C42A-1011 1330h POSTER

Soil nitrogen dynamics during seasonal transitions: N retention and loss in ecosystems of the Sierra Nevada, California

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The maintenance of nitrogen (N) limitation in many terrestrial ecosystems may be mediated by N losses that occur during seasonal transitions. In the southern Sierra Nevada, short-duration nitrate pulses associated with spring snowmelt in the alpine, and with fall rains at lower elevations, may account for greater than 90% of annual DIN export. To evaluate the role of microbial processes in mediating such losses of N, we examined overwinter variation in soil N dynamics at a high (2800 m) and low (750 m) elevation site. The fall transition marked a period of intense nitrifier activity at both sites: field incubations showed five-fold to 30-fold increases in soil NO_3^- pools with the onset of fall freeze-thaw and rewetting events, followed by 60%-75% decreases in total soil inorganic N and net N mineralization rates. Nitrogen held in microbial biomass decreased significantly at the alpine site but recovered to growing-season levels under snowpack, indicating biotic sequestration of N. With the onset of spring snowmelt, microbial biomass again decreased, producing an increase in soil inorganic N concentrations and a shift from net N_2O consumption to production. These results, paired with results of laboratory incubations, indicate that physical disturbances incurred during seasonal transitions may enhance nitrification and gaseous losses from soil, and that large fluctuations in microbial biomass may regulate N production and export in these systems.

C42A-1012 1330h POSTER

Nitrogen Dynamics Along the Western Slope of the Sierra Nevada, California

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Along the western slope of the Sierra Nevada, elevation ranges from 200 to 4000 meters over a distance of less than 25 km. Biomes along this gradient range from chaparral, through mixed conifer and Giant Sequoia forests to alpine fell fields. Rates and forms of N loss from these biomes vary considerably. In middle elevation oak and mixed conifer forests, dissolved organic nitrogen (DON) is the dominant form of N in catchment outflow (>95%) and, on an annual basis, is less than or about equal to inorganic N loading (DIN)(ca. 4 kg/ha/yr). In catchments near the elevation extremes, DIN export is significant and, when combined with DON losses, catchment N-losses balance or can exceed inorganic N loading. DIN export from Sierra Nevada catchments is generally confined to hydrologic flushing periods during seasonal transitions (e.g., transitions from dry summers to fall rains, and from winter to spring snowmelt). In alpine catchments nitrate pulses typically range from 5-20 uEq/L, while in middle elevation catchments nitrate levels are less than 1 uEq/L. Nitrate concentrations during first flush storms in chaparral catchments can exceed 500 uEq/L and may be related to elevated dry deposition of N (10 kg/ha/yr). These observations suggest: (1) forested ecosystems in the Sierra Nevada are generally more N-retentive than alpine or chaparral systems (2) ecosystems at elevational extremes are less N-retentive and may be more sensitive to changes in N deposition rates and 3) abrupt seasonal transitions may be a common mechanism controlling nitrate losses in alpine and chaparral ecosystems.

C42A-1013 1330h POSTER

Use of fluorescence spectroscopy to detect the seasonal change in the redox state of dissolved organic matter in Nymph Lake, Rocky Mountain National Park, CO

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Fluorescence spectroscopy was used to examine the redox state and chemical character of dissolved organic matter (DOM) in Nymph Lake, a seasonally ice-covered lake in Rocky Mountain National Park, CO. Water samples were collected monthly beneath the ice from December through April during the 2002/2003 winter and spring seasons. A sample was also collected in June when the lake was ice free and well mixed. Excitation-Emission Matrices (EEMs) of filtered, whole water samples shifted in a manner consistent with laboratory reduced fulvic acid (Klapper et al. 2002) as the winter season progressed. The EEMs from December through March showed a pattern of decreasing intensity and disappearance of the two peaks in region A and C (peaks labeled according to Coble et al. 1990). The April EEM showed an increase in intensity and reappearance of the two peaks, suggesting some oxidation had occurred. The two peaks in region A and C had the highest intensities in the June EEM, suggesting further oxidation and/or input of oxidized DOM during snowmelt. Titration with ferric citrate of the reduced March and partially reduced April samples resulted in an increase of ferrous iron concentration proportional to the amount of ferric iron added. Furthermore, titration with ferric citrate caused a shift in the March and April EEMs; peaks in regions A and C reappeared in the March sample and the intensities of those peaks were increased in the April sample. An increase in ferrous iron concentration with a simultaneous shift in the EEMs upon addition of ferric iron provide compelling evidence that redox-active moieties of DOM serve as electron shuttles for microbially mediated ferric iron reduction under the ice in Nymph Lake. Trends in dissolved oxygen, ferrous and ferric iron concentration, and Eh potential under the ice provided additional evidence for microbially mediated reduction of Nymph Lake DOM. Lastly, the EEMs from this study clearly show that the redox-active moieties of DOM, quinones (Scott et al. 1998), are largely responsible for the fluorescent character of Nymph Lake DOM, and likely contribute to the fluorescence of DOM from many environments.

C42A-1014 1330h POSTER

Seasonal variation of a snow algal community on an Alaskan glacier

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There are cold tolerant algae (snow algae) growing on the surface of glaciers. Several species of snow algae have been reported on Alaskan glaciers. Seasonal variation of the snow algal community was investigated on Gulkana Glacier in the Alaska Range from May to September, 2001. Chlorophyll, nutrients, and stable isotope for carbon and nitrogen (particulate organic matter) were also measured. The snow algal community on this glacier varied with time, in particular changed with snow melting and nutrients in the snow. When the glacier is covered with snow (May), the algal community consisted of mainly only one species of alga (Chlamydomonas nivalis, alga of red snow). The algal biomass and chlorophyll concentration increased with snow melting in early summer. When the glacial ice surface appeared, the community structure changed drastically. The community on the ice consisted of some of different species. The community structure and biomass kept almost constant after the ice surface appeared. Nutrients measurements showed that nitrogen was likely limited on the algal growth rather than phosphate. Especially, the nitrate was depleted from August to September. Results of stable isotope measurements also support the nitrogen limitation of the snow algae in late summer.

C42A-1015 1330h POSTER

Global Mercury Pathways in the Arctic Ecosystem

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The sudden depletions of atmospheric mercury which occur during the Arctic spring are believed to involve oxidation of gaseous elemental mercury, Hg(0), rendering it less volatile and more soluble. The Hg(II) oxidation product(s) are more susceptible to deposition, consistent with the observation of dramatic increases in snow mercury levels during depletion events. Temporal correlations with ozone depletion events and the proliferation of BrO radicals support the hypothesis that oxidation of Hg(0) occurs in the gas phase and results in its conversion to RGM (Reactive Gaseous Mercury). The mechanisms of Hg(0) oxidation and particularly Hg(II) reduction are as yet unproven. In order to evaluate the feasibility of proposed chemical processes involving mercury in the Arctic atmosphere and its pathway after deposition on the snow from the air, we investigated mercury speciation in air and snow pack at Resolute, Nunavut, Canada (latitude 75°N) prior to and during snow melt during spring 2003. Quantitative, real-time information on emission, air transport and deposition were combined with experimental studies of the distribution and concentrations of different mercury species, methyl mercury, anions, total organic carbon and total inorganic carbon in snow samples. The effect of solar radiation and photoreductants on mercury in snow samples was also investigated. In this work, we quantify mercury removed from the air, and deposited on the snow and the transformation to inorganic and methyl mercury.

C42A-1016 1330h POSTER

Photolysis of Nitrate and Nitrite in Artificial Snow and Artificial Ice

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It is well known that nitrate and nitrite undergo photolysis in aqueous solution. Recent studies show that these reactions are likely to occur in natural snow as well. Therefore it is of interest to measure rates of photolysis of nitrate and nitrite in snow and ice. In this study artificial snow was made by spraying a solution onto the wall of a reservoir containing liquid nitrogen. Artificial snow and ice were irradiated in a sealed quartz tube with a UV lamp and production of hydroxyl radicals was quantified. Hydroxyl radicals produced in these processes react with dimethyl sulfoxide to release methyl radicals, which were trapped by 3-amino-2,2,5,5-tetramethyl-1-pyrrolidinyloxy free radical (3AP). The 3AP-CH_3 compound was later derivatized to produce a highly fluorescent adduct, which was measured by HPLC. Snow produced the highest yield of hydroxyl radicals and ice the lowest. Nitrite had higher yield than nitrate. The calculation of photolysis rates for nitrate and nitrite in snow and ice is discussed.

C42B MCC: 3002 Thursday 1340h

CLPX: Cold Lands Processes Field Experiment I *(joint with H)*

Presiding: **D Cline,** NOAA National Operational Hydrologic Remote Sensing Center**; K Elder,** Rocky Mountain Research Station, U.S. Forest Service

C42B-01 1345h

An Overview of the Data Collected During the Cold Land Processes Field Experiment

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The Cold Land Processes field experiment (CLPX) was completed in the spring of 2003. Background data collection for the experiment began in the fall of 2001. Detailed data were collected during four intensive field campaigns during the winter and spring of 2002 and 2003. A total of 38 data sets were collected from ground-based, airborne and satellite instruments. Data range from detailed field observations of snow properties and meteorological and other parameters at spatial scales of several meters to diverse active and passive airborne and satellite remote sensing measurements over hundreds of square kilometers. High-resolution model output is also included in the one-terabyte data collection. Recognizing this breadth, complexity, and volume of data, CLPX investigators ensured that scientific data management was an integral part of the field experiment. The National Snow and Ice Data Center (NSIDC) is the primary archive for CLPX data and has been the lead player in the overall management and distribution of CLPX data. NSIDC was intimately involved in the collection, quality control, and distribution of the field data collected during four intensive field campaigns. NSIDC has also developed a common gridding scheme for the CLPX study area to facilitate intercomparison and integration of the gridded satellite data and model output. NSIDC is producing several of the satellite data sets in these grids and is ensuring the archival, documentation, and distribution of all the data. In this poster, we will present summaries of the various data sets, their parameters, and spatial and temporal coverage. We will provide examples of several of the data sets and highlight the CLPX gridding scheme and rigorous quality control of the field data. Many of the data sets are currently available, and we will present the latest status of all the data sets and how to access them.

URL: http://nsidc.org/data/clpx

C42B-02 1400h

Airborne Measurements of Snow Cover Properties During the Cold Land Processes Experiments (CLPX02/03) Using the Polarimetric Scanning Radiometer (PSR)

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The Cold Land Processes Experiment (CLPX) is a NASA-funded multi-year experiment to study remote sensing of winter snow pack properties on the Colorado side of the Rocky Mountains. The purposes of CLPX are to improve the estimation of snow amount and forecasting of spring flooding due to snowmelt, and to study the role of the cryosphere on the Earth's climate. Cold land regions form an important component of the Earth's hydrologic cycle, and interact significantly with water resources, global weather, and climate. Multispectral polarimetric microwave brightness temperature maps of snowpack in the Colorado Rocky Mountains were obtained using the NOAA Polarimetric Scanning Radiometer (PSR) during three CLPX missions in February 2002, February 2003, and March 2003. The PSR CLPX data offers unique high-resolution information about snow extent, polarimetric emissivity, and snow water equivalent at scales commensurate with natural inhomogeneities in terrain, vegetation cover, and precipitation patterns. The current PSR/A system includes a scanhead capable of providing imagery at most of the AMSR-E imaging bands. During February-March, 2002 the PSR/A scanhead was flown on the NASA DC-8 aircraft (N717NA) and during the two February-March, 2003 missions the PSR/A was flown on NASA P-3 aircraft. The PSR/A was operated in conical scanning mode at low altitude (2km AGL) to provide multiband microwave imagery over dry mid-season snow and during the onset of snow melt in Colorado with spatial resolution of 140/500 m for high and low frequencies respectively. We present multiband polarimetric snow microwave images over the three CLPX mesocell study areas (MSAs) in the AMSR-E bands. We relate the microwave brightness temperature to the physical snowpack quantities such as snow water equivalent (SWE). Comparisons of the PSR/A-derived SWE with the in situ measurements, gamma observations, and AMSR-E measurements are presented. In addition, we show that the brightness temperature associated microwave emissivity variations are up to 20-25%.

URL: http://www.etl.noaa.gov/data/psr/clpx03/

C42B-03 1415h

Testing AMSR-E Snow Retrievals With Cold Lands Processes Experiment Data

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Snow cover is an important component of the global hydrological cycle. Not only does it constitute a critical seasonal and long-term storage factor but it also affects global climate mass and energy dynamics. Accurate estimation of snow mass is important, therefore, for effective characterization of the hydrological cycle at different space and time scales. Satellite passive microwave observations have been used to estimate global snow depth and snow water equivalent (SWE) since 1979. However, during this time the instruments available have been able to observe snow mass over spatial domains only at regional scales; finer scale observations have not been possible. The Advanced Microwave Scanning Radiometer - EOS launched in 2002 aboard NASA's Aqua platform, has improved spatial resolution capabilities compared with previous passive microwave instruments and, potentially, can be used to estimate snow depth and SWE with increased accuracy at the regional scale. The Cold Lands Processes Experiment (CLPX) provides an opportunity to examine the spatial variability of snow mass and to determine controls on its observability by AMSR-E in complex and simple terrains. This paper investigates the characteristics of AMSR-E retrievals of SWE in the CLPX study domain. Level 2A AMSR-E estimates of SWE at the 25 x 25 km Equal Area Scaleable grid (EASE grid) are used in the study. The three Mesocell Study Areas (MSA), North Park, Fraser and Rabbit Ears Pass, are used as the spatial framework and data from the intensive observing periods during February and March 2003 are used for testing the AMSR-E retrievals. Field measurements of SWE from the ground campaign are compared with AMSR-E estimates. In North Park MSA, extensive SWE field surveys were conducted within the entire 25 x 25 km MSA to enable the characterization of SWE variability at the AMSR-E grid scale. For the other two MSAs, only intensive study area measurements were made and these data cannot be used to represent the average SWE at the AMSR-E scale of observing. The Polarimetric Scanning Radiometer (PSR), a passive microwave radiometer with similar AMSR-E channel frequencies, was flown aboard the NASA P-3 aircraft during the 2003 study periods. Data from this instrument has a spatial resolution varying from 100-500 m (depending on local terrain conditions). These data, calibrated with ground measurements, over all three MSAs, are used to test the AMSR-E retrievals of SWE and to help further improve our understanding and accuracy of estimates of SWE from AMSR-E.

C42B-04 1435h

Assessing Scale Effects on Snow Water Equivalent Retrievals Using Airborne and Spaceborne Passive Microwave Data

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The Climate Research Branch (CRB) of the Meteorological Service of Canada (MSC) has a long-standing research program focused on the development of methods to retrieve snow cover information from passive microwave satellite data for Canadian regions. Algorithms that derive snow water equivalent (SWE) have been developed by CRB and are used to operationally generate SWE information over landscape regions including prairie, boreal forest, and taiga. New multi-scale research datasets were acquired in Saskatchewan, Canada during February 2003 to quantify the impact of spatially heterogeneous land cover and snowpack properties on passive microwave SWE retrievals. MSC microwave radiometers (6.9, 19, 37, and 85 GHz) were flown on the National Research Council (NRC) Twin Otter aircraft at two flying heights along a grid of flight lines, covering a 25 by 25 km study area centered on the Old Jack Pine Boreal Ecosystem Research and Monitoring Site (BERMS). Spaceborne Special Sensor Microwave/Imager (SSM/I) and Advanced Microwave Scanning Radiometer (AMSR-E) brightness temperatures were also acquired for this region. SWE was derived for all passive microwave datasets using the CRB land cover sensitive algorithm suite. An intensive, coincident ground sampling program characterized in situ snow depth, density, water equivalent and pack structure using a land cover based sampling scheme to isolate the variability in snow cover parameters within and between forest stands and land cover types, and within a single spaceborne passive microwave grid cell. The passive microwave data sets that are the focus of this investigation cover a range of spatial resolutions from 100-150 m for the airborne data to 10 km (AMSR-E) and 25 km (SSM/I) for the satellite data, providing the opportunity to investigate and compare microwave emission characteristics, SWE retrievals and land cover effects at different spatial scales. Initial analysis shows that the small footprint airborne passive microwave SWE estimates match the range and variability of the in situ measurements, indicating that passive microwave SWE retrievals can capture local scale SWE variability if the spatial resolution is sufficiently fine. The large footprint spaceborne passive microwave SWE retrievals fall into the centre of the normally distributed in situ measurements, thereby providing a reasonable integrated estimate of mean grid cell SWE, even in a complex, mixed land cover area. A suite of micrometeorological variables from seven tower sites within the study area were also acquired to aid the interpretation of the passive microwave brightness temperatures by providing key variables such as soil moisture, and soil, snow, air, and tree temperature. Land and forest cover datasets including land cover type, canopy closure, and forest stem volume were also obtained from the Canadian Forest Service. Analysis of these collective datasets will advance our understanding of important scale and process issues related to the remote estimation of SWE from passive microwave data, and complement the research activities carried out within the NASA Cold Land Processes Experiment (CLPX).

C42B-05 1450h

Modelling CLPX IOP3 Radiometric Data by Means of the Dense Media Theory: Preliminary Results for the LSOS Test Site

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The capabilities of the Dense Media Radiative Transfer model using the Quasi Crystalline Approximation with Coherent Potential (QCA-CP) to reproduce measured radiometric data were tested using the University of Tokyo Ground Based Microwave Radiometer (GBMR-7) during the third Intensive Observation Period (IOP3) of the NASA Cold-land Processes Field Experiment (CLPX). The data were collected at the Local-Scale Observation Site (LSOS), a 0.8 ha study site consisting of two open meadows separated by trees. Intensive measurements were also made of snow depth and temperature, density, and grain size profiles. A DMRT model is needed to describe radiative transfer in

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a medium such as snow because the assumption of independent scattering used in classical radiative transfer theory (CRT) is not valid. Validation of the DMRT approach requires a relationship between measured snow grain size and the DMRT approximation of snow grain radius as spherical particles with a mean radius of the log-normal particle-size distribution. This relationship is very important for a better understanding of snow modelling and for practical applications. DMRT simulations were compared with observations of microwave brightnesses at 18.7, 36.5 and 89 GHz (V and H polarizations) collected on February 19-25, 2003. Observation angles ranged from 30° to 70°. Model inputs included measured snow parameters except mean grain size. The average snow temperature, fractional volume and depth were held constant, together with the ice and soil permittivities. The minimum and maximum measured mean grain sizes were used to test the capabilities of the DMRT to reproduce the brightnesses as upper and lower limits. The sensitivity to the largest and smallest measured grain size in the three classes of minimum, medium and maximum observed grain sizes was also investigated. DMRT particle sizes yielding a best-fit to the experimental data for each date were computed. Results show that the measured brightnesses fall within the range of simulated brightnesses using the smallest and largest measured grain size values. The DMRT best-fit radii are comparable to the average radii for the medium observed grain sizes.

C42B-06 1505h INVITED

Sensitivity of 6.7 GHz Brightness to Snow Wetness

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We monitored dual-polarized 6.7, 19, and 37 GHz brightnesses of a snow pack at the Fraser, CO, site of the Cold Lands Processes Experiment (CLPX). Our contributions to CLPX include observations from the Truck Mounted Radiometer System (TMRS3) and the MicroMet Station (MMS) during winter and spring of 2003. Dual-pol 19 and 37 GHz brightnesses observed by satellite sensors are used operationally to estimate the Snow Water Equivalent (SWE) of dry snow on the prairie. The empirical algoriths that produce these SWE estimates fail when now packs contain liquid water. Our hypothesis is that a lower frequency brightness, like data from the 6.9 GHz channel of AMSR, in conjunction with a snow model could supplement 19 and 37 GHz brightnesses to yield SWE for wet snow packs. The retrieval process would be much like that used to estimate soil moisture. Our final measurements associated with CLPX occurred in May, 2003. We have processed and delivered our MMS data to the NSIDC archive, and are processing the TMRS3 data for delivery in fall, 2003. We will report our progress toward analyzing these brightness data during periods of wet snow pack.

C42B-07 1525h

Ground-Based FMCW radar measurements: a summary of the NASA CLPX data

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Frequency Modulated Continuous Wave (FMCW) measurements were made from the ground at one site (LSOS) during the 2002 campain and at 4 different sites during the 2003 CLPX campain. The system transmits a signal whose frequency varies linearly with time, and the transmitted and recieved signals are mixed before data aquisition to produce a signal which contains the differences in frequencies between the two signals. Measurements were made at C-, X-, and Ku-Band frequencies. Broadband (4GHz) measurements show a great deal of vertical stratigraphy within the snowpack, however narrowband measurements were also made to simulate airborne measurements. Experiments were also performed at different look angles, and metal reflectors were placed at various depths for calibration. All of the data collected during the NASA CLPX mission are summarized.

URL: http://ucsu.colorado.edu/~marshalh/CLPX.html

C42C MCC: 3002 Thursday 1600h

CLPX: Cold Lands Processes Field Experiment II *(joint with H)*

Presiding: **D Cline,** NOAA National Operational Hydrologic Remote Sensing Center**; K Elder,** Rocky Mountain Research Station, U.S. Forest Service

C42C-01 1605h

Analysis of airborne and spaceborne hyperspectral data for the 2003 Cold Land Processes Experiment

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Airborne and spaceborne hyperspectral data were collected during the first and second intensive observation periods (IOP) of the 2003 NASA/NWS Cold Land Processes Experiment (CLPX) in the Rocky Mountains of Colorado. These data were acquired to provide calibration and validation of snow cover products from the CLPX core passive and active microwave remote sensing measurements. The airborne data were measured by the NASA/JPL Airborne Visible Infrared Imaging Spectrometer (AVIRIS) during both IOPs of 2003. The spaceborne data came from the NASA EO-1 Hyperion imaging spectrometer in the middle of each IOP. Field spectra of calibration targets were collected near the time of acquisitions with an Analytical Spectral Devices FR field spectroradiometer. Core field measurements in the CLPX included stratigraphy of snow grain size. The imaging spectrometer data were atmospherically corrected to apparent surface reflectance using the HATCH model. Field spectra from calibration targets were used to calibrate the apparent surface reflectance data. The apparent surface reflectance data were then analyzed for subpixel snow covered area, grain size, vegetation covered area, and rock covered area using the Multiple Endmember Snow Covered Area and Grain size model (MEMSCAG). This model is a coupling of Multiple Endmember Spectral Mixture Analysis (MESMA) and the radiative transfer model DISORT. Grain size retrievals were compared with core CLPX measurements of surface grain size.

C42C-02 1620h

Comparing simulated and measured sensible and latent heat fluxes over snow

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Verifying simulated sensible and latent heat fluxes over snow has seldom been attempted because of the difficulty in direct measurement. Recent development of more robust eddy correlation (EC) systems allowed us to directly measure fluxes of heat and water vapor over snow during the 2003 NASA Cold Lands Processes Experiment. Measurements were made from February through melt-out of the snowcover in mid-June, 2003, at the Local Snow Observation Site (LSOS) in the Fraser Experimental Forest in Colorado. The measurement system was located in an open stand of pines, along with two additional meteorological measurement systems which monitored radiation, temperature, wind, humidity, snow and soil temperature, and snow depth. Precipitation was measured at the near-by USFS climate monitoring station. Th ough the EC system was operated continuously for nearly 5 months, reliable data are available only during relatively clear periods between storms. The point model SNOBAL was used to simulate the snowcover energy and mass balance over this same period of time. Measured fluxes follow the same trends as simulated with sensible heat flux being toward the snow and latent heat flux away from the snow. However, the magnitude of the simulated fluxes were less than those measured by the EC system. This measurement effort shows the need to better tune the EC system to conditions over snow, particularly during storms and condensing conditions. It also indicates that snowcover energy balance simulations are sensitive to wind measurement errors under low-wind conditions such as that found below a forest canopy.

C42C-03 1635h

Snow Cover Distribution Modeled From NASA Cold Land Processes (CLPX) Field Measurements

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Snow distribution was modeled over nine 1-km square field sites in Colorado. The sites were measured as part of the NASA Cold Land Processes Experiment (CLPX) during the winters of 2002 and 2003, at the end of February and March in both years. In each field site more than 500 snow depth and 16 snow pit locations were identified for sampling. Due to logistics and safety, all sites were not measured in some cases. We have distributed snow depth and density over all nine sites for all four sampling dates using a combination of methods including classification and regression trees, and geostatistics. The maps of snow depth, density and water equivalent were produced as a baseline for comparison of other estimation methods, applications such as runoff modeling, and as a tool for sensor and algorithm development for remotely sensed data collected during the CLPX field campaigns. Sites used in the study varied greatly in terms of physiography and climate. Sites included a wide range of elevation, land use, and vegetation cover from grassland to thick forest. Resultant snowpacks ranged from shallow, intermittent and discontinuous snow cover to deep snowpacks.

C42C-04 1650h

Snow Water Equivalent in the Mesocell Study Areas, Cold Land Processes Field Experiment (CLPX)

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One goal of the NASA Cold Land Processes Field Experiment (CLPX) was to estimate the mean snow water equivalent (SWE), and its associated uncertainty, for each of the three 25-km by 25-km Mesocell Study Areas (MSA). The principal purpose of these estimates is to serve as "ground truth" to validate single-footprint SWE retrievals from the EOS Advanced Microwave Sounding Radiometer (AMSR-E) and to compare with various models. Many factors make accurate estimation of SWE over areas of this size (625-km2) challenging. The large spatial variability of SWE within areas of this size demands a very large number of ground observation to adequately represent the mean and variation. Limited accessibility and logistical constraints prohibited this approach. Instead, airborne gamma radiation measurements were used to measure SWE throughout each MSA. This technique, used operationally by the National Weather Service, is based on the attenuation of natural terrestrial gamma radiation by the atomic mass cross-section of water (ice or liquid) contained in the snowpack and the upper 20-cm of soil. The background gamma radiation is measured in the fall, then the radiation is measured again when snow is present. The attenuation characteristics are well-known, making this a reliable approach to measuring the total SWE + soil moisture present. To separate these two components, soil moisture is estimated. Initial real-time SWE estimates for the three MSA were based only on rough estimates of soil moisture characteristics. In subsequent analysis, we have used soil moisture data collected during each of the flights to