Project Atmospheric Brown Clouds

Annual Report

November 2004 – December 2005

Compiled by the

UNEP Regional Resource Center for Asia and the Pacific

January 2006

Lead institution for Science: Science Team Chaired by Prof. Ramanathan	**Prepared by:** UNEP; Lead Institution for Impacts and Policy

Collaborating Institutions: (name; principal contact)

- ICIMOD, Nepal; Mr. Basantha Shrestha
- Ministry of Energy, Environment and Water, Maldives; Mr. Abdulla Amjad
- Chulalongkorn University, Thailand, Dr. Boossarasiri Thana
- C4/SIO, USA; Prof. Veerabhadran Ramanathan
- Max-Planck Institute for Chemistry, Germany; Prof. Paul J. Crutzen
- University of Iowa, USA; Prof. Gregory Richard Carmichael
- FRCGC, Japan; Prof. Hajime Akimoto
- University of Tokyo, Japan; Prof. Nakajima Teruyuki
- TERI, India; Dr. R.K. Pachauri
- NPL, India; Prof. Ashesh P. Mitra
- Seoul National University, Republic of Korea; Soon-Chang Yoon and Prof Kyung-Ryun Kim
- University of Stockholm, Sweden; Prof. Henning Rodhe
- Peking University, China; Prof. Zhang Yuanhang
- CAS, China; Prof. Shi Guang-Yu

Table of Contents

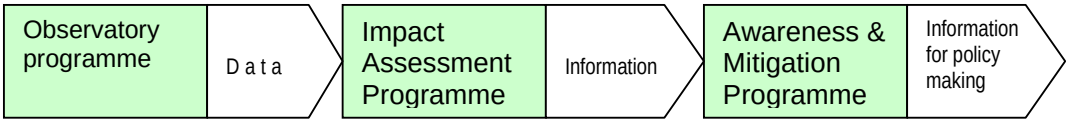
List of Abbreviations

ABC	Atmospheric Brown Cloud
ABC-EAREX	ABC East Asian Regional Experiment
AIT	Asian Institute of Technology
APMEX	ABC Post Monsoon Experiment
C^4/SIO	Center for Clouds, Chemistry and Climate at the 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-K2-CNR	International high altitude research project
FRCGC	Frontier Research Center for Global Change, Japan
IARI	Indian Agricultural Research Institute
ICIMOD	International Center for Integrated Mountain Development
IICT	Indian Institute of Chemical Technology
IITM	Indian Institute of Topical 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
Sida	Swedish International Co-operation Agency
TERI	The Energy and Resources Institute
UNEP	United Nations Environment Programme
WHO	World Health Organization

Executive Summary

The Atmospheric Brown Cloud (ABC), a layer of brownish haze, is caused by air pollution emissions containing aerosol particulates. The brownish haze layer reduces the amount of sunlight that can reach the Earth's surface. Reduction in sunlight can have significant impacts on the terrestrial and marine ecosystems. A preliminary assessment of ABC, has been completed by the INDOEX research. Potential direct and indirect consequences of the haze include regional and global climate change and impacts on ecosystems, the water cycle, agriculture and human health. To address these concerns, a project titled Atmospheric Brown Clouds (ABC) was jointly initiated by UNEP, along with the INDOEX scientists.

Project ABC comprises of 3 major programmes: (i) observatory programme, (ii) impact assessment programme, and (iii) awareness & mitigation programme. The observatory programme aims to build the monitoring capacity and data on 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.



In November 2004, an agreement between the Government of Sweden and the UNEP RRC.AP was signed for the implementation of the project Atmospheric Brown Clouds.

This first annual report consists of: a) introductory section covering the context and aspiration of Project ABC; b) progress (during Nov 04 – Dec 05); and c) proposed activities for the year 2006. There is a section showing the completed reporting templates for each ABC activity. 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 and other relevant information.

Overview Table of ABC Progress November 2004 – December 2005

LFA Output	LFA Activity	Progress of workplan and use of funds	Recent meetings/events	Proposed activities for 2006
1. Increased capacity to study ABC in the region	1.1 Conduct aerosol observatory programme together with capacity building activities	-On Schedule	- Developed MoU with the national institutions in Maldives, Nepal, and Thailand for the establishment of observatories; - ABC Post Monsoon Experiment (APMEX) field campaign held in Hanimaadhoo, Maldives in October – November 2004 (summary report is provided in Annex 4); - Training programme on aerosol measurement held in Hanimaadhoo, Maldives in November 2004 (summary report is provided in Annex 4A); - ABC East Asia Regional Experiment (ABC-EAREX) held in Gosan, Republic of Korea during March – April 2005; - Science Team meeting held in Shanghai, China during 4-5 April 2005 (summary report is provided in Annex 2) - ABC data analysis workshop held in Bangkok, Thailand on 5 December 2005. - Science Team meeting held in Bangkok, Thailand in December 2005 (proceedings is provided in Annex 3)	- Continue operation of observatories - Explore the possibility of establishing additional monitoring stations in high altitude areas - Conduct field campaigns - Science Team meeting
	1.2 Conduct precipitation observatory programme together with capacity building activities	-On Schedule	- The first field test to measure soot in aerosol particles and in rain water was carried out during the APMEX field campaign at Hanimaadhoo in October – November 2004 - Scientists from MISU and IICT visited proposed monitoring sites and completed site selection - Detailed MoUs have been negotiated and agreed upon with the national institution	- Finalize the method development and field tests - Consolidate the monitoring activities at Sinhagad, Godavari and Hanimaadhoo. - Plan for the establishment of a fourth monitoring site in the region. - Initiate analysis and interpretation of the data
2. Increased understanding of the impacts of ABC on health,	2.1 Conduct impact assessment programme on	-On Schedule	- Working group meeting held in Bangkok, Thailand on 7 – 8 December 2005 as part of the first impact assessment	- identify the lead institutions and the team which will participate in this capacity building programme on human

LFA Output	LFA Activity	Progress of workplan and use of funds	Recent meetings/events	Proposed activities for 2006
agriculture, and water budget.	human health		workshop (Annex 5) - Developed scope of health impact assessment programme (Annex 6) - Identified initial list of institutions for conducting health impact assessment programme (Annex 6)	health - Development of a white paper on human health impact assessments - Conduct one working group meeting on human health impact assessments.
	2.2 Conduct impact assessment programme on agriculture	-On Schedule	- Working group meeting held in Bangkok, Thailand on 7 – 8 December 2005 as part of the first impact assessment workshop (Annex 5) - Developed scope of agricultural impact assessment programme (Annex 7) - Identified initial list of institutions for conducting agricultural impact assessment programme (Annex 7)	- identify the lead institutions and the team which will participate in this capacity building programme on agricultural impact assessment - Development of a white paper on agricultural impact assessments - Conduct one working group meeting on agricultural impact assessment.
	2.3 Conduct impact assessment programme on water budget	-On Schedule	- Working group meeting held in Bangkok, Thailand on 7 – 8 December 2005 as part of the first impact assessment workshop (Annex 5) Developed scope of water budget impact assessment programme (Annex 8) - Identified initial list of institutions for conducting water budget impact assessment programme (Annex 8)	- identify the lead institutions and the team which will participate in this capacity building programme on water budget - Development of a white paper on water budget impact assessments - Conduct one working group meeting on water budget impact assessment.
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	- Developed the scope of study on the quantification of ABC impacts on the economy (Annex 9) - Presented ABC to policy makers, scientists, and civil society groups at various forums and bilateral discussions: National Stakeholders meeting under the Malé Declaration held in Islamabad, Pakistan in December 2004 National workshop on ABC held in Beijing, China in March 2005. National Stakeholders meetings on eco-housing	- Initiation of studies on compilation of available mitigation measures. - initiate studies on economic impacts of ABC - Establish a home page for ABC at UNEP web site - A home page for the aerosol and precipitation chemistry part of ABC - Present ABC at major forums and bilateral discussions

LFA Output	LFA Activity	Progress of workplan and use of funds	Recent meetings/events	Proposed activities for 2006
			held in Maldives and Sri Lanka in May 2005. Scientific Advisory Committee meeting of EANET held in Niigata, Japan in August 2005 Sub-regional Environment Policy Dialogue held in Bhutan in September 2005. Regional coordination meeting under the Malé Declaration held in Delhi in October 2005. Scientific conference on environment and health held in Bangkok on 5-7 December 2005. Second high-level meeting on environment and health held in Bangkok on 12-13 December 2005 - Compiled the regional report on air pollution / atmosphere to CSD-14. ABC is highlighted in the report.	

Project Atmospheric Brown Clouds (ABC)

ANNUAL REPORT

NOVEMBER 2004 – DECEMBER 2005

1. Introduction – context and aspirations for the project ABC

Atmospheric Brown Cloud (ABC), a layer of brownish haze, is caused by air pollution emissions containing aerosol particulates. The brownish haze layer reduces the amount of sunlight that can reach the Earth's surface. Reduction in sunlight can have significant impacts on terrestrial and marine ecosystems. Preliminary assessment has been completed by Indian Ocean Experiment (INDOEX) research. Potential direct and indirect consequences of the haze include regional and global climate change and impacts on ecosystems, the water cycle, agriculture and human health.

To address these concerns, the ABC project was jointly initiated by UNEP in collaboration with a network of scientists. Under the project, scientists are participating in the establishment of a network of ground-based monitoring stations throughout Asia to study the composition and seasonal pattern of the haze. UNEP has pledged to facilitate and assist with science, research and capacity building programmes. UNEP will also present the results to Governments. Considering the significance of the issue, the Swedish International Development Co-operation Agency (Sida), approved a proposal for US$ 2.983 million for the implementation of project ABC. In view of these, an agreement between the Government of Sweden and UNEP on support to ABC-Asia Programme was signed in November 2004. An implementation plan was prepared, including 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. 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 health, ecosystem and agriculture, and climate change and water budget under one common framework; and

(iii) to raise awareness on the issue and promote actions for mitigation.

This would be achieved mainly through 3 major programmes:

(i) Observatory programme,

(ii) Impact assessment programme, and

(iii) Awareness & 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.

This report highlights the achievements of the Sida supported project ABC during the reporting period of November 2004 – December 2005.

2. Major highlights/events during November 2004 – December 2005

2.1 Observatory Programme

2.1.1 Climate and Aerosol observatory programme:

Efforts have been devoted to establishing monitoring sites. This involved development of formal agreement with the local institutions, several visits to the site by the Science Team, procurement and installation of equipments at the monitoring sites, and training of local scientists and technicians. Memorandum of Understanding (MoU) have been signed with the national governments and local institutions for the establishment and operation of the observatories in Kathmandu, Nepal; Hanimaadhoo, Maldives; and Phimai, Thailand. These sites are now fully operational with trained manpower. Hanimaadhoo observatory is considered as one of the ABC super sites. A resident scientist, Dr. Praveen from India, is operating the site as a resident scientist. Scientists from Maldives are being trained by the resident scientist on the operation of the observatory. These new sites are in addition to the existing ABC sites: ABC super site in Gosan, Republic of Korea, which is operating with the financial support from the Government of Korea and the other observatories located in China and Japan

Activities under the observatory programme are coordinated through regular meetings of the ABC Science Team. The first Science Team meeting, during the reporting period, was held in Shanghai, China on 4-5 April 2005. The meeting reviewed the operation of existing observatories and reviewed a proposal from Ev-K2-CNR committee for the establishment of high altitude observatory stations for ABC. A summary report from the meeting is provided in Annex 2.

The second Science Team meeting, during the reporting period, was held in Bangkok, Thailand on 4-5 December 2005. The meeting focused on the results of the observatories and its relevance for the impact assessment studies. The meeting approved the proposal to establish high altitude observatories in Pakistan and Nepal as ABC complementary sites. The meeting also reviewed a proposal for establishing an observatory in Bangladesh. More details were requested from the Scientist in Bangladesh. Summary of the meeting is provided in Annex 3.

Apart from regular monitoring, field campaigns were also organised to promote intensive monitoring and intercomparison. The first ABC field campaign, ABC Post Monsoon Experiment (APMEX), was organised in Hanimaadhoo, Maldives during October – November 2004. The campaign included surface based observations, aircraft based observations, instrument intercomparison, and model validation. Summary report of the APMEX campaign is provided in Annex 4.

The Maldives observatory, together with the APMEX campaign has provided new insights into how rapidly the north Indian ocean gets charged with pollution during the transition from southwest (summer) to the winter season northeast (dry season) monsoon. The Maldives observatory has provided the first continuous data sets for several pollutants including black carbon and organics and a full seasonal cycle of aerosol forcing.

The second field campaign, ABC East Asia Regional Experiment (ABC-EAREX), was held in Gosan, Republic of Korea during March – April 2005. ABC-EAREX focused on pollutant transport and modification, aerosol physical, chemical and radiative characterization, pollutant effects on the radiation budget and climate, regional differences, and inflow and outflow regime comparison. Inter-calibration of instruments was also conducted during this campaign.

Analysis of data has started to some extent. The first Data Analysis workshop was held in Bangkok on 5 December 2005. The data obtained during the APMEX and ABC-EAREX campaigns were shared and discussed among the scientists.

One of the important goals of ABC is to train the next generation of Asian scientists in the study of aerosols and related issues. The first ABC Training School for students and young scientists was organised in Hanimaadhoo, Maldives during the APMEX campaign. The Training School was announced through website and e-mail contacts. From the applications received, students were selected based on merit while maintaining a balance in the geographical and gender aspects. A total of 15 students from seven countries participated in this Training School. Summary report of the training school is provided in Annex 4A.

2.1.2 Precipitation and aerosol chemistry programme:

The major part of the efforts during the reporting period regarding the aerosol and precipitation chemistry component of ABC has been devoted to establishing four monitoring sites: Sinhagad outside Pune in India, Hanimaadhoo in the Maldives, Godavari outside Katmandu in Nepal and Phimai in Thailand. This work has involved several visits by Department of Meteorology at Stockholm University (MISU) and Indian Institute of Chemical Technology (IICT) scientists to these sites, and extensive exchange of information between scientists at MISU and scientists and technicians at the institutes responsible for these sites. 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 Dr. Umesh Kulshrestha in supervising the monitoring and looking after quality control issues.

The monitoring program on aerosol and precipitation chemistry at these three sites is now ongoing and samples are being analysed chemically and checked for quality. A major emphasis has been placed on development and testing of new advanced methods for measuring soot in air and in precipitation. Despite several initial problems, the method now seems to be working satisfactorily.

A member of the Stockholm team participated in an international workshop in Leipzig on inter-calibration of soot measurements.

The first field test to measure soot in aerosol particles and in rain water was carried out during the APMEX field campaign at Hanimaadhoo in October – November 2004, in which Lennart Granat from MISU took part. Preliminary results from this campaign 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 sulfate 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.

In the ABC Science Team (ST) meetings in Shanghai, April 2005 and in Bangkok, December 2005, Prof.Henning Rodhe has made presentations of the progress of the aerosol and precipitation chemistry work in South Asia. In Bangkok, during the ABC Impact Assessment workshop, he presented estimates of the sensitivity of Asian soils to deposition of acidifying pollutants. These results were largely derived within the RAPIDC program.

2.2 Impact Assessment Programme

This programme focuses on the assessment of impacts of ABC on human health, agriculture, and water budget. Data from the observation systems and other relevant programs were used to conduct these impact assessments.

A major ocean-atmosphere model study was published in 2005, which revealed that ABCs have led to a large dimming of solar radiation over S. Asia, by as much as 7% reduction from 1950s to 2000. This ABC induced dimming along with increased atmospheric solar heating by soot, led to a weakening of the monsoon circulation and reduction of the life sustaining monsoon rainfall in India. These results were subsequently incorporated in a collaborative study between climate scientists and economists to assess the impact of ABCs on rice production in India. Preliminary results suggest that the ABC induced dimming and rainfall reduction may have contributed to the slow down of rice production since the 1980s.

During the reporting period, activities on impact assessment programme were primarily devoted to the development of scope of each of the impact assessment studies and identification of appropriate institutions for participating in the capacity building programme. This is being conducted in consultation with the ongoing initiatives and relevant institutions in Asia. The first consultation workshop on ABC impact assessment programme was held in Bangkok, Thailand on 7-8 December 2005. Ongoing initiatives related to ABC impact assessment were reviewed during the workshop. The Proceedings of the impact assessment workshop is provided in Annex 5. Impact assessment experts involved in the RAPIDC programme, participated in this workshop also.

Working group sessions to define the scope for each of the impact assessment area (human health, agriculture, and water budget) were also organised during the workshop. Scope of the impact assessment programmes together with the initial list of institutions identified for each of the impacts assessment programmes on human health, agriculture, and water budget are provided in Annex 6, 7, and 8 respectively.

2.3 Awareness and Mitigation Programme

This component focuses on promoting alternative strategies (mitigation options) through providing information for policy making. Findings from the observatory and impact assessment components will be interpreted in economic term and disseminated together with economic and technical measures for mitigation.

Much of the work under this component will start once the results from the observatory programme and impact assessment programme are available. During the reporting period, much of the efforts under this programme were devoted to developing implementation arrangements and promoting awareness on the issue of ABC. A working group on economic impacts of ABC was organised in Bangkok, Thailand on 8 December 2005 as part of the impact assessment workshop. Recommendations of the working group are enclosed as Annex 9.
The issue of ABC was presented to policy makers, scientists, and civil society groups at various forums and during bilateral discussions. These include:

National Stakeholders Forum in Pakistan: The National Stakeholders Forum under the Malé Declaration was held in Islamabad, Pakistan in December 2004. Over 40 stakeholders from Pakistan participated. The Forum was inaugurated by Mr. Javed Hasan Aly, Secretary, Ministry of Environment.

Policy makers and Scientists in China: The national workshop on ABC was held in Beijing, China in March 2005. The workshop was opened by the Vice Minister, State Environment Protection Agency (SEPA) of China and the Executive Director of UNEP. The meeting was attended by over 50 scientists and policy makers from China.

National Stakeholders in Maldives and Sri Lanka: The National Stakeholders meetings on eco-housing was held in Maldives and Sri Lanka during May 2005. In Maldives, the meeting was opened by the Deputy Minister, Ministry of Environment, Energy and Water and had over 50 participants. The meeting in Sri Lanka was attended by 30 participants.

Scientists from East Asia: The Scientific Advisory Committee meeting of EANET held in Niigata, Japan in August 2005. It was attended by over 50 scientists from East Asia.

Wise persons: The Sub-regional Environment Policy Dialogue was held in Bhutan in September 2005. The meeting was participated by Deputy Minister, National Environment Commission, Bhutan; Minster for Natural Resource Use and Environment Protection, Turkmenistan; Minister, Ministry of Environment, Indonesia; Minister, Ministry of Environment, Republic of Korea; and Minister, Ministry of Natural Resources and Environment, Samoa.

Policy Makers from South Asia: The regional coordination meeting under the Malé Declaration was held in Delhi in October 2005. The meeting was inaugurated by the Minister, Ministry of Environment and Forests, India . Regional stakeholders from South Asia and representatives from the implementing agencies and national focal points of Malé Declaration, participated in this meeting..

Civil Society: A scientific conference on environment and health was held in Bangkok during 9-11 December 2005. The conference was opened by Professor Dr. H.R.H. Princess Chulabhorn and participated by over 200 participants from East Asia. The "Highlights" of the conference adopted by the participants, identifies ABC as an emerging issue: "*The Atmospheric Brown Cloud (ABC) is expanding in depth and extent. In the dry season, ABC is hovering over Asia and gradually extending into other continents. More scientific knowledge is needed on its source, dynamics, composition and impacts on human health, agriculture and water budget*."

High Level policy makers: The second high-level meeting on environment and health was held in Bangkok during 12-13 December 2005. The meeting was attended by over 40 senior officials representing the environment and health agencies of ASEAN and North East Asian countries.

The fourteenth session of the Commission on Sustainable Development is scheduled to be held in May 2006. The session will review the progress in the implementation of the outcomes of the World Summit on Sustainable Development (WSSD), focusing on 4 major thematic areas:

(i) Energy for sustainable development;

(ii) Industrial development;

(iii) Air pollution/atmosphere; and

(iv) Climate change

UNEP compiled the review report by analyzing the status of atmospheric issues as well as response measures at national, sub-regional, and regional levels. The review report identifies ABC as an important initiative. The impacts of ABC is identified in the 9 page regional message: "*The region is vulnerable to natural disasters but lacks capacity to effectively mitigate impacts from such disasters including potential climate changes related impacts, haze, **brown clouds** and the lingering aftermath of the tsunami and South Asian earthquake.*"

3. The future plans for the next 12 months (January – December 2006)

3.1 Observatory Programme

3.1.1 Climate and Aerosol observatory programme

The plan for 2006 includes the following main activities.

- Continue operation of observatories: The monitoring stations established under the project ABC will continue its operation and data collection. These activities require continuing substantial support in the form of both technical

Proposed high altitude observatories (yellow stars).

maintenance and capacity building. The data obtained from the observatories will be discussed in the data analysis workshops.

- Explore the possibility of establishing additional monitoring stations in high altitude areas: Under this proposal, additional observatory stations will be established in the Karakoram and Himalaya mountain regions. Proposed activities include:

    (i) Establishment and operation of observatories for monitoring aerosols at the Pyramid International Laboratory-Observatory, Lobuche, Nepal.

    (ii) Establishment and operation of observatories in the Baltistan region of Pakistan.

    (iii) Data collection on the presence of aerosols and other related pollutants, like black carbon and greenhouse gases.

    (iv) Onsite training of local scientists and technicians.

- A Science Team meeting is proposed to be held during 2006. The meeting will review the monitoring results and consider the proposals for the additional observatory programmes. 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. Hence, the Science Team meeting is considered as the major forum for ABC scientists to share the data and information.
- The scientists will conduct field campaigns to intensify the monitoring during the key period. Campaign are being planned during February-March period. Training for capacity building of young scientists will also be considered during the campaigns.

3.1.2 Precipitation and aerosol chemistry programme

The plan for 2006 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, which is done in collaboration between scientists in Asia and at MISU, will result in a technical publication.
- 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 the Andaman Islands, has had to be abandoned for logistical reasons. An alternative location near Kanpur 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 scientists focusing on the effects of air pollution (climate, water balance, agriculture, health).

3.2 Impact Assessment Programme

The plan for 2006 includes the following main activities.

- Identify the lead institutions and the team which will participate in capacity building programme. An impact team comprising sub-networks on each of the impact assessment areas (human health, agriculture, and water budget) will be established. In order to facilitate capacity building, a lead institution will be identified to take the lead role in the region. This requires consultations with the national governments and development of agreements with lead institutions.
- A white paper will be developed by lead international scientists for each of the impact assessment areas. Agricultural impact is of high priority. A river basin approach will be followed for conducting the study. The initial study will focus on two major river basins in Asia: (i) Ganges basin, and (ii) Yangtze basin. Studies on the impact of ABC on water budget is also of high priority. The impacts of ABC-air pollution on health is obviously important. But since many studies on air pollution and health are already underway, ABC impact assessment programme may give a low priority for this issue. Studies of human health impacts in the rural areas are proposed.
- Conduct one impact assessment workshop. The workshop will invite the working groups on each of the impact assessment areas. White papers and implementation arrangements, including lead institutions, are expected to be finalised during this workshop.

3.3 Awareness and Mitigation Programme

The plan for 2006 includes the following main activities.

- Initiate the compilation of available mitigation measures: This will include discussions with the ABC Science Team and institutions from Asia. Agreements with institutions, will be developed, for conducting this compilation.
- Initiate studies on the economic impacts of ABC: This will include formation of a team comprising environmental economists, and development of agreements.
- Present ABC at the major forums and bilateral discussions.
- Establish a home page for ABC at the UNEP web site: This will facilitate the dissemination of project information for a wider audience.
- A home page for the aerosol and precipitation chemistry part of ABC, coordinated by MISU, will be set up.

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

Lead institution: Science Team Chaired by Prof. Ramanathan	**Prepared by:** UNEP

Collaborating Institutions: (name; principal contact; contact details)

- ICIMOD, Nepal; Mr. Basantha Shrestha
- Ministry of Energy, Environment and Water, Maldives; Mr. Abdulla Amjad
- Chulalongkorn University, Thailand, Dr. Boossarasiri Thana
- C4/SIO, USA; Prof. Veerabhadran Ramanathan
- Max-Planck Institute for Chemistry, Germany; Prof. Paul J. Crutzen
- University of Iowa, USA; Prof. Gregory Richard Carmichael
- FRCGC, Japan; Prof. Hajime Akimoto
- University of Tokyo, Japan; Prof. Nakajima Teruyuki
- TERI, India; Dr. R.K. Pachauri
- NPL, India; Prof. Ashesh P. Mitra
- Seoul National University, Republic of Korea; Soon-Chang Yoon and Prof Kyung-Ryun Kim
- University of Stockholm, Sweden; Prof. Henning Rodhe
- Peking University, China; Prof. Zhang Yuanhang
- CAS, China; Prof. Shi Guang-Yu

Description of activities: (actions carried out; trips made; progress in the project)

- MOU's were signed with the Governments of Maldives, Government of Nepal, ICIMOD, and Chulalongkorn University for capacity building in aerosol monitoring.
- Monitoring Stations were established at Hanimaadhoo (Maldives), Kathmandu (Nepal), and Phimai (Thailand).
- The APMEX campaign was held for the South Asia region during 1 October to 15 November 2004, with the main station at Hanimaadhoo, Maldives. The results were presented during the Data workshop held in December 2005 at Bangkok.
- The EAREX2005 campaign was held for East Asia during March – April 2005. The results were presented during the Data workshop held in December 2005 at Bangkok.
- The ABC Training School for young scientists from Asia on aerosol measurement was held in Hanimaadhoo, Maldives in October - November 2004.
- Convened two Science Team meetings.
- Several visits by scientists from the ABC Science Team to the regional observatories in Maldives, Nepal, Thailand, Republic of Korea, and China.

Description of outputs:

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.

Report of the field campaigns, training school, and Science Team meetings.

Description of results:

Fifteen young scientists from Asia have been trained and are participating in the monitoring programmes at the national level. The main results of the activities have been a demonstrated ability of Asian scientists to participate in the aerosol observatory programme.

What extent the activities so far has lead to fulfilment of the programme purpose:

The analysis of the data obtained from regular monitoring and through the APMEX and EAREX campaigns, has thrown light into the kind of data and data quality required. Wet deposition monitoring, monitoring of trace gases and the monitoring of transport of moisture have been recommended. The suitability of sites have also been reviewed, leading to recommendations for adding more onshore sites, especially around areas with more impacts.

Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)

The analysis of the data and the findings of the 2 campaigns (EAREX and APMEX) have been presented in the Data Workshop and Science Team meeting.

Science Team meeting provided the opportunity for interaction with other programmes of project ABC.

Schedule: (is the project on track, ahead of schedule or behind schedule in relation to the detailed work plan)

The project is progressing 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:

- All the observatories in the ABC network, including the observatories established in Hanimaadhoo, Kathmandu, and Phimai will continue the operation
- Explore the possibility of establishing additional monitoring stations in the high altitude areas.
- Establishment of new observatories in the high altitude areas of Nepal and Pakistan
- Explore the feasibility of establishing a new observatory in Bangladesh
- Scientists will conduct field campaigns to intensify the monitoring during February-March period.
- Convene a Science Team meeting

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

Female scientists were encouraged to apply for the ABC Training School and 3 female scientists were trained during the reporting period.

Other information:

4.1.2 Capacity building on precipitation and aerosol chemistry

Lead institution: Department of Meteorology(MISU), Stockholm University, SE-10691 Stockholm, Sweden	**Prepared by**: MISU

Collaborating Institutions: (name; principal contact; contact details)

- IICT, Hyderabad, India. Dr. U. Kulshrestha, umesh_iict@rediffmail.com
- IITM, Pune, India. Dr. P.S.P. Rao. raopsp@yahoo.com
- ICIMOD. Dr. Bidya Banmali Pradhan. bbanmali@icimod.org
- NPL, New Delhi, India. Prof. A.P. Mitra. apmitra@mail.nplindia.ernet.in
- Ministry of the Environment, Energy and Water, Male, Maldives. Mr. Nilam Mohamed. nilam.mohamed@environment.gov.mv
- Institute for Tropospheric Research, Leipzig, Germany. Prof. J. Heintzenberg; jost@tropos.de

Description of activities: (actions carried out; trips made; progress in the project)

- Transfer of knowledge to scientists and technicians at the monitoring sites in Nepal, India and the Maldives in connection with the establishment of the measurements of the chemical composition of aerosols and precipitation.
- Several visits by scientists from MISU to the monitoring sites in Asia in connection with the installation of equipments. 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.
- A visit by Dr. Umesh Kulshrestha from IICT, Hyderabad to MISU in March 2005 for planning the implementation of this component of the ABC program. One of the foci of this visit was the question of quality control and quality assurance of the data obtained in the program.

Description of outputs:

Data from the monitoring program is now being collected and will be made available after quality control has been completed.

Presentations made by Prof. Henning Rodhe on this issue at ABC workshops, have been published in workshop reports.

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.

What extent the activities so far has lead to fulfilment of the programme purpose:

The activities so far have followed the program plan and thus fulfilled its purpose.

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 Sinhagad (Pune) have also been coordinated with those carried out within the Composition of Asian Deposition (CAD) program of RAPIDC.

Once the Impact Assessment component of ABC gets under way, efforts will be made to strengthen the interaction with such studies.

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 have taken longer time than expected and this has led to a slight delay in the development of the quality 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?)

The total limit for the budget item “other costs” has already been exceeded. This is due to a misjudgement from our side when preparing the budget. The cost for shipping of samples, customs etc have been much higher than expected. We request that an amount of 65,000 $ be reallocated from budget item “equipment” to “other costs”.

We now already foresee that the budgeted amount for “fees” will be insufficient. On the other hand, we will probably be able to fulfil our goals without using up all the money currently allocated to “equipment”. We would therefore like to come back at a later stage to request to reallocate some of the funds from “equipment” to “fees”.

Plans for next 12 months

- A three day course on atmospheric chemistry in general and aerosol and precipitation chemistry in particular will be organized in Delhi (or Hyderabad) in November 2006.
- Two Asian students will be recruited to do pursue PhD studies in Asia under the combined guidance of supervisors from Asia and from MISU.
- As laid out in the MoUs with IITM, IICT and ICIMOD, one scientist from each one of these institutes will visit MISU during 2006 for discussions about the progress of the program.
- An attempt will be made to recruit an Asian postdoc to spend at least half a year at MISU with the analysis and interpretation of the data.

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

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 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 for 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. Ramanathan	Prepared by: UNEP

Collaborating Institutions: (name; principal contact; contact details)

A tentative list is given below:

- Chulabhorn Research Institute, Thailand – expertise in toxicological, molecular epidemiological, epidemiological studies; state-of-the-art facilities, and network of scientific collaborations with research and academic institutions worldwide.
- Asian Institute of Technology (regional graduate university located in Thailand): air quality modeling, air pollution monitoring (ambient, sources), exposure assessment. Has a surburban monitoring station (at AIT) with 3 year data of PM2.5 and PM10, coordinating a regional air pollution research network of 6 Asian cities
- 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 asessment, 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)

Impact Assessment Workshop was held in Bangkok in December 2005. A working group on Impact Assessment on Health was formed during this workshop, which discussed and made recommendations about initiating the activities.

Description of outputs:

Report of the impact assessment workshop.

Report of the Working Group on Impact Assessment on Health.

Description of results:

The main result achieved during the reporting period is the network of experts on ABC-human health impact assessment. The network recommended to establish a team for the impact assessment on health, comprising of the Science Team Chairman and Vice Chairman, and a lead scientist representing a lead institution. This core team will network with other professionals and institutions.

What extent the activities so far has lead to fulfilment of the programme purpose:

The discussions during the Impact Assessment workshop and by the Working Group have lead to a better understanding of the way forward and the mechanism for implementing the impact assessment studies.

Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)

Health impact assessment programme is expected to use the results from the observatory programme. Science Team meeting provide 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 workplan)

Project activities are on track.

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

Till dtae, the financial plan has been adhered to.

Plans for next 12 months:

- The team for the impact assessment study would be constituted. For this purpose, a lead institution for the study would be selected. A lead scientist from that institution would be a member of the impact team.
- The Secretariat for the study would be established at UNEP RRC.AP.
- A whitepaper on the issue would be developed, which would provide a roadmap for the human health impact assessment.
- The study would be initiated.
- An impact assessment workshop would be conducted.

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

Thirteen female participants attended the impact assessment workshop. It is around 30 percent of the total participants.

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:

- 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
- IRRI

Description of activities: (actions carried out; trips made; progress in the project)

Impact Assessment Workshop was held in Bangkok in December 2005. A working group on Impact Assessment on Agriculture was formed during this workshop, which discussed and made recommendations about the proposed activities.

Description of outputs:

Report of the impact assessment workshop.

Report of the Working Group on Impact Assessment on Agriculture.

Description of results:

The main result achieved during the reporting period is the network of experts on ABC-Agricultural impact assessment. The network recommended to establish a team for the impact assessment study on agriculture, comprising of the Science Team Chairman and Vice Chairman, and a lead scientist representing a lead institution. This core team will network with other professionals and institutions. The recommendation by the working group was to have more monitoring stations in the rural and agricultural areas.

What extent the activities so far has lead to fulfilment of the programme purpose:

The discussions during the Impact Assessment workshop and by the Working Group have lead to a better understanding of the way forward and the mechanism for implementing the study.

Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)

Health impact assessment programme is expected to use the results from the observatory programme. 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 workplan)

Project activities are on track.

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 team for the impact assessment study would be constituted. For this purpose, a lead institution for the study would be selected. A lead scientist from that institution would be a member of the impact team.
- The Secretariat for the study would be established at UNEP RRC.AP.
- A whitepaper on this issue would be developed, which would provide a roadmap for the agricultural impact assessment.
- The study would be initiated.
- An impact assessment workshop would be conducted.

Issues related to HIV/aids, gender, equity and poverty issues: Thirteen female participants attended the impact assessment workshop. It is around 30 percent of the total participants.
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:

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.
- Prof. Jietai Mao, Peking University, Beijing, China
- Dr. Likun Ai, Institute of Atmospheric Physics, CAS

Description of activities: (actions carried out; trips made; progress in the project)

Impact Assessment Workshop was held in Bangkok in December 2005. A working group on Impact Assessment on Water Budget was formed during this workshop, which discussed and made recommendations about the proposed activities.

Description of outputs:

Report of the impact assessment workshop.

Report of the Working Group on Impact Assessment on Water Budget.

Description of results:

The main result achieved during the porting period is the network of experts on ABC-water impact assessment. The network recommended to establish a team for the impact assessment, comprising of the Science Team Chairman and Vice Chairman, and a lead scientist representing a lead institution. This core team will network with other professionals and institutions. The services of specialised institutions with experience in coupled models, was recommended.

What extent the activities so far has lead to fulfilment of the programme purpose:

The discussions during the Impact Assessment workshop and by the Working Group have lead to a better understanding of the way forward and the mechanism for implementing the study.

Interactions in the Programme: (are activities sufficiently co-ordinated with other parts of the Programme)

Water balance impact assessment programme is expected to use the results from the observatory programme. Science Team meeting provide 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 workplan)

Project activities are on track.

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 team for the impact assessment study would be constituted. For this purpose, a lead institution for the study would be selected. A lead scientist from that institution would be a member of the impact team.
- The Secretariat for the study would be established at UNEP RRC.AP.
- A whitepaper on this issue would be developed, which would provide a roadmap for the water impact assessment.
- The study would be initiated.
- An impact assessment workshop would be conducted.

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

Thirteen female participants attended the impact assessment workshop. It is around 30 percent of the total participants.

Other information:

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)

- Collaborating institutions will be identified during 2006.

Description of activities: (actions carried out; trips made; progress in the project)

- Impact Assessment Workshop was held in Bangkok in December 2005.A working group on Economics and policy implementation was formed during the Workshop, which discussed and made recommendations about the proposed activities.
- Presented ABC to policy makers, scientists, and civil society groups at various forums and bilateral discussions:
  - (i) National Stakeholders meeting under the Malé Declaration held in Islamabad, Pakistan in December 2004
  - (ii) National workshop on ABC held in Beijing, China in March 2005.
  - (iii) National Stakeholders meetings on eco-housing held in Maldives and Sri Lanka in May 2005.
  - (iv) Scientific Advisory Committee meeting of EANET held in Niigata, Japan in August 2005
  - (v) Sub-regional Environment Policy Dialogue held in Bhutan in September 2005.
  - (vi) Regional coordination meeting under the Malé Declaration held in Delhi in October 2005.
  - (vii) Scientific conference on environment and health held in Bangkok during 9-11 December 2005.
  - (viii) Second high-level meeting on environment and health held in Bangkok during 12-13 December 2005
- Compiled the regional report on air pollution / atmosphere to CSD-14. ABC is highlighted in the report.

Description of outputs:

Report of the impact assessment workshop.

Report of the Working Group on Economics and policy implementation.

Regional report on air pollution / atmosphere to CSD-14.

Description of results:

The main results achieved during reporting period include: dissemination of information on ABC for wider audience; highlighting it as a regional issue in the regional message to CSD-14; and noted as an emerging issue in the proceedings of a scientific seminar on environment and health.

What extent the activities so far has lead to fulfilment of the programme purpose:

The discussions during the Impact Assessment workshop and by the Working Group have lead to a better understanding of the way forward and how the impact assessments 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)

This programme will utilise the outcomes of the impact assessment programmes. 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 workplan)

Project activities are on track.

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: - 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
Issues related to HIV/aids, gender, equity and poverty
Other information:

REPORT OF THE WORKING GROUP FOR IMPACT ASSESSMENT ON HEALTH

1. Science Objectives and Priorities for ABC Health Impact Assessment Studies

- Examine Impact of ABC on *rural health*. (Control for indoor air pollution exposure in rural areas). Rural locations are not being examined by PAPA or Asian Clean Air Initiative (ACAI) but are focus of ABC monitoring network.
- Examine health effects of ABC in urban areas (influence of background pollution levels rather than local urban emissions).
- Attempt to attribute impact of specific sources (or composition) on health effects (eg.emissions from vehicle emissions, biomass burning, power plants, secondary particulates). Requires development of improved emission inventories.

2. Types of Studies

- Toxicological
- Epidemiological
- Integrated assessment modeling to examine
  - impact of specific sources on exposure and health outcomes
  - impact of potential future regulatory control options (eg. Future potential emission scenarios) on exposure and health outcomes

3. Information from ABC monitoring and modeling activities needed for impact assessments

- Chemical composition and concentrations at surface.
  - Aerosols: PM10, PM2.5, carbonaceous particles (BC, OC), PAH, metals, ions (eg. SO4-, NO3-
  - Gases: O3, CO, NOx,SO2, VOC
- Temporal resolution: useful to have data in all seasons. Include dry/wet season; harvest season and period of agricultural waste burning.
- Access to data from urban locations would be useful in addition to primarily suburban/rural monitoring data from ABC. Collaboration with PAPA and ACAI is desirable.

4. Capacity Building Activities

- Establish standardized protocols for toxicological and epidemiological studies.
- Agree on modeling approaches
- Training of technical personnel in experimental protocol
- Standardize data management and handling
- Training in data analysis

5. Funding Leverage Opportunities

- ABC
- Work with PAPA and ACAI
- World Bank
- Asian Development Bank
- Foundations
- UNEP

6. Key Institutions & Individuals (to be expanded)

- Chulabhorn Research Institute, Thailand – expertise in toxicological, molecular epidemiological, epidemiological studies; state-of-the-art facilities, and network of scientific collaborations with research and academic institutions worldwide.
- Asian Institute of Technology (regional graduate university located in Thailand): air quality modeling, air pollution monitoring (ambient, sources), exposure assessment. Has a surburban monitoring station (at AIT) with 3 year data of PM2.5 and PM10, coordinating a regional air pollution research network of 6 Asian cities
- WHO will provide technical support, and review protocols for epidemiological studies and provide linkage
- Fudan University (Shanghai, China): a member of PAPA program. Good quality data of air pollution and human mortality and morbidity, and expertise in integrated assessment on human health & air pollution and provide suggestion to Chinese policy-maker.
- Institute for environmental health and related product safety Chinese center diseases control and prevention, China, Beijing- expertise in air quality monitoring, personal exposure asessment, toxicological, molecular epidemiological, epidemiological studies and air quality standard and guideline setting, network of scientific collaborations with research and academic institutions worldwide and local CDC in China.
- National Physical Laboratory, Delhi, India. Aerosol measurement data, characterization, etc., Dr. Mitra
- Patel Chest Institute, Delhi, Dr. Chabra
- National Inst. Occupational Health, Ahmedbad, Calcutta
- Cancer Research Institute, Calcutta, Dr. Lahiri
- Indian Council of Medical Research, Delhi, provide coordination for health related effects of climate change.