**Geography 403**
**Lecture 8**
**Geographic Information Systems**

*Needs:* Lect_403_8.ppt

**Key Terms and Concepts**
**GIS Backround and Basics**
**GIS Example Operations and Applications**
**Georeferencing with TerrSet/IDRSI**

A. GIS background

PP1 1. Geographic approach to problems--traditional maps
2. Historically used "overlays" of information to look for areal correlations
a. Hard to transform information to same scale and projection
b. Tremendously tedious manual work

PP2 3. A GIS is a computer-based system that allows locations (geocoding-georeferencing) to be related to attributes (property ownership, rainfall, soil type, zoning)
a. A geographic framework for an area of interest is established
b. Attribute information is added as “layers”

PP3 c. Data can be used to produce maps, but the map is an output product, rather than a data source, as in traditional research methodology (maps do serve as data sources for the GIS, however)

PP4 d. “New” information can be generated (ex. start with soil type, rainfall and topography--produce slope, soil erodibility, runoff potential, and combine into erosion potential for a region)

B. GIS Basics

1. Data types
a. Point-for a selected specific point
b. Areal-for a specific area or volume
2. Storage/Display approaches
a. Raster-"grid cell"--high storage, low computation, useful for data that "have values everywhere" like remotely sensed images
b. Vector-(points, lines, and polygons approach)--low storage, high computation, useful for data that have values that are the same over certain areas, like property ownership

C. Using a GIS to help solve problems

PP5 1. As in most research problems, an appropriate question must be framed “Where is the best place to put the village dump?”
2. Raw data must be gathered and “digitized” to form a basic data set
3. Analysis “tools”
a. Basic--data base query, developing “Boolean” (binary-logical) images--coverages

i. Segregate data in a coverage by some criteria, producing a "either it is or it isn't result, ex. slopes of less than 5%

b. OVERLAY--combine images to produce a new result, by doing a math operation to every data bit (with two boolean images multiplied, this produces a result like a FORTRAN "AND" operator (only areas with both features remain "1")

c. RECLASS-ASSIGN--have groups of values rather than just 0 and 1 (create categories from raw data)

d. REGRESS-SCALAR-TRANSFORM--use a few points to establish a relationship, and extend to all location to produce a coverage or layer (i.e. have altitude, want temperature everywhere, but only have at a few point)

e. OVERLAY--ratio images (like N.D.V.I.)

f. SURFACE--develop “new” information like slopes from topography

g. ORTHO—“drape” information over 3-D surfaces

h. DISTANCE-buffer--find the distance from any type of objects and “buffer” them

i. COST-PATHWAY--apply “friction” to movement (include quality of roads in a transportation assessment, and determine the least cost route

j. VIEWSHED-WATERSHED--determine the "exposure" and drainage of a particular area (site for a roadside park with the best view)

D. Example applications

1. Use thermal imagery to approximate topography??? Have only altitudes and land cover types of a few locations (Yosemite)
2. Determine best site for a landfill (classic)
3. Plan site of a new hospital to maximize accessibility
4. Many more examples...

E. Georeferencing Example

PP6 1. Transfer information from one image to another in TerrSet/IDRISI using RESAMPLE

a. “Rubber-sheet” transformation

b. Problems with accurate translation (compare nearest neighbor or bilinear sampling, and linear or higher level mathematical formula)

c. Allows incorporation of remote sensing imagery into the “geographic grid” for full utilization in a GIS

2. Example with Milwaukee Near CIR image (milw234.rst)

a. Rotate image to put north near top (milw234r.rst)

b. Using an existing correspondence file (milwgeor.cor) as translation key

>first line: number of points
>next lines (coordinates in start image (x,y), coordinates in finish image (x,y)
>obtain for points that can be located on both the image and some other source with geo-locational information.

| | | | | | |
|---|---|---|---|---|---|
| #1 | 306 | 588 | -87.921 | 43.221 | I43& Mequon Road |
| #2 | 428 | 388 | -87.916 | 43.176 | I43& Brown Deer Road |
| #3 | 580 | 36 | -87.925 | 43.129 | Bottom of φ in Milw. River |
| #4 | 74 | 514 | -87.982 | 43.230 | Elbow of Milw. River near Thiensville |
| #5 | 58 | 34 | -88.044 | 43.148 | Good Hope and 107th Street |
| #6 | 150 | 264 | -87.998 | 43.180 | East end of pond near 76th&Brown Deer Rd |
| #7 | 568 | 422 | -87.880 | 43.171 | |
| #8 | 242 | 427 | -87.954 | 43.202 | |
| #9 | 211 | 672 | -87.932 | 43.243 | |
| #10 | 103 | 483 | -87.980 | 43.222 | |
| #11 | 293 | 326 | -87.955 | 43.178 | |
| #12 | 561 | 155 | -87.915 | 43.124 | |
| #13 | 302 | 474 | -87.935 | 43.203 | |
| #14 | 58 | 689 | -87.963 | 43.263 | |
| #15 | 126 | 71 | -88.024 | 43.148 | |
| #16 | 224 | 439 | -87.956 | 43.203 | |
| #17 | 564 | 76 | -87.924 | 43.110 | |
| #18 | 46 | 565 | -87.983 | 43.240 | |

c. View GCP points (including magnify function), add or remove GCP points based on RMS values (note mislocation of #3)
d. Output reference parameters, lat/long reference system (-88.10 to -87.85 and 43.06 to 43.28)
e. Output reference parameters, new number of columns and rows (relates to resolution) 875 c x 1045 rows
f. Linear solution (milw234rglnn.rst or milw234rglbi.rst) or quadratic solution (milw234rgqbi.rst)