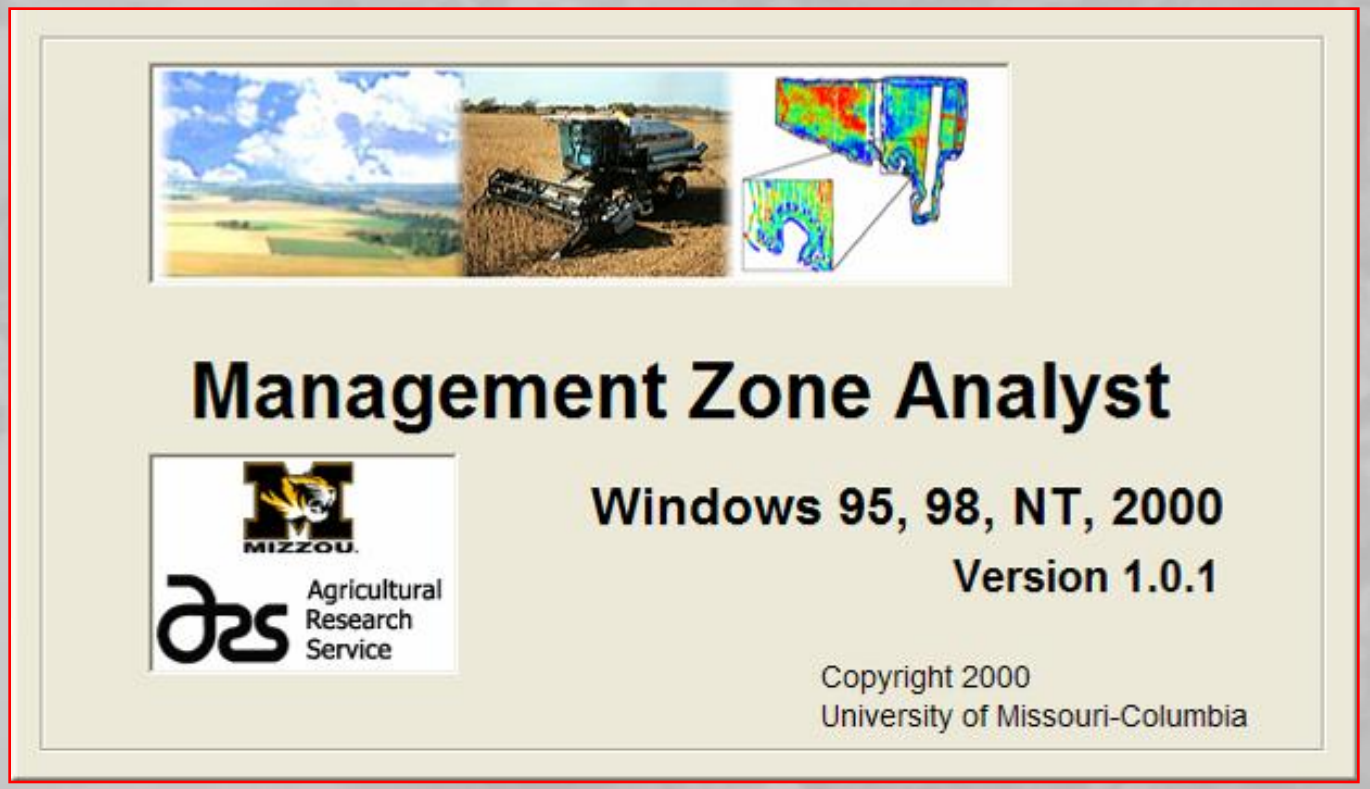
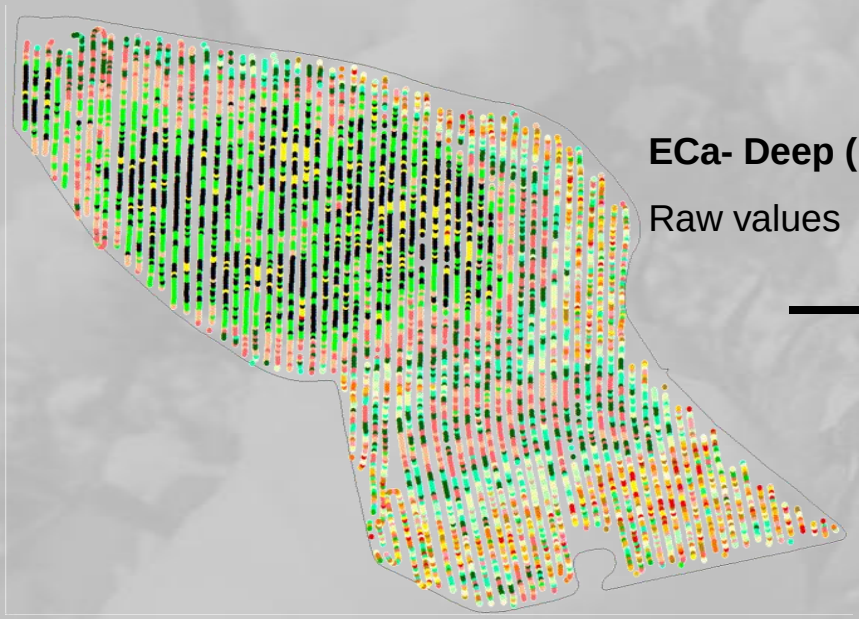
Management zone analyst (MZA): software for subfield management zone delineation



Fridgen, J.J., N.R. Kitchen, K.A. Sudduth, S.T. Drummond, W.J. Wiebold, and C.W. Fraisse. 2004. Management zone analyst (MZA): software for subfield management zone delineation. *Agronomy Journal.* 96: 100-108.

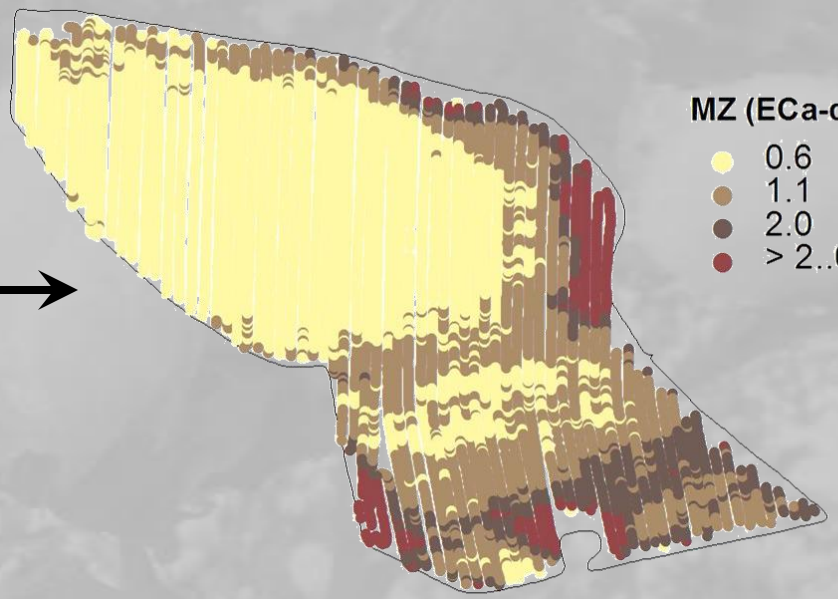
http://www.ars.usda.gov/services/software/download.htm?softwareid=24&modecode=36-20-15-00

How does MZA classify a data set into zones?



ECa- Deep (mS/m)

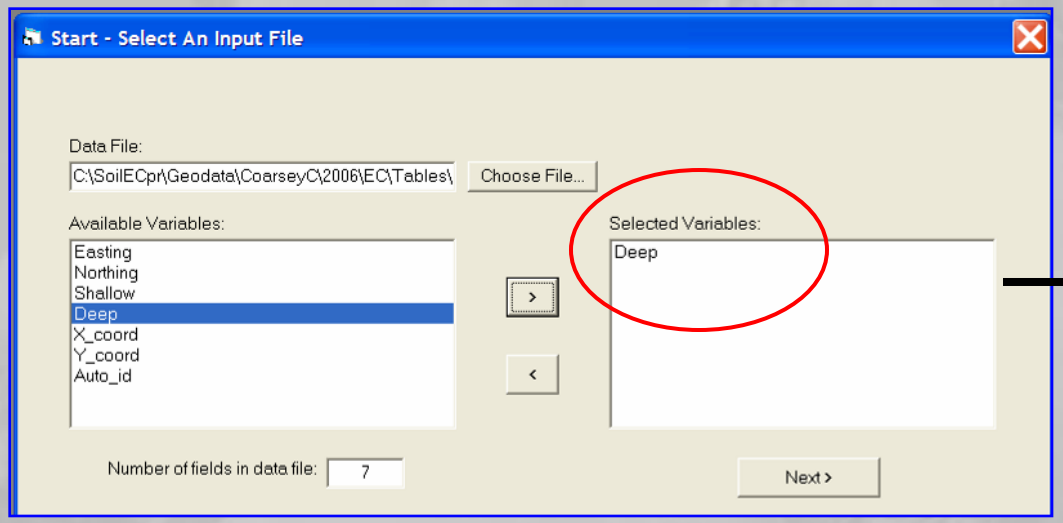
Raw values

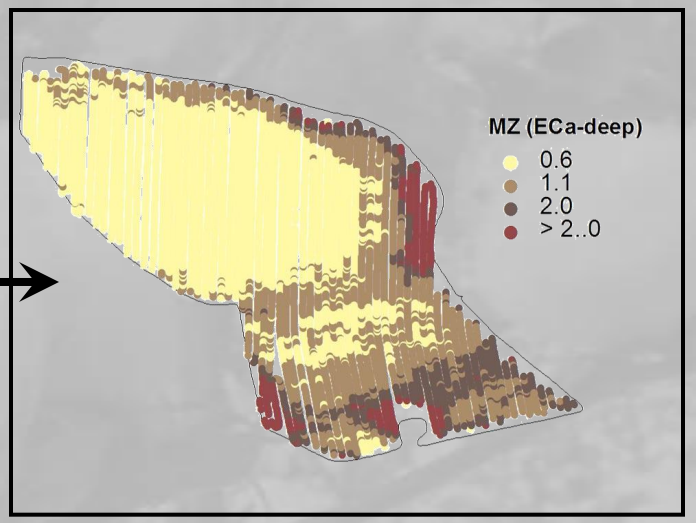


- MZA using an unsupervised fuzzy classification:
  - Find the "most alike" areas in the field.
  - Compare all the observations to each other and cluster the similar ones together.
  - Generate clusters or "zones".

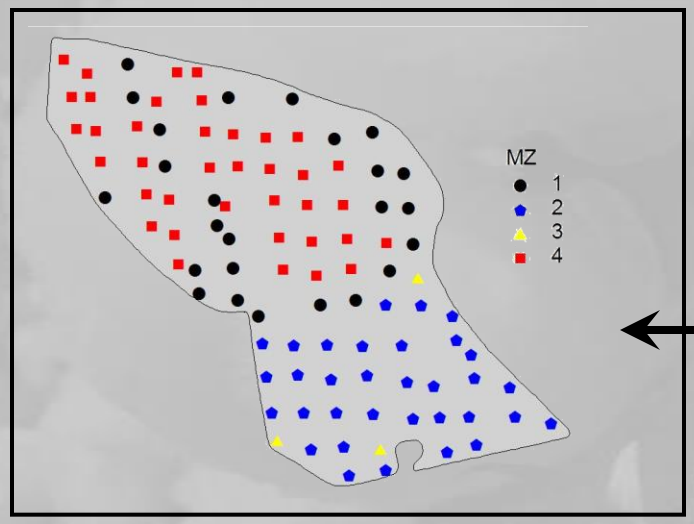
MZA: software for subfield management zone delineation

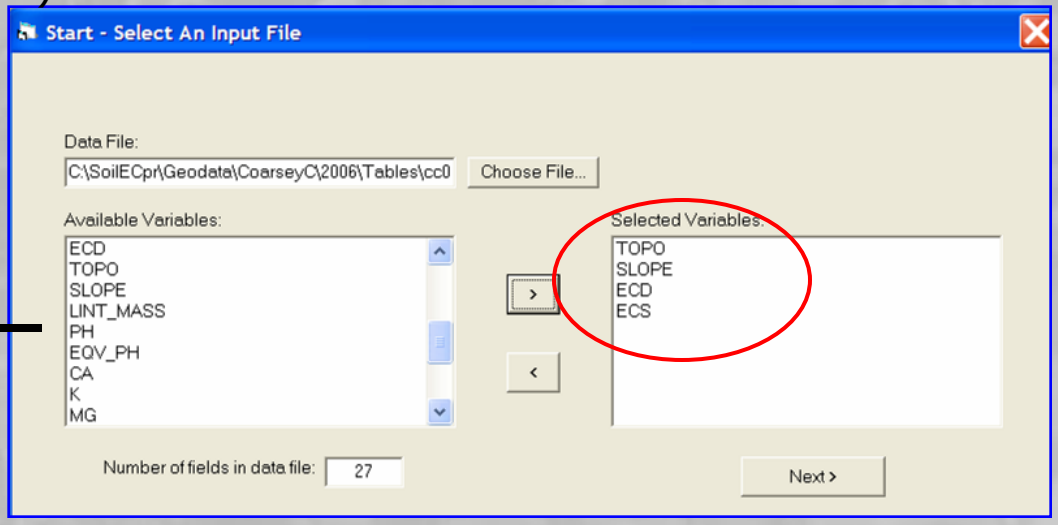
a) MZ based on a single variable





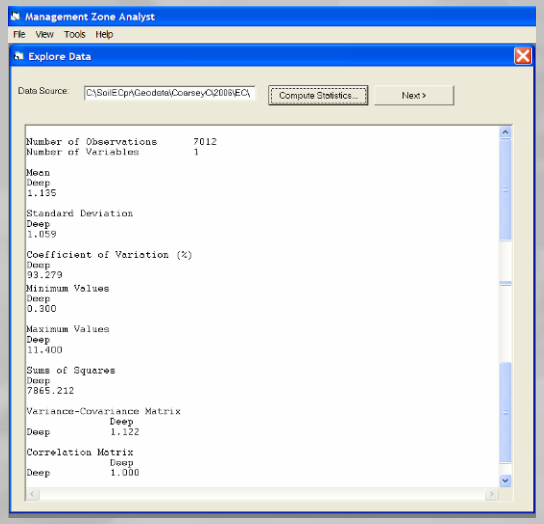
b) MZ based on a combination of variables



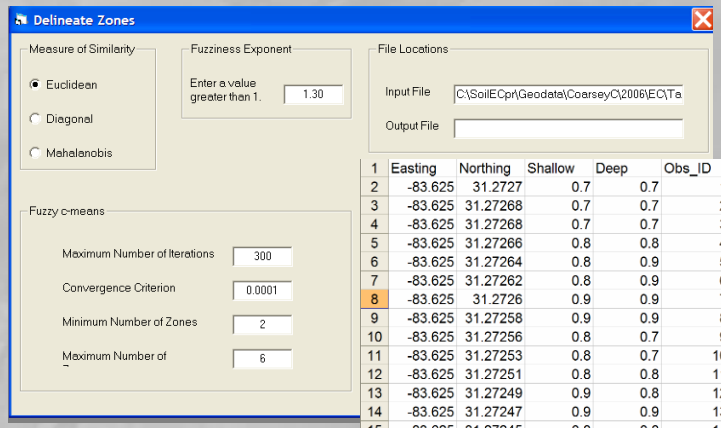


MZA's Functionalities

1. Descriptive statistics

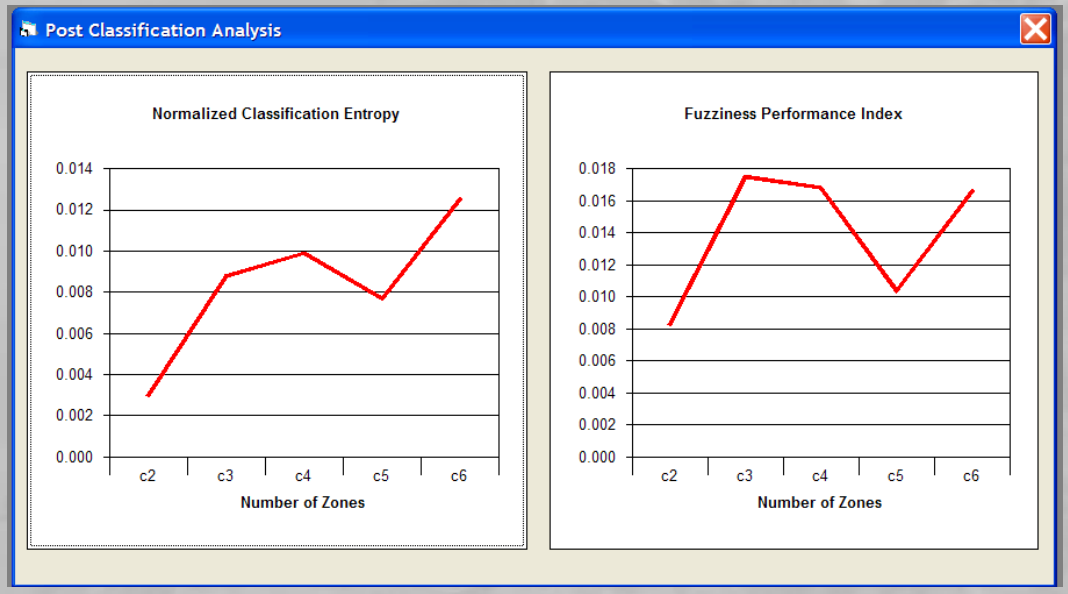


2. Delineation of the zones



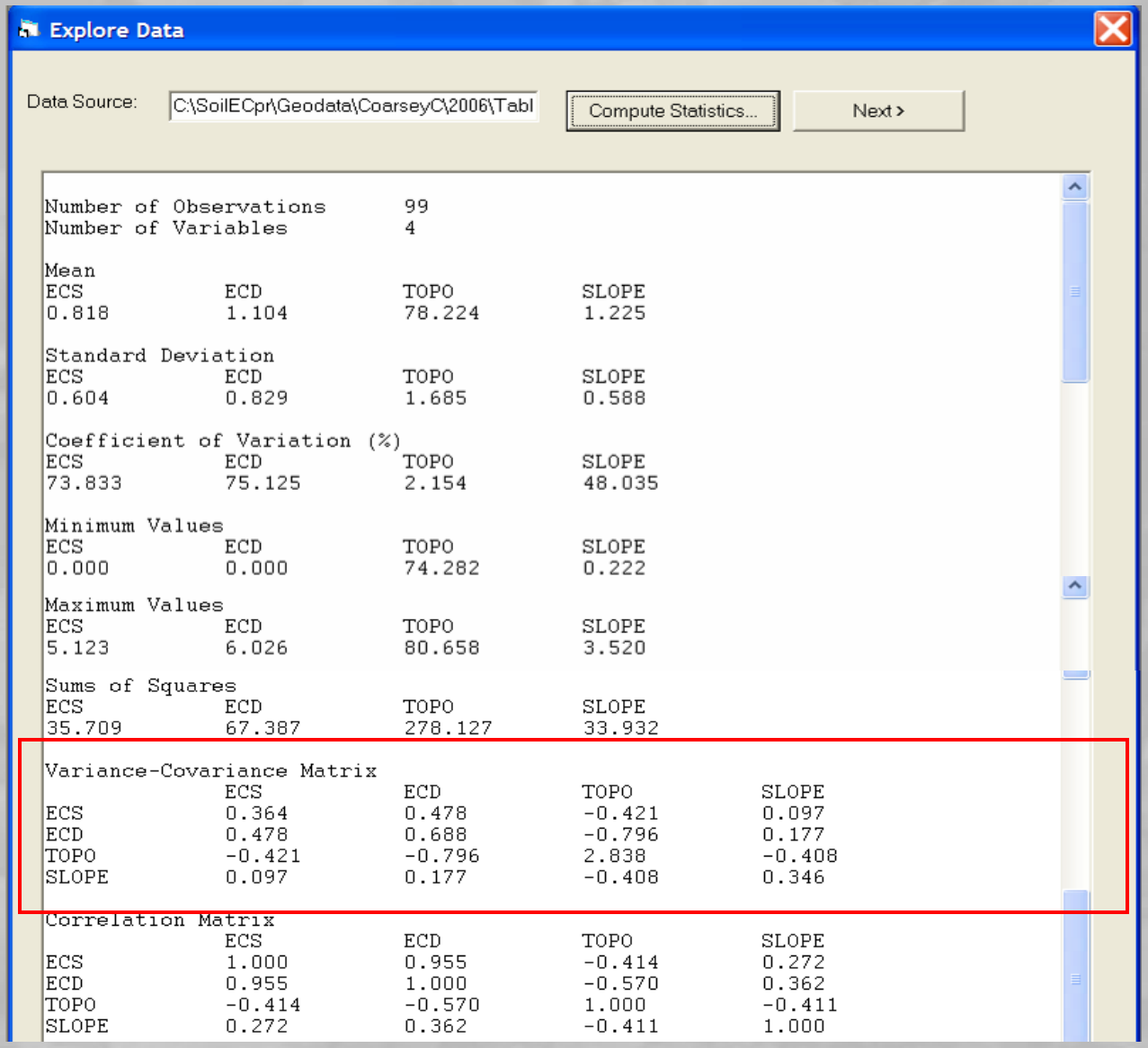
	Easting	Northing	Shallow	Deep	Obs_ID	MZ2	MZ3	MZ4	MZ5	MZ6
2	-83.625	31.2727	0.7	0.7	1	1	1	4	3	6
3	-83.625	31.27268	0.7	0.7	2	1	1	4	3	6
4	-83.625	31.27268	0.7	0.7	3	1	1	4	3	6
5	-83.625	31.27266	0.8	0.8	4	1	1	4	3	4
6	-83.625	31.27264	0.8	0.9	5	1	1	4	2	4
7	-83.625	31.27262	0.8	0.9	6	1	1	4	2	4
8	-83.625	31.2726	0.9	0.9	7	1	1	4	2	4
9	-83.625	31.27258	0.9	0.9	8	1	1	4	2	4
10	-83.625	31.27256	0.8	0.7	9	1	1	4	3	6
11	-83.625	31.27253	0.8	0.7	10	1	1	4	3	6
12	-83.625	31.27251	0.8	0.8	11	1	1	4	3	4
13	-83.625	31.27249	0.9	0.8	12	1	1	4	3	4
14	-83.625	31.27247	0.9	0.9	13	1	1	4	2	4
15	-83.625	31.27245	0.8	0.8	14	1	1	4	3	4
16	-83.625	31.27242	1	0.9	15	1	1	4	2	4
17	-83.625	31.2724	0.8	0.8	16	1	1	4	3	4
18	-83.625	31.27238	0.9	0.9	17	1	1	4	2	4
19	-83.625	31.27235	0.9	0.8	18	1	1	4	3	4
20	-83.625	31.27233	0.8	0.8	19	1	1	4	3	4

3. Evaluation of classification performance by the number of zones



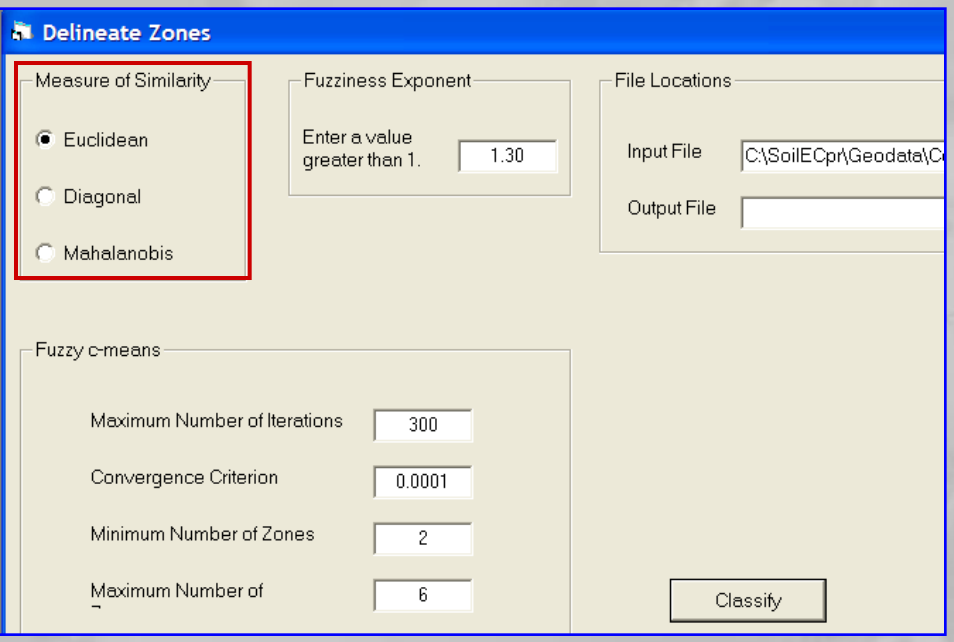
MZA's Functionalities

1. Descriptive statistics (Univariate and Multivariate statistics)



MZA's Functionalities

2. Delineation of the zones



Scenario	Measure of Similarity
One classification variable (i.e. Yield or ECa-deep)	**Euclidean**
Equal variances; covariances ≈ 0	Euclidean
Unequal variances; covariances ≈ 0	Diagonal
Unequal variances; covariances ≠ 0 (i.e. ECS, ECD, Topo, SLOPE)	**Mahalonobis**

Structure of the variance-covariance matrix:

Covariance

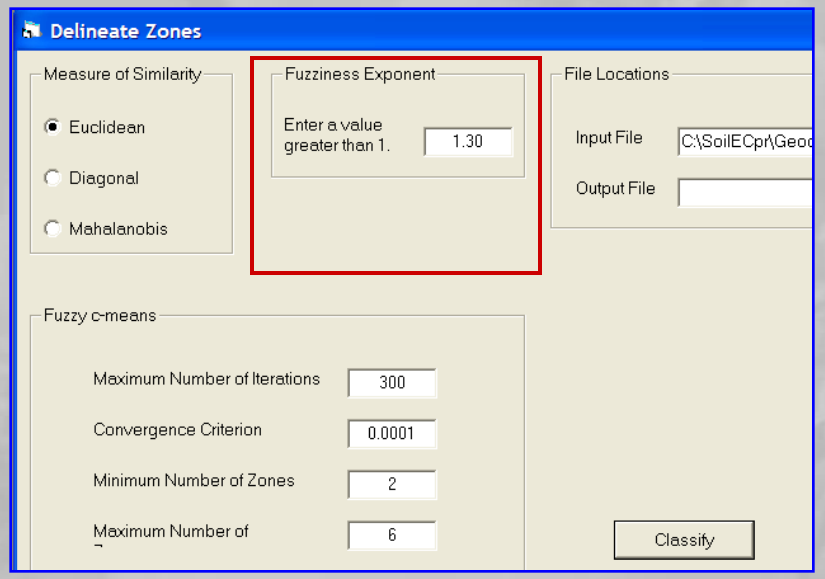
Variance-Covariance Matrix

	ECS	ECD	TOPO	SLOPE
ECS	0.364	0.478	-0.421	0.097
ECD	0.478	0.688	-0.796	0.177
TOPO	-0.421	-0.796	2.838	-0.408
SLOPE	0.097	0.177	-0.408	0.346

Variance

MZA's Functionalities

2. Delineation of the zones



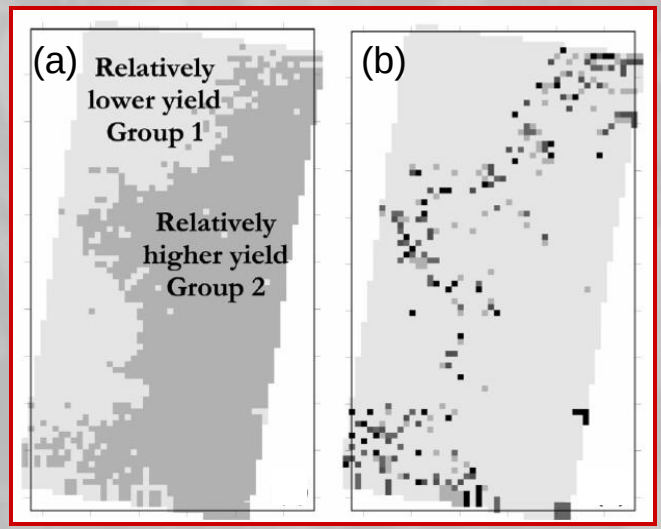
- MZA uses a Fuzzy unsupervised classification method.
- Observations can be members of more than one zone. This scenario usually occurs at the transitory areas (edges) between zones
- Fuzziness exponent ≈ 1 more distinct zones (i.e. no membership sharing)

Example:

MZ based on yield data (Boydell and McBratney, 2006)

(a) High and low yielding zones

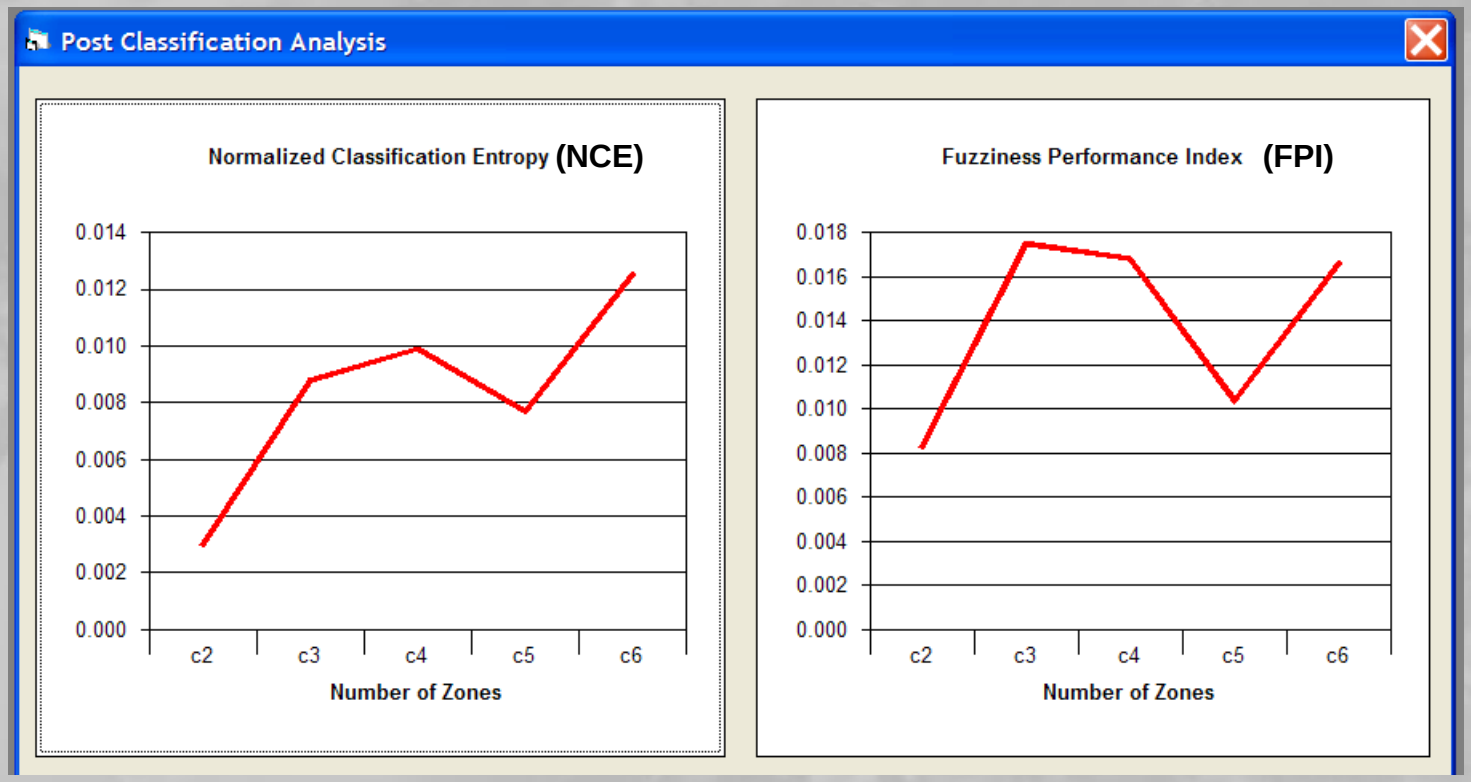
(b) The dark colors represent areas where membership is spread equally between the two zones



MZA's Functionalities

3. Evaluation of classification performance by the number of zones

HOW MANY UNIQUE ZONES A FILED SHOULD BE DIVIDED INTO?



NCE – Measures the homogeneity of the zones.

FPI – Measures the degree of separation between the zones.

FPI ≈ 0, distinct classes → less membership sharing

" The optimum number of zones is when both indices are at the minimum values".

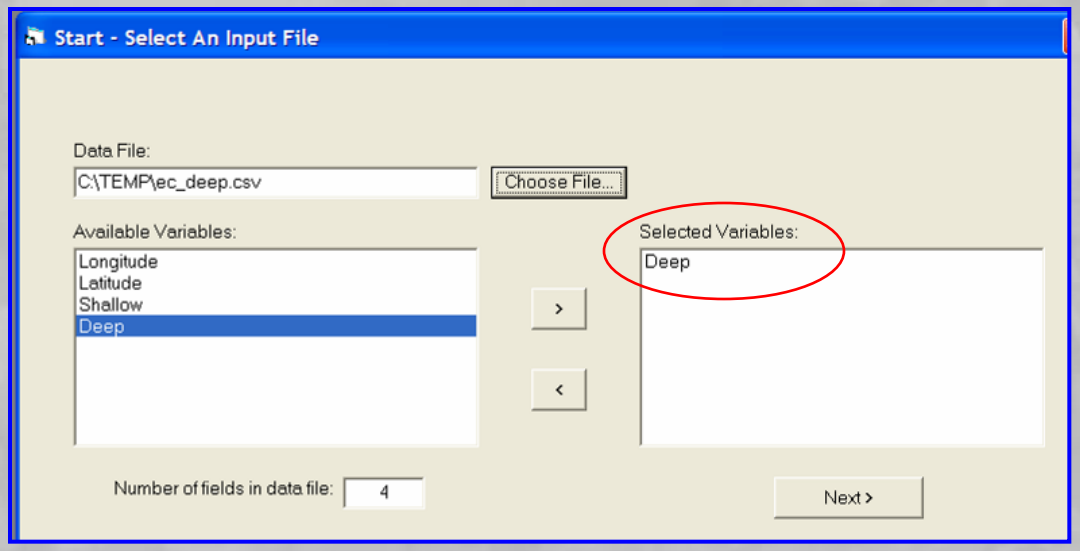
Example : MZ based on EC_a-Deep data

1. Data as comma-delimited ASCII text files (csv or txt)

Coordinates (Geographic or projected) | Variable(s)

Longitude	Latitude	Shallow	Deep
-83.625	31.2727	0.7	0.7
-83.625	31.27268	0.7	0.7
-83.625	31.27268	0.7	0.7
-83.625	31.27266	0.8	0.8
-83.625	31.27264	0.8	0.9
-83.625	31.27262	0.8	0.9

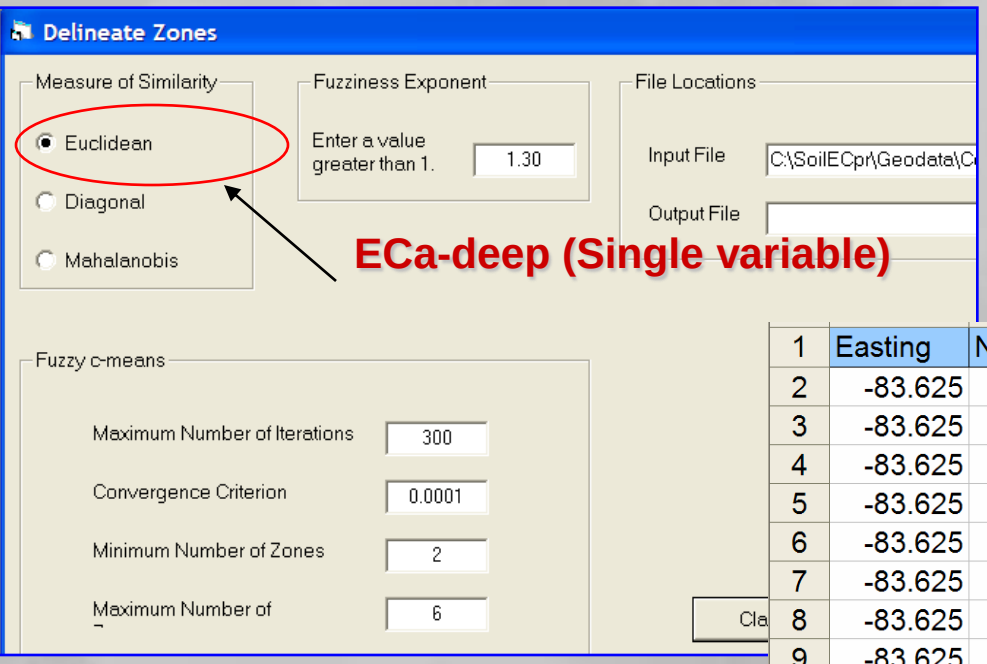
2. Selecting the variable(s) for the zones delineation



Example : MZ based on ECa-deep data

3. Calculating descriptive statistics

4. Classifying the ECa-deep data



5. Results from the classification

1	Easting	Northing	Shallow	Deep	2	3	4	5	6
2	-83.625	31.2727	0.7	0.7	1	1	4	3	6
3	-83.625	31.2727	0.7	0.7	1	1	4	3	6
4	-83.625	31.2727	0.7	0.7	1	1	4	3	6
5	-83.625	31.2727	0.8	0.8	1	1	4	3	4
6	-83.625	31.2726	0.8	0.9	1	1	4	2	4
7	-83.625	31.2726	0.8	0.9	1	1	4	2	4
8	-83.625	31.2726	0.9	0.9	1	1	4	2	4
9	-83.625	31.2726	0.9	0.9	1	1	4	2	4
10	-83.625	31.2726	0.8	0.7	1	1	4	3	6
11	-83.625	31.2725	0.8	0.7	1	1	4	3	6
12	-83.625	31.2725	0.8	0.8	1	1	4	3	4
13	-83.625	31.2725	0.9	0.8	1	1	4	3	4
14	-83.625	31.2725	0.9	0.9	1	1	4	2	4
15	-83.625	31.2724	0.8	0.8	1	1	4	3	4
16	-83.625	31.2724	1	0.9	1	1	4	2	4
17	-83.625	31.2724	0.8	0.8	1	1	4	3	4
18	-83.625	31.2724	0.9	0.9	1	1	4	2	4

5. Selecting the best number of zones