QUANTIFYING URBANIZATION IN GRAND TRAVERSE COUNTY, MI

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Growth in Grand Traverse

- What does that mean in terms of land use?
- What are the environmental effects?
- Help to understand urbanization better

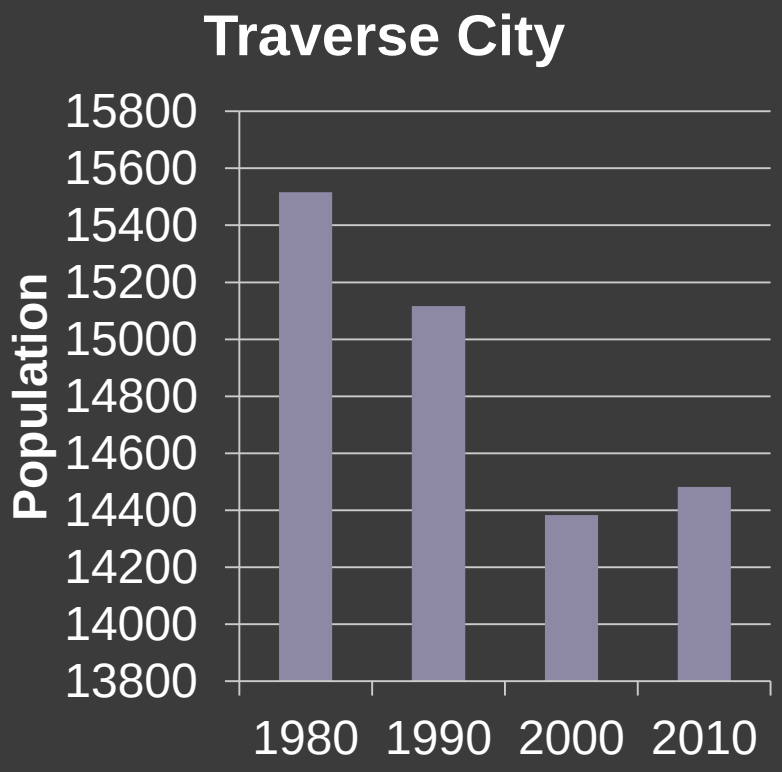
The County

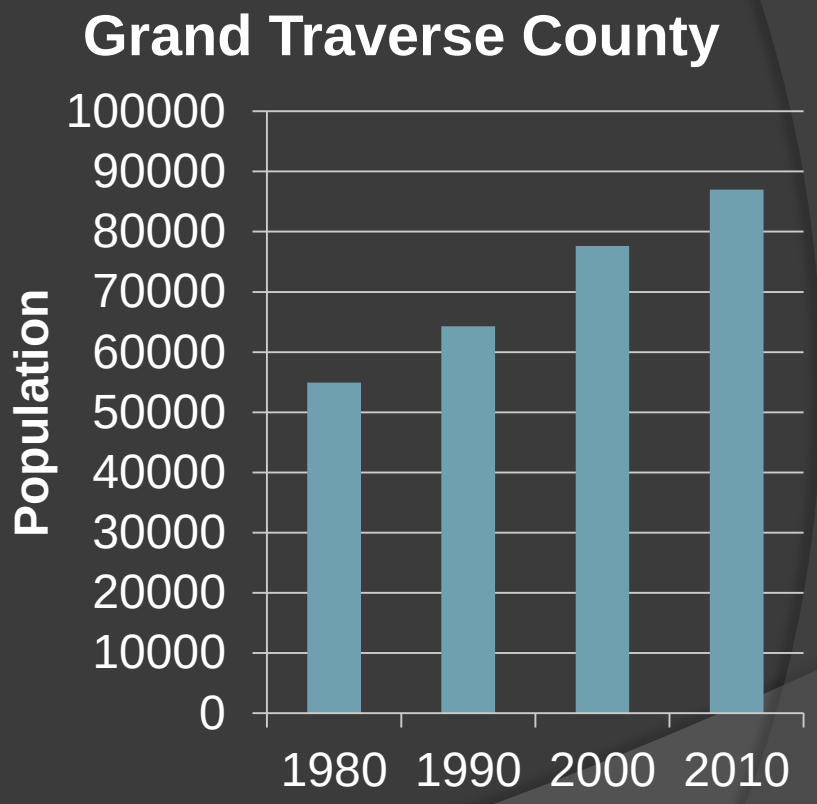
- Tourism and agriculture important
- Largest community – Traverse City
- Population: 86,896

Research Goals

- Collect images from 1984 and 2010
- Classify images based on land use type
- Determine increase in urbanization
- Study environmental effects of urbanization

Population


Traverse City
Population
15800
15600
15400
15200
15000
14800
14600
14400
14200
14000
13800
1980
1990
2000
2010


Grand Traverse County
Population
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1980
1990
2000
2010

Research Methodology

Landsat 5-TM

- 30m x 30 m resolution
- 7 bands available
- 3 utilized
- Full vegetation between June and August
- July 11, 1984 and June 17, 2010

Natural Color Band Widths

- Oriented as 3-2-1

Band Number	Wavelength (μm)
1	.45 - .52
2	.52 - .60
3	.63 - .69

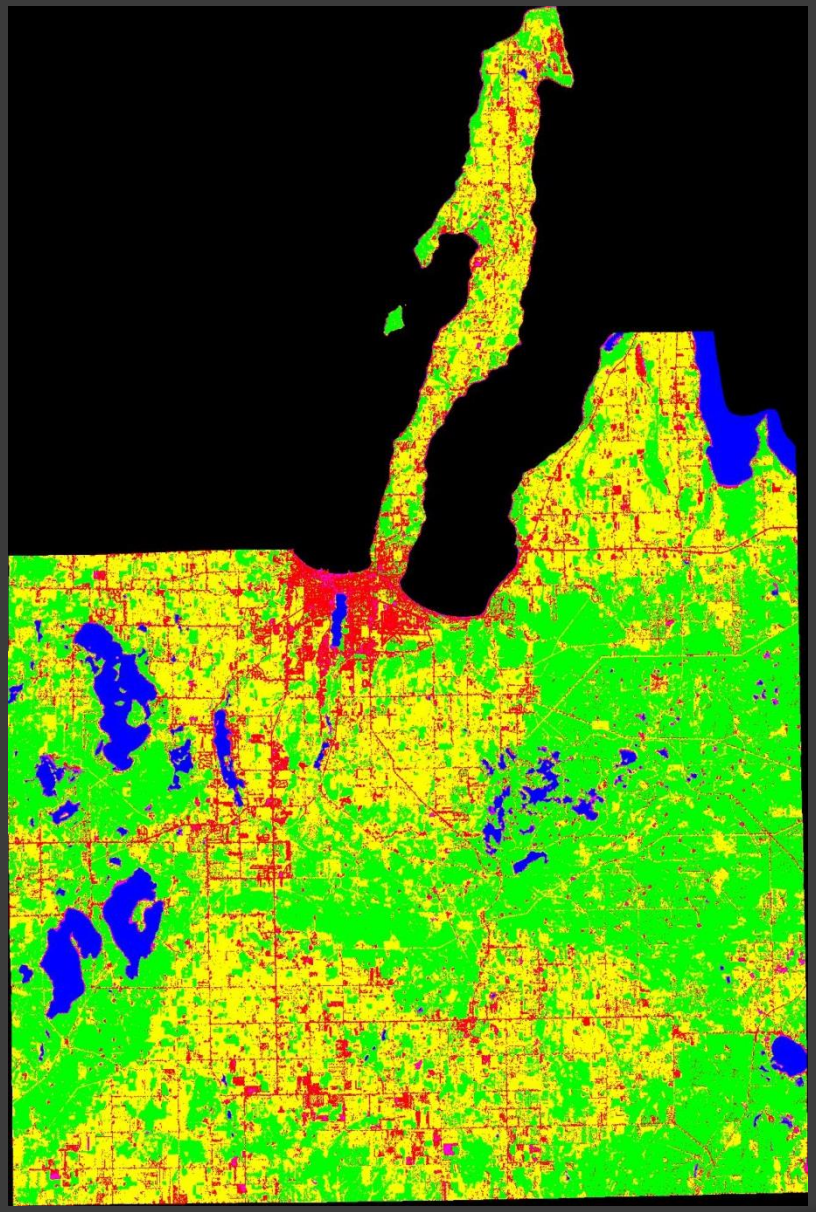
Classification

- Gaussian maximum likelihood method
  - Uses both variance and covariance
- Classification groups
  - Sand or bare land
  - Agriculture or grassland
  - Human-developed land
  - Forests or wetlands
  - Water

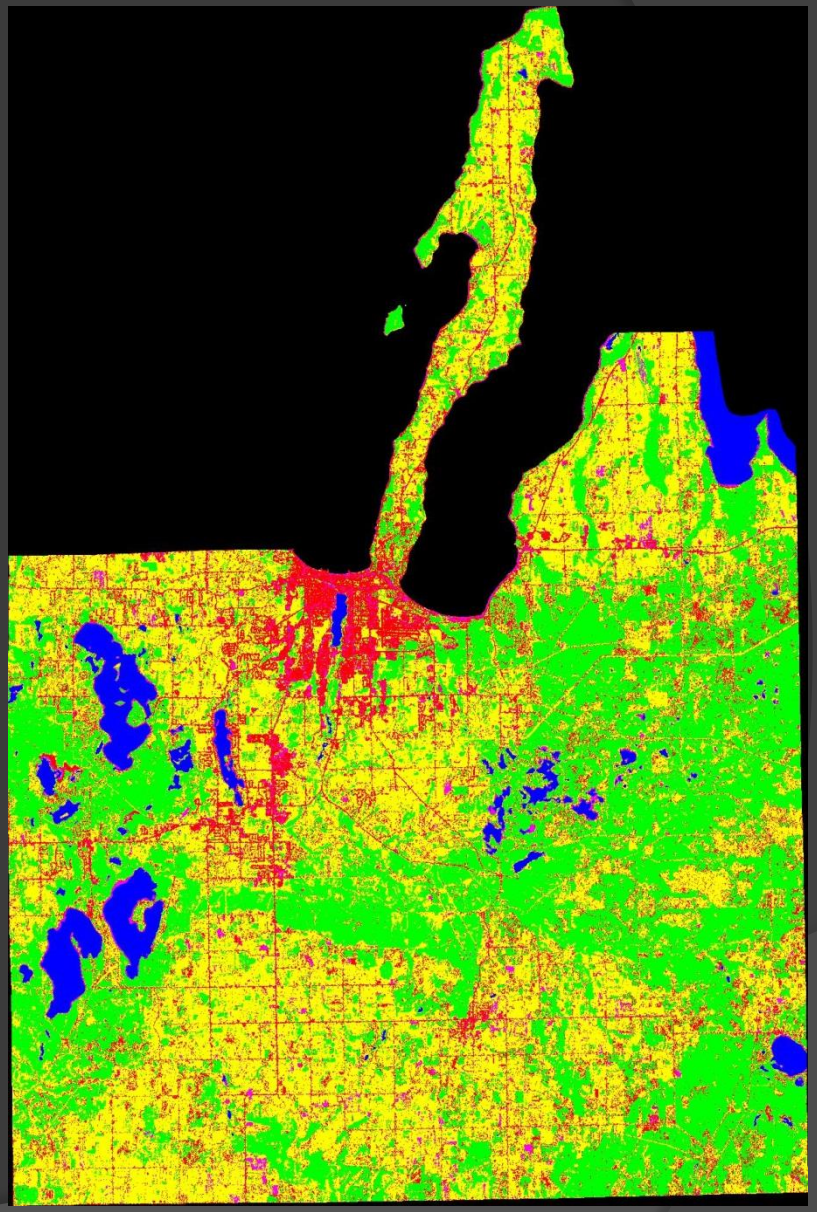
	# of Samples (Polygons)				
Year	Forest/Wetland	Sand/Bare Earth	Agriculture/Grassland	Developed	Water
1984	12	14	18	12	15
2010	15	15	21	15	15

	# of Pixels in Samples				
Year	Forest/Wetland	Sand/Bare Earth	Agriculture/Grassland	Developed	Water
1984	4547	62	1009	965	2818
2010	2512	38	746	1030	1202

1984



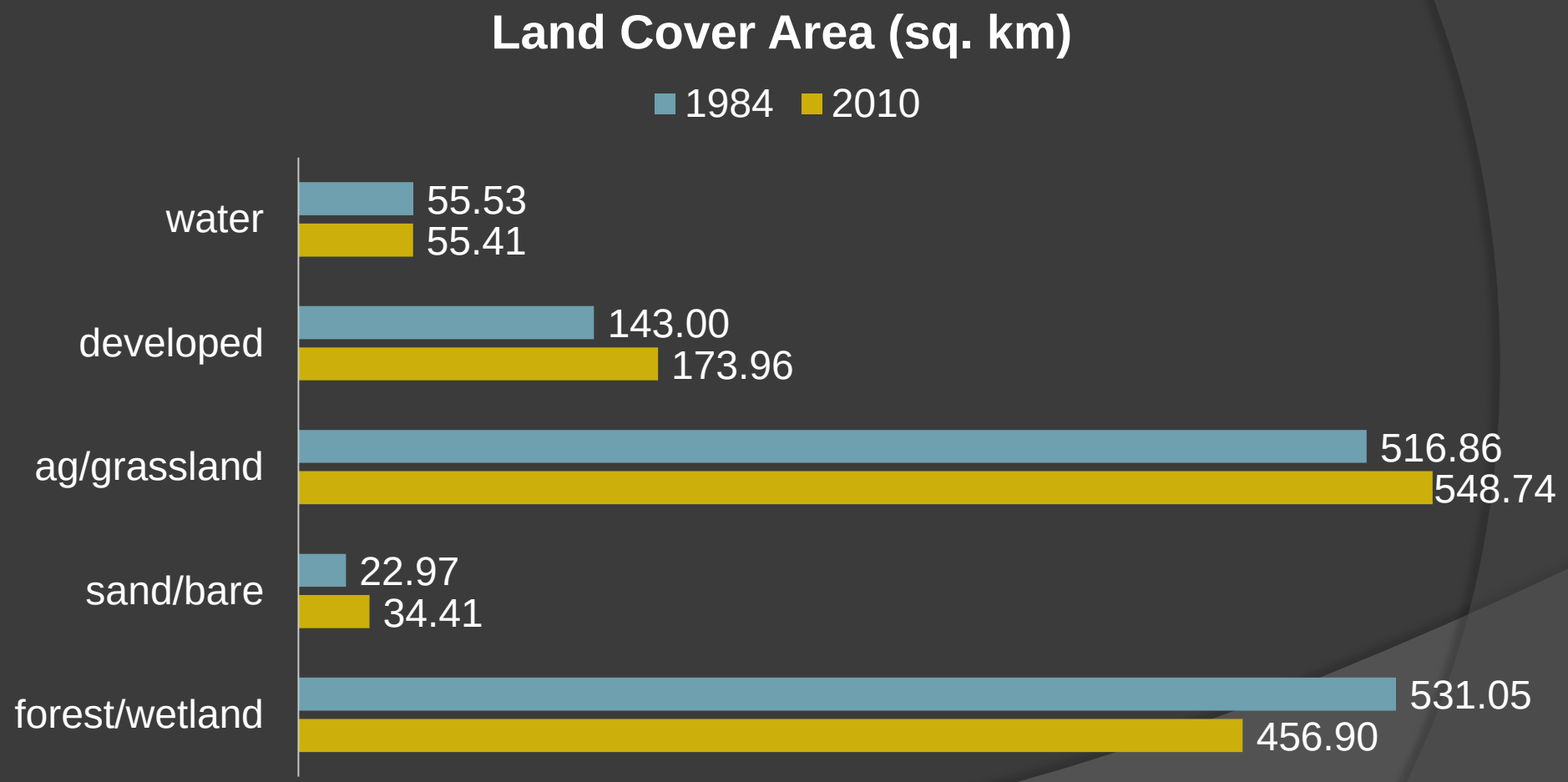
2010



Land Change

1984	# of pixels	Percentage of land cover	Area (sq. km)
forest/wetland	590060	41.83	531.05
sand/bare	25520	1.81	22.97
ag/grassland	574290	40.72	516.86
developed	158890	11.27	143.00
water	61697	4.37	55.53
total	1410457		1269.41
2010			
forest/wetland	507664	35.99	456.90
sand/bare	38236	2.71	34.41
ag/grassland	609706	43.23	548.74
developed	193286	13.70	173.96
water	61565	4.36	55.41
total	1410457		1269.41

Land Change


Land Cover Area (sq. km)
1984
2010
water
55.53
55.41
developed
143.00
173.96
ag/grassland
516.86
548.74
sand/bare
22.97
34.41
forest/wetland
531.05
456.90

Urbanization changes

- 2.4% increase as part of county
- 21% increase from urbanized lands in 1984

Forest and Agriculture/Grassland Changes

Qualitative Analysis

Issues in Classification

- Distinguishing between sand/bare, ag/grassland, and some urban areas
- Under-utilization of bands
  - Particularly band 4 (Near IR)
- Land cover dilution

Classification Dilution

Environmental Effects

Water Resources

- Impermeable Structures
  - Parking lots, highways, etc.
- Allow for run-off
  - Petrochemicals, eutrophic nutrients
- Effects on water quality and thus biodiversity
- Sedimentation
- Boardman River had 600 erosional locations
  - 150 have been remediated as of 2000

Water Resources

- Buffer zones can help remediation
- Citizen activism in clean water important
- Policy must be enforced for overall water security

Biodiversity and Loss of Habitat

- Homogeneity of species
- Fragmentation
- Conservation and brownfield development important

Agro-Industry Pollution

- Williamsburg Receiving & Storage Co. maraschino cherry plant
- Produced large amounts of wastewater
- Northern Michigan Environmental Action Council and local citizens file lawsuit
- Wastewater now transported to wastewater facility

Boardman River Dam Removal

- Dams have major effects on hydrology and aquatic species
- In August 2011, a proposal was put forward to remove dam on Boardman
- This would allow native vegetation in the region to return

Future Policy

- Important to keep environmental concerns in the forefront
- Environmental damage can happen in areas considered pristine
- Economic and environmental concerns must be balanced

Special Thank You

- Dr. Emerson
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- Lee Honors College

Questions