PolSARPro & Land Retrievals

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Land cover classification from PolSAR data with PolSARPro

Outlines

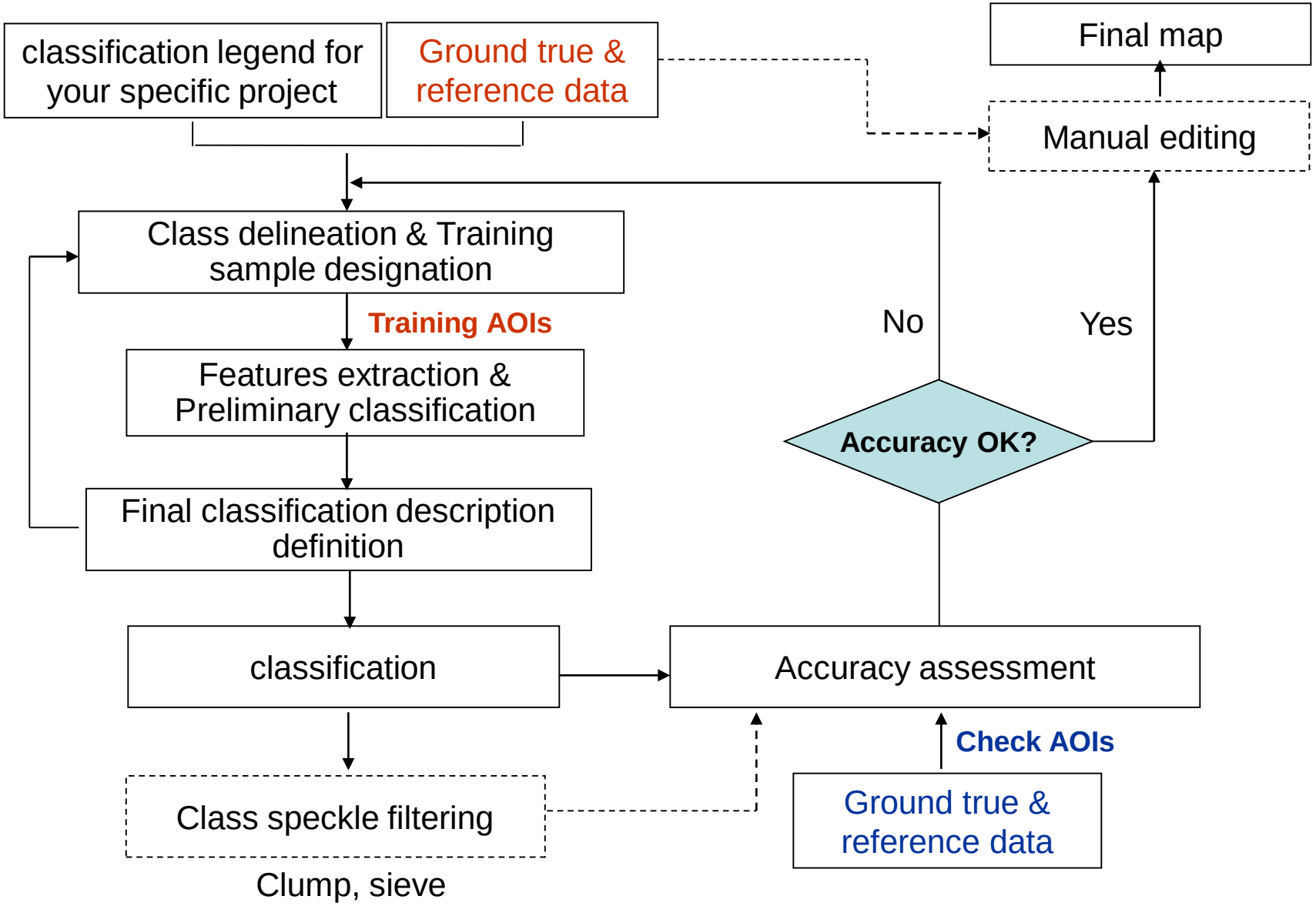
I. **Introduction**

II. **GF-3 PolSAR dataset**

III. **Practical**

I. Introduction

1.1 General technique framework for remote sensing image classification



I. Introduction

1.2 Classification system and legend defining

Classification system

- It is an abstract representation of the situation in the field using well defined diagnostic criteria
- One define it as: “The ordering or arrangement of objects into groups or sets on the basis of their relationships”

A classification system is

- scale independent: the classes should be applicable at any scale or level of detail;
- source independent: independent of the means used to collect information, whether it be through satellite imagery, aerial photography, field survey or using a combination of sources.

Remote sensing classification legend

- It is the application of a classification system in a specific area using a defined mapping scale and specific data set

Classification legend is

- Scale and cartographic representation dependent;
- Data and mapping methodology dependent.

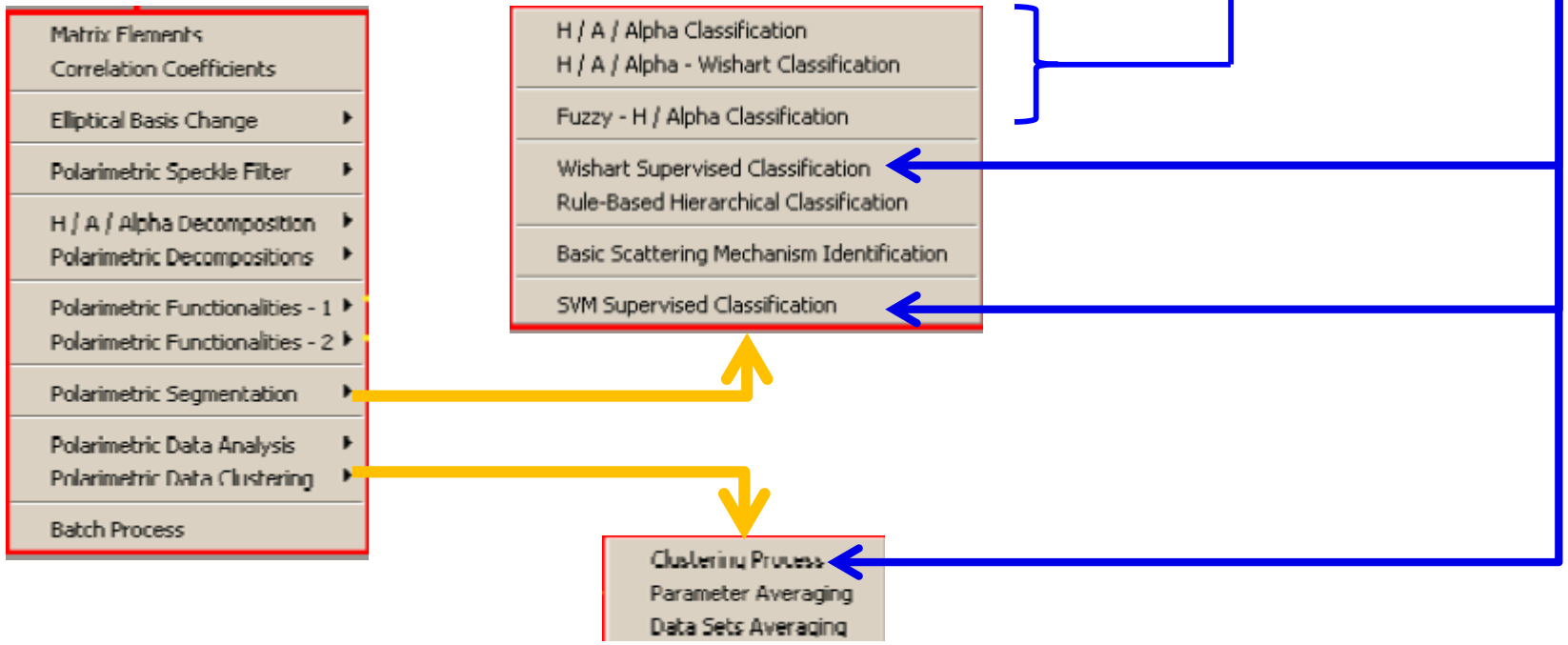
I. Introduction

1.3 Classification method introduction through PolSARPro

Pixel based ←→Object based

Unsupervised←→Supervised

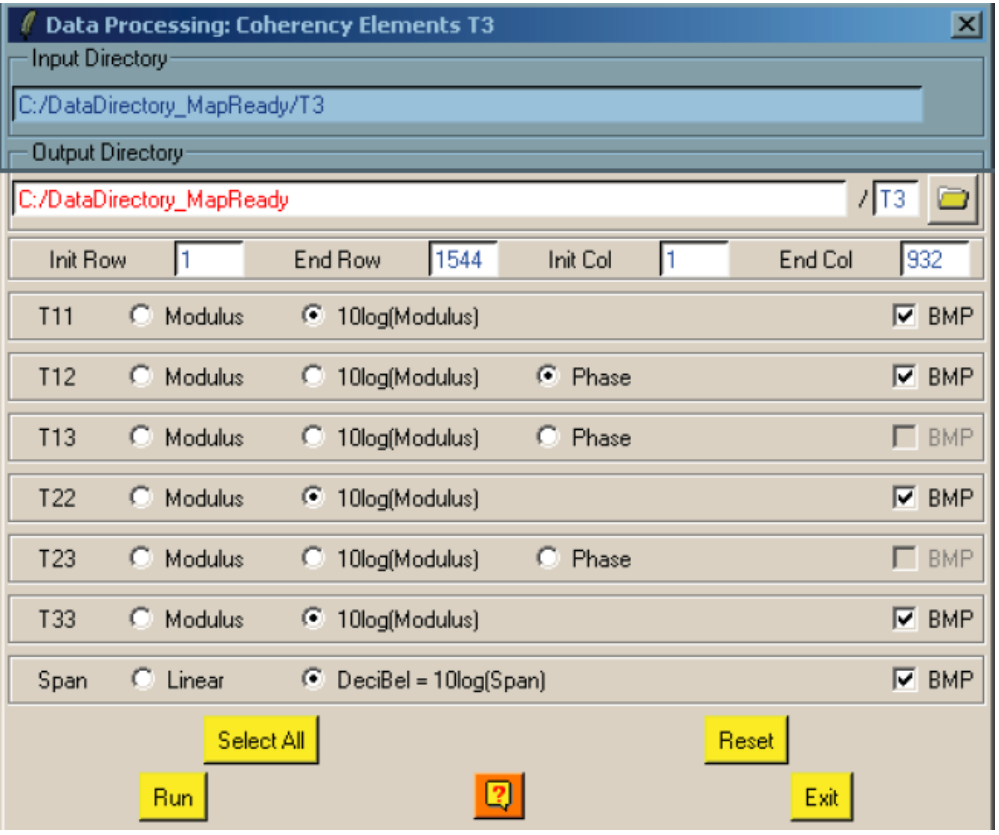
-Currently only pixel based classifier
-Object based is not available



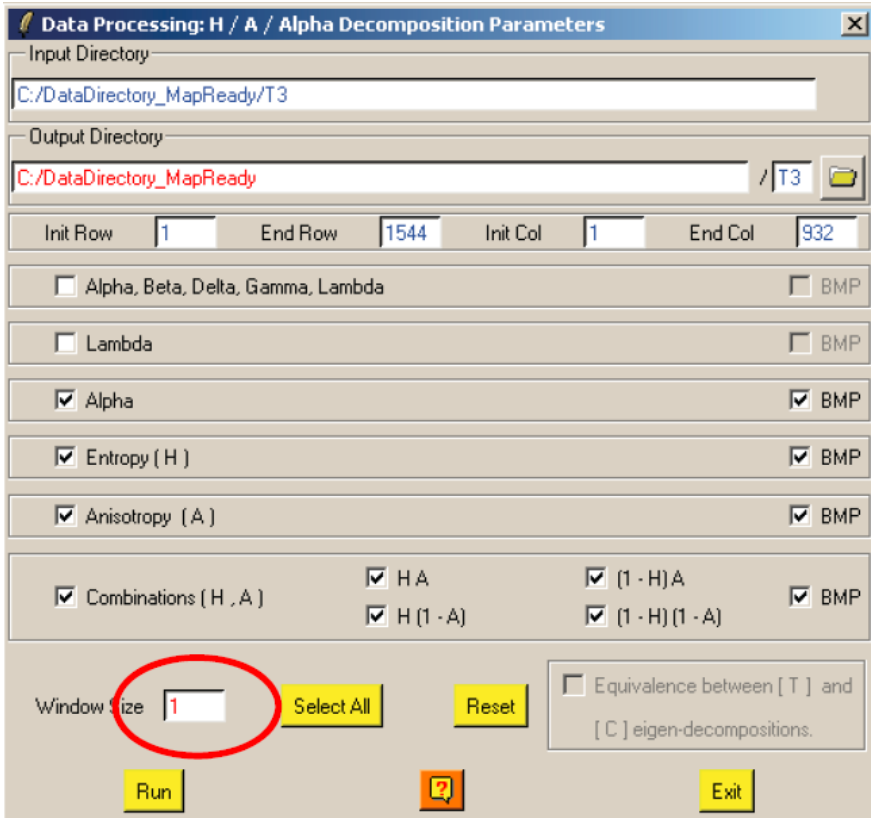
1.4 Feature selection and transformation

Features available in PolSARPro:

(1) Matrix elements, eg. [T3]



(2) Polarimetric decomposition features eg. H/A/Alpha decomposition

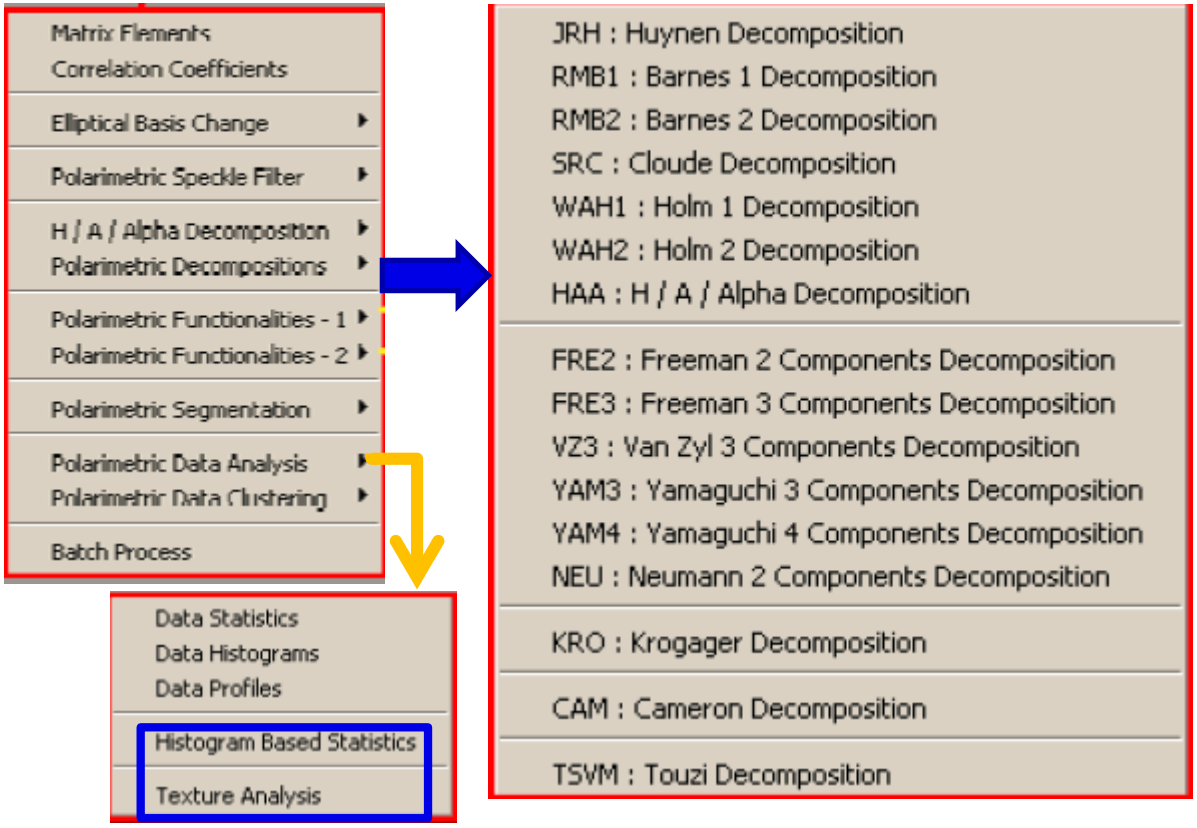


All the elements can be used as features

1.4 Feature selection and transformation

Features available in PolSARPro:

(2) Polarimetric decomposition features and many others provided by PolSARPro:



But it does not mean the more the better for classification:

Dimension disaster problem:

- **With fixed training samples, accuracy increases with dim to one maximum acc., then decreases**
- **The key reason is there are correlations between features , and more feature needs more training samples to solve the classification model.**

PorSARPro solution:

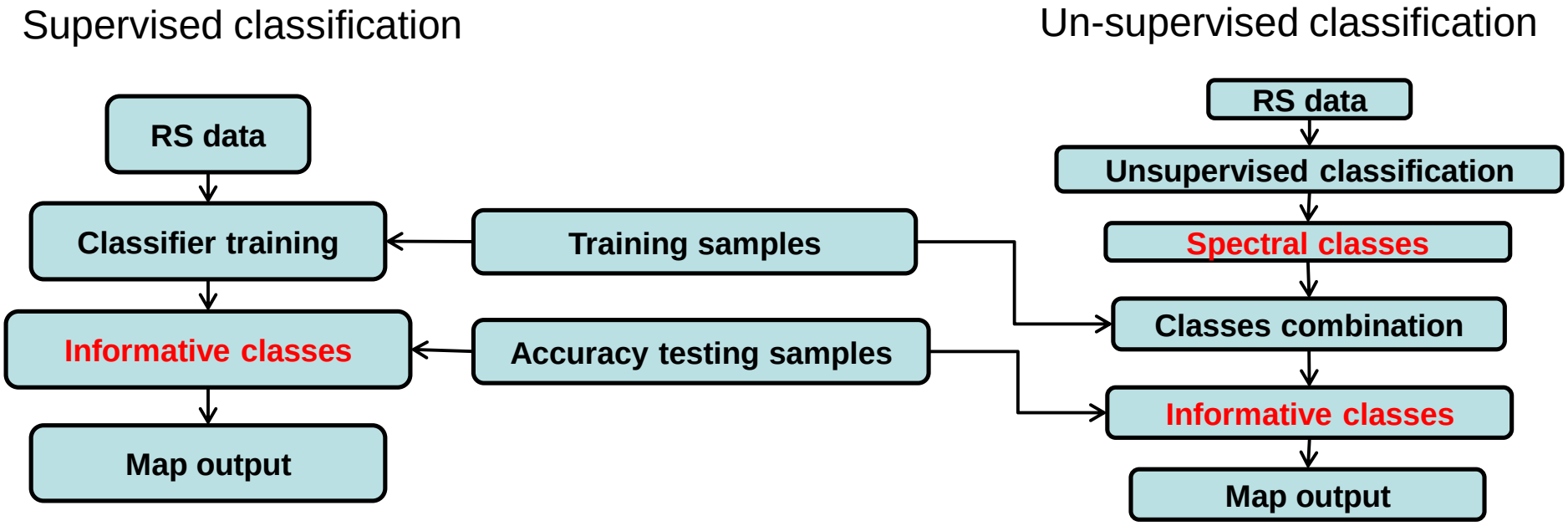
- **SVM supervised classification, lets you to choose features.**

1.5 Classifier training and testing

- **“spectral classes “ and “informative classes”**
  - **Spectral classes**
    - Classes can be spectrally separated, optical remote sensing
    - Classes can be separated by polarmteric mechanism or PolSAR data itself
  - **Informative classes: useful for real applications**

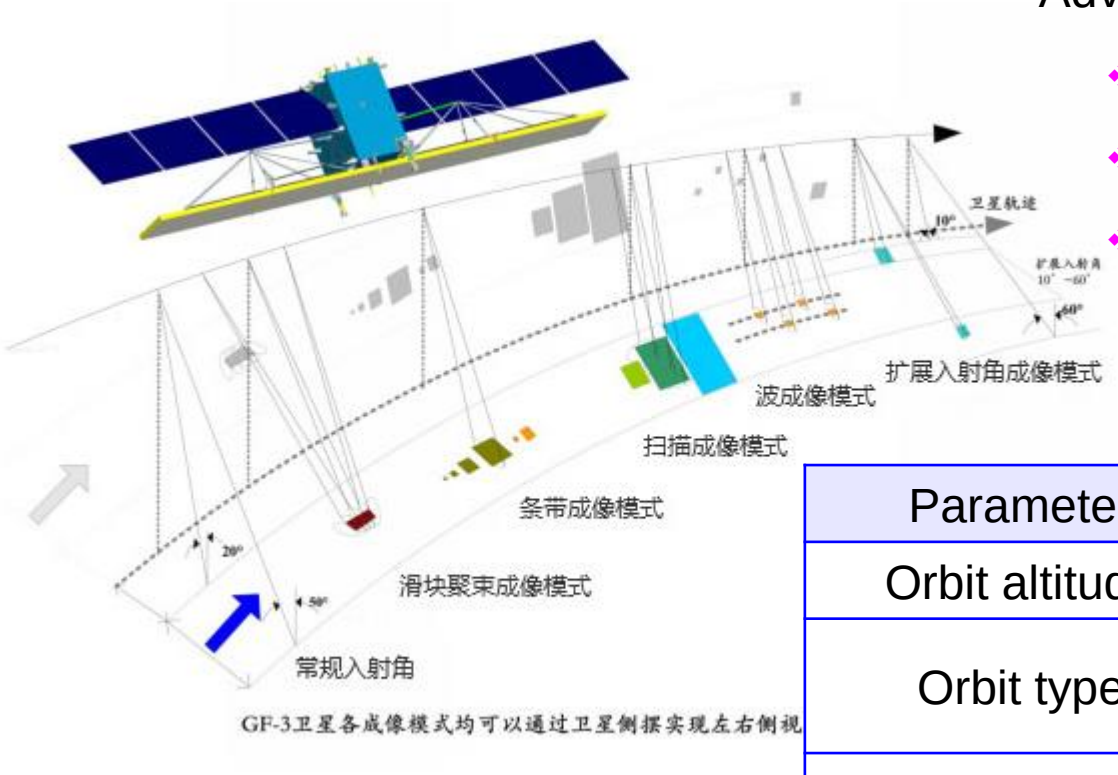
But,

- **Without training it is harder to get informative classes**



II. GF-3 PolSAR dataset

2.1 The Specifications of GF-3 Satellite



Advantages:

- **High spatial resolution (1 m)**
- **Multi imaging mode (12 types)**
- **Universal application (Ocean, Disaster reduction, Meteorology)**

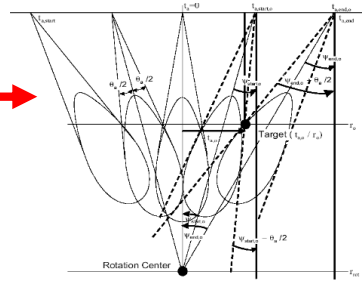
Parameter	Specification
Orbit altitude	755 km
Orbit type	Sun synchronization repeating orbit
Revisit cycle	29 days
Band	C
Incidence angle	10° ~ 60°

II. GF-3 PolSAR dataset

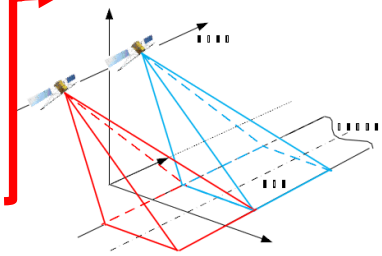
2.1 The Specifications of GF-3 Satellite

NO.	Mode	Incidence angle	Resolution (m)	Width (Km)	Polarization
1	SL	20-50	1	10	Single
2	UFS	20-50	3	30	Single
3	FSI	19-50	5	50	Dual
4	FSII	19-50	10	100	Dual
5	SS	17-50	25	130	Dual
6	QPSI	20-41	8	30	Full
7	QPSII	20-41	25	40	Full
8	NSC	17-50	50	300	Dual
9	WSC	17-50	100	500	Dual
10	GLO	17-53	500	130	Dual
11	WAV	20-41	10	5	Full
12	EXT	10-60	25	80	Dual

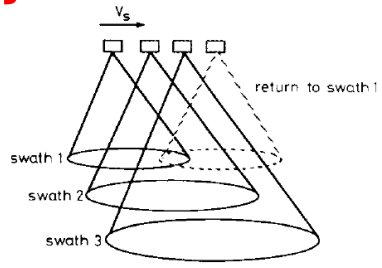
Spotlight



Stripmap



ScanSAR



II. GF-3 PolSAR dataset

2.2 Practical Data of GF-3

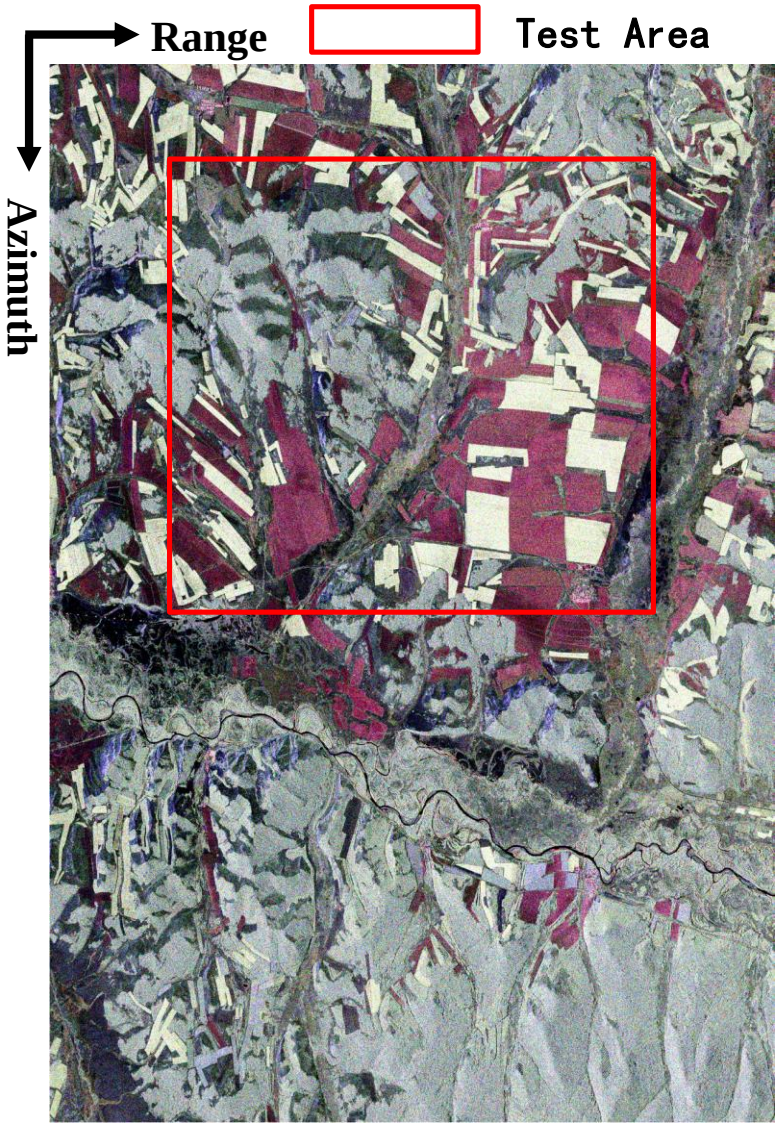
- GF-3 PolSAR Data
  - Observation Mode:

    QPSI (Quad Polarization Strip I)
  - Observation Date:

    Aug. 03. 2017.
  - Pixel Spacing(azimuth×range):

    5.01 m × 4.50 m.
  - Center incidence angle:

    48.8°



Calibrated and Multi-look (2 × 2) processed Result (Pauli RGB)

II. GF-3 PolSAR dataset

2.3 GF-3 PolSAR PauliRGB and the key landcover types

Subset Test Area

Forest

II. GF-3 PolSAR dataset

2.3 GF-3 PolSAR PauliRGB and the key landcover types

Subset Test Area

Wheat

II. GF-3 PolSAR dataset

2.3 GF-3 PolSAR PauliRGB and the key landcover types

Subset Test Area

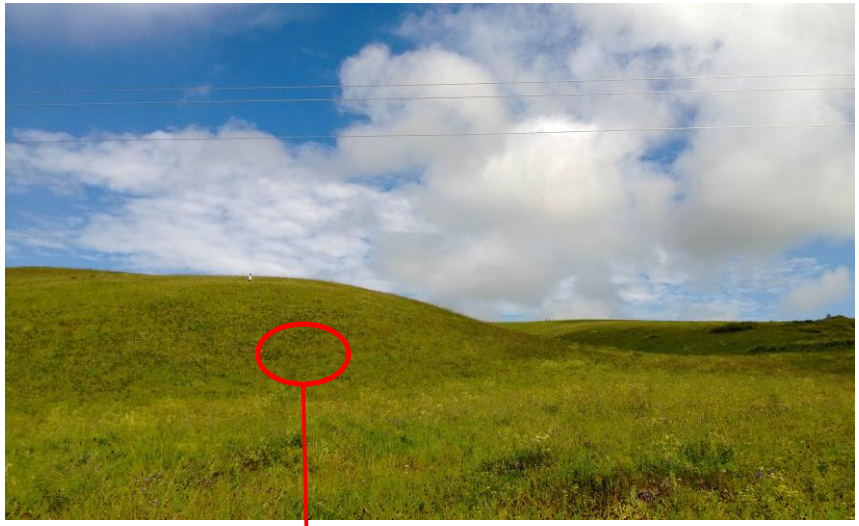
Cole

II. GF-3 PolSAR dataset

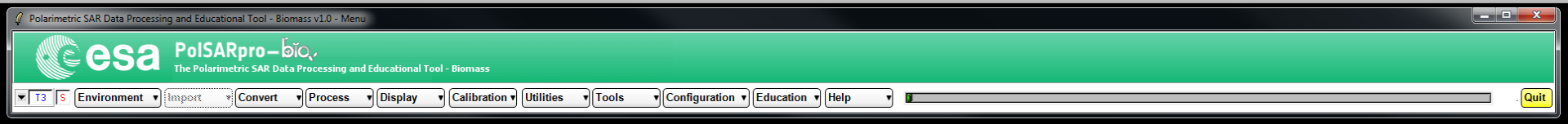
2.3 GF-3 PolSAR PauliRGB and the key landcover types

Subset Test Area

Grass

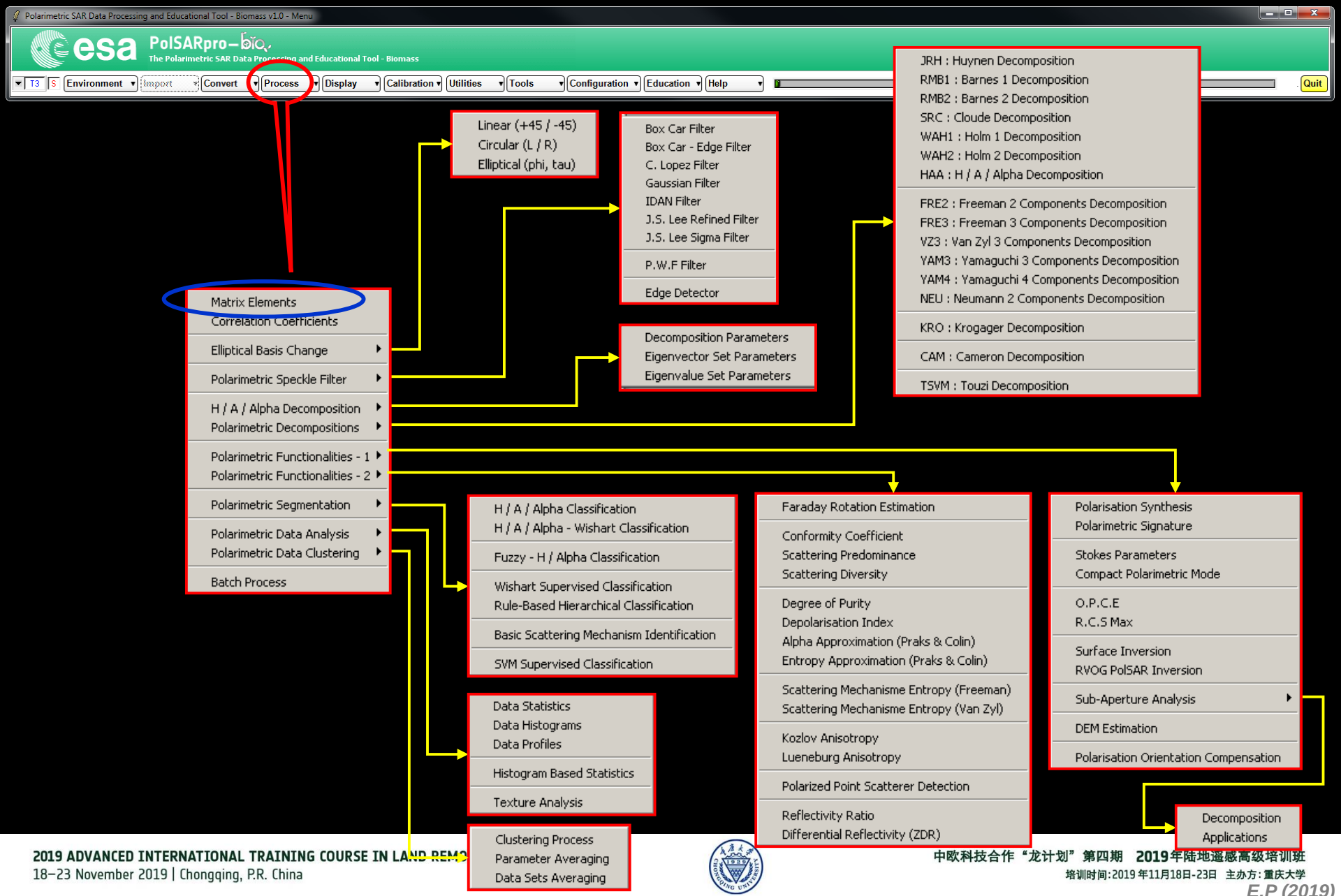


III. Practical

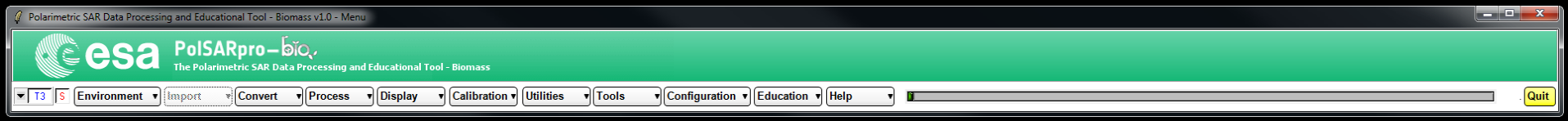


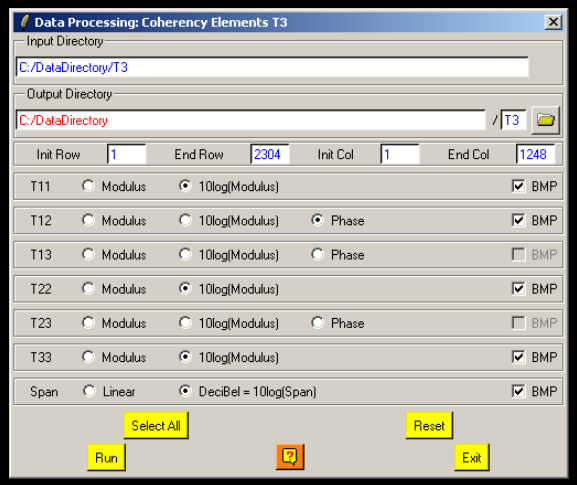
- [T3] elements
- Decomposition parameters
- H/A/alpha classification
- H/A/alpha WISHART classification
- SVM supervised classification

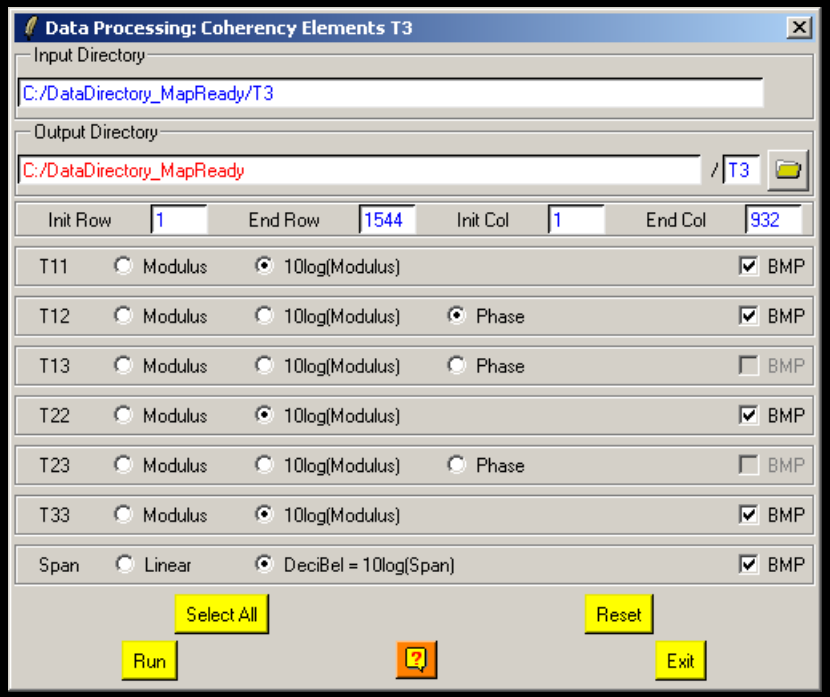
PolSARpro - Bio SOFTWARE



[T3] ELEMENTS







DATADIR

T3

config.txt

[T3x3] Elements

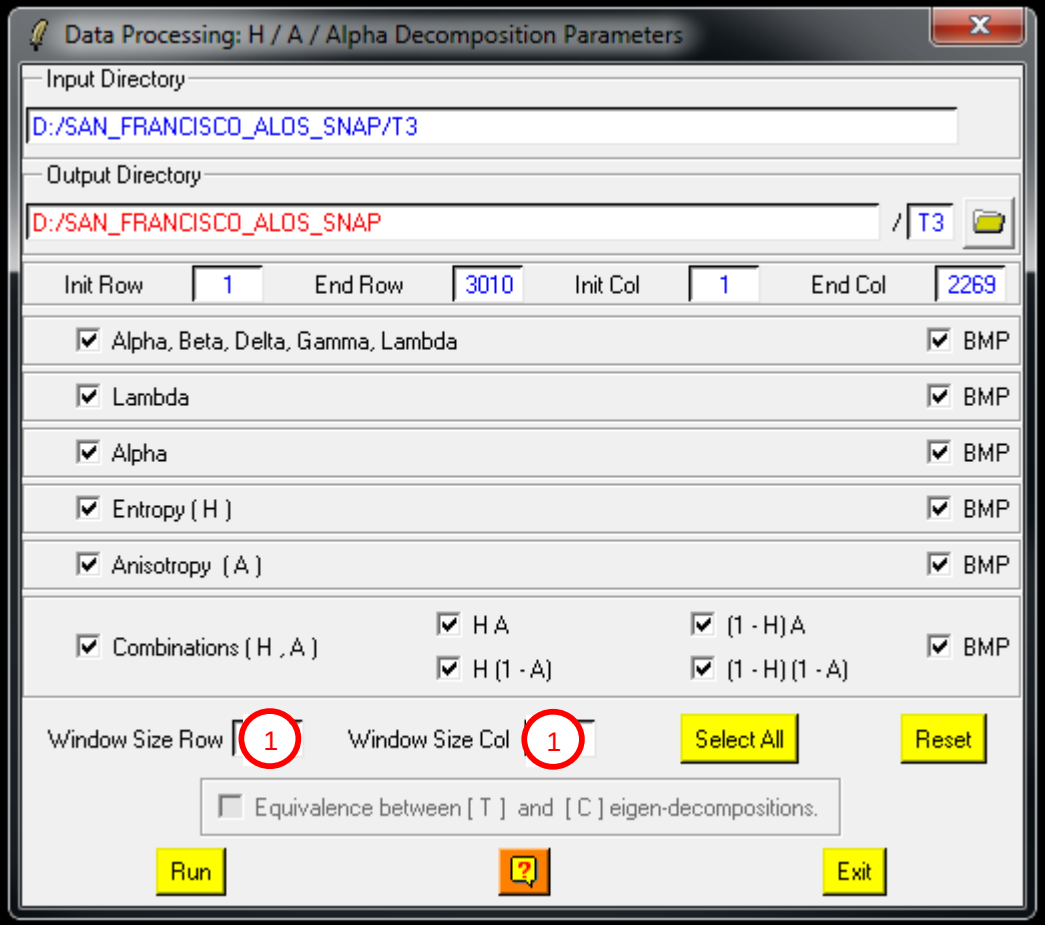
Txy_mod.bin
Txy_db.bin
Txy_pha.bin

Txy_mod.bmp
Txy_db.bmp
Txy_pha.bmp

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

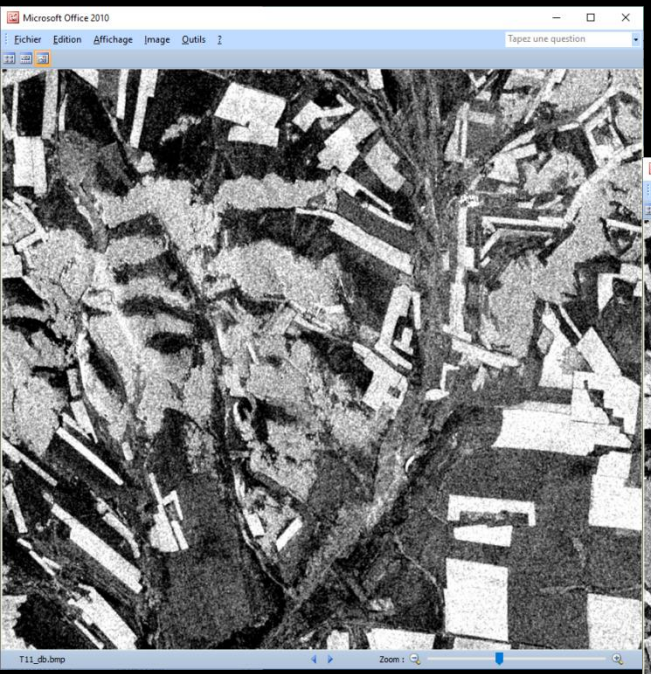
DECOMPOSITION PARAMETERS

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

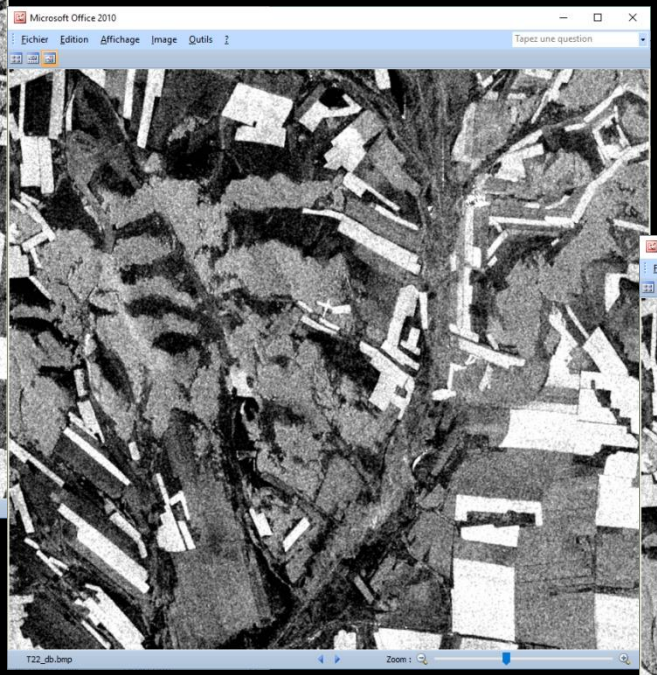


[T3] ELEMENTS

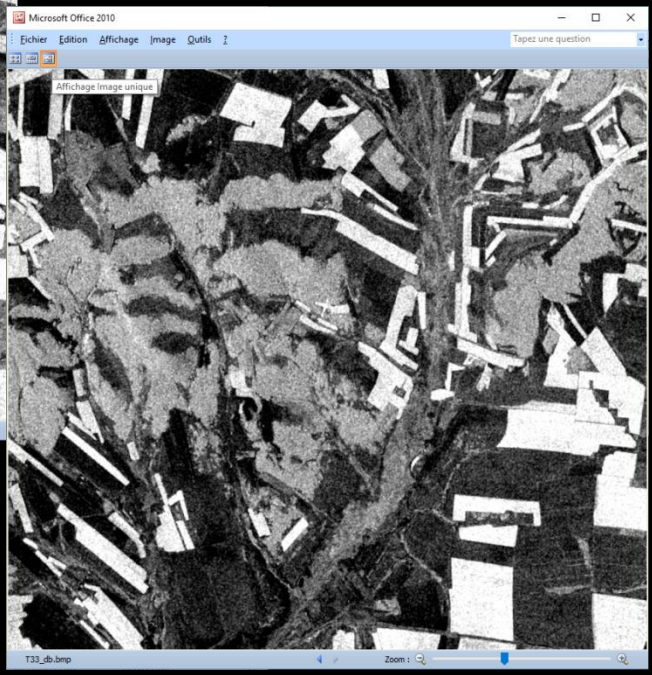
T11_dB



T22_dB

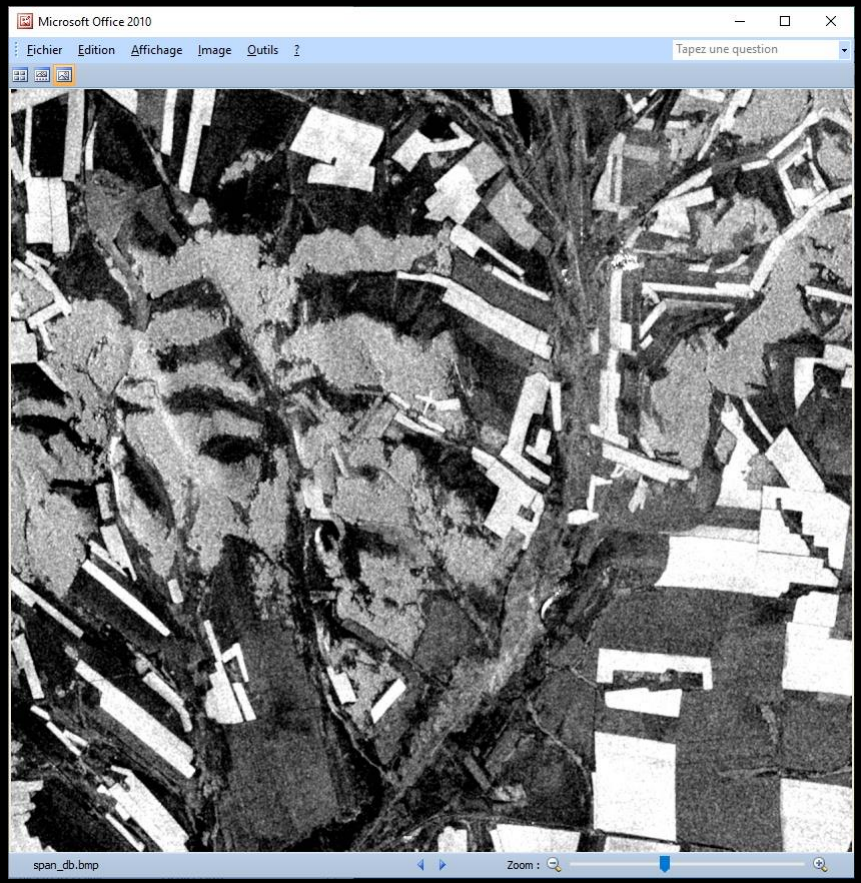


T33_dB

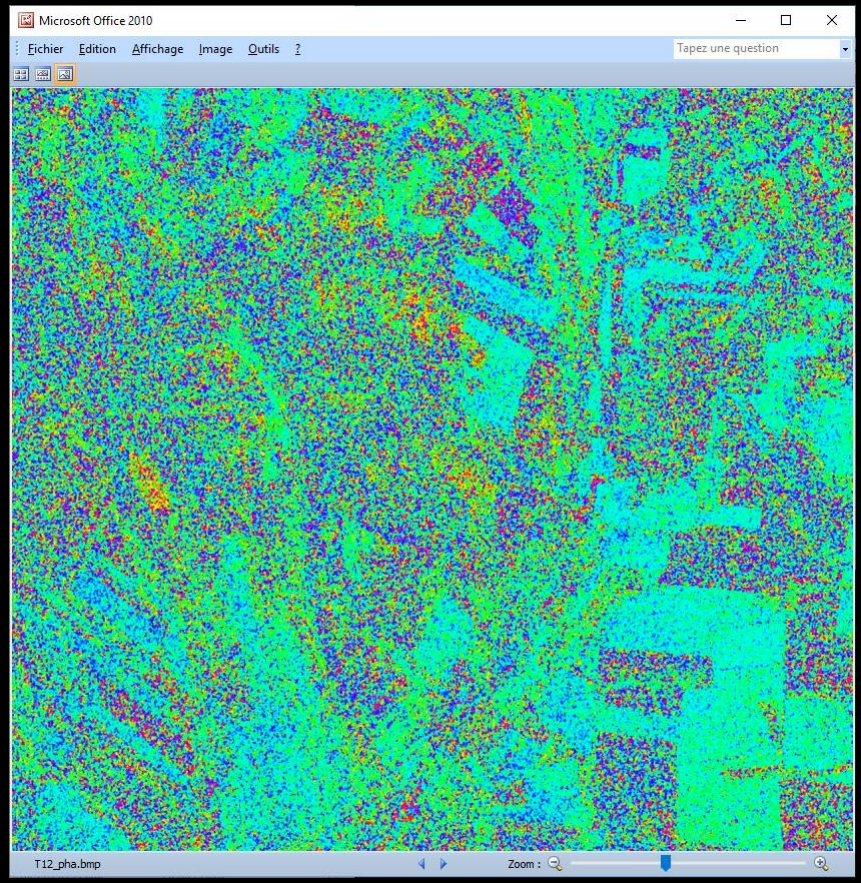


[T3] ELEMENTS

span_dB



T12_pha



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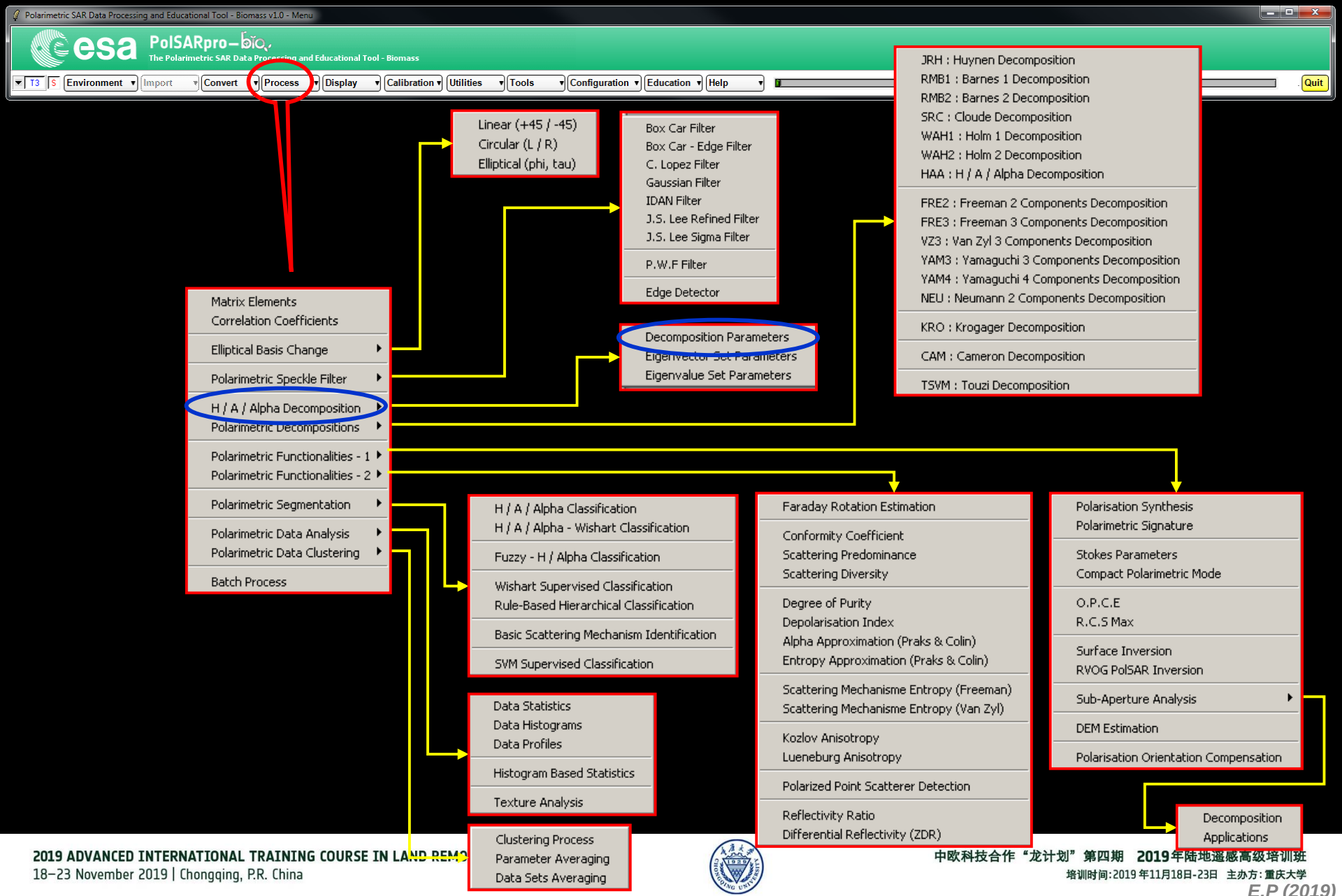
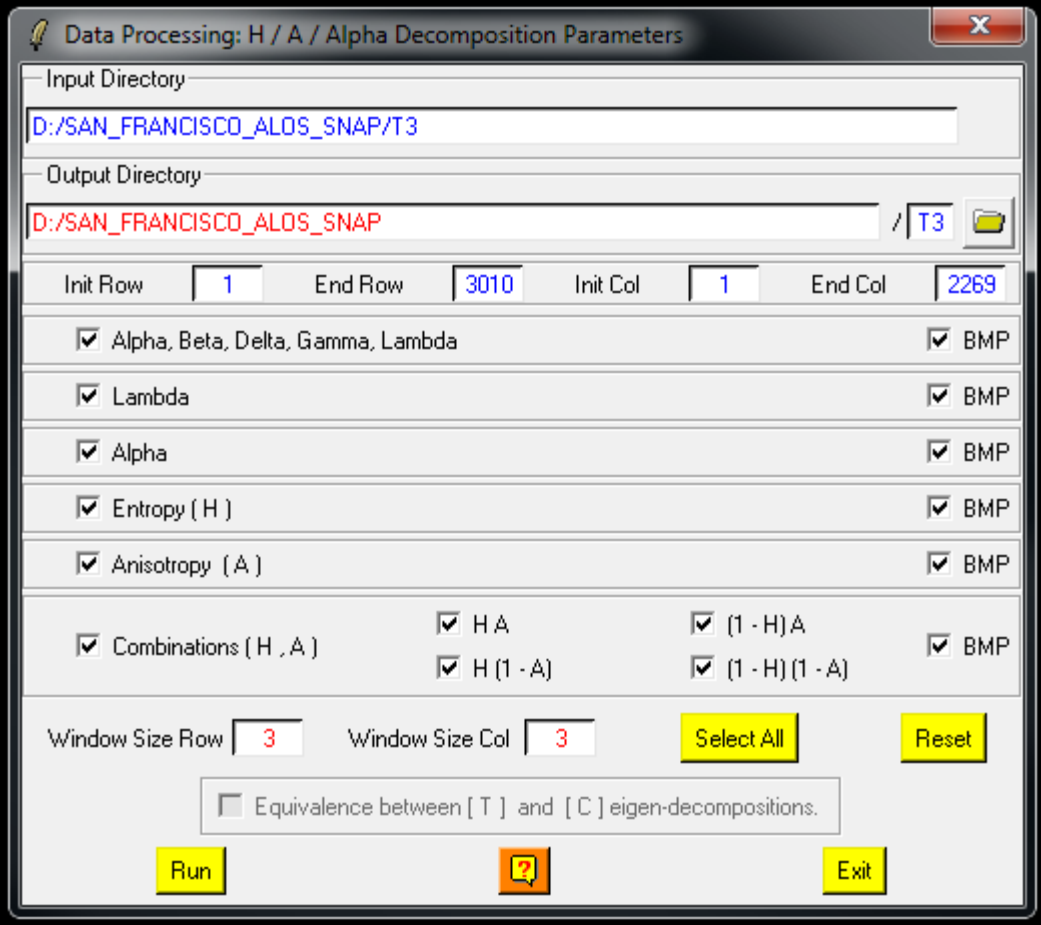


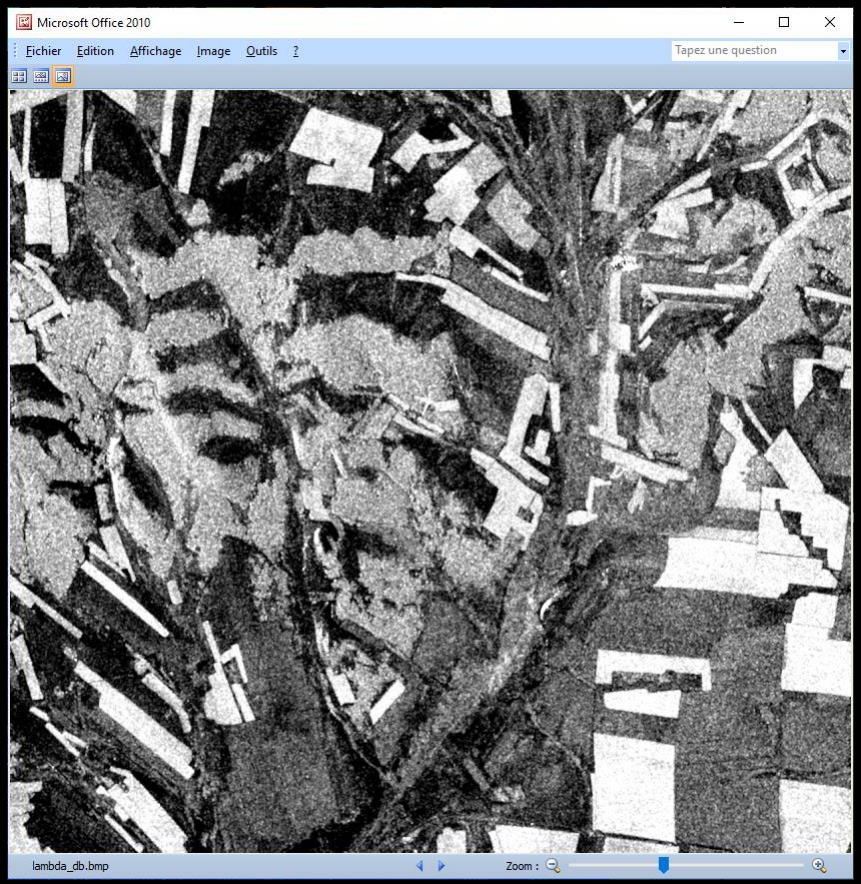
DECOMPOSITION PARAMETERS

Do it Yourself:
Select some elements, set the parameters (Nwin = 3) and view the corresponding BMP files.

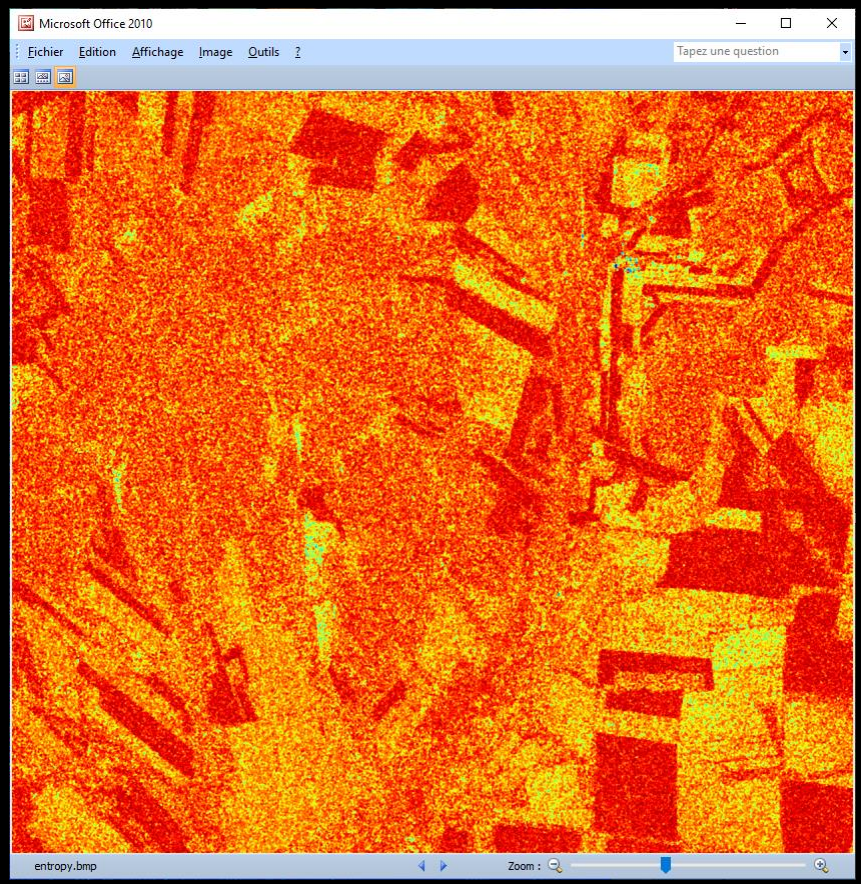


DECOMPOSITION PARAMETERS

Lambda

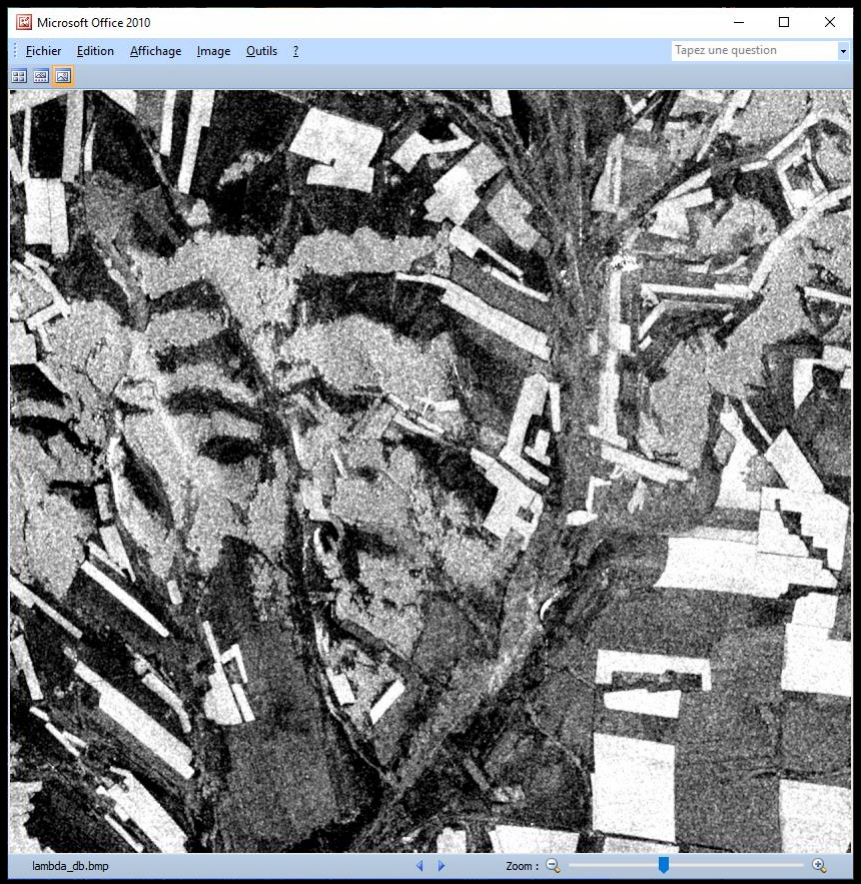


Entropy

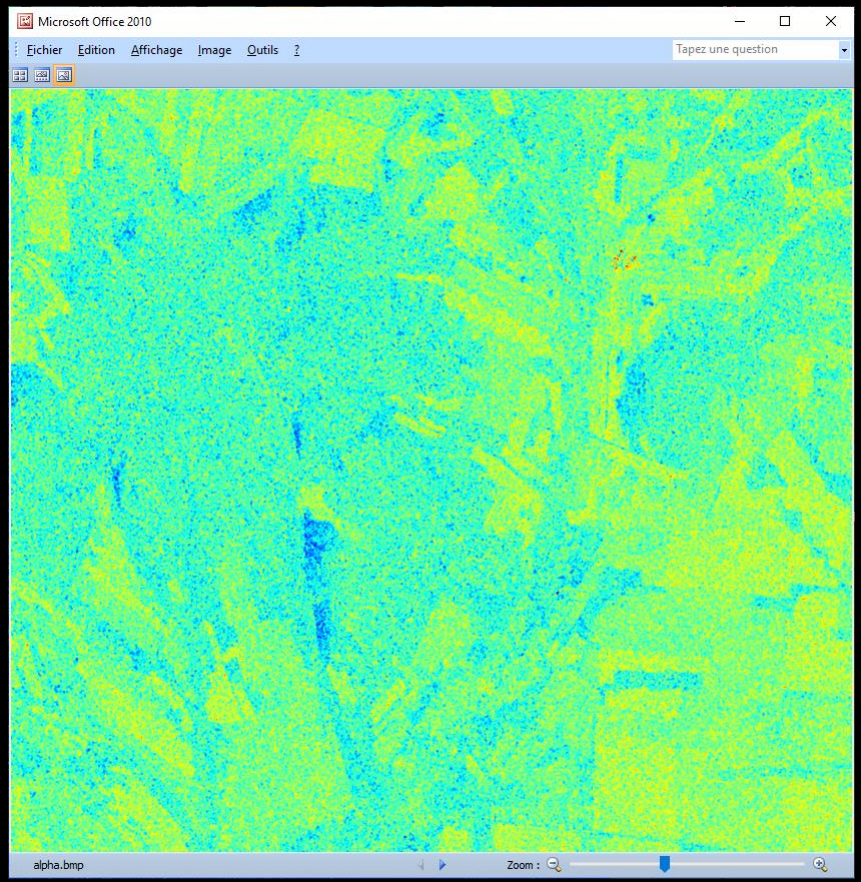


DECOMPOSITION PARAMETERS

Lambda

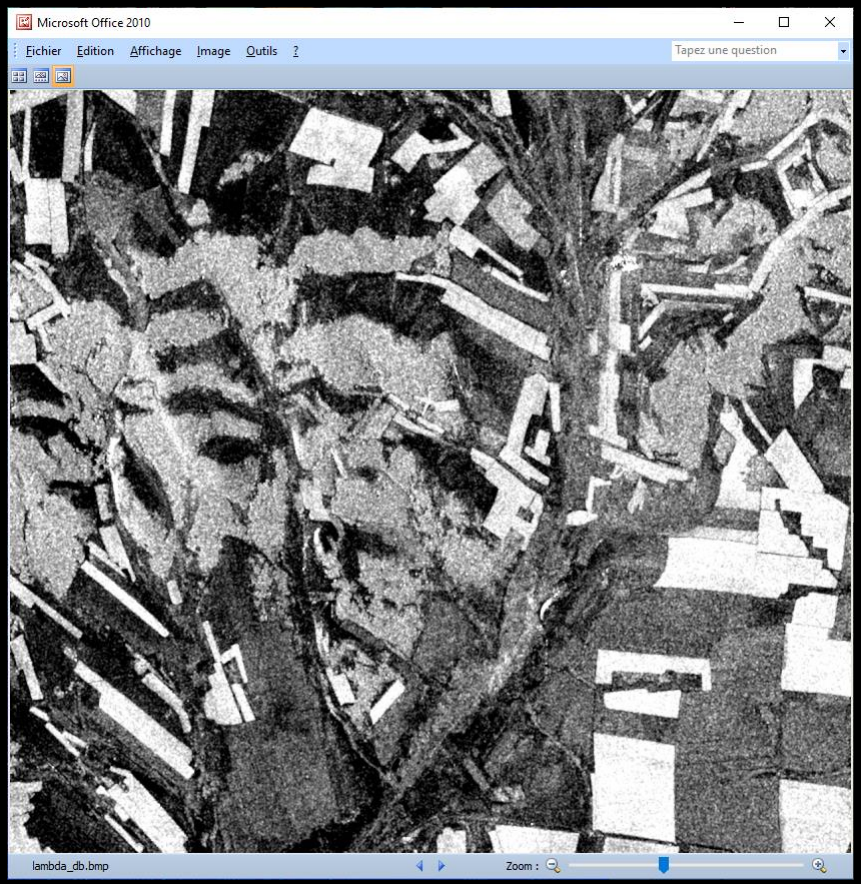


Alpha

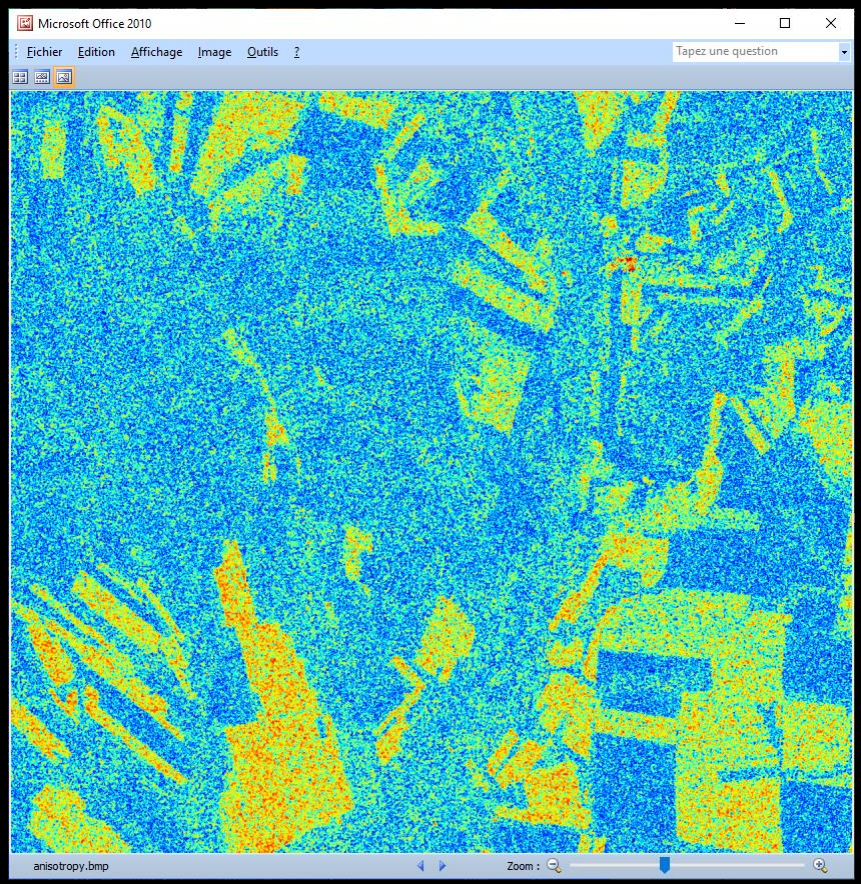


DECOMPOSITION PARAMETERS

Lambda

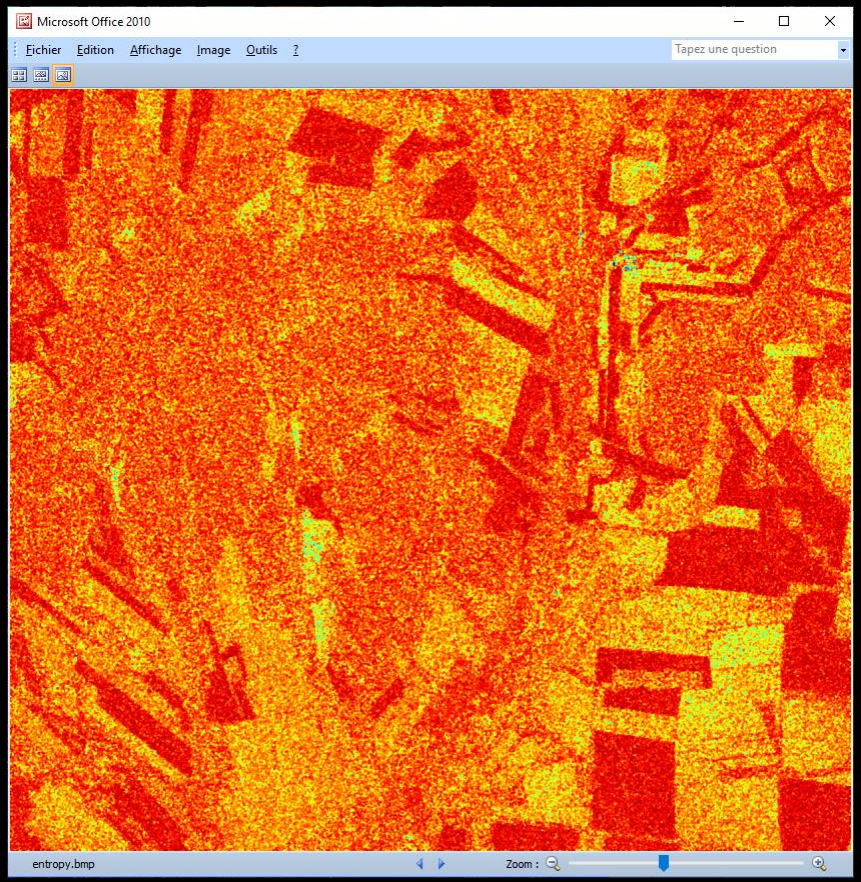


Anisotropy

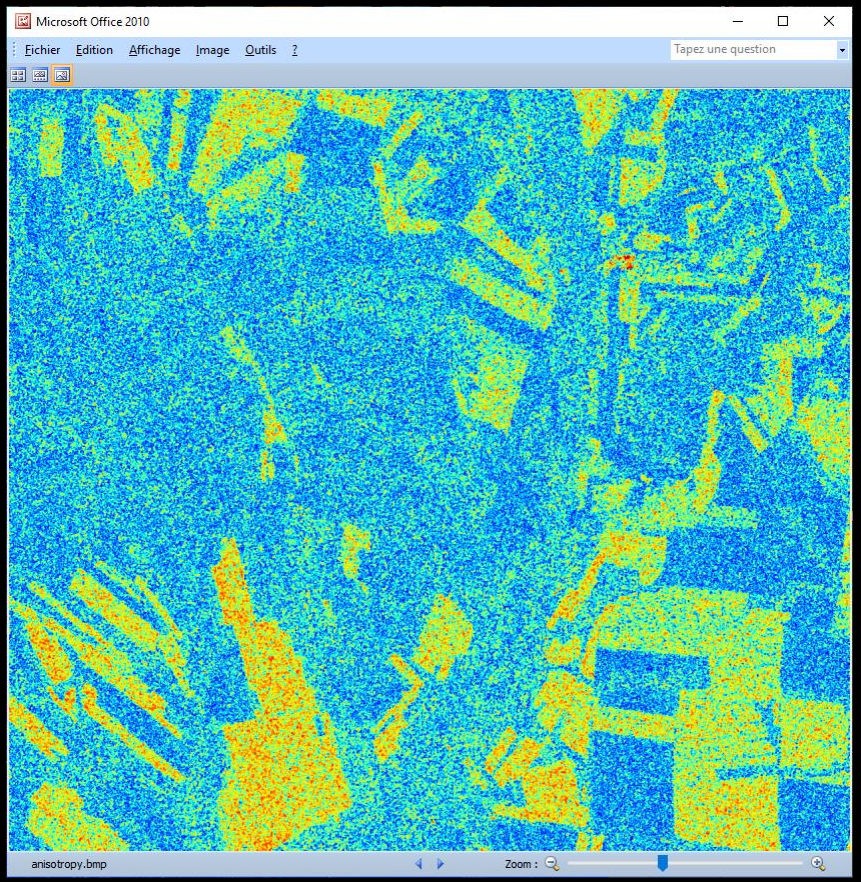


DECOMPOSITION PARAMETERS

Entropy

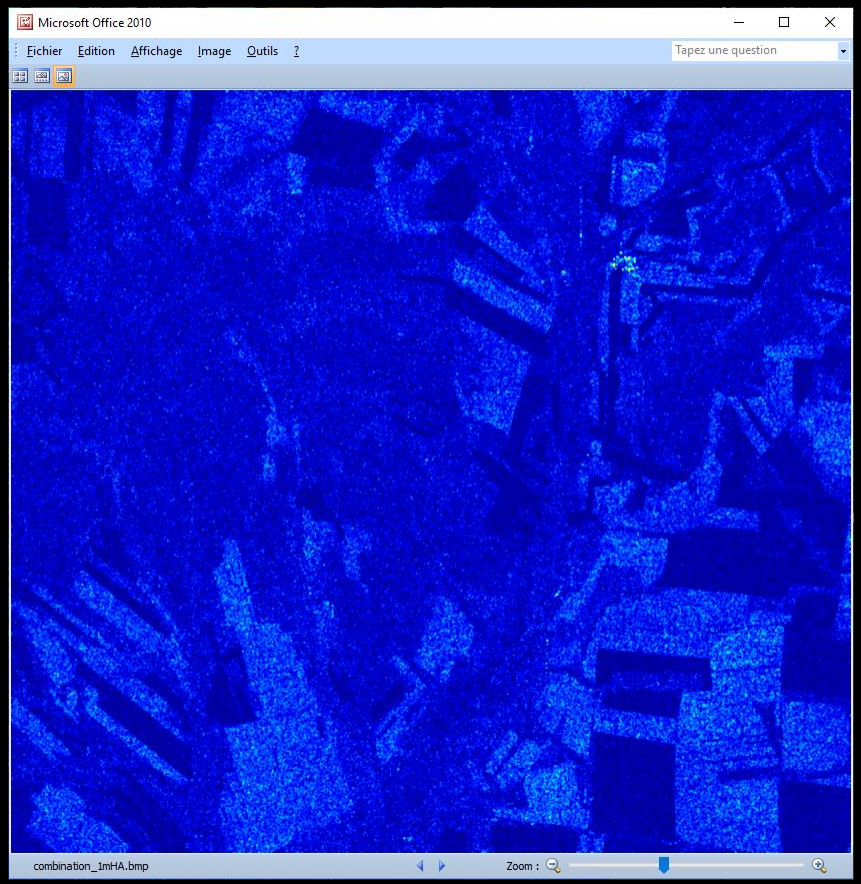


Anisotropy



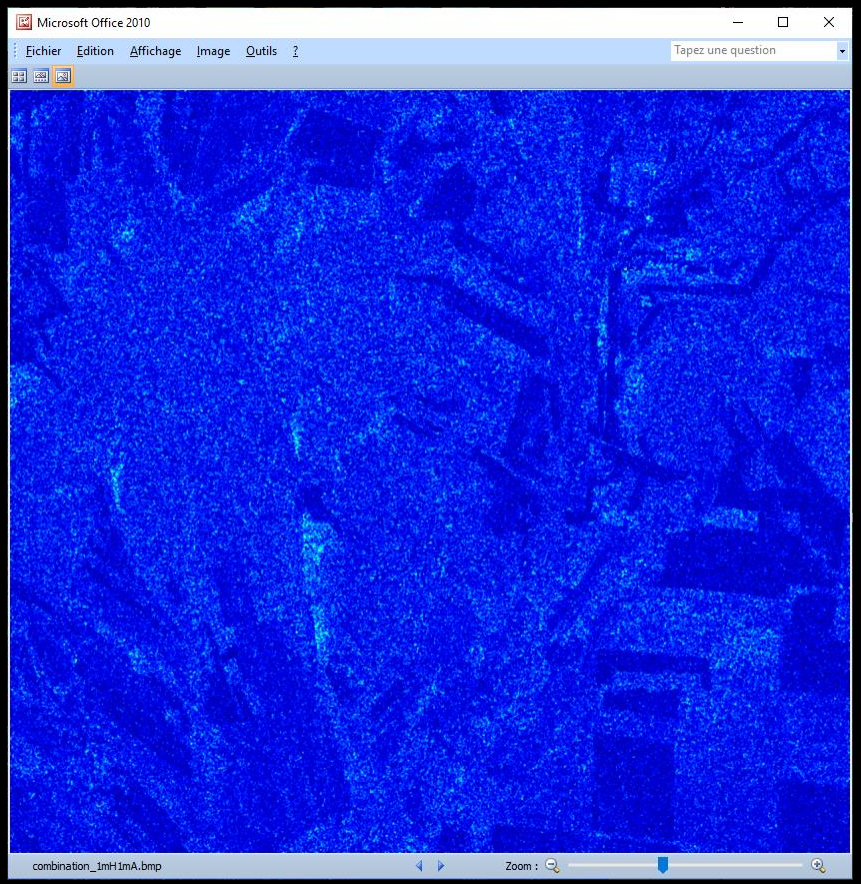
DECOMPOSITION PARAMETERS

(1–H) A



low to medium entropy

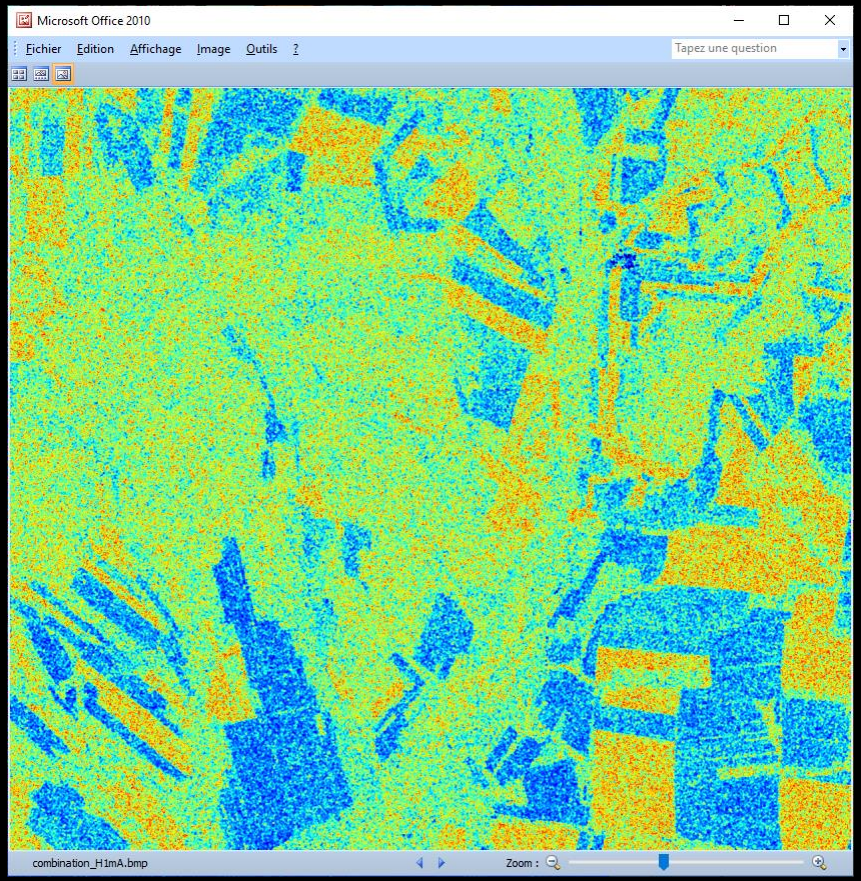
(1-H) (1-A)



low entropy and low anisotropy

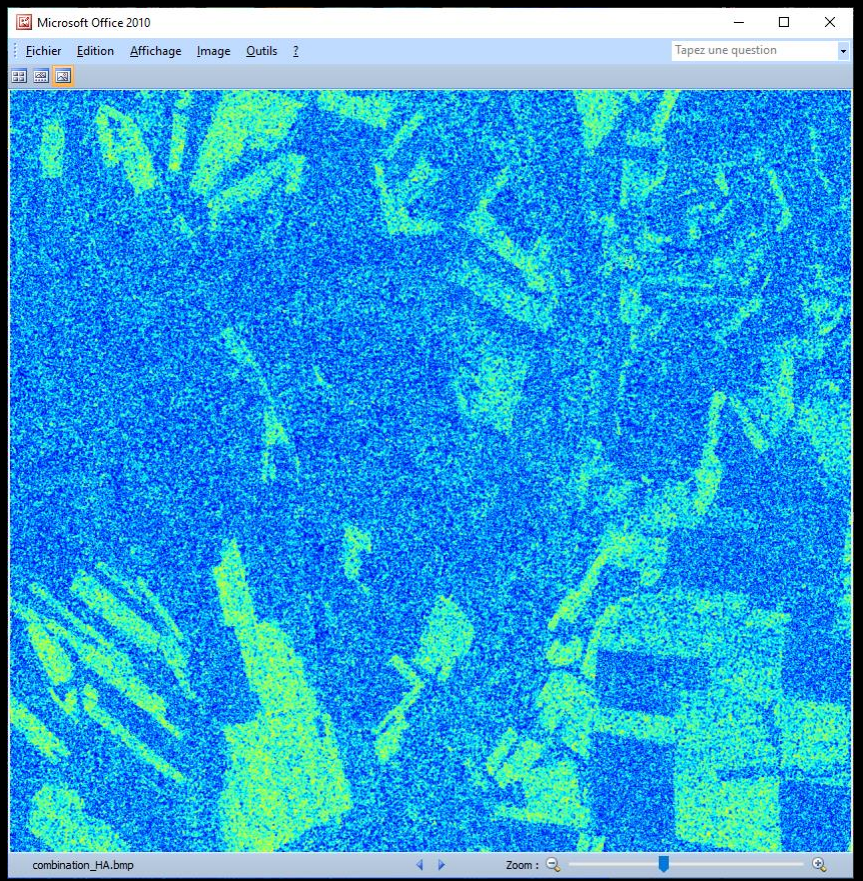
DECOMPOSITION PARAMETERS

H (1-A)



high entropy and
low anisotropy

HA



high entropy and
high anisotropy

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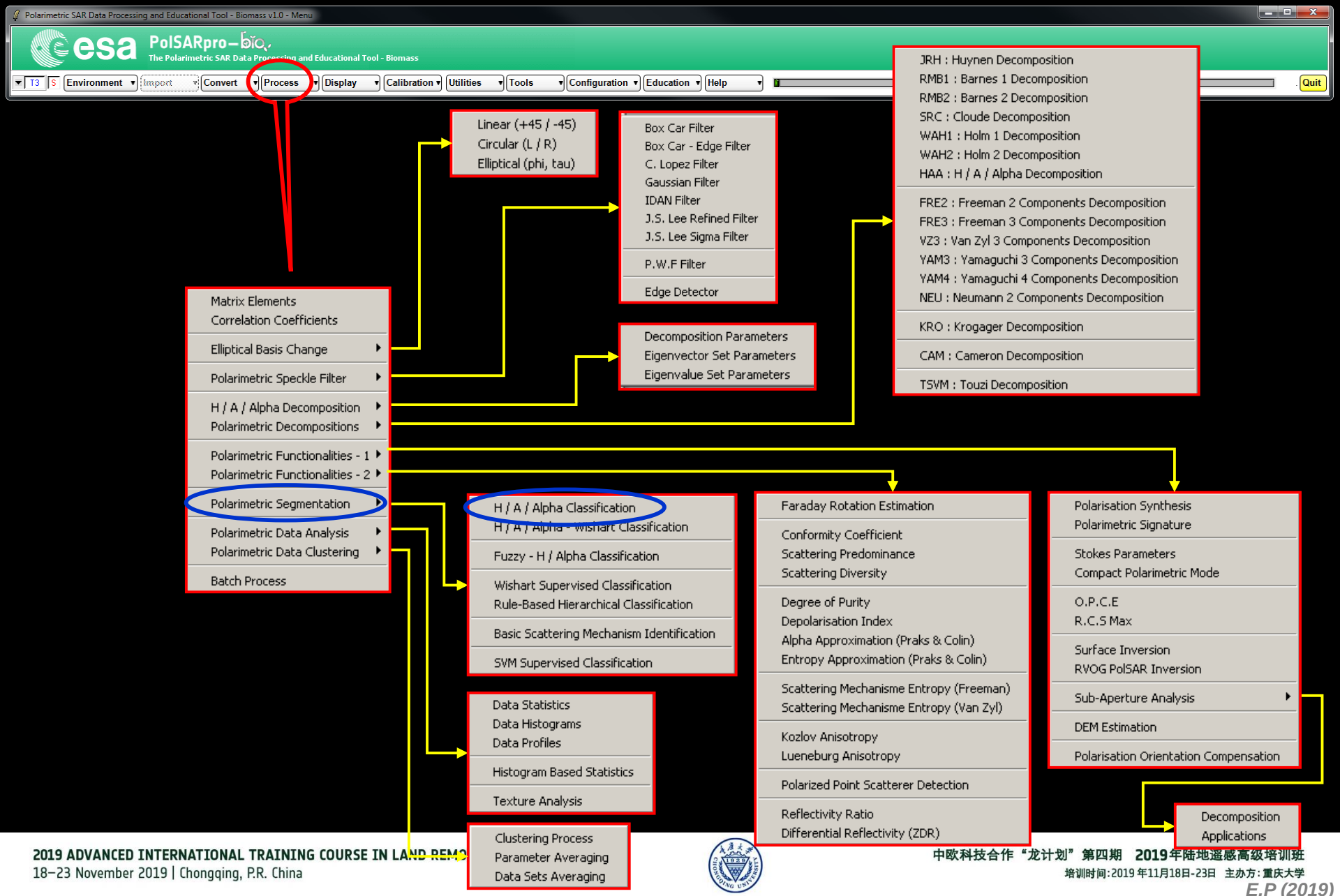
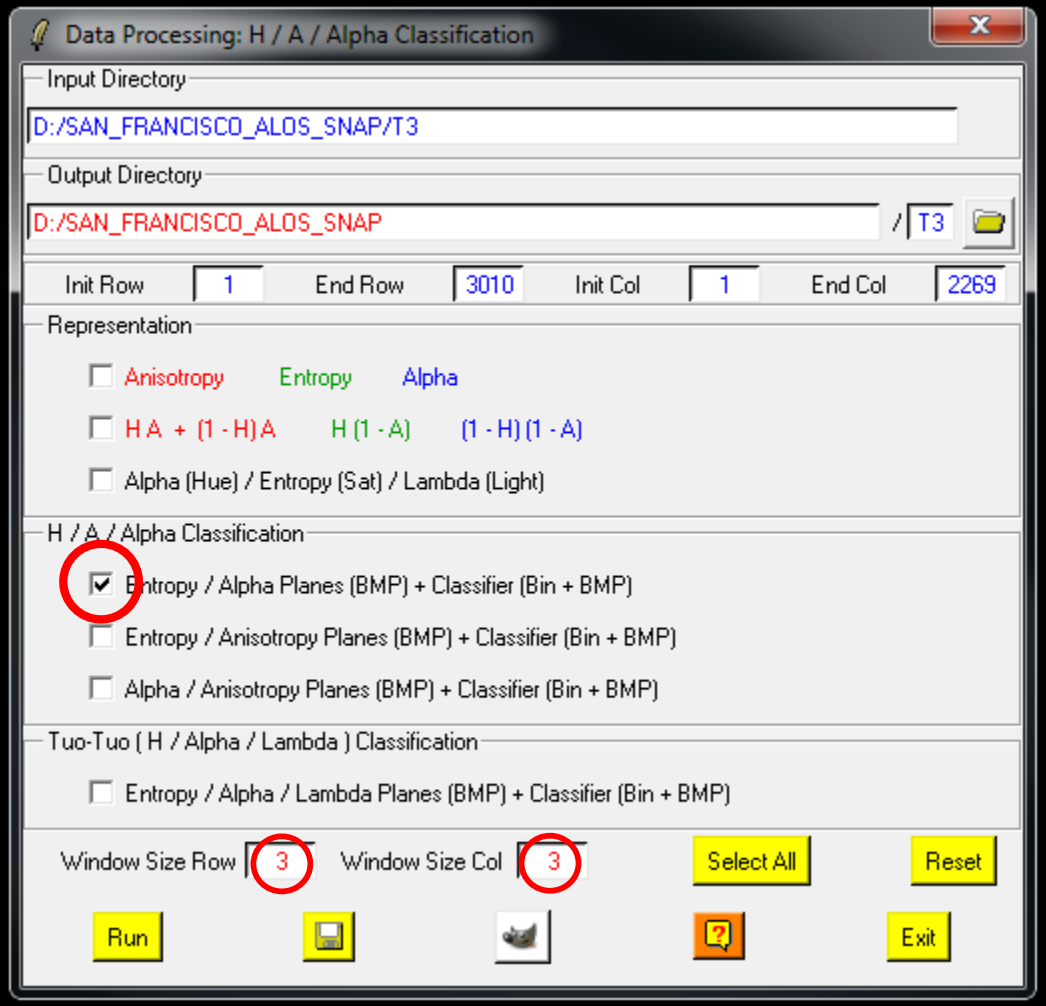
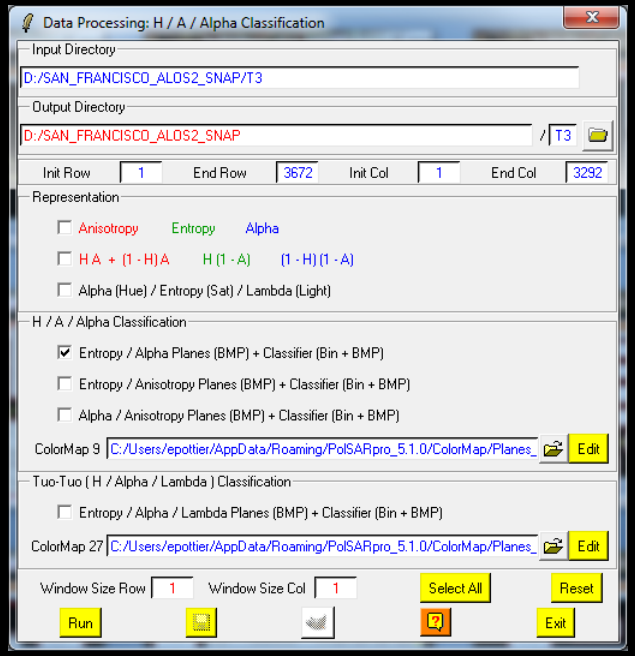


H / A / alpha CLASSIFICATION

Do it Yourself:
Select some elements, set the parameters (Nwin = 3) and view the corresponding BMP files.



H / A / alpha CLASSIFICATION

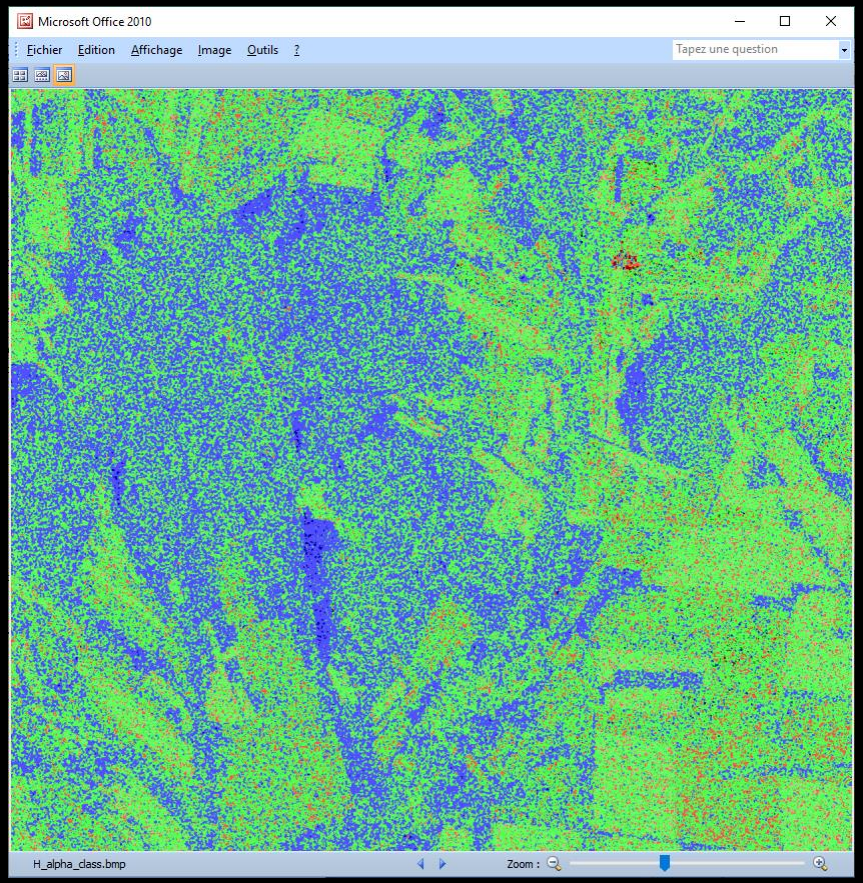


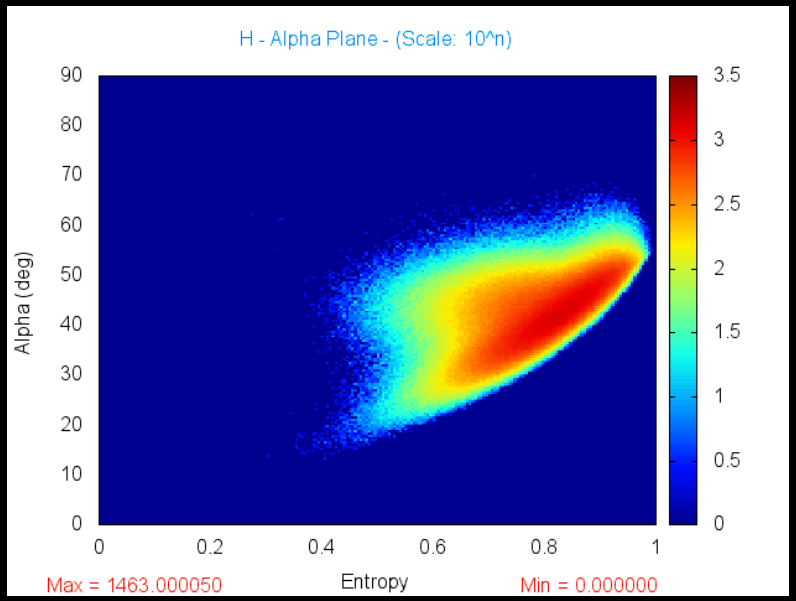
Do it Yourself:
Select some elements, set the parameters (Nwin = 1) and view the corresponding BMP files.

DATADIR

- **config.txt**
- **[T3x3] Elements**
- **entropy.bin, anisotropy.bin, alpha.bin**
  combination_HA.bin, combination_1mHA.bin,
  combination_H1mA.bin, combination_1mH1mA.bin
  H_A_class.bin, H_Alpha_class.bin, A_Alpha_class.bin
- **entropy.bmp, anisotropy.bmp, alpha.bmp**
  combination_HA.bmp, combination_1mHA.bmp,
  combination_H1mA.bmp, combination_1mH1mA.bmp
  H_A_class.bmp, H_Alpha_class.bmp, A_Alpha_class.bmp
  H_A_occurence.bmp, H_Alpha_ occurence.bmp,
  A_Alpha_ occurence.bmp, H_A_segmented.bmp,
  H_Alpha_ segmented.bmp, A_Alpha_ segmented.bmp
  HAlphaLambda_RGB.bmp, HAAlpha_RGB.bmp
  HACombinations_RGB.bmp

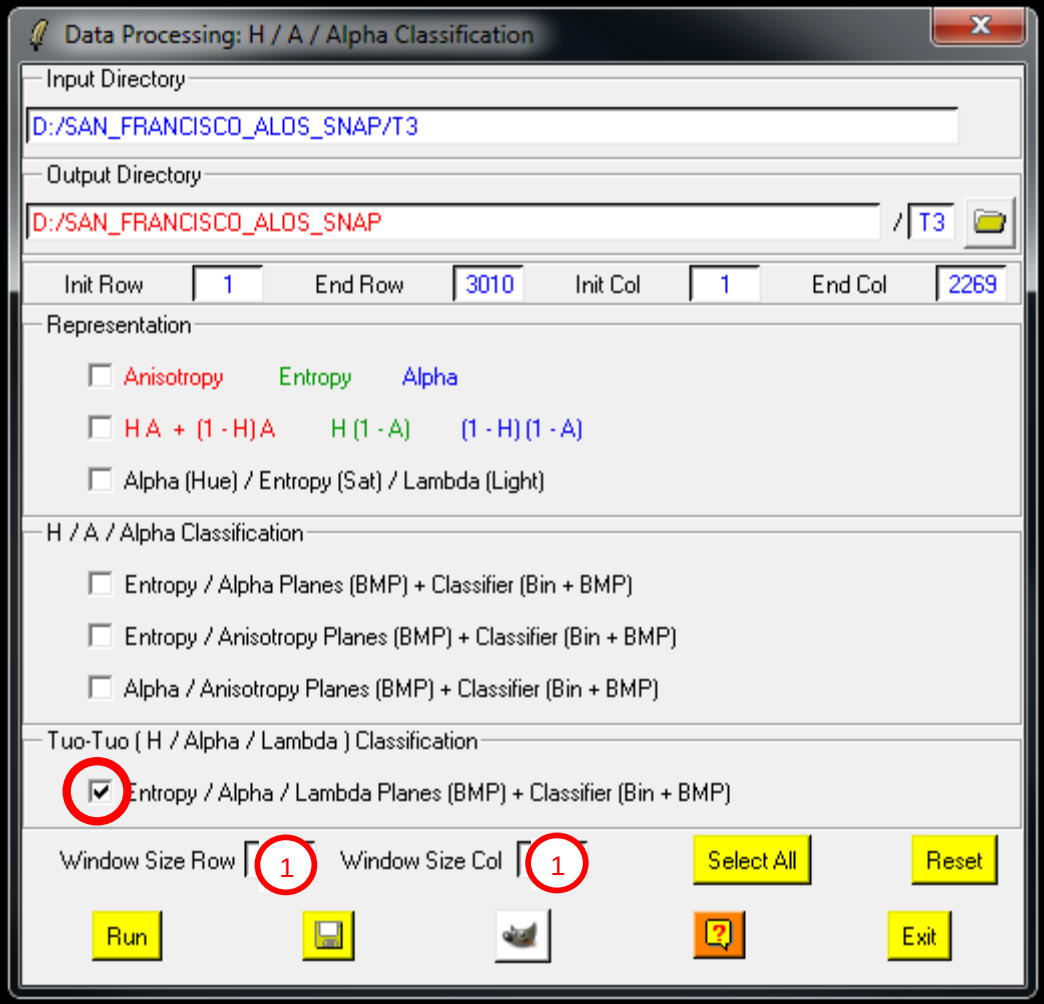
H / A / alpha CLASSIFICATION



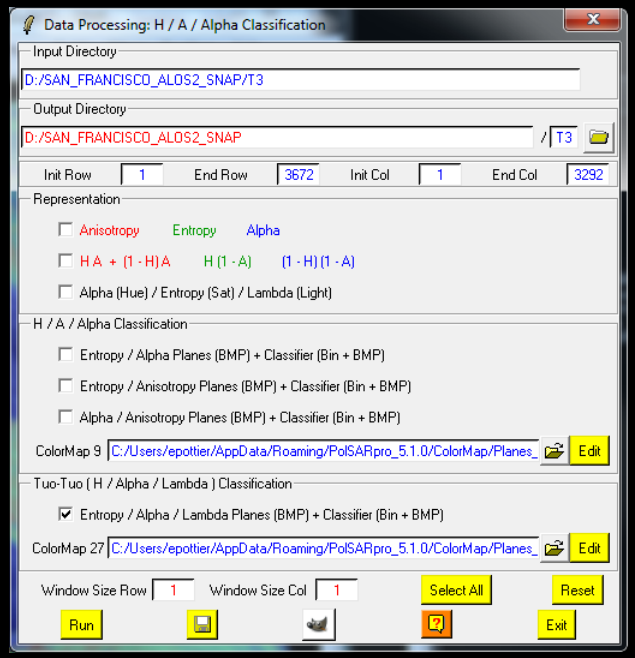


H / alpha / Lambda CLASSIFICATION

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



H / alpha / Lambda CLASSIFICATION

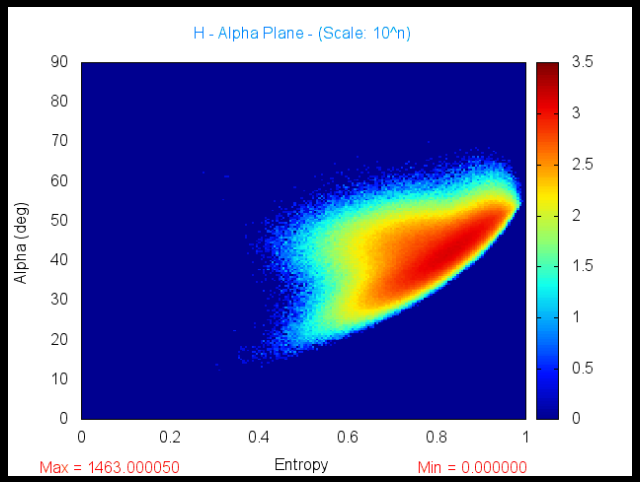


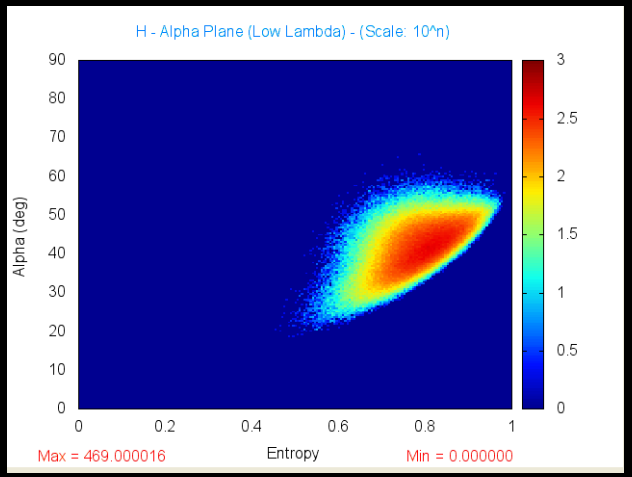
Do it Yourself:
Select some elements, set the parameters (Nwin = 3) and view the corresponding BMP files.

DATADIR

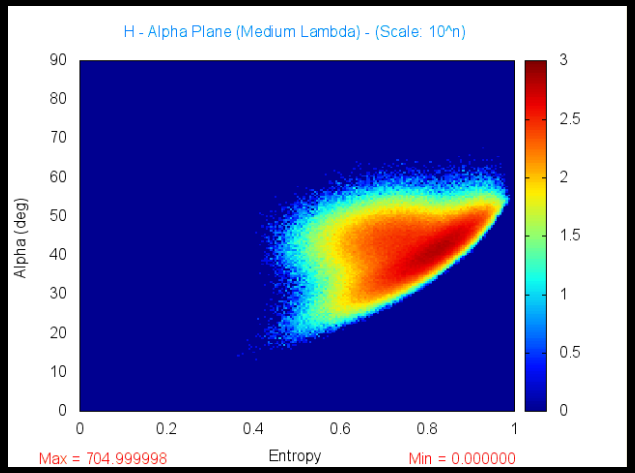
- **config.txt**
- **[T3x3] Elements**
- **H_alpha_lambda_class1(2,3).bin,**
  H_alpha_lambda_occurence_class1(2,3).bin,
  H_alpha_lambda_segmented_class1(2,3).bin,
  H_alpha_lambda_class.bin,
- **H_alpha_lambda_class1(2,3).bmp,**
  H_alpha_lambda_occurence_class1(2,3).bmp,
  H_alpha_lambda_segmented_class1(2,3).bmp,
  H_alpha_lambda_class.bmp,

H / alpha / Lambda CLASSIFICATION

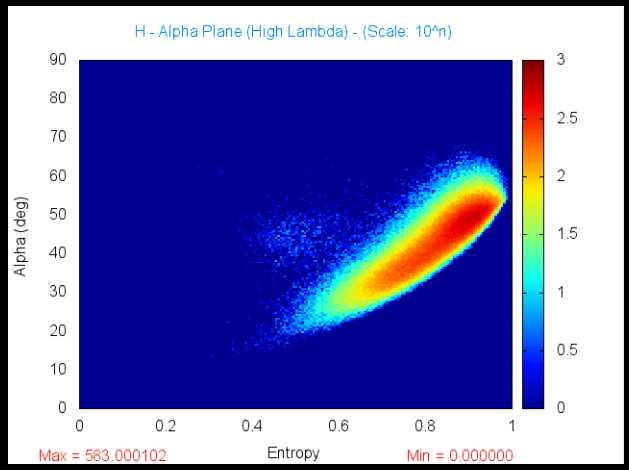




Low λ

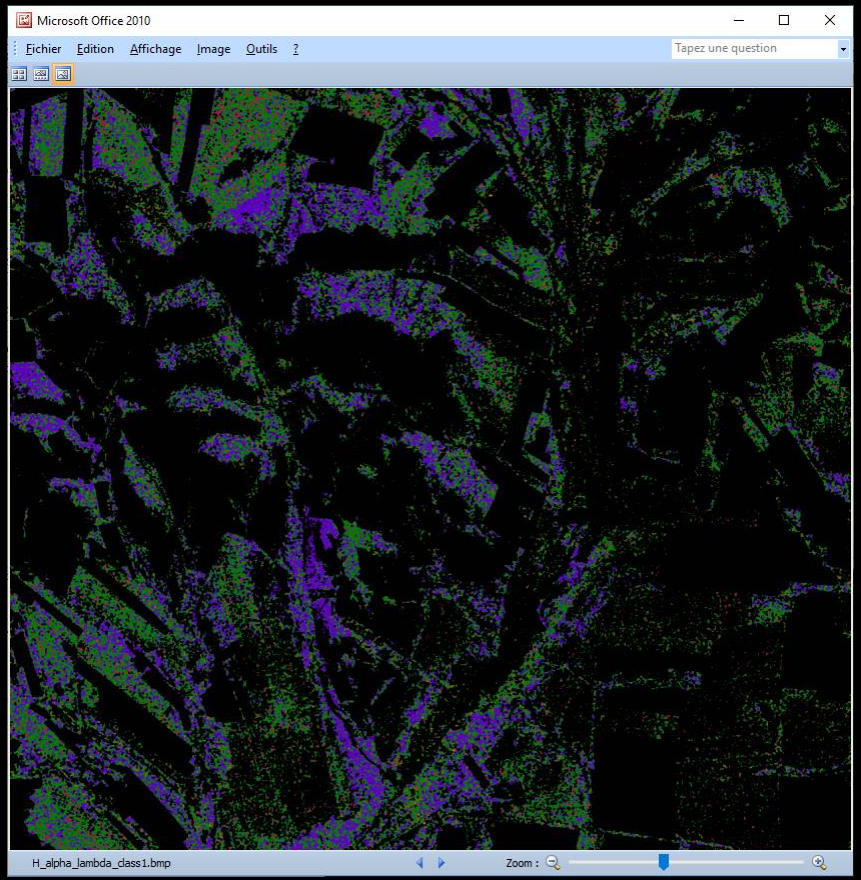


Medium λ

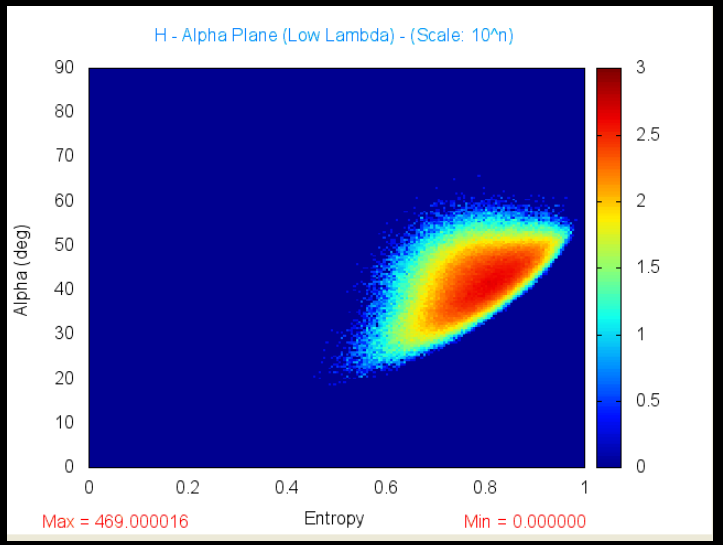


High λ

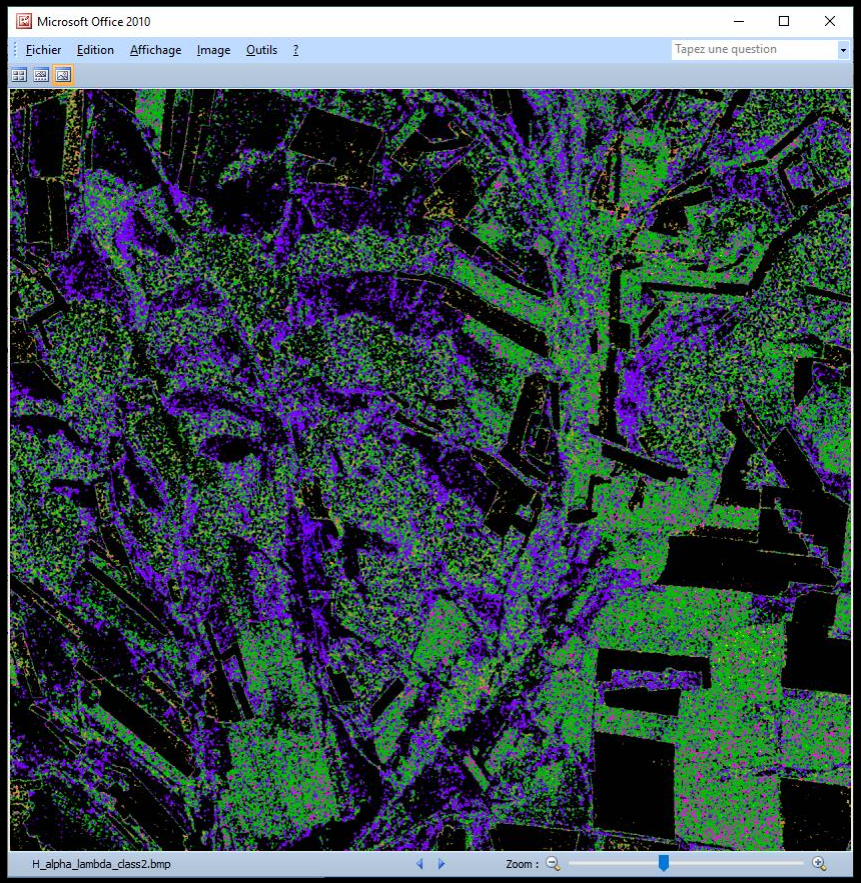
H / alpha / Lambda CLASSIFICATION



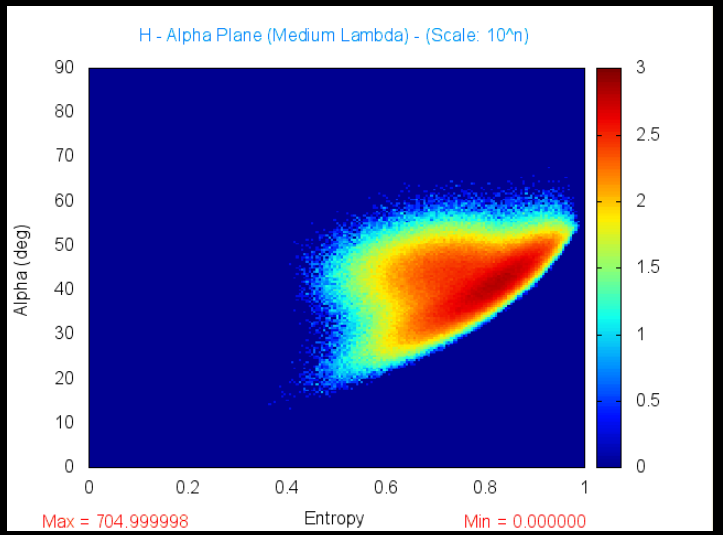
Low λ



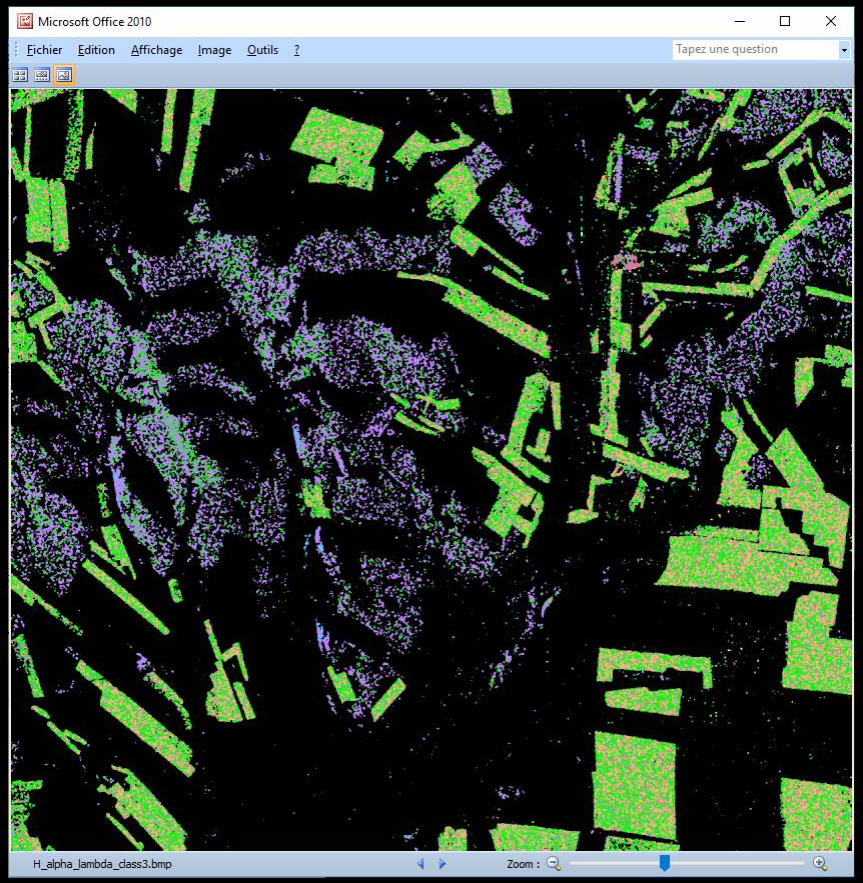
H / alpha / Lambda CLASSIFICATION



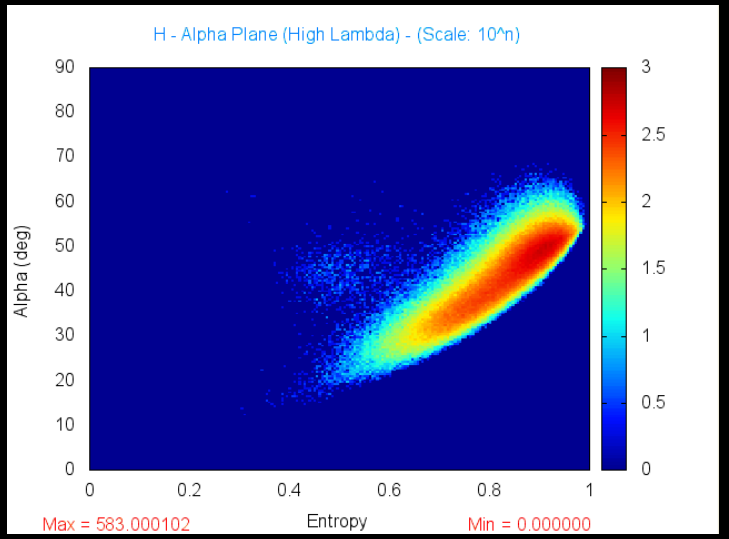
Medium λ



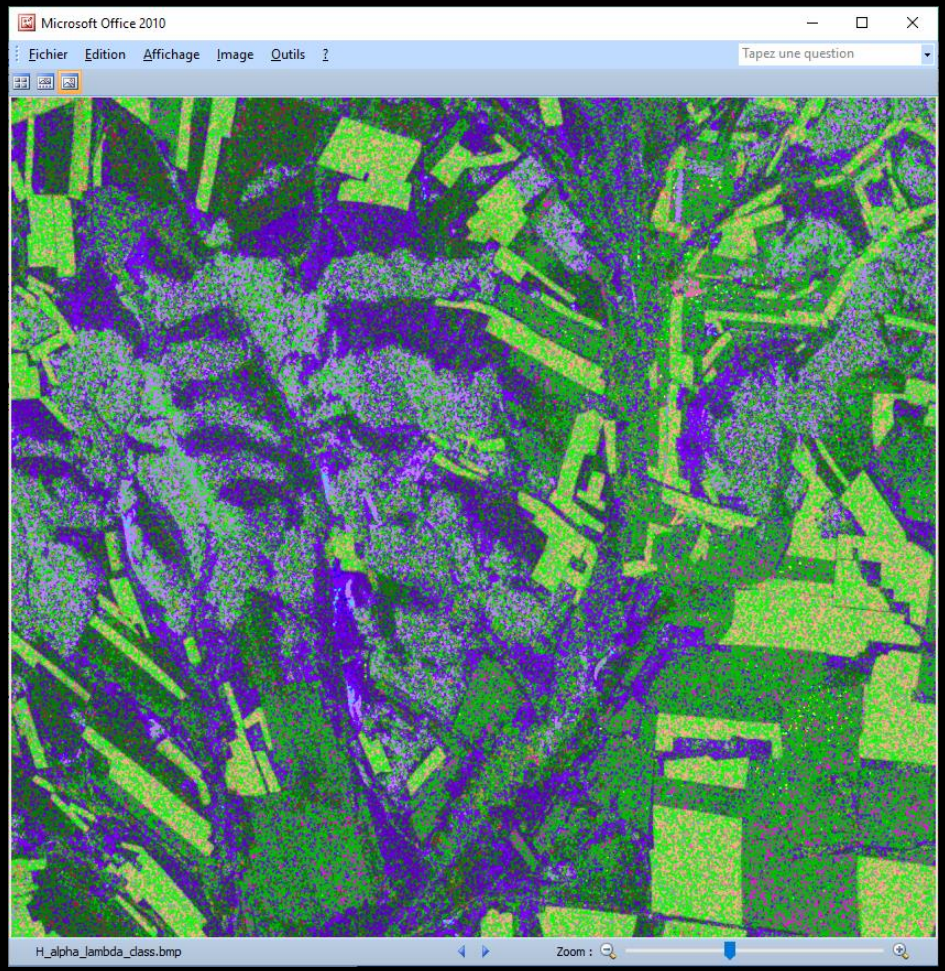
H / alpha / Lambda CLASSIFICATION

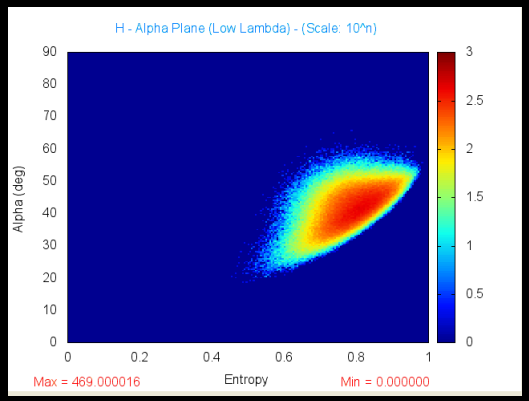


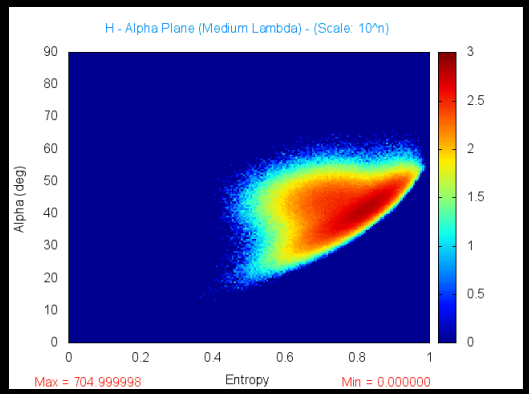
High $\underline{\lambda}$

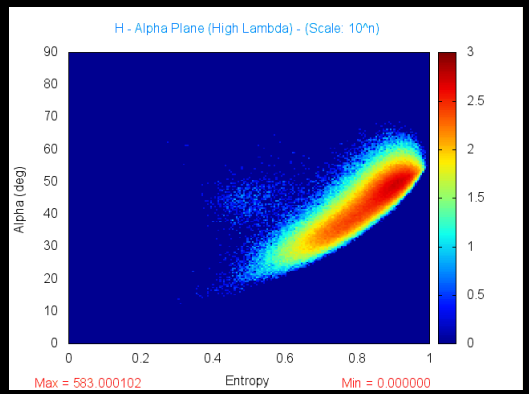


H / alpha / Lambda CLASSIFICATION

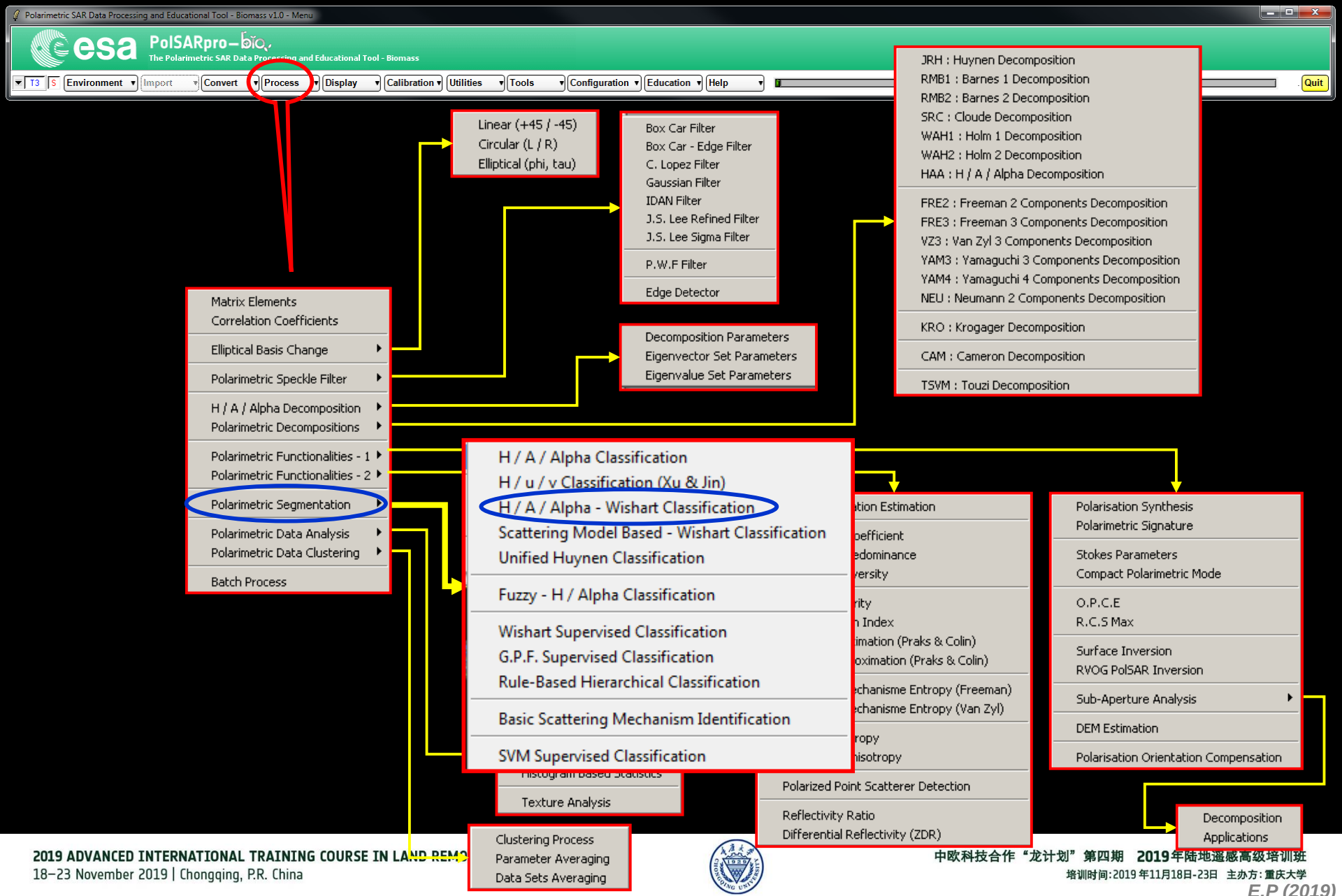




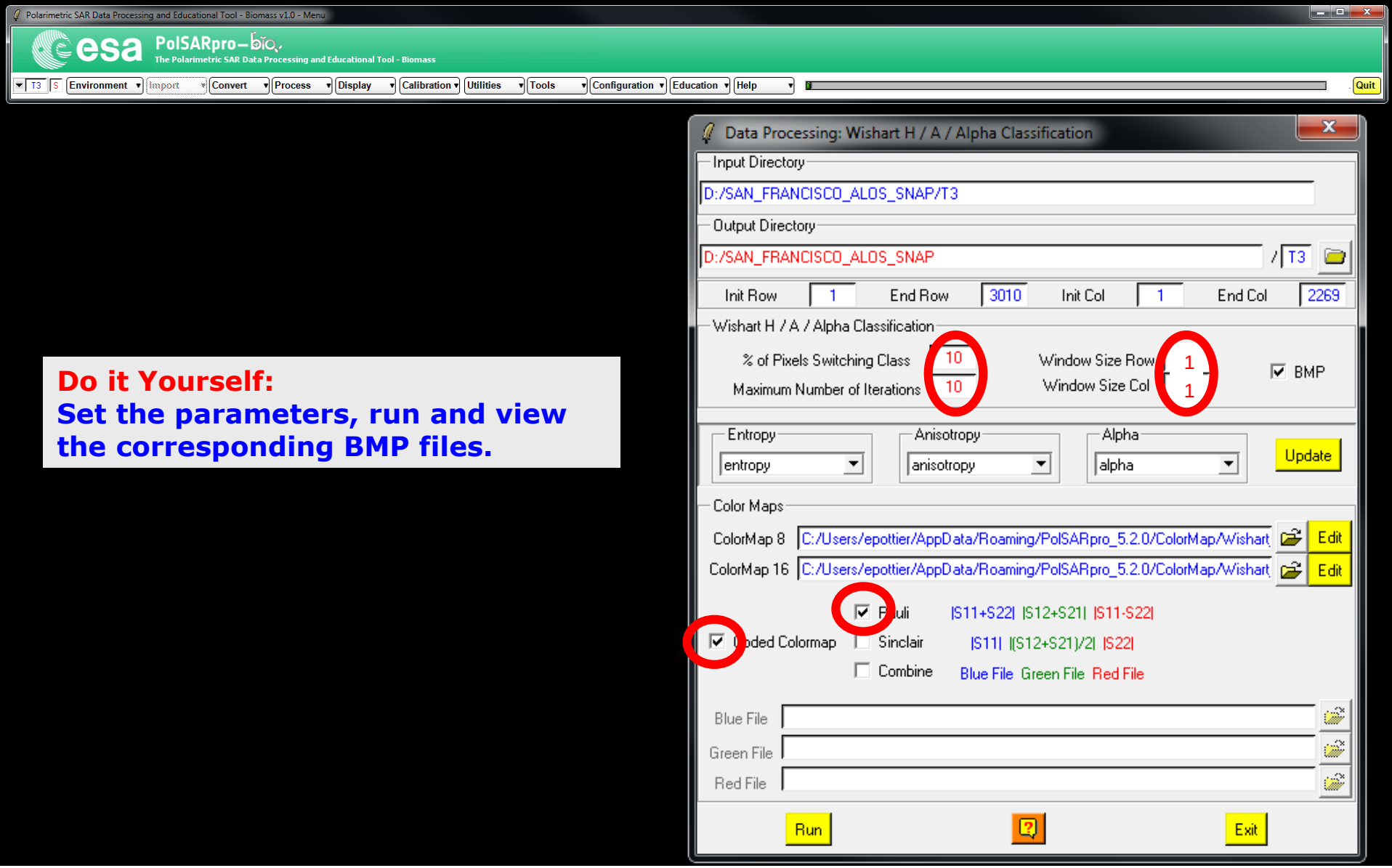




PolSARpro - Bio SOFTWARE

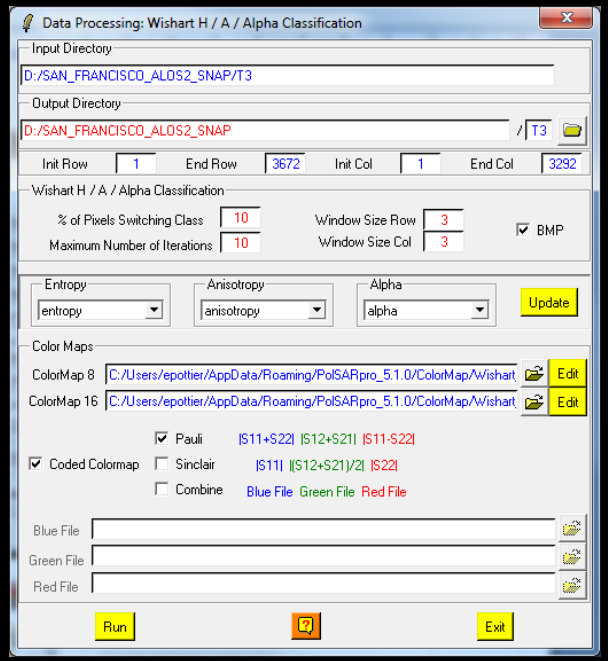


WISHART - H/A/alpha CLASSIFICATION



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

WISHART - H/A/alpha CLASSIFICATION



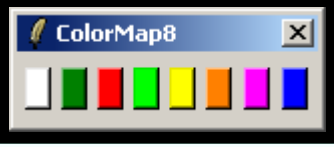
DATADIR

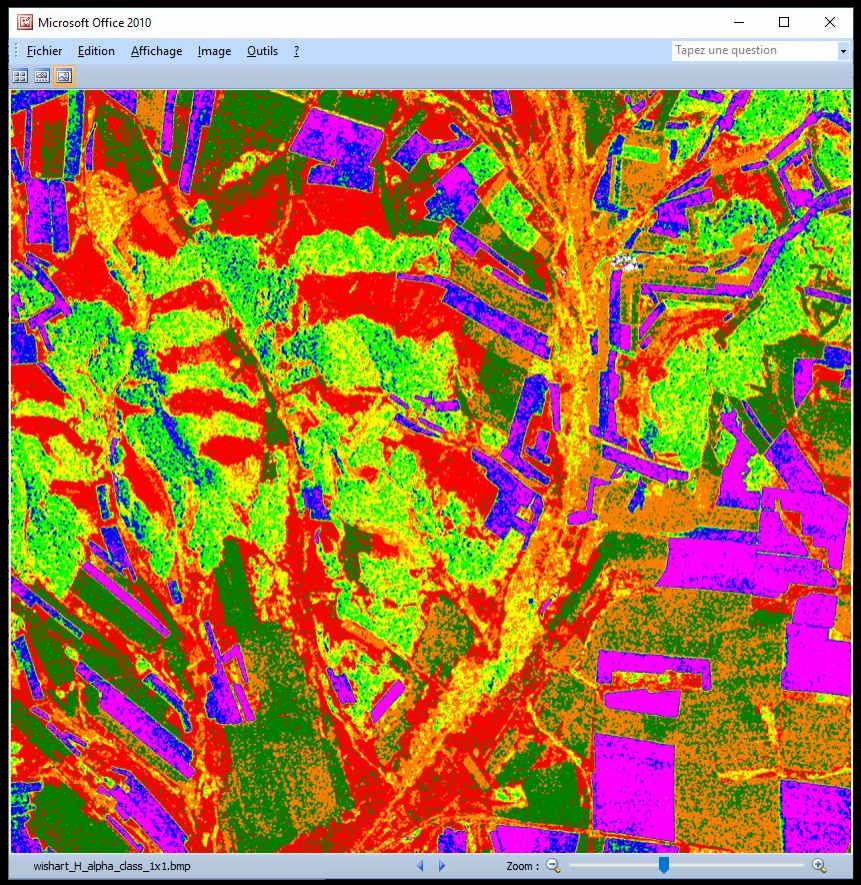
- config.txt
- [T3x3] Elements
- Wishart_H_alpha_class_X.bin
  Wishart_H_A_alpha_class_X.bin
- Wishart_H_alpha_class_X.bmp
  Wishart_H_A_alpha_class_X.bmp

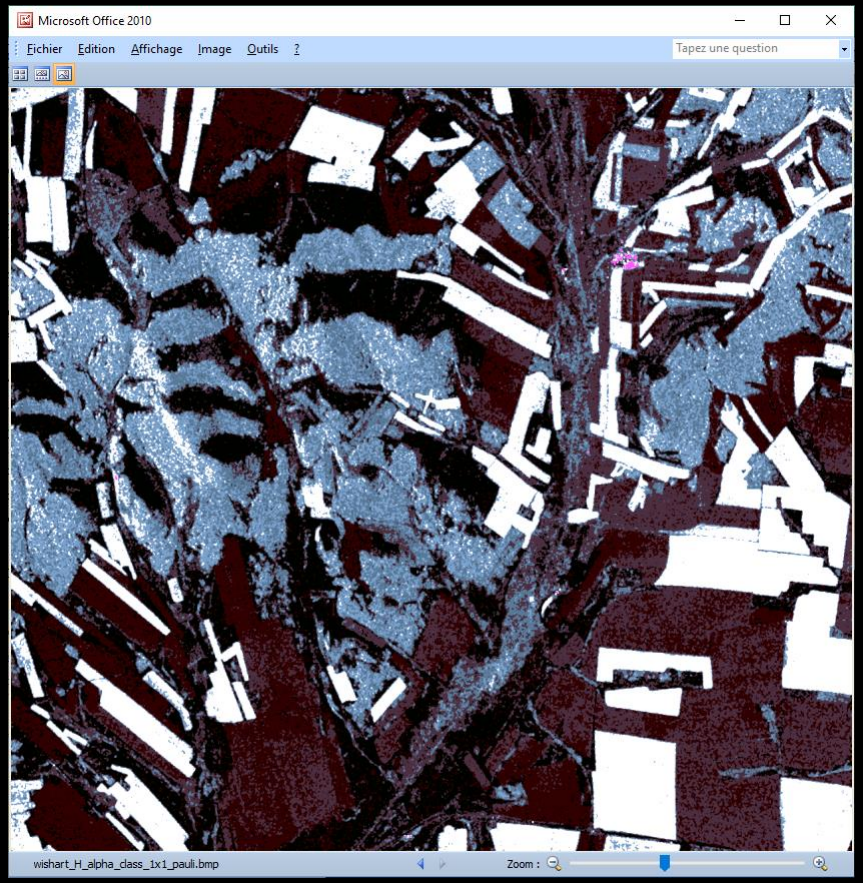
X = window size

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

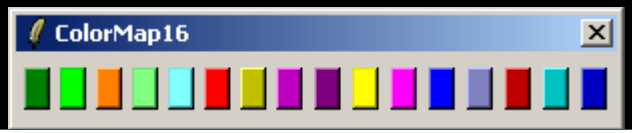
WISHART - H/A/alpha CLASSIFICATION

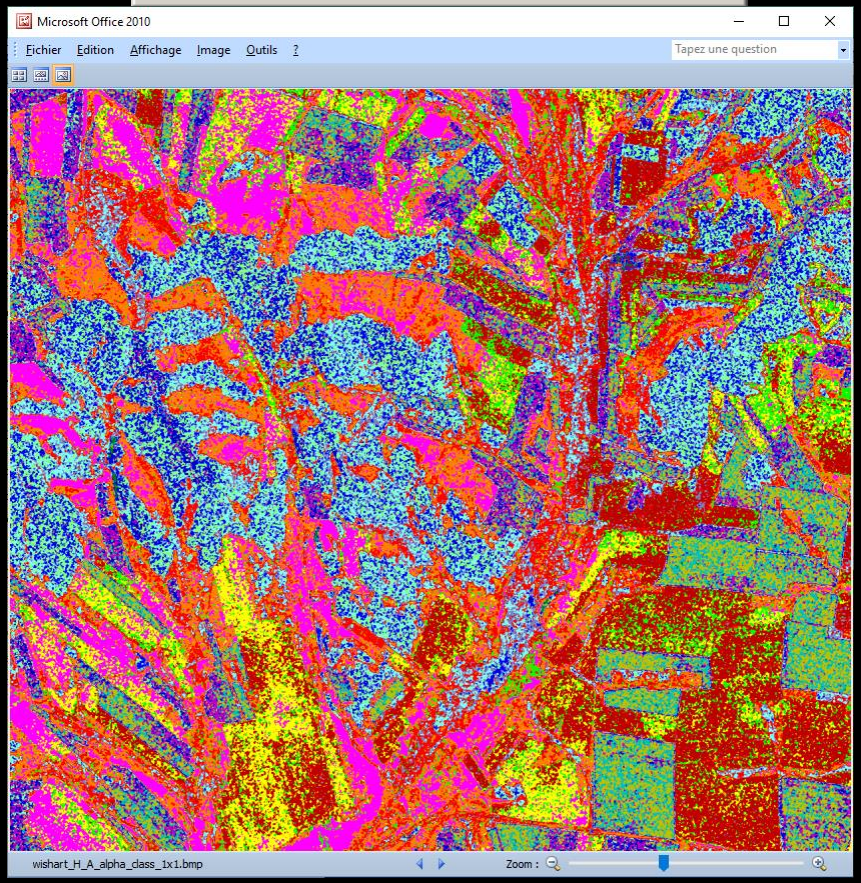


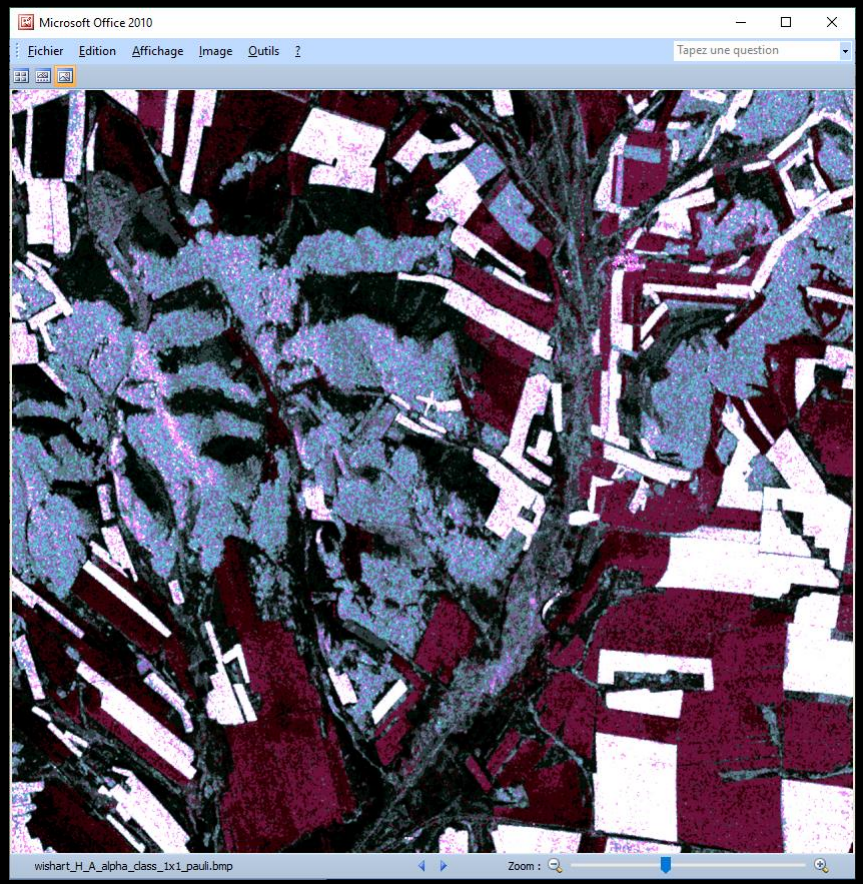




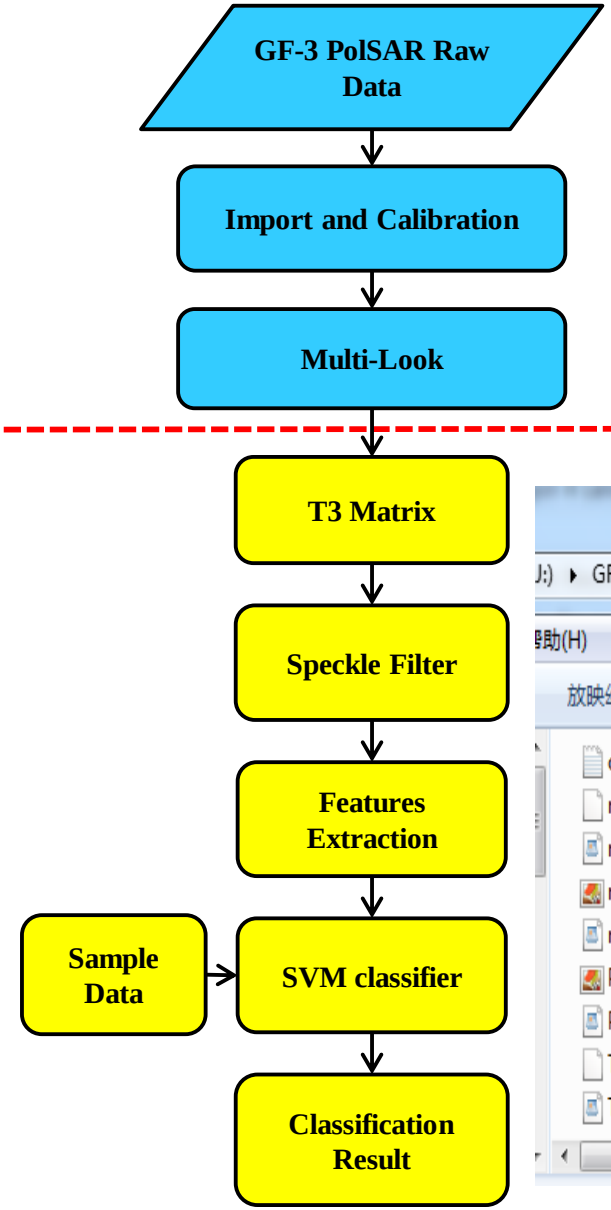
WISHART - H/A/alpha CLASSIFICATION



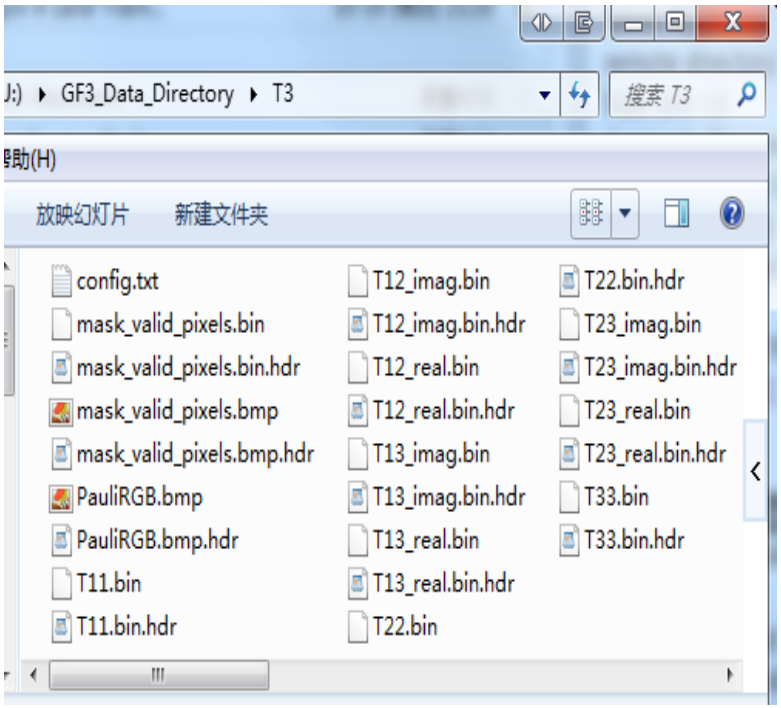




SVM supervised classification



We started this practical session from T3 matrix that has been calibrated and multi-look processed.



- GF-3 QPSI Quad-Pol
- Range pixel spacing: 9.0 m
- Azimuth pixel spacing: 10.0 m

SVM supervised classification

Step-1: Define classification system & classification legend


ICS 07.040
A 76

GB

中华人民共和国国家标准

GB/T 21010—2017
代替 GB/T 21010—2007

土地利用现状分类

Current land use classification

Classification system:

1. 耕地(crop land)
   1.1 水田(paddy)
   1.2 水浇地(irrigated)
   1.2 旱地(dry)
2. 园地(garden)
3. 林地(forest)
   3.1 乔木林地(arbor)
   3.2 竹林地(bamboo)
   …
4. 草地(grass land)
   4.1 天然牧草地(natural grass land)
   …
5. 商服用地(commercial)
6.

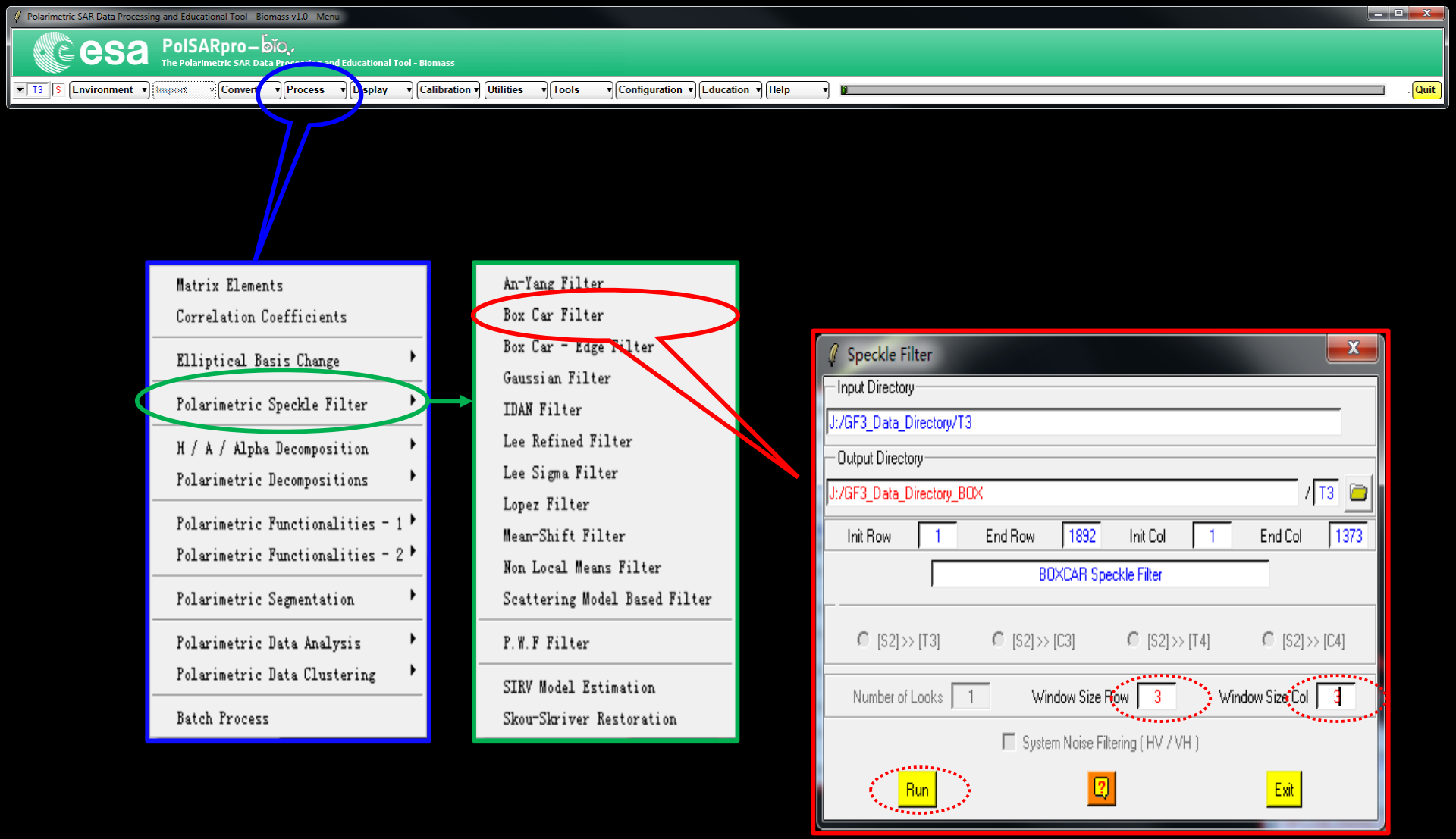
…

12. 其他土地(others)

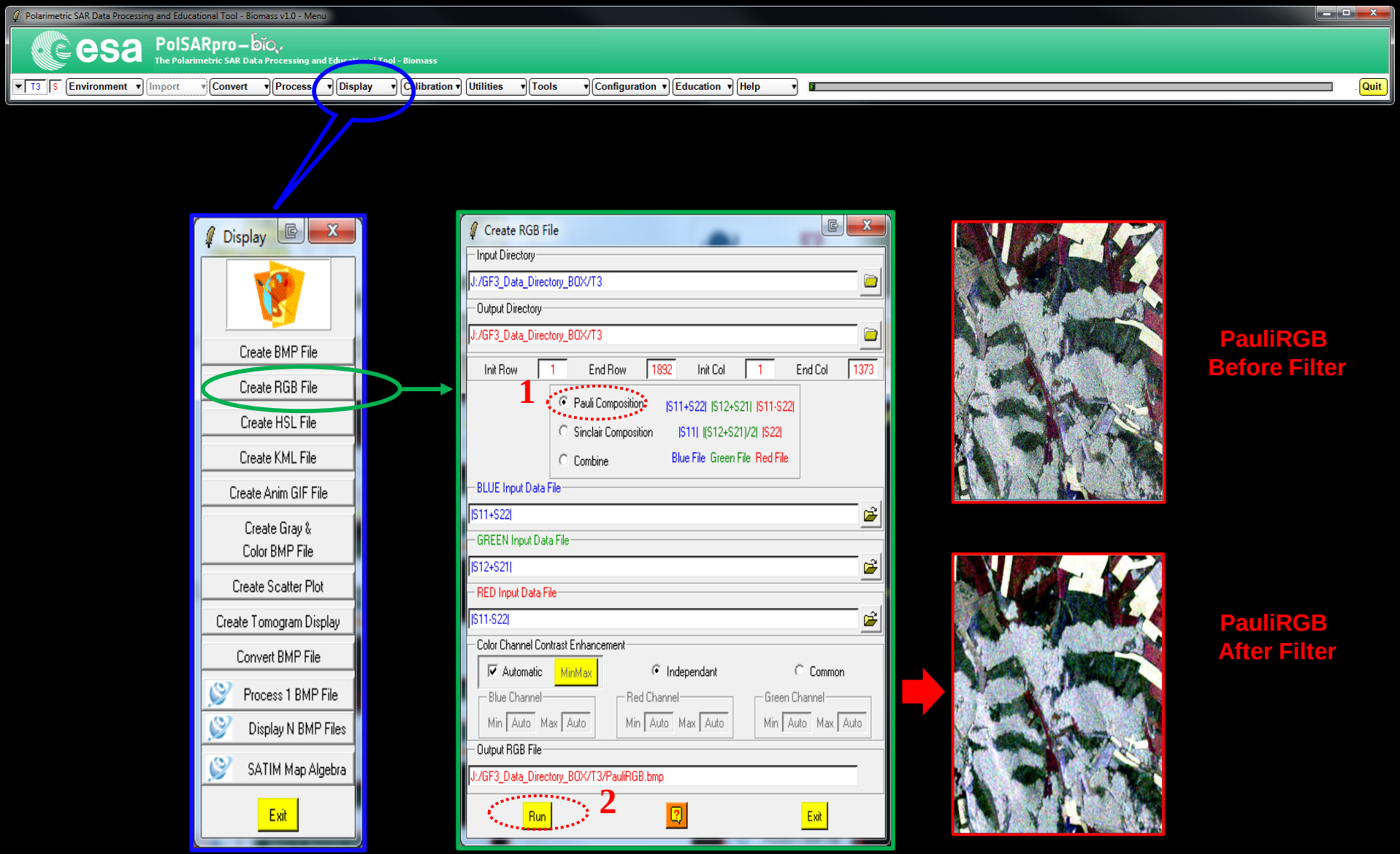
Legend:

1. **Wheat**
2. **Cole**
3. **Forest**
4. **Grass**

Step-2: Speckle Filter



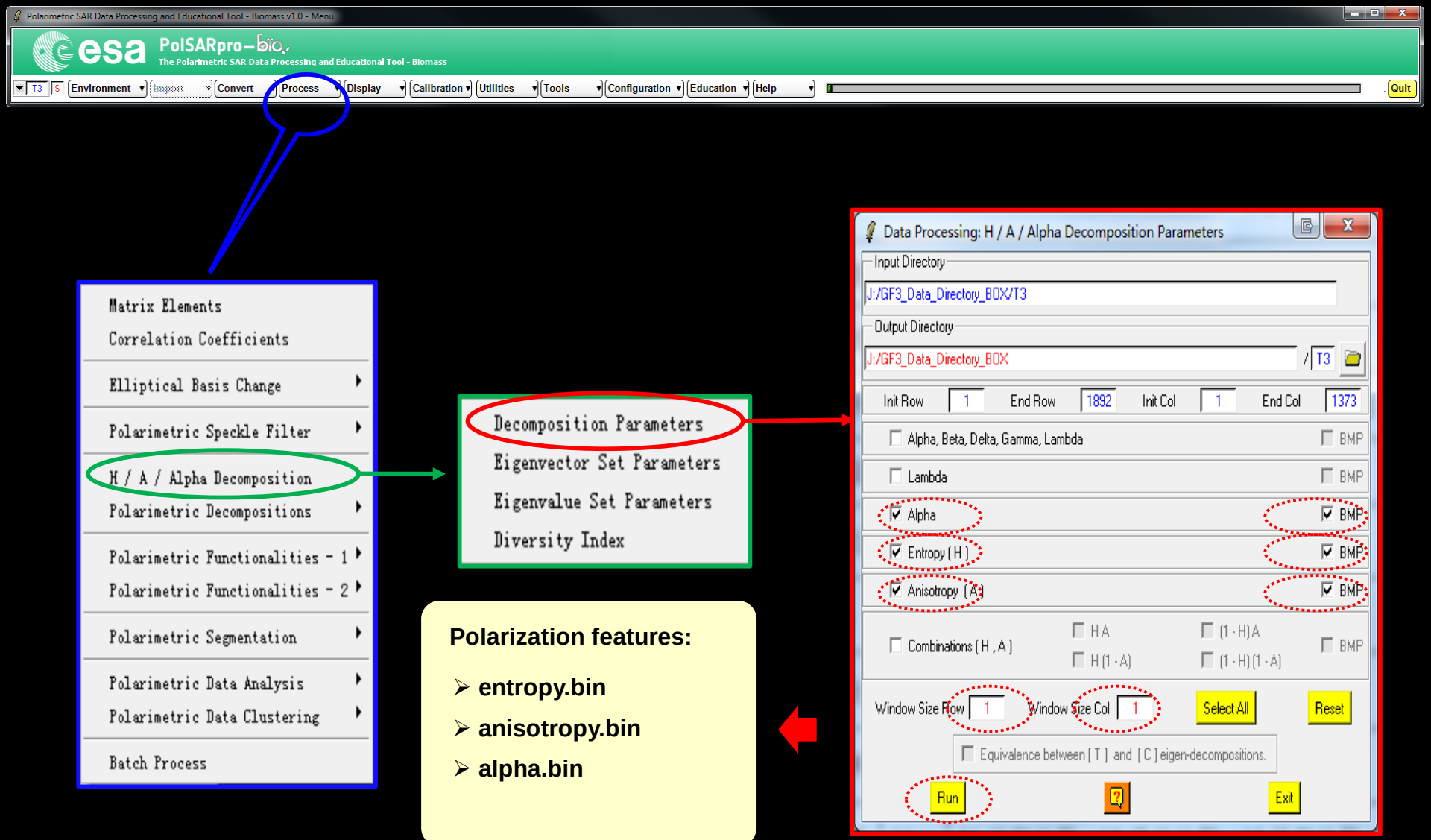
Step-2: Speckle Filter



PauliRGB
Before Filter

PauliRGB
After Filter

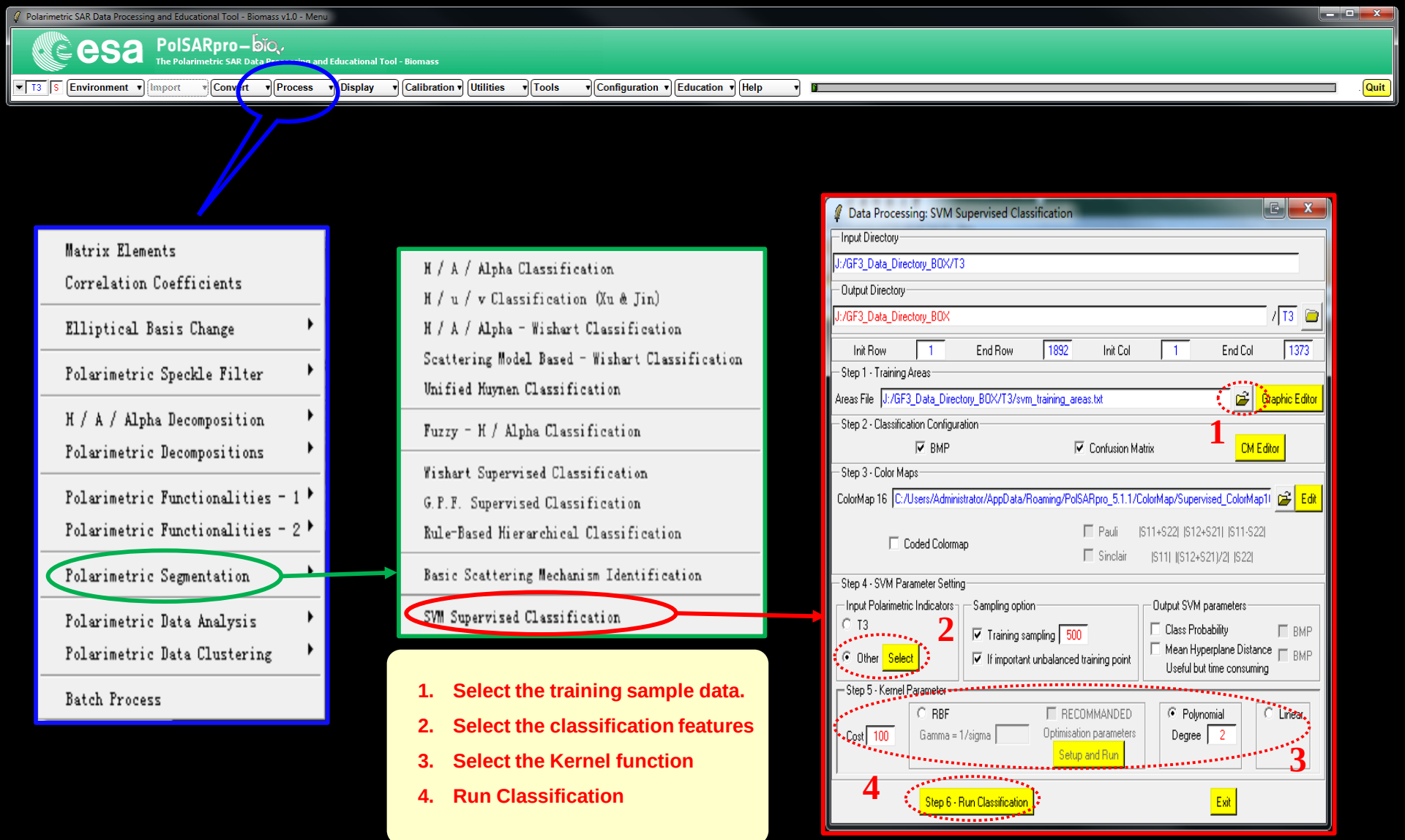
Step-3: Features Extraction



Polarization features:

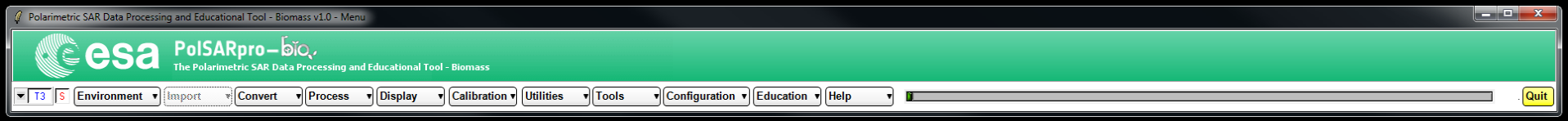
- **entropy.bin**
- **anisotropy.bin**
- **alpha.bin**

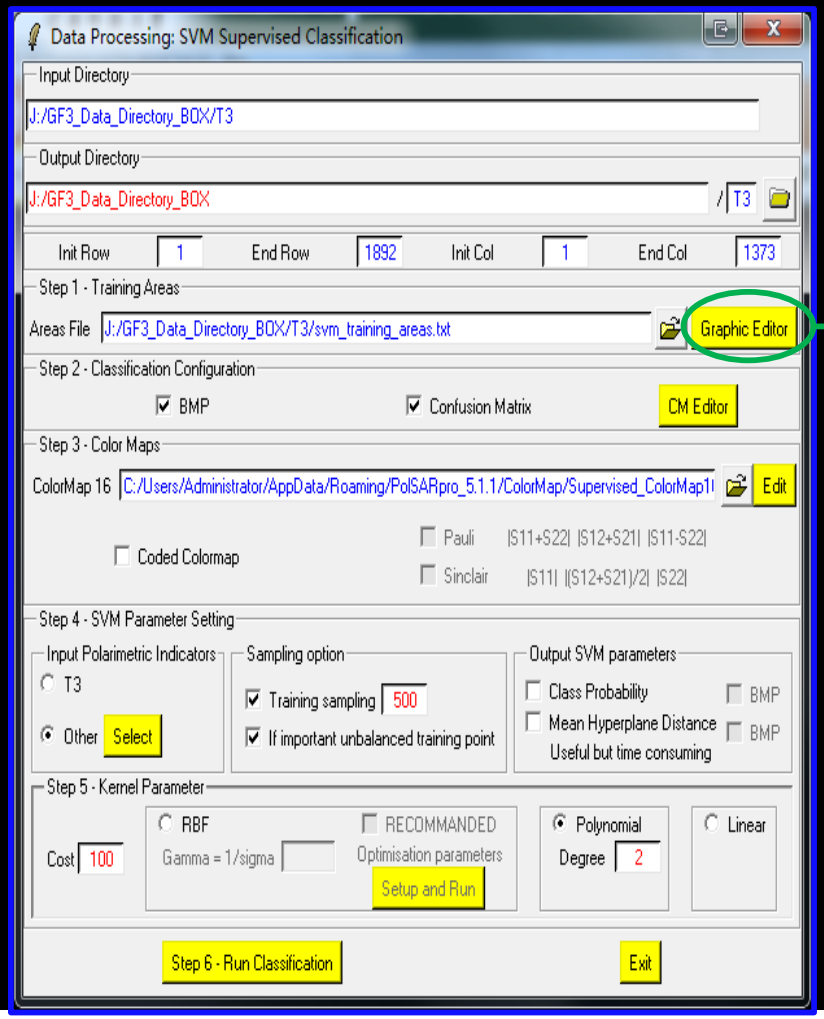
Step-4: SVM classifier



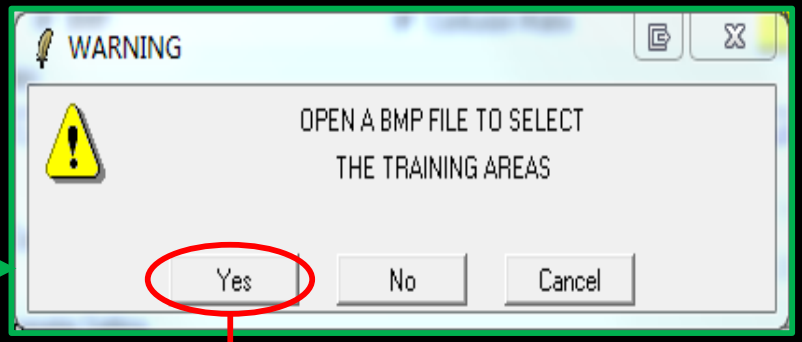
1. Select the training sample data.
2. Select the classification features
3. Select the Kernel function
4. Run Classification

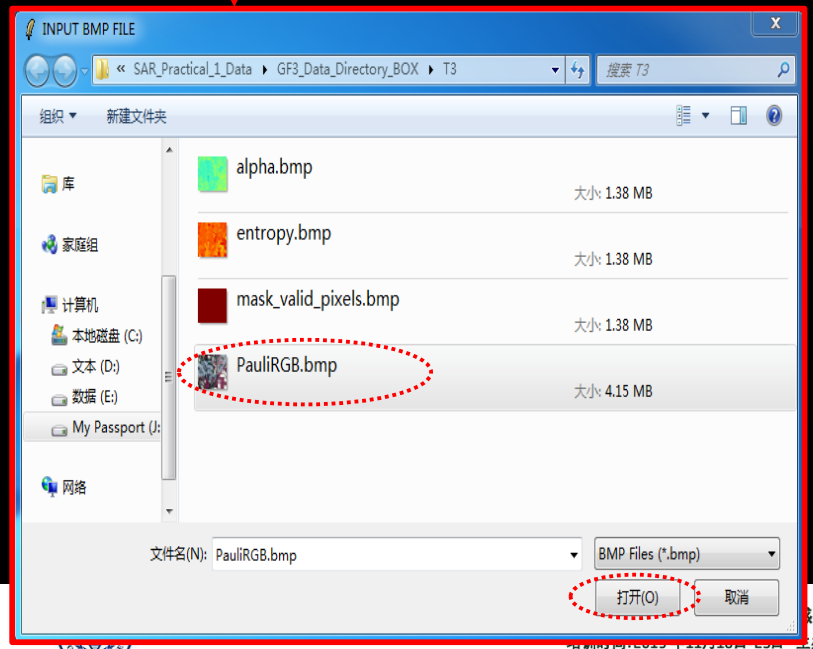
Step-4: SVM classifier





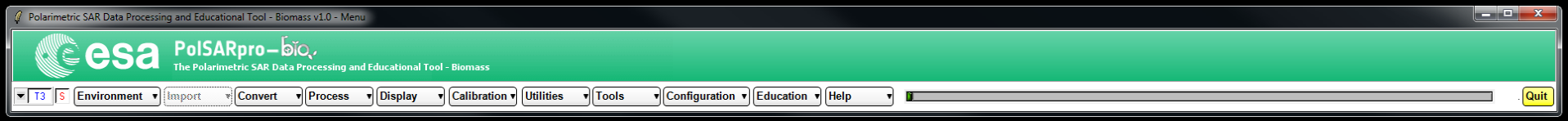
1. Select the training sample data.

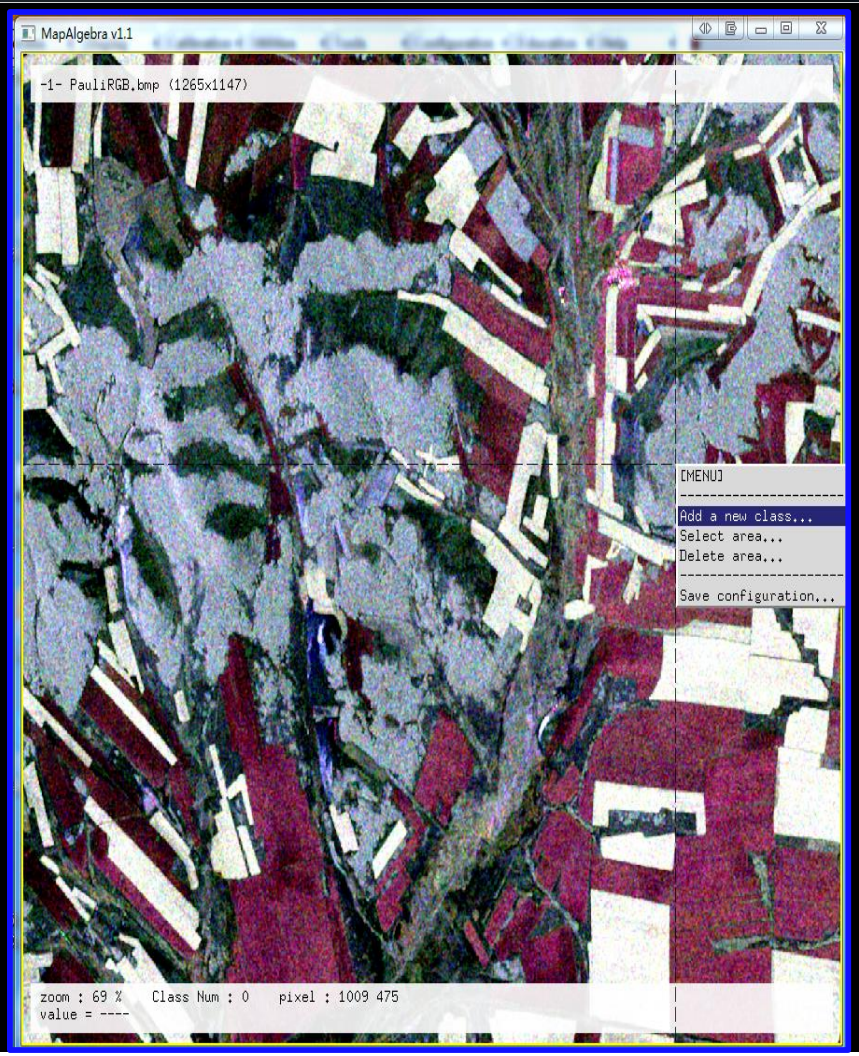




E.P (2019)

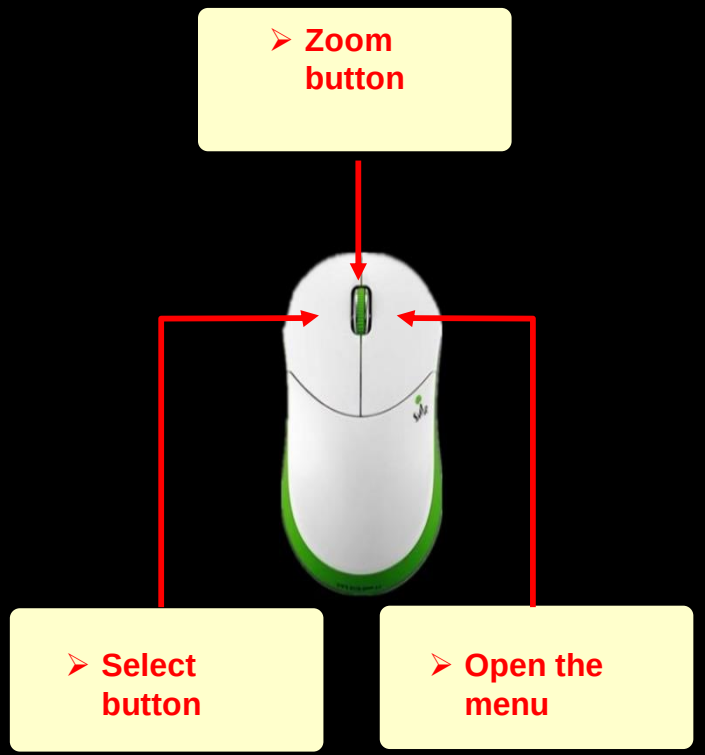
Step-4: SVM classifier





1. Select the training sample data.

Basic operation:



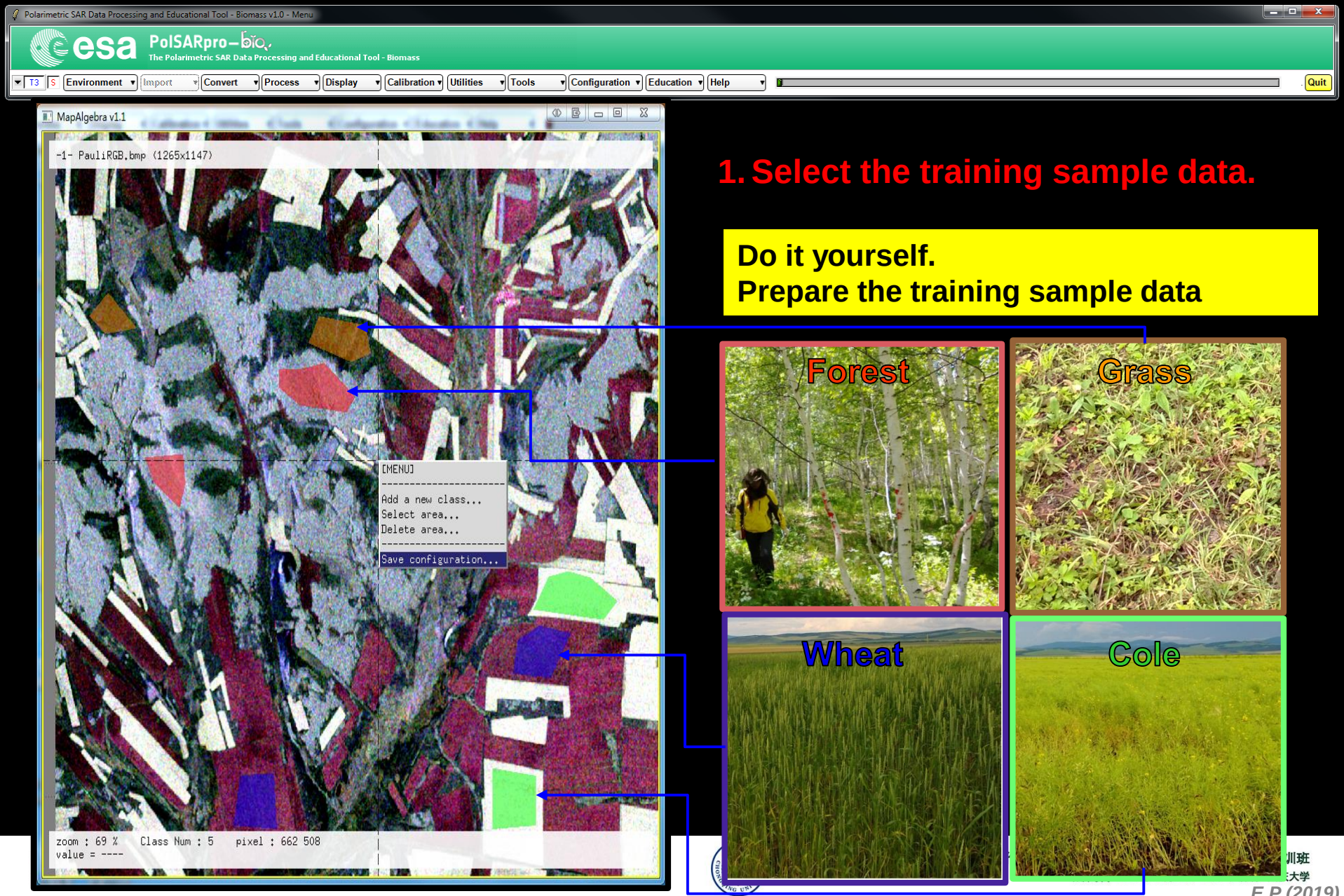
Step-4: SVM classifier

1. Select the training sample data.

Basic operation:

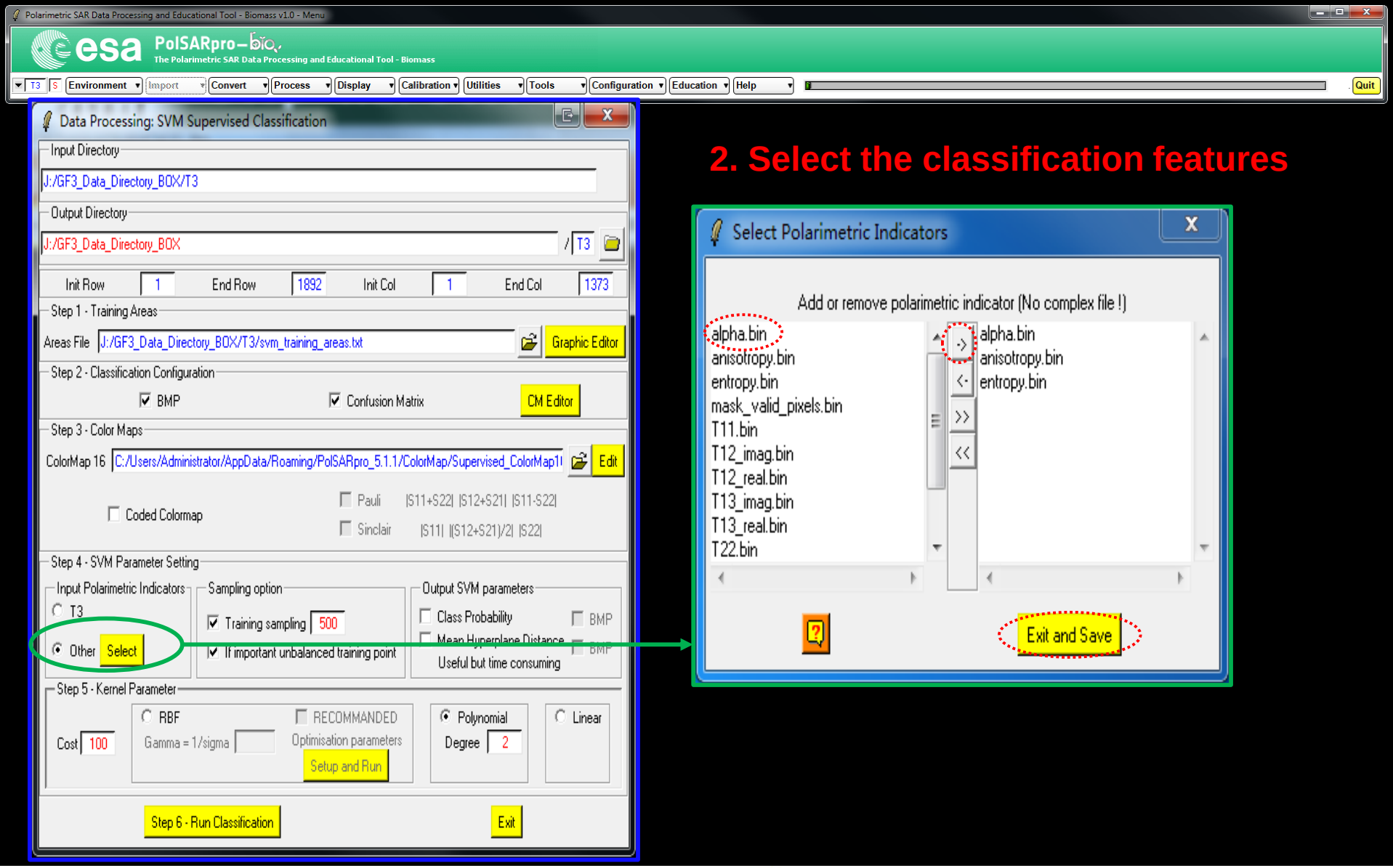
1. Add a new class 1.
2. Select first area for class1
   - ① Click 'Select area' , draw a polygon
   - ② Click 'Select area' , stop drawing;
   - ③ Click 'Delete area' .
3. Select second area for class1;
4. ....
5. Add a new class 2.
6. Select first area for class2;Select second area for class2;....
7. ....
8. Save configuration

Step-4: SVM classifier



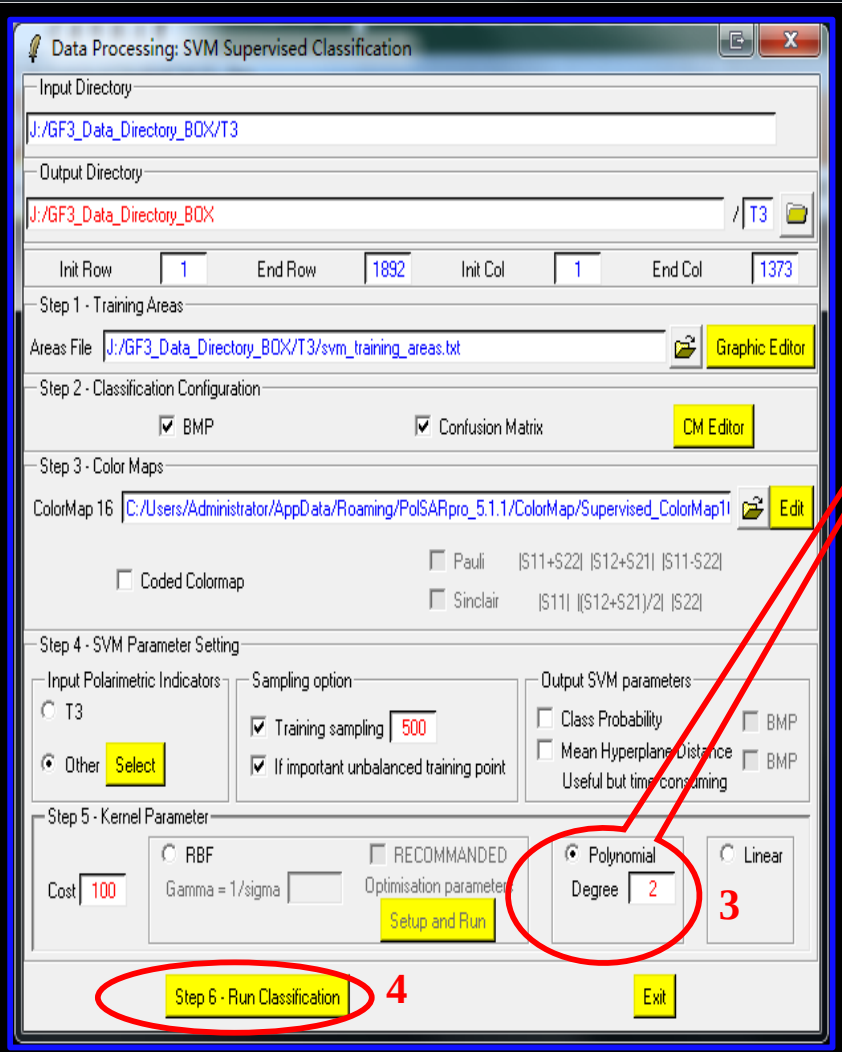
E.P (2019)

Step-4: SVM classifier



2. Select the classification features

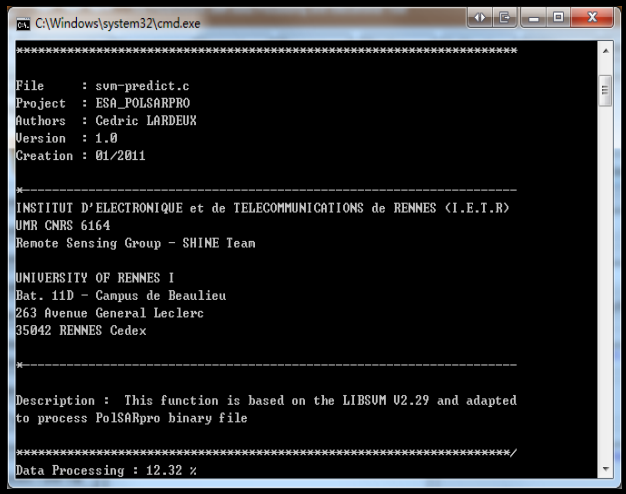
Step-4: SVM classifier



3. Select the Kernel function

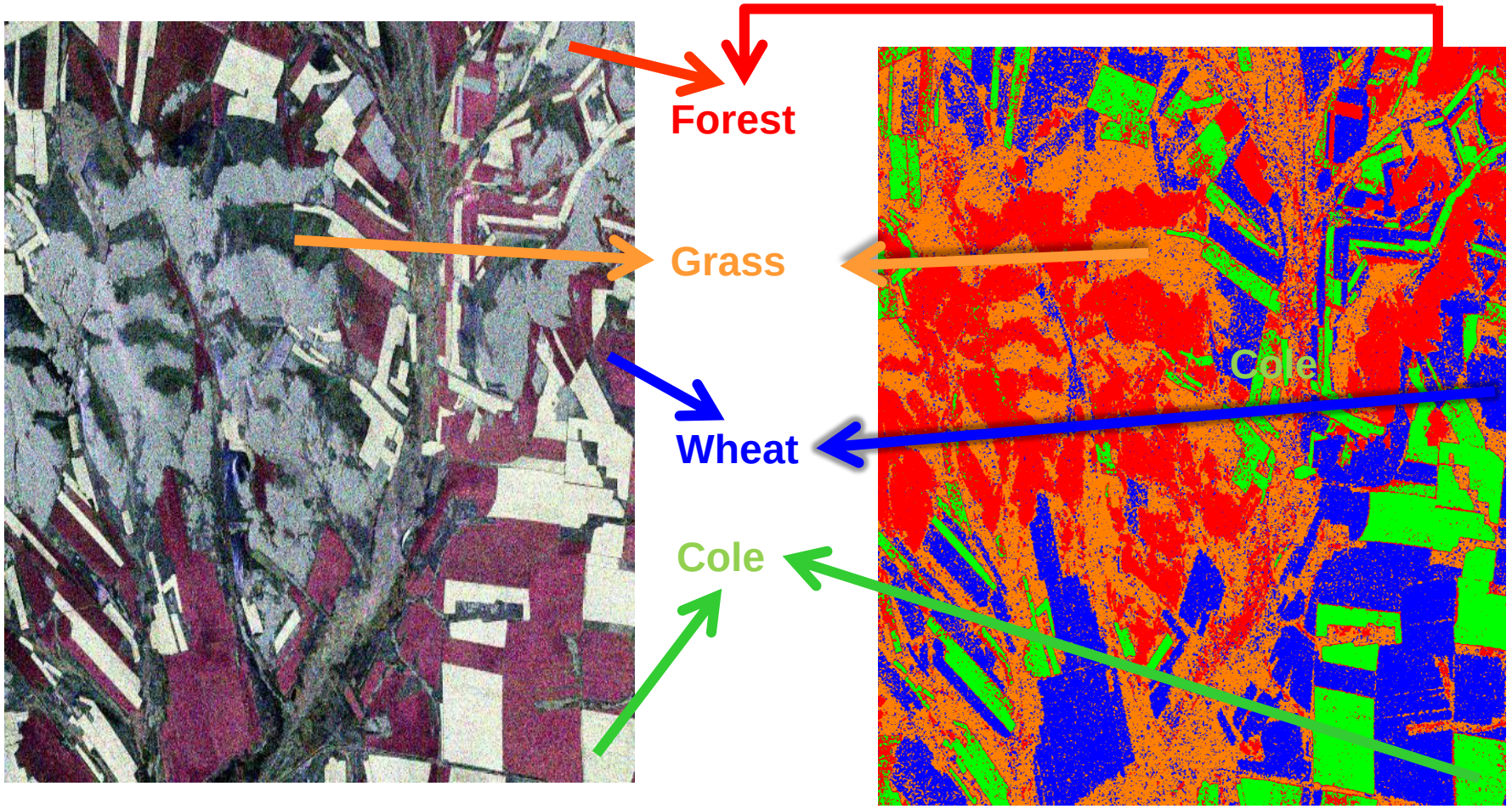
- We choose polynomial kernel function
- Degree:2

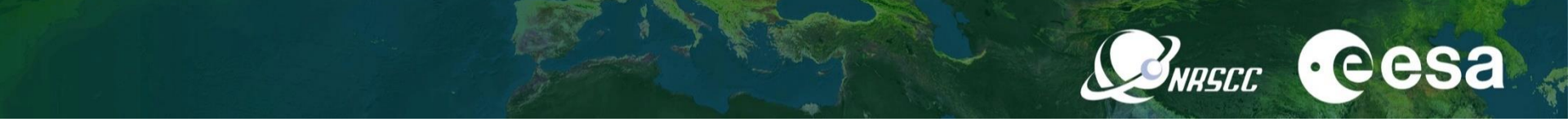
4. Run Classification



II. GF-3 PolSAR dataset

Classification result vs. GF-3 PolSAR Pauli-RGB image





Thanks