C41C-1001 0830h POSTER

A High Speed, Long-Range Mobile Communications Link for use in Polar Regions

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The Polar Radar for Ice Sheet Measurements (PRISM) project has developed a high bandwidth, wireless communications link between an autonomous rover and a manned vehicle deployed on a polar ice sheet to exchange real-time video, timing signals for a bistatic radar, and rover sensory data. The PRISM project is developing advanced intelligent remote sensing technology that involves radar systems, an autonomous rover, and communications systems to measure detailed ice sheet characteristics, and to determine bed conditions (frozen or wet) below active ice sheets in both Greenland and Antarctica. While this wireless communications link is being developed to fill a need within the PRISM Project, the same technology will allow polar researchers separated by moderate distances (∼10 km) to exchange data. The communications link is based on a high data rate 802.11b wireless technology, and a prototype system has been tested and evaluated during field experiments conducted at the North-GRIP ice core drilling camp in Greenland (75° 06´ N, 42° 20´ W) from June 23-July 17, 2003. The IEEE 802.11b standard works in the 2.4-2.483 GHz band and has been widely used for high-speed data transfer in a WLAN (Wireless Local Area Network). It typically has a range of a few hundred meters and theoretical data rates on the order of 11 Mbps. It has been used for a number of applications in home and office environments. We modified a 802.11b system to operate up to a maximum distance of about 8 km and investigated the radio propagation environment over the flat terrain of the Greenland ice sheet. We evaluated its performance along three different tracks of 8 km in length, and made throughput measurements at intervals of 0.5 km. We measured the received signal strength and noise level in 2-s intervals along these 8 km tracks. Also we conducted experiments for four different antenna heights (1, 2, 3 and 5 m) for developing a radio propagation model for WLAN communication over the ice sheet. We found that peer-to-peer communication between nodes on the ice had data rates varying from 4.5 Mbps at close range to 2.5 Mbps at a distance of 8 km from the base station. The design, propagation model, throughput and coverage of this peer-to-peer communications system in Greenland are presented in this paper. This WLAN system has numerous applications in polar field camps. We tested the transfer of real-time video segments across this link for our educational outreach efforts in the field. These video segments were subsequently uploaded using an Iridium-based Internet link, and sent back to the University of Kansas. The wireless Internet connectivity was also made available to members of the North Grip camp, who were able to access e-mail and the Internet from their tents and common areas. However, throughput for wireless access to the Internet was limited by the Iridium-based Internet connection that had a maximum bandwidth of 9.6 Kbps.

C41C-1002 0830h POSTER

Historical Arctic and Antarctic Surface Observational Datasets

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A new historical data set of surface observational data from several station locations in the Arctic and Antarctic is now available through the National Snow and Ice Data Center (NSIDC) Distributed Active Archive Center (DAAC). This product consists of basic meteorological data extracted from the National Climatic Data Center (NCDC) DATSAV2 and DATSAV3 surface observation data base. The mandatory data section contains meteorological information on basic parameters such as wind speed and direction, surface pressure, air temperature and visibility. These are the most commonly reported parameters and are available most of the time. The data are stored in ASCII files for each station and year that data are available and browse images are also provided. There are a total of 104 stations for the Arctic and 136 for the Antarctic. The time period of coverage starts as early as 1913 in the Arctic and extends through 2002, although data gaps occur and data are available for different years at different stations.

C41C-1003 0830h POSTER

Arctic Sea-Ice Measurement from Aircraft

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Monitoring sea ice thickness has proven difficult and numerical models are plagued by a scarcity of in situ data in the polar regions. Satellites cannot directly measure ice thickness, but the possibility exists of estimating ice thickness from ice freeboard measurements from new ESA and NASA altimetric satellites. Measuring ice freeboard from satellites, however, poses a significant scientific challenge. We discuss a method to measure ice freeboard using radar and laser altimeters aboard a P-3 aircraft, where the lower aircraft altitude reduces many of the measurement ambiguities, with the goal of improving satellite freeboard measurement. From airborne freeboard estimates, ice thickness is inferred from assumptions of snow, ice, and water density and verified using various ground-truthing opportunities. We present estimates of ice thickness from our existing extensive radar-altimetric sea-surface topography data set (1992-1999) that spans two-thirds of the Arctic Ocean basin. Ultimately, the goal is to convert satellite altimeter measurements to ice thickness estimates for model inputs to yield near-real-time ice thickness estimates.

C41C-1004 0830h POSTER

The New Polar Explorers of the 21st. Century: Autonomous Vehicles

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Throughout the history of polar exploration and research, the difficulties and hazards of the polar environments have proven to be daunting and sometimes deadly. Field efforts require extensive planning and logistics support while deployment and operation of research instruments is limited by power availability, maintenance requirements and access. At a time when the high latitudes are increasingly recognized as bellwethers of climate change, the observation network for the polar regions remains considerably less extensive than is the case for lower latitudes. In some cases, such as arctic drifting camps and coastal weather stations, the monitoring network is actually decreasing. Furthermore, for critical measurements such as sea ice thickness, no direct means currently exist for obtaining spatially and temporally distributed surface measurements. While satellite data promise to provide useful insights into ice mass and several key atmospheric and oceanic conditions, the need still exists for accurate, extensive surface measurements of sea ice and its variability in space and time. As we move into the 21st. century, new methods of observing the Polar Regions need to be implemented - methods that can overcome many of the present limitations listed above. Autonomous vehicles provide one such approach. Through advances in electronics and other essential technologies, it is now possible to deploy robotic vehicles that can operate in the ocean, on the ice and land, and in the sky. Presently, a variety of autonomous vehicles applicable to the Polar Regions are being designed and, in some cases, deployed and operated in the high latitude regions. The IPY offers a unique opportunity to develop a consistent, polar-wide observing network. Such an observing network would include autonomous vehicles combined with more intensive measurements obtained using other methods at key locations around the Arctic rim and in Antarctica. These vehicles bridge the gap between sparsely distributed, existing measurement sites and weather stations, localized and infrequent aircraft campaigns, and extensive but limited information provided by satellites. As an example, one can envision a combination of field measurements, piloted aircraft, surface rovers, robotic aircraft, and satellite observations used to map spatial variability and interannual changes in sea ice thickness. The proposed observing network would be coupled to a suite of oceanic and atmospheric measurements to understand the forces that drive the formation, drift and melt of the ice cover. The result would be improvements in weather and ice forecasting, climate modeling and remote sensing algorithms. Together, such an observing network would provide accurate and detailed information needed to detect climatic changes unambiguously.

C41D MCC: 3002 Thursday 1020h

Snow Cover and Biogeochemical Cycling I *(joint with B, H)*

Presiding: **M Sturm,** Cold Regions Research and Engineering Laboratory Alaska**; P D Brooks,** University of Arizona

C41D-01 1020h INVITED

The Interaction of Snow Physical Processes With Vegetation in Open and Forested Biomes

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It is well accepted that the physical processes which drive snowcover accumulation, redistribution, transformation and ablation are intimately governed by their interaction with the properties of both local and regional vegetation. It is more recently accepted that the type, structure and spatial distribution of vegetation are themselves affected by snow processes such that natural snow-vegetation-climate systems have evolved distinctive characteristics in various cold regions biomes. The human ecology of snow-vegetation systems is less well known, but extremely important as vegetation is managed to promote beneficial snow characteristics for the purposes of agricultural management in many snowy cultivated farming regions of the world. This paper will review recent field observations and descriptions of characteristic snow process-vegetation interactions and phenomena in various circumpolar biomes and the potential transferability of observed processes and snow-vegetation relationships amongst biomes in the circumpolar world. The spatial distributions of processes and states within a biome are shown to have important implications for aggregated descriptions of snow at the biome scale; the stability of these distributions will be emphasised.

C41D-02 1035h INVITED

Relating Snow Transport to Ecosystem Structure and Function: Lessons from Libby Flats

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The effects of variable snow cover on ecosystem structure and function have been well-documented in cold, temperate ecosystems, especially in high-elevation treeline and alpine landscapes where long, windy winters can produce dramatic variations in snow depths over short distances. Additionally, wind directions, snowfall, and resultant snow-distribution patterns are essentially the same year after year, allowing for relatively steady state environmental conditions and ecosystem properties. These chronic and heterogeneous snow-cover patterns have been associated

with ecosystem structure (e.g., plant species distributions, soil characteristics) and function (e.g., decomposition, primary production, nutrient cycling, water balance) in systems where winters are long and most precipitation falls as snow. We sought to determine the impacts of a heterogeneous snow distribution on ecosystem properties in a 6.25 km^2 upper-treeline ecotone, called Libby Flats, in south-central Wyoming. This involved modeling and validating snow accumulation, ablation, and meltwater flow spatially coupled with observations of snow depth and density, soil moisture, soil temperature, plant species composition and cover, biomass, gross decomposition, and gopher activity. Model simulations successfully represented the general spatial patterns of snow redistribution and ablation, but field measurements pointed the way for model improvements. Dominant cover types varied with snow depth, meltwater flow, and soil temperature. Decomposition rates changed with soil moisture, soil temperature, snow depth, and length of time covered by snow. Gopher activity was inversely related to soil moisture and positively related to soil depth, soil temperature, snow water equivalent, and graminoid biomass. The role of snow in this landscape is best understood as a function of transport. Transport of snow and snow meltwater play distinctive roles in the spatial patterns of cover within the Libby Flats landscape. Snow is transported to areas where wind speeds are reduced, and once snowmelt ensues during the spring and summer, water is absorbed into the soil, evaporated, or transported downslope. These concatenated factors involving water movement produce temporally shifting gradients of available moisture and site conditions (e.g., soil temperature and moisture) that influence, and are influenced by, ecosystem structure and function.

C41D-03 1050h

Vegetation and Variable Snow Cover: Spatial Patterns of Shrubland, and Grassland Snow

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Regions that experience long winters with snowfall and high winds frequently exhibit heterogeneous snow distribution patterns that arise from interactions among snow, wind, topography, and vegetation. Variable snow cover and resultant heterogeneities in albedo and growing season length can affect local weather patterns and energy budgets, and produce spatially covariable ecosystem properties. While snow influences local atmospheric processes and ecosystems, an important and underappreciated feedback exists between vegetation and snow cover. Plant size, canopy density, and rigidity determine how much snow accumulates on the lee side of individual plants (e.g., shrubland vs. grassland). In addition, the canopy can also influence how much energy reaches the snowpack, thereby hindering or accelerating snowmelt. An overhanging canopy reduces incoming solar radiation while providing a source of turbulent sensible and longwave radiative energy. Historically, most snow vegetation interaction studies have been limited to areas that experience an abundance of snow (e.g., mountainous areas) where trees have a large influence on seasonal snowcover. In contrast, snow cover patterns associated with shrublands and grasslands have received little attention, despite covering vast expanses (53%) of the seasonally snow-covered globe. In this study, snow depths were measured every two weeks from December through March in a small, 0.25 km^2 study area located in North Park, Colorado. The study area possesses little topographic relief and consists of shrub patches, dominated by greasewood (*Sarcobatus vermiculatus*) and sagebrush (*Artemisia tridentata*), embedded in a matrix of graminoids (sedges, rushes, and grasses). Snow cover patterns and spatial statistics were dramatically different in graminoid-dominated cover compared with shrub cover. The graminoid snow cover was thinner, less variable, and more ephemeral than the shrub snow pack. Snow was readily eroded by wind from graminoid areas and deposited into the shrub patches, where drifting on the lee sides of individual shrubs was apparent. As a result, the snow cover over graminoid species was shallow and ablated quickly. In contrast, shrubs accumulated deeper snow that persisted longer. Variable snow accumulation patterns, their respective effects on snowpack characteristics, ecosystem properties, and the implications of these variable snow regimes for climate models and in terms of vegetation cover change are described.

C41D-04 1105h INVITED

Carbon and Nitrogen Cycling During the Winter-Summer Transition in a Sub-arctic Heath Understorey Ecosystem

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The close biogeochemical coupling between terrestrial carbon and nitrogen (N) cycles, and the predominant N limitation of plant production in the Arctic indicate that the response of high latitude ecosystem carbon balance to climate change could be strongly influenced by effects on the N cycle. General Circulation Models consistently predict that regional warming will be most rapid at high latitudes during winter, and will be accompanied by increased snowfall. Here, I will describe an experimental investigation of the linkages between winter and summertime biogeochemical cycling in the heath understory of a sub-arctic birch forest. Our approach was to monitor the partitioning of an isotopically enriched 15NH4 addition among microbes, plants, and the soil solution through a series of winter harvests, and a subsequent mid-summer harvest. To investigate the influence of plants on ecosystem N cycling through the winter-summer transition, the isotopic label was added to control plots and to plots from which plants had been removed early in the previous growing season. Our study demonstrates that plants had negligible influence on the seasonal patterns of microbial carbon or N accumulation in the soils of this ecosystem within the time-frame of the experiment. Instead, ecosystem N cycling was dominated by a substantial release of recently acquired N (i.e. 15N label) from soil microbes during the winter-summer transition. Our results strongly suggest that although some of the microbial N released during this period was rapidly acquired by plants, a large proportion was lost as leachates and/or gases. These results will be discussed in the context of the influence of wintertime biogeochemical activities on annual N cycling at the landscape-level, and the potential for increased snowfall to influence N fluxes and net carbon balance in the Arctic.

C41D-05 1120h

The Effect of Trees on Nitrogen Cycling in the Forest-Alpine Tundra Ecotone, Niwot Ridge, Colorado

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A unique unidirectional flux of materials characterizes the forest-alpine tundra ecotone (FATE) on Niwot Ridge, Colorado. In the alpine it is known that topography affects the redistribution of resources. Trees at treeline are hypothesized to accumulate water nutrients, and organic matter by functioning as snow fences, trapping materials blown from the adjacent tundra. In addition, the heterogeneity of snow redistribution dramatically changes the moisture content of soils and the growing season length. This redistributed material likely includes nitrogen of anthropogenic origin. These subsidies were hypothesized to be greatest nearest the alpine tundra, the source of the material, and downwind of trees, because of the tree-wind interaction. The goal of this research was to look for indirect evidence for this redistribution by measuring the total pools of carbon and nitrogen, nitrogen cycling rates and resin bag available nitrogen. Total soil carbon and nitrogen, in situ N mineralization, and resin bag available N were measured upwind and downwind of individual trees at three sites within the FATE. Total carbon and nitrogen generally increased with altitude across the ecotone and were higher downwind than upwind of trees. Resin bag available nitrogen was greater downwind of trees than upwind of trees and decreased with elevation. The predominant form of nitrogen was nitrate. Nitrogen mineralization was also lower upwind of trees than downwind of trees, significantly so at the tree island site, and increased with elevation. At the closed forest site, ammonium was the dominant form of nitrogen produced, but nitrate was more abundant at the higher elevation sites. These results indicate the spatial heterogeneity in soil pools and fluxes of nutrients. Future work aims to link these processes directly to the eolian inputs, quantify the inputs and losses of nitrogen to these soils and determine if this ecotone, or select locations within it, is approaching nitrogen saturation.

C41D-06 1135h

Identification of Previously Unknown Groups of Microorganisms Under the Tundra Snowpack

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Recent work has shown that microbial communities are active under snow. In fact, in some tundra soils these organisms reach their year-round peak in late winter. These communities can function at temperatures down to at least $-5^{o}C$ and are fuelled by dead plant material laid down in the Autumn. Until now the identity of these cold adapted microbial communities was a complete mystery. We used microbiological and molecular techniques to elucidate the phylogenetic composition of these under-snow microbial communities. At the broadest taxonomic level, we show that fungi dominate the under-snow world. More detailed molecular analyses revealed a high diversity within the fungi and we identified three clades that constitute major new groups of fungi (at the subphylum or class level) that have not been previously described or cultured. An abundance of hitherto unknown fungi that are active beneath the snow significantly broadens our understanding of both the diversity and biogeochemical functioning of fungi in cold environments.

C41D-07 1150h

Irreverent Soils: Nitrogen Dynamics In Taiga Forests During Winter

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We measured annual net nitrogen mineralization, nitrification, and amino acid production in situ across a primary successional sequence in interior Alaska, USA. Net N mineralization rates during the growing season from green-up (late May) through freeze-up (late September) accounted for approximately 60% of the annual inorganic N flux, whereas the remaining N was released during the apparent dormant season. Nitrogen release during winter occurred primarily during October-January with only negligible N mineralization during early spring in stands of willow, alder, balsam poplar and white spruce. By contrast, black spruce stands also exhibited substantial mineralization after snow melt during early spring. The high rates of N mineralization in late autumn through early winter coincides with high turnover of fine root biomass in these stands, suggesting that labile substrate production, rather than temperature, is a major controlling factor over N release in these ecosystems. The results are consistent with the low temperature sensitivity of N mineralization previously documented for taiga soils, and demonstrate that measurements of soil processes restricted to the growing season may greatly underestimate annual flux rates of inorganic nitrogen in high-latitude ecosystems.

C41D-08 1205h

Carbon limitation of heterotrophic respiration under seasonal snowpacks: Implications for carbon balance in seasonally snow-covered ecosystems

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Longer growing seasons and higher atmospheric CO2 concentrations may increase the terrestrial carbon sink in the northern hemisphere. The fate of this newly-fixed carbon is not well known, but increased carbon uptake typically increases litter and labile carbon inputs to soil. Here, using CO2 flux surveys and additions of 13C-labelled carbon to snow-covered soil, we demonstrate that winter CO2 fluxes are likely to increase in response to increased carbon availability, potentially offsetting the growing season carbon sink.

Mean daily over-winter CO2 fluxes were significantly related to soil carbon content at the landscape scale. Similarly, labile carbon additions to soil increased subnivian CO2 fluxes 25 to 80 percent after 24 hours and 76 to 85 percent after 30 days. Although fluxes remained elevated 30 days following carbon addition, isotopic analyses indicated that the source of the respired carbon was soil organic matter and not added carbon. The magnitude of the increase in CO2 fluxes, coupled with increased utilization of endogenous organic matter, suggest that increases in labile carbon availability from litter may prime heterotrophic mineralization of stored soil organic matter.

C42A MCC: Level 2 Thursday 1330h

Snow Cover and Biogeochemical Cycling II Posters *(joint with B, H)*

Presiding: **M Sturm,** Cold Regions Research and Engineering Laboratory Alaska**; P D Brooks,** University of Arizona

C42A-1005 1330h POSTER

Contrasting Responses of Arctic Tussock Tundra to Early Season Snow Melt: Growth Acceleration Versus Frost Damage

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Climate warming scenarios for the Arctic include early snow melt marking the beginning of the growing season. From the perspective of the vegetation, early snow melt may have advantageous or disadvantageous effects. With warm weather following snow melt, bud break and flowering will occur early providing a longer period for growth and photosynthesis. However, if very cold weather follows snowmelt, plants will be exposed directly to freezing conditions that plants under the snow would not. Such exposed plants may suffer freeze damage and delayed bud break. We have been experimentally manipulating snow cover at Toolik Lake, Alaska, since 1995. In 9 years of early snow removal treatments, in only two years has the second scenario occurred, in 2001 and 2002. Here we document the effects of very cold conditions following snow removal on green biomass as assessed by NDVI of treatment plots relative to controls. In 2001 evergreens shrubs were killed, bud break was delayed, and NDVI was lower on treatment plots relative to controls. In contrast, in a year with warm spring temperatures following snow melt, 1999, NDVI on treatment plots was significantly greater than that of controls. Cold conditions following snow melt may lead to death of shrubs and delayed budbreak, effects that will carry over throughout the growing season and ultimately, affect community composition and ecosystem function.

C42A-1006 1330h POSTER

Flowpath Transformations of Precipitation Chemistry in an Arctic Tundra Catchment

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This paper traces the drainage pathways followed by rainfall and snowmelt in an actic tundra basin. The major hydrological processes operating within each flowpath segment from the surface of melting snow to the basin outlet are related to changes in the ion chemistry of the water flowing from each segment. In so doing, this paper offers physically-based explanations for the transformation of major ion concentrations and loads of snowmelt water as it travels to the stream outlet in this environment. Despite representing only five percent of the basin water equivalent, snow drifts were found to control the ion chemistry of the water in hillslope flowpaths and in the stream channel. As the initial pulse of ion-rich meltwater was conveyed through hillslope flowpaths, the concentrations of most ions increased, and the duration of peak ionic pulse lengthened. The hillslope runoff process also replaced Na+ and Cl-, the major ions in the percolate with Ca2+ and Mg2+. Over the first three metres of surface flow, concentrations of most ions increased by one to two orders of magnitude, which was roughly equivalent to the concentration increase that resulted from percolation of relatively dilute water through 0.25 m of unsaturated soil. On slopes below a large melting snowdrift, ion concentrations of meltwater flowing in the saturated layer of the soil were very similar to the relatively dilute concentrations found in surface runoff. However, once the snowdrift ablated, sub-surface flow ion concentrations rose steadily above parent meltwater concentrations. Water chemistry in the stream channel strongly resembled that of drainage from adjacent hillslopes. In-channel geochemical processes increased the concentration of most ions with flow distance in the major channel.

C42A-1007 1330h POSTER

Shrub Height and Snow Depth In The Alaskan Arctic

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Deciduous shrubs are predicted to increase in size and abundance in arctic tundra with climate warming. However, one barrier to this increase in shrubs may be exposure of taller stems above the snow pack where winter damage from dessication, abrasion, cold and browsing can occur. We measured shrub height and snow depth along transects at several sites from Atquasuk (70.5 N 157.5 W) and Oumalik north of the Colville River to sites south of the Colville River (Ivotuk) and in the Seward Peninsula (64.9 N 163.7W). We found that, although summer shrub heights are often greater than snow depths, these shrubs are usually snow covered by the Deep Cold stage of winter. One or a combination of two mechanisms account for this:1) 'lay over' of stems pushed over by wind or snow load and 2) buildup of snow around and over shrubs by the trapping of blowing snow by a dense network of branches and shoots. As deciduous shrubs become taller in response to climate warming, these mechanisms may allow them to remain protected in the winter despite an even greater mismatch in shrub height and snow depth.

C42A-1008 1330h POSTER

The Impact of Snow-up Timing on Arctic Winter Soil Temperatures

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For ecosystems that are snow-covered during a significant part of the year, variations in the nature and timing of snow pack development can produce large year-to-year differences in the thermal regime of the soil. Here we use continuous snow-ground interface temperature measurements from two consecutive winters taken across a variety of vegetation types on the Seward Peninsula, Alaska, to quantify these differences. The first winter (2000-2001) had an above-average snow pack that was largely in place by November. The second winter had a below-average snow pack that did not develop until January. Interface temperatures the second winter averaged 10 to 20°C lower than the first despite similar air temperature regimes. Moreover, distinct differences in soil thermal regime that developed as a function of different vegetation types the first winter were largely absent in the second. The measurements also show that with increasing canopy height and stem diameter, the thermal regime of the soil is spatially more heterogeneous. The results suggest that larger changes in winter soil thermal regime can be induced through changes in the timing of the development of the winter snow pack than can be induced through step changes in winter air temperature.

C42A-1009 1330h POSTER

Snow removal and ambient air temperature effects on forest soil temperatures in northern Vermont

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We measured deciduous forest soil temperatures under control (unmanipulated) and snow-free (where snow is manually removed) conditions for four winters (at three soil depths) to determine effects of a snow cover reduction such as may occur as a result of climate change on Vermont forest soils. The four winters we studied were characterized as:cold and snowy', warm with low snow', cold with low snow', and cool with low snow'. Snow-free soils were colder than controls at 5 and 15 cm depth for all years, and at all depths in the two cold winters. Soil thermal variability generally decreased with both increased snow cover and soil depth. The effect of snow cover on soil freeze-thaw events was highly dependent on both the depth of snow and the soil temperature. Snow kept the soil warm and reduced soil temperature variability, but often this caused soil to remain near 0 deg C, resulting in more freeze-thaw events under snow at one or more soil depths. During the cold snowy' winter, soils under snow had daily averages consistently $>$ 0 deg C, whereas snow-free soil temperatures commonly dropped below -3 deg C. During the warm' year, temperatures of soil under snow were often lower than those of snow-free soils. The warmer winter resulted in less snow cover to insulate soil from freezing in the biologically active top 30 cm. The possible consequences of increased soil freezing include more root mortality and nutrient loss which would potentially alter ecosystem dynamics, decrease productivity of some tree species, and increase sugar maple mortality in northern hardwood forests.

C42A-1010 1330h POSTER

Trace Metal Concentrations in Snow From the Yukon River Basin, Alaska and Canada.

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We report here on metal concentrations in snow collected from the Yukon River basin. Atmospheric transport of metals and subsequent deposition is a known mechanism for introducing metals into the northern environment. Potential sources of airborne elements are locally generated terrestrial sources, locally derived anthropogenic sources, and long range atmospheric transport. Sites were distributed along the Yukon River corridor and within the southeastern, central, and western basin areas. Snow samples were taken in the spring of 2001 and 2002 when the snow pack was at its maximum. Composite samples were taken from pits using clean techniques. Mercury was analyzed using cold vapor atomic fluorescence spectrometry. All other elements were analyzed by inductively coupled plasma-mass spectrometry. In samples from remote sites, the concentration for selected metals ranged from: 0.015 - 0.34 ug/L for V, 0.01 - 0.22 ug/L for Ni, $<$0.05 - 0.52 ug/L for Cu, 0.14 - 2.8 ug/L for Zn, 0.002 - 0.046 ug/L for Cd, 0.03 - 0.13 ug/L for Pb, 0.00041 - 0.0023 ug/L for filtered-Hg. Because the entire snow pack was sampled and there was no evidence of mid-season thaw, these concentrations represent the seasonal deposition. There was no significant difference in the seasonal deposition of V, Ni, Cu, Zn, Cd, and Pb at these sites between 2001 and 2002, and no north-south or east-west trend in concentrations. Samples taken from within communities, however, had significantly higher concentrations of V, Ni, Cu, Zn, and Cd in 2001, and Ni, Cu, and Pb in 2002 relative to the remote sites. Our data indicate that the atmospheric deposition of metals in the Yukon River basin is relatively uniform both spatially and temporally. However, communities have a measurable but variable effect on metal concentrations.

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