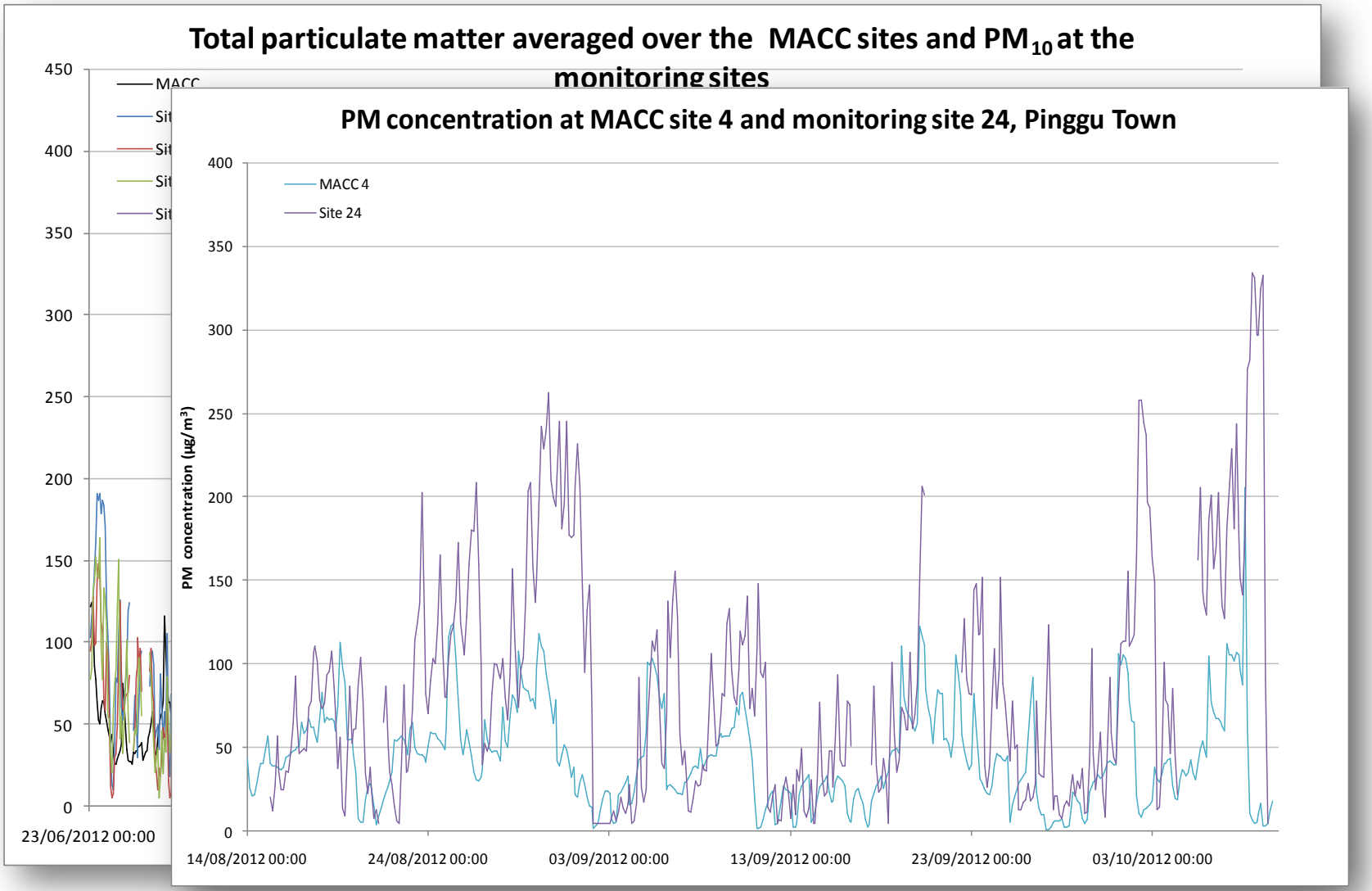
CERC

Locations of MACC grid points and Beijing monitors

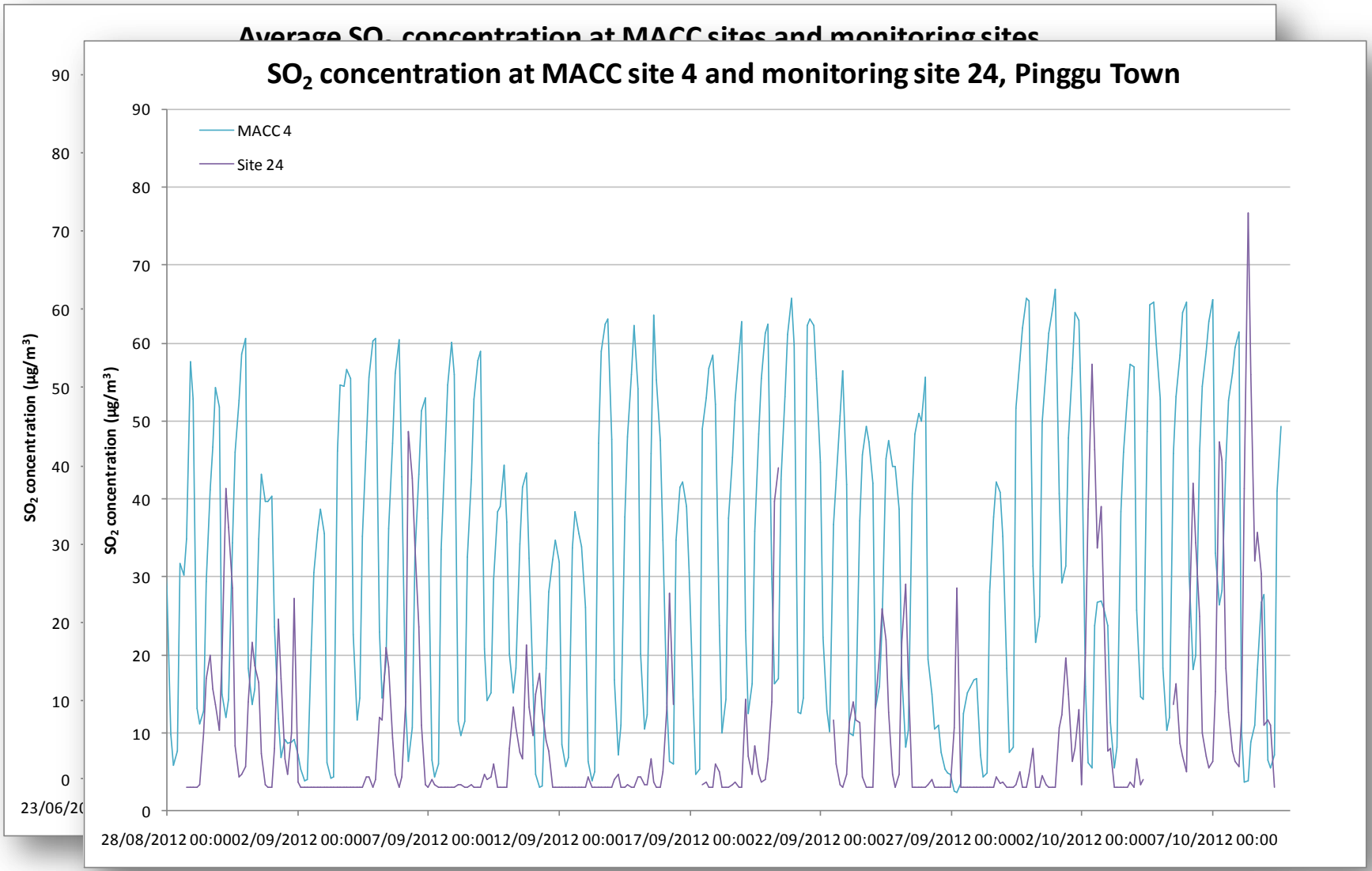
NO_2 validation



PM_{10} validation



SO_2 validation



Pollutant mapping based on validation

ADMS-Forecast	MACC-II
O3	vmr_o3
NO2	vmr_no2
NOx	vmr_no2 + vmr_no
SO2	0.5*vmr_so2
CO	vmr_co
PM10	mmr_sulfaer + mmr_bc_hydrophilic + mmr_bc_hydrophobic + mmr_oc_hydrophilic + mmr_oc_hydrophobic + mmr_seasalt1 + mmr_seasalt2 + mmr_seasalt3 + mmr_dust1 + mmr_dust2 + mmr_dust3 + Nitrate
PM2.5	0.9*mmr_sulfaer + 0.95*mmr_bc_hydrophilic + 0.95*mmr_bc_hydrophobic + 0.95*mmr_oc_hydrophilic + 0.95*mmr_oc_hydrophobic + mmr_seasalt1 + 0.5*mmr_seasalt2 + mmr_dust1 + mmr_dust2 + 0.25*mmr_dust3 + 0.8*Nitrate
BC	mmr_bc_hydrophilic + mmr_bc_hydrophobic
OC	mmr_oc_hydrophilic + mmr_oc_hydrophobic
Nitrate	mmr_sulfaer (no nitrate in MACC-II global product)
Sulphate	mmr_sulfaer

Concluding remarks

- MACC-II global product being used as background levels in an ADMS-Forecast system set up in Beijing
- The Beijing system is not yet running with real local emissions data; expect BMEMC to implement local emissions this year
- So far found the MACC-II global product to be reliable and efficient to use, particularly the WCS
- Some recommendations for improvement:
  - SO2 overestimated (maybe due to outdated emissions?), but NO2 and PM10 show good agreement with measured values
  - Would like nitrate to be added to the MACC-II global product
- Our experience with the MACC-II global product leads us to think ADMS-Forecast can be applied anywhere in the world

Thank you for your attention