



Project Atmospheric Brown Clouds (ABC)

Annual Report

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List of Abbreviations

ABC	Atmospheric Brown Clouds
EAREX	East Asian Regional Experiment
AIT	Asian Institute of Technology
APMEX	ABC Post Monsoon Experiment
C ⁴ /SIO	Center for Clouds, Chemistry and Climate/Scripps Institution of Oceanography
CAS	Chinese Academy of Science
CCSR	Center for Climate System Research, University of Tokyo
CSD-14	Fourteenth Session of the Commission on Sustainable Development
Ev-K ² -CNR	International High Altitude Research Project
FRCGC	Frontier Research Center for Global Change, Japan
IARI	Indian Agricultural Research Institute
ICIMOD	International Centre for Integrated Mountain Development
IICT	Indian Institute of Chemical Technology
IITM	Indian Institute of Tropical Meteorology
INDOEX	Indian Ocean Experiment
IRRI	International Rice Research Institute
ISD	Tongji Institute of Sustainable Development,
LFA	Logical Framework Analysis
MISU	Department of Meteorology at Stockholm University
NIES	National Institute for Environmental Studies, Japan
NPL	National Physical Laboratory, India
RAPIDC	Regional Air Pollution in Developing Countries
RRC.AP	Regional Resource Centre for Asia and the Pacific
Sida	Swedish International Development Co-operation Agency
TERI	The Energy and Resources Institute
UNEP	United Nations Environment Programme
WHO	World Health Organization
WMO	World Meteorological Organization

Executive Summary

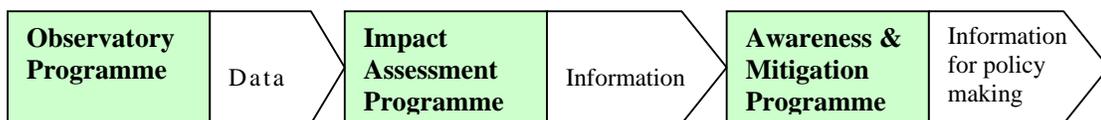
Air pollution containing aerosol particles emitted from anthropogenic sources such as fossil fuel and bio-fuel combustions and natural source like biomass burning, and associated long-range transport lead to widespread layers of brownish haze, referred to as Atmospheric Brown Clouds (ABC). The atmospheric brown clouds hovering over a large area in continental South Asia and Indian Ocean was first discovered by the INDOEX (Indian Ocean Experiment). The pollution haze, which is a major emerging environmental issue, occurs frequently in all other heavily inhabited regions and downwind. It is a transboundary, trans-continental and trans-oceanic phenomenon. ABC can reduce the amount of solar energy that can reach the Earth's surface and hence influence the Earth's energy budget. The reduction in sunlight can have significant direct and indirect implications to regional climate, temperature, precipitation cycle and patterns, agriculture, human health as well as the terrestrial and marine ecosystems.

In collaboration with the INDOEX scientists, UNEP commissioned a report in 2001 on the preliminary assessment of the extent and possible impacts of ABC in Asia. In order to better understand the extent of ABC and its impacts, UNEP has established a project titled **Atmospheric Brown Clouds (ABC)-Asia** in 2002. It is a concerted effort of UNEP, an international group of prominent atmospheric scientists and researchers from Asia, Europe and the United States, the national governments in Asia, and development cooperation agencies.

Project ABC comprises of 3 major programmes:

- (i) Observatory programme,
- (ii) Impact assessment programme, and
- (iii) Awareness and mitigation programme.

The observatory programme aims to build the monitoring capacity, including the human resources, and data on ABC. The impact assessment programme aims to assess the potential impacts of ABC on agriculture, water budgets, and human health using the data from the observatory programme. Findings from the impact assessment programme will provide information for policy making through the programme on awareness and mitigation. The Logical Framework of the Project is provided in [Annex 1](#).



In November 2004, the Government of Sweden and the UNEP RRC.AP signed an agreement for the implementation of the project Atmospheric Brown Clouds (ABC)-Asia.

This second annual report consists of:

- a) introductory section covering the context and aspiration of Project ABC;
- b) progress over the year 2006; and
- c) proposed activities for the year 2007.

There is a section showing the completed reporting templates for each ABC activity, followed by a short section on the financial status of the project. The reporting template form follows the Logical Framework Analysis (LFA) structure of the ABC Proposal. Finally, there are a series of annexes detailing the minutes of important ABC meetings, financial report and other relevant information.

Overview Table of ABC Progress January – December 2006

LFA Output	LFA Activity	Progress of work plan and use of funds	Meetings/events in 2006	Proposed activities for 2007
1. Increased capacity to study ABC in the region	1.1 Conduct aerosol observatory programme together with capacity building activities	- On Schedule	<ul style="list-style-type: none"> - Climate and Aerosol Observatories are set up in Maldives, Nepal, and Thailand as stipulated in the MoUs; - Establishment of ABC-Pyramid station (a high altitude station) in the Himalaya, Nepal. - Maldives Autonomous unmanned aerial vehicle Campaign (MAC) conducted in Hanimaadhoo, Maldives in March 2006 (Annex 2). The technique was a first of its kind in atmospheric monitoring. - Assessment of seven ABC observatories [Maldives, Nepal, India (Pune and Kharagpur), Thailand, Korea and Japan] and capacity building (Annex 3). - Ad Hoc Science Team meeting held in Bangkok, Thailand on 6 December 2006 (Annex 4) - International Training School on Atmospheric Brown Clouds conducted in Bangkok and Hanimaadhoo during 4-14 December 2006 for 25 young researchers (Annex 5); - Global distribution of ABCs has been identified and the regional hotspots have been documented. 	<ul style="list-style-type: none"> - Continue operation of observatories - Establishment of Central ABC Data Archival System at UNEP RRC.AP. - Three-month Training Programme for scientists from Maldives. - In collaboration with Ev-K2-CNR, plan for the establishment of a high altitude Observatory in Karakoram mountain range in Pakistan - EAREX- 2007, a regional atmospheric field campaign to be conducted in east Asia in collaboration with American PACDEX. - WPAC-UAV, an international atmospheric characterization experiment in the eastern pacific with 9 UAVs (unmanned aerial vehicles), among other platforms. - Science Team meeting (s)
	1.2 Conduct precipitation and aerosol observatory programme together with capacity building activities	-On Schedule	<ul style="list-style-type: none"> - Installation of precipitation and aerosol samplers at 3 ABC sites (Hanimaadhoo, Sinhagad and Godavari) - Scientists from MISU and ICT visited those monitoring sites and completed installation, and monitoring activities at three sites are consolidated. - Generation of unique data on Black Carbon concentration in precipitation 	<ul style="list-style-type: none"> - Finalize the development and field tests of new method for sampling and analysis of soot in precipitation and aerosol - Plan for the establishment of a fourth monitoring site in the region, most likely at Kharagpur, India. - Continue analysis and interpretation of data

LFA Output	LFA Activity	Progress of work plan and use of funds	Meetings/events in 2006	Proposed activities for 2007
				with involvement of Asian scientists and students
2. Increased understanding of the impacts of ABC on health, agriculture, and water budgets.	2.1 Conduct impact assessment programme on human health	- On Schedule	<ul style="list-style-type: none"> - Chulabhorn Research Institute (CRI), Thailand has been selected as the lead regional institutions to lead the impact assessment study; and the MoU has been signed between CRI and UNEP RRC.AP. - Meeting of UNEP and CRI held in Bangkok in April discussed the TOR for conducting health impact study. - Meeting of Health Impact Study Group (HISG) held in Bangkok on 4 December 2006 (Annex 6). 	<ul style="list-style-type: none"> - Development of the draft report on the assessment of the impacts of ABC on human health. - Conduct 1-2 HISG meeting on human health impact assessment. - Complete a scientific report on the assessment of the impact of ABC on human health
	2.2 Conduct impact assessment programme on agriculture	-On Schedule	<ul style="list-style-type: none"> - Indian Agriculture Research Institute (IARI), India has been selected as the lead regional institutions to lead the agriculture impact assessment study; and the MoU has been signed between IARI and UNEP RRC.AP. - Meeting of UNEP, IARI and Science Team Chair held in Delhi in 3-4 August discussed the TOR for conducting agriculture impact study. - Meeting of Agriculture Impact Study Group (AISG) held in Bangkok in 5-6 December 2006 (Annex 7). 	<ul style="list-style-type: none"> - Development the draft report on the assessment of the impacts of ABC on agriculture. - Conduct 1-2 AISG meeting on agriculture impact assessment. - Complete a scientific report on the assessment of the impacts of ABC on agriculture
	2.3 Conduct impact assessment programme on water budget	-On Schedule	<ul style="list-style-type: none"> - Meeting of UNEP, NTU and ST Chair held in Singapore on 26 July discussed the TOR for conducting water impact study. - Meeting of UNEP, NTU, ST Chair, Vice Chair and some ST members held on 7 December 2006 discussed scope of the water impact assessment programme (Annex 8). - Nanyang Technological University (NTU), Singapore has been selected as the lead regional institutions to 	<ul style="list-style-type: none"> - Sign the MoU between NTU and UNEP for conducting the study on assessment of the impacts of ABC on water. - Development of the draft report on the assessment of the impacts of ABC on water budgets. - Conduct 1-2 water impact study group (WISG) meeting on water impact assessment.

LFA Output	LFA Activity	Progress of work plan and use of funds	Meetings/events in 2006	Proposed activities for 2007
			lead the water impact assessment study; and the MoU is being negotiated between IARI and UNEP.	- Complete a scientific report on the assessment of impacts of ABC on water budgets.
3. Knowledge concerning mitigation measures developed and effectively communicated to decision makers and general public.	3.1 Development and compilation of mitigation measures and targeted dissemination	- On Schedule	<ul style="list-style-type: none"> - Meeting of UNEP, experts from AIT and ST Chair, Vice-chair and some ST members held UNEP RRC.AP on 7 December discussed the scope of the mitigation programme (Annex 9). - Presented ABC to policy makers, scientists, and civil society groups at various forums and bilateral discussions: <ul style="list-style-type: none"> Regional stakeholder cum coordination meeting and intergovernmental meeting under the Malé Declaration held in Thimphu, Bhutan in September 2006. ABC was presented at 3rd regional dialogue of air quality management initiatives and programs in Asia held in Bangkok on 12 October 2006. ABC was presented at the Better Air Quality (BAQ) conference held in Yogyakarta, Indonesia in 13-15 December 2006. ABC was presented to the 8th Session of EANET held in Hanoi, Vietnam in 29-30 November 2006. - ABC has been highlighted in the UNEP GEO Year Book 2006. 	<ul style="list-style-type: none"> - Initiation of studies on emission of ABC precursors from various sectors and compilation of available mitigation measures. - Initiate studies on economic impacts of ABC - Establish a homepage for ABC at UNEP RRC.AP website - Present ABC at major forums and bilateral discussions, and workshops - Publication of ABC results in a special issue of JGR (Journal of Geophysical Research) in June. - Dissemination of ABC publication and data. - Consultation meetings on ABC in Nepal and Pakistan.

1. Introduction – Rationale and Mission of the Project ABC

Air pollution containing aerosol particles emitted from anthropogenic sources such as fossil fuel and bio-fuel combustion and natural source like biomass burning and associated long-range transport leads to widespread layers of brownish haze, referred to as Atmospheric Brown Clouds (ABC). The atmospheric brown clouds hovering over continental South Asia and Indian Ocean was first discovered and documented by the INDOEX (Indian Ocean Experiment). The pollution haze occurs frequently in all other heavily inhabited regions and downwind. It is a transboundary, trans-continental and trans-oceanic phenomenon. ABC can reduce the amount of solar energy that can reach the Earth's surface. This in turn can have significant direct and indirect impacts on regional climate, temperature, precipitation cycle and patterns, and consequently the agriculture, human health as well as the terrestrial and marine ecosystems.

In recognition of the findings of the INDOEX and subsequent studies, and to address these concerns, the ABC project was jointly initiated by UNEP in collaboration with a network of scientists in Asia, Europe and the United States. The scientists, including the local scientists, have been participating in the establishment of a network of ground-based monitoring observatories in Asia to study the composition and seasonal pattern of the haze. There are over a dozen fully operational observatories in Asia now. UNEP facilitates and assists with science and research programmes, capacity building in the region, and impact assessment programme. UNEP will also present the results of observation and impact assessment to the governments with an aim to promote policy making guided science-based information.

Considering the significance of this emerging environmental issue, the Swedish International Development Co-operation Agency (Sida) approved a proposal of US\$ 2.983 million for the implementation of Project Atmospheric Brown Clouds (ABC)-Asia. The Government of Sweden and UNEP signed an agreement in November 2004 to support the ABC-Asia programme. An implementation plan was prepared that included the activities and the approaches to be used, a detailed work plan, and the budget breakdown.

The underlying principles of the project ABC include promoting regional capacity building and facilitating interactions between scientific and policy making process so that the policy makers are equipped with science-based information when the policy options designed for the mitigation of the impacts of atmospheric brown clouds.

The specific **objectives** are:

- (i) To develop the science and the capacity to study the issue of aerosols in the region;
- (ii) To assess the impacts of Atmospheric Brown Clouds on water budgets, agriculture, human health and climate change under a common framework; and
- (iii) To raise awareness on the issue and promote actions for mitigation.

This would be achieved through 3 major programmes:

- (i) Observatory programme,
- (ii) Impact assessment programme, and

(iii) Awareness & mitigation programme.

The observatory programme aims to build the necessary physical infrastructure for atmospheric monitoring (radiation, aerosol, precipitation, and meteorology) and data on atmospheric brown clouds (ABC) for better insights on science of ABC, as well as training of local scientist and technicians. The impact assessment programme aims to assess the potential impacts of ABC on agriculture, water, and health and regional climate using the data from the observatory programme. The firm information based on sound science, i.e., the findings from the impact assessment programme, will provide valuable basis for policy making through the programme on awareness, outreach and mitigation.

This report highlights the achievements of the Sida-supported project ABC during the reporting period of January – December 2006.

2. Major highlights/events during January – December 2006

2.1 Observatory Programme

2.1.1 Climate and Aerosol Observatory Programme

In the year 2006, considerable efforts have been devoted to continued operation of the ABC observatories in the region, and capacity building, both physical infrastructure and human resource. This involved visits to the site by ABC scientists and UNEP, procurement and installation of equipments at the monitoring sites, and training of local scientists and technicians as stipulated in Memoranda of Understandings (MoUs). The Nepal Climate Observatory in Godavari, Kathmandu (NCO-G), Maldives Climate Observatory at Hanimaadhoo (MCO-H) and Gan (MCO-G), and Thailand Climate Observatory at Phimai, (TCO-P) are now fully operational with trained local manpower.

There are other existing/proposed ABC observatories/sites, as shown in the Figure 1 below: Indian Climate Observatory-Pune (ICO-P), the Indian Climate Observatory-Kharagpur (ICO-K), Nepal Climate Observatory-Pyramid (NCO-P), Thailand Climate Observatory-Phimai (TCO-P), the Japan Climate Observatory-Okinawa (JCO-O), Korea Climate Observatory-Gosan (KCO-G), Pacific Climate Observatory-Momote (PCO-MT), Pacific Climate Observatory-Midway (PCO-MW), Pacific Climate Observatory-Mauna Loa (PCO-ML), and National Atmosphere and Climate Observatory-Trinidad Head (NACO-T).

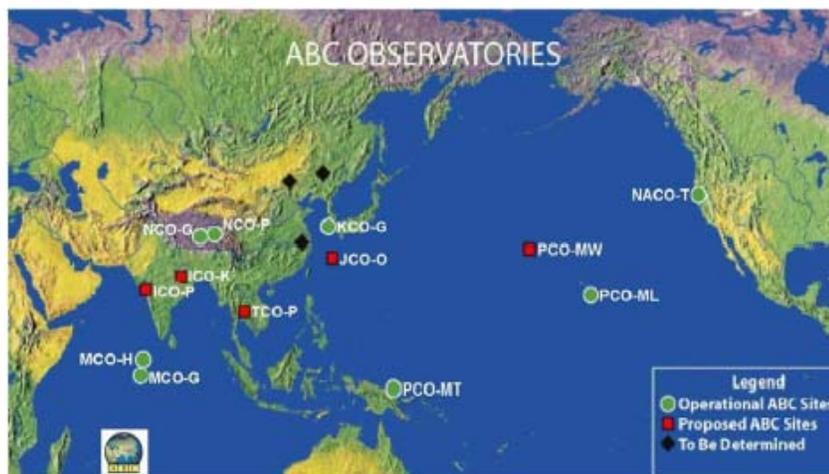


Figure 1: The Map of the location of ABC Climate and Aerosol Observatories

MCO-H is one of the ABC super observatories, and serves as regional research and training facility. Dr. Praveen Siva, a resident scientist, is operating and maintaining a number of state-of-the-art atmospheric instruments as a resident scientist, and also training the Maldivian scientist on the operation of the observatory, operation of and maintenance of instruments and data analysis. The governments of Korea, Japan and India are providing financial supports to the ABC observatories in those countries. Korea Climate Observatory at Gosan (KCO-G) is another super observatory for the project ABC. The ABC observatories have provided the first continuous data sets for several pollutants including black carbon and organics and a full seasonal cycle of aerosol forcing.

The ABC Science Team (ST), led by Prof. V. Ramanathan, provides the science guidance. The monitoring activities at ABC observatories under the observatory programme are coordinated through its regular meetings, in addition to the regular advices from the ST Chair and vice-chair between two ST meetings. The full-scale ST meeting was not held during the reporting period. However, an *Ad Hoc* Science Team meeting was held in Bangkok, Thailand in 5-6 December 2006. The meeting reviewed the operation of existing observatories, approved the proposal to include in the ST a scientist from EV-K2-CNR, which operates Nepal Climate Observatory at Pyramid (NCO-P), a high altitude observatory stations for ABC. The meeting also reviewed and decided inclusion of proposed ABC observatories in India. A summary report from the meeting is provided in [Annex 4](#).

In addition to regular monitoring at the observatories, intensive field campaigns are also conducted at given locations/regions. A MAC (Maldives Autonomous Aerial Vehicle Campaign) field campaign was conducted in Hanimaadhoo Maldives in March 2006. Atmospheric sampling was carried out in Maldives with several Unmanned Aerial Vehicles (UAVs) by the Center for Clouds, Chemistry, and Climate (C4) team led by Prof. V. Ramanathan. Three UAVs were deployed in stacked formation, below, inside and above the cloud, to observe the response of cloud to the particles and amount of solar radiation penetrating through the cloud. This unique technique, first of its kind in atmospheric monitoring, demonstrated the ability of UAVs to conduct complex science missions and collect unique data on a problem of great importance to climate change and global warming. The summary of the MAC campaign is provided in [Annex 2](#).

Another major accomplishment of the project ABC is the documentation of the global extent of the atmospheric brown clouds and also identification of five regional hot spots as well as thirteen mega city hot spots with high values of anthropogenic aerosol optical depths (AODs), solar absorption and surface dimming. The recent study by the ABC scientists that utilized the satellite observations, global assimilated aerosol data sets, data from ABC observatories, a Monte Carlo aerosol-cloud-radiation (MCAR) model and a regional chemical transport model (STEM2k) to characterize the spatial extent of atmospheric brown clouds and their direct radiative forcing. East Asia, Indo Gangetic Plains, Indonesian region, southern Africa and the Amazon basin are the regional hotspots (Figure 2). Atmospheric brown clouds are not restricted to these regions only. The brown clouds also extend well into the western Pacific Ocean, the tropical Indian Ocean and the eastern Atlantic Ocean. The study also focuses on regional differences between emissions, aerosol properties and radiative forcing. For example, SO₂ emission from India is a factor of 3 lower than that of US and a factor of 4 lower than that of China, but the annual mean anthropogenic AOD over India is a factor of 2 larger than that of US and about the same as over China. The study establishes clearly the importance of the atmospheric brown clouds for global anthropogenic radiative forcing.

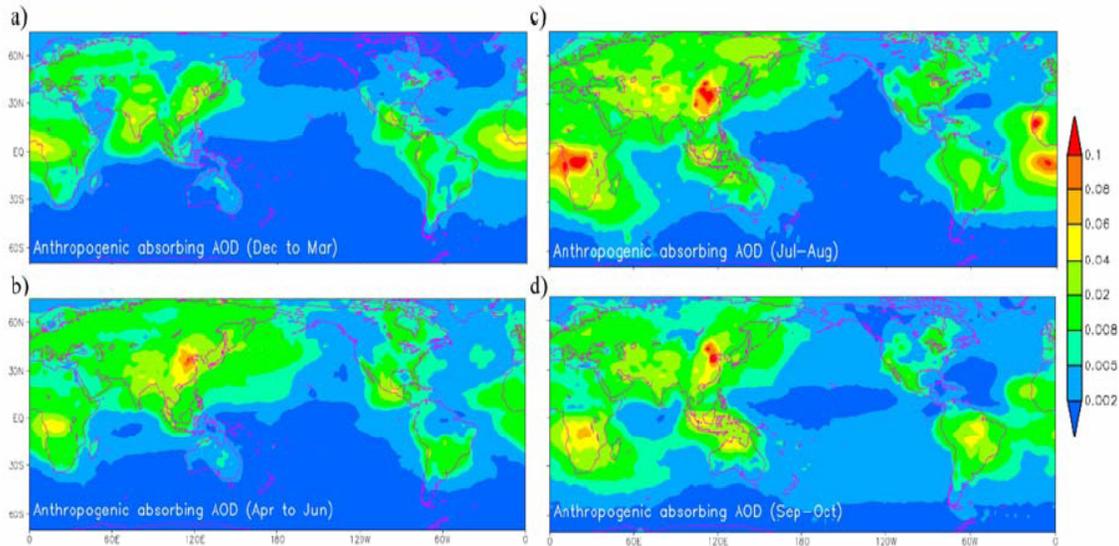


Figure 2. Global distribution of anthropogenic absorption optical depth for 2001-2003 (*Ramanathan et al. 2007 in ABC special issue of J. Geophys. Res.*). Soot and dust are the main contributors to the absorption optical depth.

One of the important goals of ABC is to train the next generation of Asian scientists in the study of aerosols and related issues. In this regard, a Training School was announced through website and e-mail contacts, and more than 70 applications were received. The second international training school on atmospheric brown clouds (ABC) was organised during 4-14 December in Bangkok and Hanimaadhoo. The training school was aimed at (a) 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, and (b) 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, and (2) a second week (10-14 Dec.) of hands-on training at the Maldives Climate Observatory at Hanimaadhoo (MCO-H), a super observatory for the Project ABC. A total of 25 young scientists and graduate students (10 female and 15 males) from 11 countries participated in the training school. The students were selected based on merit while maintaining a balance in the geographical and gender aspects. Nearly half of the participants rated the training school as excellent, while remaining 43% rated it as good. Summary of the training school is provided in [Annex 5](#).

ABC Science Team Chair and Vice Chair had recommended UNEP to carry out the assessment of the existing as well as proposed observatories and sites regarding the management of observatories and the capacity enhancement of local scientists and technician. In 2006, UNEP carried out an assessment of the management of the observatories, operation and maintenance of the instrumentations at those sites, data and its availability for archival, and the enhancement on the scientific and technical capacities of the local scientists and technicians at 7 ABC observatories in the region. The report, which consisted of assessment of current situation about the operation of observatory, available instruments at each observatory, availability of the data for archival, capacity building at the local

level, and some recommendations for further improvement, was presented to the Ad Hoc ST Meeting and discussed. The summary of the assessment report is provided in [Annex 3](#).

2.1.2 Precipitation and Aerosol Chemistry Programme

During the reporting period, one of the major activities under this component of ABC was establishment of 3 precipitation and aerosol chemistry monitoring sites: Sinhgad near Pune in India, Hanimaadhoo in the Maldives, Godavari in the outskirts of Katmandu in Nepal. The activities included several visits to these sites by Department of Meteorology at Stockholm University (MISU) and Indian Institute of Chemical Technology (IICT) scientists, and extensive exchange of information between scientists at MISU and scientists and technicians at the local institutes responsible for these sites. The idea of setting up fourth site at Andaman Island in India was abandoned due to logistic reasons. The 4th site may be chosen near Kharagpur, India.

Detailed MoUs have been negotiated and agreed upon with the Indian Institute of Tropical Meteorology (IITM), Pune and International Center for Integrated Mountain Development (ICIMOD), Kathmandu. In addition, agreements have been signed between MISU and IICT, Hyderabad, regarding the role of each institution. As agreed in the MoUs, the precipitation and aerosol sampling instruments have been installed at 3 sites (Sinhgad, Hanimaadhoo and Godavari), and the monitoring activities are now ongoing satisfactorily with sample collection and analytical analysis, quality control as well data analysis. Dr. Umesh Kulshrestha of IICT, Hyderabad, supervises the aerosol and precipitation chemistry monitoring at 3 sites and looks after quality control issues, as agreed in the MoUs between MISU and IICT.

A major emphasis has been placed on development and testing of new advanced methods for measuring soot in air and in precipitation. The preliminary results from measurements at these sites showed that an unexpectedly large amount of soot had found its way into the rainwater. This implies that the initially strongly hydrophobic soot particles must have adsorbed appreciable amounts of sulphate or other soluble material to make them prone to absorb water and thereby be subjected to precipitation scavenging. Information of this kind is crucial when it comes to modelling the transport of soot and other aerosol components.

Prof. Henning Rodhe, Vice Chair of ABC Science Team and the Principal Investigator of the precipitation and aerosol chemistry programme, has made presentations of the progress of the aerosol and precipitation chemistry work in South Asia at the ABC Steering Committee (SC) meeting in Hanimaadhoo, Maldives on 8 March 2006, and at the ABC Science Team (ST) meeting in Bangkok in 5-6 December 2006.

2.2 Impact Assessment Programme

ABC impact assessment programme focuses on the assessment of impacts of ABC on human health, agriculture, and water budgets. The research studies conducted by the ABC scientists over last 2 years have revealed that ABCs have led to a large reduction of solar radiation, as much as 7% reduction, in South Asia from 1950 to 2000. This ABC induced dimming has decreased the heating of the North Indian Ocean which, combined the heating of the lower atmosphere due to soot, can lead to weakening of the monsoon circulation and change in precipitation patterns. Such changes will have a significant impact on agriculture, water security, and repercussion to the livelihood of millions of people. Project ABC has initiated integrated studies with tClimate-Agro-Economic Crop Models of

the climate effects of greenhouse gases (GHGs) and ABCs. The model simulations suggest that the increase in minimum temperature by GHGs combined with the decrease in rainfall due to radiative forcing of ABCs may have contributed to as much as 15% reduction in rice production in India since the 1980s, and thus help account for the observed slowdown of the growth rate of rice production in Indian rain-fed states.

The first consultation workshop on ABC impact assessment programme was held in Bangkok, Thailand on 7-8 December 2005. Since the scope of the impact assessment programme was defined in year 2005, in the year 2006, the major activities of impact assessment programme were devoted to the development of Terms of Reference (ToR) and Memorandum of Understanding (MoU) for conducting the assessment studies on the impacts of ABC on human health, agriculture and water budgets. UNEP assisted the Science Team in identifying appropriate regional institution to lead the impact assessment study, as well as appropriate institutes and experts to contribute to the impact assessment study. This is being conducted in consultation with the ongoing initiatives and relevant institutions in Asia. The following institutions have been selected to coordinate the impact assessment studies.

- Indian Agricultural Research Institute (IARI), India [Agriculture]
- Chulabhorn Research Institute (CRI), Thailand [Health]
- Nanyang Technological University (NTU), Singapore [Water budgets]

Memoranda of understanding have been concluded between UNEP and IARI, and UNEP and CRI, and MoU for the water budget impact study is being negotiated with NTU. Prof. V. Ramanathan, Prof. Henning Rodhe and Prof. Teruyuki Nakajima serve as lead ST members for the agriculture impact, health impact and water budget impact studies, respectively. Lead institutions are establishing impact assessment networks, comprising experts from Asia as well as from outside the region, on their respective areas.

A consultation meeting was organized at CRI in April 2006 to discuss the ToR for ABC -health impact assessment study that led to signing of a MoU between UNEP and CRI in July 2006. The second meeting held at CRI on 4 December, which was attended by UNEP, CRI, ABC ST Vice Chair and some experts, reviewed the progress of the health impact assessment programme, discussed and the skeleton for the impact assessment study and the report.

Likewise, a consultation meeting was organized at IARI in August 2006 to discuss the ToR for ABC -agriculture impact assessment study that led to signing of a MoU between UNEP and IARI in late August 2006. The agriculture impact assessment workshop was organized in Bangkok in 5-6 December 2006. The workshop was attended by UNEP, IARI, ABC ST Chair, ST Vice-Chair and some ST members and experts. This second meeting reviewed the progress of the agriculture impact assessment programme, discussed and elaborated the scope and framework for the impact assessment study and the report.

Similarly, UNEP organized a consultation meeting was organized at NTU in July 2006 to discuss the ToR for ABC -water impact assessment study. Prof. V. Ramanathan also attended the meeting. A follow up meeting was organized at UNEP RRC.AP on 7 December 2006 that clarified some issues and reviewed the white paper prepared by NTU for water impact study. The meeting was attended by UNEP, NTU, ST Chair, ST Vice-Chair and some science team members. Currently, a MoU has been developed, and it is being reviewed the NTU.

The summary of the impact assessment meetings held in Bangkok in December 2006 is provided in [Annex 6, 7 and 8](#), respectively, for health, agriculture and water impacts.

2.3 Awareness and Mitigation Programme

This component aims to promote the interaction between science and policy making process so that the policy makers are better equipped with the science-based information while developing alternative strategies (mitigation options). This is done in such a way that the data from the ABC observatories and other relevant programme will be utilized in the impact assessment process, and the findings of impact assessment component will be translated to economic term and disseminated together with economic and technical measures for mitigation of the impacts of ABC. It has been agreed that the ABC impact assessment studies will estimate the economic implications of ABC in those respective areas

Much of the work under this component will start once the results from the observatory programme and impact assessment programme are available. However, a meeting of experts from AIT, ST chair and vice-chair and some ST members, and UNEP was organized on 7 December to discuss the scope of the mitigation programme. The summary of the meeting is enclosed as [Annex 9](#). A white paper is being developed by AIT. On the other hand, in order to promote awareness on the ABC issues, the science and potential impacts of ABC and ongoing activities were presented to policy makers, scientists, and civil society groups at various forums and during bilateral discussions. These include:

- *Regional Stakeholders cum Coordination Meeting and Intergovernmental Meeting of Mal' Declaration:* The Regional Stakeholders cum Coordination meeting Forum and intergovernmental meeting under the Malé Declaration was held in Thimphu, Bhutan in 12-13 September 2006. Over 40 stakeholders from South Asia participated. The meeting was inaugurated by His Excellency, Lyonpo Yeshey Zimba, the Minister for Trade and Industry, Bhutan.
- *Regional Dialogue of Air Quality Management Initiatives and Programmes:* ABC was presented at 3rd regional dialogue of air quality management initiatives and programs in Asia held in Bangkok in 12-13 October 2006. The programme was organized by Clean Air Initiative- Asia (CAI-Asia). There were over 30 participants.
- *Eighth Session of IG of the EANET:* ABC was presented to the 8th Session of the Intergovernmental Meeting on EANET (Acid Deposition Monitoring Network in East Asia) held in Hanoi, Vietnam in 29-30 November 2006. The meeting was attended by more than 40 participants from 13 East Asian and South East Asian countries.
- *Better Air Quality (BAQ):* ABC was presented at the Better Air Quality (BAQ) conference held in Yogyakarta, Indonesia in 13-15 December 2006. There were more than a thousand participants.
- *UNEP GEO Year Book 2006:* ABC was highlighted in Feature Focus: Energy and Air Pollution in UNEP GEO Year Book 2006. UNEP GEO Year Book is intended to provide a bridge between



science and policy, and stimulate calls for action. It is thus widely distributed and highly appreciated.

3. The Future Plan for the Next 12 Months (January – December 2007)

3.1 Observatory Programme

3.1.1 *Climate and Aerosol Observatory Programme*

The plan for 2007 includes the following main activities.

- Continue operation of observatories: The monitoring stations established under the project ABC will continue the operation and data collection. These activities require continuing substantial support in the form of both technical maintenance and capacity building. The transfer of the technology and knowledge to the local institutions and scientists will continue.
- Establish ABC Data and Information Service Center (A-DISC) at UNEP RRCAP. The data archival system will serve as a repository where ABC data are gathered, archived, managed and disseminated. The archival will also include the publications on ABC.
- High altitude Climate and Aerosol Observatories: The following activities are planned;
 - (i) Continue operation of Nepal Climate Observatory at Pyramid (NCO-P) near Mt. Everest in the Himalaya. Proposed activities include:
 - (ii) Explore the possibility of establishing second high altitude observatory, Pakistan Climate Observatory at Karakoram (PCO-K).
 - (iii) Data collection on the presence of aerosols and other related pollutants, like black carbon and greenhouse gases at those two observatories.
 - (iv) Onsite training of local scientists and technicians.
- A Science Team meeting is proposed to be held in August 2007. The meeting will review the monitoring results and consider the proposals for the additional observatory programmes. The ST meeting will also discuss the plan for the next 4 years that will include observation, impact assessment, awareness and mitigation. The archival of data at the central archival will continue. A mechanism for data sharing will also be discussed in this meeting. The global ABC programme includes over 15 observatories that are being supported by different donors and organizations, and governments. Hence, the Science Team meeting is considered as the major forum for ABC scientists to share the data and information, and plan for the year-to-year progress and plan, as well as plan next phases.
- As a part of capacity building efforts in Maldives, two Maldivian scientists will be provided 3-month intensive training in atmospheric science, measurement principles and techniques, data quality assurance and quality control and data analysis in collaboration with Center for Cloud, Chemistry and Climate (C4) at Scripps Institution of Oceanography, where ABC Science Secretariat is located.

- ABC scientist have planned for two major regional atmospheric characterization experiments to study the East Asian Dust-Monsoon-Climate interactions:
 - (1) EAREX-2007 (East Asian Regional Experiment -2007). Atmospheric Scientists from East Asia will conduct a regional intensive field campaign in collaboration with the American PACDEX campaign (with high altitude Gulf Aircraft) to understand the impact of East Asian Dust storms on regional climate and Environment. ABC Science Team members, Prof. S.-C. Yoon and Prof. T. Nakajima will take lead for EAREX-2007.
 - (2) WPAC UAV (Unmanned Aerial Vehicles) Studies: This experiment will deploy 9 UAVs over the eastern Pacific Ocean to understand the Dust-ABC-Monsoon Interaction (PI: Prof. V. Ramanathan). This will be a collaborative project with China, Korea, Japan and US.

3.1.2 Precipitation and Aerosol Chemistry Programme

The plan for 2007 includes the following main activities.

- To finalize the method development and field tests of the new method for sampling, handling and analysis of soot in aerosol particles and in rainwater. This work is done in collaboration between scientists in Asia and at MISU. A technical publication is under preparation.
- To consolidate the monitoring activities at Sinhagad, Godavari and Hanimaadhoo. These activities require continuing substantial support in the form of both technical maintenance and capacity building.
- To plan for the establishment of a fourth monitoring site in the region. The original plan to set it up in Andaman Island has had to be abandoned for logistical reasons. An alternative location near Karagpur in India is currently being investigated in cooperation with the recently established Indian ABC committee.
- The analysis and interpretation of the observational data will be initiated. Although this work will be coordinated by MISU, Asian scientists and PhD students will be actively involved. Close liaison will be maintained with the scientist focusing on effects of air pollution (climate, water balance, agriculture, health).
- A post-doc from India will spend an extended period at MISU and participate in the analysis and interpretation of the data.

3.2 Impact Assessment Programme

The plan for 2007 includes the following main activities.

- Complete formation of Impact Assessment Groups: (1) Health Impact Study Group (HISG), (2) Water Impact Study Group (WISG), and Agriculture Impact Study Group (AISG) comprising of the three lead institutions, other collaborating institutions and experts from Asia and outside and lead ST members. Currently, ABC is focussing these issues with high priority.

- The initial study on impacts of ABC on water and agriculture will focus on two major river basins in Asia: (i) Ganges basin, and (ii) Yangtze basin. The impact of ABC on health is obviously an important issue. But since many studies on air pollution and health are already underway, mainly in urban areas, the Project ABC will emphasise the assessment of health impact in the rural areas.
- Complete the following 3 assessment reports by the end of the year 2007:
 - (i) a scientific report on impacts of ABC on water budget, including a summary report for policy makers;
 - (ii) a scientific report on impacts of ABC on agriculture, including a summary report for policy makers; and
 - (iii) a scientific report on impacts of ABC on human health, including a summary report for policy makers.
- Convene 1-2 meetings of the 3 impact assessment groups, as necessary.
- Convene a combined impact assessment workshop in December 2007. The workshop will finalize the three impact assessment reports.

3.3 Awareness and Mitigation Programme

The plan for 2007 includes the following main activities.

- Complete a roadmap for mitigation programme of the Project ABC.
- Continue the compilation of available mitigation measures: This will include discussions with the ABC Science Team and institutions from Asia, selection of a lead regional institution to coordinate the studies on mitigation of ABC precursors from different sectors. A white paper will be developed. Agreements with institutions will be developed for conducting this study.
- Initiate studies on the economic impacts of ABC: This will include formation of a team comprising environmental economists, and development of agreements.
- Establish a home page for ABC at the UNEP web site: This will facilitate the dissemination of project information for a wider range of audience.
- ABC consultation meetings, one each in Nepal and Pakistan, to bring up the ABC issue to government officials, researchers at the local institutions and universities, as well as bring together the people involved in ABC-related activities in those countries, and the planned activities.
- Present ABC at the major forums and bilateral discussions.

3.4 Preparation for the Next Phase

The project ABC has come far along since its conception 4 years ago with establishing a network of ground based observatories equipped with state-of-the-art instrumentation, development of the science of ABC and its potential implications to regional climate, training next generation of researchers in

Asia, and the initiation of studies on assessment of impacts of atmospheric brown clouds on water budgets, human health and agriculture. Prof. V. Ramanathan, ABC ST Chair expressed the satisfaction at the Ad Hoc ST Meeting in December that the project has completed Phase I, and requested the meeting to focus on development of Phase II. The Ad Hoc ST meeting has decided to move to Phase II.

A comprehensive 4-year plan (2008-2012) is being developed in consultation with ABC ST members and the national science teams. The Steering Committee, which comprises of UNEP, ST Chair and ST Vice-Chair, will convene in June in Nairobi, and review the draft of the programmes for the Phase II. The comprehensive four 4-year programme, which will be prepared by the end of 2007, will highlights the achievements in the Phase I and emphasize the needs for further activities in science and observation, impact assessments and initiation of policy dialogues for mitigation and prevention.

4. LFA of the Project ABC

4.1 Develop the science and capacity to study the issue of aerosols in the region

4.1.1 Capacity building in aerosol observatory

<p>Lead institution: Science Team Chaired by Prof. V. Ramanathan</p>	<p>Prepared by: UNEP</p>
<p>Collaborating Institutions: (name; principal contact)</p> <ul style="list-style-type: none"> - Chinese Academy of Science (CAS), CHINA; Prof. Shi Guang-Yu - Peking University, CHINA; Prof. Zhang Yuanhang - Max-Planck Institute for Chemistry, GERMANY; Prof. Paul J. Crutzen and Mark Lawrence - The Energy and Resources Institute (TERI), INDIA; Dr. R. K. Pachauri - National Physical Laboratory (NPL), INDIA; Prof. Ashesh P. Mitra - Physical Research Laboratory, Ahmedabad, INDIA, Dr. A. Jayamaran - FRCGC, JAPAN; Prof. Hajime Akimoto - University of Tokyo, JAPAN; Prof. Nakajima Teruyuki - Seoul National University, Korea; Prof. Soon-Chang Yoon and Prof. Kyung-Ryul Kim - Ministry of Energy, Environment and Water, MALDIVES; Mr. Abdulla Amjad - ICIMOD, NEPAL; Dr. Gabriel Campbell - University of Stockholm, SWEDEN; Prof. Henning Rodhe - Environment Division, WMO, SWITZERLAND, Dr. Leonard A. Barrie - Chulalongkorn University, THAILAND, Ms. Boossarasiri Thana - C4/SIO/UCSD, USA; Prof. Veerabhadran Ramanathan - University of Iowa, USA; Prof. Gregory R. Carmichael 	
<p>Description of activities: (actions carried out; trips made; progress in the project)</p> <ul style="list-style-type: none"> - Monitoring Stations were established and fully operational at Hanimaadhoo (Maldives), Kathmandu (Nepal), and Phimai (Thailand). - MAC Campaign in Hanimaadhoo, Maldives using UAVs (Unmanned Aerial Vehicles). - The ABC Training School for young scientists from Asia on aerosol measurement, radiation measurements and precipitation measurements was held in Bangkok (Thailand) and Hanimaadhoo (Maldives) during 4-14 December 2006. - Convened a (ad hoc) Science Team meeting in December 2006. - Several visits by ABC scientists and UNEP to the regional observatories in Maldives, Nepal, Thailand, Republic of Korea, India and Japan. - A study that has documented the global distribution of ABCs and identified the major regional hot spots. 	
<p>Description of outputs:</p> <ul style="list-style-type: none"> - Functional Monitoring Stations at Hanimaadhoo, Kathmandu, and Phimai. - Data from the monitoring stations are being collected and discussed among the Science Team for validation and interpretation. - Publication of findings in peer reviewed journals. 	

<ul style="list-style-type: none"> - Report of the field campaigns, training school, and Science Team meetings.
<p>Description of results:</p> <p>Twenty Five young researchers, technicians and senior students (21 from Asia) have been trained during the training school, and most of them are participating in the monitoring programmes at the national level.</p> <p>The main results of the activities have been a demonstrated ability of Asian scientists to participate in the aerosol and radiation measurements.</p>
<p>What extent the activities so far has lead to fulfilment of the programme purpose:</p> <p>The activities so far under observatory programme such as establishment of observatories, and installation of instruments, transfer of knowledge to local scientists, and training and capacity building, have followed the programme, and hence fulfilled its purpose.</p>
<p>Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)</p> <p>The activities at many ABC observatories have been well coordinated with each other in terms of operation of instruments and data generation.</p> <p>The data generated at ABC observatories and the outputs of various numerical models are being collected and used as inputs to the impact assessment studies so that the impact assessment studies will be strengthened.</p> <p>Science Team meeting provided the opportunity for interaction with other programmes of project ABC.</p>
<p>Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed work plan)</p> <p>The activities of project are progressing on schedule.</p>
<p>Finances: (is the financial plan being adhered to - are there any difficulties?)</p> <p>Till date, the financial plan has been adhered to.</p>
<p>Plans for next 12 months:</p> <ul style="list-style-type: none"> - Continue operation of observatories in Nepal (NCO-P and NCO-G), Maldives (MCO-H and MCO-G), and Thailand (TCO-P). - Establish additional high altitude monitoring stations in the Karakoram Mountain (PCO-K). - Establish ABC Data and Information Service Center (A-DISC) at UNEP RRCAP. - ABC Scientists will conduct EAREX-2007, and WPAC-UAV intensive field campaigns in East Asia. - 3-month Training programme for scientists from Maldives - Convene Science Team meeting (s)
<p>Issues related to HIV/aids, gender, equity and poverty issues:</p> <p>The participation of female scientists in observatory and capacity building programme has been encouraging, though is it not yet balanced.</p> <ul style="list-style-type: none"> - 10 Female researchers participated in the ABC Training School in December 2006. - Person in charge for ABC observatories at Godavari (Nepal) and Phimai (Thailand), Ms. Bidya Banmali Pradhan and Ms. Boosarasiri Thana, respectively, are female.
<p>Other information:</p>

4.1.2 Capacity Building on Precipitation and Aerosol Chemistry

<p>Lead institution: Department of Meteorology, Stockholm University (MISU), SE-10691 Stockholm, Sweden</p>	<p>Prepared by: MISU</p>
<p>Collaborating Institutions: (name; principal contact; contact details)</p> <ul style="list-style-type: none"> - Indian Institute of Chemical Technology (IICT), Hyderabad, India. Dr. U. Kulshrestha, umesh_iiict@rediffmail.com - Indian Institute of Tropical Meteorology (IITM), Pune, India. Dr. P.S.P. Rao. raopsp@yahoo.com - International Centre for Integrated Mountain Development (ICIMOD). Dr. Bidya Banmali Pradhan. bbanmali@icimod.org - National Physical Laboratory (NPL), New Delhi, India. Prof. A.P. Mitra. apmitra@mail.nplindia.ernet.in - Ministry of the Environment, Male', Maldives. Mr. Nilam Mohamed, nilam.mohamed@environment.gov.mv - Institute for Tropospheric Research, Leipzig, Germany. Prof. J. Heintzenberg jost@tropos.de 	
<p>Description of activities: (actions carried out; trips made; progress in the project)</p> <ul style="list-style-type: none"> - Transfer of knowledge to scientists and technicians at the monitoring sites in Nepal, India and the Maldives in connection with the operation of the measurement program for the chemical composition of aerosols and precipitation. - Several visits by scientists from MISU and by Dr. Kulshrestha from IICT to the monitoring sites in Asia in connection with installation and maintenance of the equipment. In addition to the capacity building activities aimed at the persons directly involved in the monitoring program, these visits have also included scientific presentations to wider groups of scientists at the institutes in question. - Visit to MISU by Dr. P.S.P Rao from IITM, Pune in October 2006 for discussion of the measurement program at Sinhadagad. One of the foci of this visit was the question of quality control and quality assurance of the data. - Henning Rodhe participated as a lecturer in a two week training school arranged by ABC in Bangkok in December 2006. 	
<p>Description of outputs:</p> <ul style="list-style-type: none"> - Data from the monitoring program are now being analyzed and quality controlled. - Publications are being prepared in collaboration with Asian scientists. - Presentations made Henning Rodhe at ABC workshops have been published in workshop reports. 	
<p>Description of results: The main result of the activities has been a demonstrated ability of several Asian scientists to operate and handle the various equipments used in the monitoring program.</p>	
<p>What extent the activities so far has lead to fulfilment of the programme purpose: The activities so far have followed the programme plan and thus fulfilled its purpose.</p>	
<p>Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme) The activities at the Hanimaadhoo and Godavari monitoring sites have been well coordinated with other ABC measurement activities carried out at this site. The activities at Sinhadagad (Pune) have also been coordinated with those carried out within the Composition of Asian Deposition (CAD) program of RAPIDC.</p> <p>Once the Impact and Assessment component of ABC gets under way, efforts will be made to strengthen the interaction with such studies.</p>	
<p>Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed workplan) The project is progressing essentially on schedule. The establishment of the MoUs with some of the Asian partners has taken longer time than expected and this has led to a slight delay in the development of the quality</p>	

assurance work. The establishment of the fourth monitoring station has been delayed mainly because of uncertainties in the organization of the Indian ABC program.

Finances: (is the financial plan being adhered to - are there any difficulties?)

MISU's Financial Report for the year 2005 showed a deficit on the post "Other costs" and a surplus on "Equipment". The post "Equipment" has been divided into two posts to clarify that MISU has far more expenses with a cost character than with a durable existence. The financial outcome for the year 2006 has the same tendency as for the year 2005.

In this report "Equipment" has been renamed "Equipment and consumables" to better reflect what was originally meant. The sum of the budget allocations "Durable equipment" (USD 82.000) and "Equipment and consumables" (USD 323.000), agrees with the budget item "Equipment" in the Memorandum. The post "Other costs" has been reserved for costs other than those directly related to the precipitation and aerosol chemistry measurements such as e.g. transport costs and phone calls.

Necessary reallocations between these budget posts for 2005 will be made retrospectively in the final report next year. At a later stage we would like to come back to a request to reallocate some of the funds from "equipment and consumables" to "fees".

Problems: (have any problems been encountered- give details)

In addition to what has been said above there have been some problems with the operation of the Sinhagad site. These include technical aspects with the instrumentation and irregular communications and dispatches of samples. A certain lack of commitment from the scientists at IITM seems to be a contributing factor. If this situation continues this collaboration may have to be reconsidered.

Plans for next 12 months

- The three day course on atmospheric chemistry in general and aerosol and precipitation chemistry in particular previously scheduled for November 2006 is now planned for late 2007 (the reason for the delay is the more ambitious training school arranged by ABC in December 2006).
- As laid out in the MoUs with IITM, IICT and ICIMOD, one scientist from each one of these institutes will visit MISU during 2007 for discussions about the progress of the program.
- An Indian postdoc (female) has been recruited to spend at least half a year at MISU with the analysis and interpretation of the data.
- As Vice Chair of ABC Asia Henning Rodhe will spend considerable time on the operation of the overall program. His involvement in the ABC impact studies, especially the health aspects, will intensify.

Issues related to HIV/aids, gender, equity and poverty issues and plans for the handover of responsibility to the region

The gender balance among our Asian partners is clearly uneven. In both India and the Maldives all participants in the monitoring activities are males. In Nepal on the other hand, the person in charge of the monitoring station is a female (Dr. Bidya Banmali Pradhan). Efforts will be made to recruit scientists and technicians of both sexes to the workshop and to other capacity building activities. The postdoc recruited to MISU is a female Indian scientist.

The responsibility for the handling of the monitoring equipment has already to a large extent been handed over to Asian scientists and technicians. The responsibility for chemical analysis etc. will be gradually transferred to Asian laboratories, as their capacity to this has been built up.

Other information:

4.2 Increase understanding of the impacts of ABC

4.2.1 Assessment of ABC Impacts on Human Health

Lead institution: Impact Team Chaired by Prof. V. Ramanathan	Prepared by: UNEP
Collaborating Institutions: (name; principal contact; contact details) A tentative list is given below: <ul style="list-style-type: none"> - Chulabhorn Research Institute (CRI), Thailand – expertise in toxicological, molecular epidemiological, epidemiological studies; state-of-the-art facilities, and network of scientific collaborations with research and academic institutions worldwide. - WHO will provide technical support, review protocols for epidemiological studies and provide linkages - Fudan University (Shanghai, China): a member of the PAPA program. Has good quality air quality and epidemiological database. They have expertise in integrated assessment on human health & air pollution and in policy framing. - Institute for Environmental Health and Related Product Safety, Chinese Center for Disease Control and Prevention, Beijing- expertise in air quality monitoring, personal exposure assessment, toxicological, molecular epidemiological, epidemiological studies, air quality standard and guideline setting. Has a network of scientific collaborations with research and academic institutions worldwide and local CDC in China. - NPL, Delhi, India. Aerosol measurement data, characterization, etc., Dr. Ashesh Mitra - Patel Chest Institute, Delhi, India. Dr. Chabra - National Institute of Occupational Health, Ahmedbad and Calcutta, India. - Cancer Research Institute, Calcutta, India. Dr. Lahiri - Indian Council of Medical Research, Delhi, India. provides coordination for health related effects of climate change. 	
Description of activities: (actions carried out; trips made; progress in the project) <ul style="list-style-type: none"> - A consultation meeting was held at CRI, Bangkok to discuss the ToR for health impact studies. - A MoU has been signed between CRI and UNEP RRC.AP - A meeting of Health Impact Study Group (HSG) was held in Bangkok on 4 December 2006. The meeting defined the scope of the impact assessment study and preparation of the assessment report. 	
Description of outputs: <ul style="list-style-type: none"> - Report of HISG Meeting. 	
Description of results: The main result in 2006 is the development of the scope for the health impact study and formation of health impact assessment group (HISG). The impact assessment study is underway, and will be completed by the end of year 2007 with a detailed report on health impacts of atmospheric brown clouds.	
What extent the activities so far has lead to fulfilment of the programme purpose: The discussions at the consultation and HSG meetings have lead to a better understanding of the way forward, refinement of the scope of the study. The activities so far have followed the project plan and thus fulfilled the purpose.	
Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme) Health impact assessment study is expected to use the results from the observatory programme. Science Team meeting provides the forum for coordination among the various programmes of Project ABC.	

The efforts will be made to strengthen the interaction with similar studies such as the one under RAPIDC.
Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed workplan) Project activities are on schedule.
Finances: (is the financial plan being adhered to – are there any difficulties?) Till date, the financial plan has been adhered to.
Plans for next 12 months: <ul style="list-style-type: none"> - The health impact assessment group (HSG) will continue on studying the ABC's impacts on human health, and prepare a detailed scientific assessment report with a summary for the policy makers. The report will also document the current situation of research activities related to health impacts of air pollution and human resources in the region, and explore the gaps in the research activities or capacity in the region. This report will be one of the major accomplishments of the impact assessment programme and hence the project ABC. - Meetings of HSG will be convened as required. - An impact assessment workshop would be conducted in December 2007.
Issues related to HIV/aids, gender, equity and poverty issues: Two female scientists are participating in the assessment study of the impacts of ABC on human health. There will be an effort to bring more female scientists on board the health impact assessment group.
Other information:

4.2.2 Assessment of ABC Impacts on Agriculture

Lead Institution: Impact Team Chaired by Prof. Ramanathan	Prepared by: UNEP
Collaborating Institutions: (name; principal contact; contact details) A tentative list is given below: <ul style="list-style-type: none"> - Indian Agriculture Research Institute (IARI), India, for bio-monitoring and crop modeling (O₃ and aerosol) in collaboration with other Indian research institutes including Banaras Hindu University, NPL, TERI, and Punjab Agricultural University. - The Rice-Wheat Consortium, which is convened by CIMMYT and is based at the CIMMYT-India office. The Rice-Wheat Consortium coordinates agricultural research across the Indo-Gangetic Plain, which includes Pakistan, North India, Nepal and Bangladesh. - The APCEN network established as part of the RAPIDC programme could be important for capacity building within south Asian countries. - Department of Global Agricultural Sciences, Graduate School of Agricultural and Life Sciences, University of Tokyo - International Rice Research Institute (IRRI). - Food and Agriculture Organization (FAO) 	
Description of activities: (actions carried out; trips made; progress in the project) <ul style="list-style-type: none"> - A consultation meeting was held at IARI, Delhi to discuss the ToR for health impact studies. - A MoU has been signed between IARI and UNEP RRC.AP - A workshop of Health Impact Study Group (ASG) was held in Bangkok in 5-6 December 2006. The meeting defined the scope of the impact assessment study and preparation of the assessment report. 	
Description of outputs: Report of ASG Meeting.	
Description of results: The main result in 2006 is the development of the scope for the agriculture impact study and formation of agriculture impact assessment group (ASG). The impact assessment study is underway, and will be completed by the end of year 2007 with a detailed report on agriculture impacts of ABC.	
What extent the activities so far has lead to fulfilment of the programme purpose: The discussions at the consultation and ASG meetings have lead to a better understanding of the way forward, refinement of the scope of the study. The activities so far have followed the project plan and thus fulfilled the purpose.	
Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme) Agriculture impact assessment programme is expected to use the results from the observatory programme and the model simulation results. The Science Team meeting provides the forum for coordination among the various programmes of Project ABC.	
Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed work plan) Project activities are on schedule.	
Finances: (is the financial plan being adhered to - are there any difficulties?) Till date, the financial plan has been adhered to.	

Plans for next 12 months

- The agriculture impact assessment group (ASG) will continue on studying the ABC's impacts on agriculture, and prepare a detailed scientific assessment report with a summary for the policy makers. The report will also document the current situation of research activities related to agriculture impacts of air pollution and human resources in the region, and explore the gaps in the research activities or the capacity in the region. This report will be one of the major accomplishments of the impact assessment programme and hence the project ABC.
- Meetings of ASG will be convened as required.
- An impact assessment workshop would be conducted in December 2007.

Issues related to HIV/aids, gender, equity and poverty issues:

Two female scientists are participating in the assessment study of the impacts of ABC on agriculture. There will be an effort to bring more female scientists on board the agriculture impact assessment group.

Other information:

4.2.3 Assessment of ABC Impacts on Water Budget

Lead institution: Impact Team Chaired by Prof. Ramanathan	Prepared by: UNEP
Collaborating Institutions: (name; principal contact; contact details) A tentative list is given below: Singapore - Nanyang Technological University (NTU), Singapore India - Department of Science and Technology. Dr. P. S. Rao - Indian Meteorological Department, New Delhi. Mr. B. Lal - IITM, Pune. Dr. K. Rupa Kumar - Commission Water Agency, New Delhi - IIT, Delhi. Prof. Maethlisharau/Prof. Gosain - National Institute of Hydrology, Roorkee. - National Institute of Environment Engineering, Nagpur. Dr. Devotta - National Institute of Oceanography. Dr. Sethye - Jadavpur University, Calcutta. Prof. Asish Mukherjee - Institute of Hydrology, Roorkee University. Japan - University of Tokyo: T. Nagajima (CCSR); T. Koike (CEOP); J. Matsumoto (post-GAME) - JAMSTECH & FRCGC: H. Akimoto (ABC); M. Yamanaka (GEOSS) - NIES: S. Emor (global warming initiative) - Dr. Sung Nam Oh, Director, Earth Environmental Research Center, National Institute of Environmental Research China - Prof. Dahe Jiang, UNEP- Tongji Institute for Sustainable Development (ISD), Tongji University. - Dr. Likun Ai, Institute of Atmospheric Physics, CAS	
Description of activities: (actions carried out; trips made; progress in the project) - A consultation meeting was held at NTU, Singapore to discuss the ToR for water impact studies. - A MoU has been developed, and it is being negotiated with NTU. - A meeting of NTU, UNEP, ST Chair and Vice Chair and Some ST Members was convened at UNEP RRC.AP on 7 December 2006 for the further discussion on the scope of the Water impact study and formation of Water Impact Study Group (ASG). The meeting reviewed the white paper presented by NTU, specified and narrowed down the scope of the impact assessment study and put forward suggestions for preparation of the assessment report.	
Description of outputs: Report of ASG Meeting.	
Description of results: The main result of the water impact assessment programme in 2006 is the development of the scope for the water impact study and initiation for the formation of agriculture impact assessment group (ASG) led by NTU, the lead regional institution. The impact assessment study is underway, and will	

<p>be completed by the end of year 2007 with a detailed report on water impacts of ABC.</p>
<p>What extent the activities so far has lead to fulfilment of the programme purpose:</p> <p>The discussions at the consultation and ASG meetings have lead to a better understanding of the way forward, refinement of the scope of the study. The activities so far have followed the project plan and thus fulfilled the purpose.</p>
<p>Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)</p> <p>Agriculture impact assessment programme is expected to use the results from the observatory programme and the model simulation results. The Science Team meeting provides the forum for coordination among the various programmes of Project ABC.</p>
<p>Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed work plan)</p> <p>Project activities are on schedule.</p>
<p>Finances: (is the financial plan being adhered to - are there any difficulties?)</p> <p>Till date, the financial plan has been adhered to.</p>
<p>Plans for next 12 months:</p> <ul style="list-style-type: none"> - The agriculture impact assessment group (ASG) will continue studying the ABC's impacts on agriculture, and prepare a detailed scientific assessment report with a summary for the policy makers. The report will also document the current situation of research activities related to agriculture impacts of air pollution and human resources in the region, and explore the gaps in the research activities or the capacity in the region. This report will be one of the major accomplishments of the impact assessment programme and hence the project ABC. - Meetings of ASG will be convened as required. - An impact assessment workshop would be conducted in December 2007.
<p>Issues related to HIV/aids, gender, equity and poverty issues:</p> <p>The WISG has not been constituted yet. There will be an effort to bring female scientist on board the WISG.</p>
<p>Other information:</p>

4. 3 Raise Awareness on ABC and Promote Actions for Mitigation

4. 3.1 Development and Compilation of Mitigation Measures and Targeted Dissemination

Lead institution: UNEP	Prepared by: UNEP
Collaborating Institutions: (name; principal contact; contact details) A tentative list is given below: <ul style="list-style-type: none"> - Asian Institute of Technology (AIT), Prof. Ram M. Shrestha. - Other collaborating institutions will be identified during 2007. 	
Description of activities: (actions carried out; trips made; progress in the project) <ul style="list-style-type: none"> - A meeting of UNEP, ST Chair, Vice Chair and some 2 other ST Members, and experts from AIT was held at UNEP RRC.AP on 7 December 2006 to discuss the scope of mitigation programme. The meeting has agreed that AIT will produce a while paper for the mitigation programme. - Presented ABC to policy makers, scientists, and civil society groups at various forums and bilateral discussions: <ol style="list-style-type: none"> (i) Regional Stakeholders cum Coordination Meeting, and Intergovernmental Meeting under the Malé Declaration held in Thimphu, Bhutan in 12-13 September 2006. (ii) Third Regional Dialogue of Air Quality Management Initiatives in Asia held in Bangkok on 12-13 October 2006. (iii) 8th Session of EANET held in Hanoi, Vietnam in 29-30 November 2006. (iv) Better Air Quality (BAQ) conference held in Yogyakarta, Indonesia in 13-15 December 2006. - ABC was highlighted in the UNEP GEO Year Book 2006. The year book is intended to stimulate the action. 	
Description of outputs: Report of the Meeting on Mitigation.	
Description of results: The main results achieved during reporting period include: dissemination of information on ABC for wider audience; highlighting it as a regional and emerging issue.	
What extent the activities so far has lead to fulfilment of the programme purpose: The discussions at the December meeting has lead to a better understanding of the way forward and how the “awareness and mitigation Programme” be designed and how the outcomes of the impact assessments studies could be translated into policy packages for decision makers and for awareness building.	
Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme) The firm information (from impact assessment programme) based on sound science (from observation programme) will be utilise to design the awareness, outreach and mitigation programme. The Science	

<p>Team meeting provides the forum for coordination among the various programmes of Project ABC.</p>
<p>Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed work plan)</p> <p>Project activities are on track.</p>
<p>Finances: (is the financial plan being adhered to - are there any difficulties?)</p> <p>Till date, the financial plan has been adhered to.</p>
<p>Plans for next 12 months:</p> <ul style="list-style-type: none"> - Initiation compilation of existing mitigation measures. - initiate studies on economic impacts of ABC - Establish a home page for ABC at UNEP web site - Establishing a home page for the aerosol and precipitation chemistry part of ABC - Present ABC at the major forums and bilateral discussions
<p>Issues related to HIV/aids, gender, equity and poverty</p> <p>There will be an effort to include female scientists in the awareness and mitigation programme.</p>
<p>Other information:</p>

5. Financial Report

To be completed.

Attachments

Annex 1

Logical Framework Analysis of the Project ABC

LOGICAL FRAMEWORK LEVEL	INTERVENTION LOGIC	OBJECTIVELY MEASURABLE AND VERIFIABLE INDICATORS	SOURCES OF VERIFICATION	IMPORTANT ASSUMPTIONS/EXTERNAL FACTORS
OVERALL OBJECTIVE 1.1	Promotion of sustainable development through (i) better understanding of aerosols which is an issue of global significance, (ii) build the capacity in the region to study the issue on a long term basis (iii) promotion of mitigation options.	National plans for emission reduction	Published government and scientific reports	National governments will incorporate ABC recommendations into their sustainable development strategies.
PROJECT PURPOSE 2.1	Increase understanding of impacts of ABC and develop and implement mitigation measures for emission reduction	Reports on the development of capacity and mitigation measures and the implementation of relevant actions in the region by governments	Assessment by project members	Closed collaboration from all the participating parties.
OUTPUT 3.1	Increased capacity to study ABC in the region	Established aerosol monitoring observatory stations Established precipitation chemistry observatory stations Trained expertise to operate the station in the region	Progress and technical reports on the aerosol monitoring Progress and technical reports on the precipitation chemistry observatories Reports and publications of scientists from the region	Close cooperation from National governments and other collaborating partners in establishing the observatories; financial support from the donors.

LOGICAL FRAMEWORK LEVEL	INTERVENTION LOGIC	OBJECTIVELY MEASURABLE AND VERIFIABLE INDICATORS	SOURCES OF VERIFICATION	IMPORTANT ASSUMPTIONS/EXTERNAL FACTORS
OUTPUT 3.2	Increased understanding on the impacts of ABC on health, agriculture, and water budget.	Projected trends, Impact assessments, and trained scientists	<p>A comprehensive scientific report on the impacts of haze on health</p> <p>A comprehensive scientific report on the impacts of haze on agriculture</p> <p>A comprehensive scientific report on the impacts of haze on water budget</p> <p>Publications from scientists in the region.</p>	Sufficient information will be available for impact assessment
OUTPUT 3.3	Knowledge concerning mitigation measures developed and effectively communicated to decision makers and general public.	<p>Available mitigation measures- Adoptable alternative scenarios, strategies, and recommendations</p> <p>Increased government attention – number of projects focused on mitigation</p> <p>Increased media attention – volume and quality of coverage</p>	<p>Reports and demonstrations on policy actions, mitigation options, renewable and alternative energy scenarios</p> <p>Assessment by project members: government initiatives focused on mitigation.</p> <p>Assessment by project members: number of newspaper articles, Radio/TV reports</p>	The outcome of the project fits the requirements for emission reduction and sustainable development

LOGICAL FRAMEWORK LEVEL	INTERVENTION LOGIC	OBJECTIVELY MEASURABLE AND VERIFIABLE INDICATORS	SOURCES OF VERIFICATION	IMPORTANT ASSUMPTIONS/EXTERNAL FACTORS
ACTIVITY 4.1	Conduct aerosol and precipitation observatory programmes together with capacity building activities for scientists in the region.	4 observatories for aerosol monitoring	<i>Data reports from the observatories; biannual progress reports.</i>	Active participation of participating organizations, related countries, consultants, and other stakeholders in the activities
		4 observatories for monitoring precipitation and aerosol chemistry	<i>Data reports from the observatories; biannual progress reports</i>	
		Training programmes	Report of the training	
ACTIVITY 4.2	Conduct impact assessment program (impact on water budget, impact on agriculture, impact on health) together with capacity building activities	Impact assessment study on health	Biannual progress reports	Active participation of participating organizations, related countries, consultants, and other stakeholders in the activities
		Impact assessment study on agriculture	Biannual progress reports	
		Impact assessment study on water budget	Biannual progress reports	
		Impact working group meetings	Biannual progress reports; meeting reports	
ACTIVITY 4.3	Development and compilation of mitigation measures and targeted dissemination	Legal/economic/technological instruments	Technical reports; biannual progress reports	Active participation of participating organizations, related countries, consultants, and other stakeholders in the activities
		Information package for policy makers which include: quantification of pollutant damages and proposed mitigation measures.	Information package; biannual progress reports	
		Awareness programs for head of the governments, parliamentarians, sub regional environment policy dialogues, youth groups and civil societies.	Reports of SEPD and relevant meetings	

Annex 2

Summary Report of the MAC Filed Experiment in Maldives

Annex 3

Report on Assessment of Seven ABC Observatories and Capacity Building

1. Background

Project Atmospheric Brown Clouds (ABC) is a concerted effort among UNEP, an international group of distinguished atmospheric scientists and researchers, 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 in the Asia-Pacific region, a major environmental challenge facing the region. The project is guided by a Steering Committee led by a representative from UNEP and a Science Team led by Prof. V. Ramanathan (chair) and Prof. Henning Rodhe (vice-chair).

Through the capacity building program, which is one of its major programs, the project aims at developing the physical infrastructure, human resources and network of experts and institutions in the Asia-Pacific region to study the science and potential impacts of atmospheric brown clouds in the region. Over the last 4 years since ABC project was conceived in August 2002, about a dozen climate observatories have been/are being established in Maldives (2), Nepal (2), India (2), Pakistan (1), Thailand (1), China (3), Rep. of Korea (1) and Japan (1), as indicated in the map in page 2 (adopted from Ramanathan et al. 2006, submitted to JGR) The local scientists, technicians or resident scientists maintain those stations and carry out measurements. There are number of instruments deployed at those sites for radiation, aerosol species, gas-phase species, precipitation chemistry, and meteorological measurements.

It is crucial that the observatories are properly maintained and high-quality credible data are collected. It is necessary to assess the current status of those observatories and ensure that the management of observatory, operation and maintenance of various instruments, data collection, analysis and storage are harmonized among observatories. As recommended by Prof. V. Ramanathan, and encouraged by Prof. Henning Rodhe the following seven climate observatories were visited recently;

1. Maldives Climate Observatory at Hanimaadhoo (MCO-H),
2. Nepal Climate Observatory at Godavari (NCO-G),
3. Thailand Climate Observatory at Phimai (TCO-P),
4. Indian Climate Observatory at Pune (ICO-P),
5. Indian Climate Observatory at Kharagpur(ICO-K),
6. Korea Climate Observatory at Gosan (KCO-G) and
7. Japan Climate Observatory at Okinawa (JCO-O).

The visits were carried out with the following objectives

1. assessment of the current state of observatories: management, operation and maintenance of instruments, data generation and quality control, and capacity enhancement.
2. preparation for the ABC International Training School to be held in December in Bangkok and Hanimaadhoo.
3. assessment of status of data availability for archival at UNEP RRCAP.

This report summarizes the assessment of current state of the observatories, concerns raised by the local partners and some recommendations for harmonization among the sites. The possibility of establishing centralized data archival at UNEP RRCAP is also discussed.

2. Visit to Maldives Climate Observatory at Hanimaadhoo (MCO-H)

2.1 Site

In Maldives, ABC has two observatories, (i) Maldives Climate Observatory at Hanimaadhoo (MCO-H) (6.78°N, 73.18°E) in Hanimaadhoo Island near the northern end of Maldives, and (ii) Maldives Climate Observatory at Gan (MCO-G) (0.69°S, 73.15°E) south of equator. The MCO-H is a super observatory of Project ABC.



2.2 Visit and Meeting

MCO-H was visited during 2-6 September 2006.

Meeting:

- (i) Mr. Praveen Siva, Resident Scientist and 3 Technicians at MCOH. Praveen provided the details on instrumentation at MCO-H. It was a good opportunity to get a complete picture of a number of instruments that are being deployed at this world-class observatory. Three technicians at MCO-H were also consulted regarding their responsibilities.
- (ii) Mr. Abdul Muhusin Ramiz, Deputy Director of the Department of Meteorology, Male'. The issues at MCO-H and the upcoming training school were also discussed with him.

2.3 Current Situation

Mr. Praveen Siva, who is a resident scientist at MCO-H, looks after the operation and maintenance of instruments. He also supervises and trains 3 technicians from the Meteorology Department of Maldives. Meteorology Department has provided 3 technicians, 4 security guards, 2 house keepers and 1 office boy. Three technicians are able to assist Praveen in changing filters, collecting precipitation samples and store them, and cleaning inlets and domes etc. Mr. Hung Nguyen from C4 is the manager of the site. MISU has assigned Dr. U. Kulshrestha from IICTM to supervise the operation of instruments and quality control of aerosol and precipitation measurements. More than 40 state-of-the-art instruments are being operated at MCO-H and MCO-G. This site generates about 20 MB data every day.

2.4 Concerns

Three technicians provided by the Department of Meteorology do not have the proper background and qualification who can understand the basic science of those instruments deployed at MCOH. They are capable of changing filter, collecting rain samples and aerosol samples. They are being trained but they will not be able to operate other instruments in the absence of resident scientist.

2.5 Recommendations

In the absence of resident scientist, there will be a serious shortage of a local technician/scientist who can run the observatory. It is therefore crucial that Meteorology Department should assign a person with proper background and qualification (preferably a graduate), and dedicate him for the training with the assistance of resident scientist so that he/she can operate the instruments and keep the observatory running in the absence of resident scientist. MCO-H is a super observatory and it has been used a training facility during ABC training school and a venue for meeting of high level delegates including UNEP Executive director. During this visit it was felt that the observatory needs a storage room. Mr. Muhusin informed that the Meteorology Department will construct a storage room behind the main observatory building, possibly in 2007.

3. Visit to Nepal Climate Observatory at Godavari (NCO-G)

3.1 Site

There are two ABC observatories in Nepal, (i) Nepal Climate Observatory at Godavari (NCO-G) (27.59°N, 85.38°E) in Kathmandu which is operated by ICIMOD (International Center for Integrated Mountain Development), and (ii) Nepal Climate Observatory at Pyramid (NCO-P) (27.95°N, 86.82°E) at the base of Mt. Everest, which is a high altitude (5,079 m asl) observatory, and it is operated by Ev-K²-CNR (Italy).



3.2 Visit and Meeting

The NCO-G was visited in 21-22 September 2006.

Meeting:

Ms. Bidya Banmali Pradhan (main person for ABC activities), Pradeep Dangol (data analyst), Narendra and Purna (Technicians), and Basanta Shrestha (Head of MENRIS) at ICIMOD.

3.3 Current Situation

Five persons, 2 professional (Bidya and Pradeep) and 3 technicians (Purna, Jeevan and Narendra) are involved in ABC activities at ICIMOD. Mr. Pradeep Dangol has been selected for the ABC training School. Nobody from the government agencies is involved so far. Radiation measurements are carried out at the ABC tower in the premises of ICIMOD headquarters at Khumaltar, while other instruments are deployed at Godavari, a field site of ICIMOD, which is in the outskirts of Kathmandu valley. There are a number of state-of-the-art instruments at ICIMOD HQ and Godavari. MISU has assigned Dr. U. Kulshrestha from IICTM to supervise operation of instruments and quality control of aerosol and precipitation measurements at this site. Radiation measurements are carried out with the help of C4, UCSD. This site generates about 6 MB data everyday. The data and the samples are sent to respective institutes in US and Sweden for post-sampling analysis and further analysis.

3.4 Concerns

The instruments at Godavari are housed in a non-air-conditioned room. Also, this room, which is a part of a conference room, is not originally designed as a shed for housing instrumentation

It is quite common to have 2-3 hours load (Power) shading in Kathmandu during dry season. This has become a problem for continuous operation of instruments. They have tried with several back up batteries; however it is still not sufficient to last for several hours.

There has been a significant enhancement in knowledge of the local scientists in terms of atmospheric issues and familiarity with radiation, aerosol and precipitation instrumentation. However, they feel that an intensive training on operation and maintenance of specific instruments would be beneficial. It is expected that ABC training school will partly solve this issue. In the ABC research, ICIMOD wants to see the effects, if any, of ABC on mountain environments.

3.5 Recommendations

The scientists at ICIMOD are interested to have a sunphotometer (CIMEL) or sky radiometer at ICIMOD. Prof. Tamio Takamura has shown interest (during my visit to Okinawa) to assist in deploying a Skynet radiometer in Kathmandu, provided the financial resources are arranged. He has also indicated that JICA has provided funds in the past to purchase radiometers for the developing countries. UNEP may wish to approach JICA for financial support.

4. Visit to Thailand Climate Observatory at Phimai (TCO-P)

4.1 Site

The TCO-P (15.18°N, 102.56°E) is located in the vast plain with the agricultural setting about 400 km to the northeast of Bangkok. It was established in collaboration with Prof. T. Nakajima (University of Tokyo) and Prof. T. Takamura (Chiba University).



4.2 Visit and Meeting

The TCO-P was visited in 21-22 October 2006.

Meeting:

Ms. Boosarasiri Thana, person in-charge for the observatory and Mr. Akkaneewut Chabangborn, a project assistant from Chulalongkorn University, Bangkok.

4.3 Current Situation

The observatory has a nice two-story building with air-conditioned rooms and regular power supply. The site has a set of state-of-the-art instruments. Operation, maintenance and repair of the existing instruments are carried out with the help of Japanese collaborators. UNEP RRC.AP, C4 (UCSD) and Chulalongkorn University have agreed to augment this site with additional instruments.

Only 3 people from Thailand (Thana, a student and an assistant from Chulalongkorn University) are involved with the measurements at this observatory. Government agencies are not involved yet. It does not receive financial support from government. However, TCO-P is located next to Royal Rain-Making Research Center, and its staff provides security to TCO-P.

This site generates about 10 MB data everyday. The data is transferred to Chulalongkorn University (Thailand) and Chiba University (Japan) via satellite, and quality check and further analysis is carried out at those two Universities.

4.4 Concerns

Currently, local scientist/technicians from Chulalongkorn University visit the observatory on a regular basis and ensure proper operation of instruments. The existing instruments are continuous or semi-continuous those require minimal human supervision. If the instruments that require day to day operation and supervision, such as 24-h filter sampling, then the observatory will require a resident scientist.

4.5 Recommendations

This is an excellent and only one ABC observatory in a unique location in Southeast Asia. It may be a good idea to augment this observatory with filter based aerosol sampling for chemical analysis and instruments for aerosol number size distribution. However, it is also critical to make sure that the local scientists, whose number is very limited, can operate and maintain those instruments.

5. Visit to India Climate Observatory at Pune (ICO-P)

5.1 Site

ICO-P has been proposed to be a new ABC observatory in India. The site ($18^{\circ} 21' N$, $73^{\circ} 45' E$) is located on a hill top (1,450 m asl) in Sinhagad about 40 km from Pune city. Prof. Henning's group (MISU) is operating some instruments under ABC at Sinhagad in collaboration with Indian Institute of Tropical Meteorology (IITM), Pune. This is a unique location which experiences maritime air mass from southwest with minimal continental influence and continental air mass from other sectors. The fog and clouds can be directly sampled at this site as fog and clouds frequently engulf the site.



5.2 Visit and Meeting

ICO-P was visited on 30 November 2006.

Meeting: Prof. P.S.C. Devara (main person for ABC activities at Pune), Dr. P. E. Raj, Mr. Momin, and Mr. Krishnakant Budhavant, ABC project assistant, and Dr. B. N. Goswami, Director, IITM

5.3 Current Situation

The IITM, Pune has an impressive set of different types of Lidars and other instruments for radiation, aerosol optical depth and aerosol measurements, as well as instruments for storm research at the IITM complex in Pune. There are excellent groups of scientists dedicated to atmospheric research. The Sinhagad site has only a couple of instruments [PSAP, Black carbon, High Volume Sampler, GRIMM aerosol analyzer is also being operated on some occasions, Rain water collector, Cloud water collector and Automatic Weather Station) that are housed in a small room provided by the telecommunication company. The room is not air-conditioned; through it could be air-conditioned if needed. The telecom/TV tower has been utilized to mount radiation instruments. Prof. Devara supervises the ABC activities at this site, and Mr. Krishnakant and other technicians maintain and operate the instruments. Mr. Krishnakant has been selected for ABC school. MISU has assigned Dr. U. Kulshrestha from IICTM to supervise operation of instruments and quality control of aerosol and precipitation measurements.

The Sinhagad station generates 2-5 MB data daily.

5.4 Concerns

The existing infrastructure may not be adequate to deploy more instruments.

Dr. Goswami, the director of IITM clearly mentioned that he didn't like the idea of collecting samples at the site and sending abroad for further analysis. "As long as there are facilities available in IITM the post-sampling analyses should be carried out at IITM", said Dr. Goswami.

5.5 Recommendations

This site could be augmented with radiation instruments which do not require frequent maintenance or day-to-day human supervision.

As the site is about 40 km from the city, and day to day commute is quite inconvenient, deployment of instruments, such as PM10, PM2.5 filter samplers, that require daily operation seems in appropriate at the moment unless some solution is proposed by IITM.

It is important that we should clarify the issue of sample collection and analysis, in other word the role of this observatory. This is in fact the concern of other observatories as well.

6. Visit to Indian Climate Observatory at Kharagpur (ICO-K)

6.1 Site

IIT Kharagpur (IITKgp), which is about 150 km to the west of Kolkata (Calcutta) City, is surrounded by a vast area of agricultural setting in the great Indo-Gangetic plain. Indian Climate Observatory at Kharagpur (ICO-K) has been proposed to be a new ABC observatory in India.



6.2 Visit and Meeting

The ICO-K was visited on 1 Nov 2006.

Meeting:

Dr. A. N. V. Sataynarayana, Assistant Professor at CORAL (Center for Oceans, Rivers, Atmosphere and Land Sciences). He will be the main person for ABC activities at ICO-K.

Prof. S.K. Satsangi, Head of CORAL, and Dean of Post Graduate Studies and Research.

Prof. P.C. Pandey, CORAL

Dr. M. Mandal, Visiting Faculty, CORAL

Prof. R. K. Panda, Dept. of Agriculture and Food Engineering

Prof. S. K. Dube, Director, IIT Kharagpur.

6.3 Current Situation

ICO-K has been proposed to be an ABC observatory. There are so far no instruments under ABC project. The group of scientists at IITKgp will soon set up a 30-m tall tower at the site within IITKgp campus premises (shown in the picture) with various instruments under the “Storm Research Project”. There are weather and radiation data available for some time that has been basically used for agrometeorology research. The data can be shared with future ABC activities. IITKgp has an excellent group of experienced scientists as well as active new faculty members at IITKgp who are interested in ABC related research. Dr. Sataynarayan has been selected as a participant for the ABC training school. This will be an excellent opportunity for him to be familiar with the various aspects of atmospheric brown cloud issue as well as the instruments used to measure various parameters.

The scientists at CORAL and the IIT Kgp administration, including Prof. Satsangi and Prof. Dube are willing to provide any assistance they could provide to set up new ABC observatory.

6.4 Concerns

The main concern is a limited physical infrastructure such as a tower or a permanent building for housing various instruments. There is a building across the road from the proposed site for the tower that may be used to house the instruments and as a control room as Dr. Sataynarayan and colleagues described during visit. It is in fact too far from the proposed tower, if we intend to install aerosol instruments in the future.

6.5 Recommendations

1. This is an excellent location for setting up ABC observatory in the Indo-Gangetic Plain, which is of great interest to ABC research in particular impacts of ABC on agriculture. Certainly, the proposed observatory will be a valuable asset to project ABC and IIT Kgp.
2. If IIT Kgp is to be selected as a new ABC site, it is necessary that the minimum physical infrastructure in particular the shed (or Van) with the tower and sampling lines should be constructed first.
3. We may start at the beginning with a couple of radiation instrumentation and meteorological measurements, and gradually add aerosol instruments and instruments for gaseous species as the group of scientists at IIT Kgp acquire the knowledge to operate, maintain and collect quality data out of those instruments.

7. Visit to Korea Climate Observatory at Gosan (KCO-G)

7.1 Site

KCO-G (126.16°E, 33.29°N, 72 m above msl) is located on the western tip of Jeju island. The location of this site is unique as it is situated about 100 km south of the Korean peninsula, 250 km west of Kyushu, Japan, and 500 km east-northeast of Shanghai, China, a heavily industrialized region in China. This is another ABC super observatory.



7.2 Visit and Meeting

The KCO-G was visited on 10 November 2006.

Meeting:

Prof. Soon Chang Yoon and Prof. K.R. Kim from Seoul National University, and Prof. Chang-Hee Kang from Cheju National University. Prof. Yoon and Prof. Kim are science team members of Project ABC.

7.3 Current Situation

One of the ABC sheds with a 16-m tower is located besides other sheds that house several instruments for radiation, aerosol species, and meteorological parameters. The aerosol instruments are yet to be installed. Another shed, which is under construction, will house various instruments to monitor various gaseous species. There are a couple of other sheds with a suite of instruments maintained by Ministry of Environment. The data collected by Ministry and Meteorology Department can be shared said Prof. Yoon and Prof. Kim. The ABC observatory and other

There is a resident scientist who looks after the day-to-day operation and maintenance of the ABC observatory and the instruments. Prof. Yoon, Prof. Kim and their graduate students are involved with ABC activities and data analysis.

7.4 Concerns

Since the ABC observatory is under construction and there is a strong group of Professors and scientists, including Prof. K.R. Kim and Prof. S.C. Yoon, in Rep. Korea who are involved in atmospheric research, there is nothing significant that we should be concerned with.

7.5 Recommendations

This is a site in an exceptional location in East Asia where continuous increase in atmospheric pollution in the recent years due to impressive development activities especially in China has gathered attention of people of various walks including scientists, policy makers and general people at large. Therefore, this observatory should be equipped as soon as possible with a suite of instruments for radiation, aerosol and gaseous species measurements. This observatory will certainly generate a valuable dataset.

The expertise of Korean scientists and experiences gathered at this site may be used to improve the conditions of the other observatories and harmonize them among others.

8. Visit to Japan Climate Observatory at Okinawa (JCO-O)

8.1 Site

The observatory is located at Cape Hedo (28.87 °N, 128.26 °E) in the northwest corner of Okinawa Island in Japan. This observatory is known as Cape Hedo Atmosphere and Aerosol Monitoring Station (CHAAMS). This site is located in a unique and location for atmospheric studies as this site receives frequently the heavily polluted continental air mass mainly from China to the west of the site in addition to chiefly maritime air mass from other sectors.



8.2 Visit and Meeting

The JCO-O was visited on 11 November 2006.

Meeting:

Prof. Tamio Takamura of Chiba University and Dr. Shiro Hatakeyama from National Institute for Environmental Studies (NIES), Tsukuba, Japan. Prof. Takamura is a key person for SKYNET radiometer networks, and Dr. Hatakeyama is a Chief of Asian Atmosphere Section at NIES.

8.3 Current Situation

There are almost 3 dozen instruments deployed at CHAAMS by a couple of Japanese research groups. The list of instruments at this site is given in Annex 5. There are strong groups of Professors (for instant Prof. T. Nakajima, Prof. T. Takamura, and Dr. S. Hatakeyama), researchers, and graduate students in Chiba University and NIES involved in the ABC related activities in Okinawa site and data analyses.

Depending upon the deployment of various instruments this site generates a vast amount of radiation, aerosol optical depth, gaseous and aerosol species and meteorological data.

8.4 Concerns

Prof. Takamura mentioned that the data generated at the CHAAMS could be shared with other ABC partners and also be made public through a common repository site such as one at UNEP RRCAP. The main point that Prof. Takamura was concerned was the quality of data, i.e., we need to maintain a standard protocol operation of various instruments at various ABC sites. Once the data quality is ensured then such credible data can be shared.

8.5 Recommendations

This site, which has a most complete set of measurements among the 7 sites visited recently, will be a valuable asset to the Project ABC. The atmospheric data collected at the site are extremely important to understand the ABC issue in northeast Asian region.

The experiences gathered at this site and the expertise of the Japanese groups can be used to design common standard protocols for instrument operation and maintenance, and also data reporting formats.

9. Recommendations

Project ABC has provided a unique and unprecedented opportunity to collect the atmospheric data in the Asia-Pacific region in particular South Asia which is one of the least sampled atmosphere in the globe. There is no doubt that the project has contributed valuable findings and knowledge to the scientific community. Such findings will certainly help design policy options that are based on sound scientific assessments to mitigate atmospheric pollution in Asia and the Pacific region.

Most of the participating countries in the region, research institutions and local scientists and technicians have found ABC project an excellent platform for the physical capacity building as well as human resource development in the atmospheric issues. In order to collect the credible data, which is vital for anything we want to generate out of ABC project, as well as for the capacity building, the following points are recommended which are based on my impression during my visits to 7 ABC observatories that Science Team and UNEP may wish to consider.

- i. **Data:** The quality of data is ensured only through an uncompromised adoption of Standard operating protocols for various instruments deployed at various ABC observatories. The standard and uniform operating conditions among all ABC observatories, such as air-conditioned rooms, will also lead to generation of credible and precise data. It is thus recommended that Project ABC needs to develop a guideline for the operating conditions of the observatories, as well adopt uniform and standard operation and maintenance protocols for the various instruments deployed/ or to be deployed at ABC observatories.

Once the data quality is assured, it will be equally important to have a standard data reporting format so that the data generated at ABC observatories can be stored and made public through servers such as eKH (Environment Knowledge Hub) at UNEP RRC.AP. Science Team may wish to form a task force to design the data reporting format.

There should also be a clear policy on data management, for example, when and how to make them public.

- ii. **Capacity building and role of observatories:** There is no doubt that there has been tremendous progress in capacity building at the local level through Project ABC. However, it is felt during the visits that some of the partner scientists and institutions were not clear on the role of their observatories, and they have many expectations. It is thus felt important that we should clearly define the capacity building program. In other words, what are the things we want to accomplish in each observatory/country through capacity building program? This will depend pretty much on how we define the role of each observatory.
- iii. **Approach JICA:** During the visit to Japan Climate Observatory at Okinawa (JCO-O), Prof. Tamio Takamura from Chiba University, who is one of the key persons of SKYNET, a network of sky radiometers and radiation instruments to understand aerosol-cloud-radiation interactions, has mentioned that he could help install SKYNET Sky Radiometers, provided there is a financial support for this. He mentioned that JICA had provided financial support to the developing countries, for example China, to purchase, install and maintain Sky Radiometers. UNEP may wish to approach JICA for the financial support to install such radiometers at existing or proposed ABC sites such as Godavari, Kathmandu (Nepal) and IIT Kharagpur (India).

Annex 4

DISCUSSION RECORD

Ad Hoc Meeting of ABC Science Team

Miracle Grand Hotel, Bangkok

06 December 2006

An Ad hoc meeting of the Project Atmospheric Brown Cloud (ABC) Science Team (ST) was held in Bangkok on 6 December 2006. The meeting was attended by ST members and UNEP (see at the end of report). The meeting was chaired by Prof. Ramanathan, ABC ST Chair.

Major Discussions and Conclusions

- a) Introduction: Prof. Ramanathan, ABC Science Team Chair, during his introductory remark, expressed the satisfaction that Project ABC has completed phase I and requested the meeting to focus on development of the phase II. ABC Science Secretariat in collaboration with ABC-Asia Secretariat will send a formal letter requesting the national science teams to provide their plan for the next 4 years.
- b) Video Conference with the UNEP Executive Director: Surendra Shrestha, UNEP Regional Director, provided a brief on the Video Conference held on 5 December between the UNEP Executive Director (ED) and ST Chair and ST Vice-Chair. The brief included: (i) the ED expressed his appreciation to the ST for partnership with UNEP in bringing out the science of the ABC; (ii) the ED also stated that UNEP is fully committed to take the ABC program into the next phase in the coming four years; and (iii) first draft of a comprehensive proposal for the next 4 years will be prepared by March 2007.
- c) Progress on impact assessment studies (Health): Prof. Rodhe provided a brief update on the progress in the health impact assessment study. Progress included: (i) Chulabhorn Research Institute (CRI), as the lead regional institute for health impact assessment study, has started the preparation of assessment report; (ii) outline of the health impact assessment report has been completed by the CRI; and (iii) the first draft report will be available by March 2007. The meeting made the following decisions and recommendations:
 - Prof. Rodhe, with inputs from Prof. Schauer, will serve as the lead ST member for the health impact assessment programme;
 - linkage between ABC and health is weaker in the current draft outline and therefore more focus on ABC is required;
 - health impact assessment network needs to be expanded by including additional experts from India (Dr. C. Sharma) and RAPIDC programme (Prof. Frank Murray); and
 - UNEP will send a letter to CRI informing the recommendations from this meeting.
- d) Progress on impact assessment studies (Agriculture): Prof. Ramanathan and Prof. Mitra provided a brief update on the progress in the agricultural impact assessment study. Progress included: (i) Indian Agricultural Research Institute (IARI), as the lead regional institute for agricultural impact assessment study, has started the preparation of assessment report; (ii) agricultural impact study is currently focusing on two major crops, rice and wheat, for 2 sessions, summer and winter respectively; and (iii) Interim report will be completed by March 2007 and the report will be updated in July by including results from modeling activities. The meeting made the following decisions and recommendation:
 - Prof. Ramanathan will serve as the lead ST member for the agricultural impact assessment programme; and

- Dr. Reiner Wassmann of IRRI, Dr. David Dawe of FAO, and Dr. Sikka of India will serve as the advisors for the agricultural impact assessment study.
- e) Progress on impact assessment studies (water): Prof. Ramanathan provided a brief update on the progress in the water impact assessment study. Progress included: (i) ABC Science Team Chair and UNEP visited Nanyang Technological University (NTU), Singapore in August 2006 to discuss their interest to participate in the water impact assessment study; (ii) and Currently NTU is being considered for the regional lead institute.
- It was decided that Prof. Nakajima will serve as the lead ST member for the water impact assessment programme.
- f) Progress on observatory programme: Prof. Rodhe, Prof. Nakajima, Hung, Prof. Ramanathan, and Maheswar presented the progress on precipitation chemistry observatories, East Asian Regional Experiment (EAREX), aerosol observatories, Pyramid observatory, and assessment of ABC observatories and capacity building, respectively. It was followed by updates on national observatory programmes in India, Japan, and Rep. of Korea by Prof. Mitra, Prof. Nakajima, and Prof. Kim, respectively. The meeting made the following decisions and recommendations:
- One scientist from Ev-K²-CNR committee (Pyramid observatory) will be invited to join the ST;
 - Results of regional field experiments of project ABC will be published through Journal of Geophysical Research (JGR) in June 2007.
 - UNEP will discuss the possibility of including ABC into Global Earth Observation System of Systems (GEOSS);
 - ABC could be highlighted during the celebration of Earth Year during 2007-2009. Major celebrations will be held during 2008;
 - UNEP will establish ABC data archival system at its Regional Resource Center in Bangkok. Activities will start with compilation of existing papers and data bases into a data CD. UNEP will coordinate the activities with inputs and guidance from Prof. Kim for Northeast Asia, and Hung for South Asia. The data CD will be released together with a news release;
 - Prof. Ramanathan will consult with ABC ST members from China on strengthening the ABC observatory programme in China; and
 - Prepare a comprehensive four year program that includes the science and observation; impacts and initiation of policy dialogue for mitigation and prevention by the end of 2007.
- g) Communications: The meeting discussed the need to improve the communication between the lead institutions for the impact assessment studies and the ST. Major decisions and recommendations include:
- ST has assigned a lead ST member for each of the impact assessment studies. These ST members will serve as the communication focal points for their respective impact assessment studies.
 - Lead institutions for the impact assessment studies will be requested to assign focal points for communication.
 - The meeting requested UNEP to establish an intra-net for impact assessment programme. The intra-net will facilitate information sharing between ST and impact assessment experts and provide a venue for discussion among the impact assessment experts and ST.
 - UNEP will inform these decisions to lead impact assessment institutions.

- h) Training School: Prof. Lawrence provided a brief on the 2nd ABC training school organized during 4-14 December. Prof. Mitra, during his presentation on national (Indian) ABC programme, invited the ST and UNEP to organize the 3rd Training school in India during a national ABC training programme scheduled to be held in Darjeeling. The meeting made the following decision and Recommendation:
- Training school could be organized every 2 years. A working group comprising the course directors and organizers (C4 and UNEP) will be established one year in advance for organizing the 3rd training school.
 - The 3rd training school will be organized in 2008 in Darjeeling, India in collaboration with Indian ABC programme. UNEP was requested to coordinate the organization of the 3rd training programme.
- i) Next ST meeting: It was proposed that the next meeting of the ST be held in August 2007 in Korea.

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Annex 5

Report on the Second International Training School on Atmospheric Brown Clouds (ABC)

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

1. Background

Project Atmospheric Brown Clouds (ABC) is a concerted effort among 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), an emerging environmental challenge. The 3 major programs of the project are 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 the Project ABC has been organizing the International Training School on Atmospheric Brown Clouds at a regular basis. The first training school was organized in October 2004 with active participation of 15 young researchers and graduate students from 7 countries in Asia. As a part of the ongoing capacity building activities of the Project ABC, the 2nd **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), and Swedish International Development Cooperation Agency (Sida). The summary of the training school is presented here.

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 the Science Team Chair (Prof. V.Ramanathan) and Vice Chair (Prof. H. Rodhe), a working group was set up consisting of two course directors and organizers from UNEP and C4 as follows. 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 the 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 merit while maintaining the geographical balance and demographic distribution. A total of 25 participants (10 female and 15 male) from 11 countries (Bangladesh, China, India, Italy, Maldives, Nepal, Pakistan, Rep. of Korea, Thailand, United States, and Vietnam) were selected. The list of the candidates who participated in the training school is presented at the end of the report.

4.2 Resource Persons

There were 16 resource persons including the ST Chair, Vice Chair, ST Members, and other prominent scientists from Asia and outside in the training school. The list of resource persons is presented at the end of the report.

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 in to 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 (MCO-H), a super observatory for the Project ABC.

5.1 Course Lectures

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 provided. 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. The following lectures were delivered, and the detail of those lectures is available in electronic version (compiled in a CD).

- 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*]
- Lecture 4: Recent developments on GHG monitoring (CO₂ 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*]

- 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*]
- 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*]
- 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*]



Course Lecturers and Trainees at UNEP RRC.AP, Bangkok

5.2 Hands-on training

The hands-on training part was conducted from 10 to 14 December at Maldives Climate Observatory in Hanimaadhoo, The Maldives. The training part was divided into 4 courses as follows, and thus participants were also divided into 4 smaller groups accordingly such that each participant gets an opportunity to handle each set of instruments for a day. The groups were rotated so that all will be exposed to all MCOH instruments. The following is the course outline.

- 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 MCO-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. The trainees 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 participants listening to an instructor at MCOH

The participants collected the data with various instruments and analyzed the data. 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 sunphotometer, global, direct and diffuse fluxes in the short and long-wave bands with pyranometers, pyrhelimeters, and Meteorological observations. They were able to compute parameters such as single scattering albedo, Angstrom coefficient, and radiative forcing.

The participants also learned how to interpret their results with the aid of other simultaneously measured parameters. 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. Every participant was given a chance to present the data analysis result.

At the end of the program, the participants briefly presented their research activities, and explained 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 play with instruments, collect data, analyze and interpret them.

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 Shtrestha, 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 both part as unsatisfactory or as poor.

7. Certificate of Participation

UNEP issued the certificate of participation to all participants who completed the training school successfully.

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Annex 6

DISCUSSION RECORD Meeting on ABC Health Impact Assessment Chulabhorn Research Institute (CRI), Bangkok;

4 December 2006

A meeting on the health impact assessment programme of the Project Atmospheric Brown Cloud (ABC) was held in Bangkok on 4 December 2006. The meeting aimed to agree on the structure and coverage of the health impact assessment report, and provide the guideline towards the same. The meeting was attended by the members of ABC Science Team (ST), Chulabhorn Research Institute (CRI), and UNEP (annex 1). The meeting was chaired by Prof. Nay Htun, International Advisor to CRI.

Major Discussions and Conclusions

- i. Draft Outline for the Report on Health Impact Assessment and Status of Preparation: Dr. Settachan of CRI presented the draft outline for the report on health impact assessment. The meeting reviewed the outline and advised that the following recommendations be considered for further development of the outline.
 - Project ABC is moving towards a policy dialogue in 2008. The health impact study is an important document to be presented to the policy makers during the policy dialogue;
 - The connection between ABC and human health is strengthened in the proposed outline. ST has conducted modeling studies on ABC;
 - A section on ABC and air pollution could be included;
 - ABC plays a major role in human health effects in rural areas. Therefore, the study should consider health impacts in rural areas as a priority area.
 - ABC has impact on climate change. Climate change effects on health could also be discussed in the assessment report.
 - ABC could affect human health through its impacts on water budget and agriculture. Such indirect effects could also be indicated in the assessment report;
 - CRI will revise the outline of the report based on the discussions at this meeting.
- ii. Concept note on ABC and Human health: Prof. Schauer presented a concept note on ABC and human health. The meeting agreed that the concept paper will be a useful input in developing the health impact assessment report by CRI.
- iii. Coordination and network: The meeting discussed the establishment of a coordination mechanism for conducting the health impact assessment study under the project ABC. Following decisions and recommendations were made on coordination;
 - Experts from South Asia and Regional Air Pollution in Developing Countries (RAPIDC) programme need to added to the existing network members;
 - ST members could be invited to attend the next authors meeting on ABC health impact study;
 - The scientific papers and reports on ABC will be collected and shared with the authors;
 - CRI will share the outcome of this meeting with the chapter authors;
 - A 2-3 page summary on the ABC health impact assessment programme will be presented to the next Ministerial Forum on Environment and Health scheduled to be held during 25-27 April 2007 in Bangkok.
 - Coordination among ABC impact assessment studies: UNEP, the Secretariat for the ABC impact assessment study, will develop an intranet for impact assessment studies by Feb

2007. ABC related documents will be made available through this intranet. In addition, the intranet will also provide discussion forums on each of the impact assessment studies.

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DISCUSSION RECORD
Meeting on ABC Agricultural Impact Assessment
Miracle Grand Hotel, Bangkok,
5-6 December 2006

A meeting on the agricultural impact assessment programme of the Project Atmospheric Brown Cloud (ABC) was held in Bangkok during 5-6 December 2006. The meeting focused on formulating a framework for the assessment of the impacts of atmospheric brown clouds (ABC) on agriculture production in Asia. The meeting was attended by the scientists from Asia and other regions who are working in the field of agriculture impacts of air pollution, ABC Science Team (ST) members and UNEP (annex 1). The meeting was co-chaired by Dr. A. K. Singh and Dr. N. Kalra, both from the Indian Agricultural Research Institute (IARI) which has been designated as the regional lead institution for ABC agricultural impact assessment study.

Major Discussions and Conclusions

i. Contents of the impact assessment report: Dr. N. Kalra presented the proposed contents of the agricultural impact assessment report. The meeting made the following recommendations for further development of the report:

- Frequency and severity of natural disasters are increasing. Grain storage is going down and food security has become an emerging issue. The assessment report should clearly come up with estimates on how much of the current food security issue is due to ABC, and also advise what are the policy options for the policy makers;
- The new IPCC report on the impact of climate change is expected to be released in January 2007. Since ABC and climate change have combined effect on agriculture, findings of the new IPCC report will be a useful reference material for the ABC agriculture impact report;
- Apart from the assessment of the ABC impact on agriculture, the report should recommend research programmes for further study on ABC impacts on agriculture;
- Semi-arid region is one of the hotspot for the ozone impact on agriculture. In this regard, studies conducted by Prof. Kobayasi need to be incorporated in the assessment report;
- Impacts of suspended particulate mater, especially the fly ash, could be highlighted in the report;
- Air pollution has direct impacts on crop yield. However, impact of rainfall mainly affects the crop production through reduction in cultivated area. This indirect effect of rainfall could be considered in the report;
- ABC effects on precipitation and thereby on water availability could be added into to simulation model, if it is not taken care by the soil water balance in the model;
- Data for the aerosol effects on crop yield could be obtained from ABC observatories. Aerosol optical depth data is available from all the ABC observatories. C4 and IRRI will discuss on obtaining this data for the assessment report;
- Land use change could be considered as one the factor affecting the crop yield;
- Study should focus on two major crops and two major seasons: (i) rice crop cultivated during summer rain season; and (ii) wheat crop cultivated during winter rain season; and

- Study should focus on selected regions. The regions should cover both irrigated as well as rain fed crops.

ii. Existing initiatives on agriculture impacts of air pollution: Scientists from Asia and other regions who are working in the field of agriculture impacts of air pollution made presentations on ongoing initiatives and their findings in the ABC impact areas. Ongoing initiatives included:

- Assessment of the impacts of poor air quality to agriculture in Asia by Dr. Lisa Emberson, Stockholm Environment Institute;
- Impacts of climate/climate change on rice production: Previous and envisaged research of the International Rice Research Institute (IRRI) by Reinner Wassmann, IRRI;
- Impact of climate change on agriculture (including hydrological impacts) by A. K. Singh, IARI;
- Impacts of ABCs and GHGs on rice in India by Jeffery R. Vincent, University of California, San Diego (UCSD); and
- Air pollution and agriculture, a cause of national concern: Studies from Indo-Gangetic plain, India by S.B. Agrawal, Banaras Hindu University.

iii. Workplan for the report preparation: Dr. N. Kalra presented a draft workplan for preparing the assessment report. After discussion, the meeting agreed on the following timeline for the report preparation:

- Interim report by 31 March 2007: the interim report will be based on the assessment of current knowledge over the period of 1970 – 2000, and some projections from IRRI models.
- Comments by ST by April 3rd week: interim report will be circulated for comments by ST and other relevant experts, and they will send their comments within 3 weeks.
- Updated interim report by June: updated interim report will include projections and validation results from available models;
- Comments by ST by July 3rd week: updated interim report will be circulated to ST and relevant experts for comments and they will send their comments within 3 weeks.
- Final report will be completed by September 2007.

iv. Report writing: the meeting made the following decisions and recommendations for writing the report:

- A report writing team comprising Dr. Kobayasi, Dr. Lisa, Dr. Vincent, and Dr. Agarwal could be established. IRRI will send invitation letters for each of the members in the report writing team; and
- An advisory team comprising Dr. Sikka, Dr. Wassmann, and Dr. David Dawe could be established.

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Annex 8

DISCUSSION RECORD Meeting on ABC Water Impact Assessment UNEP RRC.AP, Bangkok

7 December 2006

A meeting on the water impact assessment programme of the Project Atmospheric Brown Cloud (ABC) was held in Bangkok on 7 December 2006. The meeting focused on formulating a framework for the assessment of the impacts of Atmospheric Brown Clouds (ABC) on water budgets. The meeting was attended by the members of ABC Science Team (ST), Nanyang Technological University (NTU) and UNEP (annex 1). The meeting was chaired by Prof. Nakajima, the lead ST member for the ABC water impact assessment study.

Major Discussions and Conclusions

- i. White paper: Dr. Wang, Associate Professor at NTU presented the white paper prepared by NTU for conducting the ABC water impact assessment studies. The meeting reviewed the white paper page by page and provided recommendations for further development of the white paper. Recommendations included:
 - o The team which will conduct the water impact assessment could be referred to as water study group.
 - o Scope of the white paper should cover the followings:
 - i. Precipitation and soil moisture
 - ii. Direct effects of ABC on precipitation
 - iii. ABC effects on precipitation through climate change
 - iv. Glacial water and
 - v. Coastal water
 - o The third assessment report on climate change published by IPCC in 2001 include a separate section on Asia and it will be a good reference for the ABC water impact assessment report;
 - o UNEP will assist NTU to obtain the third assessment report and the fourth assessment report when it is published in early 2007;
 - o NTU could use the available model results by the ST and other relevant experts for the preparation of the assessment report;
 - o Detailed scientific activities for conducting the ABC water impact assessment should be given in the section 4.2 and 4.3 of the white paper dated 7 December 2006;
 - o NTU will revise the white paper based on the discussions at this meeting by January 2007.
- ii. Networking on water impact assessment: The meeting discussed the establishment of a network for conducting the water impact assessment study under the Project ABC. Following decisions and recommendations were made on the networking:
 - The partner institutions in the network should cover the major river basins, atmospheric and cloud chemistry, surface water, glacial waters and climate change effects;

- Prof. Nakajima, the lead ST member for the water impact assessment study, will consult relevant institutions and propose a networking structure for the ABC water impact assessment to ST Chair and Vice-Chair; and
- Based on the recommendations from ST Chair and Vice Chair, UNEP will inform NTU on the proposed network and partnership for conducting ABC water impact assessment studies in January 2007.

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Annex 9

DISCUSSION RECORD Meeting on ABC Mitigation Programme UNEP RRC.AP, Bangkok

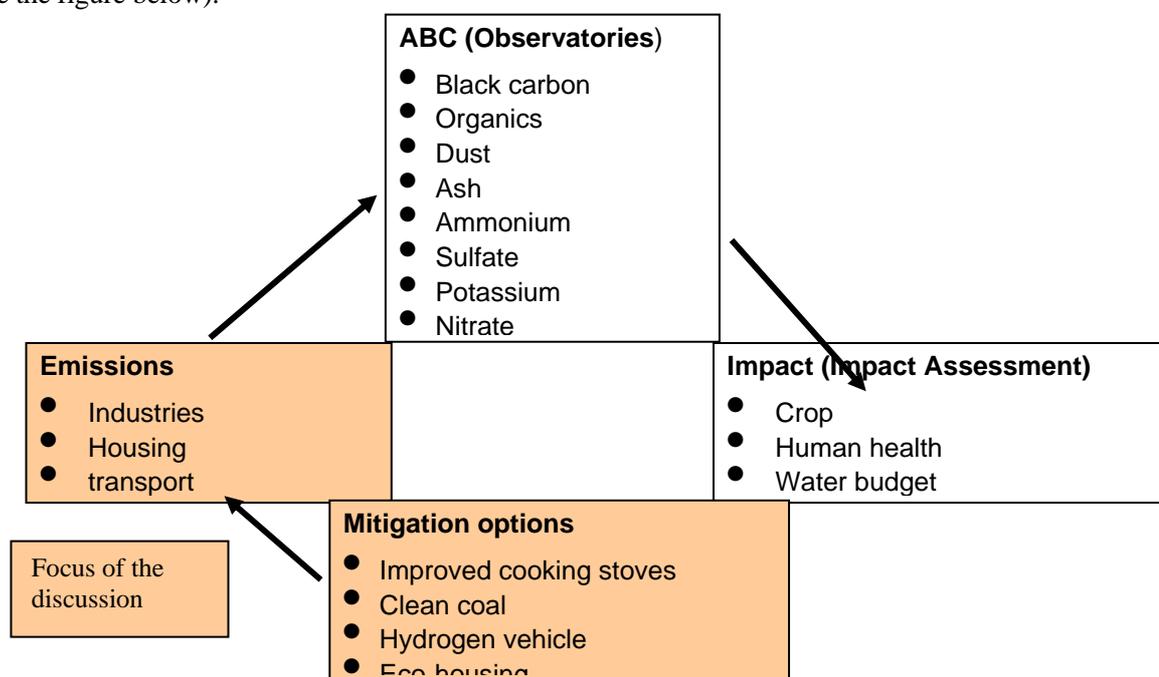
7 December 2006

Project ABC comprises of 3 major programmes: (i) observatory programme, (ii) impact assessment programme, and (iii) awareness and mitigation programme. The observatory programme aims to build the monitoring capacity and data on Atmospheric Brown Clouds (ABC). The impact assessment programme aims to assess the potential impacts of ABC on agriculture, water, and health using the data from the observatory programme. Findings from the impact assessment programme will provide information for policy making through the programme on awareness and mitigation.

An initial discussion on the mitigation programme of the Project Atmospheric Brown Cloud (ABC) was held in Bangkok on 7 December 2006. The meeting focused on estimating emissions under different mitigation and business as usual (BAU) scenarios. The meeting was attended by the members of ABC Science Team (ST), experts at Asian Institute of Technology (AIT) and UNEP (annex 1). The meeting was chaired by Prof. Ramanathan, ABC ST Chair.

Prof. Ram Shrestha of AIT made a presentation on AIT and its activities on modeling and emission estimates. Major discussions included:

- i. Discussions focused on strengthening investigation of the linkages between emissions and concentrations of ABC constituents and its impacts on crop, human health, and water budget (please see the figure below).



- ii. Future studies on emission studies could focus more on black carbon emission as well as emissions from biomass burning.
- iii. Emissions of ABC under different policy scenarios would be conducted. Each scenario should consider major emission sources.

- iv. The ST is widely interested on emission estimates under different scenarios. Prof. James Schauer could be able to provide more details on available emission estimates within the ABC community.
- v. AIT will prepare a concept paper for developing emission estimates under different mitigation scenarios for the consideration by the ST Chair and Vice-Chair.

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