ACE-Asia

Asian Pacific Regional
Aerosol Characterization Experiment

Radiative Forcing due to Anthropogenic Aerosols
Over the Asian Pacific Region

Project Prospecus

Organized by the
International Global Atmospheric Chemistry Project's (IGAC)

Aerosol and Process Studies (ACAPS)
Aerosol – Cloud Interactions (ACI)
East Asian/North Pacific Regional Study (APARE)
and
Marine Aerosol and Gas Exchange (MAGE)
Activities

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Project Summary

Atmospheric aerosol particles affect the Earth's radiative balance directly by scattering or absorbing light, and indirectly by acting as cloud condensation nuclei (CCN), thereby influencing the albedo and life-time of clouds. At this time, tropospheric aerosols pose one of the largest uncertainties in model calculations of the climate forcing due to man-made changes in the composition of the atmosphere (IPCC, 1996). Accurately quantifying the direct and indirect effect of anthropogenic aerosols on the radiative forcing of climate requires an integrated research program (NRC, 1996) that includes:

- in-situ measurements covering a globally representative range of natural and anthropogenically perturbed environments to determine the chemical, physical, and radiative properties of the major aerosol types, the relationships among these properties and the processes controlling them,
- satellite observations to quantify the temporally and spatially varying aerosol distributions, and
- chemical transport and radiative transfer models to calculate radiative forcing by aerosols and to provide a prognostic analysis of future radiative forcing and climate response under various emission scenarios.

The International Global Atmospheric Chemistry Program (IGAC) has planned a series of Aerosol Characterization Experiments (ACE) that integrate in-situ measurements, satellite observations, and models to reduce the uncertainty in calculations of the climate forcing due to aerosol particles. ACE-Asia is the fourth in this series of experiments and will consist of three focused components in the 2000-2004 timeframe:

1. In-situ and column integrated measurements at a **network of ground stations** will quantify the chemical, physical and radiative **properties of aerosols** in the ACE-Asia study area and assess their spatial and temporal (seasonal and inter-annual) variability (2000-2004).
2. An **intensive field study** will be used to quantify the spatial and vertical distribution of **aerosol properties, the processes** controlling their formation, evolution and fate, and the **column integrated clear-sky radiative effect** of the aerosol (Late March through April, 2001).
3. **The effect of clouds on aerosol properties and the effect of aerosols on cloud properties (indirect aerosol effect)** will be quantified in focused intensive experiments (Spring 2001 and Spring 2002 or 2003).

ACE-Asia has been divided into three separate components so that measurement campaigns can be carefully focused to address the goals of each component. This structure acknowledges that the various components are in different stages of scientific readiness and have different instrumental, sampling, meteorological, and logistical needs. Each of the focused components of ACE-Asia has its own Science and Implementation Plan to elaborate its goals, research plan, needed measurements, platforms and investigators. This document describes the overall need for an ACE-Asia experiment, the scientific goals and objectives of the experiment as a whole, the preliminary

goals of the three components, the models that will integrate our understanding of the climatic effect of aerosol particles, and the operational structure of the experiment.

Further information about ACE-Asia can be found on the Project Website (saga.pmel.noaa.gov/aceasia/) or from members of the ACE-Asia Executive Committee:

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I. Introduction and Rationale

Atmospheric aerosol particles affect the Earth's radiative balance directly by scattering or absorbing light, and indirectly by acting as cloud condensation nuclei (CCN), thereby influencing the albedo, life-time, extent and precipitation of clouds. In many regions the natural aerosol has been substantially perturbed by anthropogenic activities, particularly by increases of sulfates, nitrates, organic condensates, soot, and soil dust. The present day global mean radiative forcing due to anthropogenic aerosol particles is estimated to be between -0.3 and -3.5 Wm^{-2}, which must be compared with the present day forcing by greenhouse gases of between +2.0 and +2.8 Wm^{-2}(IPCC, 1996). Furthermore, the global distribution of aerosol particles is extremely inhomogeneous due to their relatively short lifetimes (in the range of 4-5 days, *IPCC, 1996*). This results in a negative forcing that is focused in particular regions and subcontinental areas. This uneven forcing can cause continental to hemispheric scale effects on climate patterns.

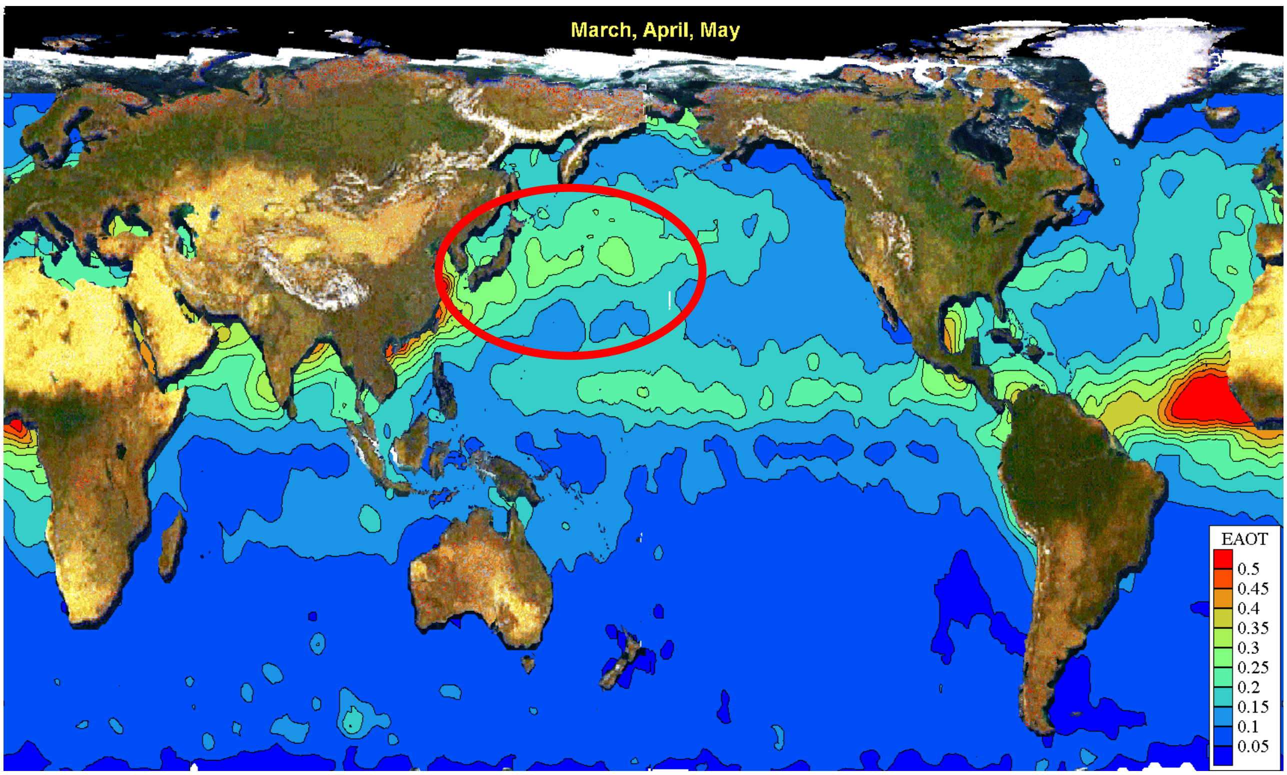
Although aerosol particles have this potential climatic importance, they are poorly characterized in global climate models (NRC, 1996). This is a result of a lack of both comprehensive global data and a clear understanding of the processes linking aerosol particles, aerosol precursor emissions, and radiative effects. At this time, tropospheric aerosols pose the largest uncertainty in model calculations of the climate forcing due to man-made changes in the composition of the atmosphere. The IGAC Aerosol Characterization Experiments (ACE) were designed to address this uncertainty and have two overall goals:

- to reduce the overall uncertainty in the calculation of climate forcing by aerosols and,
- to understand the multiphase atmospheric chemical system sufficiently to be able to provide a prognostic analysis of future radiative forcing and climate response.

Achieving these goals requires further development of chemical transport models to produce accurate global aerosol distributions, clear and cloudy sky radiative transfer models to calculate the radiative effects of aerosols, and climate system models to study the interaction of aerosol particles within the integrated climate system. Further developing and testing of these models require simultaneous measurements of aerosol chemical, physical, and radiative properties and the processes controlling those properties. Radiative transfer models require values for aerosol optical properties such as the light scattering efficiency per unit mass (α_{sp}), the upward scattered fraction ($\overline{\beta}$) or asymmetry factor (g), the fraction of light scattered versus that absorbed or single scattering albedo (ω_o) and the dependence of scattering by the aerosol on relative humidity (f_{sp}(RH)). All these properties depend in turn on the chemical composition, size distribution, morphology and state of the mixture of the aerosol. Measurements of aerosol chemical and physical properties, such as the mass distribution of all chemical species, the degree of mixing of various chemical species, and the overall size distribution, are thus needed to link global aerosol distributions with aerosol optical properties. Improving chemical transport models requires a quantitative understanding of precursor gas and aerosol emissions and the processes controlling aerosol formation, transport, chemical transformation and removal.

Measurements are clearly needed in a globally representative range of natural and anthropogenically perturbed environments. One important region is Eastern Asia and the

Northwest Pacific. Asian aerosol sources are unlike those in Europe and North America: much more coal and biomass are burned (often with minimal emission controls), adding more absorbing soot and organic aerosol to parts of the Asian and Pacific atmosphere (Chameides et al., 1999). Economic expansion in many Asian countries will unavoidably be accompanied by increases in fossil fuel burning. Without extensive pollution-control measures, this will increase the amount of SO_2, organic matter, and soot emitted into the East Asian atmosphere. The presence of Eastern Asia desert dust adds complexity, since it can both scatter sunlight back to space (leading to a cooling effect) and absorb solar and infrared radiation (leading to a warming effect) (Sokolik and Toon, 1999). 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 (van Aardenne et al., 1999). The fact that much of the Asian aerosol then blows out over the Pacific implies that significant changes in radiative forcing may be expected over large areas.



Aerosol optical depth over the oceans as measured by AVHRR. The red circle shows the plume from the Asian continent that will be studied in ACE-Asia (figure from R. Husar)

ACE-Asia will require the human and financial resources of many countries. This international cooperation will lead to jointly developed, state-of-the-art tools (models) and highly trained scientists in every country so that each country can each formulate the best possible public policy regarding aerosols and their climatic effects.

II. ACE-Asia Scientific Goals and Objectives

The goals of ACE-Asia are to determine and understand the properties and controlling factors of the aerosol in the anthropogenically modified atmosphere of Eastern Asia and the Northwest Pacific and to assess their relevance for radiative forcing of climate. To achieve these goals, ACE-Asia will pursue three specific objectives:

- Objective 1. Determine the physical, chemical, and radiative properties of the major aerosol types in the Eastern Asia and Northwest Pacific region and investigate the relationships among these properties.
- Objective 2. Quantify the interactions between aerosols and radiation in the Eastern Asia and Northwest Pacific region
- Objective 3. Quantify the physical and chemical processes controlling the evolution of the major aerosol types and in particular of their physical, chemical, and radiative properties.

II.1. Objective 1: Properties

The ACE approach in addressing objective 1 is two-fold. The first step is to characterize the regional and temporal distribution of aerosol properties in clean, polluted, and dusty airmasses. Closure experiments are used here to validate the chemical and physical aerosol measurements and assess their uncertainty. The second part of objective 1 investigates the relationship between the physical, chemical, and radiative properties. Specifically, can the measured physical and chemical properties of the aerosol be used to predict the local and column integrated radiative properties of that same aerosol? This approach has been used successfully in ACE-1 (Covert et al., 1998; Huebert et al., 1998; Quinn and Coffman, 1998) and ACE-2 (Collins et al., 2000; Durkee et al., 2000; Livingston et al., 2000; Neususs et al., 2000; Putaud et al., 2000; Russell and Heintzenberg, 2000; Schmid et al., 2000; Welton et al., 2000) and will be a key strategy of ACE-Asia. This strategy becomes increasing important as the complexity of the aerosol mixture increases. ACE-1 studied a predominantly background sea-salt and non-sea-salt (NSS) sulfate aerosol (Bates et al., 1998). The aerosol encountered in ACE-2 included this background plus the ionic and organic aerosol from the European continent (Raes et al., 2000). Aerosols in the ACE-Asia region will likely be a complex mixture of sea-salt, combustion derived ionic, organic and soot particles, mineral dust and biogenic non-sea-salt sulfate and organic species.

II.2. Objective 2: Aerosol-Radiation Interactions

The second objective is to quantify the various impacts that aerosols have on radiative fields in the Eastern Asia and Northwest Pacific region. Of particular interest is the impact on radiative fluxes at a variety of atmospheric levels (e.g., the surface, the top of the boundary layer, the upper troposphere, the top of the atmosphere). These flux changes, when sustained over sufficient areas and times, are the radiative forcings that drive climate processes. In addition to sustained, extensive flux changes, instantaneous flux change measurements are also of interest to test the mutual consistency of measured fluxes, measured aerosol properties, and the models that calculate flux changes from these properties. Other interactions of interest include the effects of various types of aerosols on direct-beam solar transmission, or optical depth, and on the radiances measured by satellite-, aircraft- and surface-based radiometers (and hence the ability to retrieve aerosol properties from those radiances).

II.3. Objective 3: Processes

The realism of aerosol models is limited in large part by our ignorance of process rates. Critical processes for describing Asian aerosols include chemical reaction rates that generate condensible species, surface exchange processes that remove some reactants and supply others, nucleation processes that form new particles, a suite of competing heterogeneous processes such as coagulation, condensational growth, and wet removal that control the size distribution, and cloud processing that promotes aqueous phase reactions.

II.4. Modeling

Mathematical models are the integrator of our understanding of atmospheric processes. The ultimate goal of ACE-Asia is to parameterize the information we have gained in the form of models of many types, so that the models can be used during times and at places where observations are not possible. Data analysis will be carried out hand-in-hand with model implementation and evaluation: each particular experimental goal has associated with it an appropriate physico-chemical model that serves as the test-bed for evaluating the data obtained against our overall understanding of the atmospheric science. Moreover, some of those models may be used prior to the experiment in the design of the best possible measurement strategy.

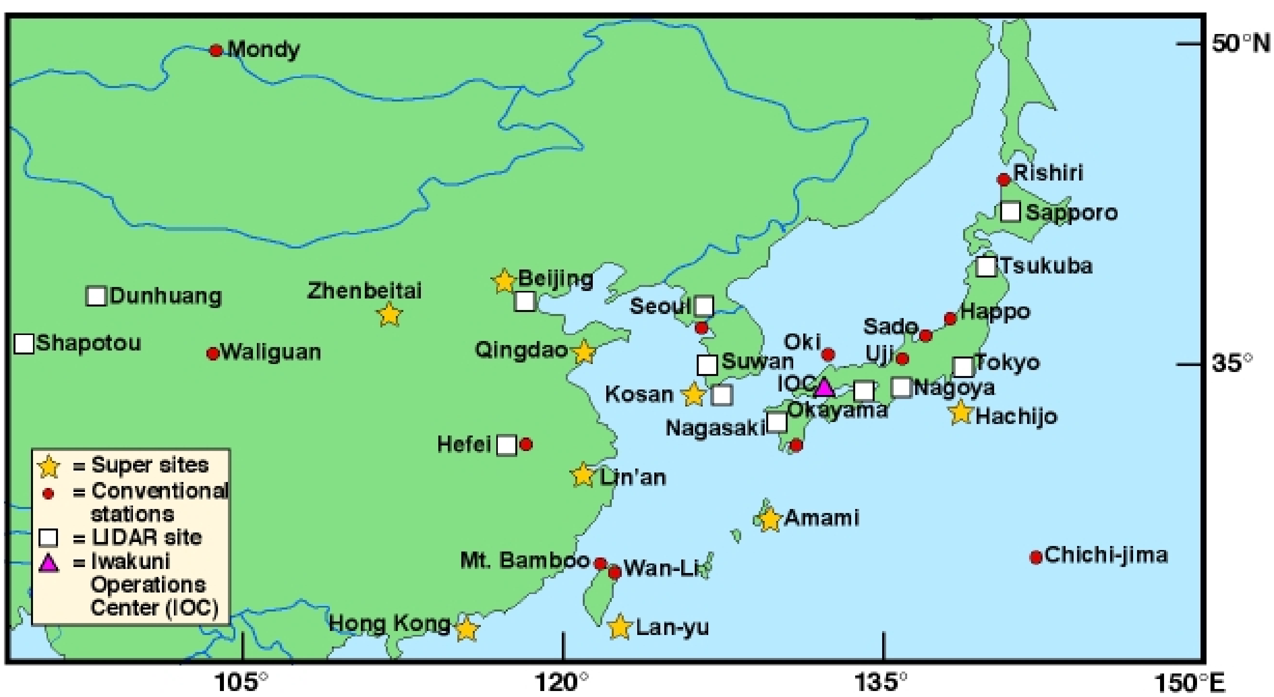
The ACE-Asia region encompasses some of the most complex gas-particle atmospheric dynamics on the Earth. Gas-phase emissions of organics, NO_x, and SO_2 from the Asian continent undergo photooxidation as air masses are advected eastward over the Pacific. Gas-to-particle conversion occurs as condensable species are produced in the gas phase. These continental outflows contain anthropogenically-derived particles as well as wind-blown mineral dust. In the continental outflow region, primary aerosols of mineral dust and sea salt origin, and the continental anthropogenic aerosols, are transformed by gas-aerosol interactions. A key issue is the extent to which particles of continental origin retain their source identity in the face of gas-to-particle conversion and cloud droplet activation and evaporation. For the first time in any global experiment the chemical evolution of mineral dust aerosol will be assessed. It is expected that chemical processing of mineral dust particles will be especially important in terms of its radiative and cloud nucleating properties because of the massive anthropogenic emissions present. Prediction of radiative properties of the evolving aerosols requires knowledge of their size distribution and chemical composition, the latter to be able to calculate particle refractive indices. Models are therefore required that track both gas-phase photochemistry as well as aerosol size and composition. Such models have only fairly recently been developed (Pilinis and Seinfeld, 1988; Meng et al., 1998), and they have been rigorously evaluated with ambient data only for the Los Angeles basin.

For analysis and interpretation of ACE-Asia data models will be required at several scales. However, there are a number of interactions between these models: (1) Box process models will be driven with temperature and humidity fields issued from trajectory calculations and evolving surface emissions. (2) Radiative transfer models will be fed with aerosol profiles from 1-D and 3-D CTMs. (3) Due to their low computational cost one-dimensional Lagrangian CTMs may host detailed box process models. At the same time they may be viewed as representing just one column of a global 3-D model when hosting more simplified aerosol and chemistry models that are typically used in 3-D CTMs. A 1-D Lagrangian CTM therefore can be used as a test-bed to validate and improve parameterizations developed for 3-D CTMs.

It is intended to have these models formulated, tested, and running prior to the actual intensive experiments. In the preparation of the experiment, archived NCEP and ECMWF fields of typical ACE-Asia situations will be used to run the 1-D Lagrangian and 3-D CTMs. During the experiment itself forecasted meteorological fields will be used as model input to simulate likely gas and aerosol conditions before missions are flown. Of course, actual model runs for data evaluation can only be carried out after the experiment, but this should greatly reduce the time needed to evaluate data after the experiment.

III. Focused Components of ACE-Asia

The scientific goals and objectives of ACE-Asia cannot be realistically accomplished in a single measurement campaign. Determining and understanding the properties and controlling factors of the aerosol in the ACE-Asia region will require measurements over a variety of time and spatial scales and under a variety of meteorological conditions. In order to coordinate the required investigators, platforms and instruments and maintain a scientific focus on the goals and objectives outlined above, ACE-Asia will be organized around three components. Each component will combine measurements of aerosol properties and processes with models to evaluate the data obtained against our overall understanding of the science. A brief overview of the goals and strategies of the three components follows.



Locations of network sampling sites.

Component 1 – Network Operations

In-situ and column integrated measurements at a **network of ground stations** will quantify the chemical, physical and radiative **properties of aerosols** in the ACE-Asia study area and assess their spatial and temporal (seasonal and inter-annual) variability. The goals of the characterization studies are to:

- determine the physical, chemical and radiative properties of the aerosol in the ACE-Asia region and assess the regional and temporal (seasonal to interannual) variability of these properties,
- determine the regional distribution of aerosol (organic, ionic, mineral dust) sources and sinks,
- intercompare satellite and ground-based measurements of optical depth, and
- test and refine regional chemical transport models.

The ground station studies will be the background for ACE-Asia, providing information on spatial variability of aerosol chemical, physical and radiative properties and seasonal and longer-term trends in those properties. The network data sets will be critical for planning the ACE Asia intensive investigations and for putting those results in a broader context. In addition to their contributions for ACE-Asia, the measurements to be made at the ACE-Asia stations will complement ground-based studies being undertaken for the China Metro-Agro Plex experiment (China MAP) and for the Transport and Chemical Evolution over the Pacific experiment (TRACE-P). To the greatest extent possible, resources will be shared among the three programs, with coordination facilitated by APARE.

The network will focus on the outflow from Asia over the Pacific. Since the extent of the dust impact is observed every spring as far away as the Aleutians and North America (Jaffee et al., 1999), these should form the northern and eastern boundaries of the network. The western boundary would be near the Chinese deserts (the dust source regions) and the southern boundary would be around 20-30° N, to avoid the trade winds that deliver marine aerosols onto the continent. Two types of stations are envisioned for the network: basic and enhanced. The basic stations will be outfitted with a more limited set of instruments (including one common sampler for aerosol chemical composition and various instruments for optical and radiative studies) compared with the enhanced stations, and typically will operate at a lower sampling frequency than the enhanced ones. The enhanced sites will include measurements of chemical and physical size distributions, precursor gases, and aerosol optical properties.

The overall operating plan for the network is for the science teams from the various participating countries to purchase the sampling equipment and as much as possible to conduct the analyses internally. Quality control and quality assurance will be coordinated through ACE-Asia and APARE. Support for instrumentation and analyses will be requested for situations in which obvious scientific gaps exist or to pursue areas of research that could make use of the network infrastructure. Information on the various network sites can be found on the project web page.

Component 2 – Intensive Studies of Aerosol Chemical, Physical, and Radiative Properties and Controlling Processes

Intensive field studies will be used to quantify the spatial and vertical distribution of **aerosol properties, the processes** controlling their formation, evolution and fate and the **column integrated clear-sky radiative effect** of the aerosol. The goals of these studies are to:

- determine the physical, chemical and radiative properties of the aerosol in the ACE-Asia region and assess the vertical, regional and temporal (diurnal to multi-day) variability of these properties,
- quantify the direct radiative effect of the combined natural and anthropogenic aerosol in the ACE-Asia study area,
- refine satellite aerosol retrievals in the ACE-Asia region so that satellite observations can be used to obtain a high temporally and spatially resolved assessment of the clear-sky direct effect of aerosols on radiative transfer,
- assess the major processes controlling the oxidation mechanisms of aerosol precursor gases and the formation, evolution and deposition of aerosol particles,
- improve the parameterizations used in chemical transport models in order to obtain more accurate regional distributions of aerosol properties, and
- test and refine radiative transfer models used with chemical transport models to calculate direct radiative forcing by aerosol particles.

Chemical transport models (CTMs) are a critical element in aerosol radiative forcing studies as they are the only means by which the atmospheric aerosol can be partitioned into natural and anthropogenic components. They also provide a prognostic capability to explore the effects of increasing or decreasing aerosol precursor emissions on atmospheric aerosol concentrations. To accurately calculate an atmospheric aerosol distribution, CTMs must incorporate a quantitative parameterization of precursor gas and aerosol emissions and the processes controlling aerosol formation, transport, chemical transformation and removal.

The ship, aircraft, and ground-based measurements during the intensive field operations will contribute to the regional characterization of aerosol properties by providing data over and downwind of the continent and in the vertical. These measurements will provide data to test and refine regional chemical transport models. Organic, inorganic, and elemental tracers (e.g. specific organic molecular markers of vegetation or combustion) will be used to apportion aerosol components to different natural and anthropogenic sources. Flight plans and ship operations will be directed to sample regional aerosol features (e.g. dust layers, urban and industrial plumes) under different synoptic meteorological patterns and at various distances from shore.

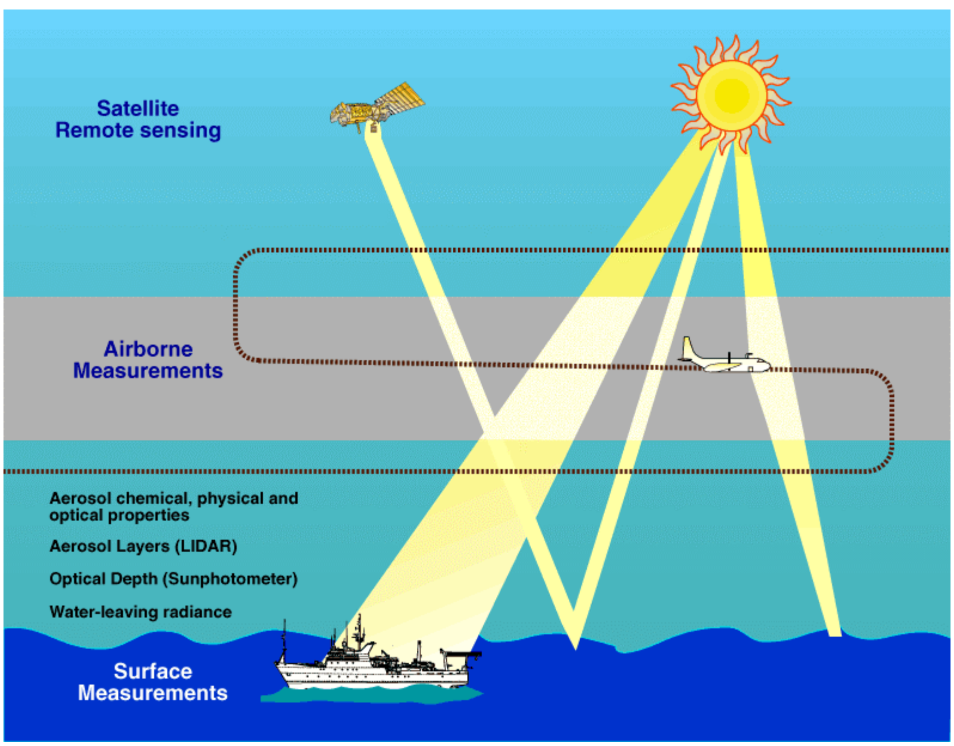
Measurements of in-situ aerosol properties will form the basis for assessing aerosol direct radiative forcing, which is defined as the change in the global radiation balance attributable to changes in the amount of light scattered and absorbed by particles suspended in the atmosphere. Quantifying this forcing requires the integration of multiple measurement and modeling approaches:

Radiative transfer models, coupled with chemical transport models, are needed to partition the radiative effects of aerosols between the natural and anthropogenic components and thus quantify aerosol direct radiative forcing. These models must rely on accurate parameterizations of aerosol properties.

Satellites are needed to assess the temporal and spatial variability in aerosol columnar extinction. These observations can be used to assess the direct radiative effect of the combined natural and anthropogenic aerosol. However, the algorithms used for these retrievals must again rely on accurate parameterizations of aerosol properties.

In-situ measurements of aerosol chemical, physical, and radiative properties and radiative fluxes throughout the vertical column can be used to directly quantify the radiative effect of the combined natural and anthropogenic aerosol and provide the parameterizations needed for satellite retrievals and models.

The combination of in-situ measurements, columnar extinction measurements (surface-based, air and space-borne radiometers), radiative flux measurements and models produces an overdetermined data set that can be used to evaluate the combined uncertainty of the models and measurements used to assess the direct radiative forcing of aerosols in the ACE-Asia study area.



Component 3 – Cloud-Aerosol Interactions

The effect of clouds on aerosol properties and the effect of aerosols on cloud properties (indirect aerosol effect) will be studied in the 2001 intensive experiment and in a more focused experiment in 2002 or 2003. The first campaign will focus on the interaction of aerosols with warm clouds. The work involving mixed phase clouds will occur in the second major campaign when developments in instrumentation and bigger aircraft platforms may be available. The goals of the ACE-Asia cloud studies will be to:

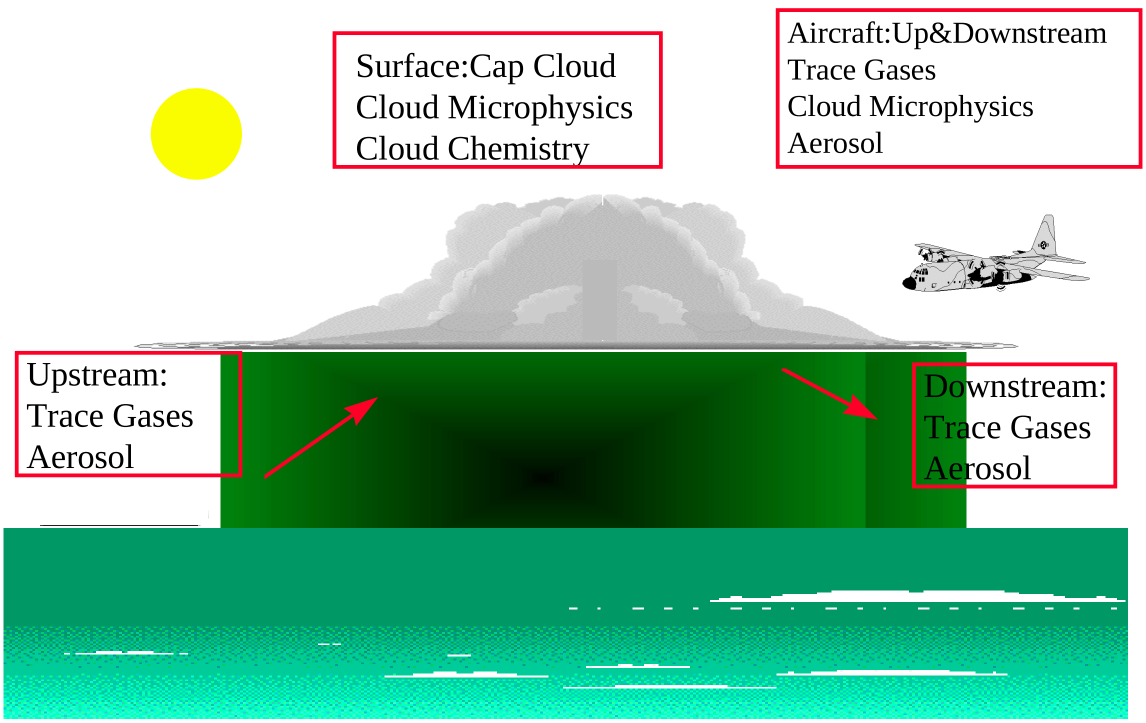
- quantify the relationships between the physical and chemical properties of aerosols and the microphysical and radiative properties of the clouds that form on them,
- quantify the effect of cloud processing on the aerosol properties, and
- determine the relationships between aerosol properties, cloud microphysics, the onset of precipitation and cloud lifetime in order to improve the parameterizations used in cloud processing models, chemical transport models, and radiative transfer models.

Clouds play an important role in the Earth's energy balance, water cycle, and the global cycles of many atmospheric constituents, including aerosols. The increasing aerosol burden in the ACE-Asia region has the potential to greatly affect cloud radiative properties, cloud distributions, cloud lifetimes and precipitation patterns. Clouds also are one of the most important processes controlling the aerosol size distribution and optical properties. Although the qualitative features of this processing have been known for years (Hoppel et al., 1990), this process is still difficult to quantify in chemical transport models.

The dynamical nature of clouds makes it very difficult to quantify the effect of aerosols on clouds and the effect of clouds on aerosols (cloud processing). Addressing aerosol-cloud interactions will require several approaches:

- A hill cap cloud on Cheju Island can be used as a flow through reactor where the reactive trace gases and the aerosol size distribution, hygroscopic properties, and size resolved chemistry can be measured before, within, and after a passage through cloud. (2001)
- Cloudy Lagrangian studies can be performed in post cold frontal convective cloud regions and in stable warm sector conditions to investigate the evolution of the aerosol spectrum by cloud processing, the entrainment of aerosol and precursor gases from the free troposphere, the role of sea-salt generated at the ocean surface, and the formation of drizzle in the cloud. (2002 or 2003)
- Cloudy column closure experiments with airborne measurements of spectrally resolved radiation above and below cloud can be used to assess aerosol indirect forcing. (2002 or 2003)
- Frontal systems can be studied using a combination of 1 or 2 aircraft platforms and two Doppler Radar Systems. These studies will focus on the rainbands which are the regions responsible for much of the aerosol processing and removal. (2001)

ACE-3 PACIFIC ISLAND CAP CLOUD EXPERIMENT



IV. Project and Data Management

IV.1. Management Structure

1) The Science Team includes all PIs participating in the project from every country.
2) The ACE-Asia Scientific Steering Committee (SSC) consists of:
   a) the Convenors (or a designated Activity Committee member) of ACAPS, APARE, MAGE, and GIM,
   b) the chair of each ACE-Asia National Committee,
   c) the leader(s) of each of the three components, and
   d) a representative of each major modeling effort, observing facility, and platform, including the most comprehensive surface sites.
3) The SSC elected a Lead Scientist and appointed an Executive Committee to manage the experiment. These scientists are listed in the project summary at the beginning of this document.

IV.2. Data Policy, Protocols, and Archive

The development and maintenance of a comprehensive and accurate data archive is a critical step in meeting the goals of the ACE. The overall ACE data management philosophy is to make the completed data set available to the world research community as soon as possible in order to better incorporate aerosols into global climate models. A centralized data archive will be established to combine the entire ACE-Asia data set. This integrated data base will allow users a single access to the variety of measured and derived fields obtained during ACE-Asia. A central data archive is sometimes a difficult issue, since many groups and nations have traditionally kept their data to themselves. However, the benefits far outweigh the liabilities as everyone has access to a much larger data set than they could possibly obtain or pay for alone.

The following data protocols, established for ACE 1 and 2, will hold for all ACE-Asia participants. Listing as a participant in the Science and Implementation Plan on the ACE-Asia web site constitutes agreement to this data policy. *Anyone not willing to abide by this policy will not be considered a participant in ACE-Asia, and will not be given early access to the project data prior to its public release.* Obviously, there is no benefit to making coordinated measurements if they are not shared among the participants.

1. All investigators participating in ACE-Asia must agree to promptly submit their data to the central data base to facilitate intercomparison of results, quality control checks and inter-calibrations, and an integrated interpretation of the combined data set.
2. All data shall be promptly provided to other ACE investigators upon request. A list of ACE-Asia investigators will be maintained by the SSC and will include the principle investigators directly participating in the field experiment and the modellers who have provided guidance in the planning of ACE Asia activities.
3. During the initial data analysis period (one year after the data were collected), no data may be provided to a third party (journal articles, presentations, research proposals,

other investigators) without the consent of the investigator who collected the data. This initial analysis period is designed to provide an opportunity to quality control the combined data set.

4. It is the intent of the ACE science team that all data will be considered public domain at the end of the ACE-Asia field experiment and that any use of the data will include either acknowledgment or co-authorship at the discretion of the investigator who collected the data.

5. Data that can be traced to intercompared instruments will be given a "quality-checked" flag in the data archive. This will provide data archive users with a "confidence level" assessment when comparing different data sets.

IV.3. Tentative ACE-Asia Schedule

Nov 14-16, 1997	Science Team Meeting, Nagoya, Japan
Nov 10-13, 1998	Science Team Meeting, Cheju Island, Korea
Nov 11-13, 1999	Science Team Meeting, Kunming, China
Jan 2000-Dec 2003/4	Surface Network Operations
June 2000	SSC meeting, Tokyo, Japan
Oct 2-4, 2000	Science Team Meeting, Hawaii
Dec 4-5, 2000	Mission Simulation Exercise, Boulder
Late March-May 2001	Intensive Observation Period
November 2001	Data Workshop/Science Team Meeting, Seattle?
Fall 2001	Surface Site Workshop, Chinese Taipei?
Spring 2002	Joint TRACE-P/ACE-Asia workshop, NCAR?
Summer 2002	Small, focused integrating workshops
Nov 2002	JGR special section manuscript deadline
March/April 2003	?Second Intensive Observation Period? Cloud-Aerosol Interaction Study
Meeting Presentations	
July 2001 Aug 2001 10 - 14 Dec 2001 8 - 13 Sept 2002 19 - 25 Sept 2002 Dec 2002	Asian Aerosol Conference, Pusan Clean Air Congress, Seoul AGU, San Francisco International Aerosol Conference, Taipei IGAC/CACGP meeting, Crete AGU, San Francisco

IV.4. Interaction with other programs

ACE-Asia plans to work closely with a NASA GTE experiment, TRACE-P (Transport and Chemical Evolution over the Pacific) that is planning to study Asian outflow to the Pacific in February and March of 2001. It will involve flights of both NASA's P-3 and DC-8 aircraft. The focus of TRACE-P is on photochemistry in Asian outflow, which is complementary to the ACE-Asia aerosol-oriented focus. We plan to coordinate some part of our flight hours and ship observations to take advantage of the complimentary sets of instruments brought by the two programs. We will also work closely with the APEX (Asian Particulate Environment Change Studies) program, being organized by Prof. Nakajima. APEX will coordinate observations during a variety of periods from 2001 through 2004.

IV.5. World Wide Web

Further information can be found on the ACE-Asia web site: http://saga.pmel.noaa.gov/aceasia/. The web site includes the Science and Implementation plans for each component, proposed platforms and measurements, instrument working groups, and a list of all persons having asked to be informed about ACE- Asia.

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