



# Interrelationship between Climate Change, Urban Air Quality and impacts: rationale for addressing air pollution and GHG emissions

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**Core Environment Program –**

**Biodiversity Conservation Corridors Initiative (BCI) Symposium**

**Bangkok, Thailand**

**27-28 April 2006**

- Introduction to CAI-Asia.
- Status of Air Pollution and Air Quality Management in Asia and in the GMS.
- Linkage between air pollution, climate change and crop yield.
- Challenge to urban air quality management and climate change mitigation.
- Proposed Pilot Project: Impacts of climate change and air pollution on crops, forests and ecosystems





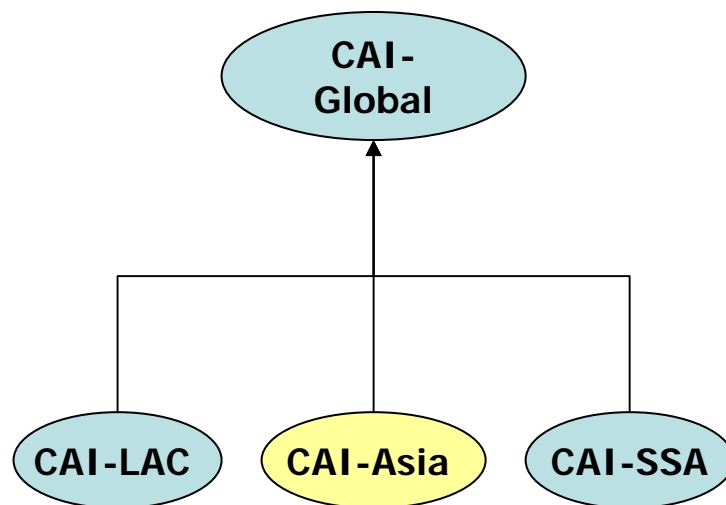
# What is CAI-Asia?

- In 2000 and 2001 growing awareness on the need for a regional movement on air quality in Asia
- Emerging consensus that air pollution was a growing developmental problem and that it was not being addressed by any of the multilateral organizations such as UNEP, UN-ESCAP or ASEAN

**CAI-Asia initiates, coordinates, and in selected cases implements AQM initiatives with the aim to improve air quality management and air quality in Asian Cities**

## CAI-Asia Components:

- Knowledge Management
- Capacity building
- Policy and regulatory frameworks
- Integrated air quality management policies and strategies
- Piloting projects to encourage innovation





# CAI-Asia Membership

## CITIES

- Dhaka**, Bangladesh
- Chittagong**, Bangladesh
- Phnom Penh**, Cambodia
- Chengdu**, China
- Chongqing**, China
- Hangzhou**, China
- Harbin**, China
- Guangzhou**, China
- Tianjin**, China
- Hyderabad**, India
- Mumbai**, India
- Pune**, India
- Jakarta**, Indonesia
- Surabaya**, Indonesia
- Yogyakarta**, Indonesia
- Ulaanbaatar**, Mongolia
- Kathmandu**, Nepal
- Lahore**, Pakistan
- Islamabad**, Pakistan
- MMDA**, Philippines
- Makati**, Philippines
- Naga**, Philippines
- Singapore NEA**
- Colombo**, Sri Lanka
- Bangkok**, Thailand
- Chang Mai**, Thailand
- Haiphong**, Vietnam
- Hanoi**, Vietnam
- Ho Chi Minh City**, Vietnam

## Government Agencies

- Andhra Pradesh Pollution Control Board
- Balochistan EPA, Pakistan
- Central Pollution Control Board, India
- Department of Energy, Philippines
- Department of Environment and Natural Resources (DENR), Philippines
- Department of Environment, Bangladesh
- Department of Forest, Ecology and Environment, India
- Department of Transportation and Communications, Philippines
- Dhaka Transport Coordination Board, Bangladesh
- Environmental Management Bureau (EMB), Philippines
- Environmental Management Bureau, Ministry of the Environment, Japan
- Environmental Protection Agency (EPA), Afghanistan

- Environmental Protection Department of Hong Kong SAR (EPD)
- Hydrocarbon Development Institute of Pakistan
- Ministry of Environment, Cambodia
- Ministry of Environment, Indonesia
- Ministry of Public Works and Transport, Cambodia
- Ministry of Road Transport and Highways, India
- Pakistan Environmental Protection Agency (Pak-EPA)
- Pollution Control Department (PCD), Thailand
- SUPARCO
- Sindh Environmental Protection Agency
- State Environmental Protection Administration (SEPA)
- Vietnam Register

**56 NGOs and Academic Institutions in the Region**

## DEVELOPMENT AGENCIES

- Asian Development Bank
- German Agency for Technical Cooperation (GTZ)
- Government of Finland
- Government of Japan
- Government of Norway
- Government of the Netherlands
- Hewlett Foundation
- IUCN - The World Conservation Union
- Sida
- The World Bank
- USAID/USAEP
- United States Environmental Protection Agency (EPA)

## FULL PRIVATE SECTOR Member

**Ford Shell**

## ASSOCIATE PRIVATE SECTOR Member

- Asian Clean Fuels Association (ACFA)
- Corning Incorporated
- DEKRA AG
- IPIECA
- Johnson Matthey
- MAHA Maschinenbau Haldenwang GmbH
- SGS (Societe General de Surveillance)
- Clean Diesel Tech. Inc.



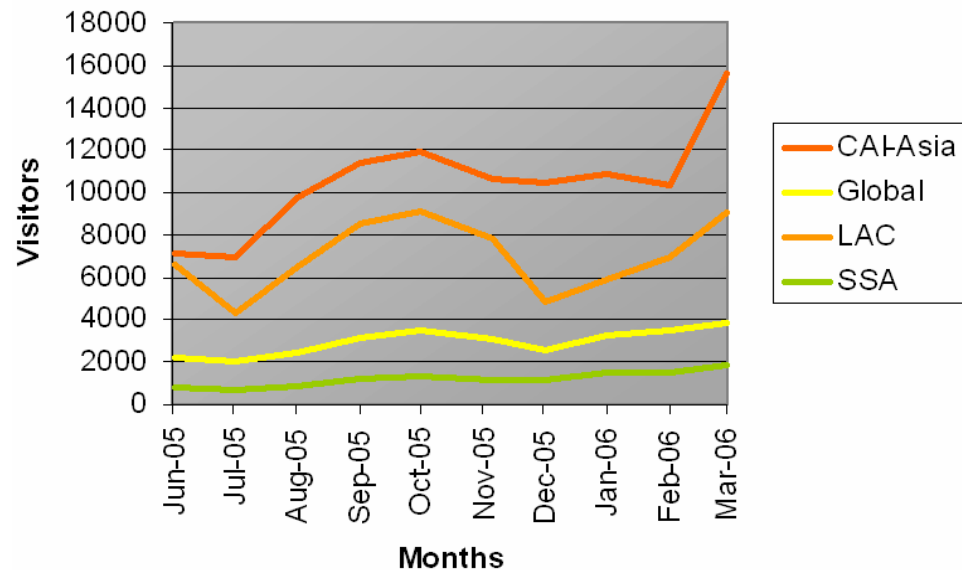
# CAI-Asia: Knowledge Management

[www.cleanairnet.org/caiasia](http://www.cleanairnet.org/caiasia) and CAI-Asia Listserv

| Key Stats       | CAI-Asia |
|-----------------|----------|
| Unique Visitors | 20,391   |
| Visits          | 28,246   |
| Ave. per Day    | 911      |
| Hits            | 650,865  |
| Page Views      | 101,280  |

- Contains more than 3,800 documents and counting ...
- Receives on average 900 visitors per day
- Has the capacity to organize large amounts of information in a systematic manner

Unique Visitors (June '05 to Mar '06)



## CAI-Asia listserv

- The most active listserv on AQM in Asia
- Over 900 members
- Over 2700 posts since 2002
- Country-specific listserv for local networks also being set-up

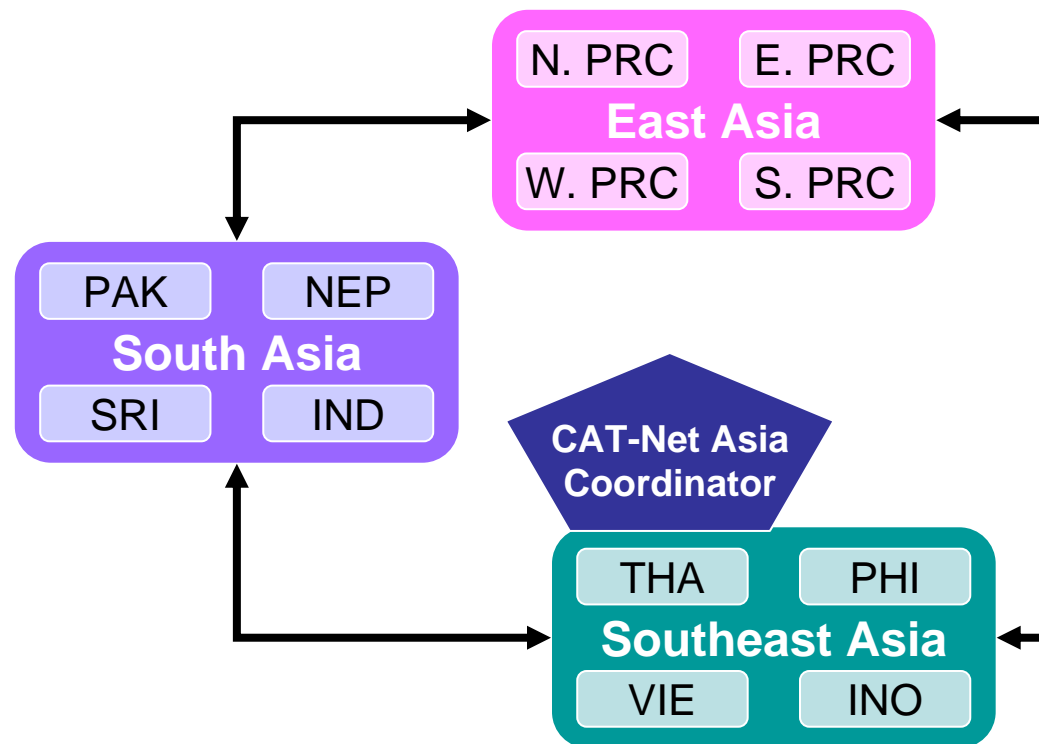




# CAI-Asia: Capacity Building

- Effective AQM that will make a difference in Asia will require a massive capacity building on AQM
- Current training programs will need to be improved in quantity and quality:
  - Get more training institutions involved
  - Develop more training courses to include cobenefits of urban AQM and climate change mitigation
  - Train more trainers
  - Conduct more trainings
- CATNet Asia is a separate program in CAI-Asia to enhance its sustainability and its impact

## CATNet Asia





# CAI-Asia: Policy Forums

CAI-Asia has created a series of policy forums in Asia to discuss urban air quality management :

- Regional Dialogue of Air Quality Initiatives (co-hosted with UNEP) – since 2004. (2006 meeting will be on 12 June in Bangkok)
- First Governmental Meeting on Urban Air Quality (co-hosted with UNEP, MoE Indonesia, UNCRD on September 2006
- 2006 Annual development partners' coordination meetings in CAI-Asia member countries with established local networks - China, Indonesia, Nepal, Pakistan, and Philippines, Sri Lanka and Viet Nam.
- Regional Forum on Environment and Health UNEP/WHO - (CAI-Asia as AQ focal point) on November 2006
- CAI-Asia Oil Industry Dialogue where oil sector companies in Asia are involved in developing fuel road maps for the region.
- Better Air Quality (BAQ) workshops which have had great impact on raising the profile of AQM in Asia. Since 2002 about 2,000 decision makers have participated in BAQ workshops. BAQ workshops have helped to shape policy processes in CAI-Asia member countries and cities.





# CAI-Asia: High Profile Pilot Programs

- CAI-Asia pilot programs focus on areas where there is a widely acknowledged shortage of knowledge and/or concepts.
- CAI-Asia initiates or supports pilot programs but implementation is carried out through member or partner organizations:
  - **Public Health and Air Pollution in Asia (PAPA) Program, implemented through Health Effects Institute**
  - Developing Integrated Emission Strategies for Existing Land Transport (DIESEL)
  - Partnership for Sustainable Urban Transport in Asia (PSUTA) implemented in cooperation with EMBARQ/WRI
  - Sustainable Urban Mobility in Asia (SUMA). In partnership with Sustainable Urban Transport Project – GTZ, Interface for Cycling Expertise (I-CE), EMBARQ, the World Resource Center for Transport and Environment, United Nations Centre for Regional Development- Environmentally Sustainable Transport Program, Institute for Transportation and Development Policy (ITDP)
  - Emission Factor Development in cooperation with TERI
  - CAI-Asia Oil Industry Dialogue with range of oil companies
- Pilot programs help to generate credibility, mobilize partners, policy inputs and investment opportunities



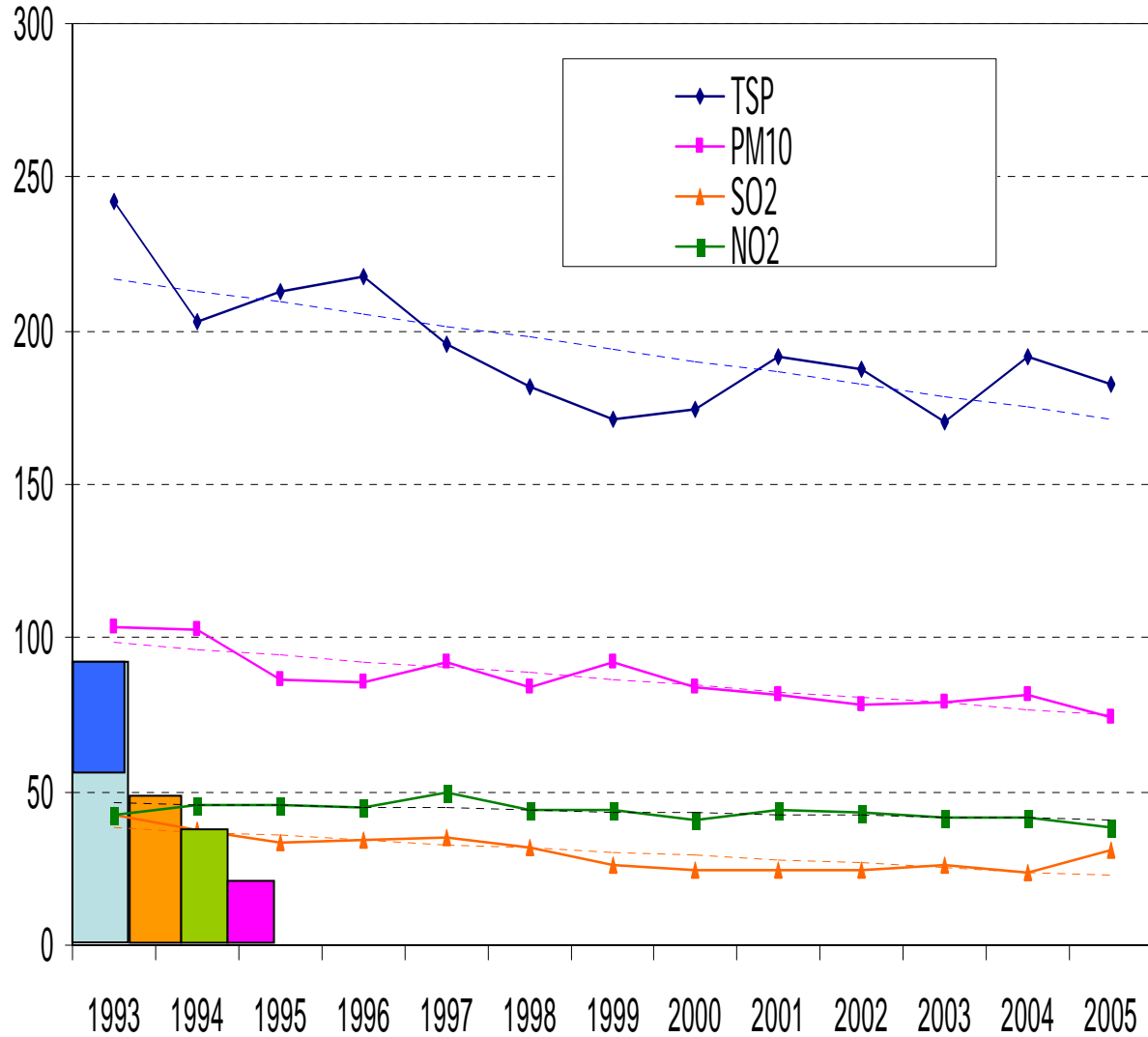


# Status of Air Quality in Asia

- Ambient air quality in Asia is generally improving withstanding increase in motorization and energy use
- Average ambient TSP, PM10 and SO<sub>2</sub> trends are improving
- There is an observed SO<sub>2</sub> increase in 2005
- Average ambient TSP and PM10, however, continue to exceed WHO and USEPA guidelines
- Average ambient SO<sub>2</sub> is in compliance with WHO guideline

- WHO (1979) TSP guideline, 60-90µg/m<sup>3</sup>
- WHO SO<sub>2</sub> guideline, 50µg/m<sup>3</sup>
- WHO NO<sub>2</sub> guideline, 40µg/m<sup>3</sup>
- WHO (2005) PM10 guideline, 20µg/m<sup>3</sup>

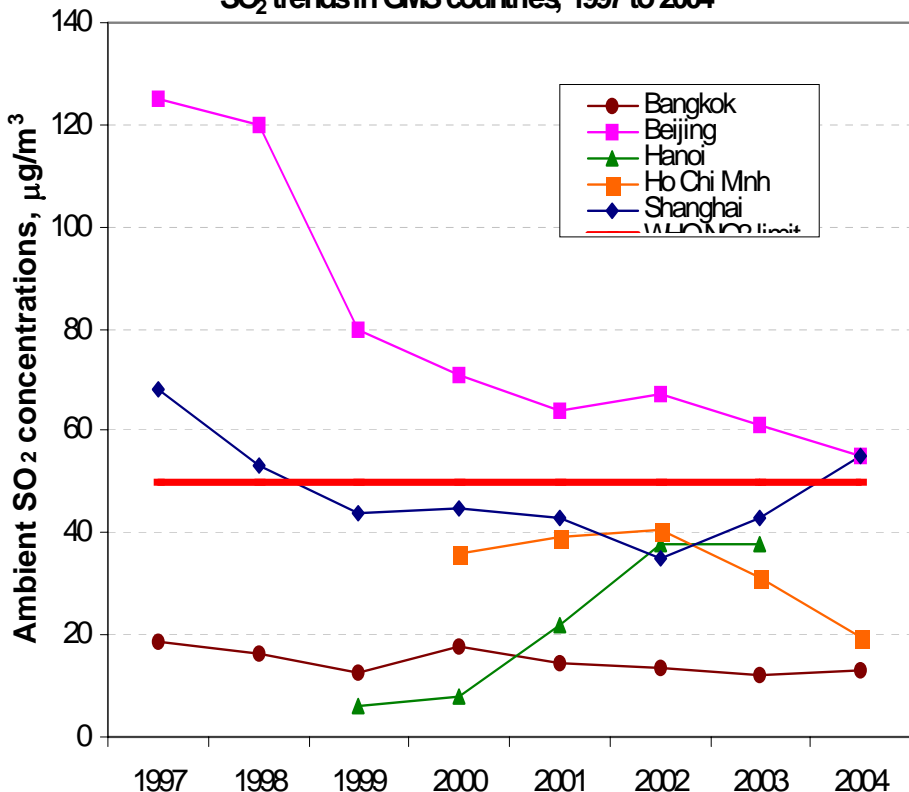
Aggregated Annual Ambient AQ Trends, µg/m<sup>3</sup> (1993 to 2005)



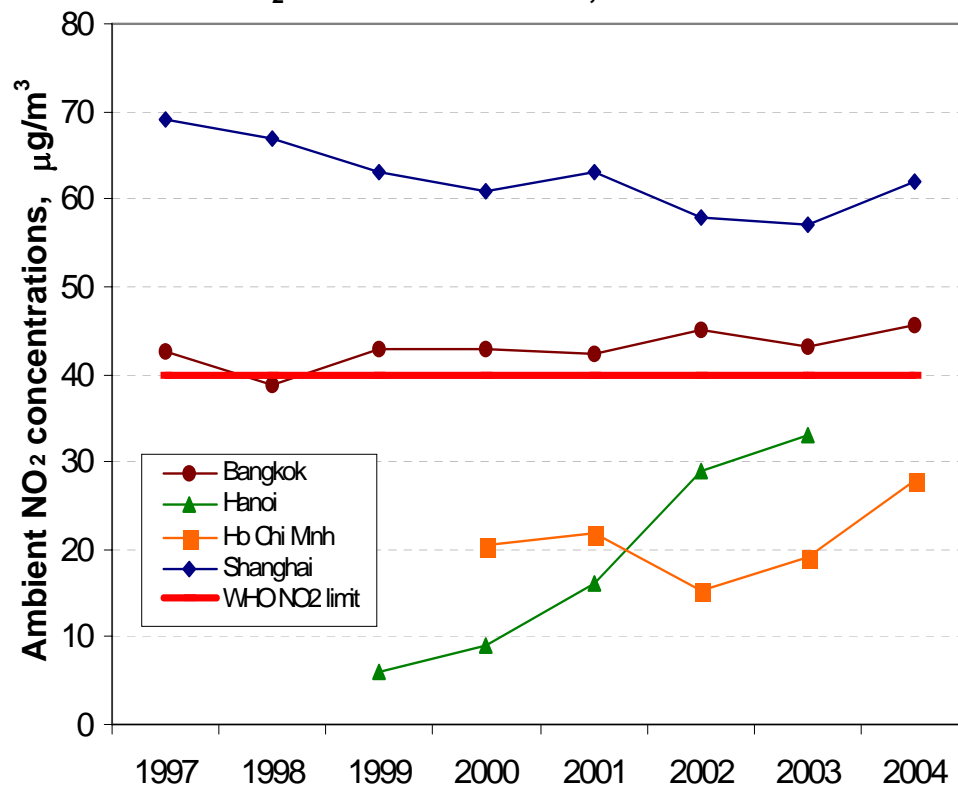


# Status of Air Quality in the GMS region (1)

SO<sub>2</sub> trends in GMS countries, 1997 to 2004



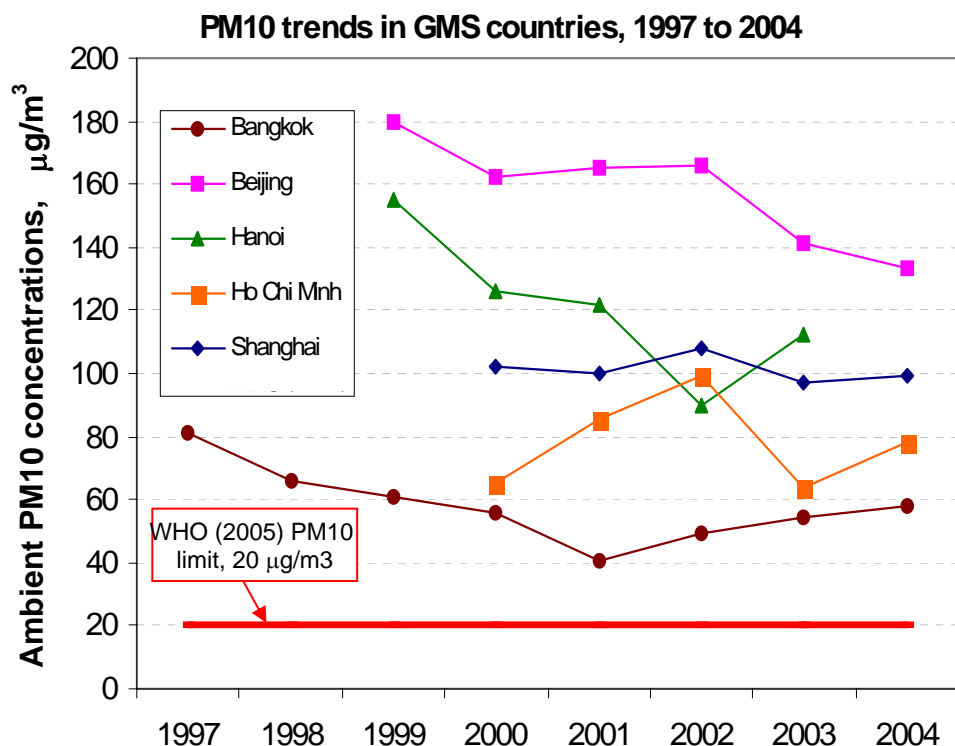
NO<sub>2</sub> trends in GMS countries, 1997 to 2004



- AQ data for Laos, Cambodia and Myanmar are not readily available.
- NO<sub>2</sub> is increasing in Bangkok, Hanoi, HCMC and Shanghai with Shanghai and Bangkok exceeding WHO NO<sub>2</sub> guidelines.
- SO<sub>2</sub> tendencies in the cities are variable. SO<sub>2</sub> is increasing for Hanoi and Shanghai but decreasing for Ho Chi Minh and Beijing.



# Status of Air Quality in the GMS region (2)



- AQ data for Laos, Cambodia and Myanmar are not readily available.
- Ambient TSP has been improving but continue to exceed the WHO guidelines.
- PM10 is showing increase in the recent years for most of the cities and also continue to exceed WHO guidelines

- **Ozone is increasingly being monitored in major cities in Asia.**
- **In most cases, it is still not monitored by secondary or smaller cities.**
- **Reporting of ozone results are not made as frequent as other pollutants, eg. PM10.**
- **Ambient standards and averaging times for ozone are highly variable from one city/country to another.**





# Benchmarking Air Quality Management in Asia

- The Benchmarking study involved 20 cities in Asia representing various economic levels and geographic coverage.
- The cities were categorized according to four AQM capability indices – 1) AQ measurement; 2) data availability and assessment; 3) emission estimates; and 4) AQ management enabling capacity.
- Cities with high levels of economic development tend to have well-developed AQM systems
- Benchmarking of AQM capability can assist cities in setting priorities and developing strategies for strengthening their AQM capability

| AQM Capability | AQM Capability Scoring | Cities  | Level of Economic Development/ Trends of Air Pollution  |
|----------------|------------------------|---|---|
| Excellent I    | 91-100                 | Hong Kong, Singapore, Taipei, Tokyo           | <ul style="list-style-type: none"> <li>• High technology applied</li> <li>• Low air pollution</li> </ul>  |
| Excellent II   | 81-90                  | Bangkok, Seoul, Shanghai                      |   |
| Good I         | 71-80                  | Beijing, Busan                                | <ul style="list-style-type: none"> <li>• Maturing of cleaner processes, use of cleaner fuels and mature emission controls.</li> <li>• Further improvement of air quality</li> </ul>   |
| Good II        | 61-70                  | New Delhi                                     |   |
| Moderate I     | 51-60                  | Ho Chi Minh, Jakarta, Kolkata, Manila, Mumbai | <ul style="list-style-type: none"> <li>• Cleaner processes developed. Systematic AQM procedures developed</li> <li>• Air pollution decreasing from high levels</li> </ul>   |
| Moderate II    | 41-50                  | Colombo                                       |   |
| Limited I      | 31-40                  | Hanoi, Surabaya                               | <ul style="list-style-type: none"> <li>• Urbanisation, industrialisation and mobilisation continued. Initial systematic AQM procedures applied</li> <li>• High but stabilising levels of air pollution. Serious health and environmental impacts</li> </ul> |
| Limited II     | 21-30                  | Dhaka, Kathmandu                              |   |
| Minimal        | 0-20                   | -   | <ul style="list-style-type: none"> <li>• Increased urbanisation, mobilization and industrialisation. Only ad hoc AQM.</li> <li>• Deterioration of air quality through rising levels of air pollution</li> </ul>   |





# Status of Air Quality Management in the GMS

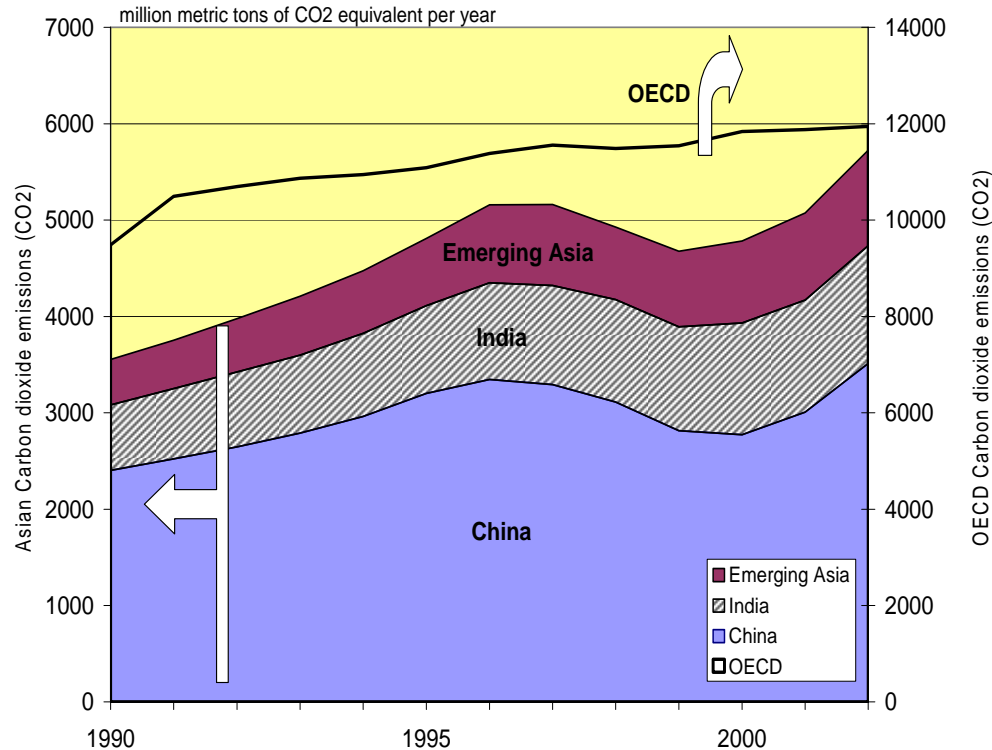
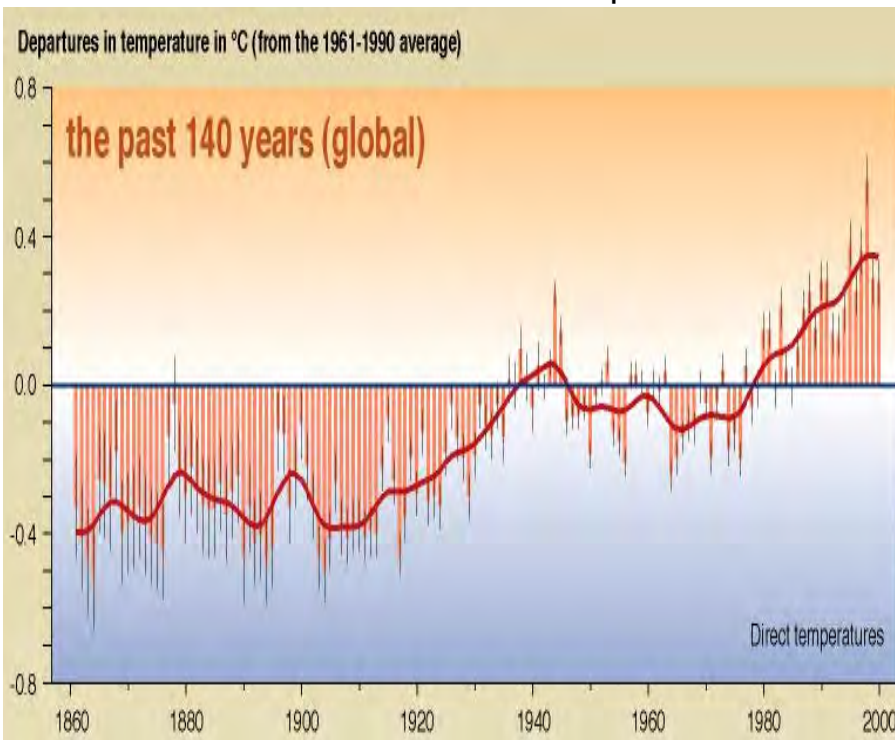
| Country  | Estimated AQM capability | Description of Air Quality Status and AQM   |
|----------|--------------------------|---|
| Cambodia | Minimal to Limited       | Air pollution is a growing concern. Air quality monitoring is not institutionalized and AQM is adhoc.   |
| Laos     | Minimal to Limited       | Air pollution is a growing concern. Air quality monitoring is not institutionalized and AQM is adhoc.   |
| Myanmar  | Minimal to Limited       | No information on air quality data.<br>No specific national legislation governing air pollution.  |
| PRC      | Moderate to Excellent    | Pollutant concentrations are highly variable for the different cities and provinces which may range from low air pollution to very poor air quality. Air quality is consistently monitored and data in air pollution index available. |
| Thailand | Good to Excellent        | Air quality is being monitored consistently with data readily available. Air quality management capability is generally good.   |
| Viet Nam | Limited to Moderate      | Air quality monitoring system is most advanced in HCMC but relatively adhoc in other areas.   |

- Air quality management in Thailand and some parts of PRC is more advanced than the rest of other GMS countries
- Air quality is not yet a priority concern in the other GMS countries
- Availability of information on air quality management as well as on levels of air pollution is either lacking or limited in Cambodia, Laos and Myanmar, which may hinder accurate assessment of their air quality management capabilities





## Variations of the earth's surface temperature

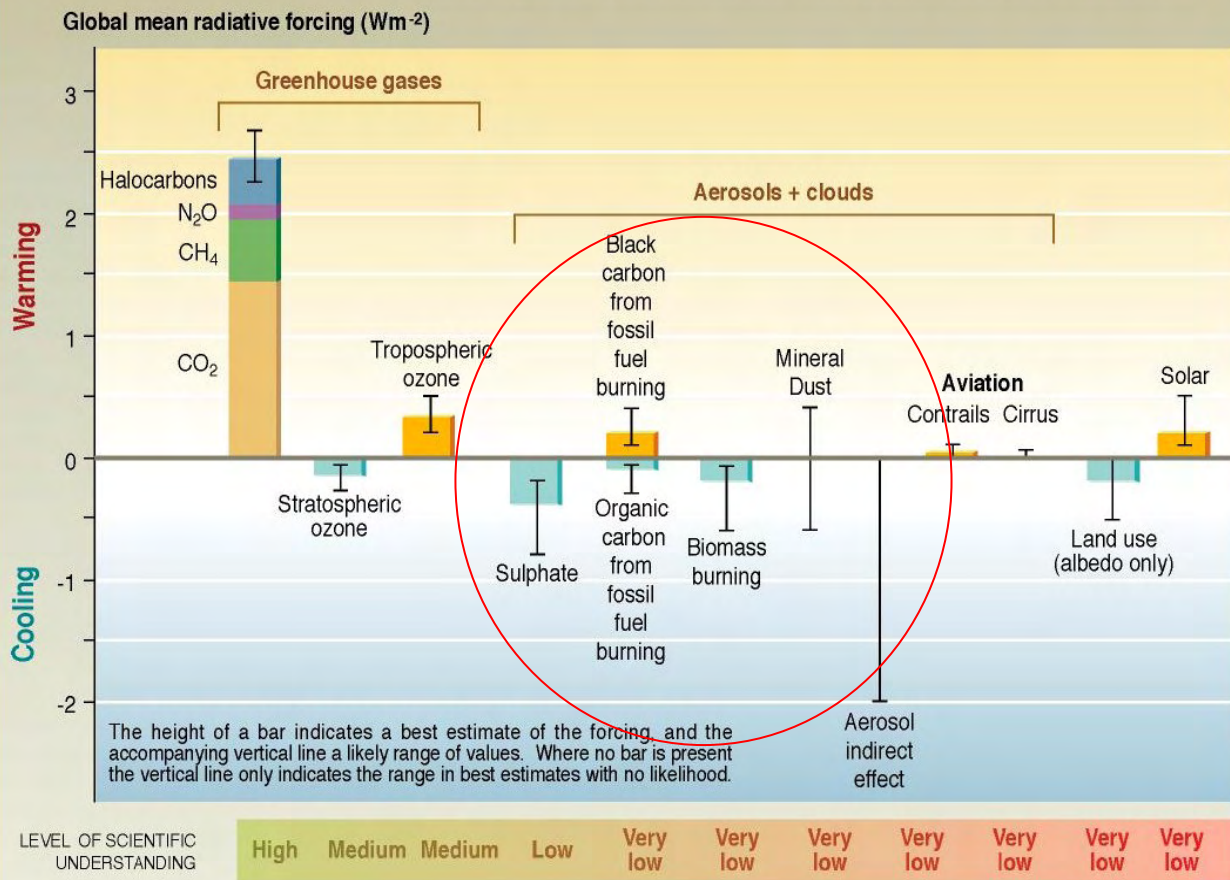


- While apparently seen as modest change, it is now accepted that the temperature change is producing changes in the climate system - that include increase in precipitation in the Northern Hemisphere over most mid- and high latitudes accompanied by a decrease in rainfall over much of the sub-tropical land areas, which then may impact largely on Asia agriculture.
- These changes are strongly linked to increasing anthropogenic activity and greenhouse gas (GHG) emissions that principally derive from an unprecedented increase in carbon-based-energy consumption.
- Climate change and Urban air quality problems have common drivers such as urbanization and population growth, energy consumption and mobilization.
- Both GHG and air pollutant concentrations in the atmosphere are exhibiting increasing trends



# Air pollution links with climate: UNFCCC Process

Anthropogenic and natural forcing of the climate for the year 2000, relative to 1750



- The IPCC Working Group I in its 2001 Third Assessment Report has recognized that dust, tropospheric ozone, black C, sulphates and other aerosols and PM have impact on climate but level of scientific understanding on this is still low
- Working Group I Outline for The Fourth Assessment Report\*\* (to be completed in 2007) will devote a specific section on "Air Quality and Climate Change" (under Chapter 7).
- This may suggest, then, that air pollution problem has or will have in the future a more substantial impact on climate and will require more in-depth attention

Image Source: IPCC, 2001. Third Assessment Report – The Scientific Basis

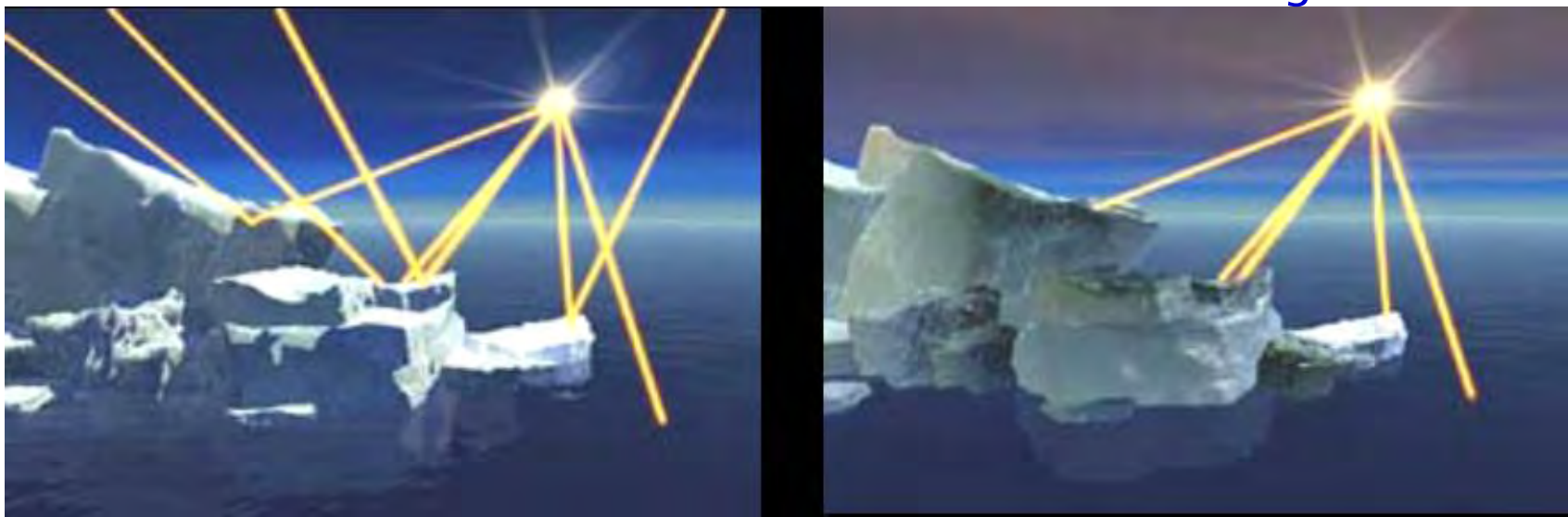
\*\* Outline for the IPCC Working Group I Contribution to the Fourth Assessment Report

Climate Change 2007: The Physical Science Basis - <http://www.ipcc.ch/activity/wg1outlines.pdf>



# Air Pollution links with Climate: Evidence (1)

## Evidence that PM affects albedo and causes melting of ice



- As the dark soot falls on the ice surface, it increases the albedo, reduces its capability to reflect back radiation thereby causing increase in temperature and melting of the ice.
- Black carbon (soot) has been implicated to play a role in the melting of ice and snow. Research in the Arctic atmosphere reveals that about one-third of the soot comes from South Asia, one-third from burning biomass or vegetation around the world, and the remainder from Russia, Europe and North America.
- Warming of the Arctic and diminishing of the sea-ice cover and glaciers have been attributed to changing weather and effects of pollution.
- Environmental changes in the arctic will affect global weather patterns including that of the GMS.

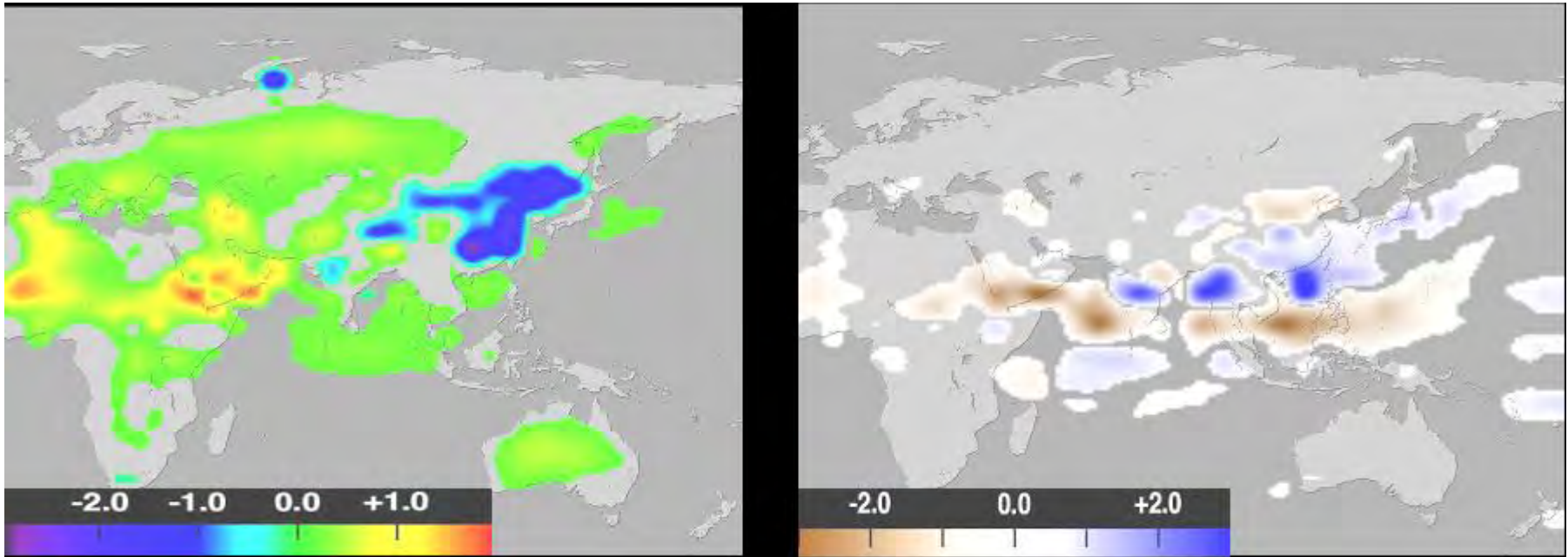
Source: NASA, 2005 - [http://www.nasa.gov/vision/earth/environment/arctic\\_soot.html](http://www.nasa.gov/vision/earth/environment/arctic_soot.html)





# Air Pollution links with Climate: Evidence (2)

## Evidence that PM affects temperature and weather patterns



**Soot changes ground temperatures in Asia**  
(in degrees Celsius)

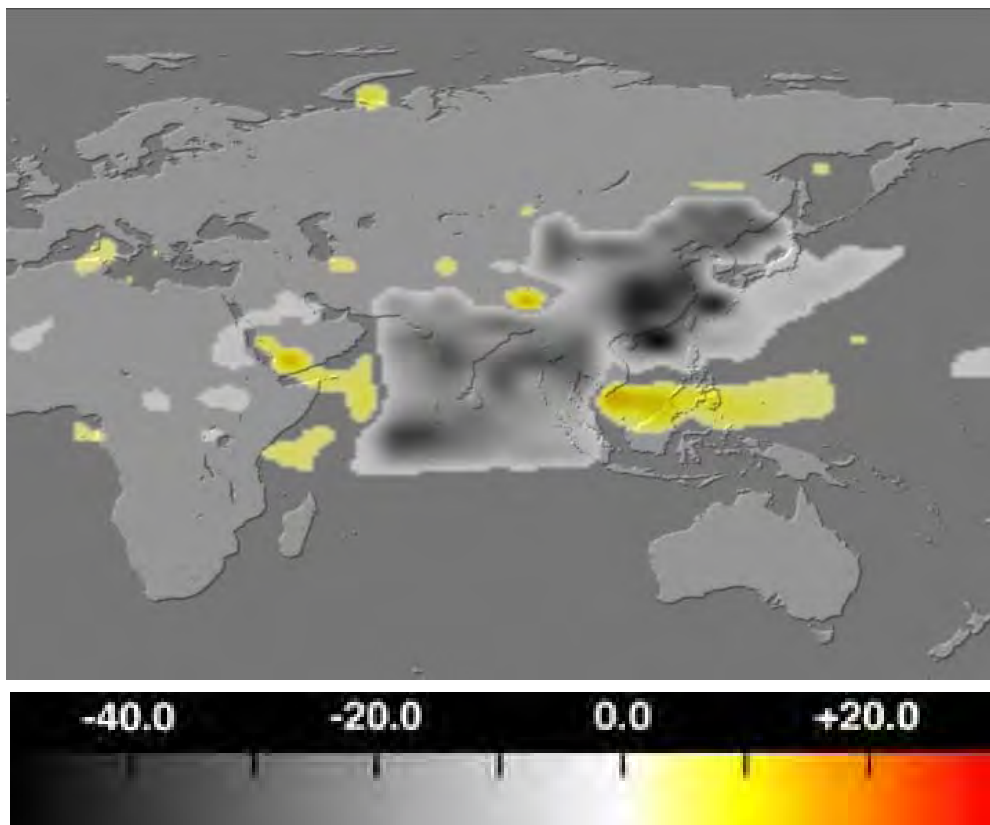
**Soot intensifies floods and droughts in Asia**  
(in inches rainfall)

- black carbon can affect regional climate by absorbing sunlight, heating the air and thereby altering large scale atmospheric circulation and the hydrologic cycle.
- NASA climate study reveals that large amounts of black carbon (soot) particles and other pollutants are causing changes in precipitation and temperatures over China

Source: NASA, 2002 - <http://www.gsfc.nasa.gov/topstory/20020822blackcarbon.html>



# Air Pollution links with climate and crop yield



- Soot blocks solar radiation from the ground thereby reducing crop yields.
- Aerosol data from 46 ground stations in China, shows the decrease in solar energy reaching the ground (in black) during the summer months (June, July and August). Yellow shows where the sunlight has increased.

Source: NASA, 2002 - <http://www.gsfc.nasa.gov/topstory/20020822blackcarbon.html>





# CAI-Asia proposed pilot project under GMS CEP (1)

**Proposed Title:** Impacts of climate change and air pollution on crops, forests and ecosystems

## Objectives:

- Conduct an assessment of current and future impacts of climate change and air pollution on crops and ecosystems
- Provide institutional strengthening and capacity building for regional and national institutes in the techniques involved in these assessment in selected institutions in the Greater Mekong region, including sharing of information and assessments.
- Facilitate monitoring at pilot sites and modelling by institutions in the region for future integrated assessments.
- Raise awareness, communication and networking among decision-makers about the associated policy issues

## Implementation:

- The project is proposed to be conducted as a partnership between the Asian Development Bank, Clean Air Initiative for Asia, Murdoch University, the Stockholm Environment Institute and partner organisations in the Greater Mekong sub-region.





# CAI-Asia proposed pilot project under GMS CEP (2)

## Structure of the integrated assessment:

| Components  | Approach  |
|---|---|
| Spatially resolved ambient concentrations or deposition of ozone, acids and SO <sub>2</sub> | <b>Modelling of current and future emissions calibrated with field measurements in BCI corridors using passive samplers</b> |
| Exposure of vegetation to air pollutants  | <b>Calculated using exposure indices and exposure-response relationships</b>  |
| Ecological and agricultural losses  | <b>Estimated based on exposure-response functions, and measurements in the region</b>                                       |
| Economic values   | <b>Estimated value of lost production of economically important crops and trees</b>   |
| Policy implications   | <b>Comparisons with estimated losses if current ambient air quality standards were met</b>                                  |



- CAI-Asia focus is on urban air quality but is increasingly focusing on the impacts of air pollution in surrounding areas of cities.
- Improved knowledge on the linkage between air pollution, changes in climate and corresponding impacts to agriculture and biodiversity helps to raise awareness for action and makes it more likely that action will be undertaken to address sources of air pollution.
- Growing knowledge basis can facilitate and speed up policy making on controlling emissions within the GMS region and to strengthen enforcement
- CAI-Asia is happy to
  - (a) help build capacity to develop and implement a study on linkages between Climate, Air Pollution and agriculture, forestry and biodiversity
  - (b) disseminating the results of the study and assist GMS countries in designing and implementing strategies to reduce emissions of pollutants that impact negatively on agriculture, biodiversity and food security.



- Dedicated sub-workshop on the proposed project as part of the BAQ 2006 workshop to expand the project concept and develop initial buy-in from policy makers in the region.
- Increased documentation on the topic in the CAI-Asia website.





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<http://www.cleanairnet.org/caiasia>

