



# **ΕΙΣΑΓΩΓΗ ΣΤΟ GIS**

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# What is GIS?

- GIS – Geographic Information Systems
- Software package that allows a user to:
  - Create maps
  - Organize, manipulate and analyze information contained in maps
- GIS packages vary in complexity and cost
- Specialized ag GIS packages now available

# The nature of geographic problems

The structure of the real world

- Complex
- Dynamic
- Natural components
- Planned components



# What does GIS enable us to do?

The 5 Ms of GIS (Longley et al., 2001)

1. Mapping

“A diagrammatic representation of features (e.g. woods) or phenomena (rainfall) that includes location, orientation and scale information”.

2. Measurement

“the act or process of measuring” (Dictionary definition)

“involves a quantity, units and a measurement scale”

3. Monitoring

“intermittent surveillance (regular or irregular) to ascertain extent of compliance with pre-determined standard, or departure from expected norm” (Academic definition)

# What does GIS enable us to do?

The 5 Ms of GIS (Longley et al., 2001)

## 4. Modelling

“cartographic modelling and map algebra (inherently 2D and static)”

“simulation modelling of physical processes, i.e. transport of material, energy, (3D and dynamic in time)”

## 5. Management

“the technique, practice, or science of managing or controlling” (Dictionary definition)

“everybody agrees there is a need for better management of resources” ... “better management requires informed decisions” ... “informed by analysis of relevant data, i.e. need understanding”

# Definition(s) of GIS

An organised collection of computer hardware, software and people for the input, storage, update, display, manipulation, analysis and combination of all forms of spatially referenced data

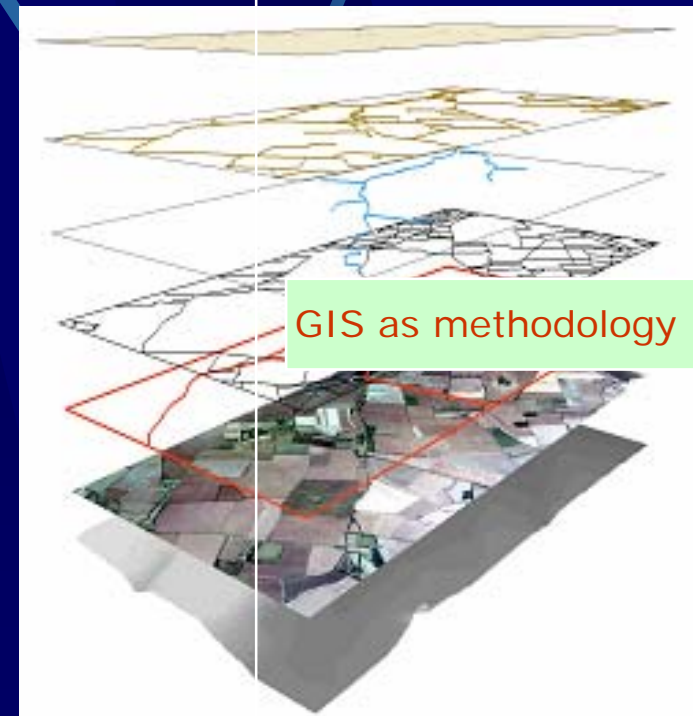
Source: ESRI 1997

'A GIS is a system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which are spatially referenced to the Earth' (Department of the Environment 1987). Department of the Environment, 1987. Handling Geographic Information. Report of the Committee of Enquiry chaired by Lord Chorley. HMSO, London.

Grimshaw (1994), Bringing GIS into Business, defined GIS as 'a group of procedures that provide data input, storage and retrieval, mapping and spatial analysis for both spatial and attribute data to support the decision-making activities of the organisation'.

Clark (1992), The GIS Survival Guide, GeoData Institute, Southampton, GIS is a complete approach to your operations, analysis and decision support.'

GIS as a tool

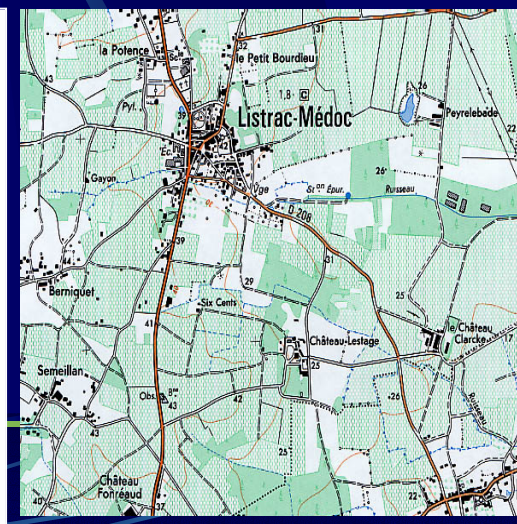
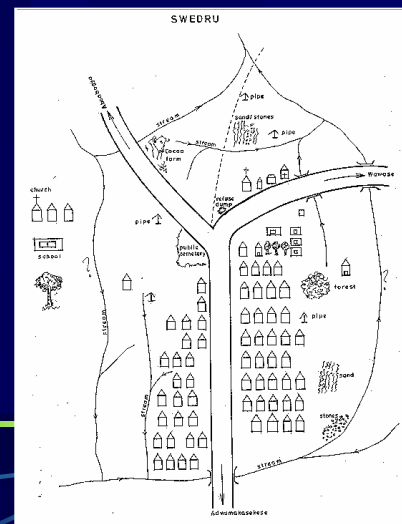


GIS as methodology

GIS as a science

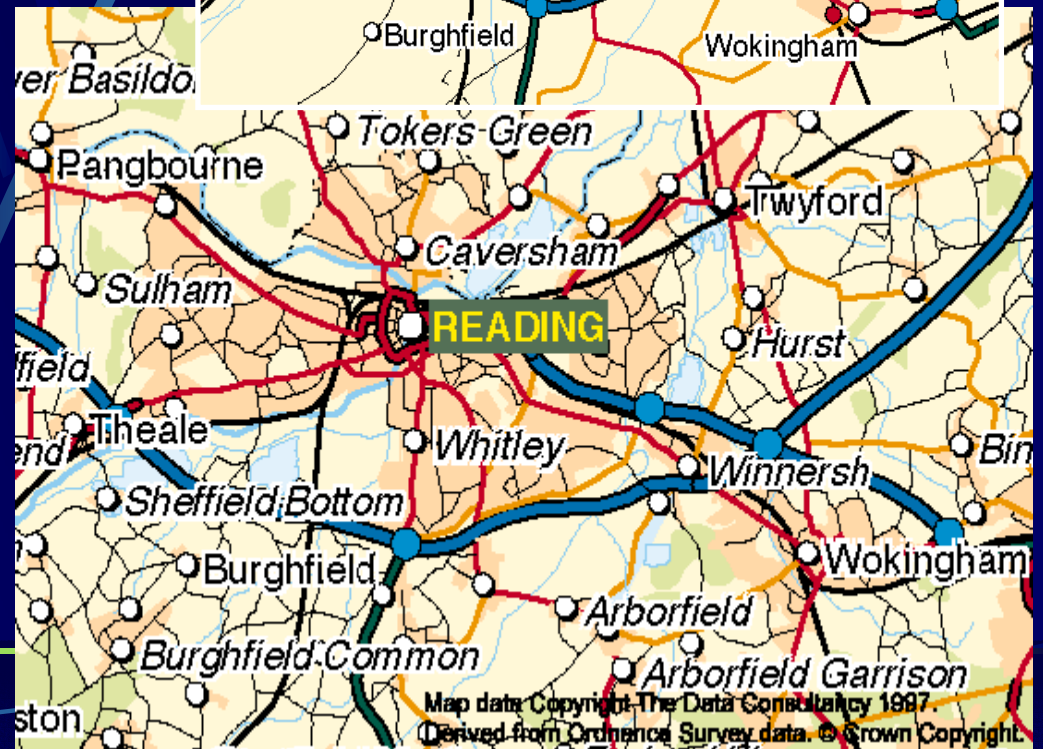
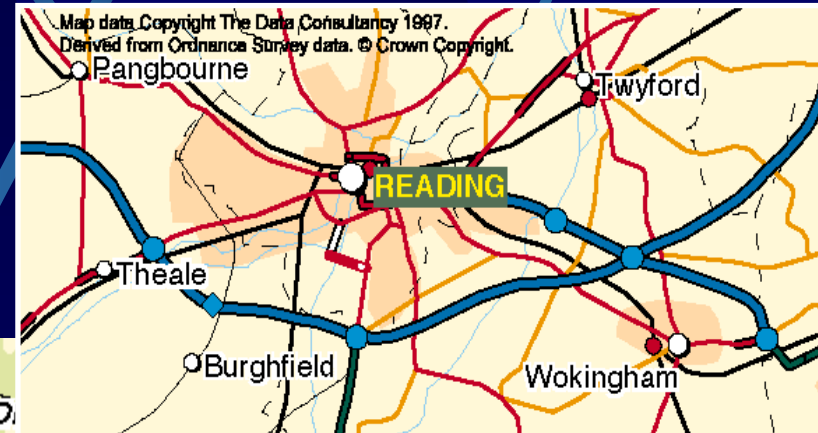
# Conceptual models of the “real world”

- Maps
- Tables of data
- Text based description
- Artistic images
- Mental Images
- Digital images



# The Map

- Selection
  - based on a set of rules
  - perception
- Classification
- Description
- Representation





# The building blocks – entity model

- Entity (or object)

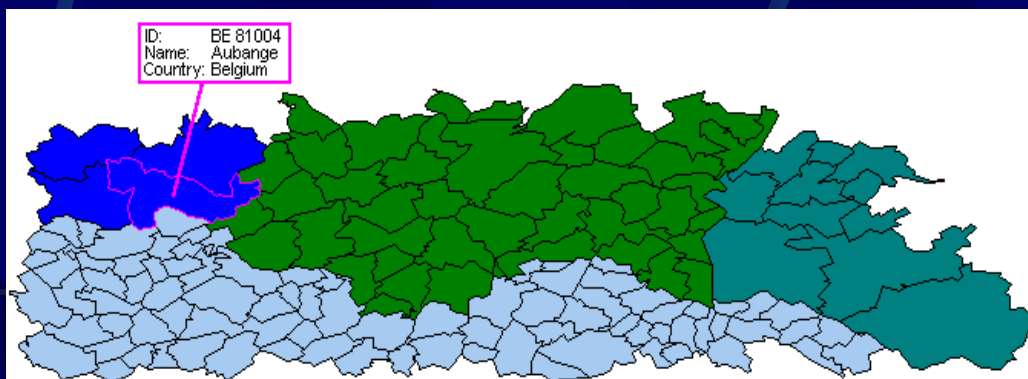
- feature that can be mapped
- it has a spatial location
- identifiable
- characteristics

- Attribute (or characteristic)

- data about entity
- one entity can have many attribute

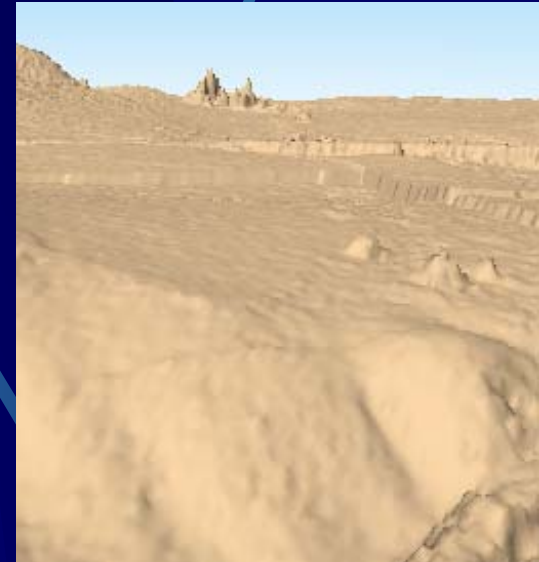
- Spatial Relations (through topology)

- adjacency, connectivity, proximity, and coincidence



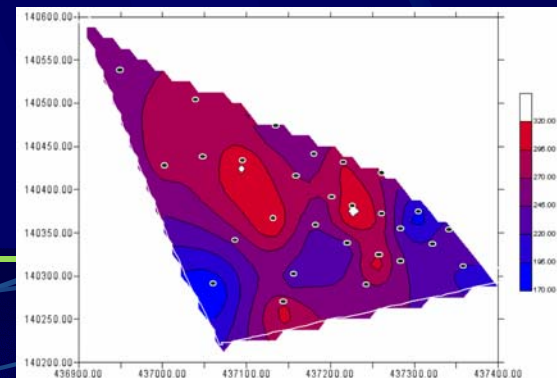
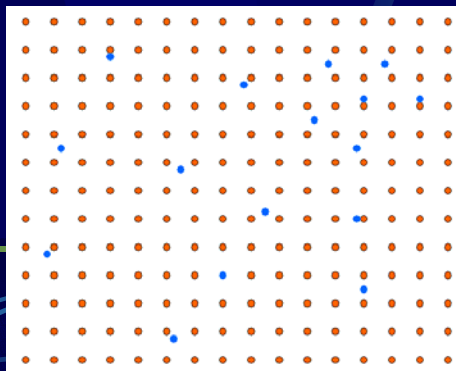
# Models of the “real world”

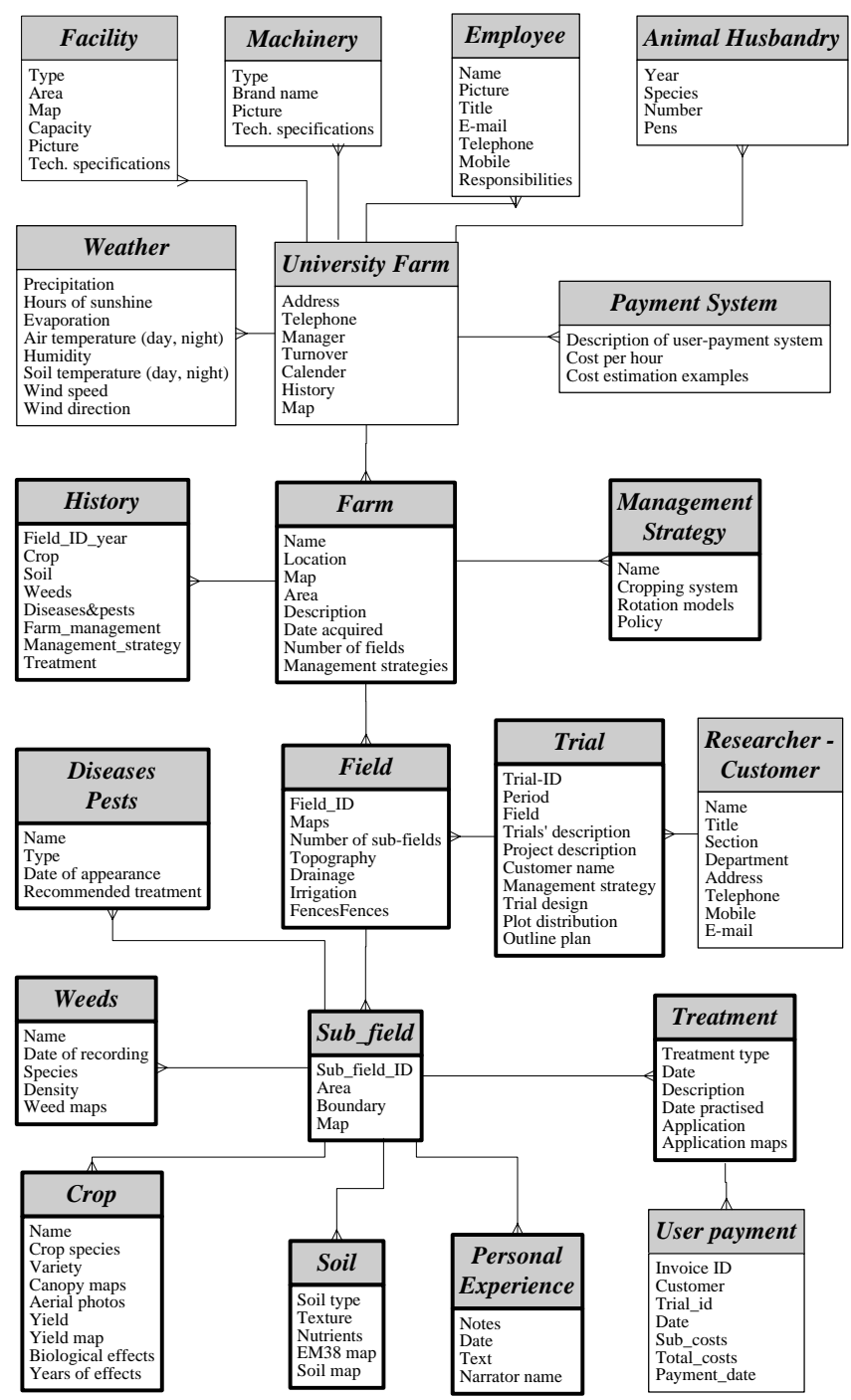
- some phenomena are not well represented by the entity model
- elevation, crop yield, temperature and soil chemistry are good examples
- they exist everywhere i.e. are continuous within defined boundaries (every point has an elevation or temperature)
- they are not discrete entities
- do not have discontinuities



# The building blocks – field model

- bounded, e.g. agricultural field boundary, country boundary
- sample (based on proper spatial sampling design methodology) of results of a measurement process (magnitude, units, uncertainty) – analogous to attributes of entity model
- model (usually mathematical) for creating a continuous surface from sample observations
- pixel size – means of approximating the continuum
- assessment of quality of modelled field (observed – modelled)





# Systems Analysis of the information in farm office

## Information Analysis of the KVL University Farm

### Entity Relationship Diagram for KVL UF

# Systems Analysis of the information in farm office

## Information design for the KVL University Farm



PDA's design and implementation

*Martin Kyhn*

# What are the components of GIS?

5 components of GIS

- A computer technology
- Some spatial Data
- A range of functions
- The implementing organisation
- A body of knowledge

# What is unique about GIS?

Spatial = any data organised within a multi-dimensional frame

Geo(graphic) = representing the surface of the earth

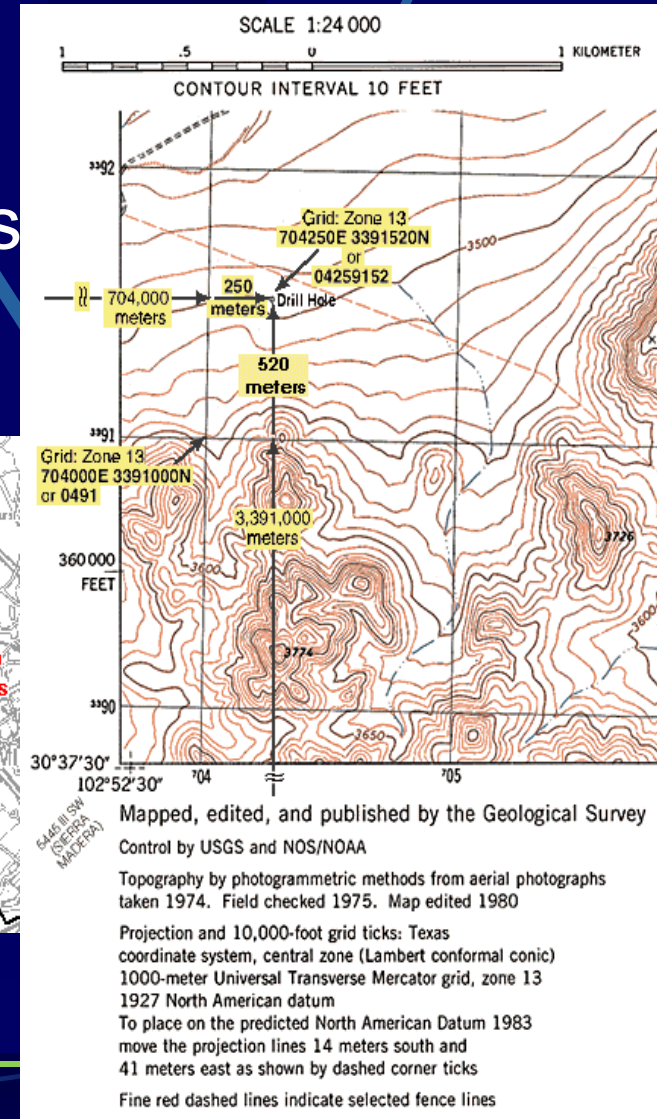
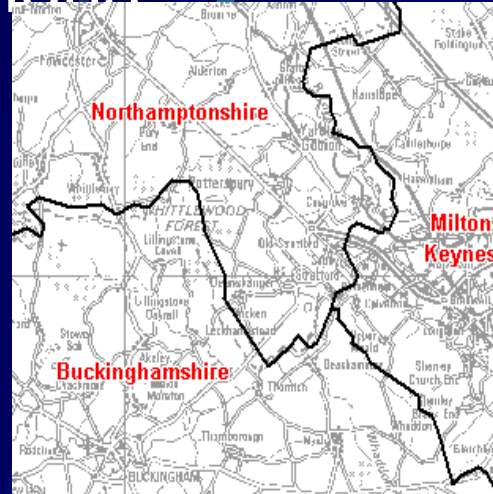
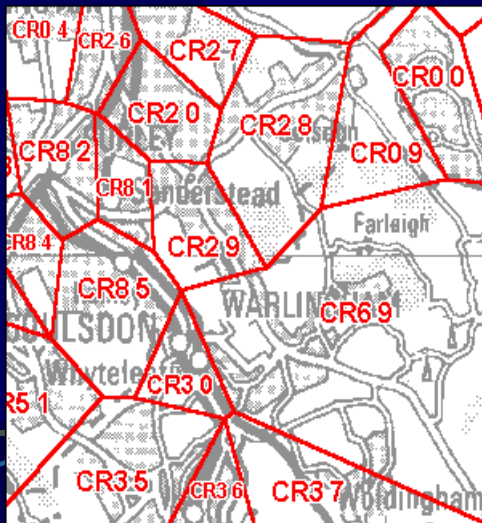
Data are spatially referenced or are linked to spatially referenced objects

Information is communicated to the user through maps or tabular data associated with maps

GIS is a multi disciplinary tool

# SPATIAL LOCATION OF ENTITIES: WHERE ON EARTH ARE WE?

- Geographic coordinates
- Cartesian (projected) coordinates
- Postal codes
- Administrative regions





# Spatial Data

- Digital map data
- Aerial photographs
- Field data
- Remotely sensed images
- Paper maps and plans
- Socio-economic data
- DIGIMAP
- Local authorities/Cities Revealed
- GPS readings/field surveying
- NRSC (Landsat)
- Field sketches, historical maps, plans
- Census of population, questionnaires

# Spatial data - analogue vs. digital

## ● Analogue

- paper maps
- printed aerial photographs
- tables of statistics

## ● Fixed scale

## ● Need to be converted to digital format

## ● Digital

- digital data files
- remotely sensed images
- GPS output files

## ● Scale 'free'

## ● File format predetermined

## ● Download or copy

# Functions

- Input - manual or digital
- Display - by object or attribute
- Simulation - 3D
- Selection - by multiple criteria
- Measurement
- Reclassification
- Overlay
- Connectivity
- Neighbourhood analysis
- Relational DBMS
- Output - hardcopy or digital
- A method to visualize, manipulate, analyze, and display spatial data
- “Smart Maps” linking a database to the map

# GIS Analysis

- Includes functions for:
  - storage and retrieval including presentation of data
  - constrained queries that allow the user to look at patterns in the data
  - modelling procedures or functions for the prediction of what data might be at a different time and place

# GIS Analysis

- Measurement

- distance, area, perimeter

- Query

- spatial, attribute

- Buffering

- inside, outside

- Neighbourhood operations

- reclassification

## Interpolation

- prediction

## Surface analysis

- slope, aspect, viewsheds

## Network analysis

- routes
- supply and demand

## Overlay

# GIS and Precision Ag

- GIS in Precision Ag is used to organize, manipulate and analyze data layers collected from fields
- Examples of data layers
  - Soil types
  - Soil nutrients
  - Soil pH
  - Elevation (topography)
  - Yield
  - Weed prone areas
  - Past insect infestations
  - Field boundaries
  - Management Zones

# Important Data Parameters

- Data must have certain attributes to be used in GIS analyses
  - Most importantly, data must be geo-referenced
  - Geo-referenced means that each datum is associated with its own latitude and longitude

# Base Maps

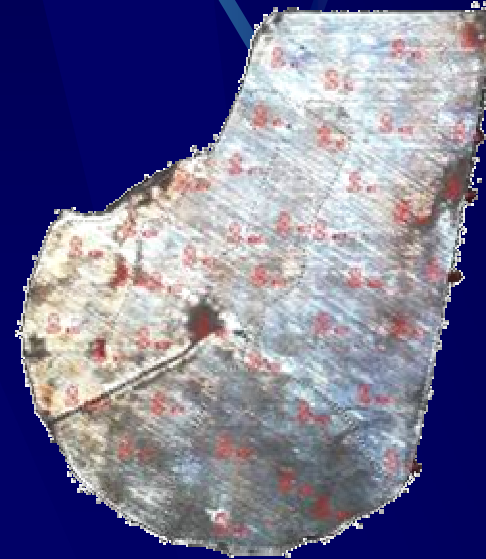
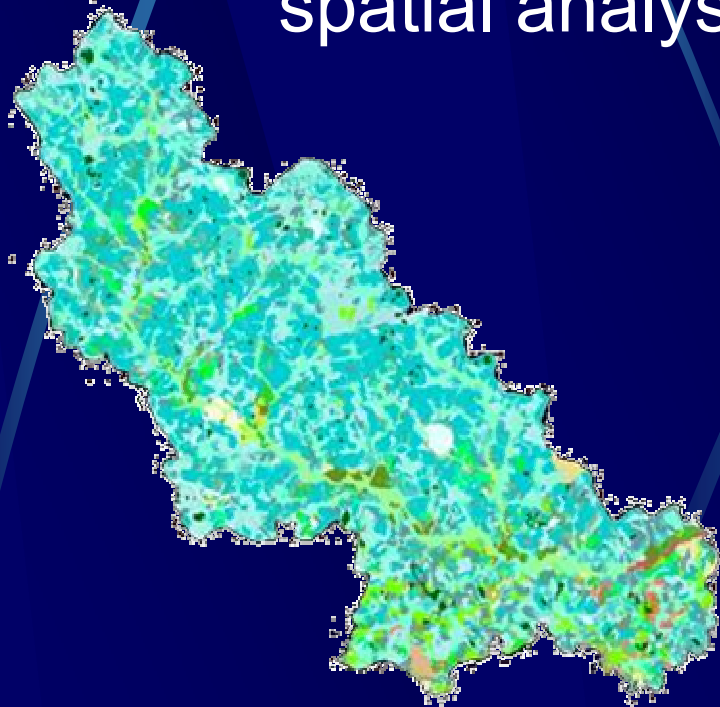
- Aerial photographs
- Road networks
- Hydrography
- Landcover
- Many others





# Most Used GIS Packages

- ESRI *Arc/Info* or *ArcView* for spatial analyses
- ERDAS *Imagine* for satellite image and aerial photo interpretation



# GIS for Ag Applications

- Farm Site
- SSToolbox
- JDOffice (John Deere)
- Instant Yield Map (Case IH)
- AgInfo GIS
- SMS Basic (AgLeader)
- Golden Software (Surfer)



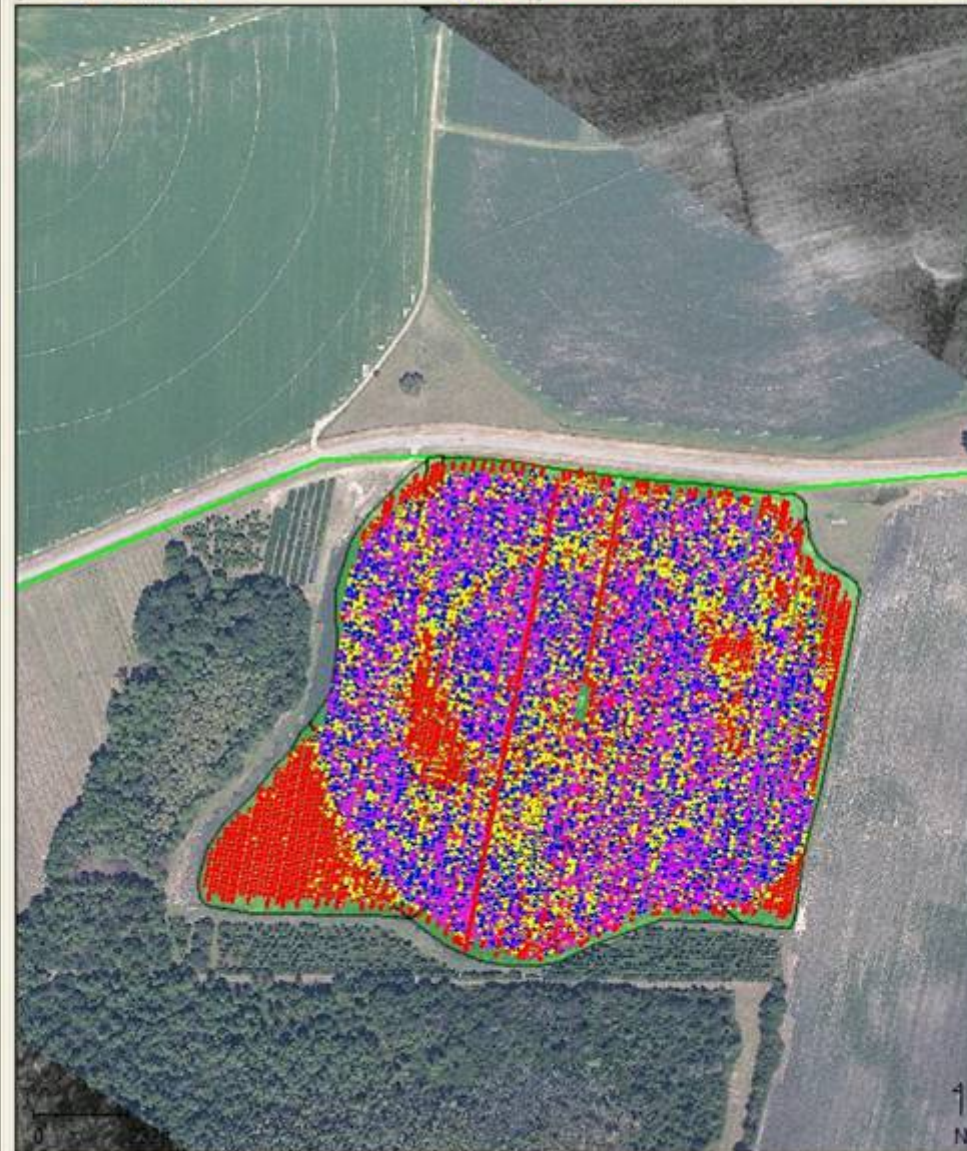
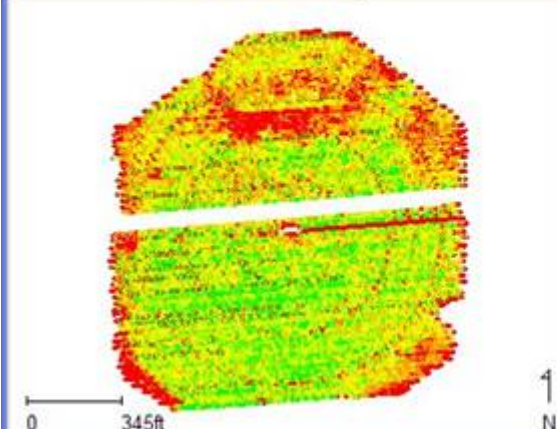
Spatial Management System (SMS)

- Grower A
- Grower B
- Grower C
- Louie Perry
  - Perry/Lasseter
    - PERRY1
      - 2000
        - Cotton Harvest
          - COTTON1
            - Picking - 1
  - Perry/Lasseter
    - PERRY2
      - 2000
        - Generic
          - Cotton Harvest
            - COTTON1
              - Picking - 1
        - 2002
          - Generic
            - Cotton Harvest
              - COTTON3
                - Picking - 1
  - Stacey Mixon
  - Wesley Lott

Main Monitor

Create New Map >>

Add to Current Map >>



- N sensor data | COTTON | 2002 | PERR
- Weed Incidence | COTTON | 2002 | PER
- Picking - 1 | COTTON3 | 2002 | PERR
- Topo data | COTTON | 2001 | PERRY2
- Management Zone | COTTON | 200
- Picking - 1 | COTTON1 | 2000 | PERR

Layer On

Lint Mass Yield

Transparency - 100%

Lint Mass Yield (lb/ac)

1,266.33 - 3,632.56	(7.87)
1,170.09 - 1,266.33	(7.98)
1,037.17 - 1,170.09	(7.98)
0.00 - 1,037.17	(7.55)

Picking - 1 | COTTON1 | 2000 | PERRY2

# Summary

- Geo-spatial data provide increasingly important basis for decision making
- GIS is founded on 2 key abstractions of reality (object/entity and field based concepts)
- What does GIS enable us to do?
- What are the main components of GIS?
- What holds GIS together?