GuidosToolbox Workshop

Part 3: GTB program features

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The workshop will address the following topics:

GWS 1: Introduction/motivation for new ways of image analysis

GWS 2: Pattern Analysis (M)SPA

GWS 3: GuidosToolbox: program features and processing options

GWS 4: Hands-on examples using training data:

a) Data preparation, MSPA, Google Earth overlays, batch process

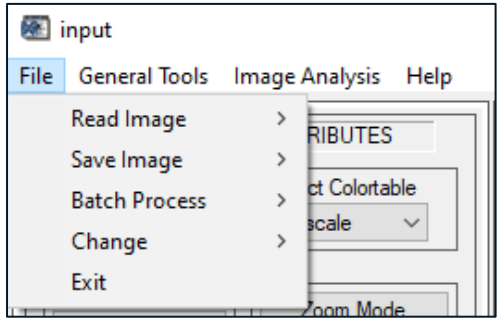
b) Distance, fragmentation, network, restoration, change, …

GuidosToolbox Workshop

Key features grouped in 4 menus

(GTB Manual: https://ies-ows.jrc.ec.europa.eu/gtb/GTB/GuidosToolbox_Manual.pdf)

File:
File management, Batch-processing, Change analysis…



General Tools:
Pre-processing, generic image filters, GIS software…

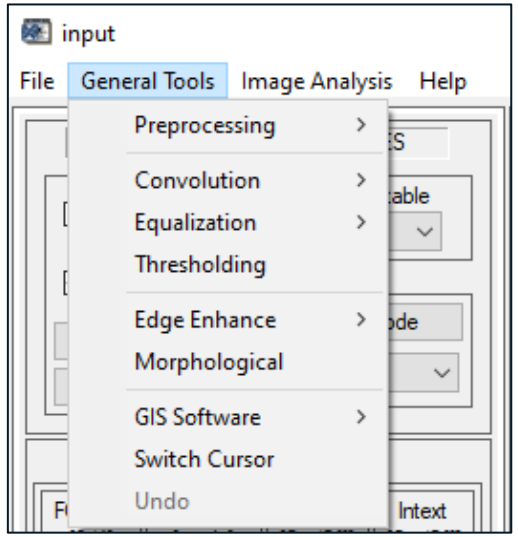
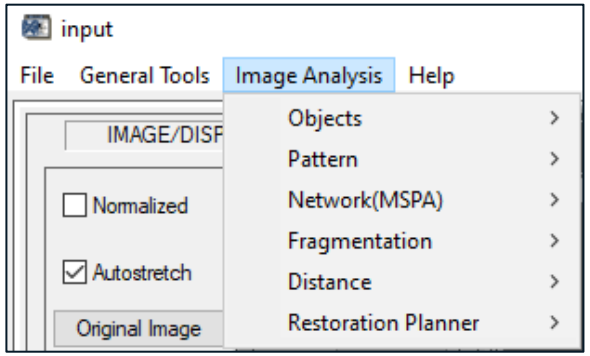
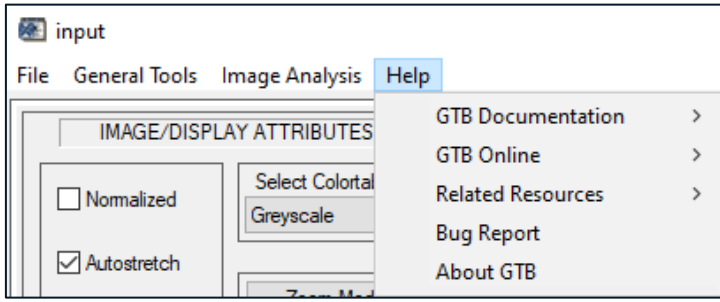


Image Analysis:
Dedicated thematic image analysis tools…



Help:
Program documentation, GTB product sheets, workshop material, further resources …



- **Input**: categorical raster maps, binary/grayscale masks, land cover, resistance maps, …
- **Output**: thematic feature maps and statistics, Google Earth image overlays, …

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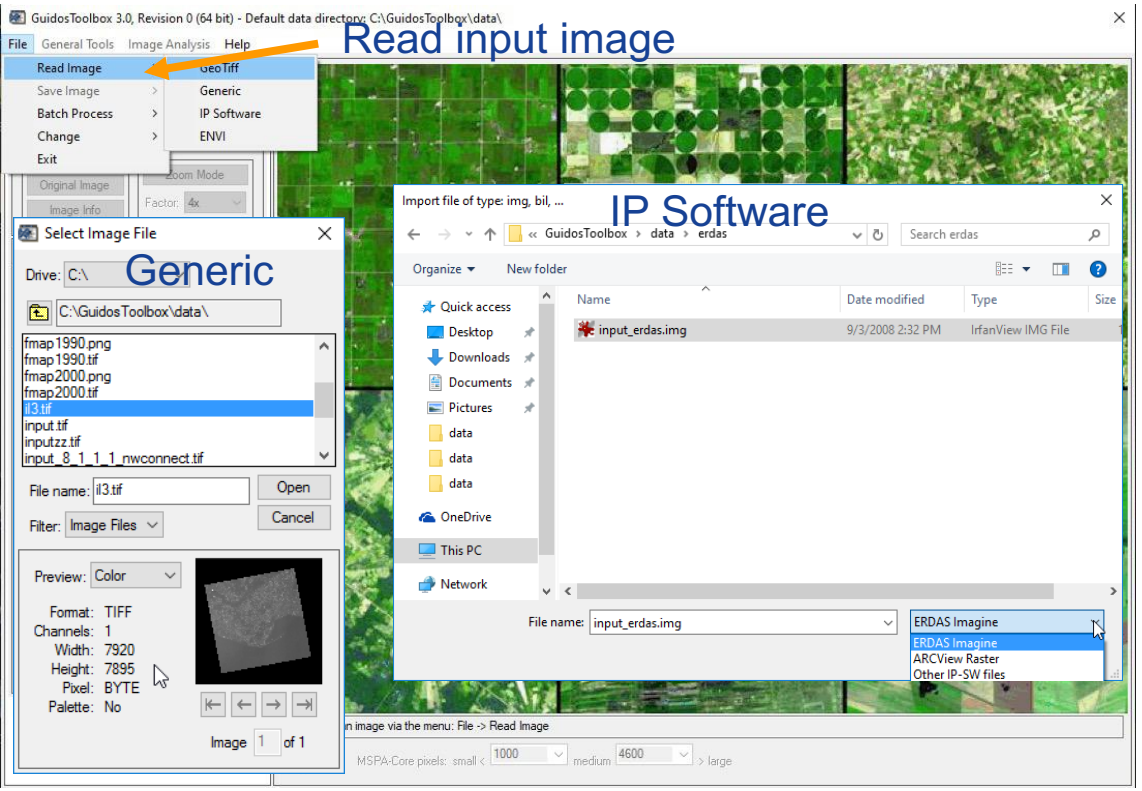
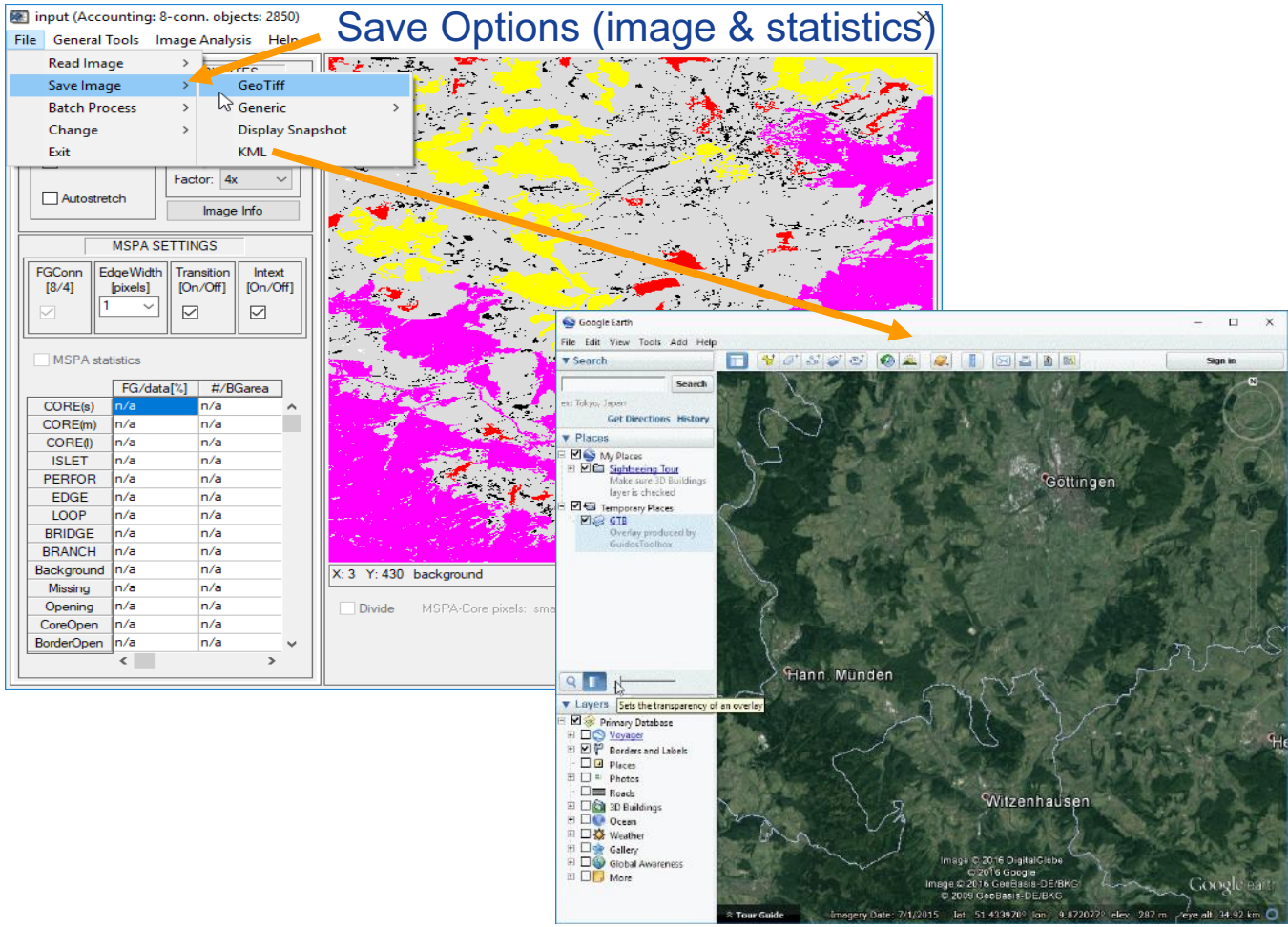
1. File → Read/Save Image

Read Image: Various raster image input formats, default: GeoTiff



Save Image: Various raster image output formats, default: GeoTiff



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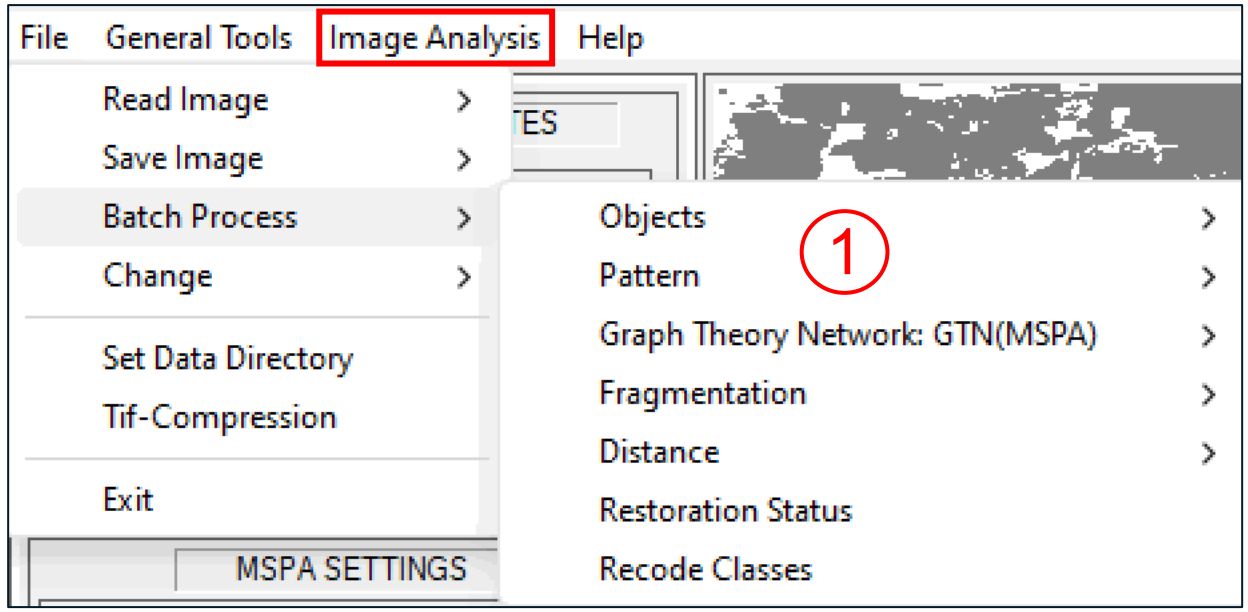
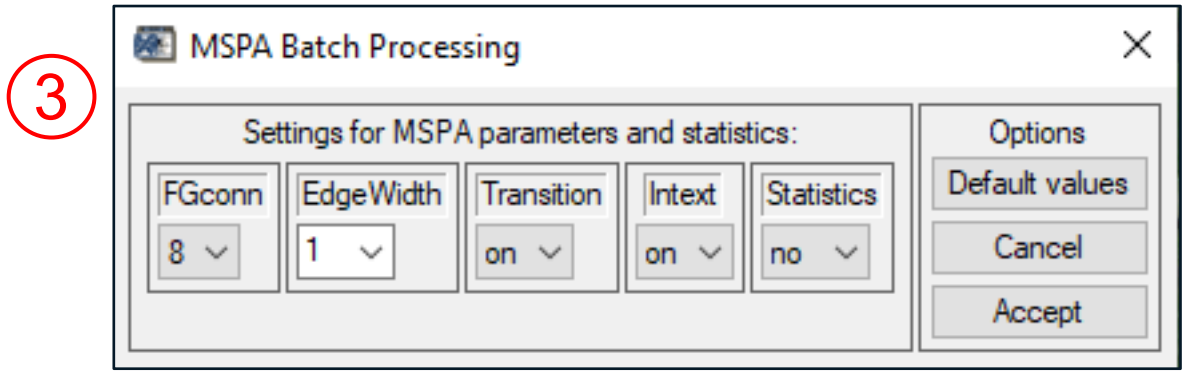
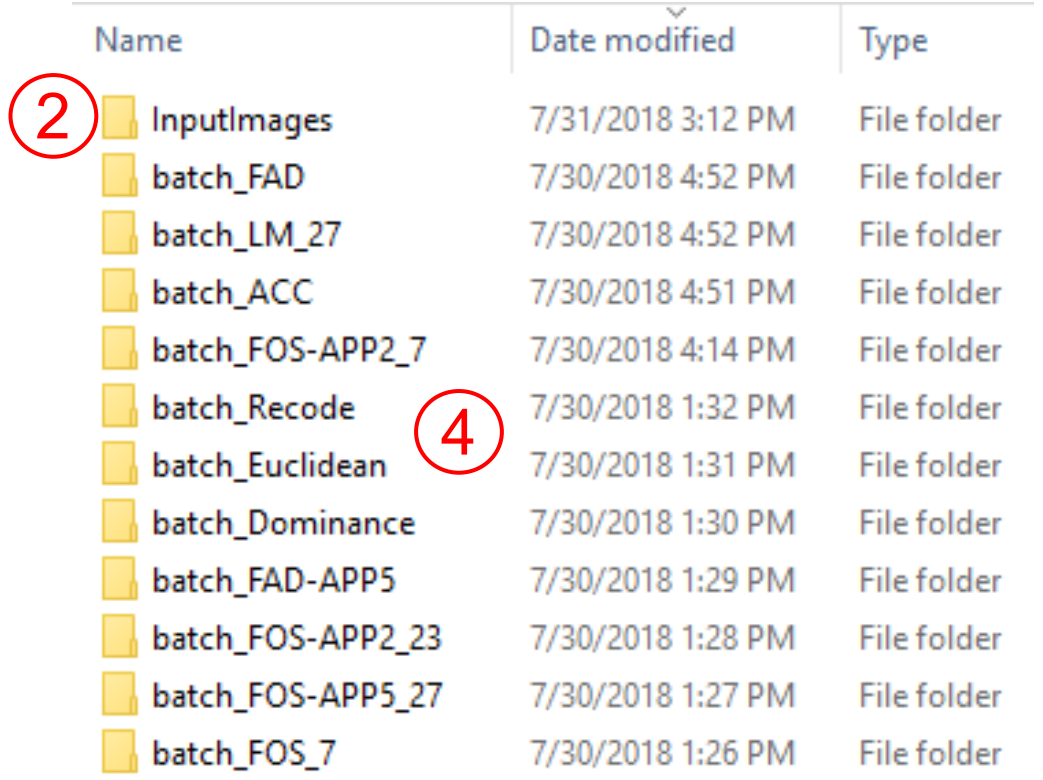
1. File → Batch Process

Batch Process: Similar options as in *Image Analysis* menu section





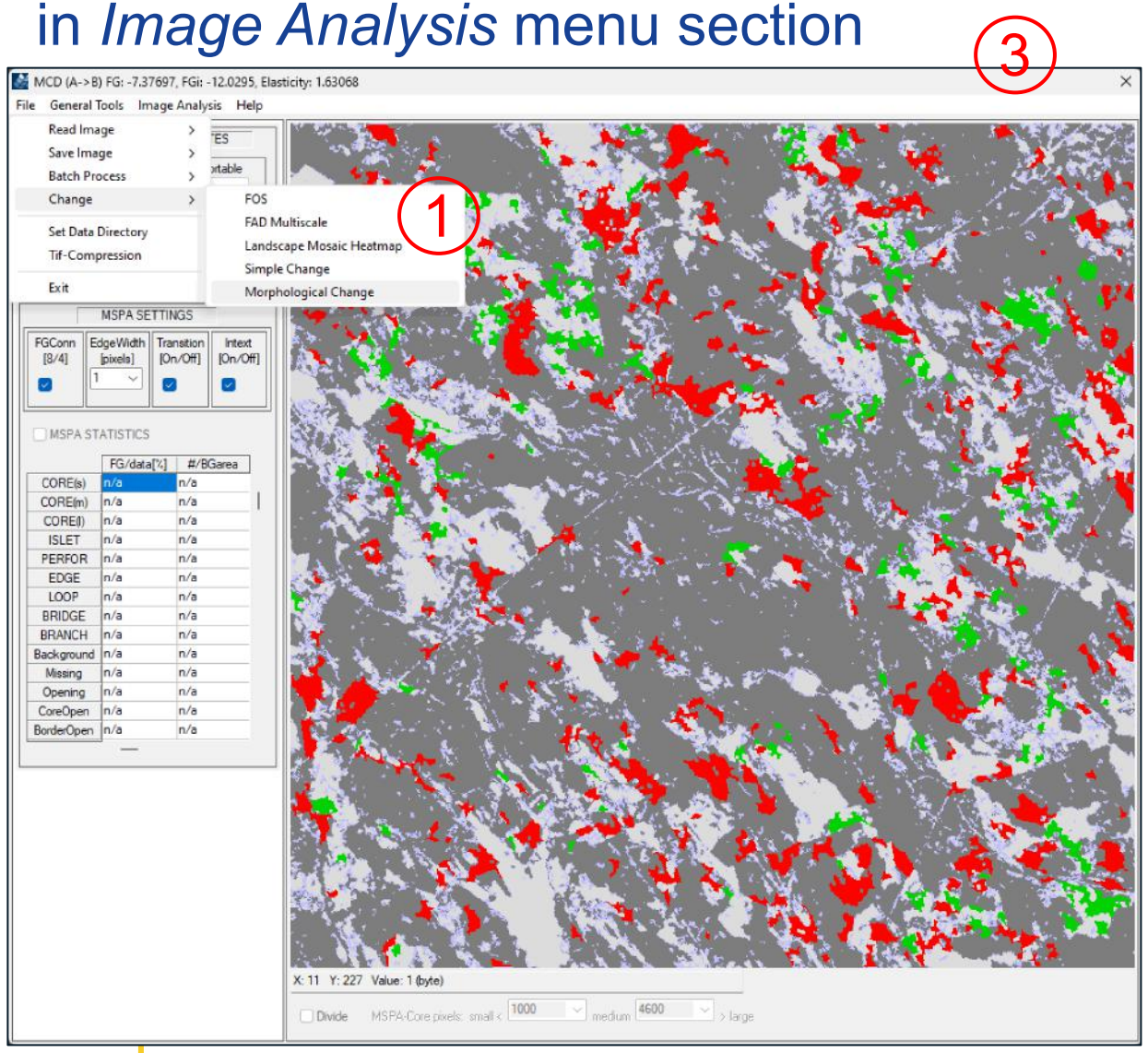
1. Select batch processing type
2. Select folder with your input images:
3. Set processing options
4. Results in parent folder: *batch_type*

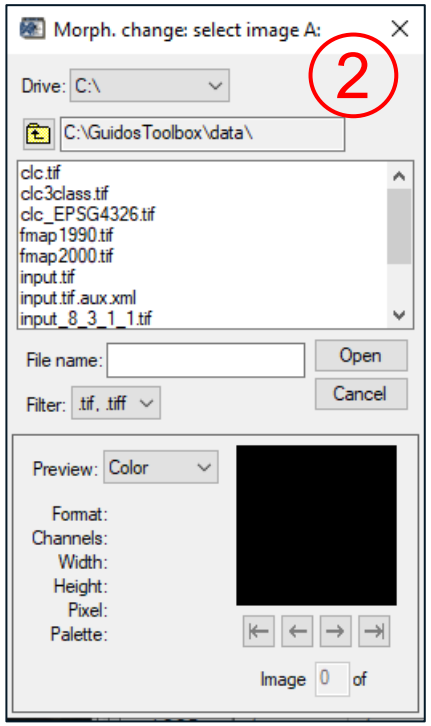


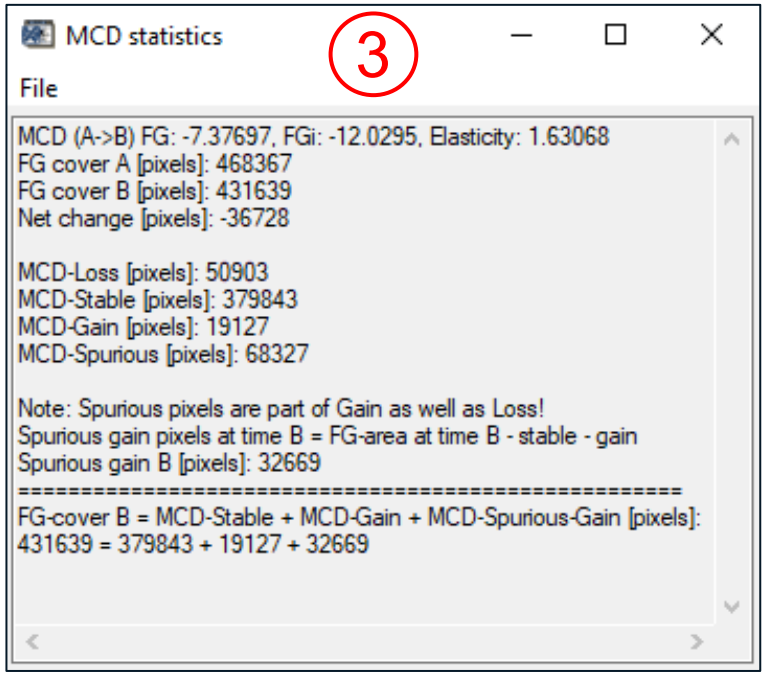
1. File → Change

Change: Similar options as in *Image Analysis* menu section

1. Select change type
2. Select two matching input images
3. Results in GTB







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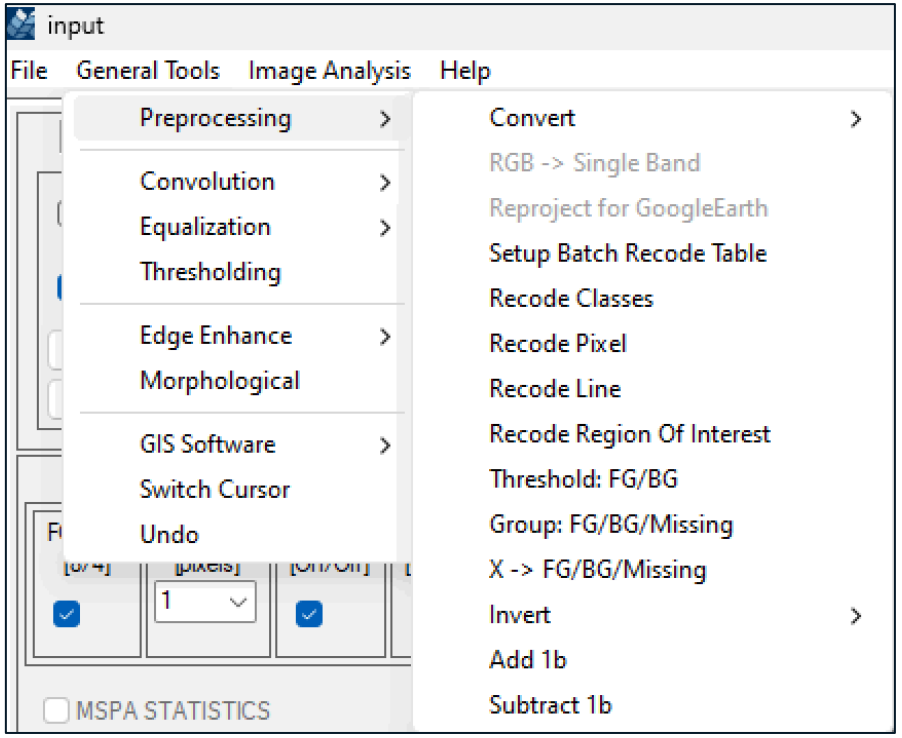
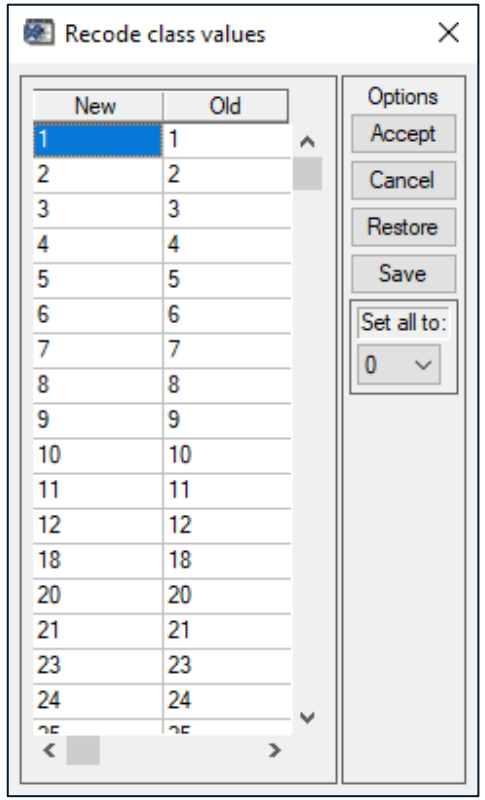
Setup/modify your image.

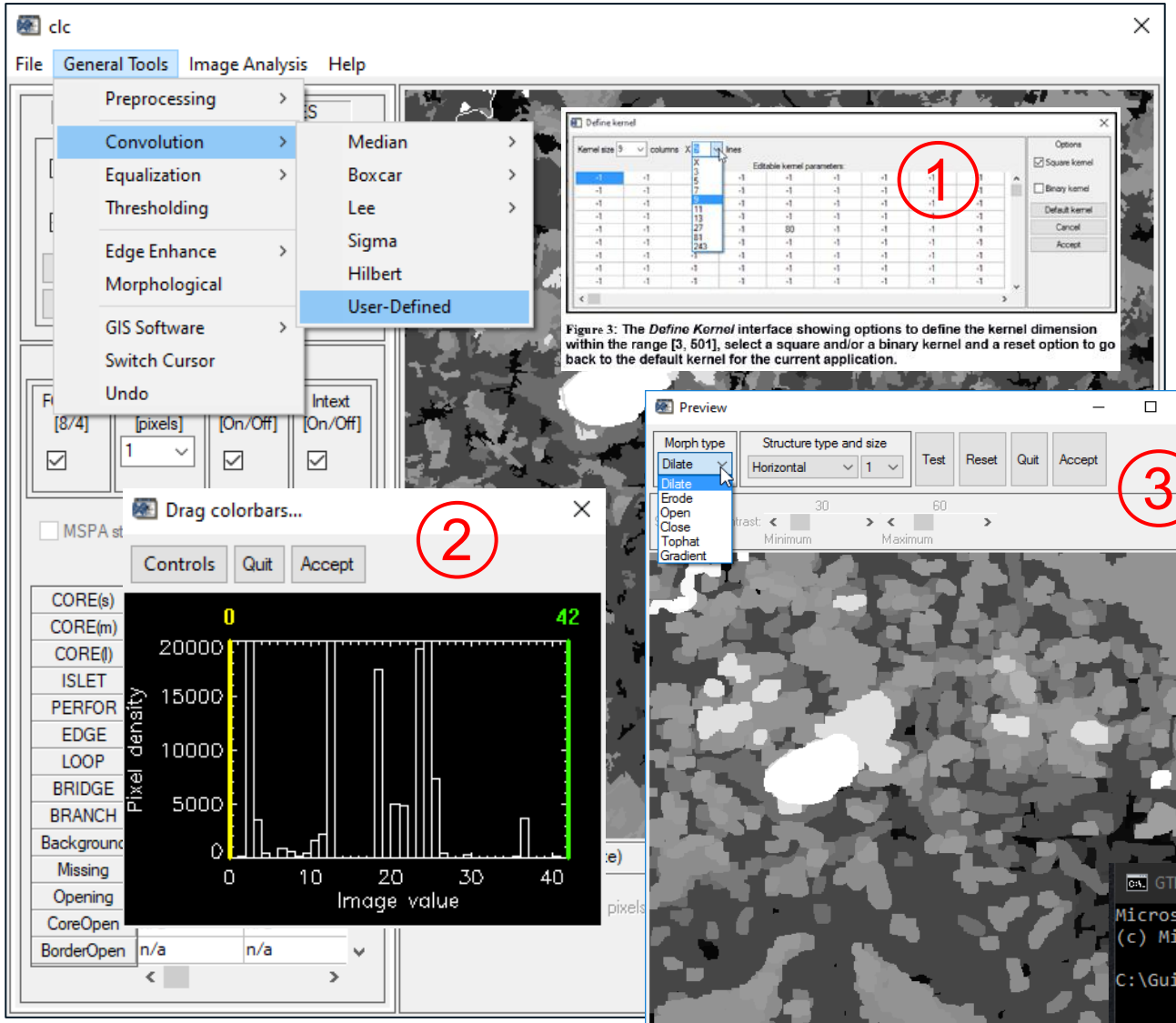


Use any of these options, or combine them with other General Tools, for a custom setup of your image.



- Convert data type
- Tri-band to single layer
- Reproject for Google Earth
- Setup batch recoding
- Recode image classes or regions
- Threshold to binary image
- Assign FG/BG/Missing
- Invert class assignment
- Shift class value up or down

Setup/modify your image.



Choose from a variety of image filters:

- Convolution filters
- Custom, user-defined filter (1)
- Equalization, Interactive Tresholding (2)
- Edge detection and enhancement
- Morphological Toolbox (3)
- GIS Software:
  - GTB-Terminal (4)
  - OpenEV Viewer (5)

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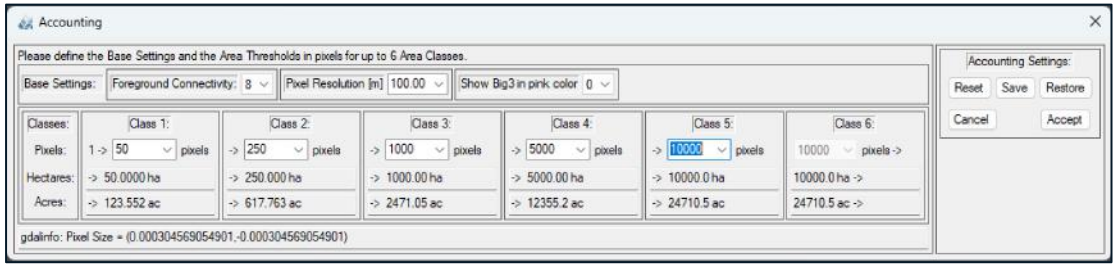
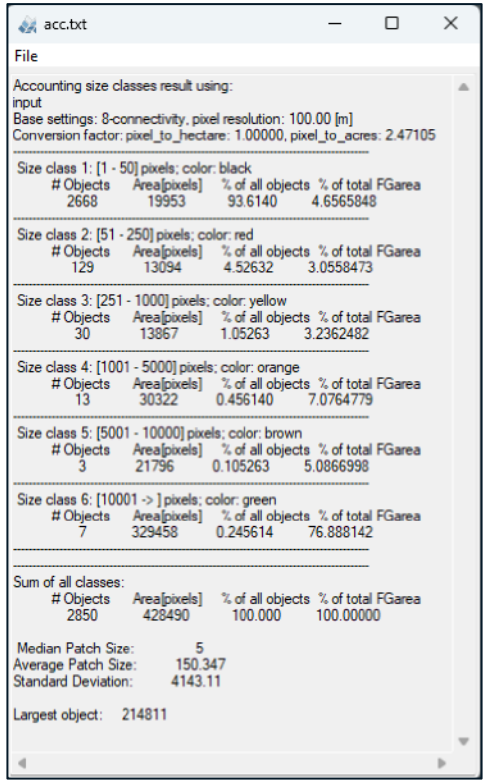
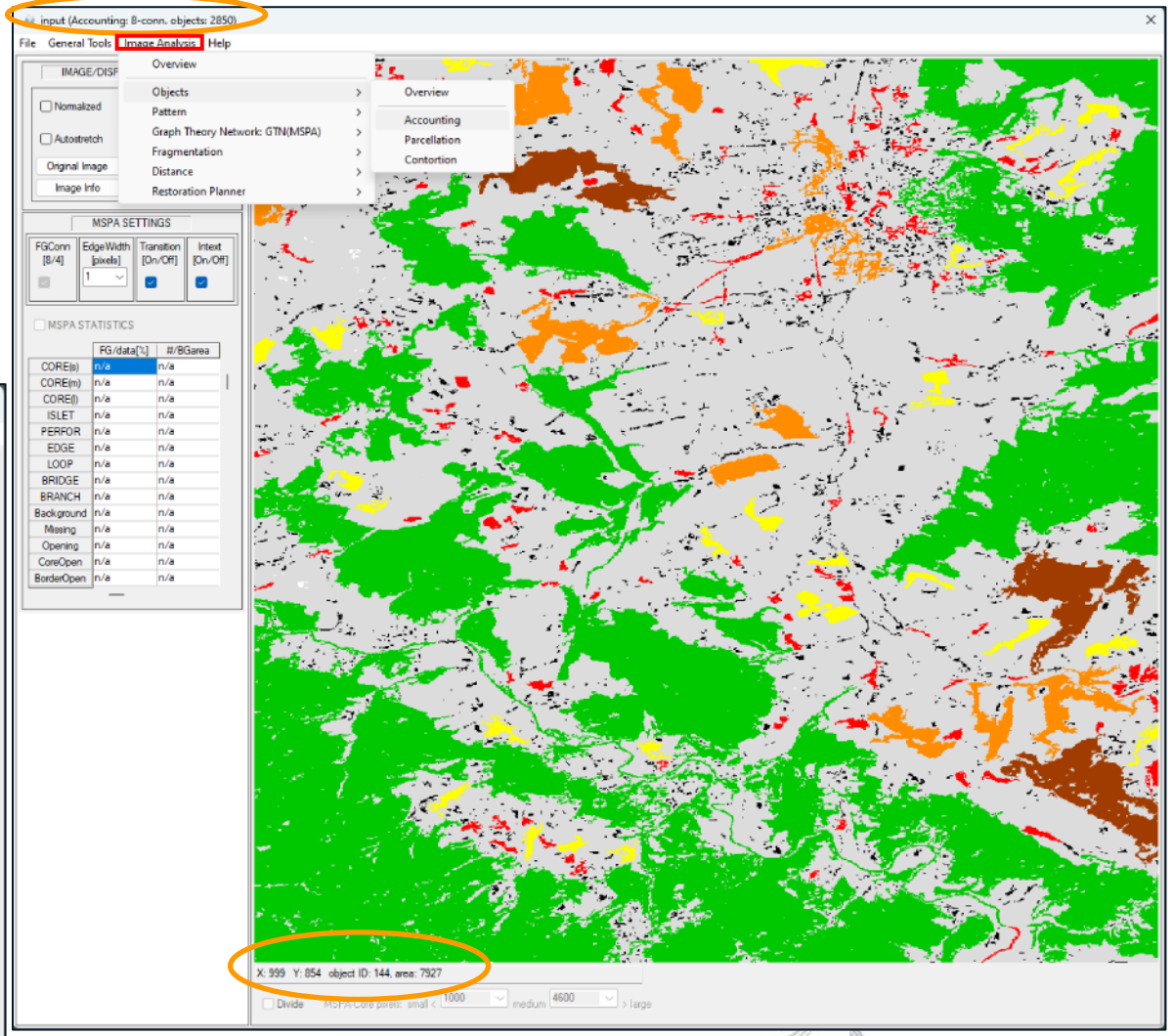
Accounting: Group objects in up to 6 user-defined area classes

1) Define area size-classes





2) Resulting map and statistics



[Accounting product sheet]

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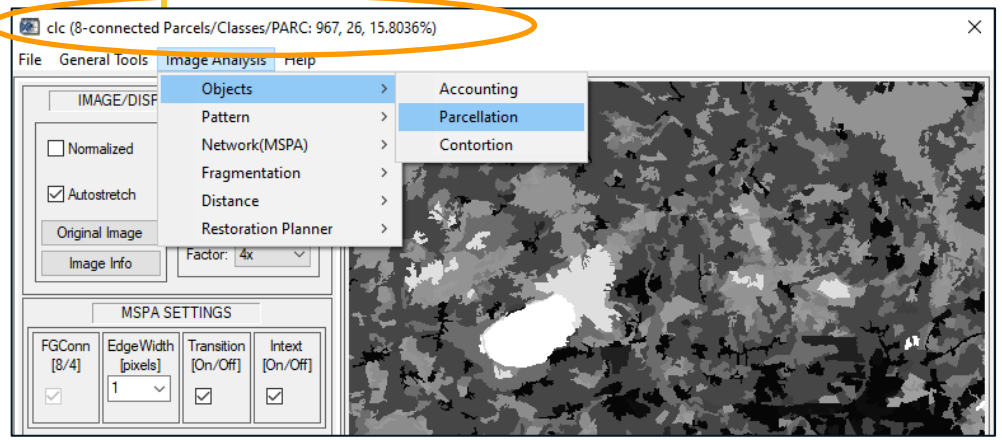
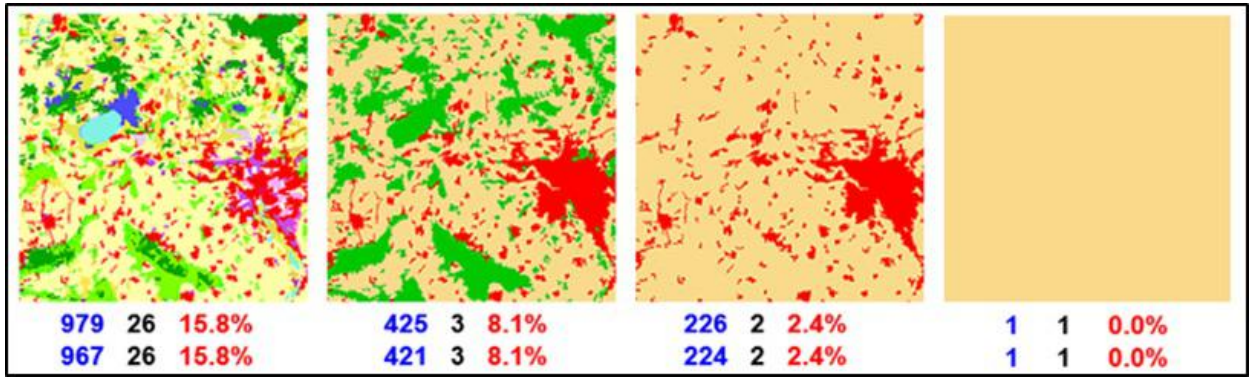
Parcellation: Splitting index for each land cover class and the entire image



 # Parcels / # Classes / Parcellation



Class	Value	Count	Area[pixels]	APS	AWAPS	AWAPS/data	DIVISION	PARC[%]
1	1	2	2792	1396.0000	1998.3600	1.3948	0.2843	2.4207
2	2	201	432930	2153.8800	24287.2000	2628.6600	0.9439	20.8507
3	3	35	56446	1612.7400	3655.9400	51.5909	0.9352	19.8106
4	4	5	6131	1226.2000	1335.9000	2.0476	0.7821	11.0293
5	5	1	418	418.0000	418.0000	0.0437	0.0000	0.0000
6	6	2	14708	7354.0000	7779.0500	28.6036	0.4711	4.6105
7	7	14	10134	723.8570	783.5970	1.9852	0.9227	18.5281
8	8	3	1779	593.0000	701.8210	0.3121	0.6055	6.7325
9	9	6	6687	1114.5000	1979.0300	3.3084	0.7040	8.8130
10	10	15	25139	1675.9300	4503.9000	28.3059	0.8208	12.4460
11	11	28	36026	1286.6400	1773.8400	15.9761	0.9508	21.7950
12	12	61	2013006	33000.1000	875187.0000	440439.0000	0.5652	6.0291
13	18	139	278701	2005.0400	7531.4400	524.7550	0.9730	26.1377
14	20	48	80188	1670.5800	2995.8400	60.0575	0.9626	23.7932
15	21	53	77036	1453.5100	2042.6800	39.3399	0.9735	26.2749
16	23	108	308382	2855.3900	38797.6000	2991.1200	0.8742	15.0047
17	24	111	398163	3587.0500	29455.4000	2932.0100	0.9260	18.8483
18	25	93	118067	1269.5400	2976.5900	87.8591	0.9748	26.6402
19	26	4	6717	1679.2500	2505.7000	4.2077	0.6270	7.1374
20	27	1	675	675.0000	675.0000	0.1139	0.0000	0.0000
21	29	1	3828	3828.0000	3828.0000	3.6634	0.0000	0.0000
22	32	1	1022	1022.0000	1022.0000	0.2611	0.0000	0.0000
23	35	2	1577	788.5000	941.6470	0.3712	0.4029	3.7324
24	36	14	57507	4107.6400	22376.6000	321.7020	0.6109	6.8321
25	40	1	2092	2092.0000	2092.0000	1.0941	0.0000	0.0000
26	41	18	59849	3324.9400	32760.4000	490.1690	0.4526	4.3618
8-conn. Parcels:		967	4000000	4136.5049		450657.9072	0.8873	15.8036

Features:
- Summary for all objects & for all classes
- Normalized index
- Detect and measure the dominant parcellation class

Low:
Homogeneous land cover, low fragmentation, few/large land cover classes

High:
Heterogeneous land cover, Highly fragmented

Parcellation product sheet

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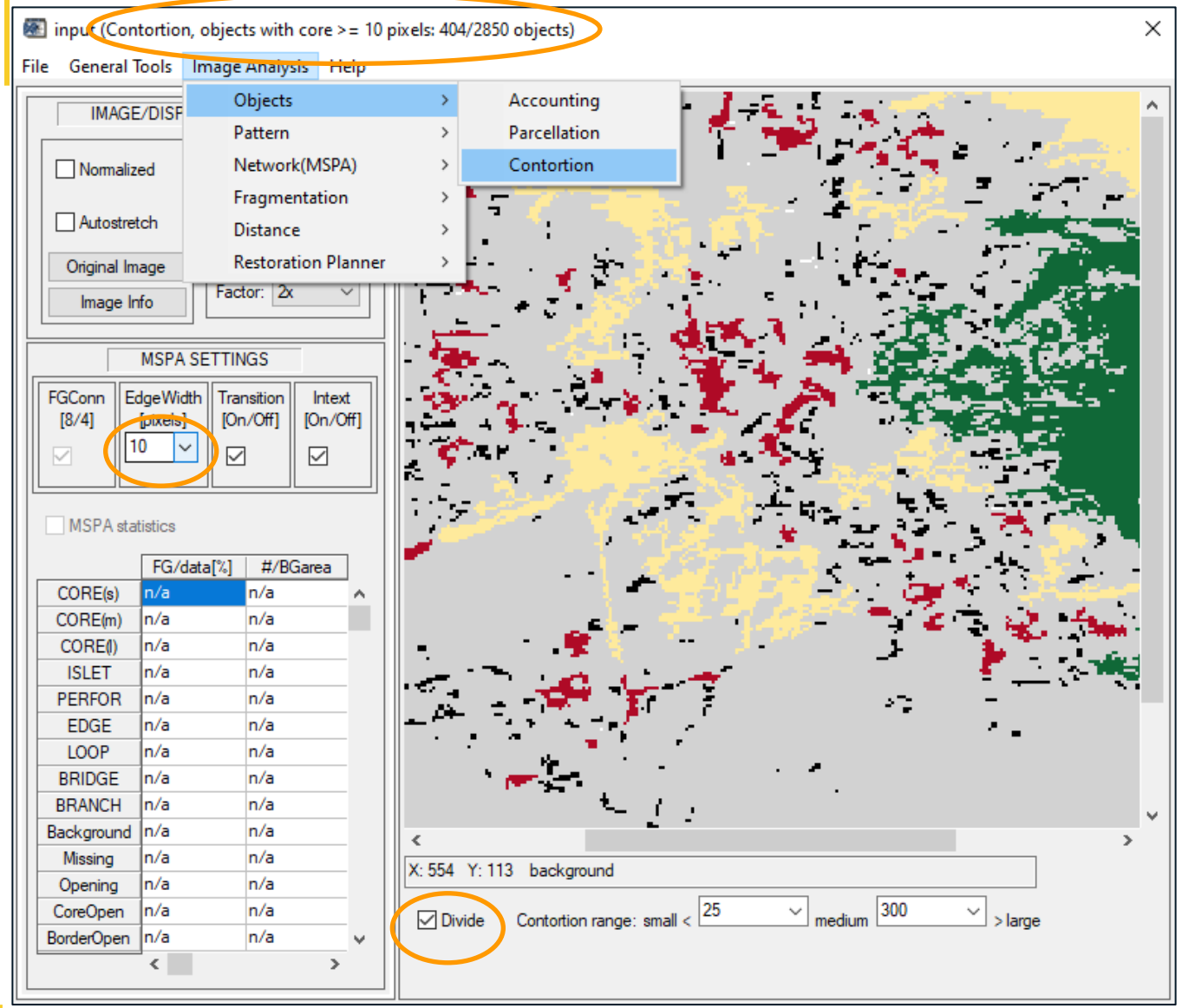
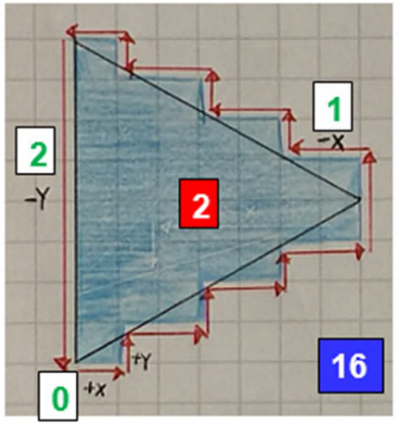
Contortion: Measure the regularity of object perimeters





Features:

Low count: regularly shaped objects (agricultural fields, buildings, etc.) Anthropogenic

High count: Natural objects

User can define minimum object size of interest & set threshold to group contortion

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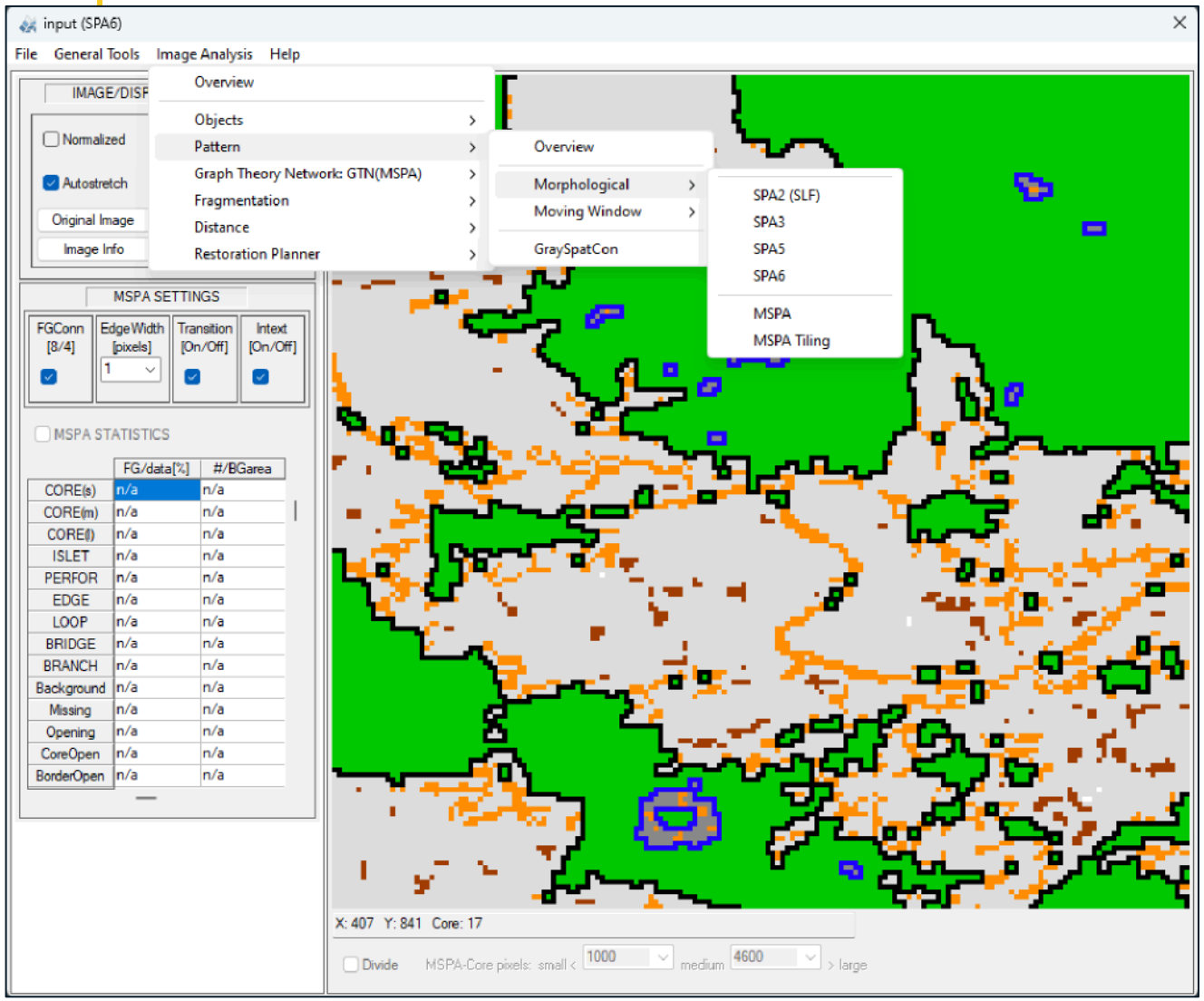
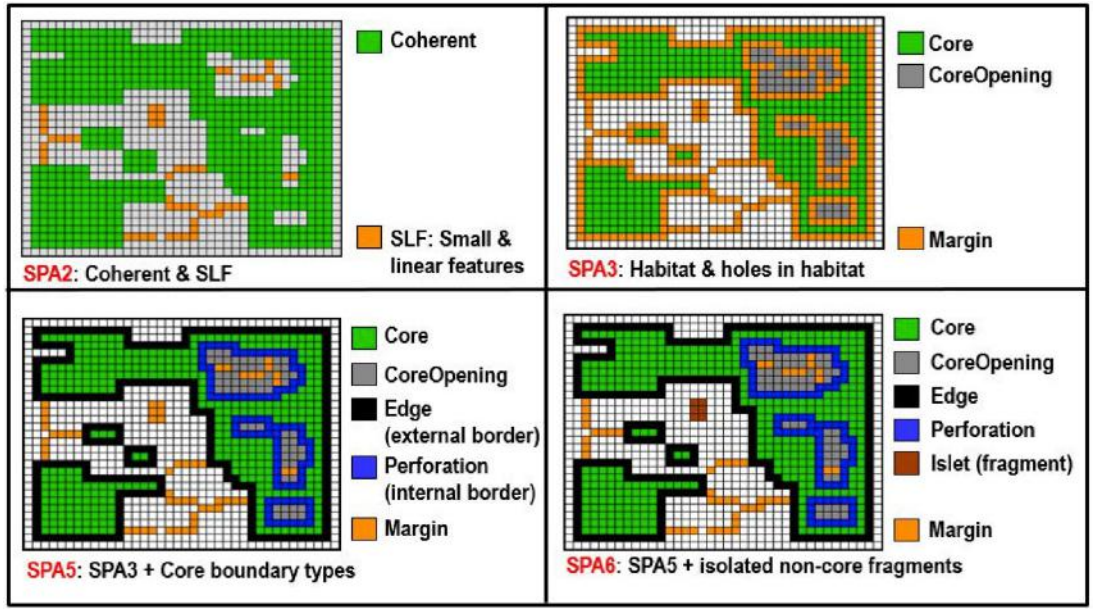
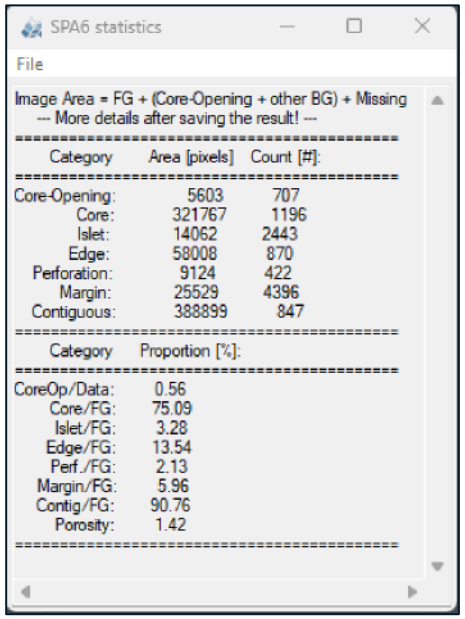
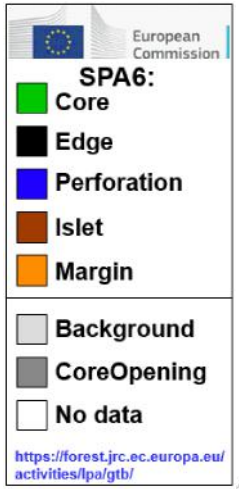
SPA2/3/5/6: Simplified Pattern Analysis in 2-6 classes including CoreOpening









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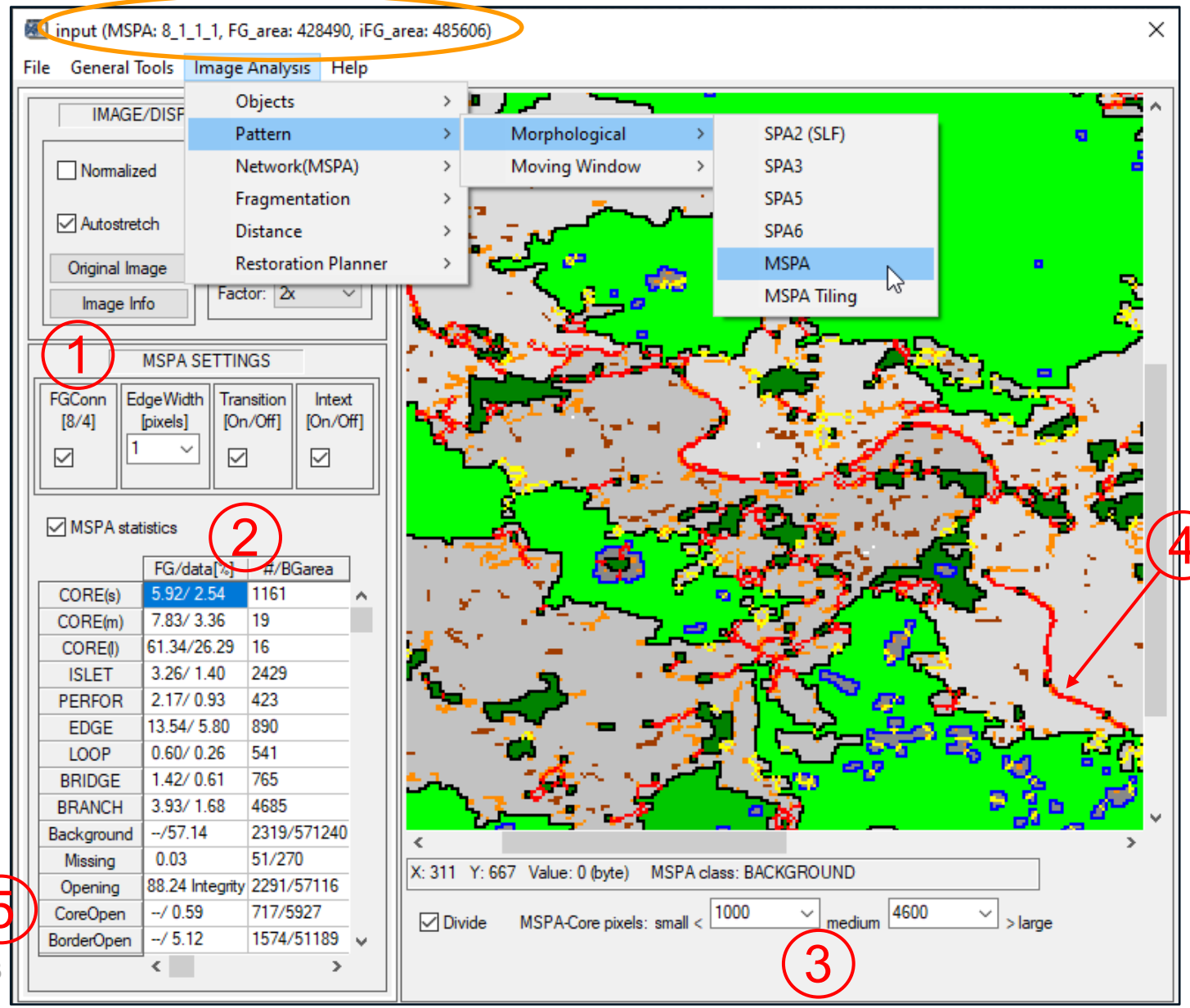
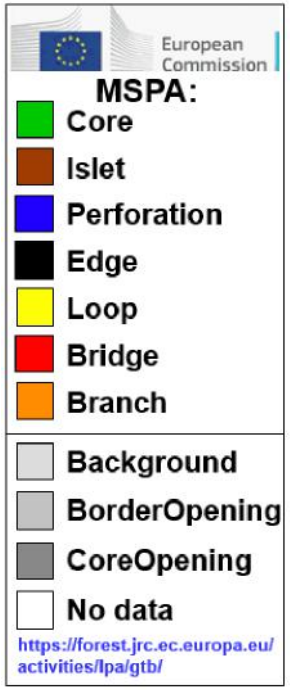
MSPA: Spatial Pattern Analysis in up to 25 classes



Features:

1. Flexible processing via four MSPA-parameters
2. Detailed statistics
3. Core grouping
4. Corridor detection (Bridge)
5. Measure area of holes

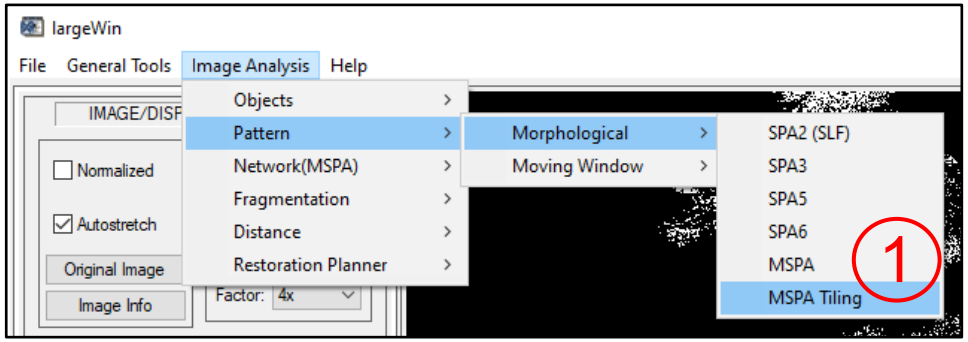


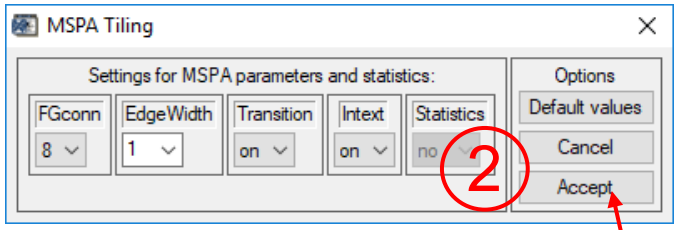
[Pattern product sheet](#)
[Pattern website](#)

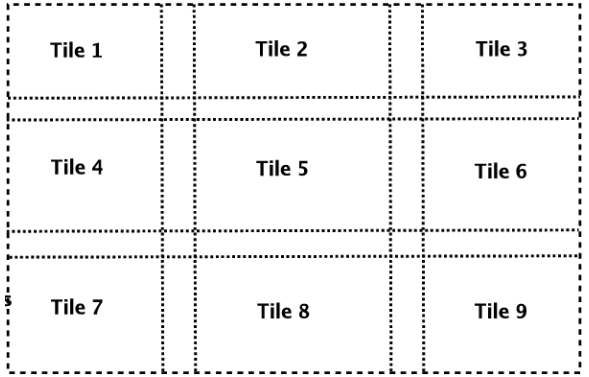
European Commission

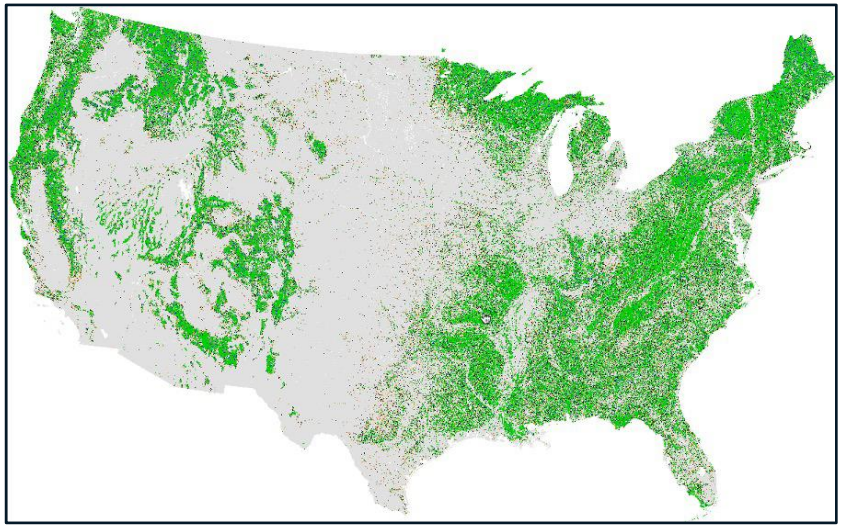
MSPA Tiling: MSPA for **large** maps. Warning: very slow & potentially incorrect!

Correct solution: use GWB MSPA when processing large maps!









1. Select geotiff input image
2. Set MSPA-parameters
3. Accept: let GTB do the job…

a) Cut buffered sub-tiles
b) MSPA loop over buffered sub-tiles
c) remove buffers and reassemble
d) save the final result as geotiff

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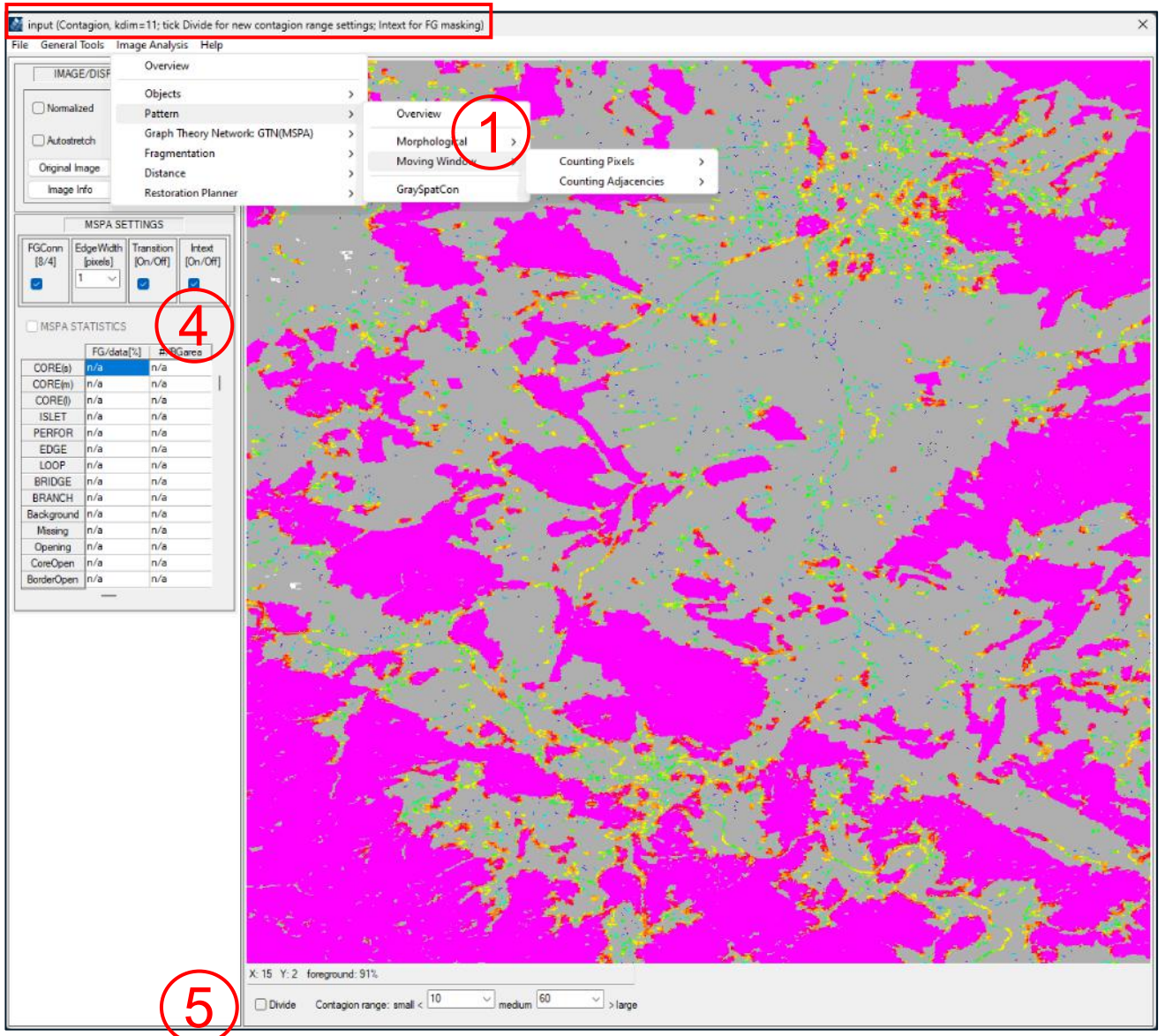
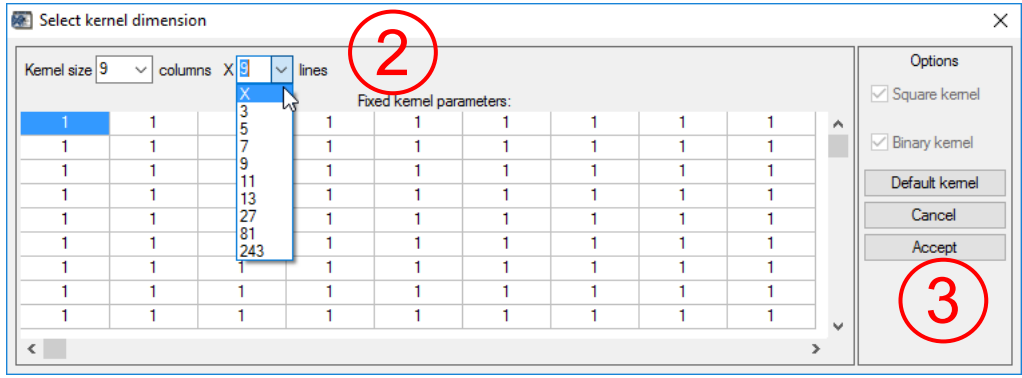
Moving Window: Various kernel filters, e.g., counting adjacencies (contagion)



Features:

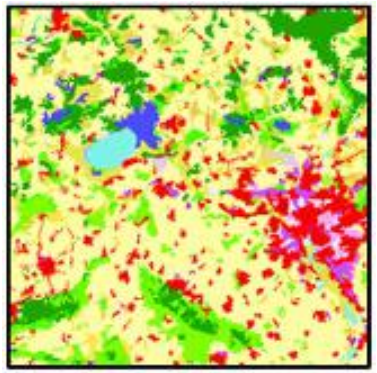
1. Select analysis type
2. Set kernel-parameters
3. Accept: start analysis



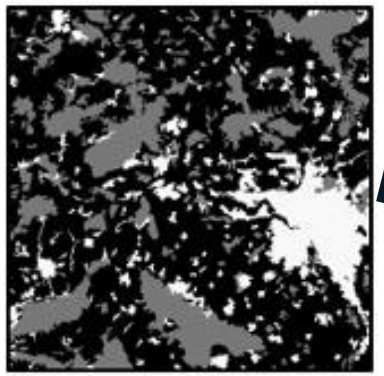
4. Mask FG-switch
5. Color-group range settings

Landscape Mosaic: Measure land cover composition and human impact

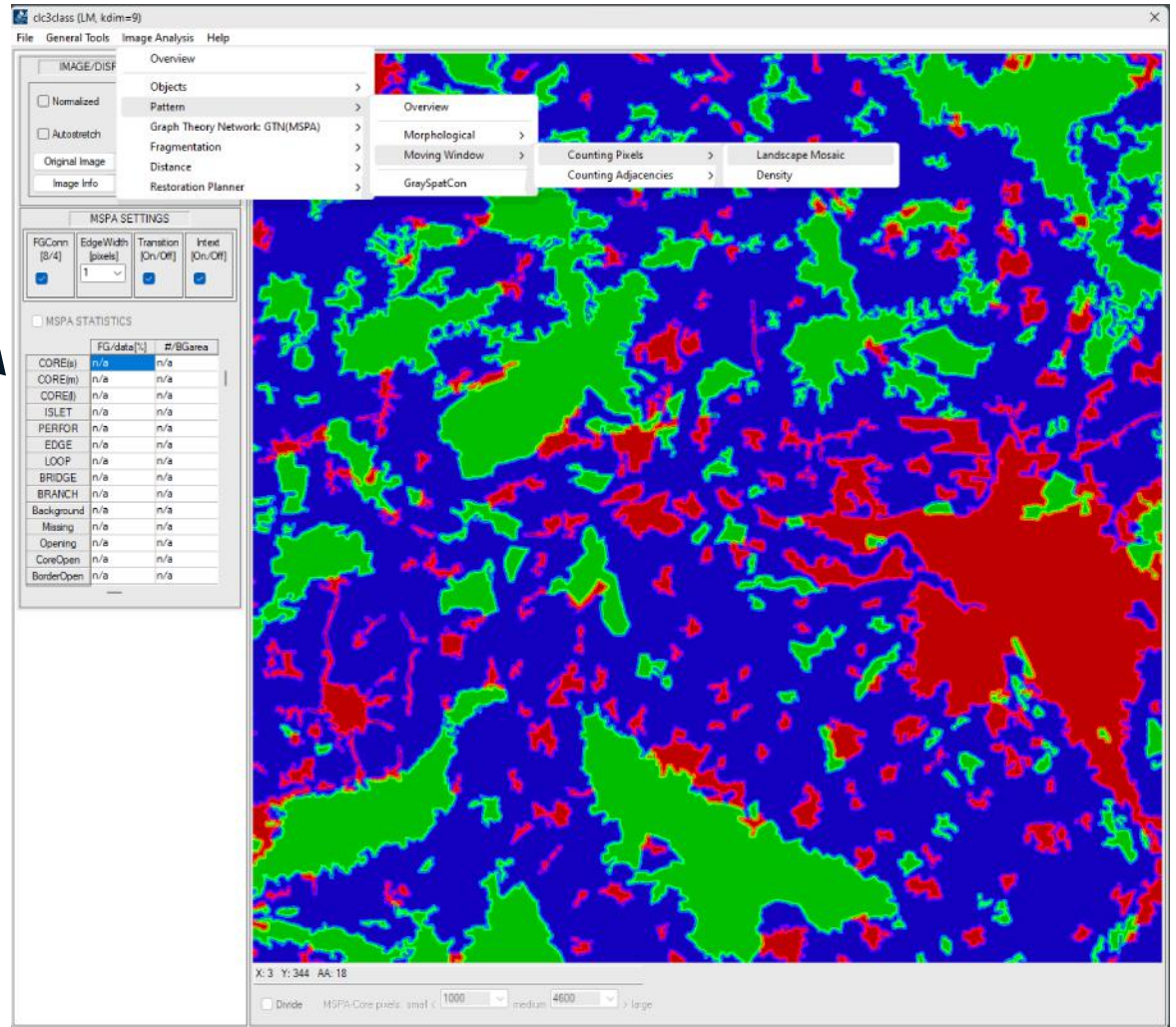
Land cover map

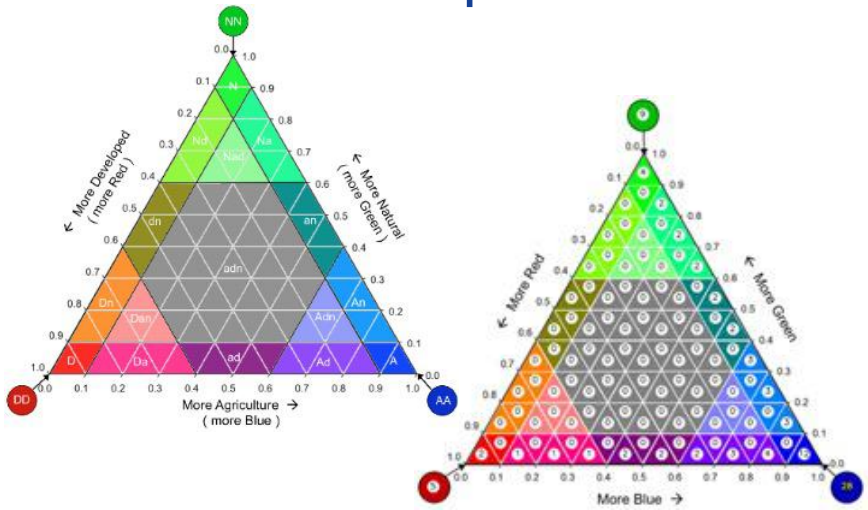


Agr./Nat./Developed



Heterogeneity in Agriculture/Natural/Developed
(at user-selected observation scale)





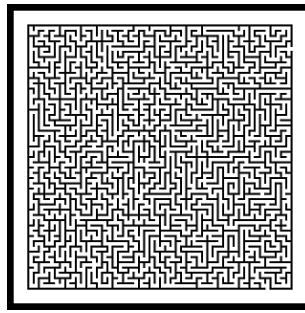
Measure composition

- Geometric concept
- Monitor & quantify influence of the three components
- Heatmap summary

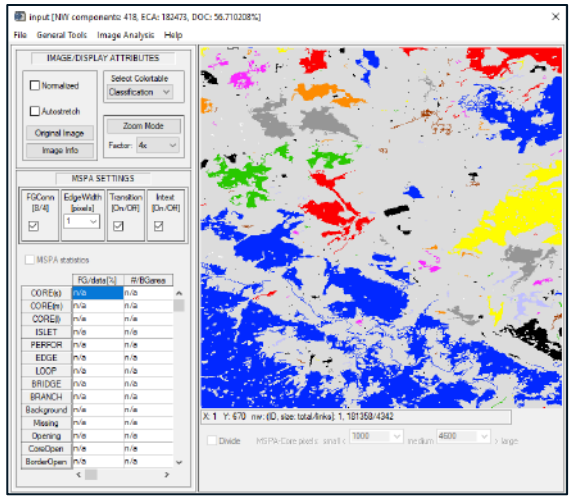
LM product sheet
LM paper

European Commission

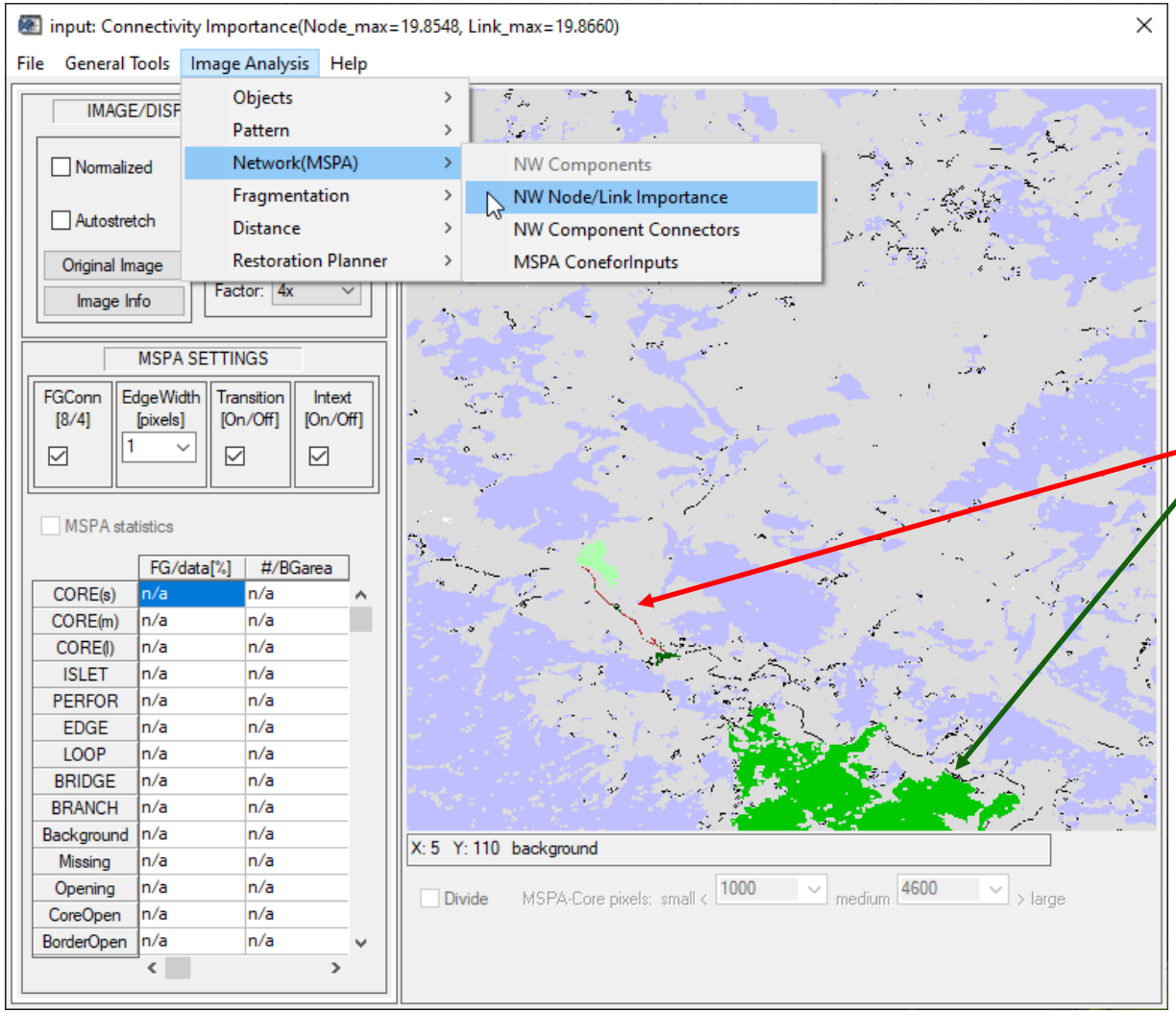
Network: NW-components; importance of connectors and habitat patches…



NW-components



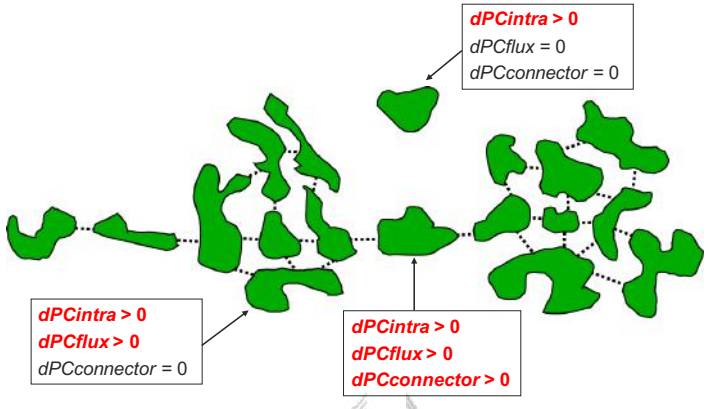
Node/Link-importance



- Use MSPA to detect habitat patches/corridors

- Conversion to Nodes & Links

- Use graph theory to rank and locate the most important corridors and habitats in the current network (highest priority for protection/conservation)



Additional options:

- Component connectors
- Setup input data for graph-theory analysis e.g., in Conefor

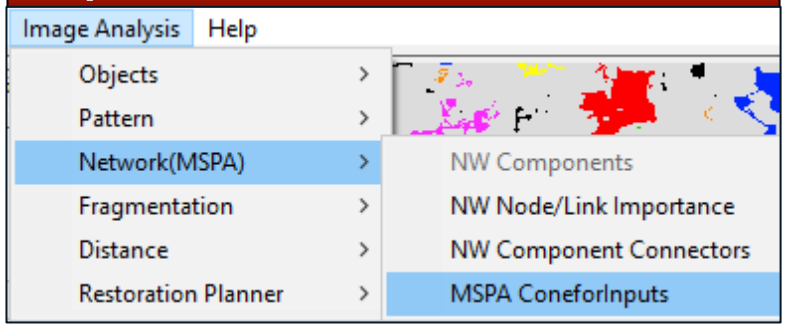
MSPA+Network analysis paper

European Commission

3. Image Analysis → Network

Graph theory: Requires two tables*: Nodes & Links.* You have 2 options in GTB:

1.) MSPA ConeforInputs

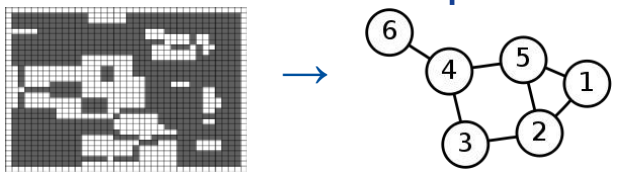


Connectivity: defined by MSPA

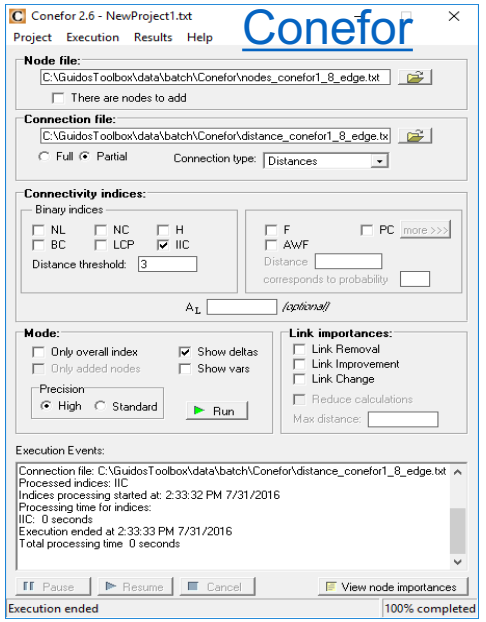
Nodes = MSPA-class Core

Links = MSPA-class Bridge

MSPA → Graph Theory



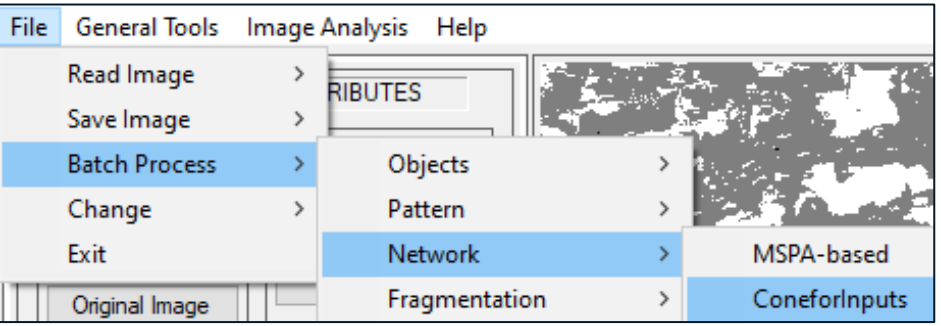
Conefor

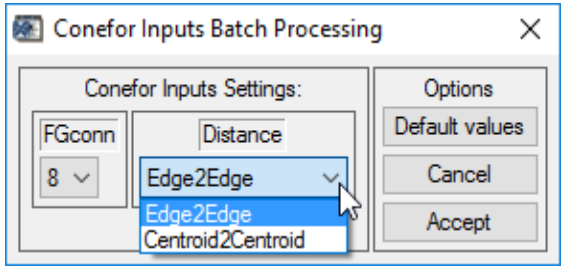


Input image: MSPA image

2.) ConeforInputs

Connectivity: defined by Euclidean distance threshold



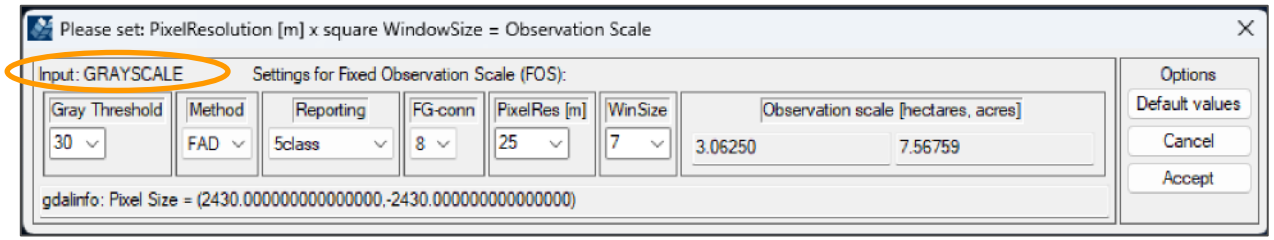


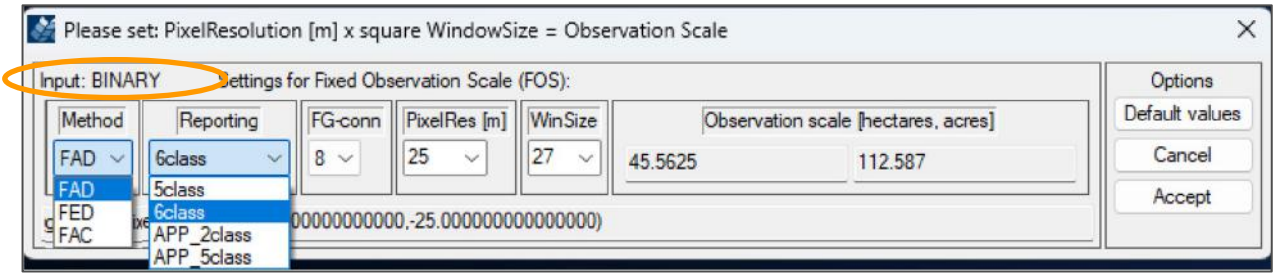
Additional options:
- Select FG-connectivity
- Select distance type
- Accept: write out input tables for graph-theory analysis in Conefor

Input image: raster image with network objects assigned to 2 byte

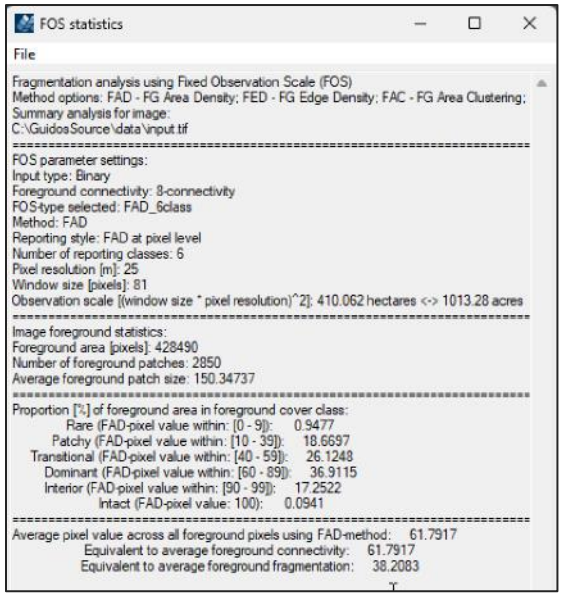
Fragmentation: Choose from indices to map products to multiscale analysis…

1) Select type of input, method, reporting, scale, etc.





2) Resulting map and statistics showing the degree of fragmentation in 2-6 classes for the selected observation scale.



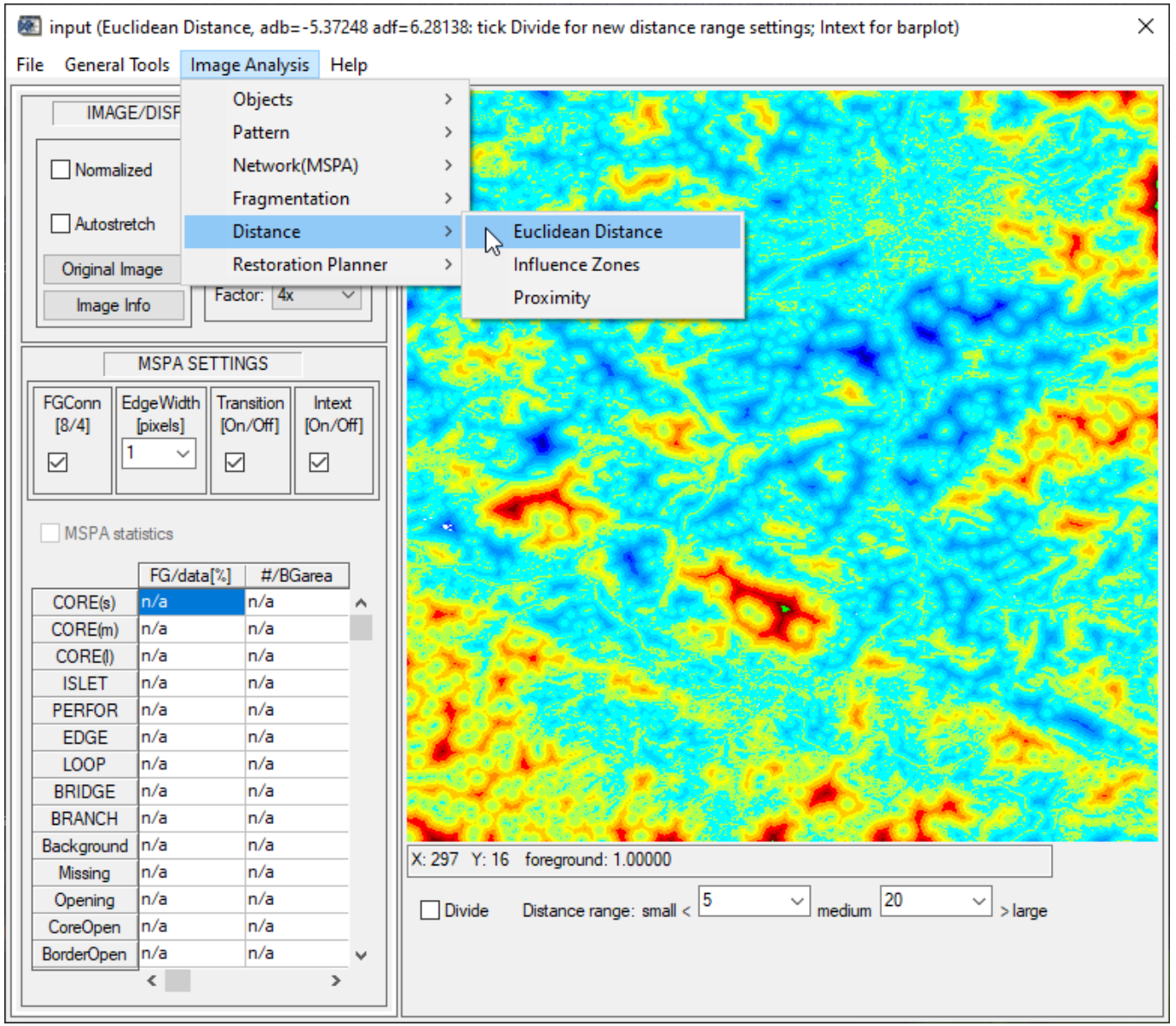
[Binary vs grayscale paper]
[Fragmentation product sheet]

European Commission

Euclidean: Pseudo elevation map showing shortest distance to FG/BG boundary

Distance [m]

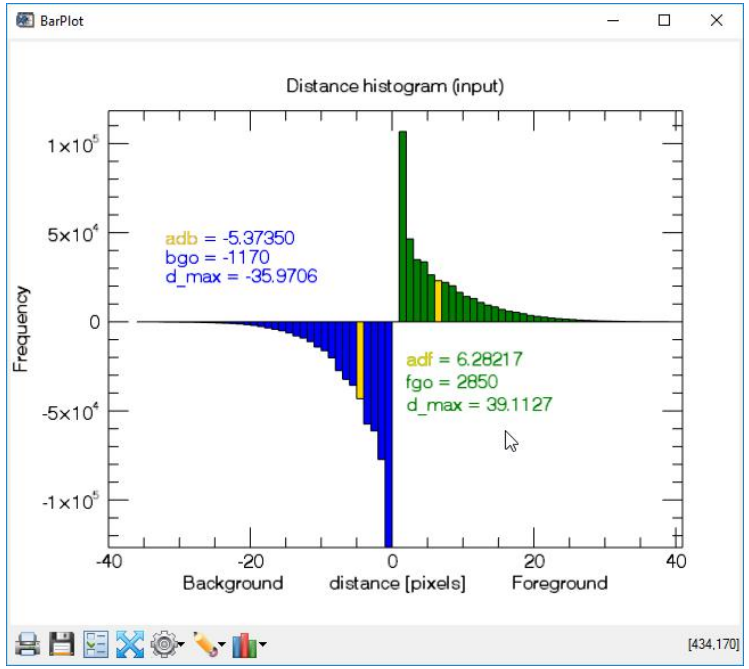
- [4500 → 5000]
- [4000 → 4500]
- [3500 → 4000]
- [3000 → 3500]
- [2500 → 3000]
- [2000 → 2500]
- [1500 → 2000]
- [1000 → 1500]
- [500 → 1000]
- [0 → 500]
- −[0 → 500]
- −[500 → 1000]
- −[1000 → 1500]
- −[1500 → 2000]
- −[2000 → 2500]
- −[2500 → 3000]
- −[3000 → 3500]
- −[3500 → 4000]
- −[4000 → 4500]
- −[4500 → 5000]



- Locate compact habitat

- Distance to habitat boundary

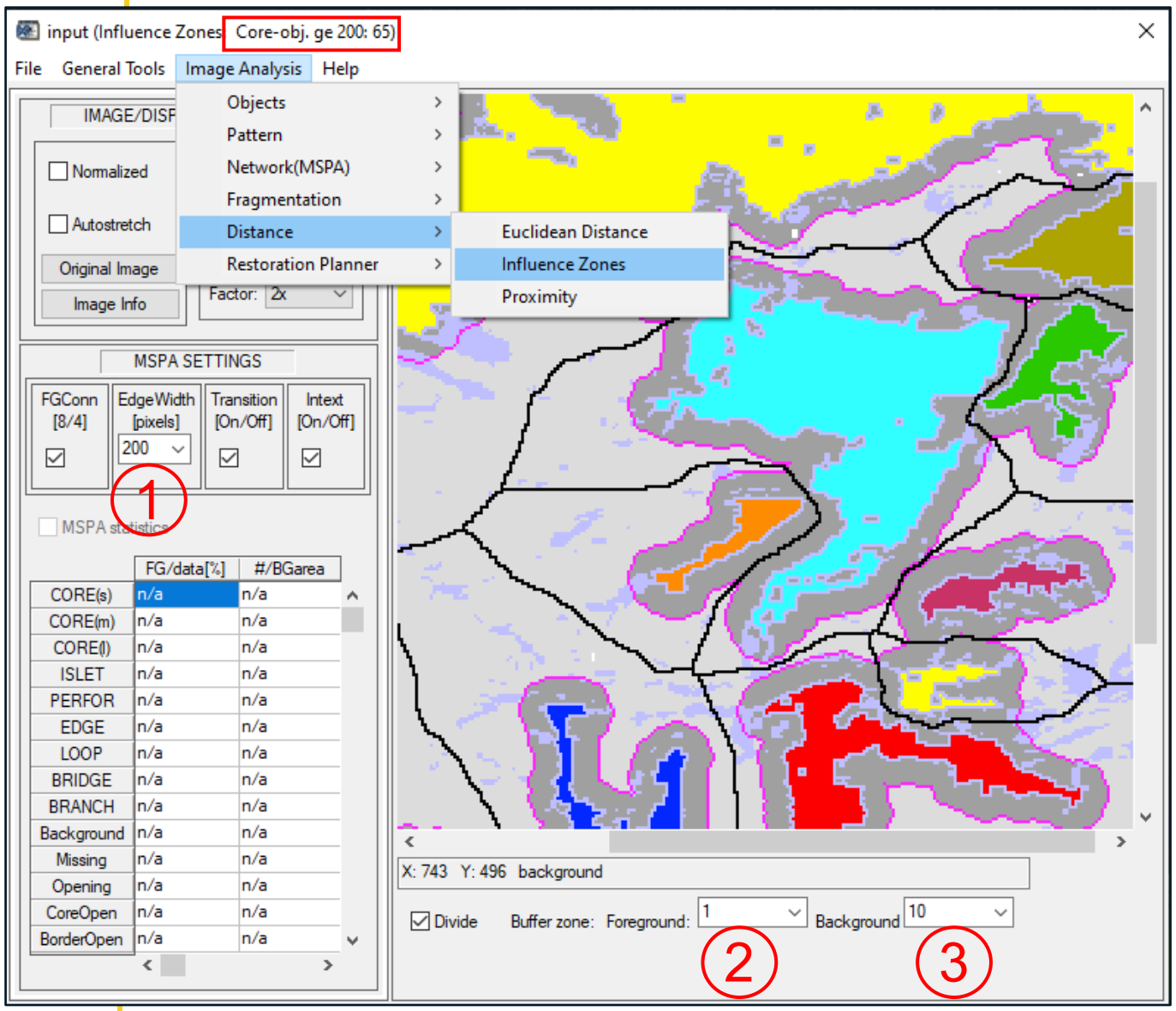
- Hypsometric curve summary



Distance product sheet

European Commission

Influence Zones: Distance between selected objects



Features:

1. Select minimum object area of interest
2. Set FG-buffer to define Core objects
3. Set BG buffer for Outreach Zone

— Watershed: equal distance between neighboring objects)

Neglected:
- object < min. object area, or
- buffer into foreground (2)

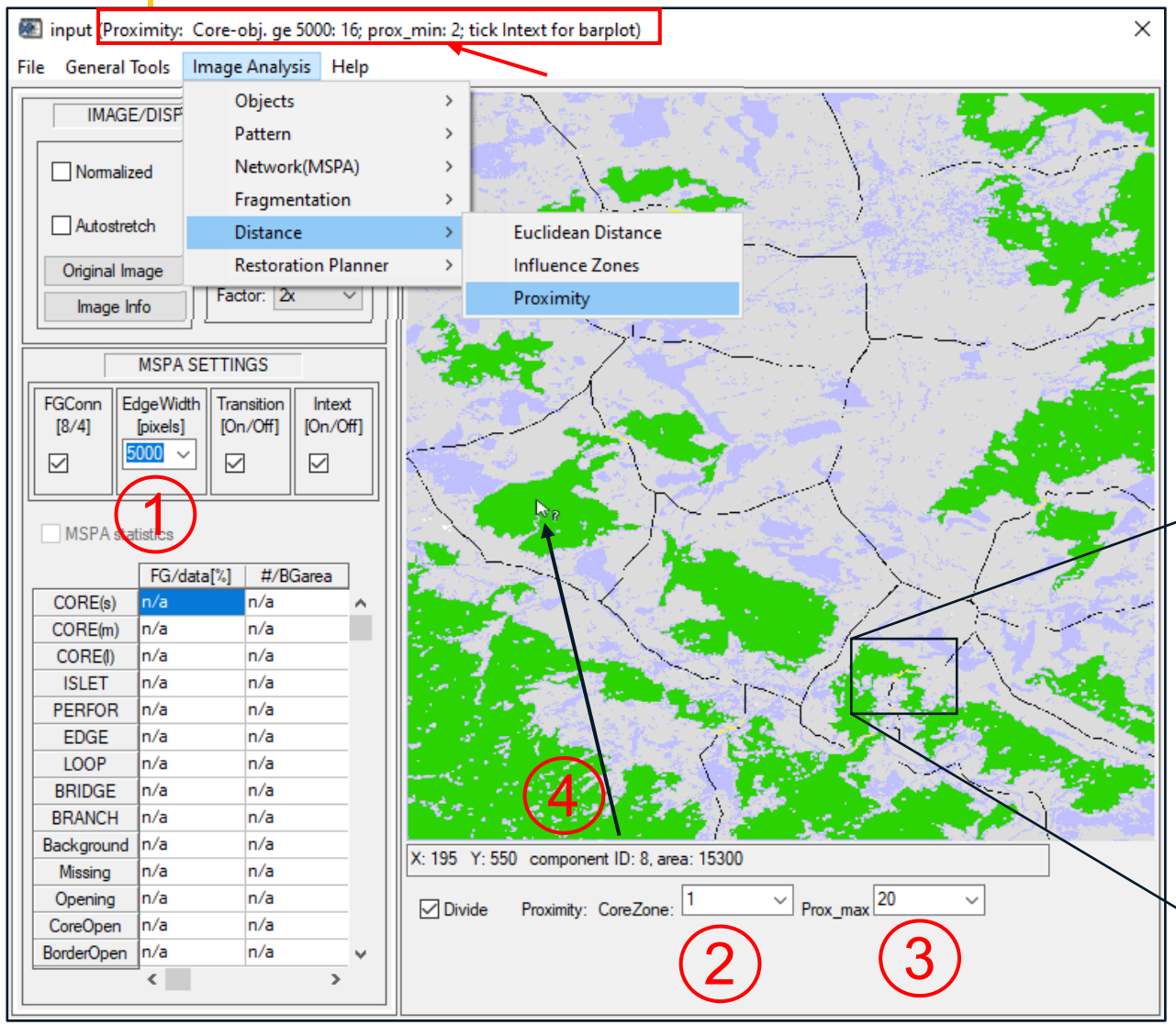
Outreach Zone into background (3)

— Outreach Zone boundary

European Commission

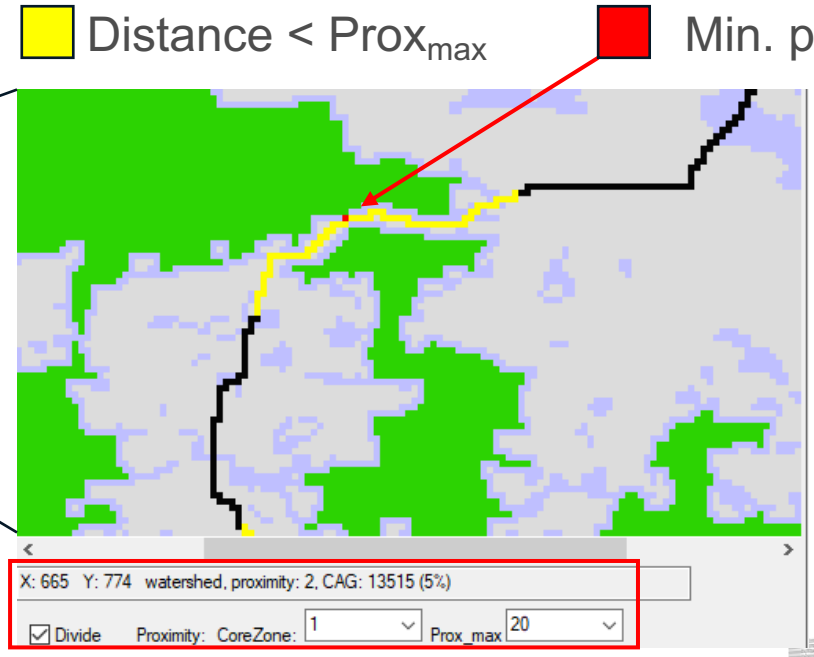
3. Image Analysis → Distance

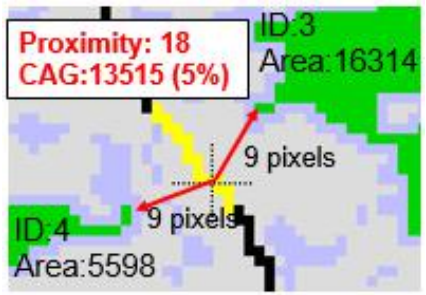
Proximity: Locations where pairwise distance < X (restoration planning)



Features:

1. Select minimum object area of interest
2. Set FG-buffer to define Core objects
3. Set proximity threshold
4. Mouseover component ID/area
5. Mouseover watershed: proximity between neighb. components and Connected Area Gain (CAG)





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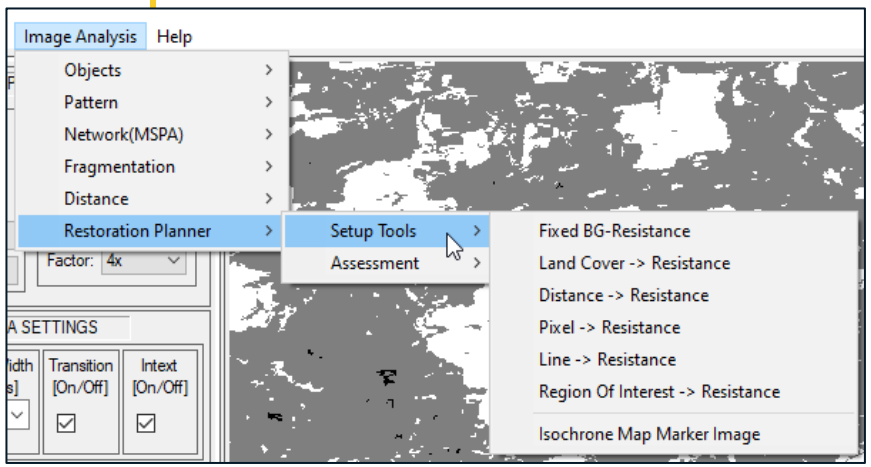
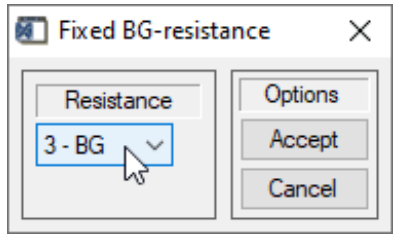
3. Image Analysis → Restoration Planner

Setup Tools: Guided help to define resistance or marker maps

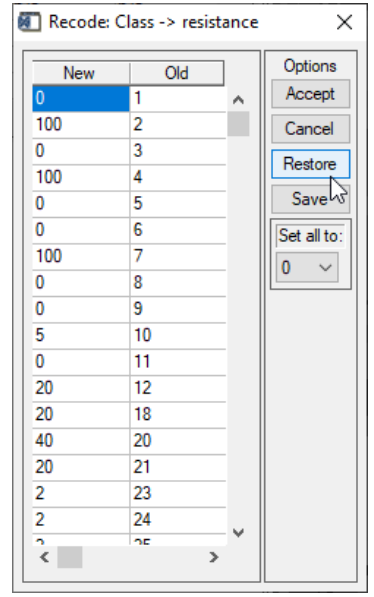


Resistance [%]: proxy for restoration effort



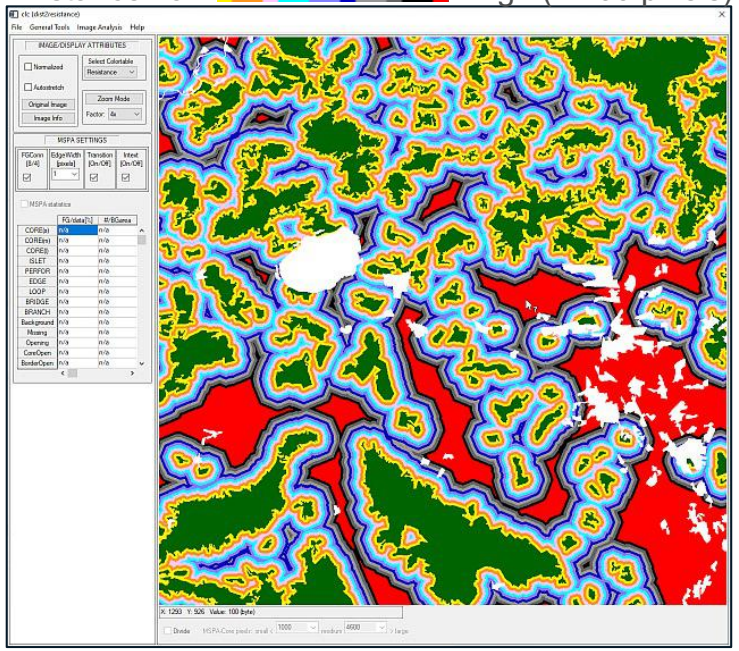
Fixed BG-Resistance: assign a constant resistance value to all background pixels:

Land Cover → Resistance: assign or reclassify land cover class-specific resistance values:



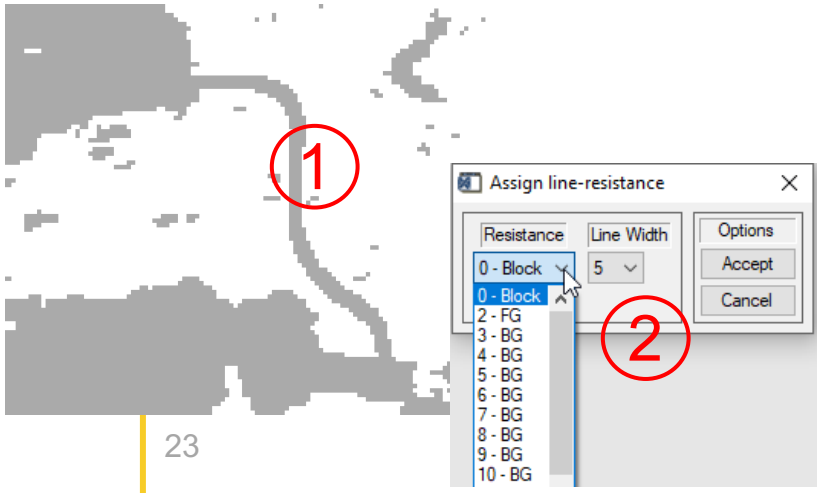
Distance → Resistance: ~ distance from FG-objects (birds/flying insects):

Distance: low  High (≥ 100 pixels)

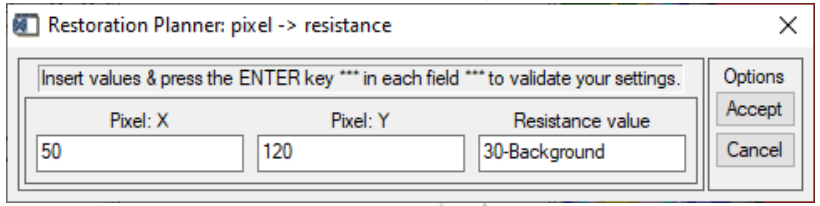


Line → Resistance:

1) draw a freehand or straight line
2) assign width/resistance value



Pixel → Resistance: assign custom resistance value to a given pixel:



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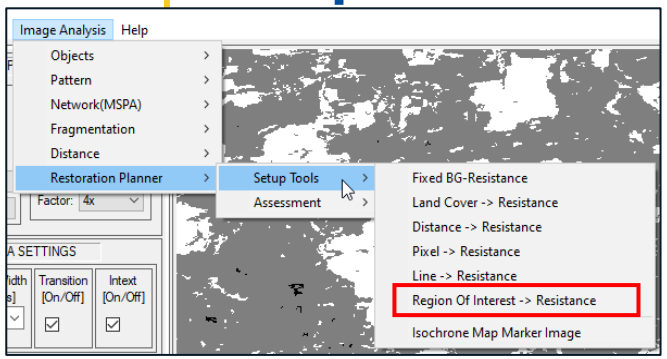
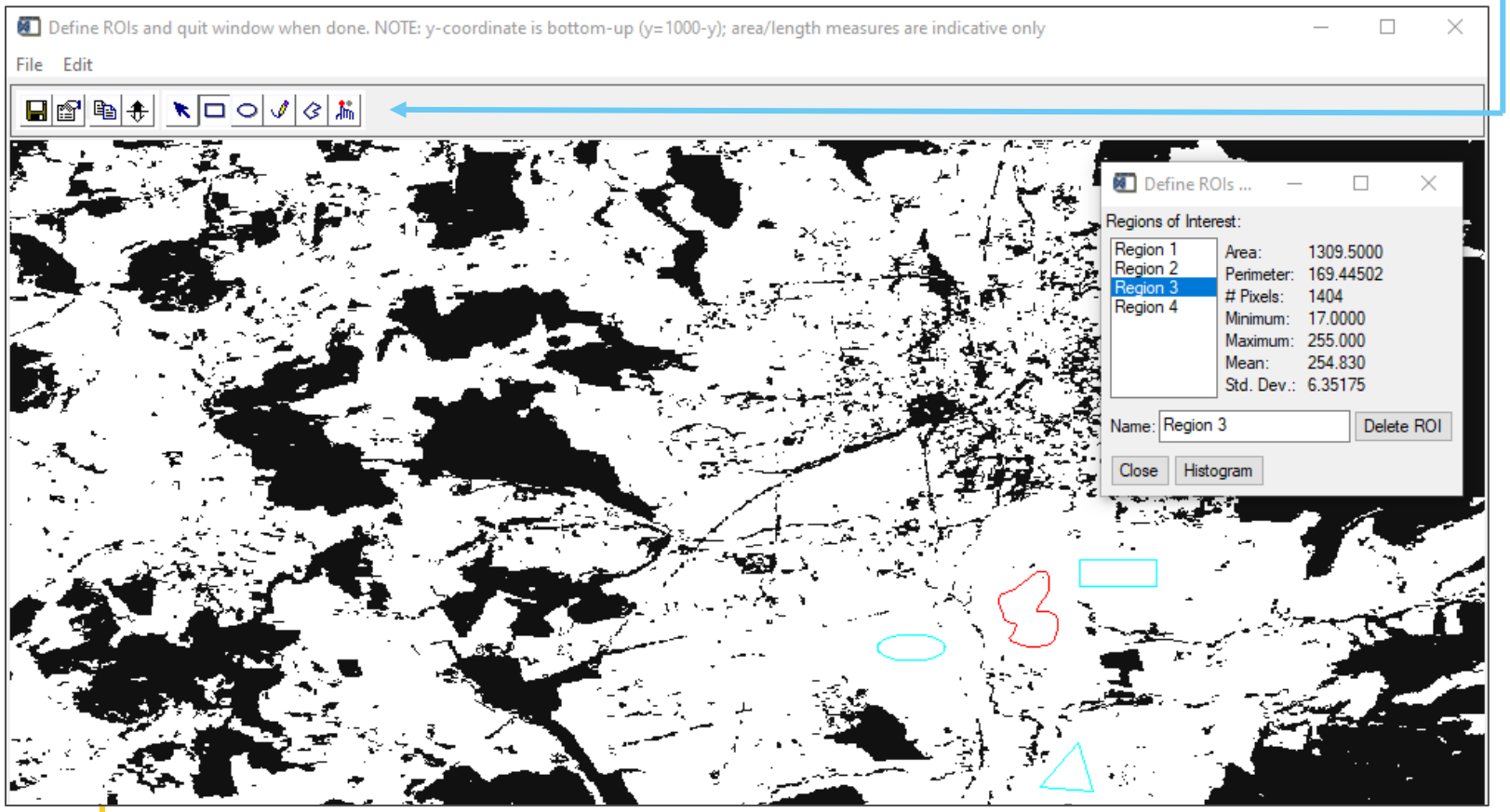
Setup Tools: Guided help to define resistance or marker maps



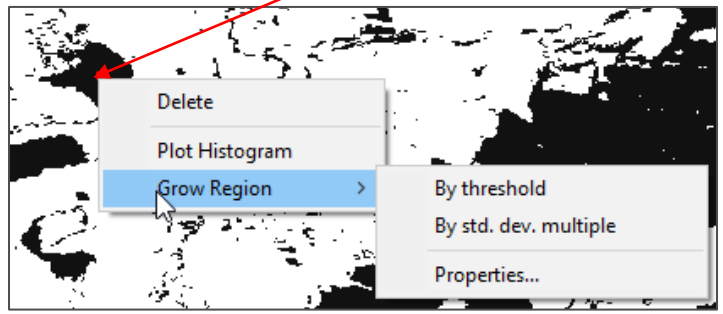
Region Of Interest (ROI) → Resistance:

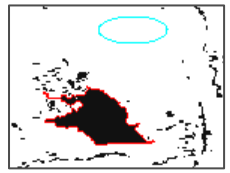
assign resistance values to custom regions:



ROI Selection Tool features:

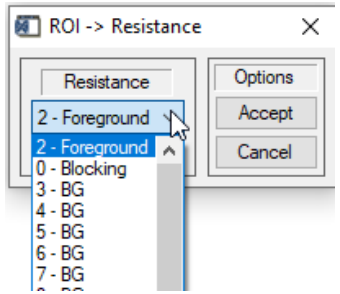
- Add new ROI: rectangular, oval, freehand, or polygon
- Shift or warp the shape of a ROI
- Region Growing to select irregular feature: setup a small Marker, then right-click on it for region growing





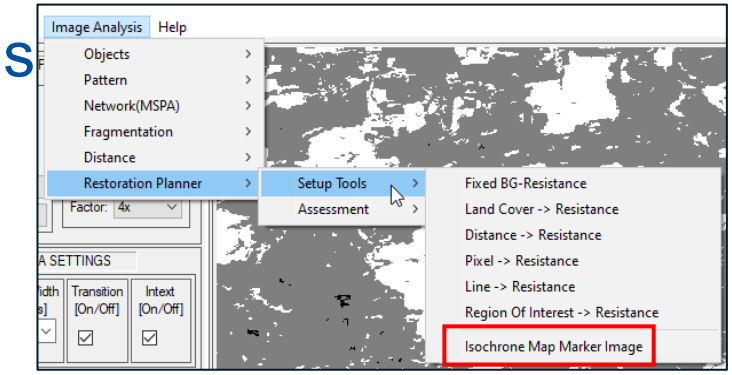
Irregular feature is selected

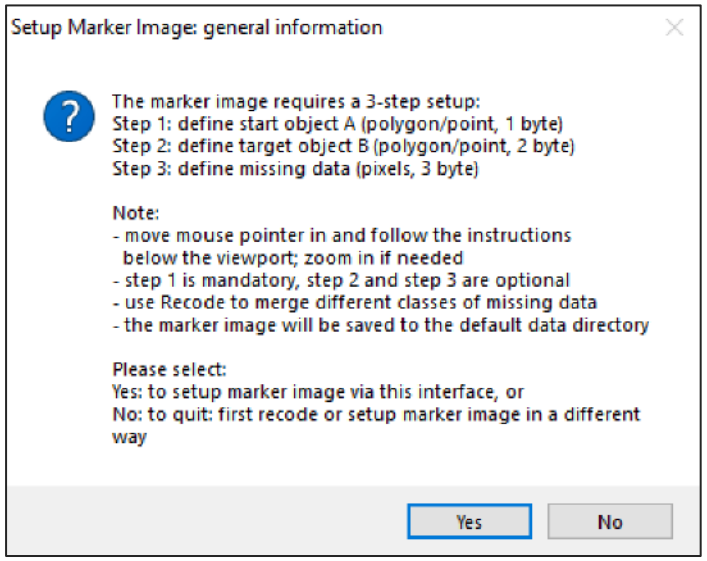
- Close window & assign resistance for all ROIs:



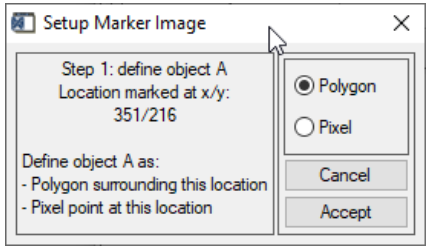
European Commission

Setup Tools: Set start/target object for travel time analysis

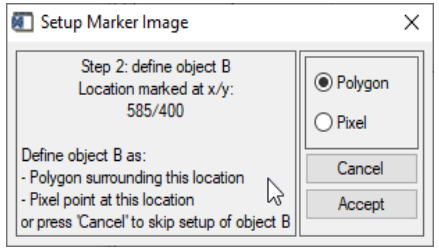




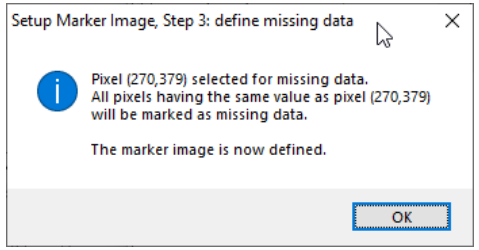
1) Click Start object & press Enter key:



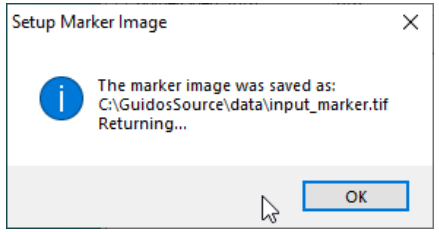
2) Click Target object & press Enter key (optional):



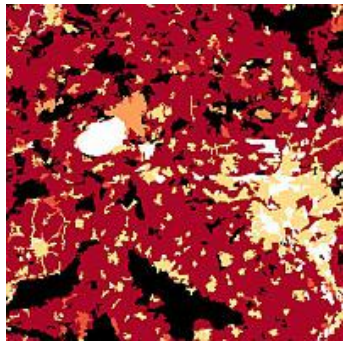
3) Click specific pixel & press Enter key to define missing data (optional):

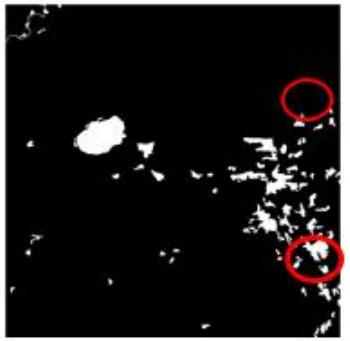


Marker Image is saved for travel time analysis:

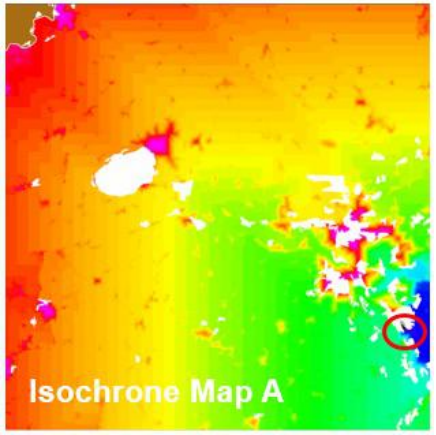


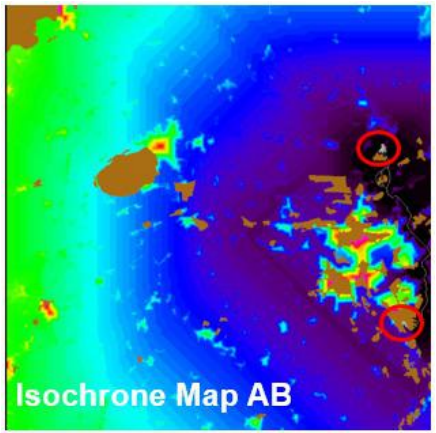
Resistance Map + Marker Map





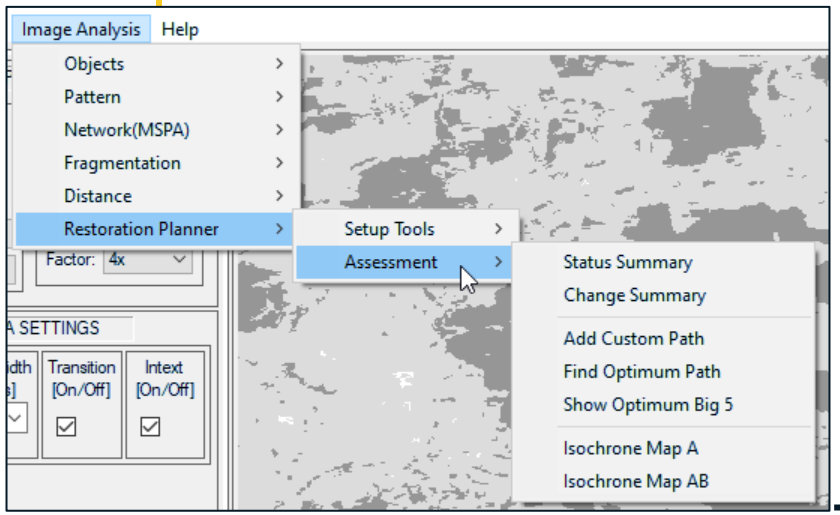
Isochrone Map A or Isochrone Map AB





European Commission

Assessment: Network status summary and evaluate restoration efficiency



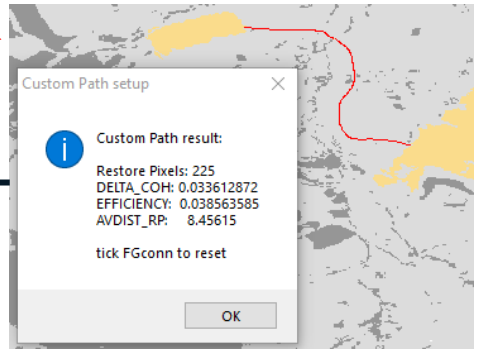
Status Summary: including reachable area (ECA) and overall Coherence [%].

	A	B	C	D	E	F	G	H	I
1	FNAME	AREA	RAC[%]	NR_OBJ	LARG_OBJ	APS	CNOA	ECA	COH[%]
2	fm00.tif	304837	47.505411	3952	247536	77.134868	1188516	247829.13	81.298902
3	molise_80.tif	131321	29.568011	266	42565	493.68797	41423	48469.757	36.909372
4	montana.tif	533462	26.025076	32	355485	16670.688	882233	358898.55	67.277247

Change Summary: gain in **Δ** ECA and **Δ** Coherence.

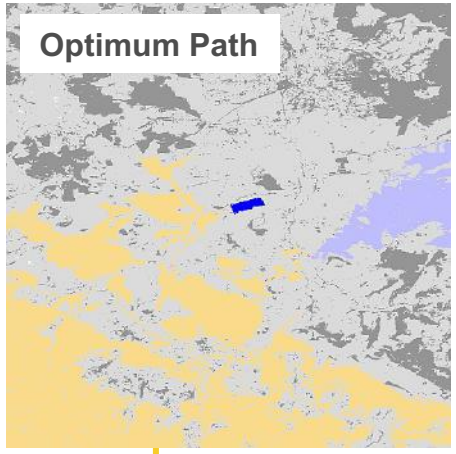
	A	B	C	D	E	F	G	H	I	J
1	REST_PIX	AVDIST_RP	EXP_3	EFFIC	ECA_ORIG	ECA_NEW	DELTA_ECA	COH_ORIG	COH_NEW	DELTA_COH
2	359	8.293	1077	23.46145	221292.76	246560.74	25267.982	51.644789	57.493603	5.8488133

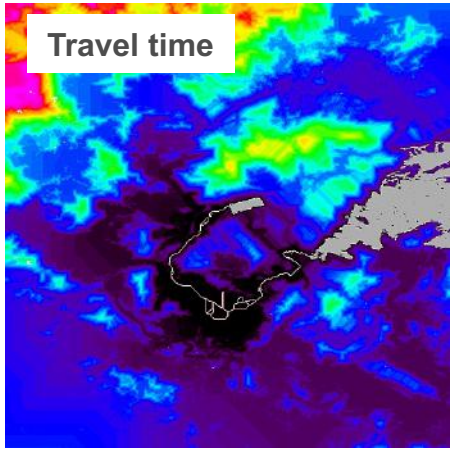
Custom Path: ***I want this path.***
- Draw *Freehand* or *Straight Line* path (1 pixel width)
- Instantly get restoration path statistics



Optimum Path: ***I want the optimum path between two objects of my choice.***
- Interactively select Start & Target object
- Get LCP + cost surface between 2 objects

	A	B	C	D	E	F	G	H	I	J	K	L
1	SIZE_A	SIZE_B	REST_PIX	AVDIST_RP	EXP_30	EFFIC	ECA_ORIG	ECA_NEW	DELTA_ECA	COH_ORIG	COH_NEW	DELTA_COH
2	1451	33508	65	1.80456	1950	24.151311	221292.76	268387.81	47095.056	51.644789	62.626224	10.981435





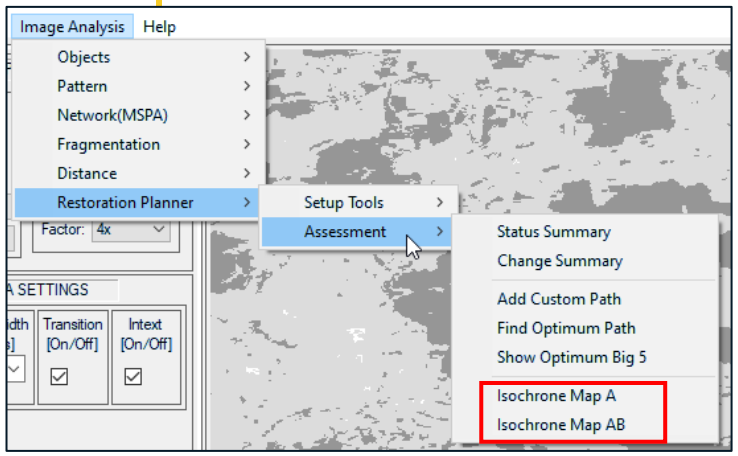
Optimum Big 5: ***best pairwise path between the 5 largest objects***

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	RESTORE	SIZE_A	SIZE_B	REST_PIX	AVDIST_RP	EXP_30	EFFIC	ECA_ORIG	ECA_NEW	DELTA_ECA	COH_ORIG	COH_NEW	DELTA_COH
2	1 <-> 2	214811	33508	18	2.14992	540	90.476013	221292.76	270149.8	48857.047	51.644789	63.044285	11.3995
3	1 <-> 3	214811	26366	43	1.24715	1290	34.731307	221292.76	266096.14	44803.386	51.644789	62.094668	10.4499
4	1 <-> 4	214811	14983	8	1.20711	240	131.12431	221292.76	252764.99	31472.233	51.644789	58.988605	7.34382
5	1 <-> 5	214811	13850	2	1.41421	60	217.68263	221292.76	234353.72	13060.958	51.644789	54.69267	3.04788
6	2 <-> 3	33508	26366	23	4.66506	690	5.8013699	221292.76	225295.7	4002.9452	51.644789	52.576165	0.931376
7	2 <-> 4	33508	14983	61	1.79058	1830	35.133502	221292.76	285587.07	64294.309	51.644789	66.640159	14.9954
8	2 <-> 5	33508	13850	56	1.85377	1680	27.135228	221292.76	266879.94	45587.183	51.644789	62.275681	10.6309
9	3 <-> 4	26366	14983	41	1.239	1230	2.6203955	221292.76	224515.84	3223.0865	51.644789	52.391973	0.747183
10	3 <-> 5	26366	13850	40	1.23462	1200	2.5434958	221292.76	224344.95	3052.195	51.644789	52.352216	0.707427
11	4 <-> 5	14983	13850	5	1.08284	150	9.9899756	221292.76	222791.25	1498.4963	51.644789	51.993898	0.349109

Restoration planner product sheet

European Commission

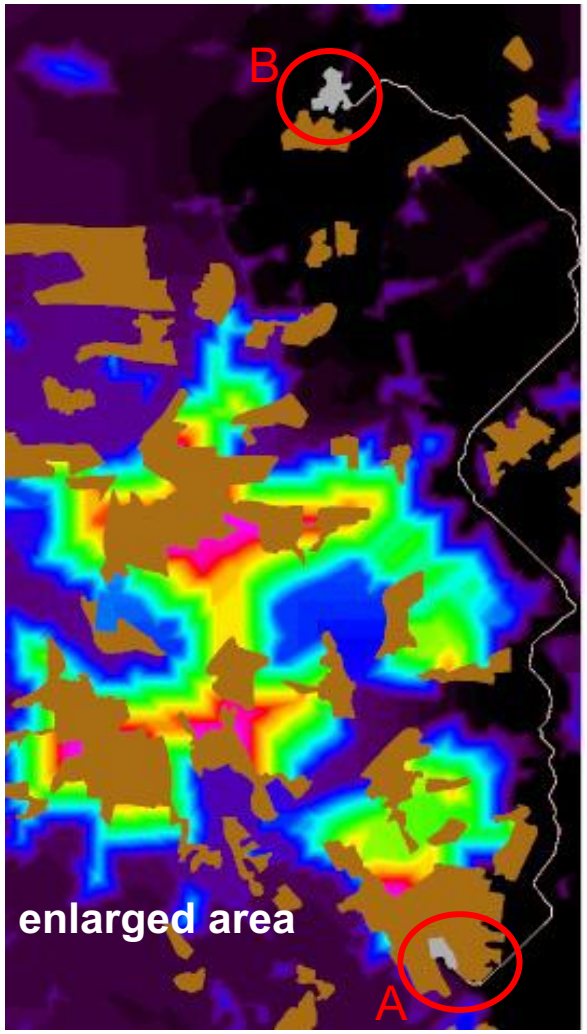
Assessment: Network status summary and evaluate restoration efficiency



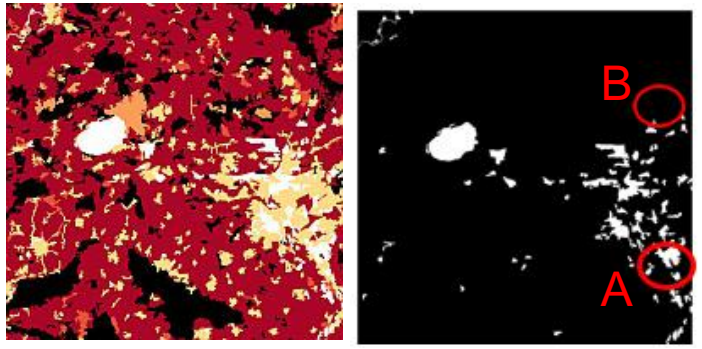
Isochrone map: show the travel time (TT) map.

- **Isochrone Map A:** TT map from object A
- **Isochrone Map AB:** TT map (A) + TT map(B) = cost surface + optimum path (A↔B)

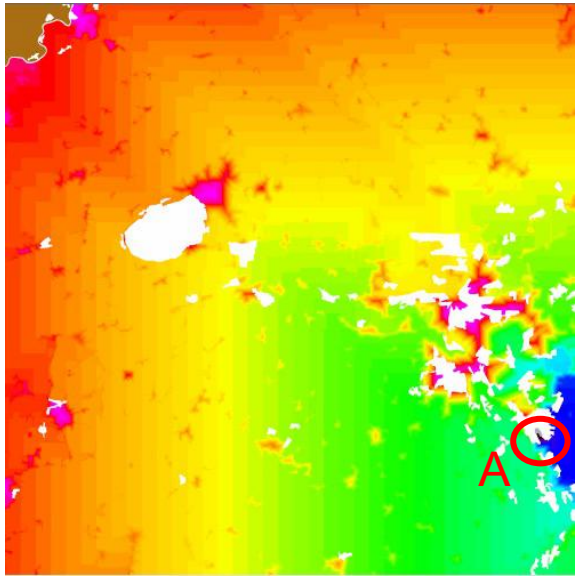
TT Map: Evaluate local resistance fields → guidance in restoration/conservation planning.



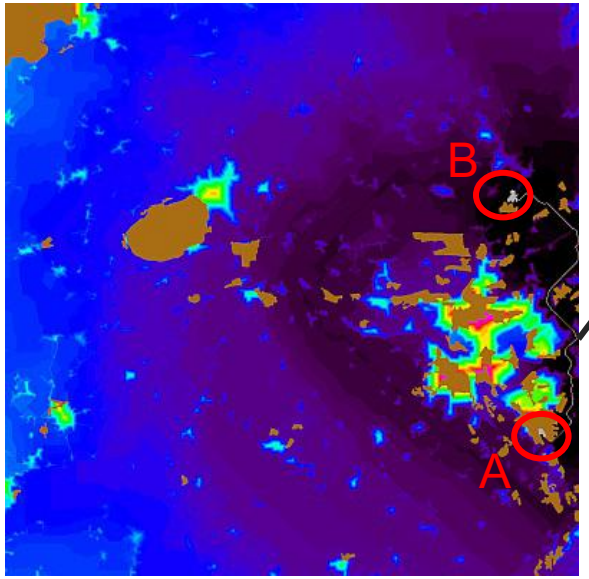
Resistance Map + Marker Map →



Isochrone Map A



Isochrone Map AB



low high

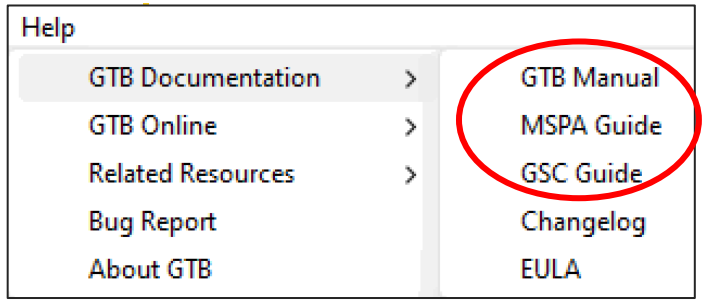
Least Cost Path

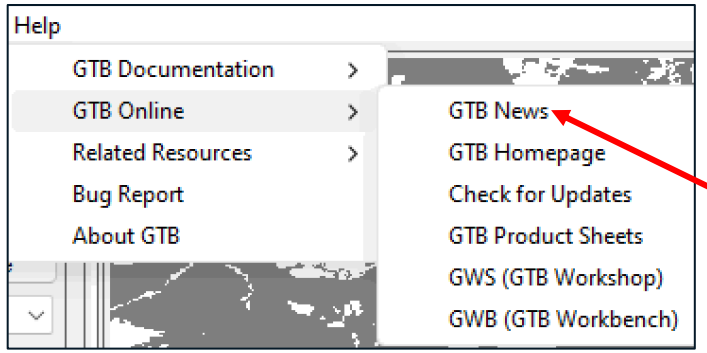
☐ blocking, i.e. water

■ unreachable

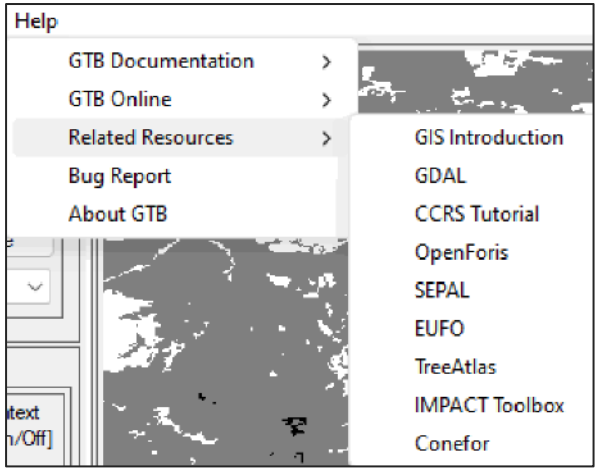
European Commission

Help: GTB documentation, GTB and other related online resources, bug report template

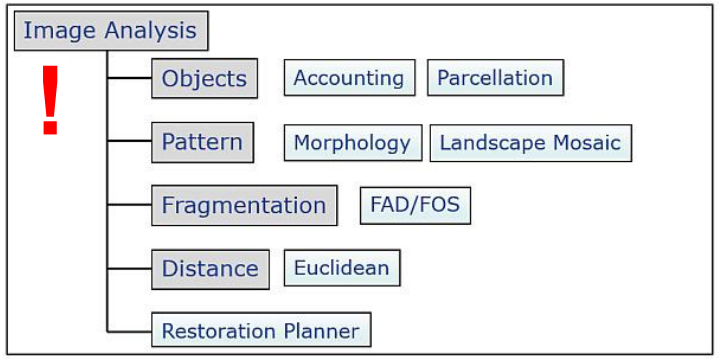


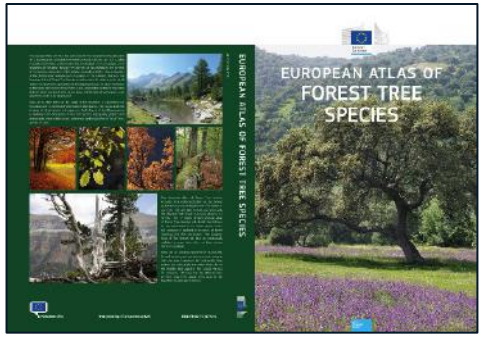


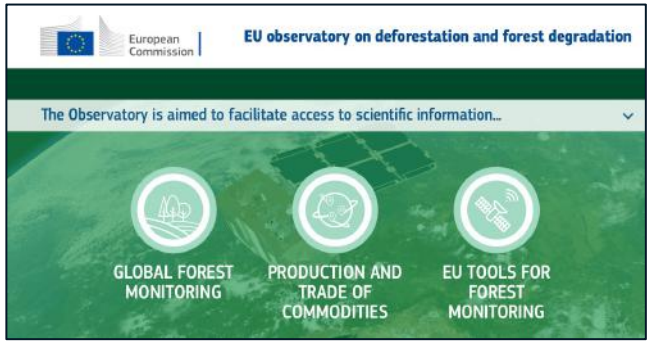
latest news …

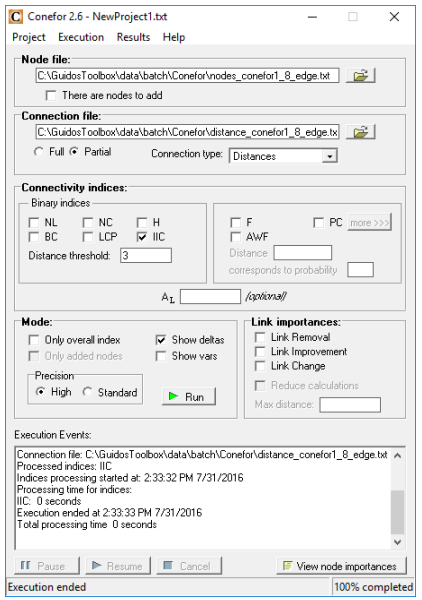


The GTB Product Sheets:









European Commission

Thank you

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