Estimating and Mapping Chlorophyll *a* Concentrations in the San Joaquin River using Landsat Imagery

Edmund Yu

American River College

Study Questions

- Could Landsat 5 TM imagery be used to accurately estimate chlorophyll *a* (chl *a*) concentrations on the San Joaquin River and thus, supplement the mandated water quality programs in that region?

Outline

- Why do we care about chl a?
- Why use Landsat 5 TM imagery?
- Study Area
- Workflow Overview
- Results
- Implications

Why do we care about chl *a*?

- It is a proxy for phytoplankton and is important for photosynthesis.
- Phytoplankton are an important food source for zooplankton, invertebrates and some species of fish.
- Some phytoplankton species (i.e., blue-green algae) could produce toxic blooms.
- It is an indicator of water quality.

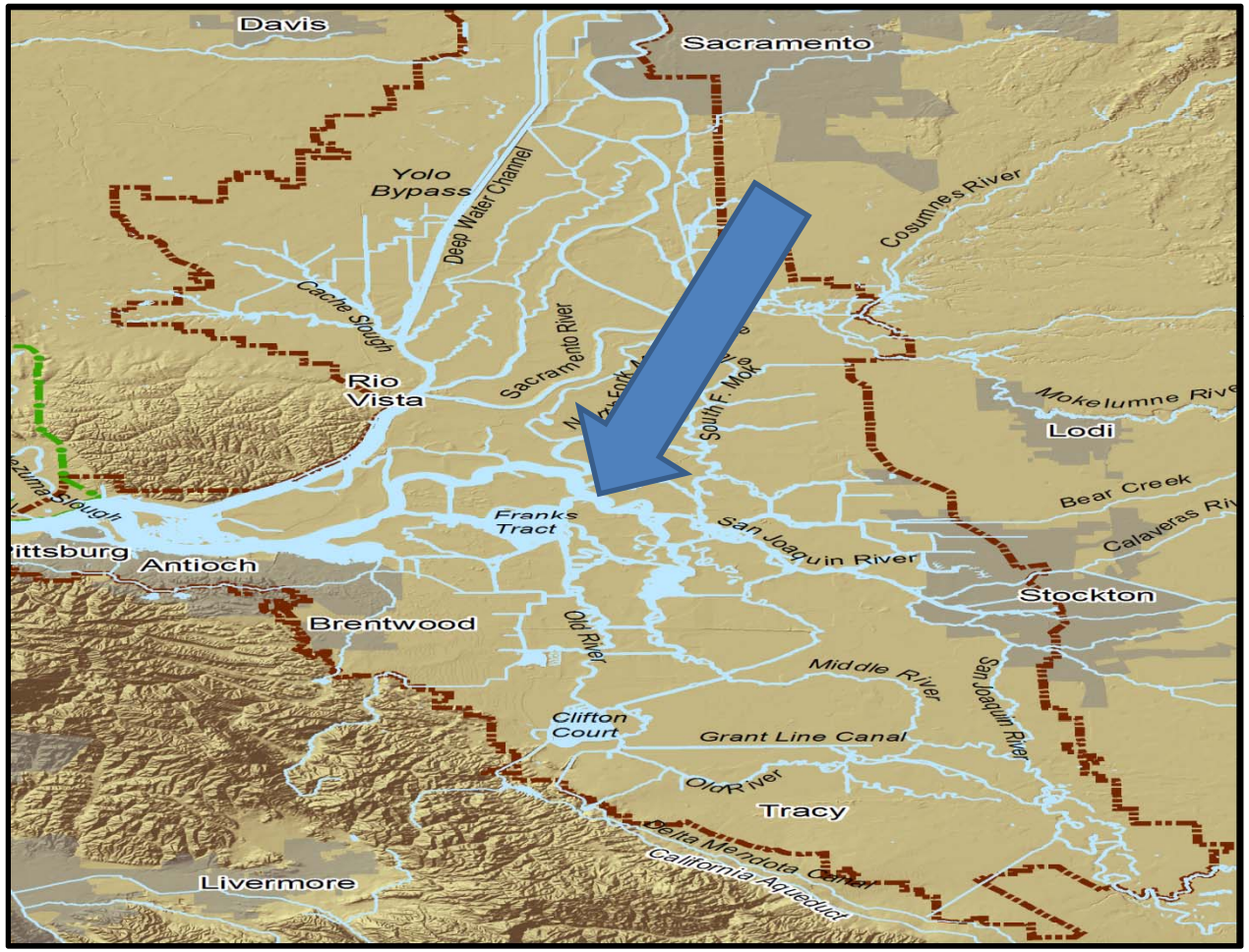
Why use Landsat 5 TM imagery?

It is cheap

and

readily available for use

Study Area: The San Joaquin River

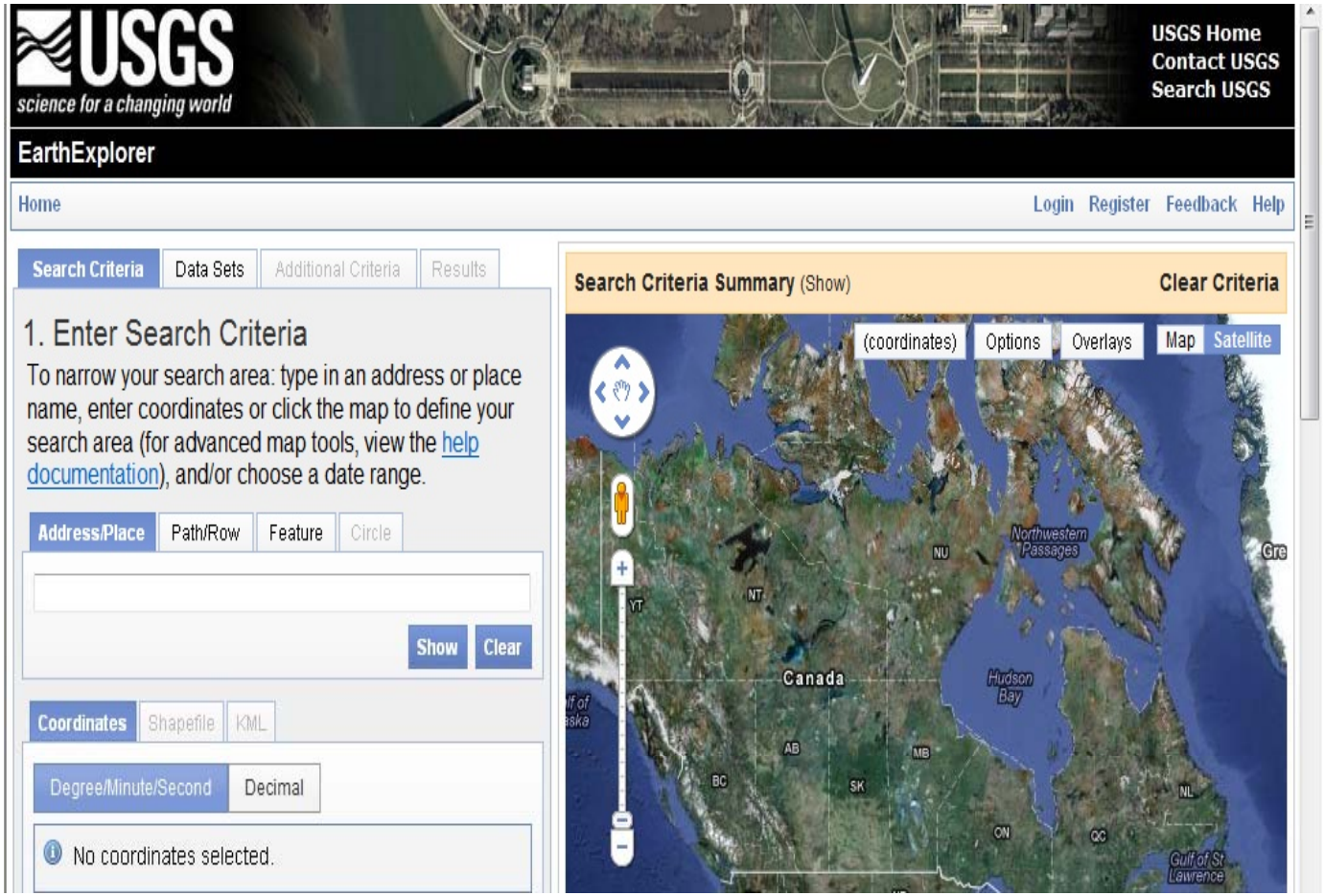


Map from DWR

Workflow Overview

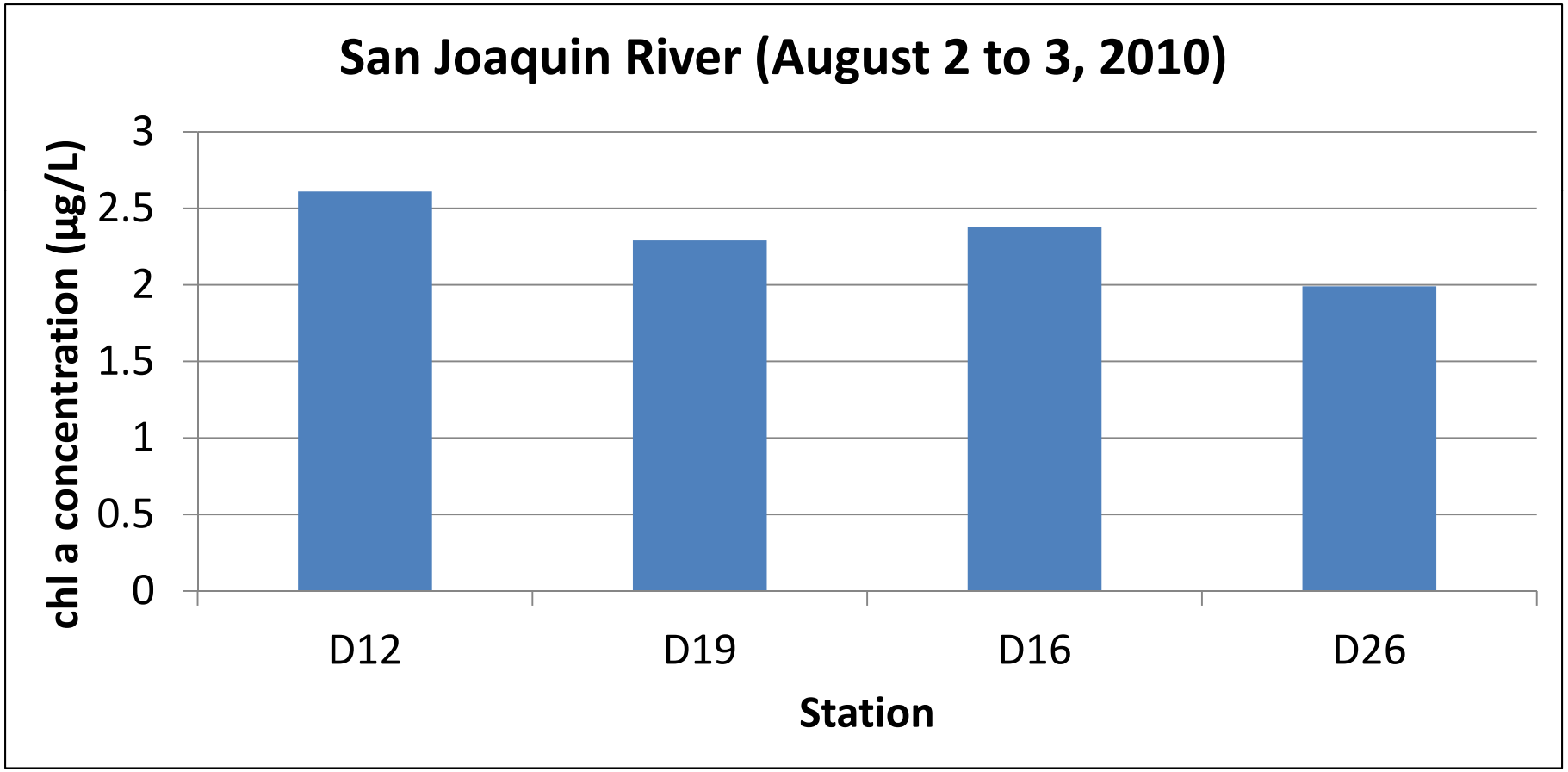
Step 1: Obtain a Landsat 5 Image from July 29, 2010 at the Earth Explorer Website

http://earthexplorer.usgs.gov/



Step 2: Obtain discrete chl *a* samples from the San Joaquin River from the Bay-Delta Monitoring and Analysis Website:

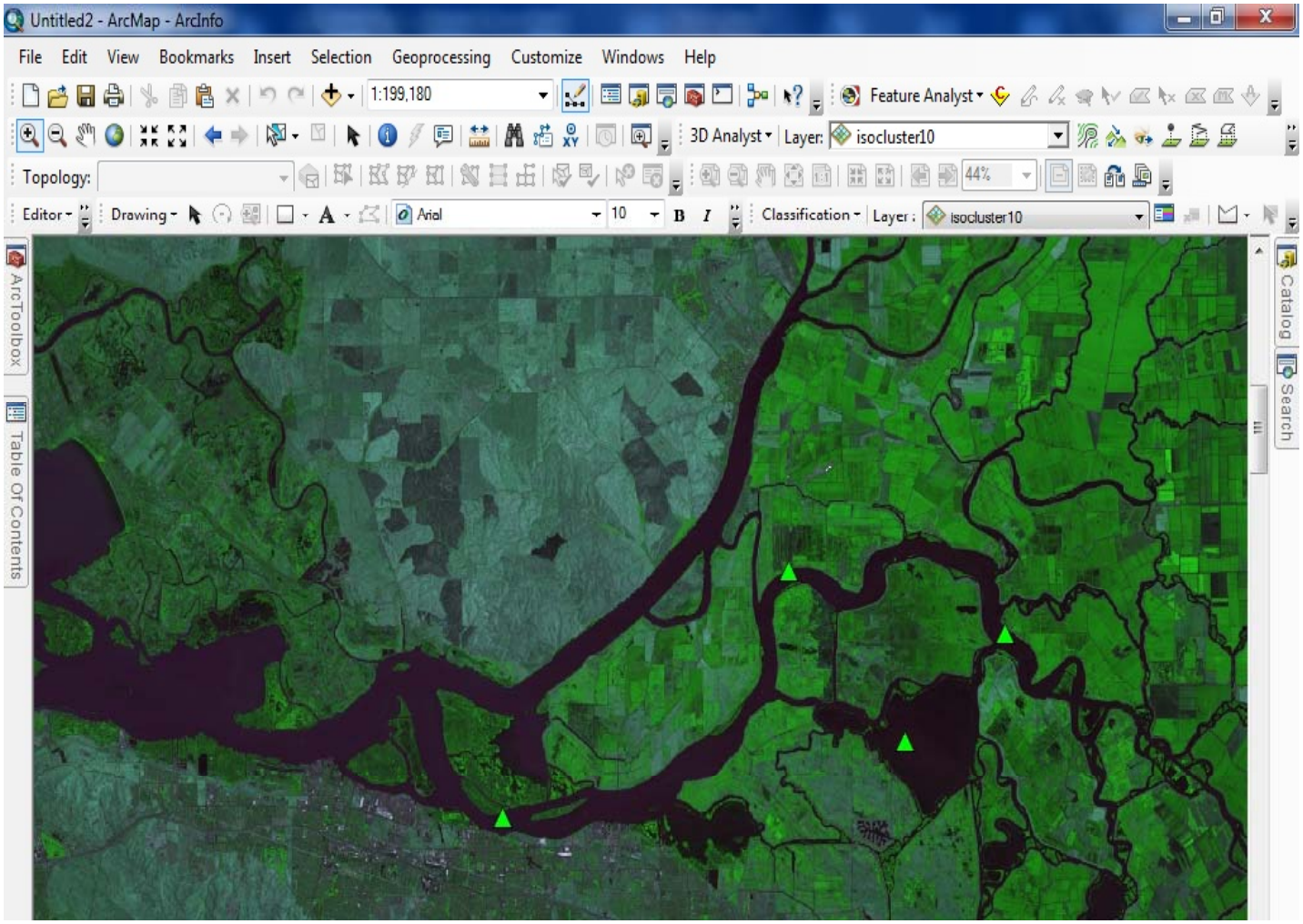
http://www.water.ca.gov/bdma/meta/



Match up GPS coordinates for each station from the metadata on website and create shapefiles for the stations

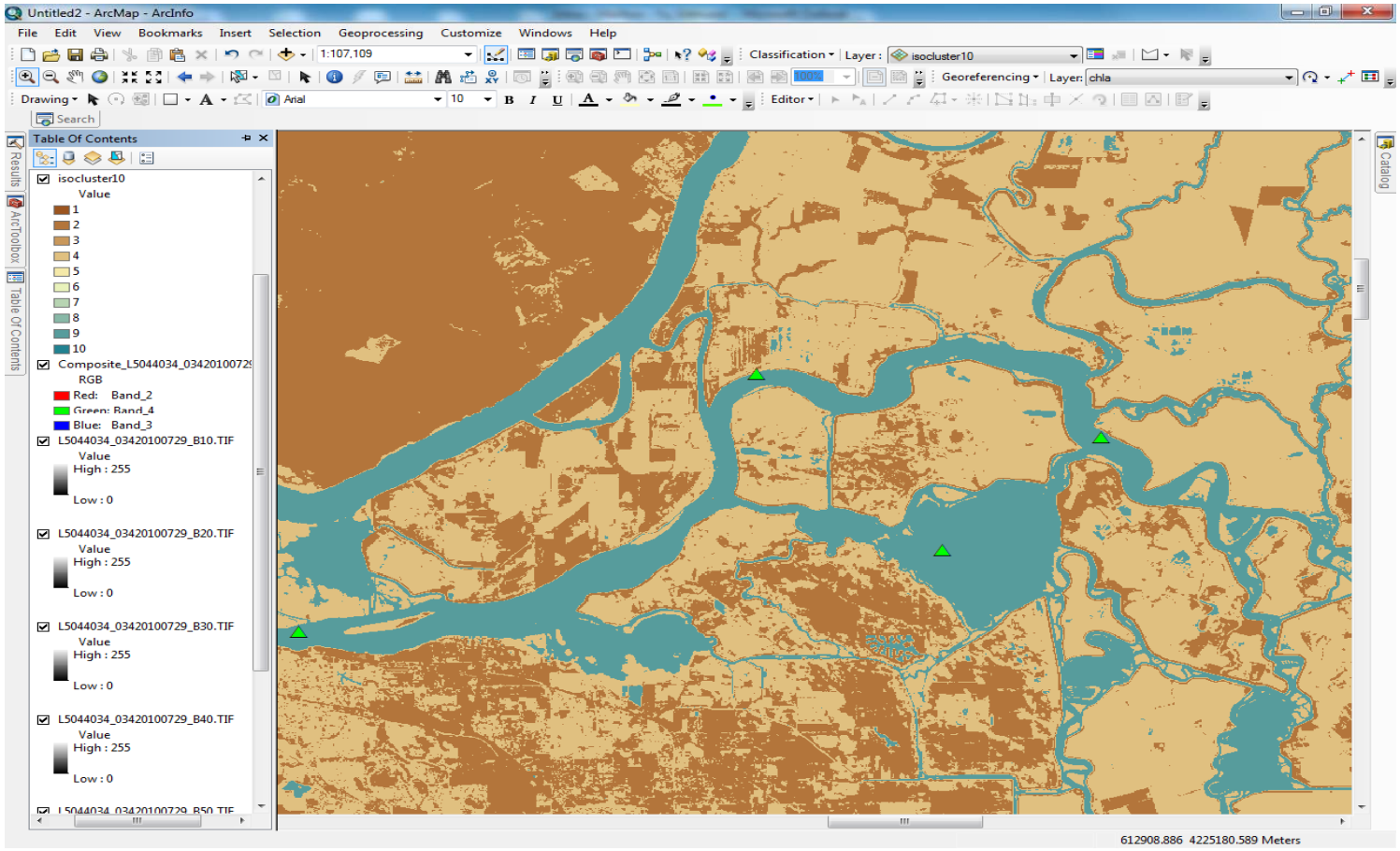
Step 4: Load Landsat files and discrete chl *a* data into ArcMap and apply appropriate coordinate system.

Step 5: Composite Landsat files using Image Analysis



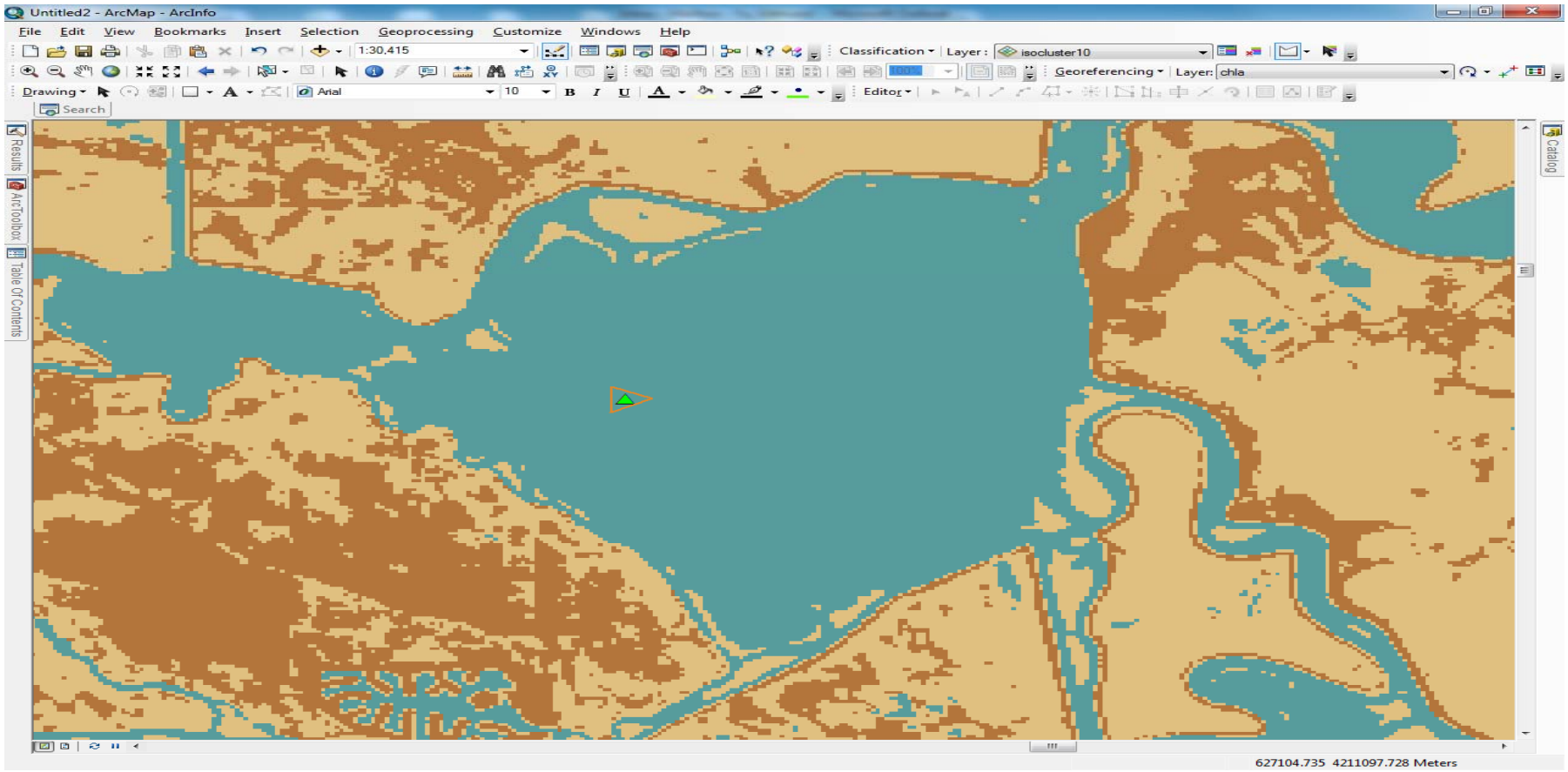
Triangles represent the discrete sampling locations.

Step 6: Run an unsupervised 10 class classification on the composite Landsat image to assist with identifying the river

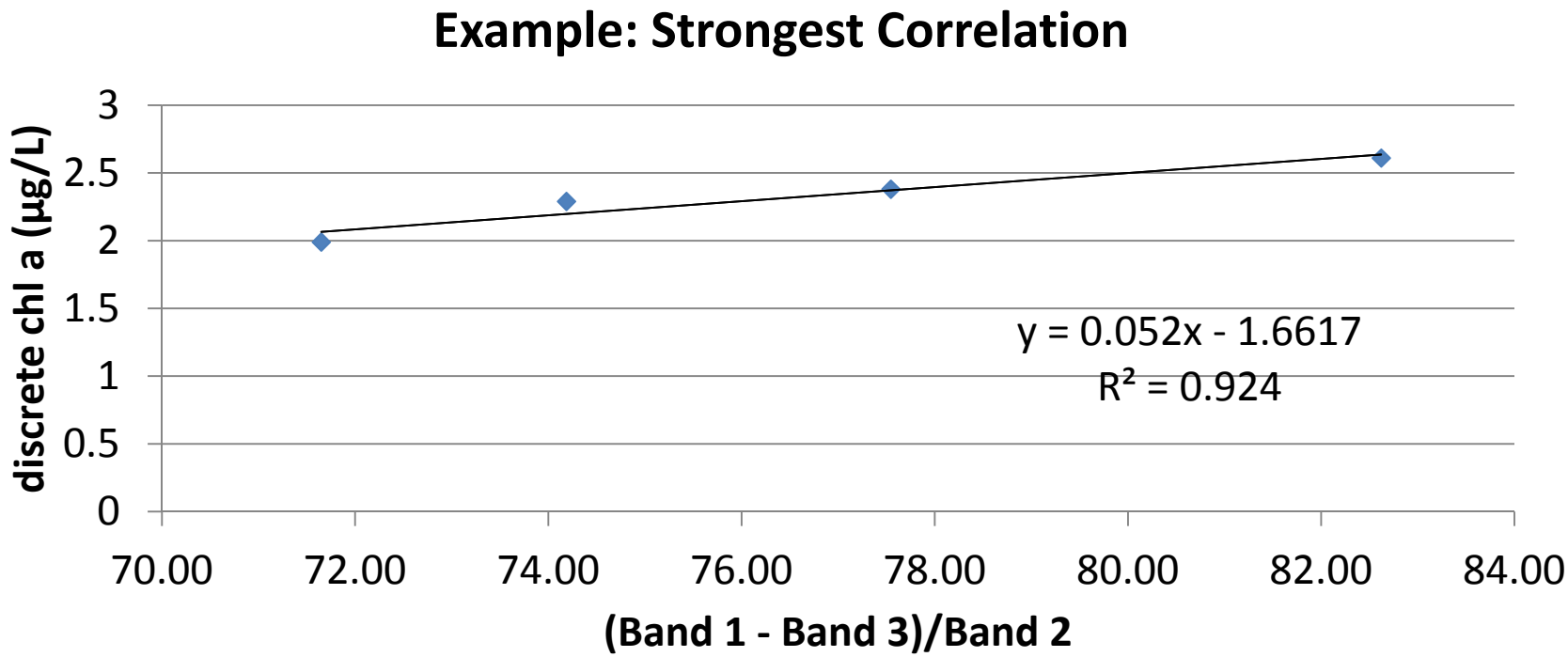


<u>Class 9 is an appropriate classification for water</u>

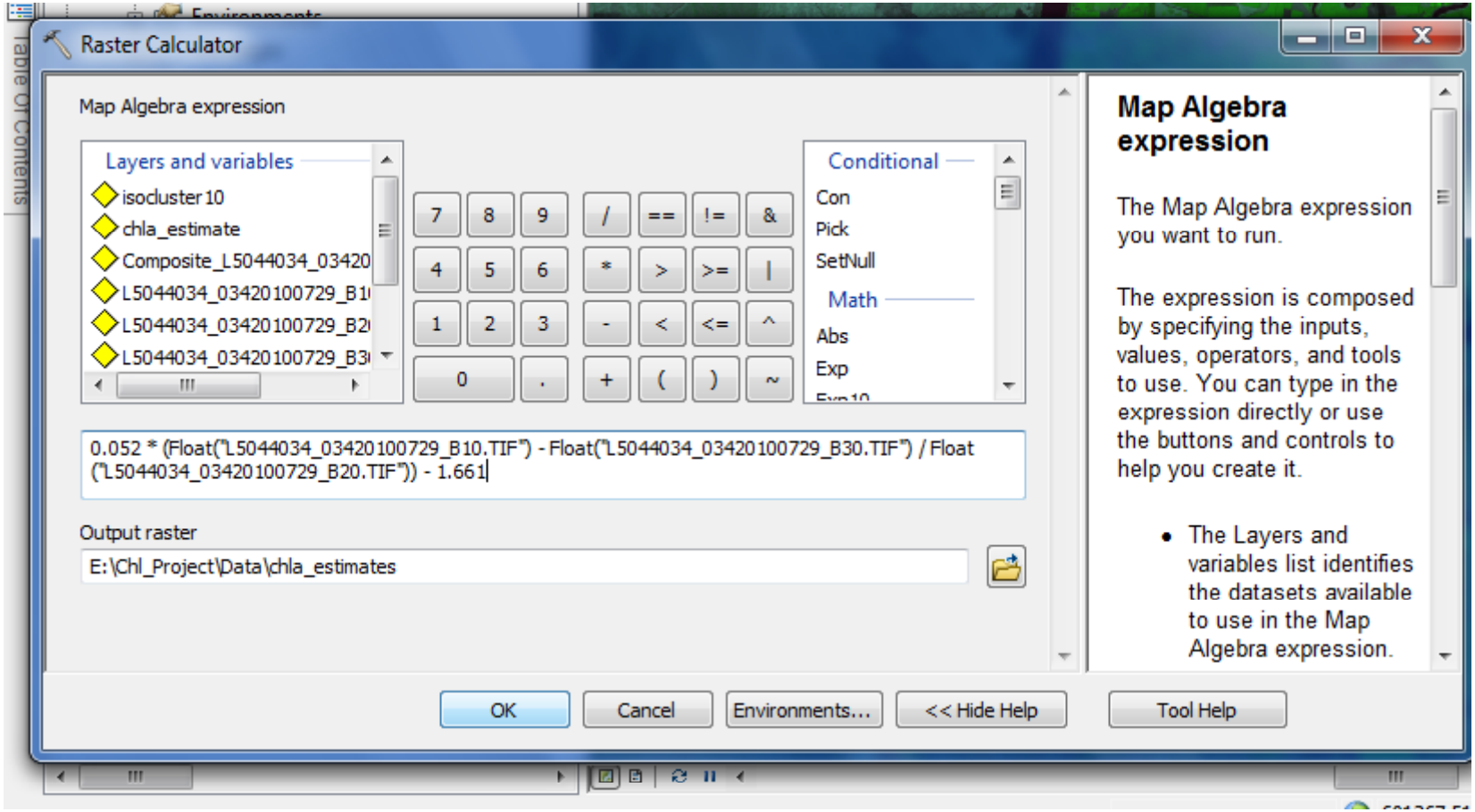
Step 7: Create training sites based on discrete sampling stations to determine spectral signatures.



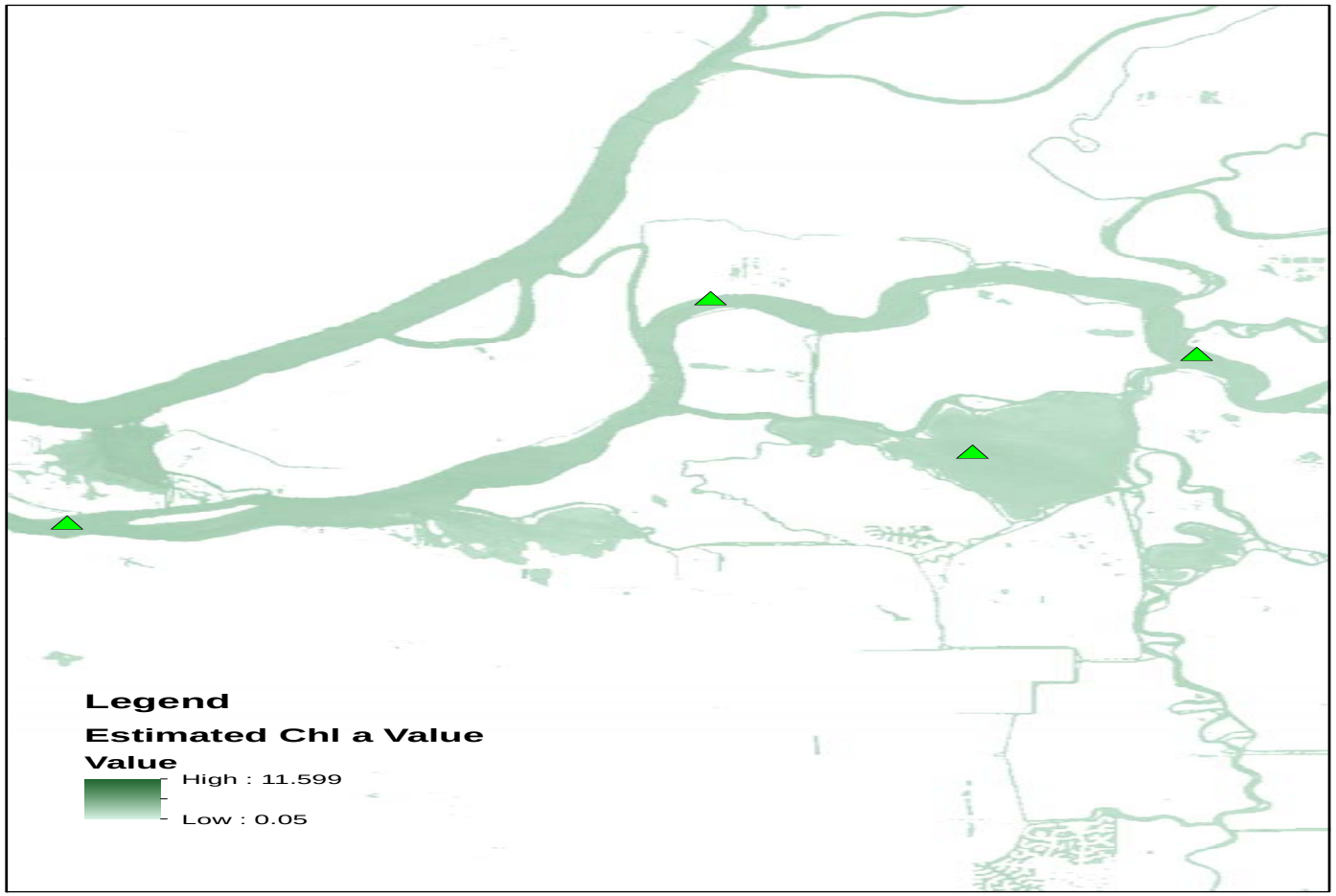
Step 8: Extract spectral signatures from training sites and look for the strongest correlation between the band ratios and discrete chl *a* samples.



Step 9: Use algorithm from regression equation to estimate chl *a* with raster calculator

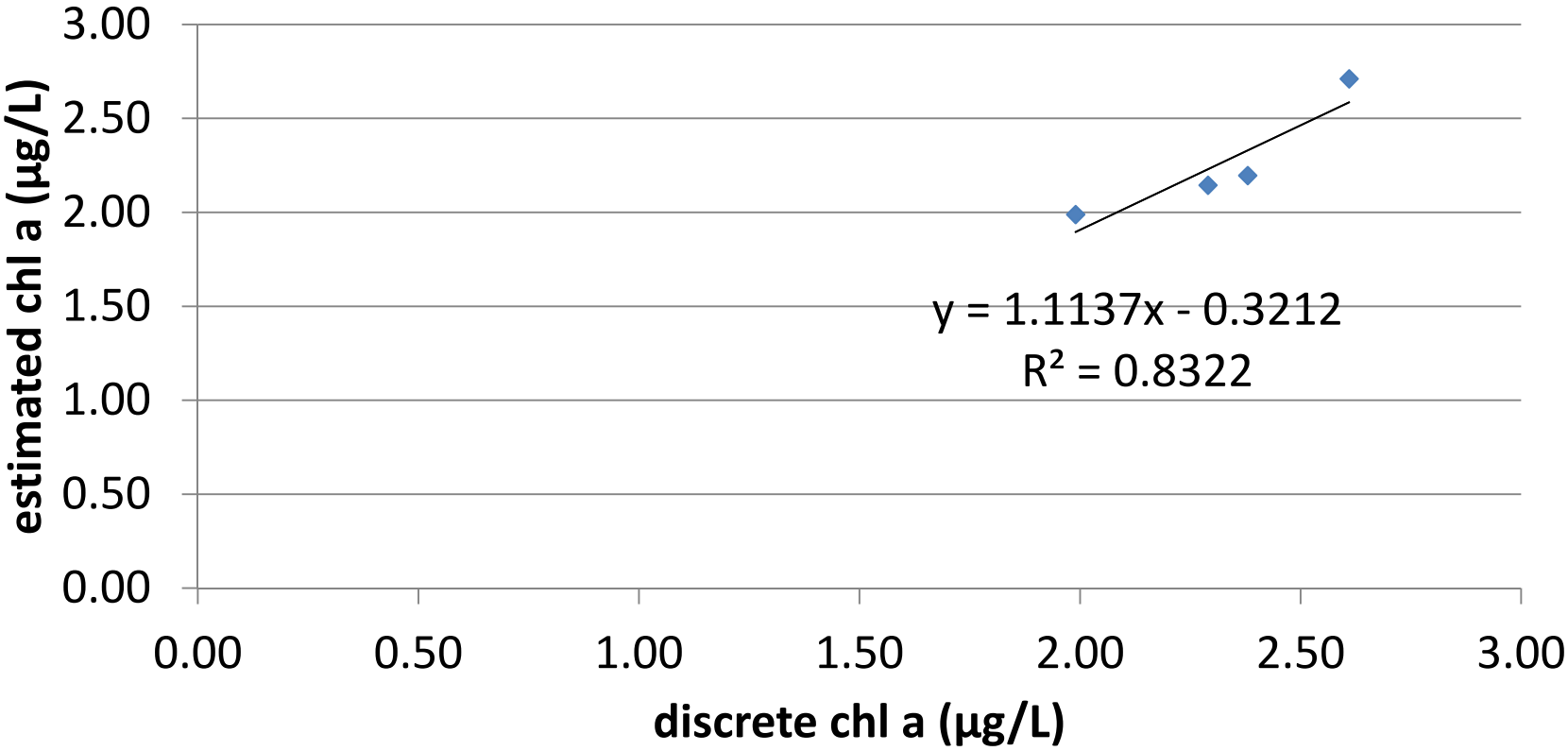


Results from algorithm



Not a whole lot of variation

How accurate are the calculated estimates when compared to the discrete values?



Correlation is fairly high. However, the calculated estimates are slightly higher than the discrete values. In addition, chl *a* concentrations were fairly low during this time period. These results may not apply during higher chl *a* concentrations.

Implications

- Using Landsat 5 TM imagery could potentially supplement discrete monitoring by providing better spatial coverage.
- These results are preliminary and should be used for discussion purposes only. No strong conclusions could be made from the project.
  - There were many limitations with this study design, such as not using an atmospheric correction on the Landsat image and the limited number of discrete samples (i.e., 4) used for the regression.
- Further research needs to be done on the best algorithm to use for the San Joaquin River.

Acknowledgements

Professor Nathan Jennings, American River College

Francine Mejia, University of Idaho

CA Department of Water Resources

US Geological Survey