



## **Project Atmospheric Brown Clouds (ABC)**

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**Second  
International Training School on Atmospheric Brown Clouds (ABC)**

4-14 December 2006

[Bangkok (Thailand) and Hanimaadhoo (Maldives)]

**Bangkok, Thailand**

**Feb 2007**

**Table of Contents**

<b>1. Background</b>	3
<b>2. Announcement</b>	3
<b>3. Coordinators/Organizers</b>	3
<b>4. Participants</b>	3
4.1 Trainees	3
4.2 Resource Persons	4
<b>5. Program</b>	5
5.1 Course Lectures in Bangkok	5
5.2 Hands-on Training at MCO-H	7
5.2.1 Activities at MCO-H	7
<b>6. Evaluation</b>	9
<b>7. Certificate of Participation</b>	9
<b>8. Recommendations</b>	10

**Annexes**

Annex 1: List of Participants

Annex 2: List of Resource Persons

Annex 3: Summary of Evaluation

**1. Background**

Project Atmospheric Brown Clouds (ABC) is a concerted effort of UNEP, a group of distinguished atmospheric scientists and researchers led by Prof. V. Ramanathan, governments in Asia, and research institutions in Asia, Europe and the United States to address the causes and impacts of occurrence of atmospheric brown clouds (ABC) in the Asia-Pacific region, a major environmental challenge facing the region. The project ABC has three major programs; observatory program, impact assessment program, and awareness and mitigation program.

The regional capacity building, which is one of its important components of the project ABC, aims at enabling the scientists and researchers in the Asia-Pacific region to study the science and potential impacts of atmospheric brown clouds (ABC) in the region through the development of necessary physical infrastructure and training young scientists and researchers in the field of atmospheric science. In order to enhance the knowledge in atmospheric science of the young researchers and senior students from the region and encourage/enable their participation in all components of the project from the beginning of the implementation of the project, the Project ABC has been organizing the International Training School on Atmospheric Brown Clouds on a regular basis. The first training school was organized in October 2004 with active participation of 15 participants from 7 countries in Asia.

As a part of the ongoing capacity building activities of the Project ABC, the **Second International Training School on Atmospheric Brown Clouds (ABC)** was organized during 4-14 December 2006 with the financial support from National Science Foundation (NSF), National Oceanic and Atmospheric Administration (NOAA), USA, and Swedish International Development Cooperation Agency (Sida), Sweden.

The summary of the training school is presented here. The report was prepared by the UNEP and the Course Directors for the ABC Training School.

## **2. Announcement**

The ABC Training School was announced in the UNEP Regional Resource Centre for Asia and the Pacific (UNEP-RRCAP) website in July 2006, in the UCSD ABC homepage, and also distributed through ABC Science Team's e-mail contacts and the meetings organized or participated by UNEP.

## **3. Coordinators/Organizers**

With the recommendations from ST Chair (Prof. V. Ramanathan) and Vice-Chair (Prof. Henning Rodhe), a working group was set up consisting of two course directors and organizers from UNEP and C4. Prof. K.-R Kim and Dr. Mark Lawrence, who are the members of the ABC Science Team, acted as Course Directors.

## **4. Participants**

### **4.1 Trainees**

More than 70 applications were received from young and enthusiastic researchers, post doctoral researchers and graduate students involved in atmospheric studies in 18 countries.

The course directors, with the important advises from ST Chair and Vice Chair, ranked all applicants based on merits such as their level of education, involvement in ABC activities in their home country, involvement in atmospheric research activities, their potential to be involved with ABC in future and continue research in atmospheric studies. From the pool of the applications received, the participants for the training school were selected based on these merits while maintaining a balance in the geographical and demographic distribution. A total of 25 participants (10 female and 15 male) from 11 countries, mostly from Asia were selected. The list of selected candidates who participated in the training school is given below. The detail of the participants is presented in Annex 1.

1.	Dr. Abdus Salam,	BANGLADESH
2.	Ms. Mingxia Ji,	CHINA
3.	Mr. Xin Wang,	CHINA
4.	Mr. Krishna K. Budhavant,	INDIA
5.	Dr.(Ms.) B. Padma Kumari,	INDIA
6.	Dr. A.N.V. Satyanarayana,	INDIA
7.	Mr. Shivraj Sahai,	INDIA
8.	Ms. Maria E. Vuillermoz,	ITALY
9.	Dr. (Ms.) Angela Marinoni,	ITALY
10.	Mr. Ahmed Muslim,	THE MALDIVES
11.	Mr. Yazeed Ahmed,	THE MALDIVES
12.	Mr. Ahmed Saleem,	THE MALDIVES
13.	Mr. Sharfulla Thoaha,	THE MALDIVES
14.	Mr. Faruhad Moosa,	THE MALDIVES
15.	Mr. Pradeep Dangol,	NEPAL
16.	Mr. M. Athar Haroon,	PAKISTAN
17.	Ms. Seung Yeon Kim,	REPUBLIC of KOREA
18.	Ms. In-Jin Choi,	REPUBLIC of KOREA
19.	Mr. Akkaneewut Chabangborn,	THAILAND
20.	Mr. Thawatchai Sudjai,	THAILAND
21.	Ms. Boosarasiri Thana,	THAILAND
22.	Dr. Daam Settachan,	THAILAND
23.	Ms. Patricia Castellanos,	UNITED STATES
24.	Ms. Kathleen A. Mar,	UNITED STATES
25.	Ms. Tuyet Mai Tran Thi,	VIETNAM

#### 4.2 Resource Persons

There were 16 resource persons including ST Chair, Vice Chair, ST Members and other prominent scientists from Asia, Europe and USA. The list is given below, and the detail is presented in Annex 2.

1.	Dr. M. Lawrence,	Max-Planck Institute for Chemistry, GERMANY
2.	Dr. U. Poeschl,	Max-Planck Institute for Chemistry, GERMANY
3.	Dr. D. Sikka,	New Delhi, INDIA
4.	Dr. N. Kalra,	IARI, INDIA
5.	Prof. T. Nakajima,	University of Tokyo, JAPAN
6.	Prof. K. -R. Kim,	Seoul National University, Rep. KOREA
7.	Mr. P. Siva,	Maldives Climate Observatory at Hanimaadhoo, MALDIVES

8. Dr. B. Rajasekhar, University of Singapore, SINGAPORE
9. Prof. H. Rodhe, University of Stockholm, SWEDEN
10. Dr. H. Garivait, Env. Research and Training Center (ERTC), THAILAND
11. Dr. V. Surapipith, Pollution Control Department, THAILAND
12. Dr. M. Rupakheti, UNEP RRC.AP, THAILAND
13. Dr. D. -Y. Kim, Center for Cloud, Chemistry and Climate (C<sup>4</sup>), UCSD, USA
14. Dr. M. Ramana, Center for Cloud, Chemistry and Climate (C<sup>4</sup>), UCSD, USA
15. Prof. V. Ramanathan, Center for Cloud, Chemistry and Climate (C<sup>4</sup>) UCSD, USA
16. Prof. J. J. Schauer, University of Wisconsin, USA

## 5. Program

The training school was aimed at

1. providing the participants with the theoretical background and overview of current knowledge in atmospheric science as a basis for helping them to interpret the measurements they will be making within ABC,
2. familiarizing the participants through hands-on training with the operation and functionality of the instruments for ABC monitoring and research.

In order to achieve these objectives the training school was divided into two parts:

1. A first week (4-8 Dec.) of intense lectures on atmospheric issues and discussion sessions at UNEP Regional Resource Center for Asia and the Pacific (RRC.AP) at Asian Institute of Technology, Bangkok.
2. A second week (10-14 Dec.) of hands-on training at the Maldives Climate Observatory at Hanimaadhoo (MCOH), an ABC super observatory.

### 5.1 Course Lectures in Bangkok

Most of the lectures were of 1.5 hour long with about 15 min for discussion and interaction with the lecturer, and among the participants. There were two video lectures. The hard copies of reading materials and lecture notes provided by some lecturers were also distributed to the trainees. Despite our attempt to collect lecture notes before the school began, it was not successful as most of the lecturers didn't provide the material before the deadline given to them to submit the teaching materials; this is likely to have in part been due to the tight schedule for selecting and confirming lecturers and for them to prepare their lectures before the school, which can hopefully be improved on with a longer planning period prior to the next training school.

The following lectures were delivered. The detail of these lectures is available in electronic format (compiled in a CD).

#### **4 December**

- Lecture 1: Overview of the climate system [*Prof. V. Ramanathan*]  
 Lecture 2: Industrial ecology and sustainable development [*Dr. Bala Rajasekhar*]  
 Lecture 3: Is global warming man-made? A story of the Keeling curve [*Prof. K. R. Kim*]

**5 December**

- Lecture 4: Recent developments on GHG monitoring (CO<sub>2</sub> and man-made compounds), GHG activities in ABC [*Prof. K. R. Kim*]
- Lecture 5: Introduction to atmospheric gas and aerosol Chemistry [*Prof. James J. Schauer*]
- Lecture 6: Overview of in-situ measurement techniques (especially recent advances) for aerosol research [*Prof. James J. Schauer*]



Course Lecturers and Trainees at UNEP RRC.AP, Bangkok

**6 December**

- Lecture 7: Aerosol optical properties and radiative forcing over the Asian region [*Dr. D. Y. Kim* (Video lecture)]
- Lecture 8: Aerosol impacts on the Earth's climate examined using satellite remote sensing and a climate model [*Prof. Teruyuki Nakajima*]
- Lecture 9: Aerosol chemical and optical properties [*Dr. Ulrich Pöschl* (Video lecture)]
- Lecture 10: Impact of pollution on crops [*Dr. Naveen Kalra*]

**7 December**

- Lecture 11: The Asian Monsoon and its variability in relation to atmospheric aerosols, and insights into the role aerosols may play in the agriculture of South Asia [*Dr. Dev Raj Sikka*]
- Lecture 12: ABC-Asia: Air pollution, brown clouds and climate change [*Prof. V. Ramanathan*]

- Lecture 13: Regional Modelling and Emissions Dataset Development for Southern Asia [Dr. Vanisa Surapipith]  
 Lecture 14: Transport of pollutants in the tropical troposphere [Dr. Mark Lawrence]

### **8 December**

- Lecture 15: Wet and dry deposition processes: Impacts on material, crops and natural ecosystems [Prof. Henning Rodhe]  
 Lecture 16: Principles of precipitation chemistry analysis and results from a study of possible acidification in Thailand [Dr. Hathairatana Garivait]  
 Lecture 17: Field measurements and laboratory investigations of particulate matter and trace metals [Dr. Bala Rajasekhar]  
 Lecture 18: Outlook: Difficulties in understanding and modeling tropical convection and wet deposition [Dr. Mark Lawrence]

## **5.2 Hands-on training in Hanimaadhoo**

The hands-on training part was conducted from 10 to 14 December at Maldives Climate Observatory at Hanimaadhoo, Maldives. The overall scientific coordination for the training part was provided by Prof. K.-R. Kim and Dr. Maheswar Rupakheti, while the supervision of the instruments and training was provided by Dr. Muvva Ramana, Mr. Praveen Siva and Dr. Maheswar Rupakheti. The training part was divided into 4 courses as follows, and thus participants were also divided into 4 smaller groups accordingly such that and each group gets an opportunity work with each set of instruments for a day. They were rotated so that all were exposed to all MCOH instruments.

- Course 1: Aerosol physical properties (Total particle number counts with CPC, Fine particle number size distribution with SMPS, Coarse particle size distribution with APS, and inlet systems) [Dr. Maheswar Rupakheti]  
 Course 2: Aerosol optical properties (Absorption coefficients and Black Carbon concentration with Aethalometer, Scattering coefficient with Nephelometer) [Praveen Siva]  
 Course 3: Solar radiation fluxes (Direct, Diffuse and Global solar radiation instruments, Net radiation in NIR) [Dr. Muvva V. Ramana]  
 Course 4: Radiation fluxes and aerosol optical depths (AOD) (Narrow band radiometer, CIMEL sunphotometer, Microtops sunphotometer) [Dr. Muvva Ramana]

### **5.2.1 Activities at MOC-H**

The instructors introduced various instruments to the trainees and provided with the working principles and parameters measured with those instruments. They were instructed on the step-by-step procedure for the data analysis, including the quality check, and interpretation of the analysis. They were then given hands-on training and demonstration in operating and collecting data from a variety of state-of-the-art instruments for radiation, aerosol, precipitation and meteorological measurements.

The trainees collected the data with various instruments and analyzed the data. At the end of the day each group presented their data, data analysis and interpretation of the data and possible science behind the variation of various parameters. The participants were able to measure aerosol total number concentrations with CPC, aerosol number size distributions

with SMPS and APS, aerosol optical properties i.e. scattering coefficients with Nephelometer and absorption coefficients with Aethelometer, aerosol optical depth (AOD) with CIMEL sunphotometer, AOD, column ozone and water vapor concentrations with Microtops sun-photometer, global, direct and diffuse fluxes in the short and long-wave bands with pyranometers, pyrheliometers, and Meteorological observations. They were able to compute parameters such as single scattering albedo, Angstrom coefficient, and radiative forcing.



The participants listening to an instructor at MCOH





### Training Instructors and Trainees at MCO-H, Maldives

The participants also learned to interpret their results with the aid of other simultaneously measured parameters. Every participant was given a chance to present the data analysis result. At the end of the program, they were given a chance to present their research activities, and asked how they could benefit from the training school or link their research with ABC activities. Overall, everyone participated actively, and it was very encouraging to see their eagerness to work with the instruments, collect data, analyze and interpret them. Prof. Kim provided a brief but motivating history and science of stratospheric ozone depletion, and he concluded the training at MOC-H.

## 6. Evaluation

UNEP carried out an evaluation of the both parts of the training school by the participants. The evaluation session at the RRC.AP for the teaching part was attended by Mr. Surendra Shrestha, the UNEP Regional Director for Asia and the Pacific. The evaluation questionnaire was prepared by UNEP in consultation with the course directors; Prof. K.-R. Kim and Dr. Mark Lawrence.

Overall, 47% of the participants rated the teaching part in Bangkok as excellent while remaining 42% rated it as good. Likewise, 44% rated the training part at MCO-H as excellent while 50% rated it as good. None of the participants rated either part as unsatisfactory or as poor. The evaluation questionnaire and its detailed analysis including the comments from the participants is presented in Annex 3.

## 7. Certificate of Participation

UNEP issued the certificate of participation to all participants who completed the training school successfully. The sample of the certificate is shown below.



## **8. Recommendations**

Based upon the experience during the training school and the comments from the participants the following points may be considered to improve the organization of training school and make it more effective in achieving its objectives.

- Provide the hard copies of all lecture notes and reading reference materials at the beginning of the training school.
- Given the composition of participants with a wide range of qualification and experience, it will be more appropriate to provide them a refresher course for a day or two with the content designed to include the fundamental aspects of atmospheric science and climate science, including the important terminologies. For this point, it should be noted, however, that travel and availability constraints of the lecturers may make this only partly possible.
- Provide a simple and step-by-step instruction (hard copy) for the operation of various instruments and data analysis procedures.

**Annex 1****LIST OF PARTICIPANTS****Second International Training School on Atmospheric Brown Clouds (ABC)**

4-14 December 2006 in Bangkok (Thailand) and Hanimaadhoo, Maldives

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Note: Ms. Thana and Dr. Settachan attended only the teaching part in Bangkok, and three technicians at MCO-H from the Department of Meteorology, Maldives (Mr. Saleem, Mr. Thoaha, and Mr. Moosa) participated in only the training part at MCO-H. Mr. Tongchai Kanabkaew from Asian Institute of Technology (AIT) participated in the teaching part in Bangkok as an observer.

**Annex 2****LIST OF RESOURCE PERSONS**

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2. Prof. Henning **Rodhe**

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### Annex 3

#### Summary of the Evaluation

1. How did you know about the training school?  
UNEP website, forwarded by UNEP to governments, personal communication with UNEP staff, supervisors/Professors, e-mail announcements in the institute, colleagues, scientific community.

The participants responded to the following questions with rank score from 1 through 5, where, 1 = *not at all*, 2 = *a little*, 3 = *somewhat*, 4 = *mostly*, 5 = *completely*. The table shows the percentage of responses to the individual question. The numbers without parentheses represent the evaluation of the teaching part in Bangkok while those in the parentheses represent the evaluation for training part in Hanimaadhoo.

<i>Overall Objective and Content</i>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
2	Were the objectives clear and precise?	0 (0)	0 (0)	5 (6)	<b>60</b> (31)	35 ( <b>63</b> )
3	Were the objectives attained?	0 (0)	0 (0)	10 (12)	<b>70</b> ( <b>50</b> )	2 (38)
4	Was the content well structured?	0 (0)	0 (0)	25 (6)	<b>65</b> ( <b>63</b> )	10 (31)
5	Was the content linked to the objectives?	0 (0)	0 (0)	5 (0)	<b>65</b> (37)	30 ( <b>63</b> )
6	Was the content presented clearly?	0 (0)	0 (0)	15 (12)	<b>70</b> ( <b>50</b> )	15 (38)
<i>Methodology</i>						
7	Was the method used appropriate for the training program and you as a professional?	0 (0)	0 (0)	25 (6)	<b>55</b> ( <b>63</b> )	20 (31)
8	Did the methodology help you to share your own knowledge and experience?	0 (0)	0 (0)	25 (12)	<b>60</b> ( <b>59</b> )	15 (29)
9	Did the instructors teach course effectively?	0 (0)	5 (0)	0 (0)	<b>70</b> (33)	25 ( <b>67</b> )
10	Was the level of the material too difficult?	25 ( <b>50</b> )	<b>35</b> (14)	20 (25)	20 (12)	0 (0)
11	Was much of the material irrelevant or uninteresting to you?	<b>37</b> ( <b>53</b> )	9 (20)	18 (20)	36 (7)	0 (0)
12	Were the visual aids (e.g., power point presentation) clear and easy to follow?	0 (0)	0 (0)	11 (0)	42 (44)	<b>47</b> ( <b>56</b> )
<i>Logistics</i>						
13	Was the training venue adequate?	0 (0)	0(0)	5 (6)	40 (44)	<b>55</b> ( <b>50</b> )
14	Was the timing of the agenda comfortable?	0 (0)	6(6)	20 (13)	<b>50</b> ( <b>44</b> )	30 (38)
15	Was the length of the sessions appropriate?	0 (0)	10 (12)	25 (25)	<b>50</b> ( <b>50</b> )	15 (13)

16. Overall, how would you rate the training school?

Bangkok: Excellent: **47%**, Good: 42%, Average: 11%, Unsatisfactory: 0%, and Poor: 0%.  
Hanimaadhoo: Excellent: 44%, Good: **50%**, Average: 6%, Unsatisfactory: 0%, and Poor: 0%.

### Comments/feedbacks for Teaching part in Bangkok

17. What did you consider the best part and worst part of the training?

Best part: Good lectures and lecturers, expertise, Prof. Ramanathan's lecture, contact with scientists, learning about atmospheric science, science issues, aerosol measurement methods and aerosol chemistry, lots of topics covered, improved knowledge.

Worst Part: Mostly NO, food, modeling theory, reading material, short time for interaction with lecturers, emission inventory, video lectures, long breaks.



18. How would you improve the training or make it more interesting?  
Teach slowly, more interaction with lecturers, theoretical teaching and training on instruments at the same place, organize mini poster session where students can present their research, provide 15 min each to present participants' research at the beginning of the school, provide more case studies, provide some practical assignments or exercises, mention in the lectures which instruments used to measure various parameters such as scattering/absorption coefficients, more emphasis on ABC-centric aspects, send the topics to be covered to participants before they come to the training school.
19. How could the training materials be improved?  
Start with basics/background in atmospheric science related to the lecture, make available the hard copy of the lecture notes/training materials at the beginning of the school, provide more reading material, distribute CD of the lecture notes and reference materials, do not use the video lectures as they are sometimes difficult to follow,
20. How will the training help you in future job?  
Decide my goals, contact and networking with scientists, help increase knowledge in aerosol effects, help understand the real problem related to ABC, gain in theoretical knowledge, developed skill in aerosol measurement, got a big picture of understanding where my research can fit in, useful for future involvement in ABC activities, will share knowledge with my students, gained knowledge in new areas, got big picture of ABC.

#### **Comments/feedbacks for Training in Hanimaadhoo**

17. What did you consider the best part and worst part of the training?  
Best part: to work with the instruments and the data analysis, good lectures, interaction of instructors with the participants, working with other participants, hands-on training, sunphotometer and AOD, radiation and size distribution  
Worst part: mostly NO, not enough time to work with instruments, less time for interaction with instructors, rain water sampling and filtration, travel schedule.
18. How would you improve the training or make it more interesting?  
Provide the hard copies of the training materials/manuals before the lectures, give more time to work with individual instruments, provide the posters of each instruments with specifications, methodology of use and working principles, more interaction with instructors and trainees as well as among trainees, use black board to explain the things, direct operation of instruments, give some background lectures on basics of atmospheric science, the speaker should speak slowly, provide meteorological data with other data that aids to the interpretation of the data analysis.
19. How could the training materials be improved?  
Provide the hard copy of the training material/presentation before the lecture, provide more information on instruments,
20. How will the training help you in future job?  
Operate instruments smoothly, generate quality data and analysis, confidence in setting and running observatory, useful orientation for current/future research and setting up research goals, use aerosol/radiation information in modeling.