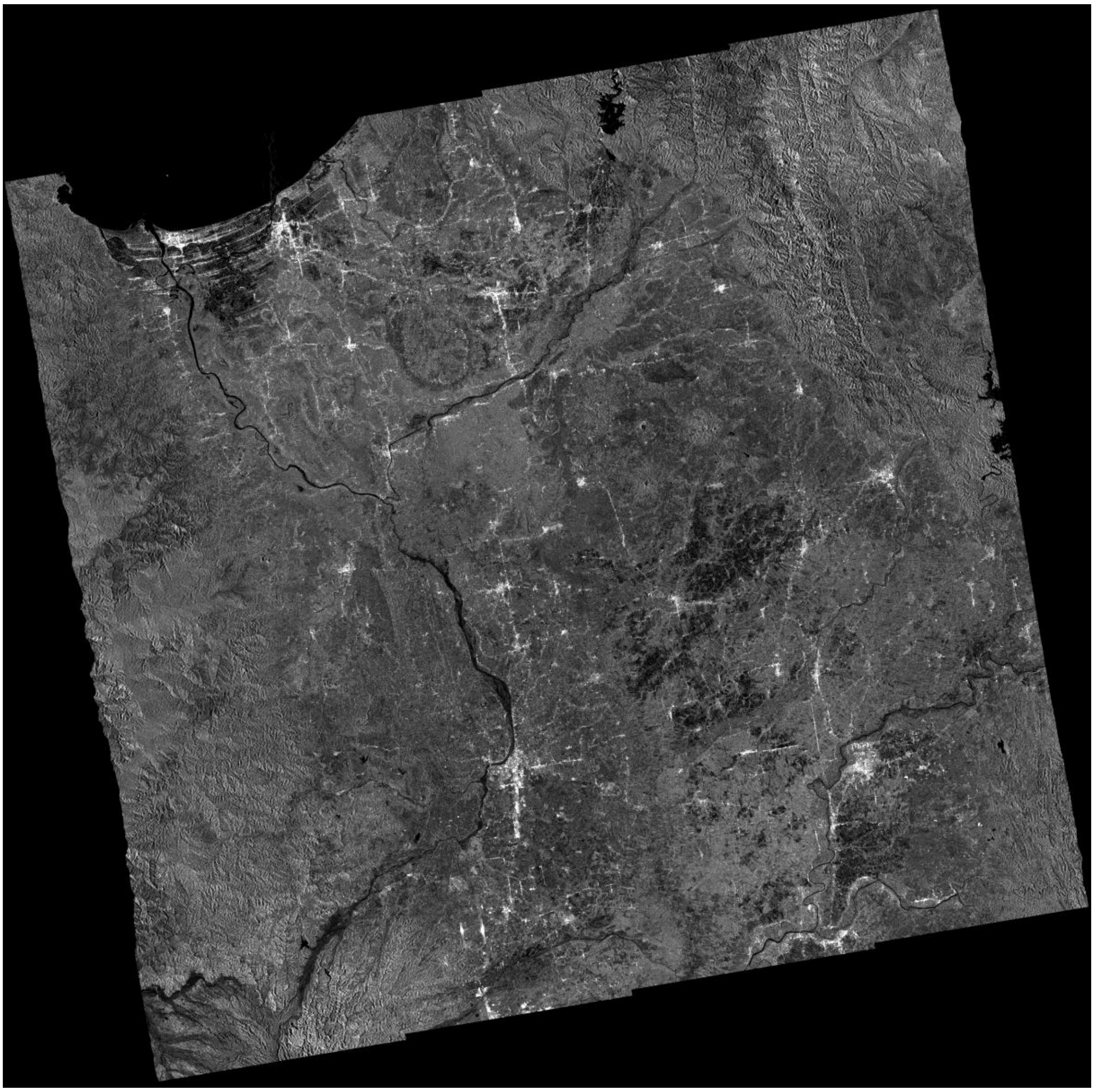
KOMPSAT-5 PRODUCT SPECIFICATIONS
Standard Products Specifications

Fair Access to Space



Lingayen Gulf, Philippines

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1. KOMPSAT-5 SAR INSTRUMENT OVERVIEW

KOrea Multi-Purpose SATellite (KOMPSAT-5, hereafter) mission objectives are the provision of SAR images for Geographic Information Systems applications, and the Korean national environment and disaster monitoring System. The mission orbit is circular and the satellite altitude is 550 Km.

The KOMPSAT-5 SAR payload includes X-band (9.66 GHz) Synthetic Aperture Radar with a fixed antenna capable of electronic steering both in the azimuth and the elevation planes.

The elevation steering capabilities, allows defining an access region spanning approximately from 18.3° up to 49.0° in terms of the corresponding off-nadir angle (20° - 55° incidence angle @ 550 Km). Such range includes one nominal access spanning approximately from 18.3° up to 40.6° in terms of the corresponding off-nadir angle (20° - 45° incidence angle @ 550 Km) in which nominal performance are granted.

The SAR is designed to implement different types of Image Operation Mode that are briefly detailed in the following paragraphs.

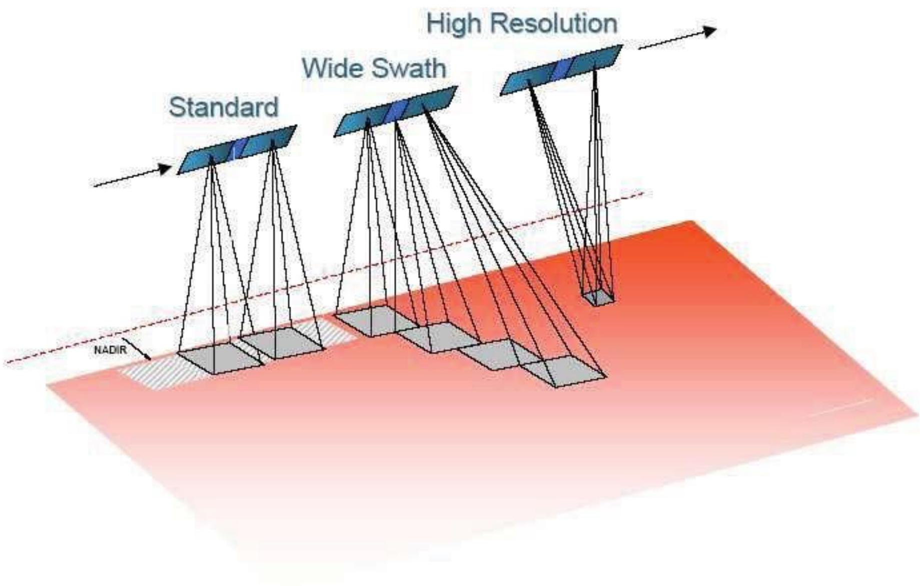


Figure 1-1 Measurement Mode

The SAR is capable of operating in three measurement modes: Standard Modes, High Resolution Modes and Wide Swath Modes. Each mode provides different characteristics in terms of ground sample distance (i.e. geometrical resolution) and swath-width.

The “K5 System Enhanced” foresees the enhancement of SAR P/L with four additional operative modes:

- EH : Enhanced High Resolution mode
- UH : Ultra High Resolution mode
- ES : Enhanced Standard mode
- EW: Enhanced Wide Swath mode.

Image Operation Modes are briefly detailed in the following paragraphs.

1.1 High Resolution Modes

In these imaging modes the antenna is steered (in the azimuth plane) during the overall acquisition time in order to illuminate the required scene for a time period longer than the one of the standard strip side view. This increases the length of the synthetic antenna and therefore the azimuth resolution. Such improvement of the radar performance is paid by a loss of azimuth coverage. For the achievement of a range resolution comparable with the azimuth one, a chirp bandwidth less than or equal to 240 MHz is requested hence, implying the need of de-chirping of the received echo in order to reduce the downlink data rate. In such configuration the acquisition is limited in the azimuth direction due to the technical constraints deriving from the azimuth antenna pointing.

In High Resolution modes, the spot extension is achieved by a steering scheme, which requires the center of the beam steering to be located beyond the center of the imaged spot.
The electronic steering scheme, allows increasing the observed Doppler bandwidth for each target, though the instantaneous footprint is however interested by a sliding effect in the azimuth direction.

In the following a brief summary of the main imaging characteristics of the High Resolution Modes is given.

- HR: High Resolution Mode

  It allows achieving 5 Km of swath width in the overall Access Region, the resolution is equal to 1m in the azimuth direction, and while it is variable in the range (1 m of range resolution is guaranteed at 45° of incidence angle).

- EH: Enhanced High Resolution Mode

  The Enhanced High Resolution mode has been conceived in order to provide as much as possible a uniform resolution (i.e. 1 m) in the range direction. Due to H/W characteristics, only in a reduced part of the access region is possible to achieve a range resolution better than 1m.

- UH: Ultra High Resolution Mode

  The Ultra High Resolution mode has been conceived in order to improve the range and azimuth resolution up to 0.85m. Due to H/W characteristics, only in a reduced part of the access region is possible to achieve a range resolution better than 1m.

1.2 Standard Modes

These imaging modes are obtained by pointing the antenna along a fixed direction with respect to the flight platform path. The antenna footprint covers a strip on the illuminated surfaces as the platform moves and the system operates. In such configuration the acquisition is performed on a continuous strip on the ground, hence it is virtually unlimited in the azimuth direction, but the current maximum SAR instrument duty cycle is 120 s. In this mode the radar Tx/Rx configurations are time invariant, allowing receiving from each ground scatterer the full Doppler bandwidth allowed by the azimuth aperture of the antenna beamwidth.

In the following a brief summary of the main imaging characteristics of the Standard Modes is given.

- ST: Standard Mode

It allows achieving 30 Km of Swath in the most of the Access region at a variable resolution. In particular this mode allows achieving a resolution of 3m @ 45° and a resolution between 8m ÷ 4m over the largest part of the access region.

- ES: Enhanced Standard Mode

The Enhanced Standard mode has been conceived in order to improve the range resolution by exploiting the characteristics of the 120MHz IF filter, which can be used with a bandwidth greater than 120 MHz At this aim a new mode at 2.5m of range resolution, has been designed.

1.3 Wide Swath Modes

This imaging mode allows larger swath in range with respect to the Standard one, but with a less spatial resolution. Larger range swaths are obtained by periodically stepping the antenna beam to neighbouring sub-swaths. In this mode only a part of the synthetic antenna length is available in azimuth and consequently the azimuth resolution is reduced. In such configuration the acquisition is performed in adjacent strip mode, hence it is virtually unlimited in the azimuth direction.

In the Wide Swath Mode, some elementary beams have been defined depending on the selected PRF ambiguity number and the acquisition incidence angle. Each configuration represents one of the subswaths that properly combined will cover the required total ground swath.

In the following a brief summary of the main imaging characteristics of the Wide Swath Modes is given.

- WS: Wide Swath Mode

It allows achieving total swath width between 90 and 120 Km in the nominal access region and a ground sample distance at 1 Look at 20 meters.

- EW: Enhanced Wide Swath Mode

  The EW mode is focused on improving the radiometric resolution by implementing a dramatic increase of range resolution (20 m → 5 m) in order to apply a multi-look technique at image processing time (4 looks) which allows better image uniformity.

2. PROCESSING LEVELS OVERVIEW

SAR Standard product consists of SAR signal data or SAR image (originated by standard processing of the signal data) distributed on magnetic, optical or electronic media.

The standard processing of the KOMPSAT-5 SAR data has been thought to be as much as possible aligned with the definition deriving from literature.
If some alternative approach has been in some case adopted for the product specification, it has been however oriented to add value to the output data, preserving in any case the possibility for the final user to remove the effects of the additional non-standard processing applied to the data. Implementation of such policy will be better detailed in the following sections.

KOMPSAT-5 products may be classified according to the following basic features:

- instrument mode
- The level of processing that has been applied to the data.
- data information (e.g. weighting function, projection)

The KOMPSAT-5 SAR processors implement four levels of standard processing (from 0 up to level 1D), which a specific output product corresponds to. More than one product can correspond to each processing level:

- a product obtained by a basic processing will be in the following referred with the suffix <A> and <B>;
- a product obtained by a dedicated processing will be in the following referred with the suffixes <U> and <W>;

2.1 PRODUCT TYPE

The following table summarizes the feature of the KOMPSAT-5 SAR Standard Products, which can be considered applicable independently on the instrument mode:

Table 2-1 List of SAR Standard Products

Proc. Lev.	Code	Sample Information	Projection
0	RAW_B	In-Phase and Quadrature of the echoed data with annexed Noise and Periodic Calibration measurements	Time ordering organization within pulse and between pulses
1A	SCS_B	Single Look Complex	Slant Range / Azimuth (Zero-Doppler)
	SCS_U		
	SCS_A		
	SCS_W		
1C	GEC_B	Geocoded Earth Ellipsoid	UTM, EGM96 EQPOT Surface
	GEC_A		
	GEC_W		
	WEC_B	Geocoded Earth Ellipsoid	GEOG, EGM96 EQPOT Surface
	WEC_A		
	WEC_W		
1D	GTC_B	Geocoded Earth Terrain	UTM, DEM + EGM96 EQPOT Surface
	GTC_A		
	GTC_W		
	WTC_B	Geocoded Earth Terrain	GEOG, DEM + EGM96 EQPOT Surface
	WTC_A		
	WTC_W		

The following table summarizes the data types to be used for storage of the data layers of the KOMPSAT-5 SAR Standard Products, independently on the SAR operation mode.

Table 2-2 Data types for SAR Standard Products

Product	Dataset	Sample Format	Bits per Sample	Samples per Pixel	Type Represent.
RAW_B	Echo Data Noise Data CAL Data Replica	byte	8	2	Little Endian
SCS_B SCS_U	Focused data	int 16 bit	16	2	Little Endian
SCS_A SCS_W		*float 16 bit	16	2	Little Endian
GEC_B WEC_B	Signal Amplitude	int 16 bit	16	1	Little Endian
GEC_A WEC_A GEC_W WEC_W		*float 16 bit	16	1	Little Endian
GTC_B WTC_B	Signal Amplitude	int 16 bit	16	1	Little Endian
GTC_A WTC_A GTC_W WTC_W		*float 16 bit	16	1	Little Endian

* A 16bit float, so called FAB16, is used for HDF float products and standard 32bit float is used for GeoTiff .

The float 16 bit sample format is the operational baseline due to its wider dynamic range, smaller amplitude and phase errors respect to integer 16 bit data format, as shown below:

16 bit Integer

- dynamics [0,+96] dB signed
- dynamics [0,+90] dB unsigned
- accuracy [0,1] dB
- phase errors [0,2]°

16 bit Float

- dynamics [-66,+126] dB
- accuracy < 0.005 dB
- phase errors < 0.03°

KOMPSAT-5 provides float products in HDF format in order to deliver better dynamic range, accuracy and phase error.

Peculiarities of processing levels, independently on the instrument mode are given in the following sections.

2.1.1 FAB16 Format

In the following a description of the “16 bit Float” format is provided. 16 bit Floating-point Arithmetic Binary format has been designed in 1992 (originally on VAX architecture) by Thales Alenia Space Italia (ex Selenia Spazio) to adapt dynamic range to SAR products, with a minimum loss of precision.

It specifies a binary 16 bit float as having:

- **Sign**$_{\textbf{16 BIT FLOAT}}$: 1 bit
- **Exponent**$_{\textbf{16 BIT FLOAT}}$: 4 bits
- **Precision**$_{\textbf{16 BIT FLOAT}}$: 11 bits

The following figure shows the layout, the number of bits for each field (bit ranges are in square brackets):

	Sign$_{\text{16 BIT FLOAT}}$	**Exponent$_{\text{16 BIT FLOAT}}$**	**Precision$_{\text{16 BIT FLOAT}}$**	
16 BIT FLOAT	1 [15]	4 [14-11]	1 [10]	10 [09-00]

16 Bit Float format is obtained from IEEE 754 single-precision binary floating-point as follow:

Sign16 BIT FLOAT

= (Bit [31])IEEE32

Exponent$_{\text{16 BIT FLOAT}}$

=(Bits [30-24])$_{\text{IEEE32\_DECIMAL}}$ – 64 + 6 (for INTEL and SPARC architectures)

=(Bits [30-24])$_{\text{IEEE32\_DECIMAL}}$ – 64 + 5 (for VAX architecture)

Precision$_{\text{16 BIT FLOAT}}$

=(Bits [23-13]) $_{\text{IEEE32}}$

Note that the (Bits [23])IEEE32 (that is the last bit of Exponent field for IEEE32) is inserted in Precision16 BIT FLOAT field, so (Bits [23])IEEE32 = (Bits [10])16 BIT FLOAT

“If” Conditions

Due to “Exponent$_{\text{16 BIT FLOAT}}$” field length of 4 bit:

if the result of above subtraction is lower than 0,

“Exponent$_{\text{16 BIT FLOAT}}$” field is padded with all zeros (0000)

if the result of above subtraction is greater than 15,

“Exponent$_{\text{16 BIT FLOAT}}$” field is padded with all ones (1111)

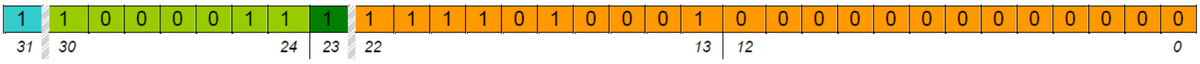
So:

(Bits [30-24])$_{\text{IEEE32\_DECIMAL}}$ greater than 73 are transformed in Exponent$_{\text{16 BIT FLOAT}}$=15 (because 73-64+6=15 and over 73 there is the “if” condition)

(Bits [30-24])$_{IEEE32\_DECIMAL}$ lower than 58 are transformed in Exponent$_{16\ BIT\ FLOAT}$=0 (because 58-64+6=0 and under 58 there is the “if” condition) .

Example

The decimal number -500.25 in IEEE 754 single-precision binary format is:



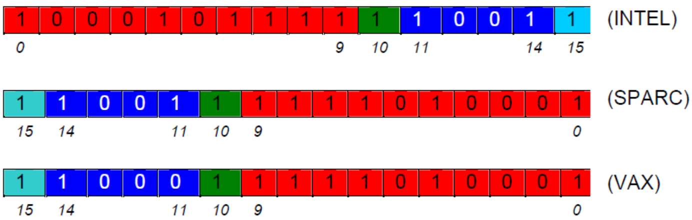
In 16 BIT FLOAT floating-point format it will be:

- Sign$_{16\ BIT\ FLOAT}$ = 1
- (Bits [30-24])$_{IEEE32\_DECIMAL}$ = 67 → No “if” conditions
- Exponent$_{16\ BIT\ FLOAT}$

  = 67 – 64 + 6 = 9 = $(1001)_2$ (for INTEL and SPARC architectures)

  = 67 – 64 + 5 = 8 = $(1001)_2$ (for VAX architecture)
- (Bits [23])$_{IEEE32}$ = 1 → Precision$_{16\ BIT\ FLOAT}$ = 1 1111010001

Thus:



2.1.2 FAB16 Conversion

```
#define EXP16_OFFS 0x3A000000
#define EXP16_UNDF 0x3A000000
#define EXP16_OVRF 0x49000000

#define FLT16_POS_OVFL 0x00007FFF
#define FLT16_NEG_OVFL 0x0000FFFF
#define FLT16_ZERO        0


typedef unsigned short Real2;
typedef float Real4;

typedef struct {
              Real2 re;
              Real2 im;
} Complex4;

typedef struct {
```

```
        Real4 re;
        Real4 im;
} Complex8;

//function FLOAT to FAB16

Real2 f16r_(Real4 *a)
{
        register unsigned int i32a = *(unsigned int *)a;
        register unsigned int e_o = (i32a & 0x7F000000);
        if (e_o < EXP16_UNDF)
                return (Real2)FLT16_ZERO;
        else if (e_o > EXP16_OVRF) {
                if (i32a & 0x80000000)
                        return (Real2)FLT16_NEG_OVFL;
                else
                        return (Real2)FLT16_POS_OVFL;
        }
        return (((e_o - EXP16_OFFS) << 3) | (i32a & 0x80000000) | ((i32a & 0x00FFE000) << 3)) >> 16;
}


//function FAB16 TO FLOAT
Real4 f32r_(Real2 *a)
{
        register unsigned int i32a;
        if ( !(i32a = (unsigned int)*a) )
                return (Real4)FLT16_ZERO;
        register unsigned int e_o = ((i32a & 0x00007800) + 0x0001D000) << 13;
        unsigned int f32r = ((i32a & 0x00008000) << 16) | e_o | (i32a & 0x000007FF) << 13;
        return *(Real4*)&f32r;
}

//function COMPLEX FLOAT to COMPLEX FAB16
Complex4 f32c_(Complex8 *a)
{
        register unsigned int i32a = *(unsigned int *)&((*a).re);
        register unsigned int e_o = (i32a & 0x7F000000);
        register Complex4 i32o;
        if (e_o < EXP16_UNDF) {
                i32o.re = FLT16_ZERO;
                goto MIDPASS;
        }
        else if (e_o > EXP16_OVRF) {
                if (i32a & 0x80000000)
                        i32o.re = FLT16_NEG_OVFL;
                else
                        i32o.re = FLT16_POS_OVFL;
                goto MIDPASS;
        }
        i32o.re = ( ((e_o - EXP16_OFFS) << 3) | (i32a & 0x80000000) | ((i32a & 0x00FFE000) << 3) ) >> 16;

MIDPASS:
        i32a = *(unsigned int *)&((*a).im);
        e_o = (i32a & 0x7F000000);
        if (e_o < EXP16_UNDF) {
                i32o.im = FLT16_ZERO;
                return i32o;
        }
        else if (e_o > EXP16_OVRF) {
                if (i32a & 0x80000000)
                        i32o.im = FLT16_NEG_OVFL;
                else
                        i32o.im = FLT16_POS_OVFL;
                return i32o;
        }
```

```
		i32o.im = ( ((e_o - EXP16_OFFS) << 3) | (i32a & 0x80000000) | ((i32a & 0x00FFE000) << 3) ) >> 16;
		return i32o;
}

//function COMPLEX FAB16 to COMPLEX FLOAT
void ssf32c_(Complex4 *i32o, Complex8 *a)
{
		register unsigned int i32a = *(unsigned int *)&((*a).re);
		register unsigned int e_o = (i32a & 0x7F000000);
		if (e_o < EXP16_UNDF) {
			(*i32o).re = FLT16_ZERO;
			goto MIDPASS;
		}
		else if (e_o > EXP16_OVRF) {
			if (i32a & 0x80000000)
				(*i32o).re = FLT16_NEG_OVFL;
			else
				(*i32o).re = FLT16_POS_OVFL;
			goto MIDPASS;
		}
		(*i32o).re = ( ((e_o - EXP16_OFFS) << 3) | (i32a & 0x80000000) | ((i32a & 0x00FFE000) << 3) ) >> 16;

MIDPASS:
		i32a = *(unsigned int *)&((*a).im);
		e_o = (i32a & 0x7F000000);
		if (e_o < EXP16_UNDF) {
			(*i32o).im = FLT16_ZERO;
			return;
		}
		else if (e_o > EXP16_OVRF) {
			if (i32a & 0x80000000)
				(*i32o).im = FLT16_NEG_OVFL;
			else
				(*i32o).im = FLT16_POS_OVFL;
			return;
		}
		(*i32o).im = ( ((e_o - EXP16_OFFS) << 3) | (i32a & 0x80000000) | ((i32a & 0x00FFE000) << 3) ) >>
16;
}
```

2.2 Processing Level 0

The Level 0 product include a set of annotations, which detail its features in terms of:

- Time Correlation Data
- Sensor Parameters
- Orbital and attitude data
- Calibration data
- Localization info
- Raw data quality statistical parameters

It's worth stating that parameters for the internal calibration of the RAW data (that is the channels' bias, imbalance and non-orthogonality) are evaluated but not applied, in order to leave the data unchanged as much as possible.

2.2.1 RAW_B Product

The RAW product contains for each sensor acquisition mode the unpacked echo data in complex in-phase and quadrature signal (I and Q) format.

It is originated starting from the following input data:

- SAR Level 0 data file
- Satellite auxiliary data
- Orbital, attitude and pointing data (only for generation of attributes)

The only processing performed to the downlinked X-band raw signal data is:

- the frame synchronization at byte level, which consists in the analysis within the CCSDS data array stream in order to find out the SYNC pattern (synchronization 16 bit word) and supplementary secondary header constant bit fields. This allows the further CCSDS packet structure extraction
- removal of the data overstructure due to the CCSDS on-board to ground transmission protocol
- data decompression in the case the BAQ algorithm has been used on board to pack the data in order to reduce the downlink rate
- re-assembly of the Packet Data Field into contiguous radar range lines in increasing time order (duplicated range lines are discarded), by zero filling of the missing echo lines or missing echo blocks
- evaluation of statistics on the RAW data
- data formatting into the output format.

The RAW product includes data acquired in each single Instrument Mode, depending on the operation of the SAR instrument during the data reception or recording period.
A RAW product will not ever combine data from more than one Instrument Mode, which are always packaged as two separate products. A RAW product must be SAR processed before it can be displayed as imagery.
Finally the product includes the QLK dataset which represent a raw data quick look (e.g. a down-sampled detected raw data array).

2.3 Processing Level 1A

The SCS product will include a set of attributes, which detail its features in terms of:

- Time Correlation Data
- Sensor Parameters
- Orbital and attitude data
- Calibration data
- Localization info
- Processing parameters
- Raw data quality statistical parameters
- Product Confidence Data
- Doppler Parameters (Doppler Centroid, Doppler Rate)

Additional considerations depending on the instrument mode need to be done

2.3.1 SCS_B and SCS_A Products

The SCS product contains for each sensor acquisition mode the focused data in complex format, in slant range and zero Doppler projection.

According to Table 2-2 SCS_B and SCS_A products have different sample format but the basic common processing features are:

The basic processing features characterizing the SCS_B product are:

- compensation of the transmitter gain and receiver attenuation
- internal calibration on the RAW data in terms of:
    - unbiasing
    - compensation of gain imbalance
    - compensation of non-orthogonality of I and Q channels
- the data focusing according to algorithm depending on the specific instrument
- weighted processing is performed with application of cosine-like windowing, so obtaining the maximum performances of the IRF features in terms of PSLR, ISLR, SSLR to the detriment of spatial resolution;
- radiometric equalization of the complex image in terms of:

- compensation of the range spreading loss
- rescaling with respect to a reference slant range in order to not alter the dynamic of the output product

Data are processed at full range and azimuth resolution; hence any multilook processing isn’t applied.

Concerning with the radiometric equalization of the single-look products, though it is considered on optional step and is explicitly to be avoided by some literature at the processing Level 1A, it has been taken into consideration in order to distribute to the users community a class of products having minimized the mis-calibration (both within scene and across swaths) originated by the SAR geometry acquisition. Moreover, to preserve the reversibility of the equalization process, an approach based on the use of a mathematical reference surface such as the ellipsoid has been selected for the compensation of the incidence angle and for the estimation and application of the range antenna pattern.
Therefore, enhanced processing based on the usage of DEM for the compensation of the incidence angle has been considered out of scope of this processing level.

This choice also derives from the considerations that usage of DEM for radiometric correction at standard processing level can introduce worsening effects on image calibration under the following conditions:

- if the DEM accuracy were of poor quality
- if problems on POD module occurred, due to on-board instruments or to data post-processing
- if the SAR image were affected by a not compensated time shift (both slow and fast time) that imply a wrong product localization on ground
- if a failure in the Doppler estimation occurred, hence implying a wrong product localization on ground

It’s worth stating that the value of the calibration constant that allows converting the information of the image sample to backscattering coefficient is appended to the distributed product but not applied to it, considering this step as matter of backscattering product origination. For that reason, the product performances listed in sections 4 (Output Format Description) that strictly depends on the measure on the image of the backscattering coefficients (radiometric accuracy, radiometric linearity, radiometric stability, local radiometric stability), have to be considered valid supposing that the quality control procedure take care of the application on the examined image of the annotated calibration constant.

2.3.2 SCS_U and SCS_W Products

An optional processing of Level 1A can be requested, differing from that one of the SCS_B product because of an unweighted processing is performed that is any windowing isn't applied on the processed bandwidth.
This processing level is thought to originate, by an approach as much conservative as possible, the focused representation of the raw signal echoed by the observed scene, in order to not change the data for higher processing levels.
For that reason, unweight processing is performed on raw data, so obtaining the maximum performances in terms of spatial resolution to the detriment of the IRF features.
For the same reason, any radiometric calibration (with the exception of the range spreading loss) isn't applied during the processing, postponing this step to optional or higher processing levels.

2.4 Processing Level 1C

The product will include a set of annotations, which detail its features in terms of:

- Time Correlation Data
- Sensor Parameters
- Orbital and attitude data
- Calibration data
- Localization info
- Processing parameters (including that one's specific to multilooking)
- Raw data quality statistical parameters
- Product Confidence Data
- Doppler Parameters (Doppler Centroid, Doppler Rate)
- Geolocation Parameters

Additional considerations depending on the instrument mode need to be done

2.4.1 GEC Products

The GEC product contains for each sensor acquisition mode the focused data, detected, geolocated on the reference ellipsoid and represented in cartographic projection (UTM or UPS depending on the Scene Center). Any geometric or radiometric correction derived by usage of terrain model isn't applied to this product.

The basic processing features characterizing the GEC_B product are:

- the same one's previously detailed for the generation of the SCS_B product (including radiometric equalization with the usage of the ellipsoid for the estimation of antenna pattern and incidence angle)
- the map projection on the ellipsoid

The data shall be aligned with the north direction. The area of the product, outside the SAR sensed image data, shall be filled with invalid value because of the rotation to align with North. GEC_B, GEC_A, GEC_W are projected in UTM.

2.4.2 WEC Products

WEC_B, WEC_A, WEC_W products have the same features of GEC products but for GEOG (geographical coordinates system) projection.

2.5 Processing Level 1D

The product includes a set of annotations which detail its features in terms of:

- Time Correlation Data
- Sensor Parameters
- Orbital and attitude data
- Calibration data
- Localization info
- Processing parameters (including that one's specific to multilooking)
- Raw data quality statistical parameters
- Product Confidence Data

- Doppler Parameters (Doppler Centroid, Doppler Rate)
- Geolocation Parameters

Additional considerations depending on the instrument mode need to be done

2.5.1 GTC Products

The GTC product contains for each sensor acquisition mode the focused data, fully calibrated with the usage of terrain model, detected, geolocated on a DEM and represented cartographic projection (UTM or UPS depending on the Scene Center). The planimetric accuracy of the product will depend on DEM accuracy.

The processing features characterizing the GTC_B product are similar to that one's listed for the processing Level 1C with the following differences:

- usage of DEM for the ground projection
- usage of DEM for the estimation/compensation of the range antenna pattern and incidence angle
- application of the calibration constant to derive the backscattering coefficient Image is represented in dB scale.

Image is represented in dB scale. GTC_B, GTC_A, GTC_W are projected in UTM.

2.5.2 WTC Products

WTC_B, WTC_A, WTC_W products have the same features of GTC products but for GEOG (geographical coordinates system) projection.

3. Auxiliary Products

In following auxiliary products can be found:

- XML
- QLK
- KML
- JGW
- RPC
- GIM

3.1.1 XML FILE

The auxiliary file provides auxiliary information related to the image file. The format of auxiliary image file is XML.

Table3.1 shows detailed information on attributes for auxiliary file.

Table 3-1 Attributes: Auxiliary File

Element			Attribute	Definition	Data Type	Allowed Values	Unit	L0	L1A	L1C	L1D
<?xml>				XML Information							
			version	XML version	Float	1		a	x	x	x
			encoding	Encoding Information	String	UTF-8		a	x	x	x
< Auxiliary>											
			xmlns: xsi	Xml Schema Element							
			xmlns: xsd	Xml Schema Definition							
			xsi	Xml Schema Location							
<Root>				Root Element of <General>							
<AcquisitionStationID>				Acquisition Station identifier	String			a	x	x	x
<DeliveryMode>				Identification of the processing mode used to meet the delivery time constraints.	String	STANDARD		a	x	x	x
<DownlinkStartUTC>				Downlink time of the first line of the Level 0 file used as input to generate the product	String		Epoch	a	x	x	x
<DownlinkStopUTC>				Downlink time of the last line of the Level 0 file used as input to generate the product	String		Epoch	a	x	x	x
<MissionID>				Mission identifier	String	KMPS		a	x	x	x
<ProcessingCentre>				Identifier of the processing center	String			a	a	a	a
<ProductFilename>				Product file name	String			a	a	a	a
<ProductSpecificationDocument>				Code of the Specification Document	String	SPE-K5E-0002-TASI		a	x	x	x

<ProductType>				Indication of the product type.	String	SCS_A SCS_B SCS_W SCS_U GEC_A GEC_B GEC_W WEC_A WEC_B WEC_W GTC_A GTC_B GTC_W WTC_A WTC_B WTC_W		a	a	a	a
<SatelliteID>				Satellite Identifier	String	KMPS5		a	x	x	x
<BitsperSample>				Number of bit per image sample	UByte	8 16 32 64		a	a	a	a
<ColumnsOrder>				Order of columns in the formatted product.	String	WEST-EAST NEAR-FAR		a	a	a	a
<ImageLayers>				Number of Image Layers	UByte	1		a	x	x	x
<ImageScale>				Scale used for image representation	String	LINEAR POWER DB		a	a	a	a
<LinesOrder>				Order of lines in the formatted product	String	NORTH-SOUTH EARLY-LATE		a	a	a	a
<SampleFormat>				Sample data type	String	INT UINT FLOAT		a	a	a	a
<SamplesperPixel>				Number of samples per pixels	UByte	2 for complex data 1 otherwise		a	a	a	a
<LeapSign>				Sign of the occurrence of the leap second	Short	+1 if positive -1 if negative 0 if not used		a	x	x	x
<LeapUTC>				UTC time of the occurrence of the leap second	String	UTC Epoch "NULL"	Epoch	a	x	x	x
<OrbitNumber>				Orbit Number relevant to the Scene Start Time	UInt			a	x	x	x
<ProgrammedImageID>				Image ID as it was programmed by Ground Segment	UShort			a	x	x	x
<SceneSensingStartUTC>				Initial acquisition time of the scene in UTC	String		Epoch	a	m	x	x

<SceneSensingStopUTC>				Final acquisition time of the scene in UTC	String		Epoch	a	m	x	x
<SelectiveAvailabilityStatus>				Status of the Selective Availability during the acquisition	String	ON OFF		a	x	x	x
<AcquisitionMode>				Instrument mode enabled during acquisition	String	STANDARD ENHANCED STANDARD WIDE SWATH ENHANCED WIDE SWATH HIGH RESOLUTION ENHANCED HIGH RESOLUTION ULTRA HIGH RESOLUTION		a	x	x	x
<AntennaLength>				Antenna length in the azimuth direction	Double		m	a	x	x	x
<AzimuthBeamwidth>				Antenna azimuth beam width	Double		deg	a	x	x	x
<LookSide>				Antenna direction	String			a	x	x	x
<MultiBeamId>				Identifier of the beams combinated to form the full swath	String	ST-01…ST-19 ES-01…ES-19 HR-01....HR-31 EH-01....EH-31 UH-23....UH-31 WD-01...WD-05 EW-01...EW-05		a	x	x	x
<OriginalBitQuantisation>				Number of quantization bits of each channel of the RAW signal	UByte	1 2 3 4 8		a	x	x	x
<RadarFrequency>				Radar frequency	Double		Hz	a	x	x	x
<RadarWavelength>				Radar wavelength	Double		Hz	a	x	x	x

<SubswathsNumber>				Number of subswaths included in scene	UByte	1 ST/ES/HR/EH/UH 4 WS/EW		a	x	x	x
<AttitudeQuaternions>				Array of quaternions representing the satellite attitude	Double(N12,4)			a	x	x	x
<AttitudeTimes>				Array of times (in seconds since the annotated reference UTC)	Double(N12)		s	a	x	x	x
<ECEFSatellitePosition>				Satellite Position in Earth Centered - Earth Fixed Cartesian coordinate system	Double(N6,3)		m	a	x	x	x
<ECEFSatelliteVelocity>				Satellite Velocity in Earth Centered - Earth Fixed Cartesian coordinate system	Double(N6,3)		m/s	a	x	x	x
<ECEFSatelliteAcceleration>				Satellite Acceleration in Earth Centered - Earth Fixed Cartesian coordinate system	Double(N6,3)		m/s^2	a	x	x	x
<NumberofStateVectors>				Number of annotated state vectors(N6)	UShort			a	x	x	x
<NumberofAttitudedata>				Number of attitude samples(N12)	UShort			a	x	x	x
<OrbitDirection>				Ascending or descending orbit designator	String			a	x	x	x
<PitchAngle>				Satellite Pitch angle rotation wrt geodetic quaternion	Double(N12)			a	x	x	x
<PitchRate>				Satellite Pitch angular rate	Double(N12)		deg/s	a	x	x	x
<RollAngle>				Satellite Roll angle rotation wrt geodetic quaternion	Double(N12)			a	x	x	x
<RollRate>				Satellite Roll angular rate	Double(N12)		deg/s	a	x	x	x
<SatelliteHeight>				Satellite ellipsoidal height measured at the image central azimuth time	Double		m	a	x	x	x
<StateVectorsTimes>				Array of times at which the satellite state vectors (Position, Velocity) are supplied	Double(N6)		s	a	x	x	x
<YawAngle>				Satellite Yaw angle rotation wrt geodetic quaternion	Double(N12)			a	x	x	x
<YawRate>				Satellite Yaw angular rate	Double(N12)		deg/s	a	x	x	x
<AzimuthPolynomialReferenceTime>				Reference azimuth time used to represent the azimuth polynomial of Doppler variation and Range spectrum central frequency	Double		s	a	x	x	x
<CentroidvsAzimuthTimePolynomial>				Coefficients of the doppler centroid azimuth polynomial coefficients	Double(6)			a	x	x	x

<CentroidvsRangeTimePolynomial>				Coefficients of the doppler centroid range polynomial coefficients	Double(6)			a	x	x	x
<DopplerAmbiguityEstimationMethod>				Identifier of the algorithm adopted for estimation of the doppler ambiguity	String	GEOMETRY		a	x	x	x
<DopplerCentroidEstimationMethod>				Identifier of the algorithm adopted for estimation of the fractional part of the doppler centroid	String	GEOMETRY ACCC MLCC		a	x	x	x
<DopplerRateEstimationMethod>				Identifier of the algorithm adopted for estimation of the doppler rate	String	GEOMETRY		a	x	x	x
<DopplerRatevsAzimuthTimePolynomial>				Coefficients of the doppler rate azimuth polynomial coefficients	Double(6)		$Hz/s^{(i+1)}$	a	x	x	x
<DopplerRatevsRangeTimePolynomial>				Coefficients of the doppler rate range polynomial coefficients	Double(6)		$Hz/s^{(i+1)}$	a	x	x	x
<RangePolynomialReferenceTime>				Reference range time used to represent the range doppler polynomial	Double		s	a	x	x	x
<AzimuthFocusingWeightingCoefficient>				Azimuth coefficients used for the weighting function applied at the focusing time to the processed portion of the full band	Double				a	a	a
<AzimuthFocusingWeightingFunction>				Type of matched filter windowing in the azimuth direction at the focusing time	String	NONE HAMMING GENERAL COSINE			a	a	a
<ECEFBeamCentreDirectionforProcessing>				Unitary vector corresponding to the direction of the beam central plane in Earth Centered - Earth Fixed reference frame	Double(N6,3)			a	x	x	x
<FocusingAlgorithmID>				Identifier of the processing algorithm adopted	String	OMEGA-KEY CHIRP SCALING RANGE DOPPLER SPECAN TIME DOMAIN			a	a	a
<InvalidValue>				Value used to fill invalid pixels/lines	Float			a	a	a	a
<L0SoftwareVersion>				Version of the L0 processor used for the core processing step	String			a	a	a	a
<L1ASoftwareVersion>				Version of the L1A processor used for the core processing step	String				a	a	a
<L1CSoftwareVersion>				Version of the L1C processor used for the core processing step	String					a	a
<L1DSoftwareVersion>				Version of the L1D processor used for the core processing step	String						a

<LightSpeed>				Light Speed	Double	2.99792458d+08	m/s	a	x	x	x
<ProductErrorFlag>				Flag indicating if errors have been reported during the product generation process.	UByte	1 if errors reported 0 otherwise		a	a	a	a
<ProductGenerationUTC>				Product generation time in UTC time format	String		Epoch	a	a	a	a
<RangeFocusingWeightingCoefficient>				Range coefficients used for the weighting function applied at the focusing time to the processed portion of the full band	Double		Hz		a	a	a
<RangeFocusingWeightingFunction>				Type of matched filter windowing in the range direction at the focusing time	String	NONE HAMMING GENERAL COSINE			a	a	a
<RangeProcessingNumberofLooks>				Number of nominal looks in the range direction	UByte				a	a	a
<ReferenceUTC>				UTC with respect the annotated slow times are referred to	String		Epoch	a	x	x	x
<ReplicaReconstructionMethod>				Designator of method for reconstruction of chirp used for image processing	String	NOMINAL REPLICA MEAN			a	a	a
<RescalingFactor>				Rescaling Factor F, used at processing time as a multiplier term applied to the signal amplitude to appropriately use the dynamic range	Double				a	a	a
<DatumRotation>				XYZ Datum rotations with respect to WGS84 Ellipsoid to be used for Helmert transformation	Double(3)		Deg	a	x	x	x
<DatumScale>				XYZ Datum scale with respect to WGS84 Ellipsoid to be used for Helmert transformation	Double			a	x	x	x
<DatumShift>				XYZ Datum shifts with respect to WGS84 Ellipsoid to be used for Helmert transformation	Double(3)		m	a	x	x	x
<EllipsoidDesignator>				Ellipsoid designator name	String	WGS84		a	x	x	x
<EllipsoidSemimajorAxis>				Semi-major axis length	Double	6378137	m	a	x	x	x
<EllipsoidSemiminorAxis>				Semi-minor axis length	Double	6356752.3142	m	a	x	x	x
<ProjectionID>				Projection descriptor	String	N/A SLANT RANGE/AZIMUTH GROUND RANGE/AZIMUTH UTM UPS		a	m	m	m

<AzimuthCoverage>				Coverage in the azimuth direction of the full scene estimated on the ellipsoid.	Double		m	a	m	x	x
<CentreEarthRadius>				Earth radius at image center	Double		m	a	m	m	m
<GroundRangeCoverage>				Coverage in ground range of the specific portion of data projected on the ellipsoid.	Double		M	a	m	x	x
<SceneCentreGeodeticCoordinates>				Geodetic coordinates (lat-lon-height) of the central image point of the full scene	Double(3)		deg,deg, m	a	m	a	a
<SceneOrientation>				Counter-clockwise measured angle between the local north at scene center and the opposite of the azimuth oriented direction	Double		deg	a	m	x	x
<ADCCharacterization>				Look Up Table for ADC Characterization	Double (256, 2)			a	x	x	x
<ADCCompensation>				Flag showing the application of the ADC compensation. For future usage	UByte	0 = Not Applied 1 = Applied			a	a	a
<AntennaPatternCompensationReferenceSurface>				Designator of the surface used for the compensation of the range antenna pattern.	String	NONE WGS84 TERRAIN			a	a	a
<AzimuthAntennaPatternCompensationGeometry>				Geometry used for the compensation of the azimuth antenna pattern.	String	NONE ACQUISITION ZERO DOPPLER			a	a	a
<CalibrationConstantCompensationFlag>				Flag showing the application of the calibration constant	UByte	0 = Not Applied 1 = Applied			a	a	a
<IncidenceAngleCompensationGeometry>				Geometry used for the compensation of the incidence angle.	String	NONE ACQUISITION ZERO DOPPLER			a	a	a
<IncidenceAngleCompensationReferenceSurface>				Designator of the surface used for the compensation of the incidence angle.	String	NONE WGS84 TERRAIN			a	a	a
<RangeAntennaPatternCompensationGeometry>				Geometry used for the compensation of the range antenna pattern.	String	NONE ACQUISITION ZERO DOPPLER			a	a	a
<RangeSpreadingLossCompensationGeometry>				Geometry used for the compensation of the range spreading loss.	String	NONE ACQUISITION ZERO DOPPLER			a	a	a
<ReferenceIncidenceAngle>				Reference incidence angle used at processing time for the normalization of the incidence angle correction	Double		deg		a	a	a

<ReferenceSlantRange>				Reference slant range R used at processing time for the normalization of the range spreading loss compensation.	Double		m		a	a	a
<ReferenceSlantRangeExponent>				Exponent of the reference slant range R used on the image amplitude at processing time for the normalization of the range spreading loss compensation.	Double		m		a	a	a
<DopplerAmbiguityConfidenceMeasureThreshold>				Normalized confidence measure of doppler centroid ambiguity. A value of zero means poor confidence	Double			a	x	x	x
<DopplerAmbiguityThreshold>				Threshold for setting the Doppler Centroid ambiguity quality flag	Double			a	x	x	x
<DopplerCentroidConfidenceMeasureThreshold>				Threshold for setting the Doppler Centroid confidence quality flag	Double			a	x	x	x
<DopplerCentroidEstimationAccuracyThreshold>				Threshold for setting the Doppler Centroid Accuracy quality flag	Double		Hz	a	x	x	x
<DopplerRateConfidenceMeasureThreshold>				Threshold for setting the Doppler Rate confidence quality flag	Double			a	x	x	x
<DopplerRateEstimationAccuracyThreshold>				Threshold for setting the Doppler Rate accuracy quality flag	Double		Hz/s	a	x	x	x
<ImageOverSaturatedPercentageThreshold>				Threshold for setting the OverSaturated Percentage quality flag	Double				a	x	x
<ImageUnderSaturatedPercentageThreshold>				Threshold for setting the UnderSaturated Percentage quality flag	Double				a	x	x
<RAWBiasThreshold>				Bias of RAW data used as threshold to set the product quality flag; two samples for the In-Phase and Quadrature signal (I-Q)	Double			a	x	x	x
<RAWGainImbalanceThreshold>				Gain imbalance of the I and Q channel of the RAW data used as threshold to set the product quality flag	Double			a	x	x	x
<RAWIQNormalityThreshold>				Measure of the Gaussian properties of I and Q channels distribution used as threshold to set the product quality flag	Double		deg	a	x	x	x
<RAWMissingLinesperBlockThreshold>				Number of allowed missing lines which constitute a gap	UShort			a	x	x	x
<RAWMissingLinesPercentageThreshold>				Maximum percentage of missing lines to total lines.	Double			a	x	x	x
<RAWOverSaturatedPercentageThreshold>				Percentage of RAW oversaturated pixels used as threshold to set the product quality flag	Double			a	x	x	x

<RAWPhaseUniformityThreshold>				Measure of the uniform properties of phase distribution of the RAW data used as threshold to set the product quality flag	Double		deg	a	x	x	x
<RAWUnderSaturatedPercentageThreshold>				Percentage of RAW undersaturated pixels used as threshold to set the product quality flag	Double			a	x	x	x
<AttitudeProductCategory>				It indicates the origin of the orbital data annexed to the product.	String	ON-GROUND DATA REAL TIME MF-Telemetry		a	x	x	x
<DopplerAmbiguityConfidenceMeasure>				Normalized confidence measure of doppler centroid ambiguity. A value of zero means poor confidence.	Double			a	x	x	x
<DopplerCentroidConfidenceMeasure>				Normalized confidence measure of doppler centroid. A value of zero means poor confidence.	Double			a	x	x	x
<DopplerCentroidEstimationAccuracy>				Standard deviation in the estimation of doppler centroid	Double		Hz	a	x	x	x
<DopplerRateConfidenceMeasure>				Normalized confidence measure of doppler rate A value of zero means poor confidence.	Double			a	x	x	x
<DopplerRateEstimationAccuracy>				Standard deviation in the estimation of doppler rate.	Double		Hz/s	a	x	x	x
<OrbitProductCategory>				It indicates the origin of the orbital data annexed to the product.	String	ORBNAV OOE POES POED POEDFINAL		a	x	x	x
	<SubSwaths>			Root Element of <SubSwaths>							
	<SubSwath>		Id								
	<AntennaBeamCode>			Code of the antenna beam as it is reported in the Level 0 data.	Ubyte			a	x	x	x
	<AntennaBeamElevation>			Nominal elevation angle associated to the antenna beam	Double		deg	a	x	x	x
	<AzimuthInstrumentGeometricResolution>			Theoretical azimuth geometric resolution of the data as derived from the radar parameters	Double		m		a	x	x
	<BeamID>			Identifier of the beam which contributes to the full swath	String	ST-01…ST-19 HR-01....HR-31 WS-01...WS-19		a	x	x	x

	<BeamOffNadirAngle>			Angle between the main lobe of the antenna beam and the geodetic nadir, measured in acquisition geometry	Double		deg	a	x	x	x
	<BurstsperSubswath>			Bursts per Subswath	UShort			a	m	x	x
	<EchoSamplingWindowLength>			Sampling Window Lengths during the acquisition of the subswath.	UShort			a	x	x	x
	<GroundRangeInstrumentGeometricResolution>			Theoretical ground range geometric resolution in the worst case, as derived from the radar parameters	Double		m		a	x	x
	<LinesperBurst>			Lines per burst	UInt			a	x	x	x
	<PassBandIFFilter>			Bandwidth of the IF filter in Hz	Double	40MHz 80MHz 120MHz		a	x	x	x
	<Polarisation>			Transmit/Receive polarisation enabled during data sensing. H = Horizontal V = Vertical	String	HH VV VH HV		a	x	x	x
	<PRF>			Pulse Repetition Frequency of the instrument during the scene acquisition	Double		Hz	a	m	x	x
	<RangeChirpLength>			Range chirp length	Double		s	a	m	x	x
	<RangeChirpRate>			Rate of the transmitted pulse	Double		Hz/s	a	m	x	x
	<RangeChirpSamples>			Number of chirp samples, as derived from Range Chirp Length and Sampling Frequency	UShort			a	x	x	x
	<Rank>			In flight pulses	UByte			a	x	x	x
	<ReferenceDechirpingTime>			Offset w.r.t. the range first time, of the reference time	Double		s	a	x	x	x
	<SamplingRate>			Range Sampling rate of the instrument during the scene acquisition	Double		Hz	a	x	x	x
	<SyntheticApertureDuration>			Duration of the synthetic aperture at the central slant range	Double		s	a	x	x	x
	<AzimuthFocusingBandwidth>			The Doppler bandwidth used at the single-look generation time	Double		Hz		a	a	a
	<AzimuthFocusingTransitionBandwidth>			The transition bandwidth in azimuth used at the single- look generation time	Double		Hz		a	a	a
	<ECEFBeamPointingforProcessing>			Unitary vector corresponding to the pointing of the antenna main lobe in Earth Centered - Earth Fixed reference frame	Double(N6,3)			a	x	x	x

	<RangeFocusingBandwidth>			The bandwidth in range used at the single-look generation time	Double		Hz		a	x	x
	<RangeFocusingTransitionBandwidth>			The transition bandwidth in range used at the single-look generation time	Double		Hz		a	a	a
	<RAWStatisticsBlockSize>			Size (in number of rows and number of columns) of the block where statistics on the RAW data are evaluated	UInt(2)			a	x	x	x
	<InternalPower>			It represents the power level of a reference signal internal to the radar	Double			a	x	x	x
	<CentreGeodeticCoordinates>			Geodetic coordinates (lat-lon-height) of the central image point (estimated on DEM for terrain projected products, on the ellipsoid otherwise) of the swath	Double(3)		(deg,deg,m)	a	m	m	m
	<AzimuthAntennaPatternGains>			Antenna two-way power azimuth pattern gain values, corresponding to the Antenna Pattern angles obtainable by other specific tags	Double(N1)		dB	a	x	x	x
	<AzimuthAntennaPatternOrigin>			Angular offset in degrees from azimuth beam center, the first value of the azimuth antenna pattern gains is referred to	Double		deg	a	x	x	x
	<AzimuthAntennaPatternResolution>			The angular step in degrees the values of the azimuth antenna pattern gains are referred to	Double		deg	a	x	x	x
	<CalibrationConstant>			It is the Calibration Constant value (K) of the subswath for energy estimation over distributed backscattering areas	Double			a	m	m	m
	<CalibrationConstantEstimationUTC>			Calibration constant estimation date	String		Epoch	a	x	x	x
	<RangeAntennaPatternGains>			Antenna two-way power range pattern gain values, corresponding to the Antenna Pattern angles obtainable by other specific tags	Double(N2)		dB	a	x	x	x
	<RangeAntennaPatternOrigin>			Angular offset in degrees from range beam center, the first value of the range antenna pattern gains is referred to	Double(N2)		deg	a	x	x	x
	<RangeAntennaPatternResolution>			The angular step in degrees the values of the range antenna pattern gains are referred to	Double(N2)		deg	a	x	x	x
	<AlongTrackVector>			Along track coordinate	Double		m	a	x	x	x
	<AzimuthCalibrationFactor>			Radiometric correction factor in the along track direction	Double		dB	a	x	x	x

	<ReferenceInternalPower>			It represents the power level of a reference signal internal to the radar, computed at the epoch of the acquisition used to retrieve the calibration constant (CALCO)	Double			a	x	x	x
	<CentralRangeFrequencyvsAzimuthTimePolynomial>			Coefficients of the polynomial representing the variation (w.r.t. the relative azimuth times) of the central frequency of the range spectrum in the azimuth direction	Double(3)		Hz/si		a		
	<DopplerAmbiguity>			Ambiguity number of doppler centroid on the scene	Short			a	x	x	x
		< BurstsPerSubswaths >		Root Element of <BurstPerSubswaths>							
		< BurstsPerSubswath>	id								
		<FinalOnBoardTime>		Value of the on-board time (derived from the on-board counter annotated in the Level 0 data) corresponding to the last line of the Level 0 file used as input	Double		s	a	x	x	x
		<InitialOnBoardTime>		Value of the on-board time (derived from the on-board counter annotated in the Level 0 data) corresponding to the first line of the Level 0 file used as input	Double		s	a	x	x	x
		<AzimuthFirstTime>		Initial acquisition time of the burst in seconds since the annotated reference UTC, derived from the OBT extracted from the downlinked product	Double		s	a	m	x	x
		<AzimuthLastTime>		Final acquisition time of the portion of the burst in seconds since the annotated reference UTC, derived from the OBT extracted from the downlinked product	Double		s	a	m	x	x
		<AzimuthRampCode>		Code of the azimuth scanning ramp as it is reported in the Level 0 data	UByte(N13)			a	x	x	x
		<AzimuthRampCodeChangeLines>		Image Rows indexes at which the azimuth scanning ramp has been changed (within data segment) w.r.t. the corresponding values of the previous line	UInt(N13)			a	x	x	x
		<AzimuthSteering>		Array of the Azimuth angles of the antenna beam set at the Azimuth Ramp Code Change Lines	Double(N13)		deg	a	x	x	x
		<ElevationRampCode>		Code of the elevation scanning ramp as it is reported in the Level 0 data	UByte(N17)			a	x	x	x

		<ElevationRampCodeChangeLines>		Image Rows indexes at which the elevation scanning ramp has been changed (within data segment) w.r.t. the corresponding values of the previous line	UInt(N17)			a	x	x	x
		<ElevationSteering>		Array of the signed (positive sign means the main lobe moves to the left) additional Elevation angles of the antenna beam, as it is set at the Elevation Ramp Code Change Lines	Double(N17)		deg	a	x	x	x
		<RangeFirstTimeChangeLines>		Image Rows indexes (starting from 0) at which the Sampling Window Start Time has been changed (within burst) w.r.t. the corresponding values of the previous line	UInt(N7)			a	x	x	x
		<RangeFirstTimes>		List of times between the rising edge of the transmit pulse and the rising edge of the receiving window opened to sample the echo of the same pulse, relevant to lines included in "Range First Time Change Lines"	Double(N7)		s	a	x	x	x
		<ReceiverGain>		The receiver attenuation settings used during the acquisition (see also Receiver Gain Change Lines)	UByte(N15)			a	x	x	x
		<ReceiverGainChangeLines>		Image Rows indexes at which the Receiver Gain has been changed (within burst) w.r.t. the corresponding values of the previous line	UInt(N15)			a	x	x	x
		<RAWAmbiguousDopplerCentroid>		Doppler centroid estimates from RAW data on a grid made up of N9xN10 blocks	Double (N9,N10)		Hz	a	x	x	x
		<RAWBias>		Bias of RAW data; two samples for the In-Phase and Quadrature signal (I-Q) estimated on valid lines of the block	Double (N9,N10,2)			a	x	x	x
		<RAWGainImbalance>		Gain imbalance of the I and Q channel of the RAW data estimated on valid lines of the block	Double (N9,N10)			a	x	x	x
		<RAWIQNormality>		Measure of the Gaussian properties of I and Q channels distribution	Double (N9,N10,2)		deg	a	x	x	x
		<RAWMissingBlocksStartLines>		Image Lines' indexes at which a readjusted (e.g. by zero filling) missing block starts. If no missing blocks occurr in data, the attribute is not present in the dataset	UInt(N16)			a	x	x	x
		<RAWMissingLinesperBlock>		Number of missing lines within each readjusted missing block If no missing blocks occurr in data, the attribute is not present in the dataset	Ushort(N16)			a	x	x	x

		<RAWMissingLinesPercentage>		Percentage of missing lines to total lines of the burst	Double			a	x	x	x
		<RAWOverSaturatedPercentage>		Percentage of RAW Oversaturated; two samples for the In- Phase and Quadrature signal (I-Q)	Double(2)			a	x	x	x
		<RAWPhaseUniformity>		Measure of the uniform properties of phase distribution of the RAW data	Double (N9,N10)		deg	a	x	x	x
		<RAWStandardDeviation>		Standard dev of RAW data; two samples for the In-Phase and Quadrature signal (I-Q)	Double (N9,N10,2)			a	x	x	x
		<RAWUnderSaturatedPercentage>		Percentage of RAW Undersaturated; two samples for the In-Phase and Quadrature signal (I-Q)	Double(2)			a	x	x	x
		<GIM>		Root Element of <GIM>				a			x
		<LayoverPixelValue>		Value used for representation of pixels in layover geometry	Short	9999					a
		<ShadowingPixelValue>		Value used for representation of pixels in shadowing geometry	Short	-9999					a
		<RescalingFactor>		Scaling factor used for representation of Incidence Angle in the GIM layer	Double	100 = Int16 0.50 = Uint8			a		a
		<Offset>		Offset used for representation of Incidence Angle in the GIM layer	Double	0 = Int16 35 = Uint8			a		a
		<InvalidValue>		Value used to fill invalid pixels/lines.	Int			a	a		a
		<LayoverPixelPercentage>		Percentage of pixels in layover geometry with respect to the pixel of the scen	Double				a		a
		<ShadowingPixelPercentage>		Percentage of pixels in shadowing geometry with respect to the pixel of the scene	Double				a		a
		<QLK>		Root Element of <QLK>				a			x
		<QuickLookColumnsOrder>		Order of columns in the quick look layer	String	WEST-EAST NEAR-FAR		a	a	a	a
		<QuickLookLinesOrder>		Order of lines in the quick look layer	String	NORTH-SOUTH EARLY-LATE		a	a	a	a
		<QuickLookColumnSpacing>		Spacing among columns of the quick look layer	Double		m	a	a	a	a
		<QuickLookLineSpacing>		Spacing among lines of the quick look layer	Double		m	a	a	a	a
		<QuickLookProjectionID>		Projection descriptor for Quick Look Layer	String	NONE WGS84 TERRAIN EGM96+EQPS			a	a	a

		<SBI>		Root Element of <SBI>				a			x
		<ZeroDopplerAzimuthFirstTime>		Time of the first line of the zero doppler focused block in seconds since the annotated reference UTC	Double		s		a	a	a
		<ZeroDopplerAzimuthLastTime>		Time of the last line of the zero doppler focused block in seconds since the annotated reference UTC	Double		s		a	a	a
		<ZeroDopplerRangeFirstTime>		Time of the first image column of the segment, including near and far zero padding effects due to SWST readjustment, multilooking, zero-doppler processing	Double		s		a	a	a
		<ZeroDopplerRangeLastTime>		Time of the last image column of the segment, including near and far zero padding effects due to SWST readjustment, transients removal, multilooking, zero-doppler processing	Double		s		a	a	a
		<ColumnSpacing>		Spacing among columns of the products	Double		m		a	a	a
		<ColumnTimeInterval>		Time spacing in the range direction between columns. Set to invalid value in the case of ground projected products	Double		s		a		
		<EquivalentNumberofLooks>		Theatrical value of the equivalent number of looks	Double				a	a	a
		<LineSpacing>		Spacing among lines of the products	Double		m		a	a	a
		<LineTimeInterval>		Time spacing in the azimuth direction between lines	Double		s		a		
		<BottomLeftGeodeticCoordinates>		Geodetic coordinates (Lat-Lon-Ellipsoidal Height) of the first pixel of the last image line	Double(3)		deg,deg, m		a	a	a
		<BottomRightGeodeticCoordinates>		Geodetic coordinates (Lat-Lon-Ellipsoidal Height) of the last pixel of the last image line	Double(3)		deg,deg, m		a	a	a
		<FarEarlyGeodeticCoordinates>		Geodetic coordinates of the pixel of the scene acquired at the far range at the azimuth first time	Double(3)		deg,deg, m		a	a	a
		<FarIncidenceAngle>		Absolute value of the incidence angle measured at the far range on the ellipsoid in zero-doppler geometry as derived by the sampling window times represented in data	Double		deg		a	a	a
		<FarLateGeodeticCoordinates>		Geodetic coordinates of the pixel of the scene acquired at the far range at the azimuth last time	Double(3)		deg,deg, m		a	a	a

		<FarLookAngle>		Look angle measured at the far range on the ellipsoid in zero- doppler geometry as derived by the sampling window times represented in data	Double		deg		a	a	a
		<NearEarlyGeodeticCoordinates>		Geodetic coordinates of the pixel of the scene acquired at the near range at the azimuth first time	Double(3)		deg,deg, m		a	a	a
		<NearIncidenceAngle>		Absolute value of the incidence angle measured at the near range on the ellipsoid in zero-doppler geometry as derived by the sampling window times represented in data	Double		deg		a	a	a
		<NearLateGeodeticCoordinates>		Geodetic coordinates of the pixel of the scene acquired at the near range at the azimuth last time	Double(3)		deg,deg, m		a	a	a
		<NearLookAngle>		Look angle measured at the near range on the ellipsoid in zero- doppler geometry as derived by the sampling window times represented in data	Double		deg		a	a	a
		<TopLeftGeodeticCoordinates>		Geodetic coordinates (Lat-Lon-Ellipsoidal Height) of the first pixel of the first image line	Double(3)		deg,deg, m		a	a	a
		<TopRightGeodeticCoordinates>		Geodetic coordinates (Lat-Lon-Ellipsoidal Height) of the last pixel of the first image line	Double(3)		deg,deg, m		a	a	a
		<ImageMax>		Image maximum value estimated separately on each channel of data excluding saturated pixels; second element of the array set to zero in the case of real data	Double(2)				a	a	a
		<ImageMean>		Image mean value estimated separately on each channel of data; second element of the array set to zero in the case of real data	Double(2)				a	a	a
		<ImageMin>		Image minimum value estimated separately on each channel of data; second element of the array set to zero in the case of real data	Double(2)				a	a	a
		<ImageOverSaturatedPercentage>		Percentage of Oversaturated pixels in the image estimated separately on each channel of data; second element of the array set to zero in the case of real data	Double(2)				a	a	a
		<ImageStandardDeviation>		Image sigma value estimated separately on each channel of data; second element of the array set to zero in the case of real data	Double(2)				a	a	a

		<ImageUnderSaturatedPercentage>		Percentage of Undersaturated pixels in the image estimated separately on each channel of data; second element of the array set to zero in the case of real data	Double(2)				a	a	a
		<_2DPolynomialsReferenceSlantRange>		Reference Slant Range {slr0}to compute each power term {(slr-slr0)n } of polynomial	Double		m		a		
		<_2DPolynomialsReferenceAzimuthTime>		Reference Slant Range {azt0}to compute each power term {(azt-azt0)m} of polynomial	Double		s		a		
		<_2DPolynomialsReferenceHeight>		Reference Height over WGS84 ellipsoid, nominally equal to ZERO	Double		m		a		
		<_3DPolynomialsColumnOffset>		This is the “SAMP_OFF” term of equation cn=(Column –SAMP_OFF) ÷ SAMP_SCALE	Int				a		
		<_3DPolynomialsLineOffset>		This is the “LINE_OFF” term of equation rn=(Row –SAMP_OFF) ÷ SAMP_SCALE	Int				a		
		<_3DPolynomialsReferenceHeight>		This is the “HEIGT_OFF” term of equation H=(Height –HEIGHT_OFF) ÷HEIGHT_SCALE	Double		m		a		
		<_3DPolynomialsReferenceLatitude>		This is the “LAT_OFF” term of equation P=(latitude –LAT_OFF) ÷ LAT_SCALE	Double		deg		a		
		<_3DPolynomialsReferenceLongitude>		This is the “LONG_OFF” term of equation L=(longitude –LONG_OFF) ÷ LONG_SCALE	Double		deg		a		
		<_3DPolynomialsColumnScaleFactor>		This is the “SAMP_SCALE” term of equation cn=(Column –SAMP_OFF) ÷ SAMP_SCALE	Int				a		
		<_3DPolynomialsLineScaleFactor>		This is the “LINE_SCALE” term of equation rn=(Row –SAMP_OFF) ÷ SAMP_SCALE	Int				a		
		<_3DPolynomialsHeightScaleFactor>		This is the “HEIGHT_SCALE” term of equation H=(Height –HEIGHT_OFF) ÷ HEIGHT_SCALE	Double		m		a		
		<_3DPolynomialsLatitudeScaleFactor>		This is the “LAT_SCALE” term of equation P=(Latitude –LAT_OFF) ÷ LAT_SCALE	Double				a		
		<_3DPolynomialsLongitudeScaleFactor>		This is the “LONG_SCALE” term of equation L=(Longitude –LONG_OFF) ÷ LONG_SCALE	Double				a		
		<_2DPolynomialsKind>		Type of Polynomials in XY format, where “X” and “Y” express the maximum degree of {(slr-slr0)n } and {(azt-azt0)m} respectively	Int				a		
		<_2DPolynomialsOffAxisAngle>		The off-axis angle related to the mechanical axis of the antenna plane	Double (32)				a		
		<_2DPolynomialsLookAngle>		Look Angle is an alias for Off-Nadir angle, then angle defined by satellite-to-nadir vector and satellite-to-scene vector	Double (32)				a		

		<_2DPolynomialsIncidenceAngle>		Incidence Angle is the angle defined by scene-to-zenith vector and scene-to-satellite vector, assuming scene position layered over WGS84 ellipsoid	Double (32)		deg		a		
		<_2DPolynomialsIncidenceAngleH1>		This polynomial computes the linear incremental angle for a given height over WGS84 in addition to previous polynomial	Double (32)		deg/m		a		
		<_3DRPCColumnNumeratorCoefficients>		This is the array of 20 double precision elements referred as “SAMP_NUM_COEF_n”	Double (20)				a		
		<_3DRPCColumnDenominatorCoefficients>		This is the array of 20 double precision elements referred as “SAMP_DEN_COEF_n”	Double (20)				a		
		<_3DRPCLineNumeratorCoefficients>		This is the array of 20 double precision elements referred as “LINE_NUM_COEF_n”	Double (20)				a		
		<_3DRPCLineDenominatorCoefficients>		This is the array of 20 double precision elements referred as “LINE_DEN_COEF_n”	Double (20)				a		

3.1.2 QLK FILE

PNG QLK is a synoptic of the entire datum, having a look to the image content and it is annexed to all SAR standard products. The quick look is originated by undersampling of the full resolution raster layer, obtained by a filter (realized by a kernel of configurable size) moving in the raw and columns directions at steps derived by the ratios of the output and input spacing.

Following tables details features of the quick look layer.

Table 3-2 Features of the Quick Look Layers

Products	Sample Information	Projection
Lev. 0	Unfocused image, detected, extracted as down-sampled of the RAW data echoes.	N/A
Lev. 1A	The same sample information of the distributed product the quick look is annexed to, detected, undersampled both in range and azimuth direction with the configurable factors depending on the sensor mode.	Slant Range/Azimuth
Lev. 1C/1D	The same sample information of the distributed product the quick look is annexed to, undersampled both in range and azimuth direction with the configurable factors depending on the sensor mode.	UTM (-80 ≤ center latitude ≤ 84°) UPS (otherwise)

Table 3-3 Data type for Quick look layer

Dataset	Sample Format	Bits per Sample	Samples per Pixel	Type Represent.	Invalid Value
Quick Look annexed to the Full resolution product	Unsigned Integer	8	1	Little Endian	0

3.1.3 KML FILE

KML Keyhole Markup Language (KML) is an XML notation for expressing geographic annotation and visualization within Internet-based, two-dimensional maps and three-dimensional Earth browsers. KML is provided for Processing Levels 1C (approximate geographical coordinates) and 1D product (with exact geographical coordinates, Google Earth DEM).

Syntax

```
<GroundOverlay>
  ...
  <Icon>...</Icon>
  <gx:LatLonQuad>
    <coordinates>...</coordinates>        <!-- four lon,lat tuples -->
  </gx:LatLonQuad>
</GroundOverlay>
```

Specifies the coordinates of the four corner points of a quadrilateral defining the overlay area. Exactly four coordinate tuples have to be provided, each consisting of floating point values for longitude and latitude. Insert a space between tuples.

The coordinates must be specified in counter-clockwise order with the first coordinate corresponding to the lower-left corner of the overlayed image.

3.1.4 World FILE (jgw, pgw)

This file is presents the image-to-world transformation. The image-to-world transformation is a six-parameter affine transformation in the form of

$$x1 = Ax + By + C$$
$$y1 = Dx + Ey + F$$

where

x1 = calculated x-coordinate of the pixel on the map

y1 = calculated y-coordinate of the pixel on the map

x = column number of a pixel in the image

y = row number of a pixel in the image

A = x-scale; dimension of a pixel in map units in x direction

B, D = rotation terms

C, F = translation terms; x,y map coordinates of the center of the upper left pixel

E = negative of y-scale; dimension of a pixel in map units in y direction

Table3-4 shows detailed information on attributes for JGW file.

Table 3-4 Attributes: JGW File

Attributes	Definition	Data Type	Dim.	Unit	1 A	1 C	1 D
Line 1	Pixel Size in the x-direction	Double	1D	Map units	a	a	a
Line 2	Rotation about y-axis	Double	1D	Degree	a	a	a
Line 3	Rotation about x-axis	Double	1D	Degree	a	a	a
Line 4	Pixel Size in the y-direction	Double	1D	Map units	a	a	a
Line 5	x-coordinate of then center	Double	1D	Map units	a	a	a
Line 6	y-coordinate of then center	Double	1D	Map units	a	a	a

3.1.5 RPC FILE

The RPC equations constitute a replacement sensor model in that they are a generic set of equations that map object coordinates into image coordinates, as shown in Figure 2-1. RPC is a well-known standardized approximated method to map from space reference surface geodetic coordinates (Longutude, Latitude, Height) onto native image space coordinates of rows and columns (r,c) which corresponds to L1A image product domain.

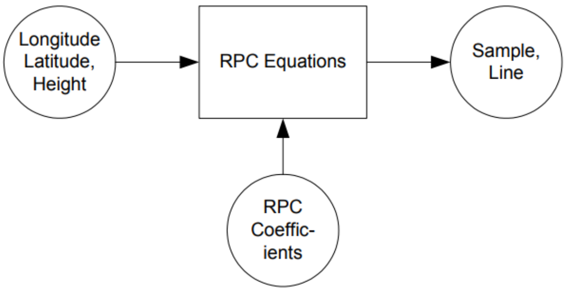


Figure 3-1: RPC SENSOR MODEL

The RPC coefficients and object coordinates are input. The equations begin by scaling the object space coordinates to a range of ±1. Then the ratio of two cubic functions is calculated for sample and line. Finally we denormalize the result to sample and line. Complete equations are shown below.

$$x=\frac{X-x_0}{x_S} \quad y=\frac{Y-y_0}{y_S} \quad z=\frac{Z-z_0}{z_S} \tag{1}$$

$$u=\frac{\sum_{i=1}^{20} C_{Si}\cdot\rho_i(x,y,z)}{\sum_{i=1}^{20} D_{Si}\cdot\rho_i(x,y,z)} \quad v=\frac{\sum_{i=1}^{20} C_{Li}\cdot\rho_i(x,y,z)}{\sum_{i=1}^{20} D_{Li}\cdot\rho_i(x,y,z)} \tag{2}$$

Where

$$\begin{aligned}\sum_{i=1}^{20} C_i\cdot\rho_i(x,y,z) &= C_1+C_2\cdot x+C_3\cdot y+C_4\cdot z\\ &+C_5\cdot x\cdot y+C_6\cdot x\cdot z+C_7\cdot y\cdot z+C_8\cdot x^2\\ &+C_9\cdot y^2+C_{10}\cdot z^2+C_{11}\cdot y\cdot x\cdot z+C_{12}\cdot x^3\\ &+C_{13}\cdot x\cdot y^2+C_{14}\cdot x\cdot z^2+C_{15}\cdot x^2\cdot y\\ &+C_{16}\cdot y^3+C_{17}\cdot y\cdot z^2+C_{18}\cdot x^2\cdot z\\ &+C_{19}\cdot y^2\cdot z+C_{20}\cdot z^3\end{aligned} \tag{3}$$

$$\begin{aligned}S&=u\cdot S_S+S_0\\ L&=v\cdot L_S+L_0\end{aligned} \tag{4}$$

RPC makes usage of normalized surface geodetic coordinates (X,Y,Z) and normalized image space coordinates (u, v) in order to maximize numerical stability of both end-user computations and determination of Rational Polynomial coefficients.

The RPC file can be used in calculating geo-location information on each pixel of the image. The RPC file implements according “National Imagery Transmission Format (NITF)” as defined in 2001 by National Imagery and Mapping Agency (NIMA).

Table3-5 shows detailed information on attributes for RPC file. Single RPC is delivered for four MS bands.

Table 3-5 Attributes: RPC File

Attributes	Definition	Data Type	Dim.	Unit
LINE_OFF	Offset for Line	Double	1D	Pixel
SAMP_OFF	Offset for Sample	Double	1D	Pixel
LAT_OFF	Offset for Latitude	Double	1D	Degree
LONG_OFF	Offset for Longitude	Double	1D	Degree
HEIGHT_OFF	Offset for Height	Double	1D	Meters
LINE_SCALE	Scale for Line	Double	1D	Pixel
SAMP_SCALE	Scale for Sample	Double	1D	Pixel
LAT_SCALE	Scale for Latitude	Double	1D	Degree
LONG_SCALE	Scale for Longitude	Double	1D	Degree
HEIGHT_SCALE	Scale for Height	Double	1D	Meters
LINE_NUM_COEFF_1	Coefficient 1 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_2	Coefficient 2 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_3	Coefficient 3 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_4	Coefficient 4 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_5	Coefficient 5 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_6	Coefficient 6 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_7	Coefficient 7 for the polynomial of the dividend in RFM for Line	Double	1D	

LINE_NUM_COEFF_8	Coefficient 8 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_9	Coefficient 9 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_10	Coefficient 10 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_11	Coefficient 11 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_12	Coefficient 12 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_13	Coefficient 13 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_14	Coefficient 14 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_15	Coefficient 15 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_16	Coefficient 16 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_17	Coefficient 17 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_18	Coefficient 18 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF_19	Coefficient 19 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_NUM_COEFF20	Coefficient 20 for the polynomial of the dividend in RFM for Line	Double	1D	
LINE_DEN_COEFF_1	Coefficient 1 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_2	Coefficient 2 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_3	Coefficient 3 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_4	Coefficient 4 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_5	Coefficient 5 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_6	Coefficient 6 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_7	Coefficient 7 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_8	Coefficient 8 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_9	Coefficient 9 for the polynomial of the divisor in RFM for Line	Double	1D	

LINE_DEN_COEFF_10	Coefficient 10 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_11	Coefficient 11 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_12	Coefficient 12 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_13	Coefficient 13 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_14	Coefficient 14 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_15	Coefficient 15 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_16	Coefficient 16 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_17	Coefficient 17 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_18	Coefficient 18 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_19	Coefficient 19 for the polynomial of the divisor in RFM for Line	Double	1D	
LINE_DEN_COEFF_20	Coefficient 20 for the polynomial of the divisor in RFM for Line	Double	1D	
SAMP_NUM_COEFF_1	Coefficient 1 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_2	Coefficient 2 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_3	Coefficient 3 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_4	Coefficient 4 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_5	Coefficient 5 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_6	Coefficient 6 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_7	Coefficient 7 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_8	Coefficient 8 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_9	Coefficient 9 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_10	Coefficient 10 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_11	Coefficient 11 for the polynomial of the dividend in RFM for Sample	Double	1D	

SAMP_NUM_COEFF_12	Coefficient 12 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_13	Coefficient 13 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_14	Coefficient 14 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_15	Coefficient 15 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_16	Coefficient 16 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_17	Coefficient 17 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_18	Coefficient 18 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_19	Coefficient 19 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_NUM_COEFF_20	Coefficient 20 for the polynomial of the dividend in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_1	Coefficient 1 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_2	Coefficient 2 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_3	Coefficient 3 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_4	Coefficient 4 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_5	Coefficient 5 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_6	Coefficient 6 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_7	Coefficient 7 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_8	Coefficient 8 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_9	Coefficient 9 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_10	Coefficient 10 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_11	Coefficient 11 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_12	Coefficient 12 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_13	Coefficient 13 for the polynomial of the divisor in RFM for Sample	Double	1D	

SAMP_DEN_COEFF_14	Coefficient 14 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_15	Coefficient 15 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_16	Coefficient 16 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_17	Coefficient 17 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_18	Coefficient 18 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_19	Coefficient 19 for the polynomial of the divisor in RFM for Sample	Double	1D	
SAMP_DEN_COEFF_20	Coefficient 20 for the polynomial of the divisor in RFM for Sample	Double	1D	

3.1.6 GIM FILE

A Geocoded Incidence Angle Mask (GIM) is provided for Processing Levels 1A and 1D product. The GIM contains information on the local incidence angle and on the location of radar shadowing and layover in a coded mask. The mask can be used for further processing such as radiometric calibration.

- Extraction of the local Incidence Angle

Local Incidence Angle = GIM value * Rescaling Factor – Offset

Incidence Angle Computation is derived from the GIM value applying the rescaling factor minus offset value.

- Extraction of the layover and shadow identifiers

The shadow areas are determined via the off-nadir angle, which in general increases for a scan line from near to far range. Shadow occurs as soon as the off-nadir angle reaches a turning point and decreases when tracking a scan-line from near to far range. The shadow area ends where the off-nadir angle reaches that value again, which it had at the turning point.

4. PRODUCTS OVERVIEW

Processing levels detailed in chapter 2 applied to data acquired in all modes allowed by the KOMPSAT-5 SAR instrument, so obtaining the products listed in the following subsections. The following table summarizes the reference applicable performance requirements:

Table 4-1 Overall Image Quality References

K5 SAR Modes		Nominal Access Region	Extended Access Region	Swath Width	Full resolution Swath	Ground Sample Distance	NEσ0
High Resolution	HR	20° ≤θ≤ 45°	45° < θ≤ 55°	≥ 5 Km	-	≤ 1 m	≤ -17 dBm^2/m^2
Enhanced High Resolution	EH	40.9° ≤θ≤ 55°	20° ≤θ< 40.9	≥ 5 Km	≥ 3 Km	≤ 1 m	≤ -17 dBm^2/m^2
Ultra High Resolution	UH	50.3° ≤θ≤ 55°	46.3° ≤θ< 50.3	≥ 5 Km	≥ 2.7 Km	≤ 0.85 m	≤ -16 dBm^2/m^2
Standard	ST	20° ≤θ≤ 45°	45° < θ≤ 55°	≥ 30 Km	-	≤ 3 m	≤ -17 dBm^2/m^2
Enhanced Standard	ES	28.8° ≤θ≤ 55	20° ≤θ< 28.8°	≥ 30 Km	≥ 30 Km	≤ 2.5 m	≤ -17 dBm^2/m^2
Wide Swath	WS	20° ≤θ≤ 45°	45°< θ≤ 55°	≥ 100 Km	-	≤ 20 m	≤ -17 dBm^2/m^2
Enhanced Wide Swath	EW	20° ≤θ≤ 55°	-	≥ 100 Km	≥ 100 Km	≤ 5 m ≤ 20 m	≤ -17 dBm^2/m^2

NOTE: *the values of Ground Sample Distance are to be intended at 1 Look*

Table 4-2 IRF Characteristics

K5 SAR Modes		PSLR	ISLR	AAR	RAR	RA
High Resolution	HR	≤ -19 dB @ nom. acc. region	≤ -13 dB @ nom. acc. region	≤ -17 dB @ nom. acc. region	≤ -17 dB @ nom. acc. region	≤ 1 dB @ nom. acc. region
Enhanced High Resolution	EH	≤ -20 dB @ nom. acc. Region	≤ -15 dB @ nom. acc. Region	≤ -17 dB @ nom. acc. Region	≤ -16 dB @ nom. acc. Region	≤ 1 dB @ nom. acc. Region
Ultra High Resolution	UH	≤ -20 dB @ nom. acc. Region	≤ -15 dB @ nom. acc. Region	≤ -21 dB @ nom. acc. Region	≤ -16 dB @ nom. acc. Region	≤ 1 dB @ nom. acc. region
Standard	ST	≤ -19 dB @ nom. acc. Region	≤ -13 dB @ nom. acc. Region	≤ -17 dB @ nom. acc. Region	≤ -17 dB @ nom. acc. Region	≤ 1 dB @ nom. acc. Region
Enhanced Standard	ES	≤ -20 dB @ nom. acc. Region	≤ -15 dB @ nom. acc. Region	≤ -18 dB @ nom. acc. Region	≤ -10 dB @ nom. acc. Region	≤ 1 dB @ nom. acc. region
Wide Swath	WS	≤ -19 dB @ nom. acc. Region	≤ -13 dB @ nom. acc. Region	≤ -17 dB @ nom. acc. Region	≤ -17 dB @ nom. acc. Region	≤ 1 dB @ nom. acc. region
Enhanced Wide Swath	EW	≤ -20 dB @ nom. acc. region	≤ -15 dB @ nom. acc. region	≤ -25 dB @ nom. acc. region	≤ -11 dB @ nom. acc. region	≤ 1 dB @ nom. acc. Region

4.1 High Resolution Mode Products

The following standard products originated depending on the processing level from data acquired in High Resolution Mode.

Table 4-3 High Resolution Product List

Product name	Processing Level
HR-RAW_B	0
HR-SCS_A HR-SCS_B HR-SCS_U HR-SCS_W	1A
HR-GEC_A HR-GEC_B HR-GEC_W HR-WEC_A HR-WEC_B HR-WEC_W	1C
HR-GTC_A HR-GTC_B HR-GTC_W HR-WTC_A HR-WTC_B HR-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in High Resolution Mode.

Table 4-4 High Resolution Product Features

	HR -RAW	HR –SCS	HR - GEC HR - GTC HR – WEC HR - WTC
Line Spacing (m)	-	~0.7	~0.35
Column Spacing (m)	-	~0.7	~0.35
Number of lines	12000~14000	~7500	16000~19000
Number of columns	11000~15000	5200~9000	16000~19000
Product Size (MB)	250~350	140~450	500~700

Next table lists the quality specifications considering the instrument operation modes nominal parameters in the nominal access region for the KOMPSAT-5 High Resolution Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition. When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-5 High Resolution Mode Products Requirement

	HR-SCS_A HR-SCS_B	HR-SCS_U HR-SCS_W	HR-GEC_A,B HR-WEC_A,B	HR-GEC_W HR-WEC_W	HR-GTC_A,B HR-GTC_A,B	HR-GTC_W HR-GTC_W
Ground Range resolution (m)	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m
Azimuth resolution (m)	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m
PSLR (dB)	≤ -19 dB	≤ -13 dB	≤ -19 dB		≤ -19 dB	
ISLR (dB)	≤ -13 dB				≤ 1 dB	
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-6 High Resolution Mode processing condition

	HR-SCS_A HR-SCS_B	HR-SCS_U HR-SCS_W	HR-GEC_A,B HR-WEC_A,B	HR-GEC_W HR-WEC_W	HR-GTC_A,B HR-GTC_A,B	HR-GTC_W HR-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1

Range Processing weighting factor	0.242	0	0.240	0	0.240	0
Azimuth Processing weighting factor	0.332	0	0.320	0	0.320	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	8.5	8.5	8.5	8.5	8.5	8.5

4.2 Enhanced High Resolution Mode Products

The following standard products will be originated depending on the processing level from data acquired in Enhanced High Resolution Mode.

Table 4-7 Enhanced High Resolution Mode Products List

Product name	Processing Level
EH-RAW_B	0
EH-SCS_A EH-SCS_B EH-SCS_U EH-SCS_W	1A
EH-GEC_A EH-GEC_B EH-GEC_W EH-WEC_A EH-WEC_B EH-WEC_W	1C
EH-GTC_A EH-GTC_B EH-GTC_W EH-WTC_A EH-WTC_B EH-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Enhanced High Resolution Mode.

Table 4-8 Enhanced High Resolution Product Features

	EH - RAW	EH - SCS	EH - GEC EH - GTC EH - WEC EH - WTC
Line Spacing (m)	-	~0.7	~0.35
Column Spacing (m)	-	~0.7	~0.35
Number of lines	12000~14000	~7500	16000~19000

Number of columns	11000~15000	6000~7000	16000~19000
Product Size (MB)	250~350	180~220	500~700

Next table lists the quality specifications considering the instrument operation modes nominal parameters in the nominal access region for the KOMPSAT-5 Enhanced High Resolution Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-9 Enhanced High Resolution Mode Products Requirement

	EH-SCS_A EH-SCS_B	EH-SCS_U EH-SCS_W	EH-GEC_A,B EH-WEC_A,B	EH-GEC_W EH-WEC_W	EH-GTC_A,B EH-GTC_A,B	EH-GTC_W EH-GTC_W
Ground Range resolution (m)	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m
Azimuth resolution (m)	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m	≤ 1m
PSLR (dB)	≤ -20 dB	≤ -13 dB	≤ -20 dB		≤ -20 dB	
ISLR (dB)	≤ -15 dB				≤ 1 dB	
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one’s up to the completion of the commissioning phase of each satellite.

Table 4-10 Enhanced High Resolution Mode processing condition

	EH-SCS_A EH-SCS_B	EH-SCS_U EH-SCS_W	EH-GEC_A,B EH-WEC_A,B	EH-GEC_W EH-WEC_W	EH-GTC_A,B EH-GTC_A,B	EH-GTC_W EH-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1
Range Processing weighting factor	0.242	0	0.240	0	0.240	0
Azimuth Processing weighting factor	0.332	0	0.320	0	0.320	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	8.5	8.5	8.5	8.5	8.5	8.5

4.3 Ultra High Resolution Mode Products

The following standard products will be originated depending on the processing level from data acquired in Ultra High Resolution Mode.

Table 4-11 Ultra High Resolution Mode Products List

Product name	Processing Level
UH-RAW_B	0
UH-SCS_A UH-SCS_B UH-SCS_U UH-SCS_W	1A
UH-GEC_A UH-GEC_B UH-GEC_W UH-WEC_A UH-WEC_B UH-WEC_W	1C
UH-GTC_A UH-GTC_B UH-GTC_W UH-WTC_A UH-WTC_B UH-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Ultra High Resolution Mode.

Table 4-12 Ultra High Resolution Product Features

	UH - RAW	UH - SCS	UH - GEC UH - GTC UH - WEC UH - WTC
Line Spacing (m)	-	~0.7	~0.35
Column Spacing (m)	-	~0.7	~0.35
Number of lines	14000~16000	~8500	16000~19000
Number of columns	11000~15000	6000~7000	16000~19000
Product Size (MB)	280~380	220~250	500~700

Next table lists the quality specifications considering the instrument operation modes nominal parameters in the nominal access region for the KOMPSAT-5 Ultra High Resolution Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-13 Ultra High Resolution Mode Products Requirement

	EH-SCS_A EH-SCS_B	EH-SCS_U EH-SCS_W	EH-GEC_A,B EH-WEC_A,B	EH-GEC_W EH-WEC_W	EH-GTC_A,B EH-GTC_A,B	EH-GTC_W EH-GTC_W
Ground Range resolution (m)	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m
Azimuth resolution (m)	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m	≤ 0.85 m
PSLR (dB)	≤ -20 dB	≤ -13 dB	≤ -20 dB		≤ -20 dB	
ISLR (dB)	≤ -15 dB				≤ 1 dB	
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-14 Ultra High Resolution Mode processing condition

	UH-SCS_A UH-SCS_B	UH-SCS_U UH-SCS_W	UH-GEC_A,B UH-WEC_A,B	UH-GEC_W UH-WEC_W	UH-GTC_A,B UH-GTC_A,B	UH-GTC_W UH-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1
Range Processing weighting factor	0.242	0	0.240	0	0.240	0
Azimuth Processing weighting factor	0.332	0	0.320	0	0.320	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	8.5	8.5	8.5	8.5	8.5	8.5

4.4 Standard Mode Products

The following standard products originated depending on the processing level from data acquired in Standard Mode.

Table 4-15 Standard Mode Product List

Product name	Processing Level
ST-RAW_B	0
ST-SCS_A ST-SCS_B ST-SCS_U ST-SCS_W	1A
ST-GEC_A ST-GEC_B ST-GEC_W ST-WEC_A ST-WEC_B ST-WEC_W	1C

ST-GTC_A ST-GTC_B ST-GTC_W ST-WTC_A ST-WTC_B ST-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Standard Mode.

Table 4-16 Standard Mode Product Features

	ST - RAW	ST - SCS	ST - GEC ST - GTC ST - WEC ST - WTC
Line Spacing (m)	-	~1.15	~1.15
Column Spacing (m)	-	~1.15	~1.15
Number of lines	25000~27000	21000~24000	38000~42000
Number of columns	12000~14000	10000~13000	30000~33000
Product Size (MB)	550~750	900~1200	2400~2700

Next table lists the quality specifications (considering the instrument operation modes parameters in the nominal access region) for the KOMPSAT-5 Standard Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition. When applicable such performances have to be considered valid both in range and azimuth directions

Table 4-17 Standard Mode Products Requirement

	ST-SCS_A ST-SCS_B	ST-SCS_U ST-SCS_W	ST-GEC_A,B ST-WEC_A,B	ST-GEC_W ST-WEC_W	ST-GTC_A,B ST-GTC_A,B	ST-GTC_W ST-GTC_W
Ground Range resolution (m)	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m
Azimuth resolution (m)	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m	≤ 3 m
PSLR (dB)	≤ -19 dB	≤ -13 dB	≤ -19 dB		≤ -19 dB	
ISLR (dB)	≤ -13 dB					

Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-18 Standard Mode processing condition

	ST-SCS_A ST-SCS_B	ST-SCS_U ST-SCS_W	ST-GEC_A,B ST-WEC_A,B	ST-GEC_W ST-WEC_W	ST-GTC_A,B ST-GTC_A,B	ST-GTC_W ST-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1
Range Processing weighting factor	0.265	0	0.260	0	0.260	0
Azimuth Processing weighting factor	0.280	0	0.250	0	0.250	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	3.1	3.1	3.1	3.1	3.1	3.1

4.5 Enhanced Standard Mode Products

The following standard products originated depending on the processing level from data acquired in Enhanced Standard Mode.

Table 4-19 Enhanced Standard Product Features

Product name	Processing Level
ES-RAW_B	0
ES-SCS_A ES-SCS_B ES-SCS_U ES-SCS_W	1A

ES-GEC_A ES-GEC_B ES-GEC_W ES-WEC_A ES-WEC_B ES-WEC_W	1C
ES-GTC_A ES-GTC_B ES-GTC_W ES-WTC_A ES-WTC_B ES-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Enhanced Standard Mode.

Table 4-20 Enhanced Standard Mode Product Features

	ES - RAW	ES - SCS	ES - GEC ES - GTC ES - WEC ES - WTC
Line Spacing (m)	-	~1.15	~1.15
Column Spacing (m)	-	~1.15	~1.15
Number of lines	25000~27000	21000~24000	38000~42000
Number of columns	15000~17000	14000~16000	30000~33000
Product Size (MB)	700~900	1100~1400	2400~2700

Next table lists the quality specifications considering the instrument operation modes nominal parameters in the nominal access region for the KOMPSAT-5 Enhanced Standard Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-21 Enhanced Standard Mode Products Requirement

	ES-SCS_A ES-SCS_B	ES-SCS_U ES-SCS_W	ES-GEC_A,B ES-WEC_A,B	ES-GEC_W ES-WEC_W	ES-GTC_A,B ES-GTC_A,B	ES-GTC_W ES-GTC_W
Ground Range resolution (m)	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m
Azimuth resolution (m)	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m	≤ 2.5 m
PSLR (dB)	≤ -20 dB	≤ -13 dB	≤ -20 dB		≤ -20 dB	
ISLR (dB)	≤ -15 dB					
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-22 Enhanced Standard Mode processing condition

	ES-SCS_A ES-SCS_B	ES-SCS_U ES-SCS_W	ES-GEC_A,B ES-WEC_A,B	ES-GEC_U ES-WEC_U	ES-GTC_A,B ES-GTC_A,B	ES-GTC_W ES-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1
Range Processing weighting factor	0.265	0	0.260	0	0.260	0
Azimuth Processing weighting factor	0.280	0	0.250	0	0.250	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	3.1	3.1	3.1	3.1	3.1	3.1

4.6 Wide Swath Mode Products

The following standard products originated depending on the processing level from data acquired in Wide Swath Mode.

Table 4-23 Wide Swath Product Features

Product name	Processing Level
WS-RAW_B	0
WS-SCS_A WS-SCS_B WS-SCS_U WS-SCS_W	1A
WS-GEC_A WS-GEC_B WS-GEC_W WS-WEC_A WS-WEC_B WS-WEC_W	1C
WS-GTC_A WS-GTC_B WS-GTC_W WS-WTC_A WS-WTC_B WS-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Wide Swath Mode.

Table 4-24 Wide Swath Product Features

	WS - RAW	WS - SCS	WS - GEC WS - GTC WS - WEC WS - WTC
Line Spacing (m)	-	~12.5	~6.5
Column Spacing (m)	-	8.5~11	~6.5
Number of lines	4X12000~15000	4X9000~11000	17000~20000
Number of columns	2600~29000	2400~2700	15000~18000
Product Size (MB)	260~300	280~320	190~220

Next table lists the quality specifications (considering the instrument operation modes parameters in the nominal access region) for the KOMPSAT-5 Wide Swath

Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-21 Wide Swath Mode Products Requirement

	WS-SCS_A WS-SCS_B	WS-SCS_U WS-SCS_W	WS-GEC_A,B WS-WEC_A,B	WS-GEC_W WS-WEC_W	WS-GTC_A,B WS-GTC_A,B	WS-GTC_W WS-GTC_W
Ground Range resolution (m)	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m
Azimuth resolution (m)	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m
PSLR (dB)	≤ -19 dB	≤ -13 dB	≤ -19 dB		≤ -19 dB	
ISLR (dB)	≤ -13 dB					
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-26 Wide Swath Mode processing condition

	WS-SCS_A WS-SCS_B	WS-SCS_U WS-SCS_W	WS-GEC_A,B WS-WEC_A,B	WS-GEC_W WS-WEC_W	WS-GTC_A,B WS-GTC_A,B	WS-GTC_W WS-GTC_W
Processing nom. range looks	1	1	1	1	1	1
Processing nom. azimuth looks	1	1	1	1	1	1

Range Processing weighting factor	0.240	0	0.240	0	0.240	0
Azimuth Processing weighting factor	0	0	0	0	0	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	-	-	-	-	-	-

4.7 Enhanced Wide Swath Mode Products

The following standard products will be originated depending on the processing level from data acquired in Enhanced Wide Swath Mode.

Table 4-27 Enhanced Wide Swath Product Features

Product name	Processing Level
EW-RAW_B	0
EW-SCS_A EW-SCS_B EW-SCS_U EW-SCS_W	1A
EW-GEC_A EW-GEC_B EW-GEC_W EW-WEC_A EW-WEC_B EW-WEC_W	1C
EW-GTC_A EW-GTC_B EW-GTC_W EW-WTC_A EW-WTC_B EW-WTC_W	1D

Next table summarizes the basic features for the KOMPSAT-5 products originated from data acquired in Enhanced Wide Swath Mode.

Table 4-28 Enhanced Wide Swath Product Features

	EW - RAW	EW - SCS	EW - GEC EW - GTC EW - WEC EW - WTC
Line Spacing (m)	-	~12.5	~6.25
Column Spacing (m)	-	8.5~11	~6.25

Number of lines	4X12000~15000	4X9000~11000	17000~20000
Number of columns	12000~13000	10000~11000	15000~18000
Product Size (MB)	1050~1200	1100~1300	190~220

Next table lists the quality specifications considering the instrument operation modes nominal parameters in the nominal access region for the KOMPSAT-5 Enhanced Wide Swath Mode focused products. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

When applicable such performances have to be considered valid both in range and azimuth directions.

Table 4-29 Enhanced Wide Swath Mode Products Requirement

	EW-SCS_A EW-SCS_B	EW-SCS_U EW-SCS_W	EW-GEC_A,B EW-WEC_A,B	EW-GEC_W EW-WEC_W	EW-GTC_A,B EW-GTC_A,B	EW-GTC_W EW-GTC_W
Ground Range resolution (m)	≤ 5 m	≤ 5 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m
Azimuth resolution (m)	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m	≤ 20 m
PSLR (dB)	≤ -20 dB	≤ -13 dB	≤ -20 dB		≤ -20 dB	
ISLR (dB)	≤ -15 dB					
Radiometric Accuracy (dB)	≤ 1 dB		≤ 1 dB		≤ 1 dB	
Geometric Conformity	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Geolocation [m]	100	100	100	100	100	100

The following table, lists the processing conditions under which, the product requirements listed in the previous table should be verified. Nevertheless, such parameters shall be considered as living one's up to the completion of the commissioning phase of each satellite.

Table 4-30 Enhanced Wide Swath Mode processing condition

	EW-SCS_A EW-SCS_B	EW-SCS_U EW-SCS_W	EW-GEC_A,B EW-WEC_A,B	EW-GEC_W EW-WEC_W	EW-GTC_A,B EW-GTC_A,B	EW-GTC_W EW-GTC_W
Processing nom. range looks	1	1	4	4	4	4
Processing nom. azimuth looks	1	1	1	1	1	1
Range Processing weighting factor	0.240	0	0.100	0	0.100	0
Azimuth Processing weighting factor	0	0	0	0	0	0
Range processed bandwidth (% of PBW)	100	100	100	100	100	100
Azimuth processed bandwidth (KHz)	-	-	-	-	-	-

5. STANDARD FORMAT HIERARCHY

The data packaging organization adopted as distribution format for the standard products is HDF5.

5.1 Format Overview

The HDF5 (Hierarchical Data Format) format and software, was developed and supported by NCSA (National Centre for Supercomputing Applications University of Illinois) since 1988 and is freely available.
It is used worldwide in many fields, including environmental science, the study of neutron scattering, non-destructive testing, and aerospace research. Scientific projects that use HDF include NASA's Earth Observing System (EOS), and the Department of Energy's Accelerated Strategic Computing Initiative (ASCI).
For more information or software the following link is available

HDF5 files are organized in a hierarchical structure, with two primary structures:

- Groups, which are container structures which can hold datasets and other groups
- Datasets, which are multidimensional arrays of a homogeneous type

A grouping structure contains instances of zero or more groups or datasets, together with supporting metadata.
Any HDF5 group or dataset may have an associated attribute list. An HDF5 attribute is a user-defined HDF5 structure that provides extra information about an HDF5 object. Attributes are described in more detail below.

The hierarchical organization of the HDF5 format is graphically represented in Figure 5-1.

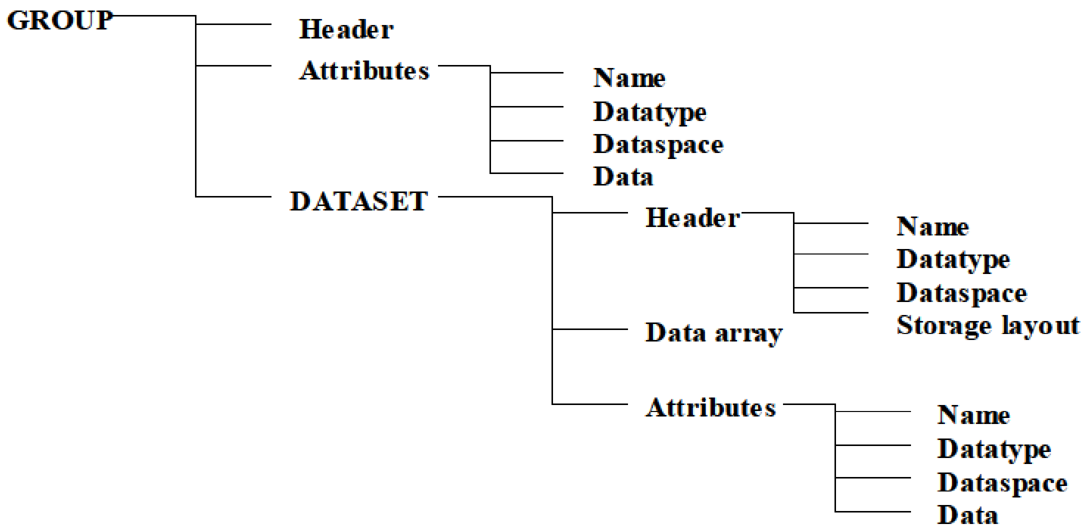


Figure 5-1: HDF5 organization

5.1.1 HDF5 Groups

An HDF5 group is a structure containing zero or more HDF5 objects. A group has two parts:

- A group header, which contains a group name and a list of group attributes.
- A group symbol table, which is a list of the HDF5 objects that belong to the group.

Working with groups and group members is similar in many ways to working with directories and files in UNIX. As with UNIX directories and files, objects in an HDF5 file are often described by giving their full (or absolute) path names.

/	Signifies the root group.
/foo	Signifies a member of the root group called foo.
/foo/zoo	Signifies a member of the group foo, which in turn is a member of the root group.

Any HDF5 group or dataset may have an associated *attribute list*. An HDF5 attribute is a userdefined HDF5 structure that provides extra information about an HDF5 object.

5.1.2 HDF5 Datasets

A dataset is a multidimensional array of data elements, together with supporting metadata. A dataset is stored in a file in two parts

- A header
- A data array.

The header contains information that is needed to interpret the array portion of the dataset, as well as metadata (or pointers to metadata) that describes or annotates the dataset. Header information includes the name of the object, its dimensionality, its number-type, information about how the data itself is stored on disk, and other information used by the library to speed up access to the dataset or maintain the file's integrity.

There are four essential classes of information in any header:

- Name
- Datatype
- Dataspace
- Storage layout

5.1.2.1 Name

A dataset name is a sequence of alphanumeric ASCII characters.

5.1.2.2 Datatype

HDF5 allows one to define many different kinds of datatypes. There are two categories of datatypes (*Atomic* datatypes and C*ompound* datatypes). Atomic datatypes can also be system-specific, or *NATIVE*, and all datatypes can be *named*:

- **Atomic** datatypes are those that are not decomposed at the datatype interface level, such as integers and floats.
- **NATIVE** datatypes are system-specific instances of atomic datatypes.
- **Compound** datatypes are made up of atomic datatypes.

- **Named** datatypes are either atomic or compound datatypes that have been specifically designated to be shared across datasets.

Atomic datatypes include integers and floating-point numbers. Each atomic type belongs to a particular class and has several properties: size, order, precision, and offset. In this introduction, we consider only a few of these properties.

Atomic classes include integer, float, date and time, string, bit field, and opaque. (Note: Only integer, float and string classes are available in the current implementation.)
Properties of integer types include size, order (endian-ness), and signed-ness (signed/unsigned). Properties of float types include the size and location of the exponent and mantissa, and the location of the sign bit.

The datatypes that are supported in the current implementation are:

- Integer datatypes: 8-bit, 16-bit, 32-bit, and 64-bit integers in both little and big-endian format.
- Floating-point numbers: IEEE 32-bit and 64-bit floating-point numbers in both little and big- endian format.
- References.
- Strings.

NATIVE datatypes. Although it is possible to describe nearly any kind of atomic data type, most applications will use predefined datatypes that are supported by their compiler. In HDF5 these are called native datatypes. NATIVE datatypes are C-like datatypes that are generally supported by the hardware of the machine on which the library was compiled. In order to be portable, applications should almost always use the NATIVE designation to describe data values in memory.
The NATIVE architecture has base names that do not follow the same rules as the others. Instead, native type names are similar to the C type names.

A compound datatype is one in which a collection of simple datatypes are represented as a single unit, similar to a struct in C. The parts of a compound datatype are called members. The members of a compound datatype may be of any datatype, including another compound datatype. It is possible to read members from a compound type without reading the whole type.

Named datatypes. Normally each dataset has its own datatype, but sometimes we may want to share a datatype among several datasets. This can be done using a named datatype. A named data type is stored in the file independently of any dataset, and referenced by all datasets that have that datatype. Named datatypes may have an associated attributes list. See Datatypes in the HDF User's Guide for further information.

5.1.2.3 Dataspace

A dataset dataspace describes the dimensionality of the dataset. The dimensions of a dataset can be fixed (unchanging), or they may be unlimited, which means that they are extendible (i.e. they can grow larger).

Properties of a dataspace consist of the rank (number of dimensions) of the data array, the actual sizes of the dimensions of the array, and the maximum sizes of the dimensions of the array. For a fixed-dimension dataset, the actual size is the same as the maximum size of a dimension.

A dataspace can also describe portions of a dataset, making it possible to do partial I/O operations on selections.

Given an n-dimensional dataset, there are currently four ways to do partial selection:

- Select a logically contiguous n-dimensional hyperslab.
- Select a non-contiguous hyperslab consisting of elements or blocks of elements (hyperslabs) that are equally spaced.
- Select a union of hyperslabs.
- Select a list of independent points.

Since I/O operations have two end-points, the raw data transfer functions require two dataspace arguments: one describes the application memory dataspace or subset thereof, and the other describes the file dataspace or subset thereof.

5.1.2.4 Storage layout

The HDF5 format makes it possible to store data in a variety of ways. The default storage layout format is contiguous, meaning that data is stored in the same linear way that it is organized in memory. Two other storage layout formats are currently defined for HDF5: compact, and chunked. In the future, other storage layouts may be added.

Compact storage is used when the amount of data is small and can be stored directly in the object header.

Chunked storage involves dividing the dataset into equal-sized "chunks" that are stored separately. Chunking has three important benefits.

It makes it possible to achieve good performance when accessing subsets of the datasets, even when the subset to be chosen is orthogonal to the normal storage order of the dataset.
It makes it possible to compress large datasets and still achieve good performance when accessing subsets of the dataset.
It makes it possible efficiently to extend the dimensions of a dataset in any direction.

5.1.3 HDF5 Attributes

Attributes are small named datasets that can be attached to one of the following structures:

- primary datasets
- groups
- named datatypes

Attributes can be used to describe the nature and/or the intended usage of a dataset or group. An attribute has two parts

- name
- value

The value part contains one or more data entries of the same data type.

When accessing attributes, they can be identified by name or by an index value. The use of an index value makes it possible to iterate through all of the attributes associated with a given object.

5.1.4 Hierarchies organization

The HDF5 allows the hierarchical organization of the information to be stored.
In order to standardize the data organization and the access to the image layers stored by the HDF5 support format, each level of the HDF5 hierarchy has been univocally assigned to the storage of a specific level of information of the SAR products according to the following scheme.

/ - Root group
Instrument Modes (Processing Level): All (0/1A/1C/1D)
For each Instrument Mode and processing level it includes:

- the attributes to be considered applicable to the whole acquisition / product, hence that are subswaths-independent
- one or more group named S<mm> detailed below
- zero or one dataset named MBI (Multi Beam Image) detailed below
- zero or one dataset named QLK (Quick Look) detailed below
- zero or one dataset named GIM (Geocoded Incidence Mask) detailed below

S<mm> groups
Instrument Modes (Processing Level): All (0/1A/1C/1D)
It includes:

- the attributes dependent on the specific subswath used within the full multi-beam swath in the case of Wide Swath mode and within the access area otherwise (for example the PRF)

- one or more dataset named B<nnn> detailed below
- zero or one dataset named SBI (Single Beam Image), in the case of Wide Swath modes, detailed below
- zero or one dataset named QLK (Quick Look) detailed below
- zero or one dataset CAL including all the ShortCal pulses acquired during the acquisition's sequence of the scene echoes.
- zero or one dataset REPLICA including all the reconstructed replica chirp.
- zero or one dataset NOISE including all the Noise measures performed during the acquisition's sequence of the scene echoes.

In the case of HR/EH/UH/ST/ES products <mm> = 01. In the case of WS/EW products <mm> $\in$ {01, 02, 03, 04} used in increasing order from the nearest subswath to the farthest one. Moreover, S01 group will always include the earliest acquired burst.

B<nnn> can be a group or dataset according to the following scheme:

B<nnn> dataset

Instrument Modes (Processing Level): All (0)

It includes:

- the attributes dependent on the time sequential data block (the burst) to be considered applicable for the acquired raw data (for example the Sensing Start Time)
- the data array with the raster layer.
- In the case of Standard and High Resolution products <nnn> = 001
- In the case of Wide Swath products <nnn> $\in$ [001, 999] used in increasing order from the earliest acquired burst to the latest one. The same number of bursts will be always included in each S<mm> group of the distributed product.

B<nnn> group

Instrument Modes (Processing Level): All (1A/1C/1D)

It includes the attributes dependent on the time sequential data block (the burst) to be considered applicable for the acquired raw data (for example the Sensing Start Time)

Q<nnn> group

Instrument Modes (Processing Level): All (1C/1D)

It is used for FDBAQ decoding in Sentinel-1 CCSDS Data decoding

SBI dataset

Instrument Modes (Processing Level): HR/EH/UH/ST/ES (1A/1C/1D) and WS/EW (1A)

It includes

- the attributes dependent on the subswath used within the access area to be considered applicable for the distributed product (for example the Line Time Interval)
- one raster data array representing the product to be distributed

MBI dataset

Instrument Modes (Processing Level): WS/EW (1C/1D)

It includes

- the attributes dependent on the mosaicked full scene to be considered applicable for the distributed product (for example the Line Time Interval)
- one raster data array representing the range/azimuth mosaicked product to be distributed

QLK Dataset

Instrument Modes (Processing Level): All (0/1A/1C/1D)

It includes the quick look of the distributed product.

GIM Dataset

Instrument Modes (Processing Level): All (1A/1D)

It includes the raster layer representing the mask of the incidence angles at which each pixel included into the level 1A/ 1D product had been acquired.

START group

Instrument Modes (Processing Level): All (0)

It includes the dataset of Calibration (CAL) and Noise (NOISE) measurements performed during the acquisition initialization sequence extracted from the downlinked RAW data

STOP group

Instrument Modes (Processing Level): All (0)

It includes the dataset of Calibration (CAL) and Noise (NOISE) measurements performed during the acquisition termination sequence extracted from the downlinked RAW data

NOISE dataset

Instrument Modes (Processing Level): All (0)

It includes the Noise data from the downlinked RAW data.

- The dataset START/NOISE (respectively STOP/NOISE), includes the Noise measurements performed during the acquisition Initialization (respectively Termination) sequence;
- The dataset /S<nn>/NOISE, includes all the Noise measures performed during the acquisition's sequence of the scene echoes

CAL dataset

Instrument Modes (Processing Level): All (0)

It includes the Calibration data from the downlinked RAW data. Three cases can be identified:

- the dataset /START/CAL, includes all the Calibration measurements (Tx1a, Tx1b and Rx performed on each row of the antenna plus an additional ShortCal pulse) performed during the acquisition's Initialization sequence;
- the dataset /STOP/CAL, includes all the Calibration measurements (Tx1a, Tx1b and Rx performed on each row of the antenna plus an additional ShortCal pulse) performed during the acquisition's Termination sequence;

- the dataset /S<nn>/CAL, includes all the ShortCal pulses acquired during the acquisition's sequence of the scene echoes.

REPLICA dataset
Instrument Modes (Processing Level): All (0)

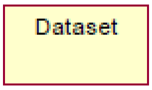
It includes the replica chirp reconstructed from the calibration data included into the downlinked RAW data. It includes a number of lines equal to the number of measured ShortCal pulses

The hierarchical organization for each Instrument Mode and Processing Level is graphically represented in the following diagrams.

A not color filled structure

represents a HDF5 structure group.

A color filled structure



represents a generic HDF5 dataset including data array and the relevant attributes. Suffixes <mm>/<nnn> between angular brackets indicates that the cardinality of the group/dataset is greater than one.

Following the Standard/High Resolution Modes Products HDF5 structures:

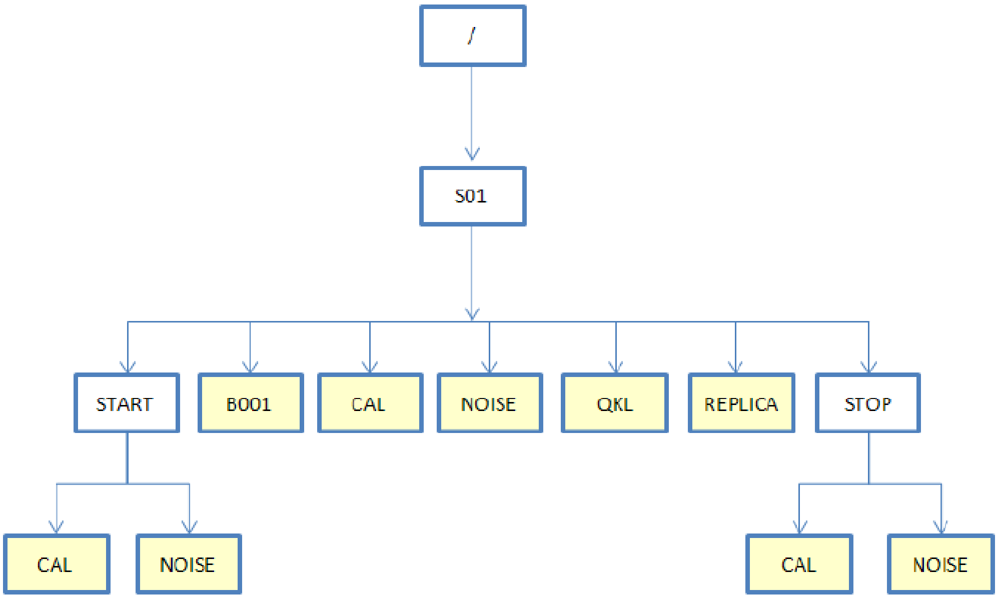


Figure 5-2: Standard/High Resolution Modes – Level 0 - RAW

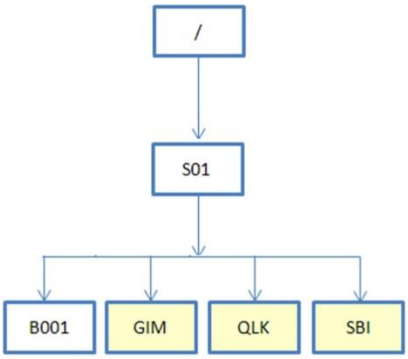


Figure 5-3: Standard/High Resolution Modes – Level 1A - SCS

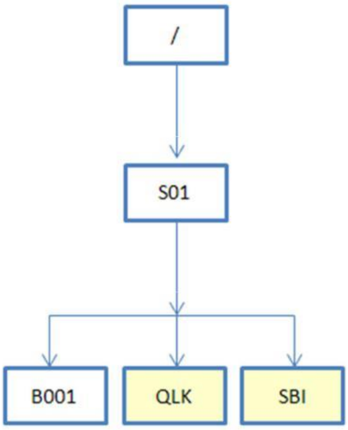


Figure 5-4: Standard/High Resolution Modes – Level 1C – GEC/WEC

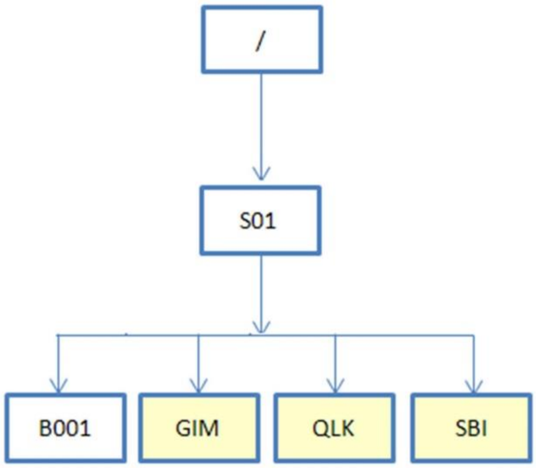


Figure 5-5: Standard/High Resolution Modes – Level 1D – GTC/WTC

Following the Wide Swath Modes Products HDF5 structures:

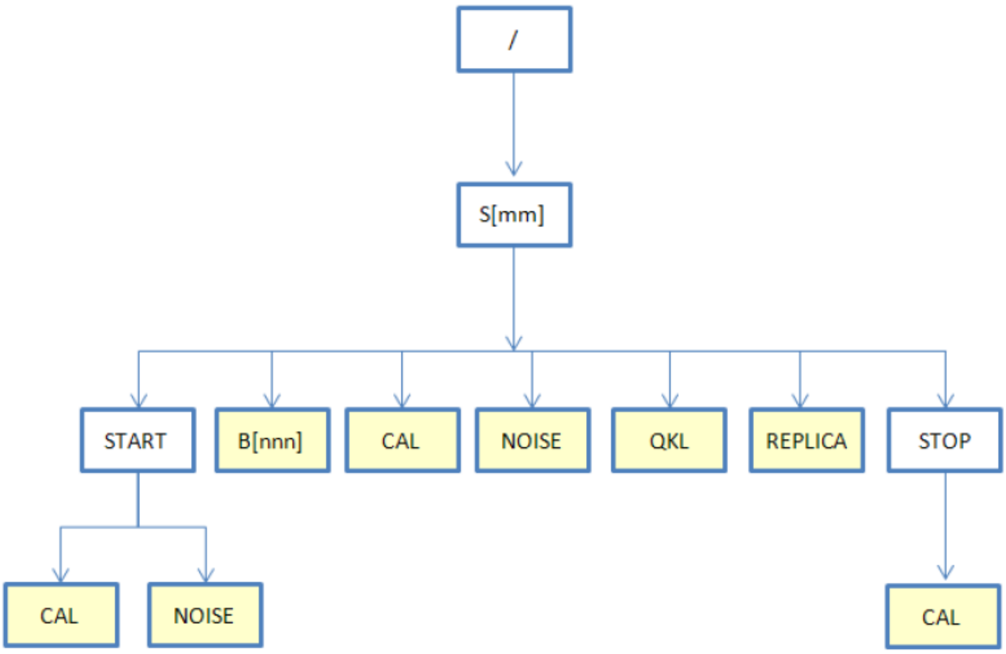


Figure 5-6: Wide Swath Modes – Level 0 – RAW

Please note that the Level 0 Wide Swath products presents the NOISE dataset of the START group in each subswath group (S<mm>) even if only for the first subswath (S<01>) this dataset will be populated according to the SAR Instrument design.

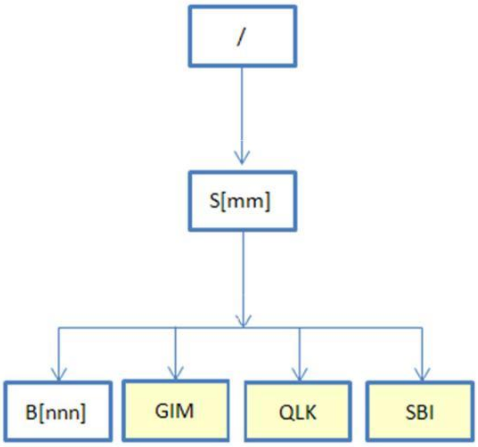


Figure 5-7: Wide Swath Modes – Level 1A – SCS

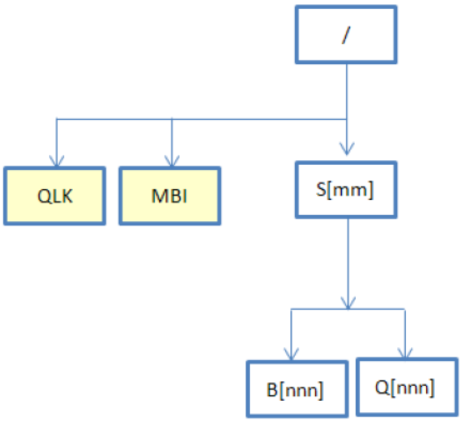


Figure 5-8: Wide Swath Modes – Level 1C – GEC/WEC

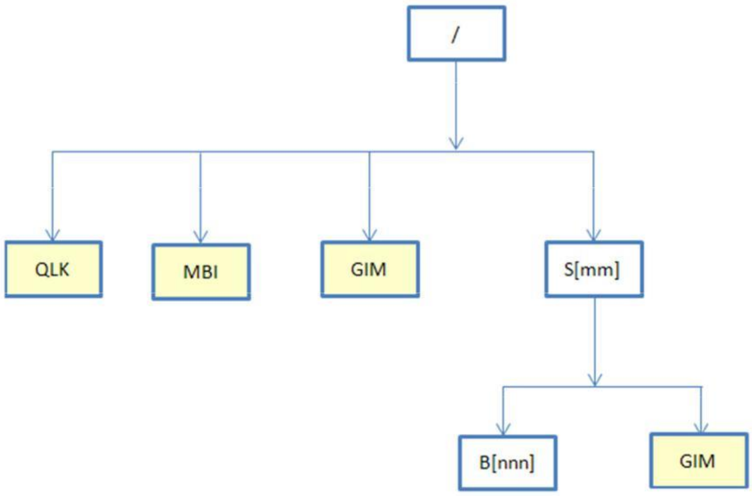


Figure 5-9: Wide Swath Modes – Level 1D – GTC/WTC

5.1.5 Ancillary information organization

The attributes to be appended (in terms of HDF5 Attributes) to the KOMPSAT-5 SAR standard products, depending on the processing Level (from Level 0 up to Level 1D) are listed in the “KOMPSAT-5 SAR Products Attributes” For each attribute the corresponding HDF5 storage structure is reported.

5.1.6 Data storage policy

The arrangement used for storage of raster data layers of the SAR Standard Products into HDF5 datasets is listed in the following table:

Samples per pixel	HDF5 data type
Two (Complex data)	Tri-dimensional array having: • the first dimension (the slowest varying) corresponding to the number of lines of the data array • the second dimension corresponding to the number of columns of the data array • the third dimension (the most fast varying) corresponding to the pixel depth, hence used for representation of Real and Imaginary part of each pixel Such representation, will be used for complex types independently on the sample format (byte, short, integer, long, long long, float, double) and sign (signed, unsigned). Data organization in file is showed in the following schema $\overbrace{I_1\ Q_1\ \dots\ \dots\ \dots\ \dots\ I_n\ Q_n}^{\text{Line 1}}\ \overbrace{I_1\ Q_1\ \dots\ \dots\ \dots\ \dots\ I_n\ Q_n}^{\text{Line 2}}\ \dots\ \dots$
One (Real data)	Bi-dimensional array having: • the first dimension (the slowest varying) corresponding to the number of lines of the data array • the second dimension corresponding to the number of columns of the data array Such representation will be used for images on single-sample pixel, independently on the sample format (byte, short, integer, long, long long, float, double) and sign (signed, unsigned) $\overbrace{P_1\ P_2\ \dots\ \dots\ \dots\ \dots\ \dots\ P_n}^{\text{Line 1}}\ \overbrace{P_1\ P_2\ \dots\ \dots\ \dots\ \dots\ \dots\ P_n}^{\text{Line 2}}\ \dots\ \dots$

6. PRODUCT PACKAGE

The support format detailed below will be used to store image layers and the relevant ancillary information, forming the output product to be distributed to the final user.

6.1 Products Organization

Specific data organization will be detailed to meet the storage needs of data acquired with all the instrument modes allowed by the KOMPSAT-5.

6.1.1 Naming Convention

The following naming convention will be used for the identification of the KOMPSAT-5 SAR Standard Products files

IMAGE file extensions are:

- SAR data in hdf5 format(~.h5) or GeoTiff(~.tif)
- Browse image (~br.jpg)
- Thumbnail image (~_th.jpg)
- Quick Look Image(~_QL.png)
- Geocoded Incidence Angle Mask file(~_GIM.tif)

ANCILLARY file extensions are:

- XML file(~_Aux.xml)
- Jgw file(~br.jgw)
- pgw file(~_QL.pgw)
- KML file(~.kml)
- RPC file(~_RPC.txt)

The naming convention uses information contained in the KOMPSAT-5 Product metadata file.

Directory

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<LLL>

IMAGE(HDF5)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<YYY_Z>_<LLL>.h5

IMAGE(GeoTiff)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>.tif

IMAGE(Browse)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_br.tif

IMAGE(Thumb)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_th.tif

IMAGE(Quick Look)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_QL.png

IMAGE(GIM) – L1A, L1D

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<YYY_Z>_<LLL>_GIM.tif

ANCILLARY(XML)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_AUX.xml

ANCILLARY(JGW)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_br.jgw

ANCILLARY(PGW)

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<c>_<bb>_<YYY_Z>_<LLL>_QL.pgw

ANCILLARY(KML) – L1C, L1D

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<YYY_Z>_<LLL>.kml

ANCILLARY(RPC) – L1A

<K5>_<YYYYMMDDhhmmss>_<tttttt>_<nnnnn>_<o>_<MM><SS>_<PP>_<YYY_Z>_<LLL>_<YYY_Z>_<MM>_RPC_<bb>.txt

The semantic of the variable sub-strings is reported in the following table:

Table 6-1 File naming convention

Sub-string code	Meaning	Allowed values
<K5>	Identifier of the satellite that acquired the scene	K5 (KOMPSAT-5)
<YYYYMMDDhhmmss>	Sensing Start Time rounded to the closest integer second	YYYY = year MM = month DD = day of the month hh = hour mm = minute ss = second
<tttttt>	Processing offset	In millisecond
<nnnnn>	Number of Orbit	[00000..99999]
<o>	Identifier of the Orbit Direction	A = Ascending D = Descending
<MM>	Instrument Mode used during the acquisition	HR (High Resolution) EH (Enhanced High Resolution) UH (Ultra High Resolution) ST (Standard) ES (Enhanced Standard) WD (Wide Swath) EW (Enhanced Wide Swath)

<SS>	Identifier of the swath (or subswath combination in the case of Wide Swath mode) used for the data acquisition	[01-...-31] for HR Mode [01-...-31] for EH Mode [23-...-31] for UH Mode [01-...-19] for ST Mode [01-...-19] for ES Mode [01-...-05] for WS Mode [01-...-05] for EW Mode
<PP>	Polarizations used during the acquisition	HH = Horizontal Tx/Horizontal Rx VV = Vertical Tx/ Vertical Rx HV = Horizontal Tx/ Vertical Rx VH = Vertical Tx/ Horizontal Rx
<c>	Channel indicator I/Q for L1A GeoTiff	I or Q
<bb>	Sub-beam ID for L1A GeoTiff	[01..04]
<YYY_Z>	Product Type	Standard Products: RAW_B SCS_A SCS_B SCS_U SCS_W GEC_A GEC_B GEC_W WEC_A WEC_B WEC_W GTC_A GTC_B GTC_W WTC_A WTC_B WTC_W
<LLL>	Processing level	L1A L1C L1D

6.2 HDF PRODUCT PACKAGE

6.2.1 HDF L1A Product

Constituents of HDF Product are shown in Table 6.2, applied to HDF Level 1A.

Table 6-2 HDF L1A Product File List

	Files	File format / Extension
HDF L1A	HDF Data	HDF5 / .h5
	RPC Files (For L1A)	Text / .txt
	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw
	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml
	Geocoded Incidence Angle Mask	GeoTiff / .tif

HDF L1A Packages are as follows:

END USER LICENSE AGREEMENT_SAMPLE DATA (V0.5).pdf
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A.h5
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_Aux.xml
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_br.jgw
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_br.jpg
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_GIM.tif
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_QL.pgw
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_QL.png
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_RPC.txt
K5_20150323230735_000000_08696_D_HR02_HH_SCS_B_L1A_th.jpg

Figure 6-1 Files in HDF L1A (SCS Product)

6.2.2 HDF L1C Product

Constituents of HDF Product are shown in Table 6.3, applied to HDF Level 1C.

Table 6-3 HDF L1C Product File List

	Files	File format / Extension
HDF L1C	HDF Data	HDF5 / .h5
	Google Earth KML	KML / .kml
	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw
	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml

HDF L1C Packages are as follows:

END USER LICENSE AGREEMENT_SAMPLE DATA (V0.5).pdf
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C.h5
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C.kml
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_Aux.xml
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_br.jgw
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_br.jpg
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_QL.pgw
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_QL.png
K5_20150323230735_000000_08696_D_HR02_HH_GEC_B_L1C_th.jpg

Figure 6-2 Files in HDF L1C (GEC or WEC Product)

6.2.3 HDF L1D Product

Constituents of HDF Product are shown in Table 6.4, applied to HDF Level 1D.

Table 6-4 HDF L1D Product File List

	Files	File format / Extension
HDF L1D	HDF Data	HDF5 / .h5
	Google Earth KML	KML / .kml
	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw
	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml
	Geocoded Incidence Angle Mask	GeoTiff / .tif

HDF L1D Packages are as follows:

END USER LICENSE AGREEMENT_SAMPLE DATA (V0.5).pdf
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D.h5
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D.kml
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_Aux.xml
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_br.jgw
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_br.jpg
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_GIM.tif
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_QL.pgw
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_QL.png
K5_20150323230735_000000_08696_D_HR02_HH_GTC_B_L1D_th.jpg

Figure 6-3 Files in HDF L1D (GTC or WTC Product)

6.3 TIFF PRODUCT PACKAGE

Constituents of HDF Product are shown in Table 6.5, applied to TIFF Level 1A.

6.3.1 TIFF L1A PRODUCT

Table 6-5 TIFF L1A Product File List

	Files	File format / Extension
TIFF L1A	Band Complex File (I Channel)	GeoTiff / .tif
	Band Complex File (Q Channel)	GeoTiff / .tif
	RPC Files (For L1A)	Text / .txt
	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw
	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml
	Geocoded Incidence Angle Mask	GeoTiff / .tif

TIFF L1A Packages are as follows:

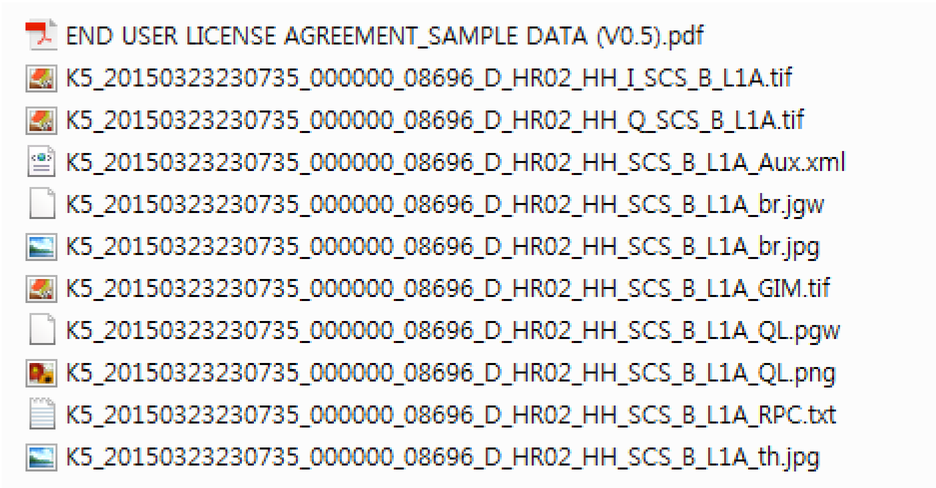


Figure 6-4 Files in TIFF L1A (HR, ST modes)

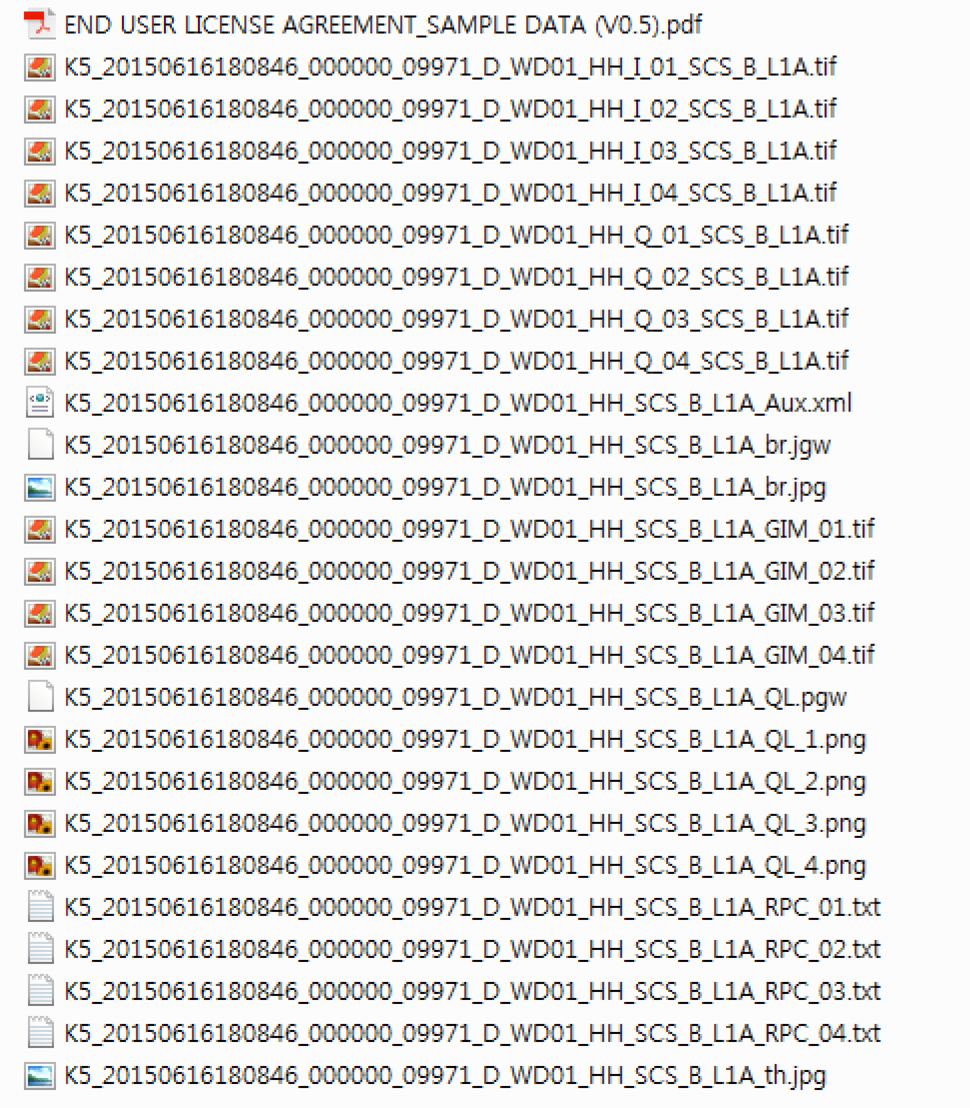


Figure 6-5 Files in TIFF L1A (WS modes)

6.3.2 TIFF L1C Product

Constituents of HDF Product are shown in Table 6.6, applied to TIFF Level 1C.

Table 6-6 TIFF L1C Product File List

	Files	File format / Extension
TIFF L1C	Amplidtude File	GeoTiff / .tif
	Google Earth KML	KML / .kml

	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw
	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml

TIFF L1C Packages are as follows:

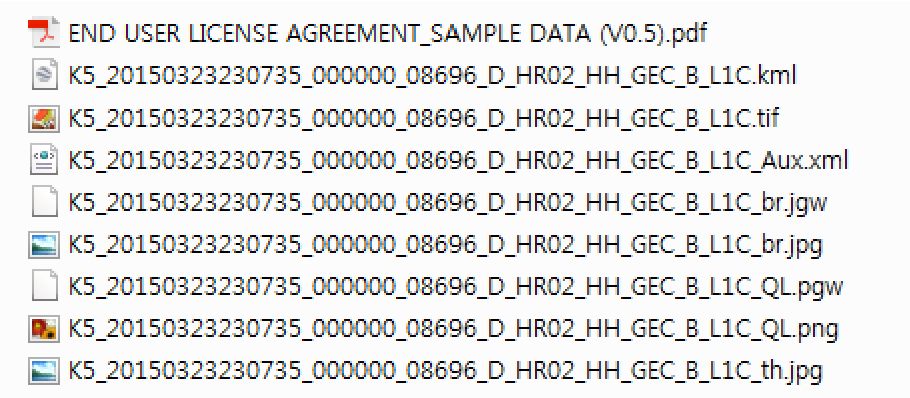


Figure 6-6 Files in TIFF L1C (GEC or WEC Product)

6.3.3 TIFF L1D Product

Constituents of HDF Product are shown in Table 6.7, applied to TIFF Level 1D.

Table 6-7 TIFF L1D Product File List

	Files	File format / Extension
TIFF L1D	Backscattering coefficient Data	GeoTiff / .tif
	Google Earth KML	KML / .kml
	Browse Image file	JPEG / .jpg
	World file(JGW) for Browse	Text / .jgw

	Quick Look file	PNG / .png
	World file(PGW) for Quick Look	Text / .pgw
	Thumbnail Image File	JPEG / .jpg
	Auxiliary File	XML / .xml

TIFF L1D Packages are as follows:

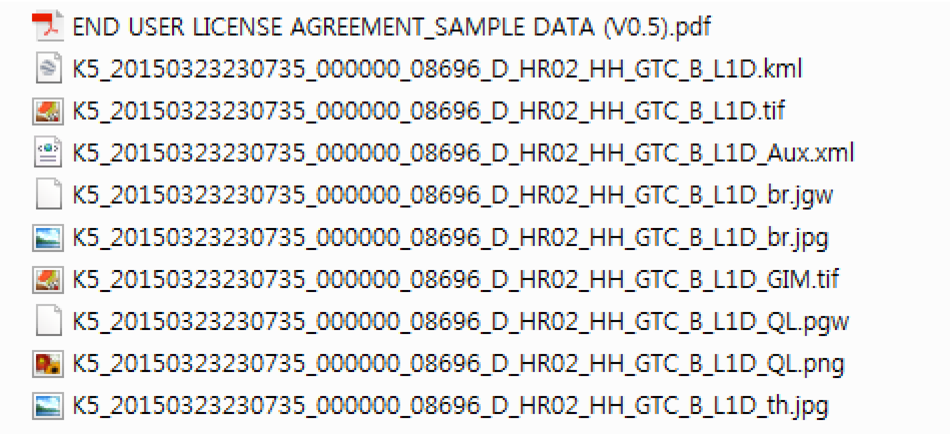


Figure 6-7 Files in TIFF L1D (GTC or WTC Product)

7. ORDER FORM

This order form is for both new tasking order and archive order. Customer should fill appropriate conditions in the order form, sign at the end of page, then send it to Order Desk (OrderDesk@si-imaging.com)at SI Imaging Services.

End User & Reseller Information

End User Info

Affiliation		Division	
Contact name		Position	
Address			
Country			
E-mail		Phone No	

Reseller Info

Affiliation		Division	
Contact name		Position	
Address			
Country			
E-mail		Phone No	

Please complete all required fields in detail. If end user information is not valid, it is considered the reseller represents the end user.

General Order Information

☐ New Task Order ☐ Archive Order

1. Licensing (☑)

☐ Standard licence (1~5)	☐ Multi-User licence (6~10)	☐ Expand (11~25)
☐ Enterprise (26+)	☐ Academic	

2. Application Fields (☑)

☐ Agriculture	☐ Mapping and Land management	☐ Defense and Security
☐ Forestry	☐ Maritime and Coastal	☐ Natural Resources and Engineering
☐ Hazards	☐ Urban Planning	☐ Other :

Production Specifications

New Task Order Info

1. Product Type (GeoTiff) (☑)
   (1) Satellite : KOMPSAT-5
   (2) Imaging Mode

Spotlight Modes	☐ EH(Enhanced)	☐ UH(Ultra)	☐ HR(Standard)
Strip Modes	☐ ES(Enhanced)	☐ ST(Standard)	
ScanSAR Modes	☐ EW(Enhanced)	☐ WS(Standard)	

   (3) Polarization(single only)

   ☐ HH ☐ HV ☐ VH ☐ VV

   (4) Product Level

   ☐ L1A ☐ L1C ☐ L1D

   (5) Product Data Type

   ☐ Integer ☐ Float

   (6) File Format

   ☐ HDF ☐ GeoTIFF

2. Parameters (☑)
   (1) Term of Validity : / / ~ / /

   (dd/mm/yyyy)

   (2) Tilt Angle (single -55 ~ -20) : ~
   (3) Orbit Direction

   ☐ Both ☐ Ascending ☐ Descending

3. Priority (☑)

   ☐ Priority (Order shall be confirmed before 03:00 UTC one working day before start of collection window)

   ☐ Standard (Order shall be confirmed before 03:00 UTC two working days before start of collection window)

4. Delivery Media (☑)

   ☐ FTP ☐ DVD

5. Request Zone info (☑)

   Country : Place Name :

6. AOI

   Estimated number of scenes : ____________ (required number of scenes is subject to actual imaging conditions)

   ☐ Circle

Center Latitude	Center Longitude	Radius
		km

≤ 1.5 km for EH/UH/HR

   ☐ Rectangle

	Latitude	Longitude
UL		
UR		

LL		
LR		

☐ Shapefile or KML/KMZ file

File Name :

7. Additional Description

Archive Order Info

1. Scene or File List (http://arirang.kari.re.kr)

Scene ID(or File Name)				
Country/Place				
Option	Product Level *(L1A, L1C, L1D)*		Product Data Type *(Integer, Float)*	
	File Format *(HDF, GeoTIFF)*		Delivery Media *(FTP, DVD)*	
	Delivery Service *(Standard, Rush)*			
Scene ID(or File Name)				
Country/Place				
Option	Product Level *(L1A, L1C, L1D)*		Product Data Type *(Integer, Float)*	
	File Format *(HDF, GeoTIFF)*		Delivery Media *(FTP, DVD)*	
	Delivery Service *(Standard, Rush)*			
Scene ID(or File Name)				
Country/Place				
Option	Product Level *(L1A, L1C, L1D)*		Product Data Type *(Integer, Float)*	
	File Format *(HDF, GeoTIFF)*		Delivery Media *(FTP, DVD)*	
	Delivery Service *(Standard, Rush)*			
Scene ID(or File Name)				
Country/Place				
Option	Product Level *(L1A, L1C, L1D)*		Product Data Type *(Integer, Float)*	
	File Format *(HDF, GeoTIFF)*		Delivery Media *(FTP, DVD)*	
	Delivery Service *(Standard, Rush)*			
Scene ID(or File Name)				
Country/Place				
Option	Product Level *(L1A, L1C, L1D)*		Product Data Type *(Integer, Float)*	
	File Format *(HDF, GeoTIFF)*		Delivery Media *(FTP, DVD)*	
	Delivery Service *(Standard, Rush)*			

2. Additional Description

Issued by the Reseller(Or End User)

Date : ______________________________

Signature : ______________________________

8. REGULATION GOVERNING IMAGE DSITRIBUTION

8.1 Copyright

In brief, copyright covers a certain number of rights granted to the author of an original work, whether scientific or artistic in nature, which are added to the usual right of ownership. At least under the copyright laws of the Republic of Korea, these rights are granted exclusively and automatically.

The users of KOMPSAT-5 data acknowledge the right of KARI to copyright protection and/or protection against unauthorized use of the KOMPSAT-5 products, in accordance with the copyright laws of the Republic of Korea and applicable international agreements. The intellectual property rights related to the KOMPSAT-5 products are protected through the end-user license agreement. The user of KOMPSAT-5 data undertake to have printed the following copyright notice on all products, in such a way that KARI/s copyright be plain to all "ⓒKARI _____(year of production), Distribution (SI Imaging Services, Republic of Korea)"

The author of a Derived Works and Products is entitled to his own copyright in return for his creative contribution. This copyright is complementary to that owned by KARI.

8.2 General Terms of Sale

When the user buys KOMPSAT-5 image and pays the current stated price, the user obtains in return one or more copies of the products requested. However, the sale is subject to the following conditions;

- The user can only use the KOMPSAT-5 products for his own private needs and is forbidden to make these products or reproductions of these products available to a third party, either on a non-paying or a paying basis, whether temporarily or permanently.
- However, KARI may grant approval to the user to sell these data and reproductions derived from them.
- All KOMPSAT-5 products (including data and derived works) must bear the indication: all "ⓒKARI _____(year of production), Distribution (SI Imaging Services, Republic of Korea)"and be accompanied by a note setting forth the above regulations.

Purchase of KOMPSAT-5 image gives the owner what is generally referred to as a right of private use, which includes the right to transform the image. On the other hand, any and all collective and public use is prohibited and particularly right to distribute the image.

8.3 Permitted Uses

The END-USER is permitted by KARI a limited, non-exclusive, non-transferable license:

(a) to install the PRODUCT on as many individual computers as needed in its premises, including internal computer network (with the express exclusion of the internet, except as provided under paragraph (g) below) for the Permitted Uses under paragraphs (b) to (i) below;

(b) to make a maximum of ten (10) copies for (I) installation of the PRODUCT as per paragraph (a) above and (II) archiving and back-up purposes;

(c) to use the PRODUCT for its own internal needs;

(d) to alter or modify the PRODUCT to produce VAPs and/or DERIVATIVE WORKS;

(e) to use any VAP for its own internal needs;

(f) to make available the PRODUCT and/or any VAP to contractors and consultants, only for use on behalf of the END-USER, subject to such contractors and consultants agreeing in writing (I) to be bound by the same limitations on use as applicable to the END-USER, and (II) to return the PRODUCT and VAP to END-USER, and to keep no copy thereof, upon completion of the contracting or consulting engagement;

(g) to post an extract, maximum size 1024 x 1024 pixels, of a PRODUCT or a VAP on an internet site, in a JPEG format, with the following credit conspicuously displayed: "includes material © KARI _____(year of production), Distribution (SI Imaging Services, Republic of Korea), all rights reserved" written in full. Such posting shall be used for promotion purposes only, and may in no event allow downloading of the extract posted, nor be used to distribute, sell, assign, dispose of, lease, sublicence or transfer such extract. Prior to any posting, the END-USER shall inform KARI, specifying the URL address used by END-USER: kocust@kari.re.kr;

(h) to print any extract, maximum size 1024 x 1024 pixels, of a PRODUCT or a VAP, and to distribute such print for promotion purposes only. Such print shall include the following credit conspicuously displayed: "includes material ©KARI _____(year of production), Distribution (SI Imaging Services, Republic of Korea), all rights reserved" written in full;

(i) to distribute DERIVATIVE WORKS.

All rights not expressly granted by KARI under the present Article 2.1 are hereby retained by KARI.

8.4 Prohibited Uses

The END-USER recognizes and agrees that the PRODUCT is and shall remain the property of KARI, and contains proprietary information of KARI and thus is provided to the END-USER on a confidential basis.

The END-USER shall not cause any contractor or consultant engaged as per the provisions of Section 4.3(f) to, do any of the following:

(a) do anything not expressly authorized under Section 4.3; and

(b) alter or remove any copyright notice or proprietary legend contained in or on the PRODUCTS.

9. LICENSING

All KOMPSAT-5 image products are subject to the terms of an end-user license that will be provided to the user at the time of delivery. The following commercial licenses are currently available from SI Imaging Services. Certain amount of uplift will be applied to the price for Muli-user, Expand, and Enterprise license and certain amount of discount will be applied to the price for Academic license.

Table 9-1 License

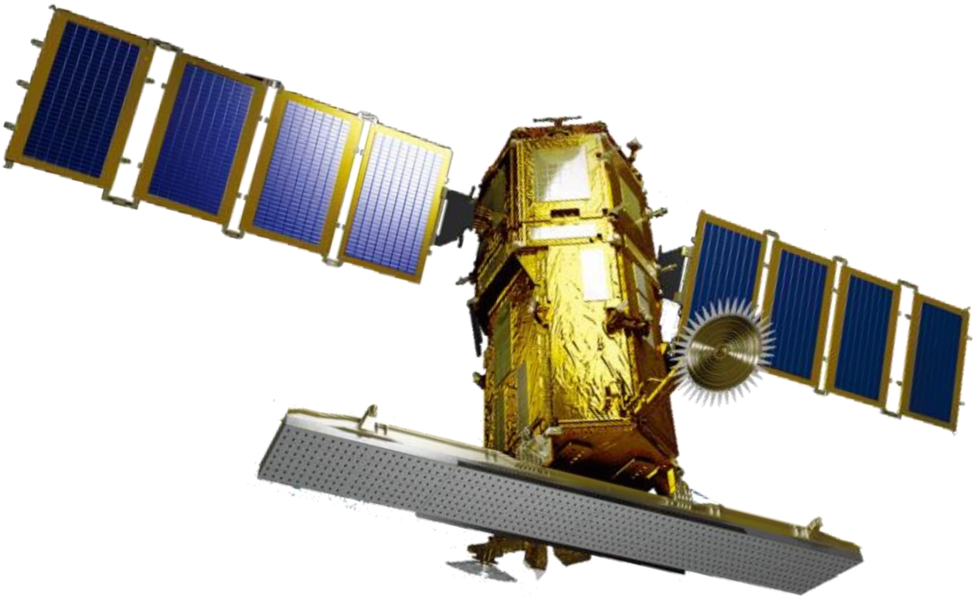
License Type	User copy	Description
Standard	1~5	Permits INTERNAL use of KOMPSAT-5 image product within 1 to 5 users* as identified by the customer at the time of purchase.
Multi-user	6~10	Permits INTERNAL use of KOMPSAT-5 image product within 6 to 10 users* as identified by the customer at the time of purchase.
Expand	11~25	Permits INTERNAL use of KOMPSAT-5 image product within 11 to 25 users* as identified by the customer at the time of purchase.
Enterprise	26+	Permits INTERNAL use of KOMPSAT-5 image product within ANY users* as identified by the customer at the time of purchase.
Academic	1~5	Permits ACADEMIC use of KOMPSAT-5 image product within 1 to 5 users* as identified by the customer at the time of purchase.

- Definition of User includes
  - One private individual
  - One company or corporation but not subsidiaries
  - One state or provincial agency
  - All departments of one county government
  - All departments of one city government
  - One Non-Governmental Organization or Non-Profit Organization
  - All departments within a single educational organization within a single country
  - One International Agency(such as United Nations) and the sponsoring host nation.

10. WARRANTY INFORMATION

- SI Imaging Services warrants that it has sufficient ownership rights in the PRODUCT to make the PRODUCT available to the END-USER under the terms thereof.
- The PRODUCT is complex; SI Imaging Services does not warrant that the PRODUCT is free of bugs, errors, defects or omissions, and that operation of the PRODUCT will be error free or uninterrupted nor that all non-conformities will or can be corrected. It does not warrant that the PRODUCT shall meet the END-USER's requirements or expectations, or shall be fit for the END-USER's intended purposes. There are no express or implied warranties of fitness or merchantability given in connection with the sale or use of this PRODUCT. SI Imaging Services disclaims all other warranties not expressly provided in End User License Agreement(EULA). In case the medium on which the PRODUCT is supplied by SI Imaging Services to the END-USER is deficient, as demonstrated by the END-USER and accepted by SI Imaging Services, SI Imaging Services shall replace said medium. Any such claim for replacement shall be submitted to SI Imaging Services within seven (7) days after delivery of the PRODUCT to the END-USER.
- In no event shall KARI nor SI Imaging Services, nor anybody having contributed to the development and/or production and/or delivery of the PRODUCT, be liable for any claim, damage or loss incurred by the END-USER, including without limitation indirect, compensatory, consequential, incidental, special, incorporeal or exemplary damages arising out of the use of or inability to use the PRODUCT, and shall not be subject to legal action in this respect. The financial cumulative liability of KARI and SI Imaging Services and of anybody having contributed to developing and/or production and/or delivery of the PRODUCT is limited to distribution of the PRODUCT and shall not in any case exceed the price paid by the END-USER to purchase the PRODUCT.

SI Imaging Services, a leading solution provider for Earth observation missions, announced an agreement with Korea Aerospace Research Institute (KARI) for "Worldwide Marketing and Sales Representative of KOMPSAT-2, 3 and 5 Image data".



Contact:

KOMPSAT Products

sales@si-imaging.com