LCLUC Abstract

Effects of land use, soils, and human populations on export of water, C, N, and P from the Mid-Atlantic coastal plain

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The Atlantic coastal plain of North America has low relief, smoothed by high sea level stands during former interglacial periods. Over the last four centuries, the area was deforested by European settlers primarily for agriculture due to the relatively good soils, although urbanization has increasingly claimed more area in the last 100 years. The disturbance and intensive use of the region, both by agriculture and increasing urban populations, has led to greater export of C, N, and P in stream discharge. The result has been declining water quality of lakes and estuaries which receive stream waters draining from this region, and many federal and state programs have been undertaken to improve water quality by watershed management (e.g., EPA's Chesapeake Bay Program). Watershed management, however, requires detailed information on watershed export, and it is difficult to measure fluxes of water, C, N, and P from many places in coastal plain watersheds because of the low relief and tidal or salt intrusion. Most gauged areas on the coastal plain are quite far inland and represent only a small fraction of the basin draining into coastal waters (e.g., the gauged areas in the Choptank and Chester basins on the Delmarva Peninsula represent <20% of the total basin area). In many cases, the areas of greatest anthropogenic impact are closer to the coastline, making the spatial extrapolation of fluxes from small gauged areas unrepresentative of the basin as a whole.

I propose to address this problem by regional application of our case study results from the Choptank and Chester basins. Under previous NASA LCLUC funding, my students and I investigated the history of land use change over the previous 150 years using a combination of historical maps, aerial photographs, and satellite imagery. This multi-scale, GIS-based approach has provided us with detailed coverages of land use at eleven time horizons from 1850 to present. In addition, we successfully employed the hydrochemical model GWLF to estimate fluxes of water, N, and P from the ungauged portions of the watershed using the local land use, soil characteristics, and human populations. We found that the greater amounts of agriculture and higher human populations near the coast line resulted in twice the N fluxes of the gauged areas, whereas P fluxes were unaffected. In the proposed research, we will extend the model capability

to C export and apply GWLF to watersheds within the Mid-Atlantic region of the coastal plain, using local gauged areas as calibration and validation sites. The goal will be to provide detailed maps or coverages of the Mid-Atlantic coastal plain (New York to South Carolina) showing current land use, soil properties, human populations, and area-based export rates of water, C, N, and P. Land use will be developed from ETM+ and other imagery, supplemented with existing databases. The hypothesis which we will test is that land use, soils, and human populations are the main determinant of CNP export from the Atlantic coastal plain, as determined from our success in calibration and validation of GWLF in other coastal plain basins. The results will be useful both for local and regional watershed management, and also for evaluating the terrestrial flux of C into the coastal zone.