	Centre National d'Etudes Spatiales	
SCA _GEO_06 TRO-34-NT-2785-CNES	**Activity : CAL/VAL** **Absolute pointing location**	**Prepared by : A Rosak** **Verified by : N Karouche**

Contents

1. OBJECTIVE

The objective of this note is to check the absolute geolocation performances of Scarab.

This study was conducted by CNES with Magellium.

2. METHODS

The geolocation performances are computed on L1A1 products on channel 2.

2.1. GCP COMPARISON WITH MAPS

The first basic method to be used is the selection of Ground Control Points (GCP), the retrieval of their geolocation and their check using maps. Due to the smooth modulation transfert function of the images, we did not expect to reach a precision of less than one pixel.

The first checks performed on several GCP showed that the geolocation performance was mainly within the pixel. Accordingly, we consider that we are reaching the limits of this method which is therefore no longer used.

2.2. COMPARISON WITH REFERENCE IMAGE

A Vegetation (VGT) Synthesis Product is used as reference image, because:

- Synthesis product is cloud free,
- VGT Band 2 has a spectral coverage included in the Scarab Channel 2 (good correlation for day acquisitions),
- VGT has a geolocation accuracy of less than 1km,
- VGT resolution is 1 km.

VGT image is binned to reach 40km resolution and resampled on the Scarab grid product. In order to avoid geometric drifts, this resampling is performed using bicubic interpolator.

Then, a matching is performed between the Scarab product and the resampled VGT image.

Here are first the resampled VGT synthesis (on Scarab focal plane geometry), and second the Scarab L1A1 product. The Arabian Peninsula, India and S-E Asia are easily recognizable.

A “flip-flop” operation on these images allow us to visually ensure that the shift between the 2 images is less than 1 pixel in both directions (along scan, and along track)

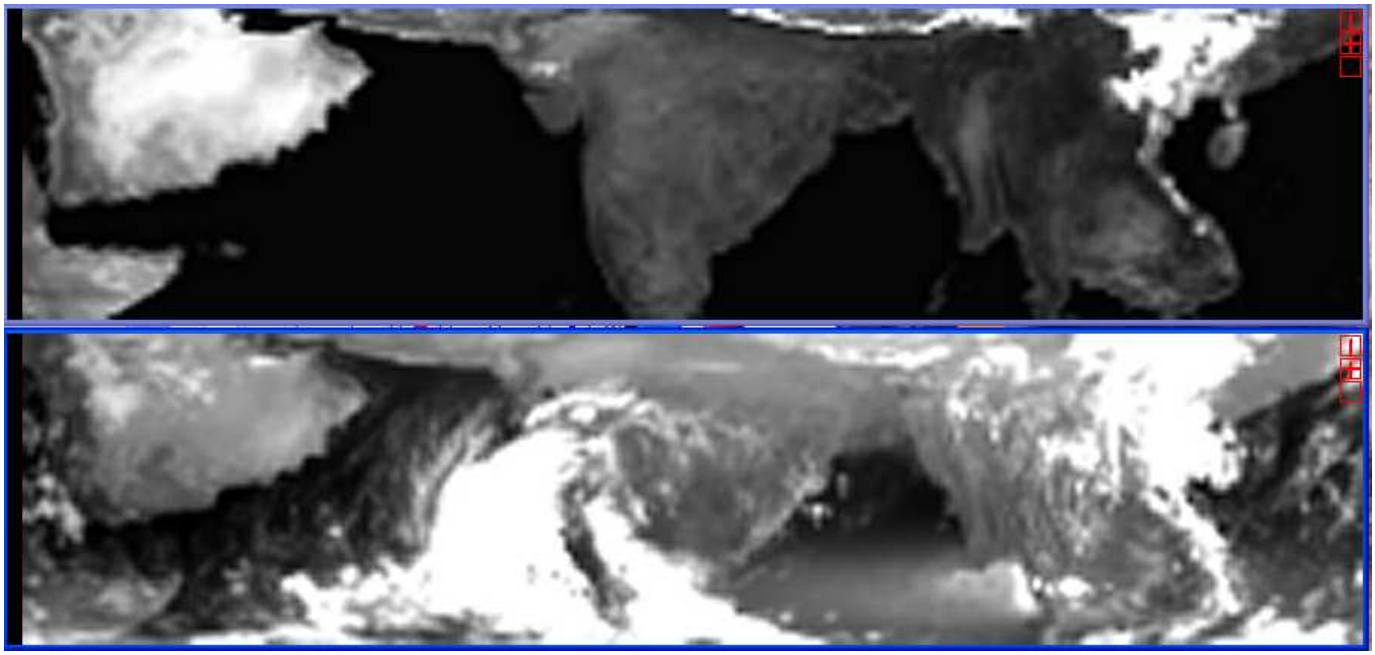

Figure 1 : Orbit 666 extract from scan 1 to scan 221,

Resampled VGT on the top, SCARAB C2 below

Visual checks do not allow the measurement of performances with an accuracy higher than 0.5 pixel.

Massive correlation should be used to reach a better accuracy.

3. SUCCESS CRITERIA

The pointing location knowledge accuracy for the SCARAB instrument shall lie within 5 km. This pointing constraint is absolute, and therefore includes instrument and bus constraints.

4. PRODUCTS USED

To obtain these results, the following orbits have been used:

- 568, 1 extract,
- 569, 2 extracts,
- 583, 2 extracts,
- 666, 2 extracts,
- 669, 1 extract,
- 711, 1 extract,
- 822, 1 extract,
- 1415, 3 extracts,
- 1686, 1 extract.

5. RESULTS

5.1. RESULTS OBTAINED WITH FLIGHT MATRICES

Histograms of shifts across (dX) and along (dY) track measured by correlation on extracts are presented hereafter:

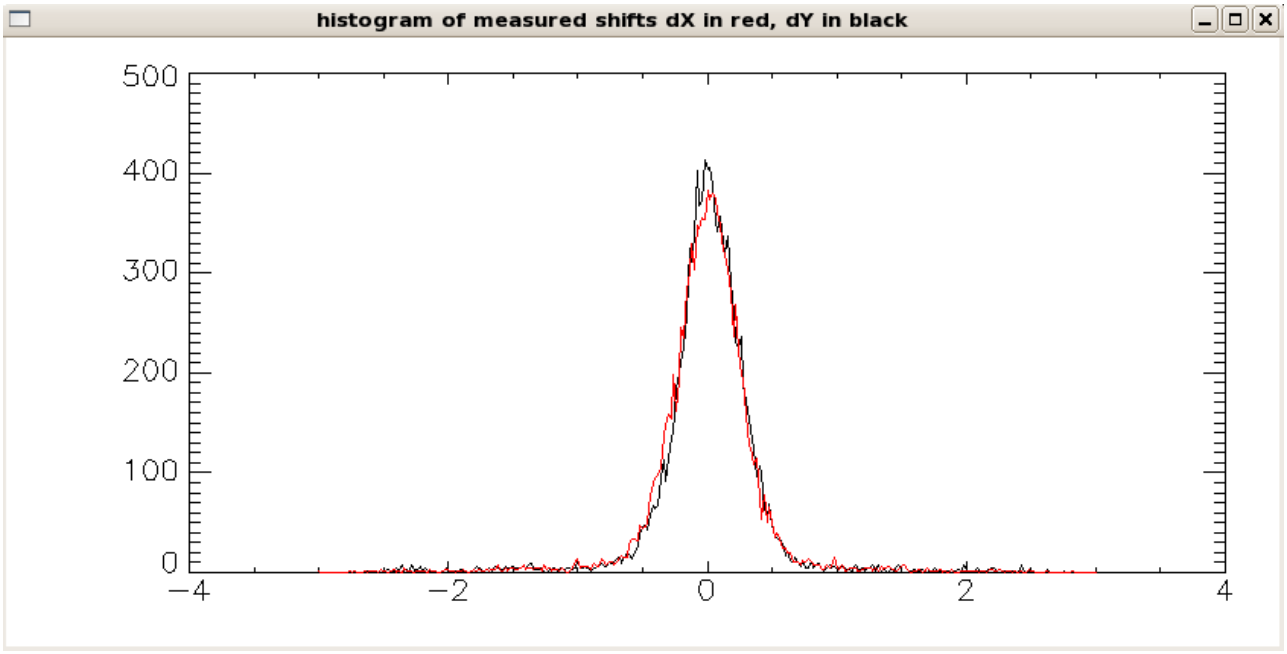

Figure 2 : Histograms of shifts across and along track measured by correlation.

The following table shows statistics computed on shifts measured by correlation and filtered according to their related correlation coefficient value.

	mean	Standard deviation
Across track shifts	0.007	0.40
Along track shifts	0.021	0.42

Table 1 : Statistics on shifts filtered according to their correlation coefficient

This table below shows statistics computed on 80% of most common values of shifts in the question above.

	Mean	Standard deviation
Across track shifts	0.015	0.17
Along track shifts	0.037	0.165

Table 2 : Statistics on shifts filtered according to their correlation coefficient

Computing final geolocation accuracy at Nadir:

Considering that at Nadir dx and dy respectively correspond to a fraction of 29.4 and 36.5 km, we can now conclude that:

- **geolocation bias** is **about 1.4 km at Nadir.**
-

Computing final geolocation accuracy at swath border (samples 0 and 50):

Geolocation bias at swath border (samples 0 and 50) will be estimated to:

- 1.5 km across track
- 2.3 km along track

Finally, global bias is estimated to be 2.7 km at swath borders.

5.2. BIAS STABILITY SURVEY

This sub-section aims to prove that statistics computed on large dataset can be trusted and thus that the results given in this chapter are reliable. In order to prove this, we are going to show that the bias computed on several products is stable. The following tables give the biases along and across track computed for several dumpwise products as well as their average. For this set of results, geolocation has been performed with new matrices.

Orbit	Y Bias (km)	X Bias (km)
583	-0,5	-0,5
666	-0,4	-0,3
669	-1,5	1,3
711	0,2	-0,3
822	1,5	1,5
1415	1,2	0,3

Table 3: Biases along and across track computed on different products

Y Bias average (km)	X Bias average (km)
0,1	0,4
Y Bias std dev (km)	X Bias std dev (km)
1,1	0,9

Table 4: Statistics on biases given in table 3

We can conclude that the **uncertainty (random bias)** of this method is better than 1 km.

6. CONCLUSION

The final performance of absolute geolocation of Scarab is:

	Nadir		Swath border	
	across track	along track	across track	along track
Maximum bias measured	0.4km	1.3 km	1.5 km	2.3 km
Uncertainty	1km	1km	1km	1km
VGT geolocation accuracy less than 1km	1km	1km	1km	1km
Total	2.4km		3.4km	
Requirement	5km		5km	

Table 5: Absolute geolocation