

# FORECAST AND REANALYSIS SYSTEM FOR URBAN AIR QUALITY IN JAPAN WITH CMAQ AND RAMS

Seiji Sugata\*, Toshimasa Ohara, Shinji Wakamatsu  
National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan

Jun-ichi Kurokawa, Izumi Ikeuchi  
Fujitsu FIP corporation, Koutou-ku, Tokyo, Japan

## 1. INTRODUCTION

Although the regulation about air environment has been progressing in Japan, the achievement of the environmental standards about gases such as ozone and aerosols has not necessarily improved, whose reason is not clear yet.

For further achievement of the atmospheric environment, investigation of each physical and chemical process and its contribution on the local behavior of the atmospheric environment is necessary, where numerical models are very useful to investigate them quantitatively.

This presentation introduces a forecast reanalysis system for urban air quality that has been developed in National Institute for Environmental Studies (NIES).

## 2. REQUIRED PERFORMANCE FOR THE SYSTEM

A forecast and reanalysis system has been developed based on the combination of a meteorological model RAMS (Regional Atmospheric Modeling System) and CMAQ. An modified interface (MCIP) to feed results of RAMS to CMAQ (Sugata et. al) is used to combine the two models.

As described in the introduction, some functions are required to the system. Both wide calculation domain to cover long-range transport and fine resolution in a local focused area to reproduce urban atmospheric environment are required. That is, it needs to cover some part of Asia and to have fine resolution, a few kilometer mesh, in focused area in Japan. Therefore, nesting method is used here.

The system is expected to have two modes; one is reanalysis mode to reproduce and

\* *Corresponding author:* Seiji Sugata, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki, 305-8506, JAPAN, e-mail: [sugatas@nies.go.jp](mailto:sugatas@nies.go.jp)

\*\* *Kanto:* Greater Tokyo metropolitan area

investigate past episodes and the other is forecast mode to forecast air quality for coming a few days.

## 3. CONFIGURATIONS AND CURRENT STATUS OF THE SYSTEM

### 3.1 Domains

Three domains are prepared so far with nesting grid feature. Namely, Asian domain, Japan domain, and Kanto\*\* domain area shown in Figure 1, whose horizontal resolution is 100km, 25km, 5km, respectively.

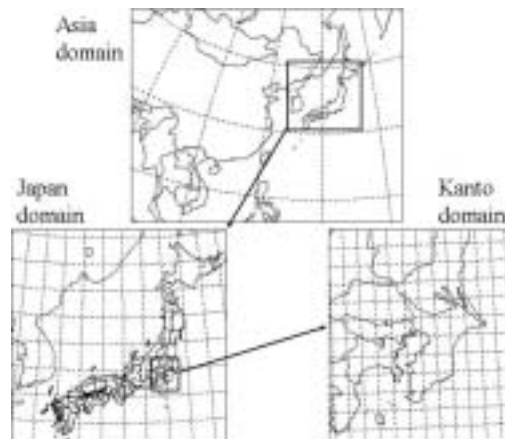


Fig. 1. Three domains currently used for the system. From the largest one, Asia domain, Japan domain, and Kanto domain. Horizontal mesh sizes are 100km, 25km, and 5km, respectively.

### 3.2 Models and input data

Meteorological data is calculated by RAMS version 4.3 and air quality is calculated by CMAQ4.4.

Daily operational weather forecasting data, Grid Point Value (GPV) data, by the Japan Meteorological Agency (JMA) are used to be assimilated in RAMS to reproduce realistic meteorological field with fine resolution.

SAPRC99 is used as a chemical system. Species of forecasted concentrations are SO<sub>2</sub>, NO, NO<sub>2</sub>, CO, O<sub>3</sub>, HNO<sub>3</sub>, NH<sub>3</sub>, NMHC as the combination of several hydrocarbons, PM2.5 as the sum of all aerosols of aiten and accumulation modes, PM10 as the sum of PM2.5 and coarse mode aerosols.

### **3.3 Initial and boundary conditions**

Initial conditions are calculated with standard ICON vertical profiles or concentration obtained by previous studies in the reanalysis mode, and with forecast data one day before in the forecast mode.

Climatology of concentrations calculated by global chemical transport model, CHASER, is used to feed lateral boundary conditions for CMAQ.

### **3.4 Computational platform**

A PC cluster is used as the platform of the system. CPUs are double Intel Xeon 3.06GHz as master nodes and fourteen Intel Xeon 2.8GHz as slave nodes.

### **3.5 Time schedule for the forecast**

Daily cycle for forecast is started from acquisition of data of JMA/GPV data at 10 UTC, which is 19 JLT (Japan Local Time). The starting time of the data is 0 UTC and forecasting period is 84 hour. Calculations by RAMS and CMAQ are carried out continuously. They finish at 23 UTC (8 JLT on the next day). RAMS spends approximately two thirds of the total calculation time.

## **4. VISUALIZATION AND PUBLIC PRESENTATION**

Forecast data obtained by the system need to be visualized for scientists and policy makers to know atmospheric conditions on a coming few days and to validate the forecast data. Therefore a visualization system is included to the system.

A user can choose the species he wants to check. Each species is displayed side-by-side with observational data, Atmospheric Environmental Regional Observation System (AEROS), provided by Ministry of the Environment in Japan.

## **5. References**

AEROS' homepage (in Japanese) <http://w-soramame.nies.go.jp/>

Sugata S., Byun D., and Uno I., 2001, Simulation of sulfate aerosol in East Asia using Models-3/CMAQ with RAMS meteorological data, *Air Pollution Modeling and Its Application XIV*, Gryning and Schiermeier eds., 267-275