Dave Tobin[2] (608-265-6281; dave.tobin@ssec.wisc.edu)

[1]JPL/Caltech, 4800 Oak Grove Drive MS 183-601, Pasadena, CA 91109, United States

[2]Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center University of Wisconsin-Madison, Madison, WI 53706, United States

Water vapor concentrations in the free troposphere acts as a powerful greenhouse gas, yet it remains poorly characterized. The Atmospheric Infrared Sounder (AIRS) on the EOS Aqua satellite has been making measurements since September of 2002. The retrieval products from AIRS include water vapor and temperature profiles with high vertical resolution, mapping over 85% of the globe twice daily. This talk is focused on upper tropospheric humidity as measured by AIRS. We will show a global view of the water vapor fields from 200 to 400 mb, as well as an intercomparison of sonde measurements and AIRS retrievals of UTH from the two ARM sites, the Tropical Western Pacific and the Southern Great Plains.

A33A-07 1330h POSTER

The Effect of Dust Aerosols on Marine Ice Clouds: A Study of MODIS Level-3 Daily Retrieval

Sun Wong[1] (301 4055917; swong@atmos.umd.edu)

Andrew E. Dessler[1] (301 4055337; dessler@atmos.umd.edu)

[1]Earth System Science Interdisciplinary Center, University of Maryland, 2207 Computer and Space Sciences Building #224, College Park, MD 20742, United States

The effect of dust aerosols on marine ice cloud particle size was studied using the Moderate Resolution Imaging Spectroradiometer (MODIS) Level-3 retrieval data. Daily averaged optical thickness of aerosol and daily statistics of ice cloud particles' effective radii were analyzed for May to September 2002 over two regions, a region in the tropical east Atlantic offshore of North Africa, and a region in the northern Indian Ocean in between the Indian continent and the Persian peninsula. It was found that, for clouds that are deep (cloud-top temperature <230K) and optically thick, increasing aerosol optical depth is associated with smaller cloud effective radii. This implies that, through deep convection, dust aerosols blown off the continents during summertime are lofted to the upper troposphere and reduce the effective radii of clouds. The sensitivity of the cloud effective radius to the aerosol loading is quite different between the regions, and reasons for this will be discussed.

A33A-08 1330h POSTER

Tracing the origins of tropical water vapor in a general circulation model

Maxwell Kelley[1,2] (212-678-5643; mkelley@giss.nasa.gov)

David Rind[1] (212-678-5593; drind@giss.nasa.gov)

[1]NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, United States

[2]MIT Dept. of Earth, Atmospheric, and Planetary Sciences, 77 Massachusetts Ave, Cambridge, MA 02139, United States

Understanding the effects of clouds upon tropical water vapor requires information regarding the geographic distribution of the clouds influencing water vapor in a particular target volume. This perspective also helps to identify certain aspects of the circulation important to water vapor. An idealized tracer approach is used to determine the geographic origins of water vapor in a general circulation model, and selected results are compared to prevailing theoretical paradigms of vapor transport. As expected, tropical water vapor enters the free troposphere primarily in convectively active regions, and the vertical structure of a vapor age tracer tracks the descent of air masses as they drift downwind into clear-sky areas. However, the zonal orientation of time-mean flow patterns allows subtropical rather than deep-tropical latitudes to be the primary contributors to subtropical water vapor, and as a result the convective sources are seasonally variable and often continental in location. Stratospheric vapor source distributions indicate that the large-scale ascent which lifts moisture through the model tropopause occurs over a broader range of longitudes than would be consistent with time-mean thermodynamic conditions, highlighting the importance of waves in the dessication of stratospheric air.

A33A-09 1330h POSTER

A Seasonal Analysis of the Influence of Convection on Tropical and Subtropical UTH using TRMM Precipitation Radar

Jonathon Wright[1] (jswright@eas.gatech.edu)

Rong Fu[1] (fu@eas.gatech.edu)

Walter Petersen[2] (Walt.Petersen@msfc.nasa.gov)

[1]School of Earth and Atmospheric Sciences, Georgia Institute of Technology 311 Ferst Dr, Atlanta, GA 30332

[2]Earth Systems Science Center, University of Alabama-Huntsville, Huntsville, AL 35899

Climate change due to the infrared water vapor feedback depends critically on the upper tropospheric humidity (UTH) distribution in the tropics and subtropics, yet the relative impacts of possible sources on this distribution remains uncertain. In this study, we flag tropical vertical water vapor profiles from the Halogen Occultation Experiment (HALOE) and Stratospheric Aerosol and Gas Experiment II (SAGE II) according to water vapor mixing ratio near 200 mb, and integrate a five day isentropic back trajectory from each profile using European Centre for Medium-Range Weather Forecasting (ECMWF) ERA-40 winds. These trajectories are then matched spatially and temporally with Tropical Rainfall Measurement Mission (TRMM) Precipitation Radar (PR) 2A25 volumetric radar reflectivities and binned according to whether the parcel in question has undergone convection that penetrates deeper than 15 km, convection that does not penetrate beyond 15 km, or no convection at all during the previous five days. Subtropical HALOE and SAGE II vertical water vapor profiles are similarly analyzed to determine the distribution of profiles originating in convective outflow from the tropics, subtropical convection from below, and transport from the extratropics. Seasonal variations in both source distributions are investigated across two summers (JJA 1998 and 1999) and two winters (DJF 1998-99 and 1999-2000). We briefly explore the potential benefits of applying the forthcoming EOS-Aura Microwave Limb Sounder measurements of water vapor to this study.

A33B CC: 520 D Wednesday 1330h

Tropospheric Chemistry (Climate)

(joint with B, GC)

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

A33B-01 1330h

Increased Northern Hemispheric Tropospheric CO Burden in 2002 And 2003 Detected From the Ground and From a Satellite

Leonid Yurganov[1] (leonid@jamstec.go.jp); Thomas Blumenstock[2] (thomas.blumenstock@imk.fzk.de); David Edwards[3] (edwards@ucar.edu); Evgeny Grechko[4] (grechko@ifaran.ru); Frank Hase[2] (frank.hase@imk.fzk.de); Isabell Kramer[2] (isabell.kramer@imk.fzk.de); Emmanuel Mahieu[5] (Emmanuel.Mahieu@ulg.ac.be); Johann Mellkvist[6] (jmell@rss.chalmers.se); Paul Novelli[7] (Paul.C.Novelli@noaa.gov); Hans-Ekhart Scheel[8] (Hans-Eckhart.Scheel@imk.fzk.de); Anders Strandberg[6] (astran@rss.chalmers.se); Ralf Sussmann[8] (sussmann@ifu.fhg.de); Hiroshi Tanimoto[9] (tanimoto@nies.go.jp); Rodolfe Zander[5] (R.Zander@ulg.ac.be); John Gille[3] (gille@ucar.edu); James R Drummond[10] (james.drummond@utoronto.ca)

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

[2]IMK-ASF, Forschungszentrum Karlsruhe, P.O. Box 3640, Karlsruhe D-76021, Germany

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

[4]Obukhov Institute of Atmospheric Physics, Pyzhevsky 3, Moscow 109017, Russian Federation

[5]Institute of Astrophysics and Geophysics, University of Liège, 4000 Liege-Cointe, Liege, Belgium

[6]Chalmers University of Technology, SE-412 96, Göteborg, Sweden

[7]Climate Monitoring and Diagnostic Laboratory, NOAA, P.O. 3328, Boulder, CO 80305, United States

[8]IMK-IFU, Forschungszentrum Karlsruhe, Kreuzeckbahnstrasse 19, Garmisch-Partenkirch D-82467, Germany

[9]National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba 305-8506, Japan

[10]University of Toronto, 60 St. George St., Toronto, ON M5S 1A7, Canada

Carbon monoxide total column amounts in the atmosphere have been measured between January 2002 and December 2003 in the High Northern Hemisphere (30°-90° N, HNH) using infrared spectrometers of high and moderate resolutions. They were compared to the mixing ratios measured in the surface layer and to the total column amounts measured by the Terra/MOPITT instrument. All the data reveal increased CO abundances in comparison with other years. Maximum anomalies (deviations from the "normal" monthly means, averaged over 2000- 2001 or over 1996 - 2001) were observed in October 2002 and August 2003. Nonetheless, these enhancements were twice as little comparing to the record high CO anomaly in October 1998. Most likely, CO emissions from the strong boreal forest fires in Russia and in Canada induced increasing CO burdens.

A33B-02 1345h INVITED

Challenges in the Incorporation of National Emissions into Global Emission Inventories: The United States as an Example.

David D. Parrish (303-497-5274; parrish@al.noaa.gov)

NOAA Aeronomy Laboratory, 325 Broadway R/AL7, Boulder, CO 80503, United States

Accurate global emission inventories and their trends over decades are critical requirements to accurately model the chemistry of the present and past global troposphere. To a large extent, global inventories are developed by compiling individual national inventories. However, the methodologies employed to develop the national inventories are not always compatible with direct incorporation to the global scale, and the national inventories may have substantial inaccuracies themselves. Consequently global inventories reflect these problems. For example the EDGAR global emission inventory indicates that the CO emissions of the U.S. have increased modestly from 1980 to 1995, while current U.S. emission tabulations report substantial decreases over this period. Further, ambient measurements indicate that U.S. emissions may have decreased even more rapidly than given in the national tabulations. The goal of this presentation is to review U.S. emissions of ozone precursors in the context of global emissions, and to identify possible areas of concern for the accuracy of global models.

A33B-03 1415h

Comparison of the The Radiative forcing of Tropospheric Ozone with Models

Wayne F.J. Evans[1] (705-748-1011 x1622; wevans@trentu.ca)

Chris J. Ferguson[1] (705-748-1011 x1654; cferguson@trentu.ca)

[1]Trent University, 1600 West Bank Drive, Peterborough, Ont K9J 7B8, Canada

There has been little experimental verification of the radiative forcing from tropospheric ozone. This paper reports on the progress which has been made towards validating the predictions of the climate forcing associated with tropospheric ozone. Measurements have been taken over the last three years with a new technique which was developed to measure the greenhouse radiative fluxes from greenhouse gases beneath clouds. These measurements are valuable since there are large spatial and temporal variations in some gases which make it difficult to quantify their climate forcing. As a result of the poor state of knowledge of the radiative forcing associated with tropospheric ozone, its reduction has been omitted in the Kyoto protocol for the reduction of greenhouse gases as are other prime constituents of smog such as nitric acid or PAN. In our technique, measurements of the surface radiative forcing from the gases below the cloud are taken against the cold black body background of the cloudy sky. Radiative fluxes from ozone, carbon monoxide, nitrous oxide, nitric acid and aerosols have been measured. The process also yields remote sensing measurements of the average boundary layer ozone concentrations. Measurements of the tropospheric ozone surface forcing made for a number of summer days during the past three years have shown that the average surface forcing is about 0.23 W/m^2. This translates to a radiative forcing of about 0.3 W/m^2; it is interesting to note that this value is consistent with the global value of 0.3

W/m^2 from models presented in the IPCC 2001 report. A comparison of the measured surface forcing with the corresponding radiative trapping is also conducted; the radiative trapping was calculated with MODTRAN 4 . The average of the measured radiative trapping fluxes from 30 days at 45 N is about 0.57 W/m^2 ; this is close to the global forcing estimate of 0.7 W/m^2 for tropospheric ozone in summer reported in the 2001 IPCC report. Our measurements have been made at 44N over all four seasons. The same technique yields measurements of the average boundary layer ozone concentrations; comparisons with surface monitors show significant errors in the surface measurements. This presents a problem for model comparisons with surface monitoring ozone measurements. In order to decrease the uncertainty of the tropospheric ozone forcing measurements further, many more measurements need to be made at different latitudes and climates.

A33B-04 1430h

Changes in Tropospheric Chemistry at 2100

Drew T Shindell[1] (212 678-5561; dshindell@giss.nasa.gov)

G Faluvegi[1] (gfaluvegi@giss.nasa.gov)

N. Bell[1] (nbell@giss.nasa.gov)

D Koch[1] (dkoch@giss.nasa.gov)

[1]NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, United States

We have performed simulations of the response of tropospheric composition to climate and emissions changes a century hence. The simulations use the newly developed state-of-the-art GISS modelE GCM in a fully coupled climate-chemistry-aerosol mode. Results are presented showing the effects of climate changes alone and of climate and emissions together. We focus on the responses of stratosphere-troposphere exchange (+ 71 Tg/yr O3), for which a wide range of predictions currently exist, and of lightning, and on the impact of changes in the hydrologic cycle. Ozone changes are compared with the CTM studies of the last IPCC assessment. Additional simulations incorporating stratospheric chemical changes and climate-induced changes in methane emissions from wetlands are also discussed

A33B-05 1445h

On the Effects of Using On-line Versus Off-line Chemical Input Fields in a Global Tropospheric Chemistry-Aerosol General Circulation Model.

Nadine Bell[1] (1-212-678-5585; nb2103@columbia.edu)

Dorothy Koch[1]

Drew T Shindell[1]

Gregory Faluvegi[1]

[1]Goddard Institute for Space Studies and the Center for Climate Systems Research at Columbia University, Armstrong Hall 2880 Broadway, New York, NY 10025, United States

Our previous global modeling approach has been to use off-line sulfate aerosol fields for the tropospheric chemistry simulations and off-line oxidant fields for the sulfate aerosol simulations. This presents inadequacies, not least because the aerosol-chemistry coupling processes occur on short time scales. We have implemented a flexible model interface between the existing tropospheric chemistry and sulfate aerosol modules within the new generation 'modelE' Goddard Institute for Space Studies general circulation model (GISS GCM), allowing us to perform simulations in either coupled (on-line) or uncoupled (off-line) mode. We use this flexible code architecture to isolate the effects of on-line versus off-line chemical input fields on the ozone and sulfate simulations. Although, on annual and global scales, the differences between the coupled and uncoupled simulations are small, significant deviations do occur on regional and seasonal scales. For example, the coupled (on-line) simulation predicts increased sulfate surface mixing ratio over central Europe in summer, (about 0.5 ppbv or 20%), relative to the uncoupled (off-line) simulation. The difference is driven by greater gas-phase oxidation of sulfur dioxide in the on-line simulation as a result of exposure to higher daytime oxidant concentrations when running in coupled mode. Similarly, the coupled model predicts significantly higher summer time hydroxyl radical levels (up to 40%) over the northeastern United States and central Europe compared to the uncoupled simulation, for reasons yet to be determined. The effect of using on-line versus off-line sulfate fields on the ozone simulation appears to be less significant. An analysis using preindustrial emissions will also be conducted. Model output, including sulfur dioxide, sulfate and ozone concentrations, from both coupled and uncoupled simulations, will be evaluated using surface observations from several networks.

A34A CC: 520 D Wednesday 1530h

Frontiers in Atmospheric Observations and Their Impacts: AIRS, AVHRR, HIAPER

Presiding: **K H Rosenlof,** NOAA Aeronomy Laboratory**; H H Aumann,** Jet Propulsion Laboratory, California Institute of Technology

A34A-01 1530h

Infrared Remote Sensing Through Clouds With the AIRS-AMSU-HSB Sounding System on Aqua: An Update

Annmarie Eldering[1] (818-354-4941; Annmarie.Eldering@jpl.nasa.gov); Sung-Yung Lee[1] (Sung-Yung.Lee@jpl.nasa.gov); Eric J Fetzer[1] (Eric.J.Fetzer@jpl.nasa.gov); Evan F Fishbein[1] (Evan.F.Fishbein@jpl.nasa.gov); Luke L Chen[1] (Luke.L.Chen@jpl.nasa.gov); Edward T Olsen[1] (Edward.T.Olsen@jpl.nasa.gov); Fredrick W Irion[1] (William.F.Irion@jpl.nasa.gov); Moustafa T Chahine[1] (Moustafa.T.Chahine@jpl.nasa.gov); Thomas S Pagano[1] (Thomas.S.Pagano@jpl.nasa.gov); Hartmut H Aumann[1] (Hartmut.H.Aumann@jpl.nasa.gov); Bjorn H Lambrigtsen[1] (Bjorn.H.Lambrigtsen@jpl.nasa.gov)

[1]JPL/caltech, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

The Atmospheric Infrared Sounder (AIRS) experiment on NASA's Earth Observing System Aqua spacecraft is a combination of infrared and microwave instruments designed for remote sensing of the atmosphere in the presence of clouds. The instruments and associated ground-based processing system have been in near full-time operation since September 2002, and have generated over 300,000 retrievals daily. The primary retrieved products are daily global fields of surface temperature, cloud height and fraction, and height-resolved humidity, temperature and minor gases. These observations are relevant to altitudes from the surface to the upper stratosphere. Central to the AIRS retrieval process is cloud-cleared radiance –the emission from the cloud-free part of a scene– generated from a combination of infrared and microwave observations. We present instantaneous and time-averaged observations of cloud-cleared radiances, cloud properties, temperature, humidity and minor gases. We describe progress toward the central objectives of uncertainties of 1 K / km for atmospheric temperature profiles, 5% for total precipitable water vapor, 20% for relative humidity profiles, 0.5 C for sea surface temperatures, and 1.0 K for land surface temperatures. Some examples of how these observations are being used to answer important outstanding questions in the atmospheric sciences are also described.

URL: http://www.jpl.nasa.gov/airs

A34A-02 1545h

First Evaluation of AIRS Data for Climate Trending

Hartmut H. Aumann[1] (aumann@jpl.nasa.gov)

Moustafa T Chahine (chahine@jpl.nasa.gov)

[1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

The Advanced Infrared Temperature Sounder, AIRS, is a high spectral resolution radiometer with spectral coverage from 3.7 to 15.4 microns, which was launched in May 2002 by NASA into polar orbit on the EOS Aqua satellite. Monitoring the sea surface temperature using the AIRS 2616cm-1 window channel relative to the NCEP provided RTG-SST shows measurement stability at better than the 8mK/year level. Eighteen months of clear night tropical ocean AIRS data have been used for the initial evaluate of mid-tropospheric temperature, lapse rate and water vapor variation for time trending and potential climate signatures using 3.7 micron and 4.3 micron CO2 R-branch channels. The Southern Oscillation during 2003 is evident in the data as a strong temperature variation with a 2.5K amplitude. This variation is tracked essentially in phase by the temperature at the 300 - 400 mbar level and the lapse rate, but with a factor of five smaller amplitude, and a 10% variation in the precipitable water. With the lifetime of AIRS expected to be seven year, the analysis of many cycles of the southern oscillation and correlation with El Nino events promises to be the start of climate monitoring from space with unprecedented accuracy. This effort can be continue by future high spectral resolution polar sounders, startimg with ISAI in 2006, followed by high spectral resolution NPOES operational sounders starting in 2008.

A34A-03 1600h

AIRS Data Mining Service at the Goddard Earth Sciences (GES) DISC DAAC

Gilberto A Vicente[1] (301-614-6749; vicente@daac.gsfc.nasa.gov); Jianchun Qin[2]; Long Pham[3]; Chris Lynnes[3]; Eunice Eng[3]; Jason Li[4] ; Robert Mack

[1]Center for Earth Observing and Space Research, George Mason University, Fairfax, VA, NASA/GSFC - DAAC Code 902, Greenbelt, MD 20771, United States

[2]Science Systems and Applications, Inc., Lanham, MD, NASA/GSFC - DAAC Code 902, Greenbelt, MD 20771, United States

[3]NASA Goddard Space Flight Center, Greenbelt, MD, NASA/GSFC - DAAC Code 902, Greenbelt, MD 20771, United States

[4]L-3 Communications Government Services, Inc., NASA/GSFC - DAAC Code 902, Greenbelt, MD 20771, United States

The Atmospheric Infrared Sounder (AIRS) is a high-resolution infrared (IR) sounder with 2378 spectral channels flying on the EOS Aqua platform with two operational microwave sounders, the Advanced Microwave Sounding Unit (AMSU) and the Humidity Sounder for Brazil (HSB). Measurements from the three instruments are analyzed jointly to filter out the effects of clouds from the IR data in order to derive clear-column air-temperature profiles and surface temperatures with high vertical resolution and accuracy. Together, these three instruments constitute an advanced operational sounding data system that have contributed to improve global modeling efforts and numerical weather prediction; enhance studies of the global energy and water cycles, the effects of greenhouse gases, and atmosphere-surface interactions; and facilitate monitoring of climate variations and trends. The NASA Goddard Earth Sciences Data and Information Services Center/Distributed Active Archive Center (GES DISC DAAC) provides long-term archive and distribution services for AIRS/AMSU/HSB data products as well science support to assist users in understanding, accessing and using the AIRS data products. However, the high data volume generated by the AIRS/AMSU/HSB instruments and the complexity of its data format (Hierarchical Data Format, HDF) are barriers to AIRS data use. Although many researchers are interested in only a fraction of the data they receive or request, they are forced to run their algorithms on a much larger data set to extract the information of interest. In order to address this problem, the GES DAAC is expanding its data mining system to accept AIRS user's algorithms by providing online tools for spectral channels and value added product sub-settings, as well as spatial, temporal and user defined profile sub-settings. This presentation will show details of the AIRS components of the GES DAAC data mining system including technical description, input data and returning products, advantages and capabilities plus algorithm examples.

A34A-04 1615h

Impact of real-time vegetation fraction from AVHRR on Eta model

Vince Wong[1] (301-763-8000; Vince.Wong@noaa.gov)

Kenneth Mitchell[2] (301-763-8000; Kenneth.Mitchell@noaa.gov)

[1]SAIC/NCEP/NOAA, 5200 Auth Road, Camp Springs, MD 20746, United States

[2]EMC/NCEP/NOAA, 5200 Auth Road, Camp Springs, MD 20746, United States

Vegetation plays a significant role in determining the partition of surface sensible and latent heat flux, so vegetation must be represented adequately in numerical weather prediction models. The NCEP operational Eta model uses the NESDIS 0.144 degree (about 14km) monthly green vegetation fraction database, which is based upon a 5-year NDVI climatology from AVHRR data observed from the NOAA's polar-orbiting satellites (1986 to 1991). In reality, vegetation fraction

A