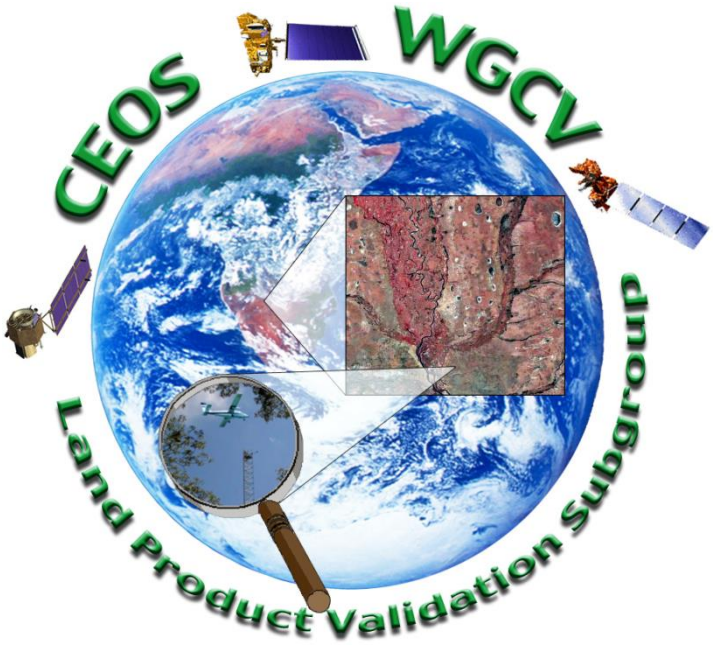


CEOS/Land Product Validation Perspective

Miguel Román (NASA GSFC)
Jaime Nickeson (SSAI)
Gabriela Schaepman-Strub (University of Zurich)

Committee on Earth Observation Satellites (CEOS)
Working Group on Calibration and Validation (WGCV)
Land Product Validation (LPV)

2015 HyspIRI Science Symposium

CEOS > WGCV > LPV

CEOS - Committee on Earth Observation Satellites

31 CEOS Members

24 Associate Members (eg UNEP, GTOS, IGBP, WMO, GCOS)

CEOS coordinates civil space-based observations of the Earth

This is achieved through its working groups and virtual constellations. The **Working Group on Calibration and Validation (WGCV)** is one of 5 CEOS working groups.

Land Product Validation (LPV) is one of 6 WGCV subgroups

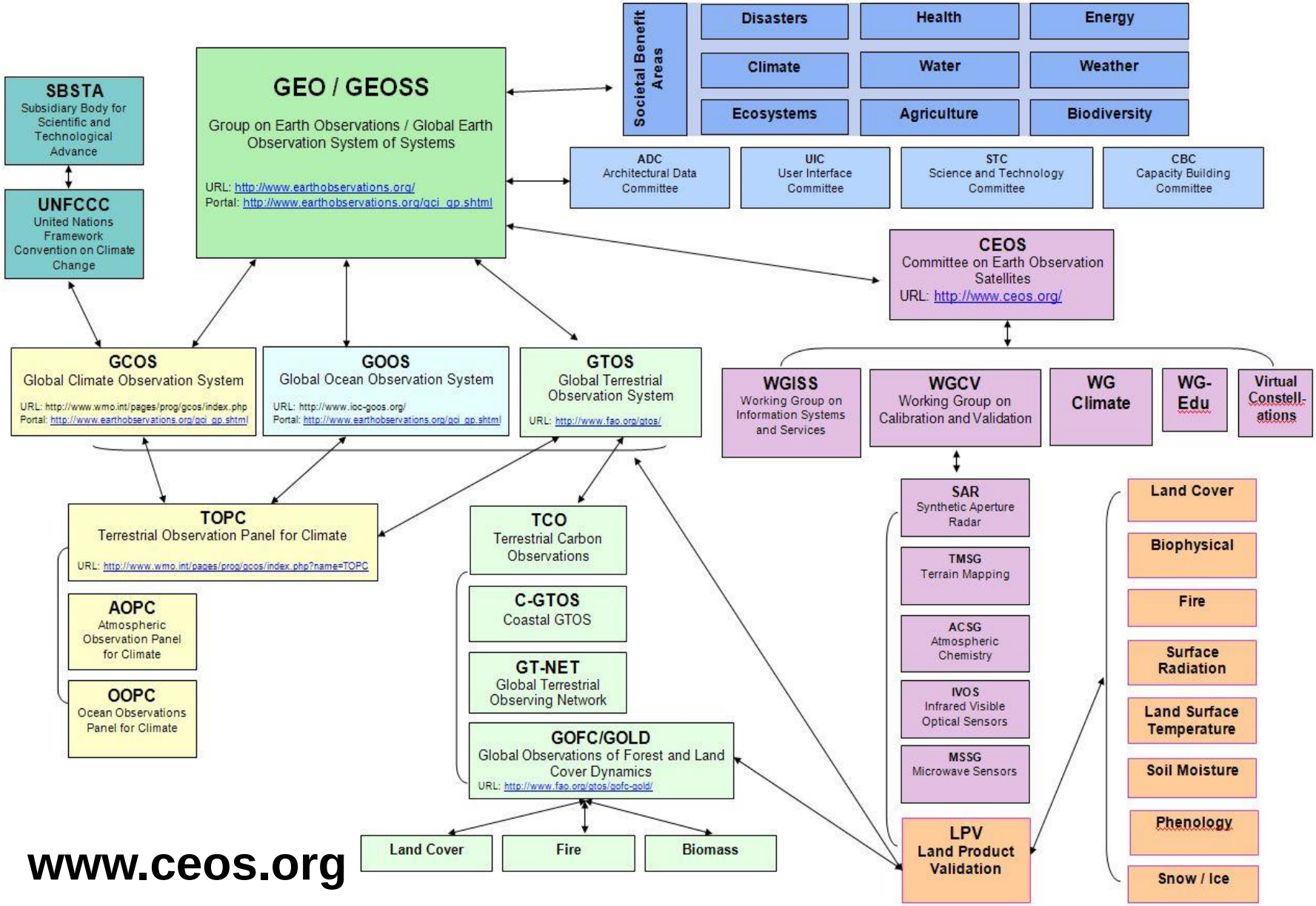
Current LPV Officers

Chair	Gabriela Schaepman-Strub	University of Zurich
Vice-Chair	Miguel Román	NASA/GSFC
LPV Support	Jaime Nickeson	SSAI/GSFC

9 Focus Areas with 2 co-leads each

CEOS WORKING GROUP ON CALIBRATION & VALIDATION

Linkages between International Programs concerned with Terrestrial Earth Observation



www.ceos.org

Land Product Validation Subgroup Objectives

1. To **foster and coordinate quantitative validation** of higher level global land products derived from remotely sensed data, in a traceable way, and to relay results to users.

2. To increase the quality and efficiency of global satellite product validation by developing and promoting **international standards and protocols** for
    - **Field sampling**
    - **Scaling techniques**
    - **Accuracy reporting**
    - **Data and information exchange**

3. To provide **feedback to international structures** for
    - Requirements on product accuracy and quality assurance
    - Terrestrial ECV measurement standards
    - Definitions for future missions

Relaying Validation Results to our Users

LPV Web Site 15 years and running..

Established in 2000

Subscribed member list has grown ***to nearly 700 members*** over the years.

Each focus area (ECV) has pull down menu of links to

- Home page
- References
- Collaboration
- Products

http://lpvs.gsfc.nasa.gov

Addressing Current NASA Earth Science Priorities:

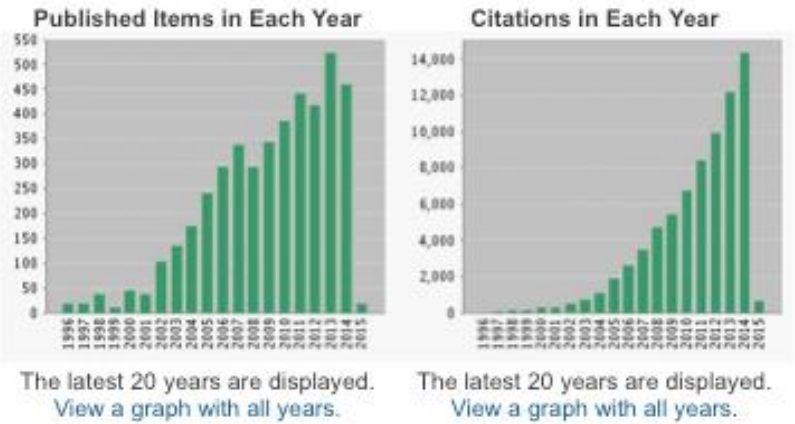
from 2015 Aqua Senior Review Panel:

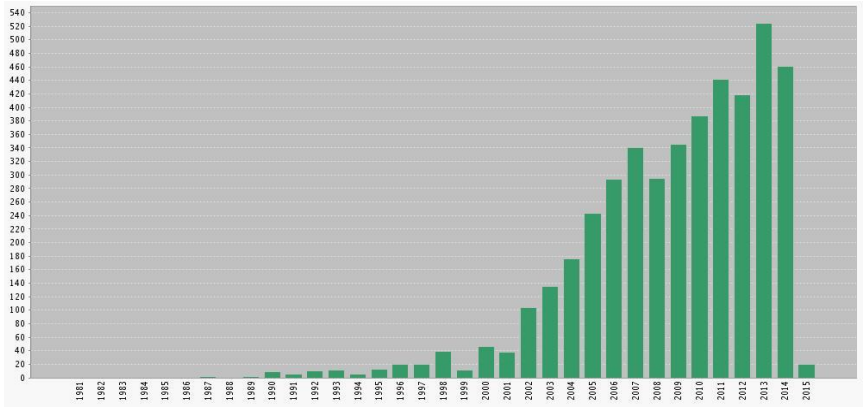
Q.14: Could there be further classification of the errors associated with the MODIS data/observations and products?

NASA/MODIS Web of Science Metrics

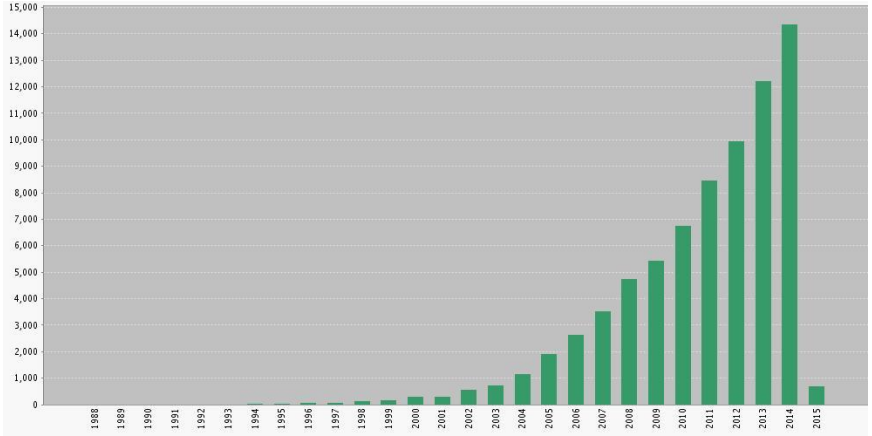
Searched word: “MODIS” **or** “Moderate Resolution Imaging Spectroradiometer”

– 5,521 items are searched





Published items in Each year (All years)

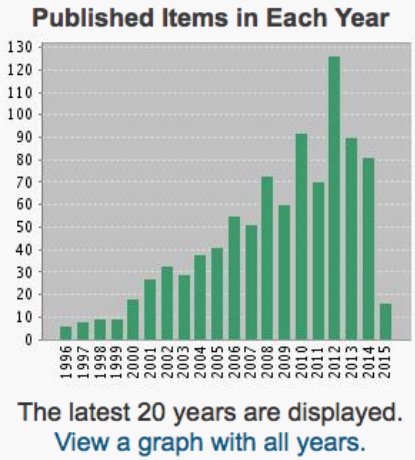


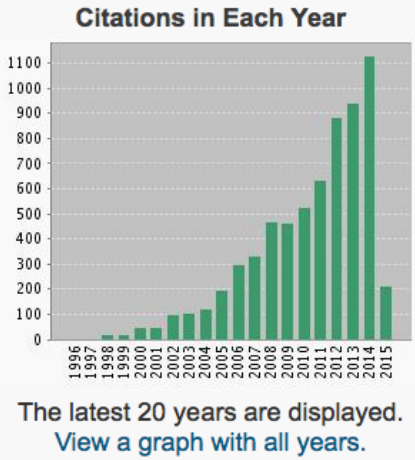
Citations in Each year (All years)

LPV Web of Science Metrics

Searched word: “Land Product Validation” **OR** “LPV”

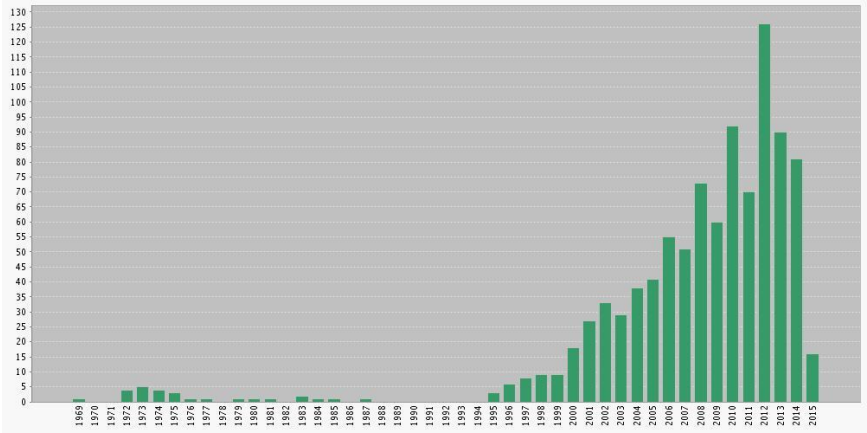
- 962 items are searched; **~80 items published in 2014; ~1100 citations**



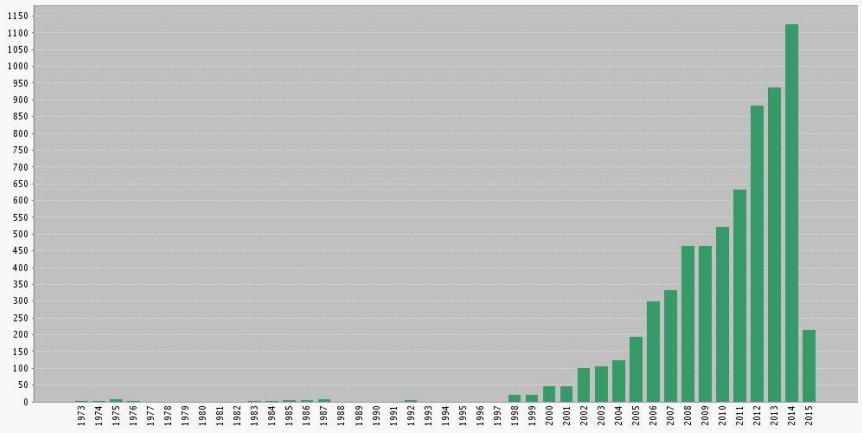


Results found:	962
Sum of the Times Cited [?] :	6635
Sum of Times Cited without self-citations [?] :	5065
Citing Articles [?] :	4309
Citing Articles without self-citations [?] :	3742
Average Citations per Item [?] :	6.90
h-index [?] :	38

Published items in Each year (All years)

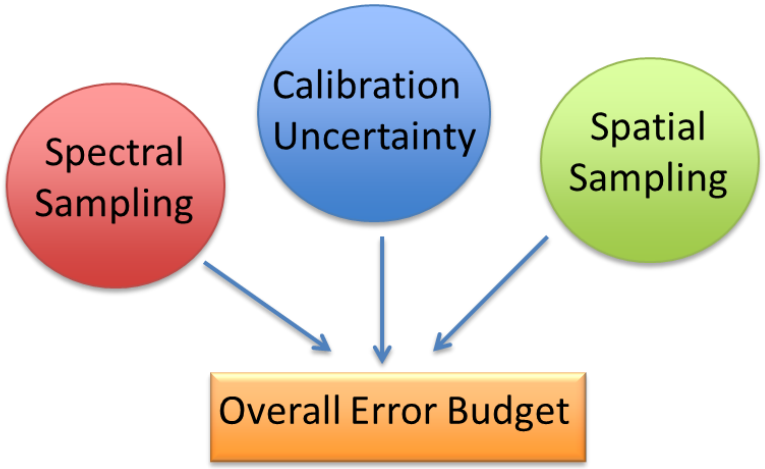


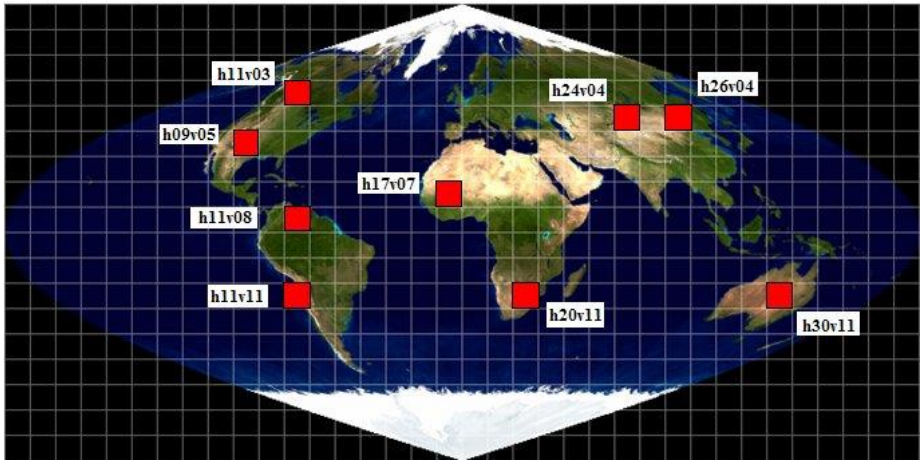
Citations in Each year (All years)



Senior Review panel's question 14: ***Could there be further classification of the errors associated with the MODIS data/observations and products?***

Mapping Aqua-MODIS Sensor Per-pixel Uncertainty (N. Pahlevan, SSAI / NASA GSFC)





Objective: **To establish a comprehensive error budget model for Aqua MODIS instrument data records (Level 1b/2) by decomposing measurement errors into its major constituents.**

Approach: **Simulations and sensitivity analyses using existing moderate-to-high spatial-spectral measurements (e.g., Landsat-8 and EO-1 Hyperion) are performed over all MODIS Land Golden Tiles – i.e., 9 regions that are representative of the variability of the majority of the MODIS Land products (shown in red squares) .**

Team Response: **At the Aqua-MODIS sensor level (Level 1b/2), further classification of errors is possible by: (1) considering all constituents within an overall error budget and (2) providing a representative global sample of land surface and retrieval conditions.**

Senior Review panel's question 14: ***Could there be further classification of the errors associated with the MODIS data/observations and products?***

Protocol for Validation of the Aqua-MODIS Land Surface reflectance using AERONET (J.C. Roger, E. Vermote and B. Holben)

Validation of Land Surface Reflectance

The Problem: **A standard land surface reflectance protocol for using reference AERONET products needs to be agreed on by the MODIS science team.**

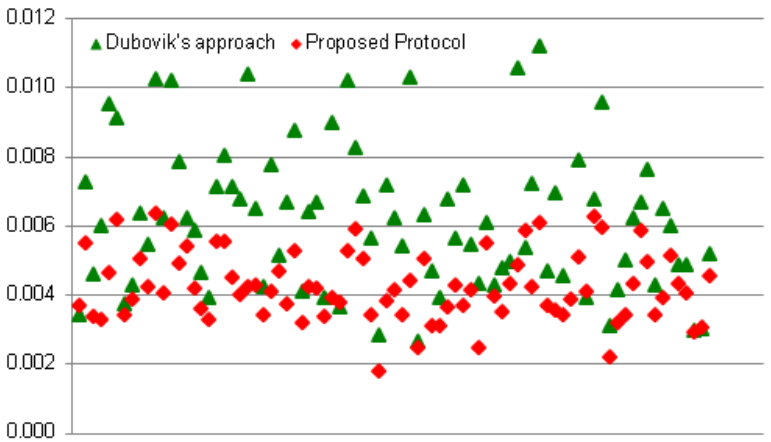
The Solution: **A validation protocol for MODIS Land surface reflectance that requires the aerosol model to be readily available.**

Description of Surface Reflectance Validation Protocol

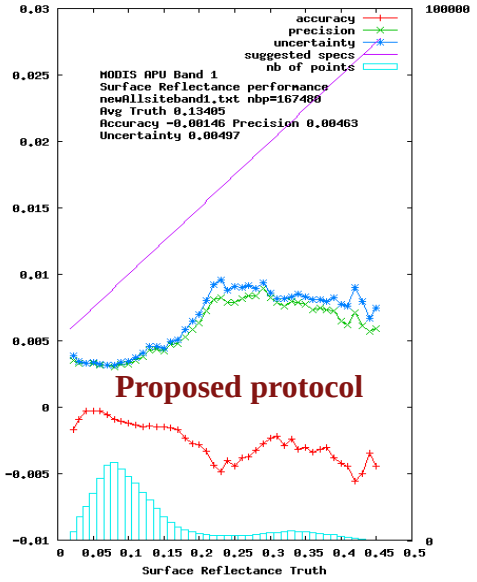
Aerosol models for each AERONET site can be defined using new regressions with optical properties (i.e., τ_{440} and α) as standardized parameters. For the aerosol models, the **aerosol microphysical properties** provisioned by AERONET, including size-distribution ($\%C_f$, $\%C_c$, r_f, r_c, σ_r, σ_c), complex refractive indices and sphericity, can also be used as standardized protocol measures.

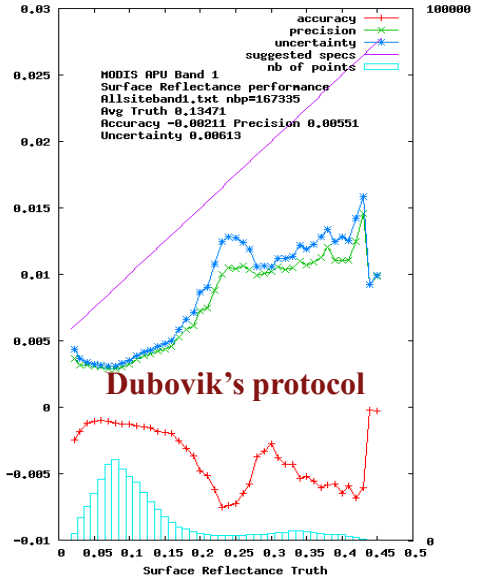
Comparisons with AERONET indicate that parameter standardization produces Accuracy-Precision-Uncertainty (APU) metrics up to 20% lower than the current baseline (Dubovik et al., 2002).

Uncertainties on the retrieved surface reflectance for 40 AERONET sites
MODIS band 1 (red) – synthetic input surface reflectance = 0.05



Example of APU for MODIS band 1 (red) for the whole 2003 year data set

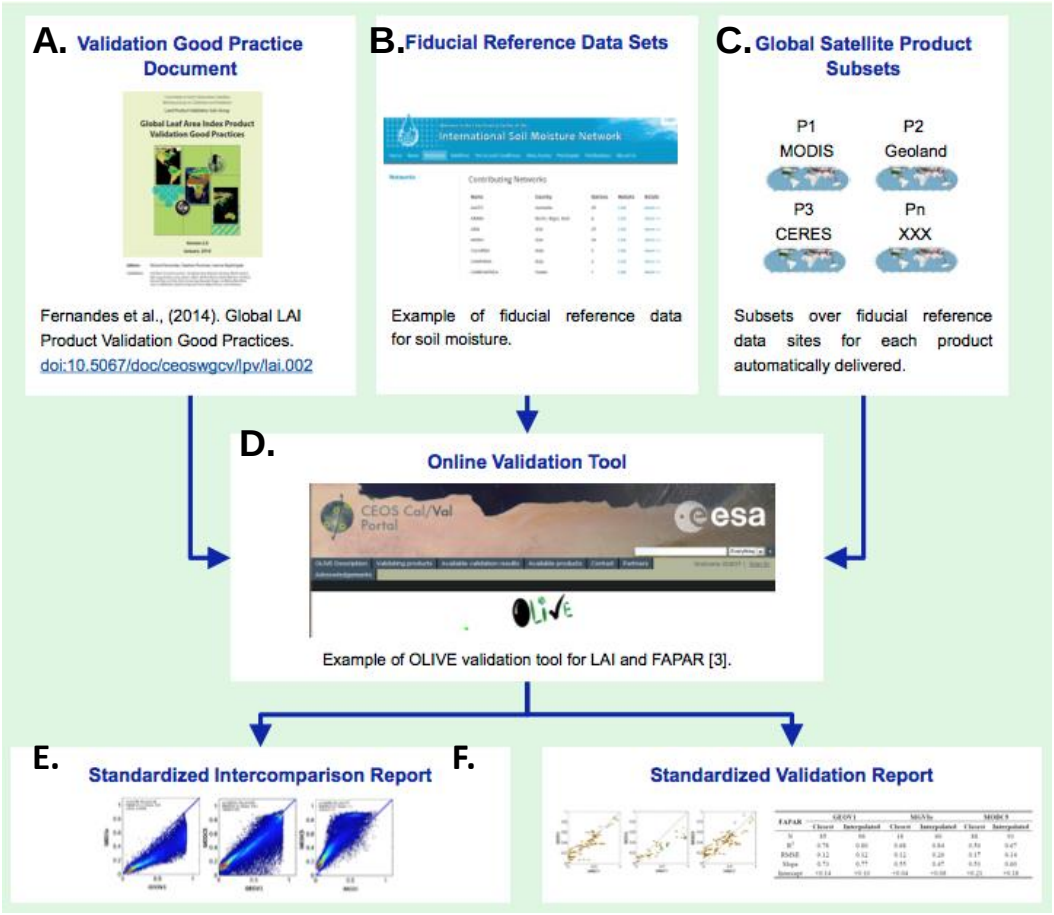




Team Response: **Further classification of errors requires the adoption of consistent and agreeable protocols across MODIS land surface reflectance products. This is also crucial to enable objective assessment and characterization of downstream product impacts (e.g., NDVI/EVI, LAI/FPAR, BRDF/Albedo/NBAR).**

Senior Review panel's question 14: ***Could there be further classification of the errors associated with the MODIS data/observations and products?***

A Global Framework for Land Product Intercomparison and Validation (Miguel Román, NASA/GSFC)



The MODIS Land Science team has adopted the global framework for product intercomparison and validation developed by the Land Product Validation (LPV) subgroup of the CEOS Working Group on Calibration and Validation (WGCV).

This framework is based on a peer-reviewed protocol (A.), collection of fiducial reference data (B.), and development of automated subsetting capabilities (C.) Each of these parts are then integrated into an online platform (D.) where quantitative tests are run, and standardized intercomparisons (E.) and validation results (F.) reported.

Team Response: At the final (Level 3+) product level, further classification of errors is possible when products are characterized in a statistically rigorous way (i.e., over multiple locations and time periods representing global conditions). Establishing a global framework for land product validation is key to this effort, and of high priority for Aqua-MODIS and future sensors.

LPV 2014-2016 Deliverables

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2014-2016			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CV-11: Validation of terrestrial ECV products	Q1 2015 – Q4 2016	The validation of terrestrial ECV products is in line with activities carried out in WGCV-Land Product Validation (LPV). The validation of ECVs covered within WGCV-LPV shall be strengthened. This includes (a) an update of validation stage, (b) ECV-specific synthesis of a state-of-the-art validation approach for each terrestrial variable with corresponding references and protocols, (c) ECV-specific identification of a golden standard for validation, and (d) continuation of development of ECV-specific validation protocols, including a community review process and updates. Results of each step will be made public via the WGCV-LPV website and finally the Cal/Val portal.	WGCV
CV-12: Evaluation of validation supersites and new validation approaches	Q2 2015	Evaluation of well-characterized supersites with data continuity prospects for validation purposes that allow for testing of products, algorithms, and validation strategies through radiative transfer modeling.	WGCV

(6/2015) Radcalnet: Gobabeb chosen as additional site.
+ CEOS Carbon Task Force action items relevant to LPV.
+ Collaborations with TERN and ICOS.

Committee on Earth Observation Satellites
CEOS

CEOS 2014-2016 Work Plan

CEOS WORKING GROUP ON CALIBRATION & VALIDATION

3D Vegetation Lab

Schaepman, M.E., Morsdorf, F., Leiterer, R., Pfeifer, N., Hollaus, M., Disney, M., Lewis, P., Gastellu-Etchegorry, J-P., Brazile, J. and Koetz, B.

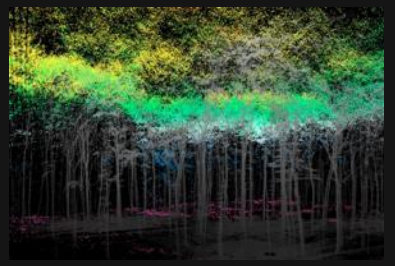
Choice of two contrasting FLUXNET sites

1. Laegeren (CH): mixed forest, various tree development stages, sloped terrain, heterogeneous background

2. Tharandt (GER): single (coniferous) species forest, evenly aged, flat terrain, homogenous background (no understorey)

'Complete' 3D reconstruction of these sites using

- laboratory, terrestrial and airborne laser scanning approaches (leaf-on and leaf-off data)
- spectral properties of foliage, understorey, soil/litter (leaf optical properties, background reflectance, biochemistry, ..)
- conventional measurements (LAI2000, hemispherical photographs, dGPS, dbh, crown dimensions, etc.)
- tree species determination



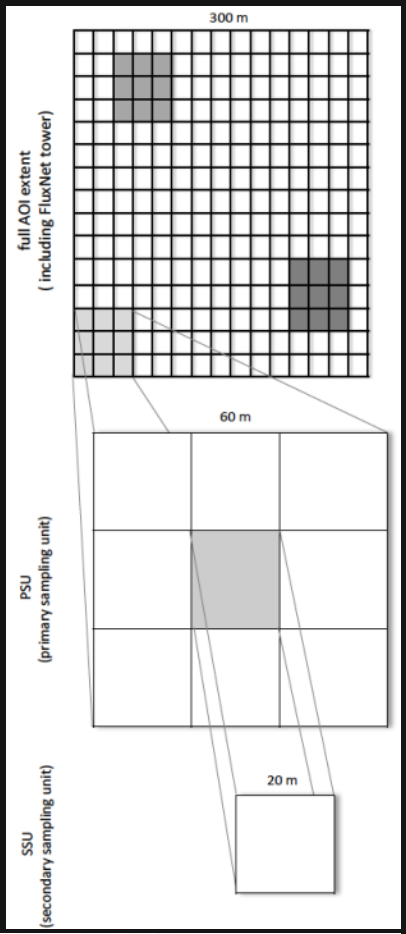
3D Vegetation Lab – Sampling Approach

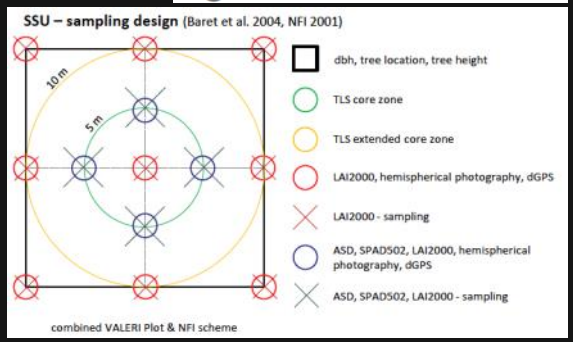
Two stage cluster sampling scheme with stratification (Köhl et al., 2006)

- First-stage clustering (area of interest, 300x300m)
- Second-stage clustering (primary sampling units, 60x60m; secondary sampling units, 20x20m (Baret et al., 2004; NFI, 2001))

Provision of fully parameterized scenes in 2013, composed of

- 3D world files
- scene analysis tools
- radiative transfer models (DART, librat, libradtran)
- exhaustive Earth observation data set
- encapsulated in a BEAM* toolbox.





* http://www.brockmann-consult.de/cms/web/beam/

OLIVE – Online Validation Exercise – Now Online!

F. Baret, M. Weiss et al., INRA, financed by ESA

CalVal Home
- Overview
- Instruments
- Sites
- Documentation
- Cal/Val Campaigns & Events
- Tools
- Projects
- QA4EO
- Data Access
- Forum
- Cal/Val Wiki
- Acronyms
- Feedback
- Links
- IVOS
- **OLIVE**

Search...
Everything

YOU NEED TO BE A CAL/VAL REGISTERED USER TO USE OLIVE. PLEASE REGISTER HERE

WELCOME TO OLIVE

The **O**n **LI**ne **V**alidation **E**xercise is a web service designed to:

- Quantify the performances of Earth observation land products (LAI, FAPAR, and FCOVER)
- Use transparent and traceable methods following standards defined by the CEOS (**C**ommittee on **E**arth **O**bservation **S**atellites) **P**roduct **V**alidation)subgroup
- Provide open access of the results to the whole scientific community.
- Capitalize on the several initiatives undertaken within the community.

OLIVE is fully supported by the CEOS/LPV subgroup and allows to reach stage 2 and 3 of the validation process: it allows to estim accuracy over a significant set of locations and time through an inter-comparison exercise between existing products. Product u quantified using reference in situ data over multiple location data representative of the Earth's surface. OLIVE is expected to help stage 4 of the validation process thanks to regular updates and to an increasing participation of the scientific community.

The scientifc community is thus largely encouraged to use OLIVE to validate and inter-compare a new product to the existing ones. exercise can be achieved in a private mode (results only accesible to user) or public (access to the whole OLIVE community).

OLIVE is still running in beta mode, the CEOS/LPV approval being still in process. Feedback, recommendations and suggetsio welcomed. Please, contact the OLIVE team at: Alessandro.Burini@esa.int

ACCESS TO OLIVE HERE

Addressing Future NASA Earth Science Priorities

- ECOSTRESS (LST, Emissivity, Evapotranspiration)
- GEDI (Biomass, Terrestrial LIDAR)
- HysPIRI (Disturbance, PFT, hazard susceptibility, Water content, LUE, Pigments, NPP/GPP, Evapotranspiration)
- Coastal Ecosystems (Biomass, Terrestrial LIDAR)
- Terrestrial Hydrology (Snow Water Equivalent)

We can't do it all, but we do what we can…

Thank You + some quotes from our colleagues..

- *LPV plays a major role for quality assessment of the Essential Climate Variables required for the monitoring of our changing planet.*
  F. Baret (INRA)
- *The international extent available through LPV greatly increases the reach and efficiency of our global intercomparison efforts.*
  R. Myneni (BU)
- *Establishing the standards and protocols for validation of global data sets is a high priority for the NASA Program and future missions.*
  C. Justice (UMD)
- *The validation efforts of LPV have set the gold standard for future global data sets, nationally and internationally.*
  J. Morisette (USGS)