A Comparison of Pond Inventories Using Satellite and Airborne Sensors

Artificial ponds exist throughout the Kansas landscape, far outnumbering natural water bodies, and they play a substantial role in modifying the environment. For example, they trap sediment, thereby affecting biogeochemical cycles, and they also provide habitat diversity and may provide a partial counterbalance to lost wetlands. For a number of reasons, including their small size, their location primarily on private property, and variations in their numbers and locations over time, small artificial ponds are often underrepresented on the digital map products and databases normally used for hydrologic analyses. To address the issue of the underestimation of ponds, images from three different satellite and airborne sensors were used to see how accurately they could locate and inventory ponds in three different study areas in Lyon and Jefferson counties. Landsat Enhanced Thematic Mapper (ETM+) 30m multispectral imagery, Terra ASTER 15m multispectral imagery, and digital orthoquads (DOQs) derived from 1m aerial photography were used to create maps of water impoundments. For the Landsat and ASTER imagery, an unsupervised clustering and classification technique was applied; for the DOQs both traditional manual methods (primarily heads-up on-screen digitizing) as well as object-oriented segmentation algorithms were applied. For each study area, we computed the number of water bodies, their size classes, and the total water surface area. Based on our assumption that the maps derived from the DOQs would provide the most detailed and accurate estimate of the actual number of ponds in the study areas, we used them as the basis for comparison with the maps derived from Landsat and ASTER imagery. Since it is generally impractical (due to cost and time considerations) to manually map small ponds from detailed imagery, our objective was to determine by how much we underestimate the number of ponds in the Kansas landscape using satellite imagery. In addition to comparing results of the DOQ inventory to maps from the two satellite sensors, we also compared them to two inventories of water bodies that were previously created. The most recent is the Kansas Surface Water Database (KSWD) which was derived from 2000 and 2001 Landsat ETM+ imagery at a minimum mapping unit of 1.5 acres and became available for use in 2003. The second inventory of water bodies is the Surface Waters Information Management System (SWIMS). This database was created using the Environmental Protection Agency's (EPA) River Reach Files (RF3). The RF3 files were developed from 1:500,000-scale NOAA aeronautical charts and 1:100,000-scale digital line graphs developed by USGS.