B22C-08 1530h INVITED

The MODIS Rapid Response Project: Near-Real-Time Processing for Fire Monitoring and Other Applications

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The Moderate-resolution Imaging Spectroradiometer (MODIS) instrument on board the Terra and Aqua satellites offers an unprecedented combination of daily spatial coverage, spatial resolution, and spectral characteristics. These capabilities make MODIS ideal to observe a variety of rapid events: active fires, floods, smoke transport, dust storms, severe storms, iceberg calving, and volcanic eruptions. The MODIS Rapid Response System (http://rapidfire.sci.gsfc.nasa.gov) was developed at NASA's Goddard Space Flight Center to provide a rapid response to those events, with initial emphasis on active fire detection and 250m-resolution imagery. MODIS data for most of the Earth's land surface is processed just a few hours after data acquisition. A collaboration between NASA, the University of Maryland and the U.S.D.A. Forest Service has been developed to provide fire information derived from MODIS to federal fire managers. Active fire locations in the conterminous United States are produced by the MODIS Rapid Response System and communicated to the Forest Service within a few minutes of production. The MODIS Rapid Response processing was also adapted to Direct Broadcast to reduce the product turn-around to just minutes after data acquisition regionally. MODIS active fire locations are used by the Forest Service to generate regional fire maps over the United States, updated twice daily and provided to the fire managers to help them allocate firefighting resources. Active fire locations are also distributed in near-real-time to the Global Observation of Forest Cover (G.O.F.C.) user community through a web interface integrating MODIS active fire locations and Geographic Information System (G.I.S.) datasets. The suite of MODIS rapid fire products is currently being complemented with a Smoke Index product and a Burned Area product that will represent two new key tools available to the fire community. Finally a new collaboration with the U.S.D.A. Foreign Agricultural Service was recently developed to generate near-real-time MODIS data for crop monitoring and forecasting applications. A rapid Vegetation Index product was created to that effect.

B22D MCC: 3014 Tuesday 1600h

Carbon Cycling in Northern Soils and Surface Waters II *(joint with H)*

Presiding: **J J Carrasco,** U.S. Geological Survey**; R G Striegl,** U.S. Geological Survey**; K P Wickland,** U.S. Geological Survey

B22D-01 1605h INVITED

The role of dissolved organic carbon in northern wetland landscapes

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Wetlands play a large role in the cycling of DOC in northern landscapes from the land surface to aquatic ecosystems and there is a strong relationship between stream DOC export or concentration and proportion of the watershed occupied by peatland. These relationships have developed through the production potential for DOC from plant tissues and peat, the hydrologic transport mechanisms and the general lack of strong retention mechanisms in peatlands and other wetlands. I examine our knowledge of the atmospheric import, internal production, adsorption by mineral soils and export of DOC in northern peatland/upland systems from Ontario, Michigan and Finland and northern Manitoba.

B22D-02 1630h INVITED

Methane Emission and Net Ecosystem Exchange in Melt and Permafrost-Plateau Bog Features Within the Discontinuous Permafrost Zone of Northern Alberta, Canada

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Recent evidence indicates northern latitude permafrost is degrading in response to changing climate conditions (elevated temperatures and changing moisture input) which may significantly alter the processing of peatland carbon. As the permafrost melts, the bog surface subsides to the level of the surrounding water table creating a collapse scar with saturated surface conditions. Previously frozen peat is now available for decomposition and may become part of methanogenic processes elevating methane pools and emissions. Increased primary production in the collapse scar provides a sink for carbon dioxide and may counterbalance the greenhouse effect of a greater methane emission from these sites. However, increased primary production may stimulate methanogenesis and provide a positive feedback to even greater methane emissions. It is this balance of methane (CH_4) and CO_2 exchange that was examined within 7 melt features in northwestern Alberta during the growing season of 2002 (May to October). To measure CH_4 and CO_2 exchange, clear phytochambers (0.28 m^3) were placed on sampling frames (0.43m^2) inserted into the peat surface. Each site had 4 sampling frames (plots) in the melt feature and 4 plots in the permafrost plateau. Methane emission was measured by headspace grab samples analyzed on a FID-GC and net ecosystem CO_2 exchange (NEE) was estimated utilizing a LiCor 6200 portable photosynthesis system. During peak methane emission in late August, melt scars ranged between 2 to 10 mg CH_4 $m^{-2}h^{-1}$ as compared to the highly variable (near zero) permafrost plateau maximum exchange of 0.15 (emitted) to -0.15 (oxidized) mg CH_4 $m^{-2}h^{-1}$. Along a transect within the melt at two sites, methane emission and NEE peaked 2 meters from the permafrost plateau edge as compared to plots adjacent to the edge or near the middle of the melt feature (20m from the permafrost plateau). During late August, NEE during full sunlight ranged from a low uptake of 80 mg CO_2 $m^{-2}h^{-1}$ in permafrost plateau plots to a high of 1000 mg CO_2 $m^{-2}h^{-1}$ in melt plots near the permafrost edge. Highly productive sites for both NEE and CH_4 emission were related to the amount of vascular plants present.

B22D-03 1645h

A model of carbon flux and sedimentation in linked landscape-lake ecosystems

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North temperate lakes play an important role in processing organic carbon derived from the landscape as a whole. Lakes act both as conduits of inorganic carbon passing from lakes to the atmosphere and as mineralization sites for terrigenous organic carbon. The carbon load processed by lakes may partially offset estimates made for terrestrial net ecosystem exchange (NEE). The view of lakes as "hot spots" for carbon processing is tempered by uncertainties in the magnitude of the carbon load from terrestrial systems, the relative contributions of organic and inorganic carbon forms to that load, and in the influence of that load on key carbon cycling processes in lakes. The balance within the lake between sedimentation and flux to the atmosphere determines whether lakes are net sinks or net sources of atmospheric carbon. Here we develop a model to study carbon processing by lakes, and calibrate the model to a range of lake conditions found in northern Wisconsin. Our model indicated that lakes processed from 3-14 percent of terrestrial NEE, venting most of that carbon to the atmosphere. Most lakes were net heterotrophic and net sources of carbon to the atmosphere. When considering lakes over gradients of TP and DOC, only those lakes low in DOC and moderate to high in TP were net autotrophic and net sinks of carbon from the atmosphere. The model was especially sensitive to two parameters that may respond to drivers not included in the model: planktivory effects on algal biomass and pH changes due to acid deposition reductions.

B22D-04 1700h

Total Carbon Export from a Boreal Forested Catchment and the Relative Importance of Temperature and Flow

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For over a decade, streamwater dissolved organic carbon (DOC) has been sampled weekly to daily on one mire and two forested subcatchments within the boreal, 50 ha Svartberget catchment in Sweden. During the last year, DIC measurements have been added. This high resolution record of outputs from different landscape elements was analyzed to examine the role of climate on DOC flux and concentration, as well as to set the DIC export from headwaters in relation to the carbon budget for this region. Over the entire study period, export of total organic carbon (OC) averaged 7 g m-2 year-1 from the forested subcatchments, and 11 g m-2 from the mire subcatchment. The snowmelt exported ca. 45 % of all TOC, but the concentration-flow pattern indicated depletion of a soil source with time. Variation in summer TOC flux was four times larger than for the winter/spring flux. This large interannual variation in summer TOC export was related to the variability in both summer temperatures and flows, especially the latter. High flows during summer mobilized much more carbon than comparable winter/spring high flows.. The importance of sampling high flows when doing flux estimates was illustrated by the fact that 5 % of the highest flow events accounted for 40 % of the exported water but more than 50 % of the total organic carbon exported. Intensive snow melting followed by warm and exceptionally wet summers released around four times more TOC than during dry years. The headwater DIC export appears to be of the same order of magnitude as DOC export, but much of the DIC has left the stream via degassing within a few hours of leaving the soil, meaning that this DIC is not seen if the DIC budget is based on measurements further downstream.

B22D-05 1715h

Increased Concentrations of Dissolved Organic Carbon During the Spring Floods in the Sagavanirktok, Kuparuk and Colville Rivers in the Alaskan Arctic

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Arctic rivers discharge 40 to 80% of their annual water volume during the spring floods in May, June and July. During May and June 2001 and 2002, intensive sampling of the Sagavanirktok, Kuparuk and Colville rivers in the Alaskan Arctic was carried out to address questions related to the transport of dissolved and particulate organic carbon to the coastal Beaufort Sea. In June 2001, water flow increased by approximately 250% during peak discharge in the Sagavanirktok River, at the same time concentrations of dissolved organic carbon (DOC) increased from 167 to 742 micromolar. As water flow decreased in the 4 days following peak discharge, concentrations of DOC decreased to <300 micromolar. Similar results were found for the Kuparuk and Colville rivers. In May 2002, concentrations of DOC in the Kuparuk River increased from 670 to >1140 micromolar in 3 days and decreased with water discharge to 600 micromolar within 6 days of peak water discharge. In the Sagavanirktok River, concentrations of DOC increased from 420 to >600 micromolar during the first two days of water discharge in 2002.

However, during the next 4 days, temperature dropped to below freezing and surface water flow in the Sagavanirktok River stopped. Consequently, concentrations of DOC decreased to 440 micromolar. However, when water flow resumed, concentrations of DOC increased to >850 micromolar before dropping to 200 micromolar within 9 days. Concentrations of particulate organic carbon averaged >5% (dry weight) in the Kuparuk River during 2002 and were significantly higher than concentrations found in the Sagavanirktok River (1.6%) during that same period. However, Based on these data, Alaskan Arctic rivers discharge >83% and >88% of the dissolved and particulate carbon, respectively, during the spring floods. These results suggest that the storage and subsequent flushing of organic carbon from arctic soils during the spring floods is an important component of the flux of organic carbon to the coastal Beaufort Sea.

B22D-06 1730h

Dissolved Inorganic Carbon Cycling in the Yukon River

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Carbon dynamics of the Yukon River are controlled by complex interactions among inorganic and organic carbon pools, including mineralization of particulate and dissolved organic carbon, hydrologic input of dissolved carbonate species, dissolution of particulate carbonates, and atmospheric interaction of CO2 and CH4. Dissolved inorganic carbon (DIC) undergoes strong seasonality in concentration and source in the Yukon River. DIC and CO2 build up under ice in winter, due to mineralization of organic carbon from the previous year's primary production and input of bicarbonate rich groundwater. Winter DIC in the main stem of the river typically approaches concentrations of 4 millimolar, with CO2 partial pressure exceeding ten times atmospheric, and delta 13C-DIC in the range of -11 to -13 permil. Spring runoff mixes a variety of source waters into the Yukon, with tributary waters from landscapes rich in wetlands contributing DIC as depleted as -18 to -25 permil delta 13C-DIC. However, the net composition of DIC in the Yukon River is dominated by dissolution of particulate inorganic carbonates in runoff and glacial melt water that increase the 13C-DIC of the Yukon River at Stevens Village from about -12.6 permil in late spring to about -5.2permil in late summer. Coincident increase in the apparent age of 14C-DIC was from about 2200 YBP to 4500 YBP. High rates of carbonate dissolution occasionally lead to uptake of atmospheric CO2 by the river during summer. Results of carbon loads modeling, water and carbonate mixing calculations, and calculations of carbon discharge to the Bering Sea by the Yukon River, not completed at the time of abstract submission, will also be presented.

B22D-07 1745h

Dissolved Organic Carbon in the Yukon River Basin

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A critical question in carbon cycling is how climate change could alter the fate and chemical nature of dissolved organic carbon (DOC) released from watersheds and transported to rivers, lakes, estuaries and coastal waters. The spatial and temporal variability of DOC in surface waters associated with the Yukon River Basin is being studied to better define the processes controlling DOC in this system. The Yukon River Basin, a large and diverse ecosystem in northwestern Canada and central Alaska, is experiencing increasing temperatures, partial melting of permafrost, drying of upland soils and changing wetland environments. However, little is known about DOC transported in the system. Specific ultraviolet absorbance (SUVA) measurements, in combination with DOC and DOC fractionation analyses, were used to determine both the amount and nature of DOC in the Yukon River and major tributaries. DOC transported in the Yukon River and its tributaries was seasonally dependent. For example, DOC concentrations in the Yukon River at Steven's Village ranged from 2 to 17 mg C/L during 2003, and SUVA ranged from 2.0 to 3.5 L/mg C m, indicating a large variation in amount and nature of organic matter in the river. Lowest DOC concentrations and SUVA values were observed in winter under low flow conditions. Greatest DOC concentrations were measured on samples collected during the spring on the leading part of the hydrograph. These samples were also found to have the greatest SUVA values indicating that the organic matter transported during this period was more aromatic than DOC transported under low flow conditions. High SUVA values are indicative of greater amounts of organic material originating in soils and wetlands of the watershed. The amount and nature of organic matter transported by the tributaries appeared to be related to relief and wetland contribution to the watershed of the tributary. Based on DOC and SUVA data, the Yukon River tributaries can be classified as dark water (high DOC, high SUVA, large amount of humic material), clearwater (low DOC, low SUVA) and glacial (low DOC, low SUVA, high particulate load).

B22E MCC: 3002 Tuesday 1600h

Validation and Application of Land Surface Products From the MODIS Sensor III *(joint with H, GC)*

Presiding: **F A Heinsch,** University of Montana**; J L Privette,** NASA Goddard Space Flight Center

B22E-01 1600h

Application of MODIS Land Products to Estimate Regional Cropland Area and Production

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The spatial and temporal coverage of MODIS offers unique opportunities for agricultural applications. Here we investigate the application of 250m MODIS vegetation index composites to map crop areas and yields in various agricultural regions in Mexico and the United States. Traditional 'hard' classification of MODIS data can lead to significant errors when estimating crop areas because a MODIS pixel is often large relative to typical field sizes. We present an approach that uses temporal reflectance signatures to determine the sub-pixel extent of various crops using linear unmixing. Endmember sets are constructed using Landsat data to identify pure pixels, and uncertainty resulting from endmember variability is quantified using Monte Carlo simulation. This approach allows endmembers to be used over broad regions and in different years, facilitating operational estimates of crop area with well-defined uncertainties. We then apply a light-use efficiency model to relatively pure pixels to determine the productivity of different crops. The resulting estimates of total crop area and production are compared with reported harvest statistics, and various sources of uncertainty are discussed.

B22E-02 1615h

Multi-year southern Africa MODIS burned area product generation and validation

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A MODIS burned area product has been developed that maps the 500m location and approximate day of burning using a change detection algorithm based on a bi-directional reflectance model-based expectation approach. The algorithm has been applied to recently reprocessed 500m daily MODIS land surface reflectance data to produce burned area data sets for all of southern Africa, including Madagascar, for 2000 onwards. This paper presents the MODIS southern Africa burned area product, describes the protocol developed to validate it, and the validation results. The validation protocol is based upon interpretations by members of the Southern Africa Fire Network (SAFNet) of multitemporal Landsat Enhanced Thematic Mapper plus (ETM+) data to derive maps of the location and approximate date of burning. The protocol was implemented in 2000, 2001 and 2002 at eleven Landsat ETM+ scenes distributed across southern Africa, from Namibia to Mozambique, to encompass representative regional variation in the conditions for which the MODIS burned area product was generated and to capture the more important factors that influence product performance. Statistical comparisons between the Landsat ETM+ derived independent burned area data and the 500m MODIS burned area product for 2000, 2001 and 2002 are described. Comparisons between the MODIS burned area products and MODIS 1km active fire detections are also presented. Constrains on our ability to precisely define the limits of MODIS burned area detection are discussed. The implications of this work for improved regional and country level burned area estimates and the need for development of validation reporting metrics specific to the information needs of different users in southern Africa are also discussed.

B22E-03 1630h

Spatially Complete Surface Albedo Data Sets: Value-Added Products Derived From Terra MODIS Land Products

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Spectral land surface albedo is an important parameter for describing the radia-tive properties of the Earth. Accordingly it reflects the consequences of natural and human interactions, such as anthropogenic, meteorological, and phenological effects, on global and local climatological trends. Consequently, albedos are integral parts in a variety of research areas, such as general circulation models (GCMs), energy balance studies, modeling of land use and land use change, and biophysical, oceanographic, and meteorological studies. The availability of global albedo data over a large range of spectral channels and at high spatial resolution has dramatically improved with the launch of the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument aboard NASA's Earth Observing System (EOS) Terra spacecraft in December 1999. However, lack of spatial and temporal coverage due to cloud and snow effects can preclude utilization of official products in production and research studies. We report on a technique used to fill incomplete MOD43 albedo data sets with the intention of providing complete value-added maps. The technique is influ-enced by the phenological concept that within a certain area, a pixel's ecosystem class should exhibit similar growth cycle events over the same time period. The shape of an area's phenological temporal curve can be imposed upon existing pixel-level data to fill missing temporal points. The methodology will be reviewed by showcasing 2001 global and regional results of complete albedo and NDVI data sets.