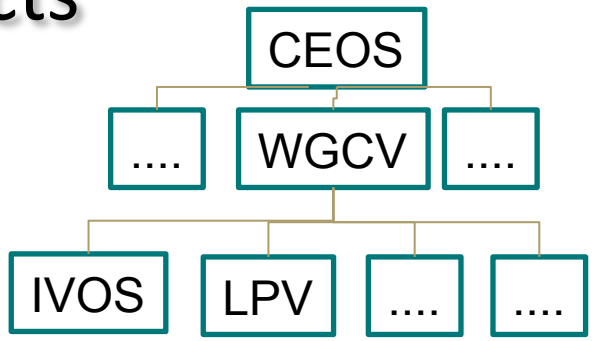
CEOS WGCV LPV Subgroup - Coordinating Validation Efforts of Satellite-Derived Land Surface Products



Happy WGCV family ;-)

Gabriela Schaepman-Strub (U Zurich) - Chair
Miguel Román (NASA GSFC) – Vice-Chair
LPV Focus Area Leads

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

IVOS, 04-06 June, 2014, Pasadena, USA

LPV Structure - Focus Areas

* ECV

Snow cover (T5)*, Ice	Thomas Nagler (ENVEO, Austria)	Tao Che (Chinese Academy of Sciences)
Surface radiation (Reflectance, BRDF, Albedo (T8)*)	Crystal Schaaf (U. Massachusetts)	Xavier Ceamanos (Meteo France)
Land cover (T9)*	Pontus Olofsson (Boston University)	Martin Herold (Wageningen University, NL)
FAPAR (T10)*	Arturo Sanchez-Azofeifa (U. Alberta)	Nadine Gobron (JRC, IT)
Leaf area index (T11)*	Oliver Sonnentag (University Montreal, CA)	Stephen Plummer (Harwell, UK)
Fire (T13)* (Active Fire, Burned Area)	Luigi Boschetti (University of Maryland)	Kevin Tansey (University of Leicester, UK)
Land surface temperature*	Simon Hook (NASA JPL)	Jose Sobrino (University of Valencia, SP)
Soil moisture*	Tom Jackson (USDA)	Wolfgang Wagner (Vienna Uni of Technology, AT)
Land surface phenology	Matt Jones (U of Montana)	Jadu Dash (University of Southampton, UK)

Supported by Jaime Nickeson, NASA GSFC

LPV 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 so they are relevant to users.
   ACROSS product intercomparison and validation!!

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

1. Foster and Coordinate Quantitative Validation...

- LPV sub-group level
  - Wiki for internal documents
  - Telecon, 1st Tuesday every 2nd month with minutes
  - LPV sub-group meetings re-established

    -> Frascati, Jan 2014

    Update of validation stage and exchange on validation methods

    Output: Update of website, review paper on ECV validation stage

- Focus Areas – product-specific validation workshops
  - Soil Moisture – July 2014
  - Land cover and Fire – July 2014
  - FAPAR – January 2014

- Internationally – chairs and focus area co-leads actively involved in projects, workshops, international activities.

... and Relay Results to Users

- International meetings
  - AGU 2012 - 2 oral, 1 poster session on validation
  - Watch out for validation session at AGU 2014, EGU 2015!!

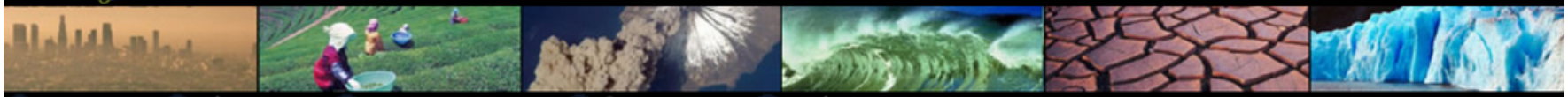
- LPV website http://lpvs.gsfc.nasa.gov/
  Currently updating with standard structure across variables
  - Names of focus area co-leads
  - Definition of variable, unit
  - CEOS LPV validation stage
  - Validation good practice document
  - Reference data sets
  - Intercomparison and validation references
  - International contributions (GCOS, GOFC-GOLD, ISMN, etc…)

- Emailing lists for each focus area

http://lpvs.gsfc.nasa.gov/

GODDARD SPACE FLIGHT CENTER | + NASA Homepage

CEOS Working Group on Calibration and Validation



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Land Product Validation Subgroup

Focus Areas

- Biophysical
- Fire/Burn Area
- Land Cover
- LST/Emissivity
- Phenology
- Snow Cover
- Soil Moisture
- SurfRad/Albedo

Announcing...

2014 Recent Advances in Quantitative Remote Sensing, 22 - 26 Sep 2014, Valencia, Spain. Abstract submission deadline, 28 Feb 2014.

37th CEOS WGCV-36, Frascati, Italy, Feb 17-21, 2014.

GV2M: Global Vegetation Monitoring and Modelling, 3rd - 7th Feb 2014, Palais des Papes, Avignon, France.

7th EARSeL Workshop on Land Ice and Snow, Feb 03 - 06, 2014, Bern, Switzerland.

Land Product Validation & Evolution workshop, Jan 28-30, 2014, Frascati, Italy.

LPV Mission

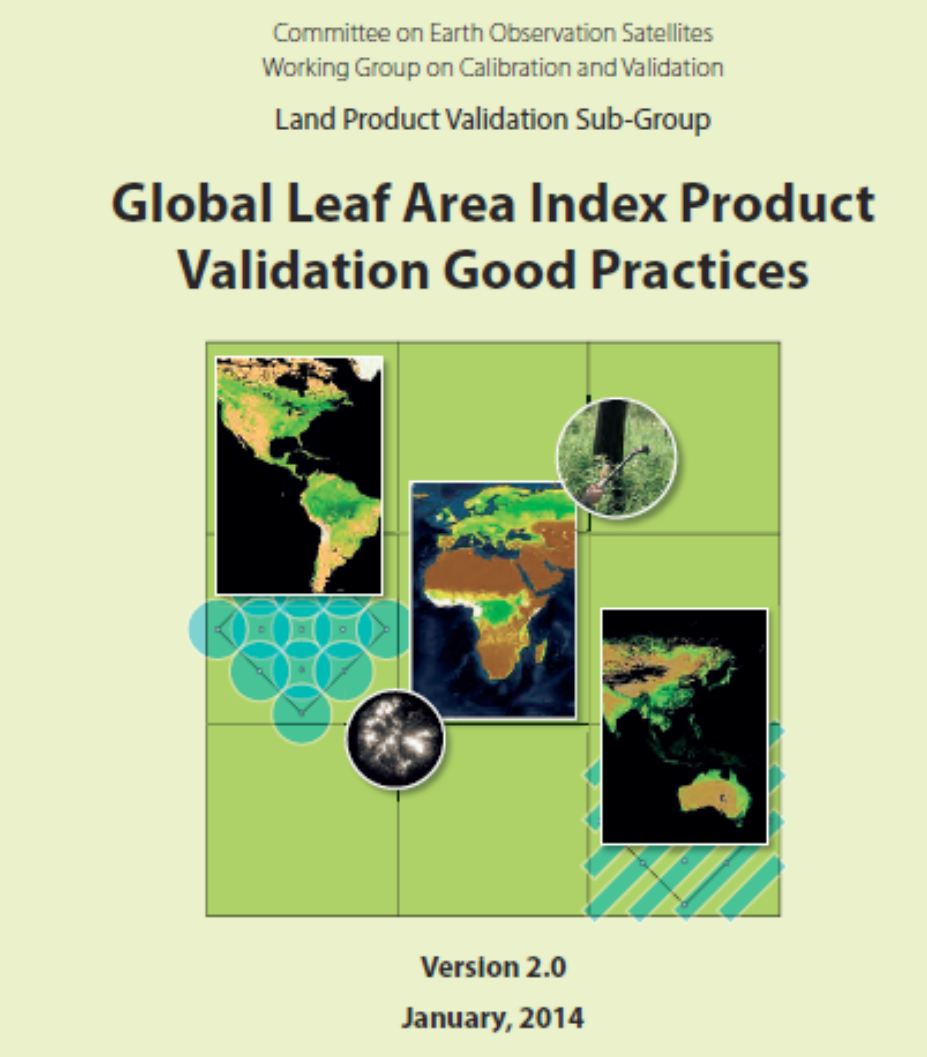
To foster quantitative validation of higher-level global land products derived from remote sensing data and to relay results so they are relevant to users

The value of satellite derived land products for science applications and research is dependent upon the known accuracy of the data. The Committee on Earth Observation Satellites (CEOS), the space arm of the Group on Earth Observations (GEO), plays a key role in coordinating the land product validation process. The Land Product Validation (LPV) sub-group of the CEOS Working Group on Calibration and Validation (WGCV) aims to address the challenges associated with the validation of global land products. The LPV subgroup activities are divided up into 8 focus areas related to product families; biophysical, surface radiation/albedo, fire/burn scar detection, land cover mapping, land

LPV Work Flow – Product Specific!

1. Good practice protocols
   - Product definitions
   - Intercomparison guides (eg. spatial, temporal resolution of different products, metrices, reporting)
   - Validation guide (eg. spatial sampling of in situ data, heterogeneity tests)
2. Identification of (in situ) reference data sets
3. Online platform(s) with standardized output for intercomparison and validation
4. Evaluate and develop *new* validation methods

LAI Validation Good Practices Version 2



- Printed version
- Online version on LPV website
- Reviewer comments and responses on LPV website
- Living document

Identification of (in situ) reference data and sites

- Generation of reference data ('golden standard')
  Example land cover: Global reference database, joint effort by USGS/Boston U/GOFC-GOLD, 500 sites world-wide mapped with very high resolution images)

- Collaboration with in situ networks
  Example albedo: NEON, BSRN, FLUXNET, TERN
  -> Test spatial representativeness of in situ measurements for satellite spatial resolution
  Example Albedo: analysis of spatial represenativeness of tower based albedometers

- New approaches - supersites with fully characterized vegetation to test algorithms and products?

OLIVE – Online Validation Exercise (CEOS Cal/Val Portal)

CalVal Home

- Overview
- Instruments
- Sites
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- **OLIVE**

Search... Everything

CalVal Home » OLIVE

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) - LPV (**L**and **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.

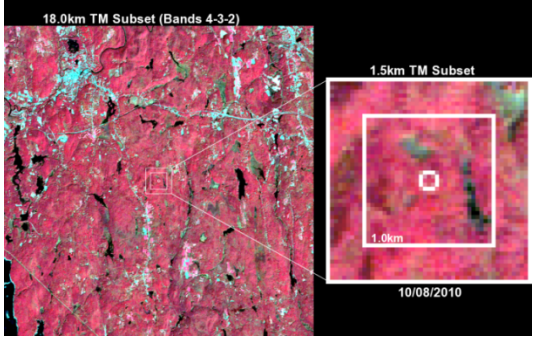
OLIVE is fully supported by the CEOS/LPV subgroup and allows to reach stage 2 and 3 of the validation process: it allows to estimate product accuracy over a significant set of locations and time through an inter-comparison exercise between existing products. Product uncertainty is quantified using reference in situ data over multiple location data representative of the Earth's surface. OLIVE is expected to help reaching the 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. A validation exercise can be achieved in a private mode (results only accesible to user) or public (access to the whole OLIVE community).

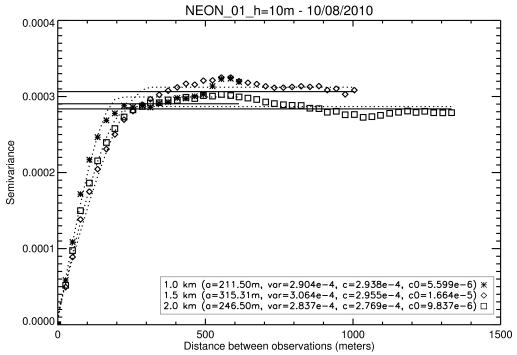
OLIVE is still running in beta mode, the CEOS/LPV approval being still in process. Feedback, recommendations and suggetsions are very welcomed. Please, contact the OLIVE team at: Alessandro.Burini@esa.int

Weiss et al., Remote Sensing, 2014

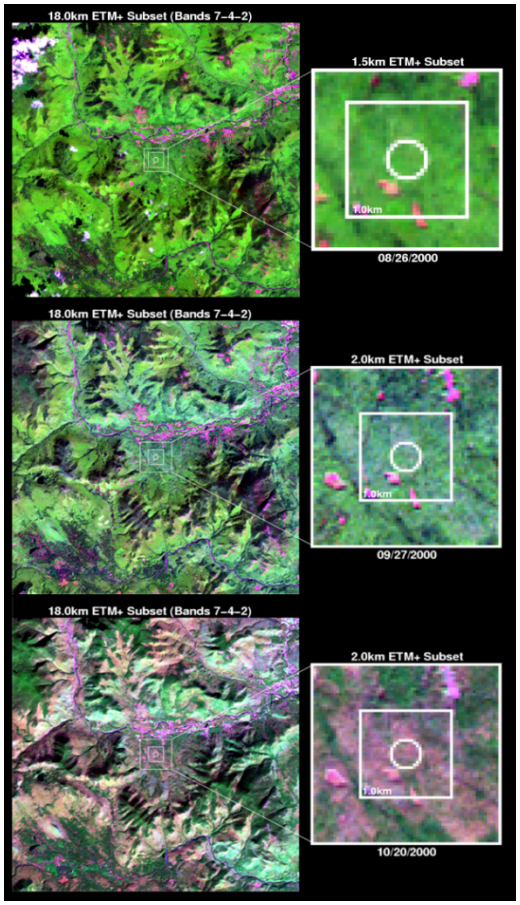
Spatially Representative Sites



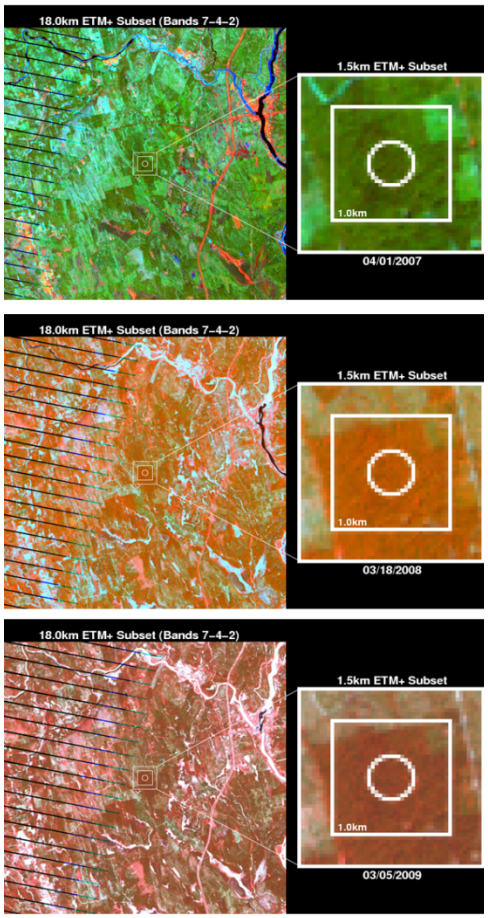
Harvard Forest 10/08/2010



Courtesy
C. Schaaf
UMASS



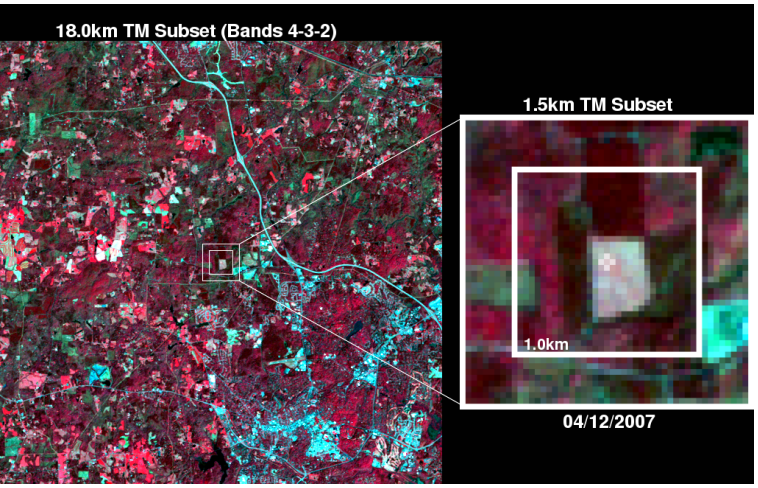
Seasonal variation (Aug, Sep, Oct 2000) in Landsat values (Bartlett Experimental Forest tower, Bartlett, NH (mixed forest)

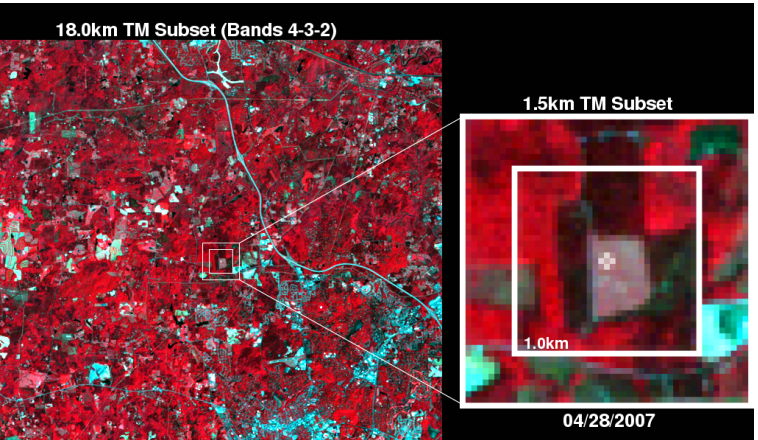


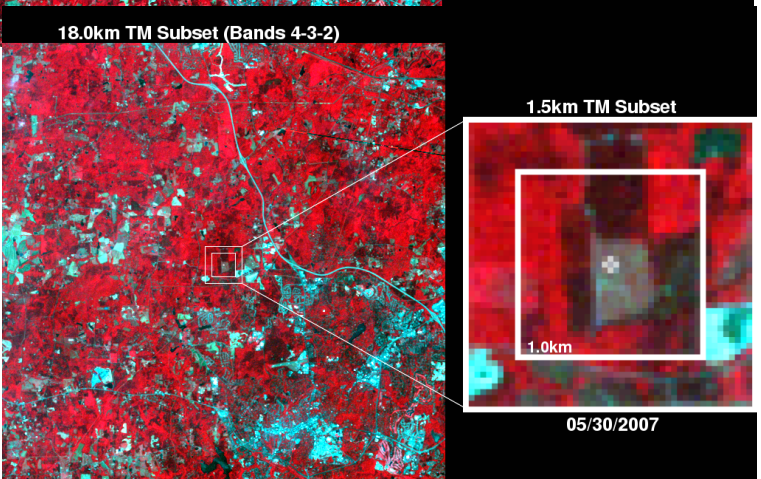
Variation in Landsat values over time (2007, 2008, 2009) due to clearcuts in the areas surrounding Howland Experimental Forest west tower, Howland, ME

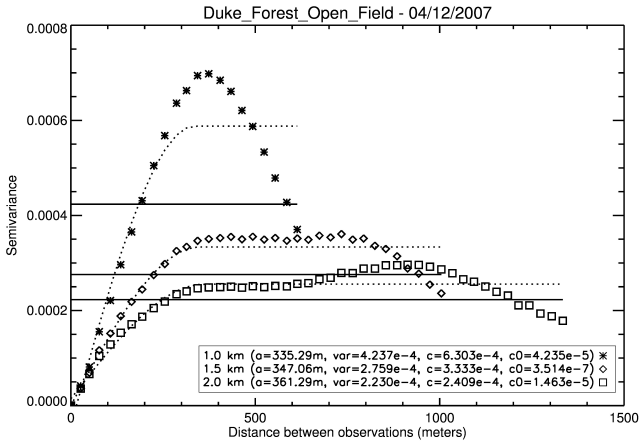
UMASS BOSTON

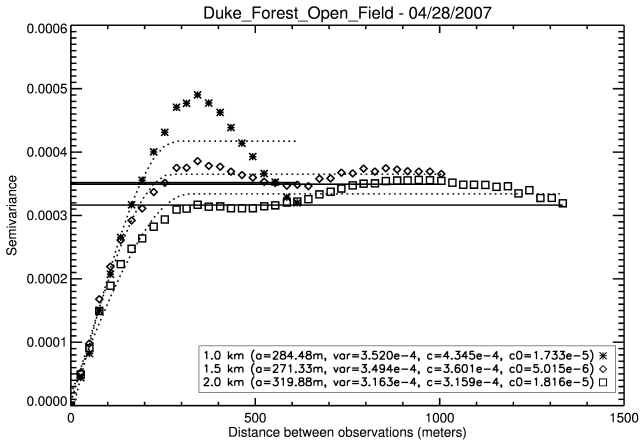
Duke Forest Open Field

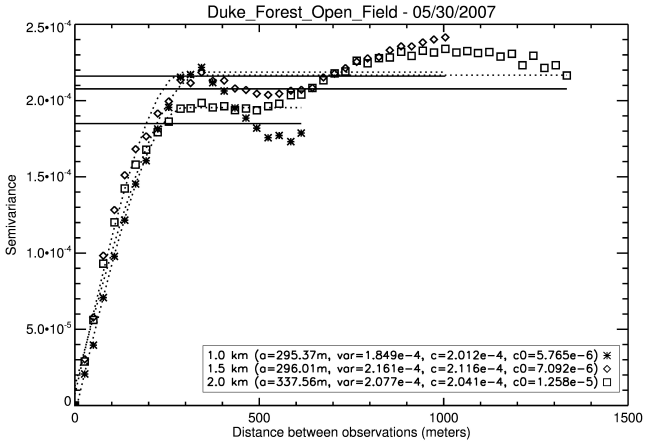












Courtesy
C. Schaaf
UMASS

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Albedometer Tower Spatial Representativeness Test

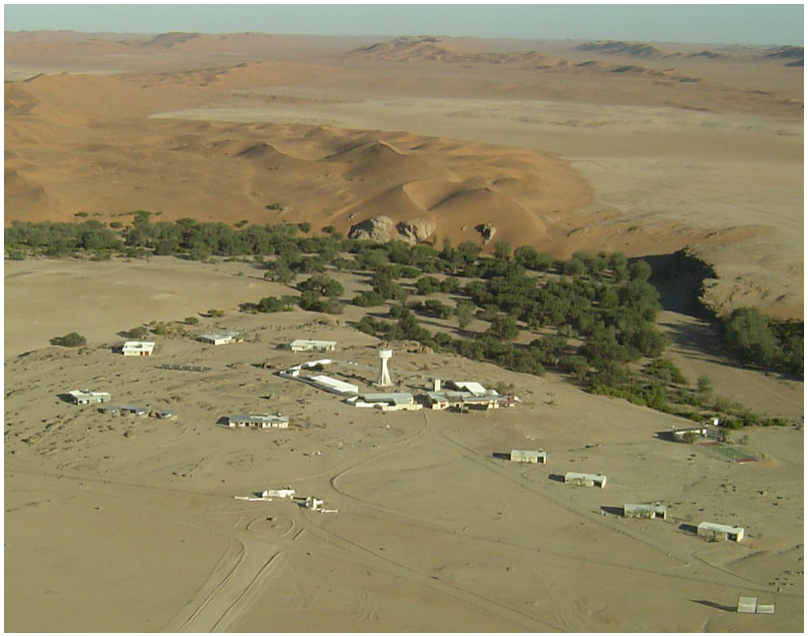
- Over 100 sites globally tested for leaf-on and leaf-off conditions

B	C	D	E	F	G	H	I	J	K	L	M
Name	Country	State	Site_ID	Lat	Lon	Tower_H	Footprint	Notes	Leaf-on Rcv(%)	Leaf-on Rse(%)	Leaf-on Rsv(
Elson Lagoon	United States	AK		71.325	-156.433056		Ground measurements, r				
SGP-CF	Unite States	OK	CF01	36.605	-97.485	60	757.7		6.49	24.92	46.78
Larned	Unite States	KS	E01	38.2	-99.31	10	126.3		-10.73	65.71	69.65
Hillsboro	Unite States	KS	E02	38.31	-97.3	10	126.3		27.35	71.38	95.15
LeRoy	Unite States	KS	E03	38.2	-95.6	10	126.3		-14.16	71.06	9.57
Plevna	Unite States	KS	E04	37.95	-98.33	10	126.3		-0.55	72.05	-17.94
Halstead	Unite States	KS	E05	38.11	-97.51	10	126.3		15.04	71.65	121.75
Towanda	Unite States	KS	E06	37.84	-97.02	10	126.3		8.14	48.15	-19.02
Elk Falls	Unite States	KS	E07	37.38	-96.18	10	126.3		31.75	54.98	93.73
Coldwater	Unite States	KS	E08	37.33	-99.31	10	126.3		-0.02	57.13	35.76
Ashton	Unite States	KS	E09	37.13	-97.27	10	126.3		-1.09	56.47	86.99
Tyro	Unite States	KS	E10	37.07	-95.79	10	126.3		5.17	62.41	27.75
Byron	Unite States	OK	E11	36.88	-98.28	10	126.3		11.76	52.07	70
Pawhuska	Unite States	OK	E12	36.84	-96.43	10	126.3		19.54	70.39	114.79
Ringwood	Unite States	OK	E15	36.43	-98.28	10	126.3		4.88	62.51	-5.66
Vici	Unite States	OK	E16	36.06	-99.13	10	126.3		-12.98	68.72	-19.58
Morris	Unite States	OK	E18	35.69	-95.86	10	126.3		2.9	50.55	35.4
Meeker	Unite States	OK	E20	35.56	-96.99	24	303.1		-11.6	57.38	35.24
Okmulgee	Unite States	OK	E21	35.62	-96.06	10	126.3		183.5	58.43	69.12
Cordell	Unite States	OK	E22	35.35	-98.98	10	126.3		4.57	62	49.12
Cyril	Unite States	OK	E24	34.88	-98.2	10	126.3		0.71	62.65	54.83

UMASS BOSTON

Gobabeb Namibia – Potential RadCalNet?

- Gobabeb not tested for representativeness yet!



Summary of Reflectance and Albedo Validation

-> MODIS albedo assessed regularly at about 40 sites globally (min. height of albedometer 5m above vegetation canopy), Albedo products validation stage 2 (-3), accuracy 5-10% (MODIS), agreement between products around 5% for most conditions

-> Largest uncertainties: shoulder seasons, high SZA, high terrain, ephemeral snow, snow variations, ice (mostly not done), coastal areas

- Schaepman-Strub, G., et al., Reflectance quantities in optical remote sensing – Definitions and case studies, RSE, 2006.
- Román, M. O., et al., The MODIS (Collection V005) BRDF/albedo product: Assessment of spatial representativeness over forested landscapes, RSE, 113, 2476-2498, 2009.
- Román,M. O., et al., Variability in surface BRDF at different spatial scales (30 m - 500 m) over a mixed agricultural landscape as retrieved from airborne and satellite spectral measurements , RSE, 115, 2184-2203, 2011.
- Cescatti, A., et al., Intercomparison of MODIS albedo retrievals and in situ measurements across the global FLUXNET network, RSE, 121, 323-334, 2012.
- Román,M. O., et al., Use of In Situ and Airborne Multiangle Data to Assess MODIS- and Landsat-Based Estimates of Directional Reflectance and Albedo TGRS, 51(3), 1393-1404, 10.1109/TGRS.2013.2243457, 2013.

Assign Product Validation Stage

Stage 1	Product accuracy is assessed from a small (typically < 30) set of locations and time periods by comparison with in situ or other suitable reference data.
Stage 2	Product accuracy is estimated over a *significant set of locations and time periods* by comparison with reference in situ or other suitable reference data. *Spatial and temporal consistency of the product with similar products has been evaluated over globally*
Stage 3	Uncertainties in the product and its associated structure are well quantified from comparison with in situ or other suitable reference data. Spatial and temporal consistency of the product with similar products has been evaluated over globally representative locations and time periods. *Uncertainties are characterized in a statistically robust way over multiple locations and time periods representing global conditions.* Results are published in the peer-reviewed literature.
Stage 4	Validation *results for stage 3 are systematically updated* when new product versions are released and as the time-series expands.

Most products currently at stage (1-) 2 (-3)!

3. Provide Feedback to International Structures

1. CEOS response to GCOS implementation plans (ie. IP-10 and following)
2. Contributions to GCOS Terrestrial Observation Panel
   -> 5 co-leads contribute to ECV reporting
3. Future collaboration with QA4ECV?
4. Future collaboration with GEO (eg. Land cover)?

Thank you!

ESA, NASA

USGS, USDA

NR Canada

Chinese Academy of Sciences

University of Zurich

University of Massachussetts

Boston University

University of Montana

University of Southampton

Wageningen University

JRC

gy