Surface reflectance, MOD09

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Surface reflectance (MOD09)

The **surface reflectance** product is an estimate of the surface spectral reflectance for each band as it would have been measured at ground level if there were no atmospheric scattering and absorption.

Bands (in nm)**:**
1   620-670
2   841-876
3   459-479
4   545-565
5   1230-1250
6   1628-1652
7   2105-2155

Home page: http://modis-sr.ltdri.org/html/surfref.htm

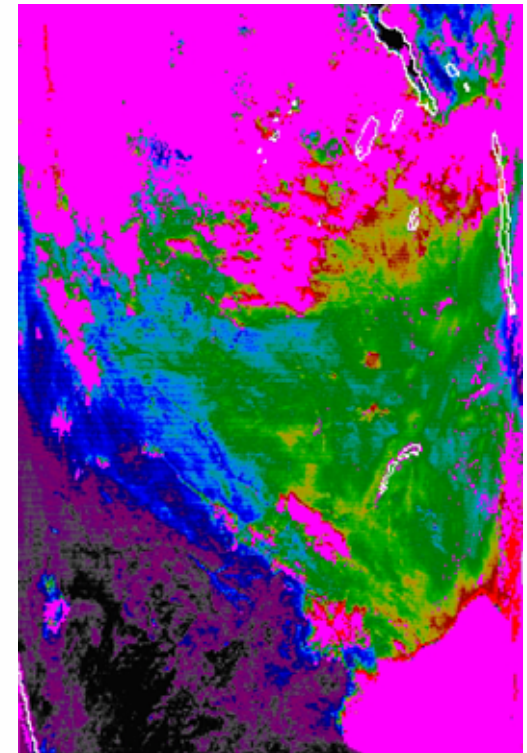# Atmospheric effect has a strong impact on remotely sensed data

MODIS Granule over South Africa (Sept,13,2001, 8:45 to 8:50 GMT)

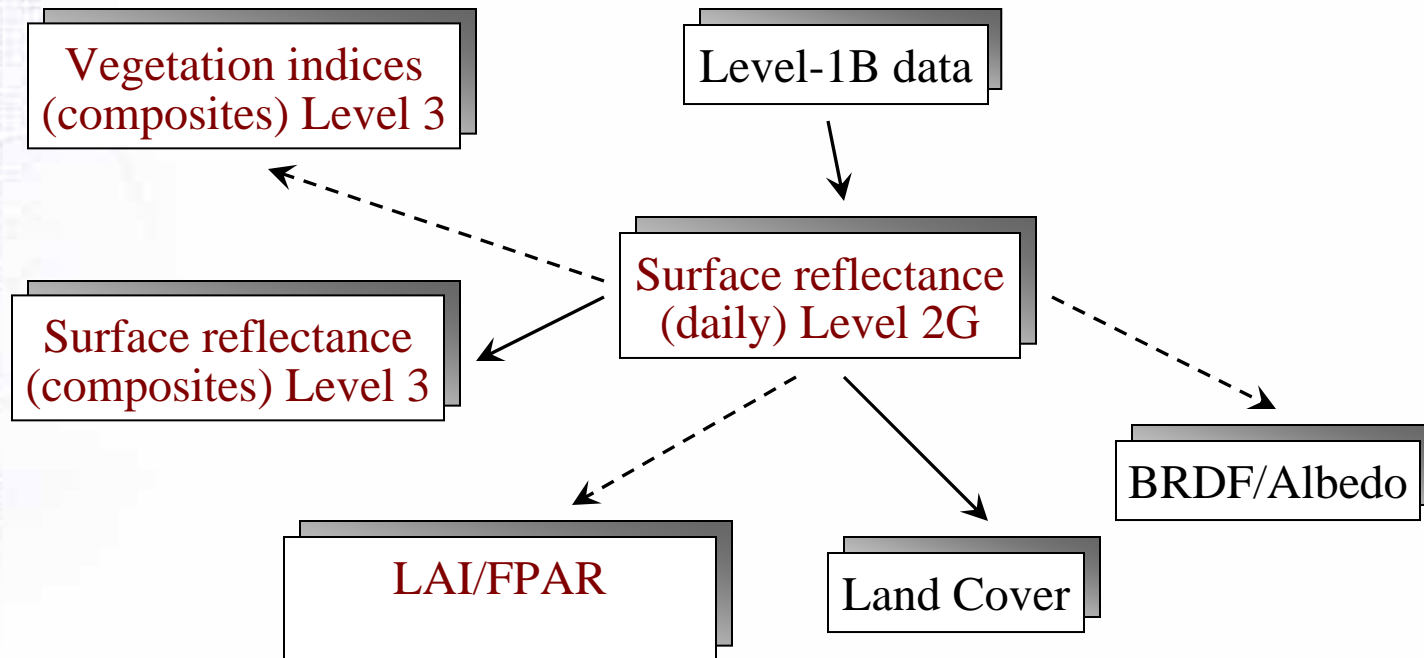RGB no correction
for aerosol effect

RGB surface reflectance
(corrected for aerosol)

Corresponding aerosol optical thickness at 670nm (0 black, 1.0 and above red) linear rainbow scale. Clouds are in magenta, water bodies are outlined in white.

Surface Reflectance as input to downstream product

Vegetation indices (composites) Level 3

Level-1B data

Surface reflectance (composites) Level 3

Surface reflectance (daily) Level 2G

LAI/FPAR

Land Cover

BRDF/Albedo

MODIS Land: http://modis-land.gsfc.nasa.gov

MOD09: Collection 4

Collection 4:	Terra	Aqua
Surface Reflectance Daily L2G Global 250 m	MOD09GQK	MYD09GQK
Surface Reflectance Daily L2G Global 500 m	MOD09GHK	MYD09GHK
Surface Reflectance 8-Day L3 Global 250 m	MOD09Q1	MYD09Q1
Surface Reflectance 8-Day L3 Global 500 m	MOD09A1	MYD09A1
Surface Reflectance Quality Daily L2G Global 1km	MOD09GST	MYD09GST

Availability: February 2000 (July 2002) through December 2006

MOD09: Collection 5: Simplifying the data format, please read the 1km QA flags

Collection 5:	Terra	Aqua
Surface Reflectance Daily L2G Global 250 m	MOD09GQ	MYD09GQ
Surface Reflectance Daily L2G Global 500 m and 1 km	MOD09GA	MYD09GA
Surface Reflectance 8-Day L3 Global 250 m	MOD09Q1	MYD09Q1
Surface Reflectance 8-Day L3 Global 500 m	MOD09A1	MYD09A1
~~Surface Reflectance Quality Daily L2G Global 1km~~	~~MOD09GST~~	~~MYD09GST~~
Surface Reflectance Daily L3 Global 0.05Deg CMG	MOD09CMG	MYD09CMG

* CMG – Climate Modeling Grid

Collection 5 main changes

- New look up tables based on 6SV including the latest dynamic aerosol models from AERONET analysis
- Refined inversion of the aerosol based on all the available bands (in particular 412nm and 443nm) and a stronger Red-Blue relationship (in collaboration with the Aerosol group).
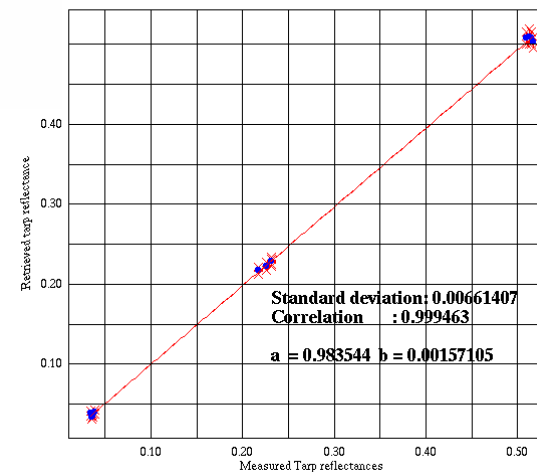- Improved internal (product specific) cloud and snow screening

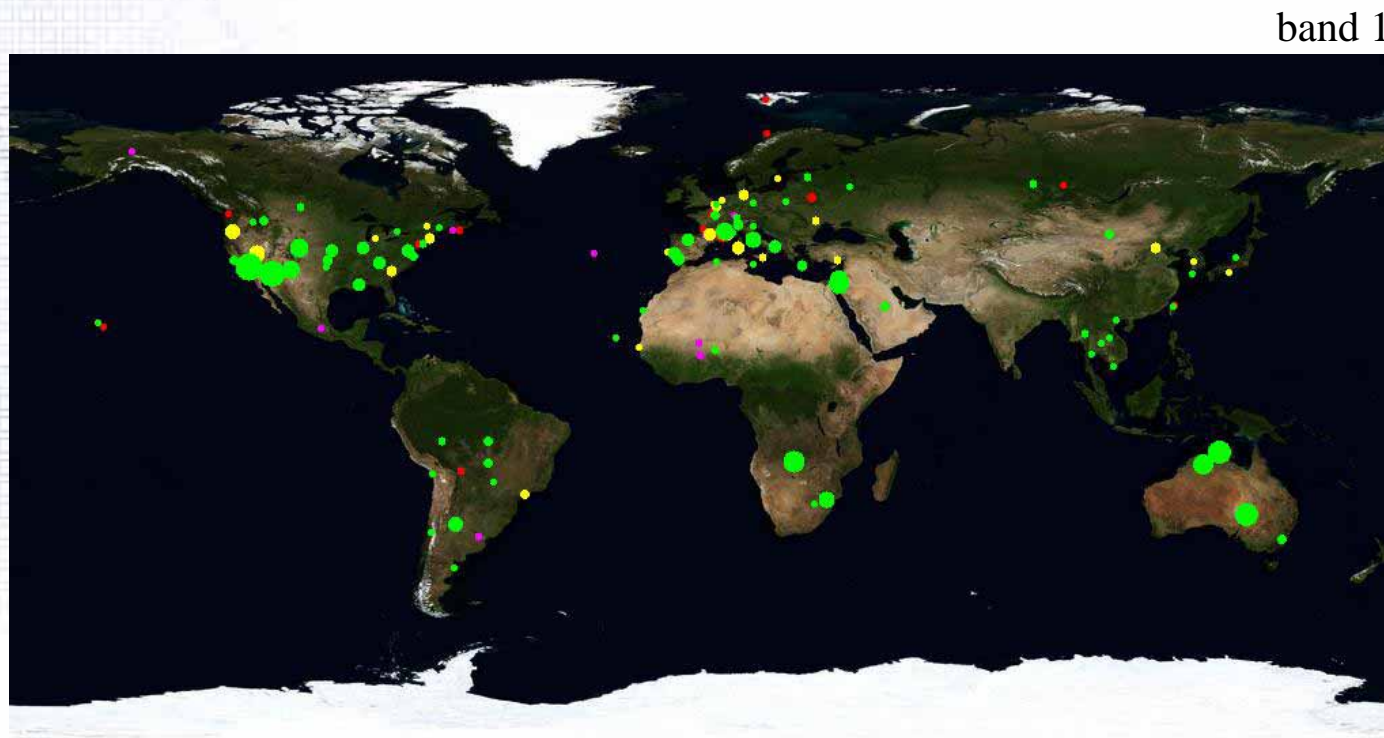# Atmospheric correction based on rigorous Vector radiative transfer (6SV)

http://6s.ltdri.org

http://rtcodes.ltdri.org/
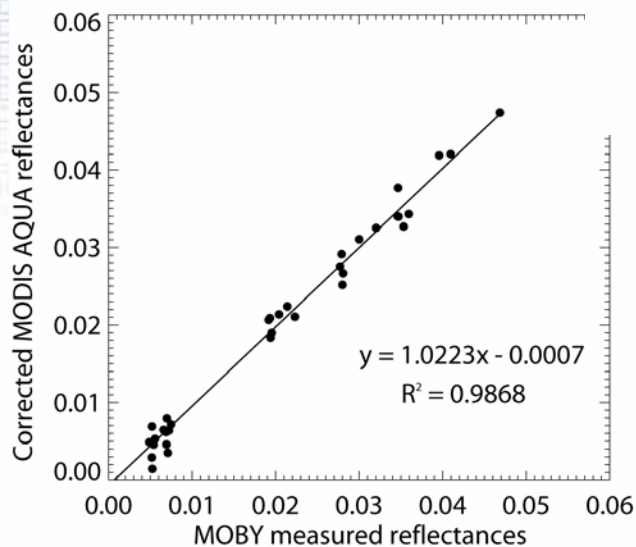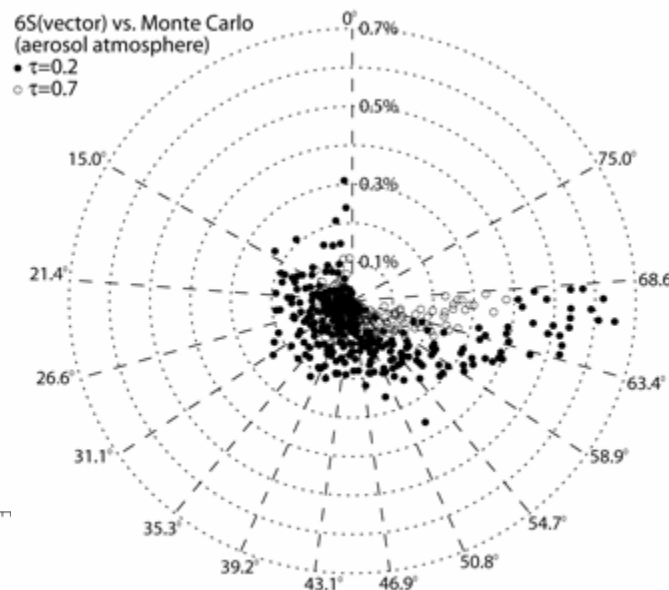
MOD09 Collection 5: Emphasis on validation

To analyze the performance of the MODIS Collection 5 algorithms, we analyzed 1 year of Terra data (2003) at **150** AERONET sites (4988 cases):

band 1

green > 80%, 65% < yellow <80%, 55% < magenta < 65%, red <55%

Percentage of good:

band 1 – 86.62%

band 2 – 94.13%

band 3 – 51.30%

band 4 – 75.18%

band 5 – 96.36%

band 6 – 97.69%

band 7 – 98.64%

Theoretical error bar:
$\pm(0.005 + 5\%)$

http://mod09val.ltdri.org/cgi-bin/mod09_c005_public_allsites_onecollection.cgi

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Mongu Zambia: 116 cases analyzed: Band 1: Good 93.7%

The percentages of observations that meet the accuracy requirement of the MODIS surface reflectance are reported in the graphs below for 116 cases. The surface reflectance obtained by performing full atmospheric correction using AERONET optical thickness and water vapor measurements is considered the 'truth'. Regression plots for each site can be displayed by clicking on corresponding bar in the graph.
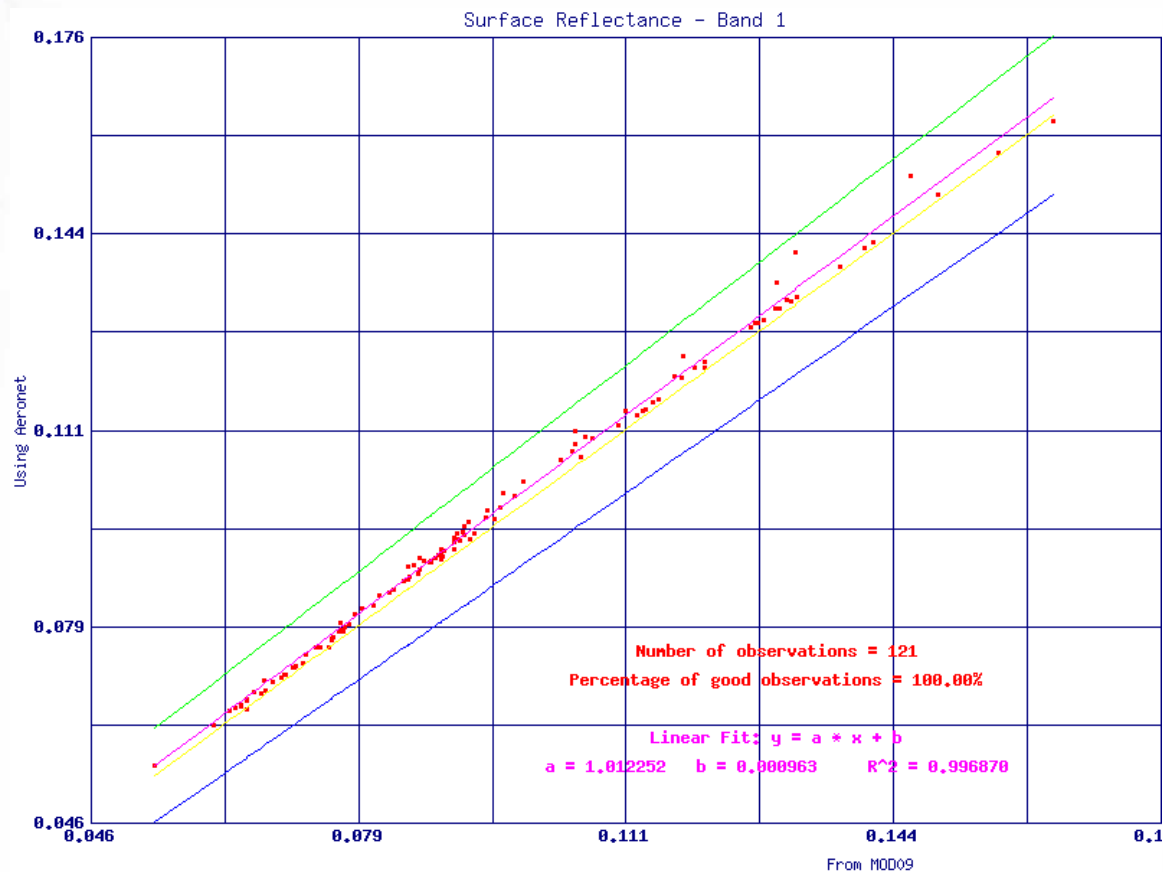
To ensure the use of AERONET measurements representative of the MODIS acquisition conditions, we filter out cases where the AERONET AOT measurement does not occur within 30 minutes of the MODIS acquisition or where the aeronet aerosol model inversion is not performed within 1 day of the acquisition.
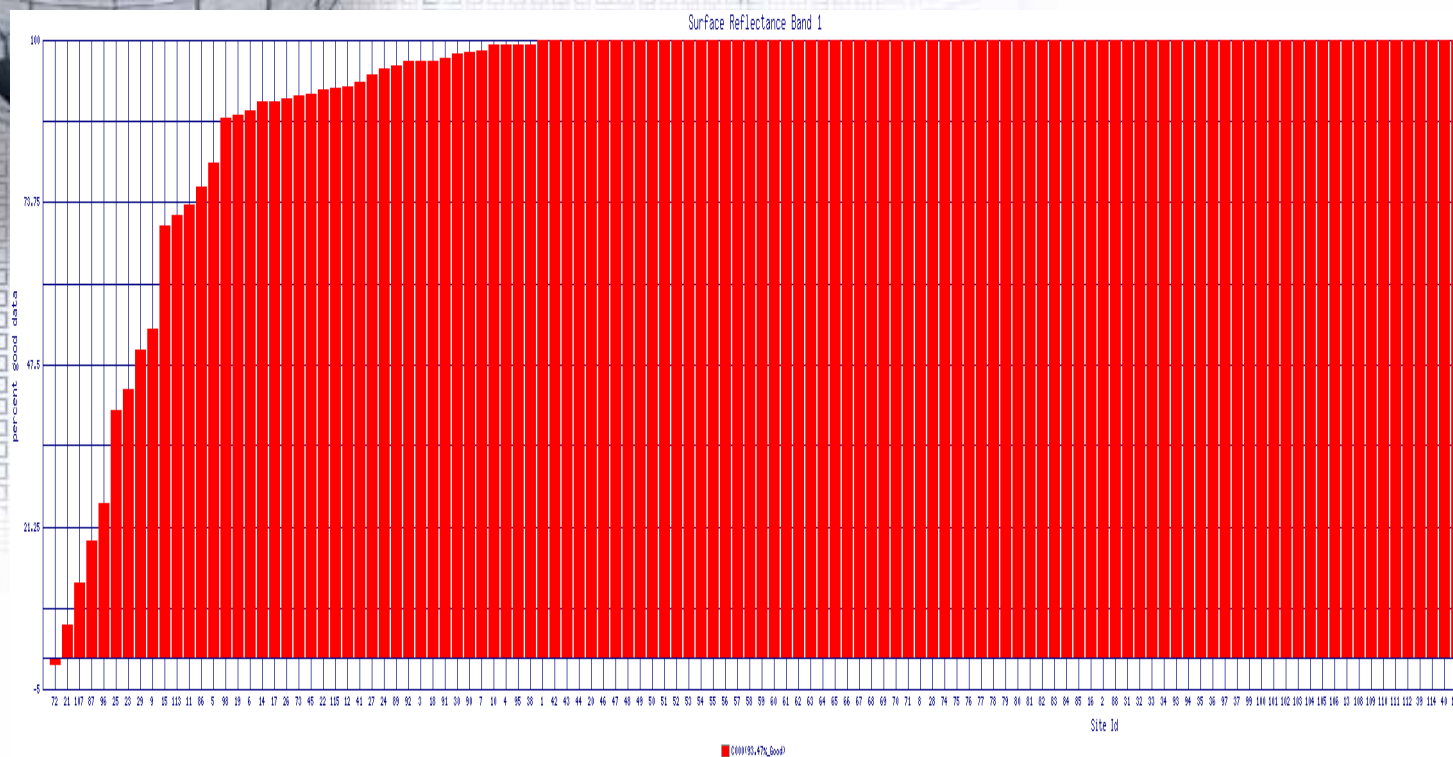
Mongu. Zambia
2003157 08:45

AOT.	AOT.	WV.	WV.	Daot.	DTaot	DTmodel	skyerr	refi550	%Good B1	nb obs	vza
0.138	0.141	2.04	2.11	0.001	15	282	1.61%	0.0209	100.00	121	0.78

Good Case

Surface Reflectance – Band 1

Number of observations = 121
Percentage of good observations = 100.00%

Linear Fit: y = a * x + b
a = 1.012252   b = 0.000963   R^2 = 0.996870

Mongu Zambia
2003126 09:30

AOT.	AOT.	WV.	WV.	Daot.	DTaot	DTmodel	skyerr	refi550	%Good B1	nb obs	vza
0.162	0.132	1.69691	1.65371	0.003	6	-124	1.52%	0.0267	40.00	20	64.29

Surface Reflectance – Band 1

Number of observations = 20
Percentage of good observations = 40.00%

Linear Fit: y = a * x + b
a = 1.004495   b = 0.007850   R^2 = 0.998577
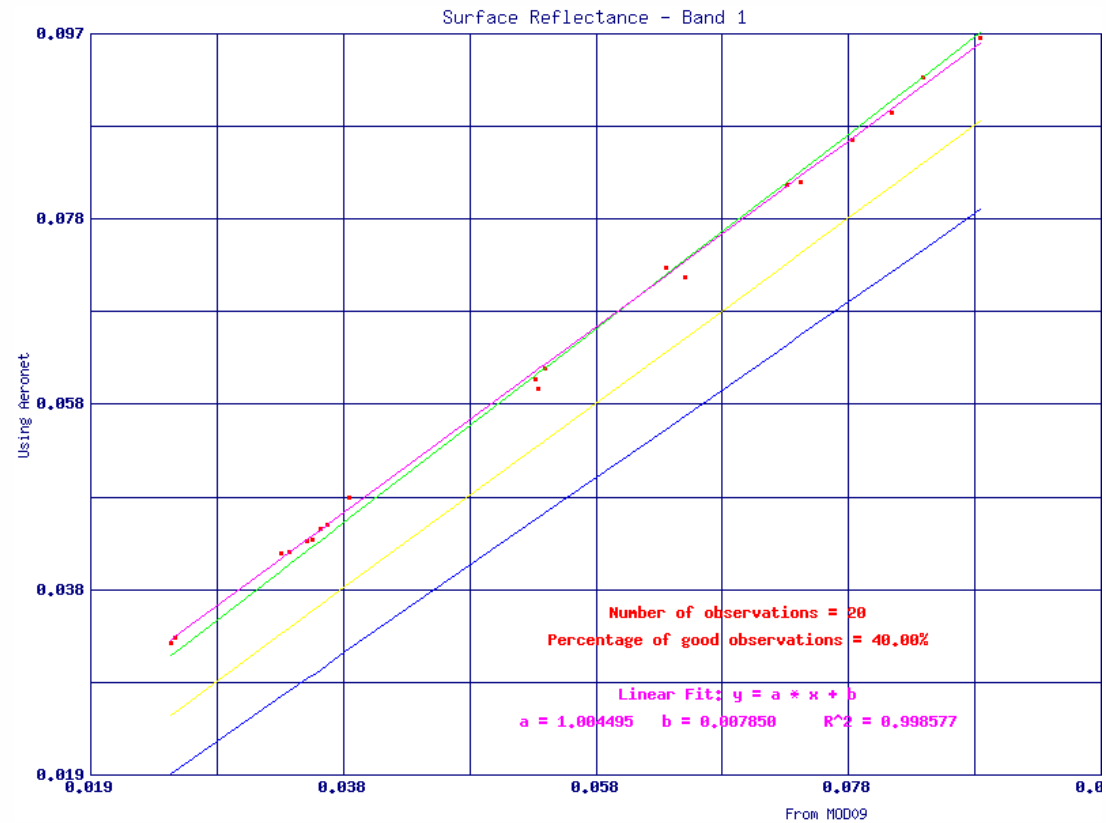
MOD09 Collection 5 assessing the impact on downstream product (EVI/VI)

NDVI
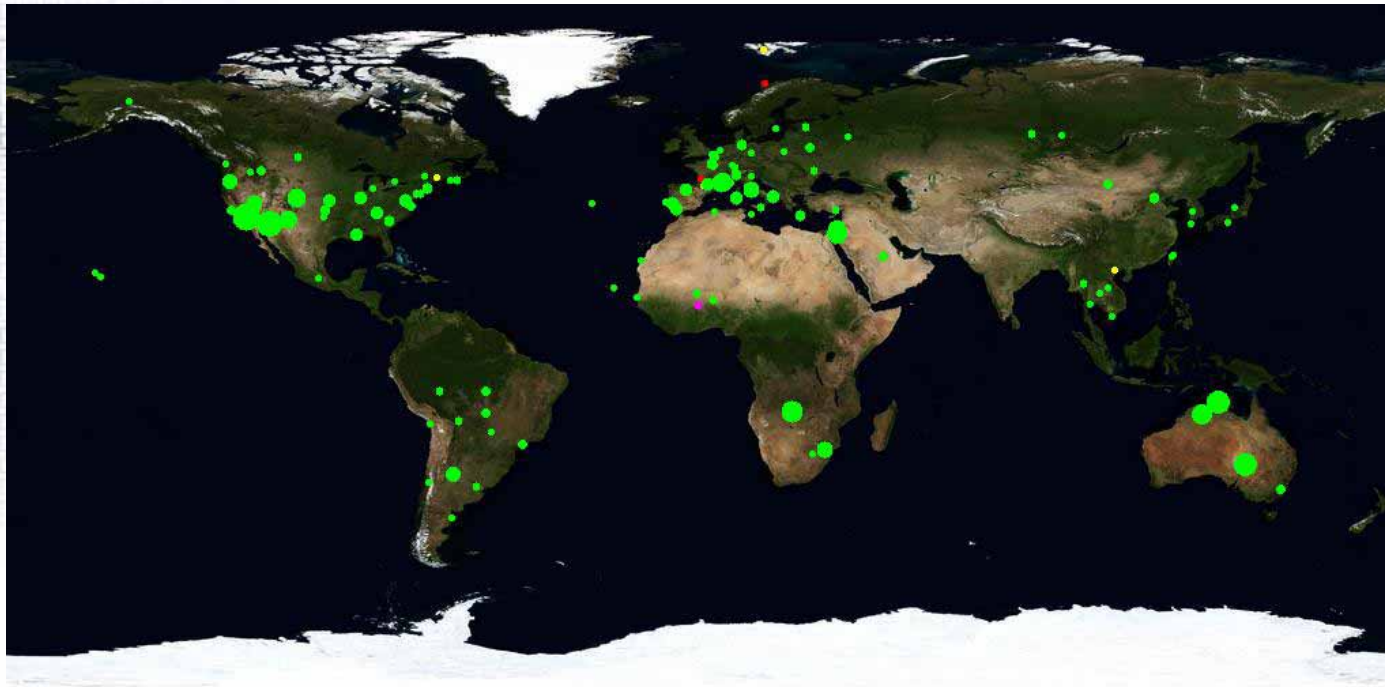
Percentage of good:
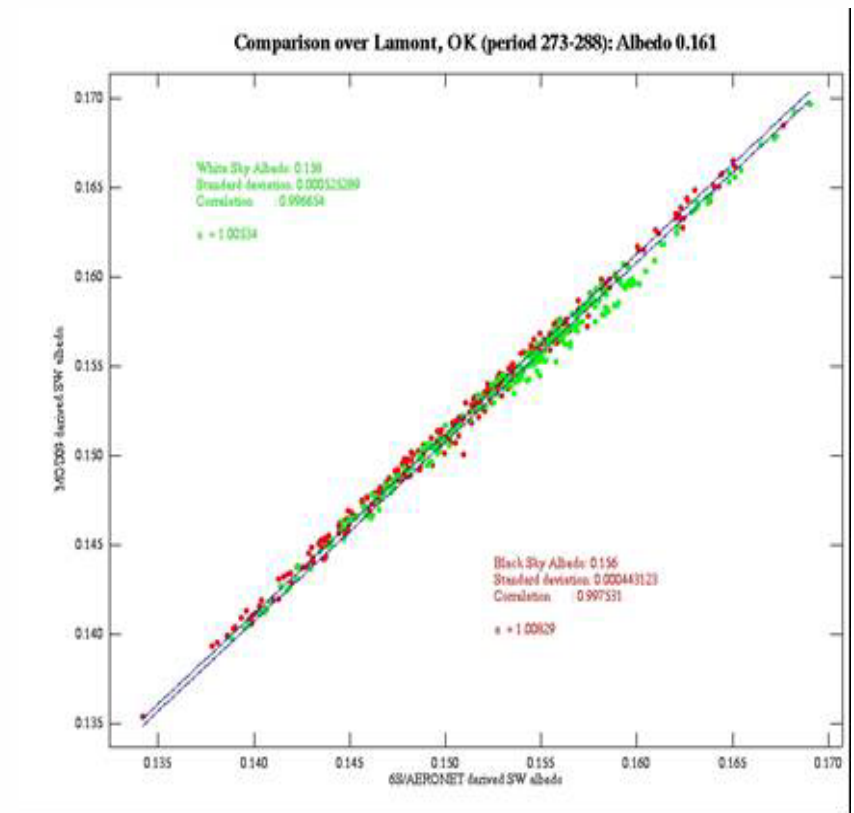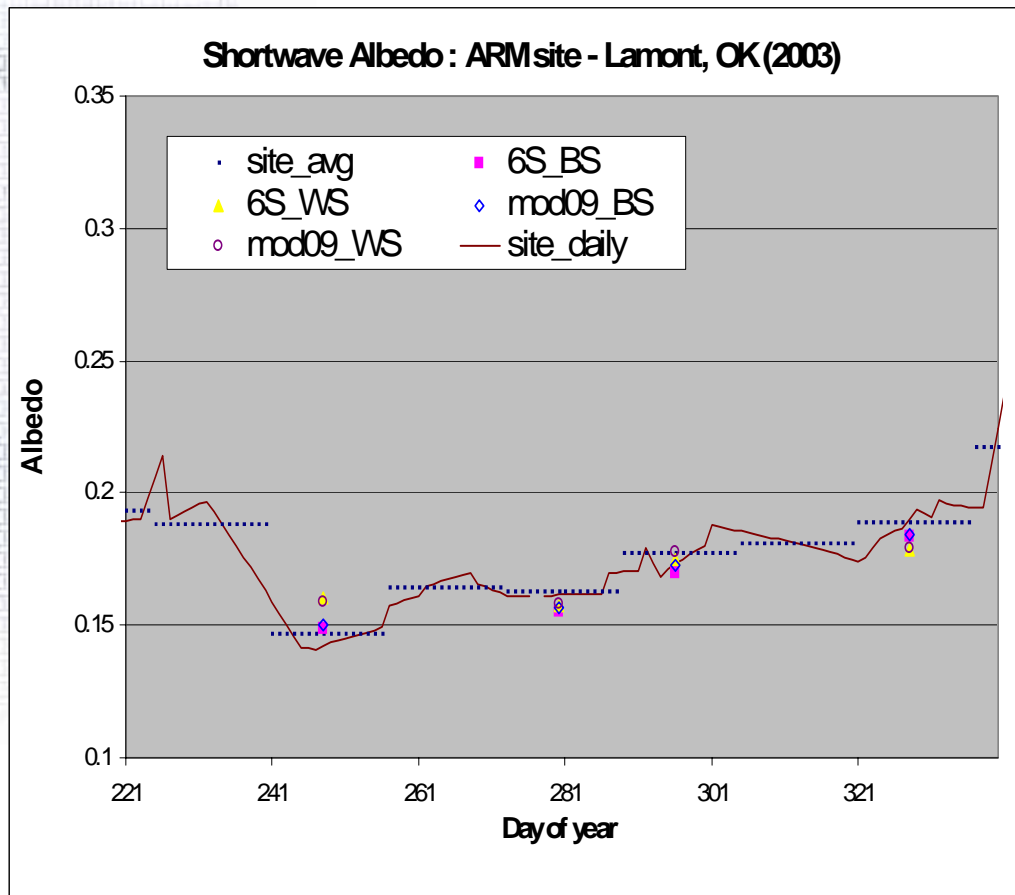NDVI – 97.11%
EVI – 93.64%

Theoretical error bar:
$\pm(0.02 + 2\%)$

green > 80%, 65% < yellow <80%, 55% < magenta < 65%, red <55%

http://mod09val.ltdri.org/cgi-bin/mod09_c005_public_allsites_onecollection.cgi

Shortwave Albedo : ARM site - Lamont, OK (2003)

Comparison over Lamont, OK (period 273-288): Albedo 0.161

Future directions: proposed 06-08

- Extend and refine the accuracy analysis

- Generate high accuracy reference data:
  Coupled AERONET inversion with MODIS/MISR-MODIS/POLDER coincident data (collaboration with AERONET Team)

- Generalize of the accuracy analysis approach to other standard directional reflectance products (including those cited before): AVHRR/VEGETATION/SeaWiFS/MERIS/TM

Collection 4/ Collection 5 Recommendations

- Use collection 5 when available
- It is ok to mix Collection 4 and collection 5 for time series, but assess the impact on your specific application
- For 'subtle' climate <u>trend</u> studies better to wait for Collection 5 completion – consistent record and documented accuracy