1.Scope of this document

On May 30, 2013, data from the Landsat 8 satellite (launched as the Landsat Data Continuity Mission on February 11, 2013) became available. ESA distributes Landsat 8 products as a near real time service (https://landsat8portal.eo.esa.int/portal/).

The scope of this document is the Level 1 product accuracy performance of products processed by ESA. The radiometric calibration stability, the geolocation accuracy and the interband registration accuracy is monitored on a monthly basis. Comparison with results from the USGS cal/val is done.

Hence the document is organized as follow

$1) Scope of this document	To introduce this document
$2) Change record	To log version of cycle reporting and input TDS considered for the month
$3)Executive Summary:	To provide a quick overview on the main findings of the month and to provide updated accuracy statistics.
$4) QC Issue	This part is dedicated to the tracking of operational issue found during exercise
$5) Radiometric accuracy stability monitoring	This part provides statistics and figures (trends) regarding the multi temporal stability of radiometric calibration of visible/NIR/SWIR data.
$6) Geolocation accuracy stability monitoring	This part provides statistics and figures on multi temporal stability of geolocation accuracy. The panchromatic image is analyzed.
$7) Interband registration	This part provides statistics and figures on geometric registration of OLI & TIRS images observed in a same date.
$8)Test site description	This part provides very brief description of test sites that are considered for our analysis.

Note that:

An insight on methods is given in “IDEAS-TN-02-L8_DataValidation.docx”;

The test data set is detailed in “TDS_L8_cyclic.xlsx”, this file is regularly updated.

2. Change record

Iss.	Rev.	Date	Reason	Comments
1	0	08/04/2015	Document creation	
1	1	26/05/2015	May 2015 cyclic report	
1	2	06/07/2015	June 2015 cyclic report	
1	3	29/07/2015	July 2015 cyclic report	
1	4	28/08/2015	August 2015 cyclic report	
1	5	28/09/2015	September 2015 cyclic report	
1	6	26/10/2015	October 2015 cyclic report	
1	7	25/11/2015	November 2015 cyclic report	
1	8	04/01/2016	December 2015 quality report	
1	9	27/01/2016	January 2016 quality report	
1	10	29/02/2016	February 2016 quality report	
1	11	24/03/2016	March 2016 quality report	

3. Executive summary

Landsat 8 data validation purpose is to assess the continuity of data accuracy of Landsat Project.

Validation Item	Comment
Radiometric accuracy stability monitoring	Temporal stability is correct (TOA reflectance standard deviation under 0.7 for blue, green, red and NIR bands and under 1.6 for SWIR1 and SWIR2 bands). Ratio between RTOA of ESA products and USGS products is 1.
Geolocation accuracy stability monitoring (Relative location)	Relative location results show a correct matching between Landsat 8 products (RMS values under 5m in both directions) No bias and no trend No site influence Temporal stability is correct (standard deviation errors under 5m in both direction)
Interband Registration	A strong influence of site is observed especially for TIRS band.

4.Radiometric accuracy stability monitoring

4.1.Objective

The objective is to assess radiometric stability of Landsat 8 data.

4.2.Methods

The method consists in monitoring the Top of Atmosphere (TOA) reflectance acquired on a bright site referred by "Libya4", known as spatially uniform (as seen with L8/OLI spatial resolution) and spectrally stable in time.

For input images, a region of interest corresponding to an area of one square degree is extracted and statistics computed. The Libyan site "Libya4" is located at latitude 28.55N, longitude 23.39E, at altitude 118m.

It is expected that the temporal evolution of TOA measurements over mission lifetime is stable.

4.3.Results and Discussions

Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) images consist of nine spectral bands with a spatial resolution of 30 meters for Bands 1 to 7 and 9. New band 1 (ultra-blue) is useful for coastal and aerosol studies. New band 9 is useful for cirrus cloud detection. The resolution for Band 8 (panchromatic) is 15 meters. Thermal bands 10 and 11 are useful in providing more accurate surface temperatures and are collected at 100 meters.

Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	Bands	Wavelength (micrometers)	Resolution (meters)
	Band 1 – Coastal aerosol	0.43 – 0.45	30
	Band 2 – Blue	0.45 – 0.51	30
	Band 3 – Green	0.53 – 0.59	30
	Band 4 – Red	0.64 – 0.67	30
	Band 5 – Near Infrared (NIR)	0.85 – 0.88	30
	Band 6 – SWIR1	1.57 – 1.65	30
	Band 7 – SWIR2	2.11 – 2.29	30
	Band 8 – Panchromatic	0.50 – 0.68	15
	Band 9 – Cirrus	1.36 – 1.38	30
	Band 10 – TIRS1	10.60 – 11.19	100*(30)
	Band 11 – TIRS 2	11.50 – 12.51	100*(30)

The statistics listed in table below are computed based on dataset of 27 L1T products (from 29/01/2014 to 20/02/2016). The S/W version is not same in all cases, since archive is not reprocessed. L1Gt products are not taken into account in these statistics:

Bands	Mean TOA reflectance (27 L1T products)	Std TOA reflectance (%)	Uncertainty (Std divided by mean)
Blue	0,246	0,0025	1,02%
Green	0,333	0,0019	0,57%
Red	0,452	0,0051	1,13%
NIR	0,574	0,0069	1,2%
SWIR1	0,668	0,0141	2,11%
SWIR2	0,588	0,0160	2,72%

Table 1 - Landsat 8 / OLI - Statistics on Temporal stability of radiometric calibration.

The temporal uncertainty (standard deviation divided by the mean) of OLI is better than 2% for all bands expect SWIR bands. It is under 3% for SWIR bands affected by atmospherically effects.

As shown in the figure below, the dispersion of TOA measurements around each center wavelength value remains quite small, except for SWIR channels, influenced by water vapor content. The spectral behavior remains correct.

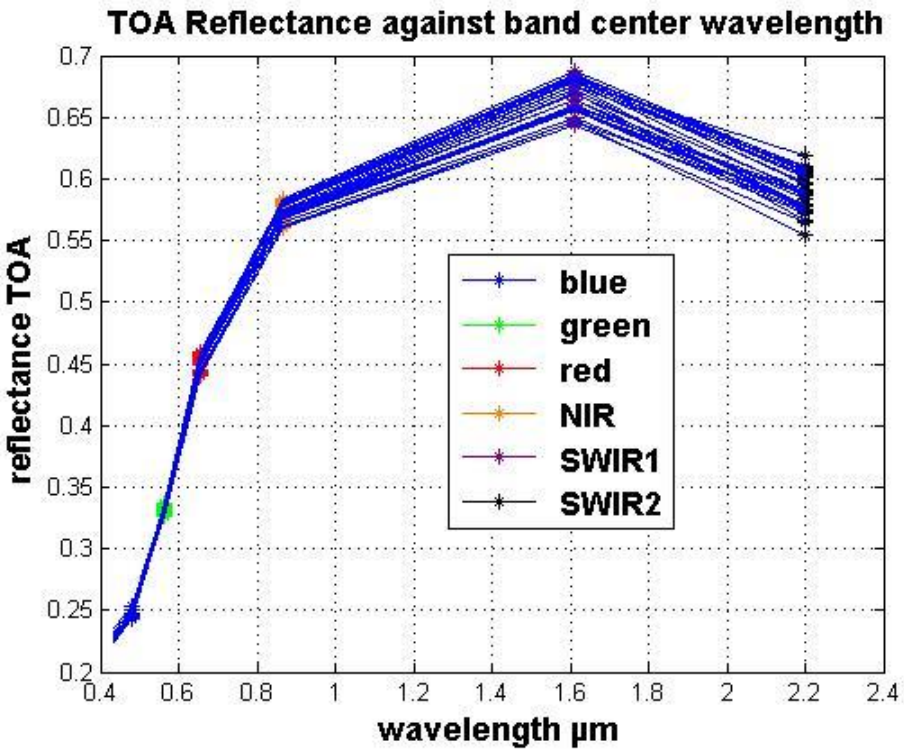


Figure 1- reflectance profile as indicator of uncertainty

The six figures below show temporal trending of Landsat 8 OLI measured TOA reflectance over Libya 4 PICS for the 6 bands since its launch. Circles correspond to reflectance values of USGS products. Linear regressions, indicated by the red lines were performed and indicate a good stability sensor.

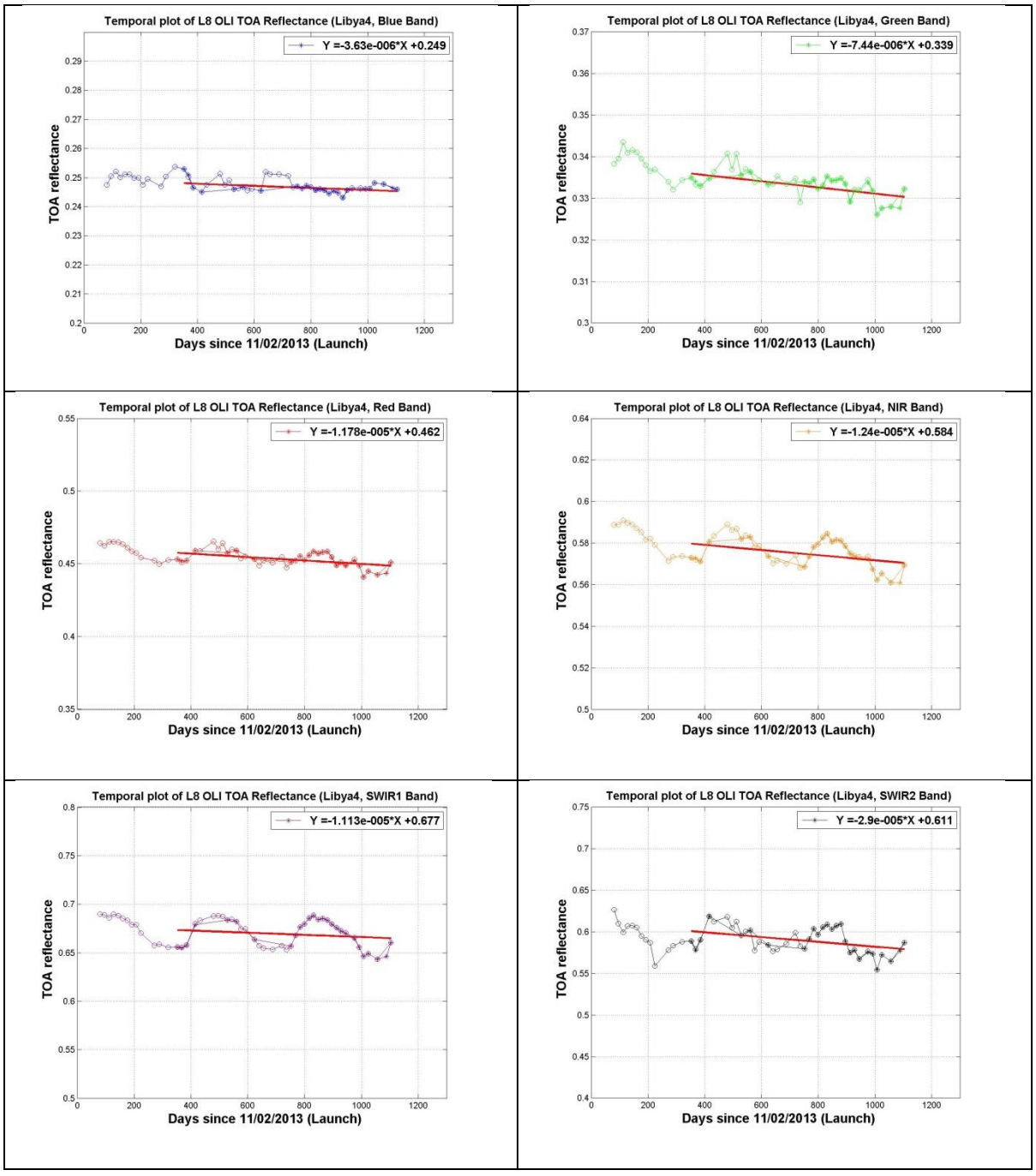


Figure 2-Temporal Trends of L8 OLI TOA Reflectances

Further investigations on the stability of OLI measured via PICS and other techniques can be found in a Remote Sensing paper[1]. The intercept value is used as a mean TOA reflectance value for comparison against USGS products and ESA products.

Bands	L8 OLI ESA products– *Intercept Value*	L8 OLI USGS products- *Intercept Value*
Blue	0,249	0,249
Green	0,339	0,340
Red	0,462	0,466
NIR	0,584	0,589
SWIR1	0,677	0,683
SWIR2	0,611	0,612

Table 2 – Comparison between L8 ESA and L8 USGS OLI TOA reflectance.

A radiometric comparison has been made between Landsat 8 ESA products and Landsat 8 USGS products.

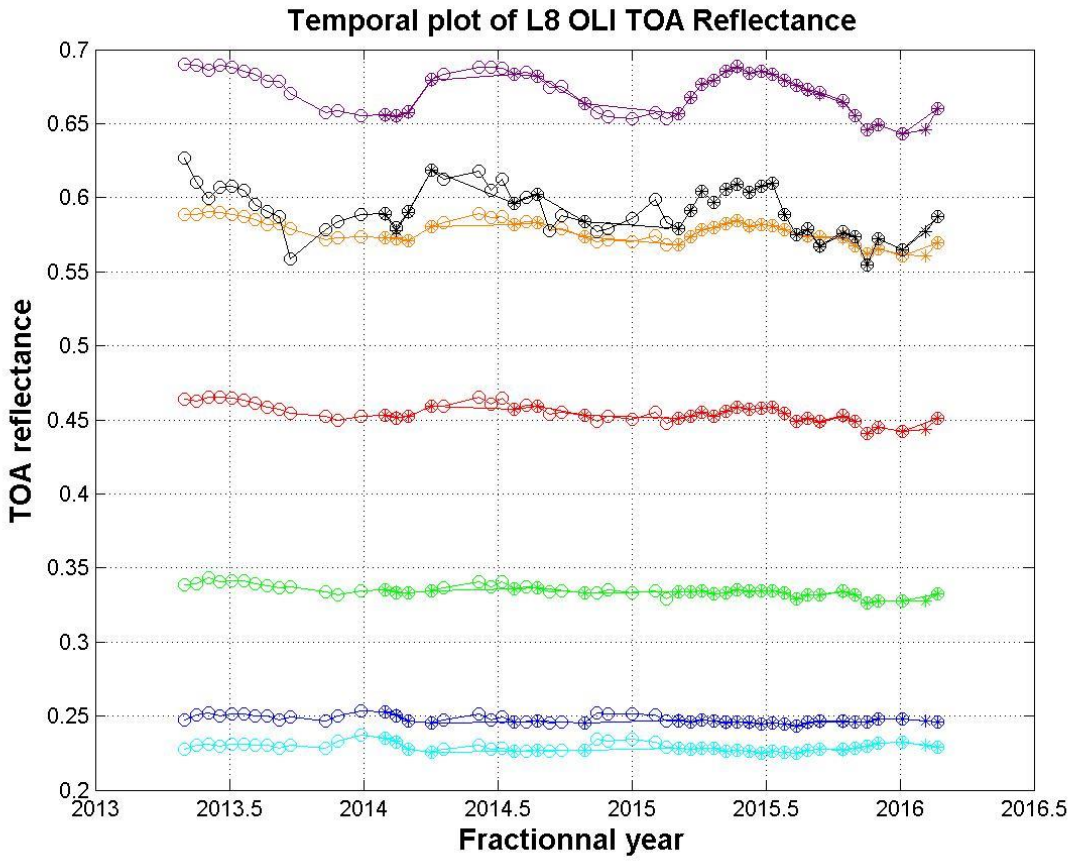


Figure 3-Temporal trend of L8 OLI TOA reflectances
Comparison of ESA products and USGS products

[1] "Radiometric Cross Calibration of Landsat 8 Operational Land Imager (OLI) and Landsat 7 Enhanced Thematic Mapper Plus (ETM+) - Remote Sensing 2014, 6, 12619-12638, ISSN 2072-4292".

The figure below shows the temporal evolution of TOA reflectance ratio for blue band. The temporal variability is correct. It is correct for all bands.

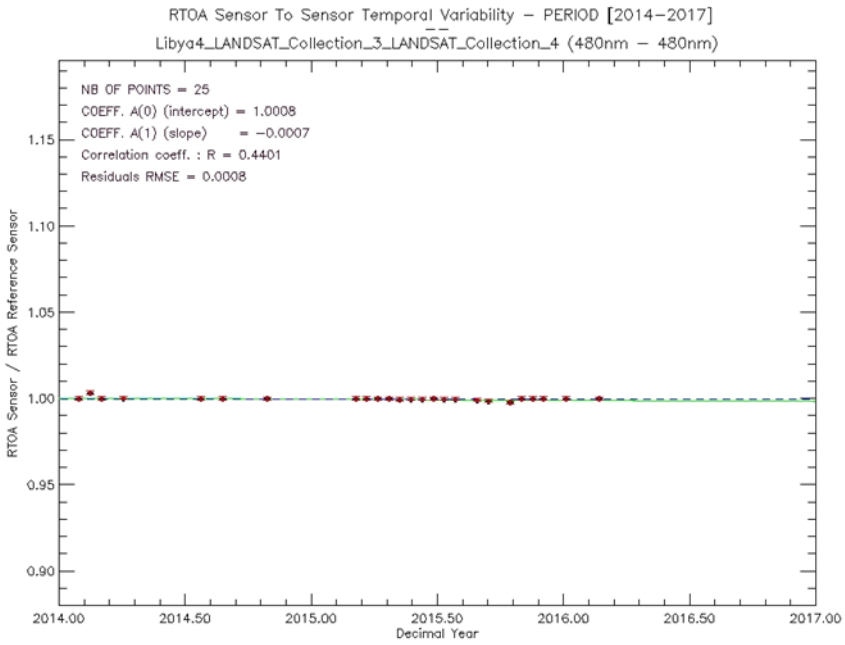


Figure 4-Temporal variability of the ratio RTOA OLI ESA / RTOA OLI USGS (blue band)

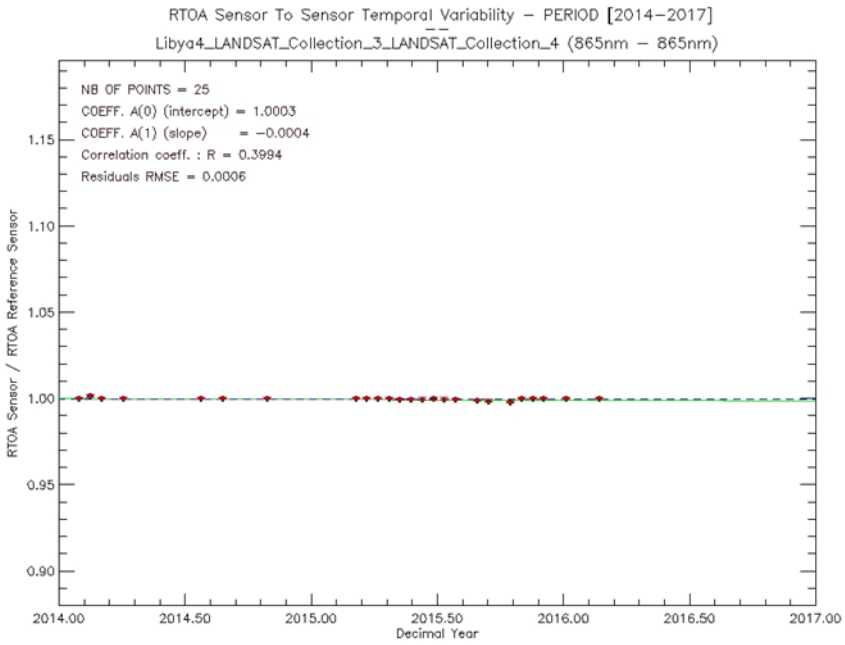


Figure 5-Temporal variability of the ratio RTOA OLI ESA / RTOA OLI USGS (NIR band)

5.Geolocation accuracy stability monitoring

5.1.Objective

The objective is to assess geometric stability of Landsat 8 data. According to USGS certification document[2], the standard deviation of the difference in the line and sample components between L1T reference product band and each L1T corresponding product band should be less than 12m.

5.2.Methods

Basically, method is based on the following processing stages:

- ✓ Dense matching processing between reference product and each product;
- ✓ Correlation grid filtering;
- ✓ Accuracy analysis.

The panchromatic image (band 8), included in L1T product, image resampled to pixel size of 15 m, is validated against a geometric reference.

Three ROI distributed over three sites are used:

- ✓ La Crau (reference product : LC81960302013243NSG00)
- ✓ Granada (reference product : LC82000342014146MTI00)
- ✓ Saragossa (reference data : LC82000312014066MTI00)
- ✓

5.3.Results and Discussions

The overall statistics over 49 L1T products (from 30/07/2013 to 08/01/2016) are the following ones, all data merged together, without taking into account the test site.

[2] "Landsat Data Continuity Mission (LDCM) International Ground Station (IGS) Data Validation and Exchange (DV&E) and Certification Plan LS-IC-12 Version 2.0".

Statistics (48 products)	Value	Comments
Mean Error Easting Direction	0,15m	No bias – No trend
Mean Error Northing Direction	0,32m	No site influence
Standard Deviation Error Easting Direction	3,78m	Correct temporal stability
Standard Deviation Error Northing Direction	3,8m	Correct correlation points repartition
Root Mean Square Easting Direction	3,78m	
Root Mean Square Northing Direction	2,82m	Correct RMS in both directions
Root Mean Square 2D	5,35m	
CE 90	1,94m	Correct CE90

Table 3 – Landsat 8 / OLI panchromatic band – Statistics on temporal stability of geolocation accuracy.

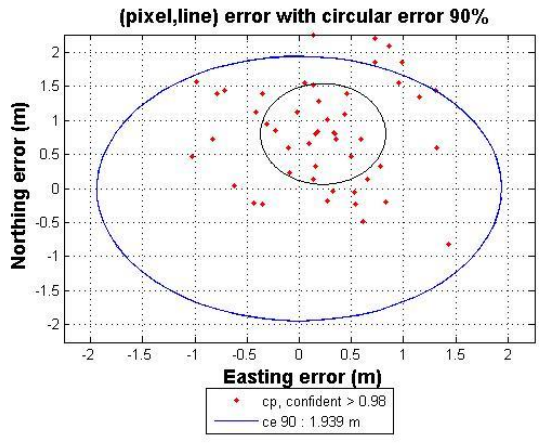
The four figures below show a very high matching between Landsat 8 products.

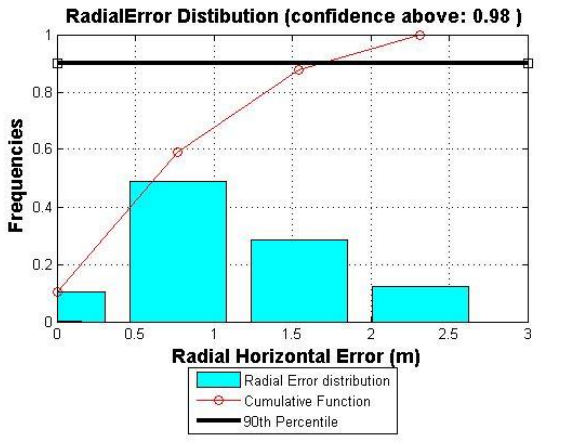
In the upper left figure, each point corresponds to one validated product. The black ellipse is 1D sigma error ellipse in normal distribution hypothesis. Global CE 90 is equal to 1.94m, which is very low compared to 15m resolution. No bias and no trend can be noticed. There is no site influence.

The radial error distribution shows that 90% of validated products have a radial error less than 2m. It confirms bias and trend absence.

In the lower left figure, each point corresponds to a correlation point. The black ellipse is still 1D sigma error ellipse in normal distribution hypothesis. Points outside the ellipse correspond to correlation noise. Global CE 90 is equal to 3.17m, which is very low.

The last figure shows a correct stability of geolocation accuracy..





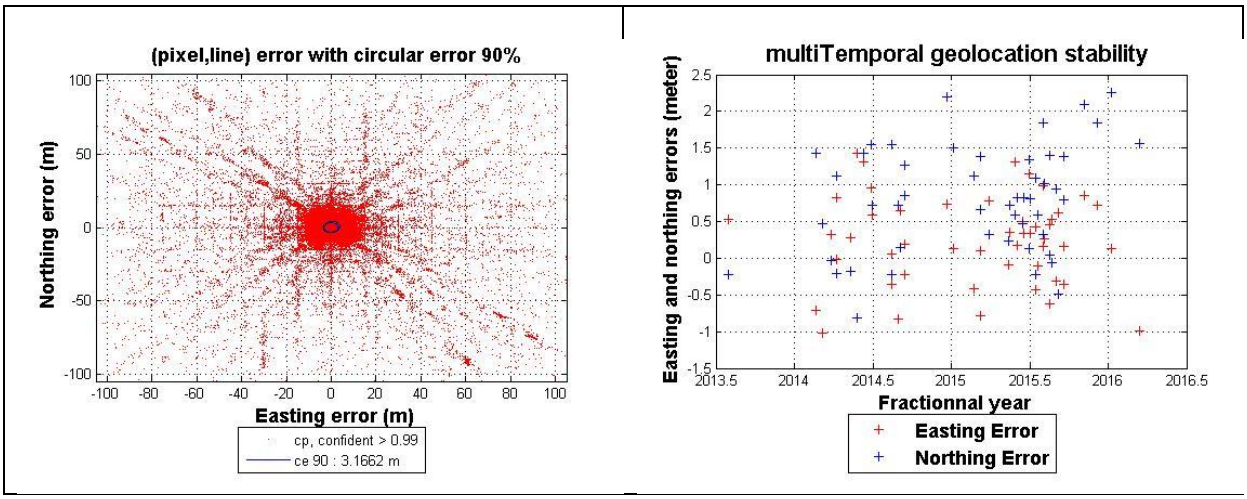
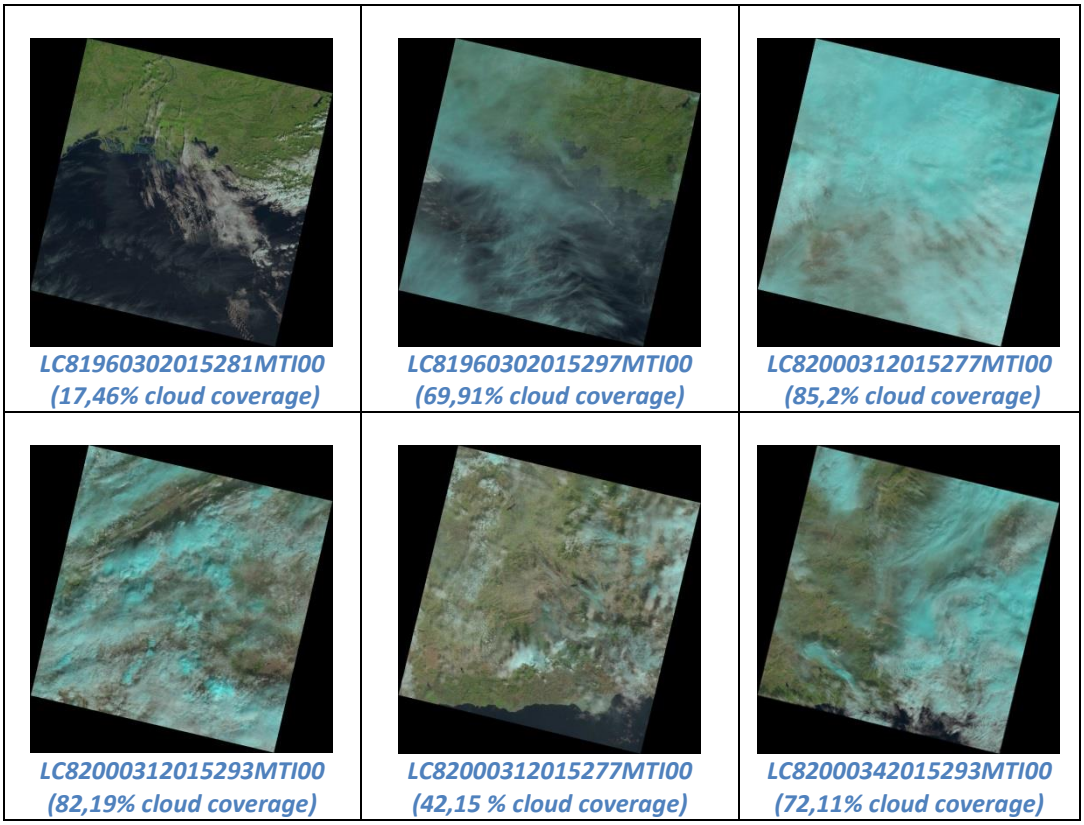


Figure 6 — Up Right) Product Circular Error @90
Up Left) Product Radial Error Distribution
Bottom Right) Point Circular Error @ 90
Bottom Left) Temporal Trends of easting and northing errors.

The correlation method is applied only on cloud free products (less than 15% of cloud coverage).



LC81960302015281MTI00 (17,46% cloud coverage)
LC81960302015297MTI00 (69,91% cloud coverage)
LC82000312015277MTI00 (85,2% cloud coverage)
LC82000312015293MTI00 (82,19% cloud coverage)
LC82000312015277MTI00 (42,15 % cloud coverage)
LC82000342015293MTI00 (72,11% cloud coverage)

Figure 7—Examples of cloud contaminated images (quicklooks).

6.Interband registration accuracy

6.1.Objective

The objective is to validate band registration accuracy by performing a Band-to-Band (B2B) alignment analysis upon validated products. According to USGS certification document[3], the RMSE-line and RMSE-sample error threshold for B2B, averaged for all within-band comparisons is:

- 0,15 pixels (4,5m) for OLI
- 0.18 pixels (18m) for TIRS
- 0.3 pixels (30m) for OLI/TIRS comparisons.

6.2.Methods

The interband registration is assessed by mean of correlation processing between two consecutive bands. A sub-sampling of 20% is done to compute correlation maps.

6.3.Results and Discussions

Statistics below show a strong influence of site. Rms are upper than 4,5m for La Crau and Saragossa sites when NIR band is taken into account. Confident pixels number is in fact very low in these cases: NIR band is impacted by atmospheric effects and correlation is not relevant.

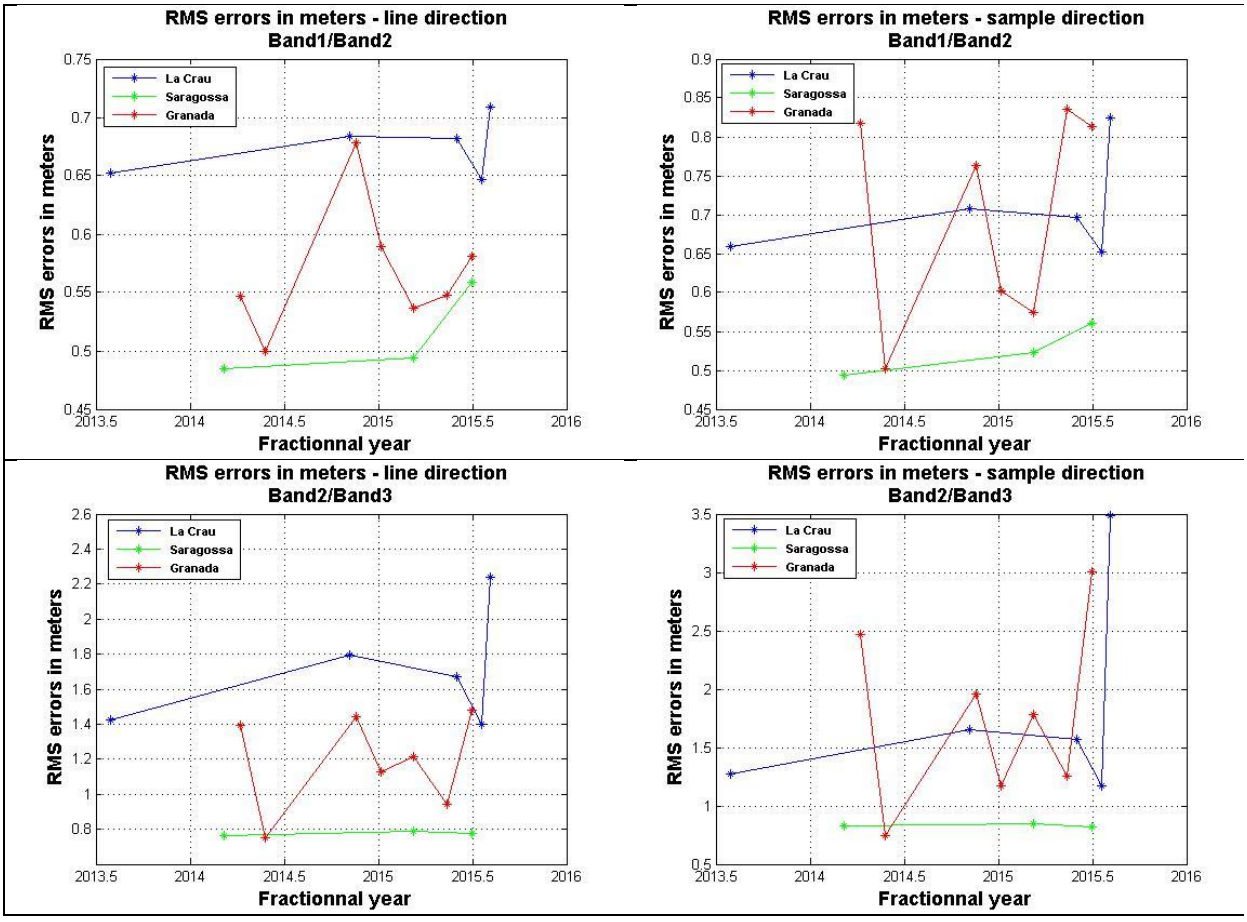
Granada site	B1-B2	B2-B3	B3-B4	B4-B5	B5-B6	B6-B7
Mean line	0.0113	0.0941	0.0083	0.0956	0.0791	-0.0815
Mean sample	0.0149	0.0396	0.0325	0.0674	0.3646	-0.0639
Std line	0.5683	1.1891	1.1963	3.8487	5.8531	1.0358
Std sample	0.7007	1.7674	1.2371	3.8369	7.4492	1.1534
Rms line	0.5685	1.1938	1.1967	3.8501	5.8659	1.0403
Rms sample	0.7012	1.7696	1.2382	3.8393	7.4908	1.1562
Rms	0.9057	2.1474	1.7240	5.4424	9.5800	1.5587
Pixels number	487230	487230	487230	487230	487230	487230
Confident pixels	409670	236530	317920	39169	23355	257100

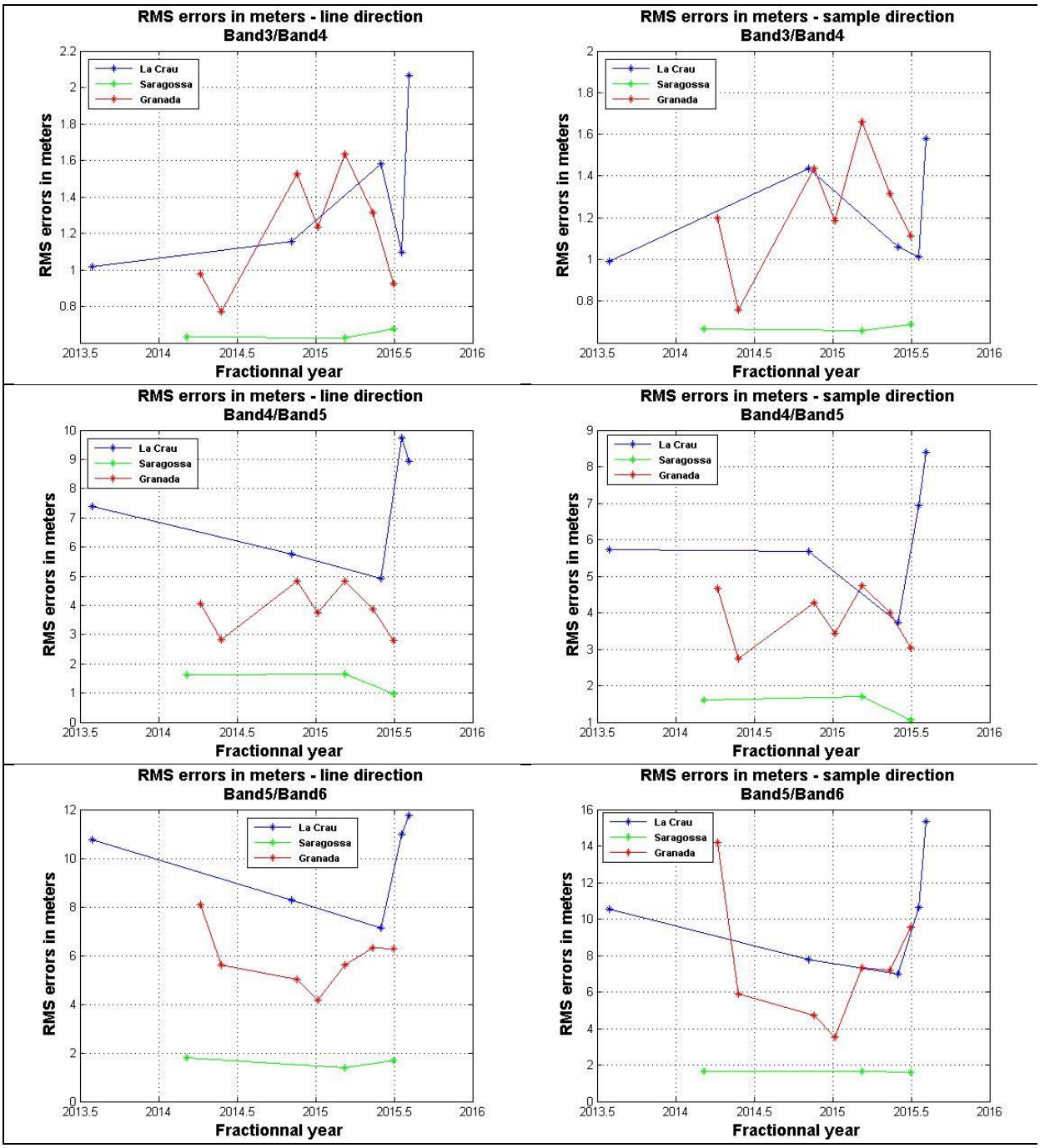
[3] "Landsat Data Continuity Mission (LDCM) International Ground Station (IGS) Data Validation and Exchange (DV&E) and Certification Plan LS-IC-12 Version 2.0".

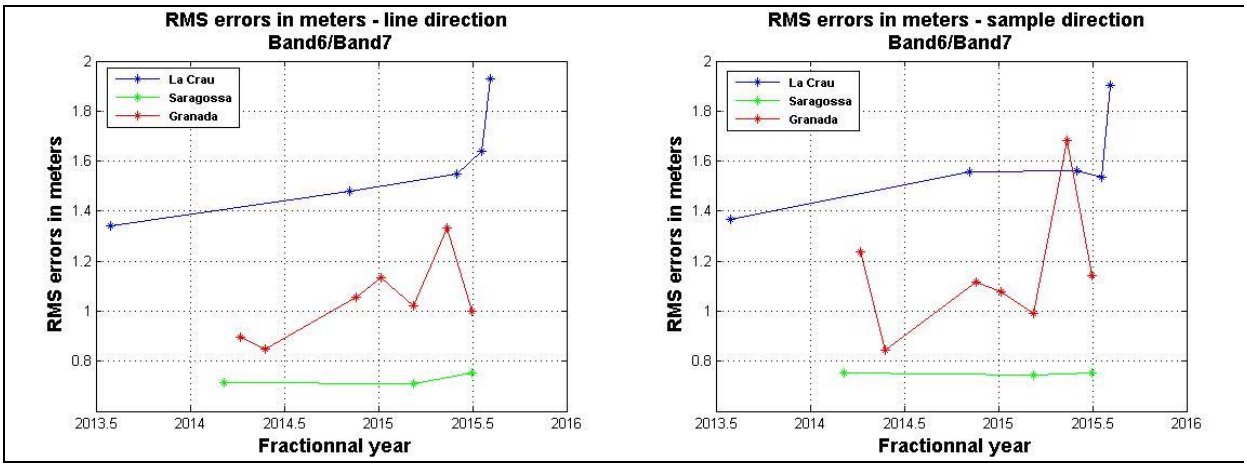
Saragossa site	B1-B2	B2-B3	B3-B4	B4-B5	B5-B6	B6-B7
Mean line	0.0237	0.0262	0.0553	0.1422	-0.0579	-0.0411
Mean sample	0.0063	-0.0322	-0.0459	-0.0180	-0.0256	-0.0528
Std line	0.5119	0.7758	0.6411	1.4051	1.6118	0.7242
Std sample	0.5261	0.8314	0.6690	1.4523	1.6317	0.7480
Rms line	0.5124	0.7764	0.6437	1.4125	1.6131	0.7256
Rms sample	0.5262	0.8322	0.6721	1.4529	1.6328	0.7503
Rms	0.7345	1.1381	0.9307	2.0266	2.2992	1.0438
Pixels number	841435	841435	841435	841435	841435	841435
Confident pixels	753060	336280	534420	42677	31522	440896

La Crau site	B1-B2	B2-B3	B3-B4	B4-B5	B5-B6	B6-B7
Mean line	0.0025	0.0038	0.0576	0.0048	0.2206	0.0264
Mean sample	0.0257	0.1059	-0.0099	-0.0534	0.7066	-0.1182
Std line	0.6748	1.7047	1.3814	7.3415	9.7669	1.5866
Std sample	0.7070	1.8259	1.2143	6.0832	10.1460	1.5787
Rms line	0.6749	1.7051	1.3828	7.3431	9.7840	1.5868
Rms sample	0.7077	1.8311	1.2159	6.0896	10.2570	1.5843
Rms	0.9783	2.5222	1.8517	9.5589	14.2058	2.2427
Pixels number	537464	537464	537464	537464	537464	537464
Confident pixels	341800	130720	211480	16434	16884	189530

The figures below show the temporal stability over La Crau, Saragossa and Granada sites.




RMS errors in meters - line direction
Band3/Band4
RMS errors in meters - sample direction
Band3/Band4
RMS errors in meters - line direction
Band4/Band5
RMS errors in meters - sample direction
Band4/Band5
RMS errors in meters - line direction
Band5/Band6
RMS errors in meters - sample direction
Band5/Band6
La Crau
Saragossa
Granada
RMS errors in meters
Fractionnal year

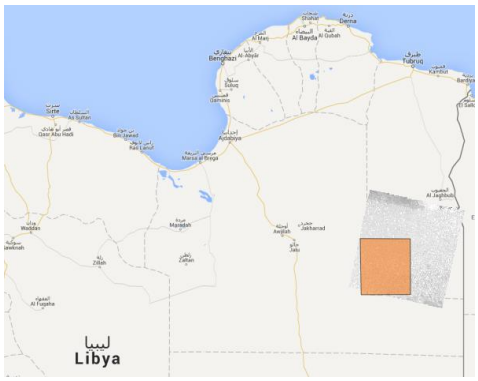

RMS errors in meters - line direction
Band6/Band7
RMS errors in meters
Fractionnal year
La Crau
Saragossa
Granada
RMS errors in meters - sample direction
Band6/Band7
RMS errors in meters
Fractionnal year
La Crau
Saragossa
Granada

7.Test site description

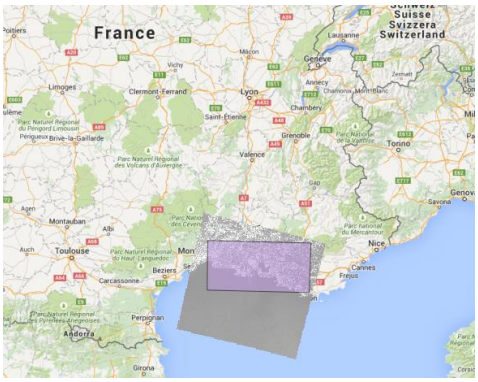
A short description of test site used in the context of this work is given herein.

Site Name ROI geo center	Validation item	Landsat WRS 2 Path/row
"Libya4" 23°23'E/28°33'N	Radiometric accuracy stability monitoring Interband registration accuracy monitoring	181/040
"La Crau" 4°51'E/43°12'N	Geolocation accuracy stability monitoring	196/030
"Granada" 3°7'W/37°28'N	Geolocation accuracy stability monitoring	200/034
"Saragossa" 1°49'W/41°45'N	Geolocation accuracy stability monitoring Interband registration accuracy monitoring	200/031
"Egypt1" 26°35'E/27°47N	Interband registration accuracy monitoring	179/041
"Belgium" 4°20'E/50°30'N	Interband registration accuracy monitoring	198/025

Table 4 – Validation sites



Libya4 site



La Crau site

Granada site

Saragossa site

Figure 8 – ROI used for radiometric accuracy stability monitoring and geolocation accuracy stability monitoring

8.Validation data

8.1.Radiometric accuracy stability monitoring (38 products)

From ESA catalog[4], data is mostly available as Level L1T (precision and terrain corrected) products. It is important to note that sometimes instead of L1T, L1Gt might be proposed. Highlighted products are L1Gt products.

Product ID	Site	Observation date	Processor
LC81810402014029MTI00	Libya4	29/01/2014	LPGS_2.2.1
LC81810402014045MTI00	Libya4	14/02/2014	LPGS_2.2.1
LC81810402014061MTI00	Libya4	02/03/2014	LPGS_2.2.1
LC81810402014093MTI00	Libya4	03/04/2014	LPGS_2.2.1
LC81810402014109MTI00	Libya4	19/04/2014	LPGS_2.2.1
LC81810402014157MTI00	Libya4	06/06/2014	LPGS_2.2.1
LC81810402014173MTI00	Libya4	22/06/2014	LPGS_2.2.1
LC81810402014189MTI00	Libya4	08/07/2014	LPGS_2.3.0
LC81810402014205MTI00	Libya4	24/07/2014	LPGS_2.3.0
LC81810402014221MTI00	Libya4	09/08/2014	LPGS_2.3.0
LC81810402014237MTI00	Libya4	25/08/2014	LPGS_2.3.0
LC81810402014253MTI00	Libya4	10/09/2014	LPGS_2.3.0
LC81810402014269MTI00	Libya4	26/09/2014	LPGS_2.3.0
LC81810402014301MTI00	Libya4	28/10/2014	LPGS_2.3.0
LC81810402014317MTI00	Libya4	13/11/2014	LPGS_2.3.0
LC81810402014333MTI00	Libya4	29/11/2014	LPGS_2.3.0
LC81810402014365MTI00	Libya4	31/12/2014	LPGS_2.3.0
LC81810402015032MTI00	Libya4	01/02/2015	LPGS_2.3.0
LC81810402015048MTI00	Libya4	17/02/2015	LPGS_2.3.0
LC81810402015064MTI00	Libya4	05/03/2015	LPGS_2.4.0
LC81810402015080MTI00	Libya4	21/03/2015	LPGS_2.4.0
LC81810402015096MTI00	Libya4	06/04/2015	LPGS_2.4.0
LC81810402015112MTI00	Libya4	22/04/2015	LPGS_2.4.0
LC81810402015128MTI00	Libya4	08/05/2015	LPGS_2.4.0
LC81810402015144MTI00	Libya4	24/05/2015	LPGS_2.4.0
LC81810402015160MTI00	Libya4	09/06/2015	LPGS_2.4.0
LC81810402015176MTI00	Libya4	25/06/2015	LPGS_2.4.0
LC81810402015192MTI00	Libya4	11/07/2015	LPGS_2.4.0
LC81810402015208MTI00	Libya4	27/07/2015	LPGS_2.4.0
LO81810402015224MTI00	Libya4	12/08/2015	LPGS_2.4.0
LC81810402015240MTI00	Libya4	28/08/2015	LPGS_2.4.0
LC81810402015256MTI00	Libya4	13/09/2015	LPGS_2.4.0
LC81810402015288MTI00	Libya4	15/10/2015	LPGS_2.4.0
LC81810402015304MTI00	Libya4	31/10/2015	LPGS_2.5.1
LC81810402015320MTI00	Libya4	16/11/2015	LPGS_2.5.1
LC81810402015336MTI00	Libya4	02/12/2015	LPGS_2.5.1
LC81810402016003MTI00	Libya4	03/01/2016	LPGS_2.5.1
LC81810402016035MTI00	Libya4	04/02/2016	LPGS_2.5.1
LC81810402016051MTI00	Libya4	20/02/2016	LPGS_2.5.1

[4] https://landsat8portal.eo.esa.int/portal/

8.2.Geolocation accuracy stability monitoring (49 products)

Product ID	Site	Observation date	Processor
LC81960302013211NSG00	La Crau	30/07/2013	LPGS_2.2.1
LC81960302014086MTI00	La Crau	27/03/2014	LPGS_2.2.1
LC81960302014182MTI00	La Crau	01/07/2014	LPGS_2.3.0
LO81960302014246MTI00	La Crau	03/09/2014	LPGS_2.3.0
LC81960302015089MTI00	La Crau	30/03/2015	LPGS_2.4.0
LC81960302015137MTI00	La Crau	17/05/2015	LPGS_2.4.0
LC81960302015153MTI00	La Crau	02/06/2015	LPGS_2.4.0
LC81960302015169MTI00	La Crau	18/06/2015	LPGS_2.4.0
LC81960302015185MTI00	La Crau	04/07/2015	LPGS_2.4.0
LC81960302015201MTI00	La Crau	20/07/2015	LPGS_2.4.0
LC81960302015217MTI00	La Crau	05/08/2015	LPGS_2.4.0
LC81960302015233MTI00	La Crau	21/08/2015	LPGS_2.4.0
LC81960302015249MTI00	La Crau	06/09/2015	LPGS_2.4.0
LC82000312014098MTI00	Saragossa1	08/04/2014	LPGS_2.2.1
LC82000312014146MTI00	Saragossa1	26/05/2014	LPGS_2.2.1
LC82000312014162MTI00	Saragossa1	11/06/2014	LPGS_2.4.0
LC82000312014178MTI00	Saragossa1	27/06/2014	LPGS_2.4.0
LC82000312014226MTI00	Saragossa1	14/08/2014	LPGS_2.3.0
LC82000312014258MTI00	Saragossa1	15/09/2014	LPGS_2.3.0
LC82000312015069MTI00	Saragossa1	10/03/2015	LPGS_2.4.0
LC82000312015149MTI00	Saragossa1	29/05/2015	LPGS_2.4.0
LC82000312015165MTI00	Saragossa1	14/06/2015	LPGS_2.4.0
LC82000312015181MTI00	Saragossa1	30/06/2015	LPGS_2.4.0
LC82000312015197MTI00	Saragossa1	16/07/2015	LPGS_2.4.0
LC82000312015213MTI00	Saragossa1	01/08/2015	LPGS_2.4.0
LC82000312015229MTI00	Saragossa1	17/08/2015	LPGS_2.4.0
LC82000312015261MTI00	Saragossa1	18/09/2015	LPGS_2.4.0
LC82000342014050MTI00	Granada	19/02/2014	LPGS_2.4.0
LC82000342014066MTI00	Granada	07/03/2014	LPGS_2.4.0
LC82000342014098MTI00	Granada	08/04/2014	LPGS_2.4.0
LC82000342014130MTI00	Granada	10/05/2014	LPGS_2.4.0
LC82000342014226MTI00	Granada	15/08/2014	LPGS_2.4.0
LO82000342014242MTI00	Granada	30/08/2014	LPGS_2.4.0
LC82000342014258MTI00	Granada	15/09/2014	LPGS_2.4.0
LC82000342014354MTI00	Granada	20/12/2014	LPGS_2.4.0
LC82000342015005MTI00	Granada	05/01/2015	LPGS_2.4.0
LC82000342015053MTI00	Granada	22/02/2015	LPGS_2.4.0
LC82000342015069MTI00	Granada	10/03/2015	LPGS_2.4.0
LC82000342015133MT00	Granada	13/05/2015	LPGS_2.4.0
LC82000342015181MTI00	Granada	30/06/2015	LPGS_2.4.0
LC82000342015197MTI00	Granada	16/07/2015	LPGS_2.4.0
LC82000342015213MTI00	Granada	01/08/2015	LPGS_2.4.0
LC82000342015229MTI00	Granada	17/08/2015	LPGS_2.4.0
LC82000342015245MTI00	Granada	02/09/2015	LPGS_2.4.0
LC82000342015261MTI00	Granada	18/09/2015	LPGS_2.4.0
LC82000342015309MTI00	Granada	05/11/2015	LPGS_2.5.1
LC82000342015341MTI00	Granada	07/12/2015	LPGS_2.5.1
LC82000342016008MTI00	Granada	08/01/2016	LPGS_2.5.1

LC82000342016072MTI00	Granada	12/03/2016	LPGS_2.5.1

8.3.Interband registration accuracy (15 products)

Product ID	Site	Observation date	Processor
LC81960302013211NSG00	La Crau	30/07/2013	LPGS_2.2.1
LC81960302014310MTI00	La Crau	06/11/2014	LPGS_2.3.0
LC81960302015153MTI00	La Crau	02/06/2015	LPGS_2.4.0
LC81960302015201MTI00	La Crau	20/07/2015	LPGS_2.4.0
LC81960302015217MTI00	La Crau	05/08/2015	LPGS_2.4.0
LC82000312014066MTI00	Saragossa	07/03/2014	LPGS_2.2.1
LC82000312015069MTI00	Saragossa	10/03/2015	LPGS_2.4.0
LC82000312015181MTI00	Saragossa	30/06/2015	LPGS_2.4.0
LC82000342014098MTI00	Granada	08/04/2014	LPGS_2.2.1
LC82000342014146MTI00	Granada	26/05/2014	LPGS_2.2.1
LC82000342014322MTI00	Granada	18/11/2014	LPGS_2.3.0
LC82000342015005MTI00	Granada	05/01/2015	LPGS_2.3.0
LC82000342015069MTI00	Granada	12/03/2015	LPGS_2.4.0
LC82000342015133MTI00	Granada	13/05/2015	LPGS_2.4.0
LC82000342015181MTI00	Granada	30/06/2015	LPGS_2.4.0