THE IMPACTS OF URBANIZATION ON SURFACE ALBEDO IN THE YANGTZE RIVER DELTA

INTRODUCTION
Motivation

Since the 20th century, there has been a rapid urbanization of the world population. United Nation prediction (2006) : 60% of the world population will live in cities by 2030.

In these newly urbanized area, we observe a local climate change : « Heat Island Effect ». Although it affects many people, the relationship between urbanization and local climate change is not well understood.

However, the role of surface properties on climate has been recognized by many recent studies.

Urbanization → Surface albedo change → Climate change.
Methodology

Remote sensing data.
Processed and analyzed by ENVI software.

**Selection of two Landsat TM images**
One from the late 80s, one from nowadays

- **Urbanization study**
  - Classification of the two images
  - Calculation of the urbanization rate

- **Albedo calculation**
  - Atmospheric correction
  - Albedo calculation using Liang’s formula

**Analysis**
Correlation of albedo change with urbanization
Study area

Mouth of Yangtze River Delta in China

Yangtze River Delta:
- One of the most industrialized and urbanized region of China.
- Highest population density of China.

Coordinates:
Long : 120°39’E    Lat : 32°40’N
Path : 118        Row : 38

Area : ~35000 km²

www.landsat.org  Acquisition date : 08/11/1989
Two provinces:
- SE Jiangsu
- NE Shanghai

Source: www.chinatouristmaps.com
Environment

➢ Geology
  Alluvial plain
  Elevation: 4m

➢ Hydrology
  Delta
  Numerous rivers and lakes
  Maze of intersecting canals

➢ Climate
  Humid subtropical climate

➢ Vegetation
  Subtropical broad-leaf evergreen.

Human_activities

➢ Primary sector
  Agriculture
  Fisheries
  Aquaculture

➢ Secondary sector
  Traditional center of textile industry
  Industrial base advancing new technology
  Import/Export

➢ Tertiary sector
  Commerce and finance

➢ Transportation
# Satellite Images

**Source:** Global Land Cover Facility  
[www.landcover.org](http://www.landcover.org)

<table>
<thead>
<tr>
<th>Author</th>
<th>NASA Landsat Program</th>
<th>NASA Landsat program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication Date</td>
<td>05/16/2001</td>
<td>May 2007</td>
</tr>
</tbody>
</table>
| Collection Name | **Landsat 5 TM scene** | **Landsat 7 ETM+ scene**  
**SLC-off Gap-filled products** |
| Image Name | ID 201-985 | ID 217-852 |
| Processing Level | Ortho, GLS 1990 | Ortho, GLS2005 |
| Publisher | USGS | USGS |
| Publisher Location | Sioux Falls | Sioux Falls |
| Product Coverage Date | 08/11/1989 | 08/15/2005 |

Source: www.landsat.gsfc.nasa.gov/images/media.html
Image preprocessing

- **Picture cut**
  Pictures of different sizes
  Band issues on the left and right sides of the 2005 image
  → Cut the pictures with ENVI software

- **Geometric and radiometric correction**
  Performed by USGS

- **Atmospheric correction**
  No clouds or hazes → No atmospheric correction needed

- **Image enhancement**
  Automatic linear contrast stretching of 2% by ENVI
Visual interpretation

### Color infrared composite

<table>
<thead>
<tr>
<th>Color displayed</th>
<th>Band</th>
<th>Spectrum region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>4</td>
<td>NIR</td>
</tr>
<tr>
<td>Green</td>
<td>3</td>
<td>Visible Red</td>
</tr>
<tr>
<td>Blue</td>
<td>2</td>
<td>Visible Green</td>
</tr>
</tbody>
</table>

### Area type

<table>
<thead>
<tr>
<th>Area type</th>
<th>Urban area</th>
<th>Vegetation</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td><img src="image1" alt="Sample" /></td>
<td><img src="image2" alt="Sample" /></td>
<td><img src="image3" alt="Sample" /></td>
</tr>
</tbody>
</table>
Yangtze River Delta

08/11/1989

08/15/2005
Classification

Methodology:
Classification processed on the Digital Numbers within the 6 non thermal bands.

Unsupervised classification
ISODATA algorithm  ENVI Software
Identification with ground reference data

Choice and definition of classes

Supervised classification
Maximum Likelihood Classifier  ENVI Software.

Accuracy assessment
Unsupervised classification

**Aim:** Evaluate the separability between classes and so guide the supervised classification.

**Principle:**
- The software groups together pixels of similar spectral pattern.
  
  *ISODATA algorithm*

- The analyst identifies the clusters.

**Chosen parameters:**
- Number of classes: Between 5 and 10
- Number of iterations: 10
- Change Threshold: 5%
08/15/2005  Unsupervised classified image

Ground reference data
Google Earth 08/23/2005
And panorama pictures

Spectral patterns

Color infrared composite
**Identification**

Remark: identification = most representative land cover type found within the class. Misclassified pixels within each class.

<table>
<thead>
<tr>
<th>Class Number</th>
<th>Class color</th>
<th>Area %</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blue 3</td>
<td>13.199</td>
<td>Water</td>
</tr>
<tr>
<td>2</td>
<td>Blue 2</td>
<td>13.693</td>
<td>Water</td>
</tr>
<tr>
<td>3</td>
<td>Seamarine</td>
<td>14.715</td>
<td>Water</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
<td>3.502</td>
<td>Inter Tidal + Urban Land</td>
</tr>
<tr>
<td>5</td>
<td>Cyan</td>
<td>4.811</td>
<td>Agricultural Land: Irrigated Paddy Field</td>
</tr>
<tr>
<td>6</td>
<td>Purple</td>
<td>4.815</td>
<td>Several land cover types</td>
</tr>
<tr>
<td>7</td>
<td>Maroon</td>
<td>4.709</td>
<td>Several land cover types</td>
</tr>
<tr>
<td>8</td>
<td>Green</td>
<td>1.728</td>
<td>Urban Land: High Density</td>
</tr>
<tr>
<td>9</td>
<td>Magenta</td>
<td>3.917</td>
<td>Urban Land: Medium Density</td>
</tr>
<tr>
<td>10</td>
<td>Coral</td>
<td>5.787</td>
<td>Agricultural Land: Dry Farmland</td>
</tr>
</tbody>
</table>
08/11/1989 Unsupervised classified image

Problem: No valuable ground surface data

Spectral patterns

Color infrared composite
# Identification

<table>
<thead>
<tr>
<th>Class Number</th>
<th>Class color</th>
<th>Area %</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blue 3</td>
<td>15.319</td>
<td>Water</td>
</tr>
<tr>
<td>2</td>
<td>Blue 2</td>
<td>12.367</td>
<td>Water</td>
</tr>
<tr>
<td>3</td>
<td>Seamarine</td>
<td>13.523</td>
<td>Water</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
<td>1.495</td>
<td>Inter Tidal</td>
</tr>
<tr>
<td>5</td>
<td>Cyan</td>
<td>3.898</td>
<td>Several land cover types</td>
</tr>
<tr>
<td>6</td>
<td>Purple</td>
<td>7.775</td>
<td>Agricultural Land : Irrigated Paddy Field</td>
</tr>
<tr>
<td>7</td>
<td>Maroon</td>
<td>6.738</td>
<td>Several land cover types</td>
</tr>
<tr>
<td>8</td>
<td>Green</td>
<td>2.54</td>
<td>Urban Land : High Density</td>
</tr>
<tr>
<td>9</td>
<td>Magenta</td>
<td>2.016</td>
<td>Urban Land : Medium Density + Inter Tidal</td>
</tr>
<tr>
<td>10</td>
<td>Coral</td>
<td>5.205</td>
<td>Agricultural Land : Dry Farmland</td>
</tr>
</tbody>
</table>
Supervised classification

**Principle:** - The analyst defines the classes and their numerical descriptors.
- The software labels each pixel with the class it belongs to.

*Maximum Likelihood Classifier*
Choice of classes

USGS « LU/ LC Classification System for Use with Remotely Sensed Data »

Landsat images → Level I Classification
1) Urban or Built-up Land  2) Agricultural Land  3) Rangeland  4) Forest Land
5) Water  6) Wetland  7) Barren Land  8) Tundra  9) Perennial Snow or Ice

Applied to our area → Urban Land, Agricultural Land, Rangeland, Forest Land, Water and Barren Land.

Unsupervised classification: - Inter Tidal as a class
- No classes for Range, Forest and Barren Lands → Problem to classify
Training samples

For each class, Training samples = representative set of sites.

Compile a numerical interpretation key, that describe the spectral pattern of the class.

<table>
<thead>
<tr>
<th>Class</th>
<th>Image</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Land</td>
<td>Color infrared composite</td>
<td>Bright blue, mixed zone</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>Unsupervised classified image</td>
<td>At least the 2 agricultural classes</td>
</tr>
<tr>
<td>Range Land</td>
<td>Visible</td>
<td>Known golf and garden</td>
</tr>
<tr>
<td>Forest Land</td>
<td>Visible</td>
<td>Known parks and forests</td>
</tr>
<tr>
<td>Water</td>
<td>Unsupervised classified image</td>
<td>At least the 4 water classes</td>
</tr>
<tr>
<td>Barren Land</td>
<td>Color infrared composite</td>
<td>Yellow</td>
</tr>
<tr>
<td>Intertidal</td>
<td>Unsupervised classified image</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
Future work

The coming week

- Training samples
- Maximum likelihood classification

Later

- Accuracy assessment
- Urbanization rate

- 2nd part of the project: Albedo calculation
Thank you!