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1. Introduction

This document provides the implementation plan and the related information of the ABC Gosan campaign, EAREX2005, organized by scientists under the UNEP/ABC-Asia project (Ramanathan and Crutzen, 2003; http://www-abc-asia.ucsd.edu). The objective of the ABC-Asia is to understand the effects of air pollution and mineral dust in the Asian region to the earth's climate and environment. Two regional experiments for the first phase of the ABC project have been planed in order to delineate the regional aspects of the effects and to compare the results from instruments used by different groups in the project in order to assure the homogeneity of data acquired by the ABC monitoring system in Asia. The earlier regional experiment preceding EAREX2005 is the ABC Maldives Monsoon Experiment (APMEX) conducted from 1 October to 15 November 2004 in the South Asian region with the main station at Hanimaadhoo, Maldives. Following the APMEX, the EAREX2005 will be conducted in March 2005 in the East Asian region (Fig. 1) where large anthropogenic emission sources of aerosols and gases are distributed. Especially in springtime the area is covered by various types of aerosols including Asian mineral dust and anthropogenic aerosols. The difference in the air mass characteristics in the two regions is important for the comparison of the two experiments.

2. Objectives of the experiment

Along with the long-lived greenhouse gases, short-lived gases and aerosols are important atmospheric constituents in the global warming and environmental change issues as addressed in the recent IPCC report. Both the direct and indirect effects of aerosols on the radiative forcing still have much larger uncertainties than long-lived greenhouse gases for the evaluation of the global warming tendency. Effects are also pointed out in terms of agricultural production and of human health.

The ABC project focuses on these climatic and environmental effects of air pollution in the Asian region. This region is important to be studied because of increasing emissions of air pollutants such as nitrogen oxides and aerosols as compared to those of other economical sectors (e.g., Akimoto, 2003; Wild and Akimoto, 2001) (Fig.2). The air mass characteristics of this region are complicated, especially in March-April season with Asian dust aerosols, air pollution sulfate aerosols, biomass burning aerosols, and sea salt aerosols as observed by satellite remote sensing (Fig.3). This complicated air mass simulated by a chemical transport model as shown in Fig. 4 (Uno et al., 2004) suggests a large regional difference in concentration of various types of aerosols, especially in terms of north-south gradient of the concentration.

Important but difficult question regarding the air pollution in this region is how the climate system would be modified by pollutants. Several processes have been identified as summarized

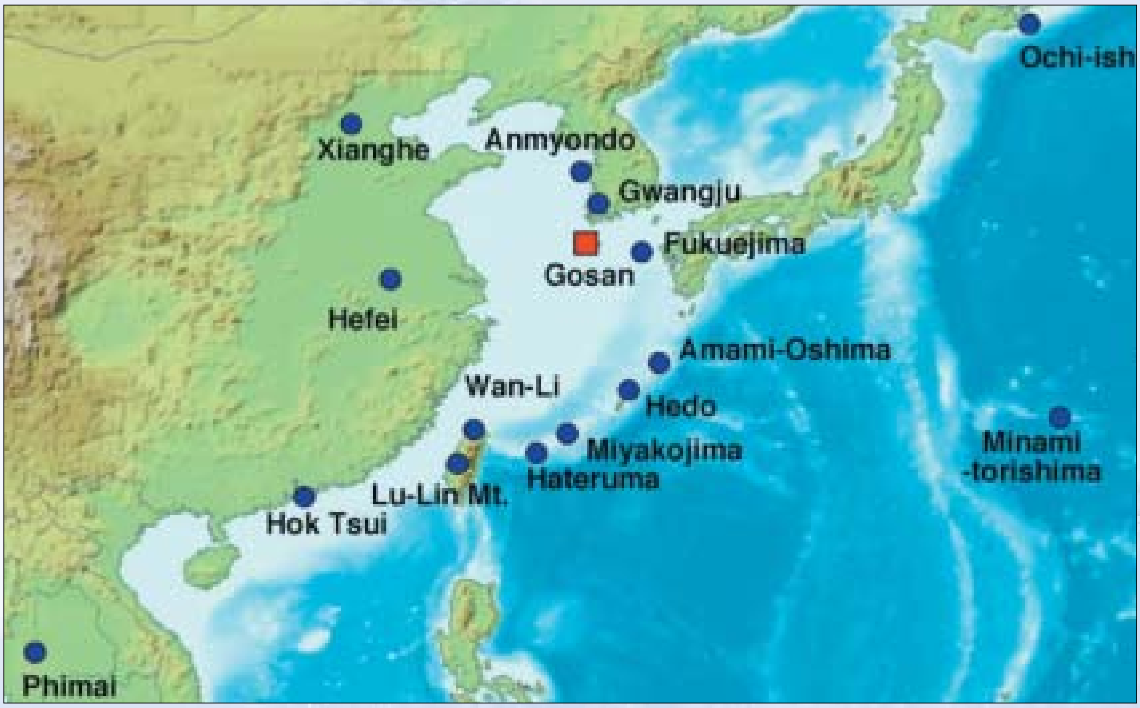

Fig. 1. The Experimental region. Site locations are also shown.

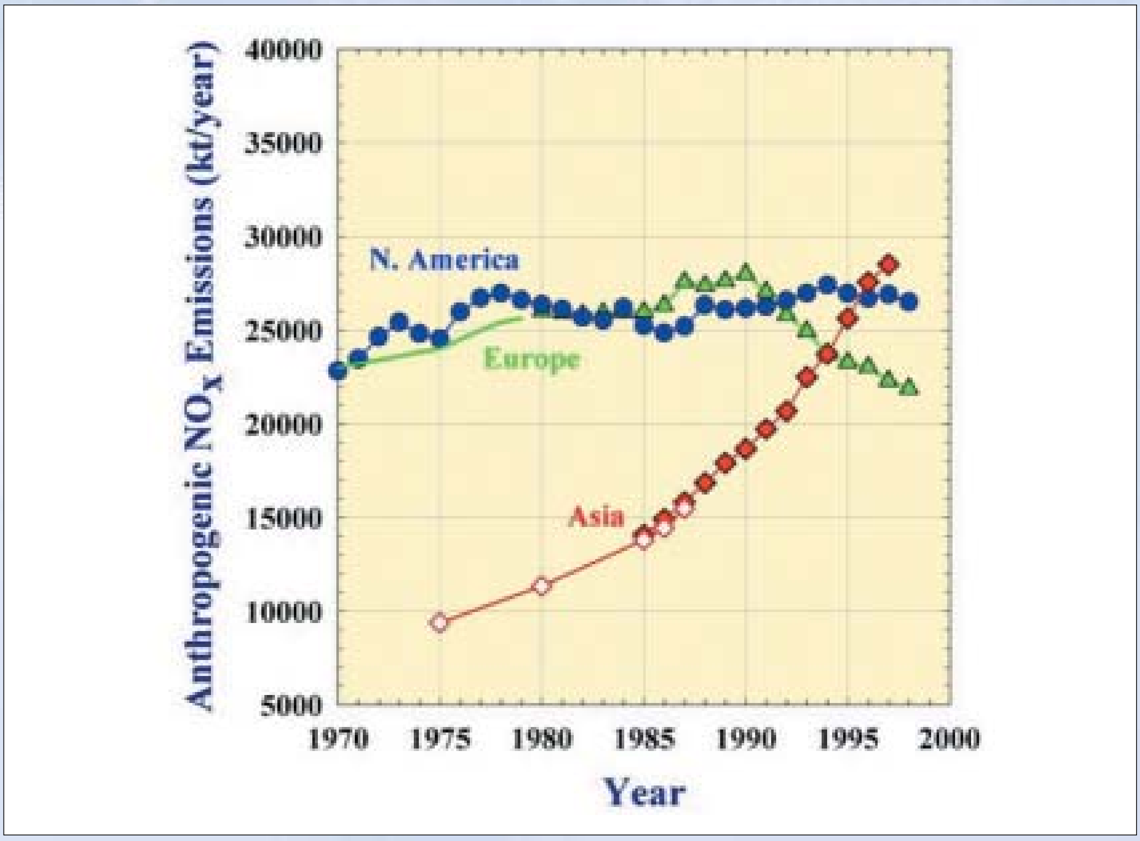

Fig. 2. Trend of NOx emissions in North America, Europe, and Asia (Akimoto, 2003).

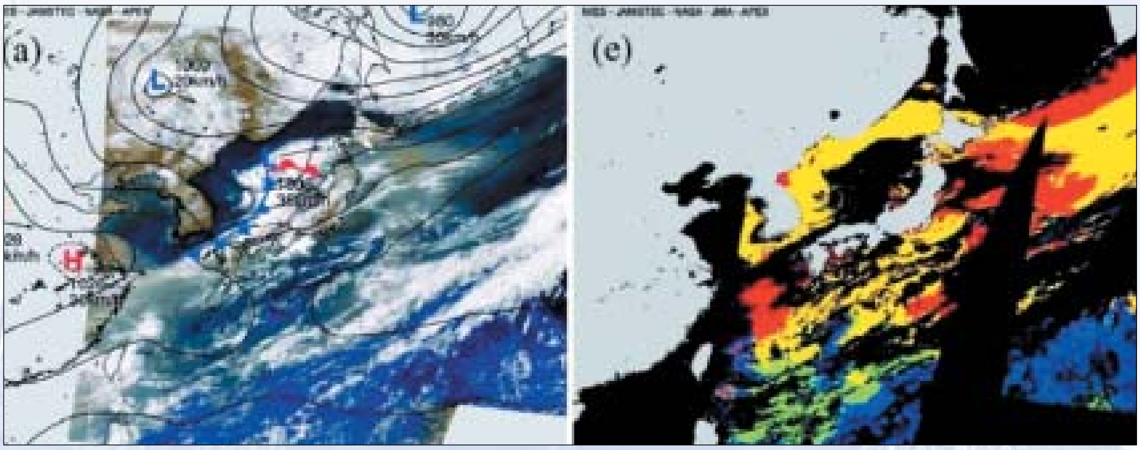

Fig. 3. A near true color image of East Asian aerosols (Panel a) and a type detection (yellow: carbonaceous; red: mineral dust; green: sulfate; blue: sea salt) from SeaWiFS four channel radiances (Panel e) on April. 14 2001. (Higurashi and Nakajima, 2002)

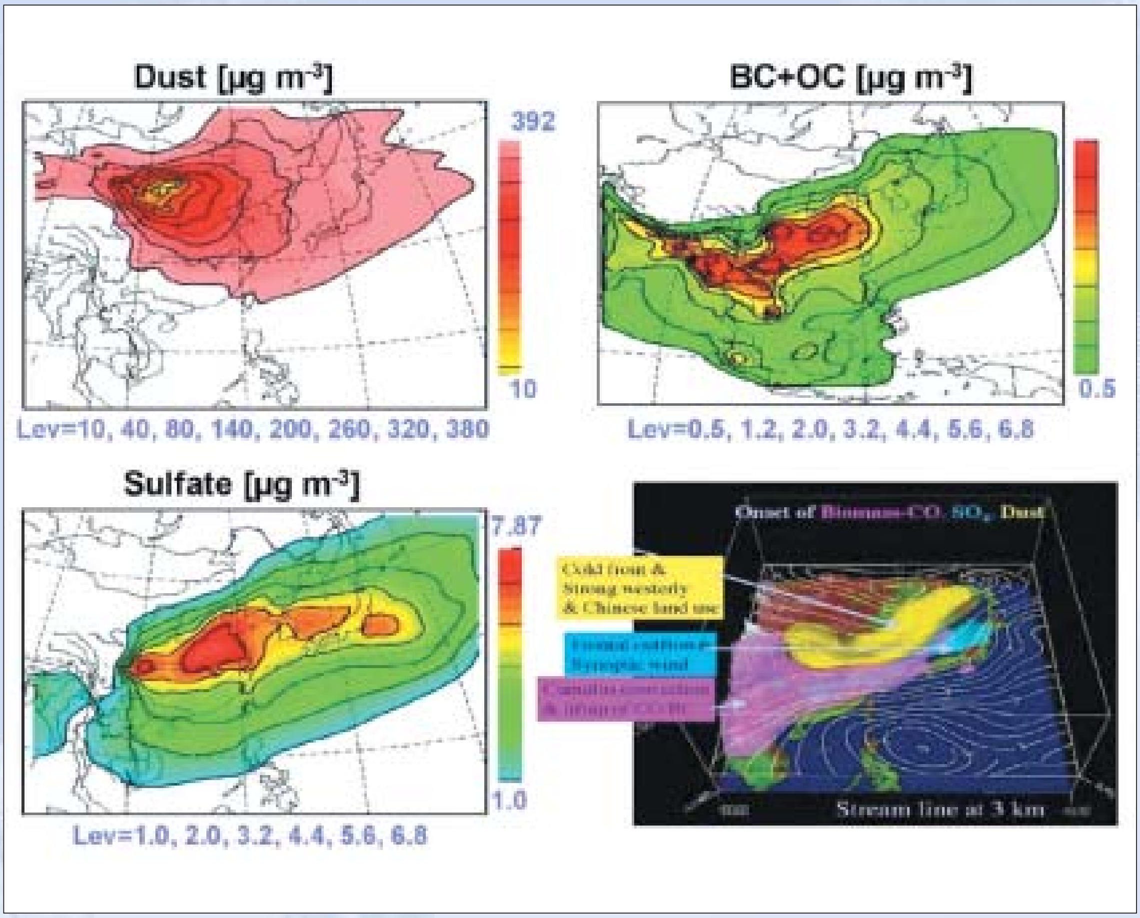

Fig. 4. Near surface concentrations of mineral dust, sulfate, carbonaceous aerosols averaged from 20 February to 30 April 2001 (Uno et al., 2002) and an example of flow patterns (Uno et al., 1997) simulated by CFORS chemical transport model.

in Fig. 5, but the magnitude of each process is very difficult to be evaluated accurately. The pollutants can make a direct effect to change the radiation budget of the earth-atmosphere system by producing greenhouse and parasol effects. Better evaluation of the direct effect requires simultaneous measurements of radiation and microphysical/chemical characteristics of pollutants. They also can produce an indirect effect to modify the cloud system. Although there are several studies of satellite remote sensing of the signature of aerosol-cloud interaction (Nakajima et al., 2001; Bréon et al., 2002; Sekiguchi et al., 2003), the radiative forcing is evaluated with large uncertainty. Another method is to use a general circulation model (GCM) for simulating the large-scale change in low-level cloud characteristics. Fig. 6 shows a comparison of the global distributions of the effective particle radius of cloud droplets from satellites and models. Depending on the parameterization schemes adopted in GCM, the radiative forcing of the indirect climate effects of anthropogenic aerosols are largely different from about -0.5 W/m^2 to -2 W/m^2 (Takemura et al., 2005). It is, therefore, useful to measure aerosols and clouds in this region to understand the different aerosol properties and their effects to the cloud system. These direct and indirect effects can produce a secondary atmospheric general circulation to modify the Monsoon circulation and precipitation.

The ABC-EAREX2005 has been organized to depict aerosol and gas distributions as well as forcing evaluation, as overlooked as above, in the East Asian region. The main station of the experiment is the Gosan observatory located in the Jejudo, Korea. Instruments are brought to the main station from various groups in order to establish a traceability of the instrumentation and analysis methods used in other stations distributed in the target regions. The instrumental intercomparison is an important activity because the ABC project is based on a long-term monitoring of air pollution and its effect to the earth's climate and environment of the Asian region.

Based on the above-mentioned background of the research, we set the objectives of the experiment as follows:

(1) Intercalibration of instruments

In order to establish a stable and accurate ABC monitoring system, gas instruments, aerosol instruments including nephelometer and absorption photometer, radiometers should be intercompared and calibrated by bringing instruments at Gosan site or other places if needed. These instruments are also compared with APMEX instruments.

(2) The following science issues will be studied by using data collected during the experiment.

Pollutant transport and modification, Aerosol physical, chemical and radiative characterization, Pollutant effects on the radiation budget and climate, Direct and indirect effects of aerosols on climate, Regional differences, and inland and outflow regions comparison, i.e., Gosan vs Maldives.

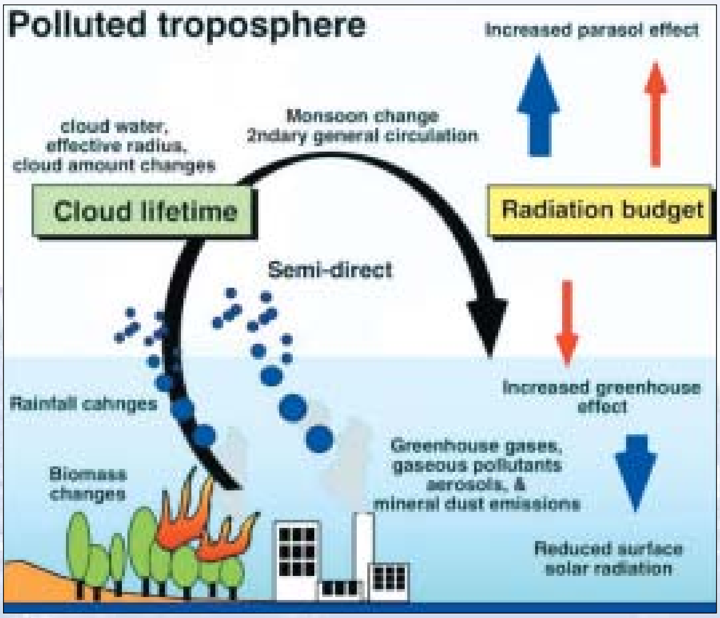

Fig. 5. Various climate effects of air pollution.

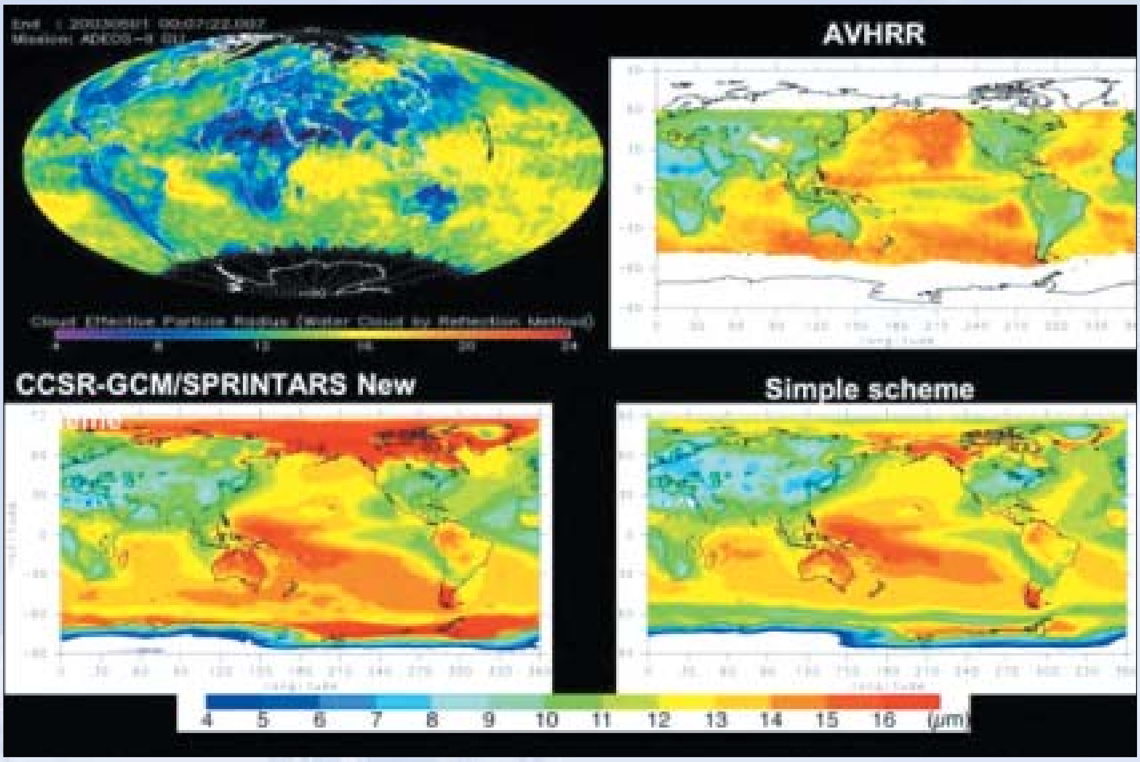

Fig. 6. Four months means (Jan., April, July, and Oct. 1990) of the effective particle radius of low cloud layers from AVHRR (Kawamoto et al., 2001) and simulated fields by SPRINTARS aerosol model with simple and new parameterizations (Takemura et al., 2005). A distribution from the ADEOS-II/GLI satellite-borne sensor is also shown (T.Y. Nakajima et al., 2004).

3. Management of the experiment

Outline of the experiment is as follows.

Management team:

Chief scientists:	T. Nakajima and S.C. Yoon (Co-Chaired)
Steering committee:	T. Nakajima, S.C. Yoon, H. Akimoto, Y. Kondo, T. Hayasaka, G.Y. Shi, Y.H. Zhang, K.R. Kim, Y.J. Kim, S.J. Lee and S.N. Oh
Discipline scientists	
Radiation:	T. Hayasaka, B.J. Sohn, and G.Y. Shi
Aerosols:	Y. Kondo, Y.J. Kim, and J.S. Han
Gases:	H. Akimoto, H. Tanimoto, K.R. Kim, T. Wang, and G. Lee

Schedule:

20 Feb. 2005	Pre-IOP starts for preparation
7 March 2005	IOP starts
25 March 2005	IOP ends
26 March	Post-IOP starts for follow-up activities
10 April 2005	Experiment ends
June 2005	EAREX2005 data analysis workshop

(IOP: Intensive Observation Period)

Experimental activities:

The following activities will be performed during the experiment:

(a) Intercomparison and calibration of instruments at Gosan. Radiometers are calibrated in Japan.
(b) Surface measurements at Gosan and other sites during the campaign period for measuring large-scale distributions of air mass characteristics and radiation budget.
(c) Satellite remote sensing to obtain large area distributions of gas, aerosol and cloud characteristics.
(d) Model simulation to provide model-simulated distributions of gas, aerosol and cloud charac teristics. Some models will provide forecasted fields for observation planning.

Headquarter:

The headquarter is located at Gosan weather station, maintained by the Korea Meteorological Administration (KMA), to manage measurement activities of the experiment. The main functions are logistical support, data management and support, and interface with various authorities and mass media. The Gosan station team will perform analysis of weather maps, GMS satellite images, and model-forecast results, as well as support at the observation sites on demand. Briefing of reviewing weather forecasts, model results, and satellite images is made each day.

Gosan site manager : Dr. Jae-Cheol Nam (jcnam@metri.re.kr), METRI/KMA

Web management:

The following EAREX2005 web site is another platform for exchanging information and data among experiment participants and users. Web sites, useful for the experiment, should be linked to this main experiment website. Participants are encouraged to make contact with the web administrator for data exchange and information exchange via the web site.

http://ABC-Gosan.snu.ac.kr/

Web administrator: Dr. Sang-Woo Kim (kimsw@air.snu.ac.kr or k-abc@air.snu.ac.kr), SEES/SNU

4. Disciplines

4.1. Radiation

Discipline scientists: B.J. Sohn (SNU), and T. Hayasaka (RIHN)

4.1.1. Background

East Asian region has been developing recently along with emission of aerosols and their precursor matters. Aerosols in East Asia have complicated structure, for example, mineral dust aerosols well known as the Asian dust event are transported over Korea and Japan mixed with polluted air including carbonaceous and sulfate aerosols. Therefore the radiative properties of these aerosols are complicated and then it is quite important to investigate both radiative properties as well as their spatial and temporal variations associated with aerosol emission, transport, interaction and deposition processes. Fig. 7 compares values of the radiative forcing due to direct and indirect effects of aerosols in Asian regions. The figure shows a regional difference in the magnitude of each forcing.

4.1.2. Scientific objectives

(1) Aerosol optical properties

The global average of the associated annual radiative forcing by aerosols at the top of the atmosphere (TOA) ranges from 0 to -2 W m^{-2}, which is comparable to the forcing induced by the increase in greenhouse gas concentration during the last century (IPCC, 2001). However, it is noted that aerosol-induced radiative forcing is subject to an uncertainty of more than a factor of two. Accordingly, IPCC (2001) reported that the uncertainties induced by different contributing factors should be resolved in order to estimate the overall uncertainty in the direct/indirect forcing estimates.

Compared to atmospheric gaseous constituents, a great deal of these uncertainties is stemmed from inhomogeneity and variability of aerosols in space and time. There are significant variabilities of the aerosol optical properties because of not only aerosol types but also source characteristics related to different origins. Thus, it is of interest to examine aerosol optical properties during the EAREX2005 campaign, where much diverse aerosol species may be found in particular during the spring time. Following optical properties will be retrieved for the aerosol characterization.

- Aerosol optical thickness
- Size distribution
- Refractive index
- Single scattering albedo
- Angstrom exponent

(2) Aerosol radiative forcing

There have been efforts to quantify the magnitude of aerosol radiative forcing (ARF) and its impact on the local and global climate. The Indian Ocean Experiment (INDOEX; Ramanathan et al., 2001a, b) quantified direct and indirect aerosol forcing from the measurements of aerosol optical properties and radiation over the Indian Ocean. They found that large ARF efficiencies (radiation flux per unit aerosol optical thickness at 0.5 μm) of -75 W m^{-2} and -25 W m^{-2} at the surface and TOA, respectively (Satheesh and Ramanathan, 2000). Chung et al. (2002) showed that the haze radiative forcing imposed by the values obtained during the INDOEX, leads to increased precipitation over the haze area by as much as 20%.

In East Asia, the Asian-Pacific Regional Aerosol Characterization Experiment (ACE-Asia) was conducted over the East China Sea (Huebert et al., 2003) and it was found that a 24 hour-averaged clear-sky shortwave net radiative forcing ranges from -26 ~ -30 W m^{-2} over East Asian oceanic and coastal region. Because the Asian continent is considered to be one of regions showing a variety of aerosols, including fossil fuel, biomass burning and dust aerosols, we need to study ARF depending on spatiotemporal variations of aerosols. Long-term monitoring near the source regions or their downwind areas is also needed.

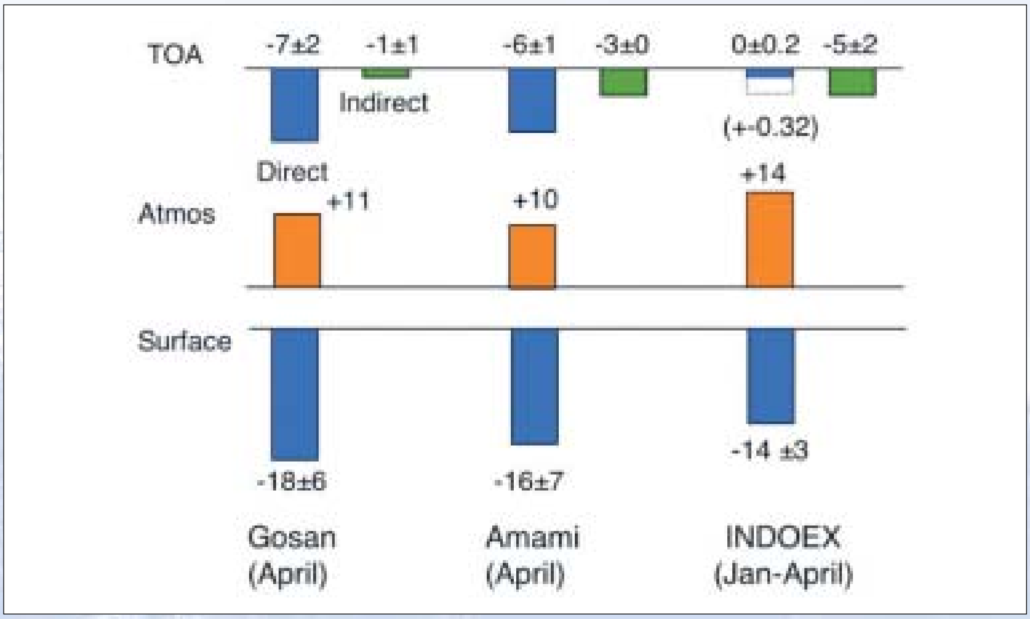

Fig. 7. A comparison of 24-hour whole sky radiative forcing of aerosol direct and indirect effects in East and South Asian regions. Gosan and Amami values by Nakajima et al. (2003) and Indoex dry season values by Ramanathan et al. (2001). The indirect forcing at surface is not shown because it is similar to that of TOA.

(3) Pollution effect on aerosols

There are many absorbing soot and organic aerosols from coal or biomass burning over the Asian and Pacific regions. Increased fossil fuel burning caused by rapid economic growth in many Asian countries results in more SO_2, organic matters, and soot aerosols emitted into the East Asian atmosphere. The oxidizing environment of the atmosphere is likely to change as the growing transportation sector raises levels of nitrogen oxides to levels like those in Europe and North America. Moreover, Asian dust particles, which could lead to both cooling by scattering sunlight back to space and warming by absorbing solar and infrared radiation, make the Asian aerosol situation more complicated. The fact that much of the Asian aerosols blow out over the Pacific under westerlies implies that significant changes in radiative forcing may be expected over large adjacent areas.

The recent studies of Clarke et al. (2004), Won et al. (2004) and Kim et al. (2004) showed that Asian dusts flowing out of source regions in Northern China can evolve into more dark dusts during the movement to the east, due to the mixing with soot particles. It is particularly interesting because the increased SSA of Asian dust can absorb more solar radiation which then can give impact on local circulation. During the EAREX2005 campaign we look for the possibility of studying the pollution impact on aerosols.

(4) Indirect effect of aerosol on radiative forcing

We will also study the indirect effect of aerosol on the cloud radiative forcing by synthesizing various data sets collected during the campaign such as satellite, lidar measurements, and cloud droplet number concentration. Obtained radiative forcing results can further be compared with results from satellite remote sensing and model simulation. Considering that East Asian region is the area showing a variety of aerosol species it may be vital to intercompare the obtained results with various other sources.

(5) Lidar intercomparison study

The SNU MPL and NIES compact Mie-scattering lidars are to be intercompared. The two lidars are both Mie-scattering lidars but use different approaches. The SNU MPL now operates as part of the NASA Micro-Pulse Lidar Network (MPLNET), and has been reconfigured to conform to MPLNET design requirements for a Type 3 MPL. SNU MPL utilizes a high-repetition micro-pulse Nd:YLF laser and a photon counting receiver system. On the other hand the NIES lidar employs a giant pulse Nd:YAG laser and an analog detection system. Major specifications of the lidars are listed in Table 1 below.

The intercomparison will be done in three aspects, i.e.: signal intercomparison, signal-to-noise ratio intercomparison, and extinction coefficient comparison.

(i) Signal intercomparison: Possible problems to be considered are saturation of photon counting with MPL at strong returns, deformation of the analog detectors and background electrical noise with the NIES lidar: the Type 3 MPL has never saturated from atmospheric returns, the new Type 4 MPL currently has a saturation problem in the lower 400 m when fog or low cloud are present. Also difference of the geometrical form factors is to be considered.

(ii) Comparisons between the SNR of the MPL and NIES lidars will be performed. Signal-to-noise intercomparison: Daytime and nighttime SNR of SNU MPL and NIES lidar will be compared. MPLNET level 1 signals are acquired at 1 min temporal resolution, and 75 m vertical resolution. However, MPLNET produces aerosol extinction profiles in its 1.5 level data product which are generated at 20 or 30 minute temporal averages. The 20 min MPL average SNR will be used for SNR comparison. In addition, overlap effects (i.e., geometrical form factor) will be intercompared also. MPLNET calculates the total level 1 signal uncertainty for all data (each min), taking into account all sources of error (not just detector noise). This procedure can be compared with the NIES lidar.

(iii) Extinction coefficient intercomparison: Extinction coefficients obtained from SNU MPL data with the MPLNET standard data reduction method will be compared with that from NIES lidar based on the iterative Fernald's method. MPLNET algorithm calculates both the aerosol extinction-to-backscatter ratio and extinction profile at times coincident with AERONET AOD observation. NIES also plan to apply the algorithm to the MPL data. In addition, the depolarization measurement function and the two-wavelength measurement function of the NIES lidar will be demonstrated. These functions will be useful for characterizing aerosols.

(iii) Extinction coefficient intercomparison: Extinction coefficients obtained from SNU MPL data with the MPLNET standard data reduction method will be compared with that from NIES lidar based on the iterative Fernald's method. MPLNET algorithm calculates both the aerosol extinction-to-backscatter ratio and extinction profile at times coincident with AERONET AOD observation. NIES also plan to apply the algorithm to the MPL data. In addition, the depolarization measurement function and the two-wavelength measurement function of the NIES lidar will be demonstrated. These functions will be useful for characterizing aerosols.

Table 1. Lidar specifications.

Parameters	NIES lidar	SNU MPLNET lidar
Wavelength	532 nm, 1064 nm	523.5 nm
Laser power	30 mJ (532 nm), 20 mJ (1064 nm)	6μJ per pulse, 15 mW
Repetition rate	10 Hz	2500 Hz
Diameter of telescope	20 cm	20 cm
Direction of measurement	Vertical (fixed)	Vertical (fixed)
Measurement range	0 - 24 km	0 - 20 km
Range resolution	6 m	75 m
Temporal resolution	15 min (typical)	Level 1 Signals:1 min Level 1.5 Extinction: 20 min
Measurement parameters	Backscattering intensity (532 nm, 1064 nm),Depolarization ratio (532 nm)	Backscattering intensity (523 nm)
Operation made	Automated, Continuous Data transmission through Internet (or telephone) (NIES LidarNet)	Automated, ContinuousData transmission through Internet (MPLNET)
Power supply	AC 100 V, 15 A	220 V, 5 A
Size	60 cm x 30 cm x 80 cm	80 cm x 80 cm x 80 cm
Weight	<120 kg including packing	< 100 kg including packing
Field of view	1 mrad	50 μ rad (transmitter) 100 μ rad (receiver)
Channel number	3 (1064 nm, 532 nm dual polarization)	1 (523.5 nm)
Detector	PM tubes (532 nm) Avalanche photodiode (1064 nm)	EG&G SPCM-PQ GAPD

4.1.3. Instrumentation

Following instruments are used for radiation studies.

Table 2. Radiation instruments.

Instrument	Gosan Campaign	Maldives Observatory
Sky radiometer	PREDE (Sohn, Oh) Cimel 318-2 (Yoon)	AERONET or PREDE
Suntracker	Kipp and Zonen 2AP-GD (Sohn)	Kipp and Zonen 2AP-GD
Pyranometer (Global and Diffuse)	Kipp and Zonen (Sohn) CM21 (0.28 - 2.8 um), EKO (Oh)	Kipp and Zonen CM21 (0.28 - 2.8 um)
Pyranometer (Global and Diffuse)	Uchiyama, Takamura, Hayasaka	Kipp and Zonen CM22 (0.2 - 3.6um) **
Pyrheliometer (Direct)	Kipp and Zonen (Sohn) CH1 (0.2 to 4.0 um)	Kipp and Zonen CH1
Pyrheliometer** (Direct)	EKO (Oh): shadow band	Eppley**, Quartz window** Calcium Floride Window**
Pyrgeometer (Global or Diffuse)	EKO (Oh), K&Z CG3 (Sohn), CG4 (Takamura)	Kipp and Zonen CG4 (4.5 to 42 um)
Narrowband Radiometer (Global and Diffuse)	MFRSR YES 415, 500, 615, 673, 870, 940 nm (Jhoon Kim)	Bio-Spherical Instruments GUV-2511 (305, 313, 320, 330, 340, 380, 395, PAR (400-700 nm))
Grating Spectrometer (Global and Direct)	PREDE (Takamura): Grating sunphotometer (Direct only) ASD (Ramanathan, Global)	ASD - FieldSpec Handheld (325 - 1075 nm)
Lidar	MPL (Yoon) - 1 Channel NIES (Sugimoto) - 2 Wl, 3 Channels	MPL or NIES
Other instruments	MW radiometer (Oh), I-Skyradiometer (Takamura), Two Nephelometers (Y.J. Kim) Aethalometer (Y.J. Kim) EKO UV-B (K.M. Lee) Nephelometer (3W, KIST) Nephelometer (3W, Ramanathan) Aethalometer (Ramanathan)	

Table 3. Utility requirements.

* Container Space: The space needed for setting up data acquisition systems or instruments inside the container. (Note: not for the outer platforms)

** Electric Power: The power needed for running instrument.

Instrument	Manager	*Container Space (m^2)	**Electric Power (KW)
Sky radiometer	Sohn (SNU)	0.8 X 0.8	1.5
〃	Yoon (SNU)		0.4
〃	Oh (METRI)		
Pyranometer (Global and Diffuse)	Sohn (SNU)	0.8 X 0.8	1.5
〃	Oh (METRI)		
Pyranometer** (Global and Diffuse)	Uchiyama (MRI)		
	Takamura (Chiba U.)		
	Hayasaka (RIHN)		
Pyrheliometer (Direct)	Sohn (SNU)	Share with Pyranometer	0.1
Pyrheliometer** (Direct)	Oh (METRI)		
Pyrgeometer (Global or Diffuse)	Sohn (SNU)	Share with Pyranometer	0.1
	Takamura (Chiba U.)		
Narrowband Radiometer (Global and Diffuse)	Jhoon Kim (Yonse U.)	0.8 X 0.8	0.54
Grating Spectrometer (Global and Direct)	Takamura (Chiba U.)		
Lidar	Yoon (SNU)	2 x 1 window (0.4 X 0.4) on the roof	1
Lidar	Sugimoto(NIES)	2 x 1 window (0.4 X 0.4) on the roof	1
MW radiometer	Oh (METRI)		
I-Skyradiometer	Takamura (Chiba U.)		
Nephelometers	Y.J. Kim (GIST)		20 w/h
Aethalometer	Y.J. Kim (GIST)		20 w/h
FT-IR	K.M. Lee (KPU)		4
EKO UV-B	K.M. Lee (KPU)		1

4.2. Aerosols

Discipline scientists: Y. Kondo (RCAST/UT), Y. J. Kim (GIST) and J.S. Han (NiER)

4.2.1. Scientific objectives

Impact of anthropogenic emissions of aerosols and their precursor gases on air quality and climate on regional scale is one of the key issues of the ABC project. To evaluate their impacts, knowledge of chemical characteristics of aerosols is essential because degrees of the impacts strongly depend on the characteristics of aerosols (size, chemical composition, mixing state, etc.). In East Asia, aerosols and their precursor gases are emitted from wide variety of anthropogenic sources. Secondary aerosols are also formed from precursor gases through photochemical reactions in the atmosphere. Chemical characteristics of aerosols can be changed also by adsorption and absorption of aerosols and gases.

Goals of aerosol studies during EARE 2005 are:

A) Characterize differences and uncertainties of in-situ aerosol measurements/techniques used for the ABC project by comparing simultaneous measurements.

B) Characterize aerosol properties (size distribution, chemical composition, and mixing state) and identify key processes of aerosol formation and removal in the Asian outflow regime.

The scientific objectives given in B) are described more in detail.

(1) Inorganic aerosol

Processes of inorganic aerosol formation are generally well understood. However, we still need to quantify processes controlling the aerosol abundances. Formation of sulfate and nitrate through gas phase and aqueous phase chemistry is to be studied. Three-dimensional model calculation can be compared with measurements to evaluate role of aqueous phase chemistry during transport. Sources of inorganic aerosol precursors are to be identified also using 3-D model calculations. Availability of ammonia can control the ion balance of inorganic aerosols. Removal of nitrate and sulfate by coarse particles (sea salt, dust) and deposition should also be quantified.

(2) Organic aerosols

Although organic aerosols constitute major fraction of aerosol mass, their chemical composition and formation processes are poorly understood. During the campaign, chemical composition of organic aerosol will be elucidated. Processes of secondary organics aerosol (SOA) formation will be studied and efforts will be made to identify important precursor VOCs for SOA. Interaction of sea salt particles with VOCs (coarse mode organic aerosols) can be also studied using data obtained during the campaign.

Elemental carbon plays a key role on radiative properties of aerosols. Understanding of mixing state of EC and EC-dust particle interaction is important to evaluate their optical properties as well as their removal processes. Understanding of removal process of EC is also important to evaluate regional scale climate impacts of Asian aerosols.

Relationship between chemical composition and hygroscopicity is very important issue. CCN activation properties can also be compared with chemical composition of aerosols.

(3) Effects of long-range transport

Transport processes, changes in aerosol properties, and removal processes are also studied. In this study, pathways of aerosol transport from the Asian continent are to be identified. Changes in aerosol properties (size, composition, and mixing state) during transport are also to be studied.

(4) Relationship between aerosol composition and optical properties.

The relationship is also important in quantifying radiative effects of aerosols.

4.2.2. Intercomparison: Techniques and Size Range

(1) Techniques

Following techniques are used and compared during the campaigns.

a) Mass concentration
- TEOM
- Beta guage

b) Size distribution: OPC, SMPS

c) Chemical composition

Inorganic: PILS (real time instrument)

Organic: Thermal-optical (Sunset Lab., real time instrument)

EC: Thermal-optical (Sunset Lab., real time instrument)

Filter samplings and chemical analysis

(2) Size range

Following size cut is adopted for the campaign.

a) Mass concentration and chemical composition

First priority: $PM_{2.5}$ (This size has been used for previous measurements at Gosan.)

Second priority: PM_{10}; mass concentration is independent of size-cut and good for comparison of chemical analysis.

Third priority: $PM_{1.0}$

It is planned to use temperature controlled (40C) cyclones. This can be important for Gosan.

4.2.3 Intercomparison: Participants and Instrumentation

Following groups will participate the campaign.

- Korea: GIST (Y.J. Kim), KIST (K.C. Moon,Y.S. Ghim), NIER (J.S. Han), METRI (S.N. Oh, J.C. Nam), SNU (S.C. Yoon, K.R. Kim), Yonsei Univ (S.S.Yum, S.H. Kim), Cheju National Univ. (C.H. Kang), Korea Univ. (M. Lee), HUFS (G. Lee)
- Japan: U. Tokyo (Kondo), Hokkaido U. (Kawamura), CCSR-U. Tokyo (Tsuruta)
- China: HKPU (Lee, Wang)
- U.S.: SIO (Corrigan, D.H. Kim)

(1) Mass concentration

- TEOM: NIER ($PM_{2.5}$)
- Beta guage: GIST ($PM_{2.5}$) and NIER($PM_{2.5}$)

(2) Size distribution

a) OPC 0.3-25 μm

- METRI/KMA

b) SMPS (0.01-1 um)

- NIER, Yonsei Univ

c) APS (aerosol particle sizer; 0.5-20 μm)

- NIER

(3) Chemical composition (filter sampling)

a) KIST

- MOUDI sampler
- Inorganic

b) NIER

- $PM_{2.5}$, PM_{10} sampler
- Inorganic, element, EC/OC

c) GIST

- $PM_{1.0}$ sampler
- Inorganic, EC/OC (?)

d) METRI

- $PM_{2.5}$ and PM_{10}
- Inorganic, organic speciation?, EC/OC
- High volume sampler (TSP)

e) Hokkaido U.

- High volume sampler (TSP)
- Inorganic, organic speciation

f) Hong Kong Polytech U.

- Analysis of sampled filters
- TSP: Organic and Inorganic compounds

g) Yonsei U. & SNU

- MOUDI (w/SNU)
- Size-fractionized concentrations of EC and OC

h) Cheju National Univ.

- High volume sampler
- Ion and Metal
- Radon

i) SNU/HUFS/KU

- $PM_{2.5}$ and TSP: sulfur, nitrogen, organic compounds

(4) Chemical composition (real-time measurements)

- Inorganic (10-30 min)
  NIER ($PM_{2.5}$) and U. Tokyo (PILS; $PM_{2.5}$ and PM_{10})
- EC/OC (60 min)
  GIST (Sunset; $PM_{2.5}$) and NIER (Sunset $PM_{2.5}$; and R&P; PM_{10})
- On-line ion monitor (GIST)
- Intercomparison of two instruments before Gosan campaign (NIER)
- WSOC (10 min) U.-Tokyo ($PM_{2.5}$ and PM_{10})
- Aerosol absorption (Black carbon) (1 min)
  Aethalometer: GIST (1 WL- $PM_{2.5}$), KIST (1 WL- $PM_{2.5}$), SIO
  BC Monitor ($PM_{2.5}$): NIER
  Size cut ($PM_{2.5}$?), Dry (40C) or ambient

(5) Aerosol scattering (Nephelometer) (1 min)

GIST (1-WL, open path and in-situ w/ 40C), KIST (TSI 3-WL), NIER (1-WL), SIO (3-WL)
Size cut ($PM_{2.5}$; no dust or sea salt), Dry (40C) or ambient?

(6) Other instrumentations

- Possibility of hygroscopicity measurement (Yonsei U.)
- Possibility of cloud droplet conc w/ FSSP (METRI and Yonsei U.)
- CN (Yonsei U.), CCN (SIO)

4.3. Gases

Discipline scientists: H. Tanimoto (NIES) (O_3), T. Wang (Hong Kong Poly. U.) (CO), K.R. Kim (SNU) and G. Lee (HUFS) (Gosan Logistics)

4.3.1. Gas measurements

Tropospheric ozone is one of the most important constituents of the earth's atmosphere. It plays a central role in determining oxidizing capacity of the troposphere through generation of the principal oxidizing agent, hydroxyl radical (OH). It is also one of major greenhouse gases contributing global warming, and has potential vegetation impact including crop yield reduction and forest decline.

Continental-scale transport of ozone may affect not only enhancement of background levels but also violations of National Ambient Air Quality Standards (NAAQS) (Naja and Akimoto, 2004; Jaffe et al., 2004). Recent chemical transport model calculations based on emissions inventory scenarios used in the IPCC predict large increase of tropospheric ozone in the future (Prather et al., 2003) (Fig. 8). Current scientific issues to be addressed thus include better understanding of distributions and long-term evolutions of ozone in the regional/hemispheric scales, and its interactions with local/regional air quality issues. For this purpose, it is important to establish regional traceability network, and achieve international comparability for ozone at ambient levels, particularly in East Asia. This would enable us to compare the data among ongoing measurement networks and accurately discuss large-scale distributions beyond their own sites and networks. It is also valuable to identify slight changes in the long-term measurement records (e.g., on a decadal scale), which possibly are caused by climate changes and human-induced emission changes.

Carbon monoxide (CO) is another important trace gas in the troposphere. Apart from being a precursor to the photochemical formation of tropospheric O_3, CO helps regulate the oxidizing capacity of the atmosphere by reacting with OH radicals. Due to its relatively long atmospheric lifetime of 1-2 months, CO is also an ideal tracer for anthropogenic pollution and has been used to aid in interpretations of chemical measurements (e.g., Jaffe et al., 1997, Parrish et al., 1991, 1998; Pochanart and Akimoto, 2003; Wang et al., 2001, 2004) and in validating chemical transport models and refining emission estimate for Asia (e.g., Carmichael et al, 2003; Tan et al., 2004; Wang et al., 2004).

The first priority of gas chemistry activities during the EAREX2005 experiment will be an intercomparison of measurement and calibration techniques/methods for ozone (O_3) and carbon monoxide (CO), which is commonly measured together with O3. Four groups will participate in the intercomparison experiment at Gosan. The SNU/HUFS/KU group has already set their instrument package (O_3, CO, NOx*, SO_2, CO_2) at Gosan site with a large-flow sampling inlet/manifold and a zero-air generator. The NIES/MRI group will bring O_3/CO instrument packages. HKPU will bring O_3/CO instruments, and canisters for VOCs sampling. The VOC data will provide valuable information on emission sources and on the 'age' of an air mass arriving at the sampling site (e.g., Wang et al., 2004; 2005). The canister samples taken by HKPU will be sent to University of California at Irvine (Dr. Ronald Blake) for analyses of CO in addition to VOCs by GC/FID method. METRI has been making whole air flask sampling for CO_2 and other GHGs at Gosan. The NCU group also will bring both O_3 and CO instruments.

Intercomparison experiments will be made by a combination of two activities: (1) international (on-site) comparison at Gosan and (2) local (off-site) comparison before/after Gosan campaign. On-site comparison will be held during pre-IOP period during EAREX 2005. NIES will act as a pilot laboratory for O_3, and bring a transfer standard (TS, TEI 49CPS), which is calibrated by the NIST Standard Reference Photometer (SRP) #35 (owned by NIES), to Gosan site. NIES has participated in an international comparison program in the summer of 2004 - a pilot study for ozone at ambient levels (CCQM-P28) - organized by Bureau International des Poids et Mesures (BIPM), and very good agreement was found between NIST SRP #35 and BIPM's SRPs (Tanimoto et al., 2004). Participating laboratory will bring their O_3 monitor, which has been pre-calibrated by their Laboratory Standard (LS). Participating laboratories should perform post-calibrations, and submit the results to the pilot laboratory. HKPU will act as a pilot laboratory for CO. Participating laboratories will bring CO standard gases from their countries (Japan, Korea, China and Taiwan). Off-site comparisons will be held after the on-site comparisons in each country. For example, off-site comparisons in Japan will be held in Tsukuba, where NIES will directly calibrate each group's LS by NIST SRP #35, and MRI will make comparisons of standard gases with GC/FID/RGD up to 3000 ppbv range.

FRCGC, CAMS, and Peking Univ. groups are not able to participate in the campaign depending on funding availability. Although NIER is conducting continuous measurements of O_3, CO, NOx*, SO_2, CO_2, and other GHGs at Gosan, data availability is still uncertain. In addition to these measurements at Gosan, it is agreed that O_3 and CO data from Anmyeon (METRI), Minamitorishima, Yonagunijima, Ryori (JMA), Taishan, Huashan, Huangshan (FRCGC), Hefei (NIES), Fukue, Amami (NIAES), Hok Tsui (HKPU), Cape Hedo (O_3, NIES), Wan-Li and An-Bo mountain (Taiwan EPA), and Lu-Lin Mt. (CO, NCU) will be available for

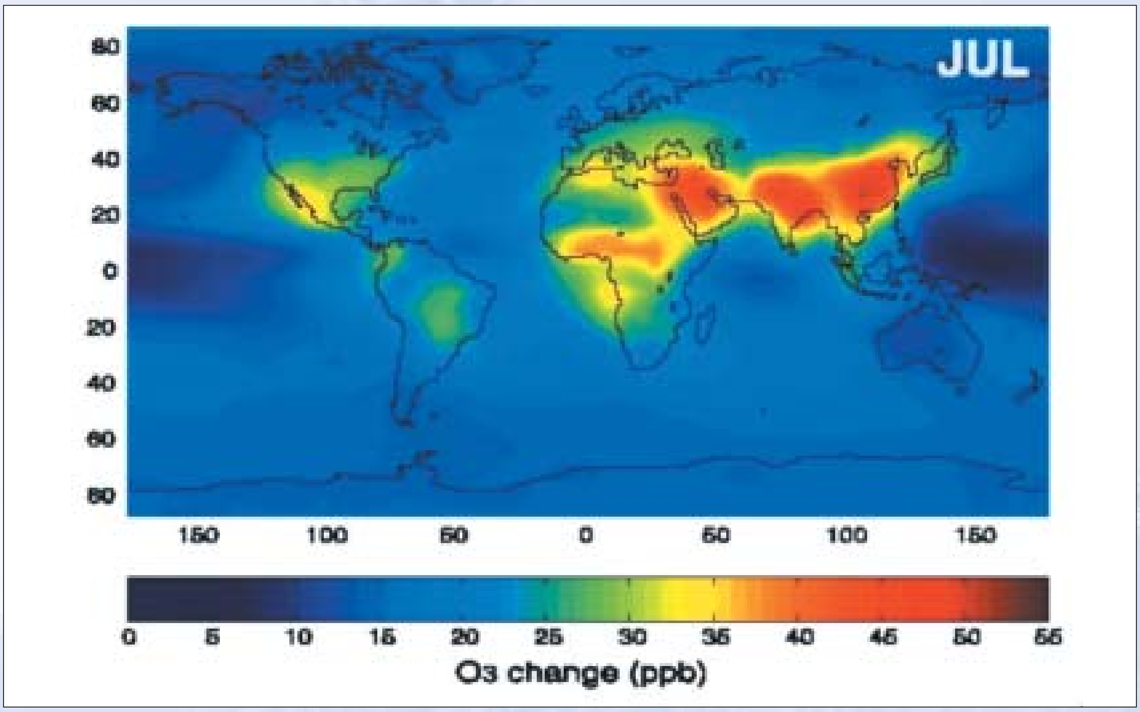

Fig. 8. Mean surface O_3 increase for July during 2000-2100 calculated by chemical transport models based on IPCC A2 emission scenario. (Prather et al., 2003)

ABC data analysis. Permission is needed to use concurrently measured data from Cape Ochi-ishi and Hateruma Island (NIES).

There remain several issues to be addressed in future: (1) How to make intercomparison with Indian scientists? Comparisons with APMEX will not be made at this time, since no instruments are installed for O_3 and CO at Maldives; (2) how to achieve traceability to the CMDL and WMO/GAW CO standards? The latter can be achieved during off-site intercomparison of standards with WMO/GAW stations in Asia.

4.3.2. Comparison procedure, time frame

February 24 - 28 (pre-IOP): Instrument installation and conditioning

March 1 - 6 (pre-IOP): Intercomparisons of calibration techniques

March 7 - 25 (IOP): Ambient measurements

March 26 - 30 (post-IOP): Instrument packing, shipping

4.3.3. Location

Container #1 and/or #2 or a new container (#6) equipped with a large-flow sampling inlet/manifold and a zero-air generator.

4.3.4. Participating groups/scientists

International (on-site) comparison at Gosan

Japan: NIES/MRI (H. Tanimoto, Y. Sawa, H. Matsueda)

China: HKPU (T. Wang)

Taiwan: NCU (G. Lin, C. Wang, C. Ou-Yang)

Korea: SNU/HUFS/KU (K.R. Kim, G. Lee, M. Lee)

Local (off-site) comparison in each country

Japan: FRCGC (H. Akimoto), NIAES (S. Yonemura)

China: Univ. Md (Zhangqing Li)

Taiwan: NCU (G. Lin, C. Wang, C. Ou-Yang), EPA (C. Wu)

Korea: METRI (B.C. Choi)

4.3.5. Instruments/items to be shipped to Gosan:

International (on-site) comparison at Gosan

Japan (NIES, MRI):

An O_3 transfer standard (TEI, 49CPS), a zero air generator (TEI, 111), an oil-free compressor, a Nafion dryer, two transformers, an O_3 monitor (Dylec, 1100), CO standard gases (SAAN, CO/Air (1.0 ppmv, 10 L), CO/N_2 (1.0 ppmv, 10 L), a CO monitor (Horiba, APMA-360)

HONG KONG (HKPU):

An O_3 monitor (TEI, 49C), a CO monitor (API, M300), a dynamic calibrator, a zero air generator (TEI, 111) with an oil-free compressor, a data logger (ESC, 8800), a high-pressure cylinder of CO-NO-SO_2 standard mixture in nitrogen (Scott Marrin), a box of 2-liter stainless steel canisters

Taipei China (NCU, EPA):

An O_3 monitor (ECOTECH, 9850D), a CO analyzer (RGD-ta3000R), 3 glass canister batches (total 24 canisters), working standard cylinders

Korea (SNU/HUFS, KU):

An O_3 monitor (TEI, 49C), a CO monitor (TEI, 48), a NO instrument (TEI, 42CTL), a SO_2 monitor (TEI, 43CTL), a CO_2 analyzer (SIEMES, 5E), a zero air generator (TEI, 111), a data logger (National Instruments and Campbell, CR10x), a CO standard gas (100 ppmv in 4 litter nitrogen cylinder (Scotty)).

4.3.6. Measurement strategy

Each group will set up and operate their measurement system in the same way as they normally did in their own studies. The sampling inlet for each group will be close to each other to ensure the same air masses to be sampled by each group. The comparison of the results from this mode will tell us if there is disagreement among each measurement system (including sampling, analyses, calibration (standard and dilution method)). Next, inter-comparison of standard will be performed on site using same detector and dilution system. This excise will let us know the consistency (or otherwise) among the standard used by each group. Another experiment will be carried out by configuring each analyzer to take samples from the same sampling inlet/manifold to check if there is any difference among different sampling inlets (this may be more important for reactive gases such us O_3). It is suggested that each group produces their data promptly at site so that preliminary comparison can be made, which would be very valuable for on-site testing to diagnose problems should they appear.

5. Collaborations

Various groups support the experiments with expected collaborations as described below.

5.1. Intercomparison with APMEX

Scientists: V. Ramanathan (PI), C. Corrigan, D. Kim, M. V. Ramana, D. Savoie and J. Schauer

a) The US team will participate with instruments (radiation, aerosol and CCN). D. Kim will be stationed in Gosan for the duration of the intense phase from March 5 to 25.

b) For the intercomparison with APMEX, the US group will provide the input for comparison.

5.2. WMO/GAW Network

WMO/Global Atmospheric Watch (GAW) stations, distributed in the East Asian region (see GAWSIS http://www.empa.ch/gaw/gawsis/find.asp), will provide baseline station support and data for the campaign. Details of the stations will be described in Sect. 6 (Surface measurements) for instrumentation and measurement parameters (Len Barrie, WMO).

5.3. AERONET

NASA AERONET sits are distributed in the experiment region (Brent Holben, NASA).

Cimel 318-2 sun/sky photometer, Gosan, S.C. Yoon (SNU)
Cimel 318-2 sun/sky photometer, Gwangju, Y.J. Kim (GIST)

Cimel 318-1 sun/sky photometer, Anmyon, B. Holben (NASA/GSFC)

Cimel 318-1 sun/sky photometer, Shirahama, S. Mukai (Kinki U.)

Cimel 318-2 sun/sky photometer, Ohsaka, S. Mukai (Kinki U.)

5.4. SKYNET

SKYNET network stations, supported by JAXA and other research groups, will provide radiation budget data and other related parameters to interpret the radiation budget.

(1) SKYNET main data center

CEReS, Chiba University (T. Takamura)

(a) Data conversion of raw data to physical meaning data

(b) Graphical view of physical data displayed in the web:

http://atmos.cr.chiba-u.ac.jp/~aerosol/skynet/rec_list/gli_sfc/gli_menu.html

(2) Sky radiometer analysis

Toyama University (K. Aoki)

Analysis of column aerosol characteristics optical thickness, Ångstrom exponent

web site: http://skyrad.edu.toyama-u.ac.jp/~kazuma/skyrad/

(3) Flux radiometer analysis

Seoul National University (B.J. Sohn)

Analysis of radiative forcing of aerosols with combination of sky radiometer and radiation data.

5.5. Lidar Networks

There are two automatic lidar networks mainly used in the experiment. One is NASA MPLNET with a single wavelength micro-pulse lidar (http://mplnet.gsfc.nasa.gov/). The other is the NIES LidarNet (N. Sugimoto, http://www-lidar.nies.go.jp/) with a two wavelength Mie polarization lidar. The specification of the two lidar system is compared in Table 1. MPLNET sites in East Asia are

Gosan, Korea (33N17', 126E10', PI: Yoon)

Anmyeon, Korea (36N30', 126E18', 45.7 m MSL, PI: Choi) - not during EAREX2005

Chung-Li, Taiwan (24N58', 121E10'50" 134.1 m MSL PI: Lin)

Xianghe, China (39N45'14", 116E57'43", 36 m MSL, PI: Tsay/Li)

NIES LidarNet stations are as below:

Sapporo, Japan (43.1N, 141.3E)

Tsukuba, Japan (36.05N, 140.12E)
Toyama, Japan (36.7N, 137.1E)
Fukue, Japan (32.63N, 128.83E)
Nagasaki, Japan (32.78N, 129.86E)
Amami-Ohshima, Japan (28.44N, 129.70E)
Miyakojima, Japan (24.7N, 125.3E)
Beijing, China (39.9N, 116.3E)
Huhehaote, China (40.94N, 111.37E)
Hefei, China (31.90N, 117.16E)
Suwon, Korea (37.14N, 127.04E)
Phimai, Thailand (17.15N, 99.95E)

5.6. BASE-Asia

Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment (BASE-ASIA, NASA project led by S.-C. Tsay et al.).

The specific objectives of the BASE-ASIA project, NASA in collaboration with Thailand's Geo-Informatics and Space Technology Development Agency, are: (1) to characterize and assess the climatic and weather-related effects (e.g., onset of Southeast Asia monsoon, precipitation pattern, etc.) of biomass burning and manmade aerosols in Southeast Asia, (2) to understand the effects of these aerosols on remote sensing observations of the atmosphere, and (3) to make measurements of regional land cover, coastal water, and oceanic primary production. A primary purpose in pursuing objective (1) is to assess the impact of existing aerosols on cloud properties and rain patterns in the region (e.g., Hsu et al. 2003). The second objective of the project directly supports NASA's broader mission to utilize satellite remote sensing to better characterize and understand climate and weather.

To achieve these objectives, satellite, aircraft, ground-based measurements and models will be utilized during the BASE-ASIA phase-I of 2004-2006. An Intensive Observation Period is planned in the months of February-March-April in 2006, pre-monsoon season to the onset of summer (Indian) monsoon. Three ground-based facilities will be deployed with two local instrumented aircraft. SMART (Surface-sensing Measurements for Atmospheric Radiative Transfer, 8'x8'x20' weather sealed trailer with thermostatic temperature control) includes a sunphotometer, a rotating shadow-band radiometer, an aerosol profilometer, a solar spectrometer, an interferometer, a whole-sky imager, a microwave radiometer, and a array of shortwave and longwave flux radiometers. COMMIT (Chemistry, Optics & Microphysics Measurements for In-situ Troposphere, 8'x8'x20' weather sealed trailer with thermostatic temperature control) contains five trace gas concentration analyzers (i.e., CO, CO_2, SO_2, NOx, and O_3), a fine and a coarse particle sizer, a mass concentration (PM-1, -2.5 & -10) analyzer, an aerosol chemical composition system, a 8-stage aerosol impactor, a seven-wavelength aethalometer, a three-wavelength nephelometer, three single-wavelength nephelometers and a system of surface meteorological probes. COPAA, which measures similar parameters to COMMIT but includes a high-volume bulk aerosol sampler, an aerosol aethalometer for black & brown carbon, and an elemental and organic carbon sampler, will be operated by University of Hawaii. This facility will be used for ground-based observations in concert with SMART-COMMIT.

The in-situ aircraft (light) will outfit with, to be provided by Universities of Maryland and Miami, three trace gas abundance (e.g., O_3, CO, SO_2) analyzers, a particle soot absorption photometer, an aerosol scattering-integrating photometer, a 3-wavelength nephelometer, an aerosol scanning mobility particle sizer, an aerosol aerodynamic particle sizer, an aerosol mass concentration analyzer, an aerosol chemistry streaker, and a condensation particle counter. The remote sensing aircraft (light) will equip with an Airborne VNIR and SWIR Imaging Spectrometer (AVSIS, spectra 0.4-1.7 μm) with a compact-scalable navigation and stabilization system, a Linear Etalon Imaging Spectral Array (LEISA, spectra 1.0-2.5 μm) imager, a Quantum Well Infrared Photodetector (QWIP, spectrum 8.3 μm) camera, a Hyperspectral QWIP Imager (HQI, spectral 3-15 μm), and an ultraviolet camera (spectral 280-360 nm).

5.7. EAST-AIRE

East Asian Study of Tropospheric Aerosols: an International Regional Experiment (EAST-AIRE, NASA project led by Z. Li et al.)

Aerosols in China are heavy-loaded, distinct and complex. They likely exert strong direct and indirect forcing on the earth's climate (Li, 2004). Not only is the magnitude of aerosol radiative forcing large, but the mechanisms by which aerosols interact with energy and water cycles may be different from those identified in cleaner environments elsewhere. East Asia is therefore an ideal test bed for examining both existing aerosol-climate paradigms and exploring new ones. To date, few in-situ measurements were made of the physical properties and chemical composition of the aerosols near the source regions. Previous international experiments conducted in the region like the ACE-Asia, was primarily off the source regions.

In order to gain a basic knowledge of the characteristics of aerosols and gases and an understanding of their climatic effects, a team of scientists from U.S. and China will conduct observational and theoretical studies, under the EAST-AIRE project. The project has a substantial observation component that includes: 1) establishment and enhancement of baseline ground observation stations to characterize more completely major types of aerosols in the region; 2) measurement of vertical profiles of gas concentrations, aerosol properties and cloud physics; 3) improvement and validation of satellite-based and ground-based remote sensing products of aerosols, clouds and radiation in the region; 4) analysis and model studies using the observational data to investigate aerosol direct and indirect effects on climate.

A major field campaign will be conducted in the spring of 2005, in partnership with the ABC GOSAN-EAREX2005. At the central station in Xianghe (70 km east of Beijing), most extensive measurements are made including 1) radiative quantities (direct, diffuse and total SW and LW fluxes) using broadband and narrow radiometers, and spectrometers; 2) cloud properties (cloud fraction and height, optical depth, liquid water path, particle size); 3) aerosol optical quantities (optical depth, scattering and absorbing coefficients, vertical attenuation profiles) using Cimel sun-photometer, Nephelometer, Aethalometers, PSAP, etc., 4) aerosol physical quantities (size distribution, mass and condensation number) using aerosol filter samplers, cascade impactors, particle sizers; 5) aerosol compositions using OC/EC analyzer, aerosol filters and sample analyzers, 6) precursor gases (ozone, NO, NOx, NOy, CO, SO_2).

6. Surface measurements

Information of surface measurement sites are given as follows.

6.1. Gosan, Korea

Location (33N17', 126E10')

Site manager: Jae-Cheol Nam (METRI/KMA)

Site scientists: Sang-Woo Kim (SNU) and So-Young Bang (METRI/KMA)

Instruments manager: Mi-Young Ko (METRI/KMA)

Program: ABC Super site, AERONET, SKYNET, MPLNET

This site is the ABC Super site in the East Asian region (Fig. 9). The other super site is located in Hanimaadhoo, Maldives in the South Asian region.

Instrumentation:

(A) Aerosol Measurement

$PM_{1.0}$, $PM_{1.0}$ Sampler, GIST

$PM_{2.5}$, $PM_{2.5}$ Cyclone and Denuder Filter Pack System, NIER

$PM_{2.5}$ EC/OC, Semi-continuous OC/EC Field Instrument, GIST, NIER

PM_{10} EC/OC, Continuous Carbon Monitor System, NIER

PM_{10} and $PM_{2.5}$ samplers, Univ. of Wisconsin

Particle Counter, Condensation Particle Counter (CPC), Yonsei Univ., Univ. of Tokyo

TSP (Ion & Metal), High Volume Tape Sampler, Cheju National Univ.

TSP, High Volume Air Sampler, Hokkaido Univ.

Particle-into-Liquid-Sampler (PLIS) IC System, Univ. of Tokyo

Fig. 9. View of the Gosan observatory (left panel), the ABC super site, and the Gosan weather station (right panel).

(B) Gas Measurement

O_3/CO Instruments, HKPU, NIES/MRI, NCU

DOAS ; NO_2, SO_2, HCHO, ClO, BrO, GIST

VOCs ; Canisters, KIST, HKPU

CO, O_3, SO_2, NOx ; Gas Analyzer, GIST, MOE, SNU/HUFS/KU

NOx/NOy, GIST

HONO, HONO Measurement System, GIST, SNU/HUFS/KU

Radon, Cheju National Univ., SNU/HUFS/KU, METRI(ANSTO)

DMS, HNO_3, PAN, NOy, H_2O_2, ROOH, SNU/HUFS/KU

(C) Radiation Measurement

- Lidar; Aerosol Profile
  Dual WL Lidar, NIES
  MPL, SNU (MPLNET)
- Pyranometer: Global & Diffuse Irradiance
  Kipp & Zonen CM22, MRI, Chiba Univ, RIHN
  Kipp & Zonen CM21, SNU, SIO
  EKO, METRI/KMA
- Pyrheliometer: Direct Irradiance
  Kipp & Zonen CH1, SNU
  EKO Shadowband, METRI/KMA
- Pyrgeometer: Global or Diffuse
  Kipp & Zonen CG3, Chiba Univ., SNU
  Kipp & Zonen CG4, SIO

EKO, METRI/KMA

- Sky Radiometer: AOD and Size Distribution

  PREDE, METRI/KMA, SNU (SKYNET)

  Cimel, SNU (AERONET)

  MFRSR, Yonsei Univ.

- Other type radiometers

  Grating Sunphotoemeter (PREDE), i-Sky Radiometer, Chiba Univ.

  Grating Spectrometer (ASD), SIO

  MW Radiometer, METRI/KMA

  FT-IR, EKO UV-B, Kyungbuk Univ.

Measurement activities and schedule:

- Surface measurement of total aerosol number concentration and submicron aerosol number size distribution during the whole campaign except the KMA ship measurement period (S.S. Yum, Yonsei Univ.)
- FSSP-100 measurement of cloud/fog droplet size distribution over the hills of Halla Mountain (S.N. Oh, METRI/KMA; S.S. Yum, Yonsei Univ.)

6.2. Anmyeon, Korea

Location (36N30', 126E18', 45.7 m MSL)

Site scientist: B.C. Choi (METRI/KMA)

Program: GAW/WMO, AERONET, MPLNET

Instrumentation:

- Green House gases

  NDIR analyzer SIEMENS Ultramat 6E CO_2

  GC-FID Aglient5890 CH_4

  GC-ECD Aglient6890N N_2O

  GC-ECD Aglient6890N CFC11, CFC12

- Air quality monitoring system

  ML9841A NOx (NO, NO_2)

  ML9850 SO_2

  ML9830 CO

  ML 9812 O_3

- Aerosol

  OPC (Optical Particle Counter) HIAC/ROYCO 5230 0.3~25 ㎛ (8 channel)

  Nephelometer TSI 3523 aerosol scattering coefficients

(450, 550, 700 nm)		
Aethalometer	MageeAE-16U	Black carbon
β-ray PM10	Thermo Anderson 650	10 μm
Aerosol LIDAR	SESI, MPL 1000	Single 523.5 nm

- Radiation

Sunphotometer	EKO, MS-110	368, 500, 675, 778, 862 nm
Broadband Radiometer	EKO, MS-53	Direct Solar radiation
	EKO, MS-801	Diffuse Solar radiation (+Shade ring)
	EKO, MS-801	Solar radiation
	EKO, MS-201	Terrestrial radiation
	EKO, MF-11	Net radiation Green

6.3. Gwangju, Korea

Location (35N13', 126E5')
Site scientist: Y.J. Kim (GIST)
Program: AERONET

Instrumentation:
Multi Channel Lidar System, GIST
Particle Size, Micro Orifice Uniform Deposit Impactor (MOUDI), GIST

6.4. Cape-Hedo, Japan

Location (26N52' 1", 128E14'52")
Site scientist: S. Hatakeyama (NIES)
Program: EANET, SKYNET, NIES LidarNet

Instrumentation:
Up/down looking flux radiometers: Kipp&Zonen CM-21 (SW), Eppley PIR (LW)
i-skyradiometer, Sunphotometer: Chiba U.
Microwave radiometer: Radiometric WVR-1100, 23.8GHz, 31.4GHz, Chiba U.
Two wavelengths Lidar, NIES
Nephelometer, Absorption photometer, RIHN
Aerosol sampling, CCSR/UT
PM_{10} & $PM_{2.5}$ sampling, NIES
SO_2 and O_3 gas analyzers, MOE or NIES

Polarimeter, Kinki-U.

Aerosol Mass Spectrometer, NIES

TEOM (aerosol mass conc.), NIES

EC/OC monitor, NIES

BC Monitor, RIHN

6.5. Amami-Oshima, Japan

Location (28N25'47", 129E40'48")

Site scientist: T. Takamura (Chiba U.)

Program: SKYNET, NIES LidarNet

Instrumentation:

	Instrument	*Product*
Aerosol		
Optical thickness Angstrom exponent	i-sky radiometer	POM-02(Prede)
Vertical profile/NIES	Lidar	NIES wavelength polarization lidar
Scattering coefficient	Integrating nephelometer	M903(Radiance Research)
Absorption coefficient	Absorption meter	PSAP(Radiance Research) Aethalometer
Particle number density	Optical particle counter	Met One Model 237 RYOCO LAS236 UCPC(3025A, TSI) LPC(TF-500, Kanomax)
Aerosol chemical composition	Aerosol sampling system GC-FPD	EC/OC, chemical species DMS, CS2, and COS analysis
Black Carbon	Black carbon monitor	
CCN	CCN counter	Two kinds of instrument
Cloud		
Optical thickness Effective radius	i-sky radiometer	POM-02(Prede)
Cloud amount	Skyview	PSV-100(Prede)
Liquid water path	Microwave radiometer	WVR-1100(Radiometrics)
Vertical profile	FM-CW 94GHz radar	Chiba Univ.
Radiation		
Direct solar radiation	Pyrheliometer	CH-01(Kipp & Zonen)
Global solar radiation	Pyranometer	CM21(Kipp & Zonen)
Terrestrial radiation (downward)	Pyrgeometer	PIR(Eppley)
Gas		
Surface ozone	Ozone meter	
Surface SO_2	SO_2 meter	
Surface NOx	NOx analyzer	

6.6. Fukuejima, Japan

Location (32N45' 7", 128E40'55")
Site scientist: Tadahiro Hayasaka (RIHN)
Program: SKYNET, NIES LidarNet

Instrumentation:

Up/down looking flux radiometers: Kipp&Zonen CM-21 (SW), CG-4 (LW)
Pyrheliometer, Kipp&Zonen, CH-1
Skyradiometer, PREDE, POM-01
Grating Sunphotometer, PREDE, PGS-100
Spectroradiometer, EKO, MS-700
Microwave Radiometer, RPG, 23.8GHz, 36.5GHz
Two wavelengths Lidar, NIES
Nephelometer, Radiance Research, M903
Absorption photometer
Aerosol sampling, S. Ohta
Optical Particle Counter, RION, KC-01D1
Wind Direction and Speed, YOUNG, MODEL 05103VM--47
Temperature and Humidity, VAISALA, HMP45
CO Analyzer, Thermo Electron, 48C
Ozone Analyzer, Thermo Electron,
Skyview, PREDE, PSV-100

6.7. Minamitorishima, Japan

Location (24N18', 153E58', 8 m MSL)
Site Scientist: H. Matsueda (MRI/JMA)
Program: GAW/WMO, SKYNET

Instrumentation:

CO_2, NDIR (Horiba, VIA510A) operated by JMA since March 1993
CH_4, NDIR (Horiba, GA360-S) operated by JMA since January 1994
CO, NDIR (Horiba, GA360-S) operated by JMA since January 1994
Surface O_3, UV absorption (Ebara, EG-2001F) operated by JMA since January 1994
Total O_3, Brewer spectrophotometer (Kipp&Zonen, Brewer Mark 2) operated by JMA since January 1997
Aerosol optical depth, Sunphotometer (Eiko Seiki, MS-110) operated by JMA since January

1995

Collection of precipitation for pH and major ion analyses operated by JMA since January 1996

Skyradiometer (PREDE, POM-02) operated by MRI (A. Uchiyama)

Pyranometer (Kipp & Zonen, CM-21) operated by MRI (A. Uchiyama)

6.8. Miyakojima, Japan

Location (24N42'58", 125E19'1")

Site scientist: A. Uchiyama (MRI/JMA)

Program: ADEC, SKYNET

Instrumentation:

Up looking flux radiometers: Kipp&Zonen CM21 and CM-21 with RG715 (SW), Eppley PIR (LW)

Pyrheliometer Kipp&Zonen CH-1 and CH-1 with RG715

Skyradiometer, PREDE

Two wavelengths Lidar, NIES

Nephelometer M903

Absorption photometer SP-Y01, PSAP

OPC 237B

SKYVIEW PREDE

6.9. Cape Ochi-ishi, Japan

Location (43N9', 145E30', 45 m MSL)

Site scientist: H. Mukai (NIES)

Program: CGER Global Environmental Monitoring Program

Instrumentation

- O_3, UV absorption, NIES
- CO, GC/RGD, NIES

6.10. Hateruma Island, Japan

Location (24N3', 123E48', 10 m MSL)

Site scientist: H. Mukai (NIES)

Program: CGER Global Environmental Monitoring Program

Instrumentation:

O_3, UV absorption, NIES

CO, GC/RGD, NIES

6.11. Hefei, China

Location (31N53'49", 117E10'22")

Site scientist: J. Zhou (AIOFM)

Program: SKYNET, NIES LidarNet

Instrumentation:

Up/down looking flux radiometers: Kipp&Zonen CM-21 (SW), Eppley PIR (LW)

Pyrheliometer EKO MS-53A

i-skyradiometer, PREDE

Microwave radiometer: Radiometric WVR-1100, 23.8GHz, 31.4GHz

Two wavelength Lidar, NIES

Nephelometer M903

Absorption photometer SP-Y01

Aerosol sampling, N. Takeuchi

SKYVIEW PREDE

6.12. Xianghe, China

Location (39N45'14", 116E57'43", 36 m MSL)

Site scientists: Zhanqing Li (UMD); Xiangao Xia

Program: EAST-AIRE, AERONET, MPLNET

Ground-based instruments measuring radiation and clouds deployed at Xianghe (Provided by the University of Maryland and NASA)

Instruments	*Manufacture*	*Observation Items*
Kipp & Zonen 1. CM21 radiometer 2. CM22 radiometer 3. CV2 ventilator 4. EKO STR-22 solar tracker.	Kipp & Zonen (USA) Inc. 125 Wilbur Place Bohemia, New York 11716 USA http://www.kippzonen.com/	Total (CM21) and Diffuse radiation (CM22) with a ventilation system (CV2). All are placed on solar-tracking system
Eppley 1. 8-48 B&W radiometer 2. Normal Incidence Pyrheliometer 3. ventilator model VEN 4. PIR (Precision Infrared Radiometer)	Eppley Lab Tom Kirk 401-847-1020 info@eppleylab.com	Diffuse and direct solar radiation; and a ventilator to be attached to 8-48 radiometer
Campbell Scientific Logger (CR23X-4M)	Campbell Scientific Inc. Mr. Craig Knox 815 W. 1800N Logan, Utah 84321-1784	Data acquisition
YES MFR-7 Rotating shadow band radiometer TSI 440A Total Sky Imager	Yankee Environment Sys. Mark Beaubien 101 Industrial Blvd. Turners Falls, MA http://www.yesinc.com	Direct and diffuse spectral radiation Cloud fraction Cloud ? Cloud re
Cimel CE-318	CIMEL Electronique 172 rue de Charonne 75011 Paris, France	Direct spectral radiance Aerosol & size distribution
MPL Lidar	NASA/GSFC	Aerosol extinction coefficient
Microwave Radiometer	Radiometric Radiance	Cloud liquid water path Precipitable water

Instruments measuring gases and aerosols (both for airborne and ground observations) deployed at Xianghe (provided by the University of Maryland)

Instruments	*Manufacture*	*Model*	*Serial #*	*Observation Items*	*Weight (lbs)*	*Dimension (cm)*
Pulsed Fluorescence SO_2 Analyzer	Thermo Electron Inc.	TEI 43C	43CTL-56185-306	Sulfur Dioxide Concentration	46.5	58 × 42 × 22
Gas Filter Correlation CO Analyzer	Thermo Electron Inc.	TEI 48C	48-39042-259	Carbon Monoxide Concentration	44.0	58 × 42 × 22
UV Photometric O3 Analyzer	Thermo Electron Inc.	TEI 49C	49-21802-201	Ozone Concentration	42.5	58 × 42 × 23
Integrating Nephelometer	TSI, Inc	3563	35630 01058	Aerosol Light Scattering at 450,550 & 700 nm	44.5	105 × 29 × 25
Particle/Soot Absorption Photometer	Radiance Research, Inc	Nil	0032	Aerosol Light Absorption at 565 nm	10.0	48 × 29 × 14
MetOne Particle Counter	MetOne, Inc.	9012	B3245	Aerosol Size Distribution 0.3-1.0 μm	4.0	12 (diameter) ×25 (height)
Condensation Particle Counter	TSI Inc.	3007	3007-0603-1001	Total Aerosol Number Concentration (<1.0 μm)	5.0	30 × 13 × 15
Rosemont Pressure Transducer	Rosemont, Inc	2008	8330	Atmospheric Pressure	4.0	12 × 10 × 8
Rustrack Data Logger	Thermo Westronics, Inc	RR2-1200	60904	Data Acquisition	3.5	30 × 19 × 5
Garmin GPS 90	Garmin, Inc.	90	60642 418	Position	2.0	16 × 5 × 3

Instruments measuring chemistry and optical properties of absorbing aerosols (provided by the University of Hawaii)

Instrument	*Measurement Parameter*
Omnidirectional Inlet & Tubing. Built by Dave covert, U. Washington	Delivers air and aerosols to all our instruments except the MOUDI impactors
TSI Model 3563 Integrating Nephelometer	Aerosol Light Scattering at 450, 550, and 700 nm for Aerosols. Alternating Total and <1 μm
Magee Scientific Model AE3 Aethalometer	Aerosol Light Absorption at 370, 450, 571, 615, 660, 880, and 950 nm for Total Aerosols
Radiance Research PSAP	Aerosol Light Absorption at 565 nm, Alternating Total and <1 um with neph
Sunset Labs Semi-continuous Aerosol Carbon Analyzer	Bulk Elemental and Organic Carbon in Aerosols
Bulk Aerosol Filter Sampler	Bulk Aerosol Concentrations of Chemical Species (e.g., sulfate, nitrate,)
2 ea MOUDI Cascade Impactors	Size-segregated Carbonaceous and Inorganic Aerosol Collections
TSI Model 3320 Aerodynamic Particle Sizer	Number Size Distribution of Particles from 0.5 to 20 μm
TSI Scanning Mobility Particle Sizer	Number Size Distribution of Particles from 15 to 700 nm
TSI Model 3760 Condensation Particle Counter	Total Aerosol Number Concentration from 15 to 1000 nm
Monitor Labs Model 9810 Ozone Analyzer	Ozone Concentration
Mettler UMT-2 Microbalance	Gravimetric Aerosol Mass
Muffle Furnace	Cleaning quartz filters for OC/EC analysis
High volume aerosol sampler	Provided by U. Miami

6.13. Hok Tsui Regional Air Monitoring Station, Hong Kong

Location (22N13', 114E15', 60 m MSL)
Site scientist: T. Wang (Hong Kong Polytechnic U.)

Instrumentation:
O_3, UV absorption, TEI model 49C
CO, GFC technique, TEI model 48

6.14. Phimai, Thailand

Location (15N11', 102E3')
Site administrator: P. Menasveta (Chulalongkorn U.)
Site scientists: B. Thana, M. Hashizume (Chulalongkorn U.)
Program: SKYNET, AERONET, NIES LidarNet

Instrumentation:
Up/down looking flux radiometers: Kipp&Zonen CM-21 (SW), Eppley PIR (LW)
Pyrheliometer EKO MS-53A
i-skyradiometer, PREDE
Microwave radiometer: Radiometric WVR-1100, 23.8GHz, 31.4GHz
Two wavelengths Lidar, NIES
Nephelometer M903
Absorption photometer SP-Y01
Aerosol sampling, N. Takeuchi
SKYVIEW PREDE

6.15. Lu-Lin Mt., Taiwan

Location (23N28'07", 120E52'25", 2862 m MSL)
Site scientists: Neng-Huei (George) Lin, Chung-Te Lee, Charlie Jia-Lin Wang (NCU)

Instrumentation:
Precipitation chemistry, rainwater collector
CO, Agilent 6890A, GC/FID/Methanizer
$PM_{2.5}$, PM_{10} mass, Anderson Dichotomous sampler
$PM_{2.5}$, -IAS IMPROVE sampler
Mass size, MOUDI-100

Aerosol inorganic ions, elements
EC/OC

6.16. Wan-Li area, Taiwan

(a) Wan-Li coastal air quality station
Location (25N10'52", 121E40'52", 7.7 m MSL)
Site Managers: P.-C. Chen, C-F. Wu (EPA)

Instrumentation:
O_3, UV absorption, ECOTECH-9810B
SO_2, UV Fluorescence, ECOTECH-9850B
CO, GFC technique, HORIBA APMA-360
$NOx/NO_2/NO$, Chemiluminescen, ECOTECH-9841B
PM_{10}, TEOM,R&P 1400
$PM_{2.5}$, TEOM,R&P 1400
WD/WS/TEMP/RAIN/RH, METONE-024A/014A/T-200/S-370/083D
ACID RAIN, OGASAWARA KEIKI-US760S

(b) An-Bo mountain air quality station
Location (25N11'13", 121E30'51", 838 m MSL)
Site Managers: B-L Chen, C.-F. Wu (EPA)

Instrumentation:
O_3, UV absorption, ECOTECH-9810B
SO_2, UV Fluorescence, ECOTECH-9850B
CO, GFC technique, HORIBA APMA-360
$NOx/NO_2/NO$, Chemiluminescen, ECOTECH-9841B
PM_{10}, β-ray Attenuate method, VEREWA F-701
WD/WS/TEMP/RAIN/RH, METONE-024A/014A/T-200/S-370/083D
ACID RAIN, OGASAWARA KEIKI-US760S

(c) Shi-Meng Site
Location: (25N16'48", 121E34'48", 20 m MSL)
Site scientist: Chung-Te Lee

Instrumentation:
$PM_{2.5}$, PM_{10} mass, R&P 2300 and 2000

Mass size, MOUDI-100
Inorganic ions, elements
EC/OC

(d) Bamboo Mt. site
Location: (25N11', 121E31', 1,103 m MSL)
Site scientist: Neng-Huei (George) Lin

Instrumentation:
Cloud droplet spectrum, FSSP-100
Cloud chemistry, ASRC collector
Precipitation chemistry, rainwater collector

6.17. KMA Research vessel measurements

Operator: J.-C. Nam (METRI/KMA)
Duration: 27 Feb. to 1 April (limited period during the ABC-EAREX2005)

Specifications of research vessel, KISANG 2000 (see Fig. 10)
- Gross Tonnage: 150 ton
- Cruising speed: 13 knot
- Complement: 40 persons

Cruising route (see Fig. 10)
Instrumentation:
Beta guage PM_{10} and Optical particle counter (J.C. Nam, Y.S. Chun, H.T. Kim, Y.H. Kim and S.B. Ryoo, METRI/KMA)
Meteorological data (WD, WS, T, P, RH etc.): AWS (KMA)
Total aerosol number concentration: CPC (S.S. Yum, Yonsei U)
Submicron aerosol number size distribution: SMPS (S.S. Yum, Yonsei U)
DMS sampler (G. Lee)

Fig. 10. The research vessel, KISANG 2000 (left panel), and Cruise track during the ABC-EAREX2005 (right panel).

7. Active sensing

7.1. Lidar

Lidar scientists: S.C. Yoon (SNU) and N. Sugimoto (NIES)
Web-site: http://www-lidar.nies.go.jp/ (NIES)
http://mplnet.gsfc.nasa.gov/ (MPLNET)

Instrumentation:
NIES/dual frequency Mie lidars at Gosan, Cape-Hedo and Fukuejima islands: 532nm and 1064nm, depolarization (Sugimoto, NIES)
SNU/MPL at Gosan (S.C. Yoon, SNU)
GIST Multi Channel Lidar System, Gwangju, 355nm, 532nm and 1064nm, depolarization (Y.J. Kim, GIST)

See Table 1 for comparison of specifications of NIES and MPL lidars.

7.2. Cloud radar

Radar scientist: H. Kumagai (NICT)
Cloud microphysics scientist: H. Okamoto (Tohoku U.)

Instrumentation:
NICT/SPIDER, 94GHz pulsed doppler radar (H. Kumagai, NICT)
FMCW CPR, 94GHz fmcw-type radar (T. Takano, Chiba U.)

The group will conduct the following shipborne experiments, Research Vessel Mirai cruise. Together with FMCW CPR, the lidar operated by NIES and infrared radiometer provided by Tohoku university will be used.

- MR05-02 (area) cruise
  Period: from 25th May to 2nd July 2005 (totally 39 days).
  Area: Western North Pacific.
  Ports: Sekinehama and Guam.
- MR05-03 (Leg1) cruise
  Period: from 6th July to 30th July 2005 (totally 25 days).
  Area: Western tropical Pacific Ocean.
  Ports: Guam and Darwin.
- MR05-03(Leg2) cruise: The observational area is the Eastern tropical Indian Ocean.

The period is from 1st Aug. to 3rd Sep., 2005 (totally 34 days). The ports are Darwin, Palau and Sekinehama.

The products are as follows:

Vertical distribution of cloud fraction
Vertical distribution of cloud mean amount
Microphysics of clouds
Vertical distribution of aerosols
Microphysics of aerosols such as types of aerosols, extinction coefficients for each type, size information

8. Satellite remote sensing

8.1. KMA dust analysis

Remot sensing Scientist: S. N. Oh (METRI/KMA)

8.2. NASA/Goddard MODIS Group

Remot sensing Scientists: S.-C. Tsay and N. C. Hsu (NASA)

Currently, the most comprehensive measurements of the earth-atmosphere system from operational satellites are acquired by MODIS sensors aboard the EOS/Terra and EOS/Aqua. Since these measurements are in the public domain of NASA/DAAC or direct broadcast, the NASA team will participate in the post-mission activities for ABC Gosan. Using the newly developed Deep Blue algorithm (Hsu et al. 2004) for MODIS and other satellites over the bright-reflecting surface, aerosol properties will be retrieved over the source regions in East Asia, in addition to the operational aerosol products. Daily maps and retrievals of aerosol optical thickness and Ångström exponent over land and water during the IOP of ABC Gosan campaign will be posted on the web site for access of science team members. The primary objectives for the satellite group at NASA/Goddard are twofold: (1) to validate the aerosol products using measurements collected in the field campaign, and (2) to better understand the properties of Asian dust and anthropogenic pollution aerosols in the region for improving satellite capability of retrieving aerosol information from space.

8.3. SKYNET group

Remote sensing Scientists: T.Y. Nakajima (JAXA) and Akiko Higurashi (NIES)
Web site: http://atm-phys.nies.go.jp/~hakiko/Aerosol.retv_top.html (Aerosol)

http://atm-phys.nies.go.jp/~particles/modis_terra.html (Cloud)

Following data are used for analysis:

MODIS: LAC, Institute of Industrial Science, University of Tokyo

TRMM: NASDA

GMS: CEReS, Chiba University

MODIS data will be used for semi-real time analysis.

GMS high resolution images have to be up on the APEX web site every day.

Following retrievals will be performed:

(1) Aerosol: A. Higurashi (NIES)

Aerosol optical thickness and Ångström exponent over ocean

(2) Cloud: T.Y. Nakajima (JAXA)

MODIS data will be used to derive the following parameters over land and ocean:

- Cloud optical thickness in visible region
- Effective particle radius
- Liquid water path
- Cloud amount for each cloud type

TRMM will be used to derive the following quantities:

- Drizzle/non-drizzle detection

Data is distributed on the APEX-web 2-8hours later after receiving raw satellite data.

(3) GMS: I. Okada (CERES/Chiba U.)

Retrieved parameters are as follows:

- Cloud amount and cloud top temperature for high/mid/low clouds every hour.
- TOA and surface radiation budget will be retrieved.

High resolution data images have to be up on the APEX web site every day.

9. Modeling

9.1. ACESS

Scientists: G. Carmichael (U. Iowa), I. Uno (RIAM/Kyushu U.)
Web site: http://www.cgrer.uiowa.edu/ACESS/acess_index.htm

ACESS (ABC Chemical Modeling and Emission Support System) will provide chemical transport simulation with STEM model. Simulation results are available at the ACESS web site.

9.2. CFORS

Scientists: I. Uno (RIAM/Kyushu U.), G. Carmichael (U. Iowa)
Web site: http://cfors.riam.kyushu-u.ac.jp/~cfors/

The present CFORS forecast will be extended from 2 days to 3 days with adding more chemical components. Other model forecasting is also available on the RIAM and NIES-web sites.

The simulation domain of ACESS and CFORS is shown in Fig. 11.

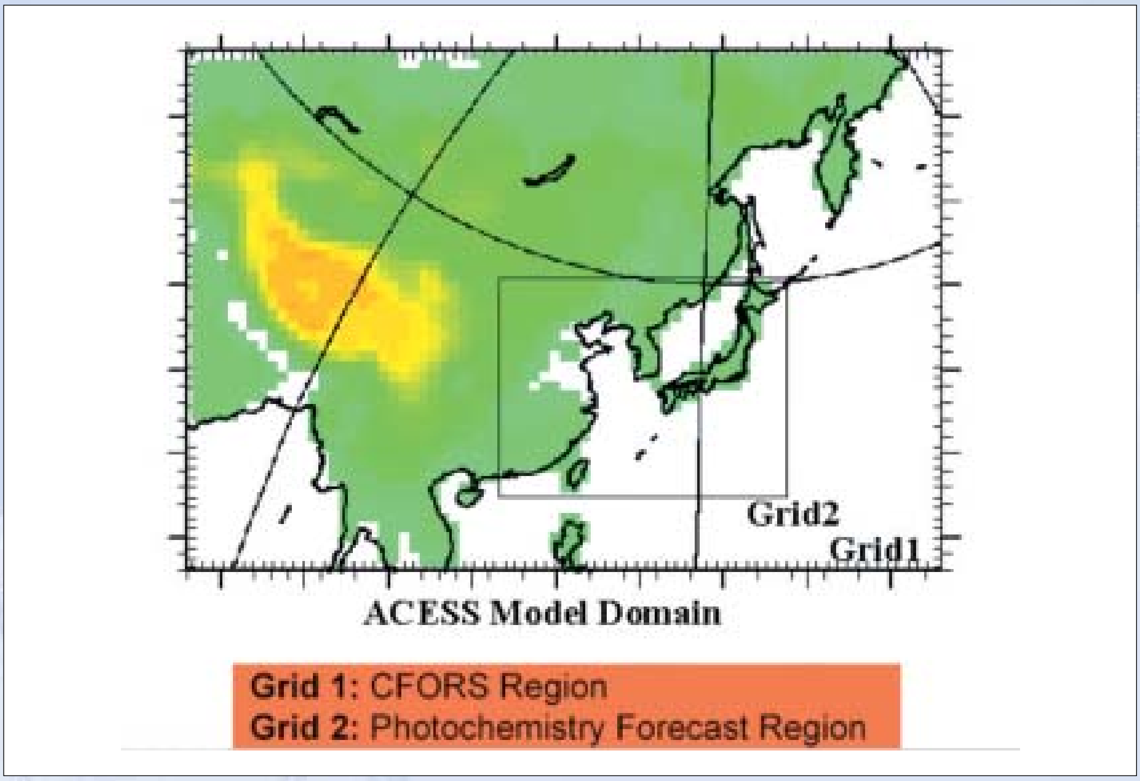

Fig. 11. Simulation domain of ACESS and CFORS.

9.3. Frontier Research Center model

Scientist: M. Takigawa (FRCGC)
Web site: http://www.jamstec.go.jp/frcgc/gcwm/

Global chemical weather forecasting system based on the CHASER (chemical atmospheric general circulation model for study of environment and radiative forcing) has been developed. This system can offer 7-day forecasted global distribution of chemical species and sulfate aerosols.

9.4. SPRINTARS

Scientist: T. Takemura (RIAM/Kyushu U.)
Web site: http://cfors.riam.kyushu-u.ac.jp/~toshi/SPRINTARS/ABC2005/

Quick-look figures are posted to the web site after five days. Posted parameters are aerosol total optical thickness, Ångström exponent, single scattering albedo, surface mass concentration (BC, OC, sulfate, soil dust, and sea salt), direct radiative forcing at TOA and surface, and cloud droplet effective radius at cloud top above 273K. The simulated results are shown by 2-dimensional maps between 90 and 180E/0 and 60N on daily mean and time sequences at Gosan on 6-hour mean.

9.5. NHM+HUCM cloud model

Scientists: T. Nakajima, T. Iguchi (CCSR/UT)

A 30-bin cloud-aerosol interaction model implemented in the JMA NHM non-hydrostatic meso-scale model.

9.6. MM5+EAAQM model

Scientist: C.H. Song (GIST)

The EAAQuM (East Asian Air Quality Model) has been improved by incorporating a size-resolved dust generation & transport module and a state-of-the-science heterogeneous particulate formation parameterization. This improved 3-D Eulerian chemistry-transport model will be used for analyzing and interpreting dust data from the ABC-Gosan EAREX2005 campaign.

10. Data policy

Participants and collaborators are encouraged to follow the data policy for making the experiment most contributory to the research community.

(1) Data owners should release the data taken in the experiment to the participants at earliest timing.
(2) Data owners have to release the data to public within one and half years.
(3) Data users have to get permission from the data owners for data use in publication. Way of courtesy, i.e., co-authorship or acknowledge in the acknowledgments, is subject to the discussion between the data user and data owner.
(4) Data users should acknowledge UNEP/ABC-Gosan/EAREX2005 Experiment in the acknowledgments of published articles.

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12. Supporting organizations

The following organizations support the observation:

International:

UNEP ABC Project
GAW/WMO

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State Environmental Protection Administration, China
China Meteorological Administration (CMA)
Institute of Atmospheric Physics (IAP)/CAS
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Japan Meteorological Agency (JMA)
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