B. Overview

B-1. Overview of the project[1]

The potential risk of high-impact weather in Southeast Asia is increasing because of economic development and urbanization. Global warming and other types of climate change may become another factor that increases the risk. The change in the research environment due to the rapid growth of computer power and Internet infrastructure has enabled us to start an international research project for prevention and mitigation of meteorological disasters in Southeast Asia. Regional mesoscale models now can be run on personal computers to perform downscaling numerical weather prediction (NWP). Data transfer on the Internet has become fast enough to perform near-real-time NWPs. Making use of the probability information obtained by ensemble NWPs is a challenge for the development of decision support tools, and assessments of the impact of new observational data on the improvement of NWPs with advanced data assimilation schemes are also an important topic.

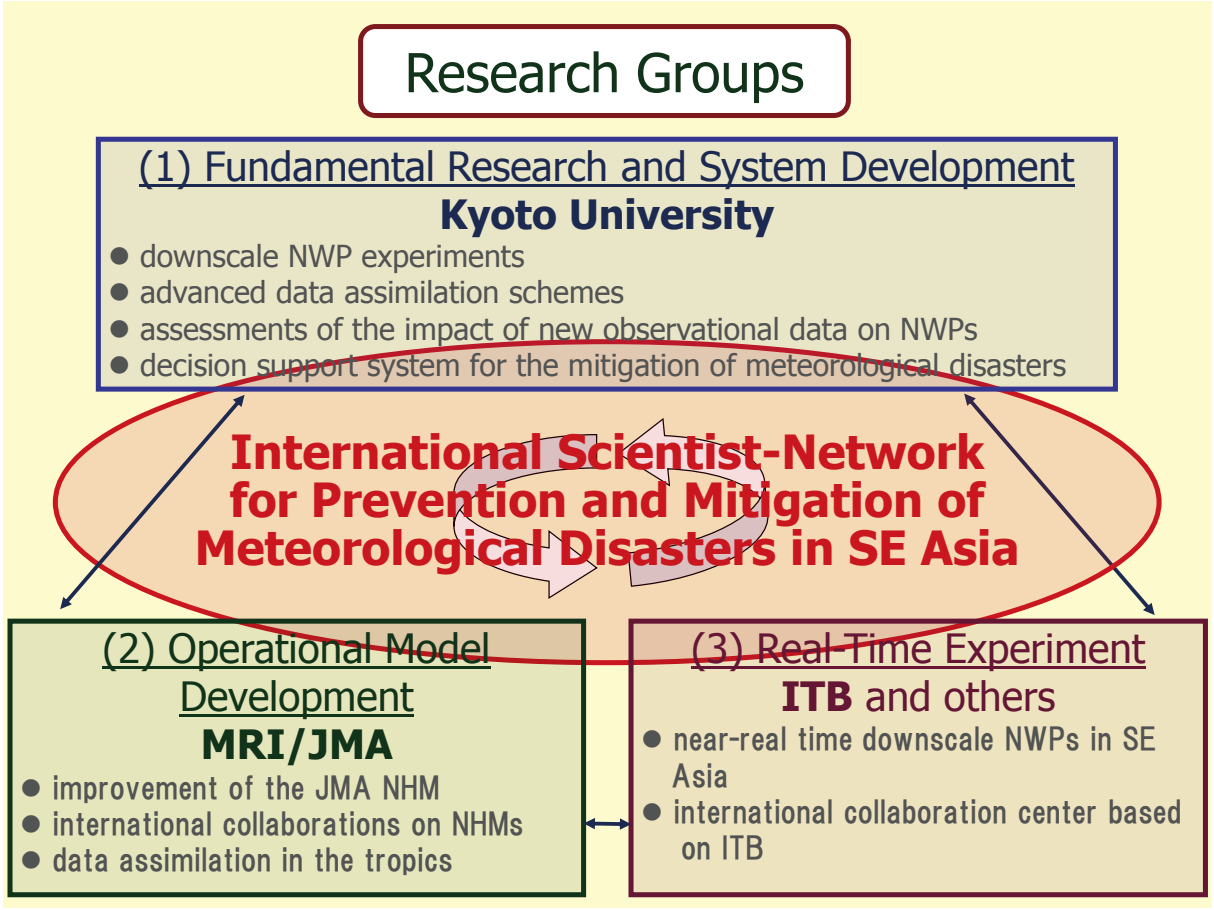

Fig. B-1-1. Three institutes and their roles in the IRPMMDSA project.

In 2007, we started the project "International Research for Prevention and Mitigation of Meteorological Disasters in Southeast Asia (IRPMMDSA)" under the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Special Coordination Funds for Promoting Science and Technology, supported for fiscal years 2007-2009 by the Asia S & T Strategic Cooperation Program (http://www-mete. kugi.kyoto-u.ac.jp/project/MEXT/). This project addressed three main subjects:

[1] S. Yoden and S. Otsuka

(1) Experimental downscale NWP in the tropics with regional mesoscale models

(2) Assessments of the impact of new observational data on NWPs with advanced data assimilation schemes

(3) Development of a unified database and decision support system for prevention and mitigation of meteorological disasters

The three main participants in this international research project were Kyoto University, Meteorological Research Institute (MRI) of the Japan Meteorological Agency (JMA), and Institut Technologi Bandung (ITB) in Indonesia. Figure B-1-1 shows the roles of the participants of this project. Fundamental research and system development was conducted at Kyoto University, and operational model development was conducted at MRI/JMA. Real-time experiments were performed at ITB and other institutes in Hong Kong, India, Singapore, and Vietnam. Our main purpose was to establish the international scientist-network for prevention and mitigation of meteorological disasters in Southeast Asia through research and development of downscaling NWP systems and by holding annual international workshops.

B-2. Overview of MRI's contribution[1]

As a major participating institution in Japan, MRI was responsible for NWP model development and application. This task consisted of three components:

(1) Refinement of the JMA nonhydrostatic model (NHM) and development of mesoscale ensemble prediction techniques for tropical areas

(2) Preparation of tools for numerical experimentations using NHM and collaborative studies to share information on tropical NWP

(3) Development of data assimilation systems in tropical areas and refinement of initialization schemes for tropical cyclones

In the first component, to apply NHM to research on prediction of disastrous meteorological phenomena in the tropics, case studies were conducted with downscale prediction (Sections C-3 and C-4) and statistical verifications of forecast accuracy including intercomparison of NHM and the Weather Research Forecasting (WRF) model (Sections C-1 and C-2). A mesoscale ensemble prediction technique for tropical cyclones also was developed.

In the second component, tools were prepared for numerical experimentations with NHM using the JMA global analysis, the global model forecast, and the JMA one-week global ensemble forecast (Section E-3). An English tutorial on the use of NHM tools was uploaded on the MRI's project website (Section G-5). Exchanges of information and mutual visits of researchers (Section G-3) were conducted in addition to participation in international workshops (Section G-1) organized by Kyoto University.

In May 2008, cyclone Nargis hit southern Myanmar and claimed more than 100,000 lives there in one of the largest meteorological disasters in Southeast Asia, mainly due to the storm surge. We conducted numerical modeling studies of this event. First, we conducted a downscale forecast experiment using NHM with a horizontal resolution of 10 km, employing the JMA global analysis and the global model forecast as the initial and boundary conditions. The track and the rapid development of Nargis were predicted, and the predictability of Nargis' storm surge with a lead time of two days was demonstrated (Section D-1). Next, we developed a mesoscale ensemble prediction system using NHM in the tropics that employs perturbations from the JMA one-week global ensemble forecast, and conducted ensemble predictions of the storm surge considering uncertainty in the forecast of Nargis' track and intensity (Section D-3). Results of this ensemble forecast were used as input data for the decision support system developed by Kyoto University (Section F-1).

In the third component, we conducted data assimilation experiments by modifying the JMA Meso 4D-VAR system to apply to tropical areas. A tropical cyclone (TC) bogus procedure was developed for the Bay of Bengal, and the impact on TC forecasts was investigated (Section D-4). Near real time analysis of precipitable water vapor using the international ground based GPS network around the Bay of Bengal was performed to show its positive impact on the Nargis forecast (Section D-5). A trial of assimilation of QuikSCAT Sea Winds data by the local ensemble transform Kalman filter was also

[1] K. Saito

conducted (Section D-2). Sections D-6 and D-7 describe studies on structures of TC relating to bogus techniques. Similar to the Nargis case, the largest meteorological disaster in Japan resulted from the storm surge of Typhoon Vera in 1959. A reanalysis experiment on Vera using a nonhydrostatic mesoscale 4D-VAR system, conducted in a special research project of JMA (ReVera), is described in Section D-8 for reference.

The researchers' network is a valuable achievement of our project. Collaborations among MRI, Kyoto University and institutions in Southeast Asia are continuing after the project period.