

# Spatial Mapping of Heterogeneous Strain Patterns Using GIS

Roy H Miller III

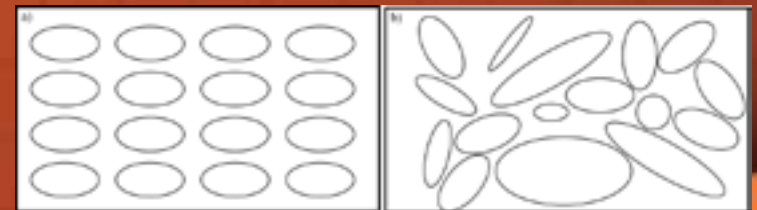
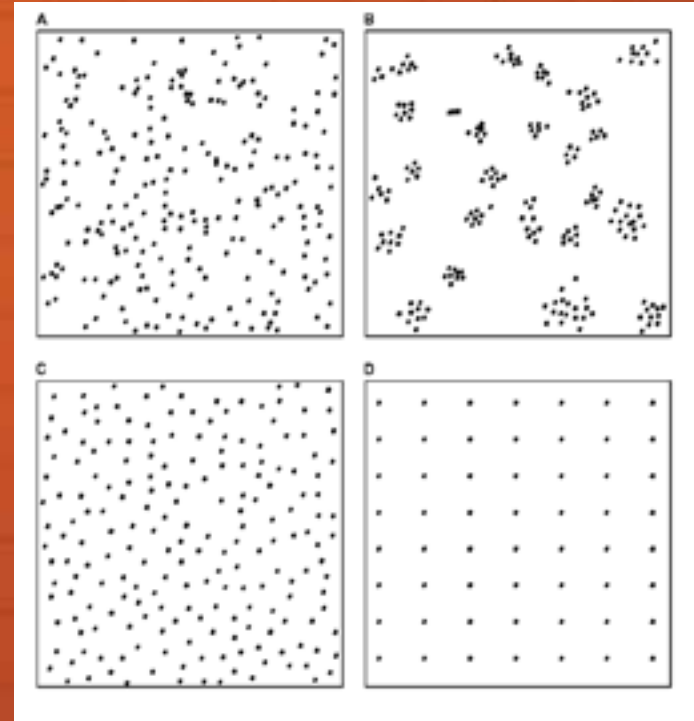
Bowling Green State University

# Overview

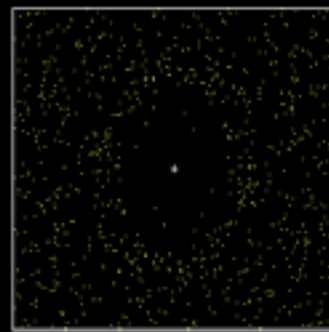
- Introduction
- Background
- Data
- Methodology
- Results and Discussion
- Conclusion

# Introduction

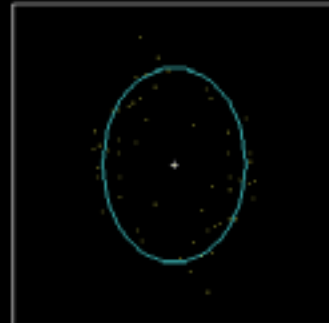
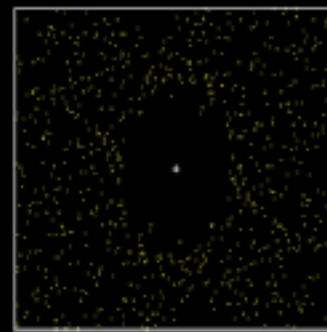
- Strain and stress on a rock
- Strain like pages to part of a story of the rock
- Finite strain analysis
- Problems with conventional finite strain methods
- Need for more thorough methods



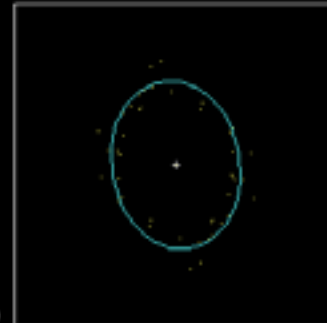
FRV PLOTS



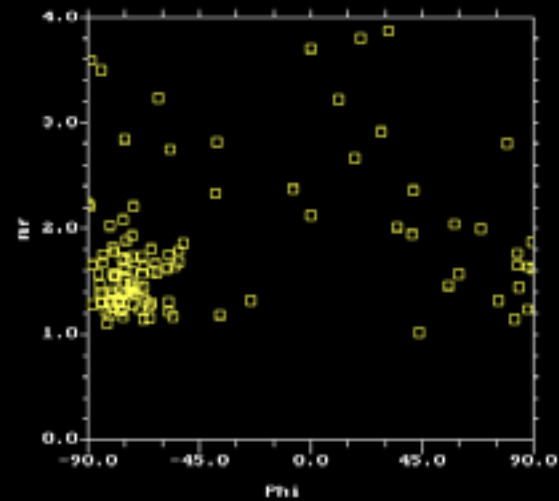
NORMALIZED FRV PLOTS



SF=1.00



Object Ellipticities



Ellipticity (e):  
 Range (n = 169): 1.012 to 3.877  
 Arithmetic Mean: 1.747 +/- 0.624  
 Harmonic Mean: 1.597

# Objectives

- 1) To assess the nature and cause for the degree of spatial heterogeneity of strain in deformed oolites at different scales.
- 2) To compare the results of this method with the Fry method, its enhancements, and the  $R_f/\phi$  method in order to show limitations with using those conventional methods as oppose to this one.

# Background

- Strain Analysis
- GIS in microscopic analysis
- Conventional Methods
  - Fry Method
  - $R_f/\phi$
  - Assumptions
    - Prefer dispersed data
    - Strain homogeneity
- Spatial Statistics

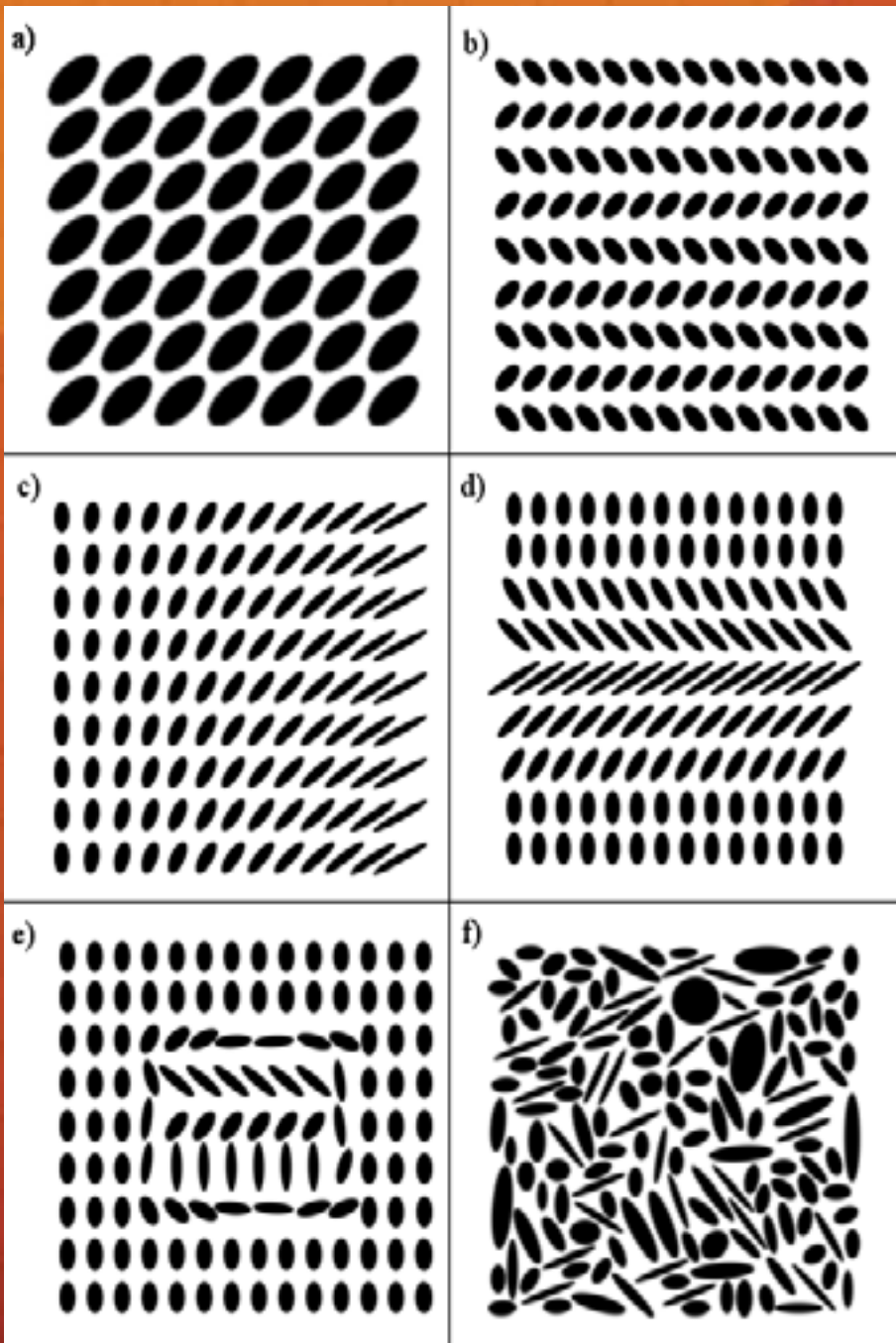
# Data

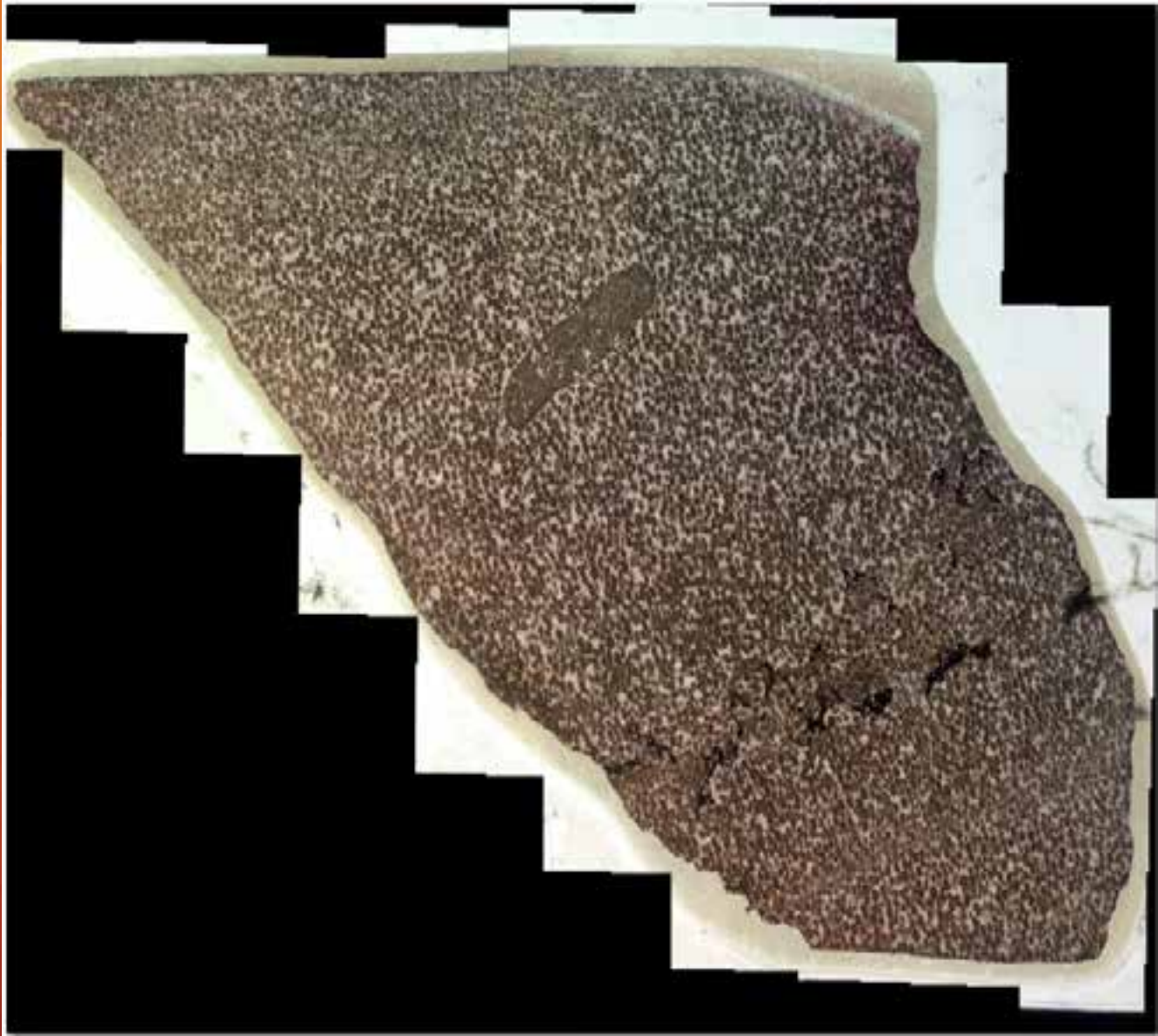
- Variables
  - Orientation
  - Strain Magnitude (Major/Minor Axes)
- Synthetics (Adobe Illustrator)
- Natural: Ordovician Beekmantown Dolomite

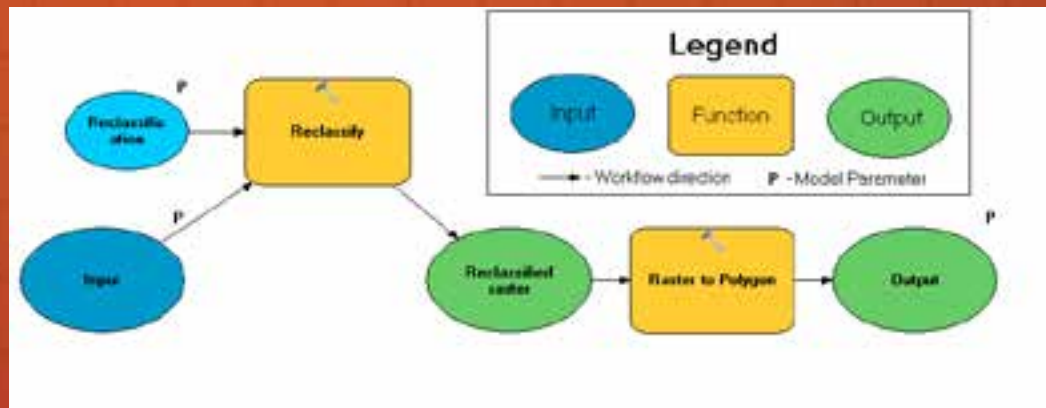
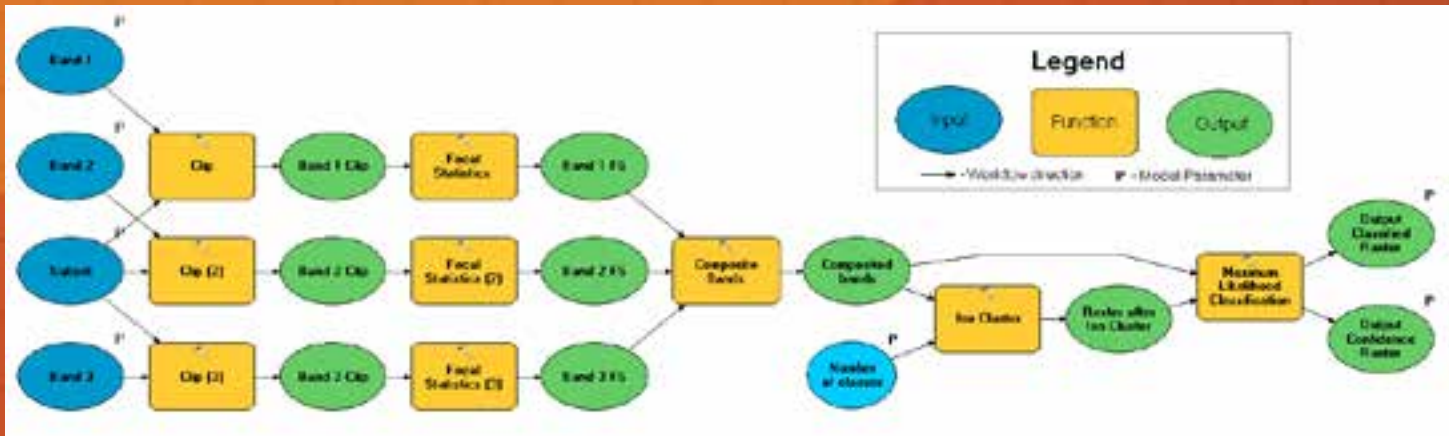
# Methodology

- Exploratory Statistics
- Distribution analysis (Global Moran's I)
- Cluster analysis
  - $G_i^*$  Statistic (Hot Spot)
  - Local Moran's I
- Create Map Composite
- T and F tests between cluster and whole data
- Measuring heterogeneity using semivariograms
- Comparison of method with Fry and Rf/phi methods

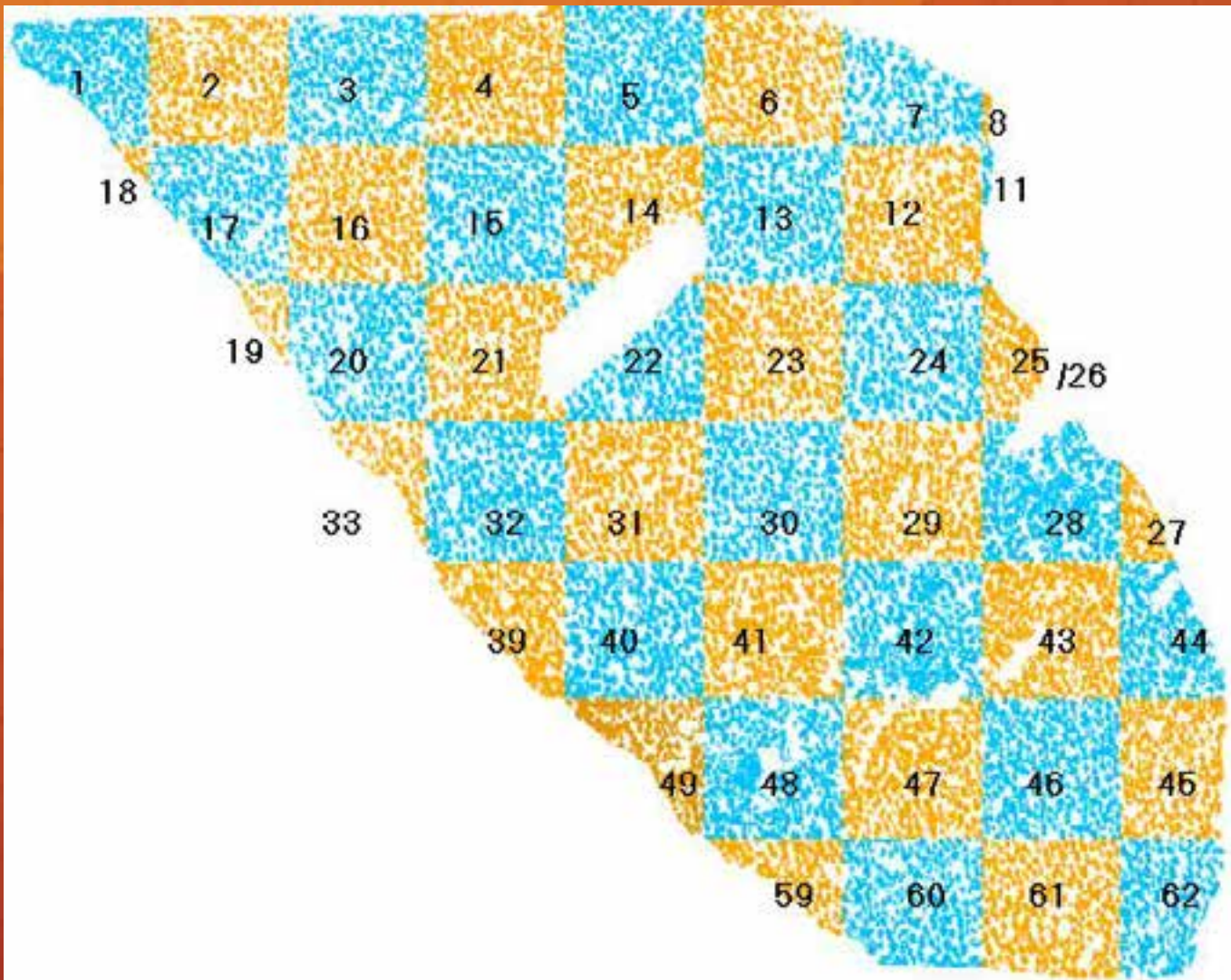


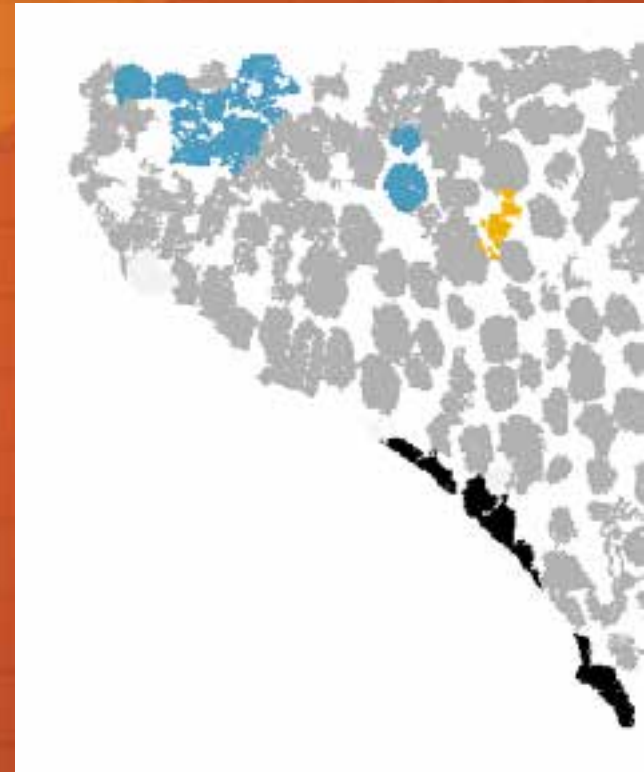
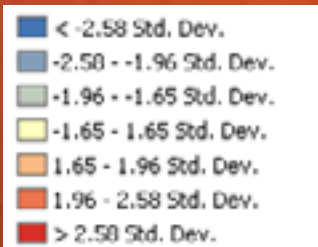
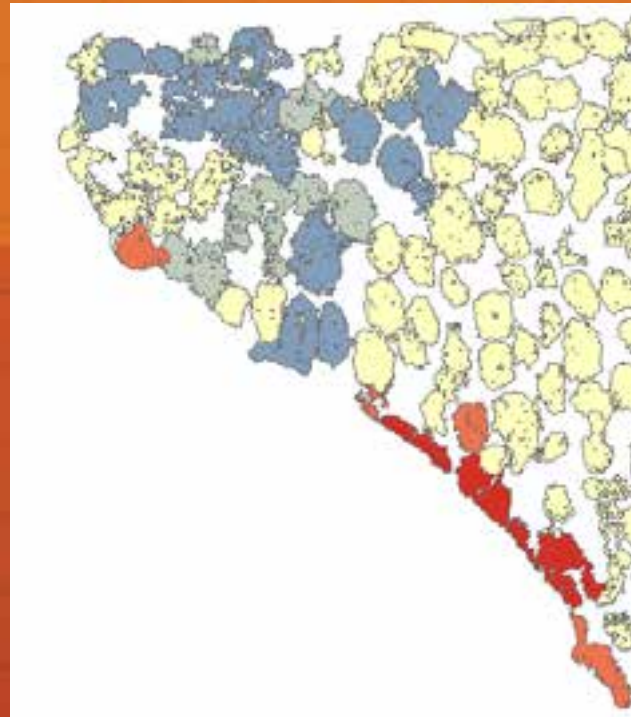








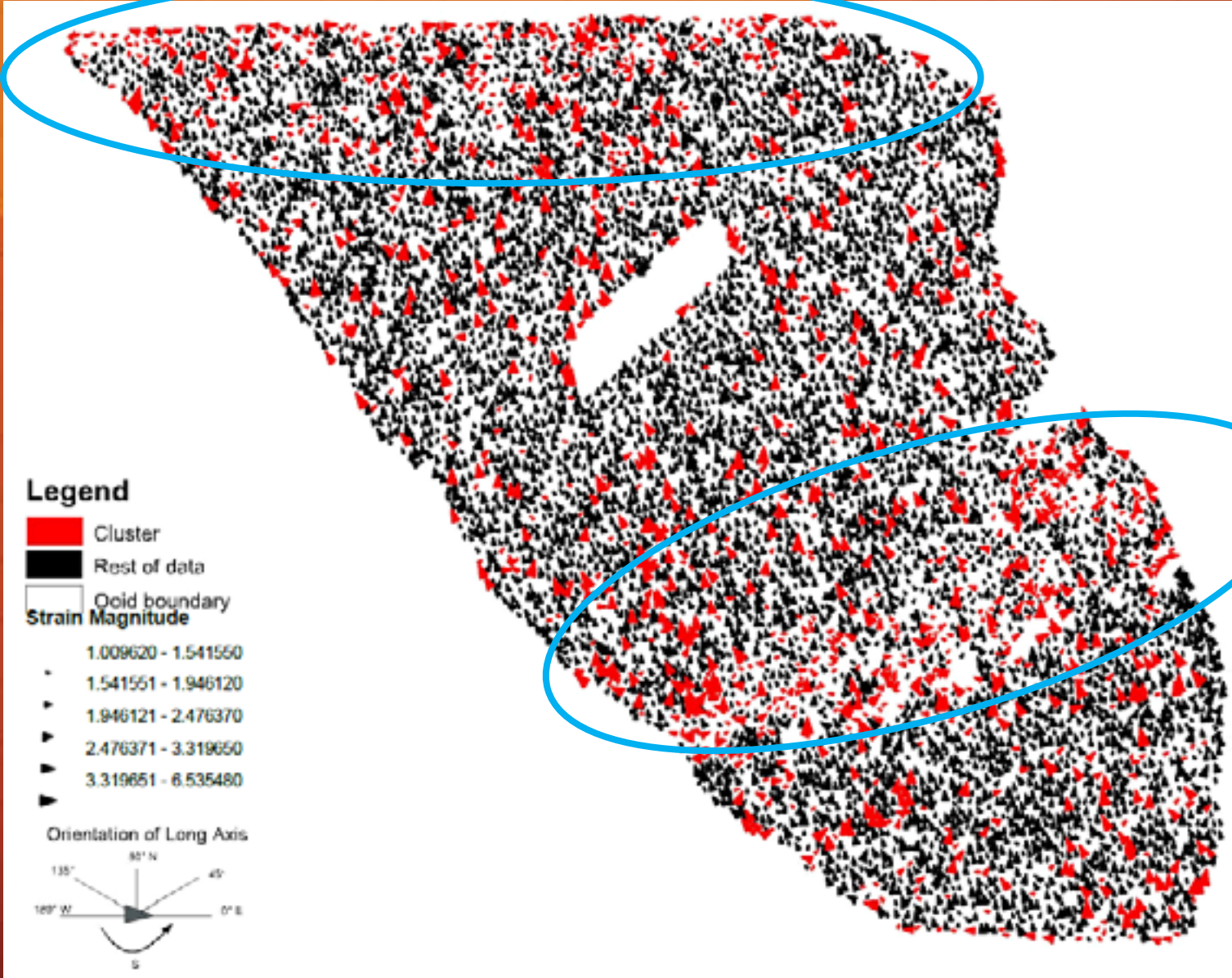




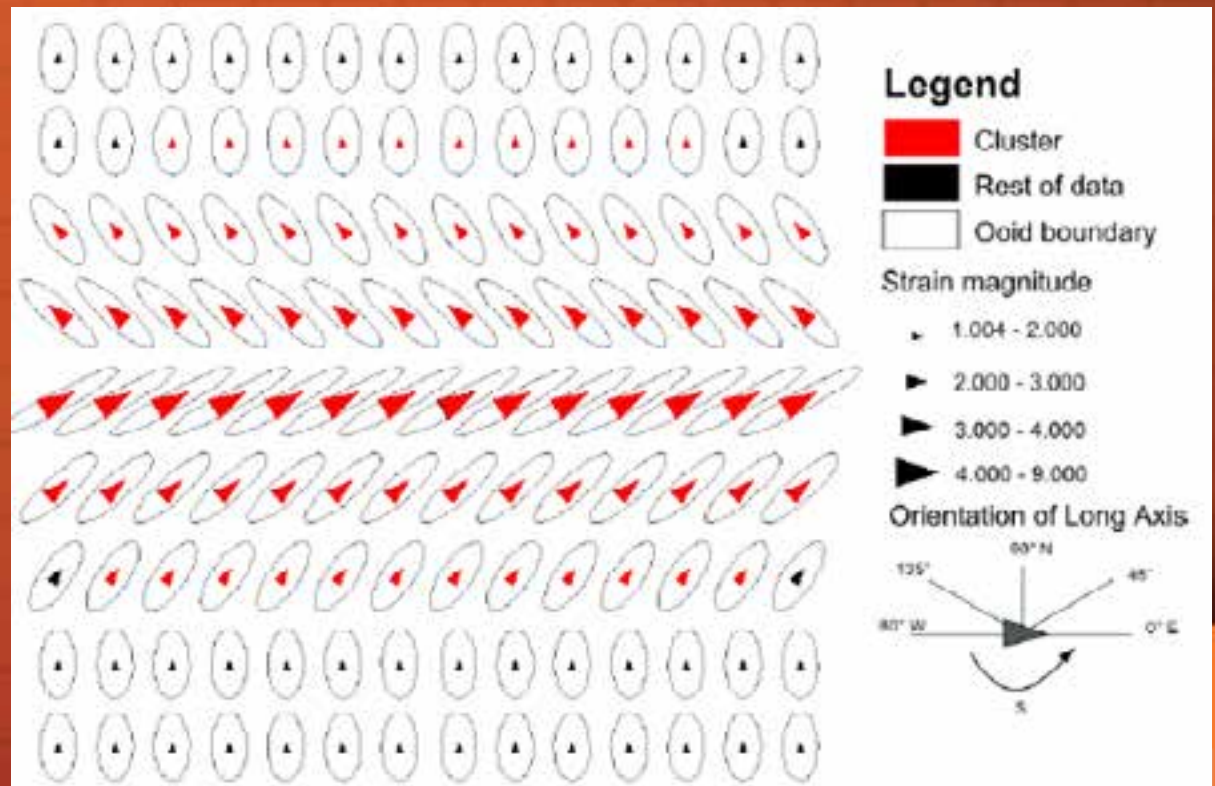
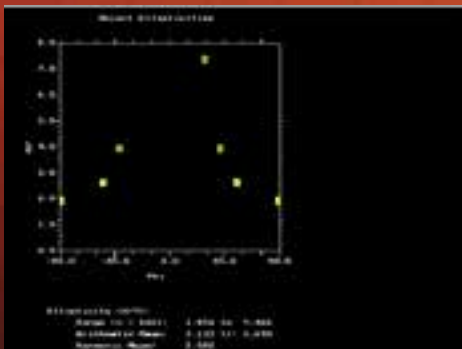
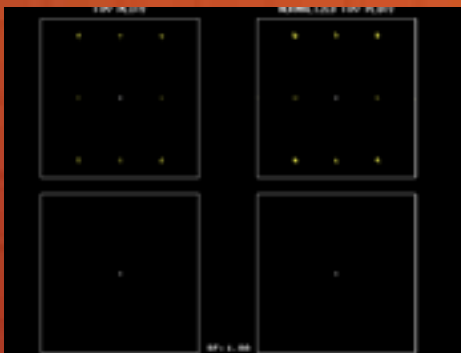
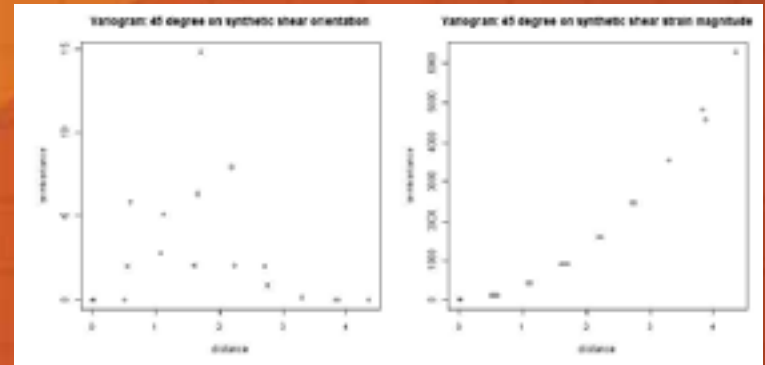
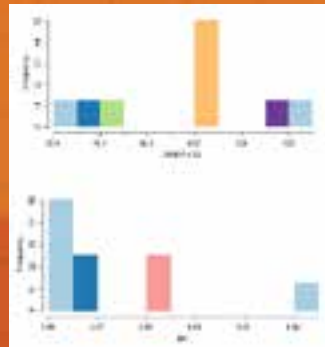
# Results

- Histograms and box and whisker plots
  - Overlook on data
  - Means
- Distribution
  - Some dispersed and clustered
  - Mostly random
- Omnidirectional semivariograms
- Directional semivariograms show anisotropy
- Maps were created
- T and F tests
  - Orientation (Pass) T 41/44 F 39/44
  - Strain magnitude (Pass) T 5/43 F 28/43
- Fry and Rf/phi plots were created



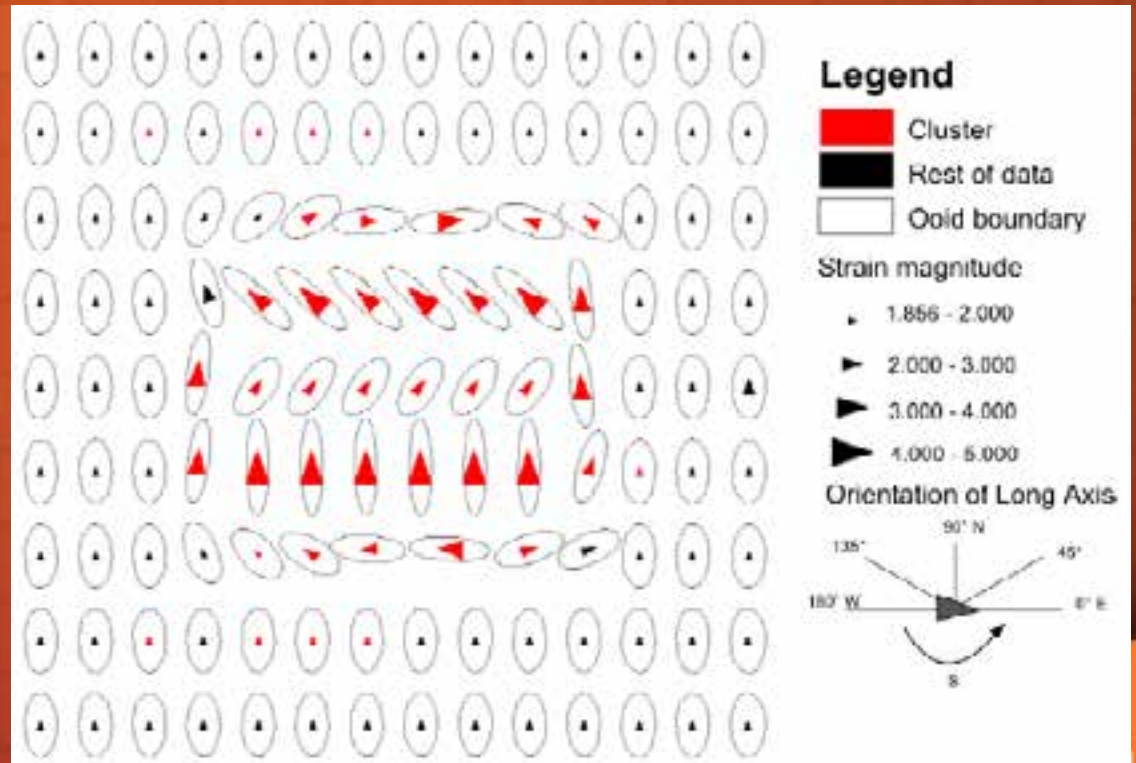
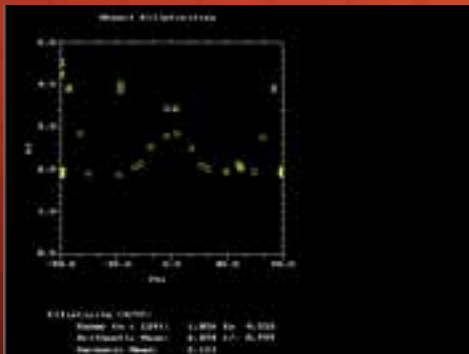
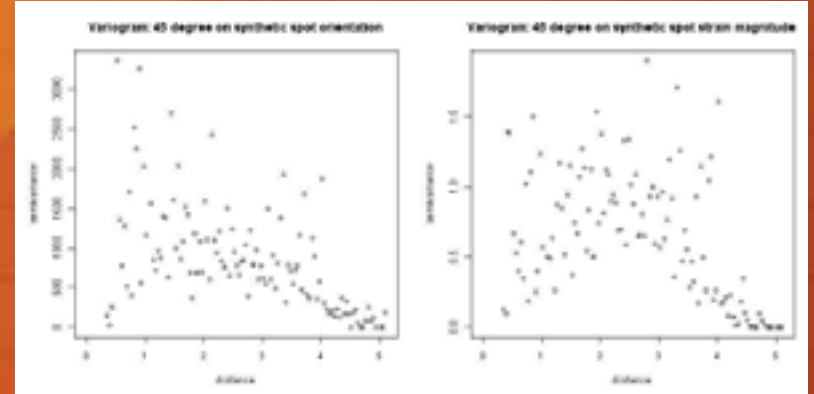
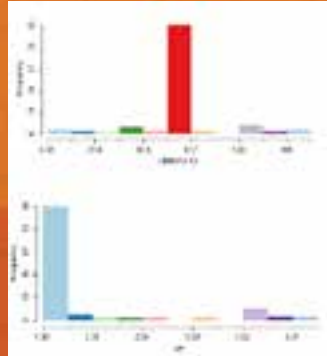


# Shear

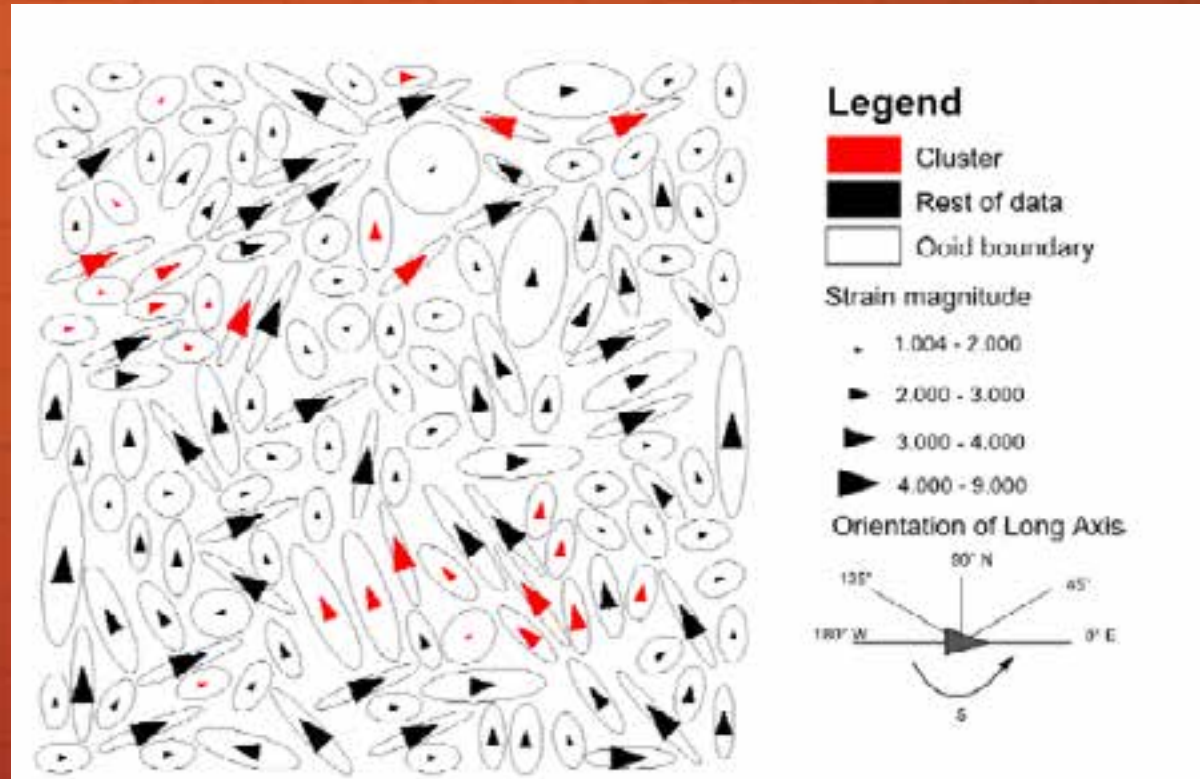
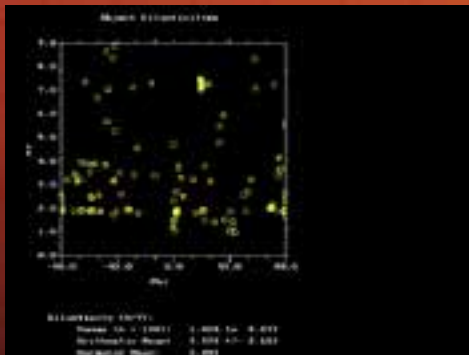
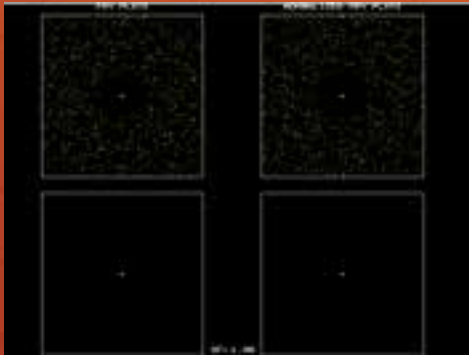
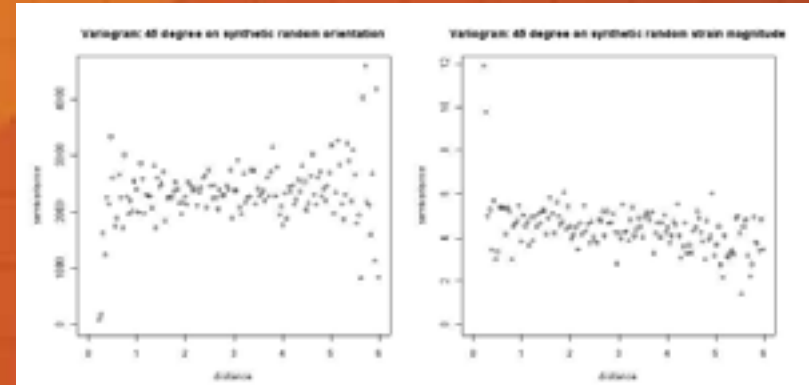
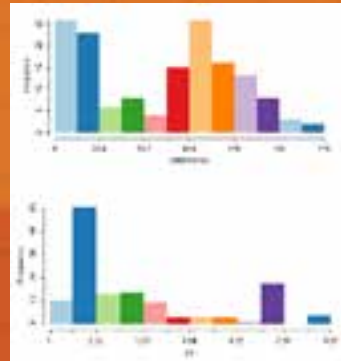




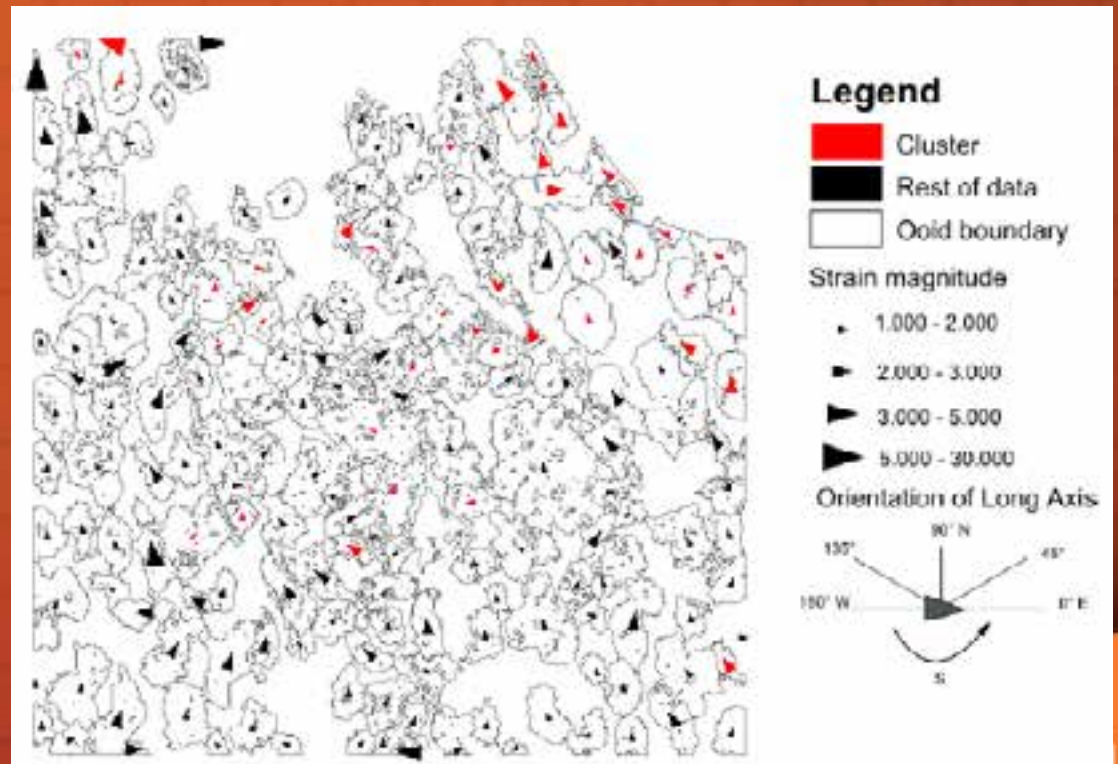
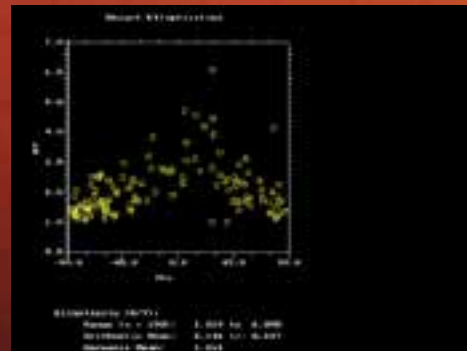
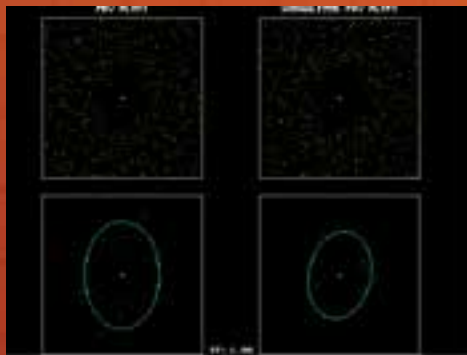
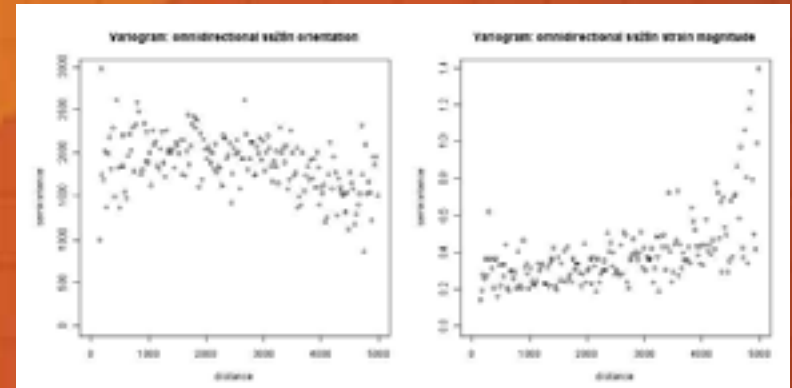
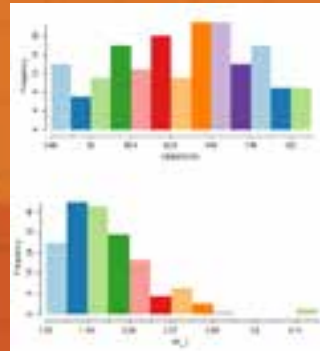
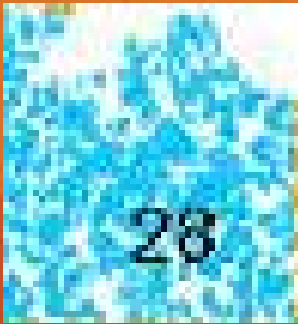
# Spot



# Random

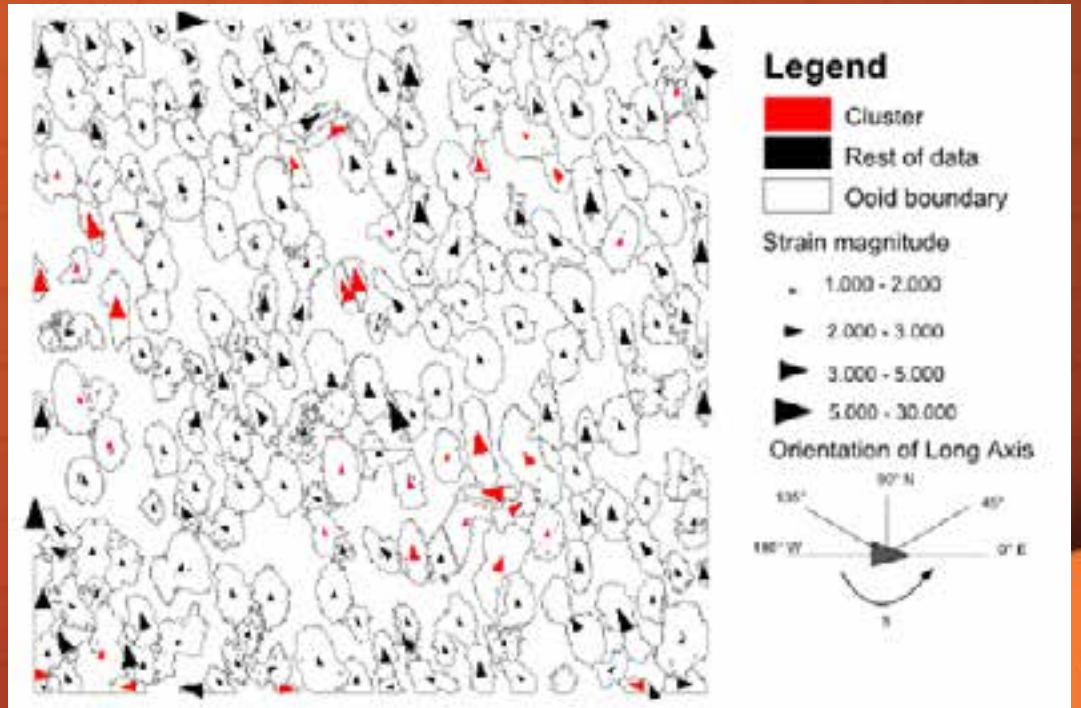
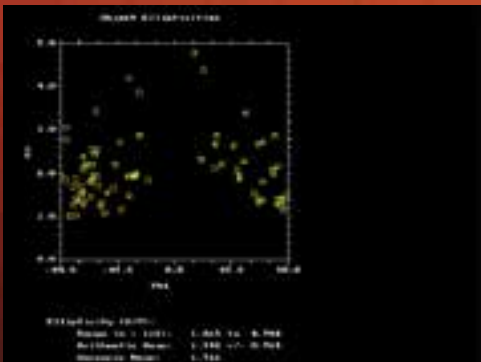
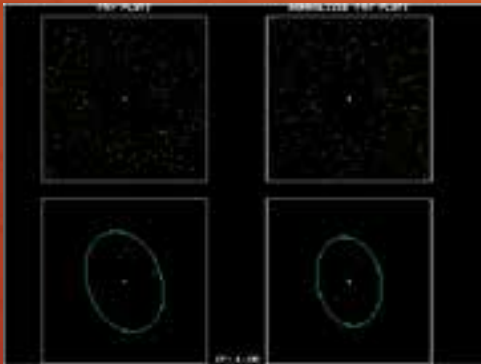
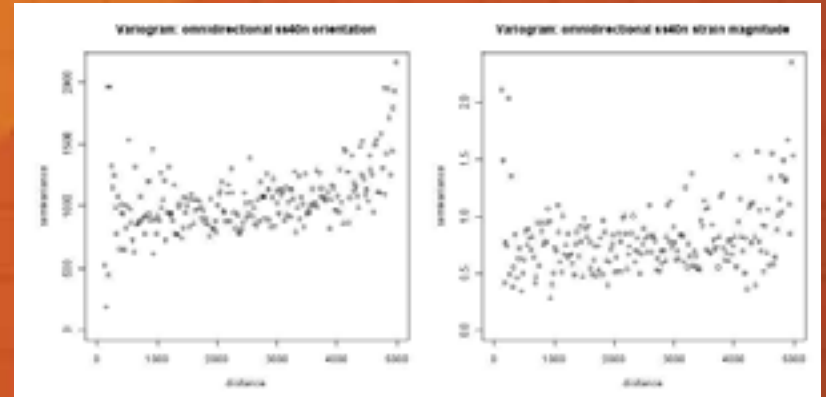
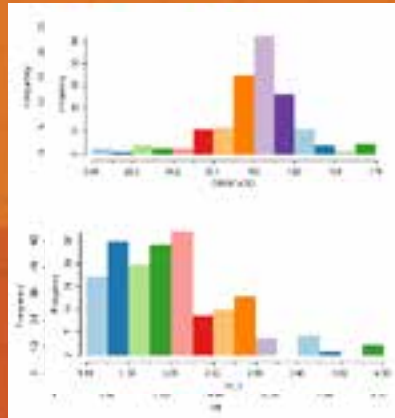
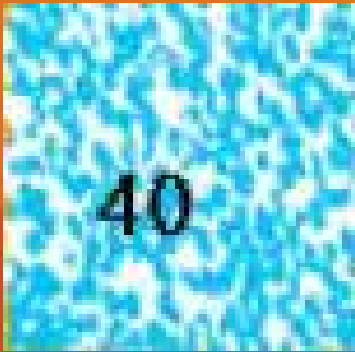


# Subset 28





# Subset 40



# Further Discussion

- Further Use for method
- Highlighting clusters
- Showing direction and magnitude

# Conclusion

- Strain analysis
- Thorough GIS based method
- Explore statistics of data
- Use of spatial statistics
- Compiling clusters and mapping
- Measuring heterogeneity
- Statistical testing
- Comparing with conventional methods

¿Preguntas?

Questions?