



Blue Water Satellite

Customer Report

Blue Water Satellite Cyanobacteria Report

Introduction

Blue Water Satellite, Inc. uses the government's Landsat satellites (Landsat 5 & 7) along with a patented algorithm to detect Cyanobacteria in rivers, lakes, streams, ponds, and water bodies around the world. Cyanobacteria are increasingly becoming a problem in the world's drinking and recreational use waters based on its production of harmful toxins and its increased proliferation due to global warming. The toxins produced by Cyanobacteria have been attributed to ailments ranging from skin rashes, to gastrointestinal disorders, and even death in humans and animals. Several recent studies have linked the toxins to Alzheimer's, Lou Gehrig's and Parkinson's diseases.

Blue Water Satellite technology is especially useful as an "early warning" for Cyanobacteria based on its ability to detect Phycocyanin in the parts per billion (ppb) range. This can be useful for treating early blooms to lower treatment costs and minimize the spread of Cyanobacteria.

Scientific Basis

Blue Water Satellite detects Phycocyanin, a pigment unique to Cyanobacteria. Reflected light from Phycocyanin produces a unique color spectrum. The Landsat satellite contains sensors that measure reflected light in 7 spectral bands. The patented Blue Water Satellite algorithm takes information from the Landsat's 7 bands and senses the unique "fingerprint" produced by Phycocyanin.

The technology and the algorithm were tested over two years comparing ground based measurements with satellite data. This study was funded by the US National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA). High correlation was achieved between satellite readings and ground based laboratory measurements of Phycocyanin. A peer reviewed paper describing the correlation studies is available from Blue Water Satellite on request.

Specifications

Blue Water Satellite makes measurements in two ranges: 0 to 5 ppb (low bloom model) and 0 to >200 ppb (high bloom model). The Landsat satellites have 30m by 30m pixel resolution on the ground and satellite sampling can be done every 16 days by using one satellite or every 8 days by using both satellites.

Since satellite frames are available back to 1982, Blue Water Satellite can analyze water bodies up to 27 years in the past as well as going forward. Typically satellite frames are posted within 24 hours so scans can usually be reported within 48 hours of satellite overpass.

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Data for XXXX Inc.

Blue Water Satellite was asked to perform Cyanobacteria scans of four lakes in XXXX, XXXX, for late August of 2008.

- Lake XXX
- Lake YYY
- Lake WWW
- Lake ZZZ

The characteristics of the lakes are shown in Table 1 (below)

Lake	Lat.	Long.	Size of Lake*	Date Scanned
Lake XXX			14,325,300 m ²	8/22/08
Lake YYY			592,718 m ²	8/15/08
Lake WWW			1,125,900 m ²	8/22/08
Lake ZZZ			877,919 m ²	9/1/08

Table 1

*Determined from the satellite scan

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Lake XXX

Lake XXX was scanned using archival data from Landsat 5 recorded on 8/22/08. In Frame #1 Lake XXX is shown as a natural color image from the Landsat satellite.



Lake XXX Frame #1

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Lake XXX

The image shown below in Frame #2 is the original 8/22/08 Landsat 5 spectral bands run through the patented Blue Water Satellite algorithm.



Frame #2

Color	Value (ppb)
Blue	0
Cyan	1.7
Light Green	2.5
Yellow	3.4
Orange	4.1
Red	>5

The processed Landsat frame shows all blue indicating that the value of Phycocyanin is near 0. (From the key above less than 1.7 ppb)

Conclusion: For August 22, 2008 the value of Phycocyanin was near 0 ppb in Lake XXX.

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Lake YYY

Lake YYY was scanned using archival data from Landsat 5 recorded on 8/15/08. In Frame #3 Lake YYY is shown as a natural color image from the Landsat satellite.

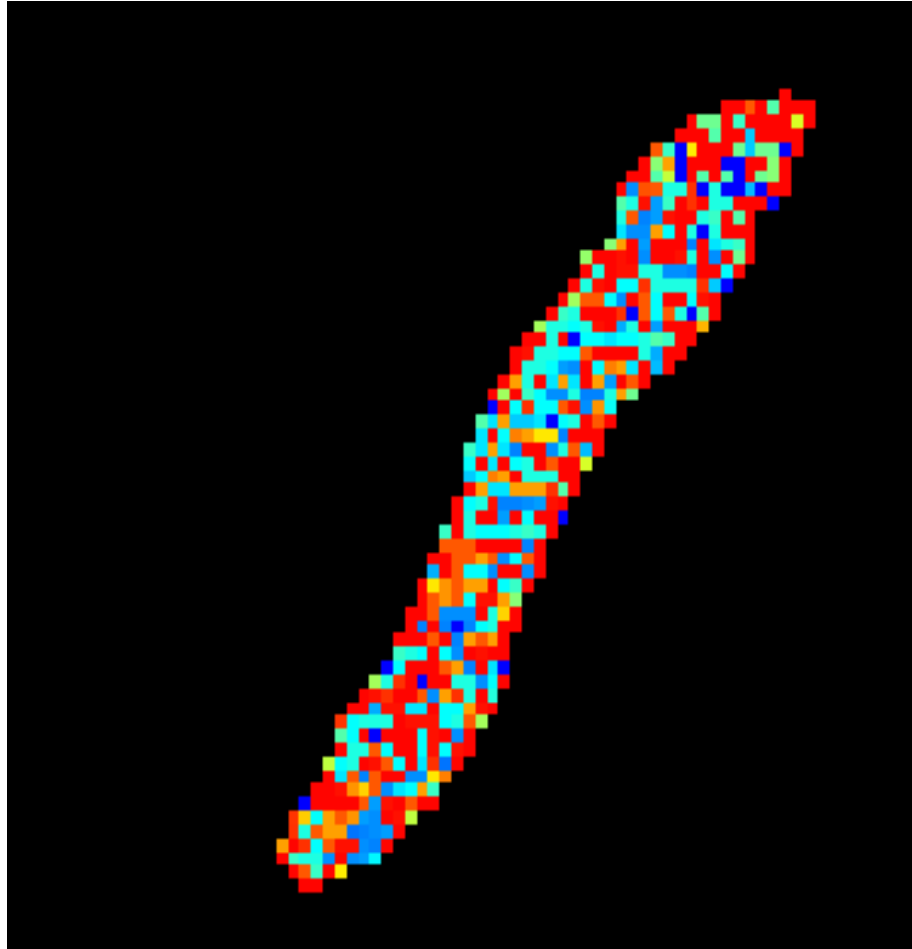


Frame #3

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Lake YYY

The image shown below in Frame #4 is the original 8/15/08 Landsat 5 spectral bands run through the patented Blue Water Satellite algorithm.



Frame #4

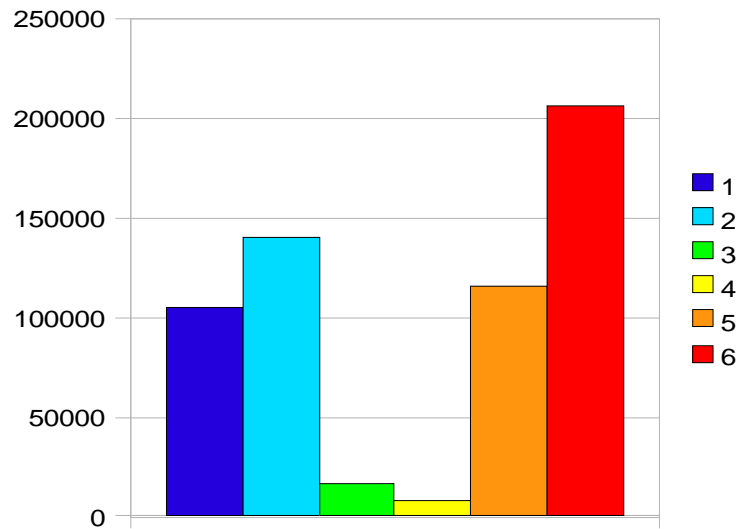
Value (ppb)	Color
0	Blue
68	Cyan
104	Light Green
140	Yellow
159	Orange
>200	Red

From the key we see significant concentrations of Phycocyanin exceeding 200 ppb in some cases. A histogram of levels of Phycocyanin is presented showing the number of pixels with readings in the various ppb bands.

Conclusion: On 8/15/08 Lake YYY had significant levels of Phycocyanin.

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Histogram of Area (m²) for Lake YYY 8/15/08



Value (ppb)	Color
0	1
68	2
104	3
140	4
159	5
>200	6

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Lake WWW

Lake WWW was scanned using archival data from Landsat 5 recorded on 8/22/08. In Frame #5 Lake WWW is shown as a natural color image from the Landsat satellite.

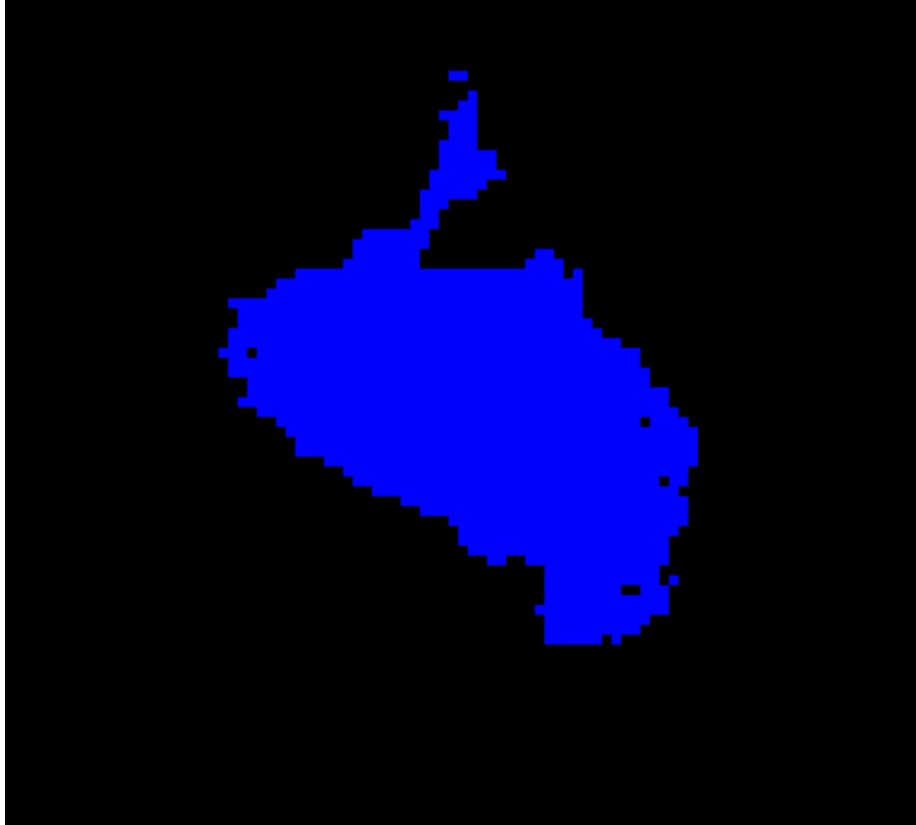


Frame #5

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Lake WWW

The image shown below in Frame #6 is the original 8/22/08 Landsat 5 spectral bands run through the patented Blue Water Satellite algorithm.



Frame #6

Color	Value (ppb)
Blue	0
Cyan	1.7
Light Green	2.5
Yellow	3.4
Orange	4.1
Red	>5

The processed Landsat frame shows all blue indicating that the value of Phycocyanin is near 0. (From the key above less than 1.7 ppb)

Conclusion: For August 22, 2008 the value of Phycocyanin was near 0 ppb in Lake WWW.

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Lake ZZZ

Lake ZZZ was scanned using archival data from Landsat 7 recorded on 9/01/08. Due to a frame handling error Landsat 5 data was not available. This is an anomaly we have never seen before. In Frame #7 below the natural color image is shown. Landsat 7 has a scan converter problem which produces the black “venetian blind” look but the data is accurate.

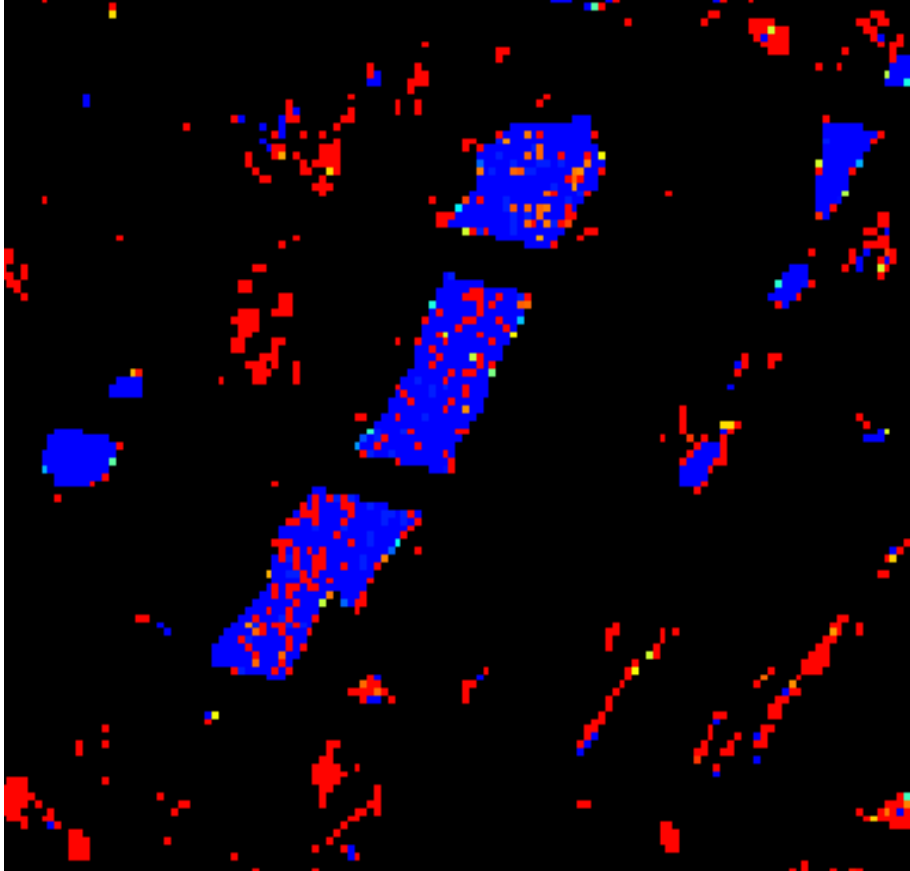


Frame #7

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Lake ZZZ

The image shown below in Frame #8 is the original 9/1/08 Landsat 7 spectral bands run through the patented Blue Water Satellite algorithm.



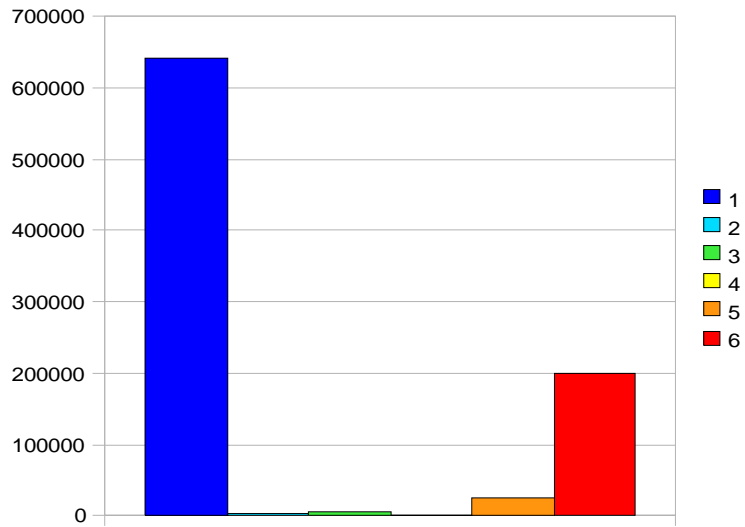
Value (ppb)	Color
0	Blue
68	Cyan
104	Green
140	Yellow
159	Orange
>200	Red

From the key we see significant concentrations of Phycocyanin exceeding 200 ppb in some cases. A histogram of levels of Phycocyanin is presented showing the number of pixels with readings in the various ppb bands.

Conclusion: On 9/1/08 Lake ZZZ had significant levels of Phycocyanin.

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Histogram of Lake ZZZ (m²) for 9/1/08



Value (ppb)	Color
0	Blue
68	Cyan
104	Green
140	Yellow
159	Orange
>200	Red

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Overall Conclusion

At the request of XXX.X, Blue Water Satellite performed satellite Cyanobacteria scans on four lakes in XXXX, XXXX, for dates between 8/15/08 and 9/1/08. Two of the lakes, Lake YYY, and Lake ZZZ had significant levels of Phycocyanin in some cases exceeding 200 ppb. In the other two lakes, Lake XXX and Lake WWW, Phycocyanin levels were very low, at or near 0 ppb.