Continuous Quality Monitoring of Copernicus Global Land Albedo products based on SPOT/VGT observations

Jorge Sánchez (1)
Fernando Camacho (1)
Roselyne Lacaze (2)
Bruno Smets (3)

(1) EOLAB
(2) HYGEOS
(3) vito vision on technology

Introduction:
SURFACE ALBEDO SPOT/VGT

geoland2

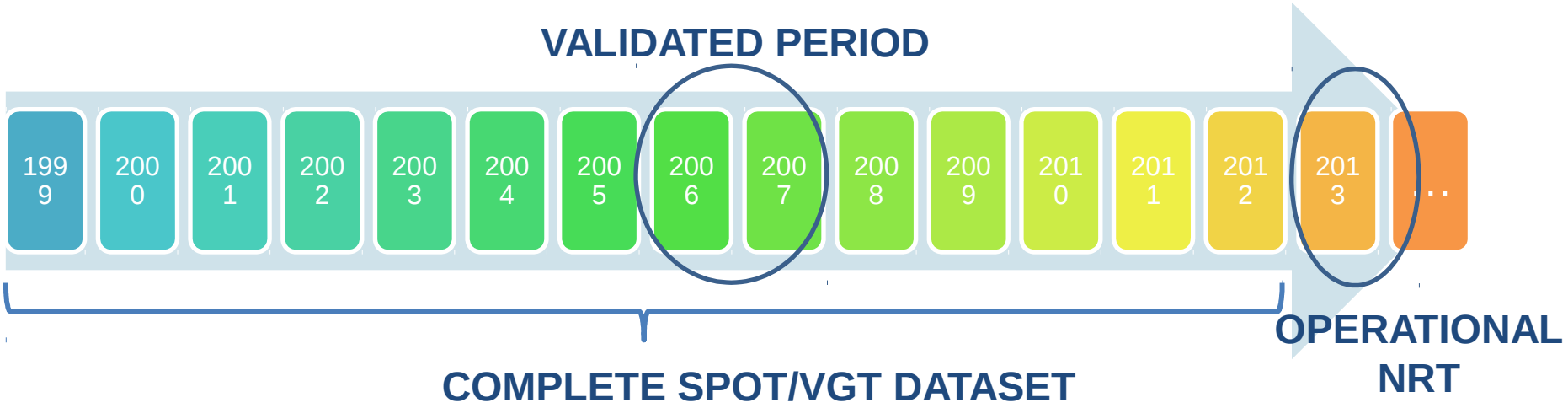
- Development of products & Scientific Validation performed for the two-year period (2006 and 2007).
- Albedo Target Accuracy:

Optimal: 5%; Target: 10% (AL>0.15) or 0.03 (AL<0.15); Threshold: 20%

Copernicus
The European Earth Observation Programme

- From 1st January 2013, the Copernicus Global Land Service is operational.
- Surface Albedo SPOT/VGT V0 & V1 is produced every 10 days at 1km resolution.

Introduction: Objective



Quality Monitoring aims to assess if the recent GIO-GL products keep the same level of quality than the fully validated products (i.e. if quality is preserved along time)

Introduction: ALBEDO datasets

- **COPERNICUS GIO-GL dataset (1-km)**
  - Surface Albedo SPOT/VGT V1 (black-sky, white-sky)
  - Surface Albedo SPOT/VGT V0 (black-sky)
- **Reference dataset**

EO-products

In-situ data

	Copernicus EU	NASA
Product	AL_VGT V1	MCD43A3 C5
Sensor/ Platform	VEGETATION/	MODIS/ TERRA+AQUA
Spaial Resolution	1 km	500 m
Frecuency	10-days	8-days
Composite Period	30-days (+12)	16-days (+16)
Coverage / projection	carrée	Glo al

NOAA

SURFRAD sites

QUALITY MONITORING PROCEDURE

Criteria	Product	Reference	Coverage
Spatial Consistency	SPOT/VGT V1 & V0	V1 validated period	Global
	Maps of the products and difference maps with reference products		
Product Continuity	SPOT/VGT V1	V1 validated period	Global
	Fraction of missing data (gaps) ; Quality Flags assessment		
Global Statistical Analysis	SPOT/VGT V1 & V0	V1 validated period	445 BELMANIP2 sites + 25 snow sites
	Histograms and Scatter-plots (R2, RMSE, Bias, Scattering) per biomes		
Temporal Consistency	SPOT/VGT V1 & V0	V1 validated period	445 BELMANIP2 sites + additional In-situ sites
	Temporal profiles over 686 sites		
Temporal Smoothness	SPOT/VGT V1	V1 validated period	445 BELMANIP2 sites
	Histograms of the short time stability		
Precision	SPOT/VGT V1	V1 validated period	20 Desert '*calibration*' sites
	Scatter-plots between two consecutive years		
Accuracy	SPOT/VGT V1	NASA MCD43A3 C5 SURFRAD Ground Data	7 test SURFRAD sites
	Scatter plots with ground truth. Accuracy compared to MODIS		
Regional Assessment	SPOT/VGT V1 & V0	NASA MCD43A3 C5	West-Europe 40ºx40º
	Difference maps, scatter-plots and performance metrics per main biome		

VALIDATION RESULTS

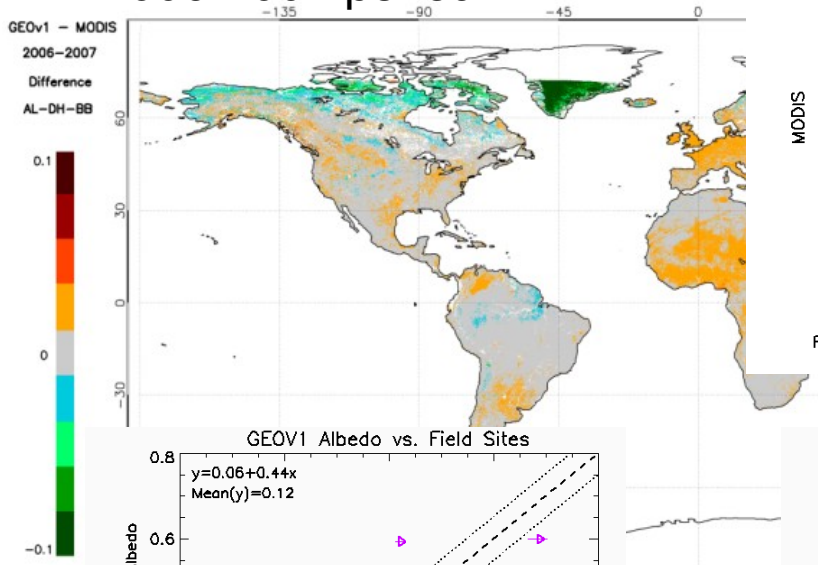
- **SPOT/VGT V1**

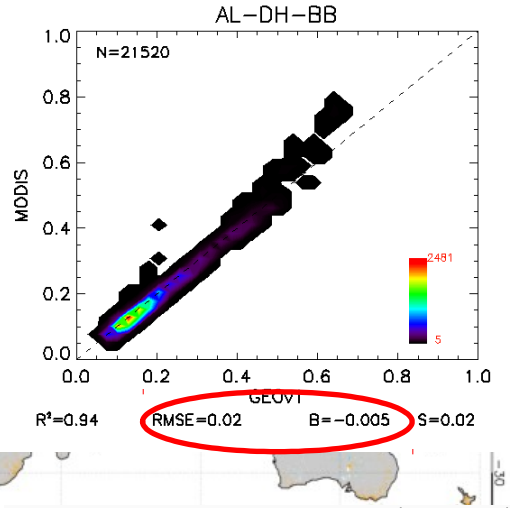
  Vs

  MODIS

  Intercomparison

Mean Difference SPOT/VGT V1-MODIS
2006-2007 period



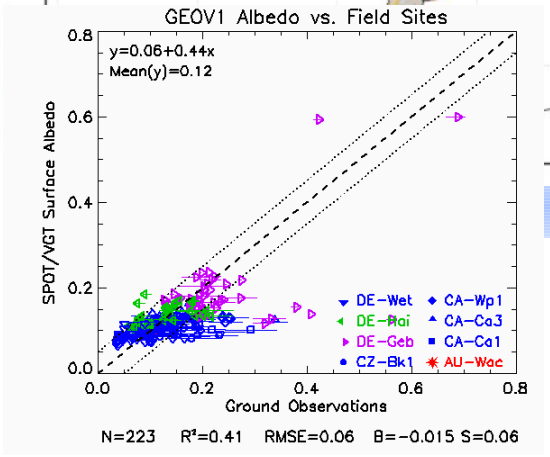


- **Direct Validation:**

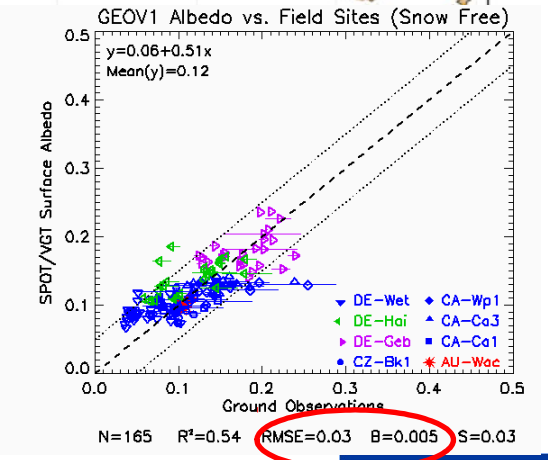
  SPOT/VGT V1

  vs

  FLUXNET Ground Data

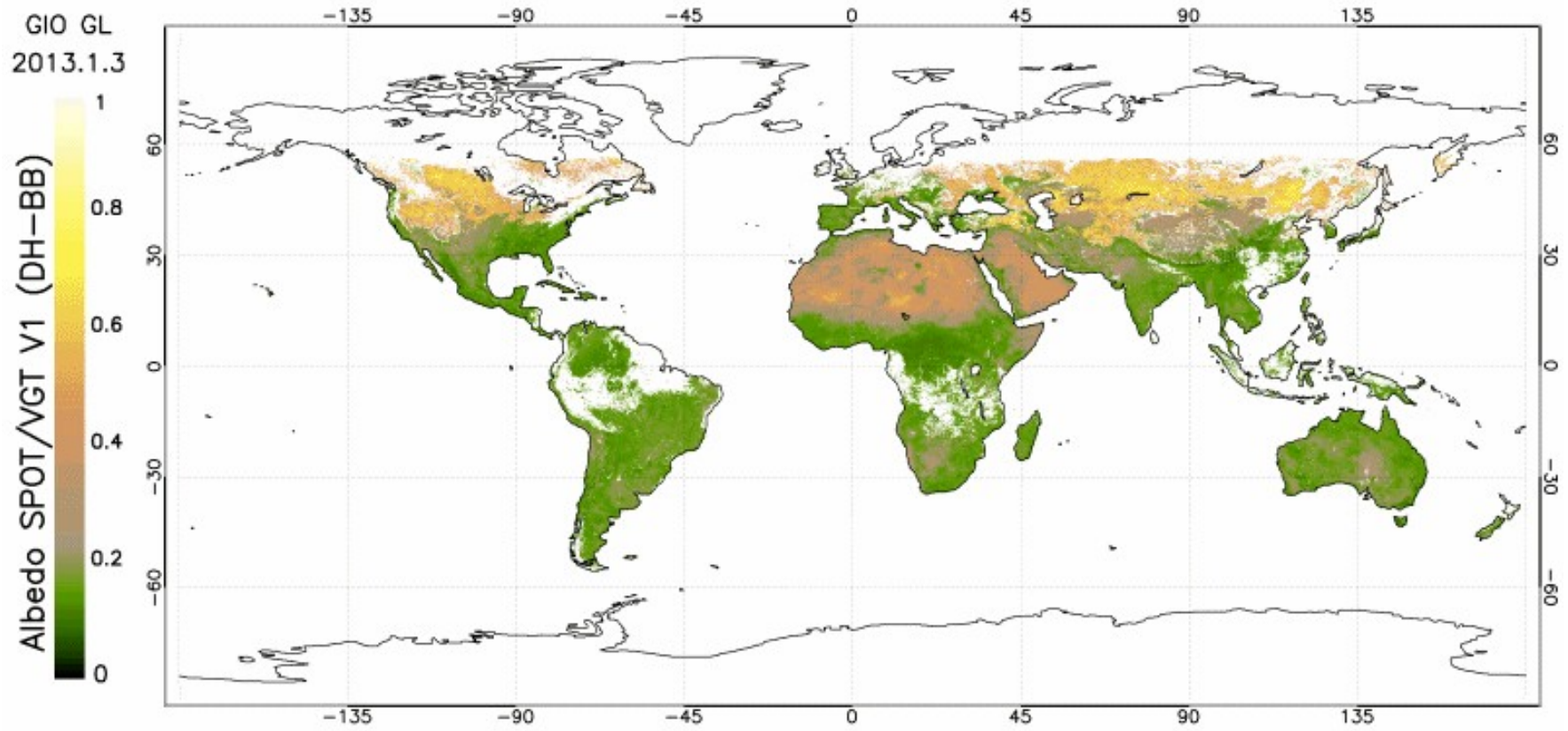


Snow FREE



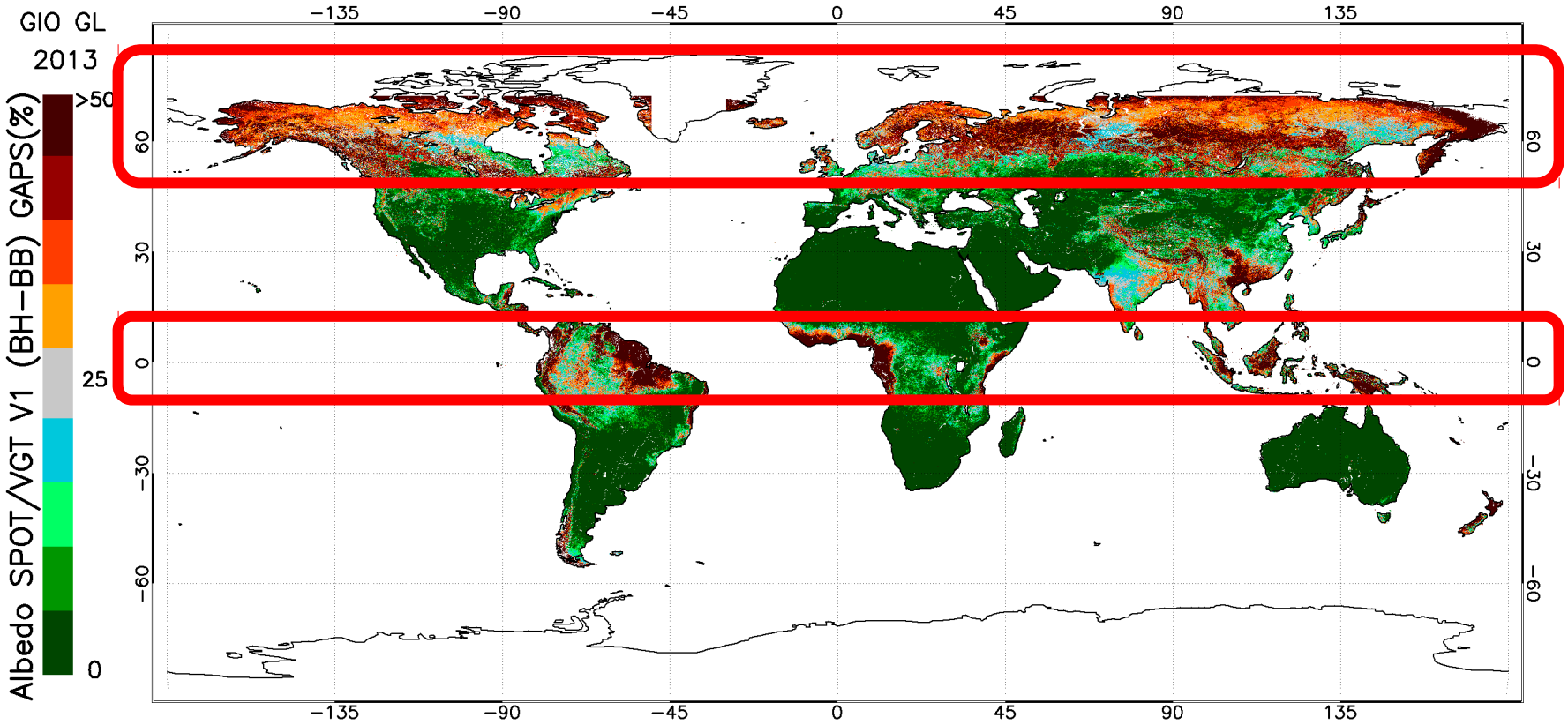
QUALITY MONITORING RESULTS

Spatial Consistency



QUALITY MONITORING RESULTS

Product Continuity



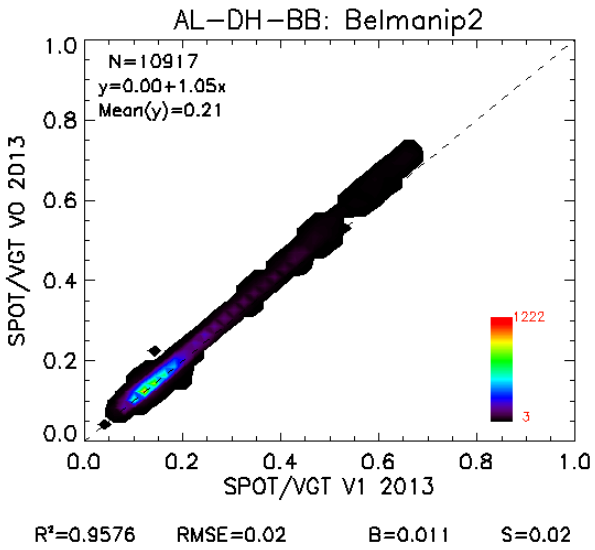
Percentage of missing values for albedo (DH-BB) V1 during the January-December 2013 period.

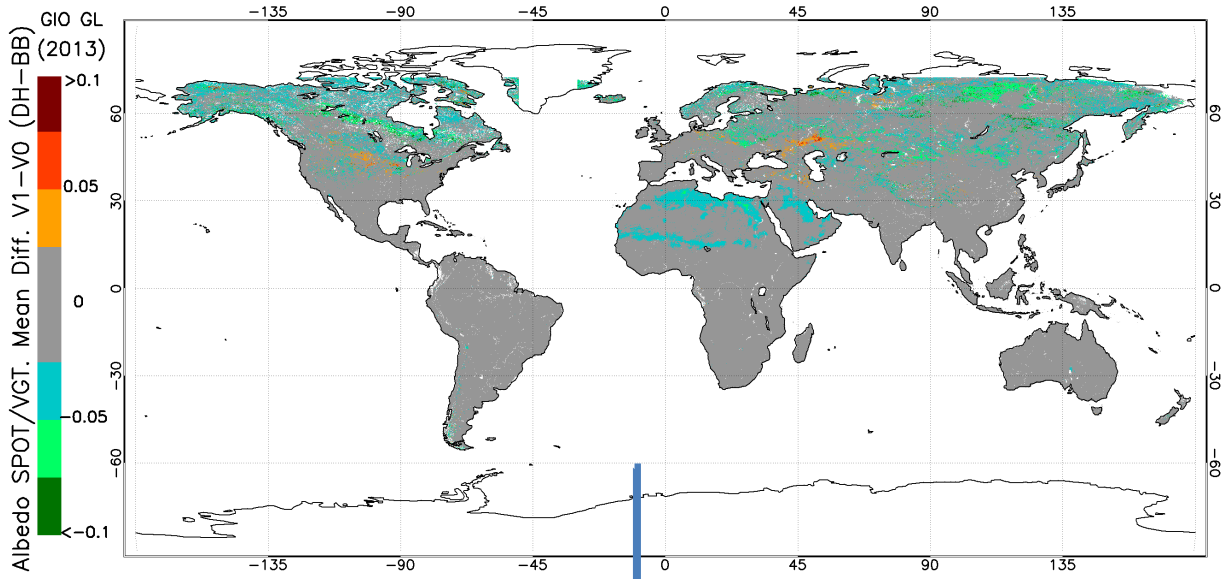
QUALITY MONITORING RESULTS

SPOT/VGT VERSION 1 vs VERSION 0

SPATIAL CONSISTENCY

2013
Mean differences
SPOT/VGT
V1 vs V0
AL-DH-BB

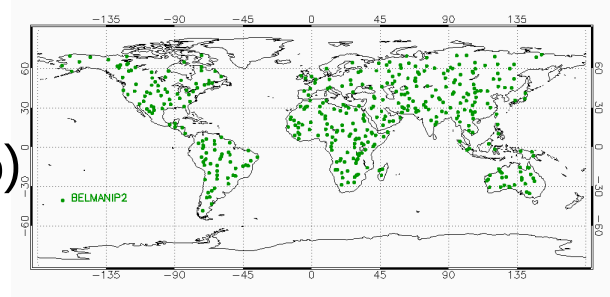




BELMANIP2

GLOBAL STATISTICAL ANALYSIS

NO BIAS!!
RMSE~ 0.02 (9%)



QUALITY MONITORING RESULTS

SPOT/VGT V1: OPERATIONAL 2013 vs VALIDATED 2007

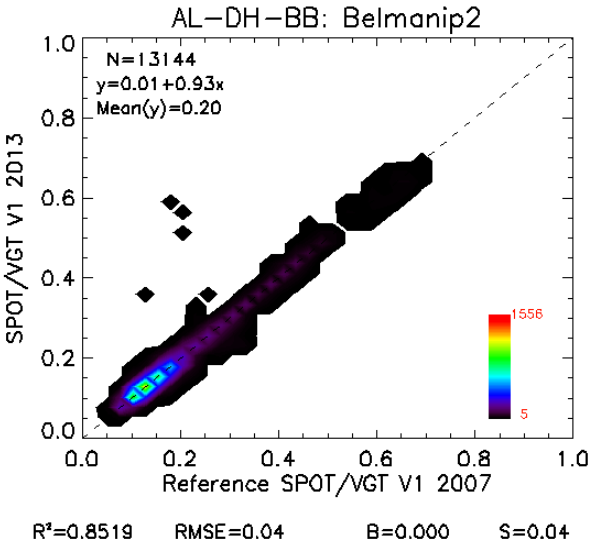
SPATIAL CONSISTENCY

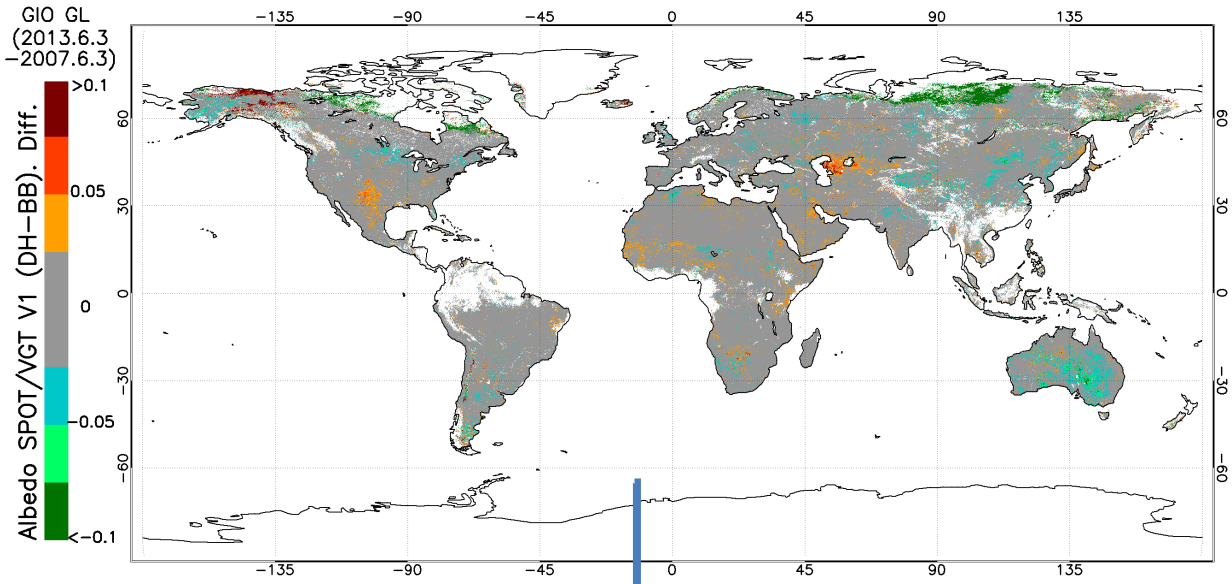
Difference maps every 10-days

RECENT 2013

vs

VALIDATED 2007

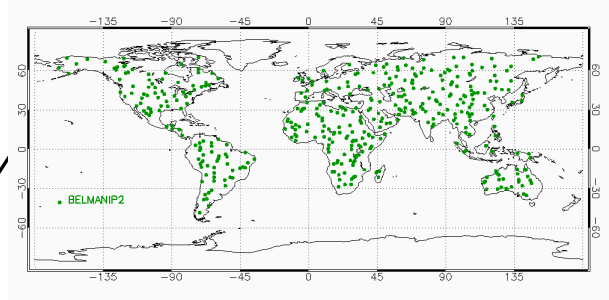




BELMANIP-2 GLOBAL STATISTICAL ANALYSIS

NO BIAS!!

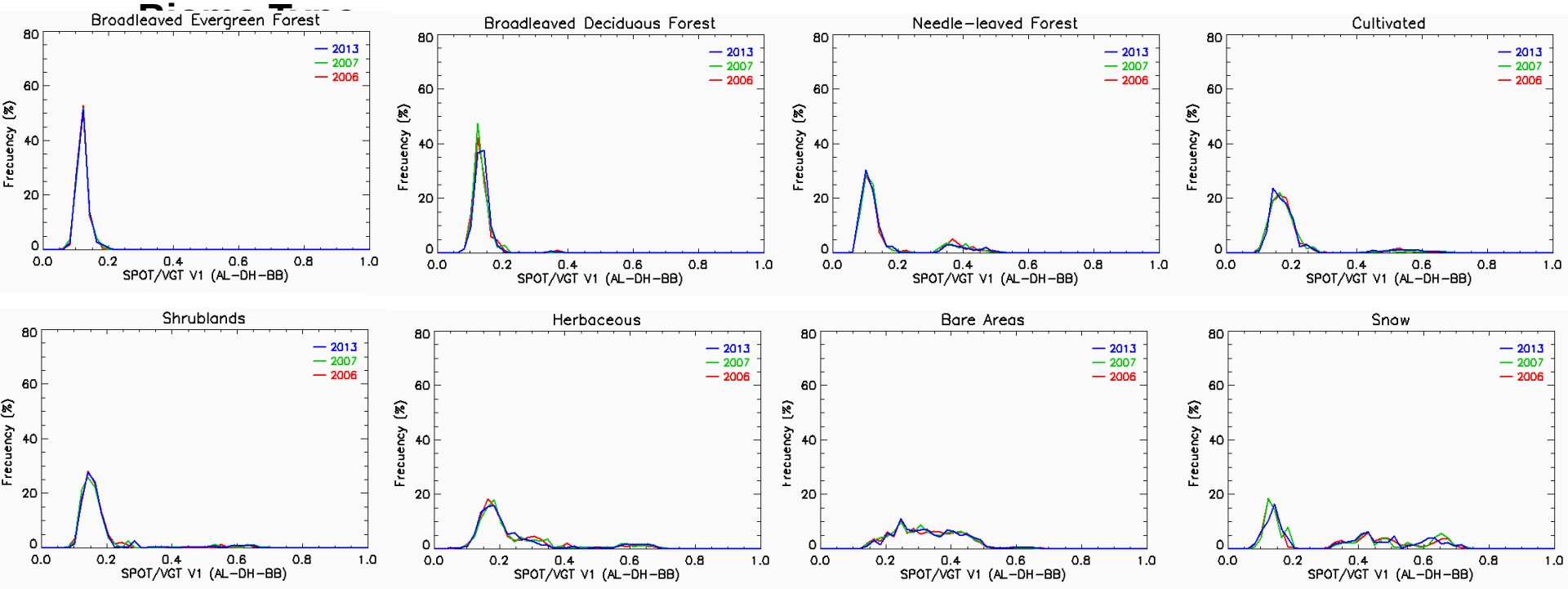
RMSE~ 0.04 (20%



QUALITY MONITORING RESULTS (cont)

Global Statistical Analysis

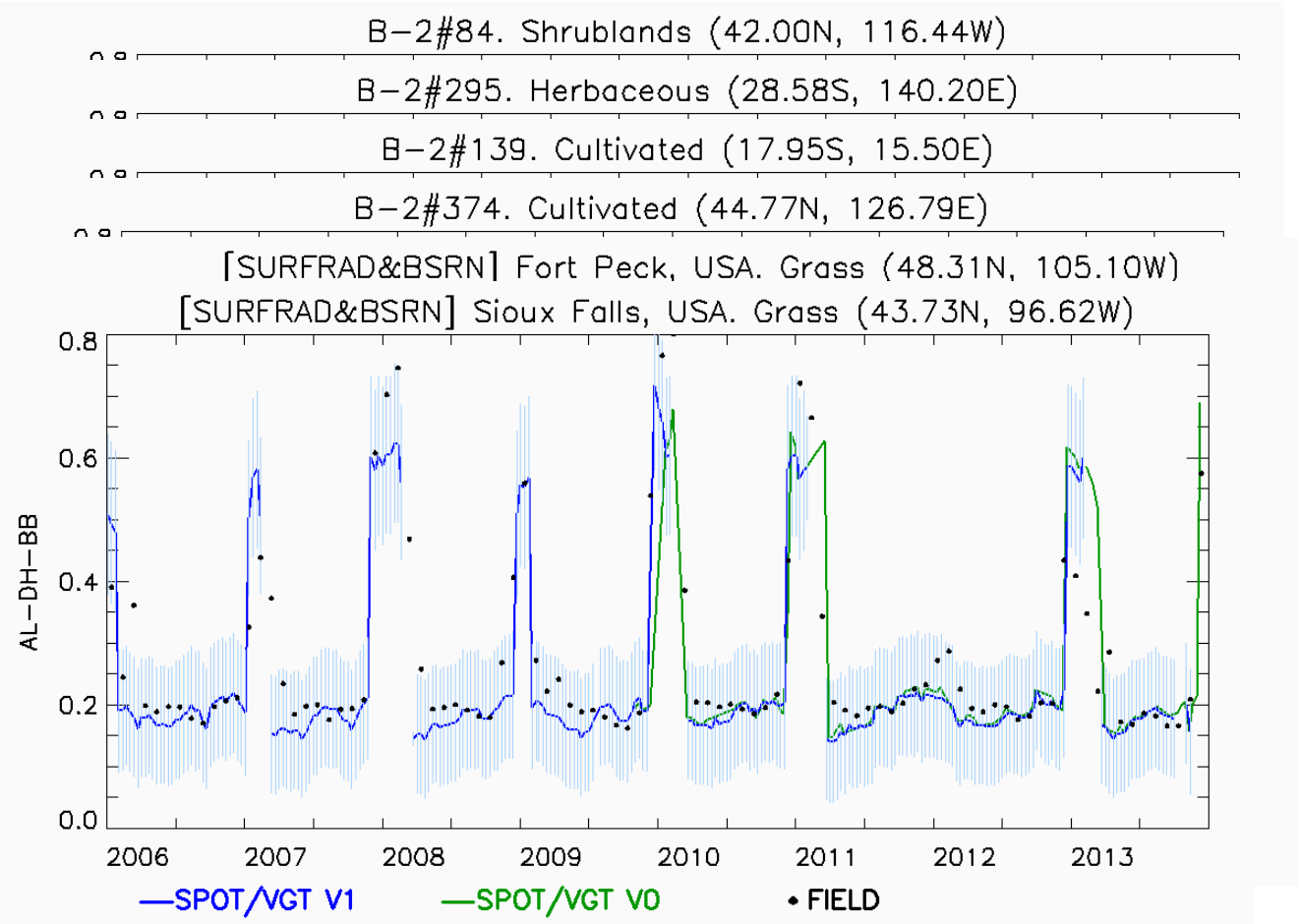
SPOT/VGT V1: Distribution of Products per Biome Type



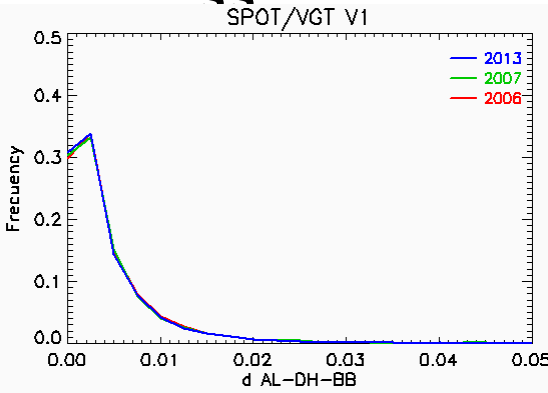
- Optimal Consistency between Recent and Validated products for all biome types

QUALITY MONITORING RESULTS (cont)

Temporal Consistency Analysis



Smoothne
ss

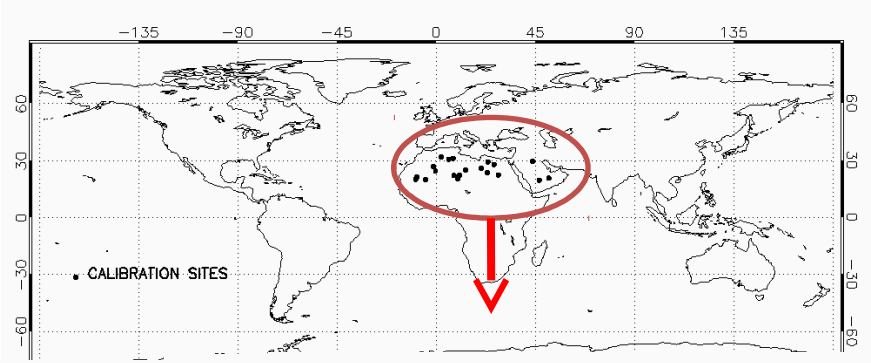


- Good temporal realism
- Similar smoothness with validated years

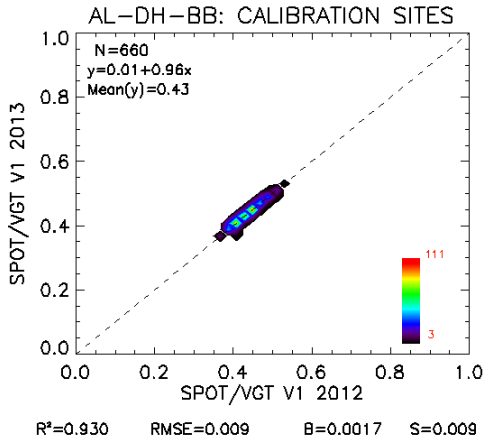
QUALITY MONITORING RESULTS (cont)

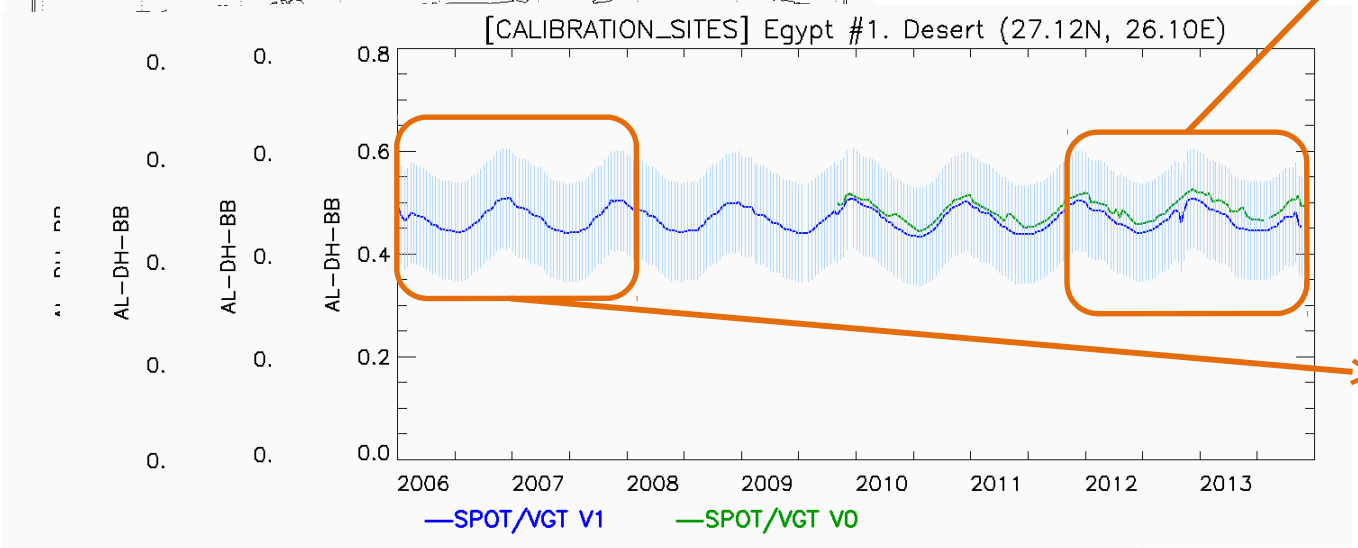
Temporal Consistency Analysis

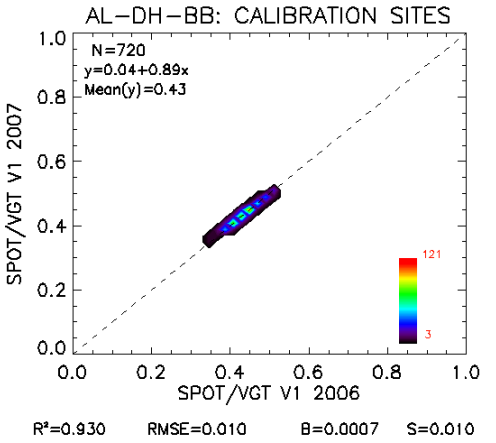
DESERTIC CALIBRATION SITES:



RMSE < 0.01 (2%)
BIAS < 0.002
(0,5%)



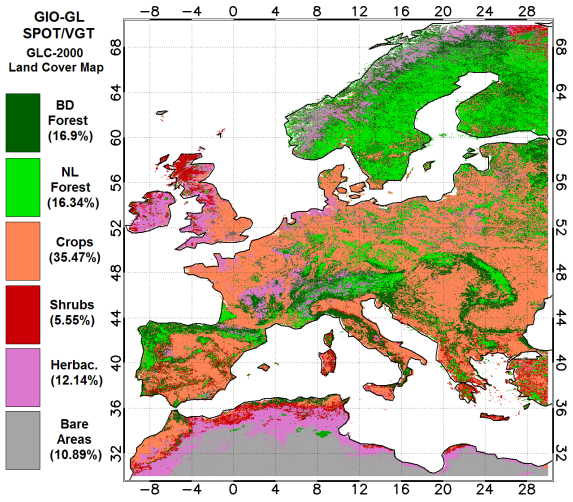


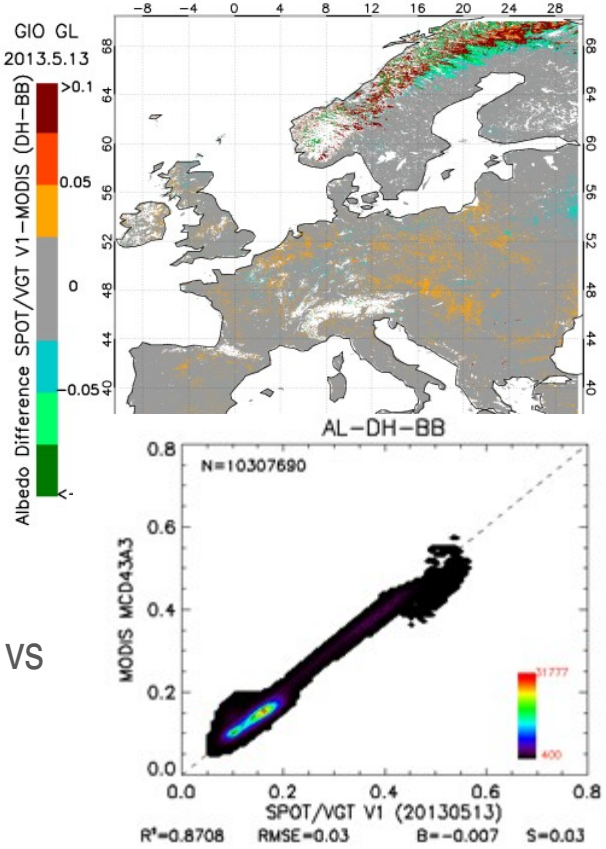


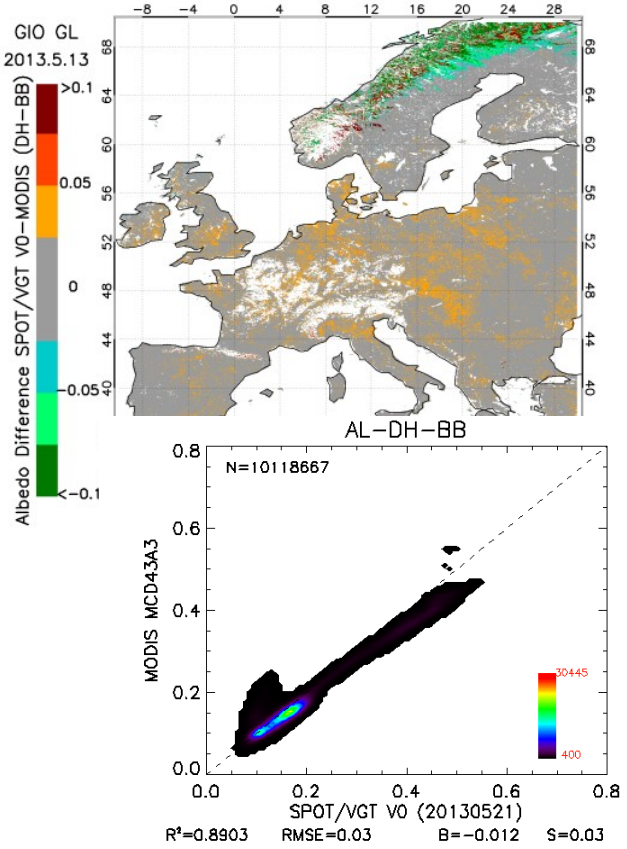
QUALITY MONITORING RESULTS (cont)

Regional Consistency: West-Europe

Inter-comparison with MODIS MCD43A3







- Good correspondance MODIS vs SPOT/VGT

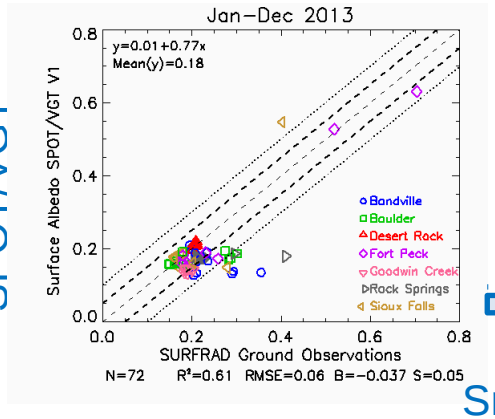
QUALITY MONITORING RESULTS (cont)

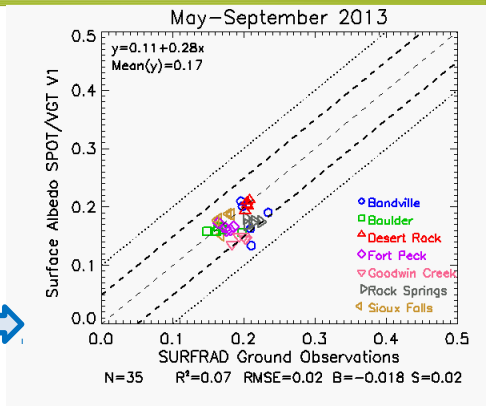
Accuracy Assessment: Direct Validation

Scatter plots versus field measurements for the January-June 2013 period over seven SURFRAD sites of different vegetation type

Site	Land Cover	Lat (deg)	Lon (deg)
Bondville	Grass	40.05	-88.37
Table Mountain Boulder	Grass	40.13	-105.24
Desert Rock	Desert	36.626	-116.018
Fort Peck	Grass	48.316	-105.1
Goodwin Creek	Grass	34.25	-89.87
Rock Springs	Crop	40.72	-77.9333
Sioux Falls	Grass	43.73	-96.62

SPOT/VGT



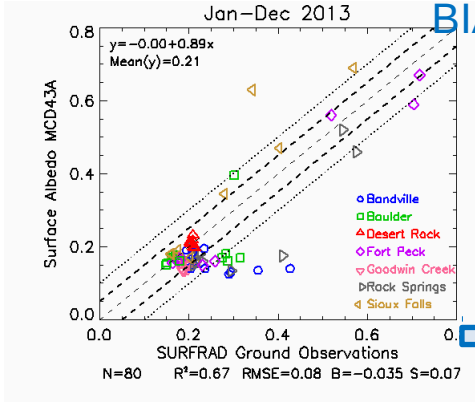


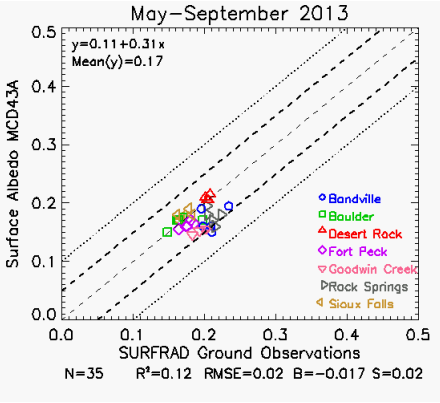
Snow Free observations

RMSE= 0.02 (~ 10%)

BIAS=-0,0

MODIS





Snow Free observations

RMSE=0.02 (~10%)

CONCLUSIONS

Quality Monitoring (Positive & Negative Performance)

Criteria	Performance	Comments
Spatial Consistency	+	Very good! No artifacts, consistent with the validated period over globe and between versions.
Product Continuity	-	Main limitations over Northern latitudes in wintertime and Equatorial areas.
Statistical Analysis	+	Distributions are very consistent (no bias) with reference validated products for all biome types. V0 and V1 very consistent (RMSE<0.02)
Temporal Consistency	±	Good consistency with ground data (temporal realism) and previous years. Some difficulties in the detection of spurious snow events.

ALBEDO SPOT/VGT V1 Operational 2013 Vs Validated 2007 over BELMANIP-2 + SNOW SITES

	AL-DH-BB
R	0,85
Bias	0,0005
RMSE	0,04

- No Bias
- RMSE between recent and validated is same as the uncertainty associated to validated products (0.05)
- **Quality of Albedo products is preserved !**

CONCLUSIONS
Quality Assessment

GCOS Requirements for surface albedo as Essential Climate Variables [GCOS-154, 2011].

Variable/ Parameter	Accuracy	Stability
Black-sky & White-sky albedos	Max(5%; 0.0025)	Max(1%)

GEOLAND-2
Albedo Target Accuracy:

- Optimal: 5%
- Target: 10% (AL>0.15) or 0.03 (AL<0.15)
- Threshold: 20%

Criteria	Performance /Comments
Precision (Stability)	+ RMSE (2%) over desert 'calibration' sites BIAS (0,5%)
Accuracy	± RMSE = 0.02 (10%) for snow-free data over seven SURFRAD stations.

→ GCOS target stability in terms of MEAN BIAS!! 0,5% < 1%

→
- Geoland-2 Target Accuracy
- No GCOS Target Accuracy!!!
- Same accuracy metrics obtained for MODIS products.
- Similar over validated period.

Evolution

http://fp7-imagines.eu/

May 2014
OBJECTIVE:
demonstration
PROBA-V 300 m
NRT production
over Europe

Thanks

http://land.copernicus.eu/global/

jorge.sanchez@eolab.es

GMES Initial Operations - Global Land (GIO-GL)