User's Guide for Maximum Inscribed Circle (MICGIS) Plugin (version 1.2.0)

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1st version of the user's guide
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About the Plugin

Maximum Inscribed Circle plugin developed for OpenJUMP is designed to delimit Maximum Inscribed Circle (MIC) that can be placed within a polygon. It is based on the MICGIS algorithm developed by Beyhan, Güler and Tağa (2020)[1]. Some minor improvements are also introduced. MICGIS algorithm performs an initial approximation of the medial axis (MA) of the polygon by using the Voronoi diagrams created for the points located along the polygon, and subsequently, makes use of the analytical/geometrical properties of the polygon, its edges and the vertices of approximate MA in conjunction with their general spatial configuration in order to delimit MIC of the polygon. In this process, MICGIS also benefits from the solutions proposed for the special cases of Apollonius' Problem.

The first step in the algorithm is the removal of the points creating collinear segments along polygon edges. This is followed by the extraction of the points located along the polygon for the creation of input points for the construction of Voronoi diagram. During this process, extra points are created between the couple of points forming the edges of the polygon for a better approximation of the MA. Enrichment of the input points is followed by the creation of Voronoi diagrams for the input points. As the vertices of the Voronoi diagram inside the polygon provides us with an approximation of the MA, these vertices are considered as the candidates for the first approximation of MIC for the polygon in the algorithm.

In this respect, the first candidate for the center of MIC is revealed in the algorithm by maximizing the radius of circle tangent interior to one of the edges of polygon on the base of these vertices. The first candidate for the center of MIC is also used by the algorithm for the determination of the possible cores that may cover the center of MIC. For each core, MICGIS performs three approximation of MIC, and if necessary, the solutions proposed for the special cases of Apollonius' Problem are also used for the approximation of the best MIC.

Installation of the Plugin

In order to install "Maximum Inscribed Cirle" plugin, file named "MICGIS.jar" that can be downloaded from github.com/burakbeyhan/maximum-inscribed-circle should be copied to the extension folder ("ext") of OpenJUMP installation. OpenJUMP can be downloaded from openjump.org. In a typical Windows-based operating system, the default address for the respective folder is as following;

C:\Program Files\OpenJUMP-1.14.1-r6147-PLUS\lib\ext

Based on the different versions of OpenJUMP installation and operating systems, the exact location of the folder may change. Once you specify the location of OpenJUMP installation, "\lib\ext", subfolder location, provides you with the exact location in order to place the plugin file (MICGIS.jar).

[1] Beyhan, B., Güler, C. & Tağa, H. (2020) An algorithm for maximum inscribed circle based on Voronoi diagrams and geometrical properties. Journal of Geographical Systems, 22, 391–418. https://doi.org/10.1007/s10109-020-00325-3

Use of the Plugin

After placing MICGIS.jar file under extensions folder, you can run OpenJUMP. In the graphical user interface (GUI) of OpenJUMP, there are two alternatives in order to initiate "Maximum Inscribed Cirle" plugin: (1) via the menu bar using Maximum Inscribed Circle menu item under "Plugins" (see Figure 1) and (2) via the toolbox using tool (see Figure 2).

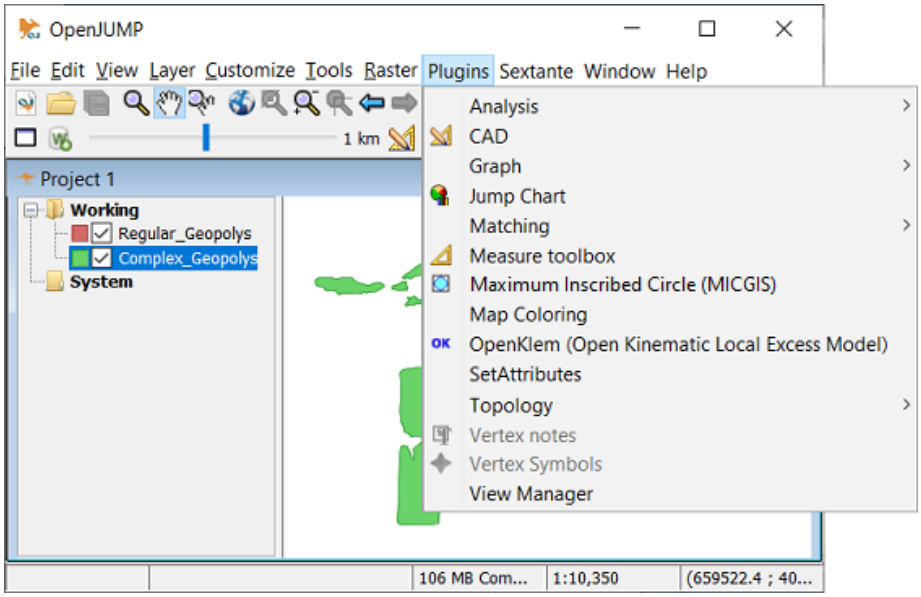


Figure 1. Menu bar option for the initialization of the MICGIS plugin.

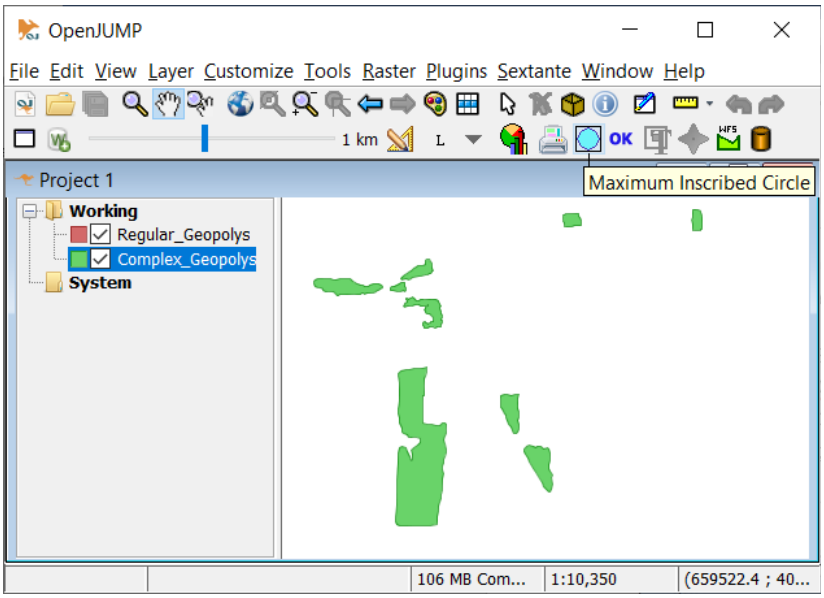


Figure 2. Toolbar option for the initialization of the MICGIS plugin.

After initialization of the MICGIS plugin, the GUI shown in Figure 3 will be activated. In the respective GUI, you can select the layer for which the analysis will be done. By default, the active layer will be shown as the selected layer in the GUI.

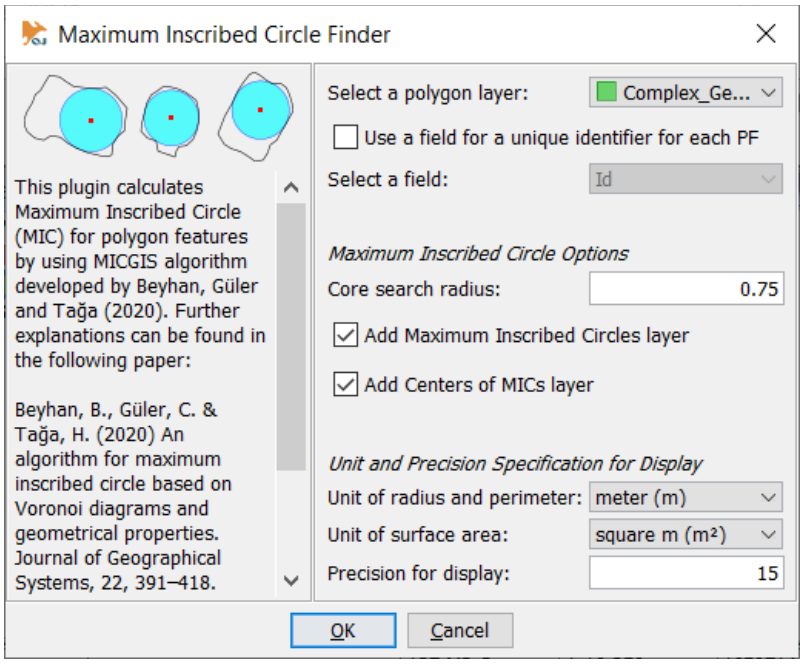


Figure 3. GUI of the MICGIS plugin.

There are also some options for the calculation and presentation of MIC. You may identify a field in the attribute table of the input layer for the match between the input layer and the resulting layers covering MICs and the centers of MICs for each polygon feature. In the GUI of the MICGIS plugin, the only external parameter required by the user in the calculation of MIC is core search radius. The default value for this parameter is 0.75. Further explanations for this parameter can be found in Beyhan, Güler and Tağa (2020). In general, it is assumed that you do not need to change the default value for this parameter.

By default, without any option, perimeter, area, radius and coordinate (x,y) information of the calculated MIC are added to the attribute table of the input layer as new fields (micperim, micarea, micradius, micX and micY). However, there are also other options for MIC in relation to the creation of new layers for the results of the analysis performed by the plugin. In this respect, there are two options: (1) adding MICs as a new layer and/or (2) adding the centers of MICs as a new layer.

User can see a sample preview of the resulting layers in the side bar of the GUI of the MICGIS plugin. If the option for adding Maximum Inscribed Circles layer is selected, the layer concerned is created, and perimeter, area, radius and coordinate (x,y) information of the calculated MICs are added to the attribute table of Maximum Inscribed Circles layer together with an identity field (IDM) showing the unique identity number for each MIC (Figure 4).

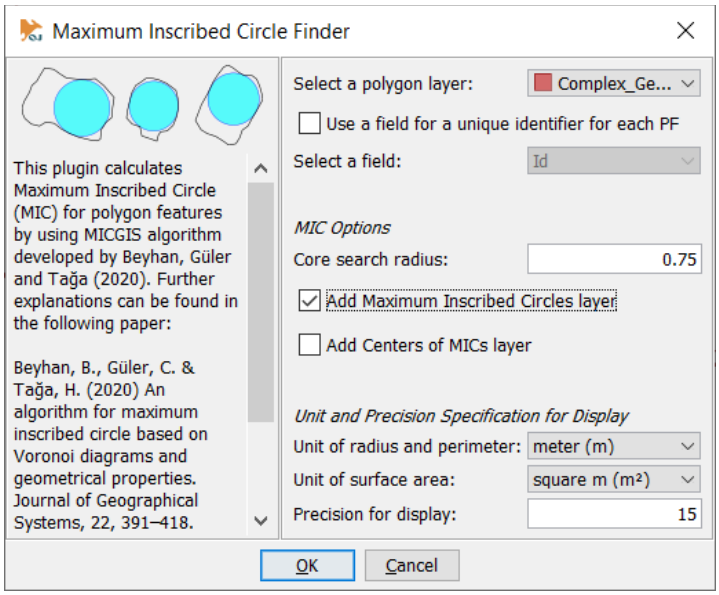


Figure 4. Sample preview of the maximum inscribed circles layer creation option in the GUI.

If the option for adding centers of MICs layer is selected, the layer concerned is created, and radius and coordinate (x,y) information of the calculated MICs are added to the attribute table of the centers of MICs layer together with an identity field (IDM) showing the unique identity number for each center of MIC (Figure 5).

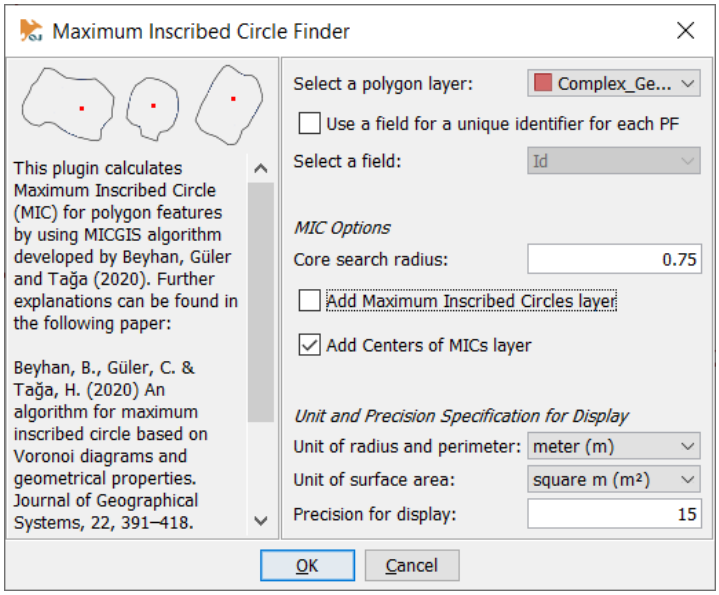


Figure 5. Sample preview of the center of MICs layer creation option in the GUI.

User can also specify the units of measurement and precision that will be used in the presentation of the results of the analysis performed by the MICGIS plugin (Figures 6 and 7). The precision is only used to display the results in the attribute table. It does not affect the precision of the calculations made by the script to delimit MIC. The default value is set to maximum value.

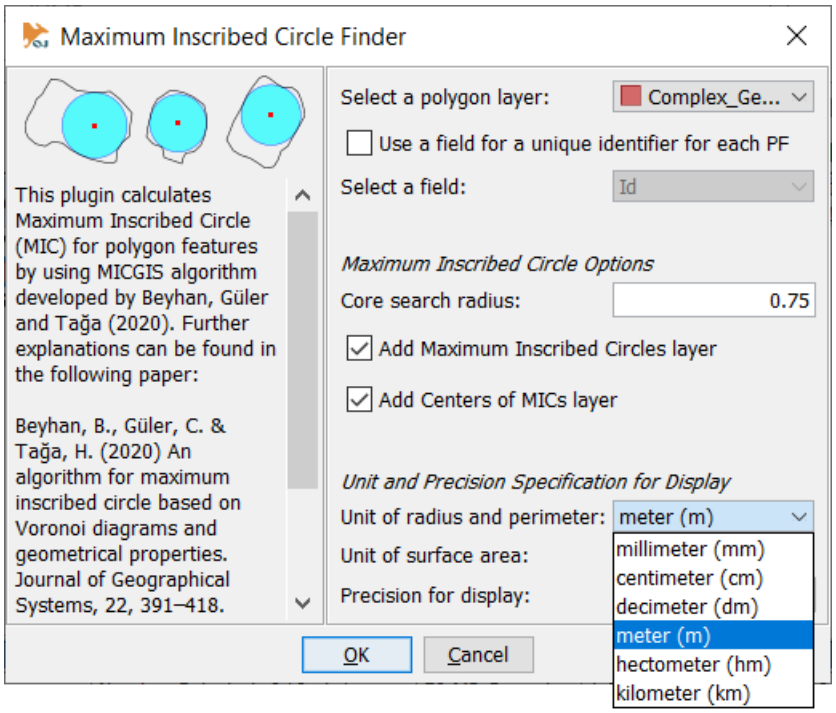


Figure 6. Selection of unit of measurement for radius and perimeter in the MICGIS GUI.

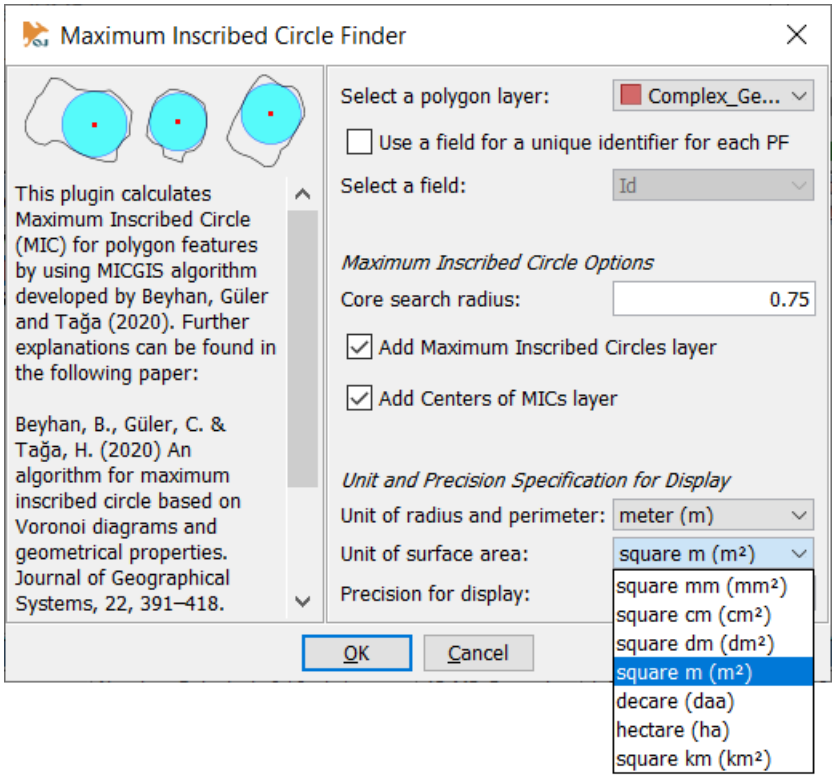


Figure 7. Selection of unit of measurement for surface area in the MICGIS GUI.

During the calculation of MICs, user is informed about the polygon feature (PF) for which MIC is calculated (Figure 8). At the end of the calculation of MICs for all PFs, desired layers are created under “MIC Analysis for [name of the layer]” category (Figure 9).

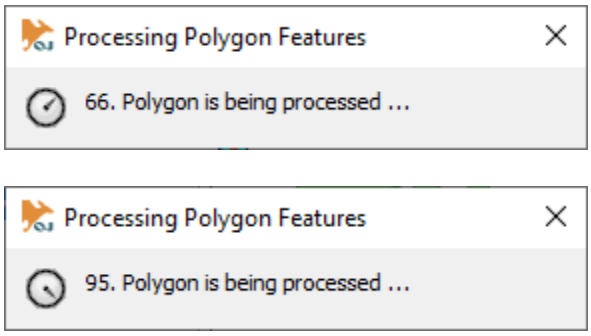


Figure 8. Information given by the MICGIS plugin during the calculation of MICs.

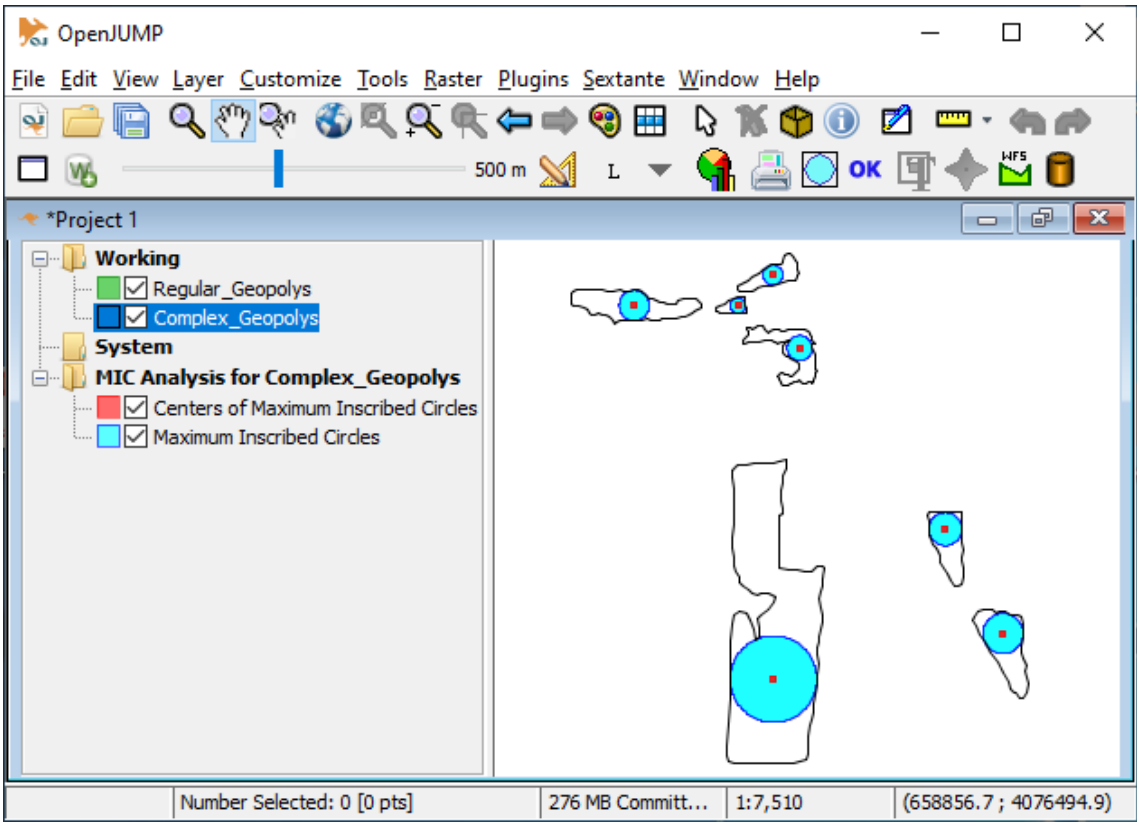
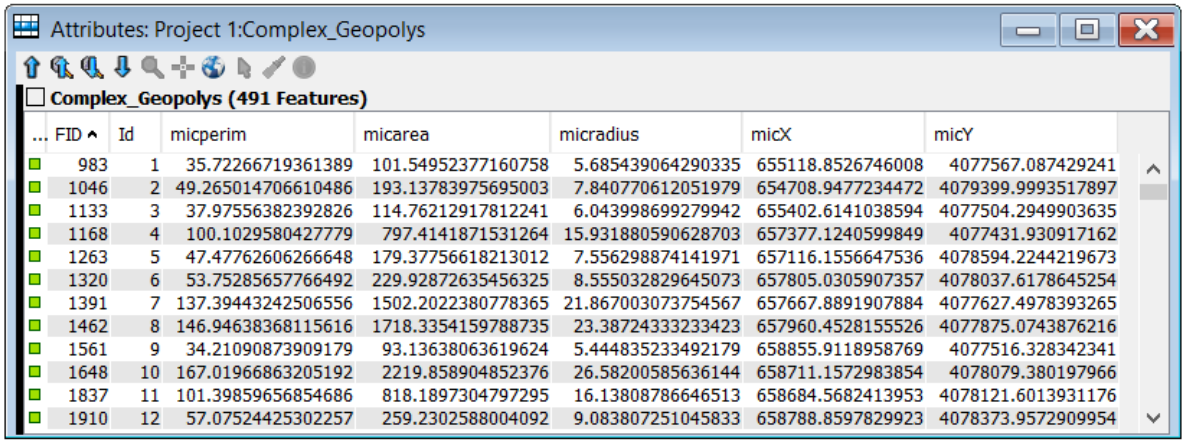


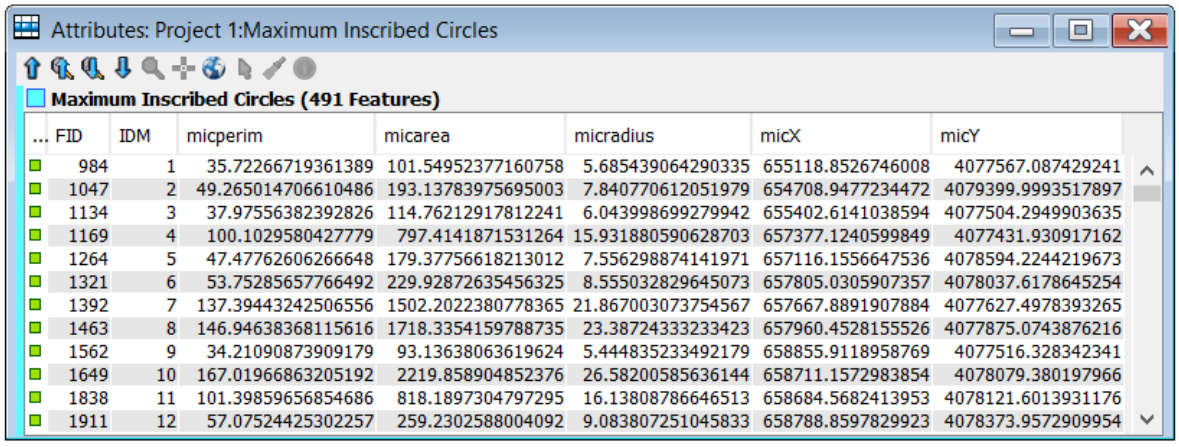
Figure 9. Presentation of the results of the analysis as new layers.

User can also see the calculated parameters in relation to MICs by opening the attribute table of the layers concerned (Figures 10, 11 and 12).



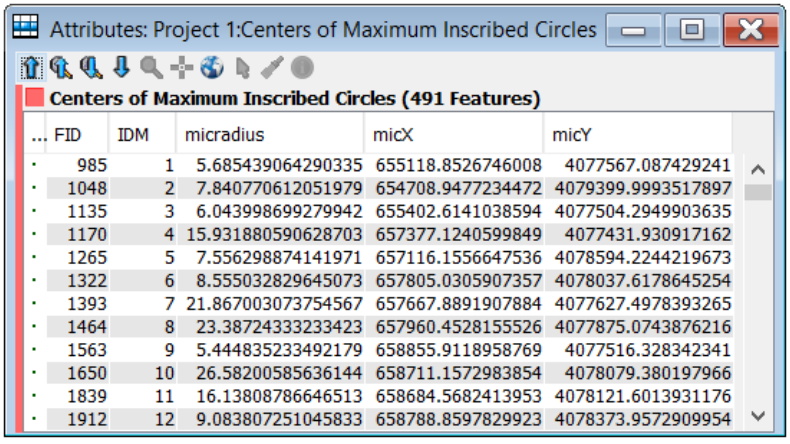
...	FID	Id	micperim	micarea	micradius	micX	micY
	983	1	35.72266719361389	101.54952377160758	5.685439064290335	655118.8526746008	4077567.087429241
	1046	2	49.265014706610486	193.13783975695003	7.840770612051979	654708.9477234472	4079399.9993517897
	1133	3	37.97556382392826	114.76212917812241	6.043998699279942	655402.6141038594	4077504.2949903635
	1168	4	100.1029580427779	797.4141871531264	15.931880590628703	657377.1240599849	4077431.930917162
	1263	5	47.47762606266648	179.37756618213012	7.556298874141971	657116.1556647536	4078594.2244219673
	1320	6	53.75285657766492	229.92872635456325	8.555032829645073	657805.0305907357	4078037.6178645254
	1391	7	137.39443242506556	1502.2022380778365	21.867003073754567	657667.8891907884	4077627.4978393265
	1462	8	146.94638368115616	1718.3354159788735	23.38724333233423	657960.4528155526	4077875.0743876216
	1561	9	34.21090873909179	93.13638063619624	5.444835233492179	658855.9118958769	4077516.328342341
	1648	10	167.01966863205192	2219.858904852376	26.58200585636144	658711.1572983854	4078079.380197966
	1837	11	101.39859656854686	818.1897304797295	16.13808786646513	658684.5682413953	4078121.6013931176
	1910	12	57.07524425302257	259.2302588004092	9.083807251045833	658788.8597829923	4078373.9572909954

Figure 10. Enriched attribute table of the input layer.



...	FID	IDM	micperim	micarea	micradius	micX	micY
	984	1	35.72266719361389	101.54952377160758	5.685439064290335	655118.8526746008	4077567.087429241
	1047	2	49.265014706610486	193.13783975695003	7.840770612051979	654708.9477234472	4079399.9993517897
	1134	3	37.97556382392826	114.76212917812241	6.043998699279942	655402.6141038594	4077504.2949903635
	1169	4	100.1029580427779	797.4141871531264	15.931880590628703	657377.1240599849	4077431.930917162
	1264	5	47.47762606266648	179.37756618213012	7.556298874141971	657116.1556647536	4078594.2244219673
	1321	6	53.75285657766492	229.92872635456325	8.555032829645073	657805.0305907357	4078037.6178645254
	1392	7	137.39443242506556	1502.2022380778365	21.867003073754567	657667.8891907884	4077627.4978393265
	1463	8	146.94638368115616	1718.3354159788735	23.38724333233423	657960.4528155526	4077875.0743876216
	1562	9	34.21090873909179	93.13638063619624	5.444835233492179	658855.9118958769	4077516.328342341
	1649	10	167.01966863205192	2219.858904852376	26.58200585636144	658711.1572983854	4078079.380197966
	1838	11	101.39859656854686	818.1897304797295	16.13808786646513	658684.5682413953	4078121.6013931176
	1911	12	57.07524425302257	259.2302588004092	9.083807251045833	658788.8597829923	4078373.9572909954

Figure 11. Attribute table of the resulting layer showing MICs.



...	FID	IDM	micradius	micX	micY
	985	1	5.685439064290335	655118.8526746008	4077567.087429241
	1048	2	7.840770612051979	654708.9477234472	4079399.9993517897
	1135	3	6.043998699279942	655402.6141038594	4077504.2949903635
	1170	4	15.931880590628703	657377.1240599849	4077431.930917162
	1265	5	7.556298874141971	657116.1556647536	4078594.2244219673
	1322	6	8.555032829645073	657805.0305907357	4078037.6178645254
	1393	7	21.867003073754567	657667.8891907884	4077627.4978393265
	1464	8	23.38724333233423	657960.4528155526	4077875.0743876216
	1563	9	5.444835233492179	658855.9118958769	4077516.328342341
	1650	10	26.58200585636144	658711.1572983854	4078079.380197966
	1839	11	16.13808786646513	658684.5682413953	4078121.6013931176
	1912	12	9.083807251045833	658788.8597829923	4078373.9572909954

Figure 12. Attribute table of the resulting layer showing the centers of MICs.