

**Harmonization:
Examples from the Land Product
Validation Subgroup**

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and Fred Baret, Sebastien Garrigues, Jaime Nickeson, and
Marie Weiss

GEO/CEOS cal/val workshop

NIST

6-8 May 2008

Acknowledgements

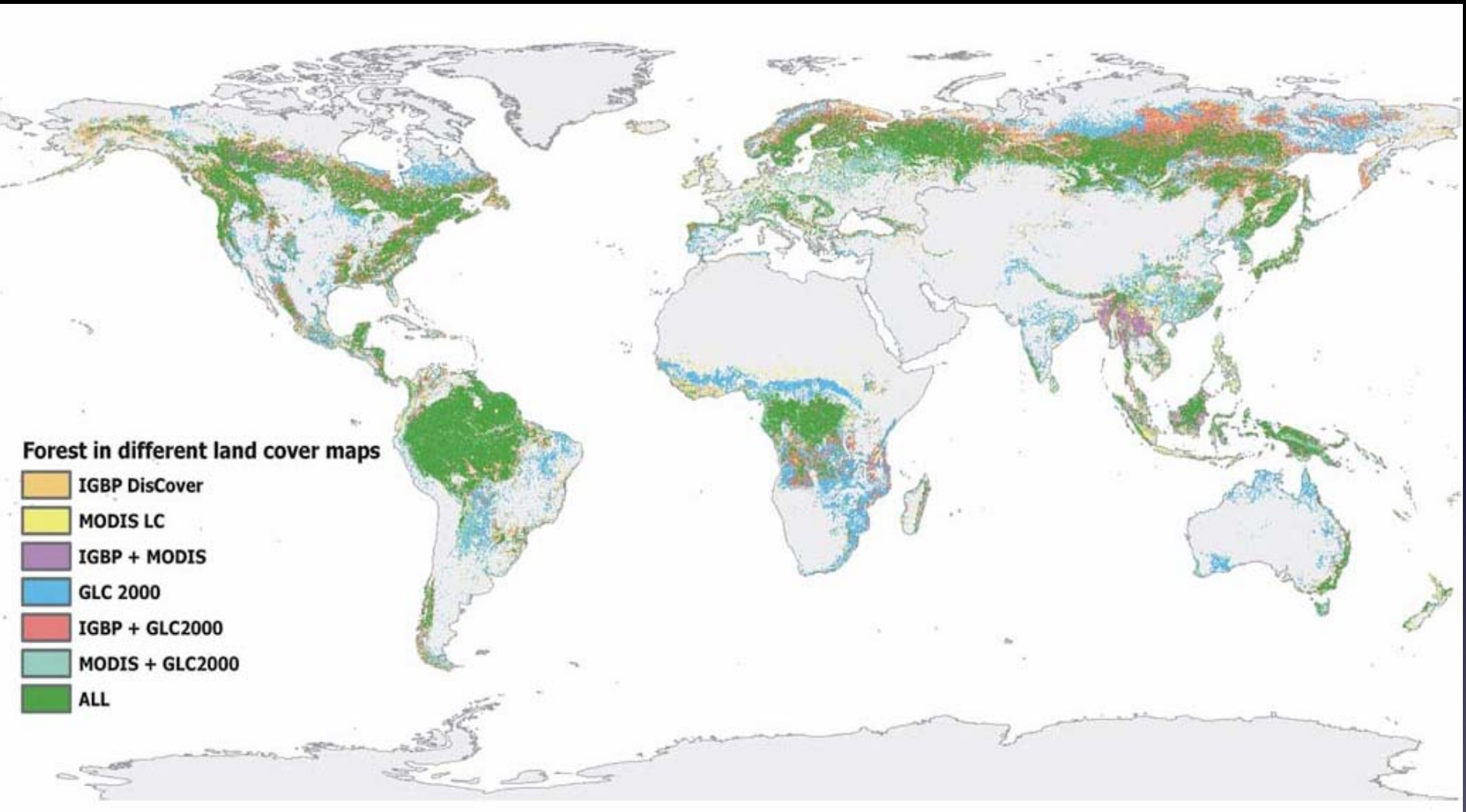
NASA funding for land validation activities have been provided through its Terrestrial Ecology program, Diane Wickland, program manager.

Chris Justice, Alan Belward and Jeff Privette were instrumental in establishing the LPV subgroup.

WGCV Chairs Desnos, Ungar, and Cao have all been helpful with LPV activities.

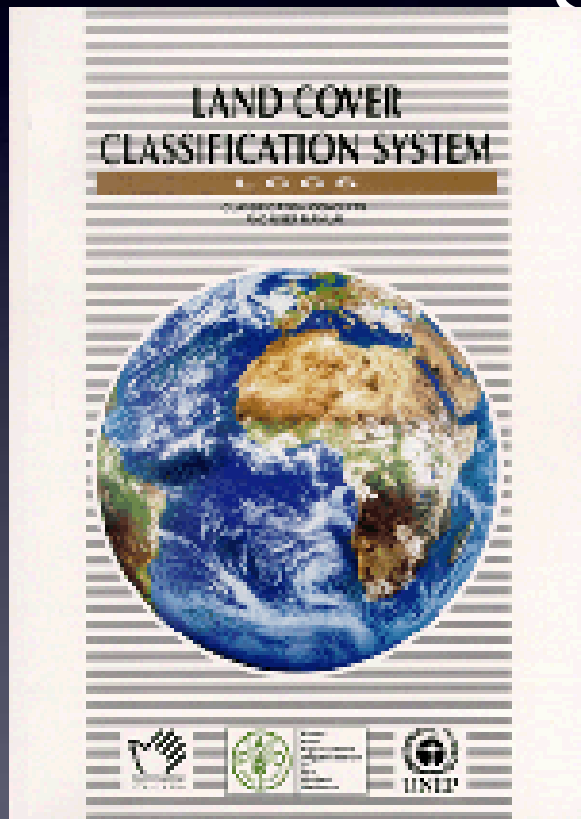


"Harmony" by Criss Digital Art
<http://criss.site.voila.fr/index.html>



Herold et al., 2006. A Joint Initiative for Harmonization and Validation of a Land Cover Datasets, IEEE TGRS 44(7)1719-1727.

Cover Classification System



Classification Concepts
and User Manual

with software

Gregorio & Jansen

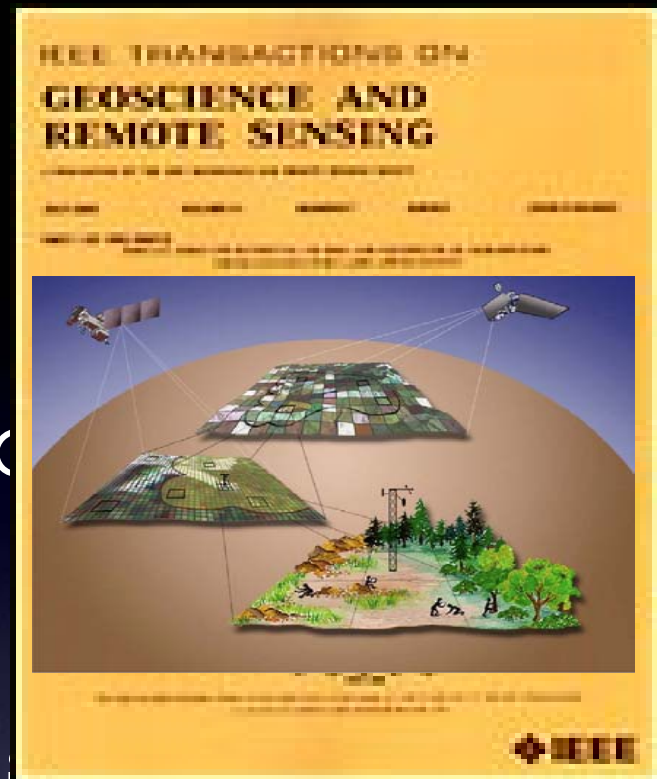
FAO Land and Water
Development Division

Documentation:
Special issue
providing
"acceptable practice

3 "framework" papers
19 "validation results

4 "user response" papers

(an attempt to solicit "user
feedback").



CEOS Document

Primary Findings on Land Cover

- Call for global inter-comparisons
- “Hybrid” statistical sampling using fixed sites
- Confidence layers (model-based accuracy)

Edited by: Strahler

Authors: Boschetti, Foody,
Friedl, Hansen, Herold,
Mayaux, Morisette,
Stehman, Strahler, &
Woodcock

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

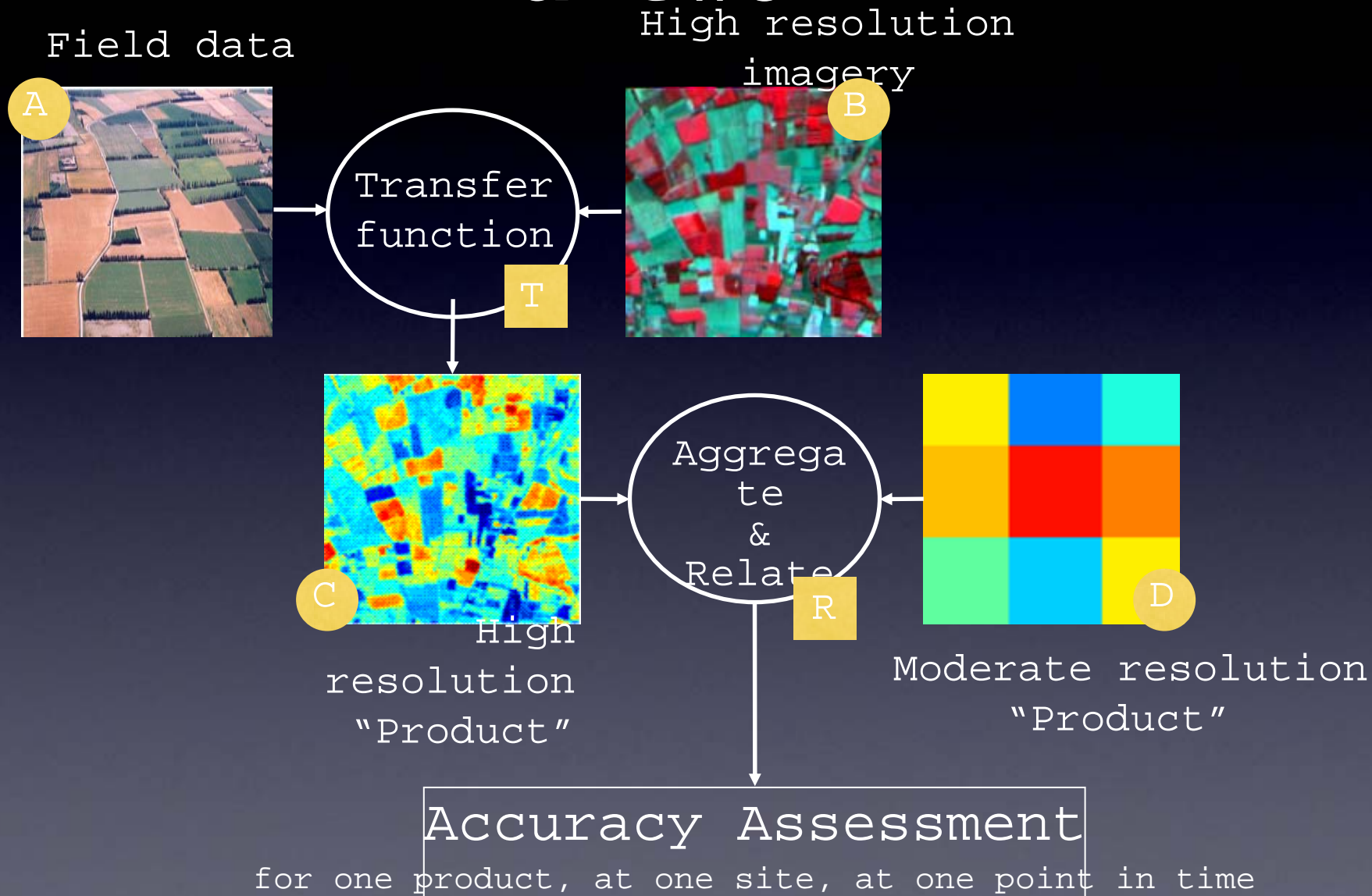
Terminology: the CEOS Validation Hierarchy

Stage 1 Validation: Product accuracy has been estimated using a small number of independent measurements obtained from **selected locations and time periods** and ground-truth/field program efforts.

Stage 2 Validation: Product accuracy has been assessed over a **widely distributed set of locations and time periods** via several ground-truth and validation efforts.

Stage 3 Validation: Product accuracy has been assessed, and the uncertainties in the product well-established via independent measurements made in a **systematic and statistically robust way that represents global conditions**.

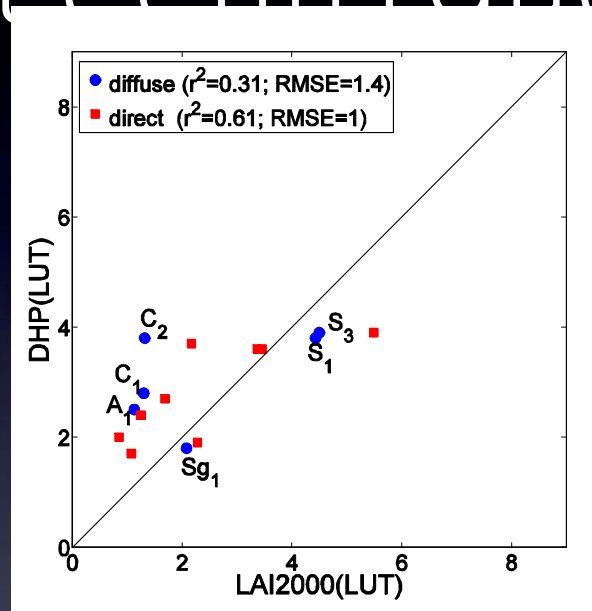
Land product validation framework



Harmonizing field measurement technique

Compared three sensors in a range of crop types and illumination conditions.

Conducted as part of WGCV-23, 2005, Argentina.



EOS Validation Core Site Data

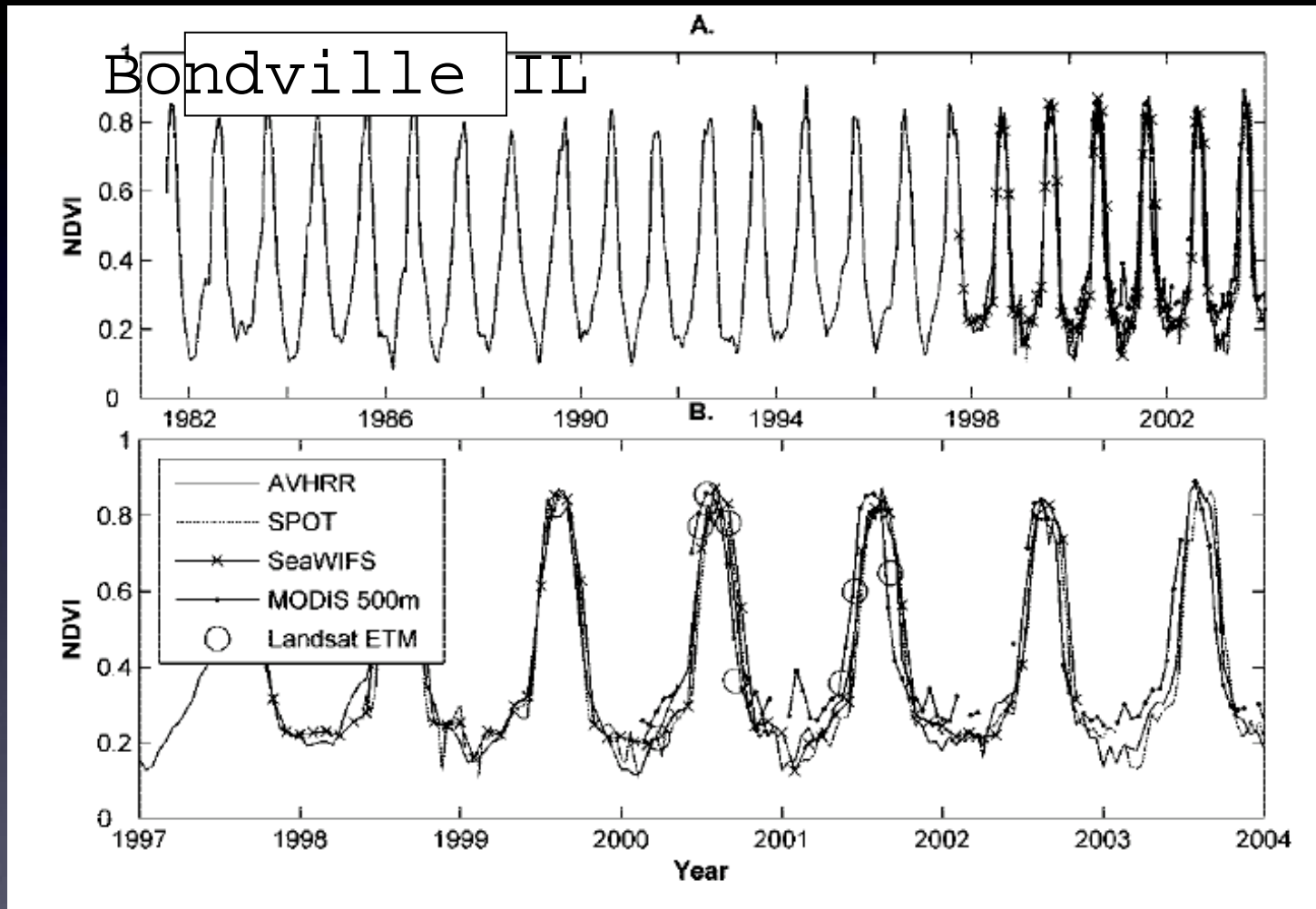
ARM CART
Barton Bendish
Bondville
BOREAS NSA
BOREAS SSA BERMS
H. J. Andrews LTER
Metolius/Cascades
Harvard Forest
Howland
JI-Paraná
Jornada (Jaru - LBA)
Konza Prairie LTER
Krasnoyarsk
Mandagjobi
Maricopa Ag. Center
Mongu (SAFARI 2000)
Walnut Gulch (San Pedro)
Sevilleta LTER
Skukuza LTER
Tapajós (SAFARI 2000)
Uardry
USDA BARC
Virginia Coast Reserve
Walker Coast Reserve
Park Branch
Barrow
Lake Tahoe
Chang Bai Shan
Mead
St. Petersburg
Lindenbergl
Grand Morlin
Sky Oaks

Satellite Data																																																
MODIS 200x200km Subsets																													C5	C5	C5	C5	C5	C5														
MODIS 7x7km ASCII Subsets																																		C5	C5	C5	C5	C5	C5									
ETM+	2	6	15	5	1	4	16	1	1	5	10	3	1		11	1	8	13	2	1	11	5	1	4	4	4																						
IKONOS	1	1	1	4	1	3	2	7	1	2	4	4	1	1	1	2	3	5	2	2	3	3	1	1	4	1	5																					
ASTER	1	1	1	1	1	1	2		3	1	2	1		1	3	7	4	2	5	1		16	1	1	4	2	12	1	1	1	1	1	1	1	1													
Atmospherically Corrected ETM+			9			1	2		1		3				6		2	7	1		8	1	1	1	1																							
AVHRR NDVI subsets																																				P	P	P	P	P	P							
SPOT-VEG NDVI subsets																																					P	P	P	P	P	P						
Digital Elevation Data																																																
MISR subsets																																						P	P	P	P	P	P					
Quickbird			P																																													
Global LC Test Sites (GLCTS)																																																
GeoCover 1990's, 2000 TM, ETM+																																								P	P	P	P	P	P			
Aircraft Data																																																
AirMISR																																																
MODIS Quick Airborne Looks																																																
AVIRIS																																																
Data Networks																																																
AERONET																																																
FLUXNET																																																
LTER/ILTER																																																
VALERI																																											P	P	P	P	P	P
CEOP (GEWEX)																																																
BSRN																																																
SPECNET																																																

	LP DAAC
	ORNL DAAC
	GSFC
	Langley DAAC
	Univ. of Arizona
	JPL
	Active Network
C5	To be Subset with MODIS Collection 5
P	Pending data extraction
#	Number of Acquisitions Available for Site

Nickeson, J., J. Morisette, J. Privette, C. Justice, D. Wickland, 2007. Coordinating Earth Observing System Land Validation, *EOS Transactions*, 88(7)81-82.

Using Core Site data: multi-sensor analysis

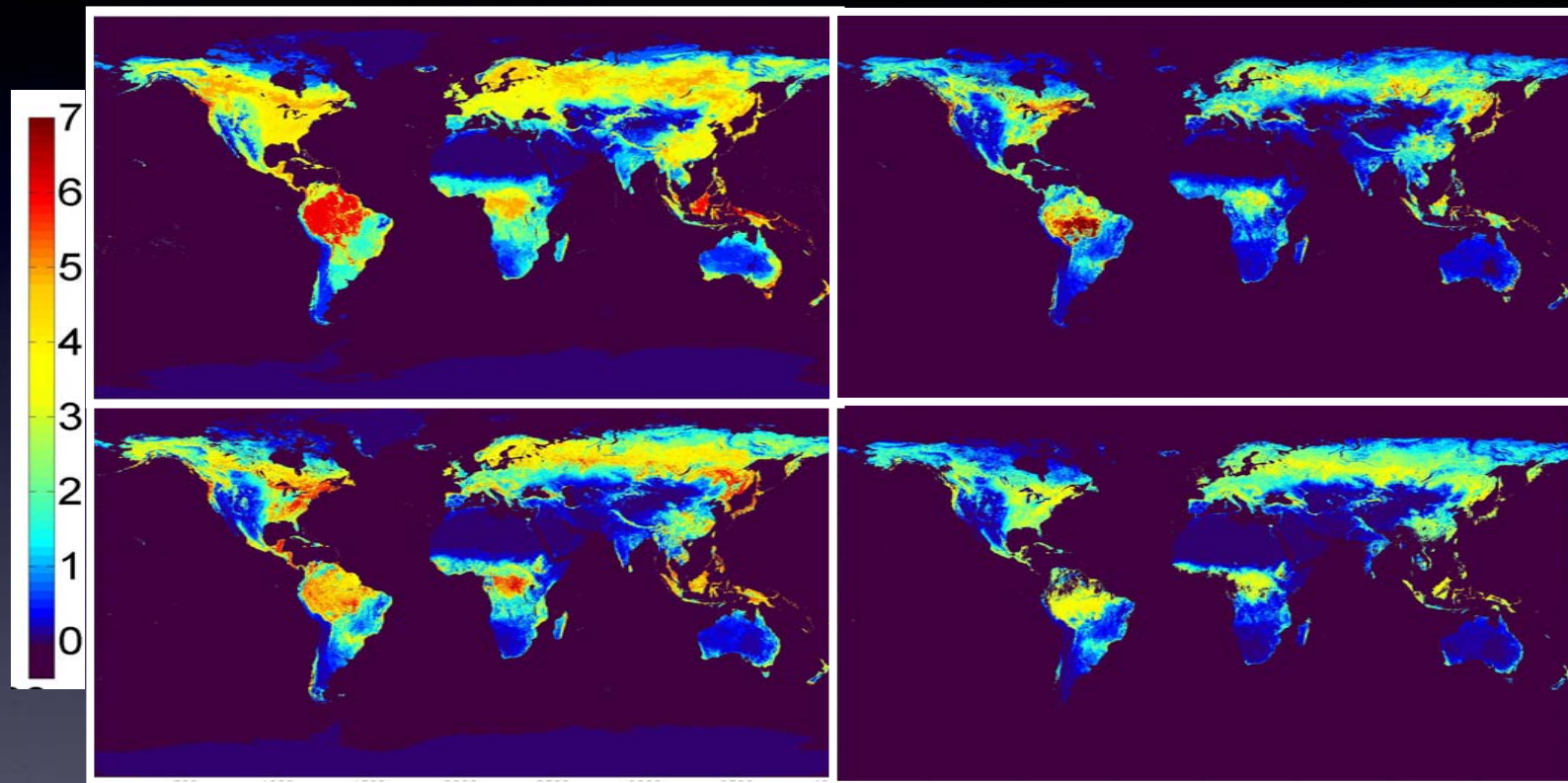


Brown, M. E. et al., 2006. Inter-Sensor Validation of long-term NDVI time series from AVHRR, SPOT-Vegetation, SeaWiFS, MODIS, and LandSAT ETM+, *IEEE TGARS*, 44(7)1787-1793.

Results of a global Leaf Area Index Inter- comparisons

ECOCLIMAP

GLOBCARBON



MODIS

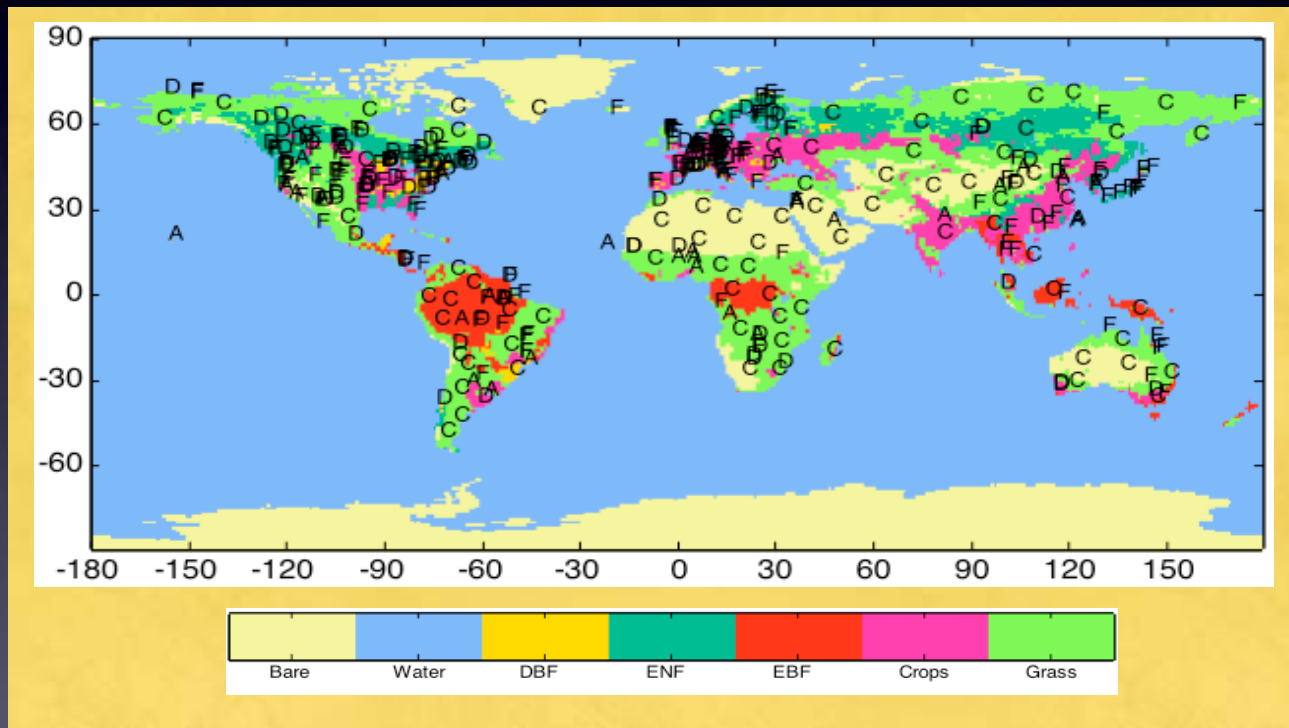
CYCLOPES

Garrigues, et al., (in press). Validation and Intercomparison of Global Leaf Area Index Products Derived From Remote Sensing Data, *JGR*.

Results:

The BELMANIP Global Network of Sites

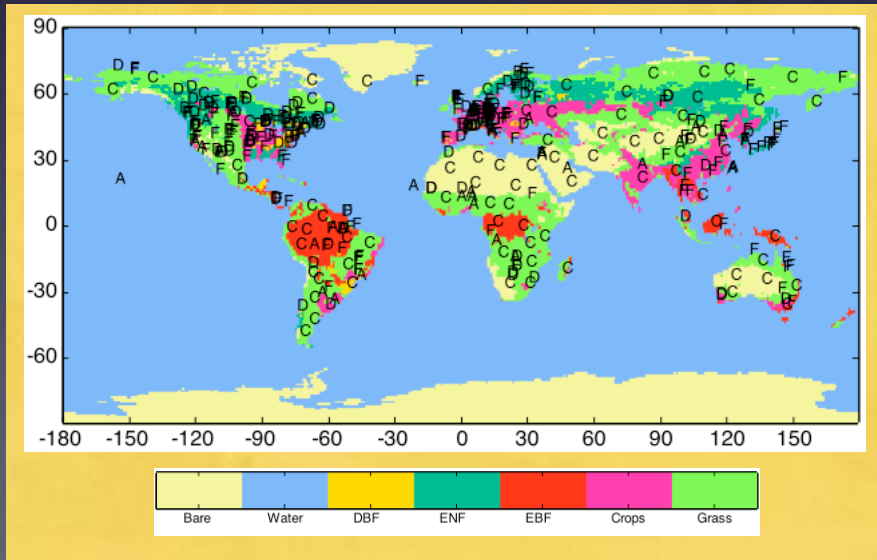
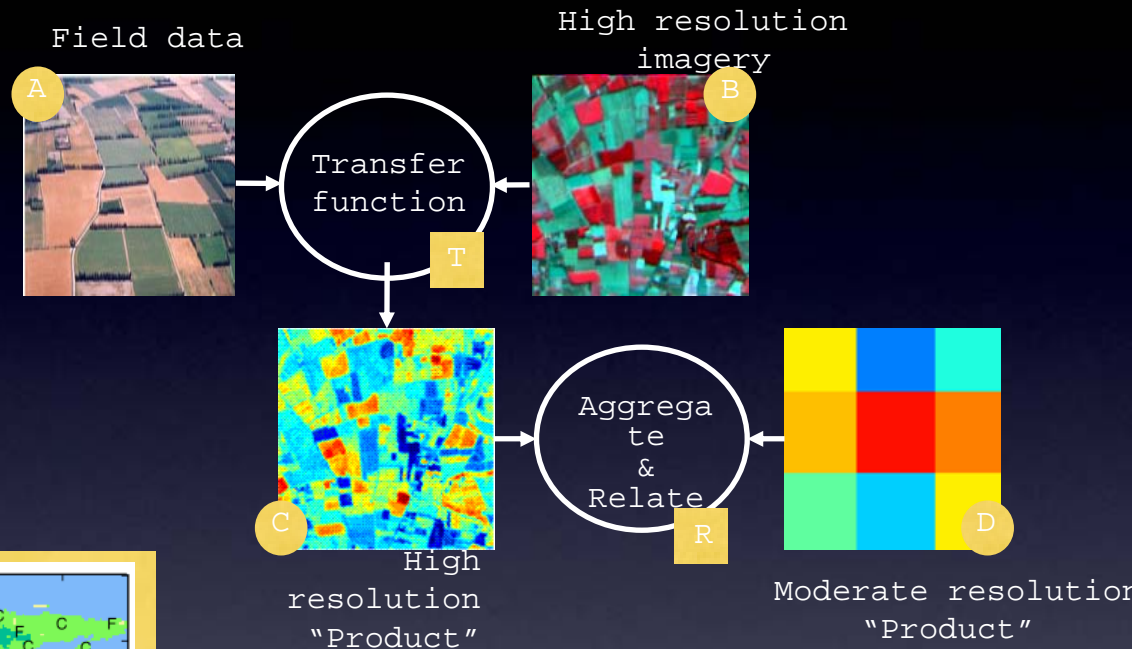
- representative sampling of global land surface types
- about 400 sites from several networks: direct validation sites (D: BIGFOOT, VALERI...), AERONET (A), FLUXNET (F)...



Baret, F., et al. 2006, Evaluation of the representativeness of networks of sites for the validation and inter-comparison of global land biophysical products. Proposition of the CEOS-BELMANIP, *IEEE TGARS*, 44(7)1794-1803.

Cal/Val portal

For each CEOS member product, provide guidance on each validation component...



... and the sites where the validation activities will occur...

..and relaying results to users.

The screenshot displays the FEWSNET Home Page in a web browser. The page features a navigation menu with categories like 'Region & Country Centers', 'Maps, Data & Imagery', 'Markets & Trade', 'Livelihoods', and 'Product Catalogue'. A central map of Africa shows food security conditions for the 2nd Quarter of 2008, with a legend indicating levels from 'Generally Food Secure' (green) to 'Extremely Food Insecure' (red) and 'Famine' (black). Below the map, there are sections for 'West Africa' (highlighting Nigeria) and 'East Africa' (highlighting Djibouti), each with a brief summary of food security issues. The page also includes a 'Latest Headlines' section, a 'Partner / Global Networks' section with a NASA logo, and a 'Most Recent Alerts' section listing alerts for Afghanistan and Djibouti. The browser's address bar shows the URL 'http://www.fews.net/Pages/default.aspx' and the search bar contains the text 'warning system'.

For: Jaime

Nickerson NASA CSE

Harmonizing results, communicated to users...

The image shows a screenshot of a web browser displaying the EOS Land Validation Home Page. The browser's address bar shows the URL <http://landval.gsfc.nasa.gov/>. The page header includes the NASA logo and the text "GODDARD SPACE FLIGHT CENTER" and "+ NASA Homepage". The main heading is "MODIS land team validation". Below this is a navigation menu with buttons for "Home", "Core Sites", "Val Status", "Campaigns", and "Documentation". A dropdown menu is open under "Val Status", listing various products: "Albedo/BRDF", "Fire", "LAI/Fpar", "Land Cover", "Land Surface Temperature", "Net Primary Production", "Snow/Ice Cover", "Surface Reflectance", "Vegetation Cover Conversion", and "Vegetation Indices". An arrow points from the text "Product 'pick-list'" to this menu. The page content includes an "Announcements" section with several bullet points, a "MODIS News" section, and a "Landsat News" section. A large text block discusses the "The MODIS Land Product Validation (LPV) subgroup" and "The Committee on validation as the process of the data product". A smaller window in the foreground shows a search for "bedo: M*D43" and a search result for "ice albedo product using region on the Tibetan Plateau" by Ma, Zhian Sun, and Wenhua Jiang, dated June 2006.

Welcome to the EOS Land Validation Home Page

http://landval.gsfc.nasa.gov/

NASA GODDARD SPACE FLIGHT CENTER + NASA Homepage

MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

Announcements:

- MODIS Collection 5 changes
- MODIS Land Collection 5 Workshop, Jan. 17-18, 2007, University of Maryland.
- View and comment on the ESDR White Papers developed by the NASA Land Measurement Team
- TGARS Special Issue on Global Land Product Validation now available
- MODIS Science Team Meeting, Oct. 31-Nov. 2, 2006, at the University of Maryland

MODIS News

- Terra
- Aqua

Landsat News

- Landsat Data Continuity Mission (LDCM) (project updates)
- LDCM home

The Committee on validation as the process of the data product (CEOS), defines validation means, the quality of the data product, and the system outputs.

The MODIS Land Product Validation Strategy

MODIS Land (MODLAND) product quality is ensured by Calibration, Quality Assurance (QA) and Validation. The MODIS land validation effort will contribute to and leverage off of international validation activities, helping to establish standards and protocols through close coordination with the CEOS Land Product Validation (LPV) subgroup, under its Working Group on Calibration and Validation (WGCV).

MODLAND uses several validation techniques to develop uncertainty information for its products. These include comparisons with in situ data collected over a distributed set of validation test sites, comparisons with data and products from other sensors (e.g., ASTER, AVHRR, MISR, TM/ETM+), intercomparison of trends derived from independently-obtained reference data, and analysis of process model results.

MODLAND's primary validation technique includes the collection of field and aircraft data, and comparison with these and with products from other satellites. The infrastructure for these efforts has resulted in the establishment of a semi-permanent array of EOS Land Validation Core Sites, most of which include a flux tower for extended temporal measurement of terrestrial biophysical dynamics over a range of landcover types. Field data are archived in cooperation with the Oak Ridge DAAC's

bedo: M*D43

ice albedo product using region on the Tibetan Plateau

Ma, Zhian Sun, and Wenhua Jiang

004

ctroradiometer (MODIS) global land studies. We evaluate the accuracy (any 2001 to July 2003) of ground in (32.30 deg N, 84.06 deg E, 4420 m) consists of semidesert or desert soil. field measurements shows that the accuracy requirement of 0.02. There is id the ground-measured albedo, with if 0.036.

as observed from AWS and derived

7-5317

daily albedo
ground
MODIS

Communicating results...

Accuracy statement for each product

EOS Validation Status for MODIS BRDF/Albedo: M*D43

http://landval.gsfc.nasa.gov/ProductStatus.php?P

MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

Status for: BRDF/Albedo (M*D43)

General Accuracy Statement

Validation at [stage 1](#) has been achieved for the surface reflectance product (MCD43). The accuracy of the high quality MODIS operational albedos is well less than 5% albedo at the validation sites studied thus far and even those albedo values with low quality flags have been found to be within 10% of field data.

Further work on albedo validation is planned. A summary of these plans can be found in the [May-June 2004 issue](#) of the Earth Observer.

Product status updated: October 2004 (modified January 2007)
Product version: Collection 4

Supporting Studies:

Title: Validation of the MODIS Bidirectional Reflectance Distribution Function and Albedo Retrievals Using Combined Observations From the Aqua and Terra Platforms
Author: Jonathan G. Salomon, Crystal B. Schaaf, Alan H. Strahler, Feng Gao, Yufang Jin
Source: IEEE Transactions on Geoscience and Remote Sensing, Vol. 44, No. 6, June 2006 1555
[View Summary Results From This Document](#)

Title: Comparison of MODIS broadband albedo over an agricultural site with ground measurements and values derived from Earth observation data at a range of spatial scales
Author: M. Disney, P. Lewis, G. Thackrah, T. Quaife, M. Barnsley
Source: Int. J. Remote Sensing, 10 December, 2004, vol. 25, no. 23, pp. 5297-5317
[View Summary Results From This Document](#)

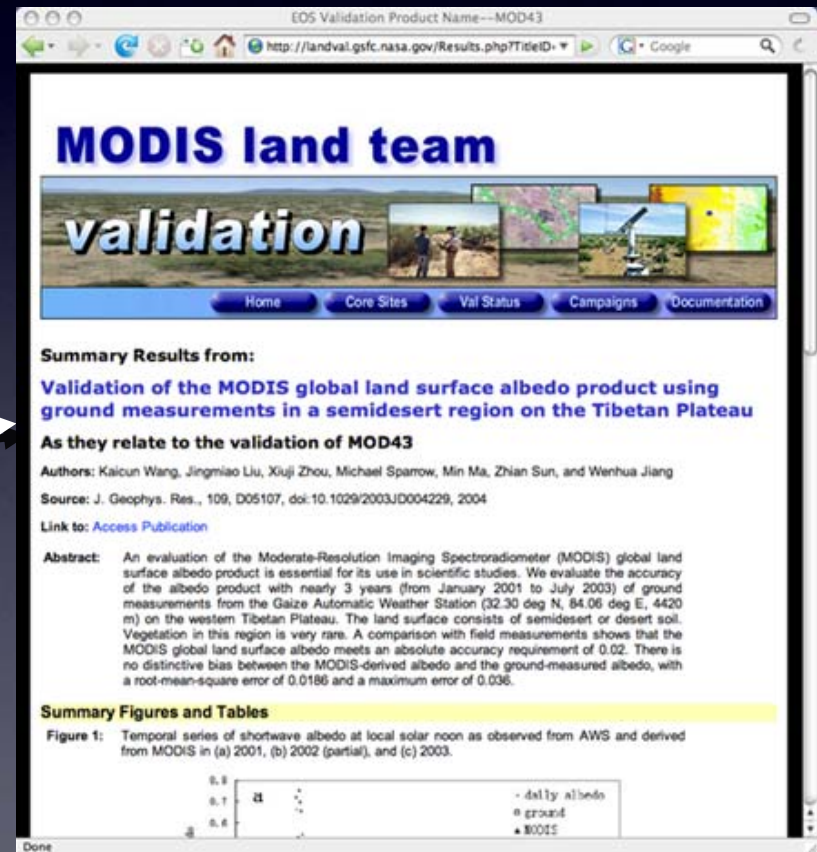
ion earth observation, improved spectral band ad in the development is for global change ODIS and is used in algorithm builds on the (HRR) and SeaWiFS MODIS. Atmospheric is improvements over ies, which will extend first evaluation of the r data products and in The MODIS surface for quantifying global

continuing to validate on to AERONET data shows that the error on optical thickness are well within the error bars adopted to derived the accuracy statement on surface reflectance (see [here](#), and the ATBD available from [PDF file](#)). Figure 1 shows the

Communicating results...

Support material for
each accuracy statement

- *updated by
product producer and
the validation
community.*



EOS Validation Product Name--MOD43
http://landval.gsfc.nasa.gov/Results.php?TitleID=

MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

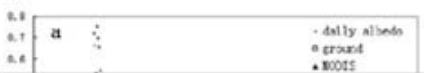
Summary Results from:
Validation of the MODIS global land surface albedo product using ground measurements in a semidesert region on the Tibetan Plateau
As they relate to the validation of MOD43

Authors: Kaicun Wang, Jingmiao Liu, Xiuji Zhou, Michael Sparrow, Min Ma, Zhian Sun, and Wenhua Jiang
Source: J. Geophys. Res., 109, D05107, doi:10.1029/2003JD004229, 2004
Link to: [Access Publication](#)

Abstract: An evaluation of the Moderate-Resolution Imaging Spectroradiometer (MODIS) global land surface albedo product is essential for its use in scientific studies. We evaluate the accuracy of the albedo product with nearly 3 years (from January 2001 to July 2003) of ground measurements from the Gaize Automatic Weather Station (32.30 deg N, 84.06 deg E, 4420 m) on the western Tibetan Plateau. The land surface consists of semidesert or desert soil. Vegetation in this region is very rare. A comparison with field measurements shows that the MODIS global land surface albedo meets an absolute accuracy requirement of 0.02. There is no distinctive bias between the MODIS-derived albedo and the ground-measured albedo, with a root-mean-square error of 0.0186 and a maximum error of 0.036.

Summary Figures and Tables

Figure 1: Temporal series of shortwave albedo at local solar noon as observed from AWS and derived from MODIS in (a) 2001, (b) 2002 (partial), and (c) 2003.



On-Line Validation Exercise

- Necessity to ensure the quality of the validation and intercomparison procedures of land surface variables
- OLIVE will be based on "state of the art" validation approaches (Morisette et al., 2006; Baret et al., 2006; Garrigues et al., 2008)
- Necessity for transparency and independency (from product maker) in the validation process
- Maximize efficiency and limit duplicated actions through coordinated international effort
- Encourage the community to provide new validation dataset following similar standard protocols defined by OLIVE: definition of an "OLIVE" reference for validation dataset
- Facilitate reprocessing of validation results with new versions of products or new validation dataset
- Provide updated and accurate assessment of product accuracy for the user community
- Force the products to better agree with the standards defined by CEOS

OLIVE Implementation

- targeted products : Land surface variables : LAI, Fapar, Fcover, albedo
- Prototype provided by INRA, Avignon & NASA's GSFC
- Operational implementation by ESA

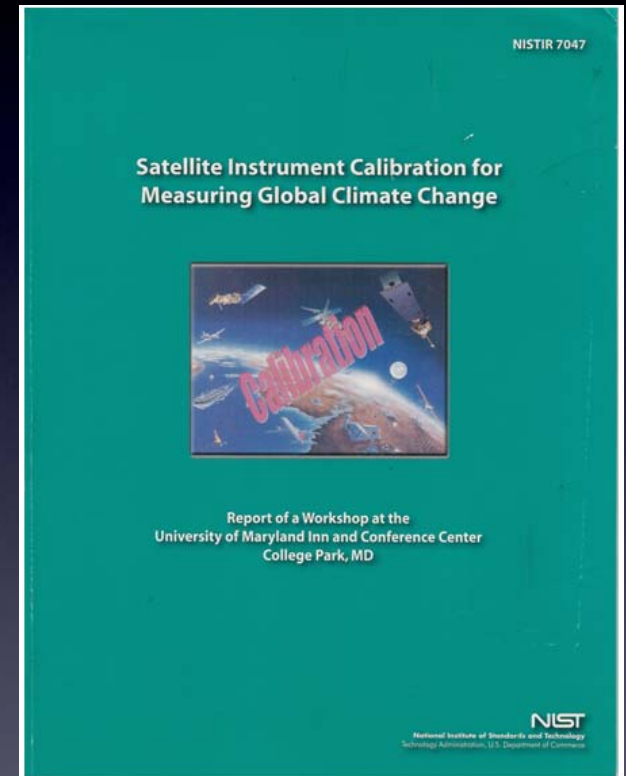
Future: There is still a need
to define land product

accuracy requirements
The land validation
community could build
on the experience of
the calibration
community.



*Achieving Satellite
Instrument
Calibration for
climate Change
May 16-18, 2006*

Ohring, G., J. et al. (2007), Achieving Satellite Instrument Calibration for Climate Change, *Eos Trans. AGU*, 88(11), 136





<http://journals.aol.com/rrveh1/WAIT-NOTYET-entries/2005/02/17/fieldnote---flight/789>