RADAR MONITORING OF WETLAND HYDROLOGY: DYNAMIC INFORMATION FOR THE ASSESSMENT OF ECOSYSTEM SERVICES

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1. ABSTRACT

Wetlands are hydrologically dynamic ecosystems which have the potential to improve water quality and provide other ecosystem services. Wetlands in the Chesapeake Bay Watershed are especially vital as they help to maintain water quality and aquatic habitat in one of the largest and historically most productive estuarine ecosystems in the U.S. Due to the substantial effect of agriculture on the ability of wetlands to function, the U.S. Department of Agriculture (USDA) serves a key role in wetland conservation and restoration. In order for the USDA to allocate funds to best manage wetlands, a better understanding of wetland functioning and distribution is necessary. Hydroperiod (i.e., temporal fluctuations in flooding and soil moisture) is the most important abiotic factor controlling wetland functioning and extent. Broad-scale forested wetland hydrology is difficult to monitor using ground-based and traditionally used optical remote sensing methods (i.e., aerial photography), but this ability is vital due to the dominance of forested wetlands in the Chesapeake Bay Watershed and throughout the U.S. C-band synthetic aperture radar (SAR) data can improve the ability to map and monitor forested wetlands, but further research is necessary to fully quantify the benefits and limitations of this approach, especially at the watershed scale [1], [2]. Research has been conducted which supports the use of C-band SAR to map and monitor Mid-Atlantic forested wetlands at the watershed scale. A forested wetland time series demonstrating characteristic variations in hydrology throughout the leaf-off season (2005-2006) has been developed for the Tuckahoe Watershed, Maryland to better represent the dynamic nature of this ecosystem. Advanced SAR images (C-HH) from the European Space Agency’s Environmental Satellite were collected over a range of incidence angles (i.e., 19\degree, 23\degree, and 29\degree). The use of multiple incidence angles improved temporal resolution and, in this way, management applicability was enhanced. Percent forest cover maps created with moderate resolution optical images [3] were used to focus the analysis and eliminate confounding signatures. Forested wetland maps derived from SAR data were compared with the U.S. Fish and Wildlife Service’s National Wetlands Inventory (NWI), the USDA Natural Resources Conservation Service’s Soil Survey Geographic Database (SSURGO), and in situ data. NWI and SSURGO maps were used as a basis for comparison because they are the most commonly relied upon national maps of wetland (NWI) and wetland soil (SSURGO) extent. Unfortunately these maps cannot be easily updated and often do not represent current conditions. The radar derived forested wetland maps and the NWI wetland maps showed a high level of agreement (88\%). The radar derived forested wetland maps and SSURGO soils maps demonstrated a lower level of agreement (54\%), primarily due to a greater estimate of hydric soils by SSURGO than forested wetlands by the radar derived maps. Wetland hydrology maps created for winter 2005, early spring 2006, and late spring 2006 showed an expected progression of increasing levels of flooding and soil moisture with the winter map having the least (11\%) and the early spring map (15\%) exhibiting the greatest amount of observable wetlands (hydrology). Results are encouraging and opportunities are being explored to include the radar derived wetland maps, as well as other biophysical parameters and digital elevation maps, in a watershed-scale decision support tool to assist USDA conservation program managers.

2. CITATIONS
