Analyzing Ocean Tracks: Investigating Marine Migrations in a Changing Ocean

NSF DRK-12 PI Meeting, August 5, 2014

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HOPKINS MARINE STATION

Agenda

- Session Goals
- Project Background
- Tour of the Ocean Tracks Interface
- Ocean Tracks Exploration
- Research Findings
- Discussion and Feedback

Product Feedback Session Goals

- Share current capabilities of Ocean Tracks interface
- Exchange strategies for supporting scientific practices with data
- Identify ways to extend Ocean Tracks work
- Connect with others for potential future collaboration

Project Background

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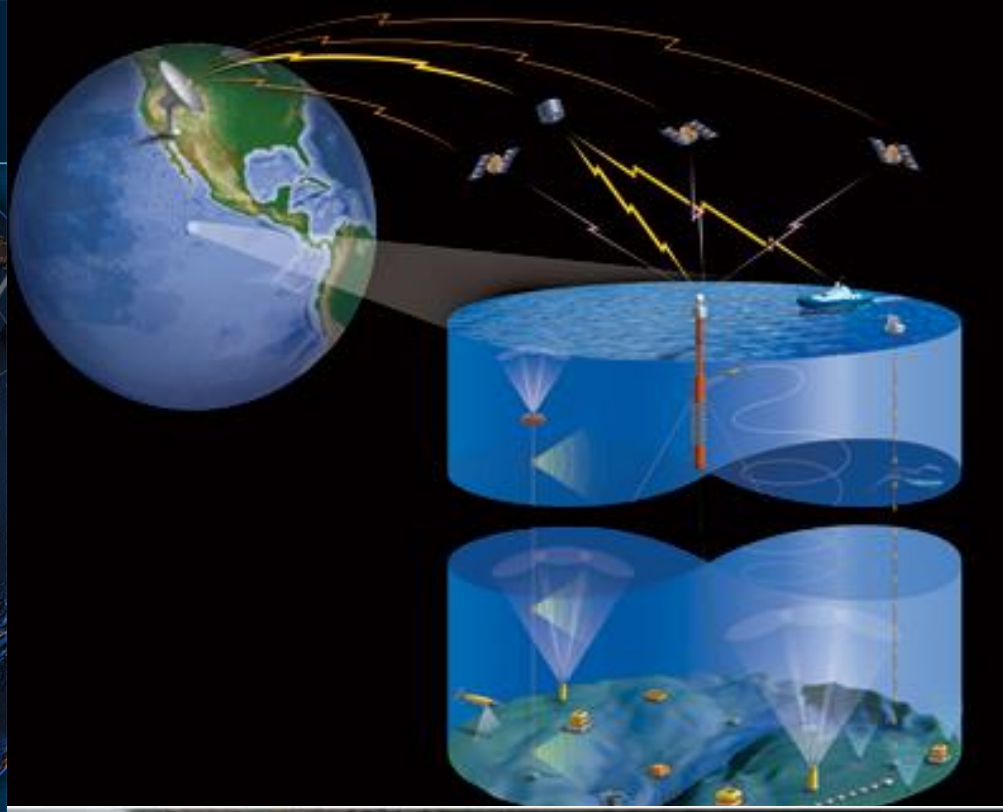
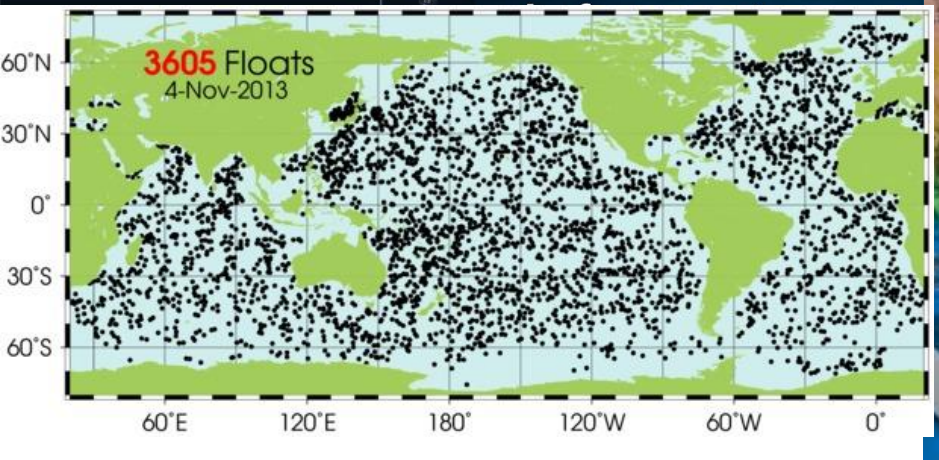
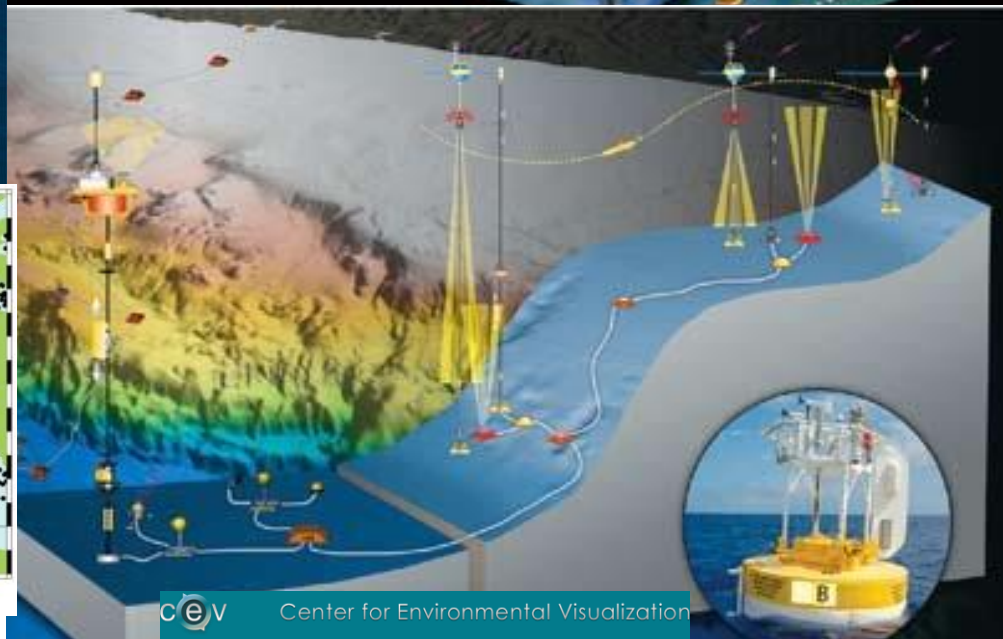
CYBER-INFRASTRUCTURE







The Opportunity

"Science is not just a body of knowledge that reflects current understanding of the world; it is also a set of practices used to establish, extend, and refine that knowledge. Both elements— knowledge and practice—are essential."

Next Generation Framework for K-12 Science Education, NRC 2011, p. 2-3

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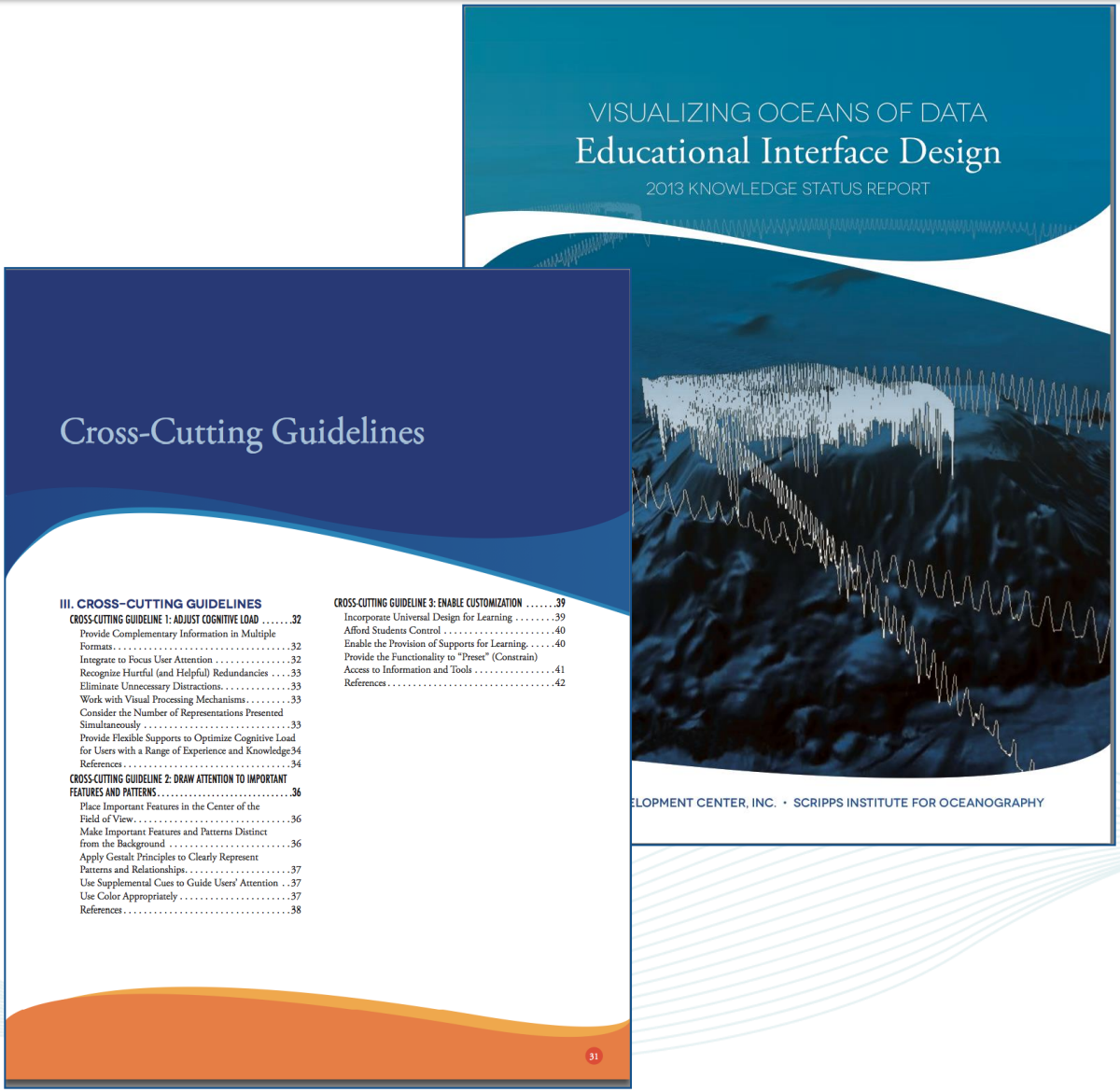
How do you design student-friendly interfaces to professionally-collected data sets?



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Goals for students

Promote scientific practices

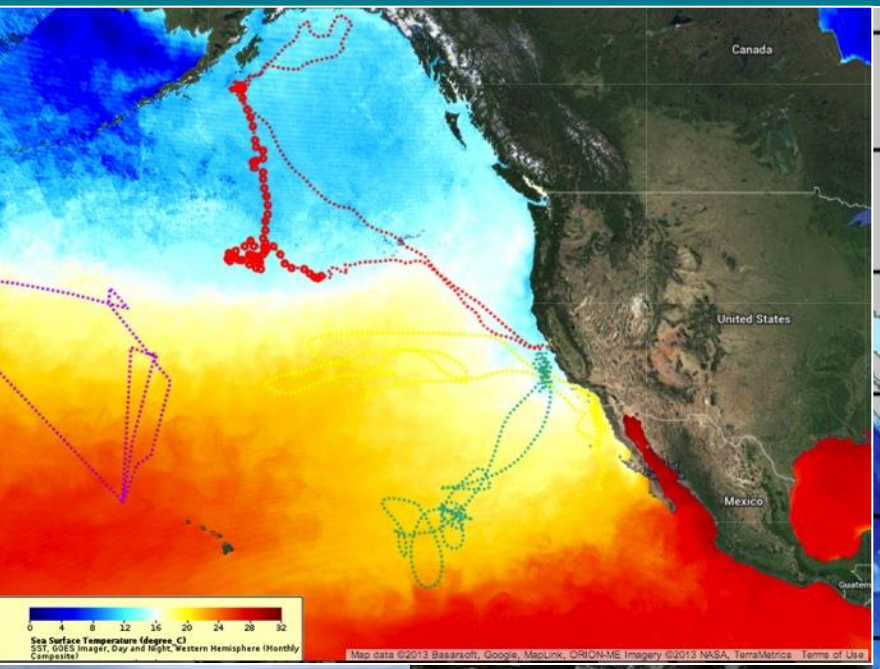
- Ask questions that can be investigated using data
- Examine relationships between variables
- Analyze and visualize data through multiple means
- Construct explanations from the data
- Select data that best support claims

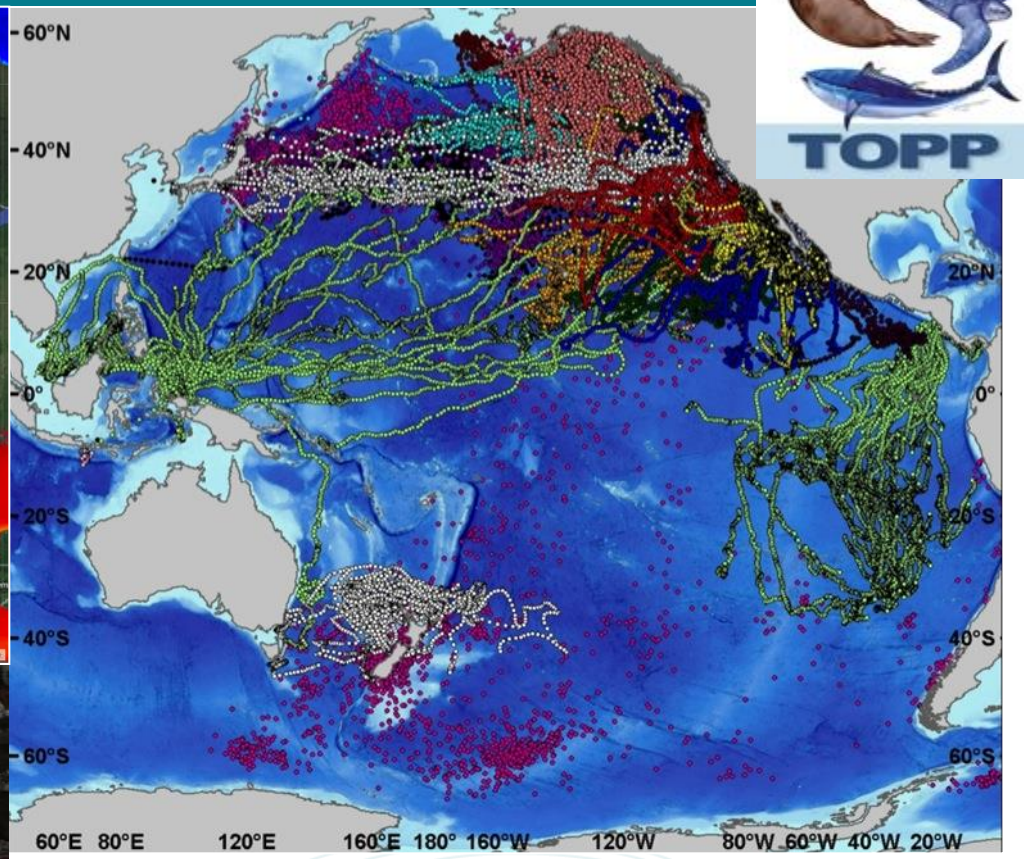
Goals for students

Explore questions of current scientific interest

- What might influence the movement of marine species?
- Why might movement be affected by oceanographic factors?
- How does the importance of these factors differ across species?
- Can we predict where marine species will congregate in the future, to target for protection?

The Data


Canada
United States
Mexico
Sea Surface Temperature (degree_C)
SST, GOES Imager, Day and Night, Western Hemisphere (Monthly Composite)
Map data ©2013 Basarsoft, Google, MapLink, ORION-ME Imagery ©2013 NASA, TerraMetrics Terms of Use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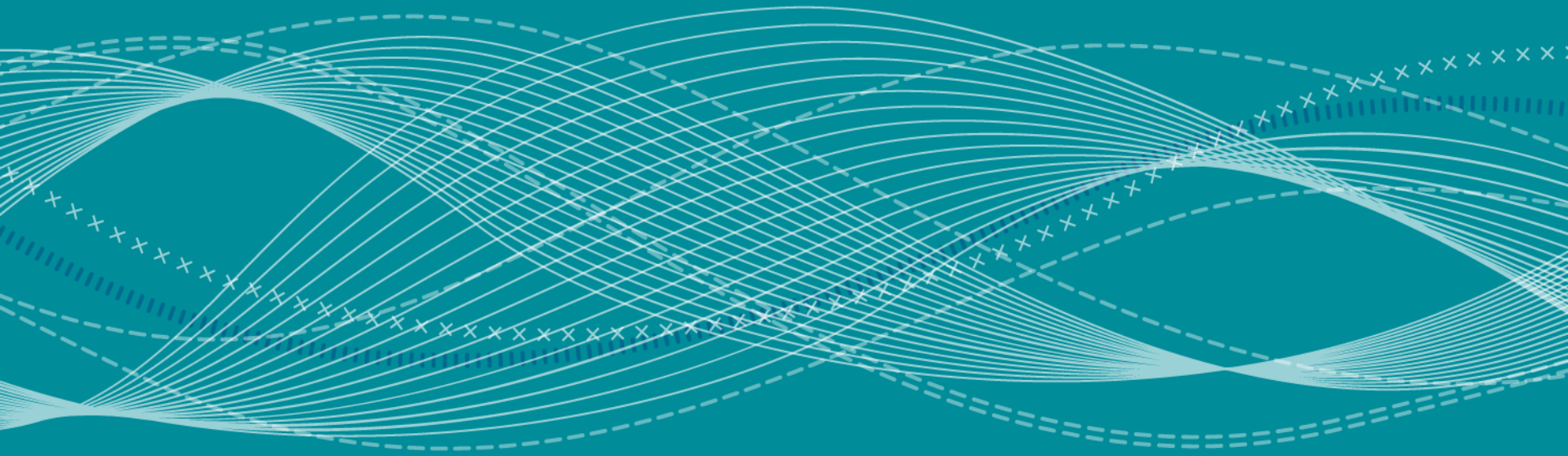
The Ocean Tracks Interface



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ANALYZING OCEAN TRACKS

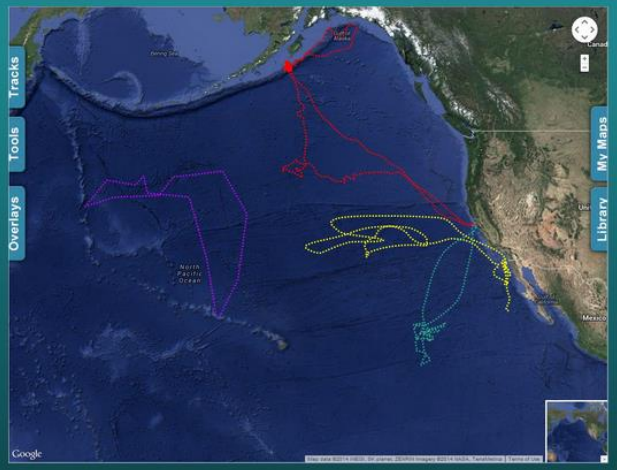
Investigating Marine Migrations in a Changing Ocean

Home | The Map | Getting Started | For Teachers | For Students | About | Contact Us

Welcome to the Ocean Tracks development site!

Ocean Tracks provides access to authentic data collected by migrating marine animals, drifting buoys, and satellites, along with tools that allow you to display and analyze these data to investigate current and important scientific questions about animal interactions with the ocean environment. The Ocean Tracks website was created by the EDC's Oceans of Data Institute and Stanford University, using funding from the National Science Foundation.

Whose tracks are these? Take me to the Ocean Tracks map to learn more!



Where the Data Come From

The animal tracking data used in Ocean Tracks come from the Tagging of Pacific Predators (TOPP) project. Click the image above to launch a video.

Tagging Bluefin Tuna

Watch the Stanford team tag Pacific bluefin tuna off the coast of Southern California.

Shark Tracking App

A Stanford scientist discusses a new tool for keeping track of tagged white sharks.

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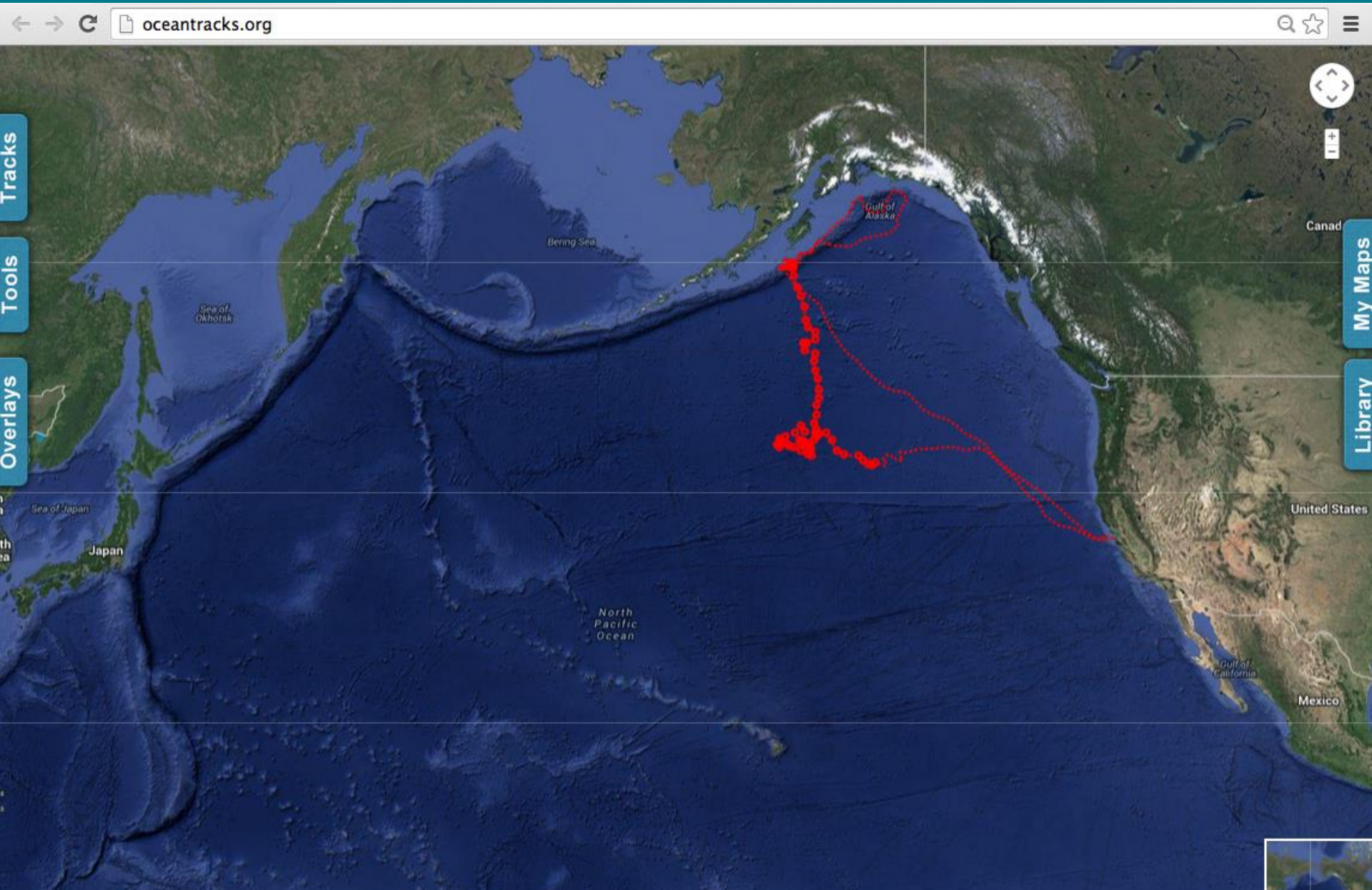
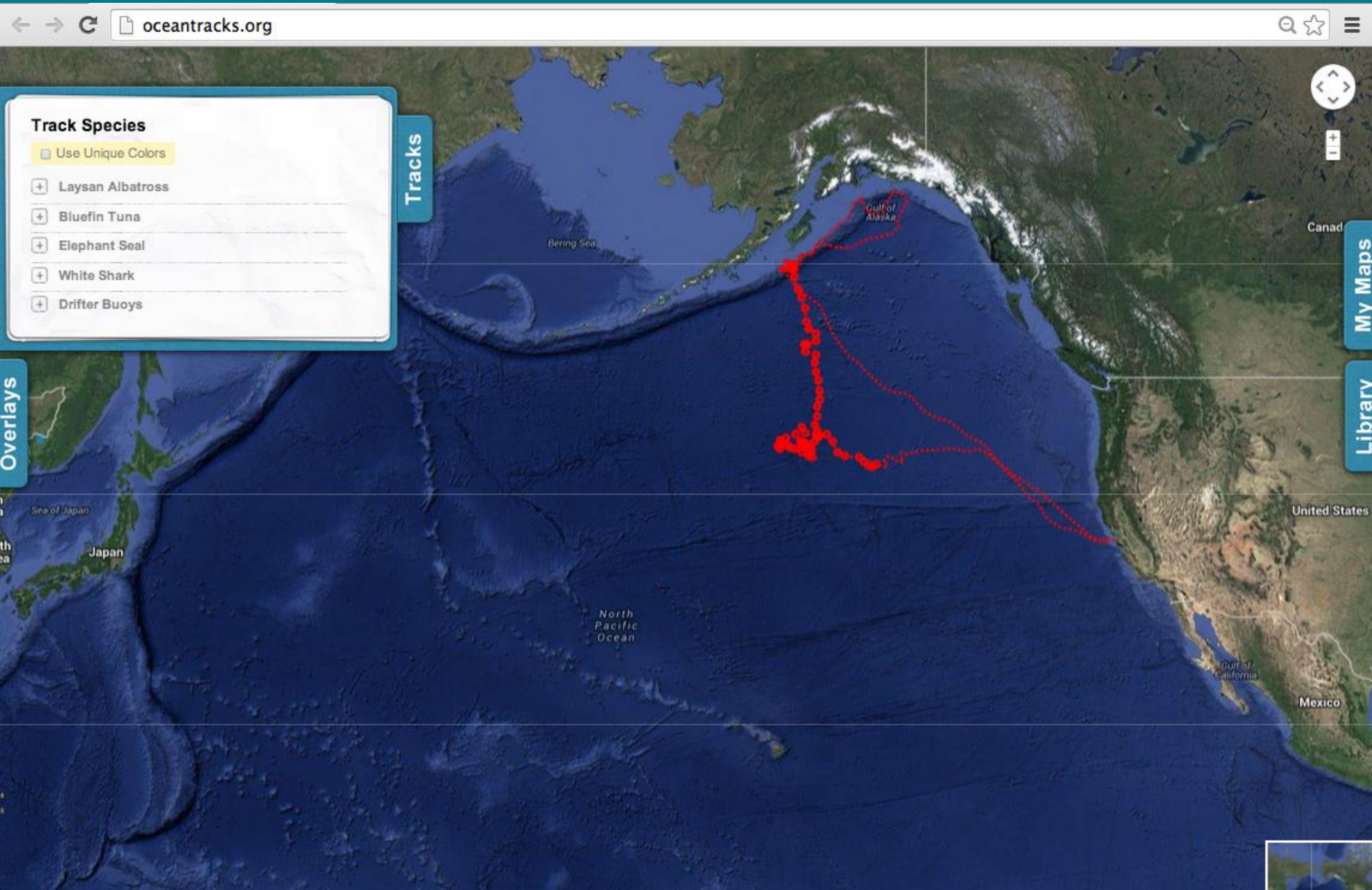
The Interface



Get students quickly to the data



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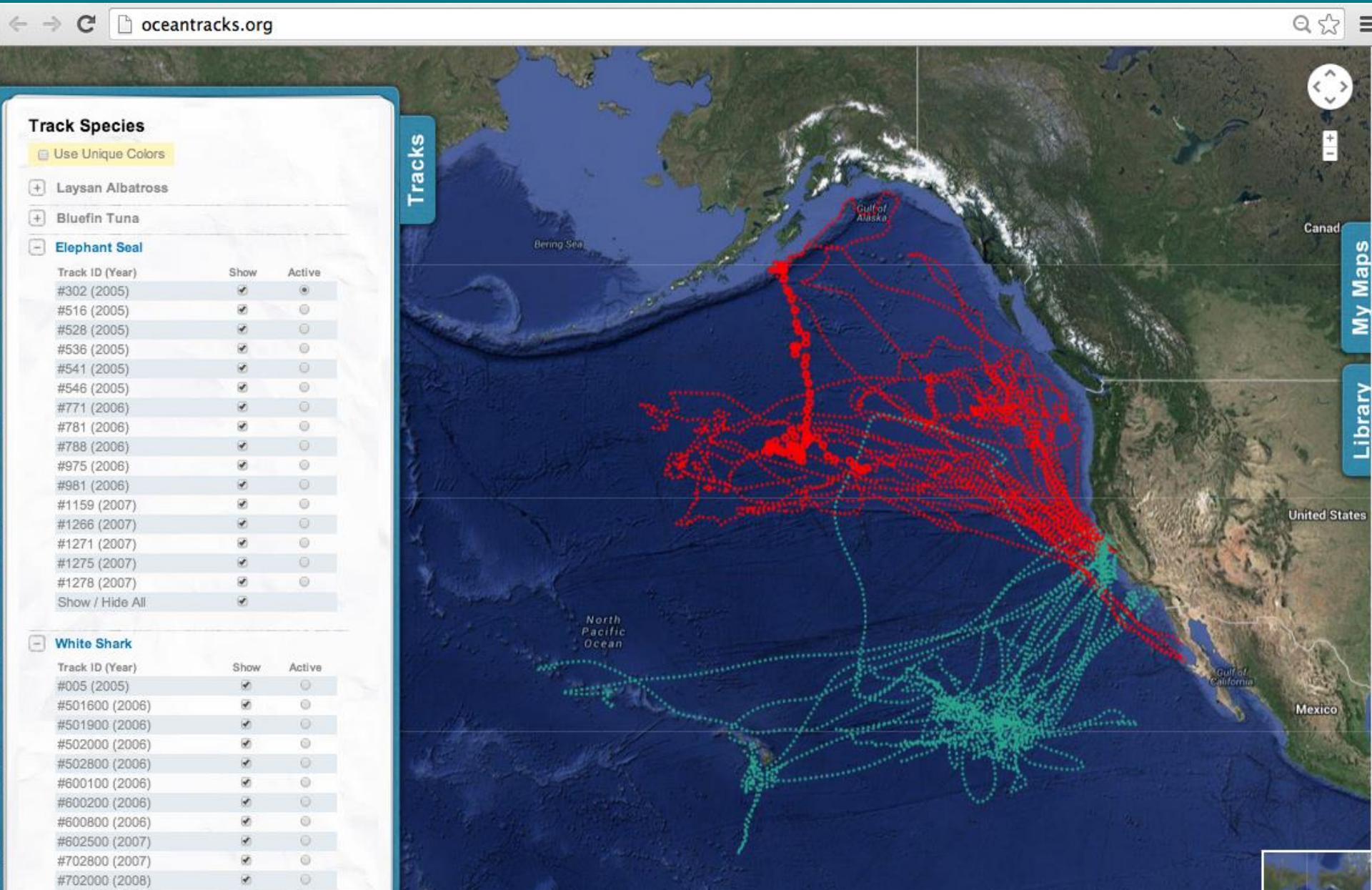
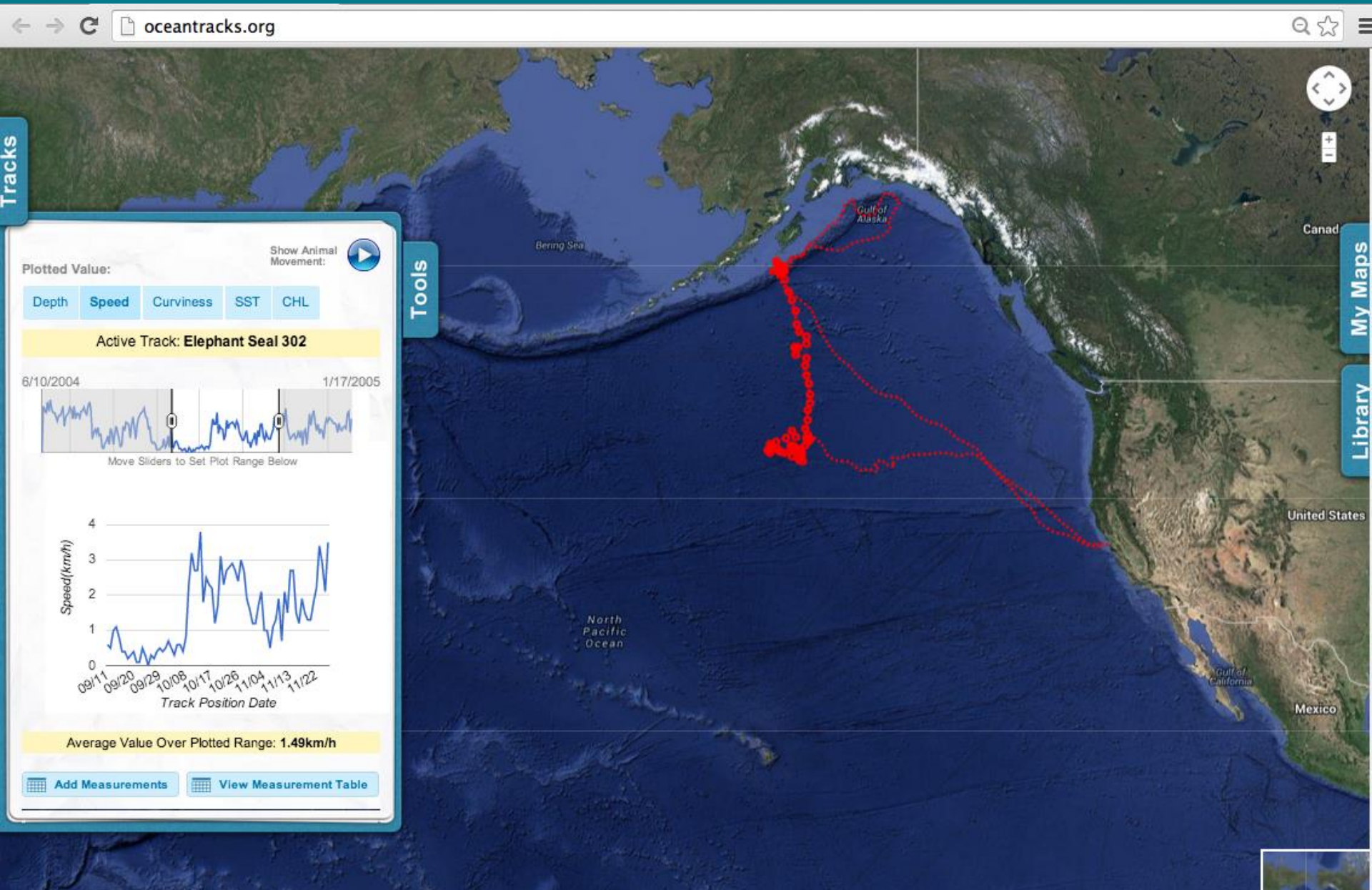


Allow them to easily create and interact with data displays



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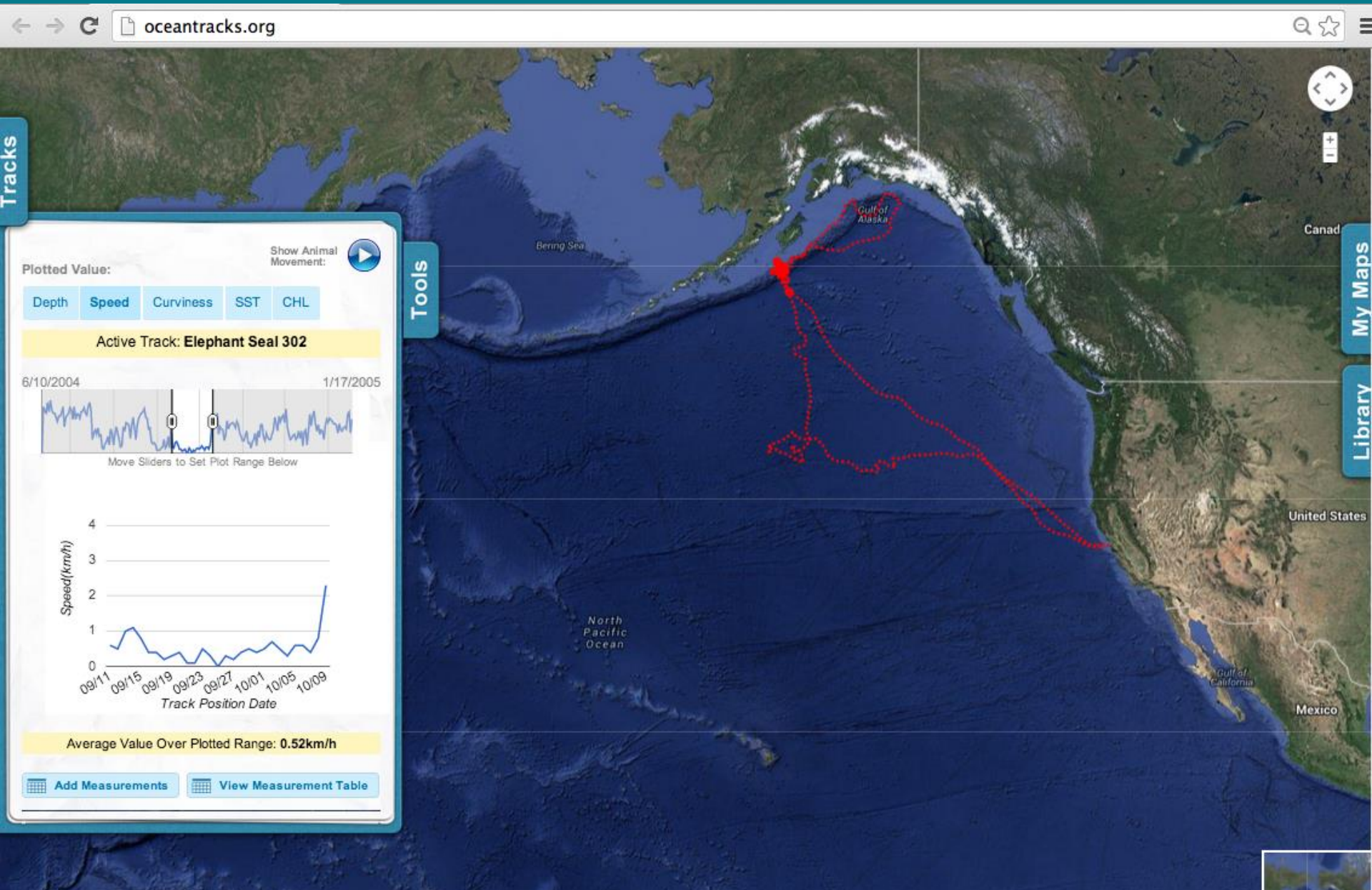

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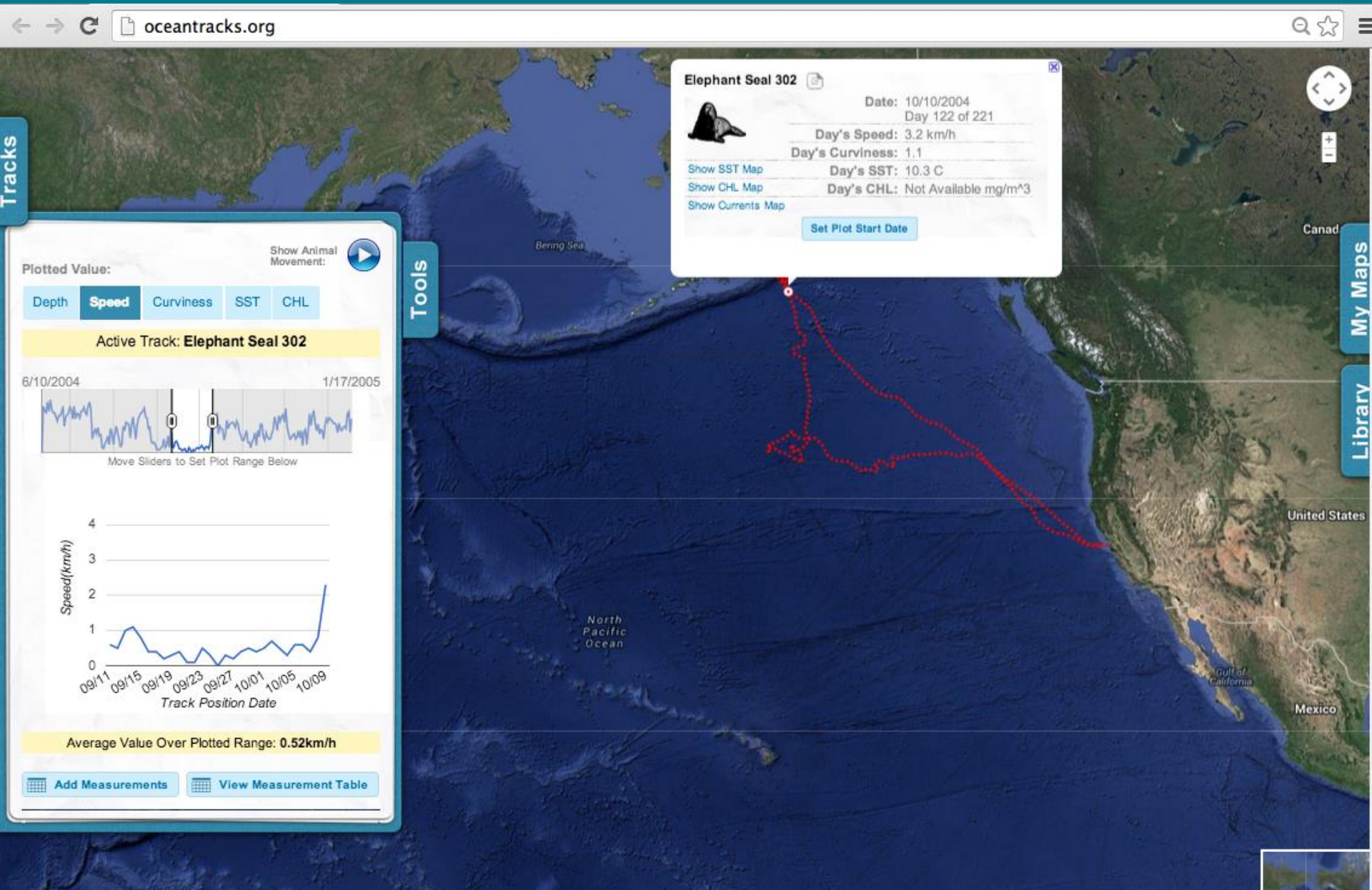

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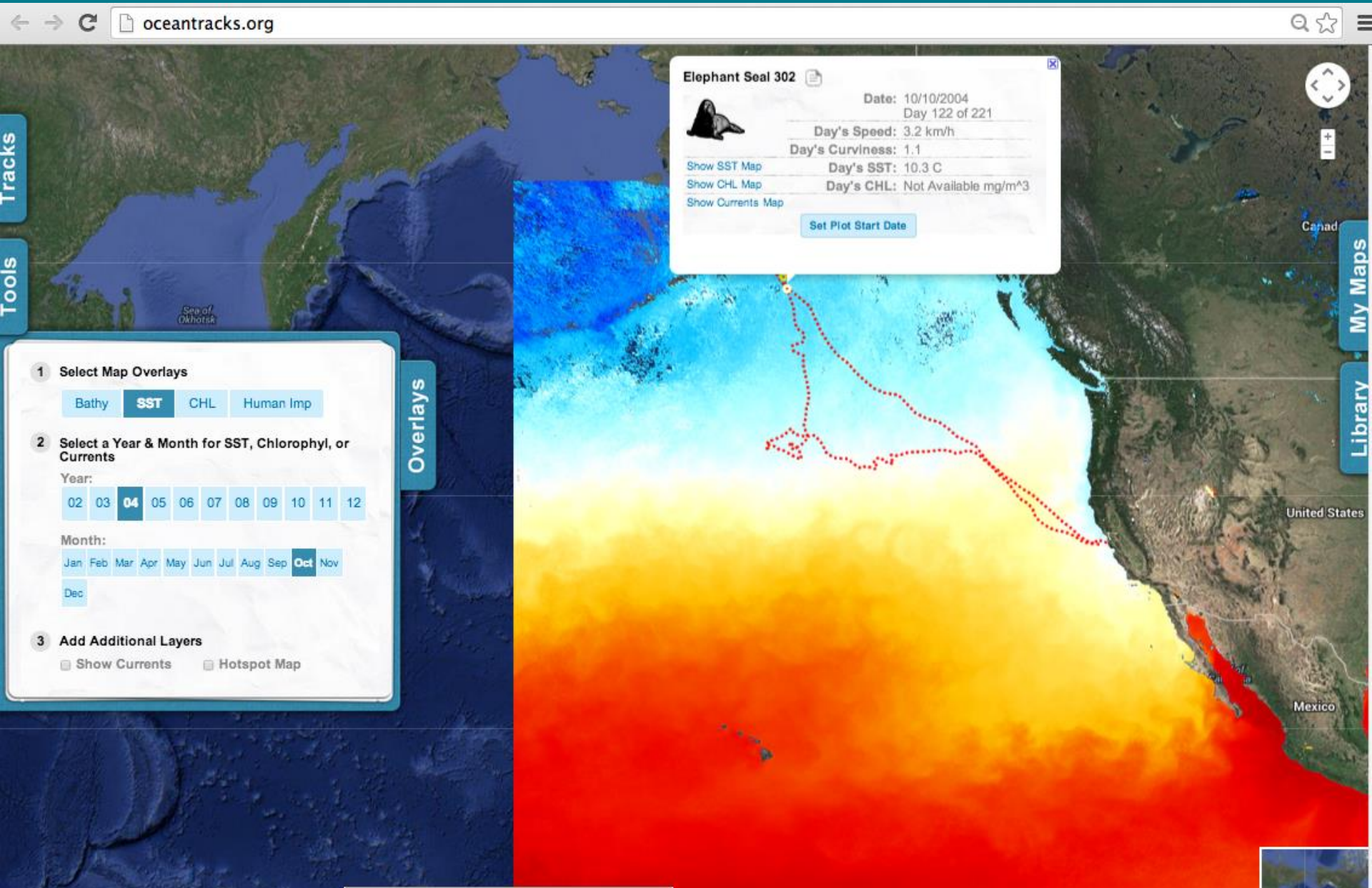

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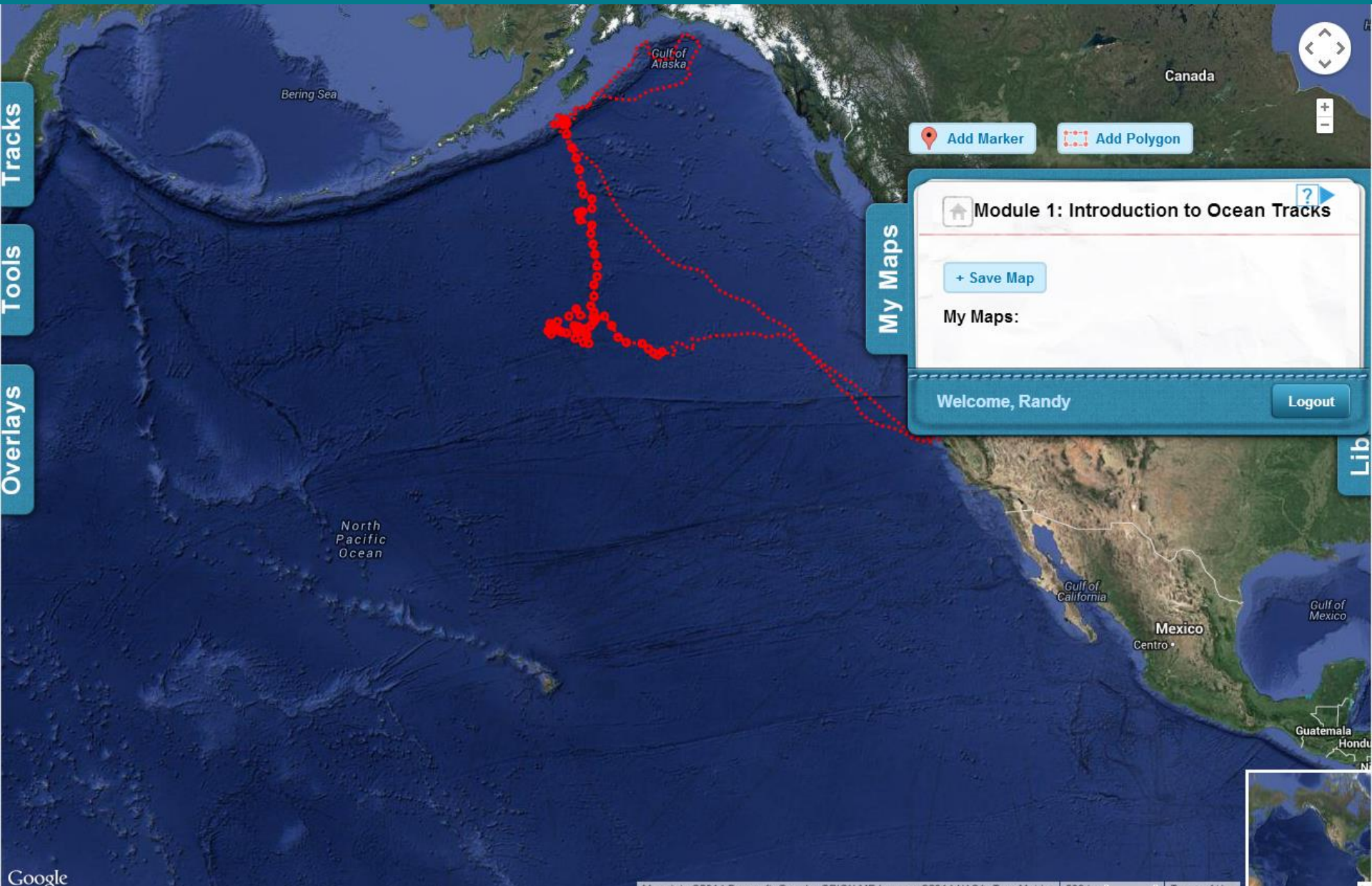

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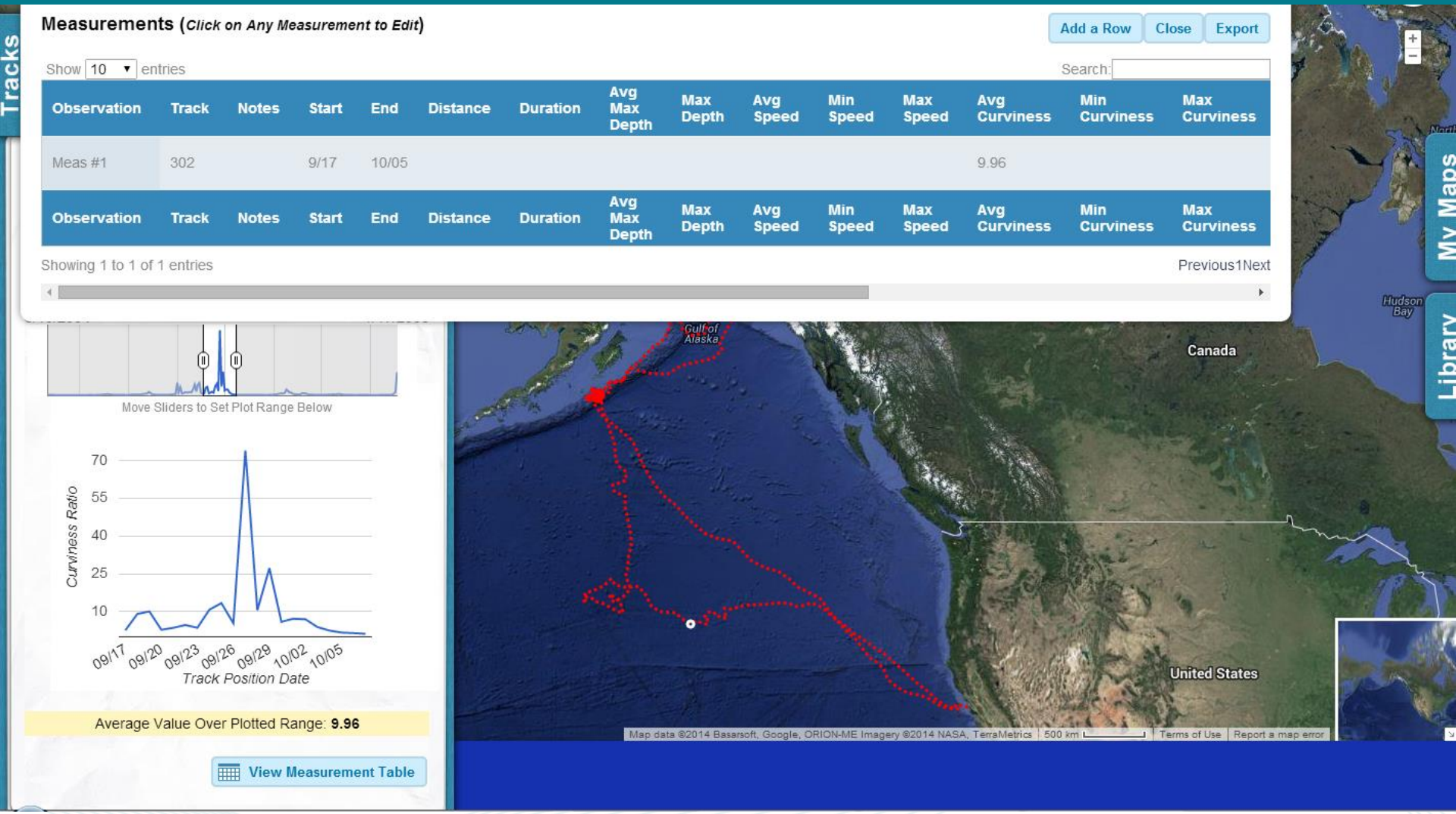

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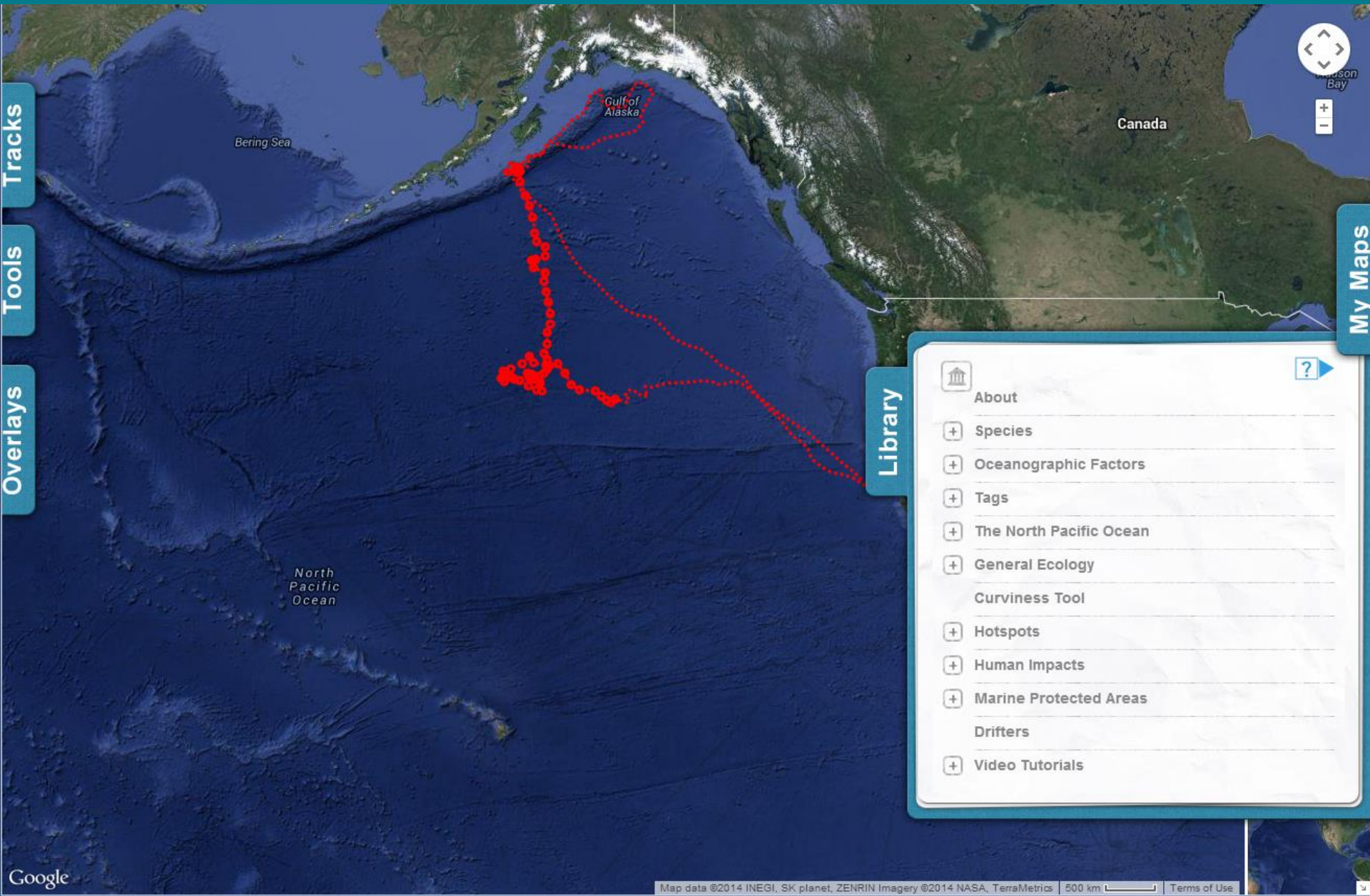


Customized content supports

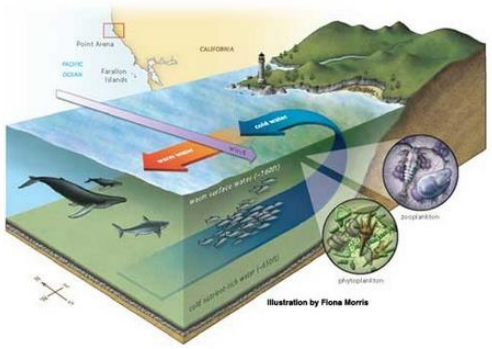
Ocean Tracks Library

Categories

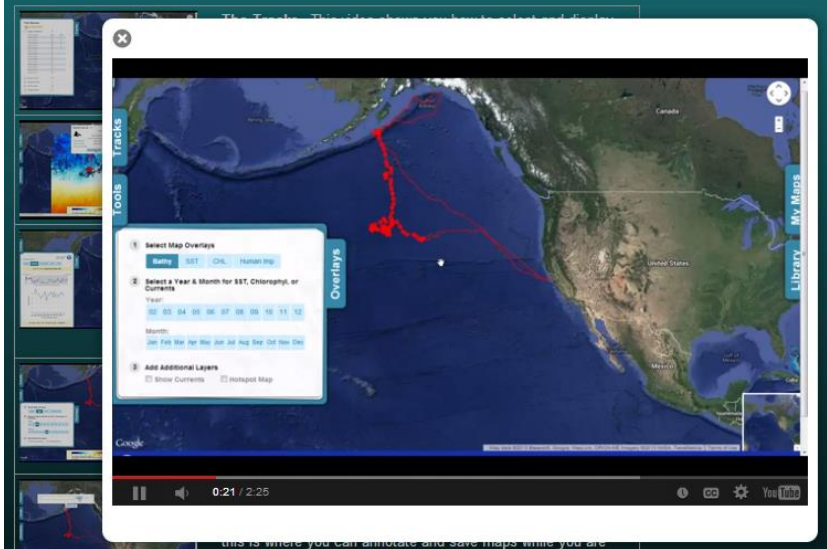
- About
- Species
- Oceanographic Factors
- Tags
- The North Pacific Ocean
  - Major Currents
  - The North Pacific Transition Zone and Transition Zone Chlorophyll Front
  - **Upwelling and the California Current**
- General Ecology
- The Curviness Tool
- Hotspots
- The Hotspot Tool
- Human Impacts
- Marine Protected Areas
- Drifters
- Video Tutorials

Upwelling and the California Current

- The California current is the **eastern boundary current** of the North Pacific Gyre, running southward from British Columbia, Canada to Baja California, Mexico. This current draws cool, nutrient rich waters from the Alaska current down along the western coast of North America.
- Western boundary currents flow deeper and stronger than eastern boundary currents. This means that cool, nutrient-rich water is closer to the surface in eastern boundary currents than western boundary currents. This results in the creation of **rich upwelling zones** in areas with eastern boundary currents, such as the California Current.
- The intensity of the California current is influenced by strong northwesterly winds. These winds predominantly blow along shore, which because of the earth's rotation (see Eckman transport) cause water to be transported in an offshore direction. This movement of water offshore causes cooler, nutrient rich water to be upwelled over the narrow continental shelf to the surface.



1. To access the map, click here.
2. The map works like other Google maps interfaces, with zoom and pan functions on the upper right hand side of the screen. You can also click and drag the map to get to a different location.
3. A small map on the bottom right hand side of the screen shows you a zoomed out view to help you orient yourself.
4. The map interface has a set of menus that expand from tabs on the left and right hand sides of the screen. Click the tab to expand the menu.
5. The track you see on the map was made by an Elephant Seal (#302). Watch the tutorial videos below to learn how to interact with this track and others.



working.

The Library - This video shows you how to access and use the Library, where you'll find more information about the animals and the ocean, as well as the technologies used to explore them.

Overview - This video is a compilation of all the videos above. It takes you through all the elements of the Ocean Tracks map interface, just as they are listed here.

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Ocean Tracks Phase 1

Curriculum and organizational supports

Easy access to data

Ocean Tracks Phase 1

Teacher facilitation

Scientific expertise

Student-friendly data analysis/ visualization tools

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Learning Modules

1. Introduction to Ocean Tracks - *diving into the data*

2. Prey Maps – *using environmental and tracking data to locate prey*

3. Biological Hotspots – *exploring relationships between individuals, species, and their shared habitats*

4. Human Impacts - *independently investigating human impacts on marine habitats*

5. Conservation Strategy - *synthesis*

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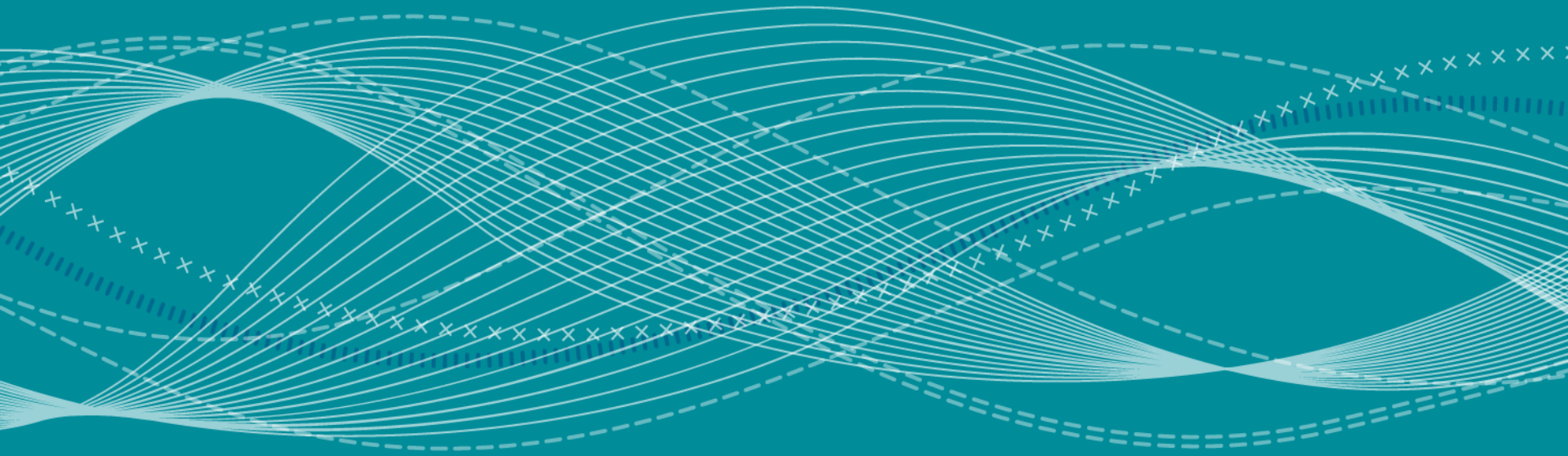
Ocean Tracks Exploration



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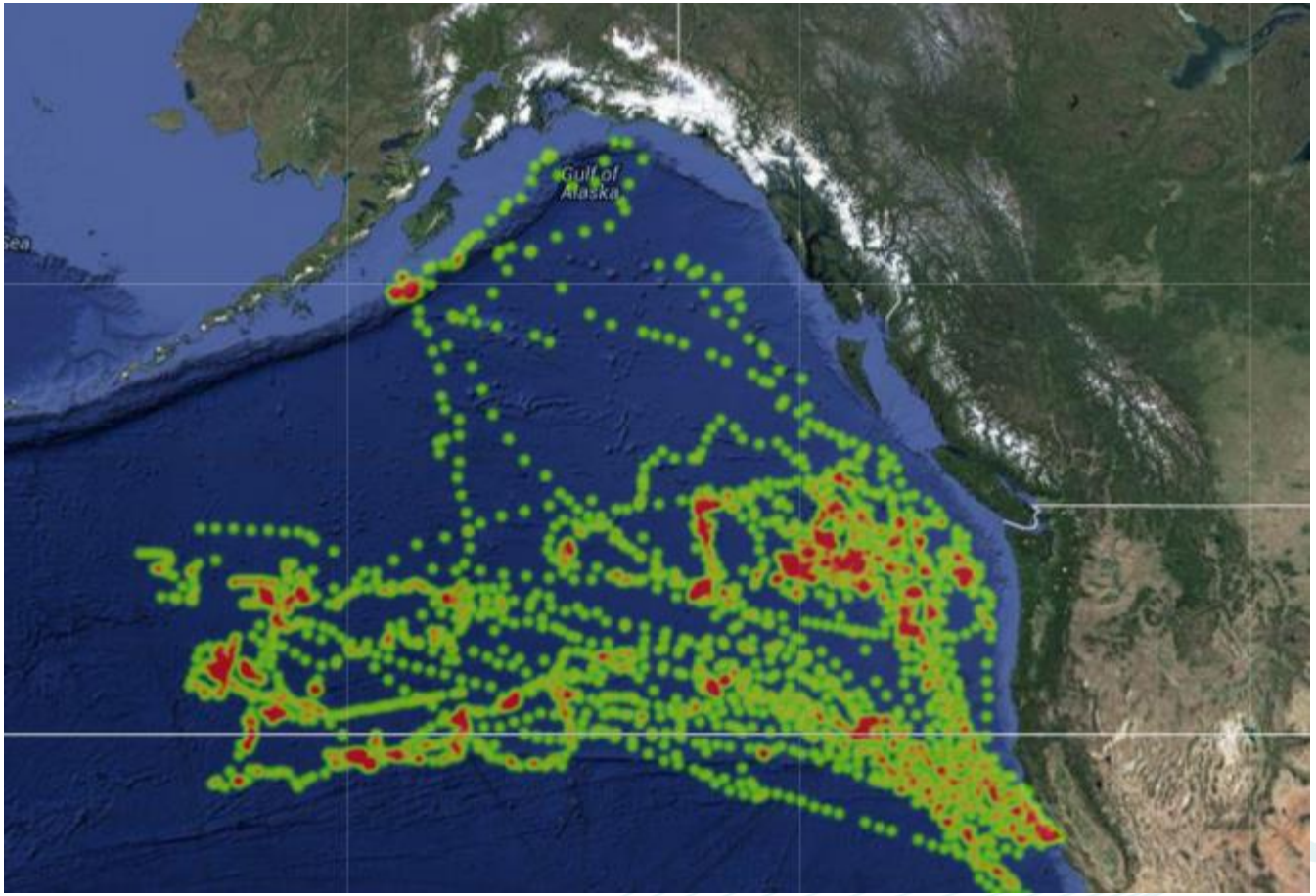
Hotspot Map



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Where are the species hot spots in the Pacific Ocean?

Using the **elephant seal** or **white shark** data available in the Ocean Tracks interface, investigate the following questions:

- Where are the habitat hot spots?
- What might the animals be doing both inside and outside of the hot spots?
- Why is this area a hot spot? Why might animals be attracted to these locations?
- What types of evidence can you provide to support your ideas?

Ocean Tracks Exploration – Report Out

- What ideas and evidence did you/your group generate?
- What did you find interesting or engaging? What other data or questions would you like to explore?
- What did you find challenging? What would you expect high school students or teachers to find challenging in a similar investigation?

Research Findings

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Research and Development Activities

- Iterative development of Ocean Tracks interface
- Initial development: alpha
  - Fall 2012–winter 2013
- Pilot test 1
  - Spring 2013, 5-6 weeks
  - 3 high school science teachers, n=61 students
- Revisions: beta 1
- Pilot test 2
  - Fall 2013, 4-6 weeks
  - 4 high school science teachers, n= 134 students
- Final revisions: beta 2

Research Questions

Usability:

- Which aspects of the interface and materials were students able to use most and least easily?

Engagement:

- Which aspects of the interface and materials were most and least engaging for students?

Scientific Practices/Thinking:

- What types of questions, reasoning, and claims did students generate using Ocean Tracks?

Data Sources

- Classroom observations
- Screen capture recordings
- Student surveys
- Student focus groups
- Online notebook entries (Pilot 1)
- Student work
- Teacher logs

Findings: Interface Usability

Successes:

- Students could easily navigate major features of the interface to access multiple types of data
  - Could quickly pan, zoom
  - Able to select and display animal tracks and overlays
  - Could use interface tools to take basic measurements
  - Able to use map markers, save maps

Findings: Interface Usability

Challenges:

- Slow Internet speed
- Windows management
- Measurement table
- Efficient use of available tools
- Teacher monitoring and commenting on student work

Findings: Student Engagement

Successes:

- Students found Ocean Tracks data interesting and engaging
  - Most enjoyed the opportunity to learn about marine animals and see their migration patterns (74% of survey responses, Pilot 1)
  - Motivated by working with real, authentic data

    "I found it most interesting that you guys actually had the power to track an animal and know exactly where they are every minute."

  - Particularly interested in human impacts layer

Findings: Student Engagement

Challenges:

- Modules felt long, repetitive
- Attention spans of 20 minutes
- Classroom management

Findings: Scientific Practices/Thinking

Successes:

- Students were able to take measurements, describe patterns, and generate hypotheses

> "I noticed that the seal track follows the area of higher chlorophyll levels. There are more nutrients in the water where there is more chlorophyll so that is why they are attracted there because there is probably a greater chance of finding suitable food there… The concentration is between 10-12 where it was lingering."
>
> *- Student work*

Findings: Scientific Practices/Thinking

Successes:

- Ocean Tracks prompted thoughtful questions

> "I thought it was cool to watch the animals to see how not only just one animal went in this certain route, but how all the animals of that species and even some animals of different species go in that particular route…
>
> "It was also interesting how within the same species, certain animals will completely separate from the normal predicted path and go do something that's miles away. It's interesting to think about what that one specific animal is doing that's different from the rest of its species."
>
> *- Student focus group*

Findings: Scientific Practices/Thinking

Challenges:

- Understanding temporal relationships among animal tracks and data overlays
- Understanding data irregularities
- Developing and describing ideas or claims based on data measurements or observations

Findings: Supports Needed

- Curriculum activities
  - How much scaffolding?
- Tools to support data recording and observations
  - How manage online?
- Context and connections to real science and scientists
  - How connect?
- Teacher supports
  - How best to prepare for using Ocean Tracks?
  - How best to support student monitoring and feedback?

Discussion and Feedback

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Future directions

Curriculum and organizational supports

Easy access to data

Ocean Tracks Phase 1

Teacher facilitation

Student-friendly data analysis/ visualization tools

Scientific expertise

For more info:

www.oceantracks.org

www.oceansofdata.org

www.edc.org

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Questions for Discussion

- What do we know about how best to support scientific practices with data?
- What additional supports should Ocean Tracks provide?
- In what ways could Ocean Tracks support others' work?
- In what other contexts might Ocean Tracks be useful?
- Which directions have the most potential to advance the field of building scientific practices with data?