## SA41B-0455 0830h POSTER

### Yearlong Na-Lidar observation of temperature and winds over full diurnal cycles above Ft. Collins, CO (40°N, 105°): Diurnal and semidiurnal tidal perturbations

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With a pair of robust Faraday Filters, Na-Lidar in Colorado State University has observed mesopause region temperature and winds (80-110km) over full diurnal cycle for more than one year. Here, we select only continuous 24-hour data sets with a total of 29 sets between May 02 and April 03 and form bi-monthly means for tidal analysis. We observed considerable daytime and nighttime differences for both temperature and winds (Zonal and Meridional). We investigated the tidal wave (Diurnal and Semi-Diurnal) activities and compared with GSWM (Global Scale Wave Model) and TIME-GCM output. Observed diurnal tides are in good agreement with GSWM prediction, though some discrepancies exist in semidiurnal tides comparison. Larger amplitude and shorter wavelength than what model predict are typically observed for semidiurnal tides. Data acquired after April 03 are used to assess tidal variability.

## SA41B-0456 0830h POSTER

### Na lidar observed atmospheric instability and OH imager observed ripples as wave breaking signatures

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The Platteville OH imager has observed the nighttime all sky images of OH ( 87±5km) airglow layers since September 2001. On the night of September 5, 2002, we observed small-scale (also called ripple-type) wave structures with horizontal wavelength of 7km and lifetimes of 14.5min. At the same night, the CSU lidar at Fort Collins was in operation, measuring mesopause region temperature, zonal and meridional winds simultaneously. Since the lidar beams in the mesopause region are within the field view of the imager, atmospheric convective and dynamic instability before, during and after the ripples traverse the lidar beam may be assessed. We found that the small-scale wave structures appear at almost the same time with the local instability and they both have similar lifetime scale. This verified that the small-scale wave structures are associated with the localized instability and as suggested in earlier work [Hecht et al., 1997, Fritts et al., 1997], the ripple structure may be taken as signatures of wave breaking. We noted that these small-scale wave fronts are perpendicular to the fronts of much longer-lived gravity waves (30 to 50km horizontal wavelength), and that lidar observed convective instability where ripples occur, as well as dynamic stability in nearby convectively stable regions.

# SA41C MCC: 2006 Thursday 1020h

## Meteors and the Mesopause II

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

## SA41C-01 1020h INVITED

### Metal Layers at High Altitudes and Near the Polar Summer Mesopause

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Since 1996 the mobile potassium lidar of the IAP Kühlungsborn has measured metal densities and temperatures at various locations from the Antarctic to the Arctic. Between 1996 and 1998 simultaneous observations with our stationary double metal lidar at 54°N have been carried out. This instrument is able to observe two additional metals which can be sodium, calcium, iron or calcium ions. Both instruments have been aligned to the same field of view. Beside the unique possibility to observe meteor trails with high altitude (7.5 m) and time resolution (1 laser pulse) the obtained data also show close correlations between different metals at altitudes above 100 km. Similar correlations with other latitudes are visible when comparing the data with potassium observations at Tenerife (28°N) and Arecibo (18°N). Recent observations of the mobile potassium lidar at Spitsbergen 78°N show that the metal layer is strongly influenced by the presents of icy particles (NLC/PMSE) under the condition of the very cold polar summer mesosphere. During hundreds of hours of observations of NLC and potassium not one event was found where potassium and NLC coexist in the same altitude. On the other side potassium and NLC are frequently observed in two adjacent altitude channels the lidar (200 m).

## SA41C-02 1040h

### Dynamics of Charged Dust in the Polar Winter Mesosphere

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Four rockets carrying charged dust detectors were launched from Poker Flat in March 2002. The goal of the experiment was to examine the relationship between dust and neutral metals in the Earth's mesosphere. Each of the four identical payloads carried instruments to measure electric fields, charged dust density and plasma density. Ground-based iron and sodium lidars were used to determine conditions near the time of launch. One rocket was launched near midnight on the night of March 6; the remaining three rockets were launched over the course of the night on March 16. The multiple launches have allowed analysis of large-scale motions of charged dust and plasma relative to the lidar-measured neutral metals. In this paper we discuss correlations between measured charged dust densities, plasma densities and neutral metals on the two nights.

## SA41C-03 1055h

### Global Satellite Observations of the Sodium Layer

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Improved understanding of the fate of meteoric material in the Earth's atmosphere requires collaboration between a wide range of scientific disciplines. Much progress has been made in recent years concerning meteoroid influx, ablation processes and subsequent chemistry. The present study contributes to these research efforts by providing a global climatology of the mesospheric sodium layer. We present data from the OSIRIS optical spectrometer onboard the Swedish Odin satellite. Limb scattering profiles from the sodium layer are observed at the atomic Na D resonance lines near 590 nm. A detailed forward model for the resonance radiative transfer has been developed; profiles of sodium number density are retrieved using an Optimal Estimation Method (OEM). Retrieved profiles reveal the seasonal and latitudinal dependence of the sodium layer. These are compared to local climatologies of lidar measurements. Complementary model simulations are based on comprehensive new laboratory results on mesospheric sodium chemistry.

## SA41C-04 1110h

### Observations of Sporadic Sodium-, Iron- and E-Layers at a High-Latitude Site.

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Sodium resonance lidar observations have been ongoing at Poker Flat Research Range (PFRR), Chatanika, Alaska (65oN, 147oW) since 1995. Iron resonance lidar measurements have been ongoing at PFRR since 2000. We present an overview of the iron and sodium layer structure at this high-latitude site. In particular we focus on sporadic metal layer events highlighting differences in the appearance and altitude distribution of the sporadic layers in the two species. We compare these neutral metal events detected by the lidar with sporadic-E layer events detected by digisonde about 50 km from PFRR at College Alaska. We also compare the events to structures observed in 2-D images of the resonantly scattered sunlight from the sodium layer. We discuss the observations in terms of modeling studies of the mesospheric metal layers and the distribution of meteoric material in the atmosphere.

## SA41C-05 1125h

### Mesospheric Fe Layers Observed at the South Pole and Rothera by a Lidar

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Recently, the University of Illinois Fe Boltzmann temperature lidar was moved from the South Pole to Rothera (67.5°N, 68°W), Antarctica. The normal and sporadic Fe layers were observed at both locations. A few meteor trails were also recorded at Rothera in January 2003. We characterize the Fe layers at both locations and make a detail comparison. The summertime Fe layer at Rothera has higher number density and a lower peak altitude compared to the Fe layer at the South Pole. These features are most likely due to the temperature difference between the two locations, as observed by the lidar. We present the observations and compare them with numerical models of the Fe layer.

## SA41C-06 1140h

### A Semi-Annual Study of the Micrometeor Influx in the Mesopause

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We present and discuss results from the first six months of a year-long observation campaign of the micrometeor influx in the upper atmosphere using the dual-beam 430 MHz Arecibo Observatory radar. The AO radar detects decelerating particles in the size range 0.5-100 microns for which precise altitude; instantaneous Doppler velocity (rms errors of the order of 10-100 m/sec) and (constant) deceleration are obtained. This provides a tool for the study of a mass-region of the interplanetary dust distribution and its influence to the mesopause that was previously inaccessible to ground-based instruments and helps bridge the gap between spacecraft dust measurements and traditional meteor radar capabilities. The meteor rate detected inside the 305 m-diameter radar beam peaks at sunrise (∼40 events per minute) when the radar points near the apex. We find the meteor flux rate as well as the geocentric velocity distribution to be strongly dependent on the topocentric declination implying a function with radiant ecliptic latitude. In addition, we present estimations of the total micrometeor mass flux derived from these observations, resulting in ∼2000 tons of meteoric material deposited over the whole earth each year in the 80-120 km altitude region. Preliminary results also show that the mass flux peaks in June (i.e. a function of ecliptic longitude) in agreement with diurnal measurements of metallic densities derived from lidar observations.

## SA41C-07 1155h

### Simultaneous Observations of Neutral Ca and K Metallic Layers from Arecibo and the Possible Influence of Micrometeoroids on Sporadic Layers

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We present a few cases of simultaneous lidar observations of neutral Ca and K metallic layers from Arecibo. During several nights, sudden enhancements in both metals were seen in the early morning hours and we tried to correlate this with the occurrence of meteor showers. Our observations show that the sporadic layers were strong during the weak Lyrids showers in June, as compared with those that occurred during the presence of fast meteor showers like the Eta-Aquarids and the Perseids. The occurrence of early morning sporadic layers appears to be consistent with the increase in meteor activity during that period, which has been reported earlier in the literature. Thus, we investigated the seasonal variations observed in sporadic micrometeoroids using the Arecibo Observatory radar operated in the meteor mode. This study revealed an increase in the sporadic activity of micrometeoroids in June, which may be partly responsible for the occurrence of strong neutral layers seen during early morning hours in the summer. Apart from this, we will discuss the different characteristics of Ca and K layers observed at Arecibo and relate them to the mesospheric chemistry.

# SA42A MCC: 2006 Thursday 1340h

## Phenomena of the Summer Mesosphere I *(joint with ED, GC)*

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

## SA42A-01 1345h INVITED

### Noctilucent Clouds and Mesospheric Water Vapor: Past and Future

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Observations of long-term (here: 10 to 25 years) variations of NLC brightness have often been explained by postulating similar, positively correlated long-term variations of the mesospheric H2O mixing ratio. The weak point in these arguments has always been, however, that until today it is not possible to measure the postulated variations of water vapor mixing ratio at NLC altitudes ( 83 km) with an accuracy and duration as required to really support the argument. Even more unsettling is the fact, that the scenario develops just into the opposite direction. All available long-term ground-based and satellite-borne observations of the H2O mixing ratio at 70 km altitude show clearly, but unexpectedly, that since the summer of 1995 this ratio decreases near-continuously, while over the same period satellite-borne observations show the mean NLC albedo to increase significantly. We have therefore studied the sensitivity of the volume backscatter coefficient of NLC layers on the ambient H2O mixing ratio by means of our 3-D COMMA/IAP model. Our results show, as expected, that a decrease in the mesospheric H2O mixing ratio should cause a strong non-linear decrease of NLC volume backscatter coefficient. Hence, our and other models fail to explain the observed long-term anticorrelation of NLC brightness and mesospheric H2O mixing ratio. From this we conclude that the lately observed increase of NLC brightness is either primarily driven by an atmospheric parameter other than the H2O mixing ratio or due to an odd latitude dependence of the long-term variations of H2O mixing ratio above 80 km altitude. This situation makes a robust prediction of future changes in NLC brightness very difficult.

## SA42A-02 1405h

### Water Vapor Enhancement in the Polar Summer Mesosphere and its Relationship to Polar Mesospheric Clouds

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Polar mesospheric water vapor exhibits a strong seasonal cycle, with summer mixing ratios dramatically higher than in winter. It is generally accepted that vertical transport from 50 km altitude towards the mesopause is one driver behind this change, however, upwelling alone cannot explain observed H2O changes. H2O near 83 km increases from 1 ppmv in winter to over 8 ppmv in summer, and upwelling accounts for roughly half of this increase. It has been suggested that evaporation of polar mesospheric clouds (PMCs) should produce a layer of enhanced water vapor. This idea was challenged using particle measurements from the Halogen Occultation Experiment (HALOE) to derive the equivalent gas phase H2O contained in PMCs. Comparing these estimates to HALOE water vapor measurements suggests that PMC evaporation is a large component in H2O enhancement near 83 km during summer.

## SA42A-03 1420h INVITED

### Long-Term Trends Derived from Satellite PMC Data

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The recent availability of long-term PMC data sets from satellites provides the opportunity to evaluate possible PMC trends over the past few decades. Satellite PMC data have daily coverage to characterize seasonal variations, sufficient detections for each season to give good statistics, quantitative information for physical analysis, and coverage of both hemispheres to evaluate global behavior. Multiple PMC data sets are available from the SBUV and SBUV/2 instruments on the Nimbus-7 and NOAA TIROS polar orbiting satellites. These overlapping data sets now provide more than 24 years of continuous data from November 1978 to the present, typically with concurrent measurements from multiple instruments during each PMC season. The SAGE II instrument has also accumulated more than 17 years of PMC data since 1985. Analysis of these lengthy data sets shows a clear anti-correlation between seasonally averaged PMC occurrence frequency and solar UV activity over the past two solar cycles, in agreement with model predictions. The SBUV data also show a significant long-term increase in PMC brightness in both hemispheres, approximately +4%/decade in the Northern Hemisphere and +7%/decade in the Southern Hemisphere. These results can be compared with information about trends in plausible source mechanisms such as mesospheric water vapor and temperature. Model results suggest that PMC brightness changes are consistent with observed long-term water vapor changes. Additional factors probably contribute to the overall PMC response for individual seasons. Future satellite instruments (SBUV/2, OMPS) will continue the SBUV PMC data record for an additional 10-20 years. Hopefully, further improvements in modeling will allow these data to become useful in characterizing the trends in atmospheric parameters.

## SA42A-04 1440h

### Can Water Vapor Increases Explain Long-term Variability in the Brightness and Occurrence Frequency of Mesospheric Clouds?

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It is now well established that stratospheric water vapor (H2O) has undergone significant increases (of the order of 1 percent/year), at least since measurements began in the 1960's, and are likely to have occurred over nearly the entire 20th century. The principle of continuity of hydrogen atoms calls for similar changes in the mesosphere. This is confirmed by recent reports of non-polar trends (0.5-1 percent per year) in H2O at 70 km as measured by the HALOE instrument on board of UARS. These trends apply to the recent period 1992-2002. It has been long suspected that water vapor variability can explain much of the variability of mesospheric clouds (MC). We consider this possibility from two aspects: (1) observationally, a long-term increase in the albedo and occurrence frequency of bright MC has been observed in SBUV and SBUV-2 data series, as well as a 10-11 year periodic component presumably related to solar cycle changes, and (2) theoretically, the CARMA microphysical model predicts an exponential dependence of MC brightness with H2O. In this paper, we compare theoretical expectations with the observed trends in albedo and occurrence frequency. Our results show that long-term increases in H2O at polar latitudes, combined with observed solar modulation in H2O, are fully capable of explaining the variability in MC brightness, although details are still uncertain (e.g. north-south differences). The measured albedo changes observed by SBUV/SBUV-2 may also contain the signal of a recent reversal of the water vapor trend since 1996. Although there is yet no evidence for long-term trends in mesopause region temperature (or temperature variability), we illustrate the model sensitivity to possible long-term cooling/warming near the mesopause. It will be necessary to conduct simultaneous measurements of these controlling factors in the presence of MC in order to sort out their relative importance.