ky lava flow. This loss of P can only be ascribed to P-uptake by plants with subsequent removal through the loss of above ground biomass through fire and/or wind removal. Over the same time frame the amount of plagioclase in the soils drops from around 22% of the <2 mm soil fraction on the youngest lava flow to virtually 0% on the 350 ky flow, suggesting a substantial release of Si. Elevated silicon in arid, basaltic soil environments often leads to formation of smectite, a feature not observed along the chronosequence. In fact, plagioclase is replaced by the kaolin mineral halloysite with allophane as an apparent precursor. Kaolin minerals are associated with moderate to intense leaching environments rather than the mild leaching conditions that influence these soils. We selected an intermediate age soil profile (170 ky lava flow) to conduct an in-depth investigation of the soil mineral composition. We detected a strong dominance of halloysite, the presence of gibbsite, but no smectite. Secondary halloysite formation is preferred over smectite formation when Si activities are relatively low, and the pH is acidic rather than alkaline. Although this mineral assemblage seems to imply formation under a wetter climatic regime, the oxygen isotopic composition of the halloysite suggests formation under soil environmental conditions similar to the present. The Si concentration in grass and tree leaves in the vicinity of the soil contain between 3 and 8% Si. Loss of these leaves to the nearby ocean (either as dried or burned residue) could be responsible for considerable Si removal in a manner similar to the P-removal. The resulting Si-deficient soil-water favors the formation of halloysite over smectite as is demonstrated by construction of mineral stability diagrams using the soil-water data from the soils along the chronosequence.

B12F MC: 122 Monday 1330h

Carbon, Climate Change, and Disturbance in Northern Forest Ecosystems I *(joint with GC)*

Presiding: **M Apps,** Natural Resources Canada**; A D McGuire,** University of Alaska Fairbanks**; J Caspersen,** Princeton University

B12F-01 1330h INVITED

Environmental Variation, Vegetation Distribution, and Carbon Dynamics in High Latitudes

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In this study, we evaluated how vegetation distribution and carbon dynamics are related to environmental variation spanned by the network of the IGBP high latitude transects. While the most notable feature of the high latitude transects is that they generally span temperature gradients from southern to northern latitudes, there are substantial differences in temperature among the transects. Also, along each transect temperature co-varies with precipitation and photosynthetically active radiation, which are also variable among the transects. Although there are similar sequences of vegetation transitions along these gradients, there is variance in climatic associations with vegetation transitions among the transects. Both climate and disturbance interact to influence latitudinal patterns of vegetation and soil carbon storage among the transects. The analyses in this study have taken an important step toward coordination of global change studies among the high latitude transects. Coordinated studies have the potential to substantially improve understanding of controls over vegetation dynamics and carbon dynamics in high latitudes in ways that will further clarify the role of high latitude ecosystems in the earth system.

B12F-02 1350h INVITED

Climate Change, Forest Fires and Carbon in Northern Forests

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Fire is a key ecological process that to a large extent is responsible for the present composition and structure of northern forests. Biodiversity, energy flows and biogeochemical cycling are greatly influenced by the fire regime. Fire activity is directly related to climate and weather. Simulations of future weather using two coupled Global Circulation Models suggest that conditions will be significantly more conducive to fire occurrence and fire spread over most of North America. Other factors such as ignition agents, fuel characteristics, fire season length and human activities will also influence the future fire regime. An altered fire regime will have significant repercussions on the vegetation and the carbon balance of northern forests.

Fire is the disturbance of most significance for the carbon cycle. Carbon is released directly from flaming and smouldering combustion. In Canada, these direct emissions have been estimated to be on average about 20% of recent annual fossil fuel emissions. In addition to combustion, carbon is lost through decomposition of fire-killed vegetation and the carbon sink strength of the regenerating forest is usually less than that of the previous mature forest. Direct carbon flux measurements suggest that it may take up to 20-30 years for a site to return to its pre-fire state in terms of daytime carbon flux in the Canadian boreal forest, although some stands may recover in about ten years.

B12F-03 1410h INVITED

Estimating Forest Carbon Stock Dynamics from Forest Inventories, Disturbance Data and Simulation Models: An Integrated Analysis for British Columbia

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Forest inventories and growth and yield projection systems are an integral part of modern forest management. This information is commonly used for the long-term planning of annual allowable cuts and timber supply analysis. A strategy for the use of such information in a comprehensive, regional carbon budget model was developed and implemented for British Columbia, Canada.

Data readily accessible from forest information systems include the area, stratification and attributes (including merchantable volume) of forests. Growth and yield tables or empirical models provide the required information on stand dynamics. Disturbance statistics (harvest, fire, insects) describe the dynamics of the forest area. Temporary and permanent sample plots provide millions of tree measurements that were used in the conversion of volume to biomass estimates. Methods previously developed for the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS2) were used to calculate belowground biomass and to establish the various dead organic matter pools. Inventory data are nearly complete, except for a small portion of the total forest area. Land-use change statistics are available for forest roads, but not yet for other causes of land-use change.

A modified version of the CBM-CFS2 was used to calculate C stocks and stock changes for the period 2000 to 2032. Results indicate that ecosystem C stocks in the timber harvest land base are changing very little, with between-year variability of - 20 to + 20 Tg C / year. In contrast, ecosystem C stocks in the non-timber harvest land base are increasing at a rate of about 100 Tg C / year, largely because of the absence of harvesting and the assumed rates of future fire and insect disturbances, which could be the result of protection efforts. Actual disturbance rates, observed in future years, could have large impacts on C stock changes.

Annual changes in C stocks will also be influenced by climate variability. Growth and yield models predict periodic annual increment based on observations averaged over multi-year periods and are currently not responsive to climate variability. Future research needs to address climate-related sources of interannual variability in both biomass and dead organic matter C stocks.

The methods and tools used in this analysis are readily transferable to other regions and forest management units with good forest inventory information and where large-scale disturbances play an important role. Such analyses will help forest managers understand and assess the implications of alternative management strategies on future forest C stocks.

B12F-04 1430h INVITED

Uncertainties in high-latitude net CO_2 fluxes, seasonality and interannual variability from a Bayesian inversion

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Atmospheric inversions are useful tools for estimating surface fluxes of CO_2, however the literature shows a broad range of results for net annual fluxes. We will present a conceptual (and non-mathematical) model of how the Bayesian style of inversion works, and then describe a number of reasons why the inversions produce different answers, such as sparcity of data, difficulty in observing the tropical flux signal because of the nature of the atmospheric transport, the assumptions made regarding the spatial distribution of fluxes within a region, aggregation error and atmospheric transport error. All these factors (and several others) make estimating net fluxes a difficult task. However, the inversions can make much more robust estimates of monthly fluxes and inter-annual variability as the signals associated with these two features are considerably larger. In particular, in the northern high-latitudes the observing networks allow solutions of the amplitude and phase of the seasonal cycle of the surface fluxes with some useful uncertainty estimates. We present a study where CO_2 flux estimates from four terrestrial biosphere carbon models from the Carbon Cycle Model Linkage Project were used as priors for a Bayesian atmospheric inversion. In this set up, the inversion is essentially used to test the biosphere models, to see if the process-based carbon flux estimates are consistent with the observations of CO_2 in the atmosphere. If the fluxes are not consistent the inversion produces estimates of what phase and amplitude are required, and from this we can gain insight into what processes in the biosphere models need to be addressed. We see this method as a valuable tool for combining the information and understanding available from the inversion and process-based methods.

B12F-05 1450h

The Role of Snow and Surface Organic Layer in Permafrost Stability in the Alaskan Northern Forest Ecosystems

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Permafrost is a prominent feature of the Alaskan boreal forest. Discontinuous permafrost underlies practically the entire area of the boreal forest in Alaska. Only the northernmost part in the southern foothills of the Brooks Range is within the continuous permafrost zone. This makes the permafrost conditions of the boreal forest in Alaska very different compared to the East Siberian boreal forest, most of which lays within the continuous permafrost zone, or to the West Siberian and Russian European North taiga where permafrost is absent in the major part of the area. The stability of permafrost is very important for the stability of northern forest ecosystems, for which permafrost serves as a foundation. As soon as permafrost starts to degrade by natural or human imposed causes, significant changes in northern ecosystems should be expected, especially if permafrost is ice-rich. Permafrost temperature is the most important indicator of permafrost stability. The closer the temperature is to 0°C, the more susceptible permafrost is to climate warming or surface disturbances. In the Alaskan boreal forest region, these temperatures are within the 0 to - 4°C range and typically warmer than -2°C. The main reason why permafrost temperatures here are so high is that the mean annual air temperatures in this region are typically within the range of -2°C to -5°C on a long-term average. However, not only air temperatures are responsible for the permafrost temperature regime. Probably the most important other natural factors are the thickness, thermal properties, and duration of the snow cover and the presence and properties of the surface organic layer. Our data show that at the permafrost sites within the Alaskan boreal forest zone, the mean annual ground surface temperatures are usually 3 to 6°C warmer than the mean annual air temperatures with the most common figures between 4 and 5°C. Most of this difference is due to the warming effect of snow cover. As a result, the mean annual ground surface temperatures in

the Alaskan boreal forest very often exceed 0°C and at some places they can be as high as 4°C. Above 0°C mean annual ground surface temperature doesn't mean that permafrost is absent at the site. Natural phenomenon that is responsible for permafrost preservation in this situation is called "negative thermal offset", defined as the difference between mean annual temperatures at the bottom of the active layer and at the ground surface. Thermal offset depends on soil thermal properties and is largest within an organic layer, especially at the sites with poor drainage conditions. At the dry sites where the moss and peat layers are absent, the thermal offset will be minimal. Also, surface organic layer thermally interacts with snow cover. This interaction is non-linear and usually results in decreasing the warming effect of snow. Disturbances related to forest fires significantly increase the probability of permafrost degradation at the present and in the near future. Severe forest fires usually destroy surface organic layer, exposing the underlying mineral soils to the surface. When the active layer dries, it will further reduce the thermal offset. This can reset the mean annual temperatures at the bottom of the active layer to a level above 0°C. In this case, permafrost will start to thaw and if permafrost is ice-rich, the thermokarst processes will take off, significantly affecting ecosystems. The results of measurements and numerical calculations of the thermal response of permafrost temperatures to forest fires will be presented.

B12F-06 1525h

Temperature and disturbance controls on soil respiration in northern boreal forests

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We combined incubations and field observations to study the effects of temperature and disturbance on soil respiration at sites in the BOREAS Northern Study Area, near Thompson, Manitoba. To address the issue of whether warming will increase release of old carbon from humic layers found in upland black spruce forest soils, we conducted incubation experiments where temperature varied from 10 to +8 degrees by approximately 2 degree intervals. The amount of CO2 evolved was highly dependent on temperature, and whether soil water was frozen or thawed. Radiocarbon measurements of the evolved CO2 showed no change with temperature, and reflected contributions to CO2 emissions from a combination of detrital and humus sources. Although the relative contribution of different pools did not change with temperature, overall CO2 evolution rates increased about 100-fold from lowest to highest temperatures. Hence increased temperatures should increase the overall release of CO2 from boreal soils, including the contribution from older, more humified pools. Total soil CO2 emissions measured along a chronosequence following fire increased with time since fire to a maximum 19 years post-fire, then declined in older forests. Changes in the sources of soil respiration along the chronosequence were investigated by comparing radiocarbon signatures of total soil respiration with the radiocarbon in CO2 derived from root respiration and short-term incubations of moss and soil.

B12F-07 1540h

Disturbance and Carbon Dynamics of Boreal Forests: A Synthesis

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Boreal forests and woodlands cover 15.75 × 108 km2 hectares, or approximately 14.5% of the land surface. Boreal forests contain a disproportionately large amount of carbon in the soil compared to other biomes, and the carbon content of the vegetation and soil together contain approximately 300 Gt of carbon equivalent to approximately 50% of the carbon in the atmosphere. However, the composition, structure and function of boreal forests are not static because of natural and human-related disturbances. Wildfires are a common natural disturbance in boreal forests, burning approximately 1-10% of total land area during extreme years. Logging of boreal forests is increasing as humans use the wood for fuel and wood products. Biogeochemical cycles of temperate forests change immediately following disturbance and during succession, but the effects of disturbance on the carbon cycle of boreal forests are poorly understood. The objective of this study was to review the literature and answer the following questions: Does disturbance immediately affect soil, coarse woody debris, and vegetation carbon content, and how do these carbon pools change during succession; do all disturbances (e.g. wildfire, logging) have a similar effect of carbon pools; how does net primary production change during succession, and are changes in net primary production during succession related to changes in canopy architecture? We will address these questions by comparing carbon budgets for boreal age sequence studies in Manitoba, Canada, Saskatchewan, Canada, northeast China, Siberia, and Alaska.

B12F-08 1555h

Forest Carbon Sinks: Evaluating the Cause and Rate of Sink Saturation

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Secondary forests in the continental United States store an estimated 0.14-0.30 petagrams of carbon per year, approximately half of the total U.S. carbon sink. However, carbon storage in secondary stands will saturate as they continue to age and recover from past disturbances. Thus, understanding the causes of sink saturation and quantifying the rate of saturation is important for predicting the long-term fate of the U.S. carbon sink. We have used the FIA database to examine the causes of sink saturation in eastern U.S. forests, including age-related declines in growth. We find that age-related declines in growth are small, and that the rate of saturation is determined primarily by the rate of approach to stable size distribution (when mortality balances growth). We have also used the FIA database to quantify the rate of sink saturation in eastern U.S. forests and predict the long-term fate of the U.S. carbon sink.

B12F-09 1610h

Disturbances in Russian Forests in 1950-2000: Impact on the Carbon Budget

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Major types of natural and human induced disturbances (D) on Russian forest land (FL, 882×10^6 ha in 1998), i.e. fire, insect and diseases, harvest, industrial transformation, pollution and other abiotic factors, are quantified for 1950–2000 based on different surveys and other available sources in terms of a unified system of indicators on disturbance regimes (Shvidenko *et al.*, 2001). Due to the lack of long-term direct monitoring of D, a number of auxiliary models was developed in order to estimate the extent and severity of D for all Russian FL at the regional level based on available measured indicators. Dynamics of disturbed areas by different types of D present non-stationary stochastic processes with significant variability (up to 10 fold) and long-term trends characteristic for individual types of D. Regional weather conditions define to a large extent the spatial distribution of major natural D (fires and insect outbreaks), which annually are concentrated in 34 regions. During the period considered, D affected on average for the entire time period about 12×10^6 ha·yr^{-1}, of which fires damaged 5.0×10^6 ha·yr^{-1}, insect infestation and diseases 4.0×10^6 ha·yr^{-1}, and harvest 1.8×10^6 ha·yr^{-1}.

Impacts of D on the carbon budget were estimated based on a model applicable to all D types. The model considers the annual carbon flux of *the ecosystem-atmosphere exchange* generated by each particular type of disturbance ρ as a function of the direct emission during a year t^1 and the post-disturbance, as a rule, biogenic fluxes generated by disturbance ρ that occurred during previous years $t < t^1$. The explicit analytical form and model parameterization depends on type, strength and scale of ρ, conditions under which ρ occurs, type and specifics of the ecosystem, and the way in which disturbance regimes (DR) are formalized. The interaction of different types of D in the framework of individual DR is described by empirical functions. The summarized annual average D flux is estimated in the range of 100 to 350 Tg C yr^{-1}, with an average for the entire period of about 200 Tg C yr^{-1}. The input of different D types varies greatly, e.g., direct fire emissions vary from 20 to 170 Tg C yr^{-1}. Our estimates (including D fluxes) of a full carbon budget for the Russian terrestrial biota (Nilsson *et al.*, 2000) correspond well with the recent estimate of net boreal terrestrial Asia sink based on inverse modeling (Maksyutov *et al.*, 2001). In the later study net annual carbon flux signals were retrieved from measurements of CO_2 concentration in the atmosphere over boreal Asia during 1993–1998. Based on temporal and spatial distribution of D, we made an attempt to identify the contribution of D emissions to the net CO_2 flux identified by inverse modeling.

Key words: Northern Eurasia forests, disturbances, carbon fluxes caused by disturbances, modeling

URL: http://www.iiasa.ac.at

B

B12F-10 1625h

To spatially explicitly quantify the indirect effect of disturbances on carbon cycle of Canada's forests

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Disturbances (i.e., fire, insects-induced mortality, and harvesting) affect the carbon cycle of forested ecosystems directly in the year of occurrence and indirectly in many years after. For example, forest fire directly releases a fraction of carbon in biomass and forest floor to the atmosphere. The carbon cycle is also affected indirectly by disturbances which set the disturbed stand to age zero. So far, most studies estimate the indirect effect of disturbances on carbon balance at regional to national scales by aggregated forests in a region or a country into a few units, and largely ignoring the effect of spatial heterogeneity of disturbances and environmental factors. Because the effects of disturbances and environmental factors are usually non-linear, ignoring their spatial heterogeneity may introduce large error in the carbon budget estimates. In order to reduce this potential large error, spatially explicit quantification of the indirect effect of disturbances are urgently needed. Spatially explicit estimates of carbon cycle at 1-km resolution also allow direct testing against field measurements, as well as provide essential information for sustainable development of natural resources. To spatially explicitly quantify the indirect effect of disturbances on carbon cycle, we need first to quantify how stand age affects NPP. Our early results indicated the effect of stand age on NPP is species and site quality dependent. Therefore, age-NPP relationships are needed for all major forest species to carry out the spatially explicitly quantification of indirect effect of disturbances. We will derive these age-NPP relationships using existing yield tables, biomass allometric equations, and recent data on fine root and foliage production. To apply these age-NPP relationships, we need geo-spatial information on species, age, and site quality. Several initiatives have been underway to develop these spatial data layers. Because the NPP derived using these age-NPP relationships are average value under mean environmental conditions, the effect of environmental variability on NPP and soil respiration should also be incorporated, before the final annual carbon balance can be estimated. Because of

the large size of Canadian forest area, the high spatial resolution required, and the limitations in the current data availability and quality, carrying out these tasks requires substantial effort. We will present our most updated progress on the conference.

B12F-11 1640h

Carbon Budget Dynamics Change Induced by Artificial Disturbance in Siberian@Taiga Region

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Boreal forest in eastern Siberia was disturbed artificially as to detect the impact of disturbance to carbon budget. The observation tower for heat-water budget and CO2 budget was established in 1999 and continuous monitoring of budgets were conducted under undisturbed condition. The biomass of the forest before disturbance was also obtained by on-the-spot investigation. Cutting over all standing trees was taken place in 2000 winter season as one of types of disturbance in the rectangle shape with dimension of 150m long and 80 m wide. Cutting down trees were all moved out the site. In some portion of the site, ground surface vegetation was burned as to simulate the fire impact of forest fire to the ground surface. The comparison of Carbon budgets both before and after disturbance indicates that CO2 flux to@the atmosphere measured as 0.2 mol/m2day after disturbance. On the other hand, CO2 flux from atmosphere was obtained as 0.5 mol/m2day before disturbance. Soil respiration changes by disturbance was compared with observed values monitored by means of chamber measurements. Ground surface burned reduced the soil respiration by 50

B21A MC: 122 Tuesday 0830h

Land Use and Land Cover Change: Observations and Consequences I

(joint with GC)

Presiding: **N Ramunkutty,** University of Wisconsin**; R Leemans,** National Institute for Public Health the Environment (RIVM)

B21A-01 0830h

The Trajectories and Impacts of Land Use and Land Cover Change: A Global Synthesis

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We have summarized the trajectories of land cover and land use change (LCLUC) and the resulting impacts through a synthesis of results from studies encompassing a wide range of environments. While the specific changes and impacts are in some ways unique to each environment, we have nevertheless identified some general principles that seem to apply across all regions. The LCLUC trajectory of a particular landscape under influence by human actions begins with the transition from conditions dominated by natural vegetation to a frontier state. Land use activities in a frontier state are centered primarily around resource extraction and development of infrastructure such as roads or ports. Under the proper conditions (e.g. soils, climate), the frontier state gives way to an agricultural landscape by further conversion of natural vegetation to agriculture and management of cleared land for agriculture. The maximum extent of this conversion is a function of local biophysical and socio-economic factors. For example conversion of arid lands may be limited by water availability, access to capital for development of water resources and access to markets for the products. Given the appropriate conditions (e.g. economic and social policy, generation of wealth), LCLUC evolves as large settlements and industrialization develop in concert with high land prices and agricultural intensification. In some cases (e.g., New England, Appalachia), economic conditions (e.g., better land for agriculture elsewhere) may result in reversion of agriculture to natural vegetation. The last stage in LCLUC is conversion of agriculture to residential and suburban environments (e.g., Baltimore/Washington corridor). Examination of global land cover indicates that every stage is currently present, with areas like the Eastern United States and Western Europe as examples of regions having experienced all stages, while parts of the Amazon basin, Siberia, and Africa are moving through the frontier transition. Whether these frontier regions will evolve along the general LCLUC trajectory will depend on biophysical and socio-economic factors. Some regions like Siberia may never evolve to the agricultural stage and persist as a frontier landscape with its associated impacts. The impacts on biogeochemical and social systems are the most dramatic during transitions between states, with lesser impacts or even recovery during periods of stasis. However, displacement of natural vegetation by anthropogenic land uses currently results in enhanced water yields and higher fluxes of elements such as N and P, which encourage eutrophication of lakes and coastal waters without further land cover change. Social and economic policies are the primary drivers of LCLUC, and regulations are critical for controlling the impacts, especially in the later stages.

B21A-02 0845h

Paleoenvironmental history of a drained tidal freshwater wetland in the Sacramento Delta, California

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The McCormack-Williamson Tract is a large island situated in the Sacramento Delta, California, USA. This leveed 1,600-acre parcel of land is slated for restoration by The Nature Conservancy, with the goal of reverting the island from intensive agricultur e to a historical tidal freshwater wetland and floodplain. To design a suitable restoration strategy, it is necessary to determine the past and present biogeomorphic processes that have operated at the study site using three cores that have been collected from the island. The length of the cores range from about 12-14 m depth and bottom out at a maximum radiocarbon age of 40,100 years before present. The lithostratigraphic facies that are identified in the cores include Holocene floodplain and channel d eposits, Scirpus marshes and associated mudflats. Pleistocene glaciofluvial outwash is recorded only in the southern section of island. Pollen and spore analyses reveal that Scirpus marshes occupied the northwest section of the site during the mid-late H olocene. Channels, riparian woodlands, and floodplain habitats occupied the remaining sections of the island throughout the Holocene. Charcoal data indicates that fire was not a significant type of disturbance, whereas the lack of pollen coupled with widespread inorganic sedimentation in many sections of the cores suggests that flooding was a frequent form of disturbance on the island throughout the Holocene. Elemental analysis, coupled with pollen data, clearly show the onset of agriculture as a land-use practice in more recent times. In combination, these data provide base-line studies that are suitable to assist in guiding restoration efforts on the island.

URL: http://lawr.ucdavis.edu/faculty/gpast/delta.html

B21A-03 0900h

Agricultural land use changes in Amazonia since the mid-1990s: preliminary results of merging agricultural census data with satellite reflectances

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As part of our research within the Large-scale Biosphere-Atmosphere Experiment in Amazonia (LBA), we are developing a time series of the spatial distribution and abundance of major agricultural activities within the Amazon and Tocantins basins. In previous papers, we have described a new method for integrating land cover classifications from remote sensors with land use information from agricultural censuses. These fused data products, available for the mid-1980s and mid-1990s at five minute (9 km) resolution, have much of the spatial detail of the satellite information and useful attribute detail from censuses; they show snapshots of the density of cropland, natural pasture, and planted pasture across Amazonia in these two periods.

In this presentation we extend, refine, and update the time series in two major ways. Because the initial method for merging land use and land cover information used already-created land cover classifications as input, it was limited by both the classification accuracy and the similarity of land cover classes to the agricultural categories of cropland and pasture. In a sense the products relied, of necessity, on uncertainties in the mapped land cover classes as a basis for the fusion. Additionally, half a decade has passed since the nominal snapshot date of the latest land use map product.

Here we present the preliminary results of merging unclassified raw satellite imagery with agricultural census data. In particular, we explore the ability of weekly NDVI composites from the mid-1990s to identify areas of known land use during the period. By investigating the relationship between density of agricultural area and composite reflectances we expect to train the classifier to identify likely agricultural land use areas within Amazonia. The adopted technique differs from typical classification algorithms that identify pure pixels of desired classes and seek similar characteristics in the image. Instead, the method simultaneously considers the relation between reflectance characteristics and agricultural census values across administrative units, and optimizes the relation between them to produce the classification. Where this relationship is strong, we also present an update of land use patterns for the past year to identify likely land use changes in the region.

URL: http://sage.meteor.wisc.edu

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Coastal Land-Use Dynamics in Southern Sonora, Mexico Between 1973-2001

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Human activities, such as urbanization, agriculture, and shrimp farming are dramatically changing the coastal landscape of southern Sonora, Mexico, and threatening the ecosystems goods and services these natural systems provide. In this study we investigate the trends of human-induced transformations of coastal lands between 1973 and the present. Subscenes from two mosaicked Landsat images from 1973 (MSS), 1986 (MSS), 1992 (MSS), 1994 (TM), 2000 (ETM), 2001 (ETM) were analyzed to evaluate land use and cover changes. We used a combination of supervised and unsupervised maximum likelihood classification to produce thematic land use and land cover maps for change detection and modeling. The results show that the