

QUARTERLY REPORT
NASA CONTRACT NAS5-31368
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WORK ACCOMPLISHED: January 1998- April 1998

EOS-IWG

Attended EOS Hydrology validation working group meeting at Princeton, April 5-7 hosted by EOS Hydrology panel Chair.

MODLER

The MODLER project was funded by the EOS Validation competition to explore sampling and instrument methodologies for measuring 3 MODIS core products, landcover, LAI and NPP over multi-hundred kilometer areas. This was originally a close collaboration with the NSF LTER program, but this is being renegotiated because few of the LTERs have flux towers. A meeting is being held in May 1998 to finalize the MODLER contribution to EOS Validation.

Global Climate and Terrestrial Observing Systems (GCOS/GTOS)

A new project, GTOS-NPP is under development that can provide a global validation of direct field measured NPP, the next planning meeting is May 1998 in Corvallis, OR. Also, a GTOS Forest cover mapping initiative is under discussion, to map the global forest cover at Landsat TM resolution. This project, if completed, could provide a very high-resolution validation of the MODIS Landcover product.

IGBP Biospheric Aspects of the Hydrologic Cycle (BAHC)

We propose that FLUXNET will host the EOS Simple Tower configuration suggested in the MODLAND validation plan. The proposed network will be a combination of Ameriflux for North America (<http://www.esd.ornl.gov/programs/NIGEC/>), EUROFLUX for Europe, OZFLUX for Australia/New Zealand, and other regions as they develop. We will be hosting the international FLUXNET workshop in June 1998 in Montana, as part of our MODLAND validation activity.

PIK NPP Workshop

The IGBP-GAIM project is running a global NPP model intercomparison. This activity is the most organized effort in the world to determine best NPP analysis for validating the MODLAND NPP product. The following two papers have been submitted by our lab for summarizing and analyzing PIK-NPP results:

Churkina, G., SWRunning, A.Schloss and PIK-95 1997. Comparing global models of terrestrial NPP: The importance of water availability to primary productivity in global terrestrial models. Global Change Biology (in review)

Churkina, G., and SWRunning. 1998. Contrasting climatic controls on the estimated productivity of different biomes. *Ecosystems* (In press)

These publications are still pending.

VEMAP - Vegetation ecosystem modeling and analysis project

The BIOME-BGC model that is part of our MODIS algorithm development for the EOS NPP product is one of the three-biogeochemistry models being tested. Currently VEMAP is building transitory climate and CO₂ datasets for the next generation of simulations. The next models will be prototypes of what now are called DGVMs Dynamic Global Vegetation Models incorporating interacting biogeography and biogeochemistry models.

We attended a VEMAP team meeting in Ft. Collins in April 1998, where the final protocols for the VEMAP II simulations were decided.

EOS – US Forest Service Fire Management project

I have worked with the US Forest Service Intermountain Fire Research Lab for the last year to design a plan to incorporate EOS data into a next generation Wildfire Management Plan. An unsolicited proposal has been submitted to Dr. Nancy Maynard at NASA HQ in March 1998.

1997 Growing Season Implementation

A c-code algorithm based on Nemani et al. (1993) and Nemani and Running's (1989) surface resistance logic has been completed and has been applied to 1997 growing season AVHRR data. Composited data were delivered to the University of Montana via an ftp site hosted by the EROS Data Center. The prototype algorithm generates both a Drought Index and a Fire Danger (Live Fuels) Index for the eleven western states one time per week. Sample products for the first and last composite periods are attached as Figures 1 and 2. During the period June 6 to October 9, a total of eighteen weekly composites were processed into prototype products. Single-band data files were ingested from the ftp site on the first day following the composite period as byte-scale BIL files. Each file contained a separate band of data; channels 1, 2, 4, 5, and a calculated NDVI channel. NDVI was calculated from calibrated (radiance and reflectance) data (Kidwell, 1991).

A web delivery system capable of distributing images and data has been constructed. We are currently in the process of constructing an interactive map delivery system using ESRI Internet map server technology. The new delivery system will allow users to select regions of interest and manipulate ancillary data sets in conjunction with the fire danger product for enhanced understanding of spatial patterns of fire danger. We suspect the first rough cut version of this map server technology to come on line towards the end of the summer (we are currently limited by campus wide bartering with ESRI).

Methods of semi-automated metadata documentation have been completed with the help of U. of MT. metadata coordinator Kathy Jurist. Metadata construction is completed with minimal producer input and html documents complete with hyperlinked contact, etc. info ready for web posting.

Lastly, a validation plan has been developed to test the sensitivity and performance of current and future implementation of the fire danger/drought product. This is a multi-tiered approach that relies on a mixture of qualitative and quantitative studies. Planned projects include assessment of spatial coincidence of danger rating with fire occurrence (derived from USFS fire location database), comparative analysis with current fire danger and drought indices, model runs, and comparisons with large scale (cartographic scale—small spatial extent) field measures of soil and vegetation (live and dead) moisture.

An example of this Fire Danger mapping system was highlighted in the NASA Earth Science Enterprise 1998 Applications Fact Book.

Fire fuels mapping initiative

We continue to explore LIDAR's ability to characterize forest structure and wildfire fuels distributions. Some of this work has been further described in a NASA ESSP Graduate Fellowship proposal by this author. Data acquisition has been a major hurdle although we have recently obtained NASA SLICER data (8-meter footprint, waveform data) from the BOREAS sites and OPTECH data (1 meter footprint, single return data) from western Canada.

Three-dimensional characterization of total volume of vegetation and empty space within a forest canopy now appears possible with waveform data from large-footprint scanning lidars like SLICER (Lefsky et. al., in press). These authors were able to use such characterizations to accurately predict biomass, LAI, basal area, and mean dbh in four classes of canopy structure from the H.J. Andrews Experimental Forest, Oregon, USA. We are following their lead with the BOREAS dataset with the goal of developing a spatially explicit 3-D forest fuels mapping routine that will help us to predict the movement of fire through canopy and surface fuels.

A major feature of this research is the partitioning of biomass volume in 3-D space. A new generation of fire behavior models requires these data for predictions of transitions between ground fire and crown fire. Our MODIS Fire Potential Product will provide quantification of fuels 'conditions' within this 3-D fuels matrix.

Four issues currently dominate our research agenda:

- 1) Testing of Lefsky et. al.'s (1998) biomass and LAI algorithms in a fuels context, and development of new ones.
- 2) development of scaling lanes between footprint sizes (ie. 8 m to 25 m)
- 3) mitigation of slope-induced pulse spreading through slope normalization
- 4) Establishment of methods to propagate lidar-derived vegetation measurements across the landscape (from narrow transects).

Finally, we have begun to explore visualization methods for lidar data. We are using lidar measurements of tree structure in established allometric equations to develop a stand visualization technique (in a topologic, vector-based GIS). This work draws heavily upon the USFS Forest Vegetation Simulator, a modeling program which grows forest stands from inventory data and visually represents them.

[Lefsky, M.A., W.B. Cohen, A. Acker, T.A. Spies, G.G. Parker, and D. Harding, 1998 (in press), Lidar remote sensing of forest canopy structure and related biophysical parameters at the H.J. Andrews Experimental Forest, Oregon, USA, 13 pp.]

GLOBE

The University of Montana has been selected as a GLOBE regional Training Center. We will host a GLOBE training workshop in May 18-23, 1998. Additionally, we have written protocol for a new GLOBE variable to be measured by all participating GLOBE schools world-wide. Our GLOBE phenology protocol has now been added to the public GLOBE web site

Validation of MODIS products

An exploratory visit to research sites in India was completed in February, 1998. Although interested individuals were met, and a potential validation area in Nagarole National Park was found, the local remote sensing activity is keyed to the Indian Space Agency satellites for applications activities, and little immediate opportunity for EOS seems available.

Jornada PROVE

A paper from the Jornada PROVE campaign has been sent to Jeff Privette for the Remote Sensing of Environment special issue.

PUBLICATIONS

Running, S.W., RR Nemani and J. Glassy. 1998. GLOBAL NET PHOTOSYNTHESIS AND TERRESTRIAL NET PRIMARY PRODUCTIVITY from the EARTH OBSERVING SYSTEM To appear in *Methods in Ecosystem Science*, edited by Sala, Jackson, Mooney and Howarth, Springer-Verlag New York, Inc.

Waring, R.H. and S.W. Running 1998. *Forest Ecosystems: Analysis at Multiple Scales*. Academic Press. San Diego.

White, J.D., S.W. Running, PE Thornton, REKeane, KCRyan, DBFagre, and CHKey (1998) Assessing regional simulations of carbon and water budgets for climate change research at Glacier Nat Park. USA. *Ecological Applications* (in press).

White, J.D., S.W. Running, R.Nemani, R.E. Keane, and K.C. Ryan. (1998). Measurement and mapping of LAI in Rocky Mountain Montana Ecosystems. *Canadian Journal of Forest Research* (in press).

Hasenauer, H., R. Nemani, K. Schadauer and S. Running. 1998. Forest growth response to change climate between 1960-1990 in Austria. *Forest Ecology and Management* (submitted).