



LAND PRODUCT VALIDATION SUBGROUP REPORT

F. Baret, S. Garrigues & J. Nightingale

WGCV-29 Avignon September 2008

- objectives and structure
- accomplishments and ongoing activities
- contribution to GEO tasks
- planed activities
- recommendations

Mission Statement & Goals

- to foster **quantitative validation** in a traceable way of *higher level global land products* derived from remote sensing data and relay results so they are relevant to users
- to increase the quality and efficiency of global satellite product validation via developing and promoting international standards and protocols for field sampling, scaling, error budgeting, data exchange
- to provide feed-back to international structures (GEO/GEOSS) for :
 - requirements and achievements on product accuracy and quality assurance
 - definitions of future mission

Products targeted

- Land cover
- Fire (active, burnt area)
- Biophysical characteristics (LAI, fAPAR, fCover, chlorophyll, phenology?)
- Energy (albedo, short and long wave fluxes, (T° ?))
- Soil (moisture, type)

Products not targeted

- Net Ecosystem Exchange/Productivity (NEE/NEP)
- Evapotranspiration

LPV structure

• A structural problem:

- biophysical products are not as close to sensors as radiometric calibration is!!
- Community is large and scattered: more focus on product families corresponding to a better identified (unified?) community (land cover, fire, biophys., energy, soil)

• A possible solution: sub-sub-groups

- Land cover
- Fire
- Biophysical characteristics
- Energy
- Soil

- (M. Herold, M. Friedl?)
- (K. tansey, C. Justice ?)
- (R. Fernandes, Nasa ?)
- (G. Shaepman, C. Schaaf?)
- (W. Wagner, Y. Kerr?)

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- accomplishments and ongoing activities
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- objectives and structure
- accomplishments and ongoing activities
- *current/future challenge*
- recommendations

LPV web site maintenance

CE®S WORKING GROUP ON CALIBRATION & VALIDATION Land Product Validation Subgroup

Home Landcover Biophysical Fire/Burn Surface Rad



Announcing...

- CEOS/LPV Workshop on LAI and fAPAR Product Validation, Mar. 15, 2007, Davos, Switzerland.
- Review the ESDR White Papers developed for the NASA Land Measurement Team
- IEEE TGRS Special Issue on Land Product Validation available
- CEOS Publication Global Land Cover Validation: Recommendations for Evaluation and Accuracy Assessment of Global Land Cover Maps (2)
- Workshop: Validation of global vegetation indices and their time series, Aug.7, 2006.
- Meeting: Long term global monitoring of vegetation variables using moderate resolution satellites, Aug. 8-10, 2006.



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

Validation is the process of assessing, by independent means, the quality of the data products derived from the system outputs

Background

The subgroup on Land Product Validation (LPV) is one of six subgroups of the Working Group on Calibration and Validation (WGCV), which itself is one of two standing working groups within the Committee on Earth Observation Satellites (CEOS, see also CEOS structure). The six WGCV subgroups are:

Subscribe!

- Infrared and Visible Optical Sensors (IVOS)
- Atmospheric Chemistry (AC)
- Microwave Sensors (MS)

Thanks to Jaime Nickeson and Jeff Morissette web curator: Jaime Nickeson, NASA GSFC

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Previous workshops

- 1) 7-8 June 2001 LAI Intercomparison ESA Frascati, Italy
- 2) 23-24 October 2002 Land Product Validation Workshop on Surface Albedo Boston MA USA
- 3) 16 August 2004 EOS LAI Intercomparison Activity Results Missoula, MT USA
- 4) 27-28 October 2005 Global Vegetation Continuous Fields Validation Workshop Brookings, SD USA
- 5) 27-28 April 2005 LPV workshop on albedo Vienna, Austria
- 6) 7 August 2006 LPV workshop on long-term VI record Missoula Montana
- 7) 8-10 August 2006 Long term global monitoring using moderate resolution satellites Missoula Montana
- 8) 23 March 2007 LPV workshop on LAI and fAPAR products Davos, Switzerland
- 9) GOFC-GOLD Land cover Symposium 14-15 October

LAI validation exercise: refinements and outreach

• LAI measurements

 Garrigues, S., N. V. Shabanov, et al. (2008). "Intercomparison and sensitivity analysis of Leaf Area Index retrievals from LAI-2000, AccuPAR, and digital hemispherical photography over croplands." *Agricultural and Forest Meteorology* 148: 1193-1209.

• LAI Intercomparison / Direct validation

- Weiss, M., F. Baret, S. Garrigues, R. Lacaze, and P. Bicheron. 2007. LAI, fAPAR and fCover CYCLOPES global products derived from VEGETATION. part 2: Validation and comparison with MODIS Collection 4 products. *Remote sensing of Environment*, 110:317-331.
- Garrigues, S., R. Lacaze, F. Baret, J. Morisette, M. Weiss, J. Nickeson, R. Fernandes, S. Plummer, N. V. Shabanov, R. Myneni, and W. Yang. 2008. Validation and Intercomparison of Global Leaf Area Index Products Derived From Remote Sensing Data. *Journal* of Geophysical Research, 113 (GO2028).

LAI Validation: conclusion

- Methods have been developed and published
- Methods have been applied and results published

• But...

- Need updates with new products versions : OLIVE on line validation exercise
- Small number of validation sites: continuous increase of number of sites (new sites and inclusion of processed archive sites) to get closer to stage 3 validation
- Very little 'continuous' ground LAI measurements: PAR@METER devices
- Revise BELMANIP: lack of inter-pixel homogeneity for some sites
- Application to other products: fAPAR, albedo

development of virtual constellation products

Objectives

- Develop consistent products from several sensors to allow simple fusion

Approach

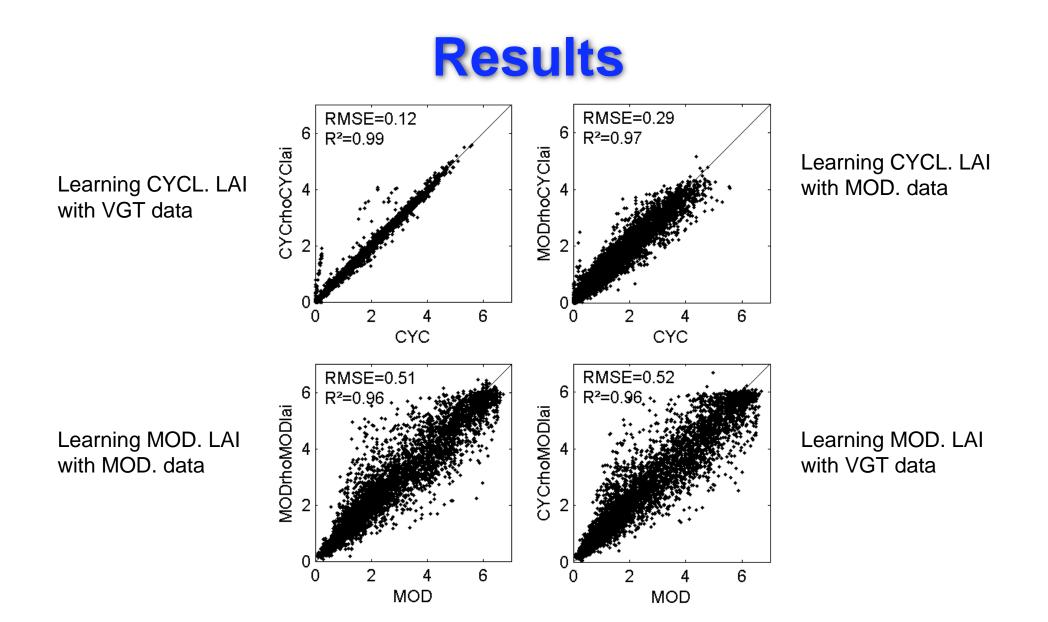
- neural networks trained with different inputs (sensors) but same outputs (products)
- Application to CYCLOPES/VEGETATION and MODIS

• Interest

- No need for absolute reflectance calibration or strong spectral consistency between sensors: just temporal and spatial stability!
- Need good geometrical consistency
- Application over instantaneous observations (including or not atmosphere)

• Results published:

- Verger, A., F. Baret, and M. Weiss. 2008. Efficiency of neural networks for consistent calibration of LAI products from input reflectance coming from several sensors: Application to CYCLOPES/VEGETATION and MODIS data. *Remote Sensing of Environment*, 112(6):2789-2803.
- Implementation in GEOLAND2 project (EC) for Long Time Series products (VEGETATION/AVHRR)



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Update BELMANIP: BELMANIP2

• Objectives:

- propose an ensemble of sites representative of vegetation type and state for inter-comparison
- Sites should be:

Flat

- Homogeneous at 1 km scale (inter pixel variance limited)

• First version of BELMANIP

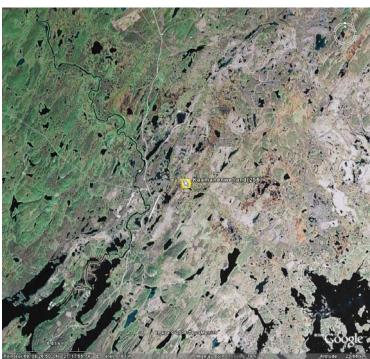
- compilation of currently existing sites: AERONET/FLUXNET/DIRECT
 ... COMPLET !
- Work published: Baret, F., J. Morissette, and 7 co-authors. 2006. Evaluation of the representativeness of networks of sites for the global validation and inter-comparison of land biophysical products. Proposition of the CEOS-BELMANIP. *IEEE Transactions on Geoscience and Remote Sensing*, 44:1794-1803.

Problems identified

 Several sites seen 'homogeneous' (same class between neighboring pixels) by ECOCLIMAP (1km) were not!







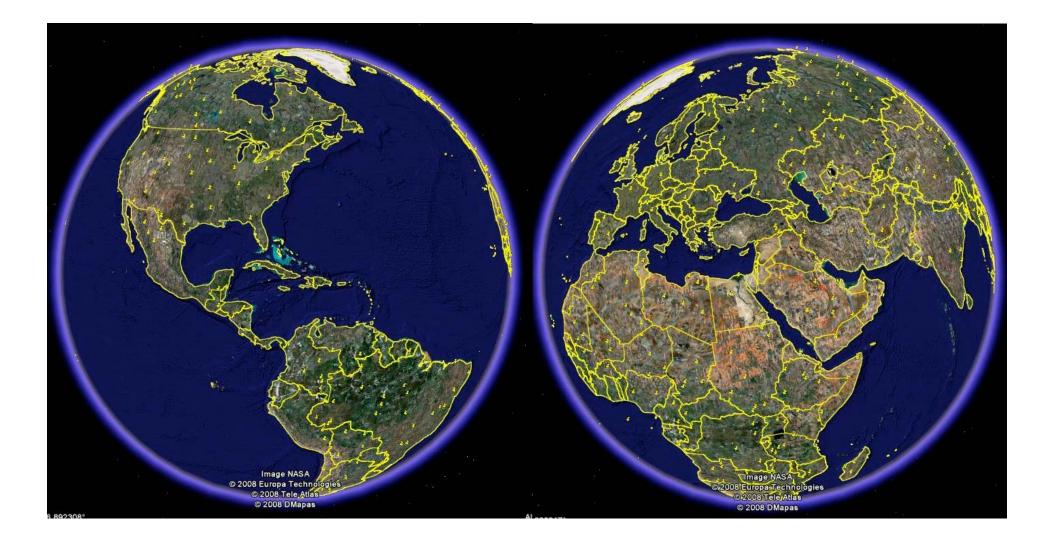


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BELMANIP2

- Site selection principles:
 - Divide latitude by 10° strips
 - Compute land cover (GLC2000 6 classes)
 - Select 'pseudo' randomly sites (number of sites proportional to frequency of GLC2000) for each class in 'homogeneous' (1km) places
 - Check with Google earth homogeneity and refine selection if necessary
- Current status:
 - Sites selected (
 - Evalution of representativity on going
 - Paper describing BELMANIP2 (short letter) in preparation

BELMANIP2



OLIVE

- Successive versions (collections) of products
- New products
- Traceability / transparency
- Consensus framework for validation
- Capitalization of information
 - For the products evaluated
 - For the ground measrements
- Easy access for the community
- development of OLIVE:
 On Line Interactive Validation Exercise
 - Supported by ESA

Characterization of products PSF

- Confusion between sampling interval and actual spatial resolution
- PSF known at the sensor level ... but several processes degrades sensor PSF
- PSF required for
 - Validation
 - Fusion
 - Between products
 - With other information
- On going work over VEGETATION, MODIS and MERIS fAPAR products

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Ongoing validation activities

- LAI and fAPAR validation
 - 3x3 km sites
 - Products included
 - MODIS collection 5
 - CYCLOPES V3.1
 - GLOBCARBON
 - MERIS (G-POD extraction)
 - Methodology
 - Inter comparison over BELMANIP2
 - Direct validation with distinction between effective and 'true' values for LAI
- M. Weiss, S. Garrigues, F. Baret, R. Lacaze

Development of continuous fAPAR and LAI measurement systems

- Current situation
 - Most sites currently instrumented/sampled correspond to 'one shot' measurements
 - Need for sampling different development stages / states of the vegetation
 - Interest in seasonality (canopy functioning)
 - Classical systems with sensors connected to a data logger exist but:
 - They are expensive (data logger)
 - Difficult to install/desinstall (wires)
- Development of a wireless affordable system (PAR@METER)

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- recommendations

Contribution to GEO Tasks

Several tasks share same contributions from LPV.

Agriculture	Task#	Task Title	Proposition for potential contribution from LPV	LPV achievements	Contact	References
	AG-0604	Forest	1) Recommendations for Evaluation and Accuracy Assessment of	 LPV with GOFC-GOLD contributed to this task by encouraging coordinated developments and providing the framework for evaluation of 	Alan H. Strahler, Philippe Mayaux,	1, 2, 3, 4
Aariculture		Mapping	Global Land Cover Maps;			
		andChange		Global LandCovermaps. Documents were written that report	LPV chair	
		Monitoring		methodology and results for the validation of land cover maps.		
			2) Proposition of using biophysical products for change detection.	2 Tobe discussed and tested		
	10 000				101/01	
griculture	AG-07-01	Improving Measureme	1) provide accuracy evaluation of inputs to vegetation productivity models	 Biophysical variables such as LAI and fAPAR are key inputs to vegetation productivity models. LPV has been focusing on those variables, 	LPV Chair, Sebestien Gantoues	5, 6, 7, 8, 9, 1 11, 12, 13, 14
		nts of	mues	by (i) proposing a clear and consensus definition of these variables, (ii)	SebalerGaligues	15, 12, 13, 14
		Biomass		describing departure of available products from the main definition, (ii)		D
		Diulias		developed of a methodological framework for accuracy assessment of		
				developed of a methodological filamework for accuracy assessment of products, and (iii). Results on evaluation of medium spatial resolution LAI		
				products, and finit, resource on evaluation of medium spatial resolution to Pri products accuracy from ground measurements and intercomparison		
				products accuracy itom ground measurements and intercomparison between available products.		
				berween available products.		
			2) provide recommendations for accuracy assessment of	2) Discussions stated at Global Vegetation Monitoring meeting (Missoula		
			productivity, gross primary production and biomass	2006) and papers published in IEEE TGARS validation special issue.		
Climate	CL-0602	Key Climate	1) Provide accuracy statements for Essential Climate Variables	1) LPV with GOFC-GOLD contributed to validate global land cover maps.	LPV chair	16.17 18.8
in the second	CEODE	Datafrom	ECVs) as defined in the GCOS Inclementation Plan for the	Similarly, LPV contributed in the validation of LAI, fAPAR and fire	D-V diai	10,0
		Satellite	terrestrial domain, Emphasis on land cover, Albedo, LAI, fAPAR,	products.		
		Systems	Fire and soil moisture products from medium resolution sensors.			
Jimate	CI-0603		- · ·			
amale	CLUBUS	Key tenestrial	Propose strategies to exploit in a consistent way historical	2) LPV proposed strategies to build consistent long time series of		20
		deservation	satellite archive and darive long time sates of products.	biophysical variables		
		sfor				
Data	DA-06-02	GEOSS	1) Provide a strategy and methods for quality assessment of land	1) A strategy has been defined for the validation of higher level products:	LPV chair	267
Jata Management	LANDU2	Quality	1) Provide a strategy and methods for quality assessment of land cover (with GOFC-GOLD) fire and biophysical products derived	 A strategy ras been delined for the valuation or higher level products: and cover (with GOFC-GOLD) and fire and LAI and fAPAR biophysical 	u-v dan	49.1
aayanan		Assurance	from satellite observations.	products. Results show that stage 2 of the validation is achieved, but stage		
		Assurance Strategy	In a second did b.	productis. Heisuitis show that stage 2 of the validation is achieved, but stage 3 (quantitative accuracy assessment representative of global conditions) is		
		chardy		is (gaa manye acculacy assessment representance or grobar conductrs) is not yet reached.		
		1	2) Maintain easy access to key information for the validation LPV.	2) A web site is set up providing information on validation activities.		21.5.89.10
	1		ay man wan dady autoos ito koy in run rand hui the Validabu'i La"V.	2) A web site is set up providing information on validation activities. Articles in peer reviewed journal have been published with results based		21, 5, 8,9, 10, 11, 12, 13, 14
	1			on methods proposed within LPV.		11, 12, 13, 14
		1	3) Organizes meetings to deline and discuss the methods and	3) Workshops have been organized to define and discuss the methods		~
		1	share results with the community.	and share results with the community.		
		1				21 22 23 18
ata	DA-06-04	Data,	1) Provide strategy for harmonization of global land cover mapping	 A strategy for harmonization of global land cover has been defined, 	Martin Herold	2
lanagement		Metadata	an in the second second second	allowing intercomparison of classifications and maps.	LPV chair	
		and Products	 Provide a stategy for harmonization through intercomparison of homologous biophysical products 	2) A strategy for intercomparing biophysical products has been proposed.		567.891
		Hamonisati	na na ogus o qui yatal poduta	2) A strategy for intercomparing biophysical picolucis has been proposed. Preliminary results are available for LAI and fAPAR.		5, 6, 7, 8, 9, 1 11, 12, 13, 14
lata .	DA-07-02	Global Land	1) Recommendations for Evaluation and Accuracy Assessment of	1) LPV with GOFC GOLD contributed to this task by encouraging	Alan H. Strahler,	1,2,3,4
lanagement		Cover	Global Land Cover Maps;	coordinated developments and providing the framework for evaluation of	PhilippeMayaux,	
				Global Land Cover maps. Documents were written that report	LPV chair	
				methodology and results for the validation of land cover maps.		
		1	2) Proposition of using biophysical products for change detection.	2) Tobe discussed and tested		
Data	DA-07-03	Virtual	1) Propose a strategy for intercomparison of products derived from	1) A strategy for intercomparison of products was proposed with	LPV Chair	5.6.7.8
lanaciement	DAUAR	Constellatio	1) Propose a strategy for intercomparison of products derived from several sensors	1) A strategy for intercomparison of products was proposed with application to biophysical variables (LA), fAPAR)	LPV Char	5,6,7,8
vanagement		Considiato				24.25
		ns	 Propose methods for merging products coming from several sensors 	2) Simple solutions proposed for merging products coming from similar sensors		29, 25
			3) Evaluate benefit of using virtual constellation products	3) Early evaluation for albedo and BRDF products		24, 25
			4) Define minimum requirements for inter-operability of sensors	4) Not yet achieved		-,
	DUGGOD	lkerf				
lisasters	DH0609		1) Propose a strategy for intercomparison of products derived from	1) A strategy for intercomparison of products was proposed with	LPV Chair	5,6,7,8
		Satellites for Risk	several sensors. 2) Propose methods for merging products coming from several	application to biophysical variables (LAI, fAPAR) 2) Simple solutions proposed formerging products coming from similar		24, 25
		Risk Managemen	 Propose methods for merging products coming from several sensors 	2) Simple solutions proposed for merging products coming from similar sensors.		24,25
		* *				24, 25
		ľ	 Evaluate benefit of using virtual constellation products Define minimum requirements for inter-operability of sensors 	3) Early evaluation for albedo and BRDF products		
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	EC MCM	late control		4) Not yet achieved	UDI/Orde	
cosystems	EC-06-01	Integrated	1) Provide uncertainties on products used to scale up local	1) Uncertainties available for few products required in the scaling up	LPV Chair	21, 5, 8,9, 10,
cosystems	EC-06-01	Global			LPV Chair	21, 5, 8,9, 10, 11, 12, 13, 14
cosystems	EC-06-01	Gidbal Carbon	1) Provide uncertainties on products used to scale up local	1) Uncertainties available for few products required in the scaling up	LPV Chair	21, 5, 8,9, 10,
		Global Carbon Observation	 Provide uncettainties on products used to scale up local doservations to region and scale 	1) Urcestainties availableforfexyproducts required in the scaling up process landcover, albodo, UAI and IAPAR		21, 5, 8,9, 10, 11, 12, 13, 14 15
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Contribution to DA-06-04

GEO Task #(DA-06-04): Data, Metadata and Products Harmoni zation

CEOS Agency : CEOS/WGCV

Point of Contact : WGCV chair , WGCV/LPV chair

1. Identify current activities contributing to this task, and the significance.

This task is addressedby WGCV under DA -06-02: Developing a data quality assurancestrategy for GEOSS (see the questionnaire for DA-06-02 for more details). In addition, theWGCV/LPV (Land Product Validation) subgroupis address ing this task as follows:

1) Provide strategy for harmonization of global land cover mapping

2) Provide a str ategy for harmonization through intercomparison of homologous biophysical products

2. Identify actions and/or deliverables related to the activities described above (these actions will be reported to CEOS). What is the identifiable result of the action?

(May be a multiyear activity, however please include action/deliverable to be completed in 2008).

Results on global LAI products validation: a paper was just recently accepted: Garrigues,
 S., R. Lacaze, F. Baret, J. Morisette, M. Weiss, J. Nickeson, R. Fem andes, S. Plummer, N. V.
 Shabanov, R. Myneni, and W. Yang. 2008. Validation and Intercomparison of Global Leaf
 Area Index Products Derived From Remote Sensing Data. Journal of Geophysical Research, accepted.

- Strategy for generating consistent biophysica l products from available medium resolution sensors. A pilot study has been completed to show how LAI could be generated in a consistent way from several sensors with application to MODIS and VEGETATION. This study shows that most of the effort should be c possible learning data base. A paper was recently accepted: Verger, A., F. Baret, and M. Weiss. 2008. Efficiency of neural networks for consistent calibration of LAI products from input reflectance coming from seve and MODIS data. Remote Sensing of Environment, accepted for publication.

- Up date BELMANIP network of sites: current BELMANIP sites are often relatively heterogeneous. They were mainly selected from already AERONET, ...). An up - date will be achieved to improve site homogeneity and representativeness. This network of sites is used for intercomparison of biophysical products. The lis of sites and description will be posted on the LPV site.

- Quantifying point spread function (PSF) of current biophysical products. PSF of instruments are generally well known, but could not directly transfer to higher level products PSF because of the several processing steps that degrade sensor PSF: int projection (and interpolation), interdate registration, effect of view angle, ... A study is currently ongoing to provide users of biophysical products with estimates of the associated PSF. It should be submitted to a peer reviewed journ (presumably RSE).

- Evaluation of several global land cover classification at regional scale. An on going study on landscape physiognomy evolution achieved over Michoacan (Mexico) will first concentrate on comparison of curre nt global classification with ground level survey. Results will be reported in a peer reviewed journal with emphasis on consistency and accuracy of these land - cover products.

WGCV-29 Avignon Sept. 2008

- fAPAR definition, ground measurements and Evaluation of global products. Altho ugh albedo has received a lot of attention for its definition, fAPAR has only received little attention while both products are subjected to similar problems. An ongoing study will provide a framework for fAPAR definition and describe how fAPAR could be me asured from ground level. A paper will be written in peer reviewed journal. Additionally, the main fAPAR products (MODIS C5, CYCLOPES V4 and JRC fAPAR) will be intercompared. Methods and results will be presented in a peer reviewed journal (presumably RSE of JGR).

1. Identify any issues (current/potential data gaps, data sharing problems , funding , etc)

- Funding requested to extend ground validation measurements and exploitation of already existing data sets.

- Need for development of on line validation biop hysical product tool: funding and web site management

These issues will be discussed at WGCV28 and addressed at WGCV29 in Sept. 08, to be hosted by the LPV chair.

2. Identify actions and/or deliverables needed to address the issues described above (these actions will be reported to CEOS). Specify when action needs to be completed . What is the identifiable result of the action?

-WGCV/LPV issues will be discussed at WGCV28 and addressed at WGCV29 in Sept. 08, to be hosted by the LPV chair .

3. Identify key intern ational organization (s) already assigned to work on this task fr om the satellite perspective. Are there any outstanding issues CEOS can help address in coordination with these organization(s).

-NASA, INRA, CNES, ESA, USGS, NOAA,

Contribution to DA-07-03

GEO Task #(DA-07-03): Virtual constella tion

CEOS Agency : CEOS/WGCV

Point of Contact : WGCV chair , WGCV/LPV chair

Identify current activities contributing to this task, and the significance.

 Propose a strategy for intercomparison of products derived from several sensors.
 Propose methods for merging products coming from several sensors.
 Evaluate benefit of using virtual constellation products
 Define minimum requirements for inter -operability of sensors

2. Identify actions and/or deliverables related to the activities described above (t hese actions will be reported to CEOS). What is the identifiable result of the action? (May be a multiyear activity, however please include action/deliverable to be completed in 2008).

- A strategy for intercomparison of products was proposed (see DA -06-04)

- Strategy for generating consistent biophysical products from available medium resolution sensors. A pilot study has been completed to show how LAI could be generated in a consistent way from several sensors with application to MODIS and VEGETATION. T his study shows that most of the effort should be concentrated on the generation of the best possible learning data base. A paper was recently accepted: Verger, A., F. Baret, and M. Weiss. 2008. Efficiency of neural networks for consistent calibration of L AI products from input reflectance coming from several sensors: Application to CYCLOPES/VEGETATION and MODIS data. Remote Sensing of Environment, accepted for publication.

- Quantifying point spread function (PSF) of current biophysical products. Product PSF is required to better define the actual spatial resolution and sampling needed for merging different products. PSF of instruments are generally well known, but could not directly transfer to higher level products PSF because of the several processing s teps that degrade sensor PSF: interband registration, projection (and interpolation), interdate registration, effect of view angle, ... A study is currently ongoing to provide users of biophysical products with estimates of the associated PSF. It should be s ubmitted to a peer reviewed journal before the end of the year (presumably RSE).

3. Identify any issues (current/potential data gaps, data sharing problems , funding , etc)

- Need to develop data fusion algorithm: temporal compositing of products coming from several sensors: funding required

- A structure to develop products derived from the fusion of already existing medium resolution sensors is needed.

These issues will be discussed at WGCV28 and addressed at WGCV29 in Sept. 08, to be hosted by the LPV chai r.

4. Identify actions and/or deliverables needed to address the issues described above (these actions will be reported to CEOS). Specify when action needs to be completed . What is the identifiable result of the action?

-WGCV/LPV issues will be discussed at WGCV28 and addressed at WGCV29 in Sept. 08, to be hosted by the LPV chair .

1. Identify key international organization (s) already assigned to work on this task fr om the satellite perspective. Are there any outstanding issues CEOS can help address in coordination with these organization(s).

-NASA, INRA, CNES, ESA, USGS, NOAA, EUMETSAT

- objectives and structure
- accomplishments and ongoing activities
- contribution to GEO tasks
- planed activities
- recommendations

Planed activities (1/2)

• Future meetings

- Albedo meeting March 2009 (Beijing) or October 2009 (London)
- Biophysical products June 2009 Montana
- Fire products 2009 ?
- Soil moisture (SMOS/SMAP) TBD 2010?
- Temporal signature in remote sensing. January 2010

Continue collecting ground validation

- GEOLAND2 (EC)
 - Compilation of existing (not compiled) sites
 - Develop new sites (4)
- TRUTH (ESA)
- ?? Are flux sites well suited?

Planed activities (2/2)

• Setup the OLIVE tool

Publication

- Publish BELMANIP2
- Publish LAI/fAPAR validation
- Publish PAR@METER results
- Publish on OLIVE
- Continue investigating methods to build virtual constellations
 - Medium spatial resolution (GEOLAND2)
 - MODIS / VEGETATION / MERIS / AVHRR
 - High spatial resolution
 - SPOT / Landsat / DMC / Rapid-eye / Formosat

- objectives and structure
- accomplishments and ongoing activities
- contribution to GEO tasks
- planed activities
- recommendations

Recommendations

• Monitoring progress of previous recommandations

- Recommend agencies to support the continuity and expansion of product validation activities to be able to quantify the associated uncertainties and allow fusion between similar products
 - A lot of progress still needed (except ESA (TRUTH) and EC (GEOLAND2))
- Encourage agencies to prepare subsets or develop tools for data/products extraction for validation activities
 - A lot of progress for ESA and VITO (US very good)
- Need more consistency in geometrical formats (grid/projection/datum)
 - To be changed into a more precise recommendation
- Need support for implementation of the 'on line validation tool' in the CAL/VAL portal
 - ESA will support this activity

New recommendations

 Encourage agencies to develop easy to use, open source, software tools for (re)projecting any product in (at least) the main projection systems used.