RELIABILITY OF WATER QUALITY AND LANDSAT DATA FOR THE DEVELOPMENT OF PREDICTIVE MODELS FOR GRAND LAKE, OKLAHOMA

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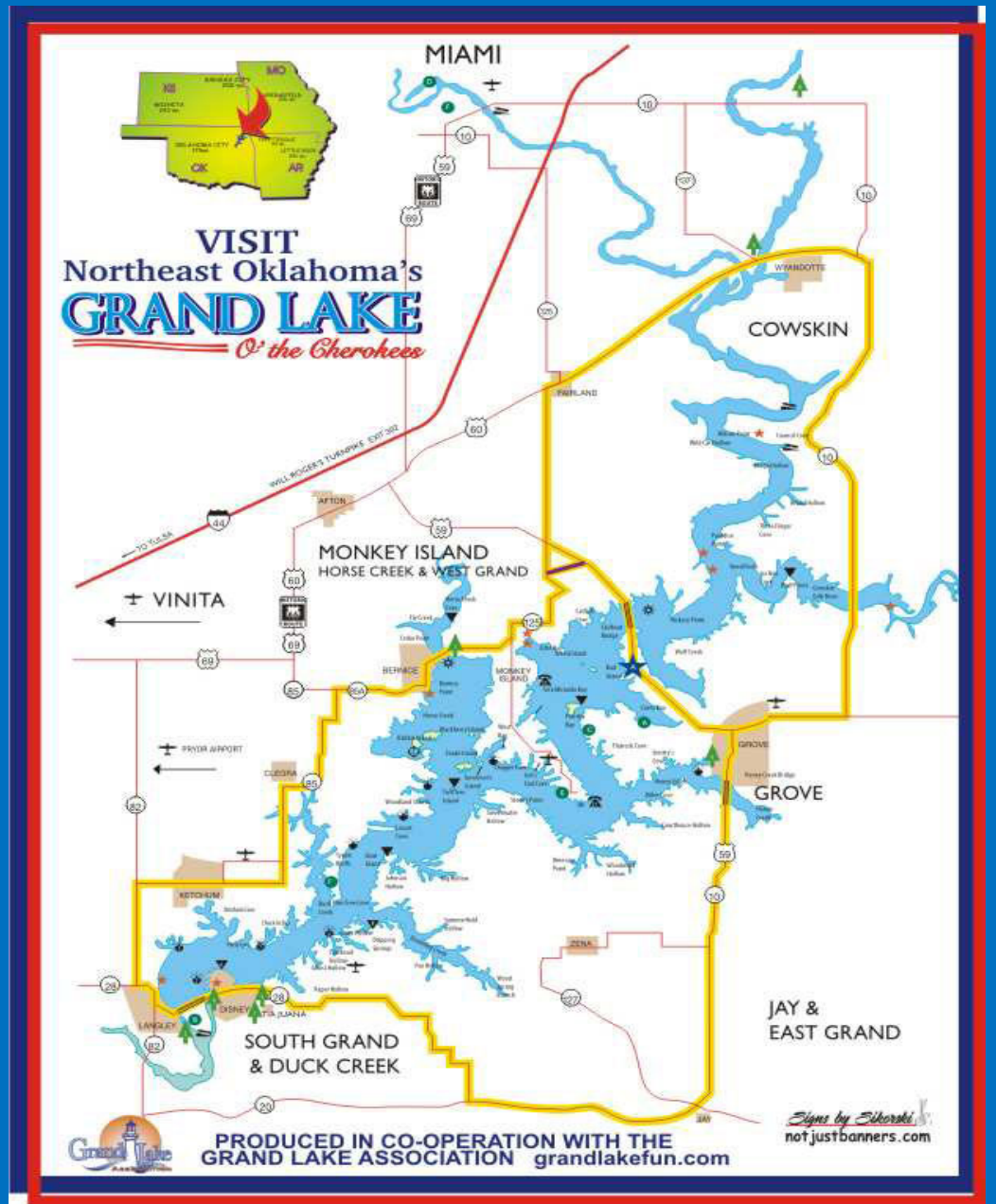
Grand Lake O' the Cherokees

- 46,500 surface acres
- Designated Uses
  - Hydroelectric power
  - Flood control
  - Water supply
  - Recreation



http://mygrandlakehomes.com/

Grand Lake Water Quality Issues

- Cyanobacteria Algae Bloom, 2011
- Elevated Microcystin over 350 µg/l
- WHO Adverse Health Effects: Microcystin >20 µg/l
- ODEQ issued alert
- GRDA shut down the reservoir on July 4th 2011
- The need for early warning systems!

Project Objectives

- Relate *in situ* water quality and Landsat data
- Algorithms that inform predictive tendencies

Presentation Objective

Determine reliability of data from water quality & Landsat for predicting Turbidity, Blue-Green Algae (BGA), & Chlorophyll a (CHL-a).

Basis:

- **Before building models - demonstrate that information from probe & Landsat are true reflections of the case**

Data Acquisition

- **USGS Earth Explorer – Landsat images**

- **ESRI Image Classification tool**
  - **Created polygons at sampling sites**
  - **Calculated mean reflectance at selected pixel**

- ***In situ* and laboratory results**

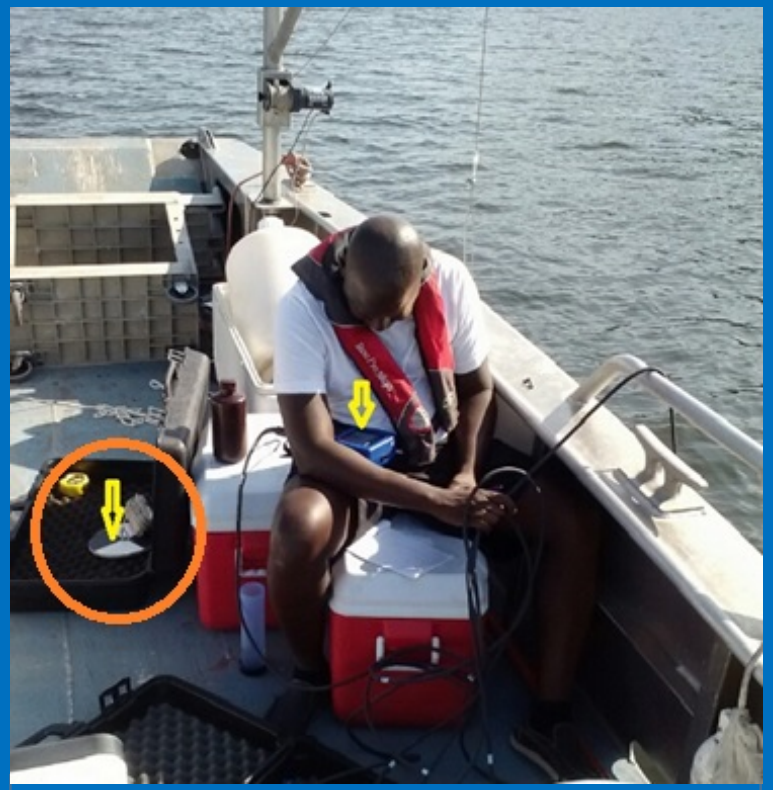
Water Quality Sampling: 2015, 2016, 2017

1. Sample dates
   - Temporally coincident satellite overpass
   - Sampling begins just prior to satellite overpass and continues for a short period after
2. Alternative
   - +/- 2 days individual satellite overpasses (acceptable)
   - Assumes no rainfall/runoff event

Sampling Sites

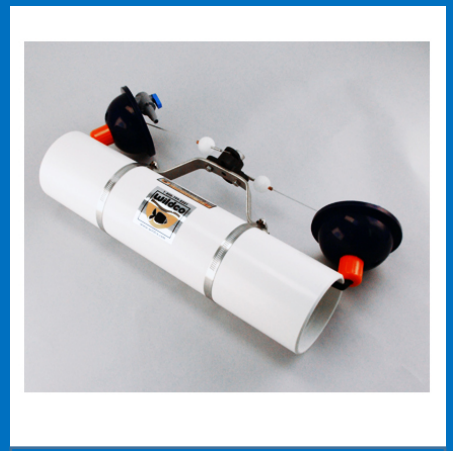
http://www.oclwa.org/pdf/2015Presentations

Field Sampling



YSI Multi-parameter Sampler
Secchi Disc

GPS Enhanced Bathymetry

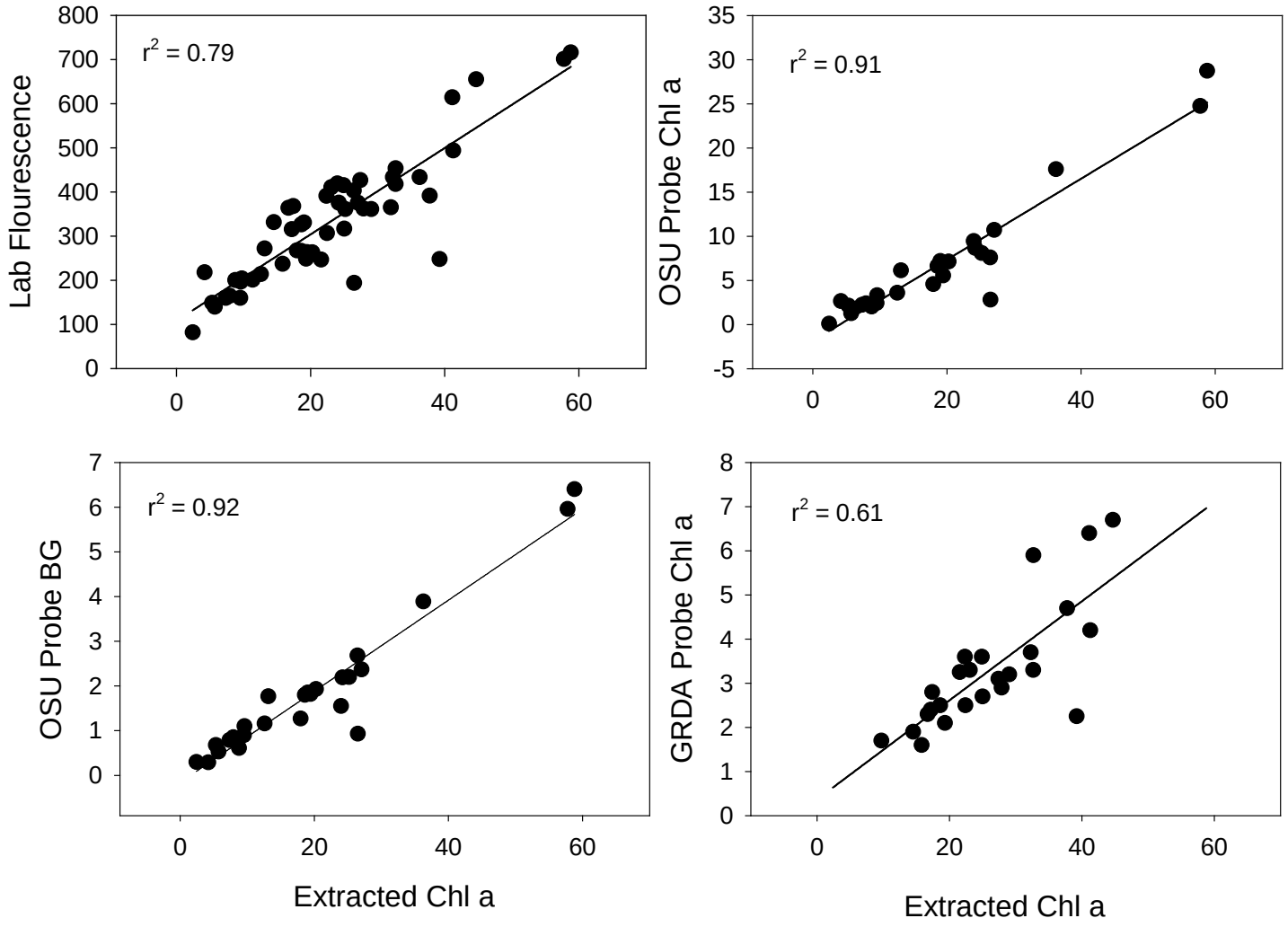


Van Dorn Sampler

Sample Bottles & Ice Chest
Water Sampling Hose

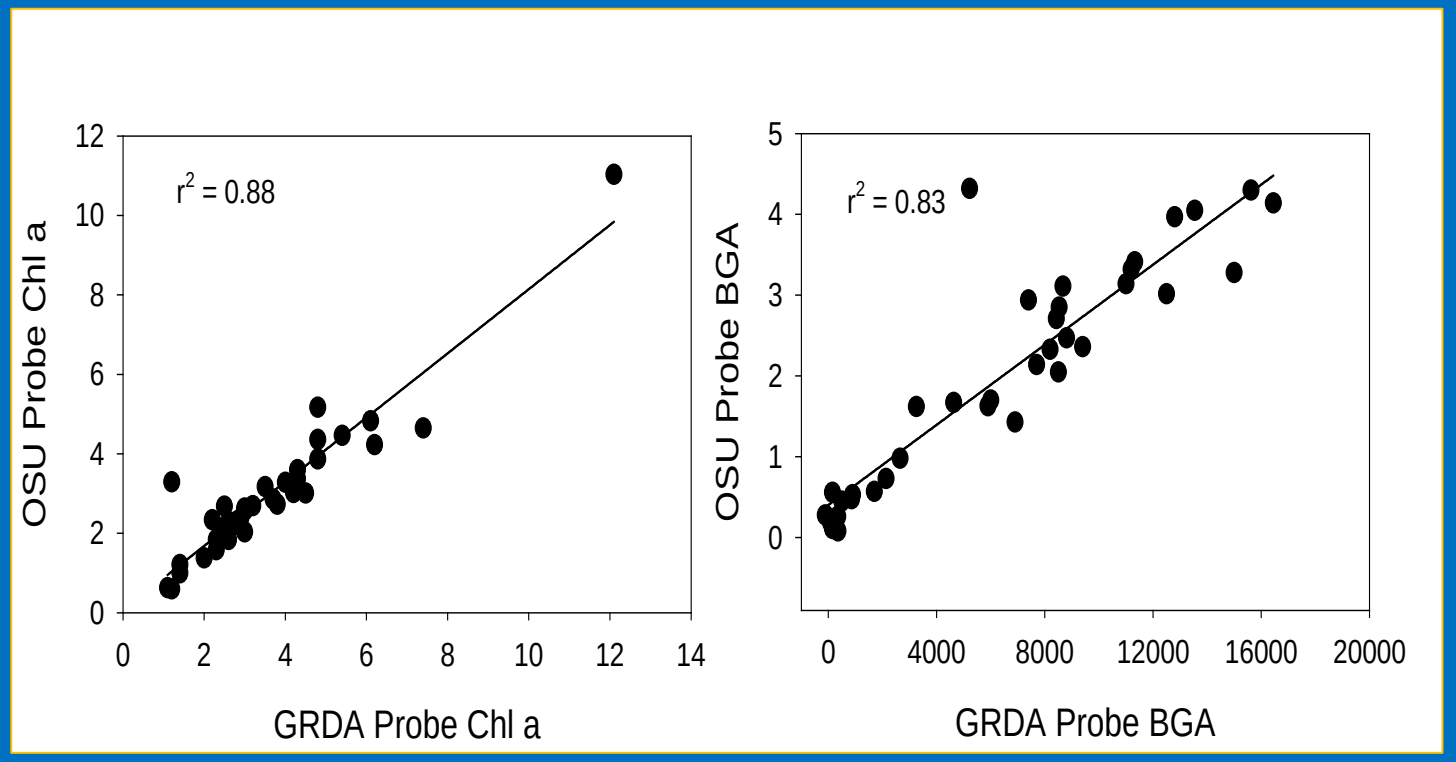
Is the Probe reliable?

Algal Biomass – Probe Comparisons



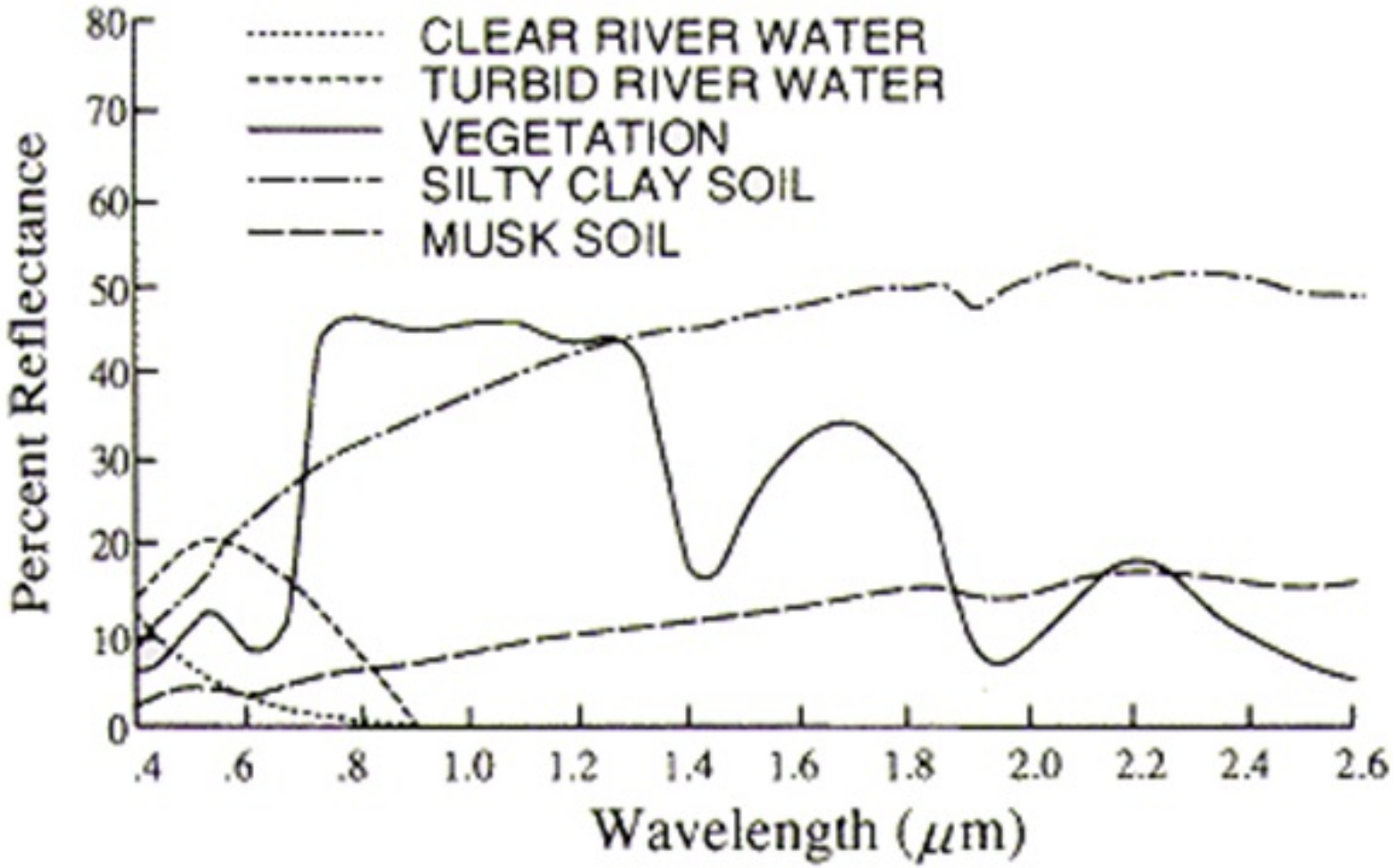
- All measures of algal biomass were correlated
  - Extracted chlorophyll, laboratory fluorescence, probe fluorescence

Algal Biomass – Probe Comparisons



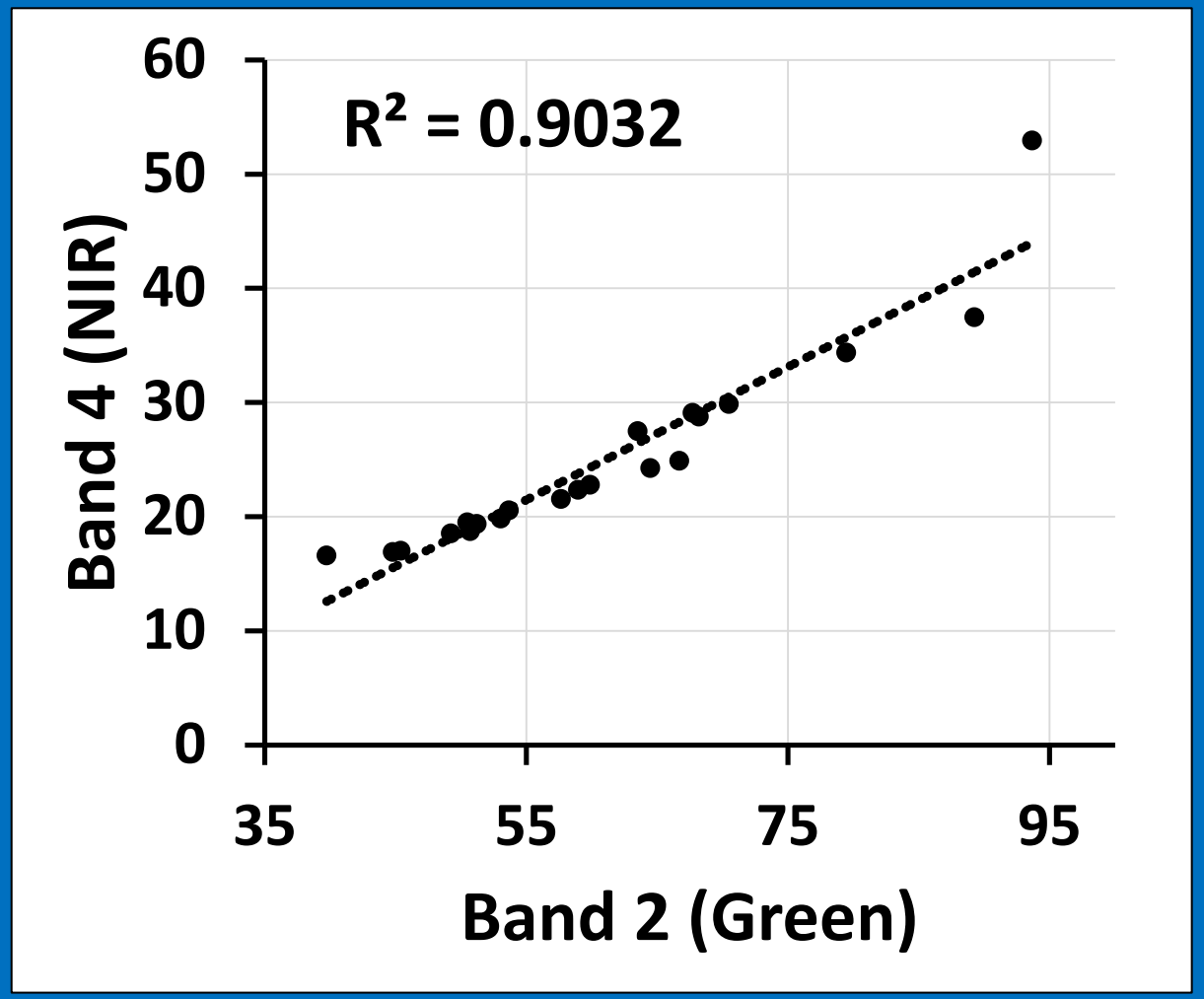
Correlations between OSU and GRDA probes were also good

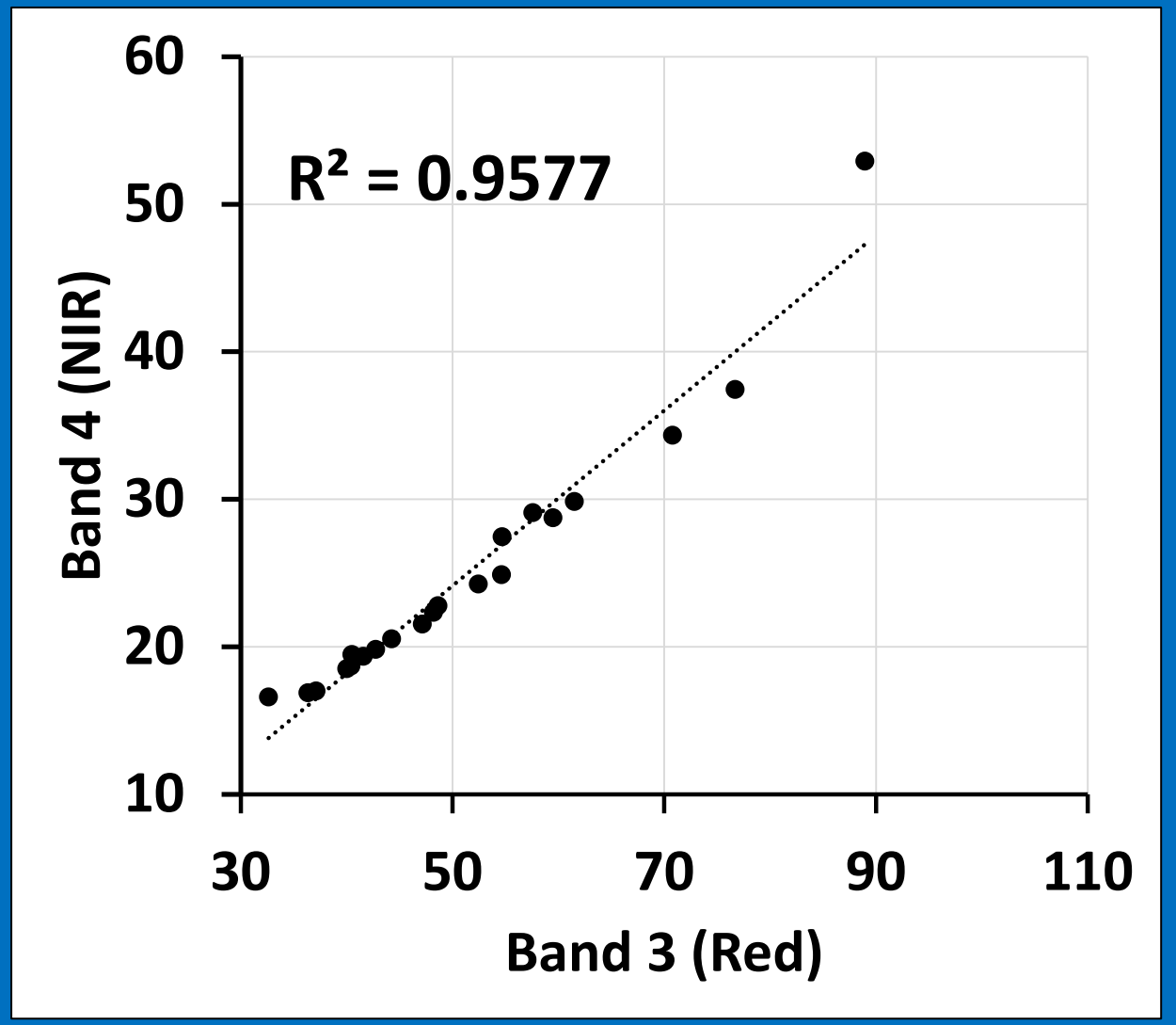
Can we reliably predict turbidity?



http://wtlab.iis.u-tokyo.ac.jp/~wataru/lecture/rsgis/rsnote/cp1/cp1-9.htm

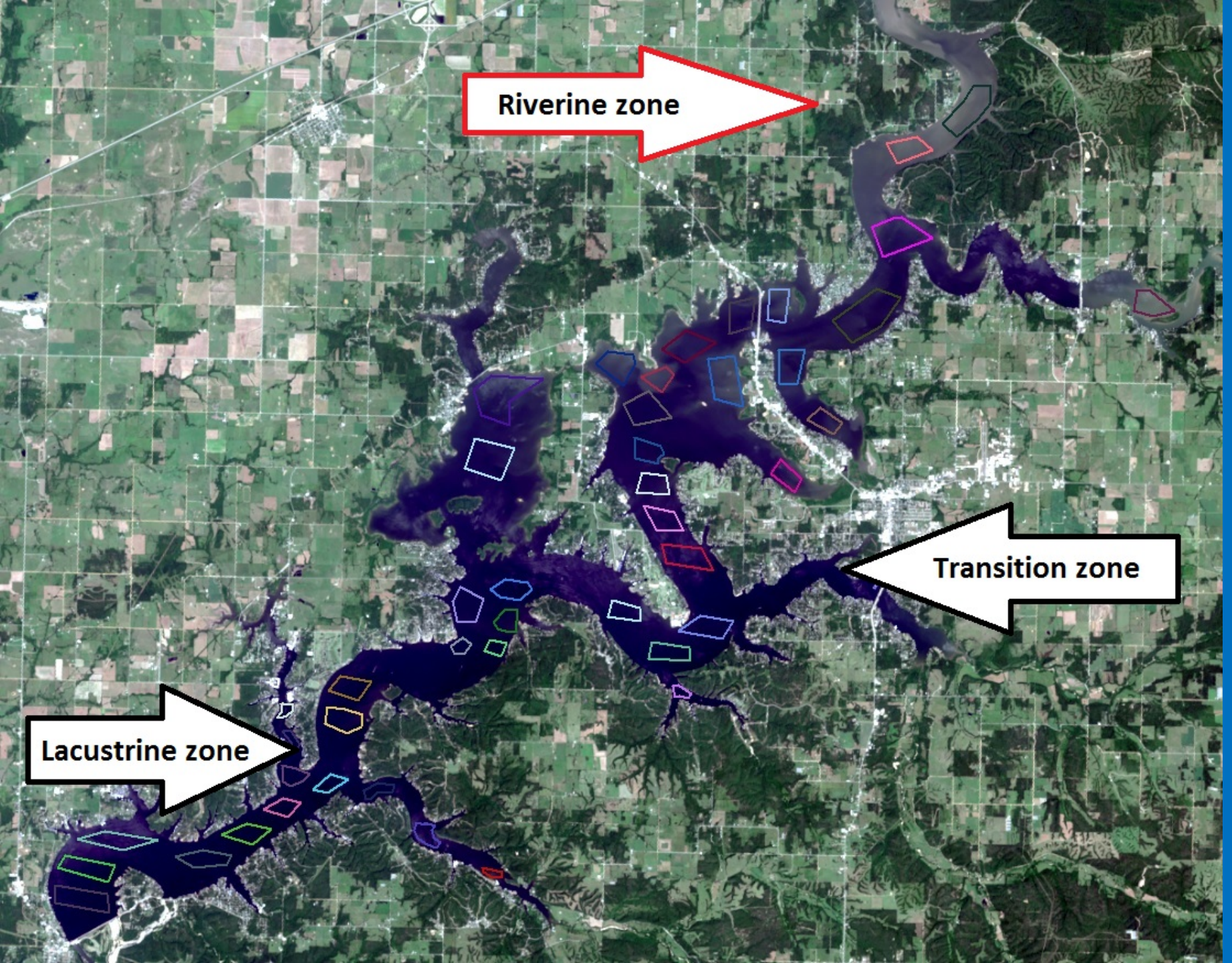
Landsat 7 (July 26th 2011)





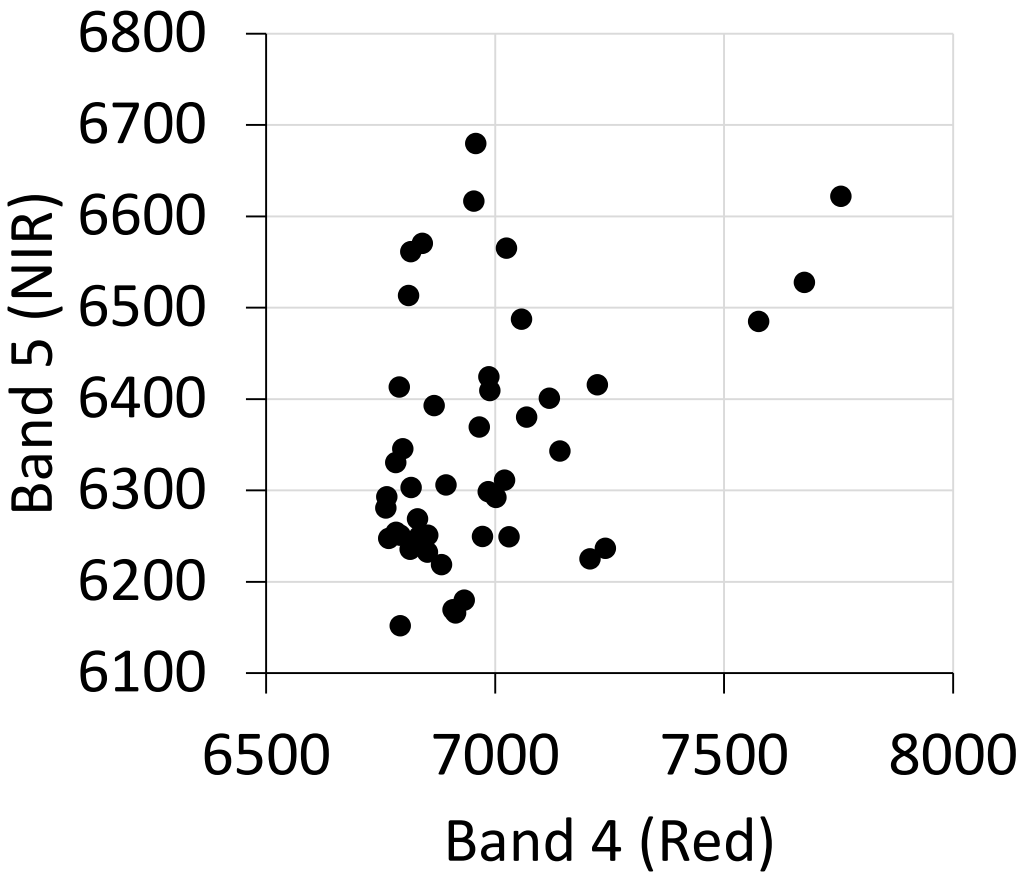
Turbidity reflects these types of relationships

Fast forward to July 2015 (Landsat 8)

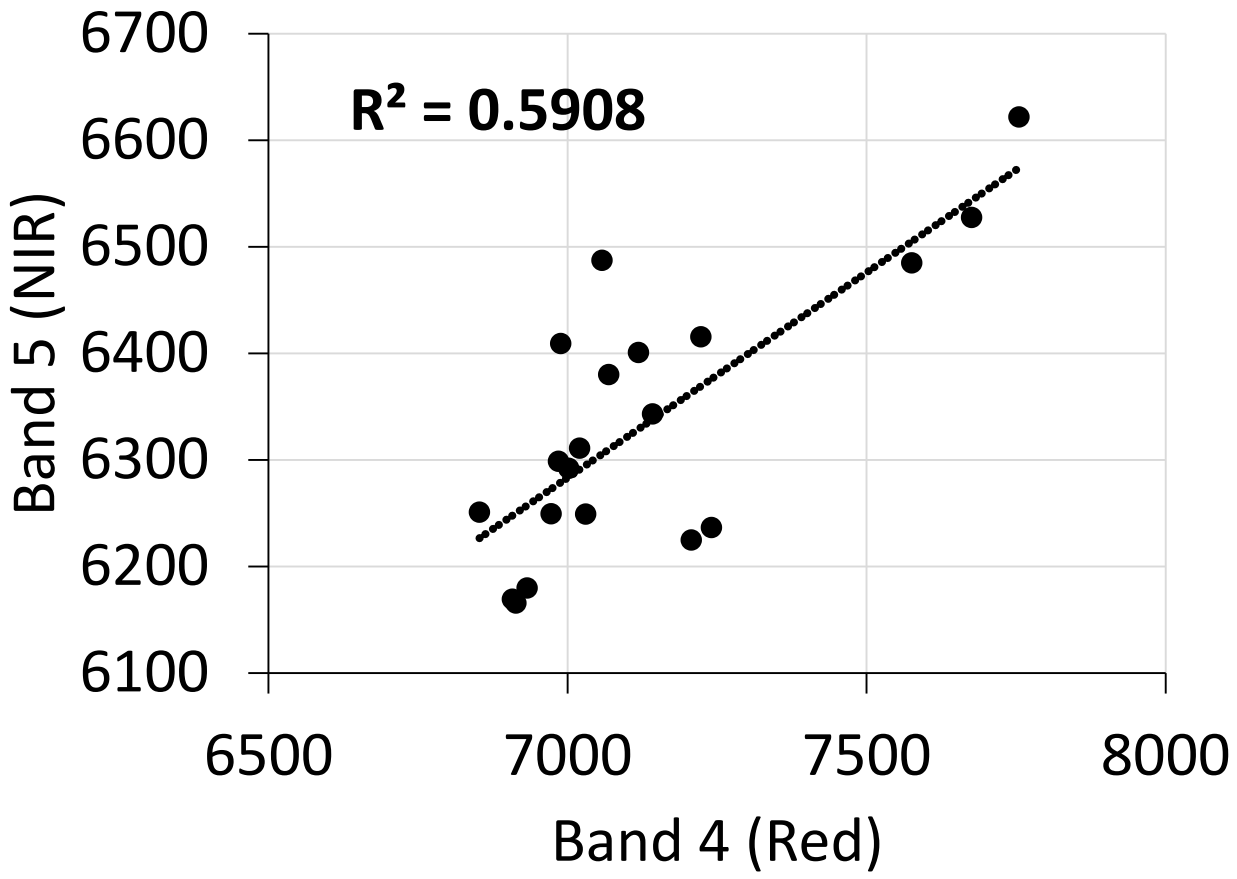


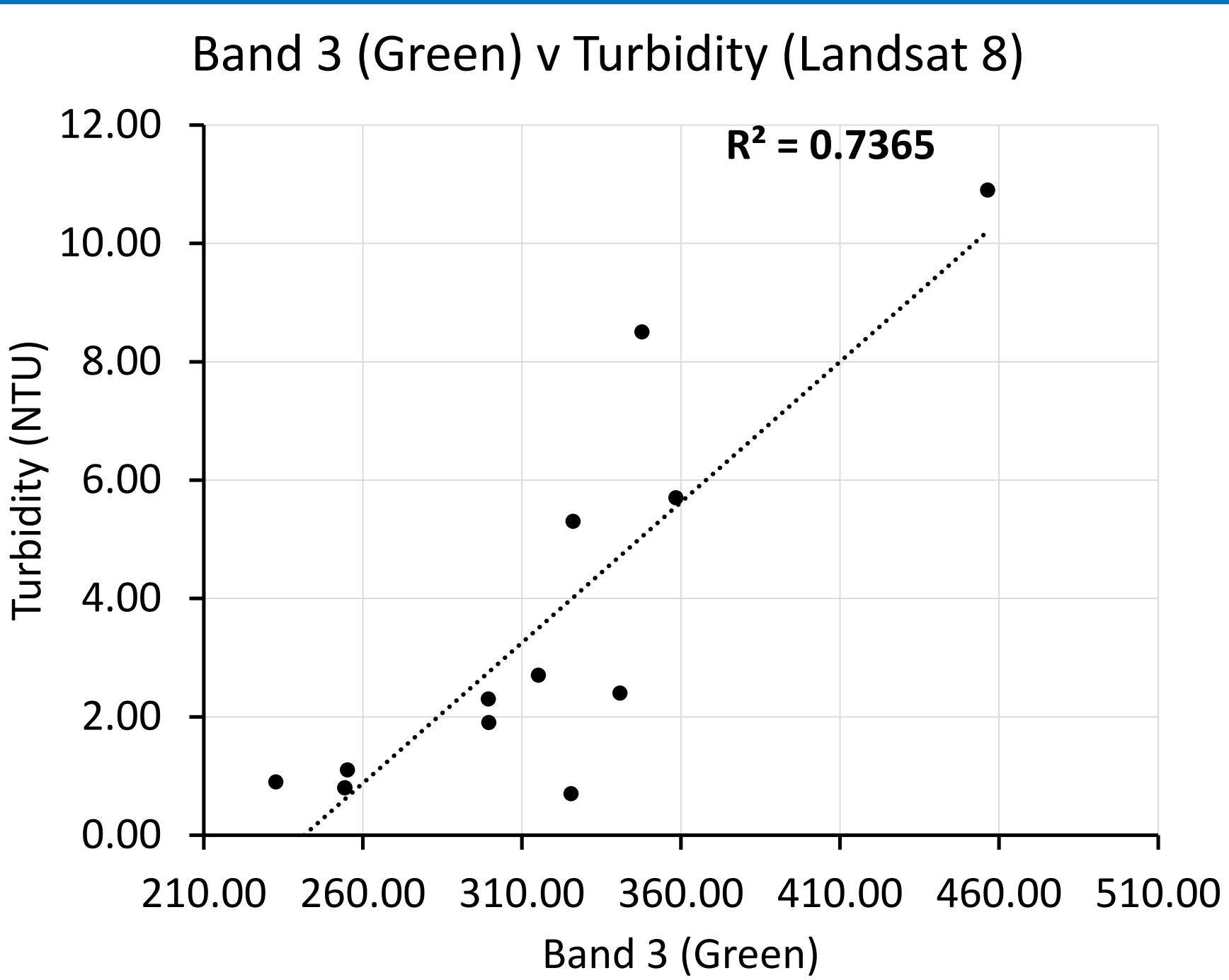
How best is this pattern reflected in spectral terms?

Feature space-Whole Lake (Landsat 8)



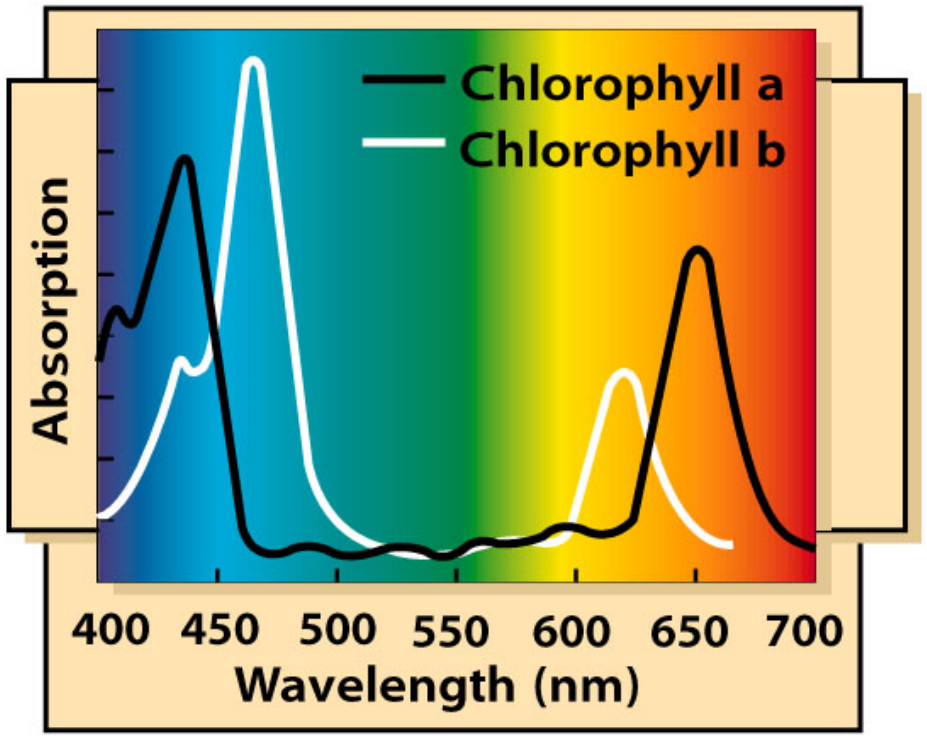
Feature space-Riverine Zone (Landsat 8)



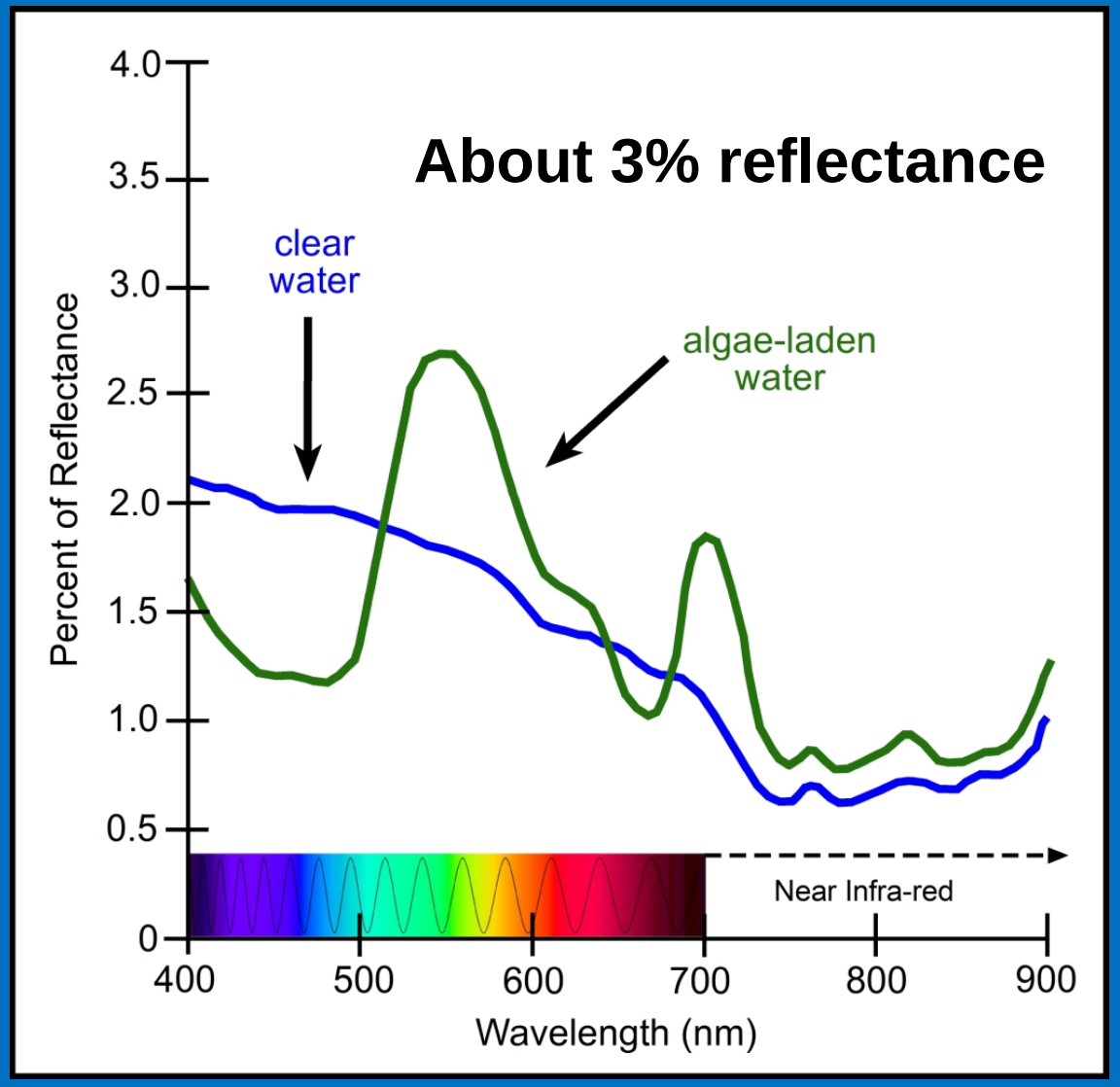


Turbidity is reliably predictable under the observed conditions

What about CHL-a & BGA?

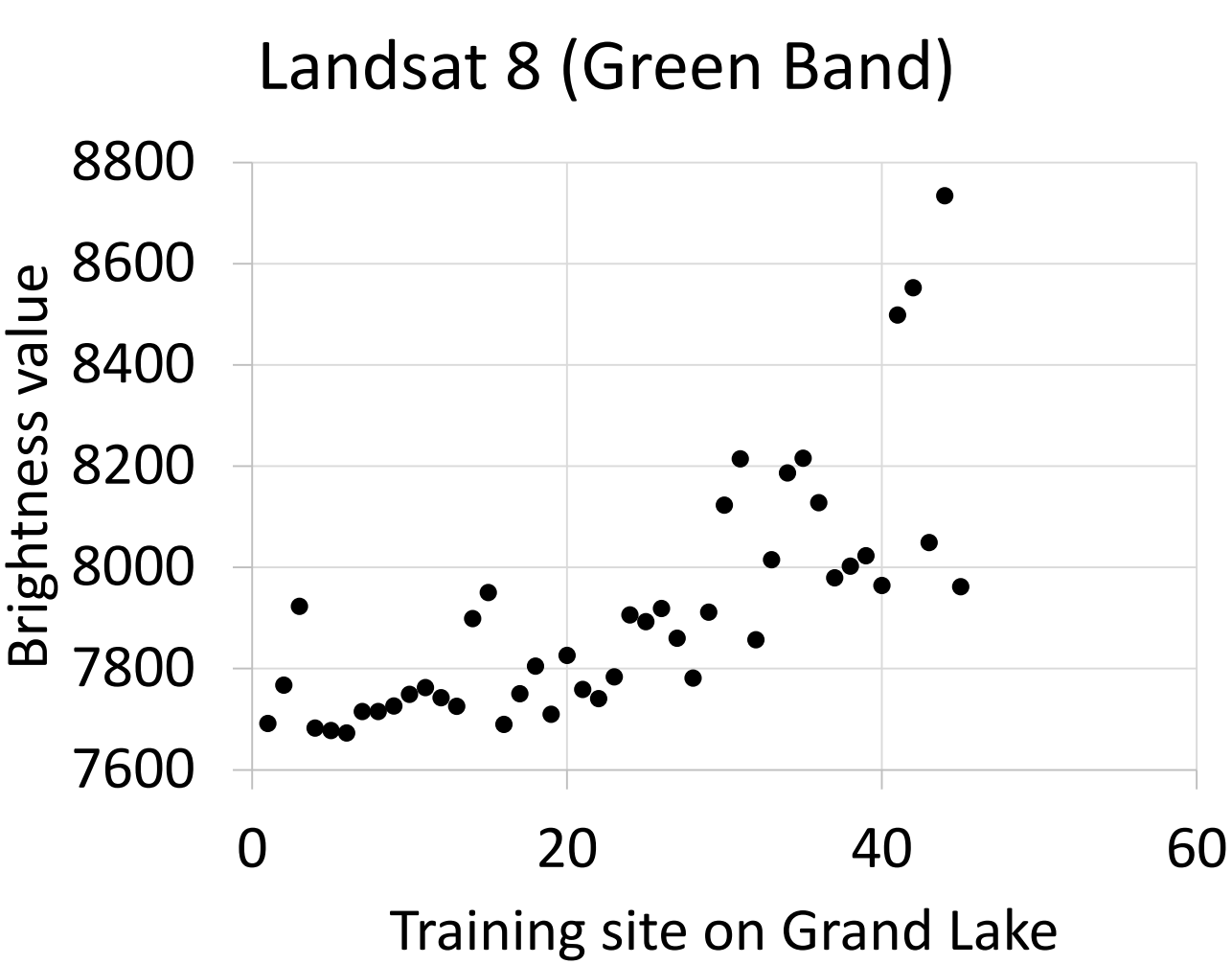


http://biologicalexceptions.blogspot.com/2013/06/the-colors-of-alien-plants.html



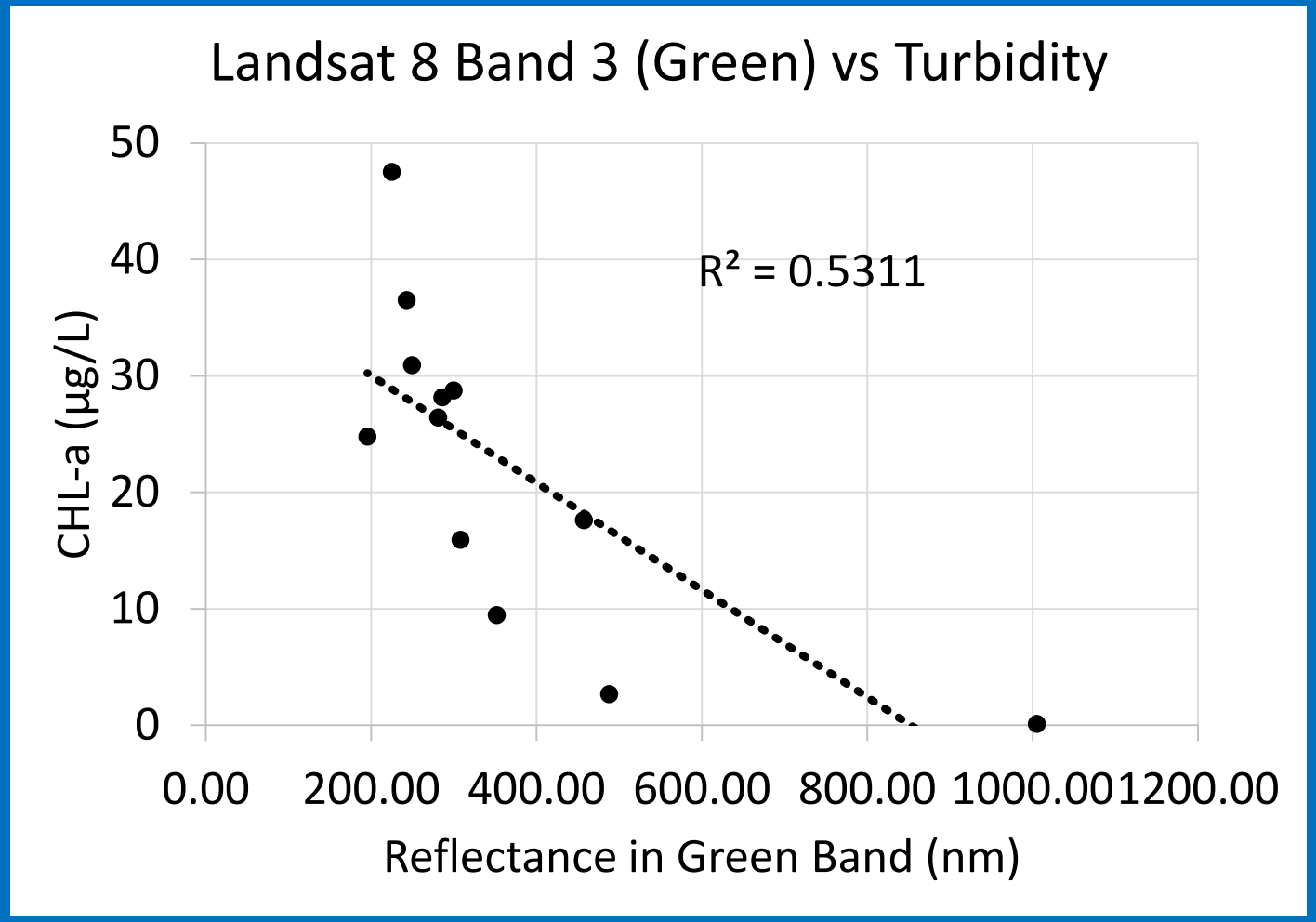
http://www.seos-project.eu/modules/marinepollution/marinepollution-c03-p05.html

Using percent BV



No of brightness values (BVs) = 2^{bits}

- **Landsat 8 = 16 bits (65,536 BVs)**
- **Highest BV = 8734.373 (13.3% compared to ~3%)**
- **Reliable predictor?**



- **Sensor: turbidity for pixel?**
- **Concentration: threshold for reflectance?**
- **Algae senescing?**

Conclusions

In situ probe:

- **Reliable concentration readings**

Landsat/water quality:

- **Seems turbidity is reliably predictable**
- **CHL-a and BGA: need more research**

Ongoing research:

- **More sampling in the summer**
- **Historical data**
- **Compare Grand Lake to other lakes in the watershed**
- **Further image processing to discriminate turbidity from algae**

References

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OCLWA

Thank you!