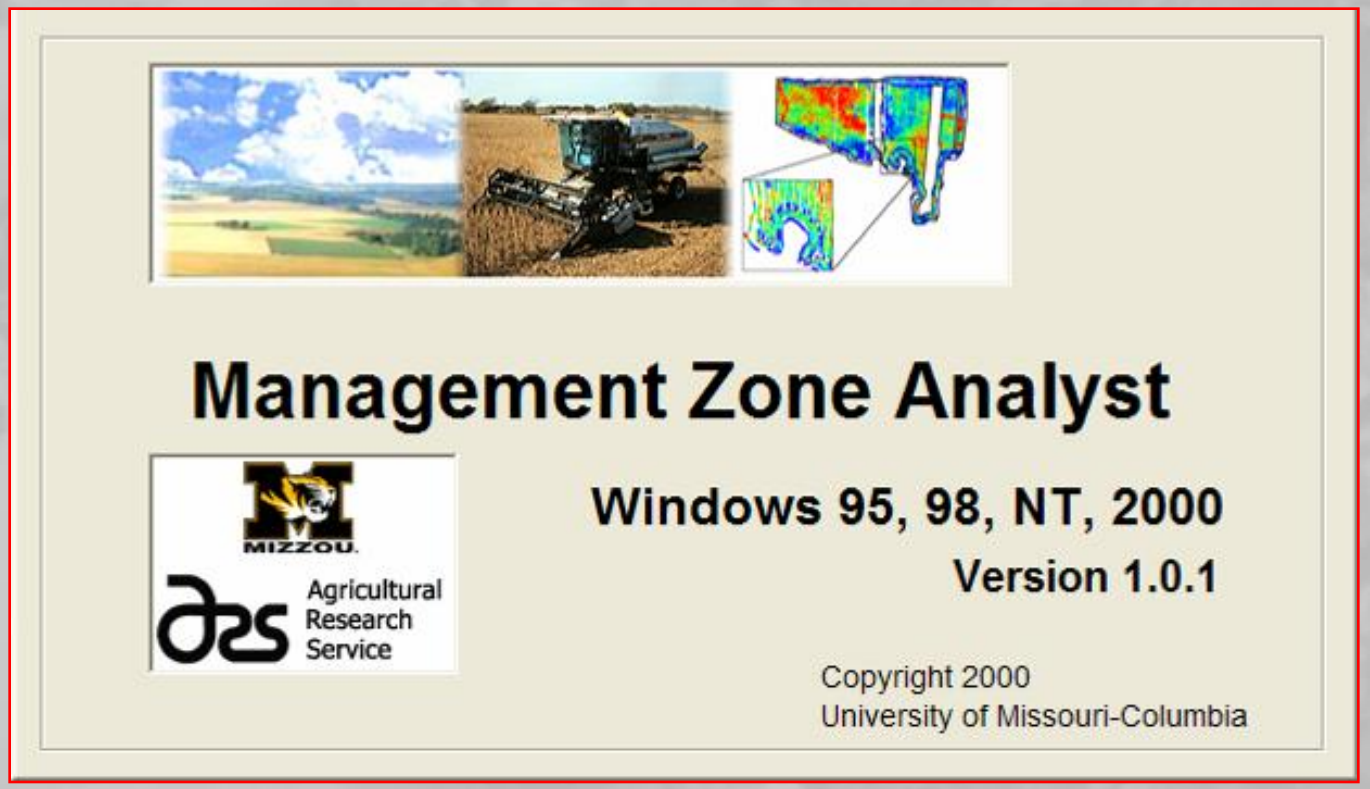
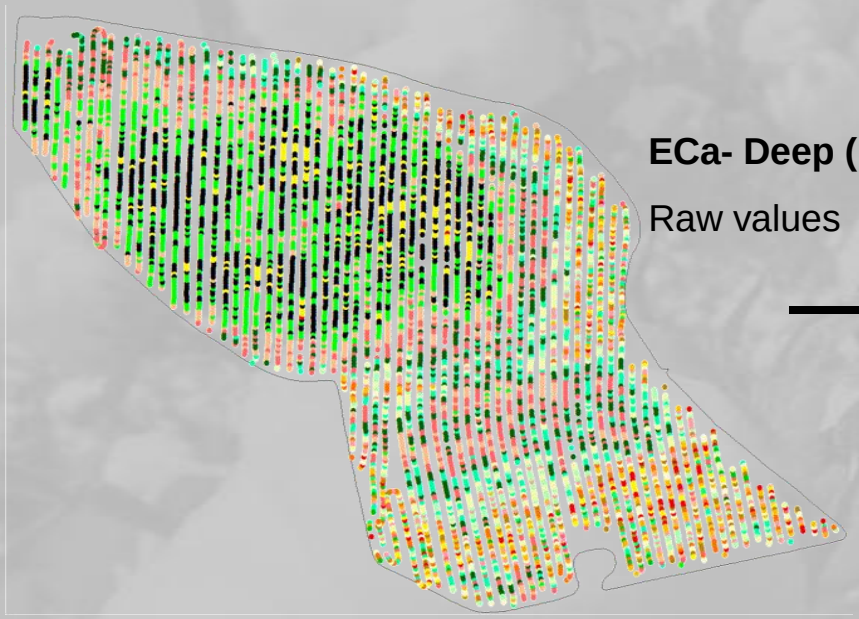
# Management zone analyst (MZA): software for subfield management zone delineation




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.

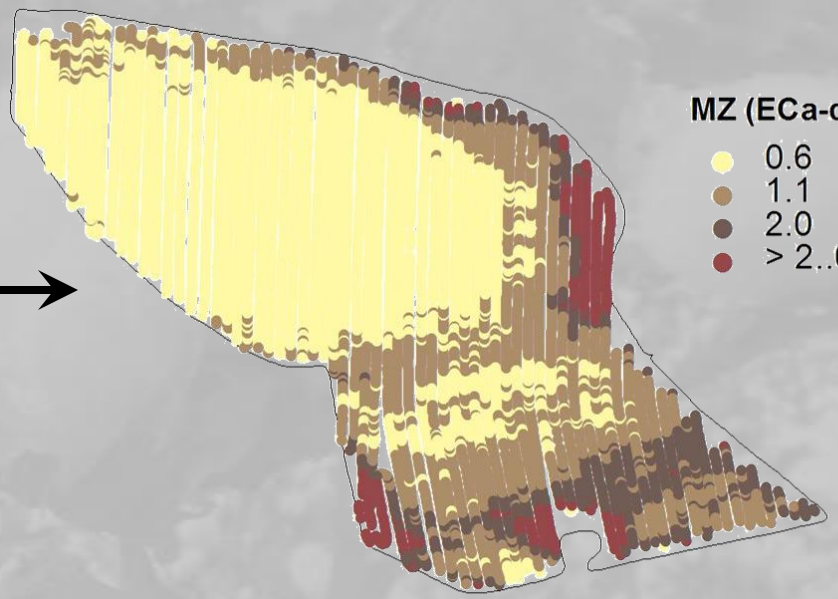
http://www.ars.usda.gov/services/software/download.htm?softwareid=24&modecode=36-20-15-00

# How does MZA classify a data set into zones?



**ECa- Deep (mS/m)**

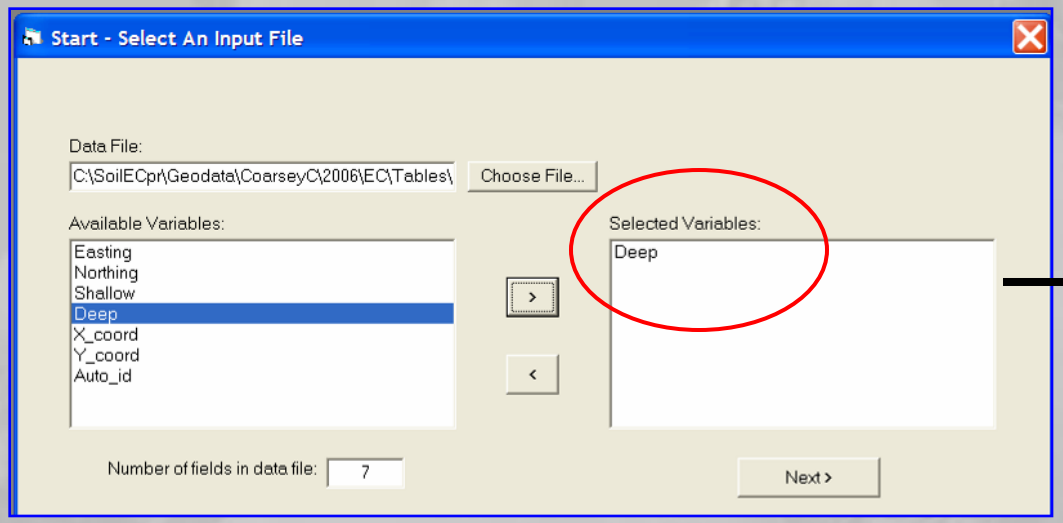
Raw values

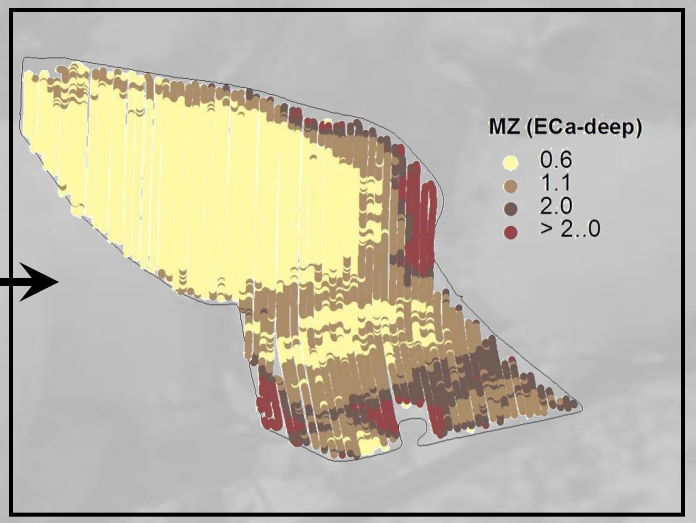



- MZA using an unsupervised fuzzy classification:
  - Find the "most alike" areas in the field.
  - Compare all the observations to each other and cluster the similar ones together.
  - Generate clusters or "zones".

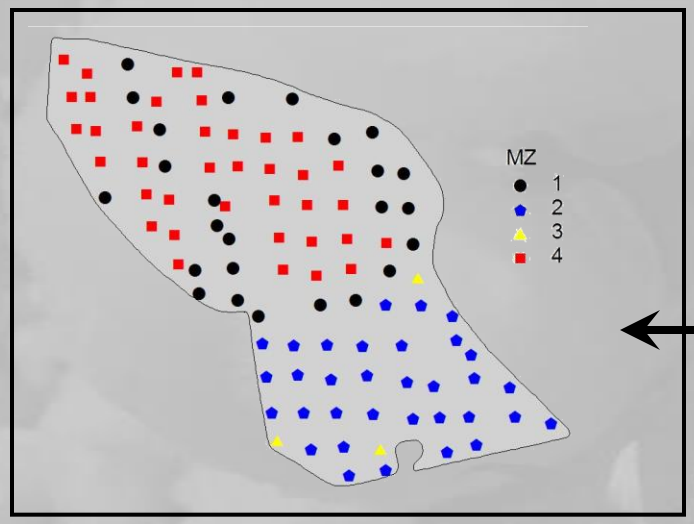
# MZA: software for subfield management zone delineation

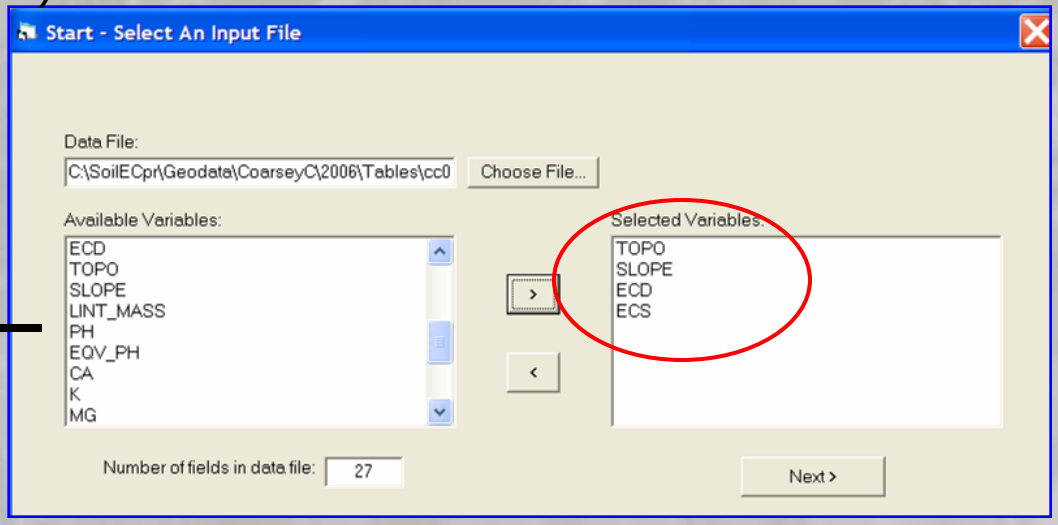
a) MZ based on a single variable



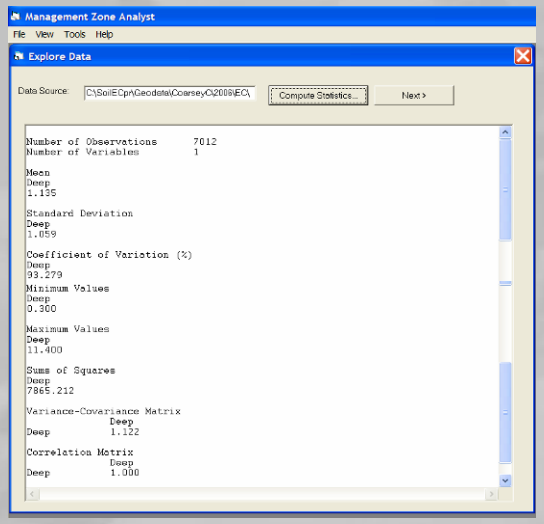

b) MZ based on a combination of variables



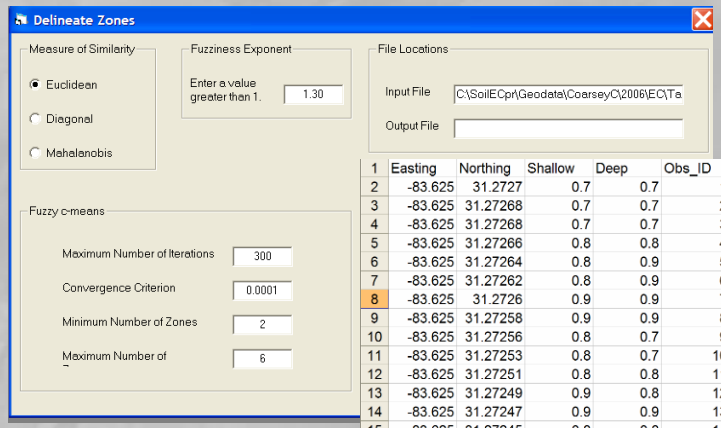



# MZA's Functionalities

## 1. Descriptive statistics

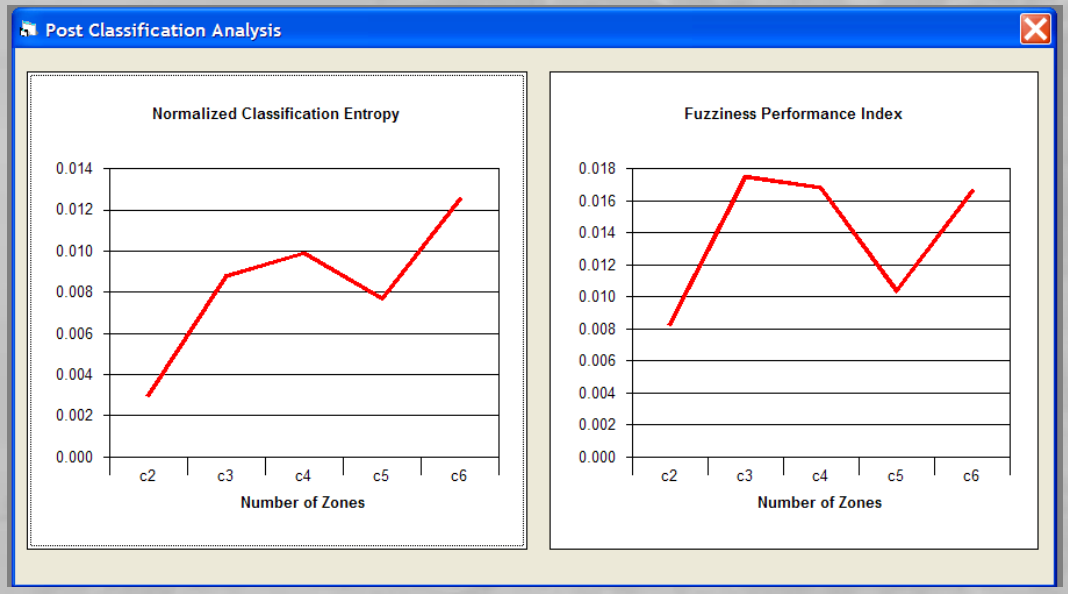



## 2. Delineation of the zones



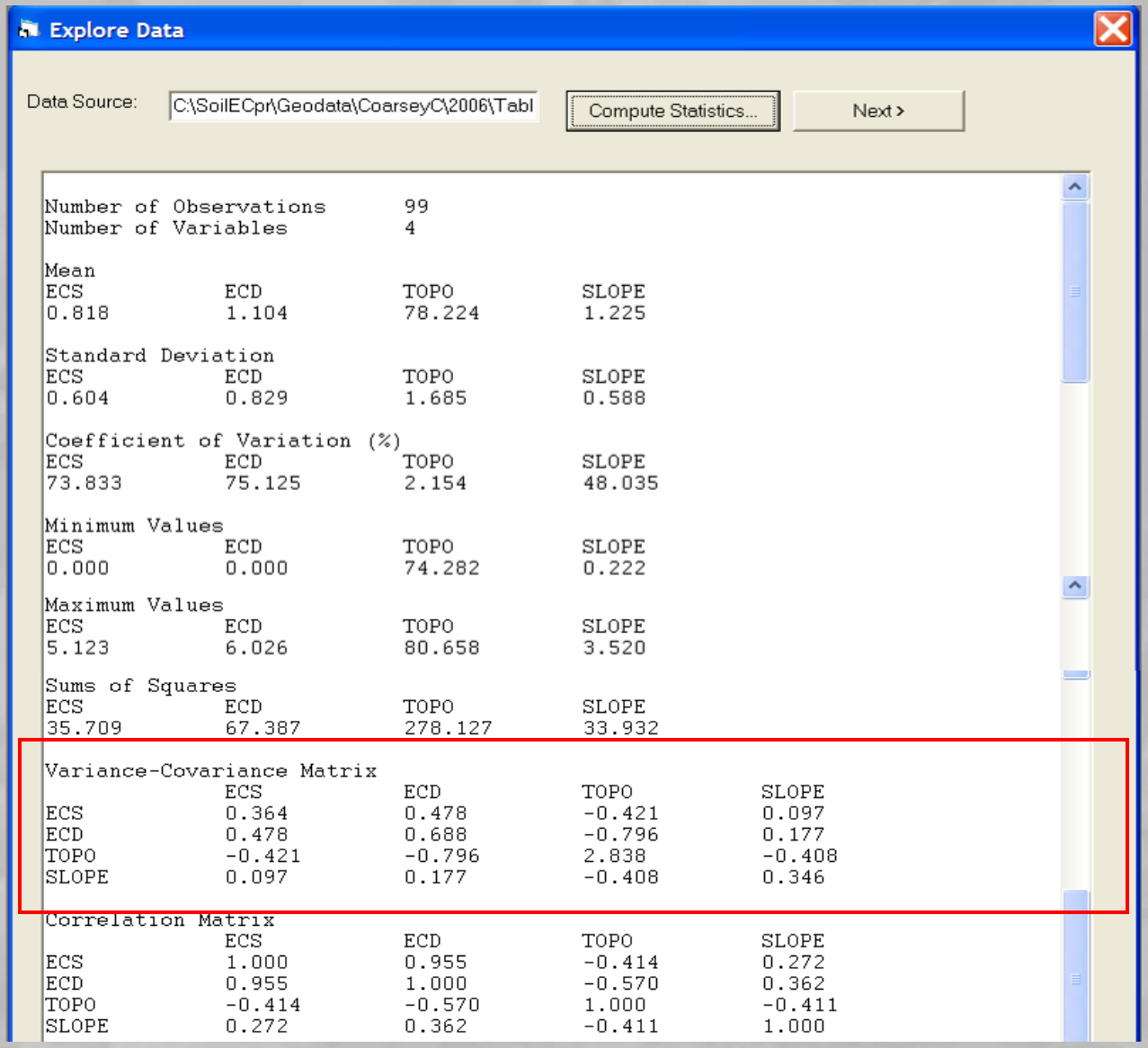

| | Easting | Northing | Shallow | Deep | Obs_ID | MZ2 | MZ3 | MZ4 | MZ5 | MZ6 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | -83.625 | 31.2727 | 0.7 | 0.7 | 1 | 1 | 1 | 4 | 3 | 6 |
| 3 | -83.625 | 31.27268 | 0.7 | 0.7 | 2 | 1 | 1 | 4 | 3 | 6 |
| 4 | -83.625 | 31.27268 | 0.7 | 0.7 | 3 | 1 | 1 | 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



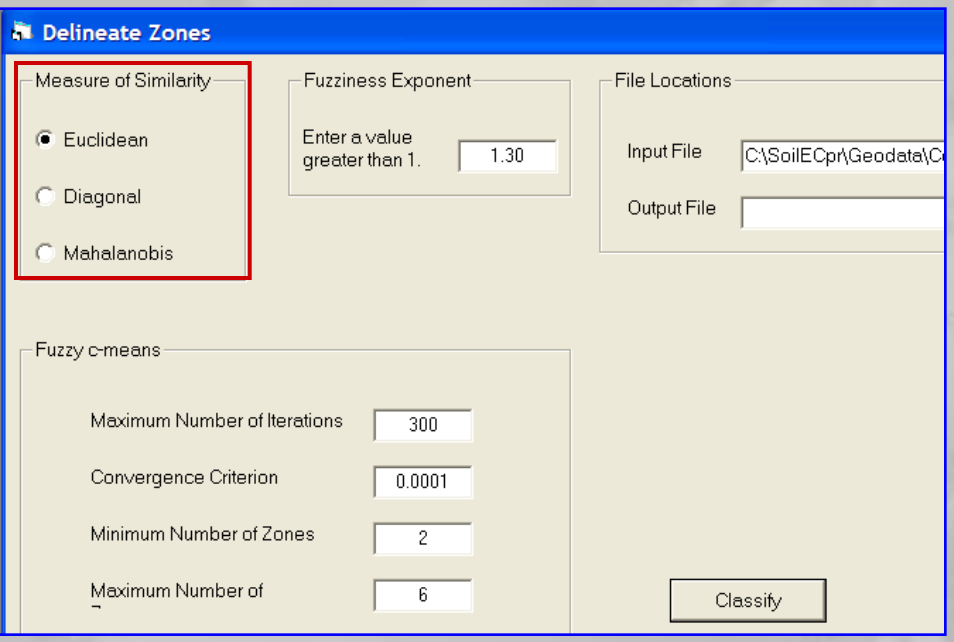
# MZA's Functionalities

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**

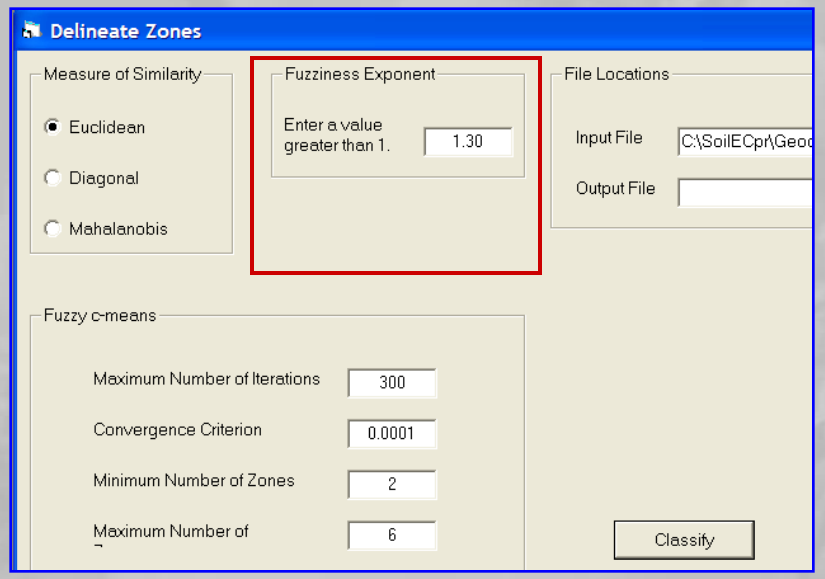
Variance-Covariance Matrix

| | 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



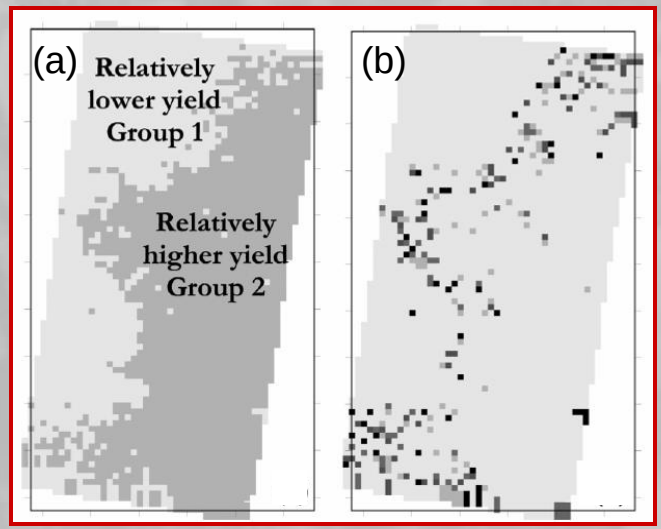

- MZA uses a Fuzzy unsupervised classification method.
- Observations can be members of more than one zone. This scenario usually occurs at the transitory areas (edges) between zones
- Fuzziness exponent ≈ 1 more distinct zones (i.e. no membership sharing)

**Example**:

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

(a) High and low yielding zones

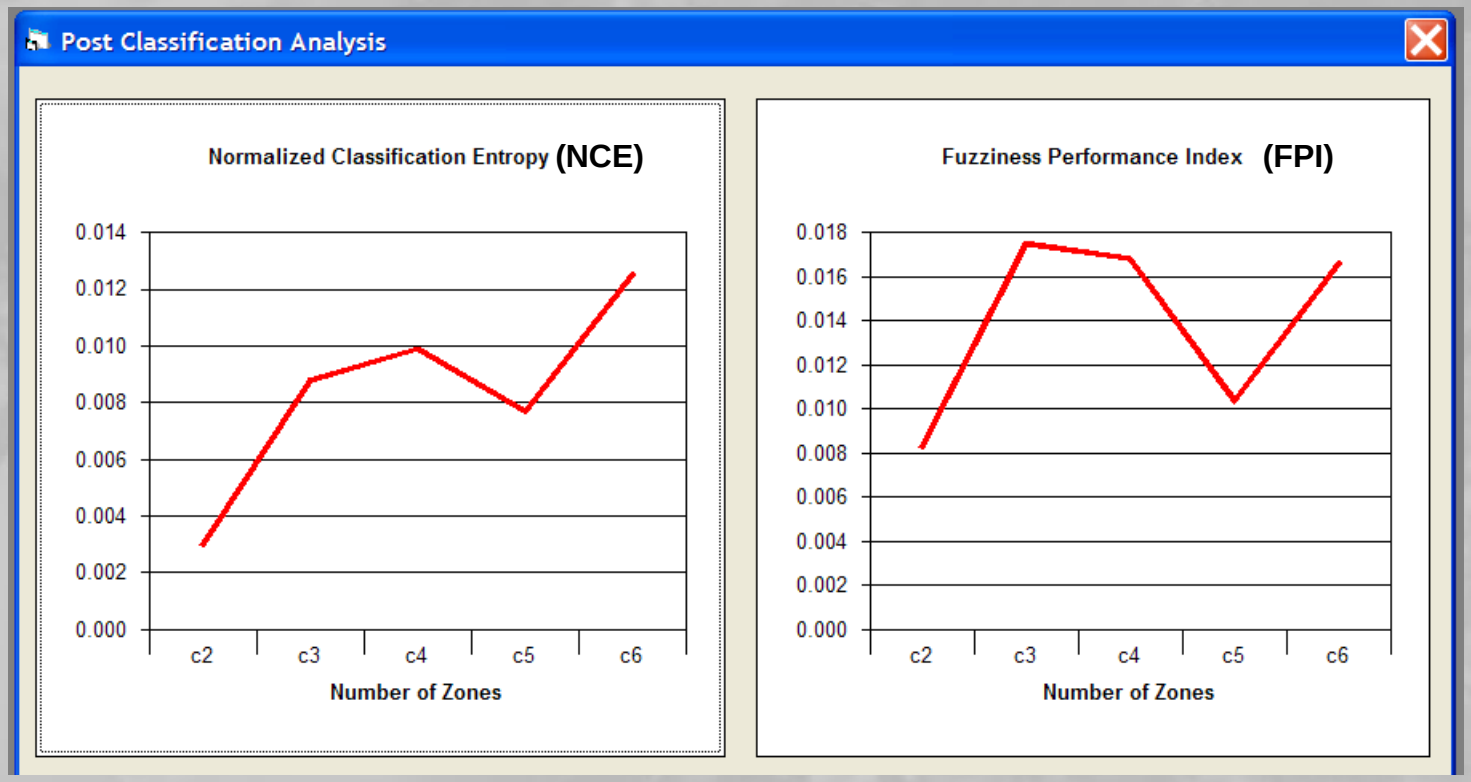
(b) The dark colors represent areas where membership is spread equally between the two zones



# 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".**

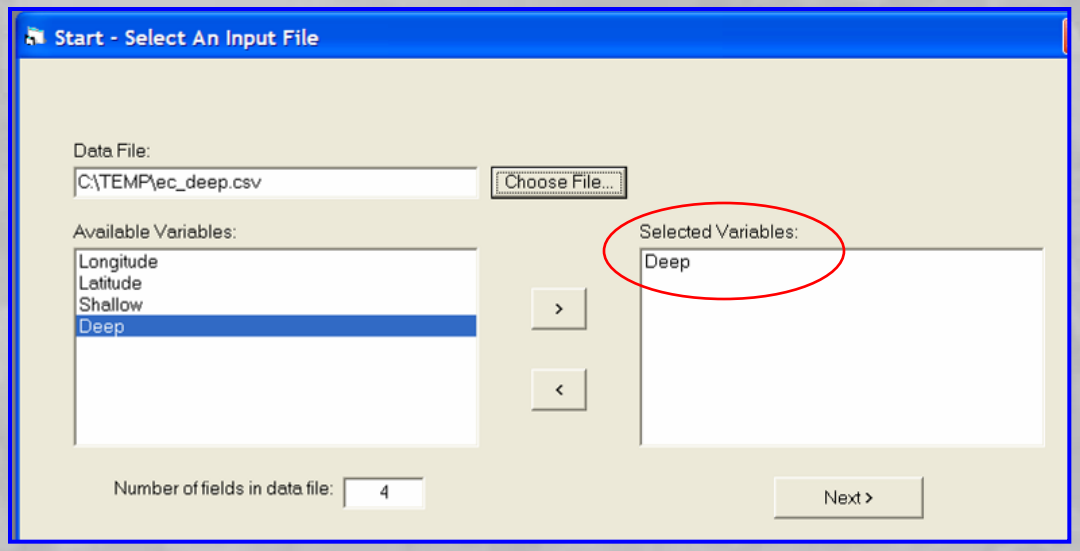
# Example : MZ based on $EC_a$-Deep data

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 |

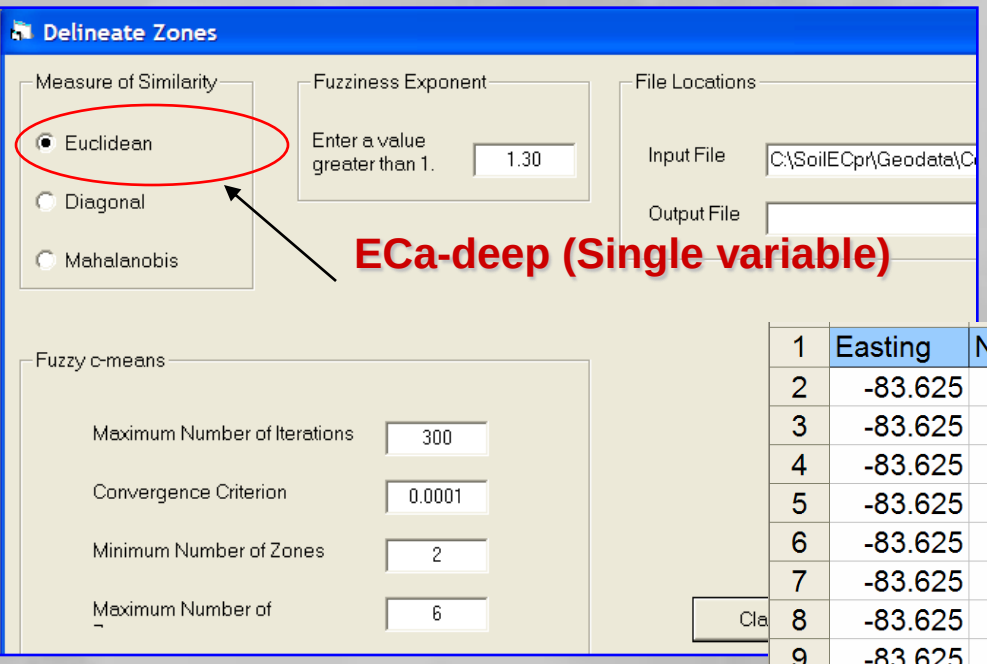
2. Selecting the variable(s) for the zones delineation



# 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