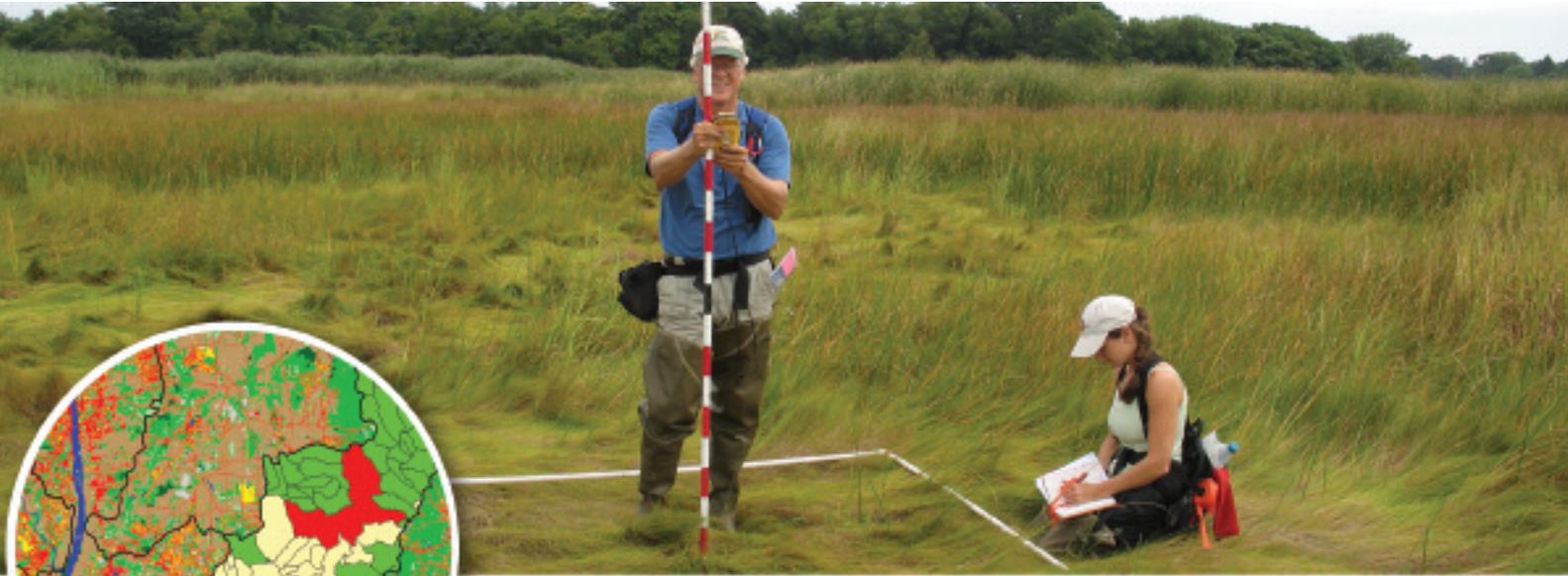
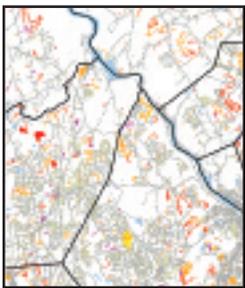


Research



CLEAR research projects use remote sensing (RS) and other geospatial sciences and technology to describe and assess changes in Connecticut's landscape. This includes studies that look at broad statewide (and sometimes regional and even global) trends in forested, agricultural and developed lands, and other efforts that focus on specific landscape elements of critical importance or special interest. Most of the remote sensing research is done out of the Laboratory for Earth Resources Information Systems (LERIS), but many other CLEAR programs conduct applied research.

For more information, go to clear.uconn.edu and click "Research".



Land cover change map for southwestern Connecticut. (New development since 1985 is shown in color.)

Tracking Connecticut's changing landscape. This ongoing project tracks changes in the state's landscape over time (1985 - 2002), with an emphasis on increases in developed land and fragmentation of forest lands. The study has become a major resource for researchers, state agencies, regional and local planners, the public and the press (see Research Impacts on page 9). Currently, the project is being updated with 2006 data. The

update will also include enhancements to the land cover classification system which will shed more light on trends in agricultural and residential land.

Impervious surfaces in the Long Island Sound watershed. In this study conducted for the Long Island Sound Study National Estuary Program, CLEAR researchers used innovative

remote sensing techniques to quantify impervious surfaces in Connecticut and southern New York from 1985 to 2002. Impervious surfaces like asphalt, rooftops and concrete are a reliable indicator of the impact of development on water resources. The information is being used to help track progress under the 2003 Long Island Sound Agreement, a management pact signed by the states of Connecticut and New York, and the federal EPA.



Researchers Dan Civco and Martha Gilmore (Wesleyan University) collect tidal marsh field data. (Photo courtesy of Sandy Prisloe, GTP.)

Assessing invasive coastal plants via remote sensing. This research effort, conducted in cooperation with Wesleyan University, the USDA Natural Resources Conservation Service and other partners, is developing cutting-edge methods to characterize and track tidal wetland plant communities from satellite data. The emphasis is on the invasive reed, *Phragmites australis*, that has replaced large swaths

Large photo, left: Sandy Prisloe (left) and Cary Chadwick (right) collecting detailed plant species data and GPS locations at study sites on the Ragged Creek tidal marsh in Old Saybrook, CT. (Photo courtesy of Joel Stocker, Forestry Program.)
 Circle photo, left: The Hohanum River Watershed, with sub-basins colored according to impervious surface levels as determined by CLEAR research.

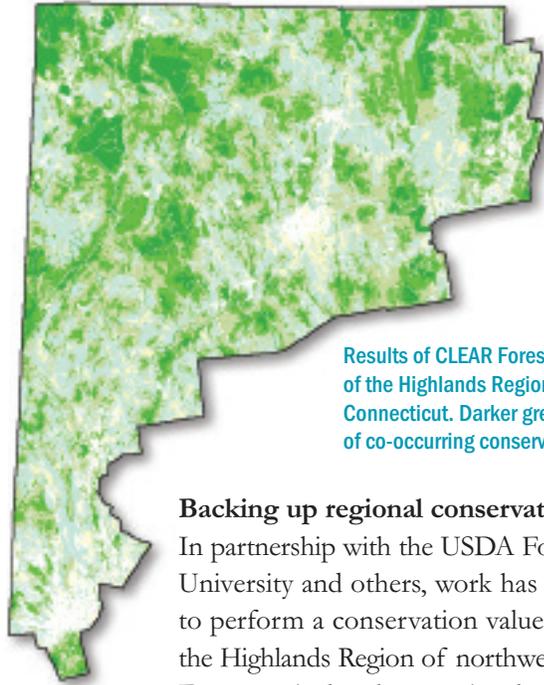
of native salt marsh vegetation along the East Coast and is the subject of control programs by the CT DEP and other organizations. By forging new research techniques, the project hopes to ultimately devise an accurate yet cost-effective way to track the distribution of invasive coastal plant species.

Looking for open space opportunities along the Connecticut coast. In partnership with CT DEP and funded by the National Oceanic and



Atmospheric Administration (NOAA), CLEAR researchers took a closer look at land cover and land cover change along the Connecticut coast. The results are being used by CT DEP in an ongoing effort to prioritize potential open space acquisition areas along the state's urbanizing shoreline.

Exploring the dynamics of global urban expansion. Conducted as part of a team that included New York University and Williams College, CLEAR researchers looked at urban extent and expansion over a ten-year period for 120 cities around the world with a population over 100,000. This ongoing study, funded by The World Bank and the National Science Foundation, is providing insight into the relationships of population growth and urban expansion in developing countries.



Results of CLEAR Forestry Program's analysis of the Highlands Region in northwestern Connecticut. Darker green shades depict areas of co-occurring conservation value.

Backing up regional conservation with science.

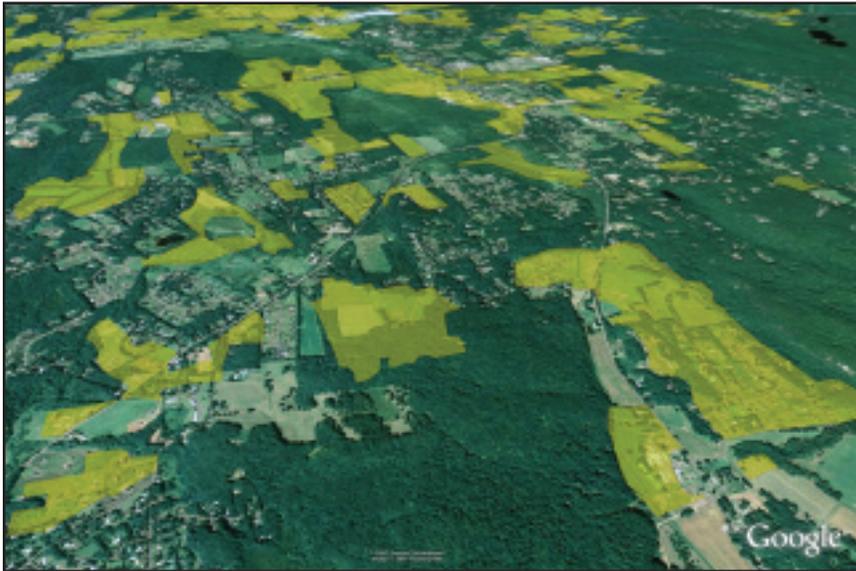
In partnership with the USDA Forest Service, Yale University and others, work has been conducted to perform a conservation values assessment for the Highlands Region of northwestern Connecticut. Forest, agricultural, recreational, water and biodiversity resources were evaluated and a series of maps prepared to inform the land conservation process outlined in the Highlands Conservation Act, and to share with concerned citizens in the Highlands Region.

Assessing coastal streamside buffers. In this study funded by the Long Island Sound Study National Estuary Program, CLEAR researchers



are assessing land cover and land cover change in the streamside (riparian) corridors of Connecticut's coastal watersheds. The national research base is increasingly finding that intact, vegetated riparian corridors are critical to protecting the health of our waterways. State and federal environmental

officials intend to use the CLEAR study as a broad-scale guide to determining where to focus riparian buffer protection and restoration efforts.



A Google Earth image of a section of Middletown, CT, with a transparent overlay showing agricultural areas in 1970. As can be seen at the bottom right, many of the areas have now been converted to development. Projecting research results on Google Earth will be an emphasis of CLEAR in the future.

Determining loss of farmland in the lower Connecticut River Valley. CLEAR researchers, in collaboration with faculty and an undergraduate student at Wesleyan, digitized agricultural areas, based on a 1970 land cover map, for the towns in the Midstate and Connecticut River Estuary Regional Planning Agencies. These data are being compared to current land use to determine how much and where agricultural land has been lost to non-agricultural uses. Plans are to expand this analysis to the rest of the state.

Student Research Projects

CLEAR strives to develop graduate and undergraduate student projects that not only serve student needs, but are integrated into the overall Center mission. Some examples include:

Why are some streams healthy, and not others?

As part of CLEAR's work with CT DEP on impervious cover and biological indicators (page 11), a graduate student is working with CT DEP staff looking at why streams with almost identical impervious cover percentages can have biotic communities of very different degrees of health. CLEAR and CT DEP hope that the results will provide clues as to what exact landscape, stream or other characteristics might be critical in preserving stream integrity.

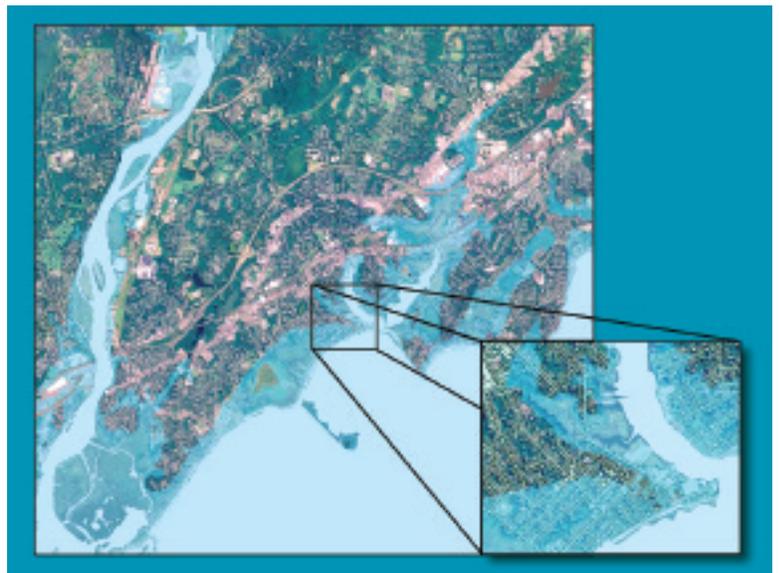
Testing of a nonpoint source pollution model.

CLEAR graduate students are testing and refining a nonpoint source pollution modeling tool created by the NOAA Coastal Services Center, developing locally-calibrated pollutant coefficients for input into the model. The results are not only relevant to Connecticut, but will be used by NOAA developers to improve the model.

Envisioning the extent of coastal storm

flooding. CLEAR graduate and undergraduate students used a NOAA model that estimates storm surge to compare differences in coastal

flooding estimates when using conventional elevation data ("NED" and "SRTM") with newer, more accurate statewide remotely-sensed elevation data known as LiDAR. The technique provides the ability to greatly improve prediction of the impact of coastal storms.



The potential effect of a 20-foot storm surge is shown for an area of the Milford, CT coastline. Light blue mask shows predicted flood areas, overlain on recent high resolution aerial imagery. (Image courtesy of Mark Hoover, CLEAR graduate student.)

Mapping state owned forest. Working with CT DEP Divisions of Forestry and Wildlife, the Extension Forestry Program is collecting and digitizing forest and wildlife stands within state forests and wildlife management areas, with the goal of producing a GIS database with detailed information about forest stands that can be used by both organizations. CLEAR is providing the training, equipment and overall data management, while CT DEP is providing two full time technicians to input the data and work with the State Foresters. There are approximately 164,000 acres of state forest and wildlife areas planned for the database.

Investigating coastal erosion of the Griswold Point sand spit. The Geospatial Technology Program, with support from the Connecticut Space Grant College Consortium, provided an assistantship to a Wesleyan graduate student to investigate the erosion of Griswold Point at the mouth of the Connecticut River. Research integrated data from field surveys, GIS and remote sensing to generate an hypothesis as to why this important coastal feature and unique habitat has almost completely disappeared.



Tracy Krueger, a Masters candidate at Wesleyan University, conducts a beach transect at Griswold Point using high-precision ground surveying equipment.(Photo courtesy of Sandy Prisloe, GTP.)

Investigations such as this help us better understand the processes that shape Connecticut's shoreline.

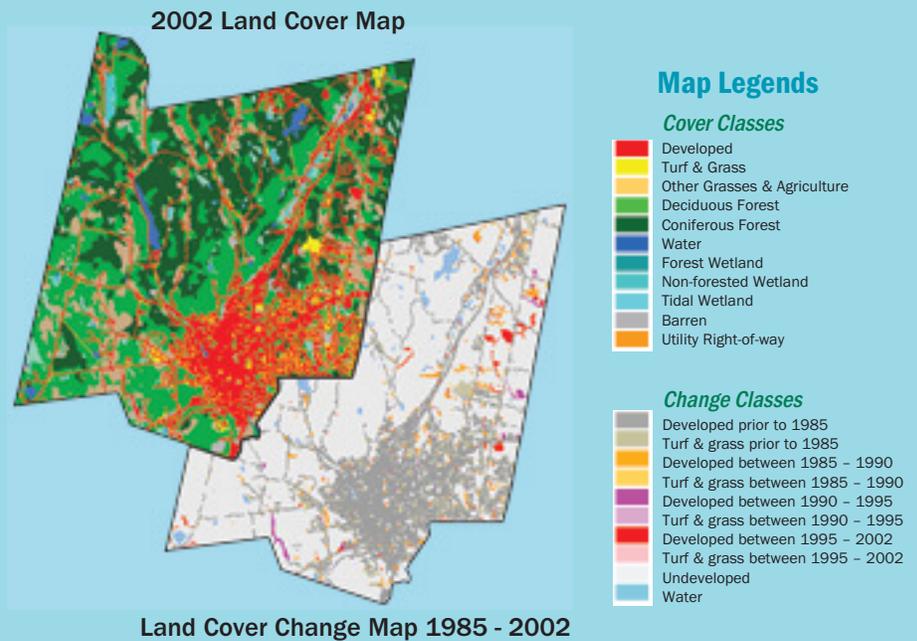
Research Impacts

CLEAR research programs are providing critical information to fuel important debates.

CLEAR land cover data provides information on the changing Connecticut landscape for citizens, local officials, state agencies, researchers and others. CLEAR faculty have conducted over 50 special briefings on this study to a wide variety of groups, and continue to fold the information into Center outreach programs. Over 600 different organizations have downloaded the actual data from the *Connecticut's Changing Landscape* web page. This demonstrates that CLEAR studies are continually informing important debates on sprawl, smart growth, forest fragmentation and other land use issues, from the Legislative Office Building to town halls across the state.

"Sprawl seems to be Topic A in Connecticut these days. Observers note with justifiable alarm that finite natural resources are shrinking fast under the pressures of growth and a tax policy that promotes poor land-use decisions. So it is timely that policy-makers have an important tool to sharpen the conversation—computer maps made available by the University of Connecticut's Center for Land use Education and Research (CLEAR)... The maps speak louder than an army of "smart growth" advocates for the benefits of regional planning and property tax reform in protecting the environment, economy and quality of life. The university center plans to incorporate the newly completed maps into an education program for municipal decision-makers. For its visionary work, it is owed the state's gratitude..."

- From The Hartford Courant Editorial Page, March 22, 2004



Map image, top-left: The 2002 land cover map for the City of Torrington, CT. As shown in the top legend, red depicts developed areas, which are often closely connected to the manicured turf areas (mostly lawns, golf courses, etc.) shown in yellow. At bottom-right, a land cover change map that shows where growth has occurred in Torrington since 1985. Dark gray areas were developed before 1985, while colored areas show new development added between 1985 and 2002.