The spread of this weekend effect may be due to a shift in ozone formation in California towards increased VOC sensitivity, as control programs during the last 20 years have reduced VOC more than NOx.

A51B-0064 0830h POSTER

Modeling the Advection of Biomass Burning Emissions Through an Urban Airshed

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The two fundamentally different tropospheric photochemical processing modes are generally represented within the chemical evolution of air masses polluted, respectively, by urban emissions and by forest-fire smoke emissions. That is, urban air masses typically have high [NO_x] and are VOC-sensitive, while biomass-burning smoke plumes tend to be dominated by NO_x-sensitive photochemistry. We investigate the photochemistry occurring (especially its effect upon the concentrations of O_3 and other secondary pollutants) when a biomass-burning smoke plume mixes with a relatively stagnant urban air mass using stationary (urban) and moving (smoke) 0-D boxes and a chemical mechanism based upon the NCAR "Master Mechanism." The impact of the advected smoke plume upon urban air quality and the effect of the urban air mass upon later smoke plume photochemical evolution are both investigated. The impact of the smoke plume upon the urban airshed is explored both as a function of the time and intensity of solar processing of the smoke plume before mixing, as well as the time of day of its arrival in the urban area. The results obtained indicate that entrainment of a smoke plume into such an urban airshed leads to sharp rises in afternoon [O_3]owing to the addition of reactive radical species. Smoke-plume photochemistry is also substantially affected by mixing with urban emissions; increases are again seen in the concentrations of O_3, as well as long-lived reservoir species, including hydroperoxides and PANs. Thus the mixing of NO_x-depleted, VOC-rich forest-fire smoke plumes with NO_x-rich, VOC-sensitive urban air masses leads to substantially enhanced concentrations of O_3 and other secondary reservoir pollurants in both air masses. These results further may be of use in the timing of prescribed forest burning so as to minimize the potential effect upon nearby urban airsheds, especially in the case of unanticipated meteorological changes.

A51C MCC: Hall D Friday 0830h

Atmospheric Dynamics and Transport Posters *(joint with GC)*

Presiding: **E Cordero,** San Jose State University

A51C-0065 0830h POSTER

On the Transformation Between Wave Trains and Coherent Structures in Large-Scale Atmospheric Flow

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Wave trains and coherent structures are among the most dominant features of the large-scale atmospheric circulation. The role of these wave trains and coherent structures in the low-frequency variability of the Earths general circulation is well understood observationally, but a dynamical connection between the two has yet to be found.

The low-frequency variability in a meridionally sheared, zonally varying background flow is examined using a non-divergent barotropic model on a midlatitude β-plane. In the long, low-frequency limit this model yields a variable-coefficient, Kortweg-deVries (K-dV) equation. The disturbance field governed by this K-dV equation is comprised of both oscillatory Rossby wave packets (ORWPs) and solitary Rossby waves (SRWs). The ORWPs are the atmospheric analogs of low-frequency wave trains and the SRWs are the analogs of coherent structures.

The zonally varying background flow has the profound effect of inducing the transformation of wave trains into coherent structures and vice versa. We find that as a wave train propagates through a zonally isolated jet flow that it may organize itself into a coherent structure. The reverse transformation is also possible; the coherent structure may breakdown into a wave train. This organization of wave trains into coherent structures and the breakdown of coherent structures into wave trains is fundamentally due to the effect of the zonally isolated jet flow on the balance between linear dispersion and wave amplitude.

A51C-0066 0830h POSTER

Effect of Hines Gravity Wave Drag Scheme on the Polar Night Jet Oscillation

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Poleward and downward propagation of anomalies in winds and temperature i.e., polar night jet oscillation, is investigated in a GCM simulation, in which Hines gravity wave drag scheme is incorporated. The model used in this study is a Meteorological Research Institute GCM of T42L45 version extending from the surface to a top level of 0.01 hPa. Time integration for 21 years is made for a control run, which uses Rayleigh friction as a simple scheme for gravity wave drag. Its e-folding time is 3-day at 0.1 hPa and 17-day at 1 hPa. The other run, experiment run, is set by replacing Rayleigh friction with Hines gravity wave drag scheme and run for the same period, 21 years. The gravity wave source is homogeneously given with rms wind of 1.5 m/s at the lowest model level. Polar night jet is intensified by 10-20 % in the experiment run because Hines scheme produces weaker deceleration than Rayleigh friction in the stratosphere. In the mesosphere, on the other hand, Hines scheme yields greater easterly momentum deposition and this results in wind reversal, i.e., easterly wind area above polar night jet as in observations. In accord with the intensification of polar night jet, its interannual variation increases in the middle stratosphere and above. The polar night jet oscillation is accordingly modified, to a large extent, as a result of the changes in polar night jet.

A51C-0067 0830h POSTER

Forced Planetary Waves, Stratospheric Ozone, and Critical Layers: Ingredients for the Stratospheric Forcing of the Troposphere

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Forced planetary waves generally extend throughout the troposphere and stratosphere and thus provide an important link between these two regions of the atmosphere. Because these planetary waves originate from mechanical and thermal forcing in the troposphere, planetary wave energy propagates upward into the stratosphere where momentum deposition via wave damping drives the zonal-mean stratospheric circulation. At the heart of this troposphere-stratosphere paradigm, wherein the troposphere forces the stratosphere, is the momentum deposition associated with the wave damping.

Here we present striking evidence showing that the interactions between ozone and the planetary waves not only affects the wave damping rate, but the interactions also produce changes in planetary wave structure and planetary wave fluxes that radiate downward into the troposphere.

Using analytical (WKB) and one-dimensional numerical modeling approaches, we show that there is a sensitive and intimate connection among the background flow, ozone, and forced planetary wave field in the stratosphere, a connection that in some cases leads to significant changes in the tropospheric wave fluxes. We find that this connection and thus the stratospheric forcing of the troposphere are dramatically strengthened if the critical level and the maximum in ozone advection are approximately coincident. Such conditions are most often met during Northern Hemisphere spring and summer. We also discuss these results in light of changes in ozone arising from natural (e.g., 11-year solar cycle) and anthropogenic (e.g., chlorofluorocarbons) perturbations.

A51C-0068 0830h POSTER

Detection and Interpretation of Patterns of Motion in Mesoscale Atmospheric Flows

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An objective analysis scheme was used to generate three dimensional flow fields from data collected during the October 2000 Vertical Transport and Mixing eXperiment (VTMX) in the Salt Lake Valley. The original observations and the examined flow fields have been analyzed using an Empirical Orthogonal Function (EOF) approach to detect recurring patterns of motion. The observations were used to identify relative strengths of valley flow, slope flow and canyon winds. For the 10 locations chosen, 2 EOFs accounted for about 75 percent of the variance. The results have been interpreted in terms of diurnal variations of the thermal flows in the Valley.

The gridded winds from the objective analyses were also analyzed using EOFs to determine the nature of variations about the general flow over a 5 by 5 grid, with 1 km spacing. Three EOFs accounted for about half the variance. We are currently interpreting the results. The preferred patterns appear to be fairly regular, and include cases of undulation in the flow, enhanced shear, and patterns similar to singular points in a flow. We will examine how the statistics of intensity for these features varies with scale, by smoothing our analyses and reapplying the EOFs at different scales. We also intend to apply the same methods to numerical simulations of the same meteorological conditions in order to evaluate the simulations, and, we hope, to extend the analysis to smaller scales than can be derived from the observations.

This work was supported by the U.S. Department of Energy, under the auspices of the Atmospheric Sciences Program of the Office of Biological and Environmental Research. We are grateful to the many VTMX participants who provided their data. They include those from Argonne, Livermore, Los Alamos and Pacific Northwest National Labs, from Arizona State and Utah Universities, NCAR, NOAA and others.

A51C-0069 0830h POSTER

On the Relationship Between Medium Frequency Scatter and Polar Mesospheric Summer Echoes

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Radar observations of the arctic mesopause region were conducted in Alaska during the summer of 2001 at the High Power Auroral Stimulation (HIPAS) Observatory and the Communications Research Laboratory (CRL) Poker Flat Medium-Frequency radar for the purpose of creating a seasonal database of polar mesospheric summer echoes (PMSE). PMSE were seen for at least 50% of the observation period. We will describe the scientific program, discuss geophysical conditions during the observations, and present some of the preliminary results. We will also predict the signals expected by typical HF (high frequency) and MF (medium frequency) radar systems using existing rocket data sets containing PMSE events.

A51C-0070 0830h POSTER

A Generalized Convective Inhibition Energy

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The common view about preconvecting soundings is that they possess both CAPE (Convective Available Potential Energy) and CINE (Convective INhibition

Energy), the latter preventing the former to be spontaneously released. The two concepts of CAPE and CINE are ambiguous, however, because they depend upon the parcel used to compute the work of buoyancy forces, as well as upon the thermodynamic transformation (adiabatic, pseudo-adiabatic) assumed in lifting the parcel. To remove the ambiguity intrinsically associated with CAPE, Randall and Wang (1992) introduced the concept of GCAPE (Generalized CAPE), defined as the minimum achievable energy difference between the total nonkinetic energy (NKE) of the column of air considered minus the total NKE of a reference soundings obtained by reorganizing the parcels along the vertical by conserving mass. Because the method focuses on how to achieve a global energy minimum without addressing the issue of whether it is achievable or how to achieve it, the concept of CINE is lost. The present work shows how to remedy to this problem, and how to define a Generalized CINE within the same framework serving to define the GCAPE.

A51C-0071 0830h POSTER

Climatological Features of Stratospheric Streamers Simulated With the Berlin Climate Middle Atmosphere Model (FUB CMAM)

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Stratospheric processes play an important role in the future development of the atmospheric ozone layer. Besides the fundamental chemical processes, transport is an important factor determining the global distribution of atmospheric trace gases, such as ozone. The influence of dynamical processes on the strength and variability of the observed total ozone decrease at midlatitudes, especially in the northern hemisphere, is still an open question.

The purpose of this study is to investigate the possible relevance of air mass exchange through the subtropical and polar transport barriers by streamers and tongues for the mid-latitude ozone distribution. Streamers can contribute to the observed total ozone decrease at mid-latitudes, through either transport of naturally low ozone values from the tropics to midlatitudes (tropical-subtropical streamer) or advection of chemically processed air from polar to mid-latitudes (polar vortex streamer).

In order to infer the long-term characteristics of stratospheric streamers, we used a 10-year integration of the Berlin Climate Middle Atmosphere Model (FUB CMAM) to produce a climatology of streamer events, details of which will be presented.

A51C-0072 0830h POSTER

The Effects of External Forcing and Grid Resolution on Simulations of Airflow in the Salt Lake Valley

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We used the Advanced Regional Prediction System (ARPS, developed at the Center for Analysis and Prediction of Storms, University of Oklahoma) for simulation of the atmospheric motions observed during the first field campaign of the Vertical Transport and Mixing eXperiment (VTMX), carried out in the Salt Lake Valley in October, 2000. The ARPS data assimilation system has been used to interpolate observed data and a background field from the ETA model (developed at the National Center for Environmental Prediction) to a coarse ARPS model grid with horizontal spacing of 20 km. Outputs from model runs on that grid have served as inputs for one-way nested grid runs on finer grids with horizontal resolution of 5 km, 1 km, and 250 m.

The flow simulations are compared with the objective analyses of observed data for several of the Intense Operation Periods (IOPs) of the VTMX field campaign. The simulations capture the evening transition period well. This paper describes the effects of initialization, boundary forcing, and grid resolution on the results from simulations of flow in the Jordan Narrows area, which separates the Utah Lake and Salt Lake Valleys. Interestingly, among other effects, increased horizontal resolution improved the near surface potential temperature predictions.

This work was supported by the U.S. Department of Energy, under the auspices of the Atmospheric Sciences Program of the Office of Biological and Environmental Research. We are grateful to the ARPS team, especially Prof. M. Xue, for their cooperation and suggestions. We also want to thank the VTMX participants who have made their data available to us for analysis.

A51C-0073 0830h POSTER

Surface Layer Flux Processes During Cloud Intermittency and Advection above a Middle Rio Grande Riparian Forest, New Mexico

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An intensive field campaign was undertaken to bring together state-of-the-art methodologies for investigating surface layer physical characteristics over a desert riparian forest. Three-dimensional sonic eddy covariance (3SEC), LIDAR, SODAR, Radiosonde, one-dimensional propeller eddy covariance (1PEC), heat dissipation sap flux, and leaf gas exchange were simultaneously in use 13 – 21 June 1999 at Bosque del Apache National Wildlife Refuge (NWR) in New Mexico.

A one hour period of intense advection was identified by $\overline{v} \gg 0$ and $\overline{u} = 0$, indicating that wind direction was transverse to the riparian corridor. The period of highest $\overline{v}$ was 1400 h on 20 June; this hour experienced intermittent cloud cover and enhanced mesoscale forcing of surface fluxes. High-frequency (20 Hz) time series of u, v, w, q, θ, and T were collected for spectral, cospectral, and wavelet analyses. These time series analyses illustrate scales at which processes co-occur.

At high frequencies (> 0.015 Hz), $\overline{T'q'} > 0$, and $\frac{K_H}{K_W} = 1$. At low frequencies, however, $\overline{T'q'} < 0$, and $\frac{K_H}{K_W} \neq 1$. Under these transient conditions, frequencies below 0.015 Hz are associated with advection. While power cospectra are useful in associating processes at certain frequencies, further analysis must be performed to determine whether such examples of aphasia are localized to transient events or constant through time.

Continuous wavelet transformation (CWT) sacrifices localization in frequency space for localization in time. Mother wavelets were evaluated, and Daubechies order 10 wavelet was found to reduce red noise and leakage near the spectral gap. The spectral gap is a frequency domain between synoptic and turbulent scales. Low frequency turbulent structures near the spectral gap in the time series of $\overline{T'q'}$, $\overline{w'T'}$, and $\overline{w'q'}$ followed a perturbation–relaxation pattern to cloud cover. Further cloud cover in the same hour did not produce the low frequency variation associated with mesoscale forcing. Two dimensional vertical LIDAR scans of eddy structure explains the observed frequency response patterns. Insight into the temporal progression of homeostatic processes in the surface layer will provide resources for water managers to better predict ET.

A51C-0074 0830h POSTER

Observations of the growth and decay of the Marine Planetary Boundary Layer from Chesapeake Light Platform

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As part of the ABOVE, AIRS (Atmospheric InfraRed Sounder) BBAERI (Baltimore Bomem Atmospheric Emitted Radiance Interferometer) Ocean Validation Experiment, project we deployed a suite of intsruments, BBAERI, ELF (Elastic Lidar Facility) and Vaisala RS-90 rawinsondes, to United States Coast Guard Chesapeake Light platform (36.91 N,75.71 W) during the months of August, September, and October 2002. This combination of instruments allowed us to simultaneously examine the Marine Planetary Boundary Layer (PBL) through active and passive remote sensing while radiosondes provided in situ data for the same time period. We will present observations of the deterioration and restoration of the Marine PBL on a diurnal cycle as well as the affects of synoptic variations on the Marine PBL. Retrievals of aerosol properties from BBAERI spectra will be shown along with validation from ELF and other aerosol instruments. A more thorough understanding of the Marine PBL is necessary to increase accuracy in climate models used for weather prediction.

A51C-0075 0830h POSTER

Revised Values for Vorticity Area Index

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Many studies of possible links between solar activity and the terrestrial atmosphere and climate system have been based on the Vorticity Area Index (VAI). The VAI is an index describing cyclonic activity, and is typically specified for the Northern Hemisphere and the 500 mb level. Nearly all studies of VAI have been based on the original Olson, Roberts and Gerety data set for VAI, which was based on the NMC data grid, or extensions thereof. The reanalysis data which are now available since 1948 can be used to calculate a new dataset for vorticities and VAI. As the reanalysis data is more homogeneous than the NMC grid expected improvements in the VAI dataset should be investigated. This poster presents such a new VAI dataset, based on NCEP reanalysis data. We find changes in the VAI which are mainly related to large jumps in the old VAI dataset which no longer are evident, as well as changes on shorter time scale. The new dataset is made available over the Internet.

A51C-0076 0830h POSTER

Optical Turbulence Forecasting

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Optical Turbulence Forecasting
E.M. Dewan, AFRL/VSSS, Hanscom AFB, MA 01731

This talk will describe a technique, or model for estimating the optical turbulence parameter (i.e. the structure content, Cn*2) by means of such measurements as temperature, pressure, and winds as a function of height at radiosonde resolution, that is a resolution of 300 meters in the vertical. This technique has recently acquired attention from its recent employment in weather forecasting systems (Frank Ruggiero, and Daniel DeBenedictis, private communication) and for the purpose of forecasting astronomical seeing conditions on Mauna Kea on Hawaii for the observatories located there (BAMS ,June, 2002, p.858-871). The model will be explained, and some experimental comparisons shown.

A51C-0077 0830h POSTER

Ensemble forecasting study on an extensive snowfall in the western U.S. using RSM

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EOS project of NASA supports ensemble forecasting of precipitation over the Colorado River Basin. In February of 2002, the Regional Spectral Model (RSM) developed in the National Centers of Environmental Prediction (NCEP) has been installed in the University of Arizona. This study shows an example for West USA with extensive precipitation. The ensemble forecasting system of RSM (hydrostatic version) and MSM (non-hydrostatic version) was used to make 48 and 72-hour precipitation forecasts in the western U.S., in which an extensive snowfall event was successfully predicted. The ensemble forecasting results are evaluated in comparison with ground observation data combining radar verification. In addition, the influence of using high resolution modeling and different forecasting period on the ensemble forecasts is also addressed. Brier skill analysis indicates that the predictability of ensemble forecasting is varied by region, scale, and time.

A51C-0078 0830h POSTER

On the Benefits of Using a Multi Model Ensemble Forecasting System to Improve Forecast Quality

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In this paper we will explore why the use of a limited area multi model ensemble forecasting system can improve the forecasting quality of realtime and climate simulations significantly relative to the best single ensemble member. We will introduce a NWP model, which is build around a kernel. This allows us to implement any number of physics schemes and dynamics schemes in one executable. In the present study we used 50 different model configurations to build one system. The integration time of this system is more than four forecast days pr. wall clock hour on a single PC processor on typical limited area model grids. We will show the capabilities of this system with ensemble members that only differ in their numerical solution of the fast processes vertical diffusion, condensation and dynamics. We will also discuss the possibility to get probabilities from such ensemble systems.

A51C-0079 0830h POSTER

A Look at HIAPER, the new NSF/NCAR Research Aircraft

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The High-Performance Instrumented Airborne Platform for Environmental Research, or HIAPER, is the new research aircraft presently being developed at the National Center for Atmospheric Research (NCAR) to serve the environmental research needs of the National Science Foundation (NSF) for the next several decades. The basic aircraft – a Gulfstream V (G-V) business jet – has been completed and will shortly undergo extensive modification to prepare it for future deployments in support of a variety of geosciences research missions. This overview presentation on HIAPER will begin with a brief discussion of the project history and an overview of the capabilities of the aircraft and the modifications to be made to the basic airframe.

Next, a summary of the NSF-led HIAPER Community Instrumentation Workshop will be given. This workshop, which was held at NCAR from 4-6 November 2002, provided participants with a forum in which to discuss the types of environmental measurements that should be made with this new airborne platform and to exchange ideas regarding technologies and instrumentation design approaches that are available and should be applied to the development of instrumentation for the aircraft. The workshop findings will be summarized, and specific recommendations regarding the major research areas in which measurements from HIAPER are most needed will be presented. Finally, a brief discussion of possible instrumentation to be considered for deployment on the aircraft will be given.

A51C-0080 0830h POSTER

Engineering and Technical Configuration Aspects of HIAPER, the new NSF/NCAR Research Aircraft

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The High-performance Instrumented Airborne Platform for Environmental Research, or HIAPER, is the new research aircraft presently being developed at the National Center for Atmospheric Research (NCAR) to serve the environmental research needs of the National Science Foundation (NSF) for the next several decades. The basic aircraft – a Gulfstream V (G-V) business jet – has been completed and will shortly undergo extensive modification to prepare it for future deployments in support of a variety of geosciences research missions.

This presentation will focus on the many design and engineering considerations that have been made and are yet to come in converting a "green" business jet into a versatile research aircraft to serve the environmental research community. The project teams composed of engineers and scientists from NCAR and the scientific community at large are faced with trade offs involving costs of modifications, airframe structural integrity, aircraft performance (e.g. weight, drag), cabin environment, locations of inlet and sampling ports and FAA certification requirements. Many of the specific engineering specifications and modifications that have been made to date will be presented by way of engineering drawings, graphical depictions and actual photographs of the aircraft structure. Additionally, projected performance data of the modified-for-research aircraft will be presented along with some of the analyses performed to arrive at critical decisions (e.g. CFD airflow analysis). Finally, some of the details of the aircraft "infrastructure" such as signal and power wiring, generic cabin layout and data acquisition will be discussed.

A51C-0081 0830h POSTER

Middle Atmosphere Temperature Trends from Small Rocketsondes

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Stratospheric temperature trends derived from United States meteorological rocketsonde measurements obtained between the late 1960's and mid 1990's are examined at the 50-, 40-, and 25-km altitude levels. Although the trends are different at each of the launch locations there is an unequivocal downward slope of about -0.1K to -0.3K per year at many of the launch sites. Distances between launch sites and, in some cases unequal data-record lengths, inhibit determination of trend inter-relationship among the various sites. Although the data only provide a 'snapshot' of atmospheric behavior for the specific location, a particular advantage resulting from using these particular rocketsonde observations is their consistency over time. Thus, using the same rocketsonde type over the data period, i.e., Datasonde, insures a significant reduction of instrument induced anomalies in the temperature profiles. Trends at the 25-km altitude level, approximately 30 hPa, are compared with trends from radiosonde observations. Both rocketsonde and radiosonde measurements were obtained at approximately the same local times and within less than 100 km of each other. Rocketsonde temperatures from the Former Soviet Union are also used and often complement trends from US data.

A51C-0082 0830h POSTER

The Spatial and Temporal Distribution of U.S. Winds and Windpower at 80 m Derived from Measurements

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This is a study to quantify U.S. wind power at 80 m (the hub height of large wind turbines) and to investigate whether winds from a network of farms can provide a steady and reliable source of electric power. Data from 1327 surface stations and 87 soundings in the United States for the year 2000 were used. Several methods were tested to extrapolate 10-m wind measurements to 80 m. The most accurate, a least-squares fit based on twice-a-day wind profiles from the soundings, resulted in 80-m wind speeds that are, on average, 1.3-1.7 m/s faster than those obtained from the most common methods previously used to obtain elevated data for U.S. windpower maps, a logarithmic law and a power law, both with constant coefficients. The implication is that U.S. windpower at 80 m is enormous and much greater than previously thought. It was found that 25.2 percent of all stations (and 44.6 percent of all coastal/offshore stations) are characterized by mean annual speeds $\geq$ 6.9 m/s at 80 m, implying that the winds over possibly one quarter of the U.S. are strong enough to provide electric power at a direct cost equal to that of a new natural gas or coal power plant. The greatest previously uncharted reservoir of windpower in the continental U.S. is offshore and near shore along the southeastern and southern coasts. The other great reservoirs, previously charted, are the north- and south-central regions. The five states with the highest percentage of stations with annual mean 80-m winds $\geq$ 6.9 m/s were Oklahoma, South Dakota, North Dakota, Kansas, and Nebraska. Other findings are (1) monthly and annual mean wind speed (and wind power) peaks in the afternoon, when electricity demand is usually high; (2) winds are Rayleigh in nature, and actual wind power at any hour of the day is close to Rayleigh wind power; (3) the standard deviation of the wind speed averaged over multiple locations is less than that at any individual location; (4) when multiple wind sites are considered, the probability of no wind power production at a given instant is substantially reduced in comparison to when one wind site is considered. In sum, a network of wind farms in locations with high annual mean wind speeds can provide a reliable and abundant source of electric power.

URL: http://fluid.stanford.edu/~lozej/winds/winds.html

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A51D MCC: 102 Friday 0830h

Transport and Effects of Anthropogenic Pollutants: Trace-P I

(joint with GC)

Presiding: **J Crawford,** NASA Langley Research Center**; D Jacob,** Harvard University

A51D-01 0830h

The NASA/GTE/TRACE-P Mission:Design and Execution

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The Transport and Chemical Evolution over the Pacific (TRACE-P) aircraft mission was conducted in February-April 2001 over the western Pacific by the NASA Global Tropospheric Experiment (GTE). It had two objectives: (1) to determine the chemical composition of the Asian outflow over the western Pacific in order to understand and quantify the export of chemically and radiatively important gases and aerosols, and their precursors, from the Asian continent; (2) to determine the chemical evolution of the Asian outflow and to understand the ensemble of processes that control this evolution. TRACE-P used two aircraft, a DC-8 and a P-3B, operating out of Hong Kong and Japan. Measurements on both aircraft included ozone and its precursors, aerosols and their precursors, and long-lived greenhouse gases. Flights were designed to capture the ensemble of major source regions and meteorological pathways contributing to the Asian outflow. Chemical forecasts from five 3-D models were used to supplement meteorological forecasts and to optimize the value of the TRACE-P data set for testing these models. Linkages were made with concurrent measurements from other platforms, including the ACE-Asia aircraft mission and satellites, in order to produce an integrated data set directed at the TRACE-P objectives. Several validation profiles were conducted for the MOPITT carbon monoxide instrument aboard the Terra satellite. Interpretation of the TRACE-P data set is now providing new insights into the nature and magnitude of Asian sources and their contributions to global atmospheric composition.