IMPLEMENTATION UPDATE

Wetland hydrology at a watershed scale: Dynamic information for adaptive management

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Wetlands provide many beneficial functions, including the reduction of pollutants and floodwater mitigation. These functions are performed through the interaction of multiple landscape components (e.g., agricultural fields, forests, urban areas, and wetlands) and therefore should be considered at the watershed scale. Wetland hydrology (i.e., flooding and soil moisture) controls ecosystem function and must be better understood to conserve remaining wetlands, monitor wetland function, and improve water quality management. The ability to monitor forested wetlands is particularly important because these ecosystems make up over half of all freshwater wetlands in the United States and are often found adjacent to croplands, where they are well-situated to reduce agrochemicals in runoff from nearby fields. Wetland hydrology is dynamic, varying at multiple temporal scales (e.g., seasonal and inter-annual) and therefore should be assessed regularly. Unfortunately, broad-scale forested wetland hydrology is difficult to monitor at all temporal scales using ground-based and traditional remote sensing methods (i.e., aerial photography). Satellite-borne radar data can provide both high spatial and temporal resolution information on wetland hydrology in forested areas, but the full potential of this approach needs further investigation.

Research is being conducted to evaluate the use of radar data for monitoring forested wetland hydrology in the Choptank River watershed, which is located on the Eastern Shore of Maryland. Wetland hydrology in the Choptank watershed affects water quality in the Choptank River, a major tributary of the Chesapeake Bay, with high nutrient and sediment loads originating from agriculture. Radar images were collected approximately three times a month from fall 2005 through summer 2006. These images were used to map forested wetland hydrology for the Choptank watershed, and a time-series was developed to better represent the dynamic nature of this ecosystem variable. Techniques were developed to increase the temporal frequency with which maps could be created. The use of images collected at multiple incidence angles improved the delivery of map products from once every three months to once a month, increasing the value and actionability of this information.

The time-series depicts expected trends in hydrology, with levels of inundation and soil moisture increasing from winter into early spring and then decreasing as evapotranspiration increases later in the spring due to higher temperatures and leaf-out. The correlation between the radar-derived maps and in situ measurements of hydrology was found to be strong. Forested wetland maps derived from the radar images were compared with the US Fish and Wildlife Service's National Wetlands Inventory (NWI) and the Natural Resources Conservation Service's Soil Survey Geographic (SSURGO) database. The radar-derived and NWI wetland maps depicted very similar patterns of wetland distribution. However, when the radar maps (1 year old) were compared to NWI (~25 years old), areas that were no longer forested wetlands were identified, along with a much smaller area of newly formed forested wetlands. As expected, SSURGO found a much larger percentage of the watershed's forests to have hydric soils than NWI or the radar-derived wetland maps found to be wetlands. This distinction is most likely caused by the categorization of soils as hydric long after they have been drained. Many of the watershed's historic wetlands were drained to promote agricultural development starting in the 1700s.

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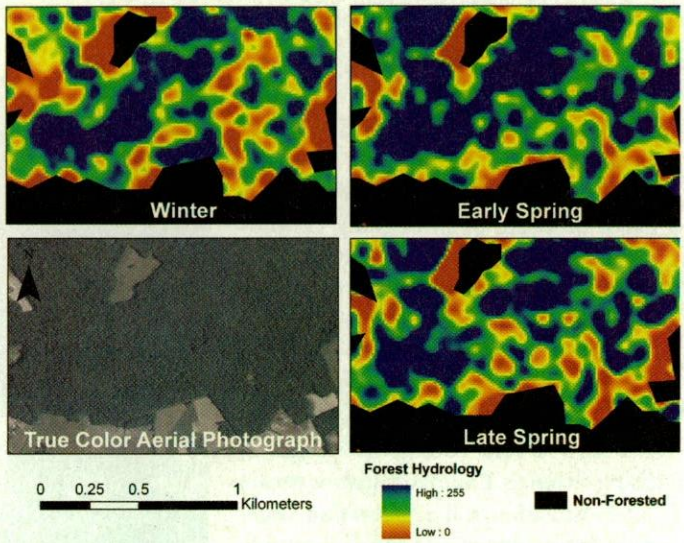

Forested wetland hydrology maps for winter, early spring, and late spring 2006, and an aerial photograph collected over the same area during summer by the National Agriculture Imagery Program. Black areas on the forested wetland hydrology maps are not forested. Forested areas are depicted as transitioning from red to blue with blue areas being wetter and red areas drier. Note the expansion of the blue (wetter) areas in the early spring and the reduction of these areas later in the spring as evapotranspiration increases.

The radar-derived maps of wetland hydrology will be used, along with other types of geospatial data, to produce a decision support tool designed to assess and ultimately enhance the effect of conservation practices on ecosystem services provided by wetlands as part of the Conservation Effects Assessment Project (CEAP). As part of the project, scientists are synergistically combining information gained from individual wetlands with landscape-scale measurements from satellite images and other geospatial datasets. The ability to quantify ecosystem services "on the ground" and then link this information to remotely sensed data represents a very powerful tool for future wetland applications. This project encourages additional interagency cooperation and is an important step toward producing a national landscape analysis tool as part of the National Wetlands Monitoring Framework. It is especially timely due to increasing attention on the health of the Chesapeake Bay.