

Introduction to PolSARpro Toolbox (Practical Session D2P2)

Eric POTTIER - Laurent FERRO-FAMIL

University of Rennes 1



A Bit Of History



The initiative development of **PolSARpro Software** is a direct result of recommendations made during the **POLinSAR 2003 Workshop** held at ESA-ESRIN in January 2003.



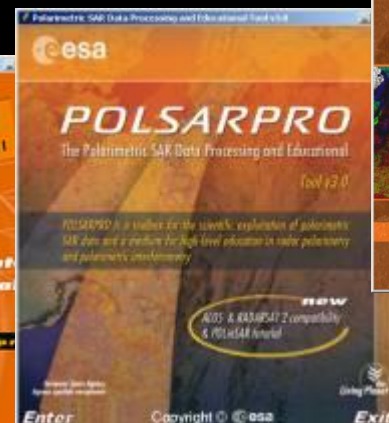
2003



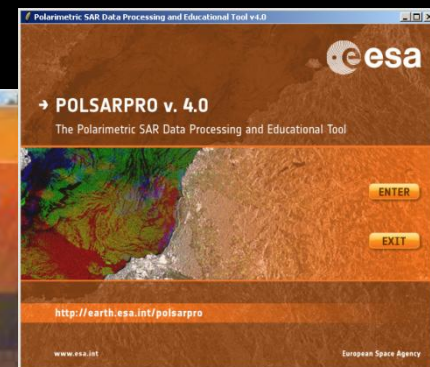
2004



2006



2007

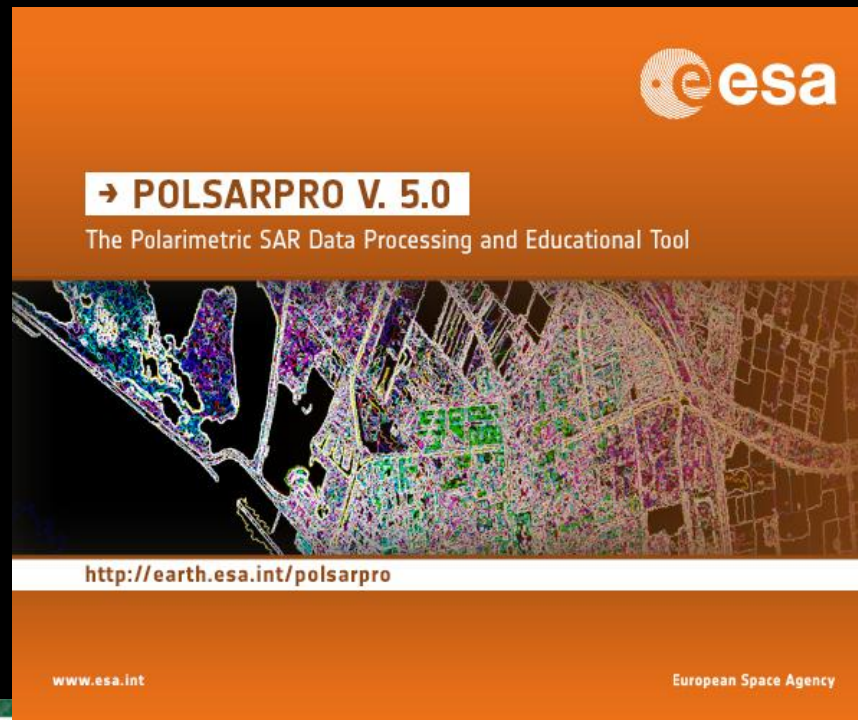


2009

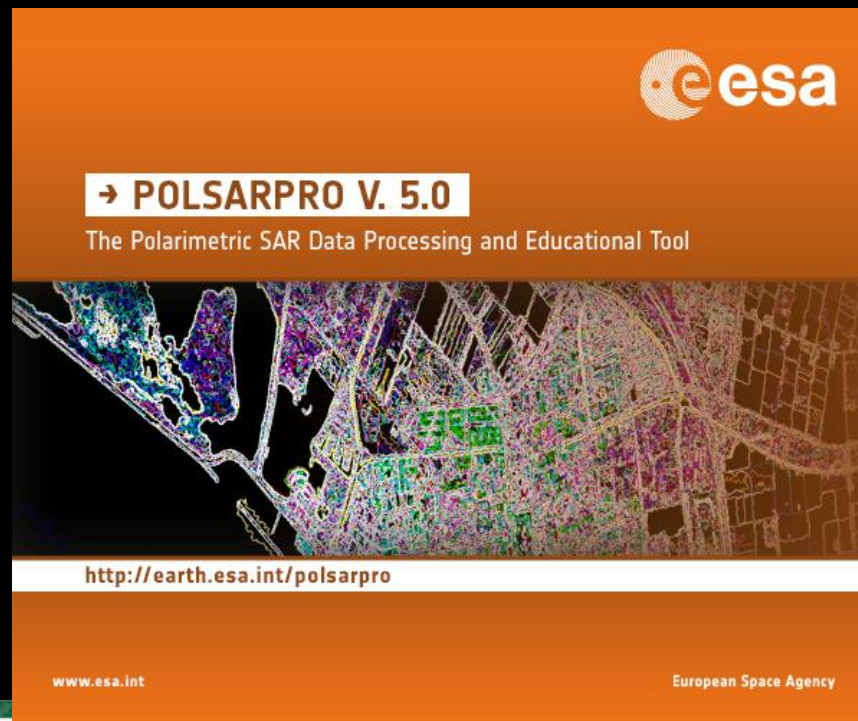
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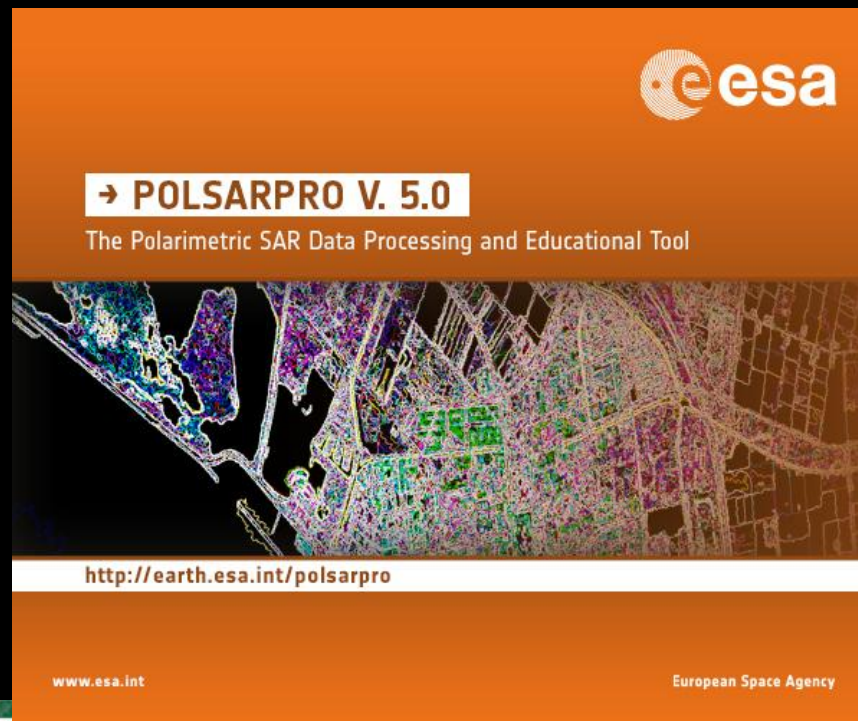
Tool specifically designed to handle :
Polarimetric data
and
Polarimetric Interferometric data.



Educational Software offering a tool for
self-education
in the field of **POLSAR** and **POL-InSAR**
data processing and analysis.

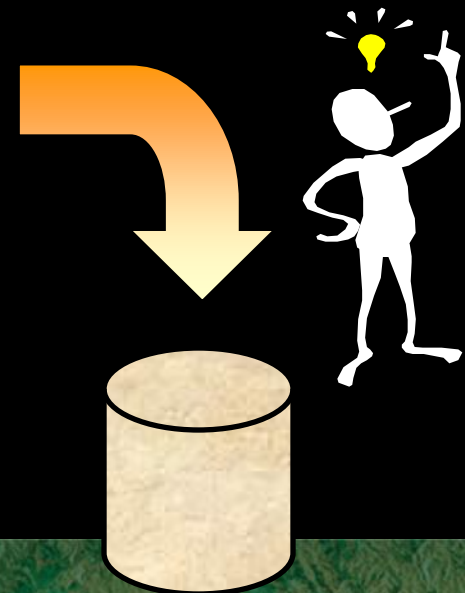
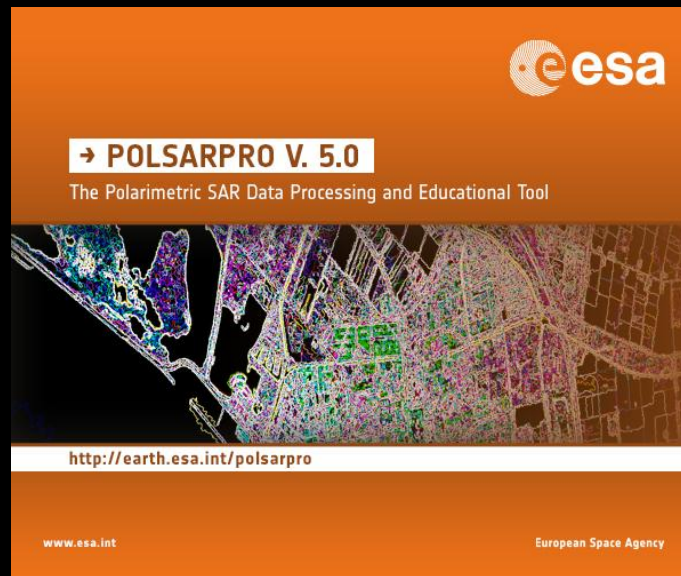
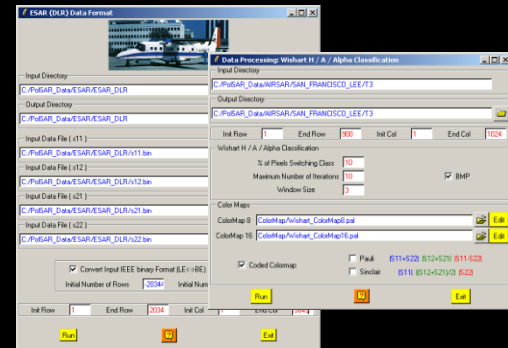


Developed to be **accessible** to :
a wide range of users
from **novices** to **experts**
in the field of **POLSAR** and **POL-InSAR**.



MODULAR STRUCTURE

Each element of the Software (**a function**) can be **extracted** and **incorporated** individually into **users'** own processing software.



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OPEN SOURCE DEVELOPMENT

PolSARpro v5.1 Software is made available following the:

Open Source Software Development (OSSD) approach, and follows the:

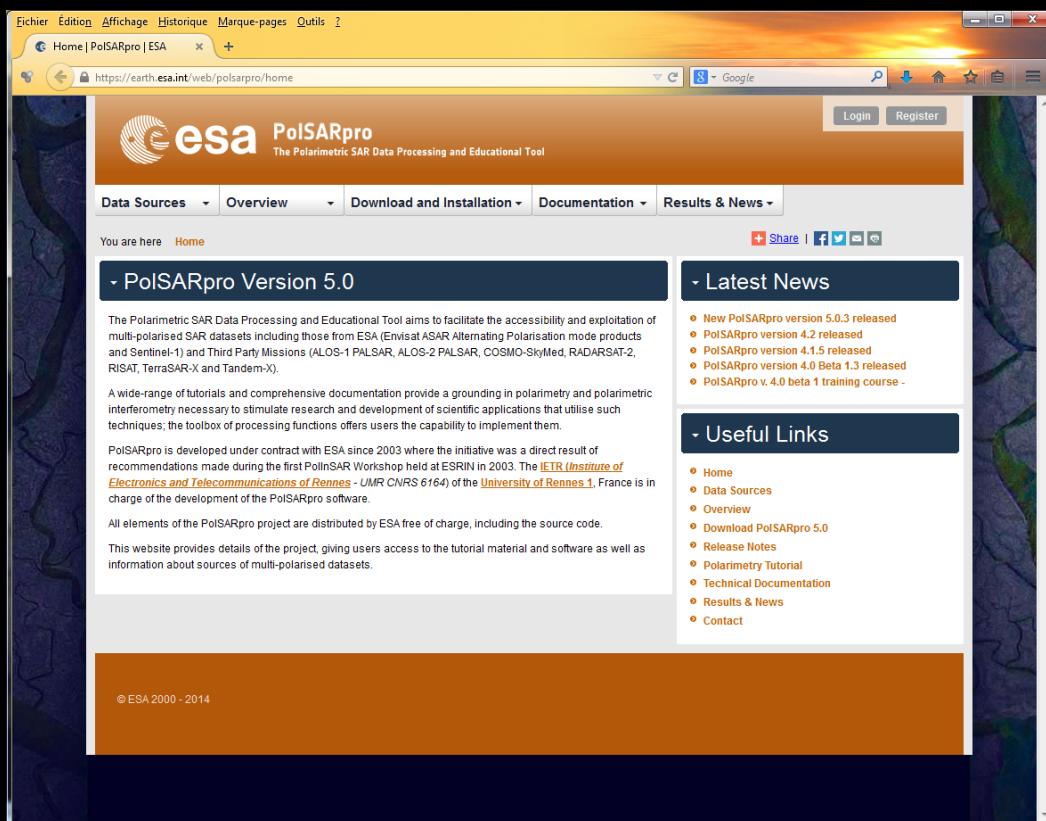
GNU General Public License v2 – June 1991.

PolSARpro v5.1 Software runs today on Windows and Linux platforms

<http://earth.esa.int/web/polsarpro/home>

The Web Site provides

- Details of the project
- Access to the tutorial and software
- Information about status of the development
- **Demonstration Sample Datasets**



New!

v5.1 (January 2017)

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PolSARpro v5.0 Contributors

Universities

- Universitat Politècnica de Catalunya (SP) (C. Lopez Martinez)
- University of Illinois at Chicago (US) (W.M. Boerner)
- Niigata University (JP) (Y. Yamaguchi, S.G. Park)
- Universidad de Alicante (SP) (J.M. Lopez Sanchez)
- ETH Zurich (CH) (I. Hajnsek, A. Marino)
- Indian Institute of Technologies, Bombay (Y.S. Rao)
- Harbin Institute of Technology, Dept.I.E (L. Zhang)
- University of Tor Vergata (IT) (M. Lavallo)
- University of Pisa (IT) (R. Paladini)
- University of Tohoku - Sendai (JP) (M. Sato)
- Universite Paris Est - Marnes la Vallee (FR) (P.L. Frison)
- University of Tsinghua (CN) (J. Yang, W. An, Y. Cui, J. Chen)
- Polimi - Milan (IT) (S. Tebaldini)
- Technische Universitat Berlin (DE) (D. D'Hondt, S. Guillaso)

Research Centers

- Applied Electromagnetic Consultants (UK) (S.R. Cloude)
- Institute of Electronics - CAS (CN) (W. Hong, Y. Li, M. Xiang)
- Institute of Forest Resources Information Techniques - CAF (CN) (E. Chen, Z. Li)
- Marc Williams Consultants (AU) (M. Williams)
- GIPSA Lab - UMR 5216 (FR) (G. Vasile)
- Center of Studies in Resources Engineering (IN) (Y.S. Rao)
- Jet Propulsion Laboratory - NASA (US) (S. Hansley, J.J. Van Zyl)
- Naval Research Laboratory (US) (T. Ainsworth, J.S. Lee)
- National Resources Canada (CA) (R. Touzi)
- Center for Earth Observation and Digital Earth - CAS (CN) (X. Li, C. Wang)
- Remote Sensing Technology Center of Japan (JP)
- Alaska SAR Facility (US) (R. Gens, D.K. Artwood)
- SERTIT (FR) (H. Yesou)
- Office National d'Etudes et de Recherche Aérospatiales (FR) (E. Colin)

Agencies

- Japan Aerospace Exploration Agency (JP) (M. Shimada)
- Deutsches Zentrum für Luft- und Raumfahrt (DE) (I. Hajnsek, K. Papathanassiou, A. Reigber)
- Canadian Space Agency (CA) (S. Chalifoux, D. Delisle)
- Centre National d'Etudes Spatiales (FR) (J.C. Souyris)

Version 5.0.3 (October 2014)

Exit

International Collaborative Project

14 Universities

14 Research Centers

4 Space Agencies



**Tsinghua University
China**



**National Space Science Center,
CAS, China**



**University of Mining and
Technology, China**



Fudan University, China



Wuhan University, China



**Studies in Resources Engineering
Indian Institute of Technology**



**Satellite Surveying and Mapping
Application Center, China**



**Universidade Federal de Alagoas
Brazil**



Xidian University, China



**University of Science and
Technology, Poland**



**Harbin Institute of Technology
China**



**University of Tehran, School of
Surveying and Geospatial
Engineering, Iran**



**Key Lab of Microwave Remote
Sensing, CAS, China**

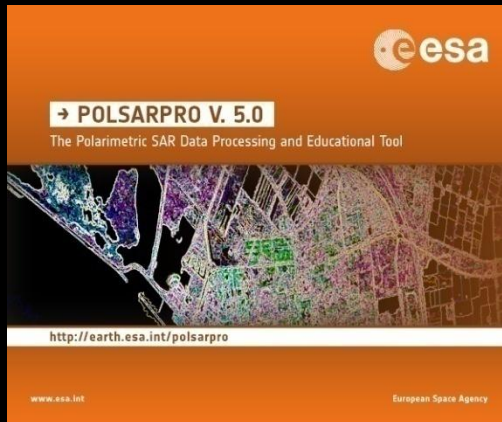


**Khajeh Nasir Toosi University of
Technology, Iran**



Dual-Pol / Quad-Pol Sensors

PolSARpro v5.1 SOFTWARE



AIRSAR



ONERA



SETHI



EMISAR



PISAR

NASDA
CRL



ESAR - FSAR



CONVAIR



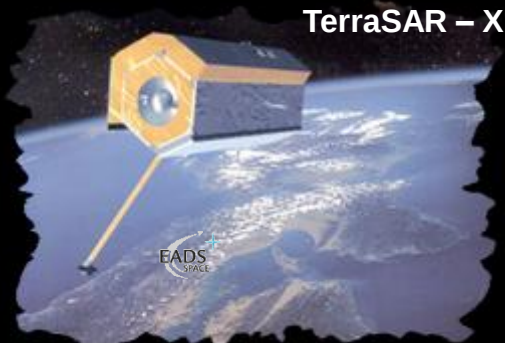
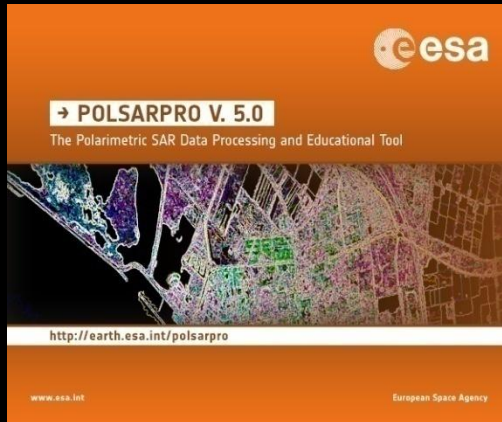
UAV-SAR

PolSARpro v5.1 Software offers the possibility to handle and convert polarimetric data from a range of well established **polarimetric airborne platforms.**

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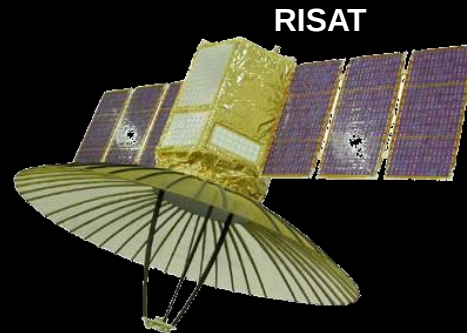
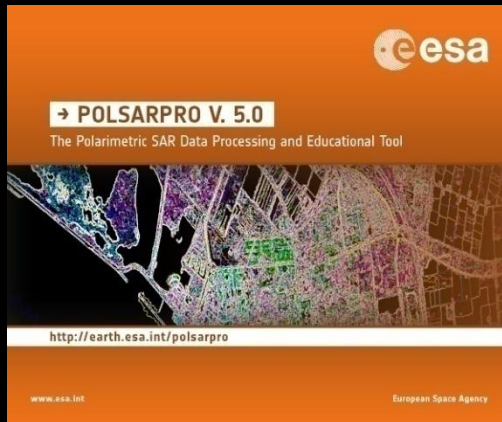
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PolSARpro v5.1 SOFTWARE



PolSARpro v5.1 Software offers the possibility to handle and convert polarimetric data from a range of well established **polarimetric spaceborne platforms.**

PolSARpro v5.1 SOFTWARE

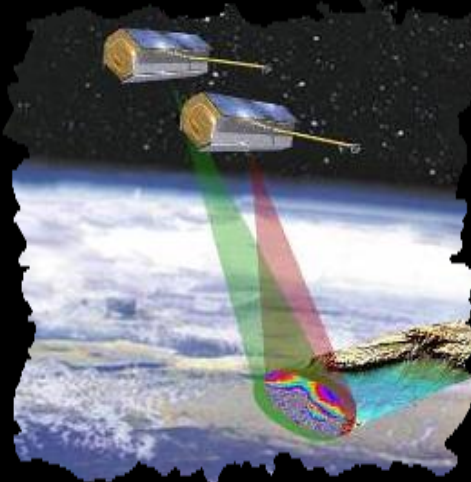


RISAT



SENTINEL 1A

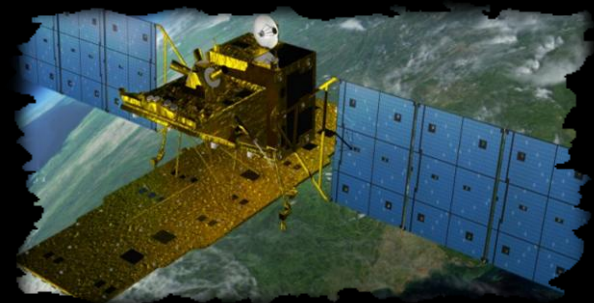
TANDEM-X



COSMO - SKYMED



ALOS-2 – PALSAR



PolSARpro v5.1 Software offers the possibility to handle and convert polarimetric data from a range of well established **polarimetric spaceborne platforms.**

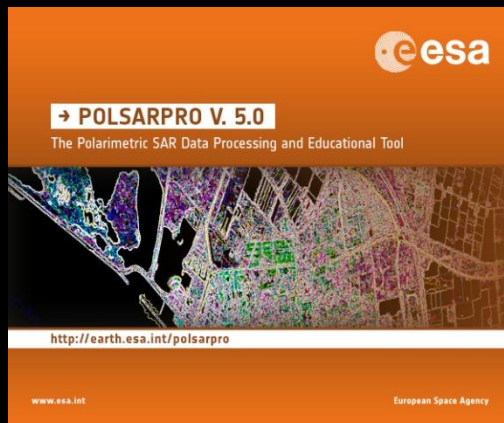
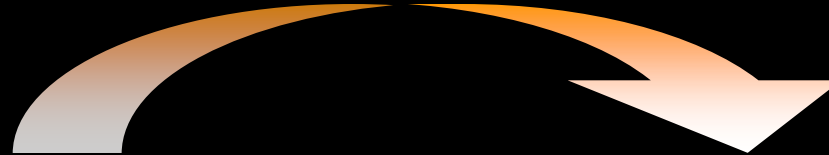
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External Softwares



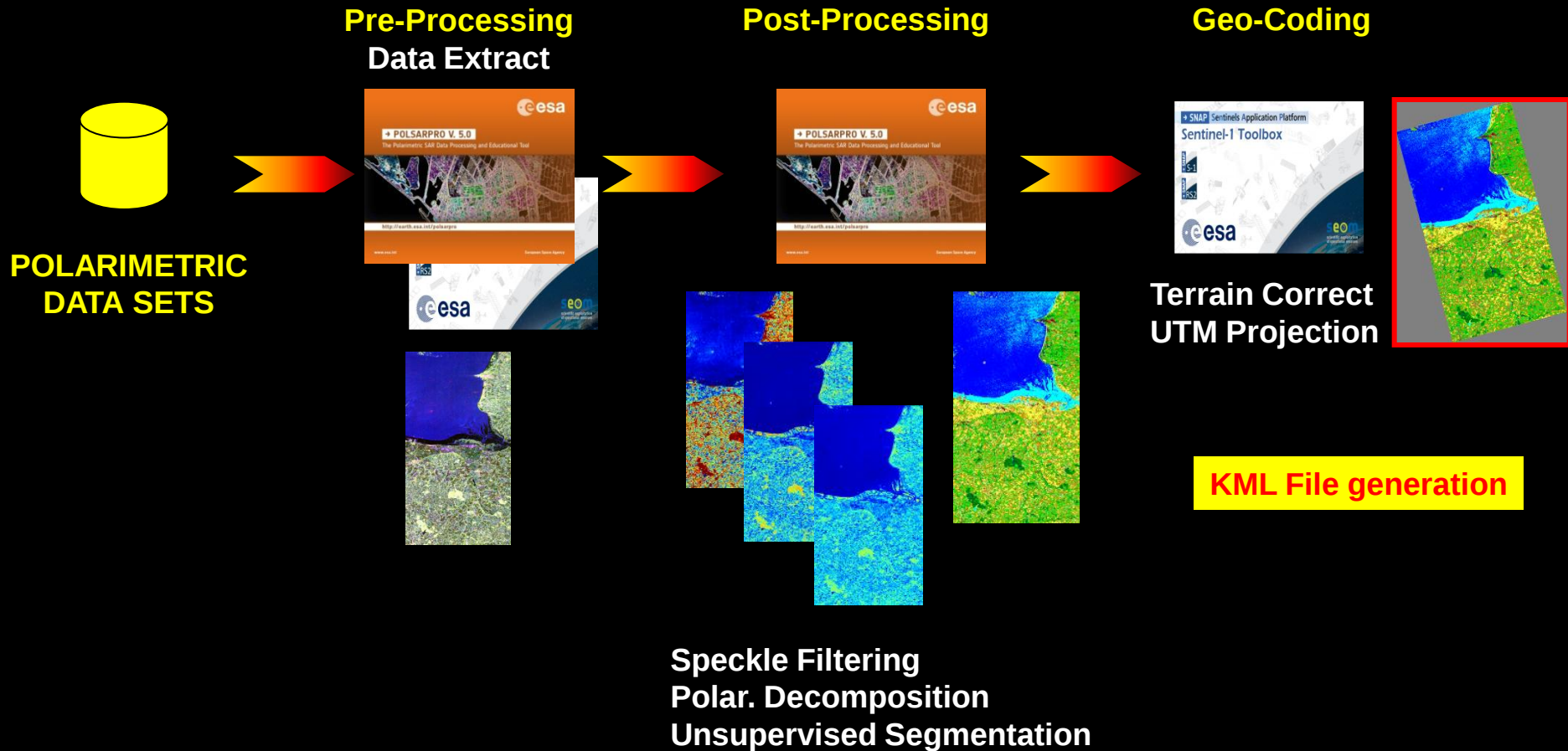


Polarimetric Data Processing

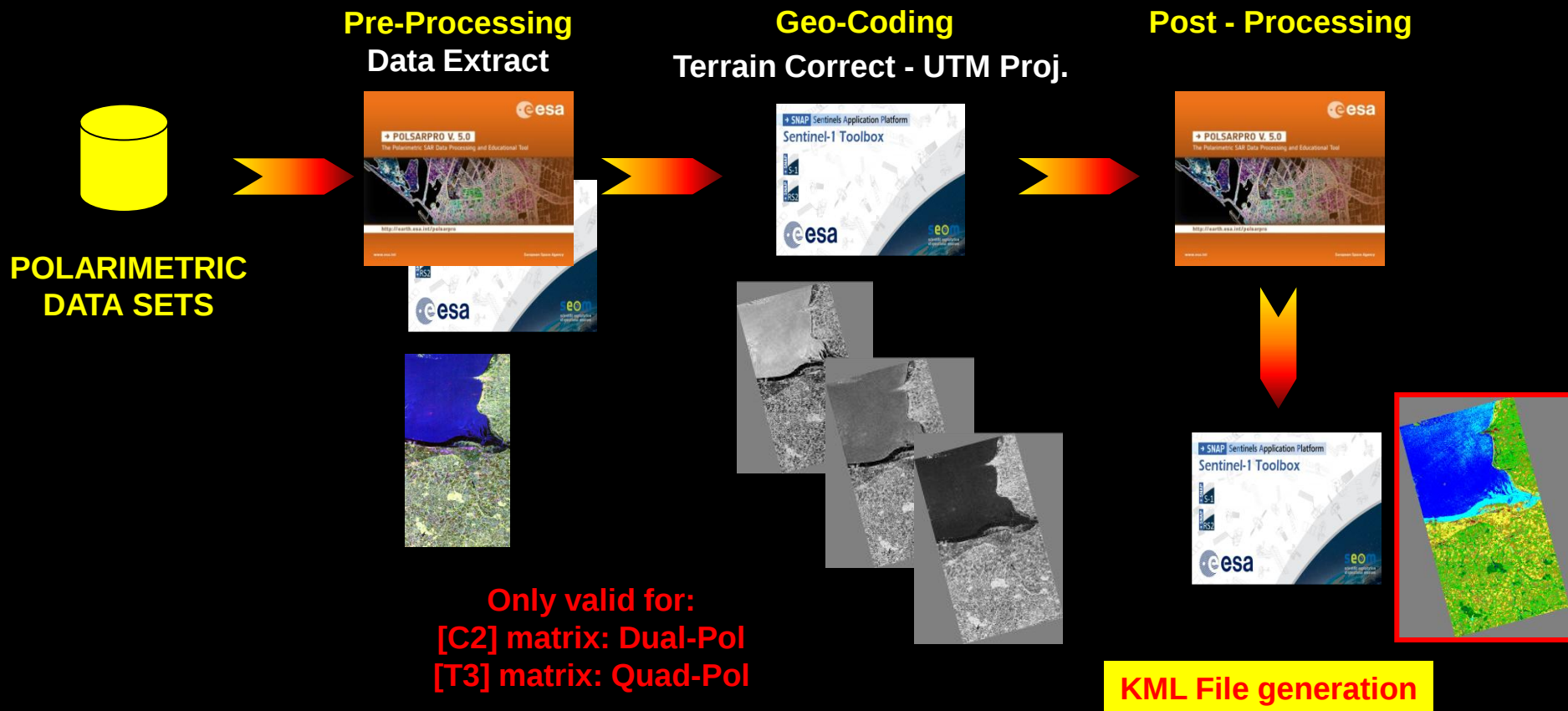


- S1 toolbox (split, deburst, merge ...)
- Geocoding toolbox
- Interferometric toolbox
(co-registration, flat Earth estimation ...)

ESA - SNAP



ESA - SNAP

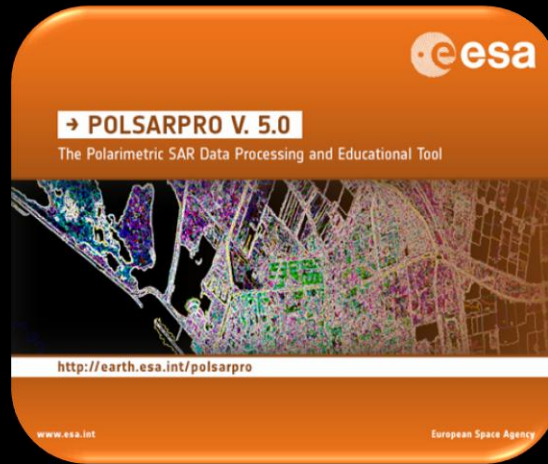




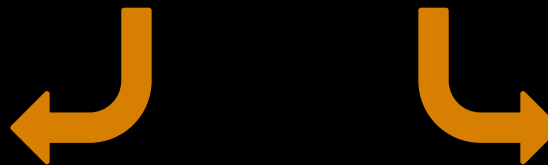
Software – General Presentation



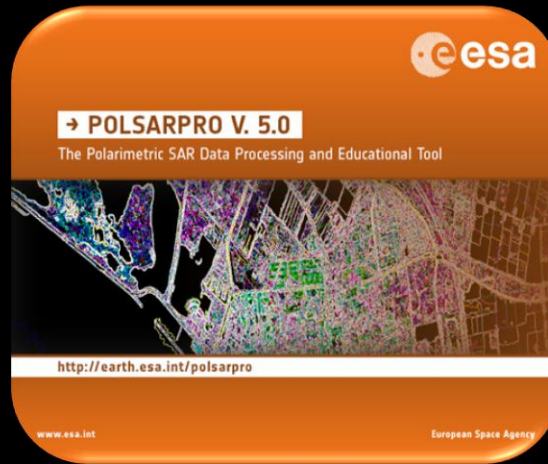
WHAT IS NEW IN THE VERSION v5.1 ?



A NEW ENGINE



A NEW DESIGN



A NEW ENGINE



Development of PolSARpro functionalities (ESA funded study)



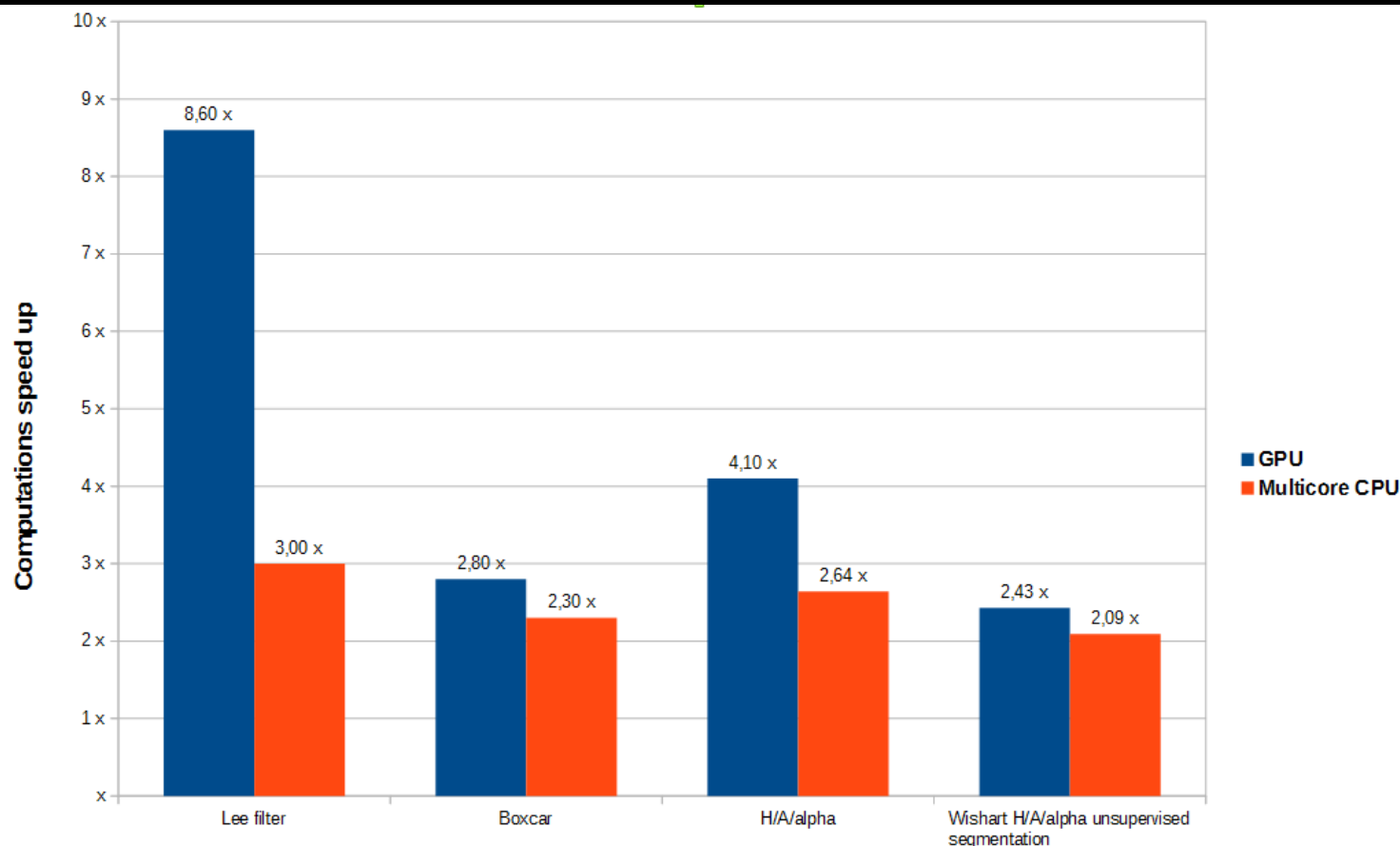
GPU

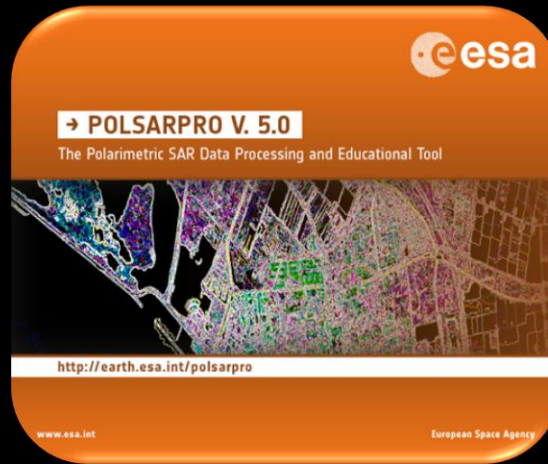


Multi-core CPU

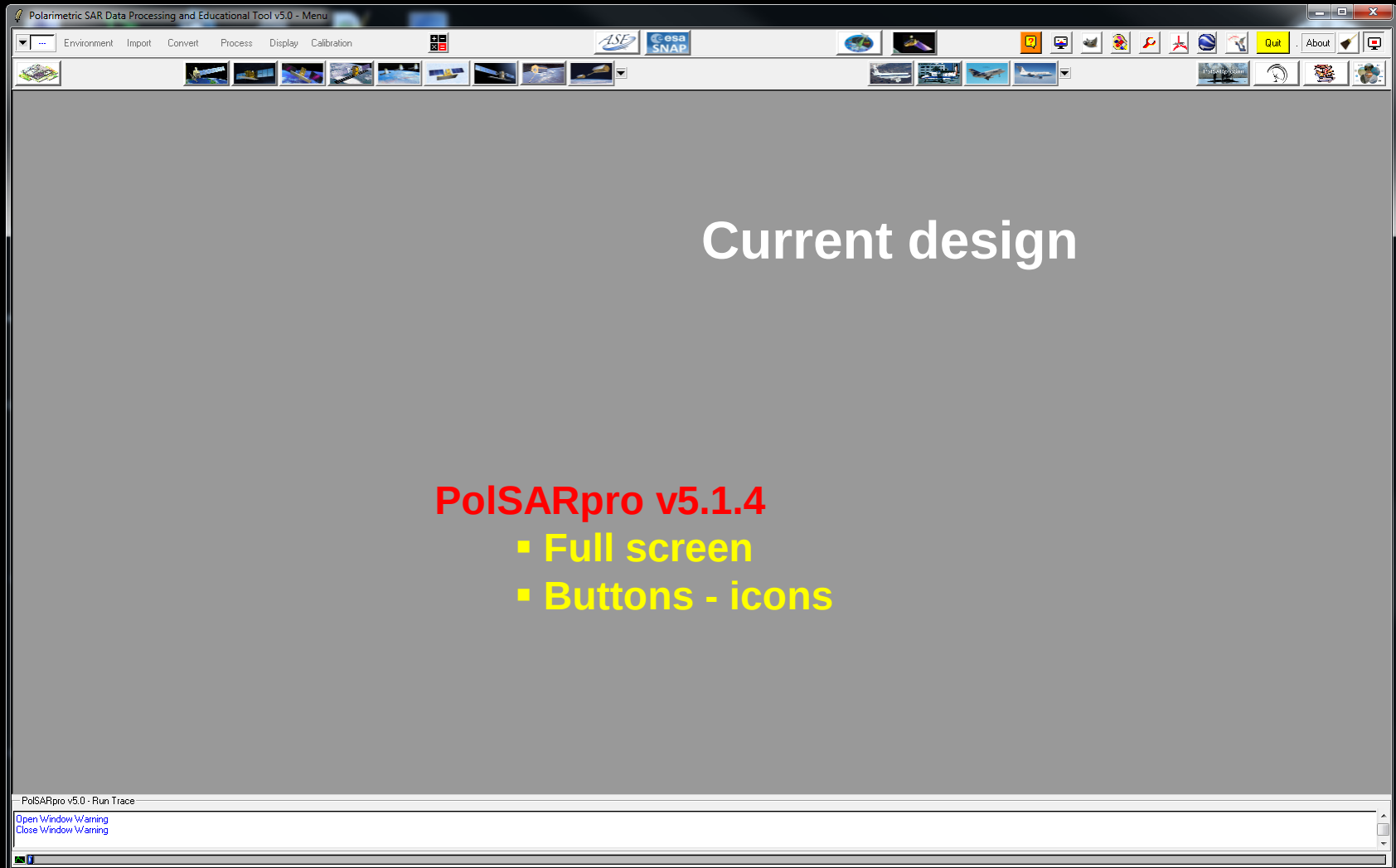


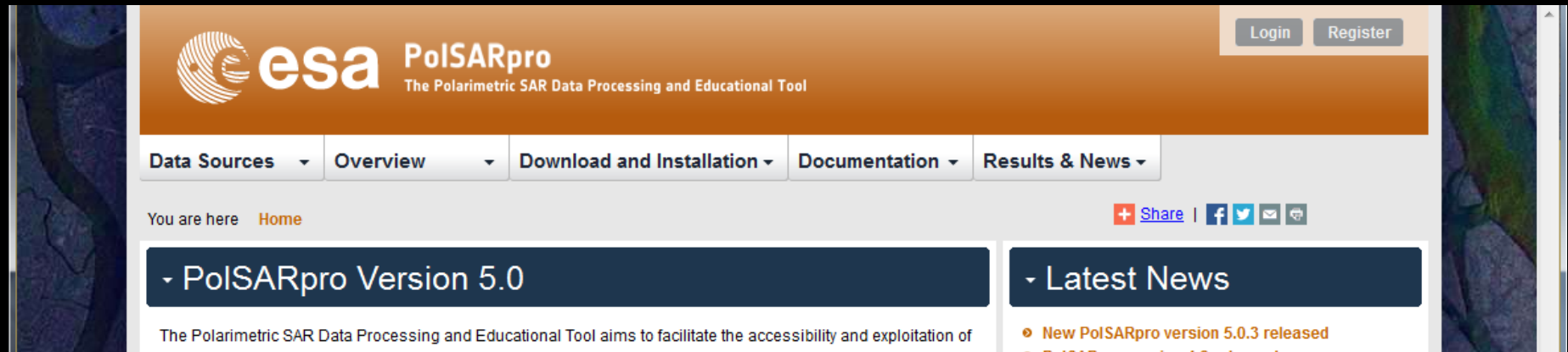
Speed-up PolSARpro computations by using multicore CPUs (parallelization) and Graphical Processing Unit (GPUs)



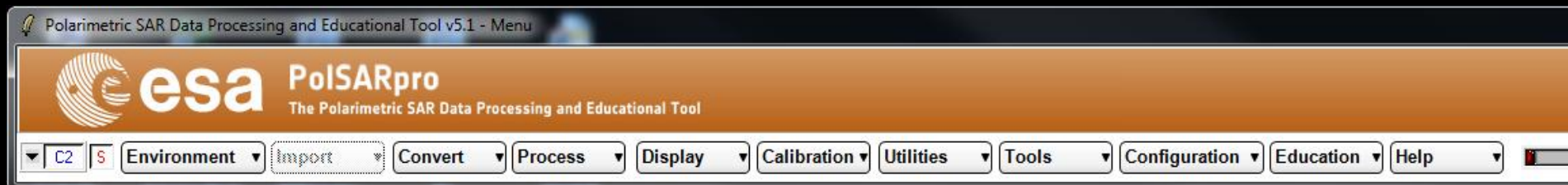


A NEW DESIGN

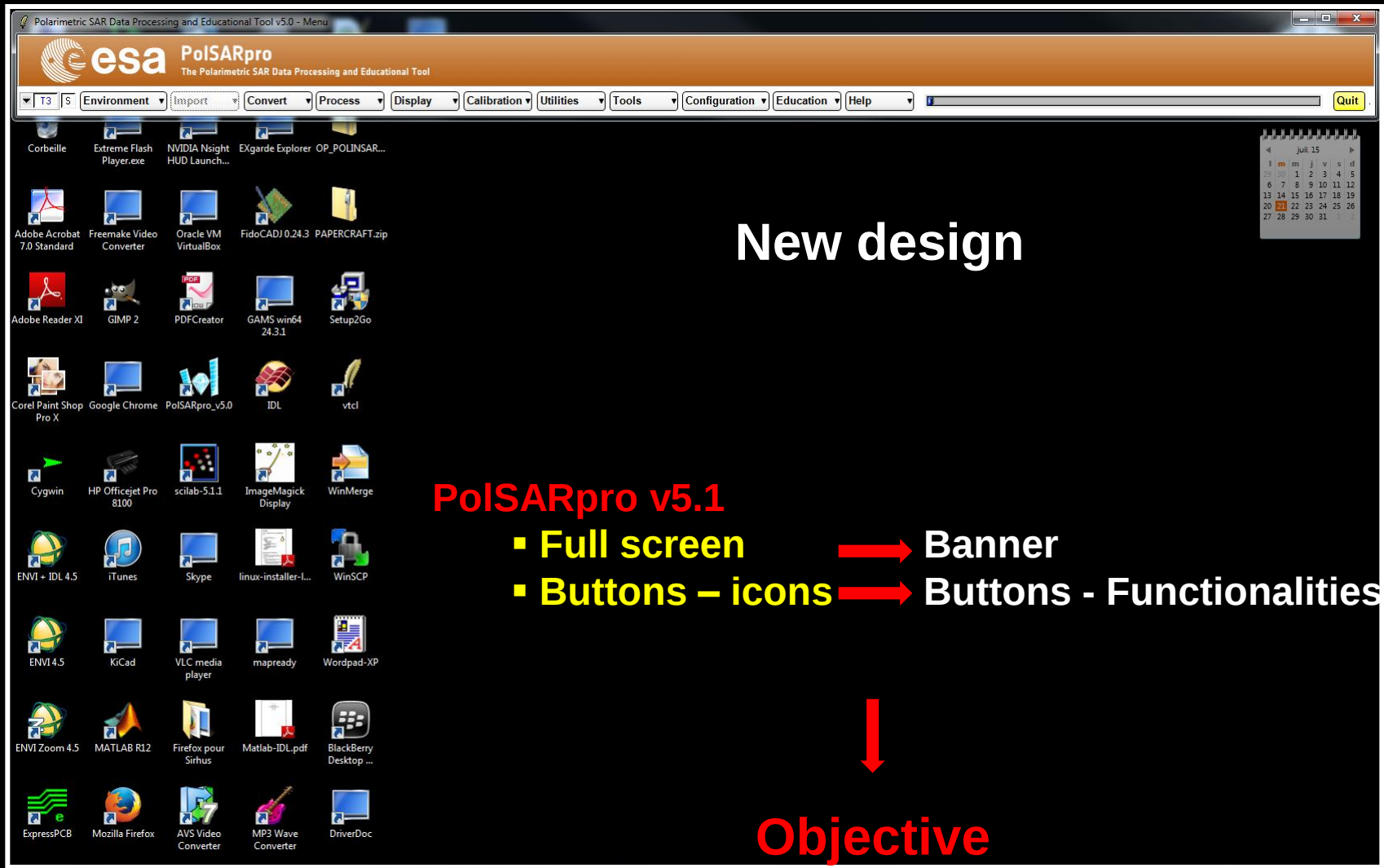




The screenshot shows the PolSARpro website interface. At the top, there is a navigation bar with the ESA logo and the text "PolSARpro The Polarimetric SAR Data Processing and Educational Tool". To the right of the header are "Login" and "Register" buttons. Below the header is a main navigation menu with dropdowns for "Data Sources", "Overview", "Download and Installation", "Documentation", and "Results & News". A breadcrumb trail indicates "You are here Home". A large orange arrow points from the "Download and Installation" menu item to the software interface shown below. The main content area features a "PolSARpro Version 5.0" section with a description: "The Polarimetric SAR Data Processing and Educational Tool aims to facilitate the accessibility and exploitation of". To the right is a "Latest News" section with a headline: "New PolSARpro version 5.0.3 released".



The screenshot shows the PolSARpro software interface. The title bar reads "Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu". The interface features a top bar with the ESA logo and the text "PolSARpro The Polarimetric SAR Data Processing and Educational Tool". Below this is a menu bar with various options: "C2", "S", "Environment", "Import", "Convert", "Process", "Display", "Calibration", "Utilities", "Tools", "Configuration", "Education", and "Help".





Hungarian
Space Office



PolSARpro v5.1 SOFTWARE



PolSARpro v5.1 SOFTWARE

The Polarimetric SAR Data Processing and Educational Tool

Menu: Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help

Desktop icons: Corbelle, Extreme Flash Player.exe, NVIDIA Nsight HUD Launch..., ExGarde Explorer, OP_POLINSAR..., Adobe Acrobat 7.0 Standard, Freemake Video Converter, Oracle VM VirtualBox, FidoCADJ 0.24.3, PAPERCRAFT.zip, Adobe Reader XI, GIMP 2, PDFCreator, GAMS win64 24.3.1, Setup2Go, Corel Paint Shop Pro X, Google Chrome, PolSARpro_v5.0, IDL, vcl, Cygwin, HP Officejet Pro 8100, scilab-5.1.1, ImageMagick Display, WinMerge, ENVI + IDL 4.5, iTunes, Skype, linux-installer-1..., WinSCP, ENVI 4.5, Kicad, VLC media player, mapready, Wordpad-XP, ENVI Zoom 4.5, MATLAB R12, Firefox pour Sirhus, Matlab-IDL.pdf, BlackBerry Desktop ..., ExpressPCB, Mozilla Firefox, AVS Video Converter, MP3 Wave Converter, DriverDoc

Calendar: July 15

Dialog Box: Data Processing: H / A / Alpha Decomposition Parameters

Input Directory: C:/ASF/T3

Output Directory: C:/ASF

Init Row: 1, End Row: 14416, Init Col: 1, End Col: 2823

Parameters:

- ☒ Alpha, Beta, Delta, Gamma, Lambda
- ☒ Lambda
- ☒ Alpha
- ☒ Entropy (H)
- ☒ Anisotropy (A)
- ☒ Combinations (H , A)
- ☒ H A
- ☒ H (1 - A)
- ☒ (1 - H) A
- ☒ (1 - H) (1 - A)
- ☒ BMP
- ☒ BMP
- ☒ BMP
- ☒ BMP
- ☒ BMP
- ☒ BMP

Window Size Row: ?, Window Size Col: ?

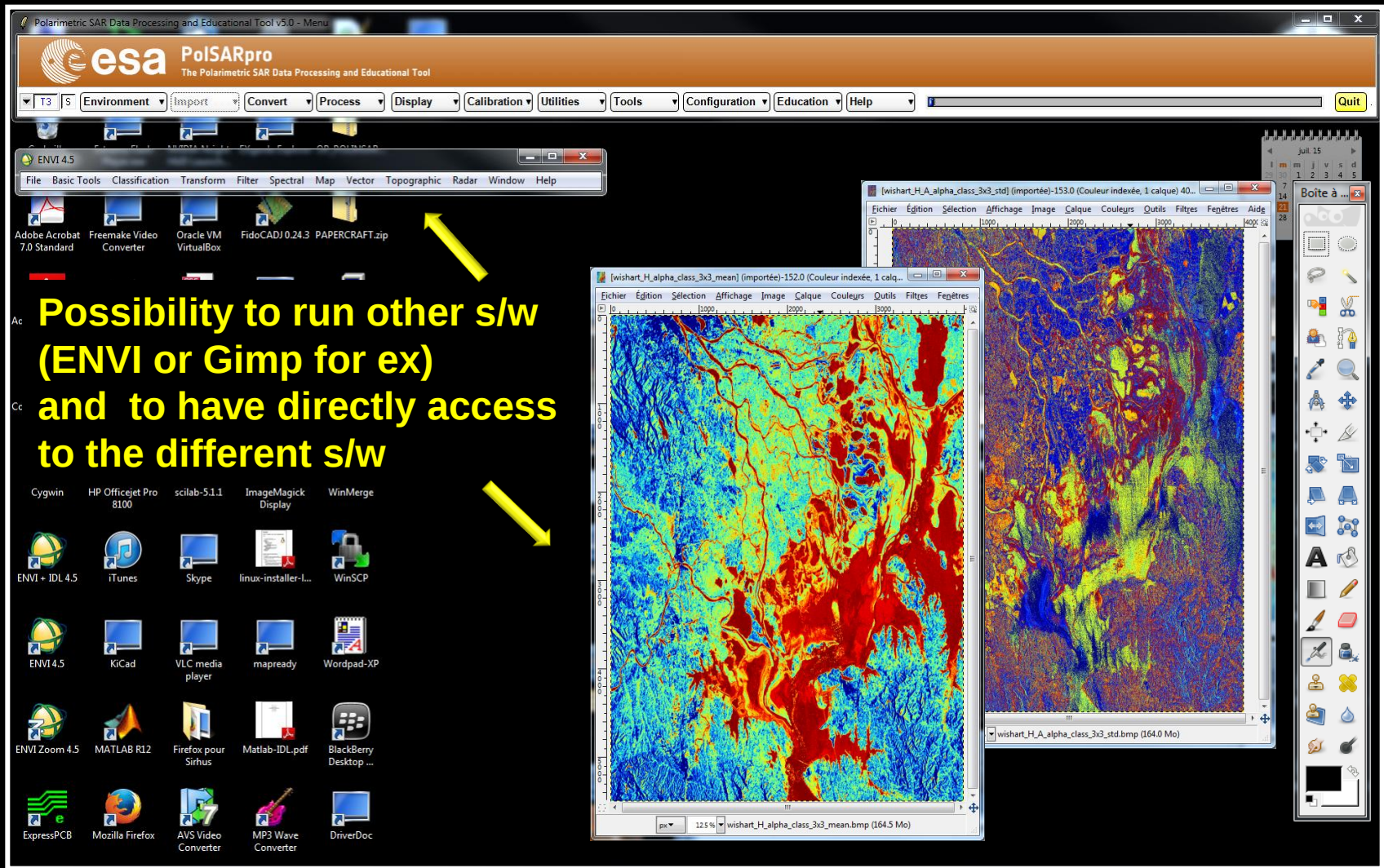
Select All, Reset, Run, Exit

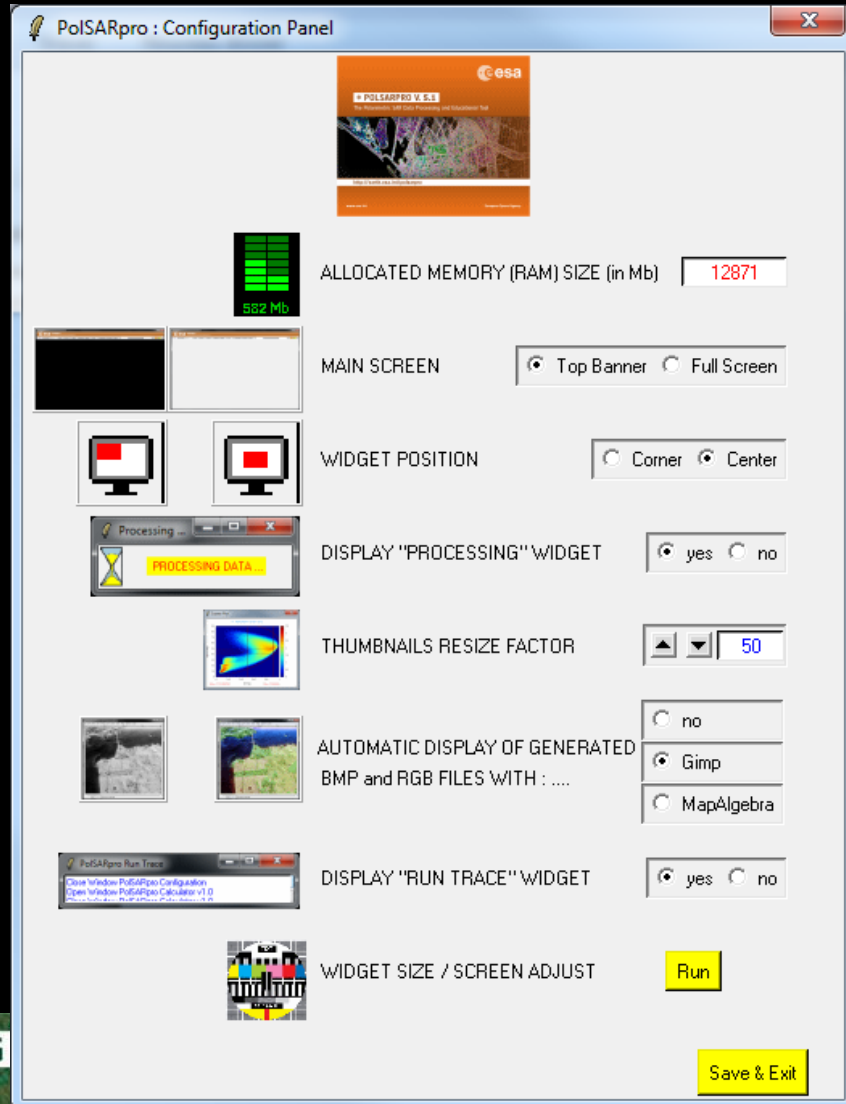
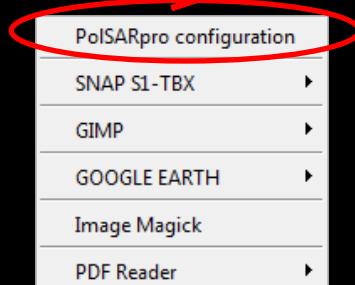
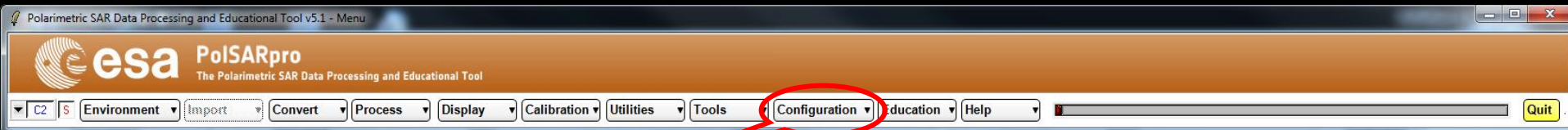
Equivalence between [T] and [C] eigen-decompositions.

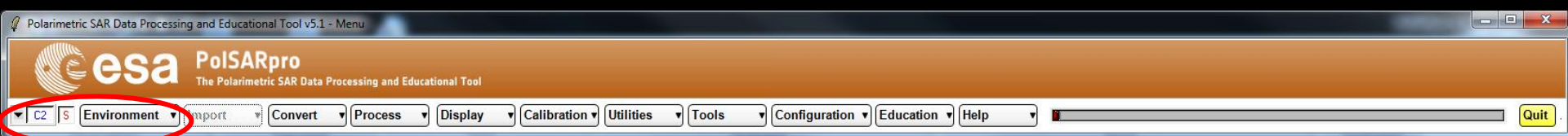
Widget on the desktop

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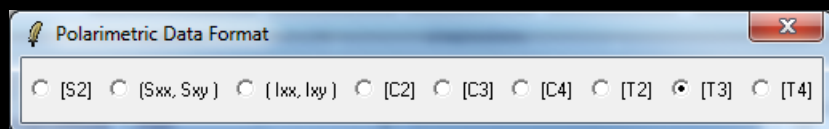
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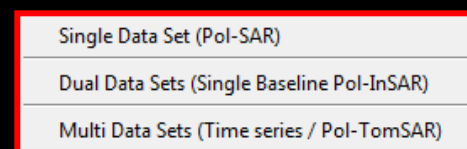




Polarimetric Data Format

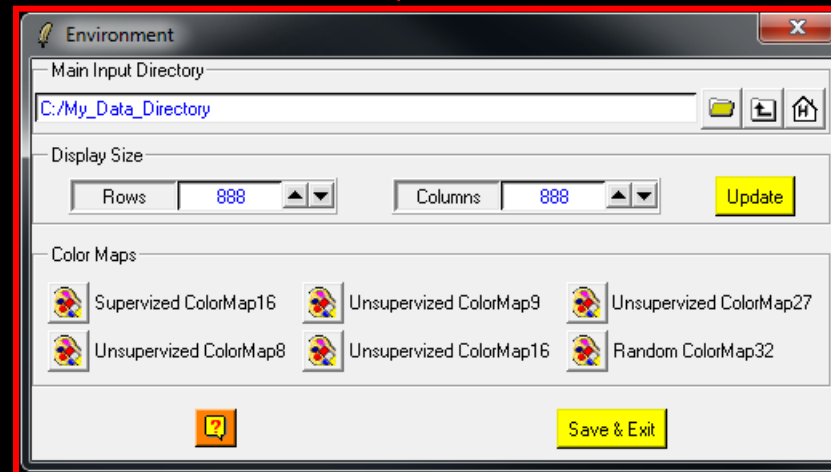
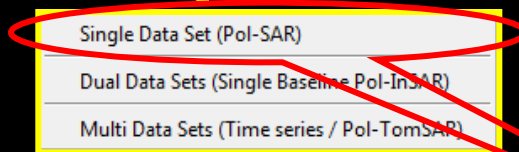
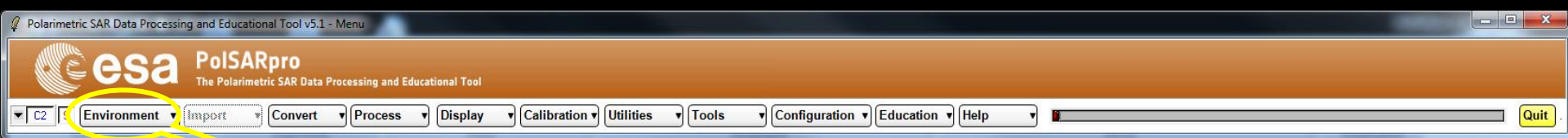


DataSet Type

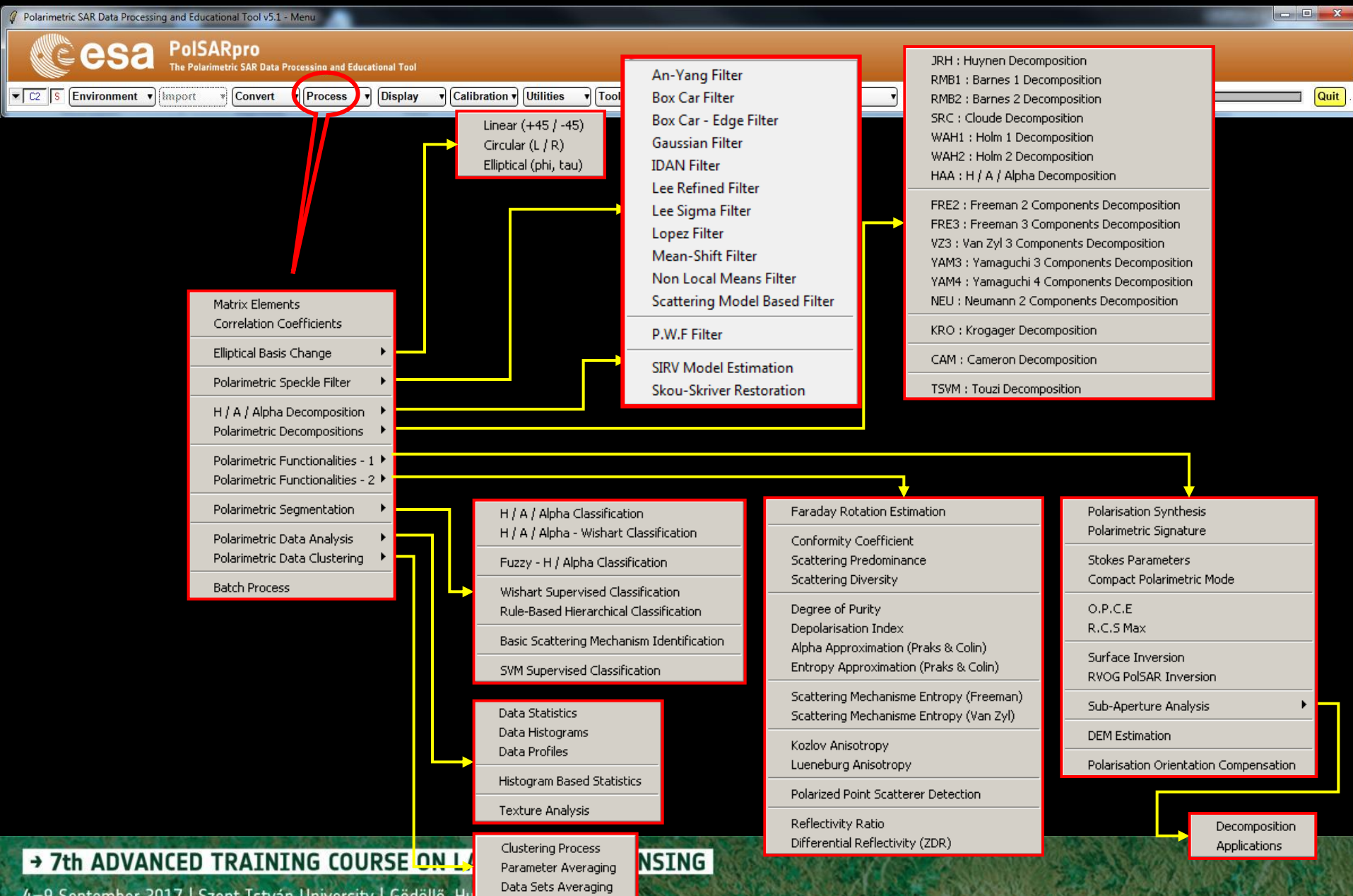


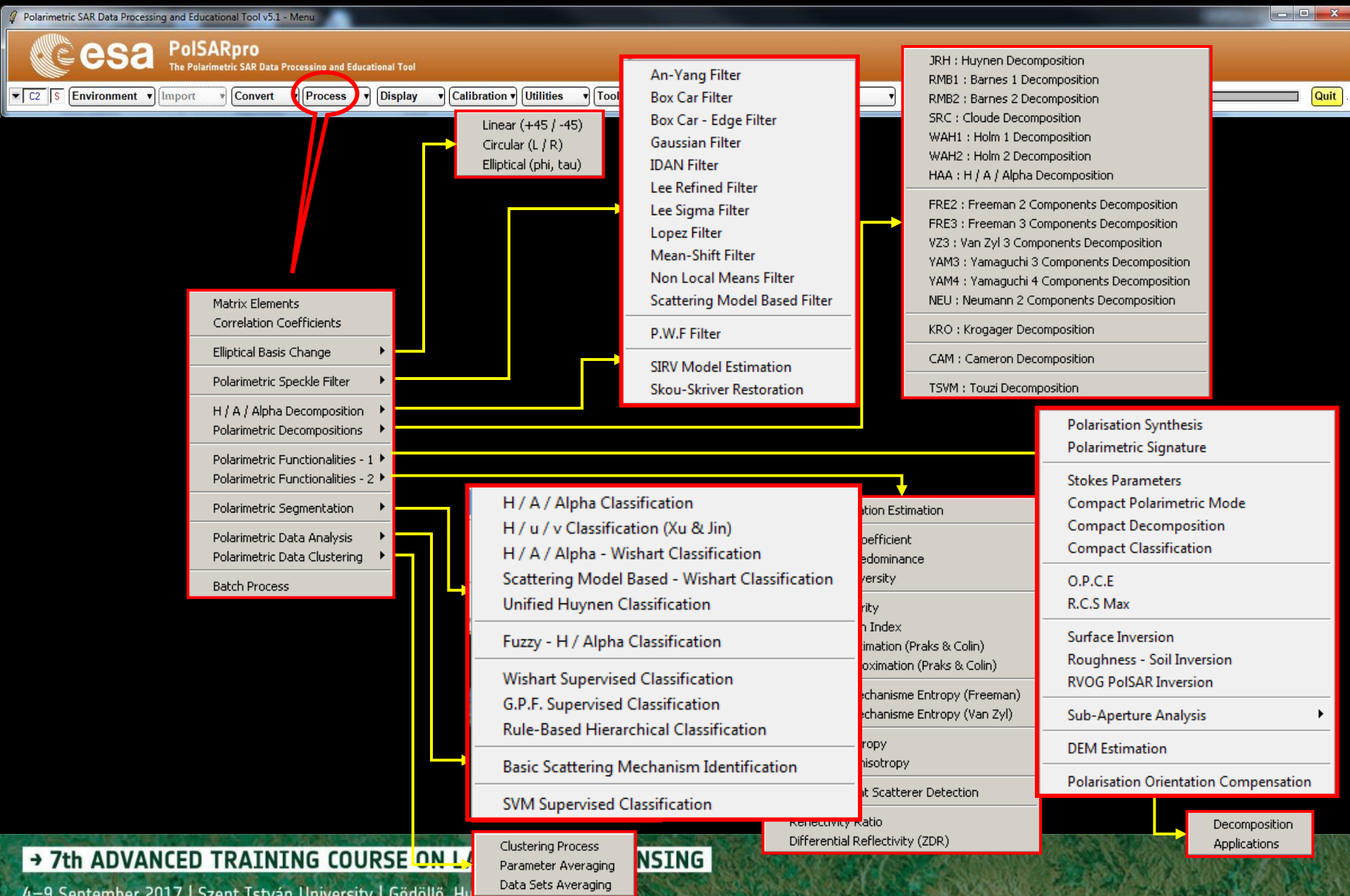


New Functionalities









Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

Environment Import Convert **Process** Display Calibration Utilities Tools

Process Menu:

- Linear (+45 / -45)
- Circular (L / R)
- Elliptical (phi, tau)

Matrix Elements / Correlation Coefficients:

- Elliptical Basis Change
- Polarimetric Speckle Filter
- H / A / Alpha Decomposition
- Polarimetric Decompositions
- Polarimetric Functionalities - 1
- Polarimetric Functionalities - 2
- Polarimetric Segmentation
- Polarimetric Data Analysis
- Polarimetric Data Clustering
- Batch Process

An-Yang Filter:

- Box Car Filter
- Box Car - Edge Filter
- Gaussian Filter
- IDAN Filter
- Lee Refined Filter
- Lee Sigma Filter
- Lopez Filter
- Mean-Shift Filter
- Non Local Means Filter
- Scattering Model Based Filter
- P.W.F Filter
- SIRV Model Estimation
- Skou-Skriver Restoration

H / A / Alpha Classification:

- H / u / v Classification (Xu & Jin)
- H / A / Alpha - Wishart Classification
- Scattering Model Based - Wishart Classification
- Unified Huynen Classification
- Fuzzy - H / Alpha Classification
- Wishart Supervised Classification
- G.P.F. Supervised Classification
- Rule-Based Hierarchical Classification
- Basic Scattering Mechanism Identification
- SVM Supervised Classification

KRO : Krogager Decomposition

CAM : Cameron Decomposition

HAA : H / A / Alpha Decomposition

JRH : Huynen Decomposition

RMB1 : Barnes 1 Decomposition

RMB2 : Barnes 2 Decomposition

SRC : Cloude Decomposition

UHDx : Unified Huynen Decomposition

WAH1 : Holm 1 Decomposition

WAH2 : Holm 2 Decomposition

AN3 : An & Yang 3 Component Decomposition

AN4 : An & Yang 4 Component Decomposition

BF4 : Bhattacharya & Frery 4 Component Decomposition

FRE2 : Freeman 2 Component Decomposition

FRE3 : Freeman 3 Component Decomposition

NEU : Neumann 2 Component Decomposition

NNED : Arie 3 Component NNED Decomposition

ANNED : Arie 3 Component ANNED Decomposition

VZ3 : Van Zyl (1992) 3 Component Decomposition

SIN4 : Singh 4 Component Decomposition

YAM3 : Yamaguchi 3 Component Decomposition

YAM4 : Yamaguchi 4 Component Decomposition

MCSM5 : L. Zhang 5 Component Decomposition

TSVM : Touzi Decomposition

Aghababaei Decomposition

2KR : Raney Decomposition

CPD : Compact-Pol Decomposition

Sub-Aperture Analysis

DEM Estimation

Polarisation Orientation Compensation

Clustering Process

Parameter Averaging

Data Sets Averaging

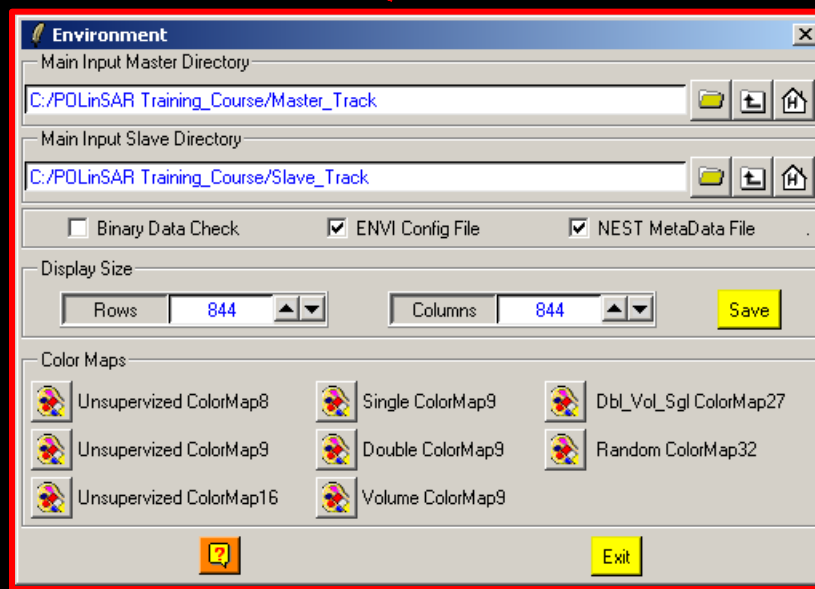
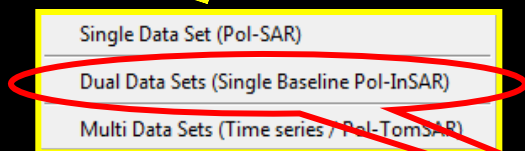
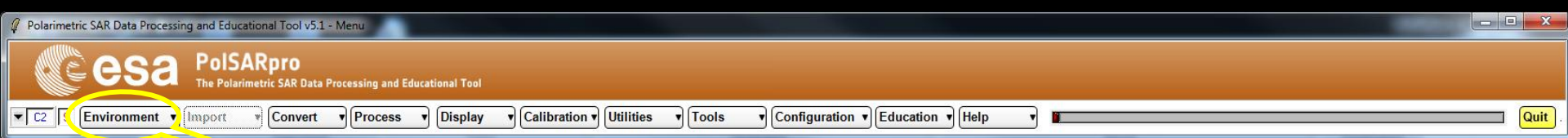
Renewability Ratio

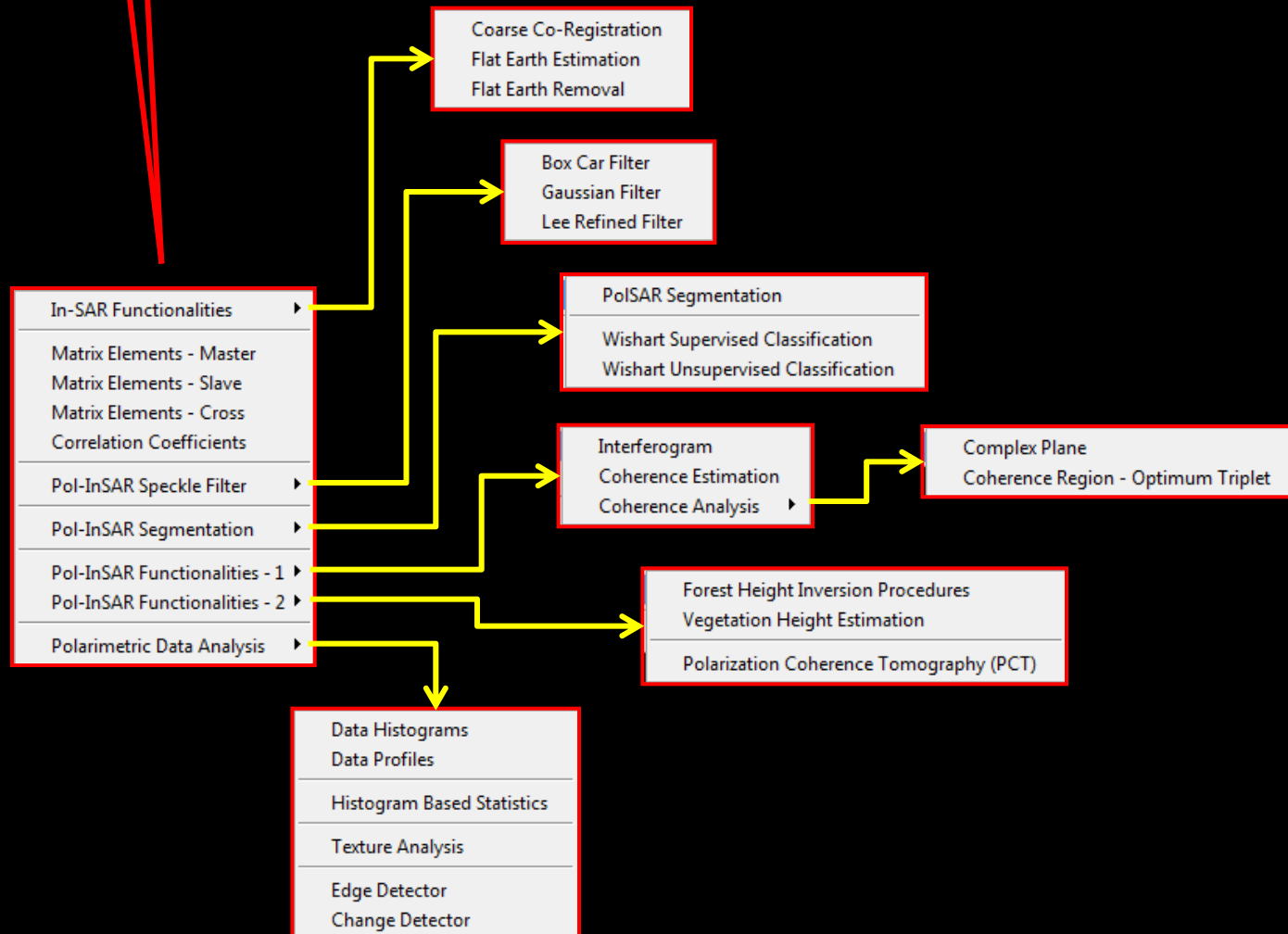
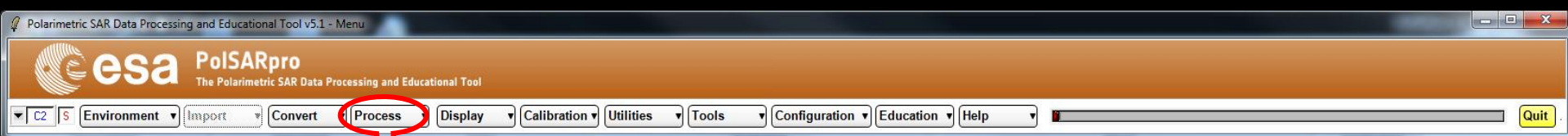
Differential Reflectivity (ZDR)

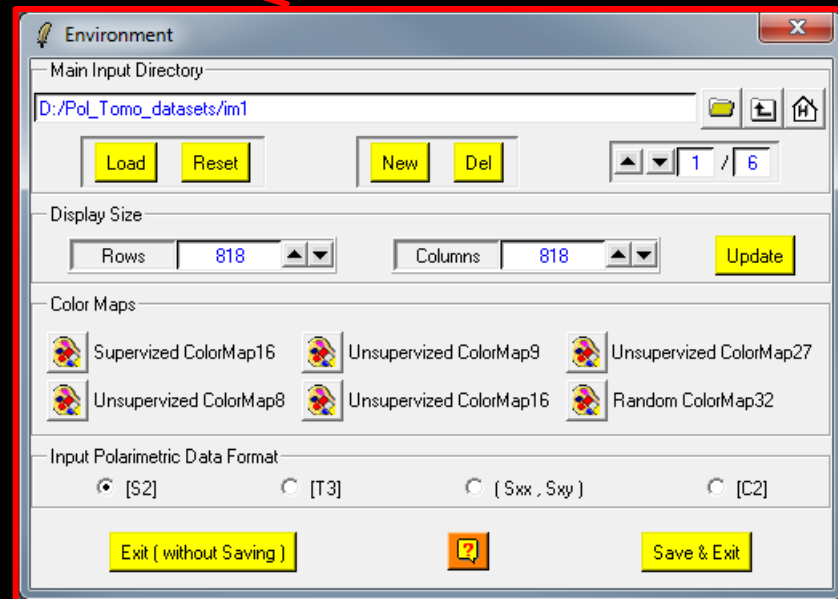
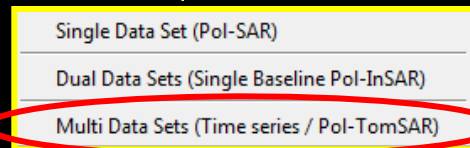
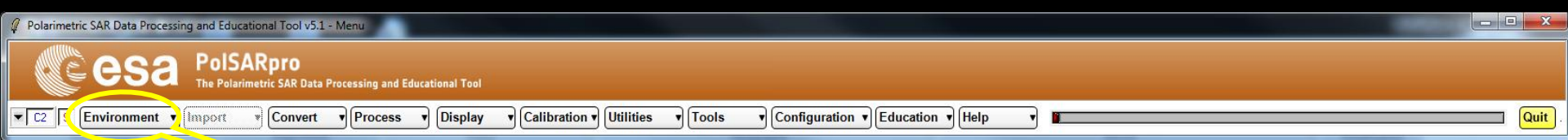
Decomposition Applications

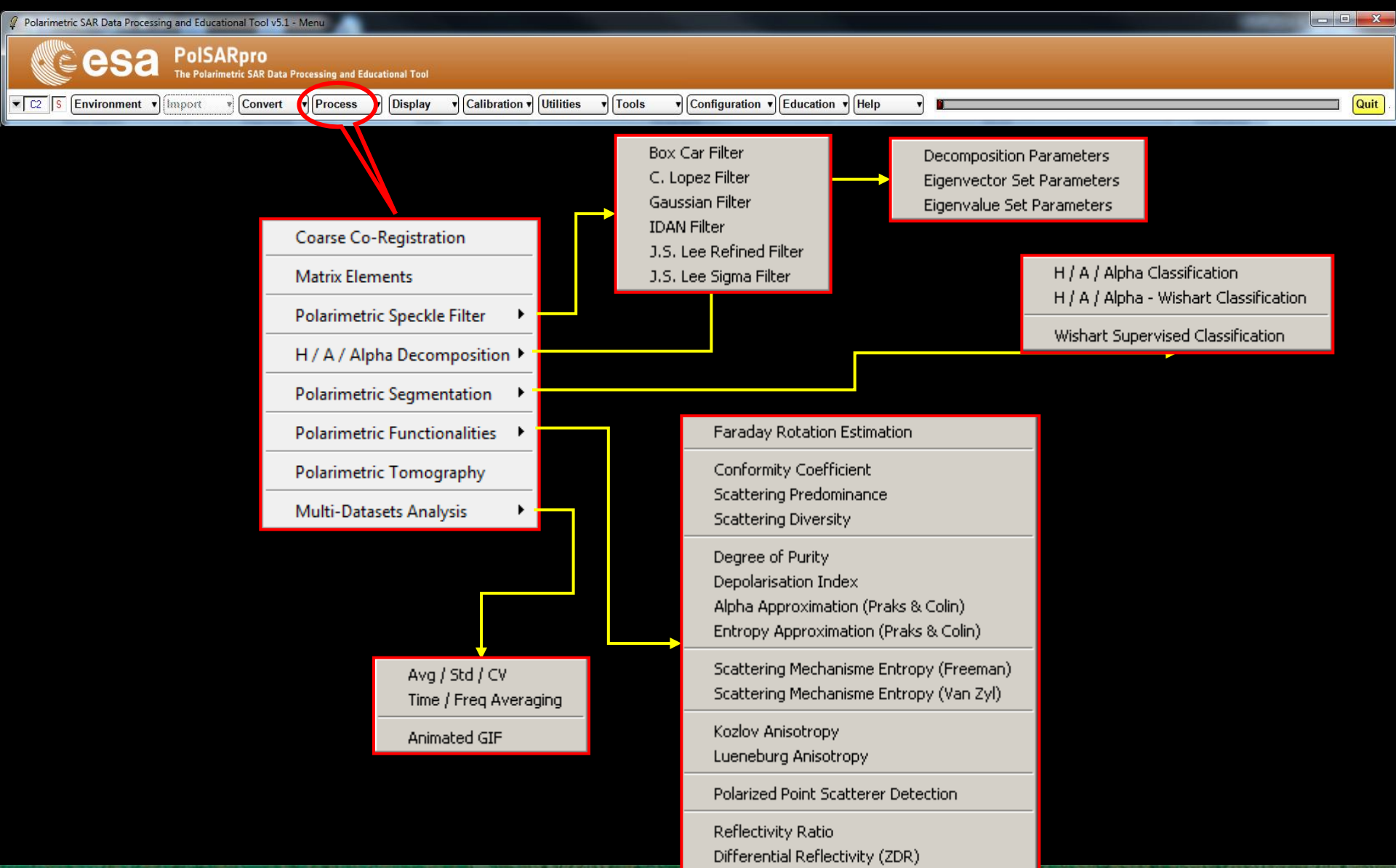
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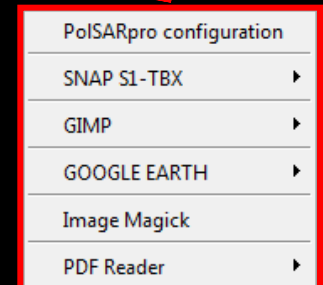
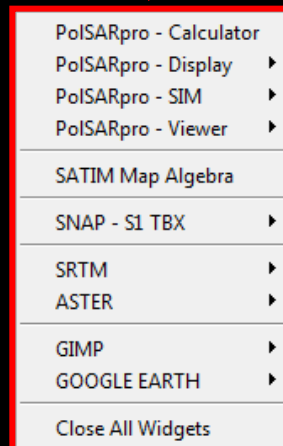
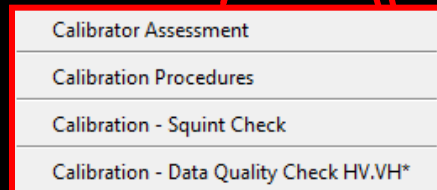
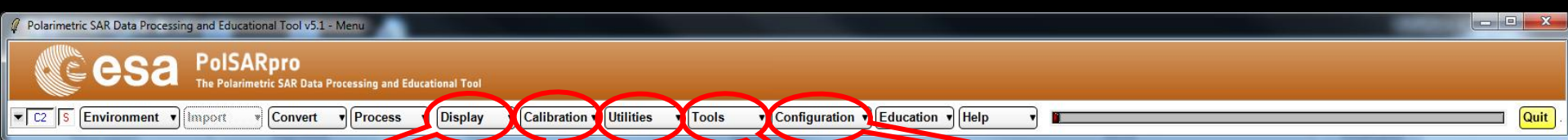
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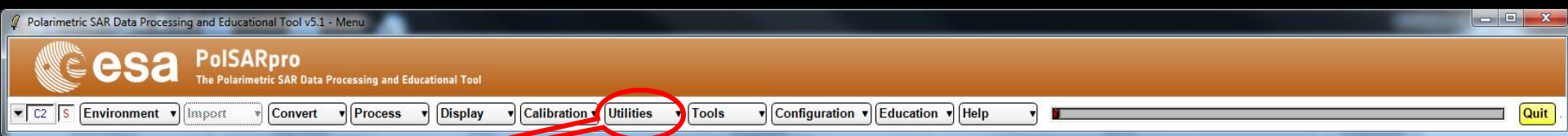












- PolSARpro - Calculator

PolSARpro - Display

PolSARpro - SIM

PolSARpro - Viewer

SATIM Map Algebra

SNAP - S1 TBX

SRTM

ASTER

GIMP

GOOGLE EARTH

Close All Widgets

PolSARpro Calculator v1.0

Op #1

(Op#1) Operator (Op#2)

Op #2

Operand #1

File Mat S / M 2x2 mat 3x3 mat 4x4 mat

STO RCL MC AC

Input File

Input File Data Format

Init Row End Row Init Col End Col

OK

Input Matrix Directory

Input Matrix Data Format

Init Row End Row Init Col End Col

OK

Input Value Type

Complex Value Float Value Integer Value

Input Value +j

OK

N x N Matrix

Complex Float Hermitian Special Unitary

m11 +j m12 +j m13 +j m14 +j

m21 +j m22 +j m23 +j m24 +j

m31 +j m32 +j m33 +j m34 +j

m41 +j m42 +j m43 +j m44 +j

OK Load Save

Output Value

+j

Exec Save ? Exit

Operator : File

(file) + value (file) - value (file) * value (file) / value

(file) .+ (file) (file) .- (file) (file) .* (file) (file) ./ (file)

. real (.) . imag (.) . arg (.) . abs (.)

. cos (.) . sin (.) . tan (.) . conj (.)

. acos (.) . asin (.) . atan (.) . boxcar (?x?)

. sqrt (.) . (.) ^2 . (.) ^3 . (.) ^ (?)

. log ([1 .]) . ln ([1 .]) . 10 ^ (.) . exp (.)

. 10log ([1 .]) . 20log ([1 .]) . (.) < (?) . (.) > (?)

OK

Operator : Sinclair Matrix : S2

[S] + value [S] - value [S] * value [S] / value

[S] .+ (file) [S] .- (file) [S] .* (file) [S] ./ (file)

[S] .+ [S '] [S] .+ [mat] [S] .* [S '] [S] .* [mat]

[S] .* [S '] [U] t . * [S] . * [U]

. conj [S] . tr [S] . det [S] . inv [S]

. eig1 [S] . eig2 [S] . eig1 [G] . eig2 [G]

OK

Operator : Hermitian Matrix : C2, C3, C4, T2, T3, T4

[M] + value [M] - value [M] * value [M] / value

[M] .+ (file) [M] .- (file) [M] .* (file) [M] ./ (file)

[M] .+ [M '] [M] .+ [mat] . inv [M] [U] . * [M] . * inv [U]

. conj [M] . tr [M] . det [M] tr (inv [mat] . * [M])

. eig1 [M] . eig2 [M] . eig3 [M] . eig4 [M]

OK

Operator : Complex / Hermitian / Float / Special Unitary NxN Matrix

[mat] + value [mat] - value [mat] * value [mat] / value

[mat] .+ [mat '] [mat] .- [mat '] [mat] .* [mat '] [mat] ./ [mat ']

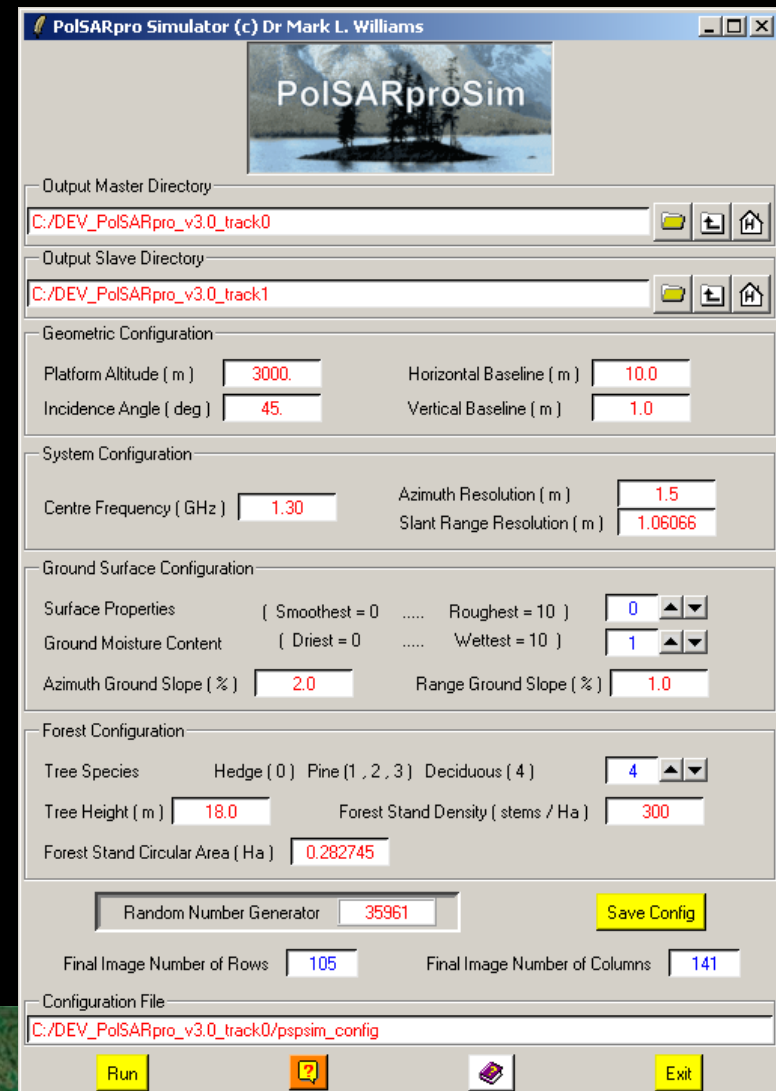
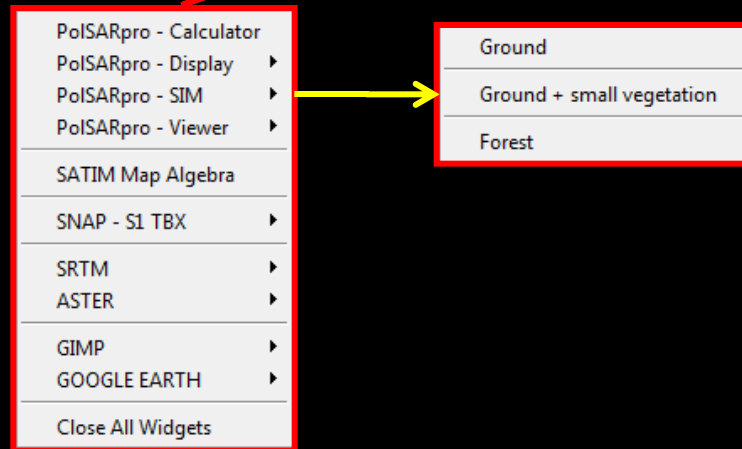
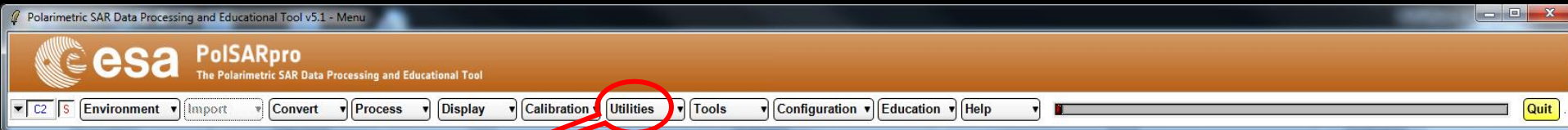
. det [mat] . tr [mat] . conj [mat] . inv [mat]

. eig1 [mat] . eig2 [mat] . eig3 [mat] . eig4 [mat]

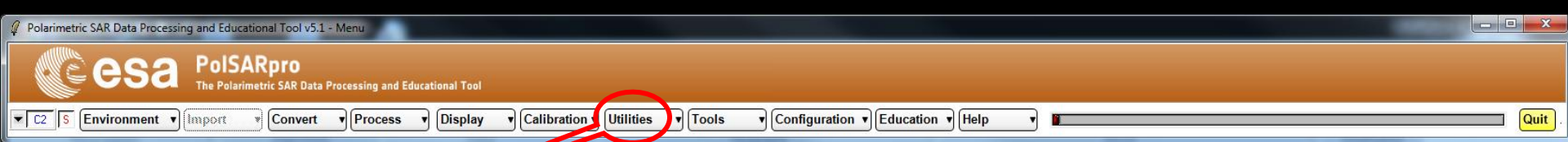
OK

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4–9 September 2017 | Szent István University | Gödöllő, Hungary



PolSARproSim is a
 rapid, coherent,
 fully polarimetric
 and interferometric
 SAR simulation of
 forest.

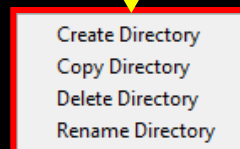
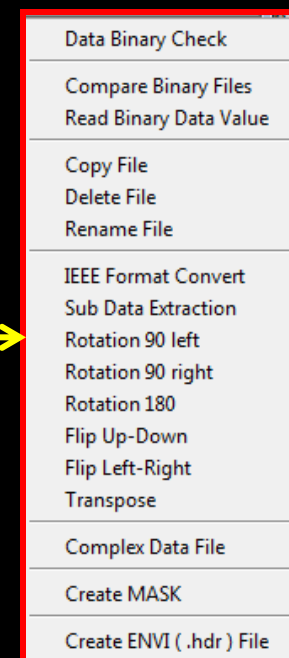
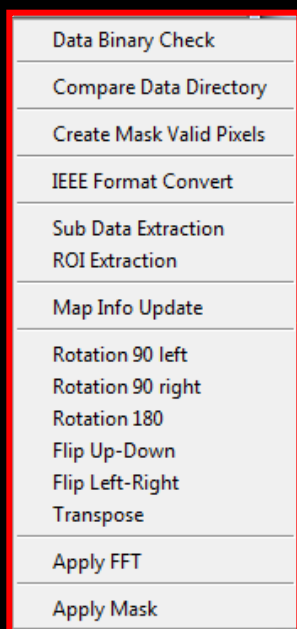
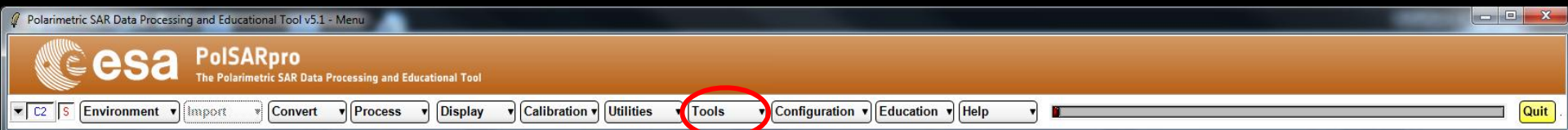


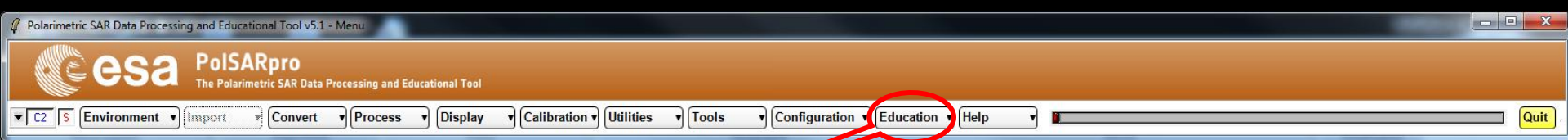
PolSARpro - Calculator
 PolSARpro - Display
 PolSARpro - SIM
 PolSARpro - Viewer
 SATIM Map Algebra
 SNAP - S1 TBX
 SRTM
 ASTER
 GIMP
 GOOGLE EARTH
 Close All Widgets

Ground
 Ground + small vegetation
 Forest

PolSARpro Ground + Small vegetation Simulator
 Output Master Directory
 C:/DEV_PolSARpro_v4.0/track_master
 Output Slave Directory
 C:/DEV_PolSARpro_v4.0/track_slave
 Geometric Configuration
 Platform Altitude (m) 3000. Horizontal Baseline (m) 10.0
 Incidence Angle (deg) 45. Vertical Baseline (m) 1.0
 System Configuration
 Centre Frequency (GHz)
 Ground Surface Configuration
 Surface Properties
 Ground Moisture Content
 Azimuth Ground Slope (%)
 Ground Surface Square Area (Ha)
 Random Number Generator
 Final Image Number of Rows
 Configuration File
 Run

PolSARpro Ground + Small vegetation Simulator
 Output Master Directory
 C:/DEV_PolSARpro_v4.0/track_master
 Output Slave Directory
 C:/DEV_PolSARpro_v4.0/track_slave
 Geometric Configuration
 Platform Altitude (m) 3000. Horizontal Baseline (m) 10.0
 Incidence Angle (deg) 45. Vertical Baseline (m) 1.0
 System Configuration
 Centre Frequency (GHz) 1.30 Azimuth Resolution (m) 1.5
 Slant Range Resolution (m) 1.06066
 Ground Surface Configuration
 Surface Properties (Smoothest = 0 Roughest = 10) 0
 Ground Moisture Content (Driest = 0 Wettest = 10) 1
 Azimuth Ground Slope (%) 2.0 Range Ground Slope (%) 1.0
 Ground Surface Square Area (Ha) 1.0
 Small Vegetation Configuration
 Mean Vegetation Height (m) 0.5
 Random Number Generator 34492 Save Config
 Final Image Number of Rows Final Image Number of Columns
 Configuration File
 Run Exit





Learning / Training Next P.I Generations

PolSAR-Ap Project



**WP360 : Review and update of
the Basic Principles and
Applications
(E. Pottier, C. Lopez Martinez)**



1 Basic Principles of SAR Polarimetry

C. Lopez Martinez¹, E. Pottier²
¹UPC Barcelona

²University of Rennes-1

1.1 Theory of radar polarimetry

1.1.1 Wave polarimetry

Polarimetry refers specifically to the vector nature of the electromagnetic waves, whereas radar polarimetry is the science of acquiring, processing and analyzing the polarization state of an electromagnetic wave in radar applications. This section summarizes the main theoretical aspects necessary for a correct processing and interpretation of the polarimetric information. As a result, the first part presents the so-called wave polarimetry that deals with the representation and the understanding of the polarization state of an electromagnetic wave. The second part introduces the concept of scattering polarimetry. This concept collects the topic of inferring the properties of a given target, from a polarimetric point of view, given the incident and the scattered polarized electromagnetic waves.

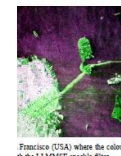
1.1.1.1 Electromagnetic waves and wave polarization descriptors

The generation, the propagation, as well as the interaction with matter of the electric and the magnetic waves are governed by the Maxwell's equations [1]. For an electromagnetic wave that is propagating in the z direction, the real electric wave can be decomposed into two orthogonal components E_x and E_y , admitting the following vector formulation:

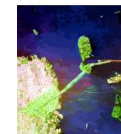
$$\vec{E}(z,t) = \begin{bmatrix} E_x \\ E_y \\ E_z \end{bmatrix} = \begin{bmatrix} E_{0x} \cos(\alpha x - kz + \delta_x) \\ E_{0y} \cos(\alpha x - kz + \delta_y) \\ 0 \end{bmatrix} \quad (1.1)$$

which may be also considered in a complex form

erating a better exploitation of the 3], the Wishart distribution allows us model for all the elements of the $\hat{\sigma}$ has been exploited for PolSAR, ed that if the filtering process is of speckle, depending on the corre- an improved estimation of the dif- the covariance or coherency matri-

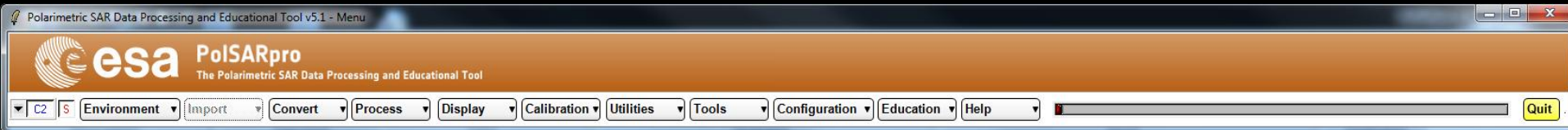


Francisco (USA) where the colour code is: the LMMSE speckle filter.

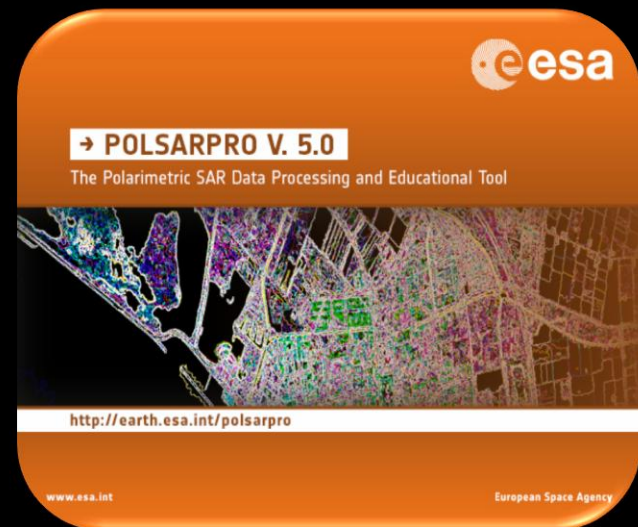


Francisco (USA) where the colour code is: the BPT speckle filter.

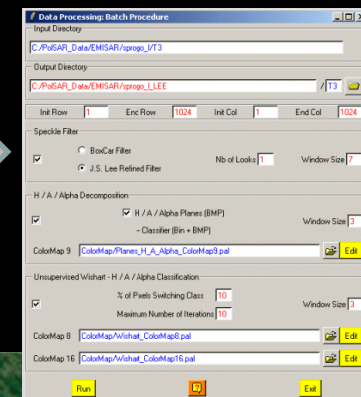
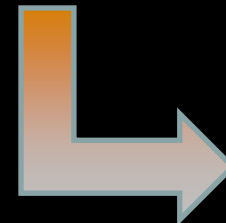
Beyond all the PolSAR data filtering techniques presented in this Section, there exist a wide variety of similar approaches in the related literature, where a com-



PolSAR-Ap Project



WP260 : Implementation of Selected Applications (E. Pottier)





PolSARpro

The Polarimetric SAR Data Processing and Educational Tool



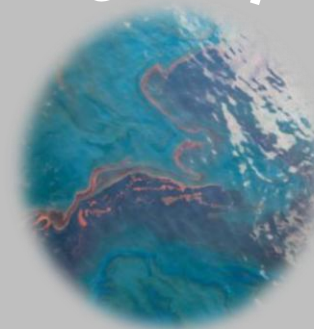
Agriculture



Forest



Ocean



ONERA



Urban

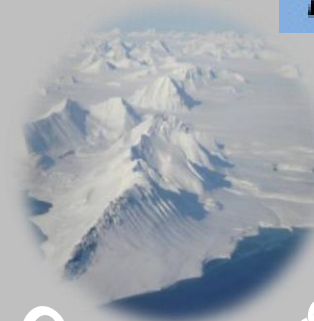
→ POLSARPRO V. 5.0

The Polarimetric SAR Data Processing and Educational Tool



<http://earth.esa.int/polsarpro>

ETH



Cryosphere


PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

C2 S Environment

PolSAR-ap Showcase : Agriculture

Input Directory

D:/My_Data_Directory/T3

Output Directory

D:/My_Data_Directory

Init Row

1

End Row

1544

Init Col

1

End Col

928

Decomposition



Window Size (Row)

Window Size (Col)

Inc Ang Unit

Degrees

Radians

Surface Soil Moisture Inversion



Soil Dielectric Constant Max

40

Increment Angle of the Incidence Angle LUT (deg)

0.1

Dihedral Soil Moisture Inversion



Soil Dielectric Constant Max

Trunk Dielectric Constant Max

Increment Angle of the Incidence Angle LUT (deg)

2D-Incidence Angle File

Enter 2D Incidence Angle File

2D Mask File

Enter (showcase_agri_mask.bin) file

Polarimetric Decomposition fs File

Enter (showcase_agri_fs.bin) file

Polarimetric Decomposition Beta File

Enter (showcase_agri_beta.bin) file

Vertical Roughness Indicator (ks) File (optional)

Output Soil Moisture File

D:/My_Data_Directory/showcase_agri_surf_mv_soil.bin

Output Soil Dielectric Constant File

D:/My_Data_Directory/showcase_agri_surf_dc_soil.bin

Output Trunk Dielectric Constant File

Run



Exit

Configuration

Education

Help

Quit

PolSAR-ap Showcase : Ocean

Input Directory

D:/My_Data_Directory/T3

Output Directory

D:/My_Data_Directory

Init Row

1

End Row

1544

Init Col

1

End Col

928

Window Size - Train

Row

51

Col

51

Window Size - Test

Row

9

Col

9

Geometric Perturbation Filter

Threshold

0.98

Reduction Ratio (RedR)

0.0025

Output Coherence File

D:/My_Data_Directory/ocean_coherence.bin

Output Mask File

D:/My_Data_Directory/ocean_mask.bin

Run



Exit



PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

C2

Environment

Import

Convert

Process

Display

Calibration

Utilities

Tools

Configuration

Education

Help

Quit

PolSAR-ap Showcase : Cryosphere

Input Master - Slave Directory

D:/My_Data_Directory/Master_Dir_Slave_Dir

Output Master - Slave Directory

D:/My_Data_Directory/Master_Dir_Slave_Dir

Init Row

1

End Row

900

Init Col

1

End Col

1024

Decomposition

Window Size (Row)

Window Size (Col)

Inc Ang Unit

Degrees

Radians

Median Filter

Window Size

8

Max Nb of Iterations

3

Inversion

Polarization Channel

HH

HV

W

Ice Dielectric Constant

2.8

Threshold

40

Range Pixel Spacing (optional)

opt

2D Incidence Angle File

Enter 2D Incidence Angle file

2D Kz File

Enter 2D Kz file

Surface to Volume Ratio File

Enter [showcase_cryo_stv_ratio_HH.bin] file

Complex Coherence File

Enter [cmplx_coh_HH.bin] file

SNR Decorrelation File (optional)

Enter SNR Decorrelation file (Optional)

Output Extinction Coefficient File (kappa)

D:/My_Data_Directory/Master_Dir_Slave_Dir/showcase_cryo_kappa_HH.bin

Output Penetration Depth File

D:/My_Data_Directory/Master_Dir_Slave_Dir/showcase_cryo_depth_HH.bin

Run

Exit

PolSAR-ap Showcase : Urban

Input Master - Slave Directory

D:/My_Data_Directory/Master_Slave_Dir/T6

Output Master - Slave Directory

D:/My_Data_Directory/Master_Slave_Dir

Init Row

1

End Row

900

Init Col

1

End Col

1024

Complex Coherence File

Output File

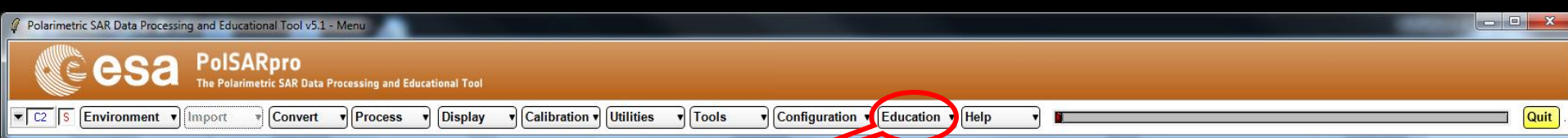
Run

Exit

→ 7th

4-9 Set

ING



PolSARap Tutorial (C. Lopez - E. Pottier) ▶

PolSARap Showcases

Lectures Notes ▶

Recent Advances (W.M. Boerner)

Basic Concepts (W.M. Boerner)

Advanced Concepts (E. Pottier, J.S. Lee, L. Ferro-Famil)

Polarimetric SAR Interferometry (S.R. Cloude, K. Papathanassiou) ▶

Surface Parameter Retrieval (I. Hajnsek, K. Papathanassiou) ▶

Single vs multi polarization interferometry

Pol-InSAR (Training Course)

Polarization Coherence Tomography (Training Course)

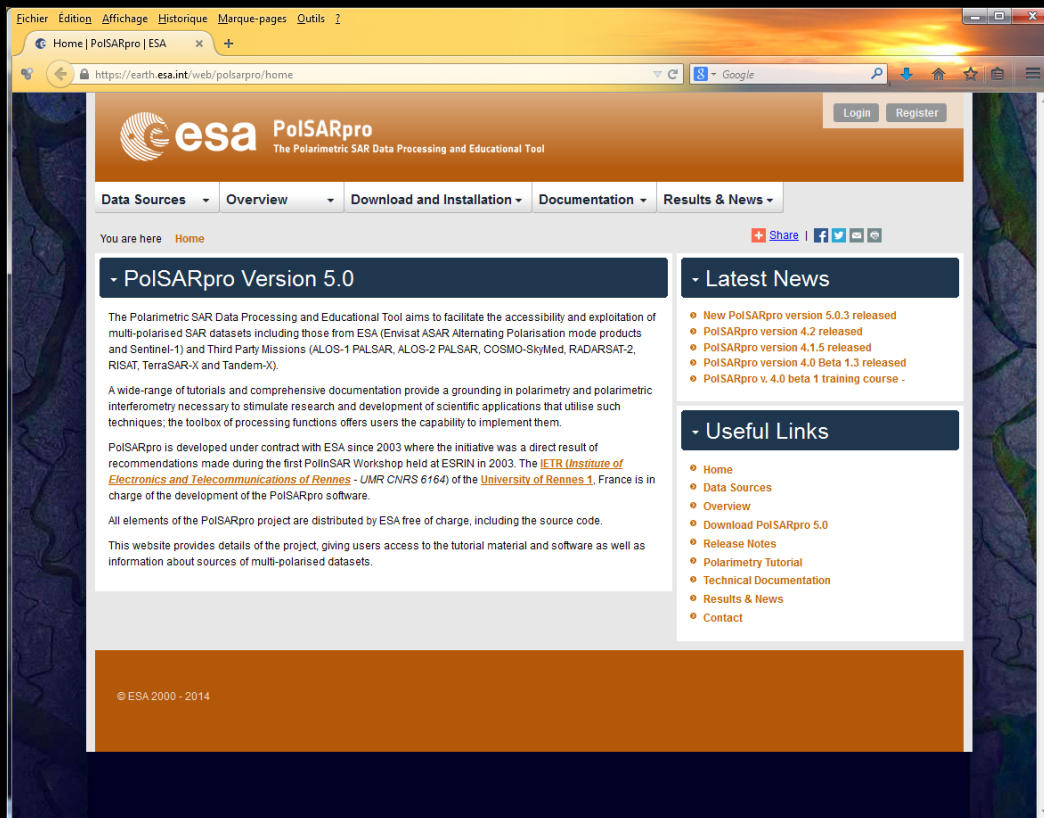


Learning / Training Next P.I Generations

<http://earth.esa.int/web/polsarpro/home>

The Web Site provides

- **Details of the project**
- **Access to the tutorial and software**
- **Information about status of the development**
- **Demonstration Sample Datasets**



<http://earth.esa.int/polsarpro/home>

Web Site provides

of the project

the tutorial

information about status
of development

Demonstration Sample
Datasets



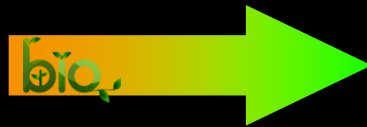
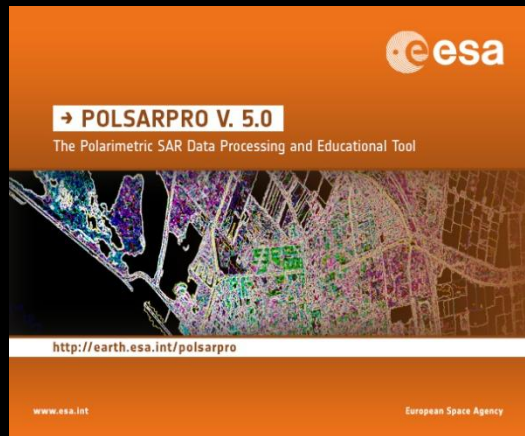
New!

v5.1 (January 2017)

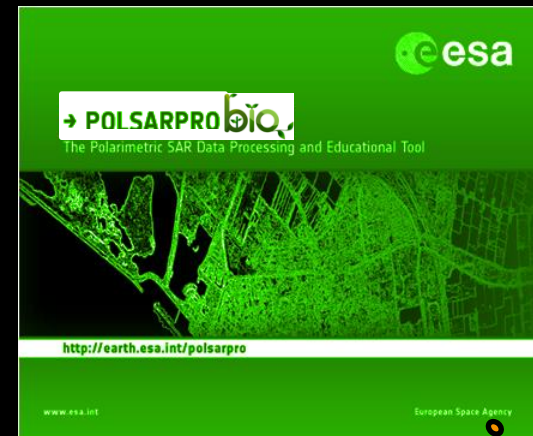
→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

4–9 September 2017 | Szent István University | Gödöllő, Hungary

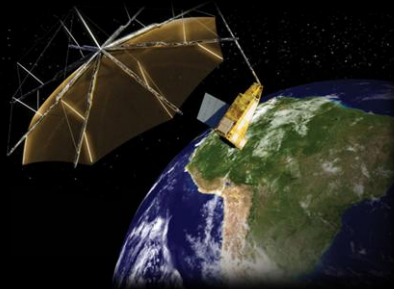
ESA & third party fully polarimetric SAR missions (**PolSARpro-Bio**)



ESA RFP - 2017



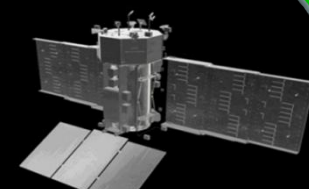
Future spaceborne sensors



BIOMASS



R.C.M



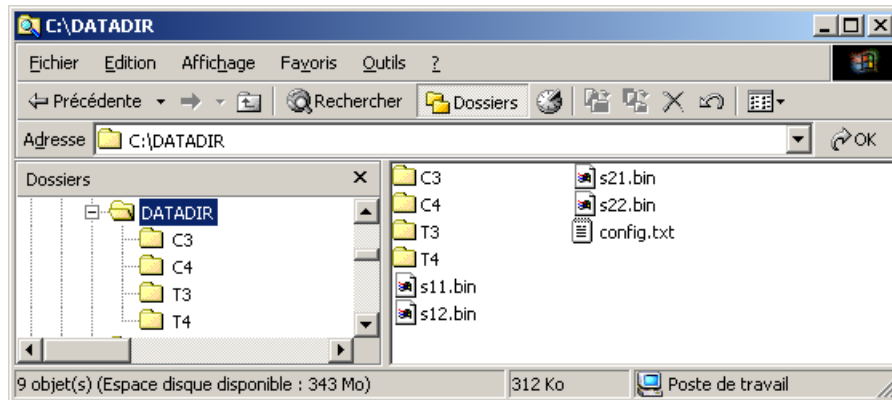
SAOCOM-CS



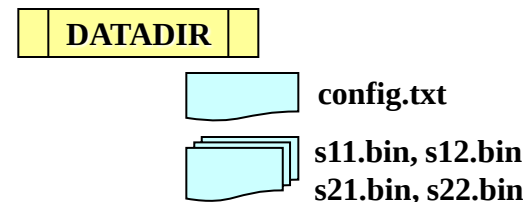
New functionalities : Pol-SAR, Pol-TomSAR and Pol-TimeSAR / Cloud-based infrastructure
SNAP / PolSARproSIM++ / QGIS Plug-in...

General Presentation of PolSARpro v5.1 Software

Compatible Raw Binary Data



2x2 Complex Sinclair Matrix [S2]



PolarCase

- Monostatic $s12.bin == s21.bin$
- Bistatic $s12.bin \neq s21.bin$
- Intensities lxy.bin

PolarType

- Full s11.bin, s12.bin, s21.bin, s22.bin
- pp1 s11.bin, s21.bin
- pp2 s12.bin, s22.bin
- pp3 s11.bin, s22.bin
- pp4 l11.bin, l12.bin, l22.bin
- pp5 l11.bin, l21.bin
- pp6 l12.bin, l22.bin
- pp7 l11.bin, l22.bin

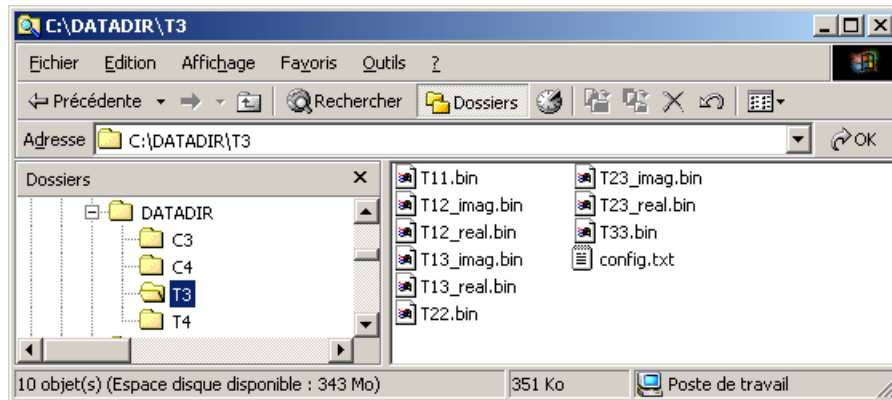
Nrow
1234

Ncol
4789

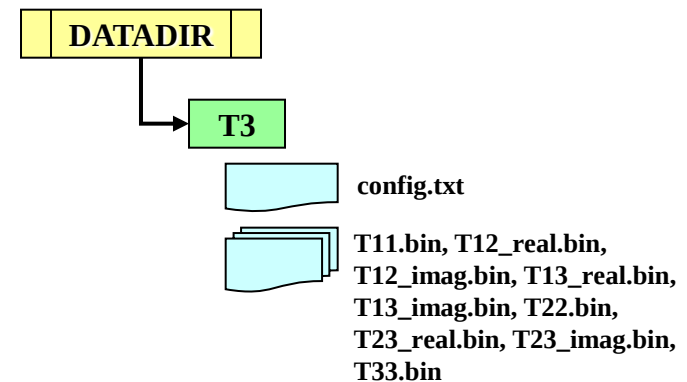
PolarCase
Monostatic/Bistatic/Intensities

PolarType
Full/pp1/pp2/pp3/pp4/pp5/pp6/pp7

Compatible Raw Binary Data



3x3 Complex Coherency Matrix [T3]



$$\underline{k}_{3P} = \frac{1}{\sqrt{2}} \begin{bmatrix} S_{11} + S_{22} & S_{11} - S_{22} & S_{12} + S_{21} \end{bmatrix}$$

$$\Rightarrow [T_3] = \langle \underline{k}_{3P} \cdot \underline{k}_{3P}^\dagger \rangle$$

$$[T_3] = \begin{bmatrix} T_{11} & T_{12} & T_{13} \\ T_{12}^* & T_{22} & T_{23} \\ T_{13}^* & T_{23}^* & T_{33} \end{bmatrix}$$

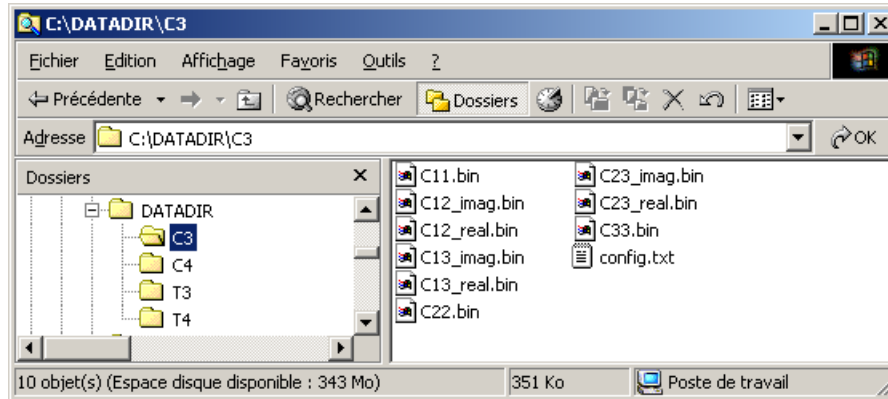
Nrow
1234

Ncol
4789

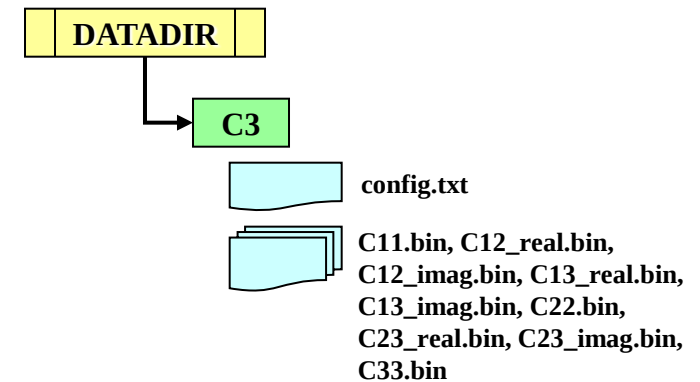
PolarCase
Monostatic/Bistatic

PolarType
Full

Compatible Raw Binary Data



3x3 Complex Covariance Matrix [C3]



$$\underline{k}_{3L} = \begin{bmatrix} S_{11} & S_{12} \cdot \sqrt{2} & S_{22} \end{bmatrix}$$

$$\Rightarrow [C_3] = \langle \underline{k}_{3L} \cdot \underline{k}_{3L}^\dagger \rangle$$

$$[C_3] = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{12}^* & C_{22} & C_{23} \\ C_{13}^* & C_{23}^* & C_{33} \end{bmatrix}$$

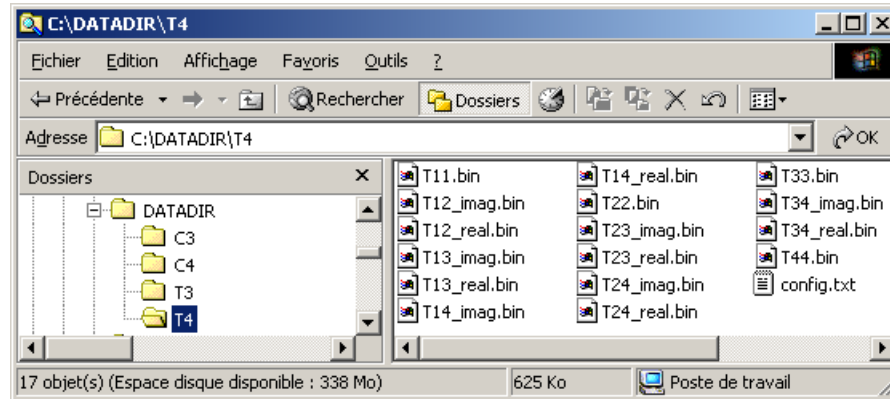
Nrow
1234

Ncol
4789

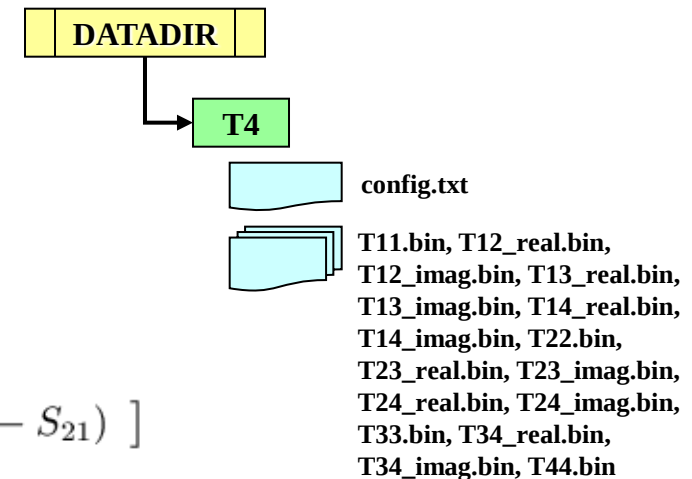
PolarCase
Monostatic/Bistatic

PolarType
Full

Compatible Raw Binary Data



4x4 Complex Coherency Matrix [T4]



$$\underline{k}_{4P} = \frac{1}{\sqrt{2}} \begin{bmatrix} S_{11} + S_{22} & S_{11} - S_{22} & S_{12} + S_{21} & j(S_{12} - S_{21}) \end{bmatrix}$$

$$\Rightarrow [T_4] = \langle \underline{k}_{4P} \cdot \underline{k}_{4P}^\dagger \rangle$$

$$[T_4] = \begin{bmatrix} T_{11} & T_{12} & T_{13} & T_{14} \\ T_{12}^* & T_{22} & T_{23} & T_{24} \\ T_{13}^* & T_{23}^* & T_{33} & T_{34} \\ T_{14}^* & T_{24}^* & T_{34}^* & T_{44} \end{bmatrix}$$

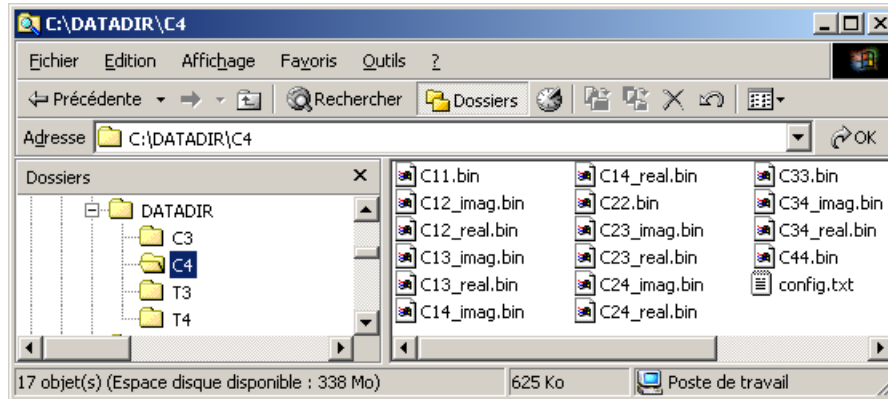
Nrow
1234

Ncol
4789

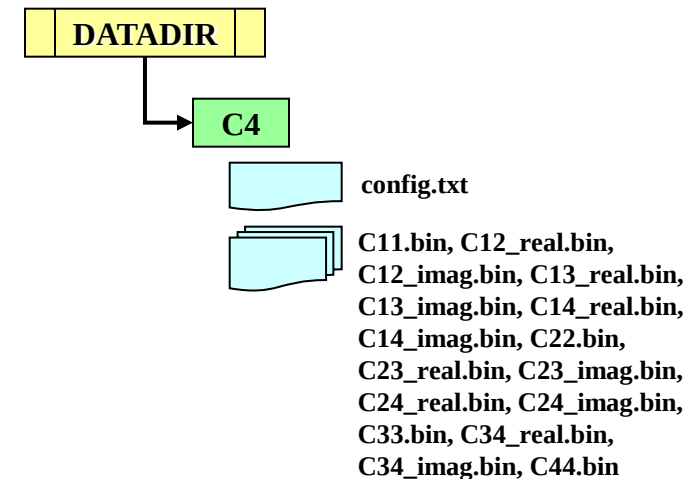
PolarCase
Bistatic

PolarType
Full

Compatible Raw Binary Data



4x4 Complex Covariance Matrix [C4]



$$\underline{k}_{4L} = \begin{bmatrix} S_{11} & S_{12} & S_{21} & S_{22} \end{bmatrix}$$

$$\Rightarrow [C_4] = \langle \underline{k}_{4L} \cdot \underline{k}_{4L}^\dagger \rangle$$

$$[C_4] = \begin{bmatrix} C_{11} & C_{12} & C_{13} & C_{14} \\ C_{12}^* & C_{22} & C_{23} & C_{24} \\ C_{13}^* & C_{23}^* & C_{33} & C_{34} \\ C_{14}^* & C_{24}^* & C_{34}^* & C_{44} \end{bmatrix}$$

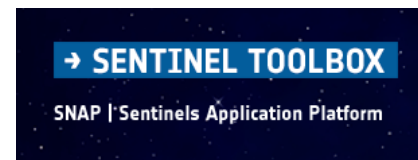
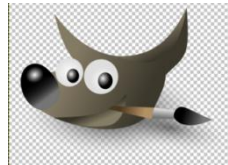
Nrow
1234

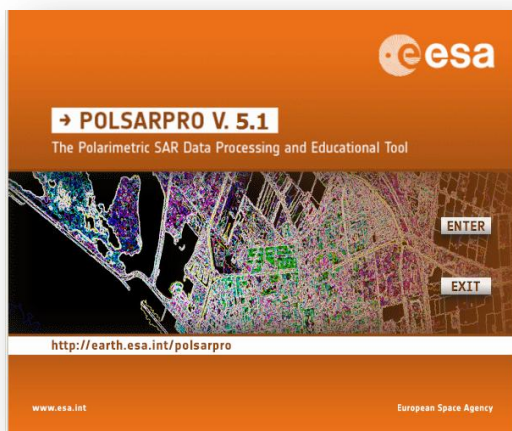
Ncol
4789

PolarCase
Bistatic

PolarType
Full

CONFIGURATION

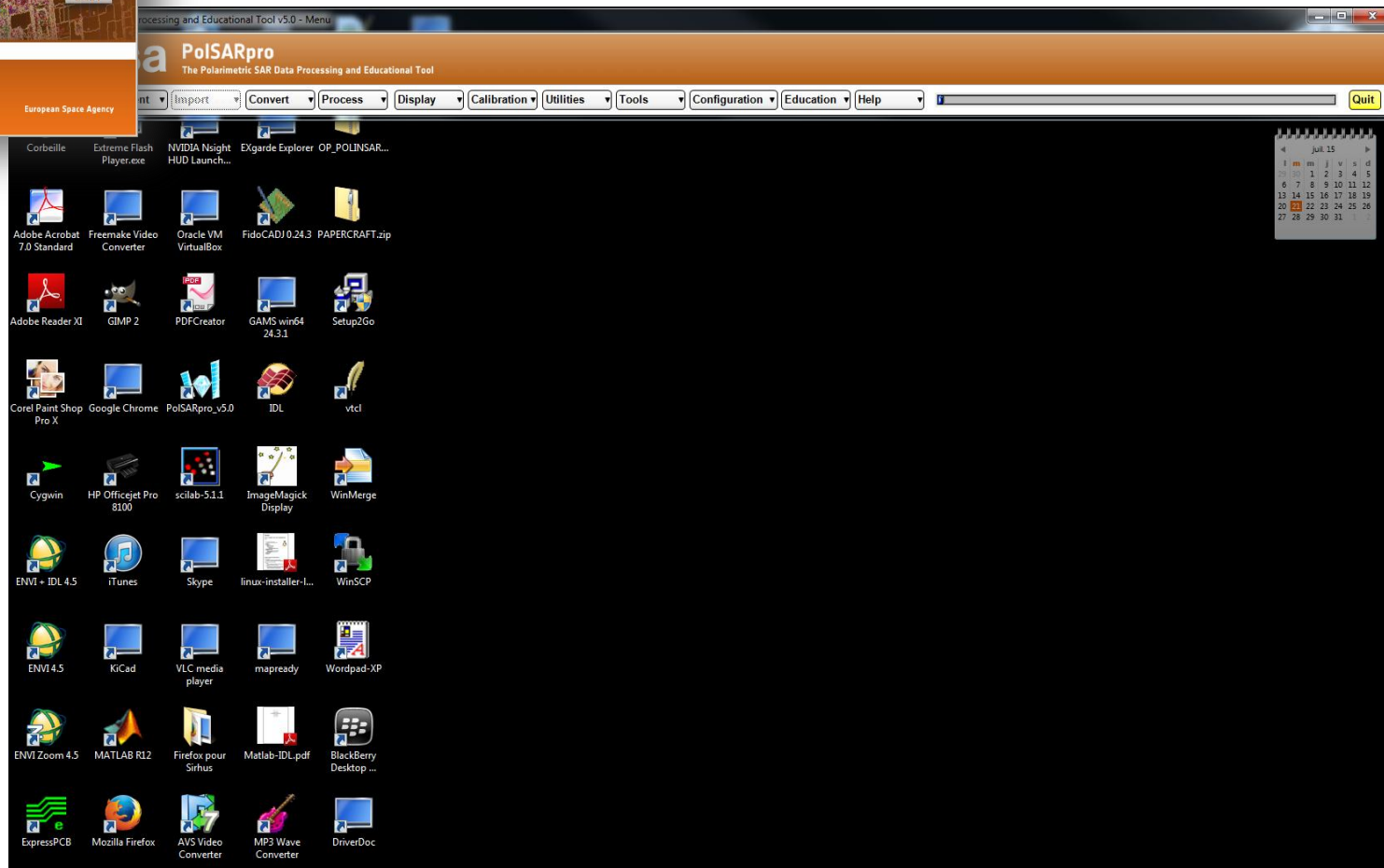




ENTRY SCREEN



MAIN WINDOW





PolSARpro v5.1 MAIN WINDOW

CONFIGURATION - 1st INSTALLATION



PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

T3

S

Environment

Import

Convert

Process

Display

Calibration

Utilities

Tools

Configuration

Education

Help

Quit

PolSARpro : Widget Size Adjust

Block 1



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per

Block 2



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per

Block 3



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per

Block 4



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per



Porrigitur porrigitur quaerente feracium quos

fructus magnitudo cuncta virtute per

Left

Center

Right

PolSARpro : Widget Size Adjust Cmd

Widget Width Size

Initial Size (pix)

520

Current Size (pix)

520

Widget Height Size

Initial Size (pix)

740

Current Size (pix)

740

Widget Size Ratio

Width Ratio

1.0

Height Ratio

1.0



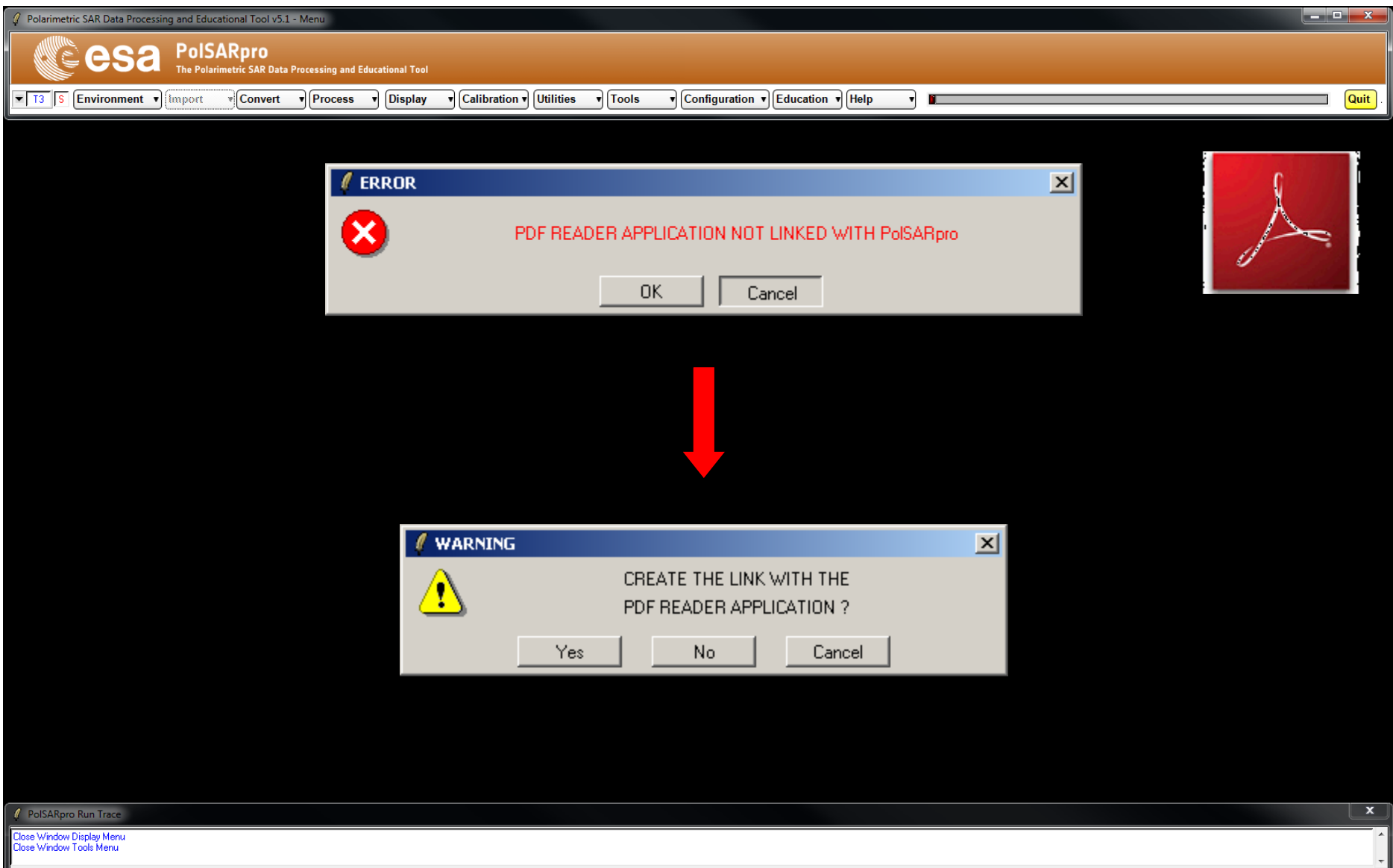
Refresh

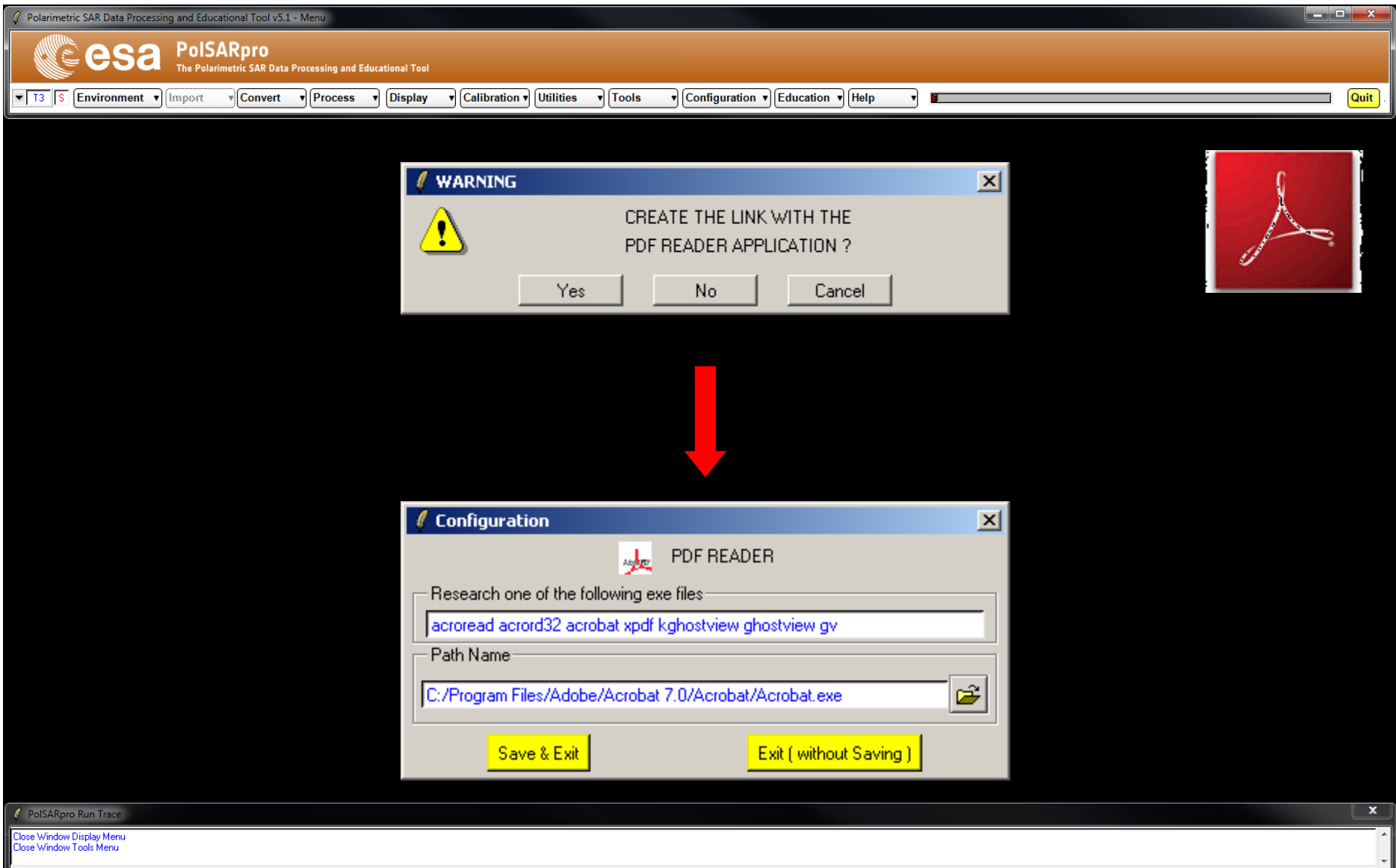
Reset

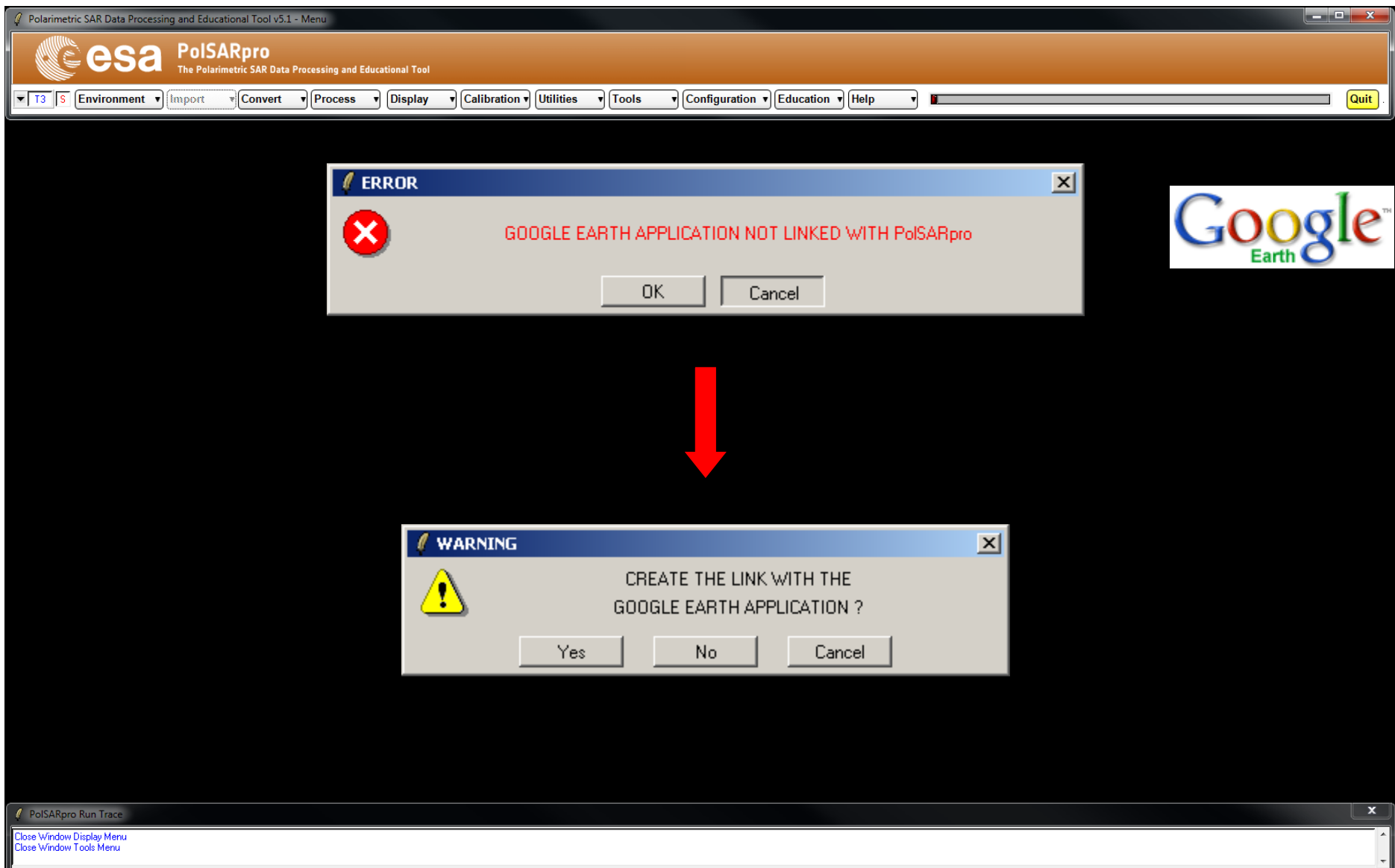
Save and Exit

→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

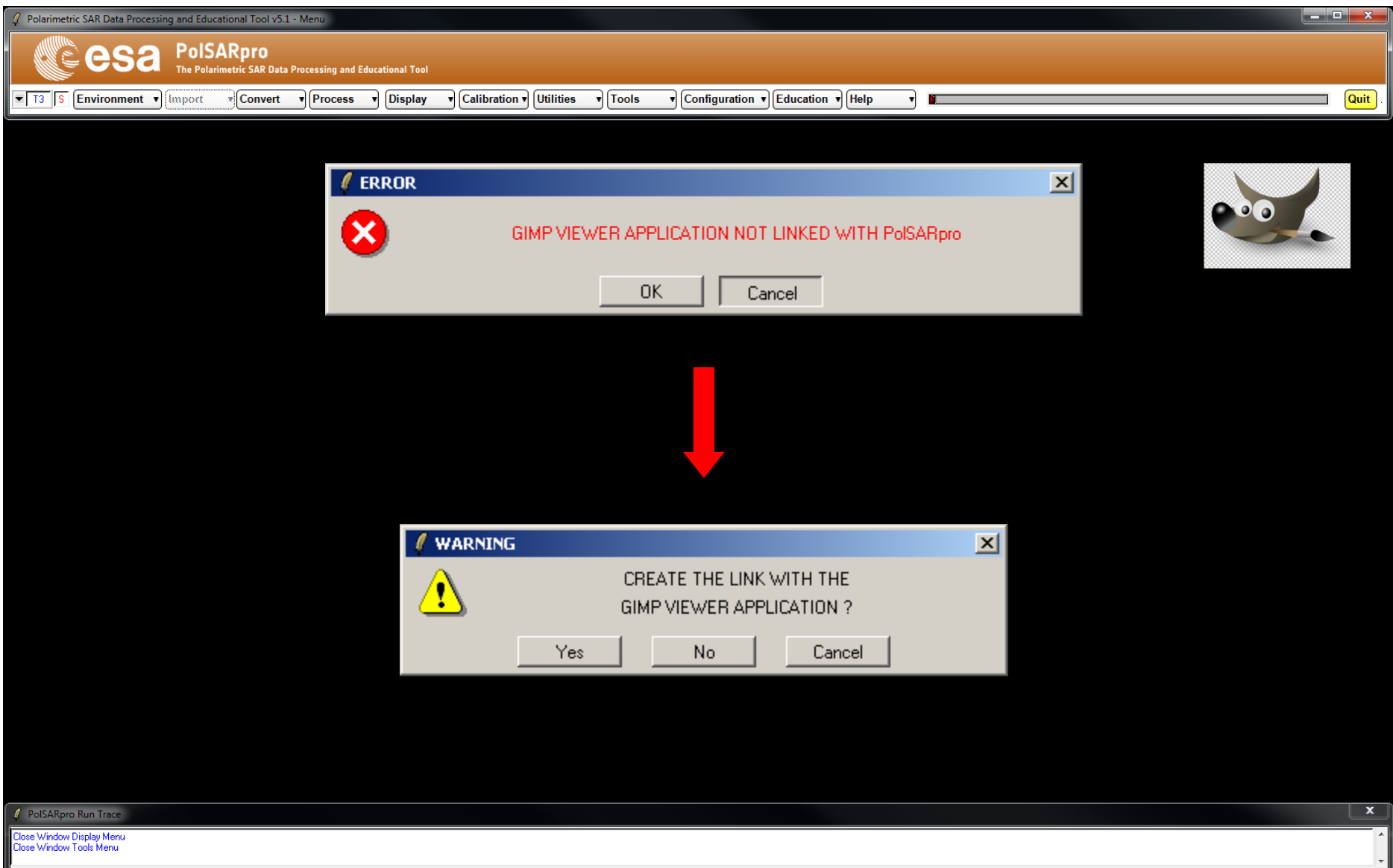
4–9 September 2017 | Szent István University | Gödöllő, Hungary

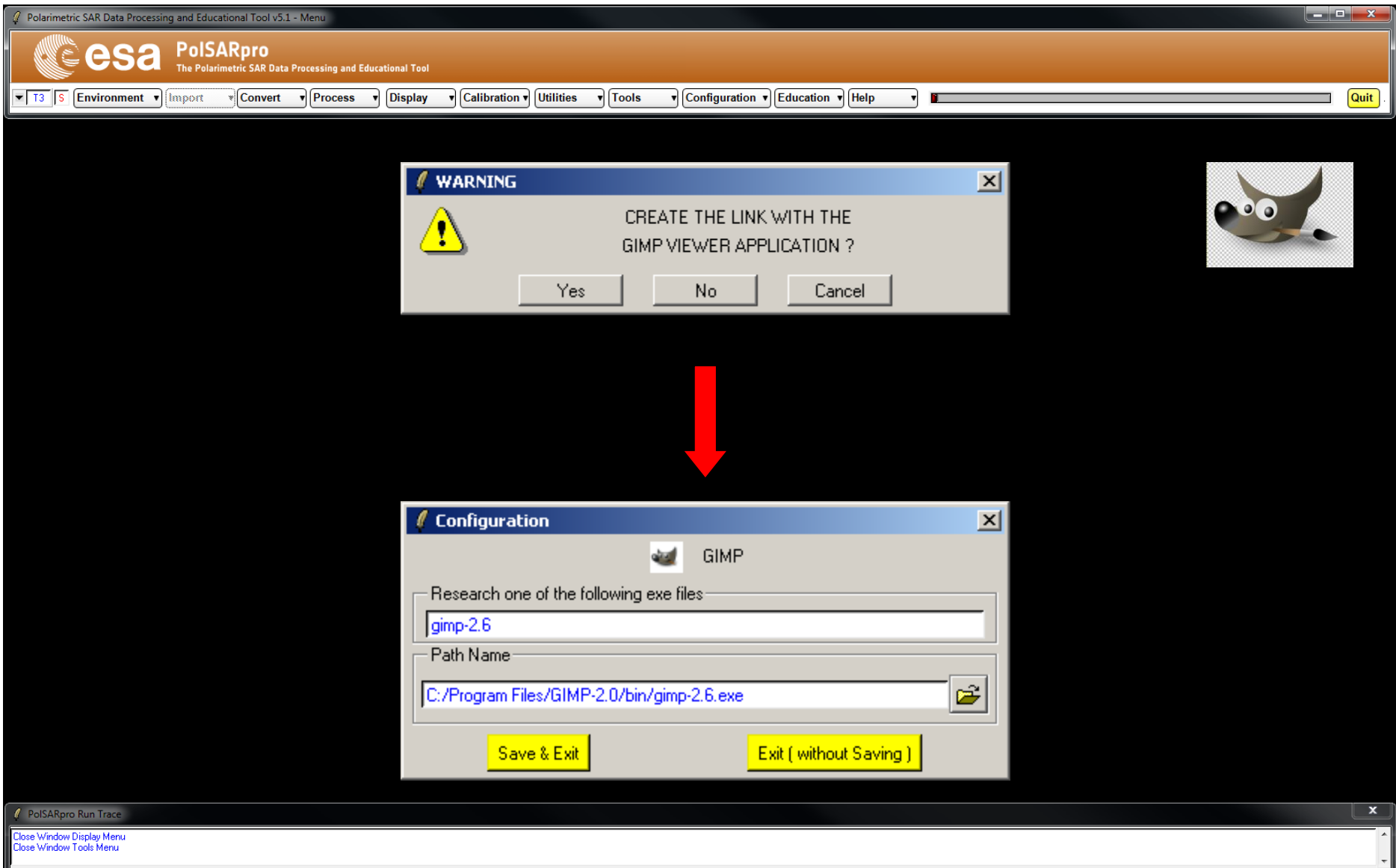


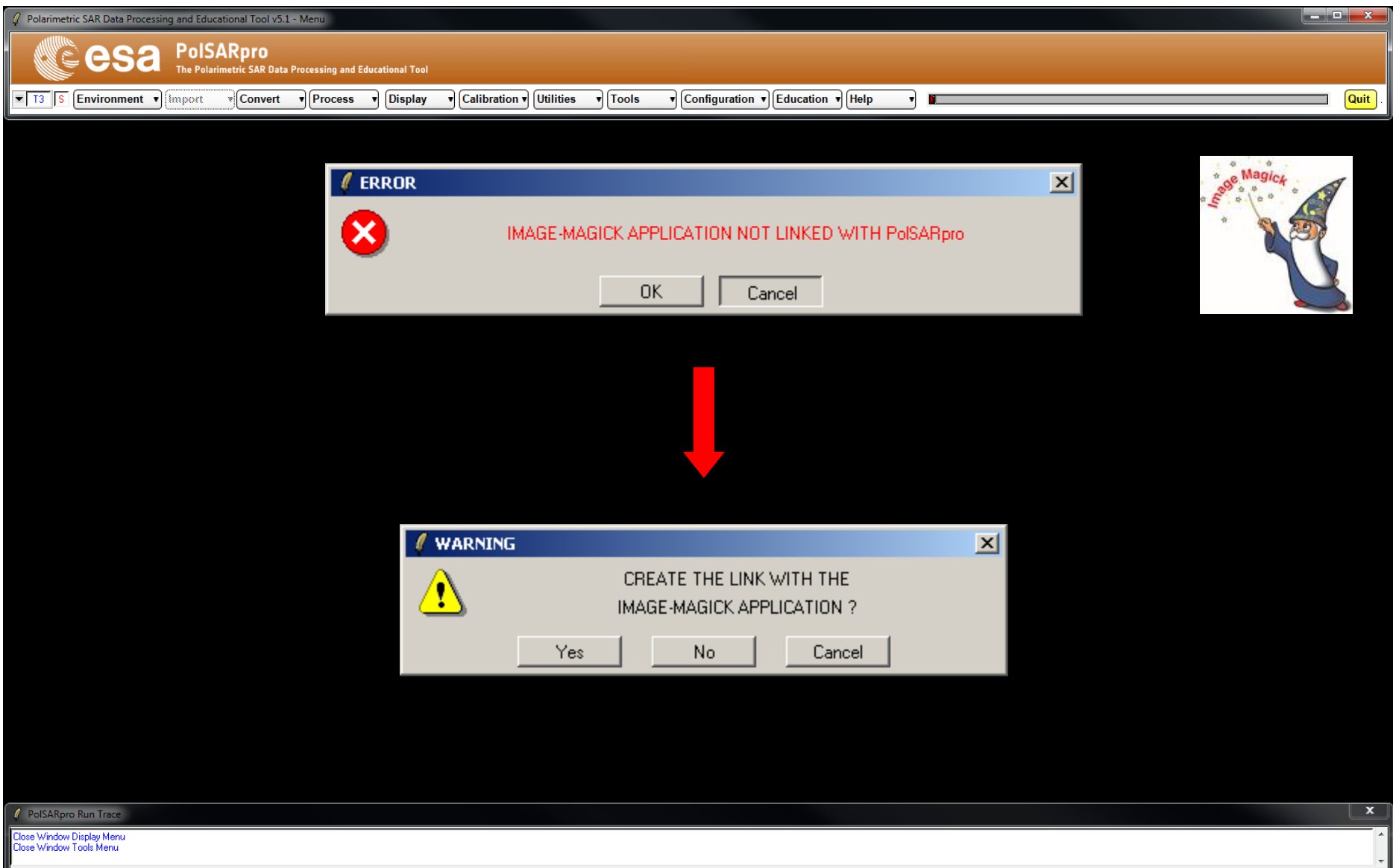




The screenshot displays the PolSARpro v5.1 software interface. At the top, the title bar reads "Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu". The main menu bar includes options: T3, S, Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help, and a Quit button. A warning dialog box is open, asking "CREATE THE LINK WITH THE GOOGLE EARTH APPLICATION ?" with Yes, No, and Cancel buttons. A red arrow points from this dialog to the Configuration dialog box. The Configuration dialog box is titled "Configuration" and shows "GOOGLE EARTH" as the selected application. It contains a text field with the path "C:/Program Files/Google/Google Earth/client/googleearth.exe" and buttons for "Save & Exit" and "Exit (without Saving)". At the bottom, a "PolSARpro Run Trace" window is visible, showing a list of actions: "Close Window Display Menu" and "Close Window Tools Menu".







The screenshot displays the PolSARpro v5.1 software interface. At the top, the title bar reads "PolSARpro v5.1 - Menu". Below it, the main menu bar includes options: T3, S, Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, and Help. A "Quit" button is located on the right side of the menu bar.

A "WARNING" dialog box is shown in the center, asking: "CREATE THE LINK WITH THE IMAGE-MAGICK APPLICATION ?". It has "Yes", "No", and "Cancel" buttons. To the right of the warning dialog is a small image of a wizard holding a wand, with the text "Image Magick" above it.

A large red arrow points from the "WARNING" dialog to the "Configuration" dialog box below it. The "Configuration" dialog box is titled "IMAGE MAGICK" and contains the following fields:

- Research one of the following exe files:
- Path Name:

At the bottom of the "Configuration" dialog box are two buttons: "Save & Exit" and "Exit (without Saving)".

At the bottom of the main window, there is a "PolSARpro Run Trace" window with the following text:

```
Close Window Display Menu
Close Window Tools Menu
```

The screenshot shows the PolSARpro v5.1 software interface. The main window has a menu bar with options: T3, S, Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help. Below the menu bar is a toolbar with buttons for Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help, and a Quit button. A red arrow points from an error dialog box to a warning dialog box.

ERROR

SNAP S1-TBX APPLICATION NOT LINKED WITH PolSARpro

OK Cancel

WARNING

CREATE THE LINK WITH THE
SNAP S1-TBX APPLICATION ?

Yes No Cancel

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

→ **SENTINEL TOOLBOX**

SNAP | Sentinels Application Platform

The screenshot displays the PolSARpro v5.1 software interface. At the top, the title bar reads "PolSARpro v5.1 - Menu". Below it, the main menu bar includes "Environment", "Import", "Convert", "Process", "Display", "Calibration", "Utilities", "Tools", "Configuration", "Education", and "Help". A "Quit" button is located on the right side of the menu bar.

A "WARNING" dialog box is shown in the center, asking: "CREATE THE LINK WITH THE SNAP S1-TBX APPLICATION ?". It has three buttons: "Yes", "No", and "Cancel". A red arrow points from this dialog to the "Configuration" dialog box below it.

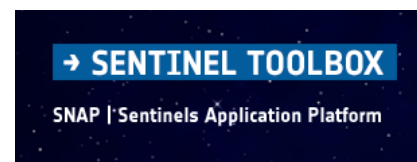
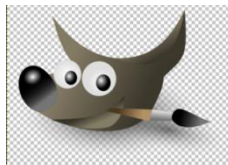
The "Configuration" dialog box is titled "Configuration" and contains a section for "SNAP S1-TBX". It has two input fields: "Research one of the following exe files" (containing "s1tbx") and "Path Name" (containing "C:/Program Files/S1TBX/s1tbx.exe"). At the bottom, there are two buttons: "Save & Exit" and "Exit (without Saving)".

At the bottom of the interface, there is a "PolSARpro Run Trace" window with a list of actions: "Close Window Display Menu" and "Close Window Tools Menu".

→ **SENTINEL TOOLBOX**

SNAP | Sentinel's Application Platform

TEST THE CONFIGURATION

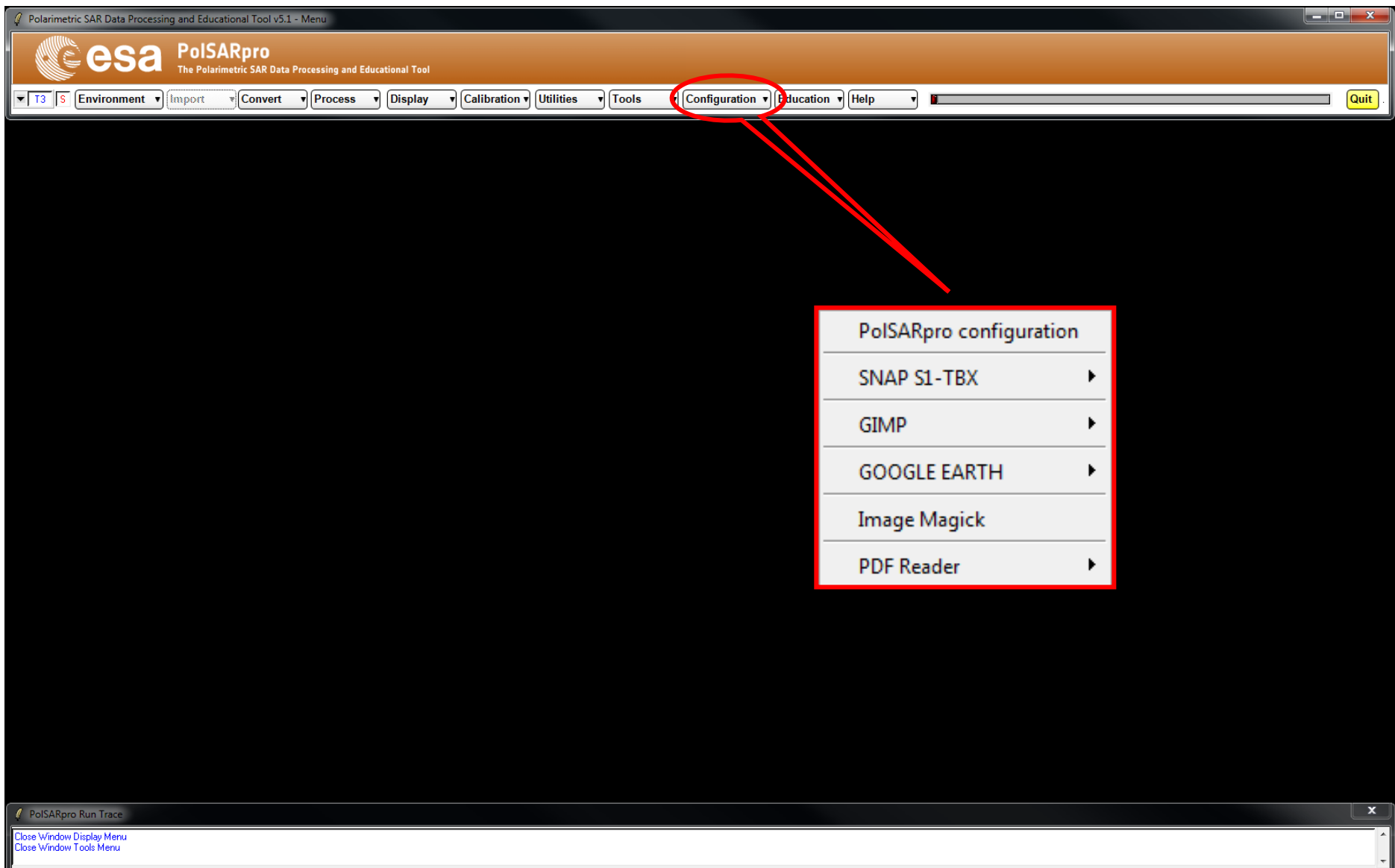




Hungarian
Space Office



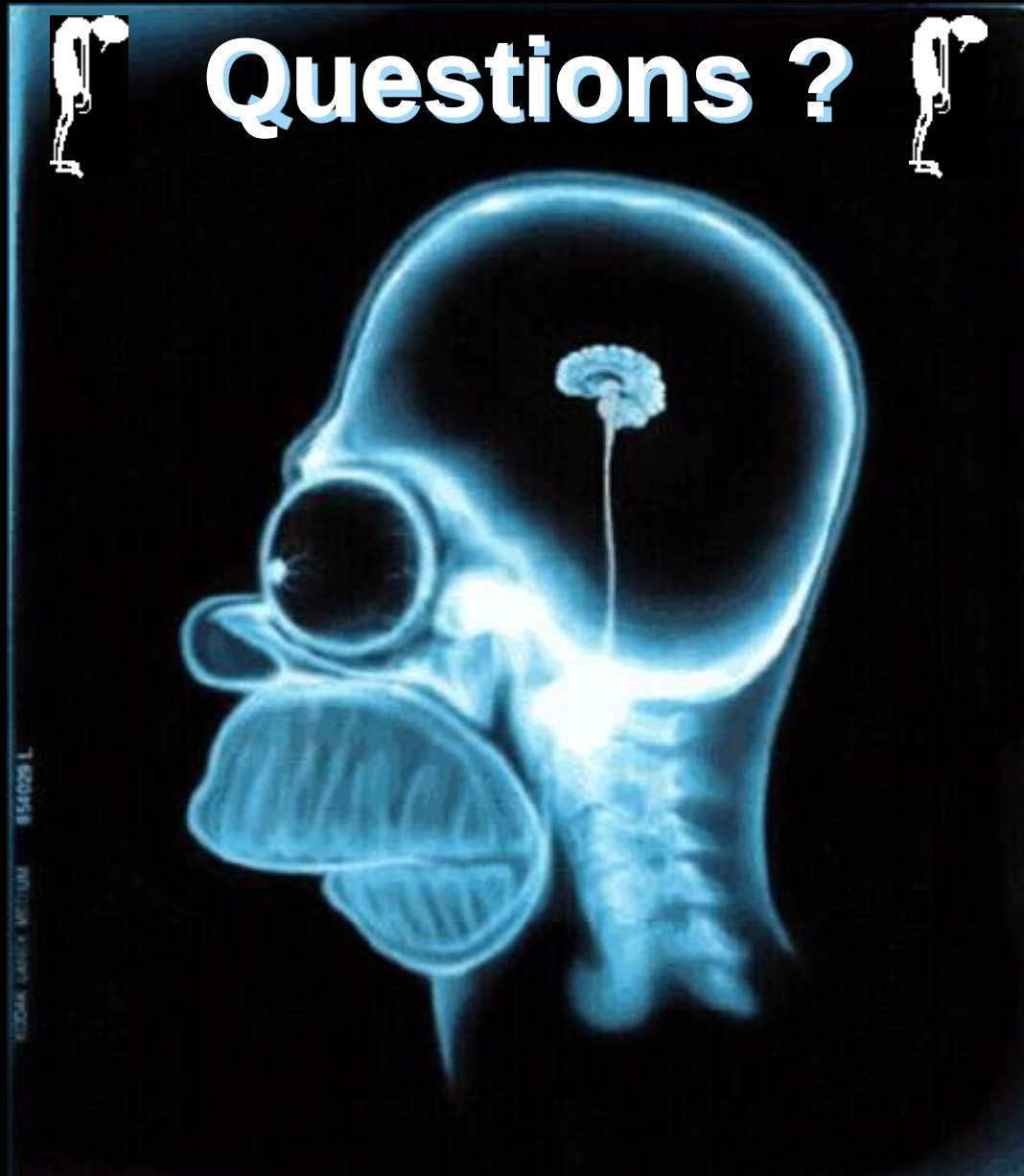
PolSARpro v5.1 SOFTWARE



→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

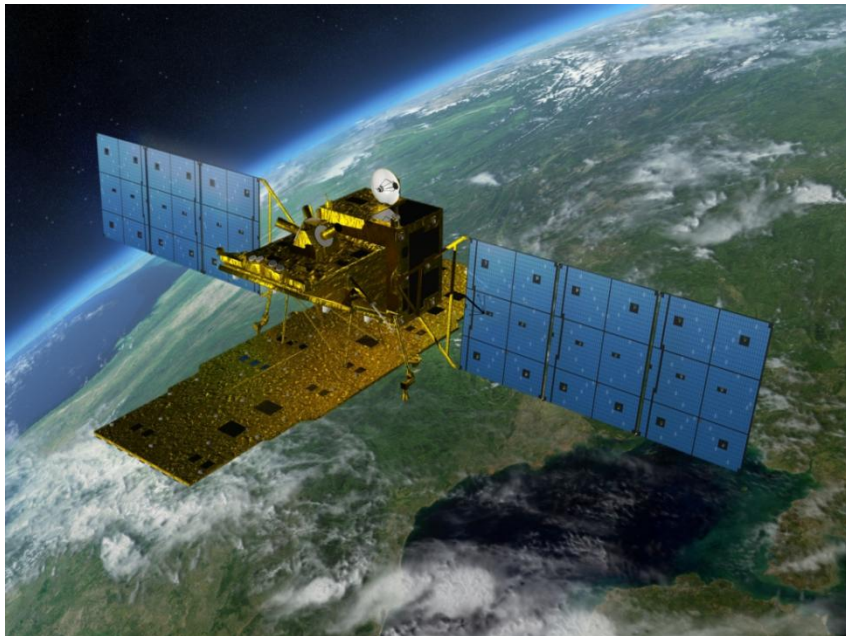
4–9 September 2017 | Szent István University | Gödöllő, Hungary

Questions ?

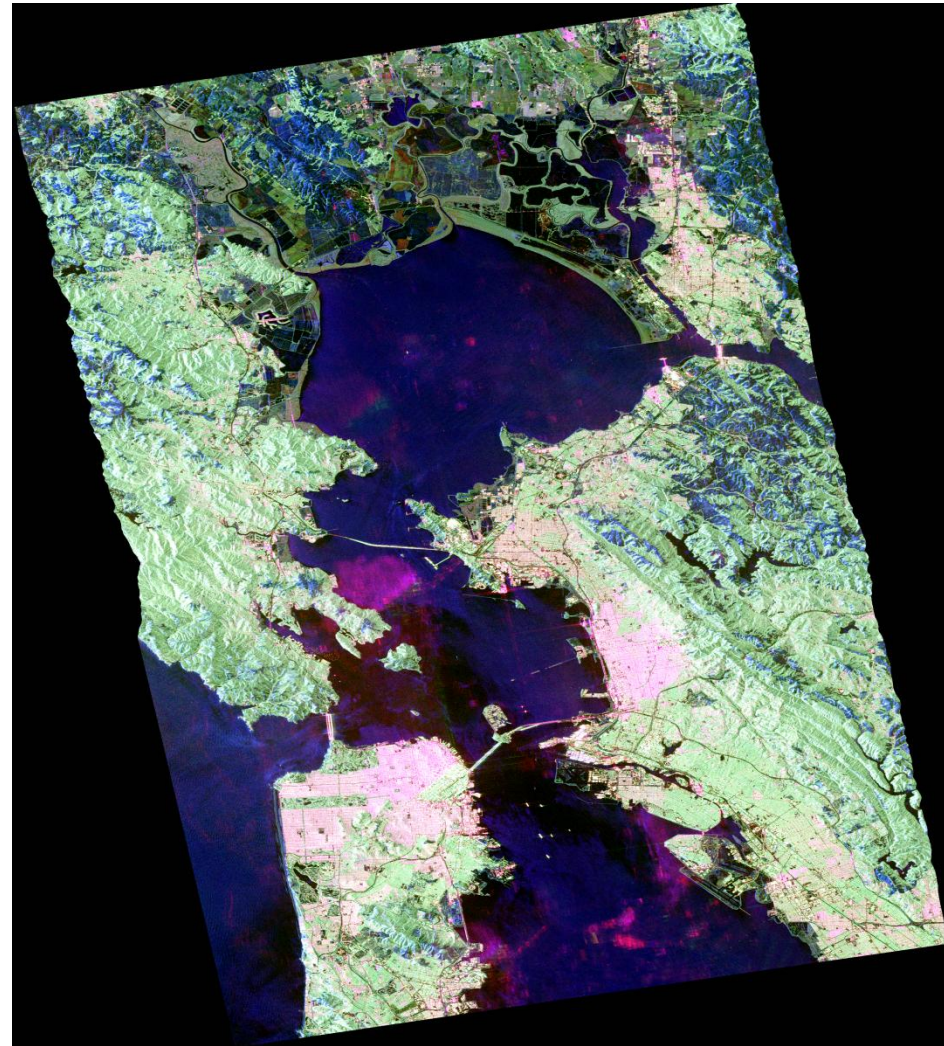


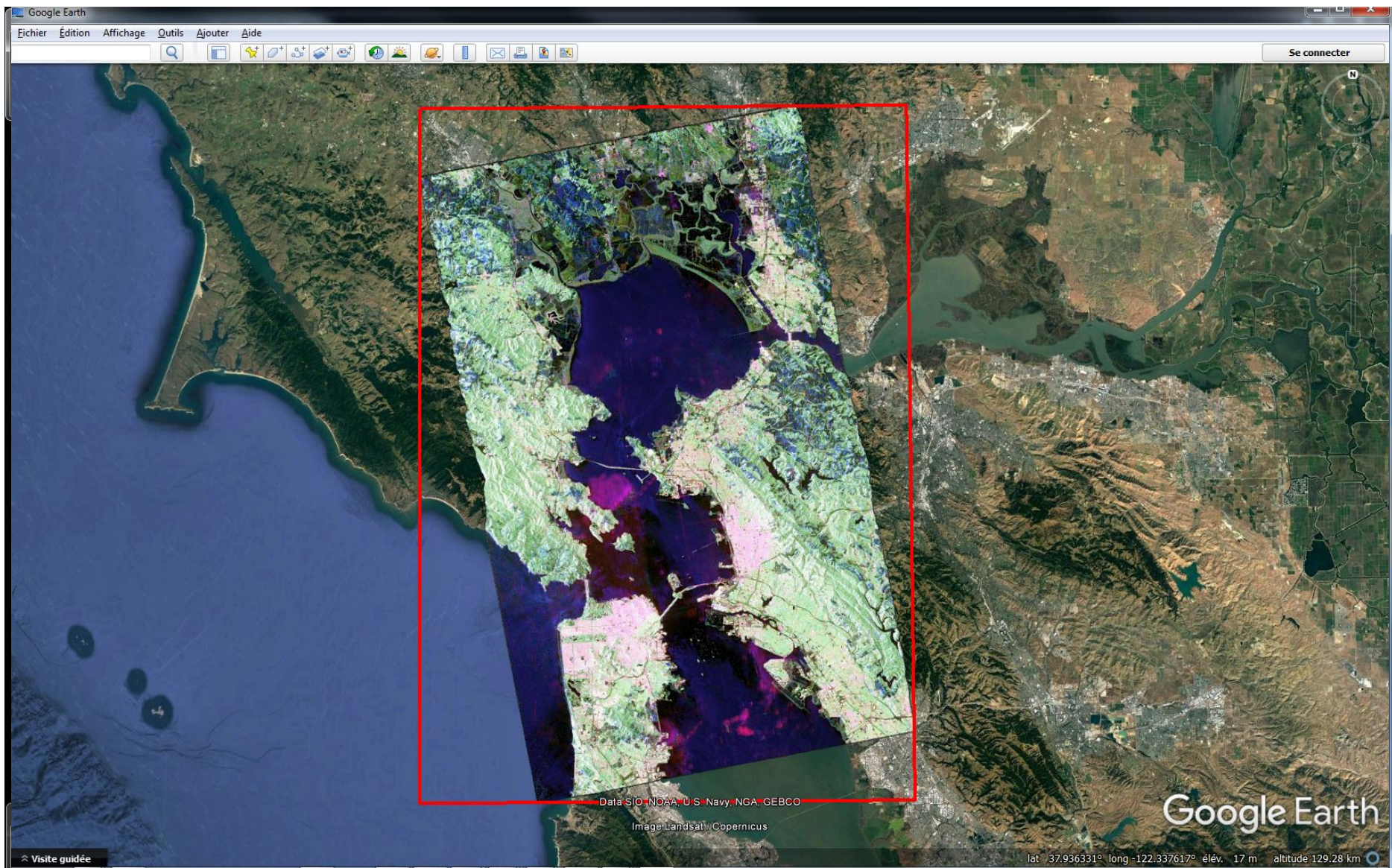
PolSARpro v5.1 Software

Practical basic session



ALOS : Advanced Land Observing Satellite
PALSAR : Phase Array L-Band SAR

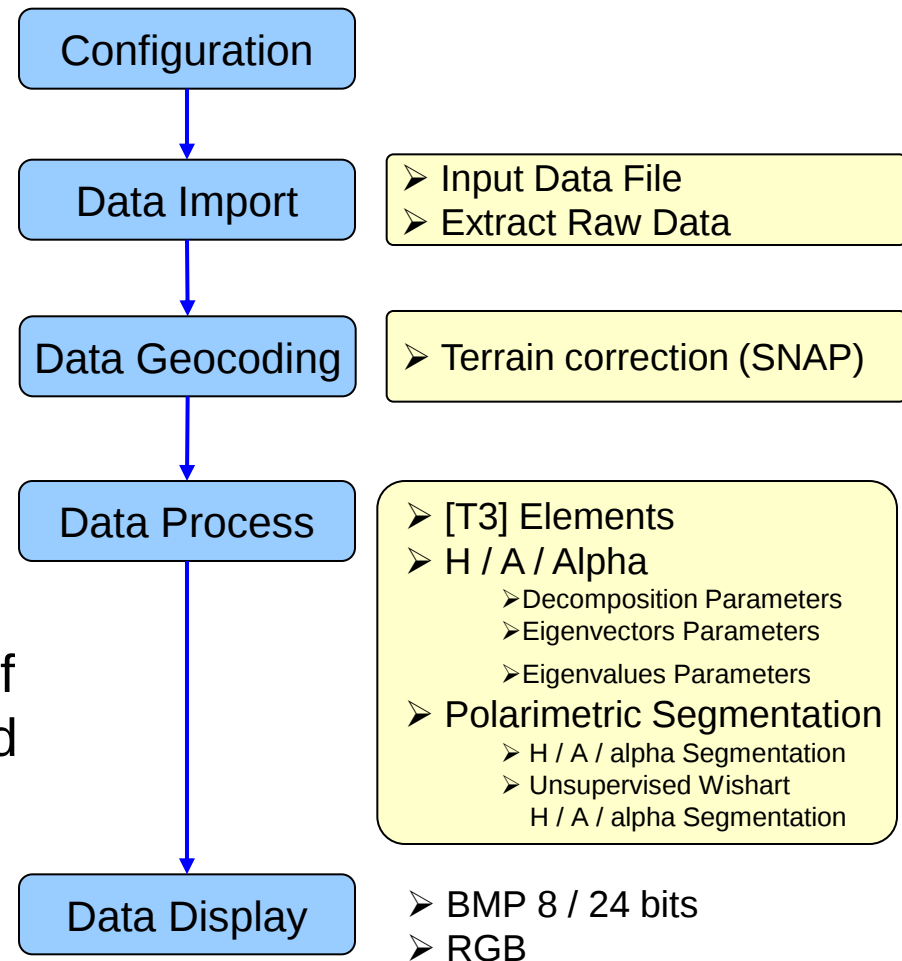


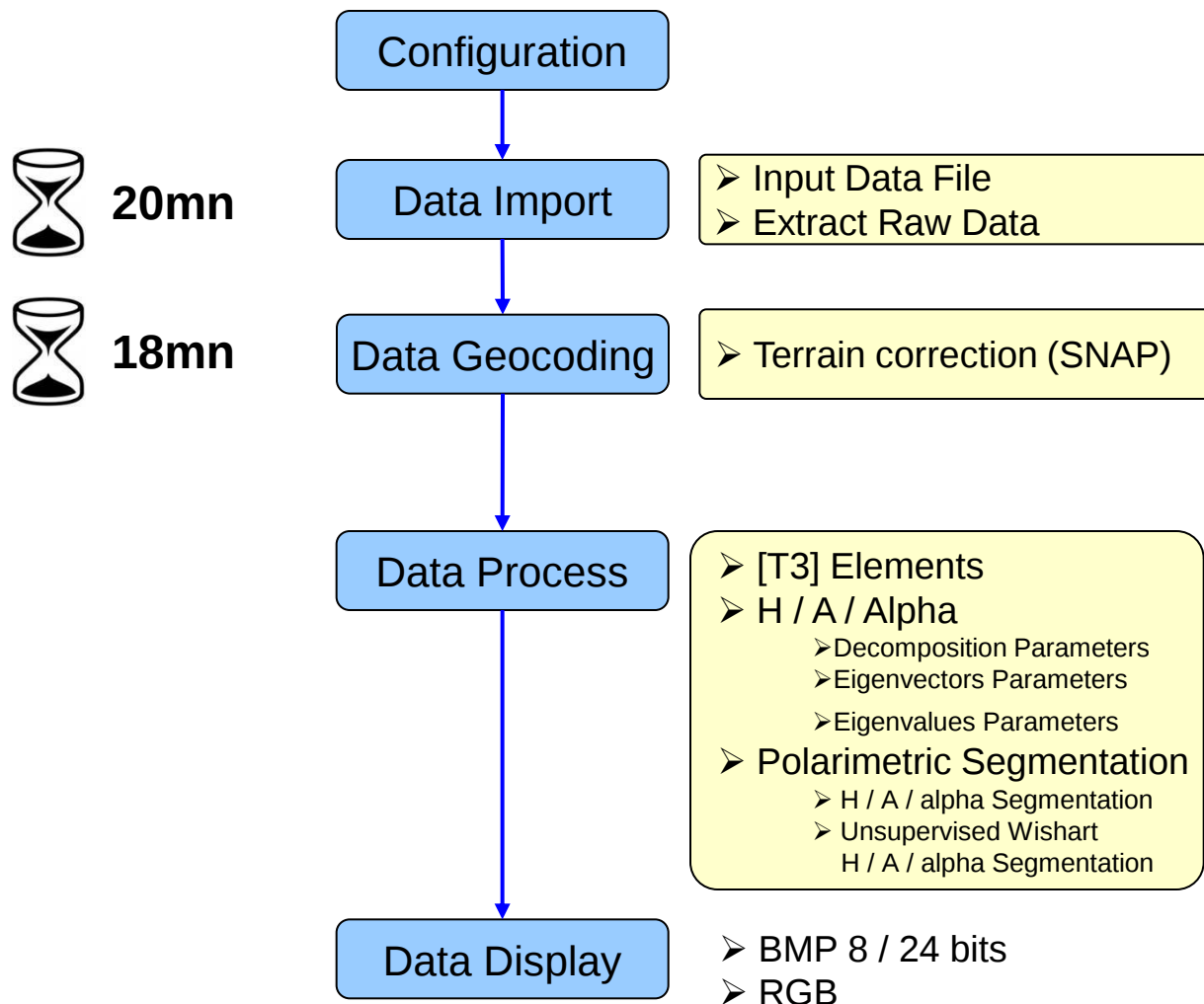


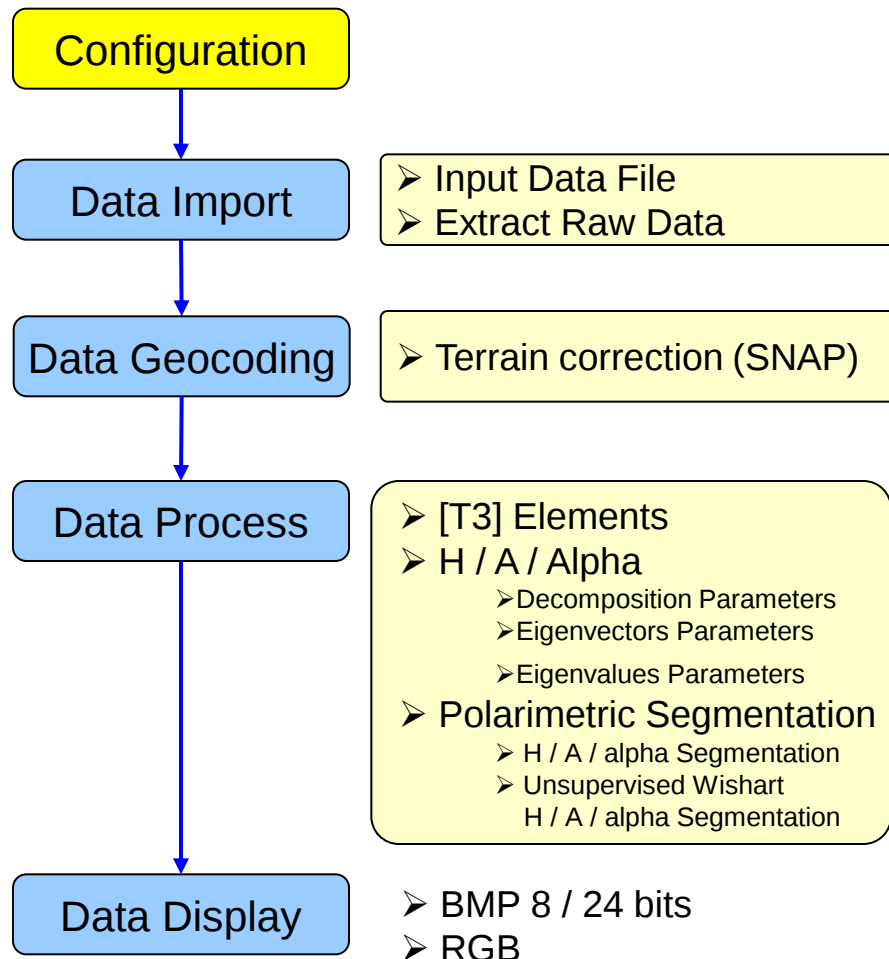
PolSARpro v5.1 Software
performs complete **end-to-end**
processing without the need for
any other software.

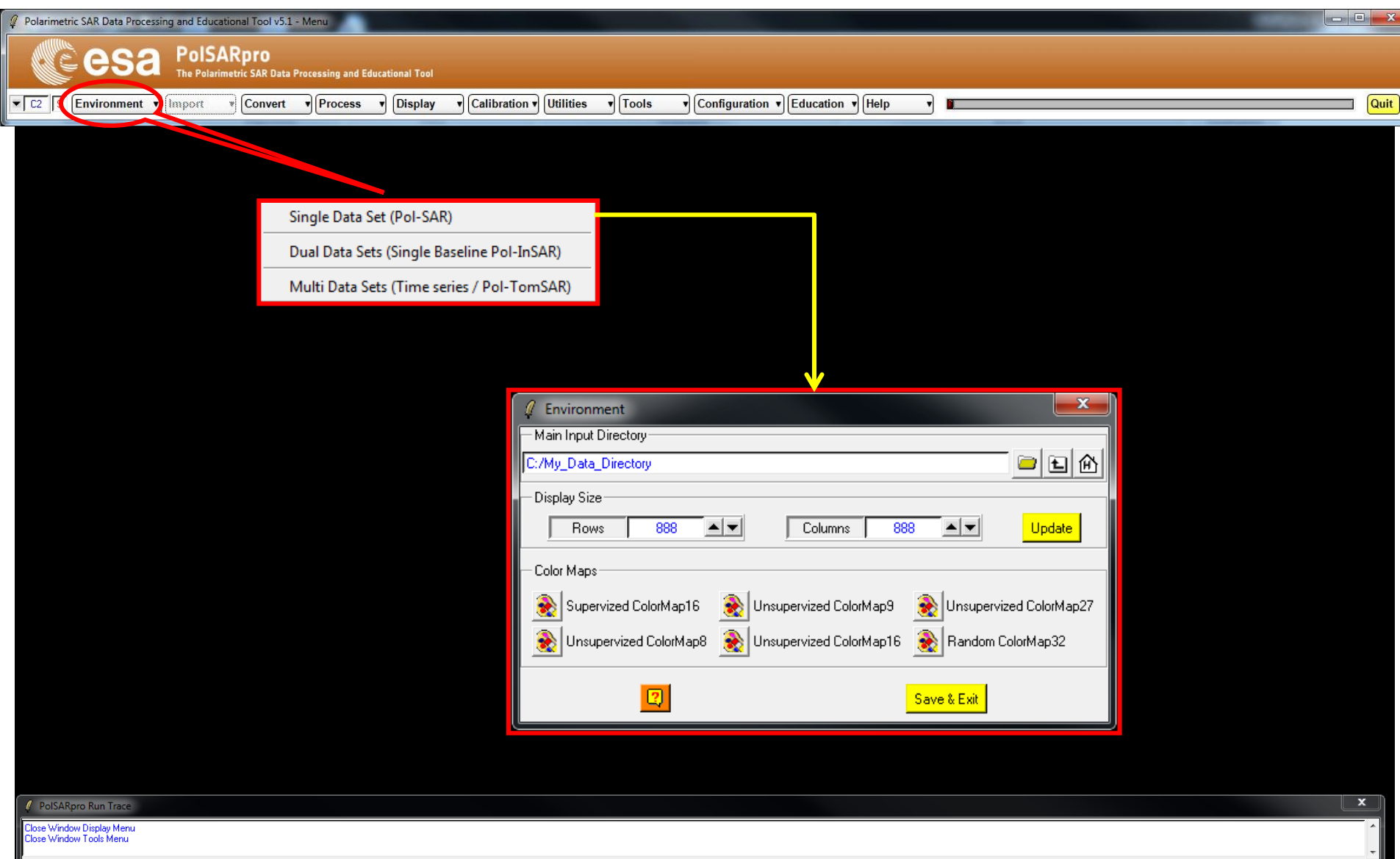
Data Processing Approach
along a '**recommended**'
and easy processing chain

Provide a **First Qualitative Analysis** of
the fully polarimetric data set processed











PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | S | Environment | Import | Convert | Process | Display | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Configure Data Main Directory location

Environment

Main Input Directory
D:\SAN_FRANCISCO_ALOS

Display Size
Main Directory
Rows: 818 | Columns: 818 | Update

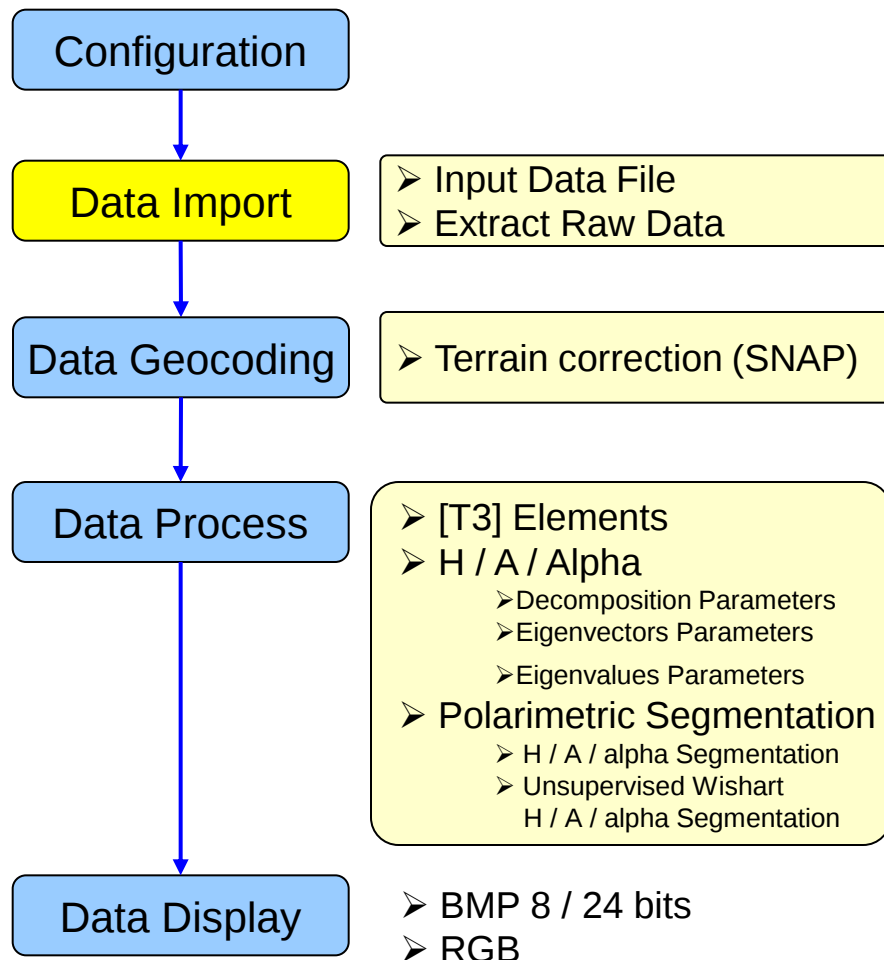
Color Maps
Supervized ColorMap16 | Unsupervized ColorMap9 | Unsupervized ColorMap27
Unsupervized ColorMap8 | Unsupervized ColorMap16 | Random ColorMap32

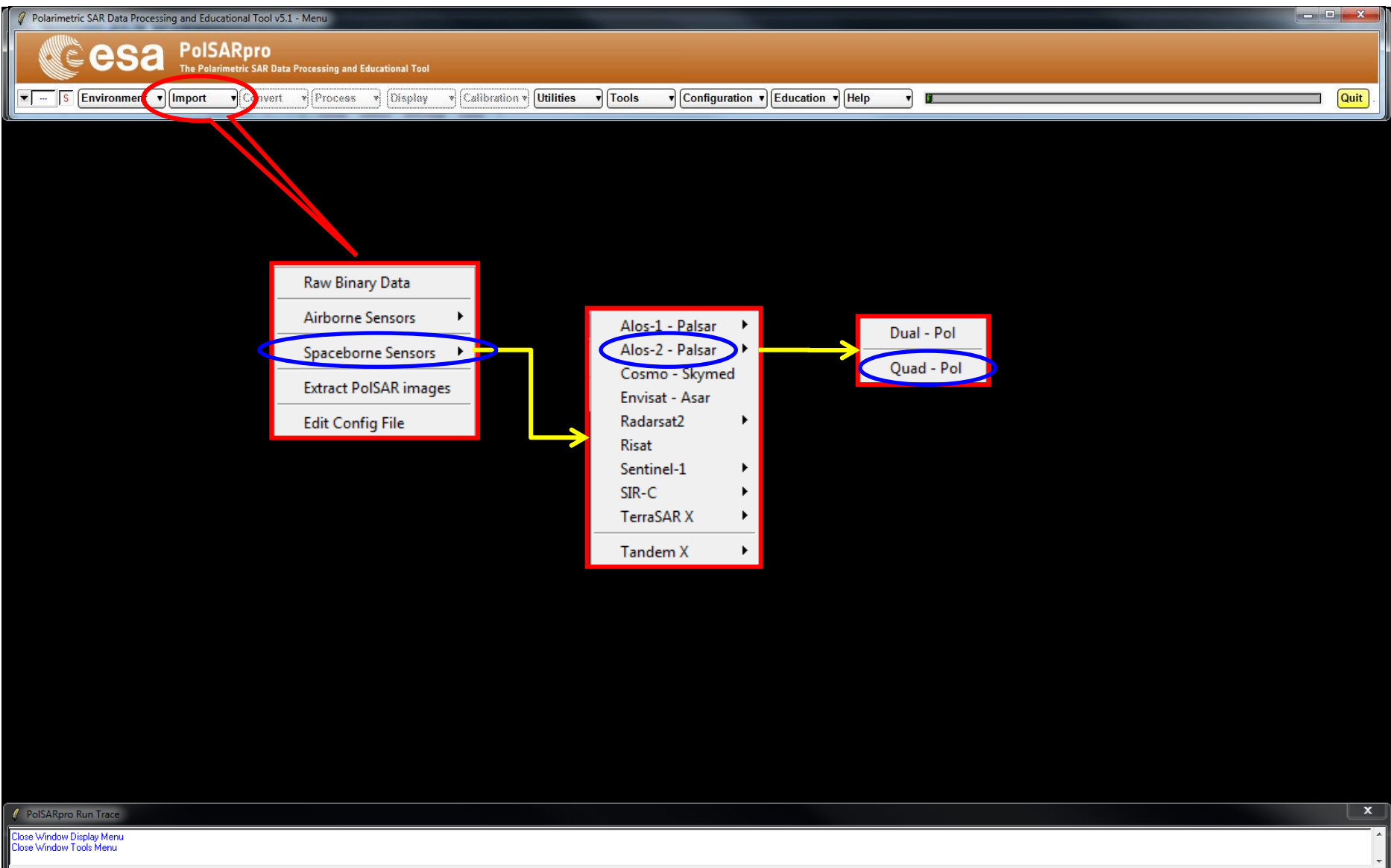
Save & Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

The screenshot displays the PolSARpro v5.1 software interface. The main window is titled "PolSARpro The Polarimetric SAR Data Processing and Educational Tool". It features a menu bar with options: T3, S, Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help, and a Quit button. Below the menu bar is a toolbar with icons for file operations and processing. The "Environment" window is open, showing the "Main Input Directory" set to "D:/SAN_FRANCISCO_ALOS". It also displays "Display Size" (Rows: 818, Columns: 818) and "Color Maps" (Supervised ColorMap16, Unsupervised ColorMap9, Unsupervised ColorMap27, Unsupervised ColorMap8, Unsupervised ColorMap16, Random ColorMap32). The "Color Map" window is open, showing the "Input ColorMap File" and "Output ColorMap File" both set to "ColorMap/Wishart_ColorMap16.pal". It includes a "Save" button and a "Color Map" palette. The "Choose a color" window is open, showing a color palette with a yellow color selected. It includes a "Couleurs de base" section, a "Couleurs personnalisées" section, and a "Couleur Unie" section with RGB values (Teinte: 40, Rouge: 255, Satur.: 240, Vert: 255, Lum.: 120, Bleu: 0).





PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | S | Environment | Import | Convert | Process | Display | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

ALOS Input Data File (JAXA - CEOS Format)

Input Directory
D:/SAN_FRANCISCO_ALOS2

Output Directory
D:/SAN_FRANCISCO_ALOS2

SAR Leader File (LED-xxxxxxxxxx-xx.x_x)
D:/SAN_FRANCISCO_ALOS2/LED-ALOS2044980750-150324-HBQR1.1__A

Check Files

Scene ID: 0750 | Orbit: A | n°: 04498 | Date: 150324
Mode: Quad Pol (HBQ) | Data Level: 1.1 | Direction: Right

SAR Trailer File
D:/SAN_FRANCISCO_ALOS2/TRL-ALOS2044980750-150324-HBQR1.1__A

SAR Image Files
s11: D:/SAN_FRANCISCO_ALOS2/IMG-HH-ALOS2044980750-150324-HBQR1.1__A
s12: D:/SAN_FRANCISCO_ALOS2/IMG-VH-ALOS2044980750-150324-HBQR1.1__A
s21: D:/SAN_FRANCISCO_ALOS2/IMG-HV-ALOS2044980750-150324-HBQR1.1__A
s22: D:/SAN_FRANCISCO_ALOS2/IMG-VV-ALOS2044980750-150324-HBQR1.1__A

Read Header | Edit Header

☐ Extract Uncalibrated Raw Binary Data

Initial Number of Rows: 22608 | Initial Number of Cols: 8080
Row Pixel Spacing: 3.205713 | Col Pixel Spacing: 2.860844

OK | ? | Cancel

ADVICE

PolSARpro WILL TAKE INTO ACCOUNT THE
ALOS-PALSAR ENGINEER CONVENTION FOR THE
DEFINITION OF THE POLARIMETRIC CHANNELS
WITH : s12 = VH and s21 = HV

OK

Do it Yourself:

Enter SAR Leader File
Check File

PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | S | Environment | Import | Convert | Process | Display | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

ALOS Input Data File (JAXA - CEOS Format)

Input Directory
D:/SAN_FRANCISCO_ALOS2

Output Directory
D:/SAN_FRANCISCO_ALOS2

SAR Leader File (LED-xxxxxxxx-xx.x_x)
D:/SAN_FRANCISCO_ALOS2/LED-ALOS2044980750-150324-HBQR1.1__A

Check Files

Scene ID: 0750 | Orbit: A | n°: 04498 | Date: 150324
Mode: Quad Pol (HBQ) | Data Level: 1.1 | Direction: Right

SAR Trailer File
D:/SAN_FRANCISCO_ALOS2/TRL-ALOS2044980750-150324-HBQR1.1__A

SAR Image Files
s11: D:/SAN_FRANCISCO_ALOS2/IMG-HH-ALOS2044980750-150324-HBQR1.1__A
s12: D:/SAN_FRANCISCO_ALOS2/IMG-VH-ALOS2044980750-150324-HBQR1.1__A
s21: D:/SAN_FRANCISCO_ALOS2/IMG-HV-ALOS2044980750-150324-HBQR1.1__A
s22: D:/SAN_FRANCISCO_ALOS2/IMG-VV-ALOS2044980750-150324-HBQR1.1__A

Read Header | Edit Header

☐ Extract Uncalibrated Raw Binary Data

Initial Number of Rows: 22608 | Initial Number of Cols: 8080
Row Pixel Spacing: 3.205713 | Col Pixel Spacing: 2.860844

OK | ? | Cancel

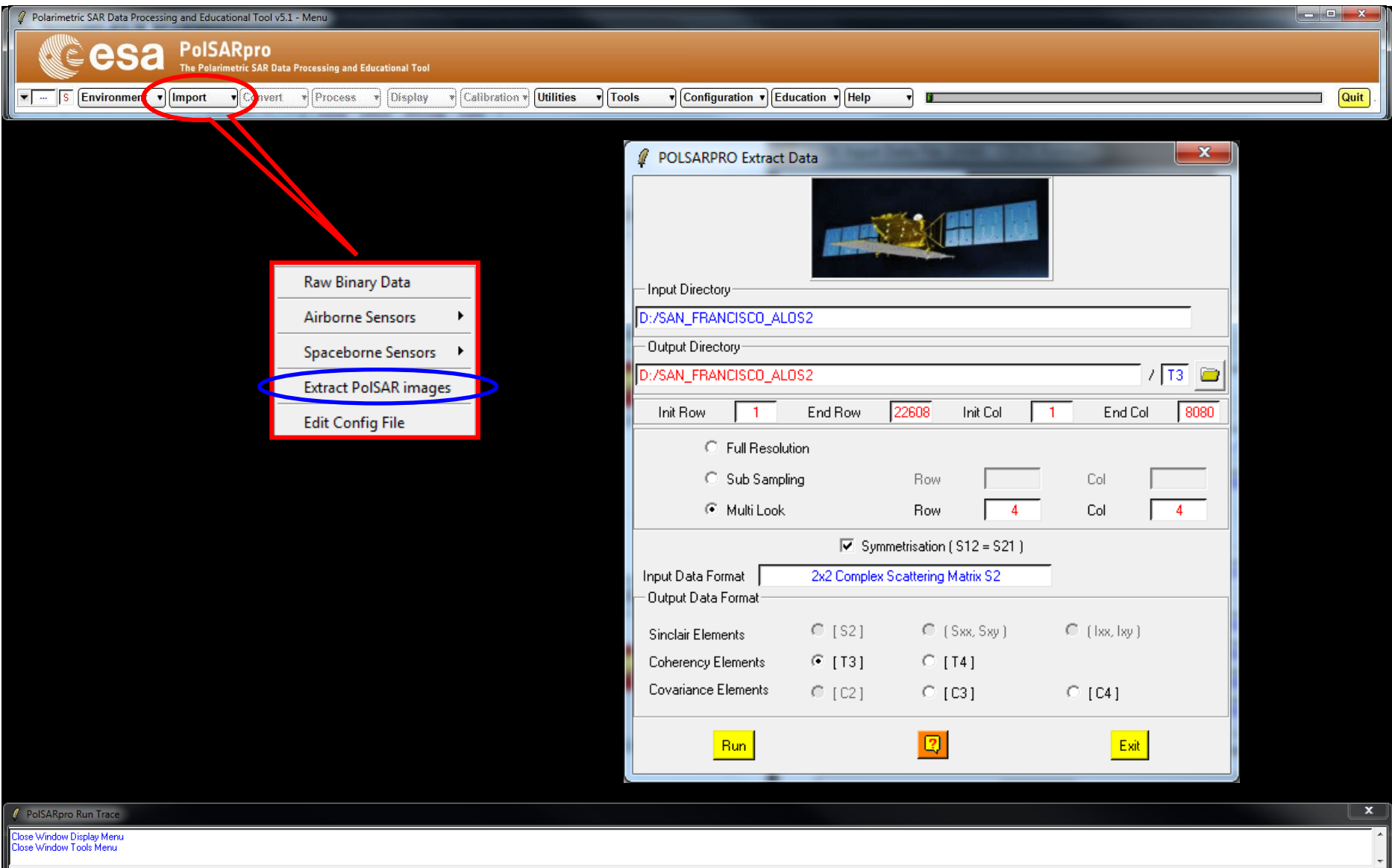
ADVICE

DON'T FORGET TO EXTRACT DATA BEFORE RUNNING ANY DATA PROCESS

OK

Do it Yourself:

Enter SAR Leader File
Read Header
OK



The screenshot displays the PolSARpro v5.1 software interface. The main window has a menu bar with options: Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, and Help. The 'Import' menu is highlighted with a red circle, and its dropdown list is shown, containing: Raw Binary Data, Airborne Sensors, Spaceborne Sensors, **Extract PolSAR images** (circled in blue), and Edit Config File.

The 'POLSARPRO Extract Data' dialog box is open, showing the following settings:

- Input Directory:** D:\SAN_FRANCISCO_ALOS2
- Output Directory:** D:\SAN_FRANCISCO_ALOS2 / T3
- Init Row:** 1, **End Row:** 22608, **Init Col:** 1, **End Col:** 8080
- Resolution Options:**
 - ☐ Full Resolution
 - ☐ Sub Sampling (Row: , Col:)
 - ☒ Multi Look (Row: 4, Col: 4)
- Symmetrisation:** ☒ Symmetrisation (S12 = S21)
- Input Data Format:** 2x2 Complex Scattering Matrix S2
- Output Data Format:**
 - Sinclair Elements:** ☐ [S2], ☐ (Sxx, Sxy), ☐ (lxx, lxy)
 - Coherency Elements:** ☒ [T3], ☐ [T4]
 - Covariance Elements:** ☐ [C2], ☐ [C3], ☐ [C4]
- Buttons:** Run, ? (Help), Exit

At the bottom, a 'PolSARpro Run Trace' window is visible, showing a list of actions: Close Window Display Menu and Close Window Tools Menu.



PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

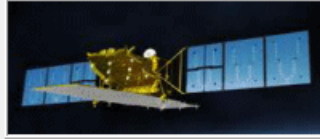
▼ T3 S Environment Import Convert Process Display Calibration Utilities Tools Configuration Education Help

Quit

Do it Yourself:

Multi Look : Row = 4 Col = 4
Run

POLSARPRO Extract Data



Input Directory
D:/SAN_FRANCISCO_ALOS2

Output Directory
D:/SAN_FRANCISCO_ALOS2 / T3

Init Row 1 End Row 22608 Init Col 1 End Col 8080

☐ Full Resolution
☐ Sub Sampling
☒ Multi Look

Row 4 Col 4

☒ Symmetrisation (S12 = S21)

Input Data Format 2x2 Complex Scattering Matrix S2

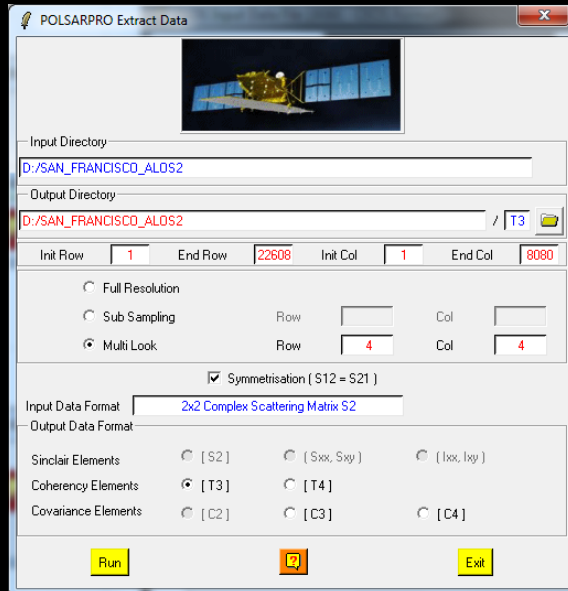
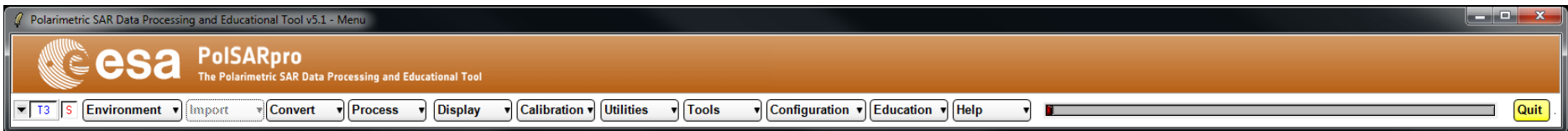
Output Data Format

Sinclair Elements ☐ [S2] ☐ [Sxx, Sxy] ☐ [lxx, lxy]
 Coherency Elements ☒ [T3] ☐ [T4]
 Covariance Elements ☐ [C2] ☐ [C3] ☐ [C4]

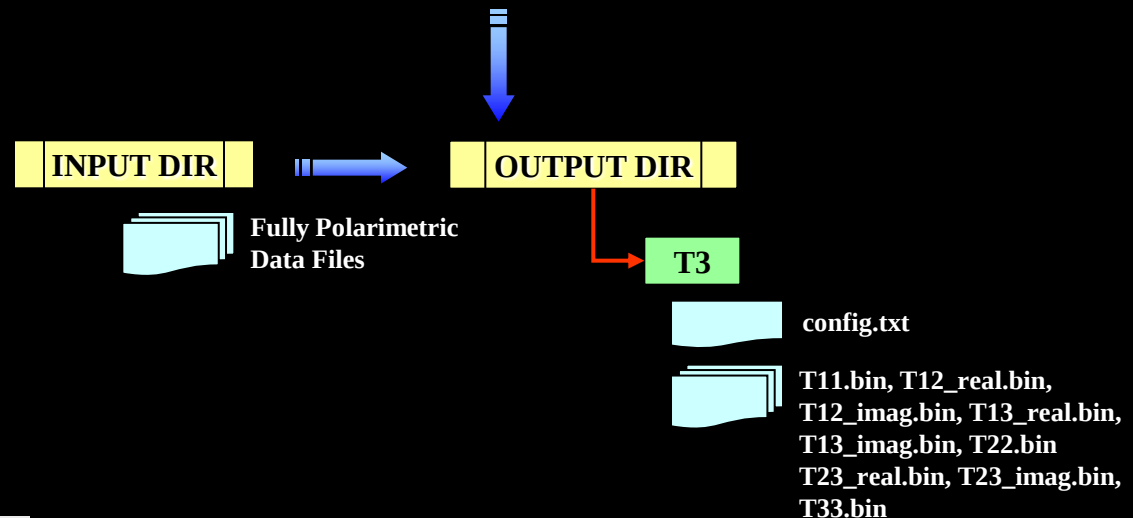
Run ? Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu



Convert ALOS2 Fully Polarimetric Data Files to Complex (3x3) Coherency Matrix [T3]



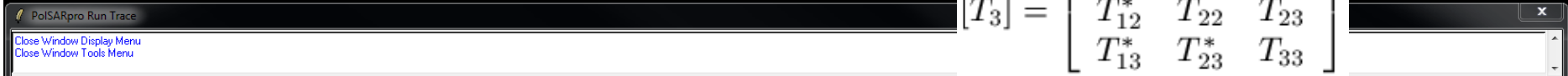
Do it Yourself:

Multi Look : Row = 4 Col = 4
Run

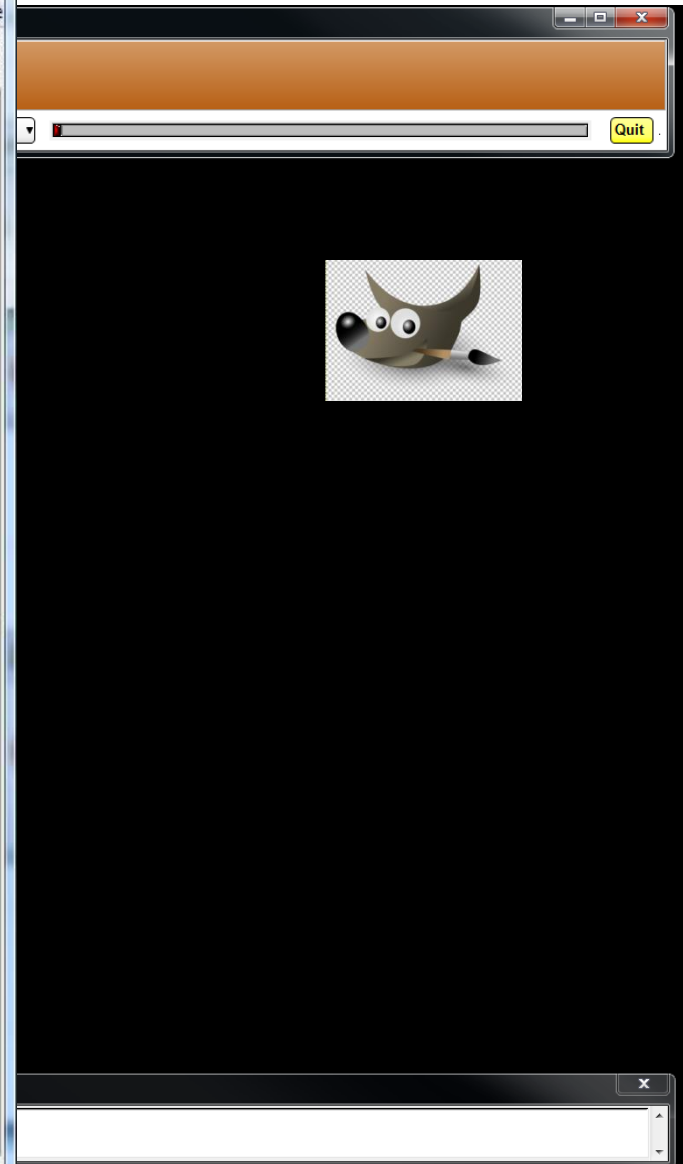
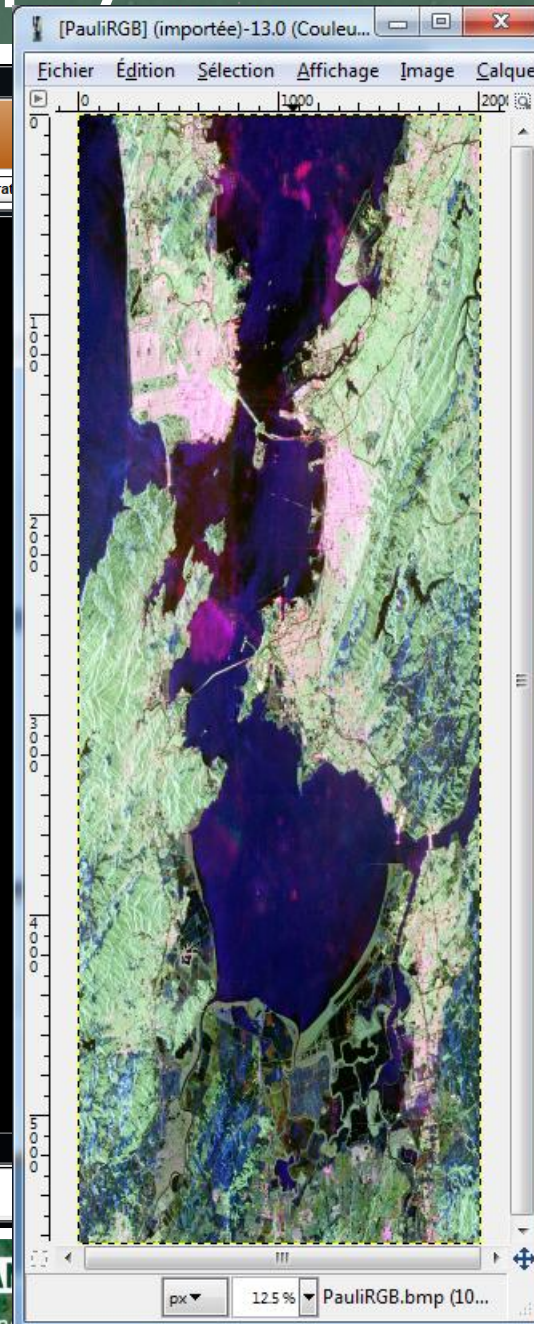
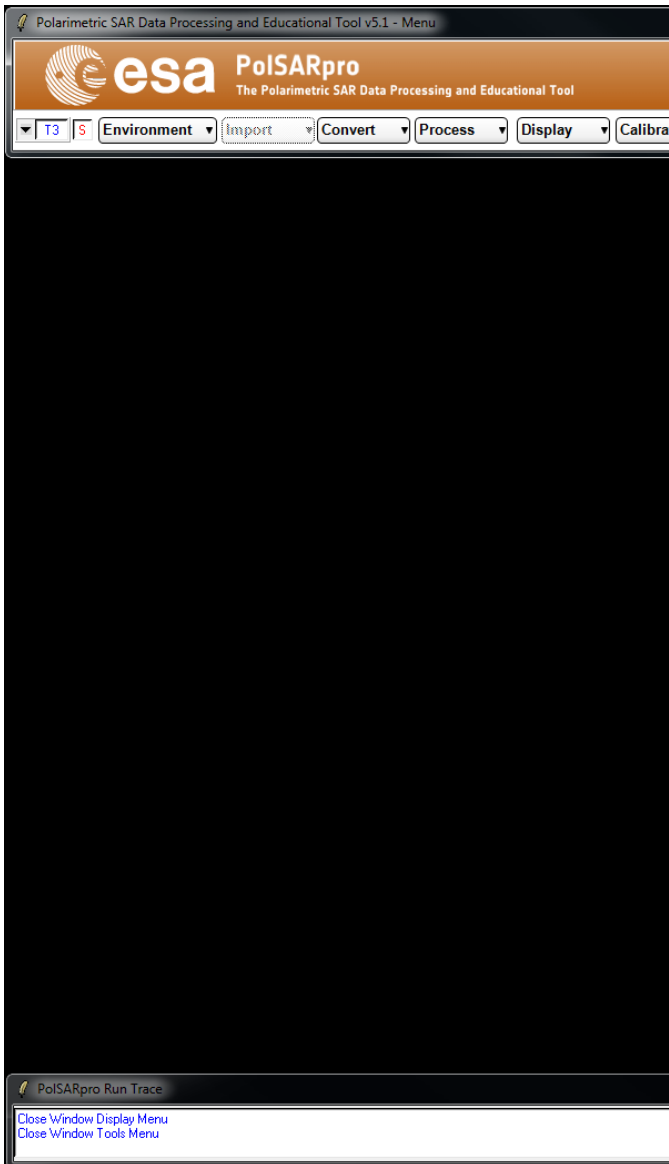
$$\underline{k}_{3P} = \frac{1}{\sqrt{2}} \begin{bmatrix} S_{11} + S_{22} & S_{11} - S_{22} & S_{12} + S_{21} \end{bmatrix}$$

$$\Rightarrow [T_3] = \langle \underline{k}_{3P} . \underline{k}_{3P}^\dagger \rangle$$

$$[T_3] = \begin{bmatrix} T_{11} & T_{12} & T_{13} \\ T_{12}^* & T_{22} & T_{23} \\ T_{13}^* & T_{23}^* & T_{33} \end{bmatrix}$$



Display Pauli-RGB Image



PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

Environment Import Convert Process Display Calibration Utilities Tools Configuration Education Help Quit

PolSARPRO V. 5.0
The Polarimetric SAR Data Processing and Educational Tool

<http://earth.esa.int/polsarpro>

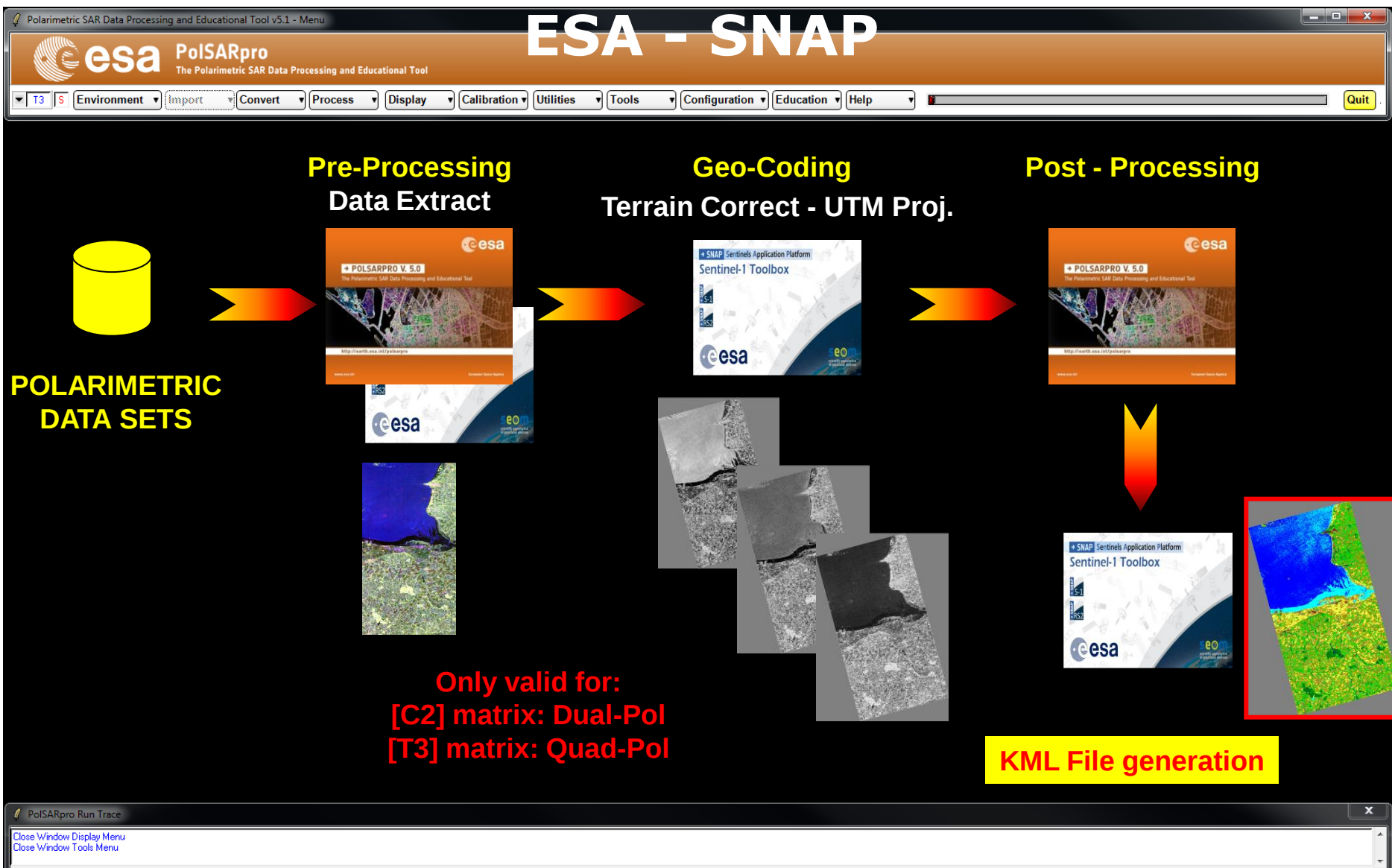
→ SNAP Sentinels Application Platform
Sentinel-1 Toolbox

- S1 toolbox (split, deburst, merge ...)
- Geocoding toolbox
- Interferometric toolbox (co-registration, flat Earth estimation ...)

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

Polariametric Data Processing



PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 S Environment Import Convert Process Display Calibration Utilities Tools Configuration

PolSARpro - Calculator
PolSARpro - Display ▶
PolSARpro - SIM ▶
PolSARpro - Viewer ▶
SATIM Map Algebra
SNAP - S1 TBX ▶
SRTM ▶
ASTER ▶
GIMP ▶
GOOGLE EARTH ▶
Close All Widgets

Geocode [C2] matrix
Geocode [T3] matrix
Geocode Parameter

SNAP - Geocode Matrix

Input Directory
D:/SAN_FRANCISCO_ALOS2/T3

Output Directory
D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Polarimetric SAR Sensor
☐ ALOS-1 (CEOS) ☒ ALOS-2 (CEOS) ☐ RADARSAT2 ☐ SENTINEL-1 ☐ TerraSAR-X

SAR Volume File
D:/SAN_FRANCISCO_ALOS2/VOL-ALOS2044980750-150324-HBQR1.1_A

Source GR Pixel Spacings
Azimut (m) 12.82284 Range (m) 20.53052 Pixel Spacing (m) 20.53052

Input Multi Look
Azimut 4 Range 4

Output Multi Look
Azimut 1 Range 1

Image Resampling Method
☒ Bilinear ☐ Cubic ☐ Nearest Neighbor

Digital Elevation Model (DEM)
☒ S.R.T.M ☐ ASTER ☐ External

DEM Resampling Method
☐ Bicubic ☒ Bilinear ☐ Bisinc ☐ Cubic ☐ Nearest Neighbor

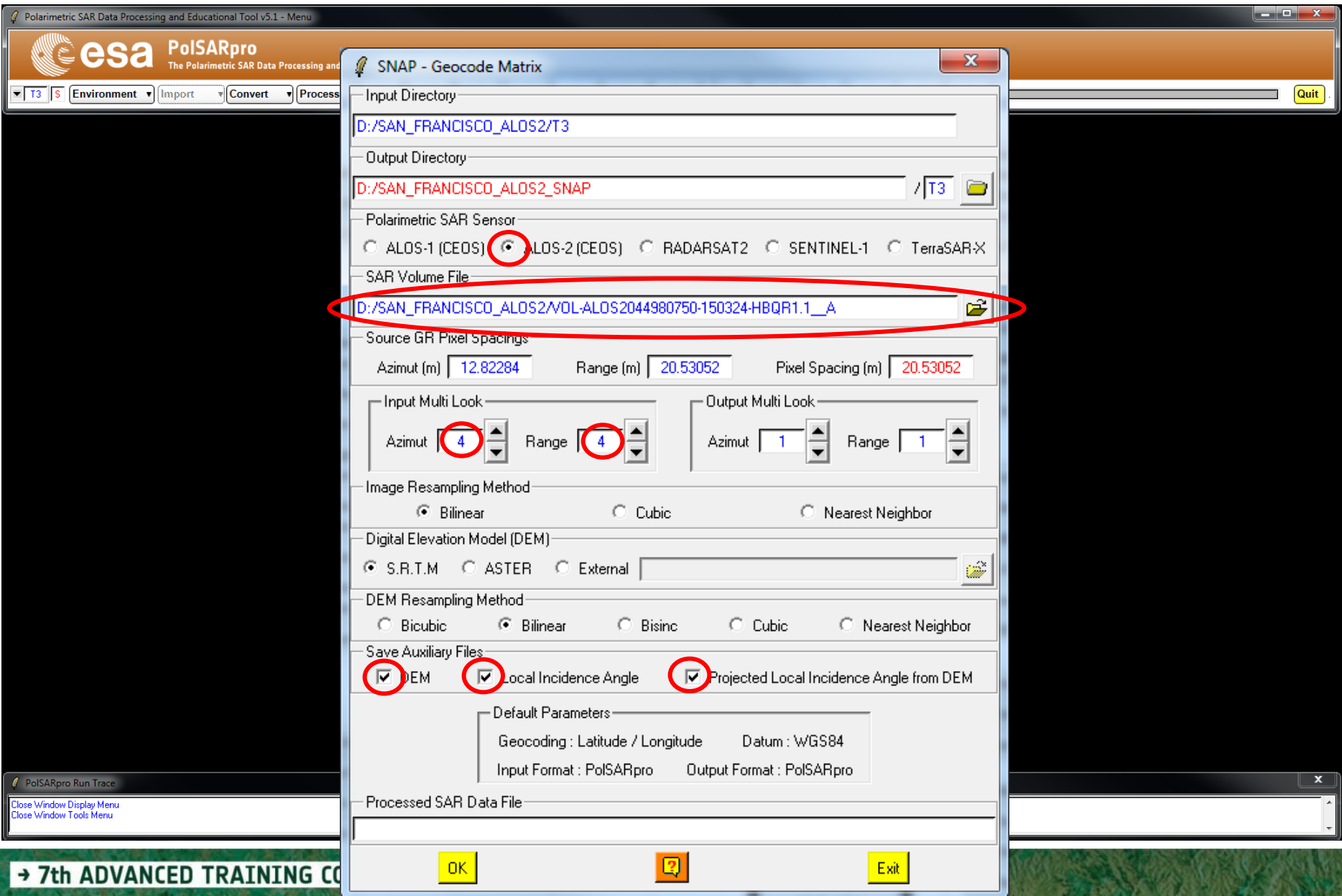
Save Auxiliary Files
☒ DEM ☒ Local Incidence Angle ☒ Projected Local Incidence Angle from DEM

Default Parameters
Geocoding : Latitude / Longitude Datum : WGS84
Input Format : PolSARpro Output Format : PolSARpro

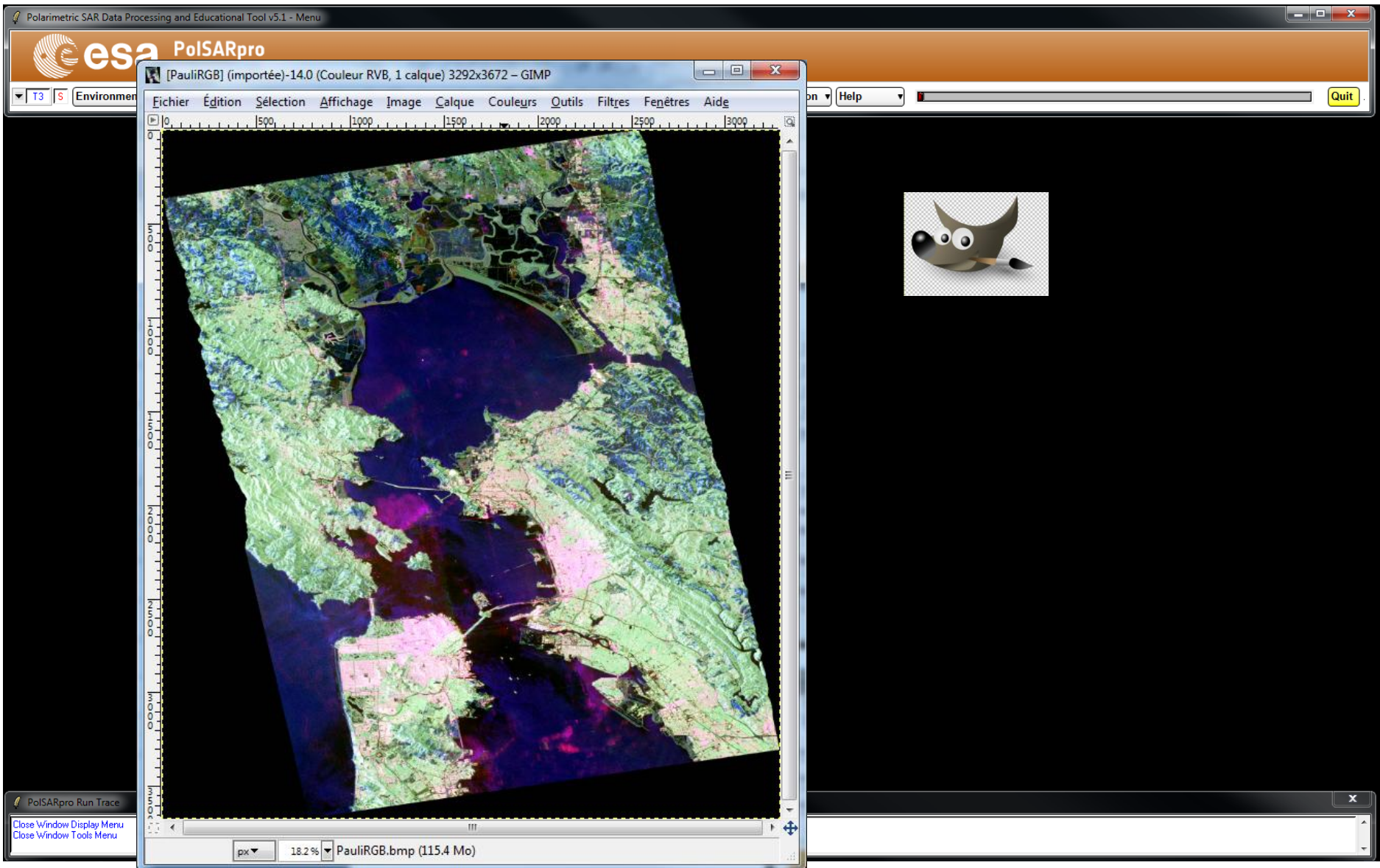
Processed SAR Data File

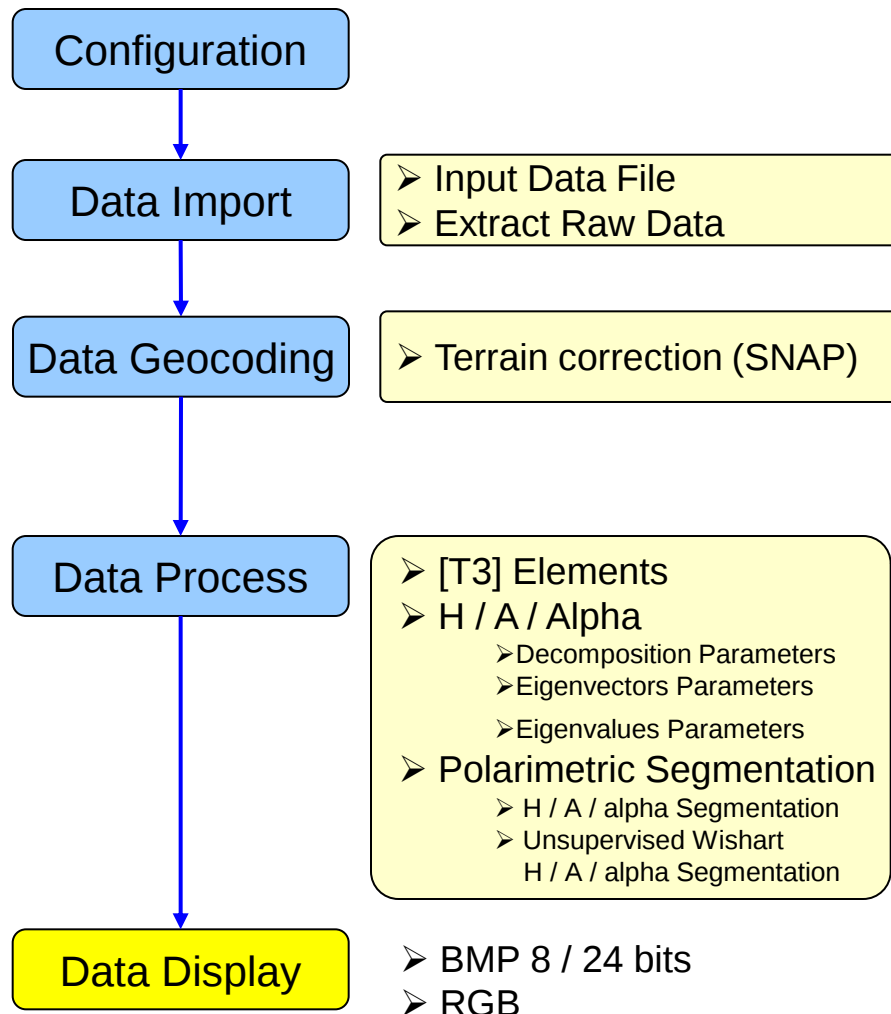
OK ? Exit

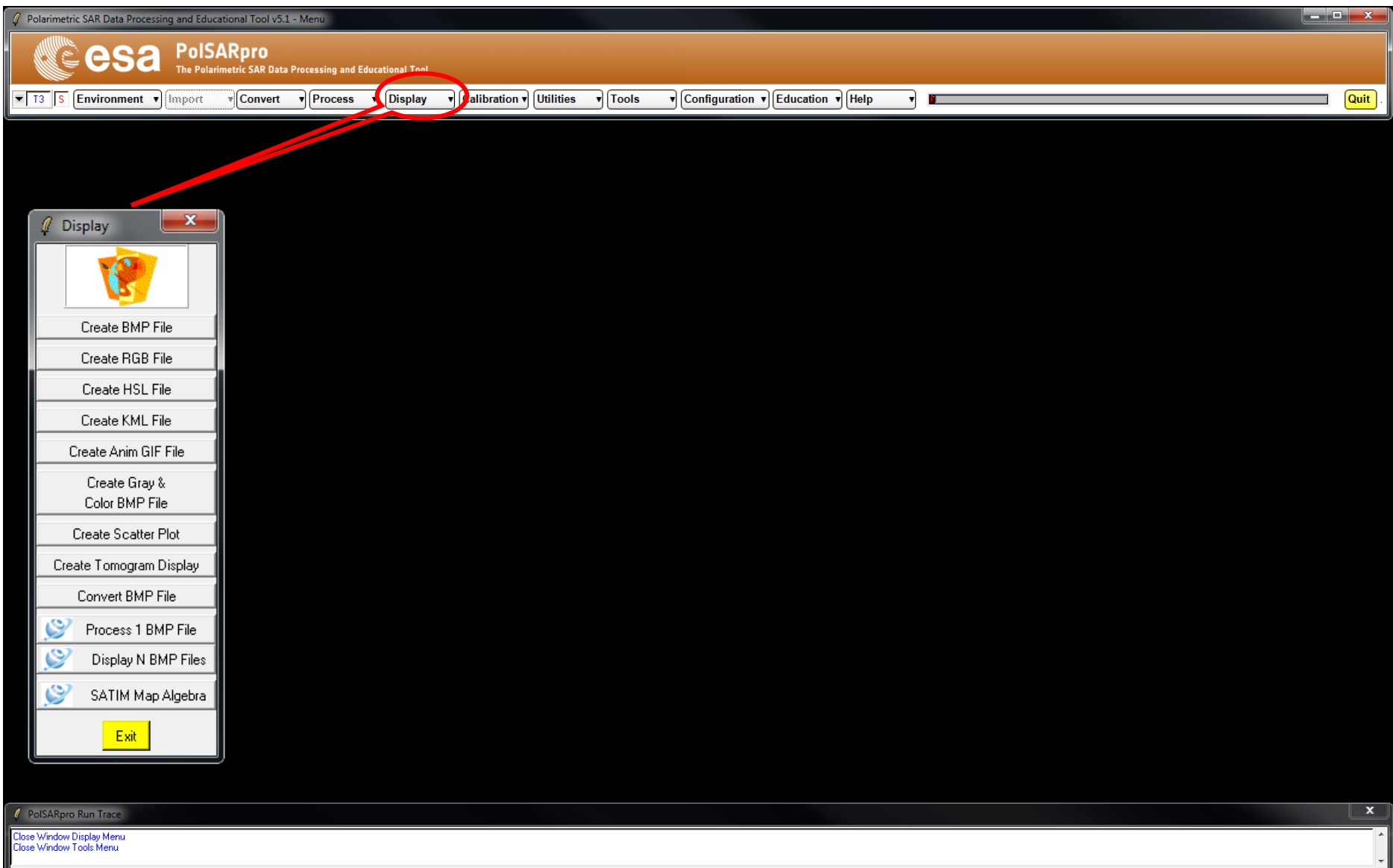
PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu



Display Pauli-RGB Image








PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help

Quit



Create BMP File

Create RGB File

Create HSL File

Create KML File

Create Anim GIF File

Create Gray & Color BMP File

Create Scatter Plot

Create Tomogram Display

Convert BMP File

Process 1 BMP File

Display N BMP Files

SATIM Map Algebra

Exit

Create BMP File

Input Data File

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.bin

Output BMP Directory

D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Init Row 1 End Row 3672 Init Col 1 End Col 3292

Data Format

Complex Float Integer

Show

Modulus 10log(Mod) 20log(Mod) Phase Real Imag

ColorMap JET

ColorMap GRAY

ColorMap HSV

ColorMap File

C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/Config/ColorMapJET.pal

Initial Number of Cols 3292

Minimum / Maximum Values

Automatic Min 0.012592 Max 0.998529 MinMax

Enhanced Contrast Min E.C 0.379729 Max E.C 0.920730

Valid Pixel Mask File

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/mask_valid_pixels.bin

Output BMP File

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy_real.bmp

Run

Exit

PolSARpro Run Trace

Close Window Display Menu

Close Window Tools Menu

PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

Create RGB File

Input Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Init Row: 1 End Row: 3672 Init Col: 1 End Col: 3292

☒ Pauli Composition |S11+S22| |S12+S21| |S11-S22|
☐ Sinclair Composition |S11| |(S12+S21)/2| |S22|
☐ Combine Blue File Green File Red File

BLUE Input Data File: |S11+S22|

GREEN Input Data File: |S12+S21|

RED Input Data File: |S11-S22|

Color Channel Contrast Enhancement

☒ Automatic MinMax ☐ Independent ☐ Common

Blue Channel: Min Auto Max Auto Red Channel: Min Auto Max Auto Green Channel: Min Auto Max Auto

Output RGB File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/PauliRGB.bmp

Run Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra
- Exit

Create HSL File

Input Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Init Row: 1 End Row: 3672 Init Col: 1 End Col: 3292

☒ Polar Decomposition : Hue (Alpha) / Sat (1 - Entropy) / Light (Span)
☐ Polar Decomposition : Hue (Alpha) / Sat (1 - Entropy) / Light (Anisotropy)
☐ Combine : Hue File / Sat File / Light File

HUE Input Data File: alpha

SAT Input Data File: entropy

LIGHT Input Data File: span

Color Channel Contrast Enhancement

☒ Automatic MinMax ☐ Independent ☐ Common

Hue Channel: Min Auto Max Auto

Val Channel: Min Auto Max Auto

Light Channel: Min Auto Max Auto

Output HSL File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/PolariHSV.bmp

Run [?] Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra
- Exit

PolSARpro Run Trace

- Close Window Display Menu
- Close Window Tools Menu

[Polar1HSV] (importée)-106.0 (Couleur RVB, 1 calque) 3292x3672 - GIMP

Fichier Édition Sélection Affichage Image Calque Couleurs Outils Filtres Fenêtres Aide

0 500 1000 1500 2000 2500 3000

0 1000 2000 3000

px 18.2 % Polar1HSV.bmp (115.4 Mo)

The screenshot shows the PolSARpro software interface. The main menu bar includes options like Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, and Help. The 'Display' menu is highlighted with a red circle, and a red arrow points to a sub-menu titled 'Display'. This sub-menu contains various options for creating and processing files, including 'Create HSL File'. A yellow arrow points from the 'Create HSL File' option to a GIMP window. The GIMP window displays a SAR image with a color scale ranging from 0 to 3000. The status bar at the bottom indicates the image is 'Polar1HSV.bmp (115.4 Mo)' and is displayed at '18.2 %'.

PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

 Exit

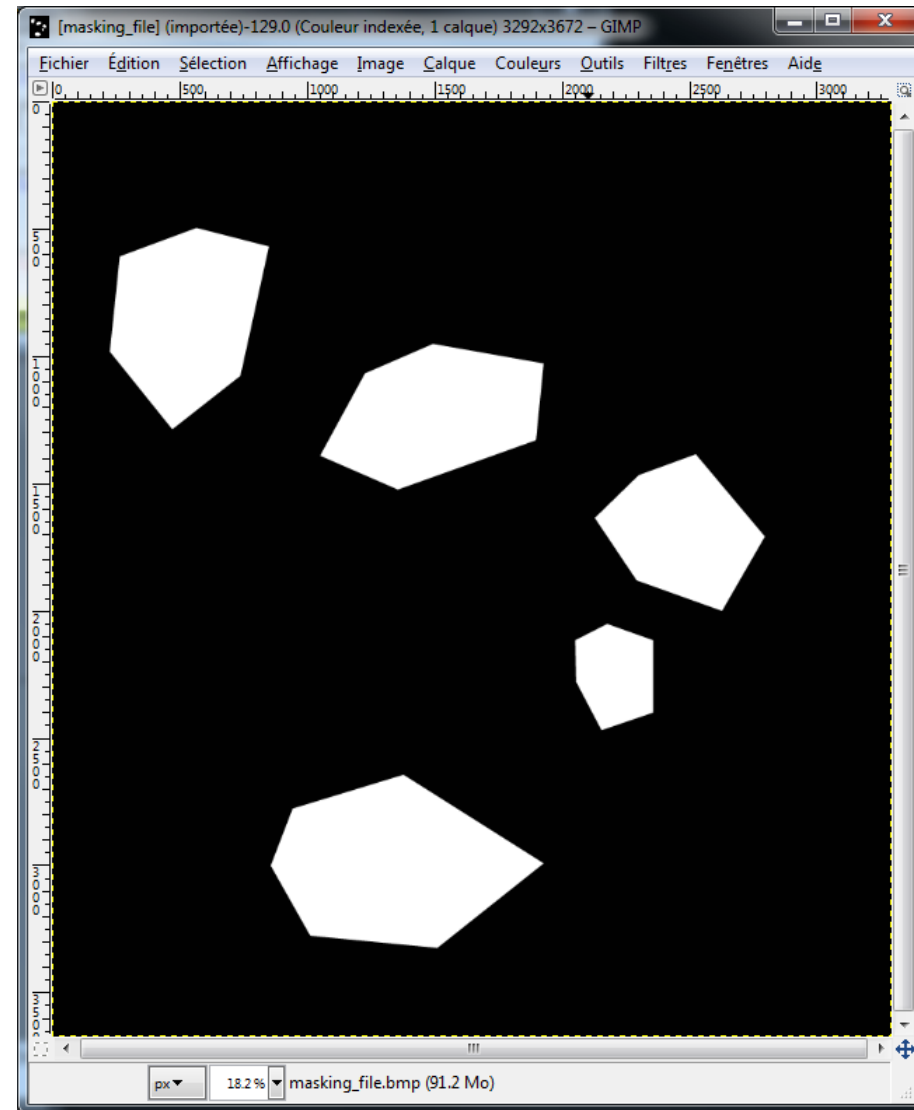
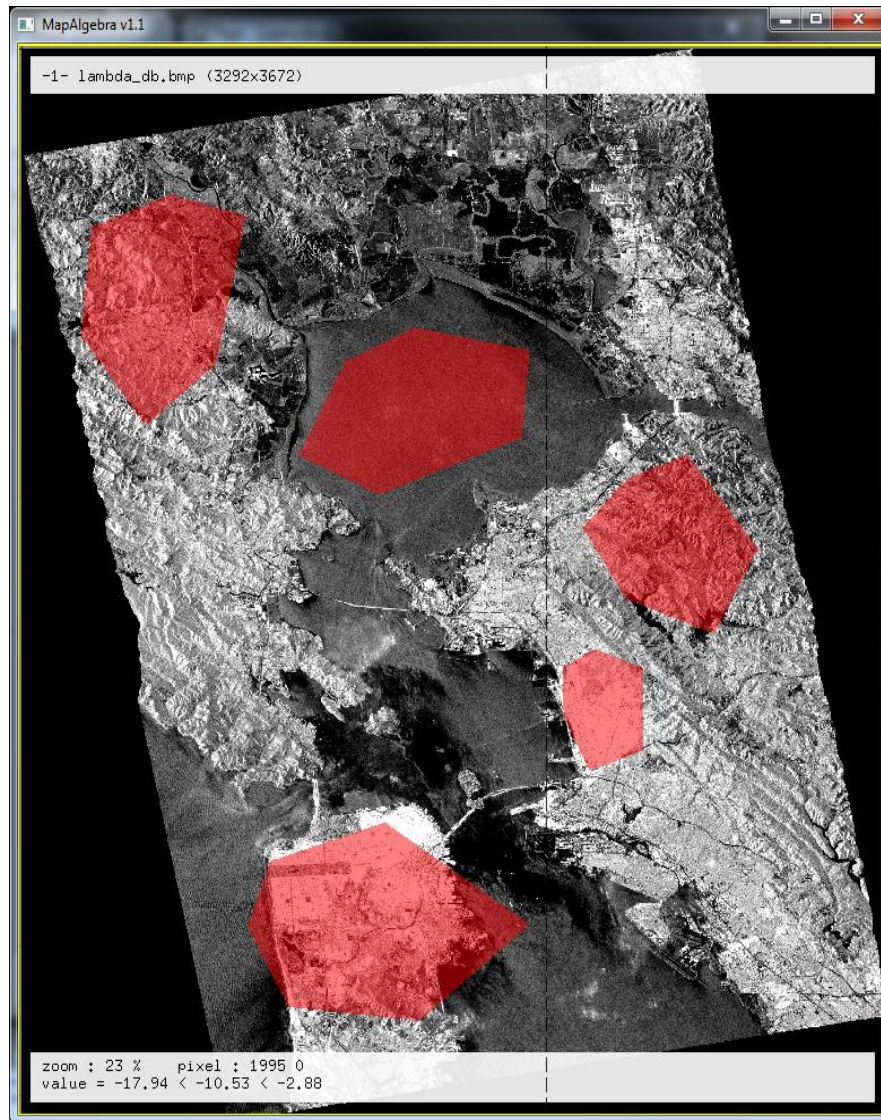
Create Gray & Color BMP File

- Input 8-bits BMP Gray Scale File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/lambda_db.bmp
N Row: 3672 N Col: 3292 N Color: 256
- Input 8-bits BMP Color Scale File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy_shannon.bmp
N Row: 3672 N Col: 3292 N Color: 256
- Input Mask File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/masking_file.bin
N Row: 3672 N Col: 3292 ☐ Invert Mask
- Check Files
- Output BMP Directory
D:/SAN_FRANCISCO_ALOS2_SNAP/T3
- Output BMP File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy_shannon_lambda_db.bmp
- Run
- Exit

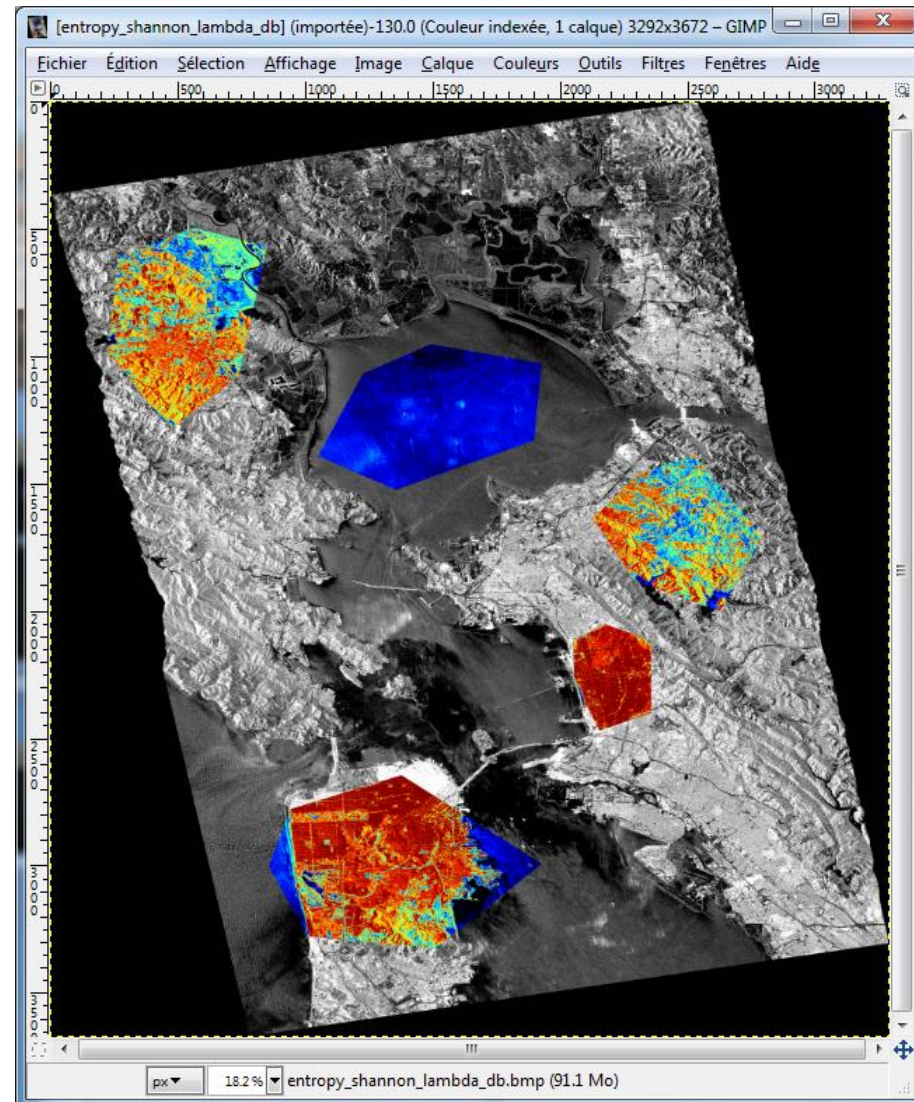
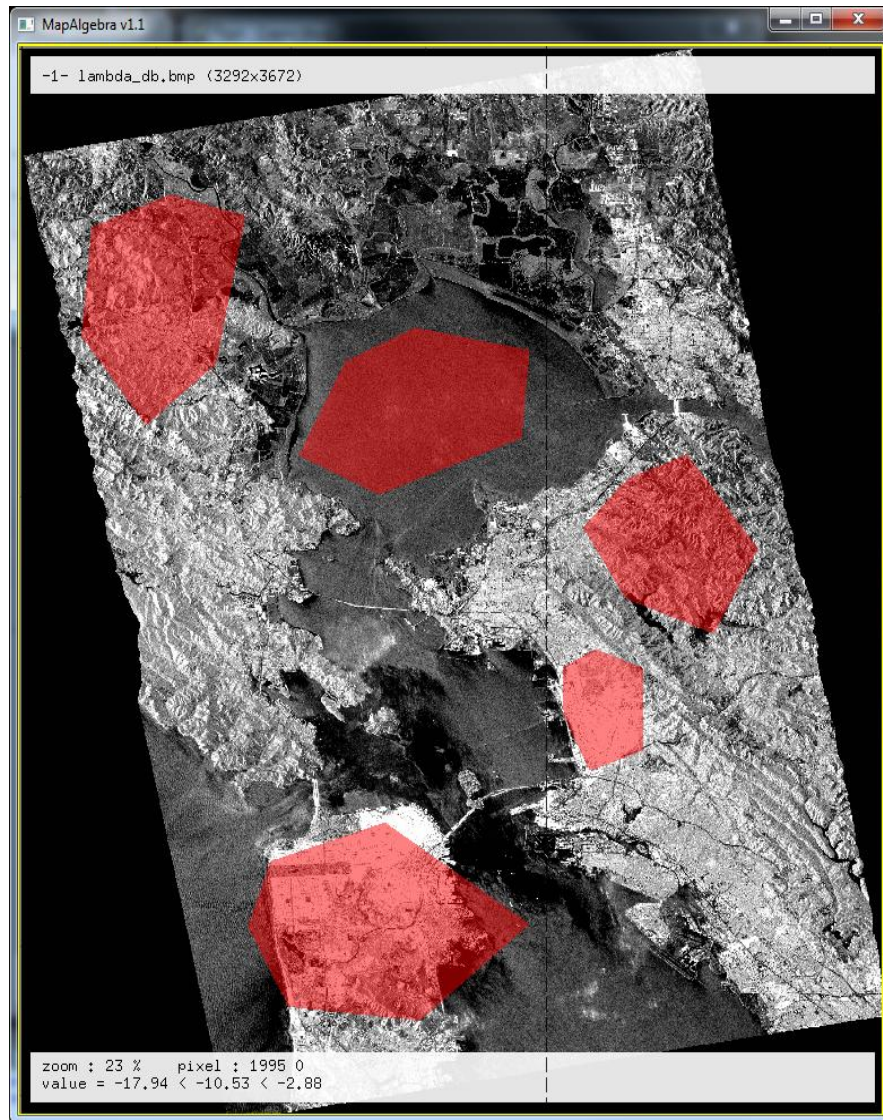
PolSARpro Run Trace

Close Window Display Menu
 Close Window Tools Menu

Create Gray & Color BMP Image



Create Gray & Color BMP Image



PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 S Environment Import Convert Process **Display** Calibration Utilities Tools Configuration Education Help Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

Create Scatter Plot

Input Data File (X)
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.bin

Data Format
☐ Complex ☒ Float ☐ Integer

Show
☐ Modulus ☐ 10log(Mod) ☐ 20log(Mod) ☐ Phase ☒ Real ☐ Imag

Minimum / Maximum Values
☐ Automatic Min 0.012592 Max 0.998529
☐ Enhanced Contrast Min E.C. 0.379729 Max E.C. 0.920730 MinMax

Input Data File (Y)
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/alpha.bin

Data Format
☐ Complex ☒ Float ☐ Integer

Show
☐ Modulus ☐ 10log(Mod) ☐ 20log(Mod) ☐ Phase ☒ Real ☐ Imag

Minimum / Maximum Values
☐ Automatic Min 0.791853 Max 89.163811
☐ Enhanced Contrast Min E.C. 19.644552 Max E.C. 53.780357 MinMax

Label (X)
Entropy

Label (Y)
Alpha

Title Scatter Plot
Entropy - Alpha plane

Run

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra
- Exit

Convert BMP File

Input BMP Image File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.bmp

N Row 3672 N Col 3292 N Color BMP 8 Bits

Output Image Format
☐ GIF ☐ JPEG ☒ PNG ☐ TIFF ☐ BMP24 >> BMP8
 Reduction Factor 2 Transparency ☐ ☐ ☐

Output Image File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.png

World File Generation
 Input GEARTH_POLY File
ENTER THE GEARTH POLY FILE
☒ Input Config Acquisition File
ENTER THE CONFIG ACQUISITION FILE
 Output World File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy

Run [?] Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 S Environment Import Convert Process **Display** Calibration Utilities Tools Configuration Education Help Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

Convert BMP File

Input BMP Image File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.bmp

N Row 3672 N Col 3292 N Color BMP

Output Image Format
☐ GIF ☐ JPEG ☒ PNG ☐ TIFF ☐
 Reduction Factor 2 Transparency

Output Image File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy.png

World File Generation
 Input GEARTH_POLY File
ENTER THE GEARTH POLY FILE
☒ Input Config Acquisition File
ENTER THE CONFIG ACQUISITION FILE
 Output World File
D:/SAN_FRANCISCO_ALOS2_SNAP/T3/entropy

Run Exit

Scatter Plot

H - Alpha Plane - (Scale: 10⁴n)

Alpha

Entropy

Max = 6127.000224 Min = 0.000000

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 S Environment Import Convert Process **Display** Calibration Utilities Tools Configuration Education Help Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

Utilities

- PoISARpro - Calculator
- PoISARpro - Display
- PoISARpro - SIM
- PoISARpro - Viewer
- SATIM Map Algebra**
- SNAP - SI TBX
- SRTM
- ASTER
- GIMP
- GOOGLE EARTH
- Close All Widgets

Process 1 BMP File
Display N BMP Files

PoISARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

Process 1 BMP Image

Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Process

T3 S Environment Import Convert P

MapAlgebra v1.1

-1- PauliRGB.bmp (3292x3672)

zoom : 23 % pixel : 1814 1909
value = ----

Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

PV5.1process

Image Size
C 3292 R 3672

Color
[Color Selection Icons]

Tools
[Tools Icons]

Color Map
[Color Map Selection Icons]

Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

The screenshot shows the PolSARpro v5.1 software interface. The main menu bar includes: File, Environment, Import, Convert, Process, **Display** (highlighted with a red circle), Calibration, Utilities, Tools, Configuration, Education, Help, and Quit. A red arrow points from the 'Display' menu to a 'Display' sub-menu on the left. This sub-menu contains options like 'Create BMP File', 'Create RGB File', 'Create HSL File', 'Create KML File', 'Create Anim GIF File', 'Create Gray & Color BMP File', 'Create Scatter Plot', 'Create Tomogram Display', 'Convert BMP File', 'Process 1 BMP File', 'Display N BMP Files' (highlighted with a yellow arrow), and 'SATIM Map Algebra'. Below these options is an 'Exit' button. The main workspace displays three image windows: '-1- PauliRGB.bmp (3292x3672)', '-2- entropy.bmp (3292x3672)', and '-3- anisotropy.bmp (3292x3672)'. Each window shows a different visualization of the same SAR data. At the bottom, there is a 'PolSARpro Run Trace' window showing the execution of the 'Display N BMP Files' command.

PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 | S | Environment | Import | Convert | Process | **Display** | Calibration | Utilities | Tools | Configuration | Education | Help | Quit

Display

- Create BMP File
- Create RGB File
- Create HSL File
- Create KML File
- Create Anim GIF File
- Create Gray & Color BMP File
- Create Scatter Plot
- Create Tomogram Display
- Convert BMP File
- Process 1 BMP File
- Display N BMP Files
- SATIM Map Algebra

Exit

Create BMP - KML File

Input BMP File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/PauliRGB.bmp

Output KML Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3

N Row: 3672 N Col: 3292 N Color: BMP 24 Bits

Input GEARTH_POLY File: D:/SAN_FRANCISCO_ALOS2_SNAP/GEARTH_POLY.kml

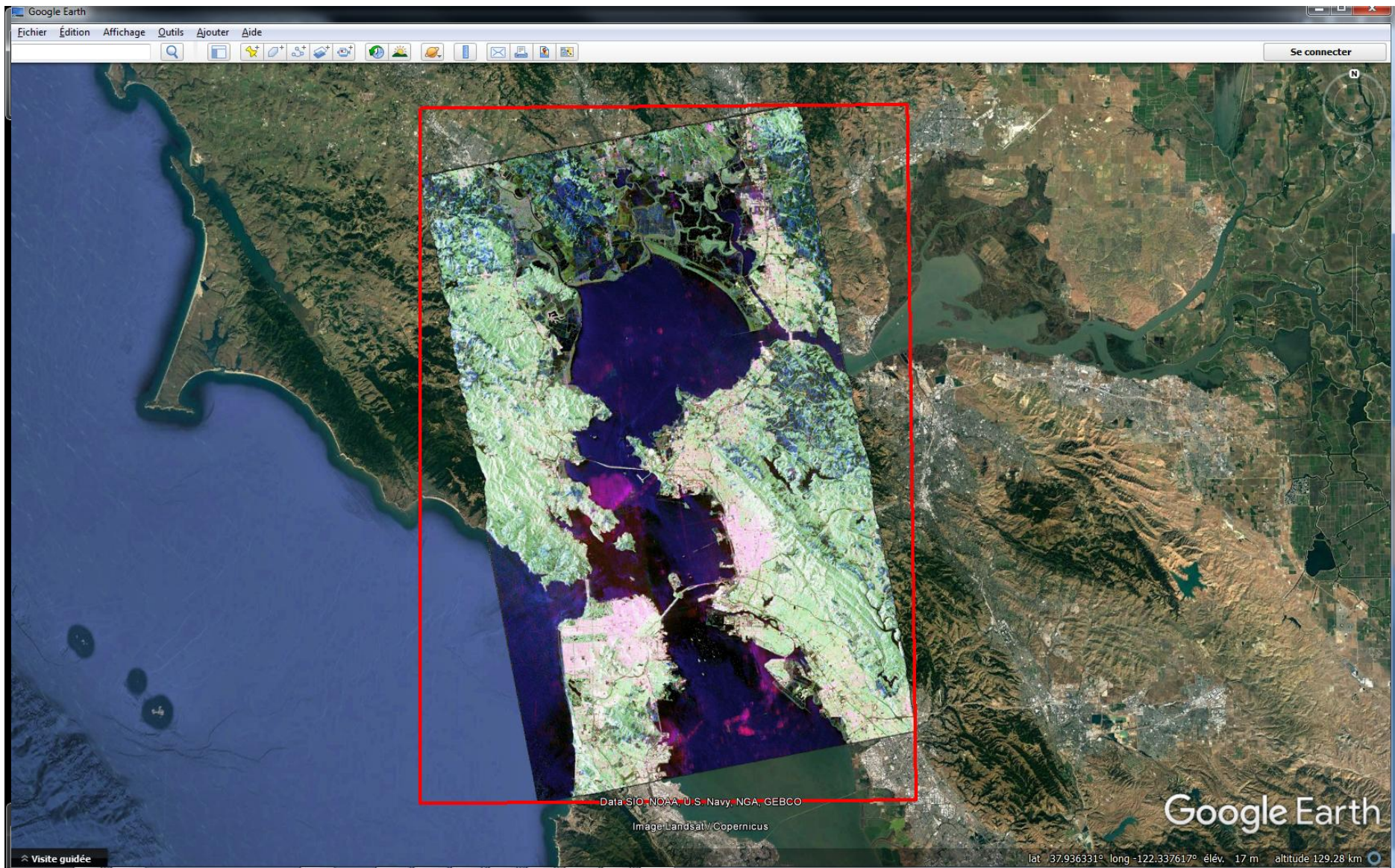
Output KML File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/PauliRGB.kml

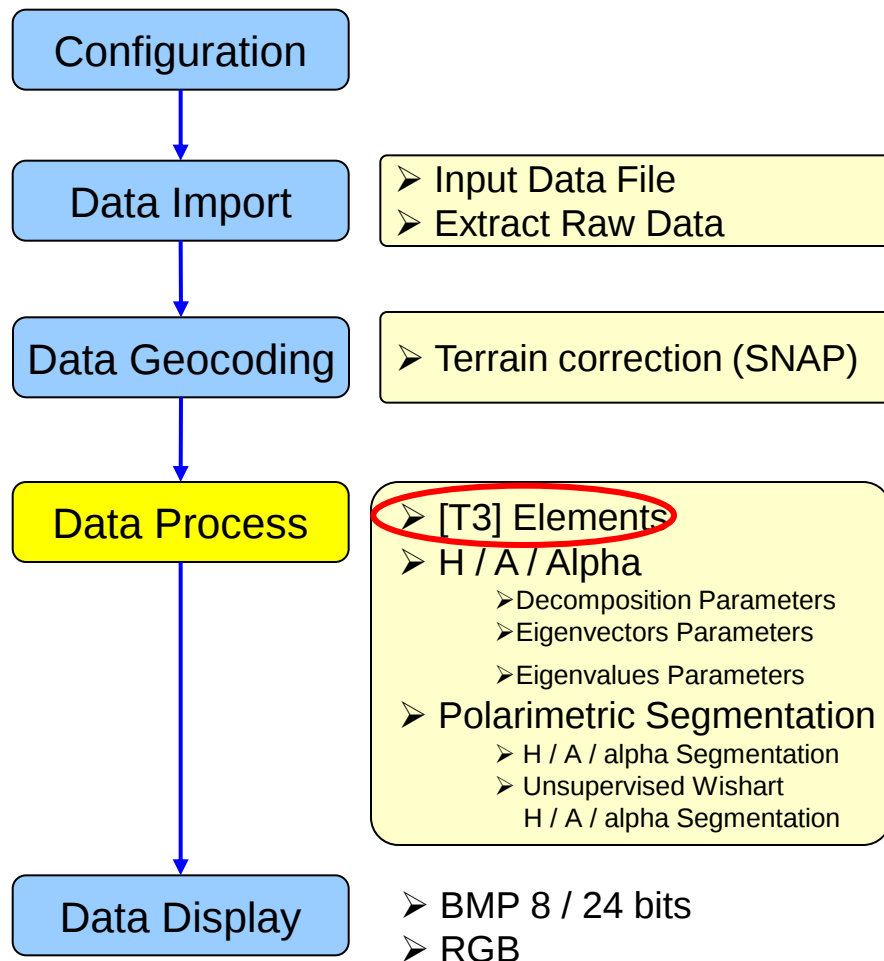
Reduction Factor: 2 Transparency: ☒

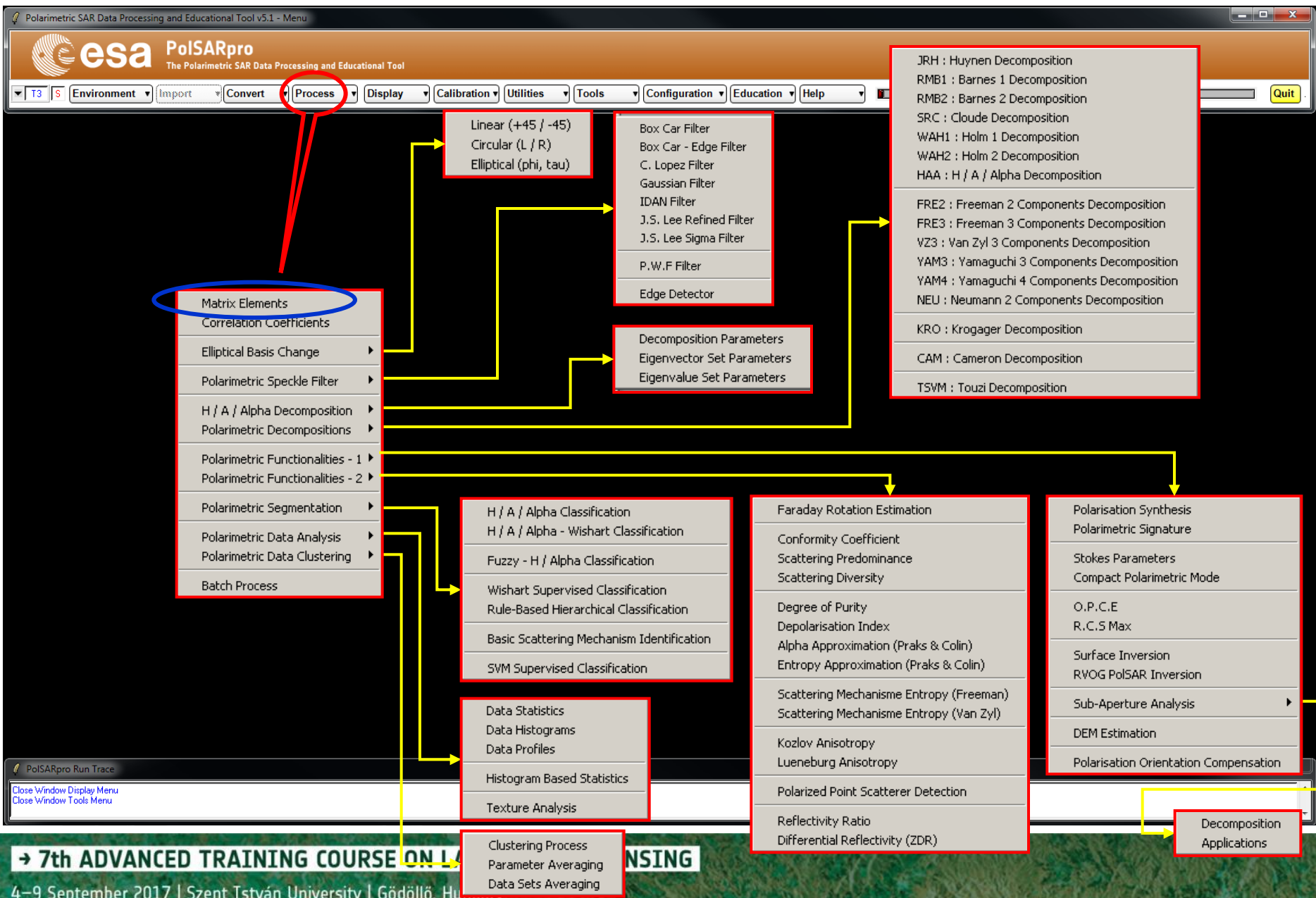
Run Exit

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu









PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

T3

S

Environment

Import

Convert

Process

Display

Calibration

Utilities

Tools

Configuration

Education

Help

Quit

Data Processing: Coherency Elements T3

Input Directory

C:/DataDirectory/T3

Output Directory

C:/DataDirectory

/T3

Init Row

1

End Row

2304

Init Col

1

End Col

1248

T11

Modulus

10log(Modulus)

BMP

T12

Modulus

10log(Modulus)

Phase

BMP

T13

Modulus

10log(Modulus)

Phase

BMP

T22

Modulus

10log(Modulus)

BMP

T23

Modulus

10log(Modulus)

Phase

BMP

T33

Modulus

10log(Modulus)

BMP

Span

Linear

DeciBel = 10log(Span)

BMP

Select All

Reset

Run

Exit

Data Processing: Coherency Elements T3

Input Directory

C:/DataDirectory_MapReady/T3

Output Directory

C:/DataDirectory_MapReady

/T3

Init Row

1

End Row

1544

Init Col

1

End Col

932

T11

Modulus

10log(Modulus)

BMP

T12

Modulus

10log(Modulus)

Phase

BMP

T13

Modulus

10log(Modulus)

Phase

BMP

T22

Modulus

10log(Modulus)

BMP

T23

Modulus

10log(Modulus)

Phase

BMP

T33

Modulus

10log(Modulus)

BMP

Span

Linear

DeciBel = 10log(Span)

BMP

Select All

Reset

Run

Exit

DATADIR

T3

config.txt

[T3x3] Elements

Txy_mod.bin

Txy_db.bin

Txy pha.bin

Txy_mod.bmp

Txy_db.bmp

PolSARpro Run Trace

Close Window Display Menu

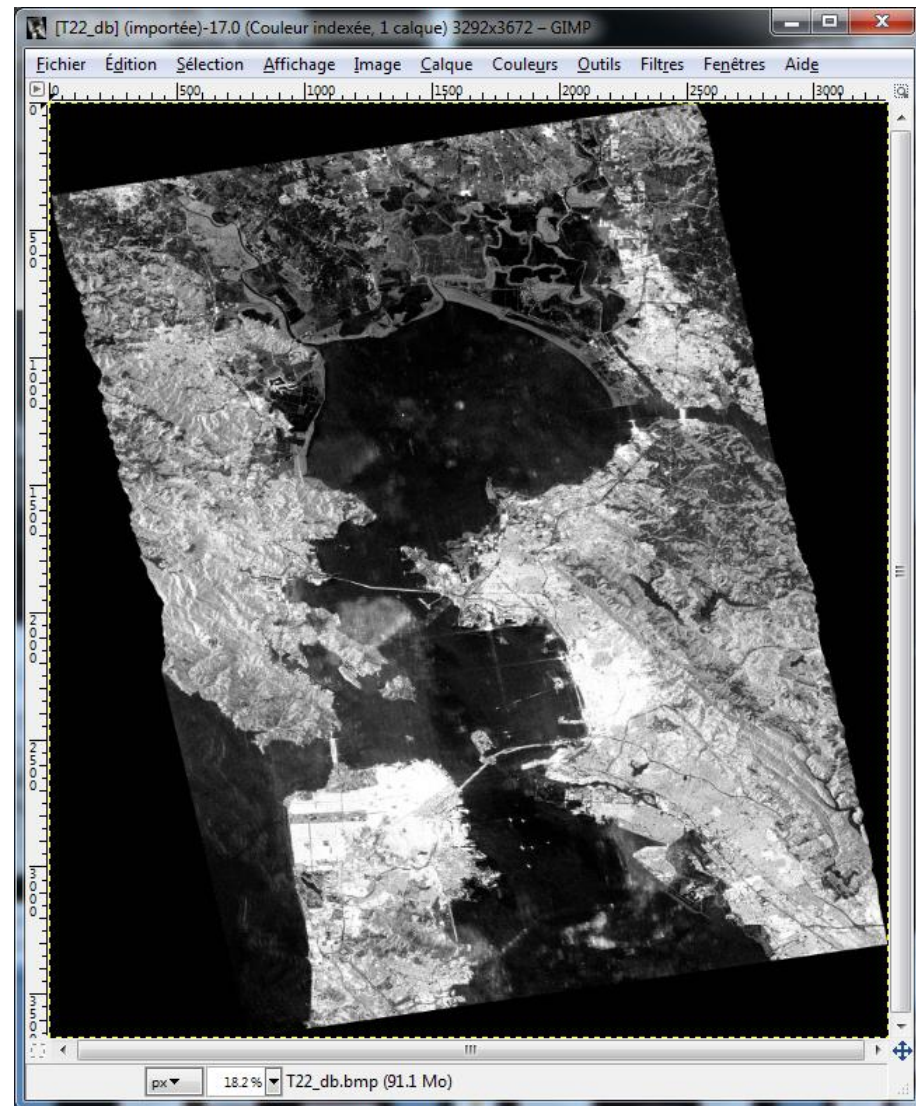
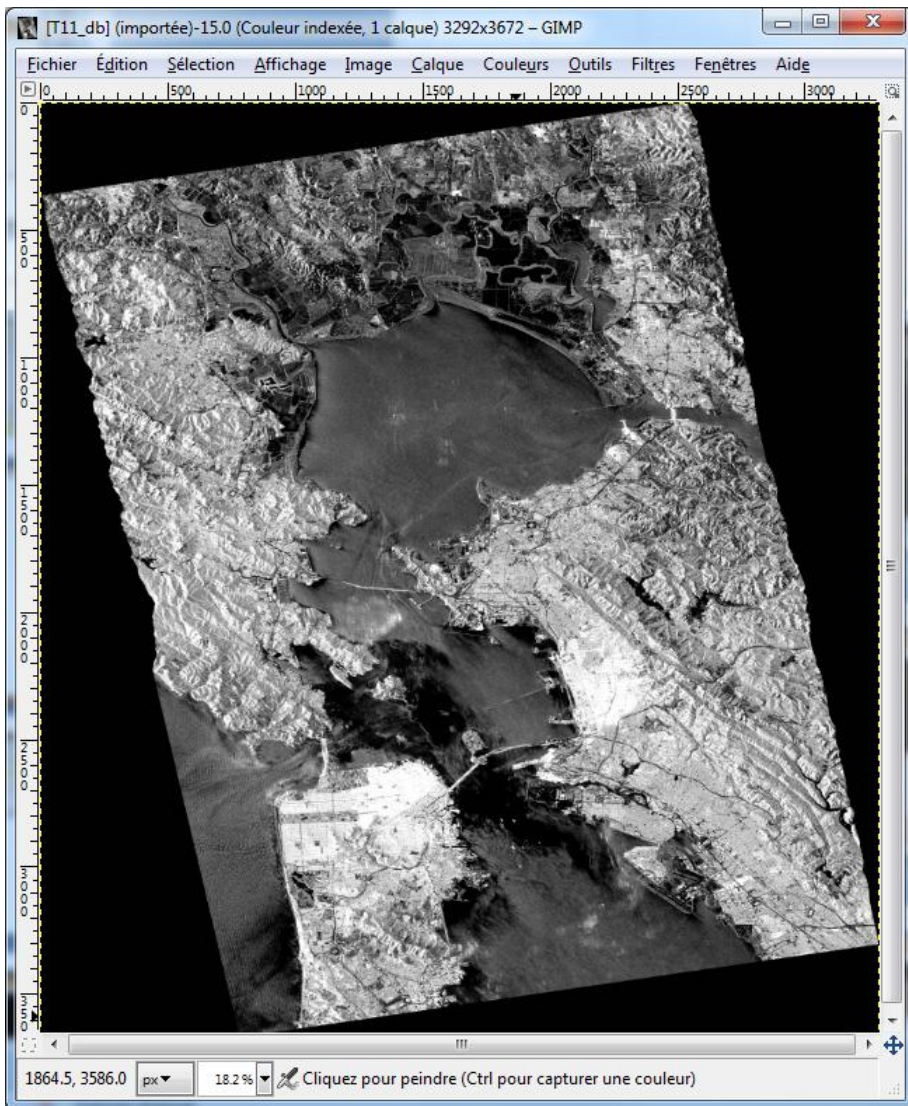
Close Window Tools Menu

Do it Yourself:

Select some elements, set the parameters and view the corresponding BMP files (select BMP).

T11_db

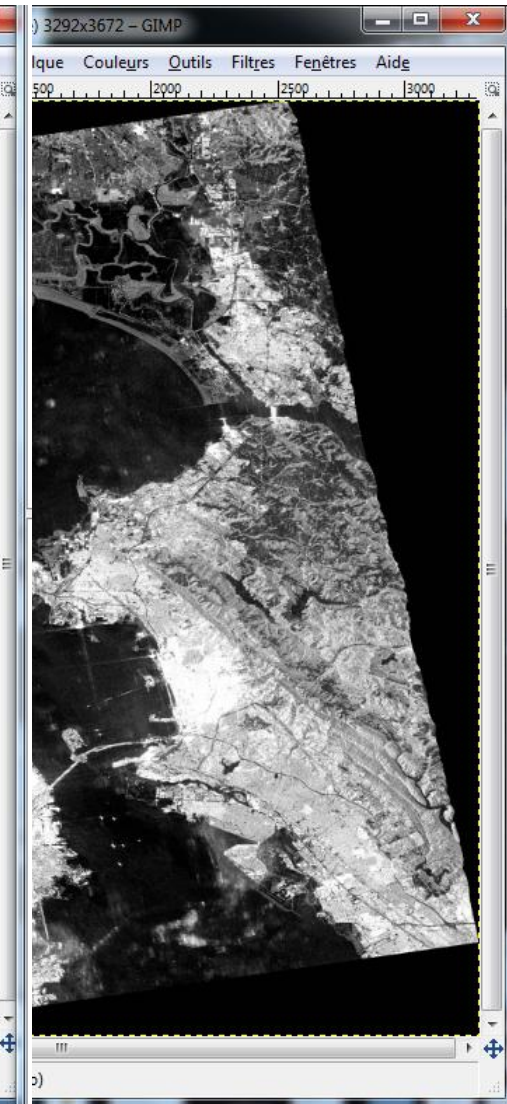
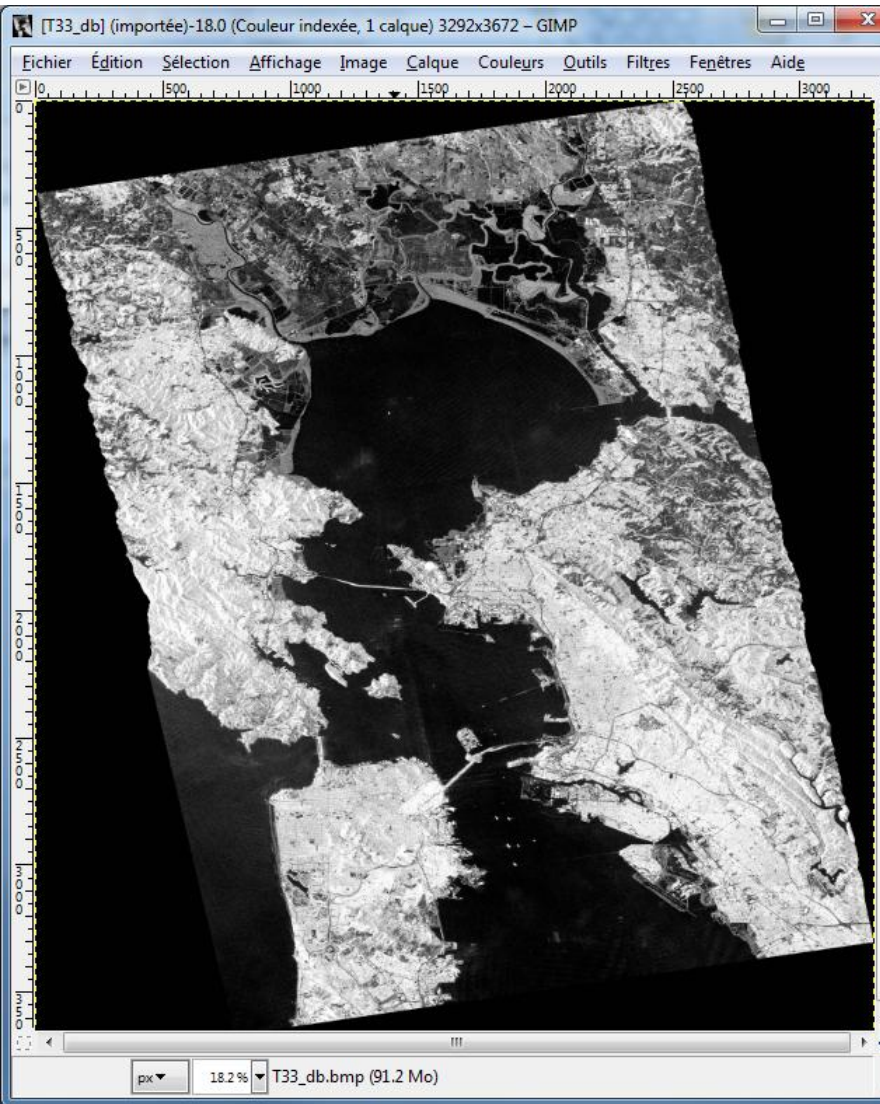
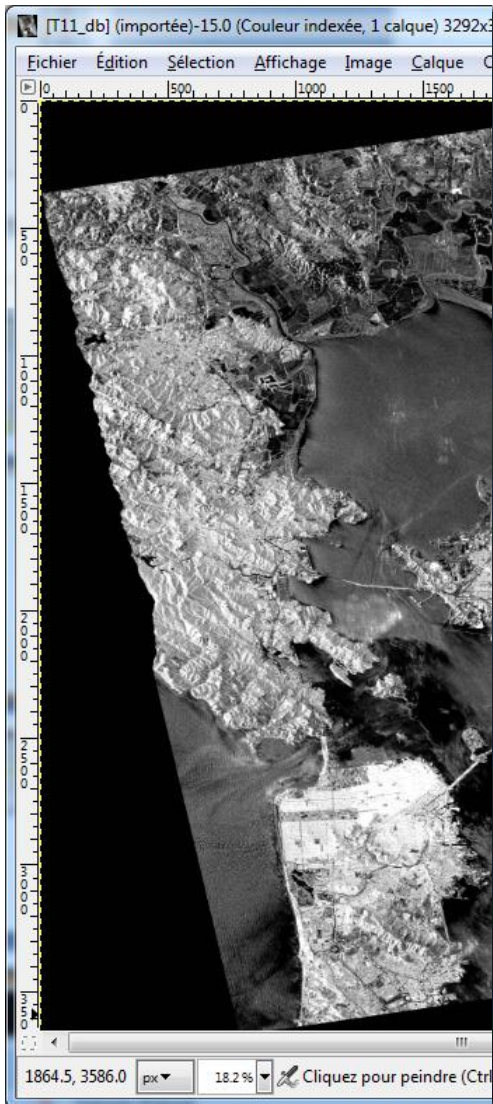
T22_db



T11_db

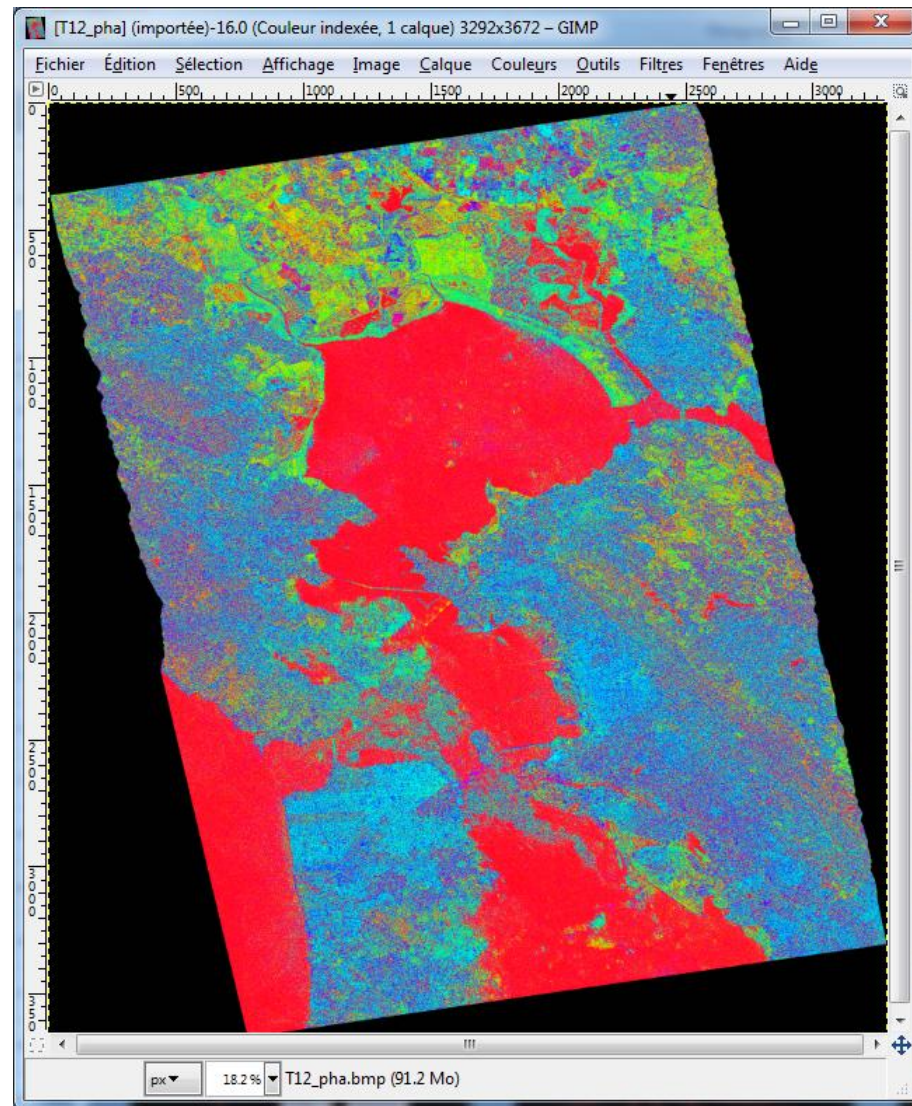
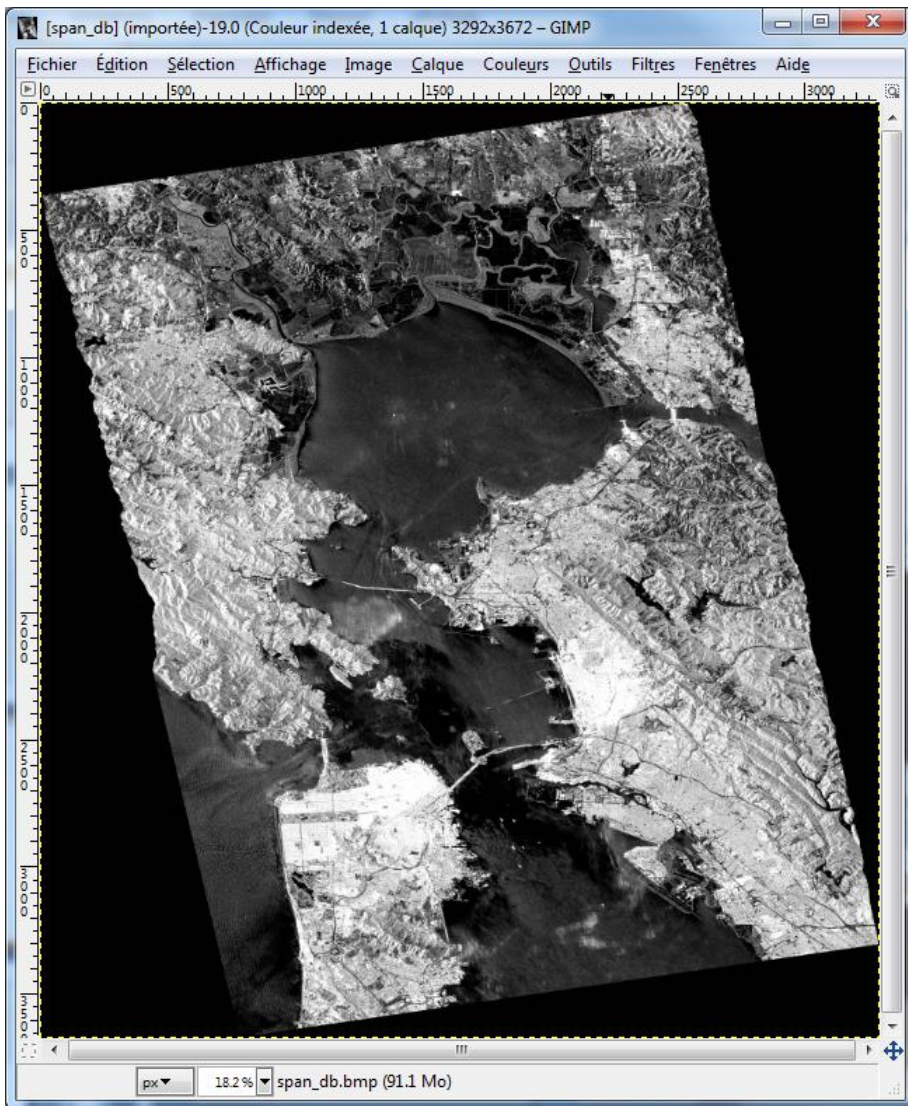
T33_db

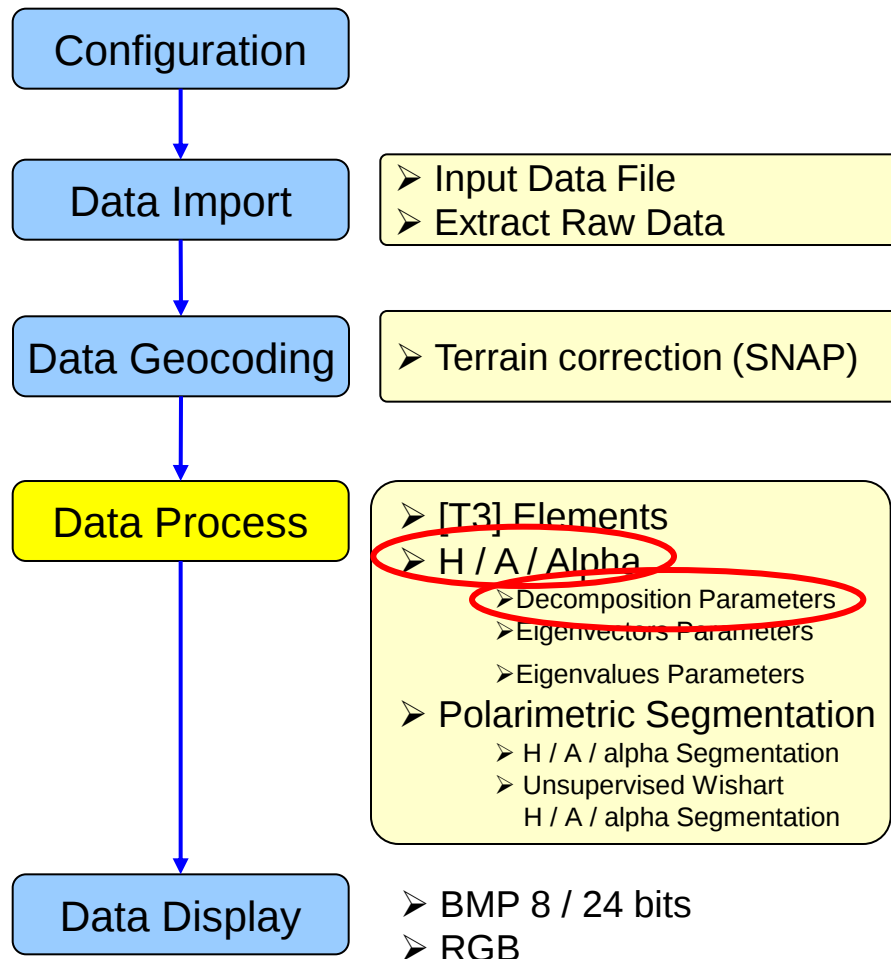
T22_db

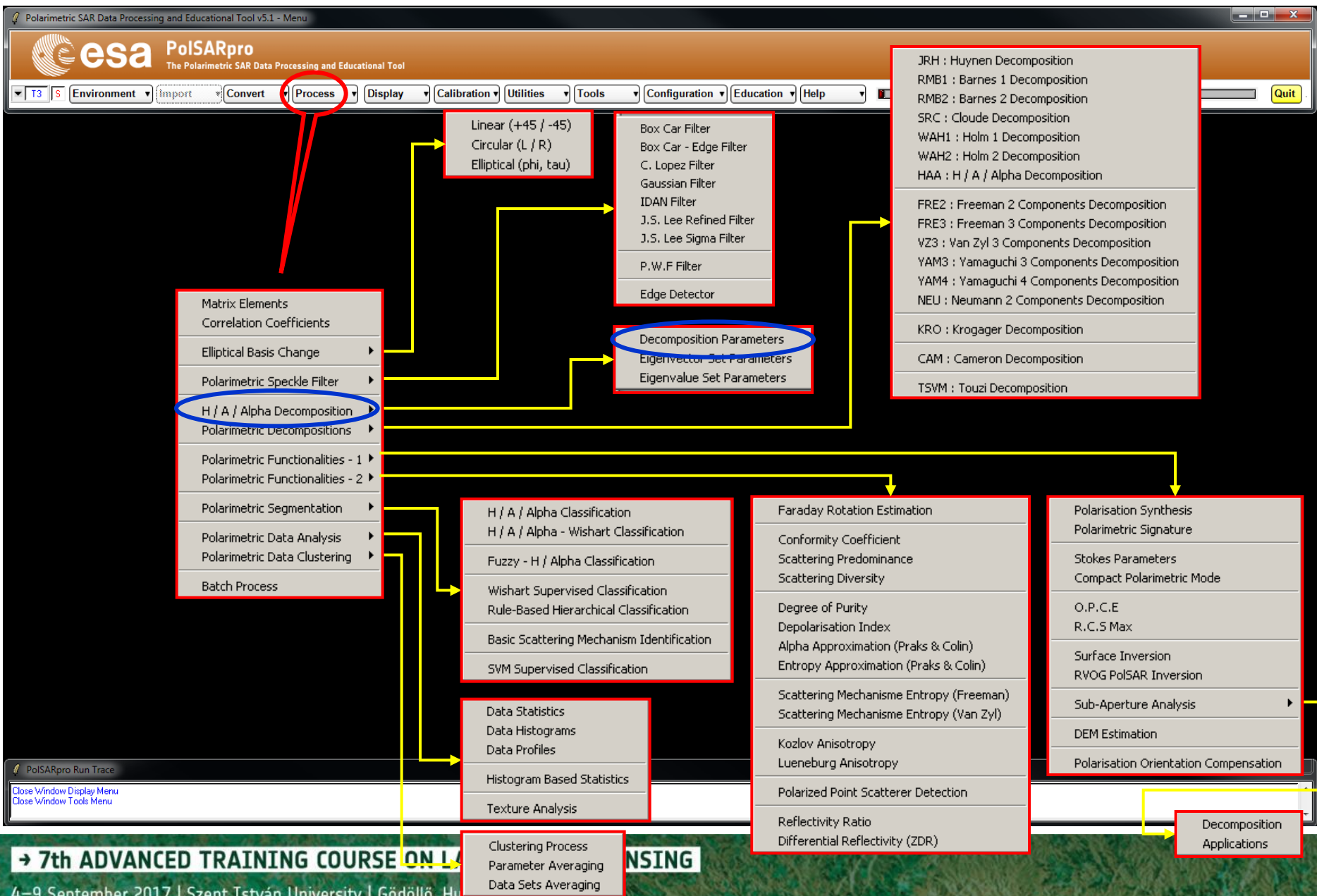


span_db

T12_pha







Do it Yourself:

Select some elements, set the parameters (**Nwin = 1**) and view the corresponding BMP files (**select BMP**).

PolSARpro Data Processing and Educational Tool v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 S Environment Import Convert Process Display Calibration Utilities Tools Configuration Education Help Quit

Data Processing: H / A / Alpha Decomposition Parameters

Input Directory
D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory
D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Init Row 1 End Row 3672 Init Col 1 End Col 3292

☐ Alpha, Beta, Delta, Gamma, Lambda ☐ BMP

☒ Lambda ☒ BMP

☒ Alpha ☒ BMP

☒ Entropy (H) ☒ BMP

☒ Anisotropy (A) ☒ BMP

☒ Combinations (H , A) ☒ H A ☒ (1 - H) A ☒ BMP

☒ H (1 - A) ☒ (1 - H) (1 - A)

Window Size Row 1 Window Size Col 1 Select All Reset

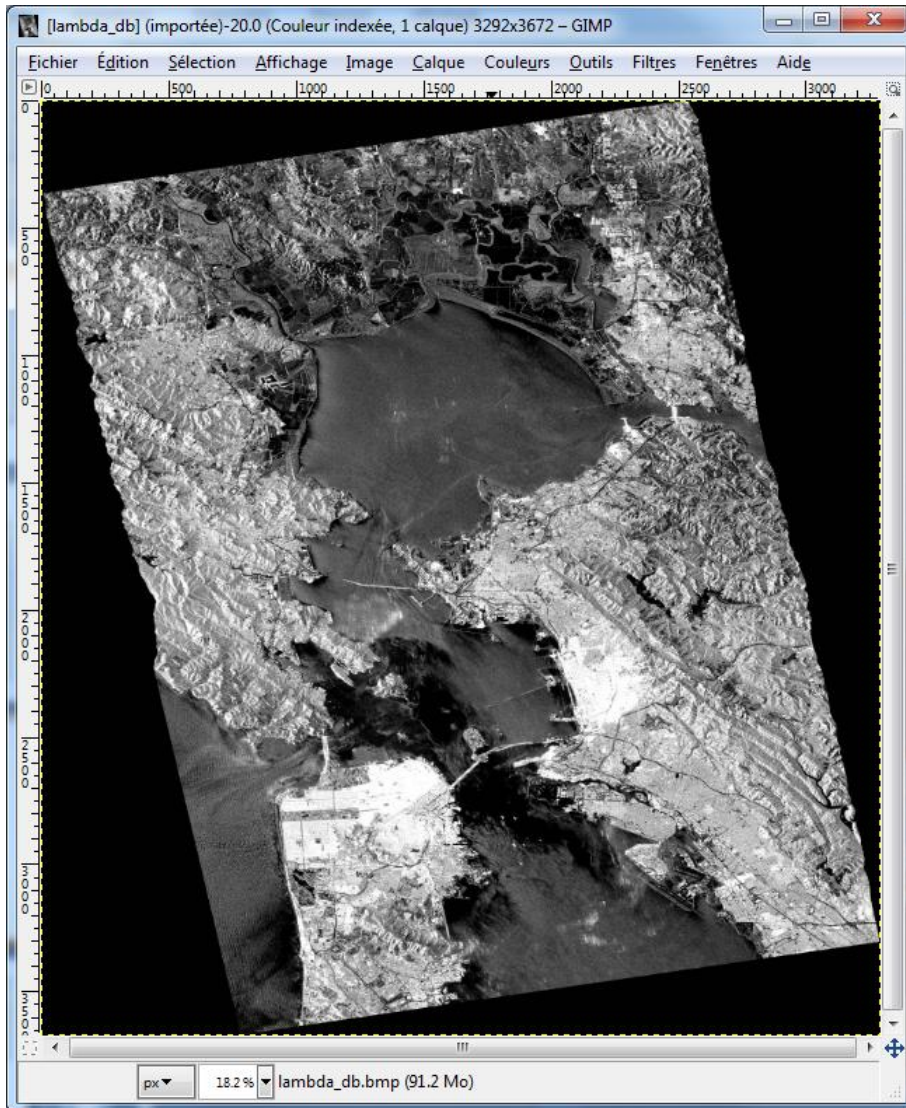
☐ Equivalence between [T] and [C] eigen-decompositions.

Run Exit

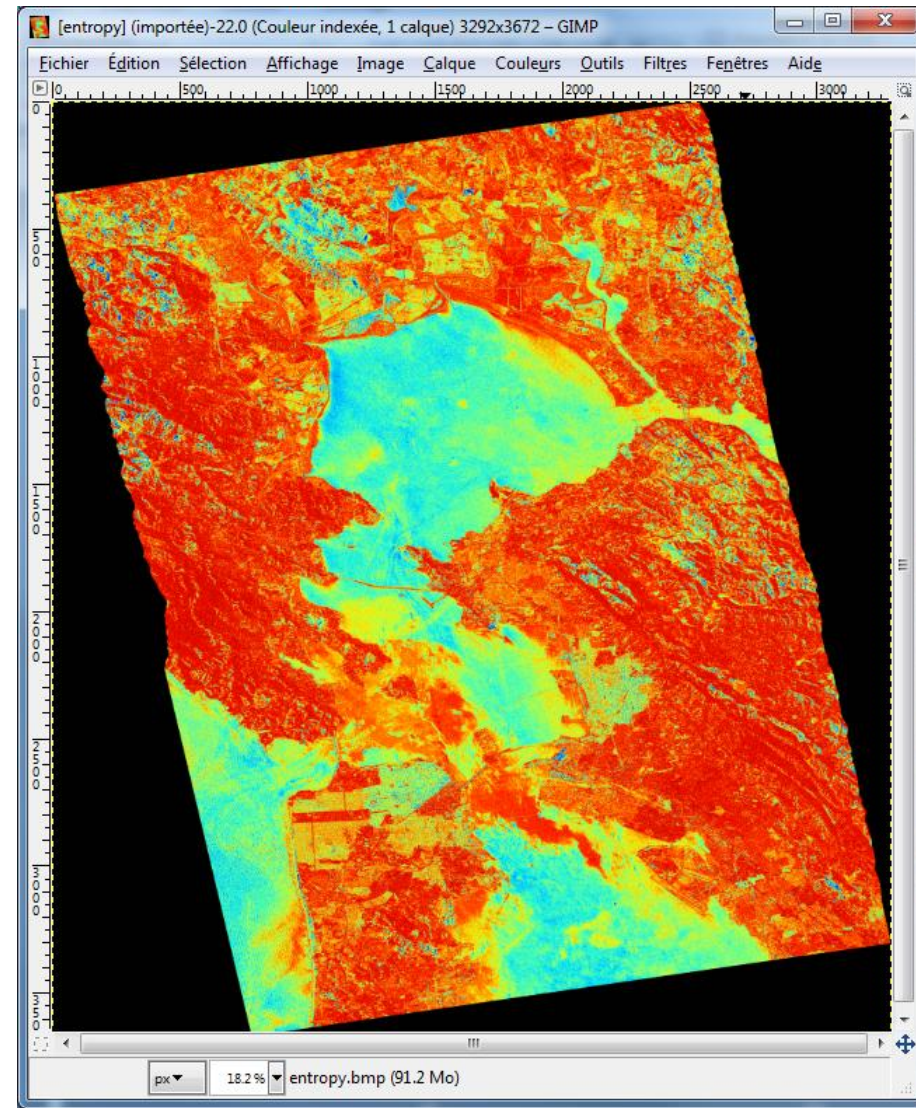
PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

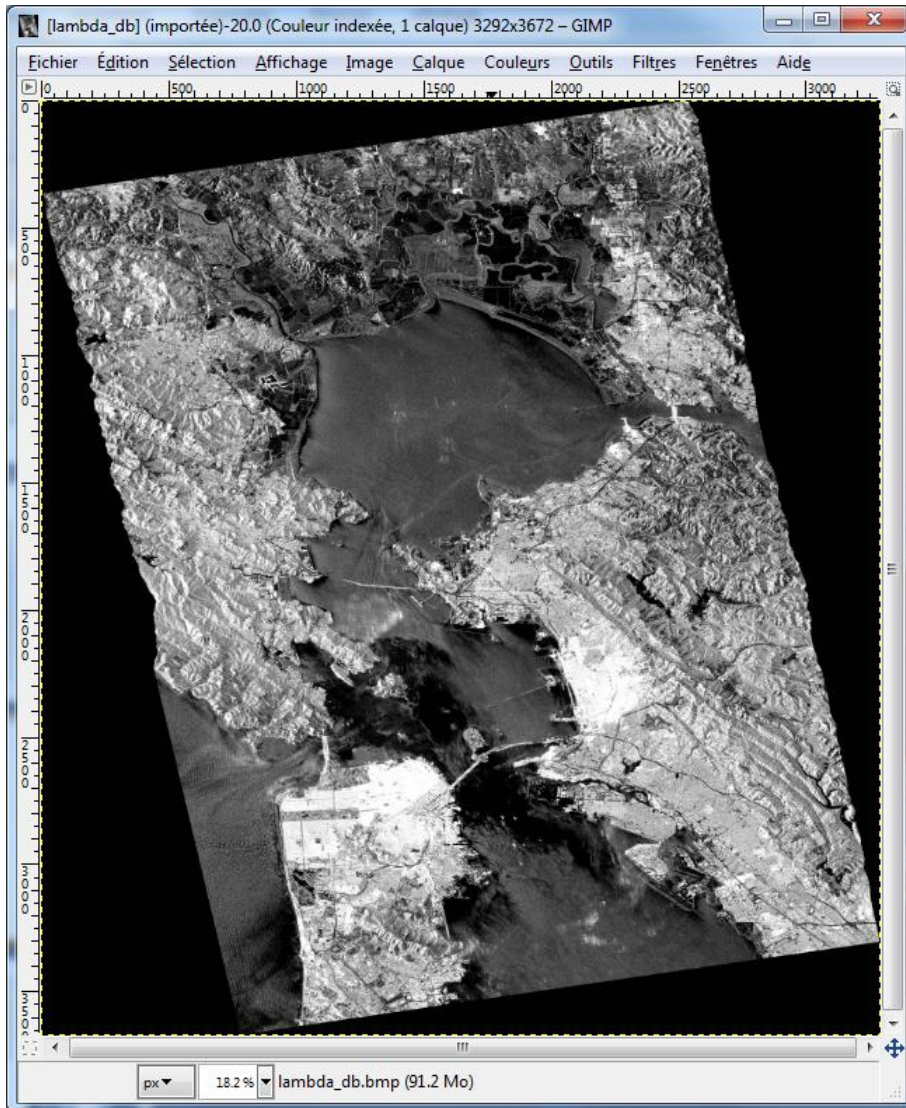
Lambda



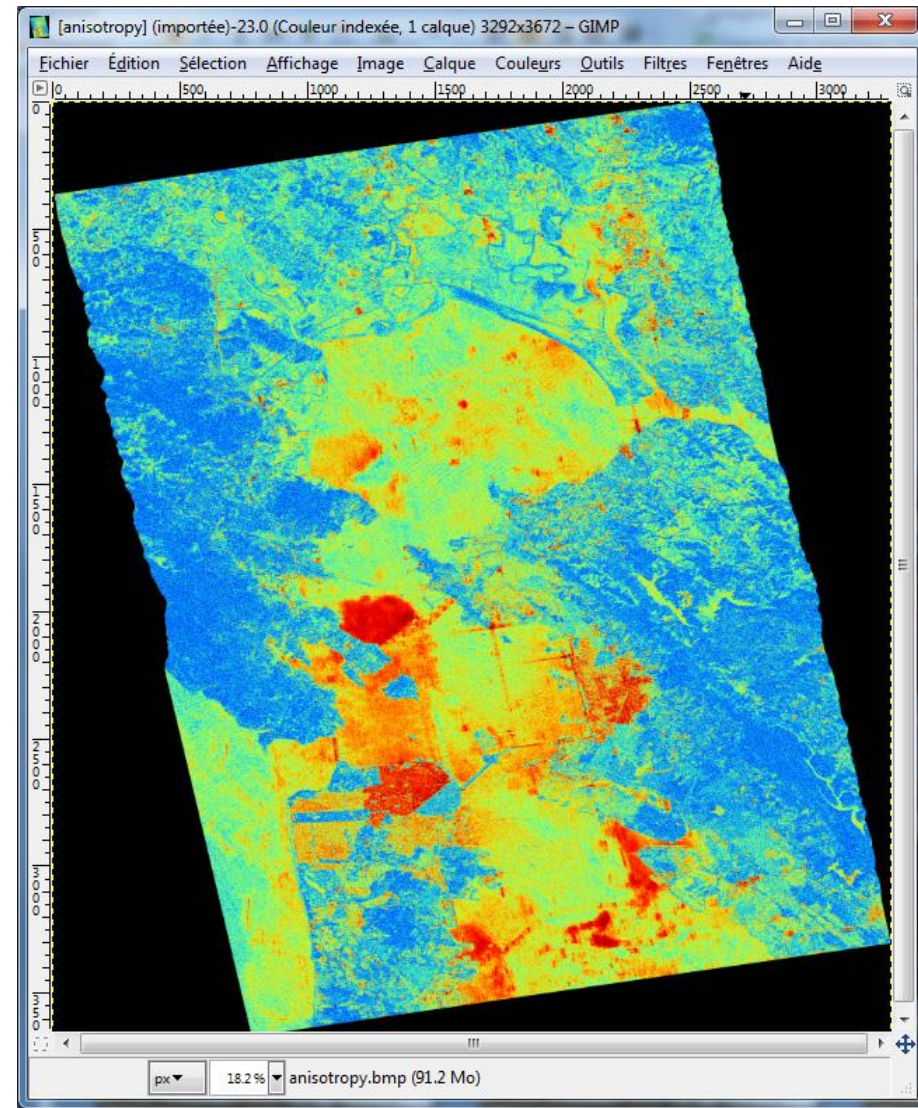
Entropy



Lambda

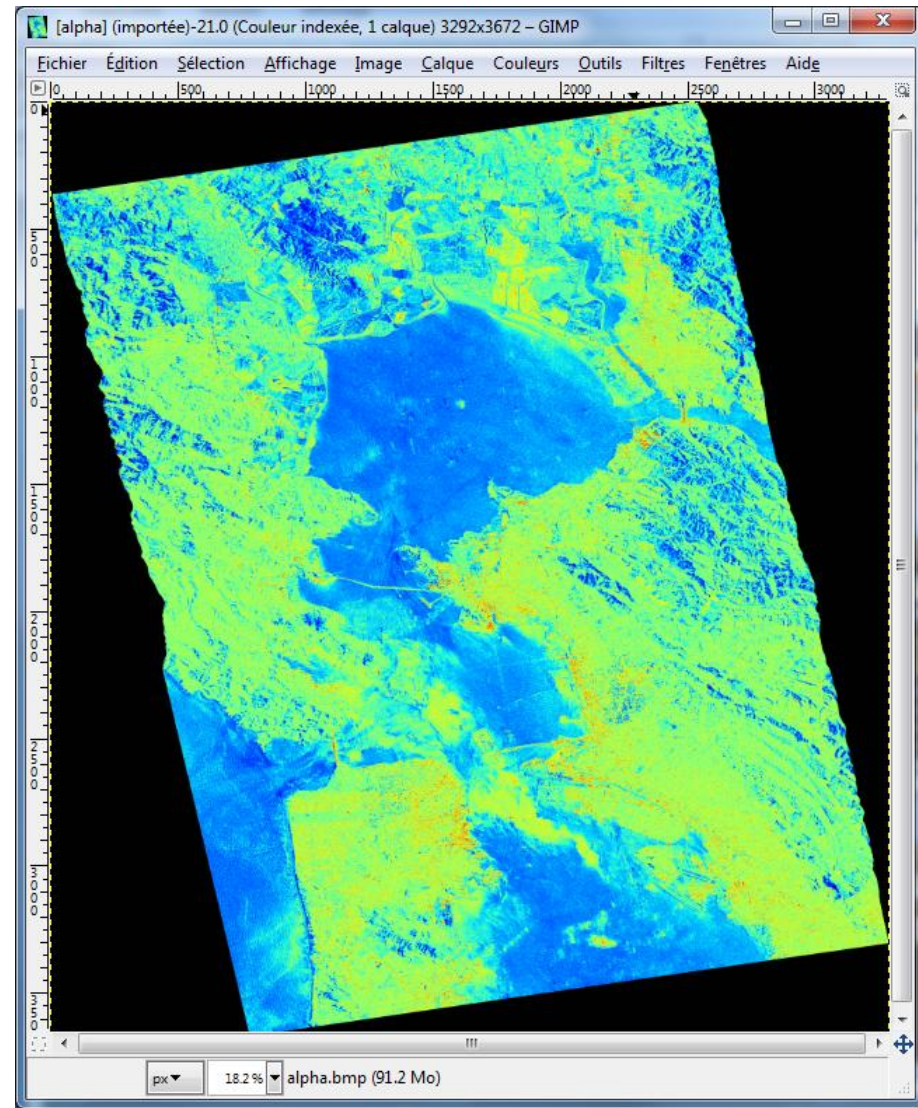
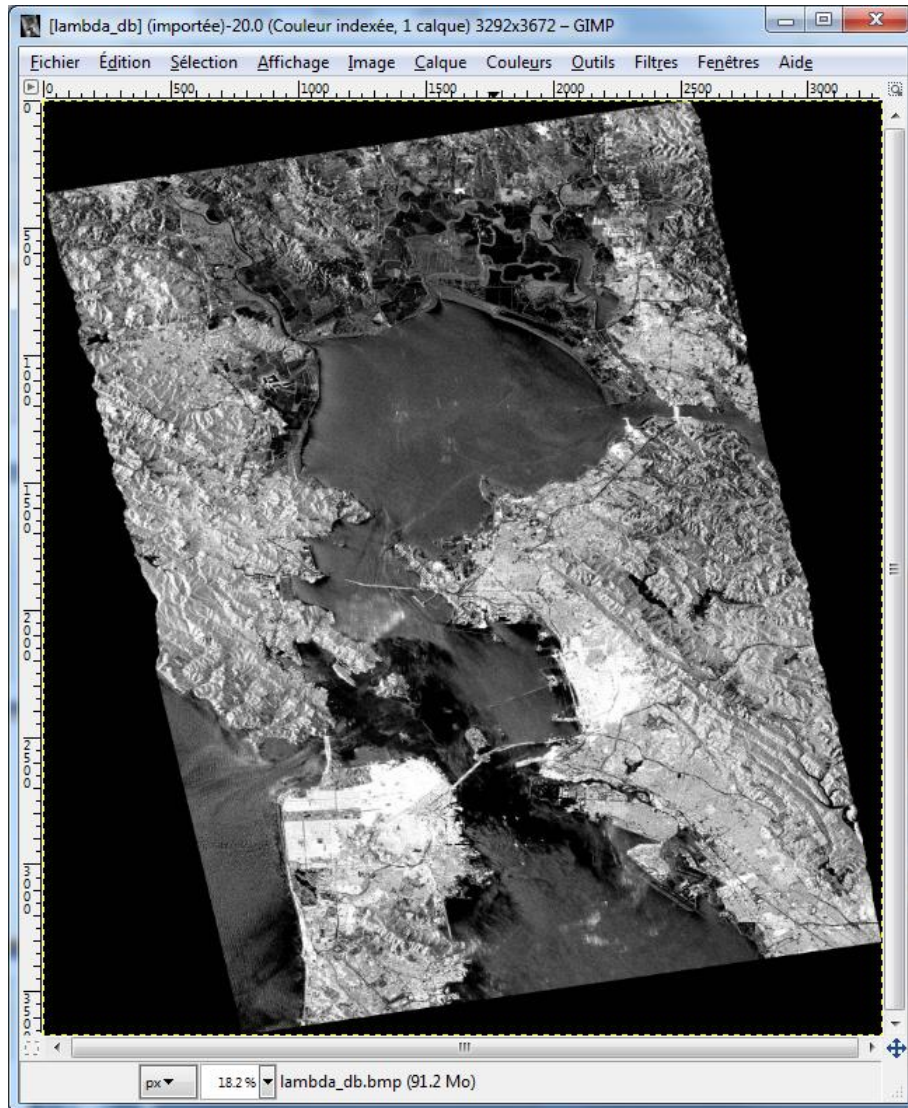


Anisotropy



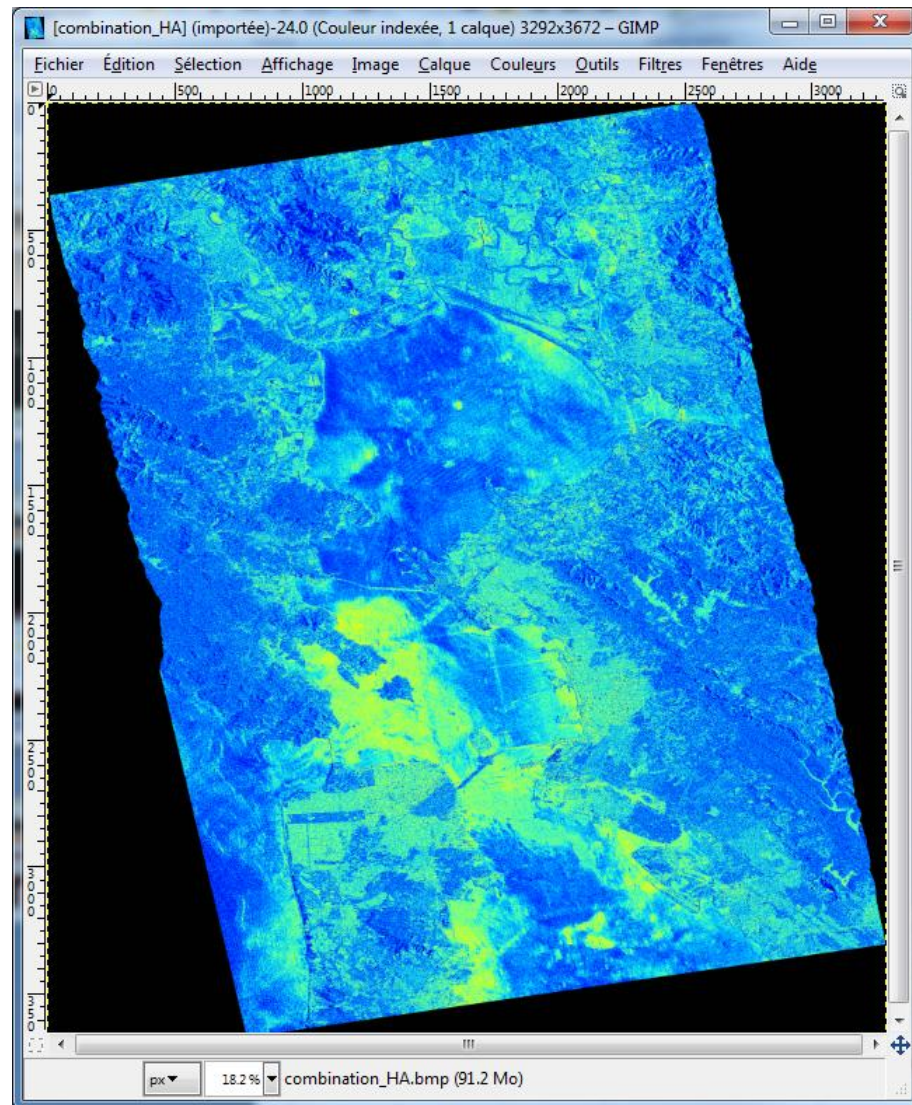
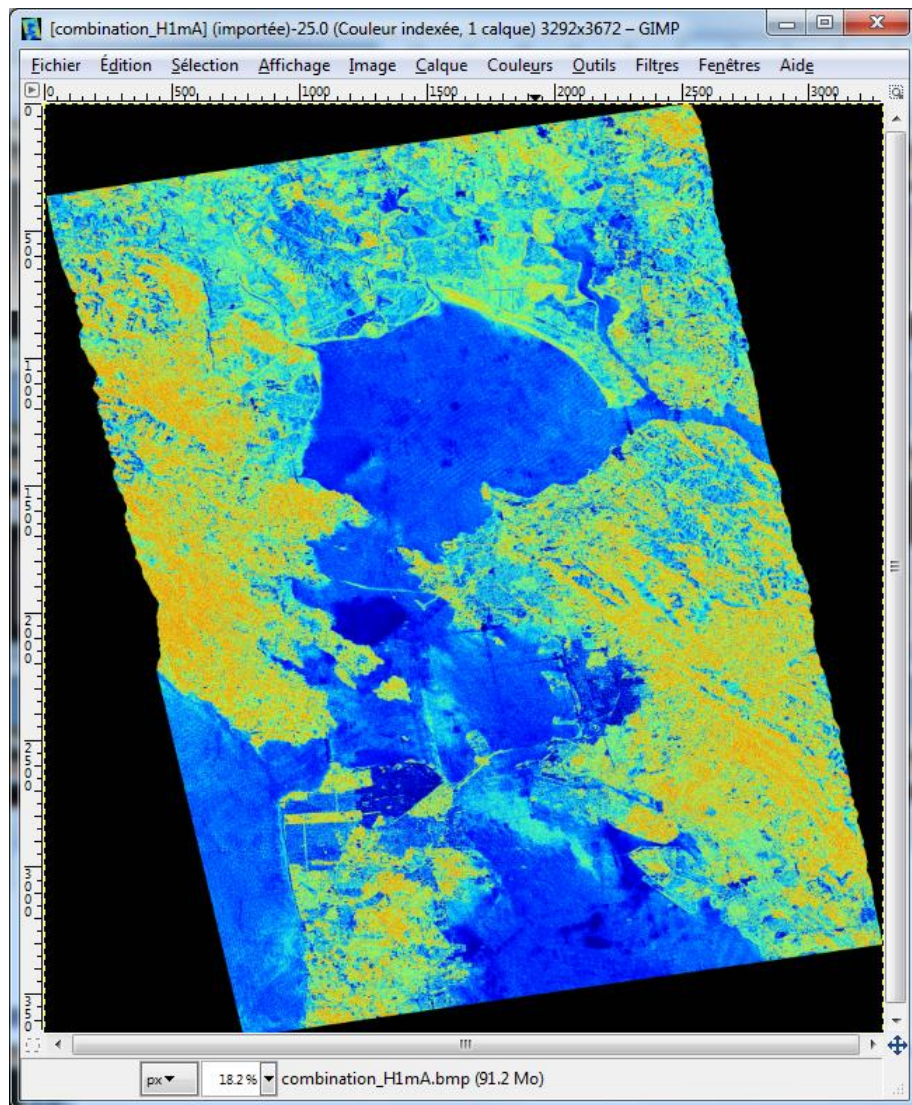
Lambda

Alpha



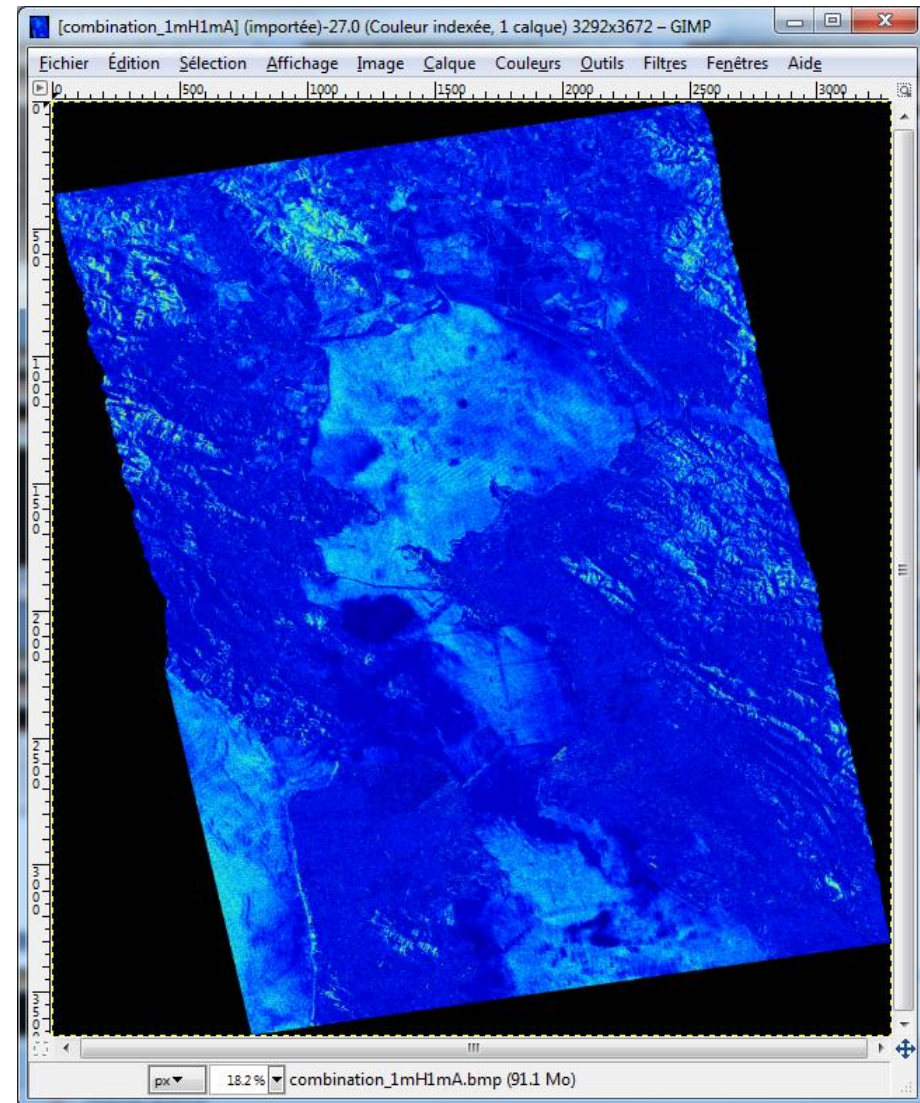
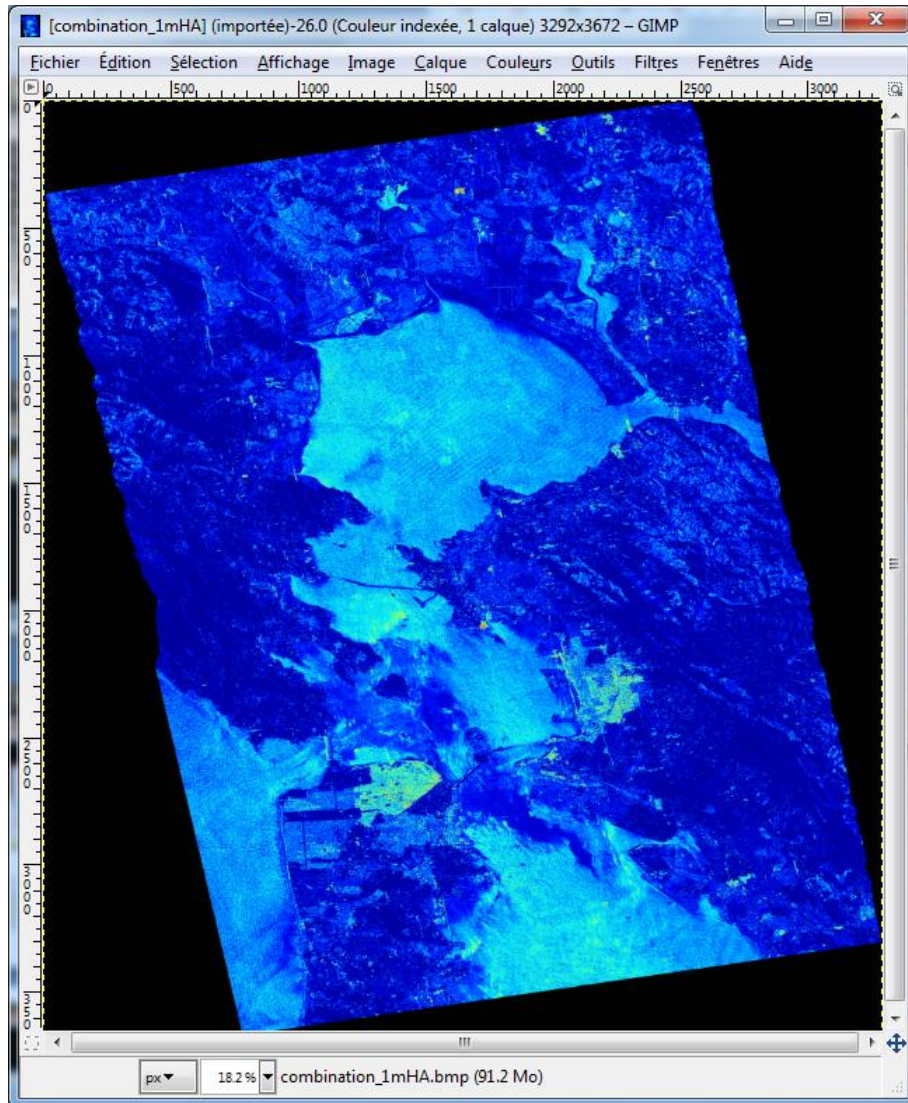
H (1-A)

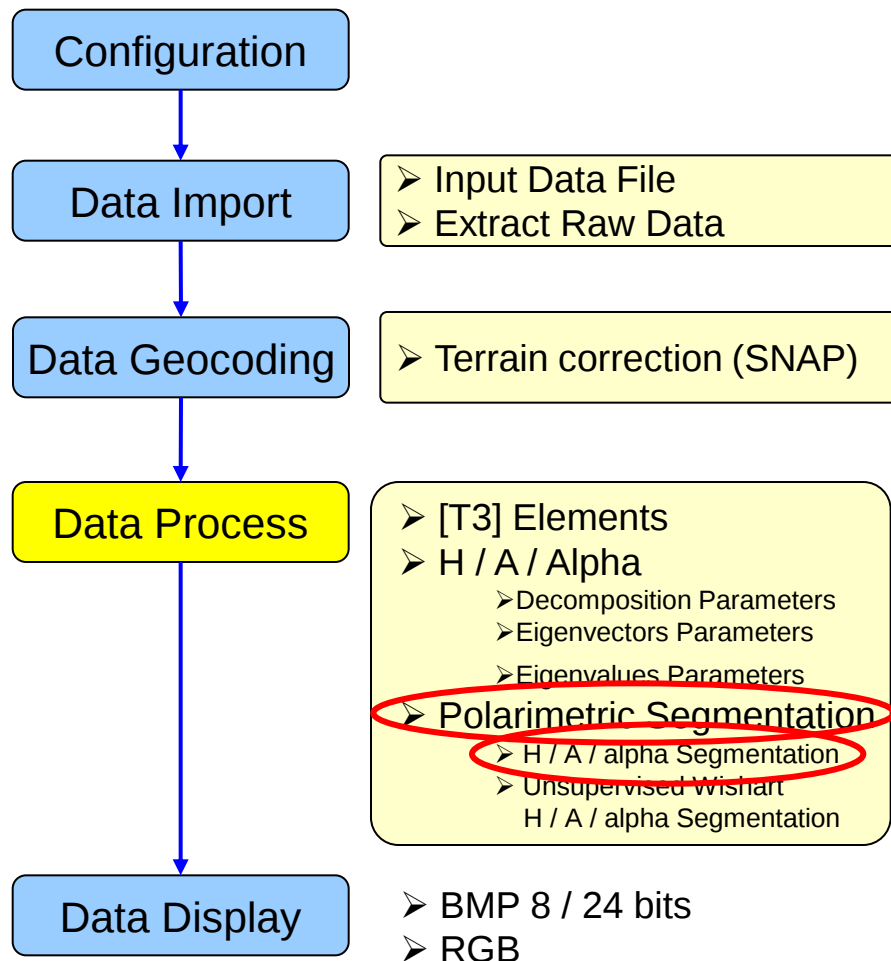
HA

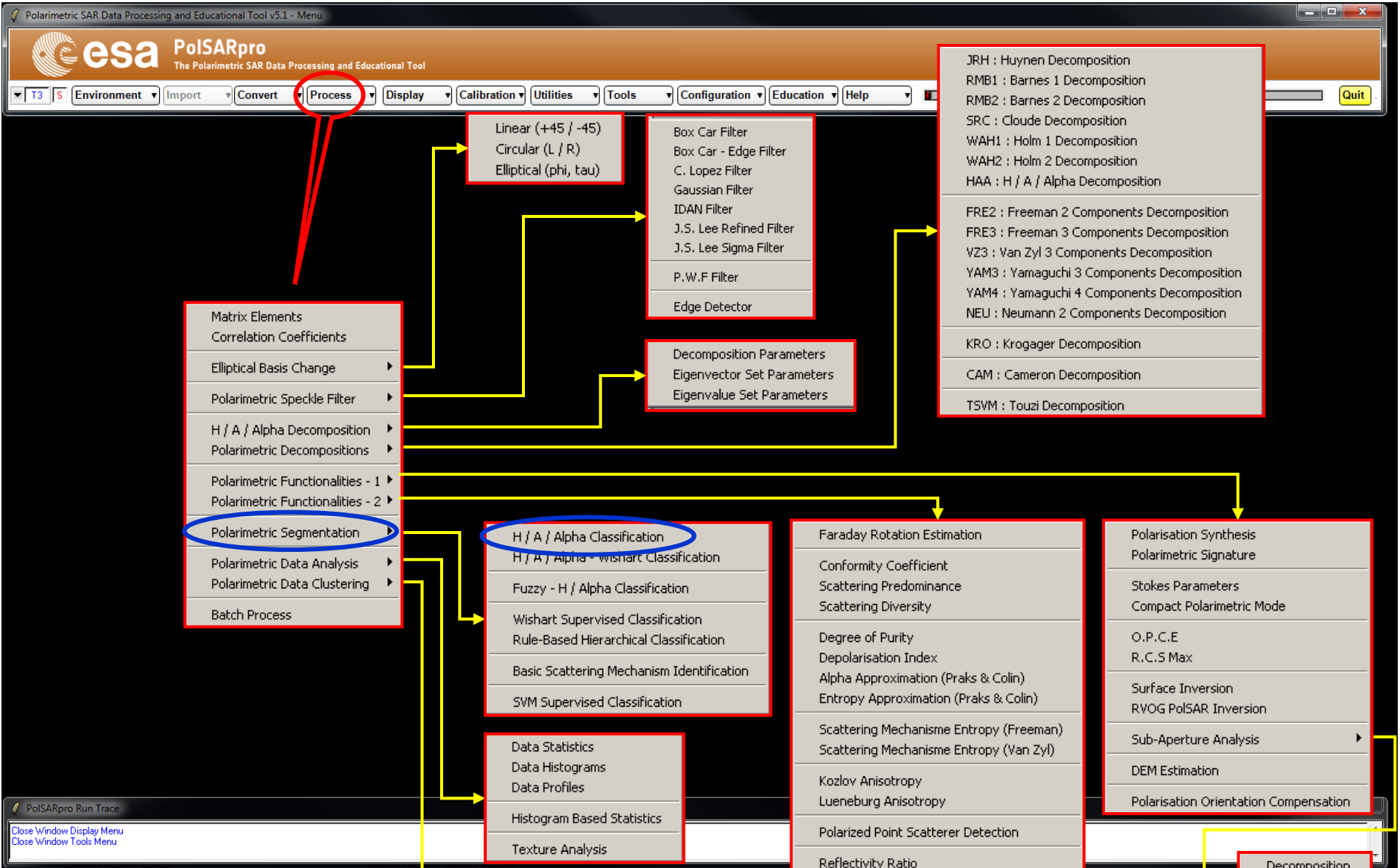


(1-H) A

(1-H) (1-A)





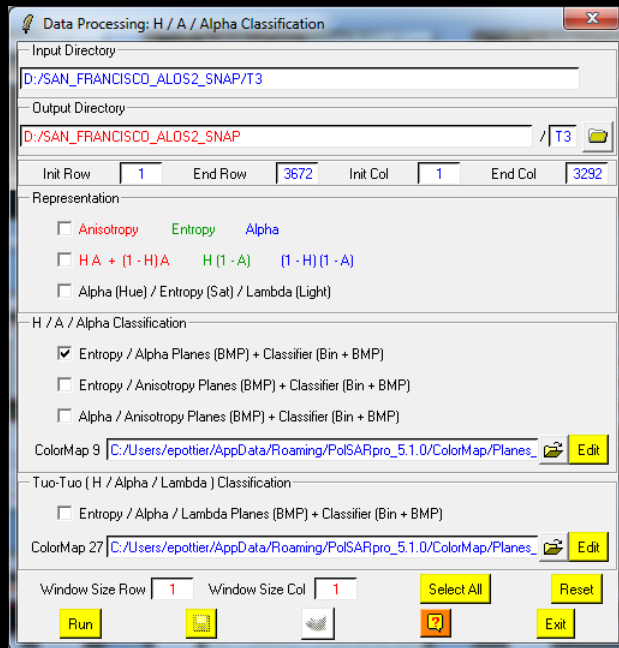
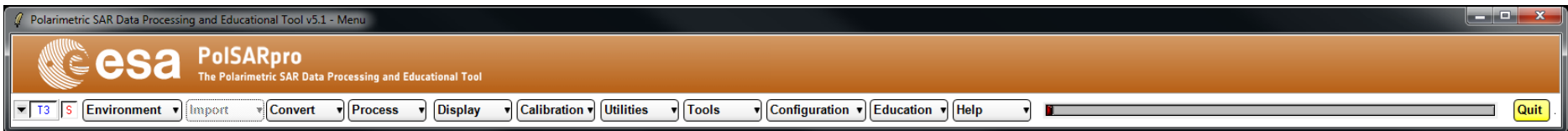


Do it Yourself:

Select some elements, set the parameters (**Nwin = 1**) and view the corresponding BMP files.

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu



Do it Yourself:
Select some elements, set the parameters (**Nwin = 1**) and view the corresponding BMP files.

DATADIR

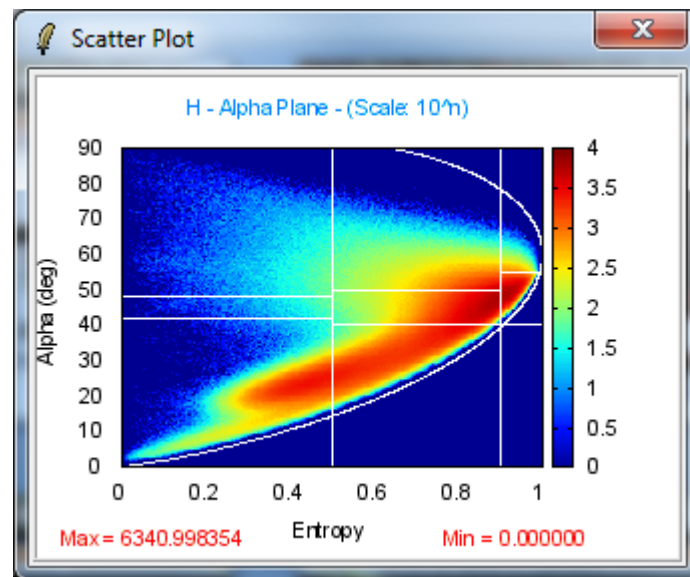
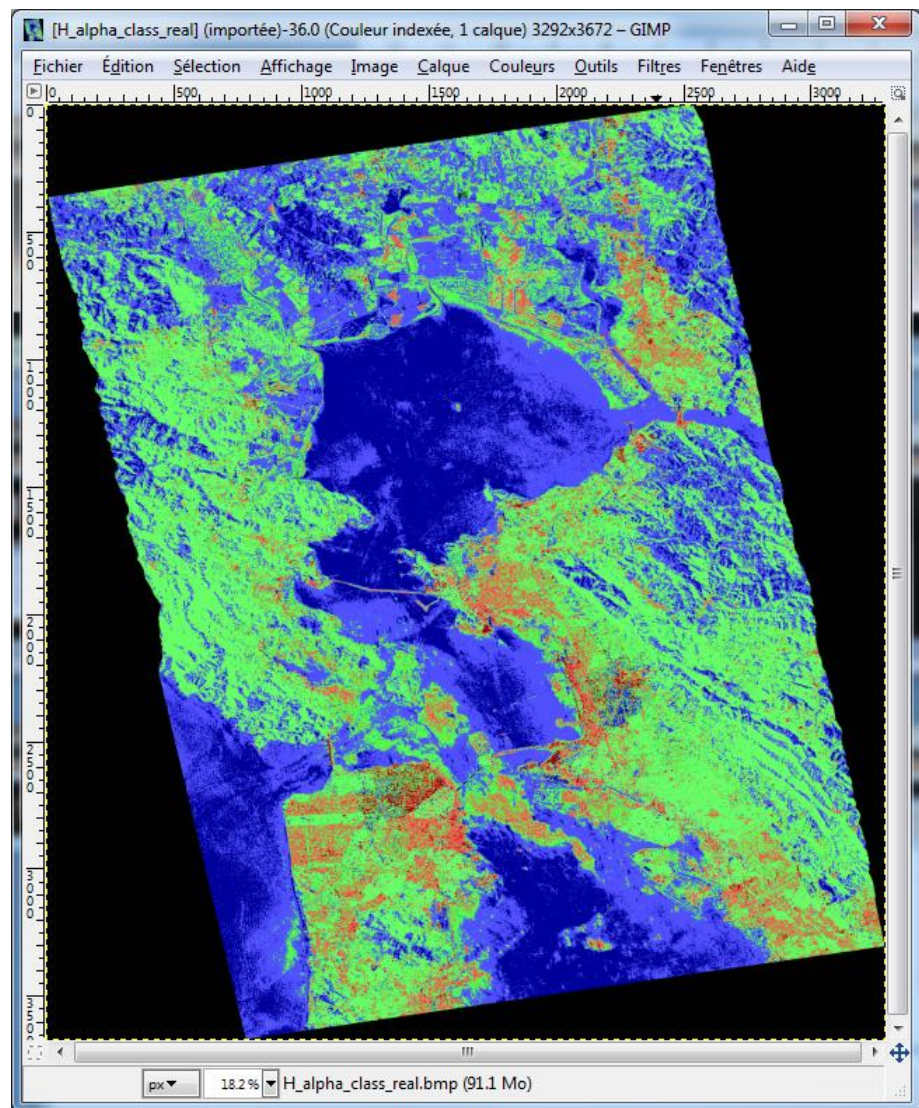
config.txt

[T3x3] Elements

entropy.bin, anisotropy.bin, alpha.bin
combination_HA.bin, combination_1mHA.bin,
combination_H1mA.bin, combination_1mH1mA.bin
H_A_class.bin, H_Alpha_class.bin, A_Alpha_class.bin

entropy.bmp, anisotropy.bmp, alpha.bmp
combination_HA.bmp, combination_1mHA.bmp,
combination_H1mA.bmp, combination_1mH1mA.bmp
H_A_class.bmp, H_Alpha_class.bmp, A_Alpha_class.bmp
H_A_occurrence.bmp, H_Alpha_occurrence.bmp,
A_Alpha_occurrence.bmp, H_A_segmented.bmp,
H_Alpha_segmented.bmp, A_Alpha_segmented.bmp
HAlphaLambda_RGB.bmp, HAlpha_RGB.bmp
HACombinations_RGB.bmp

H / A / alpha CLASSIFICATION

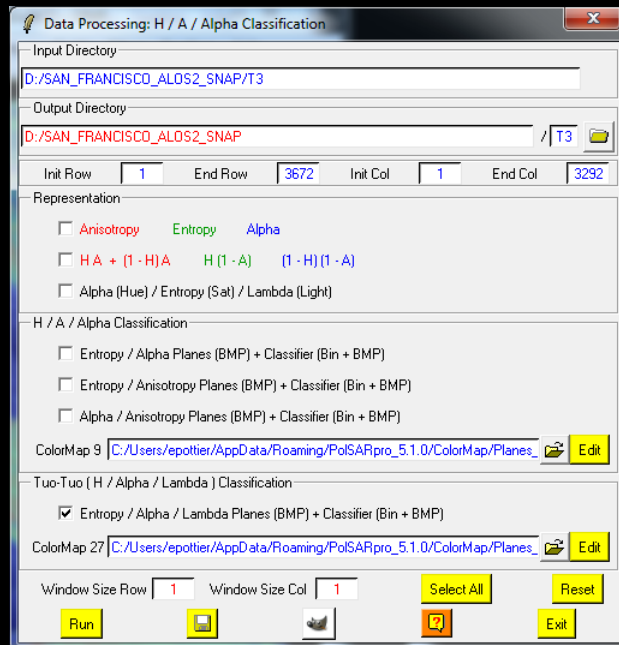
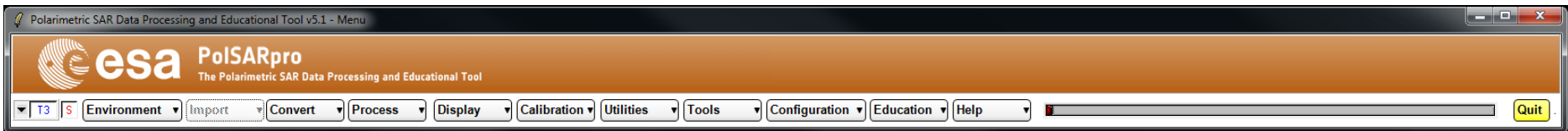


Do it Yourself:

Select some elements, set the parameters (**Nwin = 1**) and view the corresponding BMP files.

The screenshot shows the PolSARpro software interface with the 'Data Processing: H / A / Alpha Classification' dialog box open. The dialog box contains the following settings:

- Input Directory:** D:/SAN_FRANCISCO_ALOS2_SNAP/T3
- Output Directory:** D:/SAN_FRANCISCO_ALOS2_SNAP / T3
- Init Row:** 1, **End Row:** 3672, **Init Col:** 1, **End Col:** 3292
- Representation:**
 - ☐ Anisotropy Entropy Alpha
 - ☐ $H A + (1 - H) A$ $H (1 - A)$ $(1 - H) (1 - A)$
 - ☐ Alpha (Hue) / Entropy (Sat) / Lambda (Light)
- H / A / Alpha Classification:**
 - ☐ Entropy / Alpha Planes (BMP) + Classifier (Bin + BMP)
 - ☐ Entropy / Anisotropy Planes (BMP) + Classifier (Bin + BMP)
 - ☐ Alpha / Anisotropy Planes (BMP) + Classifier (Bin + BMP)
- ColorMap 9:** C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Planes_ [Edit]
- Tuo-Tuo (H / Alpha / Lambda) Classification:**
 - ☒ Entropy / Alpha / Lambda Planes (BMP) + Classifier (Bin + BMP)
- ColorMap 27:** C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Planes_ [Edit]
- Window Size Row:** 1, **Window Size Col:** 1
- Buttons:** Run, [Save], [Help], Select All, Reset, Exit



Do it Yourself:

Select some elements, set the parameters (**Nwin = 1**) and view the corresponding BMP files.

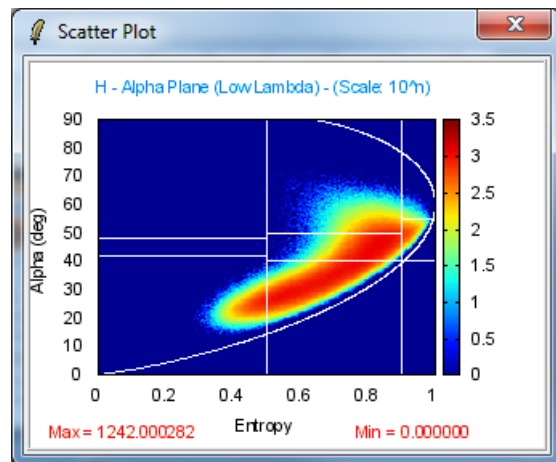
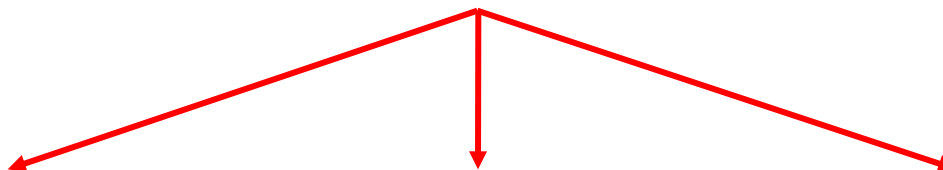
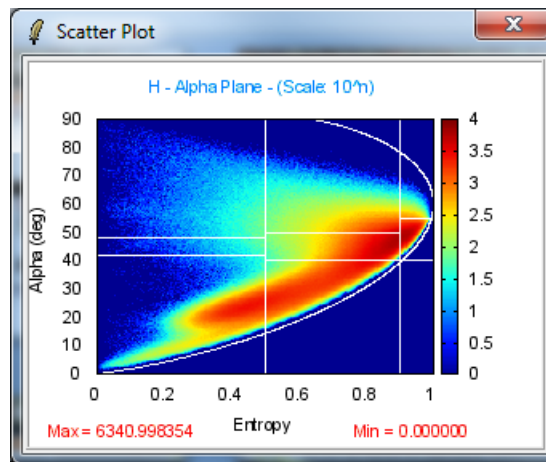
DATADIR

config.txt

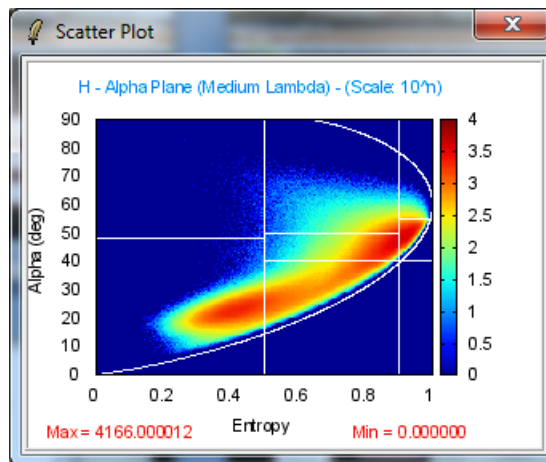
[T3x3] Elements

H_alpha_lambda_class1(2,3).bin,
H_alpha_lambda_occurrence_class1(2,3).bin,
H_alpha_lambda_segmented_class1(2,3).bin,
H_alpha_lambda_class.bin,

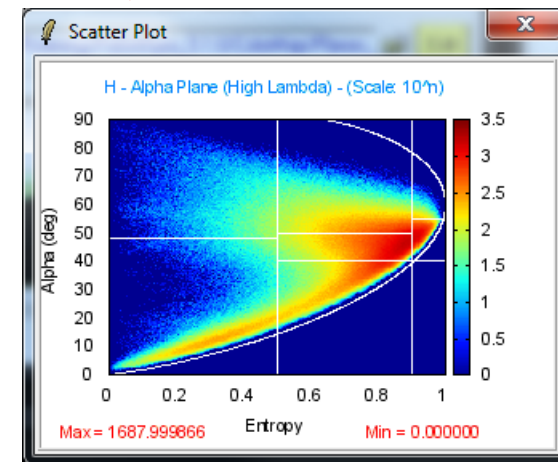
H_alpha_lambda_class1(2,3).bmp,
H_alpha_lambda_occurrence_class1(2,3).bmp,
H_alpha_lambda_segmented_class1(2,3).bmp,
H_alpha_lambda_class.bmp,



Low λ

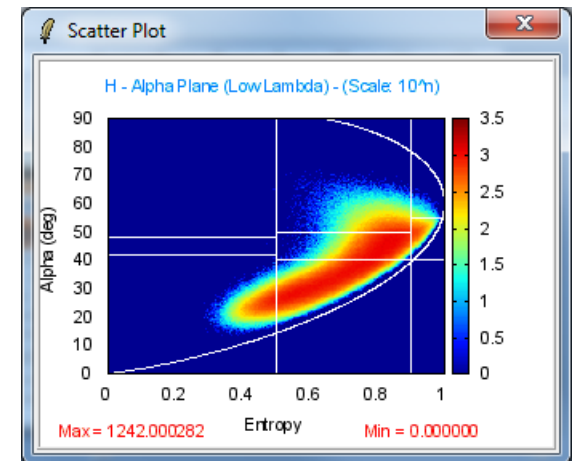
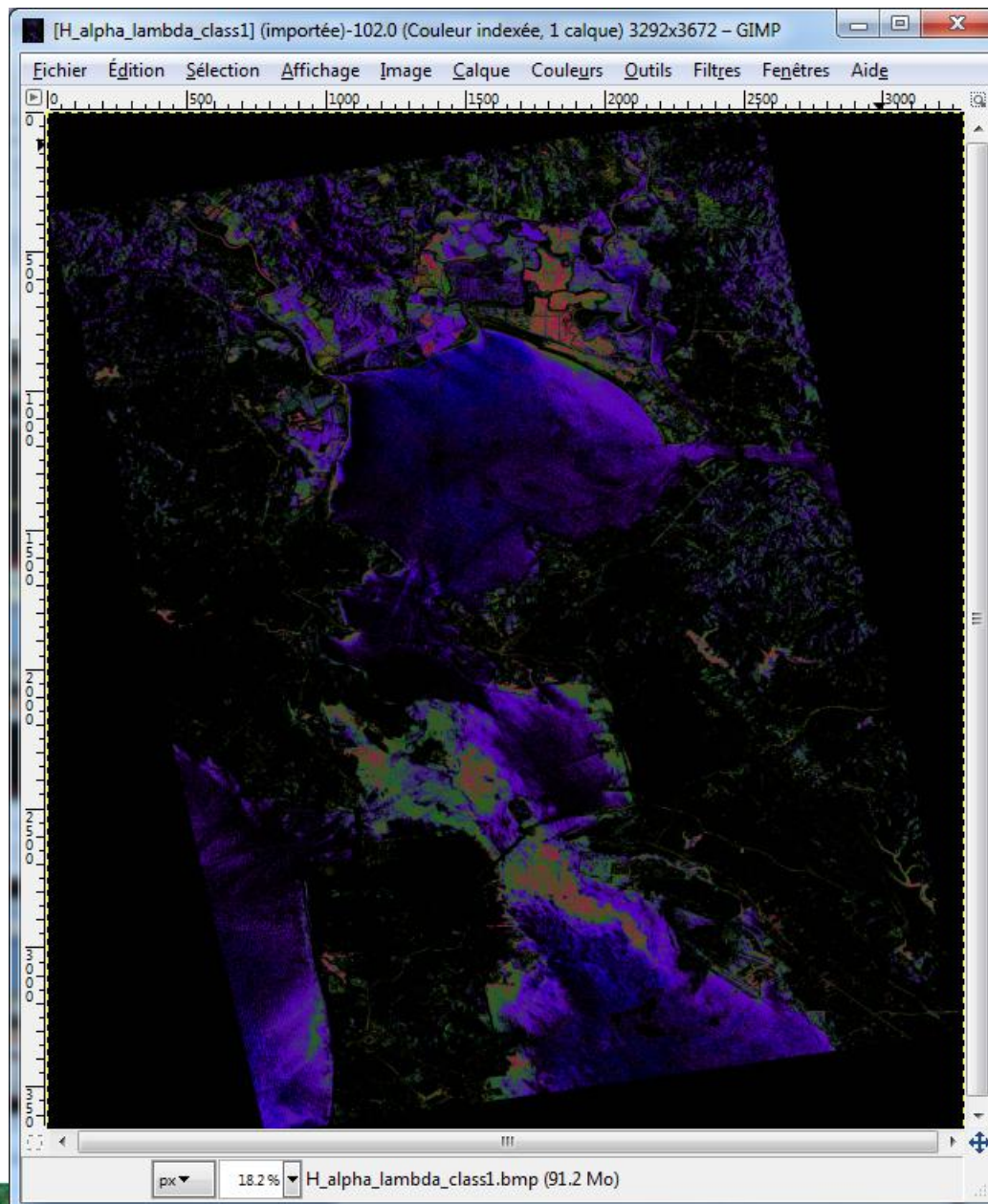


Medium λ



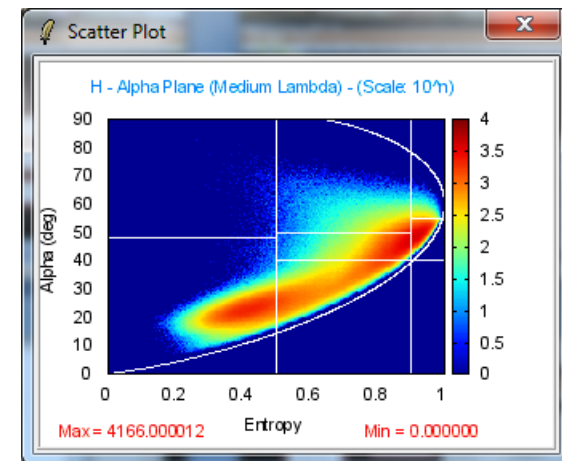
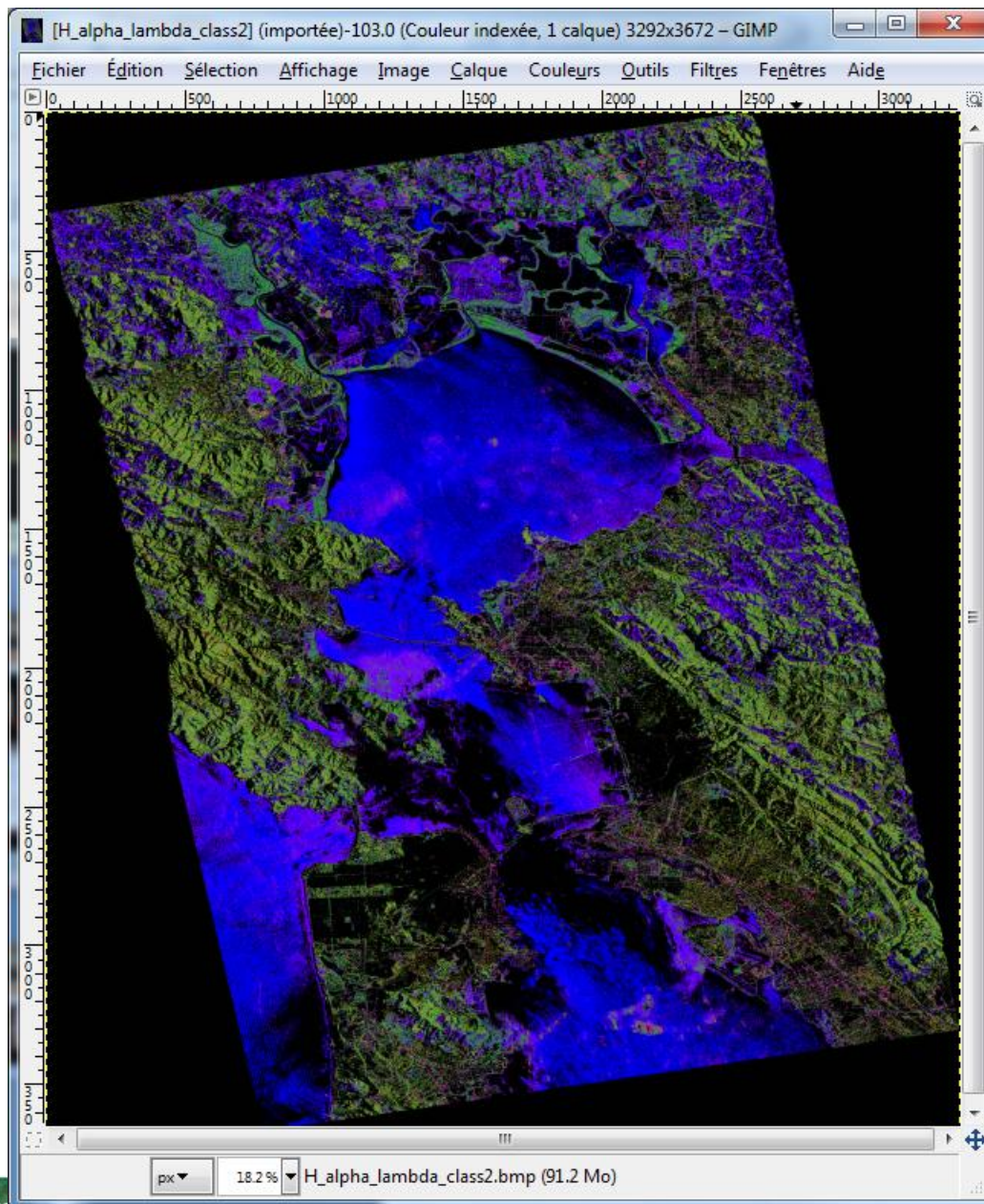
High λ

H / A / alpha CLASSIFICATION



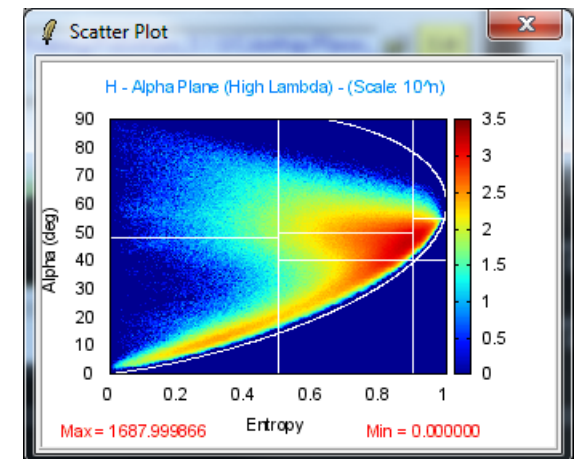
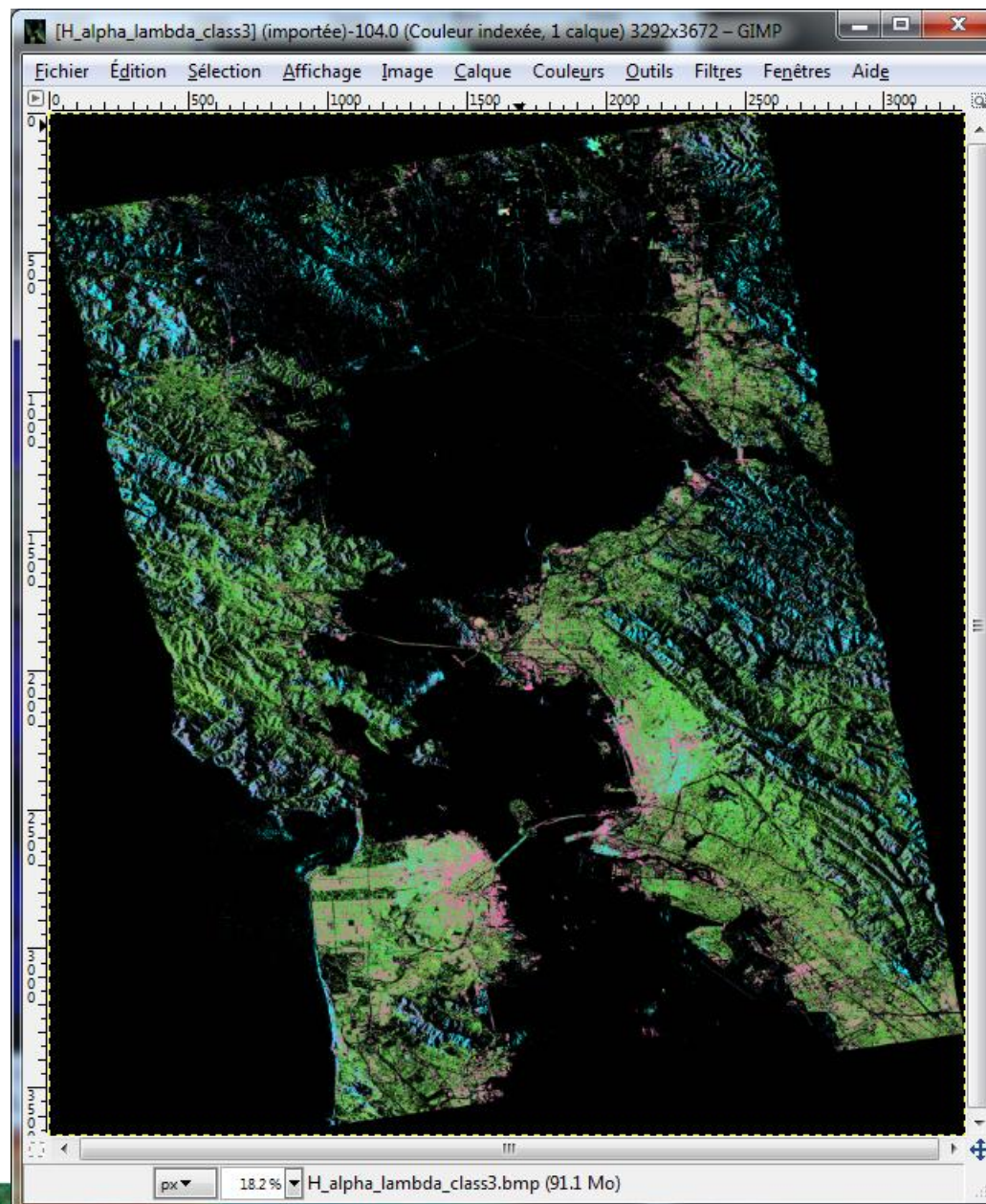
Low λ

H / A / alpha CLASSIFICATION



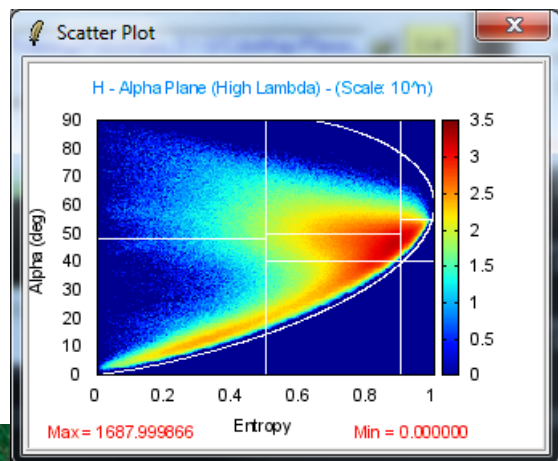
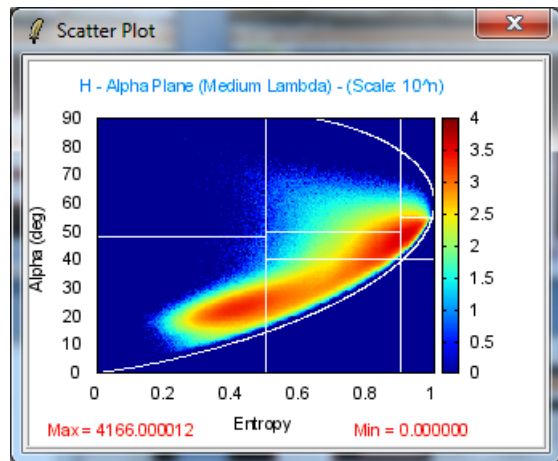
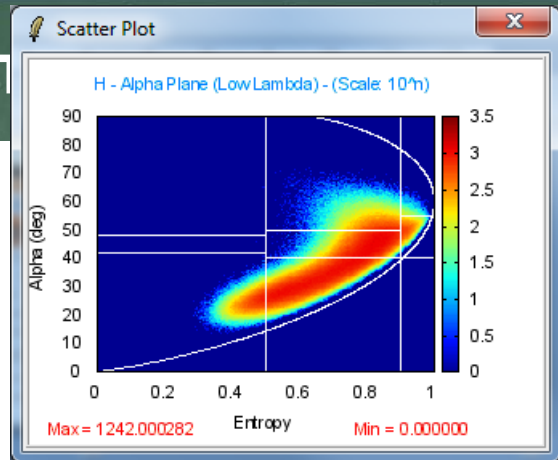
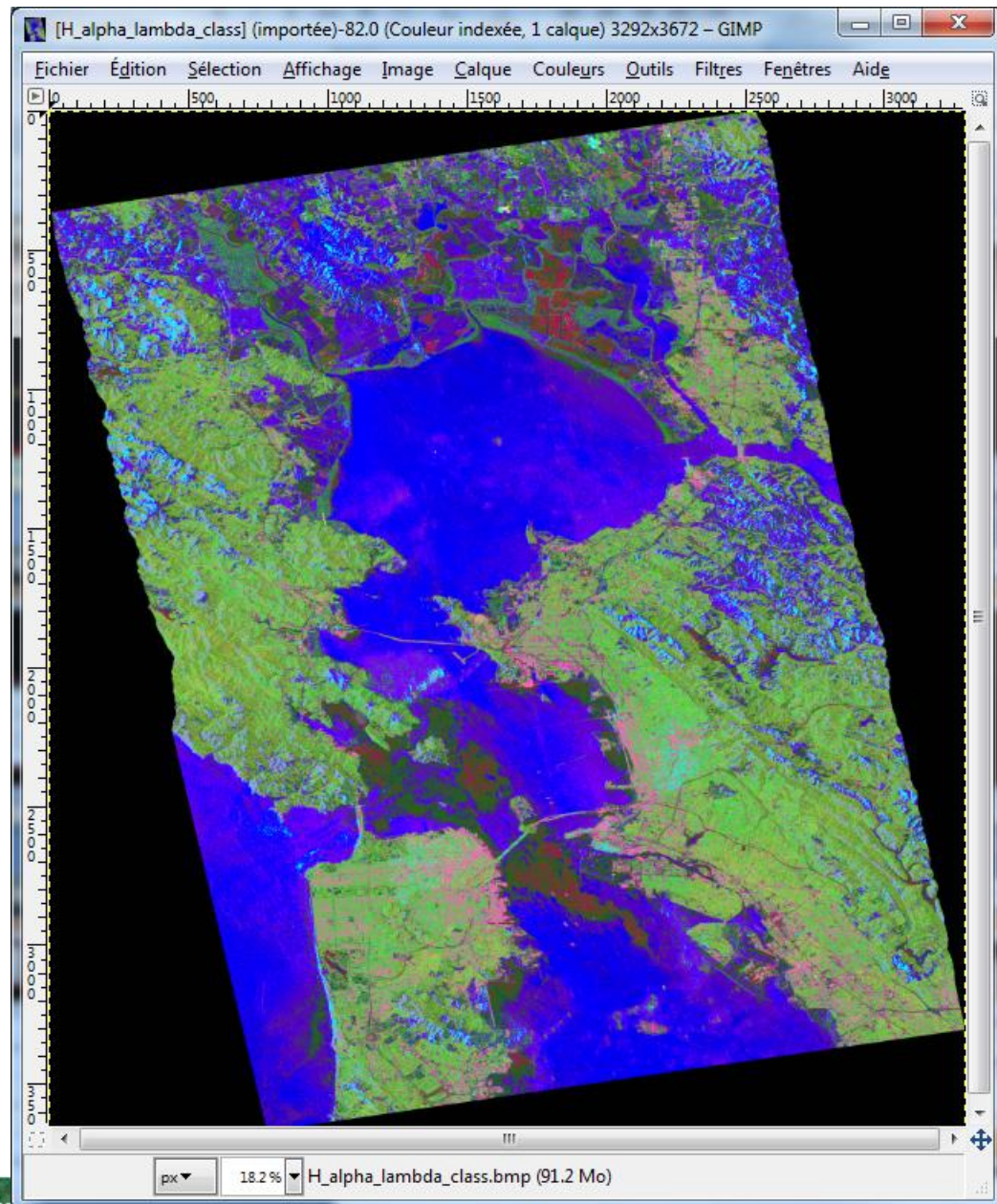
Medium λ

H / A / alpha CLASSIFICATION

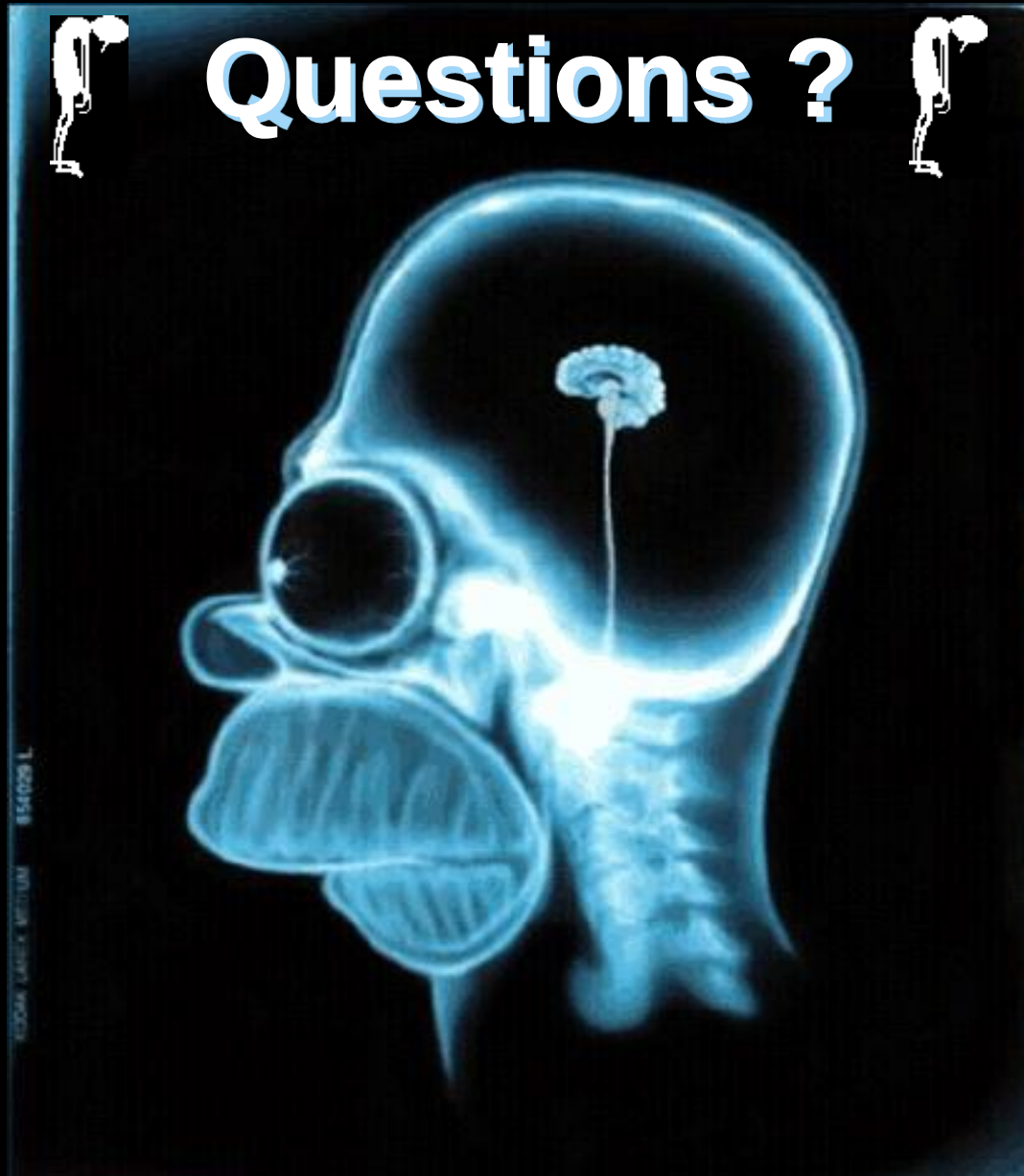


High λ

H / A / alpha CLASSIFICATION

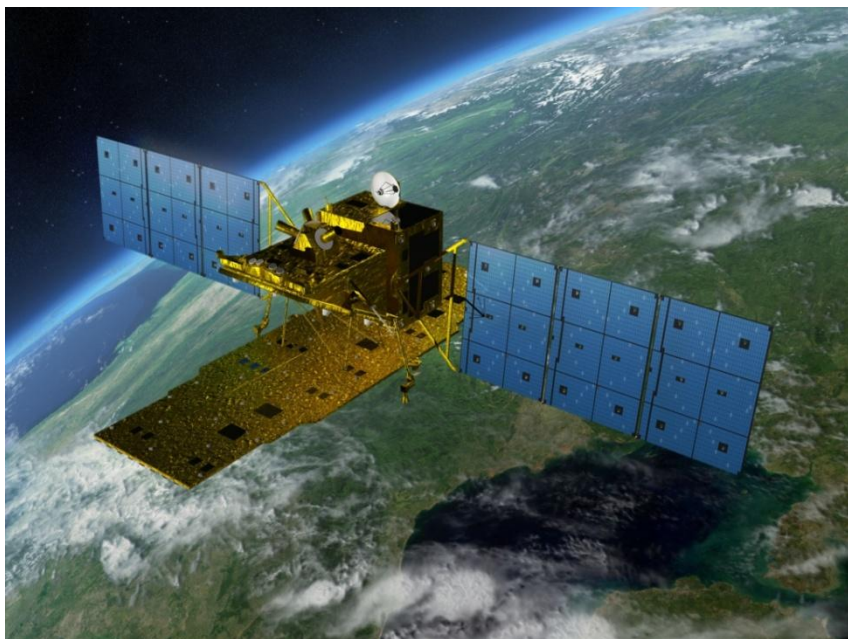


Questions ?

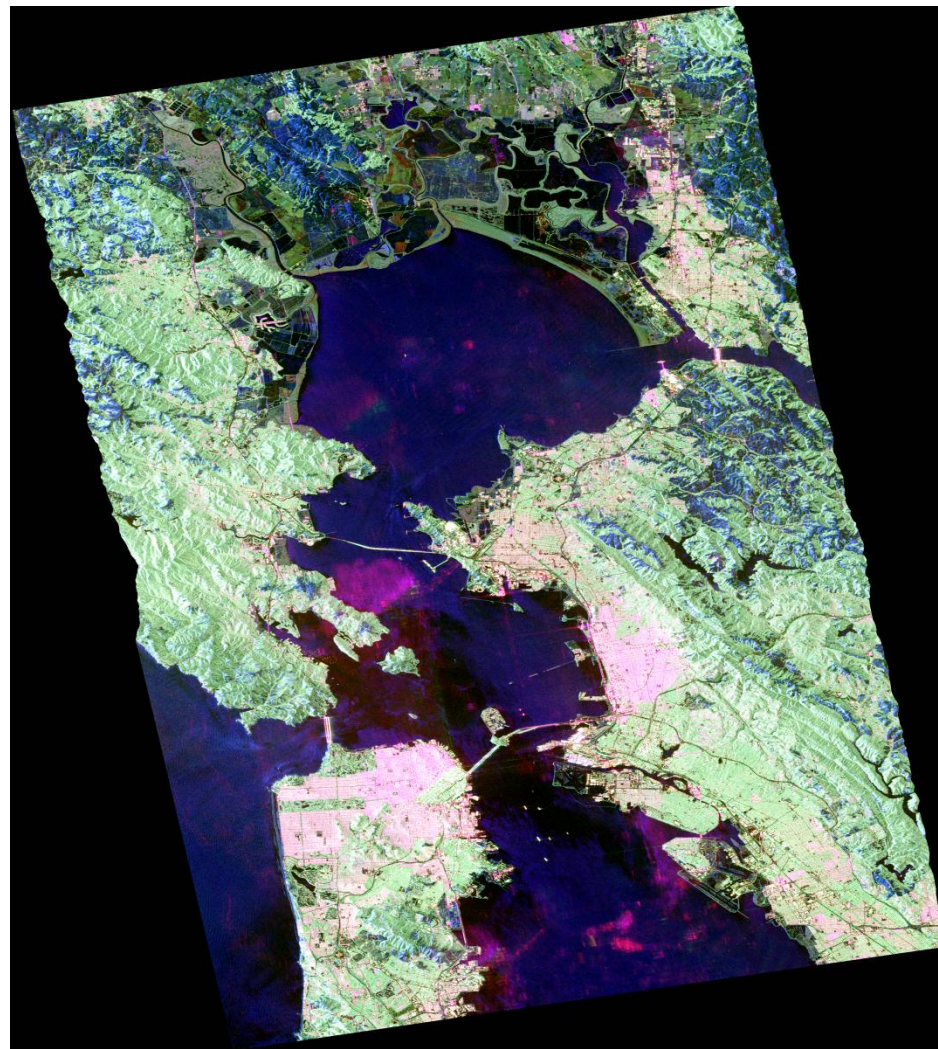


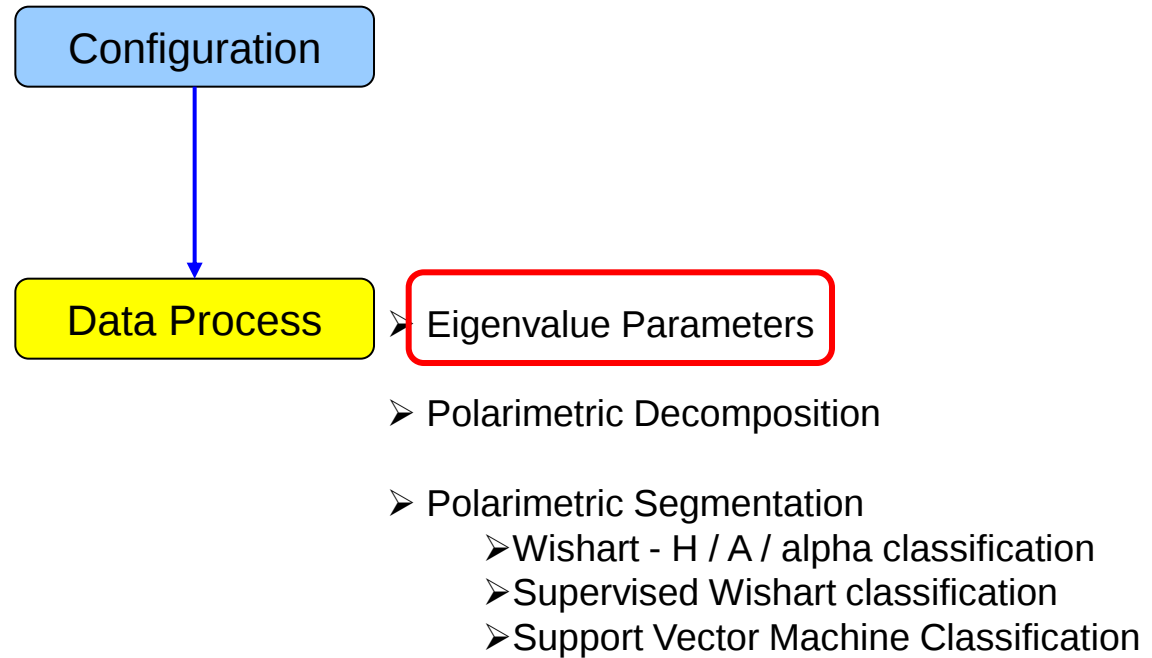
PolSARpro v5.1 Software

Practical advanced session



ALOS : Advanced Land Observing Satellite
PALSAR : Phase Array L-Band SAR





PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

Environment Import Convert **Process** Display Calibration Utilities Tools Configuration Education Help

Quit

Linear (+45 / -45)
Circular (L / R)
Elliptical (phi, tau)

Box Car Filter
Box Car - Edge Filter
C. Lopez Filter
Gaussian Filter
IDAN Filter
J.S. Lee Refined Filter
J.S. Lee Sigma Filter
P.W.F Filter
Edge Detector

Decomposition Parameters
Eigenvector Set Parameters
Eigenvalue Set Parameters

JRH : Huynen Decomposition
RMB1 : Barnes 1 Decomposition
RMB2 : Barnes 2 Decomposition
SRC : Cloude Decomposition
WAH1 : Holm 1 Decomposition
WAH2 : Holm 2 Decomposition
HAA : H / A / Alpha Decomposition
FRE2 : Freeman 2 Components Decomposition
FRE3 : Freeman 3 Components Decomposition
VZ3 : Van Zyl 3 Components Decomposition
YAM3 : Yamaguchi 3 Components Decomposition
YAM4 : Yamaguchi 4 Components Decomposition
NEU : Neumann 2 Components Decomposition
KRO : Krogager Decomposition
CAM : Cameron Decomposition
TSVM : Touzi Decomposition

Matrix Elements
Correlation Coefficients
Elliptical Basis Change
Polarimetric Speckle Filter
H / A / Alpha Decomposition
Polarimetric Decompositions
Polarimetric Functionalities - 1
Polarimetric Functionalities - 2
Polarimetric Segmentation
Polarimetric Data Analysis
Polarimetric Data Clustering
Batch Process

H / A / Alpha Classification
H / A / Alpha - Wishart Classification
Fuzzy - H / Alpha Classification
Wishart Supervised Classification
Rule-Based Hierarchical Classification
Basic Scattering Mechanism Identification
SVM Supervised Classification

Data Statistics
Data Histograms
Data Profiles
Histogram Based Statistics
Texture Analysis

Clustering Process
Parameter Averaging
Data Sets Averaging

Faraday Rotation Estimation
Conformity Coefficient
Scattering Predominance
Scattering Diversity
Degree of Purity
Depolarisation Index
Alpha Approximation (Praks & Colin)
Entropy Approximation (Praks & Colin)
Scattering Mechanism Entropy (Freeman)
Scattering Mechanism Entropy (Van Zyl)
Kozlov Anisotropy
Lueneburg Anisotropy
Polarized Point Scatterer Detection
Reflectivity Ratio
Differential Reflectivity (ZDR)

Polarisation Synthesis
Polarimetric Signature
Stokes Parameters
Compact Polarimetric Mode
O.P.C.E
R.C.S Max
Surface Inversion
RVOG PolSAR Inversion
Sub-Aperture Analysis
DEM Estimation
Polarisation Orientation Compensation

Decomposition Applications

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

→ 7th ADVANCED TRAINING COURSE ON POLARIMETRIC SAR DATA PROCESSING
4-9 September 2017 | Szent István University | Gödöllő, Hungary

Do it Yourself:
Select some elements, set the
parameters and view the
corresponding BMP files
(select BMP).

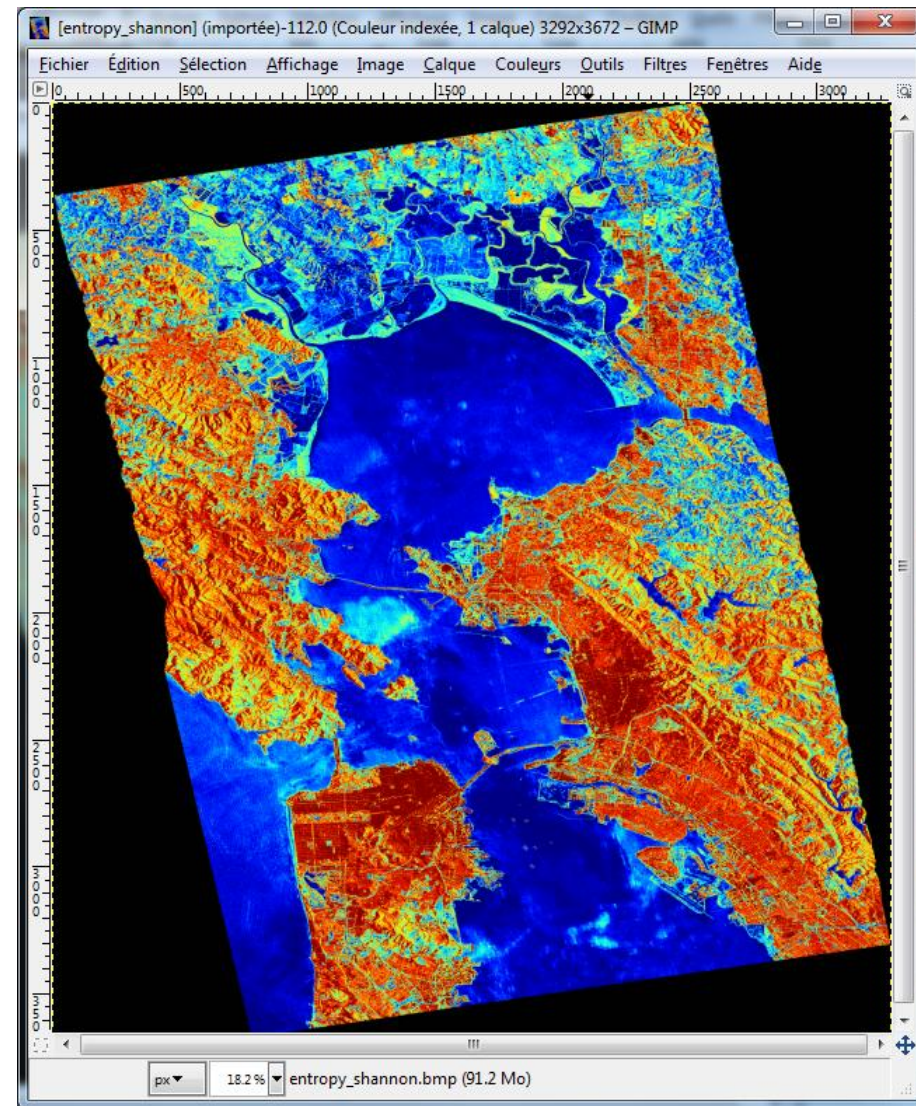
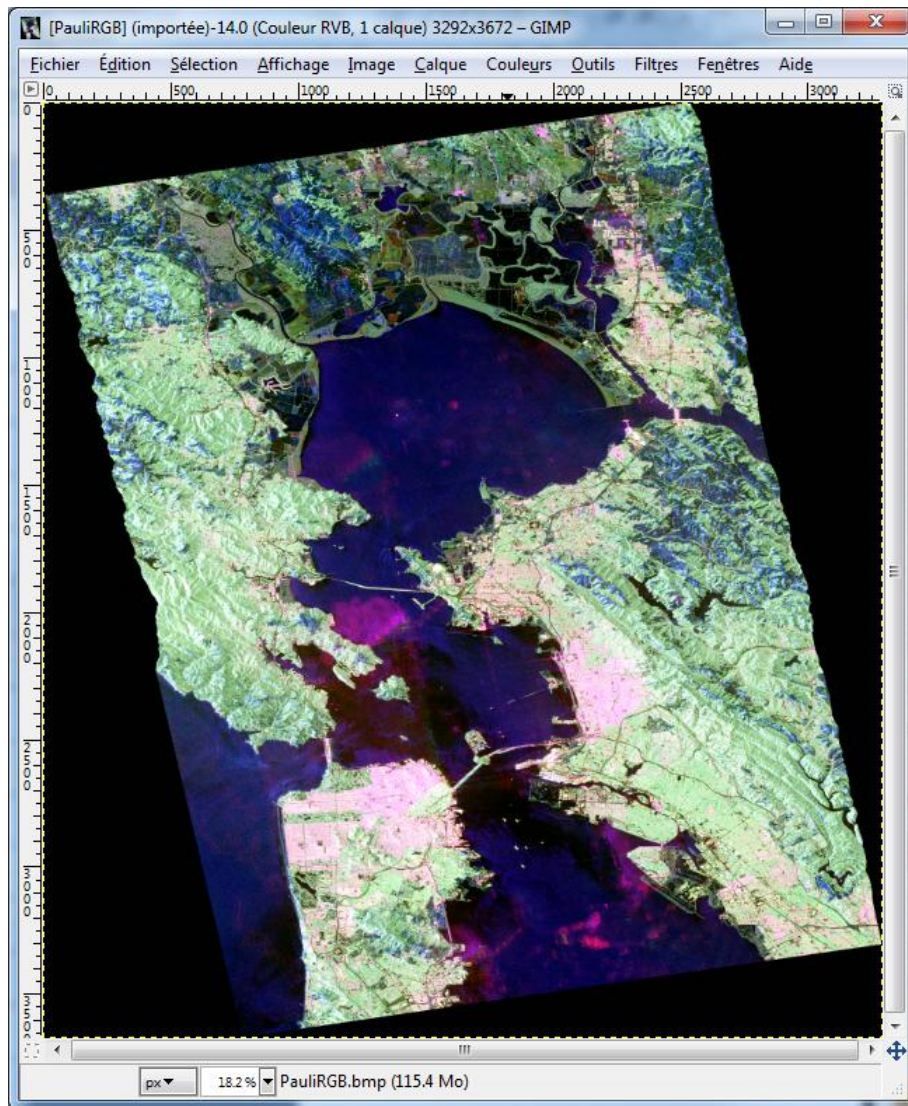
Window Size = 1

The screenshot shows the PolSARpro software interface. The main window has a menu bar with options: T3, Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help, and Quit. The 'Data Processing: H / A / Alpha Eigenvalue Set Parameters' dialog box is open, showing the following settings:

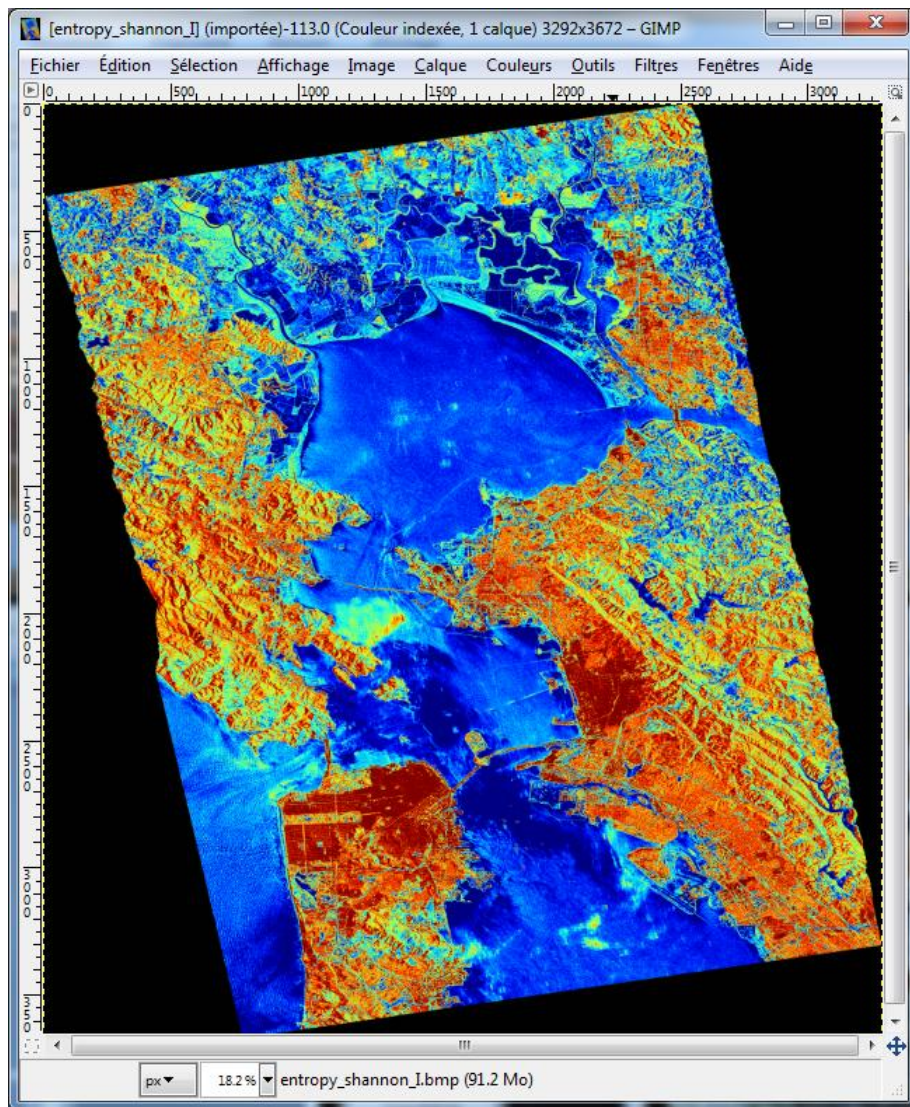
- Input Directory: D:/SAN_FRANCISCO_ALOS2_SNAP/T3
- Output Directory: D:/SAN_FRANCISCO_ALOS2_SNAP / T3
- Init Row: 1, End Row: 3672, Init Col: 1, End Col: 3292
- Parameters to be processed (checked):
 - Pseudo Probabilities (p1, p2, p3) - BMP
 - Anisotropy (A) (p2, p3) - BMP
 - Anisotropy12 (A12) (p1, p2) - BMP
 - Eigenvalues Relative Difference (S.E.R.D - D.E.R.D) - BMP
 - Polarisation Asymmetry (p1-p3, 1-3p3) - BMP
 - Polarisation Fraction (1-3p3) - BMP
 - Lueneburg Anisotropy - BMP
 - Shannon Entropy (H = Hi + Hp) - BMP
- Parameters not to be processed (unchecked):
 - Eigenvalues (L1, L2, L3) - BMP
 - Radar Vegetation Index (R.V.I) - BMP
 - Pedestal Height - BMP
- Window Size Row: 1, Window Size Col: 1
- Buttons: Select All, Reset, Run, Exit
- Equivalence between [T] and [C] eigen-decompositions: (unchecked)

At the bottom of the main window, there is a 'PolSARpro Run Trace' section with links to 'Close Window Display Menu' and 'Close Window Tools Menu'.

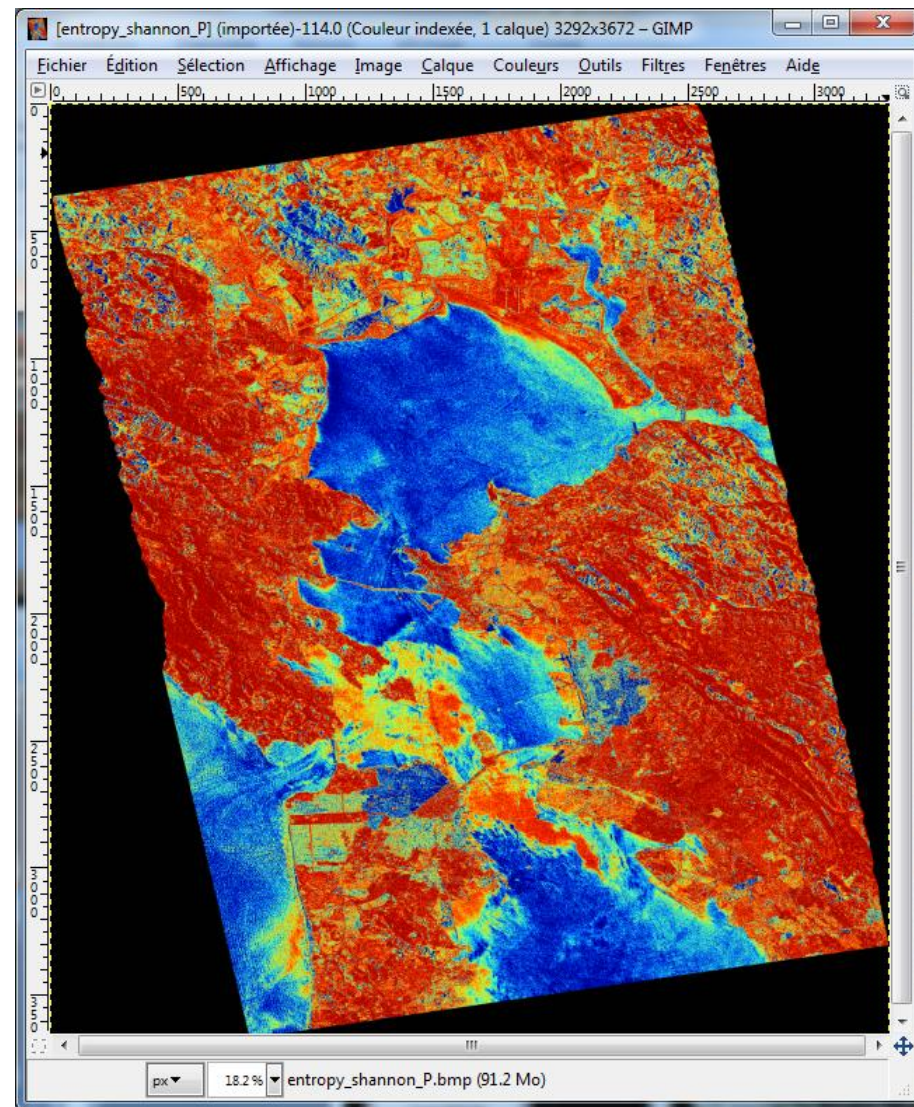
Entropy Shannon



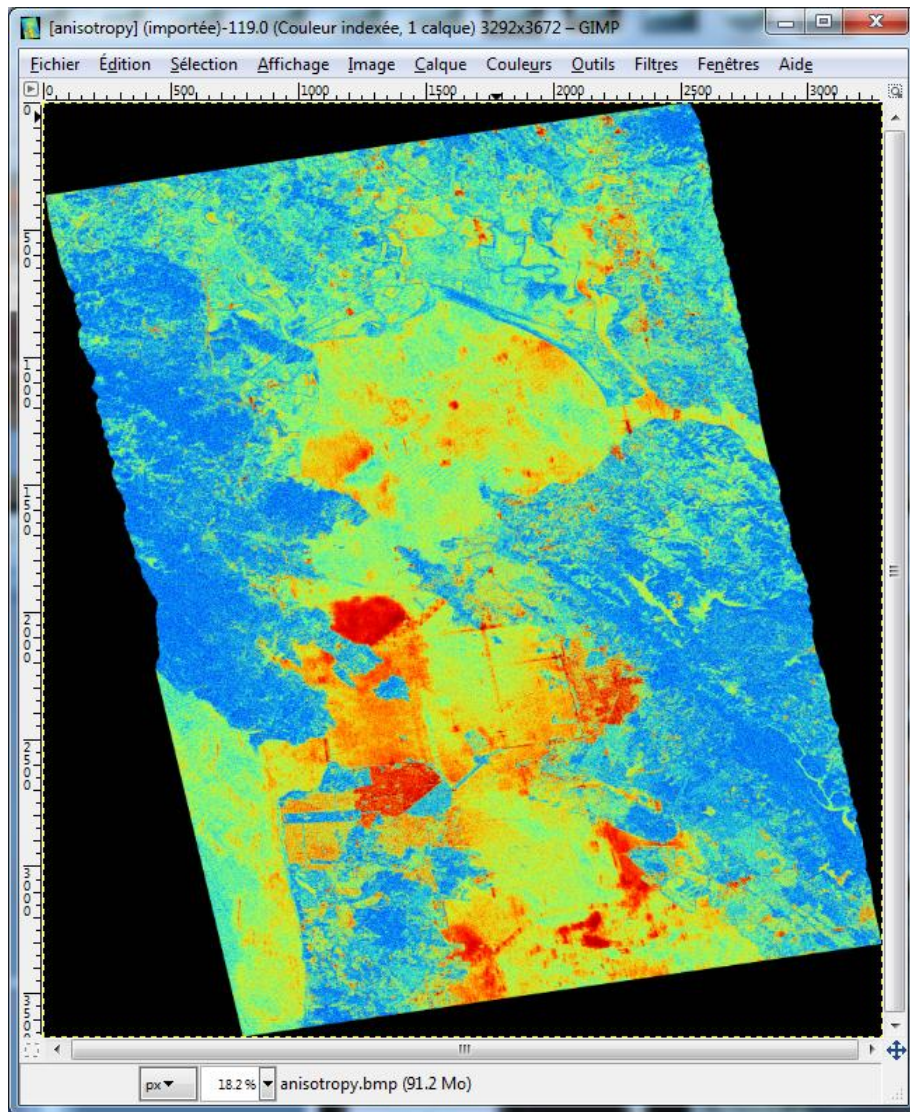
Entropy I



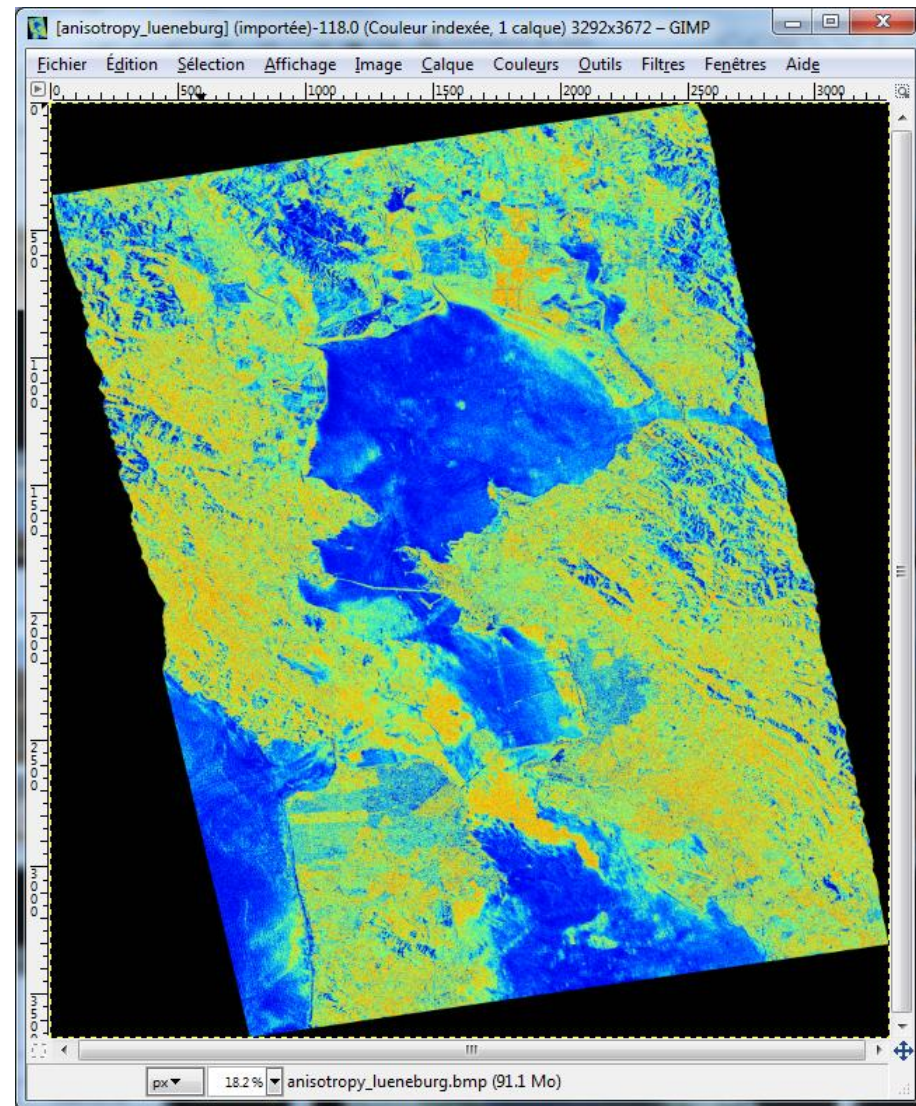
Entropy P

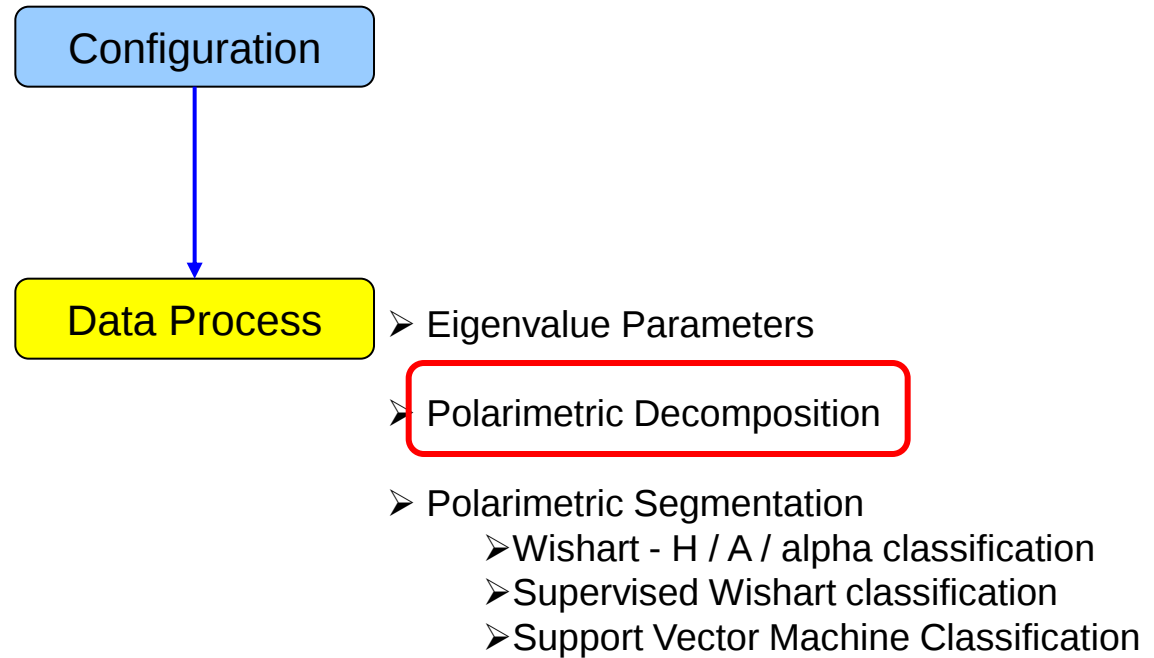


Anisotropy



Lueneburg Anisotropy





PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

Environment Import Convert **Process** Display Calibration Utilities Tools Configuration Education Help

Linear (+45 / -45)
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Box Car - Edge Filter
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Eigenvalue Set Parameters

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H / A / Alpha - Wishart Classification
Fuzzy - H / Alpha Classification
Wishart Supervised Classification
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Data Sets Averaging

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Conformity Coefficient
Scattering Prediction
Scattering Diversity
Degree of Purity
Depolarisation Index
Alpha Approximation
Entropy Approximation
Scattering Mechanism
Scattering Mechanism
Kozlov Anisotropy
Lueneburg Anisotropy
Polarized Point Scatterer Detection
Reflectivity Ratio
Differential Reflectivity (ZDR)

TSVM : Touzi Decomposition
Aghababaei Decomposition
2KR : Raney Decomposition
CPD : Compact-Pol Decomposition

Decomposition Applications

DEM Estimation
Polarisation Orientation Compensation

KRO : Krogager Decomposition
CAM : Cameron Decomposition
HAA : H / A / Alpha Decomposition
JRH : Huynen Decomposition
RMB1 : Barnes 1 Decomposition
RMB2 : Barnes 2 Decomposition
SRC : Cloude Decomposition
UHDx : Unified Huynen Decomposition
WAH1 : Holm 1 Decomposition
WAH2 : Holm 2 Decomposition
AN3 : An & Yang 3 Component Decomposition
AN4 : An & Yang 4 Component Decomposition
BF4 : Bhattacharya & Frery 4 Component Decomposition
FRE2 : Freeman 2 Component Decomposition
FRE3 : Freeman 3 Component Decomposition
NEU : Neumann 2 Component Decomposition
NNED : Arie 3 Component NNED Decomposition
ANNED : Arie 3 Component ANNED Decomposition
VZ3 : Van Zyl (1992) 3 Component Decomposition
SIN4 : Singh 4 Component Decomposition
YAM3 : Yamaguchi 3 Component Decomposition
YAM4 : Yamaguchi 4 Component Decomposition
MCSM5 : L. Zhang 5 Component Decomposition

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Do it Yourself:
Select some elements, set the
parameters and view the
corresponding BMP files
(select BMP).

Window Size = 1

PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

▼ T3 ▼ S ▼ Environment ▼ Import ▼ Convert ▼ Process ▼ Display ▼ Calibration ▼ Utilities ▼ Tools ▼ Configuration ▼ Education ▼ Help ▼ Quit

Data Processing: Polarimetric Decomposition

Input Directory
D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory
D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Init Row 1 End Row 3672 Init Col 1 End Col 3292

Freeman 3 Components Decomposition T3 Window Size Row 3 Window Size Col 3

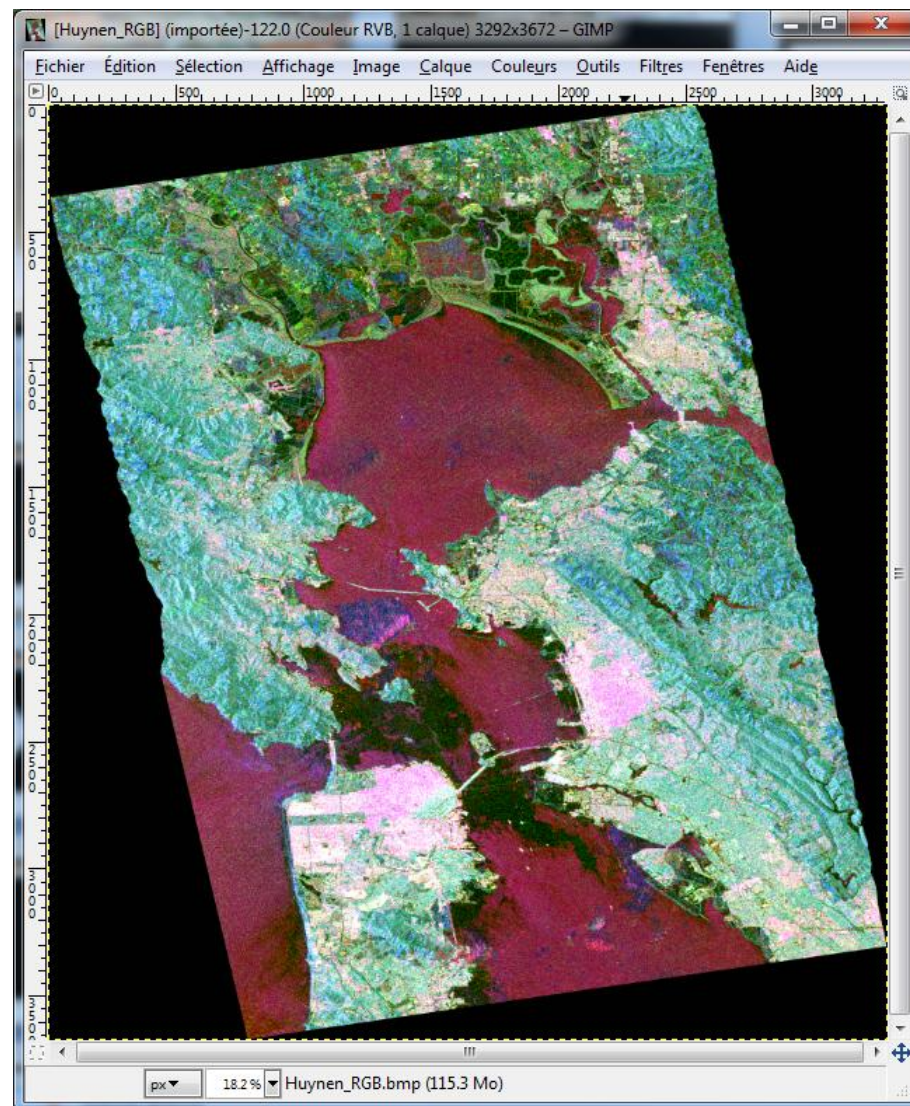
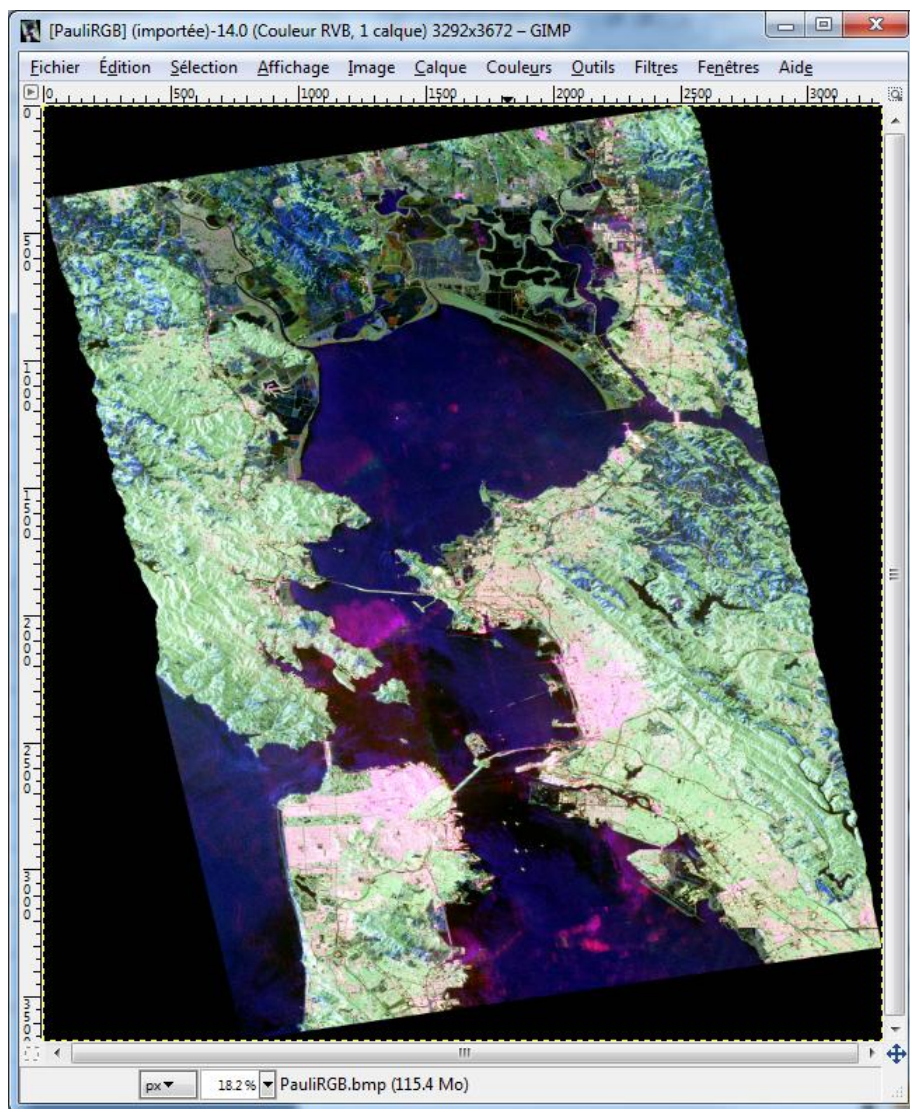
☒ TgtG TgtG TgtG ☐ BMP Target Generators (TgtG)

Minimum / Maximum Values ☐ auto Min Max

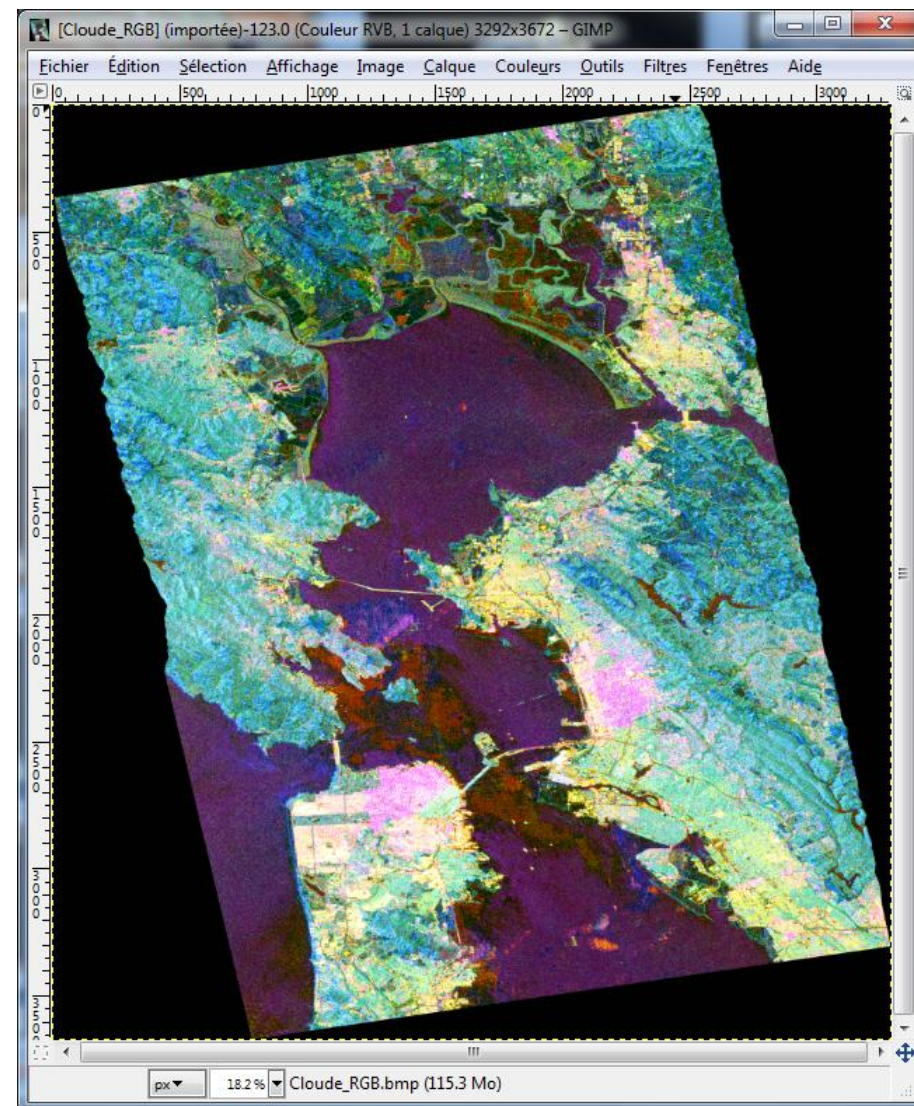
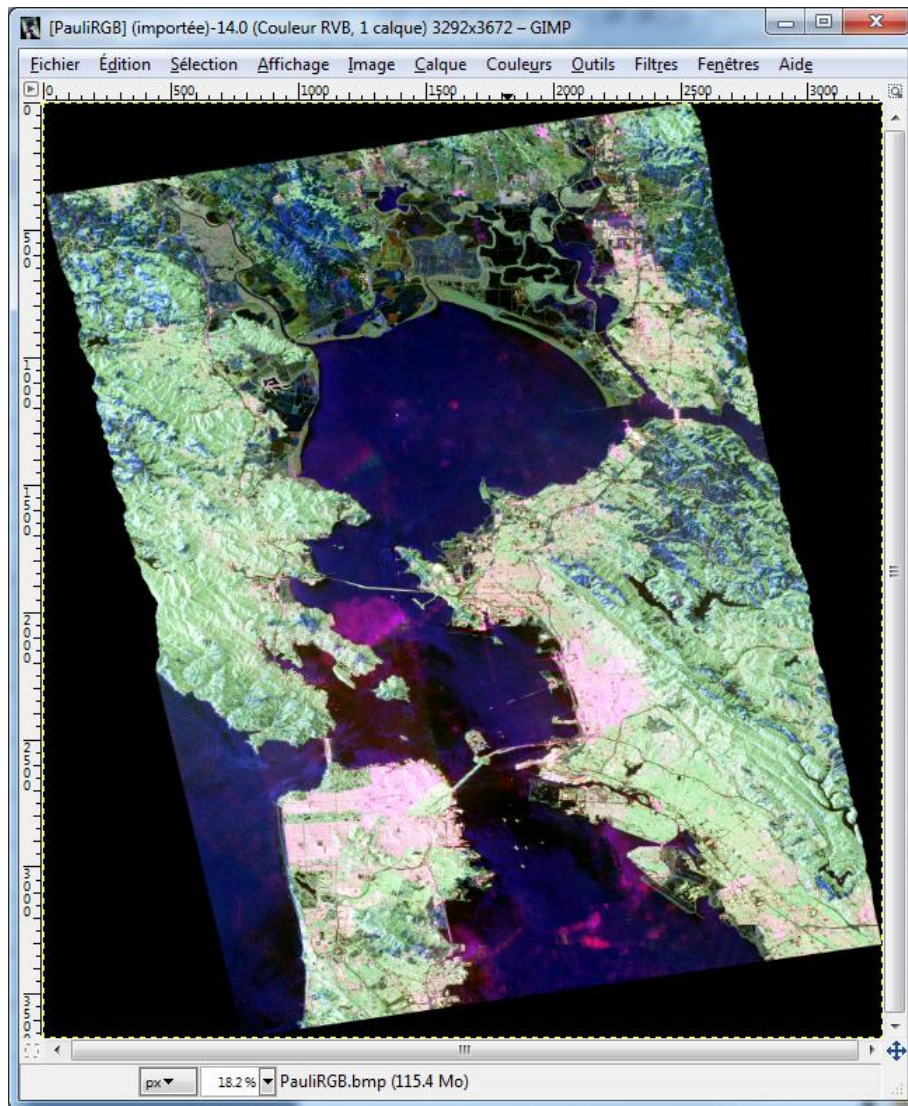
☐ Decomposition / Reconstruction Output Format ☐ T3 ☐ C3

Run ? Exit

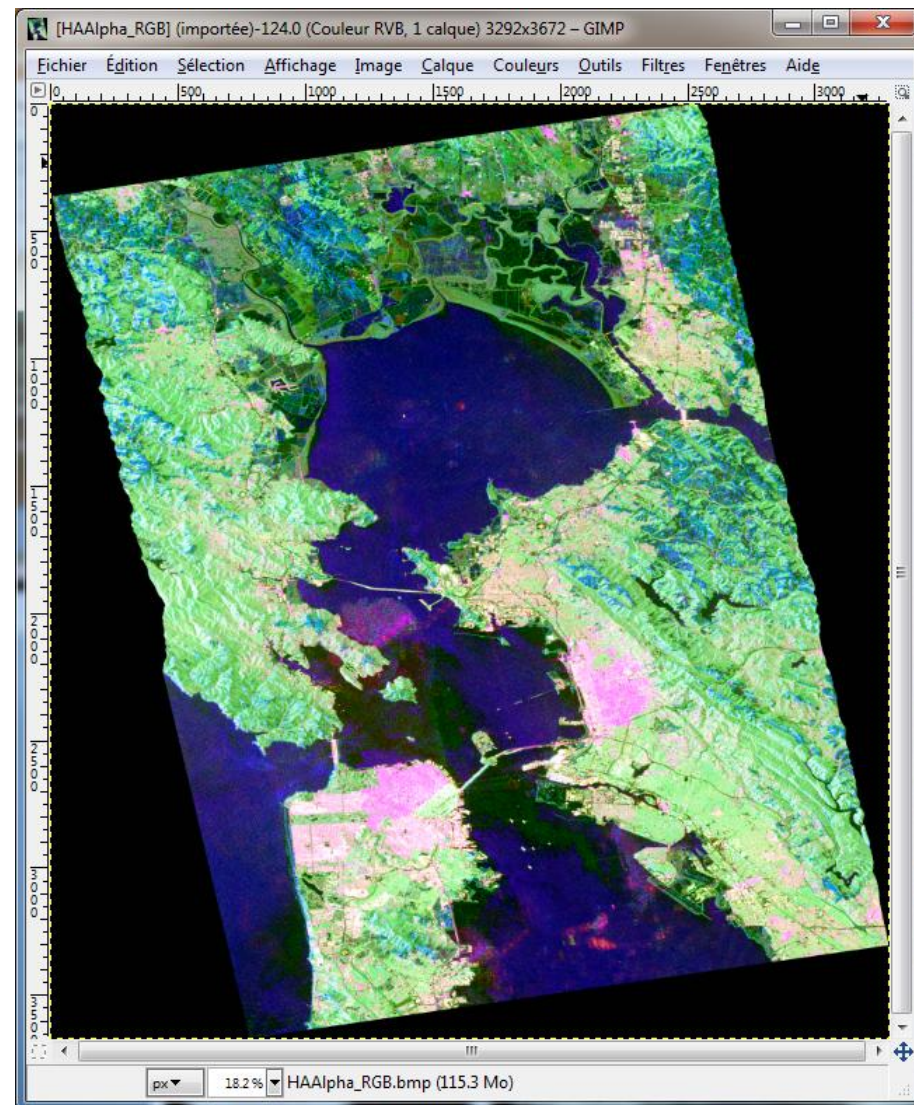
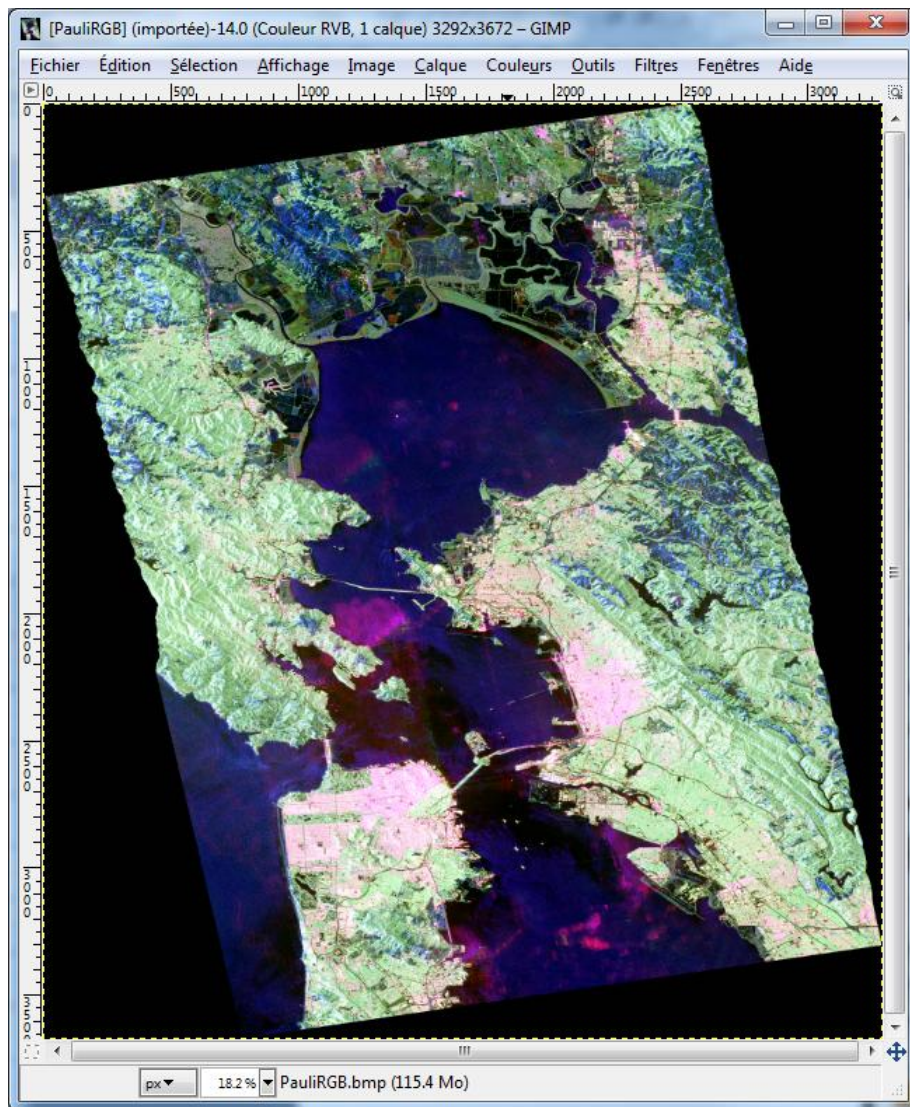
Pauli Huynen



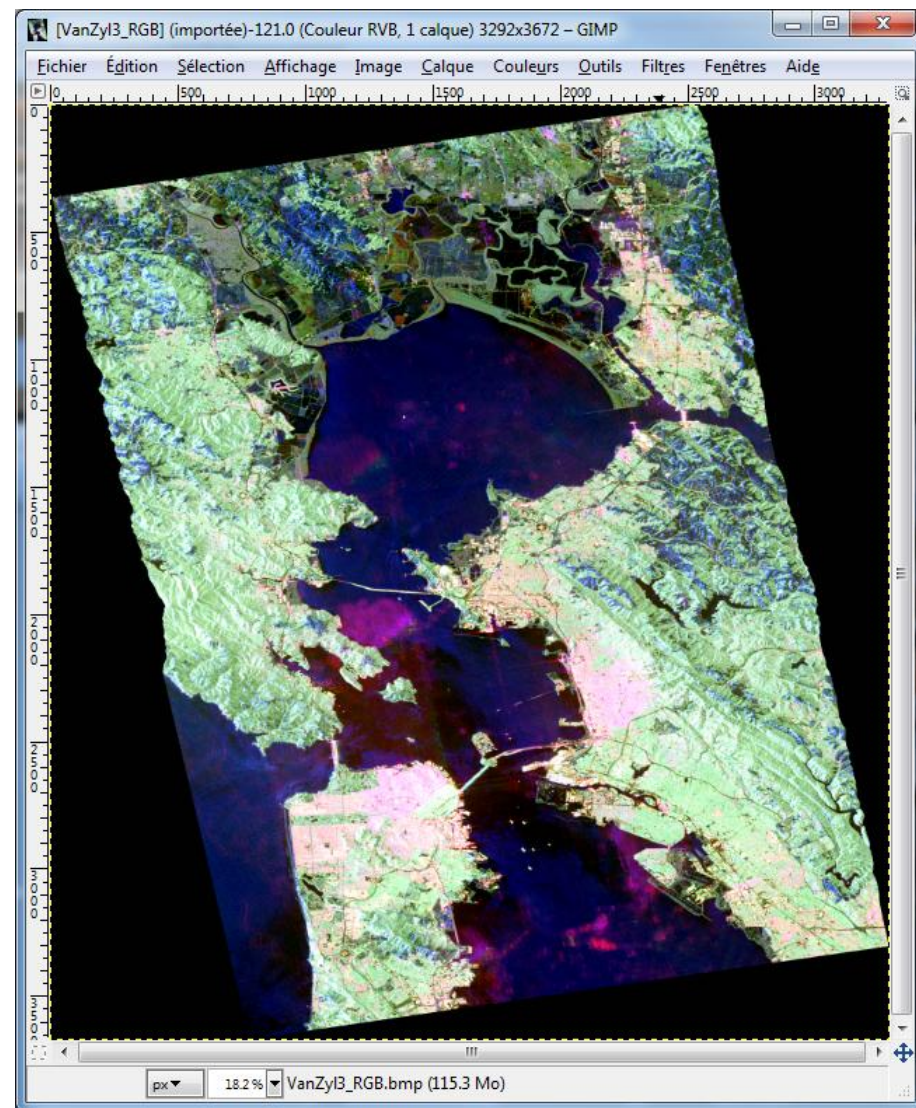
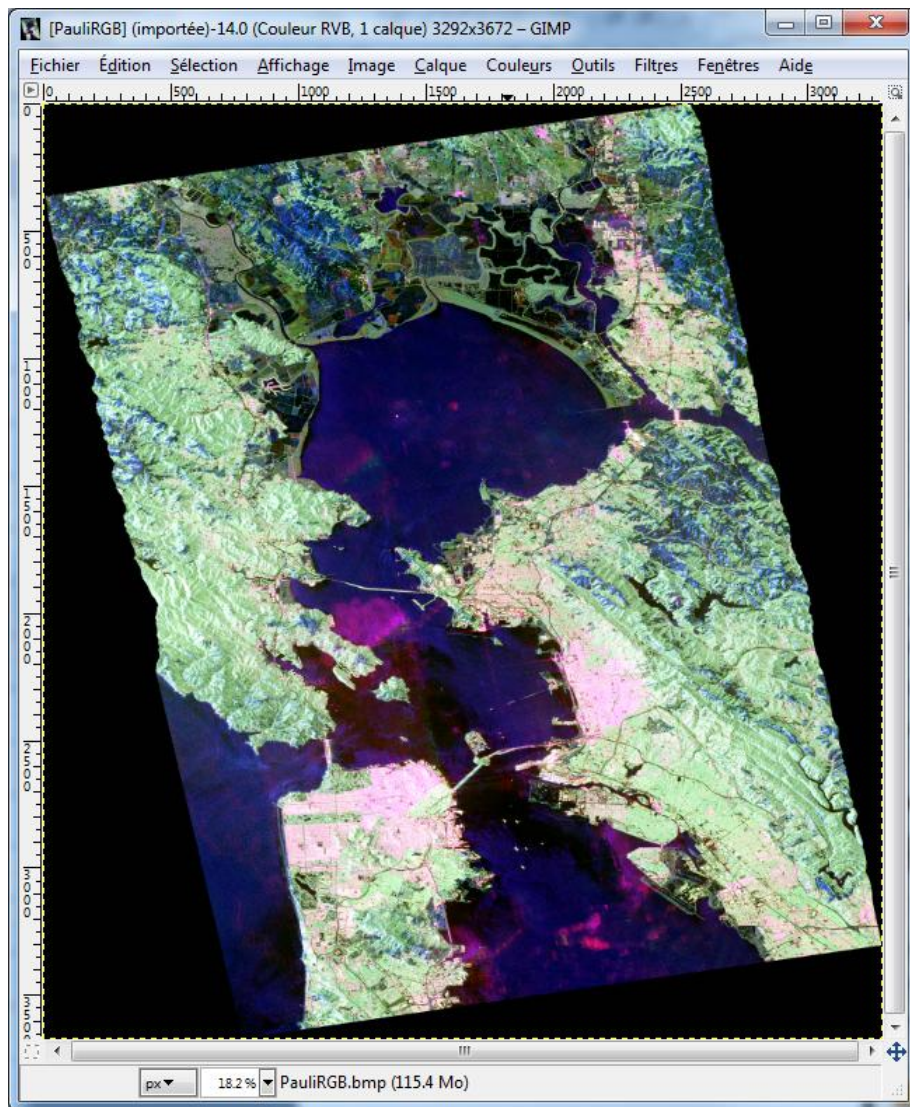
Pauli Cloude



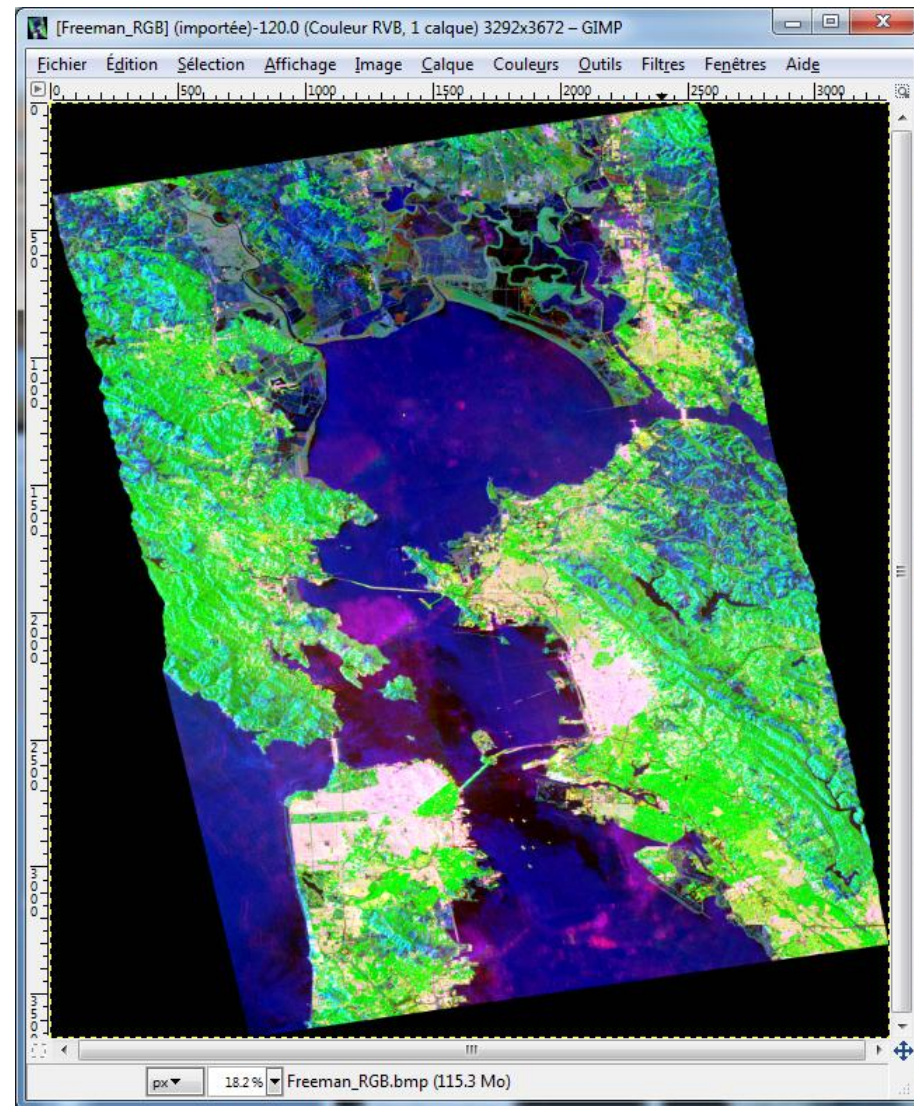
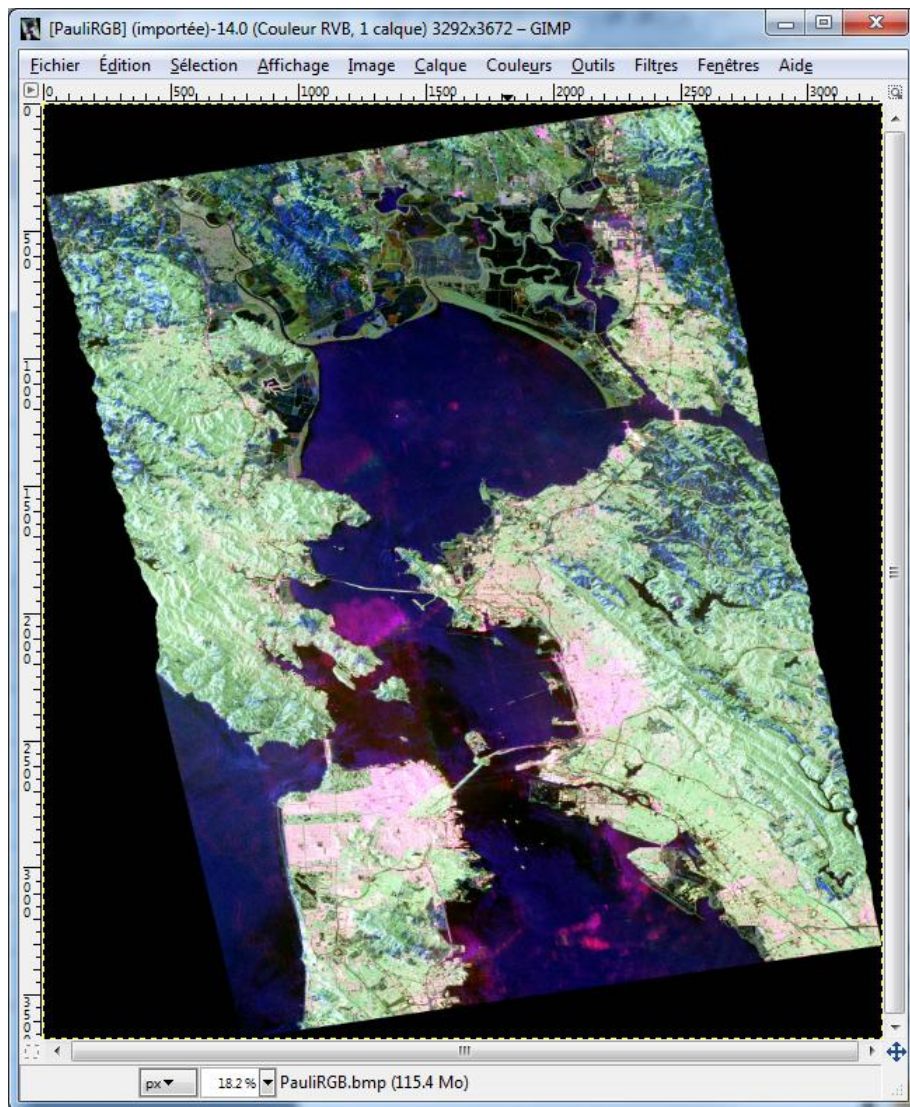
Pauli H-A-Alpha



Pauli Van Zyl 3



Pauli Freeman 3



Do it Yourself:
Select some elements, set the
parameters and view the
corresponding BMP files
(select BMP).

Window Size = 1

Yamaguchi Y40, Y4R, S4R
Singh G4U1, G4U2

Data Processing: Polarimetric Decomposition

Input Directory:

Output Directory: /

Init Row: End Row: Init Col: End Col:

Yamaguchi Decomposition

- ☐ Four Component Decomposition (Original : Y40)
- ☐ Four Component Decomposition with Rotation Transformation (Y4R or S4R)

Singh Decomposition

- ☒ Four Component Decomposition with Special Unitary Transformation (G4U1 or G4U2)

Bhattacharya & Frey Decomposition

- ☐ Four Component Decomposition with stochastic distance (Original : Y40)

Volume Scattering Model (Automatic Estimation)

- ☒ With / Without Extended Volume Scattering Model (dihedral scattering)

☒ TgtG TgtG TgtG ☐ BMP Target Generators (TgtG)

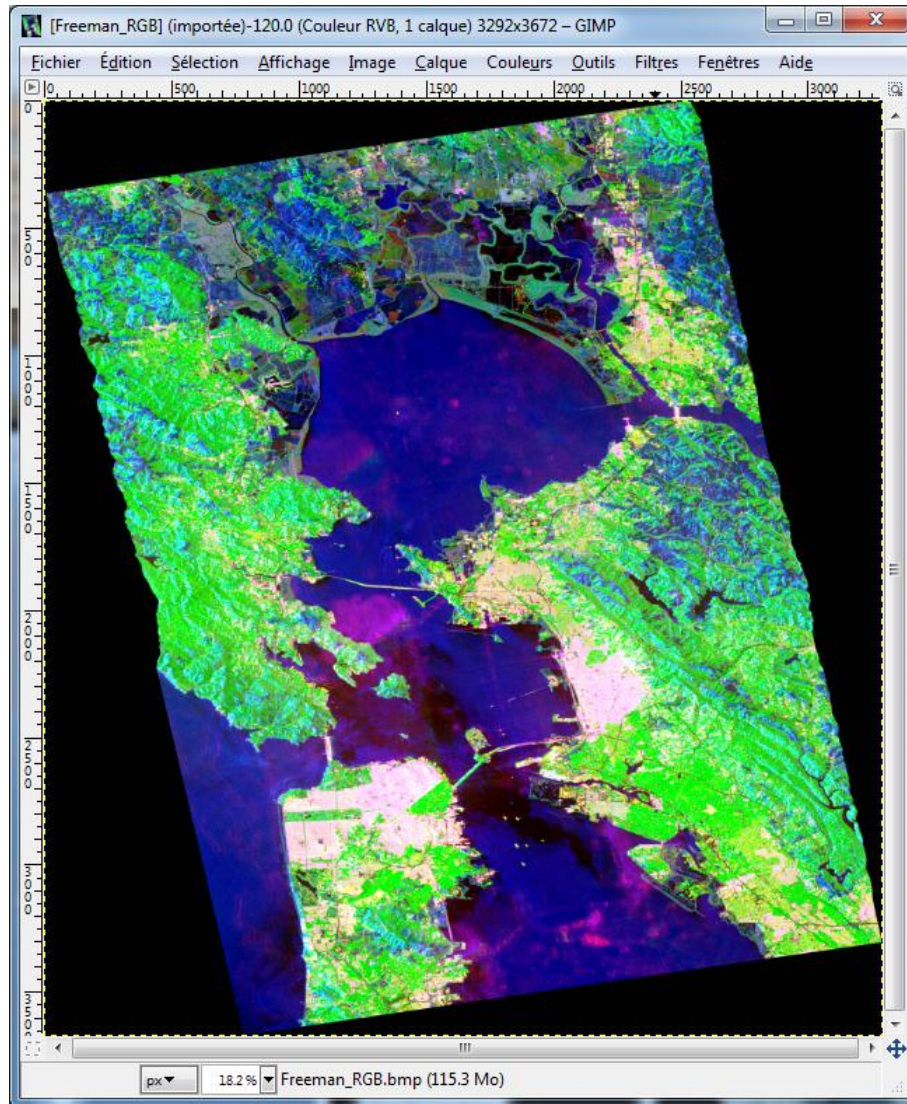
Minimum / Maximum Values ☐ auto Min Max

Window Size

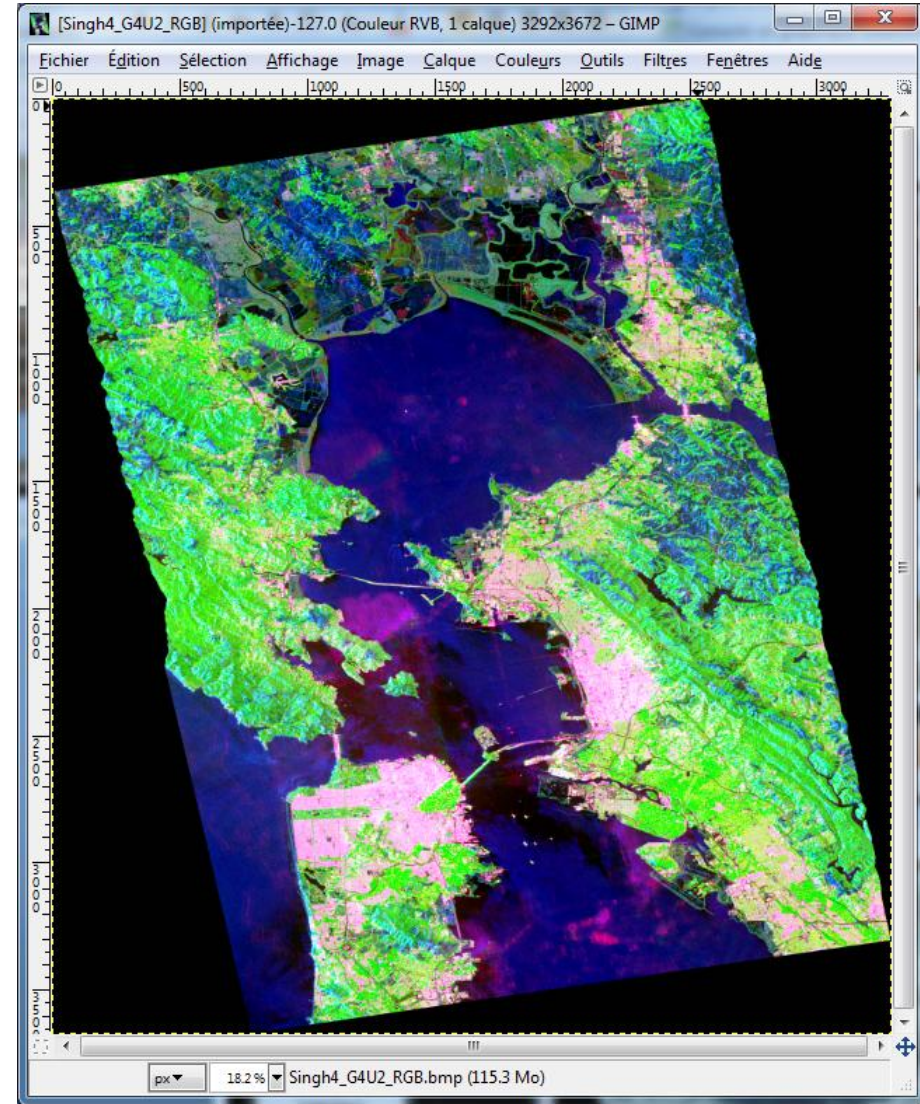
Row: Col:

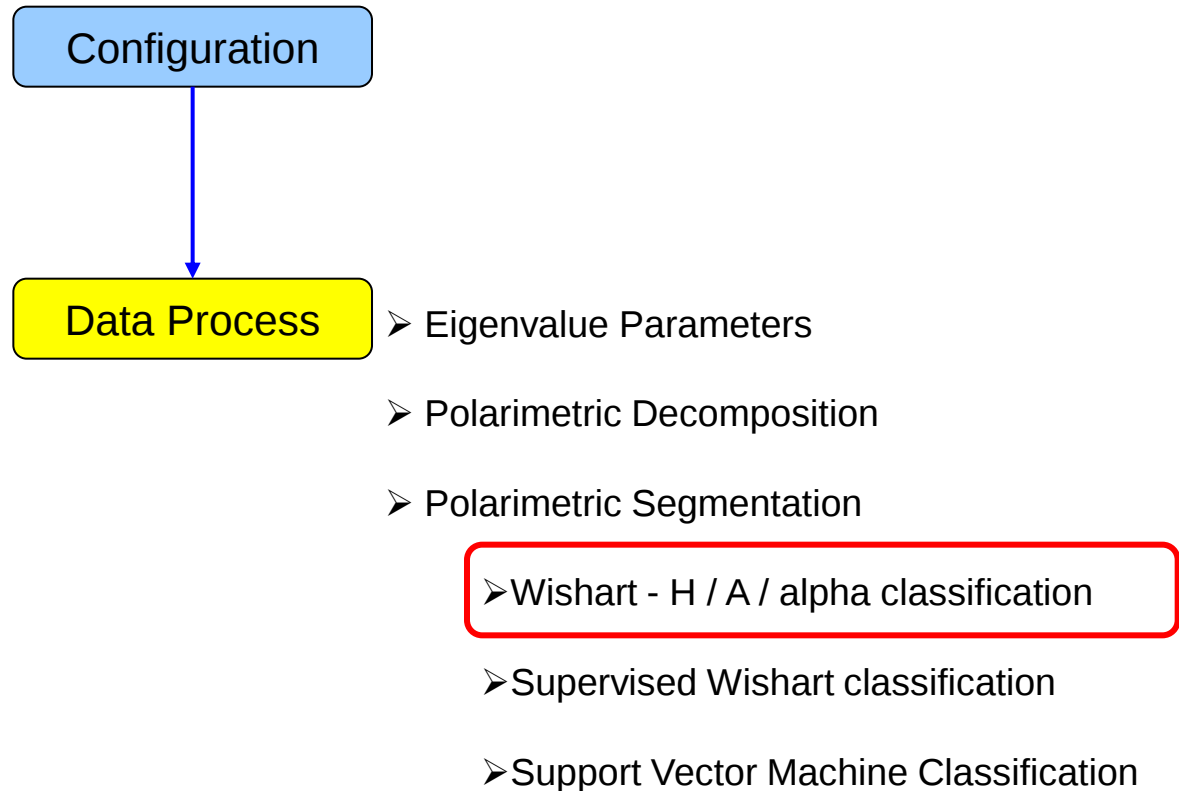
Run **Exit**

Pauli Freeman 3



Pauli Singh - Yamaguchi G4U2





PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 S Environment Import Convert **Process** Display Calibration Utilities Tools Configuration Education Help

Linear (+45 / -45)
 Circular (L / R)
 Elliptical (phi, tau)

Box Car Filter
 Box Car - Edge Filter
 C. Lopez Filter
 Gaussian Filter
 IDAN Filter
 J.S. Lee Refined Filter
 J.S. Lee Sigma Filter
 P.W.F Filter
 Edge Detector

Matrix Elements
 Correlation Coefficients
 Elliptical Basis Change
 Polarimetric Speckle Filter
 H / A / Alpha Decomposition
 Polarimetric Decompositions
 Polarimetric Functionalities - 1
 Polarimetric Functionalities - 2
Polarimetric Segmentation
 Polarimetric Data Analysis
 Polarimetric Data Clustering
 Batch Process

Decomposition Parameters
 Eigenvector Set Parameters
 Eigenvalue Set Parameters

JRH : Huynen Decomposition
 RMB1 : Barnes 1 Decomposition
 RMB2 : Barnes 2 Decomposition
 SRC : Cloude Decomposition
 WAH1 : Holm 1 Decomposition
 WAH2 : Holm 2 Decomposition
 HAA : H / A / Alpha Decomposition
 FRE2 : Freeman 2 Components Decomposition
 FRE3 : Freeman 3 Components Decomposition
 VZ3 : Van Zyl 3 Components Decomposition
 YAM3 : Yamaguchi 3 Components Decomposition
 YAM4 : Yamaguchi 4 Components Decomposition
 NEU : Neumann 2 Components Decomposition
 KRO : Krogager Decomposition
 CAM : Cameron Decomposition
 TSVM : Touzi Decomposition

H / A / Alpha Classification
 H / u / v Classification (Xu & Jin)
H / A / Alpha - Wishart Classification
 Scattering Model Based - Wishart Classification
 Unified Huynen Classification
 Fuzzy - H / Alpha Classification
 Wishart Supervised Classification
 G.P.F. Supervised Classification
 Rule-Based Hierarchical Classification
 Basic Scattering Mechanism Identification
 SVM Supervised Classification

Polarisation Synthesis
 Polarimetric Signature
 Stokes Parameters
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 O.P.C.E
 R.C.S Max
 Surface Inversion
 RVOG PolSAR Inversion
 Sub-Aperture Analysis
 DEM Estimation
 Polarisation Orientation Compensation

Polarized Point Scatterer Detection
 Reflectivity Ratio
 Differential Reflectivity (ZDR)

Clustering Process
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 Data Sets Averaging

Decomposition Applications

PolSARpro Run Trace
 Close Window Display Menu
 Close Window Tools Menu

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Do it Yourself:
Set the parameters, run and view the corresponding BMP files.

Data Processing: Wishart H / A / Alpha Classification

Input Directory:

Output Directory: / T3

Init Row: End Row: Init Col: End Col:

Wishart H / A / Alpha Classification

% of Pixels Switching Class: Window Size Row:

Maximum Number of Iterations: Window Size Col: ☒ BMP

Entropy: Anisotropy: Alpha:

Color Maps

ColorMap 8:

ColorMap 16:

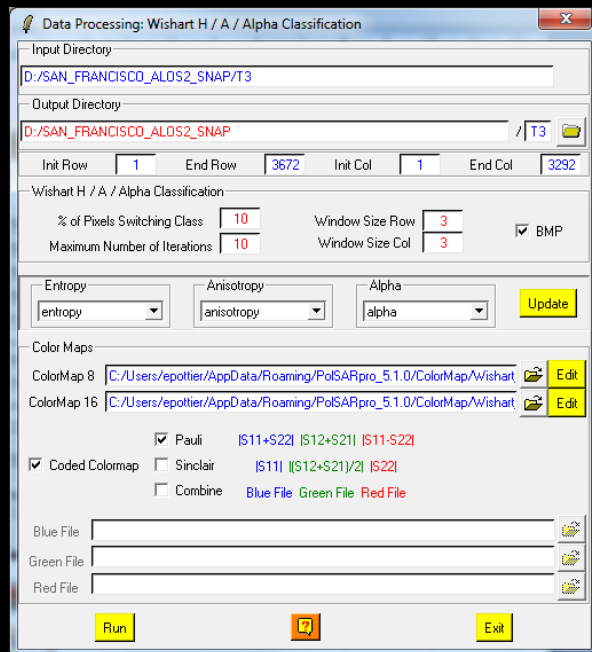
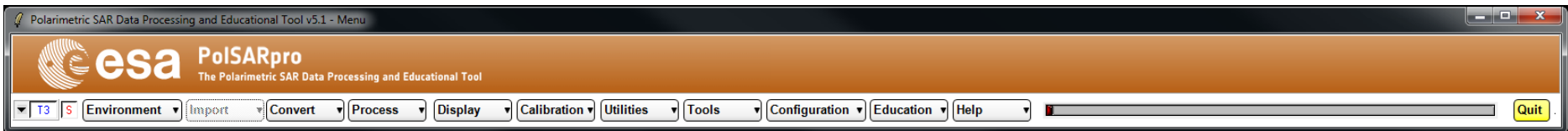
☒ Pauli ☐ Sinclair ☐ Combine

☒ Coded Colormap

☐ Blue File

☐ Green File

☐ Red File



DATADIR

config.txt

[T3x3] Elements

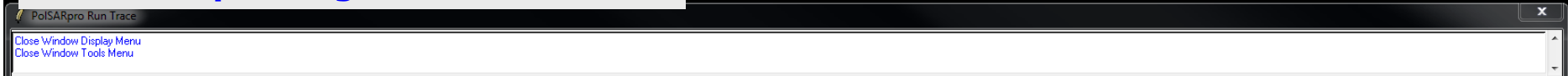
Wishart_H_alpha_class_X.bin
Wishart_H_A_alpha_class_X.bin

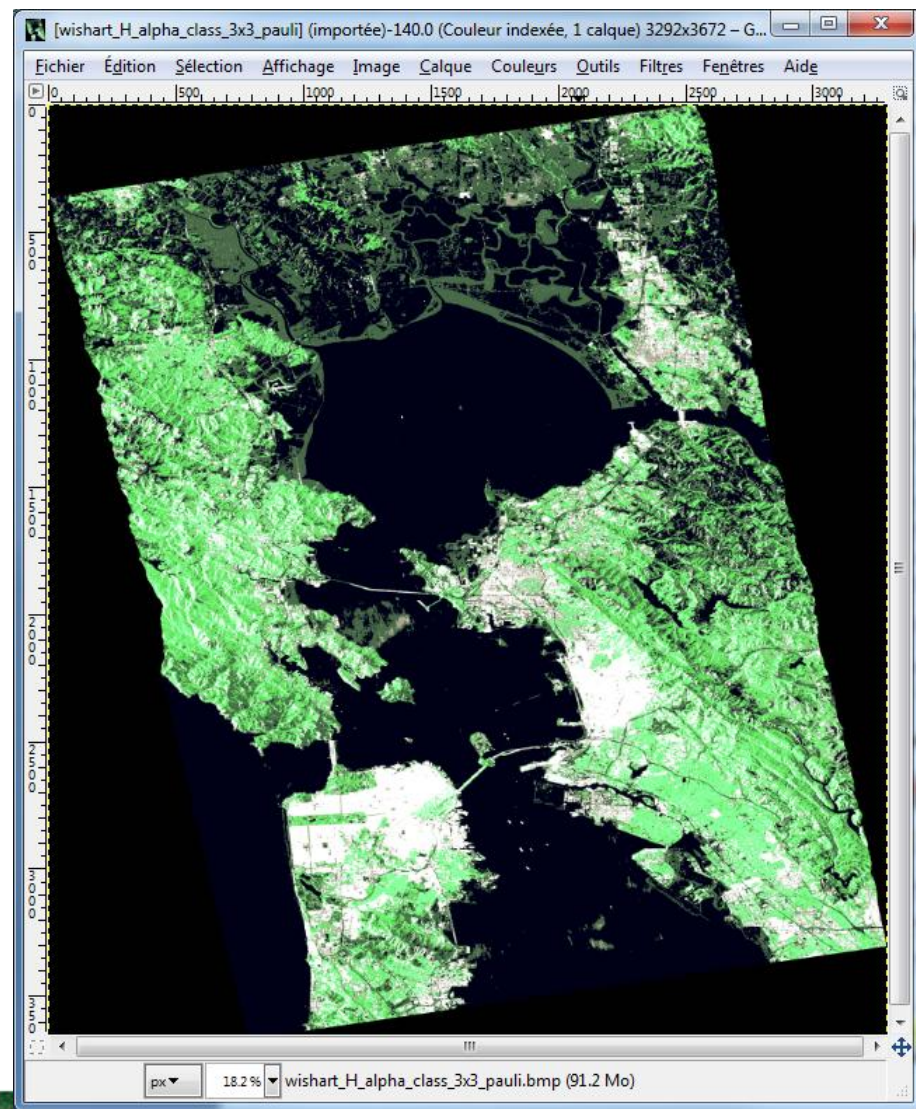
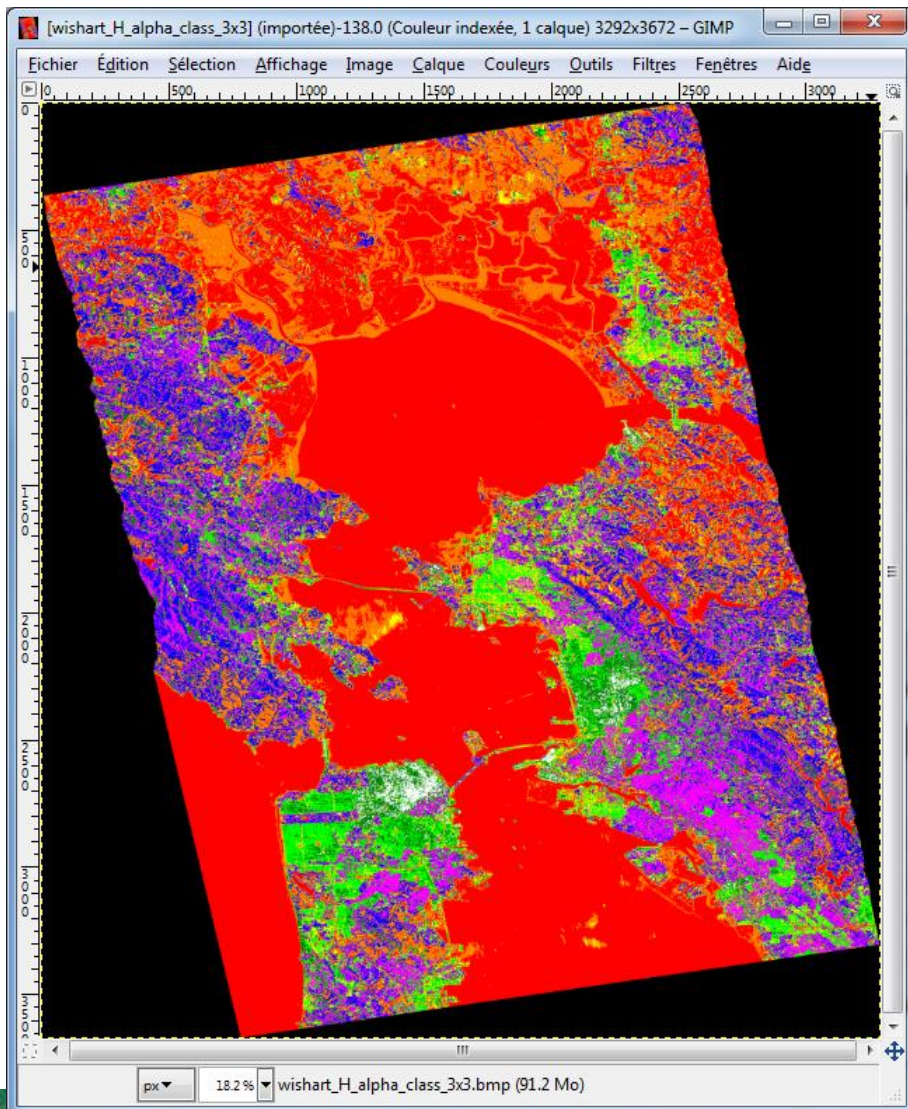
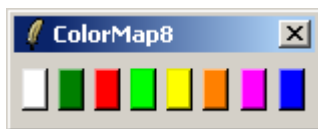
Wishart_H_alpha_class_X.bmp
Wishart_H_A_alpha_class_X.bmp

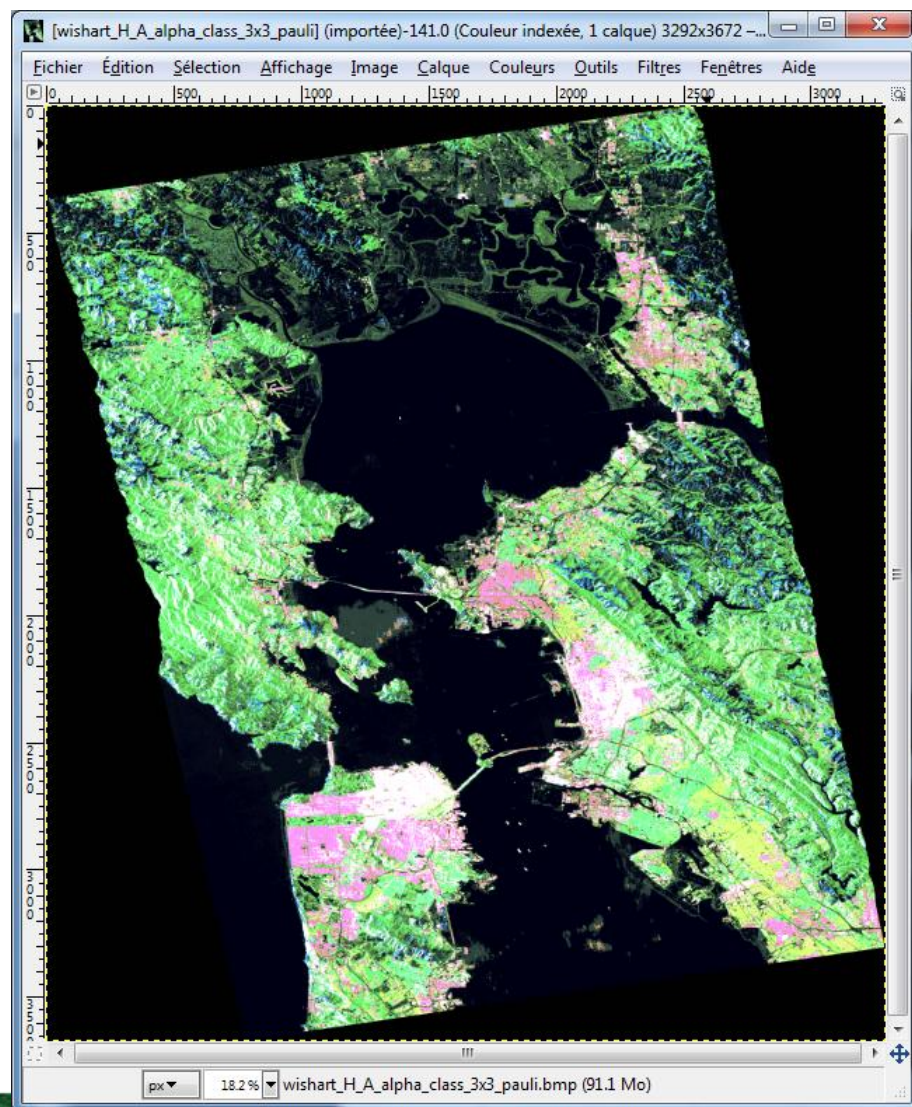
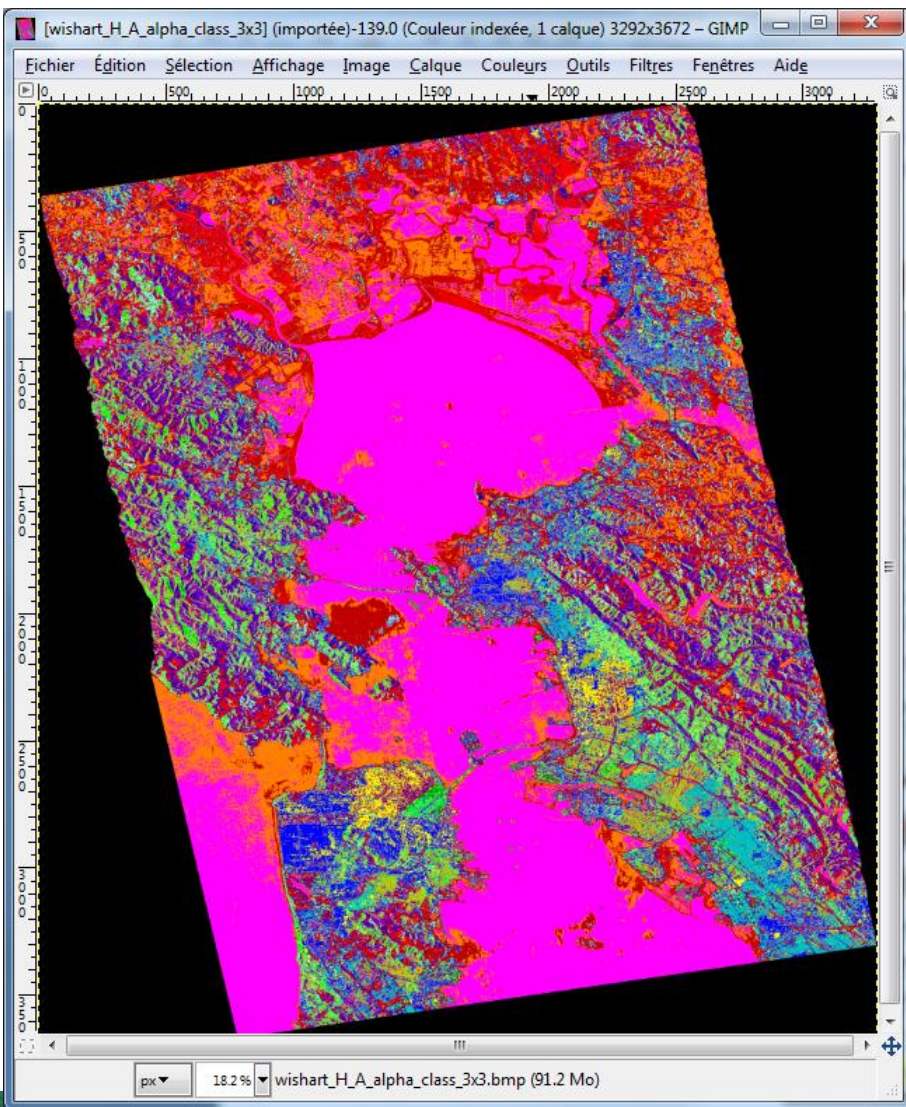
X = window size

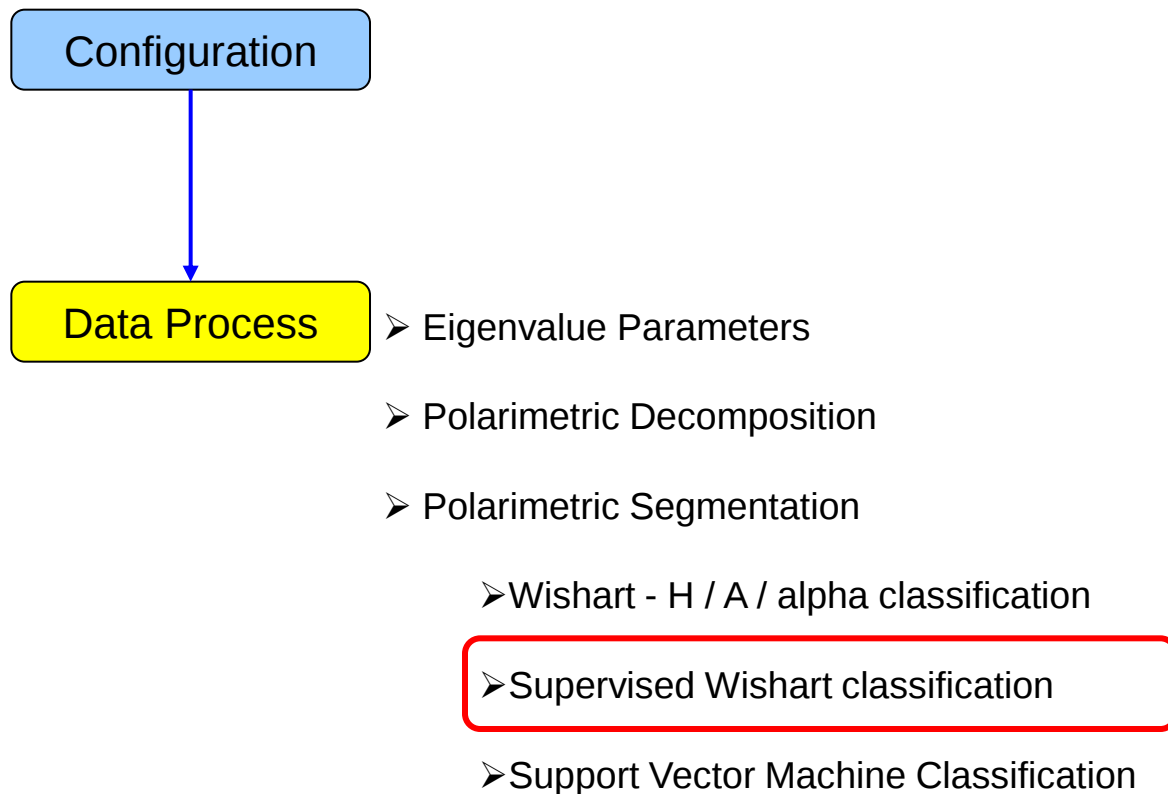
Do it Yourself:

Set the parameters, run and view the corresponding BMP files.









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Environment Import Convert **Process** Display Calibration Utilities Tools Configuration Education Help

Quit

Linear (+45 / -45)
Circular (L / R)
Elliptical (phi, tau)

Box Car Filter
Box Car - Edge Filter
C. Lopez Filter
Gaussian Filter
IDAN Filter
J.S. Lee Refined Filter
J.S. Lee Sigma Filter
P.W.F Filter
Edge Detector

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Eigenvector Set Parameters
Eigenvalue Set Parameters

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Polarimetric Data Clustering
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H / u / v Classification (Xu & Jin)
H / A / Alpha - Wishart Classification
Scattering Model Based - Wishart Classification
Unified Huynen Classification
Fuzzy - H / Alpha Classification
Wishart Supervised Classification
G.P.F. Supervised Classification
Rule-Based Hierarchical Classification
Basic Scattering Mechanism Identification
SVM Supervised Classification

Texture Analysis

Clustering Process
Parameter Averaging
Data Sets Averaging

JRH : Huynen Decomposition
RMB1 : Barnes 1 Decomposition
RMB2 : Barnes 2 Decomposition
SRC : Cloude Decomposition
WAH1 : Holm 1 Decomposition
WAH2 : Holm 2 Decomposition
HAA : H / A / Alpha Decomposition
FRE2 : Freeman 2 Components Decomposition
FRE3 : Freeman 3 Components Decomposition
VZ3 : Van Zyl 3 Components Decomposition
YAM3 : Yamaguchi 3 Components Decomposition
YAM4 : Yamaguchi 4 Components Decomposition
NEU : Neumann 2 Components Decomposition
KRO : Krogager Decomposition
CAM : Cameron Decomposition
TSVM : Touzi Decomposition

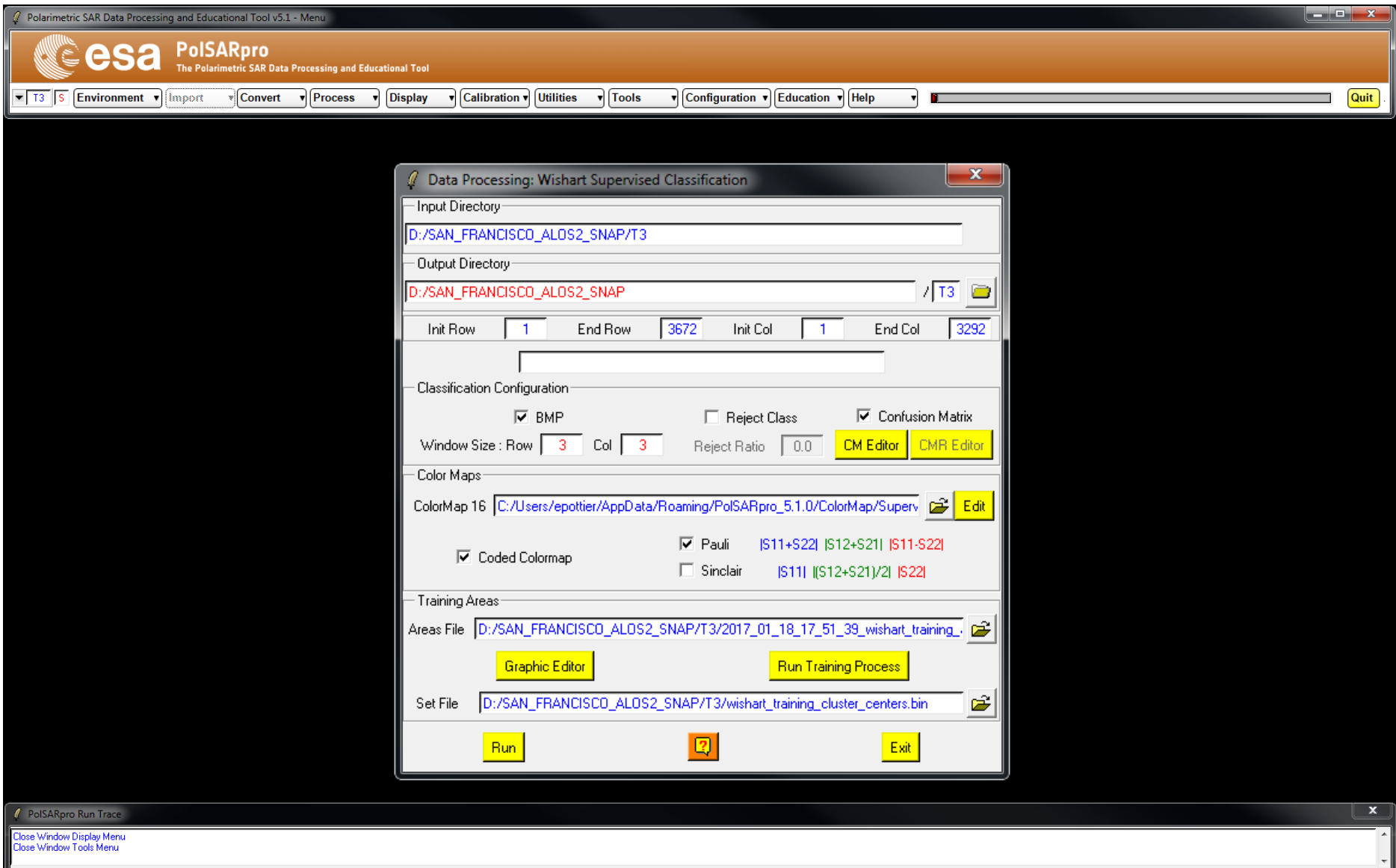
Polarization Estimation
Coefficient
Dominance
Diversity
Entropy
H Index
Identification (Praks & Colin)
Approximation (Praks & Colin)
Mechanism Entropy (Freeman)
Mechanism Entropy (Van Zyl)
Entropy
Anisotropy

Polarized Point Scatterer Detection
Reflectivity Ratio
Differential Reflectivity (ZDR)

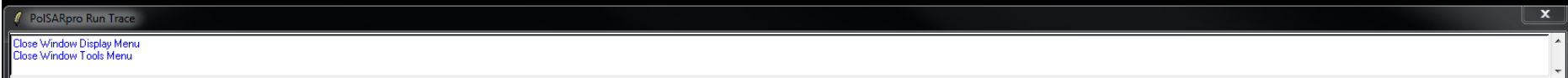
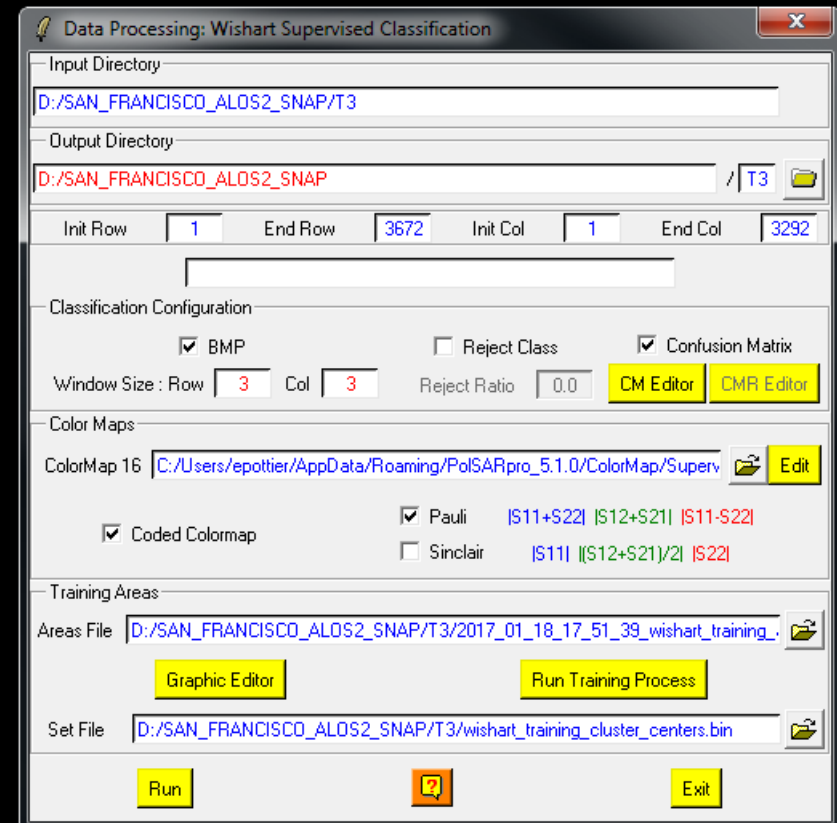
Polarisation Synthesis
Polarimetric Signature
Stokes Parameters
Compact Polarimetric Mode
O.P.C.E
R.C.S Max
Surface Inversion
RVOG PolSAR Inversion
Sub-Aperture Analysis
DEM Estimation
Polarisation Orientation Compensation

Decomposition Applications

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Run the Wishart Supervised Classification procedure





PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

T3

S

Environment

Import

Convert

Process

Display

Calibration

Utilities

Tools

Configuration

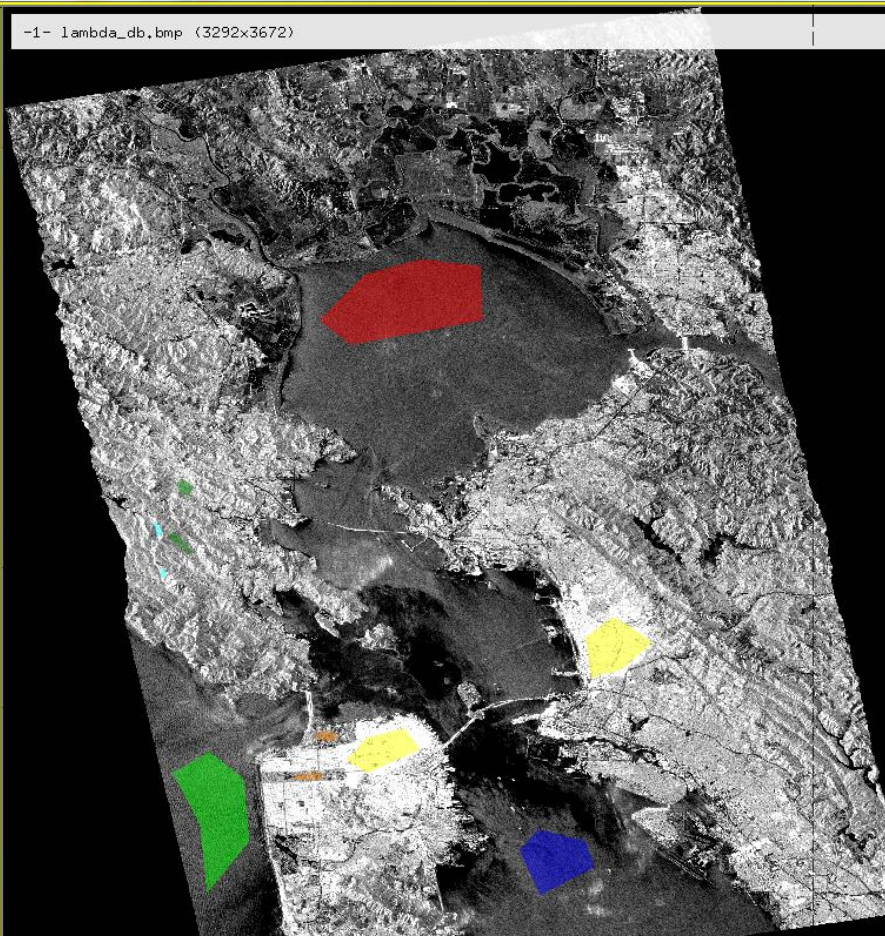
Education

Help

Quit

MapAlgebra v1.1

-1- lambda_db.bmp (3292x3672)



zoom : 23 %

Class Num : 7

pixel : 2957 0

value = -17.94 < -10.53 < -2.88

Data Processing: Wishart Supervised Classification

Input Directory

D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory

D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Init Row

1

End Row

3672

Init Col

1

End Col

3292

Classification Configuration

☒ BMP

☐ Reject Class

☒ Confusion Matrix

Window Size : Row

3

Col

3

Reject Ratio

0.0

CM Editor

CMR Editor

Color Maps

ColorMap 16

C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Superv

Edit

☒ Coded Colormap

☒ Pauli

☐ Sinclair

|S11+S22|

|S12+S21|

|S11-S22|

|S11|

|(S12+S21)/2|

|S22|

Training Areas

Areas File

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/2017_01_18_17_51_39_wishart_training_

Graphic Editor

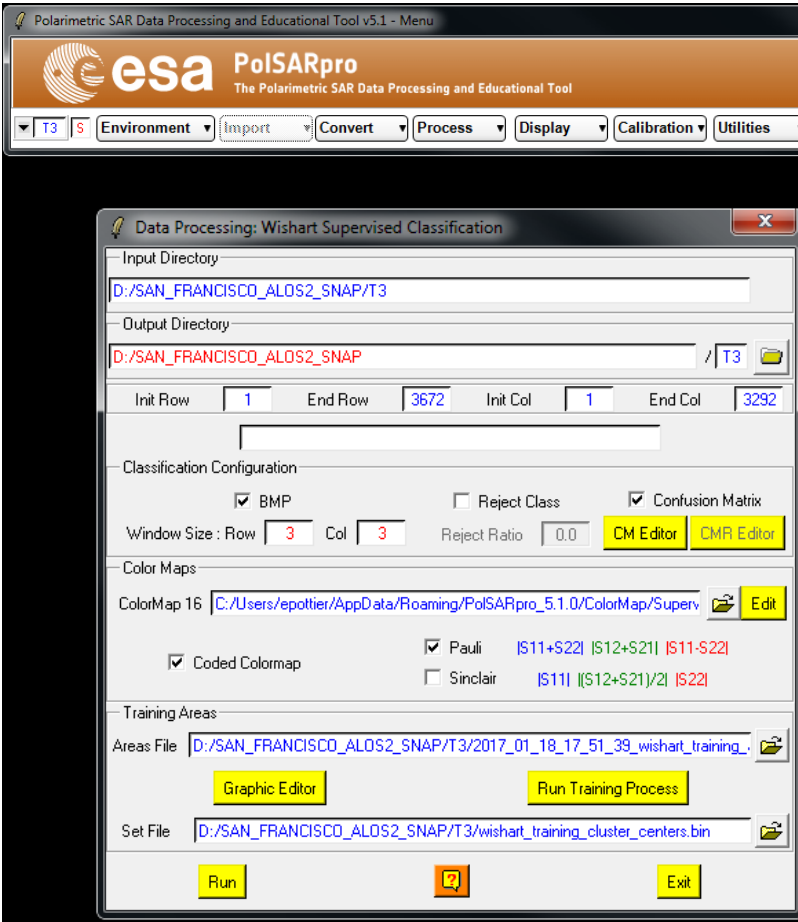
Run Training Process

Set File

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/wishart_training_cluster_centers.bin

Run

Exit



DATADIR

 config.txt

 [T3x3] Elements

Run Training Process


Training_areas.txt

 Training_areas.bin

 Training_cluster_set.bmp

Run Classification

 Supervised_class_X.bin
Supervised_class_rej_X.bin
Confusion_matrix_X.txt
Confusion_matrix_rej_X.txt

 Supervised_class_X.bmp
Supervised_class_rej_X.bmp
Classified_cluster_set.bmp
Classified_cluster_set_rej.bmp

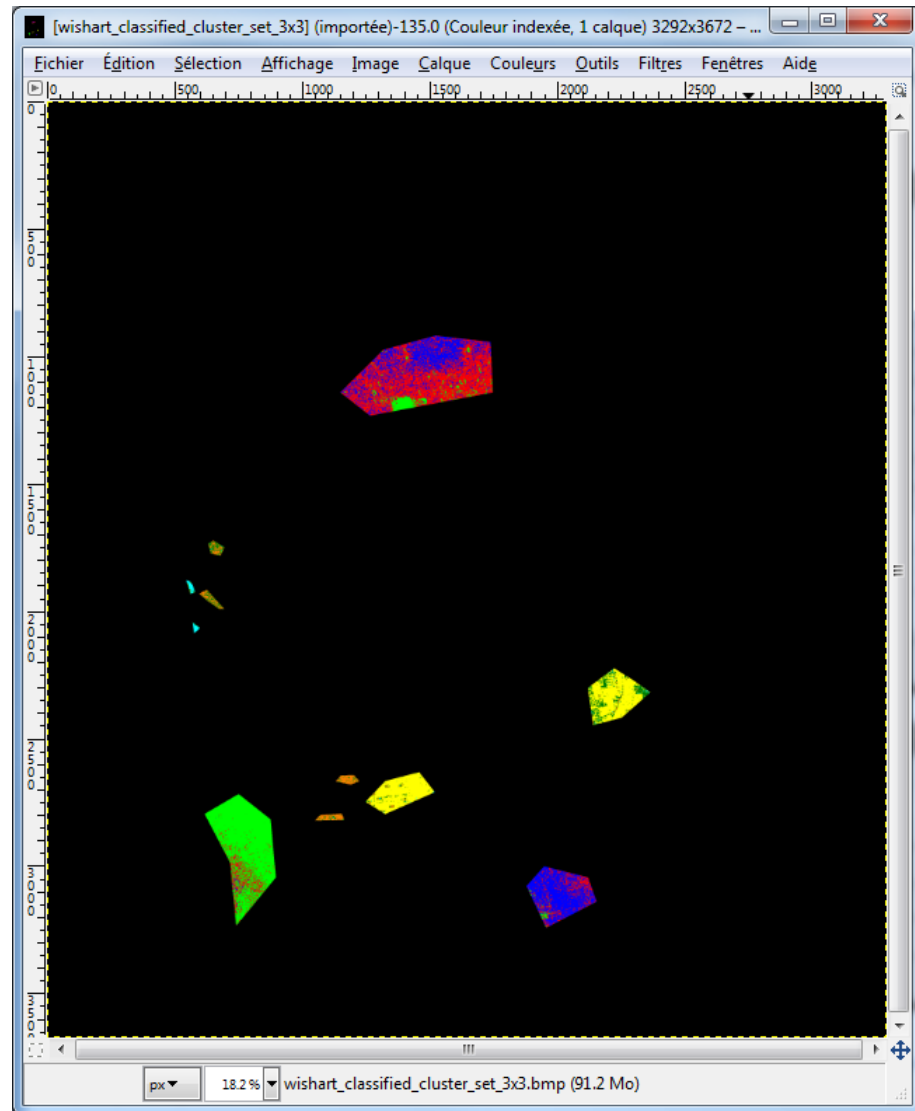
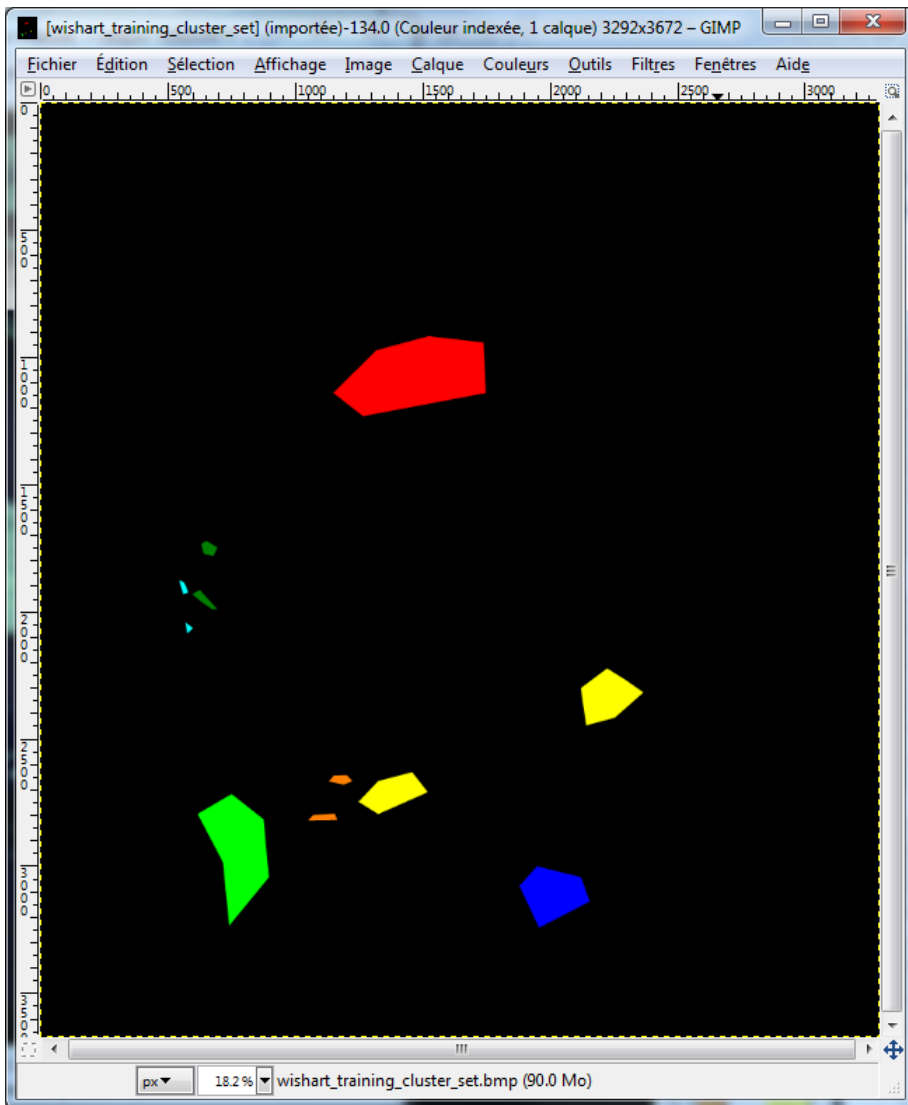
Do it Yourself:

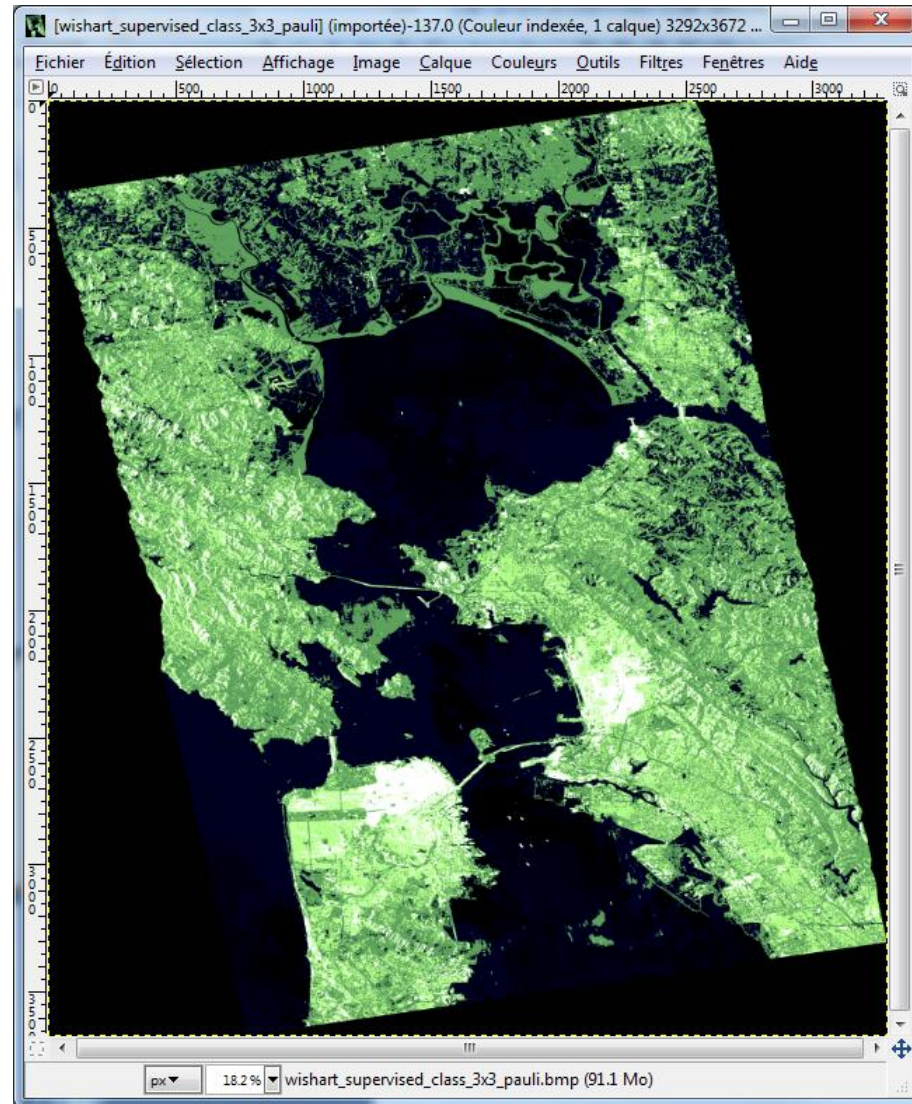
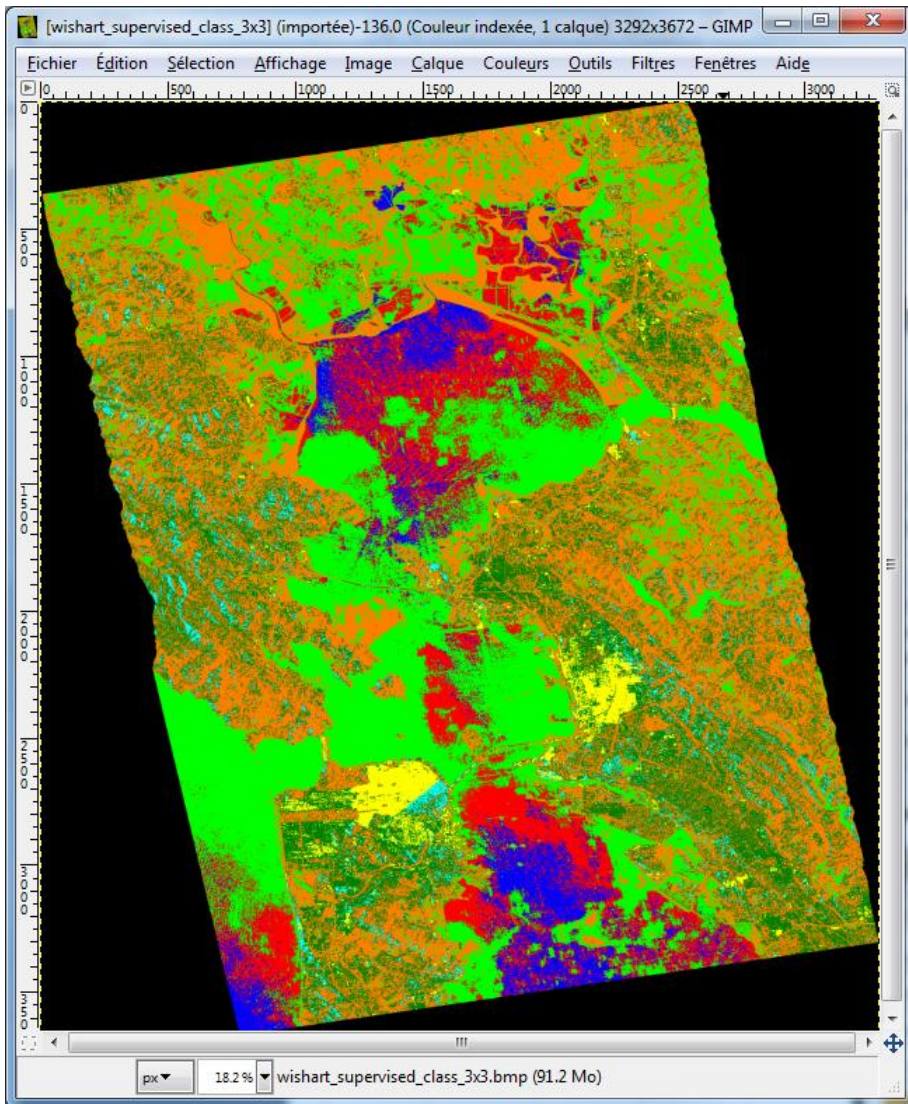
Set the parameters, select different classes, run and view the corresponding BMP files.

X = window size

→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

4–9 September 2017 | Szent István University | Gödöllő, Hungary





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Data Processing: Wishart Supervised Classification

Input Directory
D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory
D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Init Row: 1 End Row: 3672 Init Col: 1 End Col: 3292

☒ BMP
☐ Reject Class
☒ Confusion Matrix

Window Size: Row: 3 Col: 3 Reject Ratio: 0.0

CM Editor
CMP Editor

Color Maps

ColorMap 16: C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Superv... Edit

☒ Coded Colormap
☒ Pauli: |S11+S22| |S12+S21| |S11-S22|
☐ Sinclair: |S11| |S12+S21|/2 |S22|

Training Areas

Areas File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/2017_01_18_17_51_39_wishart_training...

Graphic Editor
Run Training Process

Set File: D:/SAN_FRANCISCO_ALOS2_SNAP/T3/wishart_training_cluster_centers.bin

Run ? Exit

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/wishart_confusion_matrix_3x3.txt

CONFUSION MATRIX

Rows represent the user defined clusters
Columns represent the segmented clusters
A number located at a position IJ represents the amount of pixels in percent belonging to the user defined area I that were assigned to cluster J during the supervised classification

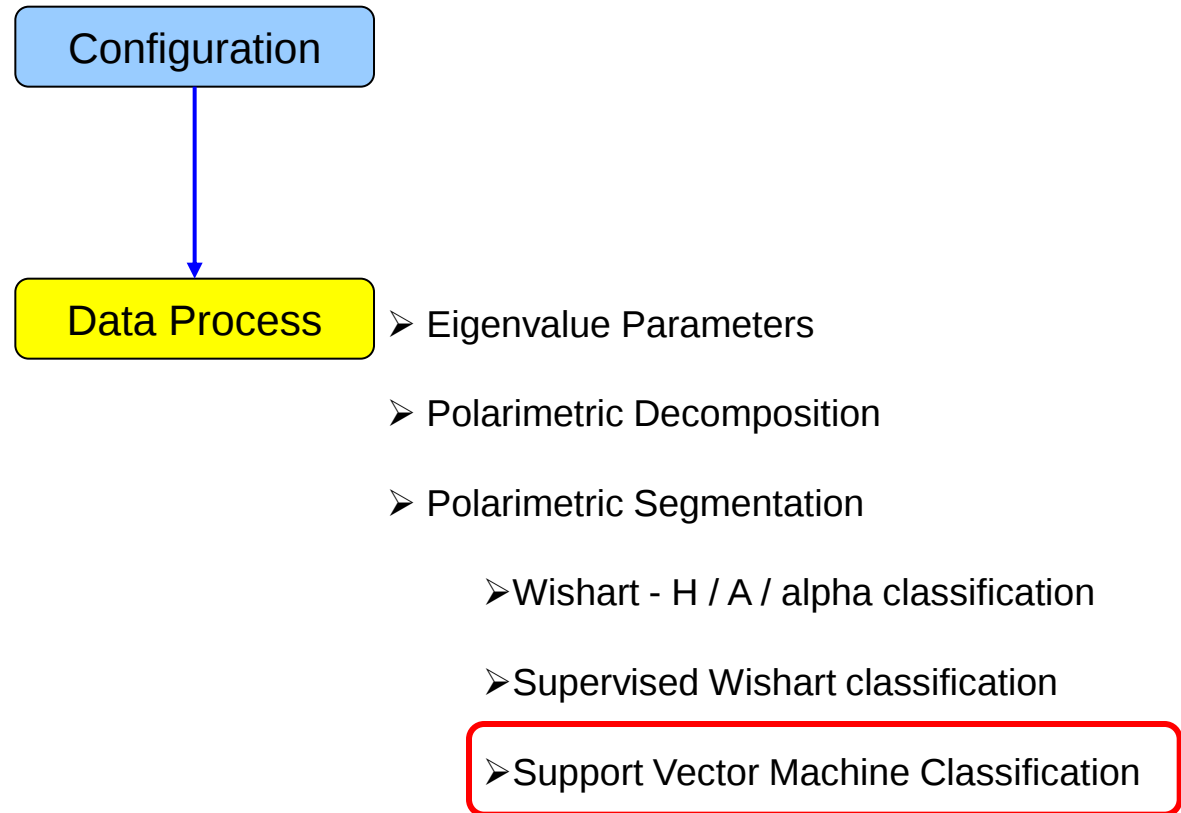
	C1	C2	C3	C4	C5	C6	C7
C1	60.03	6.63	33.34	0.00	0.00	0.00	0.00
C2	11.14	87.84	1.03	0.00	0.00	0.00	0.00
C3	23.75	1.95	74.30	0.00	0.00	0.00	0.00
C4	0.00	0.00	0.00	83.76	1.59	13.64	1.01
C5	0.00	0.17	0.00	0.17	80.43	18.84	0.39
C6	0.00	0.00	0.00	0.59	50.11	48.44	0.86
C7	0.00	0.00	0.00	0.00	3.79	14.32	81.88

Class populations

C1	128255
C2	76909
C3	40665
C4	56395
C5	4603
C6	4889
C7	1529

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu



PolSARpro v5.1 - Menu

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T3 S Environment Import Convert **Process** Display Calibration Utilities Tools Configuration Education Help

Linear (+45 / -45)
 Circular (L / R)
 Elliptical (phi, tau)

Box Car Filter
 Box Car - Edge Filter
 C. Lopez Filter
 Gaussian Filter
 IDAN Filter
 J.S. Lee Refined Filter
 J.S. Lee Sigma Filter
 P.W.F Filter
 Edge Detector

Matrix Elements
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 Polarimetric Speckle Filter
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Decomposition Parameters
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 Eigenvalue Set Parameters

JRH : Huynen Decomposition
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 RMB2 : Barnes 2 Decomposition
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 WAH2 : Holm 2 Decomposition
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 FRE2 : Freeman 2 Components Decomposition
 FRE3 : Freeman 3 Components Decomposition
 VZ3 : Van Zyl 3 Components Decomposition
 YAM3 : Yamaguchi 3 Components Decomposition
 YAM4 : Yamaguchi 4 Components Decomposition
 NEU : Neumann 2 Components Decomposition
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 CAM : Cameron Decomposition
 TSVM : Touzi Decomposition

H / A / Alpha Classification
 H / u / v Classification (Xu & Jin)
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 Scattering Model Based - Wishart Classification
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 Wishart Supervised Classification
 G.P.F. Supervised Classification
 Rule-Based Hierarchical Classification
 Basic Scattering Mechanism Identification
 SVM Supervised Classification

Polarisation Synthesis
 Polarimetric Signature
 Stokes Parameters
 Compact Polarimetric Mode
 O.P.C.E
 R.C.S Max
 Surface Inversion
 RVOG PolSAR Inversion
 Sub-Aperture Analysis
 DEM Estimation
 Polarisation Orientation Compensation

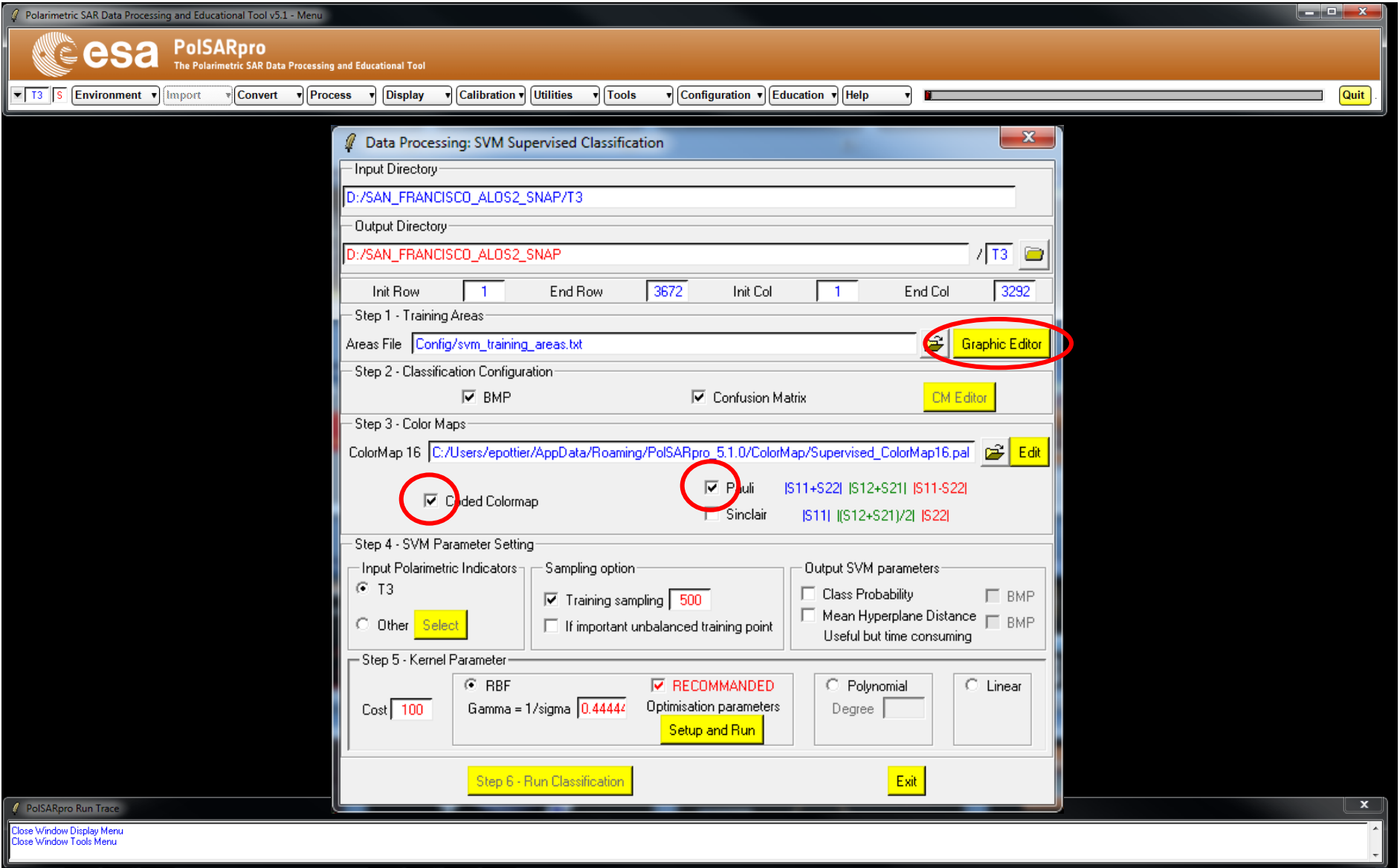
Polarized Point Scatterer Detection
 Reflectivity Ratio
 Differential Reflectivity (ZDR)

Clustering Process
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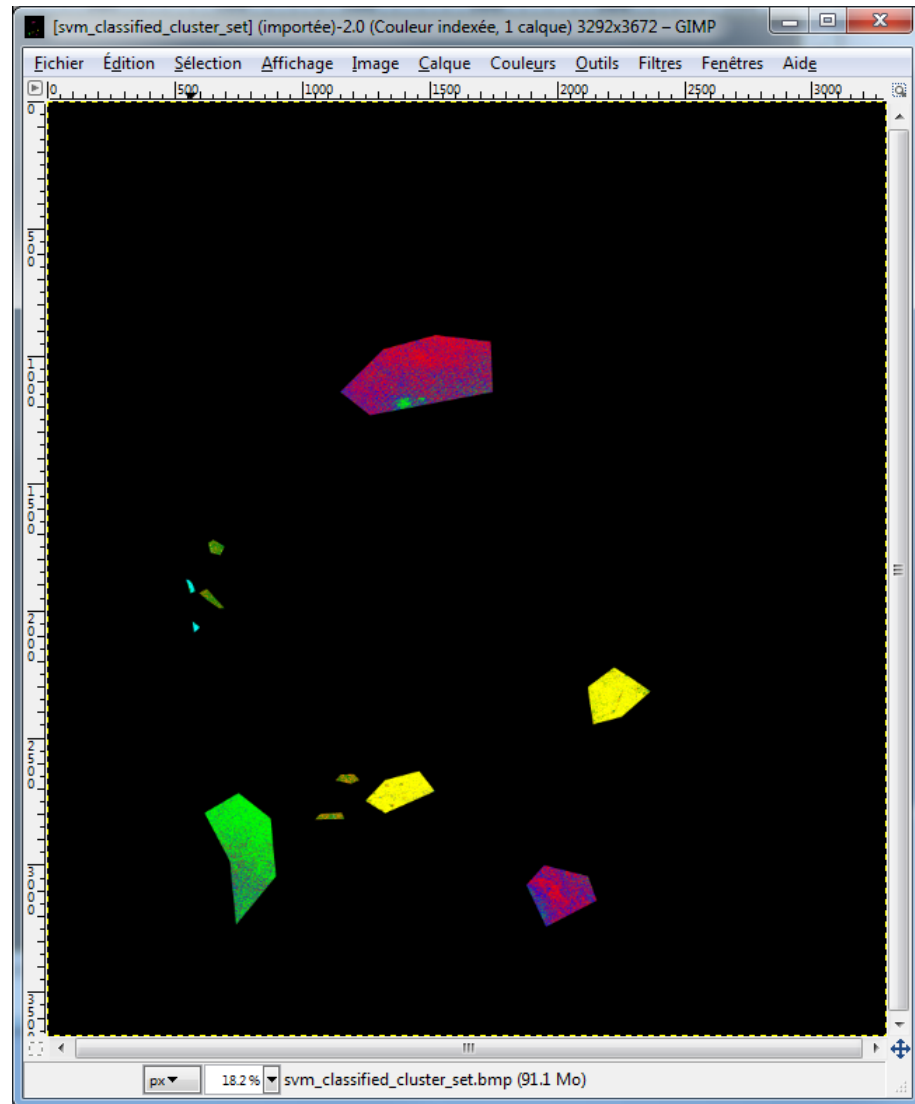
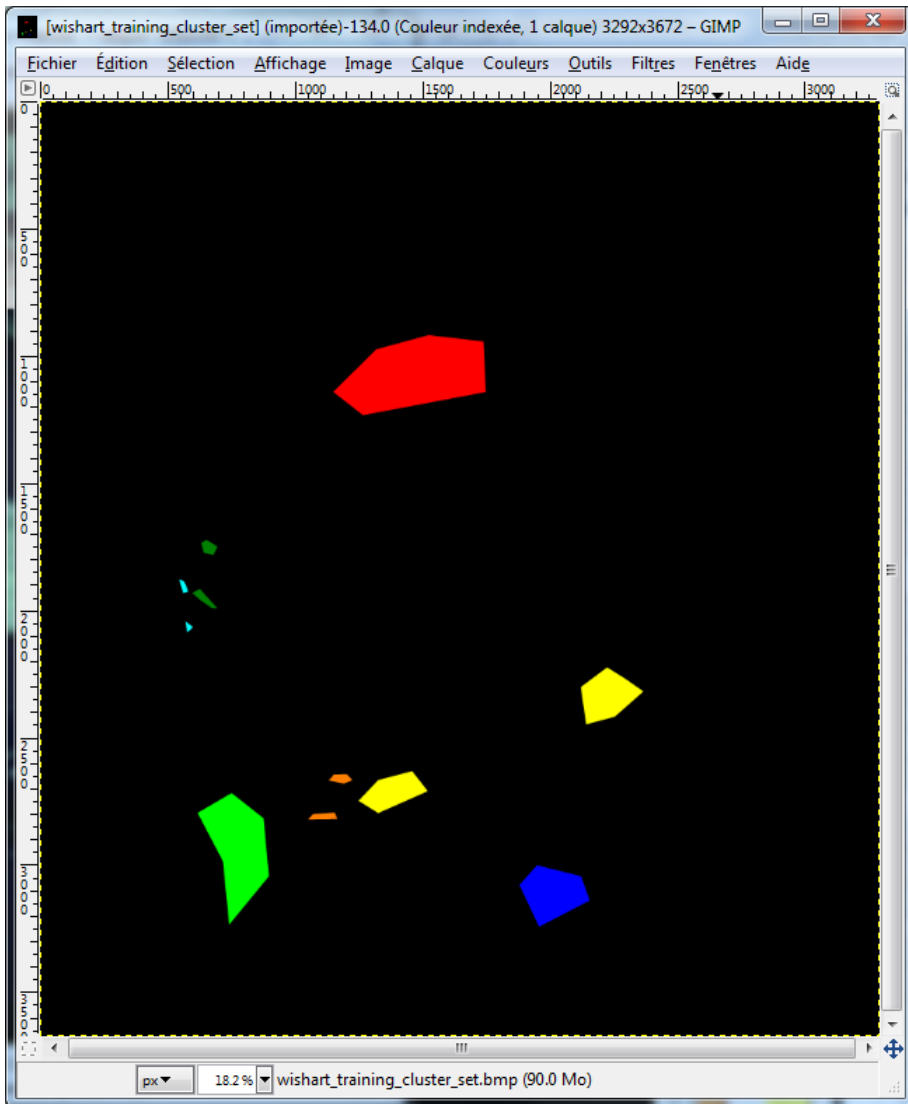


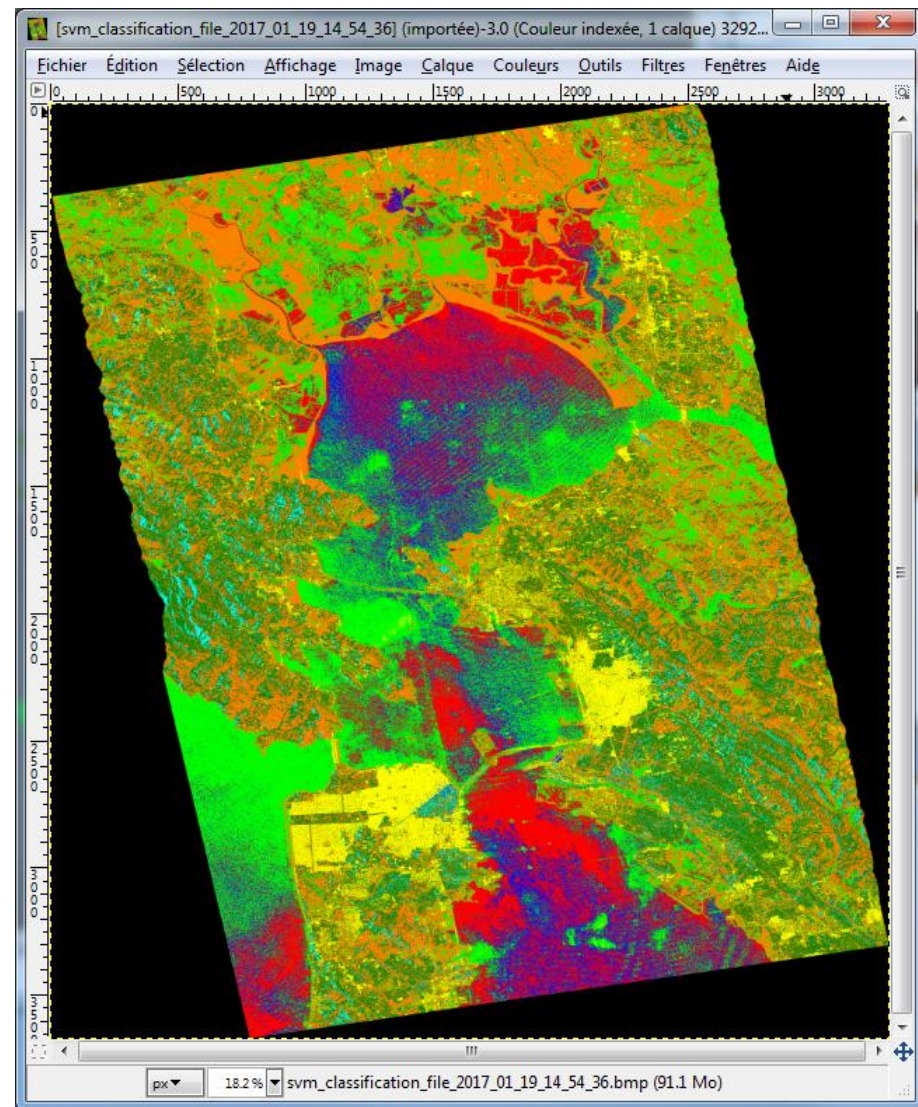
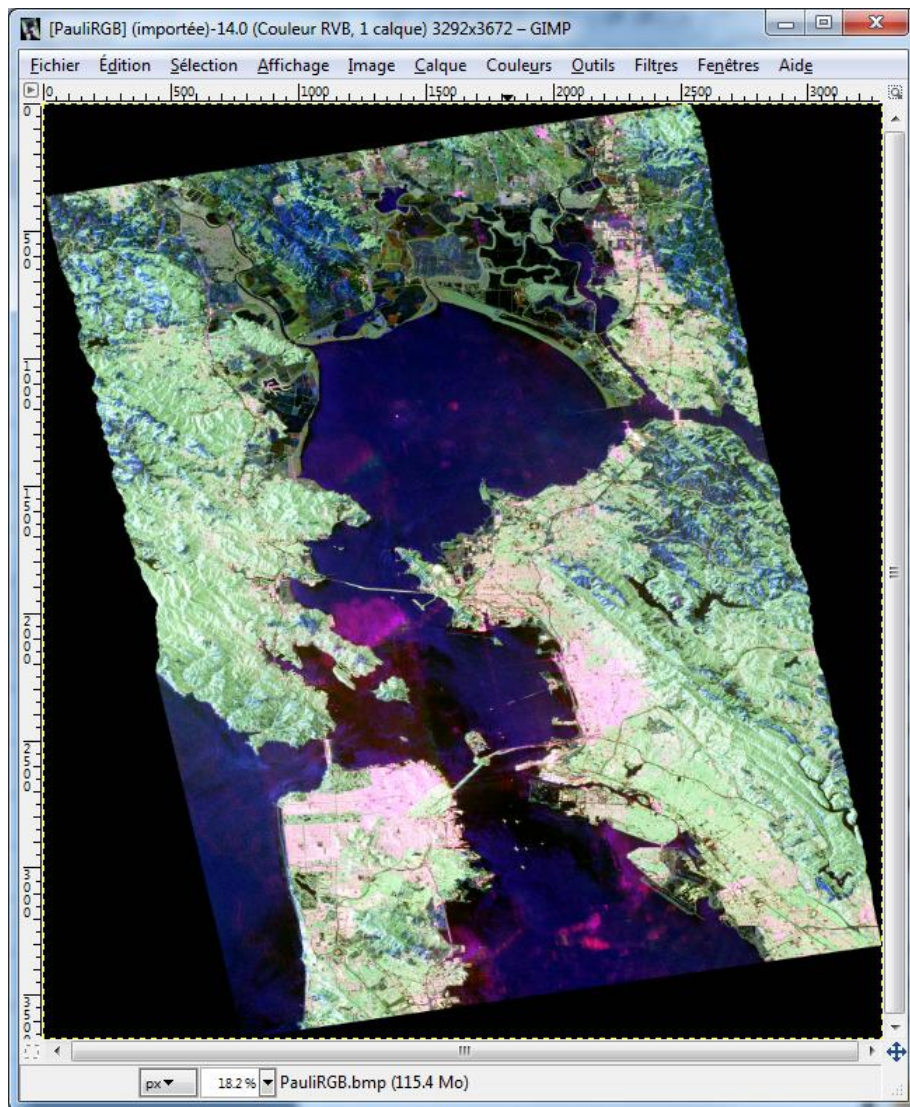
SUPPORT VECTOR MACHINE CLASSIFICATION

The screenshot displays the PolSARpro software interface, specifically the 'Data Processing: SVM Supervised Classification' window. The interface is divided into several steps:

- Step 1 - Training Areas:** Input Directory is 'D:/SAN_FRANCISCO_ALOS2_SNAP/T3'. Output Directory is 'D:/SAN_FRANCISCO_ALOS2_SNAP'. Init Row is 1, End Row is 3672, Init Col is 1, End Col is 3292.
- Step 2 - Classification Configuration:** Areas File is 'Config/svm_training_areas.txt'. BMP and Confusion Matrix are checked.
- Step 3 - Color Maps:** ColorMap 16 is 'C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Supervised_ColorMap16.pal'. Coded Colormap, Pauli, and Sinclair are checked.
- Step 4 - SVM Parameter Setting:** Input Polarimetric Indicators are T3. Sampling option is Training sampling (500). Output SVM parameters include Class Probability, Mean Hyperplane Distance, and BMP. The RBF kernel is selected, and the 'RECOMMENDED' button is highlighted.
- Step 5 - Kernel Parameter:** Cost is 100. Gamma = 1/sigma is 0.4444. The 'RECOMMENDED' button is highlighted.
- Step 6 - Run Classification:** The 'Run Classification' button is highlighted.

A blue arrow points from the 'RECOMMENDED' button in Step 4 to the 'SVM RBF Kernel Parameters Optimisation (Cross Validation) (Ne répond pas)' window. This window shows the optimization process for the RBF kernel parameters, including a graph of ISO Accuracy vs Log2(Gamma) and Log2(C). The 'Run RBF Kernel Parameters Optimisation' button is highlighted. A red circle with an hourglass icon and '50mn' indicates the time taken for this step.







PolSARpro

The Polarimetric SAR Data Processing and Educational Tool

T3

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Data Processing: SVM Supervised Classification

Input Directory

D:/SAN_FRANCISCO_ALOS2_SNAP/T3

Output Directory

D:/SAN_FRANCISCO_ALOS2_SNAP / T3

Init Row

1

End Row

3672

Init Col

1

End Col

3292

Step 1 - Training Areas

Areas File

Config/svm_training_areas.txt

Graphic Editor

Step 2 - Classification Configuration

☒ BMP

☒ Confusion Matrix

CM Editor

Step 3 - Color Maps

ColorMap 16

C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Supervised_ColorMap16.pal

Edit

☒ Coded Colormap

☒ Pauli

|S11+S22| |S12+S21| |S11-S22|

☐ Sinclair

|S11| |(S12+S21)/2| |S22|

Step 4 - SVM Parameter Setting

Input Polarimetric Indicators

☒ T3

☐ Other

Select

Sampling option

☒ Training sampling

500

☐ If important unbalanced training point

Output SVM parameters

☐ Class Probability

☐ BMP

☐ Mean Hyperplane Distance

☐ BMP

Useful but time consuming

Step 5 - Kernel Parameter

Cost

100

☒ RBF

Gamma = 1/sigma

0.4444

☒ RECOMMENDED

Optimisation parameters

Setup and Run

☐ Polynomial

Degree

☐ Linear

Step 6 - Run Classification

Exit

D:/SAN_FRANCISCO_ALOS2_SNAP/T3/svm_confusion_matrix_2017_01_19_14_5...

Wrap Text Mode

Exit

CONFUSION MATRIX

Rows represent the user defined clusters

Columns represent the segmented clusters

A number located at a position IJ represents the amount of pixels in percent belonging to the user defined area I that were assigned to cluster J during the supervised classification

	C1	C2	C3	C4	C5	C6	C7
C1	55.41	10.00	34.59	0.00	0.00	0.00	0.00
C2	8.40	76.77	14.82	0.00	0.01	0.00	0.00
C3	50.70	7.10	42.20	0.00	0.00	0.00	0.00
C4	0.00	0.20	0.78	91.44	2.38	4.77	0.43
C5	0.00	0.78	0.00	1.24	49.19	46.90	1.89
C6	0.00	0.00	0.04	3.19	26.41	67.07	3.29
C7	0.00	0.00	0.00	0.46	1.50	17.46	80.58

Class populations

C1

128254

C2

76909

C3

40665

C4

56395

C5

4603

C6

4889

C7

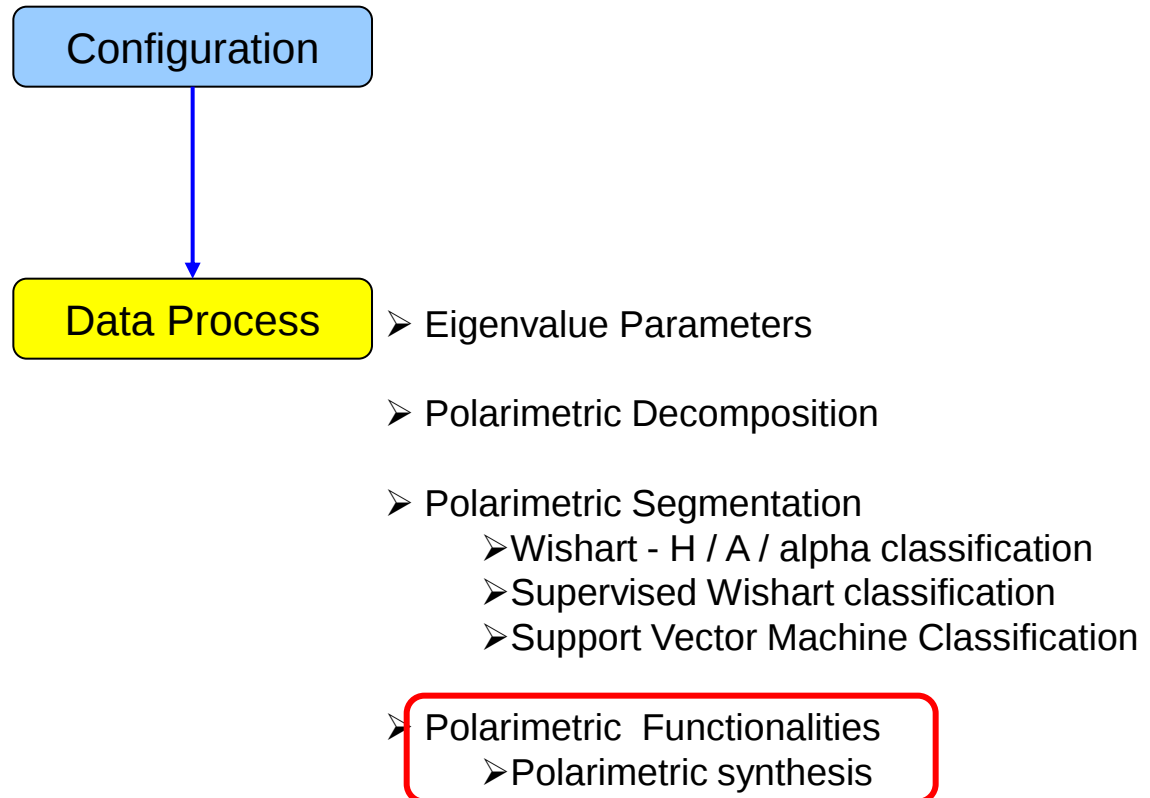
1529

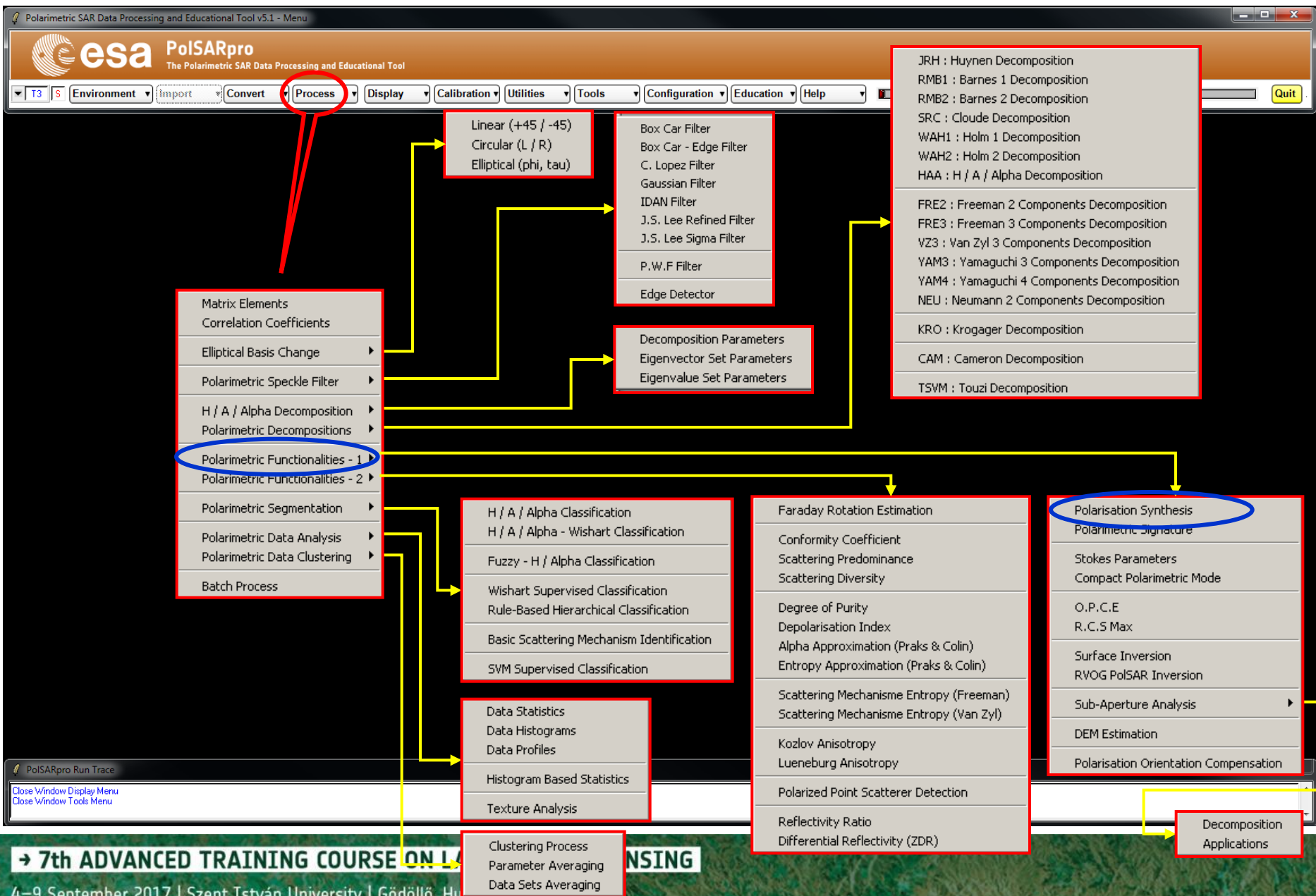
Close Window Display Menu

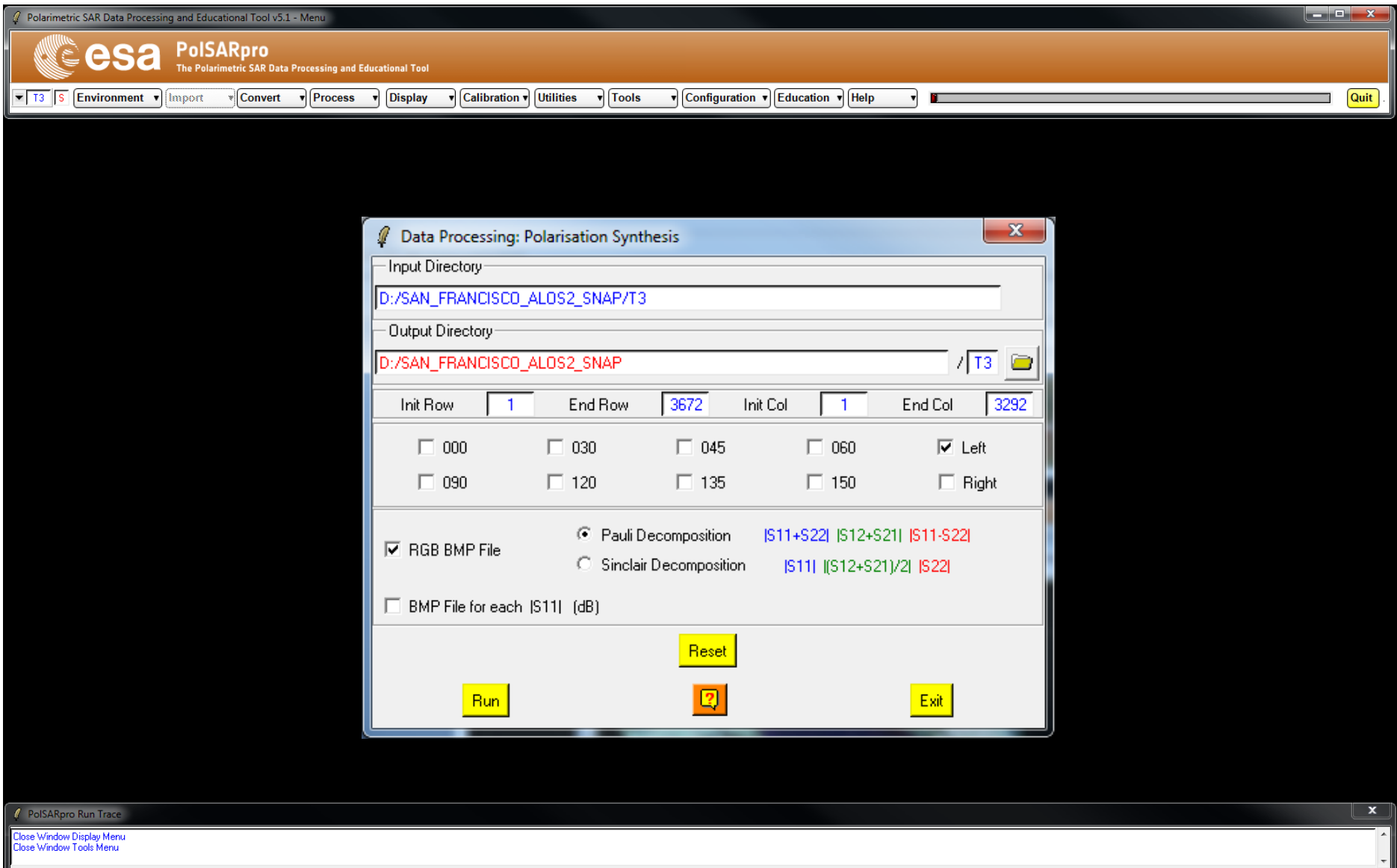
Close Window Tools Menu

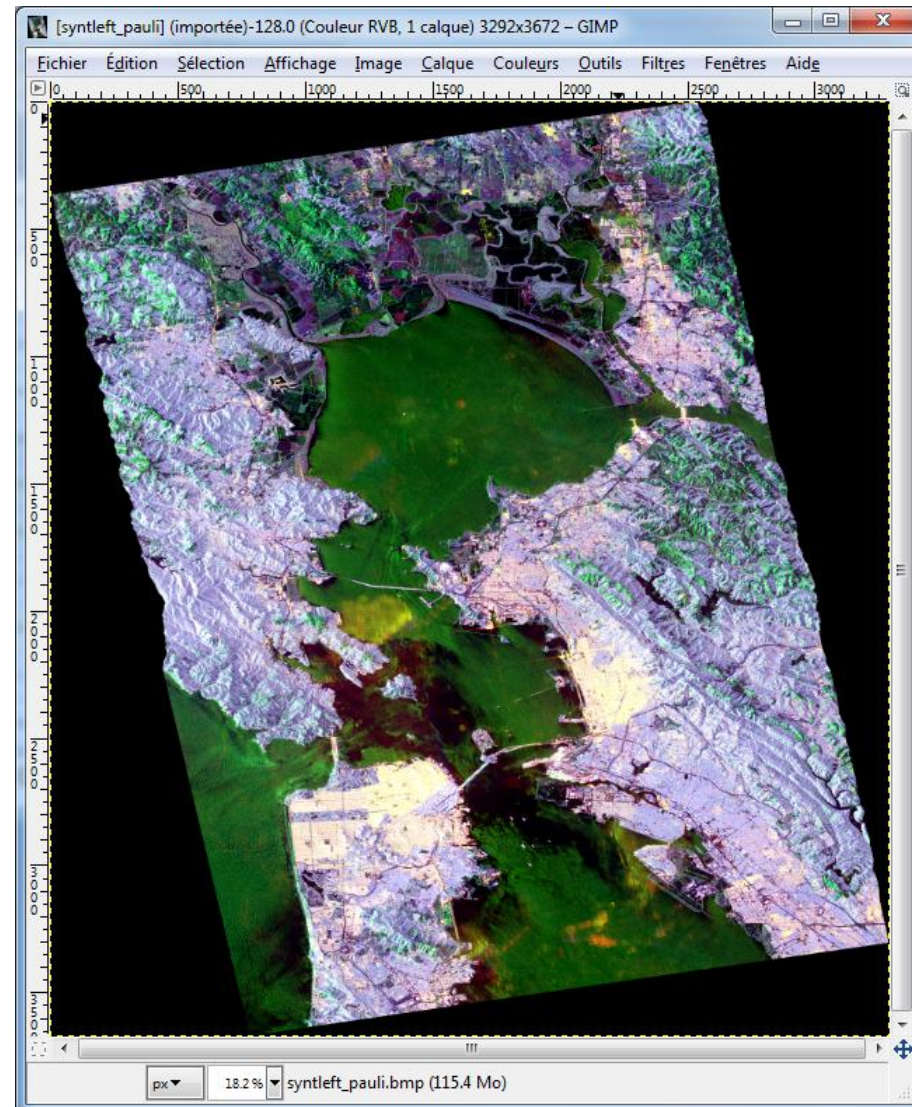
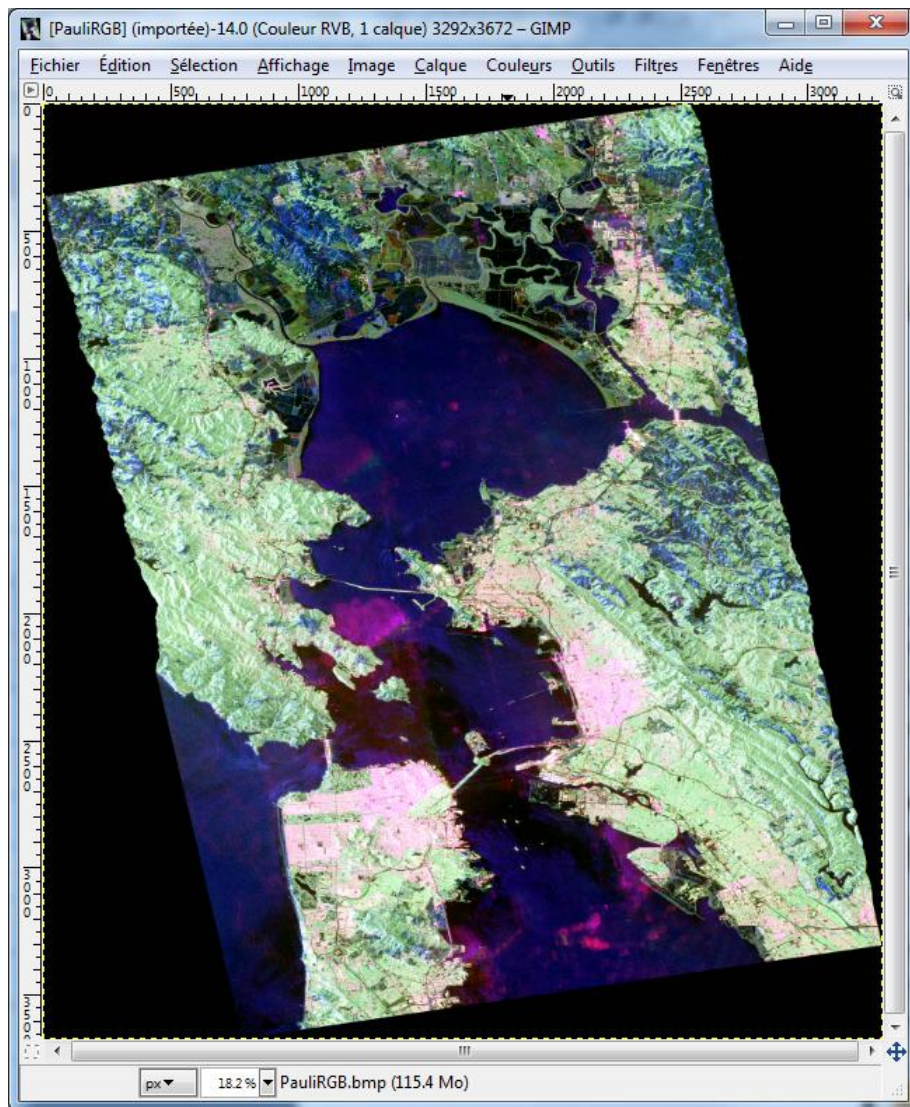
→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

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Questions ?

