

## **Syllabus for NR 378 / NR 285**

### **GIS Analysis of New York City's Ecology**

Long title: Using spatial analysis tools to help with New York City's million tree campaign

Fall semester 2008

University of Vermont



Source: Microsoft Virtual Earth

#### **Instructors**

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#### **Purpose and description**

New York City is currently undergoing a major multi-million dollar planning effort to improve the quality of its urban environment as part of its PLANYC ([www.nyc.gov/html/planyc2030](http://www.nyc.gov/html/planyc2030)). Two of the many goals of this plan are to ensure that no New Yorker lives more than 10 minutes from green open space and that 1 million trees be planted (as part of the Milliontrees NYC campaign; [www.milliontreesnyc.org](http://www.milliontreesnyc.org)). A good deal of NYC's Million Tree goal was based upon analysis performed by the US Forest Service and UVM Spatial Analysis Lab.

Students in this class will work directly with personnel at the NYC Parks and Recreation Department, including the City's Chief of Forestry and Horticulture to help them analyze the current state of the urban forest and to design plans to help them reach their environmental goals. In this class, students will learn about both the ecosystem services and socio-economic benefits associated with urban trees and forests and the biophysical and socio-economic factors associated with the stewardship of urban trees and forests. Further, they will learn and practice new spatial and statistical methodologies for a number of purposes, including multi-scale characterization, development of urban environmental typologies with spatial cluster analysis and expert system development, and prescriptive mapping processes using model building. Students will use an extensive parcel-level database, including fine-scale classified land cover, provided by the city. Hence, relatively little data acquisition or processing will be needed and students can focus on analysis.

The class will begin with a four day field trip to New York City in which students and instructors will meet with official from the Parks and Recreation Department, tour their offices and GIS facilities, meet with representatives from neighborhood stewardship groups and other institutions, such as the US Forest Service. There will also be a number of guided tours of several important parks and natural areas. Finally, there will

some GPS data collection, which will serve as an exercise in integrating field data. There will be a fee charged to students of between \$100 and \$200 for the field trip to defray expenses.

The classroom portion of the course is divided into three segments. In the first segment, students will break into groups, each of which will focus on a different service(s) or function(s) associated with urban trees (e.g. water quality, air quality, energy savings, aesthetics, recreation, property values, carbon storage, neighborhood social capital). The reading lists for these groups will come from an extensive bibliography on urban tree benefits put together by the US Forest Service at <http://www.fs.fed.us/ne/syracuse/Pubs/pubs.htm>. In the process of looking at urban forest benefits we will examine how the problem of urban forest planning fits in the literature on integration and urban ecology (which is an inherently integrated discipline).

In the second segment students will break into new groups and focus on developing a descriptive multi-scale typology to categorize areas (e.g. neighborhoods, Census tracts, boroughs, etc.) based on the need for new vegetation, accounting for factors like the level (and potentially health) of vegetation cover, land use, socio-economic characteristics of residents, and proximity to other natural features. Each group will try a different approach towards developing this typology: one will use a “bottom-up” approach using statistical cluster analysis methods. Another will implement an existing approach—the Forest Opportunity Spectrum. The third will use an expert rule-based system. Teams will be divided up so as to get the necessary representation of skills in each group. Students will present the results of the work to visiting staff from the City’s Department of Parks and Recreation, which will help in designing approaches for the next assignment. Results of this segment will tentatively be presented by videoconference to City staff.

For the final segment of the class, students will break into groups again and will work on developing prescriptive prioritization maps for targeting tree planting and other “green investments.” In this stage, students will incorporate an on-going project between the US Forest Service and the City which maps and describes areas of influence and locations of activities of the hundreds of urban environmental stewardship groups in the City. These data are crucial since the potential for stewardship is a prime criterion in the proposed location of urban forestry investments. As part of this process, students will use the Model Builder environment in ArcGIS to formalize the processes they develop and, in so doing, generate tools that could be re-deployed and adapted by the City. The theme for division of these groups has yet to be determined, but possible ways of dividing up the groups include: 1) by service or function (e.g. one group focusing on planting to maximize air quality, one on property values, etc.); 2) by scale (e.g. one group at the borough scale focusing on landscape-level targeting, one at the neighborhood scale focusing on micro-site targeting, etc.); and 3) by methodological approach (e.g. one group focusing on site selection processes, one on allocation models, one on visualization tools, etc.). Students will present these results to officials from the Department of Parks and Recreation, who will travel up to Burlington. The deliverables of the class, including data, methods, and results, will then be transferred to the City for their use and enhancement.

More detail on the content of the course is given under “course requirements” and the schedule.

### **Prerequisites**

Students enrolling in either section must have had an introductory course in GIS (NR 143, NR 343 or equivalent) and be familiar with ESRI’s ArcGIS. Undergraduates enrolling in NR 285 must be seniors.

### **Time and Place**

There will be a 4-5 day field trip to New York City the week of August 25<sup>th</sup>. Once Fall classes begin, the course will meet weekly on Mondays from 9:00-11:00. Occasionally class time may go past 11:00 when we have

special presentations. If this does not fit into students' schedules, we will look into having special presentations extend to a Wednesday session at the same time. The course meets in 222 Aiken.

### **Credits, sections and fee**

For NR 285 students, the course is 3 credits. NR 378 is, by definition, a 2 credit course. However, graduate students in 378 may enroll for an additional special topics credit (NR 385) if they wish to get 3 credits for the course. Although graduate and undergraduate students take the course under different course numbers, this operates as one course. Enrollment is limited to no more than 9 senior undergraduates and no more than 12 graduate students. There will be a fee of between \$100 and \$200 to defray the cost of the field trip. When the exact amount is determined in spring 2008 all registered students will be notified by email.

### **Course Format and Requirements**

The field trip is required, as is weekly attendance in the class. In class-activities will include a combination of short lectures, discussions, lab exercises, student presentations, and guided project work. All assignments in the class are done in groups. There are three assignments. The first is a literature review. The second is the development of a descriptive typology of urban neighborhoods based on land use and vegetation cover using GIS methods. The third is a prescriptive design for tree planting for several areas at several different scales, also using GIS and other related visualization tools. The first assignment requires a submitting a paper, while the second requires a Powerpoint presentation and documentation of GIS methods/datasets, and the third requires a Powerpoint presentation and final report, including maps and visuals.

### **Readings:**

Before going on the field trip students will read several background documents on New York City's tree planting and environmental stewardship campaigns, including the PlaNYC document. For the literature review assignment in the class, students will organize into groups based on thematic areas related to the different identified "functions" of urban trees, and choose their own reading list from an extensive list that we will provide. There will also be readings on thematic topics related to class lectures or exercises for most weeks, given below in the bibliography. Readings will be posted electronically on WebCT.

### **Academic Integrity**

This course involves a lot of writing. Acts of academic dishonesty, particularly plagiarism, are subject to UVM's rules of academic integrity. The full policy can be found at <http://www.uvm.edu/~uvmppg/ppg/student/acadintegrity.pdf>. Please be extremely careful to properly attribute everything you reference from other sources, whether paper or electronic. Pulling text from other sources without proper attribution will be considered plagiarism.

### **Preliminary Schedule**

August 25-28: Field trip to New York City

Readings: PLANYC documents

September 1: no class (Labor Day)

September 8:

- Course logistics and organization
- Discussion of urban ecology an integrative framework and urban forestry as an application of that framework

- Decide on themes that will form the focus of each Segment 1 thematic group and break into those groups (e.g. effects of urban trees on carbon storage, water quality, social capital, property values, air quality, etc.).
- Readings: Grove et al. 2006; Pickett et al. 2001

September 15:

- Lecture by instructors on research on the services associated with urban trees, focusing particularly on topics not covered by the Segment 1 groups.
- Each thematic group posts their bibliographies to the web along with a short summary document on the planned scope of their literature review by this day; this will be briefly presented in class and opened to discussion after the lecture
- Readings: Nowak and Dwyer 2007; McPherson et al. 2005; Nowak et al. 2002

September 22:

- Lecture and discussion on urban forest ecology and management
- Lab exercise using Baltimore data to help learn Arc Model Builder fundamentals
- Readings: Flores et al. 1998; Groffman et al. 2003

September 29

- Student groups turn in literature reviews
- Each group makes a 20 minute presentation on their literature review followed by discussion, potentially with NYC team linked by videoconference
- Break into new Segment 2 groups for the “spatial typology exercise,” review purpose and guidelines
- Readings: Maantay and Ziegler, chapter 9

October 6

- Lecture on spatial cluster analysis, GIS rule-based expert systems, neural nets, and typology development approaches
- Short lecture on the Forest Opportunity Spectrum and other modeling approaches for quantifying urban forest canopy and for prioritizing areas for urban forestry investments as an example
- GIS/statistical exercise on cluster analysis and typology development using pre-processed data
- Readings: Fortin and Dale, chapter 4 (short excerpt); Malczewski, 2003, part 4; Raciti et al. 2006 excerpts

October 13

- Lecture on urban canopy assessment methodologies using GIS/RS including NYC UTC analysis
- Brief Network Analyst exercise
- Typology groups work in class with instructor assistance
- Readings: Zhou et al 2008, Galvin et al. 2006 excerpts; O’Neil-Dunne and Grove

October 20 (*lecture and readings tentative depending on progress on typology projects*)

- Lecture and discussion on geodemographic segmentation and spatial “environmental marketing”
- Typology groups work in class with instructor assistance
- Readings: Troy 2008; Grove et al. 2006

October 27

- Typology groups present results in class and facilitate discussion potentially with NYC team linked by videoconference
- Organize new Segment 3 groups for “prescriptive mapping” exercise

November 3

- Lecture on urban vegetation distribution predictors and environmental marketing
- Prescriptive groups work in class with instructor assistance
- Readings: Troy et al 2007; Heynen et al 2003

November 10

- Lecture and discussion on Urban Forestry Stewardship groups
- Prescriptive mapping groups work in class with instructor assistance
- Readings: Svendsen and Campbell 2008

November 17

- Lecture and discussion on spatial interaction of crime and urban vegetation
- Prescriptive mapping groups work in class with instructor assistance
- Readings: Troy and Grove *in review*.

November 24: Thanksgiving break

December 1 (extended class):

- Final presentations in class (New York team present?)

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