"Lab 3: Synthetic Aperture Radar"

(**S**ynthetic **A**perture) **R**adar remote sensing is commonly distinguished by complex and less intuitive characteristics, especially when compared to optical remote sensing. This complexity can be associated to data acquisition and image formation as well as interpretation and application-specific processing. This lab is designed to give familiarity to basic processing and interpretation concepts germane to **side-looking spaceborne SAR**s.
We will perform the analyses on a stripmap scene collected by C-SAR instrument onboard Sentinel-1A. It is required that the SeNtinel's Application Platform (SNAP) is installed on your computer. Links and information on SNAP and Sentinel data may be found in the slides *SatGeo_GEOENGINE_SAR_LAB*.

Part I: Understanding SAR Data

a) Dawnload the Slant Range, **S**ingle **L**ook **C**omplex (**SLC**) scene *S1A_S3_SLC__1SSV_20190831T105841_20190831T105855_028812_03439D_B2D6* from *Ilias*, and open the **compressed** file in SNAP's environment.

b) SAR image scenes are oriented the same way they are acquired. Choose the co-polarized intensity band (Bands >Intensity_VV), and based on the given information in the tab *Pixel Info*, identify the motion direction of the satellite (i.e. ascending versus descending) as well as the near range and far range of the scene. Briefly explain your rationale, please.

c) Open the *World View* (View >Tool Windows >World View), and considering your answers to the previous section, conclude if C-SAR instrument has a left- or right-looking antenna. What combination(s) of satellite pass direction and side-looking antenna preserve(s) the scene orientation?

Part II: SAR Image Preprocessing

a) Subset (Raster >Subset) the image using the specified coordinates below, and apply radiometric calibration on the new subset (Radar >Radiometric >Calibrate). You may use the default parameters.

scene start: X = 2000, Y = 3500
scene end: X = 19011, Y = 20000

b) Multilooking is mainly designed for enhancing the SLC products. The goal is to obtain **approximately squared pixels** considering the **ground** (not slant!) range resolution and azimuth resolution. The number of looks, hence, is a function of

- pixel spacing in azimuth,
- pixel spacing in range, and
- incidence at scene center.

Find these parameters for Sentinel-1 **S**trip **M**ap (**SM**) mode in the *Metadata* (Product Explorer >[3] subset_0_of_...._Cal >Metadata >Abstracted Metadata). Identify the number of range looks and azimuth looks which need to be averaged to produce a **G**round

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Range, Multilook, **D**etected (**GRD**) product of pixel size 42.154945 m.
(hint: Derive the incidence at scene center from the near and far incidence angles.)

c) Multilook the image, and make sure to set the processing parameters in accordance to your answers to the preceding question. Then apply *Lee Sigma* filter to the resultant image and notice the Speckle reduction effect in each step.

d) Perform *Range-Doppler Terrain Correction* on the multilooked scene (filename ending in _Cal_ML) using the SRTM 3 sec DEM. Notice that we drop the speckle filtered product (filename ending in _Cal_ML_Spk) out of the processing chain due to the excessive degradation of spatial resolution.

Part III: SAR Data Analysis and Interpretation

a) How would you explain the indirect edges in the GRD output (filename ending in _Cal_Ml_TC)?

b) Given the land cover information in figure 1, justify the high backscatter intensity values to the east and south east of the Gulf of Urabá.

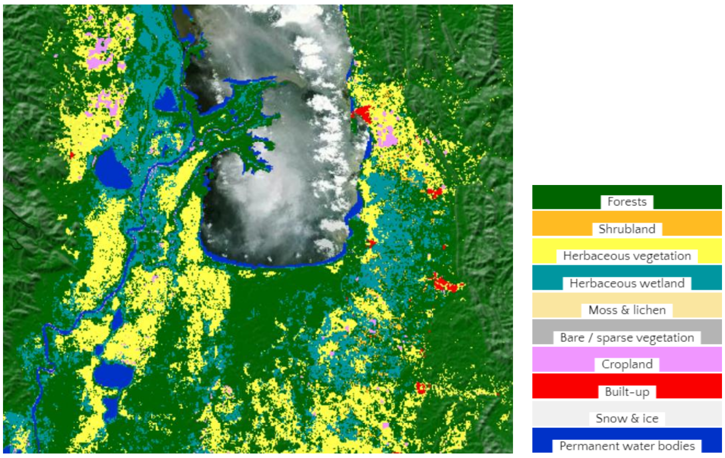

Figure 1: Land Cover, Gulf of Urabá, Colombia (source: lcviewer.vito.be)

c) Convert Sigma0_VV into dB, and try to analyze the image histogram in the *Colour Manipulation* window. Select values which separate water and (mainly) wetland from the rest of the scene, and generate two masks accordingly.

d) Open the *Mask Manager* and overlay both masks onto Sigma0_VV_db. Export the view as kmz, and open the file in Google Maps.

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