our experiments. A Bayesian network (BN) model was first contructed from the two datasets combined. This BN, referred to as the centralized BN, served as the ground truth for comparing the performance of our collective BN learning algorithm. Our preliminary experiments reveal a number of interesting trends. Correlations between specific DAO and NOAA data features are evident. Specific features are consistently observed as root nodes in the BN, suggesting that these features could possibly be the "cause" for certain phenomenon. Seasonal trends in the data reflect appropriate seasonal changes in the BN model.

URL: http://www.csee.umbc.edu/~hillol

B61A-0710 0830h POSTER

Knowledge Discovery from Remotely Sensed Vegetation Indices

Amanda B. White[1] (217-333-0107; abwhite@uiuc.edu)

Praveen Kumar[1] (217-333-4688; kumar1@uiuc.edu)

[1]University of Illinois, Hydrosystems Laboratory 205 N. Mathews Ave., Urbana, IL 61801, United States

The objective of this research is to develop KDD (knowledge discovery in databases) techniques for spatio-temporal geo-data, and use these techniques to examine seasonal and inter-annual vegetation health signals. The underlying hypothesis of the research is that the signatures of inter-annual variability of climate on vegetation dynamics as represented by the statistical descriptors of vegetation index variations depend upon a variety of attributes related to the climate, physiography, topography, and hydrology. Several scientific questions related to the identification and characterization of the inter-annual variability ensue as a consequence of this hypothesis. Various vegetation indices will be enlisted to represent vegetation health, such as NDVI (normalized difference vegetation index), EVI (enhanced vegetation index), LAI (leaf area index), FPAR (fraction of photosynthetically active radiation), PSN (photosynthesis), and NPP (net primary product). Relationships between these indices and topography and its derivatives (slope, aspect, etc.), nearness to water bodies, precipitation, temperature, etc. will be analyzed.

Preliminary investigations were performed using 13 years of 1 km resolution NDVI data from the AVHRR instrument on NOAA's POES (polar-orbiting operational environmental satellite). Deviations from the 13-year average were utilized in order to identify anomalous behavior. The pilot KDD technique includes distance-based clustering algorithms and Apriori association rule algorithms adapted for spatial-temporal data. Future work will incorporate more complex algorithms such as density-based clustering and constraint-based association mining algorithms.

B61A-0711 0830h POSTER

Self-Organizing Maps Applied to Mineral Spectra: Pure and Mixed

Robert C. Hogan[1,2] (650 604 0780; hogan@cosmic.arc.nasa.gov)

Ted L. Roush[2] (650 604 3526; troush@mail.arc.nasa.gov)

[1]Bay Area Environmental Research Institute, 645 Anthony Court, Sonoma, CA 95476, United States

[2]NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035-1000, United States

Meaningful classification of spectral data is an important first step in mineralogical analysis of terrestrial and planetary surfaces. The large data sets being gathered (Tbytes) can not be manually evaluated in a timely, efficient manner. This suggests automated classification and interpretative processing must be developed and applied.

Spectral libraries, databases of simulated or experimental spectra, play a crucial role in the identification of remotely obtained spectral data. At infrared wavelengths, linear mixing models are widely used to ascertain the principle mineral components contained in an unknown sample. An exhaustive search for spectral library candidates epresenting these components for a large database of samples is very CPU intensive, especially as the number of required components grows. A method to reduce the set of candidates in a linear mixing analysis would greatly improve the efficiency of the identification process. Classifications related to chemical and structural properties which are manifested in spectral features can be useful in this regard.

We have developed a scheme based upon self-organizing maps (SOM) that organizes spectra in an unsupervised fashion into a 2-D map. This scheme was applied to the Arizona State University (ASU) thermal emission mineral spectral library and separated the samples into clusters that relate to distinct chemical and structural groups. Three hierarchical levels of distinction arise from the SOM classification; mineral class (e.g. silicates vs. oxides), mineral subclass (e.g. inosilicates vs. nesosilicates) and mineral group (e.g. pyroxenes vs. amphiboles). In addition, we investigated spectral mixing such as occurs in natural samples. An 'unknown' spectrum, constructed from a linear mix of ASU library spectra, is 'classified' by locating it in the 2-D SOM map. Through an iterative process the end members composing the unknown mixture were recovered by evaluating the members of the library that were closest in proximity to the unknown on the 2-D SOM map. We will show our SOM classifications of the ASU library and illustrate, with several mixture examples, how the SOM map is used to zero in on library end members.

B61A-0712 0830h POSTER

Autonomous Science Analysis with the New Millennium Program-Autonomous Sciencecraft Experiment

Thomas Doggett[1] (480-965-9872; thomas.doggett@asu.edu); Ashley Gerard Davies[2] (818-393-1775; Ashley.Davies@jpl.nasa.gov); Rebecca A. Castano[2] (818-393-5344; becky@aig.jpl.nasa.gov); Victor R. Baker[3] (520-621-7875; baker@hwr.arizona.edu); James M. Dohm[3] (520-626-8454; dohm@hwr.arizona.edu); Ronald Greeley[1] (480-965-7045; greeley@dione.la.asu.edu); Kevin K. Williams[4] (202-357-1424; williamsk@nasm.si.edu); Steve Chien[2] (818-393-5320; chien@aig.jpl.nasa.gov); Robert Sherwood[2] (818-393-5378; Rob.Sherwood@jpl.nasa.gov)

[1]Arizona State University, Department of Geological Sciences, Tempe, AZ 85287, United States

[2]Jet Propulsion Laboratory-California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

[3]University of Arizona, Department of Hydrology and Water Resources, Tucson, AZ 85721, United States

[4]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC 20560, United States

The NASA New Millennium Program (NMP) is a testbed for new, high-risk technologies, including new software and hardware. The Autonomous Sciencecraft Experiment (ASE) will fly on the Air Force Research Laboratory TechSat-21 mission in 2006 is such a NMP mission, and is managed by the Jet Propulsion Laboratory, California Institute of Technology. TechSat-21 consists of three satellites, each equipped with X-band Synthetic Aperture Radar (SAR) that will occupy a 13-day repeat track Earth orbit. The main science objectives of ASE are to demonstrate that process-related change detection and feature identification can be conducted autonomously during space flight, leading to autonomous onboard retargeting of the spacecraft. This mission will observe transient geological and environmental processes using SAR. Examples of geologic processes that may be observed and investigated include active volcanism, the movement of sand dunes and transient features in desert environments, water flooding, and the formation and break-up of lake ice. Science software onboard the spacecraft will allow autonomous processing and formation of SAR images and extraction of scientific information. The subsequent analyses, performed on images formed onboard from the SAR data, will include feature identification using scalable feature "templates" for each target, change detection through comparison of current and archived images, and science discovery, a search for other features of interest in each image. This approach results in obtaining the same science return for a reduced amount of resource use (such as downlink) when compared to that from a mission operating without ASE technology. Redundant data is discarded. The science-driven goals of ASE will evolve during the ASE mission through onboard replanning software that can re-task satellite operations. If necessary, as a result of a discovery made autonomously by onboard science processing, existing observation sequences will be pre-empted to obtain data of potential high scientific content.
Flight validation of this software will enable radically different missions with significant onboard decision-making and novel science concepts (onboard decision making and selective data return).
This work has been carried out at the Jet Propulsion Laboratory-California Institute of Technology, under contract to NASA.

URL: http://ase.jpl.nasa.gov

B61A-0713 0830h POSTER

An Interoperable Framework for Mining and Analysis of Space Science Data (F-MASS)

Yubin Matt He[1] (256-824-5161; mhe@itsc.uah.edu); Rahul Ramachandran[1] (256-824-5157; ramachan@itsc.uah.edu); Xiang Li[1] (256-961-7969; xli@itsc.uah.edu); Sara Graves[1] (256-824-6064; sgraves@itsc.uah.edu); Wladislaw Lyatsky[2] (lyatsky@cspar.uah.edu); Arjun Tan[2] (atan@aamu.edu); Glynn Germany[3] (256-824-5129; germanyg@cspar.uah.edu)

[1]Matt Yubin He, TH S331 The Information Technology and System Center, The University of Alabama in Huntsville,, Huntsville, AL 35899, United States

[2]Wladislaw Lyatsky, Department of Physics Alabama AM University, Normal, AL 35762, United States

[3]Glynn Germany, 3Center for Space Plasma, Aeronomy, and Astrophysics Research, University of Alabama in Huntsville, Huntsville, AL 35899, United States

An Interoperable Framework for Mining and Analysis of Space Science Data (F-MASS) is currently being created by an interdisciplinary team composed of information technology and space science researchers. Information technology researchers on the F-MASS team are working with space scientists to adapt the innovative Algorithm Development and Mining system to provide a comprehensive framework for space science data investigations. The research will focus on problems such as the handling of the large datasets inherent in the space science communities, the heterogeneity of these data, and the incorporation of specialized data mining algorithms and domain-specific user interfaces into the framework. A set of three case studies has been selected to drive this effort. The first case study being researched is identification of polar cap boundaries. The polar cap boundary is an important parameter that determines how much energy is stored in the magnetotail. The stored energy is sporadically released, leading to the formation of strong geomagnetic disturbances, so-called substorms, which are associated with strong ionospheric currents in high-latitude ionosphere and auroras. Spacecraft UV auroral images are being analyzed using different heuristic and mining algorithms for 2-D patterns of auroras. One of the difficulties in developing such algorithms is the uneven and dynamic form of the polar cap boundary. Initial results from this case study will be presented.

B61B MCC: Hall C Saturday 0830h

Application and Validation of Land Surface Products From the MODIS Sensor Posters

Presiding: **D P Turner,** Oregon State University**; S W Running,** University of Montana

B61B-0714 0830h POSTER

Overview of the Validation of Land Surface Products From the MODIS Sensor

Jeffrey T. Morisette[1] (201-614-6676; jeff.morisette@gsfc.nasa.gov)

Jeffrey L. Privette[1] (301-614-6630; jeff.privette@gsfc.nasa.gov)

Christopher O Justice[2] (301-405-1600)

[1]NASA's Goddard Space Flight Center, Code 923 Building 33, Room G325, Greenbelt, MD 20771, United States

[2]University of Maryland, Geography, 2181 Lefrak Hall, College Park, MD 20742, United States

The MODIS Land team (MODLAND) is producing a suite of global land products whose uncertainty will be estimated through validation activities. The MODIS Land team will base its validation work on the comparison of its products to similar products derived from independent sources. The independent products are derived by combining in situ (field and tower) data with imagery from airborne and spaceborne sensors. In many cases the imagery and airborne data can be used to validate more than one product. With this, the EOS Land Validation Core Sites have been established. These sites provide easy access to multi-scale imagery as well as field and tower measurements. The poster will present the data available for the Core sites and the web-based infrastructure to access these data. It will

also list a proposed strategy to define three stages of validation and list the stage at which the MODLAND products currently stand. Each MODLAND product has established 1) particular instrumentation needs for field data collection, 2) a set of sites where these collections will be made, and 3) initial research on how to compare independently-derived data to the MODIS products. The poster will provide information on these three elements for each of the MODLAND products.

URL: http://modis.gsfc.nasa.gov/MODIS/LAND/VAL/

B61B-0715 0830h POSTER

Mapping Global Land Cover Properties and Dynamics Using MODIS Data

Mark A. Friedl[1] (617-353-5745; friedl@bu.edu)

Alan H. Strahler[1] (671-353-2525; alan@bu.edu)

Xiaoyang Zhang[1] (617-353-2525; zhang@crsa.bu.edu)

John C.F. Hodges[1] (617-353-2525; jcfh@bu.edu)

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

The Moderate Resolution Imaging Spectroradiometer (MODIS) onboard NASA's Terra and Aqua spacecraft provide a rich source of information for vegetation and land cover mapping applications. In particular, the multi-spectral and multi-temporal information supplied by MODIS allows a variety of land surface properties to be mapped and monitored at global scales in a fashion that was not previously possible. In this paper, we describe how information from MODIS is being used to characterize both the static and dynamic properties of land cover at continental to global spatial scales, and seasonal to inter-annual time scales. The MODIS land cover product (MOD12) consists of two main components. The first component includes a set of internally consistent maps depicting global land cover using several different classification schemes. These maps are designed to support the needs of diverse users engaged in studies of ecosystem and climate dynamics at continental to global scales. The map layers provided include several common classification schemes (e.g., IGBP) that have been widely used in the past, along with more recent descriptions of plant functional types that are gaining interest in the global ecology and climate community. The second component of the MODIS land cover product consists of map layers designed to provide information regarding the dynamic behavior of land cover at intra- and inter-annual time scales. These layers include maps depicting global scale intra-annual dynamics in vegetation phenology (onset of greenness and senescence, etc.), along with maps depicting regional scale inter-annual variation in land surface properties (e.g., greenness) derived from change vector analysis applied to multiple years of MODIS data. To illustrate the utility and information content of these maps, specific examples at regional scales that include a range of climate and ecosystem types are presented.

URL: http://geography.bu.edu/landcover/

B61B-0716 0830h POSTER

The MODIS Vegetative Cover and Change Products: Validation and Analysis

John RG Townshend[1,2,3] (jtownshe@geog.umd.edu); Robert A Sohlberg[1] (301-405-4292; rsohlber@geog.umd.edu); Ruth S DeFries[1,3] (rdefries@geog.umd.edu); Matthew C Hansen[1] (mhansen@geog.umd.edu); Mark L Carroll[1] (markc@geog.umd.edu); Charlene DiMiceli[1] (cdimicel@geog.umd.edu); Bethany M Semeiks[1] (semeiks@geog.umd.edu)

[1]Department of Geography, 2181 LeFrak Hall University of Maryland, College Park, MD 20742

[2]Institute for Advanced Computer Studies, University of Maryland, College Park, MD 20742

[3]Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD 20742

A suite of vegetation assessment and monitoring products have been developed using the 250m and 500m resolution visible and infrared data from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument onboard NASA's Terra and Aqua spacecraft. These products utilize the daily MODIS temporal resolution to capture the phenologic signal and to detect changes due to both natural hazards and anthropogenic activity. Recent activities have concentrated on validation and analysis of these data sets.

Vegetation Continuous Fields (VCF) provides the first data set of percentage tree cover at 500m spatial resolution. The VCF data set provides objective estimates of standing forest, which can be used to assess carbon stocks. Field validation has been completed across North America and at multiple sites in Southern Africa. Results will be presented comparing this satellite derived data set with ground derived data at national and regional scales.

Vegetative Cover Conversion (VCC) uses the MODIS 250m resolution red and near-infrared bands to produce a global alarm product for land cover change. Phenomena of interest include wildfire, flooding and deforestation. Recent field activities have been conducted to gather validation data sets for burned areas in the western U.S. Results will be shown for detection of a variety of change processes at both local and regional scales.

Finally, the authors will present results of the compositing methods employed for VCC. A change detection application requires an input data set which has been optimized for cloud free, near nadir views. Constructing a data set which maintains the maximum possible spatial resolution while removing noise presents a series of challenging trade-offs. The compositing approach will be discussed with examples.

B61B-0717 0830h POSTER

NASA MODIS Products For Military Land Monitoring and Management

Robert C Lozar[1] (217 352 6511 Ext 6367; Robert.C.Lozar@erdc.usace.army.mil)

Harold E Balbach[1] (217 352 6511 Ext 6367; Harold.E.Balbach@erdc.usace.army.mil)

[1]Corps of Engineers Research Laboratory ERDC-CNN, PO BOX 9005, Champaign, IL 61826-9005, United States

The US Army Corps on Engineers Engineering Research and Development Center, ERDC-CERL, is using MODIS products to study a large portion of the Sandhills and Sonora Desert ecoregions for monitoring ecosystem wide condition and provide a basis for military installation encroachment indicators. Because of the extent of these areas, MODIS products provide a practical input to regularly and inexpensively support the monitoring initiative. Here we illustrate how MODIS products have potential applications within an automated framework (e.g. ATtILA and FragStats) and on a case-by-case basis.

B61B-0718 0830h POSTER

Seasonal Biophysical Dynamics of Biomes from Space Using MODIS Vegetation Indices

Alfredo R Huete[1] (520-621-3228; ahuete@ag.arizona.edu)

Kamel Didan[1] (520-626-2086; kamel@ag.arizona.edu)

Piyachat Ratana[1] (520-621-1791; piyachat@ag.arizona.edu)

Tomoaki Miura[1] (520-626-2086; tomoaki@ag.arizona.edu)

[1]Department of Soil, Water, and Environmental Science, University of Arizona, 429 Shantz Bldg. 38, Tucson, AZ 85721, United States

We utilized two years of Terra- Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Index (VI) products to analyze the seasonal and spatial patterns of photosynthetic vegetation activity over a global range of biomes, from hyperarid surfaces to perhumid tropical rainforests. This was done in support of a global-based MODIS VI validation analysis. Using global land cover classification schemes and climatic data, we analyzed the seasonality patterns of major biome types and climatic regions. Both the normalized difference vegetation index (NDVI) and the enhanced vegetation index (EVI) at 250-m, 500-m, and 1-km were used to extract seasonal profile curves. The quality assurance (QA) information of the output products was used in noise removal and data filtering prior to the generation of the seasonal profiles. Histogram analyses were also performed for each biome type and climatic region as well as over site-intensive, core validation sites with flux towers. The seasonal patterns of the semiarid and savannah regions were very pronounced with distinct dry and wet seasonal trends. Forested regions exhibited less pronounced trends, with the exception of some of the deciduous broadleaf forests. The NDVI and EVI responded differently to canopy photosynthetic activity and canopy structural variations and complemented each other in the global analysis of seasonality patterns. Lastly, we compared the seasonal trends of some of the biomes with those obtained with the AVHRR-NDVI product and found the MODIS VI products to respond with greater sensitivity.

B61B-0719 0830h POSTER

MOD15A2: Global LAI and FPAR

Ranga B. Myneni[1] (+1 617 353 5742; rmyneni@bu.edu); Nikolay V. Shabanov[1] (+1 617 353 5985; shabanov@crsa.bu.edu); Yuri Knyazikhin[1] (+1 617 353-8843; jknjazi@crsa.bu.edu); Wenze Yang[1] (+1 617 353 8846; ywze@crsa.bu.edu); Huang Dong[1] (+1 617 353 8846; dh@crsa.bu.edu); Bin Tan[1] (+1 617 353 8845; tanbin@bu.edu)

[1]Department of Geography Boston University, 675 Commonwealth Avenue, Boston, MA 02215, United States

An algorithm based on the physics of radiative transfer in vegetation canopies for the retrieval of vegetation green leaf area index (LAI) and fraction of absorbed photosynthetically active radiation (FPAR) from surface reflectances was developed and implemented for operational processing of the data from the moderate resolution imaging spectroradiometer (MODIS) aboard the TERRA platform. The MODIS LAI/FPAR product has been operationally produced from day one of science data processing from MODIS and is available to the users from the EROS (Earth Resources Observation System) Data Center Distributed Archive Center. Current and planned validation activities are aimed at evaluating the product at several field sites representative of the six structural vegetation types. This poster presents overview of the main features of the algorithm and LAI/FPAR product, available to the user data sets, validation efforts and example of the application of the product to climate studies.

B61B-0720 0830h POSTER

Sources of uncertainty in the prediction of LAI/fPAR from MODIS

Jennifer L Dungan[1] (1-650-604-3618; jdungan@mail.arc.nasa.gov)

Barry D Ganapol[2] (1-520-621-4728; ganapol@cowboy.ame.arizona.edu)

[1]NASA Ames Research Center, MS 242-4, Moffett Field, CA 94035-1000, United States

[2]University of Arizona, Department of Aerospace and Mechanical Engineering, Tucson, AZ 85721-0119, United States

To explicate the sources of uncertainty in the prediction of biophysical variables over space, consider the general equation:

$$z_v(u) = f(y_v(x), \theta)$$

where z is a variable with values on some nominal, ordinal, interval or ratio scale; y is a vector of input variables; v is the spatial support of y and z; x and u are the spatial locations of y and z, respectively; f is a model and θ is the vector of the parameters of this model. Any y or z has a value and a spatial extent which is called its support. Viewed in this way, categories of uncertainty are from variable (e.g. measurement), parameter, positional, support and model (e.g. structural) sources.

The prediction of Leaf Area Index (LAI) and the fraction of absorbed photosynthetically active radiation (fPAR) are examples of z variables predicted using model(s) as a function of y variables and spatially constant parameters. The MOD15 algorithm (Knyazikhin et al. 1998) is an example of f, called f_1, with parameters including those defined by one of six biome types and solar and view angles. The Leaf Canopy Model (LCM)2, a nested model that combines leaf radiative transfer with a full canopy reflectance model through the phase function (Ganapol et al. 1999), is a simpler though similar radiative transfer approach to f_1. In a previous study, MOD15 and LCM2 gave similar results for the broadleaf forest biome. Differences between these two models can be used to consider the structural uncertainty in prediction results.

In an effort to quantify each of the five sources of uncertainty and rank their relative importance for the LAI/fPAR prediction problem, we used recent data for an EOS Core Validation Site in the broadleaf biome with coincident surface reflectance, vegetation index, fPAR and LAI products from the Moderate Resolution Imaging Spectrometer (MODIS). Uncertainty due to support on the input reflectance variable was characterized using Landsat ETM+ data. Input uncertainties were propagated through the LCM2 model and compared with published uncertainties from the MOD15 algorithm.

Ganapol, B.D., L.F. Johnson, C.A. Hlavka, D.L. Peterson, and B. Bond (1999) LCM2: A coupled leaf/canopy radiative transfer model, Remote Sensing of Environment, 70:153-166.

Knyazikhin, Y., J.V. Martonchik, R.B. Myneni, D.J. Diner, and S.W. Running (1998) Synergistic algorithm for estimating vegetation canopy leaf area index and fraction of absorbed photosynthetically active radiation from MODIS and MISR data, Journal of Geophysical Research, 103:32257-32276.

B61B-0721 0830h POSTER

Validation of the MODIS LAI Product and its relationship to Canopy Structure along the Southern Africa Kalahari Transect

Jeffrey L Privette[1] (301-614-6630; jeff.privette@gsfc.nasa.gov)

Ranga B Myneni[2] (617-353-5472; rmyneni@crsa.bu.edu)

Yuri Knyazikhin[2] (617-353-5985; jknjazi@crsa.bu.edu)

Mukufute M Mukelabai[3] (260-7-221441; mmuke@zamnet.zm)

[1]NASA's Goddard Space Flight Center, Code 923 NASA's GSFC, Greenbelt, MD 20771, United States

[2]Boston University, 675 Commonwealth Avenue, Boston, MA 02215, United States

[3]Zambian Meteorological Department, PO Box 910144, Mongu 910144, Zambia

We evaluated the operational MODIS Leaf Area Index (LAI) product using field-sampled data collected at five sites in southern Africa in March 2000. One site (Mongu, Zambia) was sampled monthly throughout the year. All sites were along the IGBP Kalahari Transect, which features progressively lower annual precipitation, and hence lower vegetation productivity, from north to south. At each site, we sampled the vegetation overstory along three 750 m transects using the Tracing Radiation and Architecture in Canopies (TRAC) instrument. The resulting plant area index (PAI) values were adjusted with ancillary stem area data to estimate LAI, and compared to the MODIS product. Results show that fractional canopy cover and PAI increase, and overstory clumping decreases, with increasing annual precipitation. Empirical relationships are provided relating these parameters to each other and to precipitation. Our results also suggest the MODIS LAI algorithm accommodates structural and phenological variability in semi-arid woodlands and savannas, and is numerically accurate to within the field measurement uncertainty.

URL: http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/terra/privette/

B61B-0722 0830h POSTER

Assessment of Provisional MODIS-derived Surfaces Related to the Global Carbon Cycle

Warren B Cohen[1] (541-750-7322; warren.cohen@orst.edu); Thomas K Maiersperger[2] (541-737-5412; tom.maiersperger@orst.edu); David P Turner[2] (541-737-5043; david.turner@orst.edu); Stith T Gower[3] (608-262-0532; stgower@facstaff.wisc.edu); Robert E Kennedy[2] (541-737-2244; robert.kennedy@orst.edu); Steven W Running[4] (406-243-4510; swr@ntsg.umt.edu)

[1]USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331, United States

[2]Forest Science Department, Oregon State University, 321 Richardson Hall, Corvallis, OR 97331, United States

[3]Department of Forest Ecology and Management, University of Wisconsin, 1630 Linden Drive, Madison, WI 53706, United States

[4]School of Forestry, University of Montana, Numerical Terradynamic Simulation Group, Missoula, MT 59812, United States

The global carbon cycle is one of the most important foci of an emerging global biosphere monitoring system. A key component of such a system is the MODIS sensor, onboard the Terra satellite platform. Biosphere monitoring requires an integrated program of satellite observations, Earth-system models, and in situ data. Related to the carbon cycle, MODIS science teams routinely develop a variety of global surfaces such as land cover, leaf area index, and net primary production using MODIS data and functional algorithms. The quality of these surfaces must be evaluated to determine their effectiveness for global biosphere monitoring. A project called BigFoot (http://www.fsl.orst.edu/larse/bigfoot/) is an organized effort across nine biomes to assess the quality of the abovementioned surfaces: (1) Arctic tundra; (2) boreal evergreen needle-leaved forest; temperate (3) cropland, (4) grassland, (5) evergreen needle-leaved forest, and (6) deciduous broad-leaved forest; desert (7) grassland and (8) shrubland; and (9) tropical evergreen broad-leaved forest. Each biome is represented by a site that has an eddy-covariance flux tower that measures water vapor and CO2 fluxes. Flux tower footprints are relatively smallapproximately 1 km2. BigFoot characterizes 25 km2 around each tower, using field data, Landsat ETM+ image data, and ecosystem process models. Our innovative field sampling design incorporates a nested spatial series to facilitate geostatistical analyses, samples the ecological variability at a site, and is logistically efficient. Field data are used both to develop site-specific algorithms for mapping/modeling the variables of interest and to characterize the errors in derived BigFoot surfaces. Direct comparisons of BigFoot- and MODIS-derived surfaces are made to help understand the sources of error in MODIS-derived surfaces and to facilitate improvements to MODIS algorithms. Results from four BigFoot sites will be presented.

B61B-0723 0830h POSTER

Where do the Field Plots Belong? A Multiple-Constraint Sampling Design for the BigFoot Project

Robert E. Kennedy[1] (541-750-7498; robert.kennedy@orst.edu)

Warren B. Cohen[2] (warren.cohen@orst.edu)

Alan A. Kirschbaum[3] (aakirsch@facstaff.wisc.edu)

Stith T. Gower[3] (stgower@facstaff.wisc.edu)

[1]Department of Forest Science, 321 Richardson Hall Oregon State University, Corvallis, OR 97331, United States

[2]USDA Forest Service, Pacific Northwest Research Station 3200 SW Jefferson Way, Corvallis, OR 97331, United States

[3]Department of Forest Ecology and Management, University of Wisconsin 1630 Linden Drive, Madison, WI 53706, United States

A key component of a MODIS validation project is effective characterization of biophysical measures on the ground. Fine-grain ecological field measurements must be placed strategically to capture variability at the scale of the MODIS imagery. Here we describe the BigFoot projects revised sampling scheme, designed to simultaneously meet three important goals: capture landscape variability, avoid spatial autocorrelation between field plots, and minimize time and expense of field sampling. A stochastic process places plots in clumped constellations to reduce field sampling costs, while minimizing spatial autocorrelation. This stochastic process is repeated, creating several hundred realizations of plot constellations. Each constellation is scored and ranked according to its ability to match landscape variability in several Landsat-based spectral indices, and its ability to minimize field sampling costs. We show how this approach has recently been used to place sample plots at the BigFoot projects two newest study areas, one in a desert system and one in a tundra system. We also contrast this sampling approach to that already used at the four prior BigFoot project sites.

B61B-0724 0830h POSTER

Scaling Issues in the Evaluation of MODIS Gross Primary Production Estimates

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

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

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

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

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

[2]USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, United States

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

The Moderate Resolution Imaging Radiometer (MODIS) is the primary instrument in the NASA Earth Observing System for monitoring of global terrestrial vegetation. Estimates of 8-day mean daily gross primary production (GPP) and PSN (GPP leaf and root autotrophic respiration) at the 1 km spatial resolution are now operationally produced from MODIS imagery using a production efficiency approach. In this study we compared the MODIS PSN product over 25-km^2 areas at several sites with scaled PSN estimates based on ground measurements and modeling. The approach to generating the ground-based PSN estimates relied on the Landsat ETM+ sensor for land cover classification and an estimate of maximum leaf area index. These spatial data along with local meteorological data were used to run a process-based carbon cycle model in a spatially distributed mode to generate the PSN estimates. At a deciduous broadleaf forest site, the summertime PSN values from MODIS were generally similar to the scaled PSN values. The phenology of the MODIS PSN indicated a faster ramp-up in the spring than was found with the scaled PSN, or with flux measurements by an eddy covariance flux tower at the site. At a tallgrass prairie site, MODIS PSN phenology also anticipated the actual spring initiation of photosynthesis and mid growing season values tended to be low relative to the scaled PSN. Assessment of these differences will require analysis of several features of the MODIS GPP/PSN algorithm, including the GPP light use efficiency factor, the estimates for incident solar radiation and local meteorology, and the effects of the MODIS 1 km spatial resolution relative to fine scale land use patterns.

B61B-0725 0830h POSTER

Comparison of MODIS-Data With Selected Model Parameters and Measured Flux-Data for two Biome Types (Broadleaf-Deciduous and Needle-Leaf Forest)

Mona Vetter[1] (49-3641-68-67-37; mvetter@bgc-jena.mpg.de)

Alexander Knohl[1] (49-3641-64-37-27; aknohl@bgc-jena.mpg.de)

Maosheng Zhao[2] (zhao@ntsg.umt.edu)

Galina Churkina[1] (49-3641-68-67-24; churkina@bgc-jena.mpg.de)

Manuel Gloor[1] (49-3641-68-67-25; mgloor@bgc-jena.mpg.de)

[1]Max-Planck Institute for Biogeochemistry, Carl Zeiss Promenade 10, Jena 07745, Germany

[2]Numerical Terradynamic Simulation Group, School of Forestry University of Monatana, Missoula, MT 59812, United States

MODIS-data were available for 2001 for the following cites: Hainich (broadleaf deciduous; beechforest) and Tharandt (needleleaf; spruceforest) both Germany, Sorø(broadleaf decidious; beechforest) Denmark and Hyytiälä (needleleaf; pineforest) Finland. The extracted MODIS-data were 5 x 5 km^2 cutoffs with center at the fluxtower cites.

For modelling of LAI and NPP we used the mechanistic model Biome-BGC (Running & Coughlan, 1988, Running & Gower,1991, Running 1994) with general ecophysiological parameterization schemes (White et al, 2000). Long term climate records were generated by MT-CLIM (Thornton et al, 2000). The modeled and measured NEE were in good agreement (R^2 between 0.71 - 0.89). The modeled annual variation of LAI was close to the measured LAI for Hainich, for the other cites maximum LAI were close to modeled maximum.

We will investigate how the MODIS parameters LAI, GPP and PSN cover measured and modeled parameters for the selected cites and biome types. This will give valuable information on how the parameters may be used for model evaluation (fluxes) or as model initialisation (LAI).

References:Running, S.W. & Coughlan, J.C.,**1988**, A general model of forest processes for regional applications. Ecological Modeling, 42, pp. 125 - 124.

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Running, S.W., **1994**, Testing forest BGC ecosystem process simulations across a climatic gradient in Oregon. Ecol. Appl., 4, pp. 238 - 247.

Thornton et al.,**2000**,Simultaneous estimation of daily solar radiation and humidity from observed temperature and precipitation: an application over complex terrain in Austria. Agricultural and Forest Meteorology, 4, pp. 255 - 271.

URL: http://www.bgc-jena.mpg.de/public/carbeur/

B61B-0726 0830h POSTER

Intercomparison of MODIS and Tower Eddy-Flux Based Estimates of Gross and Net Primary Production

Faith Ann Heinsch[1] (406-243-6218; faithann@ntsg.umt.edu); John S Kimball[1,2] (406-982-3301; johnk@ntsg.umt.edu); Alana J Oakins[1] (406-243-4326; oakins@ntsg.umt.edu); Maosheng Zhao[1] (406-243-6228; zhao@ntsg.umt.edu); Sinkyu Kang[1] (406-243-6263; kang@ntsg.umt.edu); Steve W Running[1] (406-243-4327; swr@ntsg.umt.edu)

[1]The University of Montana, NTSG, School of Forestry, 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 estimates of gross (GPP) and net (NPP) primary production from MODIS to tower eddy CO_2 flux-based estimates of these variables across a diverse range of landcover types and climate regimes represented within the Ameriflux network. The standard MODIS output uses daily minimum air temperature and humidity from the NASA Data Assimilation Office (DAO) as a control on the photosynthetic assimilation of atmospheric CO_2. We evaluate the sensitivity of MODIS outputs to input meteorology by using both DAO and site-based daily weather information to calculate MODIS (MOD17) GPP and NPP estimates. Whenever possible, any additional calculations required for MOD17 are based on other MODIS products such as land cover type (MOD12), LAI and FPAR (MOD15). The results of the two outputs are then compared to each other, providing an independent assessment of the accuracy of the MOD17 algorithm.

In the MOD17 algorithm, minimum daily temperature and average daytime vapor pressure deficit are the only environmental controls used to constrain CO_2 fluxes. Questions have arisen as to the accuracy of these constraints. Standard MODIS outputs of GPP are examined in relation to these controls at the various tower sites to determine if the environmental controls within MODIS are adequate. The addition of PPFD as an environmental control is also explored. Results indicate that MODIS and tower based results compare favorably in temperate regions, but that results vary for other regions such as the tropics and boreal and Arctic regions.

B61B-0727 0830h POSTER

A framework for continuous monitoring of the biosphere at multiple scales

Alana J Oakins[1] (406-243-4326; oakins@ntsg.umt.edu); Steve W Running[1] (406-243-4327; swr@ntsg.umt.edu); John S Kimball[1,2] (406-982-3301; johnk@ntsg.umt.edu); Faith Ann Heinsch[1] (406-243-6218; faithann@ntsg.umt.edu); Rachel Loehman[1] (406-243-5616; rachel@ntsg.umt.edu); Maosheng Zhao[1] (406-243-6228; zhao@ntsg.umt.edu); Sinkyu Kang[1] (406-243-6263; kang@ntsg.umt.edu); Richard J Olson[3] (865-574-7819; olsonrj@ornl.gov)

[1]The University of Montana, NTSG, School of Forestry, 32 Campus Drive, Missoula, MT 59812, United States

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

[3]Oak Ridge National Lab, PO Box 2008, Oak Ridge, TN 37831, United States

In response to the need for an improved regional assessment of biospheric responses to increasing atmospheric CO_2 concentrations worldwide, a collaborative effort between eddy CO_2 flux tower researchers (Ameriflux) and ecological modelers (Biome-BGC, LoTEC, and PnET-DAY) was developed to provide a structure for continuous monitoring of the terrestrial biosphere. The tower researchers provide standardized micrometeorological data to the Carbon Dioxide Information Analysis Center (CDIAC) within the NASA ORNL DAAC for dissemination to participating modelers. The results from these models, including daily ET, GPP, NEE, and NPP, are submitted to CDIAC to be posted on an Internet site for comparison on a weekly basis. More recently MODIS (Moderate Resolution Imaging Spectroradiometer) products have been incorporated into this effort with the extrapolation of 8-day estimates of GPP, NPP and LAI within a 5x5 km grid centered over the eddy flux tower sites. The use of ecosystem process models such as Biome-BGC provide a method for uncoupling net CO_2 flux measurements into respiration and photosynthetic components, which can be difficult to estimate at daily intervals, and the means for more direct intercomparison among satellite, tower and model parameters. Additionally, these models also help to resolve scaling issues, allowing point measurements from eddy flux towers to be extrapolated and compared to more regional scale outputs from MODIS.

Preliminary results using Biome-BGC indicate that the model and satellite based GPP and NPP estimates capture seasonality in net carbon exchange measurements fairly well across a wide range of biome types and climatic conditions. Differences among model results, tower measurements, and MODIS products from the MOD17 and MOD15 algorithms are primarily seen in the absolute magnitudes of the fluxes. We hypothesize that the differences between model results and tower measurements are due to several factors including differences between site meteorological conditions and regional temperature and humidity information used in the MOD17 algorithms, and a lack of consideration of site history and related factors influencing soil carbon pools and nutrient availability. Differences between tower measurements and MOD17 results may also be caused by inaccuracies of environmental controls on assimilation of atmospheric CO_2 in the MOD17 algorithm. This framework for near real-time (weekly) intercomparisons of process model, remote sensing and tower eddy flux measurement results provides a better understanding of atmospheric CO_2 exchange at multiple scales and should lead to the ability to monitor the biosphere in a manner similar to the current daily monitoring of streams and snowpack water equivalence.

URL: http://public.ornl.gov/ameriflux/Analysis/Model_Evaluation/index.html

B61B-0728 0830h POSTER

Validation Effort of MODIS LAI/GPP/NPP Products at FLUXNET Sites

Markus Reichstein[1] (++49 921 552061; markus.reichstein@uni-bayreuth.de); Dennis Baldocchi[2] (baldocchi@nature.berkeley.edu); Steve Running[3] (swr@ntsg.umt.edu); John Tenhunen[1] (John.Tenhunen@uni-bayreuth.de); Riccardo Valentini[4] (rik@unitus.it); Serge Rambal[5] (Rambal@cefe.cnrs-mop.fr); Jean-Marc Ourcival[5] (ourcival@cefe.cnrs-mop.fr); Andre Granier[6] (agranier@nancy.inra.fr); Olivier Bouriaud[6] (bouriaud@nancy.inra.fr); Christian Bernhofer[7] (bernhofer@frsws10.forst.tu-dresden.de); Thomas Gruenwald[7] (gruenwald@frsws10.forst.tu-dresden.de)

[1]Department of Plant Ecology, University of Bayreuth, Universitaetsstr. 30, Bayreuth 95447, Germany

[2]Ecosystem Science Division Dept of Environmental Science, Policy Management Berkeley Atmospheric Science Center, 151 Hilgard Hall University of California, Berkeley, Berkeley, CA 94720, United States

[3]Numerical Terradynamic Simulation Group School of Forestry University of Montana, Science Complex, Missoula, MT 59812, United States

[4]Dept. of Forest Environment and Resources DISAFRI - University of Tuscia, Via San Camillo de Lellis, Viterbo 01100, Italy

[5]DREAM Unit CEFE - CNRS, 1919 route de Mende, Montpellier 34293, France

[6]INRA, Centre de Nancy, Champenoux 54280, France

[7]Technische Universitaet Dresden IHM - Meteorologie, Pienner Strasse 9, Tharandt 01737, Germany

Various FLUXNET sites, where simultaneous observations of canopy structure, leaf area index development, net ecosystem exchange and soil respiration are available, provide an excellent basis for validating the MODLAND products that are related to ecosystem structure and carbon and water balance. Here we present our ongoing effort to compare LAI and GPP estimated via MODIS algorithms with ground-observed data at the continental scale. The sites selected for comparison range from 38^{o} to 67^{o} N and comprise boreal and temperate conifer forests (Spruce, Pine), temperate and Mediterranean deciduous forests (Beech, Oak), Mediterranean evergreen broadleaf forests and a savanna-type Mediterranean ecosystems. Emphasis is laid on whether the sensitivity of ecosystem GPP to environmental factors like available radiation, temperature and drought are captured by the algorithms of the MODIS 17 product. Further we compare the tower sites to their surrounding landscapes in terms of their capability to absorb photosynthetic radiation and their net productivity as estimated from MODIS remote sensing data. We conclude that MODIS products can be profitably used for up-scaling from eddy covariance flux sites for estimating continental carbon balance components. There is potential for improvement of the GPP algorithm, including a reparameterization of the sensitivity of GPP to drought and of the radiation-use efficiency under diffuse-light conditions. As we show, both reparameterizations can be effectively achieved by the use of eddy covariance flux data.

B61B-0729 0830h POSTER

Validation of the MODIS MOD17 Algorithms for Estimating global Net Primary Production

Maosheng Zhao[1] (zhao@ntsg.umt.edu)

Steven W. Running[1] (swr@ntsg.umt.edu)

Ramakrishna R. Nemani[1] (nemani@ntsg.umt.edu)

John S. Kimball[1] (johnk@ntsg.umt.edu)

Sinkyu Kang[1] (kang@ntsg.umt.edu)

[1]NTSG,School of Forestry, University of Montana, Missoula, MT, Missoula, MT 59812, United States

The MODIS sensor onboard NASAs flagship Terra EOS satellite now enables global operational mapping and assessment of Earths terrestrial vegetation productivity at 8-day and annual time steps and a moderate 1km spatial resolution. We evaluate annual primary production (NPP) outputs for 2001 from the MODIS MOD17A3 algorithms, using an array of surface network measurements. We compare MODIS MOD17A3 NPP outputs over different climatic regions and across different biomes against NPP observations derived from ecological site network information. A malfunction of the MODIS sensor in 2001 resulted in three missing periods of 8-day FPAR and LAI information, which are required inputs of the MOD17 algorithms. To solve this problem, we employ a method of linear interpolation of missing data to produce a complete LAI/FPAR dataset for deriving annual NPP estimates from the MOD17A3 algorithm. Our results indicate that except for some tropical regions, the MODIS NPP product effectively captures the spatial distribution of ground-based measurements of NPP. In tropical regions MODIS NPP results show generally larger differences relative to field based measurements. It is found that MOD17 daily temperature and humidity inputs from the NASA Data Assimilation Office (DAO) weather forecast model may be one factor responsible for these differences; another factor may be due to differences between site and model prescribed environmental controls on the photosynthetic fixation of atmospheric CO2 by vegetation. Overall, these results establish greater confidence in MODIS outputs and reveal possible methods for further refining and improving the MODIS NPP algorithms.

URL: http://www.forestry.umt.edu/ntsg/

B61B-0730 0830h POSTER

Validation of MODIS Active Fire Products With Coincident ASTER Data

Ivan A Csiszar[1] (3014058696; icsiszar@hermes.geog.umd.edu)

Jefferey T Morisette[2] (3016146676; jeff.morisette@gsfc.nasa.gov)

Louis Giglio[3] (3016146698; giglio@hades.gsfc.nasa.gov)

Christopher O Justice[1] (3014051600; justice@hermes.geog.umd.edu)

[1]University of Maryland Department of Geography, 2181 LeFrak Hall, College Park, MD 20742, United States

[2]NASA Goddard Space Flight Center, Code 923, Greenbelt, MD 20771, United States

[3]Science Systems and Applications, Inc., NASA/GSFC Code 923, Greenbelt, MD 20771, United States

Satellites provide valuable information for the large-scale monitoring of biomass burning over the globe. However, the accuracy of the satellite-derived fire products needs to be determined. An active fire product from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on board the polar orbiter Terra satellite has been available since 2000. A unique feature of the Terra satellite is the availability of coincident high resolution data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). In this study we used the elevated signal in the 30 m resolution ASTER channel 9 at 2.4 micron to characterize fires within the 1-km MODIS pixels. The probability of MODIS detection was determined by logistic regression as a function of subpixel fractional fire coverage and spatial heterogeneity. Examples of individual fires and summarized statistics will be presented for various regions of the globe. The effects of algorithm changes on product accuracy will also be discussed. This work is being undertaken in the framework of the international GOFC/GOLD-Fire program. Involvement of regional scientists in validation of satellite data products is encouraged and will help build a user community informed on the capabilities and limitations of a given product for subsequent application.

B61B-0731 0830h POSTER

Understanding the effect of fire disturbance and climate change on model estimates of regional carbon cycling in the boreal forest biome

Sinkyu Kang[1] (kang@ntsg.umt.edu)

John Kimball[1] (johnk@ntsg.umt.edu)

Steve W. Running[1] (swr@ntsg.umt.edu)

[1]NTSG, University of Montana, NTSG, School of Forestry, U. of Montana, Missoula, MT 59812, United States

The temperate and boreal latitudes of the Northern Hemisphere have been recognized as large potential missing carbon sink during the past two decades. Nevertheless, the mechanisms and the precise spatial pattern of a terrestrial sink for CO_2 in North America remain uncertain. Using a process-oriented biogeochemical ecosystem model (BIOME-BGC), we simulated regional carbon cycling in the BOREAS region

with emphasizing the effect of fire disturbance and the sensitivity of the carbon cycling to climate change. Our experimental design covers total 108 combinations with respects to four major landcover types (deciduous broadleaf, grass, wet and dry conifer), increasing CO_2, fire disturbance, incresed/decreased temperature and precipitation. Based on the simulation, we constructed potential vegetation maps of LAI, GPP, and NPP, which were compared MODIS land products. Distinctly distinguishable patterns of regional carbon cycling were identified depending on landcover types. Elevated CO_2 resulted in overall 15% increase in NPP, when it was compared to NPP predicted with pre-industrial CO_2 concentration before 1861. Warmer area was more sensitive to the elevated CO_2 than cooler area. Explicit fire-disturbance simulation produced slightly lower NPP and distinctly scratched patterns but did not alter significantly aerial means, compared to constant fire-mortality simulation. Increased temperature and precipitation were positively related with the increased NPP. The model estimates of regional carbon cycling were more sensitive to temperature than precipitation. Our simulation experiments show the BOREAS region is overall carbon sink but sensitive to geographic location and vulnerable to fire disturbance and future climate change.

B61B-0732 0830h POSTER

Directional Effects on Observations of Land Surface Temperature With AVHRR Over Africa

Ana C Pinheiro[1] (301-614-6696; ana@fado.gsfc.nasa.gov)

Jeffrey L. Privette[2] (301-614-6630; Jeffrey.Privette@gsfc.nasa.gov)

Robert L. Mahoney[3] (301-614-6602; Robert.L.Mahoney.1@gsfc.nasa.gov)

Compton J. Tucker[2] (301-614-6644; compton@kratmos.gsfc.nasa.gov)

[1]New University of Lisbon (Portugal), CODE 923 GSFC NASA, Greenbelt, MD Greenbelt, United States

[2]NASA's Goddard Space Flight Center, CODE 923 GSFC NASA, Greenbelt, Md 20771, United States

[3]GST, CODE 923 GSFC NASA, Greenbelt, Md 20771, United States

We characterized the directional effects on the thermal infrared signal retrieved by the NOAA Advanced Very High Resolution Radiometer (AVHRR). For that purpose, day and night GAC data were processed using the full swath width of the AVHRR/2. We developed a methodology for normalizing the land surface temperature to nadir observation and tested it over continental Africa. The methodology is based on ancillary structural information of the surface as well as empirical and modeled relationships between the scene endmembers. To assess the effectiveness of our method, we apply it to one of the EOS and SAFARI 2000 core sites: Skukuza, South Africa. The directional trends of AVHRR estimates and modeled predictions are consistent and suggest that this approach could be further developed to help reduce the systematic bias in land surface temperature from AVHRR. Our method is general and applicable to other wide field of view sensors such as MODIS.

B61B-0733 0830h POSTER

The MODIS Snow Products - an integral part of the MODIS Land Surface Products

Marilyn Kaminski[1] (303-735-5408; marilynk@nsidc.org); Greg Scharfen[1] (303-492-6197; scharfen@nsidc.org); Dorothy K Hall[2] (301-614-5771; dhall@glacier.gsfc.nasa.gov); Brad McLean[1] (303-492-1160; btmclean@nsidc.org); Siri Jodha Singh Khalsa[3] (303-492-1445; sjsk@nsidc.org); Terry Haran[1] (303-492-1847; tharan@nsidc.org); Jason Wolfe[1] (303-492-1504; wolfe@nsidc.org)

[1]National Snow and Ice Data Center, University of Colorado UCB 449, Boulder, CO 80309-0449, United States

[2]Hydrological Sciences Branch, Code 974, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, United States

[3]L-3 Communications Corporation, 1801 McCormick Dr. Suite 170, Landover, MD 20774, United States

With Moderate Resolution Imaging Spectroradiometer (MODIS) instruments now operating on the NASA Terra and Aqua satellites, a daily, global coverage stream of high quality information about the earth's surface is being collected and made available to the public. The MODIS archives at the NASA Distributed Active Archive Centers (DAACs) include a range of data sets, from individual channel radiances to geophysical parameters in swath and resampled gridded formats. The MODIS snow products, produced by the MODIS Science Team and distributed by the National Snow and Ice Data Center DAAC, are a key part of the land surface suite of products. The MODIS snow products are now providing fully automated, daily, global maps of snow cover extent at a spatial resolution of 500-m. The MODIS data from Terra have been produced since October 2000. Ongoing work to improve the performance and utility of the products includes improvements to the use of the MODIS cloud mask, algorithm enhancements to more accurately map snow cover in dense forests, a Climate Modelers Grid, easy to access browse, and plans for a snow albedo product. This paper describes the characteristics, capabilities and limitations of the MODIS snow products, their accessibility from the NSIDC DAAC, and current user support and tools.

URL: http://nsidc.org/modis

B61B-0734 0830h POSTER

New Tool for MODIS Multiple Data Ordering: A Case Study Over Lake Michigan

Dana Ostrenga (301-614-5475; dostreng@eosdata.gsfc.nasa.gov)

NASA GSFC, DAAC Building 32, Rm. S-135-1 Code 902, Greenbelt, MD 20771, United States

The Goddard Earth Sciences Distributed Archive Center (GES DAAC) has served as an intermediary between MODISi Data and the user community. This has given us the unique opportunity to communicate with the users and explore better options for accessing and ordering MODIS Data. The MODIS Data Support Team at GES DAAC has developed a much needed tool to aid users to simultaneously order multiple data products, set temporal and spatial search criteria, find appropriate satellite overpass, cloud cover of the scene, and more, all in one interface. The enhanced tool serves as a portal to the GES DAAC Web-based Hierarchical Ordering Mechanism(WHOM), removing, however, some of the drawbacks of WHOM. One of the strengths of the tool is to provide long time series of multiple MODIS Level 1 and Ocean and Atmosphere Level 2 products: something not available from WHOM but so much needed for regional studies.

This presentation will demonstrate the features of the tool using as an example a case study of Ocean Color and Surface Temperature over Lake Michigan.Readers will be guided through the whole process of selecing the relevant data, the spatial and temporal region, submitting order, and finally visualizing the MODIS products. Plans for further developments will be presented as well.

B61C MCC: Hall C Saturday 0830h

High Spatial and Spectral Resolution Remote Sensing of Urban Ecology: New Results From NASA EOS Satellite and Airborne Sensors

Posters *(joint with OS, GC)*

Presiding: **W L Stefanov,** Arizona State University**; J Grove,** USDA Forest Service

B61C-0735 0830h INVITED POSTER

Multiresolution Morphology and Metabolism of the Metropolis

Lawrence Band[1] (919-962-3921; lband@email.unc.edu); David Tenenbaum[1] (davidten@email.unc.edu); Christina Tague[2] (tague@mail.sdsu.edu); Stephen Kenworthy[1] (stk@umbc.edu); Neely Law[1] (nlaw@email.unc.edu); Mary Cadenasso[3] (cadenasso@ecostudies.org); Steward Pickett[3] (picketts@ecostudies.org)

[1]University of North Carolina, CB3220, Chapel Hill, NC 27599, United States

[2]San Diego State University, 5500 Campinile Dr., San Diego, CA 92182, United States

[3]Institute for Ecosystem Study, Box AB, Millbrook, NY 12545, United States

Small watershed research is a hallmark of the LTER network, with catchments subject to different treatments used to develop input-output budgets of water, nutrients and carbon, as well as an understanding of the relations of energy and material cycling to ecological communities and trophic systems. In the Baltimore Ecosystem Study (BES), this approach emphasizes the role of human society as part of the ecosystem such that individual and institutional activity are defined as important aspects of ecological community and trophic system dynamics. We have been adapting a spatial hydroecological modeling approach to operate across the urban-rural gradient, incorporating an explicit description of the drainage sequence, as well as human sources of irrigation water and fertilizer. As human activity tends to produce sharp gradients in land cover and topographic structure (e.g. property lines, drainage infrastructure), the behavior of human dominated ecosystems may require higher resolution information to adequately characterize system structure and function. We hypothesize that our spatial analysis and modeling methods will show greater sensitivity to topographic and land cover information in the suburban sites than in the agricultural or forested ecosystems.

In this paper we concentrate on three of the headwater catchments, including a fully forested catchment (Pond Branch), a suburban catchment (Glyndon) and an agricultural catchment (McDonogh). Continuous discharge gauging by the USGS at each of the three catchments and weekly sampling for stream chemistry have been carried out for all three catchments. Soil moisture has been sampled weekly at a set of sites along a topographic wetness gradient using portable soil moisture meters. Topographically defined flowpath networks were extracted from high resolution digital elevation models (DEMs) at 30m resolution, 5m resolution from photogrammetric sources and at 0.5m from LIDAR. Land cover at these resolutions are also extracted from high resolution airborne imagery and ETM scenes. One of the key features of the catchments we concentrate on is the ecological patch structure along topographic flowpaths and the nature of the land cover and topographic drainage right around the stream channel as these features often have an important role in modifying streamflow generation and water chemistry. Using measured soil moisture and streamflow discharge and chemistry, we test the impact of source data resolutions used to generate topographic and land cover information on our ability to model the measured soil moisture, streamflow and chemistry from these catchments.

B61C-0736 0830h POSTER

Multi-sensor Approaches to Urbanization: Using Astronaut Photography of Earth to Fill Data Gaps

Julie A Robinson[1] (281-483-5582; julie.a.robinson1@jsc.nasa.gov)

Brett McRay[1] (281-244-5106; bhmcray@ems.jsc.nasa.gov)

Edward L Webb[2] (662-524-5585; ewebb@ait.ac.th)

Alan Spraggins[1] (281-333-6705; sspraggi@ems.jsc.nasa.gov)

[1]Earth Sciences Image Analysis Laboratory (Lockheed Martin Space Operations), Johnson Space Center 2400 NASA Road 1, C23, Houston, TX 77058, United States

[2]School of Environment, Resources Development, The Asian Institute of Technology P.O. Box 4 Klong Luang, Pathum Thani 12120, Thailand

Scientists studying the rapid growth of urban areas around the globe often must combine a variety remote sensing sources to get data that meets their needs. Depending on research questions, these needs may include observations at specific points in time or with sufficient spatial resolution. Though not widely used for urban studies, astronaut photography can uniquely fill some data gaps. Early photographs taken during the Gemini and Apollo programs in the 1960s represent the oldest remotely sensed records for a number of world cities. The archive of astronaut photography of Earth is maintained in a single location, offers valuable information on urban boundaries over the last 40 years, and can fill gaps in time series studies. Although working with digitized photographs differs from satellite data, such images can be used as 3-band data, georeferenced, and used with image analysis techniques such as supervised classification and texture analysis. The results of simple land cover classifications can approximate results that would be obtained from Landsat. Using digital cameras from the International Space Station, astronauts are now routinely acquiring photographs of urban areas with 6 m or better spatial resolution. These images serve as valuable sources of information that can be analyzed directly or used to verify analyses of other sensor data. Astronaut photographs of cities are available for public searching on the web at NASA Johnson Space Centers The Gateway to Astronaut Photography of Earth. The site includes tools for searching the over 400,000 photographs taken to date as well as a special collection, Cities from Space, of outstanding city photographs.

URL: http://eol.jsc.nasa.gov