convection is suppressed, all normal modes of the system are stable or have very small growth rates (time scales of several days). However, rapid perturbation growth can still occur through non-modal interaction.

For conditions in which convection is promoted, large growth rates are found for normal modes in addition to the optimal perturbation. In that case, growth is primarily promoted by deep convection and vertical diffusion, while it is damped by large-scale stable condensation. The comparison of results from two different basic states demonstrate the nonlinearity of the single column model. Nevertheless, for even the convectively active basic state, linear behavior is apparent for several hours, comparable to the lifetime of tropical convection.

A51G-08 1054h

A Lagrangian Approach to the Validation of Spatio-temporal Cloud Properties in a General Circulation Model Using Geostationary Satellite Imagery

Eric M. Wilcox[1] (858-534-7757; ewilcox@ucsd.edu)

V. Ramanathan[1] (vramanathan@ucsd.edu)

[1]Scripps Institution of Oceanography, UCSD, 9500 Gilman Dr, La Jolla, CA 92093-0221, United States

The validation of cloudiness in general circulation models has traditionally been done by comparing time-averaged quantities, such as monthly mean cloud cover, with available observations. This approach ignores the dynamical aspects of clouds such as their lifecycle characteristics, areal coverage, temporal duration, and internal variability. Accurate simulation of the radiative forcing by clouds, and prediction of feedbacks associated with cloud cover require that the model properly represent of the spatial and temporal properties of clouds. In this study, a new Lagrangian approach to the validation of modeled tropical cloudiness is explored. An automated cloud detection and tracking algorithm is used to observe and track overcast decks of cloud with scales from 300 km to greater than 3000 km in a consecutive set of half-hourly METEOSAT-5 images and the NCAR Community Climate Model (CCM3). The algorithm is applied to the deep convective cloud systems of the tropical Indian Ocean region during the 1999 winter monsoon season. The standard diagnostic scheme used to predict cloud cover in the model is based on relationships with convective mass flux and relative humidity. The cloud fraction field is completely recalculated each model hour, hence the simulated clouds have no inherent lifetime, excepting for the time scales associated with large-scale moisture transport. This is consistent with the assumption that the lifetime of cloud material and cloud formation processes are of the same order as the model time step. In contrast, METEOSAT-5 imagery reveals that cloud cover associated with winter monsoon convection is dominated by semi-permanent overcast decks of anvil and cirrus cloud, which persist for durations of days to weeks. Statistics are compiled and compared based on large ensembles of both observed clouds and modeled clouds whose properties, such as areal coverage, temporal duration and cloud-averaged precipitation rate, have been observed throughout the lifecycle of each cloud. This approach tests whether the relationships between convection, relative humidity and cloud fraction presently applied in global-scale models of climate are sufficient to simulate the evolution and spatio-temporal scales of cloud systems associated with tropical deep convection.

A51G-09 1110h

A test for evaluating the downscaling ability of one-way nested regional climate models: the Big-Brother Experiment

Bertrand Denis[1] (514-987-3000 3302; bdenis@ec.gc.ca)

Rene Laprise[1] (514-987-3000 3302; laprise.rene@uqam.ca)

Ramon de Elia[1] (514-987-3000 3302; relia@maia.sca.uqam.ca)

daniel Caya[1] (514-987-3000 3302; caya.daniel@uqam.ca)

Jean Cote[1] (514-987-3000 2572; jean.cote@ec.gc.ca)

[1]University of Quebec at Montreal, Dept. Sc. terre-Atmos. CP 8888, Succ A, Montreal, QC H3C 3P8, Canada

The purpose of this research is to evaluate the downscaling ability of one-way nesting regional climate models (RCM). To do this, a rigorous and well-defined experiment for assessing the reliability of the one-way nesting approach is developed. This experiment, baptised the Big-Brother Experiment (BBE), is used for addressing some important one-way nesting issues.

The BBE consists in first establishing a reference virtual-reality climate from an RCM simulation using a large and high-resolution domain. This simulation is called the "Big Brother". This big-brother simulation is then degraded toward the resolution of today's global objective analyses (OA) and/or global climate models (GCM) by removing the short scales. The resulting fields are then used as nesting data to drive an RCM (called the "Little Brother") which is integrated at the same high-resolution as the Big Brother, but over a sub-area of the big-brother domain. The climate statistics of the Little Brother are then compared with those of the big-brother simulation over the little-brother domain. Differences between the two climates can thus be unambiguously attributed to errors associated with the dynamical downscaling technique, and not to model errors nor to observation limitations. In this talk, we present results of BBEs showing the sensitivity of a RCM to the spatial resolution and temporal update frequency of the lateral boundary conditions.

A51G-10 1126h

Comparison of AMIP and CMIP: How Much Does a "Perfect Ocean" Help Climate Simulation?

Curt Covey[1] (925-422-1828; covey1@llnl.gov)

Krishna M. AchutaRao[1] (achutarao1@llnl.gov)

Peter J. Gleckler[1] (gleckler1@llnl.gov)

Karl E. Taylor[1] (taylor13@llnl.gov)

Michael F. Wehner[1] (mwehner@llnl.gov)

[1]PCMDI, LLNL Mail Code L-264, 7000 East Avenue, Livermore, CA 94550, United States

Results from several atmospheric general circulation models, run with sea surface temperature and sea ice amounts prescribed to observed values for the period 1979-1994, can be compared with "control run" simulations by the same atmosphere models coupled to ocean and sea ice models. The simulations with prescribed SST and sea ice are available from the Atmospheric Model Intercomparison Project (AMIP), and coupled ocean-atmosphere simulations are available from the Coupled Model Intercomparison Project (CMIP).

In preliminary work, we have compared CMIP runs from both the NCAR Climate System Model (CSM) and the US Department of Energy - sponsored Parallel Climate Model (PCM) with an AMIP run of their common atmosphere model, the NCAR Community Climate Model Version 3 (CCM3). All three simulations have common weaknesses that presumably orginate in the atmospheric model. Replacement of the CCM3's "perfect ocean" with either the CSM's or PCM's ocean model degrades the level of agreement with observations for most fields, but r.m.s. errors in atmospheric variables from the coupled simulations are surprisingly similar to those from the simulation in which SST and sea ice are prescribed to observations.

This work was performed under auspices of the U.S. Department of Energy by University of California Lawrence Livermore National Laboratory under contract No. W-7405- Eng-48.

URL: http://www-pcmdi.llnl.gov/cmip

A51G-11 1142h

Diagnosis of Climate Model Simulations by Downscaling With a High-Resolution Regional Model

Gonzalo Miguez-Macho[1] (732-932-4958; gonzalo@envsci.rutgers.edu)

Alan Robock[1] (732-932-9478; robock@envsci.rutgers.edu)

Georgiy Stenchikov[1] (732-932-3637; gera@envsci.rutgers.edu)

Christopher Weaver[1] (732-932-7902; weaver@cep.rutgers.edu)

[1]Department of Environmental Sciences, Rutgers University, 14 College Farm Rd., New Brunswick, NJ 08901, United States

Climate models must parameterize subgrid-scale processes, and the diagnosis of the consequences of these simplifications and development of better parameterizations is an important part of improving climate simulations. Here we use a dynamical downscaling technique as a method of evaluating the performance of climate simulations from a coarse resolution general circulation model (GCM). For the eastern part of the United States, we first validate a regional model (Regional Atmospheric Modeling System - RAMS) by driving it with real atmospheric data (NCEP reanalysis) and compare the results to actual observations. RAMS is then nested within the NASA Goddard Institute for Space Studies GCM, using the same technique as when driven by reanalysis data. We compare the downscaled results to the GCM-scale simulations and to observations to identify systematic deficiencies in the GCM performance.

A51H MC: 133 Friday 0830h

Chemistry and Transport Near the Tropopause: Results From the 1999 and 2000 ACCENT WB-57F Field Campaigns I

Presiding: **R Friedl,** Jet Propulsion Laboratory**; K Rosenlof,** NOAA**; M Ross,** The Aerospace Corporation

A51H-01 0830h

Investigations of Rocket Engine Combustion Emissions During ACCENT

Martin N Ross[1] (310 336 0360; martin.n.ross@aero.org)

Randall R Friedl[2] (818 354 3800; rfriedl@jpl.nasa.gov)

[1]The Aerospace Corporation, PO Box 92957, Los Angeles, CA 90008

[2]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109

The composition of rocket combustion emissions and the atmospheric processes that determine their stratospheric impacts are poorly understood. While present day rocket emissions do not significantly affect stratospheric chemistry, the potential for vigorous growth of the space transportation industry in coming decades suggests that rocket emissions and their stratospheric impacts should be better understood. A variety of in-situ measurements and modeling results were obtained during the Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT) effort that will be used to evaluate the role of rocket exhaust in perturbing ozone chemistry in plume wakes and in the global stratosphere. We present a review of the ACCENT rocket emissions science objectives, summarize data obtained during the WB-57F plume wake sorties, and briefly discuss how the data will help resolve several outstanding questions regarding the impact of rocket emissions on the stratosphere. These include measurement of the emission indices for several important rocket engine combustion products and validation of plume wake chemistry models.

A51H-02 0845h INVITED

Distributions of NOy, HNO3, and NO During the Sept. 1999 ACCENT Flights Including an Athena Rocket Plume

B A Ridley[1] (303 497 1420; ridley@ucar.edu); J G Walega[1]; F E Grahek[1]; J A Neuman[3]; R S Gao[2]; P J Popp[3]; D W Fahey[2]; J C Holecek[3]; E C Richard[3]

[1]Atmospheric Chemistry Division, NCAR, P O Box 3000, Boulder, CO 80307, United States

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

[3]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309, United States

Total reactive nitrogen NOy and NO were measured on 6 flights of the WB57 between 4 km in the troposphere and 18 km in the lower stratosphere during the September 1999 ACCENT missions. HNO3 was measured on several flights using a chemical ionization mass spectrometer instrument. The flights were based from Ellington Field, south of Houston, Texas and examined the region above hurricane Floyd, aircraft emissions in the neighborhood of the Dallas/Fort Worth airport, and the tropical upper troposphere/lower stratosphere on a flight which terminated in Costa Rica. An overview of the distributions and some aspects of the changes in partitioning of NOy between the troposphere and lower stratosphere are given. On one flight successive passes were made through the exhaust plume of an Athena II rocket that is powered by a solid rocket motor. The passes covered a plume age of 5 to 40 min. NO in the plume was depleted as expected but the HNO3/NOy ratio was apparently much larger than can be accounted for by known gas phase processes.

A51H-03 0900h

The Emission and Chemistry of Reactive Nitrogen Species in the Plume of an Athena II Rocket

Peter J. Popp[1] (303-497-5181; ppopp@al.noaa.gov); R. S. Gao[1] (gao@al.noaa.gov); J. A. Neuman[1] (jneuman@al.noaa.gov); M. J. Northway[1] (mnorthway@al.noaa.gov); J. C. Holecek[1] (jholecek@al.noaa.gov); D. W. Fahey[1] (fahey@al.noaa.gov); C. Wiedinmyer[1] (cwiedinm@du.edu); C. A. Brock[1] (cbrock@al.noaa.gov); B. A. Ridley[2] (ridley@acd.ucar.edu); J. G. Walega[2] (walega@ncar.ucar.edu); F. E. Grahek[2] (knarf@ucar.edu); J. C. Wilson[3] (jwilson@du.edu); J. M. Reeves[3] (jreeves@du.edu); D. W. Toohey[4] (darin.toohey@colorado.edu); L. M. Avallone[4]; B. F. Thornton[4] (brett.thornton@colorado.edu); A. M. Gates[4] (amelia.gates@colorado.edu); M. N. Ross[5] (martin.n.ross@aero.org); P. F. Zittel[5] (paul.f.zittel@aero.org)

[1]NOAA Aeronomy Laboratory, 325 Broadway, Boulder, CO 80210, United States

[2]National Center for Atmospheric Research, Boulder, CO 80307, United States

[3]University of Denver, Denver, CO 80208, United States

[4]University of Colorado, Boulder, CO 80309, United States

[5]The Aerospace Corporation, Los Angeles, CA 90009, United States

In situ measurements of total reactive nitrogen (NO_y), nitric acid (HNO_3), and particles were conducted in the plume of an Athena II rocket launched from Vandenberg AFB on September 24, 1999. These measurements were obtained onboard the NASA WB-57F high-altitude research aircraft as part of the Atmospheric Chemistry of Combustion Emissions near the Tropopause (ACCENT) mission. The calculated NO_y emission index, determined from measurements made during the first 3 of 6 plume intercepts, was $2.1 \pm 1.0 gNO_2$/kg propellant, consistent with far-field rocket plume model calculations. Although nitric oxide (NO) is thought to be the primary NO_y species formed in the Athena solid rocket motor (SRM) and by hot afterburning in the plume, measurements in the plume as soon as 4 minutes after emission indicate that HNO_3 is the dominant NOy species. In the chlorine-rich plume, NO is converted to chlorine nitrate ($ClONO_2$) which reacts with water on emitted alumina particles to form HNO_3. The data suggest HNO_3 remains absorbed on alumina particles. With the potential increase in launch vehicle traffic in the coming decades, accurate modeling of the global impact of current and future rocket fleets will require the use of emission indices validated by observations.

A51H-04 0915h INVITED

Darin Toohey[1] (303-735-0002; toohey@colorado.edu); Linnea Avallone[2] (avallone@lasp.colorado.edu); Amelia Gates[2]; Brett Thornton[3] (brett.thornton@colorado.edu); Erik Richard[4] (Erik.C.Richard@noaa.gov); Ken Kelly[4] (Kenneth.K.Kelly@noaa.gov)

[1]University of Colorado, Program in Atmospheric and Oceanic Sciences, Boulder, CO 80309-0311, United States

[2]University of Colorado, Laboratory for Atmospheric and Space Physics 1234 Innovation Drive, Boulder, CO 80303-7814, United States

[3]University of Colorado, Dept. of Chemistry and Biochemistry, Boulder, CO 80309-0215, United States

[4]NOAA Aeronomy Laboratory, R/AL DSRC, Boulder, CO 80305-3328, United States

Fast-response measurements of reactive chlorine (Cl+ClO), carbon dioxide (CO_2), ozone (O_3) and methane (CH_4) were obtained on a number of flights of the WB-57 aircraft into the plumes of rockets. These measurements occurred during the RISO and ACCENT missions in the plumes of the following rockets: Delta (May 1998 and April 1999), Atlas (June 1998 and April 1999), Athena (September 1999) and Space Shuttle (September 2000). These observations have provided a solid foundation for assessing the immediate post-launch impact of rocket exhaust on atmospheric ozone abundances. In addition, the time evolution of these species traces out the complex photochemistry of inorganic chlorine in the lower stratosphere in a way that allows us to examine the rates of key reactions that are important in the background stratosphere. The highly non-linear behavior of Cl and ClO at near-zero abundances of O_3 as the plume ages and mixes with ambient air provides a unique window on small-scale (tens of meters) dynamical processes. In this talk we highlight the key observations that provide insight into important stratospheric photochemical and dynamical processes.

A51H-05 0930h

Comparison of ACCENT 2000 Shuttle Plume Data with SIMPLE Model Predictions

P K Swaminathan[1] (240-228-3950; swaminathan@jhuapl.edu)

Jeff C Taylor[1] (240-228-7826; jeff.taylor@jhuapl.edu)

Martin N Ross[2] (310-336-0360; martin.n.ross@aero.org)

Paul F Zittel[2] (310-336-6642; paul.f.zittel@aero.org)

Steve A Lloyd[1] (240-228-8164; steve.lloyd@jhuapl.edu)

[1]The Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723-6099, United States

[2]The Aerospace Corporation, P.O. Box 92957, Los Angeles, CA 90009-2957, United States

The JHU/APL Stratospheric IMpact of PLume Effluents (SIMPLE)model was employed to analyze the trace species in situ composition data collected during the ACCENT 2000 intercepts of the space shuttle Space Transportation Launch System (STS) rocket plume as a function of time and radial location within the cold plume. The SIMPLE model is initialized using predictions for species depositions calculated using an afterburning model based on standard TDK/SPP nozzle and SPF plume flowfield codes with an expanded chemical kinetic scheme. The time dependent ambient stratospheric chemistry is fully coupled to the plume species evolution whose transport is based on empirically derived diffusion. Model/data comparisons are encouraging through capturing observed local ozone recovery times as well as overall morphology of chlorine chemistry.

A51H-06 0945h INVITED

Single Particle Studies in the Upper Troposphere and Lower Stratosphere During ACCENT

Daniel J. Cziczo[1,2] (303-497-3755; djcziczo@al.noaa.gov)

Daniel M. Murphy[1] (303-497-5640; murphyd@al.noaa.gov)

David S. Thomson[1,2] (303-497-3470; dthomson@al.noaa.gov)

[1]NOAA Aeronomy Lab, 325 Broadway R/AL6, Boulder, CO 80305, United States

[2]CIRES , The University of Colorado, Boulder, CO 80309, United States

In situ measurements of individual aerosol particle chemical composition between 5 and 19 kilometers altitude during ACCENT and ACCENT 2000 revealed that upper tropospheric particles often contained more organic material than sulfate. Mass spectral NO^+ and OH peaks increased at temperatures below 195 K, providing evidence for the uptake of H_2O and HNO_3 by aerosols near the tropopause. Stratospheric aerosols were observed to consist primarily of sulfuric acid and water but with 5 wt% meteoritic material in 50% of particles. Mercury was found in over half the particles sampled just above the tropopause. Studies of aerosol particles were performed using the Particle Analysis by Laser Mass Spectrometry (PALMS) instrument mounted in the nose of the WB-57 high altitude research aircraft. Individual particles were brought into a vacuum system where light scattering was used to ascertain a rough size and trigger an excimer laser (193 nm). The laser was pulsed to hit each aerosol and desorb and ionize molecules and atoms. A complete mass spectrum was then provided by a time of flight mass spectrometer. Overall, a tremendous variety of aerosol particles was observed, with at least 45 elements detected. The results imply a wide diversity of particle sources and chemistry and may offer a possible means for understanding the transport of atmospheric aerosols.

URL: http://www.al.noaa.gov/PALMS/

A51H-07 1020h

Particle Size Distributions Measured in the Stratospheric Plumes of Three Rockets During the ACCENT Missions

Christine Wiedinmyer[1] (303.497.3310; cwiedinmyer@al.noaa.gov); Chuck A. Brock[1] (303.497.3795; cbrock@al.noaa.gov); John Michael Reeves[1] (303.871.3283; jreeves@du.edu); Martin N. Ross[2] (310.336.0260; Martin.N.Ross@aero.org); Otmar Schmid[1] (303.871.2813; oschmid@du.edu); Darin Toohey[3] (303.735.0002; Darin.Toohey@colorado.edu); James C. Wilson[1] (303.871.3002; Jwilson@du.edu)

[1]University of Denver Department of Engineering, 2390 South York St., Denver, CO 80208

[2]The Aerospace Corporation, PO Box 92957, Los Angeles, CA 90009

[3]Program in Atmospheric and Oceanic Sciences University of Colorado at Boulder , 311 UCB University of Colorado, Boulder, CO 80309-0311

The global impact of particles emitted by rocket engines on stratospheric ozone is not well understood, mainly due to the lack of comprehensive in situ measurements of the size distributions of these emitted particles. During the Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT) missions in 1999, the NASA WB-57F aircraft carried the University of Denver N-MASS and FCAS instruments into the stratospheric plumes from three rockets. Size distributions of particles with diameters from 4 to approximately 2000 nm were calculated from the instrument measurements using numerical inversion techniques. The data have been averaged over 30-second intervals. The particle size distributions observed in all of the rocket plumes included a dominant mode near 60 nm diameter, probably composed of alumina particles. A smaller mode at approximately 25 nm, possibly composed of soot particles, was seen in only the plumes of rockets that used liquid oxygen and kerosene as a propellant. Aircraft exhaust emitted by the WB-57F was also sampled; the size distributions within these plumes are consistent with prior measurements in aircraft plumes. The size distributions for all rocket intercepts have been fitted to bimodal, lognormal distributions to provide input for global models of the stratosphere. Our data suggest that previous estimates of the solid rocket motor alumina size distributions may underestimate the alumina surface area emission index, and so underestimate the particle surface area available for heterogeneous chlorine activation reactions in the global stratosphere.

A51H-08 1035h INVITED

Trace Gas Observations in the Upper Troposphere During ACCENT

Elliot Atlas[1] (atlas@acd.ucar.edu); Stephen Donnelly[1] (donnelly@acd.ucar.edu); Sue Schauffler[1] (sues@acd.ucar.edu); Verity Stroud[1] (fridd@acd.ucar.edu); Henry Selkirk[2] (hselkirk@mail.arc.nasa.gov); Randy Friedl[3] (rfriedl@jpl.nasa.gov)

[1]National Center for Atmospheric Research, Atmospheric Chemistry Division PO Box 3000, Boulder, CO 80307, United States

[2]NASA Ames Research Center, Ames Research Center Moffett Field, Moffett Field, CA 94035, United States

[3]Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA 91109, United States

Whole air samples collected on board the WB-57 aircraft during the ACCENT mission were analyzed for a wide range of volatile organic trace gases to examine trace gas composition, distribution, and possible source regions for upper tropospheric air masses. The trace gases measured include CO, methane, C2-C5 nonmethane hydrocarbons, methyl halides, halogenated solvents, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and C1-C4 alkyl nitrates. The utility of measuring different types of VOC as tracers will be discussed with an example from flights over the Gulf of Mexico. During one of these flights, levels of methyl nitrate and correlation to CO in the upper troposphere suggested convective uplift and horizontal transport from Eastern Tropical Pacific, where prior measurements have shown a uniquely strong source of methyl nitrate in the equatorial marine boundary layer. In addition to this example, distributions of other trace gases measured during the ACCENT mission will be discussed and compared to previous measurements in the upper troposphere.

A51H-09 1050h

Upper Tropospheric-Lower Stratospheric In-Situ Measurements Over Hurricane Floyd: The Impact of Tropical Cyclones on Stratosphere-Troposphere Exchange

Erik C Richard[1] (303 497 3536; richard@al.noaa.gov); Karen H Rosenlof[1] (303 497 7761; rosenlof@al.noaa.gov); Eric A Ray[1] (303 497 7628; eray@al.noaa.gov); Kenneth K Kelly[1] (303 497 3355; kellyk@al.noaa.gov); Thomas L Thompson[1] (303 497 3410; tlt@al.noaa.gov); Michael J Mahoney[2] (michael.j.mahoney@jpl.nasa.gov)

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

[2]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

The structure of hurricanes from the surface up to 200 mb (12 km) has been extensively studied. However, because of operational limitations of aircraft, very little in-situ information has been obtained within the hurricane environment in the upper troposphere-lower stratosphere (UT/LS). During the ACCENT experiment the WB-57 overflew Hurricane Floyd as it made landfall near the Georgia-South Carolina coastal boarder. High time resolution in-situ chemical measurements of ozone, methane and water vapor as well as meteorological data were obtained over a large area above Floyd, including regions of the eye-wall and eye. Two days prior, a similar flight track was followed by the WB-57 allowing for a comparison study of the influence of Floyd on the UT/LS region. In the UT/LS, ozone and methane serve as conserved tracers of stratospheric and tropospheric air, respectively and are used to compare the characteristics of the air masses. A comparison of the vertical profiles between the tropopause and 80 mb (18 km) for these two days shows lower water vapor, lower ozone and higher methane mixing ratios during the Floyd overflight. The results are consistent with local dehydration occurring above the storm, while the lower ozone and higher methane are indicative of upward transport of ozone poor and methane rich tropospheric air. In an attempt to quantify the mass flux into the stratosphere induced by Floyd we have performed an NCAR Mesoscale Model 5 (MM5) simulation. These results are compared with the in-situ data to assess the influence of Floyd on the stratosphere above the 400 K potential temperature level. Additionally, these results allow us to address the validity of the satellite results from the Total Ozone Mapping Spectrometer (TOMS) where local changes in the total ozone column have been used to elucidate hurricane evolution.

A51H-10 1105h

Horizontal variability 1-2 km below the tropical tropopause

Susan Hovde[1,3] (303 497-5217; hovde@al.noaa.gov); Adrian F Tuck[1] (tuck@al.noaa.gov); Kenneth Kelly[1]; Erik Richard[1,3]; Karen Rosenlof[1]; Stephen Reid[1,3]; Eric Ray[1,3]; Elliot Atlas[4]; Stephen Donelly[4]; Verity Stroud[4]; James Elkins[3]; Fred Moore[2,3]

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

[2]NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305, United States

[3]CIRES/NOAA, 325 Broadway, Boulder, CO 80305

[4]National Center for Atmospheric Research, PO Box 3000, Boulder, CO 80307, United States

On 19990920 and 19990921 the WB-57F aircraft flew horizontal legs between the subtropics and the tropics at pressures near 120 hPa, 1-2 km below the tropopause at longitudes between 85°W and 95°W. The ozone varied between 10 and 125 ppbv, the total water varied between 5 and 20 ppmv. The ITCZ was situated near 15°N, with the flights extending between 5°N and 30°N, and was locatable by cloud images. We examine structure in tracers along these flight tracks, with lifetimes ranging from 2 days (methyl iodide) to decades (trichlorofluoromethane). Analyses are performed to partition the recent history of the air between troposphere and stratosphere, from both sides of the ITCZ.

A51H-11 1120h

Dynamical Contributions to Midlatitude Ozone Trends

Stephen J. Reid[1] (303-497-7942; sreid@al.noaa.gov)

Adrian F. Tuck[2] (303-497-5485; tuck@al.noaa.gov)

George N. Kiladis[2] (303-497-3892; gkiladis@al.noaa.gov)

[1]University of Colorado, Campus Box 216, Boulder, CO 80309-0216

[2]NOAA Aeronomy Laboratory, 325 Broadway, Boulder, CO 80305-3337

A number of mechanisms have been proposed by other researchers to explain the 7-percent per decade decrease in column ozone in the northern hemisphere midlatitudes over the last twenty years. The mechanisms most commonly cited are (a) in-situ heterogeneous chemistry, (b) the thinning of the midlatitude ozone layer by peel-off from the wintertime stratospheric vortex, and (c) the dilution effect when polar and midlatitude air masses mix during late winter and spring. However, a significant contribution to this trend may be ascribed to dynamical changes linked to the large-scale meteorology of the atmosphere. These changes may be entirely natural, or partially exacerbated by anthropogenic climate change.

In the lower stratosphere, where the ozone trend is greatest, parcels of subtropical air, naturally-poor in ozone, are regularly transported into midlatitudes. Seen against the ambient midlatitude ozone field, these air parcels are apparent in vertical ozonesonde profiles as ozone minima, not to be confused with ozone mini-holes which may arise from a number of causes (e.g., from the passage of cyclonic and anticyclonic systems affecting the altitude of the tropopause, or from chemical ozone loss in the middle stratosphere). Nevertheless, ozone minima can reduce the total column by up to 20-percent over areas in excess of a million square-kilometres. We demonstrate that variations in the number of ozone minima seen over Europe since 1968 correlate strongly with the phases of the NAO. Using NCEP reanalysis potential vorticity as a surrogate for ozone mixing ratio, on the 380K isentropic surface where ozone minima are most prevalent, we show that minima in PV most commonly occur in midlatitudes when the NAO phase is positive, and that their increased frequency since 1987 produces a significant northern hemisphere midlatitude trend.

A contribution to the trend may also arise from small-scale transport out of the stratospheric polar vortex during winter. Using a special version of the Lagrangian particle dispersion model FLEXPART, driven with global model-level data from the European Centre for Medium-Range Weather Forecasts, we have simulated the exchange of air across the vortex boundary. The ECMWF data used for this study have a horizontal resolution of one degree, 60 vertical levels and a time resolution of three hours, achieved by combining analyses and forecasts. The study focuses on 11 March 2000, and falls within the SAGE III Ozone Loss and Validation Experiment (SOLVE), a measurement campaign designed to examine the processes controlling ozone levels at mid- to high latitudes. Model results are accompanied by, and compared with, in-situ data collected by NASA's ER-2 and DC-8 aircraft.

URL: http://www.stephenjreid.com

A52A MC: Hall D Friday 1330h

Diagnosing Systematic Errors in Numerical Models of the Climate System II

Presiding: **G L Potter,** Lawrence Livermore National Laboratory

A52A-0146 1330h POSTER

AMIP II Evaluation of the Continental Component of the Global Energy and Water Cycles

K. McGuffie[1] (+61 2 9514 2072; Kendal.McGuffie@uts.edu.au)

P. Irannejad[2] (pix@ansto.gov.au)

A. Henderson-Sellers[2] (ahssec@ansto.gov.au)

T. Phillips[3] (phillips14@llnl.gov)

[1]Department of Applied Physics , University of Technology, Sydney PO Box 123 , Broadway, NSW 2007, Australia

[2]Environment, ANSTO PMB 1, Menai, NSW 2234, Australia

[3]PCMDI , LLNL, Livermore, CA, United States

We have analysed global land-surface energy and water budget components for the period 1979-1995 simulated by 10 AGCMs participating in the second phase of the Atmospheric Model Intercomparison Project (AMIP II). The simulations are compared with three reanalysis products (NCEP/DOE, NCEP/NCAR and ECMWF) and with the global land-surface simulations by the Variable Infiltration Capacity (VIC) land surface scheme. A lack of adequate observational data at the land surface is a limiting factor for evaluation of the land-surface climate in global climate models and it is anticipated that until such data becomes available, the model derived estimates such as are produced by the reanalysis is the best available option for model validation. Results underline a number of problems in some model simulations such as non-conservation of water and energy and problematic simulation of surface evapotranspiration This is in some degree related to poor initialisation and/or bad parameterisation of soil moisture. In a comparison of three reanalysis products and VIC land surface simulations we find large differences among the AMIP II models, among the reanalyses, and between models and reanalysis in simulating surface fluxes. The simulation of latent heat flux by different models relative to each other and relative to different reanalyses estimates vary in different climate zones and the differences among reanalyses are of the same order as differences between the model simulations and reanalyses estimates. The mean latent heat flux over all land surfaces ranges from 42.1 W m^{-2} to 56.8 W m^{-2} among the validation data sets, comparable to that among the AMIP II models. Compared to ECMWF reanalysis, the mean absolute deviation latent heat flux of the two reanalyses is 6.8 W m^{-2}, much larger than the mean absolute deviation of 3.2 W m^{-2} for the AMIP II models. Use of reanalyses for model evaluation of the continental component of the global water cycle is therefore problematical. Until reliable global land-surface observational data sets become available, it may be more appropriate to consider the ensemble of the available reanalysis data sets a the best validation tool.

A52A-0147 1330h POSTER

Sensitivity of the Canadian RCM to the Surface and Atmospheric Initial Conditions

Sébastien Biner[1] (biner.sebastien@uqam.ca)

Daniel Caya[1] (caya.daniel@uqam.ca)

René Laprise[1] (laprise.rene@uqam.ca)

[1]Regional Climate Modelling Group, Département des sciences de la terre et de l'atmosphère UQUÀM, Montréal, PQ H3C 3P8, Canada

In a Regional Climate Model simulation it is usually assumed that for a given set of lateral boundary conditions (LBC) and a given model configuration, a unique simulation is produced. In other words, for a given grid location and size, the simulation of a RCM is expected to be strongly controlled by the LBC and should be independent of the initial conditions (IC). In this study we look further at this assumption.

The experimental set-up is built as follow. A one-month long Canadian RCM (CRCM) December simulation is performed followed by three 12-month CRCM simulations starting the following January 1st. All simulations are performed on the same grid and use identical time-dependent lateral boundary conditions supplied by a GCMii current climate simulation. The only difference between the three CRCM simulations is in the prescription of the IC for the atmospheric and surface fields. For the first simulation the IC for both atmospheric and surface fields were taken from the December simulation. In the second simulation atmospheric IC were taken from the GCMii simulation and surface IC from a climatological database. For the third simulation, atmospheric IC were again taken from the GCMii simulation but surface IC were taken from the December CRCM simulation. By comparing the results of the different experiments it is possible to look at the sensitivity to surface and/or atmospheric IC fields.

The results show that during the first few months every CRCM simulations follow each other closely until the beginning of summertime when there is an increase of the discrepancies between all the simulations. This increase is observed for all simulations. However, simulations sharing the same surface IC take longer before developing differences. After summertime the level of similarity between the simulations reaches values comparable to the first few months. Preliminary analysis suggests that the level of control exerted by the LBC and the more stochastic activity of parameterised subgrid scale processes are responsible for this behaviour.

A52A-0148 1330h POSTER

Zonal Mean Diagnostics of the Transport Properties of GCMs and DASs

Valery A Yudin[1] (303 497-1422; vyudin@ucar.edu)

Lawrence V Lyjak (303 497-1412; lvl@ucar.edu)

John C Gille (303 497-8062; gille@ucar.edu)

[1]NCAR, Chemistry Division PO Box 3000 1850 Table Mesa Road, Boulder, CO 80307, United States