Chapter 9

Coastal Impervious Cover and Watershed Scale: Implications for Environmental Management, New Hanover County, North Carolina

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ABSTRACT

Environmental planners seek techniques that will enable them to analyze impervious cover to develop sound management plans for coastal regions. The spatial scale in which impervious cover has traditionally been widely analyzed is mismatched to the fine-scale resolution needed for local environmental management. This study examines impervious cover in New Hanover County, North Carolina using LiDAR derived subwatersheds and United States Geological Survey (USGS) 14-digit hydrologic unit watersheds to evaluate potential scale-dependency of impervious cover estimates. Spatial analysis of impervious cover across multi-scale watersheds indicates that fine scale subwatersheds exhibit patterns not revealed with coarser watersheds. Spatial and cartographic analyses suggest that localized impervious development and its expansion in first-order drainages originating in coastal lagoon watersheds is more appropriately analyzed using fine-scale, LiDAR-derived watersheds. Results stress the importance of using scale in watershed management and hydrogeomorphic context to aid planners when making decisions involving impervious cover.

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INTRODUCTION

Water resource issues in coastal regions of North Carolina have been a major concern in recent years. Historically, this region has been thought of as a water-rich region (Griffin et al., 2013). However, with the rapid increase in population in coastal regions of North Carolina, illustrated by 71% growth in the coastal New Hanover county from 1989-2010 (U.S. Census), water resource concerns involving both supply and quality have arisen. Obviously, issues related to availability can be linked to population growth due to the increase in demand. Additional deleterious environmental impacts of population growth are also linked to water resource impacts. Population influences water resources not only through water use, but through land use and climate change as well, including long-term ecosystem disruption (Lotze et al., 2006; Turner & Rabalais, 2003). A primary by-product of population growth is that of land use change. Therefore, this study seeks to evaluate impervious cover, a negative by-product of land use change, across varying watershed scales, to include fine scale LiDAR delineated watersheds.

POPULATION AND LAND USE DRIVERS

Land use change is inevitable with population growth, especially in areas of high growth rates such as coastal southeast North Carolina. With land use change comes the addition of impervious surfaces, considered broadly as any feature or structure that hinders precipitation from infiltrating the soil. Chief among these features are concrete and asphalt surface roads and buildings (Griffin et al., 2013). With population growth the need for more transportation infrastructure as well as housing adds to the impervious surface cover of a region. Excessive impervious surface cover can impact both water quantity and quality within a region, particularly if the source of impervious runoff is close to potential sinks, as with the abundance of first-order watersheds in low-relief coastal plains.

IMPACTS AND FEEDBACKS ON LOCAL HYDRO-CLIMATOLOGY

Local hydro-climatological feedbacks may arise from impervious surfaces impacting hydrology directly via soil moisture. If precipitation does not infiltrate the soil, soil moisture status for that region decreases. When soil moisture decreases, evapotranspiration also decreases (Praskievicz & Chang, 2009). As a result of the decrease in evapotranspiration, the atmospheric moisture content may also decrease, which could lead to less precipitation recycling for the region. Precipitation recycling refers to the redistribution of water on a local scale that was evaporated from the surface (Brubaker, 1993). Therefore, as evapotranspiration decreases so could the local precipitation. This potential decrease in local precipitation could negatively impact the fresh water availability for the region. However, water quality impacts arising from additional impervious cover are more commonly noticed.

Water quality issues that can arise from the expansion of impervious surfaces are primarily due to the contaminants that tend to accumulate on the impervious surfaces. Urbanization, which increases impervious surface cover by way of buildings and infrastructure, can impact the flashiness of runoff with precipitation events (Praskievicz & Chang, 2009). The processes in which water quality and quantity are affected depend on the frequency and duration of events. If a precipitation event is over an area with impervious surfaces, that moisture is not going to infiltrate the surface, but rather be directed into
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