



Introduction to PolSARpro Toolbox

ESA-MOST Dragon 4 Cooperation

**ADVANCED LAND REMOTE SENSING
INTERNATIONAL TRAINING COURSE**

“龙计划4” 高级陆地遥感国际培训班

Eric POTTIER

20-25 November 2017 | Yunnan Normal University
Kunming, Yunnan Province, P.R. China

2017年11月20日—11月25日
云南师范大学, 中国, 昆明

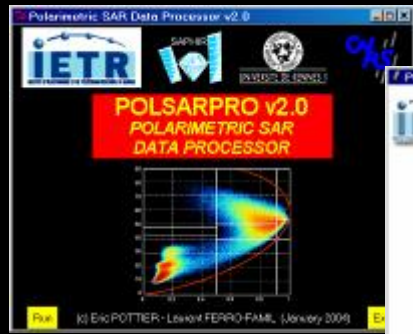
University of Rennes 1 - France



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.



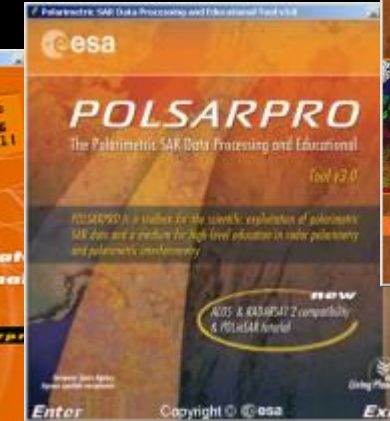
2003



2004

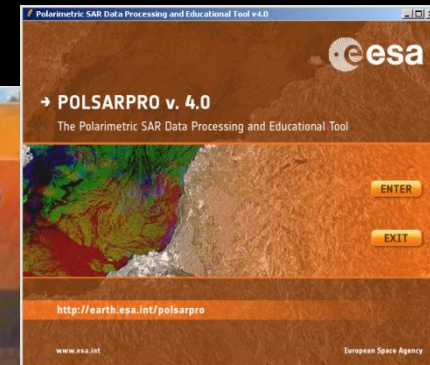


Enter



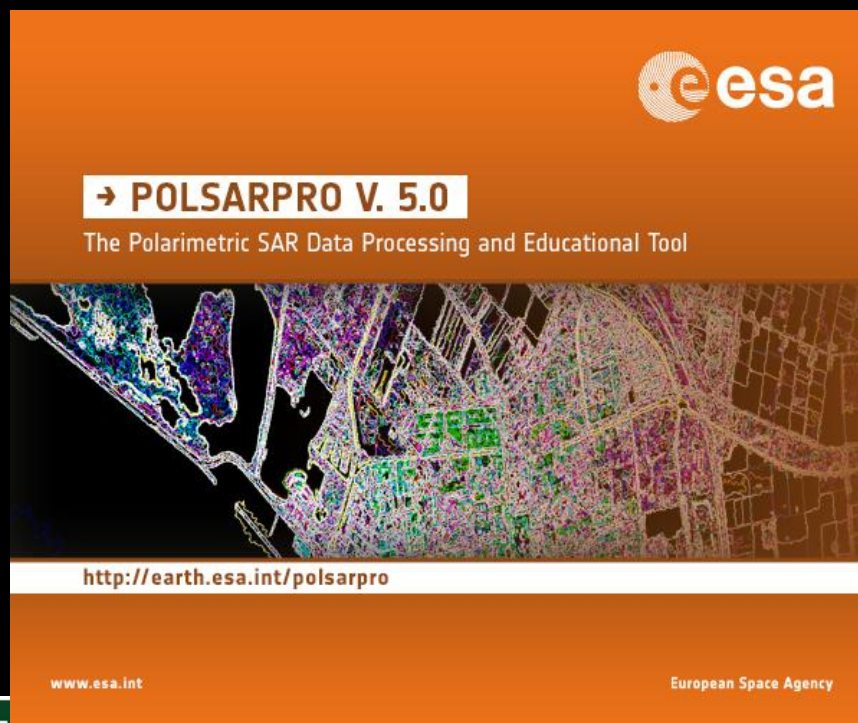
Exit

2007

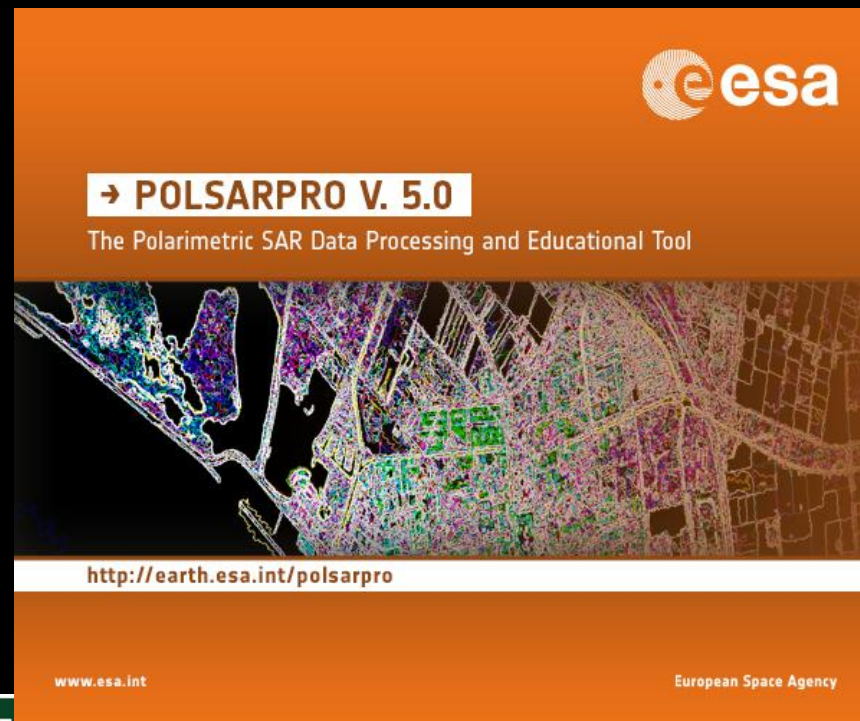


2009

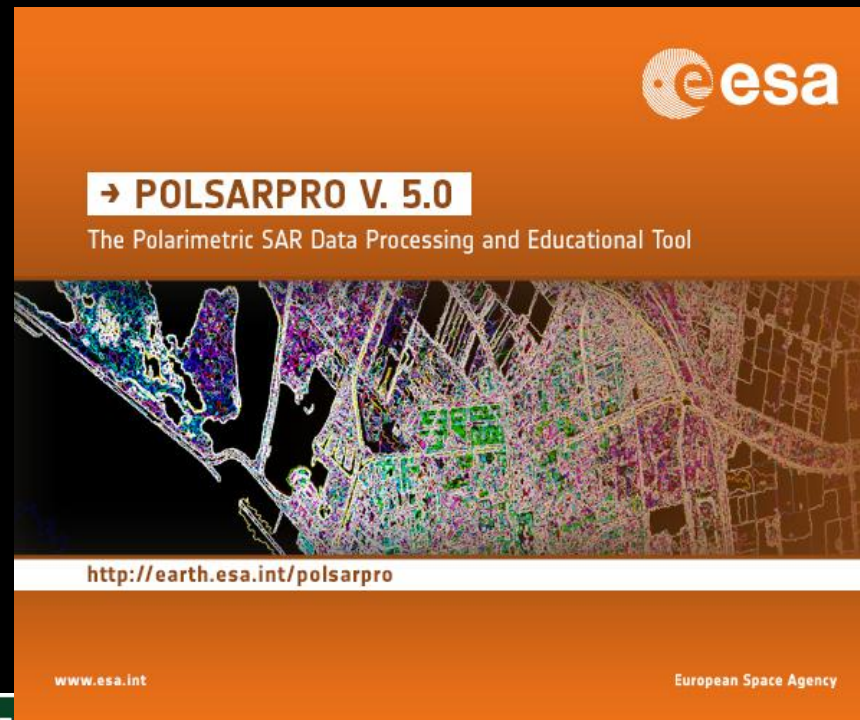
Tool specifically designed to handle :
Polarimetric data
and
Polarimetric Interferometric data.



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

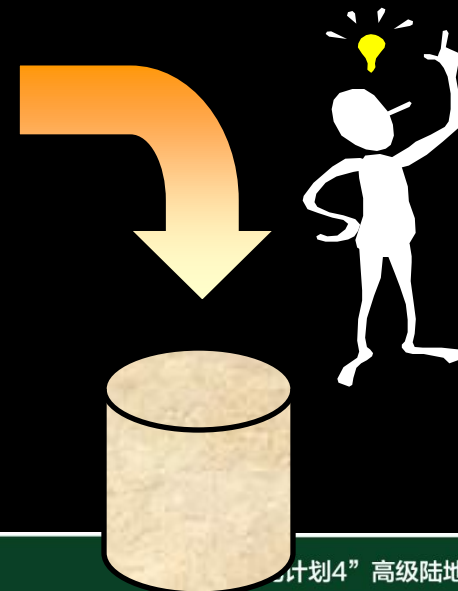
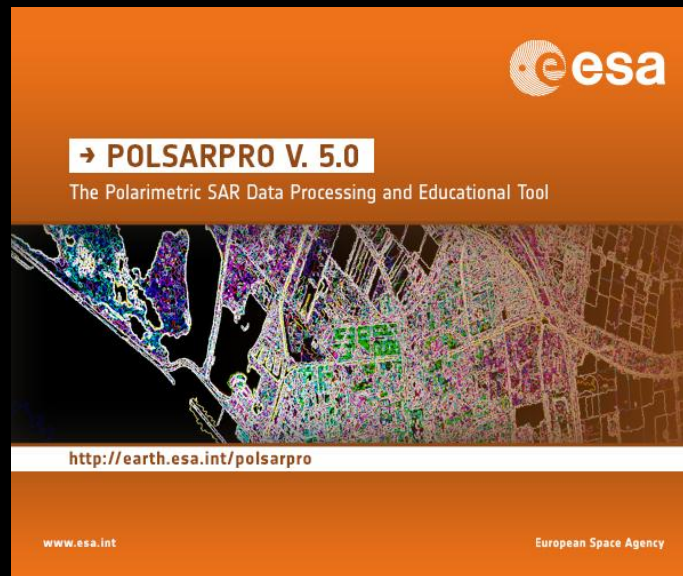
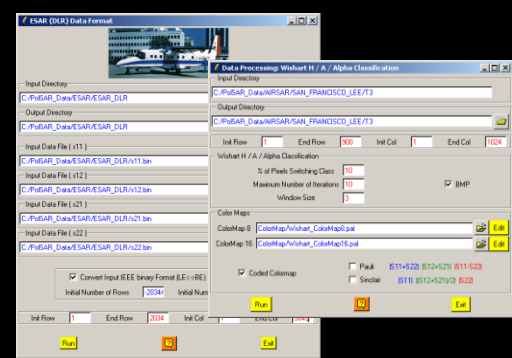


Developed to be **accessible** to :
a wide range of users
from **novices** to **experts**
in the field of **POLSAR** and **POL-InSAR**.



MODULAR STRUCTURE

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



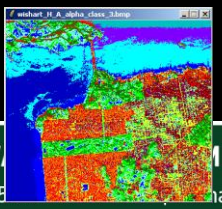
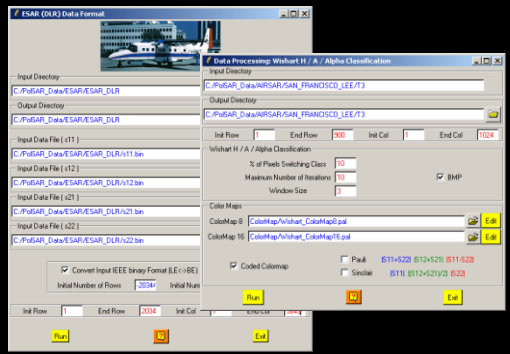
OPEN SOURCE DEVELOPMENT

PoISARpro v5.1 Software is made available following the:

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

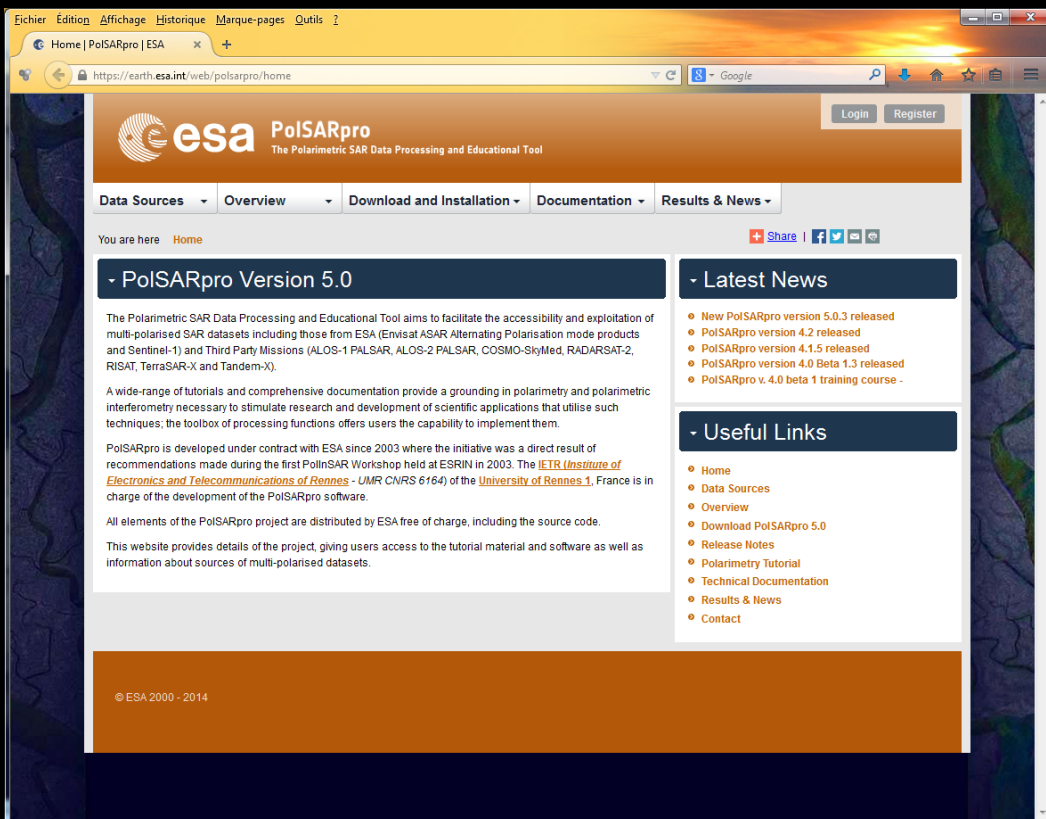
GNU General Public License v2 – June 1991.

PoISARpro 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)

PolSARpro v5.0 Contributors

Universities

- Universitat Politecnica 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. Lavalle)
- 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 Aeronautiques (FR) (E. Colin)

Agencies

- Japan Aerospace Exploration Agency (JP) (M. Shimada)
- Deutschen Zentrums 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)

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

→ **POLISARPRO V. 5.0**
The Polarimetric SAR Data Processing and Educational Tool

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

www.esa.int European Space Agency

AIRSAR



ONERA



SETHI



PISAR

NASDA
CRL

DCRS



EMISAR

ESAR - FSAR

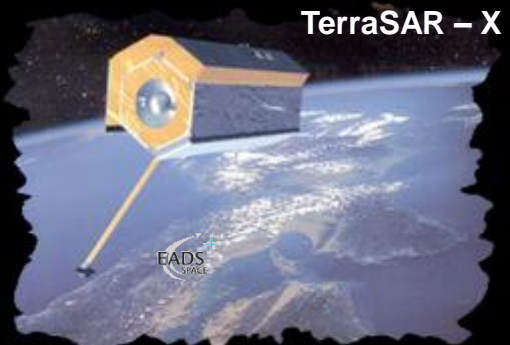
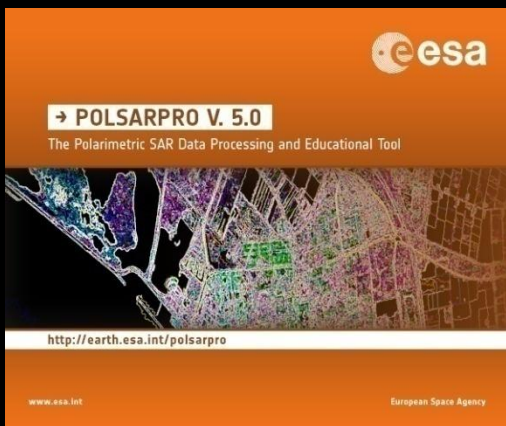


CONVAIR

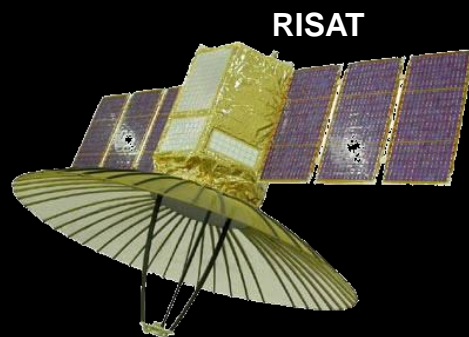
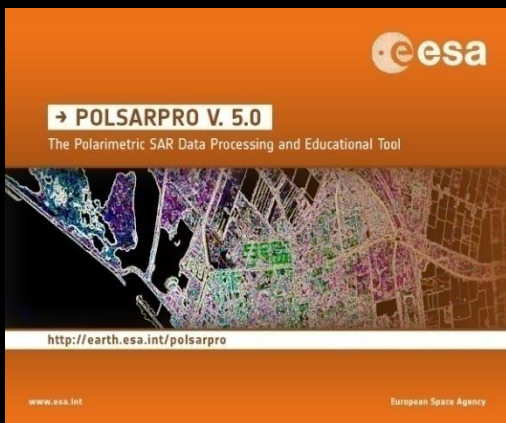
UAV-SAR



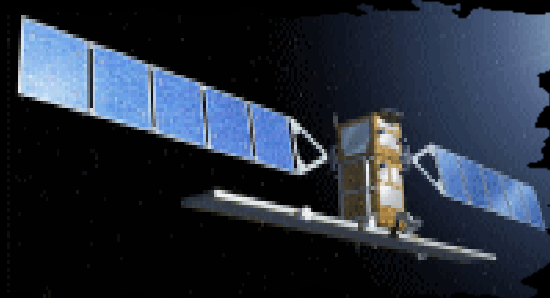
PoISARpro v5.1 Software offers the possibility to handle and convert polarimetric data from a range of well established **polarimetric airborne platforms.**



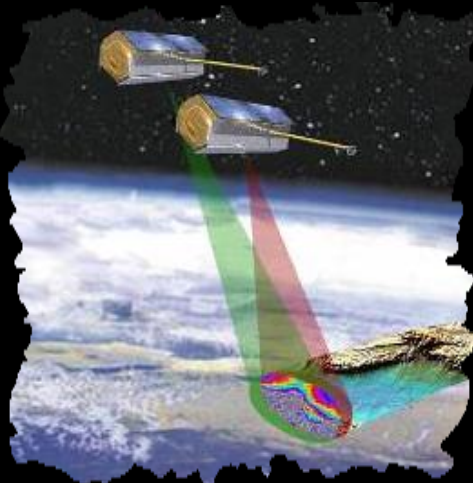
PoISARpro v5.1 Software offers the possibility to handle and convert polarimetric data from a range of well established polarimetric spaceborne platforms.



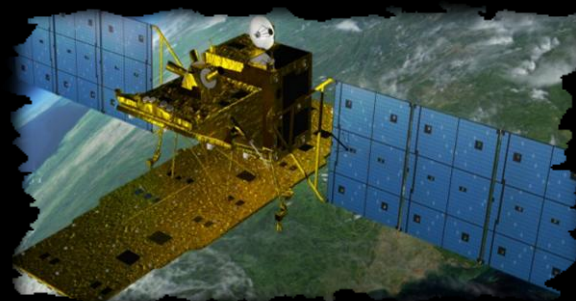
RISAT



SENTINEL 1A



TANDEM-X



ALOS-2 - PALSAR



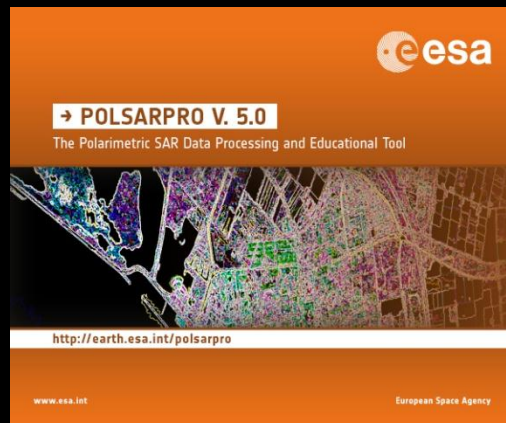
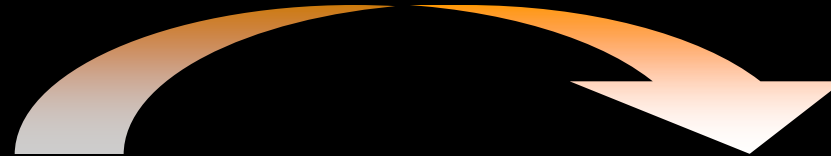
COSMO - SKYMED

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



External Softwares



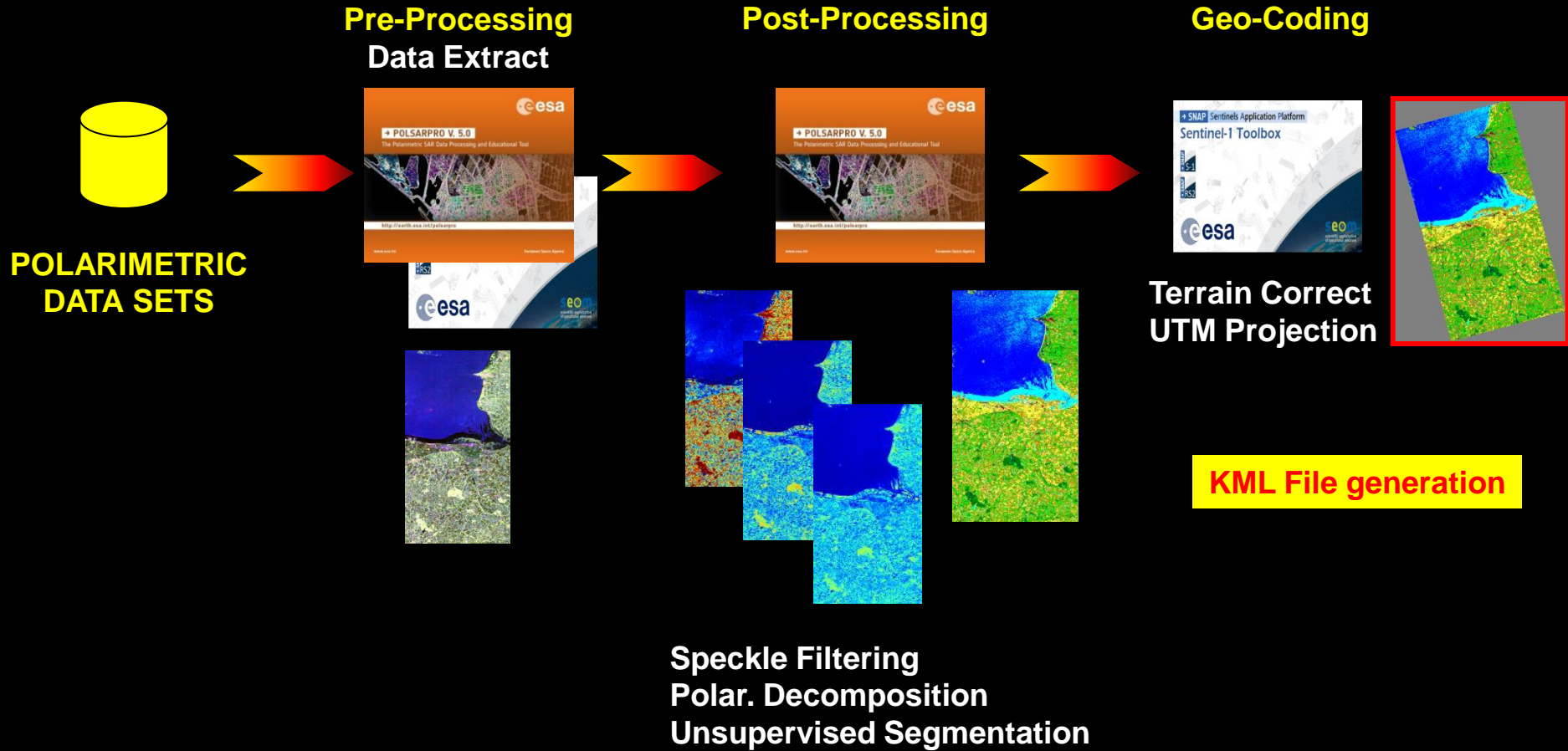


Polariametric Data Processing

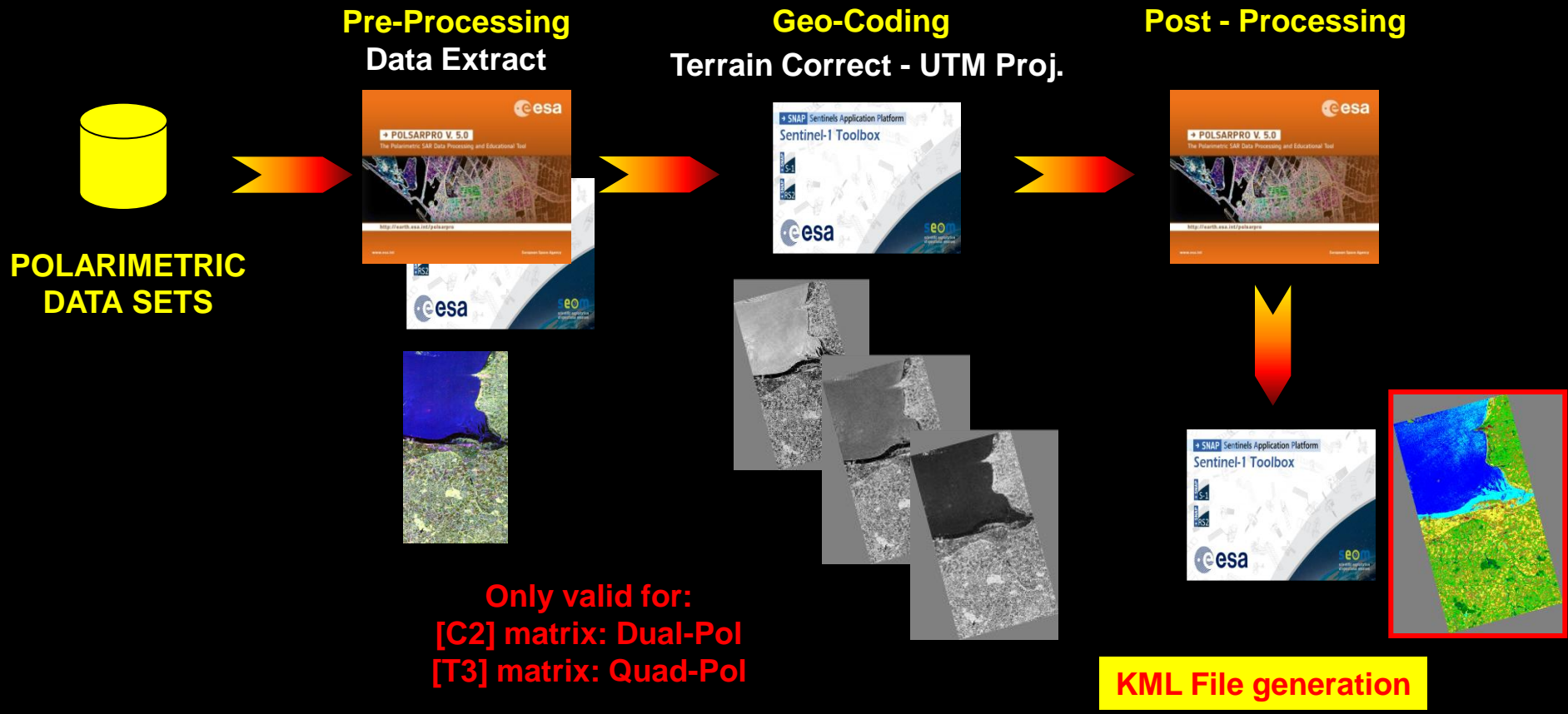


- S1 toolbox (split, deburst, merge ...)
- Geocoding toolbox
- Interferometric toolbox (co-registration, flat Earth estimation ...)

ESA - SNAP



ESA - SNAP





Software – General Presentation

New design

- Full screen → Banner
- Buttons – icons → Buttons - Functionalities

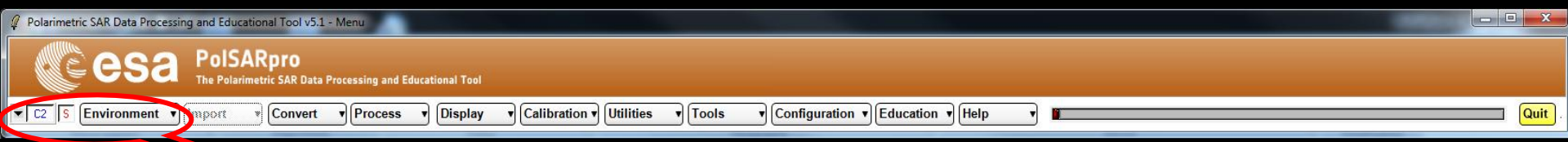
↓

Objective

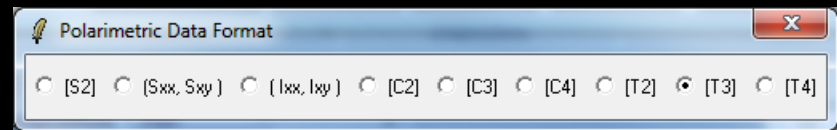
To minimize the data flow towards a

Virtual Machine (ex ESA - GPOD)

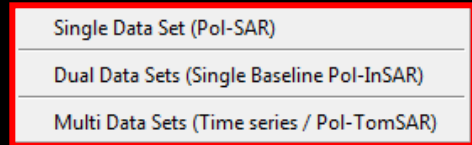
Possibility to run other s/w (ENVI or Gimp for ex) and to have directly access to the different s/w

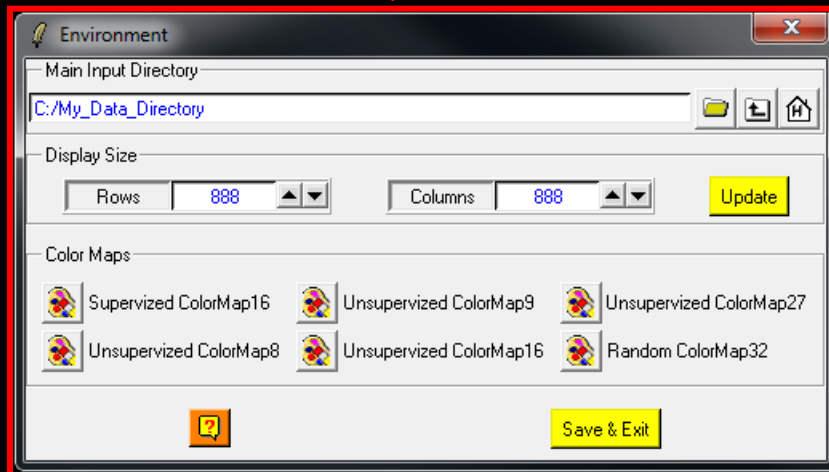
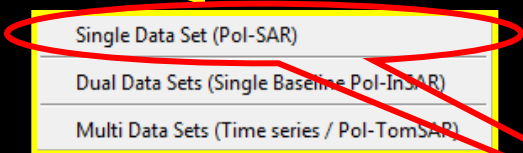
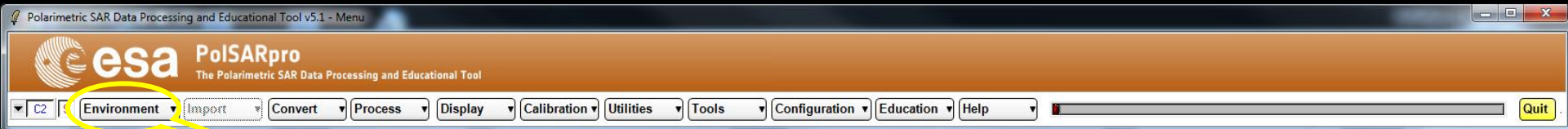


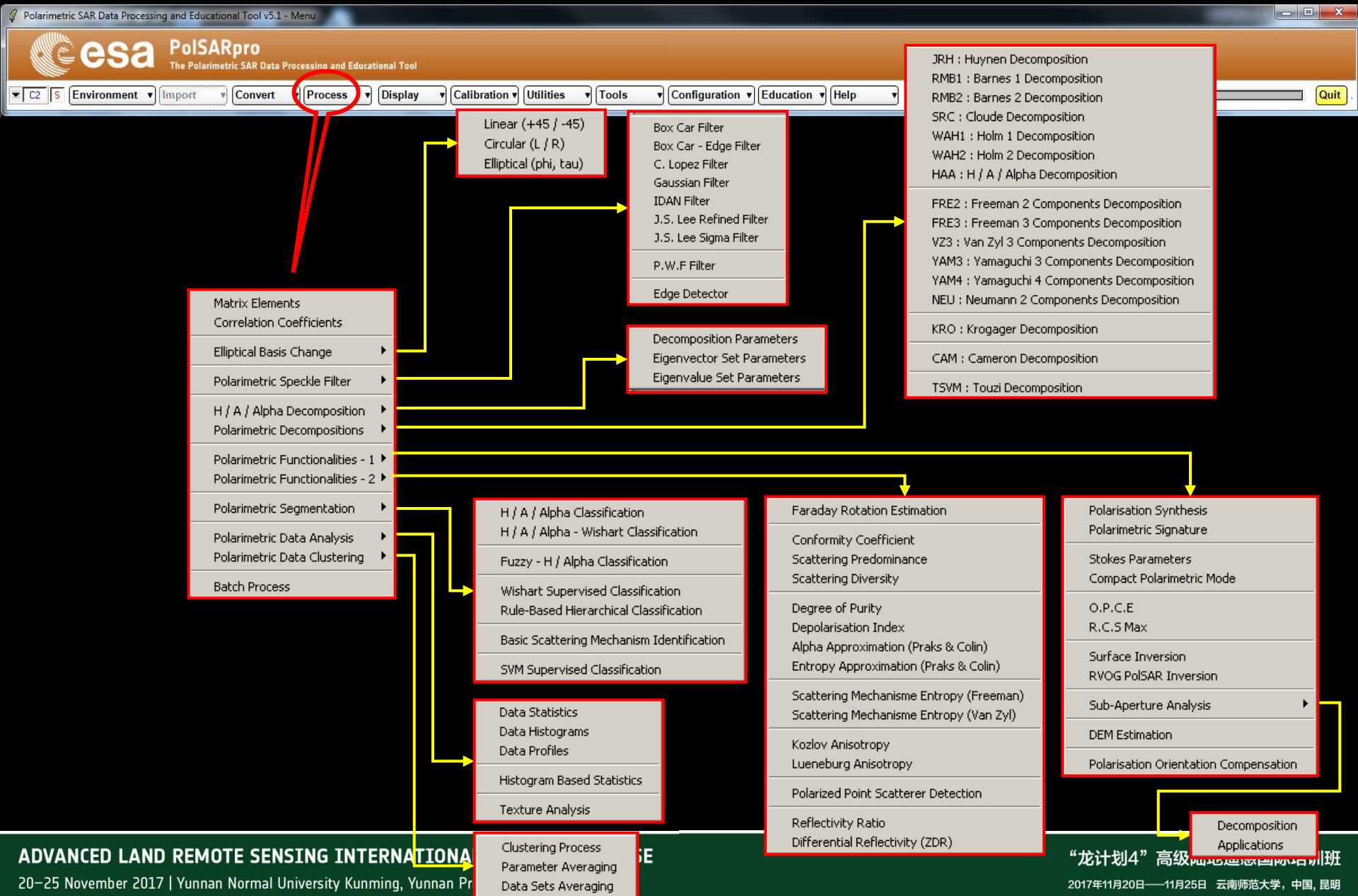
Polarimetric Data Format



DataSet Type







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

esa PoSARpro
The Polarimetric SAR Data Processing and Educational Tool

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

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 & Frey 4 Component Decomposition
FRE2 : Freeman 2 Component Decomposition
FRE3 : Freeman 3 Component Decomposition
NEU : Neumann 2 Component Decomposition
NNED : Ariei 3 Component NNED Decomposition
ANNED : Ariei 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
Aghababae Decomposition
2KR : Raney Decomposition
CPD : Compact-Pol Decomposition

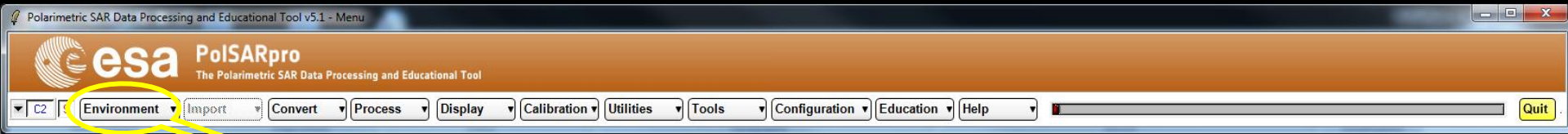
Sub-Aperture Analysis
DEM Estimation
Polarisation Orientation Compensation
Decomposition Applications

Clustering Process
Parameter Averaging
Data Sets Averaging

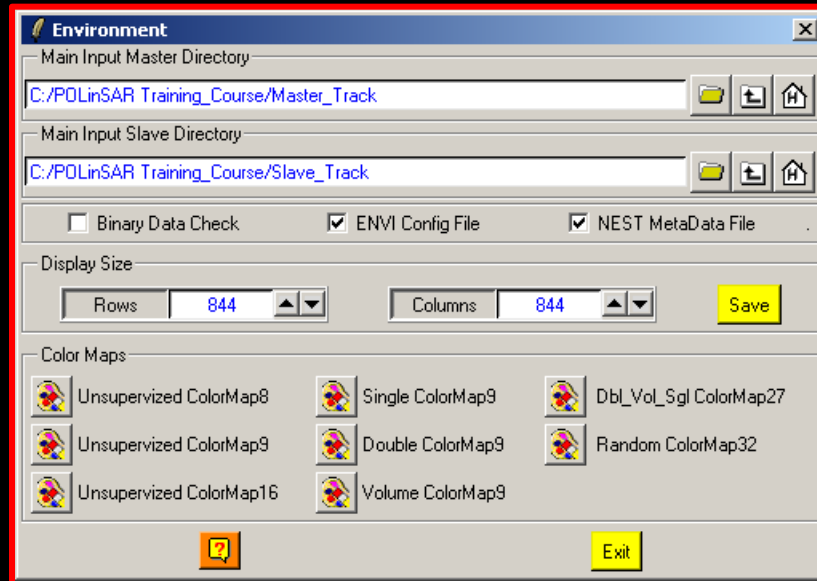
Clustering Process
Parameter Averaging
Data Sets Averaging

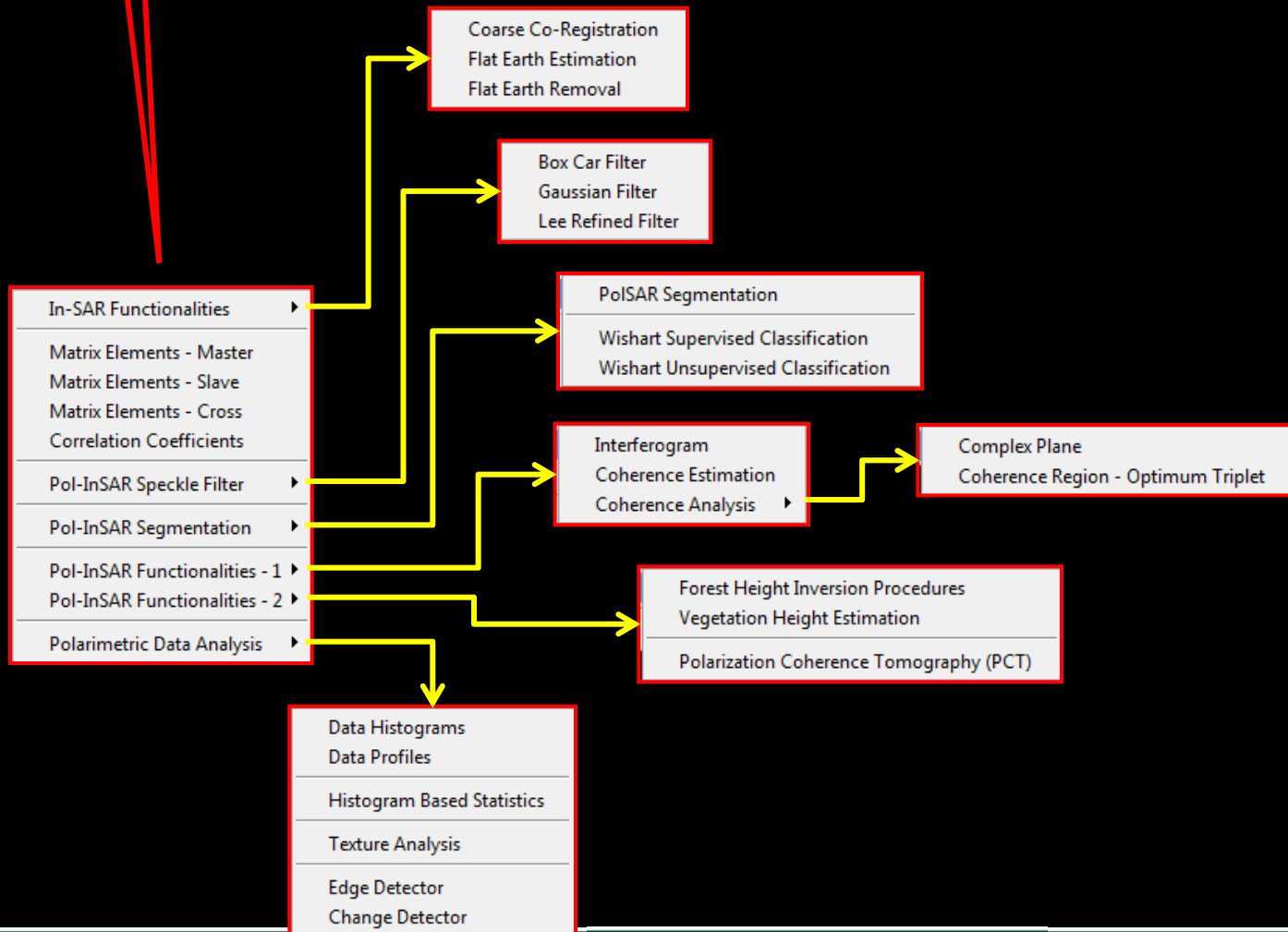
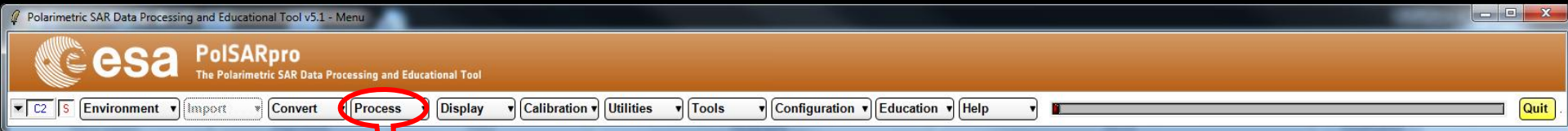
Differential Reflectivity (ZDR)

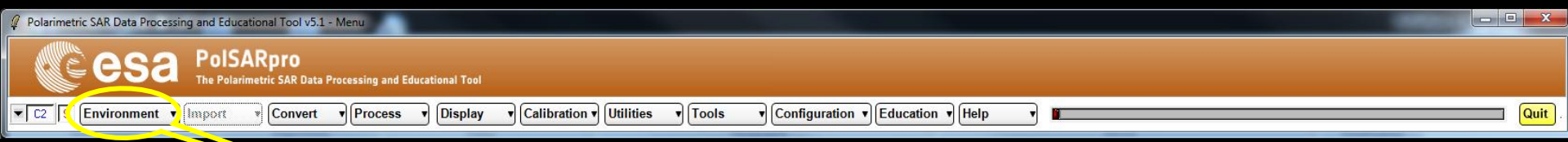
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2017年11月20日—11月25日 云南师范大学, 中国, 昆明



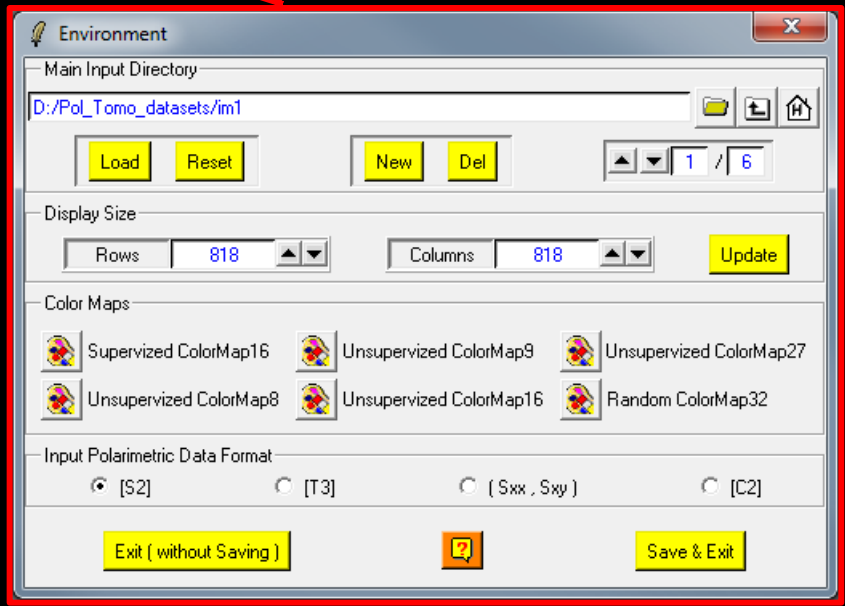
- Single Data Set (Pol-SAR)
- Dual Data Sets (Single Baseline Pol-InSAR)
- Multi Data Sets (Time series / Pol-TomSAR)

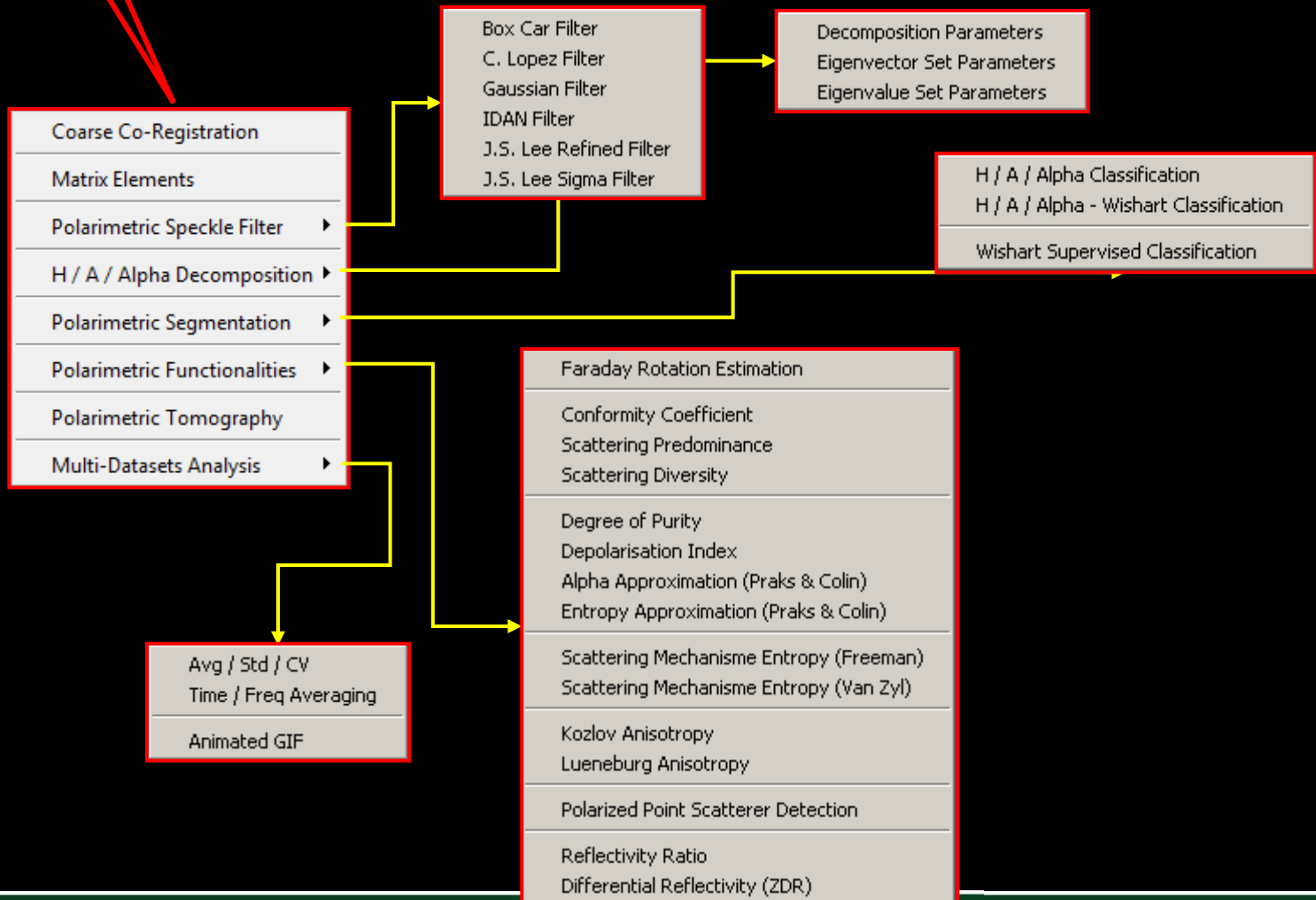
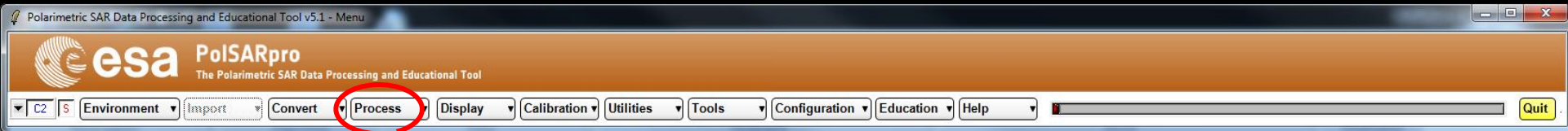


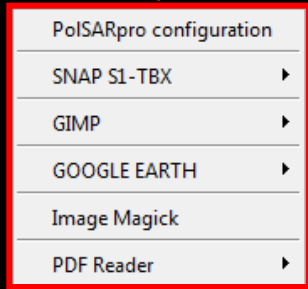
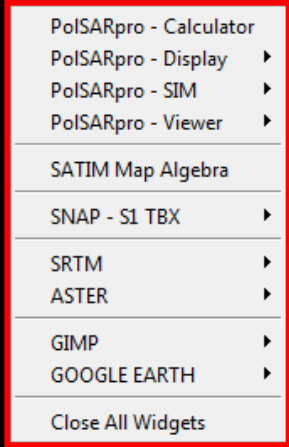
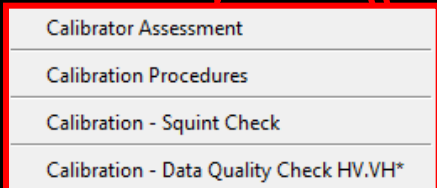
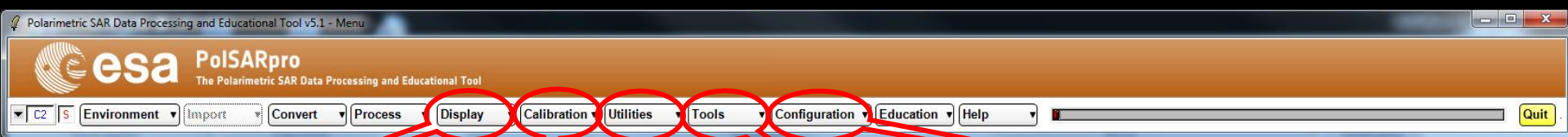


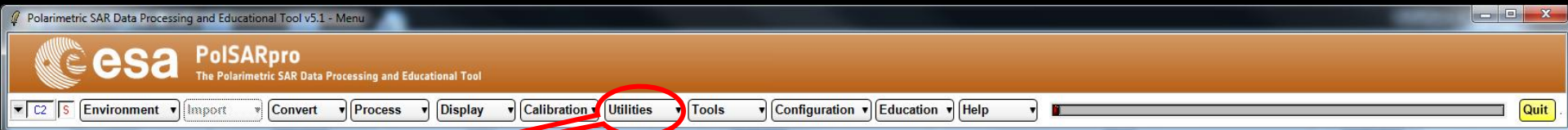


- Single Data Set (Pol-SAR)
- Dual Data Sets (Single Baseline Pol-InSAR)
- Multi Data Sets (Time series / Pol-TomSAR)









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

PoISARpro 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 OK

m11	<input type="text"/>	+j	<input type="text"/>	m12	<input type="text"/>	+j	<input type="text"/>	m13	<input type="text"/>	+j	<input type="text"/>	m14	<input type="text"/>	+j	<input type="text"/>
m21	<input type="text"/>	+j	<input type="text"/>	m22	<input type="text"/>	+j	<input type="text"/>	m23	<input type="text"/>	+j	<input type="text"/>	m24	<input type="text"/>	+j	<input type="text"/>
m31	<input type="text"/>	+j	<input type="text"/>	m32	<input type="text"/>	+j	<input type="text"/>	m33	<input type="text"/>	+j	<input type="text"/>	m34	<input type="text"/>	+j	<input type="text"/>
m41	<input type="text"/>	+j	<input type="text"/>	m42	<input type="text"/>	+j	<input type="text"/>	m43	<input type="text"/>	+j	<input type="text"/>	m44	<input type="text"/>	+j	<input type="text"/>

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. |]
- . (.) < { ? }
- . (.) > { ? }

Operator : Sinclair Matrix : S2

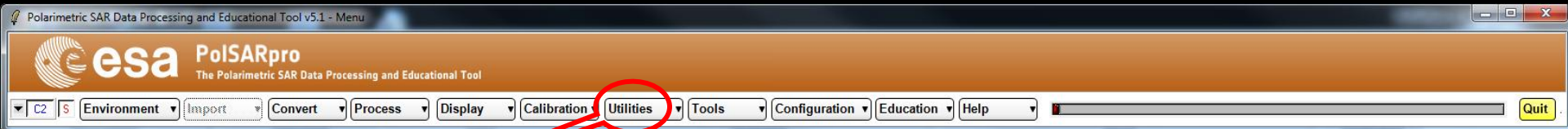
- [S] + value
- [S] - value
- [S] * value
- [S] / value
- [S] .+ [file]
- [S] .- [file]
- [S] .* [file]
- [S] ./ [file]
- [S] .+ [S']
- [S] .+ [mat]
- [S] .* [S']
- [S] .* [mat]
- [S] .* [S]
- [U] t .* [S] .* [U]
- .conj [S]
- .tr [S]
- .det [S]
- .inv [S]
- .eig1 [S]
- .eig2 [S]
- .eig1 [G]
- .eig2 [G]

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]

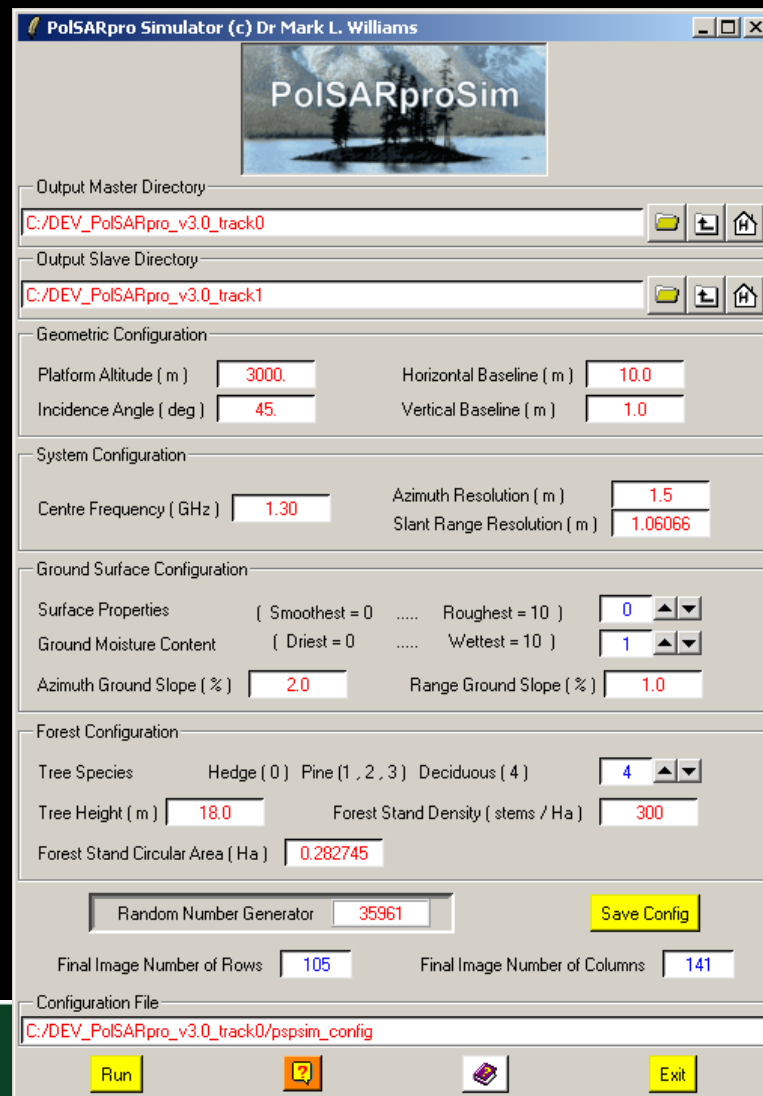
Operator : Complex / Hermitian / Float / Special Unitary NxN Matrix

- [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]

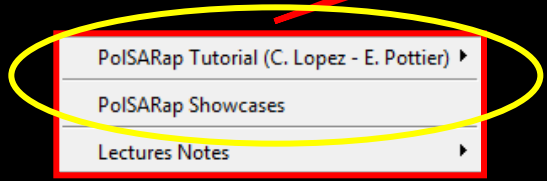
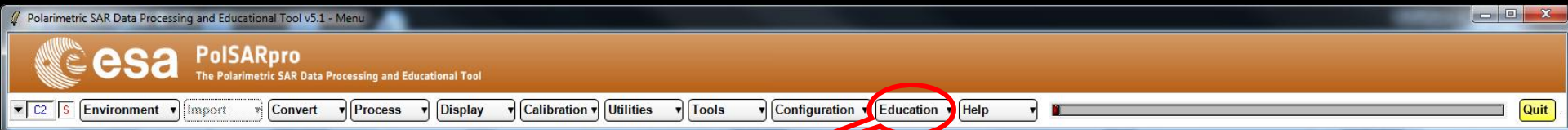


- PoISARpro - Calculator
- PoISARpro - Display
- PoISARpro - SIM
- PoISARpro - Viewer
- SATIM Map Algebra
- SNAP - S1 TBX
- SRTM
- ASTER
- GIMP
- GOOGLE EARTH
- Close All Widgets

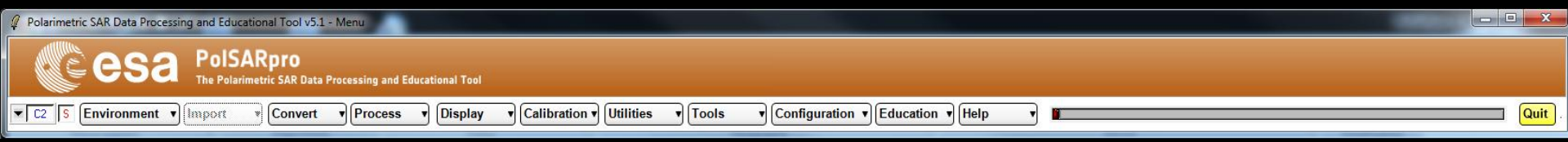
- Ground
- Ground + small vegetation
- Forest



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



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 x and y , admitting the following vector formulation:

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

which may be also considered in a complex form

erating a better exploitation of the S), the Wishart distribution allows us model for all the elements of the diel 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-

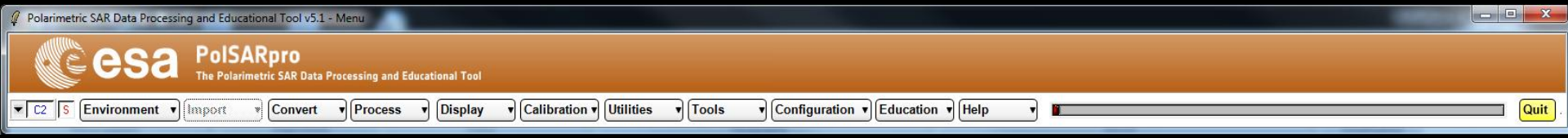


France (USA) where the colour code is the LLMMSE speckle filter.

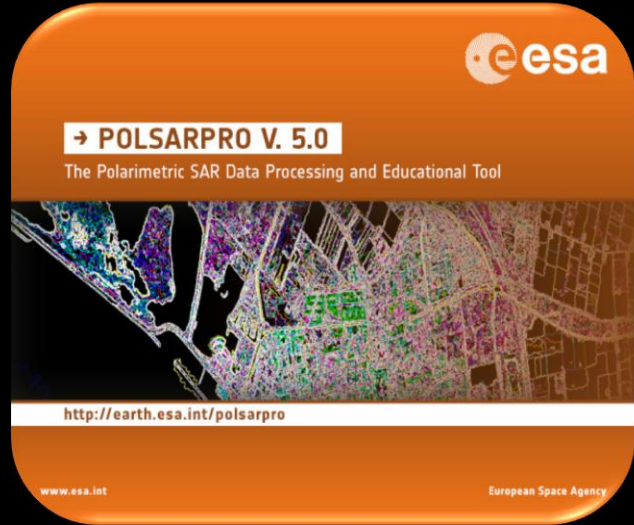


France (USA) where the colour code is the SPT speckle filter.

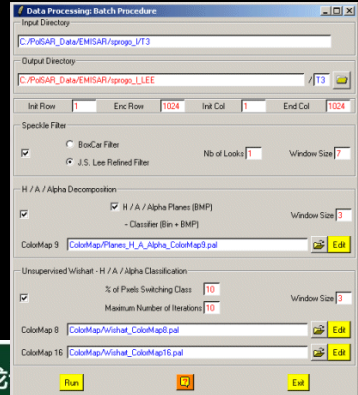
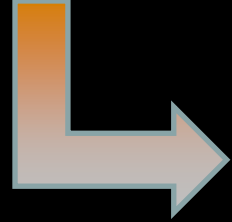
Beyond all the PolSAR data filtering techniques presented in this Section, there exist a wide variety of similar approaches in the related literature, where a con-

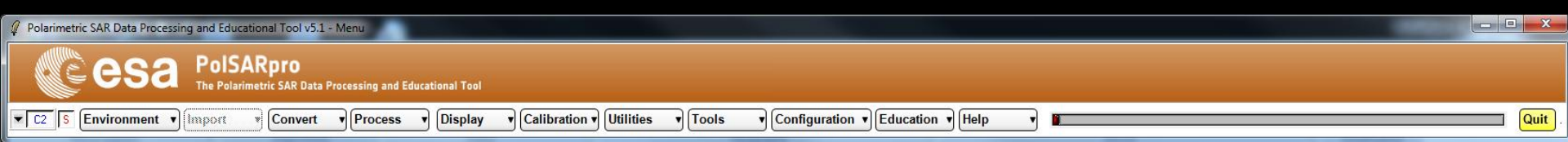


PoSAR-Ap Project



WP260 : Implementation of Selected Applications (E. Pottier)





Agriculture



Forest



Ocean



ONERA



Urban

→ POLSARPRO V. 5.0

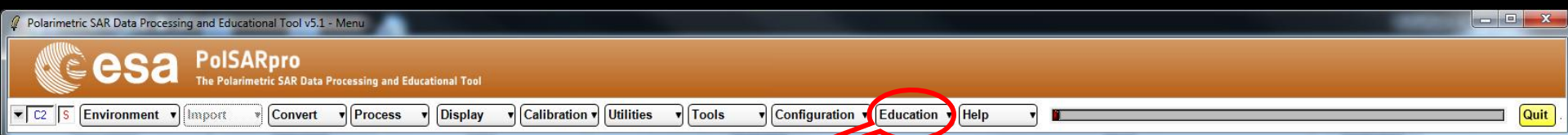
The Polarimetric SAR Data Processing and Educational Tool



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



Cryosphere



- PoISARap Tutorial (C. Lopez - E. Pottier) ▶
- PoISARap 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>

Web Site provides

Information of the project

Access to the tutorial

Information about status and development

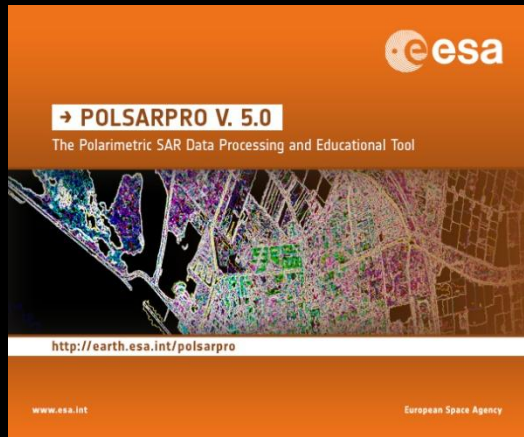
Demonstration Sample Datasets



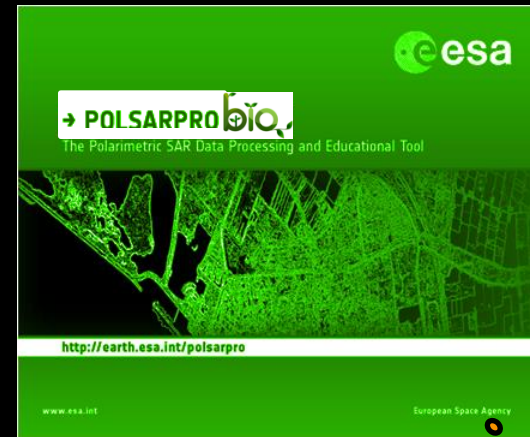
New!

v5.1 (January 2017)

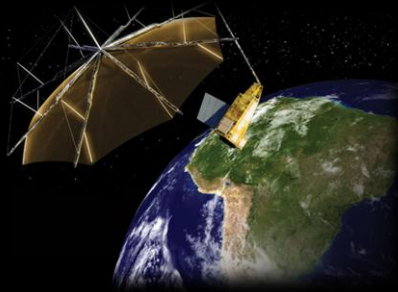
ESA & third party fully polarimetric SAR missions (**PoISARpro-Bio**)



ESA RFP - 2017



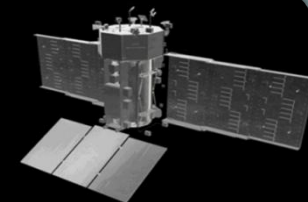
Future spaceborne sensors



BIOMASS



R.C.M



SAOCOM-CS

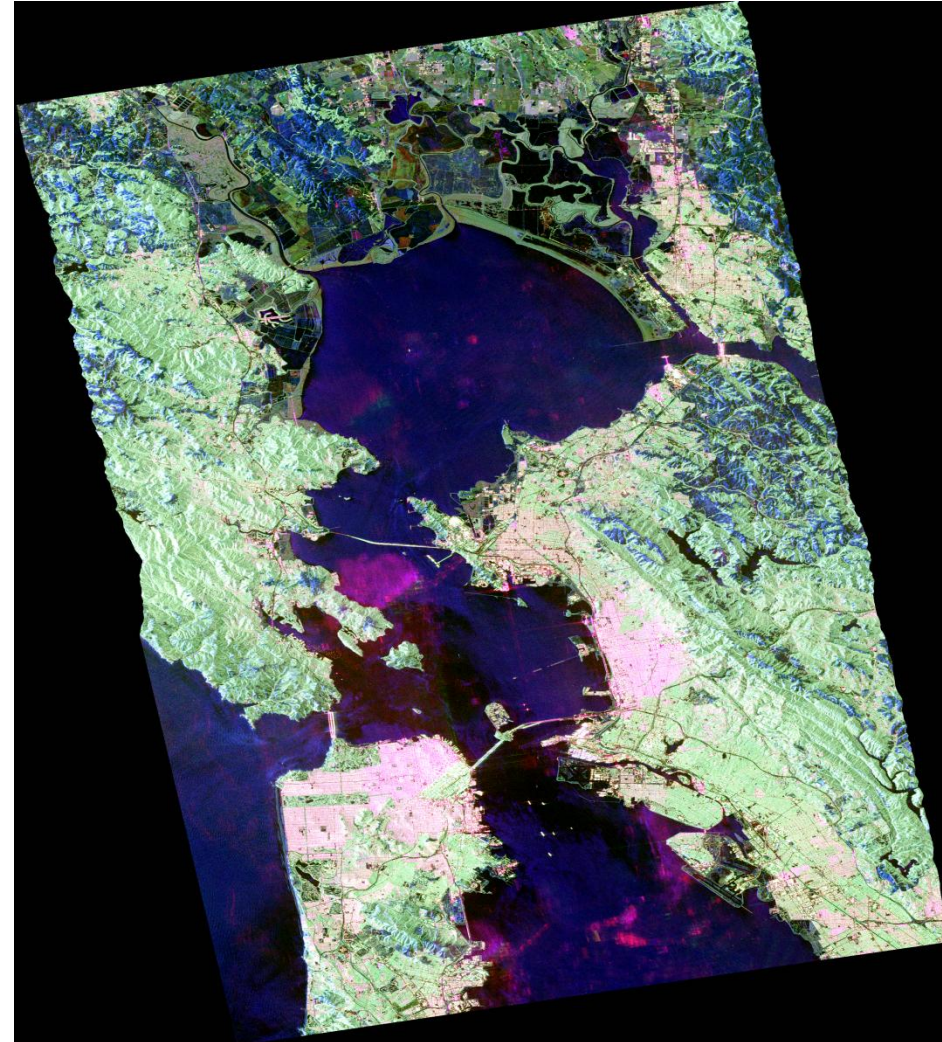
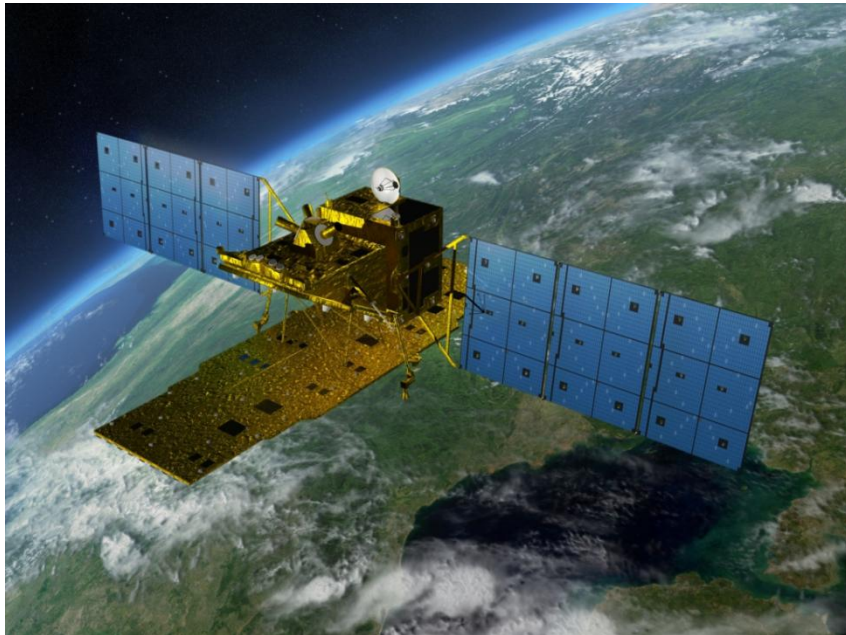
New functionalities : Pol-SAR, Pol-TomSAR and Pol-TimeSAR / Cloud-based infrastructure
 SNAP / PoISARproSIM++ / QGIS Plug-in...

PolSARpro v5.1 Software Practical session

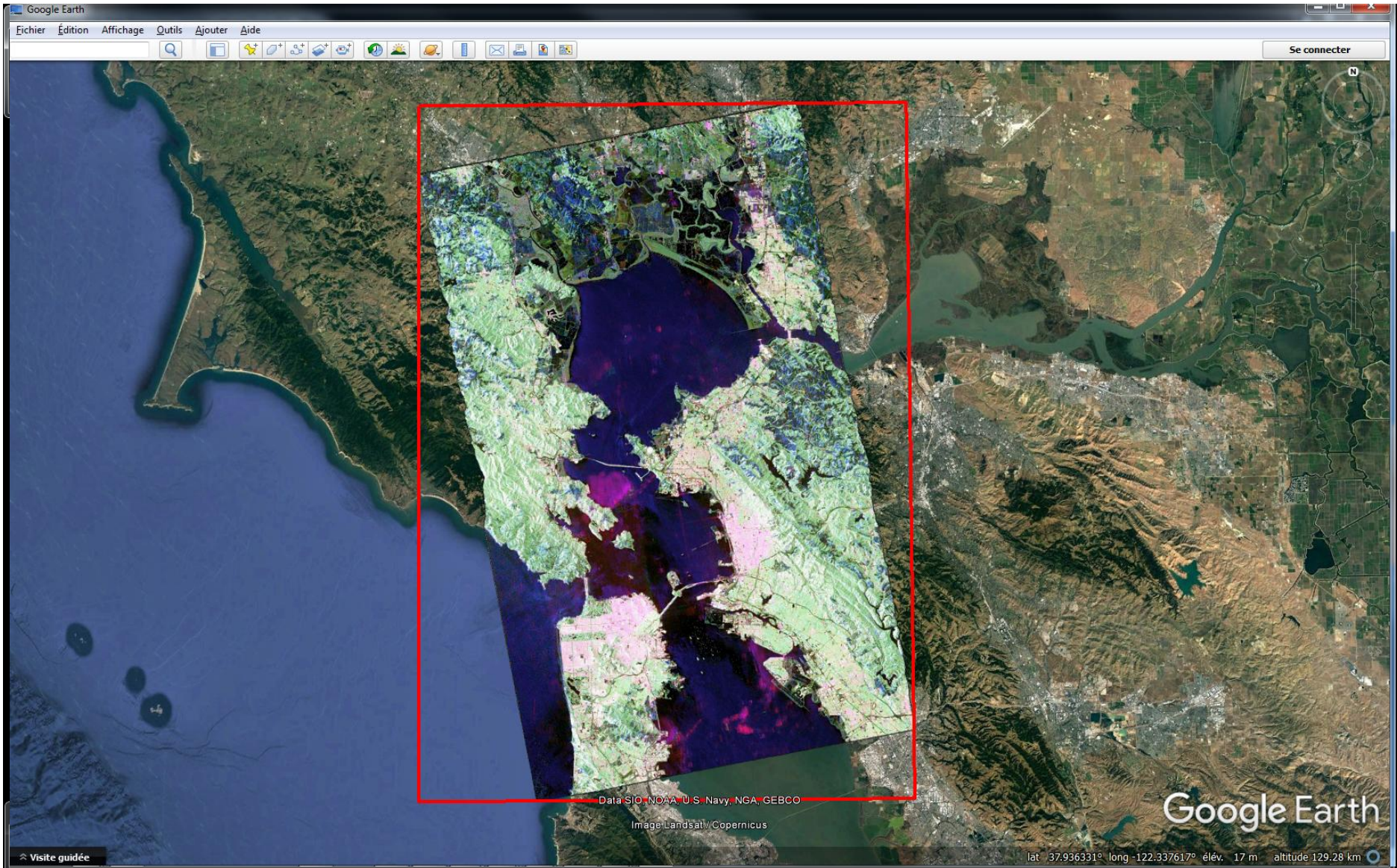
- **Installation procedure**
 - **Configuration of the PolSARpro v5.1 Software**
 - **Test the configuration**
- **Practical**
 - **Basis session**
 - **Advanced session**

PolSARpro v5.1 Software Practical session

- **Installation procedure**
 - Configuration of the PolSARpro v5.1 Software
 - Test the configuration
- **Practical**
 - **Basis session**
 - Advanced session



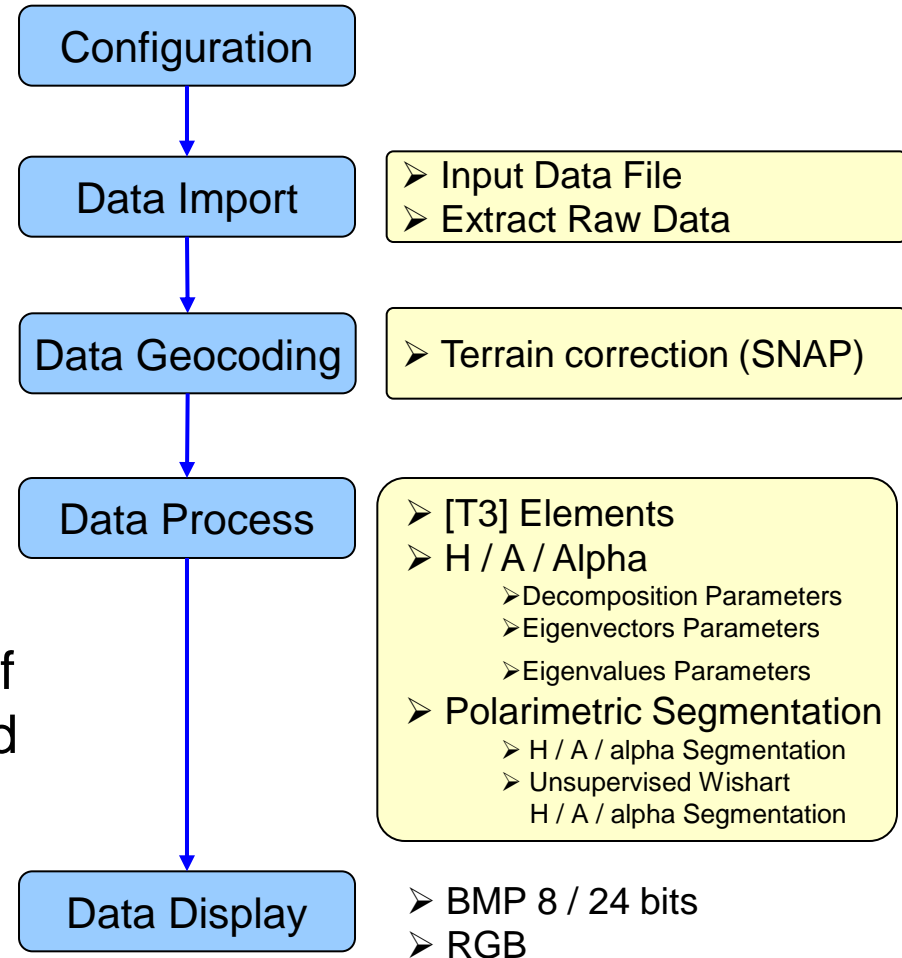
ALOS : Advanced Land Observing Satellite
PALSAR : Phase Array L-Band SAR

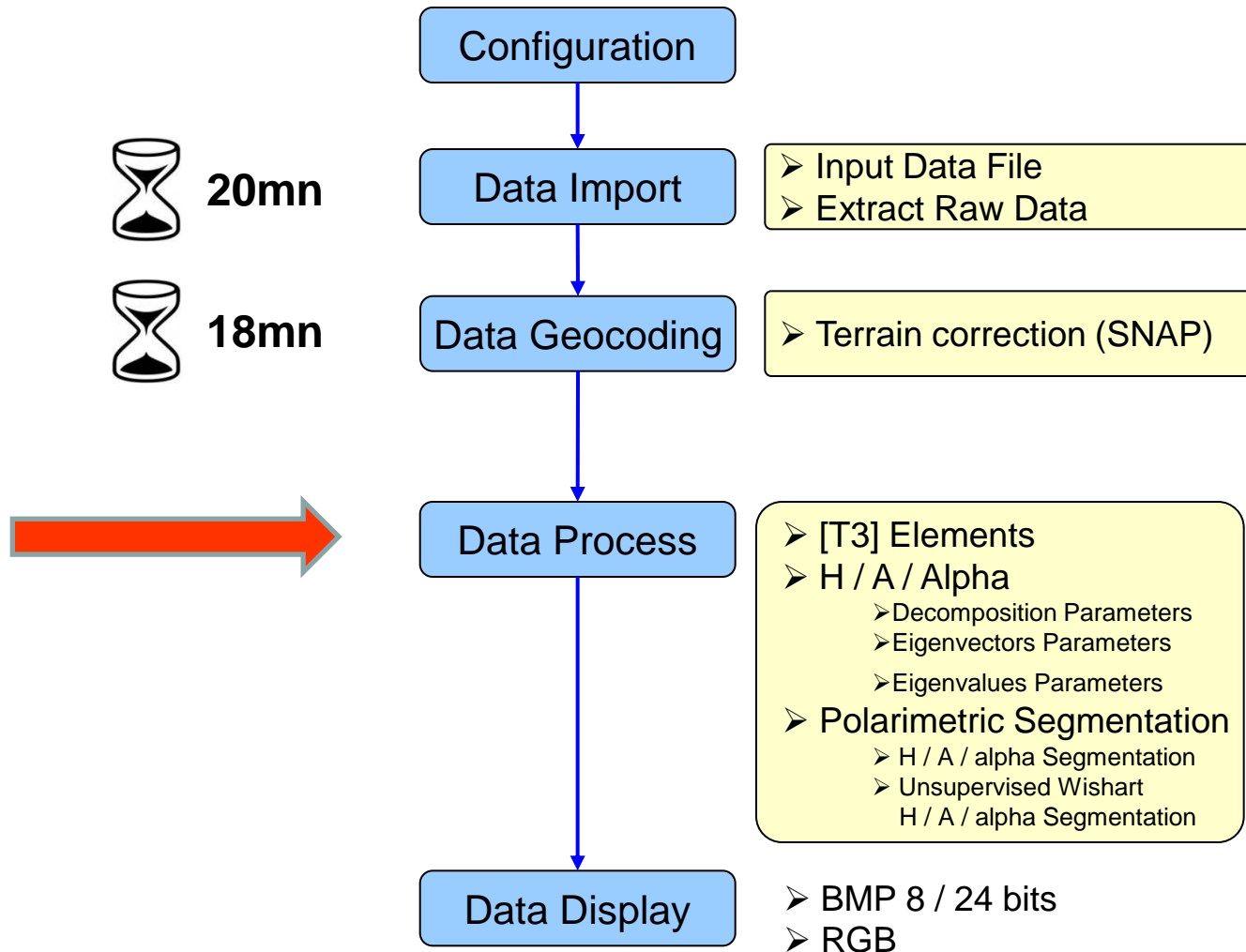


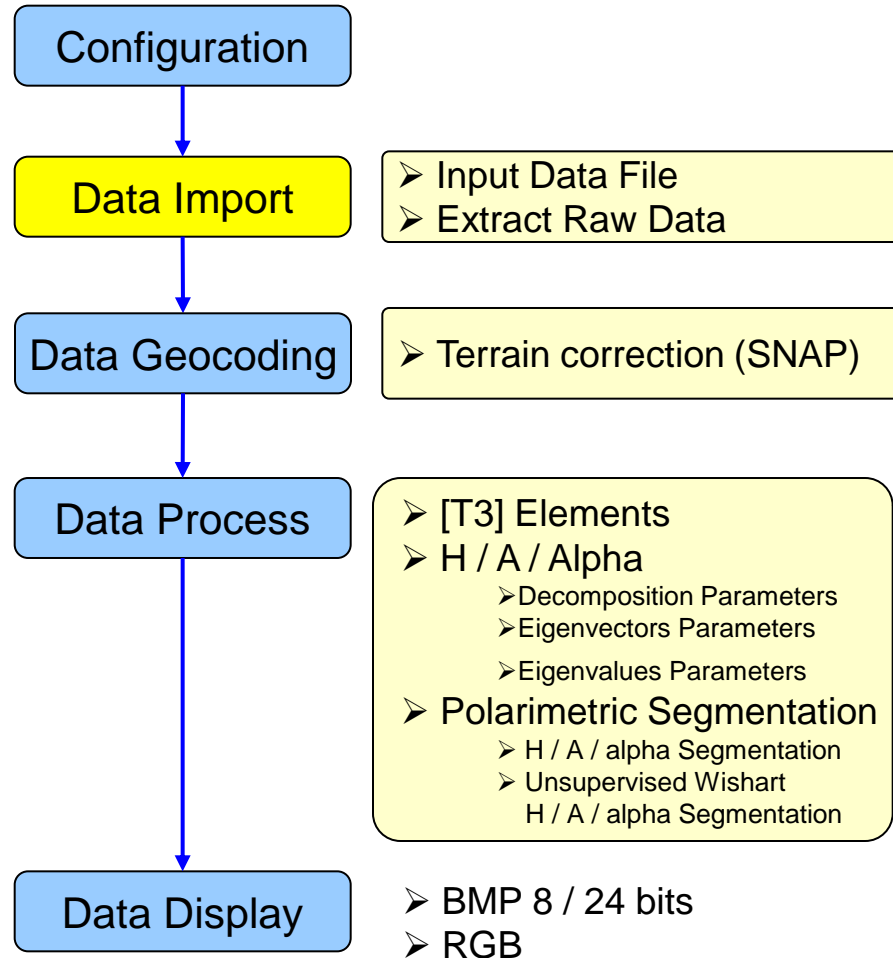
PolSARpro v5.1 Software
 performs complete **end-to-end processing** without the need for
 any other software.

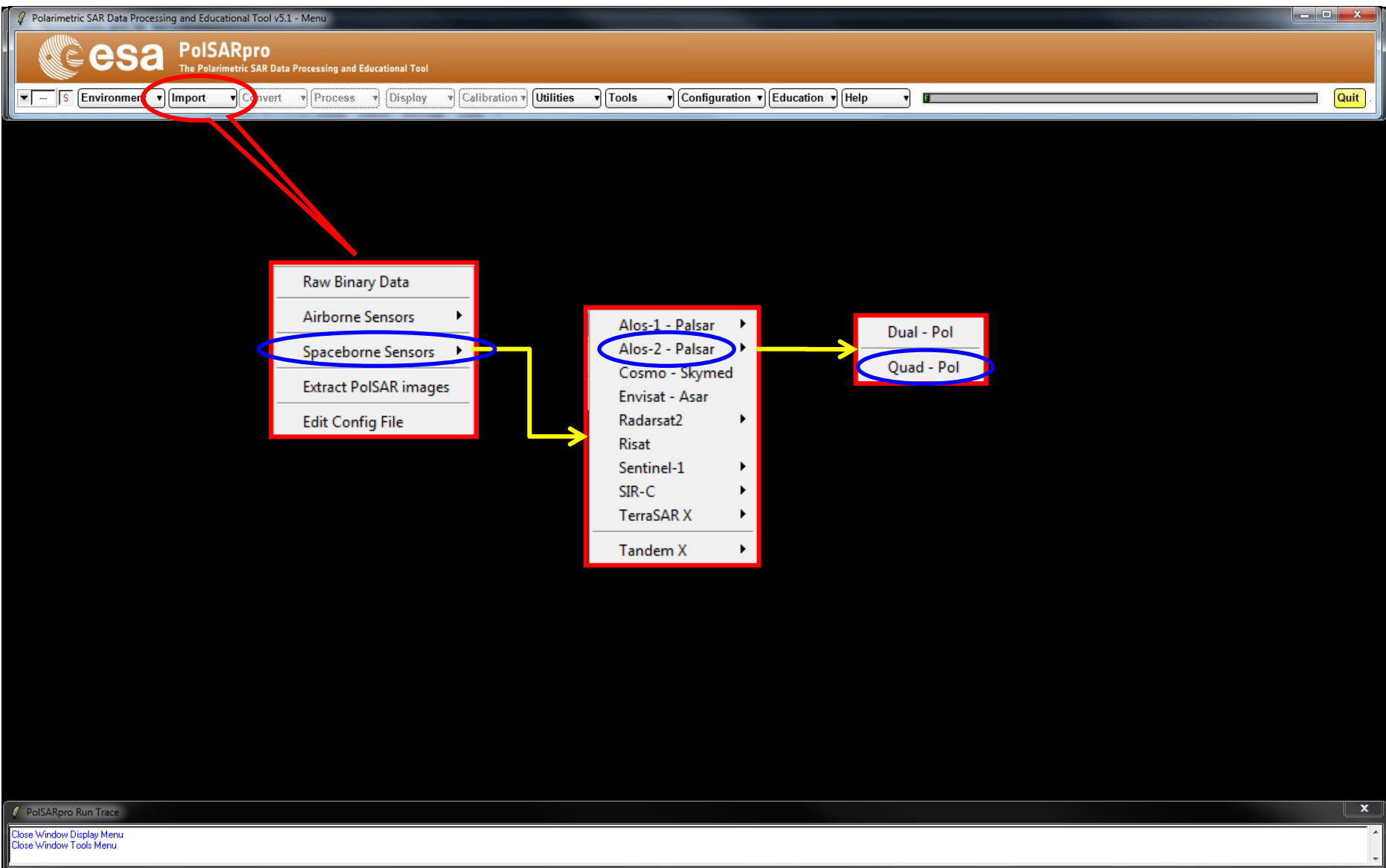
Data Processing Approach
 along a '**recommended**'
 and easy processing chain

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







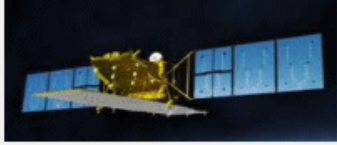


PolSARpro v5.1 - Menu

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

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

ALOS Input Data File (JAXA - CEOS Format)



Input Directory: D:/SAN_FRANCISCO_ALOS2

Output Directory: D:/SAN_FRANCISCO_ALOS2

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

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

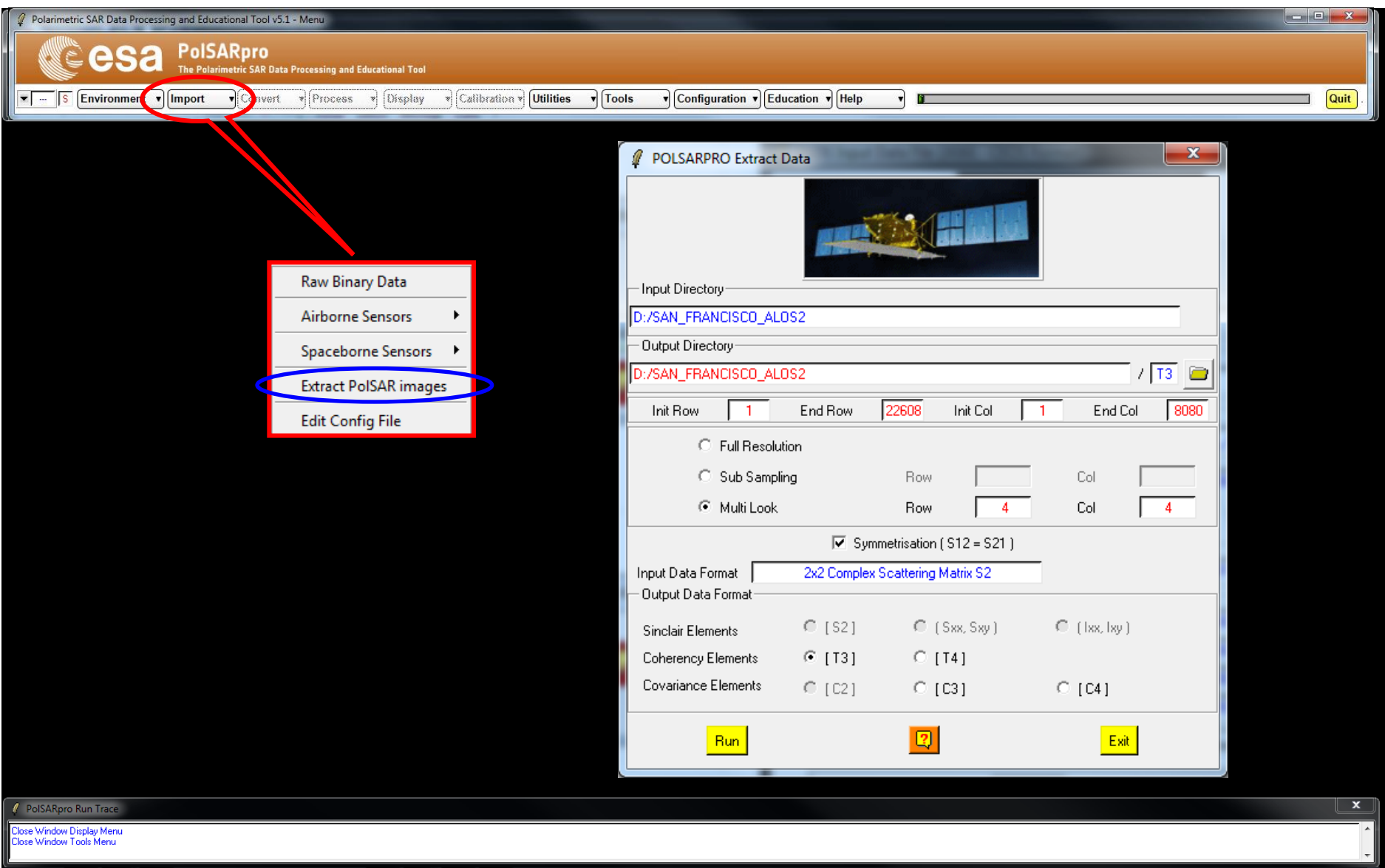
Initial Number of Rows: 22608 Initial Number of Cols: 8080

Row Pixel Spacing: 3.205713 Col Pixel Spacing: 2.860844

OK ? Cancel

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu



The screenshot displays the PolSARpro software interface. The main window title is "PolSARpro The Polarimetric SAR Data Processing and Educational Tool". The menu bar includes: Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, Help, and Quit. The "Import" menu is open, showing options: Raw Binary Data, Airborne Sensors, Spaceborne Sensors, Extract PolSAR images (highlighted with a blue circle), and Edit Config File. A red arrow points from the "Import" menu to this list.

The "POLARPRO 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: Multi Look (selected), Row: 4, Col: 4
- Symmetrisation (S12 = S21): checked
- Input Data Format: 2x2 Complex Scattering Matrix S2
- Output Data Format: Sinclair Elements [S2], Coherency Elements [T3], Covariance Elements [C2]
- Buttons: Run, Help, Exit

At the bottom, a "PolSARpro Run Trace" window shows the following text:

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

Display Pauli-RGB Image

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

esa PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 5 Environment Import Convert Process Display Calibrat

PolSARpro Run Trace

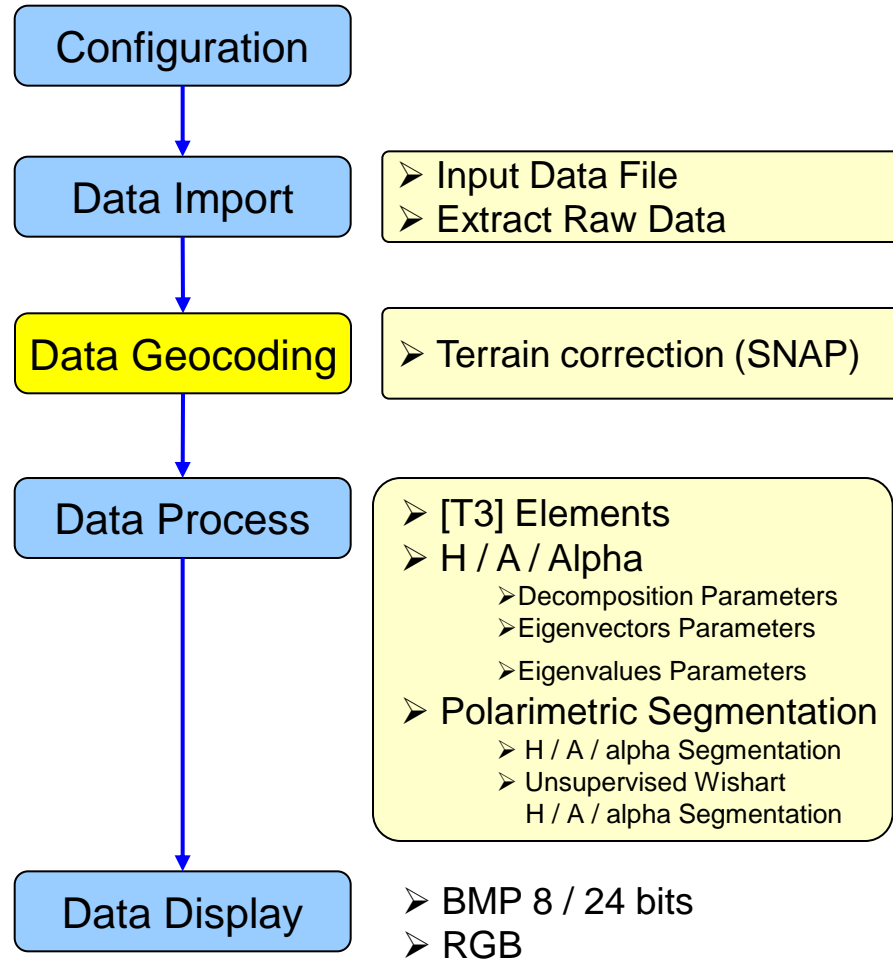
- Close Window Display Menu
- Close Window Tools Menu

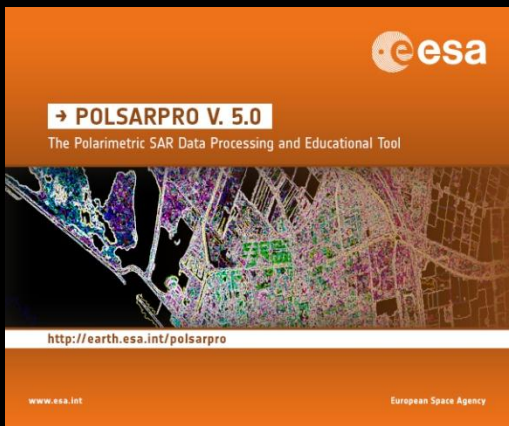
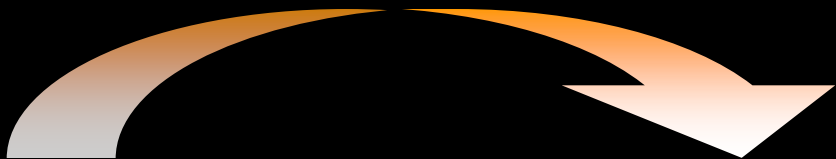
[PauliRGB] (importée)-13.0 (Couleu... - [X]

Fichier Édition Sélection Affichage Image Calque

px 125% PauliRGB.bmp (10...

Quit

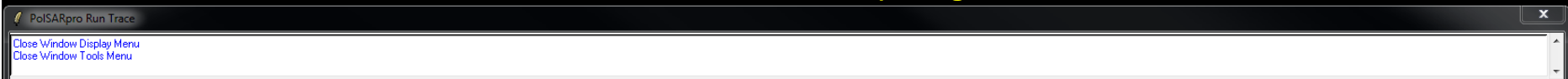


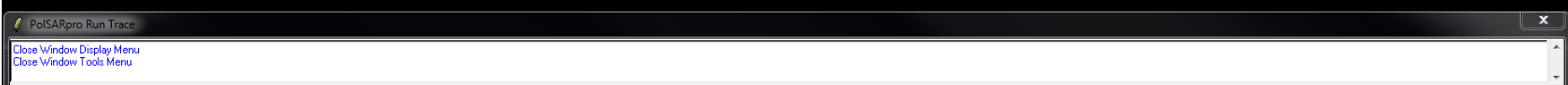
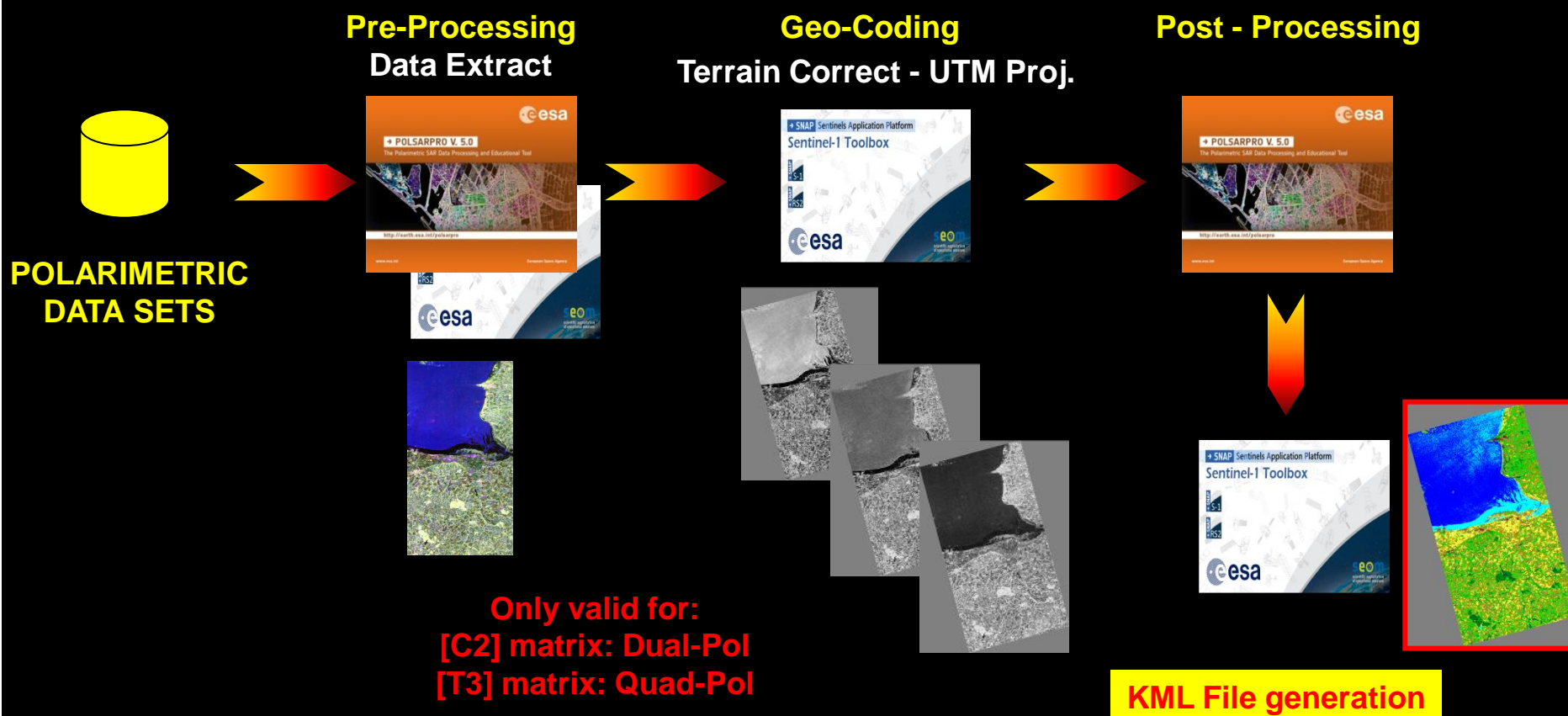


Polariametric Data Processing



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



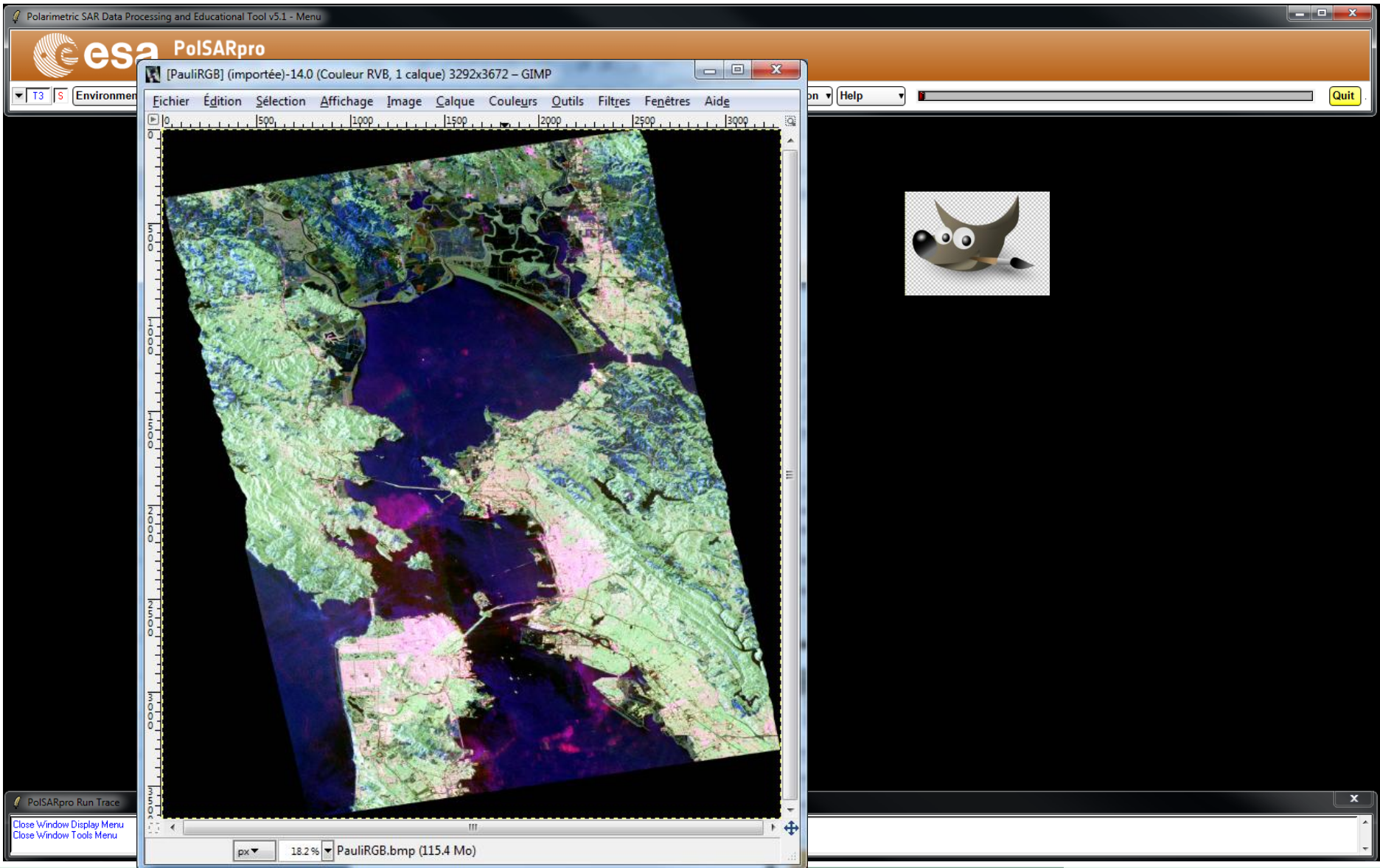


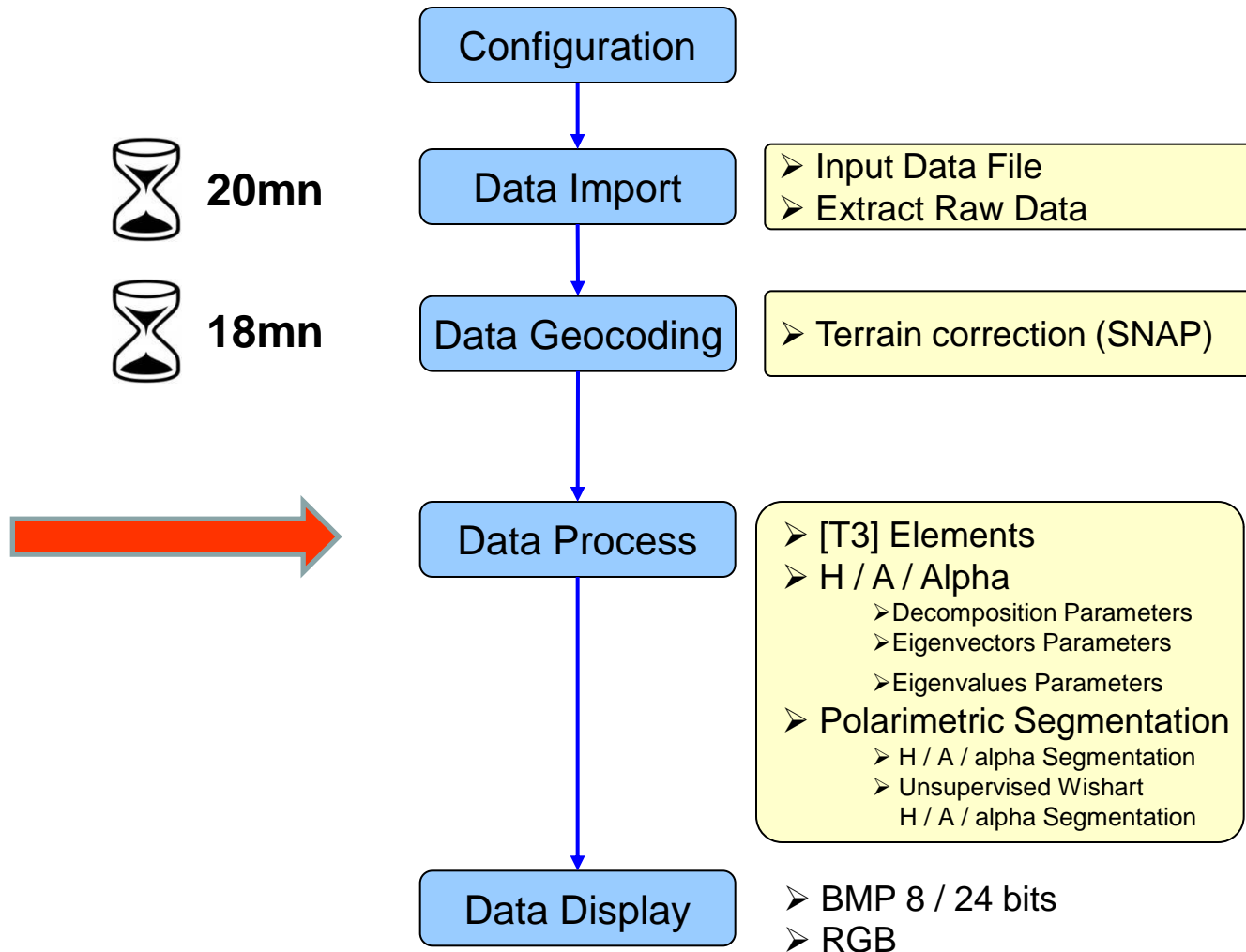
The screenshot displays the PoISARpro v5.1 software interface. The main window title is "Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu". The menu bar includes "Environment", "Import", "Convert", "Process", "Display", "Calibration", "Utilities", "Tools", and "Configuration". The "Utilities" menu is open, showing options like "PoISARpro - Calculator", "SATIM Map Algebra", "SNAP - S1 TBX", "SRTM", "ASTER", "GIMP", "GOOGLE EARTH", and "Close All Widgets". The "SNAP - S1 TBX" option is highlighted with a blue oval. A yellow arrow points from this option to a smaller dialog box titled "Geocode [C2] matrix", which contains "Geocode [T3] matrix" and "Geocode Parameter" options. Another yellow arrow points from "Geocode [T3] matrix" to the "SNAP - Geocode Matrix" dialog box. This dialog box is open and shows the following settings:

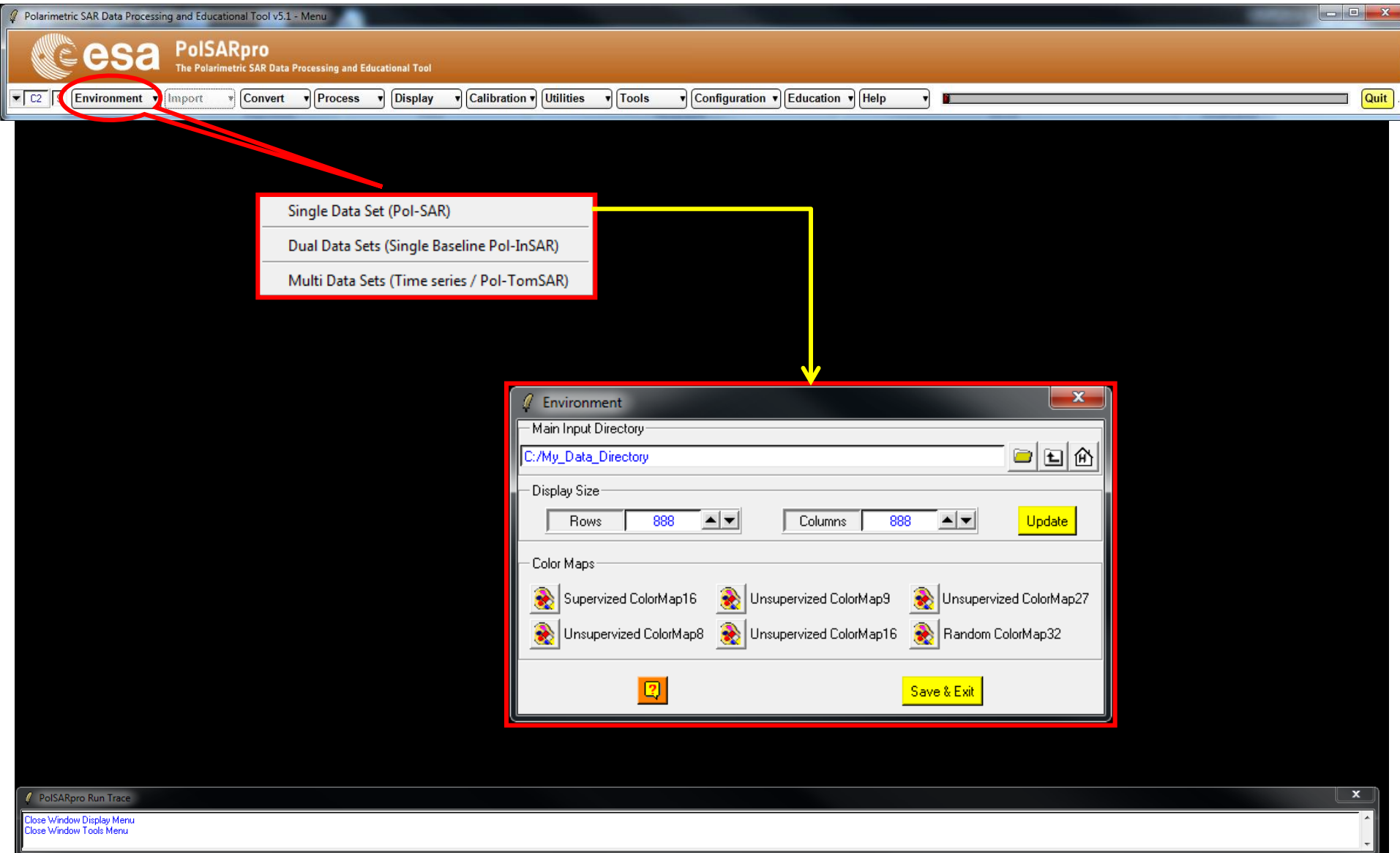
- Input Directory: D:/SAN_FRANCISCO_ALOS2/T3
- Output Directory: D:/SAN_FRANCISCO_ALOS2_SNAP / T3
- Polarimetric SAR Sensor: ALOS-2 (CEOS)
- SAR Volume File: D:/SAN_FRANCISCO_ALOS2/VOL-ALOS2044980750-150324-HBQR1.1_A
- Source GR Pixel Spacings: Azimut (m) 12.82284, Range (m) 20.53052, Pixel Spacing (m) 20.53052
- Input Multi Look: Azimut 4, Range 4
- Output Multi Look: Azimut 1, Range 1
- Image Resampling Method: Bilinear
- Digital Elevation Model (DEM): S.R.T.M
- DEM Resampling Method: Bilinear
- Save Auxiliary Files: DEM, Local Incidence Angle, Projected Local Incidence Angle from DEM
- Default Parameters: Geocoding: Latitude / Longitude, Datum: WGS84, Input Format: PoISARpro, Output Format: PoISARpro

Buttons for "OK", "Exit", and a help icon are visible at the bottom of the dialog box.

Display Pauli-RGB Image

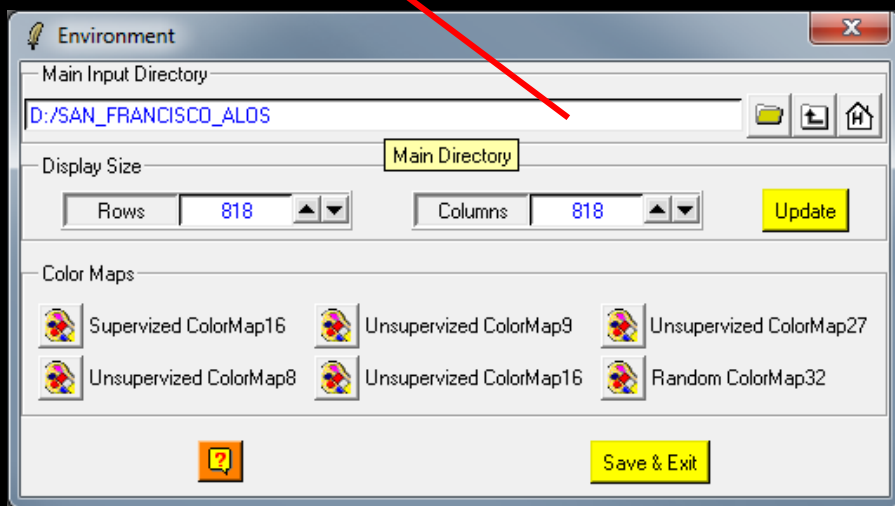






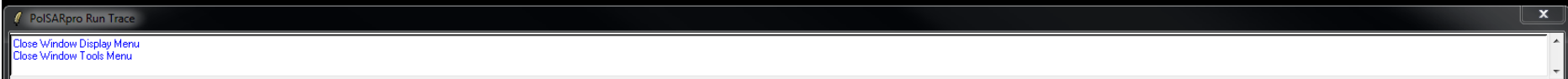


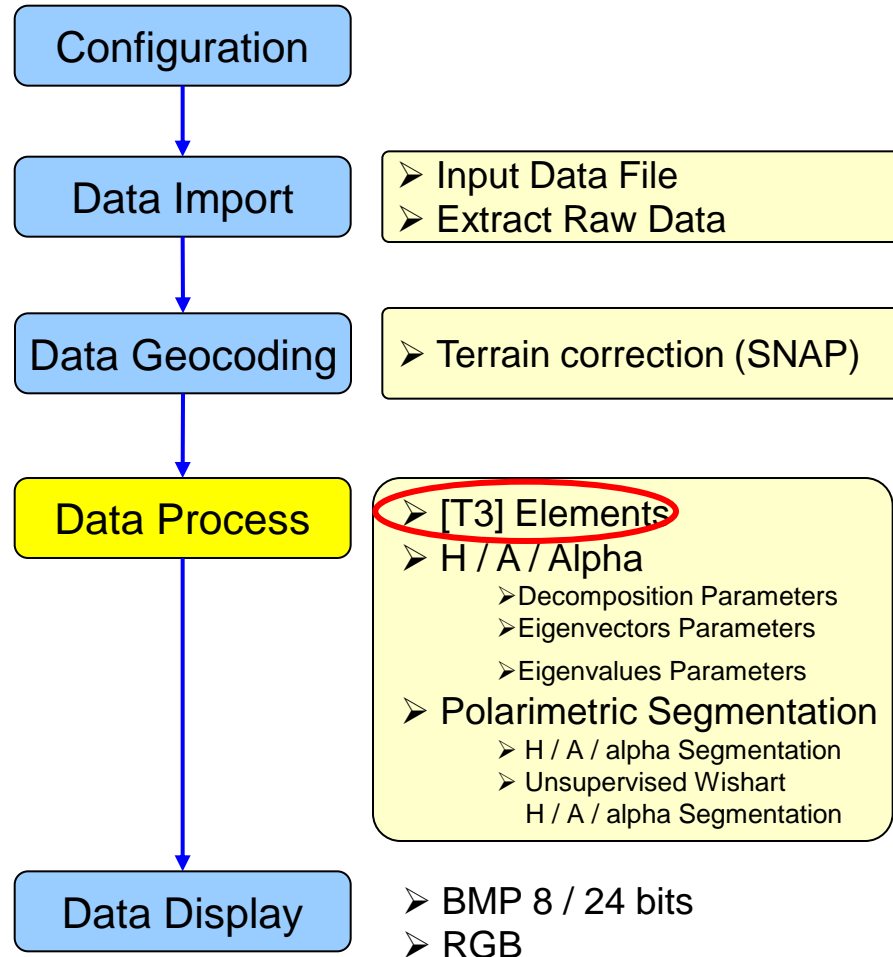
Configure Data Main Directory location



Input Data Directory :

C:\esa \ D2P2_Pottier&Ferro-Famil \ SAN_FRANCISCO_ALDS2_SNAP





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)

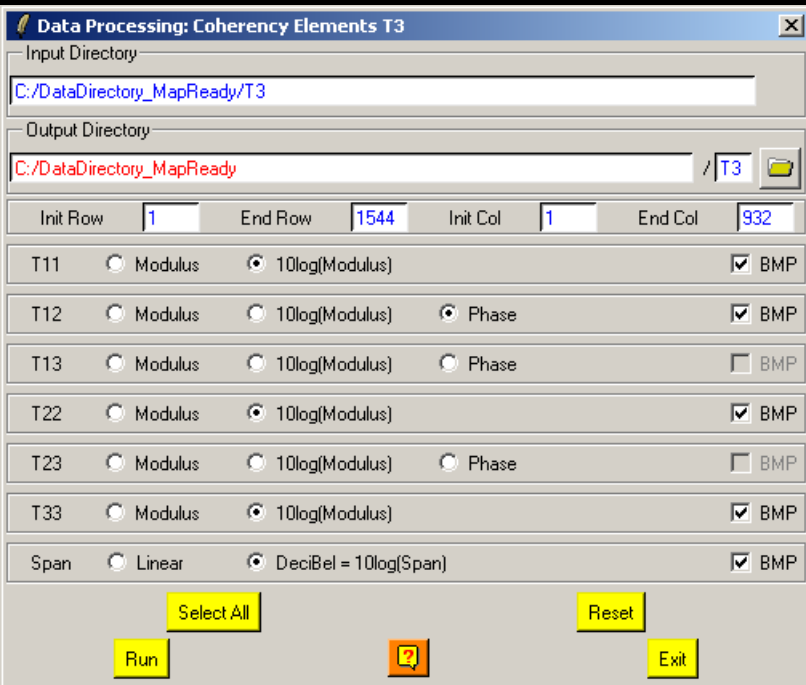
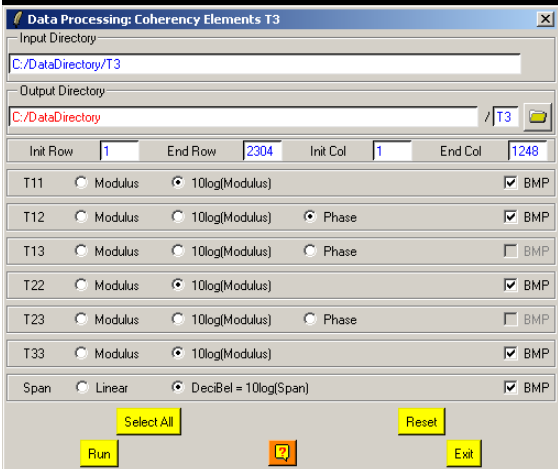
Polarisation Synthesis
Polarimetric Signature
Stokes Parameters
Compact Polarimetric Mode
O.P.C.E
R.C.S Max
Surface Inversion
RVOG PolSAR Inversion
Sub-Aperture Analysis
DEM Estimation
Polarisation Orientation Compensation

Decomposition Applications

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

ADVANCED LAND REMOTE SENSING INTERNATIONAL WORKSHOP
20-25 November 2017 | Yunnan Normal University Kunming, Yunnan Pr

“龙计划4”高级遥感应用培训班
2017年11月20日—11月25日 云南师范大学, 中国, 昆明



DATADIR

T3

config.txt
[T3x3] Elements

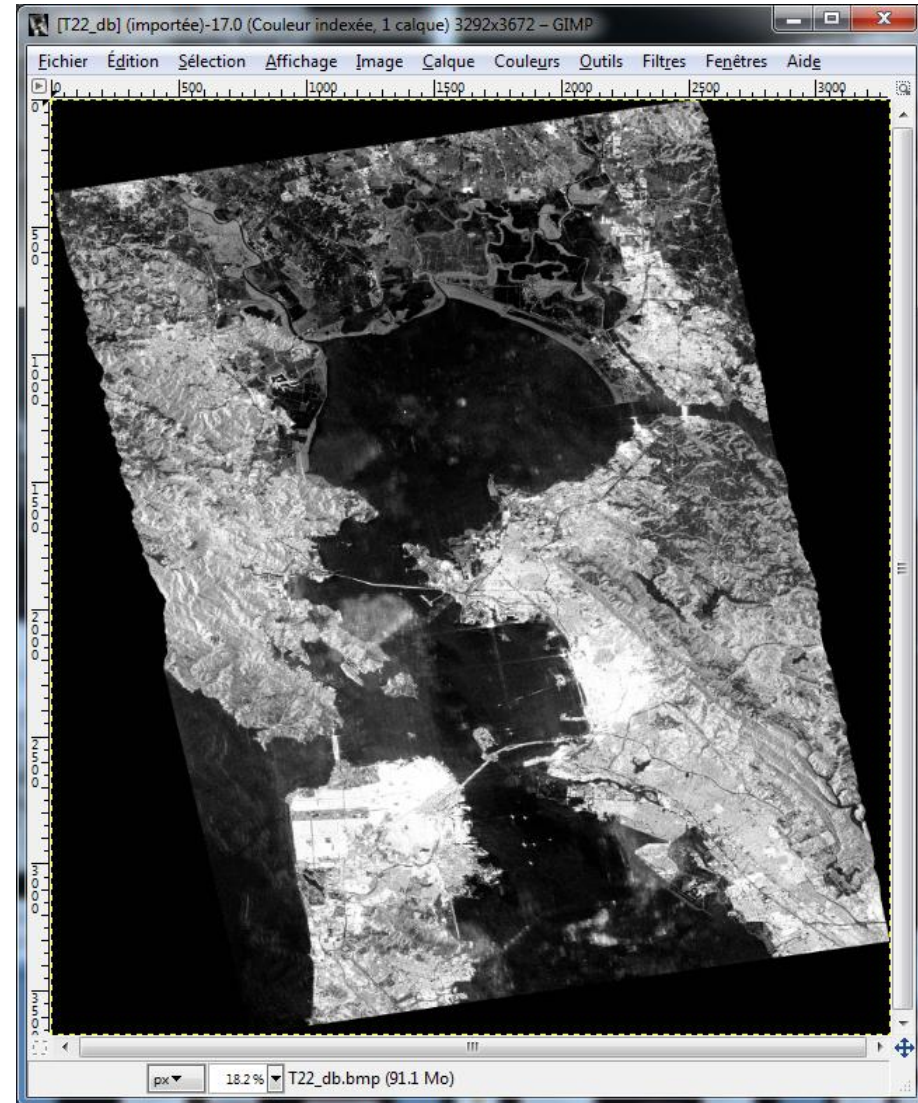
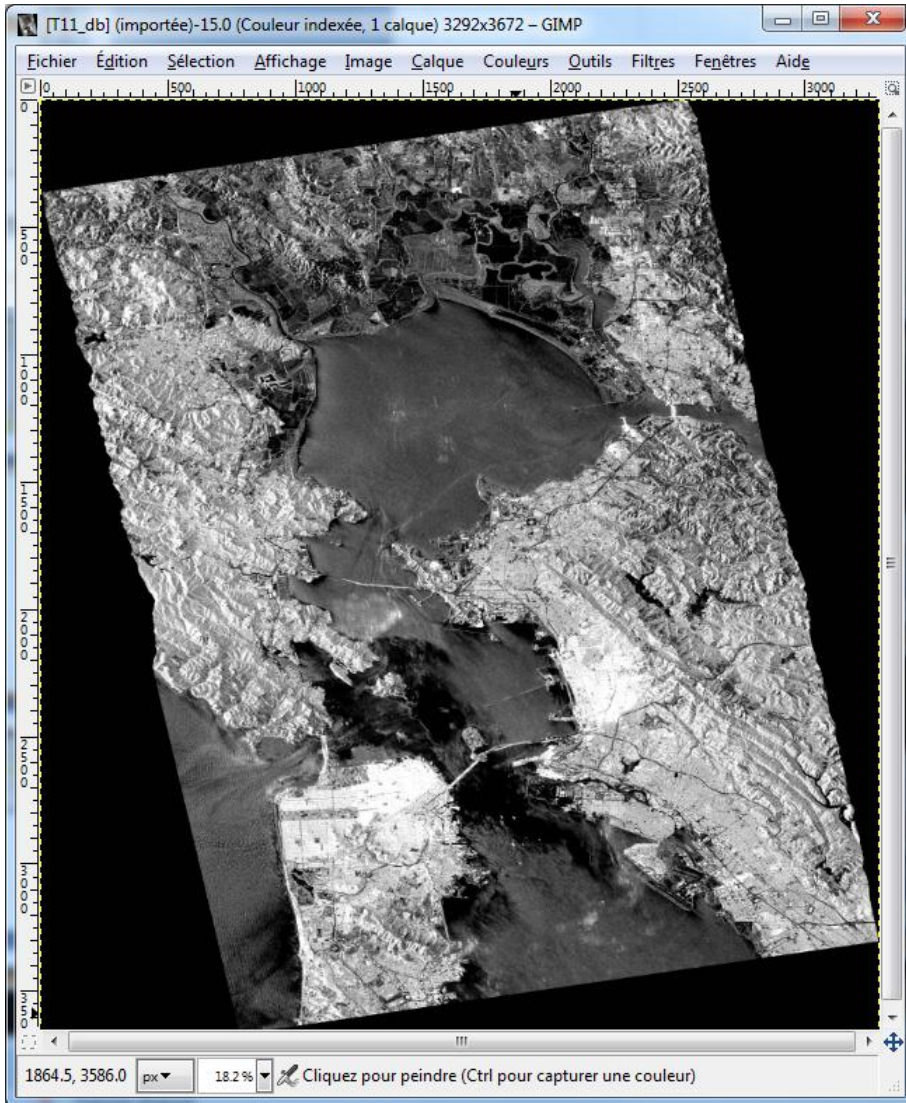
Txy_mod.bin
Txy_db.bin
Txy pha.bin
Txy_mod.bmp
Txy_db.bmp

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



T11_dB

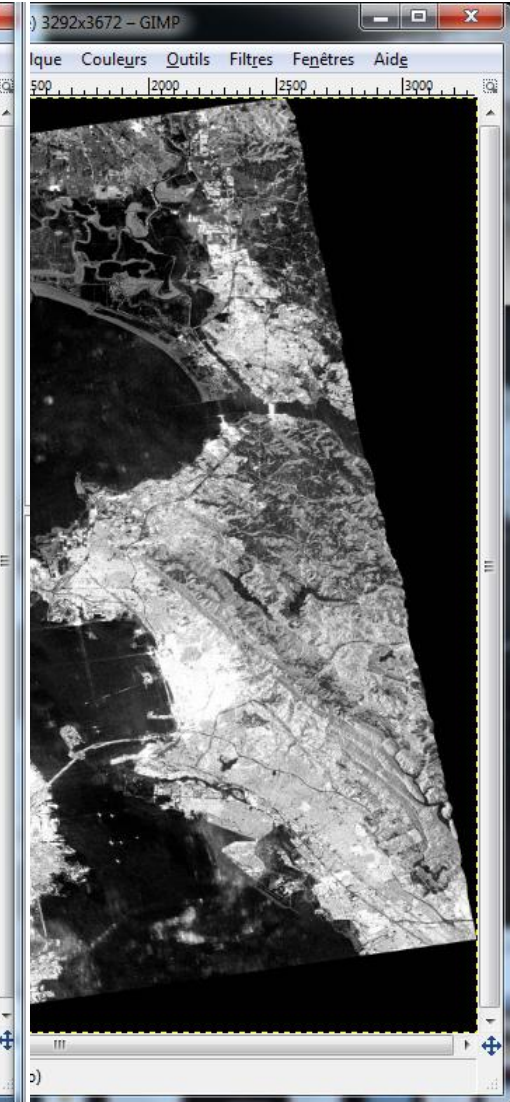
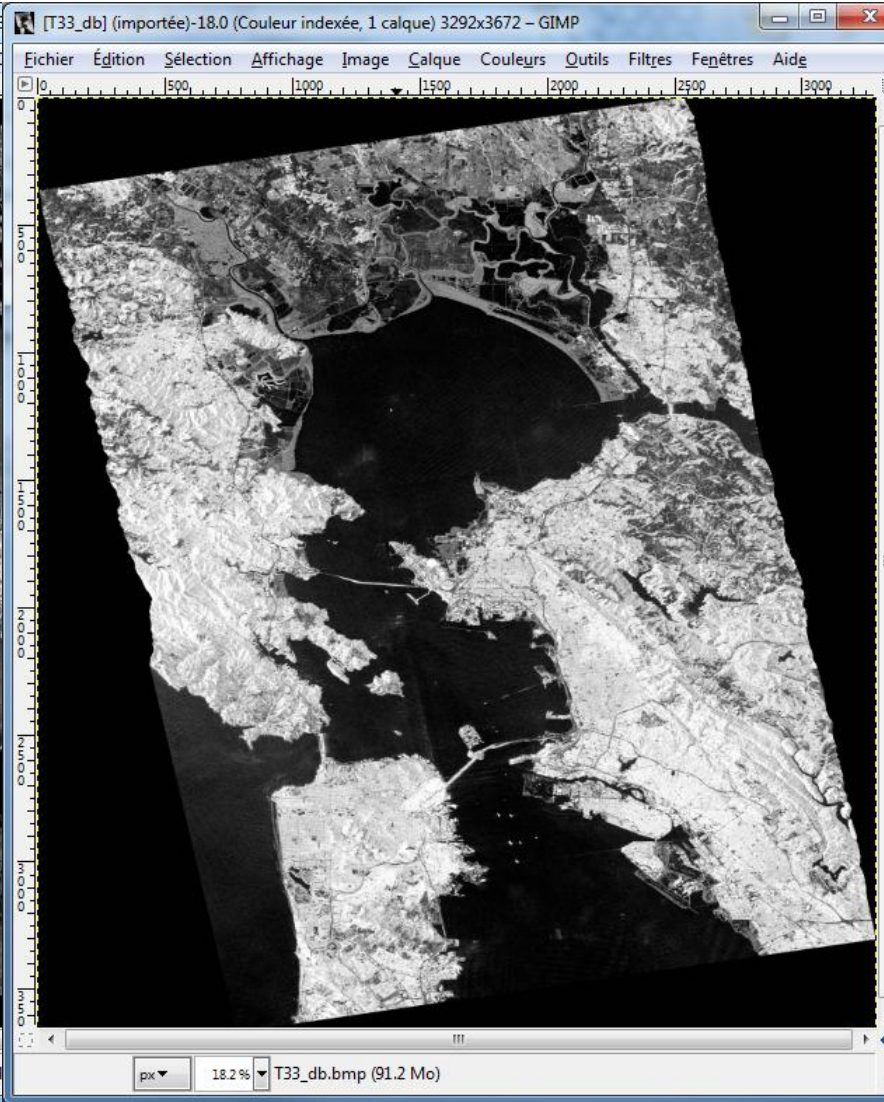
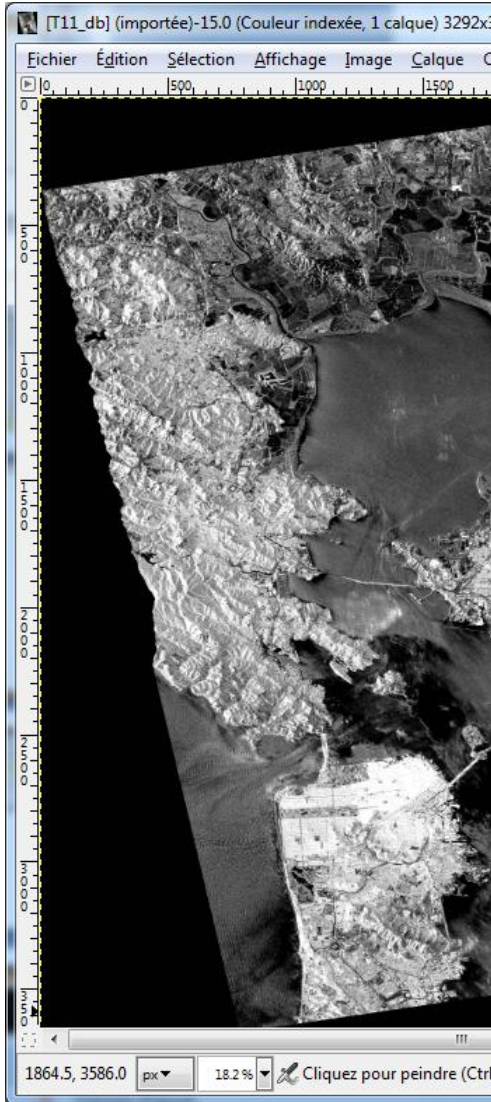
T22_dB



T11_db

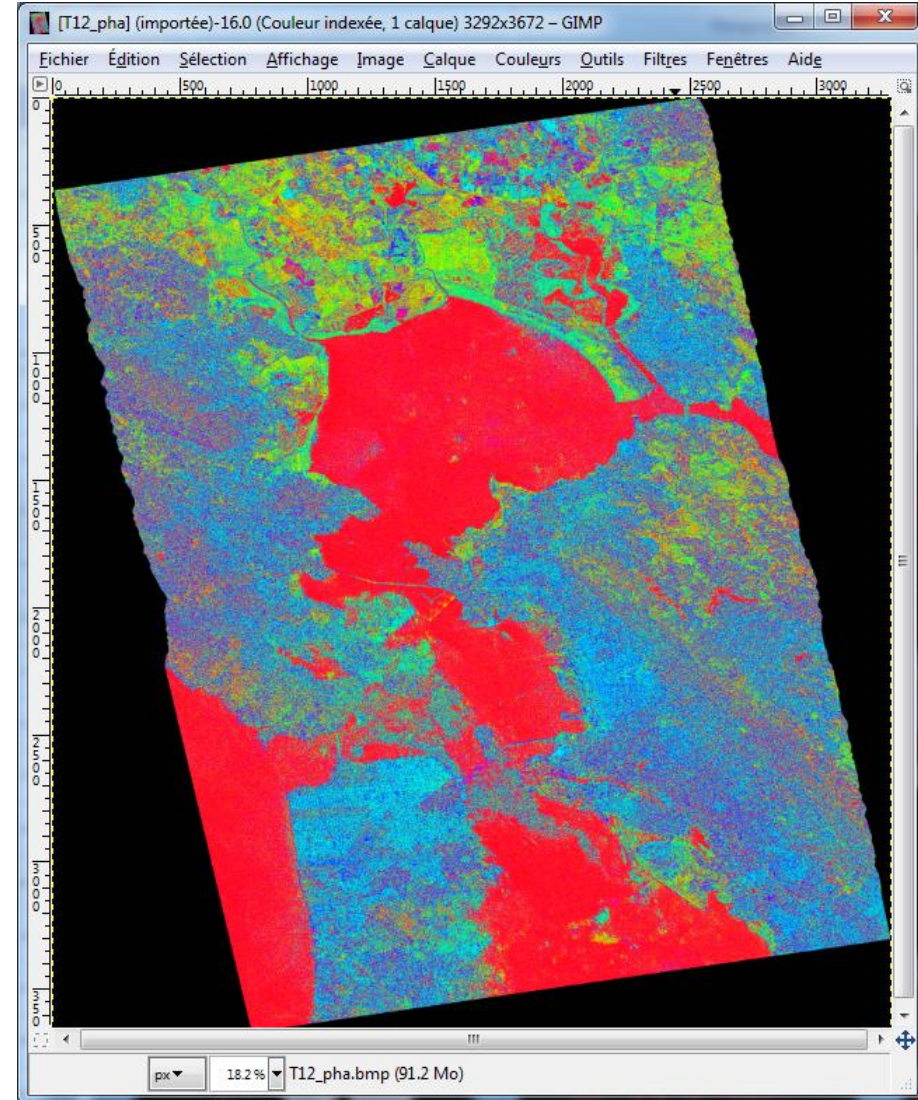
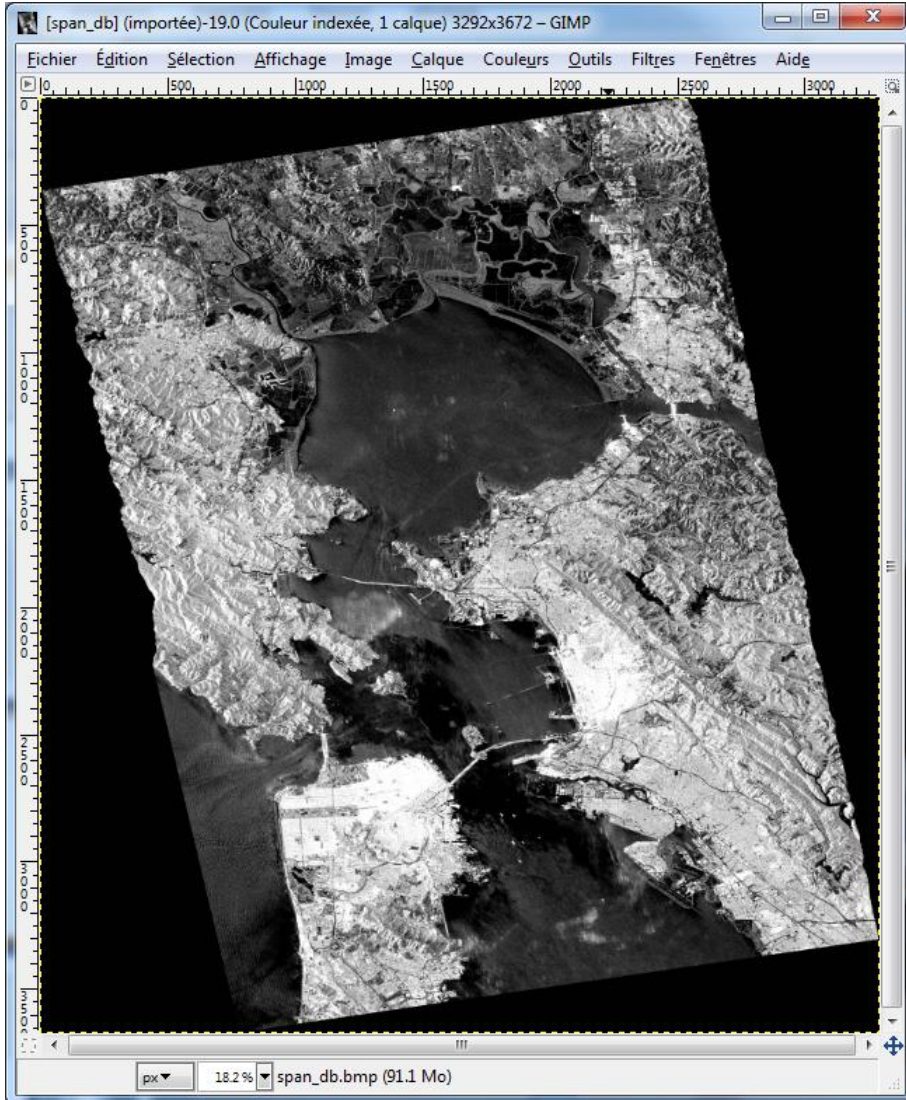
T33_db

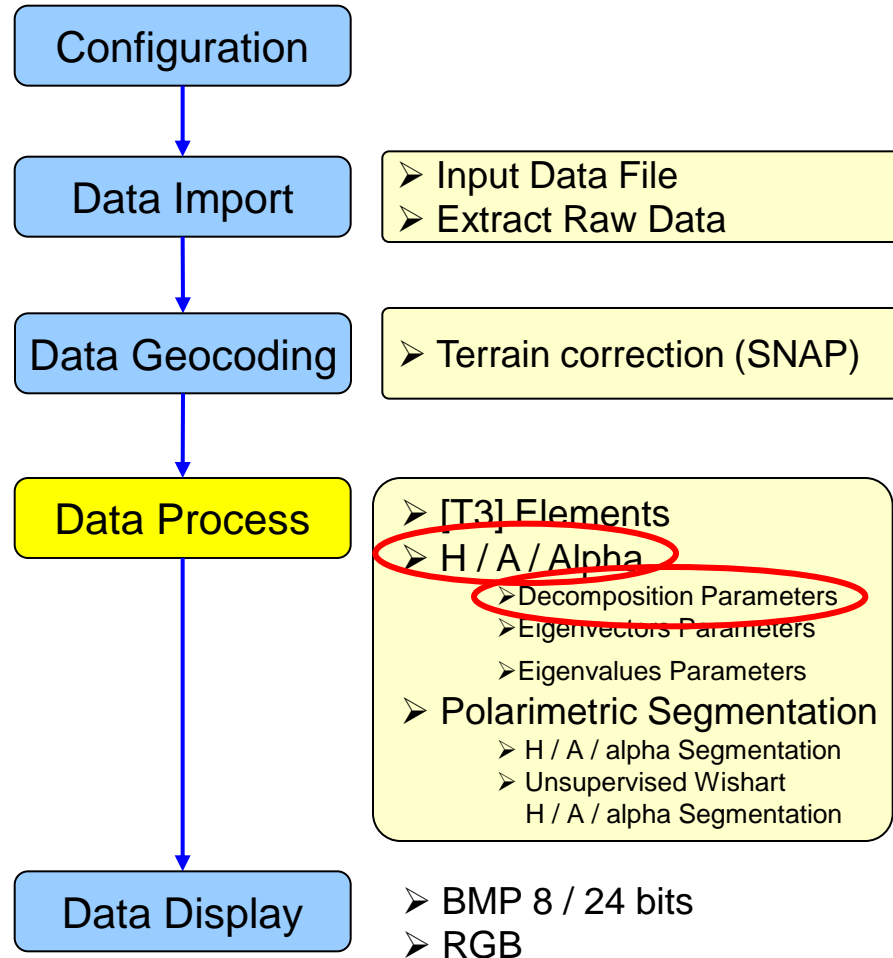
T22_db



span_db

T12_pha





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

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Eigenvalue Set Parameters

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YAM3 : Yamaguchi 3 Components Decomposition
YAM4 : Yamaguchi 4 Components Decomposition
NEU : Neumann 2 Components Decomposition
KRO : Krogager Decomposition
CAM : Cameron Decomposition
TSVM : Touzi Decomposition

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

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

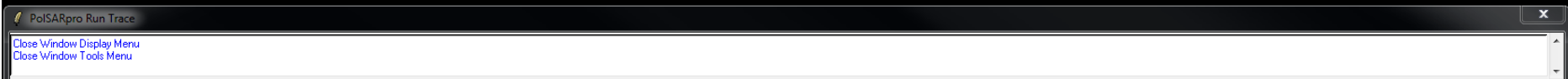
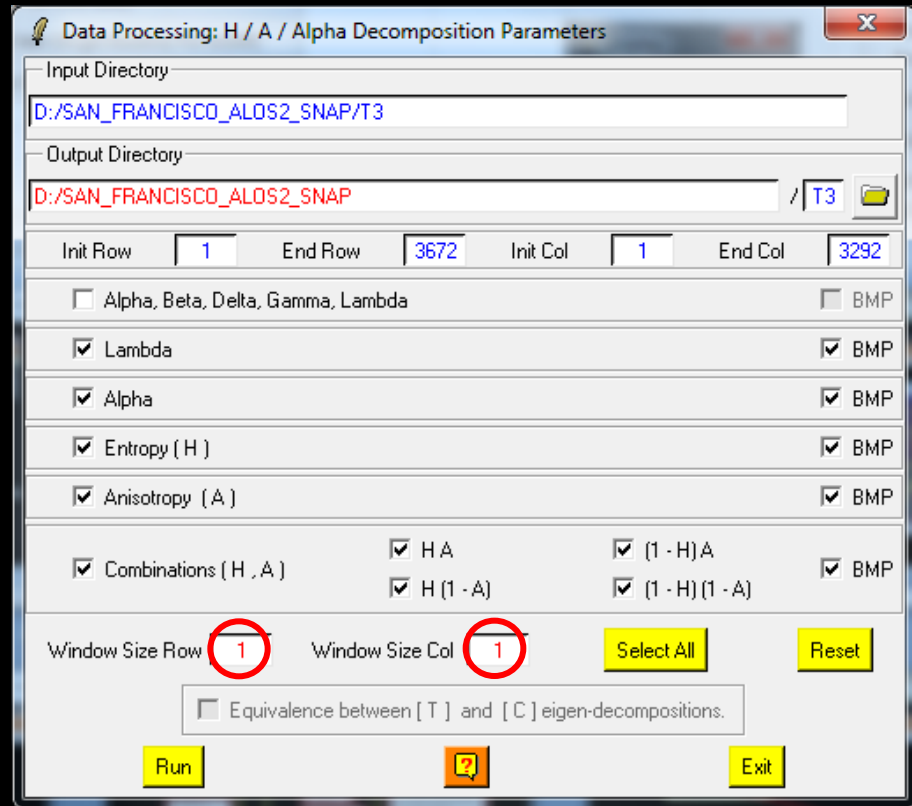
Data Statistics
Data Histograms
Data Profiles
Histogram Based Statistics
Texture Analysis

Clustering Process
Parameter Averaging
Data Sets Averaging

Decomposition Applications

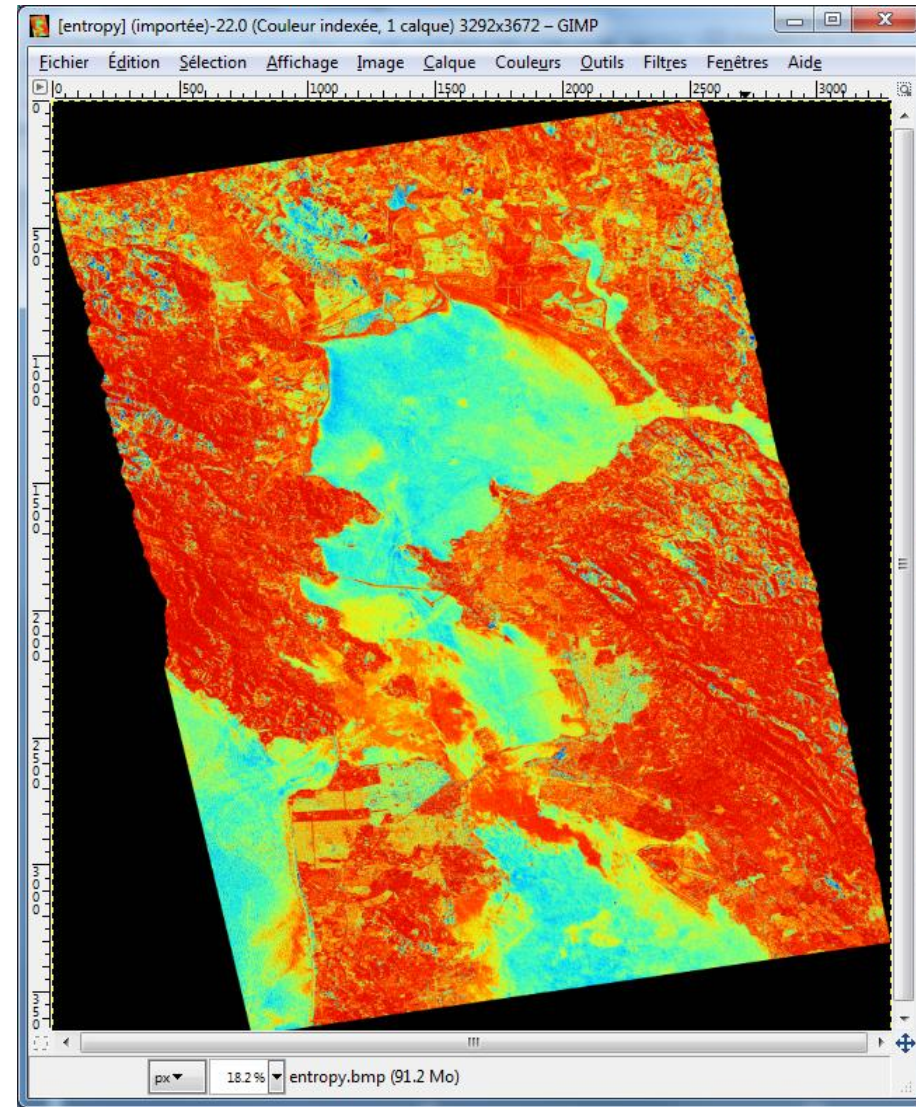
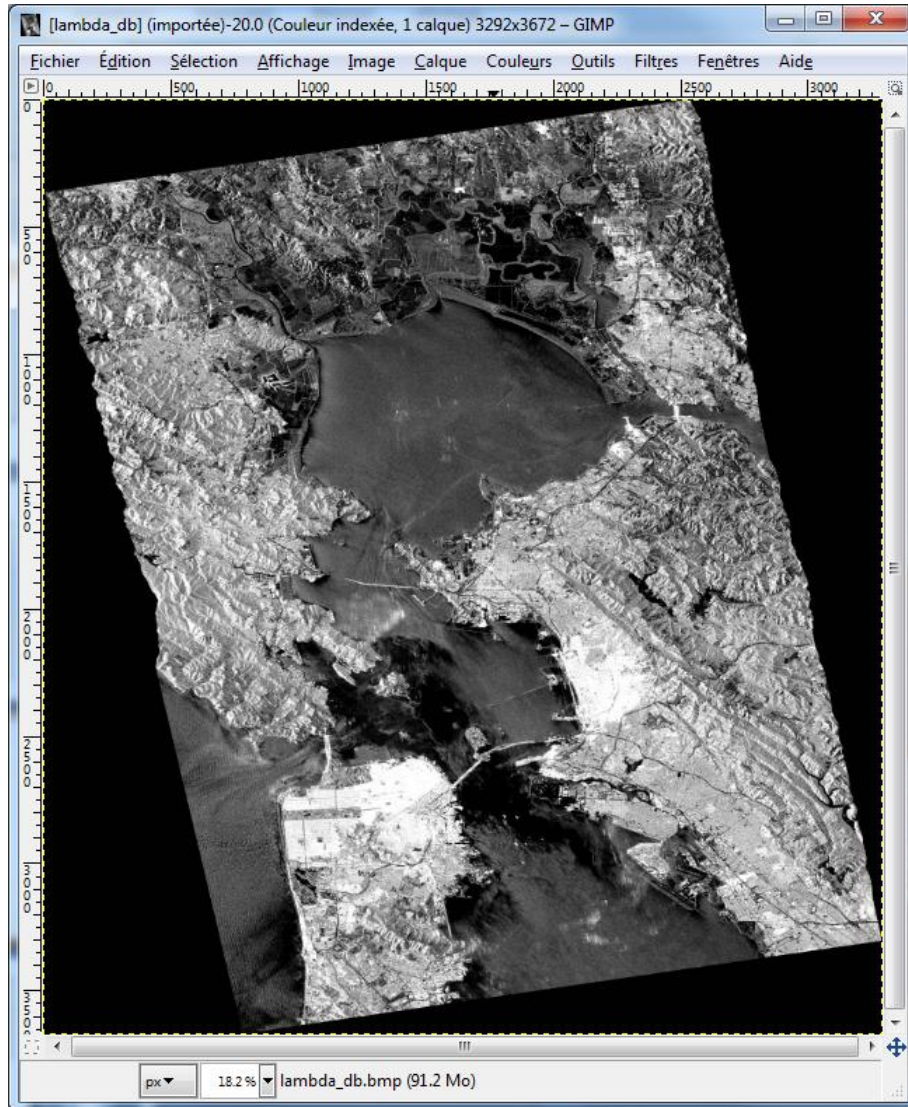


Do it Yourself:
Select some elements, set the parameters (Nwin = 1) and view the corresponding BMP files (select BMP).



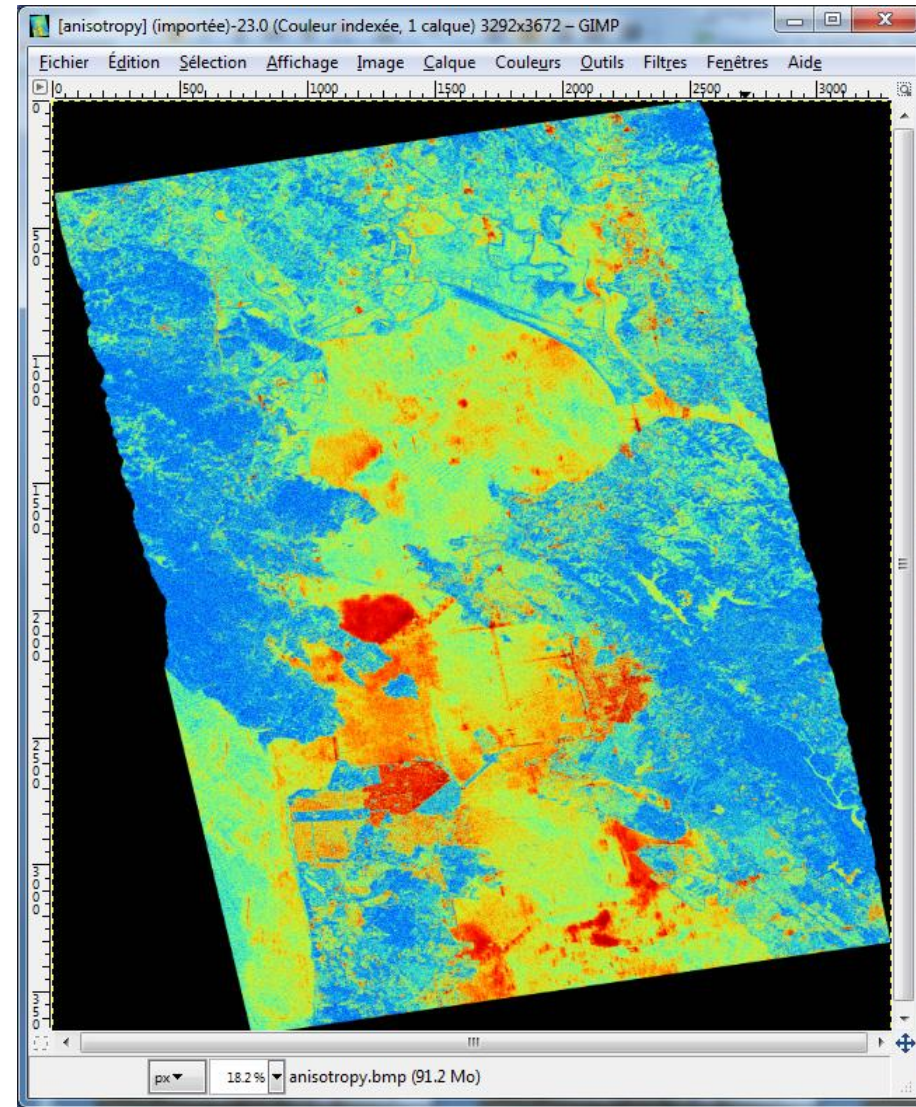
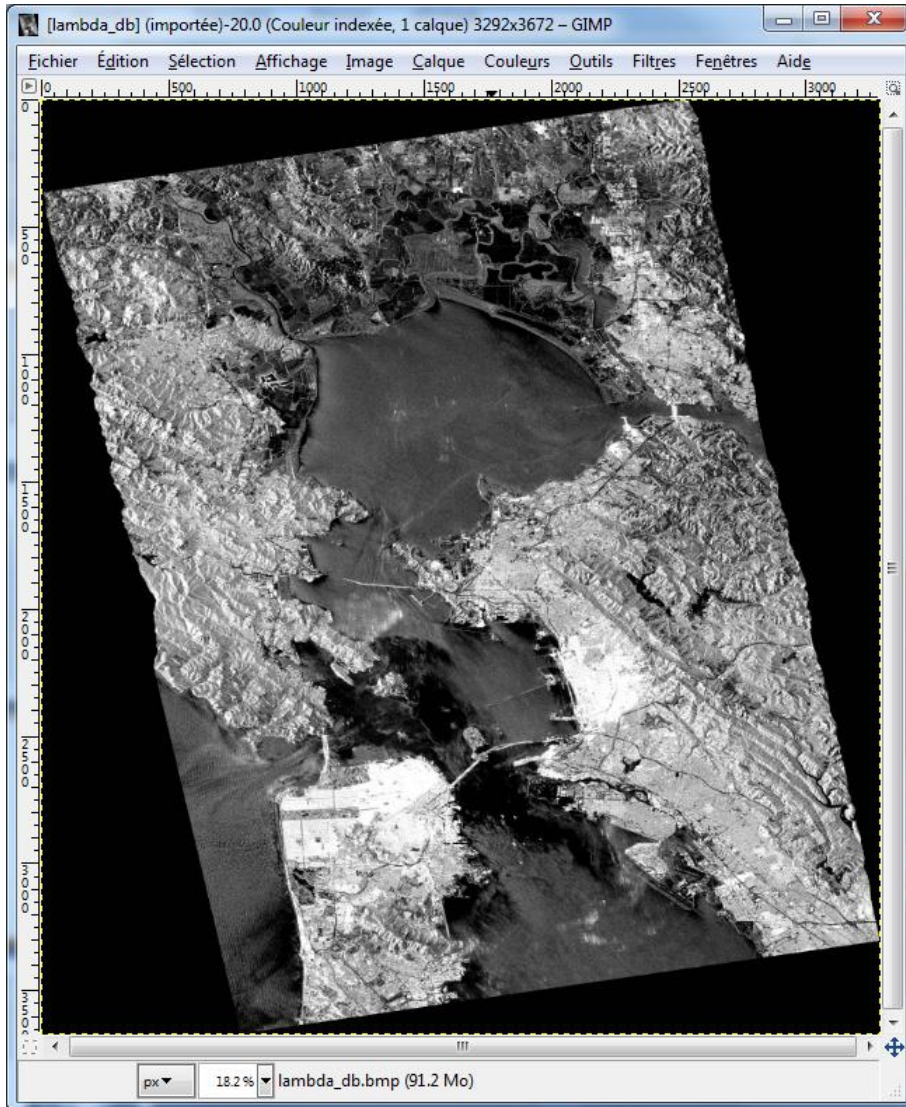
Lambda

Entropy



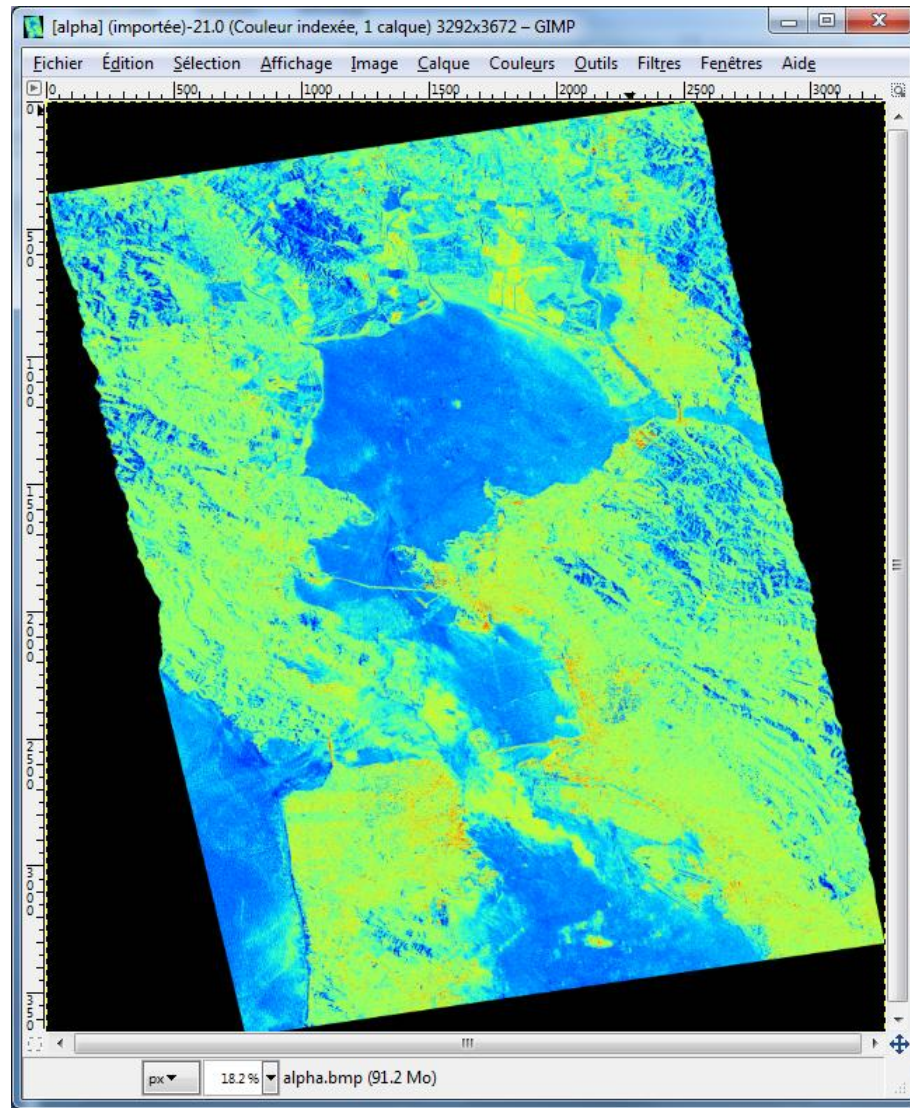
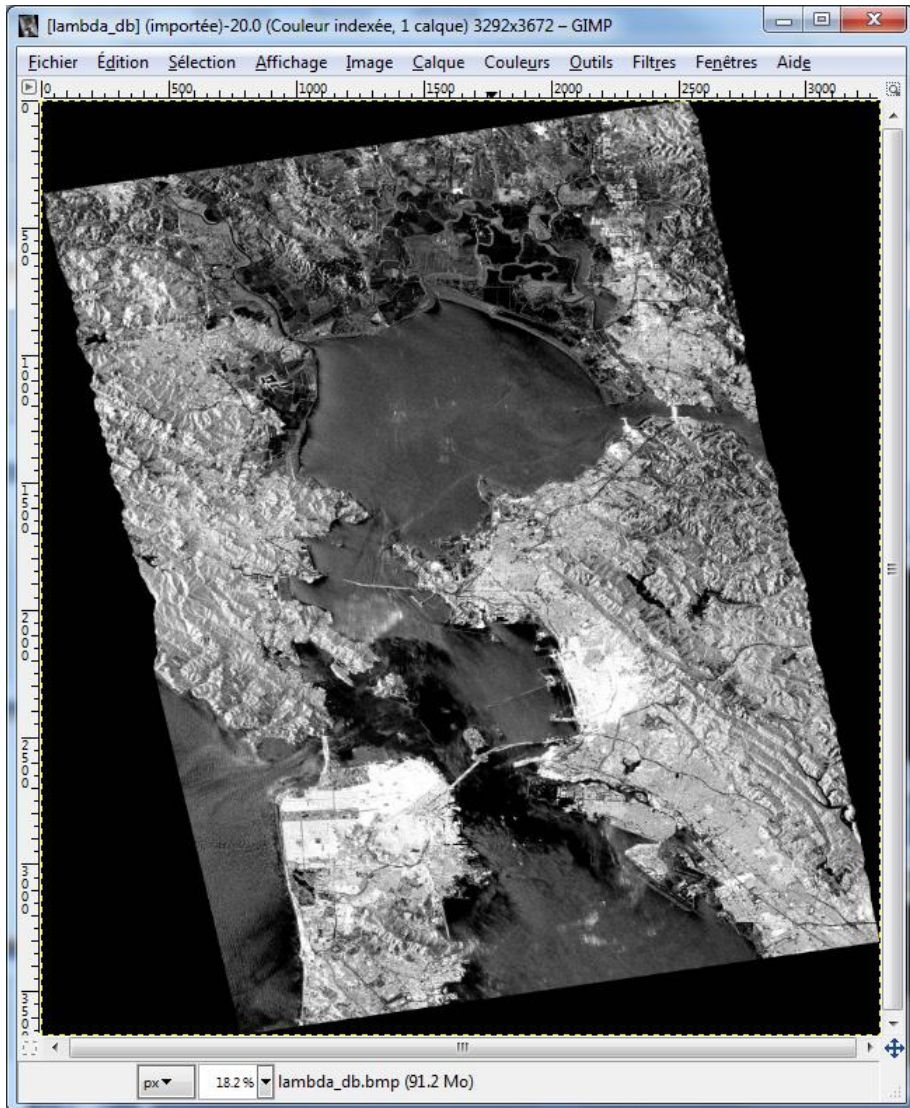
Lambda

Anisotropy



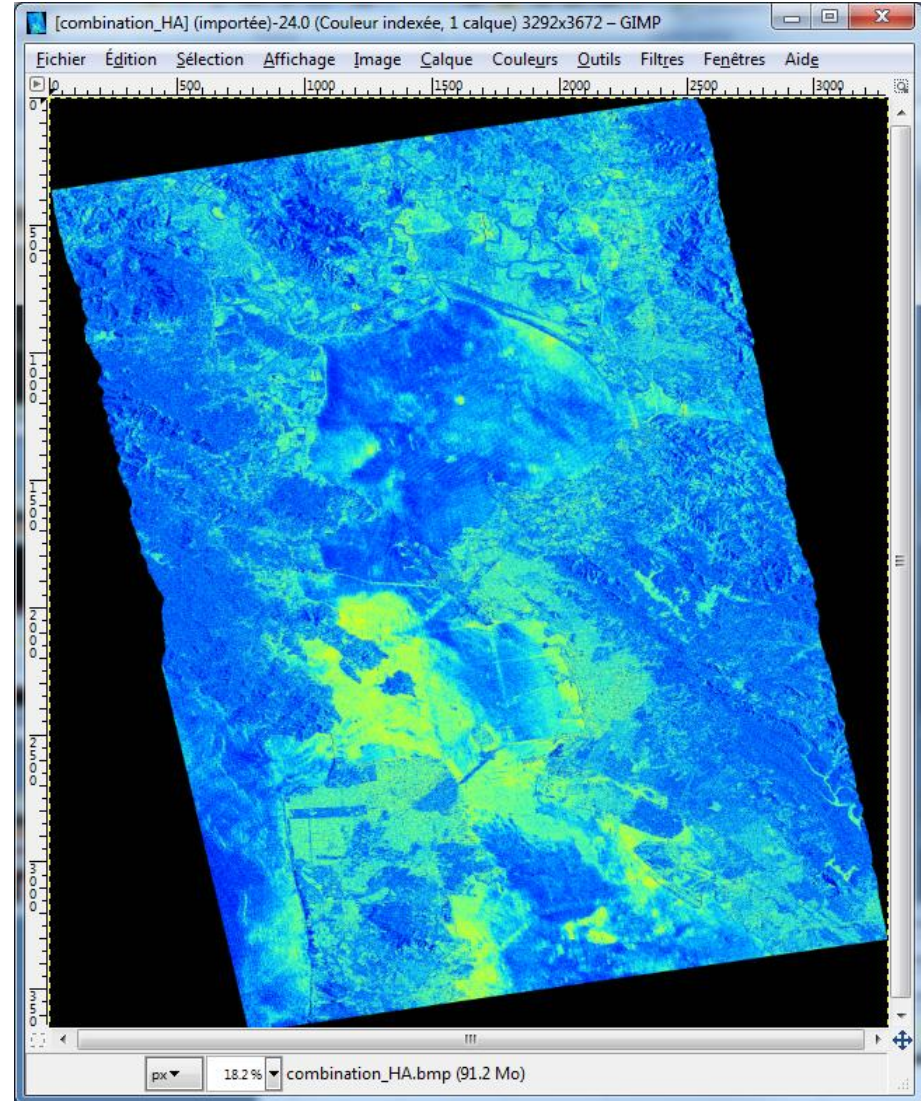
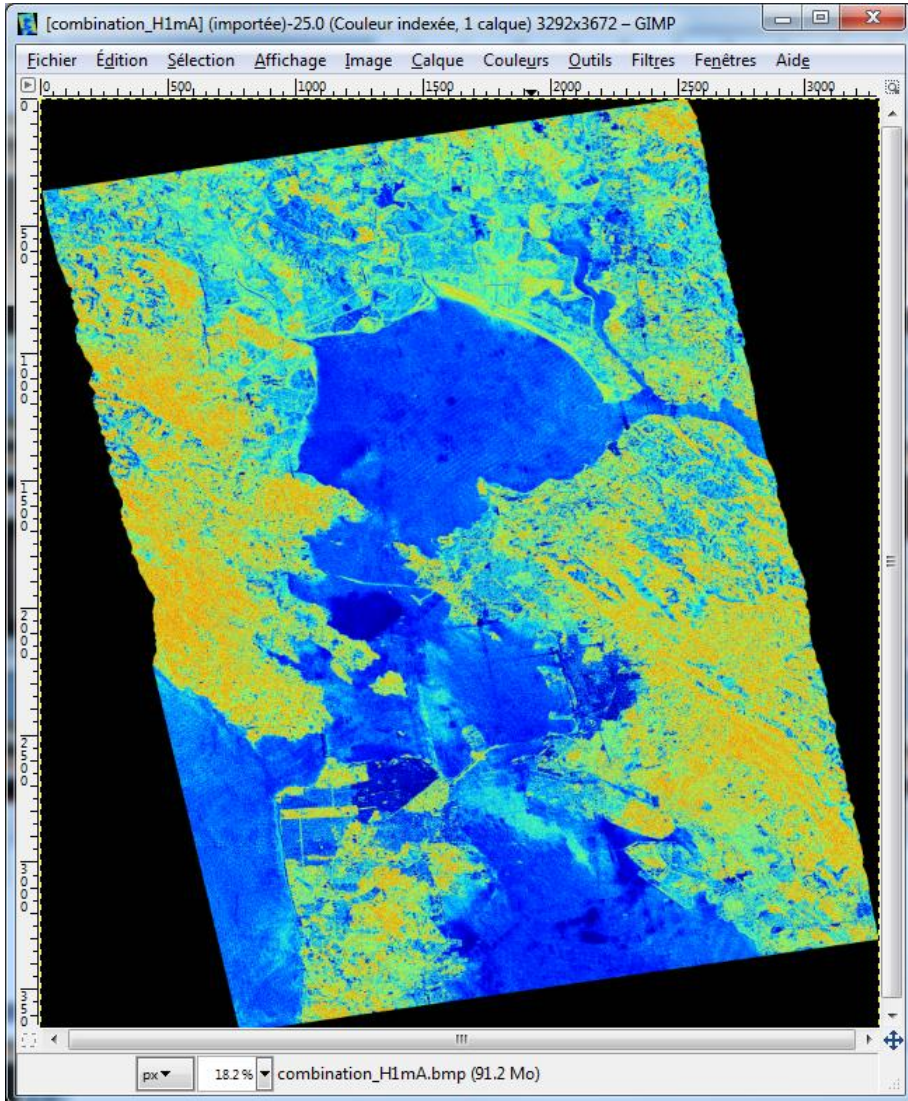
Lambda

Alpha



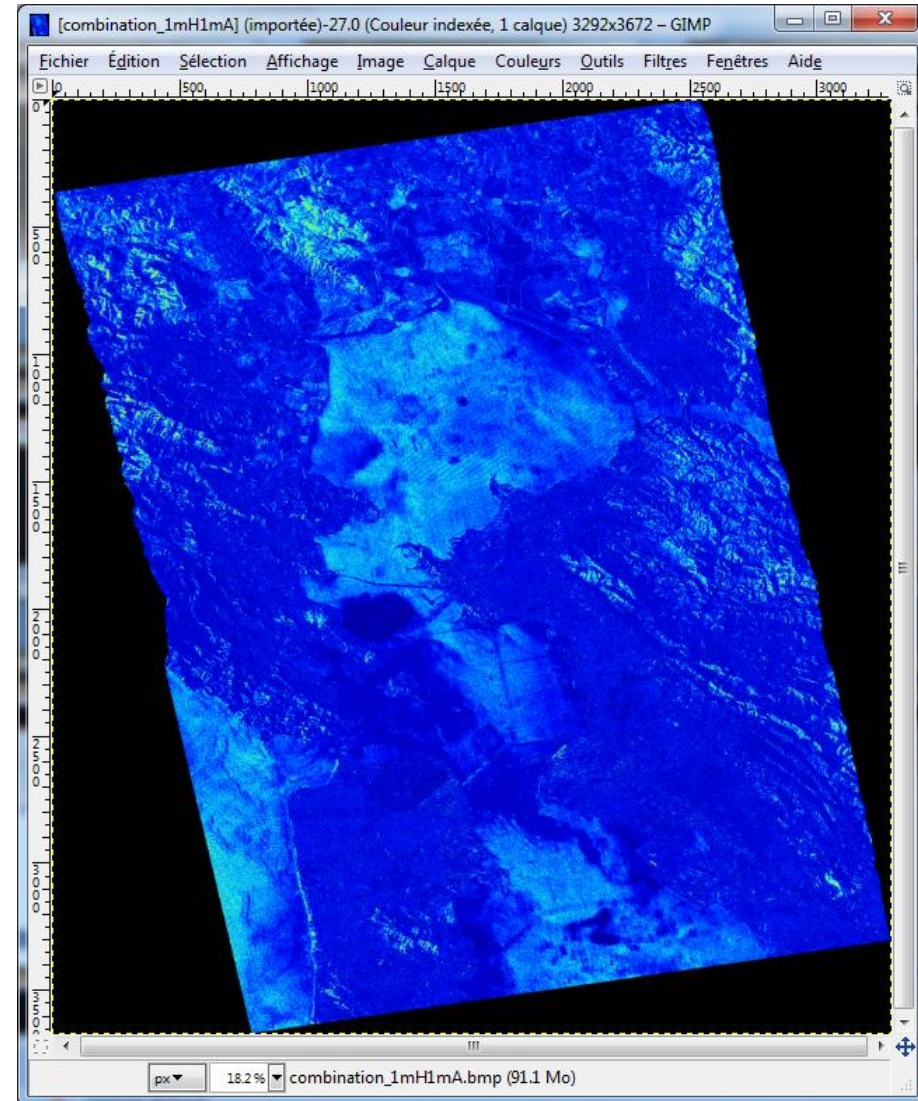
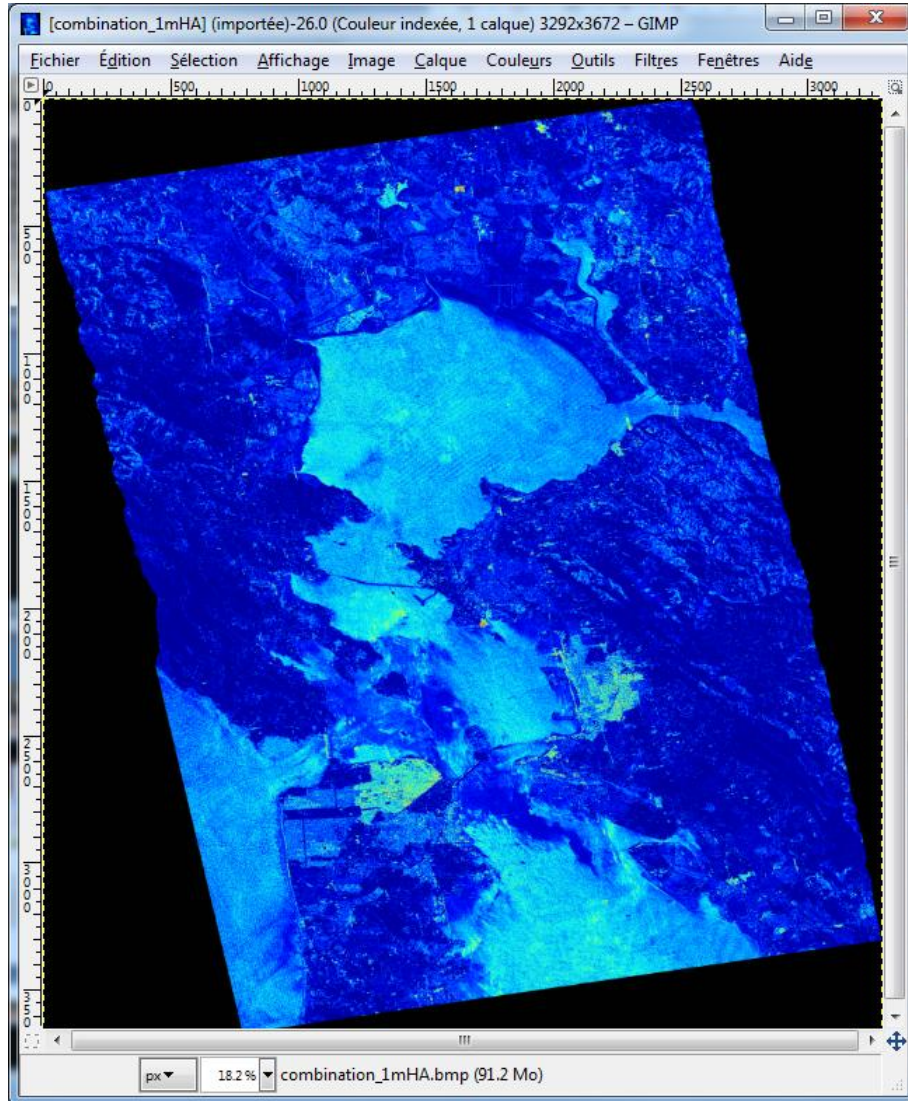
H (1-A)

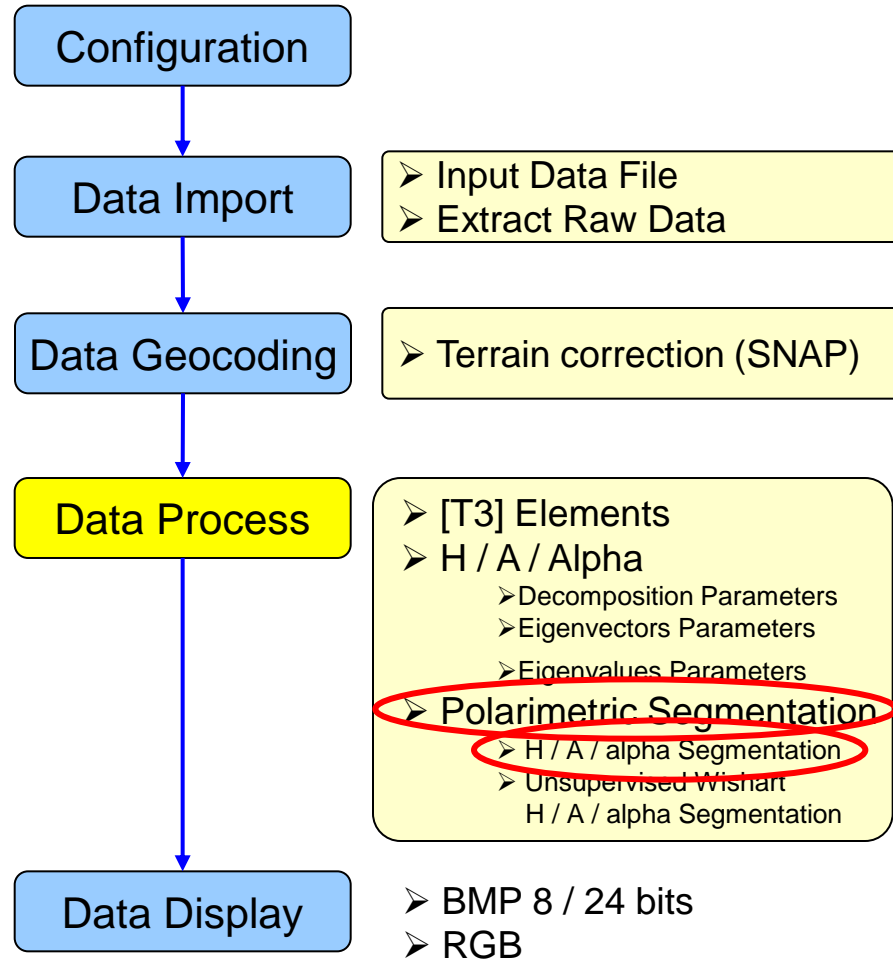
HA



(1-H) A

(1-H) (1-A)





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

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Polarimetric Data Clustering
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H / A / Alpha - wishart Classification
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Decomposition Applications

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

ADVANCED LAND REMOTE SENSING INTERNATIONAL WORKSHOP
20-25 November 2017 | Yunnan Normal University Kunming, Yunnan Pr

“龙计划4”高级遥感应用培训班
2017年11月20日—11月25日 云南师范大学, 中国, 昆明

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

PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

T3 | Environment | Import | Convert | Process | Display | Calibration

Data Processing: H / A / Alpha 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

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

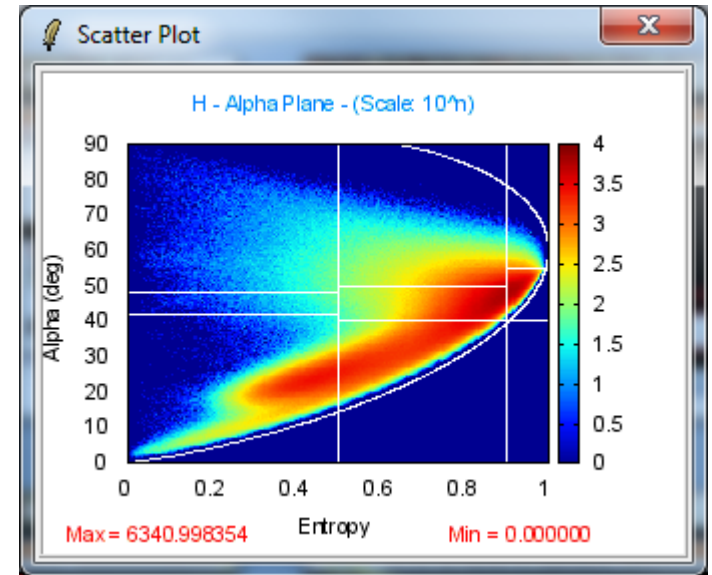
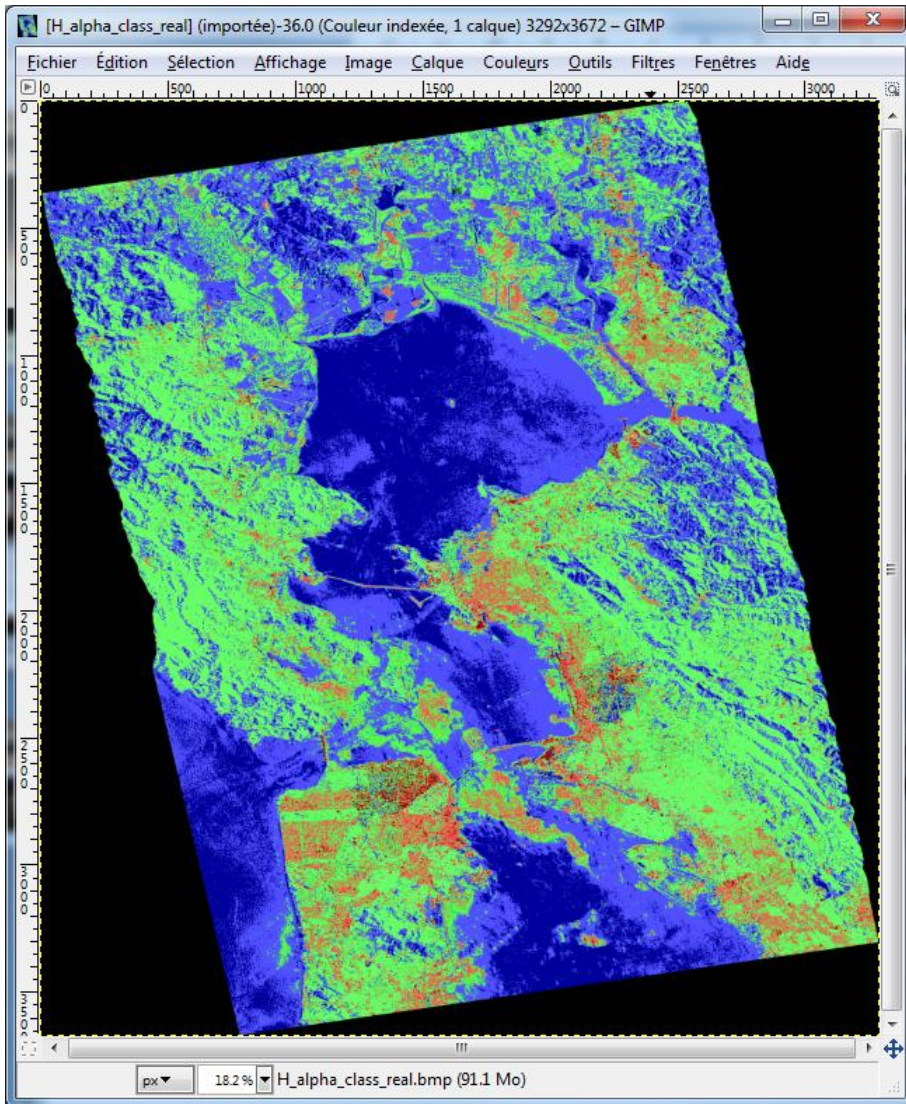
[Run] [?] [Exit] [Select All] [Reset]

ADVANCED LAND REMOTE SENSING INTERNATIONAL TRAINING COURSE

20-25 November 2017 | Yunnan Normal University Kunming, Yunnan Province, P.R. China

“龙计划4” 高级陆地遥感国际培训班

2017年11月20日—11月25日 云南师范大学, 中国, 昆明



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

Data Processing: H / A / Alpha Classification

Input Directory:

Output Directory: / T3

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

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 Edit

Tuo-Tuo (H / Alpha / Lambda) Classification

- Entropy / Alpha / Lambda Planes (BMP) + Classifier (Bin + BMP)

ColorMap 27 Edit

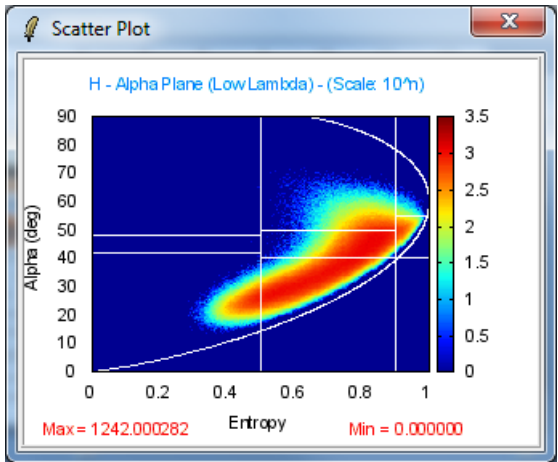
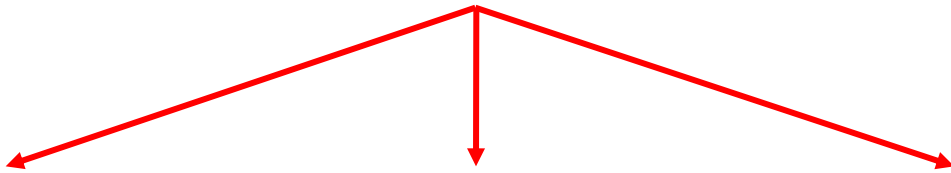
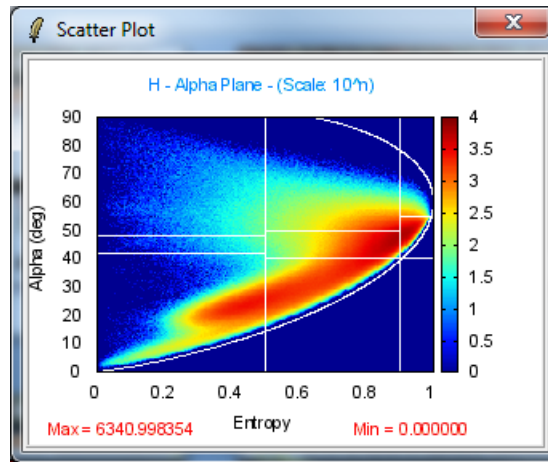
Window Size Row: Window Size Col:

Run [Save] [Print] [Help] [Exit]

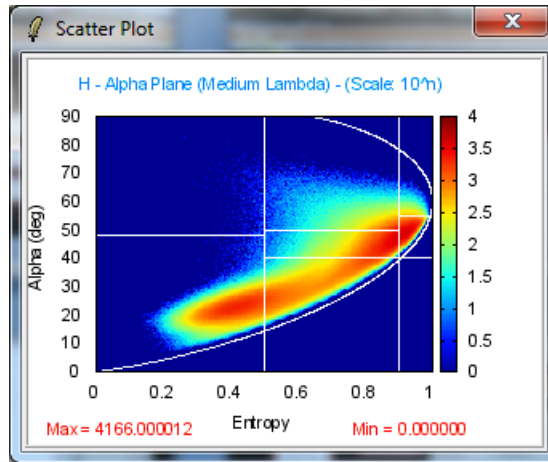
PolSARpro Run Trace

Close Window Display Menu

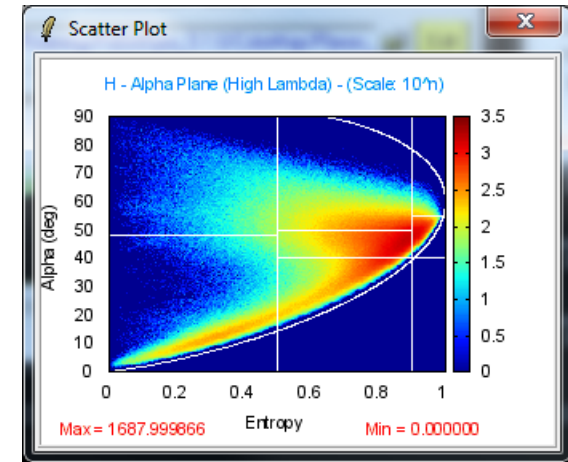
Close Window Tools Menu



Low λ

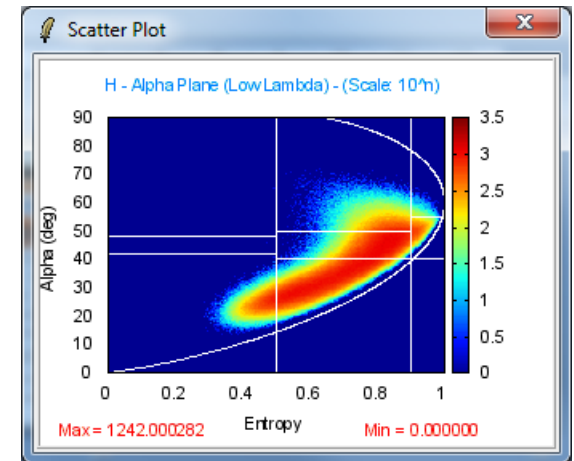
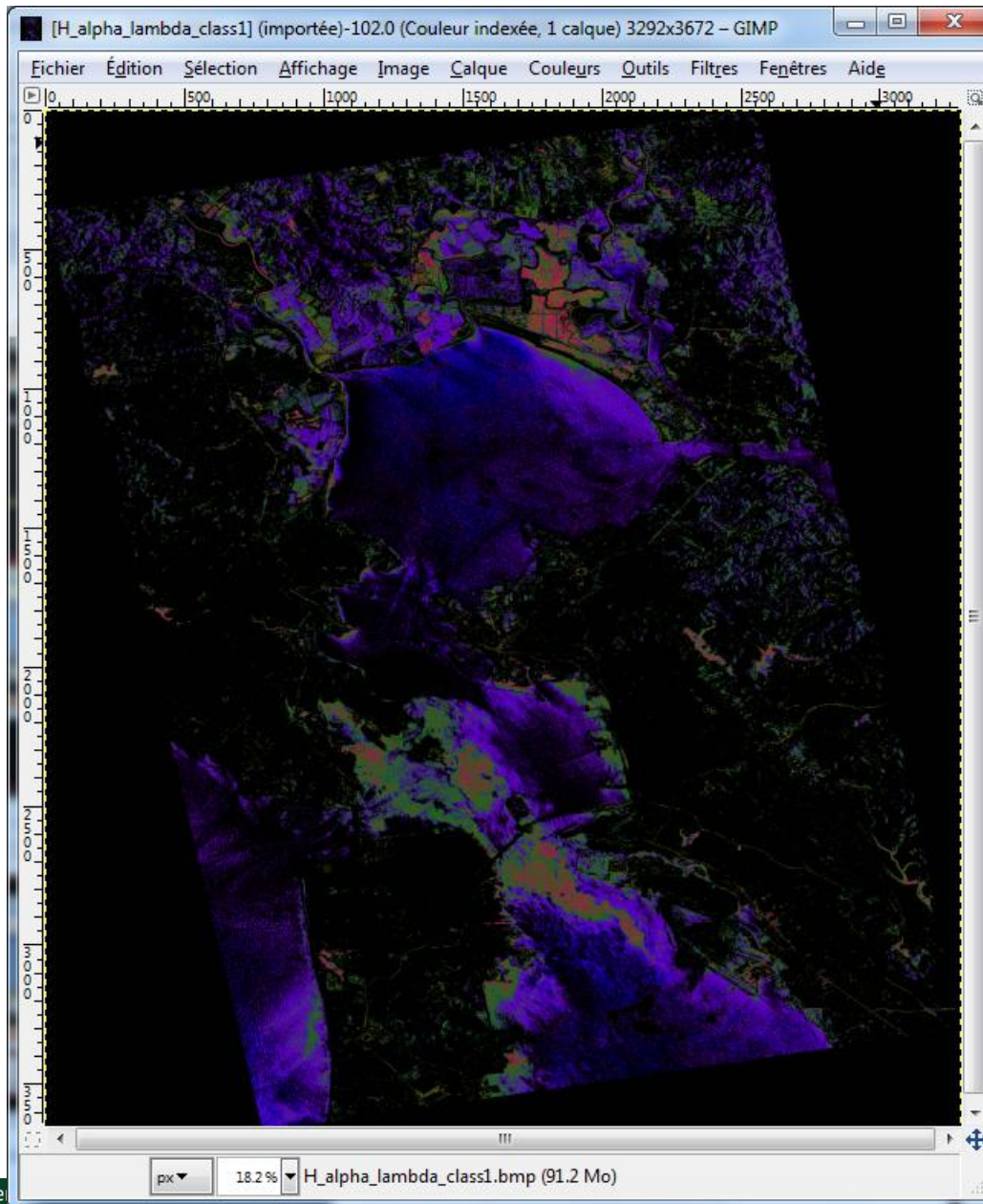


Medium λ



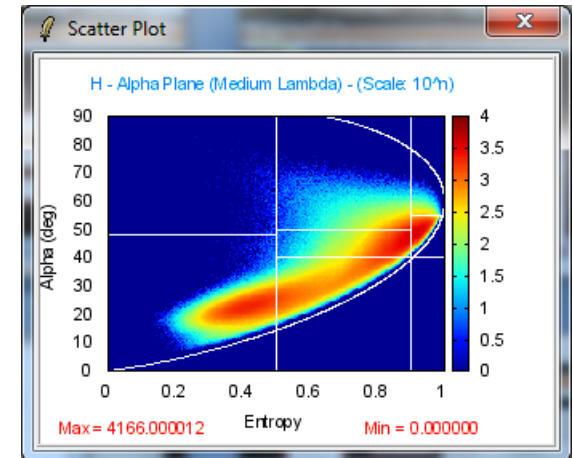
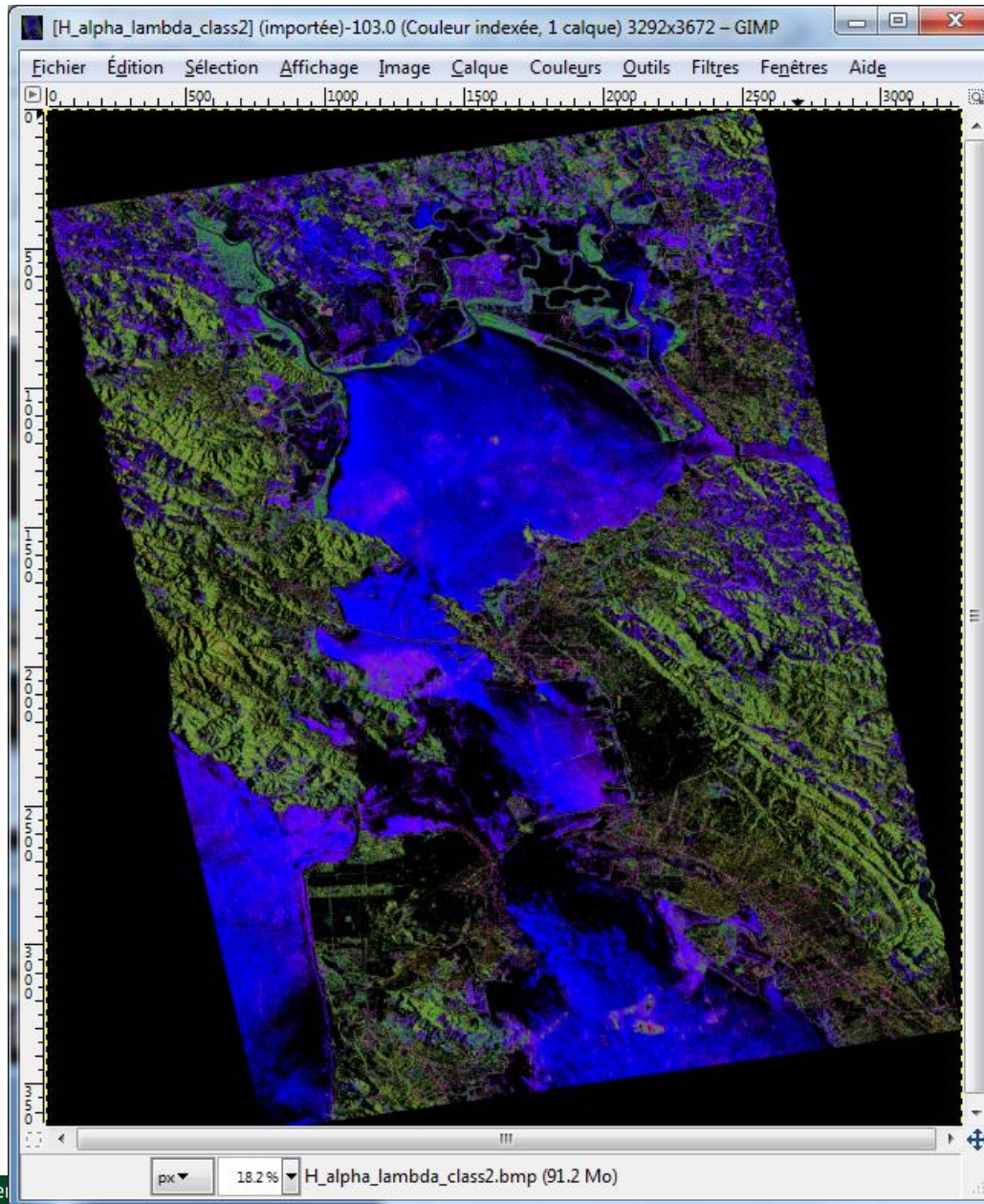
High λ

H / A / alpha CLASSIFICATION

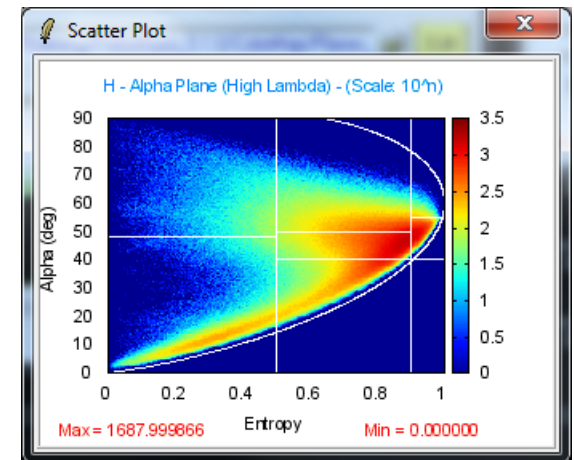
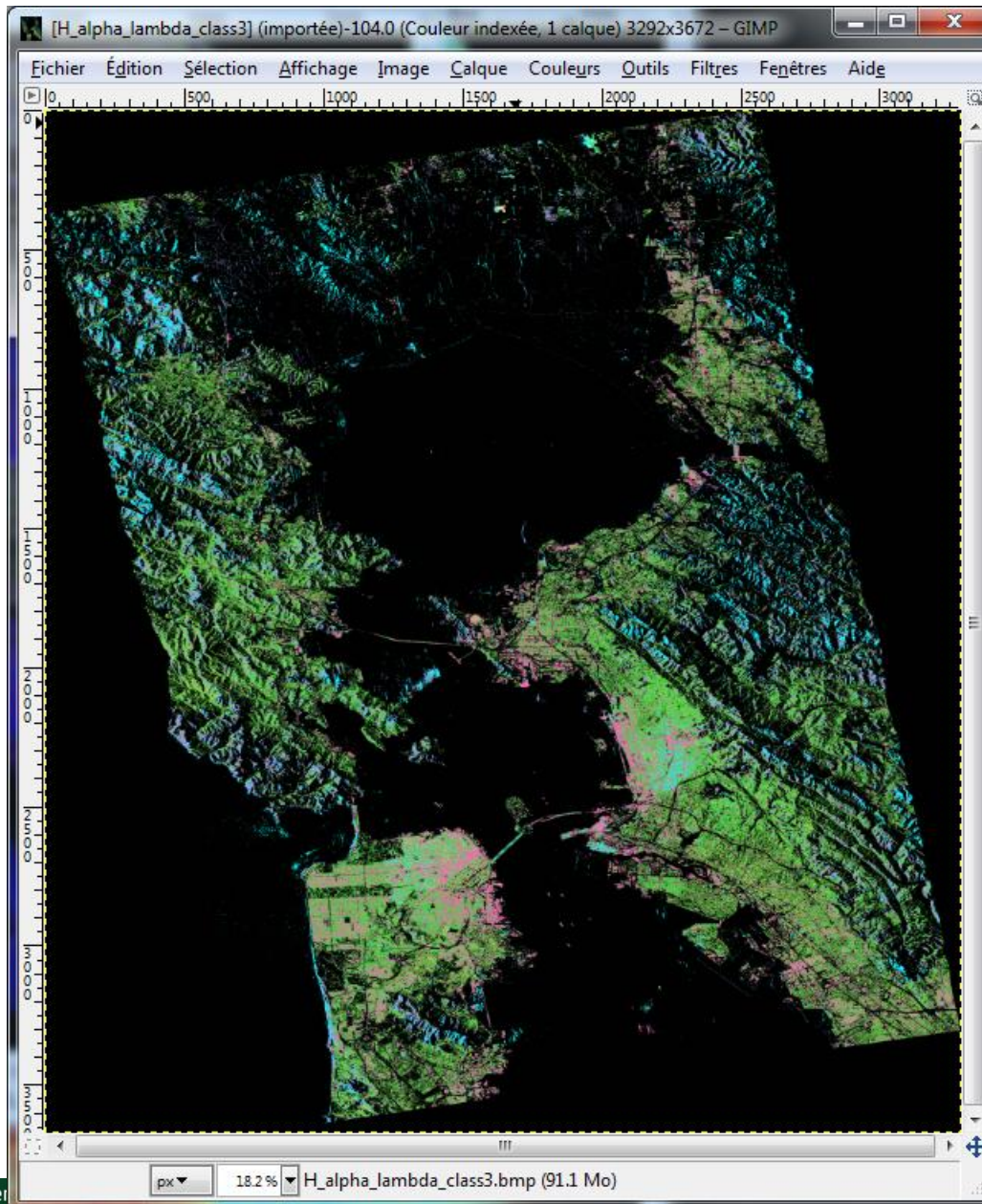


Low λ

H / A / alpha CLASSIFICATION

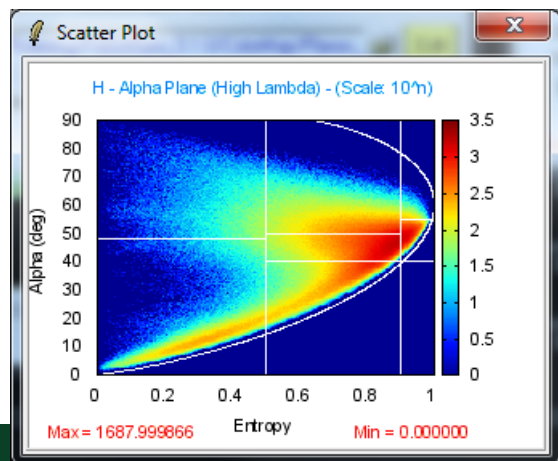
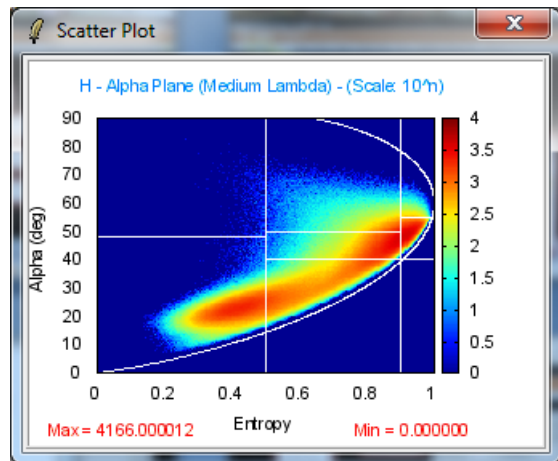
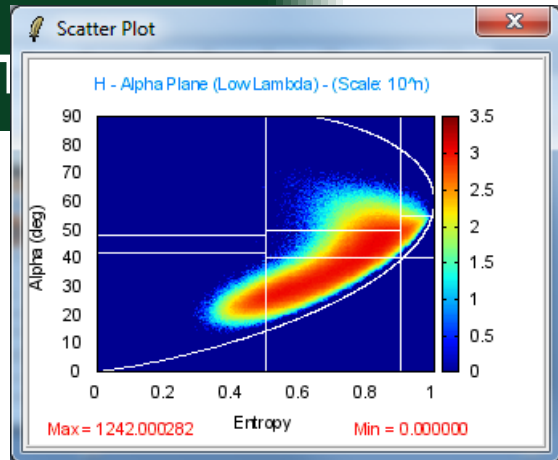
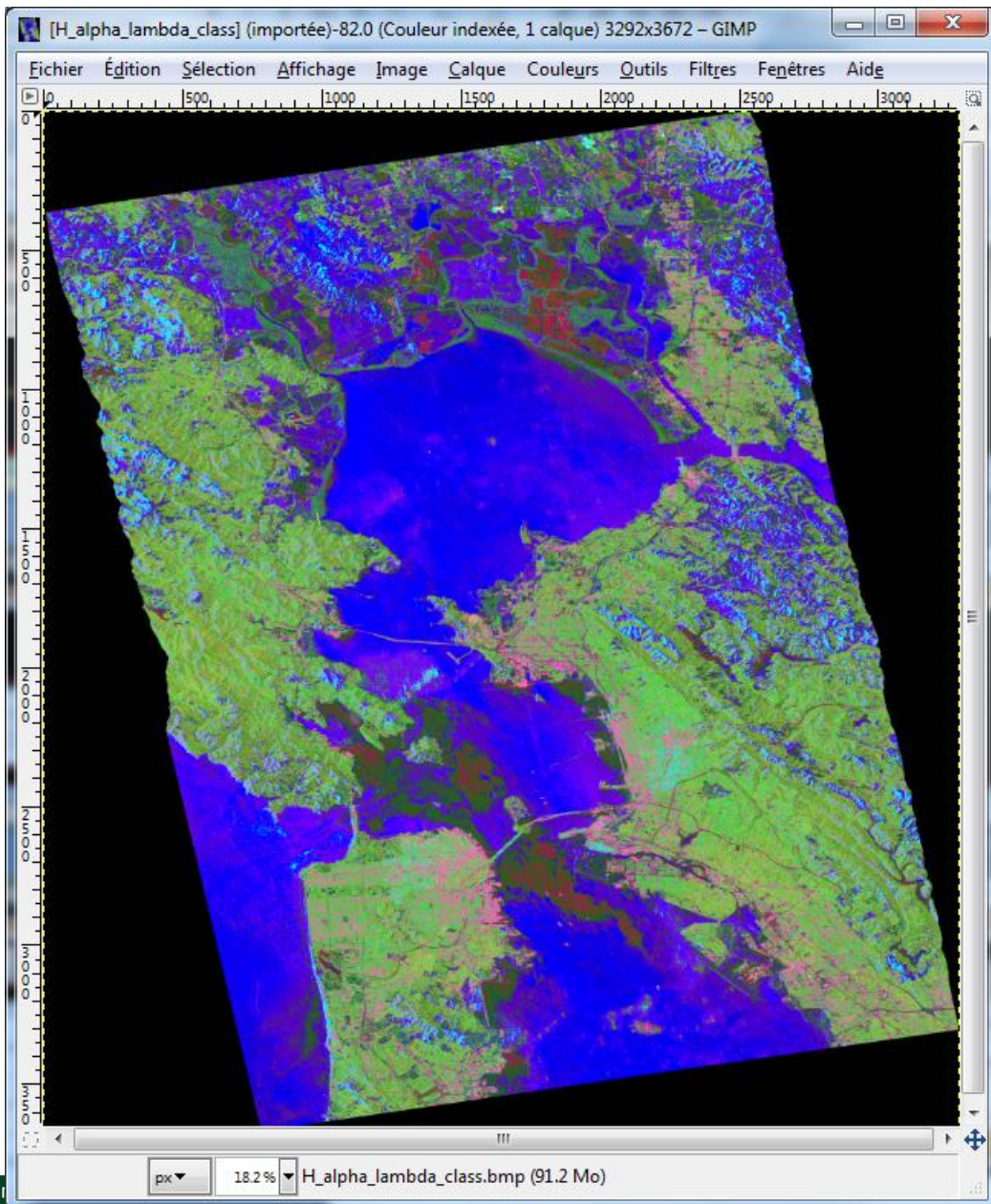


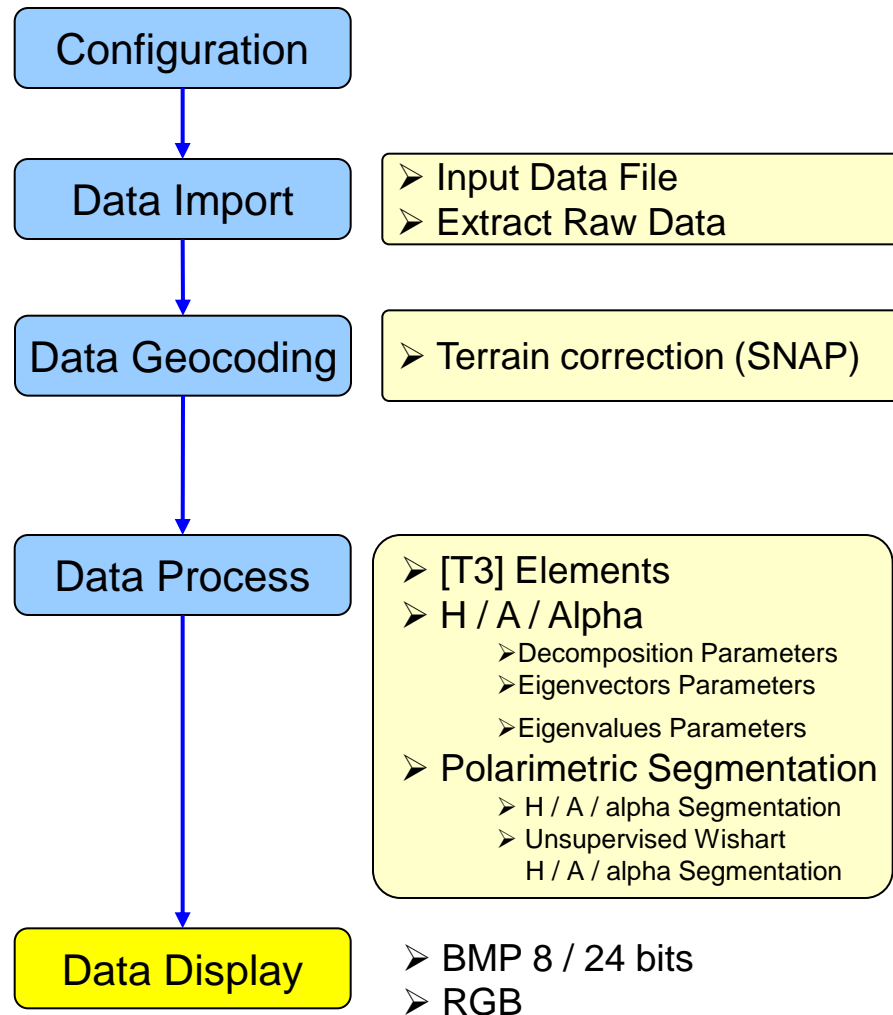
Medium λ

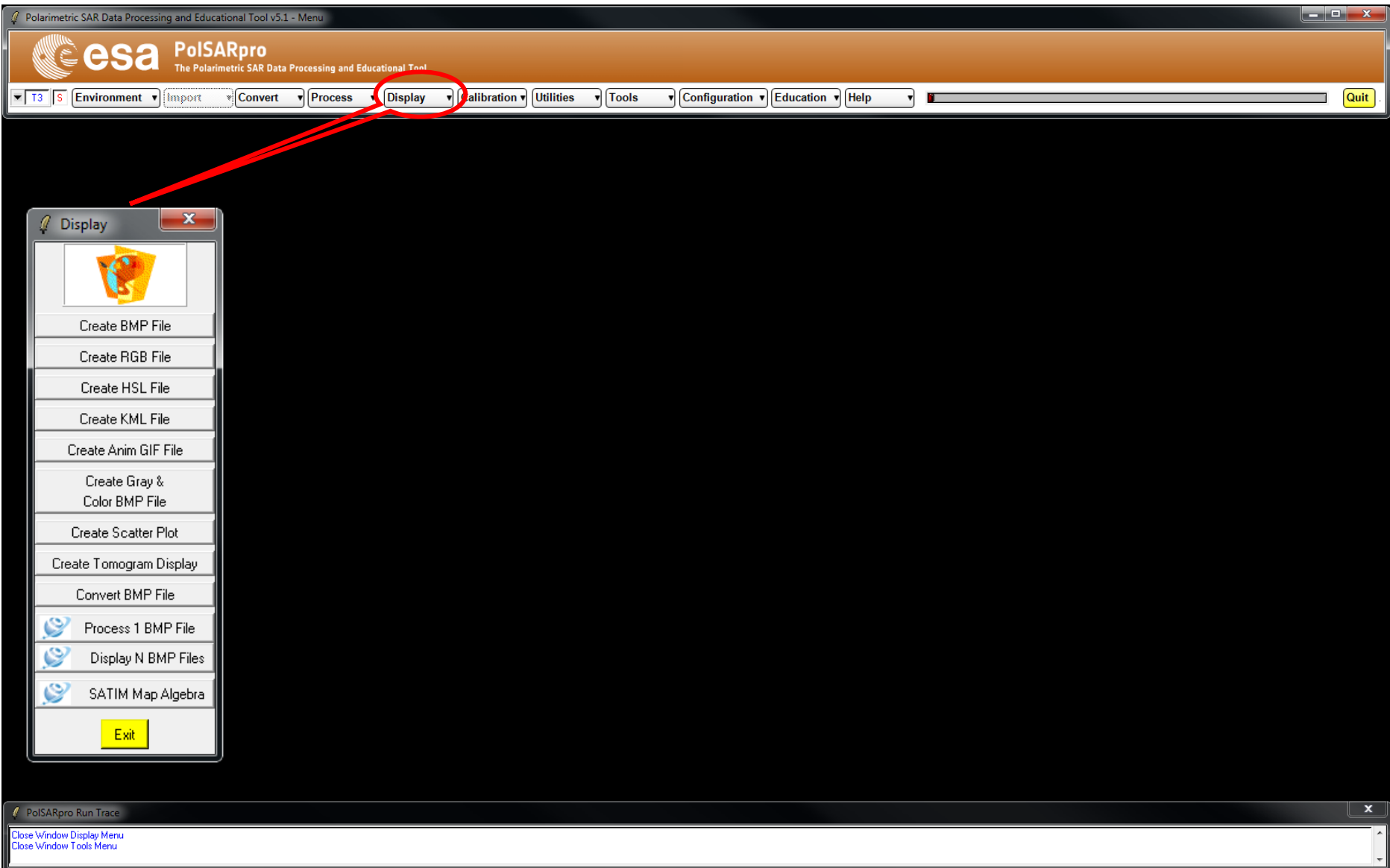


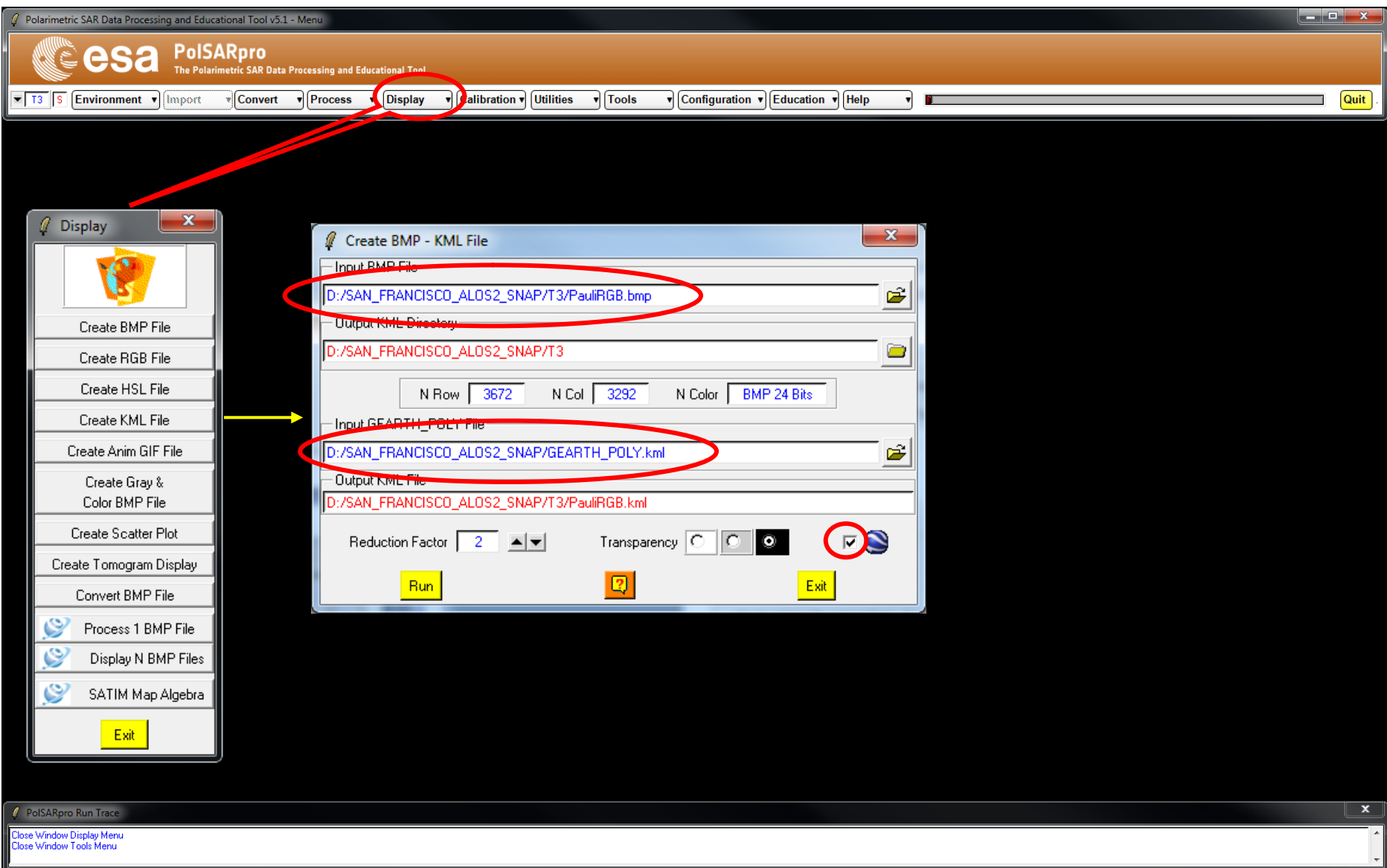
High λ

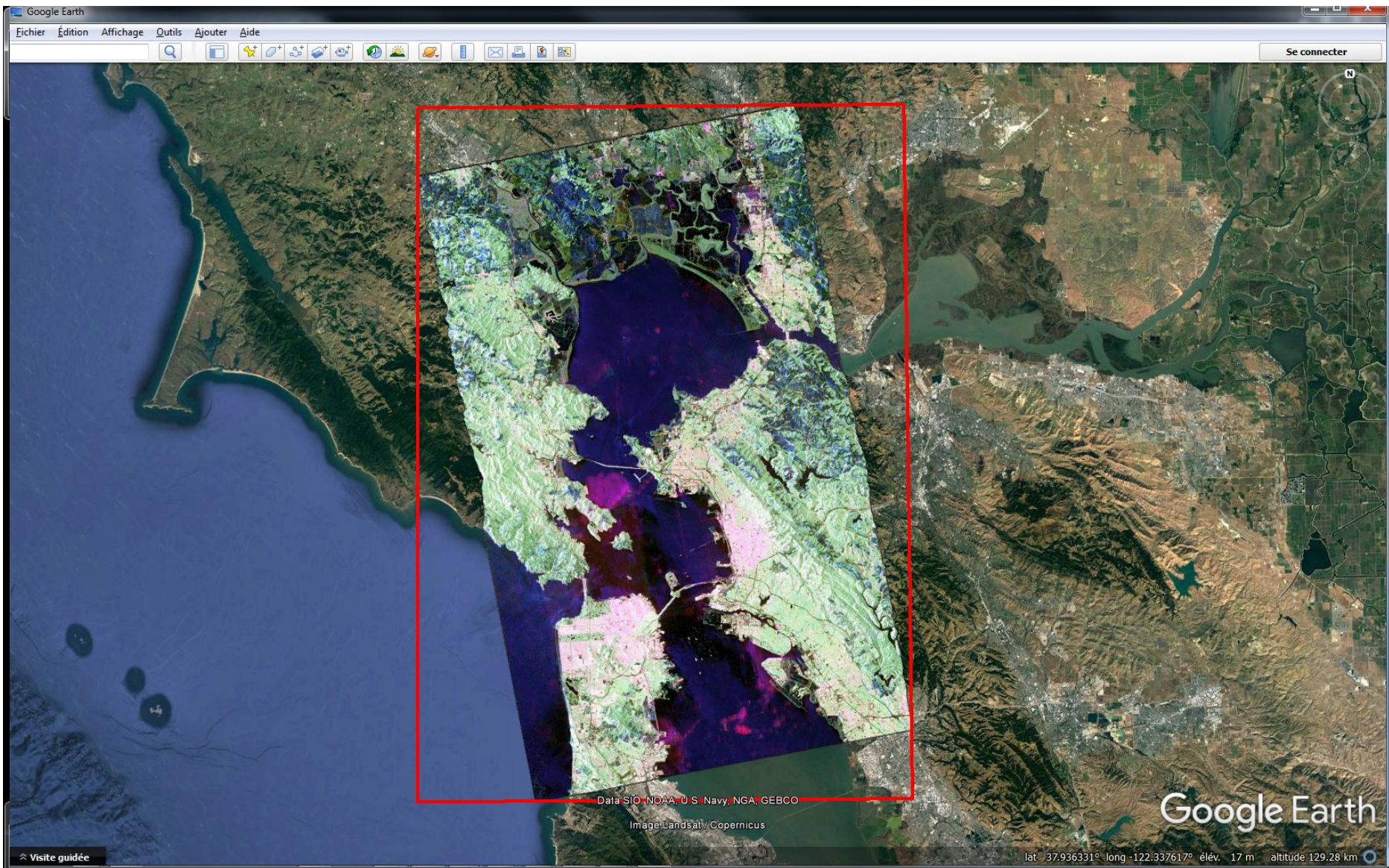
H / A / alpha CLASSIFICATION









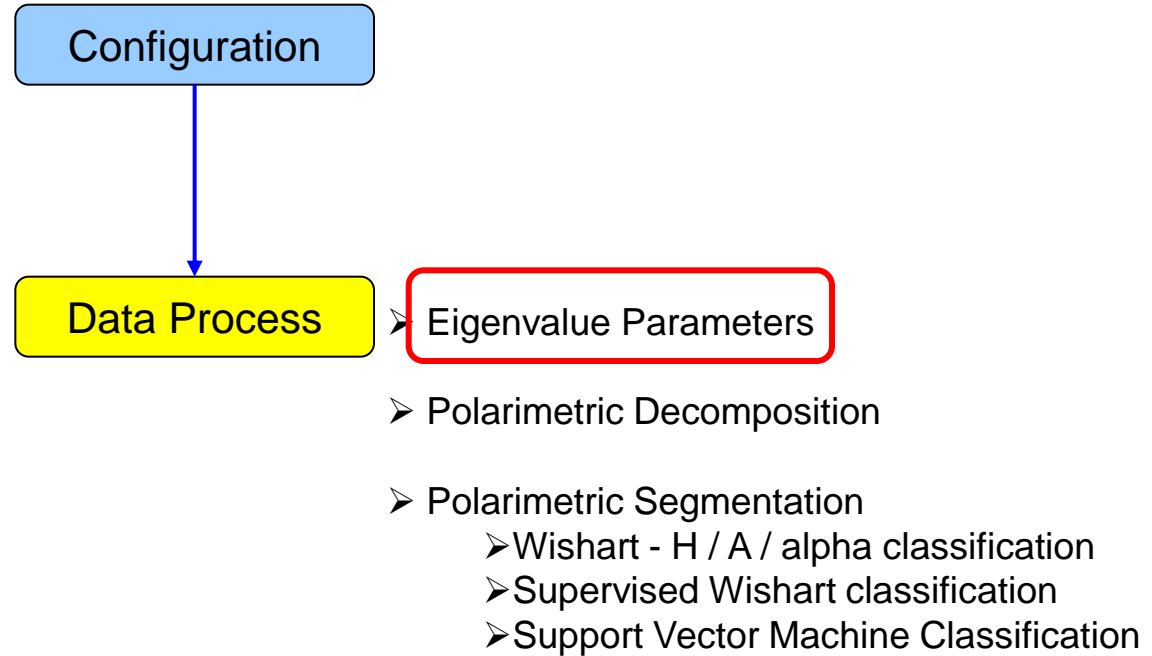


Questions ?



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PolSARpro v5.1 Software Practical advanced session



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
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Polarimetric Functionalities - 1
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Polarimetric Data Analysis
Polarimetric Data Clustering
Batch Process

H / A / Alpha Classification
H / A / Alpha - Wishart Classification
Fuzzy - H / Alpha Classification
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Rule-Based Hierarchical Classification
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Scattering Mechanism Entropy (Van Zyl)
Kozlov Anisotropy
Lueneburg Anisotropy
Polarized Point Scatterer Detection
Reflectivity Ratio
Differential Reflectivity (ZDR)

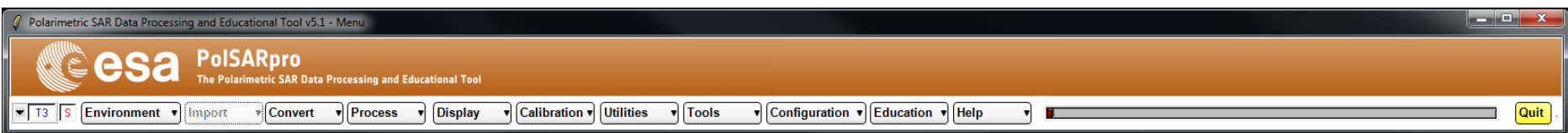
Polarisation Synthesis
Polarimetric Signature
Stokes Parameters
Compact Polarimetric Mode
O.P.C.E
R.C.S Max
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Polarisation Orientation Compensation

Decomposition Applications

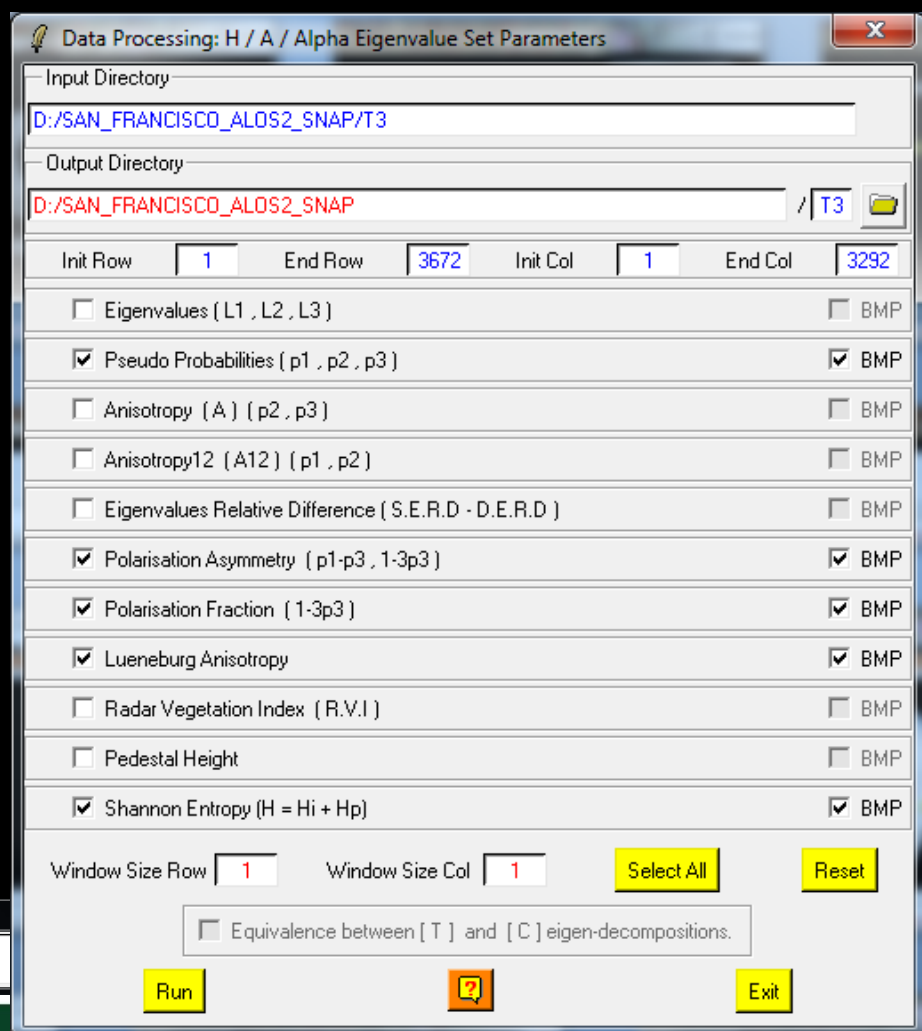
PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

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“龙计划4”高级遥感应用培训班
2017年11月20日—11月25日 云南师范大学, 中国, 昆明



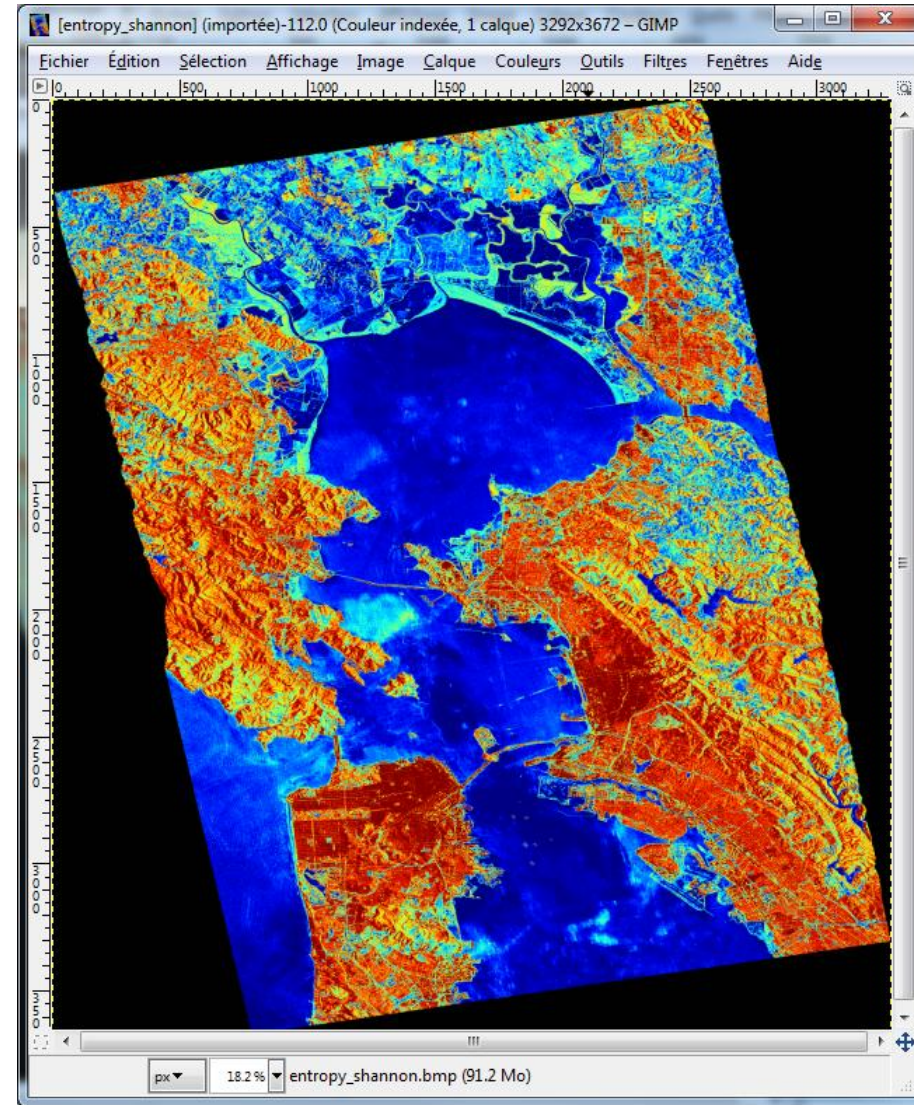
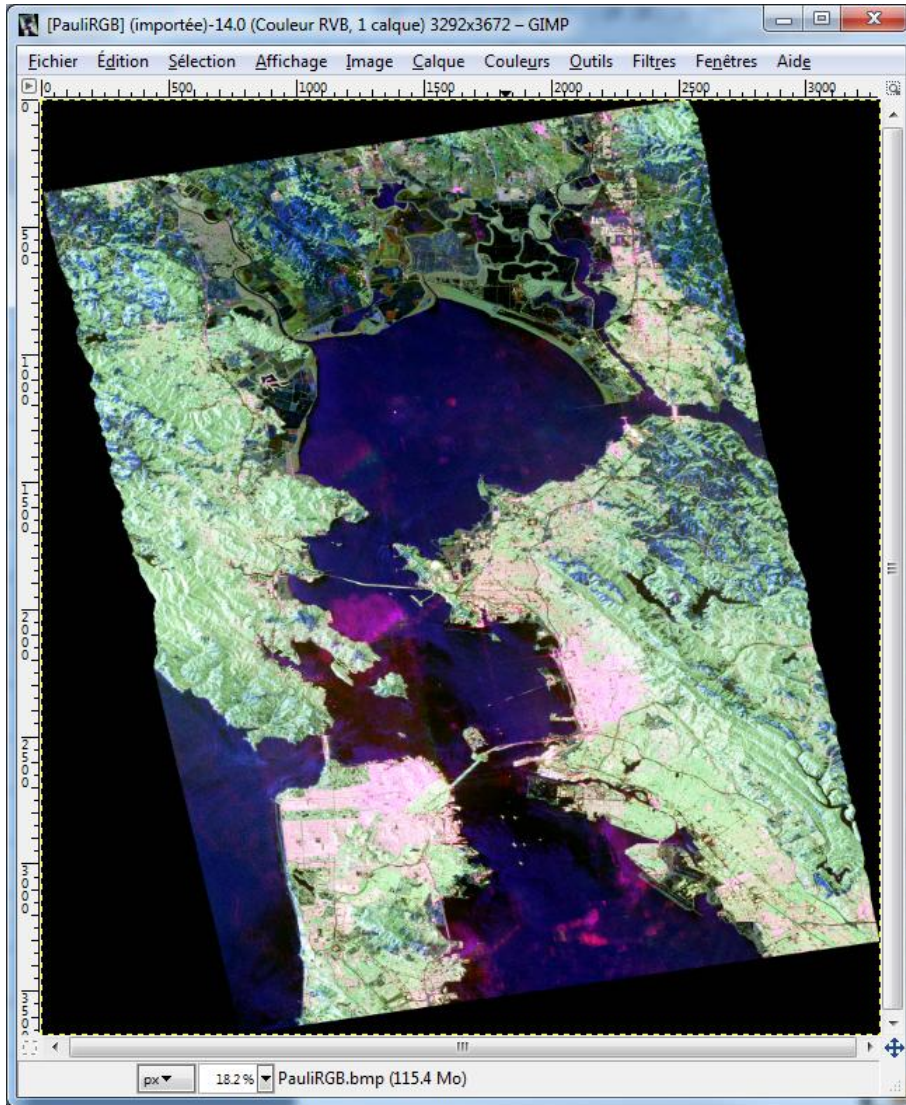
Do it Yourself:
Select some elements, set the parameters and view the corresponding BMP files (select BMP).
Window Size = 1



PolSARpro Run Trace

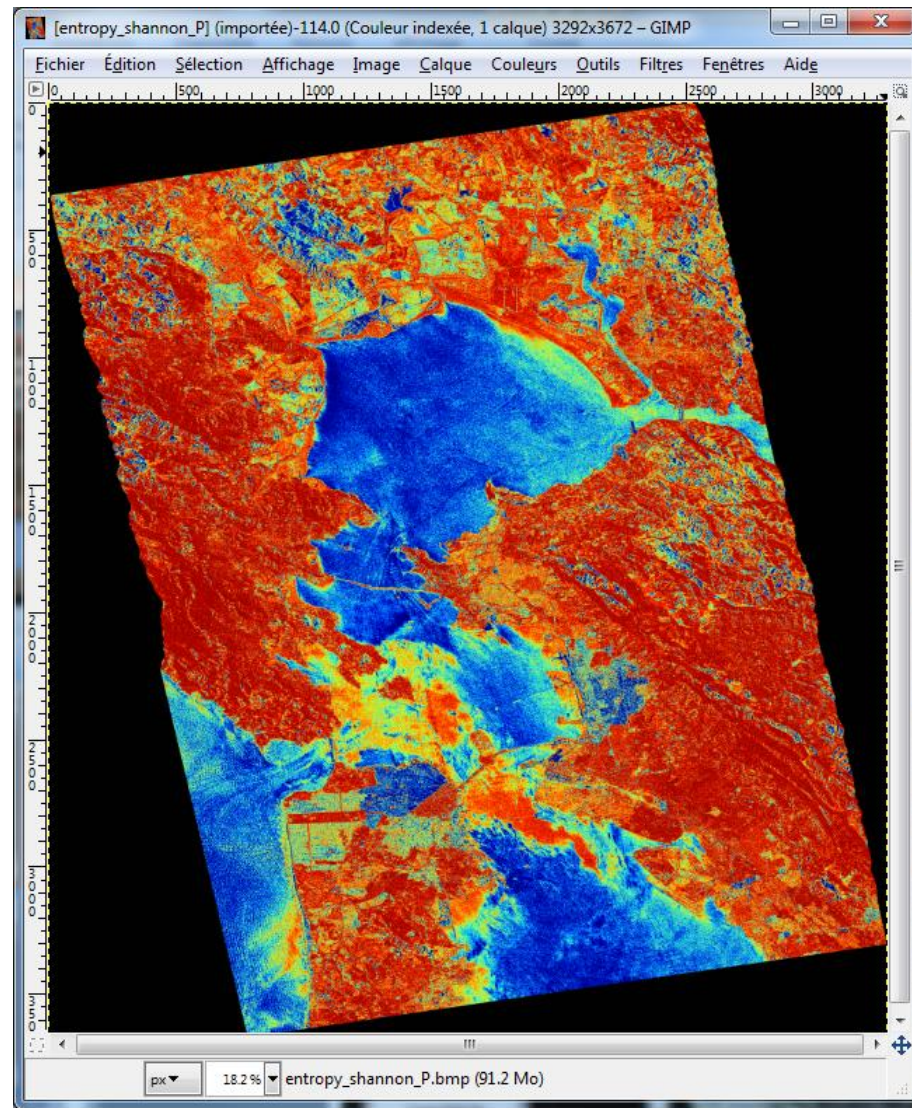
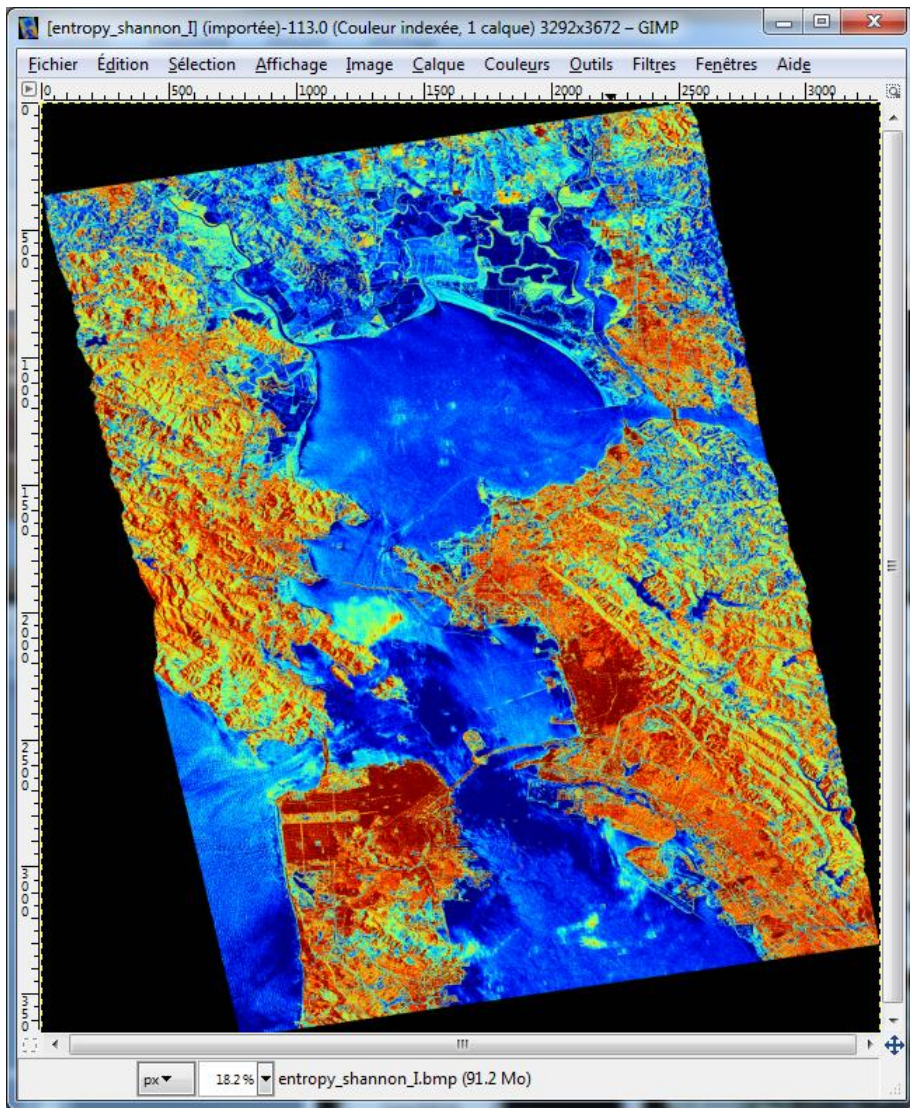
Close Window Display Menu
 Close Window Tools Menu

Entropy Shannon

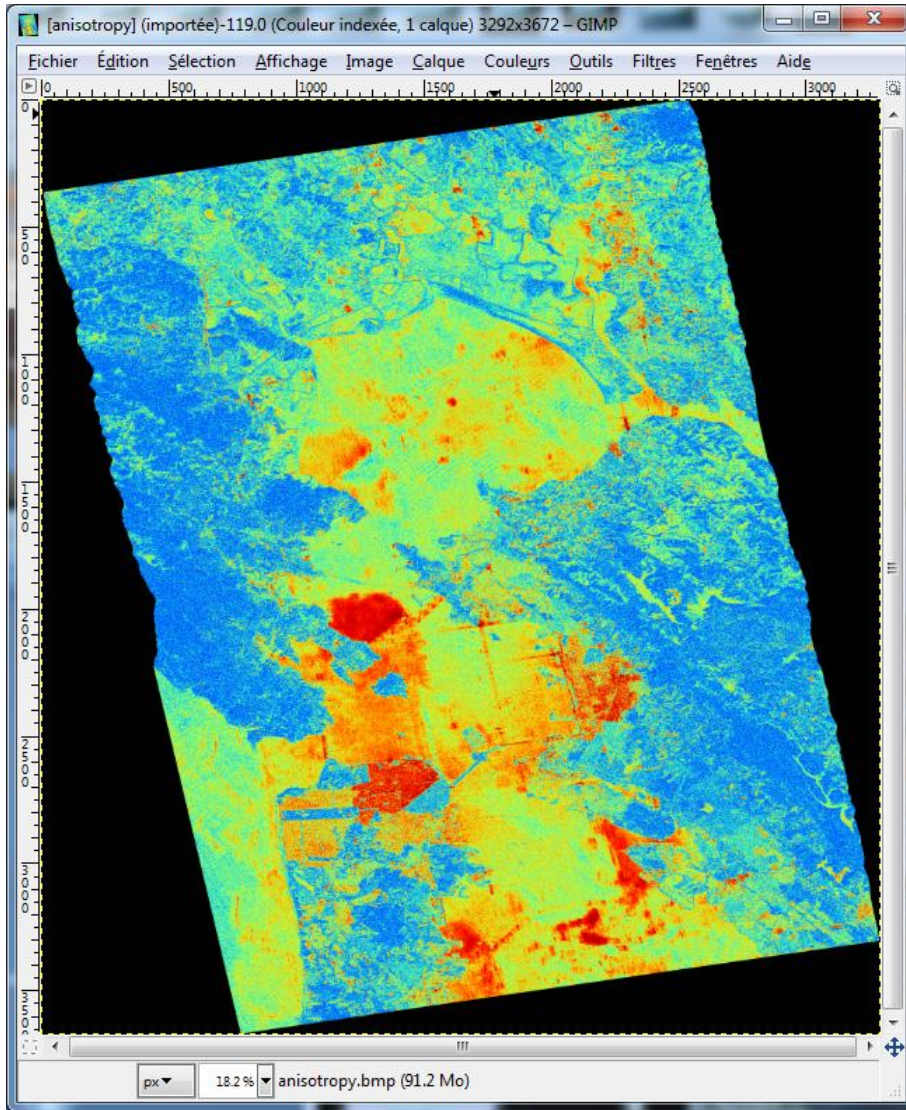


Entropy I

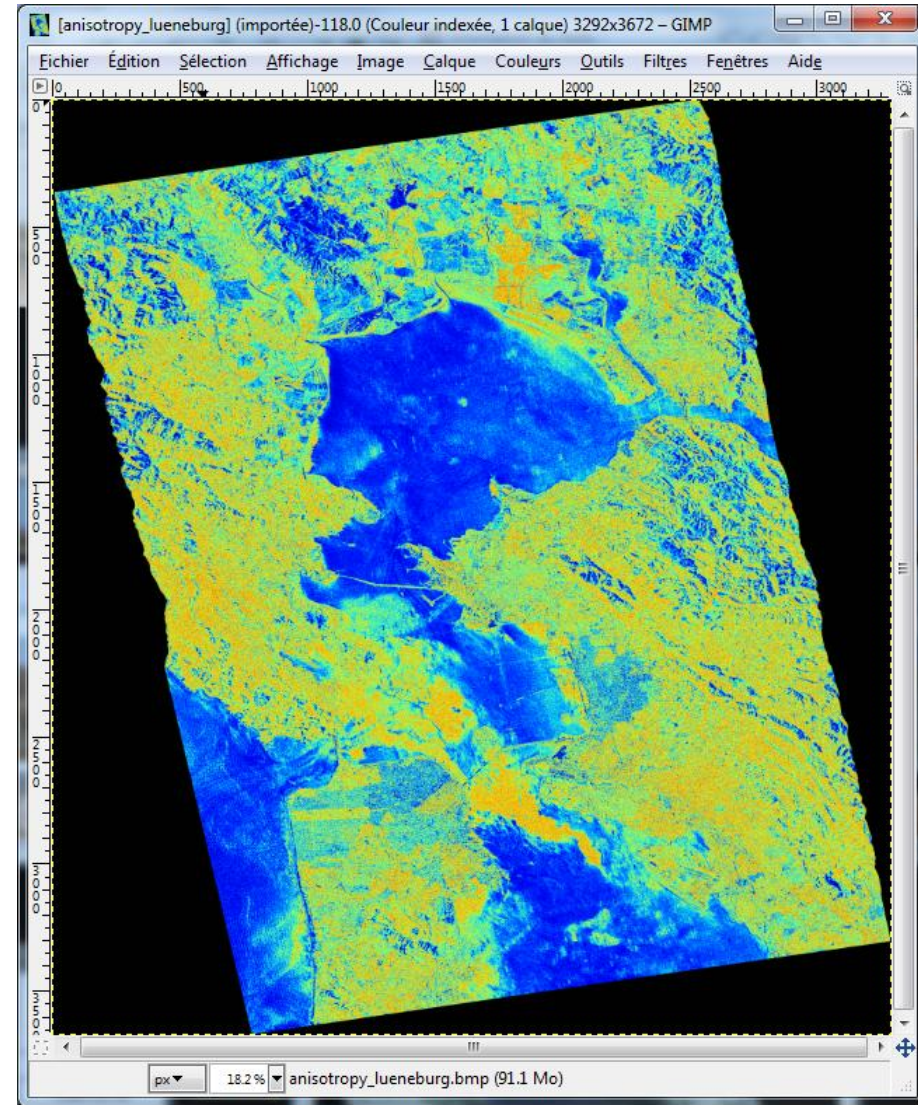
Entropy P

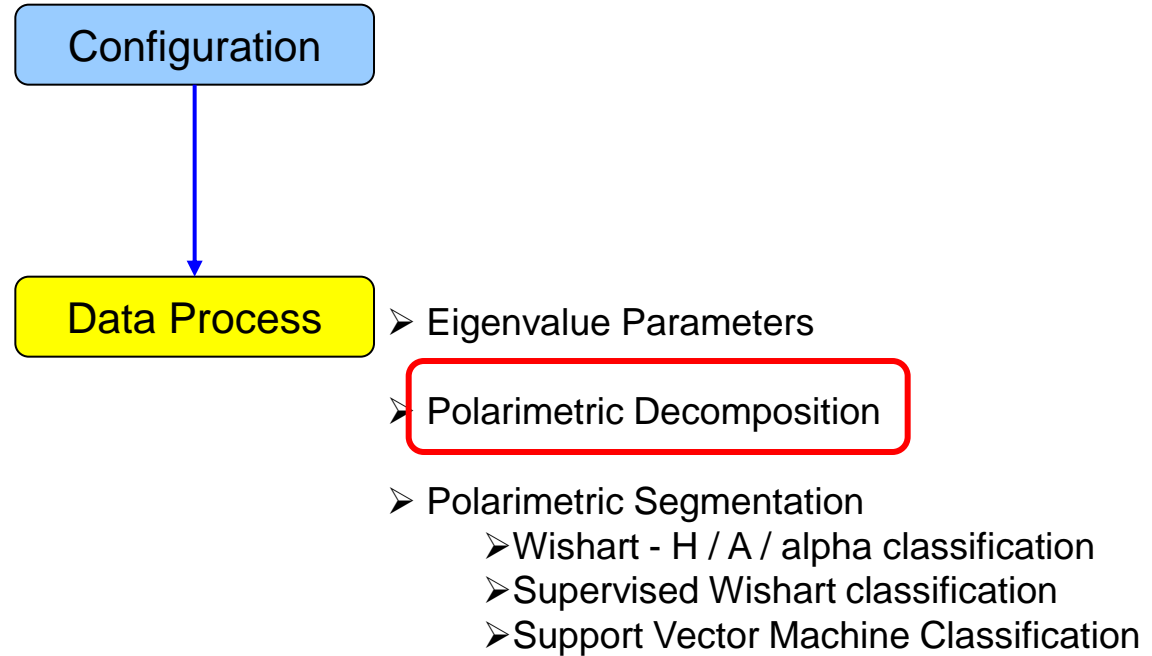


Anisotropy



Lueneburg Anisotropy





The screenshot shows the PoISARpro v5.1 software interface. The 'Process' menu is highlighted with a red circle. A red box highlights the 'Process' menu and its sub-items: Linear (+45 / -45), Circular (L / R), and Elliptical (phi, tau). A blue box highlights the 'Polarimetric Decompositions' sub-menu, which lists various decomposition methods. A yellow box highlights the 'Decomposition Parameters' sub-menu, which lists parameters for decomposition. A green box highlights the 'Classification' sub-menu, which lists various classification methods. A red box highlights the 'Statistics' sub-menu, which lists various statistical methods. A blue box highlights the 'Applications' sub-menu, which lists various applications. Arrows indicate the flow from the 'Process' menu to the sub-menus and then to the specific tools.

Process Menu:

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

Polarimetric Decompositions (Blue Box):

- 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 & Frey 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
- Aghababae Decomposition
- 2KR : Raney Decomposition
- CPD : Compact-Pol Decomposition

Decomposition Parameters (Yellow Box):

- Decomposition Parameters
- Eigenvector Set Parameters
- Eigenvalue Set Parameters

Classification (Green Box):

- 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

Statistics (Red Box):

- Data Statistics
- Data Histograms
- Data Profiles
- Histogram Based Statistics
- Texture Analysis

Applications (Blue Box):

- Faraday Rotation
- 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)
- Depolarisation
- Polarisation Orientation Compensation
- Decomposition Applications

Other Tools (Red Box):

- 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

Other Tools (Red Box):

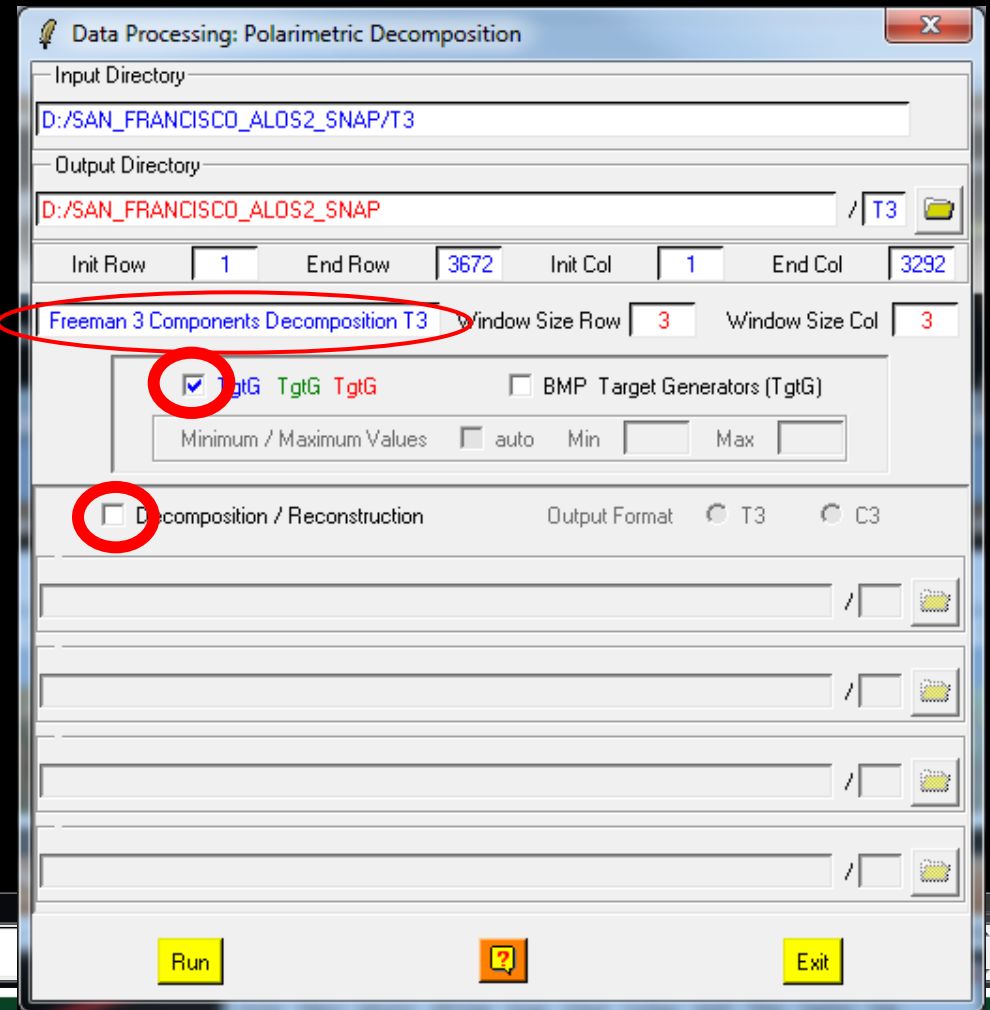
- Matrix Elements
- Correlation Coefficients
- Elliptical Basis Change
- Polarimetric Speckle Filter
- H / A / Alpha Decomposition
- Polarimetric Functionalities - 1
- Polarimetric Functionalities - 2
- Polarimetric Segmentation
- Polarimetric Data Analysis
- Polarimetric Data Clustering
- Batch Process

Clustering Process (Red Box):

- Clustering Process
- Parameter Averaging
- Data Sets Averaging



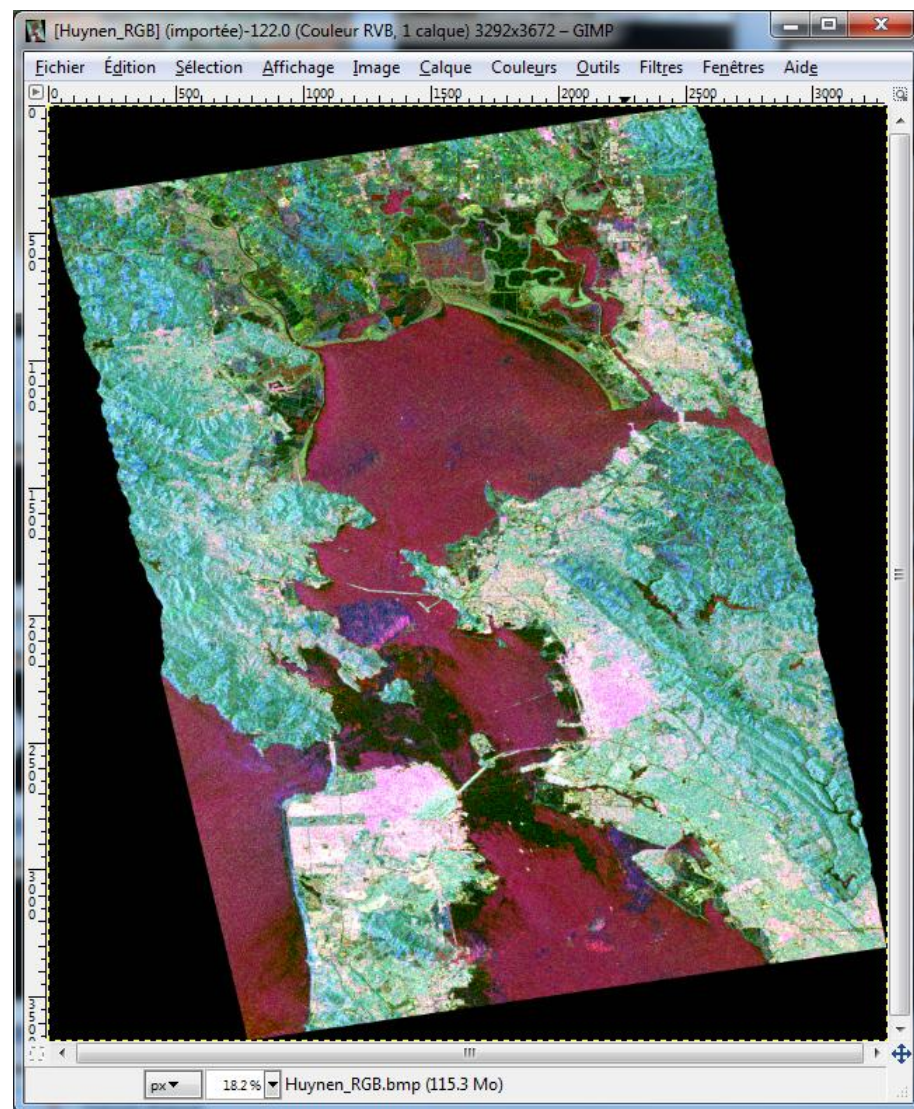
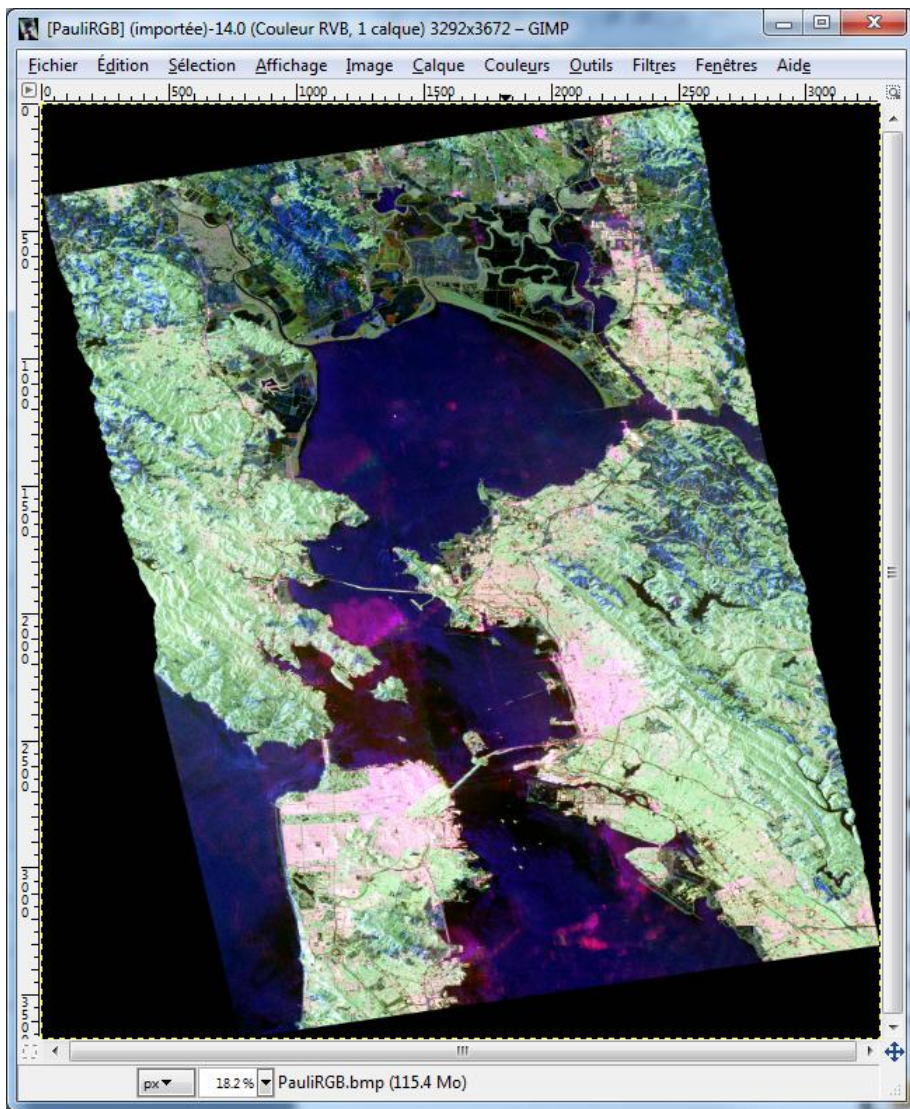
Do it Yourself:
Select some elements, set the parameters and view the corresponding BMP files (select BMP).
Window Size = 1



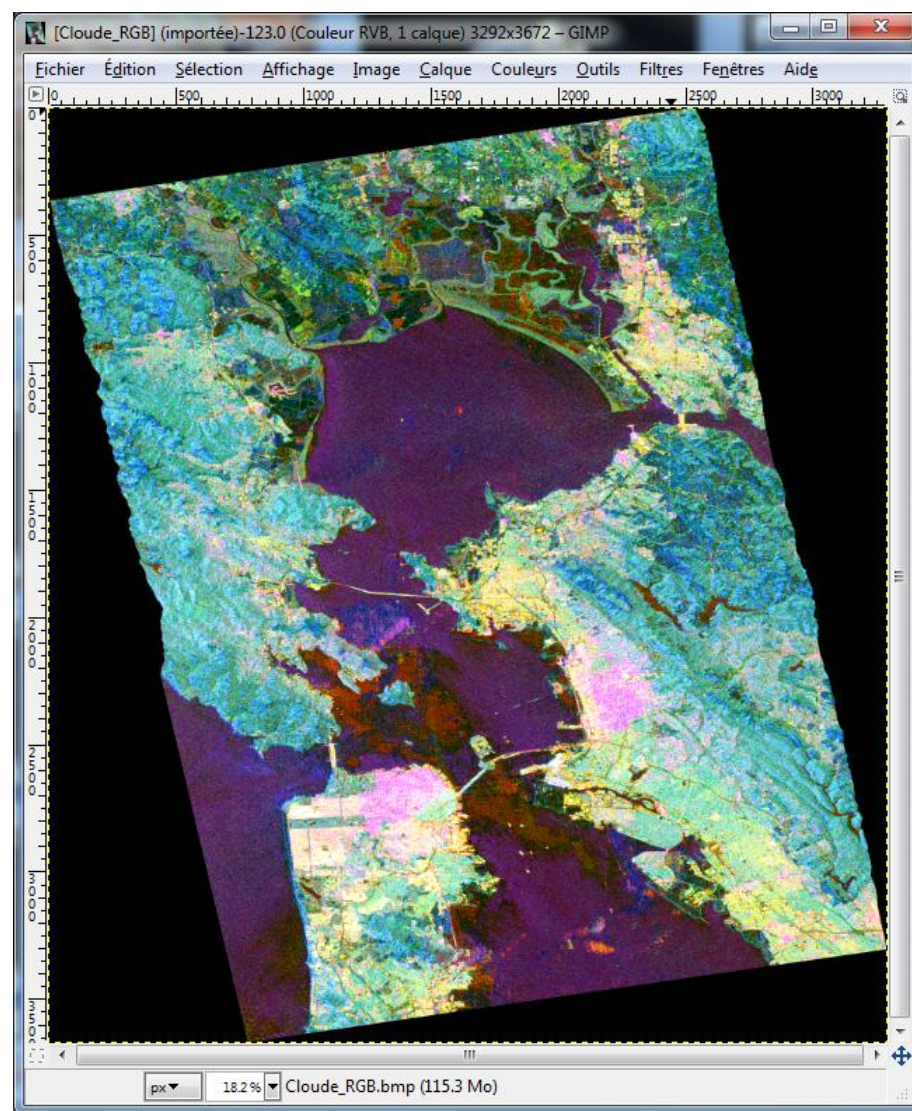
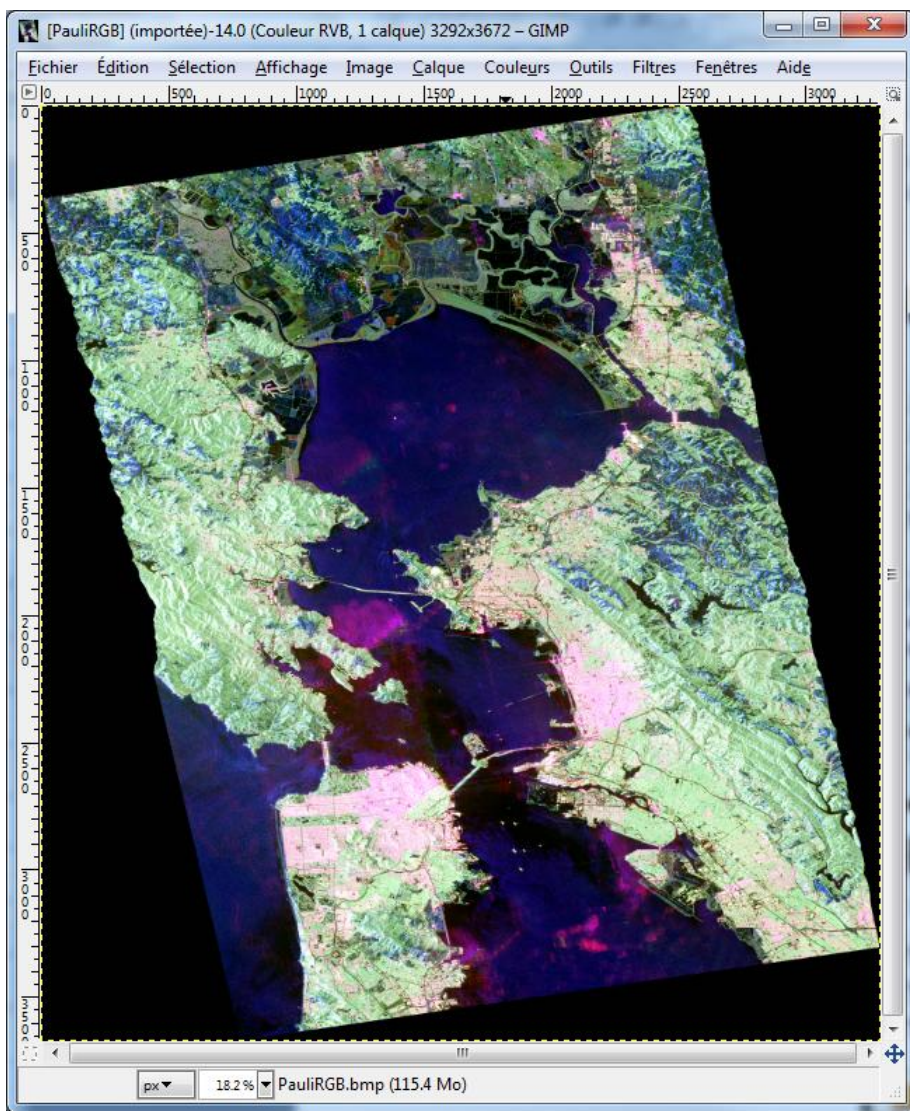
PolSARpro Run Trace
 Close Window Display Menu
 Close Window Tools Menu



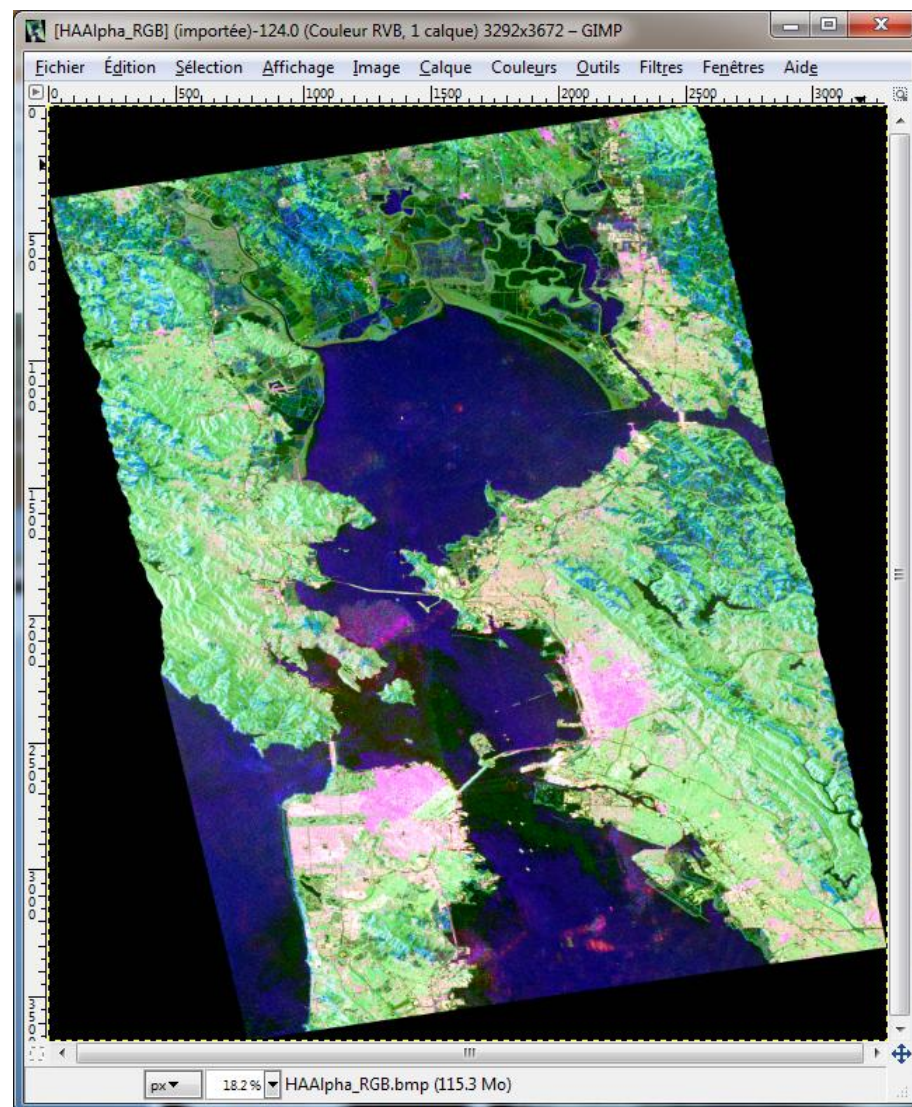
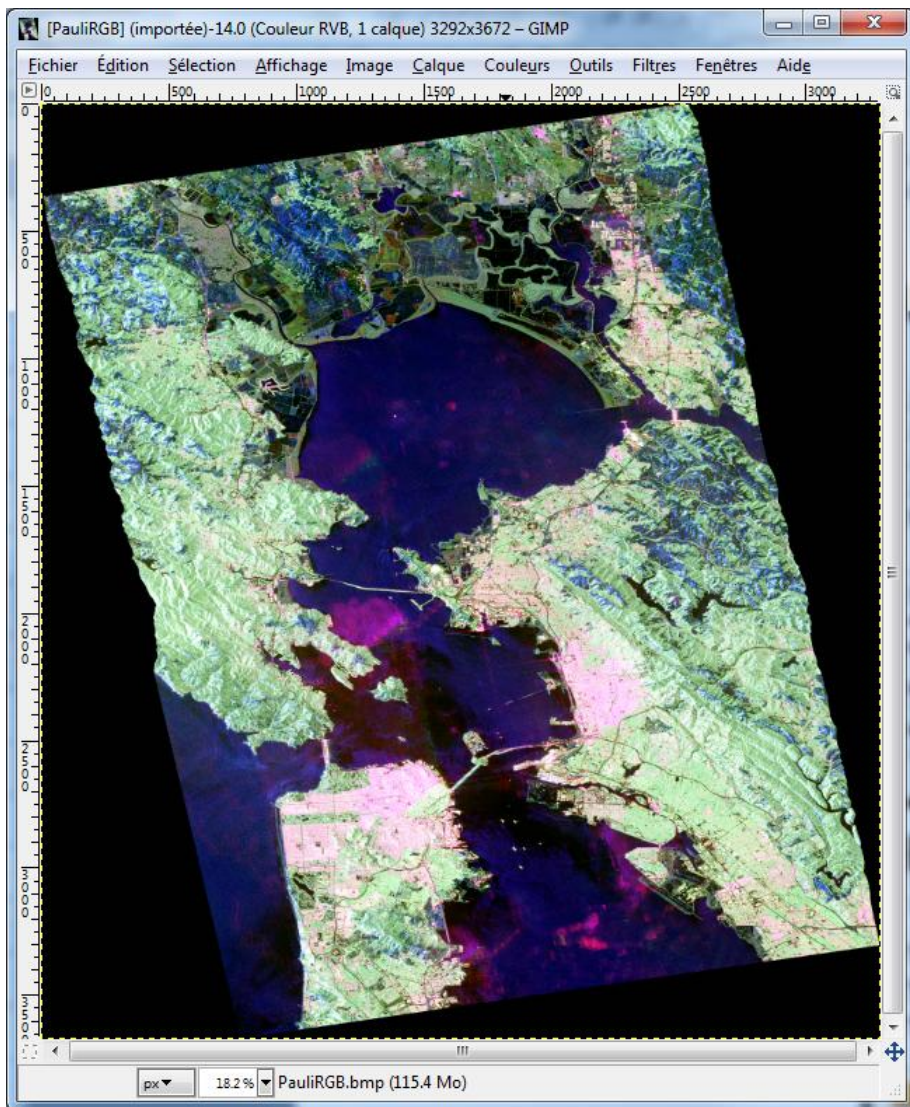
Pauli Huynen



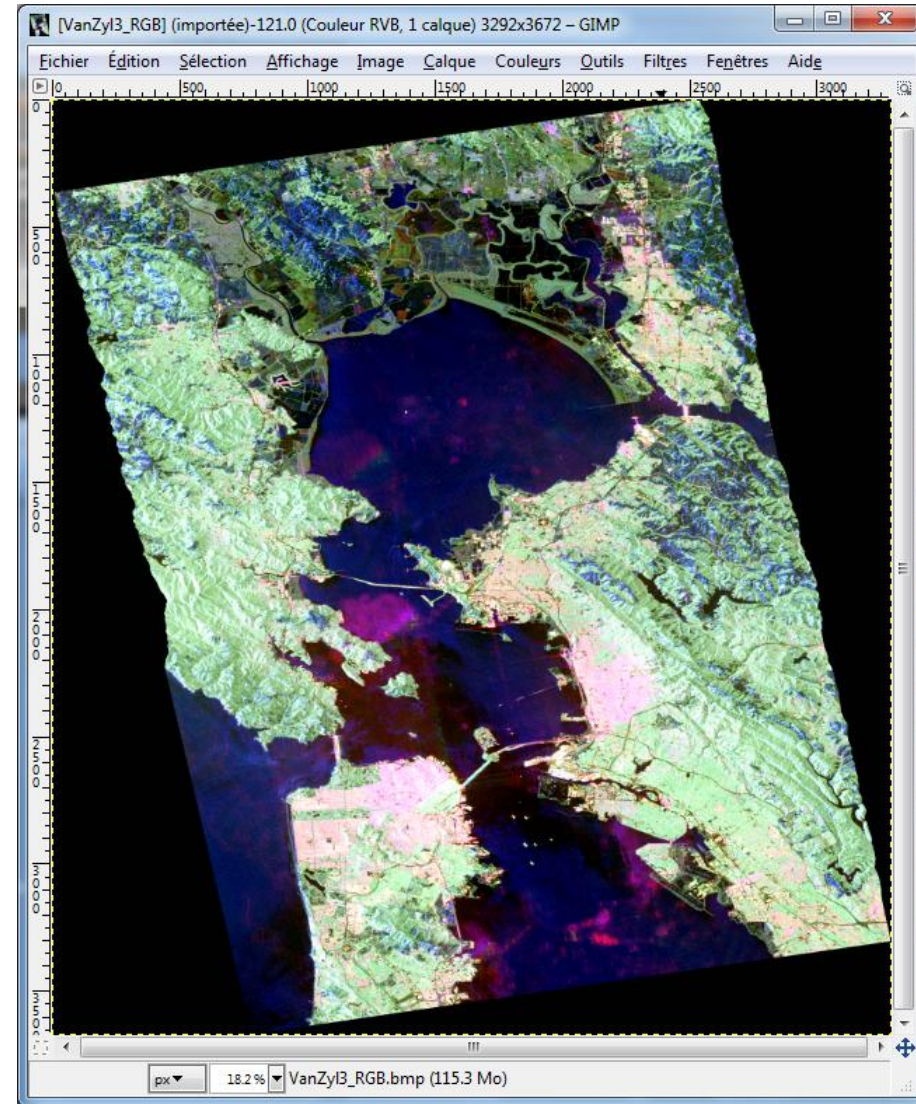
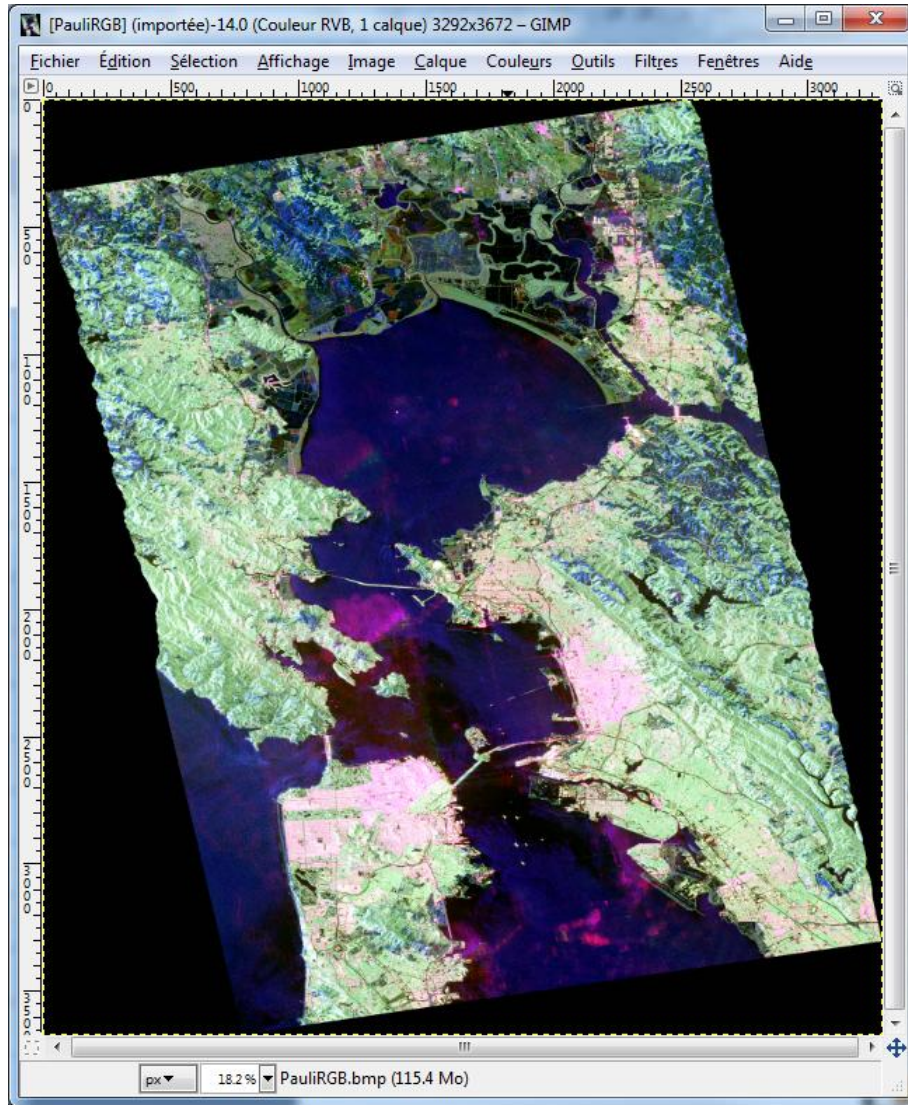
Pauli Cloude



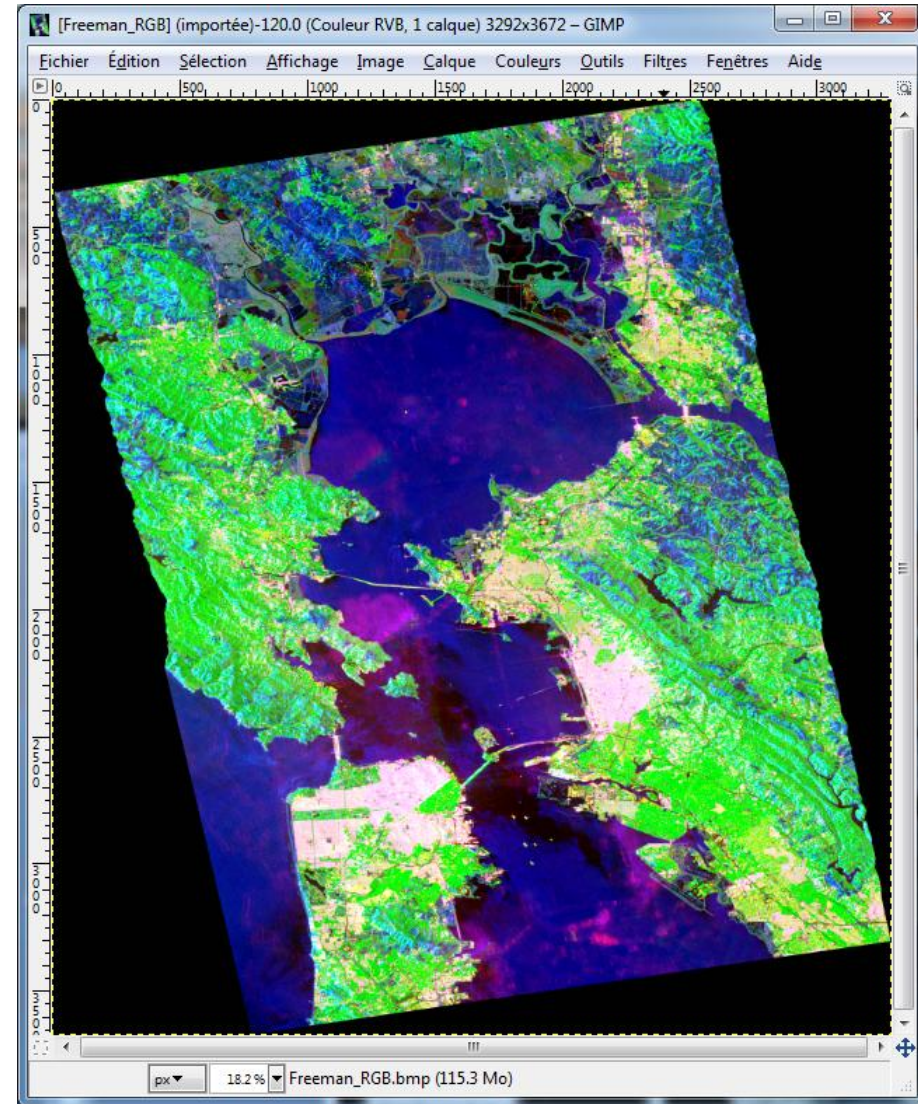
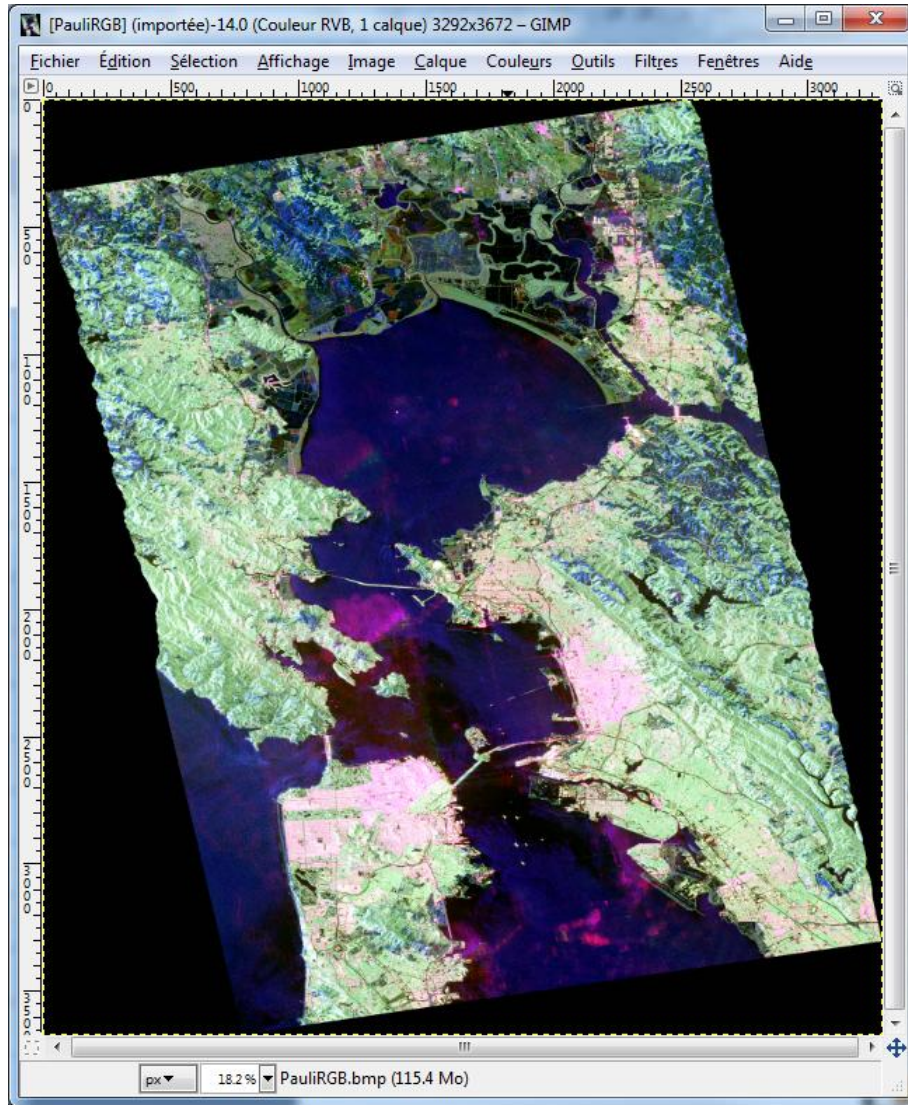
Pauli H-A-Alpha



Pauli Van Zyl 3



Pauli Freeman 3

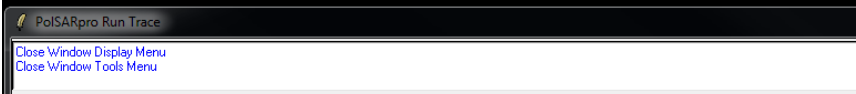
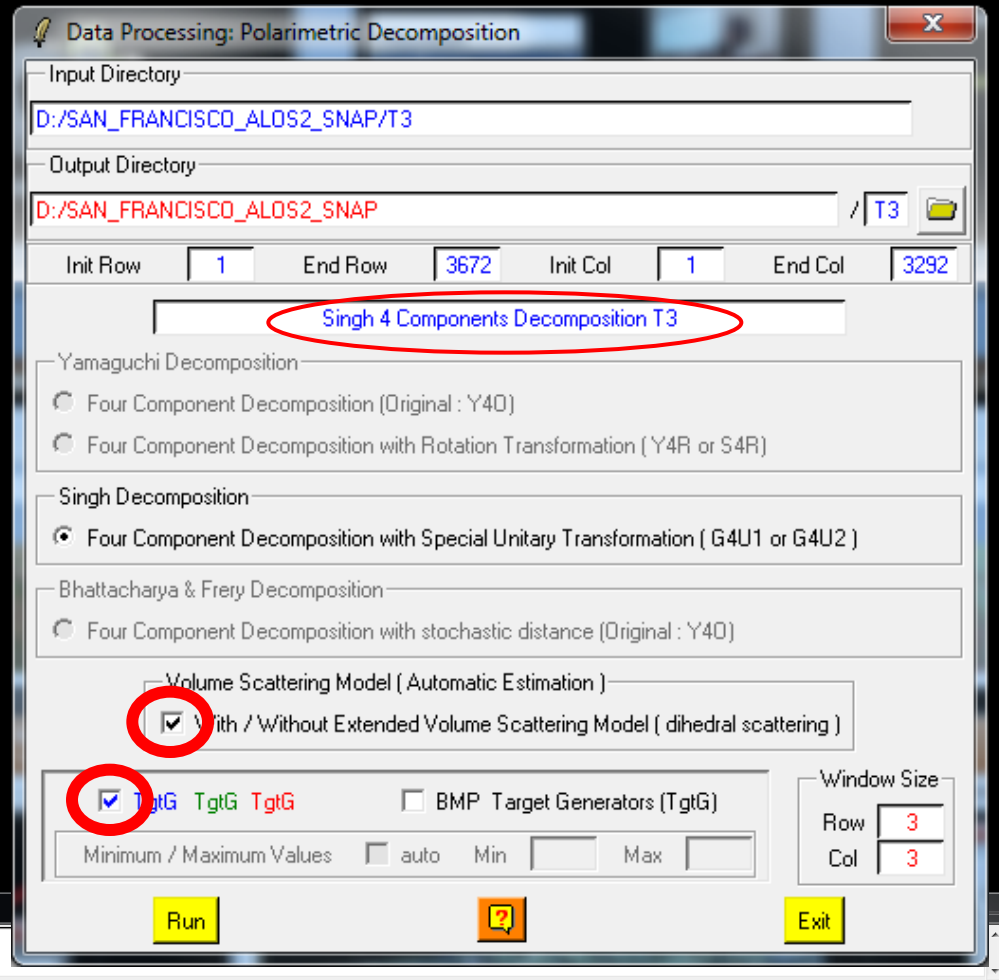




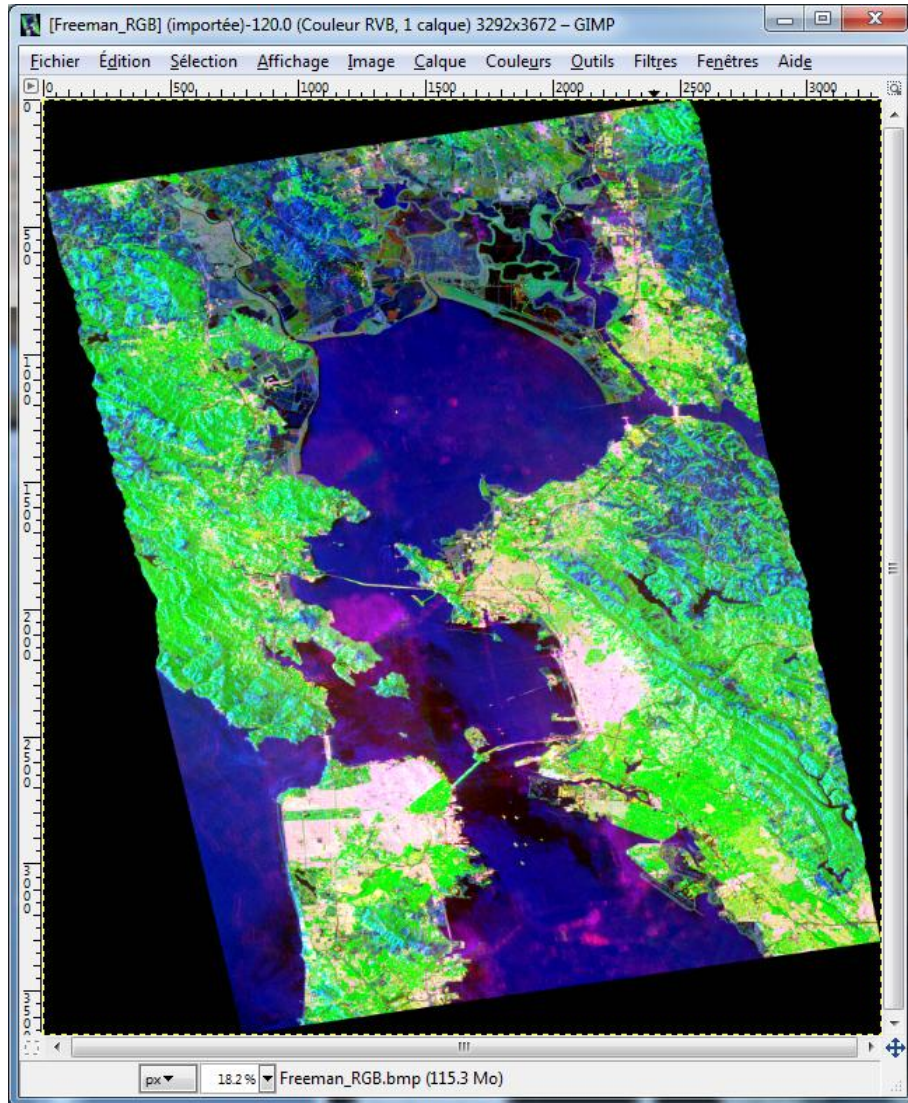
Do it Yourself:
Select some elements, set the parameters and view the corresponding BMP files (select BMP).

Window Size = 1

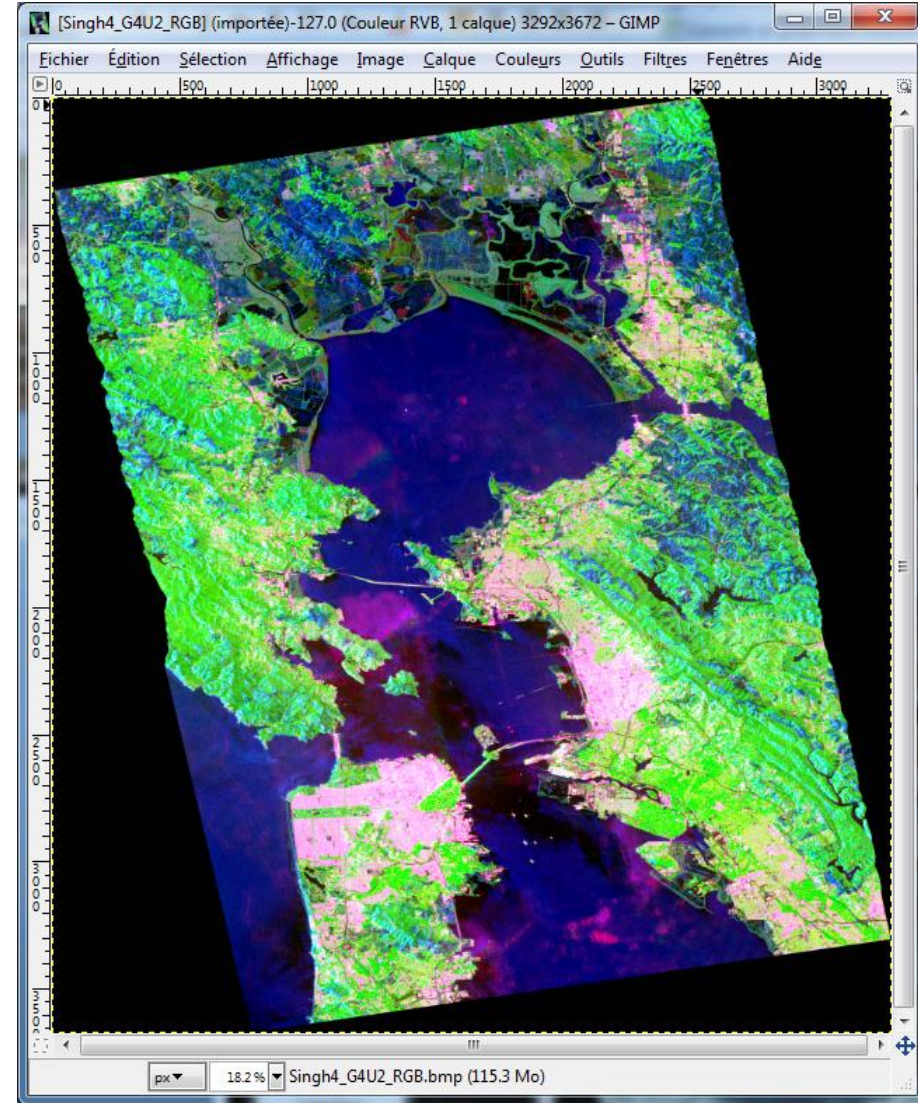
Yamaguchi Y40, Y4R, S4R
Singh G4U1, G4U2

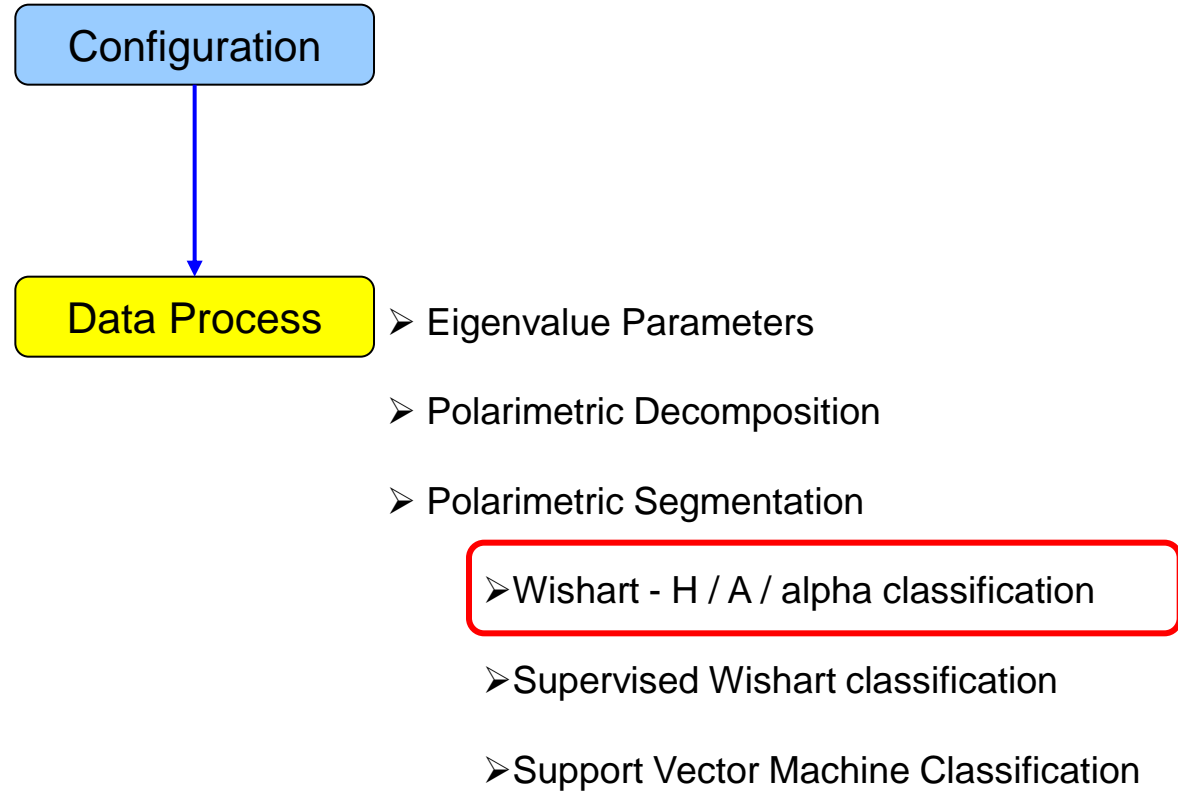


Pauli Freeman 3



Pauli Singh - Yamaguchi G4U2





PolSARpro v5.1 - Menu

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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 / 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

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

Texture Analysis

Polarized Point Scatterer Detection
Reflectivity Ratio
Differential Reflectivity (ZDR)

Clustering Process
Parameter Averaging
Data Sets Averaging

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

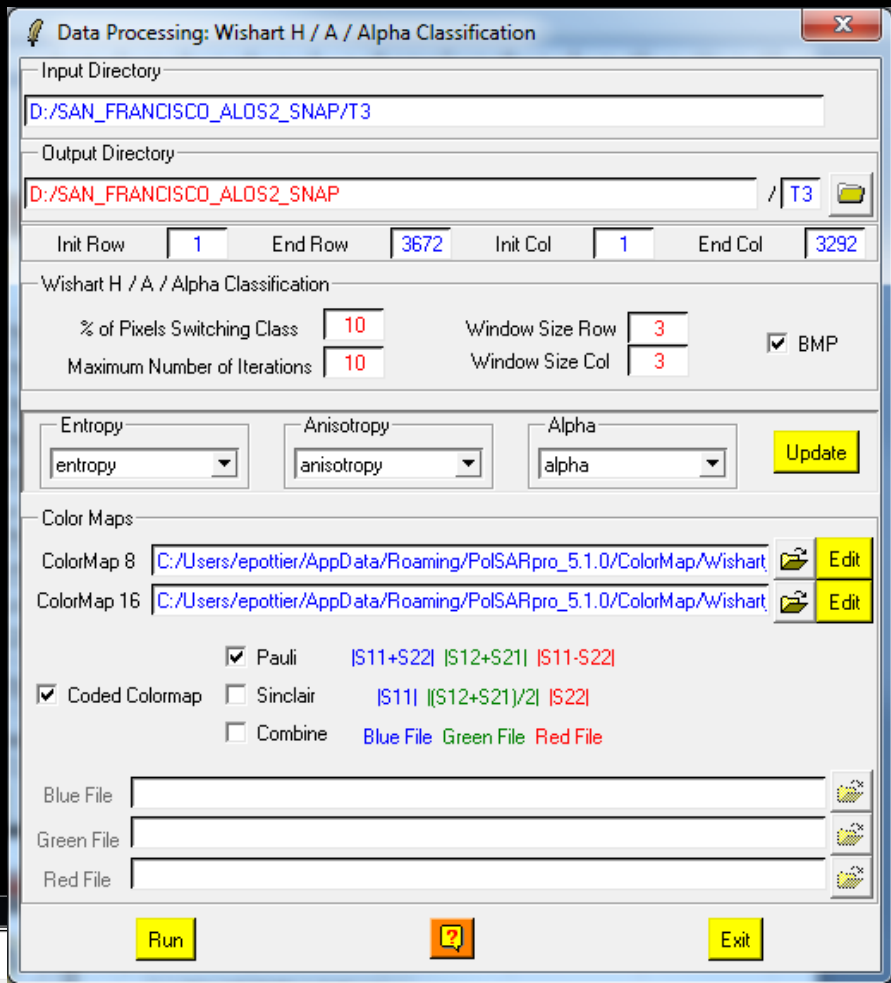
Decomposition Applications

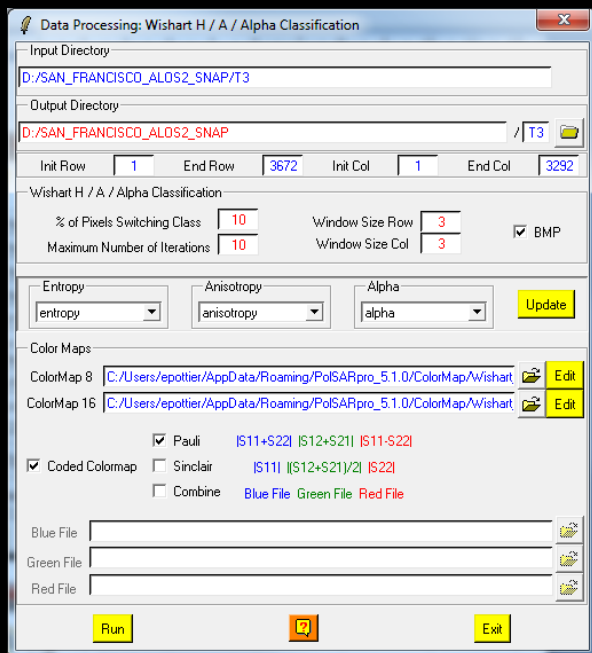
“龙计划4”高级... 云南师范大学, 中国, 昆明

2017年11月20日—11月25日

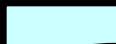


Do it Yourself:
Set the parameters, run and view the corresponding BMP files.





DATADIR



config.txt



[T3x3] Elements



Wishart_H_alpha_class_X.bin
Wishart_H_A_alpha_class_X.bin

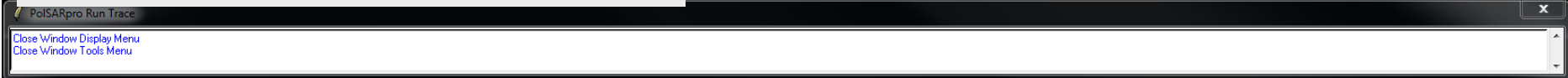


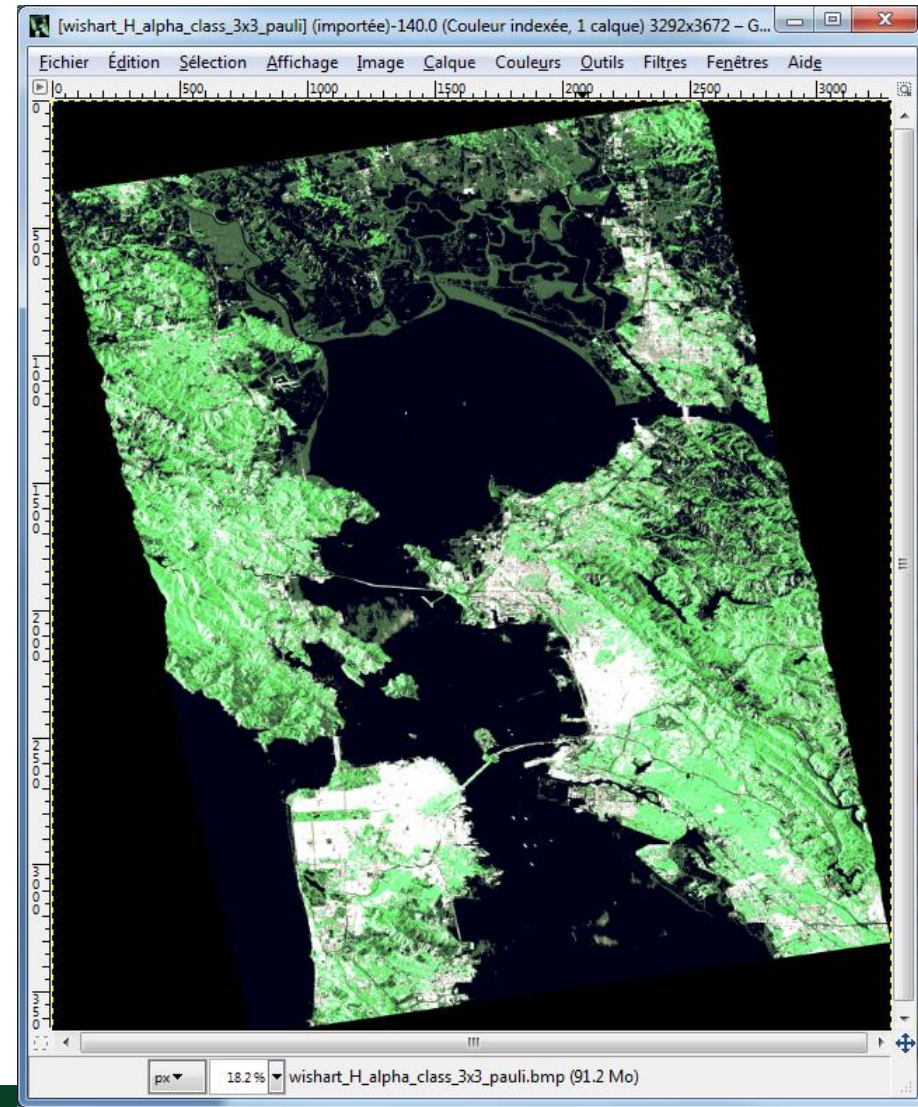
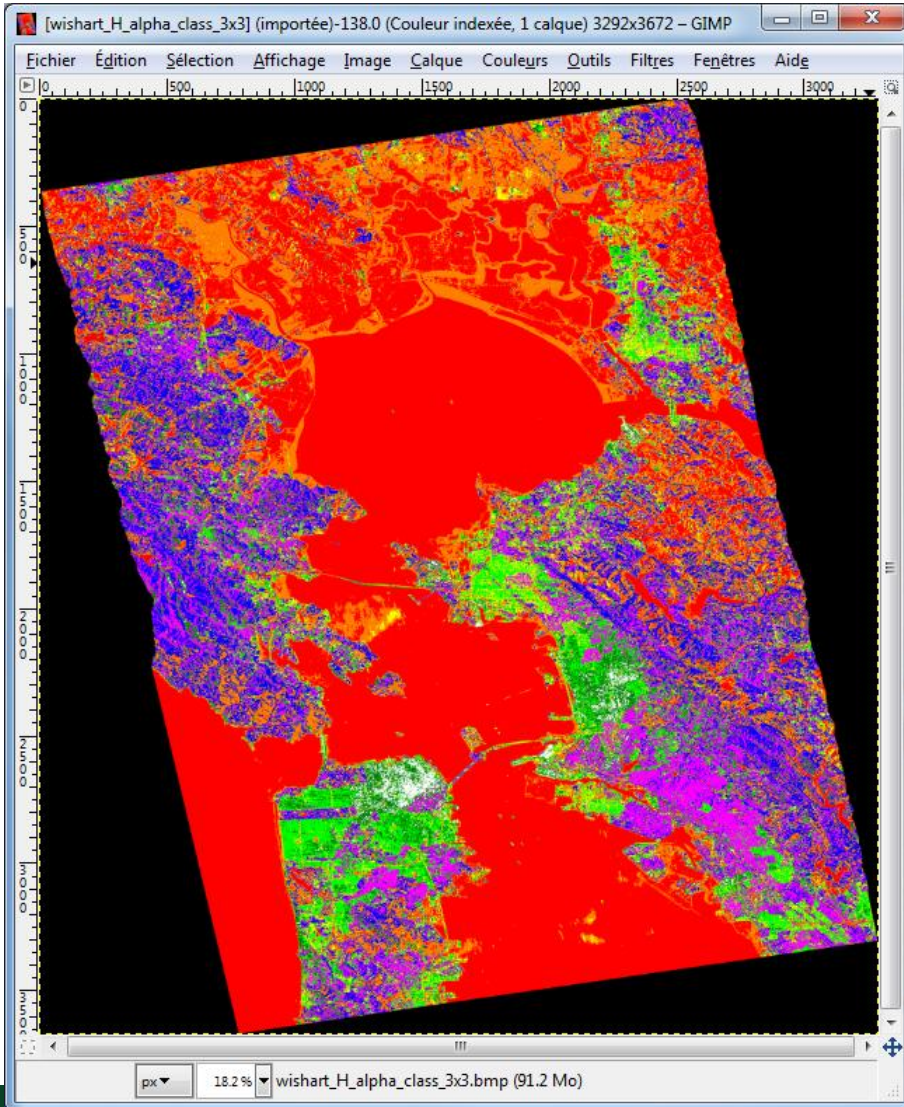
Wishart_H_alpha_class_X.bmp
Wishart_H_A_alpha_class_X.bmp

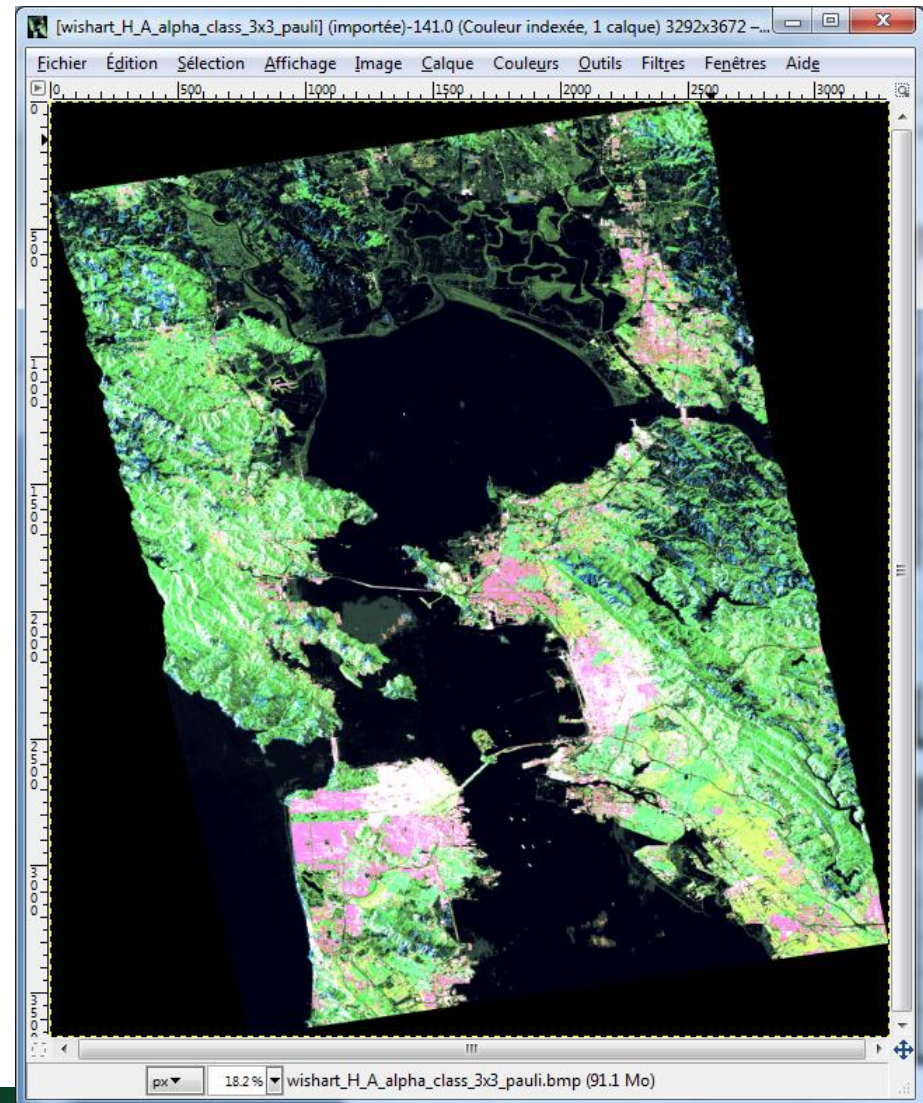
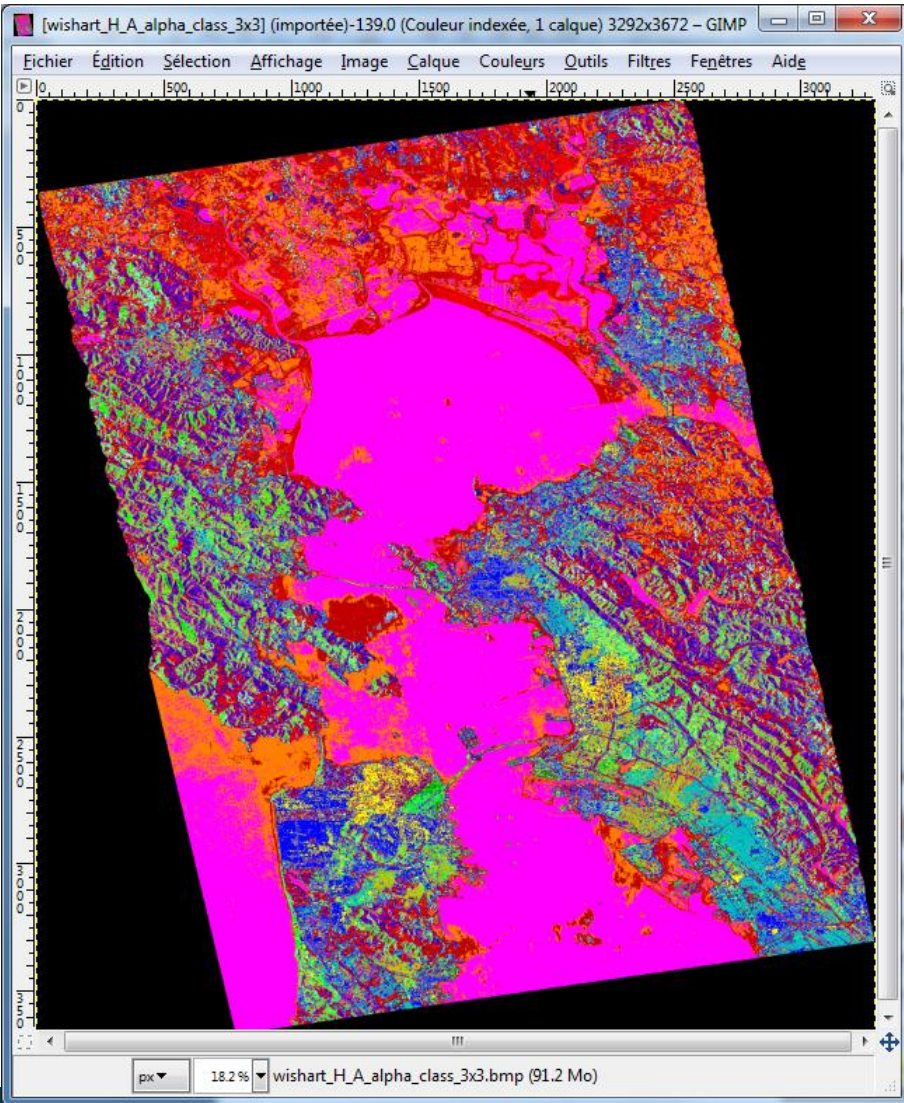
X = window size

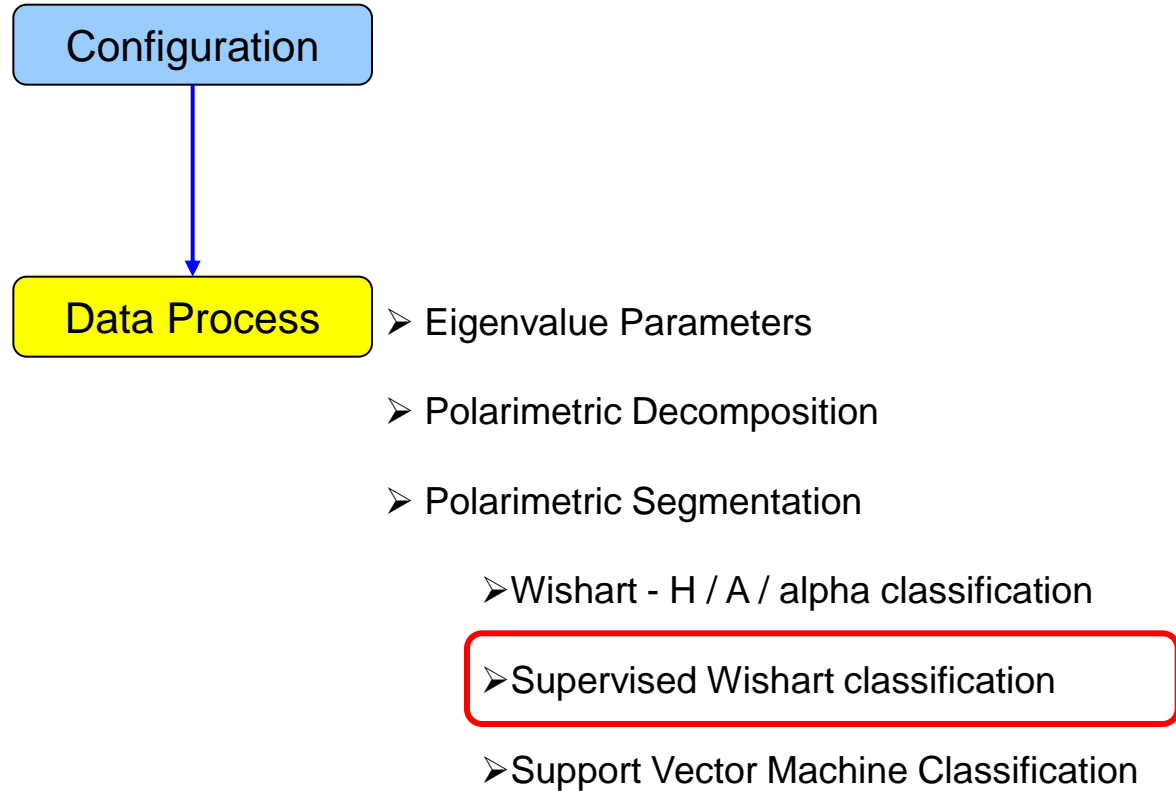
Do it Yourself:

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









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

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Circular (L / R)
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Box Car - Edge Filter
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Gaussian Filter
IDAN Filter
J.S. Lee Refined Filter
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Data Sets Averaging

Decomposition Applications

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

ADVANCED LAND REMOTE SENSING INTERNATIONAL WORKSHOP
20-25 November 2017 | Yunnan Normal University Kunming, Yunnan Pr

“龙计划4”高级遥感应用培训班
2017年11月20日—11月25日 云南师范大学, 中国, 昆明

The screenshot displays the PolSARpro software interface. The main window is titled "PolSARpro" and includes a menu bar with options like Environment, Import, Convert, Process, Display, Calibration, Utilities, Tools, Configuration, Education, and Help. A central dialog box titled "Data Processing: Wishart Supervised Classification" is open, showing the following configuration:

- Input Directory:** D:/SAN_FRANCISCO_ALOS2_SNAP/T3
- Output Directory:** D:/SAN_FRANCISCO_ALOS2_SNAP
- Row/Column Range:** 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
 - Buttons: CM Editor, CMR Editor
- Color Maps:**
 - ColorMap 16: C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Superv
 - 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_
 - Buttons: Graphic Editor, Run Training Process
- Set File:** D:/SAN_FRANCISCO_ALOS2_SNAP/T3/wishart_training_cluster_centers.bin
- Buttons:** Run, Exit

At the bottom, a "PolSARpro Run Trace" window shows the following log entries:

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




Step 1 :

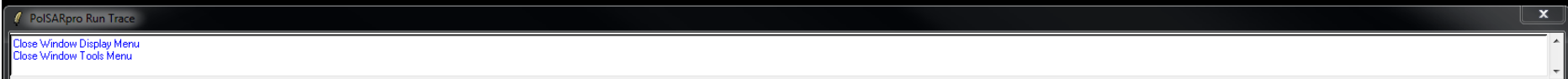
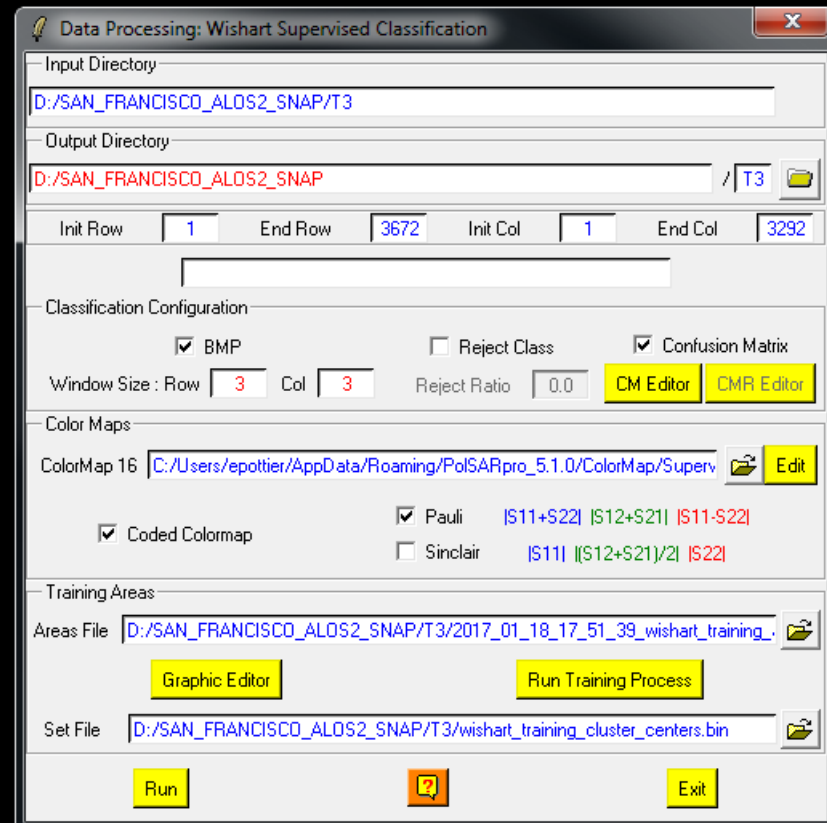
Open Graphic Editor to define graphically the Areas of Interest (AoI) or upload an existing Training Areas text file

Step 2 :

Run Training Process. This program will define the training clusters centres from the selected Areas of Interest (AoI).

Step 3 :

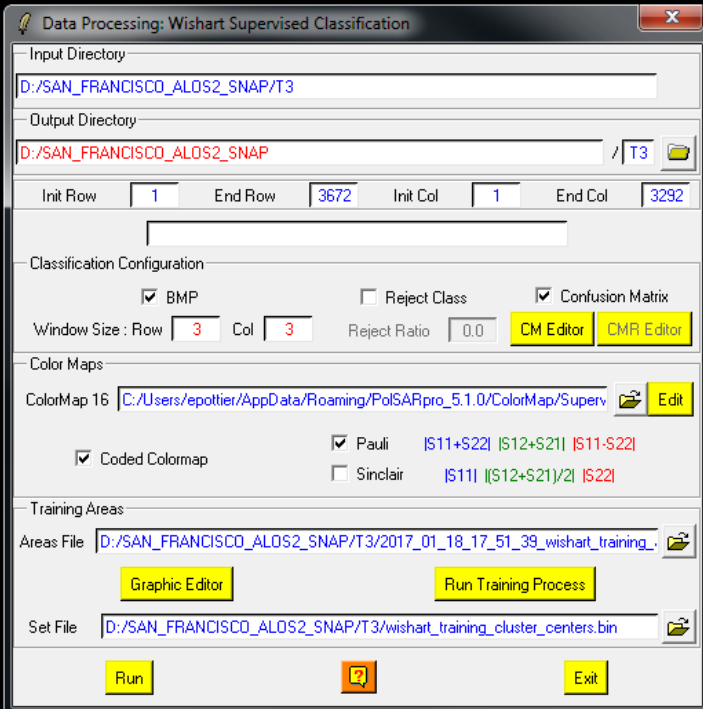
Run the Wishart Supervised Classification procedure



The screenshot displays the PolSARpro software interface. The main window shows a SAR image with several colored regions (red, green, yellow, blue) indicating training areas. A 'Data Processing: Wishart Supervised Classification' dialog box is open, showing the following configuration:

- 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
 - Buttons: CM Editor, CMR Editor
- Color Maps:**
 - ColorMap 16: C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Superv
 - 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_
 - Buttons: Graphic Editor, Run Training Process
- Set File:** D:/SAN_FRANCISCO_ALOS2_SNAP/T3/wishart_training_cluster_centers.bin
- Buttons: Run, Exit

The MapAlgebra v1.1 window shows the image file '-1- lambda_db.bmp (3292x3672)'. The status bar at the bottom indicates: zoom: 23 %, Class Num: 7, pixel: 2957 0, value = -17.94 < -10.53 < -2.88.



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

DATADIR

- config.txt
- [T3x3] Elements

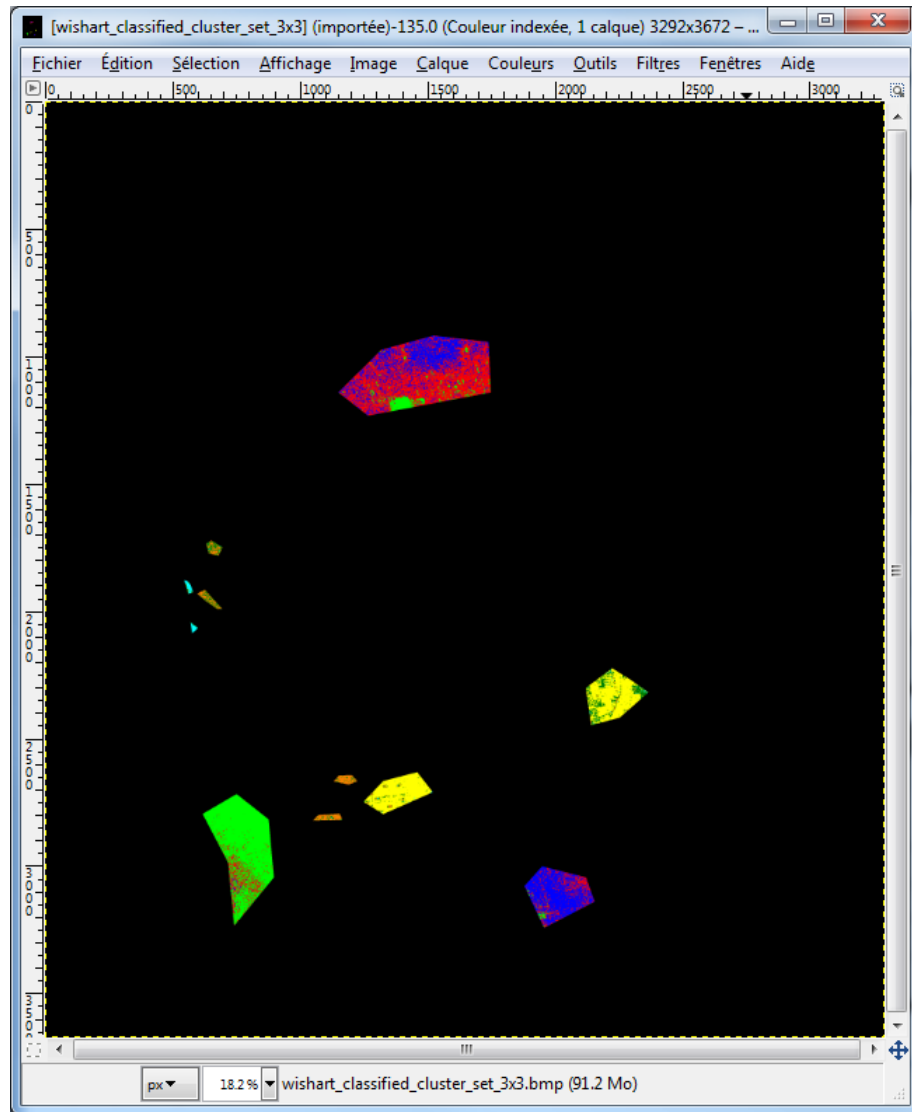
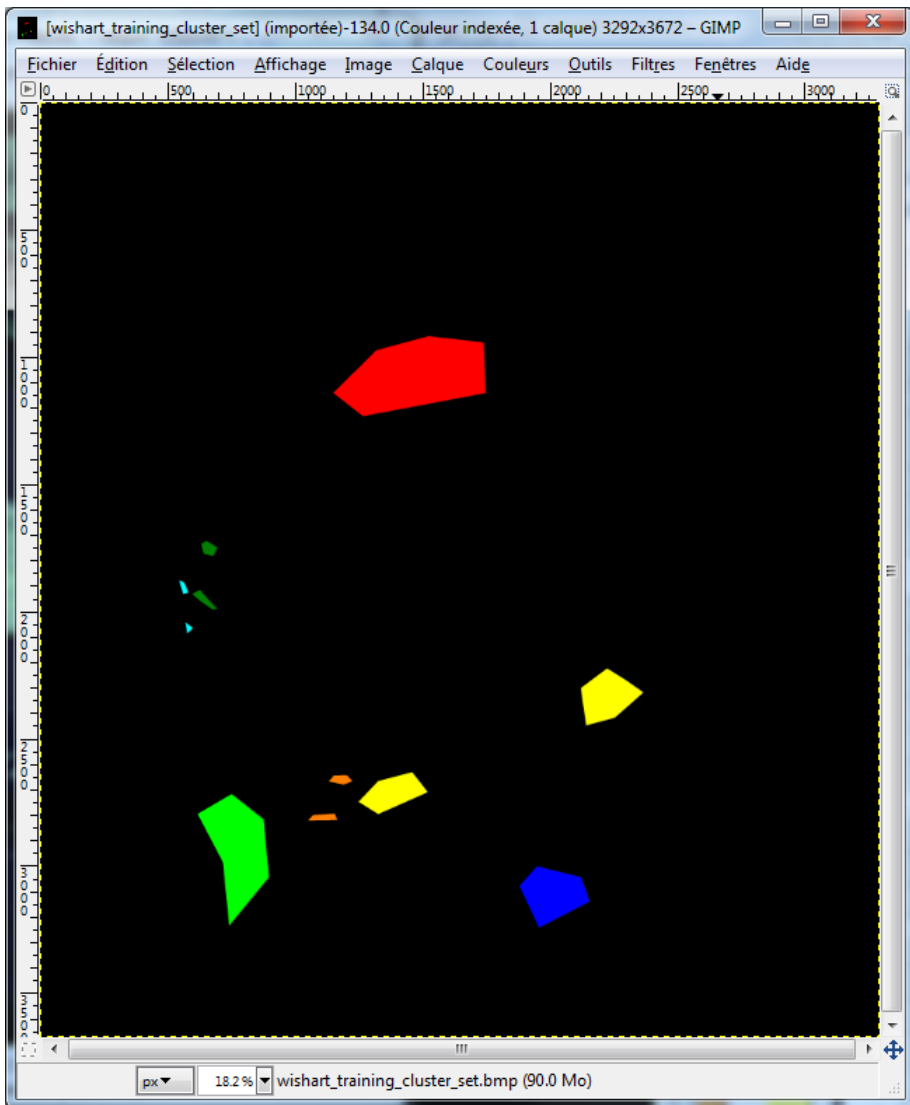
Run Training Process ← Training_areas.txt

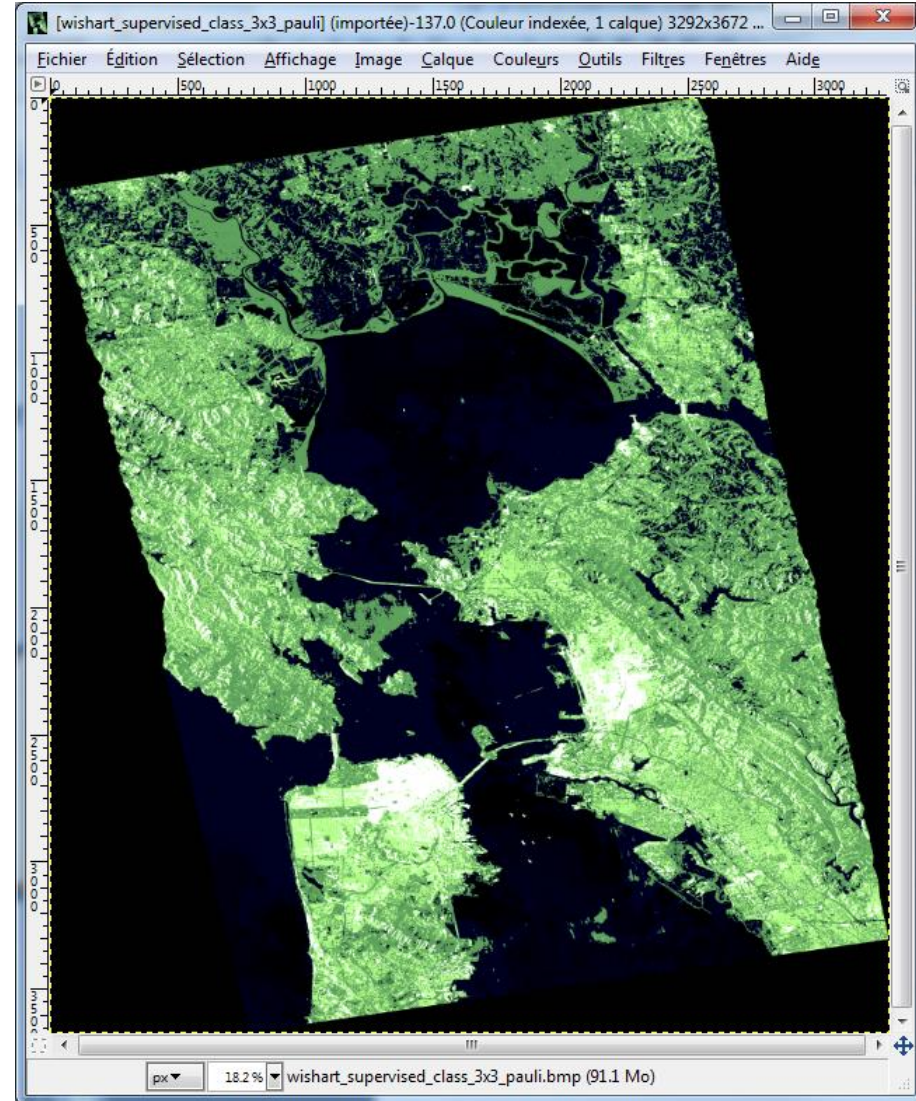
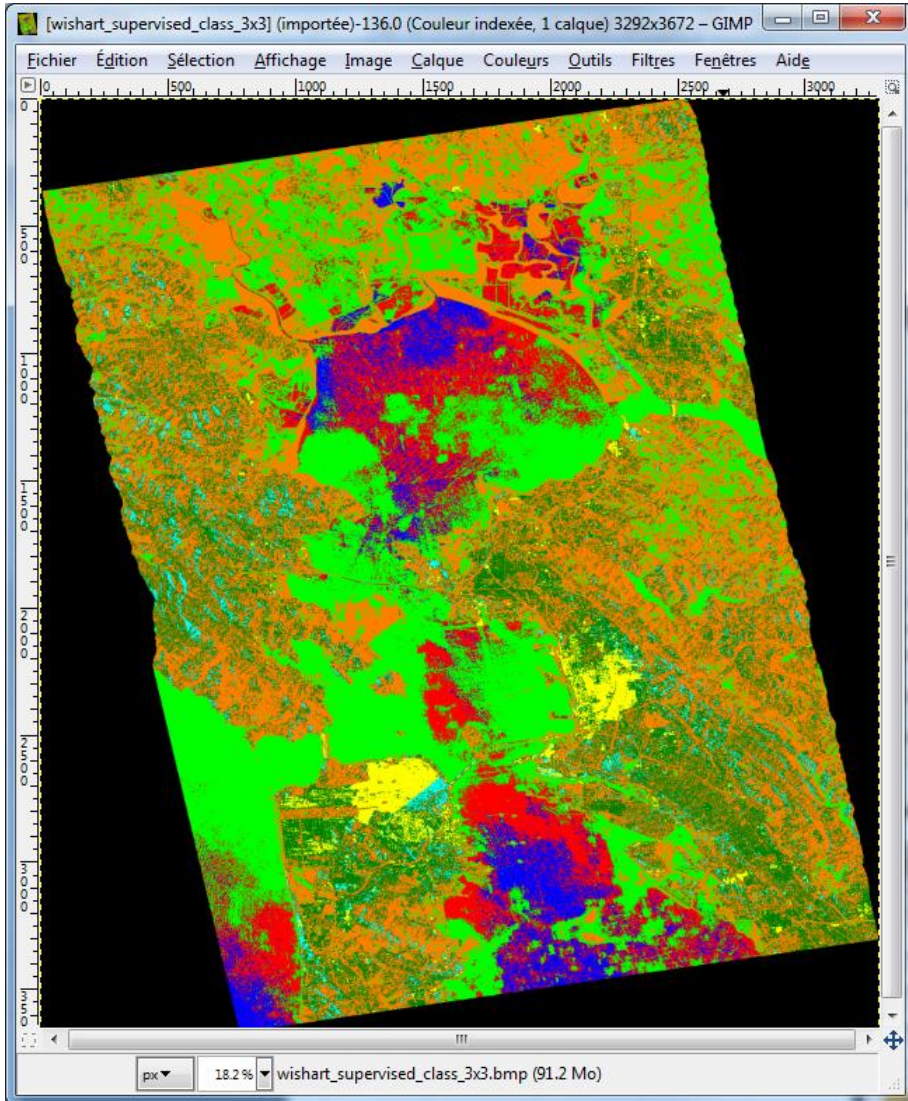
- Training_areas.bin
- Training_cluster_set.bmp

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

X = window size





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

Color Maps:

- 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_...

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

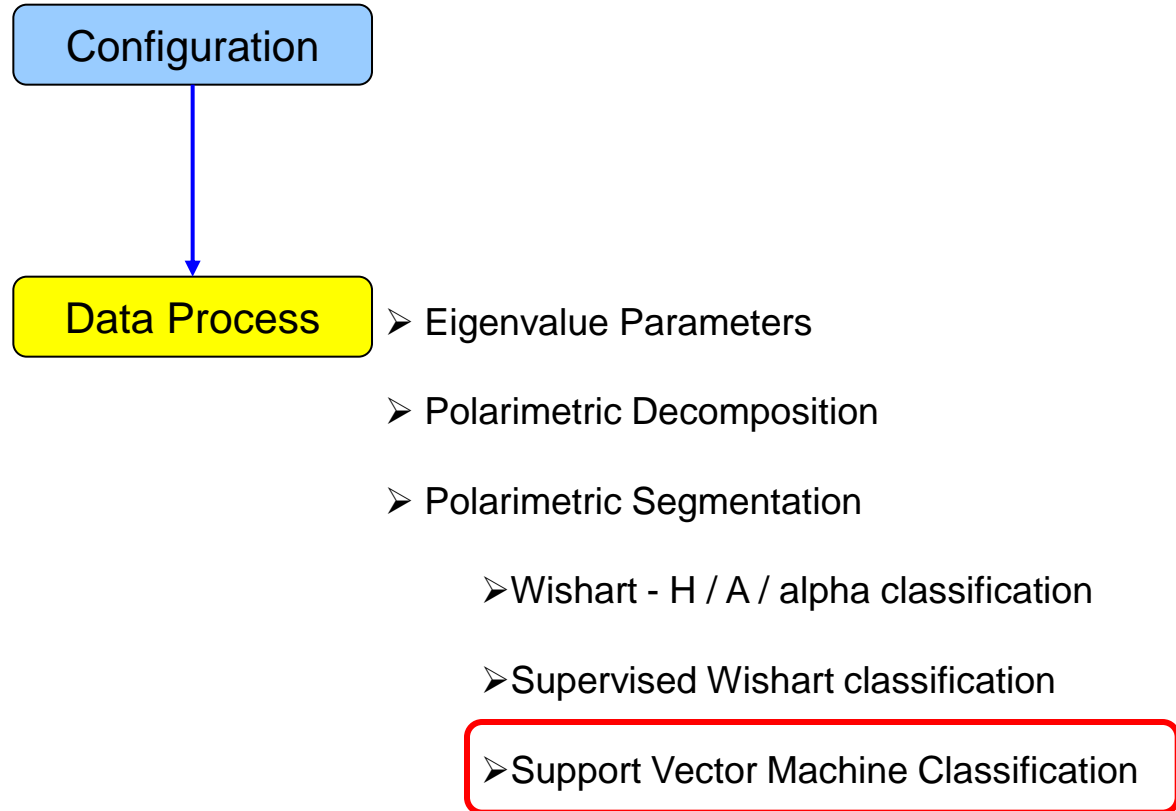
CONFUSION MATRIX

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 v5.1 - Menu

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The Polarimetric SAR Data Processing and Educational Tool

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

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Gaussian Filter
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P.W.F Filter
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Decomposition Parameters
Eigenvector Set Parameters
Eigenvalue Set Parameters

JRH : Huynen Decomposition
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RMB2 : Barnes 2 Decomposition
SRC : Cloude Decomposition
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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

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Scattering Model Based - Wishart Classification
Unified Huynen Classification
Fuzzy - H / Alpha Classification
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G.P.F. Supervised Classification
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PolSARpro Run Trace

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Decomposition Applications

“龙计划4”高级... 云南师范大学, 中国, 昆明

2017年11月20日—11月25日

PolSARpro Run Trace

Close Window Display Menu
Close Window Tools Menu

PolSARpro
The Polarimetric SAR Data Processing and Educational Tool

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

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
 RBF RECOMMENDED Polynomial Linear
Cost: 100 Gamma = 1/sigma: 0.44444
Optimisation parameters: **Setup and Run**
Degree:

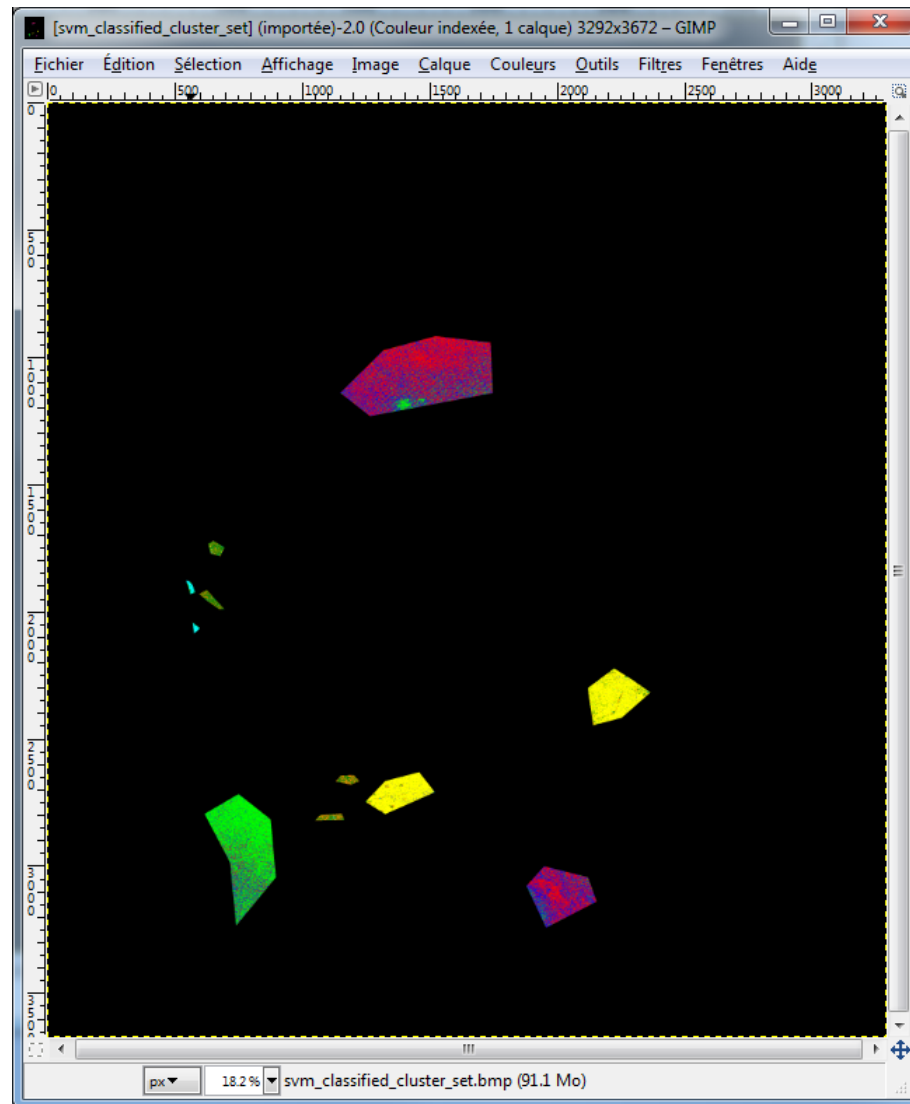
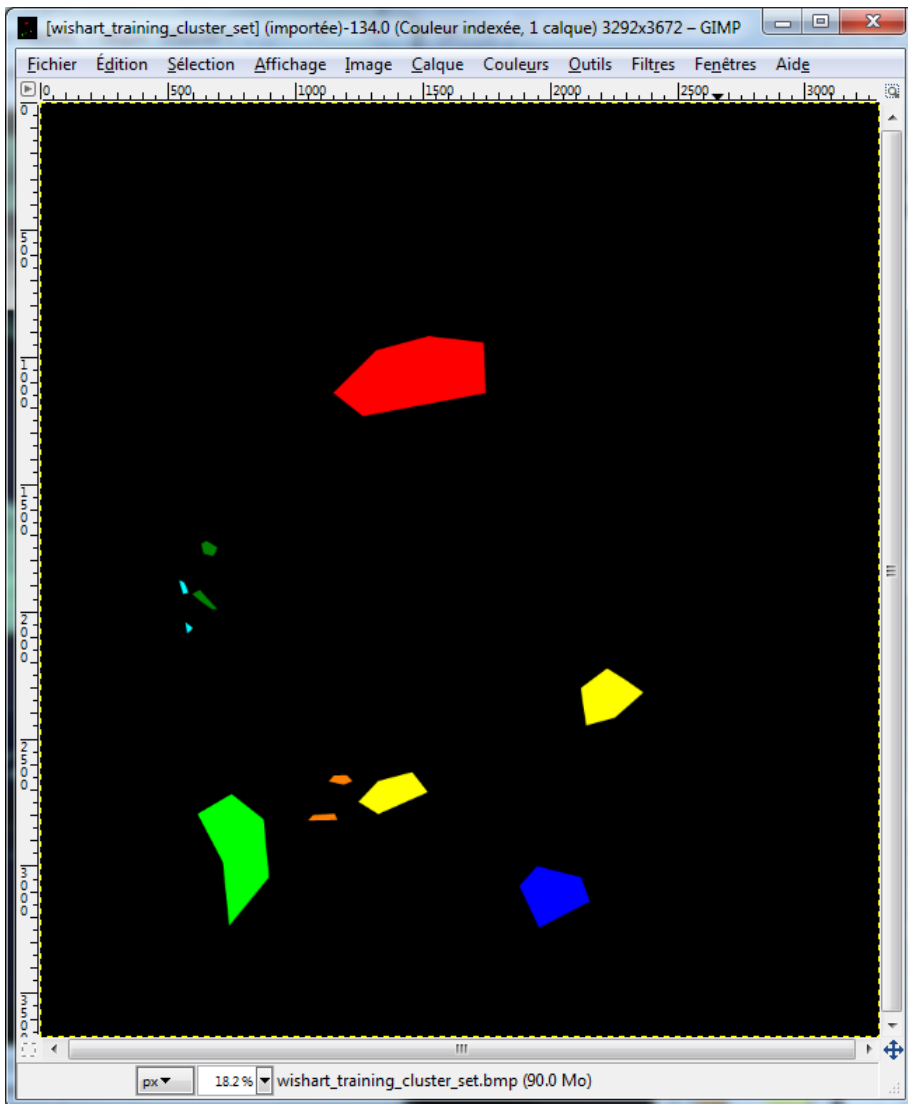
Step 6 - Run Classification **Exit**

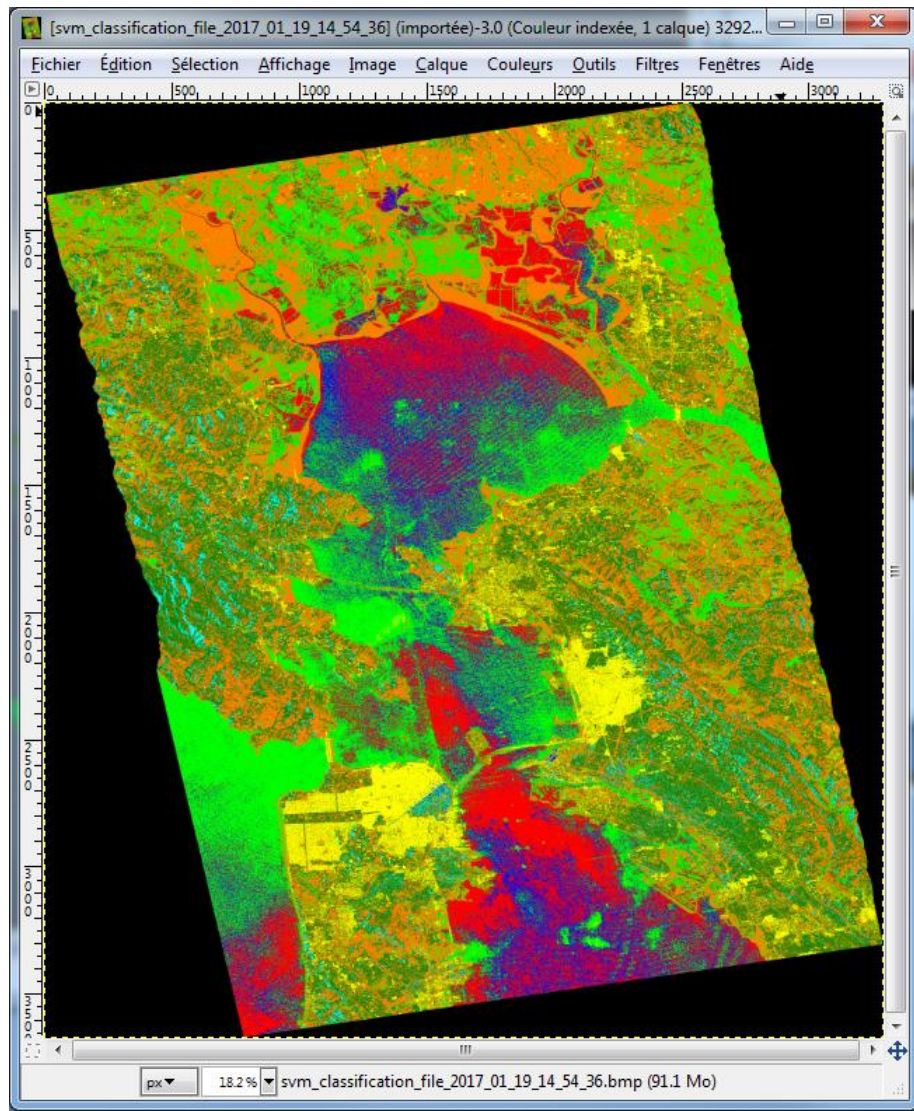
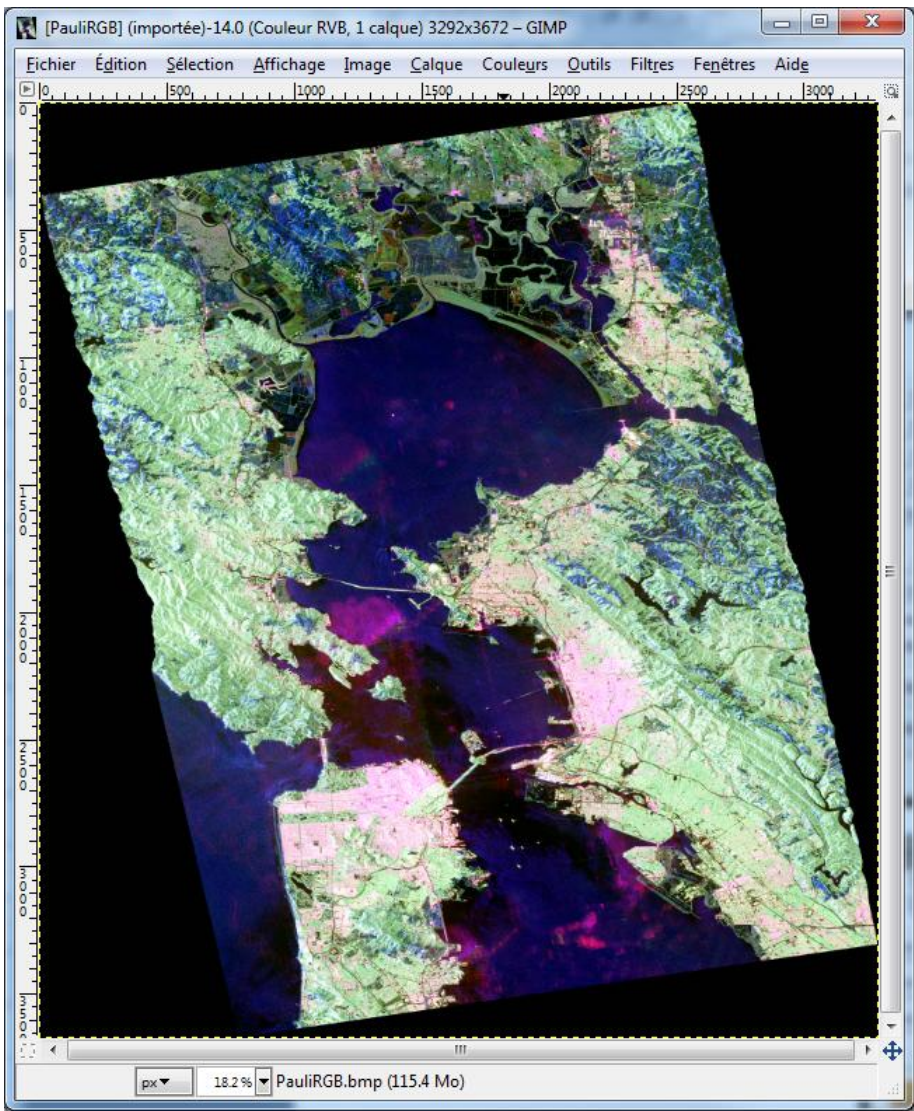
The screenshot displays the PolSARpro software interface. The main window is titled "Data Processing: SVM Supervised Classification". It includes several steps for configuration:

- Step 1 - Training Areas:** Input Directory is `D:/SAN_FRANCISCO_ALOS2_SNAP/T3`, Output Directory is `D:/SAN_FRANCISCO_ALOS2_SNAP`. Training Areas File is `Config/svm_training_areas.txt`.
- Step 2 - Classification Configuration:** BMP, Confusion Matrix.
- Step 3 - Color Maps:** ColorMap 16 is `C:/Users/epottier/AppData/Roaming/PolSARpro_5.1.0/ColorMap/Supervised_ColorMap16.pal`. Coded Colormap, Pauli, Sinclair.
- Step 4 - SVM Parameter Setting:** Input Polarimetric Indicators: T3. Sampling option: Training sampling (500). Output SVM parameters: Class Probability, Mean Hyperplane Distance, BMP.
- Step 5 - Kernel Parameter:** RBF. Cost: 100. Gamma = $1/\sigma$: 0.4444. RECOMMENDED. Optimisation parameters. Polynomial, Linear.
- Step 6 - Run Classification:** (highlighted with a red circle).

A secondary window titled "SVM RBF Kernel Parameters Optimisation (Cross Validation) (Ne répond pas)" is open, showing a contour plot of ISO Accuracy vs $\log_2(C)$ and $\log_2(\gamma)$. The plot shows accuracy values ranging from 91.8% to 93.5%. A blue arrow points from the "RECOMMENDED" box in the main window to the "Run RBF Kernel Parameters Optimisation" button in the secondary window.

A red circle with an hourglass icon and the text "50mn" is overlaid on the bottom right of the interface, indicating a 50-minute processing time.





esa PolSARpro
Quit

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

Data Processing: SVM Supervised Classification

Input Directory:

Output Directory: / T3

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

Step 1 - Training Areas
Areas File: Graphic Editor

Step 2 - Classification Configuration
 BMP Confusion Matrix CM Editor

Step 3 - Color Maps
ColorMap 16: 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 If important unbalanced training point
Output SVM parameters: Class Probability BMP Mean Hyperplane Distance BMP
Useful but time consuming

Step 5 - Kernel Parameter
Cost: Gamma = 1/sigma: RECOMMENDED Polynomial Linear
Optimisation parameters: Degree:
Setup and Run

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

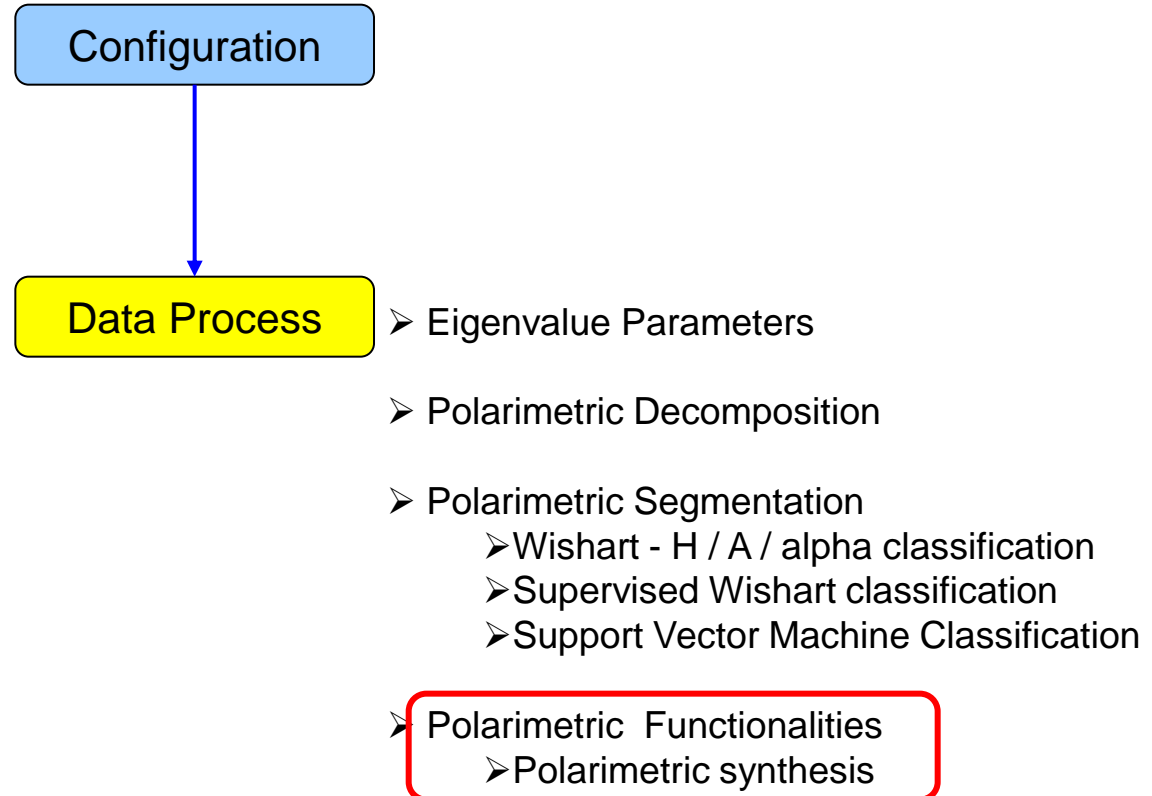
C1	128254
C2	76909
C3	40665
C4	56395
C5	4603
C6	4889
C7	1529

ADVANCED LAND REMOTE SENSING INTERNATIONAL TRAINING COURSE

20-25 November 2017 | Yunnan Normal University Kunming, Yunnan Province, P.R. China

“龙计划4”高级陆地遥感国际培训班

2017年11月20日—11月25日 云南师范大学, 中国, 昆明



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

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

Data Statistics
Data Histograms
Data Profiles
Histogram Based Statistics
Texture Analysis

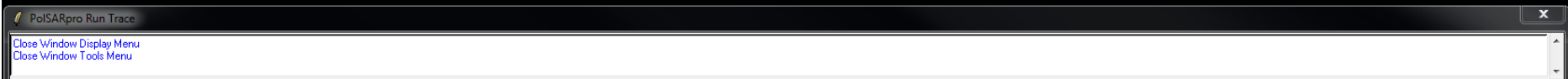
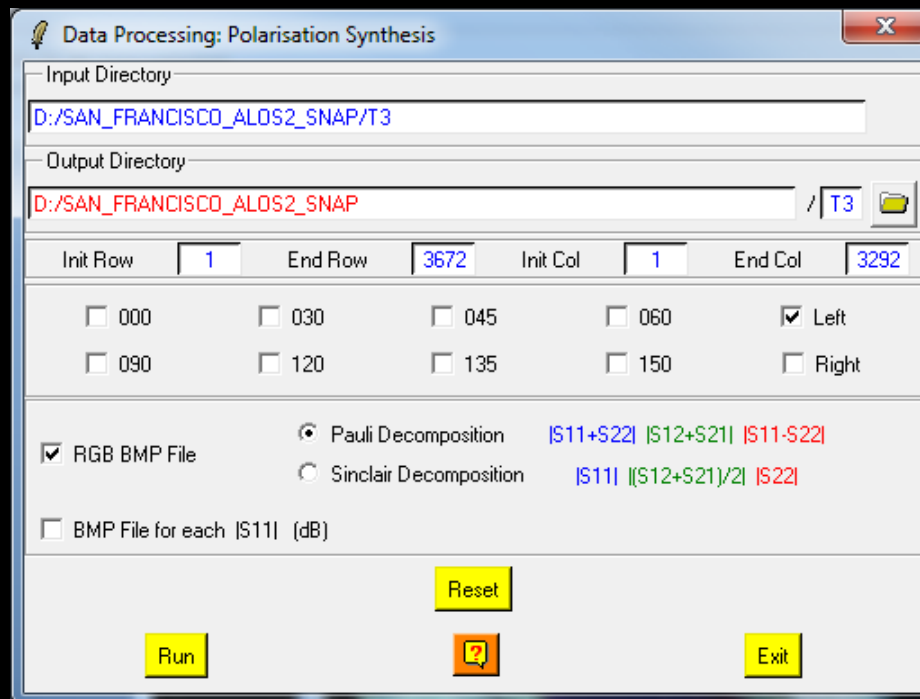
Clustering Process
Parameter Averaging
Data Sets Averaging

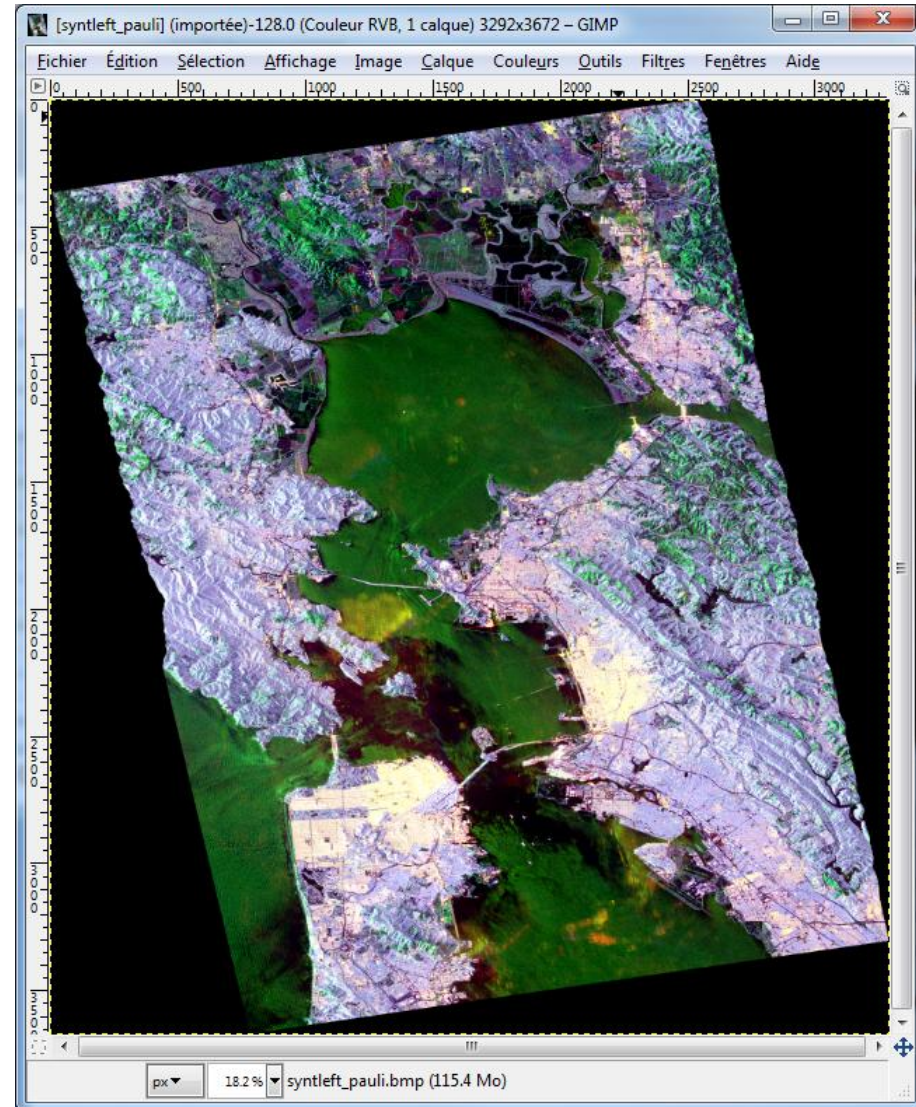
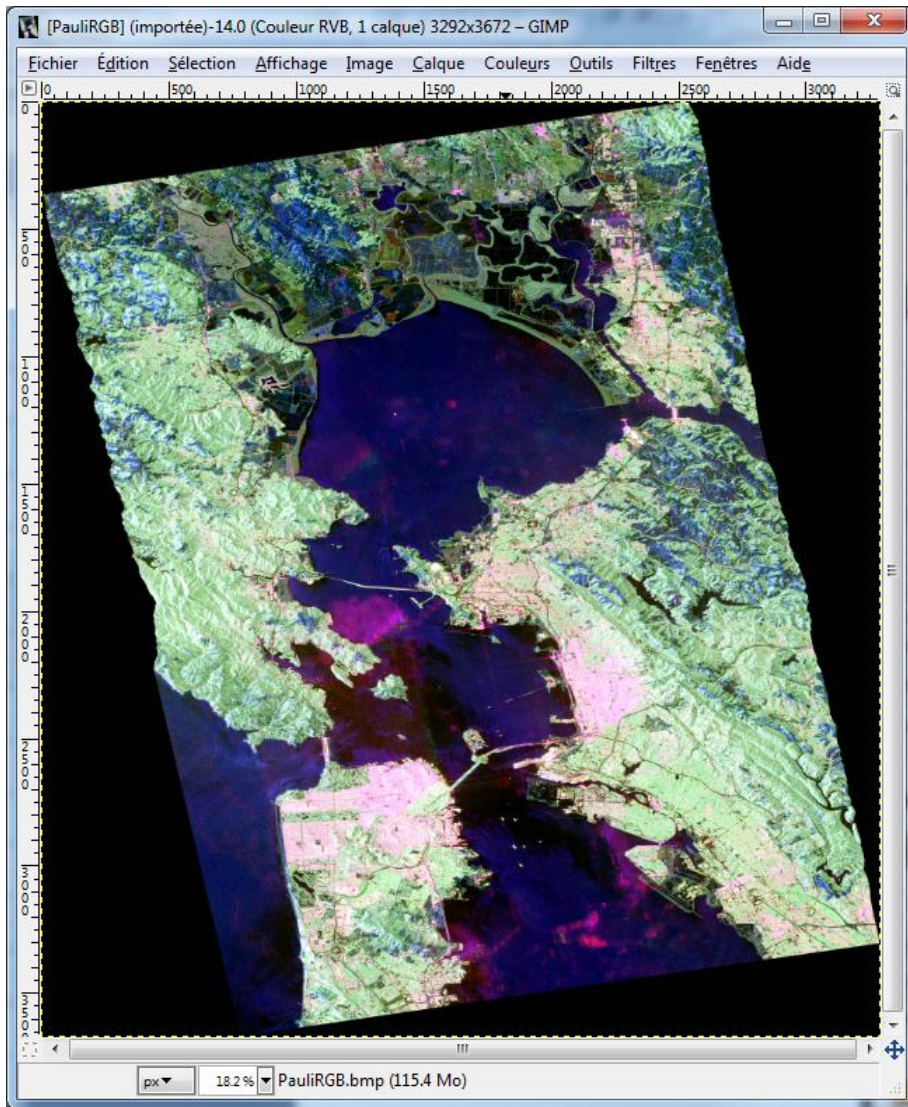
Decomposition Applications

PolSARpro Run Trace
Close Window Display Menu
Close Window Tools Menu

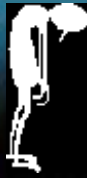
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Questions ?



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