

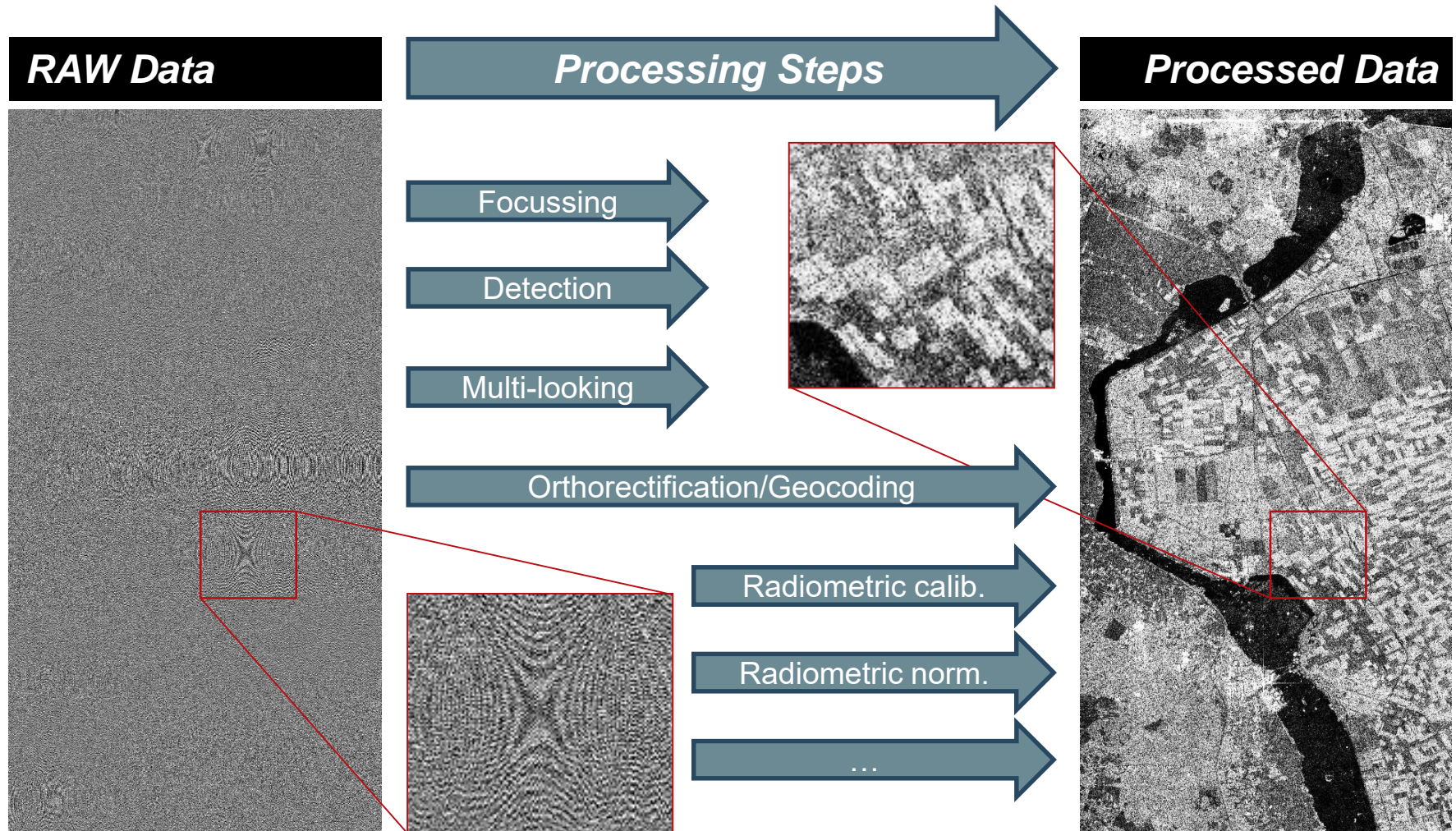


Data processing

SAR Specific Data Formats & SAR Data Processing

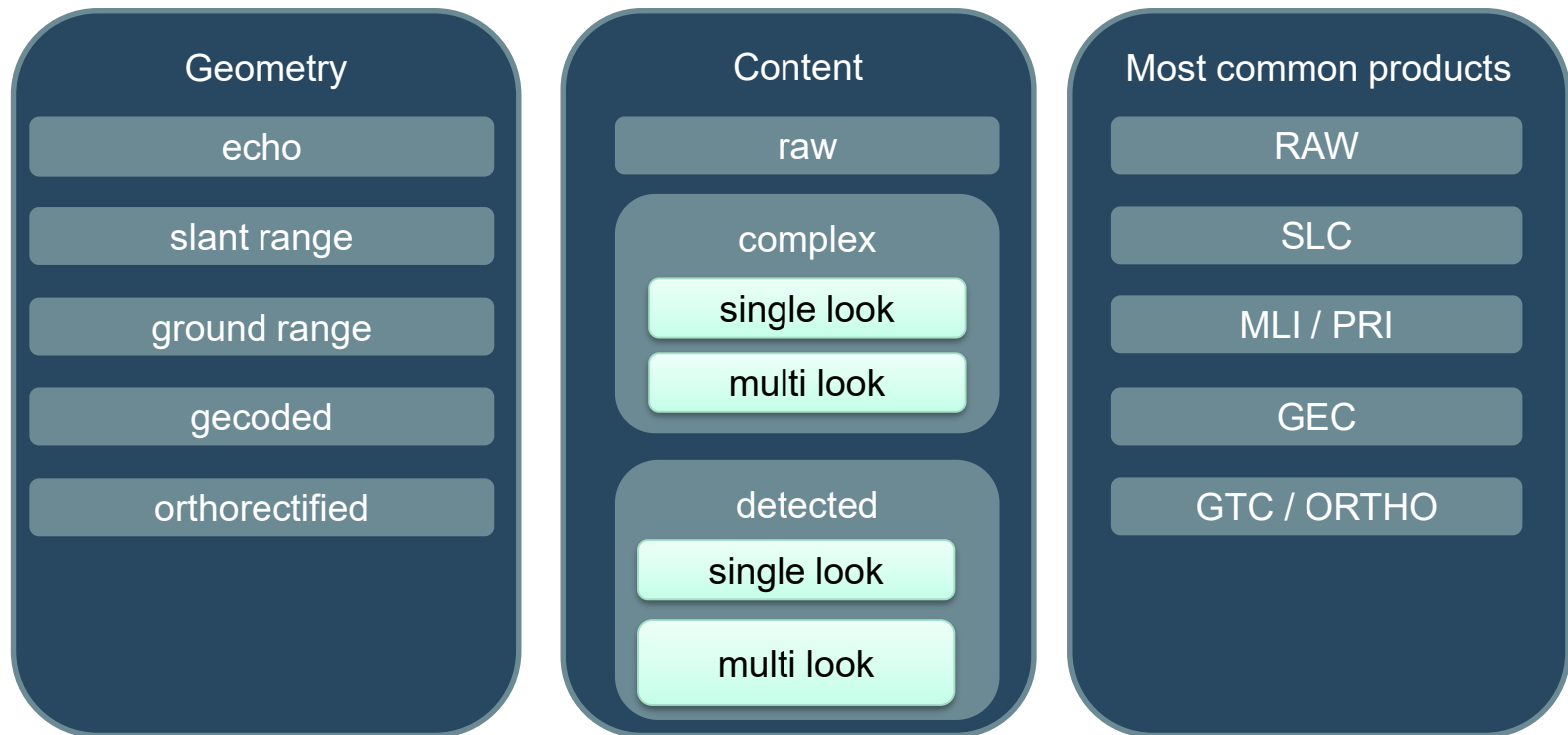
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Educational objective

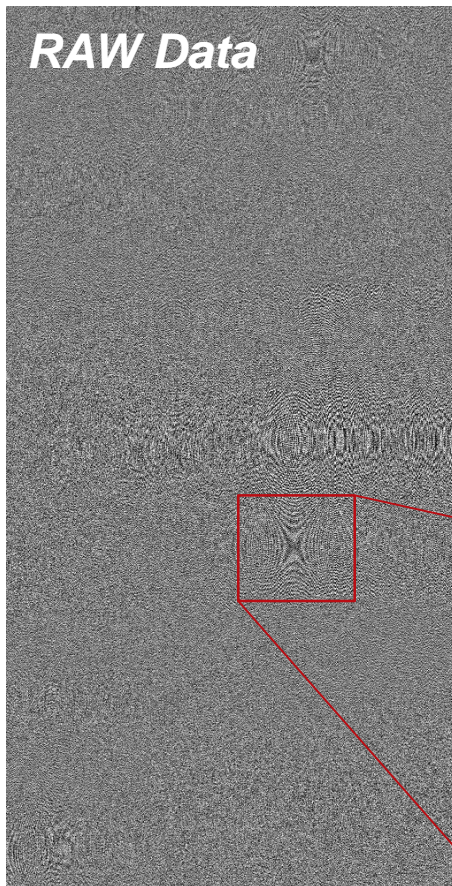


SAR-specific data formats

- Data formats are classified according to their Geometry and the data content:



What is received by the Sensor?

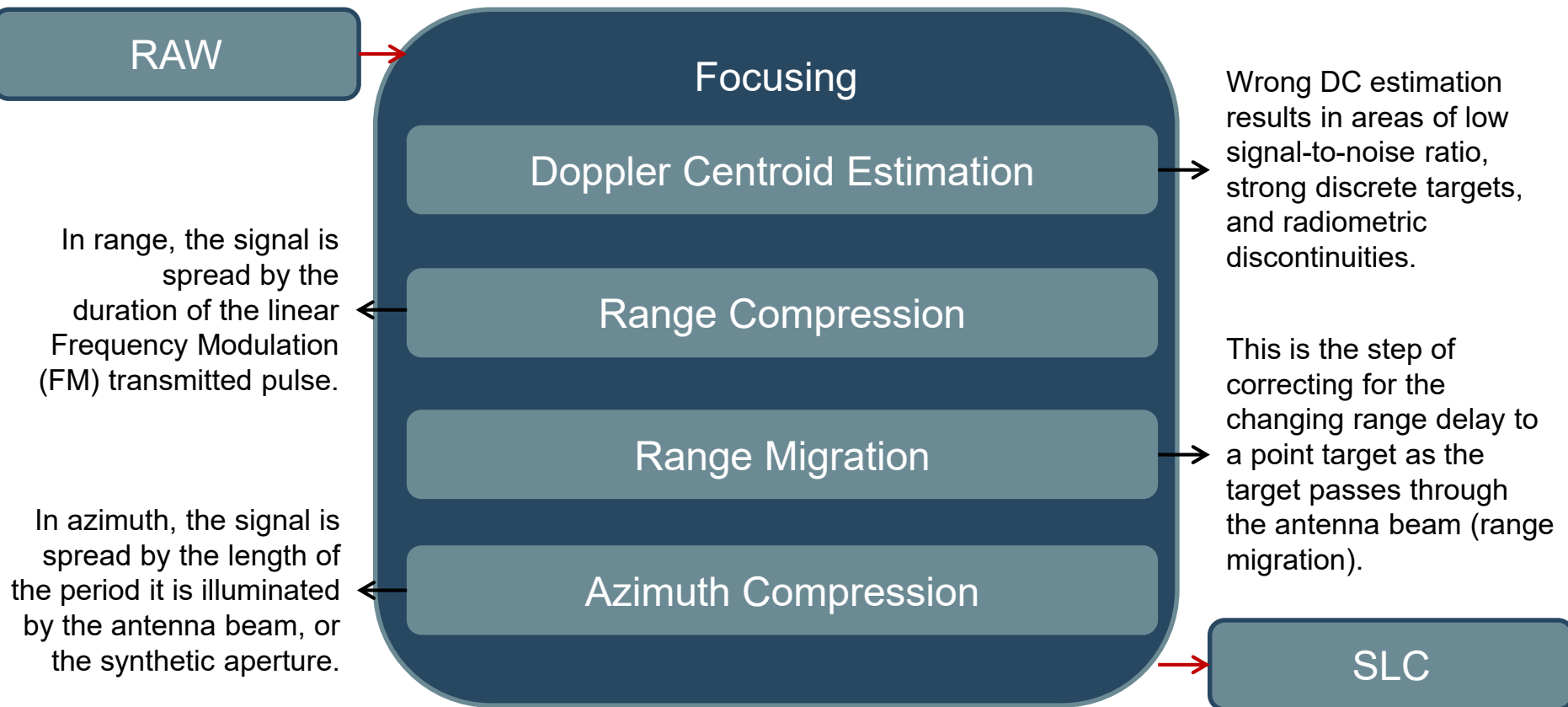


- RAW data is what has been received by the sensor
- Each line is an echo of the radar signal, that has been scattered back to the sensor by targets along the along track position
- Each pixel is a complex value (that consists of a real part and an imaginary part)

Fig. 1: This is Flevoland, a part of the Netherlands from ERS-1.

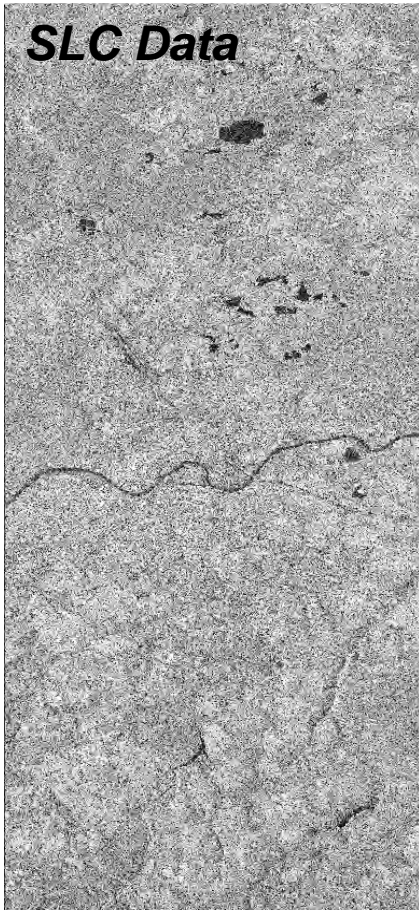
SAR processing

In the raw data, the signal energy from a point target is spread in range and azimuth, and the purpose of SAR focussing is to collect this dispersed energy into a single pixel in the output image (Single Look Complex, or SLC image).



SAR-specific data formats

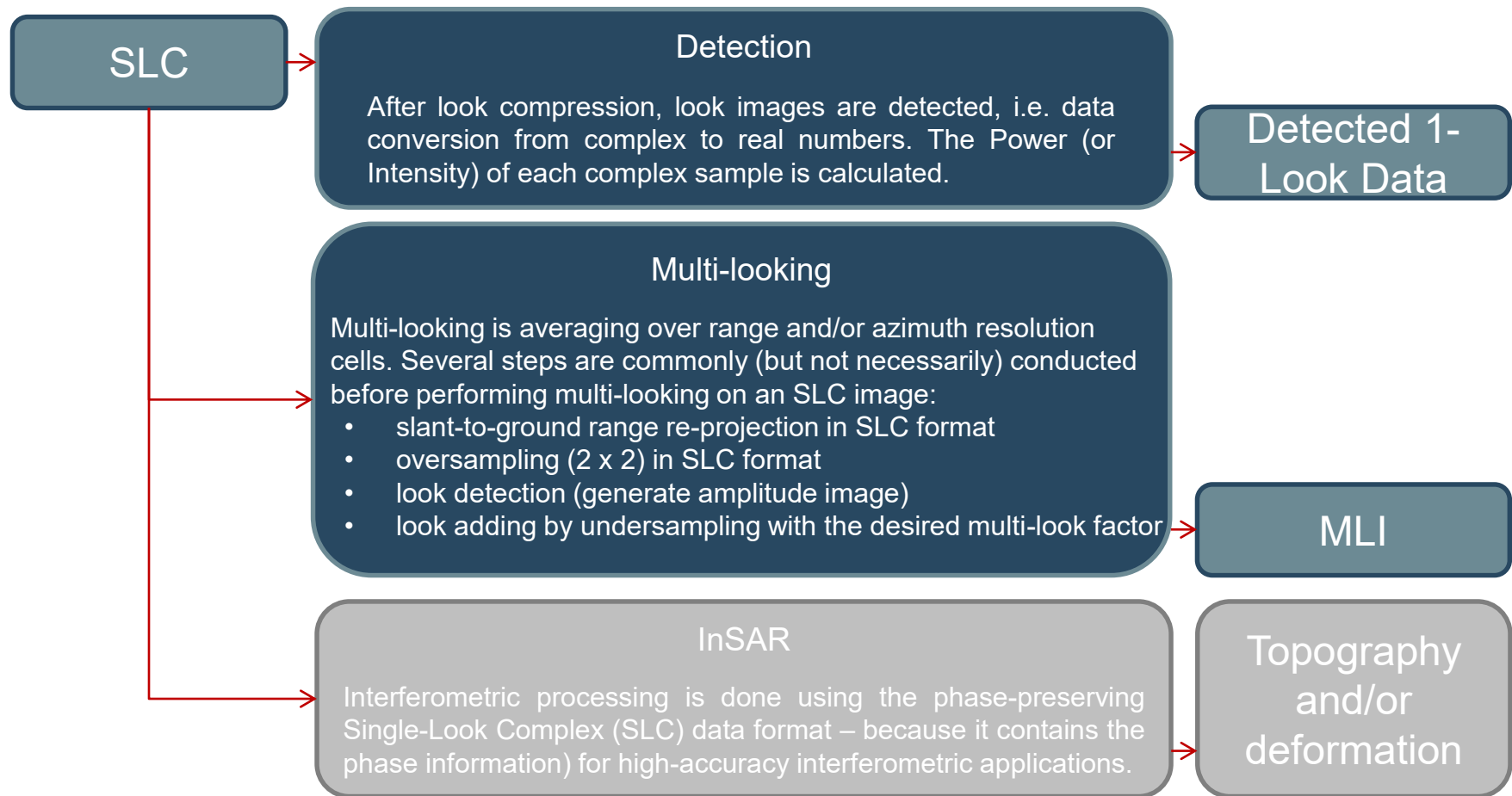
SLC Data



- Single Look Complex (SLC) is the basic single look product of the focused radar signal
- It contains the highest azimuth spatial resolution, but maximum speckle
- Each pixel is a complex number (with a real and an imaginary part)
- SLC images look extremely elongated because of rectangular resolution cell on the ground (range resolution is not constant)
- SLC data remain in slant range coordinates, they are commonly not projected onto any reference surface
- SLCs are intended for use in SAR quality assessment, calibration, and applications requiring the phase

*TSX data are delivered as **Single Look Slant Range Complex (SSC)** products, which are equivalent to the common SLC products available from other SAR satellites, like ERS-1/2, ENVISAT ASAR, RADARSAT-1 and X-SAR/SIR-C.*

SAR processing



SAR processing

Multi-looking

Goal: Speckle reduction and obtaining approximately squared pixels (in ground range resolution).

Recommendation: In order to avoid over- or under-sampling effects in the geocoded image, it is recommended to generate a multi-looked image corresponding to approximately the same spatial resolution foreseen for the geocoded image product.

How to select an appropriate number of looks?

The number of looks is a function of:

- pixel spacing in azimuth
- pixel spacing in slant range
- look angle at scene center

ground range resolution = pixel spacing range /
 $\sin(\text{look angle})$

An Example (ERS-1/2 SAR data):

= 3.99 m

= 7.90 m

= 23°

ground resolution = $7.90 / \sin(23^\circ) = 20.21\text{m}$

-> resulting pixel spacing azimuth: $3.99 \times 5 = 19.95\text{m}$

-> recommended pixel size of geocoded image 20 m

SAR-specific data formats

MLI Data



MLI – Multi-look Intensity

- Produced with commonly between 2 and 6 looks
- Multi-looking is done to find a good trade off between spatial resolution and radiometric variation due to speckle
- Multi-looking is an incoherent procedure
- Each pixel is a real (digital) number that represents the average amplitude of the signal within the pixel
- Commonly in ground range (e.g. TerraSAR-X **MGD - Multi-Look Ground Range Detected Format**)
- Reference surface for ground-projection used to produce MLI (no full geocoding though!), but range resolution is constant

SAR-specific data formats

PRI – Precision Image

- Produced by resampling MLI images into square pixels, rotating to account for the view direction of the instrument and warping by some predefined operation so that the projected image pixels are properly georeferenced onto some geographical coordinate system
- Not geocoded yet
- Still topographic distortion

SAR-specific data formats

ORTHO

- high precision terrain corrected geocoded image product
- ORTHO product is represented in map geometry.



SAR processing

Radiometric adjustment

➤ Further radiometric corrections, compensating for effects of local pixel scattering area and local incidence angle on the local backscatter, can be carried out. Two different kinds of radiometric corrections; **radiometric calibration** and **normalization**:

- Radiometric calibration: standardized backscatter “units”
- Radiometric (topographic) normalisation: corrects for topographic effects

Metadata

- Metadata include all important image and image acquisition parameter
- Metadata are stored in text format, e.g. xml format
- SAR image files always come with a metadata file
- Some examples of important information contained in a metadata file:
 - sensor (e.g. TerraSAR-X, PALSAR HH, ...)
 - acquisition date
 - range samples
 - azimuth lines
 - range looks
 - azimuth looks
 - image format (e.g. FCOMPLEX)
 - image geometry (e.g. slant range, ...)
 - range pixel spacing
 - azimuth pixel spacing
 - radar frequency
 - doppler polynomial
 - ...