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Preliminary validation of Albedo, FAPAR and LAI Essential Climate Variables products derived from PROBA-V observations in the Copernicus Global Land Service

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INTRODUCTION

The Copernicus European Earth monitoring program (formerly known as GMES) has entered in an initial operational phase.

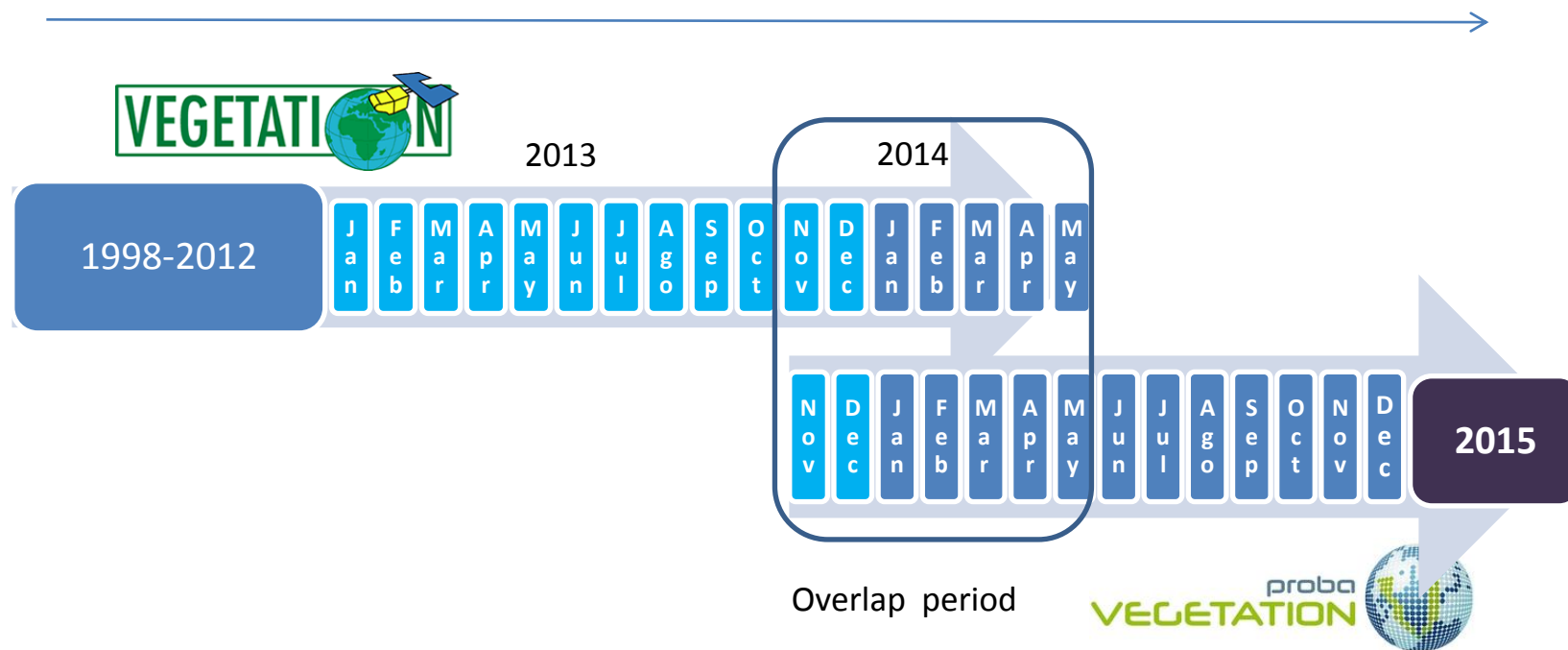
The **Global Land Service** is a component of the Copernicus Land service that provides a series of bio-geophysical products (**Albedo, LAI, FAPAR, LST, Burnt Areas, SWI...**) on the status and evolution of land surface at global scale at mid and low spatial resolution.

Production and delivery of the parameters take place in a timely manner and are complemented by the constitution of past time series.

Albedo, LAI and FAPAR variables were produced using SPOT/VGT data till the end of the mission (May 2014). Currently, the processing lines have been adapted to PROBA-V input data for the continuation of the service.

INTRODUCTION

Global Land Service



Preliminary Validation activities aims at demonstrate the consistency between SPOT/VGT and PROBA-V derived product during the overlap period

QUALITY ASSESSMENT PROCEDURE

Product Intercomparison

Quality Criteria	Product evaluated	Reference Product	Coverage
Completeness	PROBA-V V1	SPOT/VGT V1	Global 445 BELMANIP2.1
	Gap size distribution (average maps, temporal variations per biome/continent). Length of gaps.		
Spatial Consistency	PROBA-V V1	SPOT/VGT V1 MODIS C5	Global 445 BELMANIP2.1
	Visual inspection global maps Difference maps and histograms of residuals (global maps) PDFs of retrievals & histograms of residuals per biome and region (BELMANIP 2.1) Rcv variation over selected (50 km x50 km) areas		
Temporal Consistency	PROBA-V V1	SPOT/VGT V1 MODIS C5	445 BELMANIP2.1 DIRECT sites Calibration sites (Albedo)
	Qualitative inspection of temporal variations Histograms of the cross-correlation per biomes		
Intra-annual Precision (smoothness)	PROBA-V V1	SPOT/VGT V1 MODIS C5	445 BELMANIP2.1
	Histograms of the smoothness		
Statistical Analysis (Discrepancies)	PROBA-V V1	SPOT/VGT V1 MODIS C5	Global 445 BELMANIP2.1
	Scatter-plots (R^2 , RMSE, Bias, Scattering) per biomes & regions (BELMANIP2.1) Box-plots of uncertainty metrics (Bias and RMSE) per bin (BELMANIP2.1) Box-plots of uncertainty metrics per biomes & regions (Global) Regional analysis over the Africa continental region (R^2 , RMSE, Bias)		

Accuracy Assessment - Albedo

Pshenic



maps are
eS web



QUALITY ASSESSMENT PROCEDURE

Accuracy Assessment - Albedo

Site	Country	Network	Land Cover	Lat (deg)	Lon (deg)	Diffuse Method
Bondville	USA	SURFRAD	Grassland	40.05	-88.37	Direct
Table Mountain Boulder	USA	SURFRAD	Grassland	40.13	-105.24	Direct
Desert Rock	USA	SURFRAD	Desert	36.626	-116.018	Direct
Fort Peck	USA	SURFRAD	Grassland	48.316	-105.1	Direct
Sioux Falls	USA	SURFRAD	Grassland	43.73	-96.62	Direct
Bily Kriz 1	Czech Rep.	EFDC	NLF	49.50472	18.54111	Direct
Oberbärenburg	Germany	EFDC	NLF	50.78362	13.71963	Indirect
Cortes de Pallas	Spain	EFDC	Shrublands	39.22417	-0.90305	Direct
Majadas del Tietar	Spain	EFDC	Savanna	39.9415	-5.77336	Direct
El Saler-Sueca	Spain	EFDC	Crop	39.27	0.31	NaN
Puechabon	France	EFDC	EBF	43.74139	3.595833	Direct
Guyaflux	French Guiana	EFDC	EBF	5.278889	-52.9247	Direct
Castel d'Asso2	Italy	EFDC	Grassland	42.37722	12.02604	Indirect
Collelongo	Italy	EFDC	BDF	41.84936	13.58814	Direct
Brody	Poland	EFDC	Crop	52.43418	16.29952	Direct
Fyodorovskoye	Russia	EFDC	NLF	56.46153	32.92208	Indirect

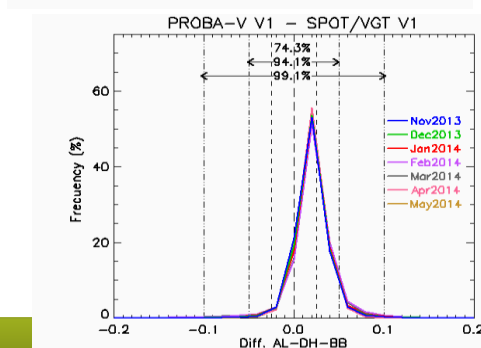
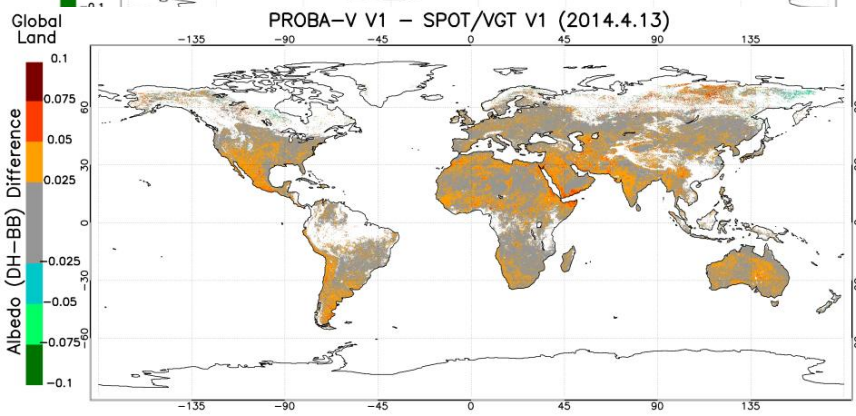
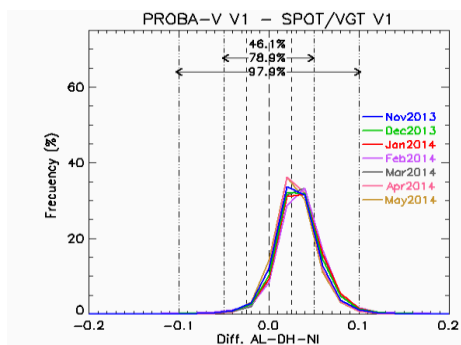
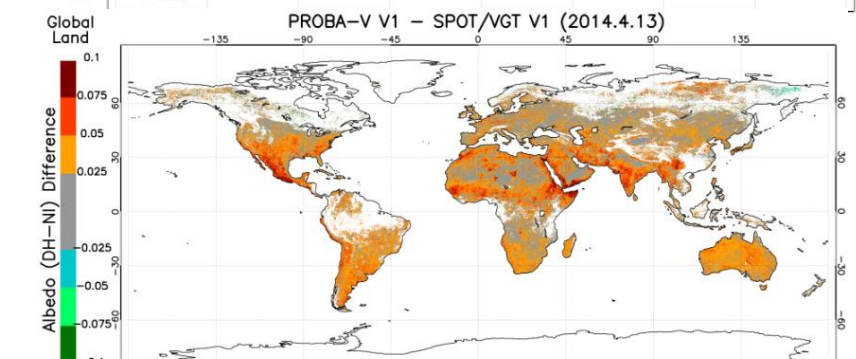
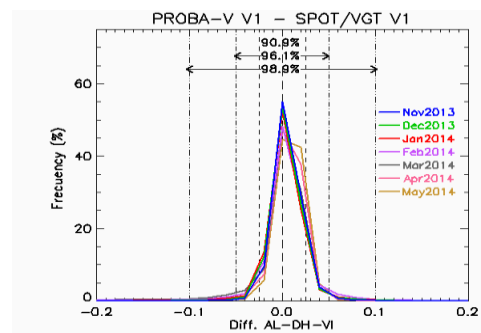
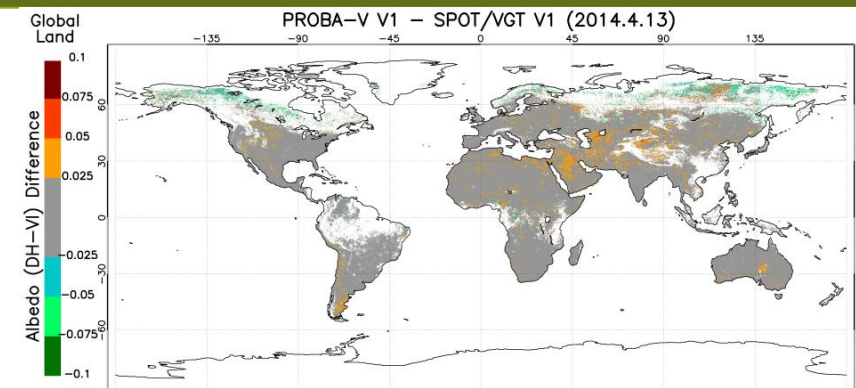
Ground Albedo values coming from SURFRAD (USA) and EFDC (Europe) networks.

Diffuse fraction was provided in most of the sites, in others was estimated using MODTRAN

Homogeneous sites at 1 km² where identified using Google Earth images. Ground data was requested to each EFDC site. This activity was supported by 

ALBEDO RESULTS

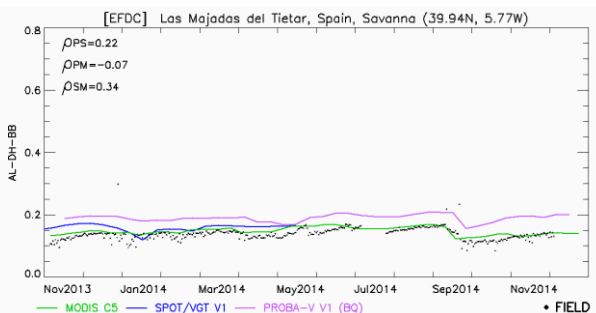
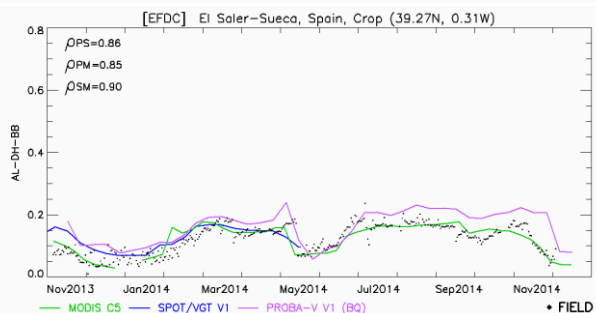
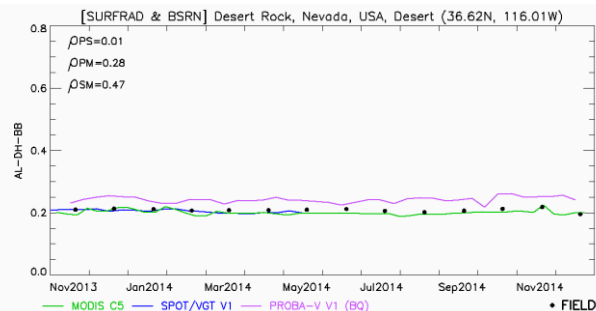
Spatial Consistency



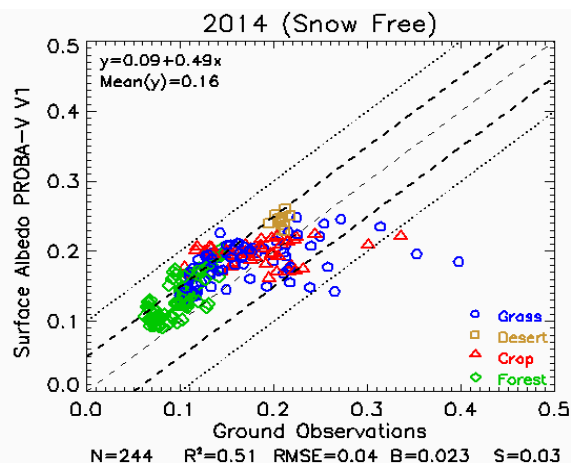
ly. Vienna - Austria, 12-17 April 2015

ALBEDO RESULTS

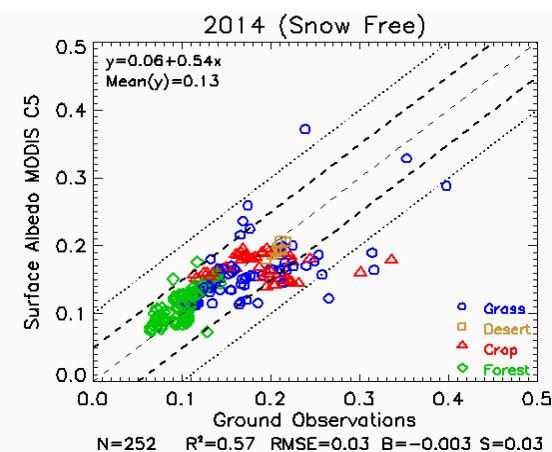
Temporal Consistency and Accuracy results



PROBA-V



MODIS C5

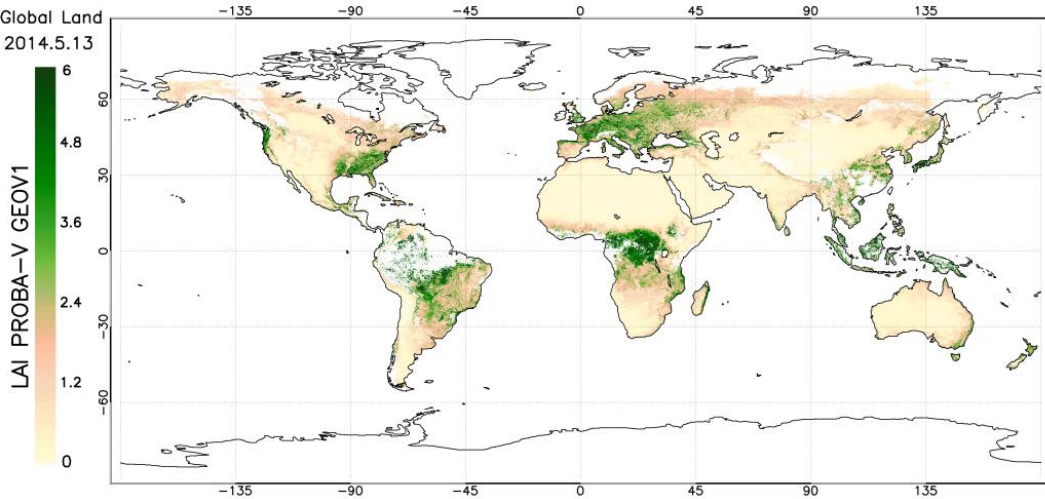


Due to the bias observed affecting mainly to NIR and BB albedos, the PROBA-V Albedo products are not being distributed.

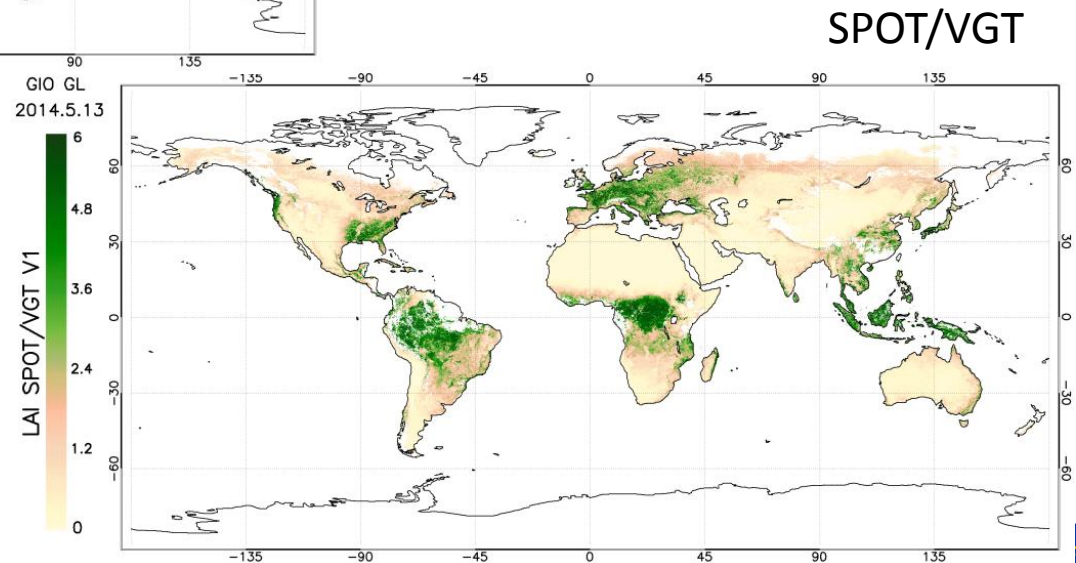
The problem which affect mostly to the SWIR TOC-Reflectance is currently under analysis

LAI & FAPAR RESULTS

Global maps

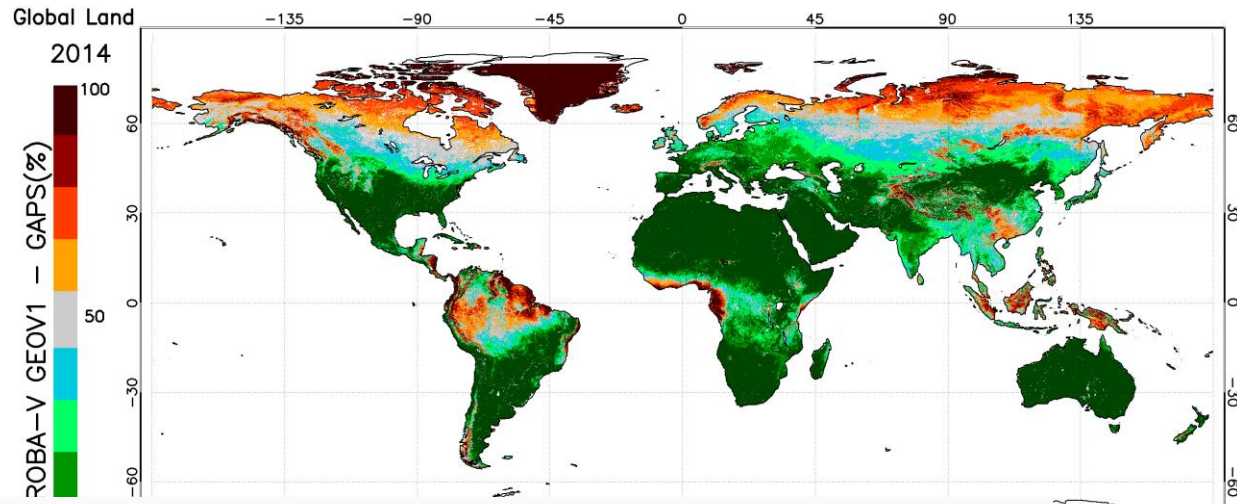


PROBA-V

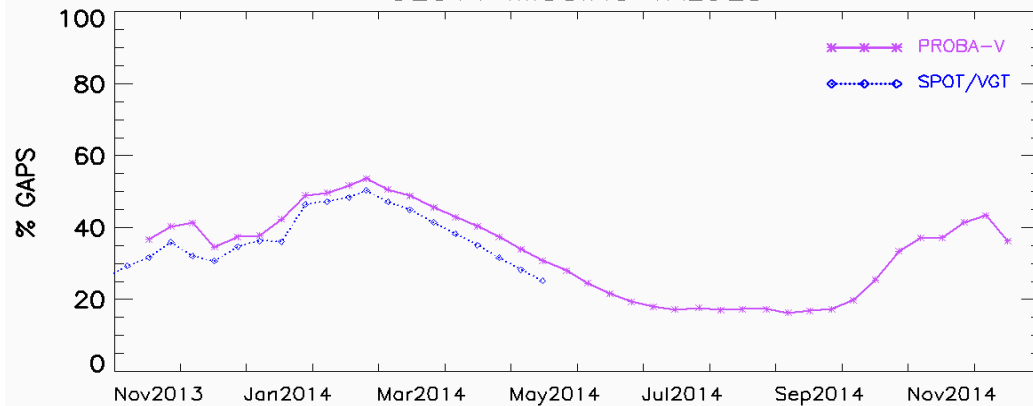


LAI & FAPAR RESULTS

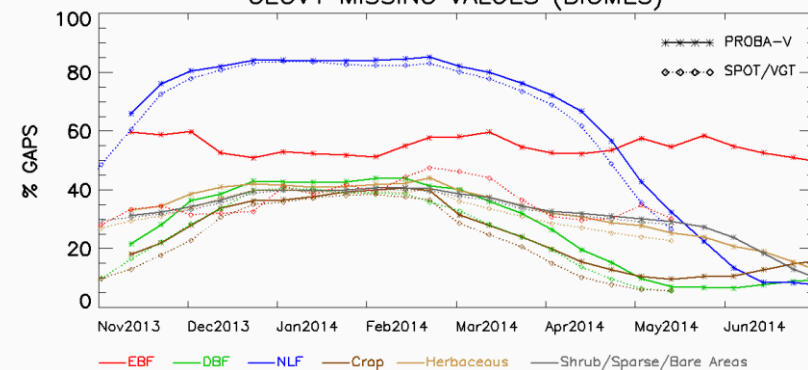
Product Completeness



GEOV1 MISSING VALUES

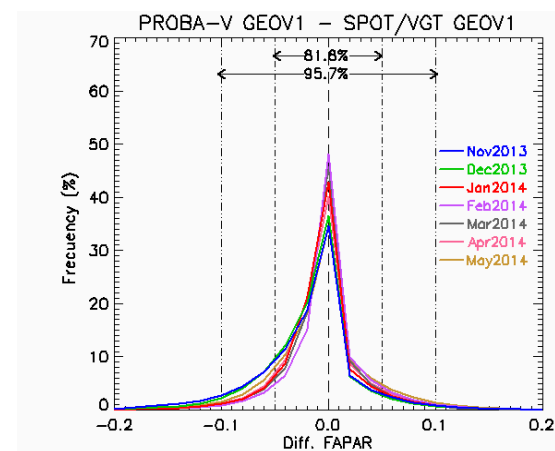
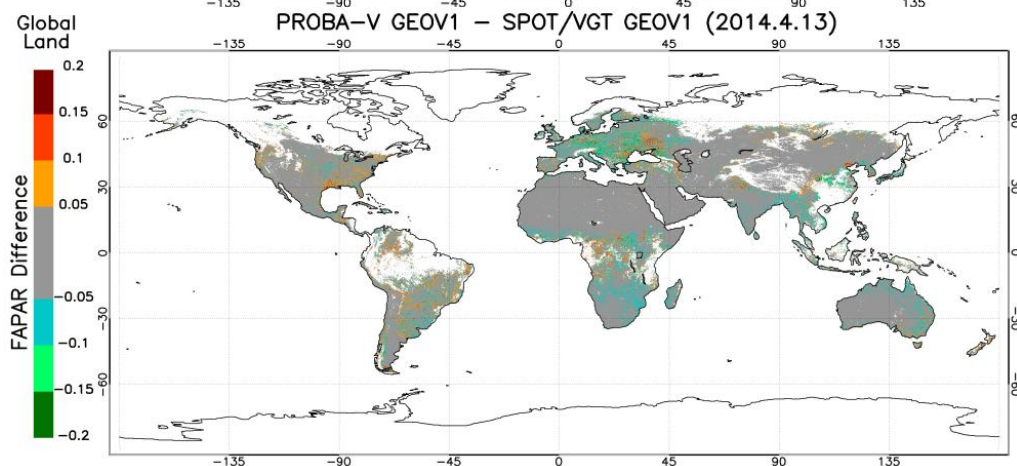
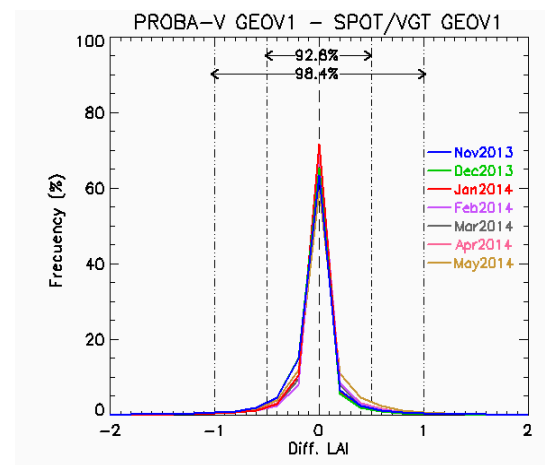
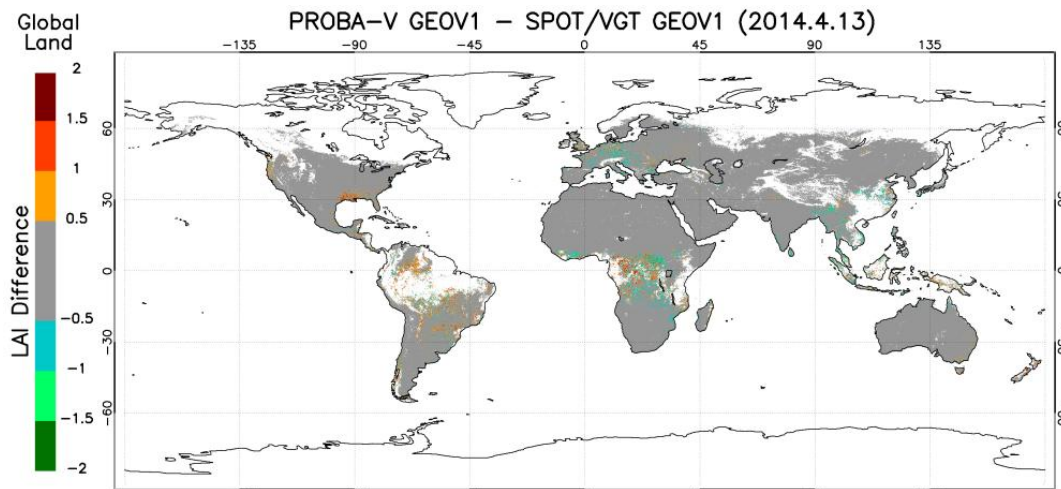


GEOV1 MISSING VALUES (BIOMES)



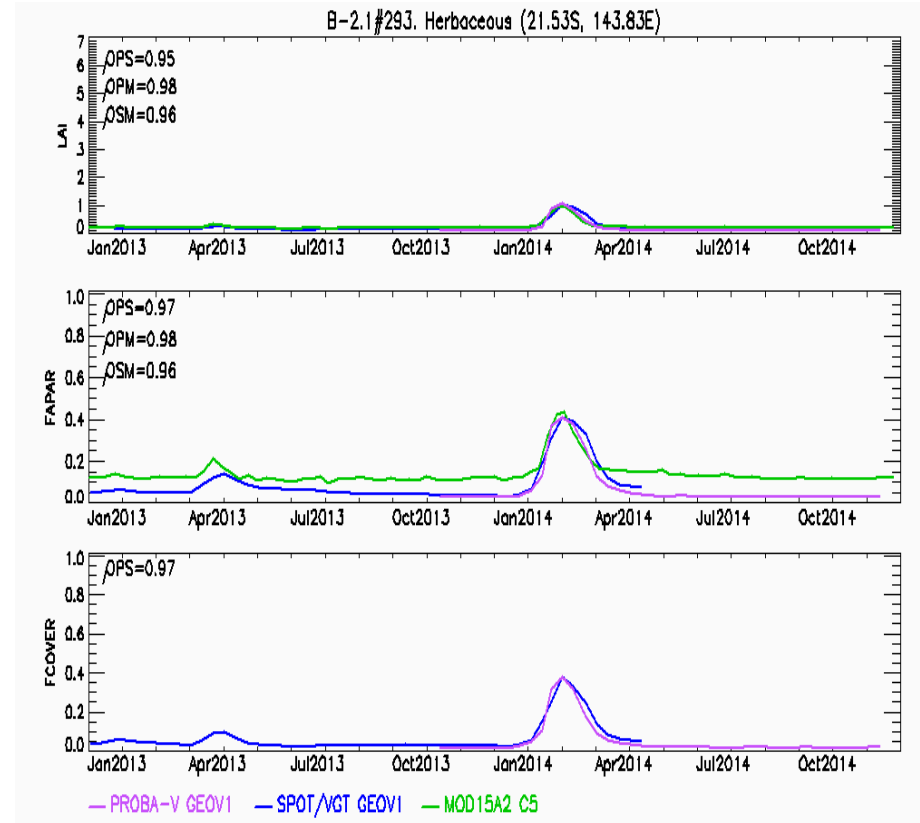
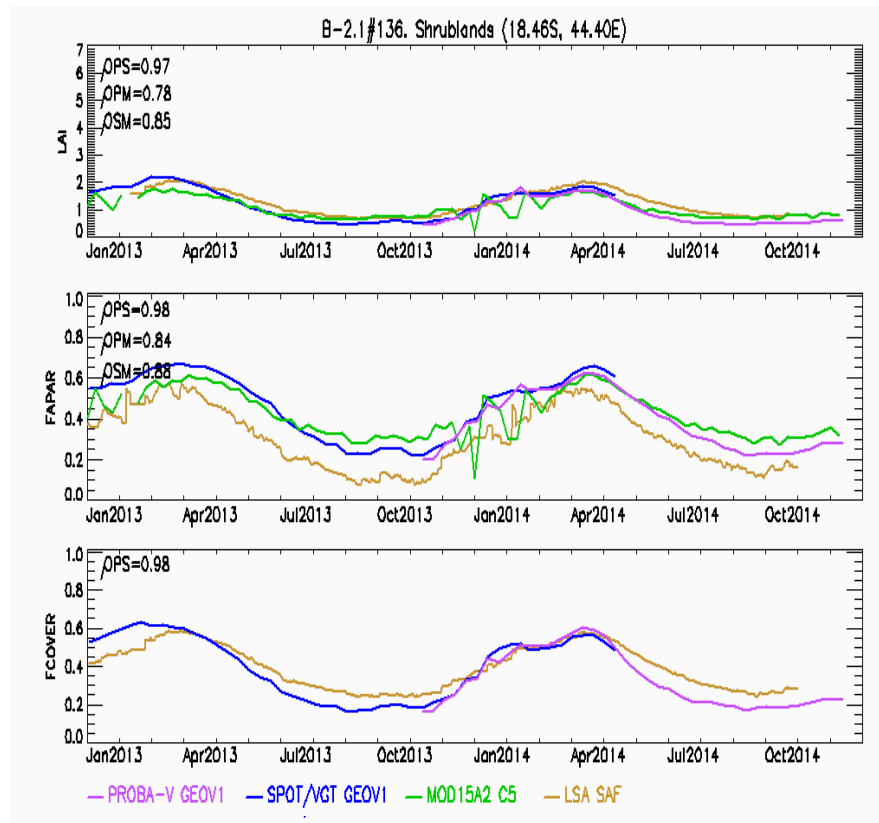
LAI & FAPAR RESULTS

Spatial Consistency



LAI & FAPAR RESULTS

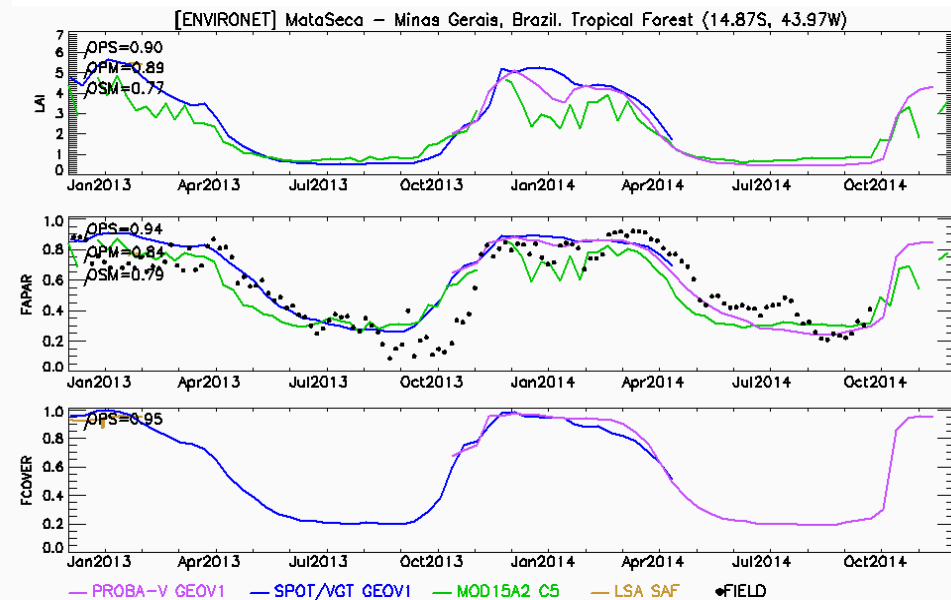
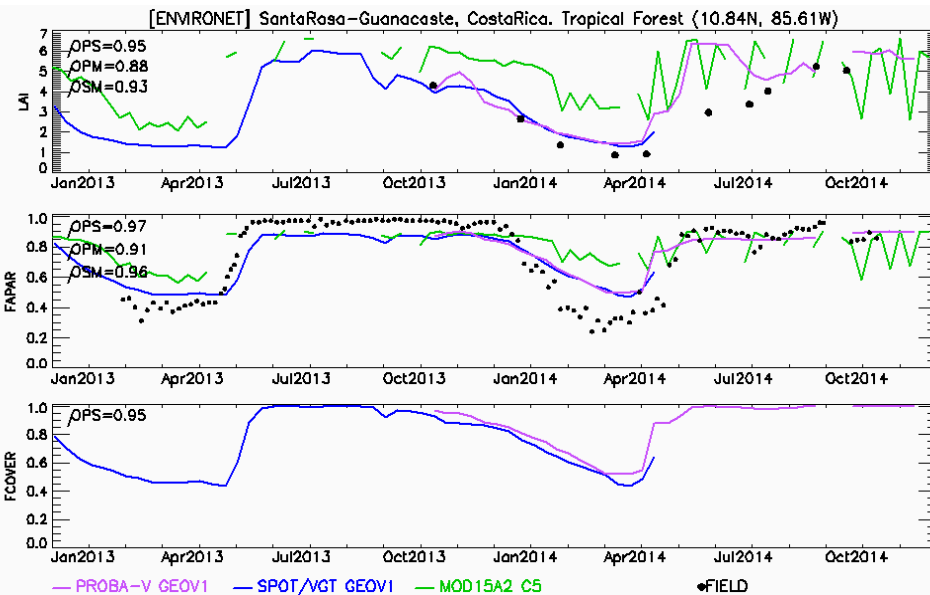
Temporal Consistency Analysis



LAI & FAPAR RESULTS

Temporal realism

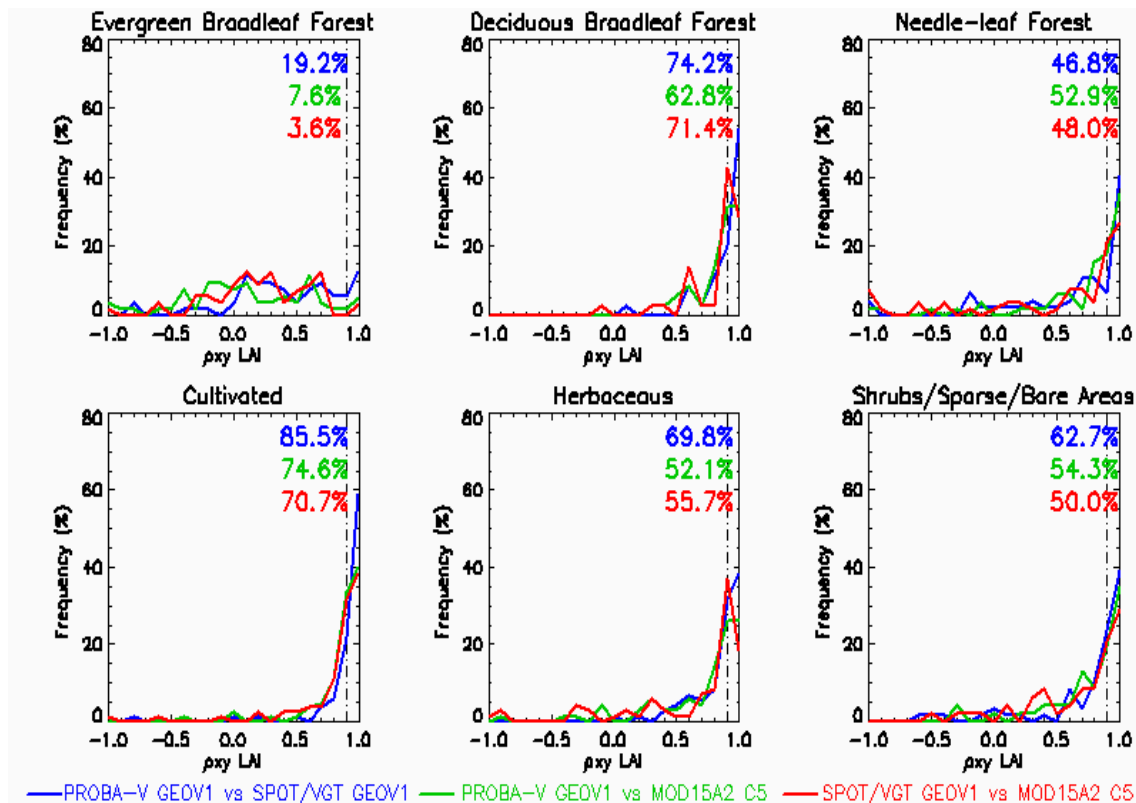
Enviro-Net sites



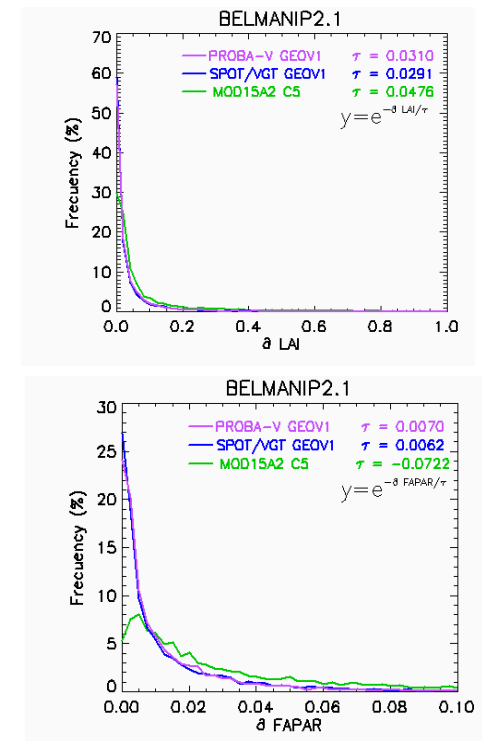
LAI & FAPAR RESULTS

Temporal Consistency and Precision

Cross-Correlation distributions



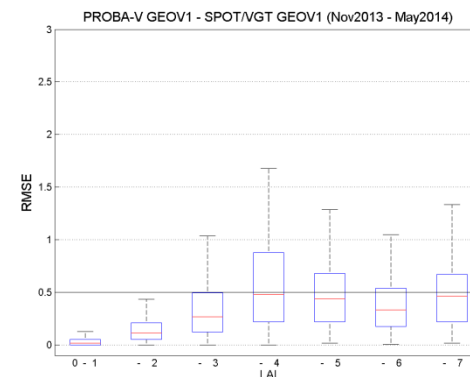
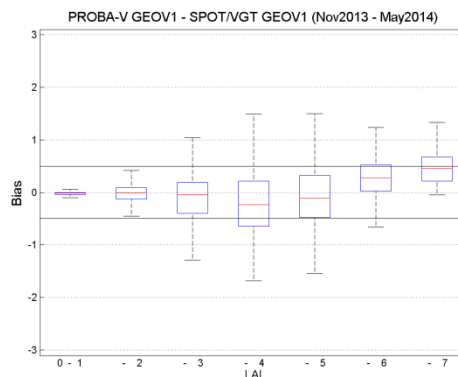
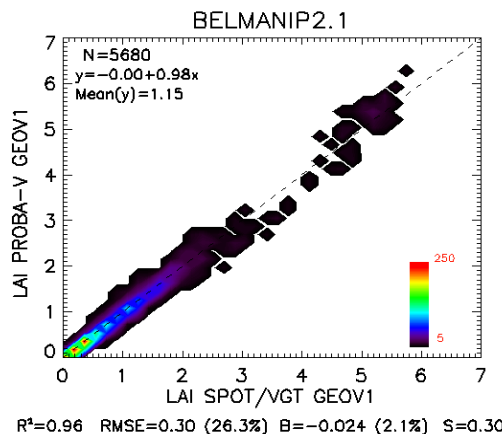
Intra-Annual Precision



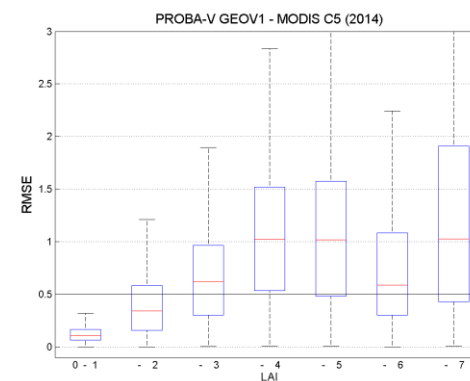
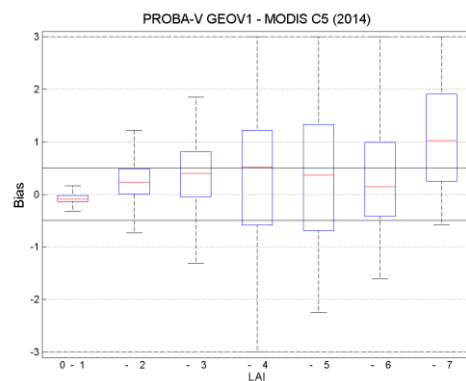
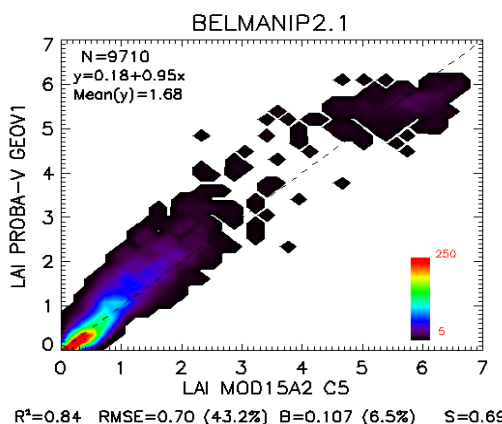
LAI & FAPAR RESULTS

Statistical Assessment

PROBA-V GEOV1 vs SPOT/VGT GEOV1 (Overlap period)



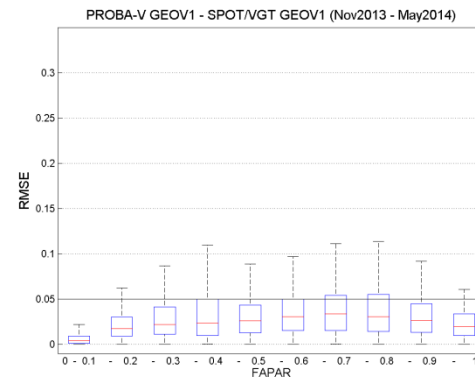
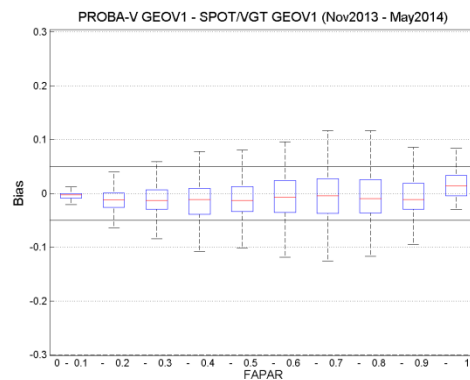
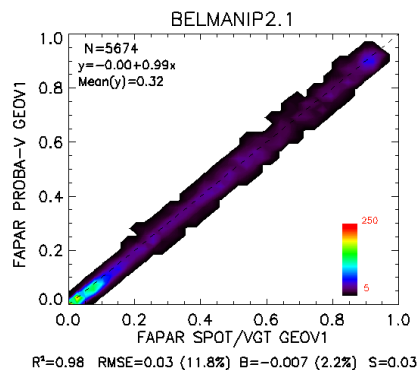
PROBA-V GEOV1 vs MODIS C5 (2014)



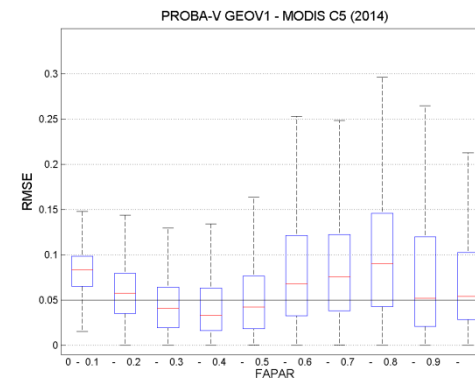
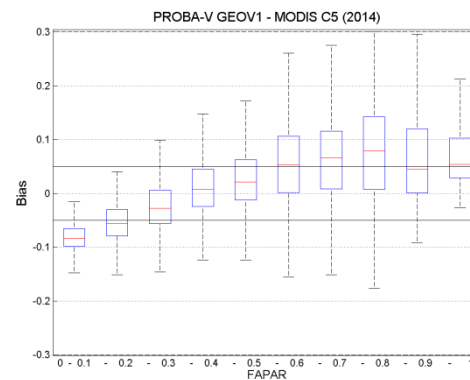
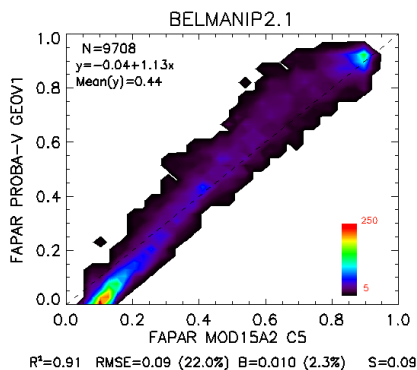
LAI & FAPAR RESULTS

Statistical Assessment

PROBA-V GEOV1 vs SPOT/VGT GEOV1 (Overlap period)

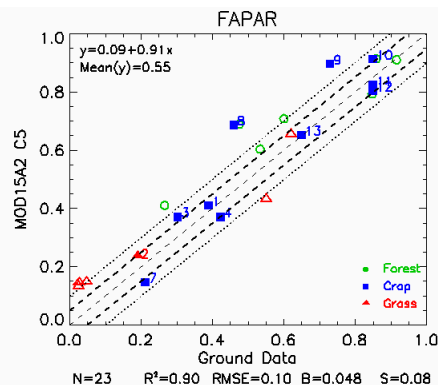
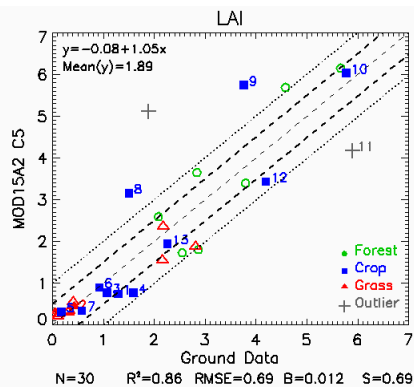
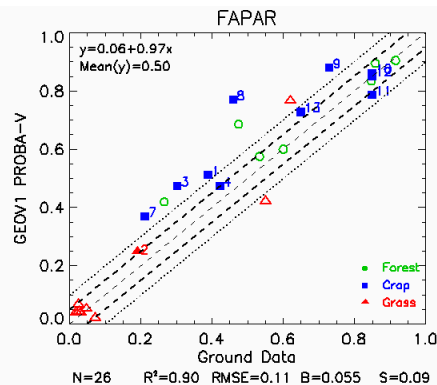
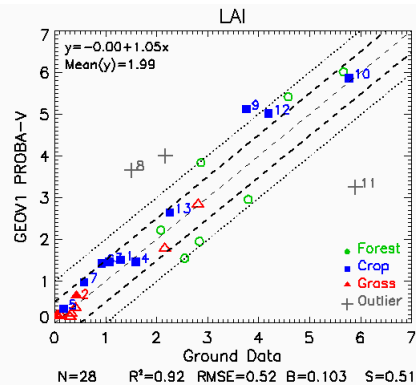


PROBA-V GEOV1 vs MODIS C5 (2014)



LAI & FAPAR RESULTS

Accuracy Assessment



PROBA-V
GEOF1
vs
Ground Data

MOD15A2 C5
vs
Ground Data

	Concomitant data (2014)		All data (2000-2014)	
	LAI	FAPAR	LAI	FAPAR
N	11	11	28	26
Correlation	0.96	0.84	0.92	0.9
Bias	0.38	0.09	0.10	0.06
RMSE	0.54	0.13	0.52	0.11
RMSE_W	N/A	N/A	0.51	0.10
Offset	0.22	0.2	0	0.06
Slope	1.07	0.79	1.05	0.97
N	12	11	30	23
Correlation	0.82	0.88	0.86	0.9
Bias	0.067	0.034	0.012	0.05
RMSE	0.84	0.09	0.69	0.1
RMSE_W	N/A	N/A	0.71	0.1
Offset	-0.12	0.02	-0.08	0.09
Slope	1.09	1	1.05	0.91

LAI & FAPAR CONCLUSIONS

QA Criteria	Performance	Comments
Product Completeness	-	Main limitations over Northern latitudes in wintertime and Equatorial areas.
Spatial Consistency	+	Optimal spatial consistency between PROBA-V and SPOT/VGT GEOV1 products. Most of the differences between both lies within 0.5 for LAI and 0.05 for FAPAR. Good repeatability over well known homogenous areas (Dense Forest and Shrublands). Good variability for known spatial gradients.
Temporal Consistency	+	Good consistency of PROBA-V GEOV1 temporal variations Cross-correlations between PROBA-V and SPOT/VGT GEOV1 (higher than 0.9 in more than 70% of the sites for most of biomes except in EBF). Quite good realism of temporal variations over two deciduous forest sites.
Intra-Annual Precision	+	Very smooth temporal profiles
Statistical Analysis of Discrepancies	+	Optimal consistency between PROBA-V and SPOT/VGT GEOV1 (RMSE=0.3, 0.03 for LAI and FAPAR over BELMANIP2.1 Larger discrepancies between both GEOV1 products and MODIS C5.
Accuracy	±	Good accuracy for LAI Slight positive bias for FAPAR But limited dataset!

Thank you for your attention!

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Quality Assessment of
Albedo, LAI, FAPAR products:
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