Evaluation of medium to low resolution satellite imagery for regional lake water quality assessments

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Abstract

This study evaluates currently available imagery from Landsat, MERIS, MODIS, and AWiFS sensors for their usefulness in regional-scale measurements of lake water clarity and chlorophyll for comprehensive lake management and scientific studies (e.g., modeling). Images from these systems were collected nearly concurrently and processed using methods similar to those developed previously for regional assessments of lake water clarity using Landsat imagery. We tested both atmospherically corrected and uncorrected imagery products; the uncorrected products performed as well as or better than the atmospherically corrected products in empirical relationships to estimate water clarity and chlorophyll. MODIS and MERIS systems, which have large swath widths and high temporal coverage are well suited for regional assessments of large lakes, but their low spatial resolution limits the number of lakes that can be assessed. Landsat imagery allows all lakes > 4 ha (more than 12,000 in Minnesota) to be assessed, but its low spectral resolution limits assessments to water clarity. The MERIS system, with spectral and spatial resolution suitable for large (>150 ha) lakes, was the only system with a spectral band set that measured key absorption and scattering characteristics of phytoplankton that could be used reliably for regional chlorophyll assessments. Although none of the currently available systems is ideal, the study yielded a better definition of the spectral, spatial, and temporal characteristics of the ideal system for regional-scale water quality remote sensing that may be realized in upcoming satellite systems.