Land Product Validation (LPV)

Hello to everbody!

Gabriela Schaepman-Strub (U. of Zurich) – LPV Chair

Miguel Roman (NASA GSFC) – LPV Vice-chair

on behalf of LPV focus areas

Update for CEOS WGCV-36, Shanghai, 13-17 May 2013

Outline

- LPV objectives and goals
- LPV structure update
- Interactions with other initiatives during report period
- Outreach to the science community
- Future meetings
- Next steps

LPV Objective & Goals

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.

To increase the quality and efficiency of global satellite product validation by developing and promoting international standards and protocols/ best practices for

- Field sampling
- Scaling techniques
- Accuracy reporting
- Data and information exchange

To provide feedback to international structures (GEOSS) for

- Requirements on product accuracy and quality assurance (QA4EO)
- Terrestrial ECV measurement standards (GCOS)
- Definitions for future missions

LPV Structure Update

Chair — **Gabriela Schaepman-Strub** (U. of Zurich)
(1 March 2013 – 2016)
replacing Joanne Nightingale (now with NPL, QA4EO)

Vice-Chair — **Miguel Román** (NASA GSFC)
(1 March 2013 – 2016)

Support — Jaime Nickeson (NASA GSFC)

8 Land Product Focus Groups – 2 international co-leads each

Focus Areas

* ECV

FOCUS AREA		
Snow cover (T5)*, Ice	Dorothy Hall (NASA GSFC)	Tao Che (Chinese Academy of Sciences)
Surface radiation (Reflectance, BRDF, Albedo (T8)*)	Crystal Schaaf (U. Massachusetts)	Gabriela Schaepman (University of Zurich, SW)
Land cover (T9)*	Pontus Oloffson (Boston University)	Martin Herold (Wageningen University, NL)
FAPAR (T10)*	Arturo Sanchez-Azofeifa (U. Alberta)	Nadine Gobron (JRC, IT)
Leaf area index (T11)*	Richard Fernandes (NR Canada)	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)

CEOS Response to GCOS IP-10 - LPV Contributions

- Coordination by WG Climate
- 10 LPV focus area leads contacted as matter experts
- Report submitted 24 September 2012
- LPV contributions to following action items

T10 Submit weekly surface and sub-surface water temperature, date of freeze-up and date of break-up of lakes in GTN-L to HYDROLARE

T13 Develop record of validated globally-gridded near-surface soil moisture from satellites

T14 Develop Global Terrestrial Network for Soil Moisture (GTN-SM)

T16 Obtain integrated analyses of snow cover over both hemispheres

T24 Obtain, archive and make available *in situ* calibration/validation measurements and colocated albedo products from all space agencies generating such products; promote benchmarking activities to assess quality and reliability of albedo products

T27 Generate annual products documenting global land-cover characteristics and dynamics at resolutions between 250m and 1km, according to internationally-agreed standards and accompanied by statistical descriptions of their accuracy.

T28 Generate maps documenting global land cover, based on continuous 10-30 m land surface imager radiances every 5 years, according to internationally-agreed standards and accompanied by statistical descriptions of their accuracy

T29 Establish a calibration/validation network of in situ reference sites for FAPAR and LAI and conduct systematic, comprehensive evaluation campaigns to understand and resolve differences between the products and increase their accuracy

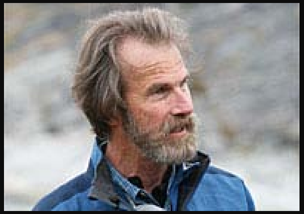
T30 Evaluate the various LAI satellite products and benchmark them against *in situ* measurements, to arrive at an agreed operational product.

T31 Operationalize the generation of FAPAR and LAI products as gridded global products at spatial resolution of 2km or better, over as long time periods as possible

T37 Develop and apply validation protocol to fire disturbance data

LPV Participation at GCOS TOPC Meeting

- GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate (TOPC), XVth Session, 6-7 March 2013
- New TOPC chair Konrad Steffen CH (Han Dolman outgoing)



- GTOS (global terrestrial observation system - FAO) is not functional anymore (R. Valentini resigned)
- Update of Implementation Plan in preparation for 2016 – evaluation of new ECVs
- Request for input to (meta-) data portals: GOSIC, ECV- inventory, OSCAR, LSI
- LPV update delivered (2nd time LPV is attending)
- TOPC-LPV action item on selection of representative validation sites

LPV Participation in QA4EO

- Teleconference participation
- Submission of first case-study on 3D vegetation lab
- Contribution of LPV to QA4EO has to be discussed in more detail with Nigel Fox and Joanne Nightingale

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.

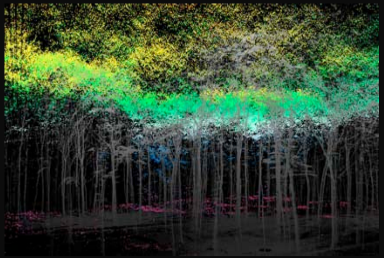
Choice of two contrasting FLUXNET sites

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

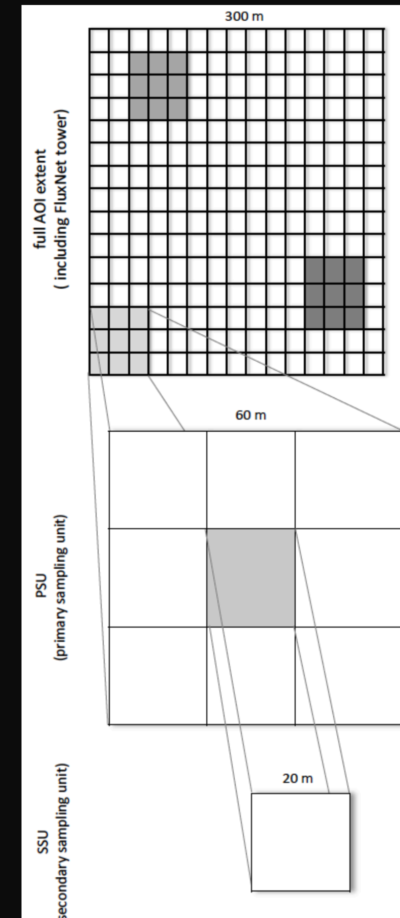
– laboratory, terrestrial and airborne laser scanning approaches (leaf-on and leaf-off data)
– spectral properties of foliage, understorey, soil/litter (leaf optical properties, background reflectance, biochemistry, ..)
– conventional measurements (LAI2000, hemispherical photographs, dGPS, dbh, crown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



3D Vegetation Lab – Sampling Approach

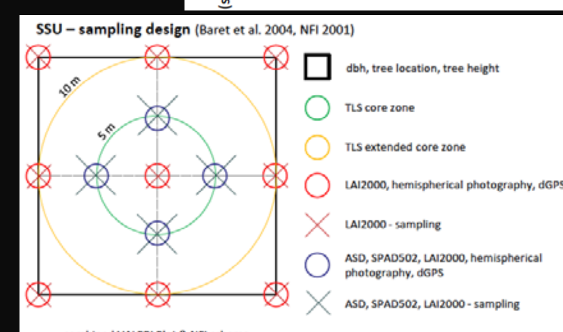
Two stage cluster sampling scheme with stratification (Köhl et al., 2006)

- 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

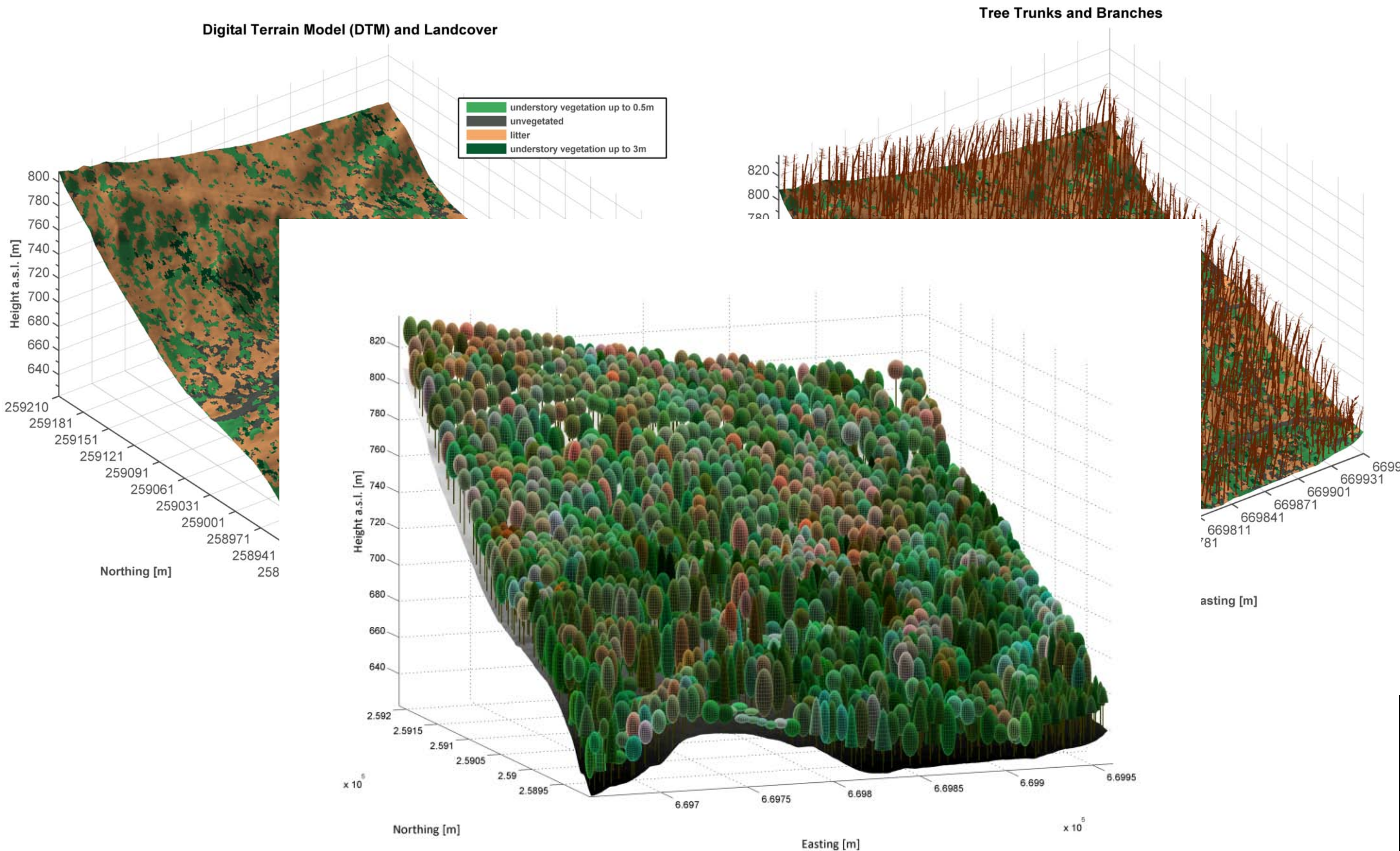
- 3D world files
- scene analysis tools
- radiative transfer models (DART, librat, libradtran)
- exhaustive Earth observation data set
- encapsulated in a BEAM* toolbox.



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

WORKING GROUP ON CALIBRATION & VALIDATION

CEOS



Digital Terrain Model (DTM) and Landcover
understory vegetation up to 0.5m
unvegetated
litter
understory vegetation up to 3m
Height a.s.l. [m]
800
780
760
740
720
700
680
660
640
259210
259181
259151
259121
259091
259061
259031
259001
258971
258941
Northing [m]
Tree Trunks and Branches
820
800
669931
669901
669871
669841
669811
asting [m]
Height a.s.l. [m]
820
800
780
760
740
720
700
680
660
640
2.592
2.5915
2.591
2.5905
2.59
2.5895
x 10^5
6.697
6.6975
6.698
6.6985
6.699
6.6995
x 10^5
Northing [m]
Easting [m]

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

Surface Radiation Focus Group

T8

Assessment of the status
of the development of the standards for the
Terrestrial Essential Climate Variables

GTOS

Essential
Climate
Variables

GTOS
63

ALBEDO

Albedo and reflectance anisotropy

- **Official recognition of the need for long-term in-situ radiation measurements for spectral and broadband BRDF/albedo.**
- **Stresses importance of BSRN, Fluxnet, AERONET.**
- **Provides guidelines for data collection protocols and standardization across the flux networks.**

Schaaf et al., 2008

WMO UNESCO UNEP ICSU FAO FIAT PANIS

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC UNEP ICSU

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE IN SUPPORT OF THE UNFCCC

(2010 UPDATE)

6.1.3. Monitoring at Terrestrial Reference Sites

Many, if not most, of the terrestrial ECVs (such as FAPAR, LAI, biomass, and albedo) are too heterogeneous spatially to make global *in situ* measurements practical. They are typically measured at a limited number of research sites or retrieved from space measurements over large areas. There are three key requirements for *in situ* measurements at reference sites in the context of long-term global climate measurements: (a) To ensure that a representative set of biomes are properly and consistently documented over long periods of time (decades or more). This will allow the details of natural vegetation changes and carbon stocks, including fluxes, to be carefully monitored at key locations; (b) to measure key meteorological ECVs to support interpretation of changes recorded at such sites; and (c) to optimize the joint use of these terrestrial reference sites with:

- a set of sites delivering essential ground data for the validation of satellite-derived products that provide extensive geographical coverage for these variables (see Action T29 dealing specifically with calibration/validation of FAPAR and LAI).
- key ecosystem sites (see Action T4).

It may be efficient to establish these reference sites by building on existing networks, such as the Flux and Energy Exchange Network (FLUXNET) and the Long-Term Ecological Research Network (LTER), and to seek overlap between those networks.

Action T3[93] *[IP-04 T3, T29]*[94]

Action: Development of a subset of current LTER and FLUXNET sites into a global terrestrial reference network for monitoring sites with sustained funding perspective, and collocated measurements of meteorological ECVs; seek linkage with Actions T4 and T29 as appropriate.
Who: Parties' national services and research agencies, FLUXNET organizations, the US National Ecological Observatory Network (NEON) and the European Integrated Carbon Observation System (ICOS), in association with CEOS WGCV, CGMS-GSICS, and GTOS (Terrestrial Carbon Observations Panel (TCO) and TOPC).
Time-frame: Implementation started by 2011, completed by 2014.
Performance Indicator: Plan for the development and application of standardised protocols for the measurements of fluxes and state variables.
Annual Cost Implications: 30-100M US$ (40% in non-Annex-I Parties).

Intercomparison of MODIS Albedo Retrievals and In-Situ Measurements across the Global FLUXNET Network

Alessandro Cescatti (EU-JRC), Barbara Marcolla (IASMA), Suresh K. Santhan Vannan (ORNL), Jerry Yun Pan (ORNL), Miguel O. Román (NASA/GSFC), Xiaoyuan Yang (BU), Crystal Schaaf (UMB), et al.

- We compared MODIS albedo retrievals with measurements taken at 53 FLUXNET sites that met strict conditions of land cover homogeneity.
- A good agreement between MODIS derived mean annual values and tower-based measurements was found ($r^2 = 0.82$).
- The mismatch is correlated with the spatial heterogeneity of surface albedo; stressing the relevance of spatially-representative in-situ data when validating satellite products.

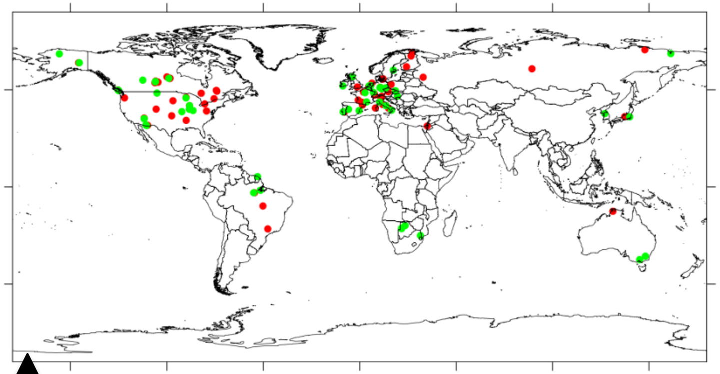


Figure 1: Spatial distribution of the 120 FLUXNET sites for which albedo measurements are available.

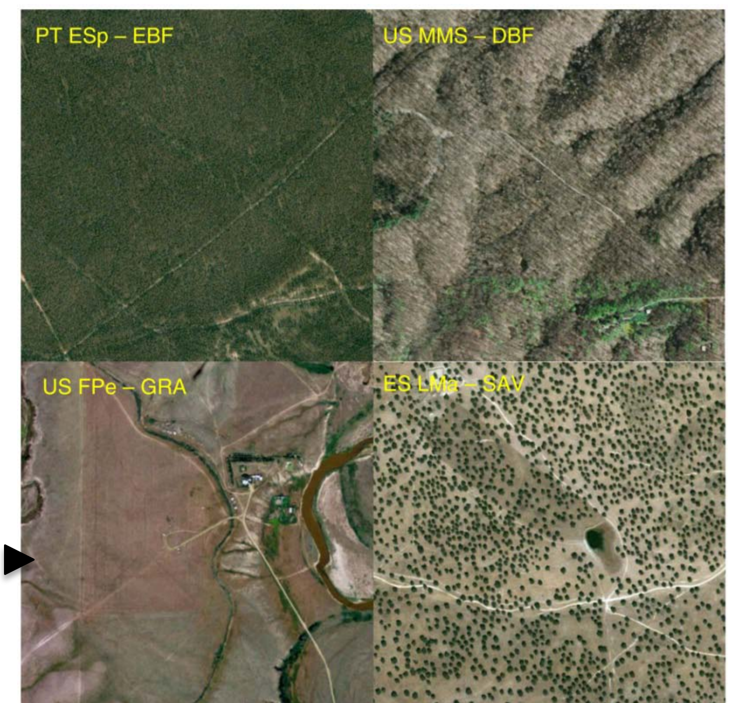


Figure 2: Classification of four FLUXNET sites according to their spatial representativeness at the resolution of MODIS satellite imagery (~1 km^2).

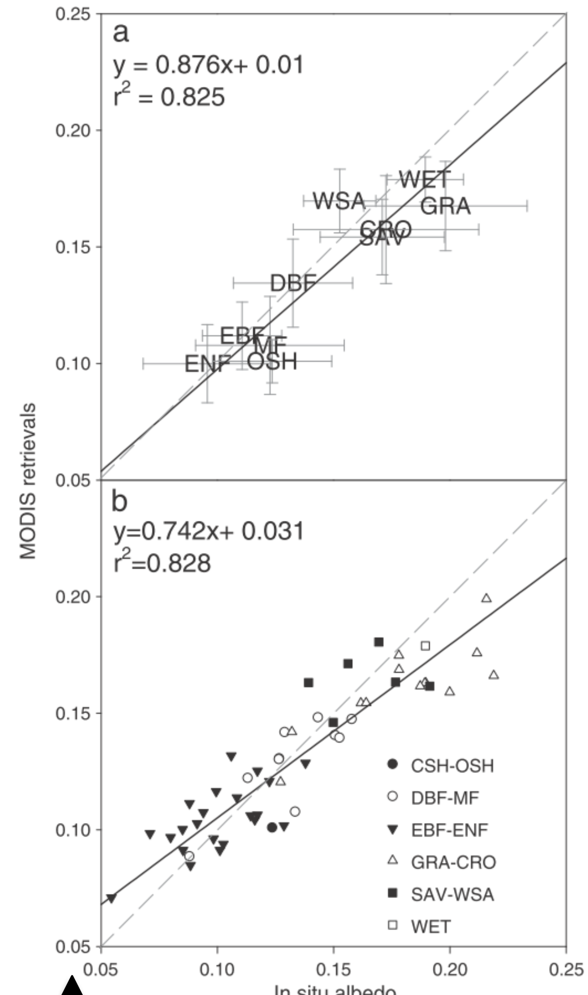
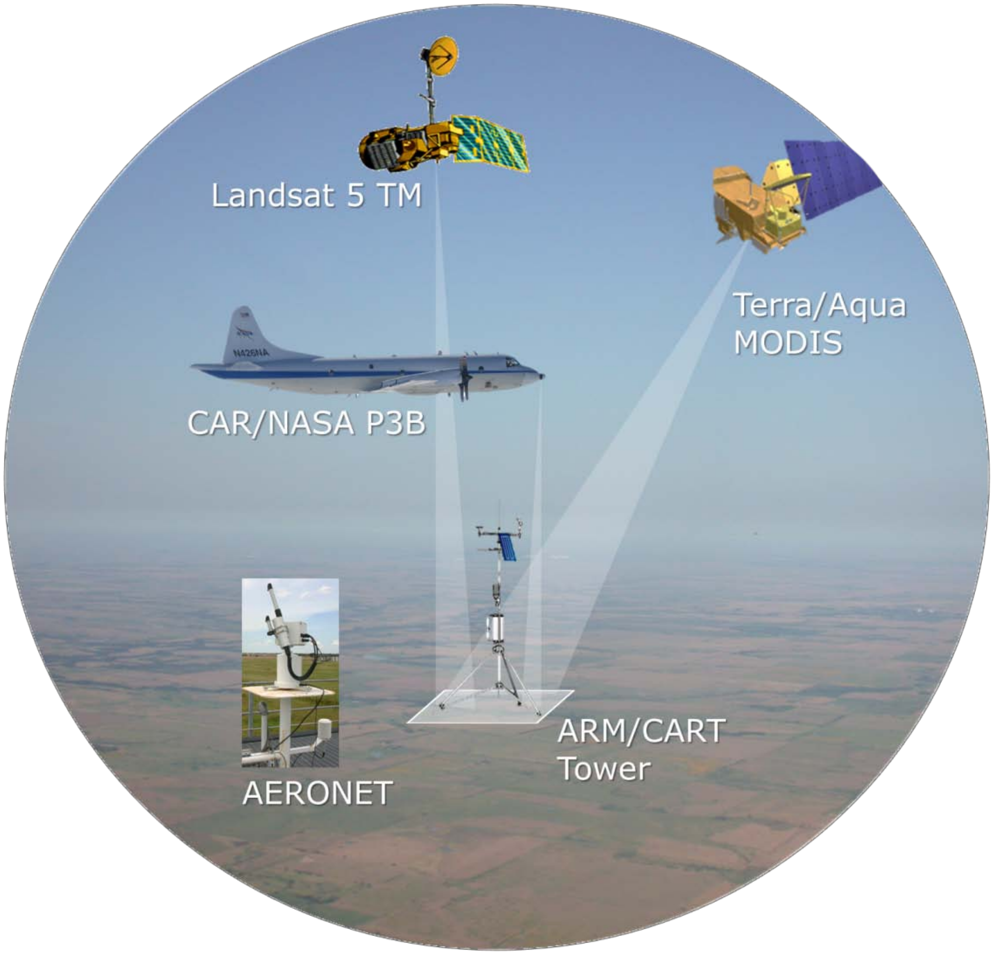


Figure 3: MODIS albedo retrievals vs. in-situ observations grouped by plant functional types (PFTs) (a), and by individual sites classified by PFT (b).

Use of in situ and airborne multiangle data to assess MODIS- and Landsat-based estimates of directional reflectance and albedo (Román et a., 2013 – TGRS)



Measurement configuration for multiscale assessment of MODIS- and Landsat-albedos.

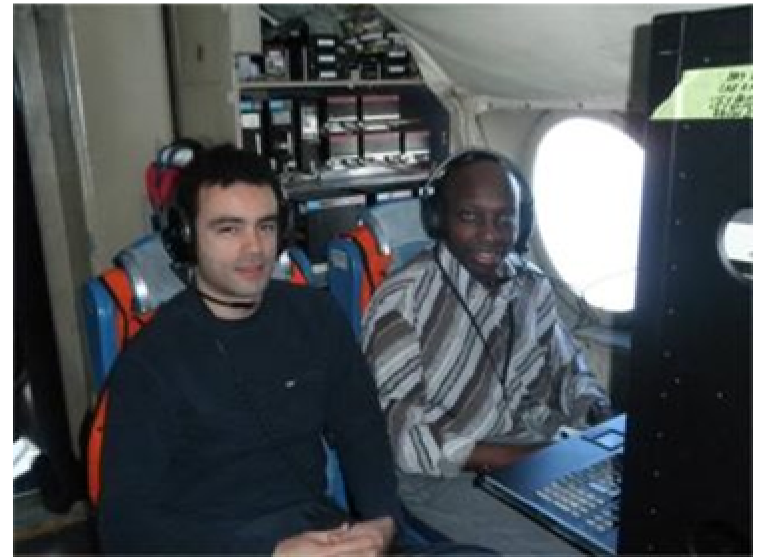
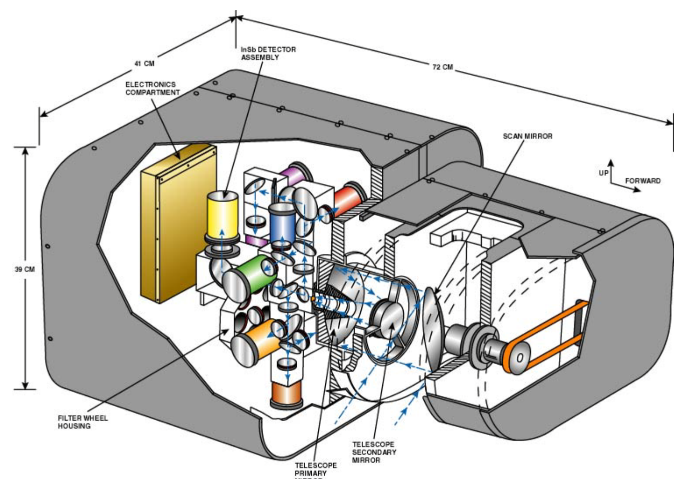


Fig. 1: Román and Gatebe on P3B during Eco/3D campaign Flight #2035.



CAR Instrument

Use of in situ and airborne multiangle data to assess MODIS- and Landsat-based estimates of directional reflectance and albedo (TGRS'13 Special Issue on Cal/Val)

Miguel O. Román, Code 619, NASA/GSFC

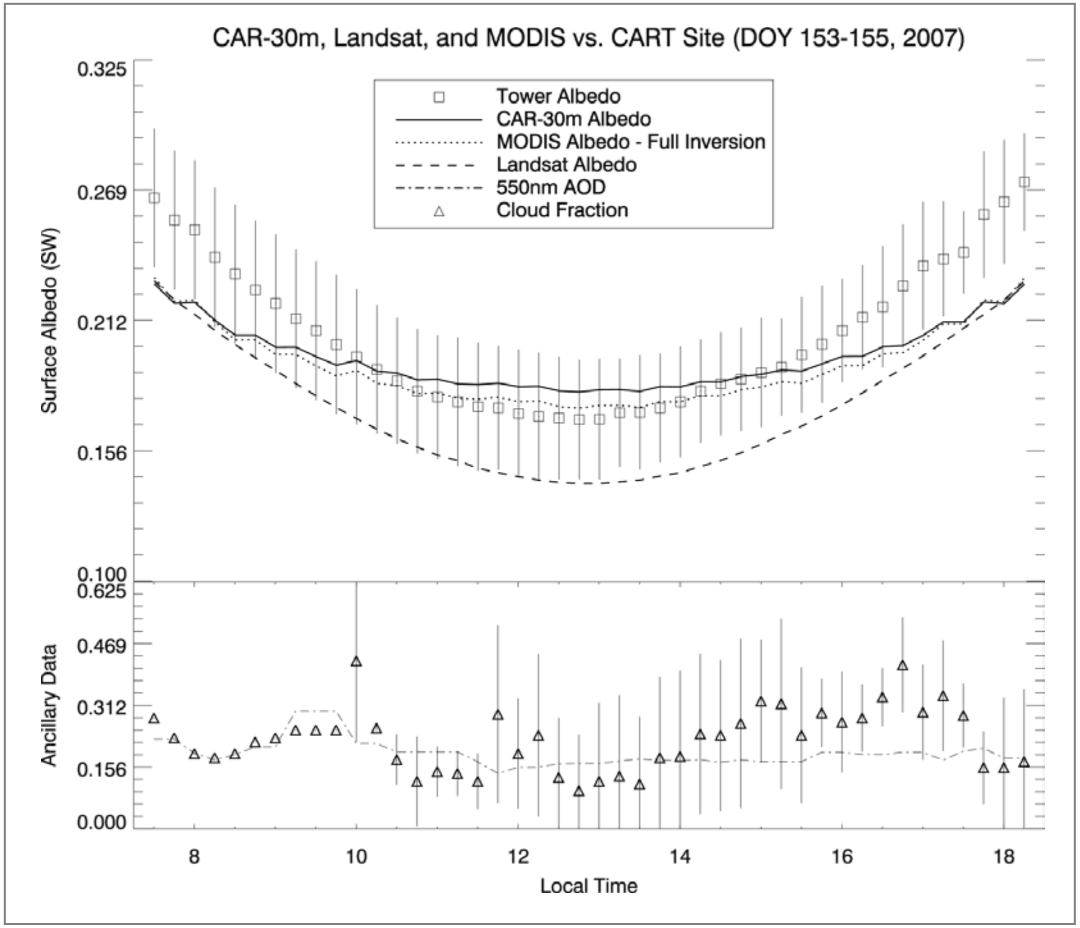


Figure 1: Comparisons between surface albedos derived from CAR, MODIS, Landsat-TM, and tower-based measurements acquired at the Atmospheric Radiation Measurement Cloud and Radiation Testbed (ARM/CART) site in northern Oklahoma.

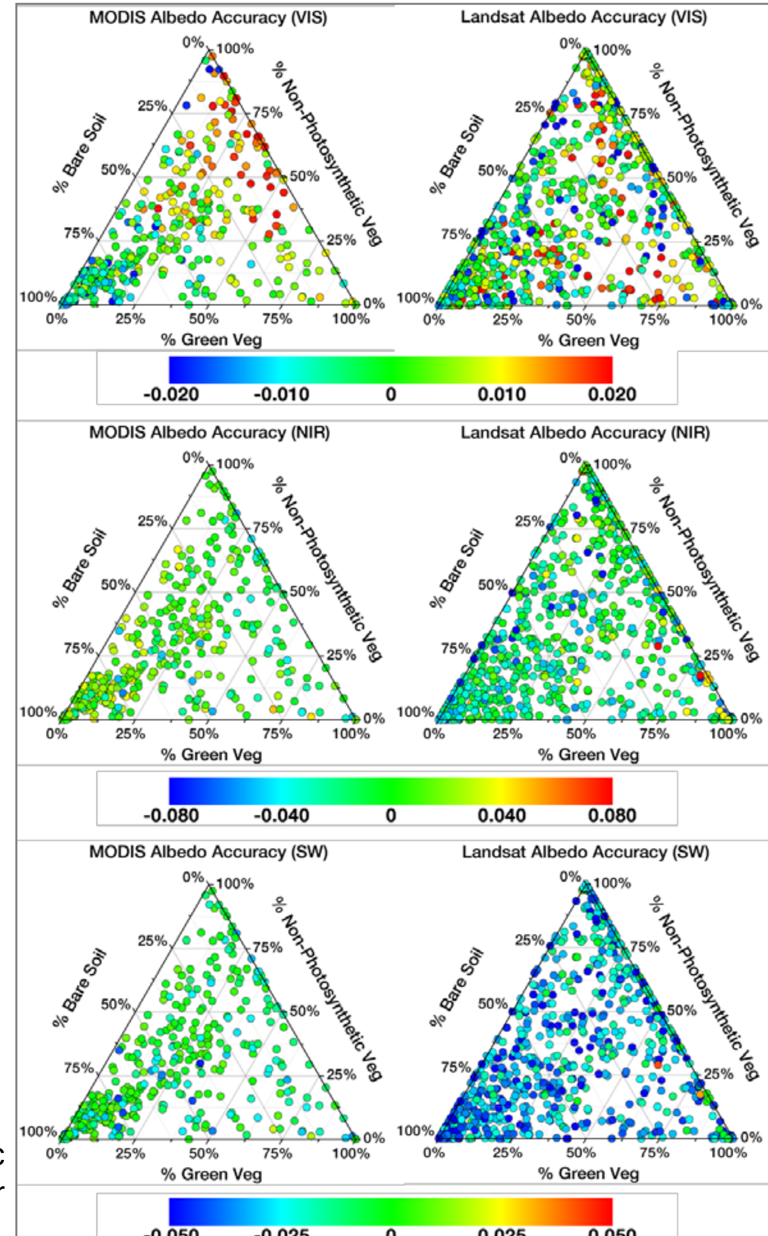


Figure 2: Ternary diagrams illustrating the pixel-specific accuracy of MODIS- and Landsat-derived albedos for a 10km x 10km region centered on the ARM/CART site.

Outreach to the Science Community

LPV submitted a session proposal to AGU fall meeting 2012 on „Quality Assessment of Satellite-Derived Land Surface Variables“.

2 oral + 1 poster session with ~30 contributions from LPV and international community, covering

- Development of validation methods
- Product or satellite specific validation results
- New datasets for ECVs

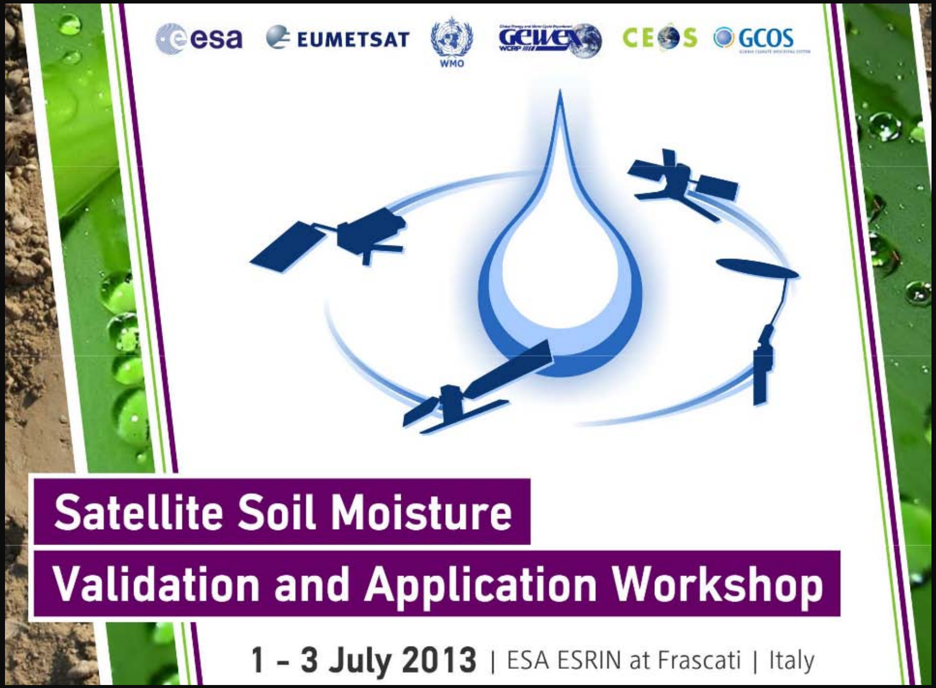
Achievements beyond exchange of scientific results

- Attracting validation community not actively involved in LPV
- Platform for validation contributions -> motivation of (young) researchers to invest their time in validation!

Goal to have alternating LPV sessions at AGU and EGU in the future. Good platform for LPV side-meetings!

Recent and Future Meetings

- Phenology Land Product Validation Workshop – side meeting AGU, Dec 2012.
- FIRE-IT and GOFC-GOLD Symposium, Wageningen University, Wageningen, The Netherlands, April 15-19, 2013.
- Satellite Soil Moisture Validation and Application Workshop, Frascati, Italy, July 1-3, 2013.



Next Steps

Strategy development and priorities for LPV 2013-16
- within WGCV terms of references
- including focus area leads in discussion

Points for discussion include
- Protocol/best practices development strategy
- Communication with emailing lists
- Coordination with WG Climate (eg. GCOS IP)
- Coordination with (meta-) data portals
- Identification and reduction of redundencies
- Definition of LPV role in QA4EO
- Website renewal and updates (WGCV, LPV, focus areas)
- Selection of representative validation sites
- Endorsement of validation data sets (and DOI assigment)
- LPV workshop on methods and results (2013/2014)
- LPV publication strategy
- Attracting next generation of focus area leads

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