A51A MC: Hall D Friday 0830h

SAFARI 2000: The Southern African Regional Science Initiative III

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

A51A-0015 0830h POSTER

Downwind Trace Gas Vertical Profiles in SE Australia Associated with SAFARI 2000 Dry Season Campaign

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In association with the SAFARI 2000 Dry Season campaign in Africa, the Commonwealth Scientific and Industrial Research Organization (CSIRO) division of Atmospheric Research conducted aircraft measurements downwind, over Australia. Five missions were conducted using a Piper Navajo twin-engine aircraft to measure trace gas vertical profiles from near surface up to 7 km above Cape Grim (41°S, 144°E) and Melbourne (38°S, 145°E) regions. Air collected in glass flasks were analysed for CO2 and its stable isotopes (d13C and d18O of CO2), CH4, CO, H2 and N2O. Air collected in passivated canisters were analysed for C2 and C3 hydrocarbons. Ozone was monitored continuously in four of these missions and ground-based LIDAR was also employed in the Melbourne region in three occasions.

Previous study on trace gas vertical profiles above Cape Grim between 1992 and 1997 had established using emission ratios that burning in Africa and S America are contributing to the enhanced mid-tropospheric content of various trace gases in SE Australia. Now the SAFARI 2000 in-situ data complemented with downwind observations in Australia provides the opportunity to more closely link the observed mid-tropospheric anomalies at Cape Grim to specific surface emissions and atmospheric processes. Combined with our previous data, this investigation of biomass burning impacts is extended for the whole period from 1992 to 2000. In this respect, we plan to collaborate with groups measuring the same trace gases in-situ during SAFARI 2000 (including ozone and VOCs) and compare the observations to simulated results from the UC Irvine chemistry transport model.

Data requests for the vertical profile data could be addressed to B.C. Pak or R.L. Langenfelds via email: bpak@halo.ps.uci.edu, ray.langenfelds@dar.csiro.au

A51A-0016 0830h POSTER

Assessing Fractional Tree, Grass, and Bare Soil Cover from NDVI and Rainfall Time Series along the Kalahari Transect, Africa

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Savanna ecosystems are water-limited, a characteristic that can be exploited to estimate fractional cover of trees, grass, and bare soil over large-scale areas from synthesis of remote sensing and rainfall measurements. A method is presented to estimate fractional cover components along the Kalahari Transect (KT), an aridity gradient in southern Africa, based upon the differing ways in which grasses and trees respond to rainfall. Mean wet season normalized difference vegetation index (NDVI) and the sensitivity of the NDVI to variation in wet season rainfall are used as input into a linear unmixing model, and end-members for this analysis are extracted on the basis of best fit to the observed data. The end-members for the mixing analysis are consistent with the qualitative characteristics of trees (high NDVI, low sensitivity of NDVI to interannual variations in rainfall), bare soil (low NDVI, low sensitivity), and the transient grass/ bare soil area (moderate NDVI, high sensitivity). Sensitivity of NDVI to rainfall was based upon the relationship between NDVI and the standardized anomalies, or z-score, of the wet season precipitation, resulting in a 22% improvement in the number of significant relationships ($p<0.1$) compared with those found for NDVI and the raw precipitation. The unmixing model yields a decrease in tree fractional cover that corresponds to the north-south decrease in mean wet season precipitation from 1600 mm to 300 mm along the KT. Potential grass cover area is limited by the tree fractional cover on the wetter end of the transect, peaks at approximately 450 mm of mean wet season rainfall, and is limited by rainfall on the more arid portion of the transect. With NDVI for grass inferred from the data, predictions of yearly tree, grass, and bare soil fractional cover can be derived. No calibration or training sets were required for this unmixing procedure, and an additional advantage of this method over traditional unmixing approaches is that cover components can be predicted for future rainfall scenarios. This remote sensing-based model framework, together with a tree/grass interaction submodel, could be used to predict long-term migration of the cover components along this gradient in response to climate variability.

A51A-0017 0830h POSTER

Characterization of Biomass Burning Aerosol Optical Properties During the SAFARI 2000 Dry Season Campaign 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 Angstrom 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. Comparisons of aerosol size distributions between sites in different regions are made, with an emphasis on events of high biomass burning aerosol loading in early September 2000. 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 shadowband radiometer data in Zambia. The attenuation of irradiance (PAR and Total shortwave) measured at the surface by biomass burning aerosols is also investigated. 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.

A51A-0018 0830h POSTER

Airborne Spectral Measurements of Surface-Atmosphere Anisotropy for Several Surfaces and Ecosystem over Southern Africa

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The Cloud Absorption Radiometer (CAR) was flown aboard the University of Washington Convair CV-580 research aircraft and took measurements on 23 flights between August 15 and September 16. On 12 of those flights, BRF measurements were obtained over different natural surfaces and ecosystem in southern Africa. The BRF measurements were done to characterize surface anisotropy in support of SAFARI 2000 science objectives principally to validate products from NASA's EOS satellites, and to parameterize and validate BRF models. In this paper we present results of BRFs taken over two EOS validation sites: Skukuza tower, South Africa (25.0 °S, 31.5 °E) and Mongu tower, Zambia (15.4 °S, 23.3 °E). Additional sites are also considered and include, Maun tower, Botswana (20.0 °S, 23.5 °E), Sowa Pan, Botswana (20.6 °S, 26.2 °E) and Etosha Pan, Namibia (19.0 °S, 16.0 °E).

The CAR is capable of measuring scattered light in fourteen spectral bands. The scan mirror, rotating at 100 rpm, directs the light into a Dall-Kirkham telescope where the beam is split into nine paths. Eight light beams pass through beam splitters, dichroics, and lenses to individual detectors (0.34-1.27 μm), and finally are registered by eight data channels. They are sampled simultaneously and continuously. The ninth beam passes through a spinning filter wheel to an InSb detector cooled by a Stirling cycle cooler. Signals registered by the ninth data channel are selected from among six spectral channels (1.55-2.30 μm). The filter wheel can either cycle through all six spectral bands at a prescribed interval (usually changing filter every fifth scan line), or lock onto any one of the six spectral bands and sample it continuously.

To measure the BRF of the surface-atmosphere system, the University of Washington CV-580 had to bank at a comfortable roll angle of $\sim$20 ° and fly in a circle about 3 km in diameter above the surface for roughly two minutes. Replicated observations (multiple circular orbits) were acquired over selected surfaces so that average BRF smooth out small-scale surface and atmospheric inhomogeneities. At an altitude of 600 m above the targeted surface area and with a 1 ° IFOV, the pixel resolution is about 10 m at nadir and about 270 m at an 80 ° viewing angle from the CAR.

A51A-0019 0830h POSTER

The 1998-2000 SHADOZ (Southern Hemisphere ADditional OZonesondes) Tropical Ozone Climatology: Ozonesonde Precision, Accuracy and Station-to-station Variability

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As part of the SAFARI-2000 campaign, additional launches of ozonesondes were made at Irene, South Africa and at Lusaka, Zambia. These represent campaign augmentations to the SHADOZ database described in this paper. This network of 10 southern hemisphere tropical and subtropical stations, designated the Southern Hemisphere ADditional OZonesondes (SHADOZ) project and established from operational sites, provided over 1000 profiles from ozonesondes and radiosondes during the period 1998-2000. (Since that time, two more stations, one in southern Africa, have joined SHADOZ). Archived data are available at: <http://code916.gsfc.nasa.gov/Data_services/shadoz>. Uncertainties and accuracies within the SHADOZ ozone data set are evaluated by analyzing: (1) imprecisions in stratospheric ozone profiles and in methods of extrapolating ozone above balloon burst; (2) comparisons of column-integrated total ozone from sondes with total ozone from the Earth-Probe/TOMS (Total Ozone Mapping Spectrometer) satellite and ground-based instruments; (3) possible biases from station-to-station due to variations in ozonesonde characteristics. The key results are: (1) Ozonesonde precision is 5%; (2) Integrated total ozone column amounts from the sondes are in good agreement (2-10%) with independent measurements from ground-based instruments at five SHADOZ sites and with overpass measurements from the TOMS satellite (version 7 data). (3) Systematic variations in TOMS-sonde offsets and in ground-based-sonde offsets from station to station reflect biases in sonde technique as well as in satellite retrieval. Discrepancies are present in both stratospheric and tropospheric ozone. (4) There is evidence for a zonal wave- one pattern in total and tropospheric ozone, but not in stratospheric ozone.

URL: http://code916.gsfc.nasa.gov/Data_services/shadoz

A51A-0020 0830h POSTER

BRF/LAI linkages for the Sua Pan and Skukuza sites, Safari 2000 Dry Season Campaign

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The Safari 2000 campaigns focused on land-atmosphere processes and the impact of regional burning on aerosols and aerosol transport. An important factor is estimating the extent and nature of the biomass available. Multi-angle data, such as that obtained from the Multi-angle Imaging SpectroRadiometer (MISR) provide unique data sets towards discerning surface properties from remote platforms. MISR operated during SAFARI 2000, in addition to in-situ measurements such as those acquired from the PARABOLA dual-hemispheric scanner. These data will be presented, and compared. Discussion as to how multi-angle information can be used to retrieve surface bi-directional reflectance (BRF) from a single observational position, and its relation to Leaf Area Index (LAI) is presented with empirical results.

URL: http://www-misr.jpl.nasa.gov

A51A-0021 0830h POSTER

Detailed Mass Size Distributions of Aerosol Species and Trace Elements at Skukuza, South Africa, During SAFARI 2000

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Two types of cascade impactors were used to collect size-fractionated aerosol samples during August-September 2001 at Skukuza, South Africa, as part of the SAFARI 2000 final dry season campaign. The impactors were a 10-stage microorifice uniform deposit impactor (MOUDI), with cut-points down to 53 nm equivalent aerodynamic diameter (EAD), and a 12-stage small deposit area low pressure impactor (SDI), with cut-points down to 45 nm EAD. Separate day and night samples were collected, starting at about 7:00 and at about 18:00 local time, respectively. The MOUDI samples were analysed for the particulate mass (PM) by weighing, and for organic carbon (OC) and elemental carbon (EC) by a thermal-optical transmission technique. The SDI samples were analysed for 28 elements by particle-induced X-ray emission (PIXE). The total concentrations (summed over all stages) varied quite substantially during the campaign (up to a factor of 50 for certain elements), but no systematic day/night difference pattern was observed. Also the size distributions were rather similar during day and night. PM, OC, EC, S, K, Zn, As, Se, Br, Rb, and Pb had most of their mass in the submicrometer size range, with maximum typically at about 0.3 to 0.5 micrometer EAD. Several of those species and elements are good indicators for biomass burning. Mass median aerodynamic diameters (MMADs) were calculated for the various elements and compared with those obtained during SAFARI-92. During this earlier campaign, which also took place in the dry season, daily samples were taken at Skukuza with a PIXE International cascade impactor (PCI). For the crustal and sea-salt elements, fairly similar MMADs were obtained in the two campaigns. For the fine-mode elements, however, the MMADs were substantially lower during SAFARI 2000 than during SAFARI-92. During this earlier campaign, the MMADs were most likely overestimated.

A51A-0022 0830h POSTER

Reactive Carbon Species from Biomass Burning Activities During SAFARI 2000: Implications for Tropospheric HOx Budgets.

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Considerable convection occurs in regions of biomass burning, resulting in vast quantities of reactive species being transported high into the troposphere. During this convective activity large amounts of water vapour are also lifted out of the boundary layer. These processes result in large perturbations to the normal clean air chemistry which is dominated by methane and carbon monoxide.

In situ measurements of a range of trace species were made during a series of flights during SAFARI 2000 on the UKMO C-130 aircraft. Whole air samples were also collected for non-methane hydrocarbons (NMHC) analysis. During one flight a polluted layer was observed off the coast of Namibia, this layer showed considerable enhancements in many species emitted during biomass burning. During a subsequent flight a large fire was encountered and studied for a considerable distance. Changes in ratios between species during the fresh and aged plumes indicated considerable photochemical activity during transport. In particular observations in aged plumes indicate a considerable fraction of acetone present was produced photochemically following emission. Simple modelling studies have been run and the results compared.

A51A-0023 0830h POSTER

Does Nutrient Dynamics Determine C3-C4 Plant Abundance in Southern African Ecosystems?

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A major feature of southern African savannas is the co-dominance of grasses, and trees / shrubs with the C4 and C3 photosynthetic pathways respectively. Several hypotheses try to explain this feature. Fires and grazing are thought to limit tree growth, allowing grasses to co-exist with trees. Niche differentiation regarding water uptake could also explain the shared dominance, with grasses taking water from the surface and trees from deeper soil layers. Nutrients are not commonly used to explain tree-grass interactions. In this study, data is presented to support the hypothesis that nutrient dynamics affects C3 and C4 distribution. Foliar P and δ^{15}N, root profiles and abundances of C3 and C4 plants, soil δ^{13}C, and gross N mineralization and nitrification rates in soils under C3 and C4 plants were analyzed along a precipitation gradient in southern Africa. The δ^{15}N and foliar P of both plant types respond differently to precipitation. Plants with the C3 metabolism are more enriched in ^{15}N with increasing aridity, and this enrichment is associated with a higher abundance of C4 plants. The δ^{15}N of C4 plants is not related to precipitation. Root profiles and soil δ^{13}C indicate that C4 roots dominate in mass and abundance from the surface to >60 cm depth, under C3 and under C4 plants. Gross N mineralization rates are significantly higher under C3 plants. Our results suggest that competition for N may be a factor in determining the abundance of C3 and C4 plants in southern African savannas, with grasses being stronger competitors.

A51A-0024 0830h POSTER

Spatial Variations in Aerosol and Cloud Condensation Nuclei Characteristics over Southern Africa

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The effect of anthropogenic aerosols on cloud optical properties is the greatest uncertainty in climatic change predictions. Cloud condensation nuclei (CCN) characteristics determine the degree to which aerosol emissions affect cloud microphysical properties. In-situ aerosol and CCN measurements have been collected from an airborne platform over southern Africa during the Aerosol Recirculation and Rainfall Experiment (ARREX) and during the Southern African Regional Science Initiative SAFARI 2000. Wet season campaigns were conducted in January 1999 and March 2001, and a dry season campaign was conducted in August/September 2000. Spatial variations in aerosol properties are investigated by considering accumulation mode aerosol concentration and size distribution in various air mass types. CCN concentrations and activity spectra are analysed in a similar fashion. Seasonal variations in aerosol characteristics are examined, and the aerosol-CCN relationship is explored. Differences in aerosol emissions and atmospheric transport and residence times are possible factors controlling spatial and seasonal differences in aerosol and CCN characteristics over the subcontinent.

A51A-0025 0830h POSTER

Spatial and temporal variations of aerosols over southern Africa

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Aerosols are an important component of the atmosphere and are now known to be important to climatic variations at a regional scale. Southern Africa is a large source of both natural and anthropogenic aerosols. Industrial emission are known to vary only slightly through the year, whereas, biomass burning emissions are concentrated at the end of the dry season, from August to October. Since 1997 as part of the Aerosol Recirculation and Rainfall Experiment (ARREX) and the Southern African Regional Science Initiative (SAFARI 2000) in-situ measurements of aerosols have been made during different seasons over large areas of the subcontinent. The aim of the investigations was to characterise the nature of the aerosols over the region as well as to obtain an idea of the spatial distribution of aerosols and how these vary seasonally. Real time measurements of aerosols have been collected using PMS Passive Cavity Aerosol Spectrometers, TSI-3011/3076 Condensation nuclei counters, a TSI-3563 Integrating Nephelometer, a University of Wyoming Cloud Condensation Nuclei counter and an Airborne Streaker Sampler. Aerosol concentration gradients have been found to exist along a north south axis. The highest concentrations occur towards northern southern Africa during the biomass burning season. This reverses in the other seasons with the main source of aerosols being the industrial complex of South Africa. Aerosols accumulate in the atmosphere over southern Africa in response to conditions associated with of a continental anticyclone that dominates the regional circulation throughout the year. This is most extreme during the winter (June August). The stable atmospheric environment of southern Africa also facilitates the formation of filaments of elevated aerosol concentrations to form and persist in the atmosphere in response to specific sources. In the vertical aerosols are frequently layered as a result of inversions or absolutely stable layers.

A51A-0026 0830h POSTER

Trajectory Model Outputs Over Southern Africa

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Trajectories provide a useful and relatively simple method of analysing possible three-dimensional transportation paths of air, aerosols, trace gases and water vapour with time. Wind trajectories advect a large number of measurements, all made at different times, backward or forward in time from the point at which they were made using forecast (during the campaign) and analysed (after the campaign) wind fields. These fields change both spatially and temporally over time.

A Lagrangian kinematic trajectory analysis is employed. The trajectory model was driven by two sets of data: forecast meteorological, real-time, 3-hourly input data during the SAFARI2000 campaign, and analysed meteorological, 6-hourly input wind data after the campaign. In both cases the resolution of the data over Southern Africa was 0.5 degrees. Five-point trajectory clusters (at 2.5 degree spacing) were run to and from Maun, Mongu, Middleburg, Windhoek, Springbok and Durban to roughly cover the whole Southern African region at multiple levels from the lower to the upper-troposphere. In total, 6163 trajectories were calculated using forecast data.

The dominant transport modes during the Southern African Regional Science Initiative (SAFARI 2000) are direct westerly and recirculated transport (predominantly on a subcontinental scale). The frequencies at which these transport modes occur vary with height and location. The trajectory output data is useful first and foremost to observe the dominant circulation patterns over Southern Africa both spatially and temporally at different levels of the troposphere and at various scales of motion. Secondly, the data is useful for anyone wishing to examine the sources of monitored upper-air aerosols and / or trace gases, to discriminate, for instance, between oceanic, clean continental and polluted continental air masses contributing to the observed concentrations. Finally, the data can be used to explain elevated or declined concentrations downwind within specified times.

A51A-0027 0830h POSTER

Individual-Particle Analysis of Aerosols From Southern Africa

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Aerosol samples were collected on the University of Washington Convair-580 research aircraft over southern Africa during the Safari 2000 Experiment. Individual aerosol particles were analyzed using transmission electron microscopy (TEM) and field-emission scanning electron microscopy (FESEM) with energy-dispersive x-ray spectrometry (EDS). The objective of the study is to characterize the major aerosol emissions from biomass burning over southern Africa, with emphasis on the sizes, shapes, compositions, mixing states, and surface coatings of the aerosols. Aging and reaction of smoke aerosols with plume transport were investigated. Particulate emissions from combustion of different vegetation types and at different burning phases were compared. Preliminary results show that aerosols from biomass burning mainly consist of amorphous carbonaceous spherules ("tar balls"); soot; K salts including KCl, K_2SO_4, and probably KNO_3 mixed with organic particles; and Ca-bearing particles including Ca carbonate, phosphate, and sulfate. Minor amounts of sea salt and minerals such as quartz, mica, smectite, and gypsum are also present. The relative concentrations of tar balls increase with distance from the fires. More KCl particles occur in fresh smoke plumes close to fire sources, whereas more K_2SO_4 and KNO_3 particles are present in aged smoke. This change indicates that KCl forming from the fire was converted to K_2SO_4 and KNO_3 through reactions with S- and N-bearing species emitted from biomass burning. The conversion of KCl resembles that of NaCl in sea salt particles, suggesting similar reaction mechanisms with the aging of smoke. More soot is present in smoke from flaming grass fires than bush and wood fires, which is probably related to the high fraction of flaming combustion of grass fires. The high abundance of organic particles and soluble salt may affect the hygroscopic properties of biomass burning aerosols and influence their role as cloud condensation nuclei. Deposition of biomass burning aerosols and export from the source regions can influence local ecosystems and the biogeochemical cycles of trace elements, such as K.

A51A-0028 0830h POSTER

Nitrogen Dynamics of the Savanna Flux Site at Skukuza, Kruger National Park.

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The SAFARI 2000 campaign aims at validating satellite-based estimates of photosynthesis and net primary productivity (NPP). The Skukuza site has two vegetation types, a *Combretum* (broad-leafed) savanna and an *Acacia* (fine-leafed) savanna. Since it is expected that these two vegetation types may have markedly different responses to global climate change, it is an ideal site for the Earth observing systems (EOS) validation experiment. NPP estimates need to be explained and supported using corresponding data on the N (nitrogen) budgets for the site.

Plants capable of nitrogen fixation usually had higher % N and lower δ^{15}N signatures than their non-nitrogen-fixing counterparts. Most species had isotopically enriched signatures relative to the standard, which was air. The mean enrichments for the legumes varied from -1.76 to 3.32, while that of the non-legumes ranged from 3.02 to 7.08. In the herbaceous layer, *Stylosanthes fruticosa* and *Macrotyloma maranguense* had the highest fixation rates, with 84% and 41% being contributed by each species respectively (4.9 - 6.8 kg N ha^{-1} yr^{-1} is fixed in this layer). Since these species occurred in dense patches at the broad-leafed site, it was assumed that this was the contribution of N_2 fixation to this savanna. The dominant N_2 fixing tree was *Acacia nilotica*, with 50 % of its N being fixed. Trees at the fine-leafed site fixed between 2.9 - 5.5 kg N ha^{-1} yr^{-1}, while herbaceous legumes contributed 4.9 - 6.8 kg N ha^{-1} yr^{-1}.

Nitrogen mineralisation is seasonal, with particularly high rates of mineralisation in spring. In winter, NH_4^+ dominates at the fine-leafed site, when it is scarcely detectable at the broad-leafed site. On the other hand, nitrate prevails in summer at the fine-leafed site, while it is being immobilised at the broad-leafed site. In contrast to another South African savanna, NH_4^+ is detected in large quantities (0.85 μg N g^{-1} dry soil day^{-1}) at both sites during summer. The nitrification rates are maintained at 0.10 μg NO_3^- - N g^{-1} dry soil per day throughout the summer period, which is about a quarter of the rate previously reported for a nutrient-poor savanna. Nitrification is as important as ammonification in fertile savanna systems even if the latter process may have rate-limiting effects on the overall process of nitrogen mineralisation. These results were much in keeping with our hypothesis that the rate of mineralisation would vary seasonally due to seasonal soil moisture and temperature variation.

In agreement with other studies in a South African savanna the annual NO flux from the broad-leafed (8 kg N ha^{-1} yr^{-1}) savanna was not significantly lower than that of the fine-leafed savanna (9 kg N ha^{-1} yr^{-1}). The seasonal pattern of NO emission from savanna soils follows that of the rainfall. A large soil NO pulse, that may contribute as much as 10% of the annual NO flux, was observed after the first rains following a prolonged dry spell. Labile organic residues could have accumulated during litter fall in autumn and hence have contributed to there being more substrate for microbial decomposition once warmer temperatures are experienced. This could stimulate faster rates of mineralisation, and nitrification resulting in large NO losses after the first rainfall following a dry spell.

A51A-0029 0830h POSTER

Development of a Canopy Environment Model - Estimates of Regional Biogenic Volatile Organic Compounds Fluxes from SAFARI 2000 measurements

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The Southern African Regional Science Initiative - SAFARI 2000 - is an international science initiative aimed at developing a better understanding of the Southern African earth-atmosphere-human system. The goal of SAFARI 2000 is to identify and understand the relationships between the physical, chemical, biological and anthropogenic processes that underlie the biogeophysical and biogeochemical systems of Southern Africa. Particular emphasis has been placed upon biogenic, pyrogenic and anthropogenic emissions, their characterization and quantification, their transport and transformations in the atmosphere, their influence on regional climate and meteorology, their eventual deposition, and the effects of this deposition on ecosystems.

Tropical savannas are globally important biomes with high potential for biogenic emissions. As biogenic VOC emissions from foliage are very sensitive to leaf temperature and light intensity (PAR), we developed a detailed canopy microclimate model that can be used to predict BVOC emission variations. Leaf temperature and PAR are computed for multiple layers in a vegetation canopy. Leaf temperature is determined by energy balance and a complex radiation transfer is used for

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computing PAR. Predicting biogenic VOC emissions at regional and global scales requires characterization of relatively broad vegetation types. In our model, seven basic growth forms are considered. Biogenic volatile organic compounds (BVOC) emissions were measured in January 2001 using relaxed eddy accumulation (REA) at the Skukuza savanna flux tower in the Republic of South Africa and the Maun flux tower in Botswana. The measured hourly and daily variations in isoprene and alpha-pinene fluxes at the two field sites are used to evaluate the flux model. In addition, we present a model sensitivity analysis.

A51A-0030 0830h POSTER

Retrievals of Tropospheric Carbon Monoxide Abundances from the Scanning High Resolution Interferometer Sounder on-board the ER-2 During SAFARI 2000

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We present the first retrievals of tropospheric carbon monoxide (CO) from the Scanning High Resolution Interferometer Sounder (SHIS) during SAFARI 2000 (S2K). With a multi-month lifetime and as a major gaseous component of biomass burning, CO is an excellent tracer of atmospheric motions and plays a critical role as a precursor to tropospheric ozone production. Flying on-board the ER-2 during S2K, SHIS accumulated approximately 90 hours of data containing nearly 650,000 infrared spectra covering the spectral region from 3.3 to 15 microns at a resolution of 1 cm^{-1} (1 cm optical path difference). CO retrievals are performed in the 4.67 micron band using an algorithm previously utilized for the HIS airborne instrument for flights over the United States in 1993 and 1995 and since adapted for CO retrievals from ground-based FTIR instruments. Sensitivity and validation studies show such CO retrievals from airborne spectra are indicative of the total CO column and/or the mean free tropospheric CO mixing ratio. In this first look at the voluminous SHIS dataset, particular attention is paid to the Timbavati fire observed on September 7, 2000 and the flight over the Okvanga Delta on August 27, 2000. Preliminary comparisons to airborne in situ CO measurements and retrievals from the MOPITT instrument in orbit onboard the Terra satellite also will be presented. Our primary goals for S2K SHIS CO research include validation of MOPITT CO retrievals and process studies such as transboundary pollution transport and regional green-up.

A51A-0031 0830h POSTER

SAPYRO: A Regional Spatio-temporal Model for Estimating Pyrogenic Emissions From Vegetation Fires in Southern Africa

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The main goal of this research is to improve the reliability and accuracy of emission estimates from vegetation fires in southern Africa by developing a spatio-temporally explicit model for the 2000 fire season, SAPYRO. Accurate quantification of regional pyrogenic emissions requires the assessment of the intra-seasonal variability of several parameters, including burned area, biomass burned and emission factors. Previous regional emission calclulations have either been based upon anecdotal estimates of these parameters or on annual burned area estimates from remote sensing and late dry season field measurements, thus introducing large errors in the emission estimates. In the described modeling approach the Moderate Resolution Imaging Spectroradiometer (MODIS) burned area product is used to estimate the burned area on a monthly basis. A dynamic fuel load model that models Net Primary Productivity (NPP) and uses field-derived relationships to allocate fuel load types is also used at a monthly time scale. The seasonality of emission factors for trace gases and aerosols is modeled to account for the vegetation moisture content variations during the fire season and the resulting effects on the type and amounts of the produced emissions. In addition, for some atmospheric species, emission factors have been found to depend on the type of ecosystem where the burning takes place, grassland or woodland. Combustion factors also vary within the fire season and are related to the fuel mixture. Conclusions are made concerning which aspects of this modeling approach require further research. This study will contribute to meeting one of the main SAFARI-2000 project research objectives.

A51A-0032 0830h POSTER

Relationship between small-scale structural heterogeneity and simulated vegetation productivity across a regional moisture gradient

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Observed variability in savanna vegetation structure is used as the basis for model estimates of the range of annual productivity between landscape patches at 10 sites along a moisture gradient in southern Africa ranging from 1000 mm to 250 mm mean annual rainfall. Variability in vegetation structure leads to ranges of simulated productivity within sites that are greater than the total range in mean productivity across all sites. In addition the changing relationships between simulated tree and grass productivity across the sites exhibit strong dependence on patch-scale vegetation structural properties. The results of this study indicate that life-form interactions have a significant role in controlling vegetation productivity across the rainfall gradient. The importance of considering heterogeneity rather than mean structure when modeling productivity in heterogeneous landscapes is emphasized. The implication of these considerations on the coupled dynamics of vegetation-atmosphere systems is discussed.

A51A-0033 0830h POSTER

Intercomparison of AirMISR, CAR, and MISR Observations of Bidirectional Reflectance Factor, Mongu Tower, Zambia, During SAFARI 2000 Dry Season Campaign

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The SAFARI 2000 Dry Season Campaign was carried out across southern Africa in August and September, 2000. The campaign had as goals: (1) study of aerosol sources, transport, modification, and deposition, (2) the impact of atmospheric constituents on African ecosystems, (3) the field measurement of surface reflectance and atmospheric aerosol properties, and (4) measurement of atmospheric and surface properties from MISR and other instruments aboard TERRA. The validation of space platform measurements would permit extension in space and time of the platform measurements. An integral component was making coordinated observations by surface and aircraft measurements. The present work focussed on validation of bidirectional reflectance factor (BRF) by the Multiangle Imaging SpectroRadiometer (MISR, the TERRA Platform), the Cloud Absorption Radiometer (CAR, GSFC, CV-580 Aircraft, University of Washington), and AirMISR (ER-2, NASA DFRC, JPL). Numerous sorties were flown by both the ER-2 (20 km altitude) and CV-580 (altitude 1 km). A single coincident flight covering miombo woodland was achieved at Mongu Tower (-15.438 deg lat, 23.253 deg long) on Sept 06, 2000 under cloud-free but hazy conditions. BRF intrcomparisons are under development between MISR (Sept 10, 2000 overpass) AirMISR and CAR. The value of CAR is that a bidirectional reflectance is measured rapidly over all azimuths and can be used to compare BRF at other azimuths of observation such as those of AirMISR and MISR. Twenty three BRF recoveries from MISR have subsequently been made covering the interval Sept. 06, 2000 - July 25, 2001. These are under screening for residual clouds to seek seasonal or other reflectance variations present. Such MISR time series provide basis for study of system impacts on a multi-year basis, a principal goal of the SAFARI 2000 experiment.

A51A-0034 0830h POSTER

Modeled Soil NO Emissions from Southern Africa During SAFARI 2000

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Soil emissions are the major source of biogenic NO_x emissions, contributing as much as 40% to the global budget. Savannas in southern Africa have been estimated to produce approximately 1 Tg N yr^{-1}, however this estimate was obtained by scaling up field fluxes on an area basis. Tropical and subtropical savanna emissions have been shown to exhibit spatial and temporal variability. The main reason for this is the change in soil temperature, moisture and nutrient content, the major controlling factors of soil NO emissions, across a region. Furthermore, emission factors differ between the various land-use types. In this study the biogenic NO emission for southern Africa were estimated using field data and mechanistic models. Soil, vegetation and land-use maps were used to divide southern Africa (south of the equator) into various land-use classes. NO emission factors (NO production and consumption rates, as well as soil temperature and moisture relationship factors) assigned to these classes were obtained either from field and laboratory measurements, or from the literature. Monthly soil temperature and moisture were modeled for southern Africa for the year 2000 using climate, soil, biomass, and geographic data. Existing moisture and temperature dependant NO emission algorithms were combined with the modeled soil temperature and moisture data to produce monthly soil NO emissions for southern Africa during SAFARI 2000.

A51A-0035 0830h POSTER

Water-Soluble Organic Species in Biomass Burning Aerosols in Southern Africa: Their Chemical Identification and Spatial Distribution

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During the SAFARI-2000 field campaign, 14 aerosol samples were collected from an aircraft in plumes from biomass fires (under both flaming and smoldering conditions), at various distances from the fire source. Also collected were 36 aerosol samples in haze layers ranging from the surface to 16,000 feet, some of which could be associated with specific fires. The samples were collected on teflon membrane filters (lower size limit of about 30nm in diameter) which were analyzed

for total aerosol mass loading and chemical composition using several analytical techniques. Particular effort was made to speciate the water-soluble portion of the aerosol organics. Seven organic acids and seven carbohydrate species (and their possible stereoisomers) were identified and quantified, along with three inorganic anions and five inorganic cations. The identified organic species accounted for up to 32% of the total aerosol mass; compared with concurrent total carbon and organic carbon measurements, the identified organics constituted at least 5% to 30% of the mass of the total aerosol organics. A number of conspicuous spatial distribution patterns were observed for these species. For instance, using K+ to correct for dilution, it was found that gluconate, oxalate, succinate, and glutarate, along with sulfate and nitrate, all increased significantly in mass concentration from the fire source going downwind. This suggests secondary formation of these species during aerosol aging. On the other hand, formate and acetate showed decreasing trends downwind, probably due to the loss of these volatile species to the gas phase. Another striking pattern is that anhydrosugars (e.g. levoglucosan) had the highest aerosol mass fraction near smoldering fires but a very low fraction in the haze layers, whereas, dicarboxylic acids showed an almost opposite trend. This implies possible chemical reaction processes converting intermediate organic products, such as levoglucosan, to smaller products like diacids, during aerosol upward transport and aging. It was also found that smoldering fires produced much more anhydrosugars and other tarry material than flaming fires. These results provide support for some earlier laboratory studies of biomass burning, but also pose new questions as to the complicated chemical reactions involved. Furthermore, it is evident that besides chemical reactions, fire types, meteorological conditions, and the properties of the reaction products, such as volatility, all play important and interconnected roles in aerosol formation in smokes. Implications of these results for the CCN activity of aerosols from biomass burning will be discussed briefly.

A51A-0036 0830h POSTER

GC/MS Characterization of Fatty Acids Extracted From Southern African Aerosols

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Fatty acids of total suspended particulate aerosol samples, collected in Mongu, Zambia during the Southern African Regional Science Initiative (SAFARI 2000) field campaign, were analyzed to characterize emissions from an important source of aerosols in the southern African region. The sample site was chosen specifically so as to decrease the influence of industrial emissions and to focus primarily on the emissions from biomass burning, of which fatty acids are a significant component. Previous investigations in southern Africa have identified emissions from biomass burning as a significant contributor to the haze layer prevalent across the subcontinent. In order to better understand the origins of the materials within the haze layer, characteristic compounds of different source materials were identified in the aerosols. This characterization may clarify the contributions to total aerosol loads from other sources, including marine aerosols or mineral dust. By determining the distributions and concentrations of distinct organic components, this study enables future investigations to quantify the contribution of emissions from biomass burning at specific geographic locations.

A51A-0037 0830h POSTER

Lidar Measurements of the Optical Characteristics of Smoke and Haze Events at Skukuza and Mongu during SAFARI-2000

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Micropulse Lidar Network (MPL-Net) was created at NASA/GSFC to establish long-term cloud and aerosol monitoring sites around the world, while participating in similarly motivated short-term field campaigns. During the SAFARI-2000 Dry Season field initiative, the MPL-Net project deployed two MPL systems to southern Africa. One was placed at the Skukuza Airport in northeastern South Africa, and the other at the meteorological complex in Mongu, Zambia. The MPL instrument is a single-channel (523 nm), elastic backscatter lidar able to profile nearly all significant tropospheric cloud and aerosol to the limit of transmitted pulse attenuation. These instruments are eye-safe and autonomously operated in a continuous, full-time mode. Measurements were made at both field sites for nearly the entire length of the experiment from 17 August to 22 September 2000.

Analysis of the normalized MPL signal yields macrophysical properties of the incident atmosphere (i.e. particulate layer boundary heights) and optical characteristics of clouds and aerosols. In this presentation we discuss processed MPL data products characterizing elevated and boundary layer-embedded smoke optical properties as measured during SAFARI-2000. The vertical/temporal distribution of the particulate extinction cross-section and corresponding layer-mean extinction-to-backscatter ratio for significant smoke events is examined, as is the corresponding variability of the column integrated aerosol optical depth as compared to less contaminated conditions. Preliminary inquires into the radiative forcing occurring during these events are described through comparisons of observed surface flux measurements to model calculations. Cross-validation efforts are also discussed involving corresponding measurements made by the NASA ER-2 Cloud Physics Lidar, NASA Ames Airborne Tracking 14-channel Sunphotometer and NASA AERONET CIMEL sunphotometers.

URL: http://virl.gsfc.nasa.gov/mpl-net/

A51A-0038 0830h POSTER

Regional fuel load modeled for two contrasting years in central and southern Africa

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Fuel load has been modeled for southern hemisphere Africa for the 1991-92 and 1999-2000 growing seasons. The 1991-92 year was generally dry due to a strong El Nino event in contrast to the particularly wet year of 1999-2000. The method integrates site-level process modeling with 15 day AVHRR NDVI data. The site model was used to simulate landscape light-use efficiency (LUE) at a series of sites in the Kalahari region ranging from evergreen woodland to arid shrubland. This site-level LUE is extrapolated over the southern African region with gridded tree cover data and gridded rainfall. The predicted net primary production (NPP) is allocated into the different fuel types (grass, litter, twigs) using empirical based relationships. The model results are compared with field measurements of fuel load at a number of sites. The results will be used for modeling of biomass burning emissions.

A51A-0039 0830h POSTER

Atmospheric Vertical Structure at Skukuza, South Africa during the 1999 and 2000 SAFARI Dry-Season Campaigns

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Data obtained during the 1999 and 2000 SAFARI Dry-Season campaigns are used to document and detail the atmospheric vertical structure at Skukuza, South Africa. The vertical structure is investigated using on-site radiosonde, ground-based Micro-pulse Lidar, and AERONET sun photometer data obtained at the Skukuza site in Kruger National Park. Data obtained from the Cloud Physics Lidar on board the NASA ER-2 and the satellite-based TOMS Aerosol Index are also used. Special attention is focused upon the boundary layer and its dynamics and the multiple stable layers throughout the atmospheric column. In addition to describing the vertical structure during both campaigns, both intra-seasonal for different weather regimes and inter-seasonal for 1999 compared to 2000, differences are investigated and evaluated.

A51A-0040 0830h POSTER

An Integrated Land Use - Land Cover Change Model for the Southern Africa Region

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A land use change model covering the Miombo region of Southern Africa region is presented. The model includes a structure that recognizes the scales at which land use change decisions are made in the region, namely the traditional authority for subsistence agricultural land use, and includes social-economic and biophysical constraints to land use at multiple levels. Land cover information for the 1990's based on maps derived from Landsat Thematic Mapper data are used to initiative the model. The model, called MELT, can be used to examine impacts of land use change on carbon pools, emissions from land use change (slash and burn agriculture or as a result of soil carbon changes), and spatial patterning of land cover. MELT provides a suitable representation of the process of land use in this region, and will be essential in providing the correct context for observed fire and emissions across the region of the SAFARI 2000 initiative. MELT is implemented using an object-oriented approach, and allows easy linkage with impacts models.

A51A-0041 0830h POSTER

Compound Specific Stable Isotope Analysis of Southern African Aerosols

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Southern Africa has recently been the focus of intensive subcontinental level study, particularly with regard to atmospheric aerosols and regional atmospheric transport. Results from these analyses have shown that emissions from extensive, often anthropogenic, biomass burning in southern Africa affects biogeochemical cycling in the region, and that emitted trace gases and aerosols as well as industrial emissions, marine aerosols and mineral dust tend to accumulate and recirculate in the well defined anticyclonic atmospheric gyre that persists for long time periods over southern Africa. The long-range transport of these materials is an important component of biogeochemical dynamics in this nutrient limited region. A recent field campaign, the Southern African Regional Science Initiative (SAFARI 2000), was conducted in part to investigate the impacts of this large-scale transport and deposition of aerosols on southern African biogeochemical cycling. As a part of the SAFARI 2000 initiative, we present data illustrating that compound specific stable isotope analysis of individual molecular components is a useful tool for the evaluation of the origins of aerosols and their generating processes. This study specifically examines fatty acids extracted from aerosols to more precisely characterize emissions produced in the high intensity biomass burning region of western Zambia, the slightly less intense biomass burning region of northeastern South Africa and a site downwind of these two regions within the gyre circulation at Sua Pan, Botswana. This discrete characterization of fatty acids contained within the organic fraction of collected aerosols establishes a means to trace biomass burning products as they are transported within the gyre and subsequently deposited on the subcontinent.

A51A-0042 0830h POSTER

Anthropogenic Emission Inventories for SAFARI 2000

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Surface emission inventories are required as input into atmospheric transport models and other investigations forming part of SAFARI 2000. We have generated an anthropogenic emissions inventory for continental Africa south of the equator. It covers the period 1999 to 2001 with a monthly temporal resolution and a 20km spatial resolution. The anthropogenic inventory covers emissions of CH4, CO2, CO, SO2, VOC (volatile organic carbons), NOx and N2O from the energy sector, mines, transport, industries and other major emitting sectors, in all major emitting countries south of the equator. The baseline country total emissions data were taken from the 1990 IPCC Greenhouse Gas Inventory Country Summaries. Emissions reported for 1990 were extrapolated to the SAFARI 2000 study period, temporally distributed by month and spatially disaggregated according to sector-specific driver surfaces. This anthropogenic emissions inventory together with others developed during SAFARI 2000, namely those for soil, vegetation, domestic biomass combustion and fire constitute a comprehensive new emissions inventory.

A51A-0043 0830h POSTER

Emissions of Volatile Inorganic Halogens, Carboxylic Acids, NH3, and SO2 From Experimental Burns of Southern African Biofuels

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As part of SAFARI 2000, biofuels (savanna grasses, shrubs, woody plants, litter, agricultural waste, and charcoal) were sampled during late summer and early autumn in the savannah of Kruger National Park, the Kalahari of Etosha National Park, and the Miombo woodlands in Zambia and Malawi. Sixty subsamples were experimentally burned under semi-controlled conditions at the Max Planck Institute for Chemistry in Mainz, Germany. Emissions were sampled with tandem mist chambers to quantify HCl, CH3COOH, HCOOH, NH3, and SO2 and with a high-volume filter pack to quantify volatile inorganic Cl, Br, and I. The elemental compositions of the fuel and ash from each burn were also analyzed. Molar emission ratios of these species relative to CO, CO2, and the elemental composition of the fuel will be calculated and used to estimate regional emissions from biomass burning over southern Africa. The relative contributions of each species to elemental mass balances during burns will also be assessed.

URL: http://jurgenlobert.org/projects/mpi_safari/and

A51A-0044 0830h POSTER

MODIS observation of aerosols over Southern Africa during SAFARI 2000: data, validation, and estimation of aerosol radiative forcing.

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Aerosol properties, including optical thickness and size parameters, are retrieved operationally from the MODIS sensor onboard the Terra satellite launched on 18 December 1999. The predominant aerosol type over the Southern African region is smoke, which is generated from biomass burning on land and transported over the southern Atlantic Ocean. The SAFARI-2000 period experienced smoke aerosol emissions from the regular biomass burning activities as well as from the prescribed burns administered on the auspices of the experiment. The MODIS Aerosol Science Team (MAST) formulates and implements strategies for the retrieval of aerosol products from MODIS, as well as for validating and analyzing them in order to estimate aerosol effects in the radiative forcing of climate as accurately as possible. These activities are carried out not only from a global perspective, but also with a focus on specific regions identified as having interesting characteristics, such as the biomass burning phenomenon in southern Africa and the associated smoke aerosol, particulate, and trace gas emissions. Indeed, the SAFARI-2000 aerosol measurements from the ground and from aircraft, along with MODIS, provide excellent data sources for a more intensive validation and a closer study of the aerosol characteristics over Southern Africa. The SAFARI-2000 ground-based measurements of aerosol optical thickness (AOT) from both the automatic Aerosol Robotic Network (AERONET) and handheld Sun photometers have been used to validate MODIS retrievals, based on a sophisticated spatio-temporal technique. The average global monthly distribution of aerosol from MODIS has been combined with other data to calculate the southern African aerosol daily averaged (24 hr) radiative forcing over the ocean for September 2000. It is estimated that on the average, for cloud free conditions over an area of 9 million square km, this predominantly smoke aerosol exerts a forcing of 30 W/m2 close to the terrestrial surface and 10 W/m2 at the top of the atmosphere (TOA). While cooling the surface and Earth system, the difference of 20W/m2 is energy that heats the atmosphere.

A51A-0045 0830h POSTER

Comparison of IMG Observations With Scanning-HIS Observations Over the SAFARI 2000 Region

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Land surface emissivities were retrieved for different African biome regions using the Interferometric Monitor for Greenhouse Gases (IMG) data set. IMG measured upwelling infrared radiance measurements over the Southern African Regional Science Initiative (SAFARI 2000) region of study from November 1996 to June 1997. Three years later during the SAFARI campaign, the airborne Scanning High-Resolution Interferometer Sounder (S-HIS) measured upwelling radiance data over the SAFARI region. In spite of the lack of temporal overlap between the IMG and S-HIS SAFARI data, the S-HIS retrievals of land-surface emissivity can be compared to those from the IMG instrument over a similar geographic region that spans different African biomes. This is possible because of the high spectral resolution of both instruments. In addition, some IMG measurements were measured during the same seasonal time period (February-March) in which the SAFARI "wet" campaign occurred three years later. The S-HIS SAFARI data validate some of the seasonally averaged IMG land surface emissivity observations.

A51A-0046 0830h POSTER

Infrared Land Surface Emissivity Retrieval from S-HIS Upwelling Radiance Measurements During SAFARI 2000

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The Southern African Regional Science Initiative (SAFARI 2000) field campaign provided an opportunity to study various infrared land surface emission characteristics. High spectral resolution upwelling radiance measurements were acquired by the Scanning High-resolution Interferometer Sounder (S-HIS). Results will be shown from flights over the Okavango Delta in Northern Botswana on 27 Aug 2000. A series of 6 parallel flight lines were flown which were able to map the entire delta region. S-HIS derived land surface emissivities will be compared to a database of AERI ground measurements to best determine surface characteristics.

The S-HIS measures upwelling emission spectra in continuous spectral coverage from 3.3 to 16.7 microns at 0.5 wavenumber resolution. This coverage is divided into three bands with separate detectors (two photoconductive HgCdTe and one InSb) to achieve the required noise performance. The bands use a common field stop to ensure accurate spatial co-alignment. S-HIS measurements occur at 0.5 second dwell times, which allow imaging with 2-3 km surface resolution during cross-track scanning, from a nominal ER-2 altitude of 18 km. Ambient and hot reference blackbodies are viewed as part of each cross-track scan, providing updated calibration information every 20 to 30 seconds.

A51A-0047 0830h POSTER

SAFARI 2000 Data Available from the Atmospheric Sciences Data Center

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Some of the goals of the Southern African Regional Science Initiative (SAFARI) 2000 field campaign were to characterize and quantify the emission from biomass burning, its transport and evolution and its effects on the local climate. To accomplish these goals measurements such as surface properties, aerosols, clouds and radiation were obtained from the surface, from aircraft and from satellites. The NASA Langley Atmospheric Sciences Data Center distributes several data sets that support the goals of SAFARI 2000. These data include Clouds and the Earth's Radiant Energy System (CERES), Multi-angle Imaging SpectroRadiometer (MISR) and AirMISR.

The CERES instrument on board the Terra spacecraft measures Earth's radiation budget and atmospheric radiation from the top-of-the-atmosphere

(TOA) using a broadband scanning radiometer. The Multi-angle Imaging SpectroRadiometer (MISR) instrument also on board the Terra spacecraft measures TOA, cloud and surface angular reflectance functions, aerosols, and vegetation properties using four spectral bands in each of nine imaging cameras oriented at different angles along-track. The AirMISR instrument on board the NASA ER-2 aircraft obtains multi-angle imagery similar to that of the satellite-borne MISR instrument.

Information about all of the available data products and how to obtain them can be found at the NASA Langley Atmospheric Sciences Data Center web site, http://eosweb.larc.nasa.gov.

URL: http://eosweb.larc.nasa.gov

A51A-0048 0830h POSTER

Carbon and Nitrogen in the Soil-Plant System Along Rainfall and Land-use Gradients in Southern Africa.

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The nearly homogeneous substrate of the Kalahari Transect allowed examination of changes in nutrient concentrations along a climatic gradient and two land use gradients. We anticipated finding soil nutrient changes that were consistent with vegetation shifts toward reduced proportional abundance of trees and overall litterfall with decreasing mean annual precipitation. Changes along land use gradients also were expected to reflect the diminished inputs consistent with the form of harvesting taking place.

Total organic C and N concentrations were measured for soil samples taken beneath and outside the plant canopy of three representatives of four vegetation types. Along the rainfall gradient, SOC decreased significantly ($p<0.05$) at the two drier sites, concurrent with a reduction in woody vegetation abundance. SON was significantly lower only at the driest site. C:N ratio was higher than expected at the driest site, due to the low SON. At land use sites, SON differences were not significant, but reflected the loss of inputs due to herbivory and wood collection. Significant differences in SON occurred between land use sites and primary research sites that shared similar MAP. Ammonium and nitrate were significantly greater only the wettest of five sites sampled (MAP 1000 mm yr^{-1}). Higher NH_4^+ and NO_3^- concentrations beneath specific tree canopies suggested nitrogen fixation, but this was contradicted by ^{15}N-isotope analysis. These concentrations may be consistent with greater litter fall. Significantly higher SOC and SON levels were found exclusively beneath woody vegetation at only the driest site on the rainfall gradient. SOC and SON were higher outside the herbaceous canopy at all sites along the rainfall gradient. SOC was significantly higher beneath grasses at two land use sites.

Vegetation changed as expected along the rainfall gradient and reflected the type of harvesting that occurred at land use sites. SOC was affected by vegetation changes at different precipitation levels, but the volume of tissue loss may have obscured trends along land use gradients. SON changes were not faithful to variations in vegetation or precipitation, but were consistent with the loss of nutrients from herbivory. The lack of fit between predictions about SON and vegetation change suggest that nitrogen dynamics may be key to understanding this system better and developing better predictive power in a landscape that is vulnerable to increased land use intensity and impacts of climate change.

A51A-0049 0830h POSTER

Soil moisture and plant stress dynamics along the Kalahari precipitation gradient

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We present an analysis of water balance and plant water stress along the Kalahari precipitation gradient, using the probabilistic model of soil moisture proposed in a series of papers by Rodriguez-Iturbe et al. (1999a), Laio et al. (2001a), and Porporato et al. (2001). The rainfall statistical characteristics, obtained from daily data of four stations along the transect, show that the rainfall gradient is mostly due to a decrease in the mean rate of storm arrivals rather than to a change in the mean storm depth. Using this information and typical vegetation and soil parameters, the analysis relates the vegetation properties along the transect with those of climate and soil, including the possibility of tree-grass coexistence in the central sector of the Kalahari.

A51A-0050 0830h POSTER

An Evolutionary Perspective on Global Vegetation $\delta^{15}N$ Co-variance With Average Annual Precipitation

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Recent regional transect studies have shown a significant negative relationship between the $\delta^{15}N$ value of vegetation and the mean annual precipitation. $\delta^{15}N$ values provide an indication of the source nitrogen utilized by the plant owing to differential fractionations from biological and chemical processes. The fact that such a relationship exists across a variety of systems is surprising given the abundance of global plant species and the complexity of the nitrogen cycle. This observed pattern suggests that there may be some biological controls on plant utilization of nitrogen that are linked to available water. After observing this relationship in samples collected as a part of the Southern African Regional Science Initiative (SAFARI 2000), we have found that this relationship holds on a global scale for published values of $\delta^{15}N$. The critical question remains; is this relationship a result of shared characteristics of related species, or more broadly is there an evolutionary reason for this relationship? Since the $\delta^{15}N$ values varied with rainfall, we hypothesize that the photosynthetic pathway utilized by plants play a role in this pattern. For example, plants that have evolved C_4 metabolism, in other words, plants that have evolved mechanisms to allow for utilization of nutrients in a way more independent of available water than their C_3 metabolizing counterparts, may exhibit different $\delta^{15}N$ with respect to our original relationship. The data collected in conjunction with SAFARI 2000 confirms this hypothesis and as a result we have used modern phylogenetic techniques (using taxonomic information as a surrogate for true phylogenetic relationships between the included plant species) to test whether evolutionary history has played a role in the $\delta^{15}N$ pattern. We anticipate that by using multidisciplinary tools this study will greatly advance ongoing research in the areas of nitrogen dynamics and vegetative biogeochemical cycling.

A51A-0051 0830h POSTER

CO and CH4 Column Retrieval From the Scanning High Resolution Interferometer Sounder (S-HIS)

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This study presents a new technique for the retrieval of CO and CH4 column amounts from high spectral resolution Fourier Transform Spectrometer (FTS) data. Results are presented from aircraft flights of the Scanning-High-resolution Interferometer Sounder (S-HIS). Case study results are presented from ER-2 underflights of the Terra satellite over controlled fires during the NASA SAFARI experiment in South Africa.

A51B MC: Hall D Friday 0830h

Polar Surface Chemistry: The ISCAT 2000 Campaign

Presiding: **A Hogan,** USACRREL, Geochemical Sciences Division

A51B-0052 0830h POSTER

Formaldehyde (HCHO) and Hydrogen Peroxide (H_2O_2) in Air, Snow and Interstitial Air at South Pole During ISCAT 2000

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For the first time, continuous HCHO and H_2O_2 mixing ratio gradients were measured in the lowest meter above the snowpack at South Pole Station. The results indicate a net HCHO and H_2O_2 release from the top snow layers at South Pole in summer, consistent with elevated atmospheric mixing ratios. Using the measured gradients, corresponding fluxes were calculated and compared with independent estimates based on simultaneous changes in surface snow composition on the one hand and measured gas phase mixing ratios in the interstitial air in the top snow layers on the other hand. In order to separate physical from photochemical processes the findings were compared with physically based air-snow transfer modeling. Results were validated with shading experiments in which the impact of shading and un-shading of the snowpack on HCHO and H_2O_2 mixing ratios in the interstitial air was investigated. The current measurements and experiments were consistent with previous results from Summit, Greenland, and suggests that temperature-driven (re)cycling of HCHO and H_2O_2 between snow and air has important implications for the interpretation of ice-core records as well as for boundary-layer photochemistry in polar regions and in the vicinity of snowpacks in general.

A51B-0053 0830h POSTER

Soluble Acidic Gases at South Pole During ISCAT 2000

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We measured HNO_3, HONO, HCOOH and CH_3COOH in the atmosphere and the firn pore air at South Pole with the mist chamber/ion chromatography (MC/IC) technique 13-27 December. Two MC samplers were operated simultaneously, one was always 85 cm above the snow surface, the other was used to sample at various heights between 30 cm below the surface up to 85 cm above. On 8 of the MC/IC sampling days we measured HNO_3 and HO_2NO_2 10 m above the snow with a CIMS technique. Average concentrations of the soluble acids 85 cm above the