



1

00:00:02,468 --> 00:00:04,770

[KATE FICKAS]: It's really an amazing little critter

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00:00:04,770 --> 00:00:08,474

and it's been around for over 3 billion years.

3

00:00:08,507 --> 00:00:13,012

In 2016, Utah Lake exploded in cyanobacteria blooms.

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00:00:13,012 --> 00:00:18,251

The problem is that many cyanobacteria produce toxins.

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00:00:18,251 --> 00:00:20,253

[NARRATOR]: You may have heard it called "blue-green algae,"

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00:00:20,253 --> 00:00:22,454

but it's really a kind of bacteria,

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00:00:22,454 --> 00:00:26,626

taking in sunlight to drive photosynthesis, and giving off oxygen.

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00:00:26,626 --> 00:00:30,504

[KATE]: It actually requires quite a bit of lab testing

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00:00:30,504 --> 00:00:33,384

to know whether or not it's a harmful algal bloom.

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00:00:33,384 --> 00:00:37,244

And what we're really worried about is people and pets

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00:00:37,244 --> 00:00:40,044

ingesting that cyanobacteria.

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00:00:40,044 --> 00:00:42,784

[NARRATOR]: Dr. Kate Fickas is a harmful algal blooms scientist

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00:00:42,784 --> 00:00:44,834

at Utah State University.

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00:00:44,834 --> 00:00:47,280

She helps the Utah Department of Environmental Quality

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00:00:47,280 --> 00:00:50,082

track conditions in lakes and reservoirs.

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00:00:50,082 --> 00:00:53,164

[KATE]: So Utah is the second dryest state in the nation.

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00:00:53,164 --> 00:00:56,889

Most of our major lakes are actually man-made reservoirs.

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00:00:56,889 --> 00:00:58,824

They're heavily used for recreation.

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00:00:58,824 --> 00:01:01,127

They're heavily used for agriculture.

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00:01:01,127 --> 00:01:04,734

And they're really important to the state, as a resource.

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00:01:04,897 --> 00:01:08,868

[NARRATOR]: In 2017, harmful algal blooms returned to Utah Lake.

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00:01:08,868 --> 00:01:13,205

This time, officials used satellite data to identify troubled locations.

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00:01:13,205 --> 00:01:15,107

But how can instruments up in space

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00:01:15,107 --> 00:01:18,711

tell us about microscopic organisms in a lake down on Earth?

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00:01:18,711 --> 00:01:21,314

By measuring their blue-green color.

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00:01:21,314 --> 00:01:24,617

Landsat collects light in visible and infrared wavelengths.

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00:01:24,617 --> 00:01:28,287

Cyanobacteria reflect more green light than plain water does,

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00:01:28,287 --> 00:01:31,524

allowing Landsat to identify algal blooms.

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00:01:31,524 --> 00:01:35,027

[NIMA PAHLEVAN]: From satellite, what we see is, basically,

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00:01:35,027 --> 00:01:37,663

that primary pigment, which is chlorophyll-a

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00:01:37,663 --> 00:01:41,300

but the color, by itself, could be misleading

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00:01:41,300 --> 00:01:47,673

a nice picture is not necessarily providing a set of quantitative data.

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00:01:47,740 --> 00:01:50,314

[NARRATOR]: Algal blooms can look beautiful from space

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00:01:50,509 --> 00:01:53,612

but the numbers behind the images are the important part.

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00:01:53,612 --> 00:01:57,216

[NIMA]: Each measurement is highly accurate, and it's very,

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00:01:57,216 --> 00:01:58,918

it's very much corresponding

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00:01:58,918 --> 00:02:01,987

to the number of photons that are leaving the body of water

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00:02:01,987 --> 00:02:04,344

which could be related to the biomass

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00:02:04,344 --> 00:02:06,826

and the amount of phytoplankton

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00:02:06,826 --> 00:02:09,128

[NARRATOR]: Dr. Nima Pahlevan is working with NASA

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00:02:09,128 --> 00:02:10,529

and the US Geological Survey

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00:02:10,529 --> 00:02:13,366

to make sure Landsat users have consistent, accurate,

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00:02:13,366 --> 00:02:16,502

and ready-to-use data about lakes and rivers.

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00:02:16,902 --> 00:02:19,004

Water is difficult to study from space,

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00:02:19,004 --> 00:02:20,673

because only a fraction of the sunlight

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00:02:20,673 --> 00:02:22,541

is reflected back to the satellite.

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00:02:22,541 --> 00:02:24,677

But engineering improvements on Landsat 8

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00:02:24,677 --> 00:02:26,178

have "levelled up" its ability

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00:02:26,178 --> 00:02:29,415

to measure the small signals from water bodies.

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00:02:29,949 --> 00:02:31,884

After Landsat collects the data,

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00:02:31,884 --> 00:02:35,087
it gets beamed down to the USGS EROS center,

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00:02:35,087 --> 00:02:36,455
where it is archived.

53
00:02:36,455 --> 00:02:40,358
The raw numbers pass through checkpoints to align the geography,

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00:02:40,593 --> 00:02:42,461
correct for sun strength,

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00:02:42,461 --> 00:02:45,431
and then compensate for the effects of the atmosphere.

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00:02:45,598 --> 00:02:51,570
[NIMA]: you're essentially removing the atmospheric scattering and absorption

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00:02:51,817 --> 00:02:54,173
[NARRATOR]: Let's break down what Nima means here.

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00:02:54,173 --> 00:02:55,941
To measure the amount of cyanobacteria

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00:02:55,941 --> 00:02:58,711
you need to know how much light reflected off the surface.

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00:02:58,711 --> 00:03:01,847
But some of that light gets scattered by molecules in the atmosphere

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00:03:01,847 --> 00:03:03,649
on the way to the satellite,

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00:03:03,649 --> 00:03:05,551
lessening the signal received.

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00:03:05,551 --> 00:03:07,686

And sometimes light that never made it to the surface

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00:03:07,686 --> 00:03:09,688
gets scattered into the satellite,

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00:03:09,688 --> 00:03:11,123
adding a false signal.

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00:03:11,123 --> 00:03:13,574
Like removing the haze from a photograph,

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00:03:13,574 --> 00:03:16,695
atmospheric corrections leave you with a quantitative measurement

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00:03:16,695 --> 00:03:19,098
of exactly how much light left the water,

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00:03:19,098 --> 00:03:21,300
known as aquatic reflectance.

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00:03:21,300 --> 00:03:23,602
[NIMA]: You would want to look at the actual

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00:03:23,602 --> 00:03:27,239
physical measurements to derive

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00:03:27,239 --> 00:03:31,310
physically meaningful products from satellite data.

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00:03:31,410 --> 00:03:32,711
[NARRATOR]: And that's the goal,

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00:03:32,711 --> 00:03:35,781
to transform the raw materials into finished products,

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00:03:35,781 --> 00:03:38,984
so that end users don't have to build it themselves.

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00:03:38,984 --> 00:03:42,755
[NIMA]: by providing aquatic reflectance products,

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00:03:42,755 --> 00:03:49,395
you're reducing, majorly reducing the burden on satellite users.

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00:03:49,695 --> 00:03:51,397
[NARRATOR]: Although it is still provisional,

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00:03:51,397 --> 00:03:53,299
Nima's Aquatic Reflectance Data Product

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00:03:53,299 --> 00:03:56,469
is available for download from the USGS.

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00:03:56,469 --> 00:03:57,870
Scientists like Kate Fickas

82
00:03:57,870 --> 00:04:02,241
convert the data product to maps showing the amount of chlorophyll-a,

83
00:04:02,241 --> 00:04:03,843
helping local officials pinpoint

84
00:04:03,843 --> 00:04:06,846
where to test for toxins and warn residents.

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00:04:06,846 --> 00:04:09,482
[KATE]: I use Landsat and other remote sensing technology

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00:04:09,482 --> 00:04:12,051
to help local health departments understand

87
00:04:12,051 --> 00:04:13,419
where there's a bloom,

88
00:04:13,419 --> 00:04:15,221

the magnitude of a bloom

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00:04:15,221 --> 00:04:17,256

and the size of the bloom.

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00:04:17,256 --> 00:04:21,404

[NARRATOR]: The spatial detail is another benefit of using Landsat data.

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00:04:21,404 --> 00:04:25,698

Each pixel is only a 30-meter square, the size of a baseball diamond.

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00:04:25,698 --> 00:04:28,968

Yet, it collects data across a broad area.

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00:04:28,968 --> 00:04:32,905

In other words, there is a lot of data at a fairly high resolution.

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00:04:32,905 --> 00:04:35,174

[KATE]: with Landsat, we can get into some of the marinas

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00:04:35,174 --> 00:04:37,510

that are popular fishing and swimming spots,

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00:04:37,510 --> 00:04:39,814

in order to inform local health departments

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00:04:39,814 --> 00:04:42,248

about making public health decisions

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00:04:42,681 --> 00:04:46,185

[NARRATOR]: For the 2017 outbreak, that's exactly what happened.

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00:04:46,185 --> 00:04:49,889

Satellite data gave an early warning to local officials in Utah.

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00:04:49,889 --> 00:04:51,524

The extra week of warning saved

101
00:04:51,524 --> 00:04:55,294
hundreds of thousands of dollars in health care costs.

102
00:04:55,895 --> 00:04:58,697
Monitoring algal blooms from aquatic reflectance data

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00:04:58,697 --> 00:05:02,201
is just one example of benefits from Landsat's data products:

104
00:05:02,668 --> 00:05:03,769
wildfires,

105
00:05:03,769 --> 00:05:04,937
snow cover,

106
00:05:04,937 --> 00:05:06,344
vegetation health,

107
00:05:06,344 --> 00:05:08,807
temperature and more are available,

108
00:05:08,807 --> 00:05:12,144
for every spot on Earth.

109
00:05:13,779 --> 00:05:16,382
Landsat's highly calibrated data products,

110
00:05:16,382 --> 00:05:18,350
free to download and use,

111
00:05:18,350 --> 00:05:22,421
are making detailed Earth-observation data more accessible to users

112
00:05:22,421 --> 00:05:25,090
and bringing a greater benefit to society.