

Tallapoosa Watershed Project

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Remote Sensing Monitoring and GIS Modeling –

Lake Watch of Lake Martin Initiative

Luoheng Han
Department of Geography
University of Alabama

John Glasier
Lake Watch of Lake Martin

Lake Watch Project Support

- Assess adequacy of current citizen-monitoring capabilities
- Test new monitoring capabilities
- Facilitate education – outreach activities

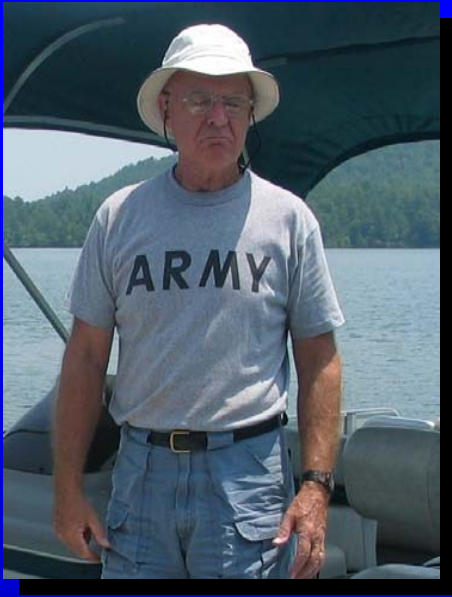
Citizen-Group Research Questions ?

- To what extent can AWW monitoring capabilities measure nutrient (and sediment) concentrations and their lake effects?

[Both current and proposed capabilities for the project]

- Are current AWW (shoreline) monitoring data representative of respective embayment conditions?
- Can close-range hyperspectral data estimate Chlorophyll-*a* concentrations?
- What's the optimal "mix" of AWW citizen monitoring capabilities that can satisfy long-term needs?

Quiz Time



2004

April

August



A



B



C



D



E



F



*Selected Lake Martin
Sample Sites –*

Where & Why Different?

Sample Site Water Color – Seasonal and Spatial Trends

2004

April

August

Tallapoosa R.
Above Coley Ck.
(main stem)

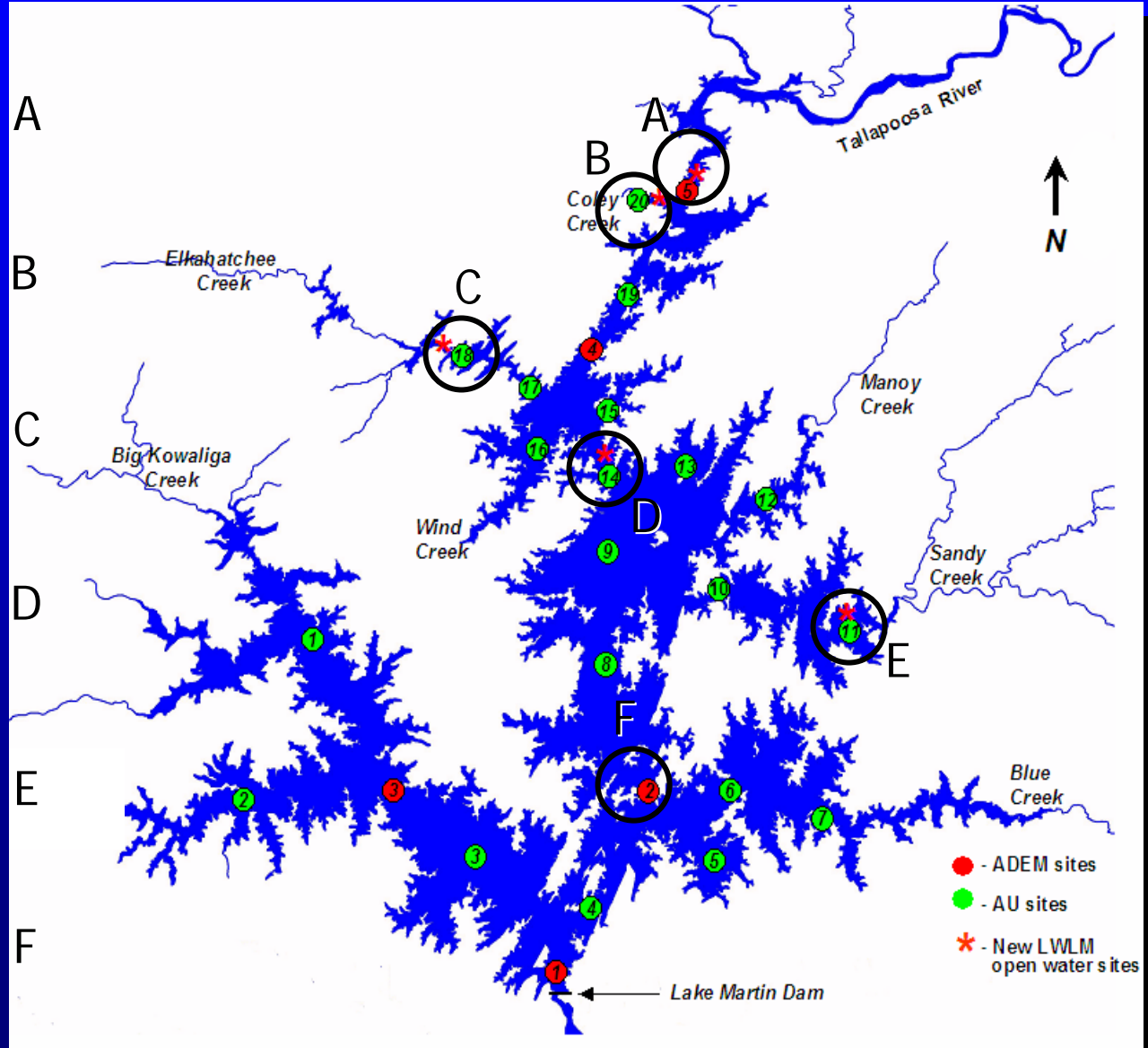
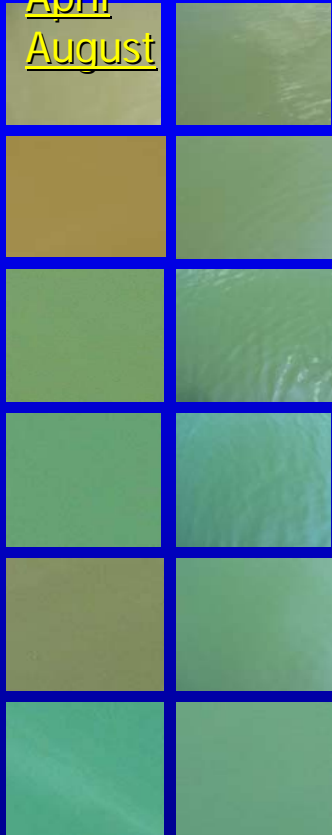
Coley Ck.

Elkahatchee Ck.

Bay Pine Is.
(main stem)

Sandy Ck.

Above
Blue Ck.
(main stem)



Sample Site Water Color – Inter-year Spatial Trends

April

2004 2005

Tallapoosa R.
Above Coley Ck.
(main stem)



Coley Ck.



Elkahatchee Ck.



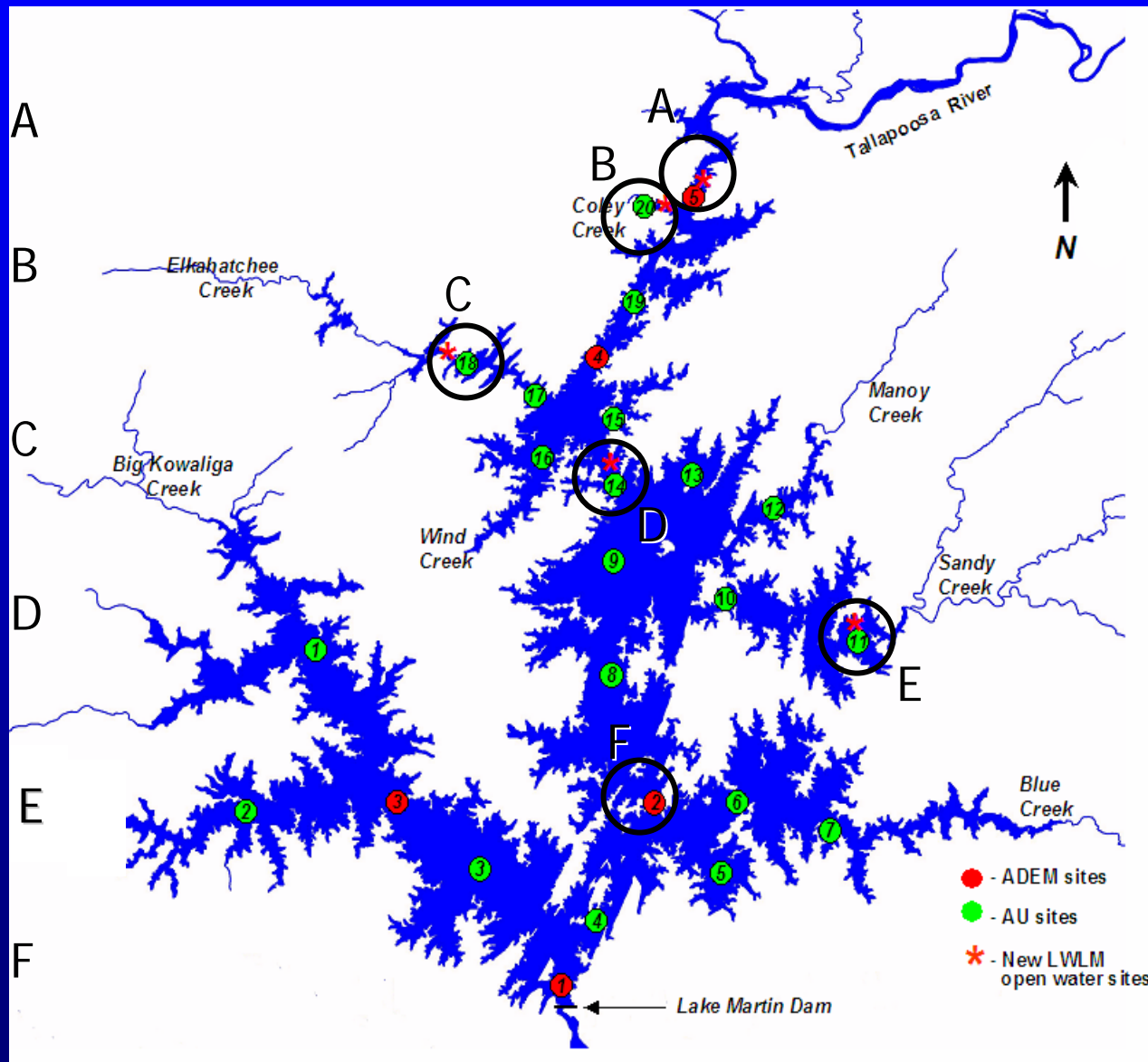
Bay Pine Is.
(main stem)



Sandy Ck.

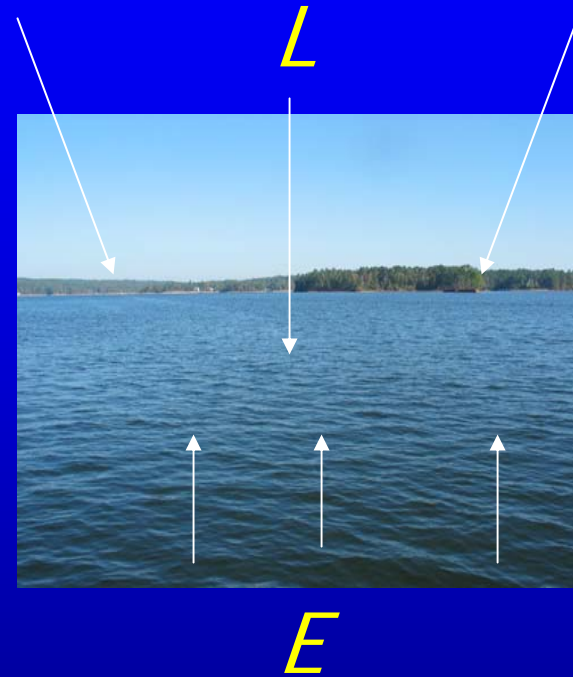


Above
Blue Ck.
(main stem)



Reflectance (%) Calculation

$$\rho = \frac{L_{\uparrow}}{E_{\downarrow}}$$



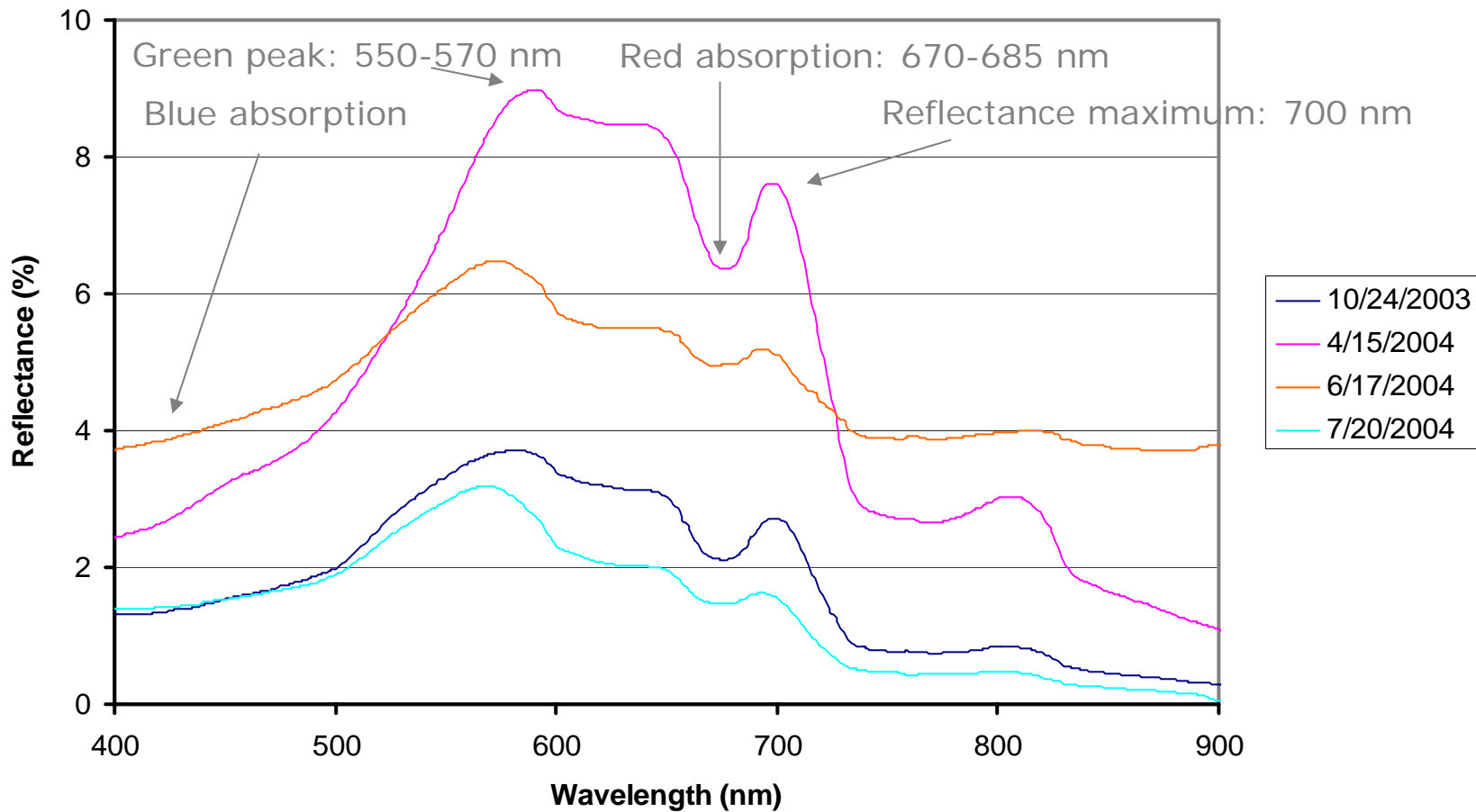
L is upwelling radiance

E is downwelling irradiance

Hyperspectral Sensors

- *ASD VNIR FieldSpec Spectrometer*
 - *UA Department of Geography*
 - *Wavelength Range (nm): 350-1150 (701 channels)*
- *The StellarNet EPP2000 Spectrometer*
 - *LWLM*
 - *Wavelength Range (nm): 350-850 (1000 channels)*

Spectral reflectance of Coley Creek Embayment over time



Remote Sensing Initiative –
Hyperspectral Reflectance Measurements of Chlorophyll
Concentration and Related Water Quality Predictors

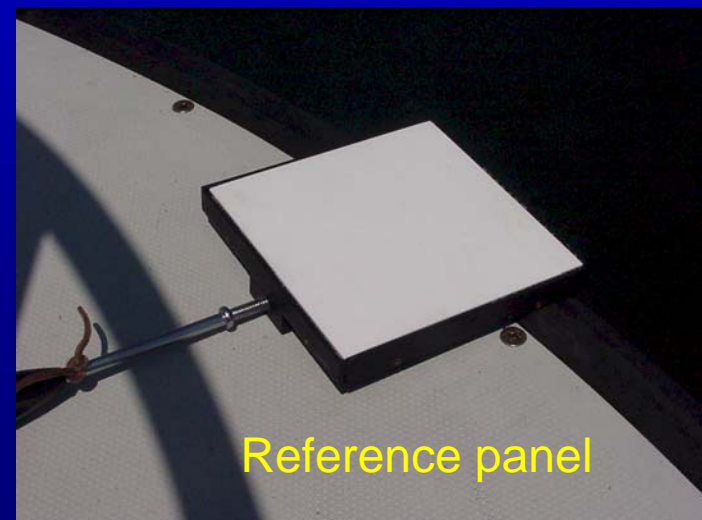
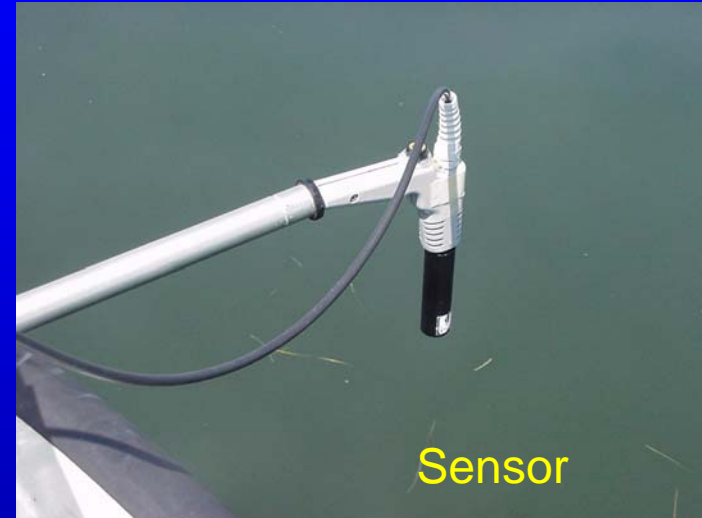


StellarNet, Inc. Spectrometer

(Model EPP2000C, 185 – 850nm, 0.5nm resolution)

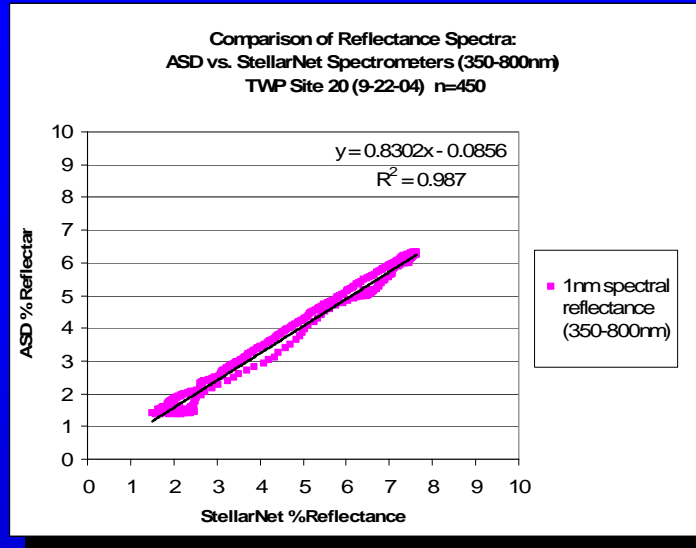


Hyperspectral Sensing at Close Range

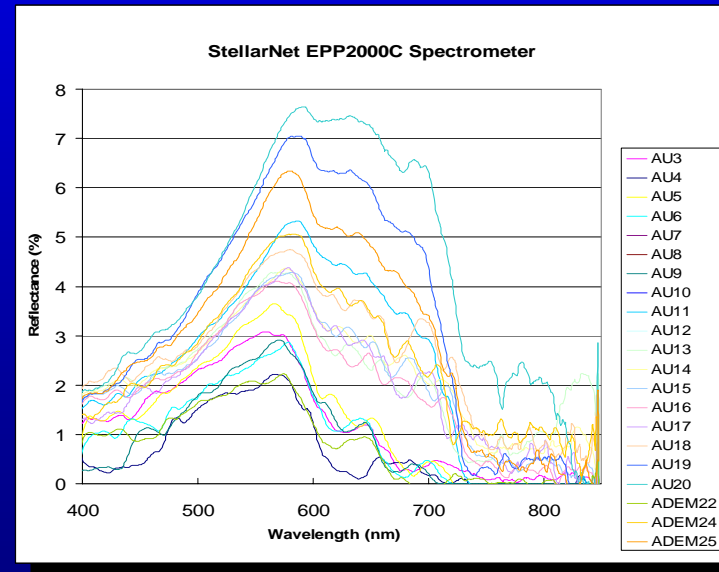
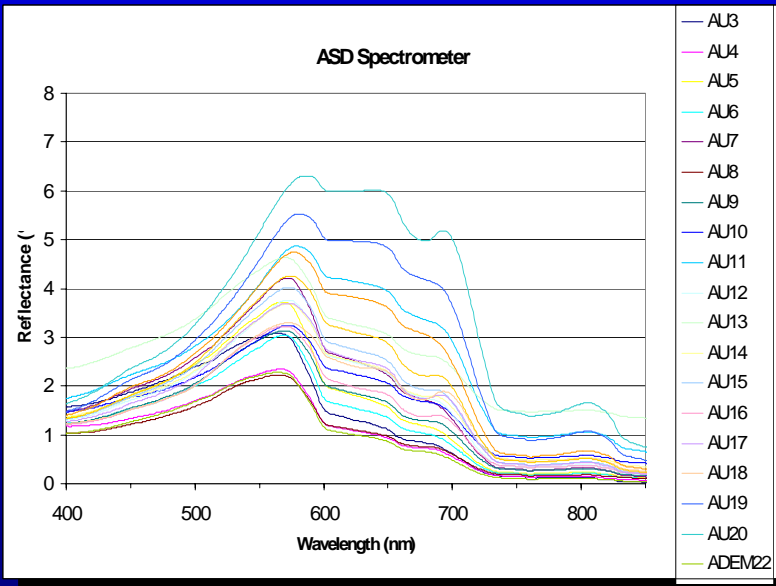


Preliminary Results

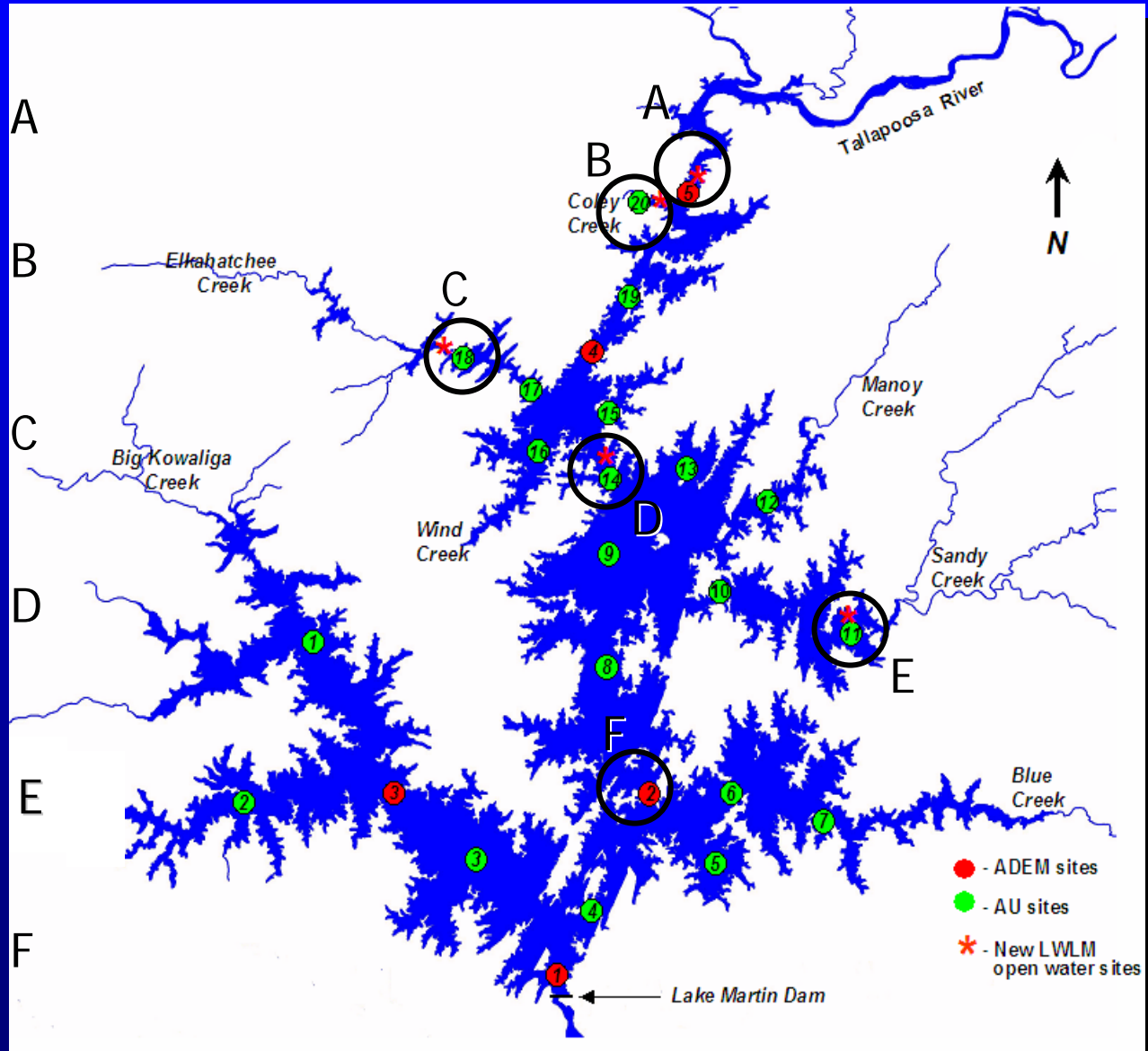
ASD & StellarNet Spectrometers



*Comparable
Performance*

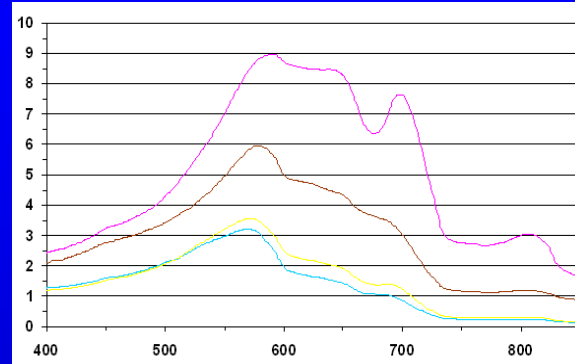


Sample Site Water Color – Inter-year Spatial Trends



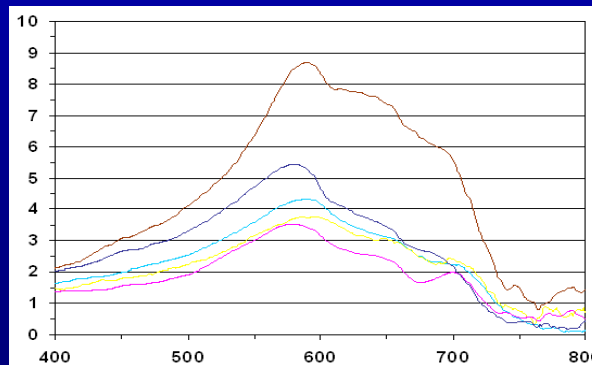
Spectral Reflectance Comparison – LWLM open-water monitoring sites

April
2004

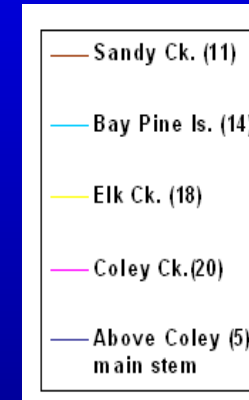


Reflectance (%)

April
2005



Wavelength (nm)



*Site number

*

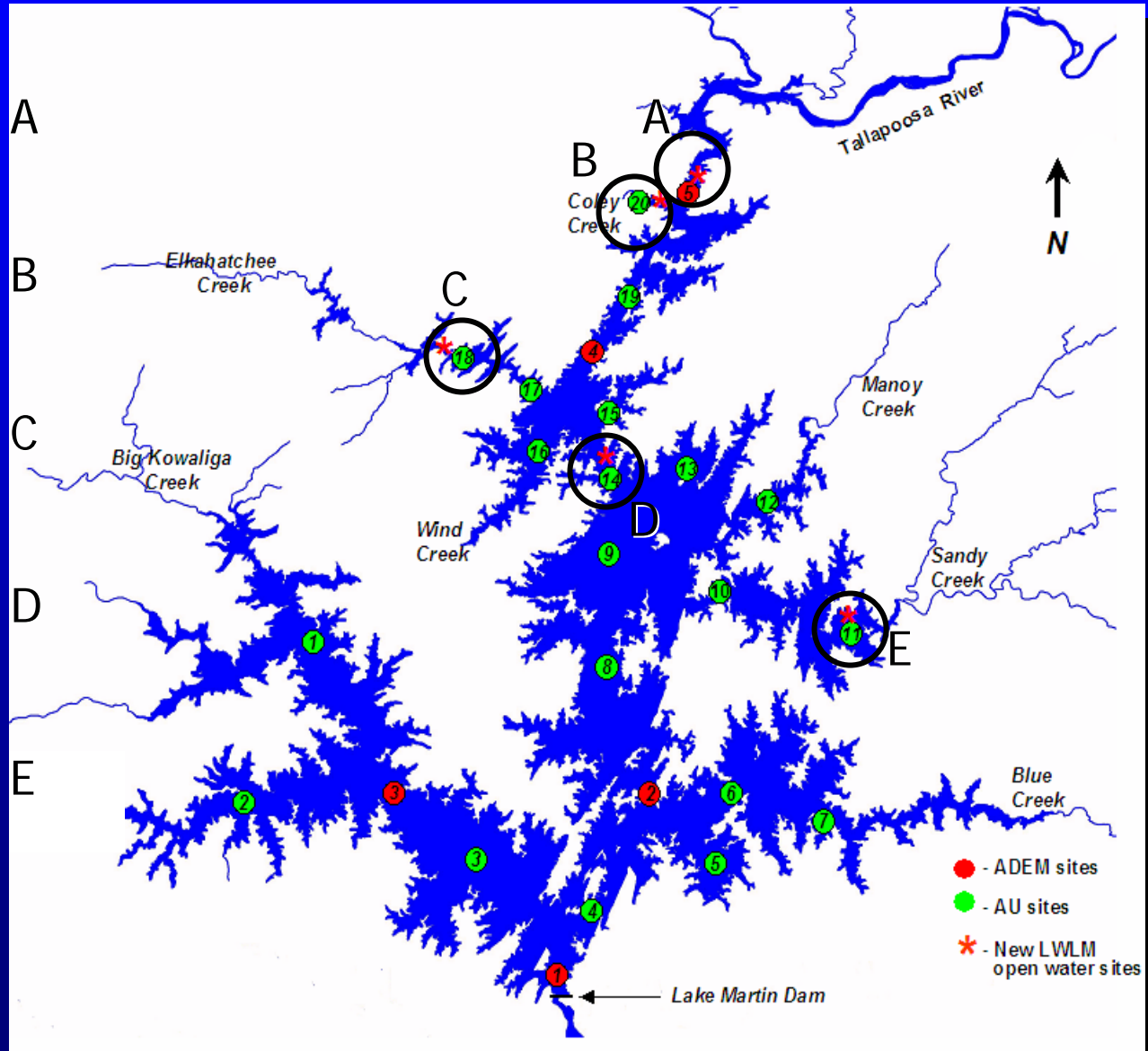
Sample Water Color – Onsite vs. Filtered Suspended Solids

April

TSS* 2005



* Sample filter (wet)



Testing and Data Collection Continues



- Demonstrate utility for AWW group use
 - Reflectance correlations and regression models
 - Assess color-metric software
- Complete duel-head modification
- Refine sampling techniques & analysis
- Enhance field portability

Portability Initiatives



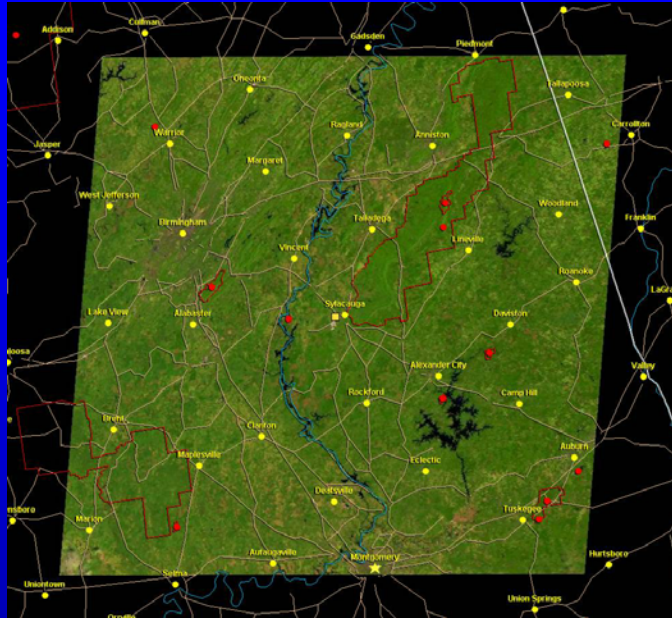
Homeland Security Version?



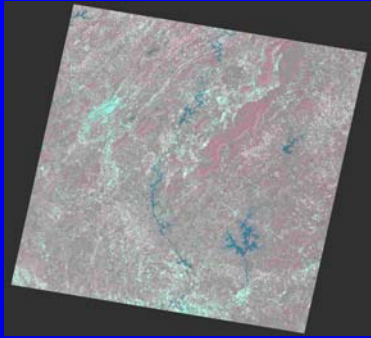
Questions?



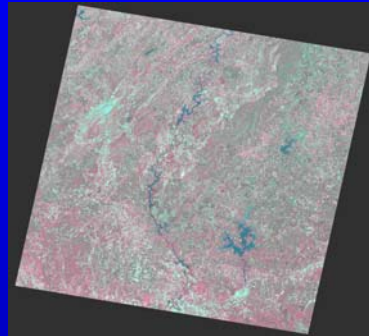
Landsat 5 TM Scene (Path: 20/Row: 37)



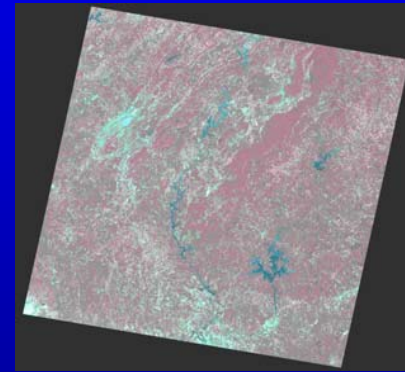
Three cloud free scenes



10/22/03

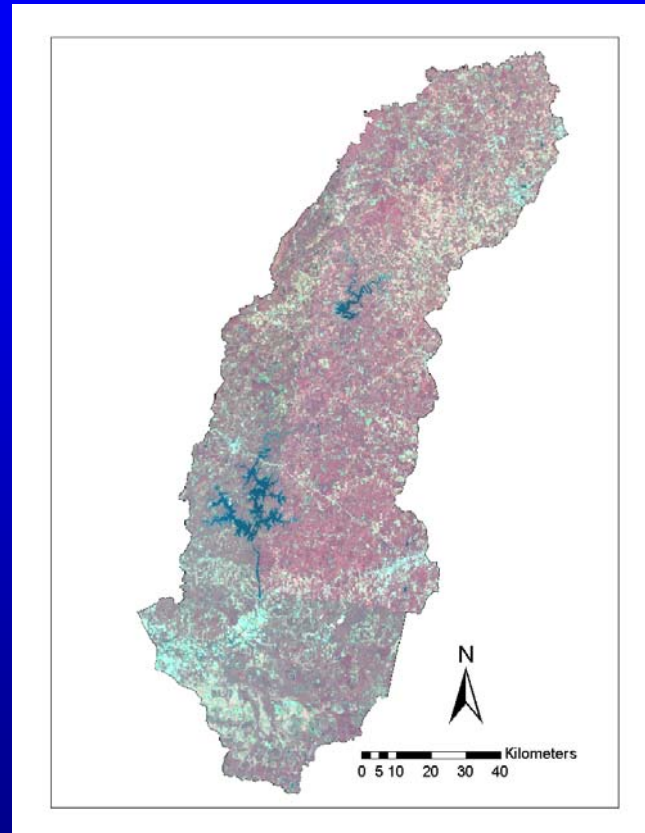


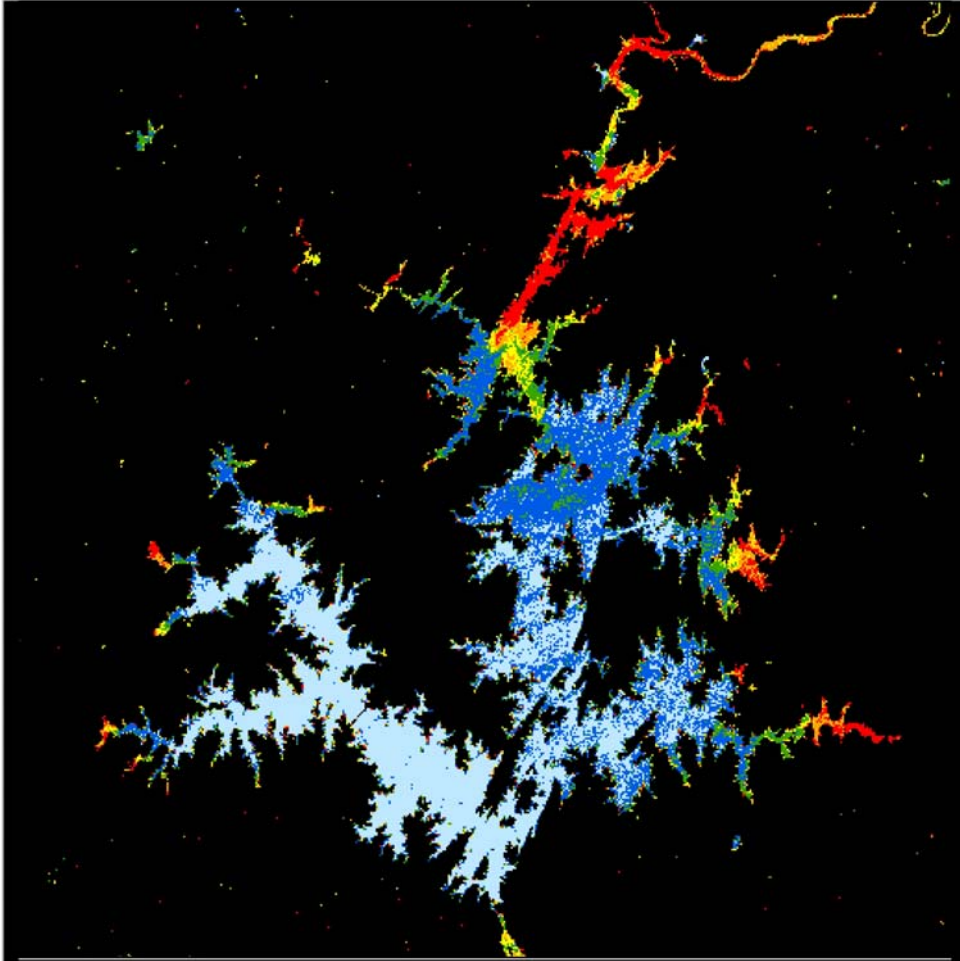
4/15/04



9/22/04

*Mosaiced Landsat 5 TM Images Covering the
Upper, Middle, and Lower Tallapoosa River Watersheds*





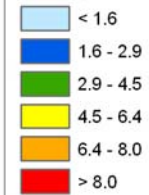
Lake Martin Chlorophyll-a

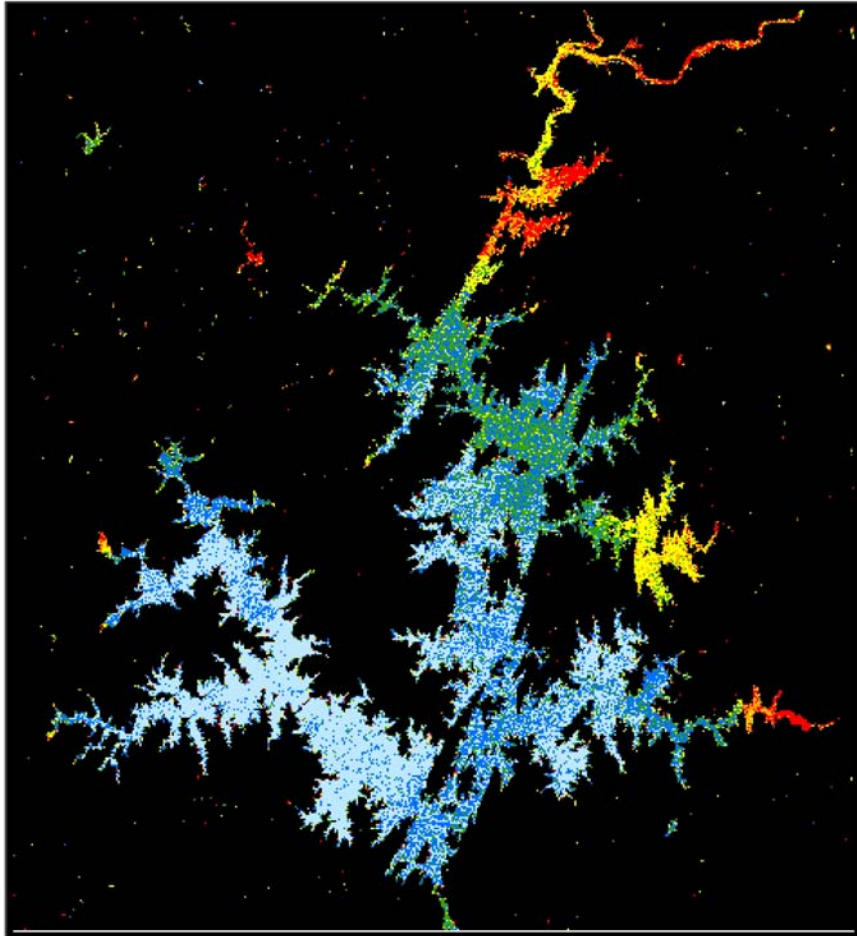
(Derived from April 15, 2004
Landsat-TM satellite image)

0 1.5 3 6 Kilometers



Chlorophyll-a micrograms/liter





Lake Martin Chlorophyll-a

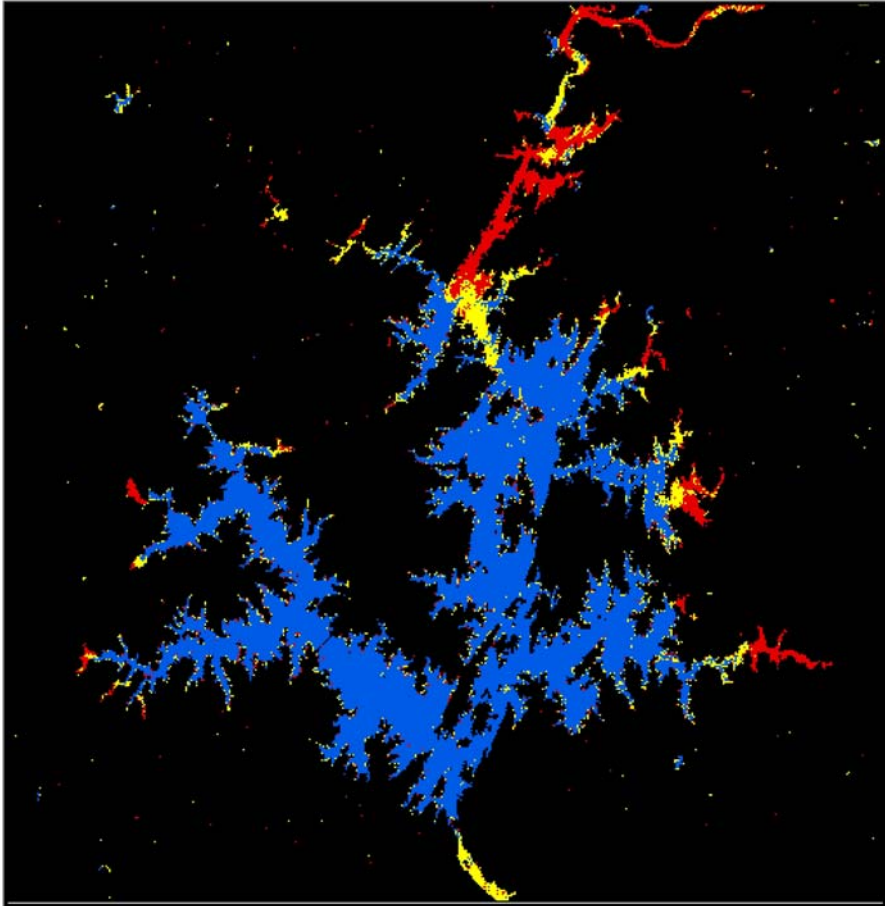
(Derived from September 22, 2004
Landsat-TM satellite image)

0 1.5 3 6 Kilometers



Chlorophyll-a micrograms/liter





Lake Martin Trophic State

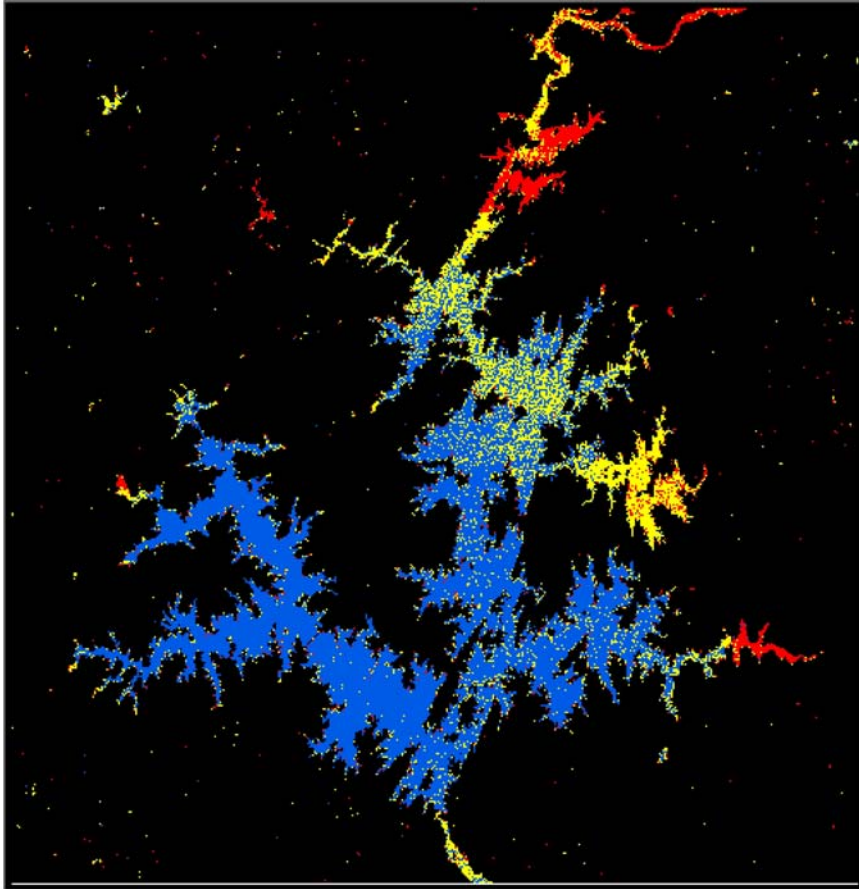
(Derived from April 15, 2004
Landsat-TM satellite image)

0 1.5 3 6 Kilometers



Trophic State

-  Oligotrophic
-  Mesotrophic
-  Eutrophic



Lake Martin Trophic State

(Derived from September 22, 2004
Landsat-TM satellite image)

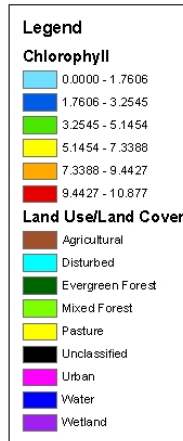
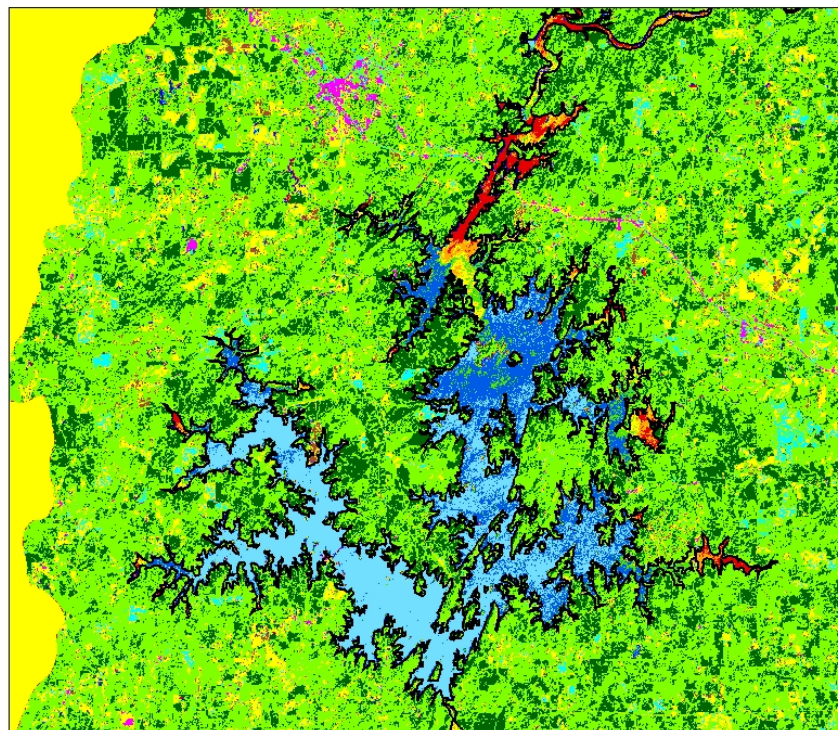
0 1.5 3 6 Kilometers



Trophic State

-  Oligotrophic
-  Mesotrophic
-  Eutrophic

Land Use/Land Cover and Lake Martin Chlorophyll



What is a GIS?



A GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data, identified by location.

Strength of GIS

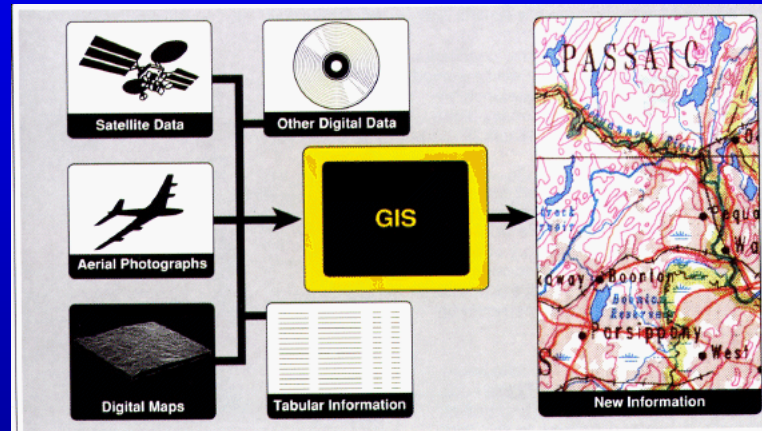


Figure 9. Data integration is the linking of information in different forms through a GIS.

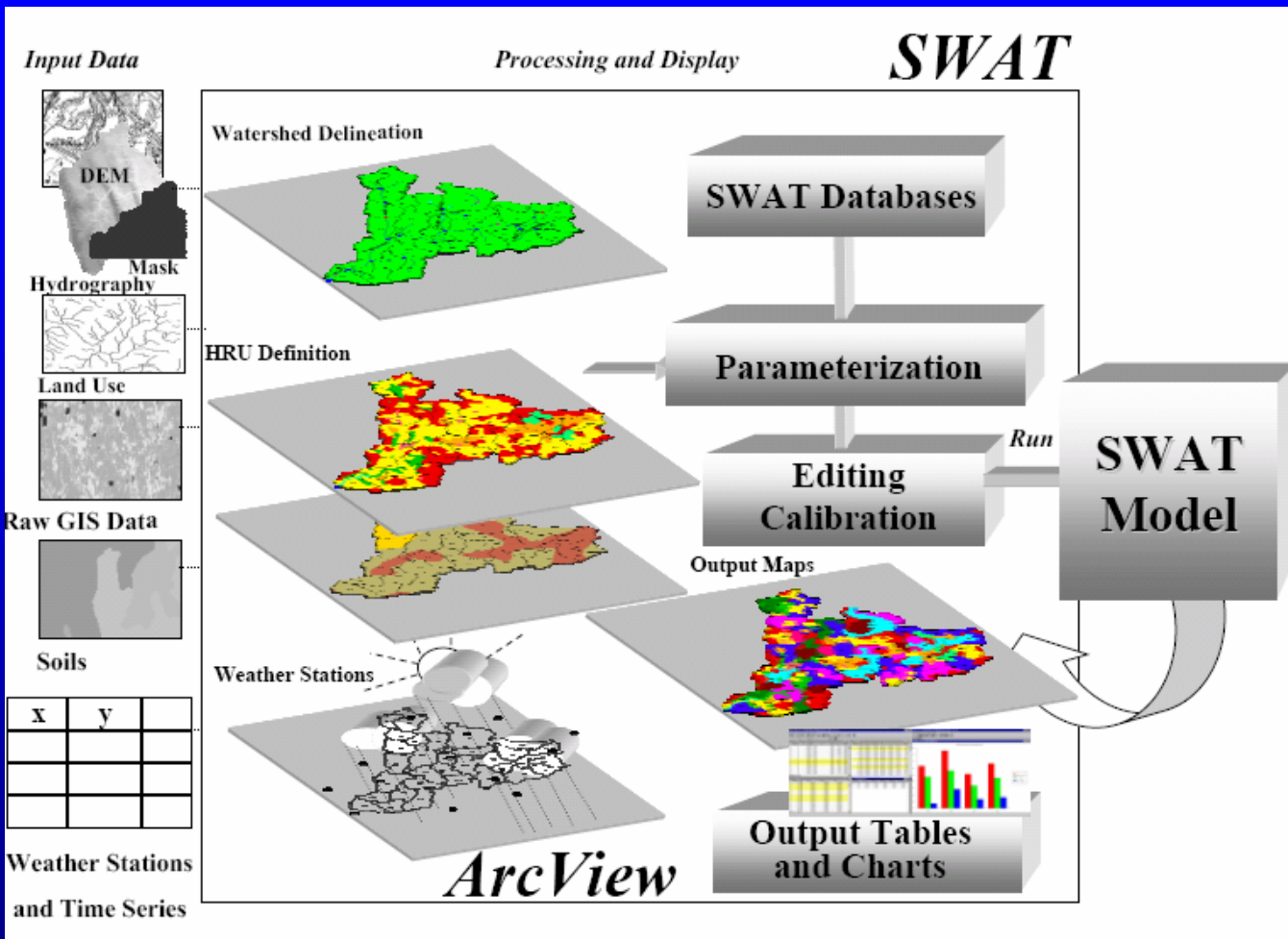
The integration of data in different forms through a GIS

Soil and Water Assessment Tool (SWAT)

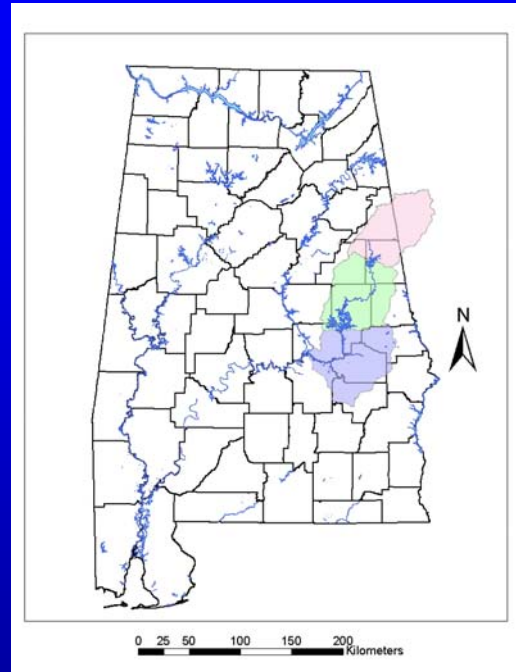
SWAT was developed to predict the effects of land management practices on:

- water*
- sediment*
- agricultural chemical yields*

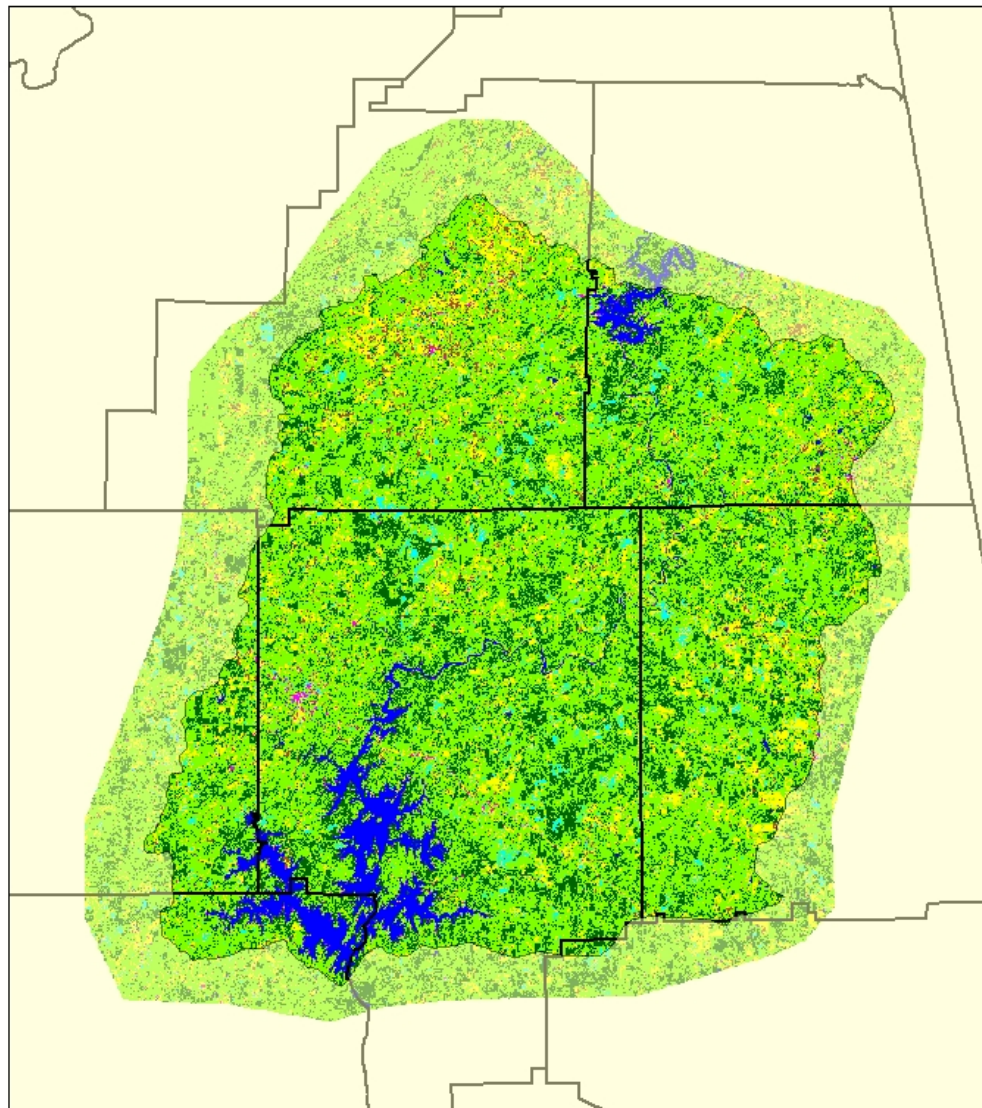
For use on large, complex watersheds with varying soils, landuse, and management conditions over long periods of time



The Upper, Middle, and Lower Tallapoosa River Watersheds



*Land Use/Land Cover Derived From Landsat 5 TM Image
Acquired October 22, 2003*



Land Use/Land Cover

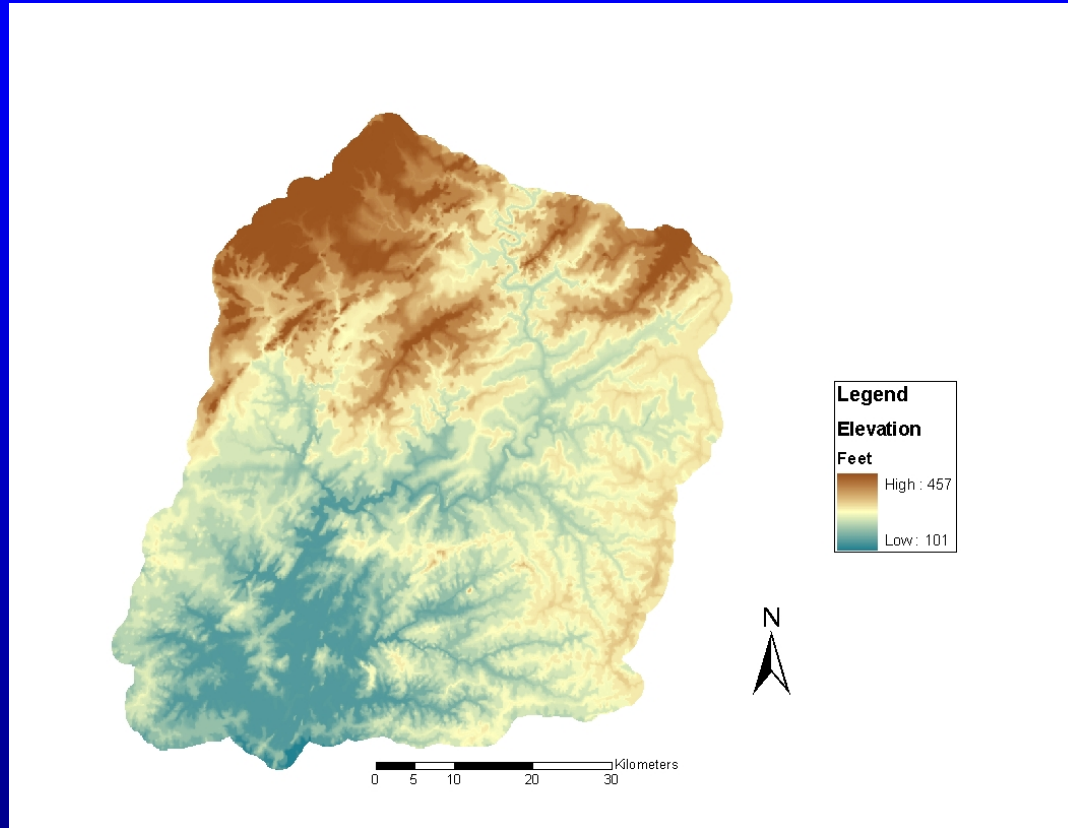
Classes

-  Agricultural
-  Disturbed
-  Evergreen Forest
-  Mixed Forest
-  Pasture
-  Urban
-  Water
-  Wetland

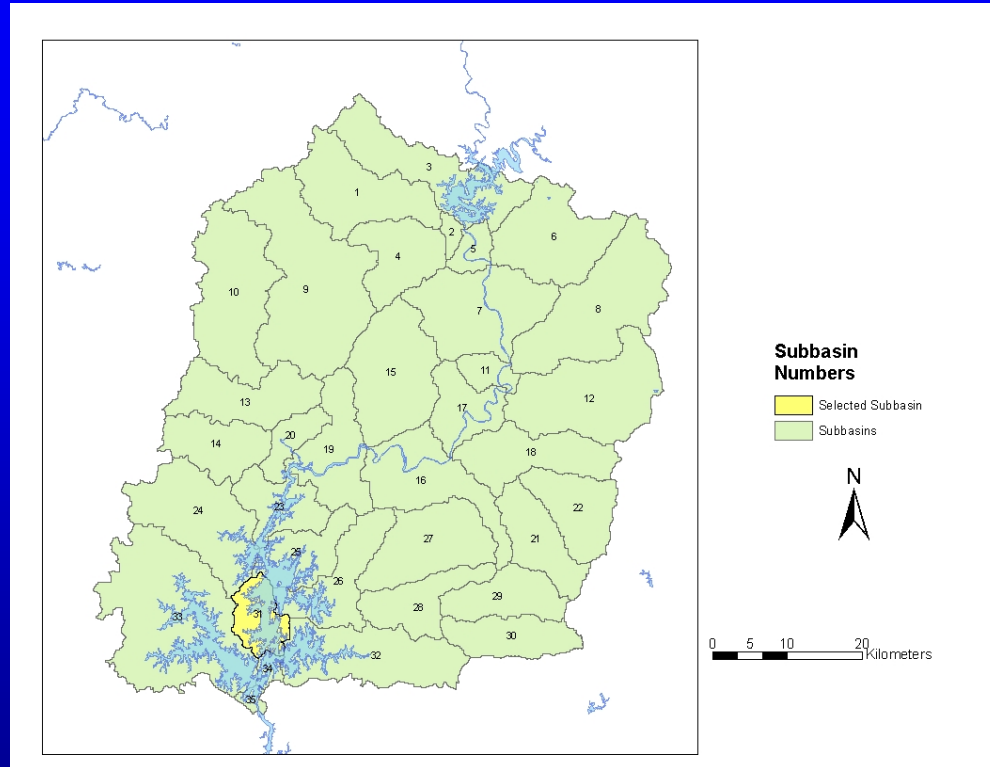


0 5 10 20 30 Kilometers

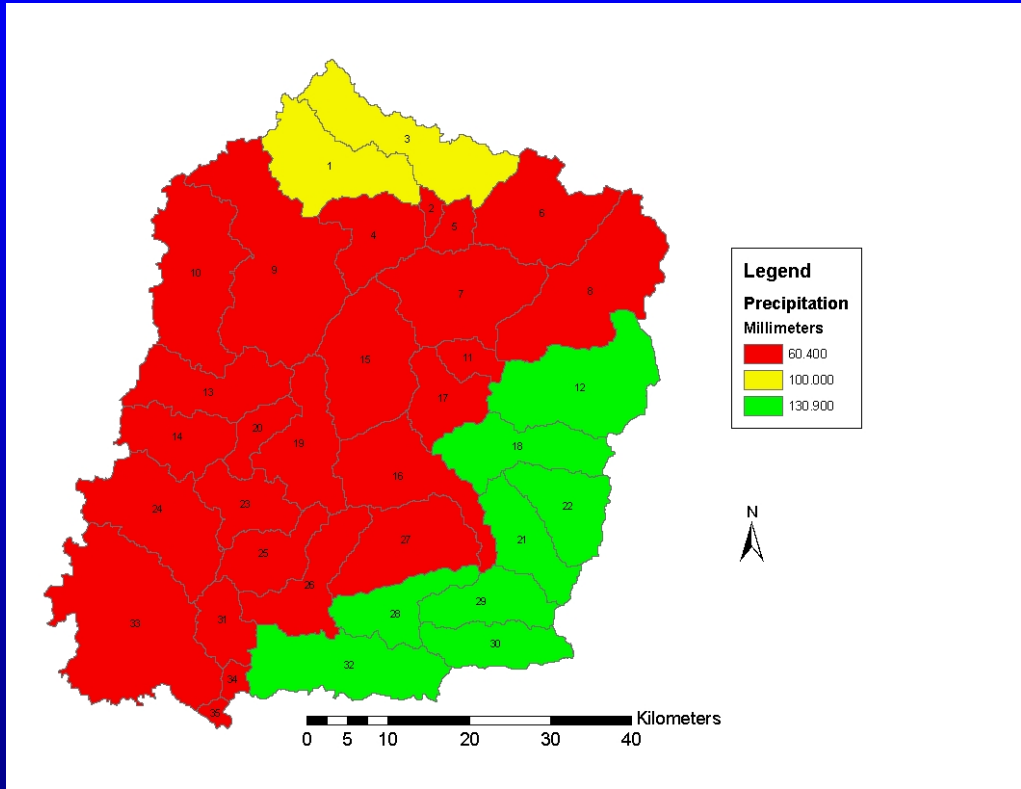
Digital Elevation Model For The Middle Tallapoosa River Watershed



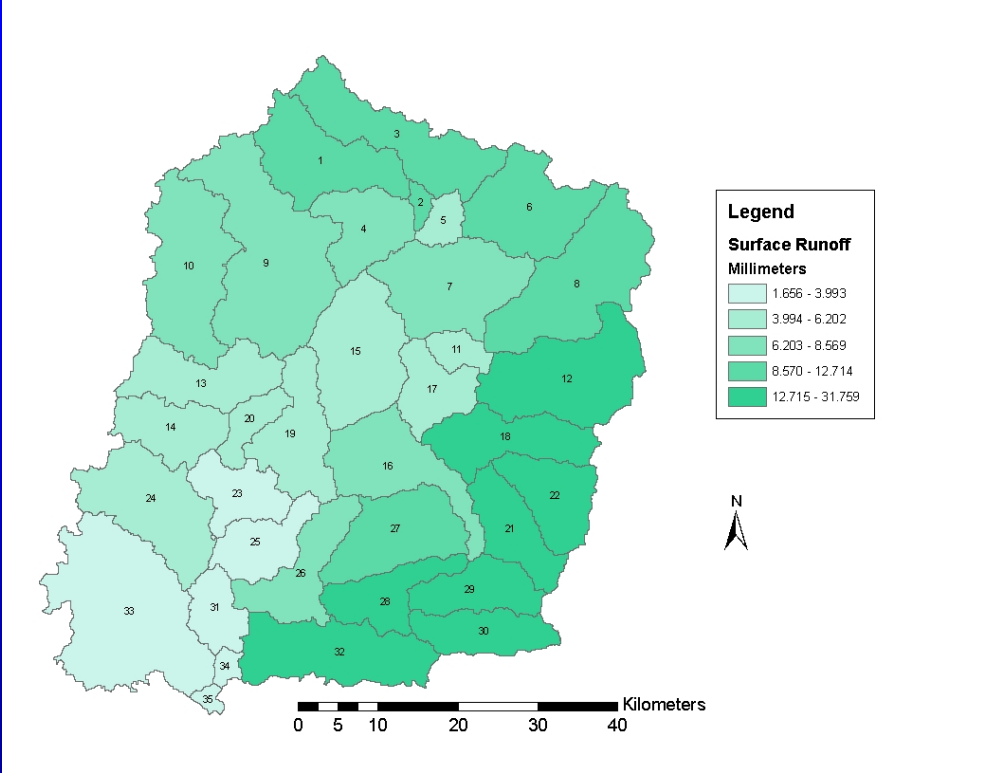
The Subbasins with major water bodies



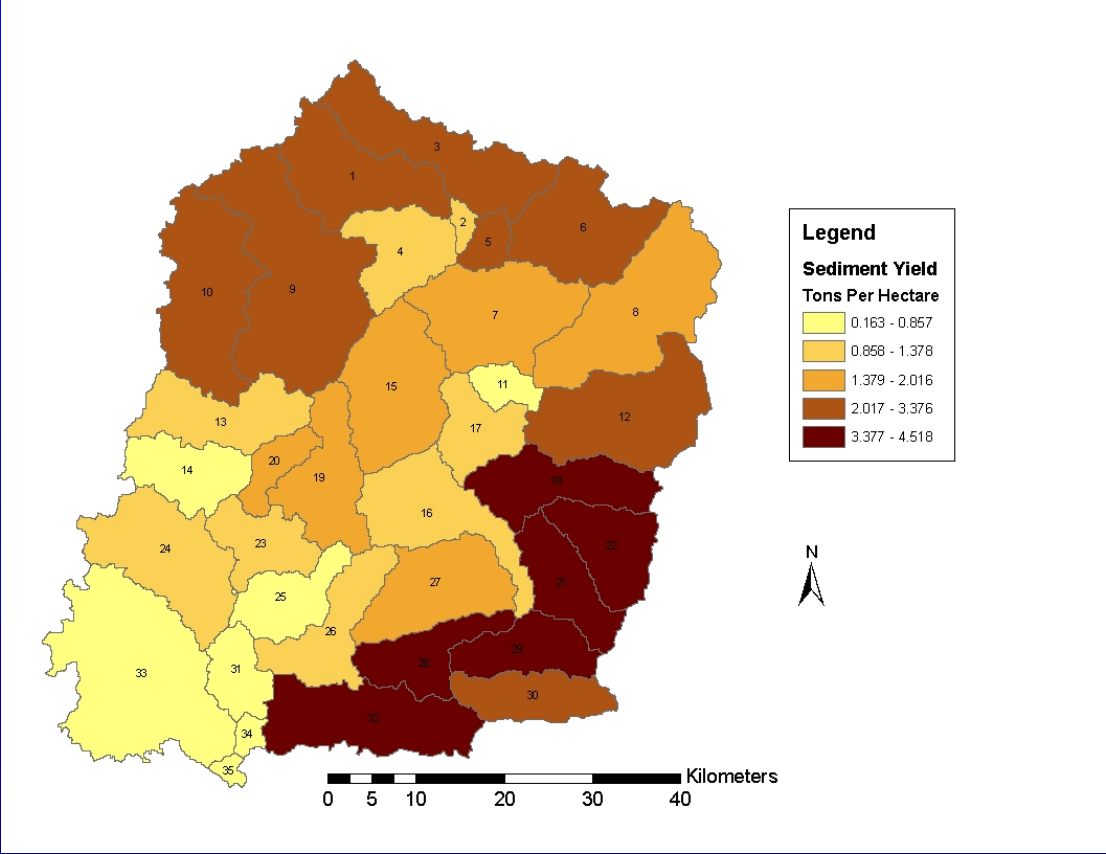
Precipitation Map For April 2004



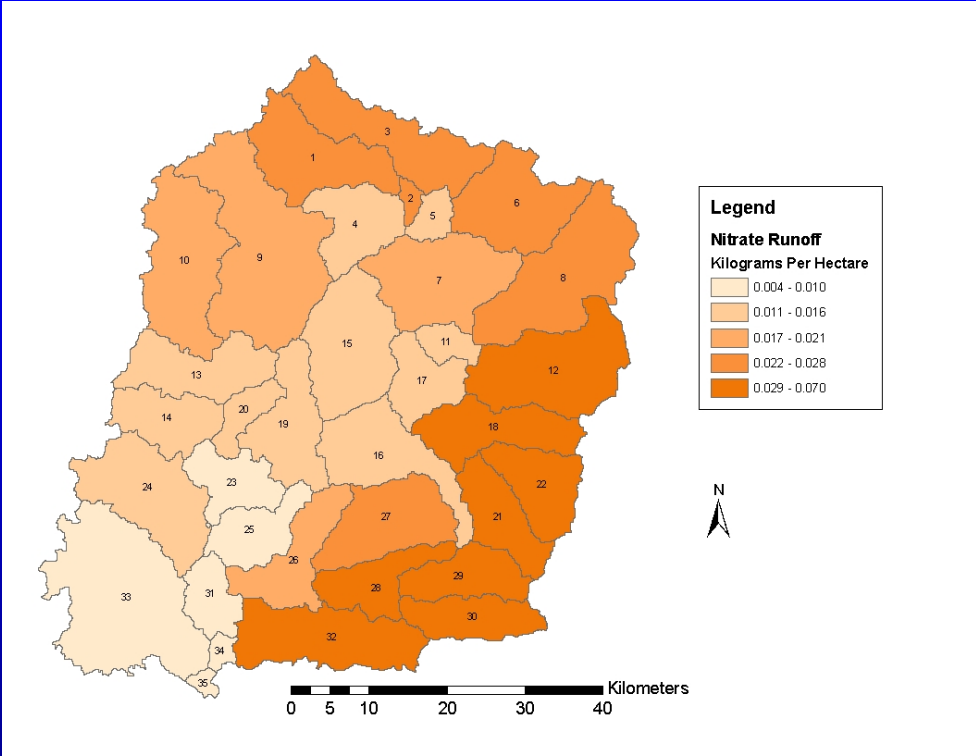
Surface Runoff Map For April 2004



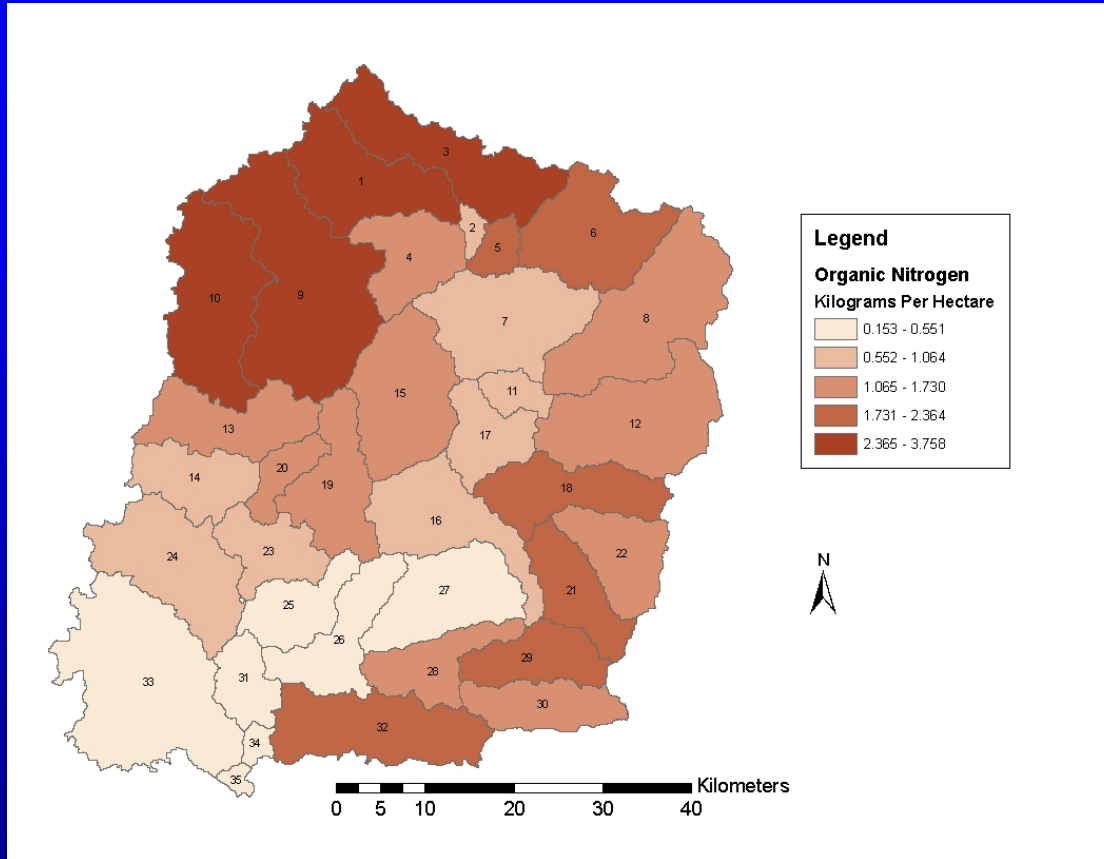
Sediment Yield Map For April 2004



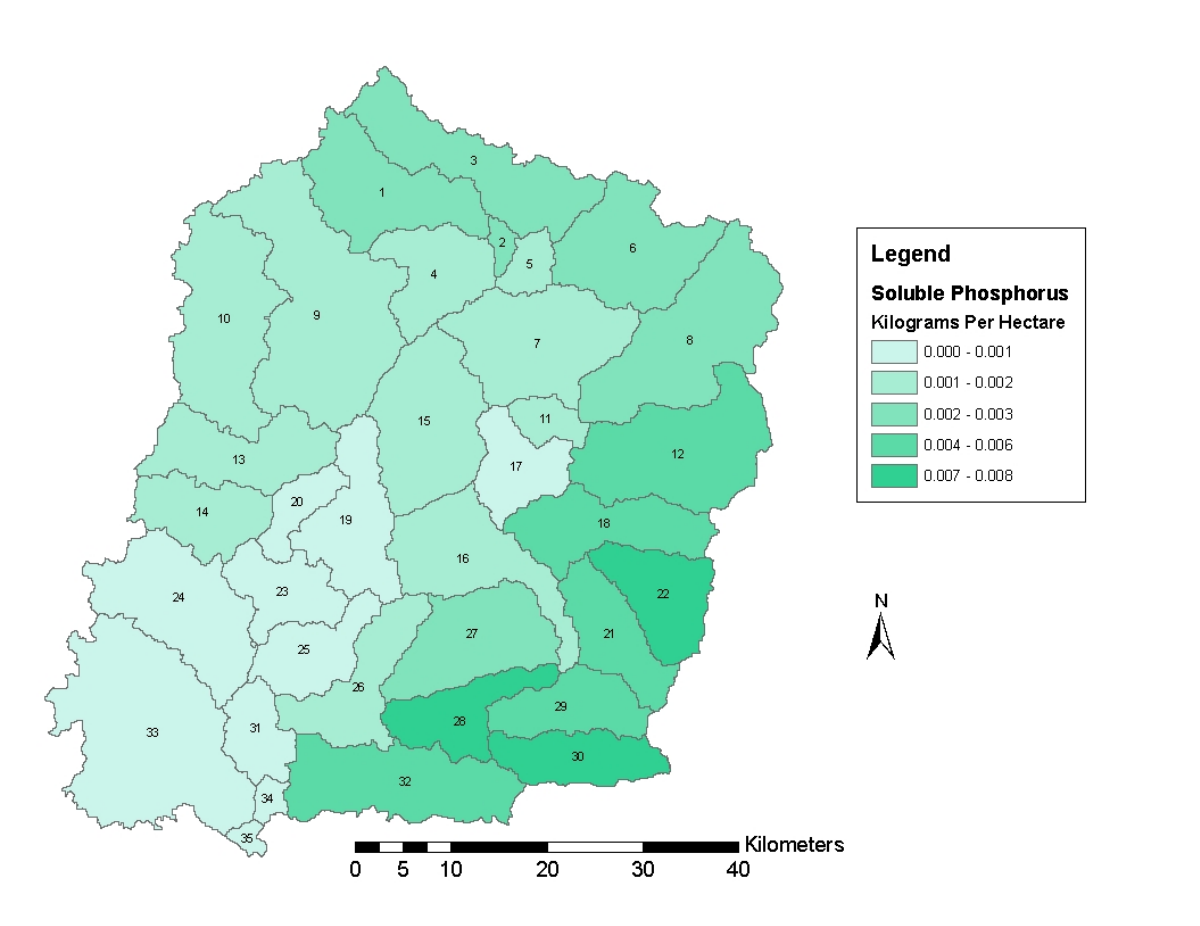
Nitrate Surface Runoff Map For April 2004



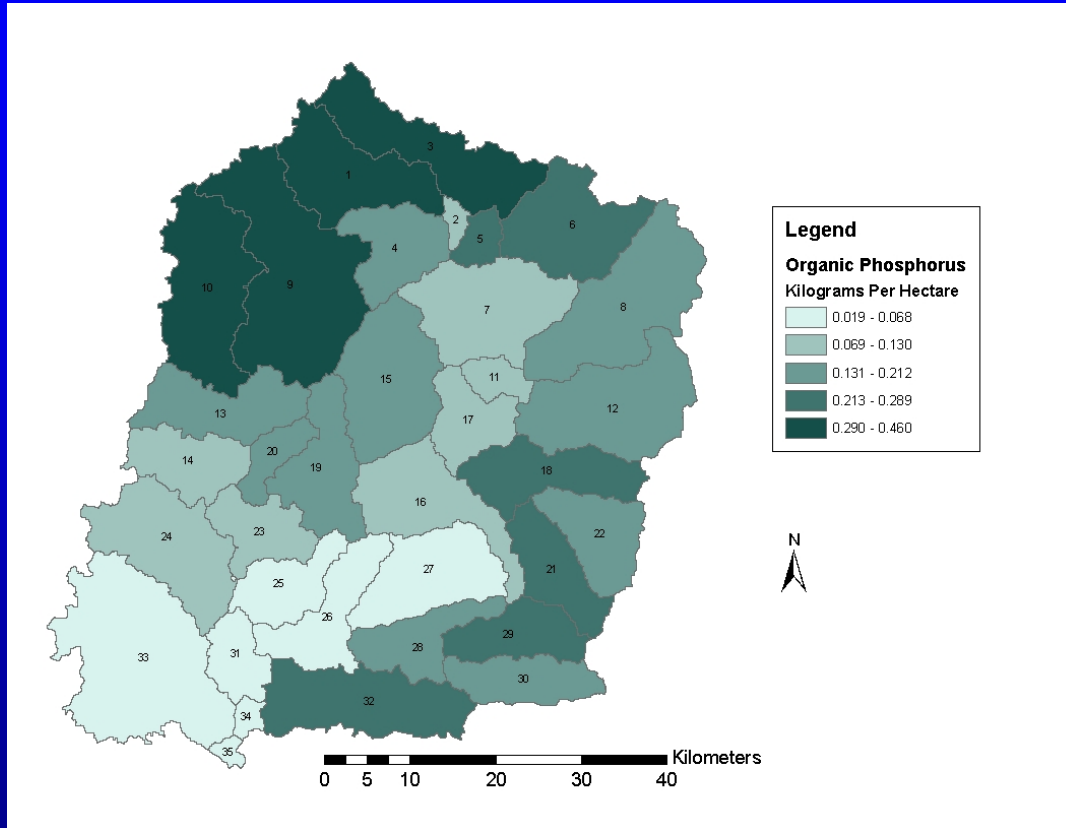
Organic Nitrogen Map For April 2004



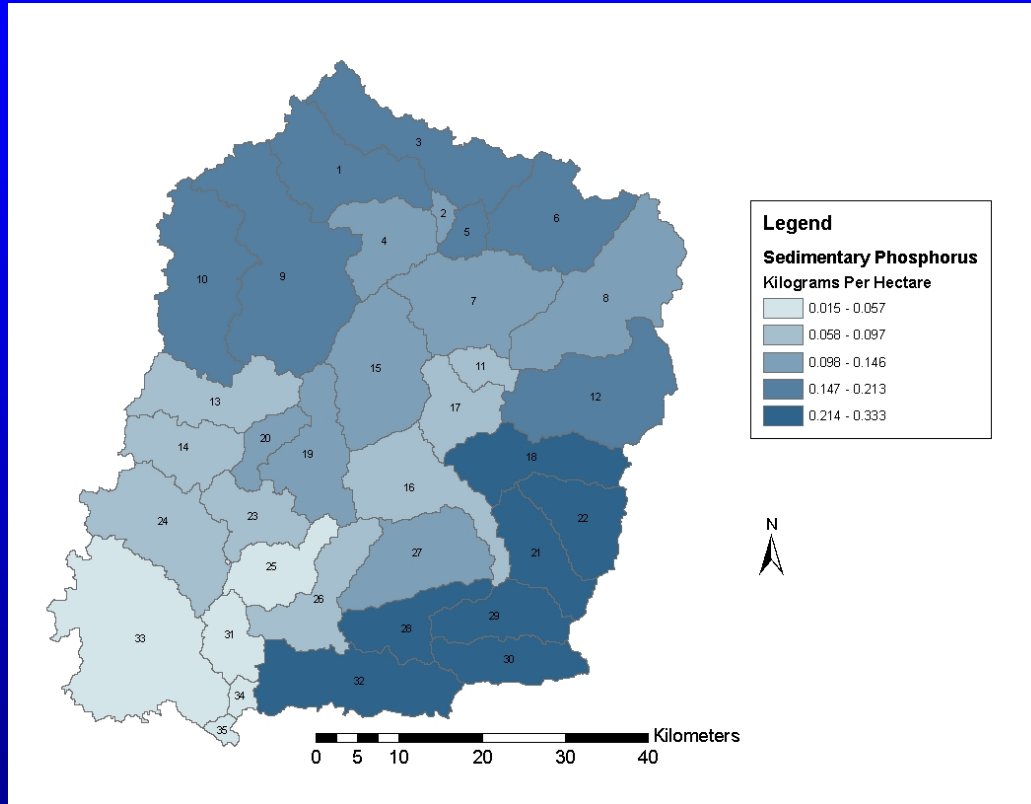
Soluble Phosphorus Map For April 2004



Organic Phosphorus Map For April 2004



Sedimentary Phosphorus Map For April 2004



Acknowledgements

- *USDA, Cooperative Research, Education and Extension System: funding*
- *AU, ADEM, LWLM, LWPOA: water sampling*
- *Russel Taylor and Gang Wang, graduate research assistants of the Department of Geography, UA: assists in data collection and processing, and GIS modeling*



Thank you.