

Consequences of Land Cover/Use Change on Two National Parks in the Upper Delaware River Basin

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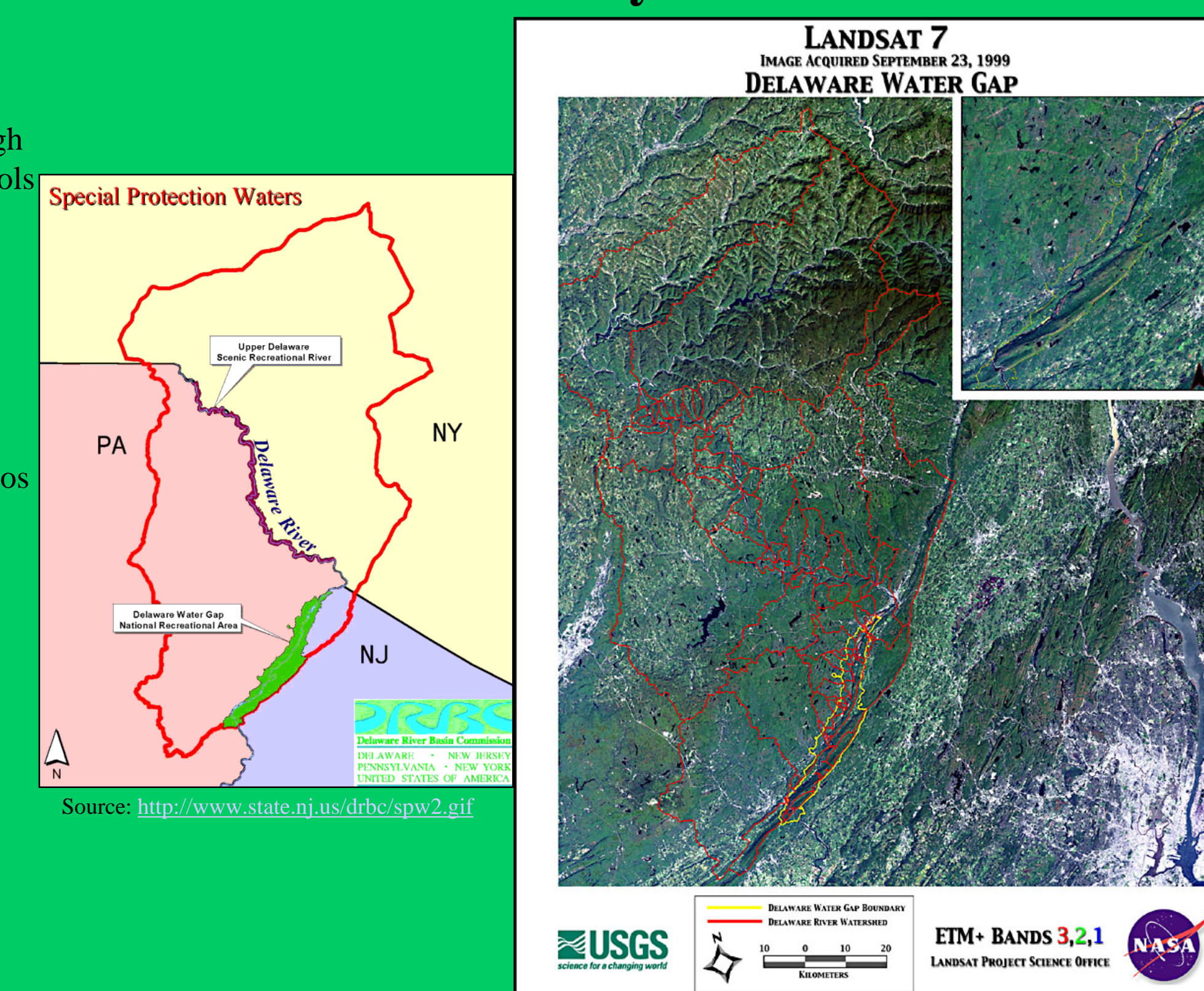
Abstract—The National Park Service (NPS) Inventory and Monitoring (I&M) Program is currently developing scientific protocols to inventory and monitor the natural resources of 270 park units with significant natural resources at the national level. The protocols are aimed at providing the critical tools needed by park managers for effective decision-making on the management and stewardship of the resources they are charged with protecting. We propose to develop and test a satellite-based regional land cover and land use monitoring protocol that addresses the immediate needs of the NPS I&M.

A pilot project that examines land cover/use changes at two parks in the Upper Delaware River Basin from 1984 to 2004 is proposed as a demonstration of the protocol. The approach is based on well-established algorithms used with coarse resolution data and uses state-of-the-art processing techniques. Sub-pixel fractions of tree, herbaceous and bare cover are derived at the 30m spatial resolution of Landsat data using higher resolution data and used to detect and monitor land cover changes in and around the Upper Delaware Scenic and Recreational River and Delaware Water Gap National Recreation Area park units, in the tri-state area of Pennsylvania, New York and New Jersey. The land cover/use products resulting from the application of the protocols are then used to guide the simulation of land cover/use changes within a simple Soil-Vegetation-Atmosphere-Transfer (SVAT) model in order to better understand the consequences of the measured land cover/use change on the water and energy cycles of the parks and surrounding areas. The data needed for product validation and model parameterization will be acquired with the assistance of students and teachers from area schools using protocols established through the GLOBE program.

Research Objectives

- To develop, test and demonstrate cost-effective, satellite-based protocol to inventory and monitor land cover/use in and around National Parks in support of the NPS Inventory and Monitoring Program.
- Measure land cover/use changes and trends in the Upper Delaware River Basin from 1984 to the present using Landsat.
- Validate the accuracy of land cover and land use change products using high spatial resolution data and field data acquired by students following protocols developed by the GLOBE program.
- Use satellite and field data to parameterize a simple point-based SVAT model.
- Use SVAT model to determine the impacts of the specific measured land cover/use changes on the water and energy cycles of the region containing the two park units.
- Provide data to simulate urban growth to 2030 with various growth scenarios using SLEUTH urban growth model.

Study Area

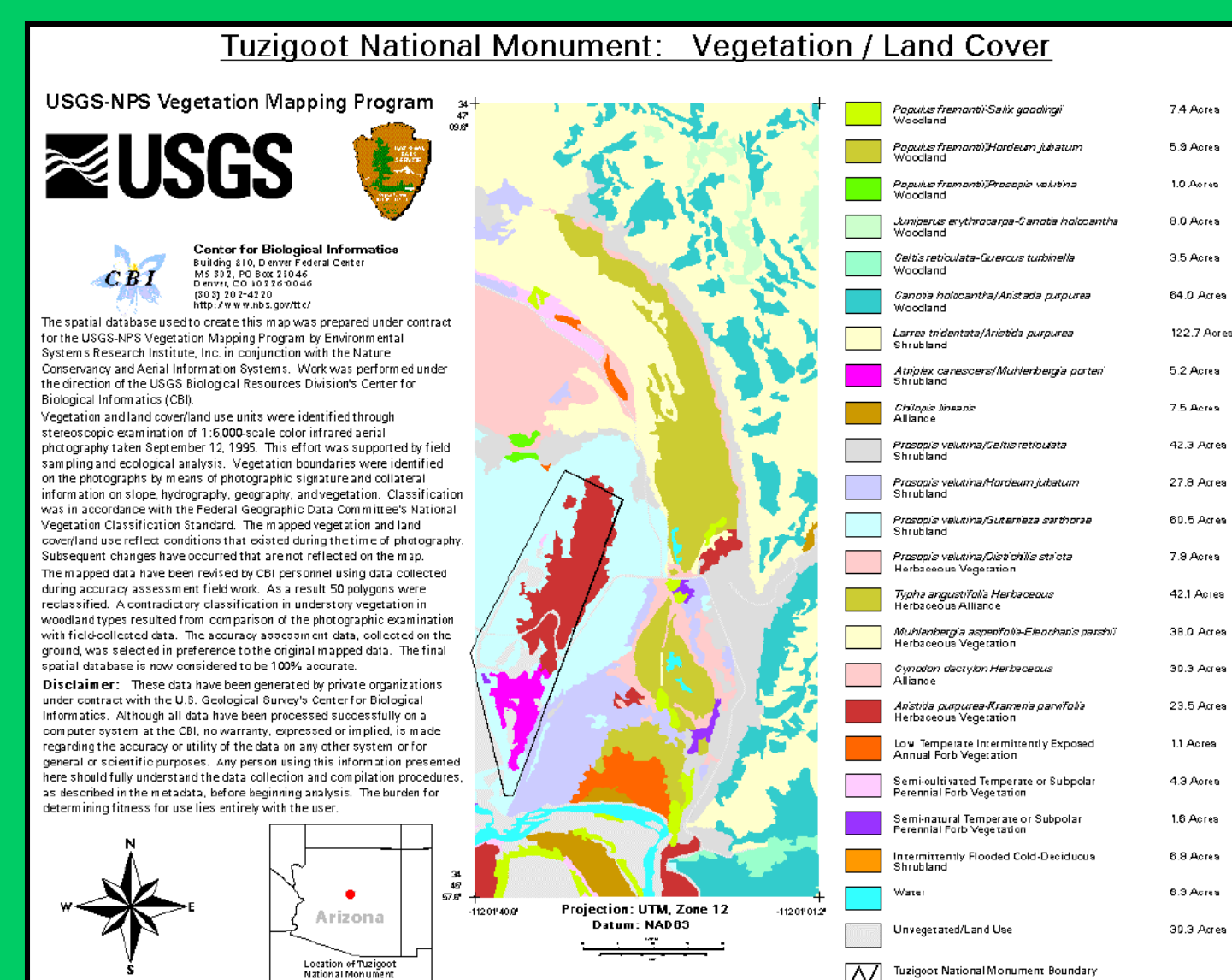


GAPS: General Purpose Simulation Model of the Atmosphere-Plant-Soil System

- Capacitance soil-vegetation-atmosphere transfer (SVAT) model
- Simulates processes with multiple approaches
- Menu driven and allows user to input and edit files
- Dynamic visualizations displayed during simulations
- Runs on any computer with any MS window operating system
- Developed by Dr. Susan Riha at Cornell University

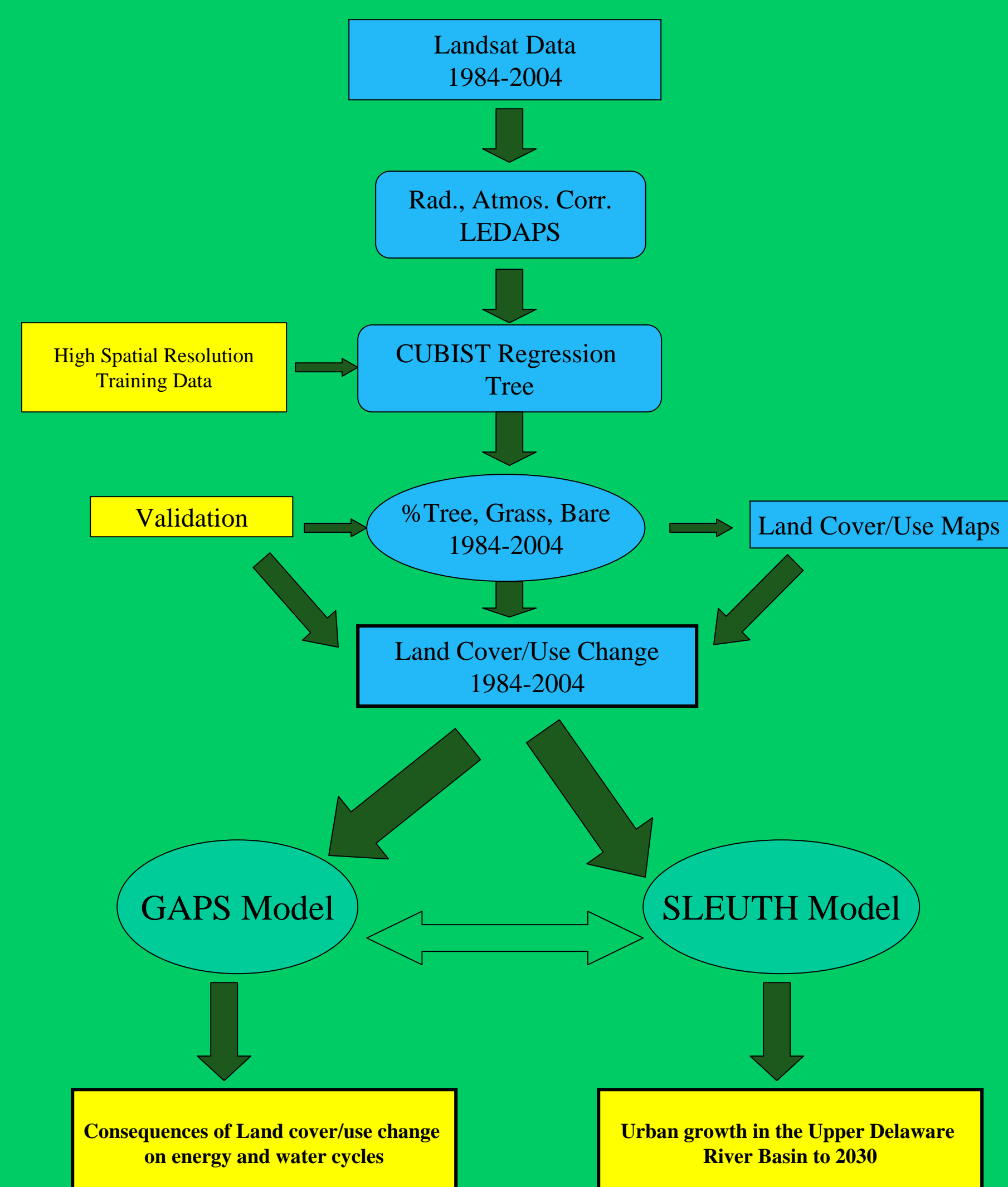
The NPS Inventory and Monitoring (I&M) Program

- Our National Park System is a cherished national asset.
- However, pressures from within and without are threatening the health of many National Parks.
- The NPS I&M program is tasked with the systematic accounting and long-term monitoring of the natural resources of the 270 park units managed by the NPS.
- Phase 1 focuses on baseline inventories, including vegetation from high resolution aerial photography (see below <http://biology.usgs.gov/npsveg/index.html>)
- The second phase focuses on 'operational' and long-term monitoring of various biotic and abiotic natural resources
- Satellite remote-sensing data such as from Landsat data can address some of these immediate needs and contribute to the long-term monitoring goals of the NPS I&M program.



Example of NPS/USGS Vegetation Mapping Program Final Product derived from Aerial Photography

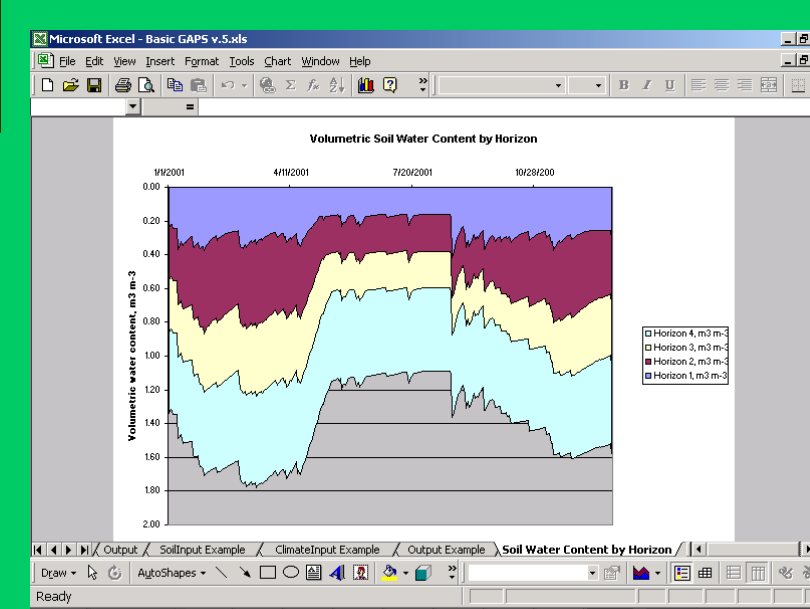
Research Overview



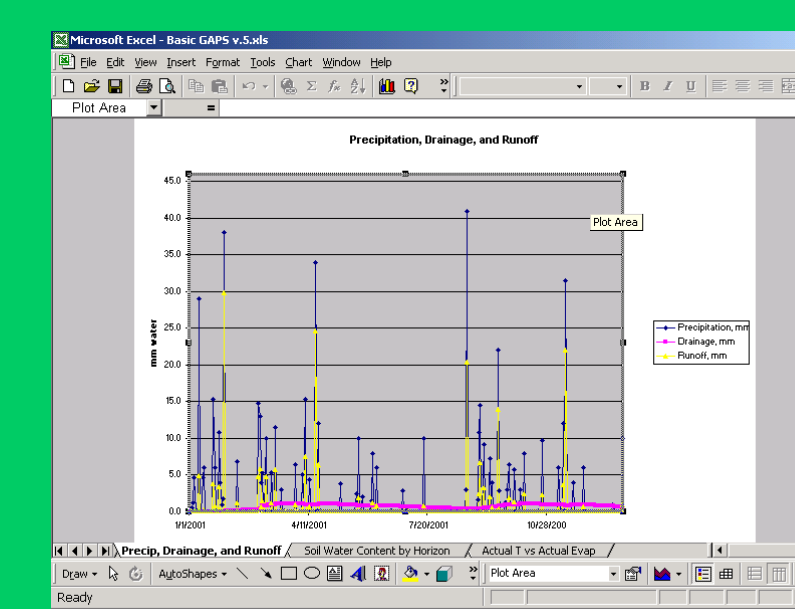
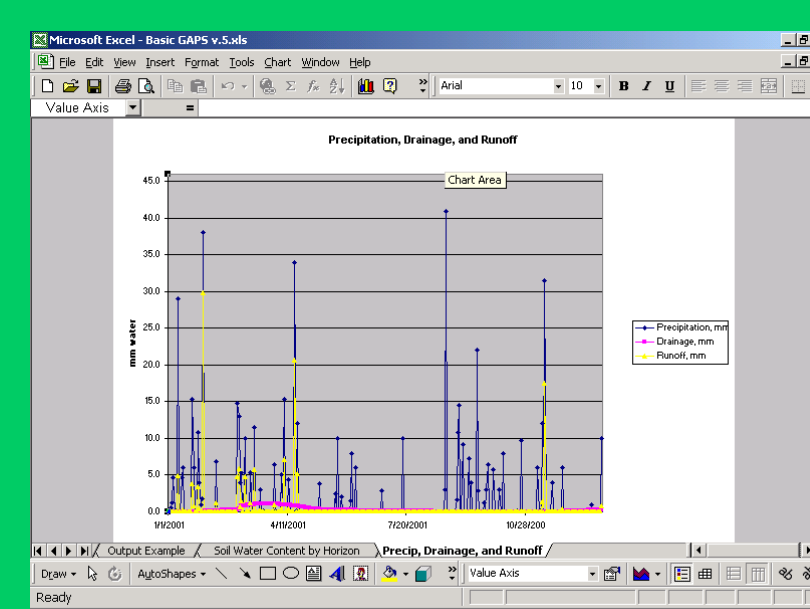
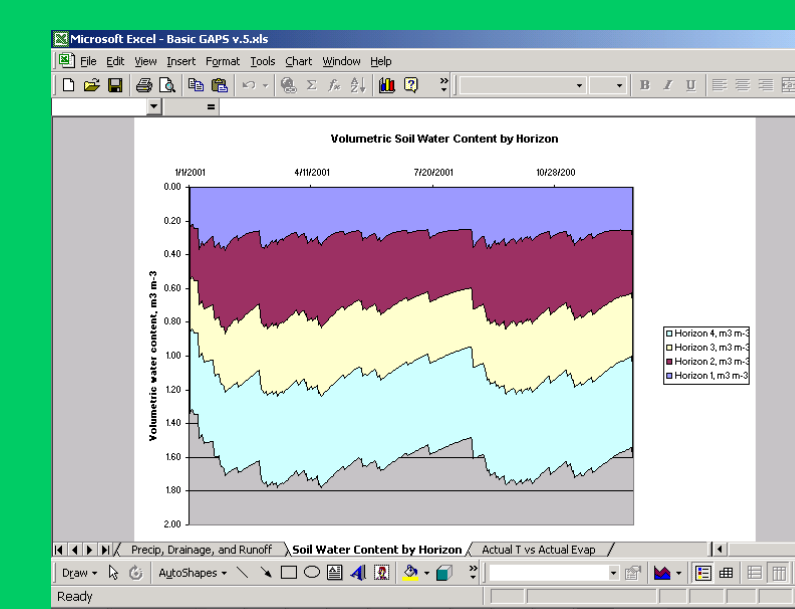
Methods

- Protocol is inspired on continuous fields (% tree, grass and bare) approach used on coarse-scale satellite data but is done at the scale of Landsat.
- Uses high spatial resolution (i.e. 1m) aerial photography and/or commercial satellite data for training/validation.
- Uses state-of-the-art processing of Landsat data (radiometric and atmospheric corrections) through the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS). <http://ledaps.nascom.nasa.gov/ledaps/ledaps.html>
- Uses state-of-the-art regression tree algorithm (CUBIST) for generation of continuous fields (%tree, grass, bare) at the scale of Landsat data.
- Uses landscape components for land cover change detection and monitoring.
- Validation involves students/educators from area schools within the setting of a national park.

100 % Forest Vegetation

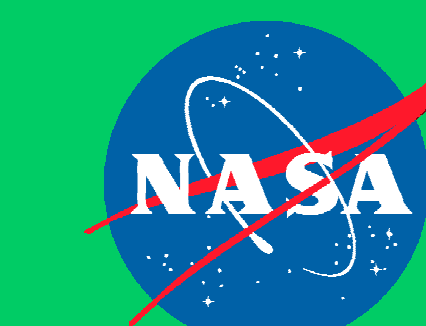


No Vegetation



Collaborators

- Upper Delaware Scenic and Recreational River and Delaware Water Gap National Recreational Area Park units.
- Jessica Robin, Univ. of Maryland, GLOBE Program and GAPS model development
- Elissa Levine (NASA/GSFC): GLOBE Program, Soils
- Anita Davis(LDCM Education and Outreach)
- Jim Irons (NASA/GSFC) LDCM, Jeff Masek LDCM, LEDAPS
- Susan Riha, Cornell Univ., GAPS model development
- Scott Goetz and Claire Jantz (Woods Hole Research Center), SLEUTH Urban model
- Pocono Environmental Education Center



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