The Roanoke River Floodplain of North Carolina

Study Area

The study area for this research is the floodplain of the lower Roanoke River, North Carolina. This region includes some of the least-disturbed broad expanses of bottomland forests in the eastern United States. In recent years, much of the area has been protected by The Nature Conservancy, and managers have become increasingly interested in mapping the environmental gradients and potential changes in hydrography that influence vegetation distributions in the region. The floodplain has been substantially affected by natural and anthropogenic disturbances. In particular, the flooding regime has been altered as a consequence of dam construction on the Piedmont portions of the river during the past 50-years. The dams have served to greatly reduce maximum discharges on the river, leading to a decreased spatial extent of inundation. The duration of the small—medium scale floods, however, has increased, leading to the speculation that some low-lying areas may now be experiencing longer hydroperiods than in pre-dam periods.

Selected Publications

Remote Sensing of Forested Wetlands: Application of Multitemporal and Multispectral Satellite Imagery to Determine Plant Community Composition and Structure in Southeastern USA

P.A. Townsend & S.J. Walsh, *Plant Ecology* 157 (2001): 129-149

Abstract

A hierarchical classification of forested wetland communities was developed for the lower Roanoke River floodplain of northeastern North Carolina, USA, through the use of multitemporal and multispectral satellite digital data. Landsat Thematic Mapper images from different seasons (March – April, May – June, July – August) throughout a single year were used to exploit the phonological variability of forest communities for generating a landcover classification of ecologically important vegetation types within the floodplain. A hierarchical classification scheme was developed that relied upon customized spectral feature sets of Landsat TM bands and their transformations to generate the classified images for each level of the forest community classification scheme. The objective was to enhance the discrimination of the community types at subsequent levels of the hierarchical classification scheme through different spectral inputs from the assembled satellite time series in conjunction with detailed floristic

information collected through in-situ methods. As such, general landcover classes were iteratively reclassified into more detailed classes at correspondingly deeper levels or nodes in the hierarchy. Vegetation classes included 21 forest communities and several other ecologically important classes in the study area. The integration of detailed field data permitted spatially-explicit and highly descriptive definitions of the forest types occurring within the floodplain. Additional field data were used to validate the compositional and structural characteristics of the mapped plant communities described by the classification scheme.

Modeling Floodplain Inundation Using an Integrated GIS with Radar and Optical Remote Sensing

P.A. Townsend & S.J. Walsh, *Geomorphology* 21 (1998): 295-312

Abstract

Synthetic aperature radar images from multi-temporal L-band and JERS-1 and C-band ERS-1 satellites, a Landsat Thematic Mapper time-series, and GIS coverages were used in an integrative approach to model the potential of flood inundation with the lower Roanoke River floodplain, North Carolina. A digital elevation model (DEM) with 1-meter vertical resolution was developed for the region from scan-digitizing mylar separates of contour lines on USGS 7.5 minute quadrangles. Several models representing potential wetness and potential flood inundation were generated from the DEMs using both raster (grid) and vector (network) analyses. The potential inundation surfaces were derived from regression models that related know flood elevations to river position and floodplain location. The GIS models were assessed by comparison to classification of flood change-detections achieved through the radar data. Statistical results indicate that the GISD-derived models successfully identified flooded areas as mapped by the radar change-detections. Further, statistical tests assessed the ability of individual radar and optical (Landsat TM) images to discriminate flooding as predicted by the GIS models. Both JERS-1 and ERS-1 images identified areas of inundation at different flood levels.

The Environmental Impact of Crayfish Biopedoturbation on a Floodplain: Roanoke River, North Carolina Coastal Plain, USA

D.R. Butler, *Landform Analysis* 3 (2002): 35-40

Abstract

A terrestrial crustacean, the crayfish, creates widespread fine-scale landforms (mounds or “chimneys”) on the floodplain of the Roanoke River in eastern North Carolina, USA. These mounds are typically 12 cm high and 8 cm in diameter, and are

composed of extremely high concentrations of clay. Non-crayfish-affected soils on the floodplain, regardless of coarser-scale land form type, are dominated by sand, illustrating that crayfish are a primary mechanism for concentrating clay and creating spatial heterogeneity on the floodplain.

Beaver Pond Identification Through a Satellite-Based Ecological Habitat Classification

P.A. Townsend, S.J. Walsh, D.R. Butler
Proceedings, American Congress on Surveying and Mapping & American Society for Photogrammetry and Remote Sensing 1 (1995): 102-111

Abstract

Landsat Thematic Mapper imagery from 1984 and 1993 and a GIS were used to identify beaver impoundments along a 250 square kilometer segment of the lower Roanoke River Floodplain, North Carolina. Areas labeled as water during processing of the satellite imagery were analyzed through a multi-step ecological habitat classification to identify likely beaver impoundments. The research served the dual purpose of reducing confusion about areas classified as water that were outside of the river channel, and assessing the spatial and temporal pattern of beaver activity in the Roanoke River region. The GIS analysis utilized the satellite vegetation classification, USGS hydrography data, and information about beaver habitat in the southeastern United States to develop a model of beaver impoundments. The criteria imbedded in the rule-based analysis included measures of adjacency to appropriate stream orders, measures of proximity to suitable vegetation types, as well as size and distance criteria designed to eliminate unsuitable areas. The satellite classification identified eight likely beaver ponds covering 10.9 hectares in 1984, while the 1993 classification identified 64 ponds covering 109.8 hectares. This ten-fold increase in the area of inundation demonstrates the impact of the widespread repopulation of beavers throughout the southeastern Coastal Plain of the United States. Beaver activity has significantly altered the landscape mosaic within the floodplain, creating new flooded patches between forest types. The processing of satellite data and the use of rule-based GIS analyses allow the extraction of improved thematic information about a region and provide spatial and compositional descriptors of beaver habitat.