PREDICTING HARMFUL ALGAL BLOOMS IN DETROIT LAKE, OR

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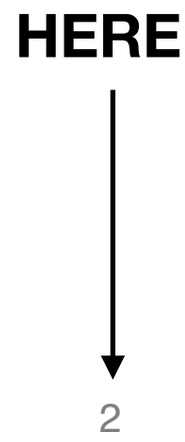
CITY OF Salem AT YOUR SERVICE

Public Works Department

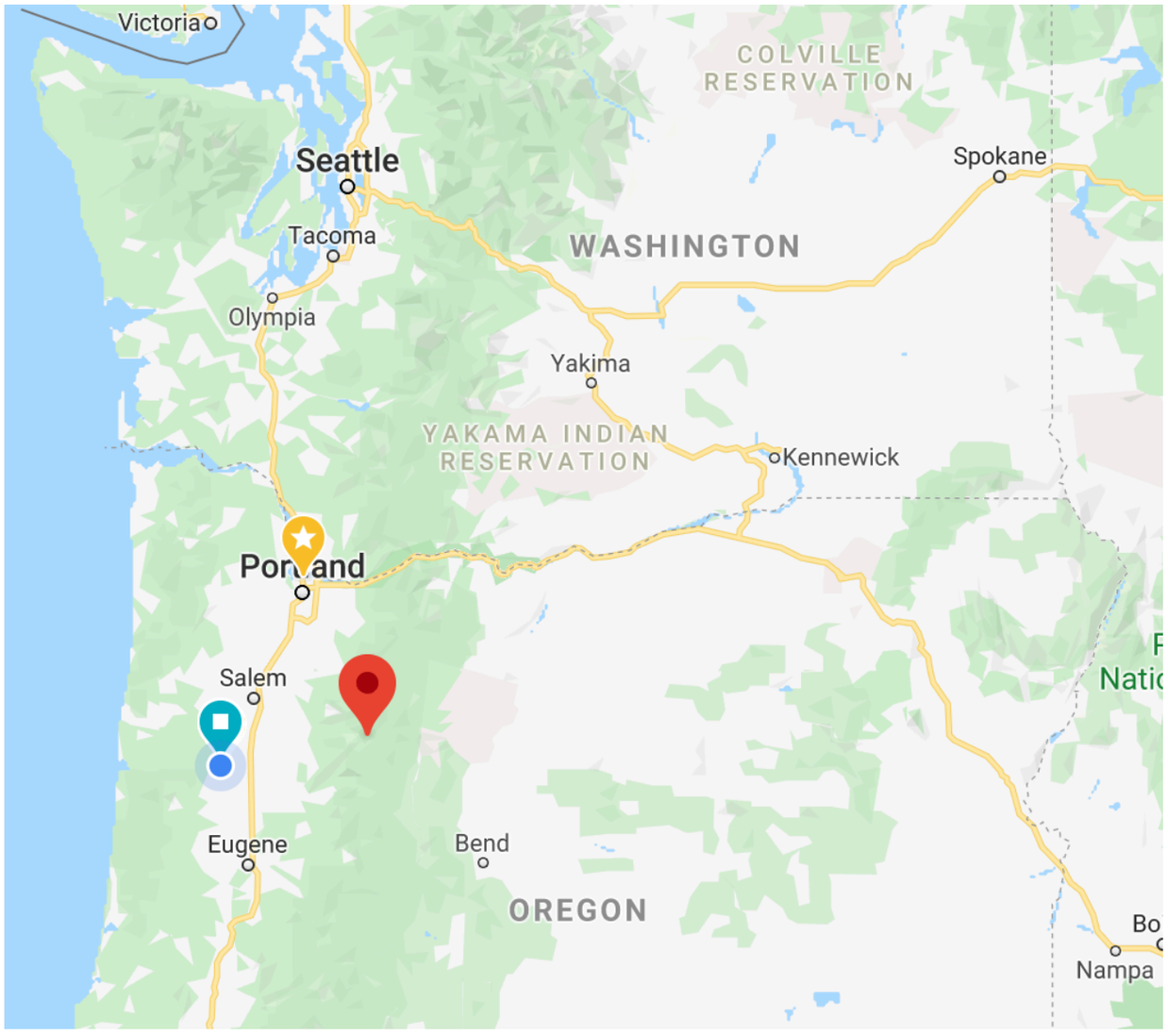
THE PREDICTION LAB

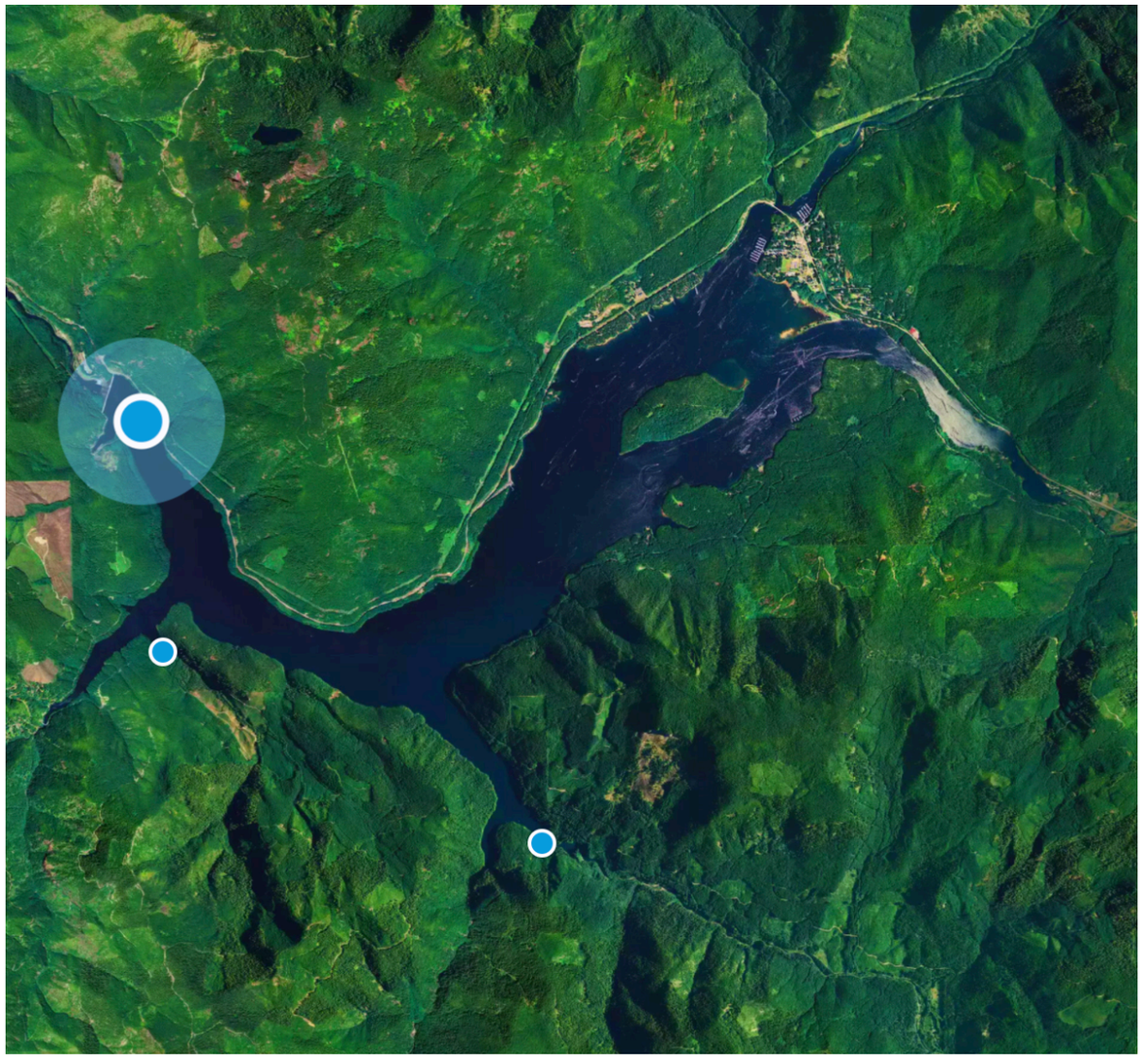
Page numbers



Detroit Lake, Oregon

- Detroit Lake is the sole source of drinking water for the City of Salem (the capital of Oregon)





Harmful Algal Blooms!

Environment | Local | Science | News | Water | Health

As Salem Frets About Toxic Algae, Should The Rest Of Oregon?

by **Erin Ross** Follow OPB June 7, 2018 6:30 a.m. | Updated: June 7, 2018 3:27 p.m. | Portland, Ore.

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Q&A: How Do Algae Blooms Affect Oregon's Water Supply?

01:54 04:16

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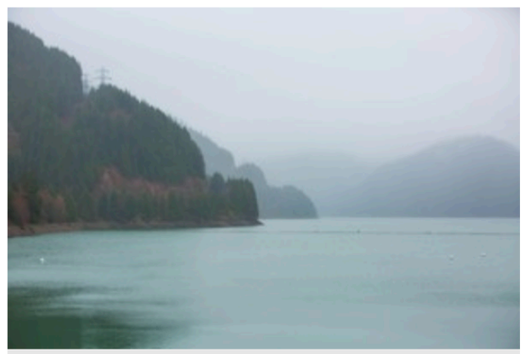

Detroit Lake in Detroit, Oregon, Saturday, March 18, 2017. Detroit Lake flows downstream into Salem's drinking water intake.

Bradley W. Parks/OPB

For the second time in two weeks, Salem is under a drinking water advisory, and there's very little the city can do about it.

Test results released Wednesday from water collected four days prior found an algae-produced toxin was present at levels deemed unsafe for certain groups to drink. It's left city and state residents asking how it happened and wondering if it will happen elsewhere.

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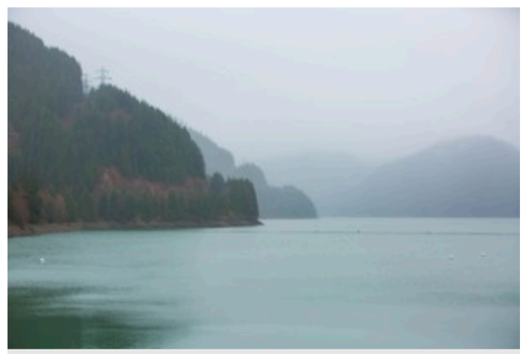

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Toxic algae blooms found in parts of Detroit Lake again, Oregon health officials warn

by KATU Staff | Wednesday, June 13th 2018

Detroit Lake. (KATU Photo)

Since 2018, the City of Salem…

… has invested in a water quality prediction system

— i.e. not just HAB detection

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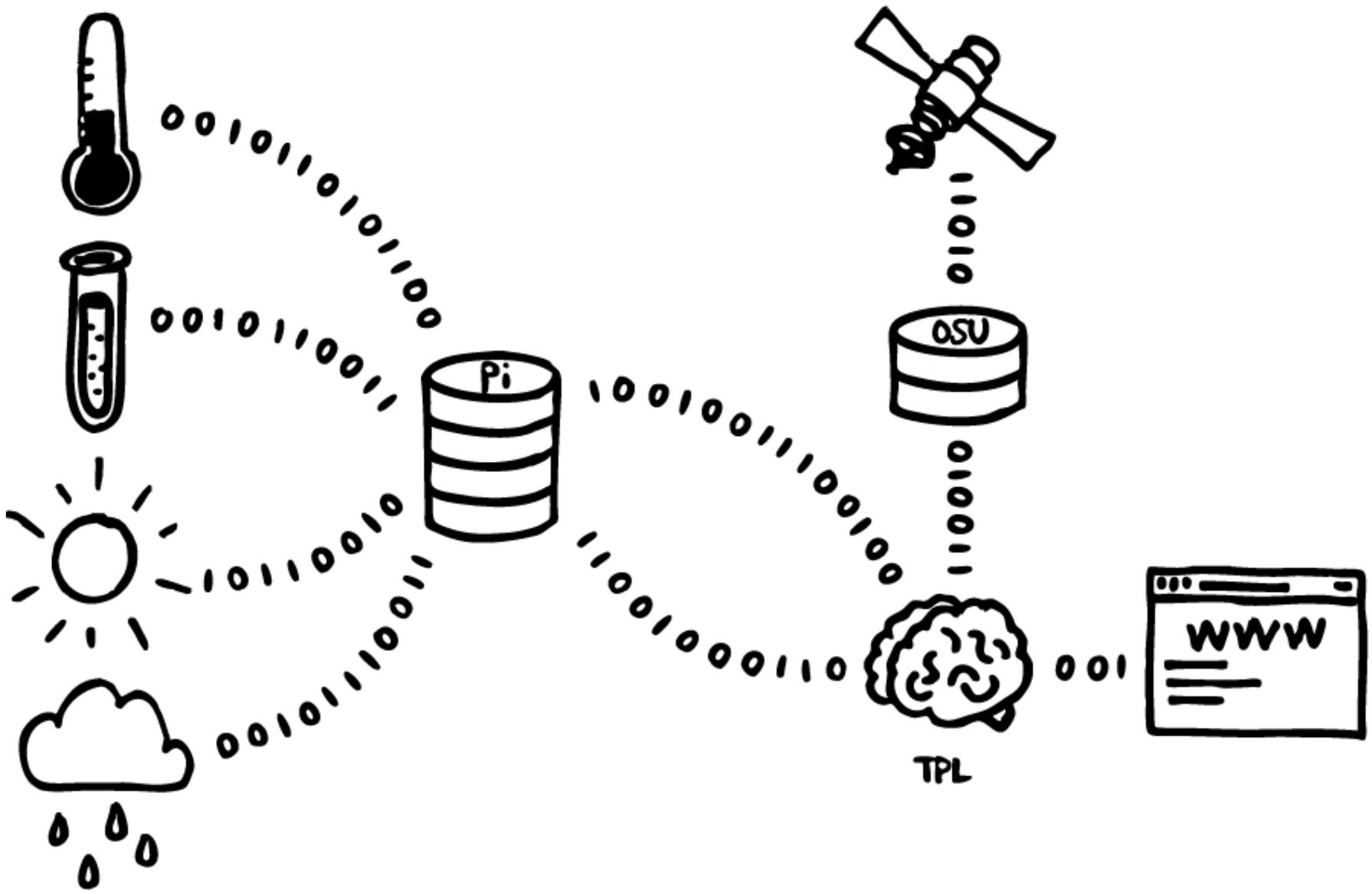

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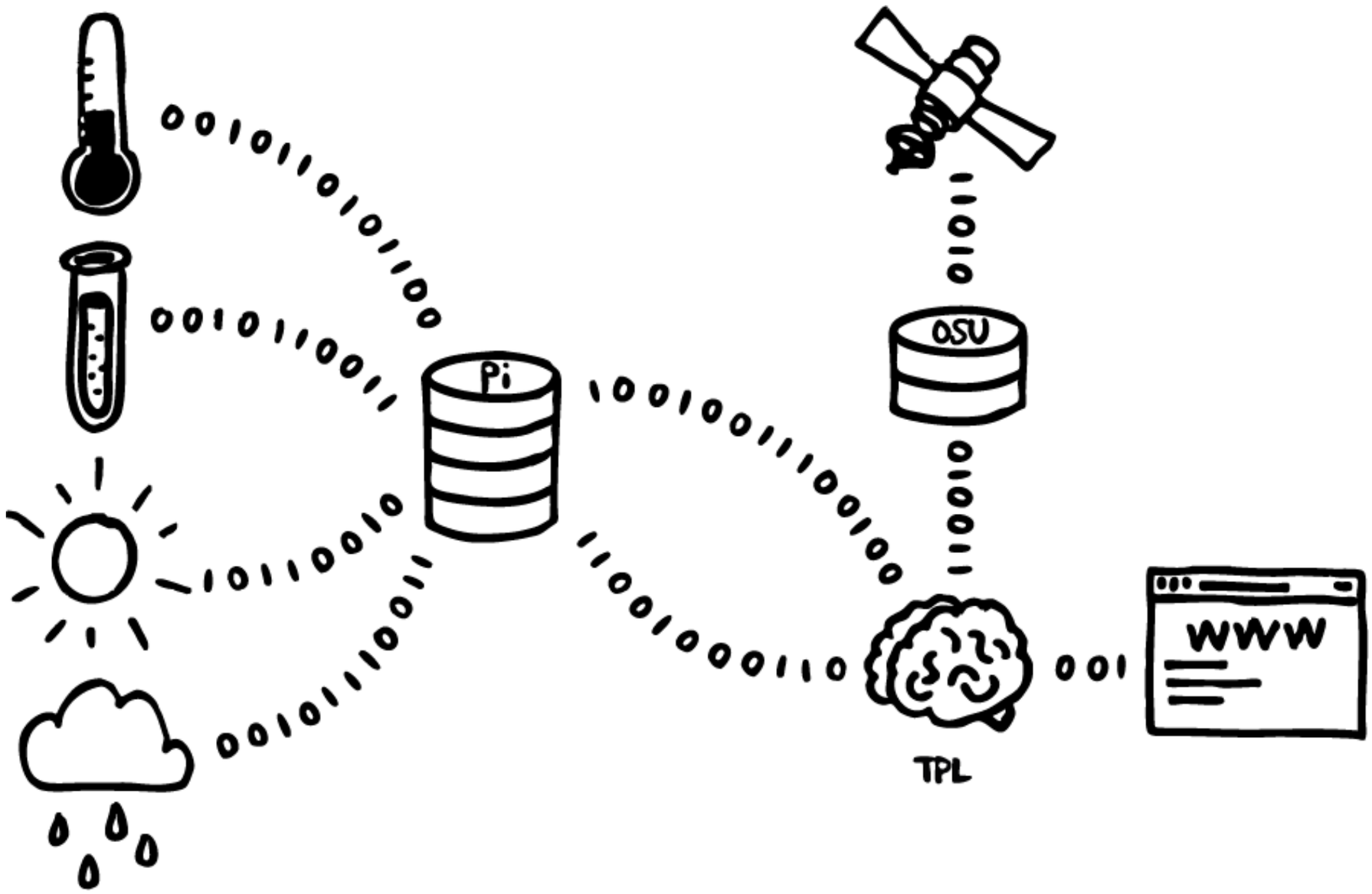

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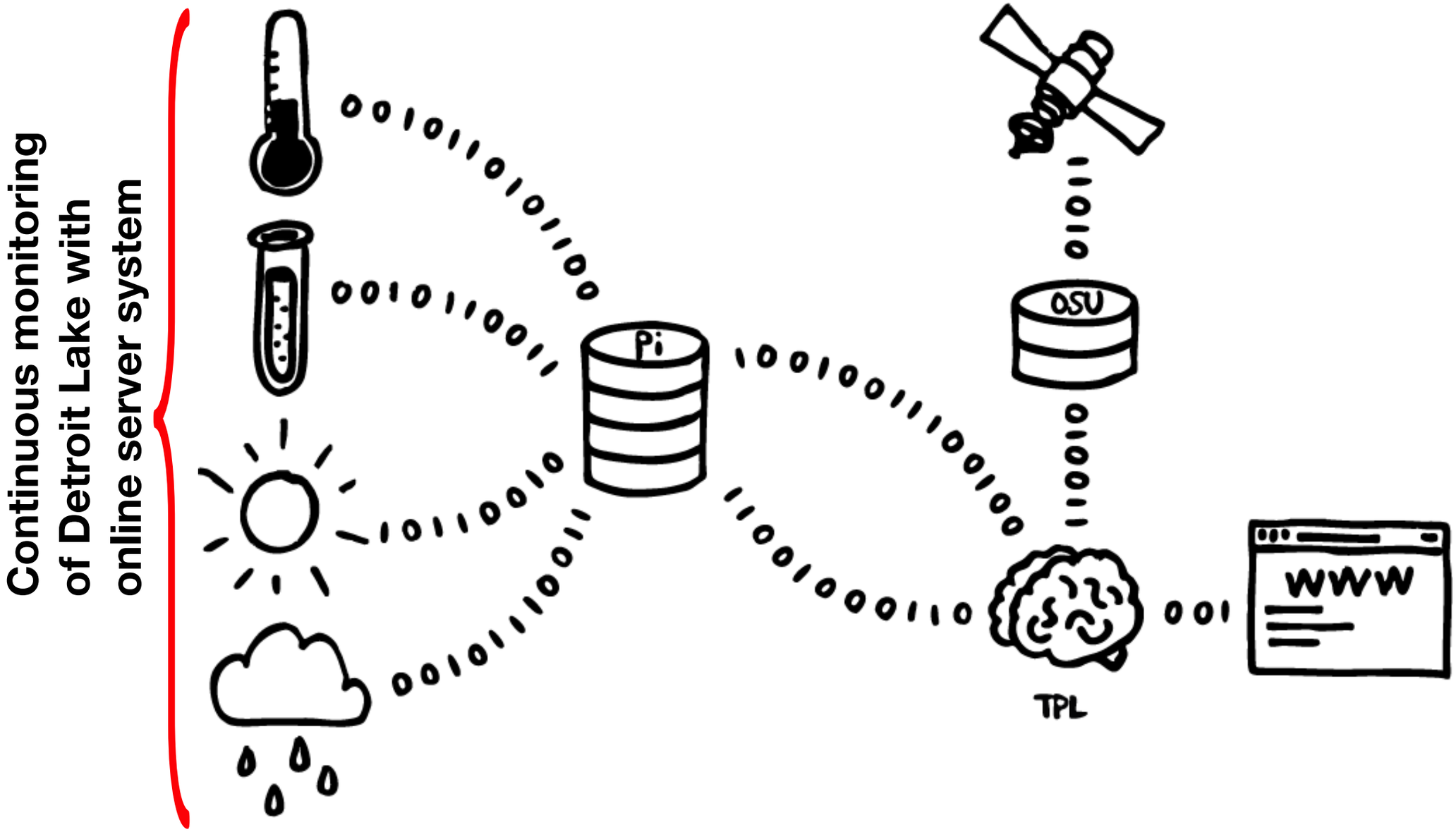

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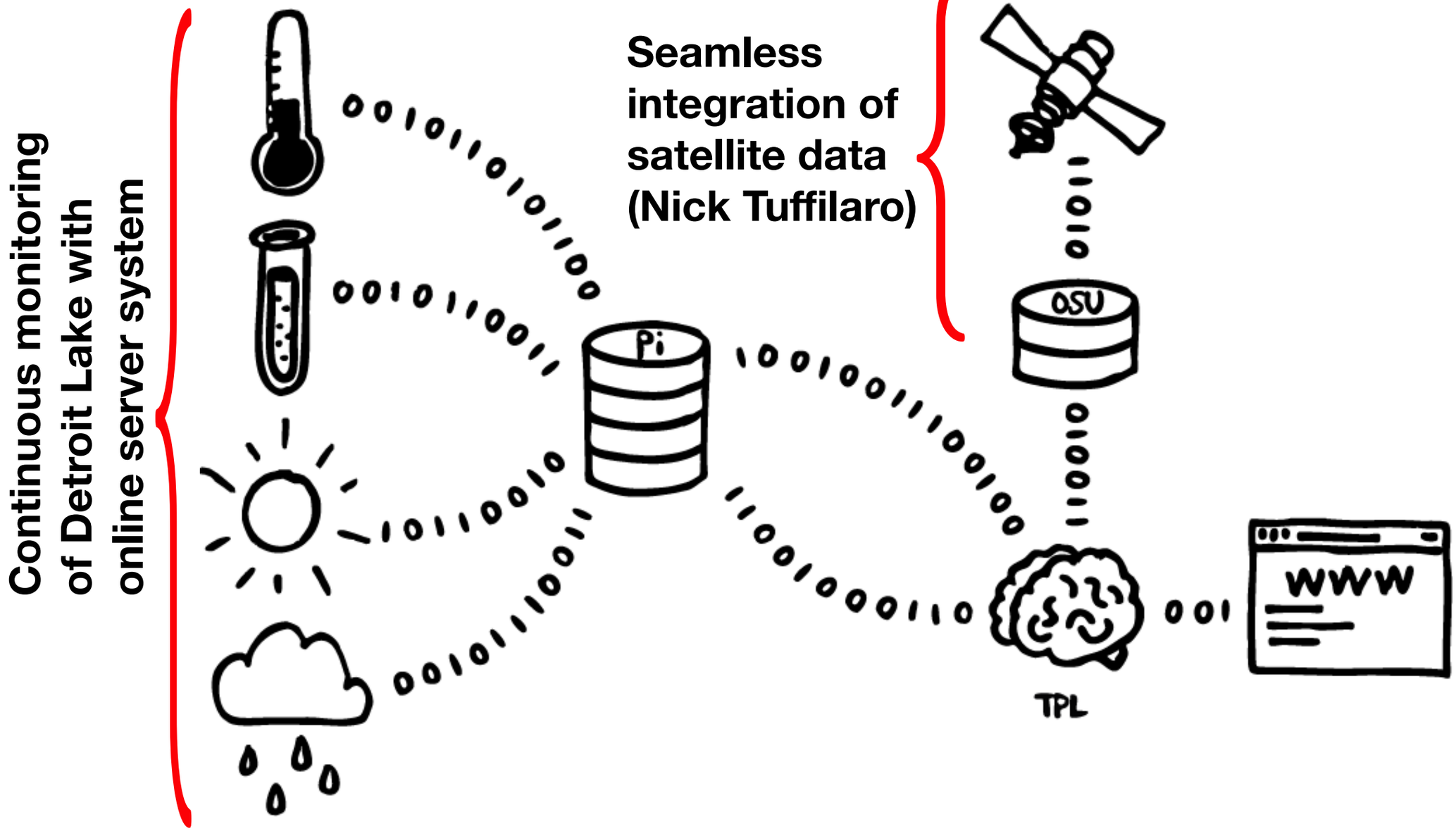

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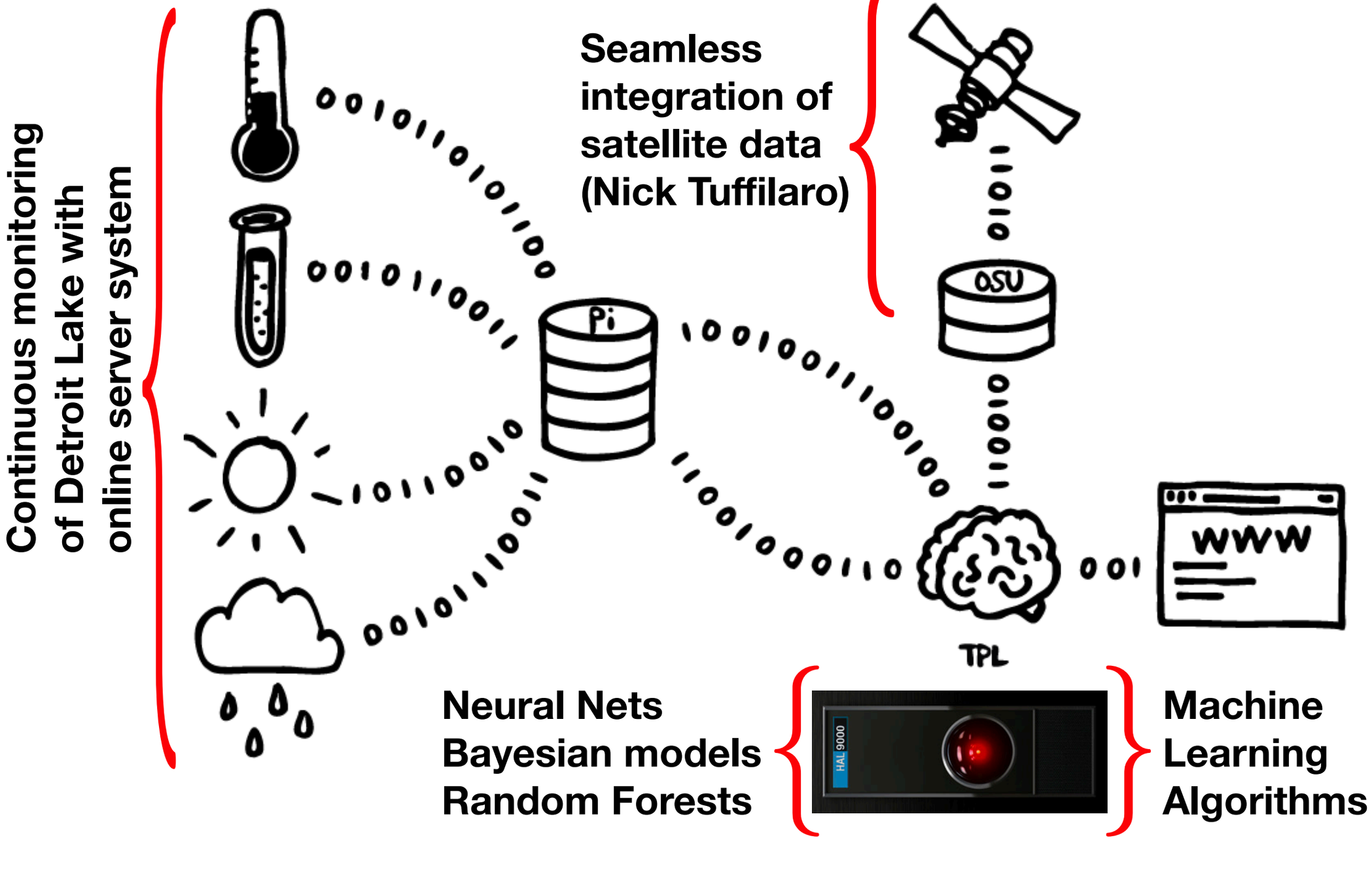

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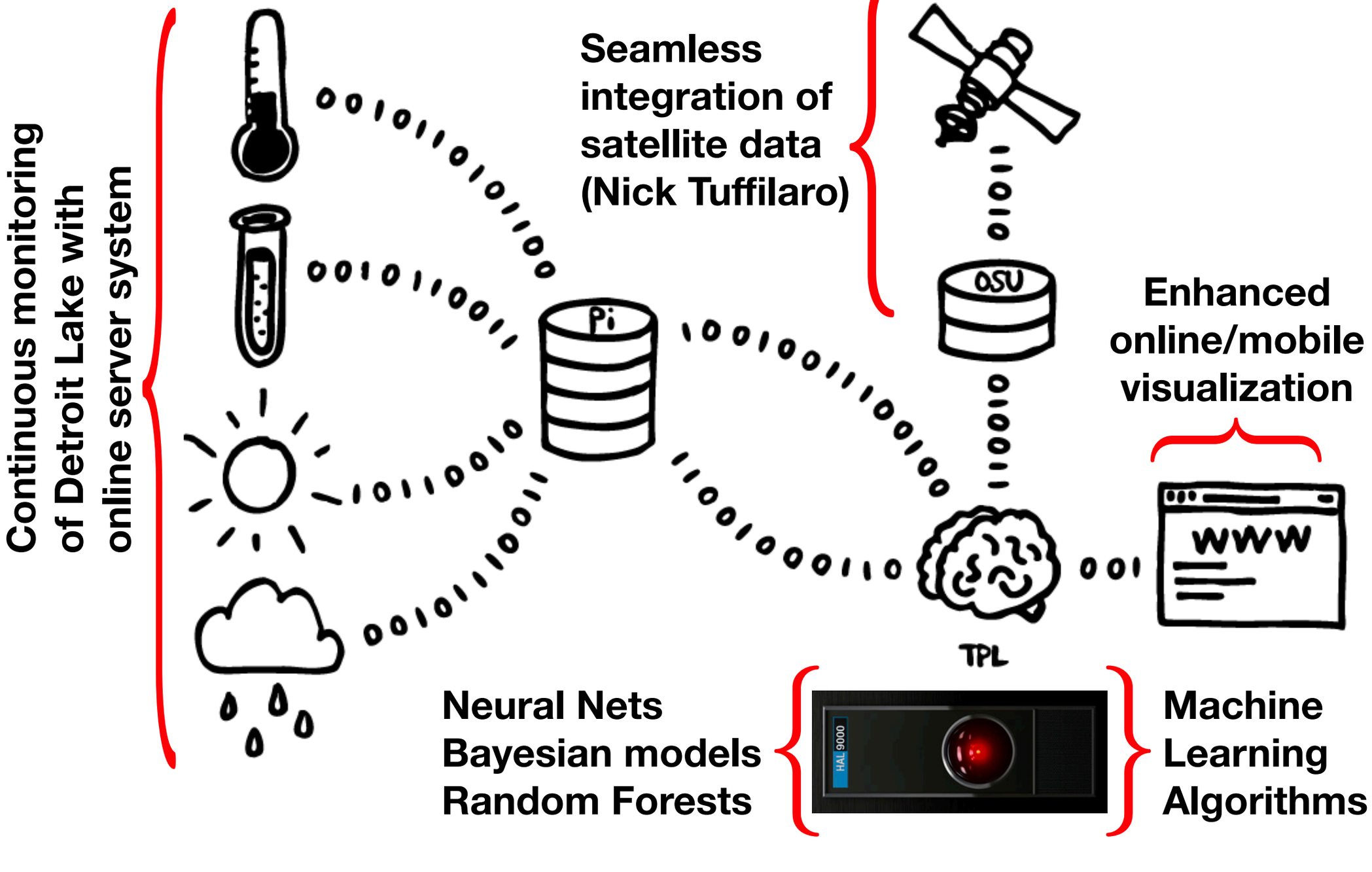

2019 HAB Season

The Prediction Lab & The City of Salem

Detroit Lake Predictions

An initiative to care for our water source

Bloom Forecast Mar 15-22

Our models suggest that in the next week lake conditions will most likely stay clear of harmful algae.

2019 HAB Season

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Detroit Lake Predictions

An initiative to care for our water source

Bloom Forecast Mar 15-22

Weekly 7-day forecasts of algal conditions in the lake using Bayesian Model Averaging

Our models suggest that in the next week lake conditions will most likely stay clear of harmful algae.

Bayesian Model Averaging

"All models are wrong, but some are useful" G. Box, a long time ago.

Bayesian model averaging for harmful algal bloom prediction

GRANT HAMILTON,[1,4] ROSS MCVINISH,[2] AND KERRIE MENGERSEN[3]

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[2]*Mathematics Department, The University of Queensland, Brisbane, Queensland 4072 Australia*
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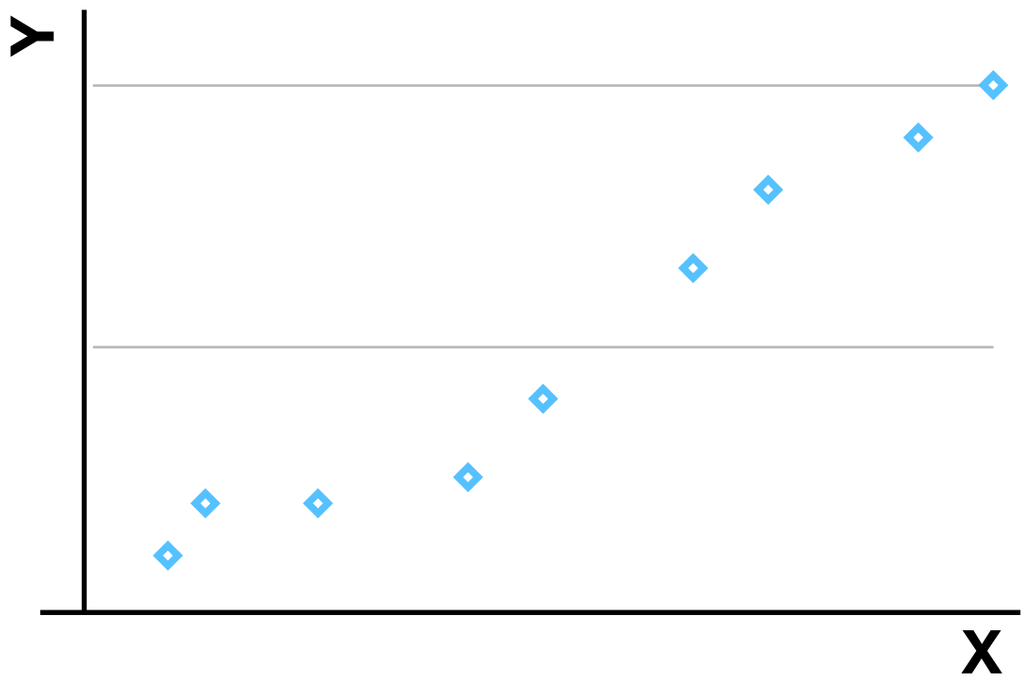

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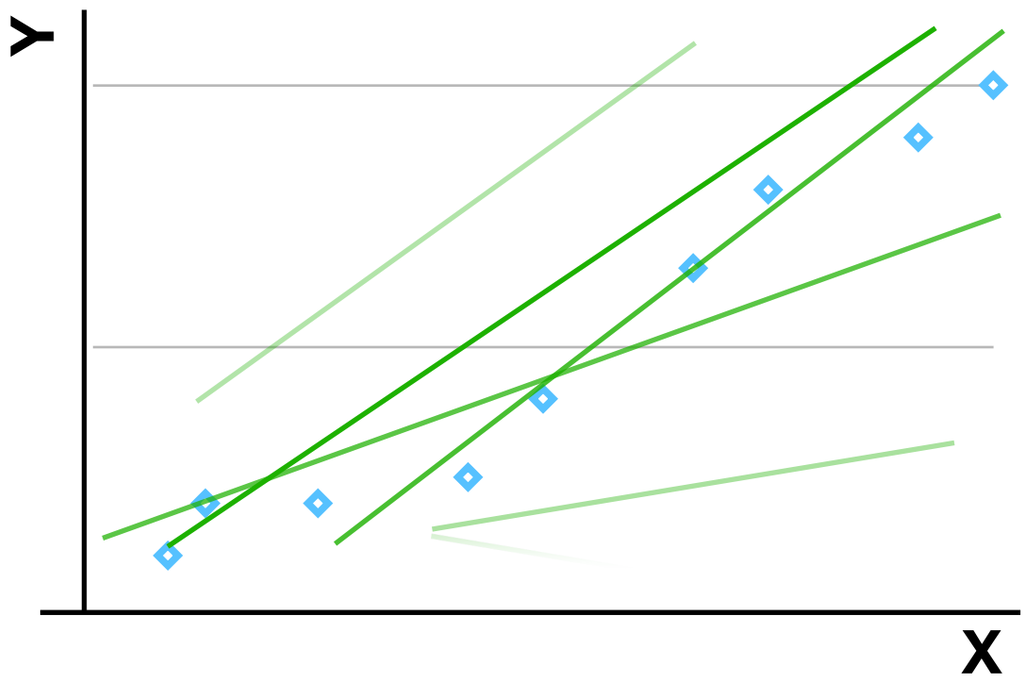

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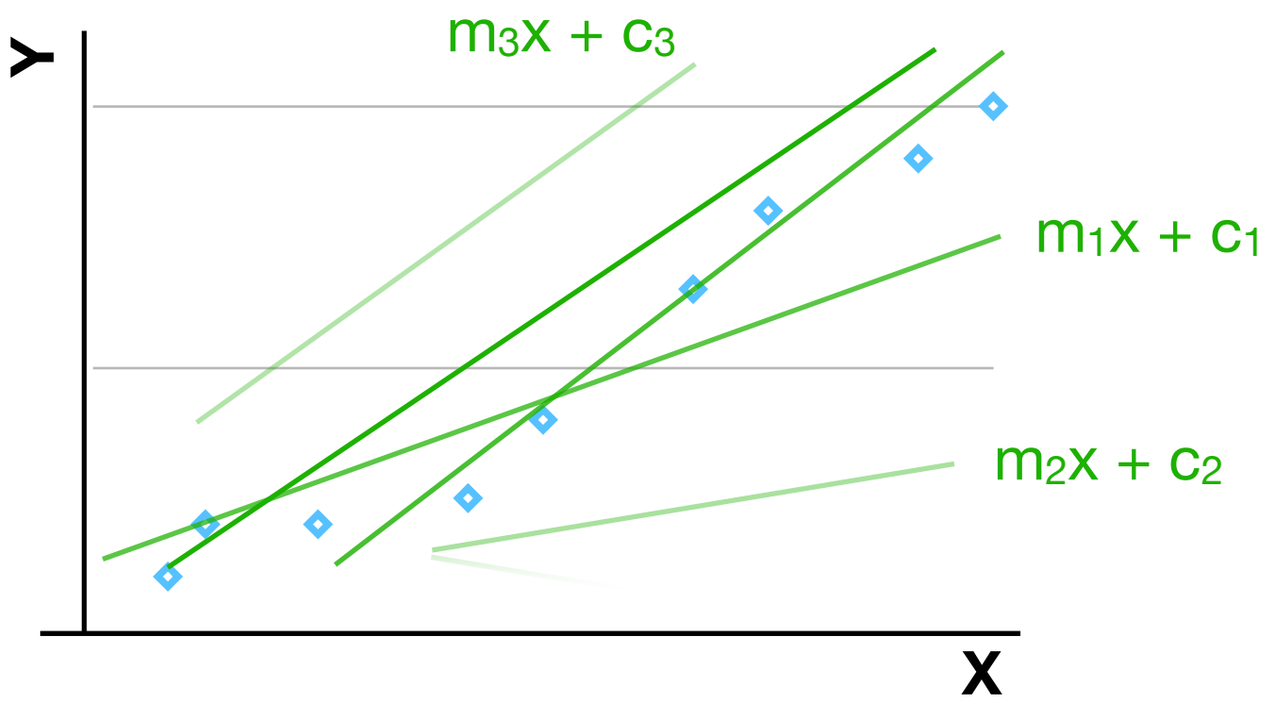

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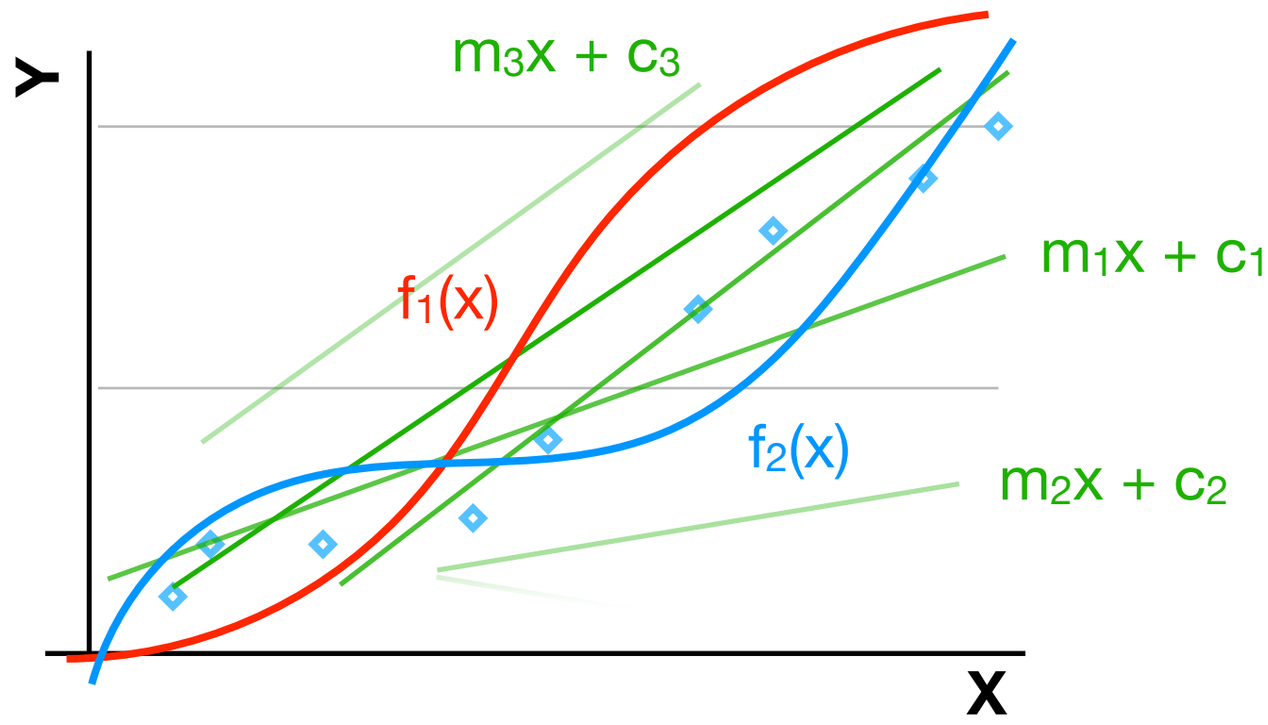

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Prediction =

β_1(model 1) +

β_2(model 2) +

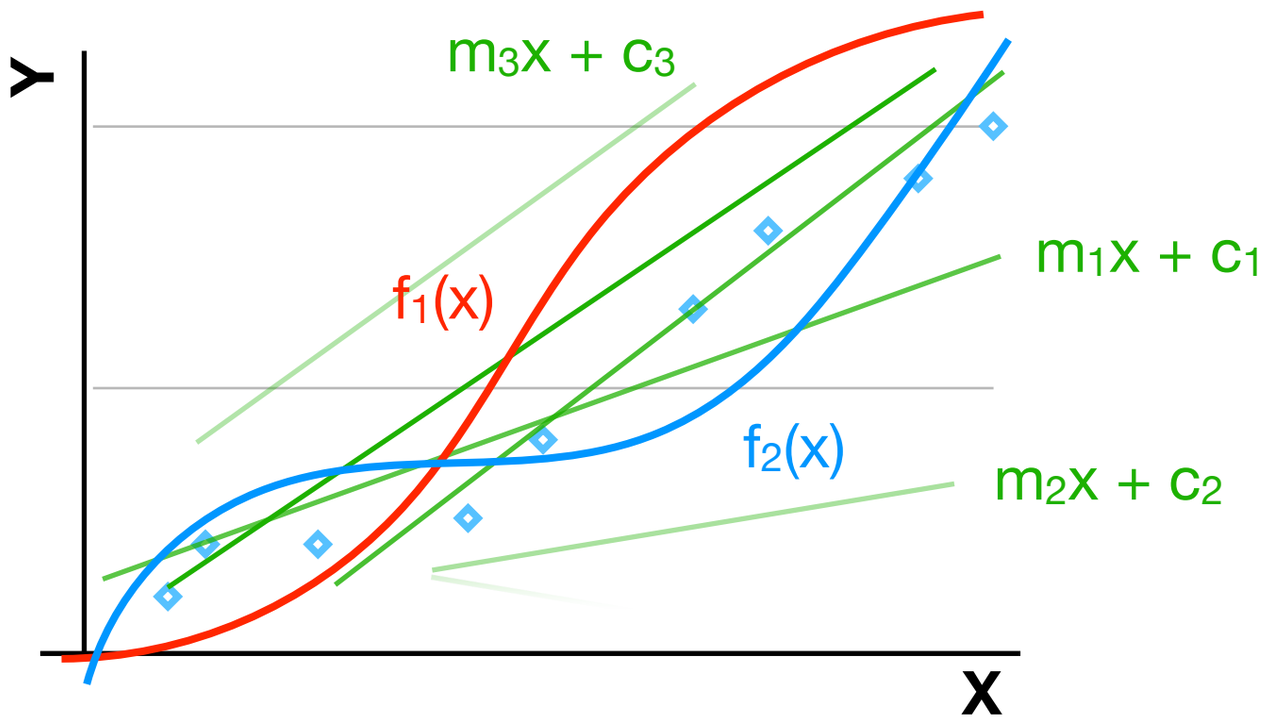
β_3(model 3) +

...

Phase 2: (neural nets)

(Random forests)

...



Bayesian Model Averaging

A prediction system that is flexible to the input data…

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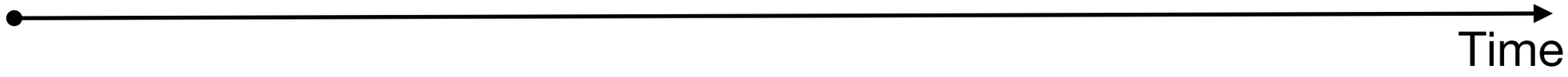

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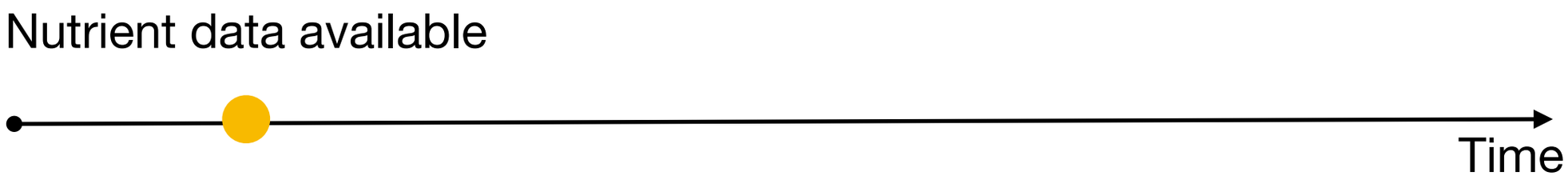

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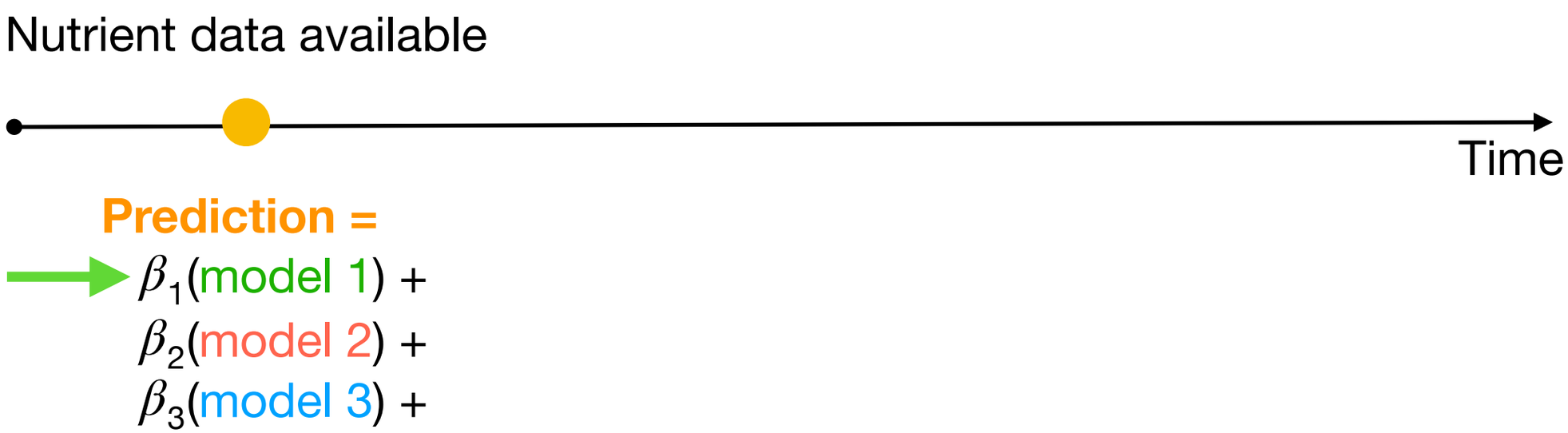

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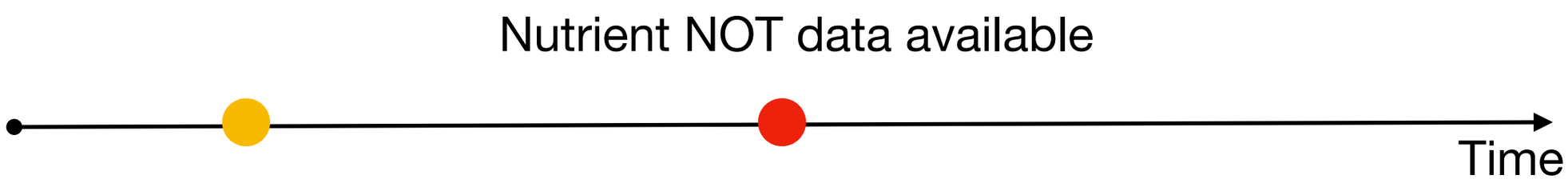

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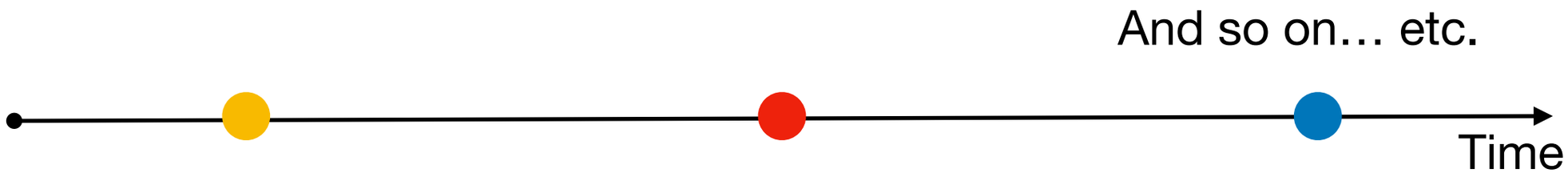

Prediction =

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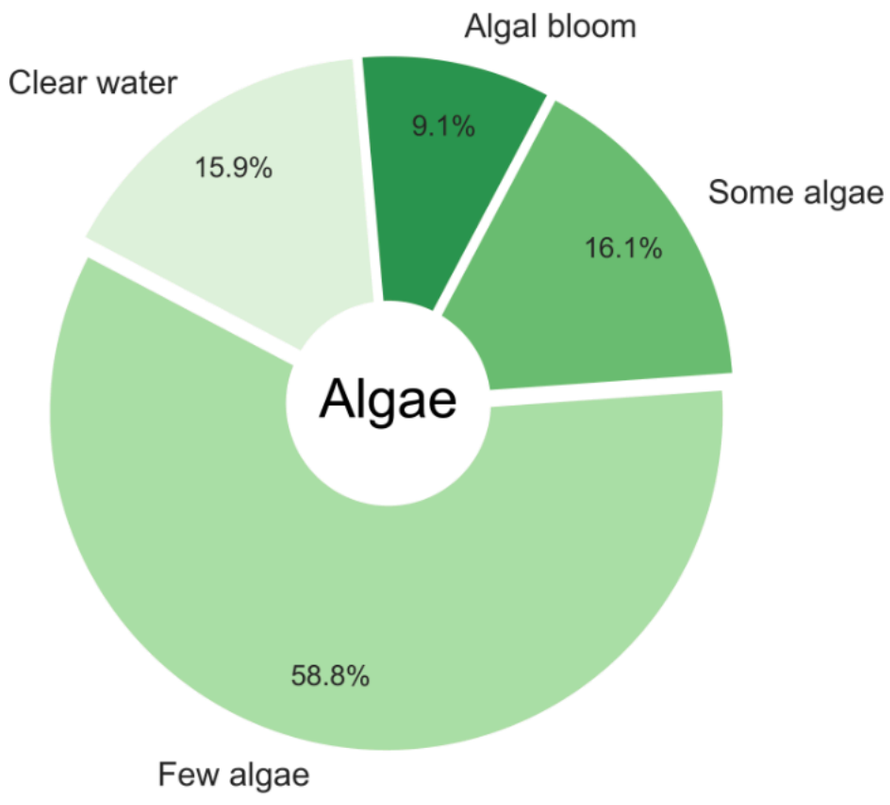
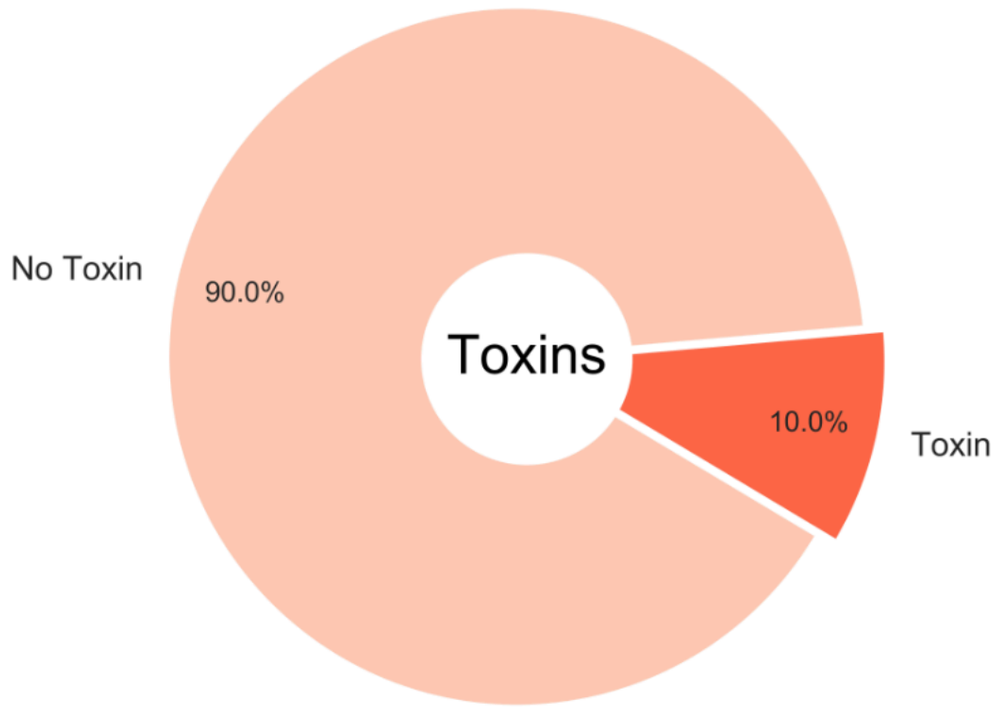
β_3(model 3) +

Machine Learning Predictions Weekly:

Bloom Forecast May 13 - May 20

Our models suggest that algae will remain abundant, and that toxins may occur.





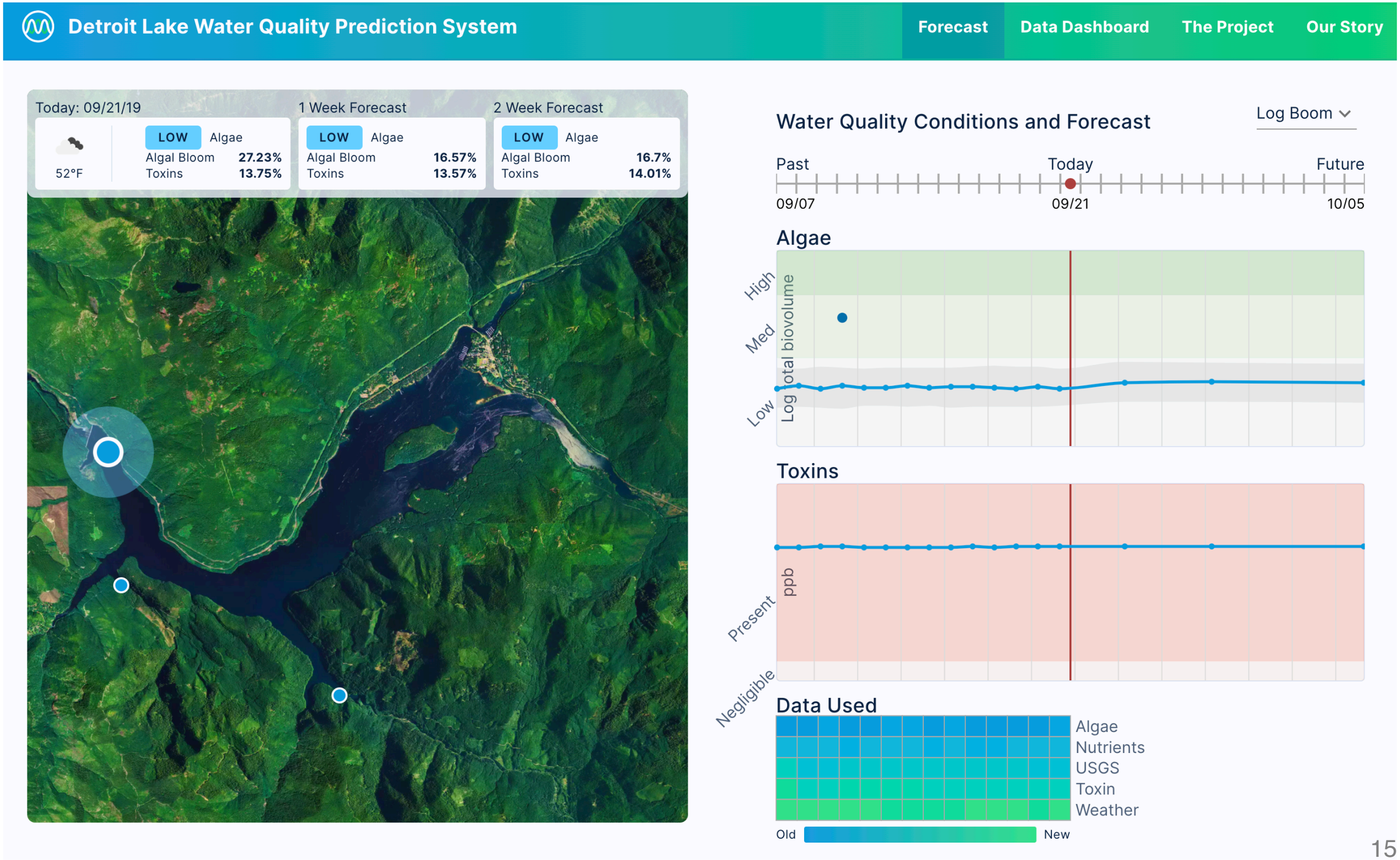
Probability of occurance (%) of different algal concentrations (left) and whether a toxin will be present in the water (right) in the next week (note that the toxin predictions are still highly experimental).

2020: Data and Modeling

For 2020, the City of Salem have expanded the operational HAB prediction product:

1. Expanded the BMA to include neural nets and other machine learning models
2. All data is now online (previously it was emailed), so near real-time updates are available
3. There is more data, including a continuous YSI vertical profiler

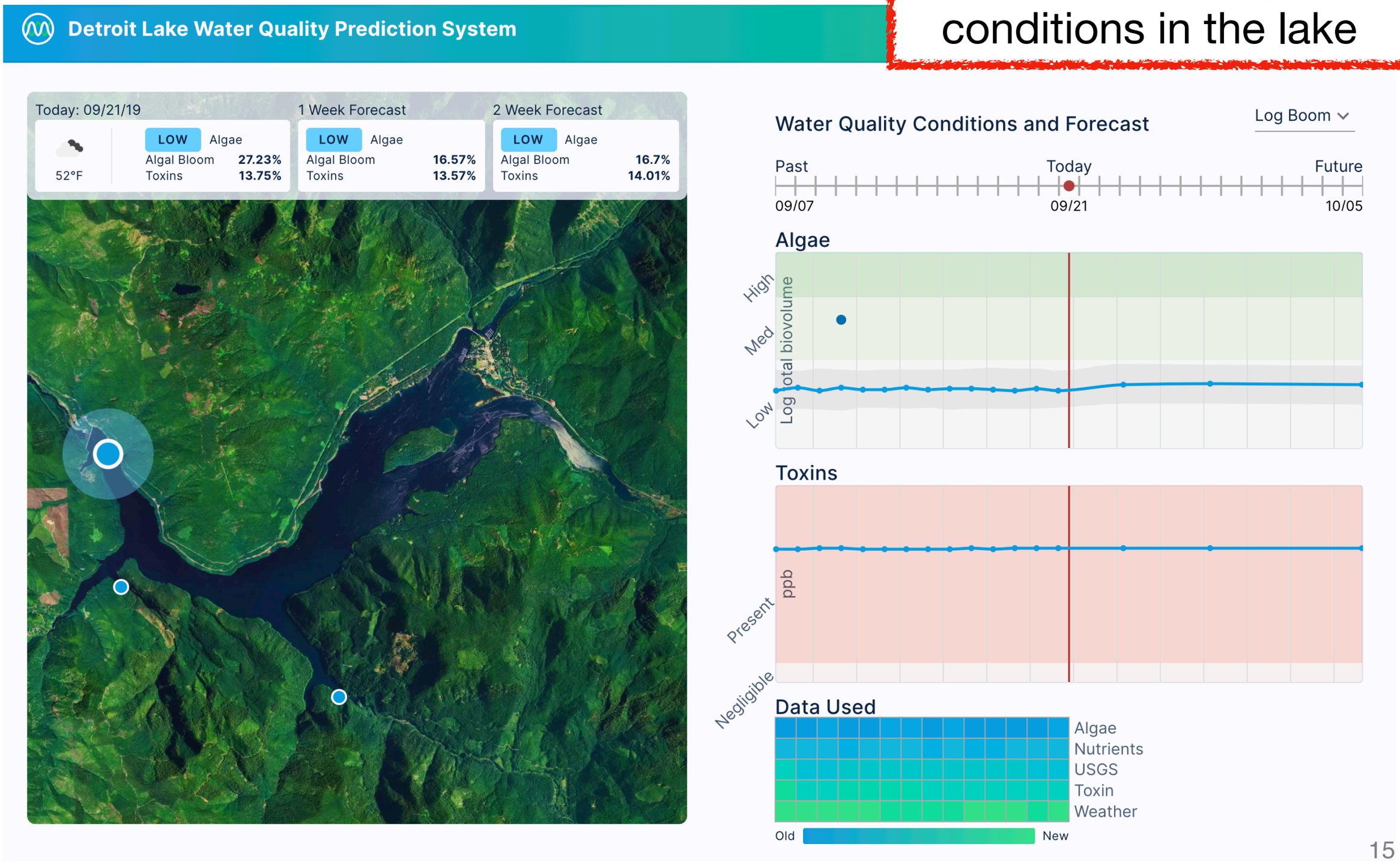
2020: Visualization



https://detroitlake.thepredictionlab.com/

2020: Visualization

3, 7 and 14-day forecasts of algal conditions in the lake



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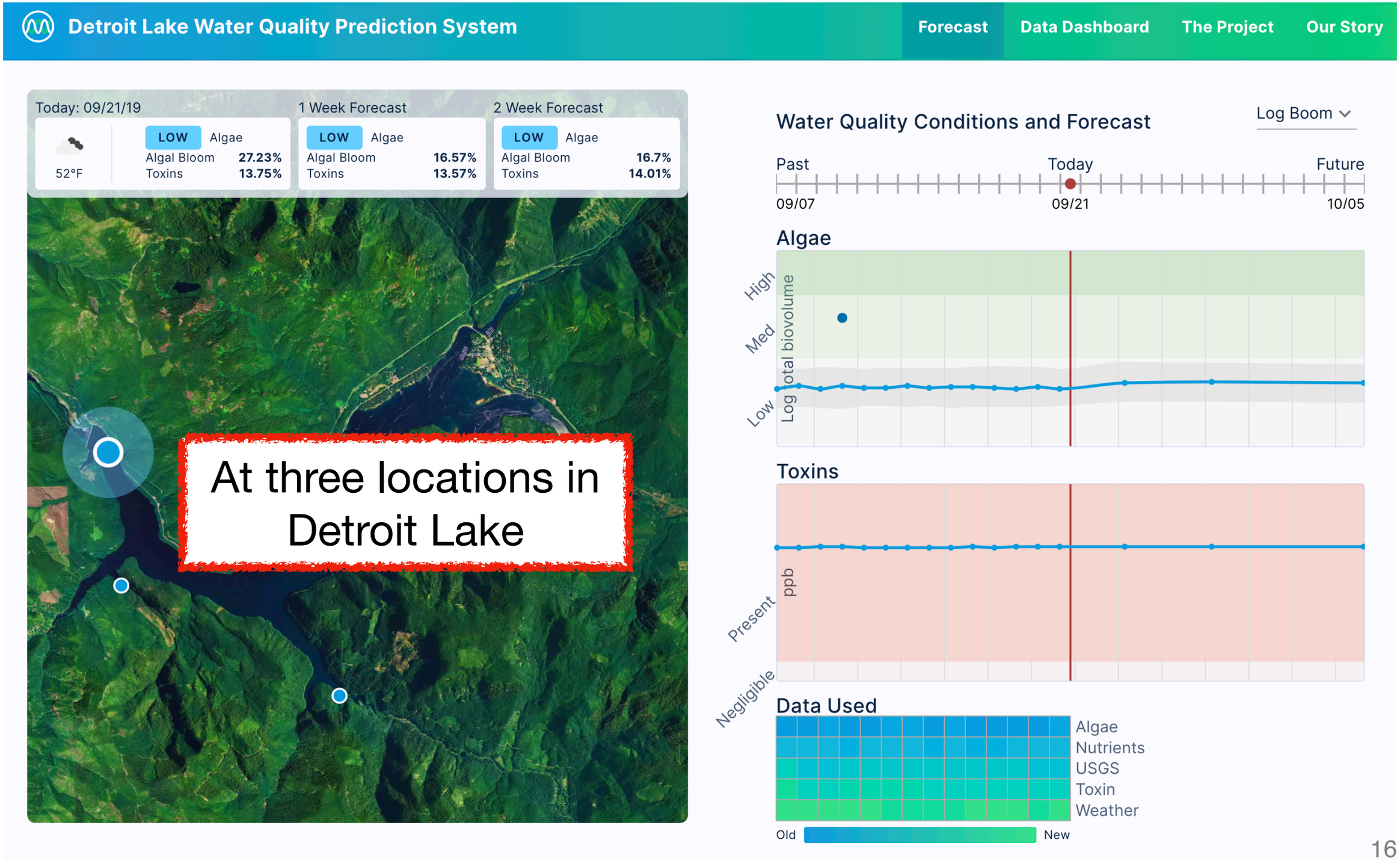

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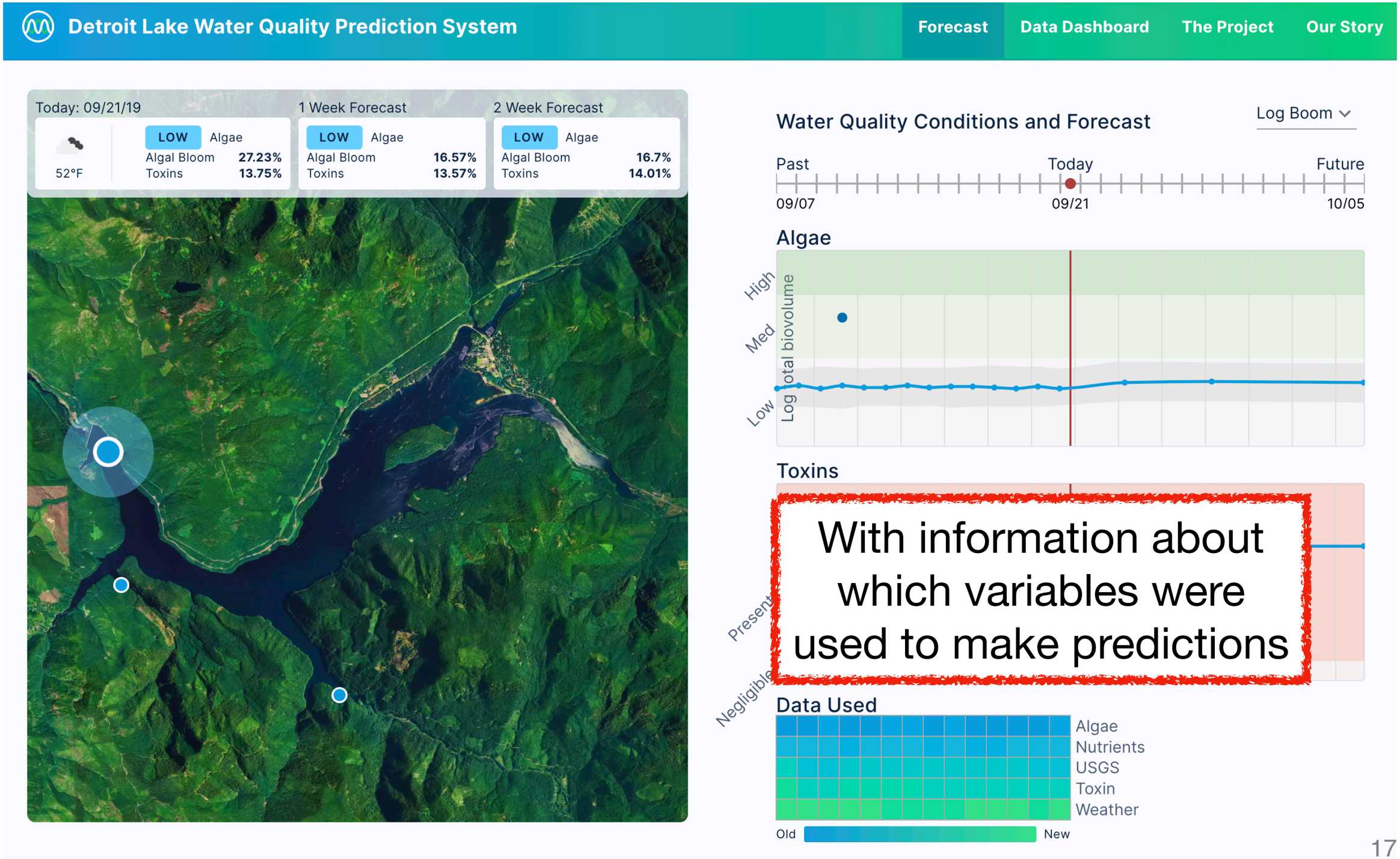

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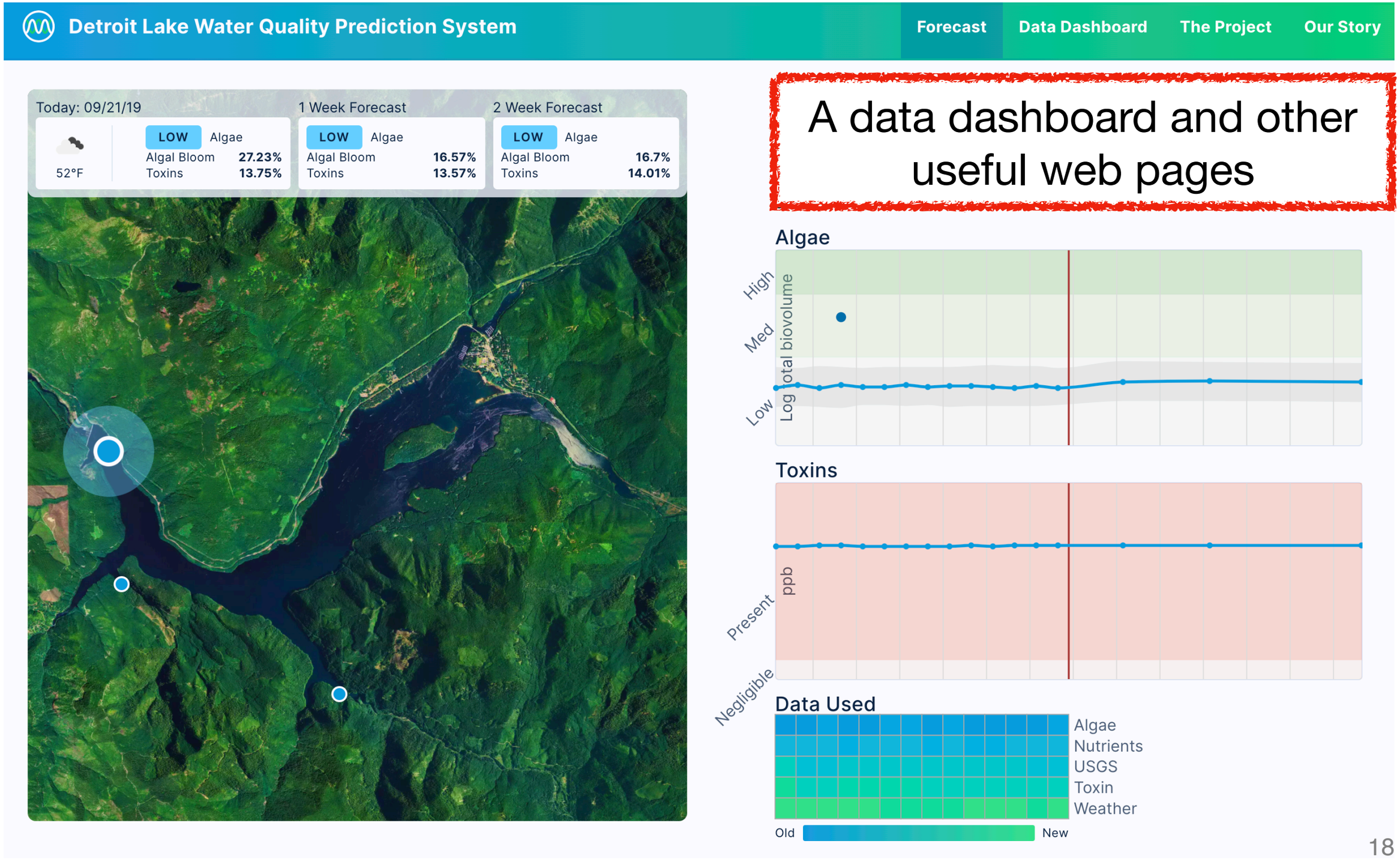

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2020: Visualization

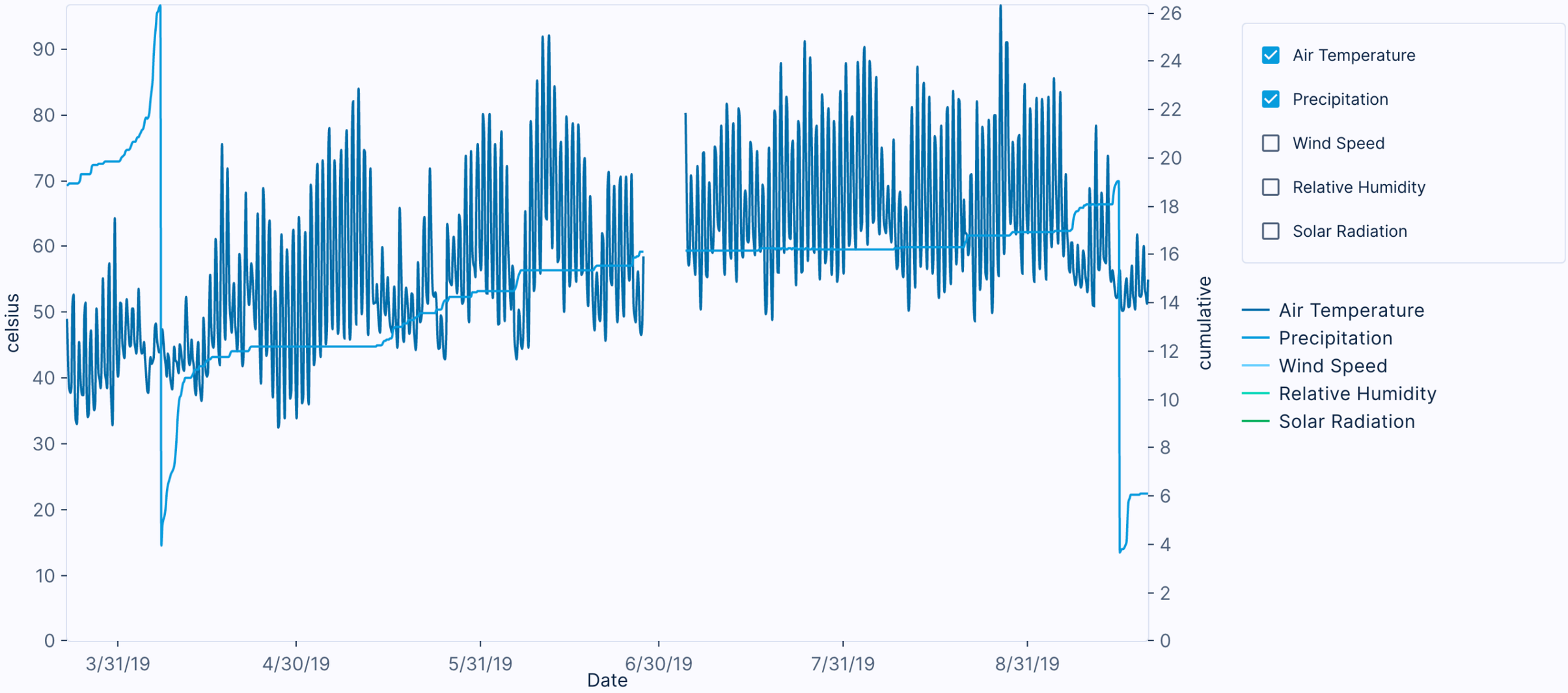
Detroit Lake Water Quality Prediction System

Forecast | Data Dashboard | The Project | Our Story

Weather & Stream Data

Weather and stream data collected continuously from the Detroit Ranger Station are shown below. Select different data and times on the right.

Date Range: Last 6 Months



2020: Visualization

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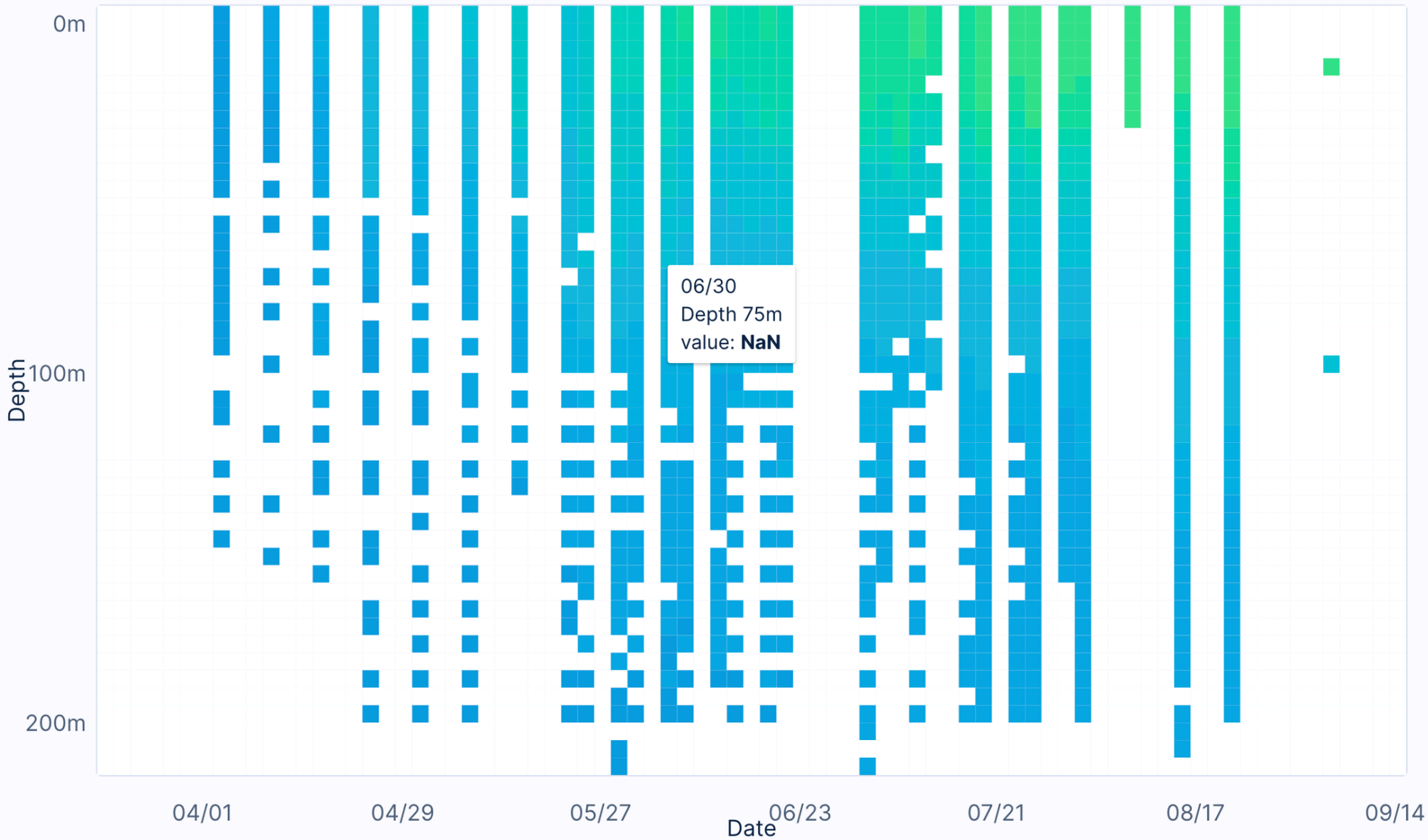
YSI Sampler Data

Data collected near the dam from a YSI sonde - a continuous water quality monitoring system - are shown below. The sonde goes up and down collecting data at a variety of depths for a number of important variables that you can select on the right. The colors in the plot indicate low to high levels of these variables at different depths (on the vertical axis of the plot) over time (on the horizontal axis of the plot).



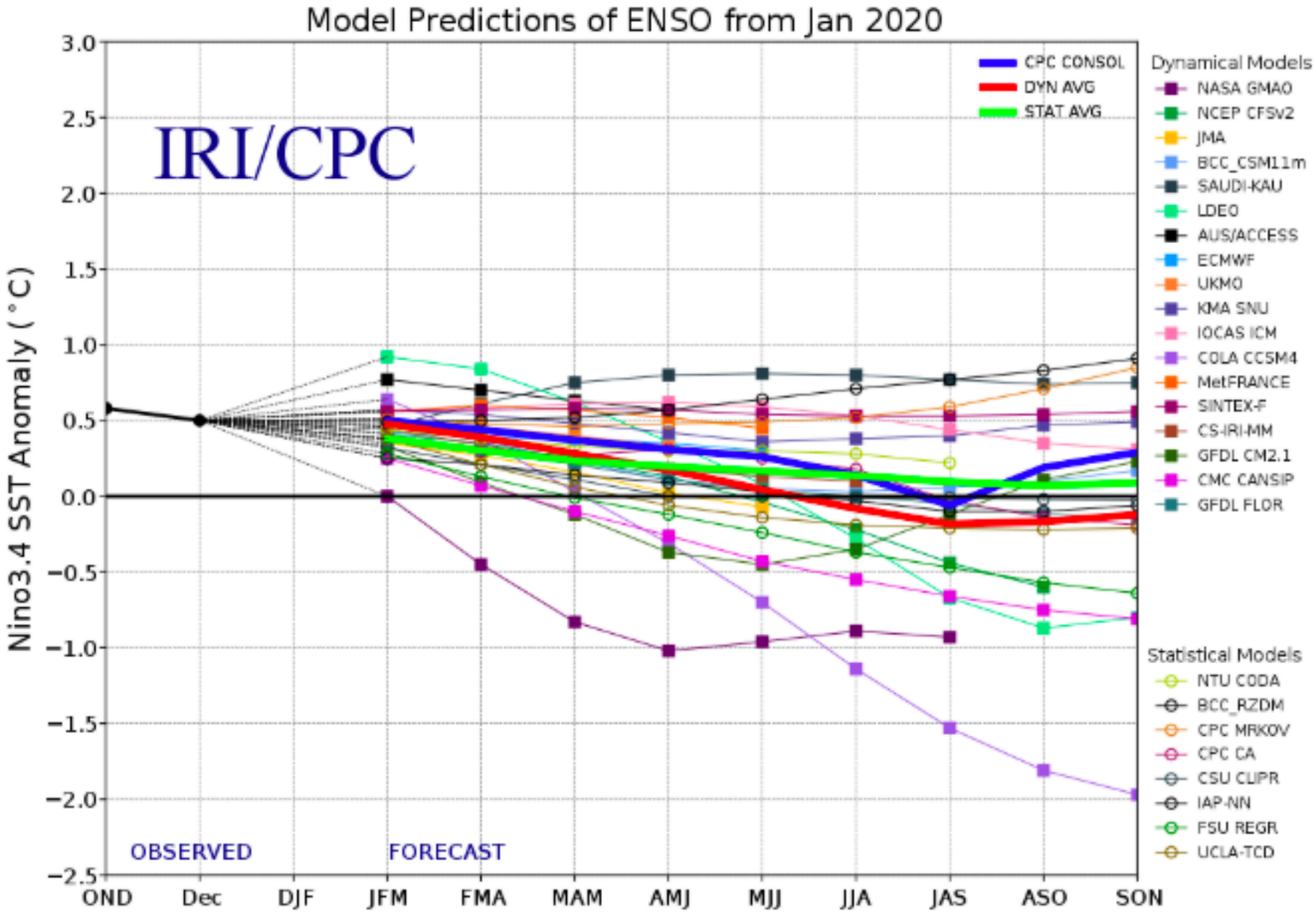
- Water Temperature
- Dissolved O2 (%)
- Chlorophyll-a (RFU)
- Turbidity (NTU)
- pH

Low — High

Next Steps

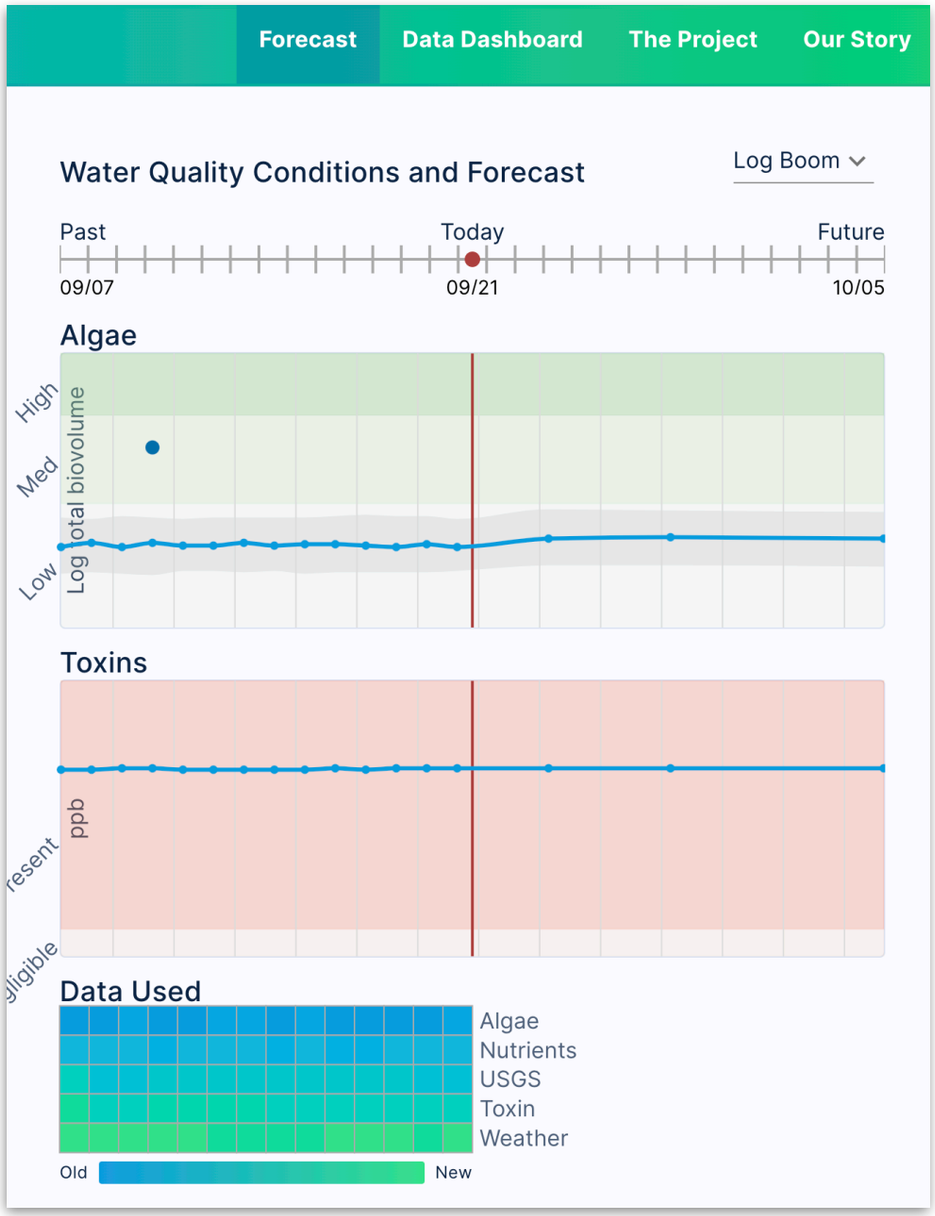
Next Steps: Seasonal Forecasts

— 6 month predictions of HAB frequency and duration based on climate forecasts



Next Steps: Regional Prediction System

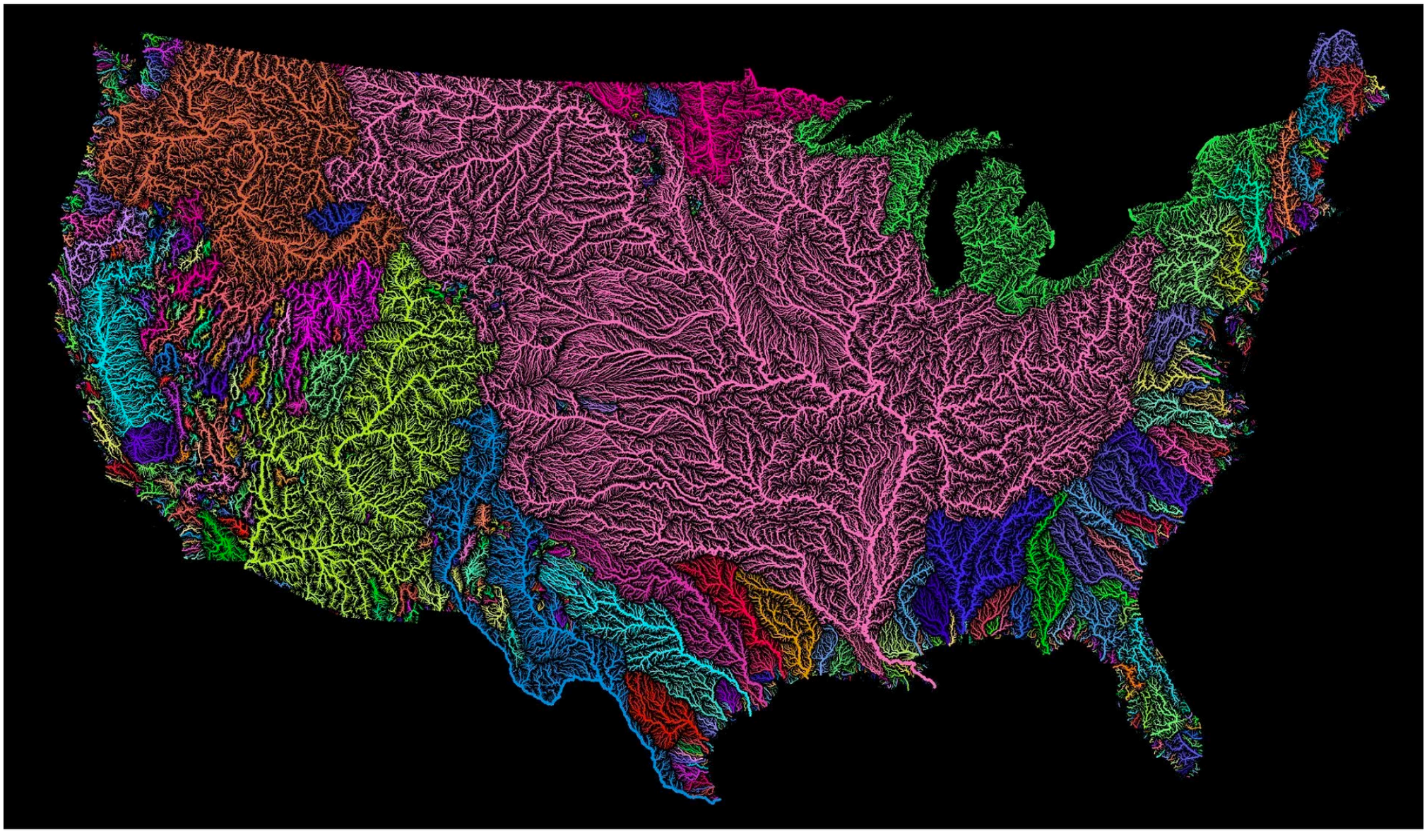
— Many municipalities collect data equivalent to those being collected at Detroit Lake



Expand predictions to temperature, turbidity, pH… etc

Next Steps: National Prediction System

— Synthesize and leverage national data
— Advance new **Transfer Learning** methods



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