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

Robert G Striegl[1] (303 236-4993; rstriegl@usgs.gov)

Mark M Dornblaser[2] (303 541-3015; mmdornbl@usgs.gov)

Jeffrey P Chanton[3] (jchanton@mailer.fsu.edu)

[1]United States Geological Survey, PO Box 25046, MS 413, Denver, CO 80225-0046, United States

[2]United States Geological Survey, 3215 Marine St., Boulder, CO 80303, United States

[3]FLorida State University, Department of Oceanography, Tallahassee, FL 32306-4340, United States

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

George Aiken[1] (303-541-3036; graiken@usgs.gov)

Robert Striegl[2] (rstriegl@usgs.gov)

Paul Schuster[1] (pschuste@usgs.gov)

[1]U. S. Geological Survey, 3215 Marine Street, Boulder, CO 80005

[2]U. S. Geological Survey, P.O. Box 25046, MS 413 Denver Federal Center, Lakewood, CO 80225

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

David Lobell[1,2] (dlobell@stanford.edu)

Gregory Asner[1,2] (gasner@globalecology.stanford.edu)

Ivan Ortiz-Monasterio[3] (i.ortiz-monasterio@cgiar.org)

[1]Carnegie Institution Dept of Global Ecology, 260 Panama St, Stanford, CA 94305, United States

[2]Stanford University, Dept. of Geological and Environmental Science, Stanford, CA 94305, United States

[3]International Maize and Wheat Improvement Center (CIMMYT), Wheat Program, Apdo. Postal 6-641, 06600 Mexico D.F., Mexico, Mexico D.F. 06600, Mexico

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

David P Roy[1] (301 614 5571; droy@kratmos.gsfc.nasa.gov)

Yufang Jin[1] (yjin@hermes.geog.umd.edu)

Chris O Justice[1] (justice@hermes.geog.umd.edu)

Louis Giglio[2] (giglio@hades.gsfc.nasa.gov)

P. Lewis[3] (plewis@geog.ucl.ac.uk)

[1]Department of Geography, 1113 LeFrak Hall, University of Maryland, College Park, MD 20742, United States

[2]Science Systems and Applications, Inc., NASA Goddard Space Flight Centre, Code 923, Greenbelt, MD 20771, United States

[3]Remote Sensing Unit, Department of Geography, University College London, 26 Bedford Way, London WC1H0AP, United Kingdom

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.

B

B22E-03 1630h

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

Eric Moody[1] (301 614-6243; moody@climate.gsfc.nasa.gov)

Michael D. King[2] (301 614-5629; michael.d.king@nasa.gov)

Steven Platnick[2] (301 614-6243; steven.platnick@nasa.gov)

Crystal B Schaaf[3]

Feng Gao[3]

[1]L-3 Communications GSI, 1801 McCormick Dr. #170, Largo, MD 20774, United States

[2]NASA, Goddard Space Flight Center, greenbelt, MD 20771, United States

[3]Boston University, Department of Geography, Boston, MA 02215, United States

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.

B22E-04 1645h

Variability of MODIS Albedo for Major Global Vegetation Types

Feng Gao[1] (617-353-8033; fgao@bu.edu)

Crystal Schaaf[1] (schaaf@crsa.bu.edu)

Alan Strahler[1] (alan@bu.edu)

Wolfgang Lucht[2]

[1]Department of Geography and Center for Remote Sensing, 675 Commonwealth Ave., Boston, MA 02215, United States

[2]Potsdam Institute for Climate Impact Research, PO Box 601203, Potsdam D-14412, Germany

The global coarse resolution latitude/longitude land surface albedo data sets derived from the Terra MODerate resolution Imaging Spectroradiometer (MODIS) have been completed for use by the global modeling community. This paper describes these Bidirectional Reflectance Distribution Function (BRDF) and Albedo Climate Model Grid (CMG) products and their variability within major global vegetation types. Preliminary results reveal that these coarse resolution global albedos have the spatial and latitudinal patterns appropriate for the underlying IGBP land cover classes, further encouraging modelers to introduce albedos as variants of ground cover, geographic location, temporal season and spatial resolution in the various climate modeling schemes.

B22E-05 1700h

Spectral and Angular Surface Albedo Properties Over the ARM Southern Great Plains Area During Spring 2003 IOP From Combined Ground and Spaceborne MODIS, MISR and Landsat Observations

Alexander P. Trishchenko[1] (613 995 57 87; trichtch@ccrs.nrcan.gc.ca)

Yi Luo[2] (613 992 87 96; yi.luo@)

Konstantin Khlopenkov[1] (613 947 12 94; kkhlopen@ccrs.nrcan.gc.ca)

Zhanqing Li[3] (301 405 66 99; zli@atmos.umd.edu)

[1]Canada Centre for Remote Sensing, Natural Resources Canada, 588 Booth Str, Ottawa, ONT K1A 0Y7, Canada

[2]Noetix Research Inc, 265 Carling Ave. Suite 403, Ottawa, ONT K1A 0Y7, Canada

[3]Department of Meteorology, ESSIC, University of Maryland, 2335 CSS Building, College Park, MD 20742-2465, United States

Information about surface albedo is required as surface boundary condition for radiative transfer modeling, aerosol retrievals, atmospheric dynamics and cloud simulations. Ground observations also provide ground truth radiation measurements for validation and intercomparison with airborne and satellite data. We present our approach and results for characterization of surface albedo spectral and angular properties during the Atmospheric Radiation Measurement Program (ARM) Spring 2003 Aerosol Intensive Observation Period (IOP) using ground-based and spaceborne combined observations. The results are presented for the ARM Southern Great Plains (SGP) study area. We conducted multiple ground spectral measurements at various locations over typical surface types in the area under mid-May conditions. The results of ground survey of landcover type distribution and Landsat ETM scene were utilized to generate the landcover map at high spatial resolution. The dominating surface types in the area during mid-May were ripening wheat (65 percent) followed by grassland/pasture (25 percent). Satellite MISR and MODIS data over the area were processed together with ground measurements collected with narrow-field-of-view probe to analyze surface anisotropic properties. Impact of the improved surface characterization on radiative transfer is assessed. This research was supported by the US Department of Energy Atmospheric Radiation Measurement Program under grant No. DE-FG02-02ER63351.

B22E-06 1715h

A Model-based Approach to Scaling GPP and NPP in Support of MODIS Land Product Validation

David P Turner[1] (541-737-5043; david.turner@oregonstate.edu)

Warren B Cohen[2] (541-750-7322; warren.cohen@oregonstate.edu)

Stith T Gower[3] (608-262-0532; stgower@facstaff.wisc.edu)

William D Ritts[1] (541-737-9306; david.ritts@oregonstate.edu)

[1]Forest Science Department, Oregon State University, Corvallis, OR 97331, United States

[2]USDA PNW Research Station, 3200 SW Jefferson St, Corvallis, OR 97331, United States

[3]Department of Forest Ecology and Management, University of Wisconsin, Madison, WI 53706, United States

Global products from the Earth-orbiting MODIS sensor include land cover, leaf area index (LAI), FPAR, 8-day gross primary production (GPP), and annual net primary production (NPP) at the 1 km spatial resolution. The BigFoot Project was designed specifically to validate MODIS land products, and has initiated ground measurements at 9 sites representing a wide array of vegetation types. An ecosystem process model (Biome-BGC) is used to generate estimates of GPP and NPP for each 5 km x 5 km BigFoot site. Model inputs include land cover and LAI (from Landsat ETM+), daily meteorological data (from a centrally located eddy covariance flux tower), and soil characteristics. Model derived outputs are validated against field-measured NPP and flux tower-derived GPP. The resulting GPP and NPP estimates are then aggregated to the 1 km resolution for direct spatial comparison with corresponding MODIS products. At the high latitude sites (tundra and boreal forest), the MODIS GPP phenology closely tracks the BigFoot GPP, but there is a high bias in the MODIS GPP. In the temperate zone sites, problems with the timing and magnitude of the MODIS FPAR introduce differences in MODIS GPP compared to the validation data at some sites. However, the MODIS LAI/FPAR data are currently being reprocessed (=Collection 4) and new comparisons will be made for 2002. The BigFoot scaling approach permits precise overlap in spatial and temporal resolution between the MODIS products and BigFoot products, and thus permits the evaluation of specific components of the MODIS NPP algorithm. These components include meteorological inputs from the NASA Data Assimilation Office, LAI and FPAR from other MODIS algorithms, and biome-specific parameters for base respiration rate and light use efficiency.

URL: http://www.fsl.orst.edu/larse/bigfoot/index.html

B22E-07 1730h

Validation of the MODIS GPP algorithm (MOD17A2) using eddy flux tower data

Faith Ann Heinsch[1] (406-243-6218; faithann@ntsg.umt.edu)

John S Kimball[2] (406-982-3301; johnk@ntsg.umt.edu)

Maosheng Zhao[1] (406-243-6228; zhao@ntsg.umt.edu)

Steven W Running[1] (406-243-6311; swr@ntsg.umt.edu)

[1]The University of Montana, NTSG/College of Forestry and Conservation, 32 Campus Dr, Missoula, MT 59812, United States

[2]The University of Montana, Flathead Lake Biological Station, 311 BioStation Lane, Polson, MT 59860, United States

We compare satellite-based regional calculations of gross (GPP) primary production from MODIS (MOD17A2) to tower eddy CO_2 flux-based estimates across a diverse range of landcover types and climate regimes represented within the Ameriflux network. Recently revised input data, including meteorology from the NASA Data Assimilation Office (DAO; GEOS-4.02) as well as leaf area index (LAI) and fraction of PAR (fPAR) from the MOD15 algorithm (Collection 4), have resulted in improvements of GPP estimates at these sites when compared to previous productivity estimates. Three possible sources of error within the MODIS GPP algorithm are explored. We evaluate the sensitivity of MODIS outputs to input meteorology by using both DAO and site-based daily weather information to calculate the MODIS GPP estimates. Comparing these results provides an independent assessment of the accuracy of the MOD17 algorithm phenology and the ability of the DAO data to capture local meteorology is also tested. The MOD15 LAI/fPAR outputs are also compared with site data to determine additional sources of error. Finally, vegetation parameters within the MOD17 GPP algorithm are examined to determine the effects of these variables on GPP results. Our analysis indicate that MODIS and tower based estimates compare favorably in temperate regions, but that results vary for other regions such as boreal and Arctic regions. The DAO meteorology appears to be responsible for much of the difference between tower-based and satellite-based estimates of GPP, but additional sources of error arise from surface heterogeneity and cloud cover.

B22E-08 1745h

Matching MODIS Products to Flux Towers: the first step in bottom-up scaling

Hans Peter Schmid[1] (812 855 6303; hschmid@indiana.edu)

Craig Wayson[1] (cwayson@indiana.edu)

Faith Ann Heinsch[2] (faithann@ntsg.umt.edu)

Steven W Running[2] (swr@ntsg.umt.edu)

[1]Indiana University, Dept. of Geography, Atm. Sc. 701 E. Kirkwood Ave., Bloomington, IN 47405, United States

[2]University of Montana, School of Forestry 437 Science Complex, Missoula, MT 59812, United States

Bottom-up scaling of tower based ecosystem fluxes to a large region involves several steps. In essence, the bottom-up approach to scaling constitutes a defensible strategy to fill the space between a set of in-situ observational nodes (i.e., the flux towers) with an estimate of the exchange that is matched to measured values at the nodes. To ensure that the space-filling process is responsive to variations of biophysical parameters related to land-cover and ecosystem type, the scaling strategy uses a suitable ecosystem exchange model as its aggregation tool. Here, we apply a bottom-up scaling strategy to gross photosynthetic exchange of carbon dioxide (GPE), and use MODIS derived 8-day composites at a 1 km resolution as the aggregation tool. As a first step in the scaling strategy, the MODIS derived GPE composites must be matched to corresponding estimates from the flux towers, to root them on the flux towers as their observational benchmarks. This paper addresses problems and issues associated with matching MODIS products to flux tower derived GPE at the hand of 7 km x 7 km MODIS product subsets centered on AmeriFlux towers in Indiana (MMSF flux) and Michigan (UMBS flux). Waypoints along our route to achieve matching include, (i) separation of directly measured net ecosystem exchange fluxes into ecosystem respiration and GPE; (ii) high resolution assessment of vegetation indexes (VI) in the area around the flux tower likely to be covered by the flux footprint, based on IKONOS or Landsat scenes. (iii) The high resolution VI will be overlaid with computed flux footprints to examine the area-to-area representativeness of flux measurements over various time scales. In particular, we will examine whether the averaging power of the spatially evolving flux footprint over an 8-day integration period (matching the MODIS time scale) is usually sufficient to provide fluxes with acceptable spatial representativeness to serve as a benchmark for MODIS products. (iv) We will compare the footprint weighted integrations of vegetation index drivers (e.g., NDVI, LAI) to those of the 49 MODIS breakout “pixels” of the 7 km x 7 km subsets. Because of residual uncertainty in the geopositioning of the MODIS pixels, and variations in the flux footprint location, it is not certain which of the 49 breakout elements matches the area in the composite tower flux footprint best. Is it always the same MODIS pixel that achieves the best match? (v) Based on the foregoing, we will examine the ratio of the MODIS derived flux to the measured flux under the condition that the footprint weighted vegetation index matches that of MODIS (i.e., by using a selection of data, based on given representativeness criteria). Finally, this analysis will allow us to derive a regression function to calibrate the MODIS derived fluxes to a spatially representative subset of tower flux measurements.

B31A MCC: 3014 Wednesday 0800h

Ecosystem Interactions with Land-Use Change I *(joint with H)*

Presiding: **G P Asner,** Carnegie Institution**; R DeFries,** University of Maryland

B31A-01 0800h

Effects of Introduced Grasses, Grazing and Fire on Regional Biogeochemistry in Hawaii

Andrew J Elmore[1] (650-325-1521; andrew@elmore.cc)

Gregory P Asner[1] (gasner@globalecology.stanford.edu)

[1]Carnegie Institution of Washington, 260 Panama St., Stanford, CA 94305, United States

African grasses introduced for grazing have expanded in geographic extent in mesic tropical systems