A22A-1055 1330h POSTER

The Statistical Nature of Heterogeneous Ice Nucleation: Laboratory Measurements with Volcanic Ash

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Cirrus cloud processes (e.g., lifetime and radiative properties) are sensitive to the competing effects of heterogeneous and homogeneous ice nucleation. Tropical cirrus also may be affected by perturbations to the background aerosol, for example due to large volcanic eruptions. To this end, we have devised a laboratory experiment for studying the mechanisms of heterogeneous ice nucleation, with specific attention given to ice formation on volcanogenic particles. The statistical nature of heterogeneous ice nucleation can yield clues about the *physical mechanisms* responsible for ice formation. Using a laboratory system capable of measuring the freezing temperature for a single ice nucleus hundreds of times we have obtained detailed estimates of the probability density functions for freezing time (or temperature). We compare these pdf's to the 'idealized' case of an inhomogeneous Poisson process based on the classical model of heterogeneous ice nucleation. In addition, we are able to perform SEM analysis of each ice nucleus and thereby estimate the influence of properties such as surface area and morphology on the ice nucleation process. The laboratory measurements have implications for ice formation in volcanic clouds and volcanically-influenced cirrus clouds, as well as for the broader phenomenon of heterogeneous liquid-solid nucleation.

A22A-1056 1330h POSTER

Tracking Convective Systems in South Florida: Source of Cirrus Anvils

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The Cirrus Regional Study of Tropical Anvils and Cirrus Layers - Florida Area Cirrus Experiment (CRYSTAL-FACE) field campaign provided a unique opportunity to study convective characteristics in South Florida. CRYSTAL FACE took place during July 2002. Four Weather Surveillance Radar - 1988 Doppler (WSR-88D) radars along with the NASA polarimetric (NPOL) 10 cm radar data were available during CRYSTAL FACE. The experiment provided a unique opportunity to study the evolution of convection and determine source regions of cirrus anvils in South Florida. The four WSR-88D and NPOL radar data were merged to provide a composite dataset of the radar echoes observed in South Florida. Radar echoes were tracked with time using cross correlation technique by determining the Lagrangian Autocorrelation between sequential radar observations. This analysis provides information about the mean wind fields and the initial source regions of the convection generating the cirrus anvils. A spectral decomposition of storm scales was applied to the dataset in efforts to gain a better understanding of the evolution of the convective systems at various storm scales. An overview of this study along with preliminary results will be presented in the poster.

A22A-1057 1330h POSTER

Formation of Anvil Ice Particles in a Deep Cumulus Updraft of CRYSTAL-FACE Simulated with an Explicit Microphysics Model - The Influence of Various Nucleation Processes

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Simulations of a cumulonimbus cloud observed by the Citation aircraft in the Cirrus Regional Study of Tropical Anvils and Cirrus Layers - Florida Area Cirrus Experiment (CRYSTAL-FACE) with an advanced version of the Explicit Microphysics Model (EMM) are presented here. Observations of the concentration of cloud condensation nuclei (CCN) by the Twin Otter aircraft in the planetary boundary layer are utilized to provide inputs to the model, together with measurements by the ER-2 and Citation aircraft. The interconnected mechanisms of secondary droplet nucleation and the warm rain process both combine to regulate the supercooled droplet concentration in the mixed phase region of the updraft, which determines the anvil ice concentration aloft. Perturbations in the turbulence enhancement coefficients for coalescence and in the CCN concentration are found to alter the properties of the anvil updraft because of their effects on the warm rain process. Homogeneous aerosol freezing can occasionally occur if the anvil ice concentration in parcels becomes very low.

A22A-1058 1330h POSTER

Deep convective cloud top heights during CRYSTAL-FACE

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We present comparisons between deep cumulus cloud top heights estimated by three methods during CRYSTAL-FACE: passive infrared radiance observed by GOES, the ER-2 CPL lidar, and MISR stereoscopic retrievals. We find that cloud top heights from GOES are somewhat underestimated. We also present a climatology of top heights by blending these platforms, obtaining thorough coverage from GOES but correcting the observations using discrepancies observed with colocated MISR (which has sparse sampling of all cloud types) and CPL (which has even more limited sampling, but highest accuracy) observations. Finally, we show that day-to-day variations in cloud top penetration over the Florida peninsula appear to be related to changes in CAPE, but that land-ocean and diurnal differences in cloud top penetrations cannot be explained by differences in CAPE.

A22B MCC: Level 2 Tuesday 1330h

Effects of Biomass Burning Plumes on the Troposphere and Stratosphere III Posters *(joint with B, AE)*

Presiding: **M Fromm,** Computational Physics, Inc.**; R B Chatfield,** NASA Ames Research Center

A22B-1059 1330h POSTER

Intercontinental Transport of Tropical Ozone from Biomass Burning - Views from Satellite and SHADOZ (Southern Hemisphere Additional Ozonesondes)

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There has been interest in the connection between tropical fires and ozone since about 1980. Photochemically reactive gases released by fires (e.g. NO, CO, volatile organic carbon) interact as they do in an urban environment to form ozone. Interacting with chemical sources, tropical meteorology plays a part in tropospheric ozone distributions in the tropics, through large-scale circulation, deep convection, and regional phenomena like the West African and Asian monsoons. An overview of observations, taken from satellite and from ozone soundings, illustrates regional influences and intercontinental-range ozone transport in the tropics. One of the most striking findings is evidence for impacts of Indian Ocean pollution on the south Atlantic ozone maximum referred to as the "ozone paradox" [Thompson et al., GRL, 2000; JGR, 2003; Chatfield et al., GRL, 2003].

A22B-1060 1330h POSTER

Convective Lofting Links Indian Ocean Air Pollution to Recurrent South Atlantic Ozone Maxima

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We extend on our analysis of equatorial tropospheric ozone to illustrate the contributions of South Asian pollution export in forming episodes of high O_3 over the Atlantic Ocean. We amplify on an earlier description of a broad resolution of the "Atlantic Paradox," for the Jan-Feb-March period, which included initial indications of a very long-distance contribution from South Asia. The approach has been to describe typical periods of significant maximum and minimum tropospheric ozone for early 1999, exploiting TOMS tropospheric ozone estimates jointly with characteristic features of the SHADOZ (Southern Hemisphere Additional Ozonesondes) ozone soundings. Further investigation of the Total Tropospheric Ozone (TTO) record for all of 1999 suggests that there are repeated periods of very long-distance Asian influence crossing Africa, with an apparent effect on those portions of the Atlantic Equatorial troposphere which are downwind. Trajectory analyses suggest that the pattern over the Indian Ocean is complex: a sequence invoving multiple or mixed combustion sources, low level transport, cumulonimbus venting, and high-level transport to the west seem to be indicated by the TTO record. Biomass burning, fossil and biofuel combustion, and lighting seem to all contribute. For the Atlantic, burning and lighting on adjacent continents as well as episodes of this cross-Africa long-distance transport are all linked in a coordinated seasonal march: all are related by movement of the sun. However, interseasonal tropical variability related to the Madden-Julian oscillation allows intermittent ozone buildups that depart from the seasonal norm.

A22B-1061 1330h POSTER

Emissions From Miombo Woodland and Dambo Grassland Savanna Fires in Southern Africa

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African savanna fires are the largest source of biomass burning emissions worldwide, and the miombo woodland ecosystem is the most abundant type of savanna in southern Africa. Dambo grasslands are major enclaves within miombo woodlands. Savanna fires in these two ecosystems accounted for over one-third of the total area burned in southern Africa during the dry season of 2000. Airborne measurements of trace gases and particles over and downwind of two prescribed savanna fires in plots of miombo woodland and dambo grassland were obtained on September 1 and September 5, 2000, respectively. These measurements provide emission factors for a number of gaseous species including carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2), dimethyl sulfide (DMS), nitrogen oxides (NO_x), ammonia (NH_3), hydrogen cyanide (HCN), methane (CH_4), non-methane hydrocarbons (NMHC), halocarbons, oxygenated compounds, as well as for particulates. Emission factors for the two fires are combined with measurements of fuel loading, combustion completeness, and burned area to estimate the emissions of trace gases and particles from miombo woodland and dambo grassland fires in southern Africa during the dry season of 2000. These estimates indicate that in August and September of 2000 miombo woodland and dambo grassland fires in southern Africa accounted for about 30%, 25%, 15%, and 64% of the emissions of CO2, CO, total hydrocarbons, and total particulate matter, respectively, emitted from all types of savanna fires in southern Africa. It is also estimated that the ratios of dry season emissions from miombo woodland and dambo grassland fires in Zambia to annual emissions from the use of biofuels in Zambia for CO_2, CO, NO_x, formic acid, CH_4, NH_3, ethane, ethene, propene, acetylene, formaldehyde, methanol, and acetic acid are 3.2, 1.5, 7.2, 2.5, 0.2, 0.6, 0.2, 0.5, 0.4, 0.3, 0.6, 0.3, and 0.5, respectively.

A22B-1062 1330h POSTER

Development of Biomass Burning Gaseous and Particulate Emissions Database for Assimilation Into Air Quality Forecast Systems.

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Biomass burning is considered to be a major source of atmospheric gases that lead to photochemical production of ozone, acid precipitation and increased particulate loading in the troposphere. The burning can also cause photochemical destruction of stratospheric ozone, and all of these effects can impact climate and air quality. Biomass burning has increased significantly on a global scale over the last 100 years. A warmer Earth resulting from global warming will lead to more frequent and larger fires especially in extra-tropical ecosystems presenting complicated scenarios for atmospheric research. We use satellite imagery and Geographical Information Systems (GIS) to analyze contemporary wild land fires and estimate trace gas and particulate emissions from global biomass burning events. The detection, frequency, and geographic and temporal distribution of these fire events will be presented. We will discuss their significance to the global budgets of trace gases, particulates and general air quality.

A22B-1063 1330h POSTER

Particle size measurements from 4 to 2000 nm during the CRYSTAL-FACE mission

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This study presents particles size distributions with the diameter from 4 to 2000 nm measured during the CRYSTAL-FACE mission on July 2002 in Florida. Particle sizes were characterized with the FCAS (90-2000 nm) and NMASS (4-100 nm) aboard the WB-57F. During several intense cloud processing events, high concentrations (>100 particles per cc) of particles with the diameter smaller than 10 nm were observed. Particle size distributions during biomass burning and Saharan dust storm events are also discussed with case studies. These observations are further compared with our previous tropical measurements from WAM (1998) and ACCENT (1999).

A22B-1064 1330h POSTER

Seasonal Variations of Carbon Monoxide over Poker Flat observed by the ground based infrared spectroscopy from 2000 to 2002

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Altitude profiles and tropospheric partial column abundances of CO during three years were retrieved from ground-based infrared solar spectra observed over Poker Flat, Alaska (65N, 147W). The spectra have been recorded with a high spectral resolution Fourier Transform Infrared (FTIR) spectrometer. The retrieval results indicate seasonal variation in the tropospheric column of the CO profile over Poker Flat with a maximum in March-April and minimum in July. These persistent seasonal variations and long term trend were detected for the first time over Poker Flats. Abnormally enhanced CO profiles appear in summer. Good correlations between CO and HCN indicate seasonal dependence. The enhanced CO and HCN tropospheric column amounts had similar sources and underwent similar dilution processes.

A22B-1065 1330h POSTER

Cavity Ring-Down Measurement of Aerosol Optical Properties During the Asian Dust Above Monterey Experiment and DOE Aerosol Intensive Operating Period

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Large uncertainties in the effects of aerosols on climate require improved in-situ measurements of extinction coefficient and single-scattering albedo. This paper describes preliminary results from Cadenza, a new continuous wave cavity ring-down (CW-CRD) instrument designed to address these uncertainties. Cadenza measures the aerosol extinction coefficient for 675 nm and 1550 nm light, and simultaneously measures the scattering coefficient at 675 nm. In the past year Cadenza was deployed in the Asian Dust Above Monterey (ADAM) and DOE Aerosol Intensive Operating Period (IOP) field projects. During these flights Cadenza produced measurements of aerosol extinction in the range from 0.2 to 300 Mm-1 with an estimated precision of 0.1 Mm-1 for 1550 nm light and 0.2 Mm-1 for 675 nm light. Cadenza data from the ADAM and Aerosol IOP missions compared favorably with data from the other instruments aboard the CIRPAS Twin Otter aircraft and participating in those projects. We present comparisons between the Cadenza measurements and those from a TSI nephelometer, Particle Soot Absorption Photometer (PSAP), and the AATS14 sun-photometer. Measurements of the optical properties of smoke and dust plumes sampled during these campaigns are presented and estimates of heating rates due to these plumes are made.

A22B-1066 1330h POSTER

Biomass Burning Particles as Potential Ice Nuclei

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Biomass burning emissions account for massive amounts of gaseous and particulate matter in the atmosphere. Assessing these emissions and their climatic effects has been the focus of several major field campaigns. It has been shown that smoke particles act as efficient cloud condensation nuclei, which can affect precipitation and indirect radiative forcing. However, to date there have been no measurements aimed at characterizing ice-forming nuclei derived from biomass burning. Such measurements are critical for understanding cloud formation and precipitation processes throughout the troposphere. Measurements to determine the activity of biomass burning particles as ice nuclei are currently being conducted in our laboratory using the Colorado State University continuous flow thermal gradient diffusion chamber (CFDC). This instrument allows for continuous freezing measurements for free-floating particles at controlled temperatures, pressures, and humidities, relevant to both cumulus and cirrus clouds. Further, the CSU laboratory is equipped with a 50 m^3 containment vessel to allow for burning of vegetation and sampling of the resulting particles. Size-selective ice nucleation measurements have been conducted at temperatures relevant for homogeneous and heterogeneous ice nucleation. Preliminary results will be presented for smoke particles generated from a variety of biomass fuel sources. This work seeks to address the dearth of data needed to better understand and model the potential effects of biomass burning particulate matter on cold clouds and climate. Future work will also include pure compounds known to be abundant in biomass burning aerosol and covering a range of solubilities.

A22B-1067 1330h POSTER

Using "Blue Spike" to Detect Biomass Burning Sites During SAFARI 2000.

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During some flights of the ER-2 while participating in the Southern African Regional Science Initiative (SAFARI 2000), the University of Wisconsin-Madison's Scanning High Resolution Interferometer Sounder (S-HIS) obtained spectra containing isolated fires within its field of view (FOV). These fire laden FOV's contain a spectral feature caused by rotational hot band transitions of CO_2 near 2400 cm^{-1}. Due to its location on the blue side of the 4.3μm band of CO_2, this feature is commonly referred to as the "Blue Spike." Using this feature we detected fires on August 24 & 27 and September 6 & 7, 2000. Fire locations are further verified by coincident increases in S-HIS retrieved carbon monoxide abundances as well as elevated temperatures in the thermal detectors of the MODIS Airborne Simulator (MAS) also onboard the ER-2. Using line-by-line radiative transfer (Genln2) with corrections for a fire's extreme high temperatures (HiTemp) we can model S-HIS spectra for various cases: background (cool surface and cool atmosphere), smoke (cool surface and warm atmosphere) and fire (hot surface and hot atmosphere) spectra. Results showing the ability to determine fire temperature and fire/smoke area within the S-HIS FOV will be presented.

A22B-1068 1330h POSTER

Comparing Measurements and Chemical Model Simulations of Smoke Plumes From an African Savanna and an Alaskan Boreal Fire

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Chemical processes in young plumes from biomass burning significantly modify the initial emissions. Field measurements show that the ratio between ozone and CO significantly increases during the first two hours following emissions into the atmosphere. Decreases in enhancement ratios have been measured for a number of hydrocarbons. Understanding the chemical reactions that lead to these fast changes is important in order to address the local and regional impacts of vegetation fires and the effects of biomass burning on atmospheric chemistry in general. Measurements in plumes from two fires in different environments (African savanna, Alaskan forest/shrub/bog mosaic) will be described and compared with simulations using a box-dilution model. In both plumes, the measurements revealed a rapid increase in the ozone mixing ratio. Model simulations, using commonly employed emissions, are not able to quantitatively reproduce the measured ozone production in these plumes. Inclusion of the emissions of recently measured higher and oxygenated hydrocarbons (e.g., furan) significantly improves the model simulations, especially for the plume from the Alaskan fire. The effects of the different emission ratios, solar inclination etc. in these scenarios on photochemical reactions in the two fire plumes are explored through the model simulations.

A22B-1069 1330h POSTER

Land cover controls on the diurnal cycle of smoke-land-atmosphere interactions

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Tropical biomass burning emits large quantities of organic and black carbon particles into the atmosphere. The highly absorbing smoke can influence land-atmosphere interactions and clouds directly, semi-directly, and indirectly. We use the NCAR single-column community climate model (SCCM) to examine how the diurnal cycle of smoke direct and semi-direct effect on the land-atmosphere system in a typical burning season depends on land covers, namely forest and pasture. The radiative and hydrological distinctions, such as albedo, LAI, roughness length, and root distribution, determine the evolution of the atmospheric boundary layer (ABL) over forest and pasture differently. Over both forest and pasture, the absorption of solar radiation by ABL smoke can decrease the cloud-top radiative cooling and dissipate cloud, which is more pronounced in the afternoon. Such semi-direct effect is offset by the reduction of surface solar flux due to aerosol extinction, leading to a net surface cooling. The net cooling does not increase monotonously with smoke loading. The surface cooling and simultaneous atmospheric solar heating inhibit the sensible heat flux significantly, consequently reduce the Bowen ratio. The latent heat flux can be negative or positive changes, depending on competition of several environmental controls by leaf temperature, solar radiation, and specific humidity. The leaf temperature decreases in response to the reduced solar flux, while the air temperature may increase in the afternoon because of large atmospheric solar heating. These smoke-land-atmosphere interactions depend on land cover and soil moisture. The reduction of sensible heat flux is larger over a dry pasture than over a wet forest. The latent heat flux decreases over the wet forest but can increases in the afternoon over the dry pasture mainly due to the decreases of leaf temperature and stomatal resistance. The air temperature over the dry pasture decreases more in the morning and late afternoon due to greater reduction of sensible flux, but increases more in the early afternoon due to more atmospheric solar heating.

A22B-1070 1330h POSTER

Operational Smoke and Volcanic Ash Plume Monitoring in NESDIS' Satellite Services Division

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The Satellite Services Division (SSD) of NOAA's National Environmental Satellite Data and Information Service (NESDIS) operationally monitors fire and smoke activity in the continental U.S. and Alaska to support fire management and air quality monitoring activities, and monitors airborne volcanic ash to support the Washington Volcanic Ash Advisory Center (W-VAAC), which issues advisories to the Federal Aviation Administration and the air transport community. Information on fires and smoke and airborne ash is obtained from GOES, AVHRR, and MODIS data, employing both automated retrieval algorithms and analyst interpretation. Using the Hazard Mapping System developed in SSD, analysts in the SSD's Satellite Analysis Branch complete a daily fire and smoke analysis, available at http://www.firedetect.noaa.gov/viewer.htm . Locations of fires noted to be producing large smoke plumes are written to a file which is used as input to a smoke trajectory forecasting program, the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, developed by the NOAA Air Resources Laboratory, which is running a demonstration forecast program, available at http://www.arl.noaa.gov/smoke/ . In addition, the GOES Aerosol and Smoke Product (GASP), developed by NESDIS' Office of Research and Applications, is being operationally implemented to monitor large aerosol events, including smoke and anthropogenic pollutants. The W-VAAC, located within SAB and the National Centers for Environmental Prediction (NCEP), issues advisories on the presence of airborne volcanic ash, based on satellite observations. Using active volcanic eruption locations as input, NCEP runs a trajectory model, the Volcanic Ash Forecast Trajectory and Dispersion (VAFTAD), to forecast ash position and concentration. This will soon be replaced by the HYSPLIT model. Multispectral color imagery of smoke and ash events, as well as many other environmentally signficant events, is produced and posted daily by SSD's Operational Significant Events Imagery (OSEI) program at http://www.osei.noaa.gov/ .

A22B-1071 1330h POSTER

Particulate Monitoring during the 2003 Prescribed Burns in Banff National Park, Alberta Canada

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Prescribed burns were conducted in Banff National Park, located in Alberta Canada, as part of a fire management and ecosystem renewal plan during May and June 2003. Burns were conducted over several weeks ranging in scale from fireguards up to several thousand hectares. No significant fires had occurred in this area since 1923. The burns occurred in a variety of fuel mixes (primarily coniferous), slopes and exposures in the Rocky Mountains, including some areas with Mountain Pine beetle infestation. On five days, portable particulate samplers (MiniVols) were deployed at one or two locations, where smoke was anticipated. Samplers were placed in pairs using quartz and zeflour filters. On four days, locations with deployed samplers received substantial exposure to intense smoke. The filters were analyzed for 65 elements using ICPMS, for 7 anions using IC, and for 22 PAH's using GC/MS. The methodology, a summary of the results and a preliminary analysis of the chemistry is presented.

A22B-1072 1330h POSTER

A Statistical Analysis of Automated and Manually Detected Fires Using Environmental Satellites

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The National Environmental Satellite and Data Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA) has been producing an analysis of fires and smoke over the US since 1998. This product underwent significant enhancement in June 2002 with the introduction of the Hazard Mapping System (HMS), an interactive workstation based system that displays environmental satellite imagery (NOAA Geostationary Operational Environmental Satellite (GOES), NOAA Polar Operational Environmental Satellite (POES) and National Aeronautics and Space Administration (NASA) MODIS data) and fire detects from the automated algorithms for each of the satellite sensors. The focus of this presentation is to present statistics compiled on the fire detects since November 2002. The Automated Biomass Burning Algorithm (ABBA) detects fires using GOES East and GOES West imagery. The Fire Identification, Mapping and Monitoring Algorithm (FIMMA) utilizes NOAA POES 15/16/17 imagery and the MODIS algorithm uses imagery from the MODIS instrument on the Terra and Aqua spacecraft. The HMS allows satellite analysts to inspect and interrogate the automated fire detects and the input satellite imagery. The analyst can then delete those detects that are felt to be false alarms and/or add fire points that the automated algorithms have not selected. Statistics are compiled for the number of automated detects from each of the algorithms, the number of automated detects that are deleted and the number of fire points added by the analyst for the contiguous US and immediately adjacent areas of Mexico and Canada. There is no attempt to distinguish between wildfires and control or agricultural fires. A detailed explanation of the automated algorithms is beyond the scope of this presentation. However, interested readers can find a more thorough description by going to www.ssd.noaa.gov/PS/FIRE/hms.html and scrolling down to Individual Fire Layers. For the period November 2002 thru August 2003 64% of the total number of fires were added manually. This ratio has shown a seasonal fluctuation with a smaller percentage of fires being added manually during the summer fire season and a larger percentage added during the winter and spring when agriculture and control burns dominate. This is due to the shorter duration and cooler depiction of the agricultural fires in the satellite imagery and the limitations and conditions specified in the algorithms. For the various algorithms 23% of the total number of fires were from ABBA, 5% were from FIMMA and 16% were from MODIS. However, there was a wide discrepancy in the percentage of automatically detected fire points that the analysts deleted for each of the algorithms. The MODIS points were most reliable with 84% passing the editing phase and this has been a fairly consistent ratio through the period. 53% of the ABBA points were retained for the final analysis. However, a much larger percentage of points were deleted during the summer season (May-August). This was due in large part to a greater number of false alarms caused by high surface temperatures and high solar reflectivity off clouds near sunrise/sunset. For the FIMMA only 39% of the points were retained. While there are a number of areas for improvement with the algorithm, the single greatest cause for the large number of deletions has been not accurately detecting noise in the imagery which is interpreted as a fire. It is hoped that this statistical information will be a useful tool in making adjustments to the algorithms that will lead to a greater number of fire detects with a smaller percentage of false alarms.

URL: http://www.ssd.noaa.gov/PS/FIRE/

A22B-1073 1330h POSTER

The Hazard Mapping System (HMS)a Multiplatform Remote Sensing Approach to Fire and Smoke Detection

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The HMS is a multiplatform remote sensing approach to detecting fires and smoke over the US and adjacent areas of Canada and Mexico that has been in place since June 2002. This system is an integral part of the National Environmental Satellite and Data Information Service (NESDIS) near realtime hazard detection and mitigation efforts. The system utilizes NOAA's Geostationary Operational Environmental Satellites (GOES), Polar Operational Environmental Satellites (POES) and the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Terra and Aqua spacecraft. Automated detection algorithms are employed for each of the satellites for the fire detects while smoke is added by a satellite image analyst. In June 2003 the HMS underwent an upgrade. A number of features were added for users of the products generated on the HMS. Sectors covering Alaska and Hawaii were added. The use of Geographic Information System (GIS) shape files for smoke analysis is a new feature. Shape files show the progression and time of a single smoke plume as each analysis is

drawn and then updated. The analyst now has the ability to view GOES, POES, and MODIS data in a single loop. This allows the fire analyst the ability to easily confirm a fire in three different data sets. The upgraded HMS has faster satellite looping and gives the analyst the ability to design a false color image for a particular region. The GOES satellites provide a relatively coarse 4 km infrared resolution at satellite subpoint for thermal fire detection but provide the advantage of a rapid update cycle. GOES imagery is updated every 15 minutes utilizing both GOES-10 and GOES-12. POES imagery from NOAA-15, NOAA-16 and NOAA-17 and MODIS from Terra and Aqua are employed with each satellite providing twice per day coverage (more frequent over Alaska). While the frequency of imagery is much less than with GOES the higher resolution of these satellites (1 km along the suborbital track) allows for detection of smaller and/or cooler burning fires. Each of the algorithms utilizes a number of temporal, thermal and contextual filters in an attempt to screen out false detects. However, false detects do get processed by the algorithms to varying degrees. Therefore, the automated fire detects from each algorithm are quality controlled by an analyst who scans the imagery and may either accept or delete fire points. The analyst also has the ability to manually add additional fire points based on the imagery. Smoke is outlined by the analyst using visible imagery, primarily GOES which provides 1 km resolution. Occasionally a smoke plume seen in visible imagery is the only indicator of a fire and would be manually added to the fire detect file. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) is a forecast model that projects the trajectory and dispersion of a smoke plume over a period of time. The HYSPLIT is run for fires that are selected by the analyst that are seen to be producing a significant smoke plume. The analyst defines a smoke producing area commensurate with the size of the fire and amount of smoke detected. The output is hosted on an Air Resources Lab (ARL) web site which can be accessed from the web site listed below. All of the information is posted to the web page noted below. Besides the interactive GIS presentation users can view the product in graphical jpg format. The analyst edited points as well as the unedited automated fire detects are available for users to view directly on the web page or to download. All of the data is also archived and accessed via ftp.

URL: http://www.ssd.noaa.gov/PS/FIRE

A22C MCC: Level 2 Tuesday 1330h

Effects of Biomass Burning Plumes on the Troposphere and Stratosphere IV Posters *(joint with B, AE)*

Presiding: **A Stohl,** Cooperative Institute for Research in Environmental Sciences (CIRES)**; N Jones,** University of Wollongong

A22C-1074 1330h POSTER

EXPERIMENTAL STUDIES OF THE MICROPHYSICS OF CLOUD CONDENSATION NUCLEI AS A FUNCTION OF ORGANIC SOLUTE

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Biomass burning has played, and continues to play a significant part in the lives of indigenous people across the world. Biomass burning results from brushfires, land clearing, and cloud-to-ground lightning strikes, this is particularly true in the tropics. A unique feature about the biomass burning aerosols is that its sources are overwhelmingly confined to the tropics despite evidence that their effects may be global in extent. Recently, Rosenfeld has argued that the inclusion of biomass aerosols into warm clouds can also inhibit precipitation. However, several reported case studies in the literature report precipitation enhancements due to aerosol entrainment as well. Quantitative relationships between the indirect forcing from clouds and anthropogenic aerosol inclusions have not been developed to a point where the resultant prediction of cloud optical properties is reliable. The problem is the lack of understanding of the basic microphysical processes governing cloud droplet nucleation and evolution. This level of understanding requires that the physical chemistry of the systems be well understood. Because such a large fraction of anthropogenic aerosol and specifically biomass aerosol are organic in nature, we have performed laboratory simulations of the nucleation of aerosols with organic inclusions. In our study, homogeneous and heterogeneous nucleation effects were studied for several organic solutions; n-Hexane, benzene, chlorobenzene, nitrobenzene, with and without crushed graphite. We will report results of the analyses of the size distribution characteristics, electrical mobility, and number density characteristics.

A22C-1075 1330h POSTER

Inverse modeling of biomass smoke emissions using the TOMS AI

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Results of inverse modeling of biomass smoke emissions using the TOMS AI and a three-dimensional transport model are presented. The IMPACT model with DAO meteorology data in 1997 are utilized to obtain aerosol spatial and temporal distributions. Two absorbing aerosol types are considered, including biomass smoke and mineral dust. First, a radiative transfer model is applied to generate the modeled AI. Then a Bayesian inverse technique is applied to optimize the difference between the modeled AI and the EP TOMS AI in the same period by regulating monthly a priori biomass smoke emissions, while the dust emissions are fixed. The modeled AI with a posteriori emissions generally is in better agreement with the EP TOMS AI. The annual global a posteriori source increases by about 13% for the year 1997 (6.31 Tg/yr BC) in the base scenario, with a larger adjustment of monthly regional emissions. Five sensitivity scenarios are carried out, including sensitivity to the a priori uncertainties, the height of the smoke layer, the cloud screening criteria of the daily EP TOMS AI, the adjustment of emissions in a lumped region outside of the major biomass burning regions, and the covariances between observations. Results suggest that a posteriori annual global emissions in the sensitivity scenarios are within 15% of that of the base scenario. However, the difference of annual a posteriori emissions between the sensitivity scenarios and the base scenario can be as large as 50% on regional scale. We are also applying the inverse model technique to the year 2000 to compare with biomass emissions deduced from an analysis based on burned areas.

A22C-1076 1330h POSTER

Space-Based Observations of the Seasonal Variations in Biomass Burning Emissions of NOx and VOCs over Africa during 2000

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We use tropospheric NO_2 and HCHO columns from the Global Ozone Monitoring Experiment (GOME) satellite instrument to map the spatial and seasonal variations of NO_x and volatile organic compounds (VOC) emissions over Africa during 2000. Our tropospheric column retrievals include the local effects of aerosols, clouds, as well as shape factors for NO_2 and HCHO from the GEOS-CHEM global 3-D chemical transport model. The GOME NO_2 columns display a very strong biomass burning signal with the well-known seasonality: fire season in Northern (Southern) Africa between November and March (May and October) with a north to south (northwest to southeast) progession. In addition, a strong signal from biogenic NO_x emissions is present throughout the wet season, with particularly high NO_2 columns in June over North Africa. Elevated GOME HCHO columns are observed over biomass burning areas, as well as over the tropical forests of central Africa (indicating strong biogenic isoprene emissions). We derive a top-down NO_x emission inventory from the GOME column NO_2 observations through an inversion with the GEOS-CHEM model. Our estimate of annual surface NO_x emissions is 8 Tg N yr^{-1} over Africa for 2000 (4.1 and 3.9 Tg N yr^{-1} for North and South Africa, respectively), which is 50% larger than our bottom-up GEOS-CHEM emission inventory. Most of the difference is attributed to stronger than expected biogenic NO_x emissions from soils, as well as to too low NO_x emission factors used in the GEOS-CHEM model for North African Savannas. We will use space based observations of active fires (ATSR, VIRS) and burned areas (GBA2000) to separate biomass burning from biogenic emissions of NO_x and VOCs, and examine their respective spatial and temporal variability during 2000. In addition, we will compare the GOME observations and GEOS-CHEM model results to studies from the SAFARI 2000 field mission over Southern Africa.

A22C-1077 1330h POSTER

Cloud-Radiation Field Changes due to the Direct Effect of Smoke Aerosols in Southeast Mexico

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In general, aerosols affect climate mainly by directly absorbing and scattering input solar radiation and indirectly through their rule as cloud condensation nuclei. Smoke aerosols from biomass burning are considered to be the second most important source of anthropogenic particles (sulfate aerosols being the first) that are influencing the climate. Numerical simulations are carried on MM5 (using the CCM2 radiative scheme) by introducing the smoke aerosol spectral optical properties in the southeastern Mexican region. The neighborhood of this region is the most important source of biomass burning aerosols in Central America during the dry season (February-June). The particles are considered to be homogeneous in composition and the optical properties are calculated using Mie theory and the Remer et al. (1998) smoke model. Simulations are performed for March 17-20 and April 18-20, 2003. These two periods resulted to be a relative maximum in the number of fires detected in the studied region according to different algorithms based on satellite imagery. GDAS data are used to initialize the MM5 model. The goal is to study the changes in the cloud-radiation field due to the aerosol direct effect varying the smoke aerosol optical properties, especially the optical depth. Preliminary results support the argument that not only the aerosol effect is important but also the cloud changes due to the radiative differences caused by the aerosol direct effect itself. These cloud effects followed very different ways sometimes depending on atmospheric conditions of course, but also on other characteristics such as orography or land surface features. The simulations indicate a wide range on the surface radiative forcing varying from -40 W/m^2 for smoke particles with an optical depth of 0.2 (at 670 nm), to -140 W/m^2 for particles with an optical depth of 0.8.

A22C-1078 1330h POSTER

The Use of Aerosol Optical Depth in Estimating Trace Gas Emissions from Biomass Burning Plumes

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We have observed significant correlations between aerosol optical depth (AOD) at 500 nm and column amounts of a number of biomass burning indicators