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Accuracy Assessment of Land Cover Maps Derived from Multiple Data Sources

Daniel Unger
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, unger@sfasu.edu

Hillary Tribby

Hans Michael Williams
Arthur Temple College of Forestry and Agriculture Division of Stephen F. Austin State University, hwilliams@sfasu.edu

I-Kuai Hung
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, hungi@sfasu.edu

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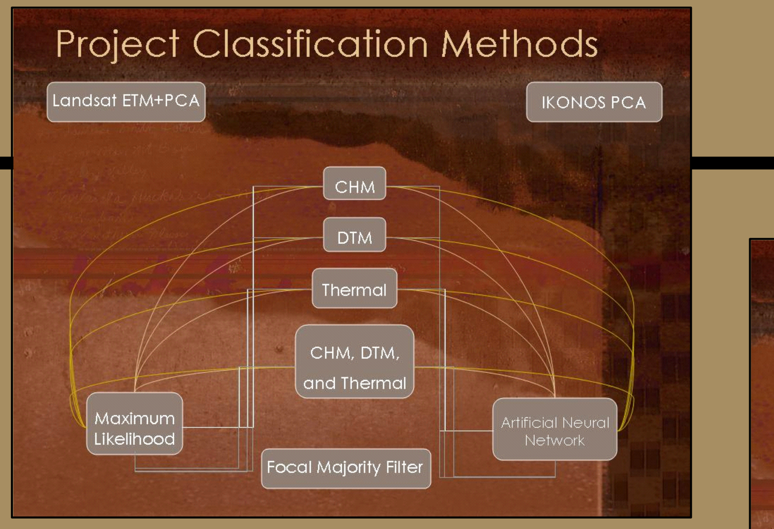
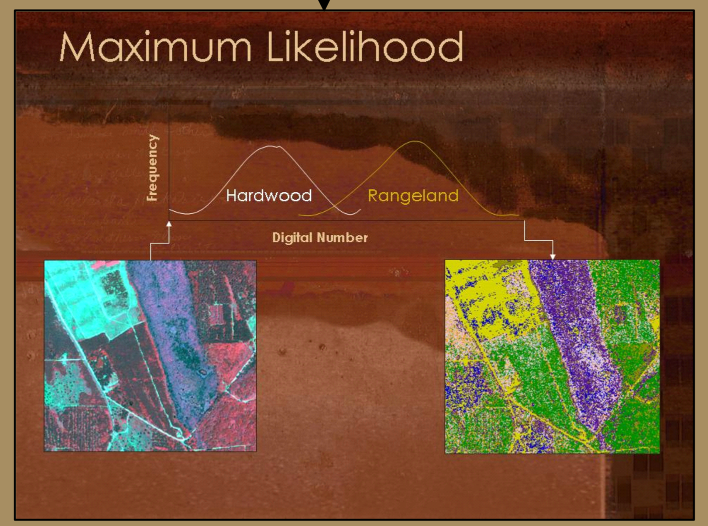
Dr. Daniel R. Unger, Associate Professor
Hilary Tribby, Research Assistant
Dr. Hans M. Williams, Kenneth Nelson Distinguished Professor
Dr. I-Kuai Hung, Assistant Professor
Arthur Temple College of Forestry and Agriculture
Stephen F. Austin State University
Nacogdoches, Texas

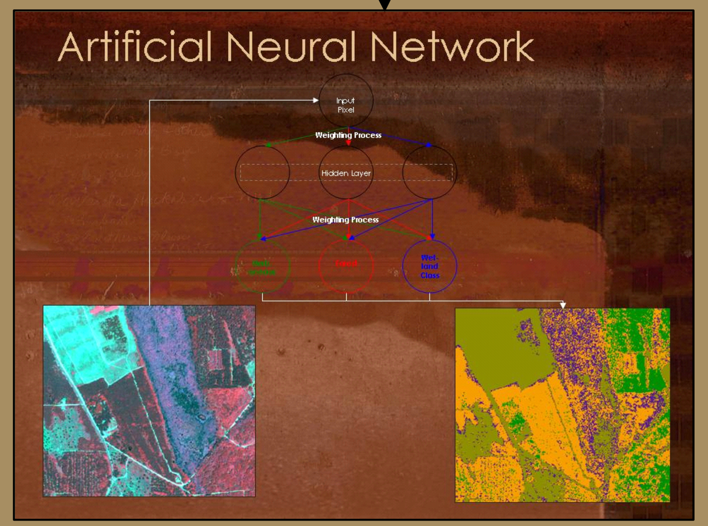
INTRODUCTION

Since remote sensing technologies are constantly changing, incorporating data into any given remote sensing project has become more complex. This project evaluated and recommended which data sources should be integrated into image classifications in order to produce the most accurate land cover map. Maximum Likelihood (ML) and Artificial Neural Network (ANN) supervised classification methods using Principal Components Analysis (PCA) were used to demarcate land cover types within IKONOS and Landsat ETM+ imagery. Three additional data sources were integrated into the classification process: a Canopy Height Model (CHM), Digital Terrain Model (DTM), and Thermal data. Both the CHM and DTM were derived from multiple return small footprint LIDAR. In addition to evaluating classification methodology, classifications were analyzed for two different classification schemes and for two classification levels; the Texas Geographic Information Council (T.G.I.C.) level 4 and 2 and the United States Geological Survey (U.S.G.S.) LULC level 2 and 1 classification schemes respectively. In addition, a focal majority filter was applied to each derived map to assess the removal of island polygons on land cover map accuracy. Study objectives were to evaluate the accuracy of single and multi-source image land cover classifications including all possible combinations of data types and to develop architecture for an artificial neural network that will process image classifications by defining the optimum variables, such as momentum, learning rate, hidden layers, and output nodes.

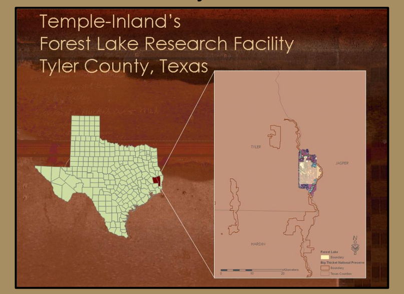
Classification Schematic







Study Site



RESULTS

The ML classification method performed statistically better than the ANN process (a=0.05). The Landsat ETM+ based classifications performed statistically better than the IKONOS based classifications (a=0.05). The most accurate land cover maps were created within the ML classification method using the Landsat ETM+ PCA and integrated multiple sources of data with $\hat{K}$ accuracies ranging from 0.4134 to 0.4868 at both U.S.G.S. levels of analysis. The least accurate land cover maps were created within an ANN of the Landsat ETM+ imagery, DTM and Thermal at the U.S.G.S. Level 1, with $\hat{K}$ accuracies of 0.0813 and 0.0828 respectively. Other extremely low accuracy land cover maps were created by the ANN T.G.I.C. Level 4 and 2 of IKONOS imagery and the integrated multiple sources of data with $\hat{K}$ accuracies ranging from 0.0876 to 0.2670.

CONCLUSIONS

Multiple Sources of data did not statistically increase land cover classification accuracy consistently. Focal Majority Filter did not statistically increase land cover classification accuracy consistently. Maximum Likelihood performed statistically better than the Artificial Neural Networks consistently. Landsat ETM+ classifications performed statistically better than IKONOS. Lower classification scheme levels performed similarly for Landsat, but statistically better for IKONOS.

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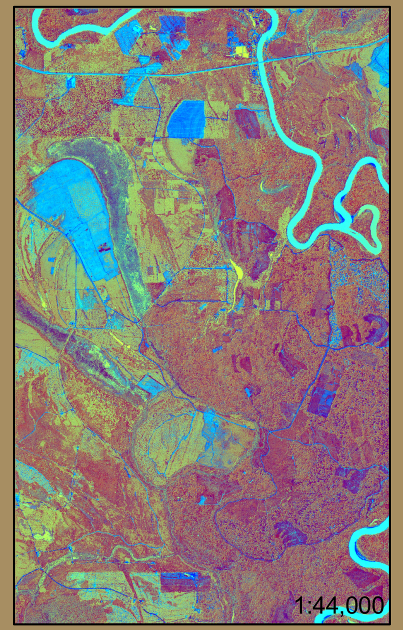
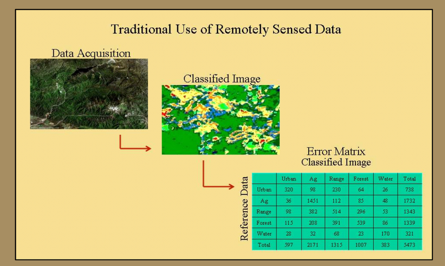
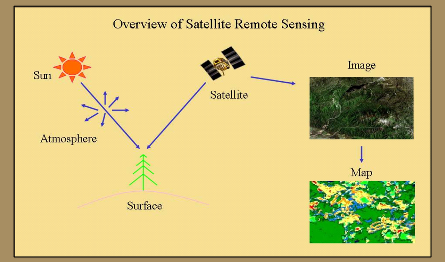
IKONOS Data Generation

(True Color Image)

(PCA)



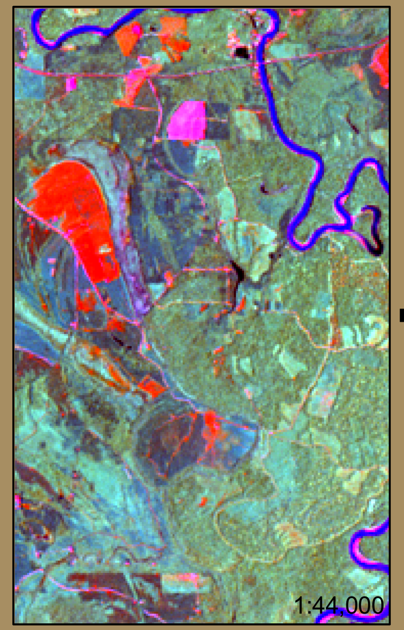




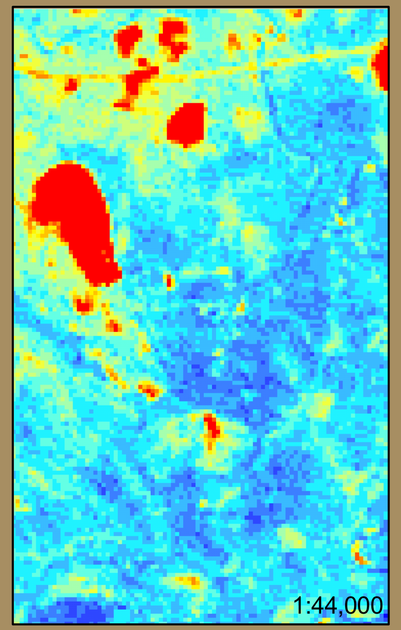
Landsat ETM+ Data Generation

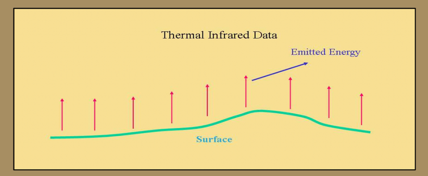
(True Color Image)

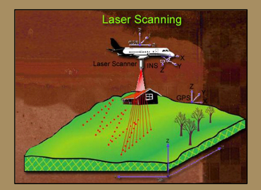
(PCA)

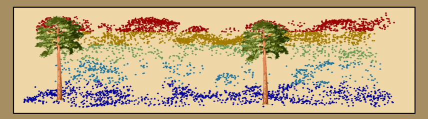


(Thermal)









LIDAR Data Generation

(LIDAR return)

(DTM)

(CHM)

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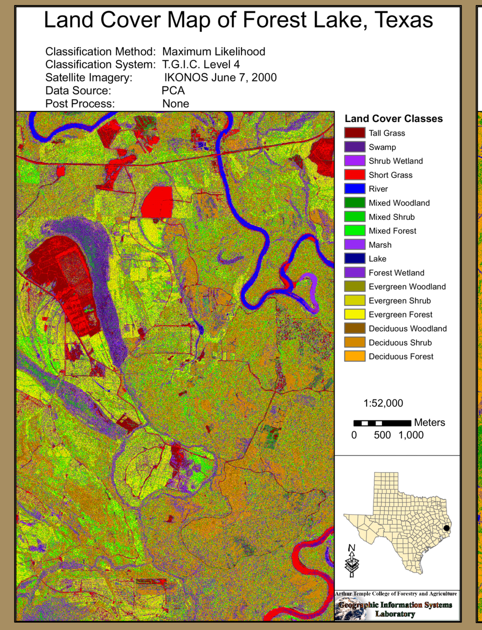
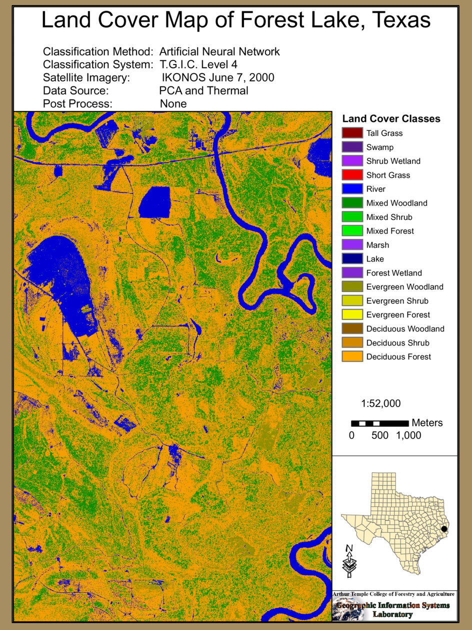
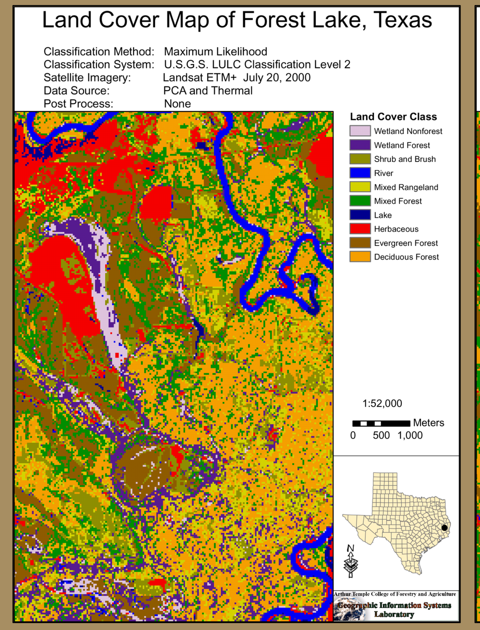
Fine Classification Scheme

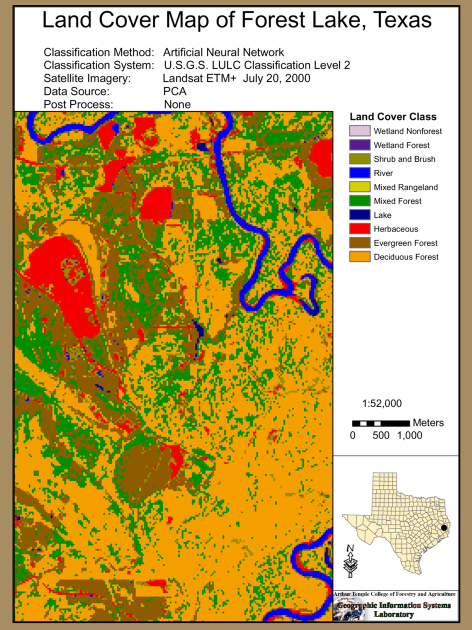
(T.G.I.C. Level 4 – Maximum Likelihood and Artificial Neural Network)





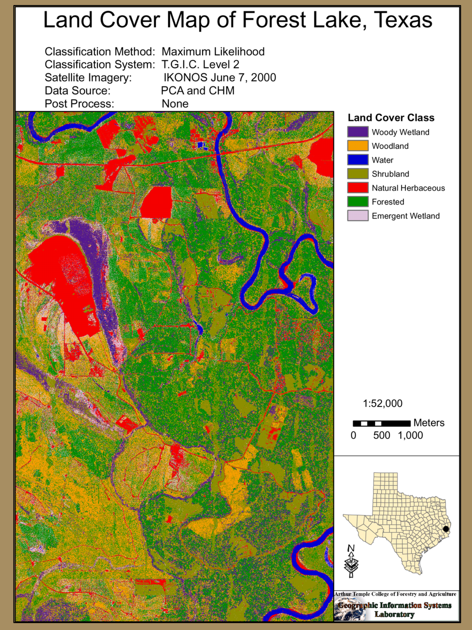
(U.S.G.S. Level 2 – Maximum Likelihood and Artificial Neural Network)

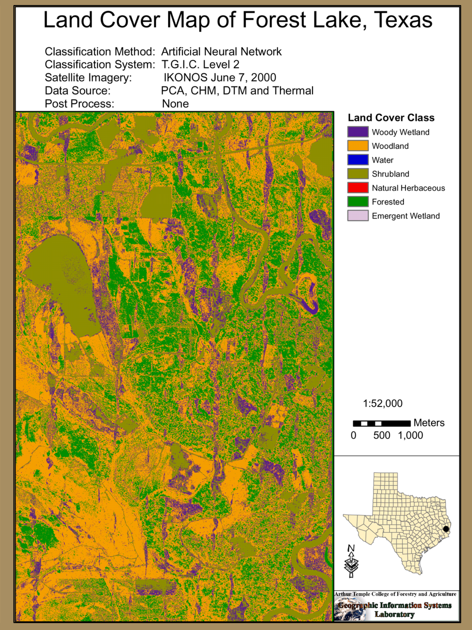




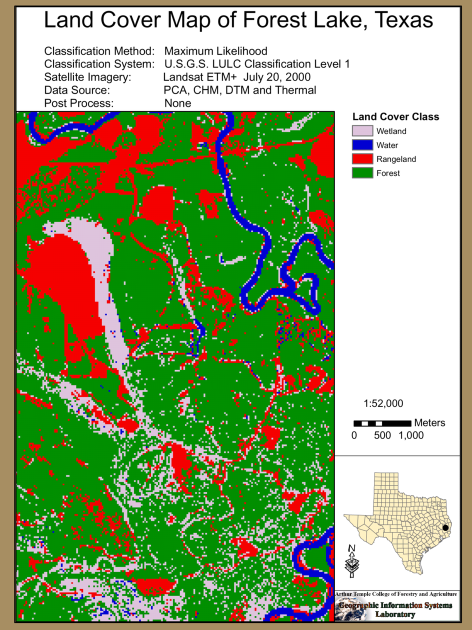
Coarse Classification Scheme

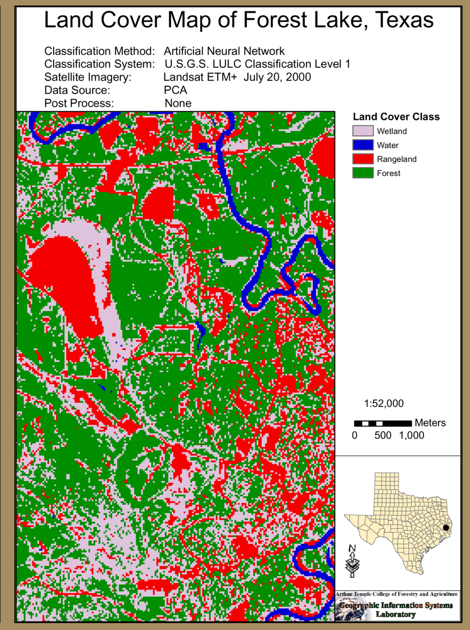
(T.G.I.C. Level 2 – Maximum Likelihood and Artificial Neural Network)





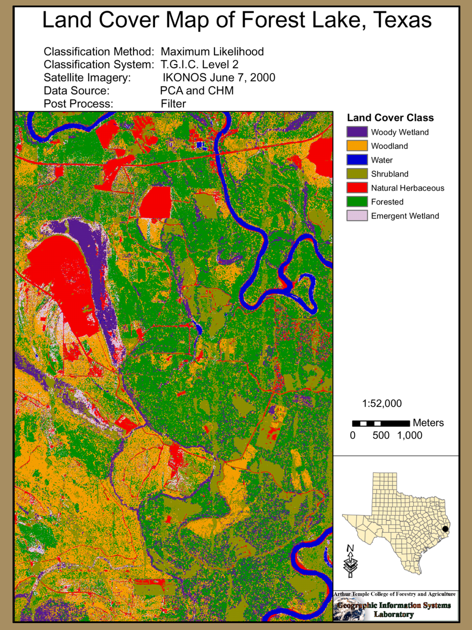
(U.S.G.S. Level 1 – Maximum Likelihood and Artificial Neural Network)

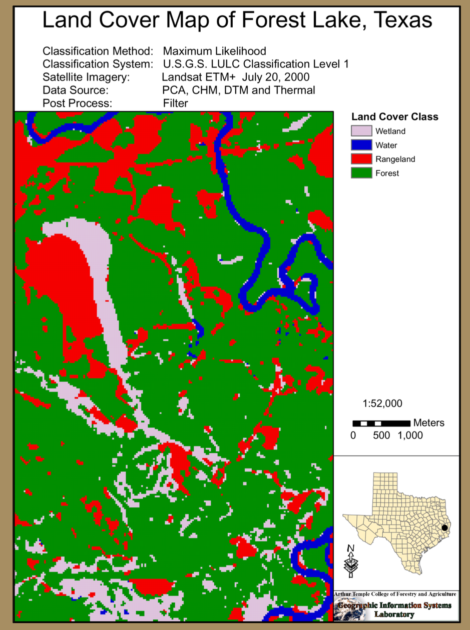




Focal Majority Filter

(Filtered – Maximum Likelihood and Artificial Neural Network)





Data source: IKONOS imagery, Space Imaging; Landsat ETM+ imagery, Forest Resources Institute; LIDAR data, Terrapoint; Vector data, Arthur Temple College of Forestry and Agriculture GIS database.

March 3, 2006
Daniel R. Unger