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Assessing the Quantity and Quality of Forested Resources in East Texas Using Remotely Sensed Data

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Research Project

Title: Assessing the Quantity and Quality of Forested Resources in East Texas Using Remotely Sensed Data

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Abstract: OBJECTIVES: Development of new or enhanced remote sensing methodologies for assessing the quantity of east Texas forests and their associated ecosystems. Development of new or enhanced remote sensing methodologies for assessing the quality of east Texas forests and their associated ecosystems. Application of temporal analysis to assess the change in the quantity/quality of east Texas forests and their associated ecosystems over time. APPROACH: Procedures to achieve the objectives will follow basic remote sensing methodology. All data acquired will undergo the basic "bread and butter" analysis of remote sensing using top-of-the-line digital image processing software. Initially, after remotely sensed data representing project areas have been acquired, the data will be subsequently radiometrically and geometrically corrected to remove any atmospheric/platform interference and to place the data into its real world position. The remotely sensed data will then be analyzed pursuant to the research objectives within spectrally unique bandwidths independently, and in combination with each other, to ascertain their ability to help us quantify, qualify and detect the change in the quantity/quality of the forested resources of east Texas and their associated ecosystems. Remote sensing methodologies utilized, including standard and enhanced procedures, will inclue: image classification, accuracy assessment, contrast enhancement, filter enhancement, ratio analysis, principle component analysis, image merging, change detection and image

arithmetic. KEYWORDS: forestry; remote sensing; image processing; quantitative analysis; quality; forest ecosystems; forest resources; regional research; forest management; product improvement; temporal distribution; changes; data acquisition; data analysis; computer software *PROGRESS:* 1999/08 TO 2005/08 Project accomplishments include a host of information derived via remotely sensed means that enhance our understanding of spatially referenced data and how they can be applied in quantifying our forested resources more effectively in terms of time and cost. Specific areas addressed in this project include the following project sub areas. Project 1: Assessed the utility of combining Landsat ETM+ multispectral, IKONOS multispectral, QuickBird multispectral and airborne hyperspectral data with LIDAR derived height information to differentiate vegetation dynamics within east Texas. Emphasis was on ascertaining the preferred combination of high spatial and high spectral data combined with LIDAR derived height data to differentiate land cover types within a supervised classification methodology versus an artificial neural network. Results indicate that land cover map accuracy remained relatively constant per classification methodology although higher levels of overall map accuracy were correlated to poor spatial resolution. Project 2: Completed a project assessing the application of QuickBird 2.44-meter multispectral data to accurately map forest cover types in east Texas. QuickBird classified imagery of east Texas was compared to corresponding 30-meter multispectral Landsat ETM+ and 20-meter multispectral SPOT classified imagery to quantify the effect of increased spatial resolution on image classification accuracy. Results indicate that land cover map accuracy is higher with poor spatial resolution data and that as spatial resolution increases land cover type differentiation is confused as the shadow evident in more high spatial resolution data occupies a considerable percentage of each images pixels. Project 3: Recently completed the development of a standardized, cost effective and repeatable methodology to map the forested resources of Texas into two categories: forest composition and age class determination. Current forest composition information was derived using Landsat ETM+ data. Current forest age class determination was obtained by spatial modeling within a Boolean format forest/non-forest cover type maps derived from Landsat ETM+, TM and MSS data collected in five year intervals from 1972 until 2002. Results indicate that age class differentiation and cover type assessment can be achieved at the landscape level using historical satellite imagery and that any subsequent land cover projects can be produced in a timely and cost efficient manner. Project 4: The geometric accuracy of QuickBird panchromatic and multispectral data of Nacogdoches, Texas was assessed. On-screen digitized control points scattered randomly throughout a QuickBird satellite image of Nacogdoches were compared with coincident GPS collected UTM field coordinates to validate the accuracy of a QuickBird standard image bundle. Results indicate that an off the shelf satellite image was well within the stated error inherent when purchasing high spatial resolution satellite imagery and that any on-screen digitized polygons derived using a high spatial resolution QuickBird image as reference will be within approximately 5 meters of its true geometric location.

IMPACT: 1999/08 TO 2005/08 Information derived from the projects will enhance our understanding of spatially referenced data (aerial photos, satellite imagery, GIS vector data, GPS data) and how they can be applied in mapping, monitoring and managing our forested/natural resources more effectively in terms of time and cost.

Web Site:

Publications: *PUBLICATIONS (not previously reported):* 1999/08 TO 2005/08 1. Unger, D., Hung, I., Williams, J., Kroll, J., Coble, D., and Grogan, J. 2005. Using Remotely Sensed Data to Map Forest Age Class by Cover Type in East Texas. Society of American Foresters 2005 National Convention, Fort Worth, Texas, October 19-23. 2. Unger, D.R., Kulhavy, D.L., and McAfee, G.D. 2005. Evaluating the Geometric Accuracy of QuickBird Imagery: A Users Perspective. Society of American Foresters 2005 National Convention, Fort Worth, Texas, October 19-23. 3. Tribby, H., Kroll, J., Unger, D., Hung, I., and Williams, H. 2005. Multi-Source Image Classification. Society of American Foresters 2005 National Convention, Fort Worth, Texas, October 19-23. 4. Hung, I.K., Williams, J.M., Kroll, J.C., and Unger, D.R. 2004. Forest Landscape Changes in East Texas from 1974 to 2002. 4th Southern Forestry and Natural Resources GIS Conference, Athens, Georgia, December 16-17, pp. 64-75. 5. Unger, D.R., Hung, I.K., and Williams, J.M. 2003. East Texas Forest Inventory (ETFI) Pilot Project: Remote Sensing Phase. Forest Resources Institute, Arthur Temple College of Forestry, Stephen F. Austin State University, http://www.fri.sfasu.edu/pages/projects/etfi/html/etfi toc.html.

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