A31B-06 0830h POSTER

Distribution of Threshold Velocities in East Asia

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An aeolian dust outbreak occurs when a wind velocity exceeds a threshold. In simpler dust models, threshold wind velocities of dust outbreak are set as a constant, 6.5 m/sec, although they should exhibit various values with differing land surface conditions. In more complex models, estimated threshold velocities are given with differing land surface conditions. However, it is not clear whether threshold velocities are correctly estimated or not. This study presents threshold velocities on maps of East Asia (30N-60N, 75E-145E), which are obtained through a statistical analysis using data of present weathers and wind velocities from surface meteorological observatories in the dust season (March, April and May) from 1988 - 2003. Two kinds of threshold velocity are defined from frequency distributions of wind velocities with and without dust outbreaks for each observatory. They are the minimum threshold velocity ($u_{t5\%}$) and the practical threshold velocity ($u_{t50\%}$). The former ($u_{t5\%}$) and the latter ($u_{t50\%}$) correspond to 5 percentile and 50 percentile (i.e., the median) of threshold velocities at such observatory for the analysis period. The minimum threshold velocity ($u_{t5\%}$) should be obtained when the land surface is in nearly the most favorable condition for dust outbreak at such observatory. The practical threshold velocity ($u_{t50\%}$) should be obtained when the land surface is in a normal condition at such observatory. The difference between minimum and practical threshold velocities ($\Delta u_t = u_{t50\%} - u_{t5\%}$) indicates the variation of threshold velocities and this can be an index of the variation of land surface conditions. Major results are summarized as follows: (1) Both kinds of threshold velocities (i.e., $u_{t5\%}$ and $u_{t50\%}$) are the largest in northern Mongolia. On the other hand, they are the smallest in the Taklimakan Desert.; (2) From the viewpoint of land cover type, both kinds of threshold velocities are the largest in the Grass/Shrub region (northern Mongolia), the next largest in the Semi Desert Shrubs region (Gobi Desert) and the smallest in the Bare Desert region (Taklimakan Desert); (3) The practical threshold velocities ($u_{t50\%}$) are conspicuously larger than those used in simple dust models, which are 6.5 m/sec, in the regions except for the Taklimakan Desert. (4) Differences between threshold velocities (Δu_t) are large in Mongolia and small in the Taklimakan Desert. This result indicates that land surface conditions are largely variable in Mongolia and almost constant in the Taklimakan Desert.

A31B-07 0830h POSTER

A simulation of the Transpacific Transport of Mineral Dust from Asia During Spring 2001: Evaluation of Results from GEOS-CHEM with Ground-based, Aircraft and Satellite Measurements

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Global simulations of the mobilization, transport, and deposition of mineral dust have been conducted using the GEOS-CHEM tropospheric chemistry and aerosol transport model. The simulations are focused on spring 2001, when a major transpacific transport of mineral dust from Asia occurred. The model is used to determine the impact of the Asian dust on aerosol concentrations over North America, and to distinguish the Asian impact from that due to local sources. Results of simulations using alternative dust mobilization schemes are compared and contrasted. The model results are assessed using data from the IMPROVE surface aerosol network over North America, together with in-situ bulk aerosol measurements made over the western Pacific during the 2001 TRACE-P and ACE-Asia aircraft campaigns. In addition, estimates of aerosol optical depth (AOD), diagnosed from the model, are compared with measurements of AOD from the MODIS satellite instrument. The observations provide important constraints to assess the fidelity of model processes. Comparisons with data near source regions focus on estimates of dust mobilization, and on deposition immediately downstream of the source. Comparisons with data at remote locations highlight transport and accumulated deposition processes in the model. The model captures the timing of observed dust mobilization episodes over Asia in Spring 2001 and subsequent transpacific transport. The model shows skill in representing the timing, geographic distribution, and longevity of large localized increases in aerosol concentrations observed at IMPROVE surface sites during April and May 2001. In addition, the model shows skill in capturing mineral dust concentrations measured from aircraft during the TRACE-P and ACE-Asia missions. Comparison with IMPROVE observations also shows simulated features with no apparent basis in the observations, and observed features not captured by the model. These anomalies highlight model limitations, and the attributes that underpin the dust mobilization calculations.

A31C CC: 220 C-E Wednesday 0830h

Atmospheric Chemistry and Aerosol Processes in West Africa: Saharan Dust, Biomass Burning, and Measured Tropospheric Ozone II Posters *(joint with U)*

Presiding: **G S Jenkins,** Howard University**; V Morris,** Howard University**; R Martin,** Dalhousie University

A31C-01 0830h POSTER

Seasonal variation of tropospheric ozone and lightning over the Tropical Atlantic

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The influence of the natural source, 'lightning', on the seasonal variation of the tropical tropospheric ozone over the Atlantic is examined. Most TOMS-derived tropospheric ozone data show that the high value of ozone is found over the Atlantic ocean in the southern hemisphere during DJF, while the low value near West Africa in the northern hemisphere where the biomass burning is widespread during that period. On the other hand, during JJA when the biomass burning region is shifted to the southern hemisphere, the high value of ozone is observed over the Atlantic ocean near the West Africa in the northern hemisphere as well as off the coast of the central Africa. The Empirical Orthogonal Function analysis is applied to the TOMS CCD tropospheric column ozone (1998 $\sim$ 2001), the lightning (1995 $\sim$ 2000) and the aerosol index (1998 $\sim$ 2001) as an alternative data of the biomass burning. The first two EOF modes of the ozone, explaining 82 % of total variance, show the variation related with the tropical ozone maximum during SON and the high value in the southern (northern) hemisphere during winter (summer) season. Moreover, these modes are highly correlated with the first two EOF modes of the lightning, which account for 72 % of total variance. On the other hand, the first EOF mode of the aerosol index, capturing 51 % of total variance, is related with the high aerosol index off the coast of the central Africa (5 $^{\circ}$ S $\sim$ 15 $^{\circ}$ S) during July through October. Also, this mode shows the high aerosol index near the West Africa during December through March, which is the Tropical Ozone Paradox. Furthermore, we found that the horizontal and vertical circulations near the tropical Atlantic are more favorable to lightning than biomass burning for the enhanced tropospheric column ozone.

A31C-02 0830h POSTER

Absorbing aerosol on precipitation: Dynamic aspects in association with CAPE and convective parameterization closure, and dependence on aerosol heating profile

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The Indian Ocean Experiment (INDOEX), conducted from 1995 to 2000 to document aerosols in South Asia during winter monsoon season, revealed the existence of a layer of highly absorbing haze in the lower troposphere. The observed haze has one of the two distinctly different vertical distributions: 1) concentrated in the planetary boundary layer (PBL) below 1.5 km, and 2) elevated profile peaking around 3km. Here, we provide the dynamical basis for understanding the direct effects of absorbing aerosols on the large-scale precipitation and the role of the aerosol vertical distribution. This was done through a series of the South Asian haze experiments with the NCAR Community Climate Model (CCM3), CCM3 with a new convection closure, and the Community Atmospheric Model (CAM2). All of the models have interactive atmosphere and land components, with prescribed sea surface temperatures. As far as the underlying land surface temperature is concerned, the lifted profile creates as much cooling as the vertically uniform haze (i.e., lifted haze extrapolated to the surface), while the PBL profile makes very little cooling. This is well explained by the balance between the near-surface warming effect and the surface cooling effect. The mechanism of the aerosol effect on precipitation distribution is investigated by examining the correspondence between aerosol profile, changes of precipitation and the atmospheric convective instability. The direct heating of the near-surface air in the PBL profile case increases CAPE significantly, and the lifted profile decreases CAPE marginally. On the other hand, the low-level heating of any profile would cause a large-scale rising motion over time, and then increase the CAPE by decreasing the mid-level temperature. Expectedly, the precipitation averaged over the haze area increases a few times more by the PBL profile than by the lifted profile in the CCM3 that uses a CAPE-based closure for the convective parameterization scheme. In the PBL profile case, the maximum precipitation increase area coincides with the maximum of the immediate CAPE increase by the PBL haze heating. As for the lifted profile, the precipitation increase maximum is located somewhat away from the immediate CAPE decrease maximum and the overall precipitation increase is very small. A new closure tries to preserve the environmental CAPE (CAPEe), and in this new closure the haze heating regardless of the vertical profile decreases the CAPEe and creates the precipitation increase maximum away from the maximum of this immediate CAPEe decrease, as does the lifted profile in the traditional closure. Using the traditional closure and the ECMWF reanalyses, we estimate the CAPE change due to the INDOEX haze and thus the precipitation change.

A31C-03 0830h POSTER

Heterogeneous Chemistry on Mineral Dust Surfaces

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Mineral aerosol can affect gas phase chemistry in the troposphere by providing reactive sites for heterogeneous reactions. The influence of mineral dust on the tropospheric photochemical cycle is the subject of our modelling study, carried out with a global general circulation model, which includes modules for aerosols and atmospheric chemistry. The simulations include the reactions between mineral dust aerosols and the gas-phase species, O3, HNO3, NO3, N2O5 and SO2. Furthermore, the sensitivity of this simulation on the range of uncertainty of the single uptake coefficients are tested. The model simulates a decrease in global tropospheric ozone mass by about 5% due to the heterogeneous reactions on dust aerosols. The strongest influence is seen over North Africa, where ozone can decrease locally up to 10 ppbv near the surface. The most important heterogeneous reaction is the uptake of HNO3 on the dust surface. The comparison of the model results to observations indicates that the model simulates well the aerosol mass transported into the Mediterranean during the dust events, and the arrival of all major dust events that have been observed during a 7 month period. The decreases in ozone concentration during dust events is better simulated by the model when the heterogeneous reactions are included.

A31C-04 0830h POSTER

How does African dust influence radiative fluxes over the African Continent and the Atlantic Ocean?

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Under previous effort in the framework of the NOAA/NASA PATHFINDER and EOS Validation in sub-Sahel Africa, work was done that can enable to assess the impact of dust on the radiative fluxes over the African continent and the Atlantic Ocean. Specifically, radiative fluxes at 0.5 degree resolution were derived from the ISCCP DX data, based on METEOSAT and GOES-E observations. Time series that cover at least one decade of satellite based estimates are now

available at this resolution. Independently, observations of aerosol properties in the sub-Sahel have been made since 1997 in the framework of the federated AERONET network. It is now possible to merge these two activities and test the effect of dust on satellite based estimates of surface fluxes. An analysis of the longer-term satellite fluxes will be presented and tests will be conducted to incorporate realistic dust properties in the inference schemes to evaluate the effect of the dust on the derived fluxes.

A31C-05 0830h POSTER

Ozone Observations During the NCAS Trans-Atlantic Saharan Dust Aerosol and Ocean Science Expedition

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The NCAS Trans-Atlantic Saharan Dust Aerosol and Ocean Science Expedition (AEROSE) was designed to provide a unique set of measurements to characterize the microphysical evolution of Saharan dust aerosol during transport across the Atlantic Ocean. Global transport of dust has been established as a significant factor in the radiative balance and oxidizing capacity of the atmosphere. Ambient ozone concentrations were measured continuously during the 27-day cruise. Ozonesondes were launched during Saharan dust events. This poster will present the measurements of ozone concentrations during the cruise and during dust events.

A31C-06 0830h POSTER

Size-Resolved Aerosol Mass and Aerosol Number Distributions Encountered During The NCAS Trans-Atlantic Saharan Dust AERosol and Ocean Science Expedition (AEROSE) 2004

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In-situ measurements of size-fractionated aerosol mass and aerosol number density distributions were performed during the NCAS Trans-Atlantic Saharan Dust AERosol and Ocean Science Expedition (AEROSE) 2004. This was a 27 day mission aboard the NOAA Ship Ronald H. Brown (RHB). The cruise tracks for AEROSE 2004 coincided with the climatological Saharan Dust storm belt (5^o N to 14^o N and 60^o W to 19^o W) between the Caribbean Lesser Antilles and the west coast of Africa. A Quartz Crystal Microbalance Cascade Impactor (QCM) and a Laser Particle Counter (LPC) were used to retrieve the mass and number distributions. Each instrument is designed to make size-resolved measurements in six size fractions. The range for the QCM is from 5.0 microns to 0.15 microns. The range for the LPC is from 25 microns to 0.3 microns. I will present the evolution of size-resolved aerosol mass distribution and aerosol number distributions during a case study dust storm event.

A31C-07 0830h POSTER

Aerosol Measurements During the NCAS Trans-Atlantic Saharan Dust AERosol and Oceanographic Science Expedition (AEROSE)

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The NOAA Center for Atmospheric Sciences (NCAS) at Howard University recently conducted a 27-day mission to characterize the evolution of chemical and physical properties of Saharan Dust during its spring time trans-Atlantic transport. The mission was designed to perform integrated atmospheric, oceanographic and satellite-based science in support of a large-scale study a single scientific phenomenon - Saharan Dust. A large suite of aerosol and chemical measurements were performed. The primary aerosol measurements were total black carbon aerosol, total condensation nuclei, PM10, size-fractionated aerosol mass distributions, and size-fractionated number distributions. Aerosol filter sampling for chemical, mycological, biological, and microphysical analysis was also performed. An overview of the preliminary results from the study will be presented.

URL: http://orbit35i.nesdis.noaa.gov/orad/sar/oceansar/AEROSE2004/

A31D CC: 520 D Wednesday 0830h

Tropospheric Chemistry (Gas Phase) *(joint with B, GC)*

Presiding: **R V Martin,** Dalhousie University**; J Thornton,** University of Toronto

A31D-01 0830h

The GODFIT Direct Fitting Algorithm: A New Approach for Total Ozone Retrieval From GOME

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We present a new Direct Fitting algorithm (GODFIT) for the retrieval of total ozone amounts from nadir viewing remote sensing spectrometers (such as GOME, SCIAMACHY, OMI and GOME-2) which take earthshine measurements in the UV ozone Huggins bands. The algorithm is designed for direct comparison with measurements, and all radiative transfer (RT) calculations are done from scratch. We use the linearized RT model LIDORT, which has a single-call facility for simultaneous computations of radiances and fast analytic calculations of Jacobians with respect to surface and atmospheric properties. RT calculations require an input profile of ozone partial columns; we use a column-classified ozone profile climatology (the TOMS Version 8 data set) which provides a unique map between the fitted total column and the input RT profile. To compensate for lack of knowledge of tropospheric aerosol, we perform calculations in a Rayleigh atmosphere and fit for the surface albedo as an internal closure parameter; the algorithm is less sensitive to the presence of aerosol than DOAS-AMF algorithms customarily used for this retrieval. The Ring effect is important in the UV, and GODFIT contains a new treatment for the correction of interference effects due to the filling-in of ozone molecular features by inelastic rotational Raman scattering. The algorithm is flexible and direct, and operates without the need for extensive look-up tables. The algorithm was applied to a subset of some 2000 GOME orbits used in validation studies for the total ozone product. The algorithm can process one orbit (2000 scenes) in under half an hour. Results were compared with ground data from a well-documented network of surface stations, with TOMS total ozone measurements (Version 8), and also with GOME-derived columns from the latest version of the GDP (operational GOME Data Processor DOAS-type total ozone algorithm). With the new results, previously observed seasonality and solar angle dependencies are greatly reduced or even eliminated in most latitudes and time zones (the exception is Antartica in the Austral Spring). New results for GOME total ozone are now of comparable accuracy to ground-based data, and in this regard, the 8-year GOME ozone data record will become suitable for trend analysis and climate studies in the near future. This application for GOME is the first proof of the direct fitting concept, and the method shows great potential for further applications in hyperspectral remote sensing.

A31D-02 0845h INVITED

Combining in situ and Remote Measurements with Models: Picking the Right Tools

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Visibility reduction, photochemical smog, and the global climate changes these pollutants engender involve complex interactions of emissions, atmospheric transformations, and transport. In situ measurements, numerical simulations, and remotely sensed data all have strengths and weaknesses, but picking the right combination of tools can avoid the limitations of any one method to advance the science and provide policy-relevant research on the causes and nature of air pollution. The Regional Atmospheric Measurement, Modeling, and Prediction Program (RAMMPP) seeks a balanced approach to air pollution studies in the Mid Atlantic. We employ surface and airborne measurements as input and tests for air quality models of the Baltimore/Washington area. Both ozone and summertime haze tend to form in blobs covering areas hundreds of km on a side and lasting several days. Point and aircraft measurements offer high accuracy, but cannot always characterize the spatial and temporal extent of these masses. To provide the big picture, we are exploring the use of satellite data including GOME and SCIAMACHY for SO_2, TOMS for tropospheric O_3, and MODIS for aerosol optical depth. Comparison with direct measurements can greatly improve retrievals of atmospheric composition. For example, GOME identified a persistent hot spot in SO_2 over eastern North America where many large, coal-fired power plants are located. Aircraft measurements confirmed the presence of this hotspot, but indicated an average column content of 0.65 DU (m atm cm), while the satellite instrument, indicated only 0.14 DU. GOME uses, however, an initial guess for the altitudinal distribution of the SO_2, and when the retrieval algorithm is corrected with the observed profile, the result is 0.42 DU. Further improving the retrieval with more representative background values yields a mean SO_2 column content of 0.52 DU, within experimental uncertainty of the aircraft value. Ozone and aerosol retrievals can be similarly customized and compared to the output of a chemical transport model such as CMAQ.

A31D-03 0915h

Satellite Mapping of Rain-Induced Nitric Oxide Emissions from Soils over Africa

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We use tropospheric NO_2 columns from the Global Ozone Monitoring Experiment (GOME) satellite instrument to map the spatial and seasonal variations of NO_x emissions over Africa during 2000. The GOME observations show not only large NO_x emissions from biomass burning during the dry season, but also comparable soil emissions during the rainy season over North Equatorial Africa. These soil emissions occur in strong pulses lasting 1-3 weeks following the onset of rain, and affect 3 million km^2 of semi-arid sub-saharan savanna. Surface observations of NO_2 from the IDAF (IGAC/DEBITS/Africa) network over West Africa provide further evidence for a strong role for microbial soil emissions at the beginning of the rainy season. By combining space-based observations of NO_2 columns and fires, we estimate that soils contribute 3.1 TgN/yr, similar to the biomass burning source (3.8 TgN/yr), and thus account for 40% of surface NO_x emissions over Africa. Extrapolating to all the Tropics, we estimate