[3]Danish Meteorological Institute Research and Development , Lyngbyvej 100, Copenhagen, OE DK-2100, Denmark

[4]Earth and Space Sciences Division Jet Propulsion Laboratory , 4800 Oak Grove Drive, Pasadena, CA 91109, United States

A possible mechanism for solar forcing of climate is being investigated. The mechanism couples changes in solar ultraviolet (UV) emission to those of ozone and temperature and circulation in the stratosphere and troposphere. This mechanism is an 'amplification mechanism' in the sense that it can magnify the effects of a small change in the UV emission to generate a significant climate effect and works as follows. At low solar activity, the ozone in the stratosphere becomes less abundant and the meridional temperature gradient there becomes smaller. This implies a weaker and warmer polar vortex and weaker planetary wave activity in the troposphere, resulting in a colder climate for the troposphere.

To investigate the interactions between the troposphere and stratosphere, which are integral to this 'amplification mechanism', we use a general circulation model of the atmosphere, the UCLA GCM. As it has been demonstrated that the response of the stratosphere to solar cycle variations is sensitive to the phase of the quasi-biennial oscillation (QBO) in tropical lower stratospheric zonal winds, we have performed two sets of experiments. In one set the QBO is in a perpetual east phase, in the other it is in a perpetual west phase. There are two GCM integrations in each set. One is a control, the other a 20% reduction in ozone mixing ratio imposed in the stratosphere. Preliminary analysis of these integrations will be presented to test the validity of this 'amplification mechanism'.

A11C-07 1025h INVITED

Assessing impact of stratospheric water vapor on climate

Piers M Forster (+44 118 9875123 ext 7986; piers@met.rdg.ac.uk)

University of Reading, Department of Meteorology University of Reading Earley Gate, Reading RG6 6BB, United Kingdom

It is now apparent that observed increases in stratospheric water vapor may have contributed significantly to both stratospheric cooling and tropospheric warming over the last few decades.

I show that if recent estimates for the observed water vapor trends are valid globally they could have contributed a radiative forcing of up to 0.3 Wm^{-2} and a lower-stratospheric cooling of more than 0.8 K over the past 20 years, with these values more than doubling if, as has been suggested, the trend has persisted for the last 40 years. I assess if such a large stratospheric cooling is consistent with observations.

A11C-08 1050h INVITED

Relationship Between Climate Variability and Total Ozone Change in the Northern Mid-Latitudes

Robert D Hudson (1-301-405-5394; hudson@atmos.umd.edu)

Department of Meteorology, University of Maryland, College Park, MD 20742-2425, United States

Traditionally, long-term changes (trends) in the total ozone amount at Northern mid-latitudes have been derived from zonal averages made over the latitude range from 25 to 60(N. We separate the total ozone field into four meteorological regimes, (1) a tropical regime south of the subtropical upper troposphere front; (2) a mid-latitude regime between the sub-tropical and the polar fronts; (3) a polar regime between the polar front and the arctic front (the polar vortex), (4) an arctic regime, north of the arctic front. The total ozone distribution within the first three regimes is quite narrow, with a width of about three per cent of the mean value. We also find that the mean value within these regimes is relatively constant from year to year. Thus the mean total ozone value that is observed between 25 to 60(N is mainly governed by the relative areas of the three regimes within these latitude limits. We find that during the period from 1978 to 1992 the area of the tropical regime increased while that of the polar regime decreased. We conclude that most of the northern mid-latitude trend in the total ozone record between 1978 and 1992 is the result of a northward movement of the mean latitude of both the subtropical and polar fronts. As there is a distinct tendency for the surface pressure systems to follow the flows aloft, e.g. the jet streams embedded in these fronts, any movement in the mean positions of the upper troposphere fronts will result in a change in the climate of the Northern hemisphere. Thus changes in climate, both short term and long-term, and the measured stratospheric ozone trends and variability at midlatitudes are closely linked.

A11C-09 1115h

Evaluation of Tropical Transport in a Global Ghemistry and Transport Model

Anne R Douglass[1] (301-614-6028; douglass@persephone.gsfc.nasa.gov)

Arlindo M. da Silva[2] (301-614-6174; dasilva@dao.gsfc.nasa.gov)

Shian- Jiann Lin[2] (301-614-6161; lin@dao.gsfc.nasa.gov)

Steven Pawson[2] (301 614-6159; spawson@dao.gsfc.nasa.gov)

Richard B. Rood[2] (301 614-6155; rrood@dao.gsfc.nasa.gov)

[1]NASA Goddard Space Flight Center, Atmospheric Chemistry and Dynamics Code 916, Greenbelt, MD 20771 0001

[2]NASA Goddard Space Flight Center, Data Assimilation Office Code 910.3, Greenbelt, MD 20771 0001

Observations of constituents from satellite, aircraft and sondes can be utilized to develop diagnostics of various aspects of tropical transport. These include tropical midlatitude isolation, the seasonal transport from the upper tropical troposphere to the midlatitude lowermost stratosphere, the seasonal cycle of the tropical total ozone and its variability. These diagnostics will be applied to constituent fields from an off-line chemistry and transport model (CTM) driven by winds from two sources. These are the Finite Volume Community Climate Model (FV-CCM), a general circulation model that uses the NCAR CCM physics and the Lin and Rood dynamical core, and an assimilation system developed by the Data Assimilation Office at the Goddard Space Flight Center that uses the FV-CCM at its core. Signatures of interannual differences in the observations, related to the tropical winds and extratropical waves, will be emphasized to understand differences between the two model transports and the transport inferred from the observations.

A11C-10 1130h

Maximum Path Height Distributions: a Measurable Quantity Independent of Mean Age and Age Distributions for Model Comparisons

Fred Moore[1,2] ((303) 497-7068; fmoore@cmdl.noaa.gov)

Eric Ray[2,3]

Geoff Dutton[1,2]

James Elkins[1,2]

[1]NOAA/CMDL, 325 Broadway, Boulder, CO 80305, United States

[2]CIRES, University of Colorado, Boulder, CO 80319, United States

[3]NOAA/AL, 325 Broadway, Boulder, CO 20305, United States

The stratospheric lifetimes of the halocarbons and nitrous oxide measured by the LACE in situ GC are dominated by simple photolysis. Between these species, local lifetimes span two orders of magnitude at any given altitude. Similarly, for each species the local photolytic lifetimes decrease by more than two orders of magnitude in going from the tropopause to 32 km. This range in lifetimes cover the dynamic time scales of stratospheric transport, making these halocarbons extremely sensitive to the altitude degree of freedom in the stratosphere and a powerful tool for studying stratospheric dynamics.

Tagging an irreducible air parcel (air particle) in terms of the maximum height encountered during its path to a final location, takes advantage of this logarithmic decrease with altitude in the local photolytic lifetimes. In particular, maximum path height identifies the molecular species that will have undergone substantial loss ($\approx$ 100 %). A measurement of these simple photolytic species at a given location in the stratosphere can then be used to calculate the distribution of maximum path heights corresponding to the distribution of irreducible air particles that make up the particular air parcel measured.

We will demonstrate a measured maximum path height distribution using LACE midlatitude data. Comparison of measured maximum path height distributions to model estimates will represent a check that would be independent from those obtained via. comparisons to mean age, and age distributions (calculated from SF_6 and CO_2 measurements). A short discussion of the interplay between maximum path height, time scales for transport, and the vertical resolution of models will be given to demonstrate the usefulness of the maximum path height concept. We hope to convince modelers to included maximum path height as an effective tracer for comparisons with measurements.

A11C-11 1145h

On the Relation Between Kinematic Boundaries, Stirring and Barriers for the Antarctic Polar Vortex

Bernard Legras[1] (legras@lmd.ens.fr)

Binson Joseph[2] (binson@math.la.asu.edu)

Tieh-Yong Koh[1] (tiehyong@alum.mit.edu)

[1]Laboratoire de Meteorologie Dynamique, Ecole Normale Superieure 24 rue Lhomond, PARIS 75005, France

[2]Dpt of Mathematics, Arizona State University, Tempe, AR, United States

A

Maximum stretching lines in the lower stratosphere around the Antarctic polar vortex are diagnosed using a method based on finite-size Lyapunov exponents. By analogy with the mathematical results known for simple dynamical systems, these curves are identified as stable and unstable manifolds of the underlying hyperbolic structure of the flow. For the first time, the exchange mechanism associated with lobe dynamics is characterized using atmospheric analyzed winds. The tangling manifolds form a stochastic layer around the vortex. It is found that fluid is not only expelled from this layer towards the surf zone, but also is injected inward from the surf zone, through a process similar to the turnstile mechanism in lobe dynamics. The vortex edge, defined as the location of the maximum gradient in potential vorticity or tracer, is found to be the southward (poleward) envelope of this stochastic layer. Exchanges with the inside of the vortex are therefore largely decoupled from those, possibly intense exchanges, between the stochastic layer and the surf zone. We stress that using the kinematic boundary defined by the hyperbolic points and the manifolds as an operational definition of vortex boundary is not only unpractical but also leads to spurious estimates of exchanges. We also present preliminary results of diagnostics based on rigorous theory of finite-time hyperbolicity.

A12A MC: Hall D Monday 1330h

General Atmospheric Sciences Contributions

Presiding: **M Avery,** NASA Langley Research Center

A12A-0034 1330h POSTER

Internal Wave Generation in the Lee of Periodic Topography

Bruce R Sutherland ((780) 492 0573; bruce.sutherland@ualberta.ca)

University of Alberta, Department of Mathematical Sciences 539 Central Academic Building, Edmonton, AB T6G 2G1, Canada

Laboratory experiments are performed to examine the generation of internal waves in uniformly salt-stratified fluid by towed two-dimensional periodic topography of finite extent. Linear theory predicts that vertically propagating internal waves are generated if the Froude number $\mathrm{Fr} = U/N\lambda < 1/2\pi$. (Here U is the towing speed, N is the buoyancy frequency, and λ is the distance between successive hill crests.) As found by Baines and Hoinka (1985), when Fr is moderately smaller than this value, a large amplitude lee wave is generated downstream of the topography. This horizontally propagating wave is characterised by spatially decaying, periodic vertical displacements of near-surface isopycnals on the order of the hill amplitude immediately in the lee of the topography. The flow is laminar.

The lee wave itself excites vertically propagating internal waves which have amplitude approximately twice that of internal waves generated directly above the topography. That is, larger waves are excited after the topographic forcing is turned off! This occurs because the internal waves resonantly interact with the lee waves acting both to establish the pattern of lee waves and to extract energy efficiently away from them.

A12A-0035 1330h POSTER

Preliminary Results From High-Resolution Simulations of Global Climate With an Atmospheric General Circulation Model

Philip B. Duffy[1] (925-422-3722; pduffy@llnl.gov)

Bala Govindasamy[1] (925-423-0771; bala@llnl.gov)

Jose Milovich[1] (925-423-6689; milovich1@llnl.gov)

Starley L. Thompson[1] (925-423-9923; thompson59@llnl.gov)

[1]Lawrence Livermore National Laboratory , 7000 East Ave. L-103, Livermore, CA 94550, United States

One factor limiting the realism of global climate simulations is the coarse spatial resolution used in this type of simulation. We investigate the effects of higher spatial resolution in global climate calculations by comparing results of simulations performed with coarse and fine-resolution configurations of the NCAR CCM3 atmospheric general circulation model. Here we compare results of simulations of present climate at different resolutions; in a separate paper, we compare results for an elevated-CO2 climate. In present-climate simulations, spatial patterns of simulated quantities are generally more realistic at higher resolution. This is especially true of quantities (e.g. precipitation) which are strongly influenced by orography. Many global and annual-mean quantities are less realistic in our higher resolution simulations; we attribute this to the use of a model version which has been tuned to perform well at coarse resolution.

A12A-0036 1330h POSTER

High Resolution CCM3 Global Climate Change Simulations

Bala Govindasamy[1] (925-423-0771; bala@llnl.gov)

Philip B. Duffy[1] (925-422-3722; pduffy@llnl.gov)

[1]Lawrence Livermore National Laboratory , 7000 East Ave. L-103, Livermoree, CA 94550, United States

In this study, we have performed two global climate simulations at T170 using NCAR's Atmospheric General Circulation Model, CCM3. The horizontal resolution is approximately 0.7 degrees in both latitude and longitude. The first case, the present day simulation, corresponds to the present day climate. In the second, 2100 simulation, the concentrations of greenhouse gases are prescribed for the year 2100AD based on Business As Usual (BAU) scenario. The SSTs for the 2100 simulation are derived from a coupled model simulation of the 21st century. Analogous coarse resolution simulations are also performed at T42 ($\sim$2.8 degree resolution). We will discuss the global climate change and climate sensitivity at these two different resolutions. We will also discuss the improvements in regional climate change simulations at the higher resolution.

A12A-0037 1330h POSTER

Sea-Salt Record of the EPICA - Dome C Deep Ice Core

Regine Rothlisberger[1,2] (44-1223-221-619; rro@bas.ac.uk); Matthias Bigler[1]; Emiliano Castellano[3]; Martine De Angelis[4]; Margareta E. Hansson[5]; Manuel A. Hutterli[1,6]; Robert Mulvaney[2]; Stefan Sommer[1]; Jorgen P. Steffensen[7]; Roberto Udisti[3,8]; Eric W. Wolff[2]

[1]Climate and Environmental Physics, University of Bern, Bern CH3012, Switzerland

[2]British Antarctic Survey, High Cross Madingley Road, Cambridge CB3 OET, United Kingdom

[3]Department of Chemistry, University of Florence, Florence, Italy

[4]LGGE, BP 96, St Martin d'Heres 38402, France

[5]Department of Physical Geography, University of Stockholm, Stockholm S10691, Sweden

[6]Dept of Hydrology and Water Resources, University of Arizona, Tucson, AZ 85721, United States

[7]Department of Geophysics, University of Copenhagen, Copenhagen DK2100, Denmark

[8]Department of Chemistry, University of Calabria, Arcavacate di Rende, Italy

As part of the European Project for Ice Coring in Antarctica (EPICA) a deep drilling at Dome C, Antarctica (75° 06'S, 123° 24'E) was launched in 1996 and a depth of 780 m had been reached by the end of the 1998/99 field season. The ice core covers approximately the last 45 kyrs. Along the whole core, high-resolution chemical analyses have been done, combining continuous flow analysis (CFA), a fast ion chromatographic method (FIC) and traditional ion chromatography (IC). The resolution achieved was of the order of one centimetre with the CFA method and 4 to 10 cm with the two ion chromatographic methods. In the last glacial period, the sodium concentrations were about five times higher than during the Holocene. Elevated sodium concentrations are also observed during the Antarctic Cold Reversal (ACR). During the last glacial period, the chloride to sodium ratio was close to the seawater ratio, whereas under present day conditions, there is a considerable chloride deficit due to post-depositional chloride losses. Chloride showed an extraordinary behaviour in the early Holocene, with slight chloride surplus compared to the sodium concentrations.

A12A-0038 1330h POSTER

East Coast Pressure Trough Indices and New England Winter Climate Variability

James A Bradbury[1] (603-862-0813; jab@gust.sr.unh.edu)

Barry D Keim[1] (barry.keim@unh.edu)

Cameron P Wake[1] (cameron.wake@unh.edu)

[1]Climate Change Research Center Institute for the Study of Earth, Oceans and Space, 39 College Road University of New Hampshire, Durham, NH 03824, United States

Although many studies have successfully defined robust spatial and temporal expressions of the North Atlantic Oscillation (NAO) in regional climates throughout the North Atlantic basin, only a few studies have addressed the manifestations of these links in New England. Using monthly gridded 500-hPa-pressure level data we define two synoptic indices, specific to the northeastern United States, with the goal of better understanding the principal mechanisms controlling intraseasonal to multi-annual winter climate variability in New England. 1) The "Trough Axis Index" (TAI) is created to quantify the mean longitudinal position of the common East Coast pressure trough, and 2) The "Trough Intensity Index" (TII) is calculated to represent the relative strength of this trough at 45.5° N. The TAI and TII are then compared with instrumental records for winter precipitation, temperature and snowfall in New England, regional sea-surface temperatures (SST), and the NAO index.

The TAI correlates most significantly with winter precipitation at inland stations, indicating that a western (eastern) trough-axis position corresponds with greater (lower) average monthly precipitation. Results also indicate that New England regional SSTs and the NAO are associated with east west shifting in the mean location of the East Coast pressure trough and storm-track preferences. The TII is significantly correlated with regional temperature and SSTs as well. Noted intraseasonal to multi-annual interrelationships between indices for regional climate, the TAI, TII, SST and the NAO provide evidence for fundamental physical mechanisms linking New England with North Atlantic winter climate variability.

A12A-0039 1330h POSTER

Tropical Forcing of North Pacific Decadal Variability Explored Using a GCM Ensemble

Joel R Norris[1] ((858) 822-4420; jrnorris@ucsd.edu)

Tamara Beitzel[2]

[1]Joel Norris, Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Drive, Dept 0224, La Jolla, CA 92093-0224, United States

[2]Tamara Beitzel, Colorado College, Colorado Springs, CO 80903, United States

The impacts of tropical forcing and internal atmospheric noise on decadal variations of wintertime North Pacific SST are explored using the GFDL R30 atmospheric GCM coupled to the Alexander mixed layer ocean model. Observed 1950-1999 SST is prescribed in the eastern equatorial Pacific to duplicate historic ENSO forcing and the mixed layer model is used elsewhere over the global ocean except for regions of climatological sea ice cover. The use of a one-dimensional mixed layer model enables a focus on the role of surface fluxes and local wind-driven turbulence in generating SST anomalies by excluding varying horizontal advection and ocean dynamics. Sixteen runs with identical prescribed eastern equatorial Pacific SST forcing but different atmospheric realizations were examined. Another eight runs with prescribed eastern equatorial Pacific SST forcing, an ocean mixed layer only in the North Pacific, and climatological SST elsewhere were also examined.

Ensemble mean North Pacific decadal SST variability resembles the observed decadal variability, but with weaker amplitude. This suggests variations in tropical forcing substantially contribute to North Pacific decadal SST variability through changes in local surface forcing. However, SST variability in individual runs can be significantly different, suggesting that a substantial stochastic component exists in the observed decadal SST variations. Surface winds from the runs are used to drive an ocean GCM to explore the uncoupled dynamical response of the ocean to atmospheric internal variability and tropical forcing.

A12A-0040 1330h POSTER

Chemical and Dynamical Tropical - Midlatitude Interactions in the Pacific Subtropics During an Extended Cold Phase ENSO Event

Melody A Avery[1] (757-864-5522; m.a.avery@larc.nasa.gov); David J Westberg[2] (d.j.westberg@larc.nasa.gov); Henry E Fuelberg[3] (fuelberg@met.fsu.edu); James H Crawford[1] (j.h.crawford@larc.nasa.gov); Jennifer R Olson[1] (j.r.olson@larc.nasa.gov); R Bradley Pierce[1] (r.b.pierce@larc.nasa.gov); T Duncan Fairlie[1] (t.d.fairlie@larc.nasa.gov); Stephanie A Vay[1] (s.a.vay@larc.nasa.gov); Glen W Sachse[1] (g.w.sachse@larc.nasa.gov)

[1]NASA Langley Research Center, Chemistry and Dynamics Mail Stop 483, Hampton, VA 23681

[2]Science Applications International Corporation, 22 Enterprise Parkway, Hampton, VA

[3]The Florida State University, Meteorology Department, Tallahassee, FL

We examine the effect of ENSO cold-phase dynamics on chemical tracer distributions in the Subtropical Pacific, and on tropical - midlatitude Interactions in the Northern and Southern Hemispheres.

A mature, significant (sustained sea surface temperature anomaly of more than 1 degree below climatology) cold phase ENSO event persisted during recent NASA Global Tropospheric Experiment (GTE) aircraft-based chemical sampling missions in March and April of 1999 and 2001. These missions provide an extensive set of chemical tracer data from the Subtropical Pacific in both hemispheres. The subtropics (20-30 deg) are complicated regions of interaction between tropical and midlatitude flow patterns, where the prevailing surface winds shift from easterly to westerly, and midlatitude fronts slow down and decay. This area of transition also coincides with heavy loading of the boundary layer and lower troposphere with combustion emissions from coastal Asia, and to a lesser extent, Australia. We show Northern and Southern hemispheric chemical tracer distributions measured over the Subtropical Pacific, correlated to both the prevailing and anomalous windfields. We also show the measured tracer gradients associated with decaying fronts in this region where midlatitude oxidant precursors are transported to an area where enhanced photochemical oxidant production is associated with abundant sunlight and water vapor.

A12A-0041 1330h POSTER

Impact of North American Land Variability on the Re-emergence of SST Anomalies in the North Atlantic

Edwin Schneider[1] (schneide@cola.iges.org)

Uma Bhatt[2] (bhatt@iarc.uaf.edu)

David Dewitt[3] (daved@iri.ldgo.columbia.edu)

[1]COLA, 4041 Powder Mill Rd. Suite 302, Calverton, MD 20705

[2]U. of Alaska, 903 Koyukuk Dr, Fairbanks, AK

[3]IRI, 61 Rt. 9W, Palisades, NY

A set of numerical simulations has been carried out to evaluate the influence of coupled land-atmosphere and ocean-atmosphere interactions on natural climate variability. The baseline experiment was a long integration of a state-of-the-art coupled atmosphere-ocean-land general circulation model (GCM). A set of three experiments was conducted: one where the ocean and land are decoupled from the atmosphere, one where the land and atmosphere models were coupled but the SST was specified, and one were the ocean and atmosphere were coupled but the land soil moisture was specified. Note that in the simulations when the land model is not interactive, soil moisture is specified but surface temperature is permitted to evolve.

By reducing the variability of soil moisture, in the specified soil moisture experiments, the atmospheric air temperature variability is reduced over North America throughout the year. This reduction of air temperature

variability acts to reduce ocean temperature variability on monthly to seasonal time scales. In addition, the strength of "re-emergence" is reduced in the western North Atlantic, in a region near the North American coast. "Re-emergence" is the mechanism by which late winter ocean temperature anomalies are sequestered below the summer ocean mixed layer and mixed back into the surface layer in the fall.

These results suggest that land variability in the midlatitudes adds persistence to the climate system on longer time scales by influencing ocean variability.

A12A-0042 1330h POSTER

Phase Identification of Acoustic-gravity Waves From Atmospheric Explosions Using Modified Ray-mode Theory

Douglas O. ReVelle (505-667-1256; dor@vega.lanl.gov)

Los Alamos National Laboratory, P.O. Box 1663, MS J577, Los Alamos, NM 87545

At long ranges from large atmospheric explosions a complicated wave train lasting several tens of minutes is typically observed. The nature of these returns (phases) can be ascertained at close ranges for higher frequencies using ray theory, but at longer ranges and lower frequencies, the full wave nature of these signals requires either a normal mode or other exact linear wave perturbation approach to predict amplitude as a function of range. In many cases what is required, however is the phase identification of these wave arrivals, i.e., the geometric path of the arriving waves and not their amplitude. In order to ascertain such phase identifications, we have modified the ray-mode (phase) theory of Tindle and Guthrie (1974-1976) to include atmospheric winds for the full acoustic-gravity wave spectrum. We have made this modification for the system of dispersion equations and atmospheric resonant frequencies for two simple analytic wave models, namely for the cases of a hydrostatic, isothermal and non-isothermal atmosphere. Previous analyses of acoustic-gravity wave arrivals have identified phases including Lamb (surface), tropospheric, stratospheric (with-wind) and thermospheric types at long range. Furthermore, counter-wind stratospheric arrivals have also been identified even though for a very long time it has been recognized that these returns did not satisfy the asymptotic high frequency Snell's law for the atmosphere. Despite this deficiency, it was also known long ago that proper amplitude values could be predicted using the modal response of the atmosphere from distant explosions including the counter-wind propagation case, even though the precise path of the waves from the source to the observation point remained unknown. Presumably the mechanism(s) responsible for the counter-wind signal arrival is due to either wave scattering or diffraction during propagation. We have now incorporated different observed atmospheric temperature and wind profiles into our modified ray-mode algorithm in order to predict the ray-mode skip distance, duct heights and thicknesses, etc. as a function of range, frequency and free wave mode number to determine the proper phase identification within the train of arriving waves. This will allow IMS (International Monitoring System) infrasound analysts a rapid method, independent of amplitude predictions, for the proper interpretation of the complex wave train from distant explosions.

A12A-0043 1330h POSTER

Tropical tropospheric temperature variations caused by ENSO and their influence on the remote tropical climate

John C Chiang[1] ((206) 616-1407; jchiang@atmos.washington.edu)

Adam S Sobel[2] (212-854-0090; sobel@appmath.columbia.edu)

[1]JISAO, University of Washington, Box 354235, Seattle, WA 98195-4235, United States

[2]Dept of Applied Physics and Applied Mathematics, Columbia University, 500 W. 120th Street, Room 202, New York, NY 10025, United States

The warming of the entire tropical troposphere to an El Nino is well established, if not well understood. This observation allows for a useful simplification of the tropical El Nino - Southern Oscillation (ENSO) teleconnection problem, through assuming that ENSO controls the interannual variability of tropical tropospheric temperatures. We examine the potential impact of this warming to tropical climate away from the ENSO region by examining the vertical adjustment of a single column model to imposed tropospheric temperature variations. The column model is set to predict the ENSO impact over P>E, P<E, and no convection regions over a hypothetical mixed layer ocean. In both regions, model precipitation and sea surface temperature (SST) responds significantly to the forcing; in general, precipitation decreases and SST increases to warmer tropospheric temperatures. However, the amplitude and phase of precipitation and SST response depends on how fast the mixed layer ocean adjusts to the forcing. We analyze the model response to understand the underlying mechanisms behind the precipitation and SST variations. We show observational evidence that suggests our model results are applicable to SST and precipitation variability over the global tropics. In particular, our mechanism offers a simple explanation why the southeastern tropical Atlantic and southeastern tropical Indian ocean SST variability is not linked to ENSO. We discuss the implications of our results to ENSO teleconnections over the global tropics.

A12A-0044 1330h POSTER

Observations and Numerical Simulations of a Meso-Gamma Circulation over the Monterey Bay

Cristina Lozej Archer[1] (650-723-1825; lozej@stanford.edu)

Mark Zachary Jacobson[1] (650-723-6836; jacobson@cive.stanford.edu)

[1]Stanford University, Department of Civil and Environmental Engineering, Stanford, CA 94305, United States

A cyclonic circulation, named the "Santa Cruz Eddy", occurs frequently in the summer time over the Monterey Bay, offshore from the city of Santa Cruz. With its horizontal size of 10-20 km, its vertical extent of 100-200 meters, and its lifetime of a few hours, it represents so far the only non-severe weather example of a meso-γ circulation in the atmosphere. It forms in the late afternoons and evenings and it causes surface winds in the Santa Cruz area to blow from the east, opposed to the main westerly flow typical of the California coastal areas.

Data collected during the summers of 2000 and 2001 showed that: (1) a strong pressure difference (i.e., up to 3 mb) exists during the day between the southern and the north-eastern parts of the bay; (2) a southerly wind starts forming in the eastern part of the bay in the early afternoon before the eddy forms, advecting cooler air northward; (3) this cooler air takes about four hours to reach the Santa Cruz area and to close the circulation associated with the eddy, which therefore forms at the end of the day; (4) the eddy seems to dissipate and then reform once or twice during the night, which suggests that two different mechanisms act to form the eddy, one during the day and one at night.

The mesoscale model MM5 is used as a tool to better understand the mechanism of formation of the Santa Cruz Eddy. The test case chosen is the eddy event of August 24th 2000, which is simulated with two one-way nested domains with horizontal resolutions of 5 and 1 km. The results confirm that higher pressure forms in the southern bay, as a consequence of the mean northwesterly flow impinging upon the mountains in the south Bay. Also, a lower pressure area forms in the north- east of the Bay (i.e., in the Santa Cruz area), due to the fact that the mountains in the north Bay protect this area from the cold marine air, resulting in stronger surface heating, higher temperature, and lower pressure. Furthermore, an area of strong surface winds forms offshore from Santa Cruz, which is believed to contribute to vorticity formation through shear.

A12A-0045 1330h POSTER

The Influence of Horizontally Heterogeneous Soil Moisture on a Coupled PBL / Land-Surface System

Edward G Patton[1,2]

Peter P Sullivan[2]

Chin-Hoh Moeng[2]

[1]The Pennsylvania State University, Department of Meteorology, University Park, PA 16802, United States

[2]National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307, United States

Land-atmosphere coupling is widely recognized as a crucial component of regional, continental and global scale numerical models. However, predictions from these large-scale models are sensitive to small scale surface layer processes like heat and moisture fluxes at the air-soil-vegetation interface as well as boundary layer treatments. Particularly, the soil moisture boundary condition has a considerable influence on medium-to-long range weather forecasts and on simulated monthly mean climatic states. The resolution used in most large scale models is however relatively coarse so that the turbulent processes in the planetary boundary layer (PBL) which control the surface fluxes are not resolved but are determined by a parameterization. In our view, the shortcomings and sensitivities exhibited by large scale numerical models are partly a consequence of inadequate modeling of the PBL and its interaction with the land surface. In order to improve existing parameterizations, a more complete understanding of the mechanics and thermodynamics of air-soil interaction and the transport of water vapor by turbulent processes in the PBL is required.

The importance of the atmospheric planetary boundary layer in land-atmosphere interactions is well known. Turbulent processes in the PBL regulate the exchange of momentum and scalars between the land surface and overlying atmosphere. Furthermore, concentrations of the important elements in the surface energy balance, heat and moisture, influence the fluxes themselves, in a feedback loop. The equilibrium state of concentrations and fluxes depends on surface conditions, entrainment and the entire temporal and spatial history of the PBL. The current understanding of the coupling between land surfaces and the PBL is, however, largely based on the study of idealized homogeneous land surfaces and cloud-free PBLs. An important next step is to examine the coupling between land surfaces and clear PBLs.

In this study, we examine the interactions between land surfaces and the atmosphere by coupling a large-eddy simulation (LES) model for the PBL to a land surface model. Typical LES investigations of heterogeneous surfaces utilize prescribed surface fluxes and use relatively coarse grid resolution. In the work described here, fine grids and large computational domains are used to examine the impact of large scale heterogeneity on PBL turbulence and the surface heterogeneity is not imposed but dictated by coupling with a land surface model.

A

A12A-0046 1330h POSTER

Operational Seasonal Precipitation Forecast For Puerto Rico And US Virgin Islands Using CCA

Yuxiang He (301-763-8000 x7529; Luke.He@noaa.gov)

Climate Prediction Center NCEP/NWS/NOAA, 5200 Auth Rd. 4, Camp Springs, MD 207464304, United States

An operational system for 3-month total precipitation forecasts for Puerto Rico and US Virgin Islands has been developed at NOAA Climate Prediction Center using the statistical method of canonical correlation analysis (CCA). The forecasts are expected to begin issued monthly beginning in 2002. The levels and sources of predictive skills have been estimated at lead times of up to one year, using a cross-validation design. The predictor fields, in order of their predictive value, are quasi-global sea surface temperature, Northern Hemisphere 700 mb height, and prior values of the predictand precipitation itself. Four consecutive 3-month predictor periods are used to detect evolving as well as steady-state conditions. Modest forecast skills (correlation > 0.4) are realized for most of the year. CCA generally outperforms persistence, even at short leads. The El Niño/Southern Oscillation (ENSO) phenomenon is found to play an important role in the precipitation variability over this region.

URL: http://www.cpc.ncep.noaa.gov/pacdir

A12A-0047 1330h POSTER

On the Acoustic Impulse Conservation law for Long Range Sound Propagation in the Atmosphere

Sergey N. Kulichkov[1] (7-095-953-4876; snk@omega.ifaran.ru)

Douglas O. ReVelle[2] (505-667-1256; dor@vega.lanl.gov)

Rodney W. Whitaker[2] (505-667-7672; rww@lanl.gov)

Oleg Raspopov[3] (812-310-5232; oleg@omr.izmi.ras.spb.ru)

[1]Oboukhov Institute of Atmospheric Physics, Russian Academy of Sciences 3 Pyzevsky, Moscow 109017, Russian Federation

[2]Los Alamos National Los Alamos National Laboratory, P.O. Box 1663, MS J 577, Los Alamos, NM 87545, United States

[3]Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Box 188, St. Petersburg 191023, Russian Federation

An experimental confirmation of the acoustic impulse conservation law (where I is the acoustic impulse with a wave profile area, S in pressure, p and time, t coordinates multiplied by the range, r from the explosion) for long range infrasound propagation in the atmosphere will be presented. Data on infrasonic arrivals at long distances (up to 300 km) from explosions with yields of 100 kg to 2000 tons (TNT equivalent) in different seasons have been analyzed. Using these data we obtained the empirical relation; Io = 0.616 X I **0.988 where Io = the initial value of the acoustic impulse I near the explosion). This relation may be used at any range from the explosion for infrasonic arrivals

of different types (tropospheric, stratospheric, mesospheric and thermospheric). The empirical relation Eo = 1.38e-10 X I**1.482 with Eo, the source energy, in kilotons and the impulse, I in kg/s, was also obtained from our data analyses. Finally, we utilized the acoutic impulse conservation law to determine a relationship between the experimental uncertainty in the dominant frequency of the explosion and the experimental uncertainty in the pressure amplitude. This result can be written in the form: (f-fo)/f = (p-po)/p where f-fo is a measure of the experimental error in observing the dominant frequency,fo, of the explosion and p-po is the corresponding error in the observation of the acoustic amplitude, po.

A12A-0048 1330h POSTER

Approaches to data quality assurance: from deployment to operation

Stephen Laudato[1] (slaudato@stevens-tech.edu)

Hans A Eide[1] (heide@stevens-tech.edu)

Gus Lindquist[1] (hglindquist@hotmail.com)

Knut Stamnes[1] (kstamnes@stevens-tech.edu)

Rune Storvold[2] (rune@gi.alaska.edu)

[1]Stevens Institute of Technology, Department of Physics and Engineering Physics, Castle Point on Hodson, Hoboken, NJ 07030, United States

[2]Geophysical Institute, University of Alaska, Fairbanks, Fairbanks, AK 99775, United States

The deployment and operation of instrumentation for monitoring of environmental parameters require special attention to data quality assurance (QA) issues. Often such instrumentation is required to run unattended on a continual basis in remote locations while exposed to harsh environmental conditions. For the instruments to yield data of know and reasonable quality several criteria have to be fulfilled. Firstly, the instruments have to perform to within known uncertainties under varying conditions. This can be achieved by performing proper calibration, set-up, and testing. Secondly, in the operational phase the data collected should pass certain quality Control (QC) tests before being used to monitor changes in environmental conditions. In order to maximize the amount of data of known and reasonable quality, these data control routines should be executed in near real time. One approach to accomplish this is to develop automated routines for collection and checking of the data, as well as making visualizations and notifications to operators if manual intervention is needed.

At Stevens Institute of Technology (SIT), the Light and Life Laboratory under the direction of Dr. Knut Stamnes is involved in the ongoing process of deploying instrumentation for the collection of data for climate science research and environmental monitoring. As Site Scientist for the North Slope of Alaska/ Adjacent Arctic Ocean (NSA/AAO) Cloud And Radiation Testbed (CART) site, one of the measurement sites commissioned by the Department of Energy's Atmospheric Radiation Measurement Program (ARM), Dr. Stamnes leads a Operations Team that is performing the data QA of that site. Working with the instrumentation at these sites, the team is developing new approaches to the problem of maximizing the collection of data of known and reasonable quality. This includes data logistics, automated QC routines, operational procedures, and instructions for the deployment of instruments.

In this poster we will present our work by describing the steps from deployment to production phase using one particular instrument as an example. We present our QA approach aimed at maximizing the collection of data of known and reasonable quality, through the deployment, operation, and daily QC of the measurements obtained with that instrument.

URL: http://odin.mat.stevens-tech.edu/

A12A-0049 1330h POSTER

An New Data Set for Climate Research and Weather Forecast: AIRS on the EOS Aqua Mission

Liguang Wu[1,2] (301-6145381; lgwu@daac.gsfc.nasa.gov)

Jianchun Qin[1,3] (301-6145323; jcq@daac.gsfc.nasa.gov)

Awdhesh Sharma[1,4] (A.K.Sharma@gsfc.nasa.gov)

[1]NASA Goddard Space Flight Center GES DISC/DAAC, Bld#32, S181A-2, code 902, Greenbelt, MD 20771

[2]Raytheon Technical Services Company (RTSC), Bld#32, code 902

[3]Science Systems Applications, Inc(SSAI), Bld#32, code 902, Lanham, MD 20706

[4]Emergent Information Technologies Inc. (EITI), Bld#32, code 902

The Atmospheric Infrared Sounder (AIRS) is selected by NASA to fly on the second Earth Observing System (EOS) polar orbiting platform, EOS Aqua, which will be launched in 2002. AIRS, together with Advanced Microwave Sounding Unit (AMSU) and Humidity Sounder for Brazil (HSB), is designed to meet the requirements of the NASA Earth Science Enterprise climate research program and the NOAA operational weather forecasting plans. AIRS constitutes an innovative atmospheric sounding group of visible, infrared, and microwave sensors that will provide measurements for temperature at an accuracy of 1°C in layers 1 km thick and humidity at an accuracy of 20 % in layers 2 km in the troposphere.

Besides the Level-1 radiance data, the new data set will contain the AIRS Level-2 products consisting of 26 parameters. These parameters are atmospheric temperature profiles (30 levels), troposphere height, stratosphere height, water vapor profile through the atmosphere, total precipitable water, cloud liquid-water content, precipitation indication, cloud-ice indication, cloud-top pressure, cloud-top temperature, fractional cloud cover, cloud spectral properties cloud type, ozone profile through the atmosphere, total ozone, methane, carbon monoxide, sea surface skin temperature, land surface skin temperature, infrared surface emissivity, microwave surface emissivity, clear-column radiance, OLR at the top of the atmosphere, outgoing shortwave radiation at the top of the atmosphere, net longwave flux at the surface and net shortwave flux at the surface.

All the data products will be released for public distribution in HDF-EOS format at the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) Distributed Active Archive Center (DAAC). The Goddard DAACs atmospheric Dynamics Data Support Team will provide science and data supports to assist users in understanding, accessing and using the AIRS data products. Services will include assistance in Level-1 and Level-2 products ordering and distribution, on-demand subsetting, tools for visualization and on-line analysis, access to various documents (such as data guides, readme, FAQ, technical notes), answering user questions. For more information about the data and the related support, please visit the DAACs AIRS web site at:

URL: http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/ atmospheric_dynamics/

A12A-0050 1330h POSTER

A Remote Sensing Study of the Urban Heat Island of Houston, Texas

David R. Streutker (713-348-3425; streutke@rice.edu)

Rice University, Department of Physics and Astronomy 6100 S Main St., Houston, TX 77005, United States

Radiative surface temperature maps of Houston, Texas were derived from satellite sensor data acquired at approximately 0400 LST on 27 separate occasions over a two year period. Urban-rural temperature differences were determined for 21 of these cases by modelling the urban heat island as a two-dimensional Gaussian surface superimposed on a planar rural background. The purpose of this study was to characterise the complete urban heat island in magnitude and spatial extent without the use of *in situ* measurements and to determine whether a correlation exists between heat island magnitude and rural temperature. The urban heat island magnitude was found to be inversely correlated with rural temperature, while the spatial extent was found to be independent of both heat island magnitude and rural temperature.

A12A-0051 1330h POSTER

Conceptual Modeling of the Climatic Role of Airborne Dust

Karen M. Shell[1] (1-858-534-6966; kshell@ucsd.edu)

Richard C. J. Somerville[1] (1-858-534-4644; rsomerville@ucsd.edu)

[1]Scripps Institution of Oceanography, Univ of California, San Diego 9500 Gilman Dr, Mail Code 0224, La Jolla, CA 92093

Airborne dust concentrations appear to be higher during glacial periods than interglacials, based on ice core, ocean sediment, and loess deposit data. In addition, humans have impacted the airborne dust distribution through land use changes. Because dust interacts with radiation (through absorption and scattering of solar radiation and absorption of terrestrial radiation), there is a possibility that these changes in dust loading could play a significant role in the climate.

An energy balance model comprised of a zonally averaged atmosphere overlying a land or ocean surface has been constructed to explore several possible mechanisms of dust-radiation interactions. Parameterized dust loading and dust transport algorithms interact with ice-albedo feedbacks and significantly alter the model climate. These idealized model results yield insights into possible climatic roles of airborne dust.

A12A-0052 1330h POSTER

Trace Element Enrichments in Dusts in Southwestern U.S. – Greater Than Pre-Anthropogenic, or Cant we Tell?

Todd K. Hinkley[1] (303-202-4828; thinkley@usgs.gov); Paul J. Lamothe[1] (303-236-1923; plamothe@usgs.gov); Gregory P. Meeker[1] (303-236-3188; gmeeker@usgsprobe.cr.usgs.gov); Xiao Jiang[1]; Mark E. Miller[2]; Robert Fulton[3]; David Trydahl[4] (dtrydahl@telis.org)

[1]U.S. Geological Survey, Federal Center, Lakewood, CO 80225, United States

[2]Grand Staircase Escalante Natnl. Mon., 180 W. 300 N., Kanab, UT, United States

[3]Calif. St. Univ. Desert Studies Ctr., Box 490, Baker, CA 92309, United States

[4]U. of Calif. White Mtns. Res. Stn., 200 Line St., Bishop, CA, United States

Modern dusts in the Southwestern U.S. commonly contain, or are accompanied by, larger amounts of ordinarily-rare trace elements than can be explained by the known compositions of the common minerals that constitute the dusts, or by the average composition of the earths crust. Whether the enrichment seen in these and other modern dusts is due to natural or industrial processes was a geochemical question until it was recently shown that pre-industrial dusts preserved in Antarctic ice are also enriched in trace elements (Matsumoto and Hinkley, 2001). Ordinarily-rare trace elements such as Zn, Cu, Pb, Cd, As, Se, Sb, and Bi are present in excess in modern Southwest dusts. Pb, Cd, In, Tl, and Ag were shown to be present in excess in old Antarctic ice.

We collected dusts in the Southwest in two ways: on dry deposition plates in lowland areas, and as strata of accumulated early-Spring snowpack in higher snow-covered areas. Antarctic ice was from the Taylor Dome core, and represents pre-industrial atmospheric deposition (1,000 27,000 y.b.p.). Non-explosive worldwide volcanic emissions appear to be the source of the trace element enrichment in old Antarctic dusts. Enrichment factors for trace elements (the factor by which the concentration of an element is greater than in the average crust of the earth) are commonly between 10 and 100 in the modern dusts, slightly higher in the Antarctic ice, although they vary by element and by sample type. In the Southwest, trace elements are especially abundant in fine-grained dusts.

The degrees of enrichment of trace elements in both the ancient dusts and fine-grained modern dusts are similar enough that it is not possible to attribute an anthropogenic component to the extra trace elements that accompany the modern dusts. The natural background of trace elements in dusts in the atmospheric load constitutes, at the least, an important baseline component for the trace element enrichment found in modern dusts. Trace element loads of modern and ancient dust are indistinguishable at present state of knowledge.

URL: http://climweb.cr.usgs.gov/info/sw/

A12A-0053 1330h POSTER

Vertical profiles of ozone, water vapor and meteorological parameters and boundary-layer conditions at Summit, Greenland during June 2000

Detlev Helmig[1] ((303) 492-2509; detlev@terra.colorado.edu); Joseph G Alfieri[1,2] ((303) 735-7804; JGAlfieri@aol.com); James Boulter[2,5] ((303) 492-6535; Jim.Boulter@Colorado.EDU); Donald David[3] ((303) 735-4727; don@terra.colorado.edu); John Birks[3] ((303) 492-7018; birks@terra.colorado.edu); Nicolas Cullen[2,3] ((303) 492-6881; cullenn@cires.colorado.edu); Konrad Steffen[2,3] ((303) 492-4524; koni@seaice.colorado.edu); Bryan Johnson[4] ((303) 497-6842; bjohnson@cmdl.noaa.gov); Samuel Oltmans[4] ((303) 497-6676; Samuel.J.Oltmans@noaa.gov)

[1]Institute for Alpine and Arctic Research (INSTAAR), University of Colorado, Boulder, CO 80309-0450, United States

[2]Geography Department, University of Colorado, Boulder, CO 80309-0260, United States

[3]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309-0216, United States

[4]National Oceanic and Atmospheric Adminstration (NOAA), 325 Broadway, Boulder, CO 80305, United States

[5]SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025, United States

The temporal and spatial distribution of boundary-layer ozone was studied during June 2000 at Summit, Greenland by surface-level measurements and vertical profiling from a tethered balloon. Three weeks of continuous ozone surface data and 133 meteorological and 82 ozone vertical profile data sets were collected from the surface to a maximum altitude of 1400 m above ground. The lower atmosphere at Summit was characterized by the prevalence of high stability conditions with strong surface temperature inversions. These inversions succumbed to neutral to slightly unstable conditions between appr. 9.00 and 18.00 hrs local time with the formation of shallow mixing heights of typically 70-250 m above the surface. Surface ozone ranged from 39 to 68 ppbv and occasionally had rapid changes of up to 20 ppb in 12 hours. The diurnal mean ozone mixing ratio showed distinct cycles indicating meteorological and photochemical controls of surface ozone. Vertical profiles were within the range of 37 to 76 ppb and showed strong stratification in the lower troposphere. A high correlation of high ozone/low water vapor indicated the transport of high tropospheric/low stratospheric air into the lower boundary layer. An appr. 1 to 4 ppb decline of ozone towards the surface was frequently observed within the neutrally stable mixed layer during midday hours. These observations suggest that the boundary-layer ozone and ozone depletion/deposition to the snowpack are influenced by photochemical processes that follow diurnal dependencies.

A12B MC: 133 Monday 1330h

Current Understanding of Tropospheric Aerosol: Advances in Laboratory and Field Measurements II

Presiding: **A M Middlebrook,** NOAA Aeronomy Laboratory**; R S Disselkamp,** Pacific Northwest National Laboratory

A12B-01 1330h

Laboratory Studies of Sulfuric Acid Aerosol Formation, Growth and Coagulation

James W Morris[1] (617-552-3632; morrisjz@bc.edu); Paul Davidovits[1] (paul.davidovits@bc.edu); John T Jayne[2]; Charles E Kolb[2]; Douglas R Worsnop[2]; Darren D Obrigkeit[3]; Gregory J McRae[3]

[1]Boston College, Chemistry Department, Chestnut Hill, MA 02467-3809

[2]Aerodyne Research Inc., 25 Manning Rd., Billerica, MA 01821-3976

[3]Massachusetts Institute of Technology, Department of Chemical Engineering, Cambridge, MA 02139

Laboratory measurements involving nucleation, condensation, and coagulation of sulfuric acid are described. Studies were carried out using a laminar flowtube at atmospheric pressure coupled to an aerosol mass spectrometer (AMS). A sulfuric acid reservoir heated to a known temperature was connected to the flowtube via heated tubing. Dry filtered nitrogen carrier gas was pre-heated and passed over the reservoir entraining an equilibrium density of the H2SO4(g) to the flowtube. The entrance to the flowtube was heated to a temperature above that of the reservoir, establishing a well-characterized decreasing temperature profile along the flowtube axis. Supersaturation (and consequent nucleation and growth) conditions were reached at a position within the flowtube determined by the temperature profile and the H2SO4 vapor pressure. The number and mass distributions of the particles formed in this way were measured on-line by the AMS at the flowtube exit. With the entrance of the flowtube at 150 C, particles were first observed at a H2SO4 vapor pressure of 10-4 torr forming particles at a number density of 104 cm-3. As the pressure increased to 3x10-2 torr, the particle number density increased to 107 cm-3. However, the median diameter increased only from 40 to 50 nm. At pressures higher than 4x10-3 torr, the size distributions were observed to exhibit broadening and a new mode appeared near 60nm, consistent with coagulation. A third mode appeared at H2SO4 pressures near 3x10-2 torr indicating further coagulation. This work is a first time on-line laboratory observation of sulfuric acid microphysics spanning nucleation and coagulation processes. The features of the apparatus enabling absolute detection of mass and number distributions will be discussed.

A12B-02 1345h INVITED

Phase Transitions of Aqueous Atmospheric Particles

Scot T Martin (617 495 7620; smartin@deas.harvard.edu)
Harvard University, 29 Oxford St., Pierce Hall, Cambridge, MA 02138, United States

The physical state of atmospheric particles affect their optical properties, their chemical reactivity, and their atmospheric lifetime. Accordingly, the prediction of particle phase is critical for accurate atmospheric modeling. Atmospheric aqueous particles, due to their small size (submicron), can deeply supercool with respect to freezing (e.g., 40 K) and deeply supersaturate (e.g., S = 35) with respect to relative humidity before crystallization begins via homogeneous nucleation. Atmospheric mineral dusts, incorporated as inclusions within aqueous particles, provide active surfaces to induce crystallization heterogeneously and thus drastically reduce the extent of supercooling (e.g., 20 K) or supersaturation (e.g., S = 5). This talk will present laboratory and theoretical work on several systems, including sulfates, nitrates, and mineral dusts. The results are crucial to providing a quantitative microphysical model that couples the interactions of these particle classes in the atmosphere.

A12B-03 1415h

Ice Phase Transitions by Atmospheric Aerosol Particles of Varied Composition

Paul J DeMott[1] (9704918257; pdemott@lamar.colostate.edu); Anthony J Prenni[1] (9704918414; tony@aerosol.atmos.colostate.edu); Cassie A Archuleta[1] (9704918641; cassie@aerosol.atmos.colostate.edu); Sonia M Kreidenweis[1] (9704918350; soniak@aerosol.atmos.colostate.edu); Daniel J Cziczo[2] (3034973755; djcziczo@al.noaa.gov); Daniel M Murphy[2] (3034975640; dmurphy@al.noaa.gov); David S Thomson[2] (3034973470; dthomson@al.noaa.gov)

[1]Colorado State University, Department of Atmospheric Science, Fort Collins, CO 80523-1371, United States

[2]NOAA Aeronomy Laboratory, 325 Broadway, R/AL6, Boulder, CO 80305, United States

This paper describes laboratory and field study measurements of water uptake and ice nucleation by surrogate and real atmospheric aerosol particles. Laboratory measurements of water uptake are made using a humidified tandem differential mobility analyzer (HT-DMA) and a cloud condensation nucleus (CCN) instrument operating at 20 to 30 $^{\circ}$C. Measurements of ice nucleation are made using a continuous flow ice-thermal diffusion chamber (CFDC) operated to -60 $^{\circ}$C for relevance toward understanding cirrus cloud formation.

Extending earlier laboratory studies of single composition aerosols, we are investigating water uptake and ice nucleation rates and mechanisms by mixed aerosols of various types, including sulfate-nitrate, sulfate-organic, mineral oxide-sulfate and black carbon-sulfate types. Methodologies will be described and results will be summarized.

Field measurements are planned to study heterogeneous and homogeneous ice nucleation by free tropospheric aerosols at a high altitude laboratory. The field study will include measurements of the compositions of aerosols that activate ice formation by homogeneous and heterogeneous ice nucleation mechanisms. This aspect of the study will be facilitated by interfacing the CFDC to the PALMS (Particle Analysis by Laser Mass Spectrometry) instrument. This combined instrument system was tested in the laboratory to quantify sampling efficiencies and validate specificity for sampling ice nucleus aerosol particles. Initial field data, if available at conference time, will be compared and contrasted with the results obtained for laboratory surrogate particles.

A12B-04 1430h

Heterogeneous Reactions on Mineral Dust: Surface Reactions of Sulfur Dioxide, Ozone, Nitric Acid and Acetic Acid on Oxide and Carbonate Particles

Vicki H Grassian[1] (319-335-1392; vicki-grassian@uiowa.edu); Hashim Ali[1] (319-335-1358; hashim-ali@uiowa.edu); Hind Al-Abadleh[1] (319-335-1358; hind-al-abadleh@uiowa.edu); Sofia Carlos-Cuellar[1] (319-335-1358; sofia-carlos-cuellar@uiowa.edu); Brenda Krueger[1] (319-335-1358; bksquared@hotmail.com); Courtney Usher[1] (319-335-1358; courtney-usher@uiowa.edu)

[1]Department of Chemistry, University of Iowa, Iowa City, IA 52246, United States

The role of heterogeneous reactions on particulate matter present in the Earth's atmosphere remains an important question in tropospheric chemistry. It has been proposed in several modeling studies that mineral dust may provide reactive surfaces for trace atmospheric gases. Laboratory studies can provide some answers concerning the kinetics of these reactions so that heterogeneous chemistry can be quantitatively assessed in atmospheric chemistry models. In our work, the heterogeneous chemistry of trace atmospheric gases including sulfur dioxide, ozone, nitric acid and acetic acid on oxide (e.g. hematite, corundum and quartz) and carbonate (e.g. calcite) particles has been investigated. These particles are used as models for mineral dust found in the atmosphere. FT-IR spectroscopy is used to interrogate the surface of the particles as they are exposed to trace atmospheric gases in order to gain additional insight into the surface chemistry. Initial uptake coefficients on powdered samples have been measured using a Knudsen cell reactor so as to quantify the rates of these reactions. The uptake kinetics have been measured as a function of powder sample mass to insure that realistic surface areas are used in the calculation of the initial uptake coefficient. The heterogeneous reaction rates are then compared to known gas-phase chemical and photochemical reaction rates for the trace atmospheric gases investigated. From this comparison, the atmospheric implications of these heterogeneous reactions are discussed.

A12B-05 1445h

Kinetics of Trace Gas Uptake by Liquid Surfaces

Charles E. Kolb[1] (978-663-9500, x290; kolb@aerodyne.com)

Paul Davidovits[2] (617-552-3617; paul.davidovits@bc.edu)

Douglas R. Worsnop[1,2] (978-663-9500, x225; worsnop@aerodyne.com)

Quan Shi[1] (978-663-9500, x280; shiq@aerodyne.com)

John T. Jayne[1] (978-663-9500, x233; jayne@aerodyne.com)

[1]Center for Aerosol and Cloud Chemistry, Aerodyne Research, Inc., Billerica, MA 01821-3976, United States

[2]Department of Chemistry, Boston College, Chestnut Hill, MA 02467-3809, United States

Over the past quarter century atmospheric scientists have gradually come to realize that "heterogeneous" or "multi-phase" gas/liquid processes play a major role in the chemistry of the Earths lower atmosphere. As we better appreciate the role of atmospheric heterogeneous processes their complex nature has become clear. The uptake of pollutants by atmospheric aerosol particles and cloud droplets and their subsequent chemical transformation often depends not only on simple mass accommodation and re-evaporation, but also on a range of other chemical and mass transport parameters, including: gas and liquid phase diffusion, solubility, and both liquid surface and bulk liquid reaction.