In the model, isotropic horizontal finite differencing is employed that conserves a variety of basic and derived dynamical and quadratic quantities. Among these, the conservation of energy and enstrophy improves the accuracy of nonlinear dynamics of the model. The hybrid pressure-sigma vertical coordinate has been chosen as the primary option. The forward-backward scheme is used for horizontally propagating fast waves, and an implicit scheme is used for vertically propagating sound waves. The Adams-Bashforth scheme is applied for horizontal advection of the basic dynamical variables and for the Coriolis terms. In real data runs the nonhydrostatic dynamics does not require extra computational boundary conditions at the top.

Since recently, the NMM has been applied operationally at NCEP. The efficiency of the computational algorithm of the model far exceeds the efficiency of algorithms of most state-of-the-art nonhydrostatic models. In high resolution NWP applications, the model has been highly competitive with other nonhydrostatic and mature hydrostatic models. Several examples of model forecasts are presented.

A61C-0106 0830h POSTER

A new numerical approach on groundwater dynamics study for land surface models

Zhenghui Xie[1] (86-10-62035477; zxie@lasg.iap.ac.cn)

Hongwei Yang[1] (hyang@lasg.iap.ac.cn)

Xu Liang[2] (liang@ce.berkeley.edu)

[1]Institute of Atmospheric Physics, Chinese Academy of Sciences, Chaoyang Qu, Beijing 100029, China

[2]University of California , 537 Davis Hall, Berkeley, CA 94720-1710, United States

Interactions between surface and groundwater play a significant role in re-distributing soil moisture in the vadose zone which impacts the partitions among water and energy budgets. However, a reasonable representation of the dynamic behavior of groundwater table would require numerically a large number of vertical soil layers under the framework based on Richard equations in general. The computational expense could thus limit the applications of incorporating surface and groundwater interactions into the land surface and atmosphere interaction studies. In this paper, a new approach is presented where the requirement of a large number of layers is relaxed. Specifically, the dynamic behavior of groundwater table represented as a moving boundary problem in the previous study by Liang and Xie [2002] is now described by a fixed boundary problem through certain mathematical transformations. With the new numerical framework, one can use significantly less number of vertical layers to obtain results that are comparable to the ones obtained with the original approach applied to a moving boundary problem. Therefore, the computation expense could be significantly reduced. The new approach was applied to two sites with encouraging results.

Reference

Liang, X., and Z. Xie, Important factors in land-atmosphere interactions: surface runoff generations and interactions between surface and groundwater, Global and Planetary Change, accepted, 2002.

A61C-0107 0830h POSTER

Impact of lakes and wetlands on present and future boreal climate

Estelle Poutou[1] ((33) 4 76 82 42 15; poutou@lgge.obs.ujf-grenoble.fr)

Gerhard Krinner[1] ((33) 4 76 82 42 36; krinner@lgge.obs.ujf-grenoble.fr)

Christophe Genthon[1] ((33) 4 76 82 42 15; genthon@lgge.obs.ujf-grenoble.fr)

[1]LGGE/CNRS, 54 rue Moliere, DU BP 96, Saint Martin d'Heres 38402, France

Impact of lakes and wetlands on present and future boreal climate

The role of lakes and wetlands in present-day high latitude climate is quantified using a general circulation model of the atmosphere. The atmospheric model includes a lake module which is presented and validated. Seasonal and spatial wetland distribution is calculated as a function of the hydrological budget of the wetlands themselves and of continental soil whose runoff feeds them. Wetland extent is simulated and discussed both in simulations forced by observed climate and in general circulation model simulations. In off-line simulations, forced by ECMWF reanalyses, the lake model simulates correctly observed lake ice durations, while the wetland extent is somewhat underestimated in the boreal regions. Coupled to the general circulation model, the lake model yields satisfying ice durations, although the climate model biases have impacts on the modeled lake ice conditions. Boreal wetland extents are overestimated in the general circulation model as simulated precipitation is too high. The impact of inundated surfaces on the simulated climate is strongest in summer when these surfaces are ice-free. Wetlands seem to play a more important role than lakes in cooling the boreal regions in summer and in humidifying the atmosphere.

The role of lakes and wetlands in future climate change is evaluated by analyzing simulations of present and future climate with and without prescribed inland water bodies.

A61C-0108 0830h POSTER

Nonlinear principal component analysis with applications to the atmosphere and ocean

Beiwei Lu[1] ((604) 822 5691; blu@eos.ubc.ca)

William Hsieh ((604) 822 2821; whsieh@eos.ubc.ca)

[1]EOS, UBC, 2219 Main Mall, Vancouver, BC V6T 1Z4, Canada

Nonlinear principal component analysis (NLPCA) by auto-associative feed-forward neural networks with 3 hidden layers of neurons has recently been applied to analyze a number of meteorological/oceanographic datasets. However, many of these datasets, especially climate datasets, tend to be relatively short and noisy. Under these conditions, the 3-hidden-layer NLPCA exhibits serious overfitting and non-uniqueness problems and is found to be an under-determined model. We also found that the overfitting and non-uniqueness problems are greatly alleviated by trimming the NLPCA network from 3 to 2 hidden layers and eliminating the bias parameters from the bottleneck and output layers, a simpler NLPCA model result. This new model is applied to several datasets – the Lorenz (1963) chaotic system, the tropical Pacific sea surface temperatures anomaly, and the tropical stratospheric zonal winds (with the quasi-biennial oscillation phenomenon).

URL: http://www.agu.org/blu

A61C-0109 0830h POSTER

Development of a Stochastic Cloud-Radiation Parameterization

Dana E Lane[1] (732 932 9081; lane@envsci.rutgers.edu)

Richard C. J. Somerville[2] (rsomerville@ucsd.edu)

Sam F. Iacobellis[2] (siacobellis@ucsd.edu)

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

[2]Scripps Institution of Oceanography, University of California, San Diego 9500 Gilman Dr. - 0224, La Jolla, CA 92093-0224, United States

A parameterization of the stochastic approach to modeling cloud-radiation interactions is being developed using archived data from the Atmospheric Radiation Measurement (ARM) Programs Clouds And Radiation Testbed sites. Initially, long time-series data from the ARM Southern Great Plains site will be used to characterize the cloud base height, cloud top height, cloud size, cloud spacing, and cloud optical properties during the year 2000. These observations will be analyzed to be input to a shortwave stochastic radiative transfer model. Subsequent analysis will include data from the Tropical Western Pacific site and the North Slopes of Alaska site. The output domain-averaged radiation fields will be evaluated using independent observations. One benefit of the stochastic approach is the ability to calculate more realistic heating rates. The impact of these heating rates on model dynamics will be investigated using a single-column model.

A61C-0110 0830h POSTER

Understanding Tropospheric Temperature Changes: Challenges for Observational and Model Studies

Tom M.L. Wigley[1] (1 303 497 2690; wigley@ucar.edu); Ben D Santer[2] (1 925 423 3364; santer1@llnl.gov); Frank J Wentz[3] (1 707 545 2904; wentz@remss.com); C Mears[3]; M Schabel[3]; G A Meehl[1]; J Arblaster[1]; C Ammann[1]; W M Washington[1]

[1]National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307-3000

[2]Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, P.O. Box 808, Mail Stop L-103, Livermore, CA 94550

[3]Remote Sensing Systems, 438 First St., Suite 200, Santa Rosa, CA 95401

One of the outstanding challenges in climate science today is to explain the discrepancies between near-surface temperature changes, satellite-based (Microwave Sounding Unit - MSU) temperature changes in the low-to-mid troposphere, and model estimates of these tropospheric temperature changes. Observed near-surface temperature changes show a marked warming over the period of MSU data availability (0.183oC/decade over Jan. 1979 through Dec. 1999). The standard Spencer and Christy MSU data show a much smaller warming trend over this period (0.032oC/decade for MSU channel 2). Model estimates of these trends vary depending on the assumed forcing and the model's sensitivity. Few model simulations have been run with the full complement of known forcings. For the NCAR Parallel Climate Model, a model with relatively low sensitivity, ensemble-mean trends over the above interval are 0.148oC/decade for the surface and 0.068oC/decade for equivalent MSU2. Some of these differences may be explained by differences in data coverage, uncertainties in or neglected forcings for model results, and different responses to ENSO in the different data sets. Even so, when these effects are accounted for, discrepancies still remain. Possible reasons for the remaining discrepancies include: errors in either the surface and/or tropospheric data; and/or model errors. The implications of model errors would be profound. The MSU data, if correct, would imply that all models are overestimating the climate sensitivity. If so, then projected future climate changes would also be overestimated. If we are to have confidence in current projections of global warming, the above discrepancies must be resolved.

The purpose of this talk is to review the surface/tropospheric temperature discrepancy issue. A new MSU-based tropospheric temperature data set will be evaluated relative to other observational data sets and to new model results. The new MSU data show better agreement with both the surface data and models. This raises important questions about the reliability of observational data sets in general, quantification of radiative forcing and climate sensitivity, the issue of model validation using imperfect observational data, and the statistical tools available to quantify model uncertainties with such data. The scientific challenges are far-reaching and of considerable importance, requiring cross-disciplinary collaborations between modelers, observational data producers and analysts, and statisticians.

A61D MCC: 102 Saturday 0830h

Transport and Effects of Anthropogenic Pollutants: Trace-P II

(joint with GC)

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

A61D-01 0830h

Chemical Characterization of Biomass Burning Aerosols over the Western Pacific as part of TRACE P

Y. Ma[1] (yilin.ma@eas.gatech.edu); R. J. Weber[1] (rweber@eas.gatech.edu); Y.-N. Lee[2]; D. R. Blake[3]; G. W. Sachse[4]; A. R. Bandy[5]; D. C. Thornton[5]; A. D. Clarke[6]; H. E. Fuelberg[7]; G. R. Carmichael[8]

[1]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA 30332

[2]Environmental Sciences Department, Brookhaven National Laboratory, Upton, NY 11973

[3]Department of Chemistry, University of California Irvine, Irvine, CA 92697

[4]NASA, Langley Research Center, Hampton, VA 23681

[5]Department of Chemistry, Drexel University, Philadelphia, PA 19104

[6]Department of Oceanography, University of Hawaii at Manoa, Honolulu, HI 96822

[7]Department of Meteorology, Florida State University, Tallahassee, FL 32306

[8]Department of Chemical Biochemical Engineering, University of Iowa, Iowa city, IA 52242

Aircraft measurements of ambient aerosol inorganic chemical composition and a variety of gases were made over the western Pacific Ocean from late February to early April 2001 during NASAs Transport and Chemical Evolution over Pacific (TRACE-P) experiment. The chemical composition of ambient water-soluble fine particles was measured from the NASA P3-B research aircraft by a Particle-Into-Liquid Sampler coupled to an Ion Chromatograph (PILS-IC). For particles smaller than 1.3 mm diameter, 5 cations (sodium, ammonium, potassium, magnesium, and calcium) and 3 anions

(chloride, nitrate, and sulfate) were measured continuously every 4 minutes.

The ionic composition of fine particles in biomass burning plumes encountered near the western Pacific are investigated. Fine particle potassium appears to be a good tracer for biomass combustion. For all flights throughout the intensive study, fine potassium was mostly correlated with absorbing aerosol (e.g. soot, r-squared of 0.73), ammonium (r-squared of 0.77) and CO (r-squared of 0.61).

A relatively pure biomass burning plume was only encountered in the vicinity of the South China Sea in the mid-troposphere with fine potassium concentration approximately 1000 pptv. In this plume, potassium was highly correlated with nitrate and nitric acid (r-squared of 0.89, 0.55 respectively). Back trajectories and estimation of biomass emissions suggest the plume was from Southeast Asia. Mixed biomass/pollution plumes were frequently encountered near the China Yellow Sea with fine potassium as high as 3000 pptv. Based on the modeled biomass emissions inventories, these unusually high Yellow Sea potassium concentrations are likely due to biofuel burning. Measurements show that ammonium/sulfate molar ratios are often significantly higher than the typically observed value of 2, suggesting ammonium associated with nitrate and possibly other organic acids in the biomass plumes. Comparison with other biomass burning and fossil fuel combustion indicators, such as CH3Cl, C2Cl4, shows that the ratio of dK+/dSO42- is positively correlated with the biomass contribution and anti-correlated to the fossil fuel contribution. This ratio may be useful in estimating contributions from biomass/biofuel versus fossil fuel combustion in the mixed plumes. Based on fine particle potassium, it is estimated that about 10 percent of the Asian outflows recorded during TRACE-P were affected by biomass burning emissions.

A61D-02 0845h

Absorbing Aerosol in Asian Outflow: Size Dependent Properties, Links to Chemistry, and Humidity Growth

Antony Clarke[1] (808-956-6215; tclarke@soest.hawaii.edu); Steven Howell[1] (808-956-5185; showell@soest.hawaii.edu); Vladimir Kapustin[1] (808-956-7777; kapustin@soest.hawaii.edu); Sarah Masonis[2] (206-543-6674; sarahd@atmos.washington.edu); Theodore Anderson[2] (206-543-2044; tadand@atmos.washington.edu); Rodney Weber[3] (404-894-1750; rweber@eas.gatech.edu); Cameron McNaughton[1] (808-956-5192; cameronm@soest.hawaii.edu); Kenneth Moore[1] (808-956-7777; kmoore@soest.hawaii.edu)

[1]Department of Oceanography, University of Hawaii, 1000 Pope Road, MSB 501, Honolulu, HI 96822, United States

[2]Department of Atmospheric Science, University of Washington, Box 351640, 408 ATG, Seattle, WA 98195, United States

[3]Georgia Institute of Technology, School of Earth and Atmospheric Sciences, Atlanta, GA 30332-0340, United States

During spring of 2001 we participated in two aircraft experiments as part of NASA TRACE-P and ACE-ASIA studying the properties of Asian aerosol advected over the North Pacific. These sequential experiments with nearly identical instrumentation provided a unique opportunity to investigate outflow from East Asia between 5°N and 50°N during the same season. Continuous size distributions were obtained from a radial differential mobility analyzer (RDMA) and a laser optical particle counter (OPC). The RDMA and OPC were operated with thermal aerosol volatilization on order to infer size dependent volatility and refractory properties. Aerosol number concentrations were also measured with both an Ultrafine Condensation Nuclei counter (UCN) and CN counters operated at 40° and 360°C. Light scattering from nephelometers and light absorption from a Particle Soot Absorption Photometers (PSAP) established coarse and fine aerosol single scatter albedo. On the ACE-Asia aircraft we also operated a dry and humidified nephelometer to reveal humidity dependence of aerosol light scattering, f(RH). Volatility measurements upon optically effective sizes provided resolution of the size-distributions for soot and Black Carbon (BC) components and the coarse dust aerosol. Fast ion-chromatography (Particle Into Liquid Sampler -PILS) was also employed and compared with aerosol volatility to resolved variations in soluble [eg. sulfate, nitrate] and refractory species [eg. dust, soot] that could influence f(RH) with about 1 minute (5km) horizontal resolution. These combined data establish links between measured aerosol light scattering and absorption, f(RH), mixing state and aerosol chemistry for the diverse environments encountered. Refractory size-distributions for soot free cases provided a means of characterizing details of the dust coarse and fine component. Subtracting the submicrometer dust component from mixed refractory distributions allowed isolation of the soot size distributions generally responsible for most absorption and provided a basis for modeling optical properties of the mixed aerosol. Aerosol plumes South of 25°N tended to have strong biomass burning signatures while those in the north had a more industrial character often mixed with pronounced dust events. Variations in combined soot, volatile species and dusts provide explanations for the variability in measured optical properties, single scatter albedo and f(RH) encountered during both programs.

A61D-03 0900h

Observations of the Hydroxyl (OH) and Hydroperoxyl (HO_2) Radicals During the NASA TRACE-P Study in Spring 2000

William Brune[1] (814-865-3286; brune@essc.psu.edu); Hartwig Harder[1]; Monica Martinez[1]; Robert Lesher[1]; Xinrong Ren[1]; James Crawford[2]; Jennifer Olson[2]

[1]Department of Meteorology, 503 Walker Building Pennsylvania State University, University Park, PA 16802, United States

[2]NASA Langley Research Center, 21 Langley Boulevard, Hampton, VA 23681, United States

Oxidation chemistry cleanses the atmosphere of chemical emissions from Earth?s surface, establishes the global ozone balance, and influences climate change. It is dominated by the hydroxyl radical, OH, but involves the hydroperoxyl radical, HO_2, together called HO_x. Measurements of OH and HO_2 were made with our Airborne Tropospheric Hydrogen Oxides Sensor (ATHOS) as part of a much larger measurement suit from the NASA DC-8 aircraft during TRACE-P in spring 2000. This mission, which was conducted mainly in the Asian plume, was an excellent test of oxidation chemistry in aged pollution plumes over the remote Pacific Ocean. In general, measured OH and HO_2 were significantly less than expected from models. This difference between measurements and models was a surprise because measured and modeled HO_x generally agreed to within a factor of 1.3 during a previous aircraft study, PEM Tropics B, which occurred over the tropical Pacific in 1998. We consider the implications of these differences between models and measurements and discuss recent activity to ensure that the ATHOS calibration was accurate.

A61D-04 0915h

Airborne Tunable Diode Laser Measurements of Formaldehyde During TRACE-P: Distributions and Measurement Box-Model Comparisons

Alan Fried[1] (303-497-1475; fried@ucar.edu); Jim Crawford[2] (757-864-7231; j.h.crawford@larc.nasa.gov); Jennifer R. Olson[2] (757-864-7231; J.R.OLSON@LaRC.NASA.GOV); James Walega[1] (303-497-1487; walega@ucar.edu); Bryan Wert[1] (303-497-1451; bwert@mail.acd.ucar.edu); William Potter[3] (918-631-3027; william-potter@utulsa.edu)

[1]National Center For Atmospheric Research, P.O. Box 3000, Boulder, CO 80305, United States

[2]NASA Langley Research Center, 21 Langley Blvd., Hampton, VA 23681, United States

[3]The University of Tulsa Department of Chemistry Biochemistry, 600 South College Avenue, Tulsa, OK 74104-3189, United States

Measurements of the important reactive intermediate formaldehyde (CH2O) were acquired by tunable diode laser absorption spectroscopy onboard NASA's DC-8 aircraft during the Transport and Chemical Evolution over the Pacific Study (TRACE-P). One-minute measurements (N = 6917) were acquired on every research flight, and this rather extensive database has allowed us to map out the distributions of CH2O, produced by photochemical processing of hydrocarbon precursors from Asia, over the Pacific Ocean. This dataset has also provided an additional opportunity to test our current understanding of photochemical box models through extensive measurement-model comparisons (N = 4472) under a variety of conditions. The present talk will present both aspects. In addition to a comparison for the full dataset, the present talk will also examine regions where the box-model fails to capture the observed CH2O structure. A brief discussion of measurement and model variance will also be presented.

A61D-05 0930h

Ozone Production and Export From East Asia During the TRACE-P Campaign: Regional vs. Global Production and Sensitivity to Meteorology

Oliver Wild[1] (81-45-778-5716; oliver@jamstec.go.jp)

Hajime Akimoto[1] (akimoto@jamstec.go.jp)

Michael Prather[2] (mprather@uci.edu)

[1]Frontier Research System for Global Change, 3173-25 Showa-machi, Kanazawa-ku, Yokohama 236-0001, Japan

[2]Earth System Science, University of California, Irvine, CA 92697, United States

The regional and global impacts of surface emissions of ozone precursors (NOx, CO and hydrocarbons) on tropospheric ozone are strongly influenced by meteorological processes through their effects on both chemistry and transport. Ozone production in the boundary layer over emission regions is important for regional air quality, and is strongly dependent on meteorological conditions such as temperature and cloud cover. However, transport of ozone precursors into the free troposphere, where ozone production efficiencies are larger, may lead to considerable additional formation over a longer time scale, and may strongly influence the total global production. The relative importance of ozone production in these different locations, and its sensitivity to meteorological processes, has not been properly quantified. This balance is particularly important for the developing regions of East Asia, which have been shown to have a large effect on ozone throughout the northern hemisphere, particularly in the springtime when meteorological variability is large. Investigating the chemical evolution of continental outflow from this region was one of the goals of the TRACE-P measurement campaign over the western Pacific Ocean in spring 2001. Using the FRSGC/UCI global chemistry-transport model to simulate ozone during this period, we demonstrate that the model can reproduce the observed ozone distributions well. We then assess the variability in ozone production in the boundary layer and over the globe from emissions over selected regions of East Asia, and investigate the relationship between them. We demonstrate that while heavy cloud cover suppresses boundary layer ozone production, the associated convective processes lead to enhanced formation in the free troposphere which may in some cases more than compensate for reduced boundary layer production.

A61D-06 0945h

HCN and CH3CN in the Pacific Troposphere: Evidence for Oceanic Sink

Hanwant B. Singh[1] (650-604-6769; hsingh@mail.arc.nasa.gov); Erin Czech[1] (650-604-1655; eczech@mail.arc.nasa.gov); Qinbin Li[2] (qli@io.harvard.edu); Daniel J. Jacob[2] (617-495-1794; djj@io.harvard.edu); Donald R Blake[3] (949-824-4195; dblake@orion.oac.uci.edu); Glen W Sachse[4] (757-864-1566; g.w.sachse@pop.larc.nasa.gov); Henry E Fuelberg[5] (850-644-6466; fuelberg@huey.met.fsu.edu)

[1]NASA Ames Research Center, M. S. 245-5, Moffett Field, CA 94035, United States

[2]Harvard University, Pierce Hall, Cambridge, MA 02139, United States

[3]University of California, Dept. of Chemistry, Irvine, CA 92717, United States

[4]NASA Langley Research Center, M. S. 472, Hampton, VA 23665, United States

[5]Florida State University, Mail Code 4520, Tallahassee, FL 32306, United States

We report the first in-situ measurements of hydrogen cyanide (HCN) and acetonitrile (CH3CN) from the Pacific troposphere (0-12 km) obtained during the NASA/TRACE-P mission (Feb.-April, 2001). The HCN column derived from these in-situ observations is in good agreement with available spectroscopic observations. The atmospheric concentrations of HCN and CH3CN were greatly influenced by outflow of pollution from Asia. Relative enhancements with respect to known tracers of biomass combustion within selected plumes in the free troposphere allow an estimation of the biomass burning source of HCN and CH3CN. The vertical structure of HCN and CH3CN indicates reduced mixing ratios in the marine biundary layer (MBL). Using a simple box model, the observed gradients across the top of the MBL are used to derive an oceanic loss rate. An air-sea exchange model is used to conclude that this flux can be maintained if the oceans are under-saturated in HCN and CH3CN

by =20%. A mean atmospheric residence time of 5.9 months for HCN and 5.1 months for CH3CN is calculated. A global budget analysis shows that the sources and sinks of HCN and CH3CN are roughly in balance but many uncertainties remain.

A61E MCC: 125 Saturday 0830h

Regional Climate Modeling I *(joint with NG, B, H, OS, GC)*

Presiding: **A Robock,** Rutgers University**; G Stenchikov,** Rutgers University

A61E-01 0840h INVITED

Comparison of Inter- and Intra-Model Variability of Precipitation in Nested Regional Climate Models

Raymond W Arritt (1-515-294-9870; rwarritt@iastate.edu)

Iowa State University, 3010 Agronomy Hall, Ames, IA 50011, United States

Variability of simulated precipitation among a suite of regional climate models (inter-model variability) is compared with variability among realizations performed using a single model (inter-model variability). Inter-model variability is evaluated from the PIRCS 1b suite of simulations for the 1993 summer flood over the north-central United States. Intra-model variability is evaluated in simulations using the MM5 model for the same domain and period. Various approaches are explored for establishing intra-model variability, such as lagged ensemble forecasts and perturbations to the physical parameterizations. It is found that inter-model variability is larger than all measures of intra-model variability. Simulations with differing physical parameterizations in MM5 is the only method that produces intra-model variability that begins to approach that of inter-model variability.

URL: http://www.mesoscale.iastate.edu

A61E-02 0855h INVITED

Mesoscale Diagnosis and Simulation of the South American Monsoon System

Ernesto Hugo Berbery[1] (301 405 5351; berbery@atmos.umd.edu)

Estela A Collini (collini@atmos.umd.edu)

Jong-Su Paek (jspaek@atmos.umd.edu)

Matthew Pyle (Matthew.Pyle@noaa.gov)

[1]Department of Meteorology, 3427 CSS Building University of Maryland, College Park, MD 20742, United States

We employ a multiyear data set of Eta model short-term forecasts as a proxy of analyses to investigate the mesoscale processes contributing to the development of the South American monsoon system. Several studies have identified the subtropical summer circulation as a monsoon phenomenon, and this has served as a framework to explain the more important components of the warm season climate system. The onset of the monsoon is associated with a quick development of precipitation over southern Brazil, which can be viewed as the southernmost extension of the tropical precipitation during its annual march over the Americas.

The Low-level Jet (LLJ) east of the Andes has been identified as a key part of the monsoon system, but unlike other LLJs, and in particular the United States Great Plains LLJ, it is present throughout the year. In fact, during the cold season it can be as intense as the summer case, but somewhat more elevated and with a weaker diurnal cycle. Therefore, the monsoon?s onset is not so much associated with a spring development of the LLJ, but rather with its changes in structure, and lateral shifts.

The higher frequency variability of the monsoon precipitation has an out-of-phase relationship with precipitation in the central La Plata basin (at about 25o S), so that increases in monsoon precipitation imply decreases to the south, and vice versa. The LLJ has a significant role in this pattern as it experiments lateral shifts during the warm season. When the LLJ has an eastward shift, it can supply moisture directly to the monsoon region, where increased precipitation is detected. Meanwhile, the moisture supply to the La Plata basin becomes weaker and a simultaneous decrease of precipitation is found over Southern Brazil/Northern Argentina/ Uruguay. When the jet shifts west, its core acquires a southward direction, effectively reducing the moisture supply to the monsoon but increasing it to the La Plata basin with the corresponding changes in precipitation. Understanding this dipole pattern, its seasonality, its linkage to local and remote forcings, and its functioning in general, should help identify the mechanisms that favor the monsoon precipitation and its variability. Longer-term simulations of the Eta model are being employed to address these issues.

A61E-03 0910h

Modeling diurnal rainfall in northwestern South America

Brian Mapes[1] (bem@cdc.noaa.gov)

Thomas T Warner[2]

Mei Xu[2]

[1]Climate Diagnostics Center, 325 S. Broadway R/CDC, Boulder, CO 80305, United States

[2]NCAR/RAP , PO Box 3000, Boulder, CO 80307-3000

Nested-grid simulation of convective weather of northwestern South America has been performed with the MM5 model. After optimization of the deep convection scheme for the coarser grids, the model produces reasonable rainfall simulations. Of special interest is the night-morning rainfall peak associated with convection offshore in the Panama Bight. This night-morning rainfall is seen to result from destabilizing effects of a gravity wave radiated from the diurnally varying heat source of the mixed layer over the Andes mountains.

URL: http://www.cdc.noaa.gov/~bem/publications.shtml

A61E-04 0925h

The Climatology of African Wave Disturbances in a Regional Model

Leonard M Druyan[1] (212-6785564; LD12@columbia.edu)

Matthew Fulakeza[1] (212-6785572; MFulakeza@giss.nasa.gov)

Patrick Lonergan[2] (212-6785544; PLonergan@giss.nasa.gov)

[1]Leonard Druyan and Matthew Fulakeza, Earth Institute at Columbia University and NASA/Goddard Institute for Space Studies 2880 Broadway, New York, NY 10025, United States

[2]Patrick Lonergan, Stinger Ghaffarian Technology and NASA/Goddard Institute for Space Studies 2880 Broadway, New York, NY 10025, United States

Our understanding of the structure and behavior of African wave disturbances (AWD) has been derived from brief empirical studies or analyses/simulations using general circulation models. In each case the spatial resolution of the observational network or the computational grid has been an issue in the interpretation of results. The current effort studies the structure and behavior of AWD based on the results of a regional climate model (RCM) run on a grid with 0.5 deg spacing over a limited domain covering West Africa. The model is driven by four times daily synchronous NCEP reanalysis data at the lateral boundaries from June 1-September 30. Thus far, seven summers have been completed. Diagnostics from this system provide distinct advantages over those from coarser resolution global models and from previous results based on sparse networks of observations. The presentation will show composites of mid-tropospheric AWD circulation, associated precipitation patterns and near-surface divergence. Spectra and wavelets of the meridional wind at selected locations will highlight favored periodicities of AWD and intraseasonal variability. Trajectories of AWD during different seasons will be mapped by spatial distributions of the vorticity variance at 700 mb. Interannual variability of AWD characteristics will be related to the interannual variability of summer monsoon precipitation over West Africa. Sensitivity of AWD characteristics to land surface influences will be examined. RCM characteristics of AWD will also be compared to previous descriptions in the literature.

A61E-05 0940h INVITED

Regional Climate Simulation and Data Assimilation With Variable-Resolution GCMs

Michael S. Fox-Rabinovitz[1,2] (301-286-3604; foxrab@atmos.umd.edu)

[1]University of Maryland, Room 2207, ESSIC, 224 CSS Bldg.,, College Park, MD 20742-2465, United States

[2]NASA/GSFC/Data Assimilation Office, code 910.4, Greenbelt, MD 20771, United States

Variable resolution GCMs using a global stretched grid (SG) with enhanced regional resolution over one or multiple areas of interest represents a viable new approach to regional climate/climate change and data assimilation studies and applications. The multiple areas of interest, at least one within each global quadrant, include the major global mountains and major global monsoonal circulations over North America, South America, India-China, and Australia. The SG-approach provides an efficient regional downscaling to mesoscales, and it is an ideal tool for representing consistent interactions of global/large- and regional/mesoscales while preserving the high quality of global circulation. Basically, the SG-GCM simulations are no different from those of the traditional uniform-grid GCM simulations besides using a variable-resolution grid.

Several existing SG-GCMs developed by major centers and groups are briefly described. The major discussion is based on the GEOS (Goddard Earth Observing System) SG-GCM regional climate simulations.

The global variable resolution SG-version of the GEOS DAS (Data Assimilation System) or SG-DAS incorporating the GEOS SG-GCM, has been developed and tested as an efficient tool for producing regional analyses and diagnostics with enhanced mesoscale resolution. Both the SG-GCM and SG-DAS include the entire tropospheric and stratospheric domains from the surface to 0.1 hPa. The prognostic and diagnostic fields are produced for all model and mandatory pressure levels.

The annual (November 1997 to December 1998) GEOS SG-GCM simulation and SG-DAS data assimilation, with 50 km regional resolution over large areas of interest, have been performed simultaneously and analyzed in terms of producing anomalous events over four areas of interest and their vicinities. They include the North and South American Monsoon Systems (NAMS and SAMS); the anomalous U.S. summer events; the summer flood in China; the spring-summer Mexican drought; the Indian and Australian monsoons; and other extreme precipitation events.

The 12-year (1987-1998) GEOS SG-GCM simulations with 60 km and 100km regional resolution over the U.S. have been performed in a limited ensemble integration mode. The preliminary analysis of the ensemble means has shown a promising potential of the SG-approach for long-term regional climate simulation at mesoscale resolution.

Brief information on development of the new SG-GCM is provided. It is the SG-version of the new NASA/NCAR FV-GCM (with the finite-volume (FV) Lin-Rood dynamics), and the NCAR CAM2 physics. Using the advanced numerical technique provides an increased computational efficiency for the new SG-GCM that will allow us to use finer regional resolution.

The international SGMIP (Stretched-Grid Model Intercomparison Project), with participation of NASA/GSFC and UMD, RPN/Canadian Meteorological Centre, Meteo-France, and Australian CSIRO, has been initiated. It has a potential connection to AMIP-II as a regional project.

A61E-06 0955h INVITED

Seasonal Climate Predictability in an AGCM and a Nested Regional Model

Michael J Fennessy[1] (301-902-1252; fen@cola.iges.org)

Eric L Altshuler[1] (301-902-1257; ela@cola.iges.org)

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

The potential for enhancing the predictability inherent in seasonal climate predictions with a global general circulation model by the use of a nested regional model is investigated by analyzing seasonal ensembles over North America and India. For the summer season, 9-member ensembles of June-July-August-September (JJAS) climate over North America and India are analyzed for five different years. For the winter season, 5-member ensembles of December-January-February-March (DJFM) climate are analyzed for 8 different years. The global models used are versions of the Center for Ocean-Land-Atmosphere Studies (COLA) atmospheric general circulation model (AGCM). The regional models used are versions of the National Centers for Environmental Prediction (NCEP) Eta model.

The results are compared to the observations with particular emphasis on the precipitation simulations. An analysis of variance is conducted to evaluate the relative abilities of the global and nested regional models in simulating the interannual signal versus the intra-ensemble noise. These merits are contrasted for the two regional domains considered.

A61E-07 1030h

The Sensitivity of Simulated Central U.S. Summer Precipitation and Atmospheric Moisture Budget to Both the Spatial Distribution and the Amount of Initial Soil Moisture

Christopher P. Weaver[1] (weaver@cep.rutgers.edu)

Matei Georgescu[1] (matt1@cep.rutgers.edu)