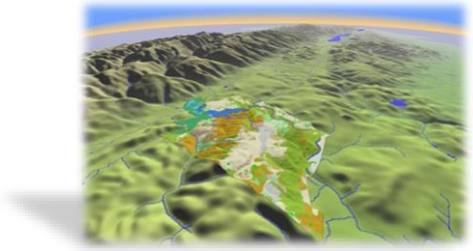
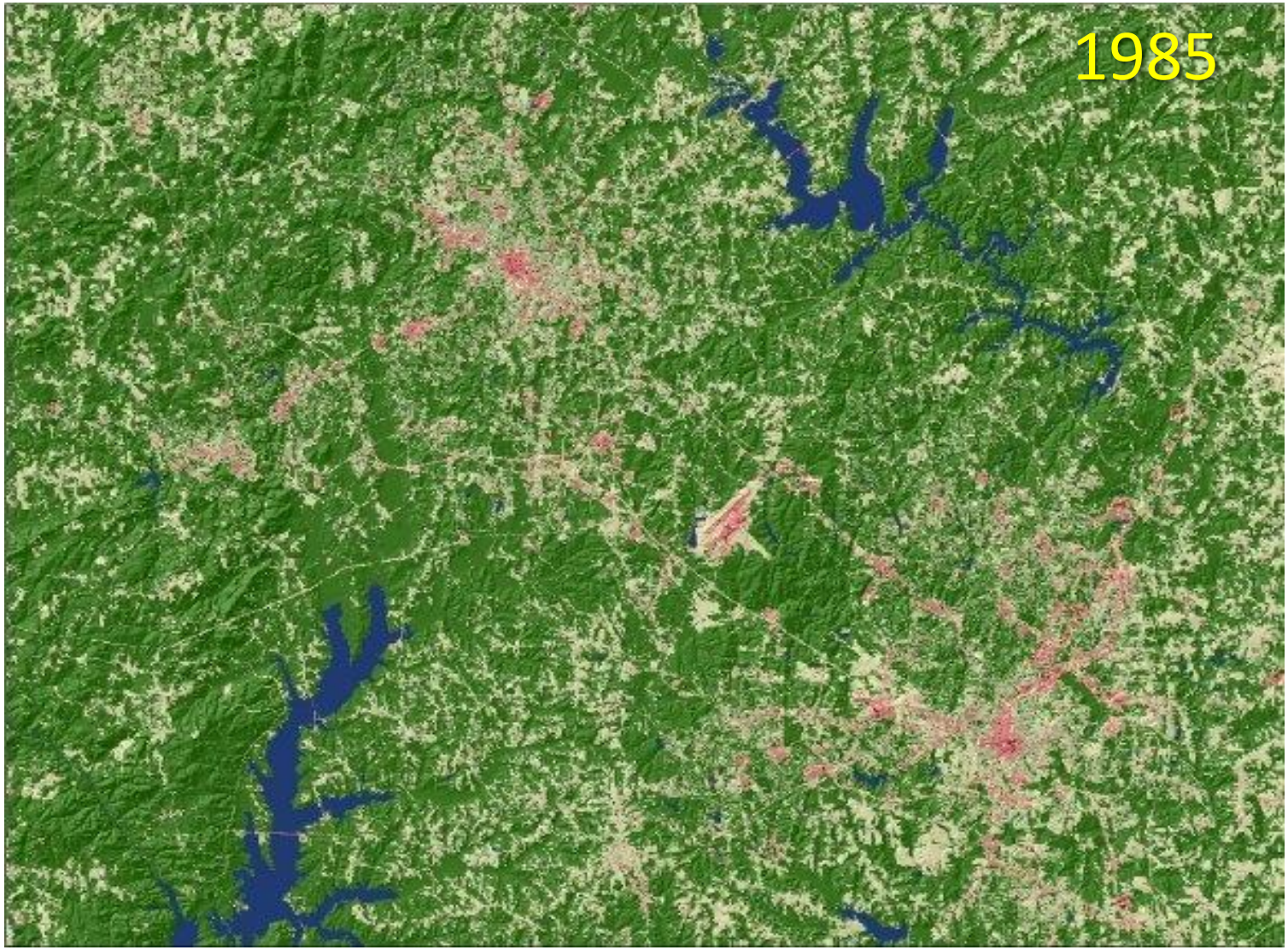


ENVIRON 761:
Monitoring & Change Detection

Instructor: John Fay

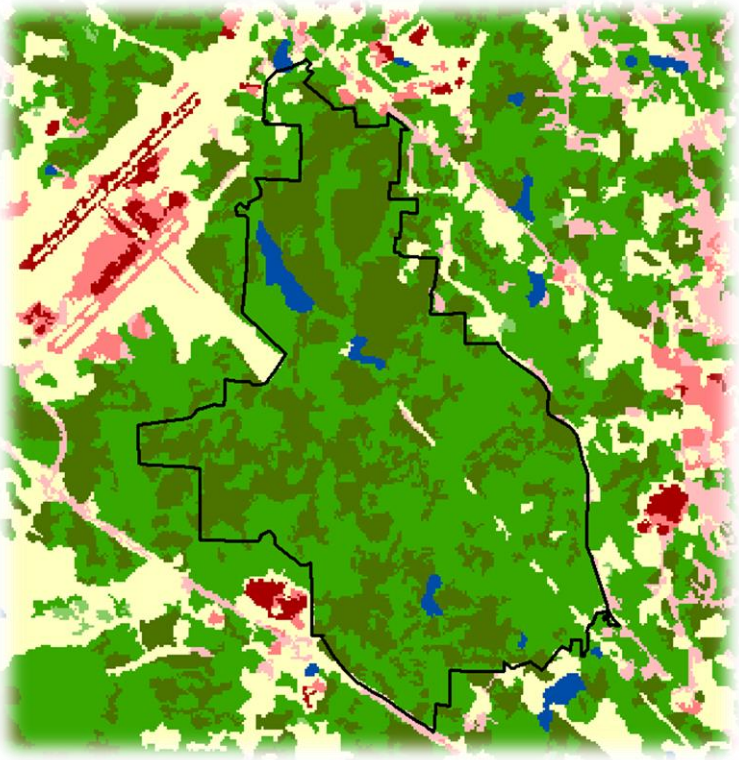
Land use change in the Triangle



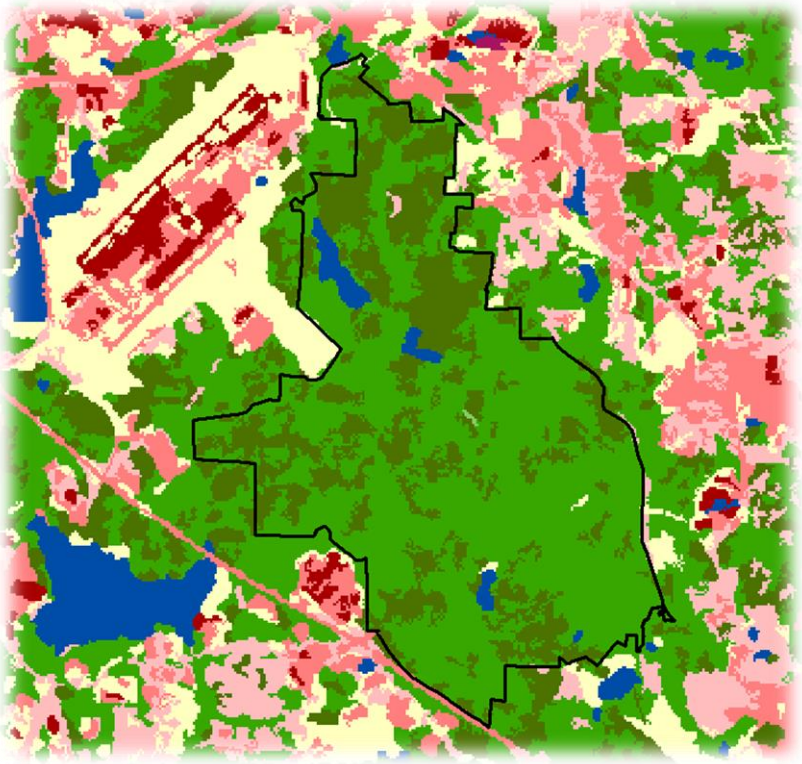
Credit: Joe Sexton (PhD ‘09) and Mike Donohue (MEM ‘08)

This week's lab exercise…

- Encroaching development



1985



2005

Measuring change

Discrete change: change in type

- land cover conversion (deforestation, development)
- detection depends on how the types are defined

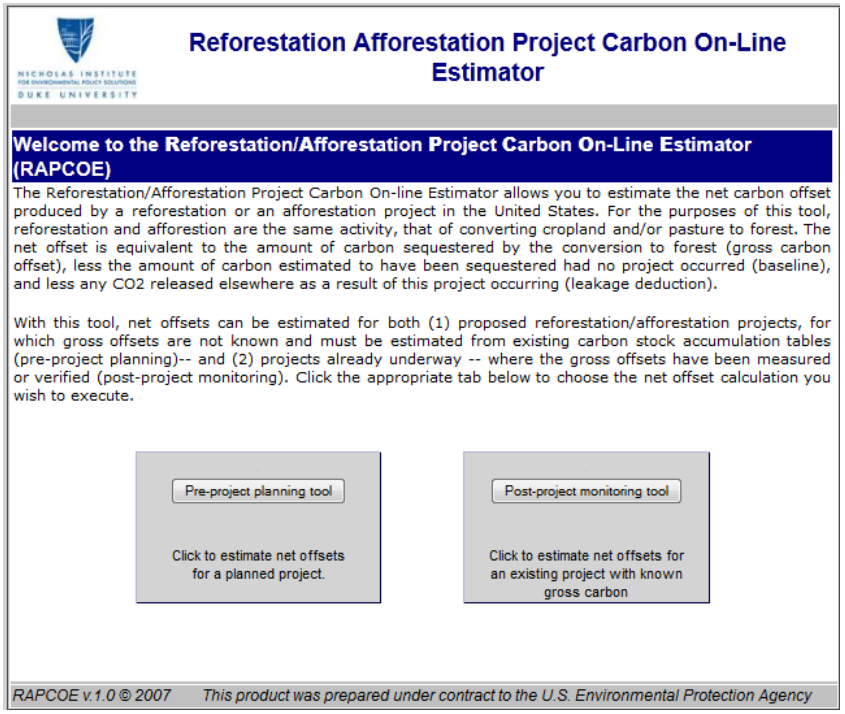
Continuous change: change in condition

- biomass accumulation
- changes in leaf area, canopy structure
- changes in fuel loads or understory density
- changes in species composition

Discrete change

Detection:

- Create difference maps from two time periods
- Recode the changes to make visual sense
  - forest → developed
  - ag → developed
  - ag → forest
  - and so on …
- The *pattern* of change is interesting:
  - where are the changes?
  - patch sizes?



Discrete change

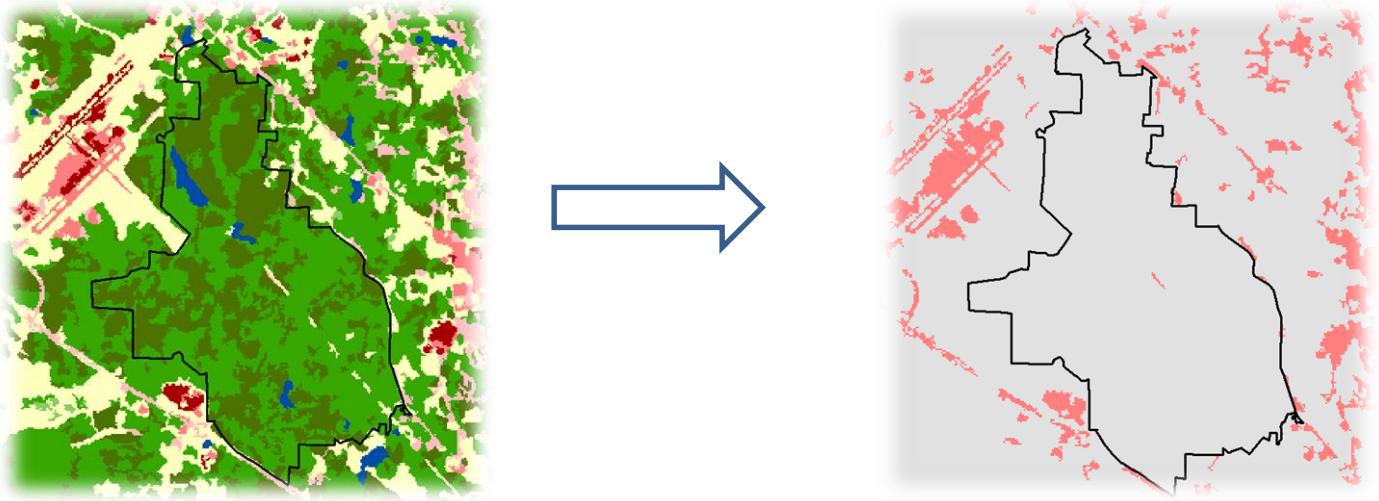
Summary:

- Tally type per sample in each time period
- Construct transition matrix (Markov model):

from: \ to:	1	2	3	4	5
1					
2					
3					
4					
5					

Change in the triangle → Development

1. Convert land cover maps into binary developed, not-developed maps

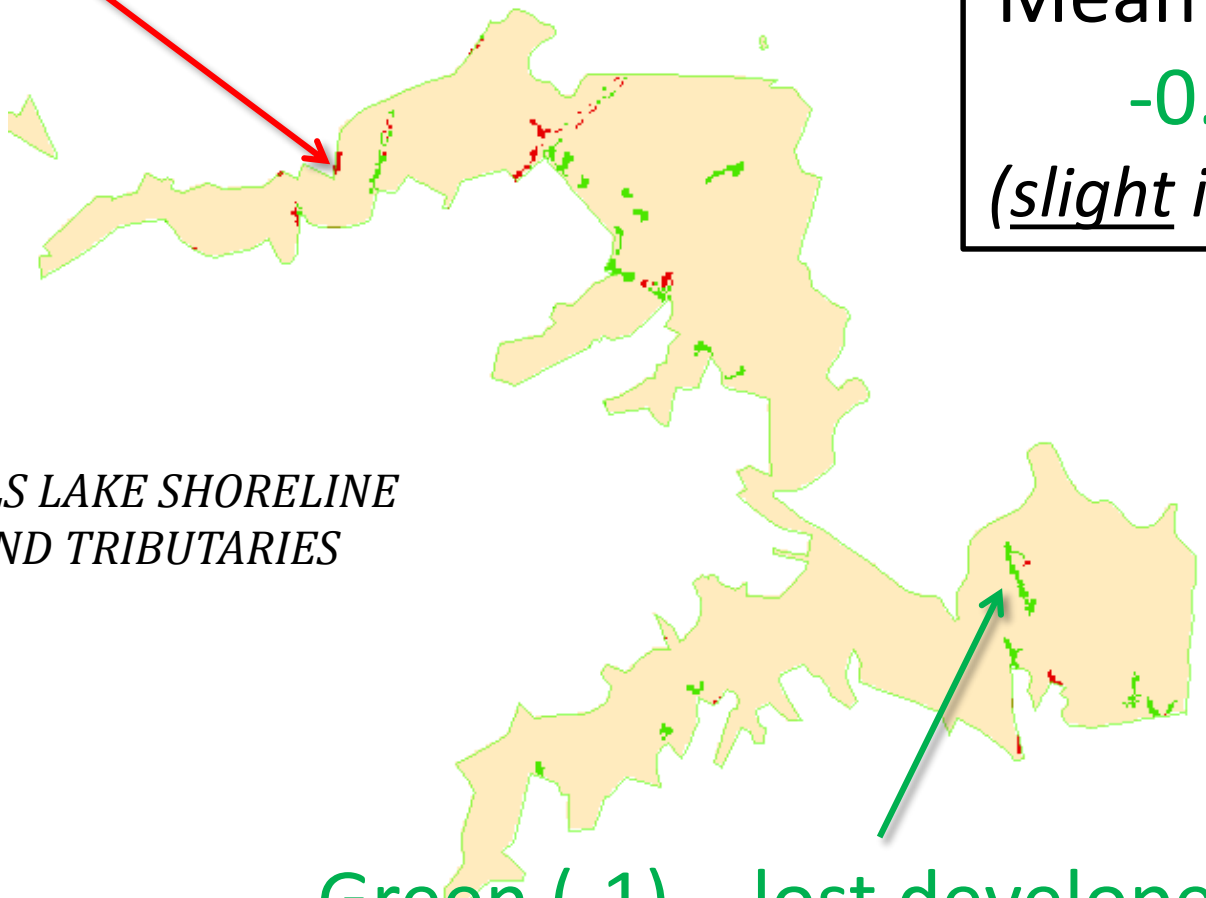


2. Subtract early date (1985) from later date (2005)

	2005	
1985	Developed (1)	Non-Developed (0)
Developed (1)	0	-1
Not-Developed (0)	1	0

Measuring Change

Red (1) – new developed land



FALLS LAKE SHORELINE AND TRIBUTARIES

Mean difference:

-0.009778

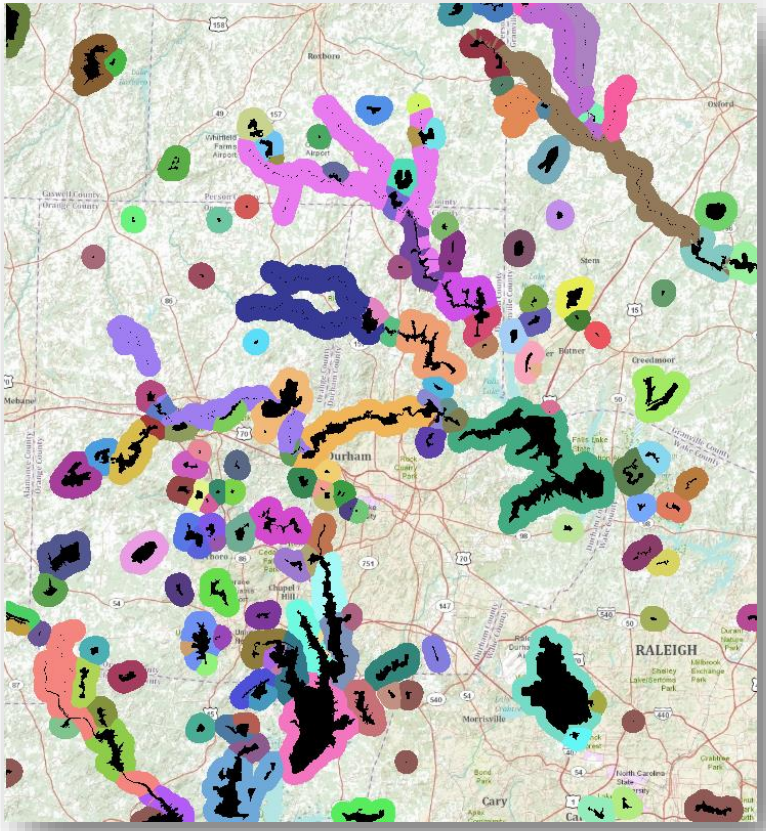
(slight improvement)

Green (-1) – lost developed land

Encroachment

Method 1:

Extend the boundaries of the SNHA's and tabulate the net gain/loss of developed area within a set proximity (e.g. 1km).

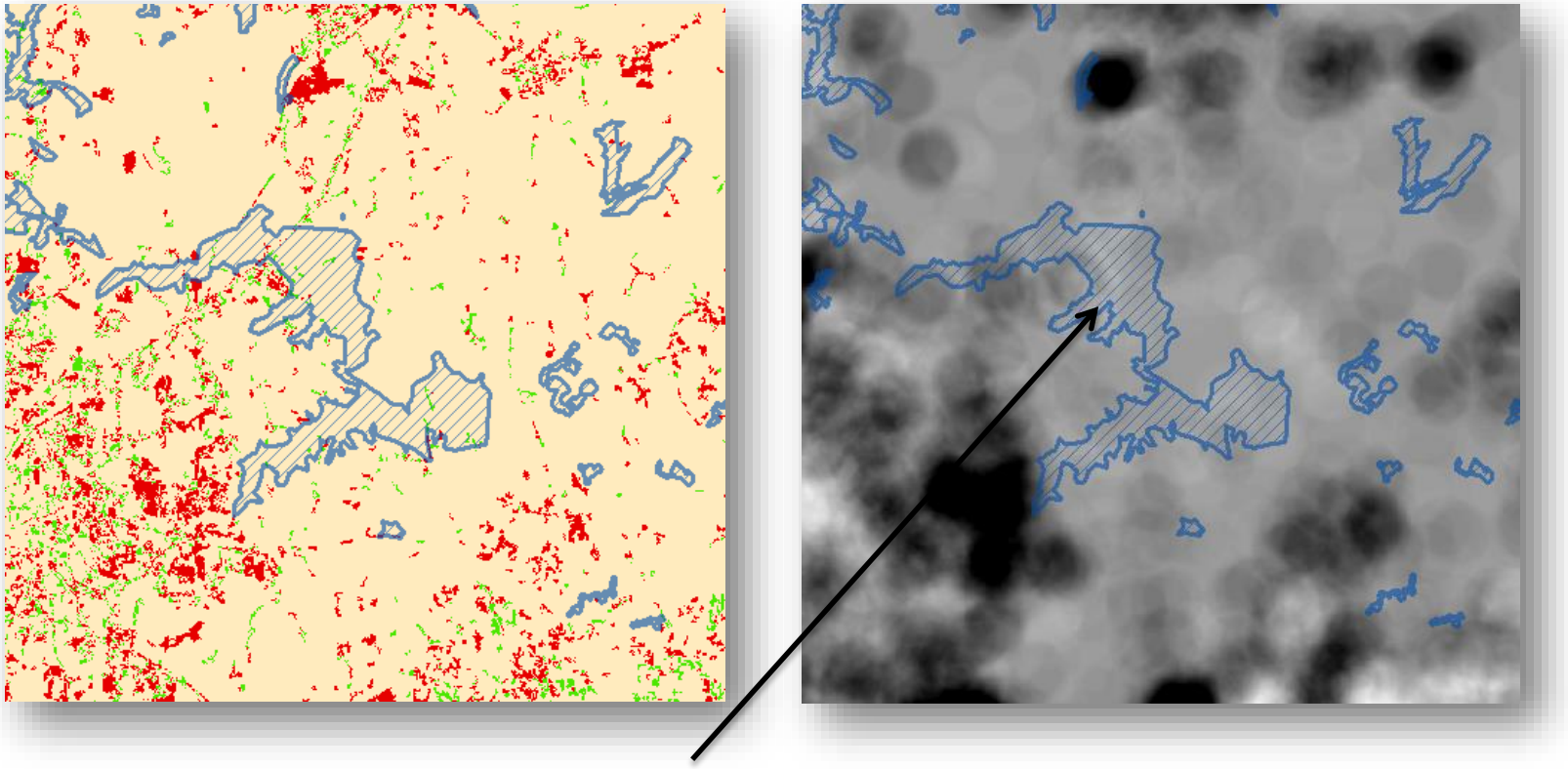


Then measure the mean of the developed gain/loss values within the adjacent areas.

Encroachment

Method 2:

Use focal analysis to extend the influence of developed gain/loss into the SNHA…



Mean value = 0.000331

Assignment: Discrete change

- For each method, indicate (e.g. via a map legend) the SNHAs with top 20% most encroaching development over the period of 1985 to 2005? Which comprise the lowest 20%?
- Do both approaches indicate the same SNHAs in the most encroached 20%?
- What drawbacks, if any, are there in using the Euclidean allocation approach?
- What drawbacks, if any, are there in using the focal statistic approach?
- A third approach involves creating 1km *vector* buffers from each SNHA polygon. What would be the major challenge in using this approach? Can this challenge be overcome? If so how? If not, why not.

Discrete vs. Continuous Change

- Discrete change, while dramatic, can miss subtle (continuous) changes in ecological condition
  - natural succession or disturbances
  - effects of management or restoration efforts

- Conservationists are often more interested in condition than type
  - measurement involves similar data collection methods
  - the analytic framework is slightly different

Continuous change: Lab Exercise

- Evaluate forest quality (greenness) within SNHAs
  - In which SNHAs are forests regenerating?
  - Are there SNHAs where forest are declining?
  - Are the new forests evergreen or deciduous?

Measuring Continuous Change

- NDVI → Greenness

- Evaluate the change in greenness over time
  - Subtract 1985 NDVI from 2005
    - Positive values → gain in greenness over time

  - Examine only forest pixels; change in greenness in other types are not interesting ecologically

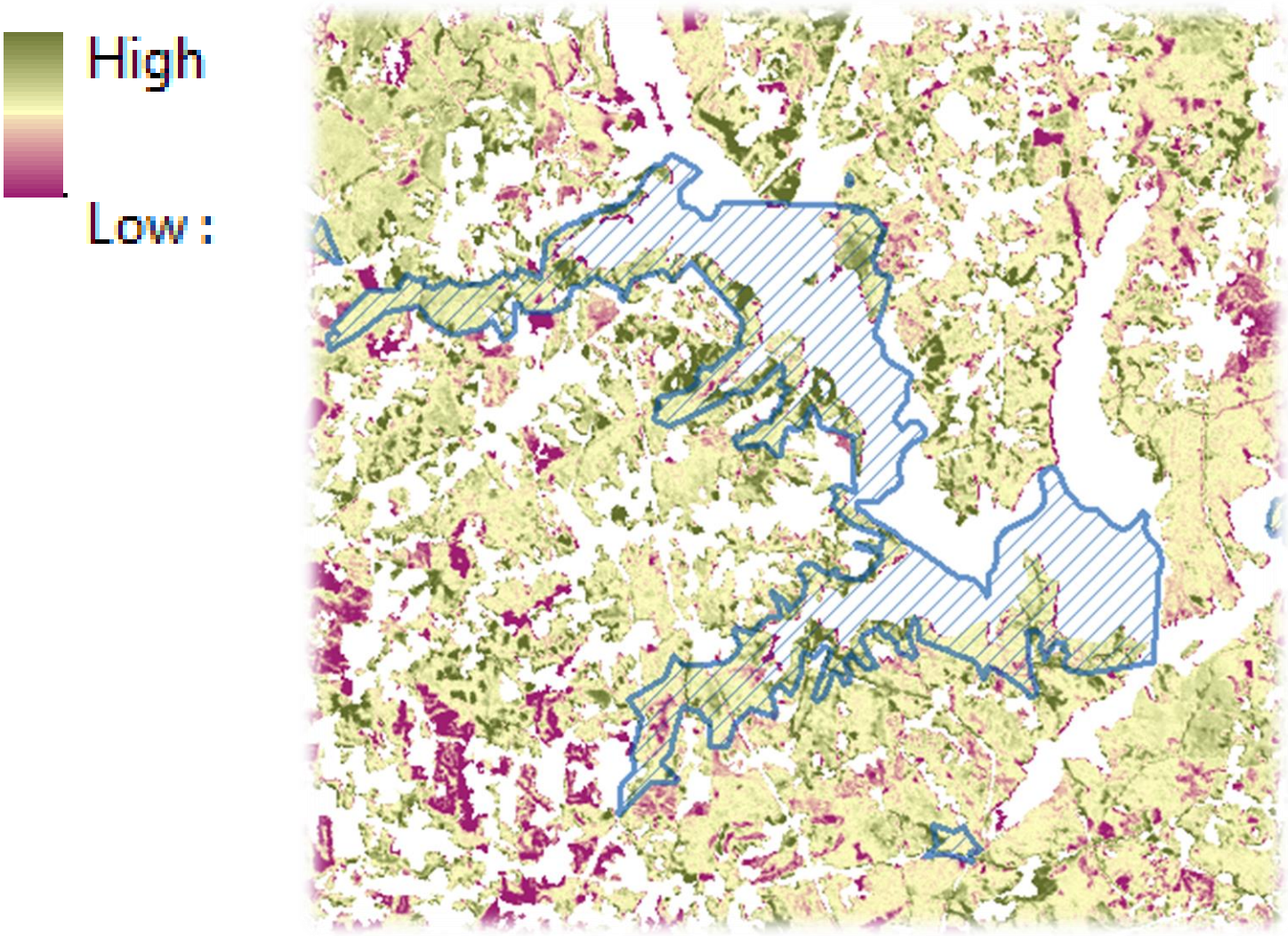
  - Compare summer to summer, winter to winter
    - Positive values in summer difference → increase in forest
    - Positive values in winter → increase in evergreen only
    - Δ Summer - Δ Winter → increase in deciduous only?

Change in NDVI

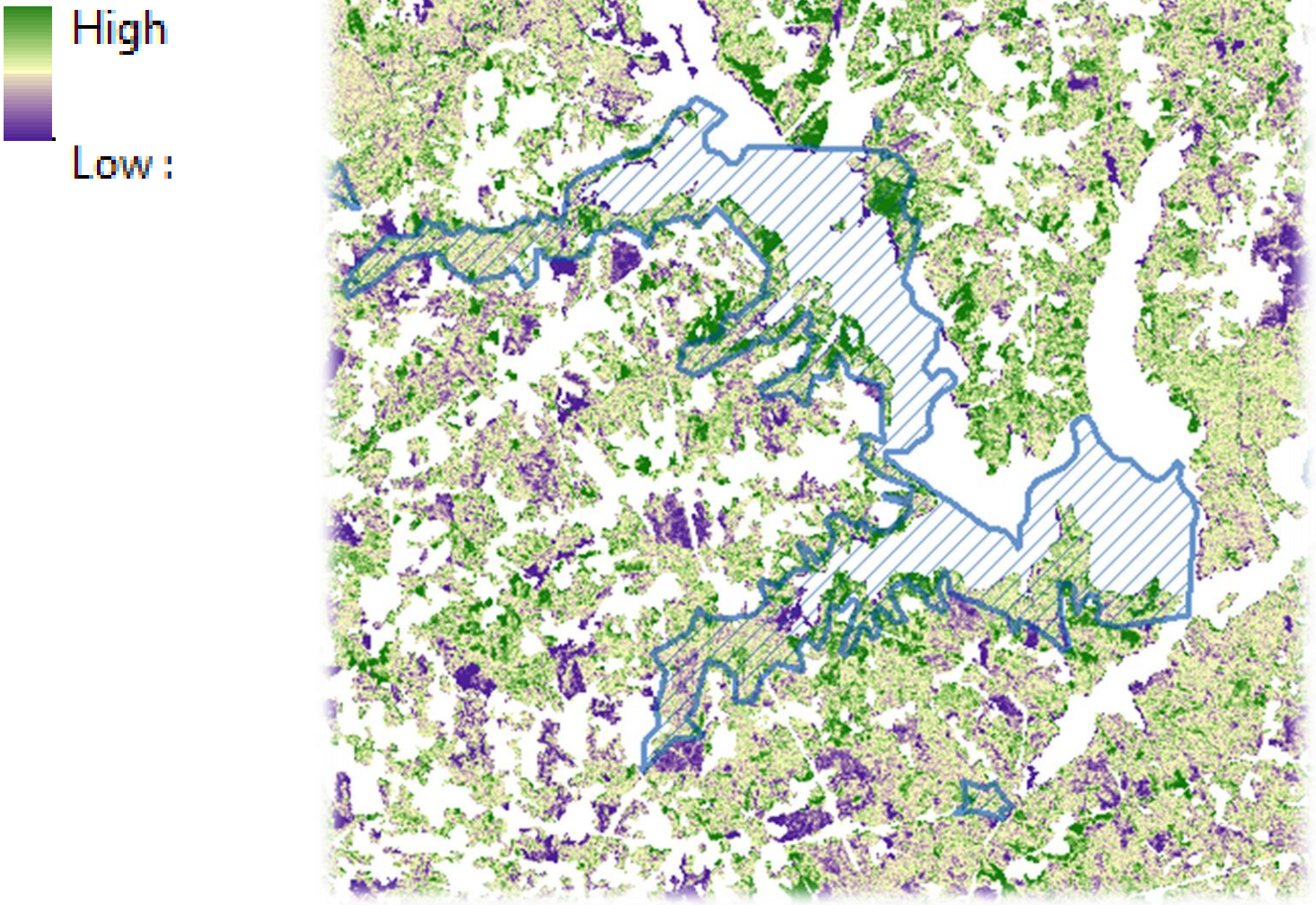
- Isolate pixels that were forest in either 1985 or 2005.
  - Other areas will change in greenness, but we're not concerned

- Subtract 1985 NDVI from 2005 NDVI within those areas
  - Difference in summer NDVI → All forest types
  - Difference in winter NDVI → Evergreen only

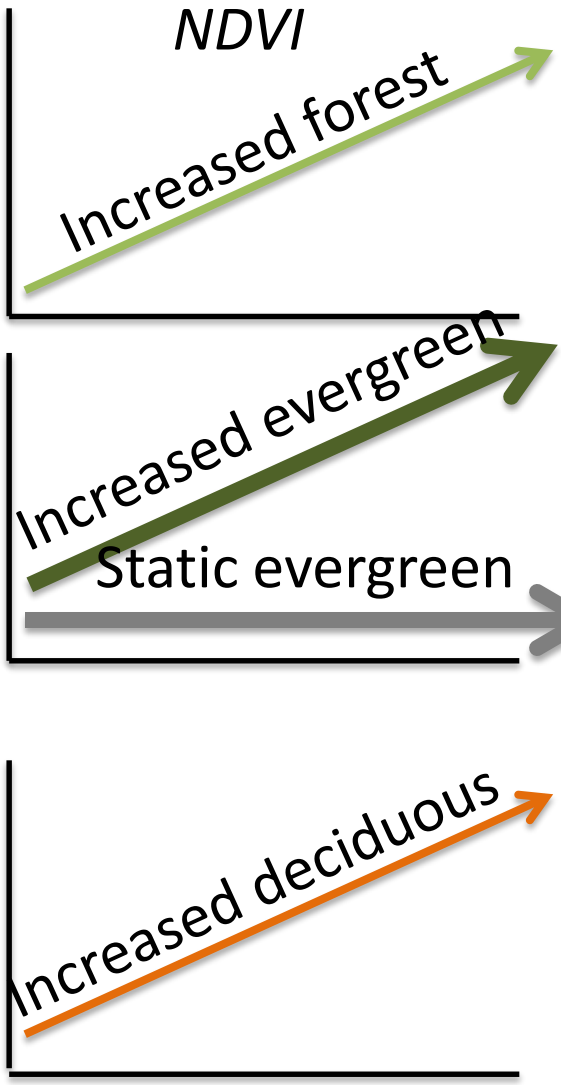
Change in Summer NDVI



Change in Winter NDVI



Change vectors



Summer ‘85

Summer ‘05

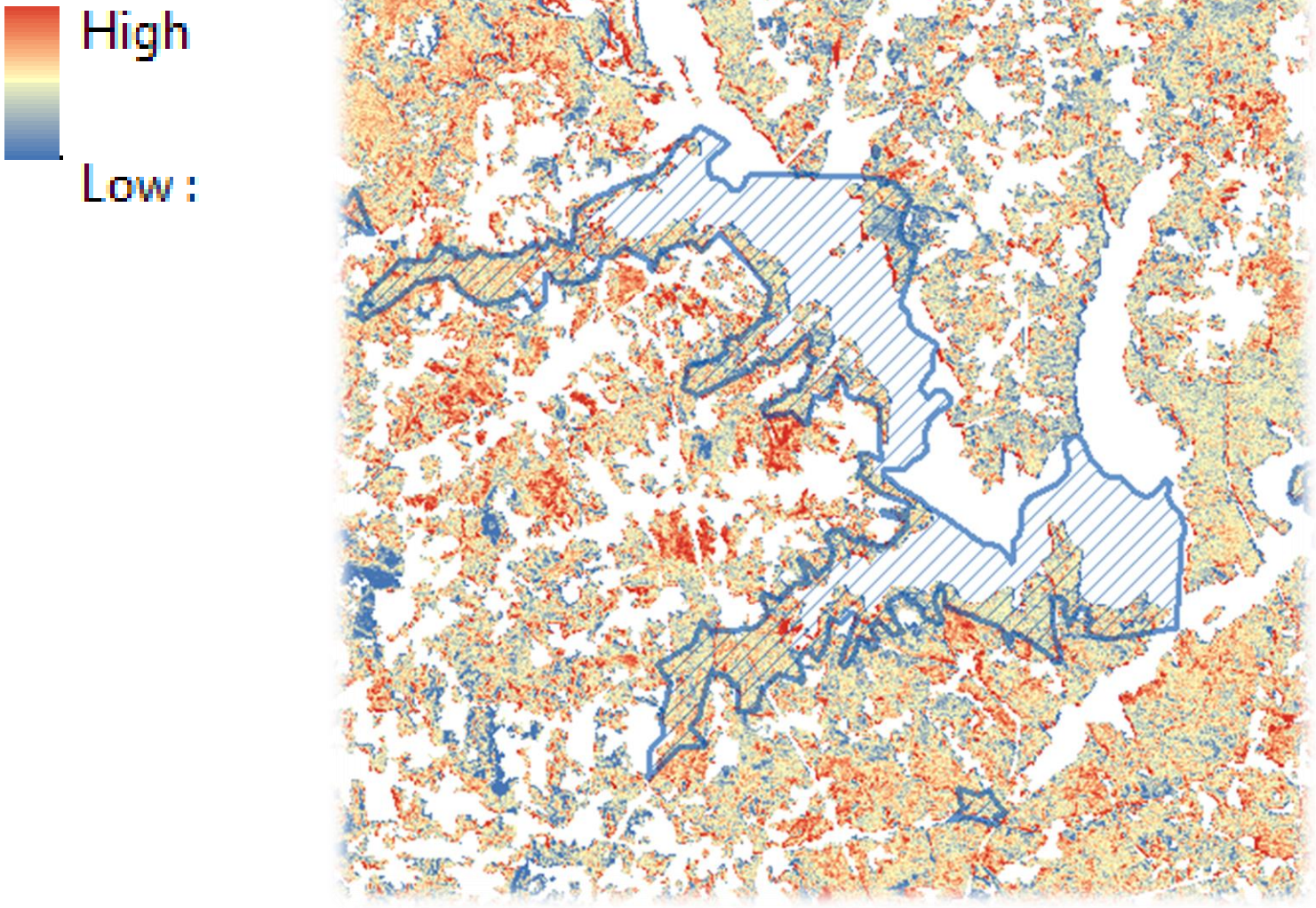
Winter ‘85

Winter ‘05

Δ Summer - Δ Winter 1985

Δ Summer - Δ Winter 2005

Δ Summer NDVI - Δ Winter NDVI



Assignment: Continuous change

- Create maps showing changes in NDVI values for Umstead State Park and its surroundings
- Describe what the maps show…
  - …in terms of forest gain/loss within the park boundaries vs. immediately surrounding it.
  - …in terms of forest succession within the park boundaries vs. immediately surrounding it.

Assignment: Continuous change *(cont'd)*

- Create a map with **two** frames:

1. *Highlight two SNHA's*: one "healthy", and another that has lost a lot of greenness from 1985-2005.

2. *Highlight two SNHA's*: one that has undergone succession, and another where increased greenness appears to be mostly from evergreens.

Predicting change…

- Agent based models (cellular automata)
  - SLEUTH
  - California Urban Futures model
- “Human” habitat models
  - Deforestation models