limits the spatial representativeness of any ground-based, point measurement of the upwelling and net SW. Hence at the surface we focus on the CERES Ocean Validation Experiment (COVE) sea platform (25km due east of Virginia Beach), which has continuous measurements of upwelling and downwelling fluxes, AOT, meteorology, and ocean waves. The Chesapeake Lighthouse and Aircraft Measurement for Satellites (CLAMS 10 July to 3 August 2001) field campaign specifically targeted the COVE sea platform to establish minor adjustments that must be made to account for local obstructions.

Surface spectral albedos were generated by the Jin-Stamnes coupled air-sea radiative transfer model, which accounts for scattering and absorption in both media explicitly; inputs include AOT, surface wind and precipitable water (measured at COVE), and chlorophyll concentration (estimated using both in situ data from the Chesapeake Bay and SeaWiFS). Simulated broadband albedos were compared with COVE observations for the afternoon clear sky conditions obtained during an entire year (3/1, 2000 to 3/1, 2001); mean differences are within 0.01; but observations are higher, suggesting that additional sediments or bubbles should be included in the code. We report further calculations using the Jin-Stamnes albedo and the Fu-Liou radiation code for the CLAMS period, comparing with fluxes observed at the surface by COVE, at altitude by aircraft, and at TOA by a CERES scanner specially programmed to target COVE; and close on the elusive aerosol forcing to atmospheric absorption.

URL: http://www-cave.larc.nasa.gov/cave/

A41B-0076 0830h POSTER

The Chesapeake Lighthouse and Aircraft Measurements for Satellite (CLAMS) Campaign: Experiment Overview

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The Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) field campaign was conducted from NASA Wallops Flight Facility and successfully executed over the middle Atlantic eastern seaboard from July 10 - August 2, 2001. CLAMS is primarily a shortwave closure experiment designed to validate and improve EOS TERRA satellite data products being derived from three sensors: CERES (Clouds and Earth's Radiant Energy System), MISR (Multi-angle Imaging Spectro-Radiometer) and MODIS (MODerate Resolution Imaging Spectroradiometer). CLAMS is jointly sponsored by the CERES, MISR and MODIS instrument teams and the NASA GEWEX Global Aerosol Climatology Project (GACP). CLAMS primary objectives are to validate satellite-based retrievals of aerosol properties and vertical profiles of radiative flux, temperature and water vapor. Central to CLAMS measurement strategy is the Chesapeake Lighthouse, a stable sea platform located in the Atlantic Ocean, 13 miles east of Virginia Beach near the mouth of the Chesapeake Bay and the site of an ongoing CERES Ocean Validation Experiment (COVE). Six research aircraft including NASA's ER-2 and OV-10, the University of Washington CV-580, the Proteus, a Cessna 210 and a Lear Jet were deployed to make detailed measurements of the atmosphere and ocean surface in the vicinity of COVE, over the surrounding ocean, over nearby NOAA buoys and over a few land sites. The measurements are used to validate and provide "ground truth" for simultaneous products being derived from TERRA data, a key step toward an improved understanding and ability to predict changes in the Earth's climate. One of the two CERES instruments on-board TERRA was programmed for Rotating Azimuth Plane Scans (RAPS) during CLAMS, increasing the CERES coverage over COVE by a factor of 10. Nine coordinated aircraft missions and numerous additional sorties were flown under a variety of atmospheric conditions and aerosol loadings. On one "golden day", July 17, all six aircraft flew coordinated patterns, vertically stacked between 100 ft and 65,000 ft over the COVE site as the TERRA satellite orbited overhead. A summary of CLAMS measurement campaign, a description of the platforms, measurements and anticipated data products will be presented.

URL: http://www-clams.larc.nasa.gov/clams

A41B-0077 0830h POSTER

Description of the CERES Ocean Validation Experiment (COVE), A Dedicated EOS Validation Test Site

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A unique test site located in the mid-Atlantic coastal marine waters has been used by several EOS projects for validation measurements. A common theme across these projects is the need for a stable measurement site within the marine environment for long-term, high quality radiation measurements. The site was initiated by NASA's Clouds and the Earths Radiant Energy System (CERES) project. One of CERES's challenging goals is to provide upwelling and downwelling shortwave fluxes at several pressure altitudes within the atmosphere and at the surface. Operationally the radiative transfer model of Fu and Liou (1996, 1998), the CERES instrument measured radiances and various other EOS platform data are being used to accomplish this goal. We present here, a component of the CERES/EOS validation effort that is focused to verify and optimize the prediction algorithms for radiation parameters associated with the marine coastal and oceanic surface types of the planet. For this validation work, the CERES Ocean Validation Experiment (COVE) was developed to provide detailed high-frequency and long-duration measurements for radiation and their associated dependent variables. The CERES validations also include analytical efforts which will not be described here (but see Charlock et.al, Su et.al., Smith et.al-Fall 2001 AGU Meeting)

The COVE activity is based on a rigid ocean platform which is located approximately twenty kilometers off of the coast of Virginia Beach, Virginia. The once-manned US Coast Guard facility rises 35 meters from the ocean surface allowing the radiation instruments to be well above the splash zone. The depth of the sea is eleven meters at the site. A power and communications system has been installed for present and future requirements.

Scientific measurements at the site have primarily been developed within the framework of established national and international monitoring programs. These include the Baseline Surface Radiation Network of the World Meteorological Organization, NASA's robotic aerosol measurement program - AERONET, NOAA's GPS Water Vapor Demonstration Network, NOAA's National Buoy Data Center and GEWEX's Global Aerosol Climate Program. Other EOS projects have utilized the COVE platform for validation measurements (short term: MODIS, MISR intermediate term: SEAWIFS). A longer term measurement program for the AIRS instrument to be deployed on the AQUA satellite is underway.

The poster will detail the unique measurement and infrastructure assets of the COVE site and present example 1.5 year time series of the major radiometric parameters. Lastly, the near term measurement augmentations that are anticipated at COVE will be discussed.

URL: http://www-svg.larc.nasa.gov/

A41B-0078 0830h POSTER

Activation of Aqueous Aerosol Particles Containing NaCl and Water Soluble Surfactant: Comparison of Measured to Modeled Results

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Atmospheric aerosol particles with diameter less than 2.5 um are composed of significant amounts of organic materials many of which can be water soluble and surface active. The role of water-soluble surface-active organic compounds in droplet formation is not well understood. This study utilizes a differential mobility analyzer and a continuous flow thermal diffusion cloud chamber to study aqueous droplet activation of particles containing sodium chloride (NaCl) and sodiumdodecyl-sulfate (SDS). SDS is used as a surrogate for atmospheric water-soluble surfactants in order to investigate the possible role of surfactants in droplet activation. Interpretation of the experimental results draws on a model developed by Li et al. (1998) describing the influence of surfactants on droplet activation. Analysis of the experimental results confirm that droplet activation of particles composed of pure (NH4)2SO4 is well described by Kohler theory, and activation of pure NaCl particles also follows theoretical predictions after a correction is made for the non-spherical shape of the dry NaCl particles. Good agreement between theory and experiment was also obtained for different SDS - NaCl mixtures when the Raoult term in the Kohler equation was generalized to take into account multiple ionic species, the variation of surface tension with surfactant concentration, and the non-spherical shape of the dry particles. Critical supersaturations increased with increasing mass ratios of SDS to NaCl. Slight departures from the theoretical description were found for some situations involving SDS -NaCl mixtures. These results suggest the predominate role of soluble organic surfactants with properties similar to SDS is to inhibit activation of inorganic salt particles that have similar properties as NaCl.

A41C MC: 123 Thursday 0830h

SAFARI 2000: The Southern African Regional Science Initiative I

Presiding: **J T Suttles,** NASA Earth Observing System**; R J Swap,** University of Virginia

A41C-01 0830h INVITED

Validation of NASA's Earth Observing System in SAFARI 2000: Southern Africa Validation of EOS (SAVE)

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The Southern African Regional Science Initiative 2000 (SAFARI) is a interdisciplinary science activity designed to increase our understanding of the southern African ecological and climate system as a whole, as well as its relationship to hemispheric and global climate. NASA's Earth Observing System (EOS) Program has contributed to and benefited substantially from SAFARI via validation activities for EOS Terra, Landsat 7 and the Total Ozone Mapping Spectrometer (TOMS). One such activity was the Southern Africa Validation of EOS (SAVE) project, which has helped validate EOS land and atmospheric products through the collection and analysis of ground- and aircraft-based measurements. In this presentation, we will review SAVE's strategy of acquiring ground, tower and aircraft measurements over a subset of the region's savanna and woodland systems. We will present validation results for the MODIS leaf area index (LAI), fractional of absorbed photosynthetically active radiation (FPAR), albedo, woody cover, fire/burn scar and aerosol products, and for the TOMS tropospheric ozone product. We will also discuss the ad hoc satellite product distribution system, developed to support SAVE and other SAFARI activities, as a model for a more general validation program. We will conclude with lessons learned and plans for future activities.

URL: http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/terra/privette/

A41C-02 0845h

Multiscale analysis and validation of MODIS LAI product over Maun, Botswana

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The development of appropriate ground-based validation techniques is critical to assessing uncertainties associated with satellite derived products. Here we present a method for validation of the MODIS LAI product with emphasis on sampling strategy for field data collection. We first validate MODIS algorithm based LAI retrievals from 30 m ETM+ data by comparing these to field measurements from the SAFARI 2000 wet season campaign, and then use the ETM+ based LAI map as a reference to specify uncertainties in the LAI fields produced from MODIS data simulated from ETM+. It was demonstrated that neglecting spatial resolution data in retrieval techniques could result in an underestimation of LAI values derived from coarse resolution data. Hierarchical analysis of data from Maun, Harvard Forest (USA) and Ruokulahti Forest (Finland) indicates that the MODIS algorithm based LAI retrievals from ETM+ data exhibit multiple characteristic scales of spatial variation. These scales can be identified with a hierarchical scene model by dividing the image into classes, regions and pixels. Isolating the effects associated with different landscape scales in variograms aids in formulation of sampling strategies. We find that (1) patterns of variance at the class, region, and pixel scale at these sites are different with respect to the importance of the three levels of landscape organization; (2) the spatial structure of LAI shows similarity across the three sites, that is, the sills level off after a lag (distance) greater than 1000 m; (3) validation needs to be performed over smaller regions, with numerous accurate field measurements; (4) the spatial structure of NDVI is not the same as that of LAI; (5) the absolute magnitudes of variance vary significantly across the three sites. Based on these results, a strategy for ground sampling is proposed for validation of moderate resolution satellite sensor biophysical products.

A41C-03 0900h

Sua Pan Surface Bidirectional Reflectance: A Validation Experiment of the Multi-angle Imaging SpectroRadiometer (MISR) During SAFARI 2000

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The Southern Africa Regional Science Initiative (SAFARI 2000) dry season campaign was carried out during August and September 2000 at the peak of biomass burning. The intensive ground field and airborne measurements planned for this campaign provided a unique opportunity to validate space sensors, such as the Multi-angle Imaging SpectroRadiometer (MISR), onboard NASA's EOS Terra platform. The MISR validation team participated with a suite of ground-based instruments, including the Portable Apparatus for Rapid Acquisition of Bidirectional Observations of Land and Atmosphere (PARABOLA III) and sun radiometers, to measure the surface bidirectional reflectance and atmospheric aerosol. Another participating air-sensor was the Cloud Absorption Radiometer (CAR) flown onboard the University of Washington CV-580. In the absence of clouds, CAR observations permit the evaluation of the surface bidirectional reflectance. This paper present the first validation study of MISR surface products by comparing MISR retrieval of the surface BRF, at Sua Pan, Botswana, with those evaluated on the ground and from the air, using the PARABOLA and CAR observations, respectively. Two different data sets are used in this study; one was collected under clear atmospheric conditions on August 27, and the other, on September 3, exhibiting hazy conditions from a wildfire started on a previous day near Sua Pan. Beside validating MISR surface products, the presence of haze and smoke on September 3 provided a case study to evaluate MISR aerosol retrieval.

A41C-04 0915h

Ecological Scale Issues in Land/Atmosphere Coupling - Examples from SAFARI 2000

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Models of the dynamics of the land surface are often based on assuming the surface can reasonably be considered to behave homogeneously. The majority of these models are formulated out of ordinary differential equations. Because the equations describing the biophysical responses of plant canopies are non-linear, one would not expect these models to adequately scale the responses of terrestrial vegetation without (at least) re-deriving the parameters. The spatial heterogeneity in savannah ecosystems challenges simple schemes of model-based scaling for this widely distributed landscape type. We investigate the consequences of spatial heterogeneity on the response of savannah landscapes with respect to models of ecosystems carbon uptake and other responses. Multiple stable states in savannah ecosystems are conceptually well documented with respect to a number of driving environmental variables. The implications of such dynamics for coupling the land and atmosphere in terrestrial models, as well as the complex management issues arising from these dynamics, will be discussed.

A41C-05 0930h INVITED

Emissions From Fires in Southern Africa

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The total mass of moderately-persistent fire-derived products, such as CO and smoke aerosols accumulated in the southern African gyre provides a test for the various emission models, which currently predict widely diverging emissions. There are five significant sources of pyrogenic emissions in the region, three of which consume biomass fuels, and two that consume fossil fuels. The biomass sources are vegetation wildfires, land use change ('deforestation') and the burning of fuelwood and charcoal for domestic energy. The fossil fuel sources are the industrial/energy sector and the transport sector. The SAFARI 2000 experiment has provided new, spatially explicit and more accurate estimates of all these sources. An extensive aircraft campaign in the fire season (August-September 2000) provided accurate information on the vertical and horizontal distribution of trace gases and aerosols in the region, and confirmed the emission factors for the various processes. Satellite coverage, especially by MODIS and MOPPIT sensors, and a network of ground-based sun photometers, assists in constructing a regional mass balance.

A41C-06 0945h INVITED

The Moderate Resolution Imaging Spectroradiometer (MODIS) fire products and SAFARI 2000: mapping and validation of regional biomass burning

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Satellite remote sensing provides the only practical means of monitoring biomass burning over large areas. The SAFARI 2000 dry season campaign included a number of biomass burning experiments with satellite data providing a mechanism to scale up these experiments to regional scale. The MODerate resolution Imaging Spectroradiometer (MODIS) was launched December 1999 on NASA's first Earth Observing System (EOS-Terra) satellite, and provided daily observations over southern Africa for most of the 2000 dry season. The new spectral bands and spatial resolution of the MODIS instrument provide the means for improved study of fire and burned area. The MODIS 1km active fire product and an experimental 500m burned area product are presented.

During the SAFARI 2000 field season the calibration of the MODIS instrument was still being evaluated and detector problems in the middle infrared significantly reduced active fire detection performance. These problems were resolved in early November 2000, after the major burning season in the region. However, the performance of the spectral bands used for burned area mapping permitted the development of a regional burned area product for the 2000 burning season. The issues affecting the performance of the MODIS fire products and their reprocessing status are described.

The SAFARI 2000 dry season campaign included a major effort to validate the EOS data products. The methodology to validate the MODIS active fire and burned area products and initial results are presented. Validation was performed by analytical comparison of product samples with higher spatial resolution satellite data - the active fire product by comparison with ASTER data and the burned area product by comparison with Landsat ETM data. The validation was performed at locations across southern Africa from dry savanna to wet miombo woodland to quantify product accuracy over a range of representative conditions. The validated MODIS fire products are being used as input into regional emissions models and their utility investigated for resource management and environmental assessment by a regional

A41C-07 1020h

Trace Gas Emissions From the Production and Use of Biofuels in the African Tropics

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Biomass burning is an important source of many atmospheric trace gases and particles that play a significant role in regional-global, tropospheric and stratospheric chemical processes, and in the global climate. About 80% of biomass burning is thought to occur in the tropics in association with traditional land management practices and domestic biofuel use. More than 220 Tg (1 Tg = 1 x 1012 g) of fuel-wood and 11 Tg of charcoal are consumed annually for domestic heating and cooking in tropical Africa alone. Approximately 90% of the fuel-wood is consumed in open fires in rural areas. Previously, the emissions for fuel-wood fires and charcoal use and production in the tropics were known for only a limited number of chemical species. During SAFARI-2000 we conducted field experiments in remote Zambian villages and observed most of the major trace gases emitted from the production and use of biofuels using open-path Fourier transform infrared (OP-FTIR) spectroscopy, which provides an artifact-free overview of the trace gases present above several ppbv. Our OP-FTIR was deployed for several spot measurements over the course of an earthen kiln charcoal-making process and of several open wood and charcoal fires, all of which were built and tended by local inhabitants. We quantified the emissions of carbon dioxide (CO2), carbon monoxide (CO), methane (CH4), nitrogen oxides (NOx), ammonia (NH3), non-methane hydrocarbons (NMHC), and oxygenated volatile organic compounds (OVOC). Our results also show much higher emission factors for methanol (CH3OH), acetic acid (CH3COOH), and formaldehyde (CH2O) from domestic biofuel production and use than from savanna fires in southern Africa. Thus, these year-round OVOC emissions will play an important role in the photochemistry of the troposphere and in the acidity of aerosols and precipitation especially in tropical regions.

A41C-08 1035h

Methyl Halide Emissions From Experimental Fires With Southern African Biofuels

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Under the auspices of SAFARI 2000, biofuels (savanna grasses, shrubs, woody plants, litter, agricultural waste, and charcoal) were sampled in the savannah of Kruger National Park, the Kalahari of Etosha National Park and the Miombo woodlands in Zambia and Malawi. More than 50 sub-samples were burned in 60 experiments under semi-controlled conditions at the biomass burning facility of the Max Planck Institute for Chemistry in Mainz, Germany.

Emissions were sampled with flasks and analyzed by GC-MS for gaseous CH_3Br, CH_3Cl, CH_3I and other halogenated compounds. The elemental compositions of the fuel and ash from each burn were also measured. Molar emission ratios of these compounds relative to CO, CO_2 and the elemental composition of the fuel as well as partial mass balances for carbon, nitrogen and halogens will be presented with emphasis on methyl halide emissions. These results will be compared to similar data in the literature and preliminary estimates for the impacts of biomass burning on regional and global budgets will be presented.

Additional resources can be found at: http://jurgenlobert.org/projects/mpi_safari/ and http://safari.gecp.virginia.edu/

A41C-09 1050h

Characterization of Biomass Burning Aerosol Optical Properties during SAFARI 2000 with AERONET Observations

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Measurements of spectral direct sun and directional sky radiances made with several AERONET network Sun-sky radiometers in August- September 2000 in southern Africa are analyzed. Time series of spectral aerosol optical depth in 7 wavelengths from 340 to 1020 nm and ngstrom derivatives are shown for August September 2000. Column integrated radiatively effective aerosol volume size distributions (radius range 0.05 to 15 microns) from inversions of the combined aerosol optical depth and almucantar sky radiance data are presented as a function of aerosol optical depth. Spectral aerosol single scattering albedo retrievals at 440, 675, 870 and 1020 nm from the AERONET sun-sky radiometers are compared to retrievals made with measurements of the fraction of diffuse irradiance from shadow band radiometer data in Zambia. Retrievals of aerosol single scattering albedo and size distributions for sites in several different regions of study in Zambia, Namibia, South Africa, Botswana and Mozambique are compared. In addition to biomass burning aerosols, some of these sites are influenced by the presence of airborne soil dust, sea salt, or industrial aerosol types.

A41C-10 1105h

Aerosol Characterization at Skukuza, South Africa, During the SAFARI 2000 Final dry Season Campaign

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Various collection devices, including single filter samplers with PM10 or PM2.5 inlet, PM10 stacked filter units and cascade impactors were used to take atmospheric aerosol samples at Skukuza in the Kruger National Park, South Africa, during the SAFARI 2000 final dry season campaign. Samples were collected continuously from 16 August until 19 September 2001, and the collection time per sample was either 12 or 24 hours. Depending upon the sampler type and collection substrates, the samples were analysed for the particulate mass (PM), organic carbon (OC), elemental carbon (EC), and/or over 40 elements. Besides the aerosol collections, also in-situ (real-time) measurements were performed for the PM and for black carbon (BC). These aerosol parameters were obtained with a Rupprecht and Patashnick tapered element oscillating microbalance (TEOM) and a Magee Scientific aethalometer. These instruments were provided with a PM2.5 inlet and were operated with 5 min time resolution. The real-time data showed that there were occasionally episodes (of several hours duration) with very elevated levels of PM and BC in the PM2.5 fraction. This was the case in the period from 30 August to 4 September and on 14 September. Maximum hourly-averaged concentrations were obtained in the early morning of 1 September, with levels of over 250 and over 7 micrograms per cubic meter for PM and BC, respectively. The analyses of the filter samples indicated that the average PM2.5/PM10 ratio was 0.66 +/- 0.12 for the PM. The ratio of total carbon (TC = OC + EC) to PM in the PM2.5 aerosol was on average 0.33 +/- 0.07 and the ratio EC/TC was 0.082 +/- 0.022 in this same size fraction.

A41C-11 1120h

Eddy Flux and Leaf-level Measurements of Biogenic VOC Emissions from two Savannas in Southern Africa

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Biogenic volatile organic compound (BVOC) emissions of isoprene and terpenes were measured in 2 savannas of southern Africa: a mopane woodland (>95% Colophospermum mopane), near Maun, Botswana and a Combretum savanna (45% Combretum apiculatum, the remainder mostly Acacia nilotica, Zizphus mucronata, Sclerocarya birrea, Grewia bicolor, and Acacia nigrescens), near Skukuza, Republic of South Africa. These 2 landscapes contain most of the dominant woody plant species found in southern Africa; mopane woodlands are a monospecific landscape occurring over a large area across southern Africa. These studies were made in January-February 2001 as part of SAFARI 2000.

Over 100 species were examined at the leaf level using cuvette techniques. In addition, relaxed eddy accumulation measurements of BVOC fluxes were made on towers in each location. Large, light dependent emissions of terpenes (mostly alpha-pinene) were observed from mopane. Of the major species in the Combretum savanna, only Acacia nigrescens emitted significant amounts of isoprene; none emitted terpenes. However, several minor species (Lonchocarpus capassa, Spirostachys africana) emitted isoprene. Net CO2 emissions were measured simultaneously on each tower; the diurnal BVOC emissions were integrated and compared with net CO2 flux measurements made simultaneously on the same tower.

The contribution of these and other BVOC emissions to net ecosystem carbon exchange will be discussed. In addition, the implications of these emissions to regional atmospheric chemistry and landscape change will be examined.

A41C-12 1135h

Urban and Rural Ozone Pollution over Lusaka (Zambia, 15.5S, 25E) during SAFARI-2000 (September 2000)

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In early September, throughout south central Africa, seasonal clearing of dry vegetation and the production of charcoal for cooking leads to intense smoke haze and ozone formation. Ozone soundings made over Lusaka during a six-day period in early September 2000 recorded layers of high ozone (> 125 ppbv at 5 km) during two stagnant periods, interspersed by a frontal passage that reduced boundary layer ozone by 30%. Smoke aerosol column variations aloft and total ozone were monitored by a sun photometer. During the 6-day measurement period, surface ozone concentrations ranged from 50-95 ppbv and integrated tropospheric ozone from the soundings was 39-54 Dobson Units (note 1.3 km elevation at the launch site). High ozone concentrations above the mixed and inversion layers were advected from rural burning regions in western Zambia where SAFARI aircraft and ground-based instruments observed intense biomass fires and elevated aerosol and trace gas amounts. TOMS tropospheric ozone and smoke aerosols products show the distribution of biomass burning and associated pollution throughout southern Africa in September 2000. Animations of satellite images and trajectories confirm pollutant recirculation over south central African fires, exit of ozone from Mozambique and Tanzania to the Indian Ocean and the characteristic buildup of tropospheric ozone over the Atlantic from western African outflow.

A41D MC: 120 Thursday 0830h

The Upper Atmosphere Research Satellite: Ten Years in Orbit I

Presiding: **G G Sheperd,** York University**; P Patra,** Frontier Research System for Global Change

A41D-01 0835h

Featured Presentation: A New Understanding of Solar Variability Derived From UARS Observations

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There is no abstract available for this presentation.

A41D-02 0855h

ACRIM2 Observations and the Long Term Total Solar Irradiance Database

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The UARS/ACRIM2 experiment has added ten years of precision total solar irradiance (TSI) observations to the long term database. A composite TSI record of more than 22 years has been constructed using results from the Nimbus7/ERB, SMM/ACRIM1, UARS/ACRIM2 and ACRIMSAT/ACRIM3 experiments. An 0.037 % per decade upward trend in TSI between the successive solar cycle minima of 1986 and 1996 has been found in this record. If a trend of comparable magnitude were present during the past century TSI variation may have been an important component of global warming. Wavelet analysis of the composite TSI record provides a view of the distribution of solar activity and TSI periodicities during solar cycles 21-23. The cascade of periodicity to larger values during the declining phase of solar maxima 21, 22 and 23 demonstrate the role of active region faculae and the active network in driving the characteristic 0.1 % (peak-to-peak) solar cycle luminosity variation.

URL: http://www.acrim.com

A41D-03 0910h

UARS measurements and their Relationship to the understanding of Dynamics in the Mesosphere and Thermosphere

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The UARS measurements constitute the most detailed and extensive set of observations ever taken of the mesosphere and lower thermosphere (MLT). These measurements have transformed our view of the MLT from what in some quarters in the mid-eighties was termed the ignorosphere - a region thought to be composed of uniform constituent distributions absent of strong dynamical influences - to what is now seen to be one of the more complex and and fascinating regions of the terrestrial atmosphere. This transformation came about primarily because of observations from the Wind Imaging Interferometer (WINDII) and the High Resolution Doppler Imager (HRDI) although significant contributions were also made by the Improved Stratospheric and Mesospheric Sounder (ISAMS), the Microwave Limb Sounder (MLS) and the Halogen Occultation Experiment (HALOE). Additional thermospheric measurements were taken by WINDII and the Particle Environment Monitor (PEM). These measurements have shown the MLT to be a region of strong dynamical variability. Firsts include long term global measurements of the tides and large scale planetary waves showing their seasonal variability, measurements of the annual cycle of the zonal mean flow, analyses of the wave forcing and dynamical balances suggesting deviations from gradient wind balance, and analyses of stationary planetary wave propagation indicating that both upward propagation and in situ generation of these waves are important. In addition, it became clear during the course of this mission that there are strong dynamical influences on the constituent distributions and these need to be understood when developing climatologies of the MLT. Although these advances are significant they show that gaps remain in our basic understanding of this region of the atmosphere. Questions remain about the momentum balances, energetics, constituent budgets and the role of gravity waves, questions which can only be resolved with future more sophisticated satellite missions.

A41D-04 0930h

The Equinox Transition in Atomic Oxygen Concentration

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The nighttime airglow emitted from the upper mesosphere and lower thermosphere is dominantly produced through reactions driven by the recombination of atomic oxygen to its molecular form. For this reason the atomic oxygen concentration may be monitored with ground-based or satellite measurements, the latter providing height profiles of the atomic oxygen number density. At mid-to high latitudes the atomic oxygen concentration is high in winter, and low in summer, reflecting the large-scale thermospheric circulation. More detailed recent observations have shown that the transition between the two is rather sudden, so that in the northern hemisphere the atomic oxygen is suddenly depleted near the end of March. This concentration remains low until near summer solstice, when it begins to recover slowly, with a sudden return to winter values soon after the fall equinox. In this presentation, ground-based observations and measurements from the WIND Imaging Interferometer (WINDII) on the Upper Atmosphere Research Satellite are combined to describe the phenomenon of the equinox transition.

URL: http://www.windii.yorku.ca

A41D-05 0945h

Highly Relativistic Electrons from UARS and Their Effect on Atmospheric Ozone

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In a study involving 5 of the instruments on UARS, we have investigated how fluxes of high-energy electrons could modify the chemistry of the upper stratosphere and mesosphere. Fluxes of high-energy electrons (E > 100 keV) have been predicted to deplete mesospheric ozone by 20% or more, and stratospheric ozone to a lesser degree. Precipitating fluxes of these electrons can increase by 1–2 orders of magnitude during highly relativistic electron (HRE) events, and often contain significant contributions from electrons with E > 1 MeV. This research has produced a database of differential electron energy spectra obtained during the decline of solar cycle 22. We have used this database to understand the radiation environment of low-Earth orbit. We will show how the HEPS data provides energy-dependent lifetimes for the energetic electrons and that elevated electron fluxes should be expected on any satellite mission lasting more than 1 week. Once the electron fluxes are known, the atmospheric effects can be predicted by model calculations and those predictions compared with composition measurements. For the instantaneous electron fluxes measured during a large May 1992 HRE, relative depletions of ozone greater than 15% were predicted to occur between altitudes of 60–80 km, where HO_x reactions cause a local minimum in the ozone concentration. The chemical signature of an HRE would be ozone depletions in the region of enhanced flux, particularly within the magnetic L-shell limits of $3 < L < 4$. Data from HEPS, CLAES, HALOE, HRDI, and MLS were combined to search for such effects during the May 1992 HRE. Mesospheric ozone measurements from HRDI and stratospheric ozone measurements by CLAES and MLS were searched for the predicted depletions. The seasonal evolution of water vapor was monitored with HALOE. Our analysis shows that between altitudes of 65–75 km the ozone mixing ratio was relatively constant within the overlapping local solar time bands during May 1992. Above 80–85 km, there was evidence of evolution through May 1992 and the HRE event.

A41D-06 1020h INVITED

UARS Measurements and their Relationship to Atmospheric Chemistry and Climate Issues

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The Upper Atmosphere Research Satellite (UARS) was launched by the Space Shuttle Discovery at 7:11:04 on September 12, 1991 and after boosting, finally reaching a 585 km, 57o inclined orbit. The satellite hosts ten experiments focused on a range of atmospheric phenomena including chemistry, dynamics, solar coupling with the atmosphere and energetic particle effects. The satellite provided an explosion of new information about the middle atmosphere and began the process of characterizing the low stratosphere and the mid to upper troposphere; both regions being vital to climate research studies. UARS experiments confirmed the role of CFCs in O3 depletion, clarified chemical process responsible for the Antarctic ozone hole, identified chemical O3 destruction in the Arctic region and shed new light on the role of dynamics as it affects latitude regions equaterward of the polar vortex. It also provided the first global measurements of HCl, HF, ClO, ClONO2 and N2O5 simultaneous with other key constituents including O3 itself, H2O, CH4, NO, NO2, HNO3, N2O, CF2Cl3, CFCl3, CO, aerosols and Polar Mesospheric Clouds. The long life of the mission has provided extended time series of key constituents and yielded remarkable and provocative results that leave many unanswered questions regarding atmospheric phenomena.

We discuss some of the chemistry and climate issues addressed by UARS in this paper and summarize findings. The ten-year chlorine record shows increases on altitude surfaces since the beginning of 2000 that are not understood; but on CH4 surfaces a clear leveling off of the pre-Montreal Protocol increase in accord with protocol predictions has occurred. The long-term fluorine record is consistent with the protocol on an altitude surface. UARS also provided important data on mid to upper troposphere H2O both in the form of vertical profiles and in altitude regions clearly showing the effect of the El Nio and correlations with sea surface temperature. We will describe these and other results in the context of chemistry and climate issues.