We shortly review our current physical understanding of the physics of polar mesosphere summer echoes (PMSE) in the scope of our recently updated theory of reduced electron diffusivity in the presence of charged ice particles. Based on the available observational data base from both ground based and rocket borne observations we critically assess our physical understanding of PMSE properties like (among others) observed seasonal variation, signal strength, spectral width, aspect sensitivity, relation to the occurrence of noctilucent clouds, relation to the occurrence of electron biteouts, electric fields, and the morphology of mesospheric neutral air turbulence. Finally, we identify remaining open questions and discuss the need for future investigations.

URL: http://www.iap-kborn.de

SA42B-06 1715h

Simultaneous Observations of Temperature, PMSE, NLC and Potassium at Spitsbergen, 78°N

Franz-Josef Lübken[1]

Josef Höffner[1] (49-38293-68130; hoeffner@iap-kborn.de)

Cord Fricke-Begemann[1]

Arno Müllemann[1]

[1]Leibniz-Institute of Atmospheric Physics, Schloss-Str. 6, Kühlungsborn 18225, Germany

Between 2001 and 2003 a potassium lidar was installed near Longyearbyen (78°N) on the north polar island of Spitsbergen which is part of the archipelago Svalbard. The potassium lidar is capable of detecting noctilucent clouds (NLCs) and of measuring temperatures in the mesopause region, both under daylight conditions. At the same place a series of meteorological rockets (falling spheres) were launched in during the ROMA campaign in 2001 which gave temperatures from the summer mesopause to the stratosphere. The location of the lidar was close to the Sousy-Radar which has frequently observed PMSE throughout the summer periods of 2001 and 2003. We give an overview on the NLC and PMSE measurements and compare the results with temperatures in the same altitude region derived from the meteorological rockets. The NLC and PMSE appearance with height and season is in agreement with the climatological variation of water vapor saturation derived from the temperature measurements.

SA42B-07 1730h INVITED

Observations of Polar Mesospheric Clouds and Aurora from the International Space Station

Donald R Pettit

NASA JSC,, Houston, TX, United States

This is a featured presentation.

SA51A MCC: Level 1 Friday 0830h

Phenomena of the Summer Mesosphere III Posters *(joint with ED, GC)*

Presiding: **J Thayer,** SRI International**; G Thomas,** University of Colorado

SA51A-0482 0830h POSTER

Laboratory Studies of Ice Growth in the Presence of Oxygen Atoms

Christopher G Morgan[1] (650-859-5263; christopher.morgan@sri.com)

James E Boulter[1] (650-859-2970; james.boulter@sri.com)

Jochen Marschall[1] (650-859-2667; jochen.marschall@sri.com)

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

In the mesopause region, where noctilucent clouds (NLCs) form and polar summertime echoes are present, atomic oxygen is the dominant reactive species. Observations by Gumbel *et al.* (1998) reveal sharp gradients and distinctive minima in oxygen atom concentration coinciding with observed NLC layers. These observations suggest an interaction between oxygen atoms and NLC particles. Recent laboratory studies conclude that the uptake coefficient of atomic oxygen on ice is not large enough to change the gas-phase concentrations in the mesosphere lower thermosphere (MLT) region (Murray and Plane, 2003). However, the question of whether or not atomic oxygen can affect the formation and growth of ice has not been experimentally addressed. To gain insight into possible interactions between atomic oxygen and ice surfaces, we directly measure ice growth rates at temperatures associated with the summertime mesopause region (110-150 K), with and without exposure of the growing ice layer to partially dissociated oxygen. A liquid nitrogen cooled cryostat is used to control the temperature of a gold mirror in a high vacuum chamber. Water vapor, either from the residual background or from an introduced source, is allowed to condense on the mirror. A microwave discharge is used to partially dissociate an oxygen stream, which is sampled into the chamber through a small orifice facing the gold mirror. Grazing angle Fourier transform infrared reflection absorption spectroscopy (FTIR-RAS) is used to monitor the rate of ice growth. Preliminary results at 130 K indicate that the ice growth rate in the presence of oxygen slows when the microwave discharge is activated and the ratio of water to oxygen is low. For H_2O/O_2 = ~0.3 %, at a total chamber pressure of about 7 μTorr, the growth rate reduction amounts to 24±9 %. Changes in the FTIR-RAS absorption profile of the OH stretching vibrations are also noted, which may indicate changes in ice morphology. Both results suggest that the presence of atomic oxygen influences how ice forms and grows, though more extensive experimentation is required to solidify this conclusion. This testing is underway and results will be presented and discussed.

Gumbel, J., D. P. Murtagh, P. J. Espy, and G. Witt, "Odd Oxygen measurements during the Noctilucent Cloud 93 rocket campaign," *Journal of Geophysical Research*, Vol. 103, No. A10, 1998, pp. 23,399-23,414.

Murray, B. J, and J. M. C. Plane, *personal communications*, 2003

SA51A-0483 0830h POSTER

Polar Mesospheric Clouds as Seen by the Halogen Occultation Experiment

Jonathan E. Wrotny[1] (1-757-727-5127; jonathan.wrotny@hamptonu.edu)

James M. Russell[1] (1-757-728-6893; james.russell@hamptonu.edu)

[1]Hampton University / Center for Atmospheric Sciences, 23 Tyler St., Hampton, VA 23668, United States

Data from the Halogen Occultation Experiment (HALOE) are being used to study Polar Mesospheric Clouds (PMCs), their long-term variations with time, northern and southern hemispheric asymmetries, and variations with latitude. HALOE has been observing the polar summer region since the end of 1991, which has provided 12 northern and 12 southern seasons of data. HALOE typically makes 2-3 sweeps through the high latitudes each summer that provide approximately 600 polar observing opportunities each PMC season. These observations can vary with latitude and time for each summer season, and since PMC occurrence frequency will depend on latitude and time, the HALOE PMC observations are normalized to the SME climatology as described by Shettle et. al. (2002) so that interannual comparisons can be made. We will present the seasonal PMC occurrence frequency and extinction, and the seasonally averaged temperature and water vapor at PMC altitudes for both the northern and southern hemisphere. PMC altitude distributions for each hemisphere and occurrence frequency with latitude and time in a season will be shown. Occurrence frequency results versus time show good agreement with the SME distribution.

SA51A-0484 0830h POSTER

Summertime Shuttle Plume Transport to the Arctic Using Lower Thermospheric Wind Observations

Michael H. Stevens[1] (202-404-7226; stevens@uap2.nrl.navy.mil)

John T. Emmert[1] (202-767-0467; emmert@uap2.nrl.navy.mil)

Douglas P. Drob[1] (202-404-1292; douglas.drob@nrl.navy.mil)

Hartogh Paul[2] (+49 5556 979 342; hartogh@linmpi.mpg.de)

[1]E.O. Hulburt Center for Space Research, Naval Research Laboratory, 4555 Overlook Ave., Washington, DC 20375

[2]Max-Plank-Institute for Aeronomy, Max-Plank-Str. 2, Katlenburd-Lindau 37191, Germany

Recent observational evidence indicates that space shuttle main engine water vapor exhaust can travel to the Arctic and create polar mesospheric clouds (PMCs). If this phenomenon is repeatable, then hundreds of metric tons of water vapor could be ushered into the Arctic lower thermosphere every summer from the shuttle and other mid-latitude launches worldwide. The shuttle-PMC link is a stringent test of our understanding of constituent transport near 110 km. We address it by compiling satellite observations of lower thermospheric winds from NASA's Upper Atmospheric Research Satellite (UARS) for use in a parcel advection model that includes effects of season, altitude, local time and latitude. We find that satellite wind climatologies yield plume motion in the direction observed but significantly slower than inferred from our observations. Reported peak wind speeds from chemical release experiments are generally higher than those from satellites in the 100-110 km region. If wind speeds are as high as the chemical release data indicate, the inferred plume motion can be reproduced. We use recent summertime shuttle plume observations from a microwave instrument measuring water vapor in the Arctic to help constrain the transport.

SA51A-0485 0830h POSTER

The response of PMCs to Shuttle Water Vapor Plumes in the Arctic

Matthew T DeLand[1] (301-867-2164; matthew_deland@ssaihq.com)

Michael H Stevens[2] (202-404-7226; stevens@uap2.nrl.navy.mil)

Christoph R Englert[2] (202-767-5528; englert@uap2.nrl.navy.mil)

Paul Hartogh[3] (+49-5556-979-342; paul@chirp.mpae.gwdg.de)

[1]Science Systems and Applications, Inc. (SSAI), 10210 Greenbelt Rd., Suite 400, Lanham, MD 20706, United States

[2]Code 7641 Naval Research Laboratory, 4555 Overlook Ave SW, Washington, DC 20375, United States

[3]Max Planck Institute for Aeronomy, Max Planck Str 2, Katlenburg-Lindau 37191, Germany

Recent work shows evidence that space shuttle water vapor exhaust can travel to the Arctic and form polar mesospheric clouds (PMCs), visible about a week after launch. A ground-based microwave spectrometer in northern Norway (69°N) has been measuring water vapor in the upper atmosphere since 1995. These data reveal that several space shuttle plumes injected in the summer were detected by the microwave spectrometer one to three days after launch. To explore whether each of these Arctic shuttle plumes leads to PMC formation, we analyze satellite PMC data collected by Solar Backscatter Ultraviolet (SBUV/2) instruments following each case where an Arctic shuttle plume was observed. Some shuttle plumes lead to significant observed PMC responses, while others lead to weaker or no observed responses. Since the orbits of most SBUV/2 instruments drift in local time and the PMC lighting conditions evolve during the season and with latitude, we examine the observational conditions for each case to quantitatively determine the detection capability of SBUV/2 following each Arctic plume observation. Using the comprehensive coverage of SBUV/2 over the polar cap, we will also quantify the spatial and temporal extent of any burst of PMC activity following a shuttle launch.

SA51A-0486 0830h POSTER

Rocket-borne Probes for Charged Ionospheric Aerosol Particles

S. Robertson[1] (Scott.Robertson@colorado.edu); B. Smiley[1] (Byron.Smiley@lasp.colorado.edu); M. Horanyi[1] (horanyi@colorado.edu); Z. Sternovsky[1] (Zoltan.Sternovsky@colorado.edu); J. Gumbel[2] (gumbel@misu.su.se); J. Stegman[2] (stegman@misu.su.se)

[1]Department of Physics, University of COlorado, Boulder, CO 80309, United States

[2]Department of Meteorology, Stockholm University, Stockholm 106 91, Sweden

Two types of rocket-borne probes are described for detecting charged aerosol particles in the ionosphere. The first are flat charge-collecting surfaces on the skin of the rockets that have returned data in four experimental campaigns. The collection surfaces have behind them permanent magnets that shield the probes from electrons. Some of the probes also have an electrical bias to repel light, positive ions. The current that is recorded is thus from heavier charged aerosol particles. This heavy charge carrier current is converted to a charge number density. The second type of probe, under development, is an electrostatic mass analyzer in which different ranges of mass are collected within the payload on surfaces with different bias potentials

URL: http://debye.colorado.edu/research.html#Rocket

SA51A-0487 0830h POSTER

Lidar and Satellite Observations of Noctilucent Clouds in the Western Arctic

Kazuyo Sakanoi[1] (ksakanoi@crl.go.jp); Kohei Mizutani[1] (mizutani@crl.go.jp); Richard L Collins[2] ((907) 474-7607; rlc@gi.alaska.edu); Scott M Bailey[2] (scott.bailey@gi.alaska.edu); Timothy E Stern[2] (fstes@uaf.edu); Weiyuan Wang[2] (ftww@uaf.edu); Aimee W Merkel[3] (merkel@ucar.edu)

[1]Communications Research Laboratory, 4-2-1 Nukui-Kita Kogenai, Tokyo 184-8795, Japan

[2]Geophysical Institute, University of Alaska Fairbanks 903 Koyukuk Drive, Fairbanks, AK 99775, United States

[3]National center for Atmospheric Research, 1850 Table Mesa Road, Boulder, CO 80305, United States

Rayleigh lidar observations have been ongoing at Chatanika, Alaska (65oN, 147oW) since 1997. Noctilucent clouds have been detected by lidar in late summer since August 1998. These lidar observations have been made near local midnight during visible noctilucent cloud displays. We report observations in the summers of 1998, 1999, 2001, 2002 and 2003. The Student Nitric Oxide Explorer (SNOE) makes satellite observations of Polar Mesospheric Clouds over the entire globe. The SNOE observations have been made near local midday since summer 1998. We focus on the lidar and satellite observations in the western Arctic during the same seasons. We discuss the cloud observations in terms of local, regional, and long-term environmental factors (i.e. temperature, water).

SA51A-0488 0830h POSTER

Early and Late Season Increases in PMC Occurrence Frequency in the 1978 to 2000 Time Period

David W Rusch[1] (3034928627; dave.rusch@lasp.colorado.edu)

Gary E. Thomas[1] (3034927767; gary.thomas@lasp.colorado.edu)

Matthew T. DeLand[2] (matthew_deland@sesda.com)

Eric P. Shettle[3] (eric.shettle@nrl.navy.mil)

John J. Olivero[4] (oliveroj@erau.edu)

[1]Laboratory for Atmospheric and Space Physics Campus Box 392 , University of Colorado, Boulder, CO 80309, United States

[2]Science Systems and Applications, Inc, 10210 Greenbelt Rd. Suite 400, Lanham, MD 20706, United States

[3]Remote Sensing Division, Naval Research Laboratory Code 7227, Washington, DC 20375, United States

[4]Department of Physical Sciences , Embry-Riddle University, Daytone Beach, FL 32114, United States

We have examined 23 years of SBUV data for changes in the seasonal distribution of PMC occurrence. In the north there are significant increases in the relative proportion of clouds that occur at the beginning of the season (between 20 and 40 days prior to solstice) and at the end of the season (60 to 80 days after solstice). In the south, significant relative increases are seen at the end of the season (50 to 70 days after solstice) but not in the beginning of the season. We found no evidence that the length of the season has changed. Because the SBUV instruments are sensitive to the brighter clouds, the results indicate that the relative number of bright clouds has increased over time at the beginning and end of the cloud season.

SA51A-0489 0830h POSTER

Backscatter Lidar Depolarization Study of NLC at Sondrestrom, Greenland

Weilin Pan[1] ((650)859-2540; weilin.pan@sri.com)

Jeff Thayer[1] ((650)859-3557; thayer@sri.com)

[1]SRI INTERNATIONAL, 333 RAVENSWOOD AVENUE, MENLO PARK, CA 94025, United States

The spherical shape of NLC particles is often an assumed property without much scientific support. Such information would impact our understanding of NLC formation and interpreting backscatter signals. The depolarization lidar technique has been used to characterize the degree of depolarization, and thereby determine the sphericity of ice particles. During the summer of 2003, Sondrestrom Rayleigh lidar system has been operated to make depolarization measurements by discriminating the cross-polarized component from NLC backscatter signals. We will report our initial experimental results and discuss the nonspherical scattering properties of NLC particles using the T-matrix algorithm.

URL: http://www.isr.sri.com

SA51A-0490 0830h POSTER

POAM Measurements of Polar Mesospheric Cloud Particle Sizes

Eric P Shettle[1] (1-202-404-8152; shettle@nrl.navy.mil)

Jerome M Alfred[2] (1-703-764-7501; alfred@cpi.com)

Jerry D Lumpe[2] (1-703-764-7501; lumpe@cpi.com)

Richard M Bevilacqua[3] (1-202-767-0768; bevilacqua@nrl.navy.mil)

[1]Naval Research Laboratory, Code 7227 Remote Sensing Division, Washington, DC 20375-5351, United States

[2]CPI, Suite 210, 8001 Braddock Road, Springfield, VA 22151, United States

[3]Naval Research Laboratory, Code 7220 Remote Sensing Division, Washington, DC 20375-5351, United States

The Polar Ozone and Aerosol Measurement (POAM II and III) satellite instruments were designed to measure ozone and other trace species in the stratosphere using solar occultation. However, the POAM instruments have proved to be sensitive enough to measure Polar Mesospheric Clouds (PMC). Because of its orbit nearly all the POAM PMC measurements are in the Southern Hemisphere (SH), where its latitude varies between 63 and 70 degrees south, during the PMC season. POAM measures transmission as function of altitude through the earth's atmospheric limb at 9 wavelengths between 355 nm and 1018 nm. POAM II on the SPOT 3 satellite was operational from October 1993 until November 1996, and POAM III on the SPOT 4 satellite has been operational since April 1998, covering eight PMC seasons in the SH. Because of the better the signal-to-noise characteristics of POAM III compared with POAM II, especially in the UV channel, our analysis of the PMC particle sizes will focus on the POAM III results. The transmission measurements are fit with a simple cloud model which allows us to determine the height of the cloud base and top, and the extinction coefficient. The multi-wavelength extinction measurements have been analyzed to determine the characteristic particle sizes in the PMCs. The modal PMC particle size typically ranges from 20 to 70 nm, with the largest sizes being more typical of those clouds, with the greatest optical thickness. Given our derived values of the particle size and PMC extinction coefficient, we also determine the PMC particle number.

SA51A-0491 0830h POSTER

An Overview of the MaCWAVE Program to Study Gravity Forcing of the Polar Mesosphere During Both Summer and Winter

Richard A. Goldberg[1] (301-286-8603; Richard.A.Goldberg@nasa.gov)

David C. Fritts[2] (303-415-9701 x205; dave@cora.nwra.com)

[1]NASA/Goddard Space Flight Center, Code 690.4, Bldg. 21, Room 212, Greenbelt, MD 20771, United States

[2]Colorado Research Associates/NWRA, 3380 Mitchell Lane, Boulder, CO 80301, United States

MaCWAVE is an acronym for Mountain And Convective Waves Ascending Vertically. This coordinated rocket, ground-based, and satellite program was designed to address gravity wave forcing of the mesosphere and lower thermosphere (MLT), with launch sequences into the polar MLT during summer (July 2002) and winter (January 2003) conditions. The summer launch program was conducted at the Norwegian Andoya Rocket Range (ARR, 69.3N); the winter program at the Swedish Rocket Range (ESRANGE, 67.9N). Correlative instrumentation included the ALOMAR radars and lidars (including the new Weber sodium lidar), ESRANGE RMR lidar, ESRAD MST radar, radiosondes, and TIMED satellite measurements of thermal, wind, and constituent structures. The data are being used to define the wave field structure, fluxes, and turbulence generation leading to forcing of the large-scale flow. During summer, launch sequences coupled with ground-based measurements at ARR addressed the forcing of the mesopause environment by anticipated convective and shear generated gravity waves. These motions were measured with two 12-hr rocket sequences, each involving one Terrier-Orion payload accompanied by a mix of MET rockets, all at ARR in Norway. The MET rockets were used to provide large scale meteorology of the mesosphere and stratosphere. The Terrier-Orions were designed to measure small scale plasma fluctuations and/or turbulence that might be induced by wave breaking in the mesosphere. During the summer series, three European MIDAS rockets) were also launched from ARR in coordination with the MaCWAVE payloads. These were designed to measure plasma and neutral turbulence within the MLT. The winter program was planned to study the upward propagation and penetration of mountain waves from northern Norway into the MLT at a site favored for such penetration. As the major response was expected to be downstream (east) of the Norwegian coast, these motions were measured with rocket sequences similar to the summer campaign, but this time at ESRANGE in Sweden. However, a polar stratospheric warming just prior to the rocket window induced stratospheric wind shears, which prevented mountain wave penetration into the mesosphere. Instead, the observed wave structure in the mesosphere originated from other sources. A program description plus preliminary results will be discussed.

SA51A-0492 0830h POSTER

Large Temperature Gradients and Strong Wave Activity in the Arctic Summer Mesopause Region During the MIDAS/MaCWAVE Rocket Campaign

Bifford P. Williams[1,2] (biffw@lamar.colostate.edu)

David C. Fritts[1] (dave@cora.nwra.com)

C. Y. She[2] (joeshe@lamar.colostate.edu)

Joe Vance[2] (jvance@lamar.colostate.edu)

[1]NorthWest Research Associates Colorado Research Associates Division, 3380 Mitchell Lane, Boulder, CO 80301

[2]Colorado State University, Department of Physics, Fort Collins, CO 80523

The Weber sodium resonance lidar at ALOMAR measured sodium density, temperature, and zonal wind at altitudes from 85 to 97 km in June/July, 2002, during the MIDAS/MaCWAVE rocket campaign at the Andoya Rocket Range (69N,16E). During the first rocket salvo on July 1, 2003, the sodium lidar measured very large vertical gradients of temperature, sodium density, and zonal wind lasting several hours. The temperature changed by 40K over 1 km in altitude with the sodium density changing by a factor of 10 at the same height. The zonal wind also showed a strong gradient, although not as striking as in the temperature. During both salvos on July 1 and July 4, 2003, the sodium density measurements showed great variability at periods ranging from tens of minutes to tens of hours presumably due to gavity waves and tides. The sodium layer exhibited large changes in abundance and layer height with several sporadic layers and sharp bottomside gradients. We will investigate the properties of the waves and their possible connection to the strong vertical gradients of temperature, wind, and sodium density.

SA51A-0493 0830h POSTER

MaCWAVE: A Survey of Mesospheric Temperature and Wind Measurements

Francis J Schmidlin (757 824 1618; francis.j.schmidlin@nasa.gov)

Richard A Goldberg (301 286 8603; richard.a.goldberg@nasa.gov)

The campaign, Mountain and Convective Waves Ascending Vertically (MaCWAVE) took place during the summer from the Andoya Rocket Range in Norway and during the winter from ESRANGE in Sweden. The purpose of MaCWAVE was to determine the morphology of gravity waves and their generation from convection during the summer and mountain wave activity during the winter. MaCWAVE included a large number of meteorological rockets comprised of 26 inflatable falling sphere flights during the summer campaign and 46 flights during the winter campaign. Temperature and wind data to approximately 90 km show summer mesospheric structure having very similar profiles although evidence of a diurnal cycle is apparent. However, the winter mesospheric structure is quite variable. Identifying mountain wave propagation of gravity waves is difficult due to easterly winds from a stratospheric warming inhibiting westerly flow over the mountains. In situ and remote observations obtained during similar time periods are examined for similarities and differences. Time series, while limited over time, show the cyclic nature of the mesospheric temperature and wind data.

SA51A-0494 0830h POSTER

Turbulence Measurements During MIDAS/MacWave 2002

Boris Strelnikov[1] (+49 38293 680; strelnikov@iap-kborn.de)

Markus Rapp[1] (+49 38293 68126; rapp@iap-kborn.de)

Arno Müllemann[1] (+49 38293 68124; muellemann@iap-kborn.de)

Franz-Josef Lübken[1] (+49 38293 68100; luebken@iap-kborn.de)

[1]Leibniz Institute of Atmospheric Physics, Schlossstr. 6, Kühlungsborn 18225, Germany

We present results from rocket borne in situ measurements of mesospheric turbulence obtained in the course of the international MIDAS/MacWave project. We apply a new data analysis technique based on wavelet analysis and identify turbulent layers with vertical extents from 100 m up to several kilometer. Our observations show that we observed the mesopause region in an extremely untypical dynamical state, in particular characterized by the fact that strong turbulence was observed below an altitude of 80 km. Evidence for this extraordinary behaviour is further identified in wind and temperature profiles obtained with meteorological rockets that accompanied the launches of the instrumented sounding rockets. Finally, we discuss our observations in the scope of current understanding of the role of breaking gravity waves for the dynamical and thermal structure of the mesopause region.

URL: http://www.iap-kborn.de

SA51A-0495 0830h POSTER

Case Studies of Mesopheric Gravity-Wave Breaking in Lidar Data

Patricia Franke (217 244-5503; pfranke@uiuc.edu)

Department of Electrical and Computer Engineering/University of Illinois at Urbana-Champaign, 1308 West Main 322 CSL, Urbana, IL 61801, United States

Lidar derived temperatures reveal dramatic episodes of gravity-wave breaking on every night during several campaigns at the Starfire Optical Range (SOR) in New Mexico, USA. Potential temperatures,derived assuming hydrostatic balance, reveal vertical parcel displacements of greater than 10 km over timescales of hours, as well as breaking events that create isentropic layers of kilometer thickness. These events results from complex interactions between intermediate period waves and the tidally determined background state. Both synoptic and spectral analyses will be presented that give insight into the dynamics of these events. Estimates of wave-associated vertical heat and momentum fluxes, calculated using lidar-doppler velocities, will also be shown.

SA51A-0496 0830h POSTER

Role of Small Scale Gravity Waves in Generating Nonmigrating Tides in the Mesosphere

John G Mengel[1] (jmengel@pop900.gsfc.nasa.gov)

Hans G Mayr[2] (301 286-7505; hmayr@pop900.gsfc.nasa.gov)

Elsayed R Talaat[3] (Elsayed.Talaat@juuapl.edu)

Hayden S Porter[4] (HaydenPorter@furman.edu)

[1]Science Systems and Applications, 10210 Greenbelt Rd., Lanaham, MD 20706, United States

[2]Goddard Space Flight Center, 8800 Greenbelt Rd., Greenbelt, MD 20771, United States

[3]Applied Physics Laboratory, 1100 John Hopkins Rd., Laurel, MD 20723, United States

[4]Furtman University, 3300 Pointset Rd., Greenville, SC 29613, United States

We demonstrated with the Numerical Spectral Model (NSM) that nonlinear interactions between planetary waves (PW) and migrating tides could generate in the upper mesosphere nonmigrating tides having amplitudes comparable to those observed. The NSM incorporates Hines' Doppler Spread Parameterization for small scale gravity waves (GW), which affect in numerous ways the dynamics of the mesosphere. The latitudinal (seasonal) reversals in the zonal circulation and temperature variations above 70 km, largely caused by GWs (Lindzen, 1981), contribute to the instabilities that generate the PWs as well as filter them. The PWs in turn are amplified by the momentum deposition of upward propagating GWs, as are the migrating tides. The GWs thus affect the migrating tides and PWs, the building blocks of non-migrating tides. We present here the results of two computer experiments, which indicate that the GWs also contribute significantly to the process of nonlinear coupling between PWs and tides. In one, we turn off the GW source to show the effect on the nonmigrating tides. In the second case, we demonstrate the effect on the stationary non-migrating diurnal tide by selectively suppressing the GW momentum source for zonal wavenumber m = 0.

SA51A-0497 0830h POSTER

On Latitudinal Dependence of Secular Variations Induced by a Dissipating Gravity Wave Packet

Tai-Yin Huang[1] (610-285-5100; tuh4@psu.edu)

Michael P. Hickey[2] (386-226-7059; michael.hickey@erau.edu)

[1]Penn State Berks and Lehigh Valley College, 148 Academic Building 8380 Mohr Lane, Fogelsville, PA 18051-9999, United States

[2]Embry-Riddle Aeronautical University, 600 S. Clyde-Morris Boulevard, Daytona Beach, FL 32114, United States

A time evolution of the response of the minor species and the OH airglow to a dissipating gravity wave packet can be simulated with a 2-dimensional, time-dependent, fully nonlinear OH model developed recently by Huang and Hickey [2002]. The wave packet was simulated using a spectral full-wave model described by Hickey et al. [2000] and Hickey and Walterscheid [2001], and then input to a 2-D chemistry model to study the secular variation of the minor species and OH nightglow. Previous studies of OH nightglow at high latitudes show strong secular variations of minor species and also of the OH brightness induced by wave transience and dissipation [Huang and Hickey, 2002]. We plan to employ the same models to study the secular variations of minor species and the OH nightglow at mid- and low-latitudes. The latitudinal dependence of the secular variations can thus be deduced. Satellite observations reveal much larger OH brightness at mid-latitudes compared to those at high and low latitudes. Therefore, we expect greater secular variations induced by the same wave packet at mid-latitudes.

SA51A-0498 0830h POSTER

Breaking of Thunderstorm-Generated Gravity Waves as a Source of Short-Period Ducted Waves Observed at Mesopause Altitudes

Jonathan B. Snively[1] (jbs231@psu.edu)

Victor P. Pasko[1] (vpasko@psu.edu)

[1]CSSL Laboratory, Penn State University, 204 EE East, University Park, PA 16802, United States

Atmospheric gravity waves with periods of 5 to 8 minutes have been observed at airglow altitudes [Taylor et al., GRL, 22, 2849, 1995; Walterscheid et al., JASTP, 61, 461, 1999; Hecht et al., JGR, 106, 5181, 2001; and references cited therein]. These waves are believed to propagate as thermally-ducted wave modes, trapped in the Brunt-Väisälä frequency minimum of the upper mesosphere and lower thermosphere [e.g., Walterscheid et al., 1999]. Many of these recently observed waves have been traced to thunderstorm activity located hundreds of kilometers from the point of observation. However, these gravity waves would be evanescent in most regions of atmosphere, where their frequency exceeds the local Brunt-Väisälä frequency. It is therefore improbable that the observed waves with short periods ($\tau \simeq 5$ min) would be able to propagate freely from a tropospheric convective source to the lower thermosphere. Thunderstorms are known radiators of gravity waves, with typical forcing periods of 10 to 16 minutes (approximately equal to the Brunt-Väisälä period of the upper troposphere) [e.g., Pierce and Coroniti, Nature, 210(5042), 1209, 1966]. Recent numerical studies have demonstrated that the breaking of low frequency gravity waves can excite harmonic secondary waves, with frequencies and horizontal wavenumbers approximately twice that of the primary waves [e.g., Franke and Robinson, J. Atmos. Sci., 56, 3010, 1999, Zhou et al., JGR, 107(D7), doi:10.1029/2001JD001204, 2002]. It has also been proposed that these radiated secondary waves may be subject to ducting near the breaking region [Vadas et al., J. Atmos. Sci., 60, 194, 2003]. It can thus be predicted that if thunderstorm-generated gravity waves, with periods of 10 to 16 minutes, were to break near mesopause, they may excite secondary waves with short periods of 5 to 8 minutes. These waves would be trapped in the lower thermospheric duct. Using a high-resolution, two-dimensional, nonlinear numerical model, we examine this process in a thermally-realistic atmosphere for a tropospheric oscillatory source modeling the effects of convection. Simulated results demonstrate that breaking thunderstorm-generated gravity waves may be able to excite quasi-monochromatic, short-period, thermally ducted wave modes at airglow altitudes. These results will be compared with linear mechanisms (such as "kissing" modes [e.g., Walterscheid et al. JGR, 106, 31825, 2001]); the applicability and limitations of the different mechanisms will be discussed.

SA51A-0499 0830h POSTER

Planetary Scale Inertio Gravity Waves in the Mesosphere

Hayden S Porter[1] (HaydenPorter@furman.edu)

Hans G Mayr[2] (301 286-7505; hmayr@pop900.gsfc.nasa.gov)

John G Mengel[3] (jmengel@pop900.gsfc.nasa.gov)

Elsayed R Talaat[4] (Elsayed.Talaat@jhuapl.edu)

[1]Furman University, 1100 Pointset Rd., Greenville, SC 29613, United States

[2]Goddard Space Flight Center, 8800 Greenbelt Rd., Greenbelt, MD 20771, United States

[3]Science Systems and Applications, 10210 Greenbelt Rd., Lanham, MD 20706, United States

[4]Applied Physics Laboratory, 1100 Johns Hopkins Rd., Laurel, MD 20723, United States

In the polar region of the upper mesosphere, horizontal wind oscillations have been observed with periods around 10 hours. Waves with such periodicity are generated in our Numerical Spectral Model (NSM), and they are identified as planetary scale inertio gravity waves (IGW). In addition to stationary waves for zonal wavenumber m = 0, eastward and westward propagating waves for m = 1 to 4 appear above 70 km, which grow in magnitude up to about 100 km and have periods between 9 and 11 hours. The m = 1 westward propagating IGWs have the largest amplitudes, which can reach at the poles 30 m/s. The IGWs are intermittent but reveal systematic seasonal variations, with the largest amplitudes occurring generally in winter and spring. The IGWs propagate upward with a vertical wavelength of about 25 km. Without the migrating tidal excitation sources, the IGWs are different but still appear with comparable amplitudes. Like the planetary waves (PW) in the model, the IGWs are apparently produced by instabilities that arise in the mean zonal circulation. When the solar heating for m = 0 is turned off, the IGWs, and PWs, essentially disappear.

SA51A-0500 0830h POSTER

Mesosphere Thermosphere Experiments for Coupling Studies

Nanan Balan[1] (+44-114-222-5234; B.Nanan@sheffield.ac.uk); S. Kawamura[2]; T. Nakamura[2]; M. Yamamoto[2]; S. Fukao[2]; H. Alleyne[1]

[1]Control and Systems Engineering, University of Sheffield, Sheffield S1 3JD, United Kingdom

[2]Radio Science Center for Space and Atmosphere , Kyoto University, Kyoto 611-0011, Japan

The mesosphere lower-thermosphere (MLT) and thermospheric F regions at low-mid latitudes are studied simultaneously by operating the MU radar (35°N, 136°E) continuously in alternate meteor and incoherent scatter modes, for the first time, under a project called MTEC-S (mesosphere thermosphere experiments for coupling studies). Four long MTEC-S campaigns of duration 7 to 10 days were conducted, one in each season in 2000-01, when solar activity ranged from medium to very high (F10.7 = 130 to 270), and a major morning storm (Dst reaching -360 nT, Kp reaching 9 and Ap rising above 120) and another moderate nighttime storm occurred during a campaign at March equinox. The campaigns provide zonal and meridional wind velocities at MLT altitudes (80-95 km), meridional wind velocity in the upper thermosphere (220-450 km), and electron density, peak height and plasma drift velocity in the ionosphere (150-600 km) with time resolution of 1.5 hours. The observed directions of the meridional wind velocity in the lower and upper thermospheres under quiet and active conditions seem to be consistent with those expected from solar driven thermospheric meridional circulation and auroral driven equatorward wind [*Roble et al.,* 1977; *Richmond*, 1978; *Rishbeth*, 1998]. The response of the ionosphere to the major morning storm is found to be dominated by the direct effect of the storm-time neutral wind during daytime and its indirect effect at night. The data sets are spectral analysed to identify the tides and waves present at different altitudes. The seasonal, solar activity and magnetic activity dependencies of these tides and waves, through which the upper atmospheric regions could be dynamically coupled, are also presented.

SA51A-0501 0830h POSTER

Quantum Mechanical Investigations of H+O_2 and O+OH Reactions

Balakrishnan Naduvalath[1] (702-895-2907; naduvala@unlv.edu)

Renat A. Sultanov[1] (sultano2@unlv.edu)

[1]Department of Chemistry University of Nevada Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154, United States

The reaction O+OH→ H+O_2 has received significant attention in connection with OH chemistry in the mesosphere. Its reverse process H+O_2 → OH+O is generally considered to be the most important reaction in combustion chemistry and it is the rate-limiting step in combustion and flame propagation processes. Here, we report quantum mechanical investigations of both processes with an aim of computing accurate values of reaction rate coefficients. The presence of two heavy oxygen atoms and long-range interaction in the O+OH channel make the calculations extremely challenging. We will determine the sensitivity of the rate coefficients to details of the interaction potential by comparing results obtained using two different potential energy surfaces for the HO_2 system.

SA51A-0502 0830h POSTER

An Optimization/IT Theory Approach to the HOx Dilemma, Data, and Modeling

Gregory Smith[1] (650-859-3496; gregory.smith@sri.com)

Michael Frenklach[2]

Ryan Feeley[2]

Andrew Packard[2]

Peter Seiler[3]

[1]Molecular Physics Lab, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025, United States

[2]Mechanical Engineering Dept., University of California, Etcheverry Hall, Berkeley, CA 94720, United States

[3]Mechanical and Industrial Engineering Dept., University of Illinois, 1206 West Green Street, Urbana, IL 60801, United States

Measurements of chemically active species in the mesosphere and upper stratosphere - O3, OH, HO2 - are poorly predicted by model calculations; the resulting HOx dilemma usually underpredicting O3 and HO2 but overpredicting OH. Some rate constant changes have been proposed for improvement. We have used results from the LLNL 2-D atmospheric model to perform a rigorous analysis of the coupling between representative MAHRSI, IR balloon, and microwave measurements and the sensitive rate parameters. By considering estimated observational and rate parameter error limits, our procedures compute which groups of observations are mutually inconsistent within the space of permissible kinetic variations. Possible kinetic revisions to optimize selected model predictions are also determined. This IT analysis procedure forms a basis to codify, sort, and analyze groups of representative data for atmospheric photochemical (or other kinetics) systems, and provides a means to reduce modeling error. The results require exclusion of 6 of the 39 target observations, particularly some low altitude (40 km) observations, and significant modifications to oxygen and ozone photolysis rates and the OH+O, OH+HO2, and O+HO2 rate constants. Research supported by the NASA ITM Program. Thanks to Dr. Peter Connell of LLNL for providing his model results.

SA51A-0503 0830h POSTER

Atmospheric Effects of Solar Maximum to Minimum UV Variation: In the Light of New Developments in Atmospheric Chemistry

Sheo S. Prasad (925-426-9341; ssp@CreativeResearch.org)

Because they are entwined, considerable attention has been given to the understanding of the atmospheric effects of solar activities so that we may more clearly understand and more reliably predict the effects of human activities on the atmosphere. The talk, therefore, will present a new modeling study of the effects of solar maximum to minimum UV variability on the Earth's mesosphere and stratosphere. Several striking developments have taken place in atmospheric chemistry, since the previous modeling studies of the effects of solar UV variability. For example, a new source of odd nitrogen (NO_X = NO + NO_2) directly from the O_2 and N_2 principals rather than their O(^{1}D) and N_2O derivatives have been found. This source is driven by solar UV with $\lambda < 205$ nm. As another example, it has been found that photodissociation of O_3 at λ193 nm (or less) produces O(^{1}S) and that this production significantly modifies the middle atmospheric source strength of the OH radicals. These new molecular processes directly amount to new mechanism to link the variable solar UV to the middle atmospheric trace species concentration, O_3, heating rates, dynamics etceteras. Without the extra OH production via the O(^{1}S), the new sources of NO_X tend to widen the gap between the model predictions and observations of middle atmospheric O_3 changes in response to solar maximum to minimum UV variation. The effect of the additional OH production is currently being modeled. The presentation will include discussions of both. Furthermore, what needs to be done in the laboratory, modeling, and observational data analysis will also be discussed.

SA51A-0504 0830h POSTER

Diurnal Variations of the Mesopause Temperature Structure by Tides and Waves as Observed by Potassium Lidar at Different Latitudes

Cord Fricke-Begemann[1] (+49-38293-68-0; fricke-begemann@iap-kborn.de)

Josef Höffner[1] (hoeffner@iap-kborn.de)

[1]Leibniz-Institute of Atmospheric Physics, Schloss-Str. 6, Kühlungsborn 18225, Germany

Investigating the diurnal temperature structure of the mesopause region (80–105 km) requires continuous measurements over complete 24-h cycles. The Leibniz-Institute of Atmospheric Physics operates two potassium temperature lidars which have been upgrade since 2000 for daytime observations. Measurements have been carried out at various locations at low (28°N), mid (54°N) and high latitudes (78°N). Decomposition of the serial temperature profiles into diurnal and higher harmonics allows the determination of tidal amplitudes and phases. Regularly, dominate semi-diurnal components with amplitudes of 10 K and more are observed. Single campaigns with continuous lidar measurements of more than 100 hours provide a reliable data base to study the influence of gravity and planetary waves on the mesopause temperature structure.

SA51A-0505 0830h POSTER

Observation and Modeling of Mesospheric Frontal Events, Bores, and Nonlinear Waves

R. H. Picard[1] (781-377-2222; richard.picard@hanscom.af.mil); M. J. Taylor[2]; E. M. Dewan[1]; S. H. Seo[2]; E. Cohen[3]; J. R. Winick[1]

[1]AFRL/Space Vehicles Directorate, 29 Randolph Rd., Hanscom AFB, MA 01731-3010

[2]Utah State Univ., Center for Atmospheric and Space Science and Physics Dept., Logan, UT 84321

[3]Arcon Corp., 260 Bear Hill Rd.,, Waltham, MA 02451

We describe and categorize observations of mesospheric frontal events in OH Meinel and atomic-oxygen green-line airglows from mid- and low-latitude sites. Such extensive and long-lasting displays were first observed by Taylor and co-workers in the ALOHA-93 Campaign and attributed by Dewan and Picard to the existence of an internal-wave undular bore, a transient phase motion in a mesospheric wave duct. Prior observations of internal-wave bores had been made on ducts in the atmospheric boundary layer and the upper ocean, and such disturbances have been found to develop into solitons under certain conditions. We examine how wave ducts supporting bores can be formed by atmospheric temperature and wind structure near the mesopause and carry out calculations of the dynamics of bore propagation and of the airglow response, comparing the result of calculations to the observations.

SA51A-0506 0830h POSTER

Numerical Simulation of Atmospheric Tidal Variability and Modulation in the Mesosphere and Lower Thermosphere

Niranjan Sharma[1] (303.735.3154; sharma@colorado.edu)

Jeffrey Forbes[1] (303.492.4359; forbes@colorado.edu)

[1]University of Colorado at Boulder, Aerospace Engineering Sciences, Boulder, CO 80027, United States

Considerable research interest exists in studying atmospheric tidal variability and modulation in the mesosphere/lower thermosphere (MLT) region of the atmosphere; presumably these modulations are due to strong wave-wave interaction between planetary waves, tides and gravity waves. Time scales of such variability are observed to be in days to years. Observational evidence exists of tidal modulation at periods of 10 and 16 days, a regular feature of MLT dynamics at high middle latitudes. Various theoretical and observational studies outline nonlinear interaction among tides, planetary and gravity waves as being the dominant process in supporting observed tidal variability. Our research work seeks to extend current modeling capabilities to simulate nonlinear interactions of planetary scale waves and atmospheric tides with effects of gravity waves in order to better understand the tidal amplitude modulation by planetary waves via strong wave-wave nonlinear interactions in the MLT region. We also anticipate significant modeling advances in support of the TIMED mission.

SA51A-0507 0830h POSTER

Interannual Variability of Diurnal Tropospheric Heating and Diurnal Tides

Dennis M Riggin[1] (303-415-9701 x208; riggin@colorado-research.com)

Ruth S Lieberman[1] (303-415-9701 x212; ruth@colorado-research.com)

[1]Colorado Research Associates Div NorthWest Research Associates, 3380 Mitchell Lane, Boulder, CO 80301, United States

We present analyses of tropospheric diurnal heating, and middle atmosphere diurnal tides. Our study highlights interannual variations, which have received comparatively little attention in the literature compared with seasonal studies. Analyses of 12 years of data from the Kauai MF radar and 8 years of data from the Christmas Island MF radar reveal significant interannual amplitude enhancements in the diurnal tide, particularly during 1992 and 1997. The amplitude maximum in 1997 is correlated with above-average tropical tidal heating due to IR absorption by water vapor. The tidal heating was derived using the NASA Water Vapor Project (NVAP) climatology. Examination of 10 years of monthly averaged tropospheric diurnal water vapor heating reveals an interannual component that maximizes over the Indian and tropical central Pacific oceans. This component explains over 40% of the total variance in the 10-year diurnal climatology of water vapor heating. We also explore the role of convective heating in modulating tropospheric diurnal forcing.

SA51A-0508 0830h POSTER

Coordinated Remote Sounding and Local Measurements of Water Vapour in the Middle Atmosphere

Jacek Stegman[1] (+46-8-162408; jacek@misu.su.se); Mikhail Khaplanov[1]; Jörg Gumbel[1]; Georg Witt[1]; Nicolas Lautie[2]; Donal P Murtagh[2]; Sheila Kirkwood[3]; Kerstin Stebel[3]; Frank J Schmidlin[4]; Karl H Fricke[5]; Ulf Blum[5]

[1]Dept of Meteorology, Stockholm University, Stockholm SE-10691, Sweden

[2]Inst of Radio and Space Sci., Chalmers U. of Technology, Göteborg SE-41296, Sweden

[3]Swedish Inst. of Space Physics, Box 812, Kiruna SE-98128, Sweden

[4]NASA/GFSC/WFF, Wallops Island, Wallops Island, VA 23681, United States

[5]Physikalisches Inst., Universität Bonn, Bonn D-53115, Germany

A complete snapshot of the water vapour distribution from the tropopause to the mesopause has been obtained from simultaneous in-situ rocket and balloon measurements conducted from Esrange on the morning of December 16, 2001 within the Odin validation programme. An active optical technique based on the dissociation of water molecules by Lyman alpha radiation generated by an on-board multicapillary Ly-alpha lamp and the subsequent detection of the optical emission from the resulting electronically excited OH radical produced outside the rocket shock front was used by the rocket borne payload Hygrosonde-II. A similar instrument was carried on the stratospheric SKERRIES balloon. A continuous vertical water vapour profile extending from 8 km to about 80 km has been compiled from the combined up- and downleg rocket measurement and the balloon sounding. Meteorological rockets (falling spheres) provided by NASA were flown before and after the Hygrosonde-II and SKERRIES flights to provide temperature, density and wind profiles in the upper stratosphere and mesosphere. Additional information on the density profile is available from the

Rayleigh lidar at Esrange operated by Bonn University. The lidar provides a mean state profile in the stratosphere and mesosphere up to 95 km altitude for the Hygrosonde-II campaign period as well as profiles before and after the rocket and balloon flights. Meteorological data for the stratospheric analysis have also been obtained from the ECMWF analysis. An analysis of the obtained distribution of middle atmospheric water relates its details to the large-scale motions and the dynamics of the region (Khaplanov et al., Middle Atmospheric Water Vapour and Dynamics During the Hygrosonde-2 Campaign, 16th ESA-PAC Symposium, 2003). At the time of the Hygrosonde-II measurements the Odin satellite was configured in aeronomy mode and provided continuous water measurements using sub-mm limb sounding. A comparison of these remotely sensed measurements during Odin passes over Esrange with the local Hygrosonde-II/SKERRIES measurements will be presented.

URL: http://www.misu.su.se

SA51B MCC: Level 1 Friday 0830h
Meteors and the Mesopause III Posters

Presiding: **J Friedman,** National Astronomy and Ionosphere Center, Arecibo Observatory**; D Janches,** National Astronomy and Ionosphere Center, Arecibo Observatory

SA51B-0509 0830h POSTER

Global Measurements of the Atmospheric Effect of the Leonid Shower

Arthur Aikin[1] (301-286-7596; aikin@carioca.gsfc.nasa.gov)

Joseph M Grebowsky[1] (301-286-6853; joseph.m.grebowsky@nasa.gov)

John P Burrows[2] (49-421-2184548; burrows@gomwez.physik.uni-bremen.de)

[1]Goddard Space Flight Center, Code 695 Laboratory for Extraterrestrial Physics, Greenbelt, MD 20771, United States

[2]University Bremen, Postfach 330440, Bremen D-28334, Germany

The nadir-viewing Global Ozone Measuring Experiment (GOME) UV/VIS spectrometer from ERS-2 is used to study the temporal variations of the column densities of metal species, including neutral/ionized Mg, Fe, and neutral Si. ERS-2 orbits the Earth 14 times per day at 795 km with an equatorial crossing time of 10:30 AM. GOME has a spectral range of 237 to 793 nm, with a wavelength resolution of 0.2 nm in the 237 to 316 nm region, and measures all wavelengths simultaneously, performing a complete spectral scan in 1.5 seconds. There are 5 wavelength channels. The 2 channels comprising the 237 to 316 nm range are integrated for 12 seconds giving a spatial resolution of 100 by 960 km. All other channels are integrated for 1.55 seconds giving a spatial resolution of 40 by 20 km. Metal data are examined from November 1996 to delineate changes in the mesospheric and thermospheric abundance of meteoric material resulting from the Leonid meteor shower. Global data from the month of November are analyzed before, during and after the shower to sort out Leonid effects from other temporal effects. In order to better quantify column amounts of different neutrals and ions and resolve the identity of unidentified spectral features, simulations of individual spectra are conducted and compared to actual data.

SA51B-0510 0830h POSTER

Statistics of meteor-head echo observations using the Jicamarca 50 MHz radar

Jorge L. Chau[1] (chau@jro.igp.gob.pe)

Ronald F. Woodman[1] (ronw@geo.igp.gob.pe)

Diego Janches[2] (djanches@naic.edu)

[1]Radio Observatorio de Jicamarca, Instituto Geofisico del Peru, Apartado 13-0207, Lima 13, Peru

[2]Arecibo Observatory, HC3 Box 53995, Arecibo 00612, Puerto Rico

We present the statistical results of recent observations of meteor-head echoes obtained with the high power-aperture Jicamarca 50 MHz radar. Our observations were concentrated at the beginning on Leonids events, specifically 2001 and 2002, nonetheless we have recently started observations at different seasons in 2003. Statistics are presented for most of the meteor parameters we are able to estimate, including among other the absolute velocities, azimuth and elevation of velocity vectors, and decelerations. So far we have not seen any evidence of Leonids signatures. Moreover, the velocity distribution of the meteors with respect to the Earth's frame of reference is clustered around the Apex, within $\pm 10^{\circ}$ transverse to the Ecliptic and no more than a few degrees in heliocentric longitude in the Ecliptic plane. Preliminary estimates of meteor fluxes, based on the meteor decelerations, are compared to the Arecibo estimates and those obtained with optical instruments.

SA51B-0511 0830h POSTER

MAGIC Collector - Direct Sampling of Meteoric Dust in the Mesosphere

Karl W. T. Waldemarsson[1,2] (twaldemarsson@ssd5.nrl.navy.mil)

Frank Giovane[2] (fgiovane@ssd5.nrl.navy.mil)

Jörg Gumbel[3] (gumbel@misu.su.se)

Jürgen Blum[4]

Philipp Reissaus[5]

[1]Department of Astronomy, University of Florida, Gainesville, FL 32611, United States

[2]E.O. Hulbert Center for Space Research, Naval Research Laboratory, Washington, DC 20375, United States

[3]Department of Meteorology, Stockholm University, Stockholm S-106 91, Sweden

[4]Astrophysical Institute, Friedrich Schiller University Jena, Jena 07745, Germany

[5]Institute of Astronautics, Technical University of Munich, Garching 85748, Germany

Recondensation of evaporated meteoric material is thought to form particles in the nanometer size range. Notwithstanding the lack of direct evidence of these particles, it has been suggested that these small particles of meteoric origin may play a key role in a number of mesospheric processes related to noctilucent clouds, polar mesosphere summer echos, charge balance and neutral chemistry. We will present a recently developed instrument, MAGIC (Mesospheric Aerosol - Genesis, Interaction and Composition), designed for *in situ* collection of neutral nanometer-size particles in the mesosphere. The instrument will for the first time allow us to bring these particles from the mesosphere into the laboratory and to study their properties in detail. The MAGIC instrument is intended to be carried on a sounding rocket and with a mass of less than 1.5 kg, the collector is completely self-contained and requires no telemetry. MAGIC collectors are currently being built at NRL, and two rocket flights in collaboration with the Virginia Polytechnic Institute and the University of Stockholm, are scheduled in the spring of 2004 from Wallops Island, Virginia, and in the winter of 2004/5 from Esrange, Sweden.

SA51B-0512 0830h POSTER

Metal and ion layers observed by resonance lidars and incoherent scatter radar at Arecibo

Jonathan S Friedman[1] ((787) 878-2612 x256; jonathan@naic.edu); Shikha Raizada[1] ((787) 878-2612 x259; shikha@naic.edu); Craig A Tepley[1] ((787) 878-2612 x257; craig@naic.edu); Qihou Zhou[2] ((513) 529-6506; zhouq@muohio.edu); Yu Morton[2] (513-529-6070; mortonyt@muohio.edu); Michael P Sulzer[1] ((787) 878-2612 x255; sulzer@naic.edu); Sixto A Gonzalez[1] ((787) 878-2612 x252; sixto@naic.edu)

[1]NAIC Arecibo Observatory, HC-03 Box 53995, Arecibo, PR 00612, United States

[2]Miami University, Manufacturing and Mechanical Engineering Department, Oxford, OH 45056, United States

Observations of the mesopause-region potassium and sodium layers using the resonance lidar technique have been carried out at the Arecibo Observatory (18.35°N, 66.75°W) for a number of years. These observations have often coincided with *E*-region observations by the incoherent scatter radar. In this presentation, we examine the seasonal and diurnal variability of K/Na/ion layer content and height. In particular, we have found that sporadic layers are far more prevalent in summer than other times of year. We have also developed algorithms to study the layer structures in detail, including the densities and trajectories of thin metal layers. The neutral metal layers will be compared to the ion layers to reveal whether and how the two phenomena are dynamically and chemically linked.

SA51B-0513 0830h POSTER

Observation and Modeling of Mesospheric Potassium Over Arecibo Observatory

Ruben Delgado[1] (301-512-6638; rubendelgado71@comcast.net)

Brad R Weiner[1] (787-764-; brad@adam.uprr.pr)

John M Plane[3] (j.plane@uea.ac.uk)

Jonathan S Friedman[2] (787-878-2612; jonathan@naic.edu)

[1]Department of Chemistry University of Puerto Rico, P.O. Box 23346 University Station, San Juan, PR 00936, United States

[2]National Astronomy and Ionosphere Center/Arecibo Observatory, HC3Box 53995, Arecibo, PR 00612, United States

[3]School of Enviromental Sciences , University of East Anglia, Norwich NR47TJ, United Kingdom

Nighttime observations of the atmospheric potassium layer were performed at the Arecibo Observatory using lidar to determine the seasonal variation in the concentration of the potassium metal atom layer. The K layer shows nightly and seasonal variation; the nightly variation was due to the presence of sporadic layers. The seasonal variability is less in the layer width, while the column abundance exhibits a semiannual variation. To understand the seasonal behavior of the K layer a one dimensional model has been developed. The model includes a meteoric deposition, vertical transport through eddy diffusion, and a full chemical scheme. To identify molecular reservoirs and sinks for the K atom, ab initio calculations were performed to estimate the thermochemistry. Rate constants for the reaction between the metal bicarbonate and atomic H, as well as ion-molecule reactions, were obtained by considering detailed balance mechanism and transition state theory. Reactions KO+ + N2, K+×O2 + O, K+×O2 + N2, and KHCO3 + H can be considered as routes that may cycle species, which can play a role as major sinks of potassium ion or neutrals in the mesospheric cycle. These studies of the metal layer contribute to a better understanding of chemical and dynamical changes that affect atmospheric composition.