



CEOS WORKING GROUP ON CALIBRATION & VALIDATION

CEOS WGCV

Land Product Validation Sub-Group

(2009 – 2010 Update)

Joanne Nightingale¹, Jaime Nickeson¹, Fred Baret²

(¹Sigma Space Corp / NASA GSFC, ²INRA)

With input from LPV Focus Group Leads



Outline

- LPV Structure → 2010
- Objectives and Goals
- LPV focus group activities and status updates
- Planned activities and meetings
- WGCV Action items for LPV

LPV Sub-group Structure

Chair: Joanne Nightingale (NASA GSFC)

Vice-Chair: TBD (Ben Koetz, ESA)

NASA EOS Validation: Jaime Nickeson / Joanne Nightingale

6 Land Product Focus Groups

- Established in June 2009
- 2 co-leads per group
- ~3-year terms

Focus Groups (June 2009)

* ECV

Focus Group	North America	Europe / Other
Land Cover *	Mark Friedl (Boston University)	Martin Herold (Wageningen University, GOFC/GOLD)
Fire* (Active/Burned Area)	Luigi Boschetti (University of Maryland)	Kevin Tansey (University of Leicester, UK)
Biophysical (LAI*, <i>f</i> APAR*)	Richard Fernandes (NR Canada)	Stephen Plummer (ESRIN, IT)
Surface Radiation (Reflectance, BRDF, Albedo*)	Crystal Schaaf (Boston University)	Gabriela Schaepman (University of Zurich, SW)
Land Surface Temperature	Simon Hook (JPL)	Jose Sobrino (University of Valencia, SP)
Soil Moisture*	Tom Jackson (USDA)	Wolfgang Wagner (Vienna Uni of Technology, AT)
Land Surface Phenology	Jeff Morisette (USGS)	TBD

LPV Objective

To foster **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

LPV Goals

- 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 / information exchange
- To provide feedback to international structures (GEOSS) for:
 - Requirements on product accuracy and quality assurance (QA4EO)
 - Terrestrial ECV measurement standards
 - Definitions for future missions

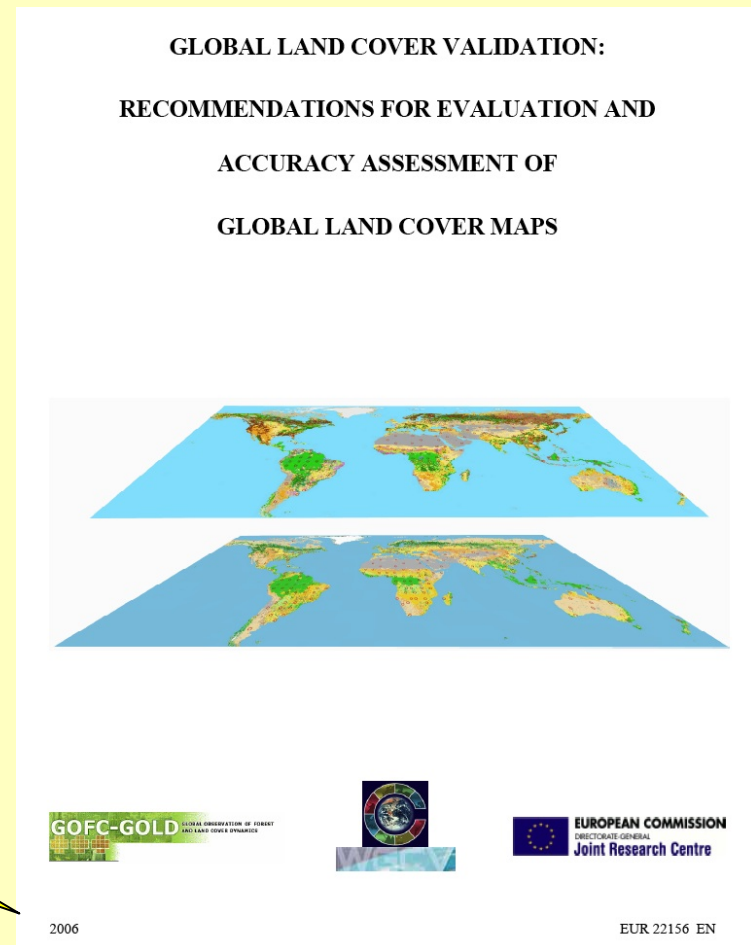
Role of Focus Group Leads

- Engage community members (via listserve), update on progress, relevant meetings
- Report back to LPV group on activities, meetings, new products, funding mechanisms
- Organize at least 1 topical workshop
 - (either every 2 years or 1 within leadership term)
- Expand LPV activities, field sites, collaboration beyond North American and Europe!
- Lead product inter-comparison activities
- Lead the development and writing of “best practice” land product validation guidelines

Land Product Protocols

- “Best practice” for land product validation
 - Current knowledge
 - Available data
 - Tools and methods
 - Tested and repeatable
 - Peer-reviewed
 - CEOS endorsed/published
 - “Living” documents

2006



Land Product Protocols cont.

- Template developed ~ June 2009 may be tailored to suit each product group
- Protocol key attributes:
 - **Background / product definitions**(ECV)
 - **Accuracy assessment** (comparison with in-situ, high resolution image reference data)
 - Existing data sets, field sites, sampling schemes, data quality issues
 - Spatial and temporal requirements for new datasets
 - **Product Consistency** (repeatability of products through time)
 - Address issues concerned with sensor calibration, data-reprocessing, algorithm refinement
 - **Product Inter-comparison**
 - **Recommendations / Conclusions**

Land Product Protocols cont.

- Process for CEOS Endorsement:
 1. Distribute to all LPV focus group leads for review
 2. Distribute to Focus group community via listserv
 3. Comments addressed in journal review style
 4. Protocol sent to WGCV Chair/Co-chair for approval
 5. Publish on LPV website, QA4EO archive and in CEOS communications
 6. Journal publication / special issue?

LPV Webpage

- Updating product

NASA GODDARD SPACE FLIGHT CENTER

CEOS WORKING GROUP Land Product V
Committee on Earth Observation Satellites

Home Landcover Biophysical S

Announcing...

- **A Workshop on the validation of land surface phenology products** - Dublin, Ireland, June 2010.
- **SMOS launched!**
- **PIERS2010 Special session on Land Products**, Xi'an, China, Mar 2010
- **Symposium - Recent Advances in Quantitative Remote Sensing: RAQRS'III**, Sep/Oct 2010, Valencia, Spain
- **4th Global Vegetation Workshop**, Missoula, MT, Jun 2009. Meeting summary in Earth Observer Sep-Oct issue, LPV Subgroup meeting summary, Nov-Dec issue.
- **The Int'l Conference on Land**

Background

Products

Meetings

Case Studies

Inter-compar

Validation

Background

The subgroup

Meetings related to Soil Moisture

Upcoming Meetings

Past Meetings

- **SMAP Algorithms & Cal/Val Workshop**
Embassy Suites Mandalay Beach Hotel & Resort
Oxnard, CA USA
6/9/2009 - 6/11/2009

The June workshop will focus on SMAP Algorithms and Cal/Val. The workshop will provide a forum to review the project Algorithm Theoretical Basis Documents (ATBDs) and Cal/Val plan, solicit input from experts in these areas, resolve key issues, and develop implementation plans. Approximately 1.5 days each will be dedicated to the algorithms and Cal/Val topics.

- **SMOS Validation & Retrieval Team Readiness Review Workshop**
Hotel Altis, Rua Castilho
Lisbon, Portugal
3/17/2009 - 3/19/2009

The primary focus of this workshop was a readiness review of the SMOS Validation and Retrieval Team (SVRT) activities in view of a launch of SMOS foreseen for 2009. It included presentations, status of the project, results from ESA campaigns, demonstration and distribution of data analysis tools, and the latest update of your SMOS Cal/Val project.

- **The 7th SMOS Workshop**
ESA-ESRIN
Frascati, Italy
10/29/2007 - 10/31/2007

The 7th SMOS workshop will focus on the preparation of the SMOS commissioning phase and related calibration and validation activities.

Following the successful testing of the MIRAS instrument the SMOS platform and payload are presently merged for final assembly, integration and test activities to form the full SMOS satellite (see http://www.esa.int/esaLP/SEMEBD90Y2F_LPsmos_0.html). Most of the efforts are thus directed towards the development of the ground segment and calibration and validation and commissioning phase activities. These efforts will be discussed in synergy with currently ongoing work on NASA's Aquarius (retrieval algorithms, calibration and validation) and other missions (ASCAT, AMSR-E etc), as well as the use of relevant auxiliary data - in view of paving the way for the future steps.

- **The 6th SMOS Science Workshop**
Technical University of Denmark
Lingby, Denmark
5/15/2006 - 5/17/2006

ESA's Soil Moisture and Ocean Salinity (SMOS) mission has been designed to observe soil moisture over the Earth's landmasses and salinity over the oceans. Soil moisture data are urgently required for hydrological studies and data on ocean salinity are vital for improving our understanding of ocean circulation patterns.

Contact: Frederic Baret
Institution: POSTEL

Temporal Coverage: 1999
Spatial Scale: 10 deg
Temporal Scale: 10-day

[Link to validation information](#)
WGCV-31 Plenary

03/02/2010

Focus Group Reporting

- 1st group meeting in June 2009, Montana
- Publication in Earth Observer
- Peer-reviewed publication *in prep*

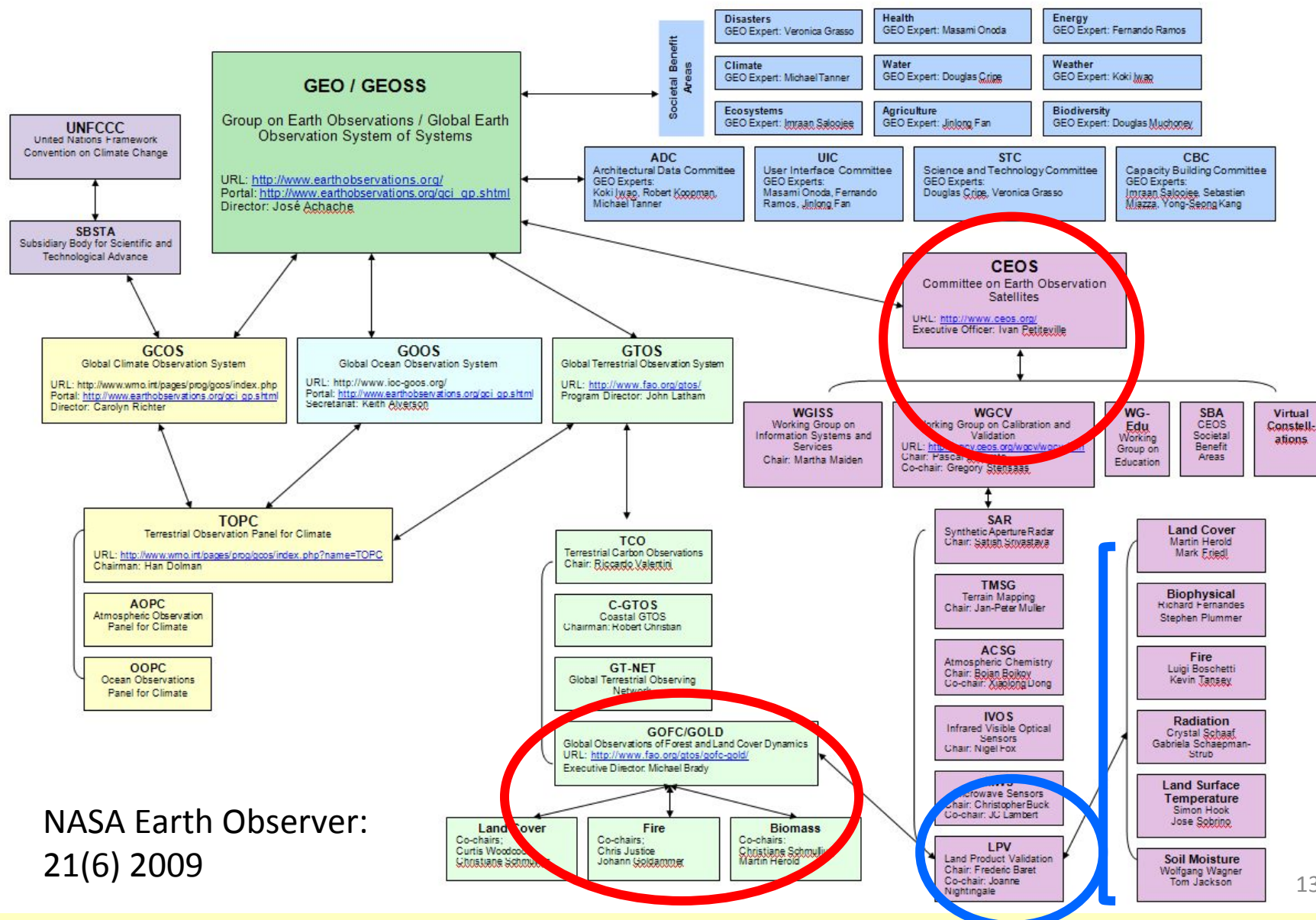


2010 strategy:

- Quarterly telecons (initial mtg: Feb 24, 2010)
- 6-monthly report updates

GEOSS Schematic

Linkages between International Programs concerned with Terrestrial Earth Observation



NASA Earth Observer:
21(6) 2009

Validation Stages

- Consensus from LPV leads / MODIS land PI's

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. <i>Spatial and temporal consistency of the product and with similar products have been evaluated over globally representative locations and time periods.</i> Results are published in the peer-reviewed literature.
Stage 3	Uncertainties in the product and its associated structure are well quantified from comparison with reference in situ or other suitable reference data. <i>Uncertainties are characterized in a statistically robust way over multiple locations and time periods representing global conditions. Spatial and temporal consistency of the product and with similar products have been evaluated over globally representative locations and periods.</i> Results are published in the peer-reviewed literature.
Stage 4	Validation <i>results for stage 3 are systematically updated</i> when new product versions are released and as the time-series expands.

Focus Group Reports

- Key activities since June 2009
- ECV and GCOS-IP 10 actions
- Planned activities / meetings
- Responsibility for ensuring ECV compliance
 - **Role for GOFC-GOLD and CEOS LPV articulated**
 - and 3 LPV co-leads are ECV document authors (Land, Albedo, Fire)

Land Cover Focus Group

Martin Herold / Mark Friedl

ECV T09: GCOS-IP10; T24, T25

Action T24 [IP-04 T23]

Action: Produce reliable accepted methods for land-cover map accuracy assessment.

Who: CEOS WGCV, in collaboration with GOFC-GOLD and GLCN.

Time-Frame: By 2010 then continuously.

Performance Indicator: Protocol availability.

Annual Cost Implications: <1M USD (10% in non-Annex-I Parties).

Action T25 [IP-04 T25]

Action: Develop an *in situ* reference network and apply CEOS WGCV validation protocols for land cover.

Who: Parties' national services, research institutes and space agencies, in cooperation with GOFC-GOLD, CEOS/WGCV, FAO GLCN, and in coordination with Action T28.

Time-Frame: Network established by 2010.

Performance Indicator: Availability of validation statistics.

Annual Cost Implications: 1-10M USD (50% in non-Annex-I Parties).

Land Cover Focus Group

- **Land Cover Validation Protocol**
 - Update to 2006 document is undetermined
- **Planning for Global Land Cover Validation Exercise**
 - Collaboration with BU, GOFC-GOLD, VIIRS Surface type validation team
 - Initial meeting at BU, Regional validation workshop in Kazakhstan
 - Provisional sample design completed with draft documentation, site interpretation protocol in progress
- **Planning for ESA Climate Change Initiative Call**
 - Discussions with JRC on independent accuracy assessment (use of FRA 2010 remote sensing survey data)
- **Accuracy assessment of land cover change**
 - Will move ahead in concert with GOFC-GOLD REDD Sourcebook updates and GEO Forest Carbon Tracking task

Fire Focus Group

Luigi Boschetti / Kevin Tansey

ECV T13: GCOS-IP10; T36

Action T36 *[IP-04 T34]*

Action: Apply CEOS WGCV and GOFC-GOLD validation protocol to fire disturbance data.

Who: Space agencies and research organizations.

Time-Frame: By 2010.

Performance Indicator: Publication of accuracy statistics.

Annual Cost Implications: 1-10M USD (Mainly by Annex-I Parties).

Fire Focus Group

- **Burned Area validation protocol** - *in progress*
 - Part II – Accuracy measures, Part III – format Standardization and metadata
 - Collaboration with MODIS/VIIIRS active fire product experts
- Protocol essential for:
 - Geoland 2 Burned Area product validation
 - Generation of fire ECV funded by ESA Climate Change Initiative - starting mid-2010
- GOFC-GOLD Fire Implementation Team Workshop
 - LPV group meeting, March 2010
- 12th session of the GCOS/GTOS Terrestrial Observation Panel for Climate meeting, review of:
 - Fire ECV documentation
 - GCOS requirements for Burned Area products
 - March 2010

Biophysical Focus Group

Stephen Plummer / Richard Fernandes

ECV T11: GCOS-IP10; T28, T29

Action T28 [IP-04 T29]⁷⁷

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

Who: Parties' national and regional research centres, in cooperation with space agencies coordinated by CEOS WGCV, GCOS and GTOS.

Time-Frame: Network operational by 2012.

Performance Indicator: Data available to analysis centres.

Annual Cost Implications: 1-10M USD (40% in non-Annex-I Parties).

Action T29 [IP-04 T30]

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

Who: Parties' national and regional research centres, in cooperation with space agencies and CEOS WGCV, GCOS/TOPC and GTOS.

Time-Frame: Benchmark by 2012.

Performance Indicator: Agreement on operational product.

Annual Cost Implications: 1-10M USD (10% in non-Annex-I Parties).

Biophysical Focus Group

- **LAI validation protocol**
 - Initial Meeting held Nov 2009
 - Next Focus Group meeting scheduled Sept 2010
- Letter sent to GTOS, GCOS : **Adoption of a consistent definition for the Leaf Area Index ECV**
 - GTOS-L2008, GTOS-GV2009, GCOS-IP10, GCOS-TEMS
 - Sent December 2009, awaiting reply
- Status of LAI and $fPAR$ validation paper *in prep*
- OLIVE (**O**n**L**ine**V**alidation **E**xercise) (Baret *et al.*)
 - Activity funded (ESA)
 - Operational 2011
- Par@meter set up in 5 experiments for continuous monitoring of LAI/FAPAR

Surface Radiation Focus Group

Crystal Schaaf / Gabriela Schaepman-Strub

ECV T08: GCOS-IP10; T22

Action T22 [IP-04 T19]

Action: Obtain, archive and make available in-situ calibration/validation measurements and collocated albedo products from all space agencies generating such products, and promote benchmarking activities to assess the quality and reliability of albedo products.

Who: Space agencies in cooperation with CEOS WGCV.

Time-Frame: Full benchmarking/intercomparison by 2012.

Performance Indicator: Publication of inter-comparison/validation reports.

Annual Cost Implications: 1-10M USD (20% in non-Annex-I Parties).

Surface Radiation Focus Group

- **Albedo Validation Protocol** - *in progress*
- Collaboration with ESA-sponsored GLOBALBEDO project
 - Started Fall 2009
- Collaboration with GMES Geoland-2 Albedo validation effort
 - Work to begin in early 2010
- More field sites required for Albedo validation
 - Discussions with BSRN (Baseline Surface Radiation Network)
 - NEON (National Ecology Observatory Network)
 - Ideally extend beyond USA and Europe
- Relevant Publications:
 - 2 papers related to MODIS Albedo validation, site suitability and spatial representativeness in relation to a satellite pixel: ***published***
 - MODIS-MISR Inter-comparison paper: ***accepted***
 - Article summarizing current state of Albedo products: ***in prep***

Soil Moisture

Tom Jackson / Wolfgang Wagner

“New ECV”

- Soil moisture validation protocol
 - Discussions in progress
 - Upcoming project meetings for SMOS Science Advisory Group and WACMOS (Water cycle multi-mission observation strategy))
- International Soil Moisture Network
 - Global in-situ soil moisture database
 - Collaboration between CEOS, GEWEX and GEO
 - Online February 2010!
 - Issues with data sharing, NASA and CEOS LPV to push collaborations

Contributing Networks

There is a growing number of soil moisture in-situ networks typically run by national and regional organisation. The networks shown on the map below have thank their soil moisture measurements to the *International Soil Moisture Network*.

Name	Country	Stations	Website
MESONET	USA	134	www.mesonet.org
OZNET	Australia	64	http://www.oznet.unimelb.edu.au/
REMEDHUS	Spain	18	http://campus.usal.es/~hidrus/
SMOSMANIA	France	12	http://www.hymex.org/

Land Surface Temperature

Simon Hook / Jose Sobrino

- **LST Validation Protocol** - Discussions to begin April 2010
- Discussions with CEOS IVOS group:
 - Roles and responsibilities of LST & Emissivity validation versus at sensor radiance
 - Inclusion of automated validation sites
- Participation in the GEO task – QA4EO
 - (Quality Assurance “4” Earth Observation)
- Participation in journal special issue:
 - Terrestrial Reference Standard Test Sites for Post-Launch Calibration
- Data from Thermal campaigns in Europe to be collated for LST webpage/data archive
- RAQS – 3rd international symposium on “Recent Advances in Quantitative Remote Sensing”
 - September 2010

Land Surface Phenology

Jeff Morisette / Joanne Nightingale

- No pre-existing LSP validation methods or papers
- LSP focus group in initial stages
 - Group co-lead to be identified
- LSP product review paper *in prep*
 - 2 global products (MODIS, SPOT-Vegetation)
 - 5 products for US/North America (MODIS, AVHRR, Data Fusion)
 - 2 products for Europe (MERIS)
 - 1 product for South Africa (AVHRR)
- LPV workshop at the Phenology conference, June 2010
 - Incorporating ground networks (NPN, PEN)
 - To bring together producers of continental- to global-scale land surface phenology products; as well as those collecting field, tower, or airborne data useful for validating those products, to develop an international protocol to quantify the accuracy of these products and initiate a validation-based inter-comparison

Moving Forward

- **Protocol development – slow...**
 - *Time, resources, concerns about existing template*
- **Cross-cutting activities with GOFC-GOLD**
 - Land cover and Fire Implementation teams
- **Validation Field Sites / Existing Networks**
 - Review of existing EOS core sites / additional sites?
 - Enhance collaboration with existing networks (FLUXNET) and new networks (NEON)
 - **Expanding outside of North America / Europe** – identify needs and requirements for field sites and instrumentation

Action T3⁷³ [IP-04 T3, T29]⁷⁴

Action: Development of a subset of current LTER and FLUXNET sites into a global reference network for ecological monitoring sites with sustained funding perspective.

Who: Parties' national services and research agencies, FLUXNET organizations, NEON, ICOS, in association with CEOS WGCV, CGMS-GSICS, GTOS (TCO and TOPC)

Time-frame: Implementation by 2010

Performance Indicator: Plan for the development and application of standardized protocols for the measurements of fluxes and state variables

Annual Cost Implications: 30-100M USD (40% in non-Annex-I Parties).

Moving Forward

- **Online Interactive environments for Cal/Val Activities**

- GECA – Generic Environment for Cal/Val Analysis - ESA
- CEOS Cal/Val Portal - ESA
- SPEC – Satellite Product Evaluation Center - ORNL

- **OLIVE – OnLineValidation Exercise**

- Tool to achieve Stage 4 “ongoing validation”

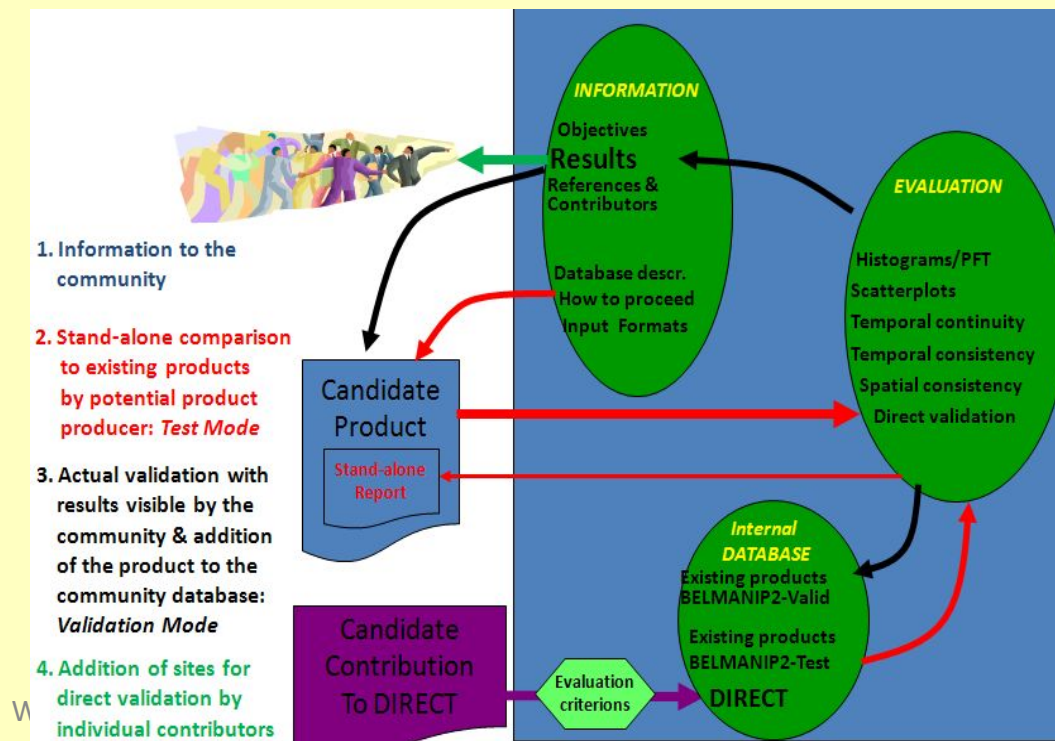
Baret, Koetz et al.

- *Test* and *Actual* validation modes to reduce “cheating”

- Easy access to validation results

- Initial demonstration with LAI, *f*PAR and Albedo

- Project to start in early 2010



03/02/2010

WGCV Actions for LPV

1. CEOS Action 23-13 WGCV Chair with GEO FCT co-leads to identify supporting role for WGCV in calibration and validation aspects of Forest Carbon Tracking activity (GEO Task CL-09-03b)
2. GEO Action (WGCV lead) DA-09-01a 8 Generation of CEOS Post-Launch Test Site list lead GyaneshChander (USGS) and the creation of the CEOS-COVE information mining tool. List currently is only Sensor Characterization but should also be expanded to a definitive list covering all CEOS cal-val sites. Need is for development of the comprehensive list inc LPV.

