Intercomparison Study of Transboundary Air Pollution Models for East Asia (MICS-Asia)

Background

Since 2001, the acid-deposition monitoring network in East Asia (EANET; organized by ADORC, the Acid Deposition and Oxidant Research Center, Japan) has been monitoring concentrations and depositions of air pollutants. Many universities and research institutes have independently been working on the estimation of source-receptor relationships and/or fluxes between countries/regions through the analysis of monitoring data by EANET or other monitoring activities. In the middle of 1990's, considerable discrepancies were found in proposed fluxes of acidic substances flowing into Japan. Aiming to clarify such discrepancies, CRIEPI and the International Institute for Applied Systems Analysis (IIASA, Austria) initiated an international comparative project of calculations by transboundary air pollution models, MICS-Asia (Model Intercomparison Study in East Asia), in 1998. Recently, MICS-Asia has entered its second phase (MICS-II) and extended its subject from acidic substances to particulate matter.

Objectives

1. To make an implementation guideline for MICS-II by continuously participating as one of the organizers of MICS-II.
2. To evaluate the consistency among the participating models and the performance of CRIEPI's model by analyzing calculated results submitted to MICS-II, focusing on the atmospheric concentration of particulate matter (sulfate and nitrate) and its related gases (sulfur dioxide and ozone).

Principal Results

1. Planning of MICS-II and present status of participating models

CRIEPI and IIASA made an implementation guideline for MICS-II with ADORC. The study domain was decided as shown in Fig.1, and the study periods were March, July and December 2001 and March 2002. Participants were requested to submit daily spatial distributions of concentrations and depositions of pollutants for the domain and periods. To compare the model themselves, participants were highly recommended to use the common input datasets on meteorology, emission inventories and boundary concentrations prepared by the organizers of MICS-II. As of March 2005, seven universities and institutes (The Seoul National University, South Korea; The Hong Kong Environmental Protection Department, China; The University of Iowa, USA; The Swedish Meteorological and Hydrological Institute, Sweden; The Kyoto University, ADORC, and CRIEPI, Japan) submitted calculated results. MICS-Asia plays the expected role in the analysis and evaluation of monitoring data of EANET.

2. Consistency of the participating models and performance of CRIEPI's model

(1) Compared with monitoring data by EANET and CRIEPI (Figs.2 and 3), the participating models, in general, showed good consistency among the models and good reproducibility for sulfate and ozone. For sulfur dioxide, the models well reproduced observed concentrations, except for polluted sites near sources. However, the consistency and reproducibility were low for nitrate. It was considered that the low consistency was caused by differences in how to give the boundary conditions, how to set the vertical coordinate, how to model the formation processes and the gas-aerosol reactions of nitrate and others.

(2) CRIEPI's model (M-7 in Figs.1-3) showed good reproducibility, in particular, for sulfate (Figs.2 and 3). This model featured the most vertical layers in the atmospheric boundary layer among the participating models. This feature was considered as a key factor in leading to such high reproducibility.

Future Developments

Factors influencing the inconsistency found above will be analyzed in further detail. The contribution of the transboundary air pollution to Japan will be explored.

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Reference

H. Hayami, 2005, "Analysis results from the Model Inter-Comparison Study on air quality in East Asia - surface concentrations of particulate matter and related gases" (in Japanese)
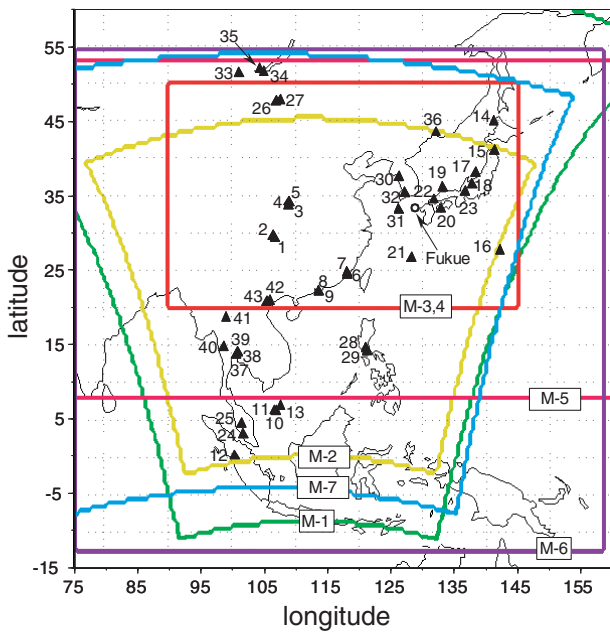
Fig.1 Participating model domains (M-*model number*) in MICS-II domain (outer frame).

▲ : monitoring stations of EANET and CRIEPI.
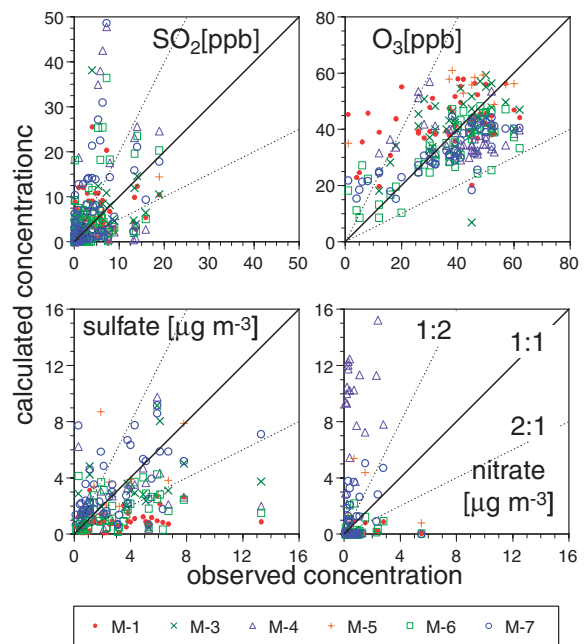
Fig.2 Calculated results of MICS-II participating models compared to monthly-mean concentrations at EANET stations.
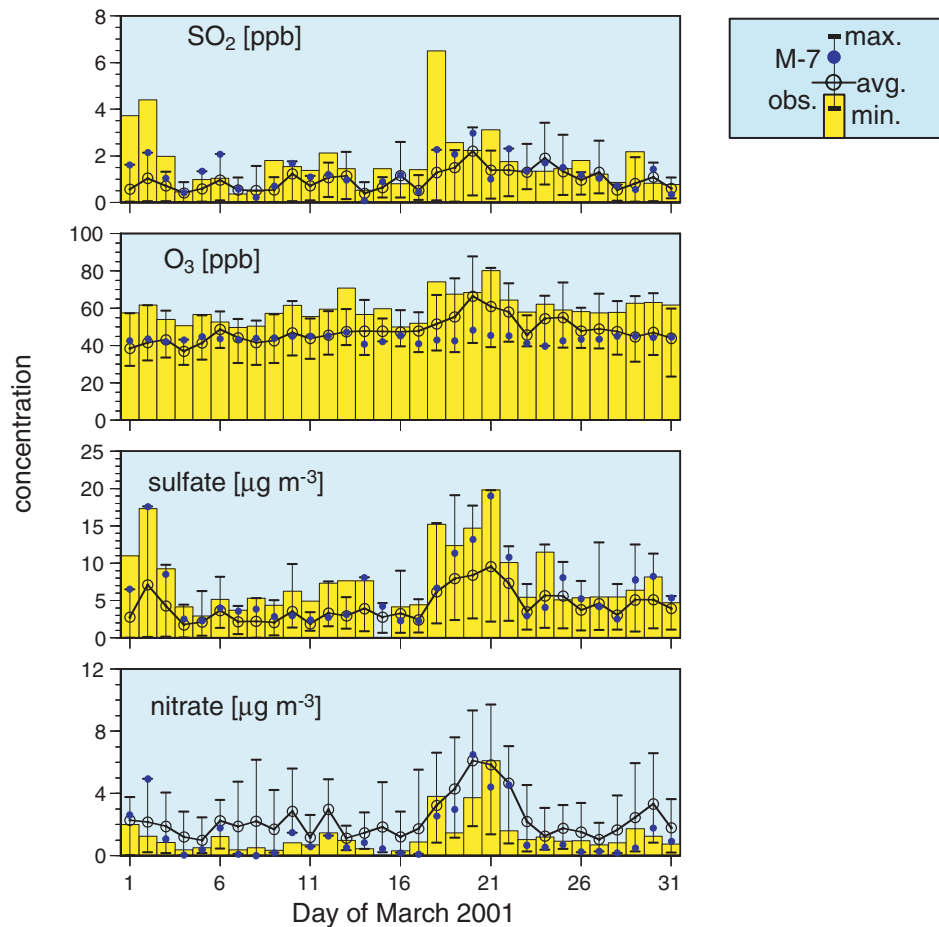
Fig.3 Daily measurements (yellow bars) and model-predicted averages and extreme values at CRIEPI monitoring station in Fukue Island, Japan, in March 2001.