GEOINFORMATICS FOR URBAN PLANNING AND MANAGEMENT

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Geoinformatics

Global Positioning System (GPS)

Satellite Remote Sensing

Geographical Information System (GIS)
STAGES OF URBAN PLANNING

1. Thematic map preparation from satellite data using visual interpretation techniques.
2. Generation of spatial framework in GIS environment for perspective and development plans.
3. Integration of thematic maps using GIS techniques for urban sprawl analysis and urban land use change analysis.
4. Area required for urbanization to be determined on the basis of population projection of the city and its growth centers.
5. Calculation of land requirements for urban development based on the carrying capacity of the region.
6. Projection of urban land use suitability analysis.
7. Urban environmental sensitivity analysis based upon both physical as well as air quality parameters.
8. Determination of composite functionality index to setup various amenities such as educational, medical, recreational etc.
Outline of this Lecture

1. Introduction to Satellite Remote Sensing

2. Use of high resolution satellite imagery for Base map preparation

3. Introduction to Geographical information System (GIS)

4. Application of Remote Sensing and GIS for Urban Planning and Management
Overview

• Fundamentals
  • What is RS
  • How it works
  • What is recorded
  • What is meant by resolutions

• The systems
  • Optical, Lidar
  • Radar

• Example of systems and related costs
  • Where: Acquisition of images
  • What we need to be aware of when purchasing
WHAT IS REMOTE SENSING?

‘REMOTE SENSING IS THE SCIENCE OF MAKING INFERENCES ABOUT OBJECTS FROM MEASUREMENTS, MADE AT A DISTANCE, WITHOUT COMING INTO PHYSICAL CONTACT WITH THE OBJECTS UNDER STUDY.’

What is Remote Sensing?

Remote Sensing can be defined as: the collection and interpretation of information about objects based on the measurement of electromagnetic energy reflected or emitted from those objects.

We can collect remotely sensed data in a number of ways: Our eyes are sensitive to a portion of the EM spectrum, airborne and spaceborne sensors can carry instruments to record EM energy...
How it works?

- Energy source: Passive/Active
- Atmosphere
- Target
- Recording devices
- Transmission/reception/processing
- Interpretation
- Application
The electromagnetic (EM) spectrum

1. Ultraviolet (\( \lambda < 0.4 \ \mu m \))
2. Visible (0.4 \( \mu m < \lambda < 0.7 \ \mu m \))
3. Reflected IR (0.7 \( \mu m < \lambda < 2.8 \ \mu m \))
4. Emitted (thermal) IR (2.4 \( \mu m < \lambda < 20 \ \mu m \))
5. Microwave (1 cm < \( \lambda < 1 \) m)

Visible Light Region of the Electromagnetic Spectrum
Types of EM energy detected by remote sensors

1. Reflected EM energy
2. Emitted EM energy
3. Scattered EM energy

Atmosphere

Earth surface
SIGNATURE

KEY TO FEATURE IDENTIFICATION FROM SPACE IMAGERY DEPENDS ON THE CHARACTERISTIC CHANGES IN THE PROPERTIES OF THE EM SPECTRUM REFLECTED/EMITTED FROM THE TARGET SURFACE – REFERRED ‘SIGNATURE’

SIGNATURES COULD BE INFERRED THROUGH:

- SPECTRAL VARIATION
- POLARISATION CHANGE
- THERMAL INERTIA
- TEMPORAL VARIATION

SIGNATURES ARE NOT COMPLETELY DETERMINISTIC; THEY ARE STATISTICAL IN NATURE WITH A MEAN AND DISPERSION
Typical Spectral Signatures

Typical Spectral Response Curves in the 0.4 to 2.6 μm Region...

Healthy Vegetation  
Dry, Bare Soil  
Clear Water  

Reflectance

Wavelength (μm)

Healthy Vegetation vs Burned Areas

Exploiting Spectral Response Curves

Unburned

High Burn Severity

Mod. Burn Severity

Low Burn Severity

Reflectance

Wavelength (μm)

The goal of remote sensing is to take advantage of differences in spectral response curves to distinguish one thing from another.

Platforms Used to Acquire Remote Sensing Data

- Aircraft
  - Low, medium & high altitude
  - Higher level of spatial detail
- Satellite
  - Polar-orbiting, sun-synchronous
    - 800-900 km altitude, 90-100 minutes/orbit
  - Geo-synchronous
    - 35,900 km altitude, 24 hrs/orbit
    - Stationary relative to Earth
IRS-1C/D Sensor Swaths

Various modes in which an image can be generated.

- **Panchromatic Sensor**
  - Resolution: 5.8 m
  - Swath width: 398 km
  - Track length: 141 km
  - Cross-track: 70 km

- **LISS-III Sensor**
  - Resolution: 23.5 m
  - Swath width: 405 km
  - Track length: 141 km
  - Cross-track: 26°

- **Wide Field Sensor**
  - Resolution: 188 m
  - Swath width: 817 km
  - Track length: 405 km
  - Cross-track: Along-track
Landsat-7 Satellite

- 705-km altitude
- 16-day repeat cycle
- 185 km swath width
- Descending node at 10:00 - ±15 min
- Whisk-broom scanner
- Radiometric resolution: \(2^8\) (256 levels)
Definition of resolution

- Also referred to as *resolving power*
- *Resolution* is defined as the ability of a remote sensor to distinguish between signals that are spatially or spectrally similar
- Four types of resolution important in remote sensing – spatial, spectral, radiometric, temporal
Quality of information derived from RS images strongly influenced by spatial, spectral, radiometric and temporal resolution of the sensor

- **SPATIAL RESOLUTION**
  instrument resolving power needed to spatially discriminate the smallest object

- **SPECTRAL RESOLUTION**
  encompasses the width of bands used from the wavelengths of the EM spectrum.

- **RADIOMETRIC RESOLUTION**
  quantify No. of discernible signal levels in a band, \{sensor’s ability to discriminate radiance differences (NE\(\Delta \rho\))\}

- **TEMPORAL RESOLUTION**
  time interval between imaging collections over the same geographic location
Information content Vs resolution. `A’ is from a scene from IRS Ocean Colour Monitor (OCM). The area in the small square marked (≈ 4km x 4km) is shown in various resolutions from B to G. The feature showing airport runway is not at all discernable at 360 and 188 meter resolution; can be barely identified at 72 meters and the details one can discern increases as the resolution improves. At 5.8m even marking on the runway can be identified.
FRESH SNOW  
GREEN VEGETATION  
DARK TONED SOIL  
LIGHT TONED SOIL  
CLEAR WATER  
TURBID WATER

GREEN BAND  
(0.52–0.59 \( \mu m \))

RED BAND  
(0.62–0.67 \( \mu m \))

NEAR IR  
(0.77–0.86 \( \mu m \))

SHORTWAVE IR  
(1.55–1.75 \( \mu M \))
Radiometric Resolution – how many different intensity levels can be discriminated by the remote sensor within a specific band?
## Current observational capabilities of Electro optical imaging instruments from Indian satellite platforms

<table>
<thead>
<tr>
<th>Electro-optical Imaging Instrument</th>
<th>Spatial foot-print (Meters)</th>
<th>Swath (Kilometers)</th>
<th>Number of spectral channels</th>
<th>Number of instruments</th>
<th>No. of days required for global coverage</th>
<th>Minimum interval required for revisiting a target (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAN</td>
<td>1</td>
<td>14.5</td>
<td>1</td>
<td>1</td>
<td>1200</td>
<td>1 to 200</td>
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<tr>
<td>PAN</td>
<td>5.8</td>
<td>74</td>
<td>1</td>
<td>2</td>
<td>48</td>
<td>5</td>
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<tr>
<td>Liss3</td>
<td>23.5</td>
<td>148</td>
<td>3</td>
<td>2</td>
<td>24</td>
<td>24</td>
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<tr>
<td>Liss2</td>
<td>36</td>
<td>140</td>
<td>4</td>
<td>1</td>
<td>22</td>
<td>22</td>
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<tr>
<td>Liss3(SWIR)</td>
<td>70</td>
<td>148</td>
<td>1</td>
<td>2</td>
<td>24</td>
<td>24</td>
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<tr>
<td>Liss1</td>
<td>72</td>
<td>140</td>
<td>4</td>
<td>1</td>
<td>22</td>
<td>22</td>
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<tr>
<td>WiFS</td>
<td>188</td>
<td>810</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>WiFS(swir)</td>
<td>188</td>
<td>810</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>OCM</td>
<td>360</td>
<td>1420</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CCD P/I</td>
<td>1000</td>
<td>300</td>
<td>3</td>
<td>2</td>
<td>Continuous daytime monitoring of earth disc</td>
<td>A region of 300km*6000 km can be covered every minute</td>
</tr>
<tr>
<td>VHRR</td>
<td>2000</td>
<td>Earth Disc</td>
<td>1</td>
<td>2</td>
<td>Continuous monitoring of earth disc</td>
<td>A region of 12000km*8000 km can be covered every 7 minutes</td>
</tr>
<tr>
<td>VHRR</td>
<td>8000</td>
<td>Earth Disc</td>
<td>2</td>
<td>2</td>
<td>Continuous monitoring of earth disc</td>
<td>A region of 12000km*8000 km can be covered every 7 minutes</td>
</tr>
</tbody>
</table>
VISUAL INTERPRETATION

COLOUR COMPOSITION

PRIME COLOUR: BLUE, GREEN AND RED

GRAY COLOUR (Black and White): Single band

PSEUDOCOLOUR: SINGLE BAND (COLOUR ASSIGNED)

TRUE COLOUR: THREE BAND COMPOSITION
  RS BAND: COLOUR
  BLUE BAND: BLUE
  GREEN BAND: GREEN
  RED BAND: RED

FALSE COLOUR COMPOSITE (FCC)
  NIR BAND: RED
  RED BAND: GREEN
  GREEN BAND: BLUE
Natural colour is generated using the primary colours – Blue, Green and Red. The green vegetation appears green. The false colour composite image uses Green, Red and Near Infrared bands as blue, green and red colour respectively. Here vegetation appears in different hues of red.
ELEMENTS OF IMAGE INTERPRETATION

I) TONE (COLOUR),
  II) TEXTURE,
  III) SHAPE,
  IV) SIZE,
  V) SHADOWS,
  VI) PATTERN,
  VII) SITE AND
  VIII) ASSOCIATION
Tone is a measure of the intensity of electromagnetic radiation reflected (emitted) by the objects

1: VEGETATION (HV G)
2: WATER BODIES
3: SAND
4: DEEP WATER
5: FALLOW (SOIL)
TEXTURE is the frequency of tonal changes on an image.

1: SMOOTH (EARLY PADDY)
2. COARSE (POTATO)
3. COARSE (LATE PADDY)
SHAPE AND SIZE

1: MAJOR RESERVOIR 2: FISHING POND AND 3: SMALL CHECK DAMS
PATTERN : SPATIAL ARRANGEMENT OF OBJECTS
1: TOWNSHIP 2: FALLOW FIELD 3: VILLAGE

ASSOCIATION
4: SAND (HIGH REFLECTANCE), 5: PADDY (GW) AND 6: PADDY (CW)
<table>
<thead>
<tr>
<th>S. No</th>
<th>Planning stage</th>
<th>Base map scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Master Plan / Landuse Plan</td>
<td>1:10,000 &amp; larger</td>
</tr>
<tr>
<td>2.</td>
<td>Zoning Plan</td>
<td>1:4,000</td>
</tr>
<tr>
<td>3.</td>
<td>Inner City/Urban Cadestre</td>
<td>1:1,000 to 1:2,000</td>
</tr>
<tr>
<td>4.</td>
<td>Urban slums/Unauthorised Developments/ Encroachments</td>
<td>1:5,000 to 1:1,000</td>
</tr>
<tr>
<td>Platform and Sensor System</td>
<td>Spatial resolution (m, pixel)</td>
<td>Year of operation</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Landsat (MSS) IRS-1A &amp; 1B (LISS-I)</td>
<td>30</td>
<td>1972, 1988 &amp; 1991</td>
</tr>
<tr>
<td>ASTER VNIR (0.52-0.86 µm) SWIR(1.60-2.42 µm) TIR(8.125-11.85 µm)</td>
<td>1.5, 20, 90</td>
<td>1999</td>
</tr>
<tr>
<td>SPOT HRV-II (MLA) IRS-1C &amp; 1-D (PAN)</td>
<td>10, 5.8</td>
<td>1998, 1995 &amp; 1997</td>
</tr>
<tr>
<td>MGMS-II</td>
<td>4</td>
<td>1983</td>
</tr>
<tr>
<td>IANUS Quickbird</td>
<td>1.0, 0.61</td>
<td>1999, 2001</td>
</tr>
<tr>
<td>CARTOSAT-1</td>
<td>3.5</td>
<td>2005</td>
</tr>
<tr>
<td>CARTOSAT-2</td>
<td>1.0</td>
<td>2007</td>
</tr>
<tr>
<td>ALMAZ</td>
<td>1.0</td>
<td>2008</td>
</tr>
<tr>
<td>RESOURCESAT-1 (LISS-IV)</td>
<td>5.8</td>
<td>2003</td>
</tr>
</tbody>
</table>

Source: Modified after Atique Rahman (2006)
Flow Chart of Visual Interpretation

Objective of study

Selection of RS data

Collateral data
SOI Toposheet
Thematic maps
Aerial data
Knowledge of the area

Field data

Generation of enhanced product

Base map

Photo interpretation key

Preliminary interpretation

Identify doubtful areas
Field verification

Interpretation modification

Accuracy Check
Evaluation

Final Mapping
Area calculation
<table>
<thead>
<tr>
<th>Land cover/land use</th>
<th>Image characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Settlements</td>
<td>Light grey clustering with particular patterns for the urban area. There may be brownish maroon patches for in between vegetation. For the rural settlement there occur no particular patterns of such image characteristics.</td>
</tr>
<tr>
<td>2. Agriculture</td>
<td>Identity rabi if the month of data acquisition is January or February or March and colour is brown red. (a) For the kharif crops same characteristics in image occur if the image data are acquired in the month of September, October or November. (b) Fallow land is identified by light grey colour within cropped area (red colour). (c) Plantation occurs as brownish maroon patches.</td>
</tr>
<tr>
<td>3. Forest</td>
<td>Dense forests are identified by dark red colour patterns. In the case of degraded forest the dark red colour patterns contain small brown or white patches. The blanks in the forest show creamy patches in the dark red background. Forest plantations are identified by dark red colour sign of particular pattern.</td>
</tr>
<tr>
<td>4. Waste Land</td>
<td>Muddy water logging occurs as blackish or deep blue spots while clear water logging area is identified by dark/bright blue patches. Comparing the images of rainy season and out of rainy season identifies temporary and permanent water logging. Marshy area is recognized as a sign of vegetation (red/pink spots) in the water logged (blackish blue/bright blue) area. Gullied land occurs as white/grey spot. The image of land with scrub contains white patches in the land area. Sandy area is classified as bright white coloration along the course of river.</td>
</tr>
<tr>
<td>5. Water bodies</td>
<td>River/stream is identified as long non-linear path coloured with dark blue/bright blue line in white background. Canals are identified as line segments sign of water bodies. Lakes/reservoirs are identified as patterns along the river. Embankment occurs as light grey structure along the river.</td>
</tr>
</tbody>
</table>
CARTOSAT-1 PANCHROMATIC PRODUCT ( RESOLUTION : 2.5 M)
COLOUR COMPOSITION OF RESOURCESAT (IRS P6) LISS-IV
What is GIS?

A system of hardware, software, and procedures ...
designed to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data ...
for solving complex planning and management problems.

A Simpler Definition of GIS

A computer system which can hold and use data describing places on the earth's surface.
Components of GIS

Computer Hardware & Software

Organizational Structure & People

Database
Geographic Features

Geographic features are represented by two types of data.

- **Spatial Data**
- **Attribute Data**
The Geographic Database

Spatial and attribute data types are linked together by a common identifier.
Data Linkage

A GIS typically links different data sets together.

This may seem trivial but can prove to be the analytical backbone of the GIS as well as its greatest selling point.

Consider the different ways in which data sets may need to be linked together.
ARC-NODE DATA STRUCTURE

BASIC GRAPHICAL FEATURES:
- POINT
- LINE
- POLYGON
**ARC-NODE DATA STRUCTURE**

**NODES, VERTICES**

**ARC-NODE STRUCTURE**

<table>
<thead>
<tr>
<th>Arc Number</th>
<th>Start Node</th>
<th>Vertices</th>
<th>End Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>d,c,b,a</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>e</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>f,g,h,i,j</td>
<td>20</td>
</tr>
</tbody>
</table>

**POLYGON STRUCTURE**

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Arc List</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,2</td>
</tr>
<tr>
<td>B</td>
<td>2,3</td>
</tr>
</tbody>
</table>
three major topological concepts:

*Connectivity*: Arcs connect to each other at nodes.

*Area definition*: Arcs that connect to surround an area define a polygon

*Contiguity*: Arcs have direction and left and right sides
### Arc-node Topology

![Graphical representation of arc-node topology]

### Arc-node List

<table>
<thead>
<tr>
<th>Arc</th>
<th>From-Node</th>
<th>To-Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>12</td>
</tr>
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<td>3</td>
<td>11</td>
<td>13</td>
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<tr>
<td>4</td>
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<td>6</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>17</td>
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</tbody>
</table>
AREA DEFINITION

Polygon-Arc Topology

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Arc List</th>
</tr>
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<tbody>
<tr>
<td>B</td>
<td>1, 6, 8, 5</td>
</tr>
<tr>
<td>C</td>
<td>2, 4, 9, 6</td>
</tr>
<tr>
<td>D</td>
<td>3, 5, 10, 4</td>
</tr>
<tr>
<td>E</td>
<td>7</td>
</tr>
<tr>
<td>F</td>
<td>8, 9, 10, 0, 7</td>
</tr>
</tbody>
</table>
CONTIGUITY : ADJACENCY

Left-Right Topology

<table>
<thead>
<tr>
<th>Arc</th>
<th>Left Polygon</th>
<th>Right Polygon</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>8</td>
<td>B</td>
<td>F</td>
</tr>
<tr>
<td>9</td>
<td>C</td>
<td>F</td>
</tr>
<tr>
<td>10</td>
<td>D</td>
<td>F</td>
</tr>
</tbody>
</table>
REGIONS, ROUTES AND EVENTS

POLYGONS VS REGIONS

Polygons

Nonoverlapping, complete partition of space

Areas, Perimeter

Regions

Possibly overlapping with void areas allowed

Areas, Perimeter

POLYGONS VS REGIONS
# ROUTES

## Route Descriptions

<table>
<thead>
<tr>
<th>Route</th>
<th>Arc List</th>
</tr>
</thead>
<tbody>
<tr>
<td>house to airport</td>
<td>2, 3, 4, 6</td>
</tr>
<tr>
<td>bus route</td>
<td>3, 16, 17, 9, 8, 7, 11, 4, 5, 14</td>
</tr>
<tr>
<td>spatial relationship</td>
<td>purpose</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>are completely within</td>
<td>selects target theme features that are completely within selector theme features</td>
</tr>
<tr>
<td>completely contain</td>
<td>selects target theme features that completely contain selector theme features</td>
</tr>
<tr>
<td>have their center in</td>
<td>selects target theme features whose centers fall inside selector theme features</td>
</tr>
<tr>
<td>contain the center of</td>
<td>selects target theme features which contain the centers of selector theme features</td>
</tr>
<tr>
<td>intersect</td>
<td>selects target theme features that intersect selector theme features</td>
</tr>
<tr>
<td>are within distance of</td>
<td>selects target theme features that are within a given distance of selector theme features</td>
</tr>
</tbody>
</table>
Two Types

1) A model of Spatial form: 
   Representing the structure and distribution of features in geographical space

2) A model of Spatial processes: 
   the processes-based interaction between the features
BASIC FUNCTIONS

MEASUREMENTS IN GIS:
  LENGTH
  PERIMETERS
  AREA

QUERIES
  TWO TYPES: SPATIAL AND ASPATIAL
**Spatial Operations**

**ASpatial Queries:**
Queries that in being answered do not use the stored \( X \& Y \) location of the feature, nor does it describe where the places are in relation to each other.

*Example:*
- How many people are working with GIS in Missouri?

**Spatial Queries:**
Queries that can only be answered using the stored \( X \& Y \) location of the feature and its relationship to other features on the earth's surface. Spatial queries cannot be answered without geography and topology.

*Examples:*
- How many people are working with GIS in the major population centers in Missouri?
- Which centers are within 100 miles of each other?
- What is the shortest route that passes through all of these centers?
SET OF QUERIES : BOOLEAN OPERATORS

A OR B

A AND B

A NOT B

A XOR B

QUERY : WHERE ARE THE ENGLISH MEDIUM SCHOOLS IN GUWAHATI CITY THAT HAVE MORE THAN 200 STUDENTS?
Making queries

- Selects records from tables/features from themes

QUERY BUILDER BUTTON
Displaying selected sets

- Selected records from tables also select features from themes
Graphical representation of tabular data

Numbers are difficult to interpret.

Charts are easy to interpret.
Two ways:

1) Attribute-based
2) Graphical-based

Note: 1) common boundaries between polygons removed
2) rebuilding the new topological relationships
BUFFERING

Quantifying a spatial entity to influence its neighbours
Or the neighbours to influence the character of a
Spatial entity
POINT BUFFER: Zone of influence
LINE BUFFER
OVERLAY ANALYSIS

(a) Met station point map + Forest polygon map = Met station point map

(b) Road line map + Forest polygon map = Road line map

<table>
<thead>
<tr>
<th>Point ID</th>
<th>Land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forest</td>
</tr>
<tr>
<td>2</td>
<td>Forest</td>
</tr>
<tr>
<td>3</td>
<td>Non-forest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Old ID</th>
<th>New ID</th>
<th>Land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Forest</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Non-forest</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Forest</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>Non-forest</td>
</tr>
</tbody>
</table>
Overlay operators

- **Forest polygon map** + **Resort polygon map** = **Polygon map**
  - Union (OR)
- **Forest** + **Resort** = **Polygon map**
  - Erase (NOT) (‘cookie cutting’)
- **Forest** + **Resort** = **Polygon map**
  - Intersect (AND)
PROXIMITY ANALYSIS
SELECTION OF LINE SEGMENT BASED ON POLYGON
POINTS WITHIN POLYGON
APPLICATION OF GEOINFORMATICS FOR URBAN PLANNING AND MANAGEMENT
CASE STUDY: suitability potential for different land use (Dai et al. 2001)

Study area: Lanzhou city, Northwest China

Fig. 2. Topography and geomorphologic elements of the study area.
Methodology (Dai et al 2001)

1. Collection and collation of data
2. Establishment of spatial database
   - Vectorize maps
   - Establish attribute database
   - Rasterize vector maps
   - Calculate distance parameters
3. Selection of appropriate factors
4. Standardization of factors
5. Computation of weights of factors
   - Establish a pairwise matrix
   - Calculate factor weights
6. Multi-criteria evaluation
   - Evaluate suitability for each category
   - Create single-category suitability map
   - Vectorize suitability maps
7. Result analysis

Interpret urban development policy
- Define land use categories
- Set areal boundary
Suitability potential for High-rise building (Dai et al. 2001)
Suitability potential for low-rise building (Dai et al 2001)
Suitability potential for the waste disposal (Dai et al. 2001)
Suitability potential for the Natural conservation category (Dai et al. 2001)

Fig. 8. Suitability potential for the natural conservation category.
Conclusion

Geoinformatics helps

1. Development of Urban Information System (UIS)

2. Understanding Urban growth processes and its environmental impact

3. Incorporating traditional knowledge on the spatial and non-spatial data
Thank You