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Consideration on collaboration with other initiatives on emission inventories and numerical modeling

Network Center for EANET

1. Introduction

The interest of transboundary air pollutions in Asia has been increasing on scientific and political concern, because countries receive clear amount of pollutants which originate from neighboring and even distant countries. Chemical transport models (CTMs) have become a critical tool in the analysis of the fate and transport of emissions in each scale. In addition, it is expected for CTMs to provide the evaluation of the transboundary air pollutions which is acceptable for the related countries and to help the development of the regional environmental policy. For example, RAINS (Regional Acidification Information and Simulation Models) which was developed by International Institute for Applied System Analysis (IIASA) contributed for the conclusion of the 1994 Oslo Protocol.

The transboundary air pollutions is the issue to be treated as not a local but a regional problem. Moreover, it is important to have a common understanding and discuss the solution for transboundary air pollution among related countries. Since EANET has been taking initiative for the evaluation of the acid deposition in East Asian region, it can be considered as most appropriate body to undertake the evaluation based on the modeling analysis in cooperation with the monitoring analysis in East Asia.

2. Collaboration with MICS-Asia Phase II

In line with “collaboration with existing initiatives on developing emission inventories and numerical modeling” included in the Work Program and Budget of EANET in 2003 through 2007, NC has been making collaboration with MICS-Asia (Model InterComparison Study in Asia) Phase II by establishing its website (*http://www.adorc.gr.jp/adorc/mics.html*) and providing EANET monitoring data for the model validations following the data disclosure of EANET.

Main purpose of MICS-Asia is not a grading test of models but the making of a common understanding of model performance and uncertainties for model development. In addition, participants in MICS-Asia can make good use of the knowledge obtained through the activities to their model development. MICS-Asia Phase I had been carried out during the period from 1998 to 2000 and sulfur compounds were mainly analyzed in its intercomparison study.

Based on discussions and outcome in Phase I, further model intercomparison study was considered as useful to improve the understanding of the long-range transport of air pollutants in Asia. While the Phase I focused exclusively on sulfur compounds, it was recognized that a wider perspective could yield important insights including nitrogen compounds, ozone and aerosols to be critical for effective control of various environmental problems. Through the interpolation of Phase I activities and discussions among participants, MICS-Asia Phase II has been conducted since 2003. Participating modeling teams were requested to use standard input data and to provide their model results in common domain and periods shown in Table 1 to undertake the following analyses;

[Analytical framework]

- Spatial distribution of monthly averaged concentrations for 13 species: SO_2, NO, NO_2, HNO_3, PAN, NH_3, O_3, sulfate, nitrate, ammonium, SO_4^{2-} in precipitation, NO_3^- in precipitation and NH_4^+ in precipitation, in the layer including the height of near surface, 300, 1500, 3000 and 6000 meters above ground level.

- Horizontal distribution of monthly averaged dry and wet depositions. 7 species: SO_2, HNO_3, NH_3, O_3, sulfate, nitrate and ammonium were selected as targets for dry deposition analysis including the discussion on deposition velocities. And 3 species: SO_4^{2-}, NO_3^- and NH_4^+ were selected as targets for wet deposition analysis.

- Spatial distribution of monthly averaged meteorological fields in the 5 layers.

- Comparison between model results and EANET monitoring data for 7 species: SO_2, NO, NO_2, HNO_3, O_3, sulfate and nitrate. Detailed comparison between simulation and monitoring was made at selected sites on monthly and daily basis.

- Comparisons with special events, which were Trace-P and other monitoring activities.

EANET monitoring data were used for the model validation. Finally, 9 modeling groups shown in Table 2 submitted their model results in the Phase II project. It was decided at the 6th workshop (February 2004, IIASA) that the outcomes of Phase II activities would be summarized as 5 kinds of topics by Working Group members as follows;

- Over view : Prof. Carmichael (Iowa Univ., U.S.)
- Ozone and its relevant gases : Dr. Z. Han (ADORC, Japan)
- Aerosols : Dr. H. Hayami (CRIEPI, Japan)
- Depositions : Prof. Z. Wang (IAP, China)
- Relationship with global model : Dr. T. Holloway (Univ. of Wisconsin-Madison, U.S.)

In the 8th workshop (January 2006, IIASA), working group members gave presentations about their progress, and fruitful discussions were made with useful comments and suggestions from other MICS participants in order to develop the contents of the papers. In addition to the five papers above, it was decided at the workshop that further scientific papers would be prepared by cooperation of MICS participants. New topics of analysis and the persons in charge were as follows:

- Emission Intercomparison : Dr. A. Kannari (Freelance, Japan)
- Sensitivity to aerosol modules : Dr. K. Saltelet (CEREA, France)
- CMAQ comparison : Prof. J. Fu (Univ. of Tennessee, U.S.)

As a result, a special section contained by eight kinds of scientific papers will be published within 2007 in the journal of Atmospheric Environment. Further details of the activities in MICS-Asia Phase II are described in its web site.

Table 1 Framework for the simulation in MICS-Asia Phase II

	Conditions for simulation
Domain	15S-60N, 75E-160E
Grid size	0.5 by 0.5 degree
Prepared emission data	SO_2, NOx, CO, CO_2, PM10, PM2.5, BC, OC, NH_3, CH_4, isoprene, terpene, VOCs (anthropogenic, biomass, natural and volcano sources)
Boundary conditions	Calculated by MOZART-2 (1)
Meteorological fields	Calculated by MM5 (2)
Period	March, July and December 2001 and March 2002

(1) Model for OZone And Related chemical Tracers version 2

(2) the fifth-generation Mesoscale Model of non-hydrostatic version

Table 2 Participating modeling teams of MICS-Asia Phase II

Modeling teams	
Prof. G. Carmichael and Dr. N. Thongboonchoo	CGRER(1), Iowa Univ., USA
Dr. M. Engardt and Dr. C. Bennet	SMHI(2), Sweden
Prof. J. Fu	Tennessee Univ., USA
Dr. C. Fung and Dr. A. Chang	Hong Kong EPD(3), China
Dr. Z. Han and Dr. Sakurai	ADORC, Japan
Dr. H. Hayami	CRIEPI(4), Japan
Dr. M. Kajino and Prof. H. Ueda	DPRI(5), Kyoto Univ., Japan
Dr. K. Sartelet	CEREA(6), France
Prof. Soon-Ung Park	Seoul National Univ., Korea

(1) Center for Global and Regional Environmental Research
(2) Swedish Meteorological and Hydrological Institute
(3) Hong Kong Environmental Protection Department
(4) Central Research Institute of Electric Power Industry
(5) Disaster Prevention Research Institute
(6) Centre d'Enseignement et de Recherche en Environnement Atmospherique

3. Expected outcomes for modeling in the Strategy on EANET Development

As is evident from the activities in MICS-Asia, CTMs can evaluate various outcomes, such as (i) spatial distribution analysis, (ii) episode analysis of high concentration phenomenon, (iii) trace analysis, (iv) source-receptor relationship analysis, and (v) future forecast based on scenario analysis for key species for acid deposition, regional health and ecosystem protection. However, feasibility studies are important to develop a better common understanding of the performance and uncertainties of CTMs in Asian applications as a first step. In this context, the Strategy on EANET Development includes the following activities to be under taken for the present;

- *Promotion of inter-comparison studies and validation of existing models on acid deposition in East Asia*
  - Recommendation on improvement of regional atmospheric transport/chemistry/deposition models (**2007-2010**)
  - Support to initiatives of participating countries on atmospheric modeling and its application (**2007-2010**)

- *Discussion on promotion of modeling activities and emission inventories*
  - Proposals on promotion of modeling activities and emission inventories (**2007-2008**)

- *Promotion of capacity building for model application on urban, national and regional scale*
  - Designation of suitable standard models of each scale for research/training application (**2007**)
  - Promotion of the training courses on application of the standard models including cooperation with other organizations (**2006-2010**)

4. Discussion on the procedure for the promotion of modeling activities in EANET

The expected outcomes in the Strategy on EANET Development are regarded as a promotion of feasibility study or capacity building to be undertaken in advance of the concrete researches by CTMs within EANET. In conclusion, the following procedure can be proposed to achieve the expected outcomes;

1. Preparation of opportunities to have a discussion for model intercomparison and improvement of models,

2. Designation of suitable standard models for research/training application,

3. Support of participating countries regarding their initiatives and promotion of the training courses,

4. Discussion on necessary researches by means of CTMs in EANET.

The experiences obtained in MICS-Asia can be applied to the execution of above procedure. In addition, if the emission inventories are developed in EANET, emission comparison study can be planned between EANET and MICS-Asia. Also evaluation based on the plural models and emission data can be persuasive for the development of the environmental policy. Thus, it is important to continue to support MICS-Asia and obtain contributions from its activities by a closer collaboration.

There are various activities regarding modeling conducted by participating countries, such as LTP Project coordinated by Republic of Korea, JICA third country training on emission and model in Thailand, and modeling and emission studies in Viet Nam. It is also important to support and create closer collaboration with those activities to consider the promotion of modeling activities in EANET. Thus, as a body to have discussions on the promotion of modeling activities and emission inventories, NC suggests establishing "**Ad Hoc Group on the promotion of modeling activities and emission inventories**" in order to enable SAC members to be informed and consulted regarding activities related to the promotion within EANET.