made this past summer at the Duke and Blodgett Research Forests again confirm that the ambient levels of the Ssqt's were very low and unless made close to the source foliage not measurable. However, Ssqt's were readily measured in branch and leaf enclosures in most of the species surveyed. Some conifer foliages produced Ssqt's at rates comparable to their monoterpenes emission rates, but more typically the rates were 1/50 to 1/100 that of the monoterpenes.

A21F-08 1205h

Towerbased and Airborne VOC Flux Measurements Over the Amazonian Rainforest During LBA-CLAIRE 2001

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Volatile organic compounds (VOC) have a major influence on the atmospheric oxidative capacity, greenhouse gas concentrations, and the formation of aerosols, which implies a crucial role of VOC in climate forcing. Even though tropical vegetation has a major impact on global VOC emission strength, these regions have been the least investigated to date, and flux estimates have high uncertainties. During the LBA-CLAIRE 2001 project (Cooperative LBA Airborne Regional Experiment 2001, as part of the Large Scale Biosphere-Atmosphere Experiment in Amazonia), canopy-scale and landscape-scale VOC fluxes were estimated for a remote tropical rainforest site north of Manaus, using different measurement techniques. Above-canopy fluxes were investigated simultaneously with surface layer gradients and relaxed eddy accumulation measurements from a 52-m tower. Airborne measurements of vertical profiles of VOC mixing ratios from 100m to 3000m were used to estimate flux rates on a regional scale. Chemical processes in the model estimates were constrained with measured values of O3, NOx and VOC. VOC flux rates will be compared with CO2 fluxes, which were determined by similar procedures.

A21G MCC: 3018 Tuesday 1020h

Integrating Aerosol Measurements and Models III *(joint with OS, GC)*

Presiding: **K A Prather,** University of California, San Diego**; G R Carmichael,** University of Iowa

A21G-01 1020h

Integrating Aerosol Measurements and Models

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Advances in aerosol measurements are providing detailed information on the properties of aerosols. Advances in modeling include correspondingly detailed representations of aerosol size, composition, hygroscopic, optical, and cloud activating properties. Here, a number of examples of measurement-model integration will be discussed, including satellite-in situ comparisons, CCN closure, CCN-cloud droplet closure, inverse modeling of aerosols, and hygroscopic closure.

A21G-02 1050h

Black Carbon Measurements in the Marine Boundary Layer

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Black carbon (BC) particles are one of the most ubiquitous yet least understood aerosols in the atmosphere. Light absorption by these particles alters the thermodynamic structure of the atmosphere and contributes to regional and global climate change. The magnitude of this impact, however, is poorly understood since so little is known about the temporal and spatial distribution of BC in the atmosphere. In addition, the residence time of BC in the boundary layer and free troposphere is one of the least known parameters in GCMs. Current estimates vary from hours to days. A major source of these uncertainties is the serious deficiency of accurate and quantitative measurements of BC properties, concentration, mass and optical extinction. Until recently there were no instruments that directly measured BC mass with sufficient accuracy, sensitivity and response time. A new instrument, the single particle soot photometer (SP2) has been developed that measures BC mass of individual particles with an accuracy of 50% or better. The patented technique uses laser induced incandescence to derive the mass of particles that absorb light at a wavelength of 1064 nm. The composition of the particle is determined from the temperature of incandescence using two colour pyrometry. The degree of mixing with non-light absorbing material is determined by comparing the light scattering and incandescence signals. The SP2 was recently flown on the CIRPAS Twin Otter to make BC measurements in the marine boundary layer during the CSTRIPE campaign in July, 2003. The measurements show multiple layers of BC with varying degrees of mixing with other, non-light absorbing material. The fraction of non-absorbing material on the BC is apparently related to the age of the particles as estimated from back trajectory analysis.

A21G-03 1105h

Insights into Particle Characteristics, Sources, Nucleation and Growth in Pittsburgh Based on Aerosol Mass Spectrometry

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An Aerodyne aerosol mass spectrometer (AMS) was deployed at the Pittsburgh EPA Supersite from September 6 to September 22, 2002, as part of the Pittsburgh Air Quality Study (PAQS). The main objectives of this deployment were 2) to characterize the size-resolved chemical composition of non-refractory (NR) components in fine particles (approx. PM1.0) and 2) to investigate the chemistry and mechanism of particle growth during the nucleation events in Pittsburgh. We first compare the AMS data with measurements from a wide variety of collocated aerosol instruments, including TEOM, semi-continuous sulfate and ammonium, 2hr- and 24hr-averaged organic carbon, SMPS, and MOUDI. Good agreement is observed for particle concentrations, compositions, and size distributions. Total NR PM1.0 mass concentration in Pittsburgh accumulates over periods of several days with intermittent cleaning due to rain or air mass change. Different aerosol species show different behavior in time and size. Sulfate and organics are the major components of fine particle mass while nitrate concentrations are lower. Significant amounts of ammonium are also present in particles, which most of the time is consistent with sulfate being present as ammonium sulfate. Size distributions of particulate sulfate, ammonium, organics and nitrate vary from day to day, showing unimodal, bimodal and even trimodal characteristics. The accumulation mode (peaking around 500nm in vacuum aerodynamic diameter for the mass distribution) and the fine mode (peaking around 200nm) are most commonly observed. Periods with high sulfate and organics mass loadings are examined. The possible sources and atmospheric processes that caused the events are suggested based on the AMS results, data of gaseous pollutants and meteorological variables and back trajectory analysis. Significant formation and growth of the nucleation mode particles were observed in three days during this deployment. These events appear to be representative of the climatology of the nucleation events observed in Pittsburgh (100 per year). One of the events is among the 10 most intense nucleation events observed in Pittsburgh over a period of 15 months. All these events showed distinctive growth of sulfate, ammonium, organics and nitrate in the ultrafine mode. During each of these 3 events, sulfate was always the first, and often the fastest, species that grew in the ultrafine particles. Significant increase of ultrafine ammonium was also observed, but usually lagged slightly (5 -10 min) behind that of sulfate. For this reason the ultrafine particles tend to be acidic during the initial stages of the nucleation event. Ultrafine organics also increased significantly during the growth of the nucleation mode particles at a later time, probably from the condensation of photochemically produced secondary organic compounds. Among all these four species, nitrate was always the least important in the growth.

A21G-04 1120h

Integrating High Temporal Resolution Single Particle Data with Atmospheric Models

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Single particle analysis can provide direct insight into the evolution of the mixing state of atmospheric particles. Information at this level can be used to gain insights into particle sources as well as atmospheric processing. There are a number of instruments which have been developed in the past decade which allow one to measure the size and chemical composition of individual particles in real time. This presentation will focus on aerosol time-of-flight mass spectrometry (ATOFMS) measurements made during ACE-Asia and other locations in the United States, focusing on the size-resolved chemical information that can be acquired with single particle mass spectrometers. The ability to use single particle signatures to distinguish between elemental carbon (EC), organic carbon (OC), and various mixtures will be demonstrated. Results will be presented showing how unique mass spectral markers can be used to discriminate between dust, sea salt, fossil fuel, and biomass particles, monitoring their relative contributions and changes in chemistry on short timescales. A discussion of how single particle measurements might be used to refine current atmospheric models by adding unique information will be presented.

A21G-05 1135h

New Techniques For Predicting Optical Properties Of Nonspherical Multicomponent Aerosols Using Single Particle Measurements

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Better understanding of diverse effects of atmospheric aerosols on climate and atmospheric chemistry requires more realistic treatments of physical and chemical properties of aerosol particles. Recent measurements demonstrate that a large fraction of aerosol particles has complex chemical composition and exhibits a variety of shapes. This paper presents new techniques for predicting the optical properties of nonspherical multicomponent aerosols containing mineral dust and/or black carbon. The strategy is to incorporate the statistical information on size-resolved composition and morphology of individual aerosol particles to predict the probability distribution of their main optical characteristics. The techniques were applied to the data provided by the aerosol time-of-flight mass spectroscopy and electronic microscopy. The predicted optical models were then used in calculations of the radiative impact of aerosols under different atmospheric conditions. Similar radiative transfer calculations were performed using a standard approach, by applying Mie theory to an ensample of spherical particles with a lognormal particle size distribution and effective refractive indices. We will address the differences in the radiative effects predicted with both approaches. Also the advantage/disadvantage of both methods will be discussed.

A21G-06 1150h

Measurement and modeling of vertically resolved aerosol optical properties and radiative fluxes over the ARM SGP site

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In order to meet one of its goals - to relate observations of radiative fluxes and radiances to the atmospheric composition - the Department of Energy's Atmospheric Radiation Measurement (ARM) program has pursued measurements and modeling activities that attempt to determine how aerosols impact atmospheric radiative transfer, both directly and indirectly. However, significant discrepancies between aerosol properties measured in situ or remotely remain. One of the objectives of the Aerosol Intensive Operational Period (IOP) conducted by ARM in May 2003 at the ARM Southern Great Plains (SGP) site in north central Oklahoma was to examine and hopefully reduce these differences. The IOP involved airborne measurements from two airplanes over the heavily instrumented SGP site. We give an overview of airborne results obtained aboard the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) Twin Otter aircraft. The Twin Otter performed 16 research flights over the SGP site. The aircraft carried instrumentation to perform in-situ measurements of aerosol absorption, scattering, extinction and particle size. This included such novel techniques as the photoacoustic and cavity ring-down methods for in-situ absorption (675 nm) and extinction (675 and 1550 nm) and a new multiwavelength, filter-based absorption photometer (467, 530, 660 nm). A newly developed instrument measured cloud condensation nucleus concentration (CCN) concentrations at two supersaturation levels. Aerosol optical depth and extinction (354-2139 nm) were measured with the NASA Ames Airborne Tracking 14-channel sunphotometer. Furthermore, up- and downwelling solar (broadband and spectral) and infrared radiation were measured using seven individual radiometers. Three up-looking radiometers were mounted on a newly developed stabilized platform, keeping the instruments level up to aircraft pitch and roll angles of $\sim 10^{\circ}$. This resulted in unprecedented continuous vertical profiles of radiative fluxes, which we will compare to modeled fluxes using the aforementioned data as input. We will also present comparisons of the vertically resolved aerosol optical properties measured aboard the Twin Otter and from two ground-based lidar systems. Finally we use a trajectory model and a three-dimensional aerosol transport and microphysics model to explore the long-range transport and evolution of smoke aerosols from Siberian fires observed over SGP May 25-28, 2003.

A21G-07 1205h

Source Fluxes of Remote Oceanic Aerosol: Ultrafine Sea-Salt, Sulfates and Clouds

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We have characterized particles produced from oceanic breaking waves that have diameters as small as 0.01 μm with peak number concentrations between 0.02-0.06 μm. Typically 60% are formed below 0.1 μm, about an order of magnitude smaller than previously documented for oceanic sea-salt. Their stability upon heating implies they are sea-salt nuclei and evolve from an externally mixed to internally mixed aerosol in the marine boundary layer. This production from breaking bubbles and the highly nonlinear dependence of bubble production on wind speed implies strong regional and temporal differences in their surface flux. The comparative strength of this flux to the flux of sulfate aerosol, often entrained into the marine boundary layer from the free troposphere, is critical to their relative role as atmospheric condensation nuclei and cloud condensation nuclei, CCN. Their relative contribution to CCN is expected to be regionally variable ranging from less than 10% to more than 90% of marine boundary layer CCN. Here we show that their size and flux can have significant impact on the origin and evolution of marine boundary layer aerosol under diverse conditions.

A22A MCC: Level 2 Tuesday 1330h

Tropical Cirrus Anvils: Properties and Processes IV Posters *(joint with SA, AE)*

Presiding: **E Jensen,** NASA Ames Research Center**; D E Anderson,** NASA Headquarters

A22A-1035 1330h POSTER

Anvil Discontinuities: Observations Of Kelvin-Helmholts Instabilities In Florida Convection Anvils

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High spatial and temporal observations from a profiling cloud radar reveal sharp shear/density boundaries in the interior of Florida convective anvils. These discontinuities where seen at all multiple levels within the anvil, lasting for periods of 15 minutes up to several hours. These discontinuity layers effectively divided the anvil into layers with distinct characteristics, and suggest different source regions for the different layers. The most prominent of these discontinuities lasted for approximately 4 hours. At times this layer exhibited clear Kelvin-Helmholtz instability breaking waves.

A22A-1036 1330h POSTER

Simultaneous Remote Sensing of Thin Cirrus and Aerosol Properties from MODIS Data

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Tropospheric aerosols and high-level thin cirrus frequently coexist and affect the atmospheric radiation budget and vertical heating rate distribution in different manners associated with their unique optical properties and altitude. However, distinguishing between these two from satellites is extremely difficult because both are optically thin with optical depths generally less than about 0.5. Presently, retrieval of such information as optical thickness and effective particle size by satellite sensors is made separately. That is, aerosols are only examined in presumed clear sky situations while thin cirrus properties are retrieved while assuming a background aerosol size distribution. There is evidence that thin/sub-visible cirrus may exist in greater quantity, especially in the tropics, than is currently being detected, which, in turn, has been leading to large errors in the retrieved aerosol properties. By using new satellite sensors with a greater number of channels and higher spectral resolution, new information is now available which may make it possible to obtain a more accurate estimate of both thin cirrus and aerosol optical properties when they occur in the same field of view. We have developed a procedure to retrieve thin cirrus and aerosol optical depth, as well as cirrus ice crystal effective size, using six Moderate Resolution Imaging Spectroradiometer (MODIS) channels. Theoretical simulations show that these particular channels are sensitive to specific aerosol and cirrus properties. Error analysis reveals that the retrieved optical depths are accurate to within 20%, while ice crystal effective sizes lie within twice that of the real value. Case studies taken from CRYSTAL-FACE indicate that our retrievals compare well with both in-situ measurements and other remotely sensed values. This new retrieval method will increase the total area in which aerosol information can be obtained and reduce the effect of thin cirrus contamination.

A22A-1037 1330h POSTER

Morphology of Tropical Cirrus Crystals Derived from Single Particle and Bulk Property Analysis

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The bulk density, surface area, asphericity and fractal dimensions of crystals in tropical cirrus clouds are derived by combining complementary measurement techniques that were employed during the CRYSTAL/FACE experiment in July, 2002. The instruments that are used in this derivation are the Cloud, Aerosol and Precipitation Spectrometer (CAPS) that measures single particle properties, the cloud integrating nephelometer (CIN) that measures ensemble light scattering and the Harvard Total Water (HTW) sensor that measures the vapor concentration of evaporated cloud particles. The asphericity of particles smaller than 50 μm is determined by comparing the forward and backward scattering light spectra that is measured with the CAPS. The ratio of the areas under the forward and back scattering spectra is proportional to the asymmetry factor and can be used in radiative transfer calculations for evaluating the flux of radiation through the cirrus layers. The fractal dimension of ice crystals larger than 200 μm is also derived from the CAPS measurements and is a measure of the crystal "roughness" , related to the surface area and bulk density. The bulk density is estimated from CAPS and HTW measurements by calculating the volume of particles from the measured size distribution and then deriving the bulk density that would give an ice water content comparable to that measured by the HTW. The evaluation produces a family of curves relating ice crystal effective diameter and bulk density to ice water content. The behavior of these curves under different temperature conditions provides information on the type and age of ice crystals. The ice crystal surface areas are derived in a