
ERSDAC PALSAR

Product Characteristics

ERSDAC-VX-PALSAR-001 Rev.1.7

September 12, 2003

August 26, 2005

October 12, 2005

December 20, 2005

June 1, 2006

March 14, 2008

February 1, 2010

Change Record

Issue	Date	Pages	Description
1.0	December 1, 2001	All	First Official Release from Vexcel Co.
1.1	September 12, 2003		Dual Polarization is defined as Level 1.5 and Quad Polarization is defined as Level 4.1. Dual Polarization section in the original version are cut and are pasted as Dual polarization chapter.
1.2	August 26, 2005	All	<ul style="list-style-type: none"> - Dual Polarization is re-defined as Level 4.1. - Removed non-existing combination of beam and sampling frequency. - Revised pixel data representation for L4.2 product. - Updated the nominal range resolution for all products (SLC, L1.5, L4.1 and L4.2). Also, updated the nominal incidence angle for L4.2 product. - Updated nominal image coverage, nominal product volume , number of pixels and number of lines in Map products. - Updated number of pixels for SLC products. - Added scene definition as appendix.
1.3	October 12, 2005	All	<ul style="list-style-type: none"> - Updated the nominal range resolution according to updated nominal incidence angle. - Removed "Nominal Incidence Angles" in tables and added "Off-nadir Angles". - Revised "Co-ordinate System" for L1.5, L4.1 and L4.2 path products - Revised scan width of 4 scans in appendix A.2 "Scene Definition of Scan Beam".
1.4	December 20, 2005	All	- Correct the radiometric error.
1.5	June 1, 2006	All	<ul style="list-style-type: none"> - Updated the nominal azimuth resolution for L1.1, L1.5 and L4.1 product to account for impulse response widening due to natural application of azimuth antenna pattern - Updated the nominal azimuth resolution for L4.2 product to account for impulse response widening due to application of Kaiser window - Updated azimuth Kaiser weighting for L1.5 products.

Issue	Date	Pages	Description
1.6	March 14, 2008	2.1, 2.3, 4.1 – 4.4	Updated the number of pixels for L4.1 Dual/Quad-polarimetric product Removed a duplicated row about Pixel/Line Spacing. Added notes for nominal image coverage of SLC Fine beams
1.7	February 1, 2010	A.1 Scene Definition of Single Beam	Added two sentences as (3) and (4).

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1. CEOS Level 1.0 Product

CEOS Level 1.0 Product		
Format	CEOS	
Product Characteristics		
Co-ordinate System	Slant Range	
Pixel Data Representation	8-bit unsigned integer for I and 8-bit unsigned integer for Q	
Nominal Product Volume	depend on observation mode	
	Range	Azimuth
Nominal Image Coverage [km]	refer to Appendix A	refer to Appendix A
Pixel Spacing [m]	natural spacing of signal data	natural spacing of signal data
Nominal Image Size	depend on observation mode	depend on observation mode
Processing Parameters		
Image Quality Characteristics		
Beams	F1 to F18, S1 to S5, P1 to P12	
Nominal Incidence Angles (°)	8 - 60	
Notes		
	A RAW Product will be ONE of beams F1-F18, P1-P12, S1+S2+S2, S1+S2+S3+S4, S1+S2+S3+S4+S5.	

2. SLC (Level 1.1), Single Look Complex Product

2.1 SLC Fine Beams – 32 MHz - F1-F9

SLC Product from Fine Beams (F1-F9) – 32 MHz									
Format	Vexcel Standard								
Product Characteristics									
Co-ordinate System	Slant Range								
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q								
Nominal Product Volume	535 ~ 1650 MB								
	Range						Azimuth		
Nominal Image Coverage [km]	71 ~ 98 ^{(*)2}						70 ^{(*)1}		
Image Quality Characteristics									
Beam	F1	F2	F3	F4	F5	F6	F7	F8	F9
Off-nadir Angles (°)	9.9	14.0	18.0	21.5	25.8	28.8	30.8	34.3	36.9
Nominal Range Resolution [m]	23.3 – 41.8	18.0 – 26.6	14.8 – 19.4	12.7 – 15.9	11.0 – 13.0	10.1 – 11.5	9.6 – 10.8	8.8 – 9.6	8.3 – 9.0
Nominal Azimuth Resolution [m]	5.1	5.1	5.1	5.3	5.1	5.1	5.3	5.1	5.2
Pixel Spacing Range [m]	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Pixel Spacing Azimuth [m]	2.9	3.0	2.8	3.6	2.8	3.1	3.5	3.1	3.1
Number of Pixels	2880	4064	5184	6144	7296	8064	8544	9440	10016
Number of Lines	22779	22321	23753	18762	24038	21505	19011	21739	19268
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR			Radiometric Error			Radiometric Linearity	
< -20.5 dB	<21.0 dB	< -15. 0 dB			< 0.25 dB			> 0.97	
Absolute Location Error		Geometric Distortion			Relative Phase Error				
< 750 m		< 40 m			< 15.0 deg ^{a)}				
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1584	1584	1584	1501	1584	1584	1521	1584	1541
Notes									
*1: 70 km of azimuth length is corresponding to 10 seconds.									
*2: Nominal image coverage of F1 beam is 98 km.									

2.2 SLC Fine Beams – 32 MHz - F10-F18

SLC Product from Fine Beams (F10-F18) – 32 MHz									
Format	Vexcel Standard								
Product Characteristics									
Co-ordinate System	Slant Range								
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q								
Nominal Product Volume	1.2 ~ 1.7 GB								
	Range					Azimuth			
Nominal Image Coverage [km]	40 ~ 71					70 ^(*)			
Image Quality Characteristics									
Beam	F10	F11	F12	F13	F14	F15	F16	F17	F18
Off-nadir Angles (°)	38.8	41.5	43.4	45.2	46.6	47.8	49.0	50.0	50.8
Nominal Range Resolution [m]	8.0 – 8.6	7.6 – 8.1	7.4 – 7.7	7.2 – 7.4	7.0 – 7.2	6.9 – 7.1	6.8 – 6.9	6.7 – 6.8	6.6 – 6.7
Nominal Azimuth Resolution [m]	5.8	5.2	5.8	5.2	5.7	5.9	5.6	5.7	5.3
Pixel Spacing Range [m]	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Pixel Spacing Azimuth [m]	4.0	3.5	4.0	3.5	3.9	4.0	3.8	3.9	3.6
Number of Pixels	10464	11072	11488	8480	8704	8832	9024	9152	7392
Number of Lines	17123	19342	17182	19455	17513	16750	17762	17301	18694
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR		Radiometric Error			Radiometric Linearity		
< -20.5 dB	<21.0 dB	< -15.0 dB		< 0.25 dB			> 0.97		
Absolute Location Error		Geometric Distortion		Relative Phase Error					
< 750 m		< 40 m		< 15.0 deg					
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1370	1547	1375	1556	1401	1340	1421	1384	1496
Notes									
*1: 70 km of azimuth length is corresponding to 10 seconds.									

2.3 SLC Dual-Polarimetric Beams– 16 MHz - F1-F9

SLC Product from Dual-Polarimetric Beams (F1-F9) – 16 MHz									
Format	Vexcel Standard								
Product Characteristics									
Co-ordinate System	Slant Range								
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q								
Nominal Product Volume	265 ~ 772 MB								
	Range					Azimuth			
Nominal Image Coverage [km]	71 ~ 98 ⁽²⁾					70 ⁽¹⁾			
Image Quality Characteristics									
Beam	F1	F2	F3	F4	F5	F6	F7	F8	F9
Off-nadir Angles (°)	9.9	14.0	18.0	21.5	25.8	28.8	30.8	34.3	36.9
Nominal Range Resolution [m]	47.2 – 83.7	36.1 – 53.1	29.6 – 38.9	25.5 – 31.7	22.1 – 26.0	20.2 – 23.1	19.2 – 21.5	17.6 – 19.3	16.6 – 18.0
Nominal Azimuth Resolution [m]	5.0	5.0	5.0	5.3	5.0	5.0	5.2	5.0	5.2
Pixel Spacing Range [m]	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4
Pixel Spacing Azimuth [m]	3.0	3.0	2.8	3.6	2.8	3.1	3.6	3.1	3.1
Number of Pixels	1440	2032	2592	3072	3648	4032	4272	4720	5008
Number of Lines	22779	22321	23753	18762	24038	21506	19011	21739	19268
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR			Radiometric Error		Radiometric Linearity		
< -20.0 dB	< -21.0 dB	< -15.0 dB			< 0.25 dB		> 0.97		
Absolute Location Error		Geometric Distortion			Relative Phase Error				
< 750 m		< 40 m			< 10.0 deg				
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1584	1584	1584	1501	1584	1584	1521	1584	1541
Notes									
*1: 70 km of azimuth length is corresponding to 10 seconds.									
*2: Nominal image coverage of F1 beam is 98 km.									

2.4 SLC Dual-Polarimetric Beams – 16 MHz - F10-F18

SLC Product from Dual-Polarimetric Beams (F10-F18) – 16 MHz									
Format	Vexcel Standard								
Product Characteristics									
Co-ordinate System	Slant Range								
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q								
Nominal Product Volume	600 ~ 850 MB								
	Range					Azimuth			
Nominal Image Coverage [km]	40 ~ 71					70 ^(*)			
Image Quality Characteristics									
Beam	F10	F11	F12	F13	F14	F15	F16	F17	F18
Off-nadir Angles (°)	38.8	41.5	43.4	45.2	46.6	47.8	49.0	50.0	50.8
Nominal Range Resolution [m]	16.0 – 17.1	15.2 – 16.1	14.7 – 15.4	14.4 – 14.8	14.1 – 14.5	13.8 – 14.2	13.6 – 13.9	13.4 – 13.7	13.3 – 13.5
Nominal Azimuth Resolution [m]	5.8	5.2	5.8	5.2	5.7	5.9	5.6	5.7	5.3
Pixel Spacing Range [m]	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4
Pixel Spacing Azimuth [m]	3.9	3.5	3.9	3.5	3.9	4.0	3.8	3.9	3.6
Number of Pixels	5232	5536	5744	4240	4352	4416	4512	4576	3696
Number of Lines	17123	19342	17182	19455	17513	16750	17762	17301	18694
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR		Radiometric Error			Radiometric Linearity		
< -20.0 dB	<-21.0 dB	< -15.0 dB		< 0.25 dB			> 0.97		
Absolute Location Error		Geometric Distortion		Relative Phase Error					
< 750 m		< 40 m		< 10.0 deg					
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1370	1547	1375	1556	1401	1340	1421	1384	1496
Notes									
*1: 70 km of azimuth length is corresponding to 10 seconds.									

2.5 SLC Quad-Polarimetric Beams 16MHz - P1-P6

SLC Product from Multi-Polarimetric Beams (P1-P6)						
Format	Vexcel Standard					
Product Characteristics						
Co-ordinate System	Slant Range					
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q.					
Nominal Product Volume	96 ~ 210 MB					
	Range			Azimuth		
Nominal Image Coverage [km]	21 ~ 77			70 ^(*)		
Image Quality Characteristics						
Beam	P1	P2	P3	P4	P5	P6
Off-nadir Angles (°)	9.7	13.8	16.2	17.3	17.9	19.2
Nominal Range Resolution [m]	48.6 – 83.7	38.2 – 50.4	35.5 – 38.9	33.5 – 36.4	32.4 – 35.2	30.4 – 32.7
Nominal Azimuth Resolution [m]	5.00	5.07	5.12	5.74	6.20	4.98
Range Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37
Azimuth Pixel Spacing [m]	3.42	3.47	3.50	3.93	4.24	3.39
Number of Pixels	1312	1440	688	720	752	784
Number of Lines	19763	19455	19305	17182	15924	19920
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR	Radiometric Error		Radiometric Linearity	
< -20.5 dB	< -21.0 dB	< -15.0 dB	< 0.25 dB		> 0.97	
Absolute Location Error	Geometric Distortion		Relative Phase Error			
< 750 m	< 40 m		< 5.0 deg			
Processing Parameters						
Number of Range Looks	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1581	1556	1544	1375	1274	1584
Notes						
*1: 70 km of azimuth length is corresponding to 10 seconds.						

2.6 SLC Quad-Polarimetric Beams 16MHz - P7-P12

SLC Product from Multi-Polarimetric Beams (P7-P12)						
Format	Vexcel Standard					
Product Characteristics						
Co-ordinate System	Slant Range					
Pixel Data Representation	32-bit signed float for I and 32-bit signed float for Q.					
Nominal Product Volume	130 ~ 210 MB					
	Range			Azimuth		
Nominal Image Coverage [km]	20 ~ 31			70 ^(*)		
Image Quality Characteristics						
Beam	P7	P8	P9	P10	P11	P12
Off-nadir Angles (°)	20.5	21.5	23.1	24.2	25.2	26.2
Nominal Range Resolution [m]	28.2 – 31.1	27.0 – 29.7	25.5 – 27.4	24.7 – 26.0	23.7 – 25.0	23.0 – 24.0
Nominal Azimuth Resolution [m]	5.27	5.06	5.36	6.06	6.13	5.00
Range Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37
Azimuth Pixel Spacing [m]	3.60	3.46	3.67	4.14	4.19	3.42
Number of Pixels	1264	1328	1184	976	1040	1072
Number of Lines	18727	19532	18415	16286	16129	19763
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR	Radiometric Error		Radiometric Linearity	
< -21.0 dB	< -21.0 dB	< -15.0 dB	< 0.25 dB		> 0.97	
Absolute Location Error	Geometric Distortion		Relative Phase Error			
< 750 m	< 40 m		< 5.0 deg			
Processing Parameters						
Number of Range Looks	1	1	1	1	1	1
Number of Azimuth Looks	1	1	1	1	1	1
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1498	1563	1473	1303	1290	1581
Notes						
*1: 70 km of azimuth length is corresponding to 10 seconds.						

3. Level 1.5 Product

3.1 Level 1.5 Fine Beams 32 MHz - F1-F9

L1.5 Product from Fine Beams (F1-F9) – 32 MHz									
Format	CEOS								
	Path Product Characteristics (Georeferenced Product)					Map Product Characteristics (Geocoded Product)			
Co-ordinate System	Ground Range					Map Projection (UTM, PS)			
Pixel Data Representation	16-bit unsigned integer					16-bit unsigned integer			
Nominal Product Volume	22 ~ 251 MB					44 ~ 501 MB			
Nominal Image Coverage	(70 ~ 98) km x 70 km ⁽¹⁾					98 km x 98 km ~ 118 km x 118 km ⁽²⁾			
Image Quality Characteristics									
Beam	F1	F2	F3	F4	F5	F6	F7	F8	F9
Off-nadir Angles (°)	9.9	14.0	18.0	21.5	25.8	28.8	30.8	34.3	36.9
Nominal Range Resolution [m]	24.2 – 43.4	18.7 – 27.6	15.3 – 20.2	13.2 – 16.5	11.4 – 13.5	10.5 – 12.0	9.9 – 11.2	9.1 – 10.0	8.6 – 9.3
Nominal Azimuth Resolution [m]	34.6	24.7	19.8	15.6	14.8	14.8	15.5	14.8	10.2
Map co-ordinate: Number of Pixels	4669	9074	8052	7999	15838	15789	15772	15738	15710
Number of Lines	4669	9074	8052	7999	15838	15789	15772	15738	15710
Pixel Spacing [m]	25	12.5	12.5	12.5	6.25	6.25	6.25	6.25	6.25
Line Spacing [m]	25	12.5	12.5	12.5	6.25	6.25	6.25	6.25	6.25
Radar co-ordinate: Number of Pixels	3902	7433	5988	5913	11600	11531	11507	11460	11419
Number of Lines	2701	5401	5401	5401	10801	10801	10801	10801	10801
Pixel Spacing [m]	25	12.5	12.5	12.5	6.25	6.25	6.25	6.25	6.25
Line Spacing [m]	25	12.5	12.5	12.5	6.25	6.25	6.25	6.25	6.25
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR		Radiometric Error			Radiometric Linearity		
< -22.5 dB	< -19.5 dB	< -15.5 dB		< 0.25dB			> 0.97		
Absolute Location Error		Geometric Distortion		Relative Phase Error					
< 750 m		< 40 m		< 15.0 deg					
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	7	5	4	3	3	3	3	3	2
Kaiser Weighting Range	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Kaiser Weighting Azimuth	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Azimuth Look Bandwidth [Hz]	225	316	395	499	527	527	506	527	770
Note: Pixel and Line spacing is also available at 5.0 meters and 10.0 meters within reason.									
*1: 70 km of azimuth length is corresponding to 10 seconds.									
*2: In the case that scene rotates 45 degrees.									

3.2 Level 1.5 Fine Beams 32 MHz - F10-F18

L1.5 Product from Fine Beams (F10-F18) – 32 MHz									
Format	CEOS								
	Path Product Characteristics (Georeferenced Product)					Map Product Characteristics (Geocoded Product)			
Co-ordinate System	Ground Range					Map Projection (UTM, PS)			
Pixel Data Representation	16-bit unsigned integer					16-bit unsigned integer			
Nominal Product Volume	165 ~ 247 MB					338 ~ 494 MB			
Nominal Image Coverage	(40 ~ 70) km x70 km ⁽¹⁾					78 km x 78 km ~ 98 km x 98 km ⁽²⁾			
Image Quality Characteristics									
Beam	F10	F11	F12	F13	F14	F15	F16	F17	F18
Off-nadir Angles (°)	38.8	41.5	43.4	45.2	46.6	47.8	49.0	50.0	50.8
Nominal Range Resolution [m]	8.3 – 8.9	7.9 – 8.4	7.6 – 8.0	7.5 – 7.7	7.3 – 7.5	7.2 – 7.4	7.0 – 7.2	7.0 – 7.1	6.9 – 7.0
Nominal Azimuth Resolution [m]	11.4	10.1	11.4	10.1	11.2	11.7	11.0	11.3	10.5
Map co-ordinate: Number of Pixels	15718	15566	15674	13375	13364	13422	13373	13364	13011
Number of Lines	15718	15566	15674	13375	13364	13422	13373	13364	13011
Pixel Spacing [m]	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Line Spacing [m]	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Radar co-ordinate: Number of Pixels	11431	11216	11369	8117	8102	8184	8115	8101	7602
Number of Lines	10801	10801	10801	10801	10801	10801	10801	10801	10801
Pixel Spacing [m]	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Line Spacing [m]	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR		Radiometric Error			Radiometric Linearity		
< -22.5 dB	<-19.5 dB	< -15.5 dB		< 0.25dB			> 0.97		
Absolute Location Error		Geometric Distortion			Relative Phase Error				
< 750 m		< 40 m			< 15.0 deg				
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	2	2	2	2	2	2	2	2	2
Kaiser Weighting Range	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Kaiser Weighting Azimuth	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Azimuth Look Bandwidth [Hz]	684	773	686	777	700	669	709	691	747
Note: Pixel and Line spacing is also available at 5.0 meters and 10.0 meters within reason. *1: 70 km of azimuth length is corresponding to 10 seconds. *2: In the case that scene rotates 45 degrees.									

4. Level 4.1 Product

4.1 Level 4.1 Dual-Polarimetric Beam 16 MHz - F1-F9

L4.1 Product from Fine Beams Dual Polarimetric (F1-F9) – 16 MHz									
Format	CEOS								
	Path Product Characteristics (Georeferenced Product)					Map Product Characteristics (Geocoded Product)			
Co-ordinate System	Slant Range					Map Projection (UTM, PS)			
Pixel Data Representation	16-bit (un)signed integer. There are 4 channels including two real channels and one complex channel.					16-bit (un)signed integer. There are 4 channels including two real channels and one complex channel.			
Nominal Product Volume	23 ~ 195 MB					43 ~ 502 MB			
Nominal Image Coverage	(70 ~ 98) km x 70 km ^(*)					98 km x 98 km ~ 118 km x 118 km ^(**)			
Image Quality Characteristics									
Beam	F1	F2	F3	F4	F5	F6	F7	F8	F9
Off-nadir Angles (°)	9.9	14.0	18.0	21.5	25.8	28.8	30.8	34.3	36.9
Nominal Range Resolution [m]	47.2–83.7	36.1–53.1	29.6–38.9	25.5–31.7	22.1–26.0	20.2–23.1	19.2–21.5	17.6–19.3	16.6–18.0
Nominal Azimuth Resolution [m]	59.83	44.87	34.90	31.57	24.93	24.93	25.97	19.94	20.49
Map co-ordinate: Number of Pixels	2334	4537	4025	4000	7919	7893	7885	7869	7854
Number of Lines	2334	4537	4025	4000	7919	7893	7885	7869	7854
Pixel Spacing [m]	50	25	25	25	12.5	12.5	12.5	12.5	12.5
Line Spacing [m]	50	25	25	25	12.5	12.5	12.5	12.5	12.5
Radar co-ordinate: Number of Pixels	1440	2032	2592	3072	3648	4032	4272	4720	5008
Number of Lines	1899	2481	3394	3128	4808	4302	3803	5435	4818
Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37	9.37	9.37	9.37
Line Spacing [m]	35.56	27.22	19.89	21.59	14.04	15.69	17.75	12.42	14.01
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR			Radiometric Error			Radiometric Linearity	
< -22.0 dB	<-19.5 dB	< -15.5 dB			< 0.25 dB			> 0.97	
Absolute Location Error		Geometric Distortion			Relative Phase Error				
< 750 m		< 40 m			< 10.0 deg				
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	13	9	8	6	6	5	5	5	4
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1584	1584	1584	1501	1584	1584	1521	1584	1541
*1: 70 km of azimuth length is corresponding to 10 seconds.									
*2: In the case that scene rotates 45 degrees.									

4.2 Level 4.1 Dual-Polarimetric Beam 16 MHz - F10-F18

L4.1 Product from Fine Beams Dual Polarimetric (F10-F18) – 16 MHz									
Format	CEOS								
	Path Product Characteristics (Georeferenced Product)					Map Product Characteristics (Geocoded Product)			
Co-ordinate System	Slant Range					Map Projection (UTM, PS)			
Pixel Data Representation	16-bit (un)signed integer. There are 4 channels including two real channel and one complex channel.					16-bit (un)signed integer. There are 4 channels including two real channel and one complex channel.			
Nominal Product Volume	180 ~ 262 MB					298 ~ 494 MB			
Nominal Image Coverage	(40 ~ 70) km x 70 km ^{(*)1}					78 km x 78 km ~ 98 km x 98 km ^{(*)2}			
Image Quality Characteristics									
Beam	F10	F11	F12	F13	F14	F15	F16	F17	F18
Off-nadir Angles (°)	38.8	41.5	43.4	45.2	46.6	47.8	49.0	50.0	50.8
Nominal Range Resolution [m]	16.0 – 17.1	15.2 – 16.1	14.7 – 15.4	14.4 – 14.8	14.1 – 14.5	13.8 – 14.2	13.6 – 13.9	13.4 – 13.7	13.3 – 13.5
Nominal Azimuth Resolution [m]	23.07	20.42	17.24	20.30	16.92	17.69	16.68	17.12	15.84
Map co-ordinate: Number of Pixels	7859	7783	7838	6688	6680	6711	6686	6681	6111
Number of Lines	7859	7783	7838	6688	6680	6711	6686	6681	6111
Pixel Spacing [m]	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Line Spacing [m]	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Radar co-ordinate: Number of Pixels	5232	5536	5744	4240	4352	4416	4512	4576	3696
Number of Lines	4281	4836	5728	4864	5838	5584	5921	5768	6232
Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37	9.37	9.37	9.37
Line Spacing [m]	15.77	13.96	11.79	13.88	11.56	12.09	11.40	11.70	10.83
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR			Radiometric Error			Radiometric Linearity	
< -22.0 dB	<-19.5 dB	< -15.5 dB			< 0.25 dB			> 0.97	
Absolute Location Error		Geometric Distortion			Relative Phase Error				
< 750 m		< 40 m			< 10.0 deg				
Processing Parameters									
Number of Range Looks	1	1	1	1	1	1	1	1	1
Number of Azimuth Looks	4	4	3	4	3	3	3	3	3
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1370	1547	1375	1556	1401	1340	1421	1384	1496
*1: 70 km of azimuth length is corresponding to 10 seconds. *2: In the case that scene rotates 45 degrees.									

4.3 Level 4.1 Quad-Polarimetric Beams 16MHz - P1-P6

L4.1 Product from Quad-Polarimetric Beams (P1-P6)						
Format	CEOS					
	Path Product Characteristics (Georeferenced Product)			Map Product Characteristics (Geocoded Product)		
Co-ordinate System	Slant Range			Map Projection (UTM, PS)		
Pixel Data Representation	16-bit (un)signed integer. There are nine channels including three real channels and three complex channels.			16-bit (un)signed integer. There are nine channels including three real channels and three complex channels.		
Nominal Product Volume	30 ~ 60 MB			76 ~ 210 MB		
Nominal Image Coverage [km]	(20 ~ 65) km x 70 km ^{(*)1}			64 km x 64 km ~ 96 km x 96 km ^{(*)2}		
Image Quality Characteristics						
Beam	P1	P2	P3	P4	P5	P6
Off-nadir Angles (°)	9.7	13.8	16.2	17.3	17.9	19.2
Nominal Range Resolution [m]	48.6 – 83.7	38.2 – 50.4	35.5 – 38.9	33.5 – 36.4	32.4 – 35.2	30.4 – 32.7
Nominal Azimuth Resolution [m]	59.95	45.67	40.92	40.23	37.20	34.90
Map co-ordinate: Number of Pixels	2054	3423	2520	2506	2505	2504
Number of Lines	2054	3423	2520	2506	2505	2504
Pixel Spacing [m]	50	25	25	25	25	25
Line Spacing [m]	50	25	25	25	25	25
Radar co-ordinate: Number of Pixels	1312	1440	688	720	752	784
Number of Lines	1647	2162	2414	2455	2655	2846
Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37
Line Spacing [m]	40.99	31.23	27.97	27.50	25.43	23.72
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR	Radiometric Error		Radiometric Linearity	
< -20.5 dB	<-21.0 dB	< -15.0 dB	< 0.25 dB		> 0.97	
Absolute Location Error		Geometric Distortion	Relative Phase Error			
< 750 m		< 40 m	< 5.0 deg			
Processing Parameters						
Number of Range Looks	1	1	1	1	1	1
Number of Azimuth Looks	13	10	9	7	7	8
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1581	1556	1544	1375	1274	1584
*1: 70 km of azimuth length is corresponding to 10 seconds.						
*2: In the case that scene rotates 45 degrees.						

4.4 Level 4.1 Quad-Polarimetric Beams 16MHz - P7-P12

L4.1 Product from Quad-Polarimetric Beams (P7-P12)						
Format	CEOS					
	Path Product Characteristics (Georeferenced Product)			Map Product Characteristics (Geocoded Product)		
Co-ordinate System	Slant Range			Map Projection (UTM, PS)		
Pixel Data Representation	16-bit (un)signed integer. . There are nine channels including three real channels and three complex channels.			16-bit (un)signed integer. . There are nine channels including three real channels and three complex channels.		
Nominal Product Volume	58 ~ 80 MB			111 ~ 141 MB		
Nominal Image Coverage	(20 ~ 30)km x 70 km ⁽¹⁾			64 km x 64 km ~ 71 km x 71 km ⁽²⁾		
Image Quality Characteristics						
Beam	P7	P8	P9	P10	P11	P12
Off-nadir Angles (°)	20.5	21.5	23.1	24.2	25.2	26.2
Nominal Range Resolution [m]	28.2 – 31.1	27.0 – 29.7	25.5 – 27.4	24.7 – 26.0	23.7 – 25.0	23.0 – 24.0
Nominal Azimuth Resolution [m]	31.68	30.36	32.23	30.36	30.58	30.03
Map co-ordinate: Number of Pixels	2793	2786	2645	2488	2494	2499
Number of Lines	2793	2786	2645	2488	2494	2499
Pixel Spacing [m]	25	25	25	25	25	25
Line Spacing [m]	25	25	25	25	25	25
Radar co-ordinate: Number of Pixels	1264	1328	1184	976	1040	1072
Number of Lines	3122	3256	3070	3258	3226	3294
Pixel Spacing [m]	9.37	9.37	9.37	9.37	9.37	9.37
Line Spacing [m]	21.63	20.74	21.99	20.72	20.93	20.49
Nominal Range PSLR	Nominal Azimuth PSLR	Nominal ISLR	Radiometric Error		Radiometric Linearity	
< -21.0 dB	<-21.0 dB	< -15.0 dB	< 0.25dB		> 0.97	
Absolute Location Error		Geometric Distortion	Relative Phase Error			
< 750 m		< 40 m	< 5.0 deg			
Processing Parameters						
Number of Range Looks	1	1	1	1	1	1
Number of Azimuth Looks	7	7	6	5	5	6
Kaiser Weighting Range	2.6	2.6	2.6	2.6	2.6	2.6
Kaiser Weighting Azimuth	2.0	2.0	2.0	2.0	2.0	2.0
Azimuth Look Bandwidth [Hz]	1498	1563	1473	1303	1290	1581
*1: 70 km of azimuth length is corresponding to 10 seconds.						
*2: In the case that scene rotates 45 degrees.						

5. Level 4.2 Product

5.1 SN1: ScanSAR Narrow Mode 1 – 16 MHz

SN1 – ScanSAR Narrow Mode 1 – 16 MHz			
Format	CEOS		
	Path Product Characteristics (Georeferenced Product)	Map Product Characteristics (Geocoded Product)	
Co-ordinate System	Ground Range	Map Projection (UTM, PS)	
Nominal Image Coverage	272 km x 300 km ^{(*)1}	404km x 404 km ^{(*)2}	
Pixel Spacing	50 m x 50 m	50 m x 50 m	
Pixel Data Representation	16 bit unsigned integer (magnitude detected)	16 bit unsigned integer (magnitude detected)	
Nominal Image Size	5440 pixels x 6000 lines	8080 pixels x 8080 lines	
Nominal Product Volume	65 MB	127 MB	
Image Quality Characteristics			
Beam Combinations	SNB		
	S1	S2	S3
Off-nadir Angles (°)	20.1	26.1	30.6
Nominal Range Resolution (m)	105.6– 153.8	89.7 – 107.9	79.2 – 90.9
Nominal Azimuth Resolution	95.3	98.6	96.7
Nominal PSLR [dB]	< -20.0		
Nominal ISLR [dB]	< -14 dB		
Radiometric Error [dB]	< 0.5		
Radiometric Linearity	> 0.97		
Absolute Location Error [m]	< 750		
Geometric Distortion [m]	< 40		
Processing Parameters			
Number of Range Looks	4		
Number of Azimuth Looks	2		
Kaiser Weighting Range	2.9		
Kaiser Weighting Azimuth	2.5		
Notes			
*1: 300 km of azimuth length is corresponding to five scenes for single beam.			
*2: In the case that scene rotates 45 degrees.			

5.2 SM1: ScanSAR Medium Mode 1 – 16 MHz

SM1 - ScanSAR Medium Mode 1 – 16 MHz				
Format	CEOS			
	Path Product Characteristics (Georeferenced Product)		Map Product Characteristics (Geocoded Product)	
Co-ordinate System	Ground Range		Map Projection (UTM, PS)	
Nominal Image Coverage	326 km x 300 km ^(*)		442 km x 442 km ^(*)	
Pixel Spacing	50 m x 50 m		50 m x 50 m	
Pixel Data Representation	16 bit unsigned integer (magnitude detected)		16 bit unsigned integer (magnitude detected)	
Nominal Image Size	6520 pixels x 6000 lines		8840 pixels x 8840 lines	
Nominal Product Volume	77 MB		151 MB	
Image Quality Characteristics				
Beam Combinations	SNB			
	S1	S2	S3	S4
Off-nadir Angles (°)	20.1	26.1	30.6	34.1
Nominal Range Resolution (m)	105.6 – 153.8	89.7 – 107.9	79.2 – 90.9	73.9 – 80.0
Nominal Azimuth Resolution	95.3	98.6	96.7	99.6
Nominal PSLR [dB]	< -20.0			
Nominal ISLR [dB]	< -13 dB			
Radiometric Error [dB]	< 0.5			
Radiometric Linearity	> 0.97			
Absolute Location Error [m]	< 750			
Geometric Distortion [m]	< 40			
Processing Parameters				
Number of Range Looks	4			
Number of Azimuth Looks	2			
Kaiser Weighting Range	2.9			
Kaiser Weighting Azimuth	2.5			
Notes				
*1: 300 km of azimuth length is corresponding to five scenes for single beam.				
*2: In the case that scene rotates 45 degrees.				

5.3 SW1: ScanSAR Wide Mode 1 – 16 MHz

SW1 – ScanSAR Wide Mode 1 – 16 MHz					
Format	CEOS				
	Path Product Characteristics (Georeferenced Product)			Map Product Characteristics (Geocoded Product)	
Co-ordinate System	Ground Range			Map Projection (UTM, PS)	
Nominal Image Coverage	373 km x 300 km ^{(*)1}			476 km x 476 km ^{(*)2}	
Pixel Spacing	50 m x 50 m			50 m x 50 m	
Pixel Data Representation	16 bit unsigned integer (magnitude detected)			16 bit unsigned integer (magnitude detected)	
Nominal Image Size	7460 pixels x 6000 lines			9520 pixels x 9520 lines	
Nominal Product Volume	88 MB			175 MB	
Image Quality Characteristics					
Beam Combinations	SNB				
	S1	S2	S3	S4	S5
Off-nadir Angles (°)	20.1	26.1	30.6	34.1	36.5
Nominal Range Resolution (m)	105.6 – 153.8	89.7 – 107.9	79.2 – 90.9	73.9 – 80.0	70.1 – 74.9
Nominal Azimuth Resolution	95.3	98.6	96.7	99.6	99.0
Nominal PSLR [dB]	< -20.0				
Nominal ISLR [dB]	< -13 dB				
Radiometric Error [dB]	< 0.5				
Radiometric Linearity	> 0.97				
Absolute Location Error [m]	< 750				
Geometric Distortion [m]	< 40				
Processing Parameters					
Number of Range Looks	4				
Number of Azimuth Looks	2				
Kaiser Weighting Range	2.9				
Kaiser Weighting Azimuth	2.5				
Notes					
*1: 300 km of azimuth length is corresponding to five scenes for single beam.					
*2: In the case that scene rotates 45 degrees.					

5.4 SN2: ScanSAR Narrow Mode 2 – 32 MHz

SN2 - ScanSAR Narrow Mode 2 – 32 MHz			
Format	CEOS		
	Path Product Characteristics (Georeferenced Product)	Map Product Characteristics (Geocoded Product)	
Co-ordinate System	Ground Range	Map Projection (UTM, PS)	
Nominal Image Coverage	272 km x 300 km ⁽¹⁾	404 km x 404 km ⁽²⁾	
Pixel Spacing	25 m x 25 m	25 m x 25 m	
Pixel Data Representation	16 bit unsigned integer (magnitude detected)	16 bit unsigned integer (magnitude detected)	
Nominal Image Size	10880 pixels x 12000 lines	16160 pixels x 16160 lines	
Nominal Product Volume	252 MB	500 MB	
Image Quality Characteristics			
Beam Combinations	SNB		
	S1	S2	S3
Off-nadir Angles (°)	20.1	26.1	30.6
Nominal Range Resolution (m)	52.8 – 76.9	44.8 – 53.9	39.6 – 45.5
Nominal Azimuth Resolution	49.1	50.6	49.6
Nominal PSLR [dB]	< -20.0		
Nominal ISLR [dB]	< -14 dB		
Radiometric Error [dB]	< 0.5		
Radiometric Linearity	> 0.97		
Absolute Location Error [m]	< 750		
Geometric Distortion [m]	< 40		
Processing Parameters			
Number of Range Looks	4		
Number of Azimuth Looks	1		
Kaiser Weighting Range	2.9		
Kaiser Weighting Azimuth	2.5		
Notes			
*1: 300 km of azimuth length is corresponding to five scenes for single beam.			
*2: In the case that scene rotates 45 degrees.			

5.5 SM2: ScanSAR Medium Mode 2 – 32 MHz

SM2 - ScanSAR Medium Mode 2 – 32 MHz				
Format	CEOS			
	Path Product Characteristics (Georeferenced Product)	Map Product Characteristics (Geocoded Product)		
Co-ordinate System	Ground Range	Map Projection (UTM, PS)		
Nominal Image Coverage	326 km x 300 km ^{(*)1}	442 km x 442 km ^{(*)2}		
Pixel Spacing	25 m x 25 m	25 m x 25 m		
Pixel Data Representation	16 bit unsigned integer (magnitude detected)	16 bit unsigned integer (magnitude detected)		
Nominal Image Size	13040 pixels x 12000 lines	17680 pixels x 17680 lines		
Nominal Product Volume	301 MB	599 MB		
Image Quality Characteristics				
Beam Combinations	SNB			
	S1	S2	S3	S4
Off-nadir Angles (°)	20.1	26.1	30.6	34.1
Nominal Range Resolution (m)	52.8 – 76.9	44.8 – 53.9	39.6 – 45.5	36.9 – 40.0
Nominal Azimuth Resolution	49.1	50.6	49.6	50.8
Nominal PSLR [dB]	< -20.0			
Nominal ISLR [dB]	< -13 dB			
Radiometric Error [dB]	< 0.5			
Radiometric Linearity	> 0.97			
Absolute Location Error [m]	< 750			
Geometric Distortion [m]	< 40			
Processing Parameters				
Number of Range Looks	4			
Number of Azimuth Looks	1			
Kaiser Weighting Range	2.9			
Kaiser Weighting Azimuth	2.5			
Notes				
*1: 300 km of azimuth length is corresponding to five scenes for single beam.				
*2: In the case that scene rotates 45 degrees.				

5.6 SW2: ScanSAR Wide Mode 2 – 32 MHz

SW2 – ScanSAR Wide Mode 2 – 32 MHz					
Format	CEOS				
	Path Product Characteristics (Georeferenced Product)	Map Product Characteristics (geocoded Product)			
Co-ordinate System	Ground Range	Map Projection (UTM, PS)			
Nominal Image Coverage	373 km x 300 km ⁽¹⁾	476 km x 476 km ⁽²⁾			
Pixel Spacing	25 m x 25 m	25 m x 25 m			
Pixel Data Representation	16 bit unsigned integer (magnitude detected)	16 bit unsigned integer (magnitude detected)			
Nominal Image Size	14920 pixels x 12000 lines	19040 pixels x 19040 lines			
Nominal Product Volume	343 MB	693 MB			
Image Quality Characteristics					
Beam Combinations	SNB				
	S1	S2	S3	S4	S5
Off-nadir Angles (°)	20.1	26.1	30.6	34.1	36.5
Nominal Range Resolution (m)	52.8 – 76.9	44.8 – 53.9	39.6 – 45.5	36.9 – 40.0	35.0 – 37.5
Nominal Azimuth Resolution	49.1	50.6	49.6	50.8	50.6
Nominal PSLR [dB]	< -20.0				
Nominal ISLR [dB]	< -13 dB				
Radiometric Error [dB]	< 0.5				
Radiometric Linearity	> 0.97				
Absolute Location Error [m]	< 750				
Geometric Distortion [m]	< 40				
Processing Parameters					
Number of Range Looks	4				
Number of Azimuth Looks	1				
Kaiser Weighting Range	2.9				
Kaiser Weighting Azimuth	2.5				
Notes					
*1: 300 km of azimuth length is corresponding to five scenes for single beam.					
*2: In the case that scene rotates 45 degrees.					

Appendix A. Scene Definition

PALSAR GDS has two scene definitions of single beam and scan beam.

A.1 Scene Definition of Single Beam

The scene is based on "scene fixed point". Scene fixed point is defined as follows.

- It is the point divided satellite foot print at intervals of 0.5 degree.
- First point is + 0.25 degree away from ascending node.

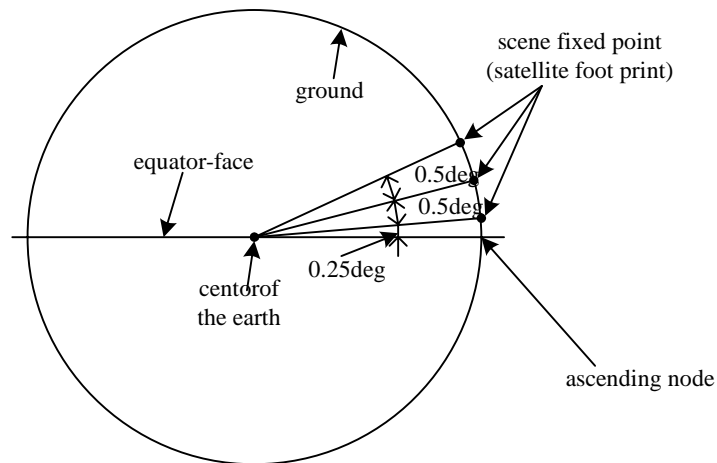


Fig. A.1-1 Scene Fixed Point

Based on scene fixed point, the scene of single beam is defined as follows.

(1) Range length of scene depends on swath width.

In the case that observation mode is fine and dual-polarimetric mode, swath width is 70 km. (Off-nadir angle is 34.3 degree on the equator.)

In the case that observation mode is quad-polarimetric mode, swath width is 30 km. (Off-nadir angle is 21.5 degree on the equator.)

(2) Azimuth length of scene is defined as 10 seconds from time of scene fixed point - 5 seconds to time of scene fixed point + 5 seconds. This length is about 70 km.

(3) No.1 of Row number is at a point +0.25 degree away from ascending node. From there, Row numbers are assigned in order up to No.720 toward along-track direction.

(4) As a response to scene shift, ascending node is assigned as No.0.50, and two-digit number after the decimal point is added to Row numbers from No.0.50 to No. 720.49.

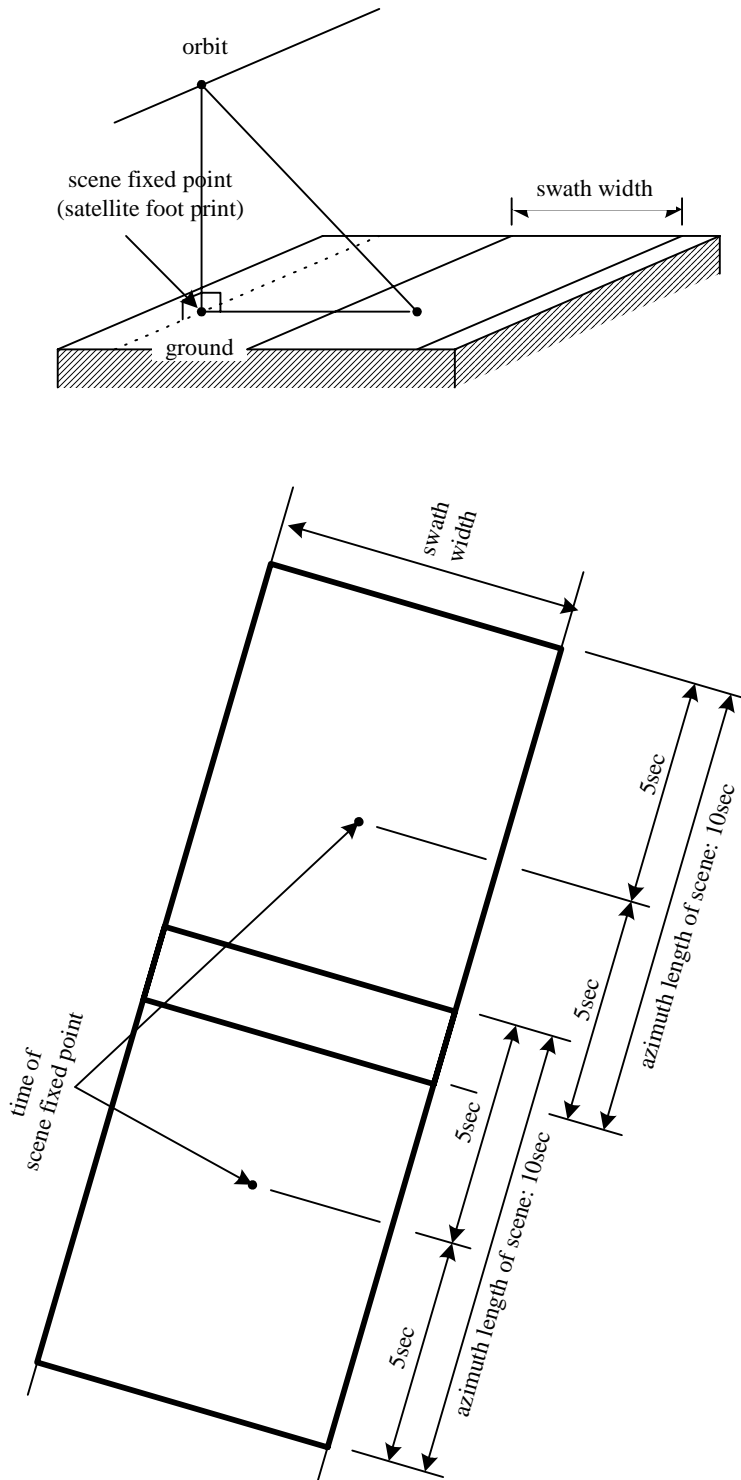


Fig. A.1-2 Scene Definition of Single Beam

A.2 Scene Definition of Scan Beam

The scene of scan beam is defined as follows.

(1) Range length of scene depends on swath width.

In the case that observation mode is ScanSAR mode and number of scans is 3, swath width is 250 km.

In the case that observation mode is ScanSAR mode and number of scans is 4, swath width is 300 km.

In the case that observation mode is ScanSAR mode and number of scans is 5, swath width is 350 km.

(These swath widths are on the equator.)

(2) Azimuth length of scene is corresponding to azimuth length of five scenes for single beam. This length is about 300 km.

(In the case that azimuth length is shorter than five scene's length for single beam, its length is azimuth length of scene.)