Determining Radar Cross Section with SNAP

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1. GRD Images (I)

- Download GRD Image from https://scihub.copernicus.eu/dhus/#/home, e.g.
  S1A_IW_GRDH_1SDV_20211226T154945_20211226T155010_041182_04E4C2_FFE0
- Open SNAP tool (e.g. V7)
- File→Open Product
- Generate subset to make further calculations faster:
  - Generate Screen Browse Image by Bands→Amplitude VV
  - Zoom in using “Hand” tool and scroll wheel
  - Raster → Subset
- Calibrate image by converting to sigma-0
  - Select subset product
  - Radar→Radiometric→Calibrate (Select sigma-0 for Output)
- Select calibrated product, Generate image: bands, VV-Channel
  - Scale display: Color manipulation, min=0, max=3
- Each pixel value now contains the sigma-0 value [m2/m2]. 1 means 100% diffuse reflection. To convert sigma-0 of one pixel to RCS, it must be multiplied with the pixel area.
  Pixel area can be found in Product → Metadata → Abstracted Metadata → range_spacing, azimuth_spacing.
  Both are 10 m in Zyprus GRD product.

1. GRD Images (II)

- Rough guess of RCS from RCS
  - Find CR by coordinates, zoom in – DOUBLE CHECK - and draw a small rectangle containing the CR and its side-lobes. E.g. 5x5 pixels. This will generate a shape in the product → Metadata → geometry structure.

  - Open Analysis→Statistics
  - Select the rectangle using the selection tool
  - Activate the geometry in the Analysis Window, press refresh → Statistics will appear

  - Interpretation:
    - The mean backscatter in the mask is 0.6402
    - The total RCS+Clutter in the 110 pixels is
      - RCS+CL = 110 * 100 m2 * 0.6402 = 38.4 dB (looks good!)
  - Now estimate the background clutter away from the peak:
    - The mean clutter sigma-0 in mask is 0.0832 (-10.8 dB)
  - Correct the peak for the Clutter power
    RCS = 10log10(110*100m2*(0.6402-0.0832)) = 37.87 dB
  - **Check: 1.5 m Trihedral = 38.3 dB**

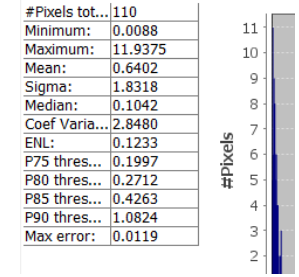
$$\sigma = \frac{4\pi\ L^4}{3\ \lambda^2}\ [m^2]$$

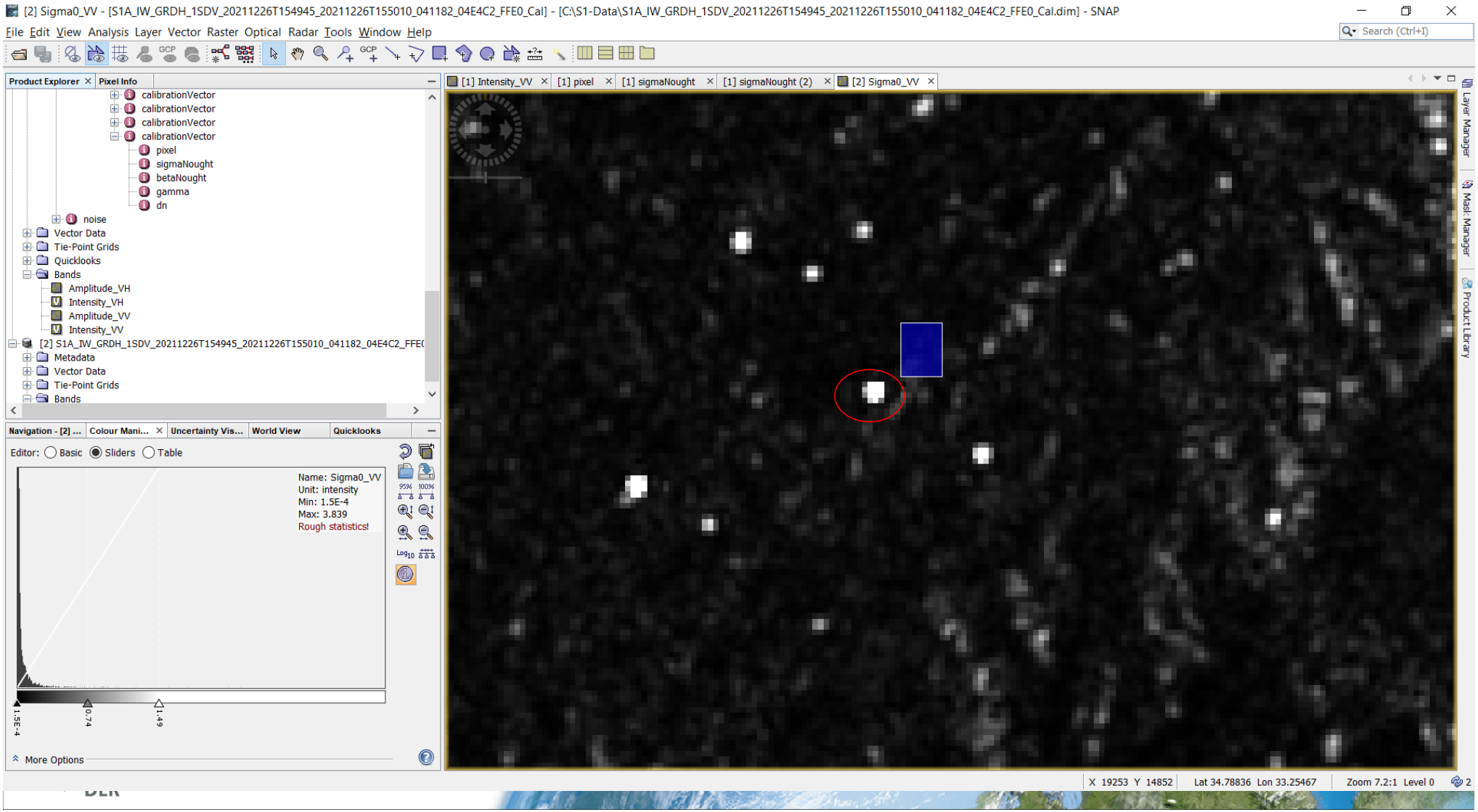
Sigma0_VV with ROI-mask **g**

#Pixels tot...	70
Minimum:	0.0152
Maximum:	0.2807
Mean:	0.0832
Sigma:	0.0604
Median:	0.0657
Coef Varia...	0.7203
ENL:	1.9273
P75 thres...	0.1042
P80 thres...	0.1158
P85 thres...	0.1395
P90 thres...	0.1796
Max error:	2.6551E-4

Sigma0_VV with ROI-mask **geometry**

#Pixels tot...	110
Minimum:	0.0088
Maximum:	11.9375
Mean:	0.6402
Sigma:	1.8318
Median:	0.1042
Coef Varia...	2.8480
ENL:	0.1233
P75 thres...	0.1997
P80 thres...	0.2712
P85 thres...	0.4263
P90 thres...	1.0824
Max error:	0.0119




[2] Sigma0_VV - [S1A_IW_GRDH_1SDV_20211226T154945_20211226T155010_041182_04E4C2_FFE0_Cal] - [C:\S1-Data\S1A_IW_GRDH_1SDV_20211226T154945_20211226T155010_041182_04E4C2_FFE0_Cal.dim] - SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Search (Ctrl+I)
Product Explorer
Pixel Info
calibrationVector
calibrationVector
calibrationVector
calibrationVector
pixel
sigmaNought
betaNought
gamma
dn
noise
Vector Data
Tie-Point Grids
Quicklooks
Bands
Amplitude_VH
Intensity_VH
Amplitude_VV
Intensity_VV
[2] S1A_IW_GRDH_1SDV_20211226T154945_20211226T155010_041182_04E4C2_FFE
Metadata
Vector Data
Tie-Point Grids
Bands
Navigation - [2] ...
Colour Mani...
Uncertainty Vis...
World View
Quicklooks
Editor: Basic Sliders Table
Name: Sigma0_VV
Unit: intensity
Min: 1.5E-4
Max: 3.839
Rough statistics!
1.5E-4
0.74
1.49
More Options
[1] Intensity_VV
[1] pixel
[1] sigmaNought
[1] sigmaNought (2)
[2] Sigma0_VV
Layer Manager
Mask Manager
Product Library
X 19253 Y 14852
Lat 34.78836 Lon 33.25467
Zoom 7.2:1 Level 0

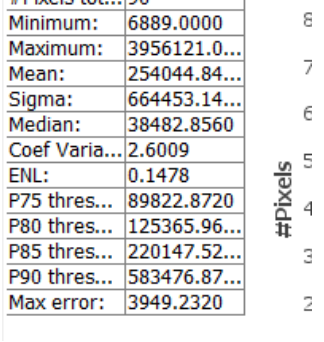
Doublecheck: Repeat in GRD Intensity image

- Coordinates: 19198, 14837 (34.78618, 33.24908)
- RCS = (90*100m2*254044.8)/Cal2=103.6 dB – 10log(600^2)= 93.6dB – 55.56dB = 38,03dB (OK)

Calibration constant (600) guessed from lists in Metadata.

Intensity_VV with ROI-mask **ge**

#Pixels tot...	90
Minimum:	6889.0000
Maximum:	3956121.0...
Mean:	254044.84...
Sigma:	664453.14...
Median:	38482.8560
Coef Varia...	2.6009
ENL:	0.1478
P75 thres...	89822.8720
P80 thres...	125365.96...
P85 thres...	220147.52...
P90 thres...	583476.87...
Max error:	3949.2320



II. SLC Images

- In my SNAP versions 7 and 8 wrong geographic coordinates are shown and I am not able to locate the CR