ABC-SLCP symposium Summary

Session1 speaker: V. Ramanathan (Scripps Institution of Oceanography, University of California at San Diego, USA & UNESCO Professor of Climate and Policy, TERI University, Delhi, India) ABC Project Possible Future Directions

A major new study was released two weeks ago, which is about a comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions from Lin et al, LANCET, 2013. Household air pollution from solid fuels accounted for 3·5 million (2·7 million to 4·4 million) deaths. Ambient particulate matter pollution accounted for 3·1 million (2·7 million to 3·5 million) deaths

As a scientific assessment, the total direct forcing by all black carbon sources is estimated as 0.88 (+0.17, _1.48) Wm^{-2}. "We confirm that black carbon, with a total climate forcing of +1.1 Wm^{-2}, is the second most important human emission in terms of its climate forcing in the present-day atmosphere. "

<u>Major new finding by ABC team:</u>

1) Yet another warming pollutant has Been identified: Brown Carbon from Open Biomass Burning and tarballs from fossil fuels. (Korea-USA Team Chung, et al, PNAS, 2012 Bahadur et al, 2012 Feng et al, 2013.)

2) Discovery of High Black Carbon Concentrations over the High Himalayas. (The Pyramid-Italy Team (S. Fuzzi and others))

3) High Black carbon concentrations over the High Himalayas. (The Pyramid-Italy Team (S. Fuzzi and others))

4) Innovative Isotope techniques yield more accurate data on relative role of biomass and fossil fuels for BC concentrations over S. Asia. (Sweden & Maldives (Gustafsson and others))

5) Forecast of ABCs for the Commonwealth Games In Delhi, India, 2012. (India and USA (Beig; Carmichael))

<u>New initiatives by ABC team:</u>

• Regional Model Intercomparison Study Japan(Nakajima), USA (Carmichael) & the

Whole Team

• SUSKAT: Field study in the Eastern Himalayas Germany(Lawrence; Rupakheti); Nepal (ICIMOD)

• LAISI: Proposed NASA-High Altitude Study of Role of Dust and Black Carbon in Himalayan Glacier Melting USA(JPL; Scripps); Italy (EC2); Germany; ICIMOD

Recommended next phase of ABC: ABC Initiate a Science, Knowledge Exchange & Action Program for reducing BC and PM from the Transportation sector In China

Session 1 speaker: Henning Rodhe (Department of Meteorology Stockholm University, Sweden) A brief history of the ABC project.

Major findings - (1) Influence climate; (2) influence the Asian monsoon (3) influence glacial melt (4) influence food security and (5) very significant public health impacts. (6) Black Carbon in ABCs have increased solar heating of the atmosphere; It is virtually certain India and China are dimmer today by about 5% to 10%, compared with the1950s; It is highly likely that ABCs have increased solar heating at elevated levels (1 to 4 km) over India and China by as much as 10% to 20% (7) Food security over ozone effect, climate effect. – The cost of health impact alone if likely to outweigh the cost of mitigation by a large margin.

Source apportionment of BC at MCOH

Project Surya : Biofuel cooking and home heating is a major source of BC.

New phase ABX project suggestion: • Revisit science and

Observation • Enhance scope • Focus on implementation of emission reduction

Measures • Contribute to CCAC and other mitigation efforts.

Enhance governance

Session 1 speaker: Terry Nakajima (Atmosphere and Ocean Research Institute, University of Tokyo) Prospects of using the UNEP/ABC-Asia project heritage for SLCP impact studies

The SLCP impact study shows the uncertainties of radiative forcing and impact assessment.

Situation:

- Consensus of reducing ABC will improve the environment and public health.
- We cannot say black carbon first.
- Need a clever path, because the resulting impact and benefit are highly path-dependent.
- Need sound basis for path selection to convince society.
- Need more research to learn about the large uncertainties

Research Program on Climate Change Adaptation, MEXT (RECCA) Development of Seamless Chemical Assimilations System and its Application for Atmospheric Environmental Materials (SALSA).

Analysis of atmospheric quality (AQ) changes events. Traffic control case study during Beijing Olympic and project Surya (India). Understanding regional AQ change events will allow a comprehensive analysis and able

to seek of the optimal mitigation path and becomes assessment of global impacts of LLGH and SLCP.

Future Study includes:

MOEJ: Active evaluation of SLCP impacts and seeking the optimal pathway (2014-)

Theme 1: AQ change event analysis ・Simulation and analysis ・Emission inventory ・Inversion algorithms

Theme 2: Integrated model and upscaling ・global ・nations and regions ・cities and household

Theme 3: SLCP impacts on climate & environ. ・Aerosols and gases ・Public health, agriculture, water cycle, sea level

Issues : (1) Science discussion of SLCP measurements and impact studies needed by us. (2) Asian nations have potential to run ABC-Asia Climate Observatories. (3) Need an international framework. (4) Any good mechanisms?: ABC, CCAC-ABC, WMO/GAW-ABC... (5) More discussion with CCAC needed.

Session 1 speaker: Daisuke Goto & Greg Carmichael (ABC-Asia modeling group) Update & results of model inter-comparison under ABC-Asia

Registered models to ABC modeling activity includes global models (SPRINTARS, GEOS-Chem, BCC_AGCM2.0.1, EMAC, MATCH), regional models (CMAQ, STEM, WRF-Chem, EMTACS, CMAQ), and radiative transfer model (MACR, FGOALS2_s)

Improvements from 2012 to 2013, Five models SPRINTARS, CMAQ, EMTACS, STEM, WRF-Chem working. Measurements are now able to measure not only aerosol but also gas. Also measuring the EANET sites of SO4 2-, SO2, and O3. Aerosols during whole year of 2006 are stored.

MICS-III TOPICS

• Topic 1: Model Intercomparison of AQ at multiple scales (Leaders: Z. Wang, K. Yamaji and J. Fu)

• Topic 2: Inter-comparison of emission inventory (Leaders: J. Woo, T. Ohara, and Q. Zhang)

• Topic 3: Air Quality/Weather/Climate Interactions (Leaders: Greg Carmichael, ZW Han, Yafang Cheng)

The Goal is to improve models and reduce uncertainties in impact estimates using ABC measurements, models and improved understanding from field experiments. For next step, discuss with measurement group in terms of availability of their results in which period and find a suitable period year. New inventory will be made by MICS group to have a source region free with emission inventories. More observations and models are required. New timeline is needed.

Session 1 speaker: Helena Molin Valdes (CCAC, United Nations Environment Program) CCAC status and prospects

SLCP measures Methane, Black carbon, HFCs.

The CCAC mission are • Launched in February 2012 by 6 countries and UNEP • First global effort to treat SLCPs as a collective challenge, with primary forcus on CH4, BC and some HFCs. • Voluntary, Partner-led effort bringing together many diverse, experienced, and influential governments, IGOs, NGOs and private sector entities to leverage high-level engagement and political will and catalyze action for near term and multiple benefits • Complementary to global efforts to reduce CO2, in particular under UNFCCC.

Next step is 1. Bringing on board key new Partners and raising Awareness, especially in the Health, Agriculture and Development communities as well as private sector and fully engaging with those communities 2. Increasing Partners high level commitment, action and capacity 3. Increasing funding toward SLCP mitigation including through MDBs and other sources 4. Scaling up Initiatives

Status on CCAC (1) Reducing BC from Heavy Duty Diesel Vehicles and Engines (2) Mitigating SLCPs from Municipal Solid Waste (3) Mitigating BC and other pollutants from Brick Production (4) Promoting HFC Alternative Technology and Standards (5) Accelerating methane and BC reductions from Oil and Natural Gas Production (6) Reducing Emissions of SLCPs from Household Cooking and Domestic Heating (7) Addressing SLCPs from Agriculture (8) SNAP - Supporting National Planning for Action on SLCPs (9) Developing the SNAP Toolkit (10) Financing Mitigation of SLCPs (11) Regional Assessment of SLCPs (12) Trust Fund (13) Approved funding to initiatives .

A Scientific Advisory Panel is to be formed to provide advice as requested by decision of the

Coalition on scientific matters related to SLCPs and near term climate change, including reviews of:

(a) emerging science in the field, (b) assessments of the impacts on climate, health, agriculture, and ecosystems, and (c) evaluations of the costs and benefits of various mitigation options.

Session 2 speaker: John A. Ogren (Chairman, WMO/GAW Scientific Advisory Group for Aerosols National Oceanic and Atmospheric Administration Earth System Research Laboratory Global Monitoring Division Boulder, Colorado, USA) Recommendations for Reporting "Black Carbon" Measurements

Issues : • Black carbon (BC) has important effects on climate and Health • BC is poorly defined in the scientific literature • BC measurements depend on the method used.

What is black carbon and what is need for calibrated BC measurements.

BC Measurement Methods

Evolved carbon, light absorption, laser incandescence, aerosol mass spectrometry, raman spectrometry, electron

microscopy.

Recommended Terminology: – Use “BC” as a qualitative term referring to any of the quantitative methods – Use terms associated with the measurement methods when reporting quantitative results. • Equivalent black carbon (EBC) • Refractory black carbon (rBC) • Elemental carbon (EC)

Session 2 speaker: Ö. Gustafsson (Stockholm University, ITM and the Bolin Centre for Climate Research) δ13C/Δ14C- sourcing of carbon aerosols in South and East Asia

- δ13C and Δ14C: diagnostic for both sources and processes of BC and BrC aerosols
- Δ14C of atmos BC: ”reality check” for emission models
  - Fossil comb sources-50% S Asia; -80% E Asia
- Water-soluble Brown C:
  - Large fossil portion; - Sign absorption relative to BC
- ABC Observatories unique infrastructure for furthering both basic and policy-oriented atmospheric science
  - Iterate with EI for improved mitigation guidance
  - Verification of actual effects of ground-based mitigaton on composition of the atmosphere and effects on radiation

Session 2 speaker: Mei Zheng (College of Environmental Sciences and Engineering, Peking University) Characteristics of Fine Carbonaceous Aerosol in Megacities of China

<u>Chinese carbon monitoring network</u>

<u>Chinese carbonaceous aerosol characteristic</u>

Concentrations

Sources

light absorption: (1) obvious wavelength dependent light absorption, with stronger light absorption during less than 500nm; (2) winter > summer，fossil fuel sources might be more important in winter

<u>Summary of Carbonaceous Aerosol in China</u>

1. High concentration of carbonaceous aerosols 2. High percentage of fossil fuel fraction 3. Higher light absorbing of organic carbon

Session 2 speaker: Jhoon Kim (P.I., GEMS Yonsei University, Seoul, Korea) Monitoring SLCP from Geostatioary Orbit : GEMS(Geostationary Environment Monitoring Spectrometer)

- Geo-KOMPSAT-2A and 2B are expected to be launched in 2017-2018 time frame and provide information on aerosol and trace gas amounts with the three instruments of AMI, GOCI-2 and GEMS.
- GEMS, a geostationary mission is expected to contribute monitoring air quality and SLCP in Asia in high temporal and spatial resolution.
- GEMS, a scanning UV-Visible spectrometer observations can contribute to provide a set of tropospheric column products over the Asia-Pacific region at spatial resolution of ~ 8 km and temporal resolution of 1 hour.
  - AOD(AI, SSA, AOCH), O3 NO2 SO2 HCHO …
  - And potentially, CH4, CO …
- GEMS can contribute to understand the globalization of pollution events, source/sink identification, and long-range transport of pollutants and SLCP, as a part of the CEOS ACC.

Session 2 speaker: S. S. Yum (Department of Atmospheric Sciences, Yonsei University, Seoul, Korea) On the submicron aerosol distributions and CCN number concentrations in and around the Korean Peninsula

- NCN and NCCN in Seoul were twice higher in winter than in summer, likely due to the East Asian annual monsoon cycle.
- A significant portion of CCN measured in Seoul may not be directly originated from local sources
  - Traffic emission profoundly influenced the diurnal variation of NCN but not NCCN.
  - There was a strong negative relationship between NCCN and PBL height but not between NCN and PBL height.
- NCN and NCCN generally decreased with height and reached down to 100s cm-3 above the PBL (~3000 m).
- The particle formation and growth event on a flight day was estimated to have occurred on an areal extent of 100 x 450 km2 or larger.

- The composite map, which is expected to be used as a valuable reference dataset for modeling and satellite remote sensing studies, indicated that the concentrations were representative of a polluted region and there was a generally decreasing trend from east to west, implying the dominant influence of continental outflow.

Session 3 speaker: Sumit Sharma (TERI) Air quality status and emissions in India

Air quality in India, Major sources,

Concerns: (1) Less penetration of LPG in rural areas (2) Urban slums still a source of biomass burning (3) Negligible PNG supplies (4) Need to revive cook stoves, bio-gas programs.

Energy and emission scenarios,

Developing NMVOX inventory

• Identifying processes of NMVOC emissions • Understanding source and type of NMVOC emissions • Data collection • Selecting emissions factors • Speciation • Allocation

NMVOC emissions : 10 Tg/year gridded emissions (36x36 km^2)

Simulations Using WRF, CMAQ models

Future scenarios and plans

• Future scenarios developed for 2030 with measures for reducing the energy consumption and controlling the pollution. • Measures divided into 2 categories – energy reduction and environmental pollution control measures.

Business as usual : Based on current state of Government policies and expected levels of enforcement through our own judgment. The scenario depicts the efforts made to be made in the future without any sense of urgency.

Alternate : This scenario is based on additional set of measures required to reduce energy consumption and emissions from different sources in the country. The scenario depicts a sense of urgency in enforcement of policy measures.

• ICAMP : India California Air Pollution Mitigation Program

• Influencing policies for transport sector emission control in India

• Focus on PM-black carbon emission inventories, regional scale simulations and radiative forcing

• Improving emission inventories using Indian emission factors and source profiles

Session 3 speaker: Ryoichi Imasu (Atmosphere and Ocean Research Institute, The University of Tokyo) Inverse analysis of CO2 emissions from a mega-sized city using satellite and in situ observation data

Observational data

【Monitoring by local government】《ground based, continuous: hourly》

【CONTRAIL】《Vertical profiles, upper tropospheric concentration》

【GOSAT】《SWIR:XCO2, TIR: upper tropospheric concentrations》

Transport model

【NICAM-TM】《Global scale model based on GCM》

【AIST-MM】《Regional scale model》

- Vertical profile of CO2 concentration
- Seasonal variation of CO2 diurnal cycle at the surface
- Comparison between observation and model calculation
- Changes in CO2 concentrations detected after the Tohoku-Pacific Ocean Earthquake
- XCO2 observed by GOSAT TANSO-FTS (SWIR) over the Kanto Plain
- Relationship between XCO2 and wind direction/speed

Session 3 speaker: Toshihiko Takemura (Kyushu University) Recent studies on the aerosol-climate interaction with global models

- Global aerosol model intercomparisons — AeroCom & ACCMIP.
- Updates on studies with SPRINTARS.
- Future projection of aerosol distribution and radiative forcing along RCPs.
- Weekly global aerosol forecasting system.
- Simulation of transport of radioactive materials from Fukushima 1st NPP.

‣Development of MIROC-ESM.

‣ Data assimilation system for aerosols.

Session 3 speaker: Daisuke Goto (National Institute for environmental studies, Japan) Simulation and application of anthropogenic aerosols in Japan using a Non-‐‐–hydrostatic Icosahedral Atmospheric Model

- We have developed a global aerosol transport model (SPRINTARS) to focus on aerosols (mainly combustion aerosol from anthropogenic sources) around Tokyo/Japan with the spatial resolution of approximately 10 km using a stretched grid system of NICAM.

- The present model can generally simulate meteorological fields, and has a capability of simulating anthropogenic primary particles, i.e., elemental carbon (EC), and secondary particles, i.e., sulfate, against the measurements, except for the areas near high mountains and heavy precipitation days.

Session 3 speaker: Chul Eddy Chung (Gwangju Inst. Science and Technology) Reducing the uncertainty in estimated global direct aerosol radiative forcing by observations

Our strategy : We constrain by observation the following variables: AOD, SSA, ASY, fine-mode fraction, vertical profile, co-location of aerosol and underlying cloud.

Employed data: MODIS, MISR, AERONET, CALIPSO

Our result is half Wm-2 of AEROCOM II

Session 4 speaker: Anindita Dutta (The Energy and Resources Institute (TERI), New Delhi, India) Health impacts of chronic exposure to household air pollution from burning of biomass fuel in rural Indian women

Every measurable health end point on the poorer side of the scale

- The study showing adverse health effects among poor, underprivileged women in their reproductive ages in rural India is important from public health perspectives

- It may motivate the government and the regulatory agencies of the country to take a serious note of the indoor air pollution (IAP) from biomass fuel use as it threatens the health of millions of women, children, and the elderly who mostly stay indoor

- We hope the findings will strengthen the demand for setting up a standard for indoor air quality in the country in the line of national ambient air quality standard

- The findings may also inspire the authorities to take measures for the reduction in HAP by improving housing, kitchen ventilation, and cook stoves

- Moreover, the parameters used in this study can be utilized for large, population-based studies to identify women at a higher risk of developing CVD, etc. so that medical intervention can be taken at the formative stage of a disease

Session 4 speaker: Chris Fook Sheng Ng (National Institute for Environmental Studies 16-2 Onogawa, Tsukuba, Ibaraki 304-8506 Japan) Assessing the short-term mortality impact of exposure to surface ozone in Japan using multi-city time-series study

- Significant excess mortality due to acute effects of O3

- Substantial seasonal variation

- Elderly with underlying respiratory condition particularly vulnerable

- Findings might be useful for predicting future impact based on downscaled data (on-going).

- Through collaboration, hazard maps for the regions of Asia/East Asia.

Session 4 speaker: Anobha Gurung (School of Forestry and Environmental Studies
Yale University, New Haven, CT) Air Pollution Exposure and Human Health
Burden in Kathmandu Valley, Nepal
- Personal PM2.5 Exposure
1. Traffic Police has the highest exposure averaging 51.2μg/m3 with hourly maximum of ~5000μg/m3.
2. Average exposure for IOW_NMR was 46.9μg/m3 and IOW_AMR was 26.2μg/m3.
3. Traffic flow, time of the day, proximity to main road, occupation type defined the exposure level present.
4. Likely to have substantial health impacts
- review

• High air pollution indicating potentially serious health consequences

• Challenges and research gaps: limited data, short time frame, small sample size, exposure assessment, all study on respiratory health

• Need of research: chronic and acute effects, risk associated with pollution mixture, vulnerability by sub-population, studies with larger sample sizes, direct exposure measure, time activity pattern

Session 4 speaker: Ho Kim (School of Public Health, Seoul National University (Korea)) Introducing HEATA (Health Effects of Air pollution and Temperature in Asia) Collaboration

HEATA (Health Effects of Air Pollution and Temperature in Asia) Collaboration

• International research network: China, Japan, Korea, Taiwan, USA

• Collect and analyze: air pollution, weather, health (mortality)

• Generate new hypothesis about health and Climate Change

Future Plans: Strengthen HEATA collaboration

• Data collection

- Other information • Health: disease, age, sex-specific mortality, morbidity, ER visit • Weather: DTR (Diurnal Temp Range), UV, duration of sunshine • Environment: PM2.5, chemical specification, LIDAR, greenness • Social & Economical: age structure, GDP, social capital, deprivation index, social support
- More data from US, South America, Europe, South Asia, Australia, etc..

• Research methodologies on CC, air pollution and health

• Hypothesis generation: Adaptation, acclimatization, sustainable society

Session 5 speaker: Bidya Banmali Pradhan (Atmospheric Environment Specialist, International Centre for Integrated Mountain Development Kathmandu, Nepal) The Atmosphere initiative at ICIMOD-Science, Mitigation and policy.

ICIMOD does….

- regional intergovernmental mountain knowledge, learning and sharing centre - devoted to sustainable mountain development
- Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan
- Influence policy and practices to meet the associated challenges emerging in the HKH.

Activities

• Observatories • Field campaigns: • Modeling centre • Creating a regional scientists' network and data centre• Improving emissions inventories • Tarai winter fog field campaign (together with IASS and Indian partners)• BC

in glaciers and snowpack

Health impact study - Together with IASS and University of Massachusetts, USA; NHRC etc – Impact on Tourism – Report – Urban transportation conference

Mitigation • Cook stove experiment • Brick kiln • Urban transportation workshop 2014 with IASS • Install diesel particulate filters on ICIMOD's diesel vehicle fleet as well as Sajha buses

Capacity Building • Grants to research students • Design competition on cookstoves

• Start Master /PhD course on Atmosphere • Grant for instrument maintenance to researchers and universities.

Session 5 speaker: Maheswar Rupakheti (Institute for Advanced Sustainability Studies e.V. (IASS) Potsdam, Germany) Overview of SusKat-ABC campaign in Nepal

Future Measurement activities

1. Aerial sampling with ultralight aircraft (300-400 h)- Fall/Winter (IASS, ICIMOD, KIT, MWP)

2. Health impact of air pollution- Winter/Summer (IASS, ICIMOD, U. Masstt., NHRC)

3. Measurement of emissions in Nepal and Bhutan- Winter/Fall (U. Montana, ICIMOD, IASS, U. Iowa, Emory, U.)

4. India-Nepal Study of Atmospheric Emissions from Waste burning (INStAnt Burn)-Winter (IASS, IISER-Mohali, MPI-C, ICIMOD)

Expectations

- A substantially improved database of local air pollution
- Objective and balanced science-based assessment of the causes and impacts of air pollution in the Kathmandu valley and the surrounding region.
- Identification of and later demonstration of selected mitigation measures and strategies that are based on sound science, are politically viable, cost-effective & realizable in a stepwise way, have a potential for scaling up to larger levels, and that have a potential for application to other regions.
- Scientific publications

Session 5 speaker: Sang-Woo Kim (School of Earth and Environmental Sciences

Seoul National University) Light-absorbing Aerosol Properties in the Kathmandu Valley during SusKat-ABC

Field Campaign

• BC mass concentration observed at Kathmandu during SusKat campaign(Dec 2012-Jan2013) is almost 10 times higher than those of East Asian sites and Maldives.

• BC concentration at Kathmandu during SusKat campaign is found to be maximum in the morning (06-09LST) due to increased vehicular movement and cooking activities including substantial burning of wood and other biomass and low wind speed. Whereas, lowest amount of BC is recorded around noon time due to development of mixing layer.

• Atmospheric absorption (i.e., atmospheric forcing) is estimated to be +48 W m-2, which is similar to those at polluted areas (e.g., Kanpur, Beijing), but almost two times higher than those at regional background stations (e.g., Maldives, Gosan, etc.). This result is consistent with the high BC to sulphate ratio.

Session 5 speaker: Friederike Höpner (Department of Meteorology, Stockholm University) Vertical profiles of aerosol optical properties and wavelength dependent absorption at the Maldives Climate Observatory Hanimaadhoo

● Polluted air masses transported from southern Asia to the northern Indian Ocean have been observed with surface and airborne measurements

● Vertically resolved aerosol optical properties are studied

● EC/OC filter measurements were used to estimate a mean Mass Absorption Coefficient for Black Carbon for the CARDEX field campaign

● Further analysis of UAV CPC profiles compared to lidar profiles are necessary Given a good agreement, lidar measurements may be used to provide high-resolution vertical estimates of BC

● Different methods to determine the absorbing particle components from wavelength dependent absorption measurements will be considered.

Session 5 speaker: Haruo Tsuruta (AORI, Univ. of Tokyo) Optical and chemical properties of atmospheric aerosols at Phimai in Thailand by surface measurements, satellite data analysis, and the SPRINTARS model

Dry season

D1: major source: Air pollutants from east Asia by NE monsoon,

D3: Major source: Biomass burning from Indochina

D2: Transition stage between D1 and D3

Nss-SO4 is frequently transported from east Asia in the early dry periods(D1, D2), and its contribution to the anural SO4 is 68% (2/3) by the SPRINTARS model. Sometimes very severe biomass burning trapped in the lower boundary layer

Soil/mineral dusts

D1: direct transport from east Asia, hardly from inner desert areas

D2: re-suspension of soil dusts in Indochina and the transport from east Asia

D3: re-suspension of local soil dusts caused by thermal plume due to biomass burning in Indochina

Wet season: Long range transport from west and possibly from the desert regions in west Asia

Optical properties

SSA: Clear seasonal variation with the minimum inD2

AOT: Highest in D3 possibly due to biomass burning

AOT and PM2.5 : Positive correlation in D2 , and in D3, however, AOT was much higher than in D2.

A possible reason might be multi layers of aerosols, as shown in CALIOP data, due to biomass burning in Indochina or transport of polluted air masses from the west.

Session 5 speaker: Meehye Lee (Department of Earth and Environmental Sciences, Korea University, South Korea) Absorption and scattering properties of organic carbon versus sulfate dominant aerosols at Gosan climate observatory in Northeast Asia.

Spectral dependence of EBC/EC ratios 370nm and 880 nm peaks

• Two types of spectral dependence with a peak at either 370 nm or 880 nm

370 nm group

• High OC/EC & OC/sulfate & EC/sulfate

• Refractory and pyrolized OC components were correlated well with PM1.0 EC1, suggesting biofuel and biomass combustion as the source of these OC fractions, particularly during winter.

• SMPS and SEM results imply that aerosols were externally mixed upon transport in fast-moving air masses that passed through the Beijing area in about one day

880 nm group

• Low OC/sulfate & EC/sulfate

• Internally mixed during slow transport over the Yellow Sea region over approximately two to four days

Absorption and scattering properties in relation to chemical compositions

• The absorption and scattering coefficients were noticeably higher for the 880 nm group but it had a lower scattering efficiency per unit sulfate mass compared to those of the 370 nm group.

• The average absorption ångström exponent (AAE) was 1.29 and 1.0 for the 370 nm and 880 nm groups, respectively, in the range 370–950 nm.

• The optical properties of aerosols were linked to chemical composition and mixing state, characteristics determined both by source and atmospheric aging processes.

• In OC dominant aerosols, absorption was enhanced in the UV region, which was possibly due to refractory and pyrolized OC compounds.

• Under sulfate dominant conditions, the sulfate coating on BC particles contributed to absorption in the visible light range without modifying AAE.

• The higher SSA of the 880 nm group than that of the 370 nm group emphasizes that the relative abundances of absorbing and scattering constituents are also important in estimating the climate effect of aerosols.

Session 5 speaker: Chul H (Song School of Environmental Science and Engineering, GIST, Korea) Transboundary Particulate Matter Pollution over Northeast Asia

- Trans-boundary PM pollution over Northeast Asia was investigated, combining CMAQ-estimated and GOCI-derived AODs via data assimilation.
- Average AOD over the Korean peninsula was found to increase by 111% due to transboundary long-range transport over a period of 1 Aril to 31 May, 2011.
- This type of study can provide a nice opportunity to enhance our capability for future investigation onto the Korean GEO sensors such as GOCI-2 and GEMS.

Session 6 speaker: Chang H. Jung (Kyungin Women's University, Incheon, Korea) ESTIMATION OF ORGANIC AEROSOL OPTICAL PROPERTIES CONSIDERING HYGROSCOPICITY AND LIGHT ABSORPTION

- Contribution of water(RH) in optical properties is considerable
- The simple calculation of radiative forcing from the data can be calculated from -2.6W/m2 to -

3.5W/m2 for core-shell mixing. (RH=60%)

- WSOC hygroscopicity influence the negative RF enhancement because of the increases in water and positive RF because of light absorbing imaginary refractivity

- The radiative forcing of WSOC aerosol can be estimated from -0.09 to -0.25 W/m2 for core-shell mixing.(RH=60%)

- The mass absorption efficiency of WSOC can be estimated 0.46-0.5 m2/g in this study (about 5 – 17% of MAE(EC)).

- Comparing with non-absorbing WSOC refractive index(mwsoc=1.53), the RF(WSOC) values of 0.08 ~ 0.11 W/m2 and MAE(WSOC) of 0.13- 0.28m2/g (Dry) can be estimated due to WSOC absorbing refractive index

- Increasing imaginary refractive index of WSOC enhances aerosol absorption (0.02m2/g/0.001i)

- Size distribution(mode fraction, FMF) change play an important role in estimating optical properties

Session 6 speaker: Annica M. L. Ekman (Department of Meteorology, Stockholm University/ Bolin Centre for Climate Research, Stockholm University) Can an influence of changing aerosol emissions be detected in the pattern of surface temperature change over Asia between 1970 and 2000?

• Can a clear aerosol effect on surface temperature be distinguished over e.g. Asia when comparing the years1970 and 2000? (local vs. far-field response).

– Over Asia, it may be possible.

– But how much of the local response is masked by changes in cloud cover due to shifts in e.g. the ITCZ?

- Uncertainty in emission database.
- Uncertainty due to the specific model used.
- Uncertainty due to the usage of a slab ocean model.

Session 6 speaker: Dilip G anguly (Indian Institute of Technology Delhi) Multi-Scale Responses Of The South Asian Monsoon System To Anthropogenic Aerosols

- The response of the South Asian monsoon system to anthropogenic aerosols is multi-scale in nature. The EHP mechanism proposed by Lau et al. [2006], “solar dimming” shown by Ramanathan et al. [2005], and the aerosol indirect effects all play important and different roles.

- Local and remote anthropogenic aerosols reduce the mean precipitation during monsoon

- Most of these reductions are due to slow response or the feedbacks associated with SST change caused by aerosols

- Increases in precipitation due to increases in BC alone are small based on IPCC AR5 emissions.

Future directions

- Constraining the model simulated distributions to match with observations would be greatly useful in relating the simulated responses to observed trends in monsoon precipitation conclusively.

- More efforts must be made towards improving the emission inventories of aerosols and the characterization of dust sources over the region.

- Efforts must also be made to improve the scavenging parameterization of aerosols in models.

- Improvements are needed in proper representation of cloud and convection related processes in global models (Invigoration versus suppression of clouds by aerosols).