Black Carbon e-Bulletin

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Capacity Building for Development of Science on Black Carbon

Black Carbon and other air pollutants, such as ozone in Atmospheric Brown Clouds (ABCs) have major adverse impacts on climate, agriculture, human health and ecosystem health on a global scale as well as at regional and local levels. Thus disconnected and isolated policy responses to global warming and to health/eco-system effects of indoor and outdoor air pollution will have unintended consequences on the climate and could possibly trigger non-linear changes. An example of an isolated policy response is the reduction of sulphur emissions (to mitigate health impacts of air pollution) without a comparable reduction in carbon dioxide and black carbon emissions, which can lead to a large increase in warming during the coming decades. In order to help decision makers to formulate an effective response (adaptation and mitigation), a common framework for addressing the combined impacts of greenhouse gases and air pollution is needed.

UNEP, recognizing the need for additional science to deepen the understanding of the source and role of aerosols in the interaction between air pollution and climate change, established the Atmospheric Brown Cloud (ABC) Science Team in 2002. The main aim of the Science Team is to develop sound science (based on reliable monitoring data over a long period) for integrated impact assessment such that it can be accompanied by appropriate capacity building measures and by development of appropriate mitigation steps, thus contributing to sustainable development.

Through the capacity building component, which is one of the project's major programmes, the project aims to develop physical infrastructure, human resources and network of experts and institutions to study the science and potential impacts of ABCs in an integrated manner. The Science Team through capacity building activities has made significant progress in the advancement of science and enhancement of capacity to study the combined impacts of greenhouse gases and air pollution.

Surface Observatories: The establishment of an integrated network of strategically located state-of-the-art ABC surface climate observatories throughout the Asia-Pacific region is a major achievement in this relatively poorly monitored part of the world. The observatories are now operated by local scientists, with regular training provided through the project and support extended by the Science Team. Many observatories are enhancements of existing observatories and a few are new. The objective of the observatories is to acquire continuous chemical and microphysical aerosol observations at key locations, with particular empha-

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Also in this Issue

Editorial: After Copenhagen

Achim Steiner, Executive Director, UNEP

While the Copenhagen climate conference held in December last year fell short of producing a legally binding global agreement, it nevertheless succeeded in pushing the climate debate to centre stage, demonstrating the complexity of the challenges and raising the political stakes. As the dust settles in the wake of the conference, the agreement that has emerged from the talks continues to attract parties. The Copenhagen Accord opened the door for concrete proposals. UN Secretary General Ban Ki-moon has pledged to move the accord from a political agreement to a legally binding agreement by the next UN climate conference in Cancun, Mexico in December this year.

As the process of multilateral negotiation continues to unfold, the reality remains that in order to effectively tackle climate change we will have to reduce carbon dioxide emissions and other climate forcing agents. This means adopting a broad approach that has a strong focus on policies to accelerate innovation and jump start immediate action. As a part of a holistic climate strategy, UNEP's focus also covers other global warming agents like black carbon, and address the need to formulate options for a post-2012 climate financial architecture so that it can best serve its member states.

There is recognition that the science on black carbon continues to develop and UNEP will facilitate scientific development and capacity building for an integrated assessment of black carbon and associated pollutants to evaluate their effects on air pollution and climate change. This will help to pave the way for a

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Atmospheric Brown Cloud (ABC) Symposium in Beijing

Fan Meng, Chinese Research Academy of Environmental Sciences, China, and Yuanhang Zhang, Peking University, China

A symposium on recent developments in scientific research and impact assessment of Atmospheric Brown Clouds (ABCs) was held in Beijing, China, on 10 December 2009. The symposium was hosted by the Ministry of Environmental Protection of China and the Chinese Research Academy of Environmental Sciences (CRAES). Around 30 distinguished atmospheric scientists and leading impact assessment experts from Peking University (PKU), CRAES, Institute of Atmospheric Physics (IAP), Tsinghua University (TU), Chinese Academy of Meteorological Sciences (CAMS), National Climate Center of China (NCC), China National Environmental Monitoring Center (CNEMC) and Environmental Development Centre of the Ministry of Environmental Protection (China-EPC) attended the symposium and presented their research work on ABCs.

Participants of the Atmospheric Brown Clouds (ABC) Symposium in Beijing

Prof. Yuanhang Zhang from Peking University, Vice Chair of the ABC-Asia Science Team, provided a briefing on the progress and work plan of the ABC-Asia Science Team, covering ABC phases I and II, including ABC observatories, modeling, impact assessment, knowledge management/dissemination and policy dialogue, as well as ABC research activities in Asian countries, such as India, Japan and Korea. He also reported on the progress of major ABC-related research project activities in China. Other symposium participants shared their new research findings related to ABC issues. Dr. Fan Meng from CRAES reported on a study of CMAQ modeling concerning the potential effect of SO_2 and NOx emission reduction in Northeast Asia on atmospheric extinction. Prof. Jietai Mao and Prof. Min Hu from PKU presented the results of surface PM_{10} concentration retrieved from satellite data and gave an overview of aerosol physical-chemical-optical properties in the Greater Beijing area. Prof. Kebin He from TU reported on the emission characteristics and evolution of PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and VOCs in China and some Asian countries. Dr. Jianzhong Ma and Dr. Jie Tang from CAMS presented new findings about the origin and climate effect of haze-cloud in northern China and summarised the measurement of aerosol BC and SSA at background sites in Shangdianzi and Li-An in China. Dr. Hua Zhang from NCC introduced her research on modeling of radiative forcing of carbonaceous aerosol and climate impact in East Asia. Mr. Haohao Zheng from CNEMC spoke on the framework and progress of the establishment of national atmospheric background monitoring sites. Ms. Lihong Ren introduced the use of aircraft in ABC monitoring. Dr. Qingxian Gao from CRAES reviewed the progress of China's effort towards a co-benefit control strategy of air pollution prevention and how to deal with climate change.

The symposium participants discussed future research and cooperation plans among Chinese institutions and how to coordinate Chinese research activities with UNEP's ABC project. All participants agreed that it is important to integrate the efforts of Chinese scientists by organizing science working groups in China and by working towards the integration of data analysis and modeling activities. The next ABC symposium, to be held in late October 2010, will be expanded to encourage the participation of more scientists.

As a follow-up activity, Peking University organized the Third International Workshop on Mega-city and Regional Air Quality Study in Beijing on 31 January to 1 February 2010. Around 40 scientists from Germany, the United States of America, Japan, Korea, and China (Mainland, Hong Kong and Taipei) attended the workshop, together with many Ph.D. students of PKU. Thirty-eight presentations were made on mega-city air pollution, its climate and health effects, and the future direction in addressing the problem. <

Joint Forum on Atmospheric Environment in Asia-Pacific

A Meeting of the Joint Forum on Atmospheric Environment in Asia and the Pacific was held in Bangkok, Thailand on 10-11 March 2010. This was a continuation of the process which began in Bangkok in March 2009, when a Joint Meeting of the Intergovernmental Networks on Regional Air Pollution in Asia and the Pacific Region was held. The Joint Forum Meeting, which was attended by representatives of regional air pollution networks as well as sub-regional intergovernmental organizations, developed a Joint Plan to promote synergy among existing air pollution related networks in the Asia-Pacific region. <

Black Carbon Mitigation Potential in the Transport Sector

In 2006, the transport sector contributed approximately 13% of overall GHG emissions and 24% of CO_2 emissions worldwide. The transport sector is the second largest CO_2-emitting sector after electricity production, and within the transport sector, road transport accounts for two-thirds of CO_2 emissions[1]. Despite efforts to lower emissions from the transport sector, black carbon emissions (a by-product of incomplete combustion in petrol and diesel engines) are expected to increase from 2020, most notably in developing and transitional regions[2].


The transport sector is one of the most promising and cost-effective areas of intervention for black carbon emissions reduction.

The UNEP Transport Unit's (TU) Partnership for Clean Fuels and Vehicles (www.unep.org/pcfv) and the Global Fuel Economy Initiative (GFEI, (www.50by50campaign.org) are working to reduce fuel sulphur levels, improve vehicle technology worldwide, and increase automotive fuel economy by 50% by 2050 globally. The UNEP Transport Unit works closely with the International Council on Clean Transportation (ICCT) in defining and communicating black carbon emissions from the transport sector, mitigation measures, and the importance of addressing road transport emissions for both CO_2 and non-CO_2 reduction. Achieving the GFEI goal will result in the reduction of CO_2 emissions by over 1 gigatonne a year by 2025 and over 2 gigatonnes by 2050, and will result in annual oil import bills worth over USD 600 billion in 2050.[3]

The level of black carbon from any given source vary – the higher the black carbon content of soot emission, the darker and therefore more warming impact. The transport sector is one of the most promising and cost-effective areas for intervention. It is also one of the most obvious sectors where change can have an immediate effect, both on atmospheric concentrations of black carbon (estimated to be the second or third largest contributor to positive radiative forcing globally that causes climate change), and on health effects on people living within close proximity to sources of high black carbon emissions.

While black carbon emissions from the transport sector are projected to be increasing[2], black carbon control may prove to be an extremely cost-effective short-term climate change and local air pollution measure. This is particularly relevant in countries where motorization is expected to increase future emissions of black carbon from the transport sector. [2]

While in the long-term CO_2 will remain the dominant contributor to climate change, black carbon reduction should not be considered as an alternative to long-term CO_2 reduction. Black carbon control may offer the opportunity to reduce warming in the immediate and short-term. This is particularly true in the transport sector where technologies already exist to reduce black carbon emissions, such as low-sulphur petrol and diesel, catalytic converters, and the introduction of environment friendly vehicles, such as electric and hybrid vehicles, and hydrogen-powered vehicles.

A number of mitigation technologies already exist which would drastically cut down the positive radiative forcing effect of black carbon and carbon dioxide on climate change. However, low sulphur fuels are a prerequisite for mitigative technologies – without which many technologies simply would not work. The most effective emission reduction strategy, albeit an 'end of pipe' option, is the installation of the 'wall-flow filter' on diesel engines, which has the ability to practically eliminate black carbon emissions when used with ultra-low sulphur fuel at 15 ppm or less.[4]

Other mitigation technologies and strategies used to reduce black carbon emissions include higher efficiency engines, light-weight and more aerodynamic vehicles and even zero carbon modes – all of which work in tandem to reduce CO_2 emissions.[4] When instituted in conjunction with mitigative technologies, policy options and strategies also work to reduce black carbon emissions. Standards for new vehicles that require diesel particulate filters and low sulphur fuels, measures to encourage required retrofitting of in-use vehicles with particulate filters, effective verification and enforcement regimes and early scrappage of high polluting older vehicles, when used in tandem with clean technologies, can have a drastic reduction effect on black carbon emissions in the transport sector.[4] <

1. International Transport Forum, "Reducing Transport GHG Emissions: Opportunities and Costs", 2009.
2. Walsh, M., 7 Global Partnership Meeting of the PCFV, 2009, Beijing.. Available at http://www.unep.org/pcfv/PDF/7gpm_Environmentalvehicles_Walsh.pdf
3. Global Fuel Economy Initiative, 2009. Available at www.50by50campaign.org
4. International Council on Clean Transport, "A Policy Relevant Summary of Black Carbon Climate Science and Appropriate Emission Control Strategies", 2009. Available at http://pre2010.theicct.org/documents/BC_policy-relevant_summary_Final.pdf.

Editorial ...

potential policy response to the issue of black carbon.

UNEP is also committed to working with various partners and stakeholders to further develop an action programme that can effectively address black carbon emission reductions within the context of the climate change regime. It recognises the need to build consensus among stakeholders, especially policy makers, on addressing the black carbon issue. As such we have commenced a dialogue on appropriate policy responses, particularly in the context of climate change mitigation and health impacts.

Sustaining the momentum for global action to address climate change remains a major challenge facing the international climate community. As countries step forward to add specific emission reduction targets to the accord, there remains a need for concrete action now while seeking fresh results from Cancun. Climate change will not wait while the multilateral negotiation process unfolds, and any action that can be taken now, on the reduction of carbon dioxide and other climate forcing agents should not be delayed. <

sis on black carbon and organics, as well as radiation, precipitation chemistry and meteorological measurements.

Currently, over a dozen ABC observatories are operational in Asia and the Pacific. These include the Maldives Climate Observatory (MCOH) which is the first aerosol observatory in the Indian Ocean with a five-year time series data on the seasonal cycle and inter-annual variability in transport, aerosol chemistry and radiative forcing, and the Nepal Climate Observatory-Pyramid (NCO-P), the highest ABC observatory in the Himalayas documenting high soot levels at elevations as high as 5 km.

Unmanned Aerial Vehicles: In addition to regular monitoring at surface observatories, intensive field campaigns are conducted using unmanned aerial vehicles (UAVs) at given locations/ regions. For example, Maldives Autonomous Unmanned Aerial Vehicles Campaign (MAC) during March-April 2004 based out of MCOH, first of its kind in atmospheric measurements, the Cheju ABC Plume - Asian Monsoon Experiment (CAPMEX)-2008 was conducted in the spring of 2008 from a base on Cheju (Jeju) Island that deployed UAVs for the first time in East Asia. The measurements carried out during the campaign, when three UAVs are deployed in stacked formation with one flying above the cloud, one through the cloud and one below the cloud, helped to understand the interaction of dust and anthropogenic aerosols (for example, black carbon, sulphates) and atmospheric solar heating due to light-absorbing aerosols, among other effects.

Training School: A training school was established with the aim of training regularly the next generation of scientists in the study of the combined impacts of greenhouse gases and air pollution. The participants attended classroom lectures by prominent atmospheric scientists and experts who provide theoretical background and an overview of current knowledge on various aspects of atmospheric brown clouds and climate change, impacts, application of a variety of scientific instruments for atmospheric aerosols, trace gases, precipitation chemistry, radiation and meteorological measurements, as well as the modeling tools. During the 3 schools in past five years, more than 100 carefully selected young researchers, post doctoral fellows and senior students have been trained. Participants are mainly from developing countries and are participating in research activities at the national level.

Data Availability: Data collected at the observatories, and modelling experiment outputs are being archived at the central data archival at the ABC-Data and Information Service Center (ABC-DISC). The data is also disseminated through the internet: http://www.rrcap.unep.org/abc/data/index.cfm <

Maldives Climate Observatory in Hanimaadhoo

Unmanned Aerial Vehicles (UAVs) during Cheju ABC Plume - Asian Monsoon Experiment (CAPMEX)
(Source: Prof. Ramanathan)

For further information:
United Nations Environment Programme (UNEP) , United Nations Avenue, Gigiri, P O Box 30552, 00100 Nairobi, Kenya; email: BCBulletin@rrcap.unep.org