

(TOA) using a broadband scanning radiometer. The Multi-angle Imaging Spectro-Radiometer (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 NH₄⁺ and NO₃⁻ concentrations beneath specific tree canopies suggested nitrogen fixation, but this was contradicted by ¹⁵N-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 $\delta^{15}\text{N}$ Co-variance With Average Annual Precipitation

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Recent regional transect studies have shown a significant negative relationship between the $\delta^{15}\text{N}$ value of vegetation and the mean annual precipitation. $\delta^{15}\text{N}$ 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 $\delta^{15}\text{N}$. 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 $\delta^{15}\text{N}$ 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 C₄ 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 C₃ metabolizing counterparts, may exhibit different $\delta^{15}\text{N}$ 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 $\delta^{15}\text{N}$ 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 (H₂O₂) in Air, Snow and Interstitial Air at South Pole During ISCAT 2000

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For the first time, continuous HCHO and H₂O₂ mixing ratio gradients were measured in the lowest meter above the snowpack at South Pole Station. The results indicate a net HCHO and H₂O₂ 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 H₂O₂ 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 H₂O₂ 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 HNO₃, HONO, HCOOH and CH₃COOH in the atmosphere and the firm 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 HNO₃ and HO₂NO₂ 10 m above the snow with a CIMS technique. Average concentrations of the soluble acids 85 cm above the

snow were high for such a remote site (38, 32, 159 and 310 ppt of HNO₃, HONO, HCOOH and CH₃COOH), presumably reflecting release from the snow. Mixing ratios in the firn air (10 to 30 cm deep) were measured on 7 days and consistently revealed large enhancements of HONO, HCOOH, and CH₃COOH (2 to 10, 2 to 50, and 1.5 to 20 times higher than ambient, respectively). In contrast, HNO₃ mixing ratios in firn air ranged from 10 to 90% of ambient values at the same time. Attempts to measure gradients in the bottom 85 cm of the atmosphere (to confirm snow to air fluxes) were inconclusive. However, on five of the days when we have HNO₃ measurements at both 85 cm and 10 m above the snow the mixing ratios were elevated (1.5 to 3 fold) at the lower elevation. To ensure that these results were not due to a bias between the two instruments, we sampled with one MC inlet adjacent to the CIMS inlet 10 m above the snow for 13 hours one day. Mixing ratios by MC/IC ranged 12 to 17 ppt during this period, on average the difference between MC and CIMS values was just less than 1 ppt (range 4 to 5 ppt) and the ratio of the measurements averaged 1.17. This level of agreement suggests that the persistent gradients measured between 0.85 and 10.0 m on other days were real. Lower HNO₃ mixing ratios in firn air than ambient argue against flux of HNO₃ out of the snow, thus we suggest that HNO₃ is higher just above the snow because it is forming there from abundant NO₂ and OH.

A51B-0054 0830h POSTER

Soluble Ions in South Pole Snow During ISCAT 2000

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The ISCAT 2000 campaign included extensive measurements of N oxides in the atmosphere above the snow and in the air filling pores in the snowpack (firn air), following up on the very high levels of NO observed above the snow during the 1998 campaign. It is likely that photolysis of nitrate, contained in the snow, is the source of elevated NO_x, HONO and HO₂NO₂ measured in and above the snowpack. Instrumental constraints limited most gas phase firn air measurements to a drift immediately adjacent to the ARO. Our measurements confirm that nitrate was abundant in this snow, reaching a maximum of 6.5 nmol g⁻¹ in the top 3 cm, and averaging 2.5 nmol g⁻¹ in the top 45 cm. We also made the first measurements of nitrite, acetate and formate in South Pole snow. The carboxylates were more than 2 orders of magnitude less abundant than nitrate, with nitrite concentrations an additional order of magnitude lower. To assess whether the snow at the foot of the building was chemically representative of the region, we sampled shallow pits 50 m away from ARO and 15 km away from the station. Concentrations of Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺, Cl⁻, NO₃⁻ and SO₄²⁻ were statistically indistinguishable in all three 2000 pits. We also compared the ion content of the upper 45 cm of snow near South Pole in 2000 to the same depth range in 3 pits sampled 10 km away from the station in 1994 and a single pit dug 40 km away in 1988. The similarity of most ions in all seven pits reinforces the conclusion that the snowpack just upwind of ARO is chemically representative of the South Pole region. Interestingly, the only trend apparent between 1988 and 2000 is a decrease in SO₄²⁻ concentration by about a factor of two.

A51B-0055 0830h POSTER

South Pole NO Observations: An Assessment of the Factors Controlling the Large Variability Seen in the ISCAT 2000 Field Study

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In December of 1998, the first observations of NO at South Pole were recorded. The surprisingly high levels observed (e.g. median value 225 pptv) were examined in the context of three possible sources: local pollution, long-range transport, and snow surface emissions. Of these possibilities, only the snow source was found to be credible. Of particular significance in our arriving at this conclusion was the fact that other investigators had previous to the ISCAT study reported evidence

for a significant snow source of NO. These observations were reported at Summit, Greenland, Alert, Canada, and even at a coastal Antarctic site. What made the South Pole ISCAT 1998 results so unusual was the finding that the median NO level was over one order of magnitude greater than at any other global site. Speculation at the conclusion of the ISCAT 1998 study was that an enhanced NO source strength from the snow at South Pole in conjunction with a very shallow mixing depth were major contributing factors promoting this difference. The ISCAT 2000 study has provided an opportunity to examine the above hypothesis in considerable detail. Centrally important in this new study were measurements of: 1) NO levels at several different heights above the snow surface; 2) NO snow to atmosphere fluxes; 3) NO levels within the snowpack as a function of depth; and 4) more intensive MET observations. The findings from these new observations have provided considerable insight into the large variability seen in South Pole NO (i.e. 10 to 500 pptv) and will be discussed.

A51B-0056 0830h POSTER

OH and HO₂ Measurements at the South Pole During ISCAT-2000

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The oxidizing capacity of the lower atmosphere at the South Pole is typically thought to not be that large. The combination of low sun angles coupled with low water concentrations would be thought to result in minimal OH production. During ISCAT-1 consistently high OH concentrations were observed. These high concentrations were thought to be due to high concentrations of NO cycling HO₂ into OH. During ISCAT-2000, elevated OH concentrations were again observed with values peaking at the 4-5 x 10⁶ molecule cm⁻³ level. To compliment the OH measurements performed, a selected ion chemical ionization mass spectrometric technique was also employed for the measurement of HO₂. During the study HO₂ concentrations were found to vary as expected in an anti-correlated manner with NO. Typical HO₂ concentrations were in the range of 6-8 x 10⁷ molecule cm⁻³ with values peaking into the 1-2x10⁸ level. Model simulations of OH and HO₂ will be presented.

A51B-0057 0830h POSTER

Direct Observations of NO in South Pole Snowpack During ISCAT 2000

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Based on the ISCAT 1998 field study, it was concluded that the abnormally high levels of NO observed at South Pole were due to large natural emissions of NO from the snow. The latter process was believed to be the result of photolysis of nitrate ions in the snowpack. During ISCAT 1998, however, no snowpack measurements were available. Reported here are the first snowpack observations of NO, NO₂, and NO_x. These measurements were made using two different chemiluminescent instruments. The measurements themselves were recorded at two different locations at South Pole, the first was approximately 100 meters from the Atmospheric Research Observatory (ARO) building, the second was 5 meters from the ARO. Measurements were recorded at snowpack depths ranging from 1 to 100cm. The time period covered by these observations was from December 10, 2000 to March 24, 2001. Details concerning measured NO and its relationship to snowpack measured levels of NO₂, NO_x, O₃, and NO₃ will be presented.

A51B-0058 0830h POSTER

Measurement of Pernitric Acid at the South Pole During ISCAT 2000

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Pernitric acid levels were measured with a chemical ionization mass spectrometer 10 m above the snow in December 2000 at the South Pole. The mean mixing ratio was 22.5 pptv. NO mixing ratios averaged 115 pptv over the measurement period, and the temperature ranged from -31.5 to -23.6 °C with a mean of -27.7 °C. HO₂NO₂ accounted for about the same fraction of the NO_y budget (NO_y = NO + NO₂ + HNO₃ + HO₂NO₂) as HNO₃, 12-13% on average, with NO contributing ~50%. For comparison, pernitric acid concentrations were predicted using a simple 0-D photochemical model. NO₂ and HO₂ were calculated from measurements of NO, O₃, photolysis frequencies, and OH. Actual HO₂ measurements were utilized when available. As expected, our measured pernitric acid levels were much lower than predicted by a simple equilibrium model alone, suggesting that thermal equilibrium was not reached. Even with the inclusion of losses due to photolysis and reaction with OH, a lifetime due to dry deposition of 3 hrs must be invoked in order to bring calculated HO₂NO₂ values closer to the measurements (predicted mean = 29.1 pptv over the measurement period). This is a slightly faster deposition velocity than indicated from the average HNO₃ lifetime of ~3.5-4 hrs required to bring preliminary modeling results into agreement with measurements. The best agreement between measured and predicted HO₂NO₂ values occurs at warmer temperatures, with predictions consistently higher than measurements at cooler temperatures. These results indicate that thermal decomposition does not control the pernitric acid lifetime in the boundary layer at the South Pole. They also support the conclusion that pernitric acid is an important HO_x sink in this region.

A51B-0059 0830h POSTER

Observations of Summertime NO Fluxes during ISCAT at the South Pole

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The flux of NO from the snow surface to the atmosphere is calculated for a 5-day period during the ISCAT 2000 field experiment at the South Pole. The modified Bowen ratio technique was used to estimate NO fluxes from measurements of NO concentration and temperature differences, and direct eddy-covariance measurements of temperature flux. The average NO flux is found to be nearly constant during this period

with a value of $0.35 \mu\text{mole/m}^2\text{d}$. We show that one of the assumptions of this method—that the measurements were in the atmospheric surface layer—is satisfied during most of the experiment. This was done by estimating the mixed layer height H by several techniques utilizing surface-layer measurements. One method is to estimate the wavelength of the peak λ_m in the velocity or temperature power spectra normalized by the height of measurement z . Previous experiments have determined empirical relations between z/λ_m and z/H , which can then be used to estimate H . For unstable conditions encountered during the latter part of ISCAT, we use spectral methods to determine the integral length scale λ_i and empirical relations between z/λ_i and z/H . Values of H generally are 50–500 m during the period when the flux was found to be nearly constant, which is more than an order of magnitude larger than the heights of the eddy-covariance measurements at 3.1 and 7.0 m.

A51B-0060 0830h POSTER

Alkyl Nitrate Concentrations in Ambient Air and Firn Samples Observed During the ISCAT 2000 Field Study

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As part of the ISCAT-2000 Program (Investigation of Sulfur Chemistry in the Antarctic Troposphere), pressurized whole air samples were collected at the South Pole Clean Air Facility between November 11, 2000 and January 1, 2001. More than 100 ambient samples were collected (0–1.5 meters above the snow) and 13 were collected between 20 cm and 130 cm below the snow surface. Within one month of filling, the sample canisters were shipped to our UCI laboratory and analyzed chromatographically for C1–C8 hydrocarbons, C1–C2 halocarbons, and C1–C4 alkyl nitrates using flame ionization, electron capture, and mass spectrometric detection. Ratios of alkyl nitrate concentrations suggest marine emissions as their dominant source. All quantified alkyl nitrates exhibited decreasing concentrations with time. Methyl nitrate changed from about 8 pptv in mid-November to about 4 pptv by the end of the year. Butyl nitrate, which has the shortest atmospheric lifetime, decreased from about 0.3 to 0.05 pptv. All alkyl nitrate concentrations were enhanced in snow samples, with maximum concentrations occurring at about 0.5 meters into the firn. Comparisons between these and data collected at Summit Greenland in 2000 will also be discussed.

A51B-0061 0830h POSTER

A CIMS Technique for the Measurement of Peroxynitric acid, Nitric Acid and Nitrogen Dioxide During ISCAT 2000 at the South Pole

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A Chemical Ionization Mass Spectrometer (CIMS) measured ambient [HO₂NO₂] and [HNO₃], and firn air [NO₂] at the South Pole during December 2000. All of these trace gases were selectively detected by reaction with SF₆ in a low pressure (14 torr) flow tube. Performing the ion chemistry at low pressures and short reaction times minimized potential interference due to reactions of SF₆ with ozone and water vapor. The extent of interfering reactions was also diminished by the relatively low ambient levels of O₃ (<40 ppbv) and H₂O (dewpoint < -25 C) at the South Pole. The detection limits obtained with this technique for HO₂NO₂, HNO₃ and NO₂ were ~5pptv, ~5pptv, and ~50pptv respectively for a one minute integration period. HNO₃ mixing ratios were found to range from below detection limit to 60 pptv with an average value of 25 pptv. NO₂ mixing ratios in the ambient air were typically at or below the 50 pptv detection limit. However, NO₂ mixing ratios in the firn air were typically between 1.0 and 1.5 ppbv at depths up to 1 meter below the surface of the snowpack. The methods used to calibrate and zero the measurements will be presented along with the results of laboratory studies of relevant ion molecule reactions.

A51B-0062 0830h POSTER

Sulfide at the South Pole During ISCAT 2000

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As part of the ISCAT 2000 field study at the Amundson-Scott South Pole Station Atmospheric Research Observatory, sulfur dioxide (SO₂) and dimethyl sulfide (DMS) were measured with a quadrupole mass spectrometer using nickel-63 (Ni-63) as the ion source. High isotopic purity sulfur-34 SO₂ and d₃-DMS were used as internal standards. Sampling periods were typically 1 second with 1 part-per-trillion by volume (pptv) detection limits with 10 sec integration.

DMS was less than 3 pptv during the entire study period. SO₂ concentrations were more variable and higher in November 2000 than in December 2000. During late November and the first week of December, SO₂ was typically 10 to 15 pptv with some periods between 20 and 40 pptv. During the mid and late December period SO₂ was typically less than 6 pptv with some periods of 8 to 15 pptv. Occasionally large increases in SO₂ were observed for periods of a few seconds due to local sources.

A51B-0063 0830h POSTER

South Pole HOx Chemistry: New Insights Based on ISCAT 2000 Observations

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During the ISCAT 1998 field study a major finding was the observation that highly elevated levels of OH were present at South Pole (SP). These levels were found to be closely linked to unexpectedly high observed levels of NO released from the snowpack. The modeling interpretative analysis of these data indicated that at high levels of NO the reaction HO₂ + NO was the dominant SP OH source but with CH₄ oxidation being the major HOx source. Model to observation comparisons revealed that for about 80% of the data the agreement with model predictions was well within the combined uncertainties. However, for approximately 10% of the data, which coincided with the highest values of observed NO, model predicted OH values were found to be significantly lower than those observed. The argument put forward to explain this apparent discrepancy was that for the highest NO levels additional HOx sources had become significant. In particular, snow emissions of CH₂O, H₂O₂, and/or HONO were considered. To a first approximation the concentration levels of these species might be expected to scale with those for NO. Although invoking reasonable concentration levels for these potential HOx sources did indeed demonstrate that model predictions and observations could be reconciled, the absence of hard measurements for these sources left our understanding of HOx photochemistry at South Pole incomplete. The recent ISCAT 2000 field program has provided direct measurements of all three of the proposed HOx sources. In addition, measurements of the very important HO₂ species were recorded for the first time at SP. Thus, these new measurements will be used as model constraints in a more detailed SP HOx analysis to be presented. Also to be reported is a new HOx budget analysis that shows the relative importance of HOx source species, and the possible importance of additional HOx sinks.

A51B-0064 0830h POSTER

Meteorological Analysis of the ISCAT 2000 Field Program

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The ISCAT program examines the chemical and photochemical conversion of marine sulfur gases in the relatively uncomplicated Antarctic atmosphere. ISCAT 2000 (Nov ? Dec 2000) was the second series of field experiments at the South Pole. The first (Nov - Dec 1998) ISCAT field experiments found unexpectedly large NO concentrations that exhibited variation that was apparently related to meteorological parameters. We hypothesize that near surface and tropospheric exchange parameters, as well as the residence time of air over ice, influence the concentration of S and NO measured at the surface. A daily meteorological advisory was transmitted to the ISCAT 2000 field party. This was derived from the South Pole sounding, and surface winds and temperatures reported by Automatic Weather Stations (AWS). Each advisory provided the field party with a forecast on the persistence of surface winds, an estimate of the time of residence over ice of surface air arriving at South Pole, and an estimate of the "vigor" of near surface mixing and exchange. Warnings were provided if changing tropospheric flows were anticipated. The McMurdo sounding was examined to provide warning of transport of the volcanic plume from Mt Erebus. Post field season meteorological analysis indicates that some processes beneath the persistent near surface inversion on the south polar plateau are related to recognizable patterns (500mb height) in the troposphere over Antarctica. Coupling of maritime flow to the surface at South Pole may be related to the position of the dominant low pressure system over the southern ocean. Persistent flow from the interior of Antarctica may be associated with tropospheric ridging. Exchange of upper tropospheric air to the near surface layers appears to be the result of summer ridge and trough structure. This presentation will discuss the possibility of deriving specific surface forecasts for atmospheric chemists from forecast models.

A51B-0065 0830h POSTER

ISCAT 2000: Major Ions and Trace Elements in Aerosols from the South Pole

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As part of the ISCAT-2000 Program (Investigation of Sulfur Chemistry in the Antarctic Troposphere), bulk, high-volume, aerosol samples were collected at the South Pole Clean Air Facility and analyzed for major ions (nitrate, sulfate, methanesulfonate, and sodium) by ion chromatography and for trace elements by inductively-coupled plasma mass spectrometry (ICP-MS). A second set of bulk high-volume samples was collected for studies of radionuclides (²¹⁰Pb, ²¹⁰Po, and ⁷Be). The two sets of samples were collected using the same samplers as in the prior ISCAT 1998 campaign. Comparisons of data from the two campaigns show that the ⁷Be activities were generally comparable for ISCAT-1998 and 2000, and they were also similar to long-term record produced by the Environmental Measurements Laboratory, Department of Energy (EML/DOE). The ²¹⁰Pb activities were more than 50% higher in 2000 than in 1998 and towards the high end of long-term EML/DOE record, suggesting relatively strong continental influences during ISCAT 2000 (November 2000 to January 2001). Nitrate concentrations (arithmetic mean, $x = 150 \text{ ng m}^{-3}$) were approximately four-times higher in ISCAT 2000 compared with the earlier study. In contrast, the concentrations of sodium ($x < 33 \text{ ng m}^{-3}$), sulfate ($x = 97 \text{ ng m}^{-3}$), and methanesulfonate (MSA, $x = 4.1 \text{ ng m}^{-3}$) all were lower in ISCAT 2000 compared with 1998. The MSA to nss-sulfate (the sulfate in excess of that which can be attributed to sea salt) ratios were similar in the two campaigns and comparable to the ratios observed in Antarctic ice cores. A positive nss-sulfate intercept seen in a scatterplot of these data suggests the existence of background, non-biogenic, non-sea salt sulfate.

Most of the forty-two elements that can readily be determined by the ICP-MS method were below detection limits in the majority of the aerosol samples. The notable exception was mercury, which was present in concentrations from < 0.1 to approximately 1 ng m^{-3} . These values of particulate Hg are comparable to or slightly higher than those observed in recent studies in the Arctic, and they are much higher than generally found in more temperate regions. While the cause for the high particulate Hg concentrations has not been determined, it is likely that the oxidation of gas-phase Hg is involved.

A51B-0066 0830h POSTER

Measurements of Sulfuric Acid and Methanesulfonic Acid During ISCAT 2000

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Gas phase sulfuric and methanesulfonic acid (MSA) were measured at the South Pole using a selected ion chemical ionization mass spectrometric technique during ISCAT 2000. Both compounds were typically quite low. Upon only a few occasions did sulfuric acid increase briefly into the 1×10^6 molecules cm^{-3} range and MSA increase into the mid 10^5 molecules cm^{-3} range. While MSA was typically close to its detection limit at about 1×10^5 molecules cm^{-3} , sulfuric acid was typically only a few times higher at 2 or 3×10^5 molecules cm^{-3} . Despite the consistently high OH concentrations measured at this site, the low observed gas phase sulfuric acid suggests that average local sulfur dioxide concentrations are probably fairly low.

Methanesulfonic acid remained low throughout the campaign, also suggesting that DMS was probably not being oxidized locally. Thus, the MS observed in aerosols is believed to have been transported in the particle phase from areas closer to the coast.

A51C MC: Hall D Friday 0830h Sampling Issues in Observing the Atmosphere I

Presiding: I Astin, University of Reading; G R North, Texas AM University

A51C-0067 0830h POSTER

Enhancing the West Antarctic Meteorological Record With Artificial Neural Networks

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Improved interpretation of the ever growing body of ice-core-based paleoclimate records from Antarctica requires a deeper understanding of Antarctic meteorology. New field campaigns and improved numerical forecasting models will ultimately provide long-term benefits but neither addresses the existing observational archive. In contrast, our work with automatic weather station (AWS) data addresses this issue directly. AWS currently provide the only year-round, continuous direct measurements of weather on the ice sheet. As the spatial coverage of the network has expanded year to year (thanks to C. Stearns and his University of Wisconsin AWS group), so has our meteorological database. Unfortunately, many of the records are relatively short (less than 10 years) and/or incomplete (to varying degrees) due to the vagaries of the harsh environment. Climate downscaling results in temperate latitudes suggest it is possible to use GCM-scale meteorological data sets (e.g., ECMWF reanalysis products) to both fill gaps in the AWS records and extend them back in time to create a uniform and complete database of West Antarctic surface meteorology (at AWS sites). Such records are highly relevant to

the improved interpretation of the expanding library of snow-pit and ice-core data sets.

Our solution uses artificial neural network (ANN) techniques to predict the near-surface meteorology recorded by AWS instruments (e.g., temperature, pressure) using large-scale features of the atmosphere (e.g., 500 mb geopotential height) from a region around the AWS. ANNs are trained to predict observed AWS data from the corresponding GCM-scale data. Intra-year prediction (of observations in the training year) has been very successful (e.g., RMS errors < 2 mbar for pressure). Inter-year prediction (of observations not in the training year) remains a work-in-progress (e.g., RMS errors are 4-5 mbar). Three ANN architectures yield similar results suggesting our approach is valid but our training methodology needs refinement.

These results support high confidence in the ANN-based predictions from the GCM-scale data for periods where AWS data are unavailable, e.g., before installation. ANNs thus provide a means to expand our surface meteorological records significantly in West Antarctica.

A51C-0068 0830h POSTER

Long-term accuracy of surface spectroradiometry in the UV, Visible, and near IR domains, and Impacts on Derived Products

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The Rotating Shadowband Spectroradiometer (RSS) is a medium-resolution field spectroradiometer developed for continuous long term field deployment. Successive improvements to the instrument have been operating for the ARM Program and elsewhere since 1997, and provide the large majority of spectral observations taken by ARM within its wavelength domain of 360 - 1100 nm. We also operate the US reference UV spectroradiometric network, consisting of 3 sites with high resolution double monochromators measuring from 280 to 400 nm at higher resolution.

We describe the long term maintenance of irradiance scales, congruence tests with solar spectra via Langley regression, and the impact of calibration uncertainties on derived products including aerosol and cloud optical depths, common trace-gas retrievals, and mean photon pathlength from O2 A-band.

A51C-0069 0830h POSTER

AMORE: Atmospheric Modeling Of Radiation Experiment

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The purpose of this talk is to present a comparison of modeled and measured clear-sky erythemal UV irradiances. Are the various models in reasonable agreement with the various measurements? Measurements were made with the USDA Reference Spectroradiometer, New Zealand's NIWA Spectroradiometer, a USEPA Brewer, and a Yankee UV-RSS. Modeling groups were given a list of clear days between June 5 and August 5, 2001. The average measured morning and afternoon aerosol optical depths at 368 nm and 332 nm were measured with a UV-MFRSR. The estimated wavelength independent aerosol asymmetry parameter and single scattering albedo, surface pressure and albedo, total column ozone, extraterrestrial solar spectrum, erythemal weighting function were supplied. Modeling groups submitted erythemal weight irradiances for every half hour. Comparisons of measurements to models showed good agreement to within 10% for SZAs out to 60 degrees. Reasons for discrepancies will be discussed.

A51C-0070 0830h POSTER

Direct Measurements of the Absorption of Solar Radiation in Clouds

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Several techniques to directly measure the absorption of solar radiation in clouds in the visible and near-IR spectral regions are discussed. Ground based and airborne measurements taken with several spectrographs covering 400-1000 nm are used. The fact that the cloud scattering properties are nearly constant over this spectral interval is exploited to estimate the absorption in clouds. No evidence is found for any unexplained absorption with an optical depth greater than 1% (across the cloud) over the spectral region studied. In addition, it is shown that optical path lengths measured using O₂ absorption bands are usually modeled accurately using a plane-parallel radiative transfer model when cloud cover is not broken. These results are discussed in the context of the "anomalous absorption" debate.

A51C-0071 0830h POSTER

Experiments in Cloudy-Sky Shortwave Flux Closure in the Tropical Western Pacific

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Datasets from the Atmospheric Radiation Measurement (ARM) Program's Tropical Western Pacific sites at Nauru and Manus are used to perform broadband shortwave flux closure experiments under cloudy skies. Vertical profiles of liquid cloud microphysical properties are retrieved from millimeter wave radar and microwave radiometer data using a new retrieval algorithm based on Bayes' theorem of conditional probability. Ice cloud properties are parameterized based on radar reflectivity and temperature. Independent pixel and plane-parallel calculations are performed using the SHDOM radiative transfer model with the RRTM shortwave k-distribution.

Differences in modeled and observed surface fluxes are analyzed in terms of cloud height, cloud fraction, and cloud variability. Due to the variability of the broken trade cumulus clouds seen in the tropics, averaging over long time periods is required to reduce rms errors between modeled and observed surface fluxes.

A51C-0072 0830h POSTER

Atmospheric Sounding by Occultation Technique using the Atmospheric Sounding by Occultation Technique using the Regional Atmospheric Model HIRHAM of the Arctic

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It is important to use experimental satellite data about the space-time distribution of meteorological parameters for validation and estimation of meteorological and climate models of the atmosphere. Particularly important is the Arctic region where there are only few meteorological stations. Low orbital satellites with GPS receivers like GPS/MET, CHAMP, Orsted give the possibility to reconstruct profiles of meteorological values by the occultation technique. But in many cases there is no sense to compare these experimental meteorological profiles with local profiles from atmospheric climate models. The reconstruction of meteorological profiles based on the assumption of a quasi-spherical atmosphere. The reconstructed meteorological profiles of a nonspherical atmosphere will be distorted ("averaged" by the irregular atmosphere), therefore it is not allowed to compare these profiles with model local