Conservation Effects Assessment Project (CEAP)

USDA AGRICULTURAL RESEARCH SERVICE

Innovative Tools for Mapping Forested Wetlands in the Choptank River Watershed

Importance of Wetlands in Water Quality Protection

Wetlands can improve water quality by storing sediments and reducing chemical pollutants, like nitrogen and phosphorous. The majority of wetlands in the Choptank River Watershed have been drained for agricultural use with initial ditches dating back to the 1700's. Most of the wetlands that remain are found inland, and the vast majority of these are forested. The ditches short-circuit ecosystem processes and negate wetland functions, such as nutrient and sediment reduction.

A typical ditch along an agricultural field. Water levels in the ditch vary with the time of year and rainfall amounts.

Study Description & Goals

While numerous factors interact to influence wetland function and extent, hydropattern (i.e., spatial and temporal fluctuations in soil moisture and flooding) is the single most important factor. Small changes in hydropattern can cause large changes in wetland characteristics and functions. In the future, greater human impact and climate change have the potential to further alter wetland hydropattern in the Choptank River Watershed. In order to understand and forecast these changes, new approaches are needed to systematically monitor and assess hydrologic conditions.

The objective of this portion of the Choptank River Watershed, Conservation Effects Assessment Project (CEAP) is to investigate the potential of satellite-based radar imagery for mapping wetland hydrology. If successful, results from this work may be applied on a regional or national scale to evaluate changes in wetland function.

Expected Outcomes

- **Radar imagery has recently been shown to be a powerful tool for accurately characterizing the hydrology of forested wetlands within the Chesapeake Bay Watershed.**
- **New methods have been developed to provide more frequent assessments of wetland hydrology as affected by weather patterns, land-use, and landscape management.**
- **This hydrological information and other landscape data can be used in the harmonization of agriculture activities and wetland ecosystem services.**
- **Maps derived from these spatial and temporal data will provide land use decision makers with information to manage wetlands and reduce the delivery of potential agricultural pollutants to surface waters.**
- **These tools can assist in the preservation of avian and amphibian wetland habitats in the Coastal Plain and will improve Chesapeake Bay health.**

Image of a typical forested wetland. Note the flooding beneath the trees. This flooding is dynamic and may not be present at all times. It is most common during the late spring before leaf-out and after rainstorms.

Approach

Challenges in Wetland Mapping

Maps showing hydrologic patterns have been difficult to produce, especially for forests. Optical images (e.g., aerial photographs, SPOT, and Landsat), traditionally used to map wetlands, are limited by cloud cover and the presence of summer foliage. In addition, existing maps that were created with optical images, such as the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database and U.S. Fish and Wildlife Service (FWS) National Wetland Inventory are difficult to update and represent conditions at one point in time. Ground-based methods are limited by subtle surface topography and the large amount of time and resources that are necessary for such a project. New methods must be developed to obtain a more complete picture of these ecosystems and to improve estimates of water quality. This is especially important because forested wetlands comprise over half of all U.S. wetlands.

Radar: An Ideal Sensor for Monitoring Forested Wetlands

Satellite-based radar sensors have the unique capability to monitor changes in the status of key hydrologic characteristics (e.g., patterns of flooding and variations in soil moisture) in wetlands throughout the year and with greater frequency, in part due to the ability of radars to collect images regardless of cloud cover, day or night. Not being restricted by clouds is especially important when collecting data during rainy periods, when wetlands are often easier to discriminate. The sensitivity of radar energy to water, and its ability to penetrate forest canopies, makes radar sensors ideal for the detection of hydrologic features below forest canopies. Although the capability of radar images for wetland research is promising, the technology is relatively new compared to other types of sensors, and further research is required to develop this capability.

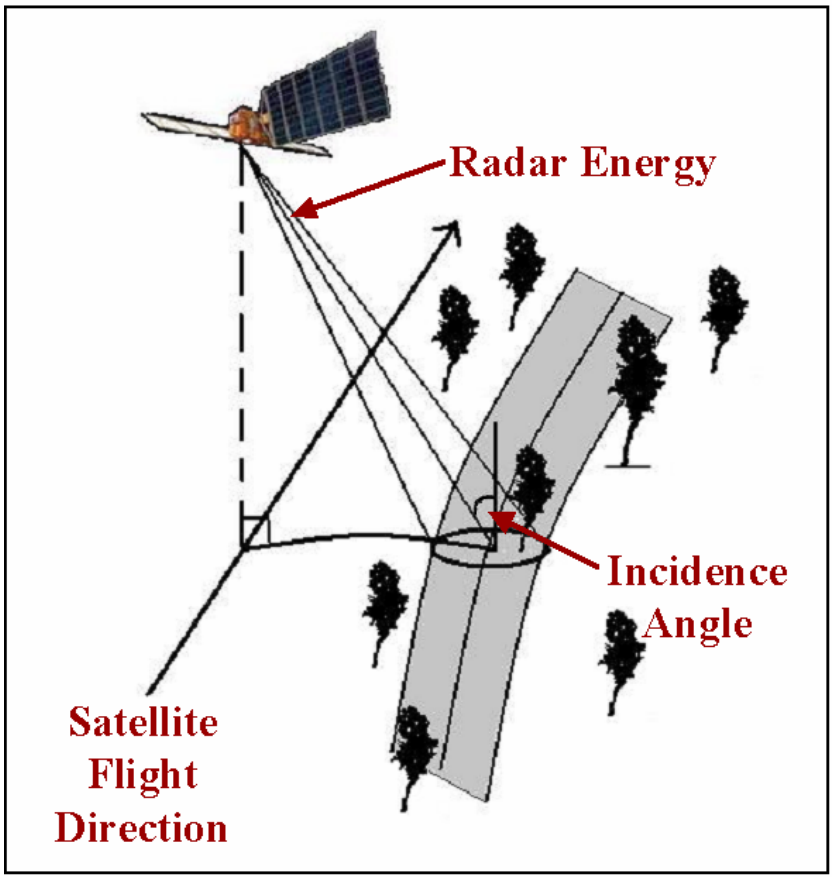
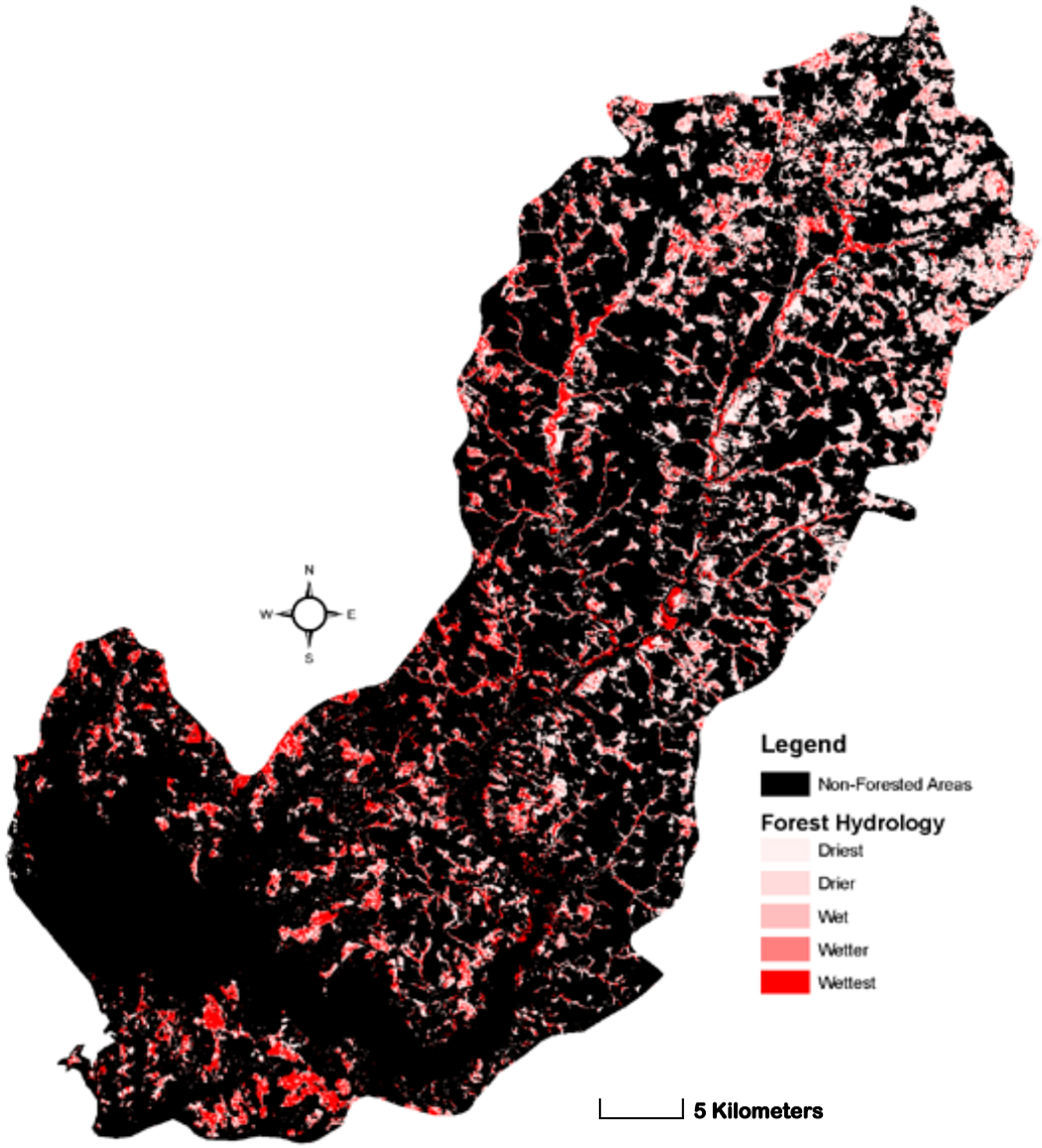


Illustration of a Radar satellite imaging the Earth's surface. Radars are termed "active" sensors because they produce and send energy towards the Earth's surface.

Novel Approach Provides Information on the Hydrology of Choptank Wetlands

Radar images were collected over the Choptank Watershed by the ENVISAT satellite from fall 2005 through spring 2006. Innovative methods were used to optimize the frequency of image collection so that current information could be used for management decisions and the impact of changing weather patterns could be better explored.

Multiple radar images were combined and used to successfully map the surface hydrology of forested areas within the Watershed. Radar maps of forest hydrology were compared to other wetland maps and information collected on the ground (i.e, soil moisture and area inundated).



A radar-based map of forest hydrology, created using images from spring of 2006. Wetter areas are redder and drier areas are lighter. All black areas were not forested and are likely to be agricultural fields, the Watershed's dominant land cover.

Improved Wetland Management

Next generation wetland maps, produced using radar, will improve water quality management by helping to better understand the fate of select agrochemicals and sediment, thus improving the health of the Chesapeake Bay.

In the future, we plan to use this and other information derived from satellite images to better parameterize water quality models. The synoptic information derived from these satellite images is relatively inexpensive and easy to update.

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One of the Choptank's many Delmarva Bays. These Wetlands of Special State Concern (Maryland) are home to rare and endangered species.

Expanding Wetland Research: A New Partnership

This work has led to a greatly expanded emphasis on wetlands research within the Choptank Watershed project. We are now working with NRCS to design an intensive wetland study in the Choptank River Watershed as part of a regional CEAP-Wetlands investigation.

The study is designed to estimate the effects of conservation practices on ecosystem services provided by wetlands and associated lands in the Mid-Atlantic region.

This new collaborative project brings together an interdisciplinary group of experts from multiple federal agencies and the University of Maryland to assess the ability of "natural," restored, and prior-converted (drained) wetlands on cropland to improve water quality in the Choptank River and ultimately the Chesapeake Bay. It will synergistically combine information gained from individual wetlands with landscape scale measurements from satellite images. Project findings will be used to assess and improve the effectiveness of conservation practices and Farm Bill programs affecting wetlands and associated lands on the Maryland and Delaware Coastal Plain. Findings will also assist the NRCS in developing landscape monitoring tools and technologies for national wetlands conservation applications.

NRCS