GEOMETRIC QUALITY PARAMETERS

L1WG – DAVOS 9th December 2015

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Metrics

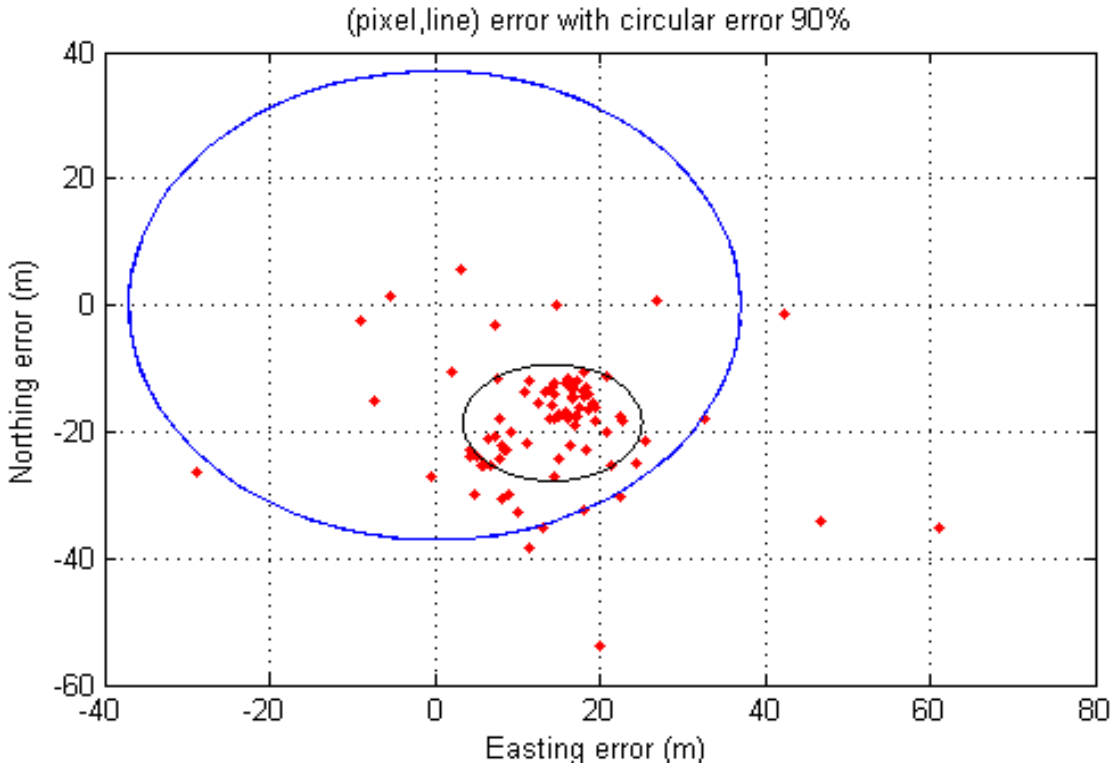
- There are an important number of accuracy metrics in the domain. The most frequent ones are:
- The standard deviation
- The Root Mean Square Error (RMSE) in one direction,
- The two dimensional RMSE (Distance RMS, DRMS),
- The Circular Error probable at 90/95 percentile (CE90/CE95),

Assumptions

- Geo positioning Random variable pair
- Bivariate normal distribution
- Independent Variables
- Standard Deviation Requirements

Circular precision index

sqr(alpha)	Probability	Notation
1.00	39.4%	1-sigma or standard ellipse – so called circular standard error.
1.18	50.0%	Circular Error Probable (CEP)
1.414	63.2%	Distance RMS (DRMS) – so called MSPE (Mean square positional error)
2.00	86.5%	2-sigma or standard ellipse
2.146	90.0%	90% confidence level
2.45	95.0%	95% confidence level
2.818	98.2%	2DRMS
3.00	98.9%	3-sigma or standard ellipse


(pixel,line) error with circular error 90%
Northing error (m)
Easting error (m)
40
20
0
-20
-40
-60
-40
-20
0
20
40
60
80

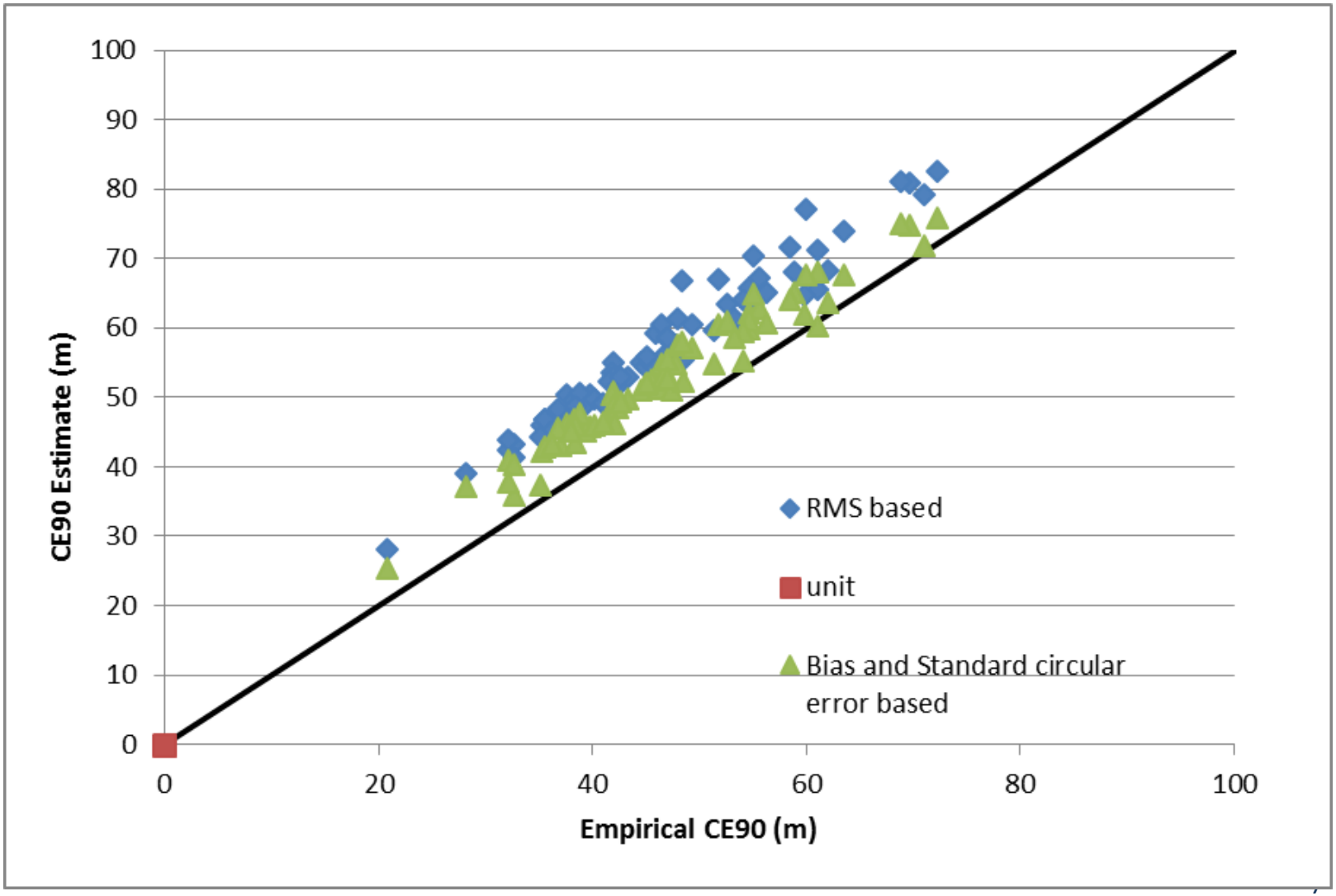
Objective

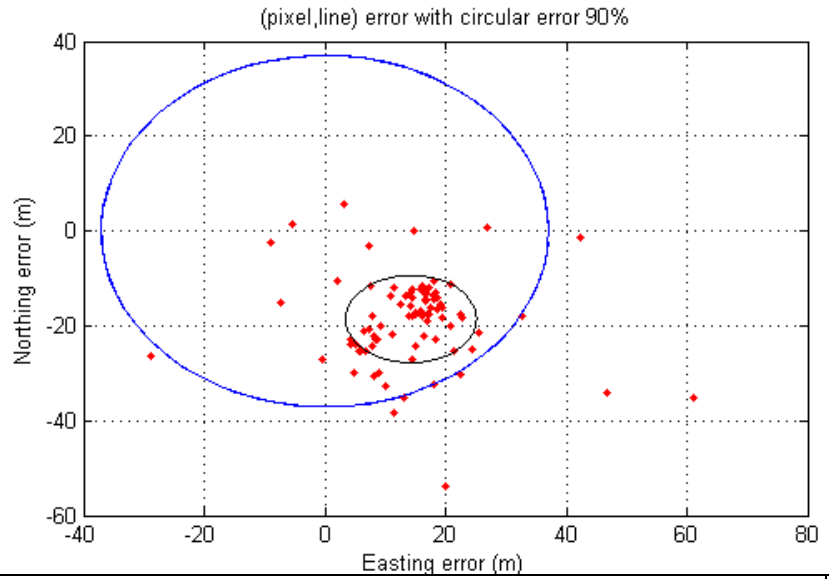
- A) Evaluate on how CE90 accuracy metric is varying depending on its formulation.
- B) Evaluate Geometric Accuracy Evaluation Method for multi temporal dataset

  Scene based / Point based measurement ?

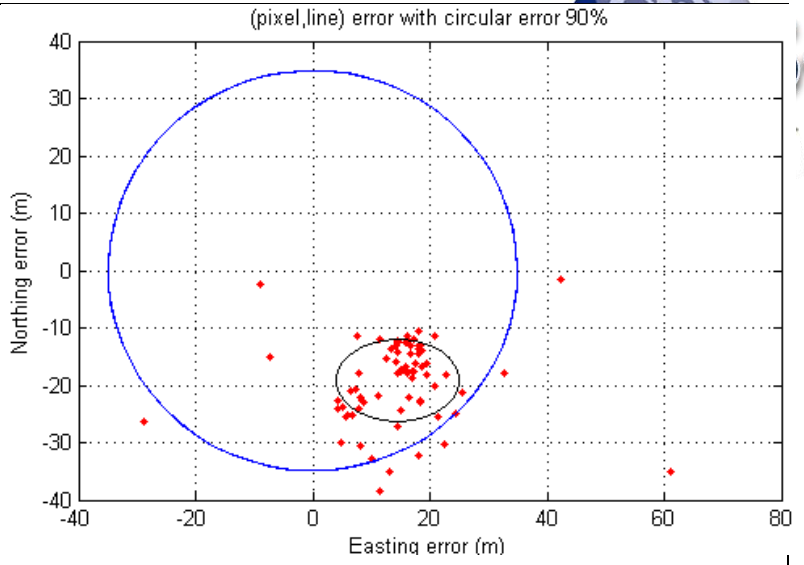
  Contraints on GCP (spatial / temporal)

- Input : 89 Landsat TM data, from 1984 => 2010
- Processsing : Image matching, 100 Gcps selected.

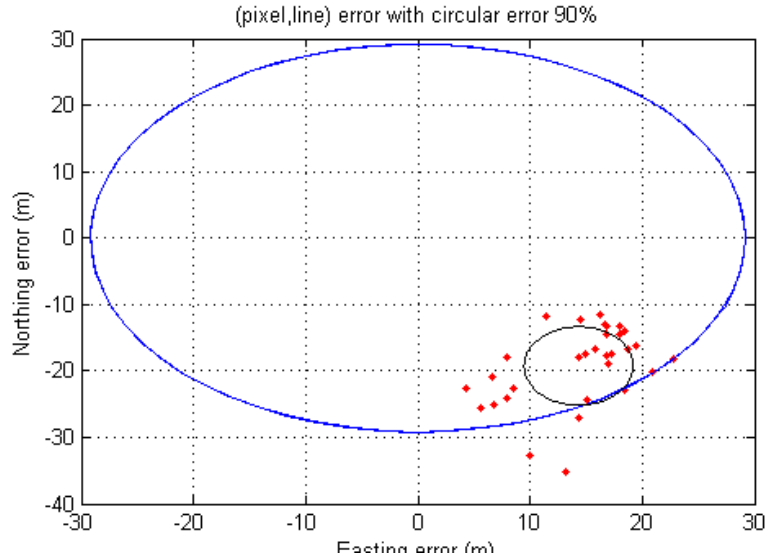

CE90 Estimate (m)
Empirical CE90 (m)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
RMS based
unit
Bias and Standard circular error based



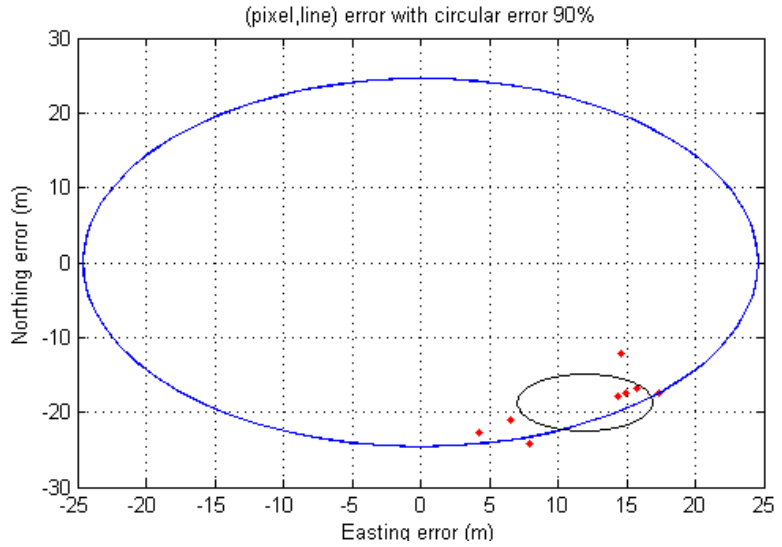
A/ 37.061 m@CE90 (89 products)



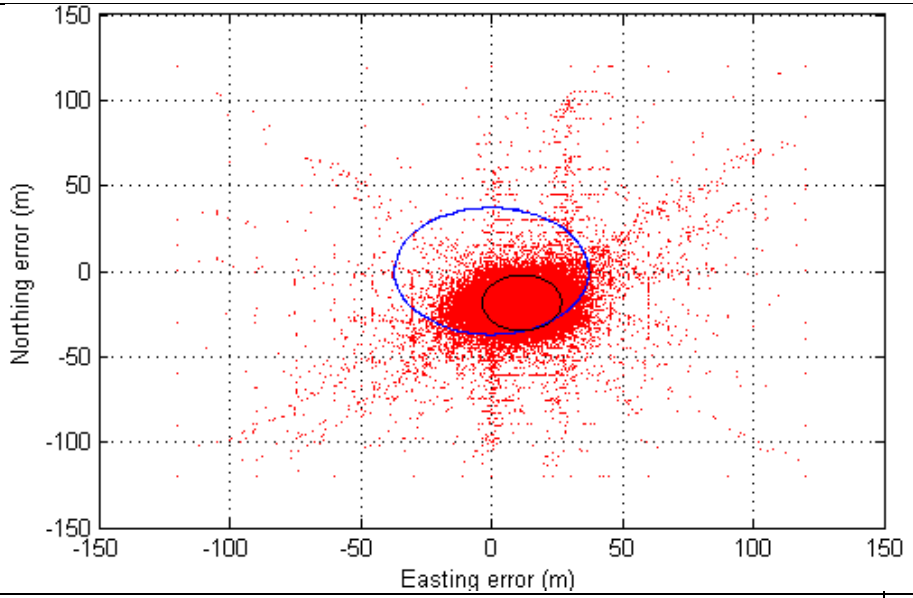
B/ 34.92 m@CE90 (74 products)

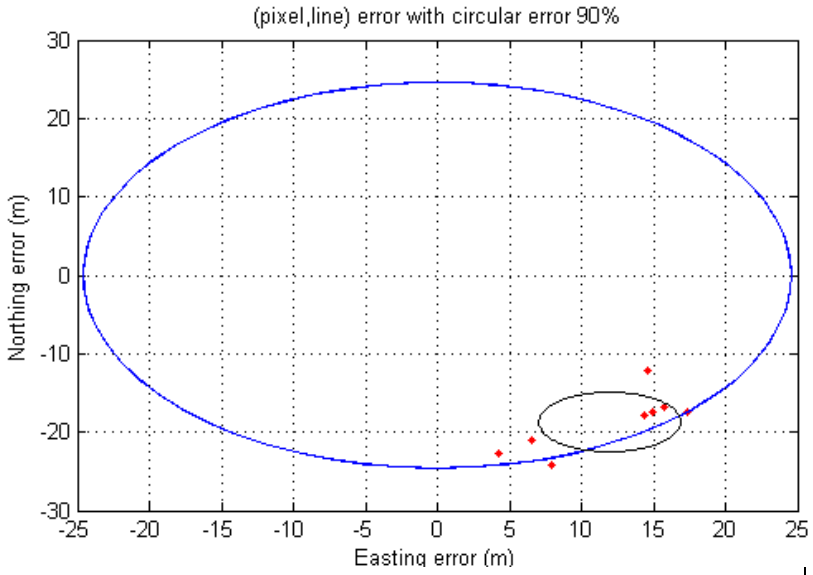


C/ 29.17 m @CE90 (39 products)

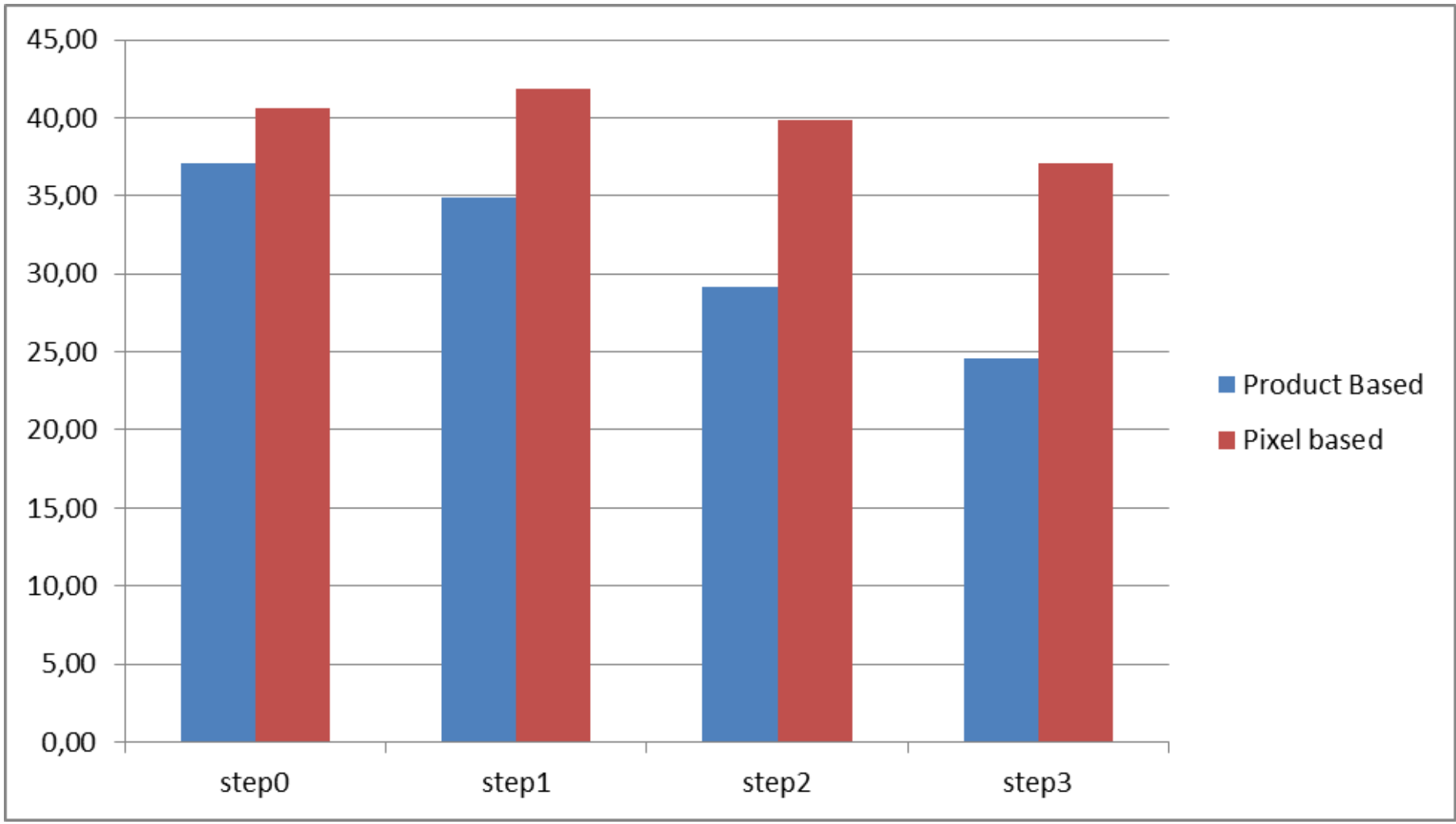


D/ 24.59 m@CE90, (8 products)





37.12 m @CE90 (8 products)	24.59 m @CE90 (8 products)


45,00
40,00
35,00
30,00
25,00
20,00
15,00
10,00
5,00
0,00
step0
step1
step2
step3
Product Based
Pixel based

LS05 TM, L1T Geometric Accuracy results

- The multi temporal accuracy of scenes from KIR / MPS dataset have been assessed, respectively path/row 196/26 and path/row 199 /31. Larger dataset for KIR Data : from Y85 up to Y05.
- In the first case, **196/26**, the reference data is from LS08 data. In the second case, 199/31, the accuracy is evaluated "relative to" one scene of the MPS input dataset.
- Very strengthen criteria on selection of Ground Control Points used for the validation (temporal stability constraint and spatial distribution of the GCP set).
- It has been discovered that for some MPS TM scenes, images were affected by geometric deformations, after investigating, it might be due to quality of Ground Control Point database used during the processing. Quite few WRS scenes are affected (images: next slide)
- A statistics on mean geometric accuracy (m) is given in table below

DS	Easting Mean Error	Northing Mean Error	Easting Std Error	Northing Std Error	Easting RMSE	Northing RMSE	2D RMSE
KIR 196/26	9.74	-20.64	16.70	20.07	20.00	28.84	35.20
MPS 199/31	0.96	0.35	17.20	15.48	17.45	15.66	23.54

LS05 TM, L1T Geometric Accuracy results (2)

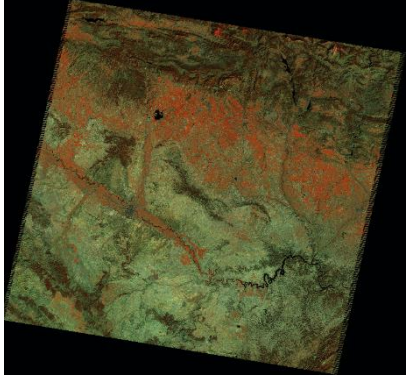
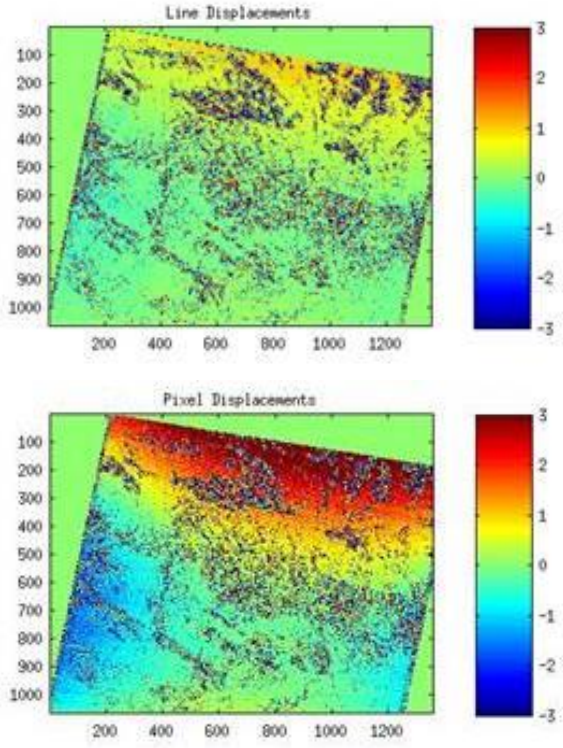
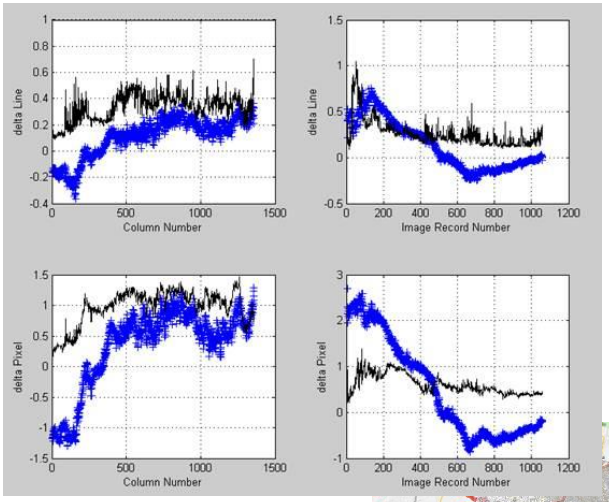


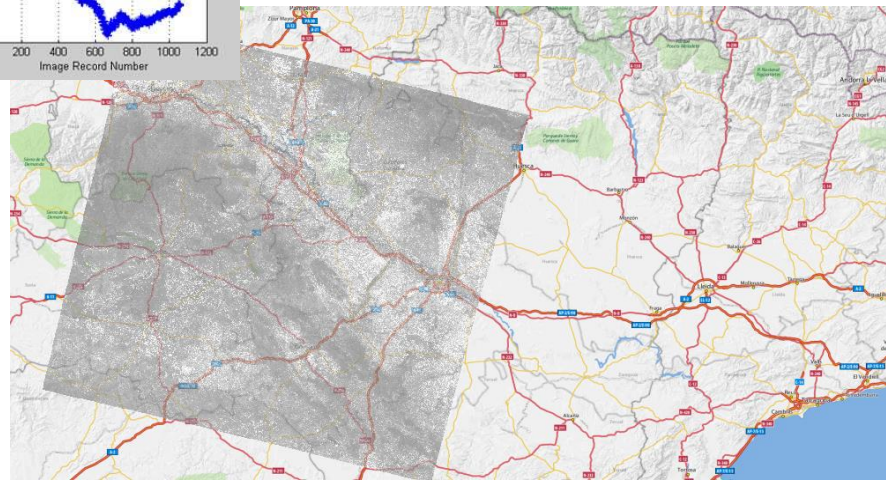
Image of Displacements, line pixel directions.



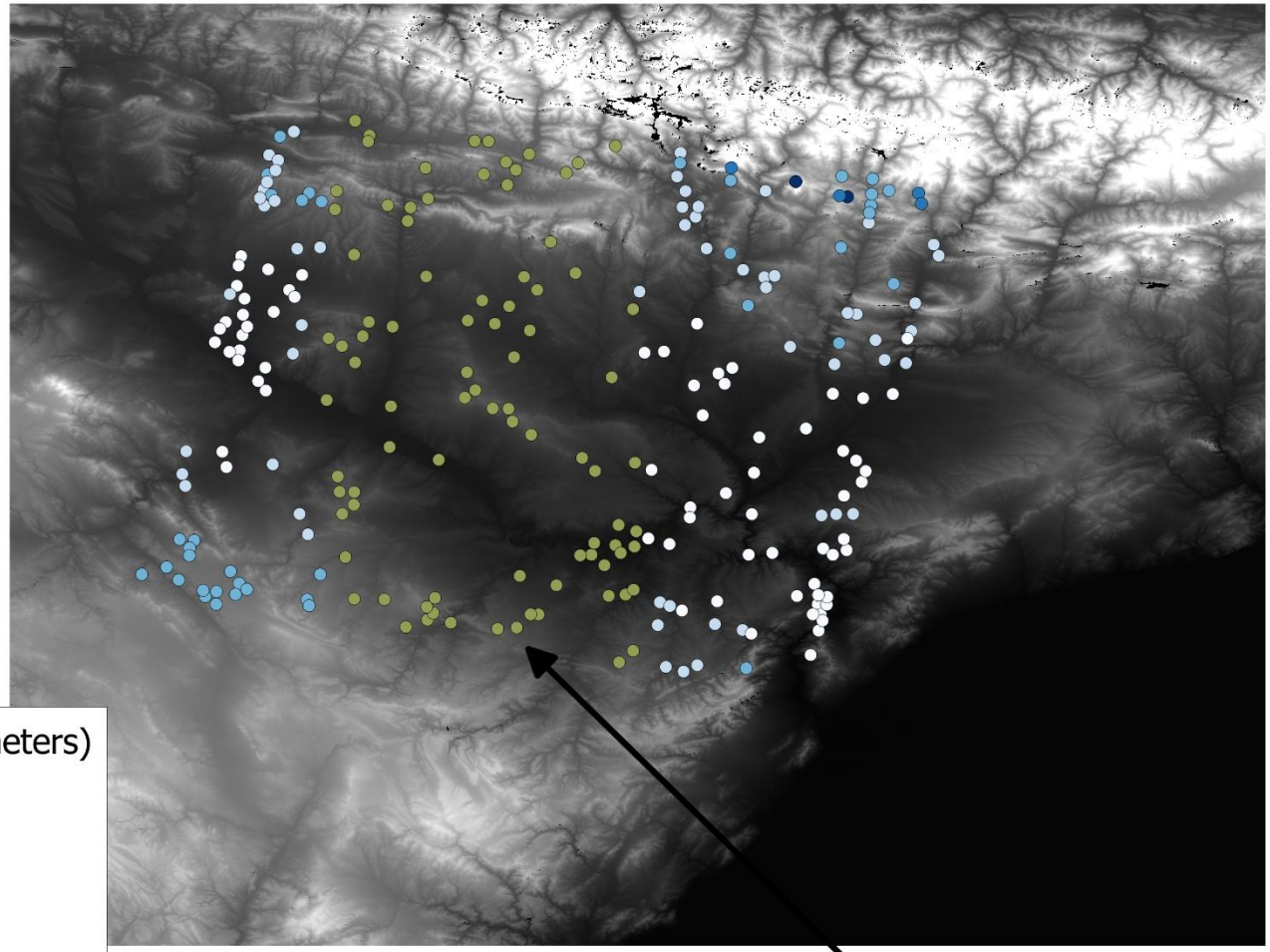
Deformation Profile - “Mean Line”, “Mean pixel”
Displacements in both Line and pixel directions



ROI located in Spain (Saragossa)
The scene displays hilly terrain relief including river and valleys with Pyrenees mountain in the top.
In this part of the image, the displacements in pixel direction are strong (> 2 px).



ACS TM GCP Chip Spatial distribution and altitude Class
for Path / Row - 199 / 031 (SLAP V3.03) on SRTMV3 image.



altitude class (meters)

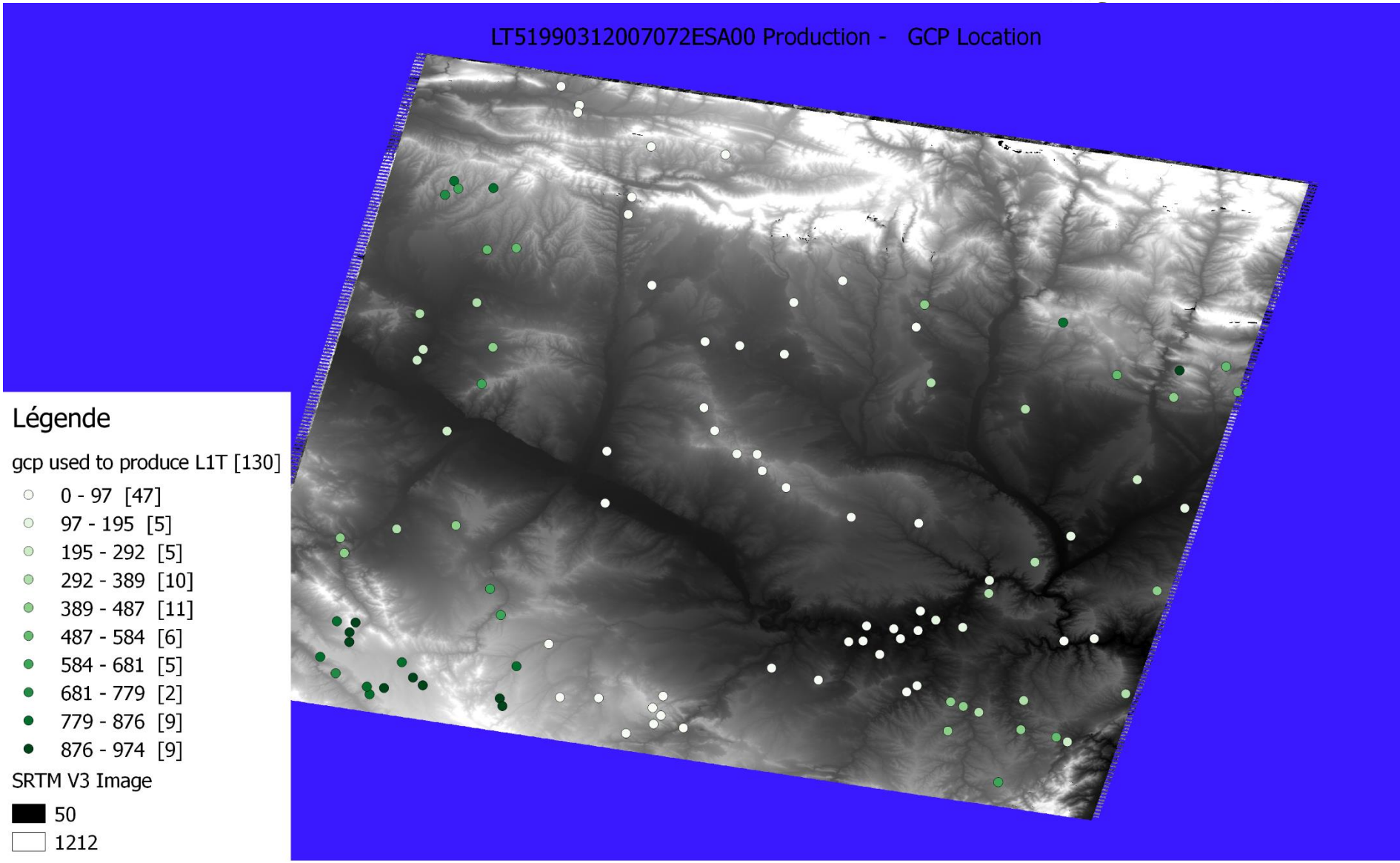
ACS_GCPLib_QC

- 0.0 - 0.0
- 0 - 385
- 385 - 769
- 769 - 1154
- 1154 - 1539
- 1539 - 1924

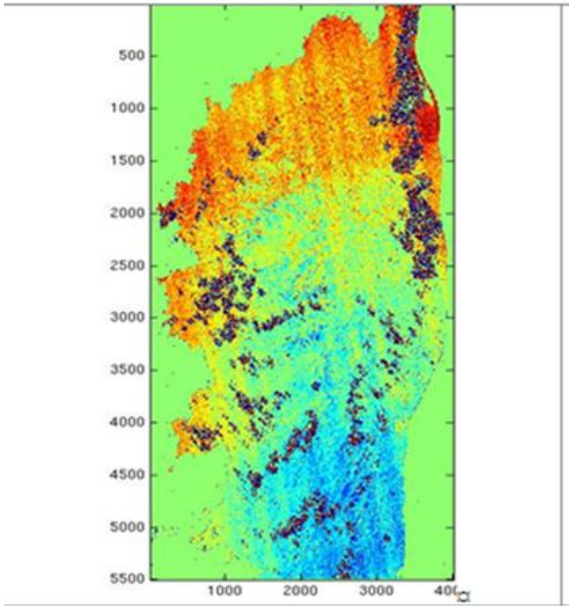
saragosse_srtm_v3

- -46
- 2192

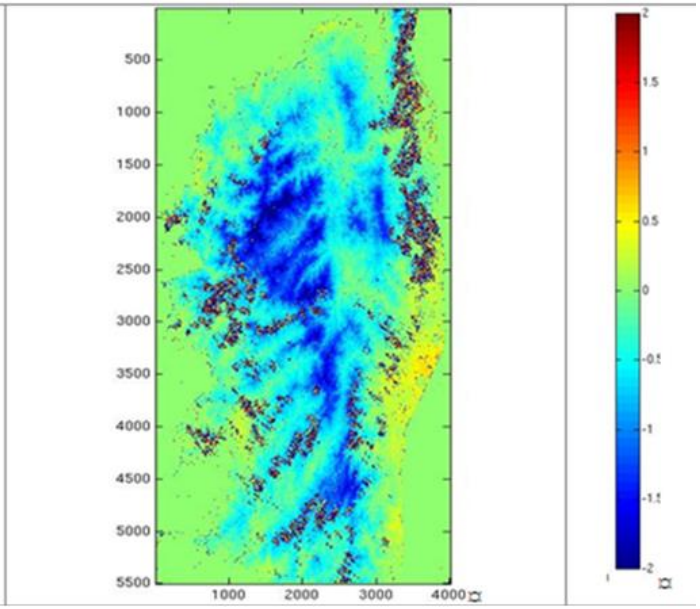
GCP Chip Elevation set to 0 : 87
Total Number of GCP Chip : 259
Maximum difference (SRTM - GCP altitude) = 1509

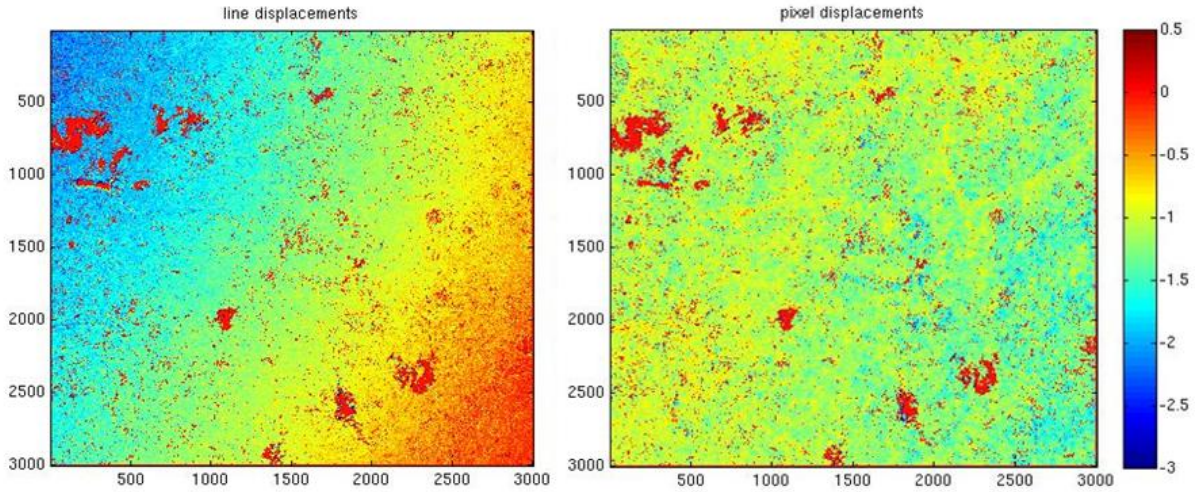

LT51990312007072ESA00 Production - GCP Location
Légende
gcp used to produce L1T [130]
0 - 97 [47]
97 - 195 [5]
195 - 292 [5]
292 - 389 [10]
389 - 487 [11]
487 - 584 [6]
584 - 681 [5]
681 - 779 [2]
779 - 876 [9]
876 - 974 [9]
SRTM V3 Image
50
1212

LINE DISPLACEMENTS



PIXEL DISPLACEMENTS




line displacements
pixel displacements
500
1000
1500
2000
2500
3000
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3

Level 1 Recom’

- Data providers fully describe the approach adopted for geo positional accuracy assessment – product and multi temporal accuracy

- Improve product including traceable metadata information about the geometric processing

Thank you

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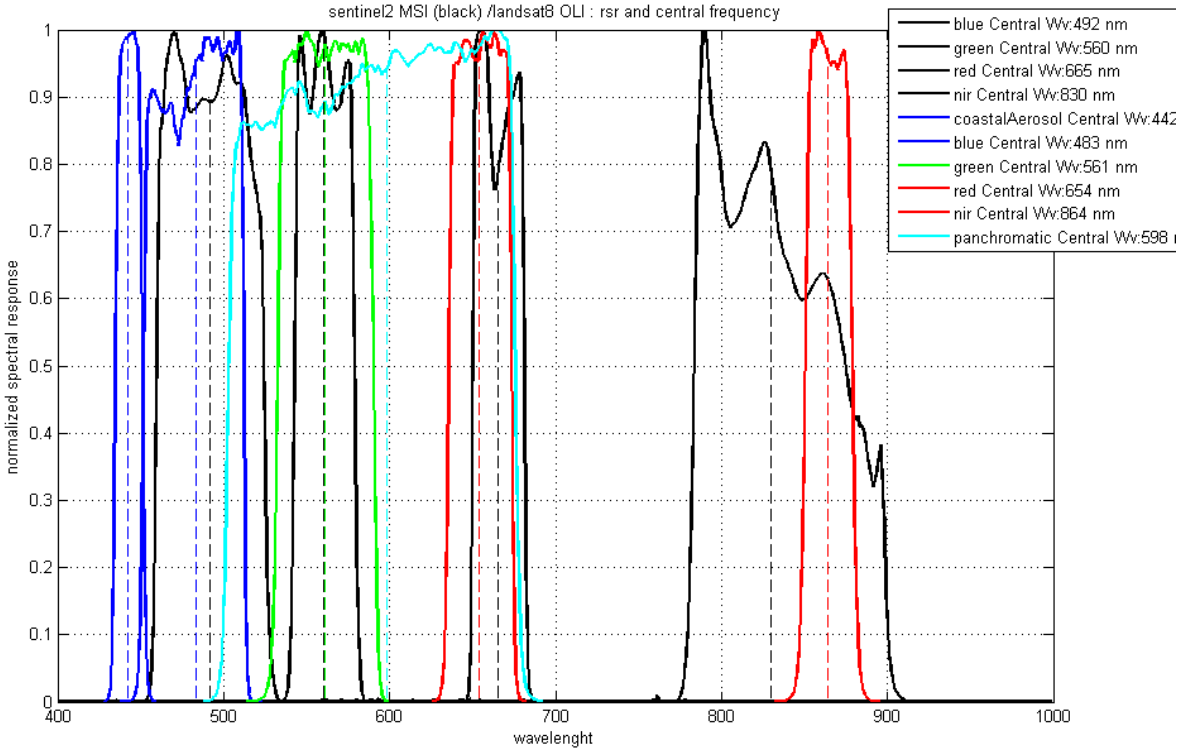

Common spectral range; LS8 OLI and Sentinel 2 MSI 10 m bands (black).