**NASA DEVELOP National Program**

**Proposed Project Summary**

**Title: Investigation of the Relationship Between Land Use/Land Cover and Water Quality**

Subtitle: Using EOS to investigate the changes in the Cahaba River’s mussel and macro-invertebrate populations due to changes in the watershed’s landscape to assist in local water and land management decision-making.

**Location:** Marshall Space Flight Center/University of Alabama at Birmingham

**Advisor:** Dr. Jeff Luvall

**Project Start/Completion Date:** Spring 2011-Summer 2011

**Project Length:** two terms

**Applied Sciences National Applications:** Water Resources, Public Health, Ecological Forecasting, Biodiversity.

**Partners/Collaborators:**

Cahaba River Society

Black Warrior Riverkeeper

University of Alabama at Birmingham- Department of Biology

Jefferson County Environmental Services Department

Freshwater Land Trust of Alabama

**Project Arose/Requested By:** Current DEVELOP student and president of the Green Initiative at UAB was interested in working with local river-keeper groups to help protect Alabama’s rivers.

**Current Management Practices & Policies:**

The Freshwater Land Trust works in Jefferson, Shelby, St. Clair, Blount, Bibb, Tuscaloosa and Chilton Counties which includes the watershed of the Black Warrior River and the Cahaba River. The mission of the Freshwater Land Trust is the acquisition and stewardship of lands that are critical for the protection of rivers and streams and that provide recreational opportunities for the community. The Freshwater Land Trust protects critical watershed area through land acquisition, conservation easements, and partnerships. To this date, they have protected or helped to protect over 10,000 acres. Their major conservation priorities include water quality protection (areas of high risk of erosion), biological conservation (sites of rare or endangered species), recreational potential (open areas near populated centers) and community conservation priorities (historical sites, pedestrian/bicycle routes, etc). Starting in the second half of 2009, the Freshwater Land Trust met with hundreds of representatives of the academic, scientific, business, environmental, recreational, and governmental sectors to help identify interest areas and create a conservation road map for the next 10 years.

The Cahaba River Society takes a balanced, science-based approach to protecting the interests of the Cahaba River, which supplies water to about one-fifth of Alabama’s people. The society is committed to educating people to improve environmental decision-making through creating working partnerships in the community. Their mission is “to restore and protect the Cahaba River watershed and its rich diversity of life.” They contributed to the foundation of the Freshwater Land Trust by securing $30 million to purchase buffer zones along Jefferson County’s riverbanks. The Cahaba River Society supports programs that focus on three main areas: growth and development, education and recreation, and watershed stewardship. The CLEAN (Children Linking with the Environment Across the Nation) program has allowed over 17,500 students to participate in educational environmental activities since its founding in 1996.

**Decision Support Tool:**

The Freshwater Land Trust consults experts in diverse fields and uses existing GIS data that is not up to date to help identify areas of concern. However, they did not have satellite remote sensing data to consider when making their decisions. Satellite remote sensing can provide useful and current maps of the encompassing watershed and quantify interest areas based on the amount of development, lack of vegetation, and slope.

The Cahaba River Society works with existing organizations such as the EPA and ADEM to identify areas of concern on the Cahaba River and implement solutions. Its board and staff include experts in fields such as business, development, water quality, public health, and biodiversity. The society also uses maps of the river provided by USGS. The research and conclusions proposed by this project can help the Society by increasing awareness of the water quality of the Cahaba River and the impacts of urbanization on the health of the river and the species that live within it.

**Transition Approach to end-user:**

Results from the DEVELOP project in the form of maps and GIS data will be provided to the end users. The Freshwater Land Trust can evaluate and use the data provided by the DEVELOP project to facilitate decision making and help in the formation of their 10-year plan. The maps and data provided by the project will help The Fresh Water Land Trust make more informed decisions and, consequently, allocate funds more efficiently when considering future projects and land acquisition. Similarly, this data can be useful to the Cahaba River Society by providing them with more up to date information about the health of the river, and also by raising awareness concerning the state of the Cahaba River in general. The Cahaba River Society will have more information available to help them make decisions about which areas of the Cahaba need the most attention, and in what ways they can benefit the river the most.

**Community Concerns:**

* The Black Warrior River and Cahaba River are the main sources of drinking water for the Greater Metropolitan Area of Birmingham.
* These rivers also support rich biodiversity and are home to species that cannot be found elsewhere.
* Urbanization and industrial development has begun to degrade the quality of the rivers.
* Local environmental groups are actively involved in restoration projects, but funds are limited and data used for decision-making is dated.
* DEVELOP can help by providing critical data for these environmental groups.

**Study Location:** Greater Birmingham Metropolitan Area, Alabama

**Project Summary**

Alabama’s rivers are filled with rich biodiversity. Rapid urbanization of Birmingham, the largest metropolitan region in Alabama, and stream eutrophication are two serious threats to the ecological value of surrounding rivers. A river’s watershed influences the dynamics, structure, and health of the stream. Major water projects are generally the most apparent form of habitat alteration, but transformations of the landscape are probably the most widespread and potent threat to rivers due to the associated consequences of landscape transformation on hydrology, vegetation cover, and terrestrial-aquatic linkages (Allan & Flecker, 1993). An increase in urbanization increases the amount and variety of pollutants in runoff (overflow), creates more erratic hydrology, increases water temperature, and reduces channel and habitat structure (Paul & Meyer, 2001). Erratic hydrology resulting from increased impervious surface area run-off conveyance and increased water temperature may be due to the loss of riparian vegetation and warming of surface run-off on exposed areas (Allen, 2004).

The connection between land use and stream health allows for the design of studies that can expand our understanding of how changes in landscape can have direct effects on stream health, in particular in the Birmingham region. Stream health, as measured by biotic assemblages and water chemistry (provided by UAB’s Department of Biology), will be used in conjunction with remote sensing/GIS studies to address if stream health can be predicted from measurements of vegetative land cover. Specifically, the study will address the following objectives: 1) track changes in landscape within the surrounding watersheds by measuring vegetative cover; 2) determine the relationship between land cover and stream health; and 3) test effectiveness of remote sensing as a management tool.

The Freshwater Land Trust, Cahaba River Society, and the Black Warrior Riverkeeper organizations stand to gain valuable information and resources from the proposed study. The Freshwater Land Trust is a non-profit organization located in Birmingham, Alabama. Their mission is the acquisition and stewardship of lands that enhance water quality and preserve open space. The Cahaba River Society is an organization dedicated to raising awareness of the health of the Cahaba River in Alabama through educational environmental programs and implementing reforms concerning the quality of the river water. DEVELOP can provide important information which can be used in the decision making processes of both these organizations.

**Earth Observations & Parameters:**

Landsat 5 TM: Land use/land cover change, NDVI

Terra (ASTER): NDVI

Digital Globe Arial Photography

**Future NASA Missions:**

Terra (ASTER): NDVI, land use/land cover change

**Models:** N/A

**Ancillary Data:**

Biotic indices provided by the Biology Department from the University of Alabama at Birmingham and the Jefferson County Environmental Services Department

**Resources Requested:**

**Students -**

* Proposed Student Team Size: 6
* Average Student Hours Per-Week: 20 hours
* Total Project Hours Per-Week: 120 hours

**Advising -**

* Proposed advisor to be funded: Dr. Jeff Luvall
* Total hours per week: 2 hours

**References**

Allan, J. D., & Flecker, A. S. (1993). Biodiversity Conservation in Running Waters. BioScience , 43 (1), 32-43.

Allen, J. D. (2004). Landscape and Riverscape: The Influence of Land Use on Stream Ecosystems. Annu. Rev. Ecol. Evol. Syst , 35, 257–284.

Paul, M. J., & Meyer, J. L. (2001). Streams in the urban landscape. Annu. Rev. Ecol. Syst., 32, 333–65.