# Ocean Tracks: Investigating Marine Migrations in a Changing Ocean

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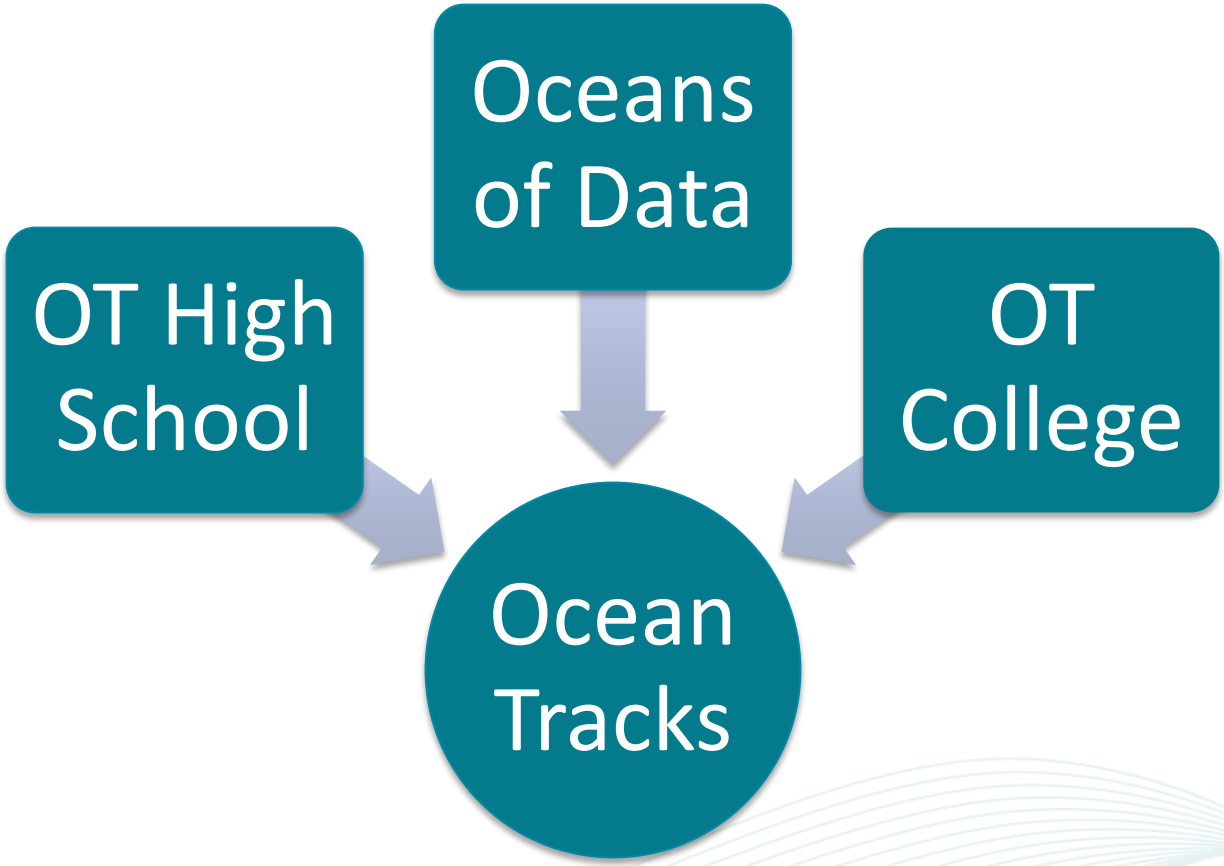
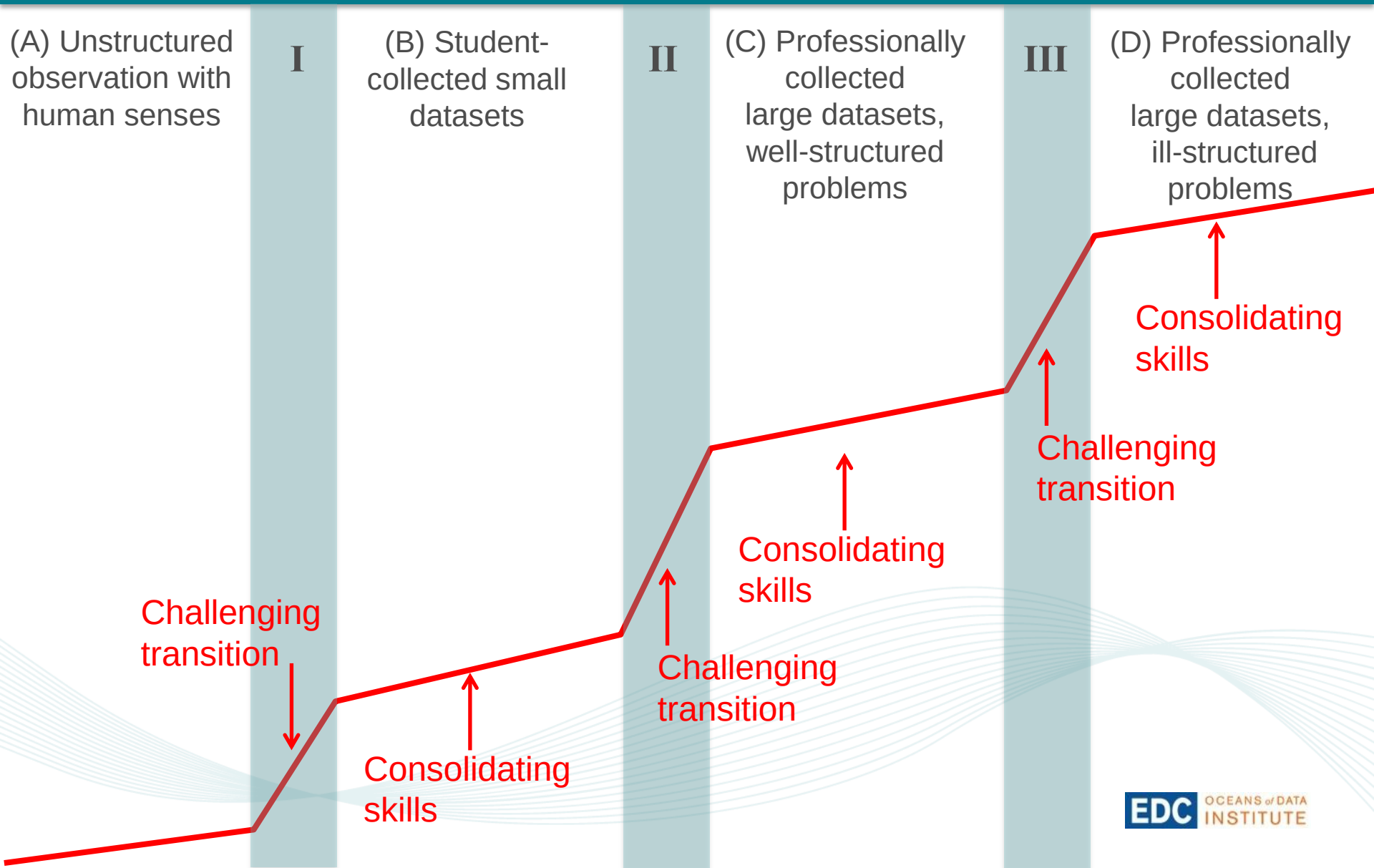
**EarthNC: Virgil Zetterlind, Brad Winney**
**Lifelong Learning Group, COSI: Jessica Sickler**


NSF EDC OCEANS of DATA INSTITUTE HOPKINS MARINE STATION

# Three+ Projects



# A Potential Learning Progression

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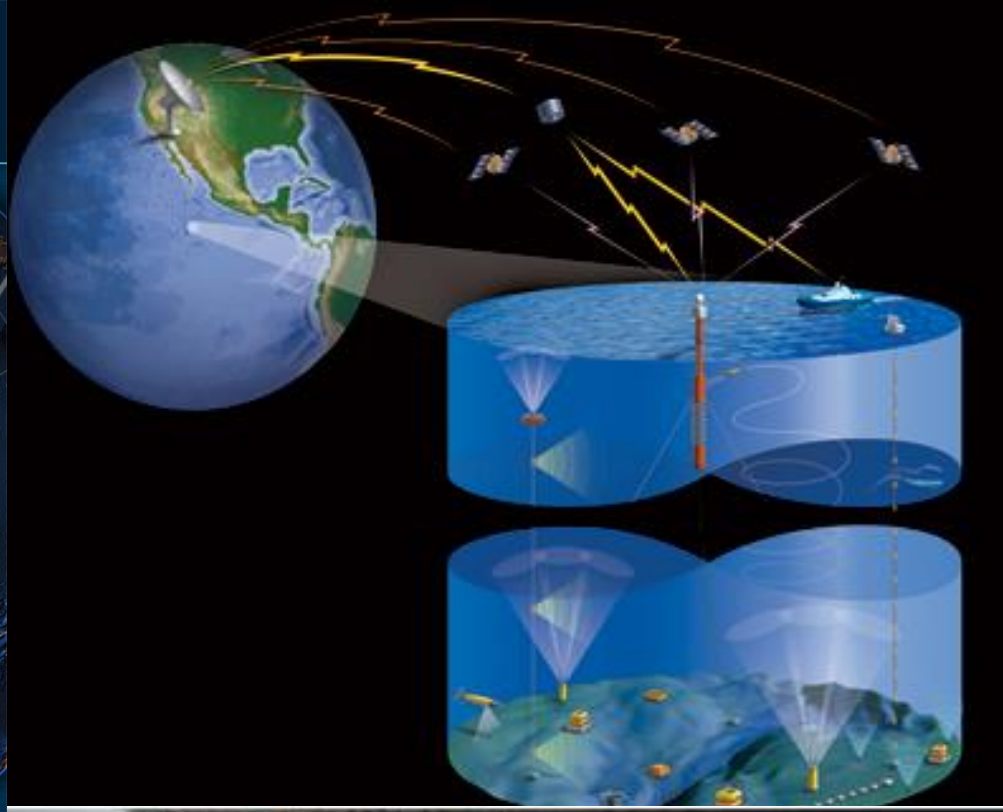
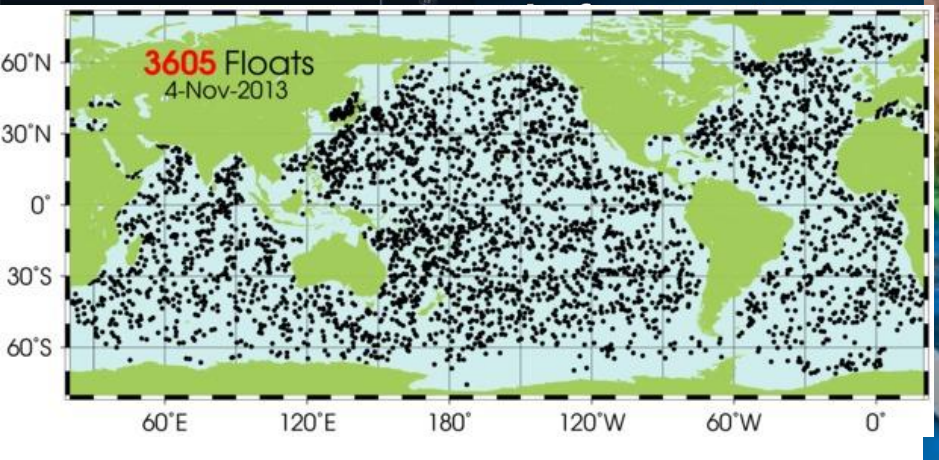
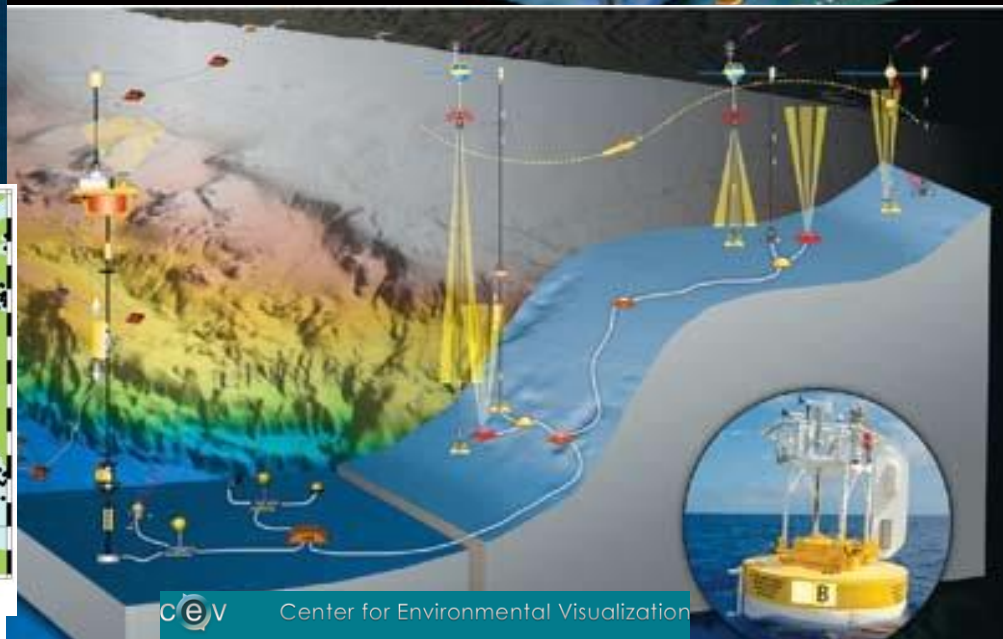
# CYBER-INFRASTRUCTURE





# 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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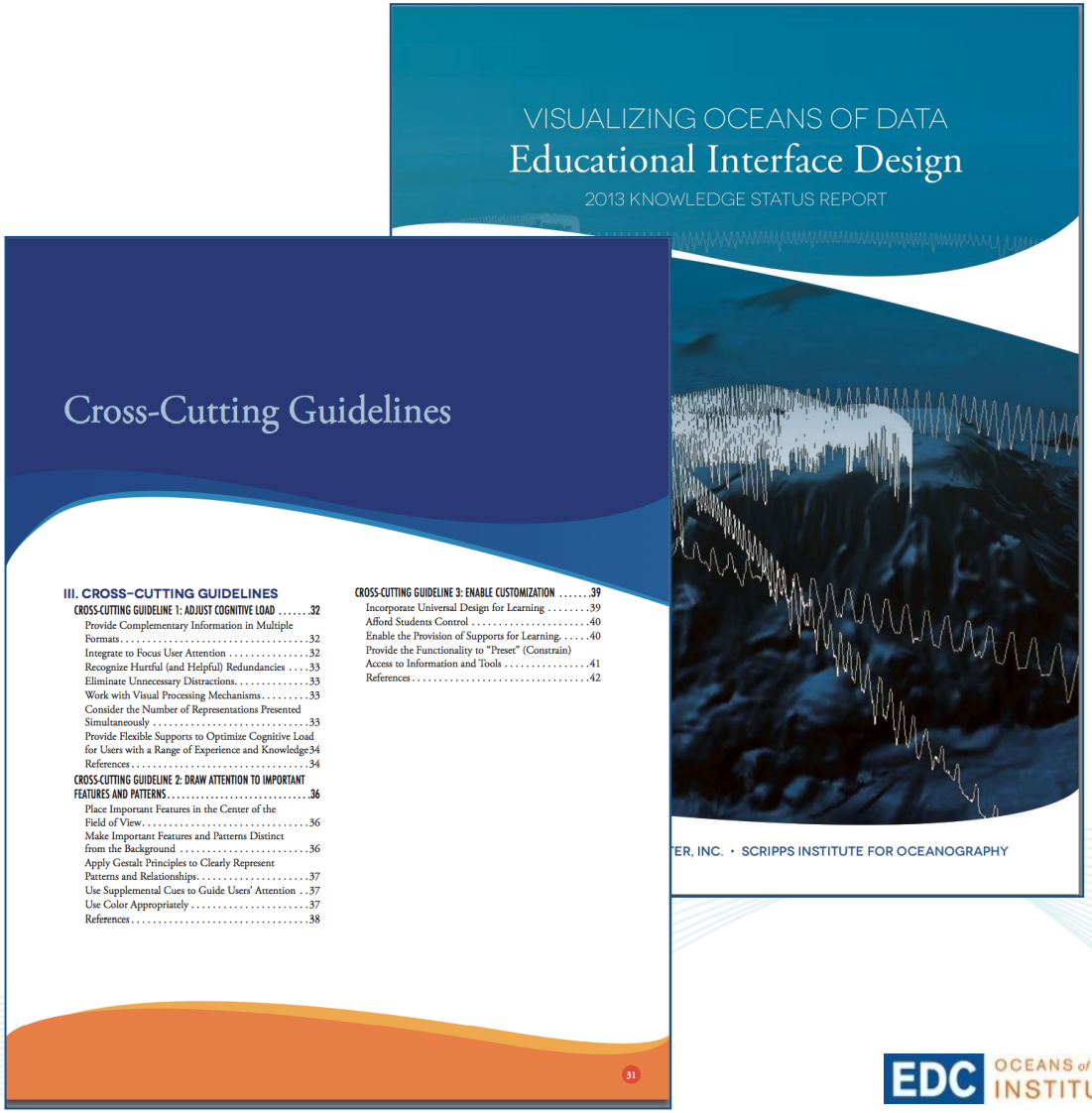
# The Challenge: Bridging interfaces built for scientists to novice users

- Remotely-collected data
- Large, complex data sets
- Expert data access and data representations may be baffling to students and teachers

# NSF-funded Exploratory Project: Oceans of Data

*In what ways can research on learning inform the design of interfaces and technology tools to be used by students accessing large scientific databases?*

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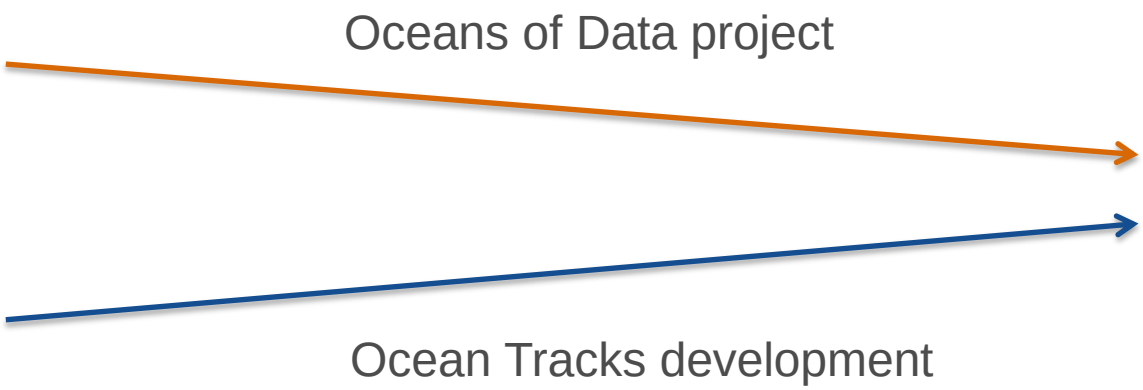
# Project Origins




Fall 2010

Fall 2012

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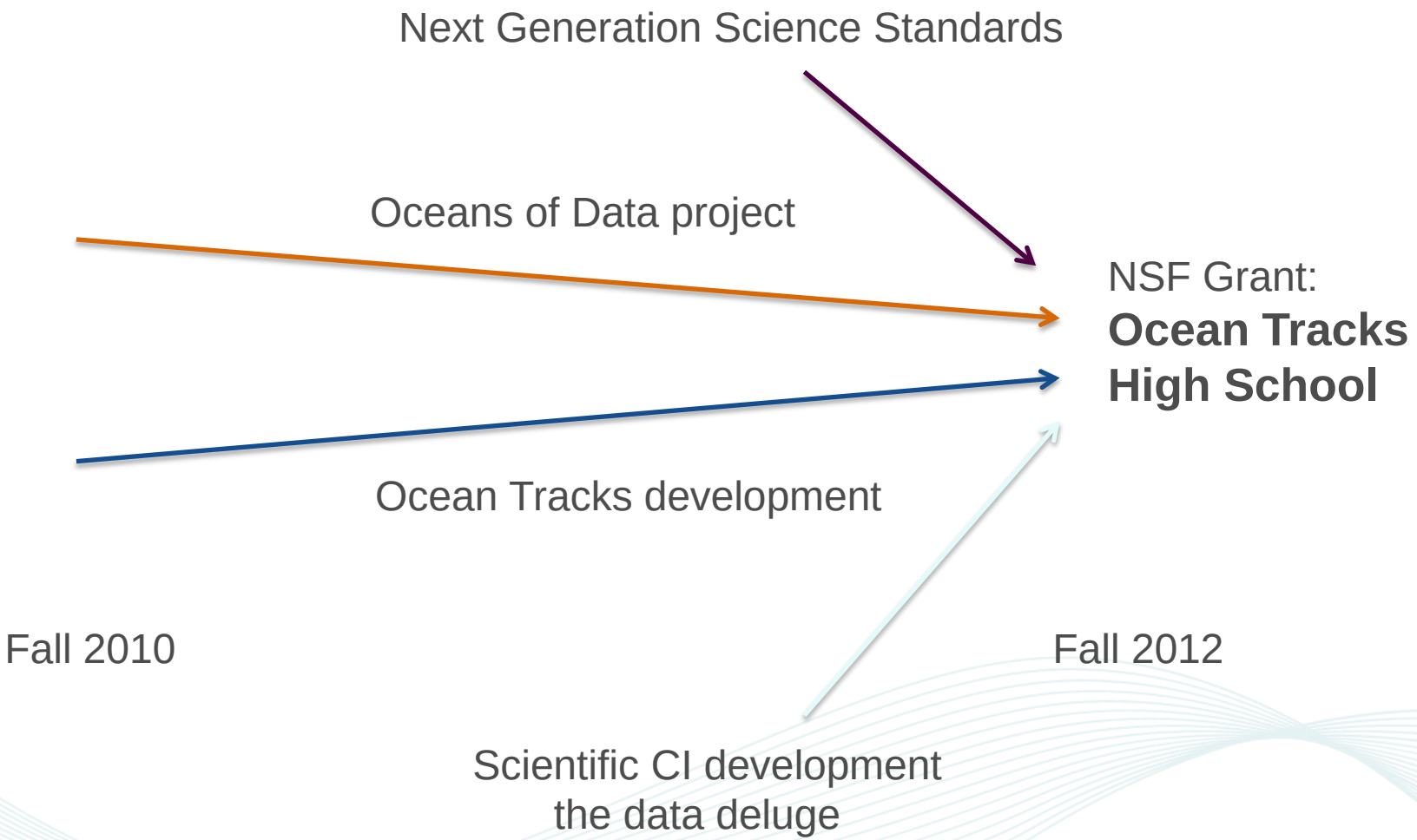
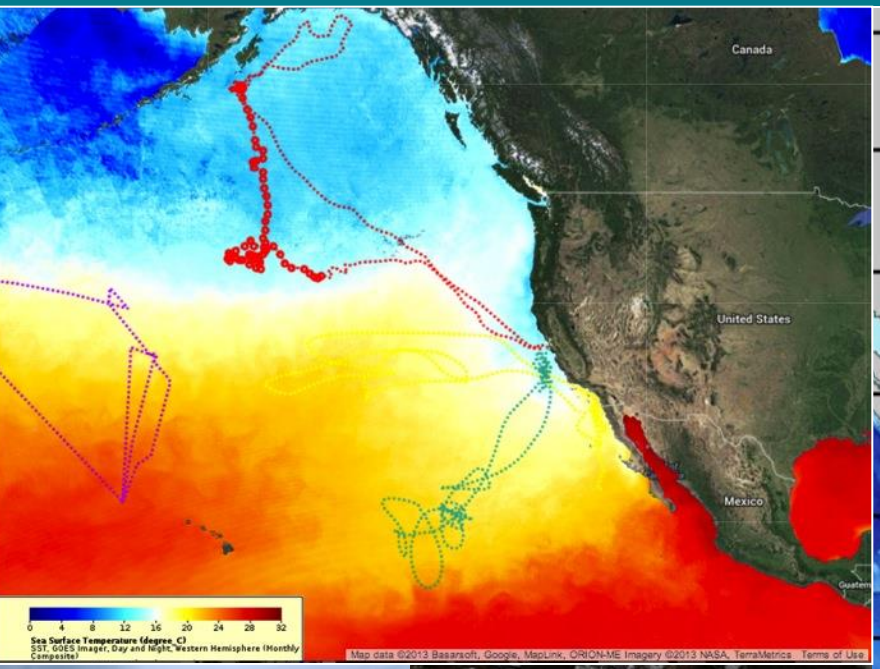
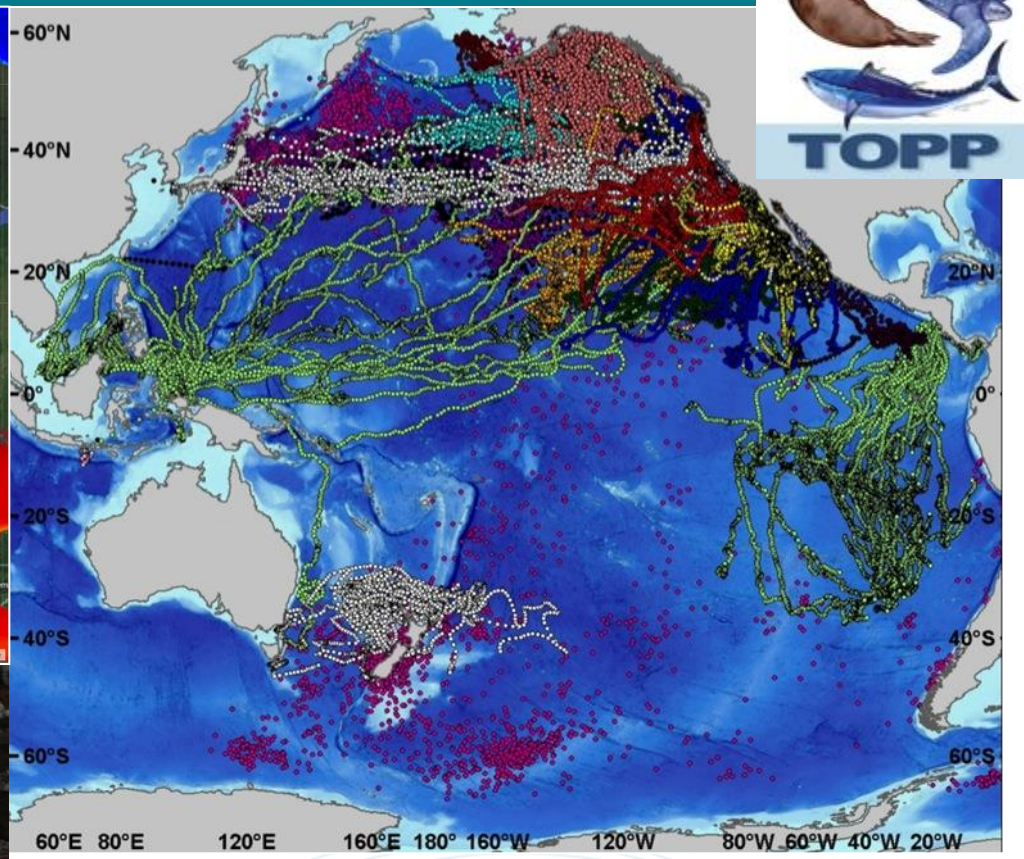
# Project Origins



# 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


60°N
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# Our Approach

Scientific questions

Identify focused set of data and data analysis tools

Develop interface, following Oceans of Data guidelines

Incorporate guided student experiences and teacher supports

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# Goals for students

**Promote scientific practices**

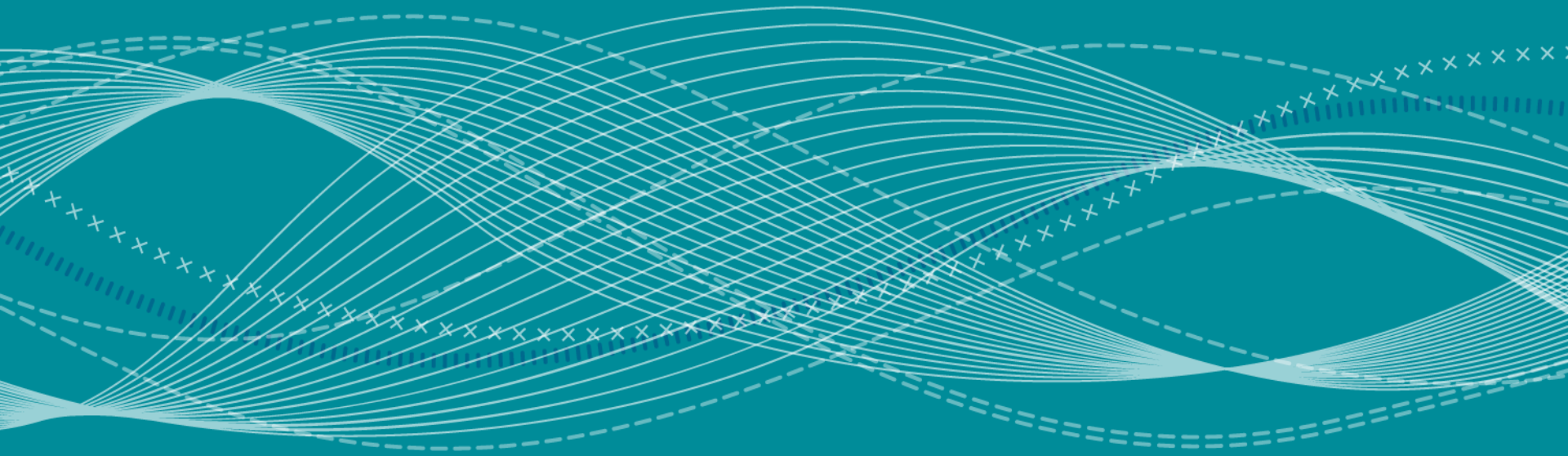
- Select data appropriate to investigate questions
- Create unique data visualizations
- Examine relationships between variables
- Construct explanations from the data
- Use multiple lines of evidence to support claims
- Develop questions that can be investigated using data

# 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 Ocean Tracks Interface



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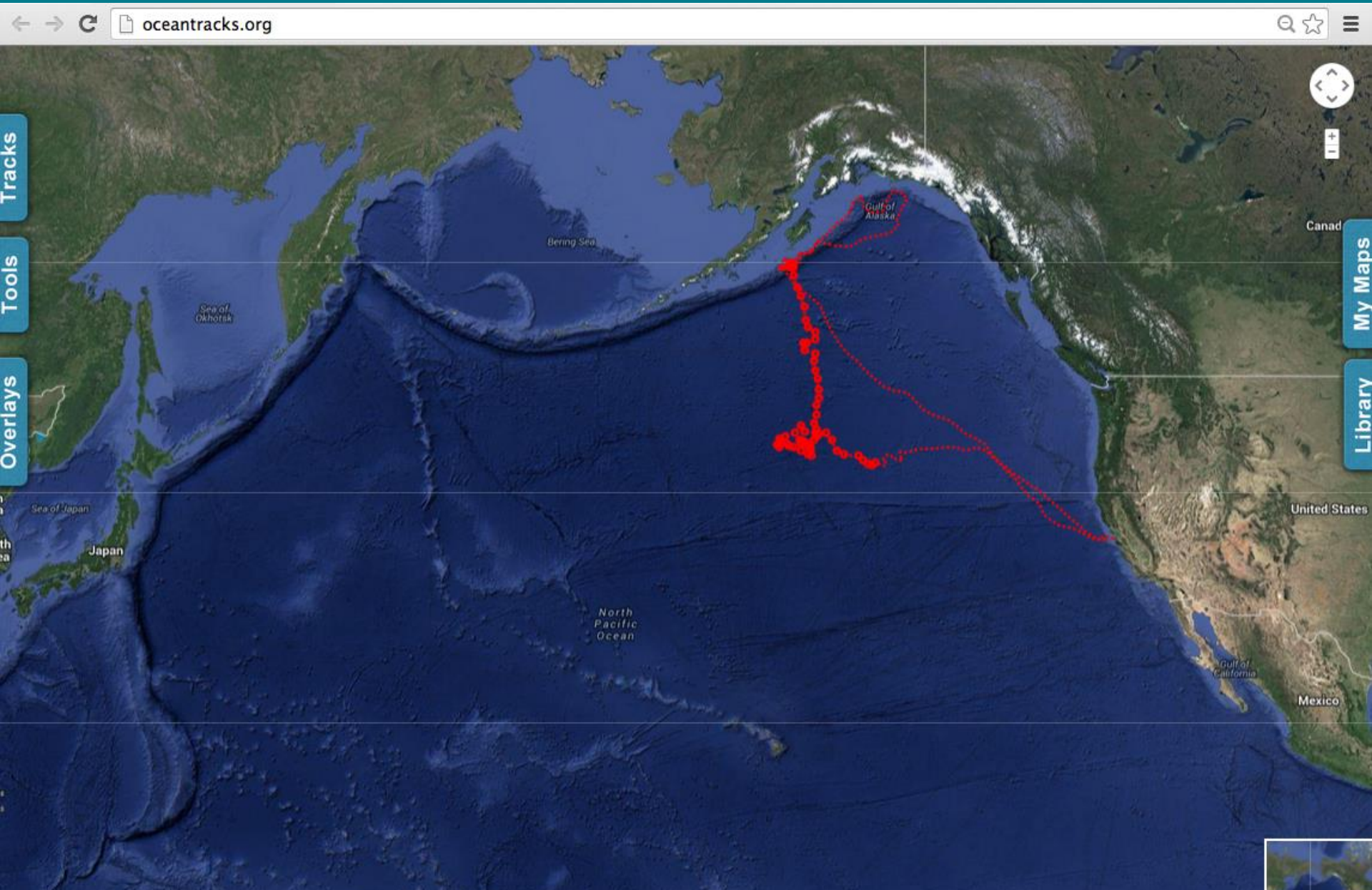
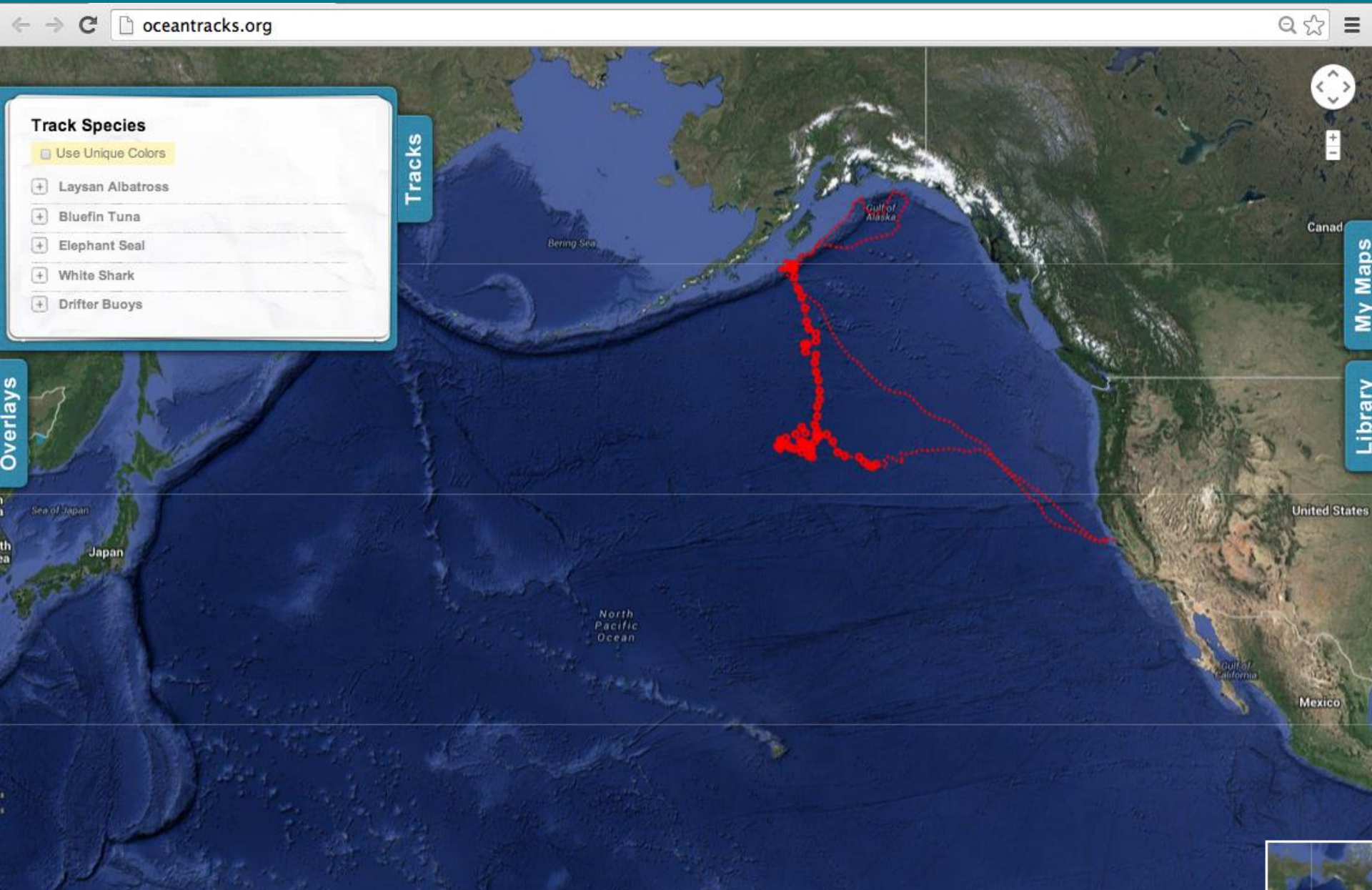
# The Interface



# *Get students quickly to the data*



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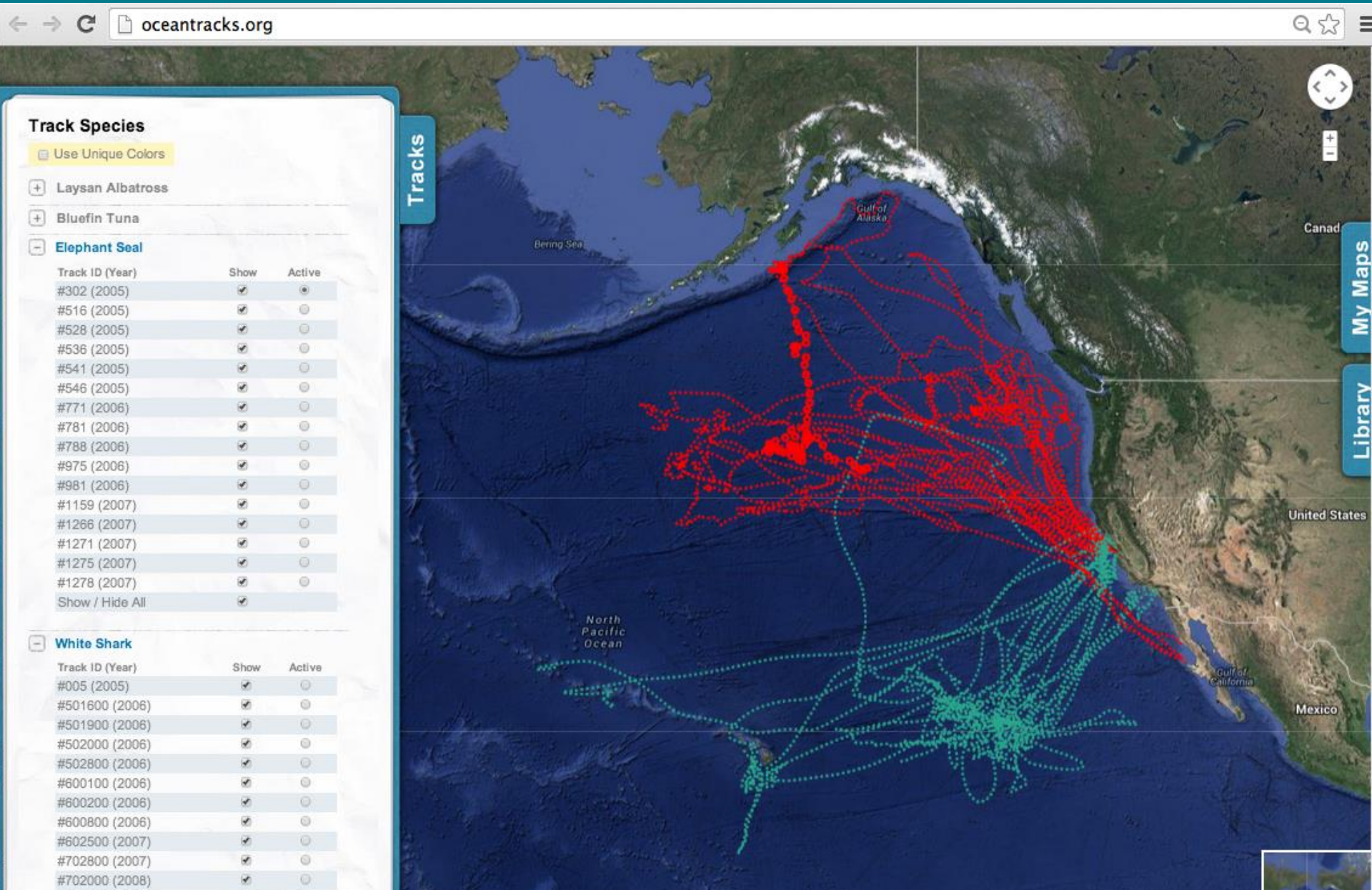
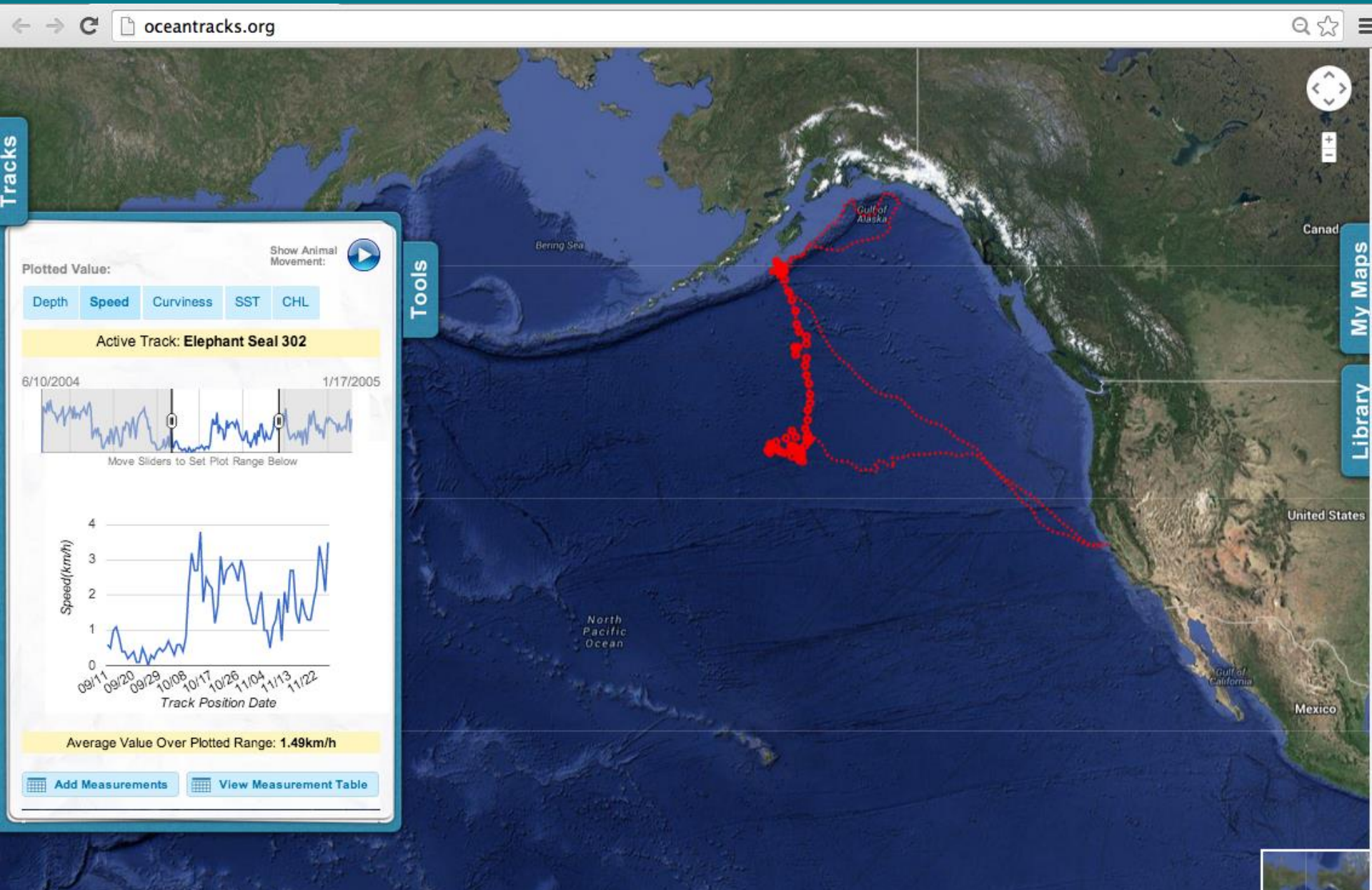


# *Allow them to easily create and interact with data displays*



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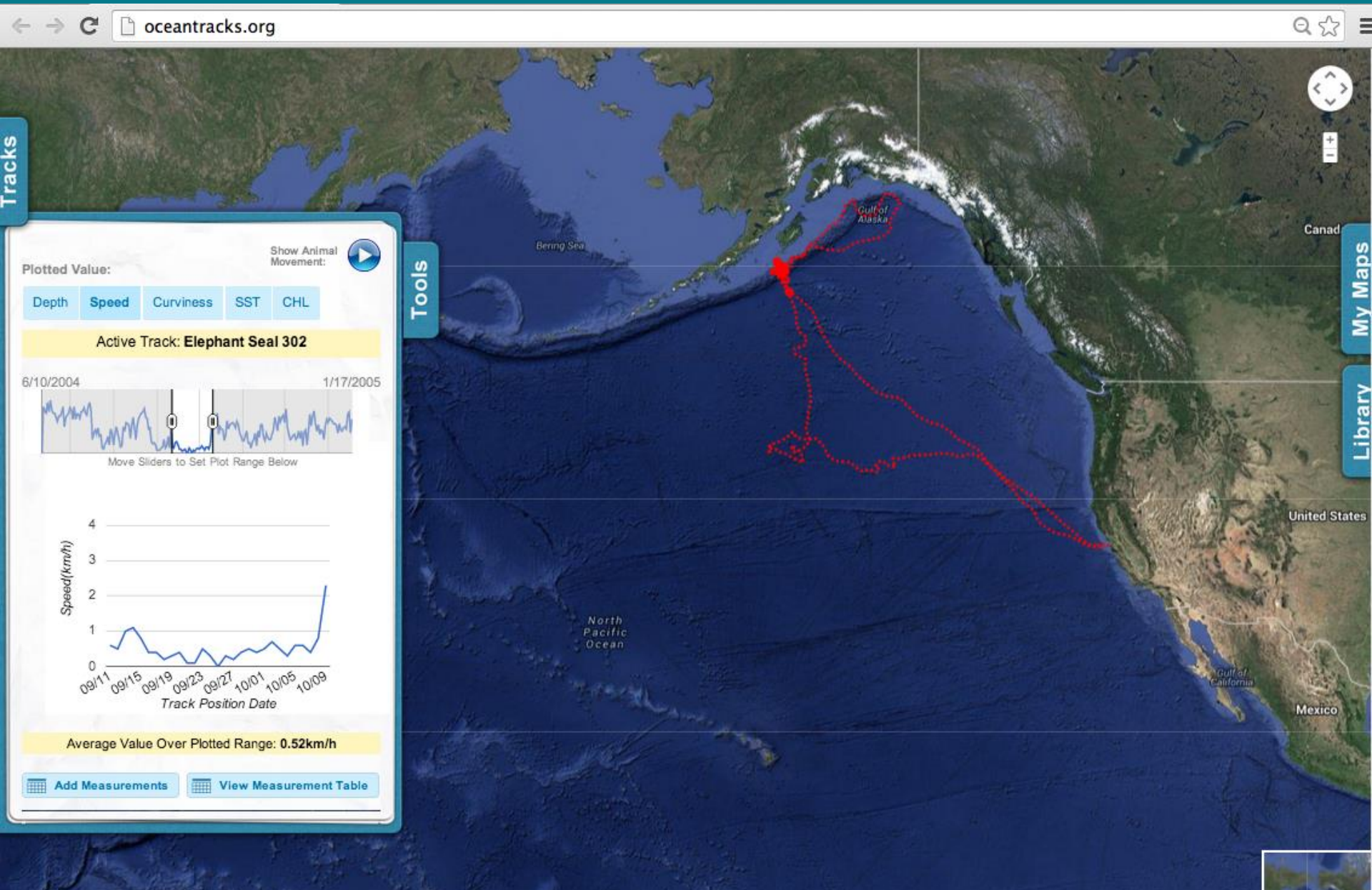

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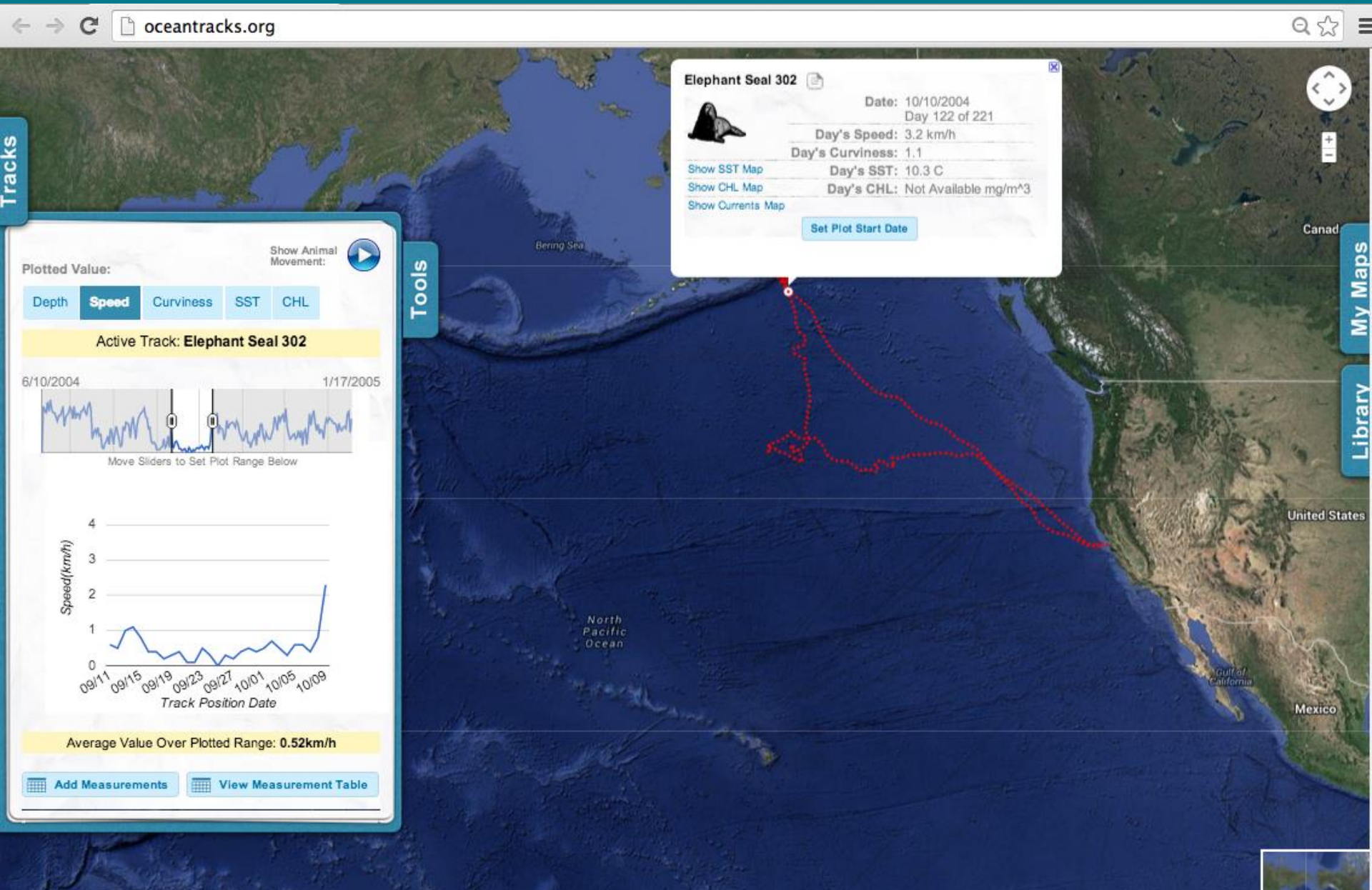

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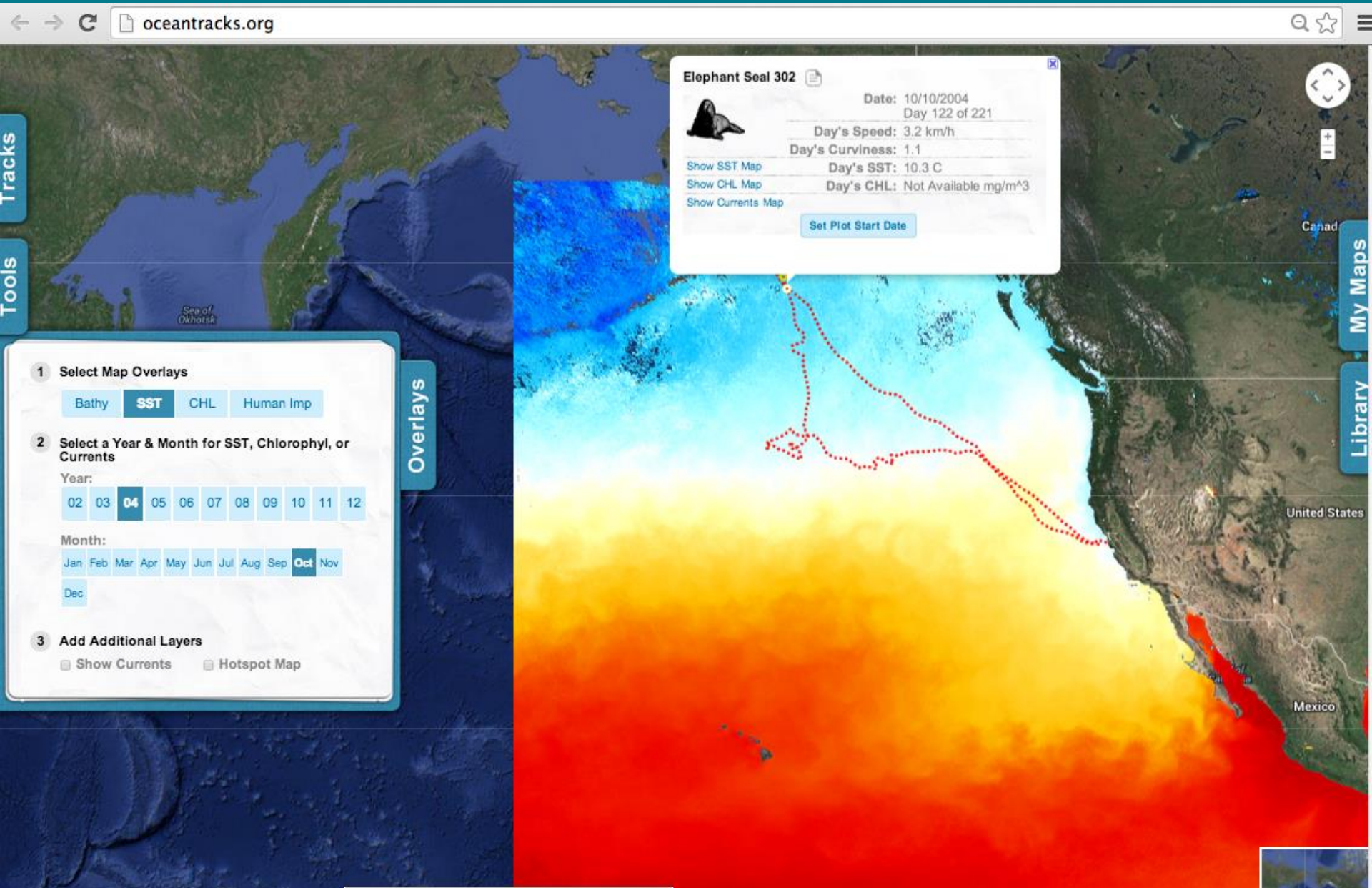

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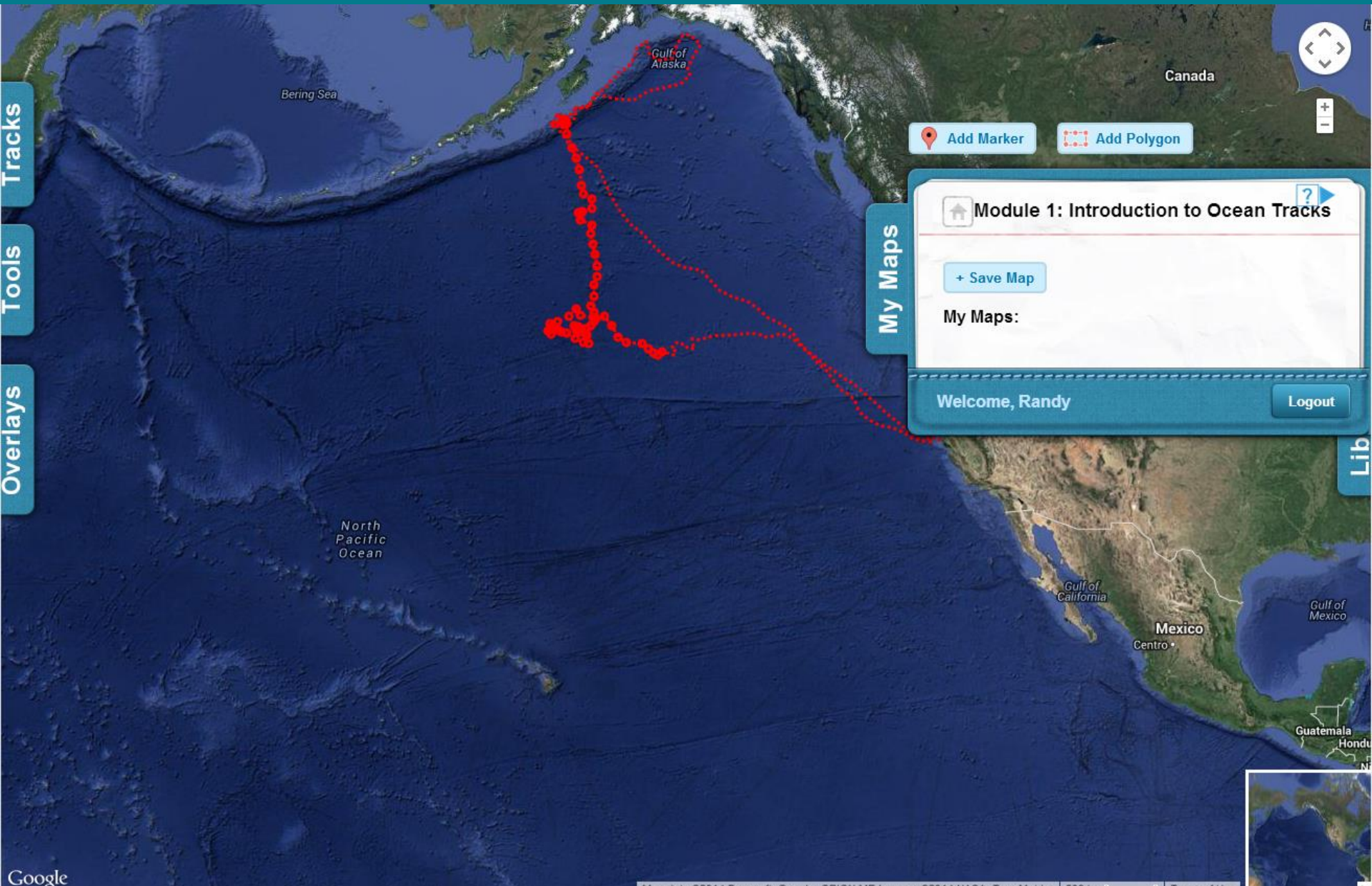
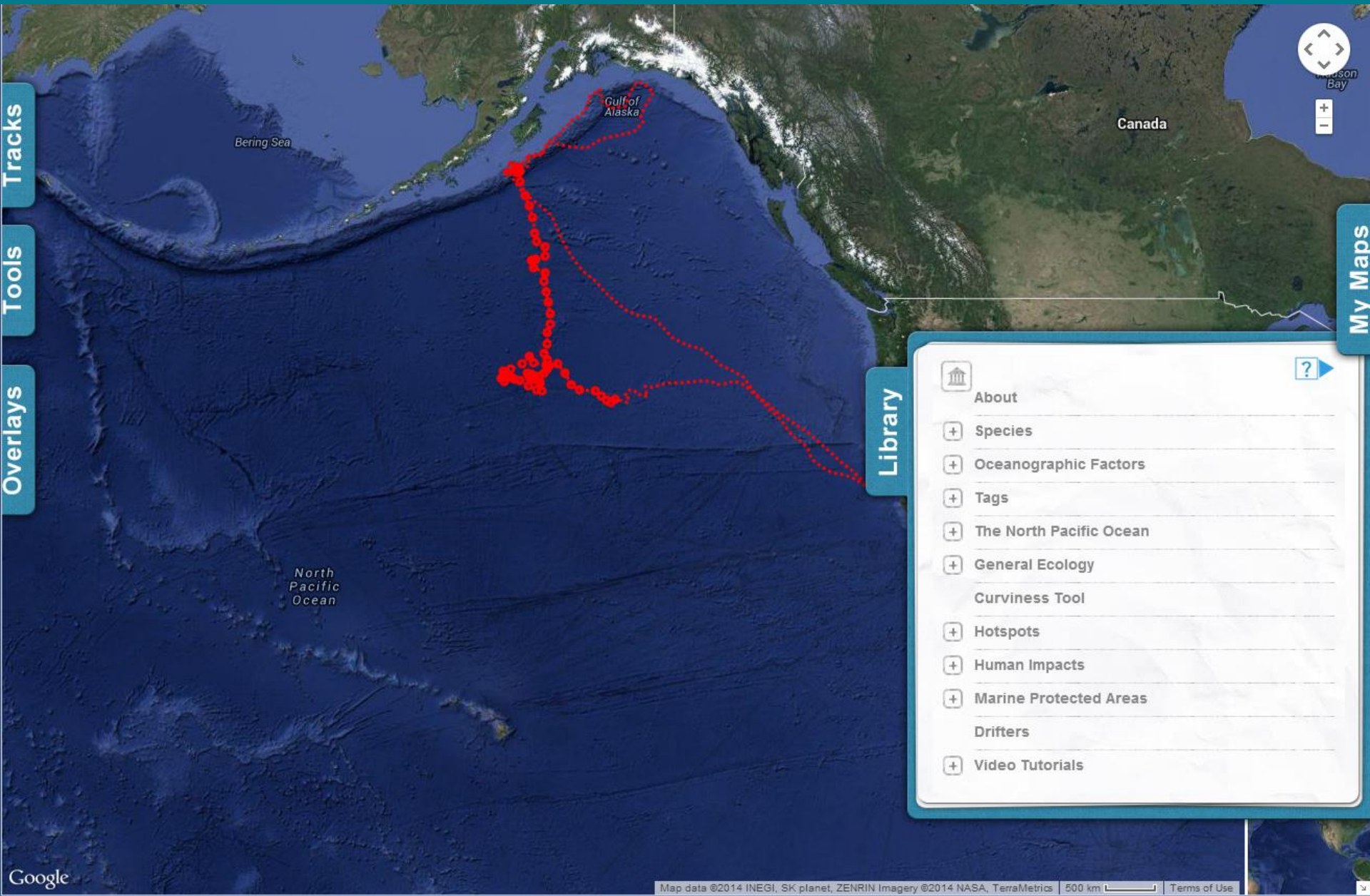


# *Provide supports that can be accessed on-demand*



# *Customized content supports*

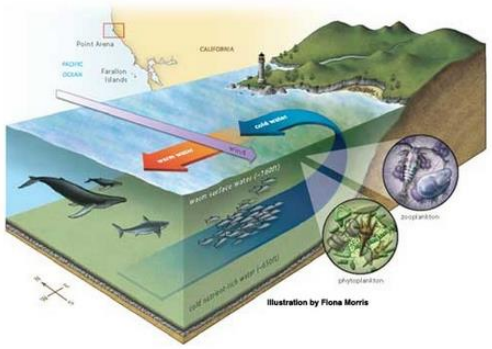
## Ocean Tracks Library

**Categories**

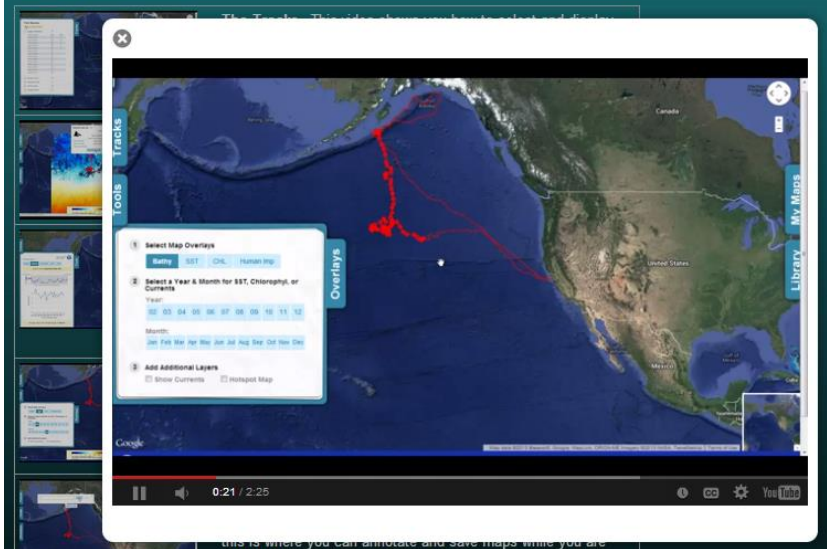
- About
- Species
- Oceanographic Factors
- Tags
- The North Pacific Ocean
  - Major Currents
  - The North Pacific Transition Zone and Transition Zone Chlorophyll Front
  - **Upwelling and the California Current**
- General Ecology
- The Curviness Tool
- Hotspots
- The Hotspot Tool
- Human Impacts
- 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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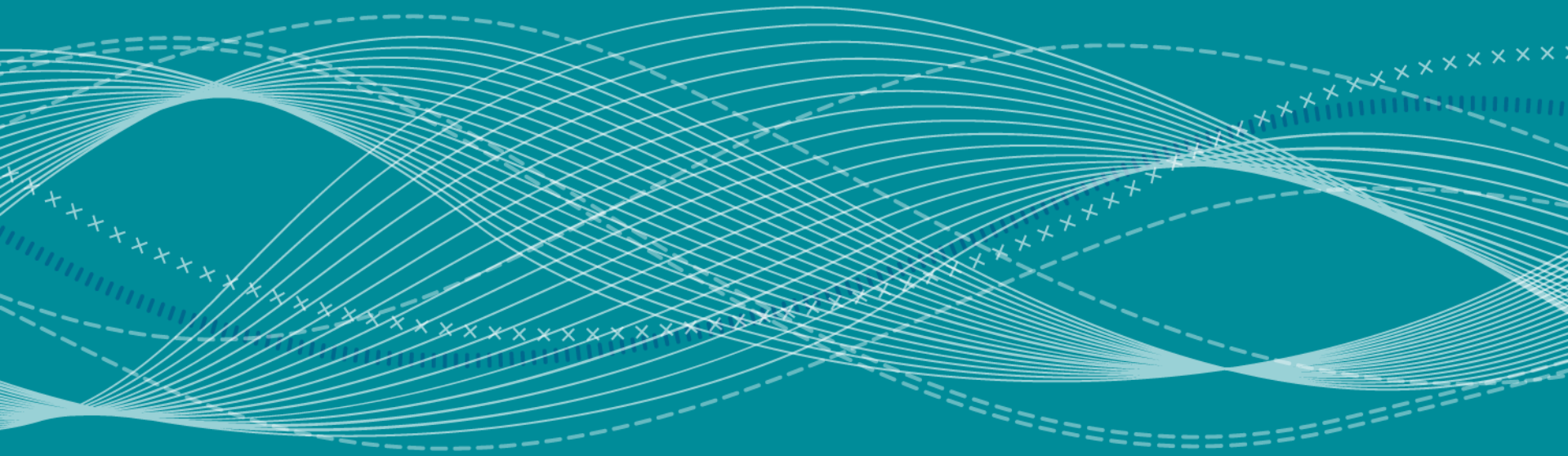
# Research Findings: OT High School



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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:

- Difficult to find balance between “not enough” and “too much” instruction in curriculum modules. “Too much” made modules tedious to students.
- Classroom management – balancing online with offline time.

# 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

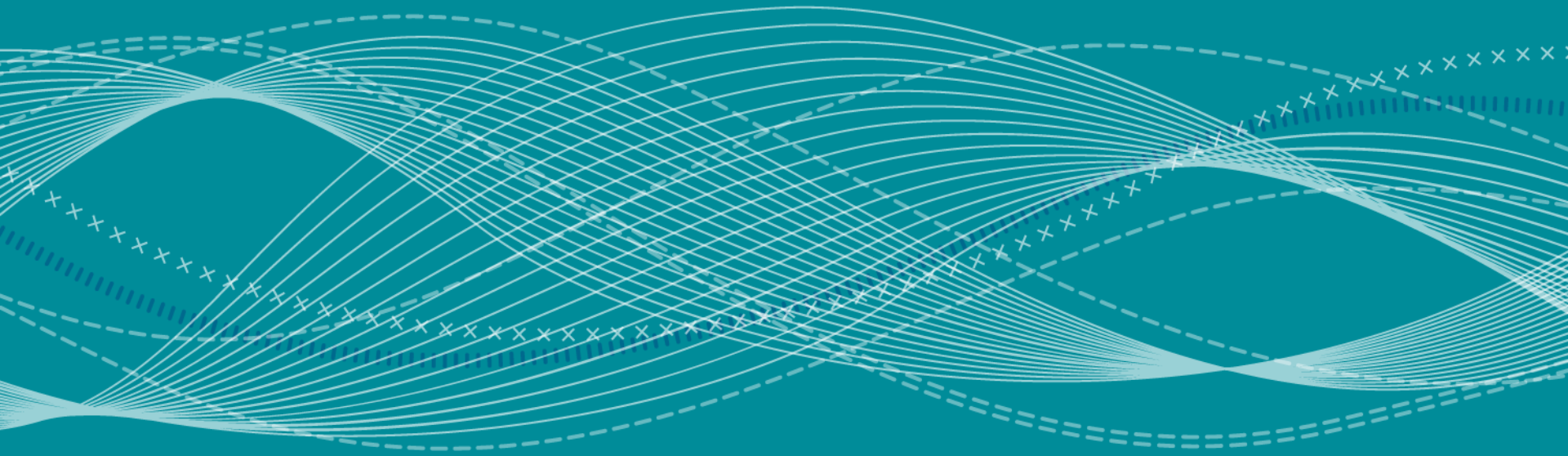
Challenges:

- 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?

# Ocean Tracks: College Edition



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# Project Motivation & Goals

- Audiences for Ocean Tracks broader than expected
- Strong interest among undergraduate faculty for tools to help students learn “big data” skills
- OT-CE project, funded in fall 2014, to create OT curriculum for undergraduate ocean science courses
- Iterative development and testing over 3 years, with Scripps Institution of Oceanography and Palomar College

# Research Questions

1. How do current oceanography and marine biology faculty use large-scale datasets in their courses?
2. What supports may be needed to incorporate *Ocean Tracks* into undergraduate science courses?
3. How do undergraduates engage in and interact with online vs. face-to-face versions of OT-CE?
4. Does OT-CE improve undergraduate students'
   - engagement in scientific practices & interest in scientific careers?
   - knowledge of core content & competence in scientific practices?

Thank you!

Thoughts/ questions?