Story by Courtney Swyden

Global Predictions

Lab uses advanced technologies to forecast change

Every morning forest rangers and specialists from the Texas Forest Service meet to make decisions about protecting the state's natural resources from fire. Essential to making these decisions are Keetch–Byram Drought Index (KBDI) maps produced daily by the Spatial Sciences Laboratory in College Station.

Spatial Sciences Laboratory Director Dr. Raghavan Srinivasan said county commissioners across the state also use the KBDI maps to determine whether to issue countywide outdoor burn bans in their county.

"The drought index is based on a daily water balance, where a drought factor is calculated with precipitation and soil moisture," Srinivasan said.

KBDI represents dryness and wetness in Texas counties on a scale of 0 (no moisture depletion) to 800 (absolutely dry conditions) and are used to estimate forest fire potential. A county with an index above 500 will institute a burn ban.

The index uses weather station estimates of temperature and Doppler radar-based precipitation estimates to produce geographic information systems (GIS) maps.

The KBDI maps are one of more than 15 map products created every day by the lab and used by the forest service, county commissioners and others.

Using computer technology and satellites, the lab currently focuses on three core spatial technologies—GIS, global positioning systems (GPS) and remote sensing technology. The lab uses these technologies to create interactive, multi-layered maps to help environmental and natural resources managers in environmental decision making, planning and problem solving as well as providing information about demographics, socioeconomic factors and public health information.

GIS technology is a computerized system that can capture, store, process and analyze spatial data. The lab uses GIS to produce the Texas Spatial Information System Web site. The Web site provides an interactive map of the state and gives information about transportation, water resources, boundaries, land and biological resources, agricultural data, demography, environmental quality and more.

The lab is currently working with the U.S. Army Corps of Engineers in developing GIS maps for its reservoirs so the Corps can better manage and conserve natural resources while providing quality outdoor recreation.

For example, GIS technology can determine boundaries of a reservoir as well as all of the features within those boundaries such as general land leasing or facilities as well as hunting and park boundaries.

Kim Hart, research assistant, and Greg Michalak, graduate student, evaluate Keetch-Byram Drought Index maps to determine drought conditions across the state.

"Boundaries need to be established so hunters, campers or park visitors can know their limits and prevent hazards," said Srinivasan.

The lab also uses GPS, a satellite navigation system useful for surveying property boundaries and fields. GPS uses satellites to locate and track any feature on Earth at any given time.

The lab is using GPS in identifying the Corps reservoirs' physical features, such as boating dock locations and park and recreation locations. The Corps puts that information on its Web site so the public has
easier access to parks or recreational areas.

Remote sensing technology uses satellites to collect data about the earth's surface to analyze changes and variations in land use and crop patterns and vegetation variations over time or as damage assessment after a natural disaster.

"Remote sensing is used to measure urban growth and what it affects," Srinivasan said. "We look at growth in terms of how it affects water quality, its impact on natural resources and how many wetlands are lost."

The lab recently worked with the Houston-Galveston Area Council to determine how many wetlands have been lost to urbanization or other land uses. Changes are easily detected using satellite images as well as high-resolution aerial photographs.

The lab has also used water quality models to study water quality protection and improvement. Water quality models are computer programs used to mimic the biological, physical, chemical and economic aspects of current land management and estimate the water quality impacts of implementing best management practices. This information helps assess water quality problems in a watershed.

Water quality models like SWAT (Soil and Water Assessment Tool), a landscaped-based (watershed) model, can predict impacts of agriculture management practices on landscapes.

The river-based water quality model, QUAL-2E, can illustrate how a river will react to certain chemicals and its processes.

WASP (Water Quality Analysis Simulation Program) is a lake-based water quality model that divides a lake into a 3-dimensional system to simulate the various chemical and biological exchanges both horizontally and vertically.

Because water quality models are vital to the Environmental Protection Agency (EPA), it provided USDA–Agricultural Research Service (USDA–ARS) with $1 million to develop the HAWQS Project (Hydrological Water Quality Modeling System). The lab is working closely with EPA and USDA–ARS to implement the project.

"The overall objective of this project is to provide a water quality modeling system that is capable of supporting a wide variety of national-scale economic benefit assessments in the EPA's Office of Water due to water quality impairments," Srinivasan said.

The modeling system will be a software product that can be installed, modified and run on EPA servers and can be made publicly available for downloading to other computers, he said.

Research is not the only aspect of the lab; education is also available for undergraduate students who want advanced knowledge of spatial analysis. A bachelor's of science degree in spatial sciences is offered under Texas A&M University's College of Agriculture and Life Sciences and College of Geosciences. Course work allows the students to use the potential of spatial sciences in problem solving.

Texas A&M also offers a graduate certificate program for GIS and remote sensing technologies. The program gives students in-depth, practical knowledge and opens the door for better job opportunities.

"The certificate program has been really successful," Srinivasan said. "We've had about 15 to 20 students every year since we started this in 2004."

LEFT: Graduate students in the Department of Forest Science use GPS technology in their studies.

RIGHT: Jennifer Jacobs, senior research associate, Kim Hart, research assistant, and Zach Vernon, graduate student, observe a GIS map generated by the lab for information on agricultural data in a certain area.

The lab collaborates with many state and federal agencies, including:

- Texas Forest Service
- Texas Water Development Board
- Texas Commission on Environmental Quality
- Texas State Soil and Water Conservation Board
- USDA–Agricultural Research Service
- USDA–Natural Resources Conservation Service
- U.S. Army Corp of Engineers
- National Weather Service

For more information about the lab, visit their Web site at http://css.tamu.edu.