

PNOTS



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2	21/11/2018	Second issue	6. Product Performances 7. Corner Reflectors Measurements 8. Distribution target Measurements	Updated sections with final Commissioning Phase data analysis
3	09/01/2019	Third Issue	6. Product Performances	Updated detected product performances in product tables Included NESZ value for SC



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1. INTRODUCTION

1.1 OBJECT

In the scope of activities of INTA as responsible of Calibration and Validation Centre, an In-flight Test Plan, together with specific Data Take and Deployment Plans, were developed to be carried out after the Commissioning phase in order to have covered all the activities considered critical for a successful Operational phase.

Due to obvious similarities on the systems and calibration tools, INTA plan was based on the strategy of DLR for Terrasar-X and TanDEM-X.

In the framework of the Agreement for the Scientific Use of PAZ data [RD.2], Hisdesat requested to INTA to support the PAZ commissioning phase leading activities related to Antenna Model Verification, External Calibration and Product Characterization as stated in [RD.1], so an adaptation of INTA plans has been carried out to answer this request.

1.2 SCOPE

This document describes the plan for execution of the activities to be carried out by INTA CALVAL Centre during Commissioning Phase and current Product Performances analyzed with available data at the end of acquisitions over calibration field in stripmap mode configuration.

2. REFERENCE DOCUMENTS

	<i>Document</i>	<i>Reference</i>	<i>Date</i>
RD-1	PAZ COMMISSIONING PHASE ACTIVITIES EXECUTION	PAZ-HDS-MT-008-17	25/10/2017
RD-2	ACUERDO DE COLABORACION CIENTÍFICA ENTRE EL INSTITUTO NACIONAL DE TÉCNICA AEROSPACIAL "ESTEBAN TERRADAS" E HISDESAT SERVICIOS ESTRATEGICOS S.A. PARA LA MISIÓN PAZ		

Table 1. Reference documents



3. OVERVIEW

This document contains:

- Update of data take plan to reflect current status of Commissioning Phase with respect to the plan defined by INTA before launching:
 - Planning of stages, milestones and configuration updates.
 - Proposal of Reviews for INTA activities.
 - Activities to be performed.
- Product Performances. Current status of product performances, mainly focused on stripmap characterization.

4. PLAN

4.1 DATA TAKES PLAN

Planned Cycles	Start Date	Executed Cycles	Start Date	
0	03-04-2018	0	03-04-2018	Instrument check-out
1-5	16-04-2018	1-8	16-04-2018	Acquisitions with nominal chain INTA calibration field in SM configuration
6-7	10-06-2018	9-10	13-07-2018	Acquisitions with redundant chain INTA calibration field in SM configuration



8-10	08-07-2018	10-13	04-08-2018	Acquisitions with nominal chain INTA calibration field in SC-SL configuration
End of acquisitions	04-08-2018	End of acquisitions	05-09-2018	Start of Operational Phase

Table 2. Data takes plan

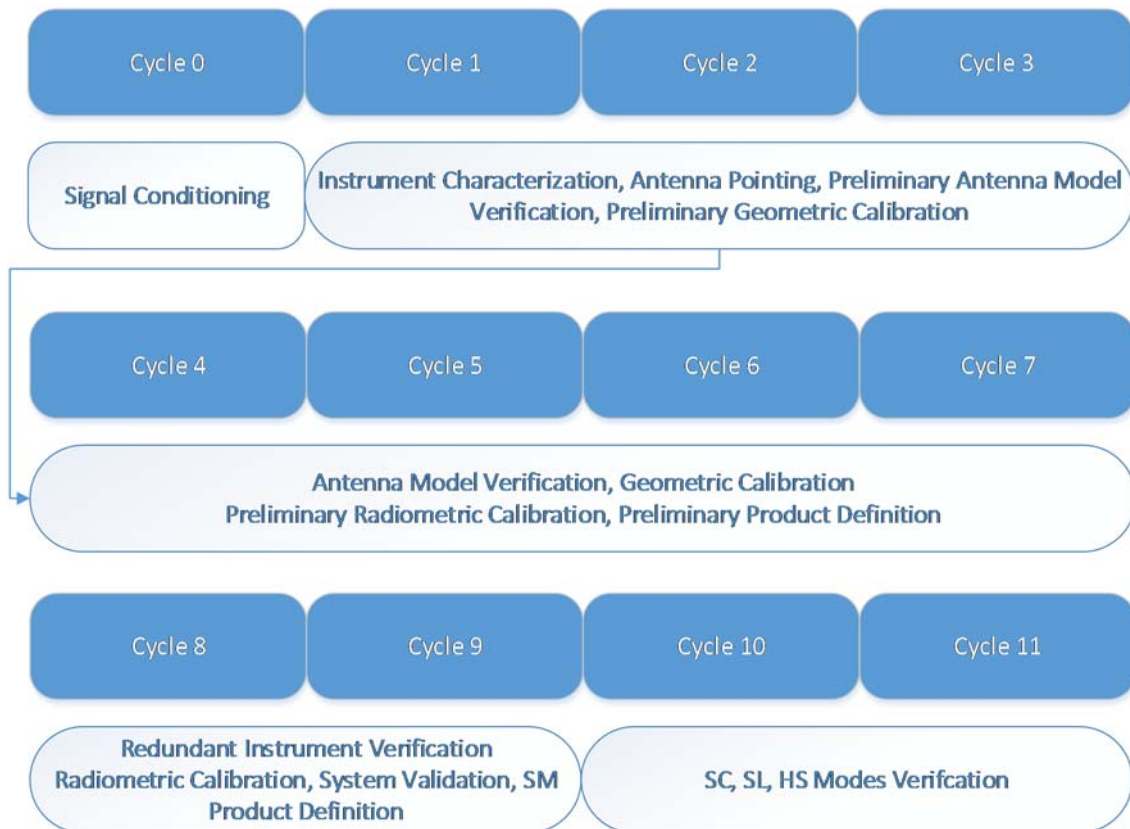


Figure 1. Initial Commissioning phase activities plan



4.2 PROPOSED REVIEWS

4.2.1 Signal Conditioning and Internal Calibration Review.

Signal Conditioning and Internal Calibration Review	Plan	Status
Programming:	Before Cycle 1 (16-04-2018)	
Topics:	Reference Power Level	Updated on 17/04/2018
	Attenuation levels for Calibration Pulses	Updated on 13/07/2018
	Interleaved Calibration Pulses Schema	N/A
	Temperature Compensation Strategy	N/A
	Update TRM Reference Table	Updated on 13/07/2018
	Update Dt_Quality Limits.	Updated on 13/07/2018

Table 3. Signal Condition and Internal Calibration Review

4.2.2 First Calibration Review

First Calibration Review	Plan	Remarks
Programming	Not after end of cycle 5 (30-05-2018)	
Topics	Preliminary Geometric Calibration Update of Instrument Delays at Ground Segment configuration	Configuration changes applied since 13/07/18
	Doppler Monitoring Results	Done.



	Preliminary Reference Antenna Patterns Validation	Correction of FM Subarray measurements delivered on 03-07-2018 Done.
	Update of TZDS table at AOCS and Attitude Steering Table at Ground Segment	Not needed
	Update Reference Antenna Pattern Set to be used at Ground Segment	Done 13/07/2018.

Table 4. First Calibration Review

4.2.3 Second Calibration Review

Second Calibration Review	Plan	Remarks
Programming	After end of Cycle 7 (08-07-2018)	24/07/2018
Topics	Review Geometric Calibration Accuracy.	Updated instrument delays 04/08/2018
	Review Preliminary Radiometric Calibration Accuracy.	If needed, update Absolute Calibration Factor Table. Foreseen Done 30/08/2018
	Review Antenna Pointing Analysis	If needed, update refAntennaPatterns. Not needed.
	Review Reference Antenna Patterns Analysis	If needed, update refAntennaPatterns. Not needed.
	Preliminary Product Definition	If radiometric and geometric calibration done, establishment of SM mode characterization. This document. First released 29/08/2018

Table 5. Second Calibration Review



4.2.4 Commissioning Phase Results Review

Commissioning Phase Results	Plan	Status
Programming	31-08-2018	30-09-2018
Topics	Product Characterization	All imaging modes
	Commissioning Phase Results Review	Start of operations

Table 6. Commissioning Phase Results Review



5. PRODUCT DEFINITION

5.1 STRATEGY

Parameter	Strategy
Azimuth Resolution	IRF analysis over Corner Reflectors
Ground / Slant Range Resolution	IRF analysis over Corner Reflectors
PSLR	IRF analysis over Corner Reflectors
ISLR	IRF analysis over Corner Reflectors
NESZ	Measured over Pacific Doldrums
Absolute Radiometric Accuracy	IRF analysis over Corner Reflectors
Relative Radiometric Accuracy	IRF analysis over Corner Reflectors
Radiometric Stability	IRF analysis over Corner Reflectors over Time
Range/Azimuth Scene Size	Extracted from processor annotations
Pixel Localization Accuracy	Geometric analysis over Corner Reflectors
Pixel Spacing	Extracted from processor annotations
Distributed Target Dynamic Range	Distributed Target Analysis
Point Targets Dynamic Range	Point Target Analysis

Table 7. Product definition strategy



6. PRODUCT PERFORMANCES

6.1 TEST DATA SET

6.1.1 Geometric Analysis

Test data set available for geometric calibration has been taken from INTA, Surat Basin and CONAE calibration fields, mostly focused on SM modes at different bandwidths.

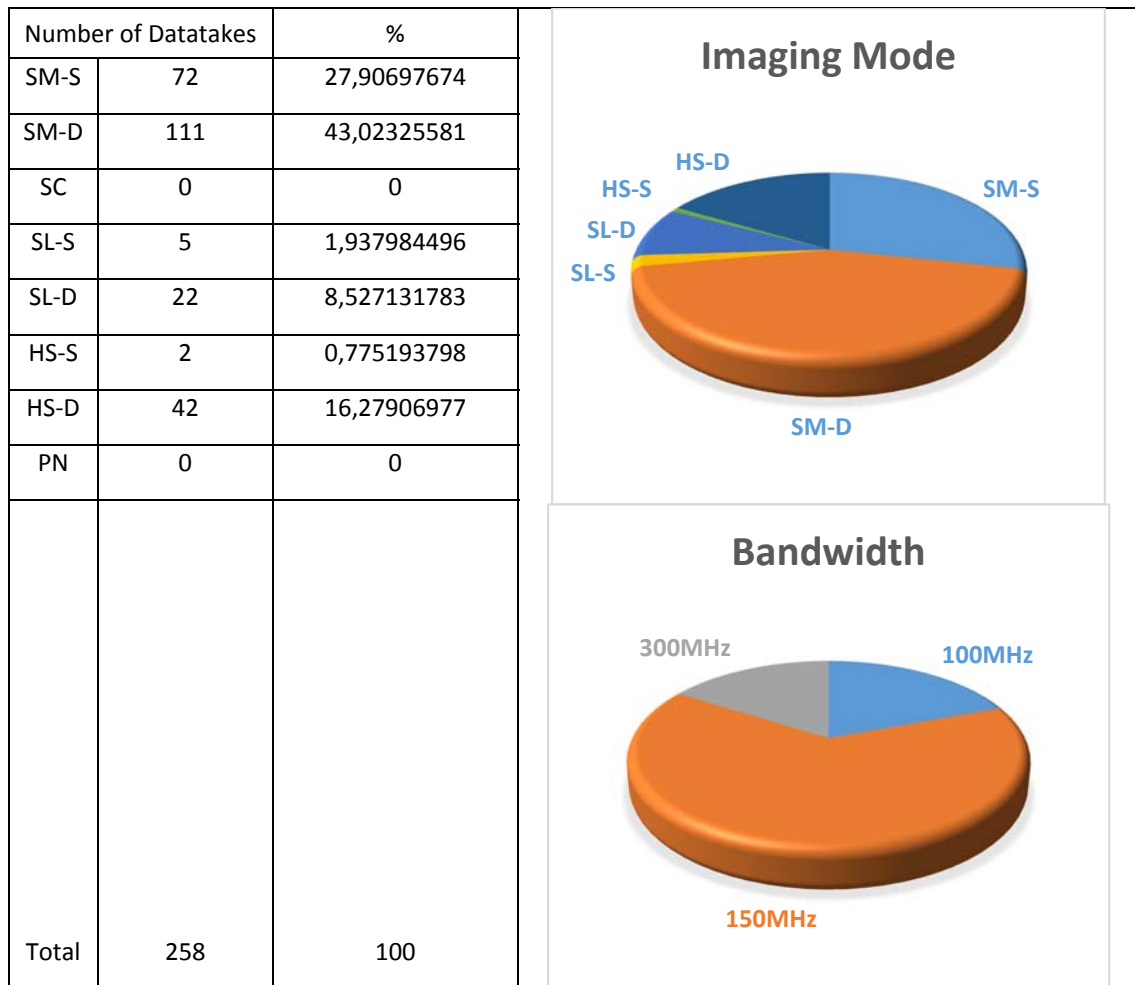


Figure 2. Test data set available for geometric analysis



6.1.2 Radiometric and IRF Analysis

Radiometric and IRF measurements need to precisely control the alignment of reflectors with respect to the satellite line of sight, so only INTA calibration field reflectors can be considered used for this purpose.

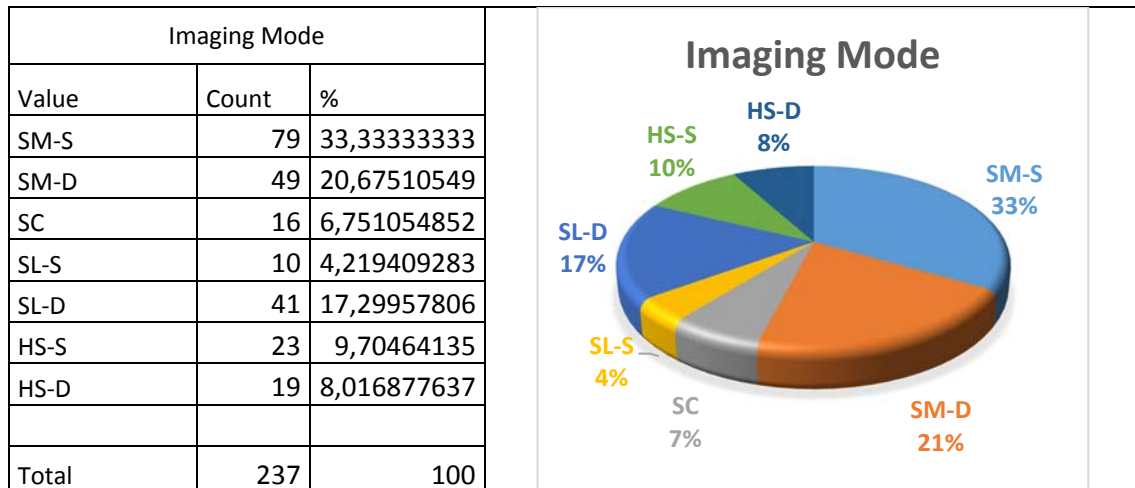


Figure 3. Test data set available for radiometric analysis by imaging mode

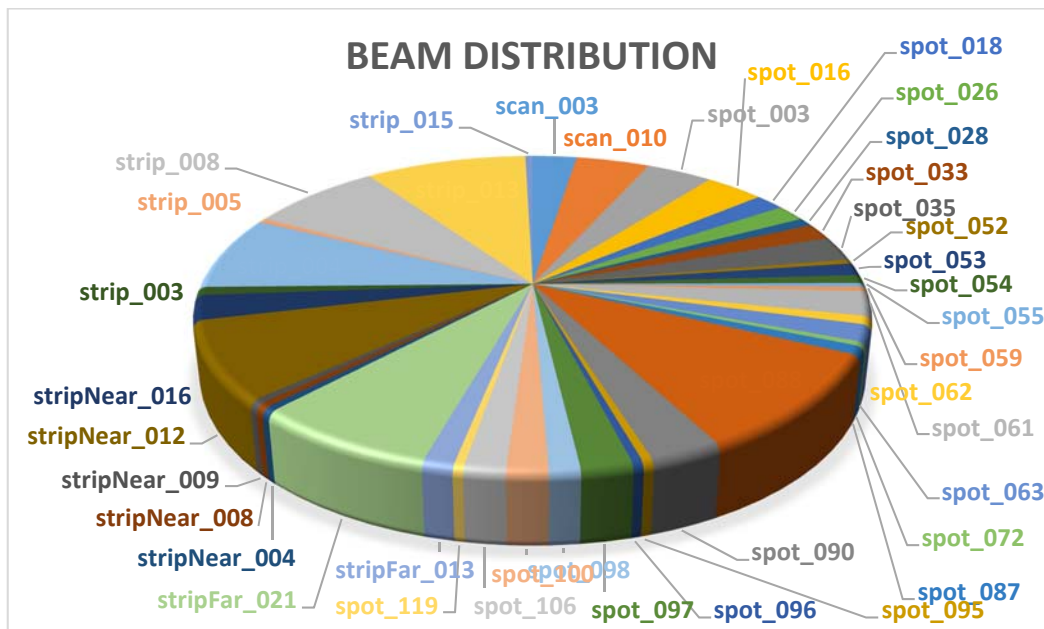


Figure 4. Beam distribution available for radiometric analysis

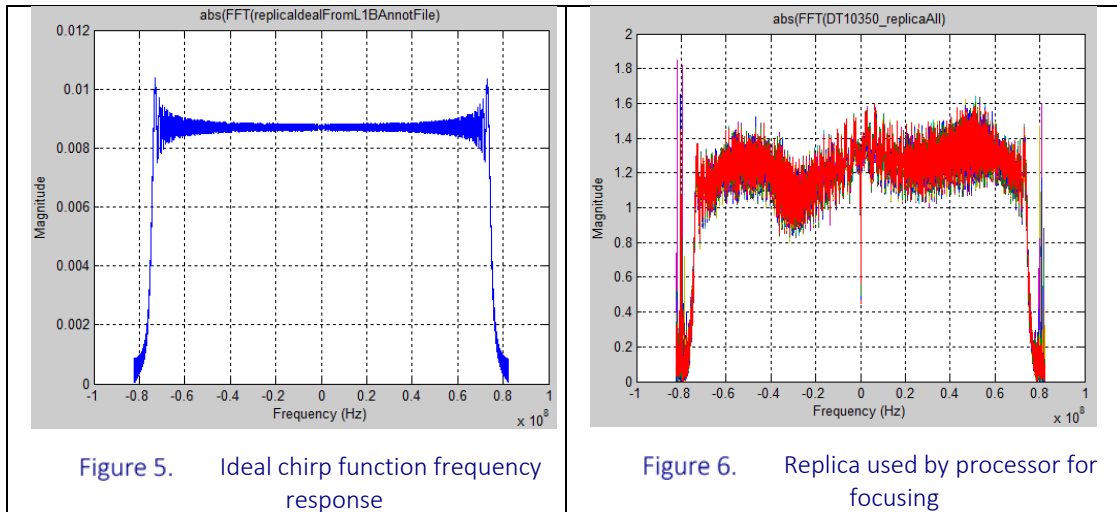
6.2 GENERAL CONSIDERATIONS

General considerations pointed out here cover three main performance areas:

1. **Focusing:** includes Range and Azimuth Resolutions, PSLR and ISLR.
2. **Radiometric Performance:** absolute and relative radiometric accuracy.
3. **Geometric Performance:** Pixel Localization Accuracy.

6.2.1 Focusing performances

Replica reconstructed from calibration pulses and used for focusing seems to be affected by spurious frequency components:



These spurious yields to impulse response functions over corner reflectors with PSLR and ISLR degraded:

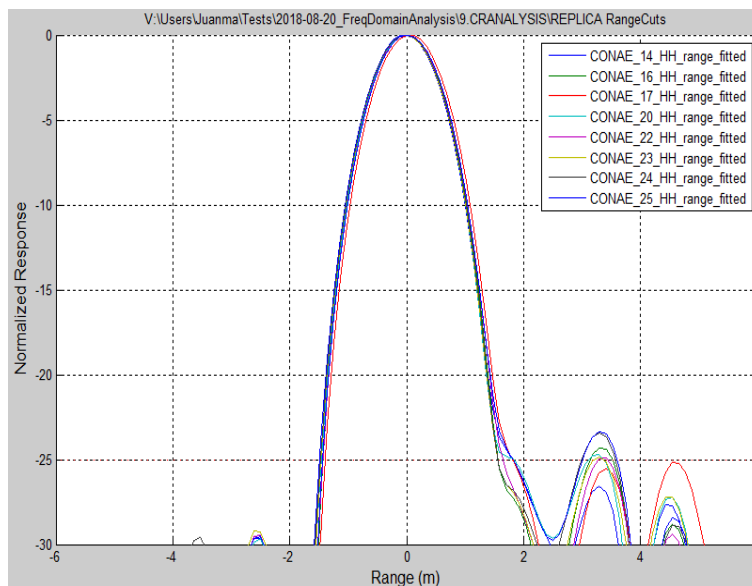


Figure 7. IRF measured over corner reflectors

As the spurious signals fall out of resolution boundaries, both slant range and azimuth resolution are not being degraded in any imaging mode measured so far.

Processing using RX cal pulses as reference function improves IRF. Modification on progress.

6.2.2 Radiometric Performances

Strategy adopted for calibration activities are based on successful Terrasar-X calibration and consisted on:

1. Extensive on-ground antenna subarray and panel level measurements.
2. On-ground Antenna Model Verification.
3. In-Flight Antenna Model Verification.
4. Antenna Pointing Verification: verification of antenna pointing in elevation and azimuth (in PAZ case, azimuth pointing verification has been performed by ASE).
5. Radiometric Calibration: set the absolute calibration factor of the system.
6. Radiometric Characterization: determination of absolute and relative radiometric accuracies.

TSX strategy relied on extensive on-ground measurements to minimize error contributions from antenna model and a reduced number of measurements in-flight for verification.

In PAZ case, an extensive in-flight Stripmap Mode Antenna Model verification has been required to compensate the fewer measurements performed on ground with respect to TSX. Results have shown acceptable errors in shape below 0.3dB according to specification in 90% of the beams analyzed and below 0.42dB in 100%.

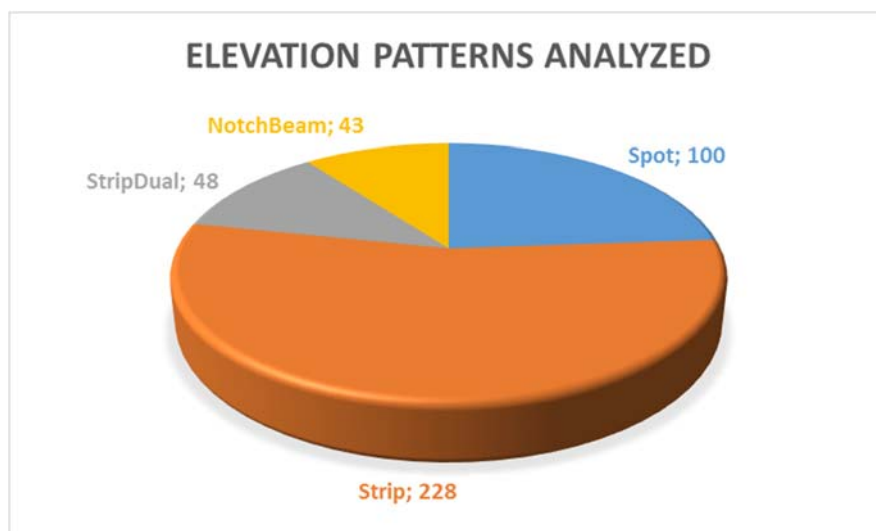


Figure 8. Reference elevation patterns analysed for Antenna Model validation

Radiometric calibration has been also based on stripmap modes since elevation antenna model should not depend on imaging mode and availability of data over the calibration field would



have been unreliable on time if all imaging modes, polarization modes and bandwidths were considered.

Radiometric measurements over Spot and Scansar modes have been taken as verification of results for Stripmap, regardless a further calibration can be considered during the mission lifetime.

6.2.3 Channel Imbalance

Channel imbalance tests have been performed during commissioning phase using dual acquisitions over corner reflectors and measuring amplitude and phase differences observed between channels.

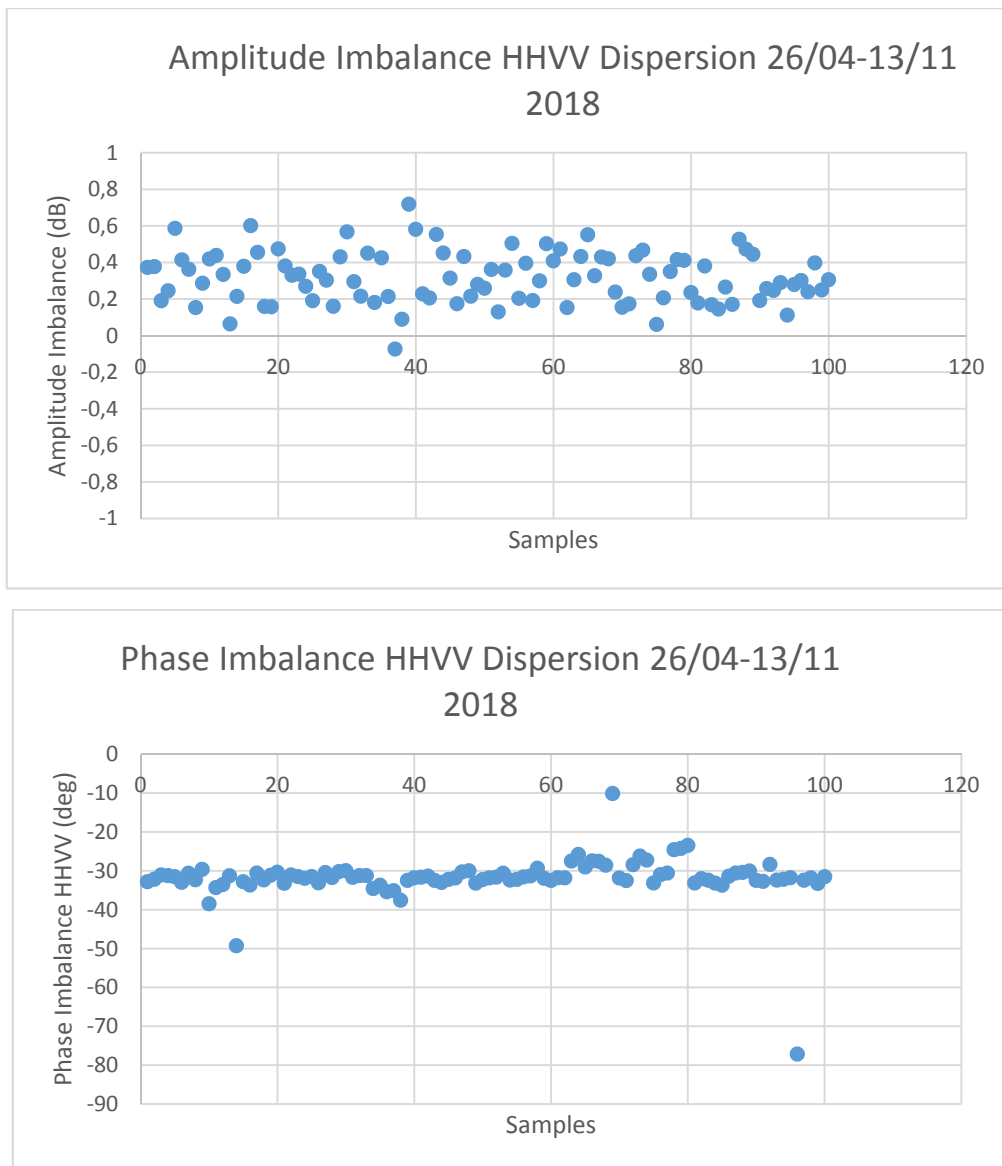


Figure 9. Amplitude and phase imbalance measured over corner reflectors



Amplitude deviation between channel measurements can also be observed in absolute calibration factor measurements if they are shown by polarization channel regardless imaging mode:

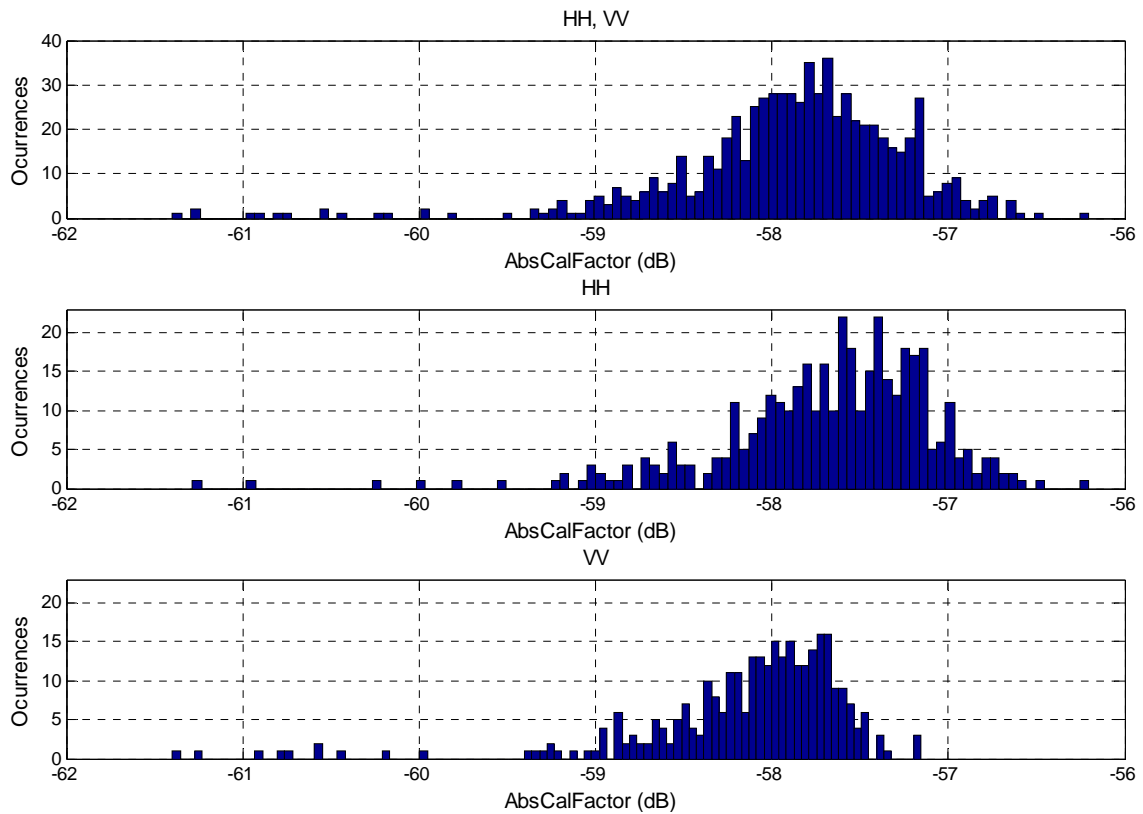


Figure 10. Histogram of measurements on All, HH and VV polarization channels

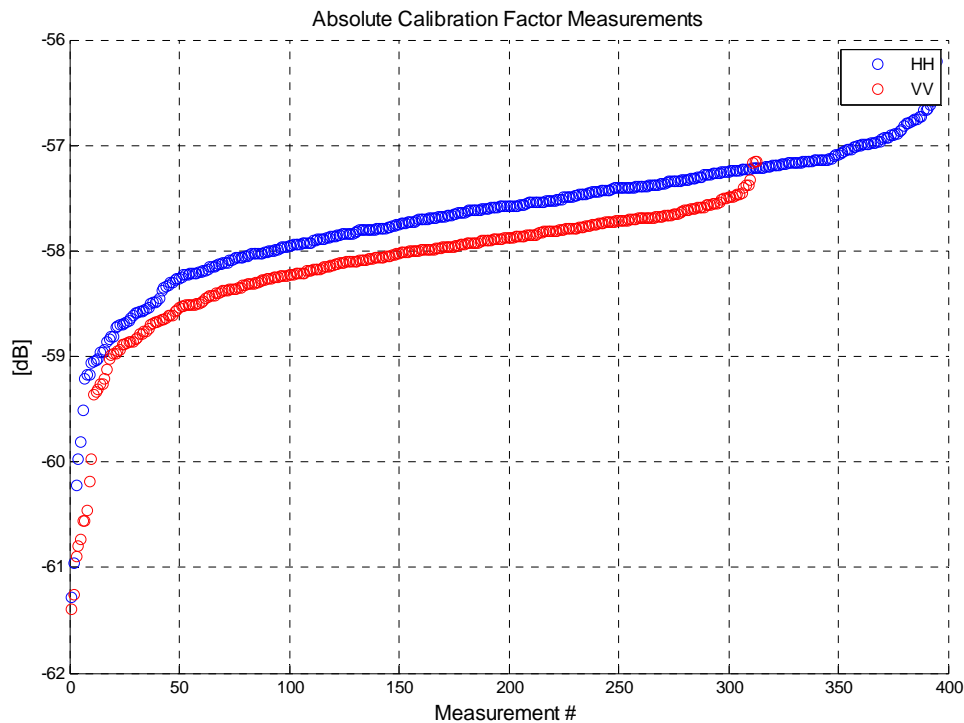


Figure 11. Summary of all CR radiometric measurements by polarization channel

As sub-array measurements provided for reference antenna pattern generation show higher gain values in VV patterns than in HH patterns, next steps will consider an offset correction both in phase and amplitude channel imbalance feature via reference antenna pattern regeneration, so an improvement on radiometric accuracy can be expected performing a ground segment configuration update.

6.2.4 Geometric Performances

Pixel localization accuracy has been improved during geometric calibration activities using extensive measurements over reflectors at INTA, CONAE and Surat Basin for 100, 150 and 300 MHz data takes.

Current performances are stable and below specification, so remaining spotlight and high resolution acquisitions have been used for verification and monitoring.



6.3 STRIPMAP SINGLE

Mnemonic	{MGD , GEC, EEC}_SE_SM_S	{MGD , GEC, EEC}_RE_SM_S	SSC__SM_S		
Imaging Mode	SM				
Product Type	Detected				Complex
Geometric Projection	{MGD, GEC, EEC}				SSC
Polarization Mode	S				
Resolution Mode	SE	RE			
Number of Polarimetric Channels	1				
Polarization Mode	{HH,VV}				
Data collection range	15-60				
Full performance range	20-45				
Range Scene size [km]	30.7				
Azimuth Scene size [km]	50.6				
Abs. Radiometric Accuracy [dB]	0.57				
Rel. Radiometric Accuracy [dB]	0.35 ⁽²⁾				
NESZ [dB]	<-16.80				
PSLR [dB]	-24,93				
ISLR [dB]	-15,63				
Distributed Target Dynamic Range	TBD				
Point Target Dynamic Range	88.17				
Incidence Angle (20-45)	20	45	20	45	-
Slant range resolution [m]	-	-	-	-	1,76/1,1 ⁽¹⁾
Ground range resolution [m]	3.52	2.99	7.65	6.53	-
Azimuth Resolution [m]	3.05	3.06	7.60	6.53	3,01
Approx. Range Pixel Spacing [m]	1.25	1.25	3.25	3.25	1.36/0.91 ⁽¹⁾
Approx. Azimuth Pixel Spacing [m]	1.25	1.25	3.25	3.25	2
Pixel localization accuracy [m]	-	-	-	-	0,65

(1): 100MHz/150Mhz

(2): Mean value

Table 8. Stripmap single product performances



6.4 STRIPMAP DUAL

Mnemonic	{MGD , GEC, EEC}_SE_SM_D	{MGD , GEC, EEC}_RE_SM_D	SSC_SM_D		
Imaging Mode	SM				
Product Type	Detected			Complex	
Geometric Projection	{MGD, GEC, EEC}			SSC	
Polarization Mode	D				
Resolution Mode	SE		RE		
Number of Polarimetric Channels	2				
Polarization Mode	HH/VV, HHH/HV, VV/VH				
Data collection range	15-60				
Full performance range	20-45				
Range Scene size [km]	16.02				
Azimuth Scene size [km]	55.31				
Abs. Radiometric Accuracy [dB]	0,30				
Rel. Radiometric Accuracy [dB]	0,24				
NESZ [dB]	<-18.5				
PSLR [dB]	-24,73				
ISLR [dB]	-15,77				
Point Target Dynamic Range	88.17				
Incidence Angle (20-45)	20	45	20	45	-
Slant range resolution [m]	-	-	-	-	1.18
Ground range resolution [m]	6.01	6.00	10.43	7.51	-
Azimuth Resolution [m]	6.13	6.11	10.40	7.52	6.04
Approx. Range Pixel Spacing [m]	2.75	2.75	4.75	3.5	0.91
Approx. Azimuth Pixel Spacing [m]	2.75	2.75	4.75	3.5	2.99
Pixel localization accuracy [m]	-	-	-	-	0,70

Table 9. Stripmap dual product performances



6.5 SCANSAR

Mnemonic	{MGD , GEC, EEC}_RE_SC	
Imaging Mode	SC	
Product Type	Detected	
Geometric Projection	{MGD, GEC, EEC}	
Polarization Mode	S	
Resolution Mode	RE	
Number of Polarimetric Channels	1	
Polarization Mode	{HH,VV}	
Data collection range	15-60	
Full performance range	20-45	
Range Scene size [km]	104.24	
Azimuth Scene size [km]	153.70	
Abs. Radiometric Accuracy [dB]	0,41	
Rel. Radiometric Accuracy [dB]	0.33	
NESZ [dB]	<-18	
PSLR [dB]	-22,91	
ISLR [dB]	-17,06	
Incidence Angle (20-45)	20	45
Slant range resolution [m]	-	-
Ground range resolution [m]	22.14	16.79
Azimuth Resolution [m]	22.04	17.66
Approx. Range Pixel Spacing [m]	8.25	8.25
Approx. Azimuth Pixel Spacing [m]	8.25	8.25
Pixel localization accuracy [m]	-	-

*(see section 8.2.3).

Table 10. ScansAR single product performance



6.6 SPOTLIGHT SINGLE

Mnemonic	{MGD , GEC, EEC}_SE_SL_S		{MGD , GEC, EEC}_RE_SL_S		SSC__SL_S
Imaging Mode	SL				
Product Type	Detected				Complex
Geometric Projection	{MGD, GEC, EEC}				SSC
Polarization Mode	S				
Resolution Mode	SE		RE		
Number of Polarimetric Channels	1				
Polarization Mode	{HH,VV}				
Data collection range	15-60				
Full performance range	20-55				
Range Scene size [km]	11.77				
Azimuth Scene size [km]	10.24				
Abs. Radiometric Accuracy [dB]	0.63				
Rel. Radiometric Accuracy [dB]	0.25				
NESZ [dB]	<-18.7				
PSLR [dB]	-25.03				
ISLR [dB]	-15.01				
Incidence Angle (20-45)	20	55	20	55	-
Slant range resolution [m]	-	-	-	-	1,18
Ground range resolution [m]	3.43	1.55	5.43	3.51	-
Azimuth Resolution [m]	2.90	1.56	5.40	3.51	1.46
Approx. Range Pixel Spacing [m]	1.25	0.75	2.25	2.25	0.91
Approx. Azimuth Pixel Spacing [m]	1.25	0.75	2.25	2.25	1.14
Pixel localization accuracy [m]	-	-	-	-	0.60

Table 11. Spotlight single product performance



6.7 SPOTLIGHT DUAL

Mnemonic	{MGD , GEC, EEC}_SE_SL_D	{MGD , GEC, EEC}_RE_SL_D	SSC__SL_D		
Imaging Mode	SL				
Product Type	Detected			Complex	
Geometric Projection	{MGD, GEC, EEC}			SSC	
Polarization Mode	D				
Resolution Mode	SE	RE			
Number of Polarimetric Channels	2				
Polarization Mode	{HH/VV}				
Data collection range	15-60				
Full performance range	20-55				
Range Scene size [km]	11.89				
Azimuth Scene size [km]	12.52				
Abs. Radiometric Accuracy [dB]	0.37				
Rel. Radiometric Accuracy [dB]	0.32				
NESZ [dB]	<-16.5				
PSLR [dB]	-25,46				
ISLR [dB]	-15,16				
Incidence Angle (20-45)	20	55	20	55	-
Slant range resolution [m]	-	-	-	-	1,17
Ground range resolution [m]	3.50	3.09	7.63	4.98	-
Azimuth Resolution [m]	3.53	3.53	7.64	4.99	3.10
Approx. Range Pixel Spacing [m]	1.5	1.5	3.5	2.25	0.91
Approx. Azimuth Pixel Spacing [m]	1.5	1.5	3.5	2.25	1.43
Pixel localization accuracy [m]	-	-	-	-	0.75

Table 12. Spotlight dual product performance



6.8 HIGH RESOLUTION SPOTLIGHT SINGLE

Mnemonic	{MGD , GEC, EEC}_SE_HS_S		{MGD , GEC, EEC}_RE_HS_S		SSC__HS_S
Imaging Mode	HS				
Product Type	Detected				Complex
Geometric Projection	{MGD, GEC, EEC}				SSC
Polarization Mode	S				
Resolution Mode	SE		RE		
Number of Polarimetric Channels	1				
Polarization Mode	{HH,VV}				
Data collection range	15-60				
Full performance range	20-55				
Range Scene size [km]	10.75 / 6.3				
Azimuth Scene size [km]	4.79				
Abs. Radiometric Accuracy [dB]	0,47				
Rel. Radiometric Accuracy [dB]	0,33				
NESZ [dB]	<16.2				
PSLR [dB]	-24,95				
ISLR [dB]	-15.25				
Incidence Angle (20-45)	20	55	20	55	-
Slant range resolution [m]	-	-	-	-	0,60
Ground range resolution [m]	1.76	1	3.11	2.83	-
Azimuth Resolution [m]	1.49	1.04	3.13	2.83	1,05
Approx. Range Pixel Spacing [m]	0.5	0.5	1.25	1.25	0,45
Approx. Azimuth Pixel Spacing [m]	0.5	0.5	1.25	1.25	0,82
Pixel localization accuracy [m]	-	-	-	-	0,62

Table 13. 300 MHz High resolution spotlight single product performance



6.9 HIGH RESOLUTION SPOTLIGHT DUAL

Mnemonic	{MGD , GEC, EEC}_SE_HS_S		{MGD , GEC, EEC}_RE_HS_S		SSC__HS_S
Imaging Mode	HS				
Product Type	Detected				Complex
Geometric Projection	{MGD, GEC, EEC}				SSC
Polarization Mode	D				
Resolution Mode	SE		RE		
Number of Polarimetric Channels	1				
Polarization Mode	{HH,VV}				
Data collection range	15-60				
Full performance range	20-55				
Range Scene size [km]	11.87				
Azimuth Scene size [km]	7.37				
Abs. Radiometric Accuracy [dB]	0.38				
Rel. Radiometric Accuracy [dB]	0.24				
NESZ [dB]	<-16.8				
PSLR [dB]	-25,59				
ISLR [dB]	-15,04				
Incidence Angle	20	55	20	55	
Slant range resolution [m]	-	-	-	-	1,17
Ground range resolution [m]	3,50	2	6,20	4	-
Azimuth Resolution [m]	2,93	2,38	6,25	4	2,16
Approx. Range Pixel Spacing [m]	1,25	1	2,75	1,75	0,91
Approx. Azimuth Pixel Spacing [m]	1,25	1	2,75	1,75	1,77
Pixel localization accuracy [m]	-	-	-	-	0,68

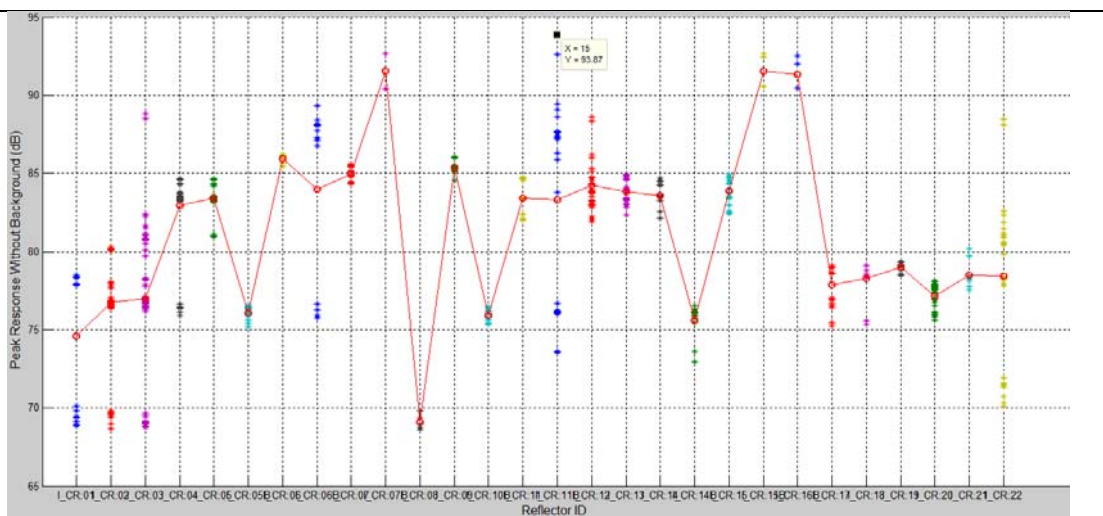
Table 14. 150MHz High resolution spotlight dual product performance



7. CORNER REFLECTOR MEASUREMENTS

7.1 POINT TARGET DYNAMIC RANGE

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	ALL
Polarization Mode	ALL
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	ALL
Statistics	
Max. Point Target Dynamic Range (dB)	93.87





7.2 SM-S

7.2.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SM	
Polarization Mode	SINGLE	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	100	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,761747055	2,564346082
Standard Deviation	0,007931808	0,106042628
Uncertainty Type A	0,000809537	0,01082293

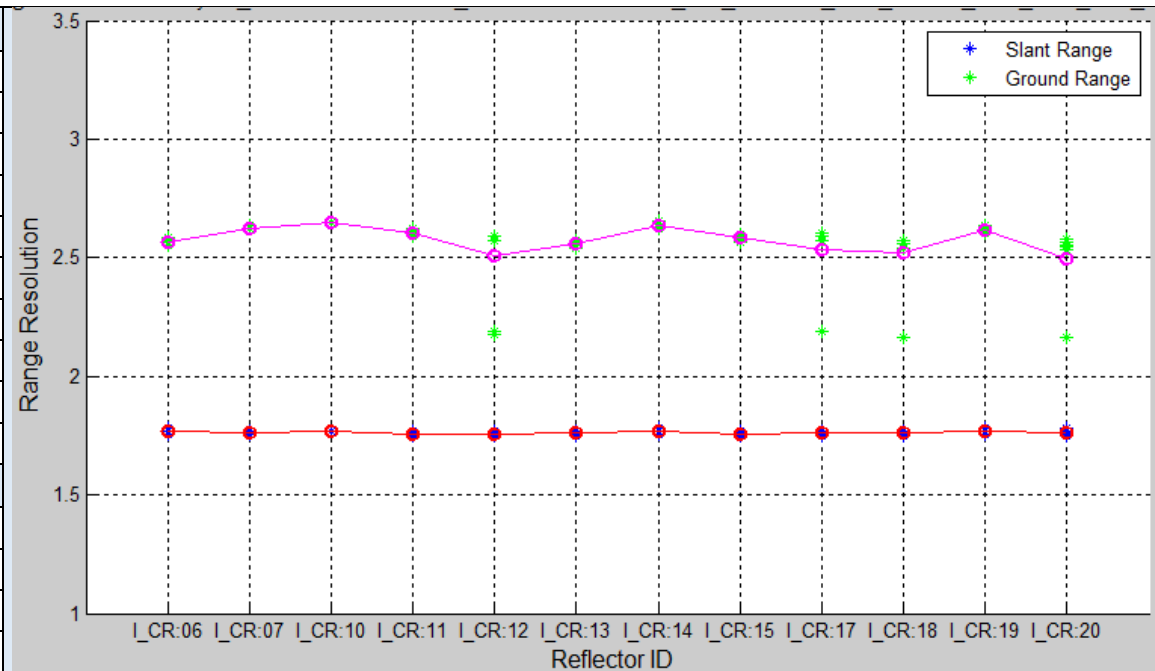


Figure 12. Range Resolution for SM-S BW=100MHz



Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-08-24	
Imaging Mode	SM	
Polarization Mode	SINGLE	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	150	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,175830249	2,497766351
Standard Deviation	0,007632631	0,369340303
Uncertainty Type A	0,000659359	0,031906143

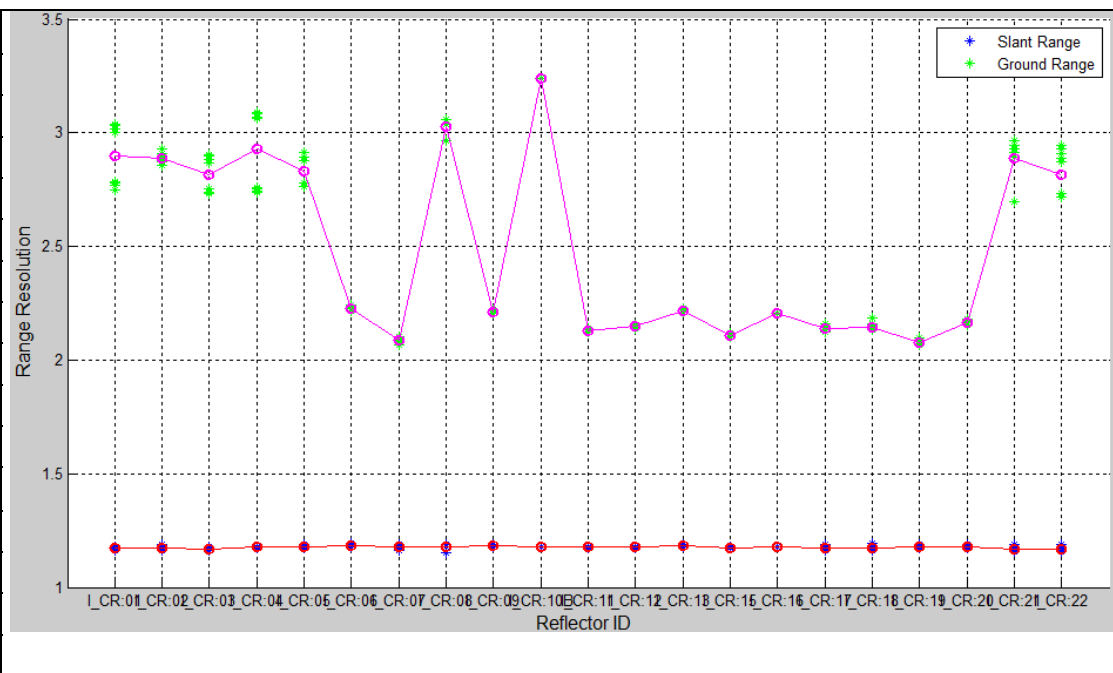


Figure 13. Range Resolution for SM-S BW=150MHz



7.2.2 Azimuth Resolution

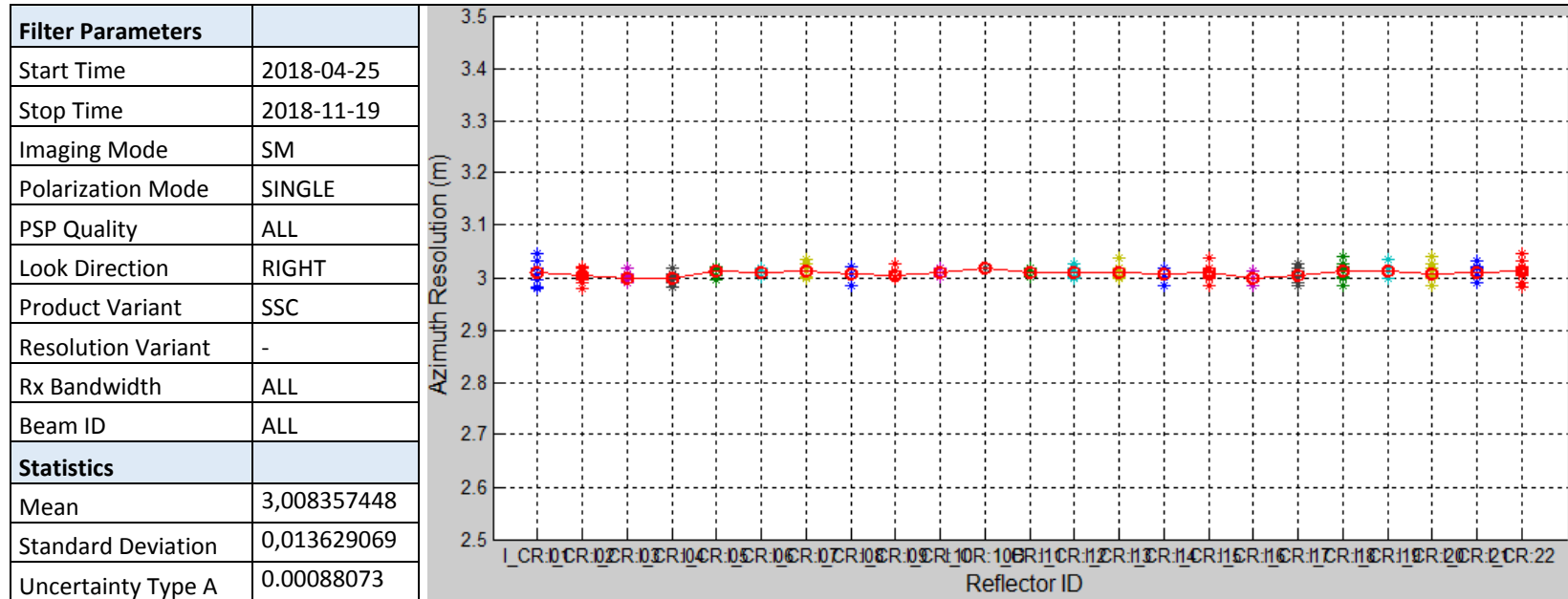


Figure 14. Azimuth Resolution for SM-S



7.2.3 PSLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SM
Polarization Mode	SINGLE
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Statistics	
Mean	-24.9329
Standard Deviation	1.2964
Uncertainty Type A	0.086045

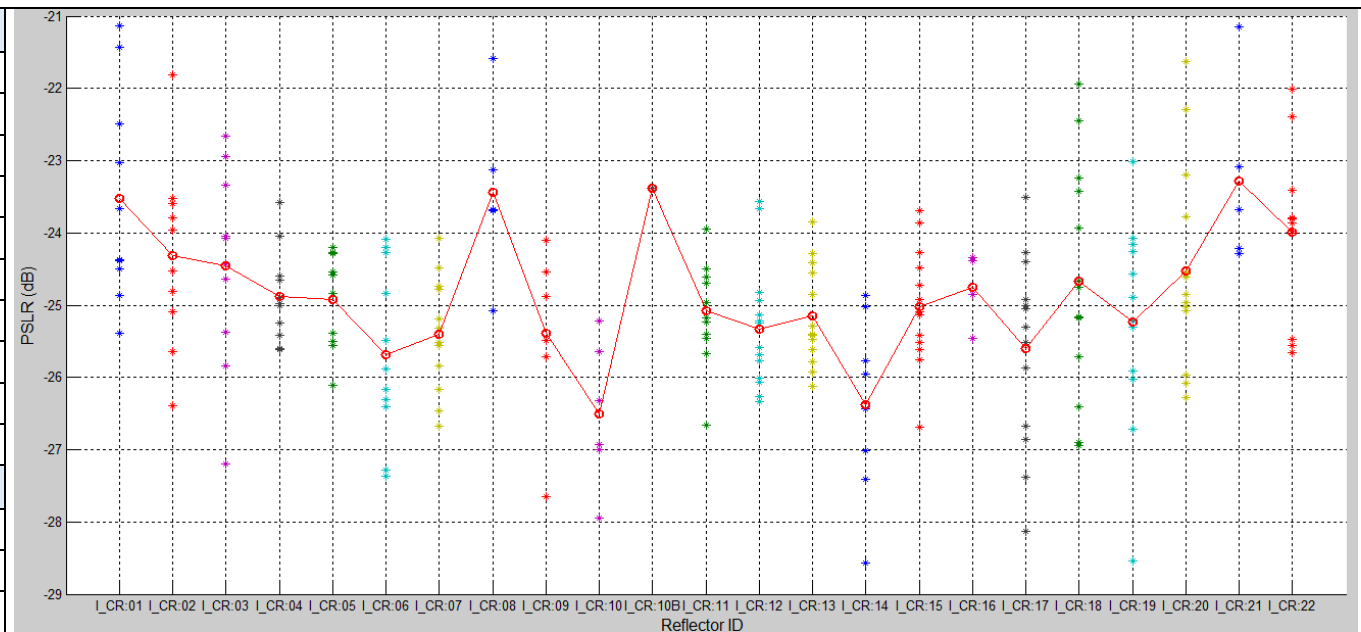


Figure 15. PSLR for SM-S



7.2.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SM
Polarization Mode	SINGLE
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Statistics	
Mean	-15.6311
Standard Deviation	0.91376
Uncertainty Type A	0.060383

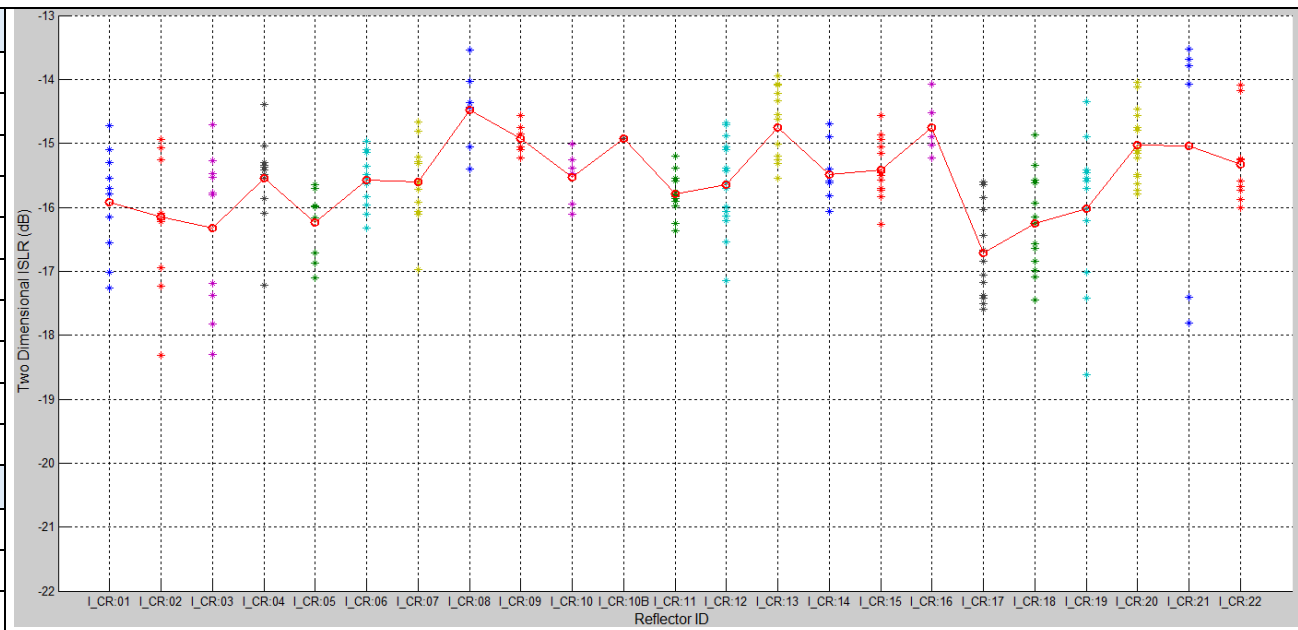


Figure 16. ISLR for SM-S



7.2.5 Pixel Localization Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SM
Polarization Mode	SINGLE
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Orbit Precision	3-SCIE
Statistics	
Mean	0,646202736
Standard Deviation	0,123383745
Uncertainty Type A	0,008135683

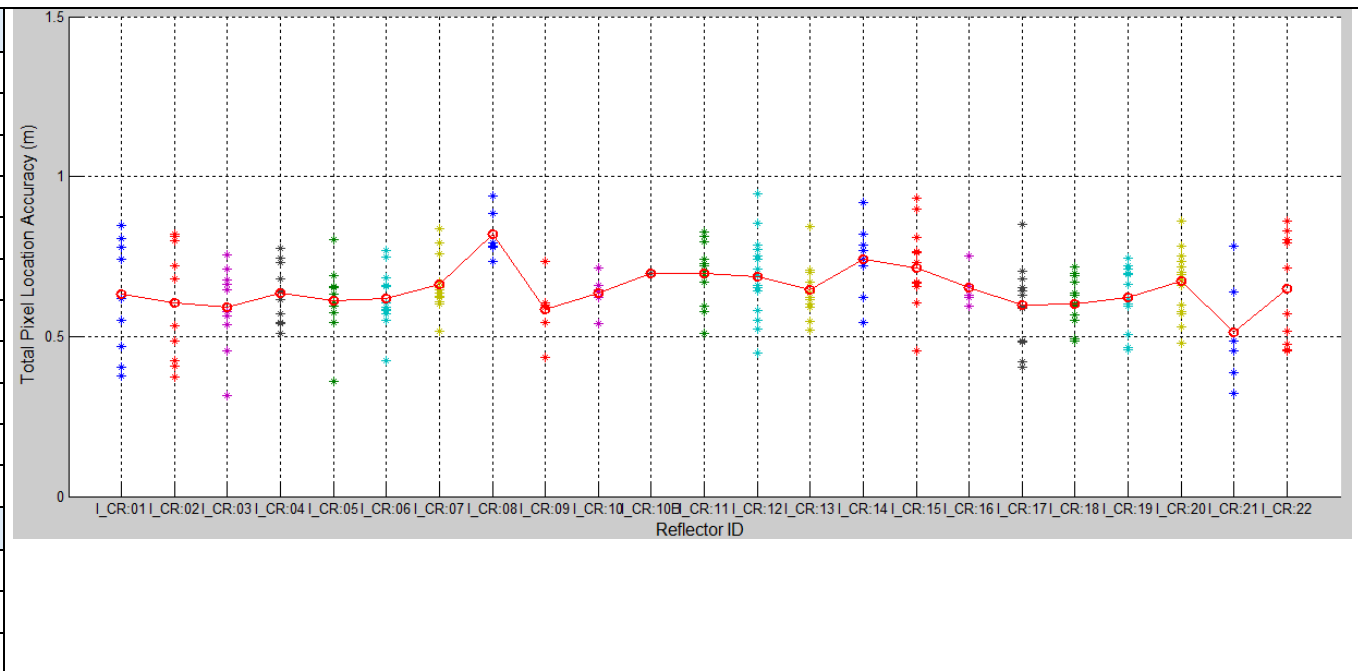


Figure 17. Pixel Localization Accuracy for SM-S



7.2.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SM	
Polarization Mode	SINGLE	
PSP Quality	APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	At Mid Range
Absolute Cal Factor	-57.7945	-57.5977
Abs. Radiometric Accuracy	0.72952	0.5705
Uncertainty Type A	0.048103	0.061164

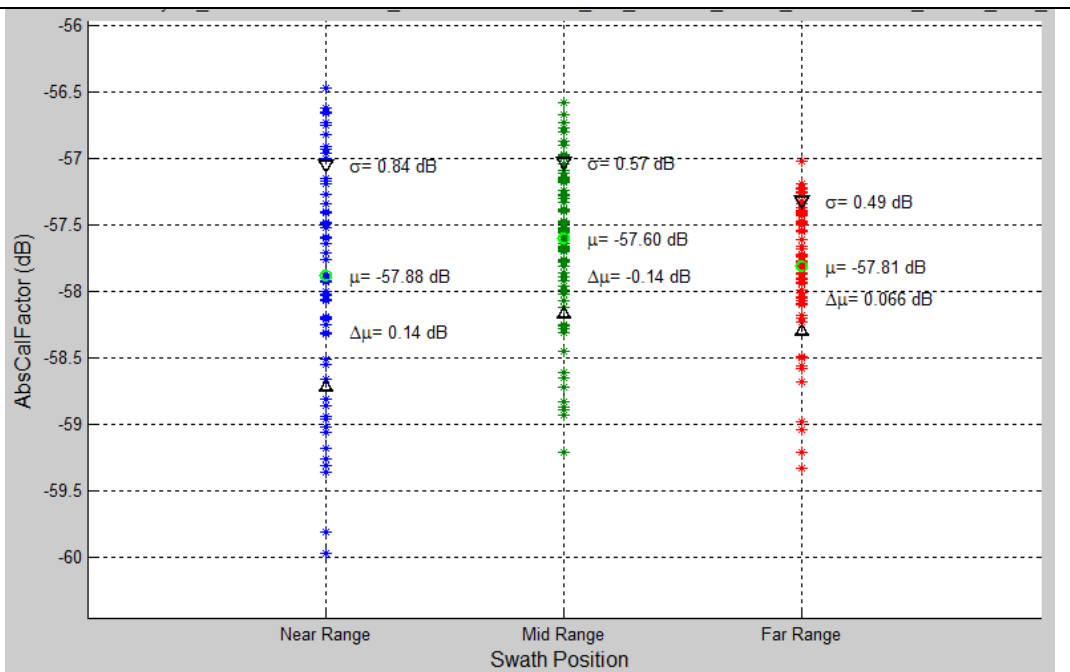


Figure 18. Radiometric measurements for SM-S



7.2.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SM
Polarization Mode	SINGLE
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
	Total
Mean	0.35
Standard Deviation	0.18

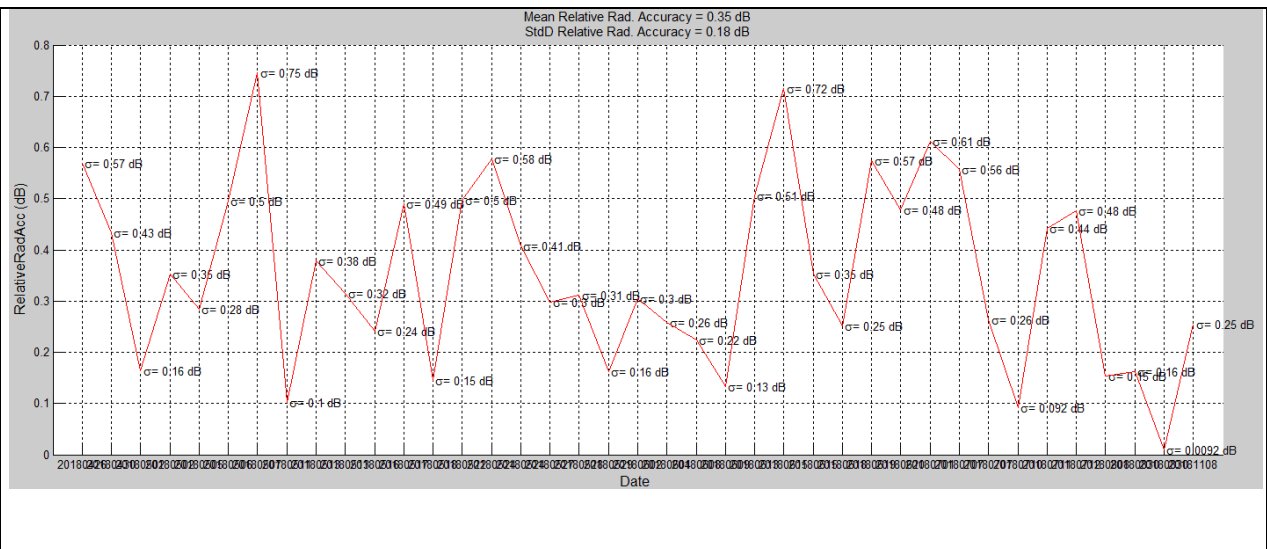


Figure 19. Relative Radiometric Accuracy for SM-S



7.3 SM-D

7.3.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-08-24	
Imaging Mode	SM	
Polarization Mode	DUAL	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	ALL	
Rx Bandwidth	ALL	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,176118278	1,707121535
Standard Deviation	0,006947469	0,163632255
Uncertainty Type A	0,000510788	0,012030483

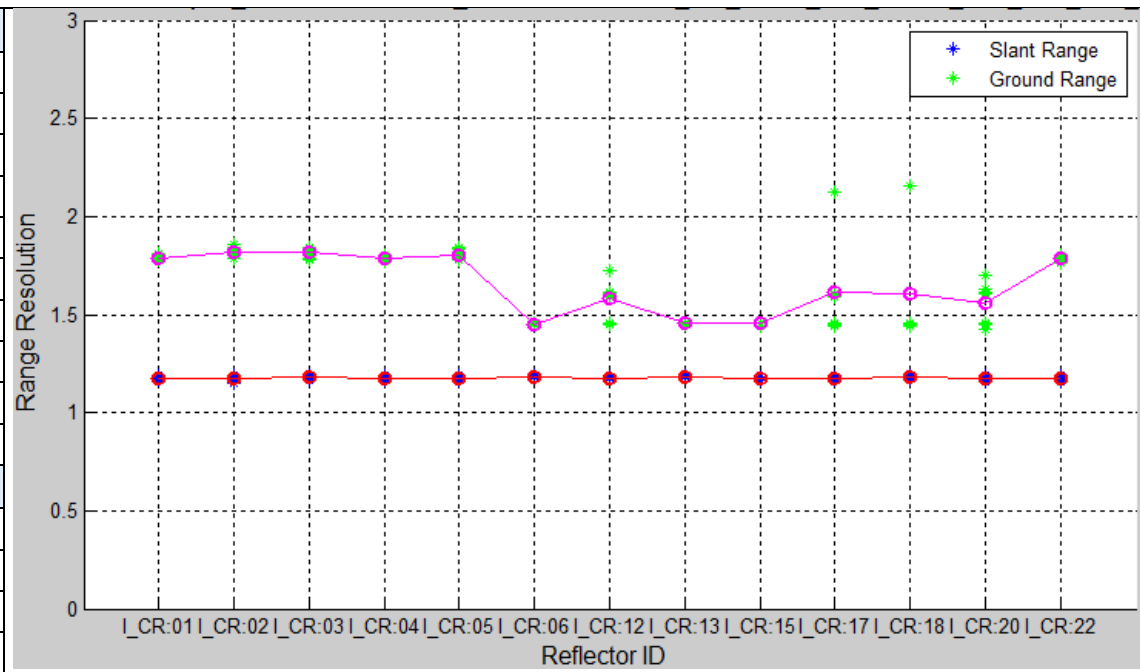


Figure 20. Range Resolution for SM-D



7.3.2 Azimuth Resolution



Figure 21. Azimuth Resolution for SM-D



7.3.3 PSLR

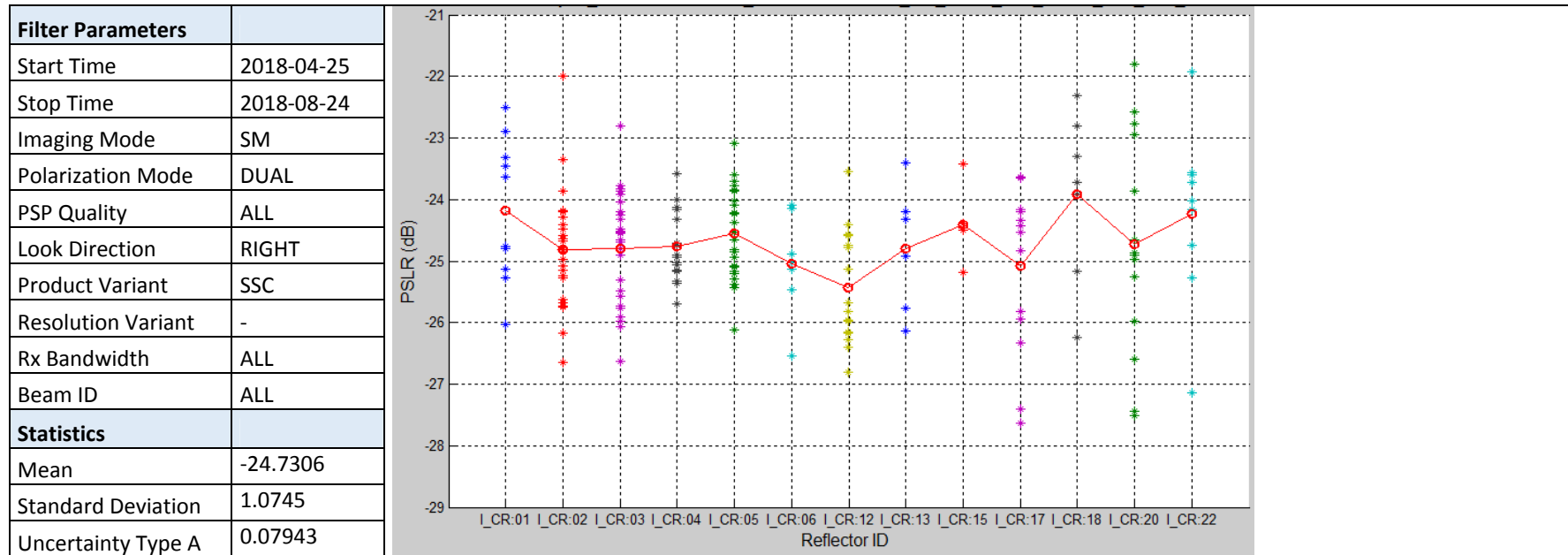


Figure 22. PSLR for SM-D



7.3.4 ISLR

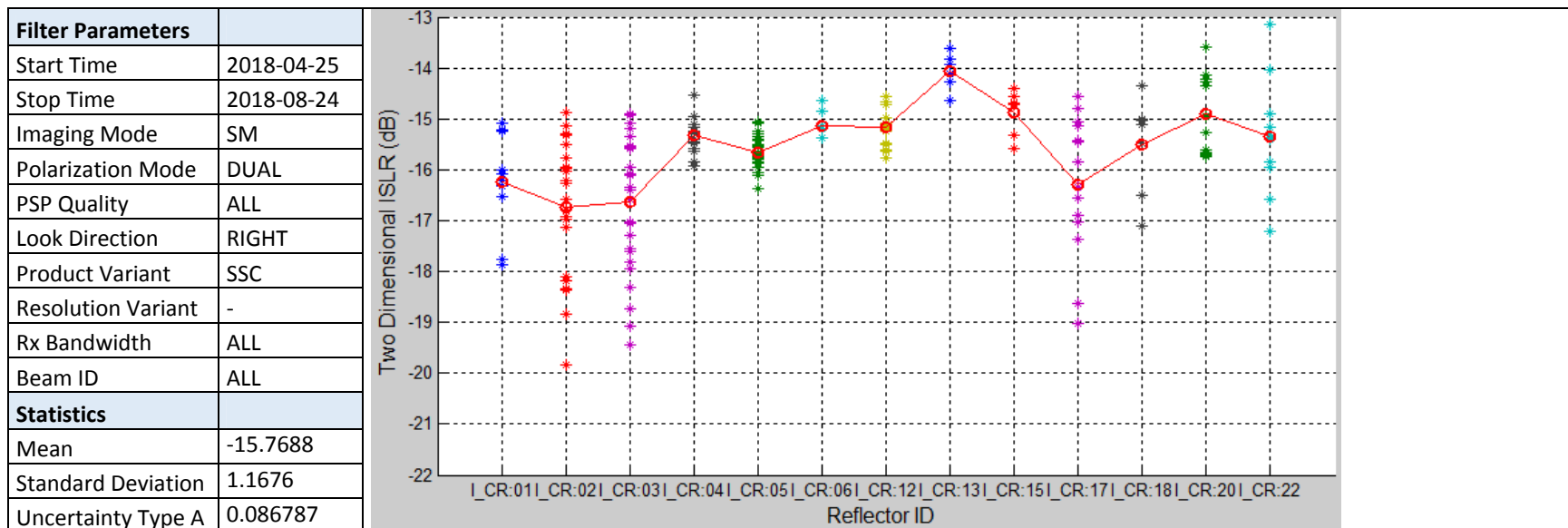


Figure 23. ISLR for SM-D



7.3.5 Pixel Localization Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-08-24
Imaging Mode	SM
Polarization Mode	DUAL
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Orbit Precision	3-SCIE
Statistics	
Mean	0.70265
Standard Deviation	0.12422
Uncertainty Type A	0.0091828

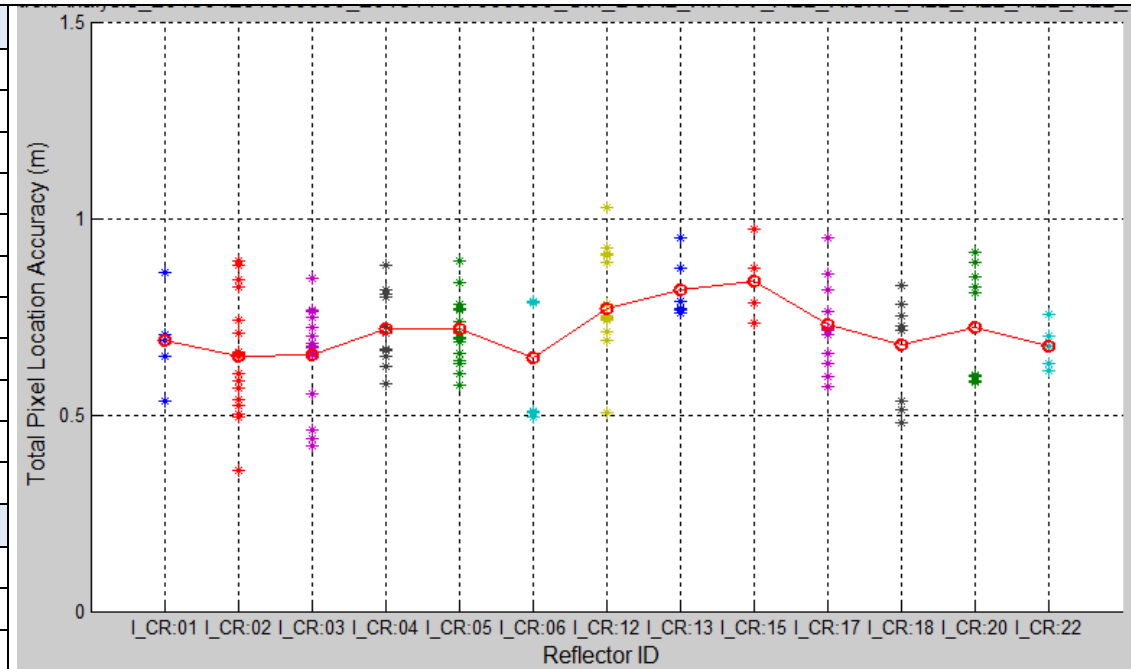


Figure 24. Pixel Localization Accuracy for SM-D



7.3.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-08-24	
Imaging Mode	SM	
Polarization Mode	DUAL	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	At Mid Range
Absolute Cal Factor	-57.7951	-57.8831
Abs. Radiometric Accuracy	0.41715	0.29996
Uncertainty Type A	0.030921	0.14998

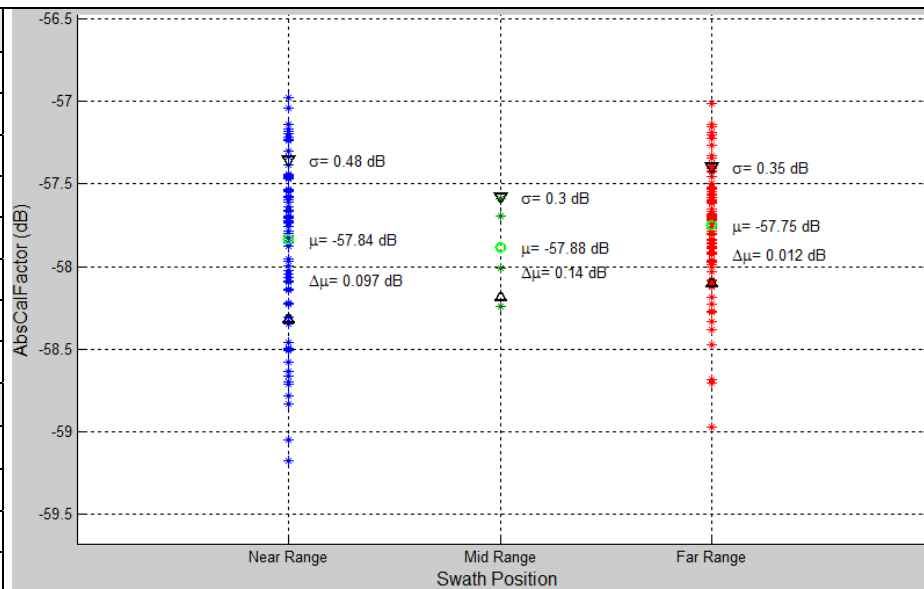


Figure 25. Radiometric measurements for SM-D



7.3.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-08-24
Imaging Mode	SM
Polarization Mode	DUAL
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
	Total
Mean	0.24
Standard Deviation	0.08

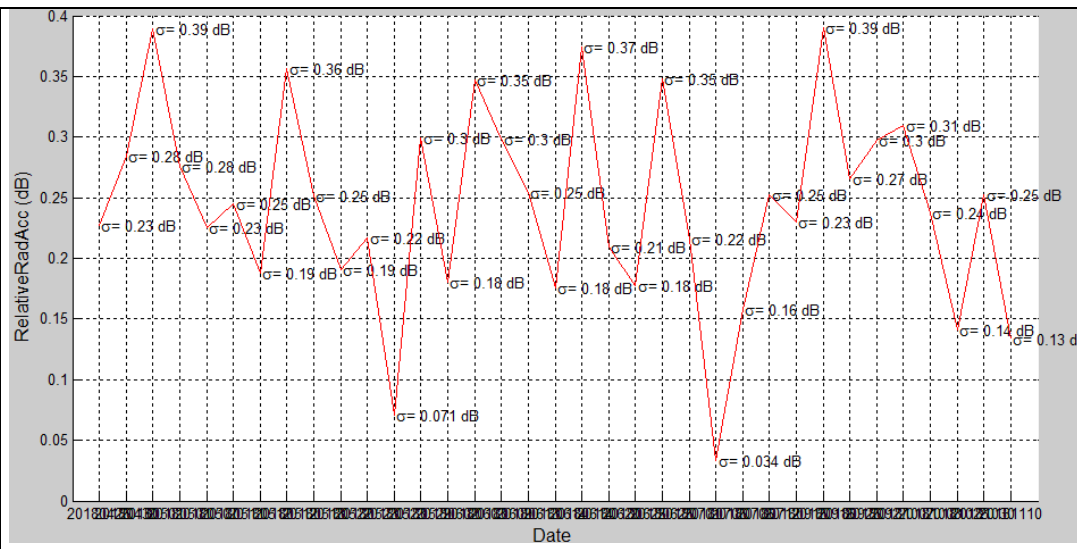


Figure 26. Relative radiometric accuracy for SM-D



7.4 SC

7.4.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SC	
Polarization Mode	S	
PSP Quality	AUTO_APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	100	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,570485608	2,362541528
Standard Deviation	0,278532901	0,861587667
Uncertainty Type A	0,022372301	0,069204387

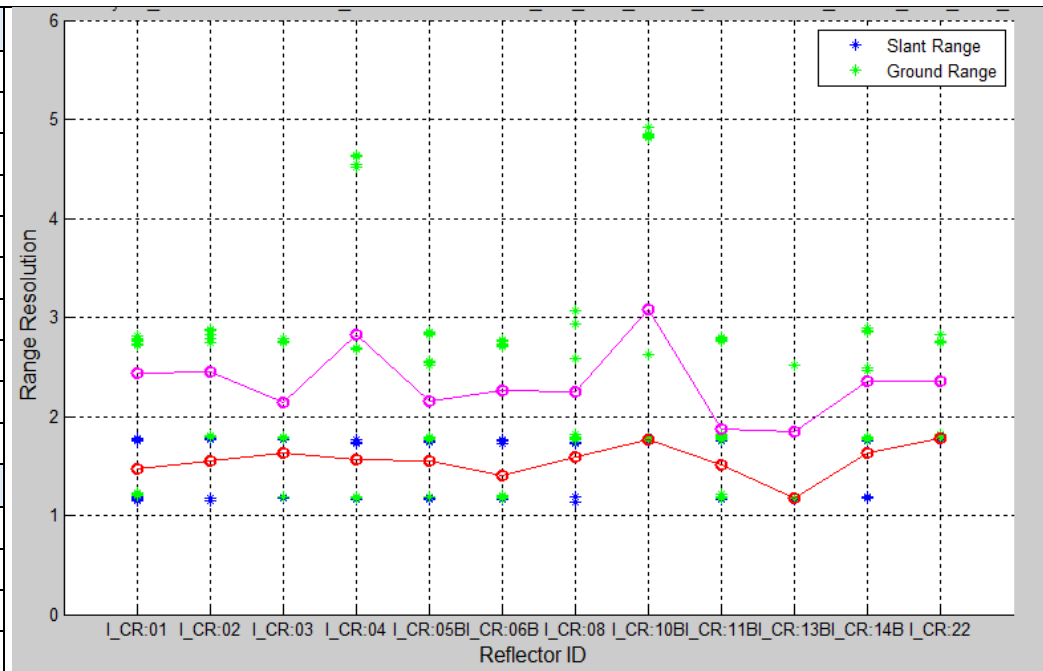


Figure 27. Range Resolution for SC



7.4.2 Azimuth Resolution

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SC
Polarization Mode	S
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	100
Beam ID	ALL
Statistics	
Mean	17,81115472
Standard Deviation	0,254602905
Uncertainty Type A	0,020450197

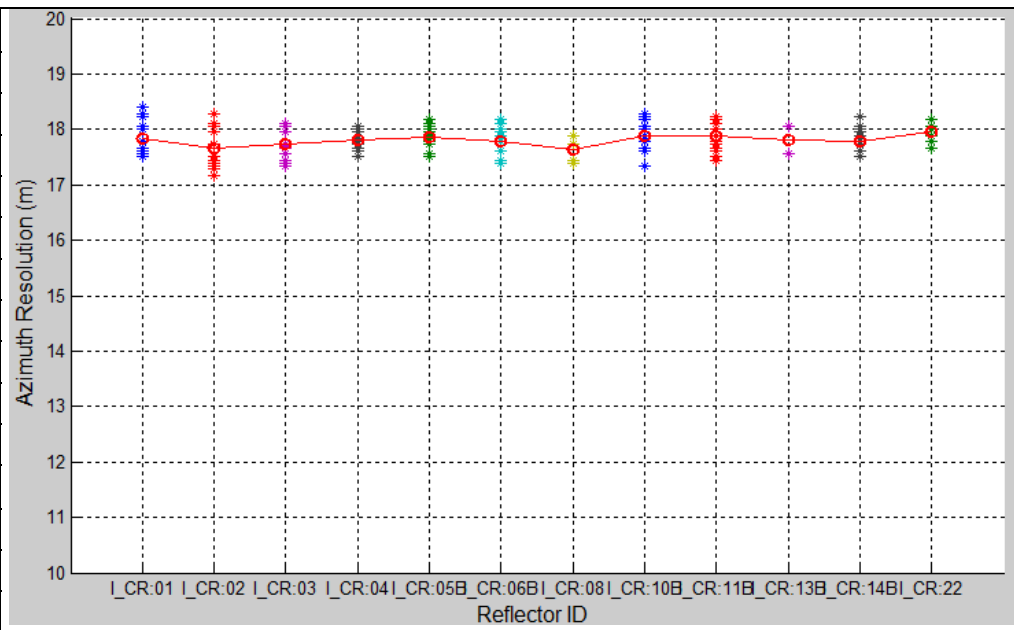


Figure 28. Azimuth Resolution for SC



7.4.3 PSLR

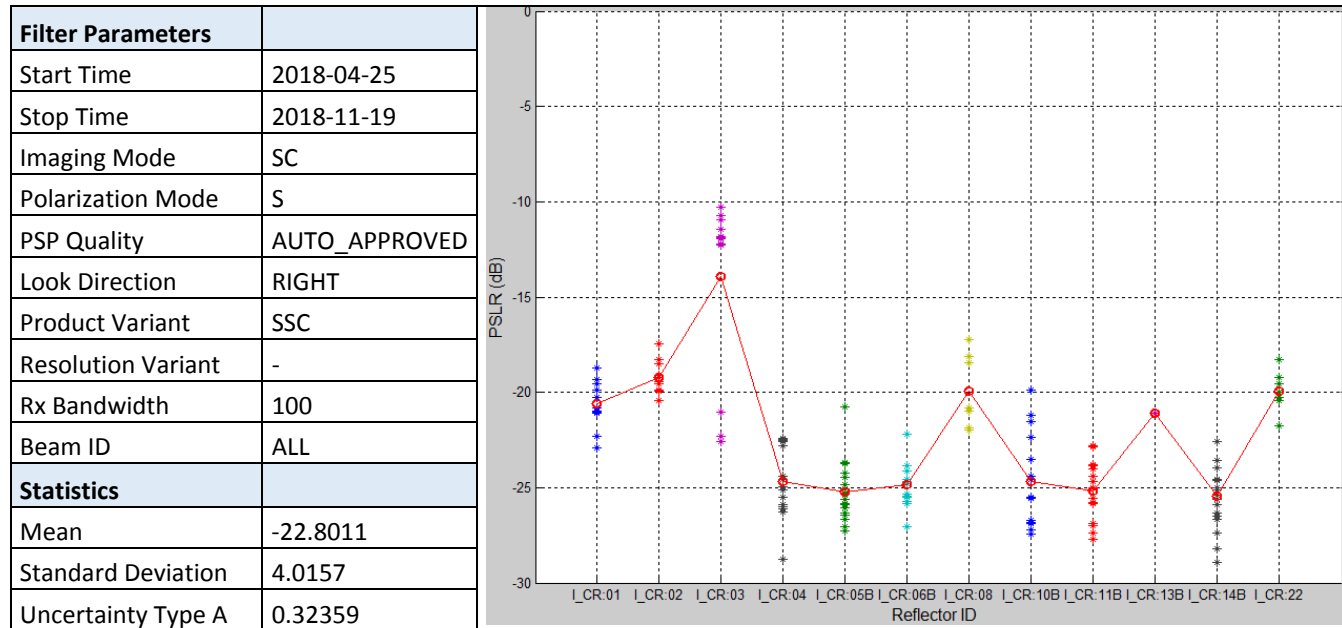


Figure 29. PSLR for SC



7.4.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SC
Polarization Mode	S
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	100
Beam ID	ALL
Statistics	
Mean	-17.0624
Standard Deviation	2.5342
Uncertainty Type A	0.20555

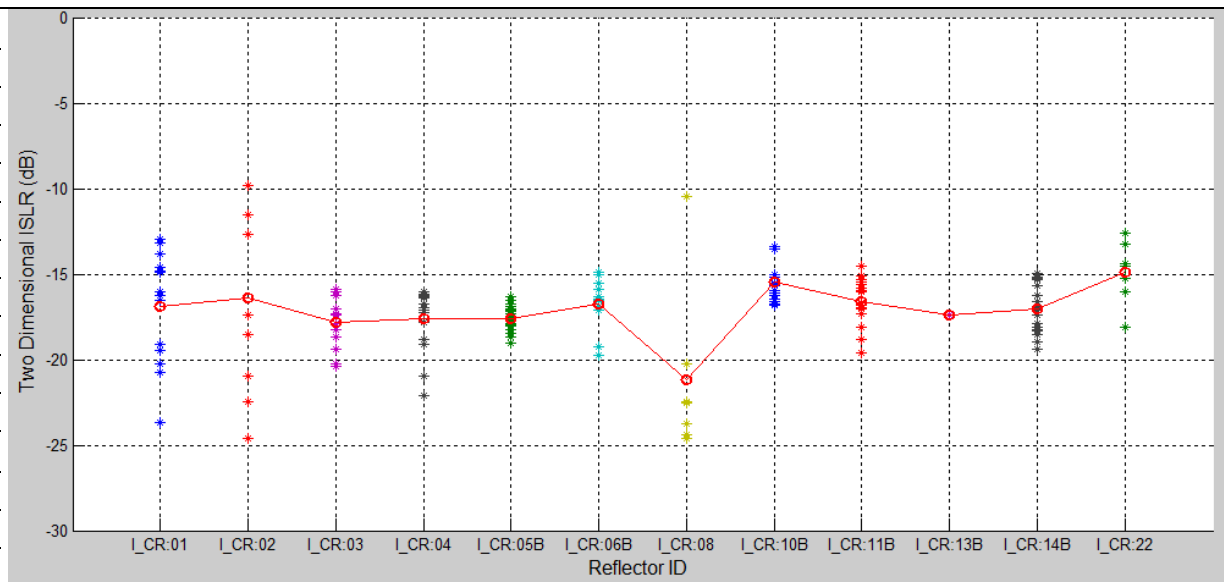


Figure 30. ISLR for SC



7.4.5 Pixel Localization Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SC
Polarization Mode	S
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	100
Beam ID	ALL
Orbit Precision	3-SCIE
Statistics	
Mean	1,515572756
Standard Deviation	1,073324118
Uncertainty Type A	0,074421637

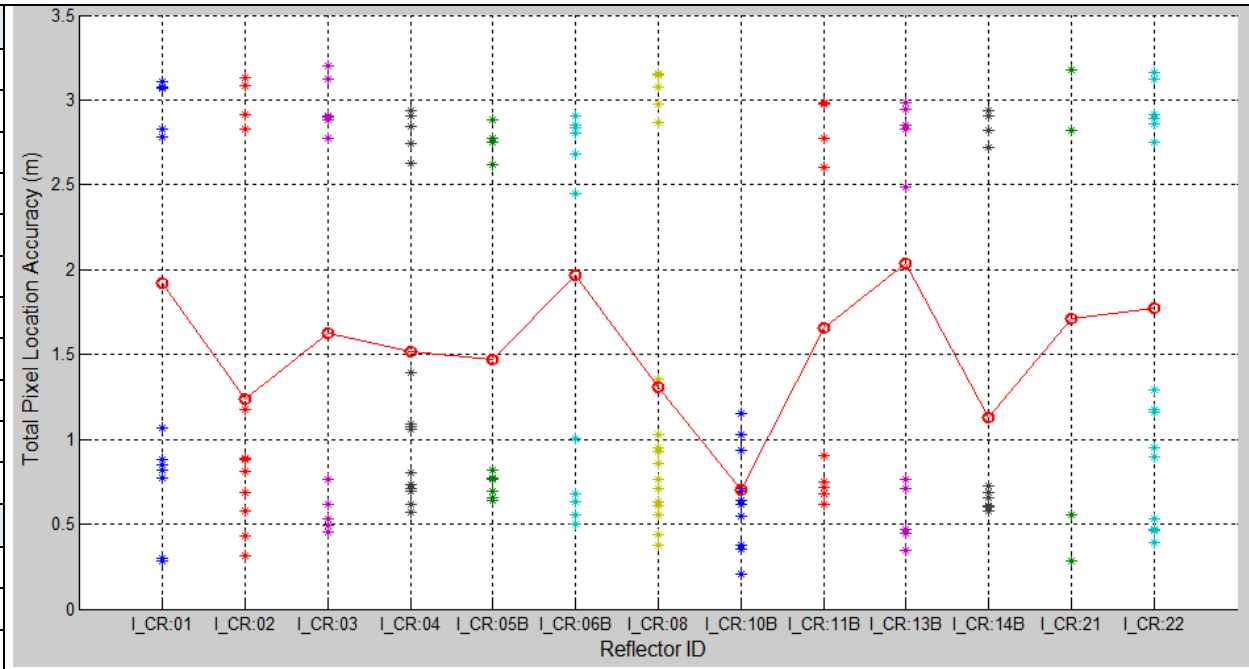


Figure 31. Pixel Localization Accuracy for SC



7.4.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SC	
Polarization Mode	S	
PSP Quality	APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	Mid Range
Absolute Cal Factor	-57.9491	-57.8369
Abs. Radiometric Accuracy	0.50538	0.41588
Uncertainty Type A	0.041127	0.081562

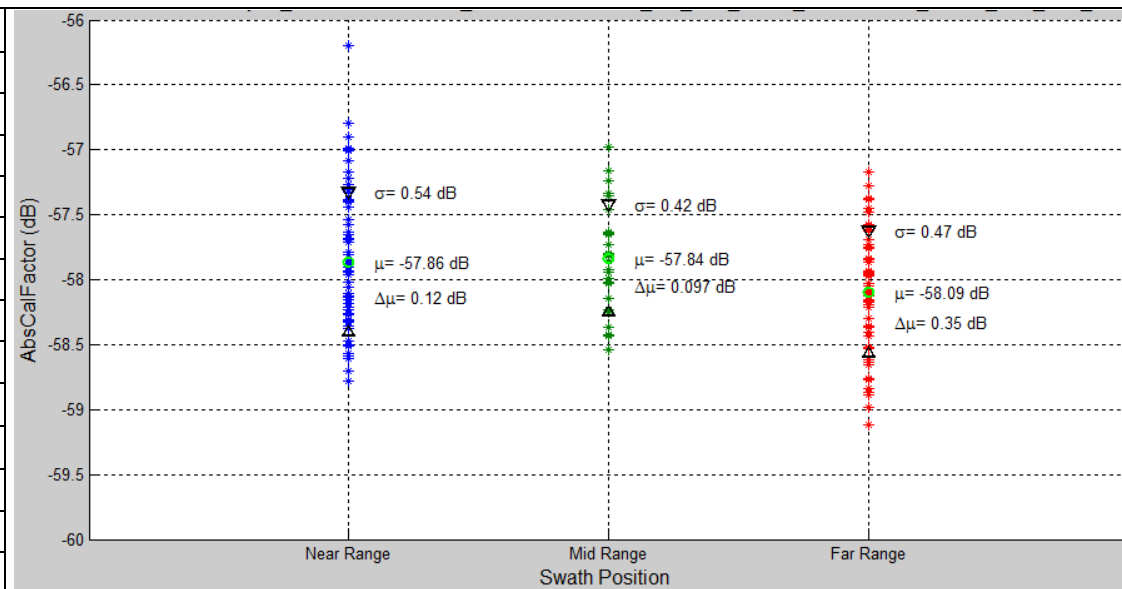


Figure 32. Radiometric measurements for SC



7.4.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SL
Polarization Mode	DUAL
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
Mean	0.33
Standard Deviation	0.11

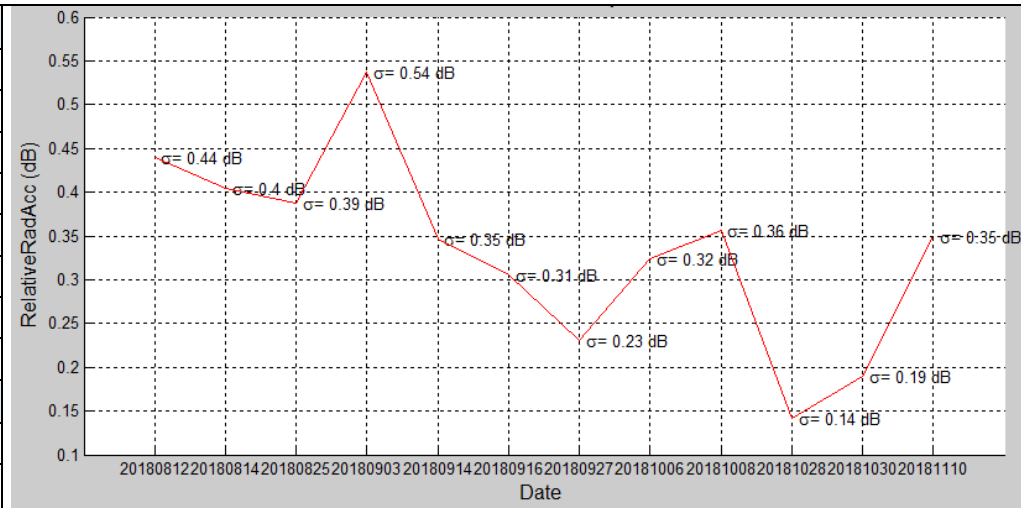


Figure 33. Relative Radiometric Accuracy for SC



7.5 SL-S

7.5.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-08-24	
Imaging Mode	SL	
Polarization Mode	SINGLE	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	ALL	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,174815293	2,388932923
Standard Deviation	0,005541965	0,687023098
Uncertainty Type A	0,001047333	0,129835162

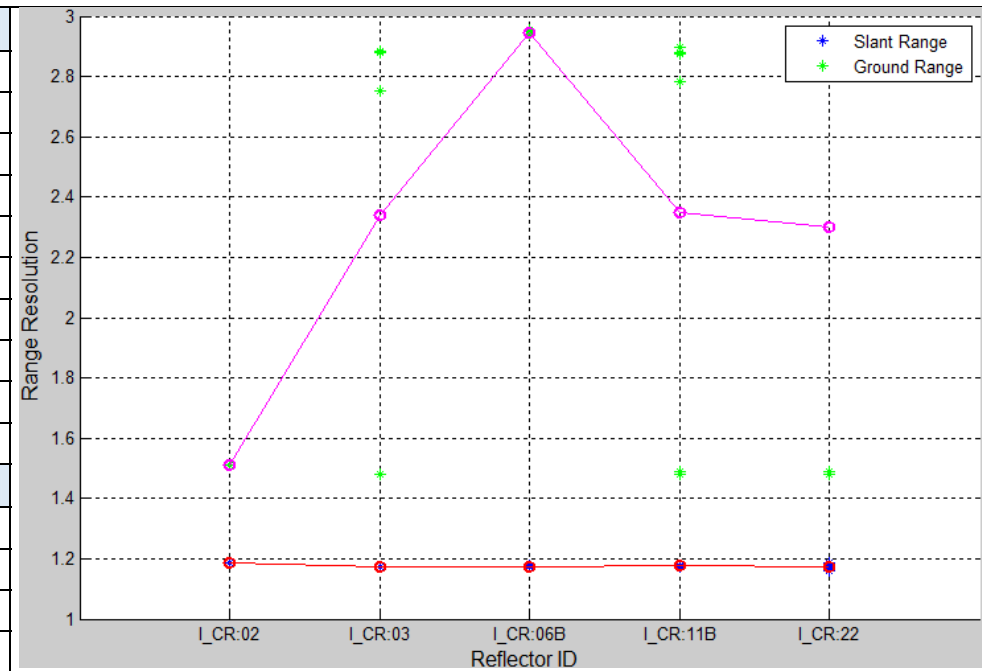


Figure 34. Range Resolution for SL-S



7.5.2 Azimuth Resolution

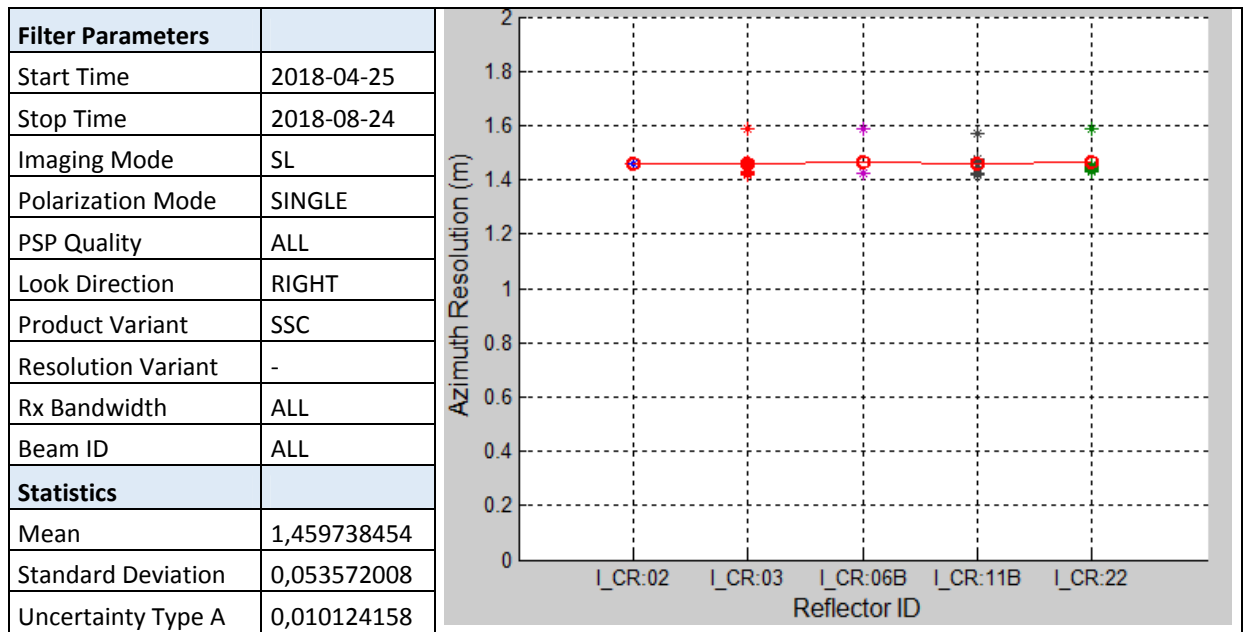


Figure 35. Azimuth Resolution for SL-S



7.5.3 PSLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-08-24
Imaging Mode	SL
Polarization Mode	SINGLE
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Statistics	
Mean	-25,03458571
Standard Deviation	0,902662834
Uncertainty Type A	0,170587241

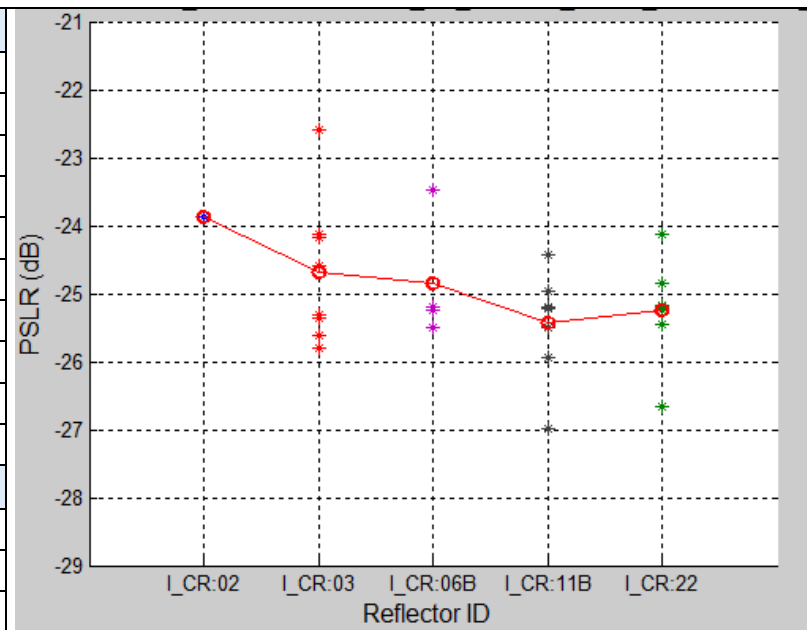


Figure 36. PSLR for SL-S



7.5.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-08-24
Imaging Mode	SL
Polarization Mode	SINGLE
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Statistics	
Mean	-15,01028571
Standard Deviation	0,75198722
Uncertainty Type A	0,142112227

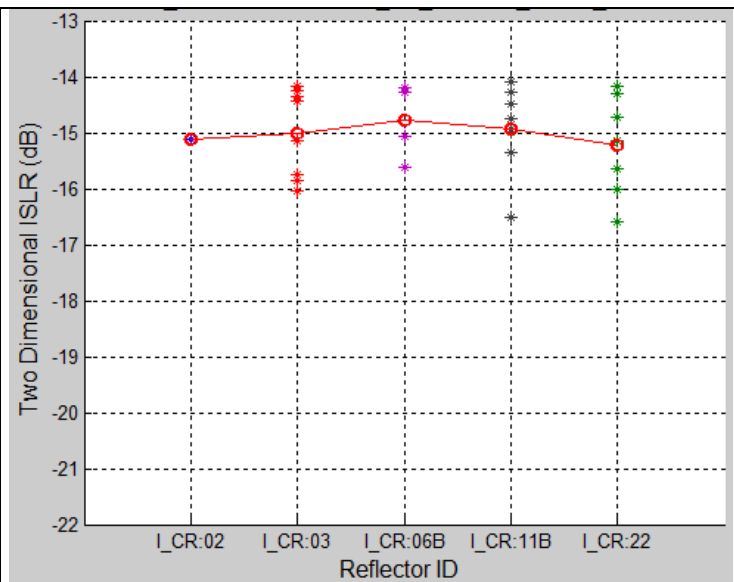


Figure 37. ISLR for SL-S



7.5.5 Pixel Localization Accuracy

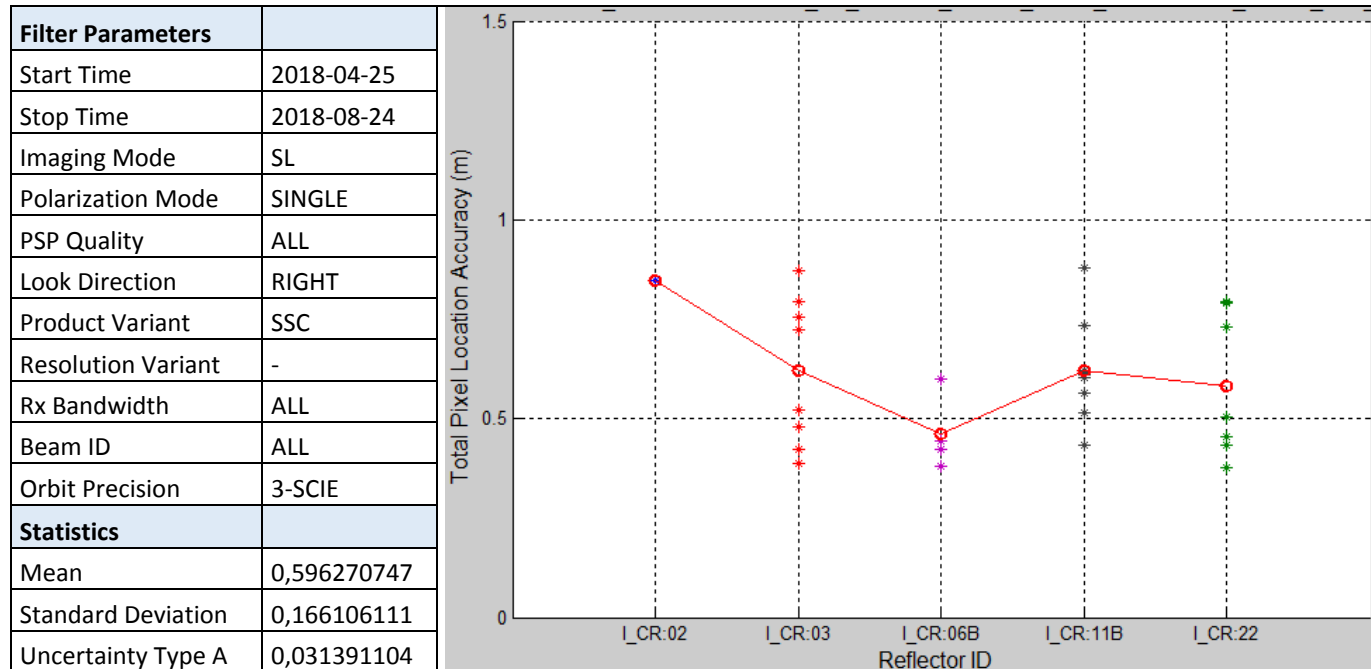


Figure 38. Pixel Localization Accuracy for SL-S



7.5.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-08-24	
Imaging Mode	SL	
Polarization Mode	SINGLE	
PSP Quality	ALL	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	At Mid Range
Absolute Cal Factor	-57,57948211	-57,65103225
Abs. Radiometric Accuracy	0,612310326	0,631887998
Uncertainty Type A	0,115715775	0,128983597

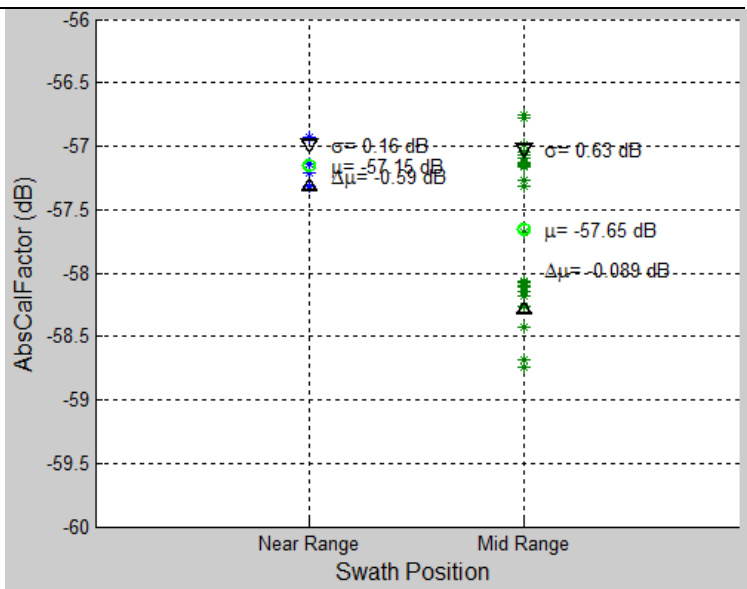


Figure 39. Radiometric measurements for SL-S



7.5.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-08-24
Imaging Mode	SL
Polarization Mode	SINGLE
PSP Quality	ALL
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
Mean	0,24570142
Standard Deviation	0,217930031

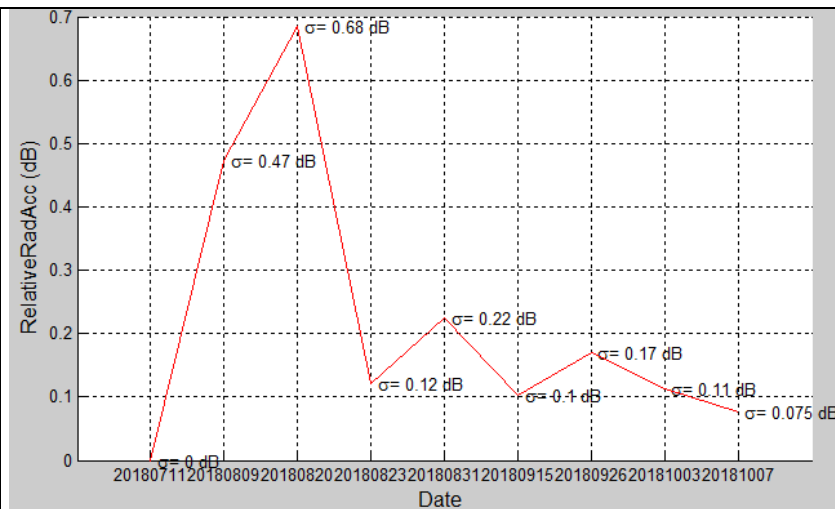


Figure 40. Relative Radiometric Accuracy for SL-S



7.6 SL-D

7.6.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SL	
Polarization Mode	DUAL	
PSP Quality	AUTO_APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	150	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,173602505	1,558235147
Standard Deviation	0,005354931	0,128693162
Uncertainty Type A	0,000697153	0,016754423

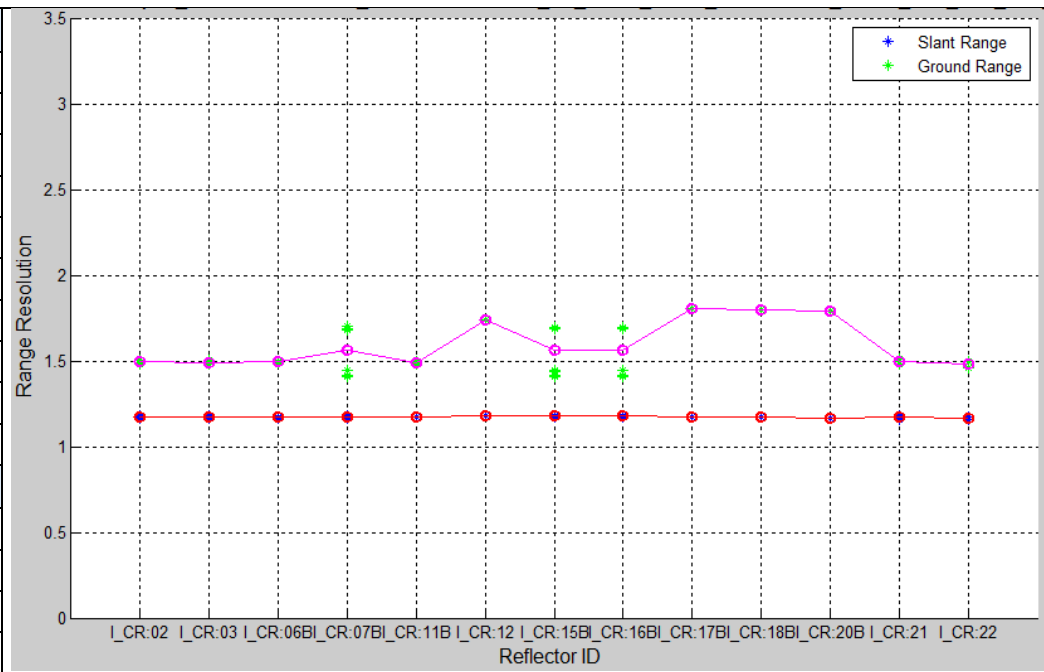


Figure 41. Range Resolution for SL-D



7.6.2 Azimuth Resolution

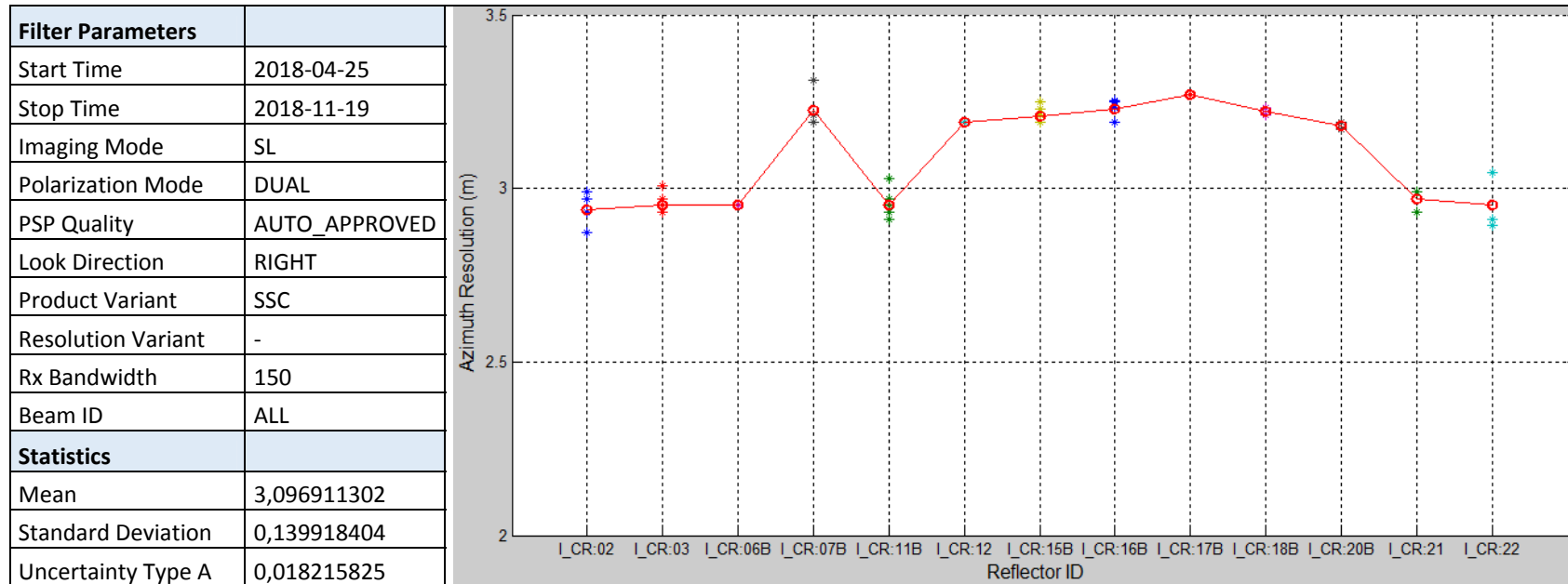


Figure 42. Azimuth Resolution for SL-D



7.6.3 PSLR

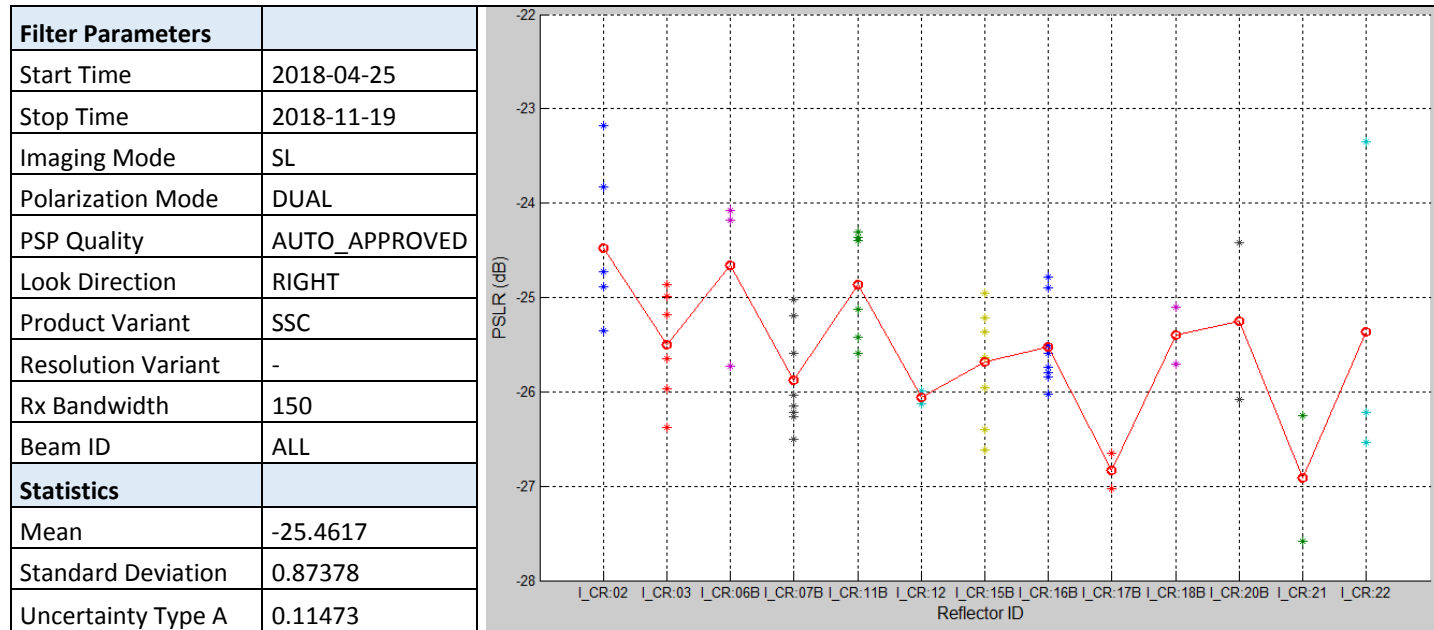


Figure 43. PSLR for SL-D



7.6.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SL
Polarization Mode	DUAL
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	150
Beam ID	ALL
Statistics	
Mean	-15.1572
Standard Deviation	0.79049
Uncertainty Type A	0.1047

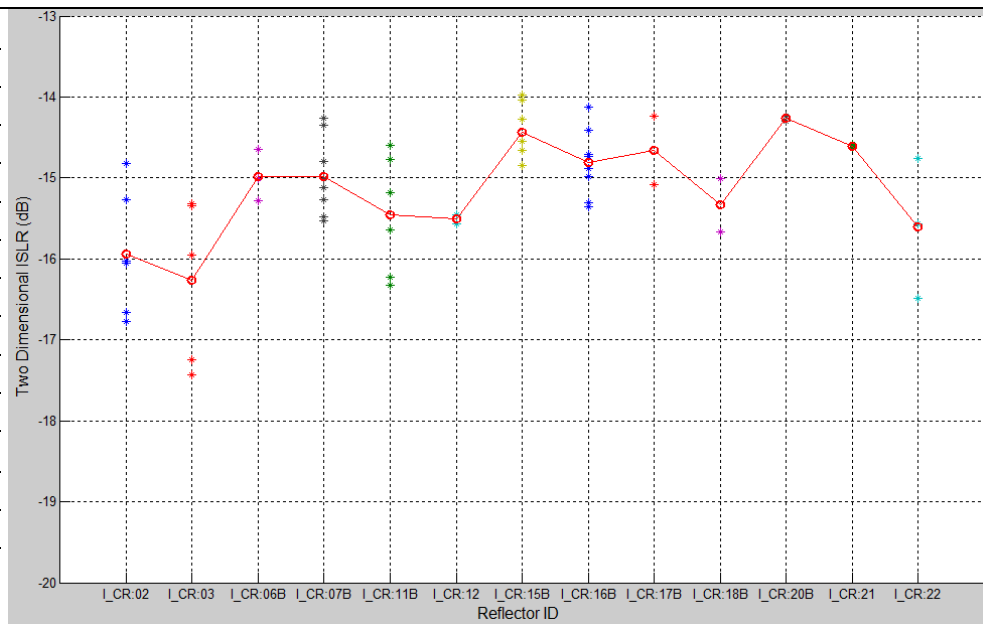


Figure 44. ISLR for SL-D



7.6.5 Pixel Localization Accuracy

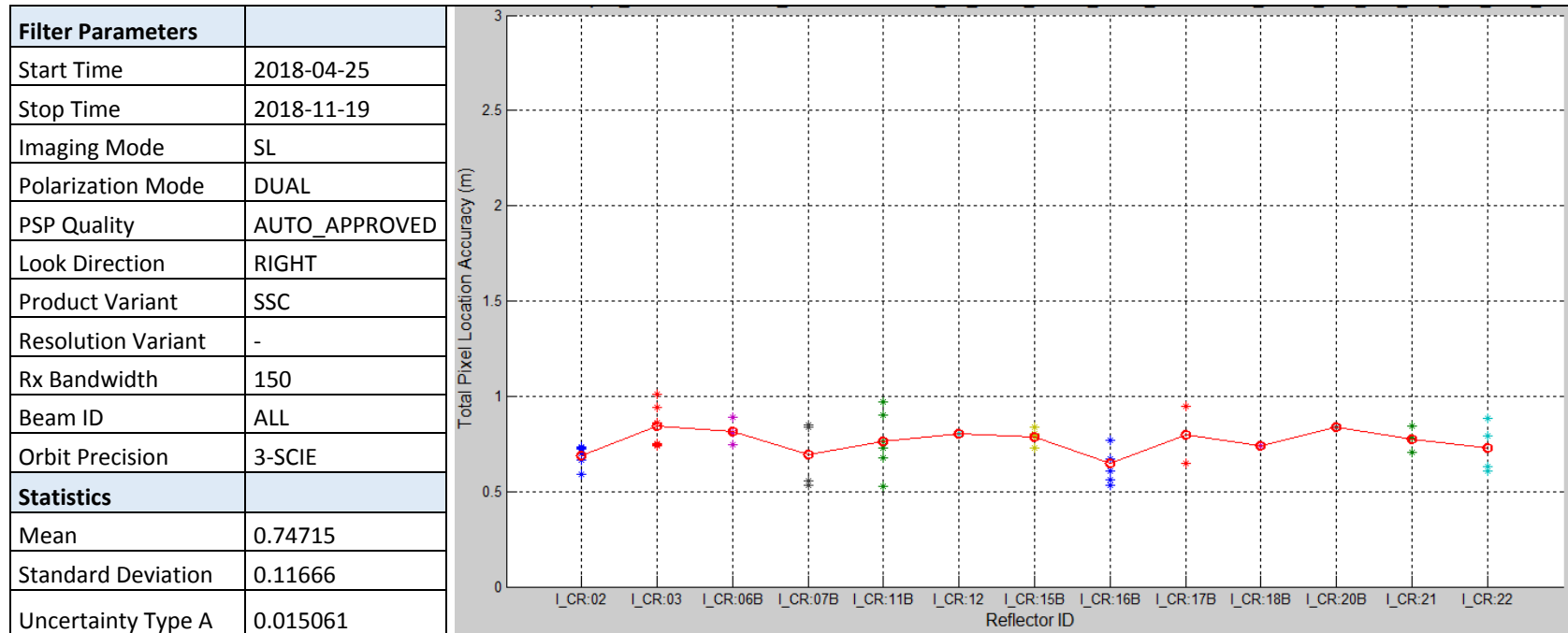


Figure 45. Pixel Localization Accuracy for SL-D



7.6.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	SL	
Polarization Mode	DUAL	
PSP Quality	APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	At Mid Range
Absolute Cal Factor	-58.0972	-58.11
Abs. Radiometric Accuracy	0.36885	0.37
Uncertainty Type A	0.055607	0.094727

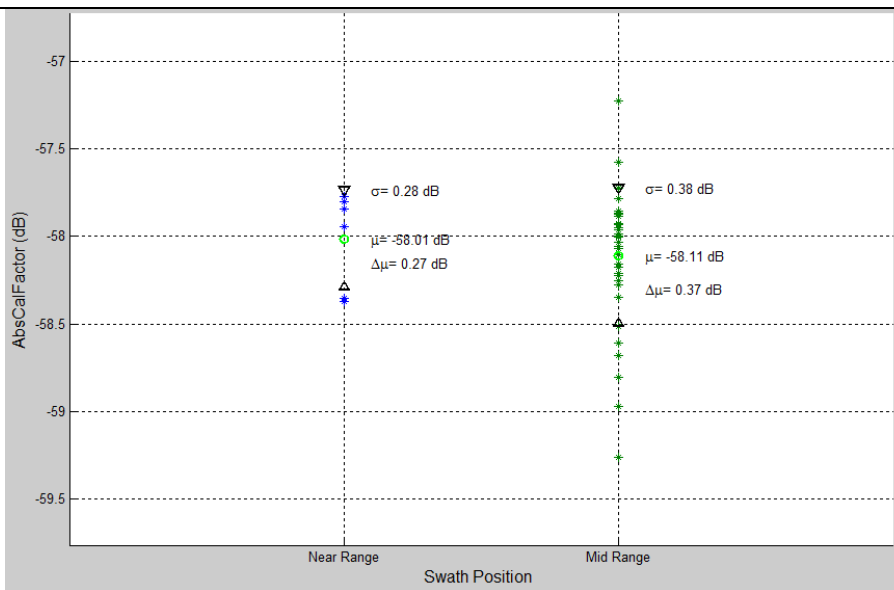


Figure 46. Radiometric measurements for SL-D



7.6.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	SL
Polarization Mode	DUAL
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
Mean	0.32
Standard Deviation	0.21

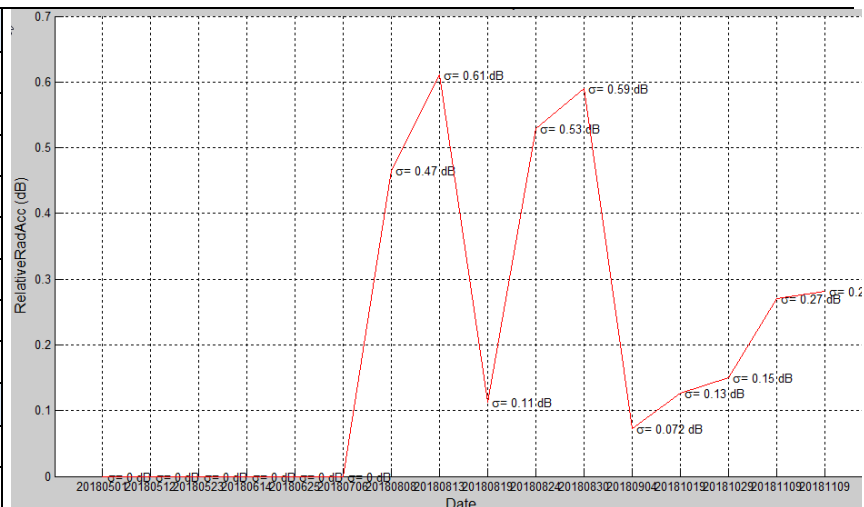


Figure 47. Relative radiometric accuracy for SL-D



PAZ

Ref: PAZ/INT/CALVAL/RPT/002

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7.7 HS-S

7.7.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	HS	
Polarization Mode	SINGLE	
PSP Quality	AUTO_APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	300	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	0,599401077	1,002266632
Standard Deviation	0,025349949	0,201580752
Uncertainty Type A	0,006545329	0,052047926

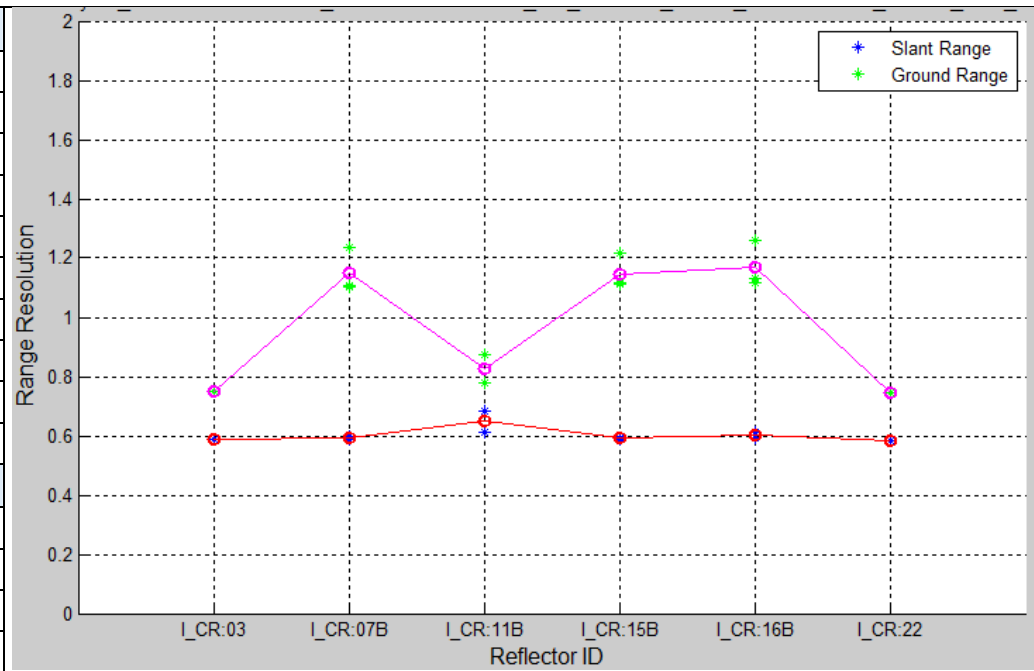


Figure 48. Range Resolution for HS-S



7.7.2 Azimuth Resolution

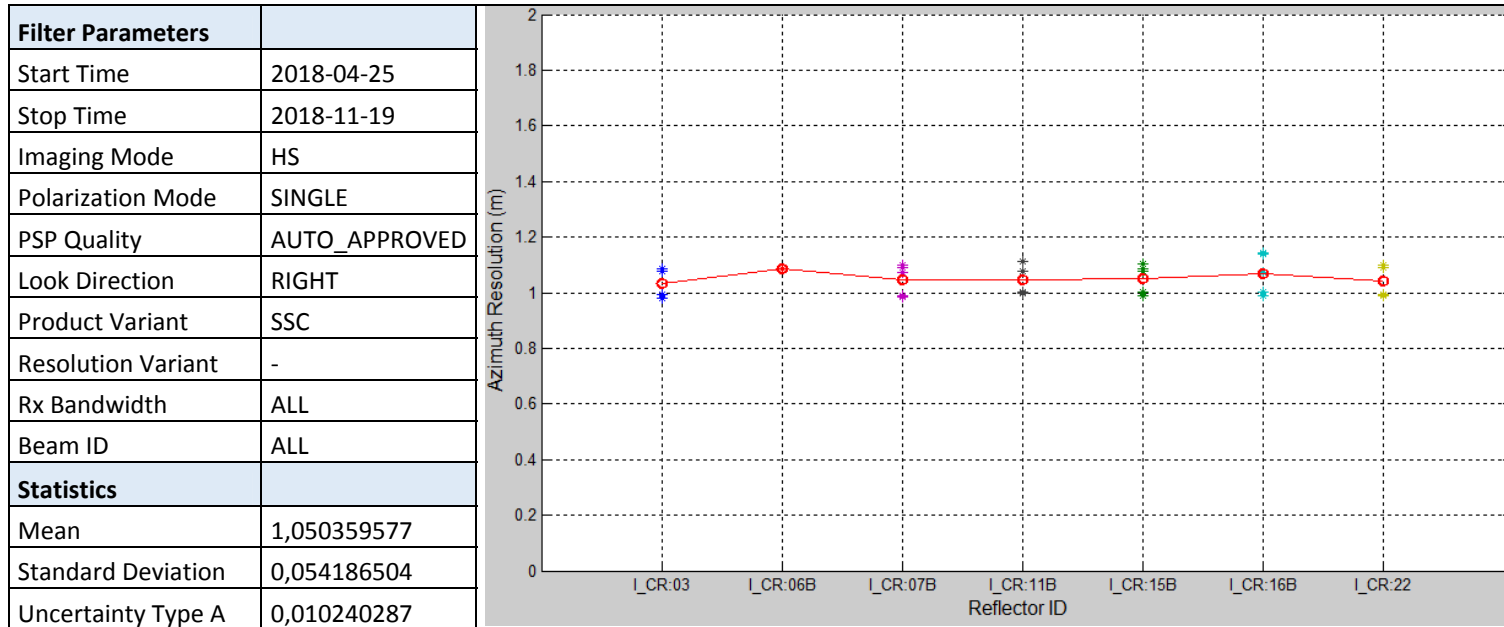


Figure 49. Azimuth Resolution for HS-S



7.7.3 PSLR

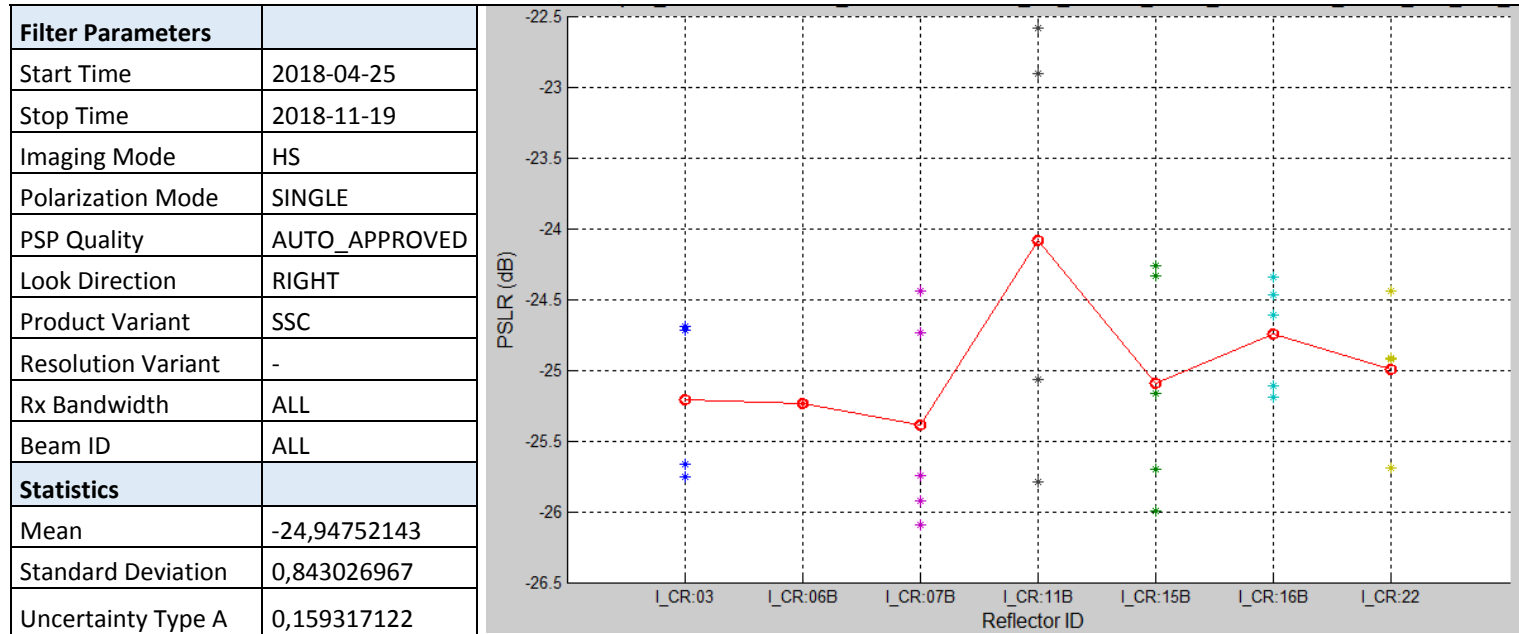


Figure 50. PSLR for HS-S



7.7.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	HS
Polarization Mode	SINGLE
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	300
Beam ID	ALL
Statistics	
Mean	-15,25291786
Standard Deviation	0,681946306
Uncertainty Type A	0,128875738

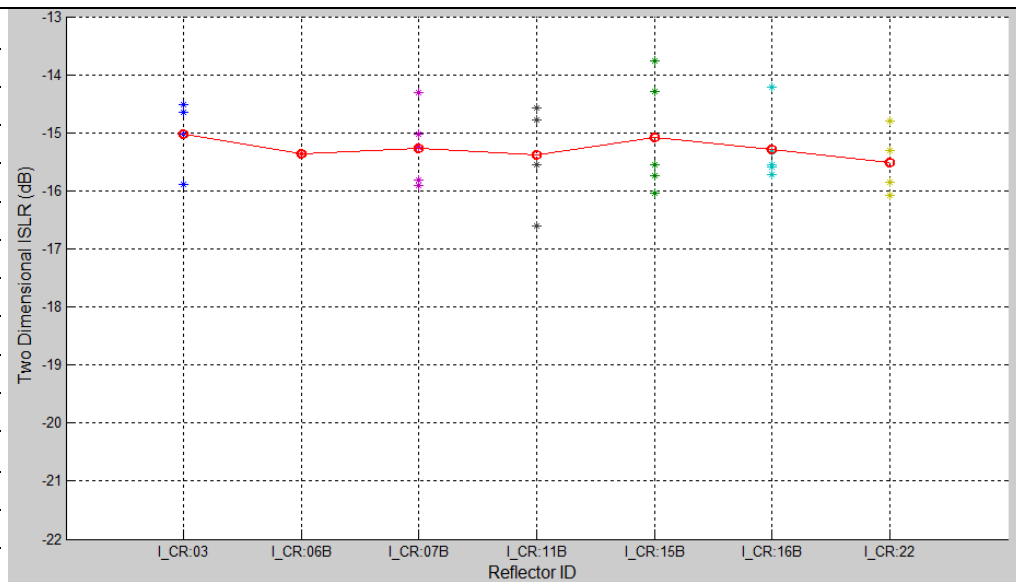


Figure 51. ISLR for HS-S



7.7.5 Pixel Localization Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	HS
Polarization Mode	SINGLE
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	300
Beam ID	ALL
Orbit Precision	3-SCIE
Statistics	
Mean	0,6151542
Standard Deviation	0,136747902
Uncertainty Type A	0,025842924

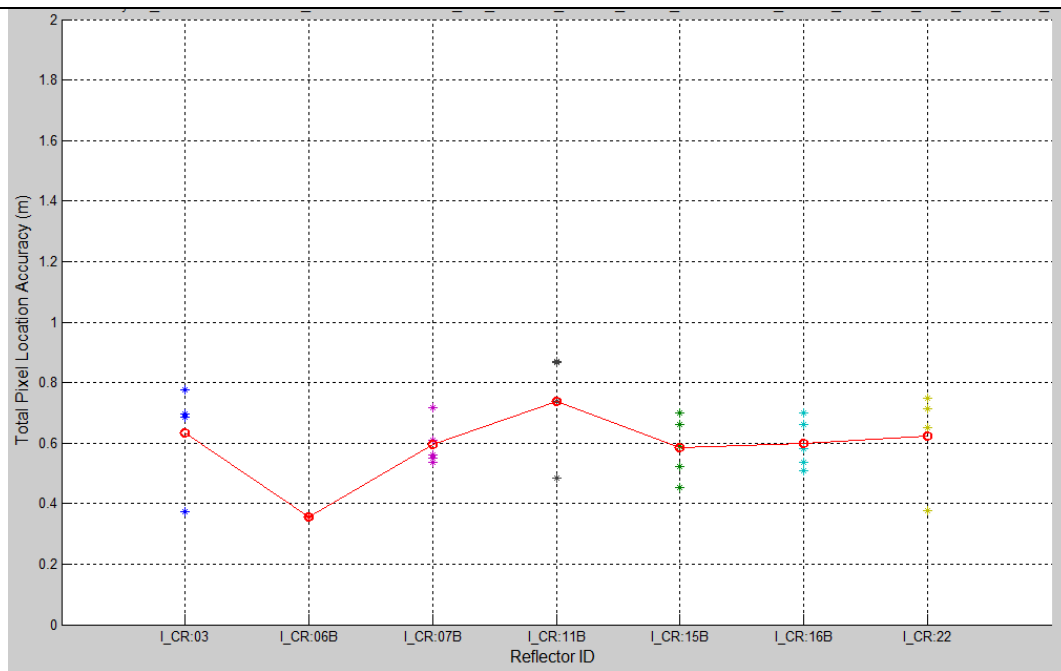


Figure 52. Pixel Localization Accuracy for HS-S



7.7.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	HS	
Polarization Mode	SINGLE	
PSP Quality	APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	Mid Range
Absolute Cal Factor	-57,68540411	-57,62856871
Abs. Radiometric Accuracy	0,556251523	0,465774256
Uncertainty Type A	0,105121657	0,095075772

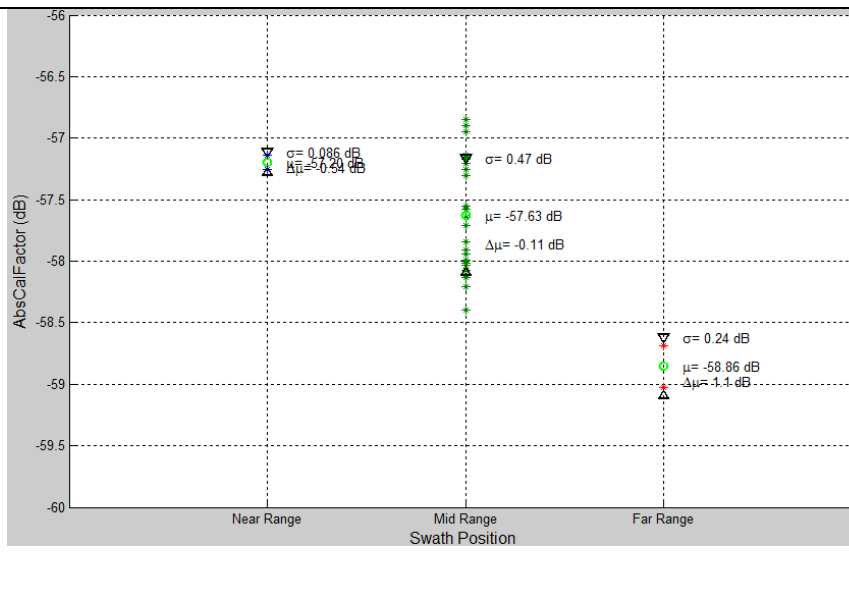


Figure 53. Radiometric measurements for HS-S



7.7.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	HS
Polarization Mode	SINGLE
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
Mean	0.33
Standard Deviation	0.41

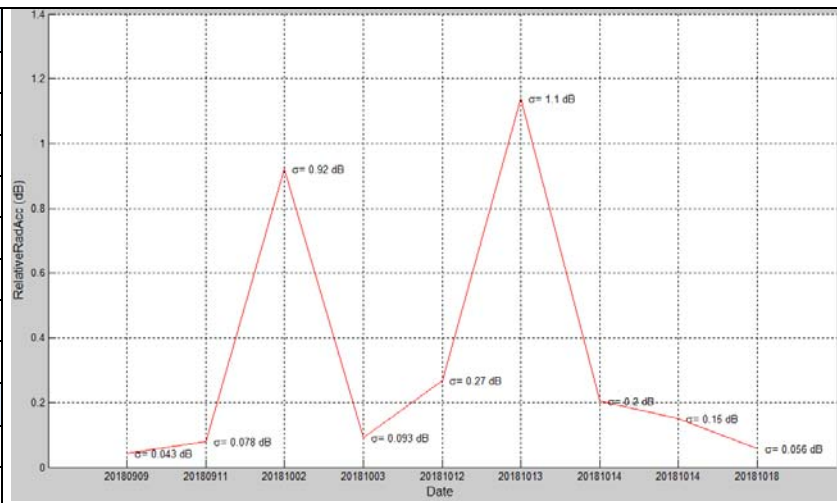


Figure 54. Relative Radiometric Accuracy for HS-S



7.9 HS-D

7.9.1 Range Resolution

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	HS	
Polarization Mode	DUAL	
PSP Quality	AUTO_APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Rx Bandwidth	150	
Beam ID	ALL	
Statistics		
	Slant Range	Ground Range
Mean	1,174646133	1,70882465
Standard Deviation	0,00774512	0,169182247
Uncertainty Type A	0,001580966	0,034534181

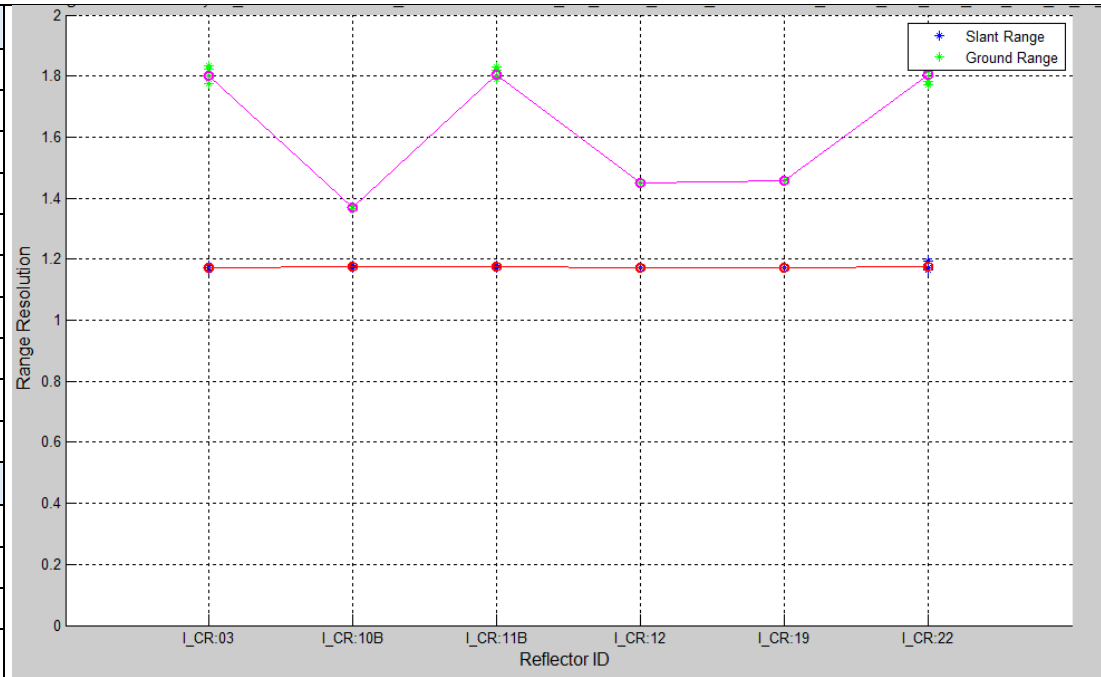


Figure 55. Range Resolution for HS-D



7.9.2 Azimuth Resolution

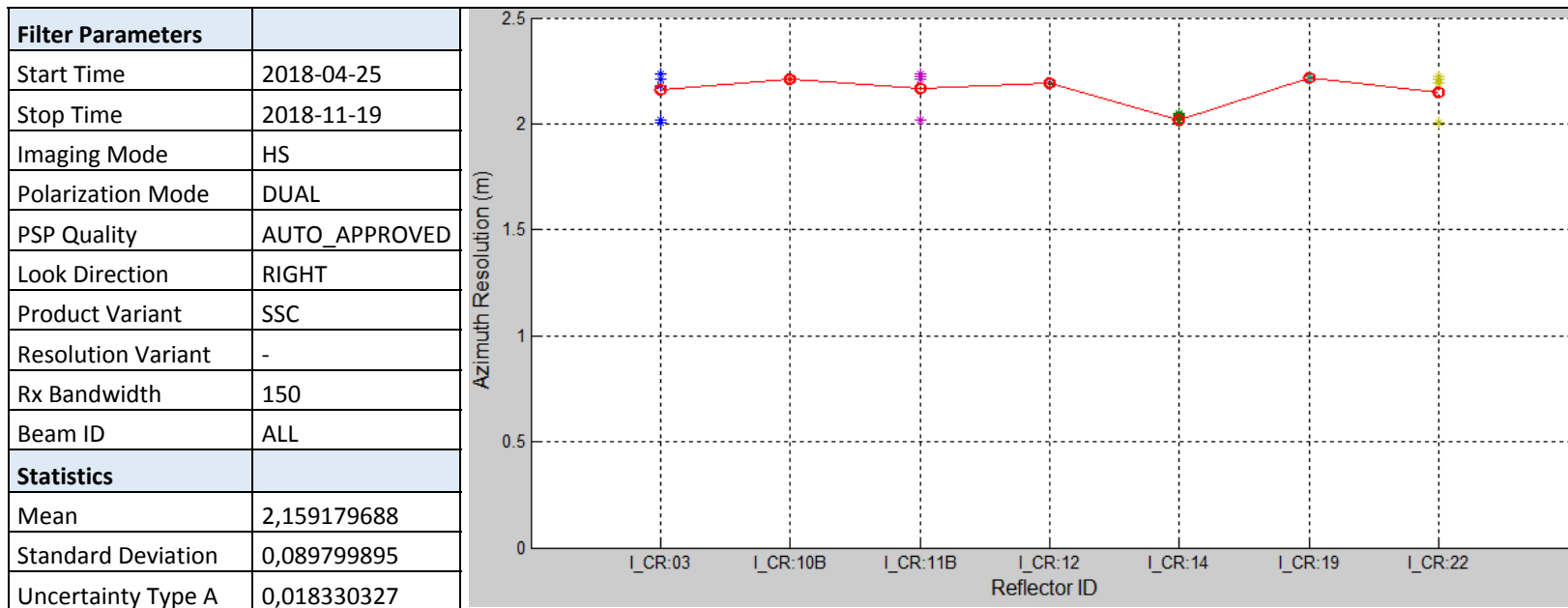


Figure 56. Azimuth Resolution for HS-D



7.9.3 PSLR

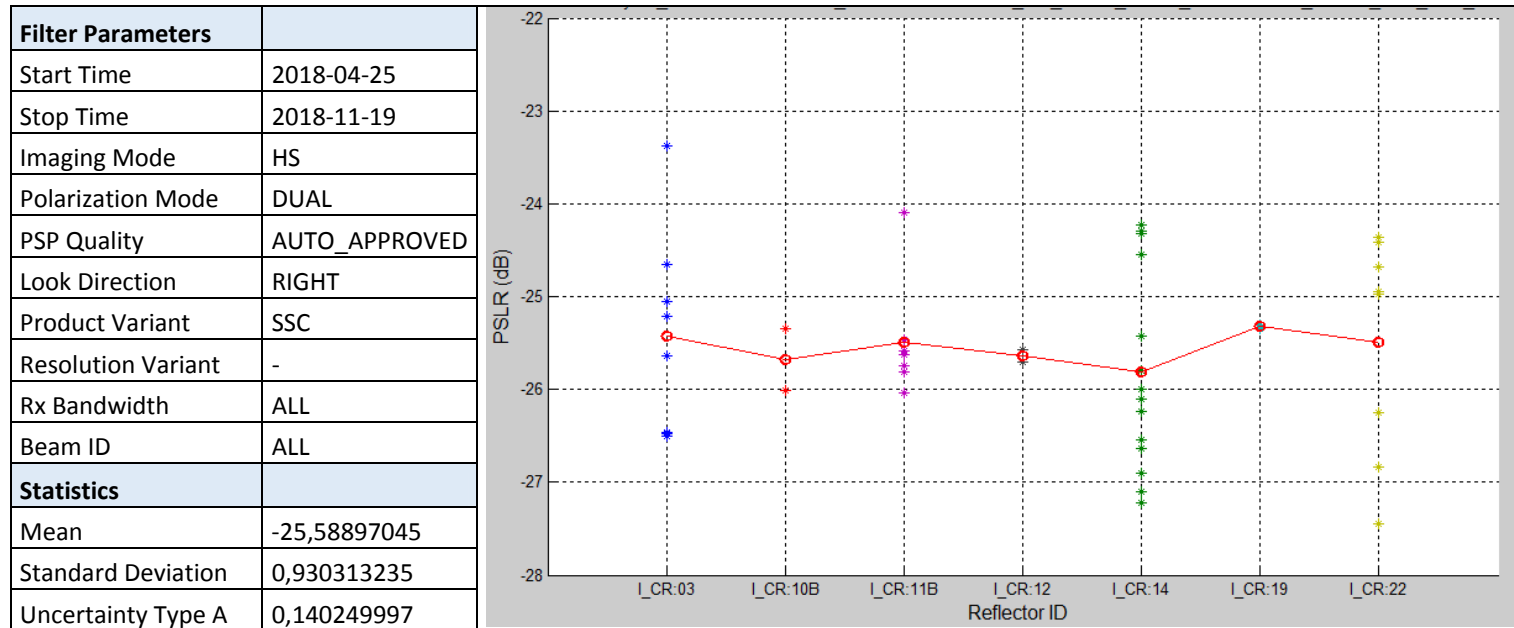


Figure 57. PSLR for HS-D



7.9.4 ISLR

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	HS
Polarization Mode	DUAL
PSP Quality	AUTO_APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Rx Bandwidth	ALL
Beam ID	ALL
Statistics	
Mean	-15,03717045
Standard Deviation	0,552203498
Uncertainty Type A	0,08324781

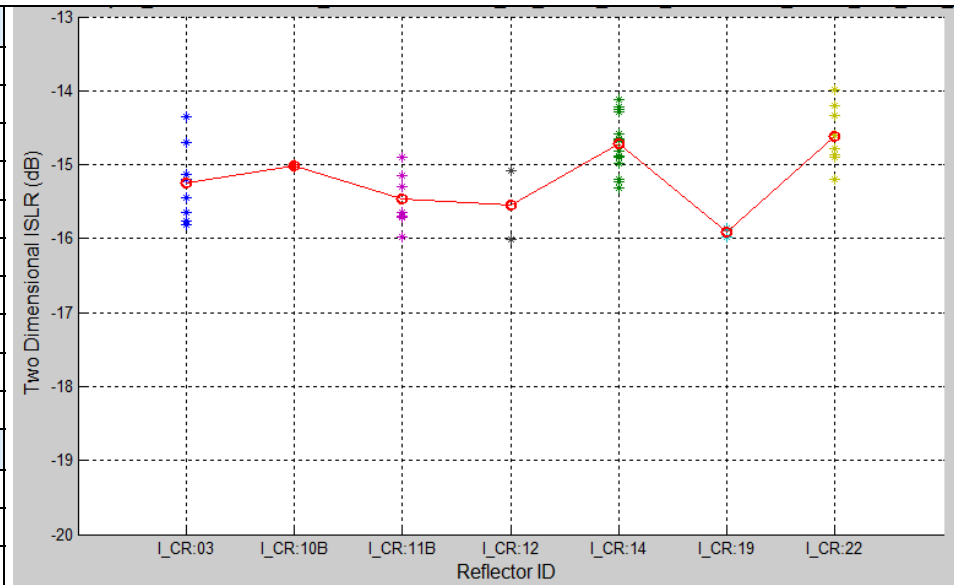


Figure 58. ISLR for HS-D



7.9.5 Pixel Localization Accuracy

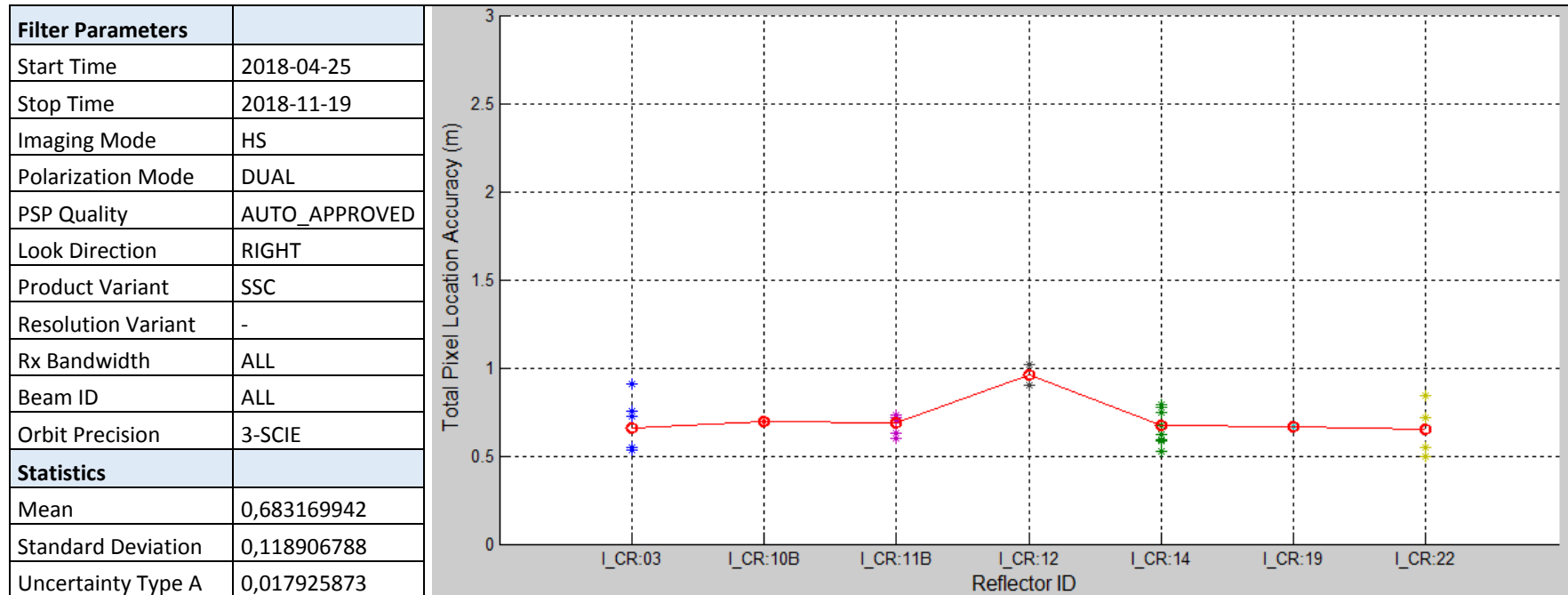


Figure 59. Pixel Localization Accuracy for HS-D



7.9.6 Absolute Radiometric Accuracy

Filter Parameters		
Start Time	2018-04-25	
Stop Time	2018-11-19	
Imaging Mode	HS	
Polarization Mode	DUAL	
PSP Quality	APPROVED	
Look Direction	RIGHT	
Product Variant	SSC	
Resolution Variant	-	
Statistics		
	Total	At Mid Range
Absolute Cal Factor	-57,87271764	-57,90118831
Abs. Radiometric Accuracy	0,403289531	0,387162219
Uncertainty Type A	0,060798184	0,059740427

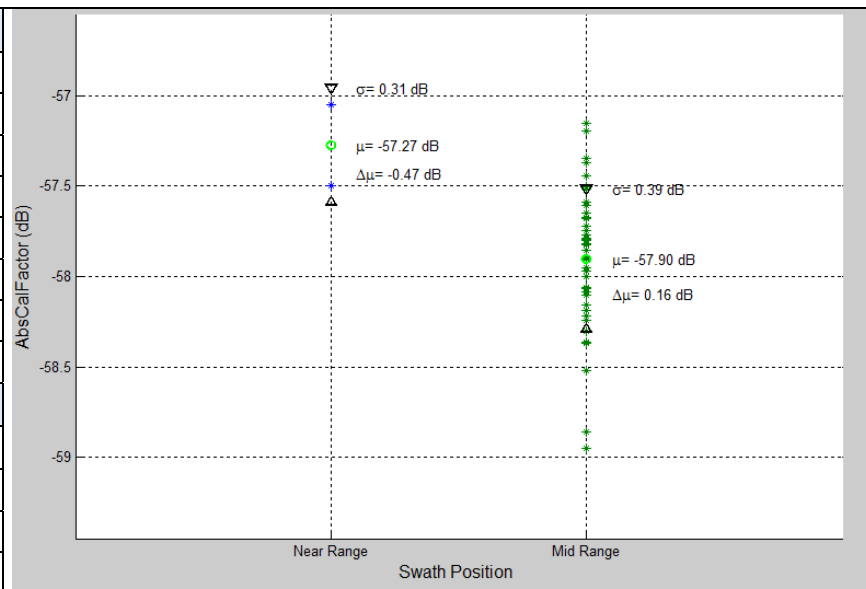


Figure 60. Radiometric measurements for HS-D



7.9.7 Relative Radiometric Accuracy

Filter Parameters	
Start Time	2018-04-25
Stop Time	2018-11-19
Imaging Mode	HS
Polarization Mode	DUAL
PSP Quality	APPROVED
Look Direction	RIGHT
Product Variant	SSC
Resolution Variant	-
Statistics	
Mean	0.24
Standard Deviation	0.10

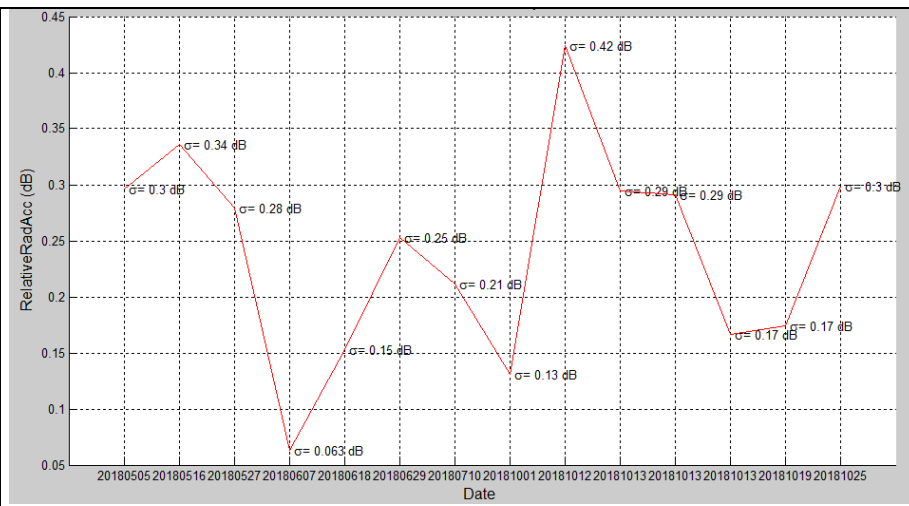


Figure 61. Relative radiometric accuracy for HS-D



PAZ

Ref: PAZ/INT/CALVAL/RPT/002

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8. DISTRIBUTED TARGET MEASUREMENTS

8.1 DYNAMIC RANGE

Measured as relationship between maximum and minimum backscatter coefficient found in L1B products excluded corner reflectors.

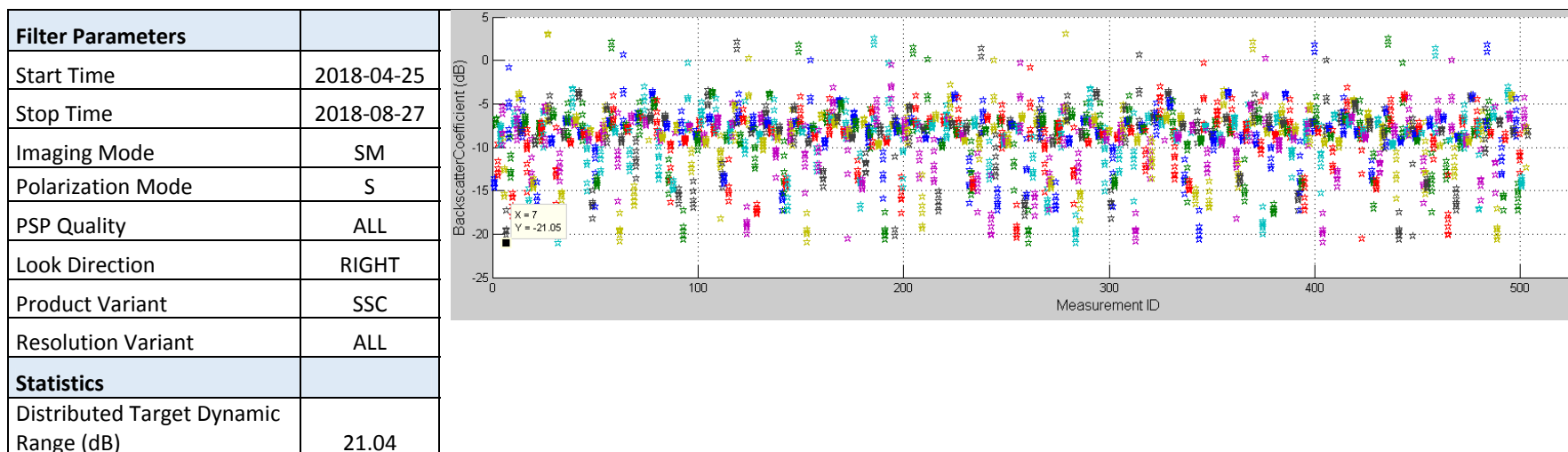
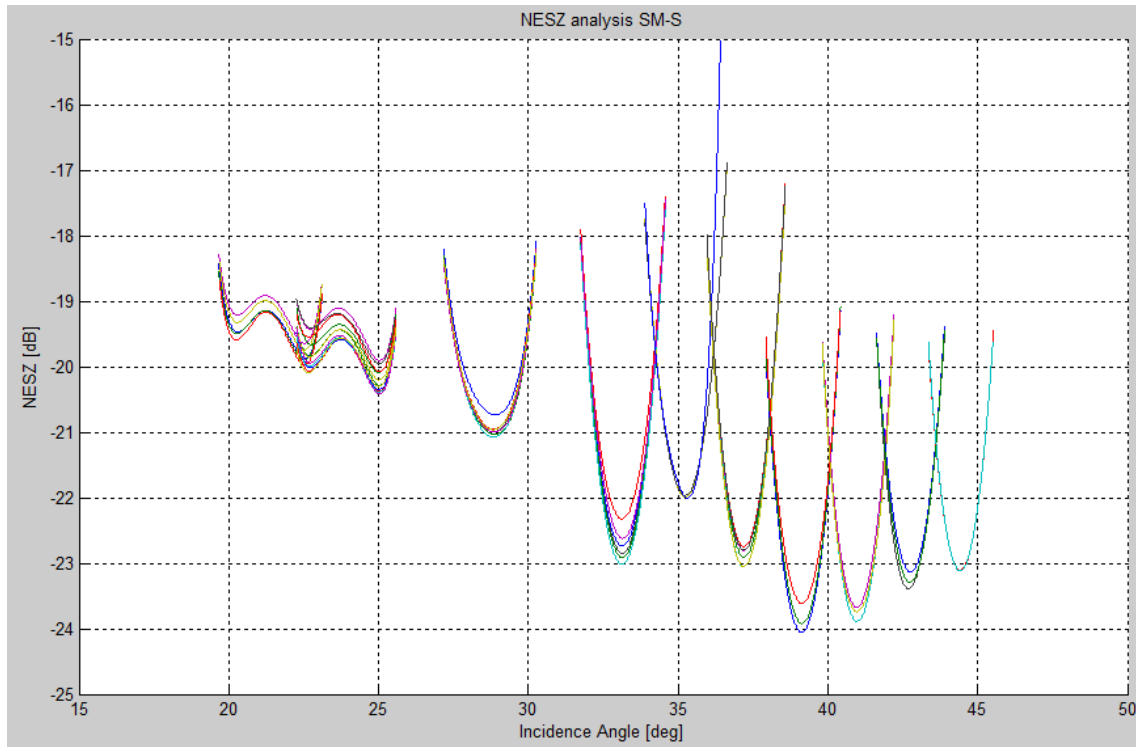


Figure 62. Distributed Targets Dynamic Range

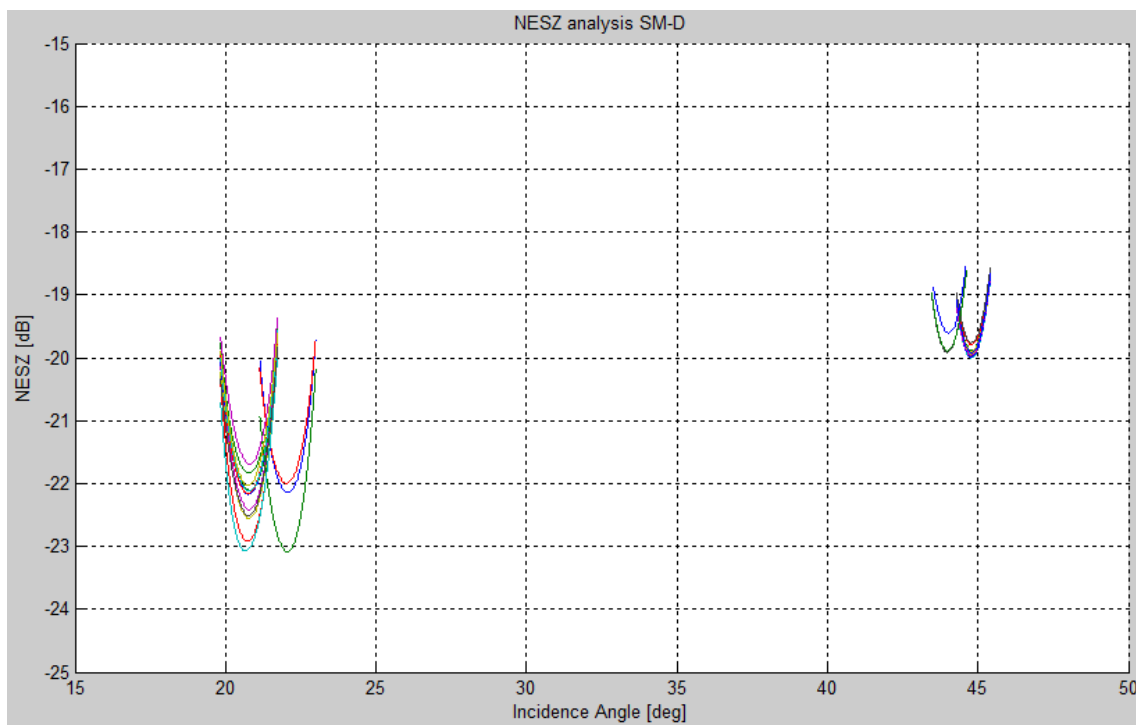


8.2 NESZ MEASUREMENTS

8.2.1 SM-S

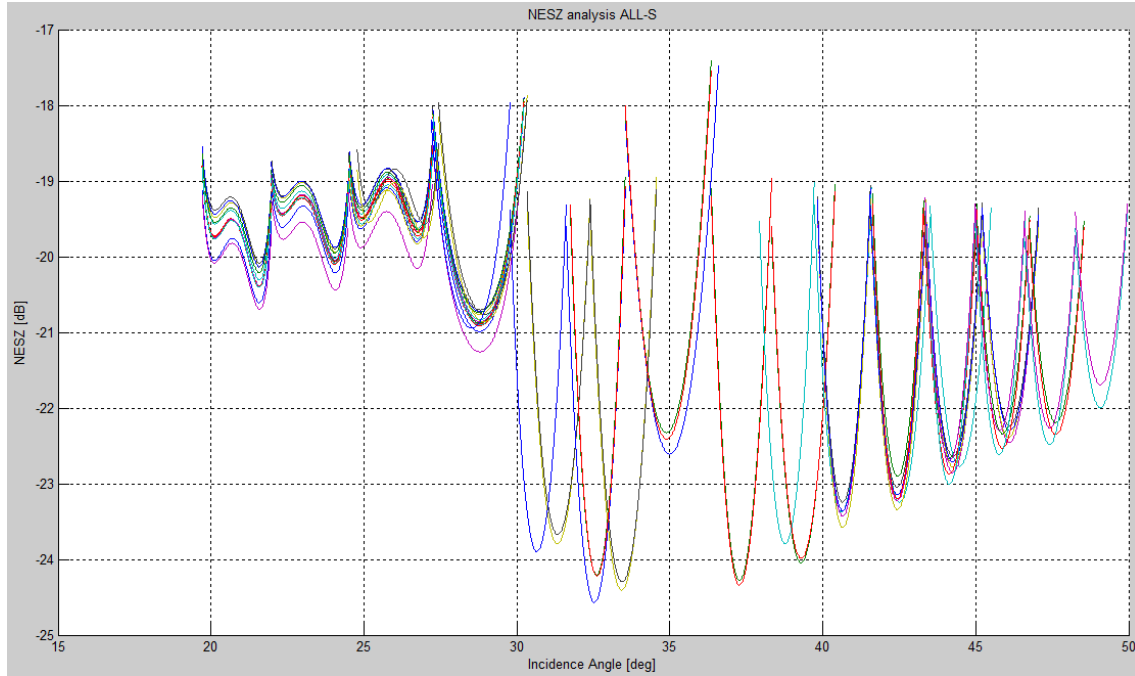


8.2.2 SM-D

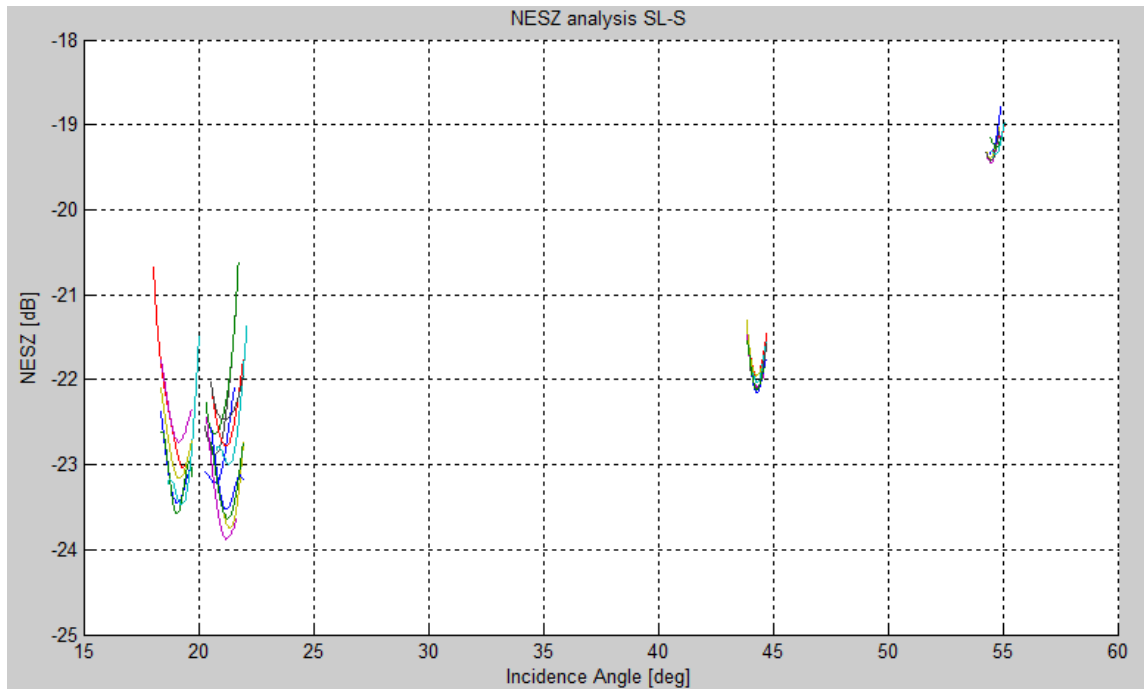




8.2.3 SC

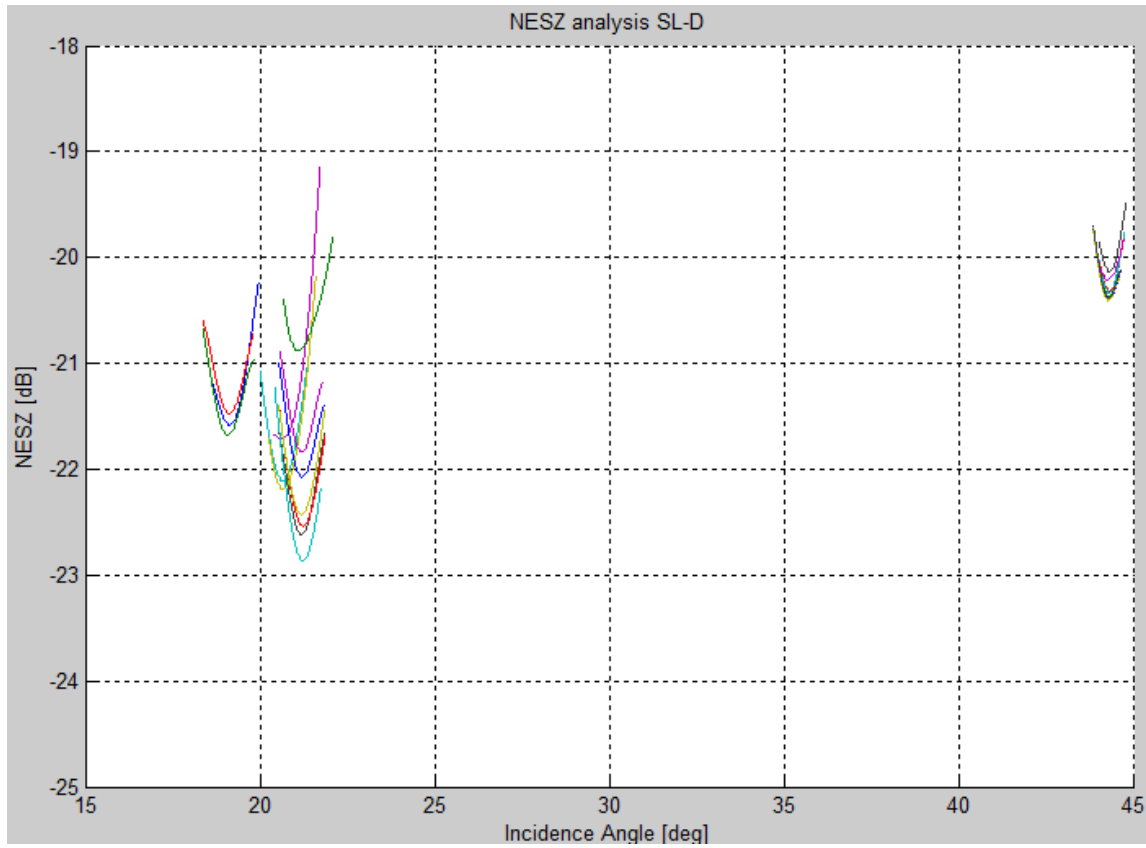


8.2.4 SL-S

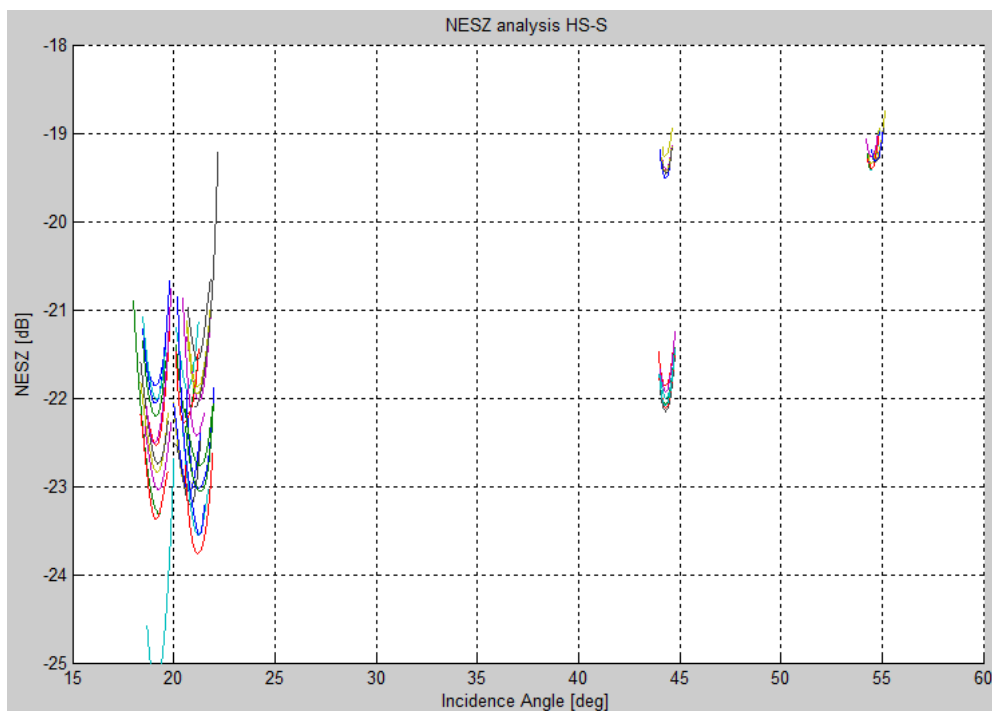




8.2.5 SL-D



8.2.6 HS-S





8.2.7 HS-D

