MODIS land team

Outline:

- *Infrastructure*
- *Early results*
- *Concerns*
- *Plans*

Jeff Morisette
jeff.morisette@gsfc.nasa.gov

Why we need to validate land products.

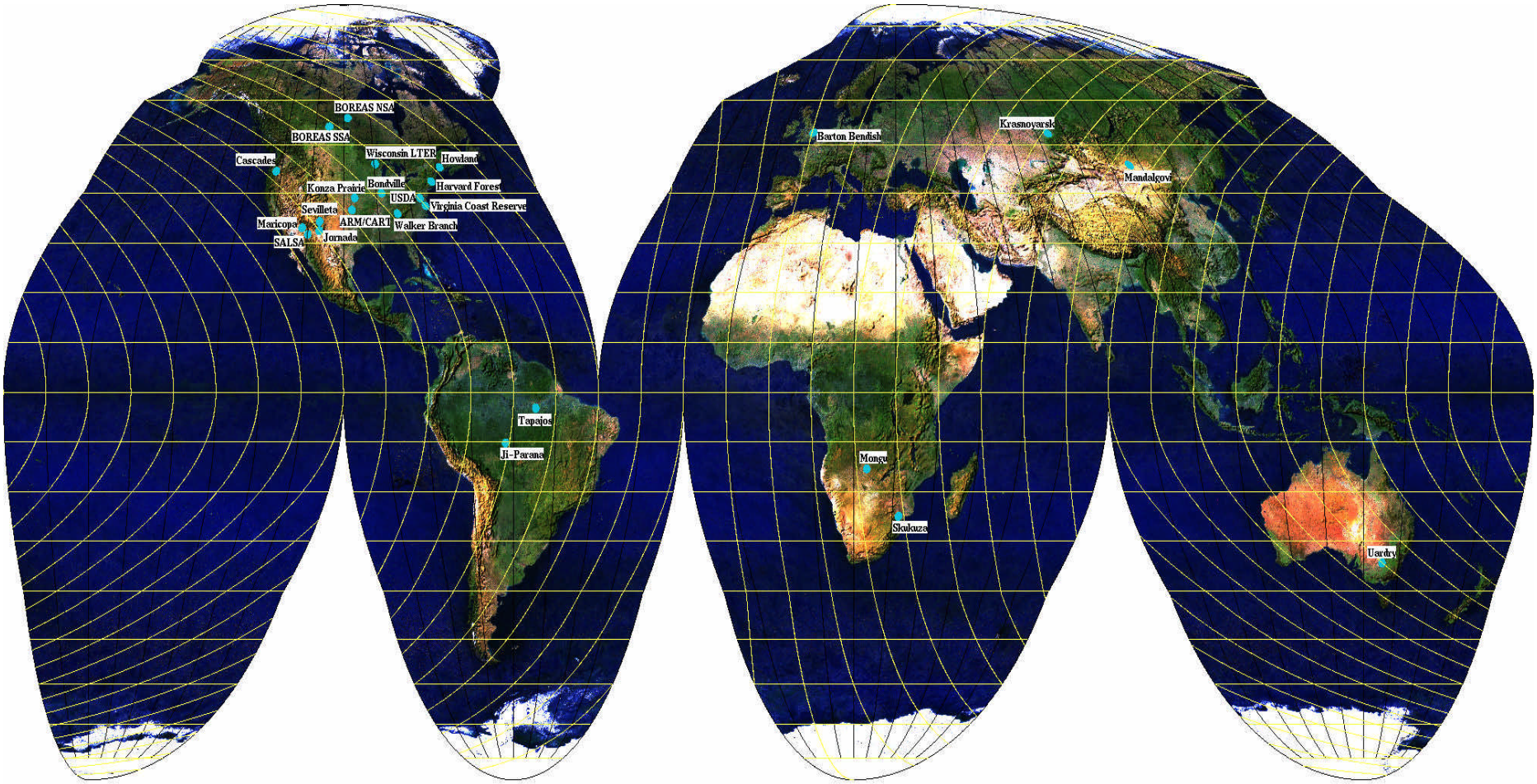
- Could be called “Estimating Uncertainty”
- Good science and resource management require understanding of product accuracy/uncertainty
- Explicit statements of uncertainty fosters an informed user community and improved use of data
- International environmental protocols and agreements imply findings 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

MODLAND validation home page

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

Off of MODIS “Mall Map”

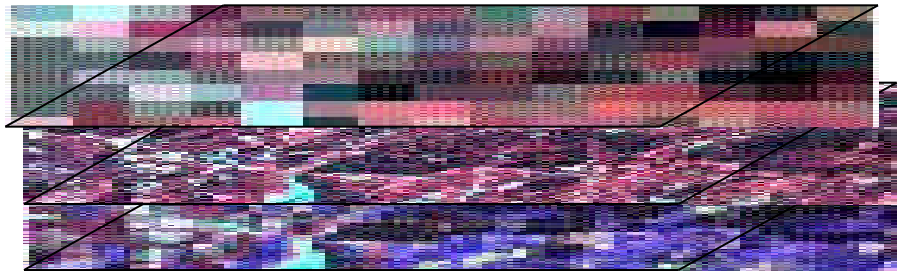
EOS Land Validation Core Sites

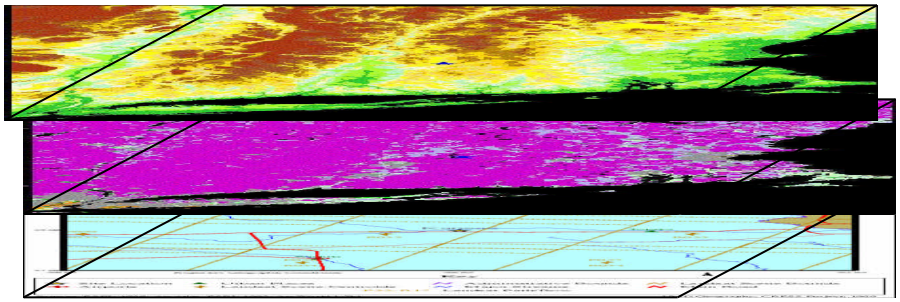


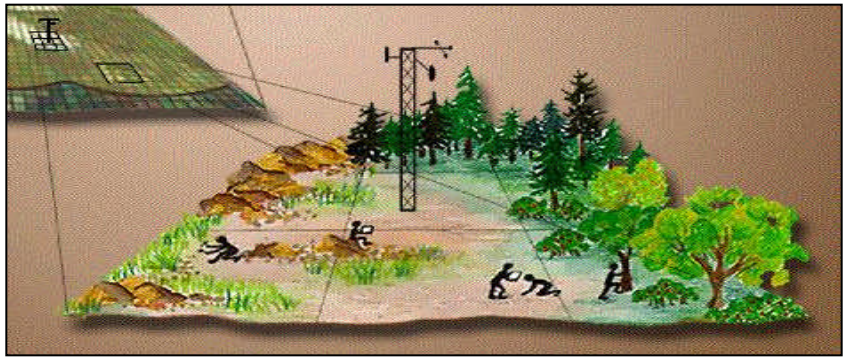
EOS Land validation core sites – Goode homolosine projection – Black grid: 10 deg. graticule – Yellow grid: MODLAND L3 tiles

Jacques Descloitres (MODLAND / LDOPE) – May 1999

Data Compilation for EOS Land Validation Core Sites







Field data graphic courtesy of the BigFoot program

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

Core Site data summary

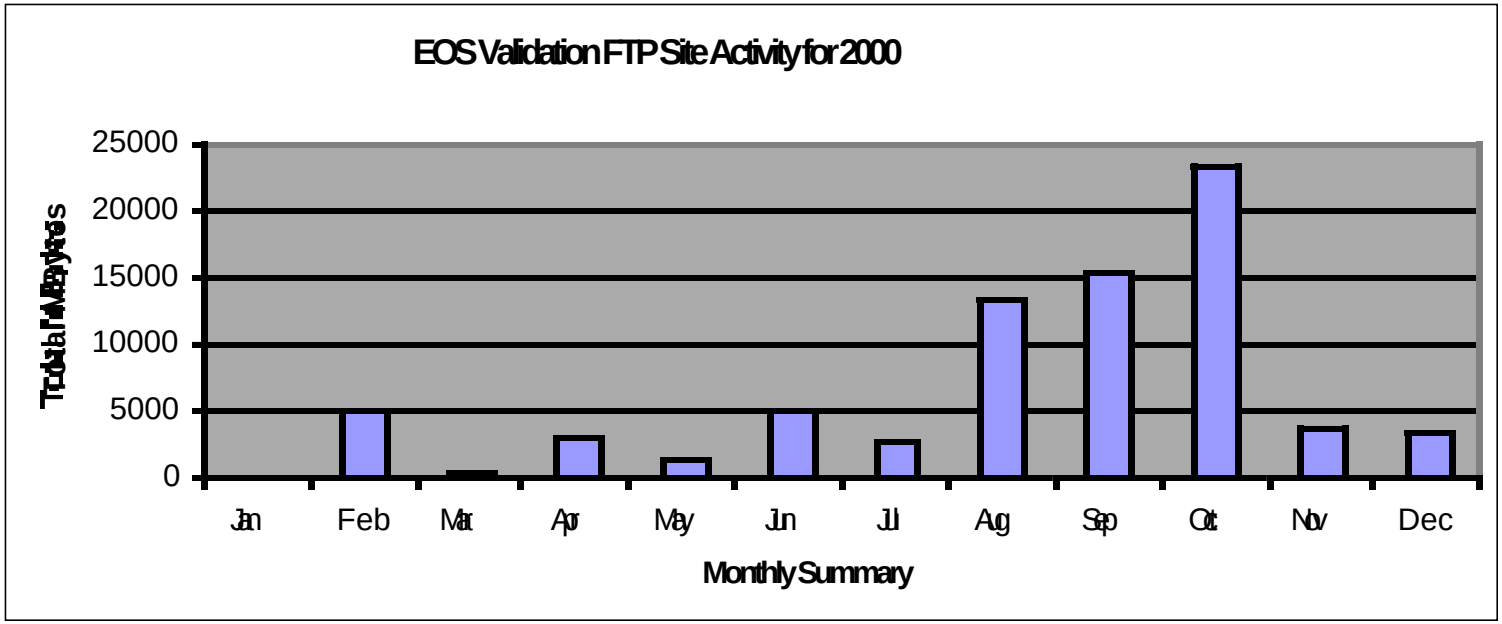
	ARM/CART	Barton Bendish	Bondville, IL	BOREAS, NSA	CascadesLTER	Harvard Forest	Howland	Ji-Parana	Jornada LTER	Konza Prairie	Krasnoyarsk	Mandalgobi	Maricopa Ag.	Mongu	SALSA	Sevilleta LTER	Skukuza	Tapajos	Uardry	USDA ARS	VCR	Walker Branch	Wisc.Park Falls
MODIS Subsets	*	*	*																				
SeaWiFS subsets																							
Ancillary report (CRESS)																							
Analyst (GLCF)																							
ETM+ (with # of acquisitions)			7	3			5			4	5	2	1		7		2		5		5			5
Ikonos		1 DEM		2		1	1	1		2	2	1			2		4				2			
Airborne (MQUALs or HR2, both)																					AT			
Global Land Cover Test Sites																								
GeoCover TM																								
AutoMEL (planned)																								
EO-1 coverage planned																								
ASTER & MISR local mode planned											1													

DAACs responsive to EOS Validation needs

EDC: John Dwyer

ORNL: Dick Olson

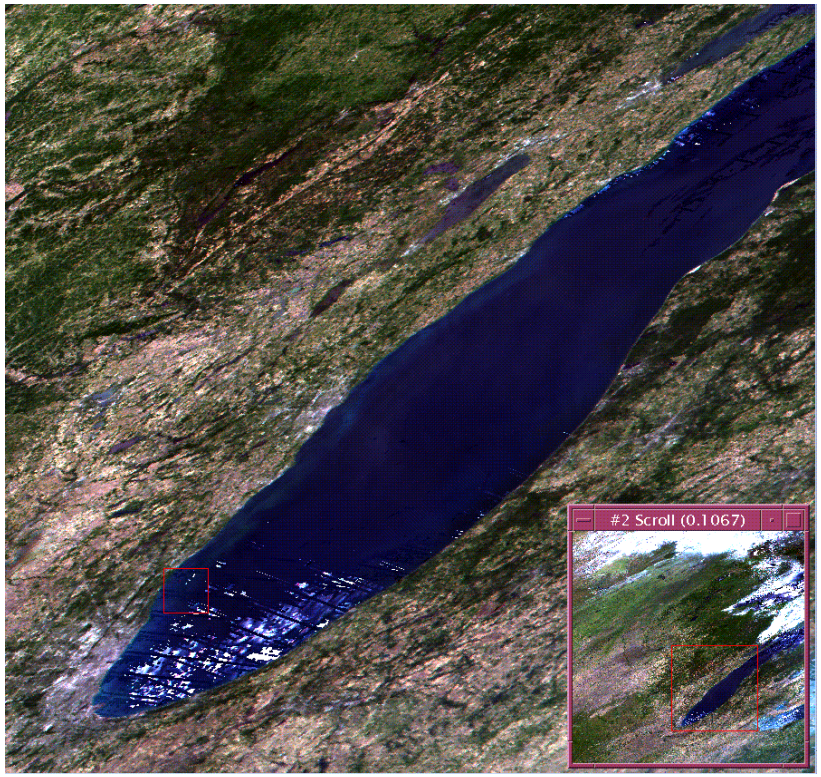
Core Validation Site Data Retrieval



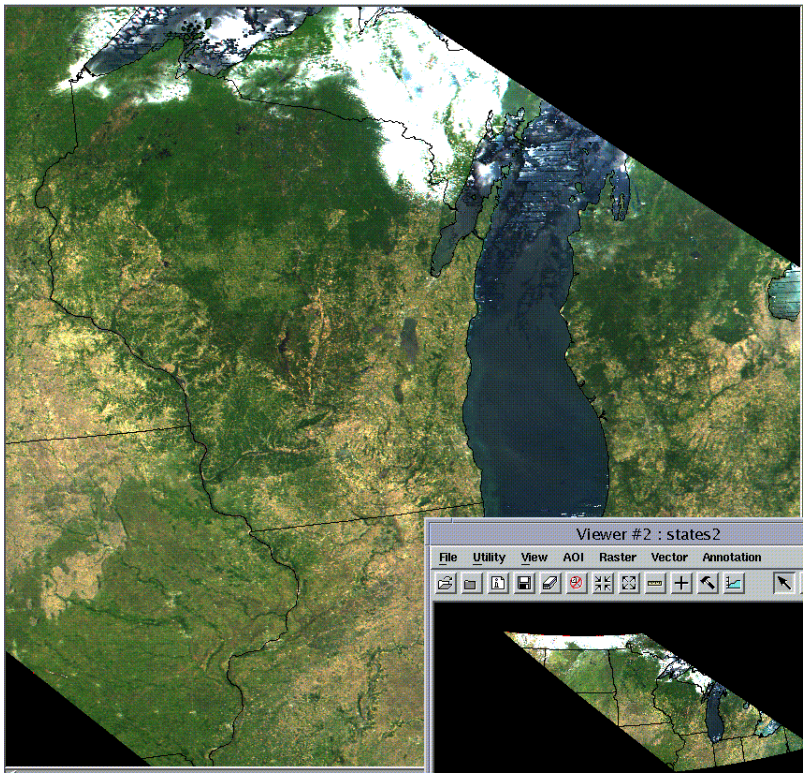
MODIS MAP REPROJECTION TOOL

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY

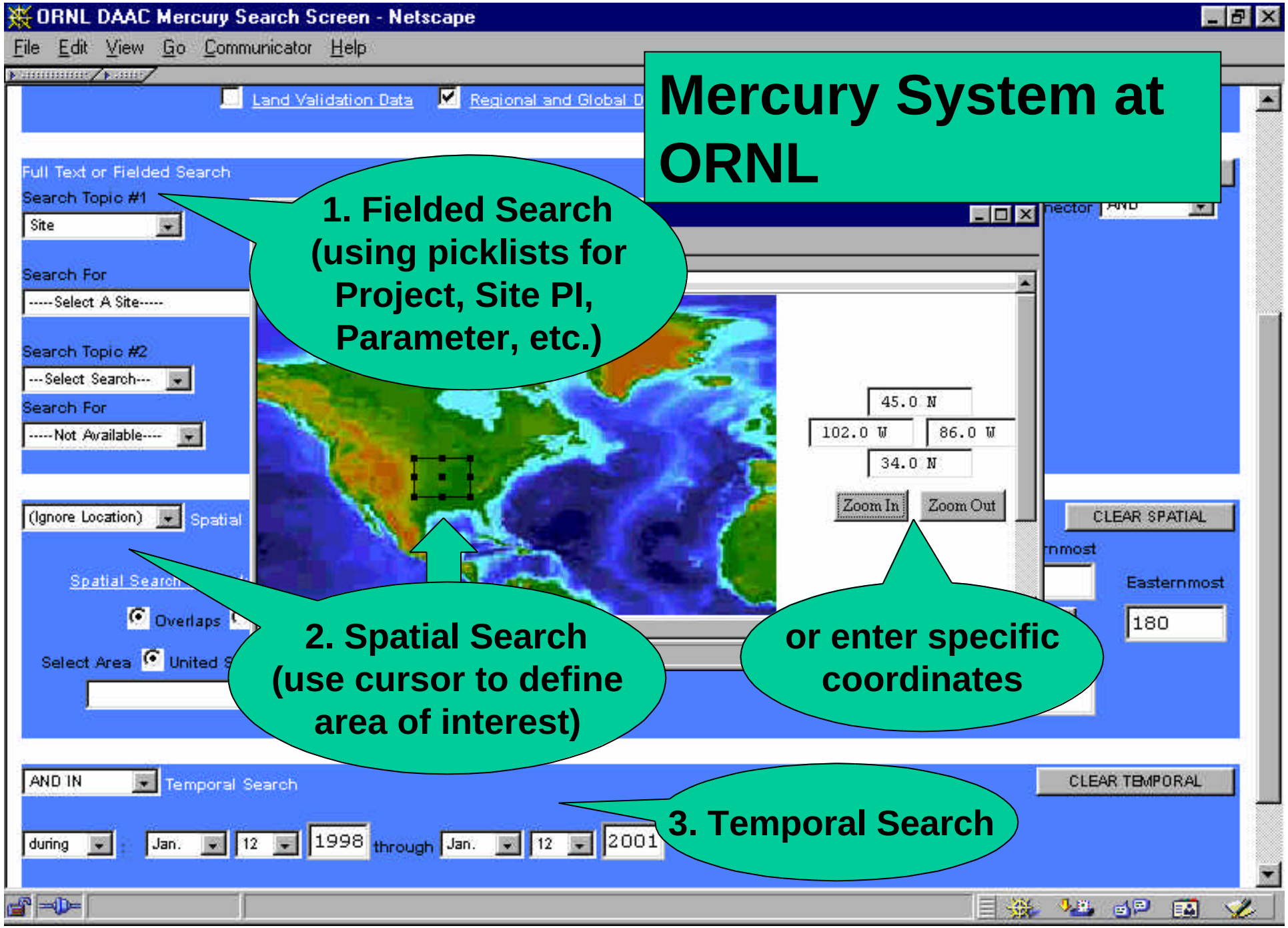
COLLEGE OF SYSTEMS ENGINEERING

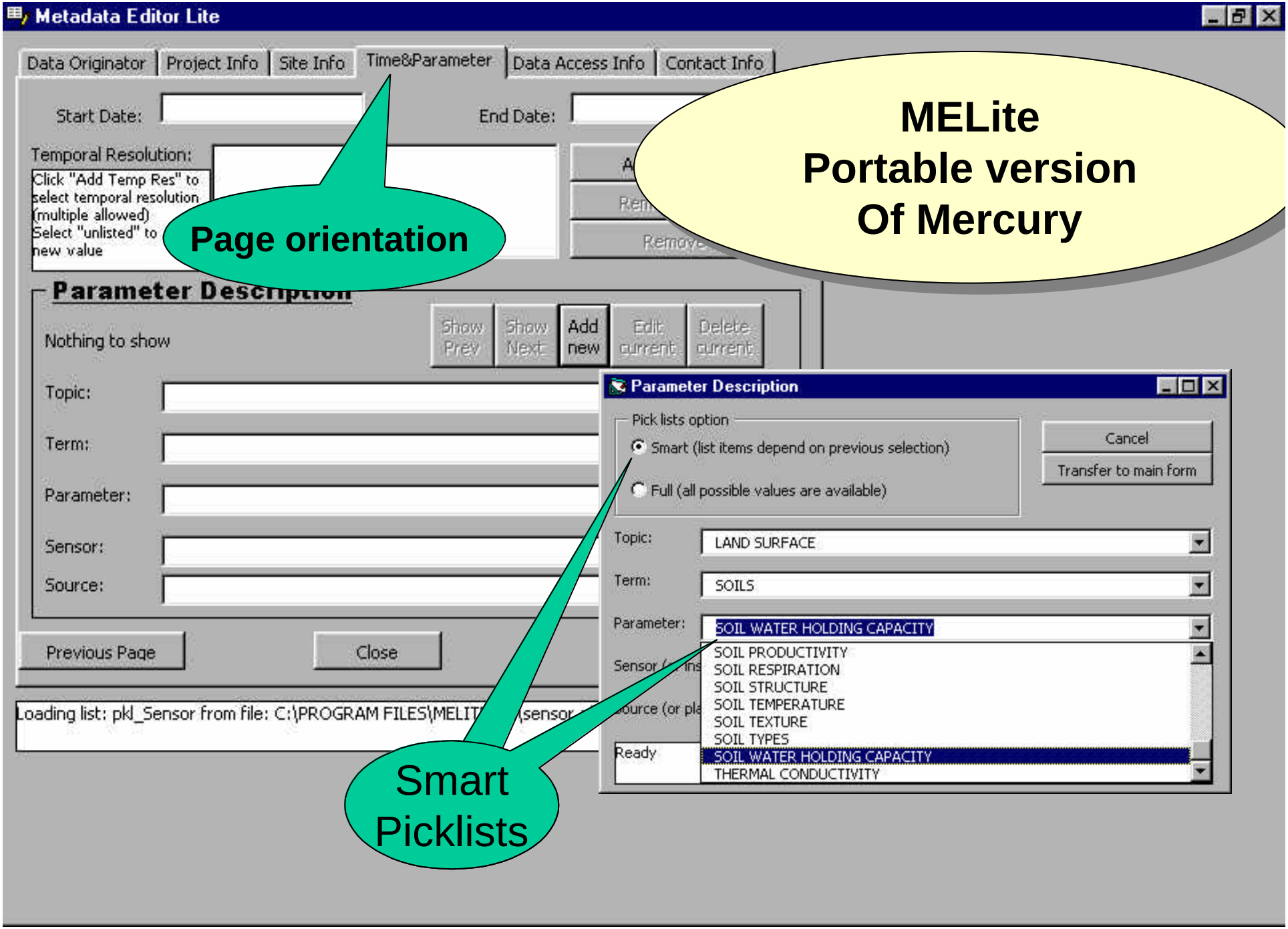


ISIN



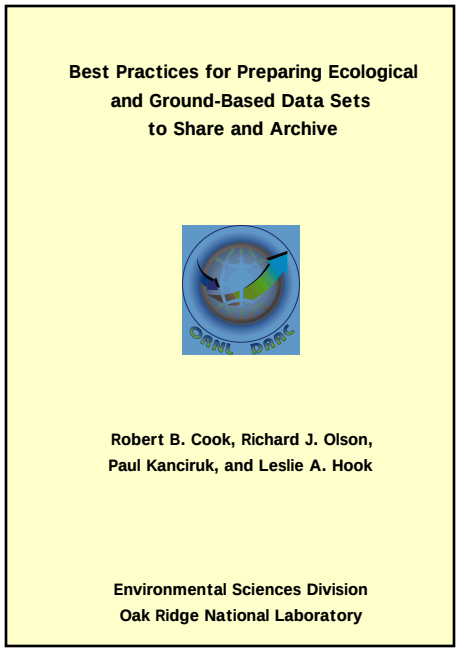
Geographic


ORNL DAAC Mercury Search Screen - Netscape
File Edit View Go Communicator Help
Land Validation Data
Regional and Global D
Mercury System at ORNL
Full Text or Fielded Search
Search Topic #1
Site
Search For
-----Select A Site-----
Search Topic #2
---Select Search---
Search For
-----Not Available----
1. Fielded Search (using picklists for Project, Site PI, Parameter, etc.)
45.0 N
102.0 W
86.0 W
34.0 N
Zoom In
Zoom Out
(Ignore Location)
Spatial
Spatial Search
Overlaps
Select Area
United S
CLEAR SPATIAL
Easternmost
180
2. Spatial Search (use cursor to define area of interest)
or enter specific coordinates
AND IN
Temporal Search
CLEAR TEMPORAL
during
Jan.
12
1998
through
Jan.
12
2001
3. Temporal Search


Metadata Editor Lite
Data Originator
Project Info
Site Info
Time&Parameter
Data Access Info
Contact Info
Start Date:
End Date:
Temporal Resolution:
Click "Add Temp Res" to select temporal resolution (multiple allowed) Select "unlisted" to new value
Page orientation
MELite
Portable version
Of Mercury
Parameter Description
Nothing to show
Show Prev
Show Next
Add new
Edit current
Delete current
Topic:
Term:
Parameter:
Sensor:
Source:
Previous Page
Close
Loading list: pkl_Sensor from file: C:\PROGRAM FILES\MELIT
Parameter Description
Pick lists option
Smart (list items depend on previous selection)
Full (all possible values are available)
Cancel
Transfer to main form
Topic:
LAND SURFACE
Term:
SOILS
Parameter:
SOIL WATER HOLDING CAPACITY
SOIL PRODUCTIVITY
SOIL RESPIRATION
SOIL STRUCTURE
SOIL TEMPERATURE
SOIL TEXTURE
SOIL TYPES
SOIL WATER HOLDING CAPACITY
THERMAL CONDUCTIVITY
Ready
Smart Picklists

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)

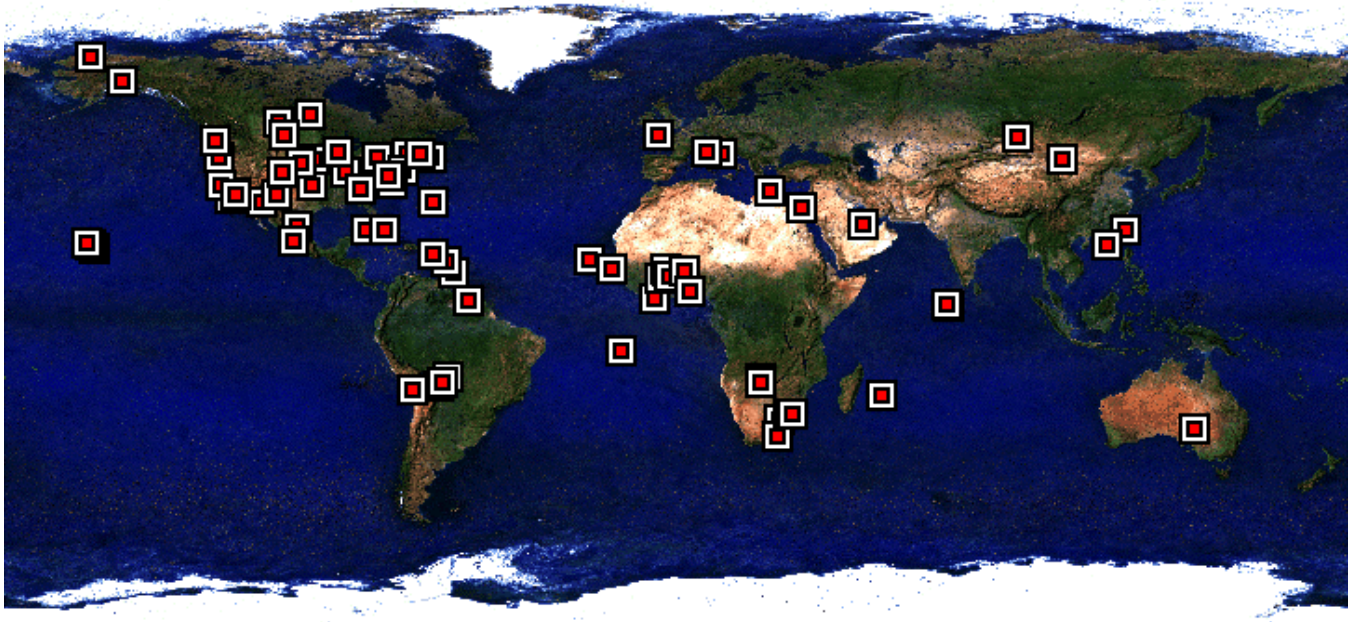
Current results

- **Science team investigations**
- **EOS Validation Investigations relevant to MODLAND**
- **Additional investigations and collaboration**

- **General approach:**
  collection of field/in-situ data,
  high resolution imagery,
  scaling to MODIS pixel

Surface Reflectance

Eric Vermote PI
EOS investigation: S. Liang
Aeronet (in-situ network essential for land validation) and MQUALS data for field data and scaling issue

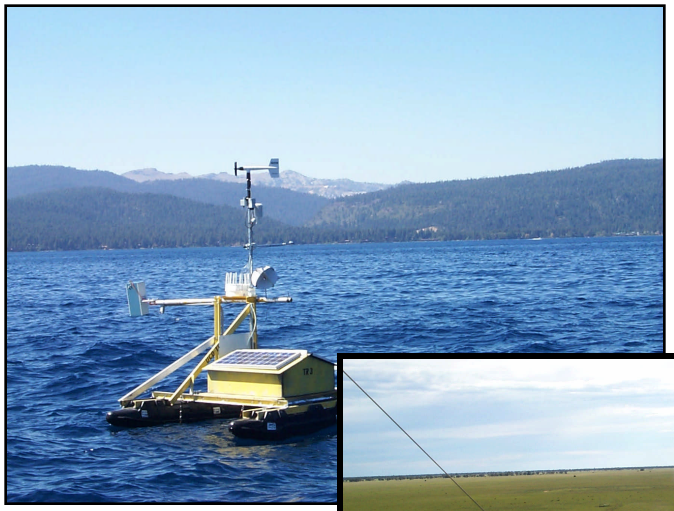


SeaWiFS composite

LDOPE / MODLAND

Land Surface Temperature

PI: Z. Wan
EOS investigation: S. Hook
ASTER and ATSR



Lake Tahoe, S. Hook

Wan

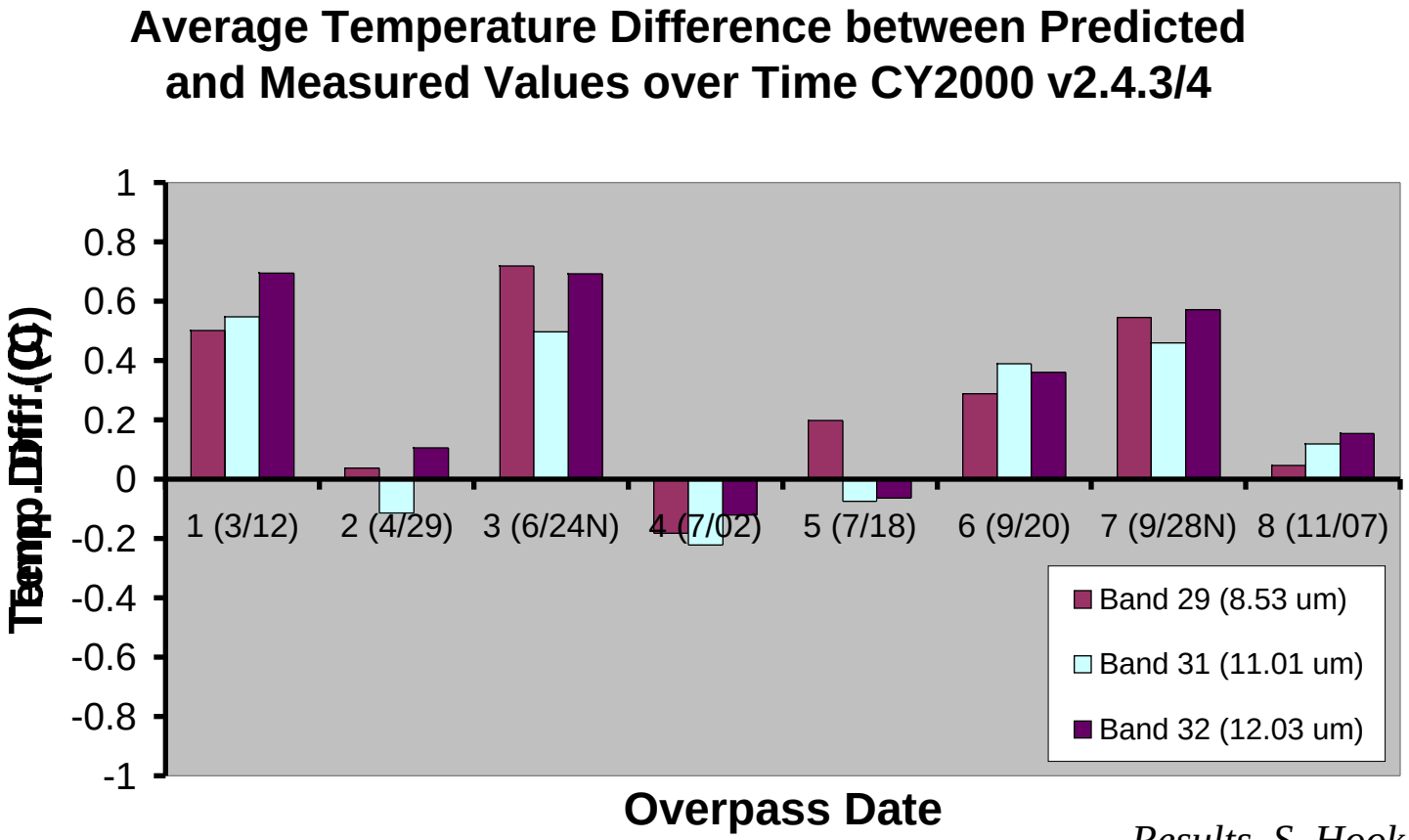
Uardry, S. Hook

Wan

LST early results:

Wan: LST over Mono Lake, better than +/- .6K

Hook: MODIS bands 29,31,32, accuracy +/- 0.4K.



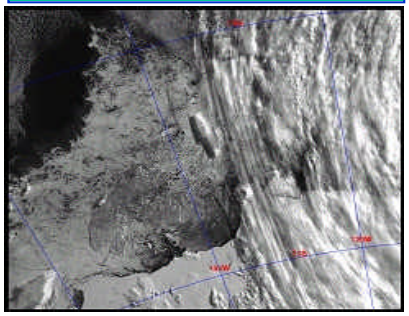
Results, S. Hook

Snow and Sea Ice

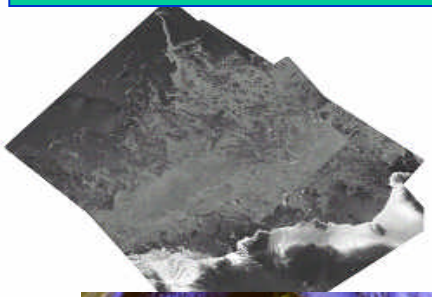
PI: Dorothy Hall

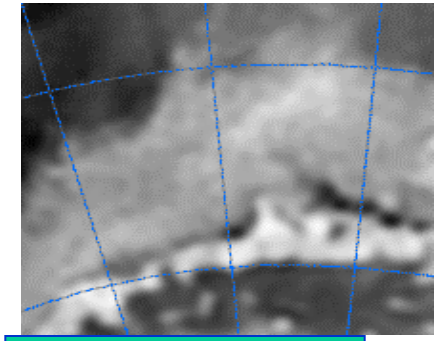
EOS investigations: S. Li, A. Nolin, and J. Shi

3/9/00 (DMSP OLS)

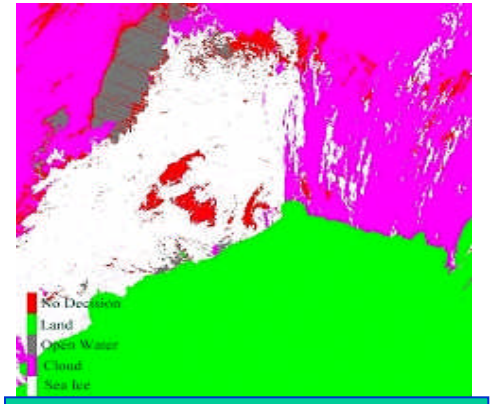


2/27-2/29/00 (RADARSAT)

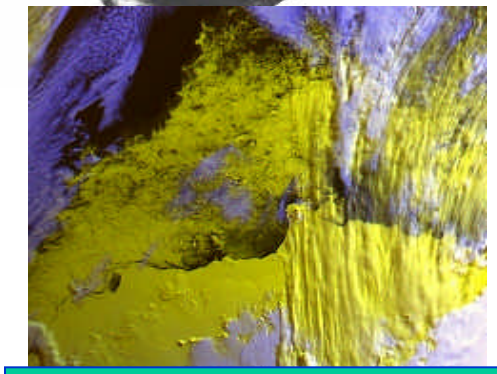




3/9/00 (QuikScat)



3/9/00 MODIS Ice Extent

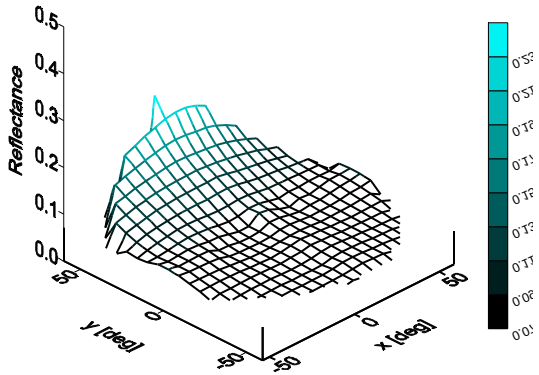


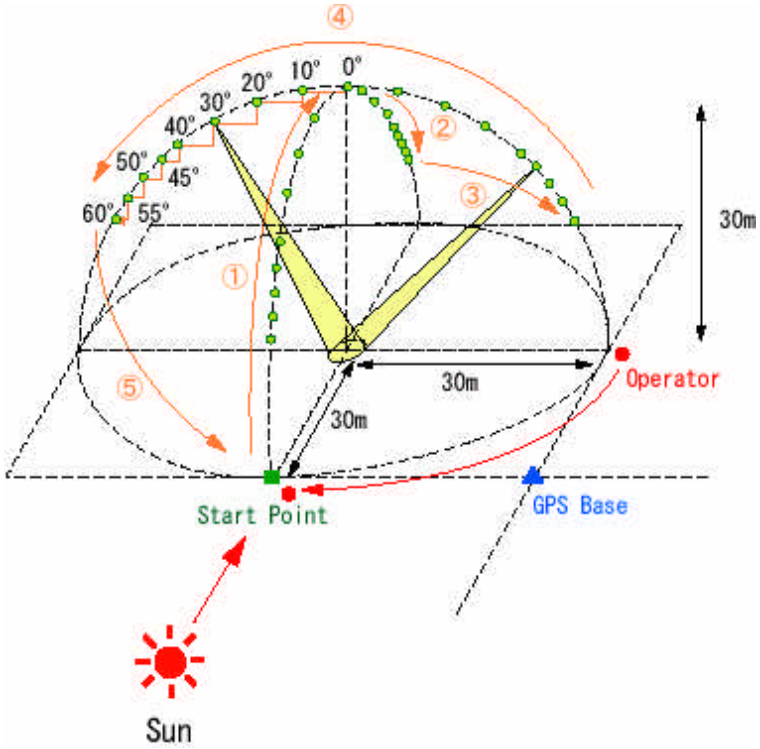
3/9/00 (MODIS Bands 3, 4, 7)

Image from S. Li

BRDF/ Albedo

A. Strahler and J.P. Muller: PIs
EOS investigation: J. Privette, S. Liang, Anne Nolin (snow Albedo)
Collaboration with GLI team, Y. Honda

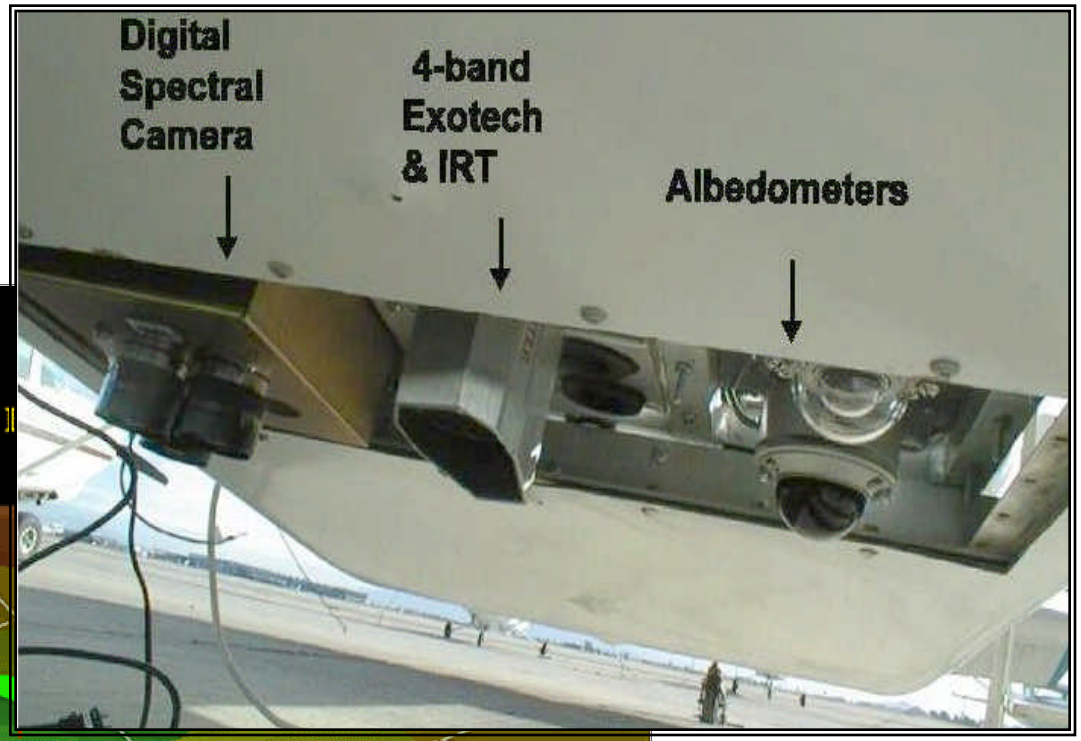


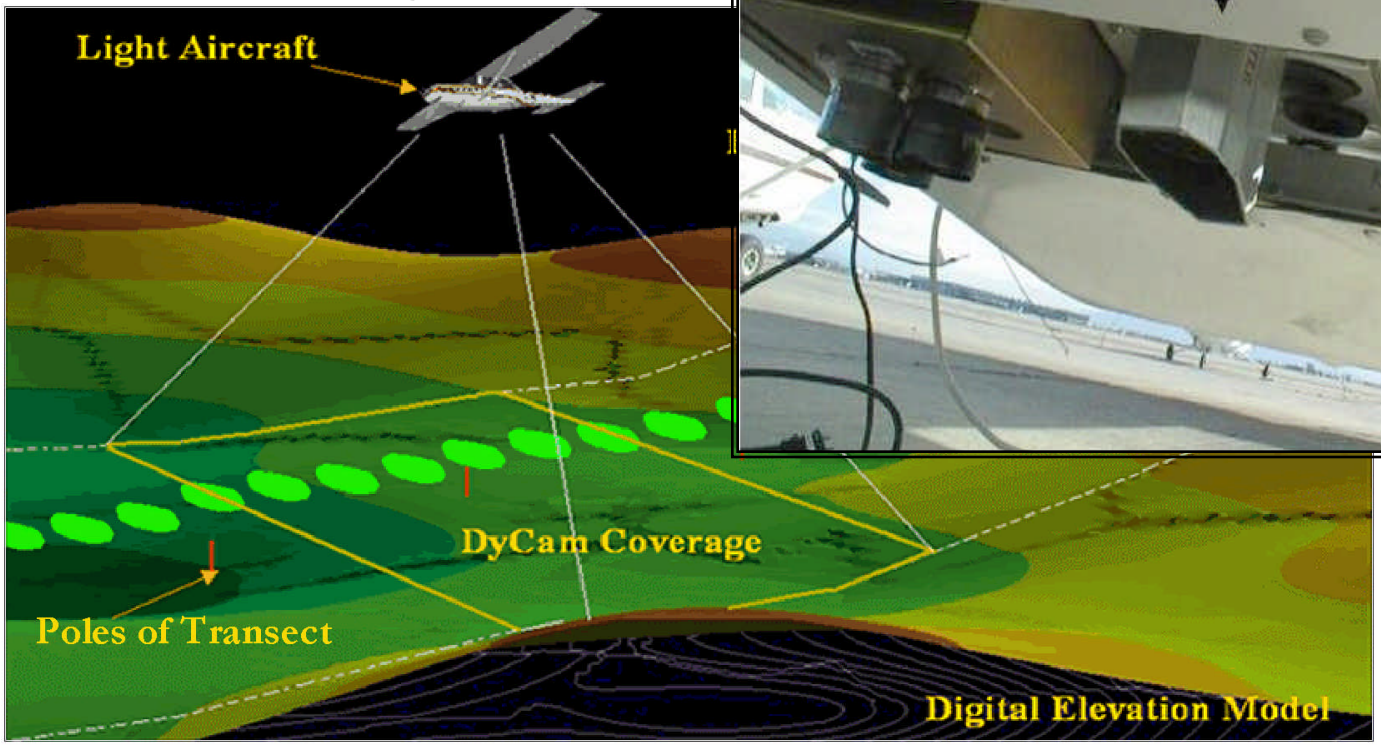


Images from Y. Honda

Vegetation Indices

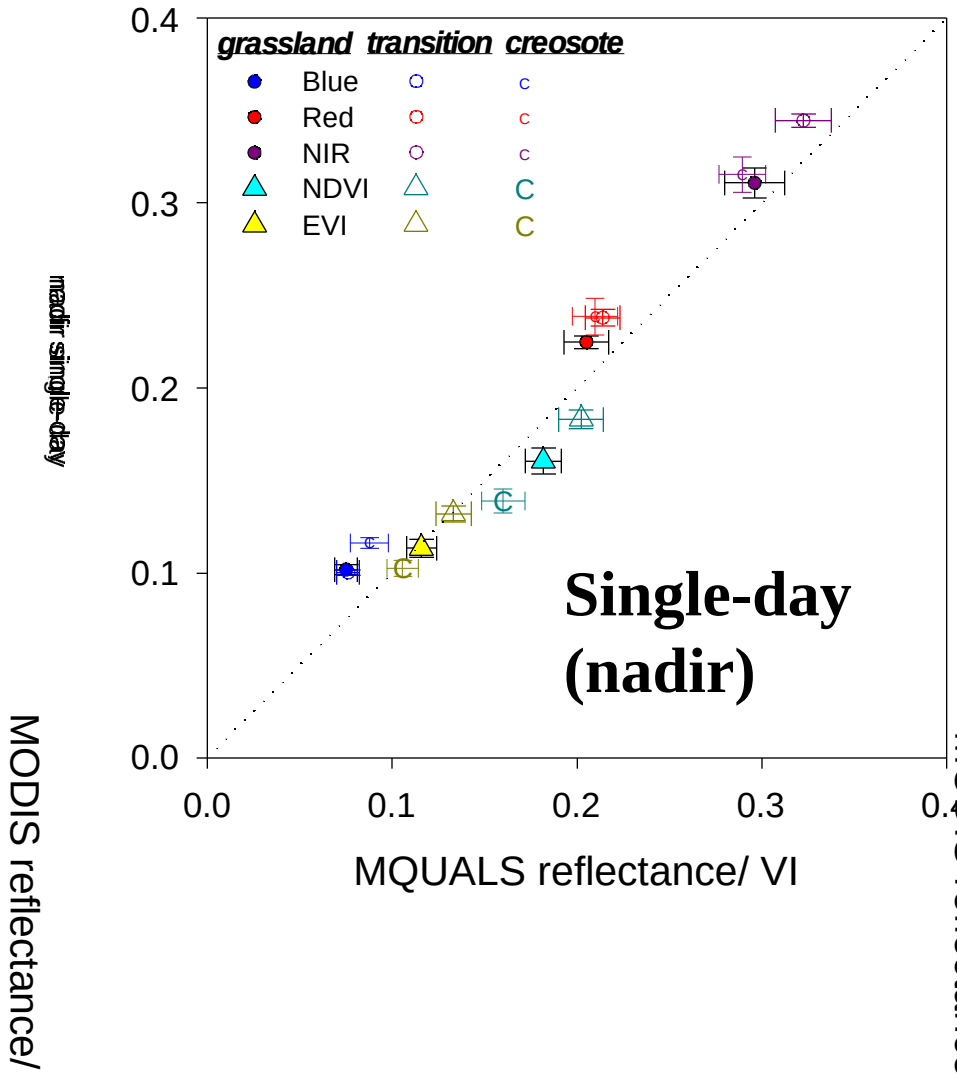
A. Huete: PI
EOS investigation:
Schowengerdt,
MQUALS system

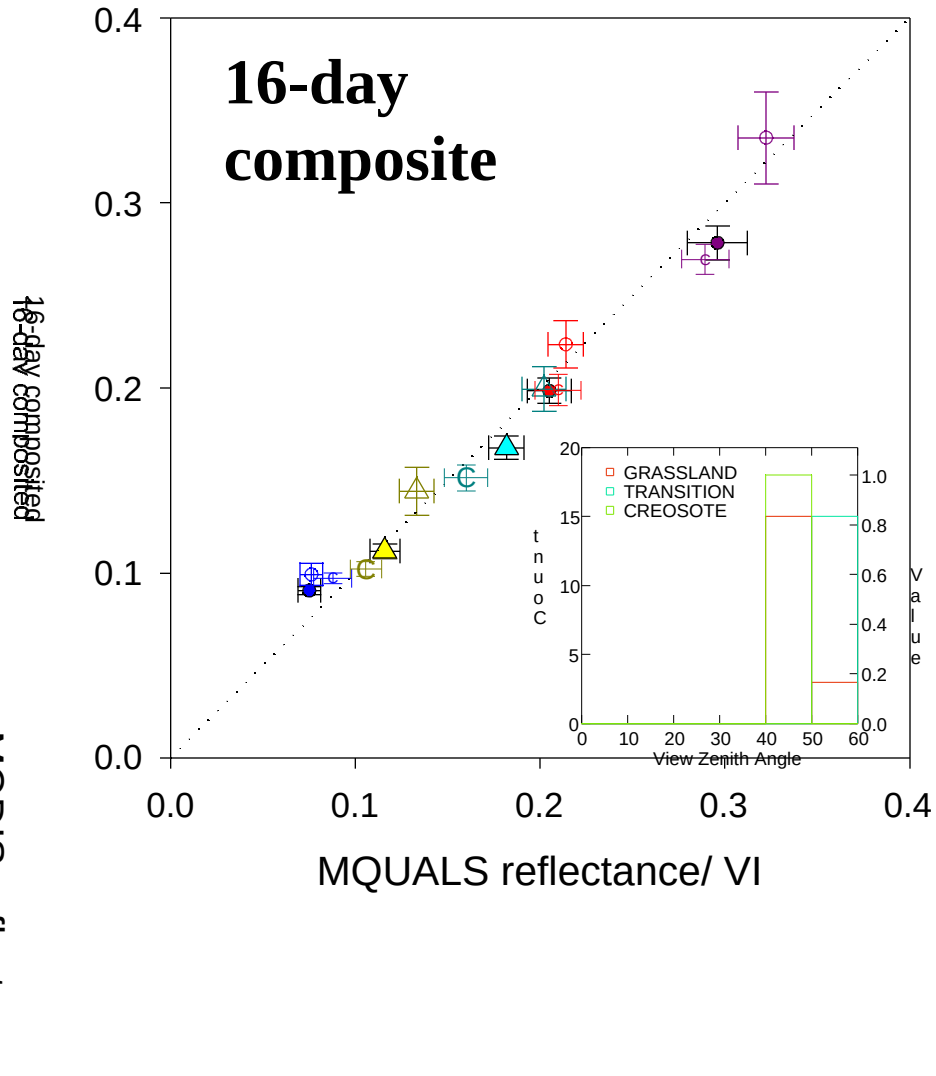




MQUALs: Huete

MQUALS vs. MODIS: Huete et al., La Jornada, NM



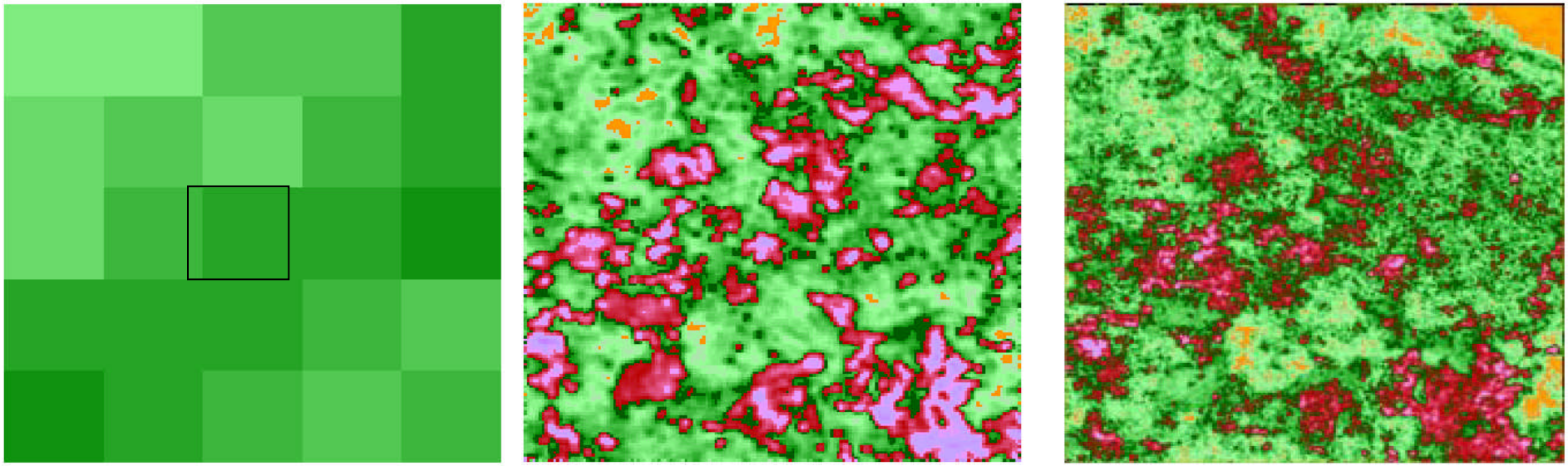


Leaf Area Index/FPAR

Ranga Myneni:PI
Investigations: J. Privette, T. Gower, and BigFoot program

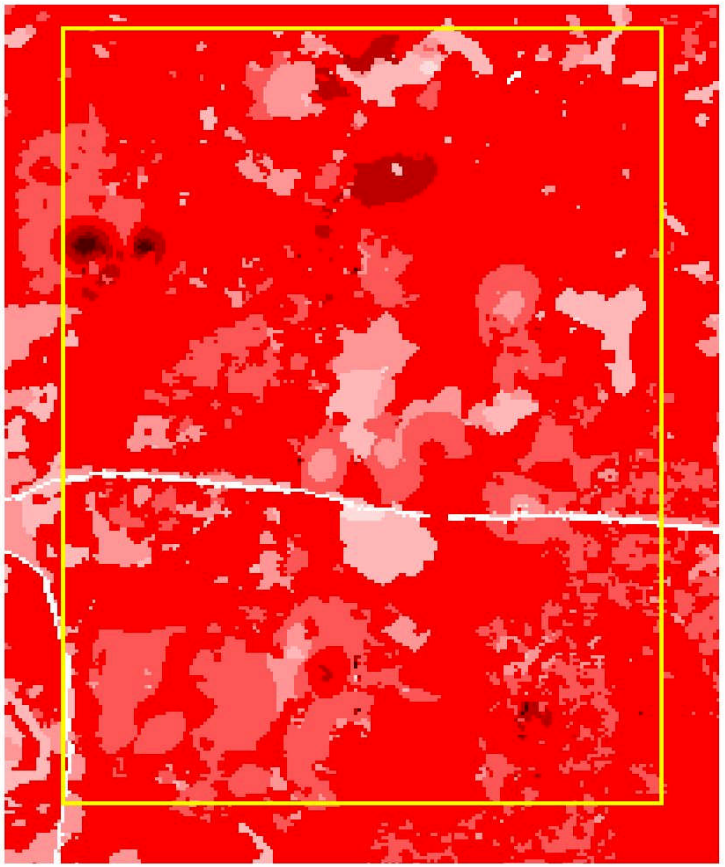
BU's LAI Map of a 5 KM Area, from SAFARI 2000

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

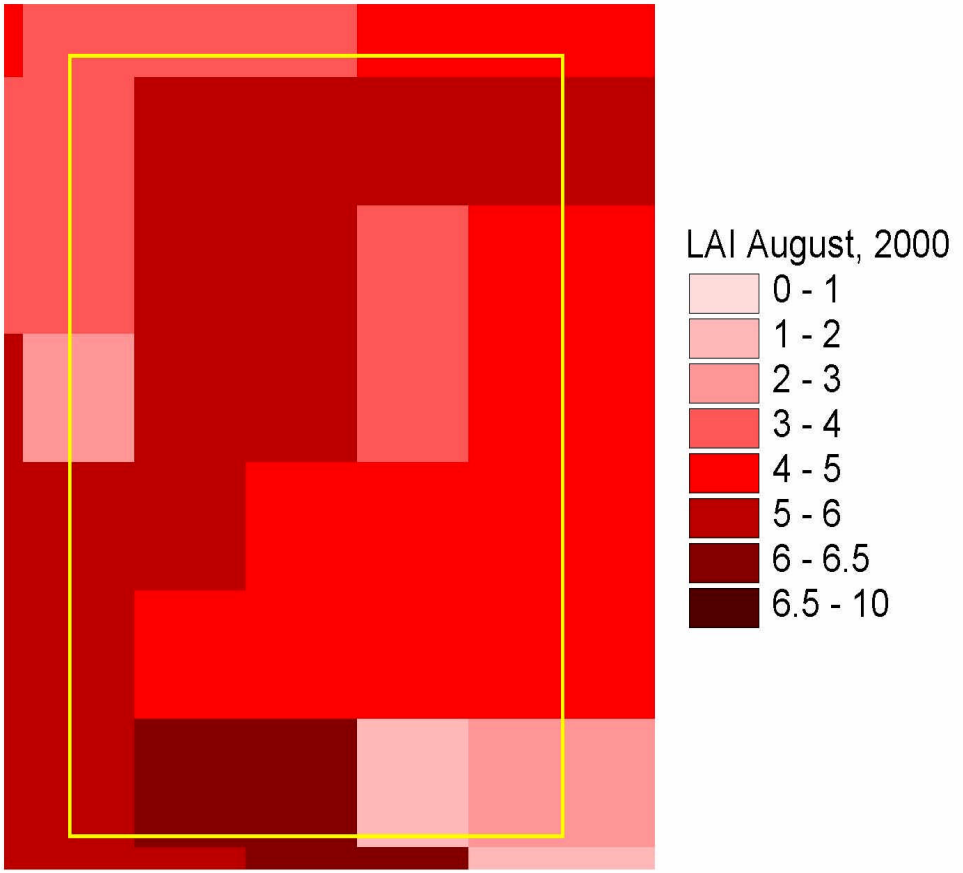


LAI Maps: Myneni

LAI: Modis vs Interpolated Field Measurements: from T. Gower's Park Falls site



Co-Kriged LAI



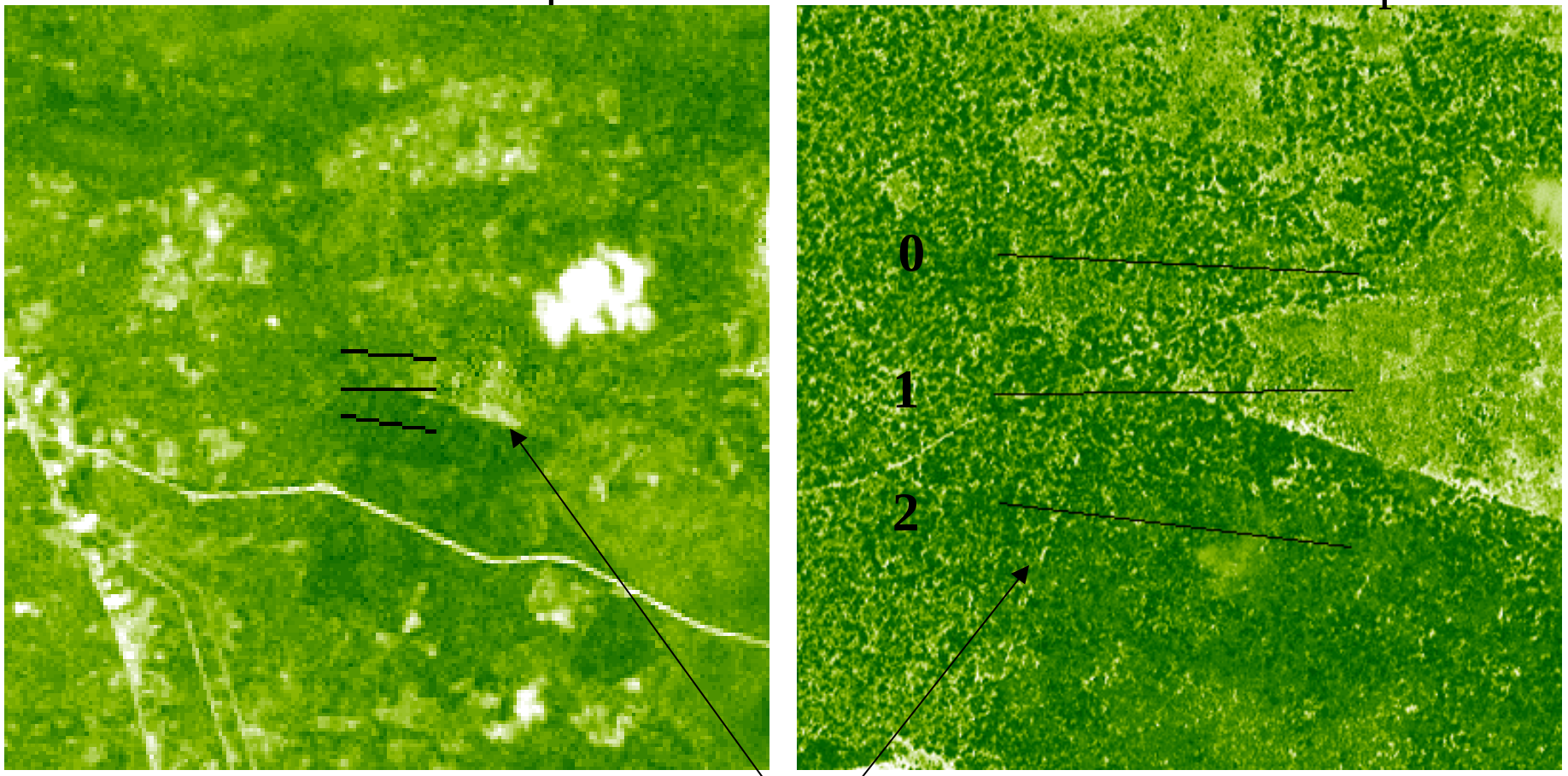
MODIS LAI

T. Gower

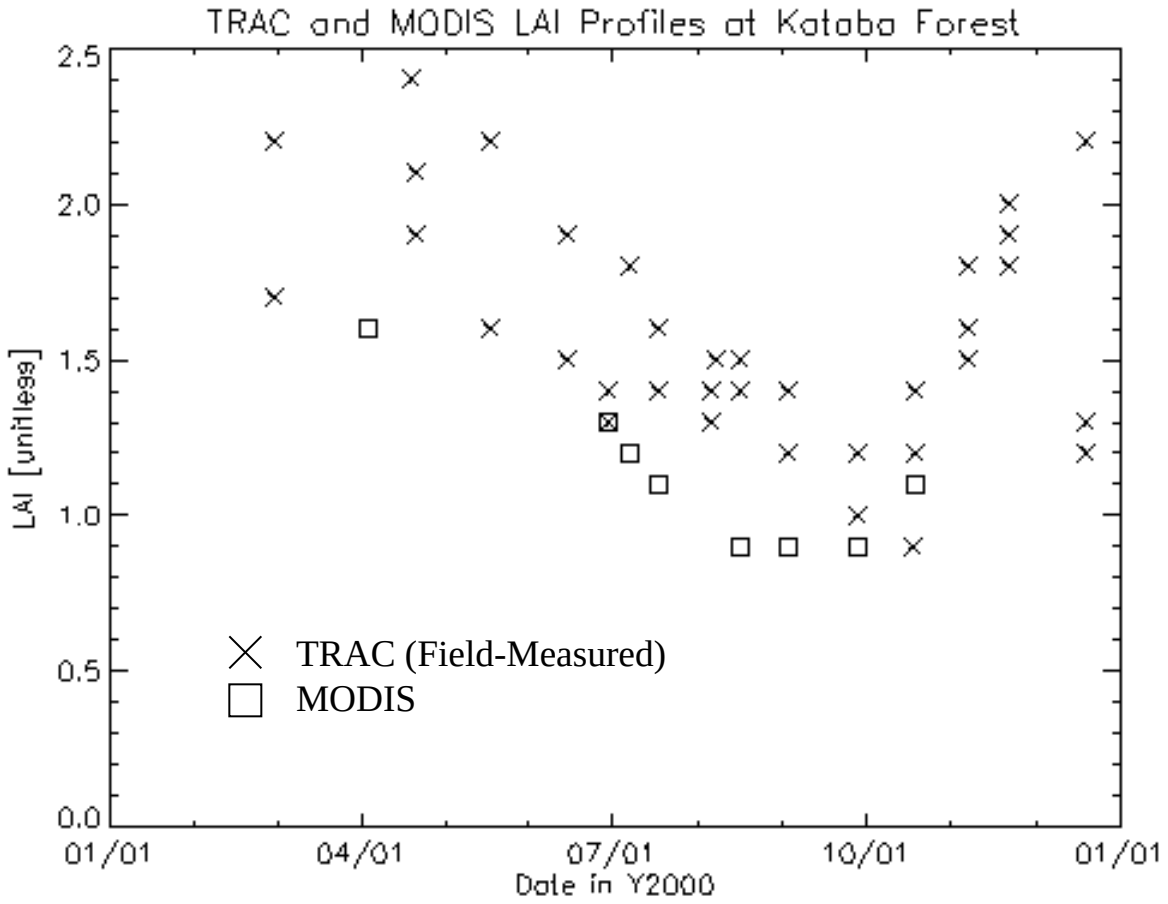
Sampling Transects at Mongu, Privette

ETM+ NDVI 30 m/pixel

IKONOS NDVI 4 m/pixel



LAI Comparison of Field-Measured and MODIS: Privette, SAFARI 2000

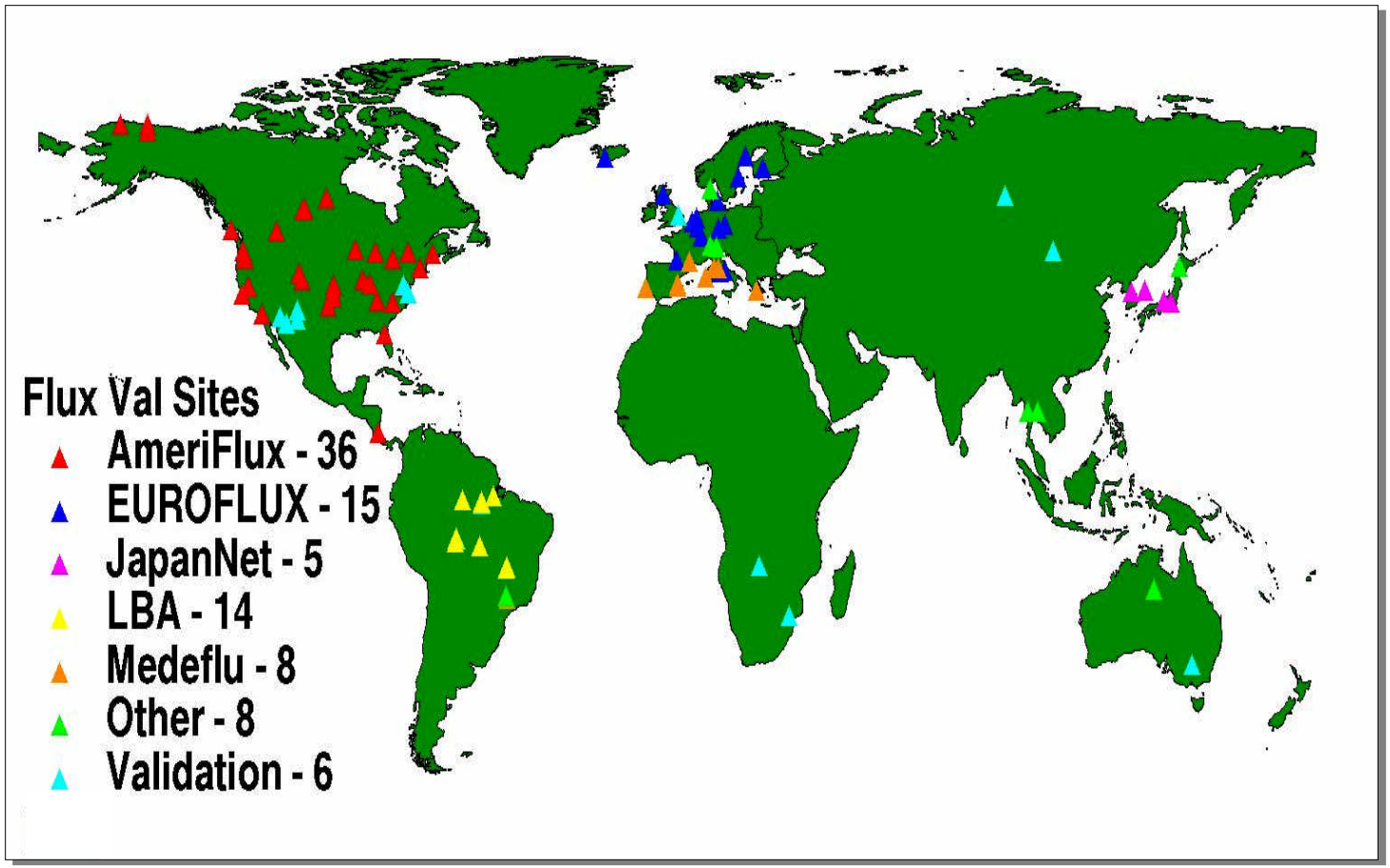


J. Privette

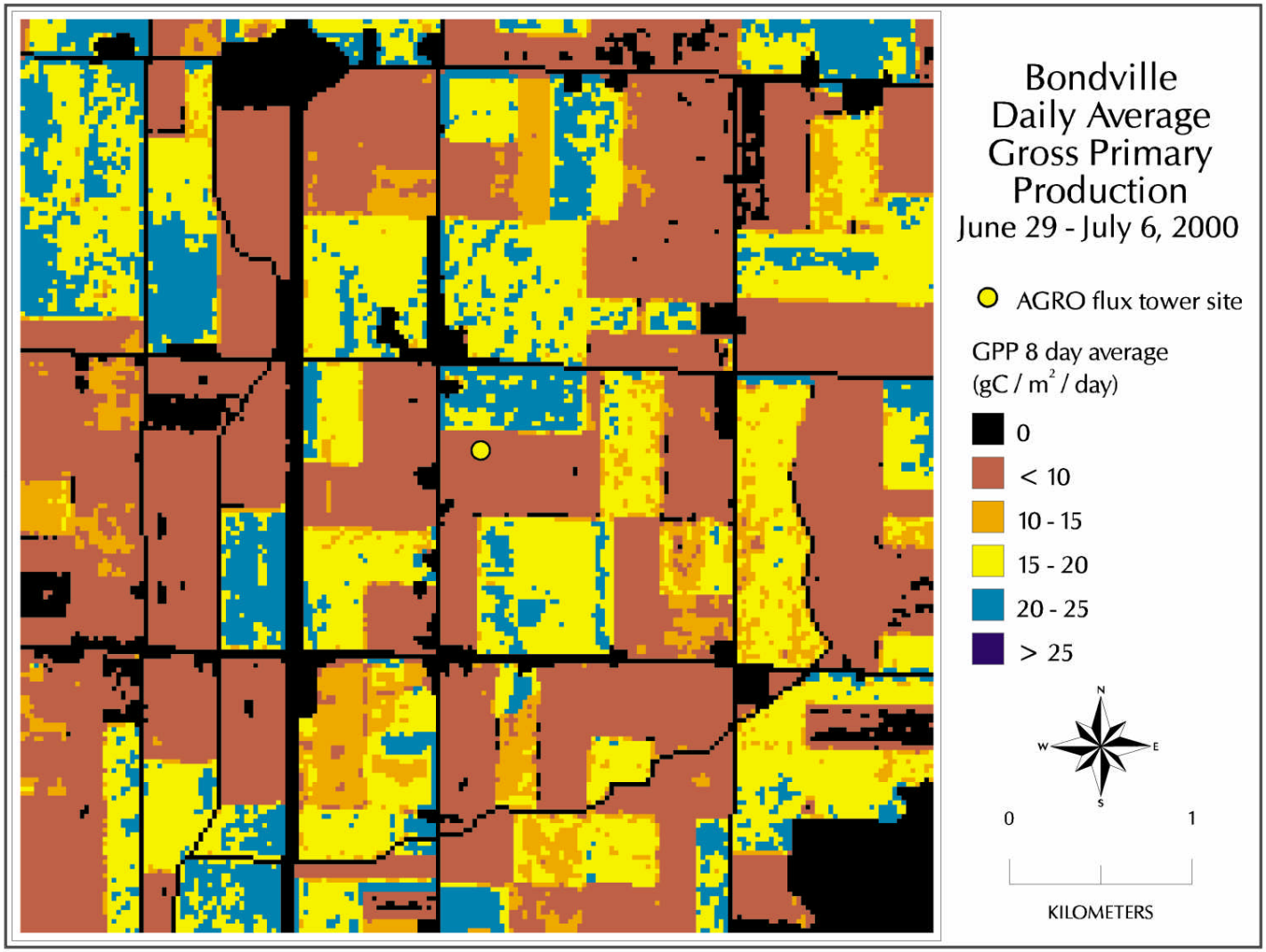
Daily Photosynthesis and Annual Net Primary Production

Steve Running: PI

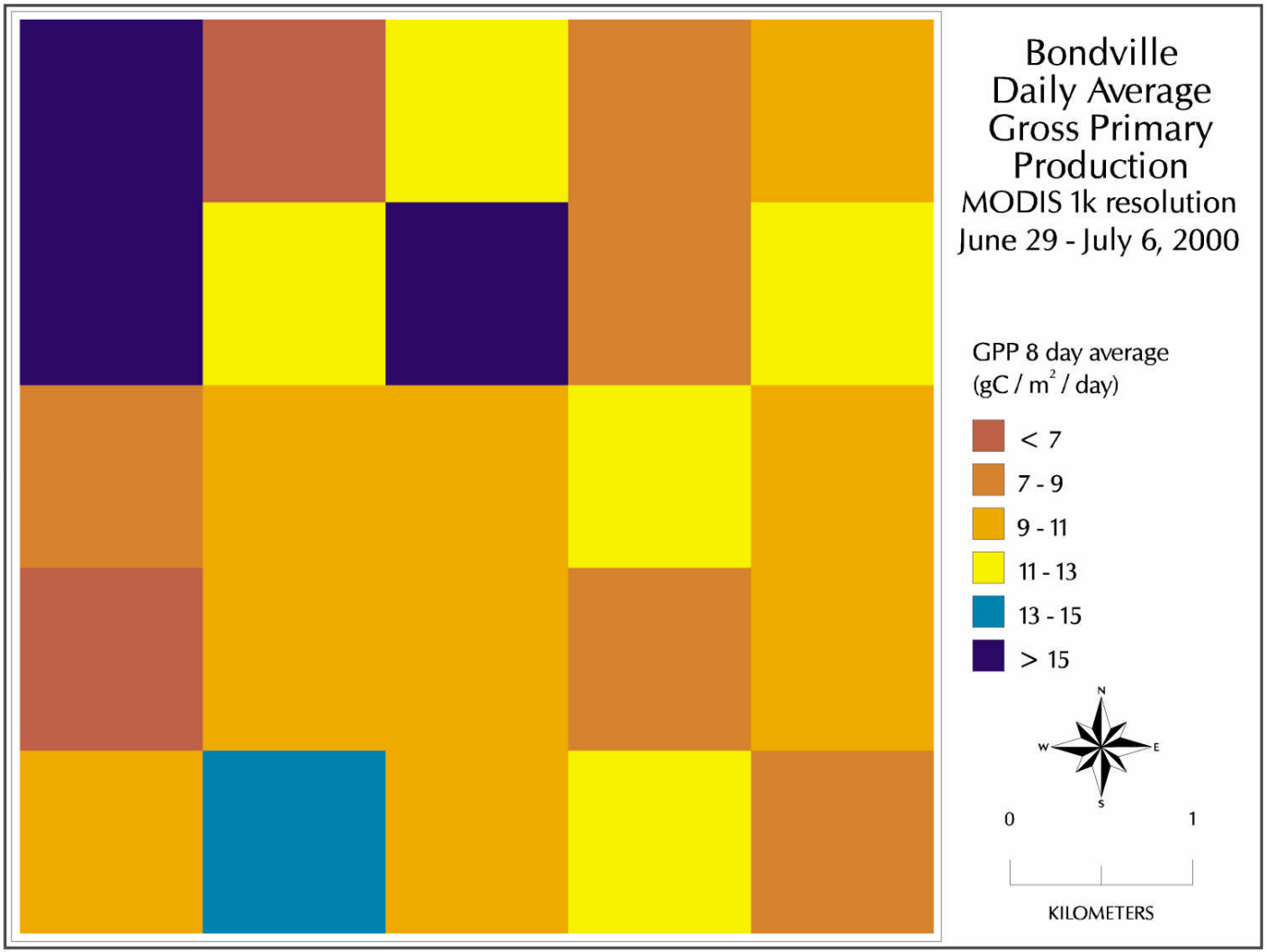
Investigation: "Fluxnet" (D. Baldacchi & D. Olson) & BigFoot



GPP: Modeled from Tower data and ETM+ through the BigFoot program



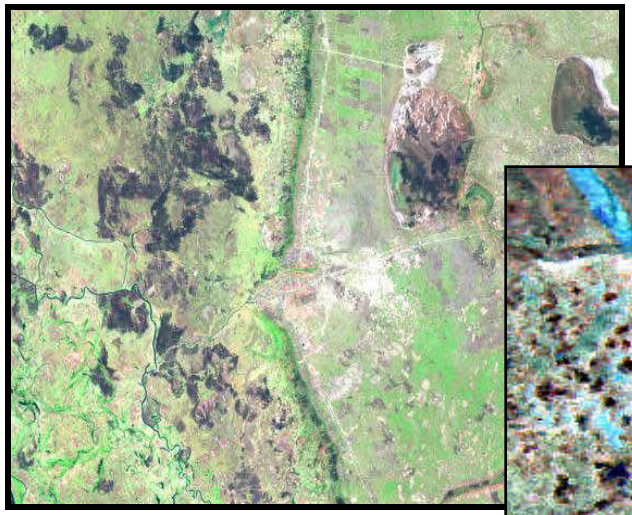
GPP: Modeled from Tower data and MODIS through the BigFoot



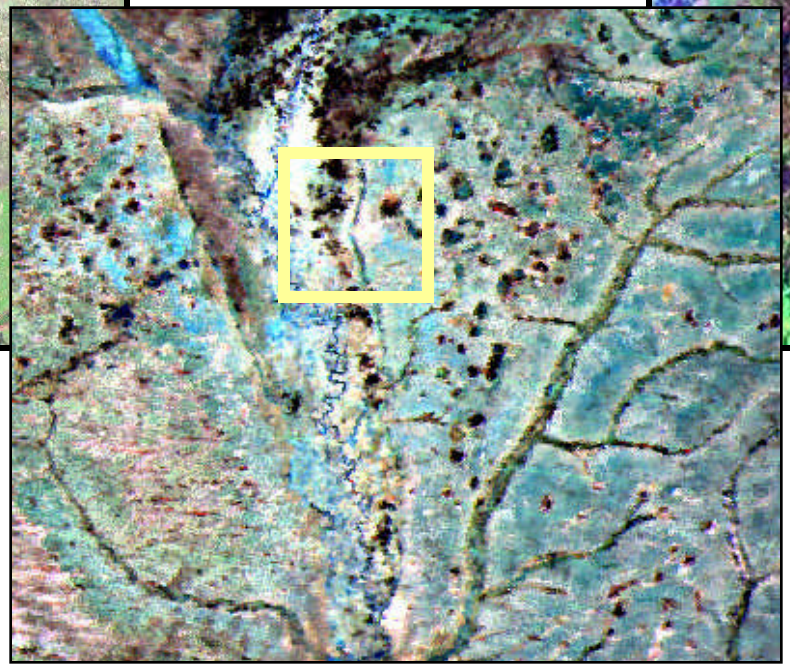
Thermal Anomalies: Fire and Burn Scar

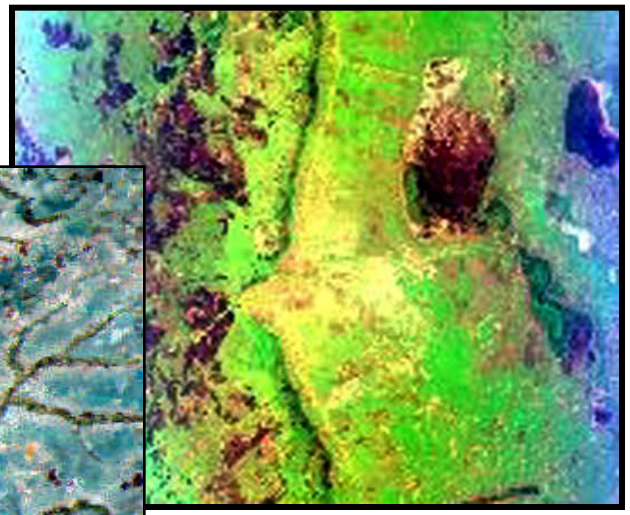
Chris Justice: PI

Investigaqtions: W. Hao/USFS, SAFARI 2000



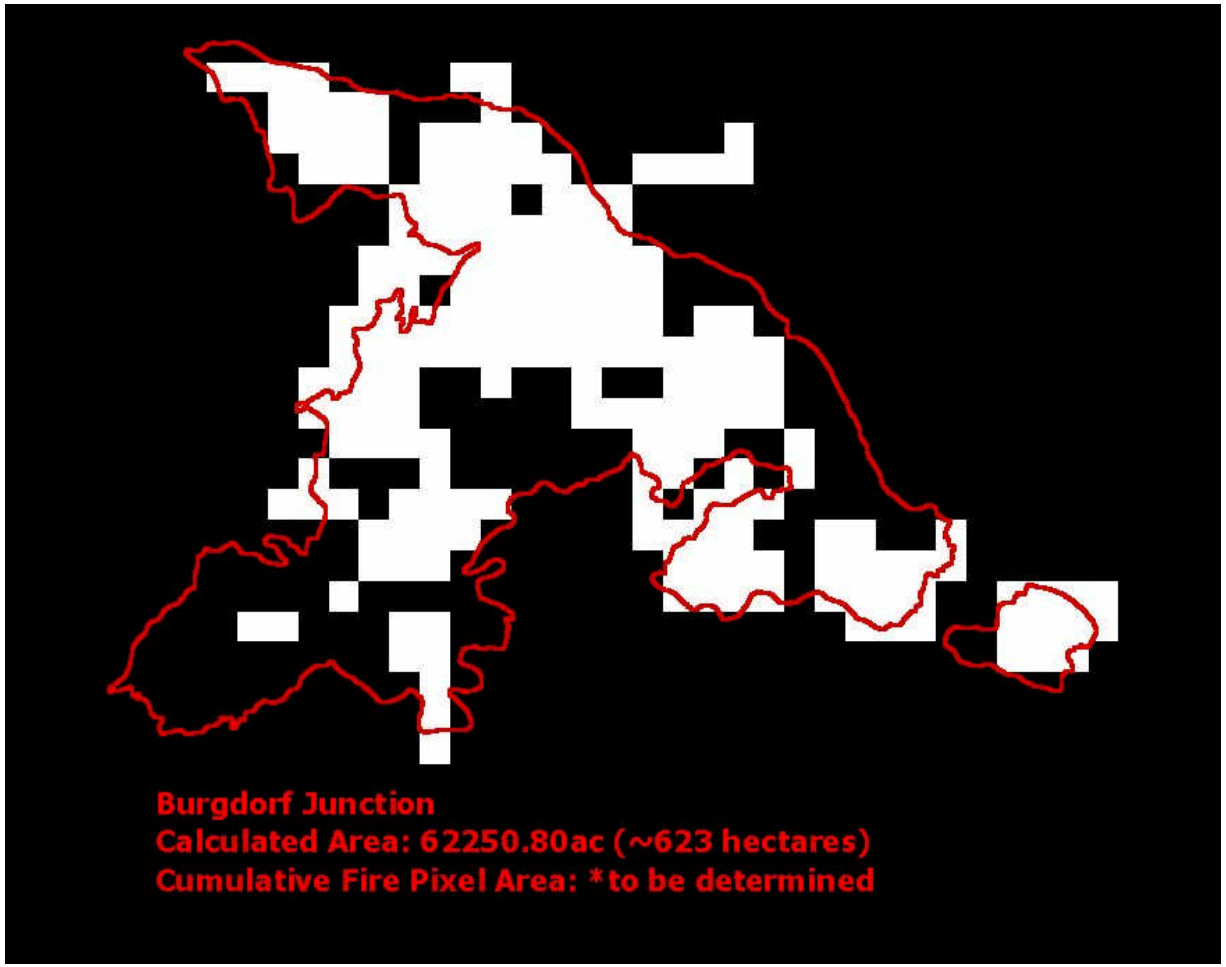
Landsat 7
composite 5, 4, 3
1st Sept 2000





MAS
composite 20, 7, 1
Sept 06 2000

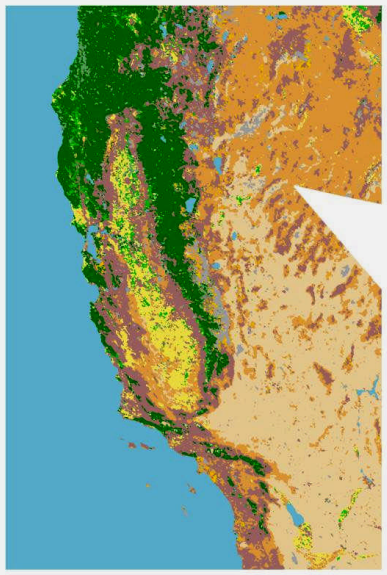
Integration with USDA Forest Service data, W. Hao



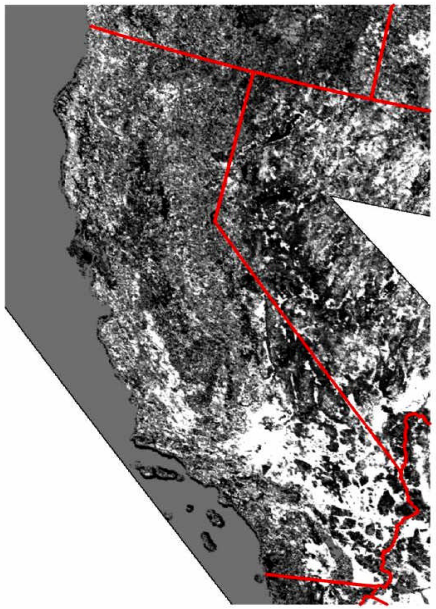
Hao

Land Cover

Alan Strahler: PI
Investigation: CEOS/Belward & BigFoot program
Focus on "STEP" database and Core Sites, ETM+ and IKONOS



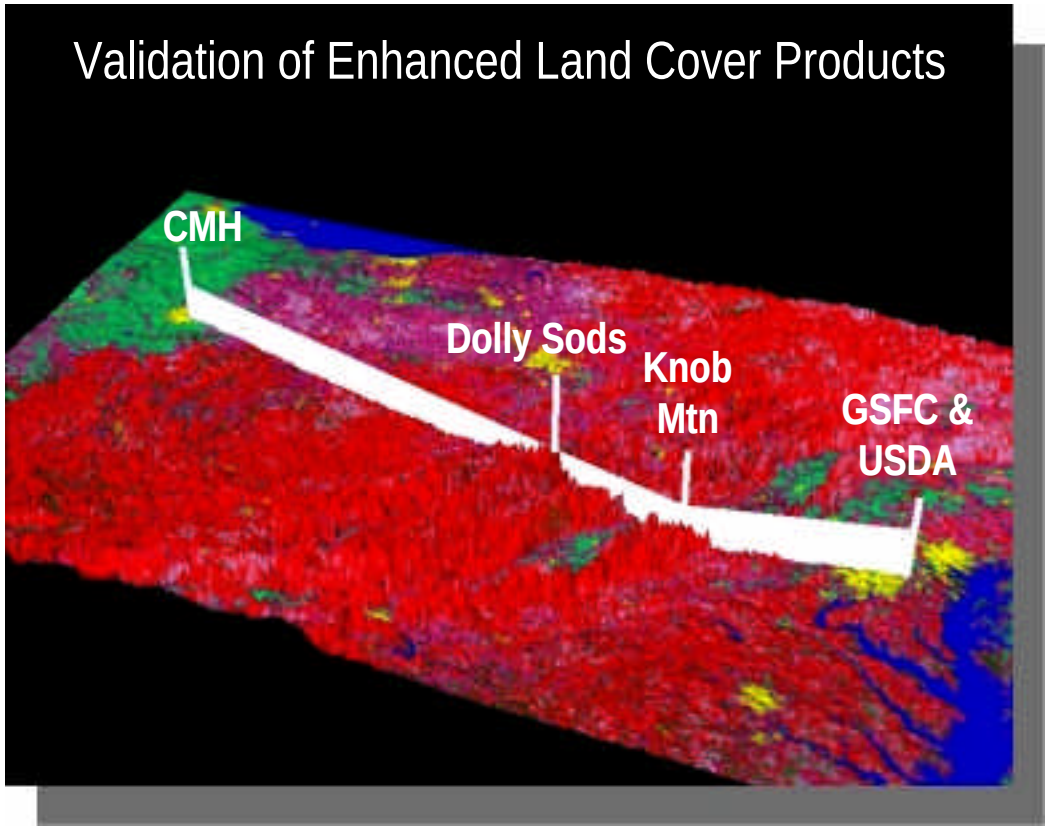
MODIS Classification



Classification Confidence

Vegetative Cover Conversion & Vegetation Continuous Fields

John Townshend & Ruth Defries: PIs
Investigation: SAFARI 2000 and "Appalachian Transect"

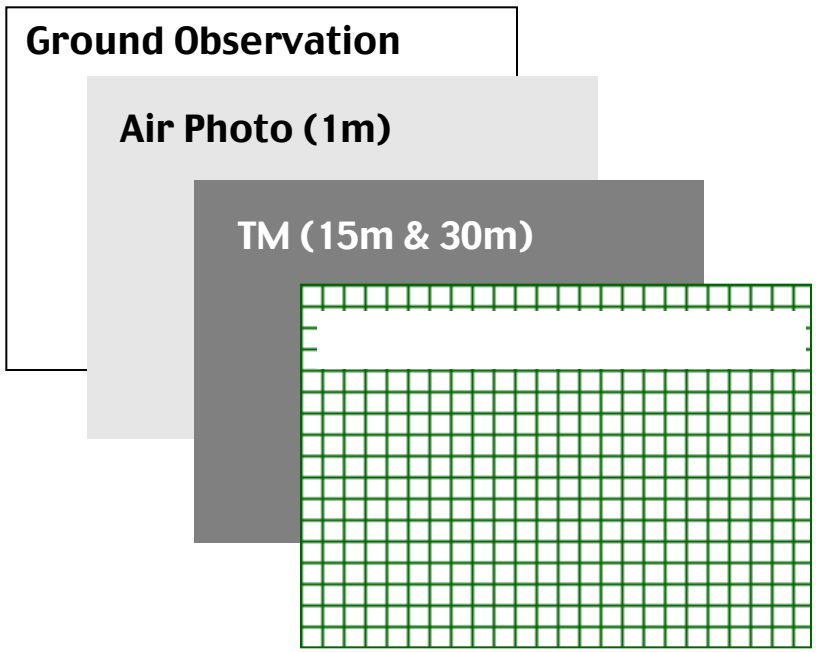


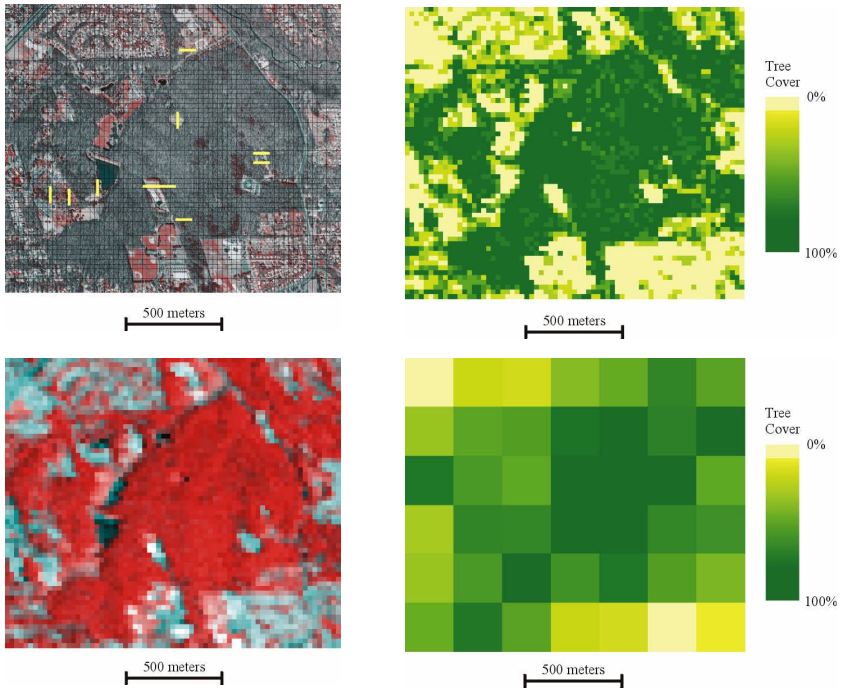
Instrument:
ADAR 5500 (RGB+NIR); 1m resolution

Acquisition Strategy:
- Leaf On: 6/30/00 – 7/2/00 (actual)
- Leaf Off: 3/27/01+ (estimated *)

* MODIS will be used to verify that snow cover has abated.

Vegetation Continuous Fields
Validation using Fine Resolution Data





- Coordinated observations from ground, air, and satellite.
- Provides the opportunity to examine scaling issues.
- Example shows prototype from U.S. field activities.
- Using IKONOS, Positive Systems ADAR, and ETM+

Concerns from Workshop

- **Availability of stable MODIS products**
- **Urgent need to reprocess MODIS data over validation sites**
- **Availability of coincident Terra data (MISR/ASTER)**
- **Continuation of Aeronet availability at validation sites**
- **Various approaches to scaling issue, no convergence yet.**
- **Effective interpretation of QA/cloud mask for understanding land products**

Concerns from Workshop (cont.)

- **Need faster response time in getting data products for field campaigns**

- **EDG currently lacks the level of support needed by scientist, including subscriptions, searching by QA fields, and ordering small subsets**

- **Limited support of HDF-EOS, in particular with respect to georeferencing**
  - **EDC "MODIS tool" should help**
  - **ONRL is considering automated application of the EDC tool to reproject and reformat validation subsets**

Reprocessing issues

- **Retrospective analysis should be geared toward validation of operational products/code**
- **Need for reprocessed data now, earliest appears to be April**
- **Reprocessing will request “best” (reprocessed?) L1B data from GDAAC**
- **MODAPS will run “best” (different than current?) PGEs**
- **Reprocessing will produce all land products**
- **How to distribution validation-related reprocessed data?**
- **Coordination with MODLAND and Validation investigators to supply MODAPS with lat/lon boxes and date/time, with respect to compositing period (by March)**

Reprocessing Targets

- **Four BigFoot sites through growing season**
- **LAI campaigns in Finland and Canada**
- **SAFARI 2000 wet and dry season**
- **Barton Bendish**
- **Snow and Ice campaigns: Keene, Greenland, S. Ocean**
- **GLI/Honda U.S. Campaign and Mandalgobi**
- **LST campaigns**
- **MQUALS flights**
- **Appalachian Transect**
- **Western US fires**

Urgent needs for sites with validation data – before 2001 field campaigns.

Plans

Continue coordination with EOS and other validation investigations through 2001

Build on network approach: Fluxnet and Aeronet as example

Details in "MODLAND Validation Plan: Update for Terra and Aqua", December 2000

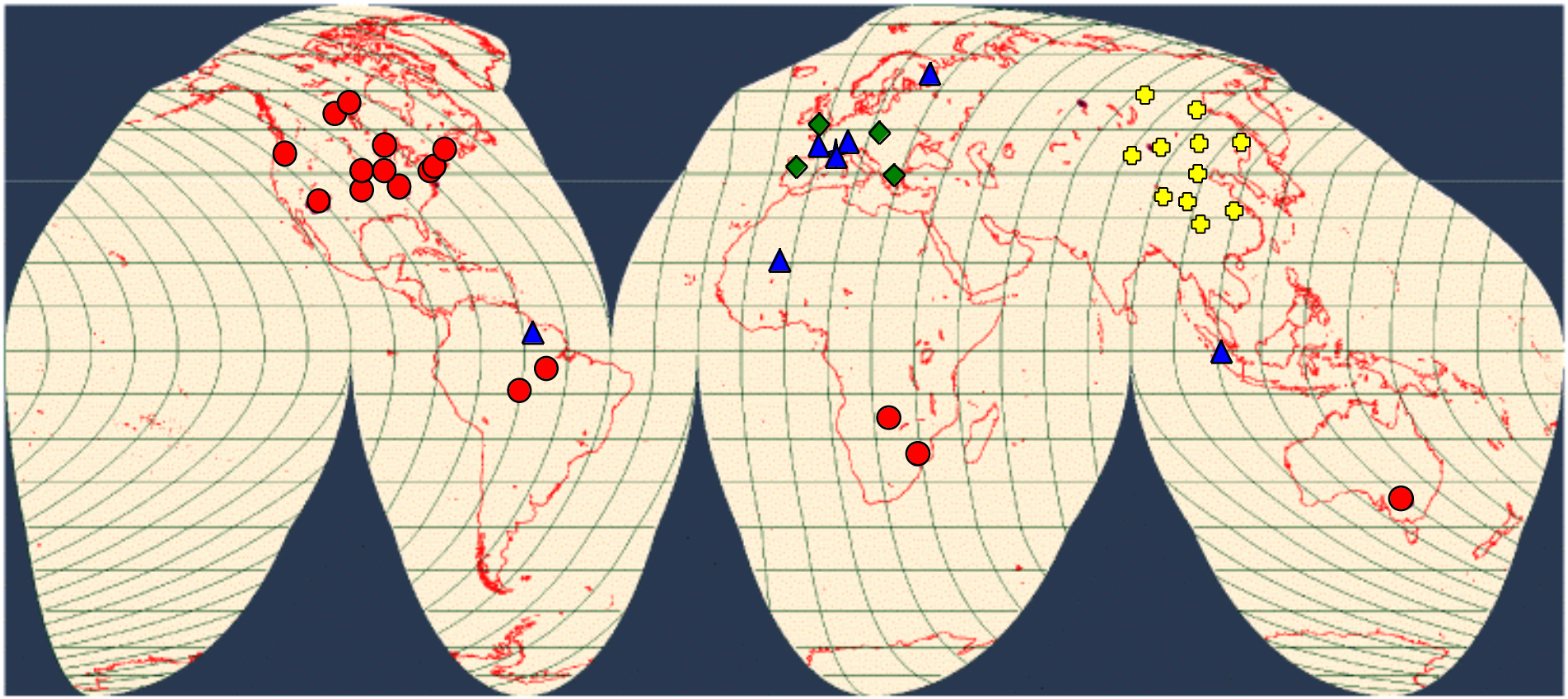
MODLAND is coordinating with Aqua validation and NPOESS to utilize lessons learned

International Activities:
CEOS Land Product Validation subgroup &
"Developments in the 'validation' of satellite sensor products for the study of the land surface", Justice et al., 2000 (reprint on table outside).

CEOS: Working Group on Cal/Val: Land Product Validation subgroup

- **Officially established as subgroup in 2000**
- **Land product validation (Levels 3, 4) is in its infancy**
  - **expectations not formed**
  - **scientific exchange is beneficial**
  - **excellence sets precedent**
- **Best science will result if**
  - **all missions support validation and validation is on-going**
  - **uncertainty information determined through standard practice**
  - **algorithms are iteratively improved based on validation results**
  - **a global validation strategy for global change issues**
- **GOFC has been chosen as an initial programmatic focus for LPV activities – emphasis on moderate resolution, level 2 and 3 products.**

Distribution of EOS and VALERI Sites



- MODLAND (NASA)
- VALERI (CNES)
- VALERI (EC?)
- VALERI (China?)

Goode Homolosine projection - MODLAND Level 3 grid

Jacques Descloitres (LDOPE) - September 1998

Assessment of Land Validation activities

There is no set definition for what it means for a product to be "validated": driver should be utility of products to address science and application questions.

Validation can be considered to have:

- **incremental stages:**
  - **explore products at a few well instrumented sites**
  - **incorporate multiple sites with similar measurements**
  - **develop a globally representative network**
- **incremental goals:**
  - **check and refine products to be on target – "unbias"**
  - **estimate product uncertainty at pilot sites**
  - **compare initial results with theoretical error bars**
  - **estimate product uncertainty with global representation**
  - **infer the impact of uncertainty on products use**

Assessment of Land Validation activities - continued

- **Range of how much MODIS data Val investigators have considered – from every available relevant product to none.**

- **The demands of initial processing has limited the ability of the science team to focus on validation**

- **External validation: initial validation needs close coupling with the science team and QA – but this requires extra effort on team and investigators.**

- **Current model of validation through funded "Validation Investigators" interacting with the science team could grow into:**
    - **additional sites**
    - **network of sites with global representation**
    - **integration with users**

Successes & Achievements

- **Validation campaigns undertaken for each MODLAND products, hard won results starting to come in**
- **MQUALS system as low-cost method of scaling**
- **MODIS subsetting, collaboration with UAH now feeding into ESDIS**
- **International collaboration (GLI, VALERI, GOFC/CEOS LPV)**
- **Bringing MODLAND team together with EOS and other investigators**
- **Standardizing measurement techniques through protocols**
- **EOS Land Validation Core Site data sharing infrastructure (ORNL/Mercury and EDC), serving as an example for CEOS Working Group on Cal/Val**
- **Utilization of existing networks: Aeronet, Fluxnet, and USFS (models for future validation)**
- **We have created “a new area of research and development” -C.J.**