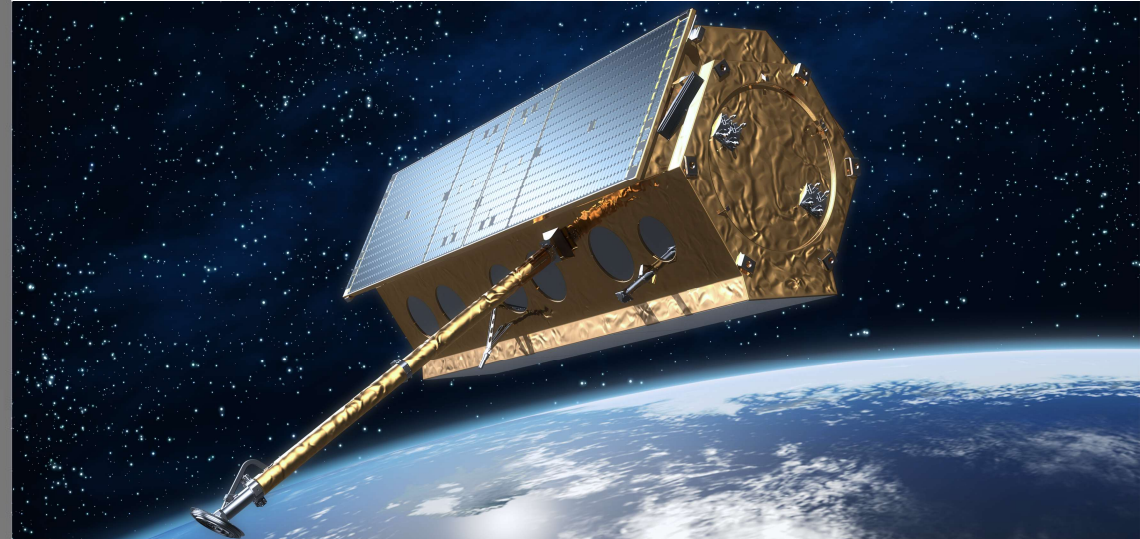# Advances in PAZ products geometric analysis

Instituto Nacional De Técnica Aeroespacial (INTA)
pcifrev@inta.es; casalvn@inta.es

PAZ satellite launched   February 2018

Calibrated during C.P

Geometric current analysis:

Pixel Location Accuracy:
    Monitoring
    - SSC product based –
    Geometric calibration update.
Pixel Geolocation Accuracy. First Characterization.
    - Geocoded products based -

Test Data Set:

Almost 150 DTs over INTA Corner Reflectors:
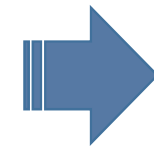Right Looking acquisitions
Variability:
Incidence Angles
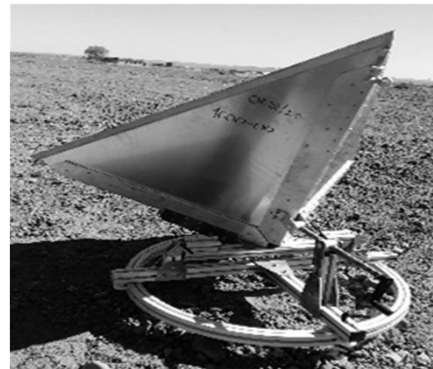Asc / Des Geometry
Imaging Mode
Polarization

Apr. 2018 ➡ Jan. 2020

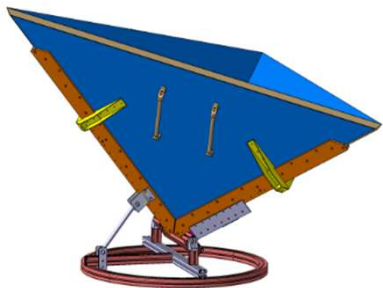## On Ground Equipment

29 Corner Reflectors
1.0m & 1.5m size

Pixel Location Accuracy

Monitoring method
Azimuth Shift
Internal Delay
-    SSC product based –

Total Datatakes: 146

Measurements: 506

Geometric Calibration Update

Results of polarization verification

Polarization Mode	Range Mean [m]	Azimuth Mean [m]	Pixel Location Accurazy Mean [m]	Pixel Location Accurazy STD [m]
S (HH)	0.151	0.163	0.245	0.132
S (VV)	0.169	0.165	0.263	0.160
D (HH)	0.099	0.250	0.273	0.143
D (VV)	0.076	0.228	0.287	0.140

Radar Coordinates Offset identified. Coordinate Systems Misinterpretation *

Descending Orbits:
CRs before than expected
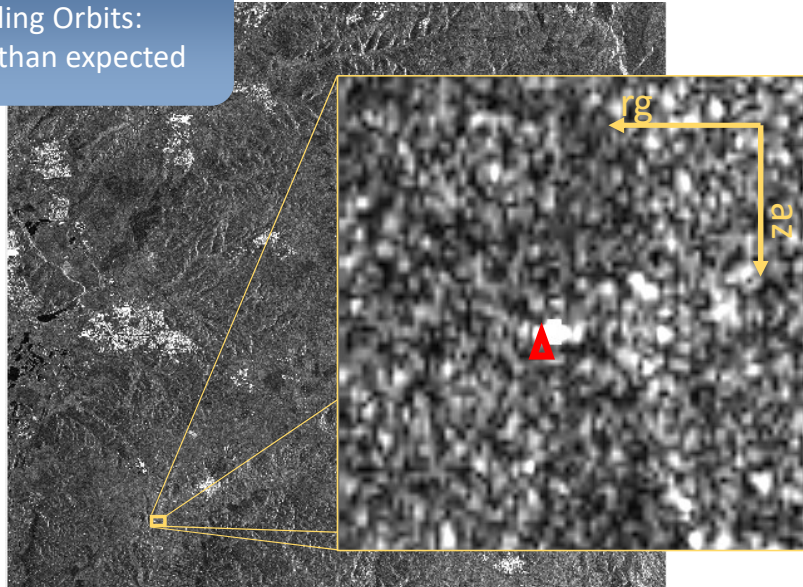
Ascending Orbits:
CRs after than expected

rg
az

az
rg
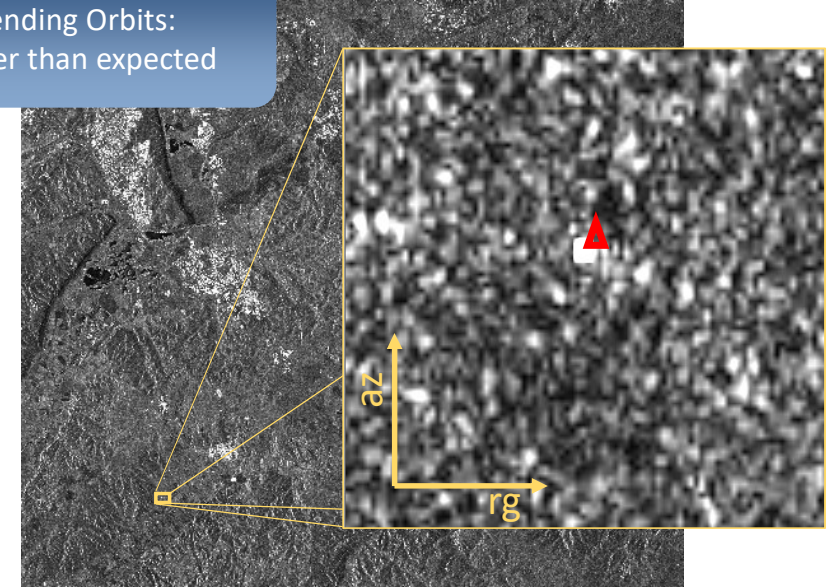
Geodetic Coordinate System/Frame of Corner Reflectors
ETRS89/ETRF2000 (Spain)

Epoch 2005.0
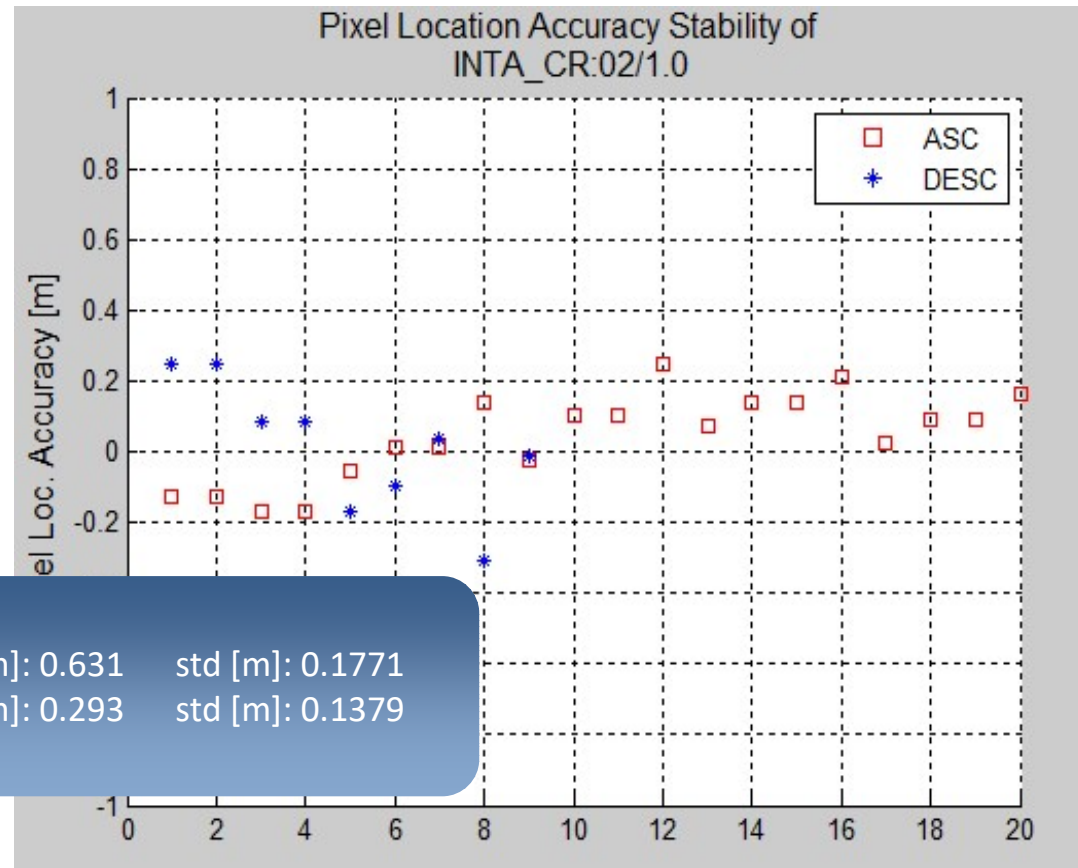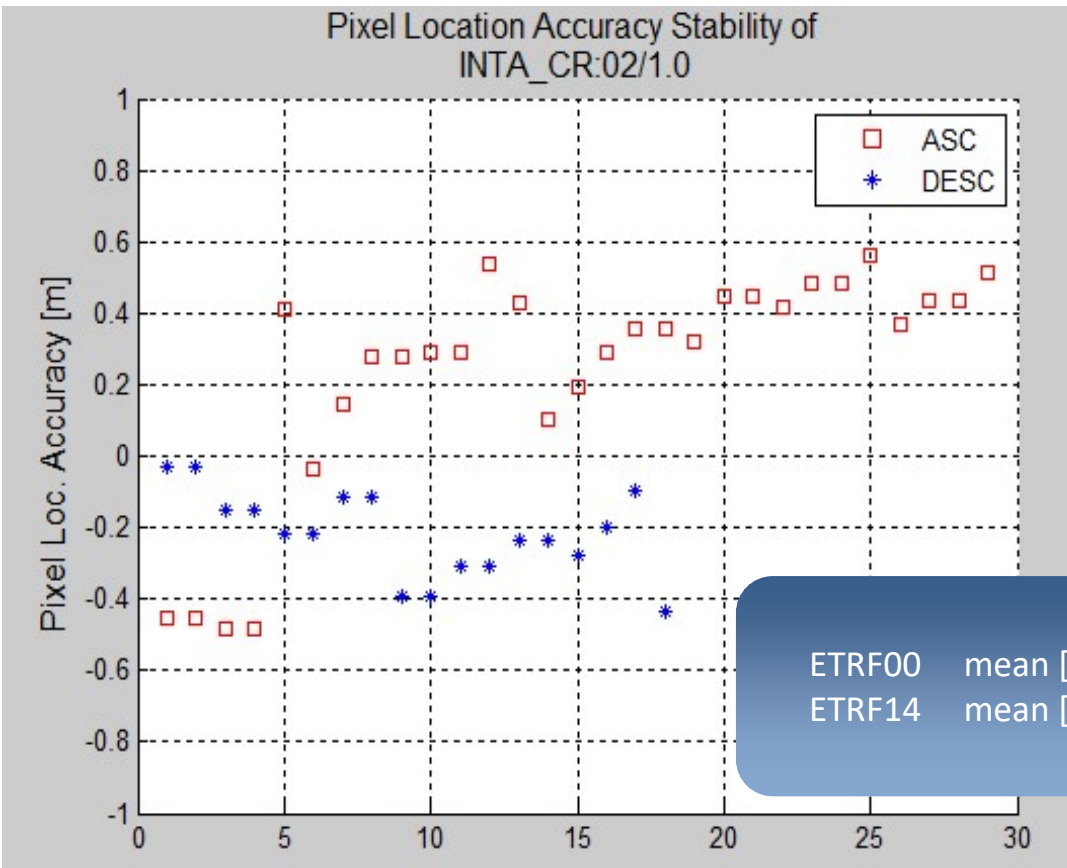
Epoch 2017.0

Before CP March 2018

PAZ Mission
Coordinate System
ITRS2014 (Epoch 2010.0)

* Recent Advances in Pixel Localization Accuracy (DLR)

Results of Coordinate System Correction: Pixel Location Accuracy

Pixel Location Accuracy Stability of INTA_CR:02/1.0

ETRF00   mean [m]: 0.631   std [m]: 0.1771
ETRF14   mean [m]: 0.293   std [m]: 0.1379

Results of Orbit direction Analysis

Orbit Direction	Range Mean [m]	Azimuth Mean [m]	Pixel Location Accurazy Mean [m]	Pixel Location Accurazy STD [m]
ASC	0.187	0.134	0.247	0.143
DESC	0.197	0.126	0.257	0.140

Conclusion of Geometric Analysis
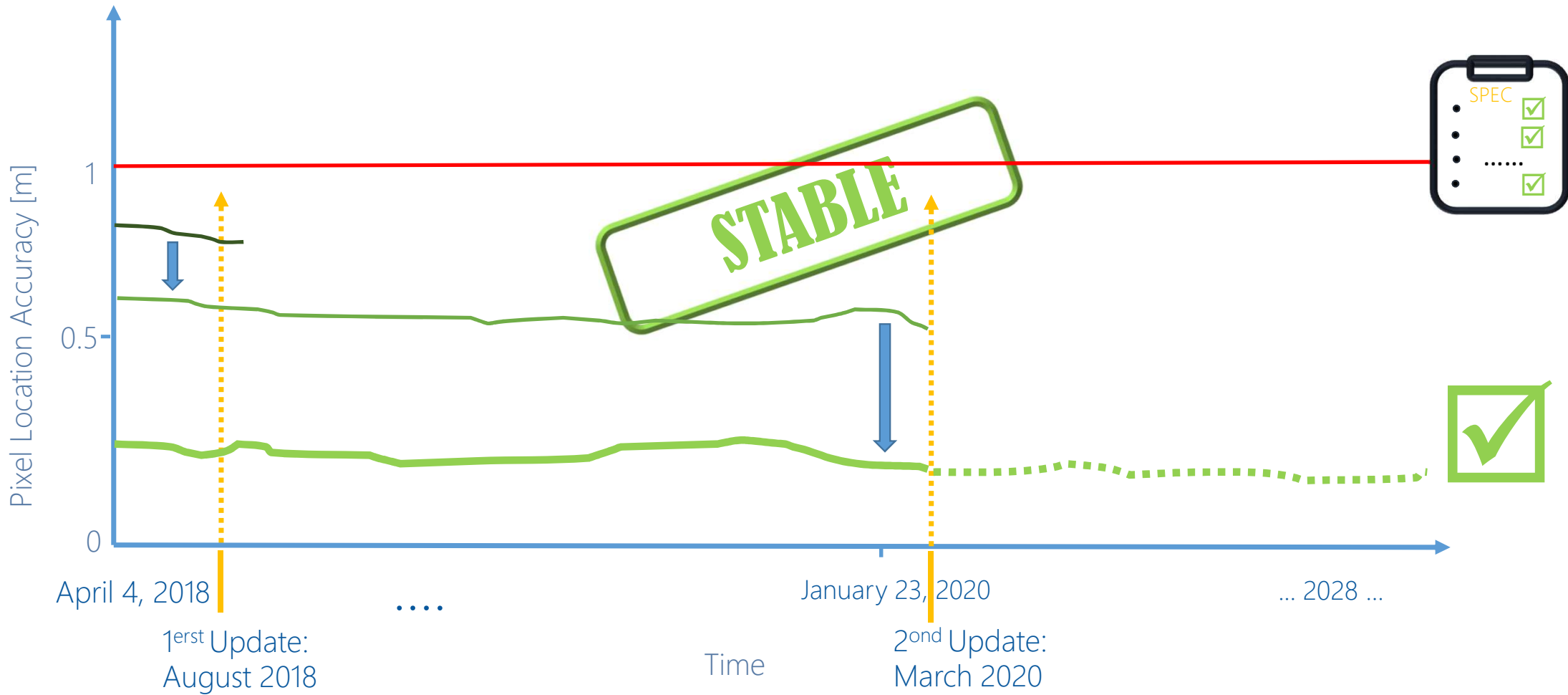
Pixel Geolocation Accuracy

First characterization
Easting   UTC
Northing UTC
- Geocoded product based –

GEC_SE & GEC_RE

EEC_SE & EEC_RE

Measurements: 1500

PAZ geocoded products:

Once solved Geometric Calibration. **Main error** sources of pixel location accuracy in geocoded products are:
   Atmospheric Path Delay: PAZ products contain annotation of signal propagation delay, correction implemented in PAZ processor.
    Orbit Accuracy: PAZ Rapid Orbit (2m) – PAZ Science Orbit (0,20m)
    Terrain height error combined wiht the acquisition incidence angle.

GEC geometry

Geocoded Ellipsoid Corrected
Map (UTM/UPS) geometry with
ellipsoidal corrections projected
using an average scene height.
(No DEM correction performed)
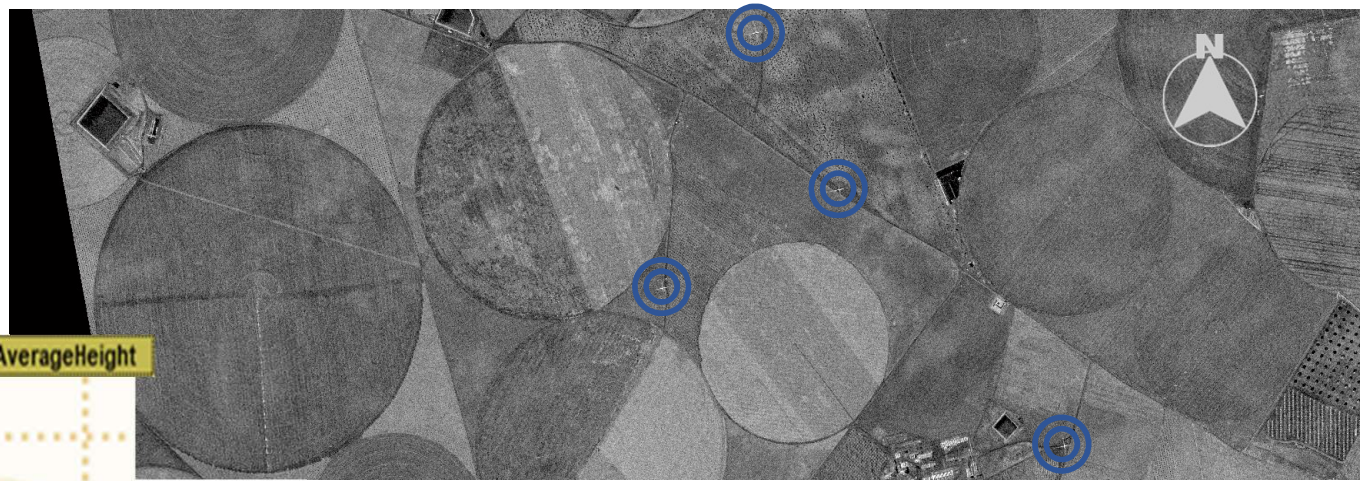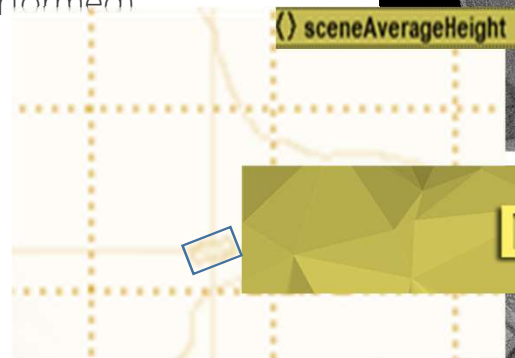
EEC geometry

Enhanced Ellipsoid Corrected
Map (UTM/UPS) geometry with
terrain correction, **using a DEM**.

GEC products location assessment:

Errors locally variables. As expected due to height difference.
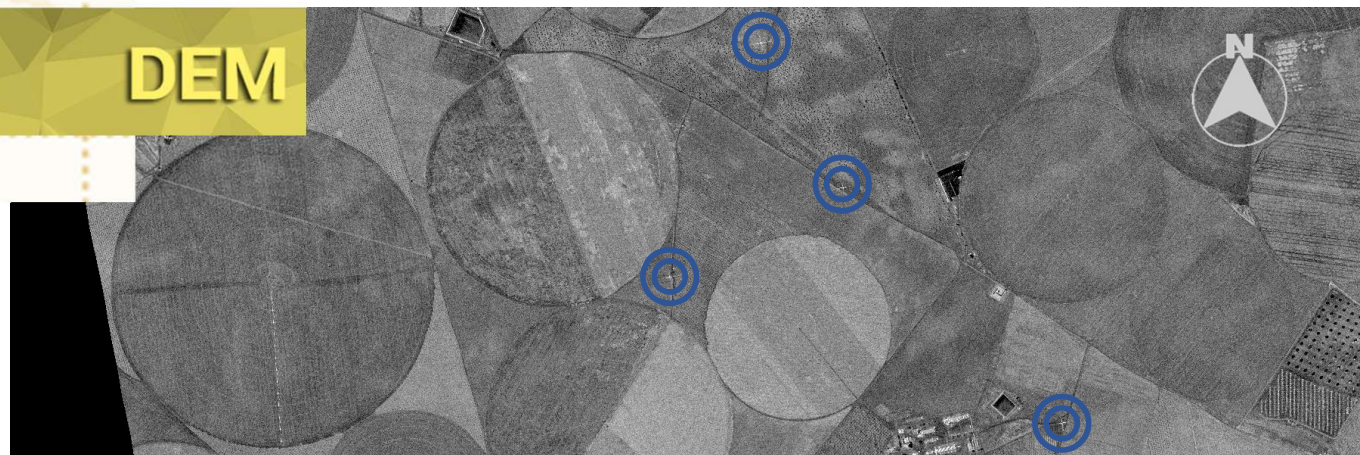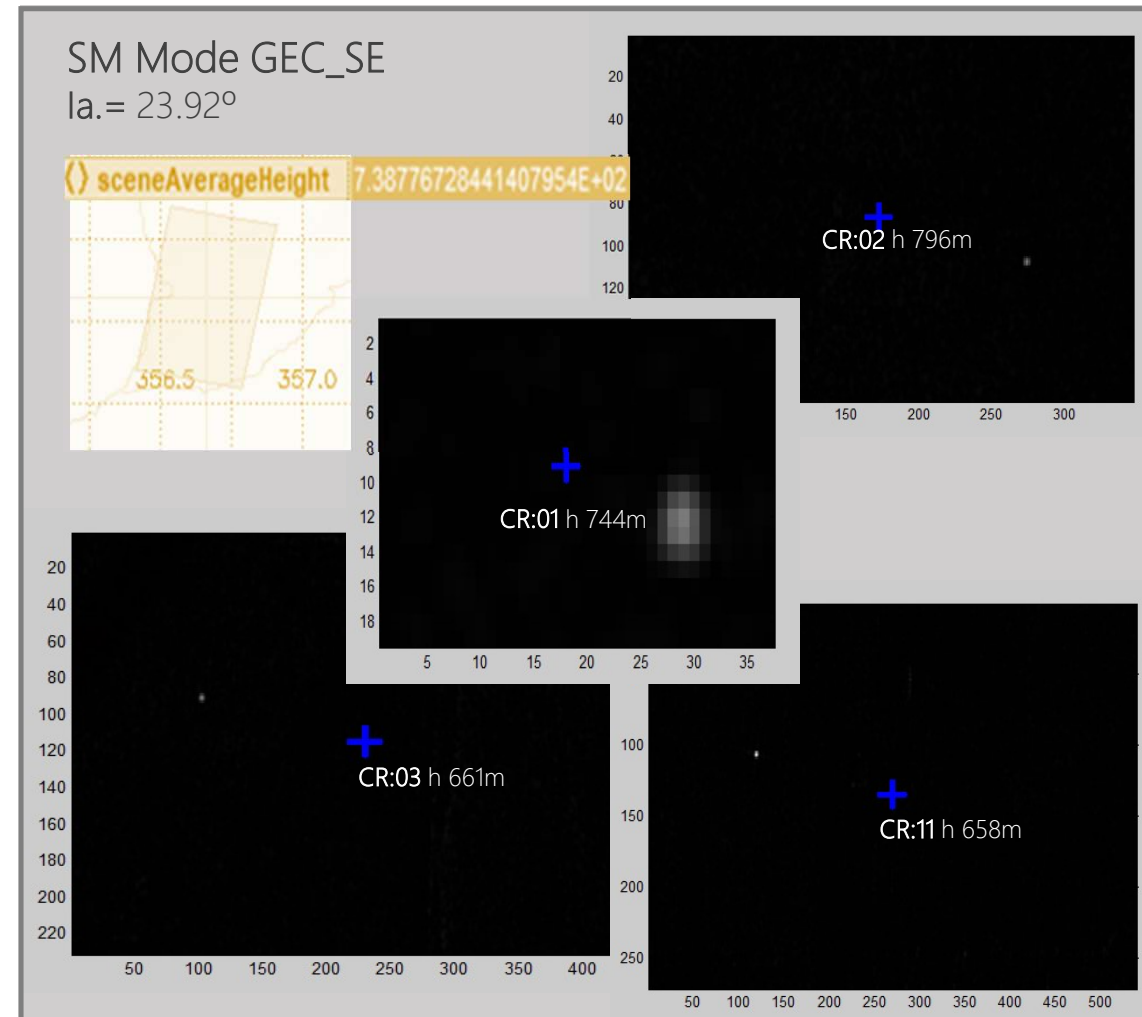Easting direcction especially sensible to heigth difference: mostly rg direction.

	Height difference w.r.t. mean scene (m)	Max. Location error due to height difference (m)	GEC-SE	
			RMS Easting (m)	RMS Northing (m)
SM-Mode	Strip_004 (Incidence angle = 23.92º)			
CR:01	5.97	13.442	**13.25**	4.11
CR:02	57.54	129.46	**127.00**	26.18
CR:03	76.82	172.85	**159.32**	29.87
CR:11	90.10	202.73	**188.03**	35.76
SL-Mode	Spot_090 (Incidence angle = 52.25º)			
CR:03	40.26	31.00	**30.02**	3.43
CR:11	53.56	41.24	**41.64**	5.23
CR:22	43.56	33.54	**32.49**	4.04
HS-Mode	Spot_063 (Incidence angle = 44.03º)			
CR:07	10.23	10.54	**10.53**	0.45
CR:15	6.68	6.89	**7.34**	0.08
CR:16	4.48	4.61	**5.05**	0.23

SM Mode GEC_SE
Ia.= 23.92º

sceneAverageHeight 7.38776728441407954E+02

CR:02 h 796m
CR:01 h 744m
CR:03 h 661m
CR:11 h 658m

EEC products location assessment:

Errors as expected due PAZ Digital Elevation Model.
Easting direcction especially sensible to heigth difference: mostly rg direction.
Differences between RE and SE product variants are related to pixel size.

	EEC-RE		EEC-SE	
	RMS Easting (m)	RMS Northing (m)	RMS Easting (m)	RMS Northing (m)
SM-Mode				
strip_004	6.92	5.81	2.37	1.99
strip_008	6.00	3.57	2.40	1.42
strip_013	4.96	3.08	2.20	1.70
SL-Mode				
spot_018	4.63	1.82	1.81	0.44
spot_090	2.75	1.62	0.33	0.55
HS-Mode				
spot_016	3.45	3.26	3.01	1.36
spot_063	2.85	1.01	2.85	0.62
spot_100	2.30	0.94	0.46	0.18

	Incidence Angle (º)	Displacement Factor	Max. Abs. Location Error (m)
strip_004	23.92	2.25	36.08
strip_008	33.16	1.53	24.49
strip_013	42.75	1.08	17.31
spot_018	24.86	2.16	34.52
spot_063	44.03	1.03	16.55
spot_090	52.25	0.77	12.39
spot_100	54.81	0.71	11.28

SRTM/ C Band DEM based.

GEC & EEC assesment. Use of geocoded products as G.I.
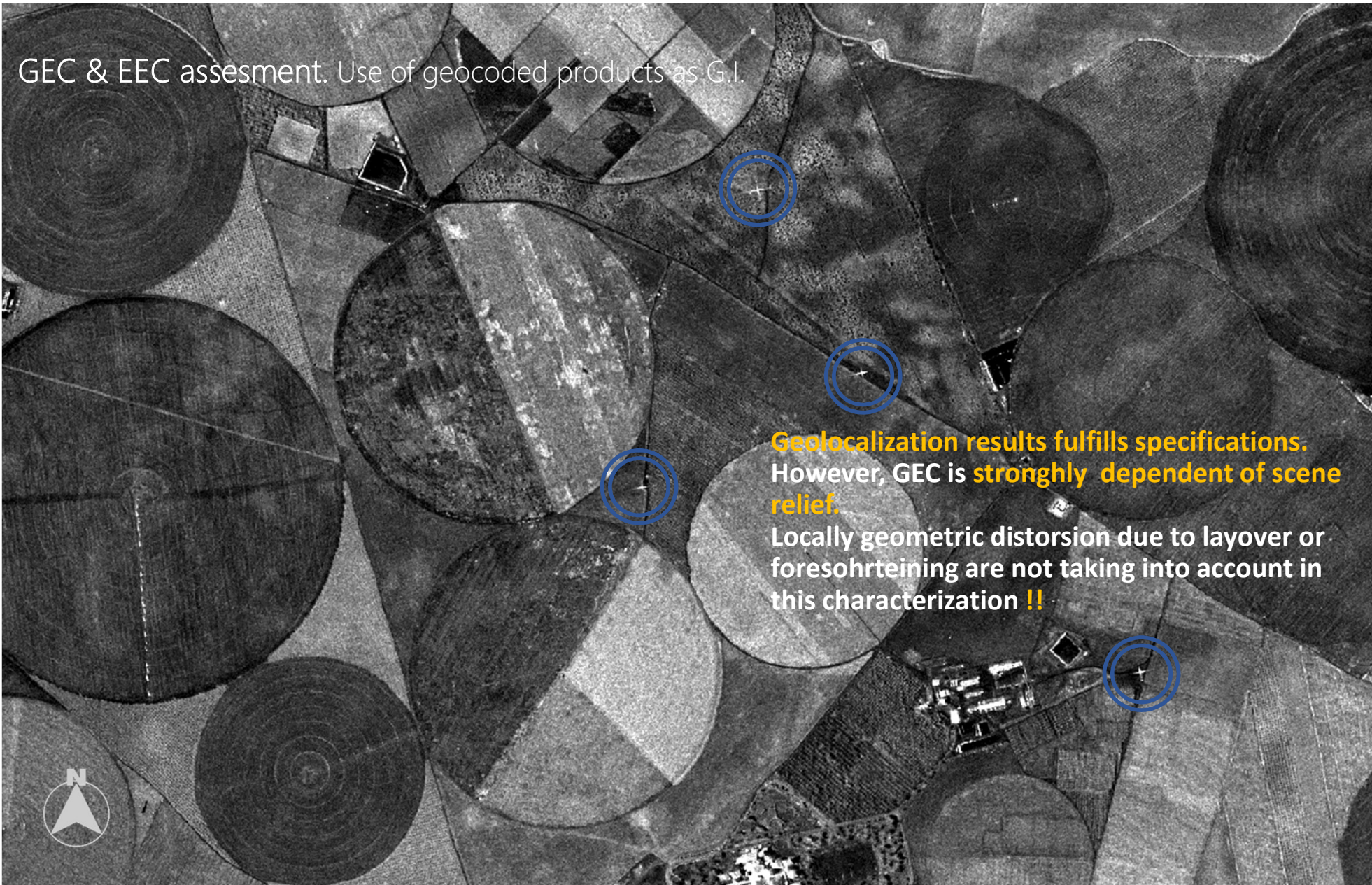
Geolocalization results fulfills specifications. However, GEC is strongly dependent of scene relief.
Locally geometric distorsion due to layover or foresohrteining are not taking into account in this characterization ‼️

THANK YOU

Instituto Nacional De Técnica Aeroespacial (INTA)
pcifrev@inta.es; casalvn@inta.es