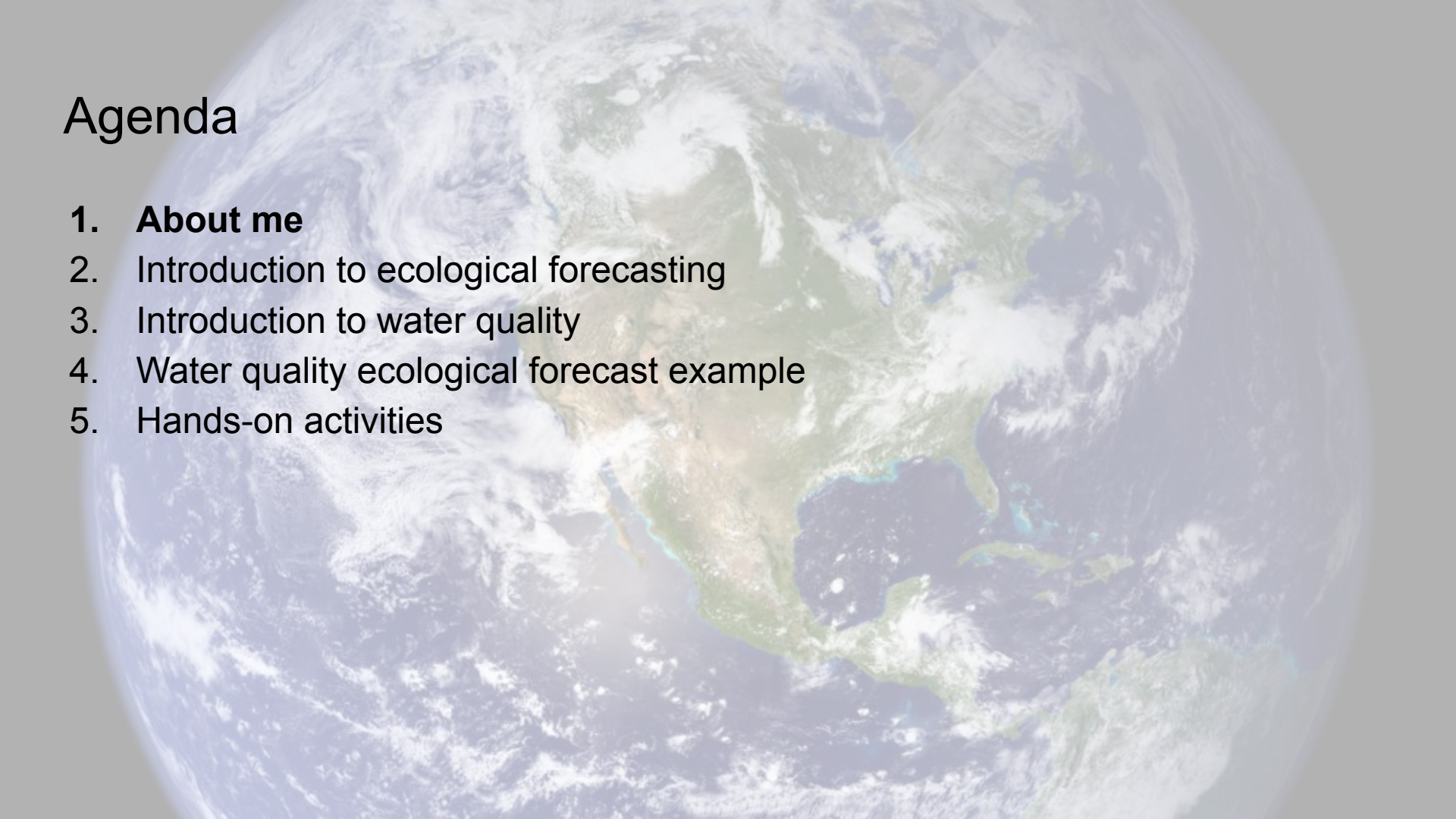
A satellite view of Earth showing the Americas and surrounding oceans, with text overlaid.

**Using environmental science to
make decisions about human
and ecosystem health**

Agenda

1. **About me**
2. Introduction to ecological forecasting
3. Introduction to water quality
4. Water quality ecological forecast example
5. Hands-on activities



Agenda

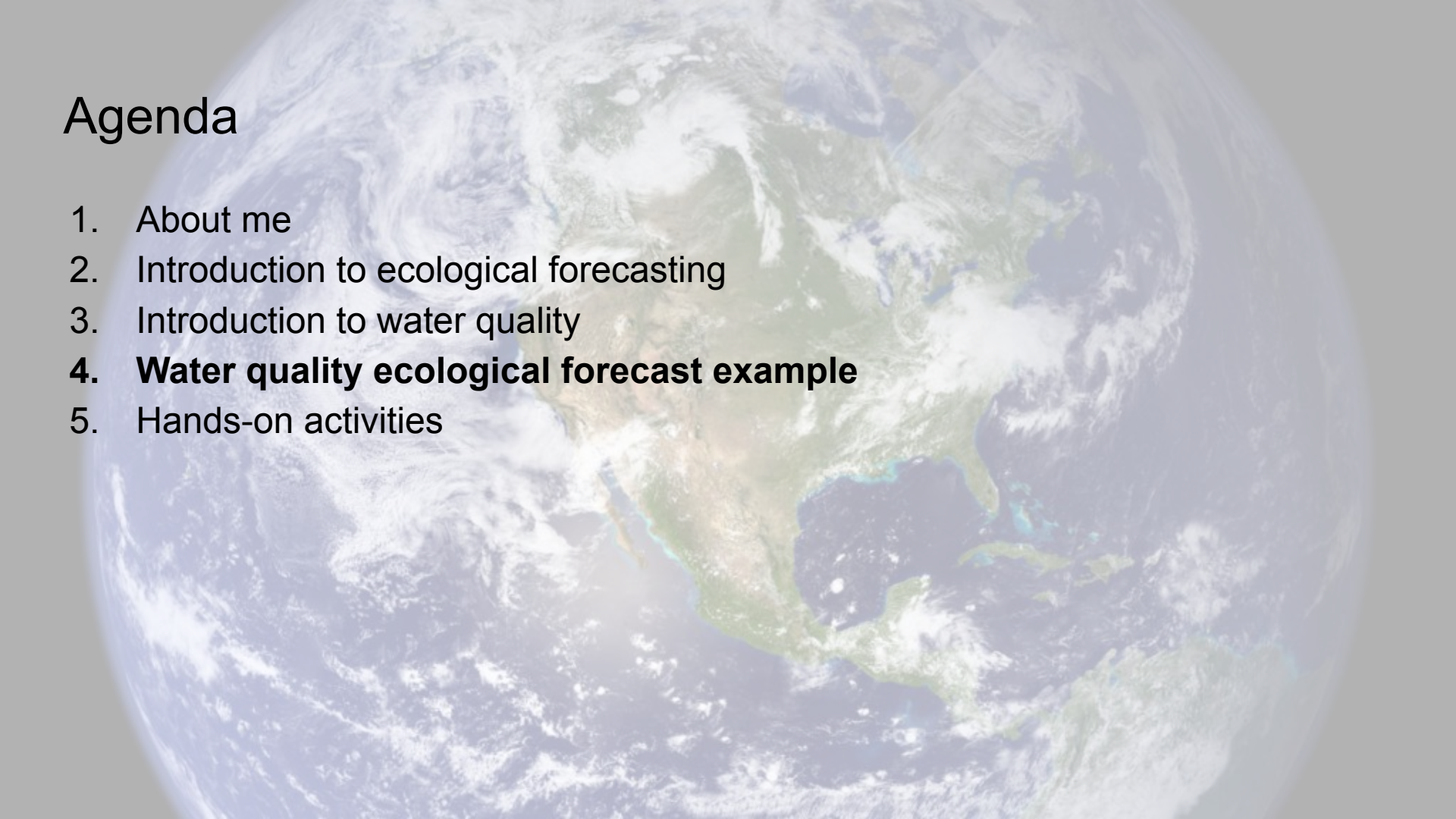
1. About me
2. **Introduction to ecological forecasting**
 - **What** is ecological forecasting?
 - **How** are ecological forecasts made?
 - **Why** are ecological forecasts helpful?
3. Introduction to water quality
4. Water quality ecological forecast example
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Agenda

1. About me
2. Introduction to ecological forecasting
3. **Introduction to water quality**
 - **What** do we mean by water quality?
 - **How** do we measure water quality?
 - **Why** do we care about water quality?
4. Water quality ecological forecast example
5. Hands-on activities

Agenda

1. About me
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3. Introduction to water quality
4. **Water quality ecological forecast example**
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Agenda

1. About me
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5. **Hands-on activities**
 - **Make decisions by interpreting ecological forecasts**
 - Create your own visualizations of ecological forecasts

Agenda

1. About me
2. Introduction to ecological forecasting
3. Ecological forecast example
4. **Hands-on activities**
 - Make decisions by interpreting ecological forecasts
 - **Create your own visualizations of ecological forecasts**



By this afternoon, you should be able to...

1. **Explain** in your own words what ecological forecasting is and why it's useful
2. **Explain** how ecological forecasting helps us manage water resources
3. **Interpret** graphs of water quality forecasts
4. **Create** visualizations to communicate water quality forecasts to different audiences

Career journey → Ecological forecasting



1. **What** is ecological forecasting?
2. **How** are ecological forecasts made?
3. **Why** is ecological forecasting useful?

Ecological forecasting

What?

*A discipline focused on making **predictions** about ecosystems and their components, similar to **weather forecasting**.*

Ecological forecasting

What?

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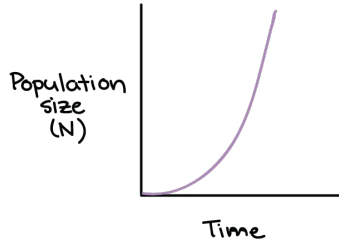
How?

$$\frac{dN}{dt} = rN$$

Exponential growth

Per capita growth rate (r) doesn't change, even if pop. gets very large.

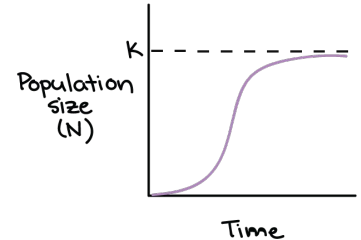
$$\frac{dN}{dt} = r_{\max} N$$



Logistic growth

Per capita growth rate (r) gets smaller as pop. approaches its max. size.

$$\frac{dN}{dt} = r_{\max} \left(\frac{K-N}{K} \right) N$$

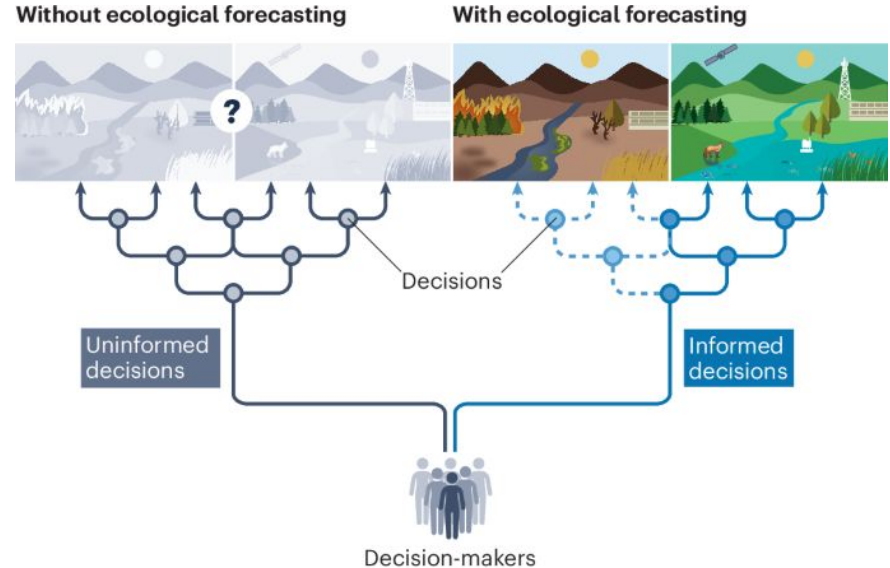


Ecological forecasting

What?

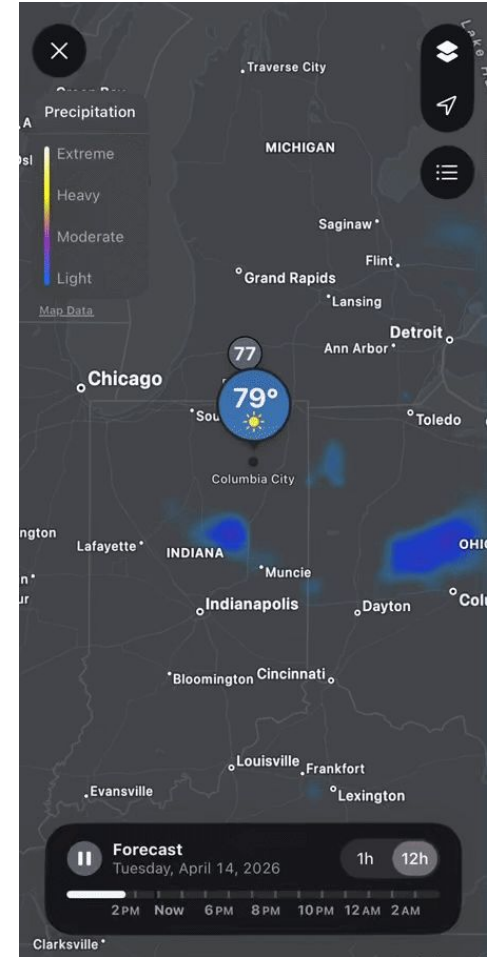
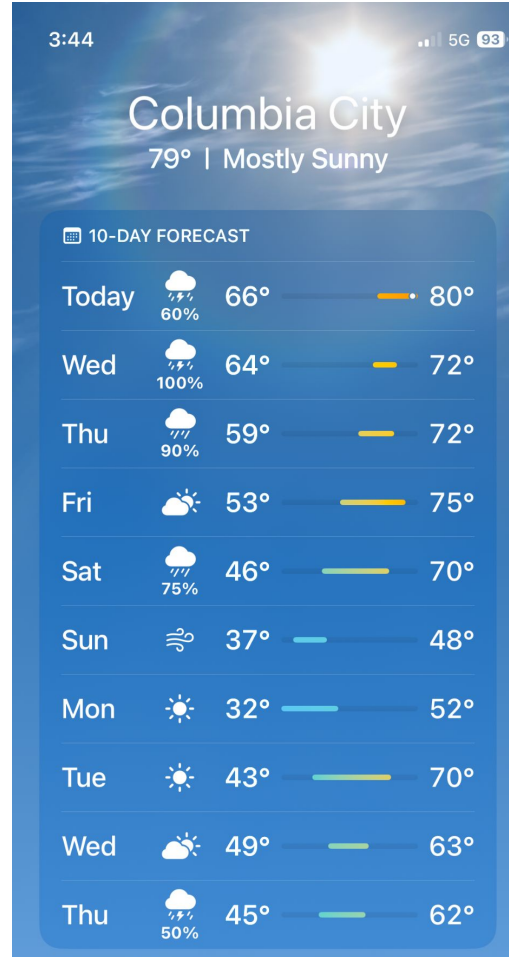
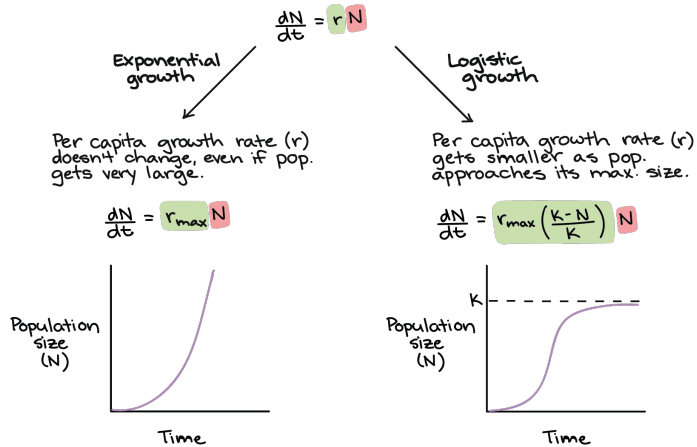
*A discipline focused on making **predictions** about ecosystems and their components, similar to **weather forecasting**.*

Why?



A forecast includes...

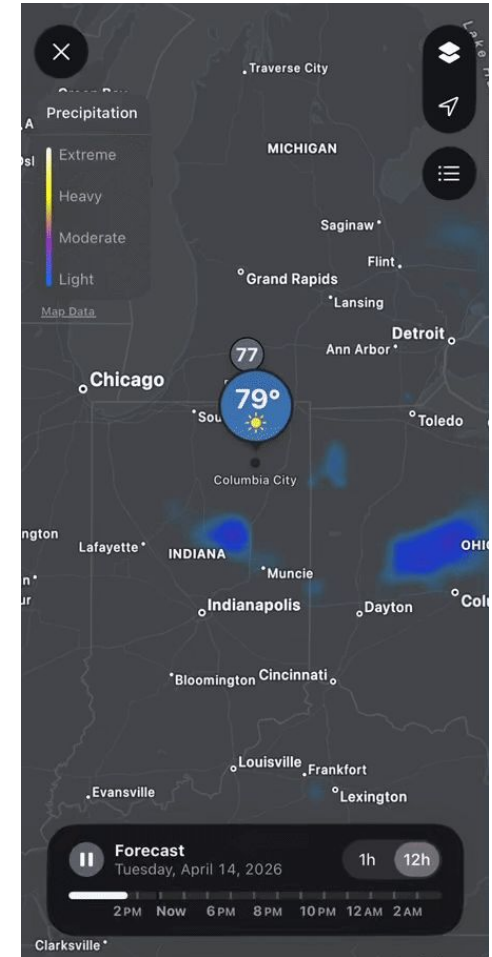
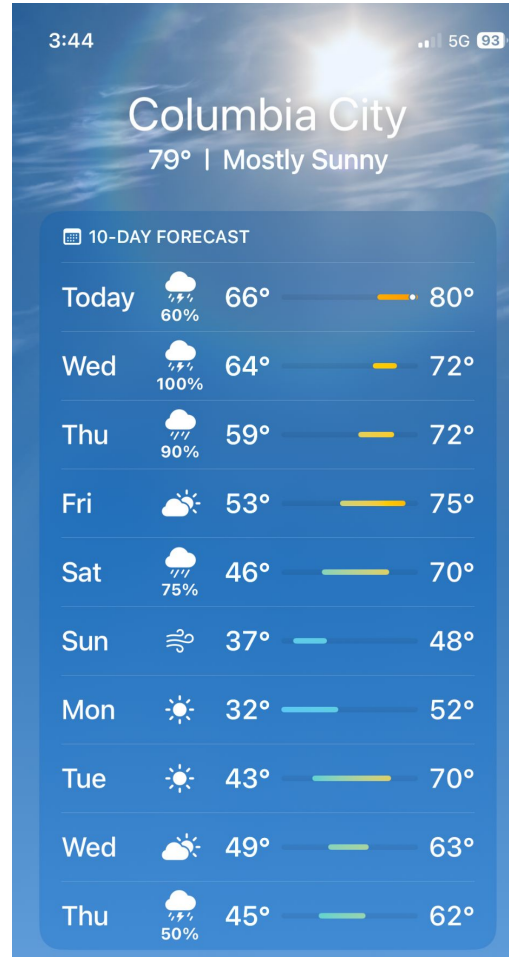
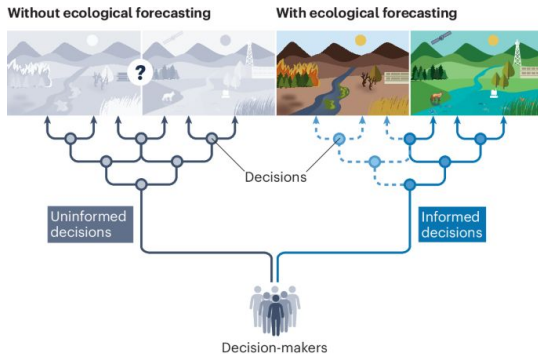
1. A prediction
2. The uncertainty



A forecast includes...

1. A prediction
2. The uncertainty

And the forecast is **actionable**



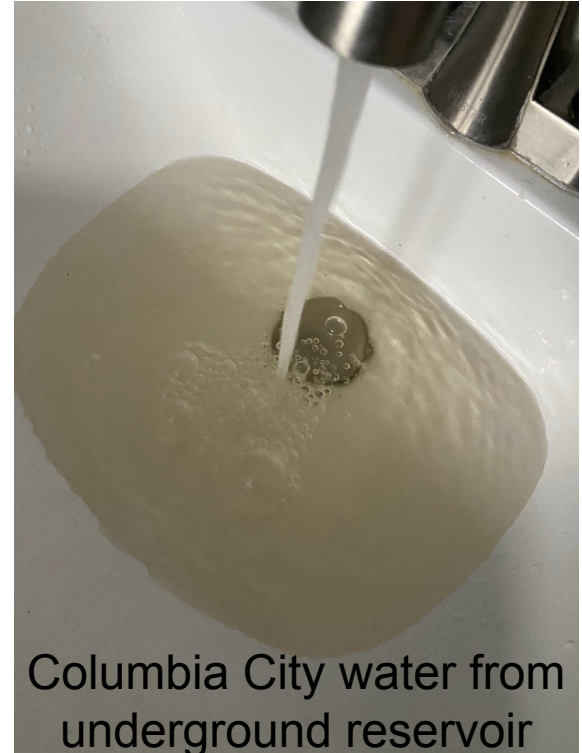
Something we might want to predict: water quality

- **What:** Water quality measures the health of water resources (lakes, rivers, ...) for supporting uses of the water by organisms, including humans
- Some natural and man-made causes of bad water quality:
 - Chemicals reacting with organic material in the water (produce toxic byproducts)
 - Algal blooms (produce toxins and decrease oxygen in water)



Something we might want to predict: water quality

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 - **Algal blooms (produce toxins and decrease oxygen in water)**



Something we might want to predict: water quality

How do we measure water quality?

- **Higher** concentrations of **algae** & **cyanobacteria**
- **Lower** water quality (higher toxin concentrations and lower oxygen)
- **Measure** concentration of **chlorophyll-a** (**chl-a**), the photosynthetic pigment in algae & cyanobacteria
 - Higher chlorophyll-a → lower water quality
 - Lower chlorophyll-a → higher water quality



Something we might want to predict: water quality

Why do we care about water quality?

Something we might want to predict: water quality

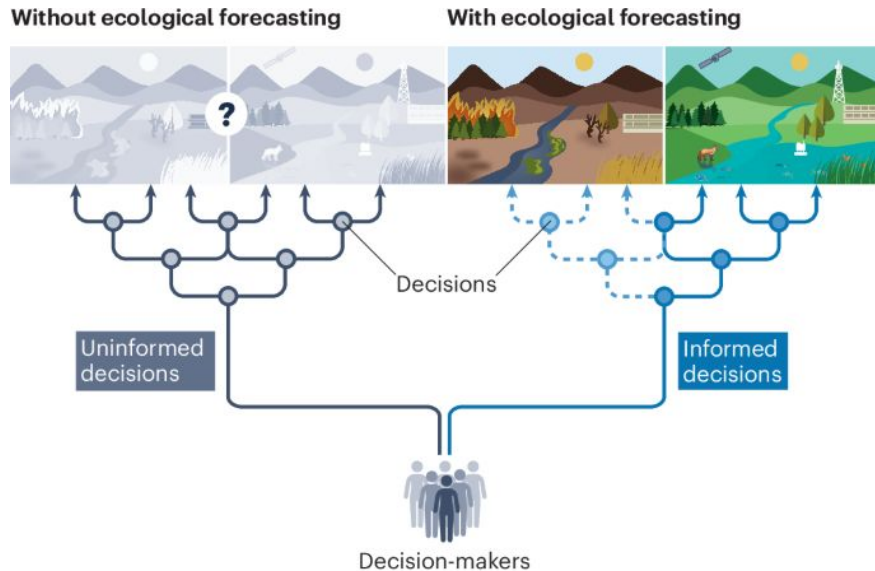
Why do we care about water quality?

- Access to healthy drinking water
- Availability of recreation (fishing, boating, swimming)
- Economic benefits of quality drinking water and recreation
- Good water quality supports healthy ecosystems



Drinking water reservoir

Something we might want to predict: water quality

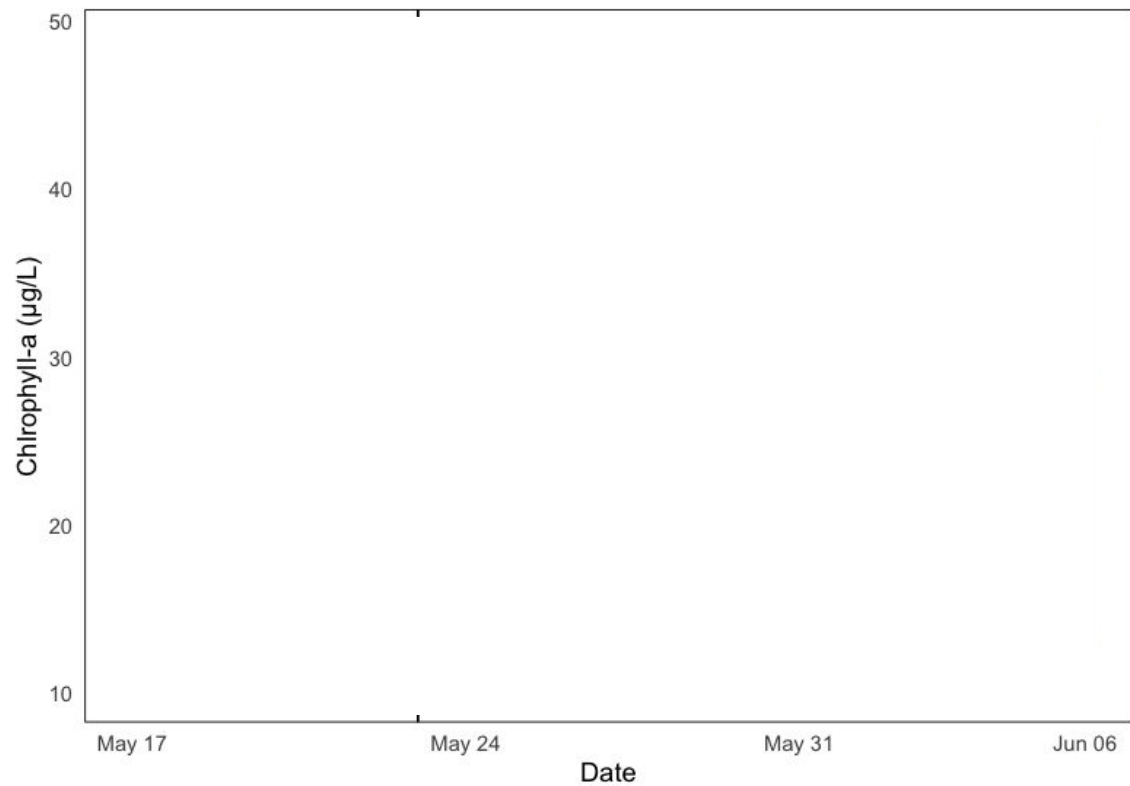


We can **predict** declines in water quality (increases in Chlorophyll a) **before they happen** and **make management decisions** to improve water quality:

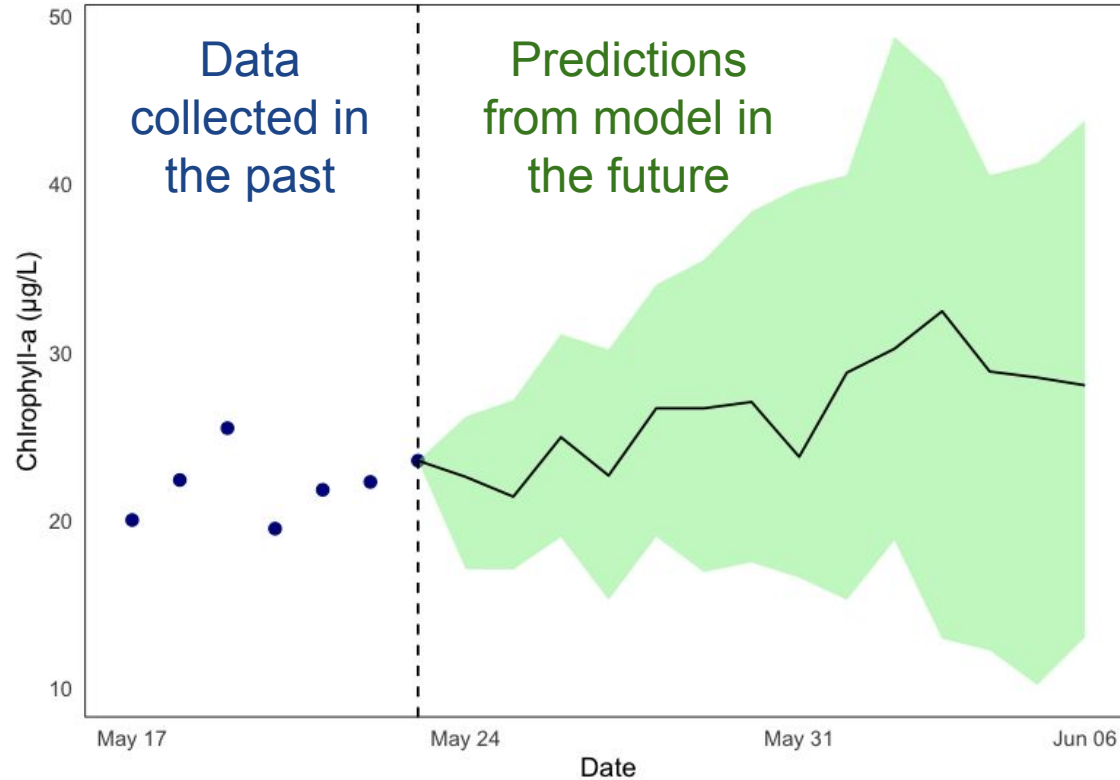
1. Stop people from drinking water
2. Stop people from using water resources for recreation
3. Use algaecide to kill algae & cyanobacteria

[Video of FLARE water quality forecast system](#)

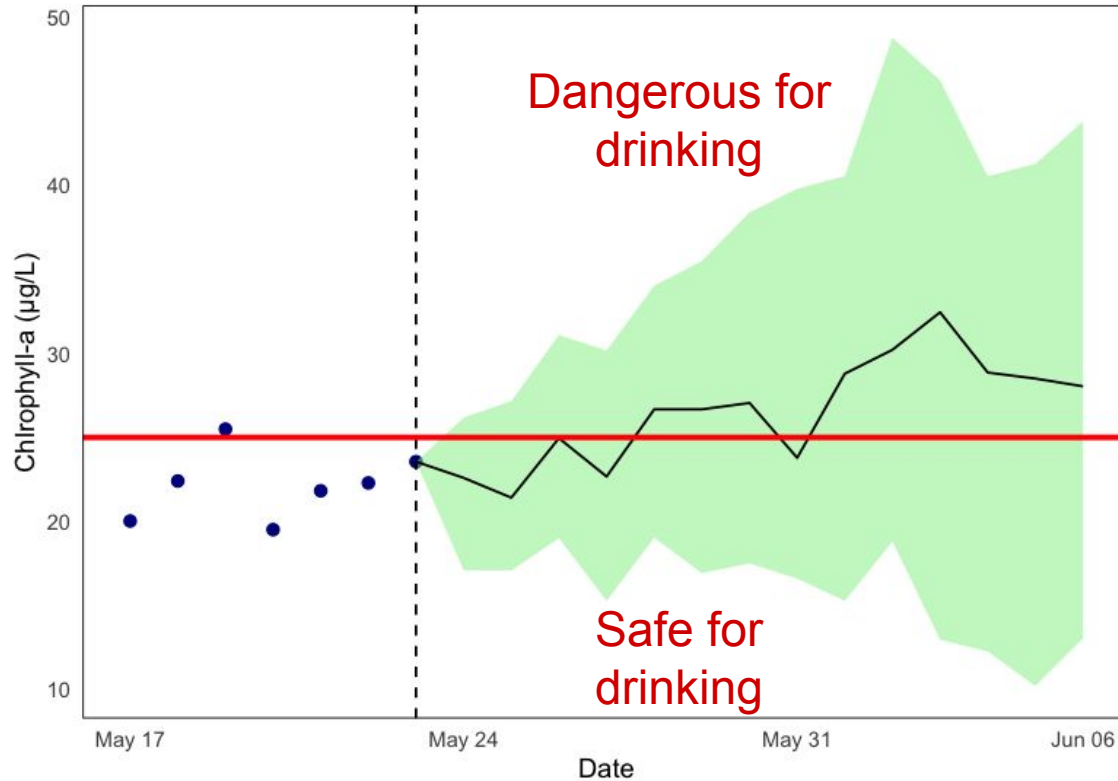
Example forecast



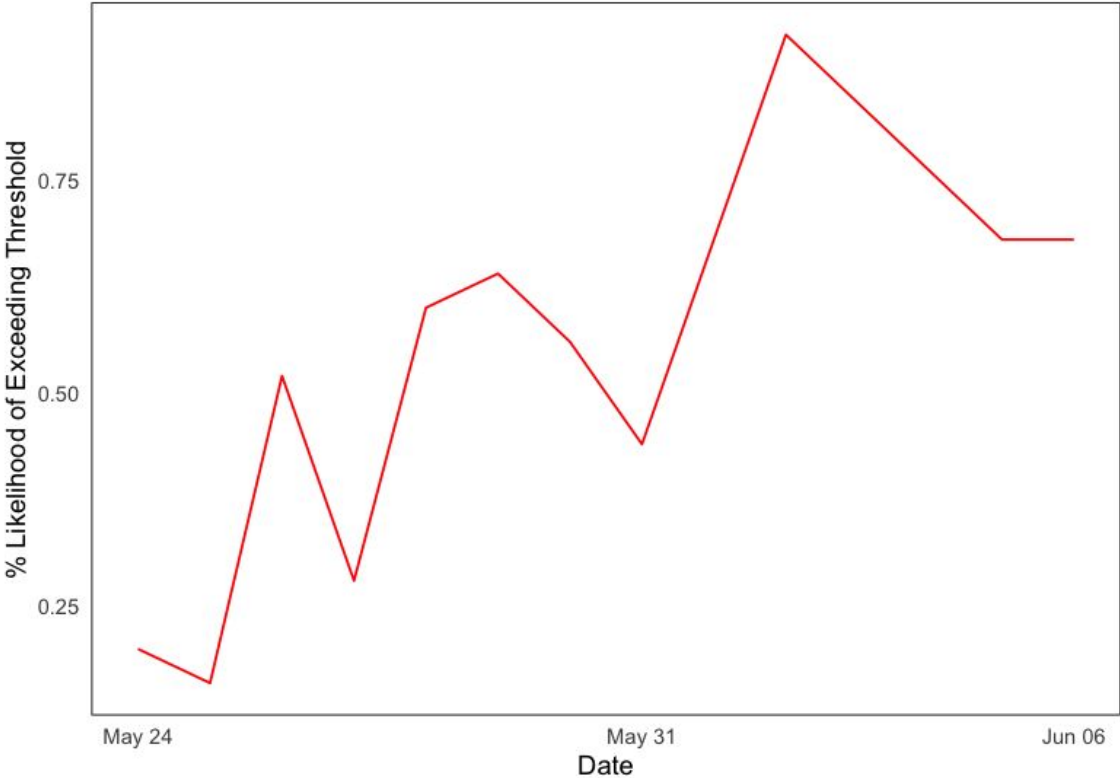
Example forecast



Example forecast



Example forecast



3:44 5G 93%

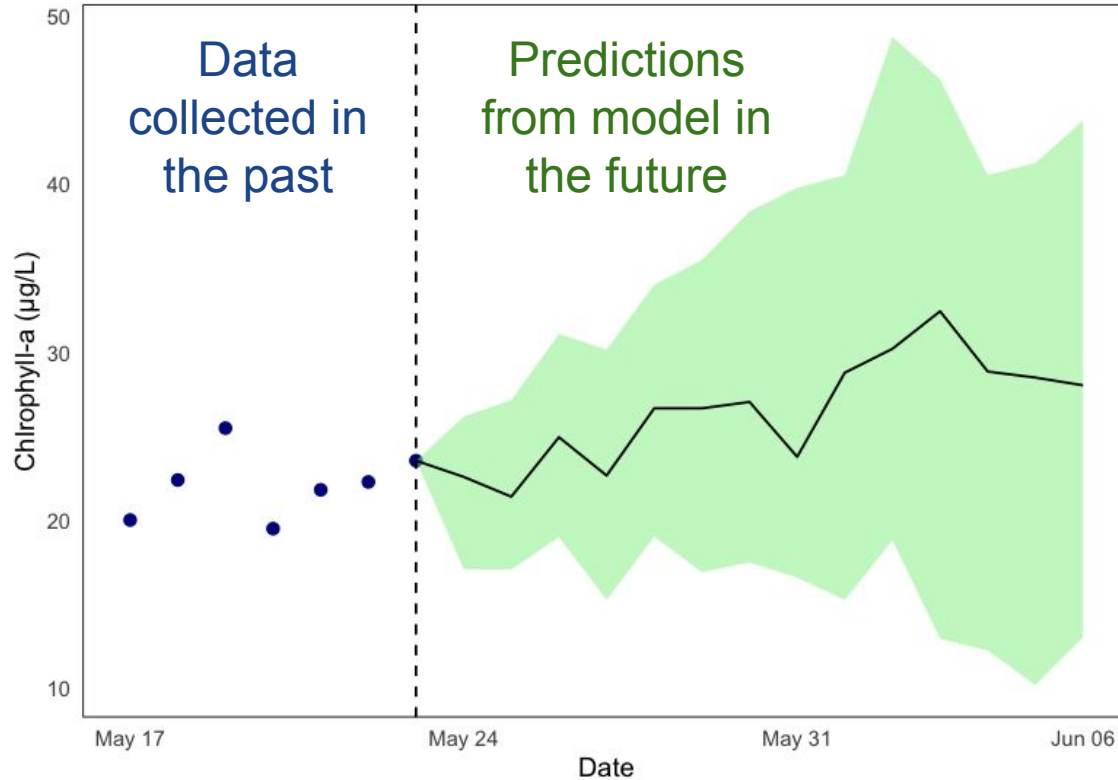
Columbia City

79° | Mostly Sunny

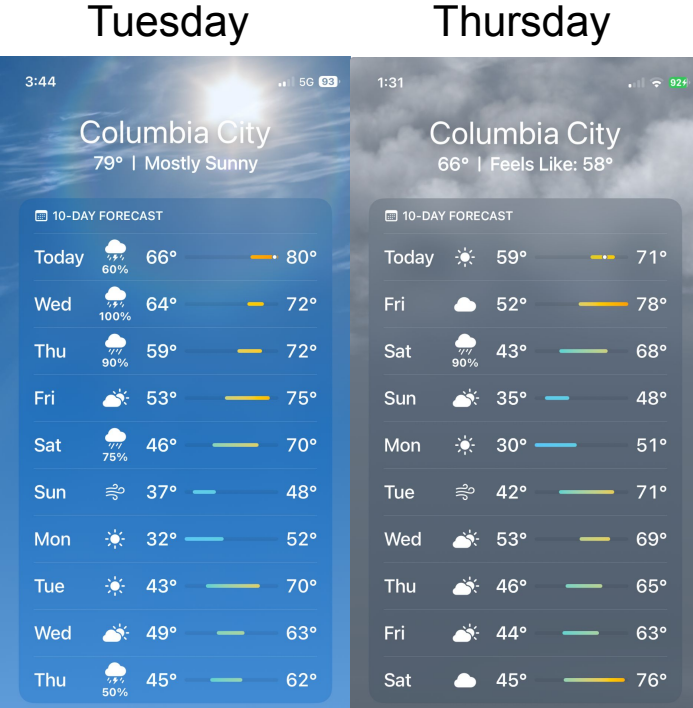
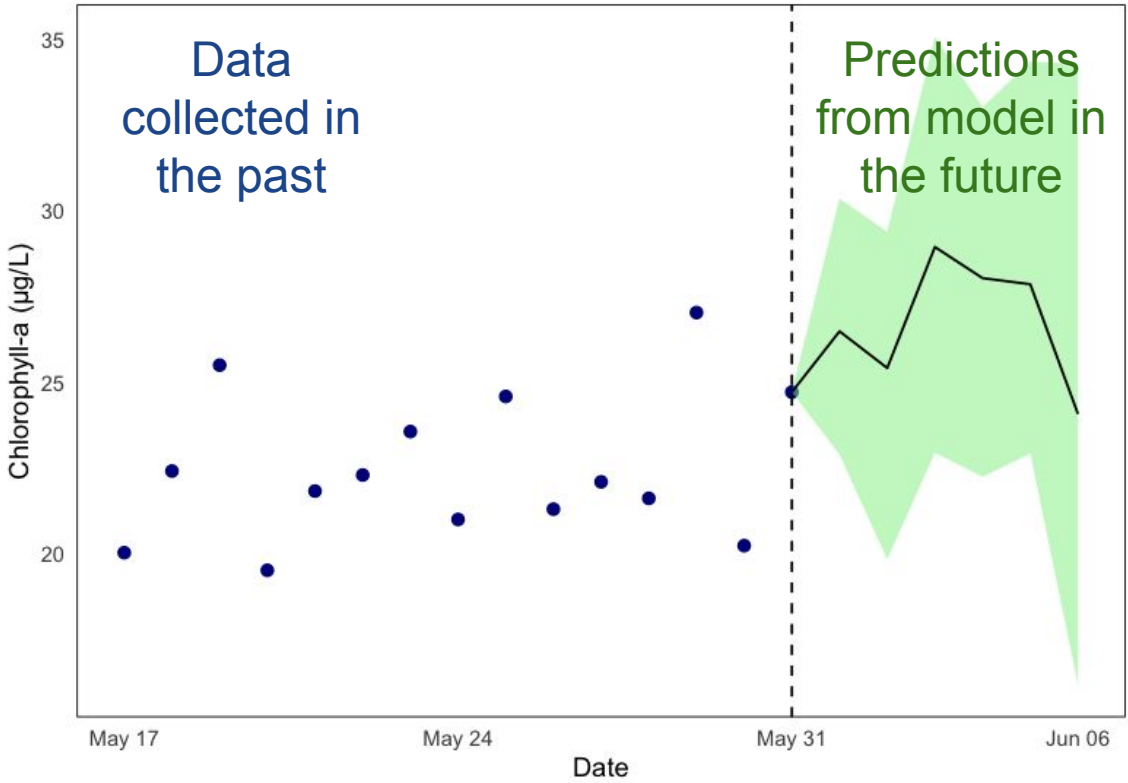
10-DAY FORECAST

Day	Weather	Low	High
Today	Cloudy with rain (60%)	66°	80°
Wed	Cloudy with rain (100%)	64°	72°
Thu	Cloudy with rain (90%)	59°	72°
Fri	Partly cloudy	53°	75°
Sat	Cloudy with rain (75%)	46°	70°
Sun	Windy	37°	48°
Mon	Sunny	32°	52°
Tue	Sunny	43°	70°
Wed	Partly cloudy	49°	63°
Thu	Cloudy with rain (50%)	45°	62°

Example forecast



Example forecast



Hands-on activities

<https://macrosystemseddie.shinyapps.io/module8/>


Module 8: Using Ecological Forecasts to Guide Decision Making

Module Overview Presentation Introduction Activity A: Explore Activity B: Decide Activity C: Customize

Resume Progress

Browse... No file selected

Help!



Using Ecological Forecasts to Guide Decision Making

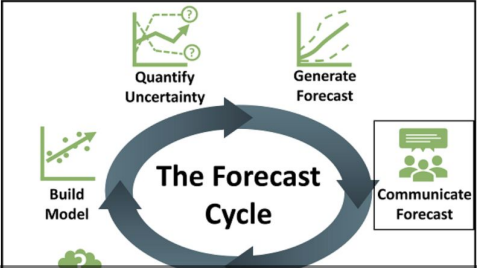
Today's focal question:

How can ecological forecasts and their visualizations aid in decision making?

To answer this question, you will complete three activities:

- Activity A - Explore ecological forecast visualizations
 - Identify different ways to visualize a forecast
 - Recognize how uncertainty is represented (or not!) in forecast visualizations
 - Pair forecast visualizations with a forecast user decision
- Activity B - Make decisions using an ecological forecast
 - Match PROACT components with a decision-making scenario
 - Make decisions using a forecast and balance multiple decision trade-offs

Ecological Forecasting Cycle



```
graph TD; BuildModel[Build Model] --> QuantifyUncertainty[Quantify Uncertainty]; QuantifyUncertainty --> GenerateForecast[Generate Forecast]; GenerateForecast --> CommunicateForecast[Communicate Forecast]; CommunicateForecast --> BuildModel; subgraph Cycle; BuildModel; QuantifyUncertainty; GenerateForecast; CommunicateForecast; end; Cycle --- ForecastCycle[The Forecast Cycle];
```

The Forecast Cycle

Activity B instructions

- Divide into pairs
- Add your name(s) in the “Before you start...” box in the Introduction tab
- Make a group name and use that for your ID number
- Click on **Activity B** tab (SKIP Activity A)
- Record your & your partners answers to each question – most questions have no right or wrong answer!
- After you **finish** and **any time you leave your computer**, save by clicking the “Save Progress” button

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Discussion questions:

1. In Objective 4a, how did your decisions change from 14 days before the event to 2 days before the event?
2. How did you and your partner use the forecast to make your decision? What aspects of the graphs helped you make your decision?
3. In Objective 4b, did you make different decisions than in Objective 4a? What changed?
4. Which type of graph was easier to interpret as a decision maker?

Activity C instructions

- Form a group with another pair
- Click on **Activity C** tab
- Record your and your group's answers to each question
- Focus on **exploring different visualizations** in Objective 8 – don't just choose one!
- After you **finish** and **any time you leave your computer**, save by clicking the “Save Progress” button
- When you finish, go to **Introduction** tab, click “**Generate Report**” and then “**Download Report**”

Activity C instructions

- Form a group with another pair
- Click on **Activity C** tab
- Record your and your group's answers to each question
- Focus on **exploring different visualizations** in Objective 8
- After you **finish** and **any time you leave your computer**, save by clicking the "Save Progress" button
- When you finish, go to **Introduction** tab, click "**Generate Report**" and then "**Download Report**"

Discussion questions:

1. What forecast user did you choose and why would a water quality forecast be useful for that user?
2. What types of forecast visualizations were easiest to interpret?
3. Hardest to interpret?
4. What types of forecast visualizations were most informative?
5. Least informative?
6. How does the audience you're communicating your research to change what type of visualization you might choose?
7. What type of visualization did you decide was most appropriate for your forecast user?