MODIS land team

Outline: **Overview, slides 2 - 6**
EOS Core Sites, slides 7 – 9
DAAC support, slides 10 – 13
Validation investigations, by MODLAND product, slides 13 – 23
Summary information, slides 24 - 27

Chris Justice, Team Leader
Jeff Privette, NASA Validation Official
Jeff Morisette, Validation Coordinator

MODIS Land Product Suites

Surface Radiation and Energy Budget Products

- **Surface Spectral Bidirectional Reflectances Corrected for Atmosphere**
- **Bidirectional Reflectance Distribution Function (BRDF)**
- **Albedo**
- **Land Surface Temperature (day & night)**
- **Snow and Ice**

Ecosystem Characterization Products

- **Spectral Vegetation Indices**
- **Fraction Absorbed Photosynthetically-Active Radiation (fAPAR)**
- **Leaf Area Index (LAI)**
- **Net Primary Production (NPP)**

Land Cover Products

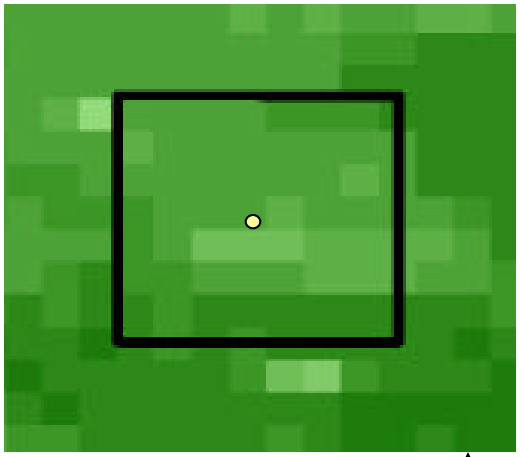
- **Land Cover**
- **Land Cover Change**
- **Fire, Thermal Anomalies**
- **Burn Scars**

MODLAND Validation Approach

- Couple field, tower, and airborne measurements with high-resolution satellite data to produce accurate high-resolution products to which corresponding MODIS land products can be compared
- Focus on the EOS Land Validation Core Sites, with special needs being met by product-specific sites
- Coordinate with EOS Validation program and other NASA funded validation-related Investigators
- Interact with other Terra instrument teams and international instruments through the Committee on Earth Observing Satellites “Land Product Validation” subgroup
- Utilize established data networks
- (e.g. AERONET and FLUXNET)
- Participate in community field campaigns
- (LBA, SAFARI 2000, GCIP)
- Collaborate with the data providers
- (PI’s, EDC & ORNL DAACs, UMd and MSU ESIPS)

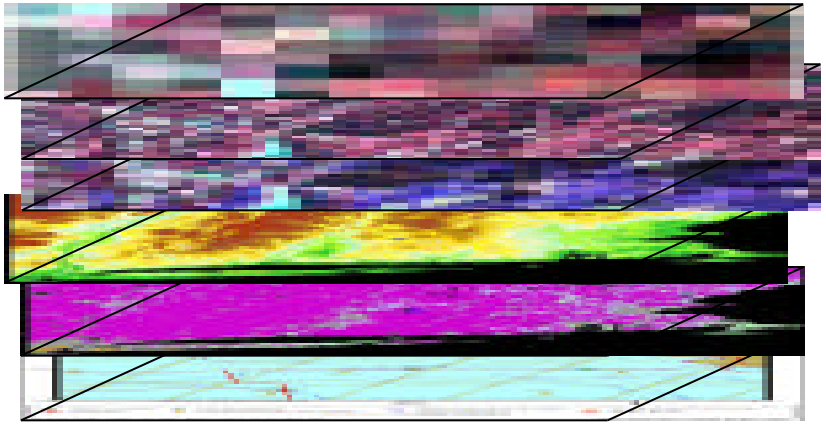
MODIS Land Discipline Team: general land product validation strategy

?

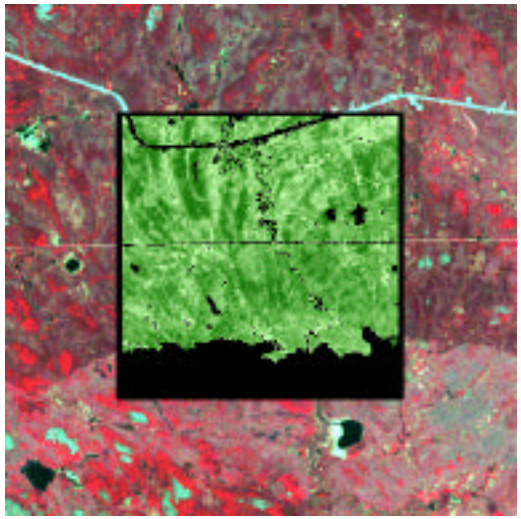


Create high res. products by coupling high res. imagery with field and tower data

Correlate



Aggregate



Some graphics courtesy of BigFoot project

Why we need to validate land products

- **Good science and resource management require understanding of product accuracy/uncertainty**
- **Explicit statements of uncertainty fosters an informed user community and improved use of data**
- **International environmental protocols and agreements imply findings will be independently evaluated and possibly challenged**
- **As more, and similar, global products are produced by CEOS members, inter-use will require characterization of each product's uncertainty**

For more information…

"Validation:
the process of assessing by independent means the quality of the data products derived from the system outputs"

- Committee on Earth Observing Satellites (CEOS)

MODLAND validation home page

http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL

MODLAND validation site hierarchy

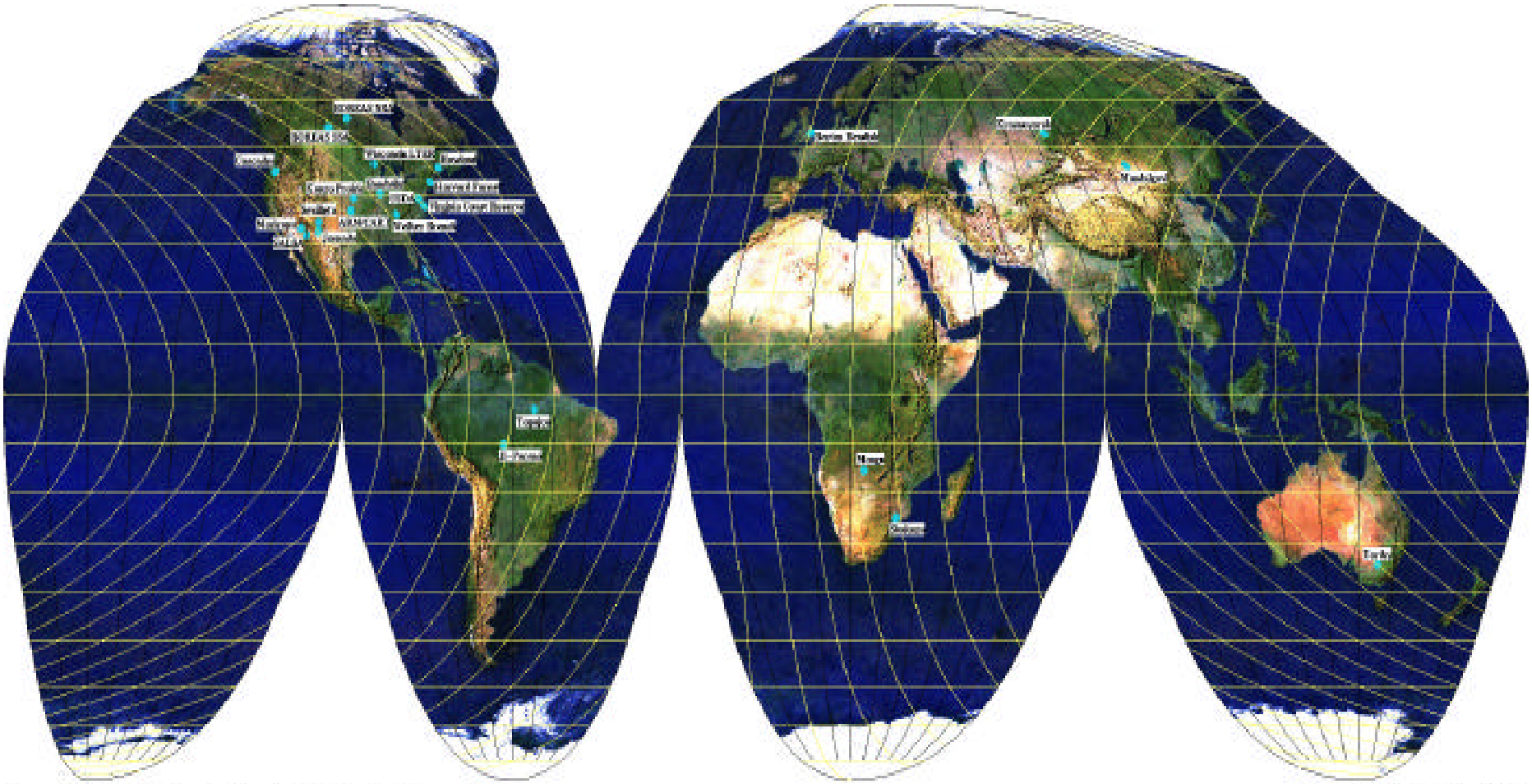
1. EOS Land Validation Core Sites

Serving as a focus for satellite, aircraft, and ground data collection of land product validation, from which scientists can readily access in-situ and EOS instrument data

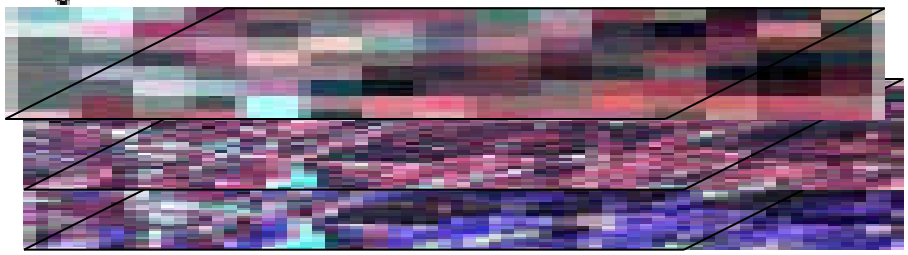
2. Product Specific Sites

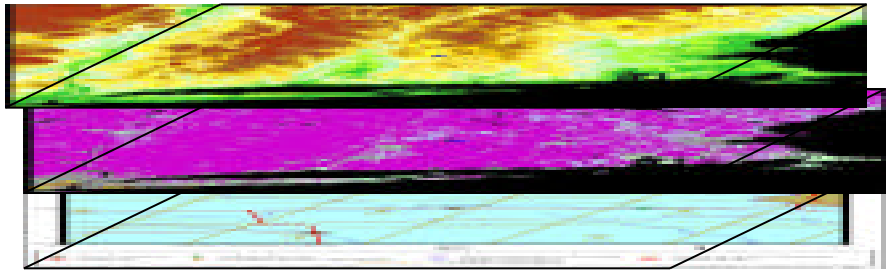
Complementing the Core Sites, meeting the specific needs of individual MODIS products. Where possible, shared data with other instrument teams with similar products (e.g. Land Surface Temp. with ASTER team)

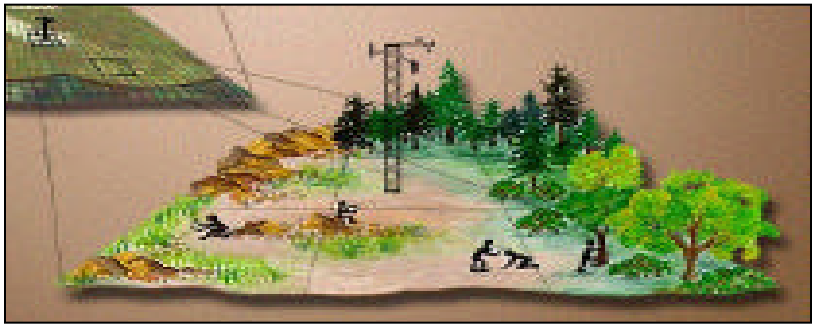
EOS Land Validation Core Sites



Core Sites data suite







Field data graphic courtesy of the BigFoot program

Satellite imagery
- **MODIS Subsets (EDC DAAC)**
- **ETM+ (EDC DAAC)**
- **ASTER data (EDC DAAC)**
- **MISR Local Mode (Langley DAAC)**
- **SeaWiFS Subsets (GSFC)**
- **IKONOS (SDP/GLCF)**
- **"GeoCover '90s TM (SDP)**
- **EO-1**

Ancillary layers and background information such as existing
- **elevation**
- **land cover**
- **reference layer**

available through UMd ESIP – GLCF

Field and airborne data: archive and access through ORNL DAAC's "Mercury System"

AERONET and FLUXNET data

Black: available for all Core Sites
Blue: available for some Core Sites,
Green: not currently available

EDC-DAAC Validation support

- **Supplying ftp directories for on-line data access to ETM+, ASTER, and MODIS subsets over the EOS Core Sites**

- **Created and supporting the "MODIS reprojection tool", allowing investigators to convert MODIS Integerized Sinusoidal Grid to other projections**
  http://edc.usgs.gov/programs/sddm/modisdist/index.shtml

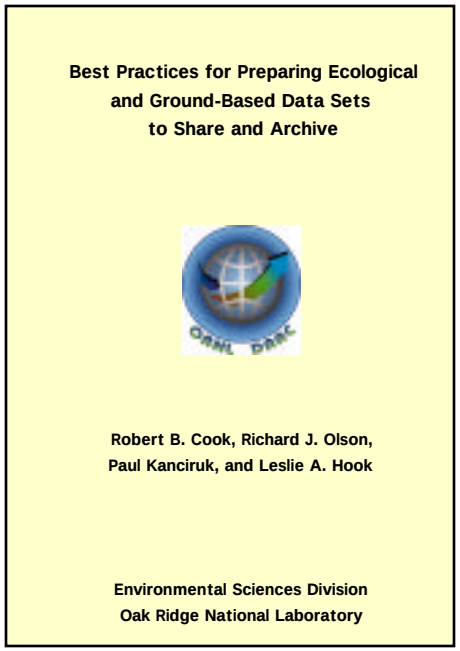
- **Providing mission operation Control for prioritized Landsat acquisitions during field campaigns**

ORNL-DAAC Validation support

- **Ingesting and summarizing MODIS subsets over key FLUXNET tower sites and working to integrate theses summaries into the *in situ* data collected at these sites**
  (http://public.ornl.gov/fluxnet/modis.cfm)

- **Created and maintaining the Mercury tool for registration and internet listing of validation-related field data**
  (*http://mercury.ornl.gov/)*

"Best Practices for Preparing Ecological and Ground-Based Data Sets to Share and Archive"



- Prepared by ORNL (Cook et al.)
- Best Practices include:
  1. Assign Descriptive File Names
  2. Use Consistent and Stable File Formats
  3. Define the Parameters
  4. Use Consistent Data Organization
  5. Perform Basic Quality Assurance
  6. Assign Descriptive Data Set Titles
  7. Provide Documentation
- Provided this document to SAFARI 2000, EOS Land Validation, BigFoot, and LBA projects
- Available on-line, in booklets, Ecol. Bull. (in press)
  (http://www.daac.ornl.gov/DAAC/PI/bestprac.html)

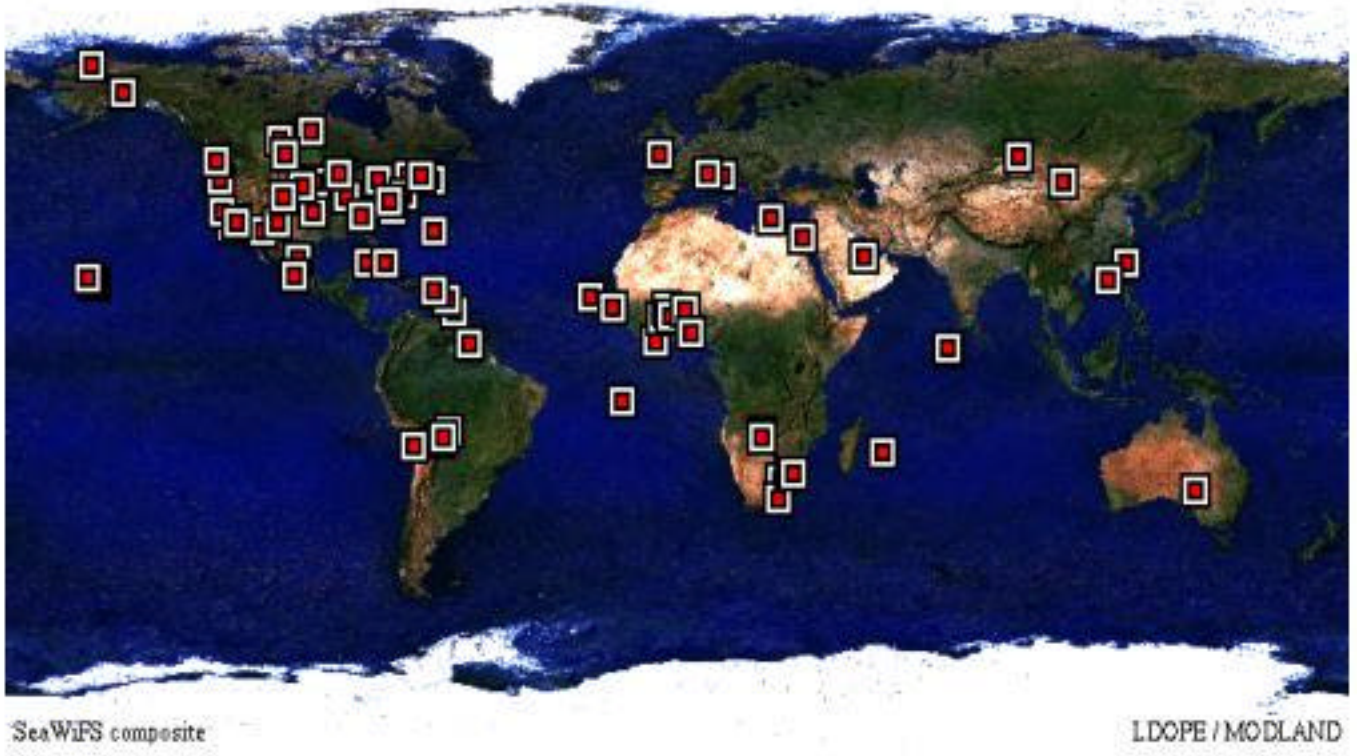
Validation activities by products

- **The following 10 slides provide the names of MODIS PI and the EOS validation investigators relevant for each product. More information on the EOS validation investigations can be found at: *http://eospso.gsfc.nasa.gov/validation/terraval.html***

- **Some products are utilizing additional sources to support validation activities. In such cases, the related URL is listed.**

Surface Reflectance

Eric Vermote PI
EOS investigation: S. Liang
Primary reference data: Aeronet *(http://aeronet.gsfc.nasa.gov:8080/)*



Land Surface Temperature

PI: Z. Wan
EOS investigation: S. Hook

Lake Tahoe, S. Hook

Wan

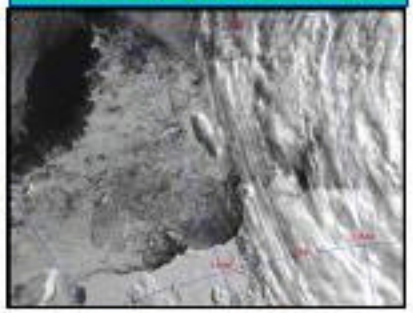
Uardry, S. Hook

Wan

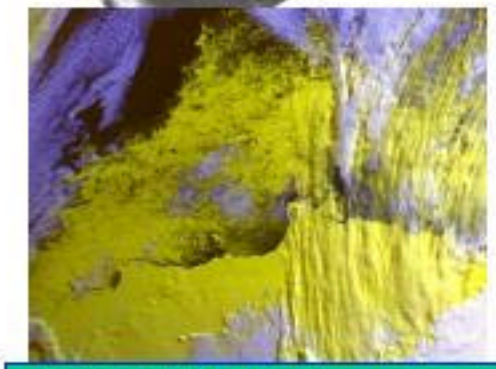
Snow and Sea Ice

PI: Dorothy Hall
EOS investigations: S. Li, A. Nolin, and J. Shi

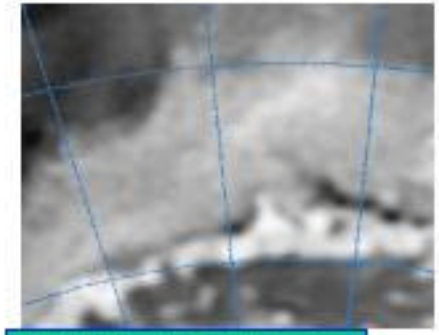
3/9/00 (DMSP OLS)



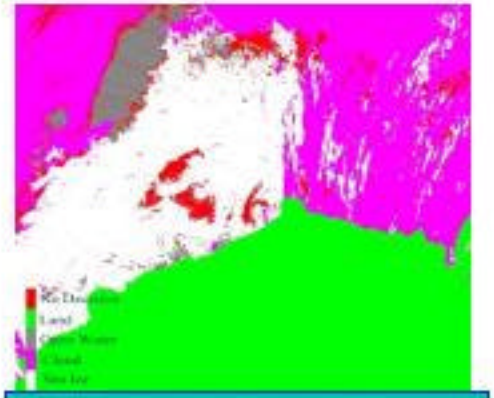
2/27-2/29/00 (RADARSAT)



3/9/00 (MODIS Bands 3, 4, 7)



3/9/00 (QuikScat)

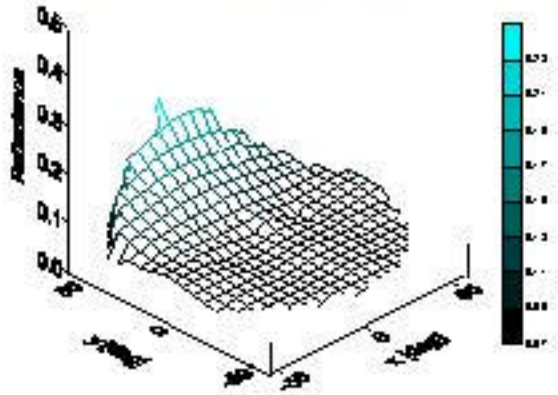


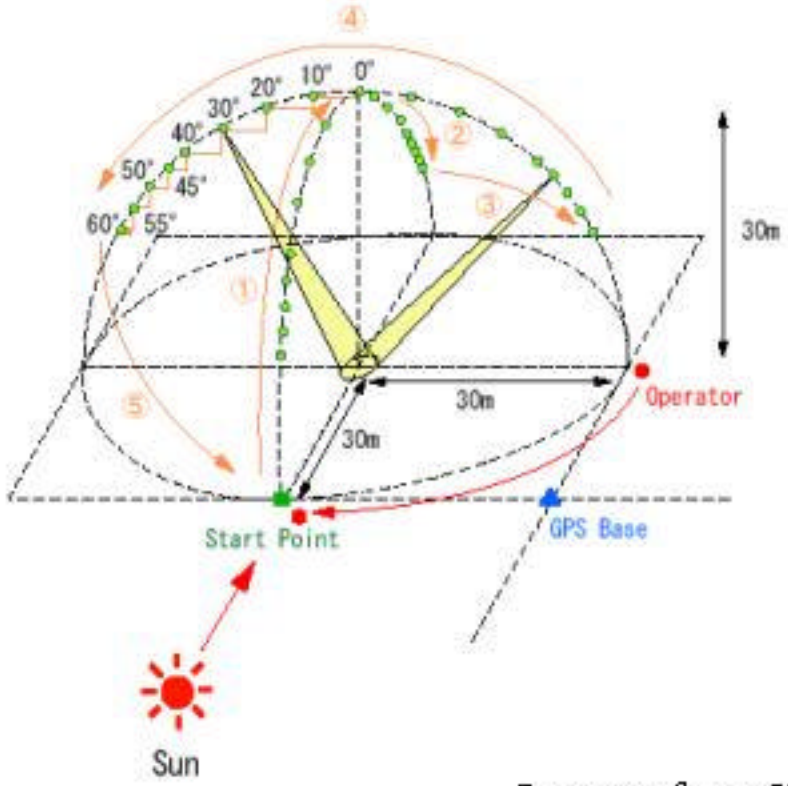
3/9/00 MODIS Ice Extent

Image from S. Li

BRDF/ Albedo

A. Strahler and J.P. Muller: PIs
EOS investigations: J. Privette, S. Liang, Anne Nolin (snow Albedo)
Collaboration with Japan's Global Land Imager team: Y. Honda, Chiba Univ.
http://rsirc.cr.chiba-u.ac.jp:8080/

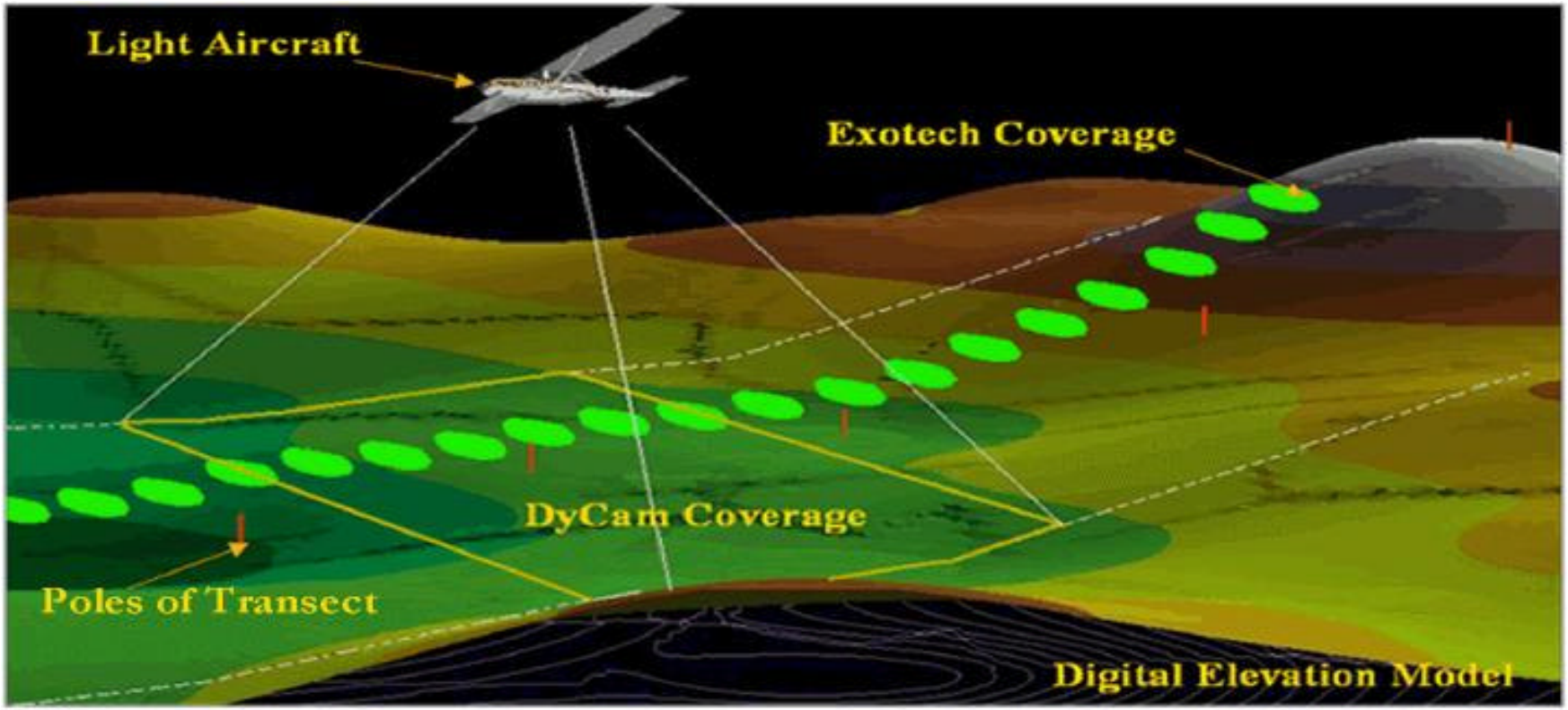




Images from Y. Honda

Vegetation Indices

Alfredo Huete: PI
Utilizing the "MQUALS" system
http://gaea.fcr.arizona.edu/validation/index.htm



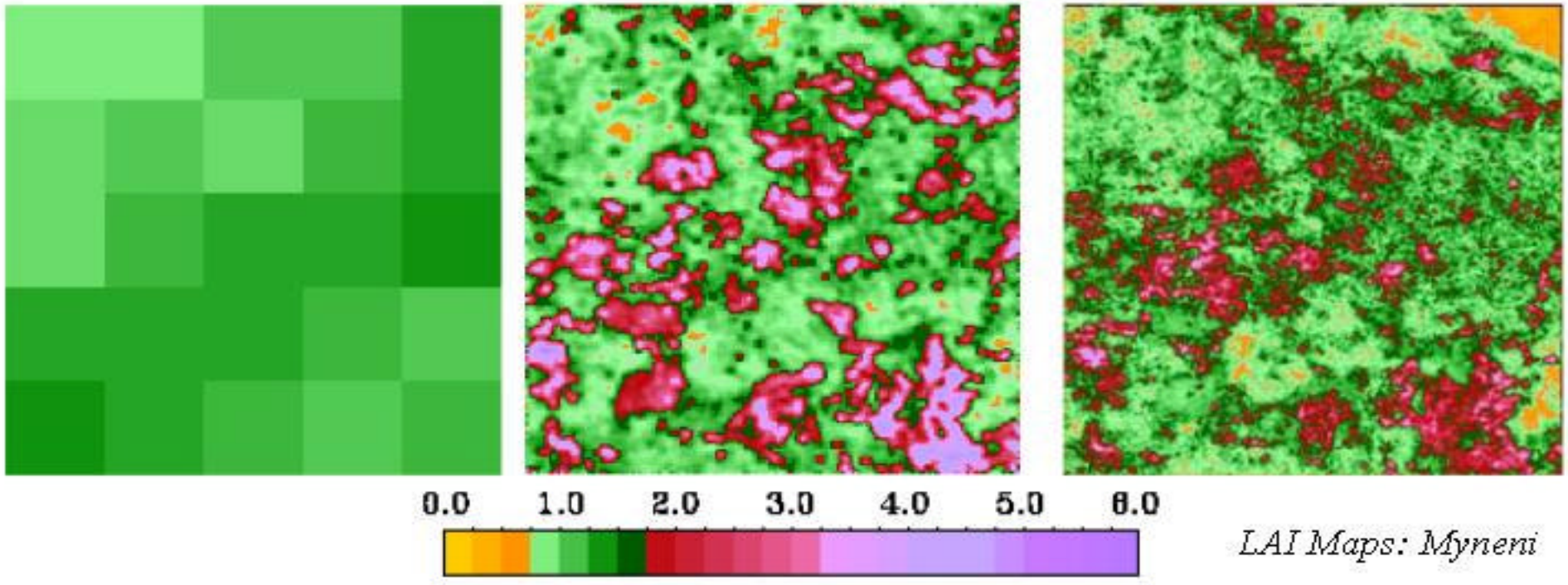
MQUALs: Huete

Leaf Area Index/FPAR

Ranga Myneni: PI
EOS investigations: J. Privette, T. Gower
NASA-funded BigFoot program
http://www.fsl.orst.edu/larse/bigfoot/index.html

Boston University's LAI Map of a 5 KM Area, from SAFARI 2000

MODIS Retrievals, Apr. 3, 2000 **ETM Retrievals, Apr.3, 2000** **IKONOS Retrievals, Mar. 30,2000**



Daily Photosynthesis and Annual Net Primary Production

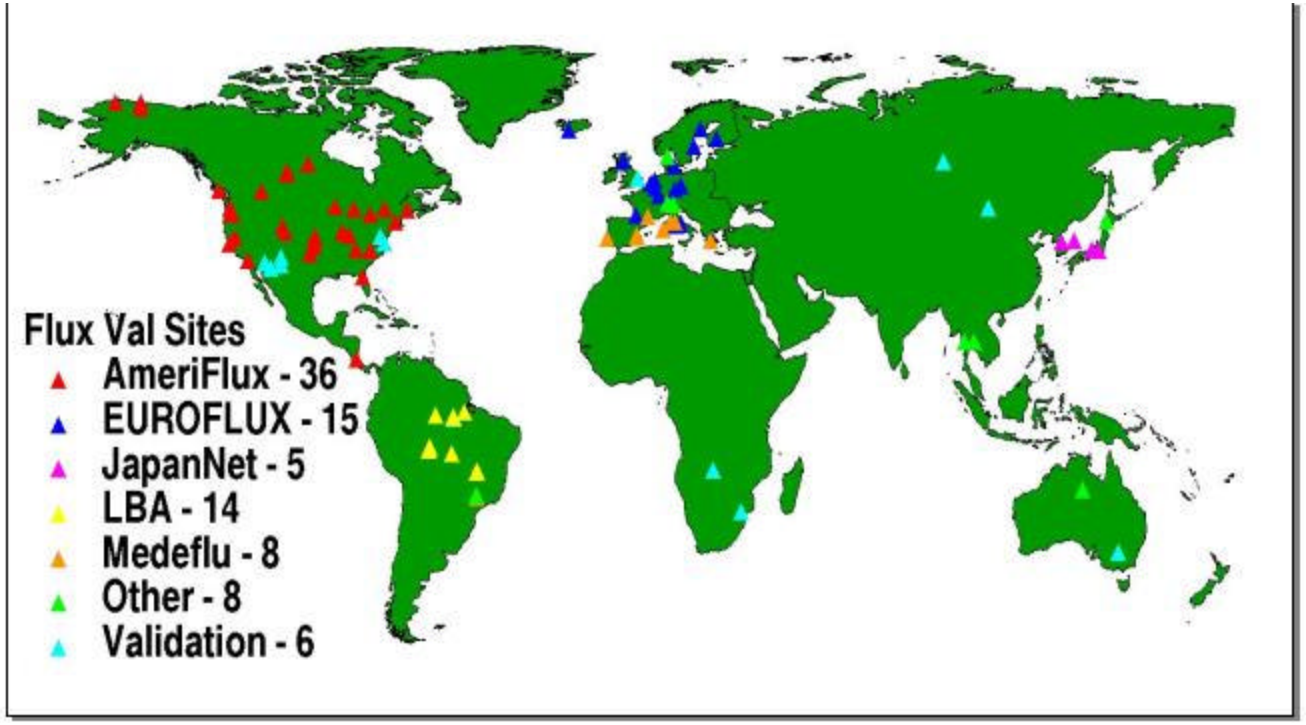
Steve Running: PI

EOS investigation: "Fluxnet" (D. Baldacchi & D. Olson)

(*http://daacl.esd.ornl.gov/FLUXNET/)*

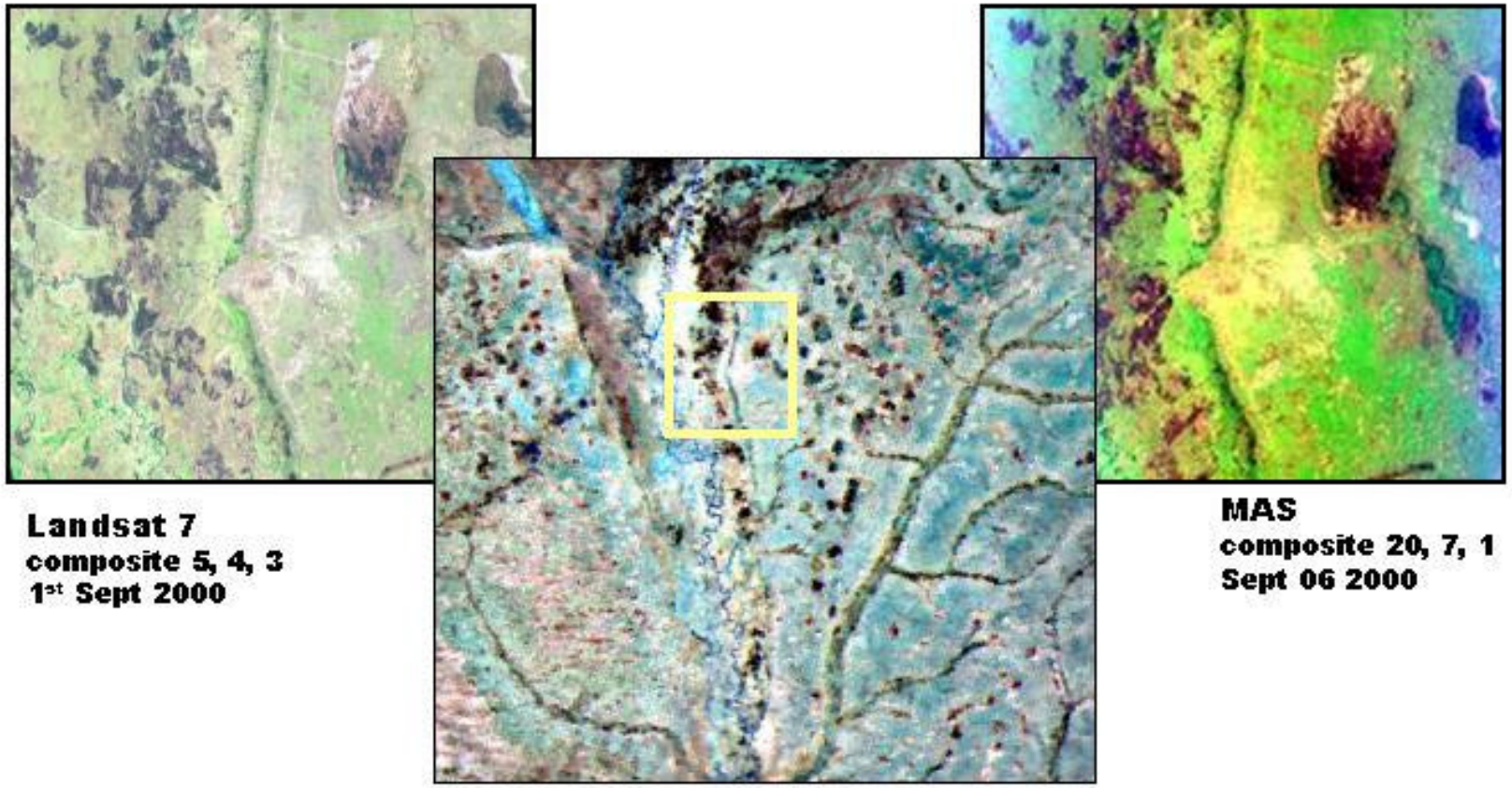
NASA-funded BigFoot program

(*http://www.fsl.orst.edu/larse/bigfoot/index.html)*



Thermal Anomalies: Fire and Burn Scar

Chris Justice: PI
EOS investigations: W. Hao/USFS,
Utilizing results and data from SAFARI 2000
(http://safari.gecp.virginia.edu/)



Landsat 7
composite 5, 4, 3
1st Sept 2000

MAS
composite 20, 7, 1
Sept 06 2000

Land Cover

Alan Strahler: PI

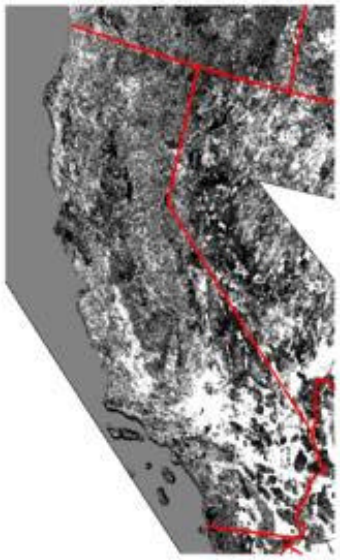
Investigation: BigFoot program

(*http://www.fsl.orst.edu/larse/bigfoot/index.html)*

Focus on "STEP" database utilizing Core Sites, ETM+ and IKONOS data

(http://crs-www.bu.edu/~jcfh/step.html)

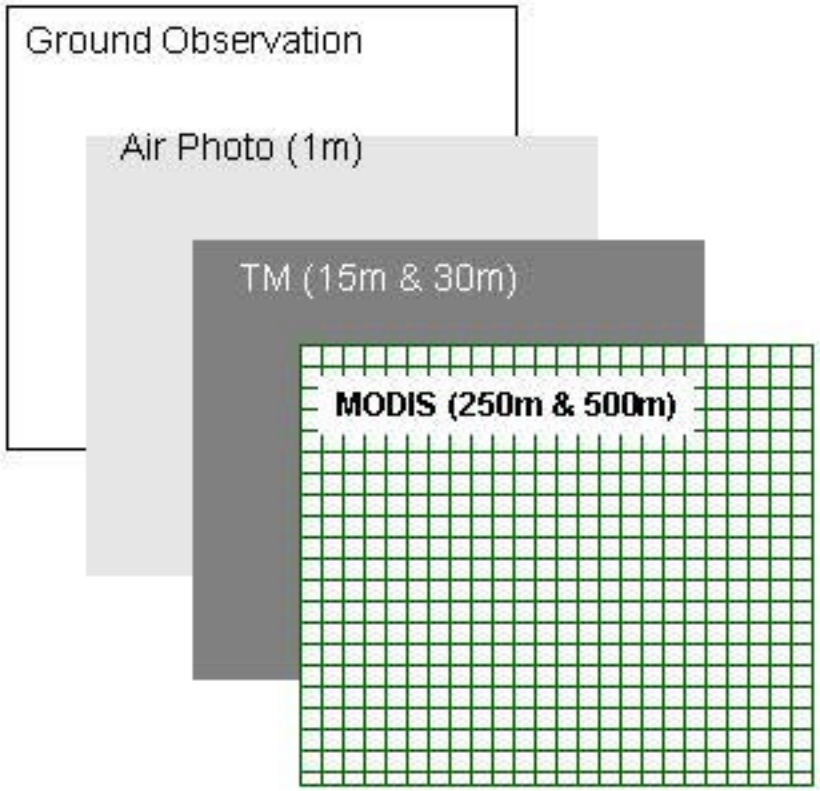
MODIS Classification

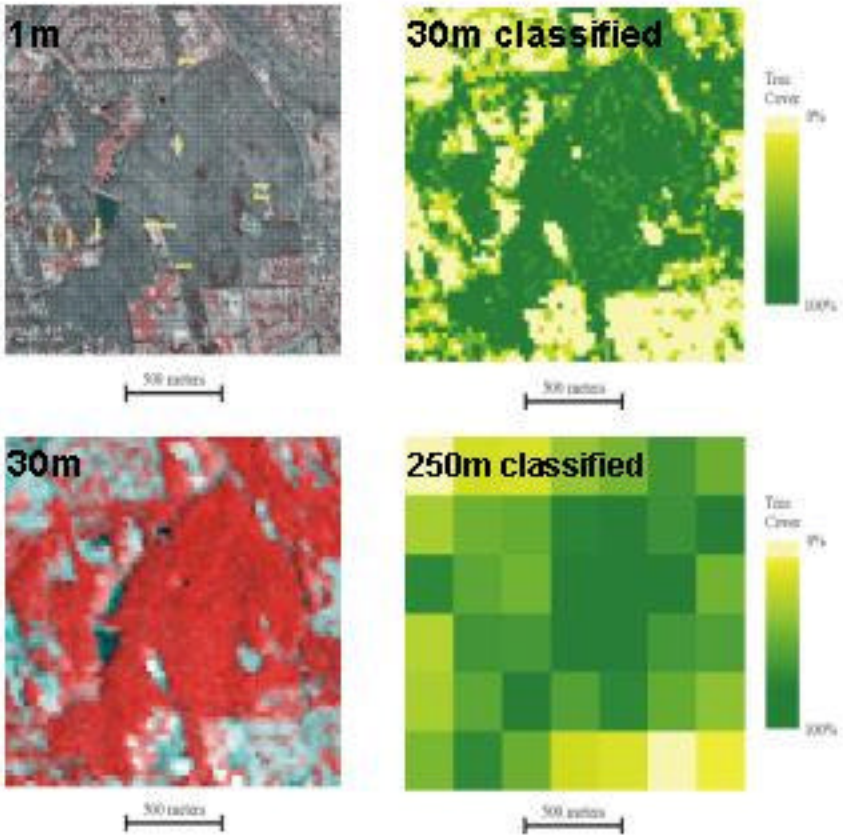


Classification Confidence

Vegetative Cover Conversion & Vegetation Continuous Fields

John Townshend & Ruth Defries: PIs
Investigation: SAFARI 2000 *(http://safari.gecp.virginia.edu/)*
and "Appalachian Transect"





Successes & Achievements

- Validation campaigns undertaken for each MODLAND products, hard won results are starting to come in
- MQUALS system successfully deployed as a as low-cost method of acquiring high resolution imagery useful for scaling
- MODIS subsetting algorithm developed for EOS Core Sites is feeding into EOSDIS
- MODLAND team, EOS validation, and other investigators coordinated through yearly meetings
- Measurement techniques being standardized through protocol development
- International collaboration has been established through Committee on Earth Observing Satellites (CEOS) Working Group on Cal/Val
- EOS Land Validation Core Site data sharing infrastructure serving as an example for CEOS
- Utilization of existing networks (Aeronet, Fluxnet) serving as a model for future validation

MODLAND interaction with CEOS "Land Product Validation" subgroup

- **Common theme across Committee on Earth Observing Satellites (CEOS) members' land product validation activities: need for protocols and "core" sites**
- **EOS Land Validation Core Sites are serving as a model**
- **Leaf Area Index inter-comparison activity is underway and helping to establish protocol and CEOS "Core" sites for validation of Biophysical products**
- **Similarly effort starting for fire product validation through collaboration between LPV and Global Observation of Forest Cover fire initiative**

More information on LPV can be found at:
http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/CEOS_WGCV/

MODLAND validation plans for Terra and Aqua

- **Build on Core Site concept**
- **Leverage off of CEOS Land Product Validation activities (international data-sharing)**
- **Utilize Carbon Cycle Science investigations (i.e. BigFoot and FLUXNET)**
- **Build on network approach: Fluxnet and Aeronet as example.**
- **Utilize future EOS Validation investigations**
- **Mercury system is in place, its use could be recommended for future programs/NRAs**
- **Coordinate with Aqua and NPOESS/NPP validation to utilize lessons learned.**

Bibliography

Justice, C., A.Belward, J. Morisette, P. Lewis, J. Privette, F. Baret, 2000, "Developments in the validation of satellite products for the study of the land surface", *International Journal of Remote Sensing*, v. 21, n 17, p. 3383 – 3390.

Morisette, J., J.L. Privette, C.O. Justice, D. Olson, J. Dwyer, P. Davis, D. Starr, D. Wickland, 1999, "The EOS land Validation Core Sites: background information and current status", *Earth Observer*, Nov/Dec, v.11, n.6, p. 21-25

Huete, A., F. Keita, K. Thome, J. Privette, W. van Leeuwen, C. Justice, J. Morisette, 1999, "A light Aircraft Radiometric Package for MODLAND Quick Airborne Looks (MQUALS)", *Earth Observer*, Jan/Feb. v.11, n. 1, p. 22-26, 39.

Privette, J., J. Morisette, R. Myneni, C. Justice, 1998, "Global Validation of EOS LAI and FPAR Products", *The Earth Observer, Nov/Dec. v.10, n.6, p.39-42*

All of the articles in the forthcoming special issue of Remote Sensing of Environment will have some information related to validation of the various products. An overview of the MODLAND validation activities will be presented in:

"Moderate Resolution Imaging Spectrometer Land Validation Activities",
Morisette, J. Privette, J, and Justice, C.