Airborne Remote Sensing Imagery for Water Quality Assessment of Minnesota's Rivers

From the University of Minnesota's Remote Sensing and Geospatial Analysis Laboratory website

Minnesota has around 92,000 miles of rivers and streams. It has been estimated that 40 percent may be impaired. To date less than 10 percent of Minnesota river and stream miles have been assessed. We are exploring the use of airborne remote sensing as a cost-effective way to gather the information needed for river assessments. We previously have had great success assessing lake water clarity using reflectance information from Landsat imagery and have found similar relationships for large rivers. However, compared with lakes, rivers and streams pose a challenging set of problems for application of remote sensing techniques to water quality assessment because:

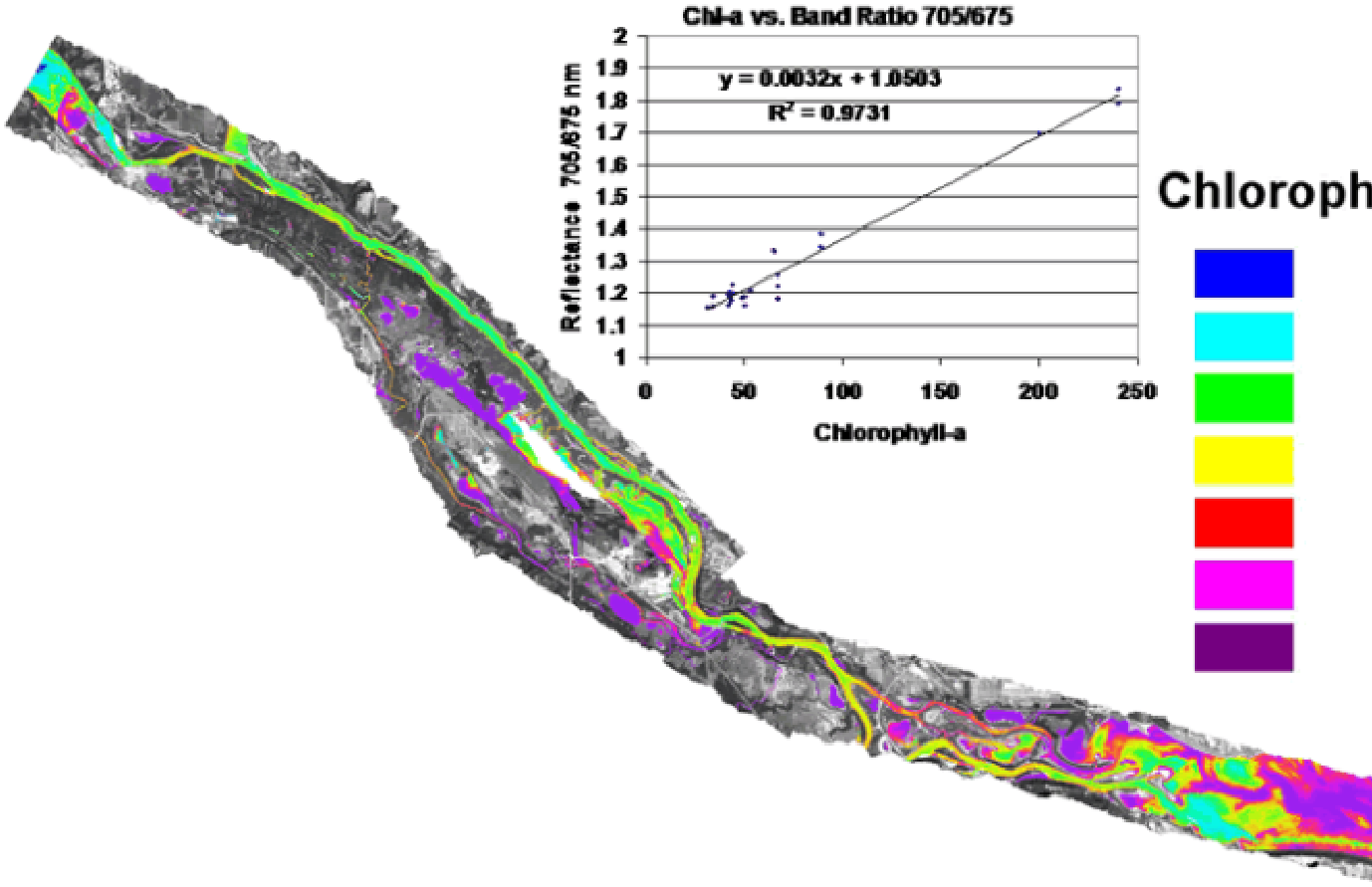
1. They are temporally more dynamic.
2. The resolution of Landsat (30 m) is too coarse for small rivers and streams.
3. If we want more than clarity, we really need a better set of spectral bands than the Landsat bands.

Our solution has been to use airborne high-resolution hyperspectral imagery obtained from a small aircraft flying over stretches of rivers. For calibration purposes, water samples were collected concurrently with the fly-overs, and to provide a range of conditions for calibrations, we focused our initial measurements around the confluences of river systems in Minnesota that have different water quality characteristics.

On August 15, 2005 an aircraft fitted with the AISA-Eagle Hyperspectral Imager (VNIR) collected high resolution 2 m hyperspectral (97 contiguous bands ~2.5 nm from 435-724 and ~10 nm from 724-950 nm) imagery over a fairly large area (36 mile stretch) along the Mississippi River from Spring Lake to Lake Pepin (identified by purple boxes on the map). At the same time staff from the Minnesota Pollution Control Agency and the Metropolitan Council collected water samples at 22 locations. The in-situ water quality data and remotely sensed data are being analyzed to determine the best model for each variable. Preliminary single band, band ratio and multiple band regression analysis models were used to create the maps of each water quality variable for each river segment.

Preliminary results are promising with strong relationships for a number of important water quality variables. With additional statistical analysis we anticipate developing improved models. Using the best-fit models from our preliminary assessment, we were able to map important water quality variables for river segments throughout each image. The maps show the complex interactions of sediment and different types of algae in these important river segments.

August 15, 2005 Water Quality Map



In the future we anticipate that remote sensing will be an important tool in assessing water and land resources including thousands of miles of rivers. This should enable us to see more detailed water quality patterns than we could ever sample with volunteers or more advanced field diagnostic methods. Remote sensing allows us to see the big picture of land and water resources as well as being able to zoom in and get a more detailed view. This "complete view" can be used to detect problem areas and help allocate limited field monitoring resources to areas that need additional attention.

This research has been conducted by the faculty and staff of the University of Minnesota, Department of Civil Engineering and College of Natural Resources -- Remote Sensing and Geospatial Analysis Laboratory and Water Resources Center, with support from the Legislative Commission on Minnesota Resources, Minnesota Pollution Control Agency and Metropolitan Council.

For many more detailed graphics and posters on this study go to: http://water.umn.edu/rivers/index.html. For a reprint of a March 6, 2006, Minneapolis Star Tribune article on this study, go to http://water.umn.edu/Documents/strib5Mar06.pdf

http://www.mngislis.org/newsletter/issue45/Airborne_Remote_Sensing_Imagery_Minnesota_Rivers.htm