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## Accuracy Assessment of Land Cover Maps Derived from Multiple Data Sources

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# Accuracy Assessment of Land Cover Maps Derived from Multiple Data Sources

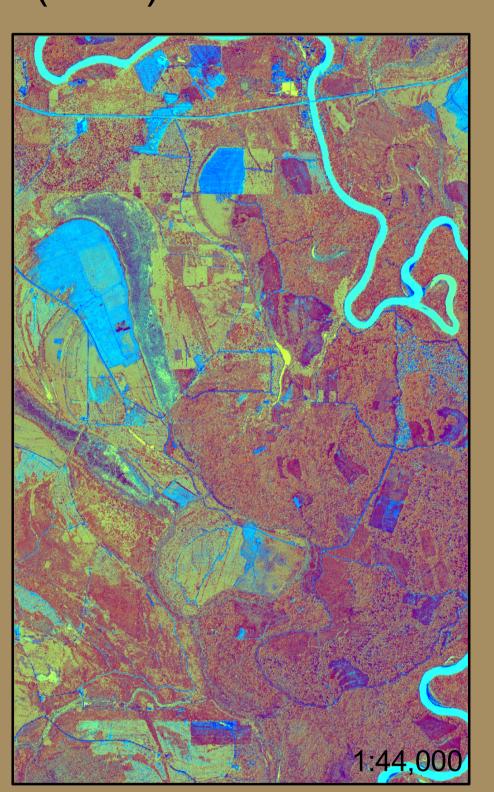
Dr. Daniel R. Unger, Associate Professor Hilary Tribby, Research Assistant Dr. Hans M. Williams, Kenneth Nelson Distinguished Professor Dr. I-Kuai Hung, Assistant Professor Arthur Temple College of Forestry and Agriculture Stephen F. Austin State University Nacogdoches, Texas

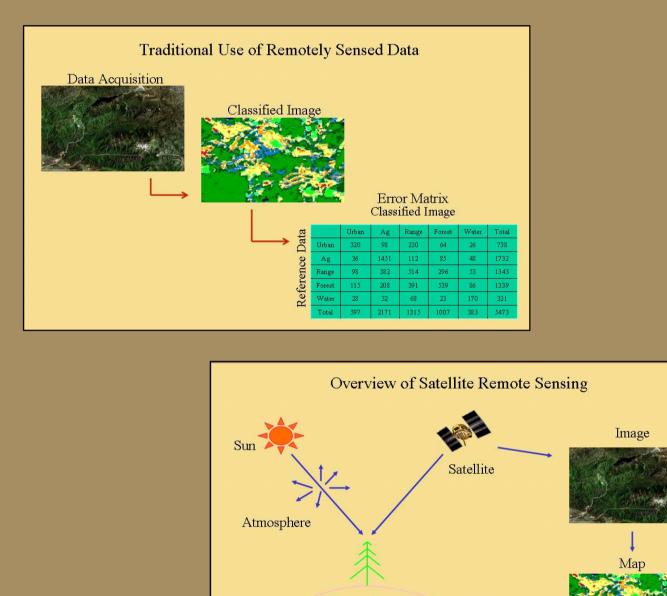


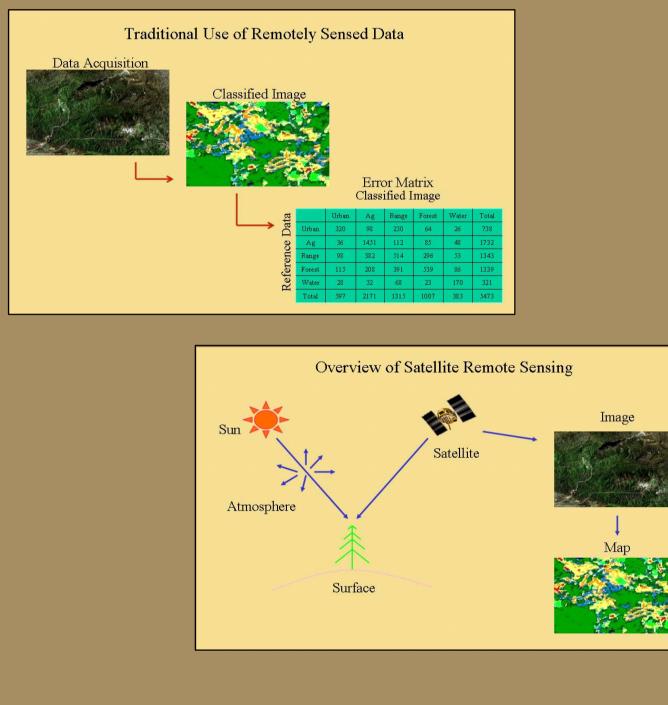
## **IKONOS Data Generation**



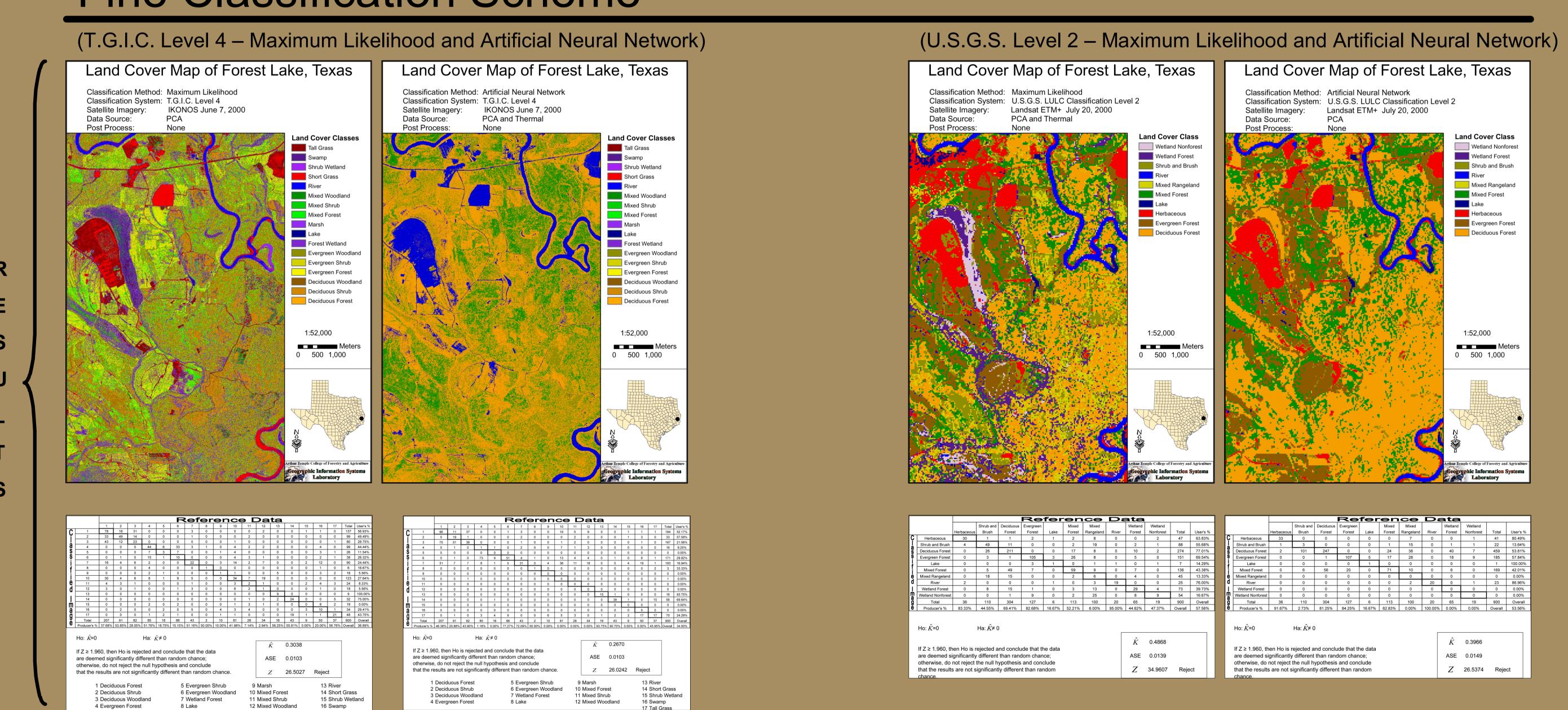
(PCA)







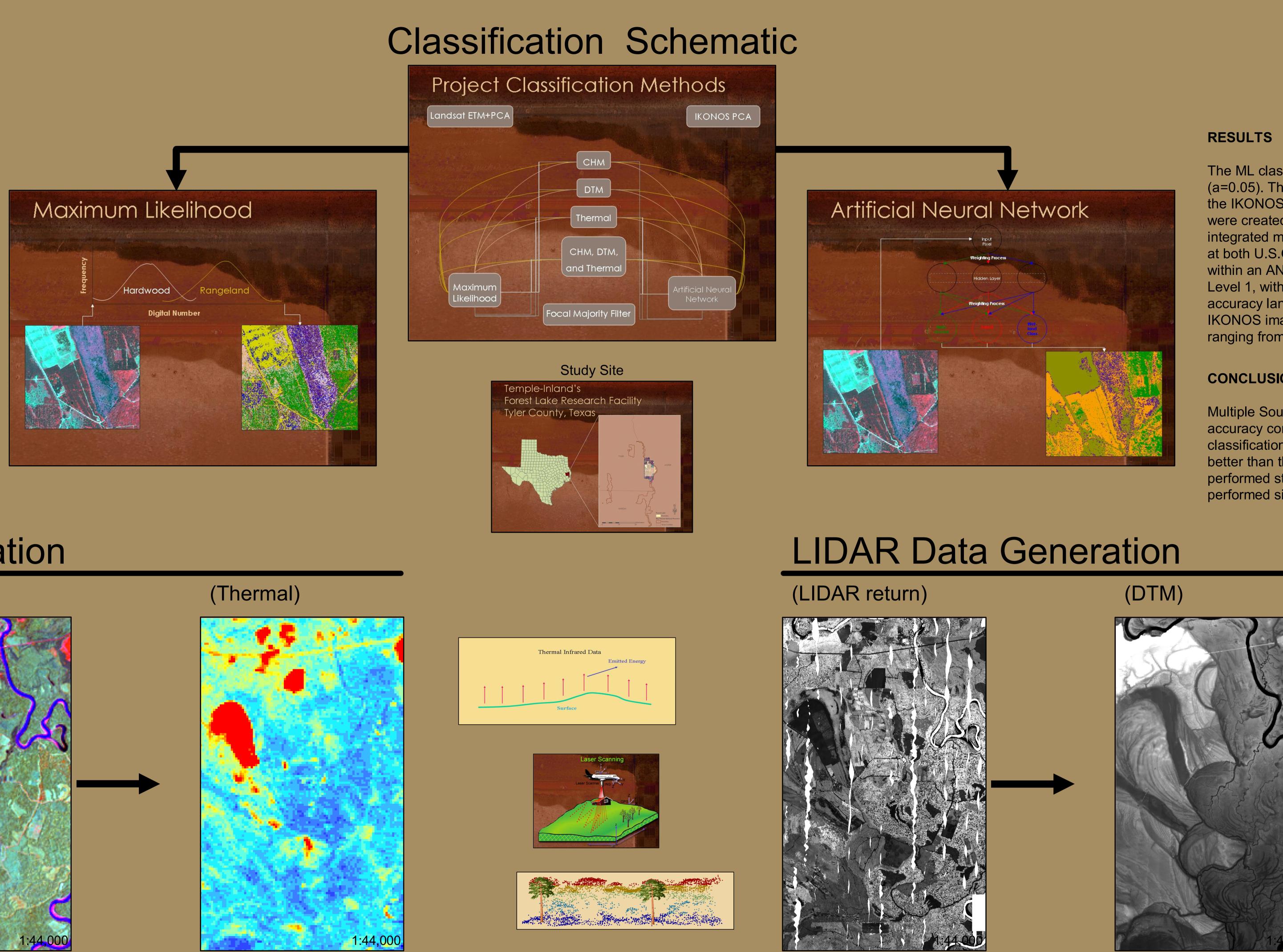
# Fine Classification Scheme





### INTRODUCTION

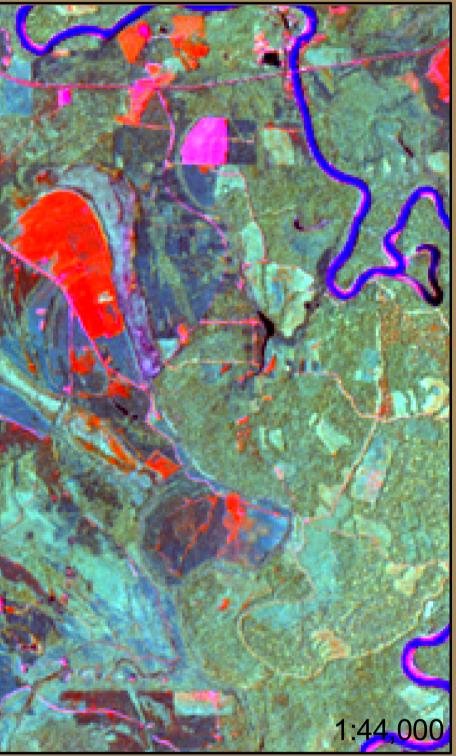
Since remote sensing technologies are constantly changing, incorporating data into any given remote sensing project has become more complex. This project evaluated and recommended which data sources should be integrated into image classifications in order to produce the most accurate land cover map. 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.



## Landsat ETM+ Data Generation



(PCA)

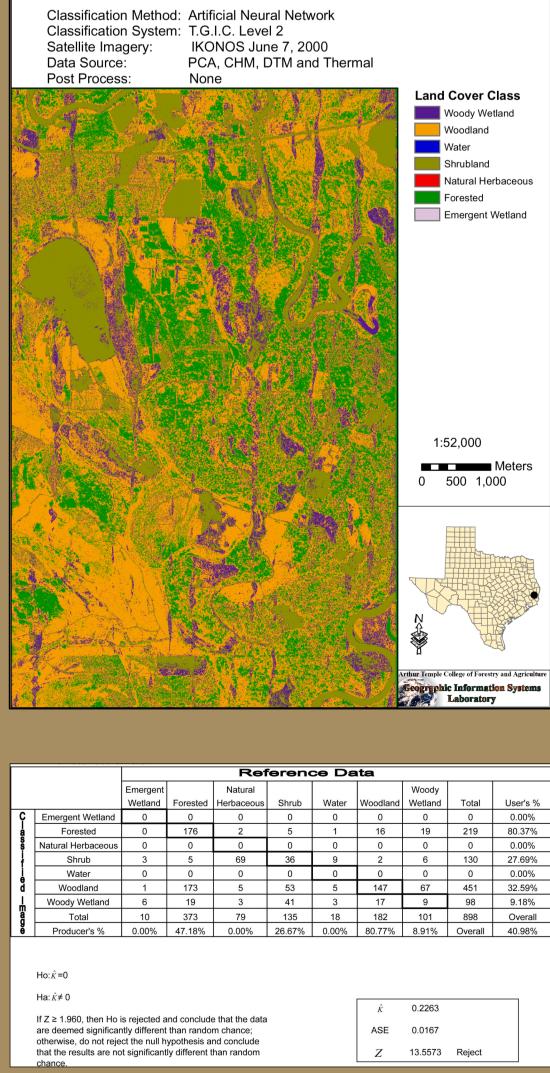


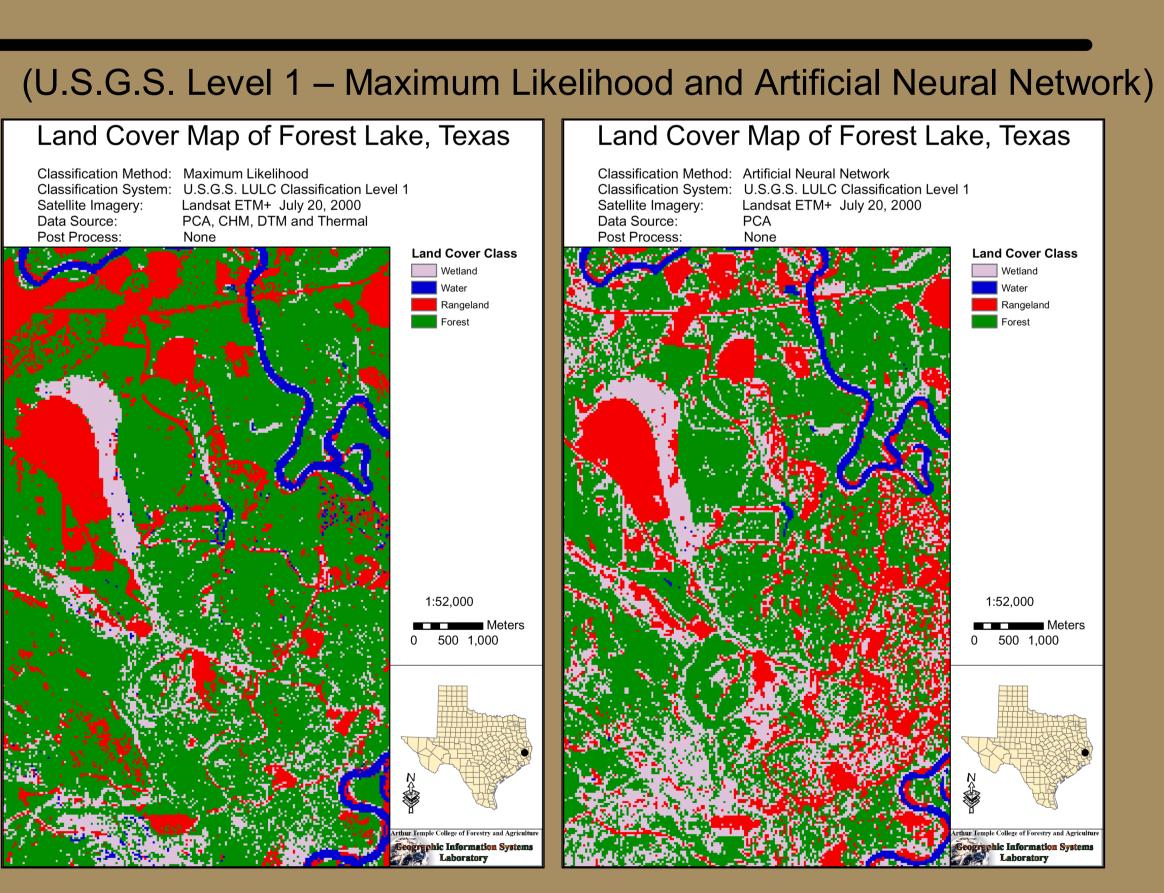
# **Coarse Classification Scheme**

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.

(T.G.I.C. Level 2 – Maximum Likelihood and Artificial Neural Network) Land Cover Map of Forest Lake, Texas Classification Method: Maximum Likelihood Classification System: T.G.I.C. Level 2 Satellite Imagery: IKONOS June 7, 2000 Data Source: PCA and CHM nd Cover Class Woody Wetland Woodland Natural Herbaceous Emergent Wetland 1:52,000 Mete 500 1,000 If  $Z \ge 1.960$ , then Ho is rejected and conclude that the data<br/>are deemed significantly different than random chance;<br/>otherwise, do not reject the null hypothesis and conclude<br/>that the results are not significantly different than randomASE0.0164Z27.2018Reject

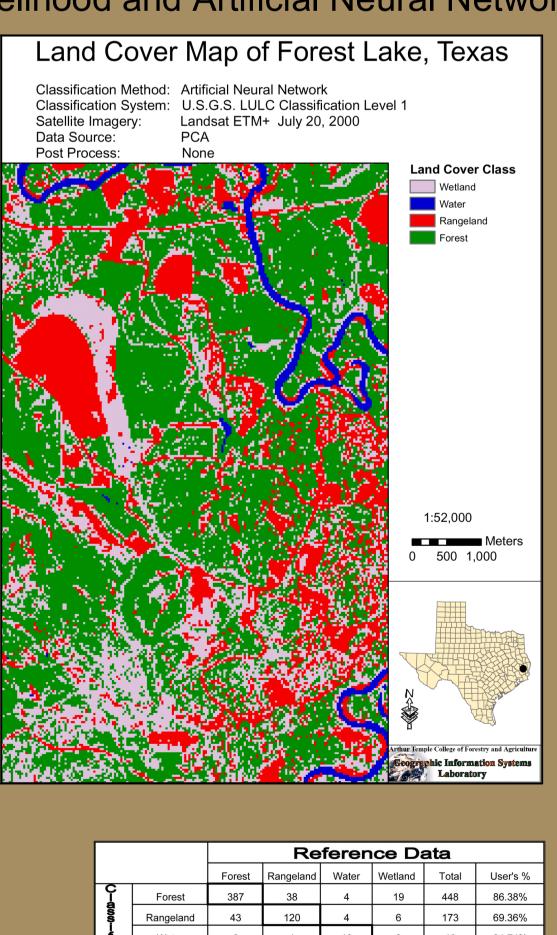
## Land Cover Map of Forest Lake, Texas





		Reference Data							
		Forest	Rangeland	Water	Wetland	Total	User's %		
ഗ—താ —⊱താ	Forest	463	93	2	36	594	77.95%		
	Rangeland	29	127	2	6	164	77.44%		
	Water	2	5	21	2	30	70.00%		
	Wetland	50	21	1	40	112	35.71%		
	Total	544	246	26	84	900	Overall		
	Producer's %	85.11%	51.63%	80.77%	47.62%	Overall	72.33%		
Ho: <i>ќ</i> = 0		Ha: <i>ƙ</i> ≠ 0							
	960, then Ho is re data are deemed		$\hat{K}$	0.4864					

that the data are been ed significantly different than random chance; otherwise, do not reject the null hypothesis and conclude that the results are not significantly different than results are not significant than results are not significant the not significant than results are not significant than results are



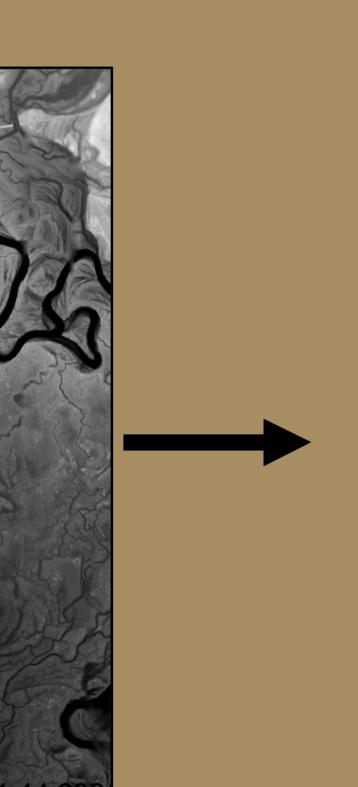
		Reference D						
		Forest	Rangeland	Water	Wetland			
ſ	Forest	387	38	4	19			
a s s	Rangeland	43	120	4	6			
ł	Water	0	1	18	0			
d	Wetland	114	87	0	59			
0-a%-+@dEado	Total	544	246	26	84			
ĝ	Producer's %	71.14%	48.78%	69.23%	70.24%			
Ho: <i> </i>	Ho: $\hat{\kappa} = 0$ Ha: $\hat{\kappa} \neq 0$							
lf Z ≥ 1.	$\hat{K}$							
that the than rar	ASE							
the null results a random	Ζ							



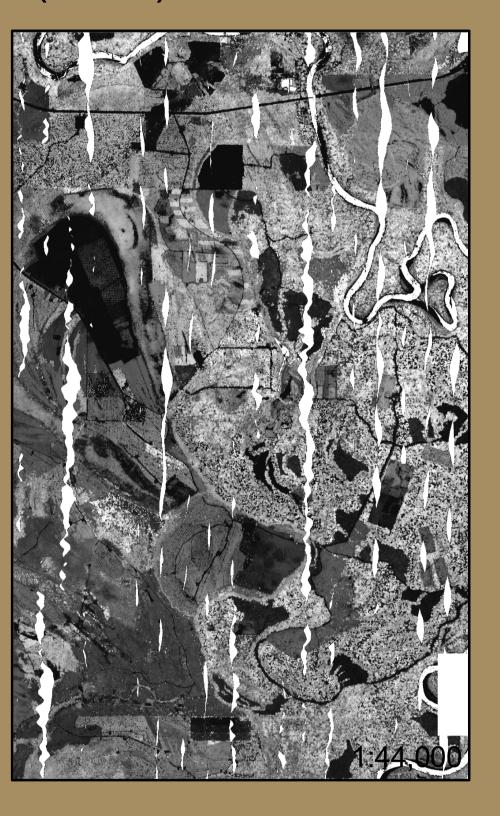
The ML classification method performed statistically better than the ANN process (a=0.05). The Landsat ETM+ based classifications performed statistically better than the IKONOS based classifications (a=0.05). The most accurate land cover maps were created within the ML classification method using the Landsat ETM+ PCA and integrated multiple sources of data with K<sup>^</sup> 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 K<sup>^</sup> 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 K<sup>^</sup> 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.



(CHM)





 Total
 10
 373
 80
 135
 18
 182
 102
 900
 Ov

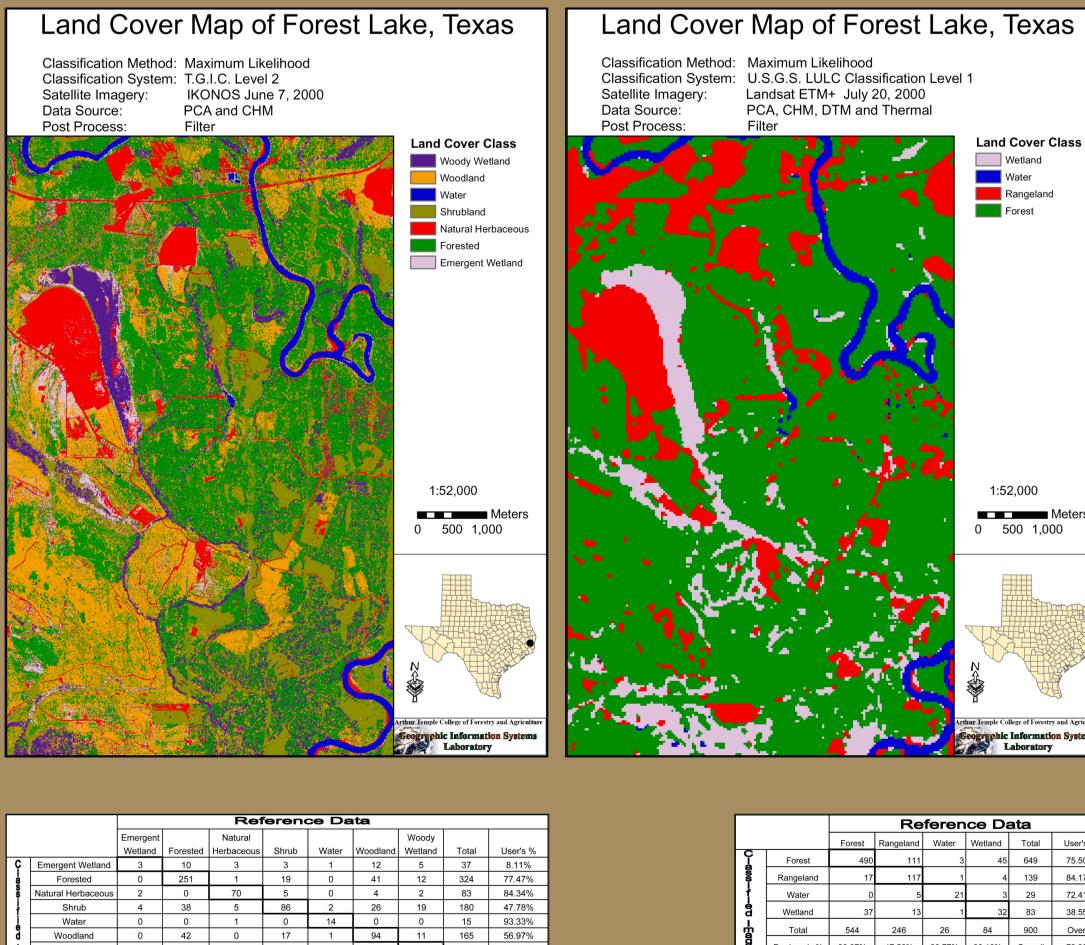
If  $Z \ge 1.960$ , then Ho is rejected and conclude that the data are deemed significantly different than random chance; ASE 0.0169

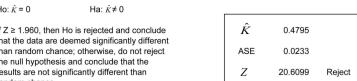
otherwise, do not reject the null hypothesis and conclude hat the results are not significantly different than random

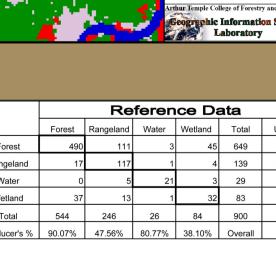
roducer's % 30.00% 67.29% 87.50% 63.70% 77.78% 51.65% 51.96% Overall 63.4

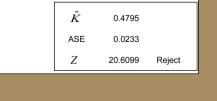
Z 30.8448 Reject

### (Filtered – Maximum Likelihood and Artificial Neural Network)









March 3, 2

