

Do It Yourself 2

Representations of polarimetric information

The objectives of this second *Do It Yourself* concern the representation of the polarimetric properties of scatterers or media.

1. COLOR CODED POLARIMETRIC IMAGES

PolSARpro permits to create color coded images representing some characteristics of POLSAR data sets. Among the various possibilities, two representations, named Pauli and Lexicographic color coding, are generally used.

1.1 Lexicographic color coding

A symmetric scattering matrix can be represented under the form of a 3-element target vector whose elements are associated to the polarimetric channels HH, VV and HV.

The square moduli of the different channel information can be coded onto the blue, red and green colors respectively in order to build an image whose color indicate their relative magnitude.

- Set the main input directory to `~/PSP_demo/DATA/Frisco` in order to select the imported San-Francisco image.
- Click Display→[T3]→Create RGB file, the display selection widget appears
- Select the Sinclair decomposition and run

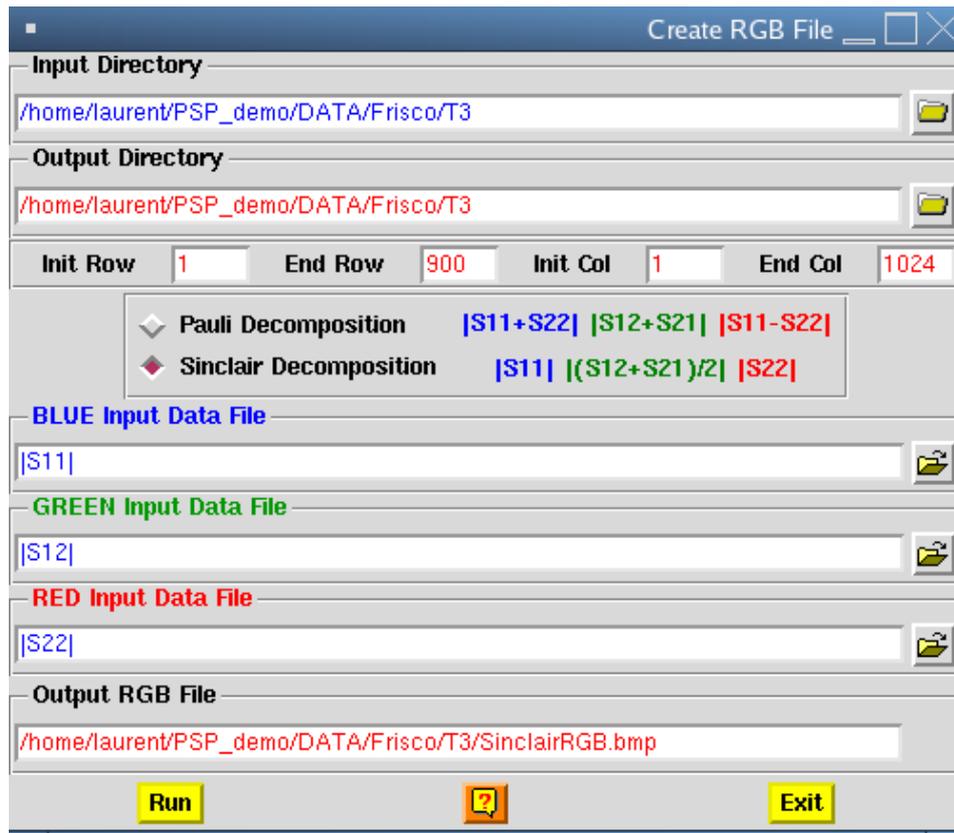


Figure 1

An RGB color coded image, PSP_demo/DATA/Frisco/SinclairRGB.bmp , has been created and is displayed in the following figure

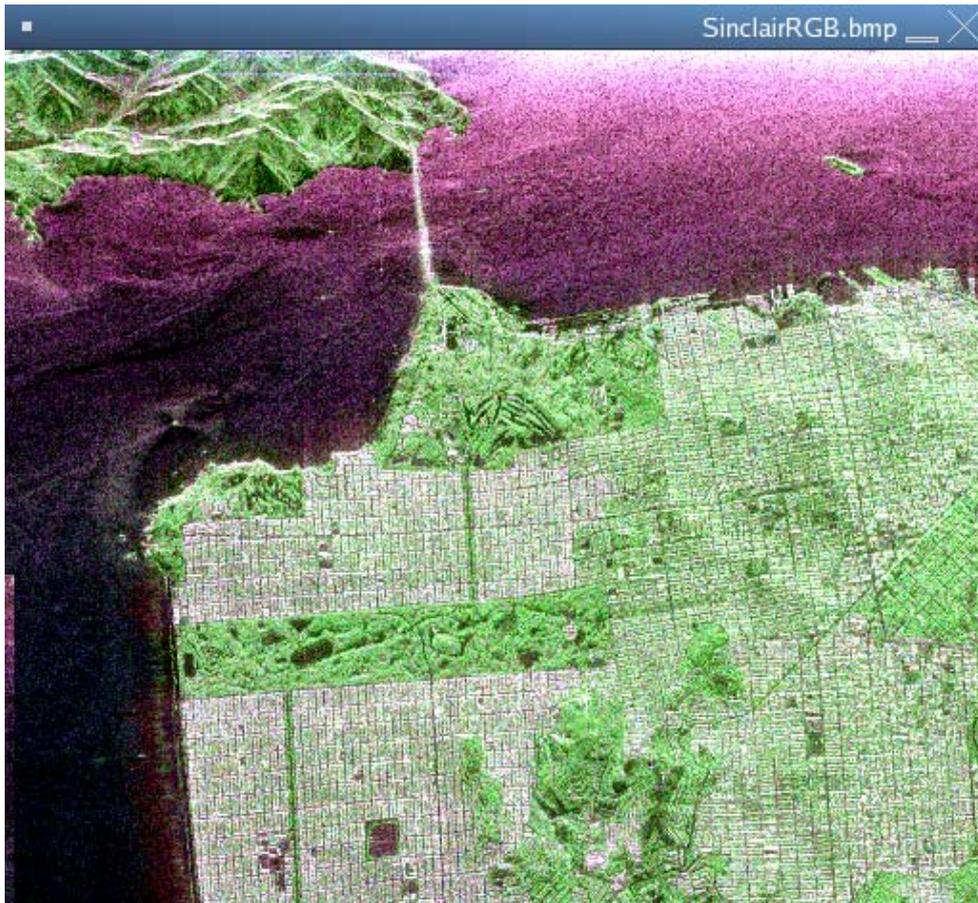


Figure 2 Lexicographic color coded image

Several interpretations can be derived from the observations of the lexicographic color coded image.

- Over the sea, the pink-purple color indicates that the HV component magnitude is small compared to other channels. The relative magnitude of HH and VV is hard to appreciate, but it seems that the VV component magnitude is slightly more important than the HH one (reddish color)
- Over forested areas, the green color indicates a dominant HV component, generally characteristic of vegetated zones.
- Over the built up areas, the dominant colors are white and green. White pixels correspond to equal amplitude over all polarimetric channels.

Remark:

One has to keep in mind that color-coded images only provide indications on the polarimetric properties of the observed scene and should be used to perform a polarimetric characterization:

- The different channels are scaled according to their own dynamic
- The displayed information only concerns backscattered intensities and does not take into account the polarimetric correlation information

- The interpretation of color mixture is very subjective

1.2 Pauli color coding

The Pauli color coding is based on a vector representation of linear combinations of scattering matrix elements. The resulting polarimetric channels $HH+VV$, $HH-VV$, HV are then associated to the blue, red and green colors respectively.

- Set the main input directory to `~/PSP_demo/DATA/Frisco` in order to select the imported San-Francisco image.
- Click `Display→[T3]→Create RGB file`, the display selection widget appears
- Select the Pauli decomposition and run

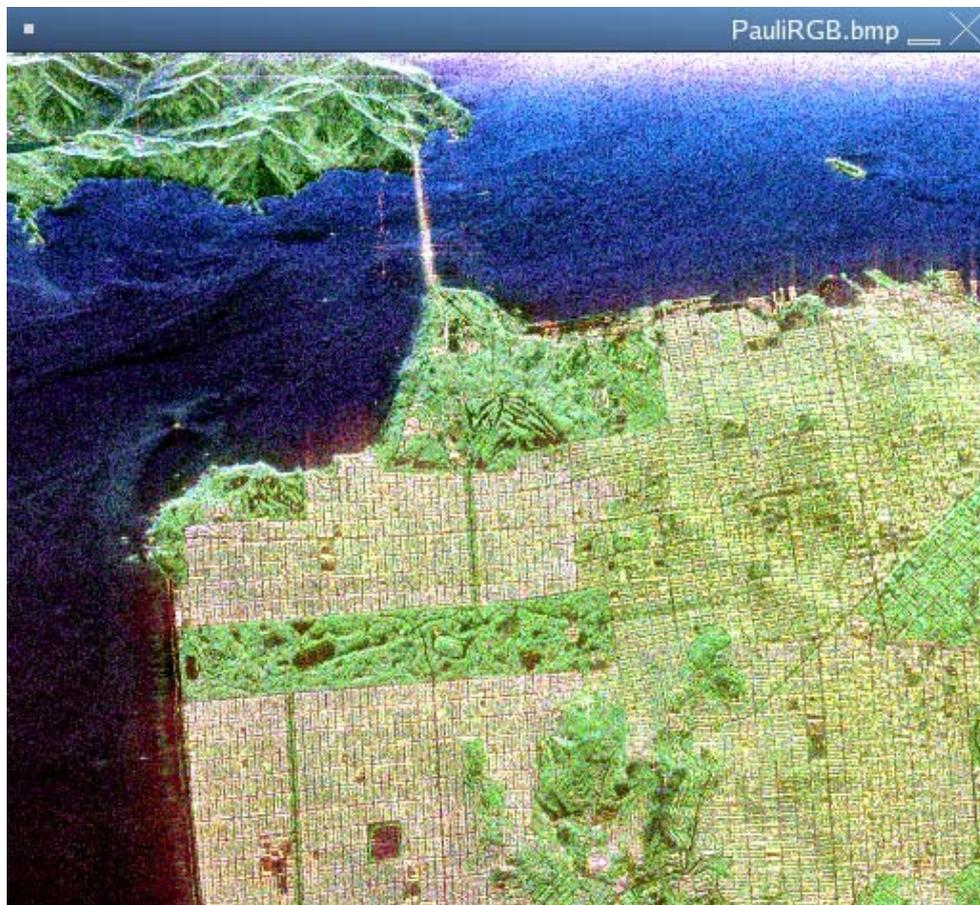


Figure 3 Pauli color coded image

Similarly to the Lexicographic color coding, interpretations may be derived from the observation of the Pauli color coded image.

- The sea appears blue on the image. This indicates that the first polarimetric channel, $HH+VV$, magnitude large compared to others, i.e. the amplitude of HV is weak and the phase argument of $HHVV^*$ is close to zero. This is characteristic of scattering over a surface.

- Over forested areas, the green color indicates a dominant HV component, generally characteristic of vegetated zones.
- Over the built up areas, the dominant colors are white and red. White pixels correspond to equal amplitude over all polarimetric channels, whereas red indicates that the phase argument of HHVV* is close to π , and denote a wave double bounce reflection.

Remark:

One has to keep in mind that color-coded images only provide indications on the polarimetric properties of the observed scene and should be used to perform a polarimetric characterization :

- The different channels are scaled according to their own dynamic
- The displayed information only concerns backscattered intensities and does not take into account the polarimetric correlation information
- The interpretation of color mixture is very subjective

2. POLARIMETRIC SIGNATURE

The polarimetric signature of a scatterer permits to fully describe its polarimetric properties. The signature is represented by the co- and cross-polarized wave intensities, computed for all possible polarization states, parameterized by the polarization ellipse aperture and orientation.

- Set the main input directory to ~/PSP_demo/DATA/Frisco
- From PolSARpro main window, click Process→T3→Single data set→Polarimetric signature : the polarimetric signature widget appears
- When invited, open the Pauli and select an area over the sea.
- Select the Mesh & contour drawing style and a linear scale

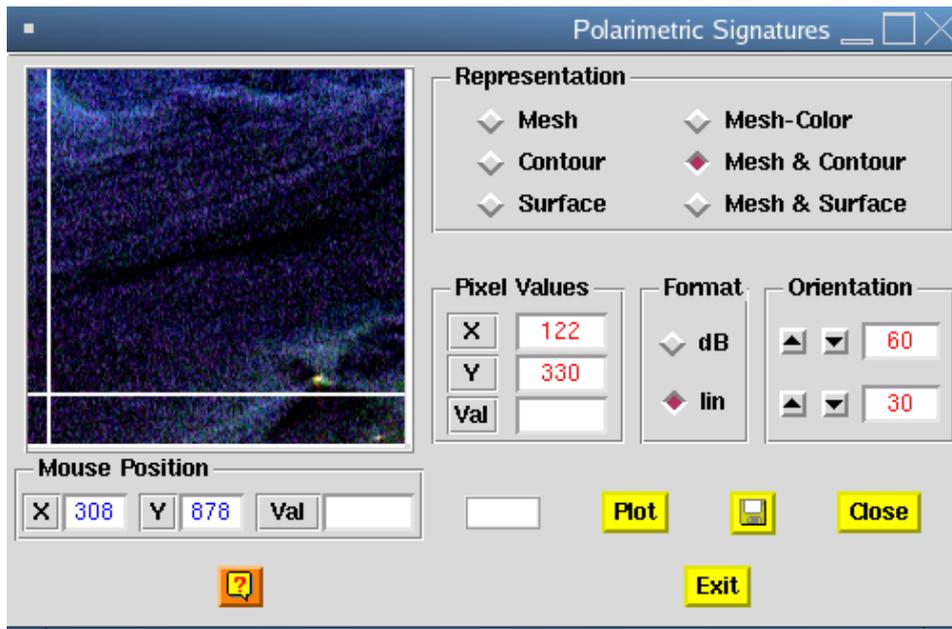
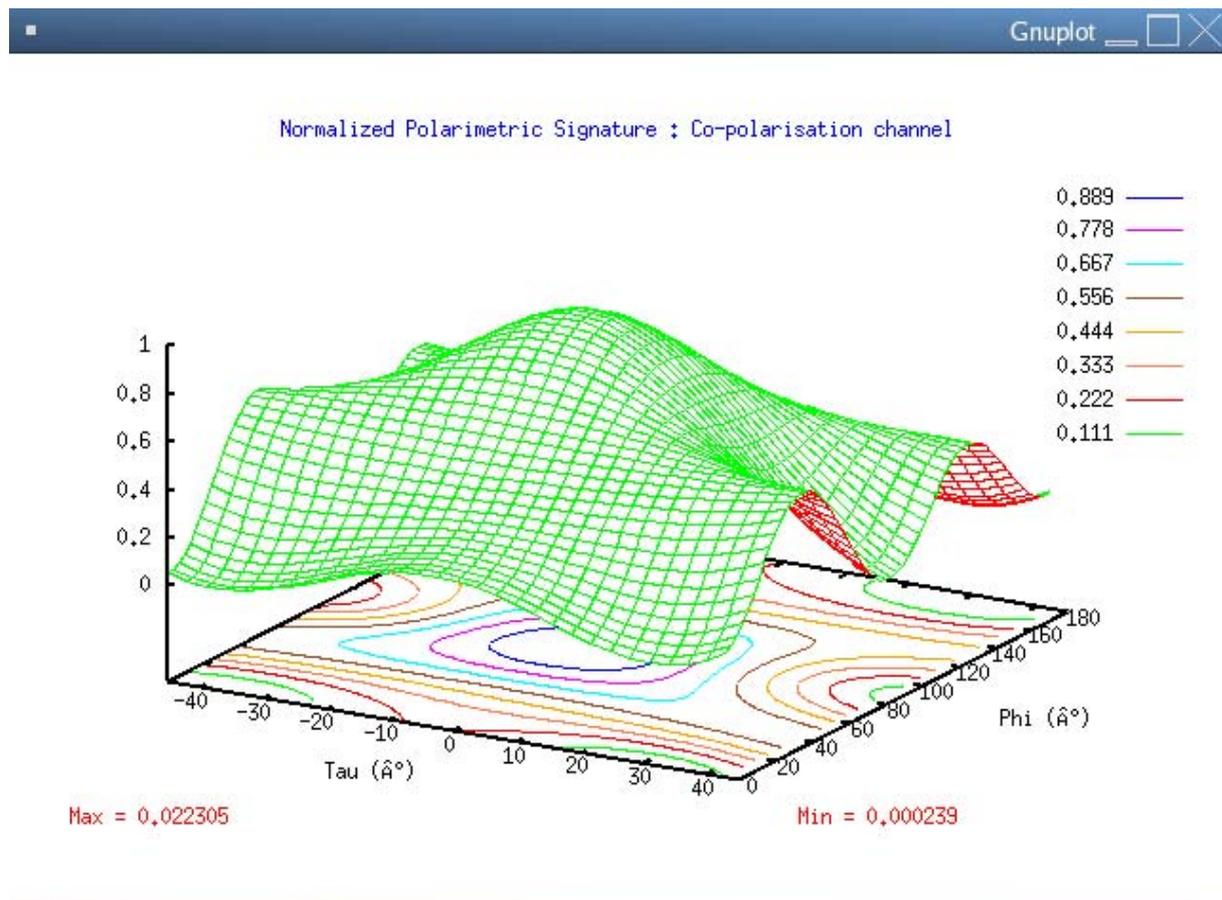


Figure 4

- Click an plot to draw the co- and cross-polarization signatures



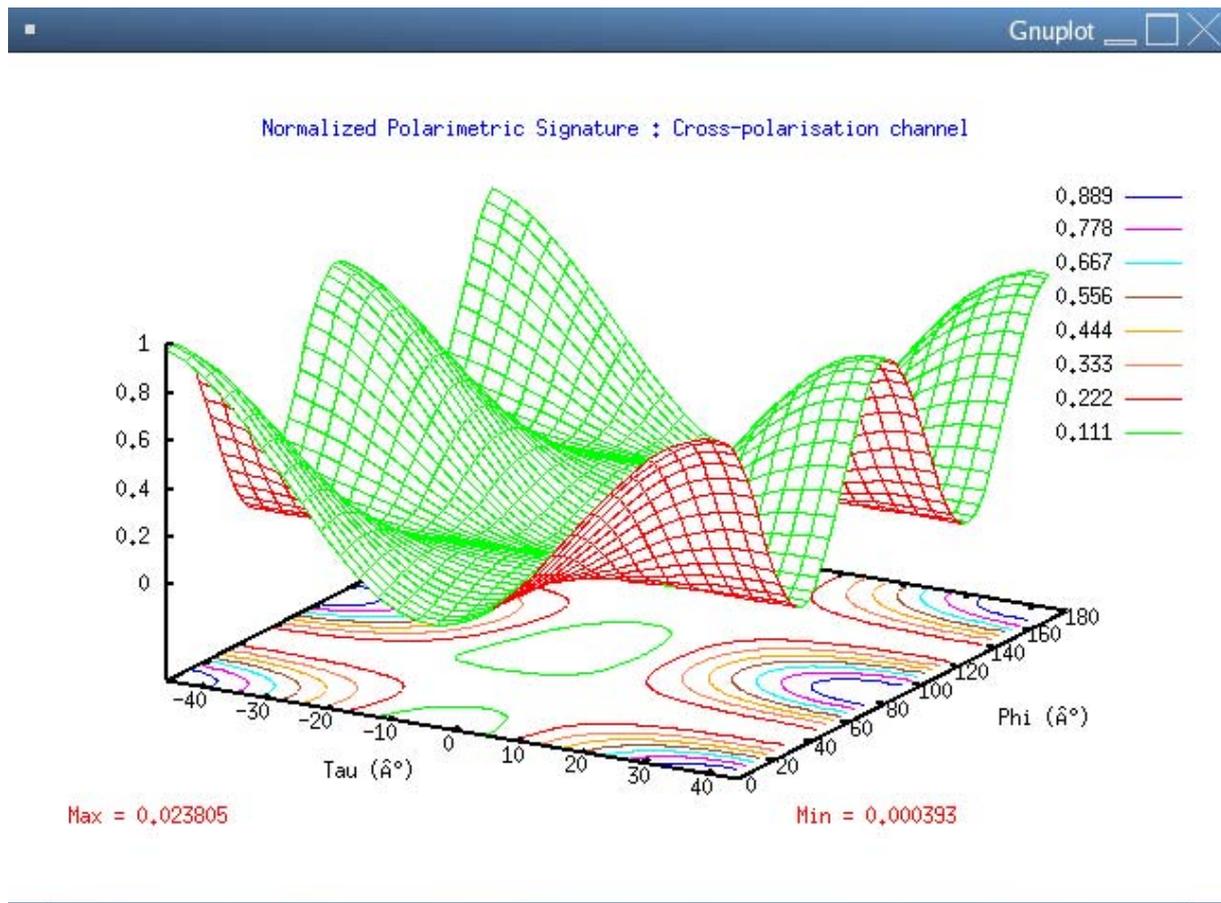


Figure 5

3. CHANGE OF POLARIZATION BASIS

Several POLSAR remote sensing applications require a change of polarization basis (azimuth slope and roughness estimations ...). PolSARpro permits to perform a change of polarization basis in a very simple way.

- From PolSARpro main window, click Process→T3→Single data set→Elliptical basis change→ Elliptical
- Set tau =20° and phi=30°, run
- A new directory, ~/PSP_demo/DATA/Frisco_ELL/T3, containing [T3] matrices in the elliptical basis is created

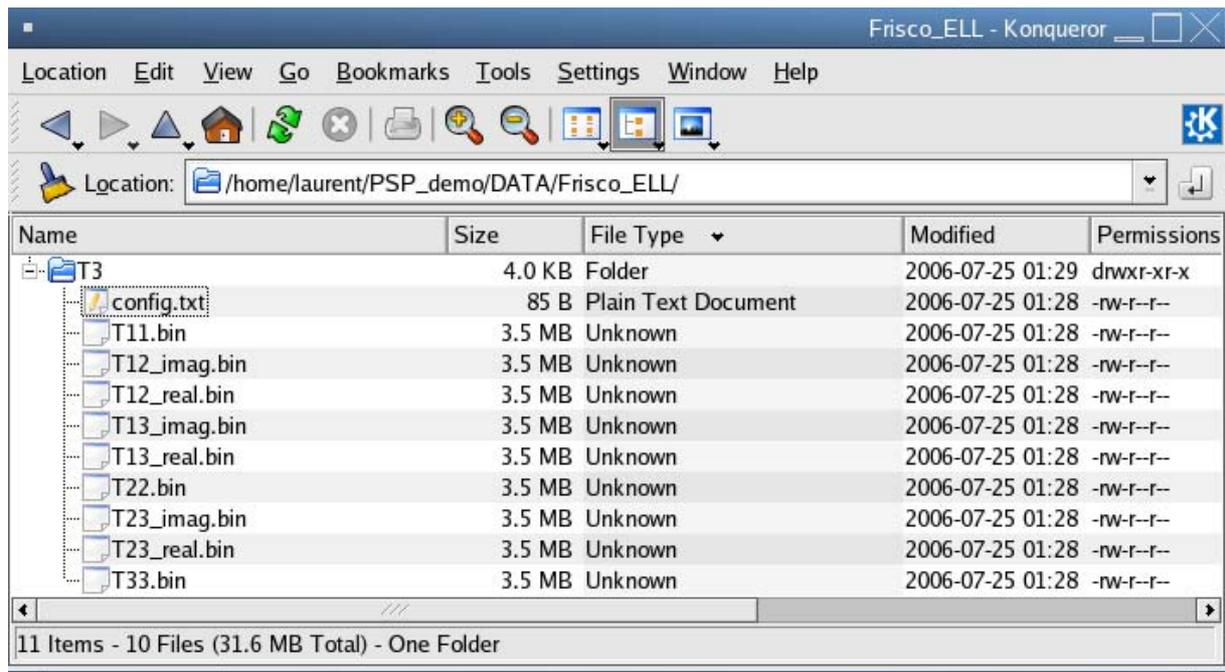


Figure 6

- Create a Pauli image. This image really looks different from the one in the original H-V basis. (Particular basis may be used to enhance some polarimetric behaviors).

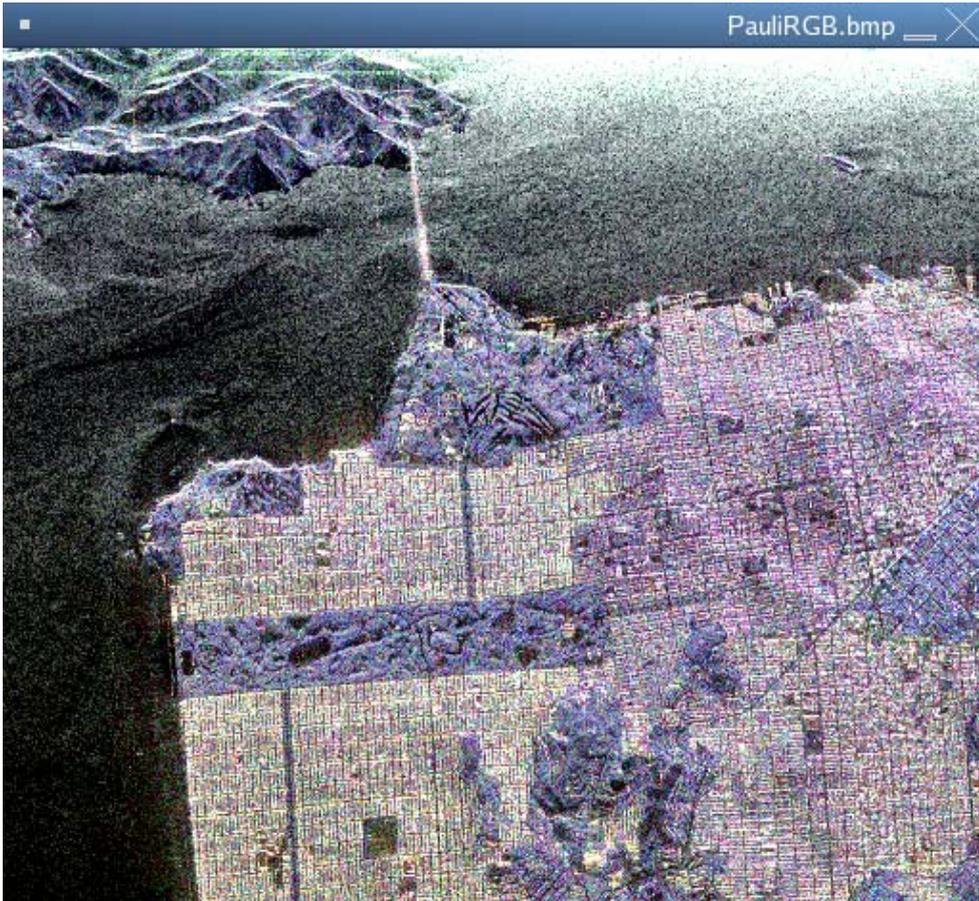


Figure 7