UNIVERSITY of WASHINGTON

Tydal

Final Project CSE 599 B1

December 14, 2016

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Outline

- Problem Description and Motivation
- Data Used
- Design and Use Cases
- Demonstration

Problem:

Problem:

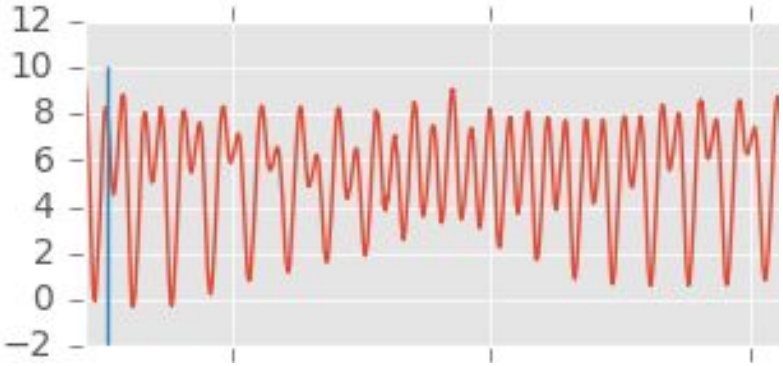
Problem Description and Motivation

Problem Description - Create an educational tool to learn about local tides and currents by interacting with data.

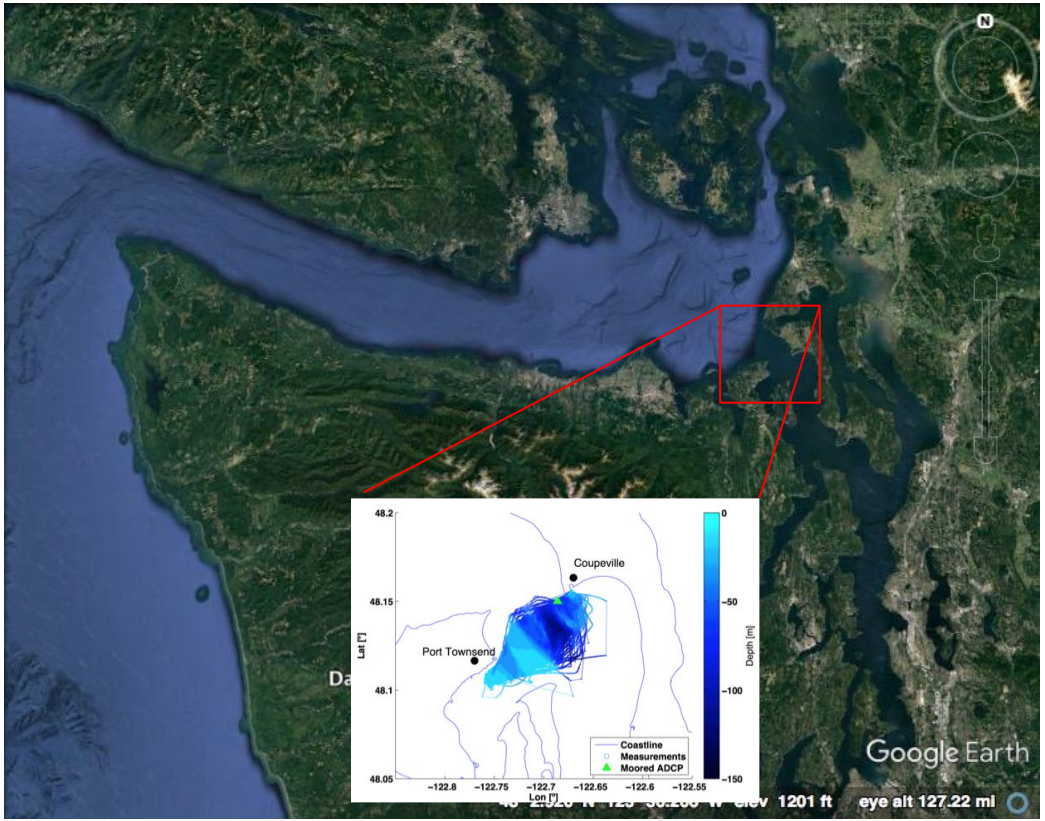
Motivation - Tides force the local water behavior, which in turn impacts ecology, fishing, recreational boating, and pollution. We aim to create an interactive educational tool to teach the basics of tides and currents in the Puget Sound.

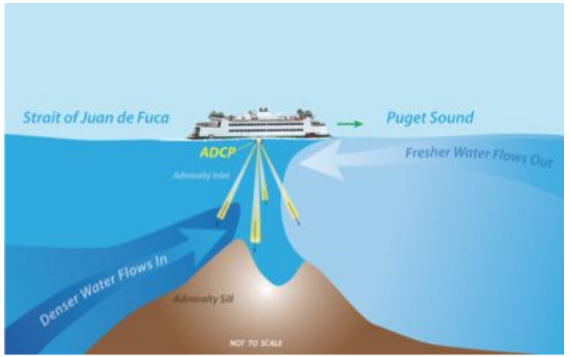
- Data from 3 local tide stations and the Port Townsend/Coupeville ferry
- Interactive demos in three parts
  - 1 - What are tides? How do the moon and sun affect tides?
  - 2 - How does this manifest to water elevations locally (in the Strait of Juan de Fuca)?
  - 3 - How are tidal currents related to changes in tidal elevation?
- Goal - Easy to use interface in web browser. Intermediate goal: each part as an ipython notebook

Data Description: Tidal Elevation from NOAA



Data Description: Tidal Currents (WADOT Ferries)



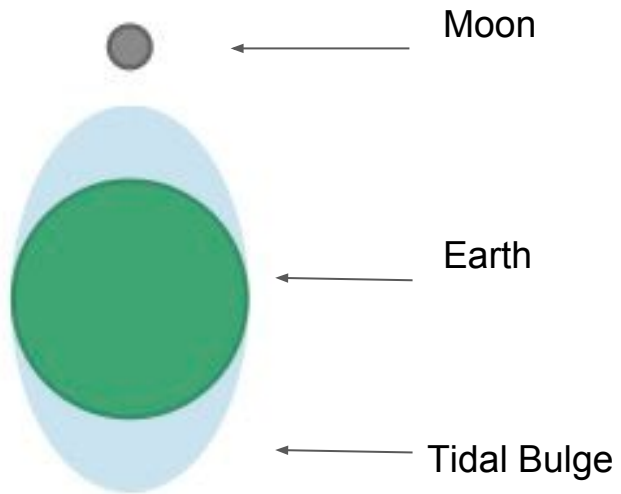


Design and Use Cases

- Module 1: Introduction to Tides
  - What causes tides?
    - Semidiurnal tides (Moon influence)
    - Sun’s influence on tides
    - Tidal elevation
- Module 2: Tides in the Puget Sound
  - How do tides move through time?
    - Show the tidal movement past three consecutive stations in the Strait of Juan de Fuca
  - How do tides manifest into the water level in the Strait and Puget Sound?
    - Overview of a day’s tidal elevation and cycle for 3 stations
    - Connection of the tidal cycle at each station to the resulting sea surface elevation
- Module 3: Tidal Currents
  - Relation of tidal currents to tidal elevation
    - Tidal currents model
    - Currents through Admiralty Inlet from instruments installed in WADOT ferries

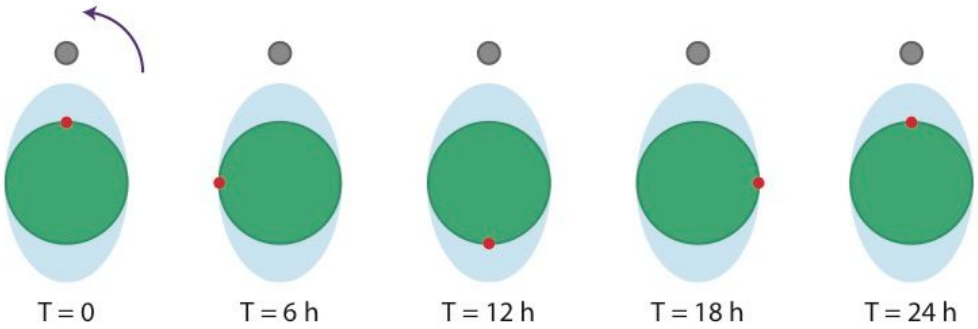
Module 1 - Tides

- Simple description of tides and their cause
  - Earth - Moon system
  - Earth - Sun - Moon system
  - Resulting tidal patterns

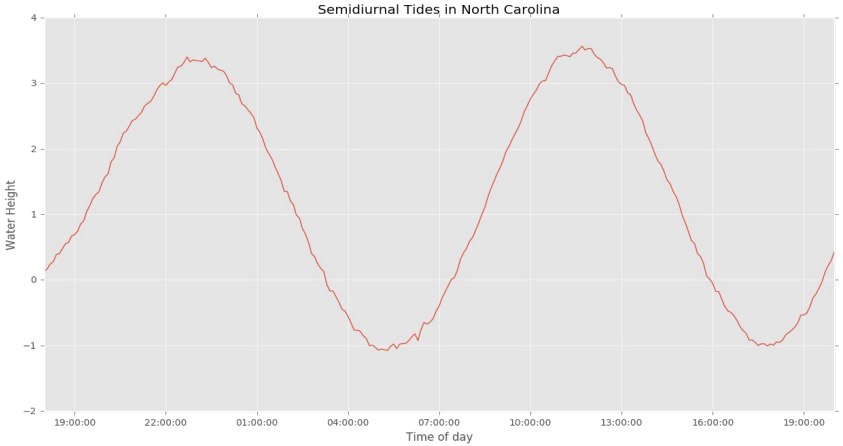


Gravitational pull of Moon on Earth’s water, generating tides.

Moon’s contribution to the tides



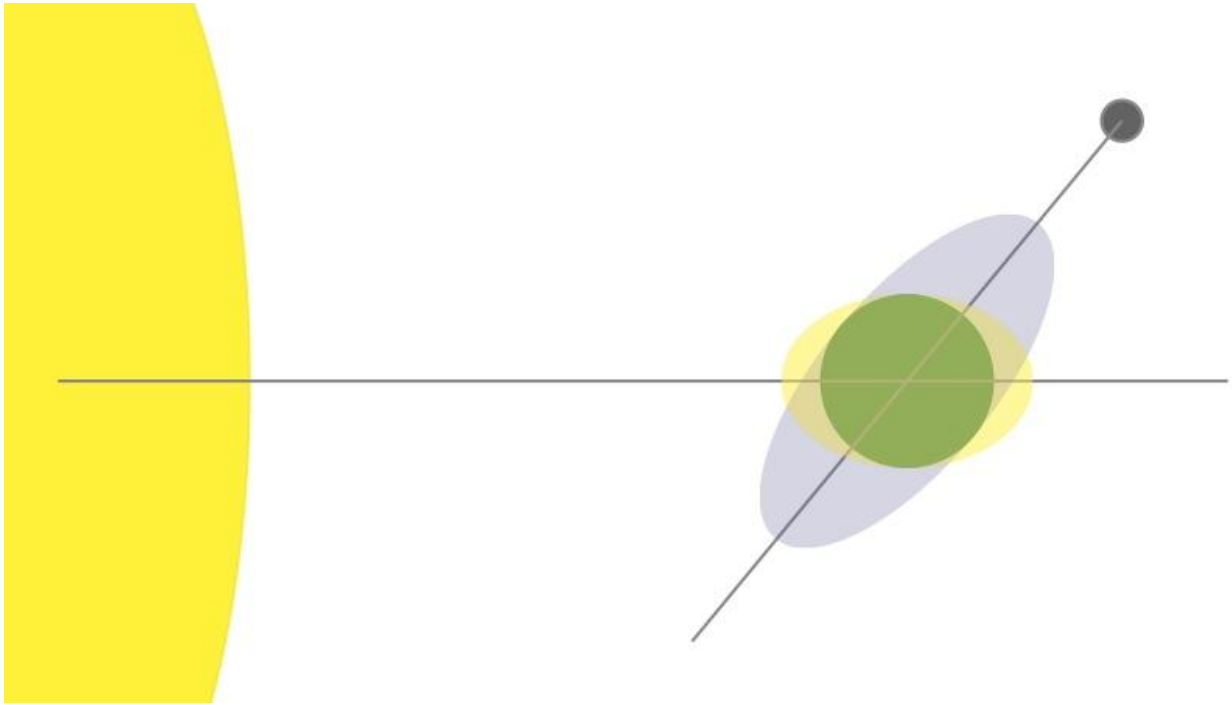
Semidiurnal Tides - Two high and two low tides of equal magnitude



Graph of tide data from North Carolina showing semidiurnal tides

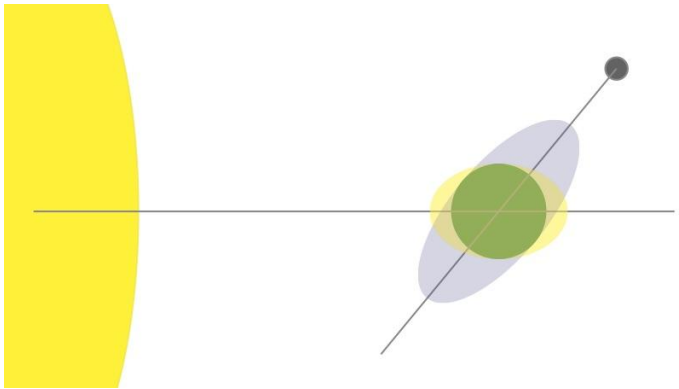
Module 1 - Tides

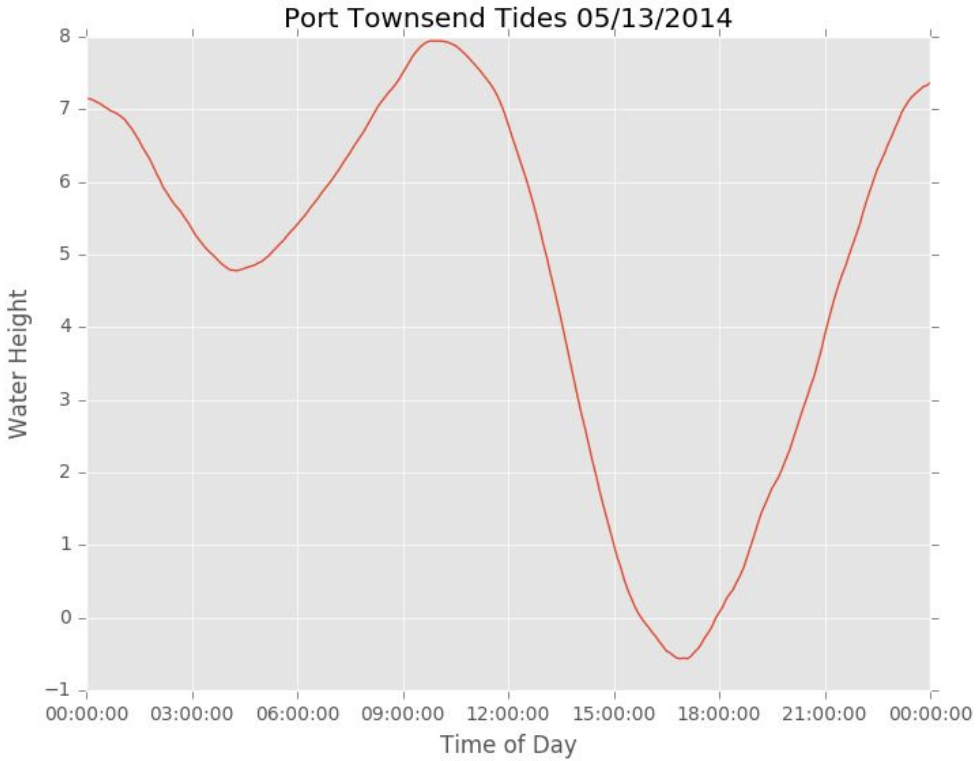
- Earth - Sun - Moon system



Module 1 - Tides

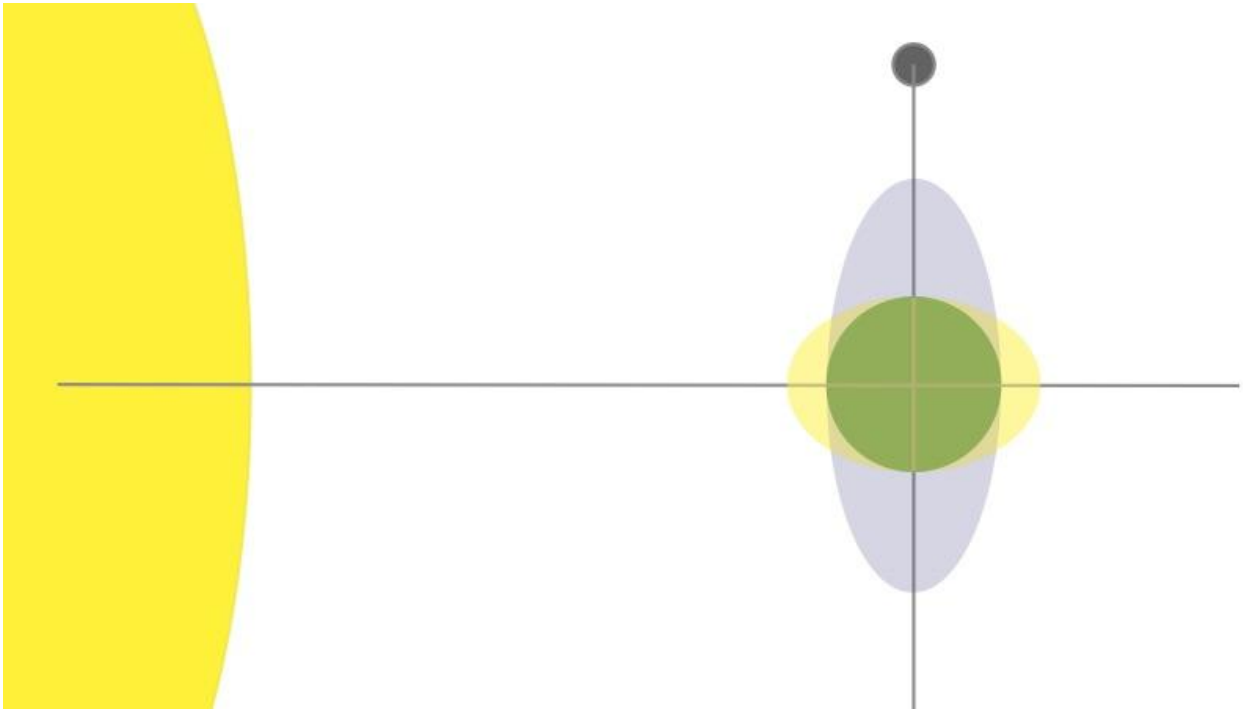
- Earth - Sun - Moon system





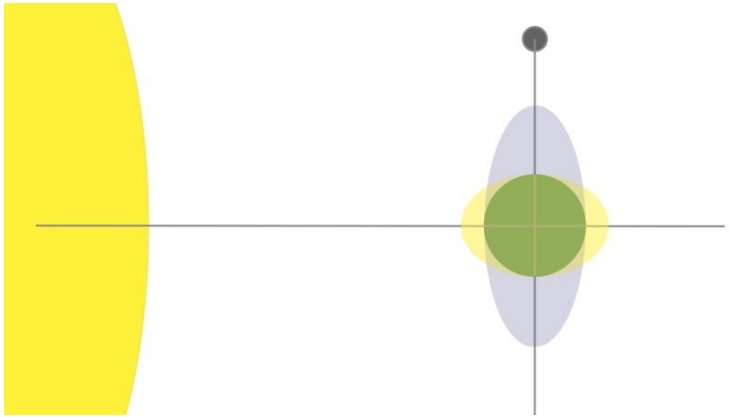
Module 1 - Tides

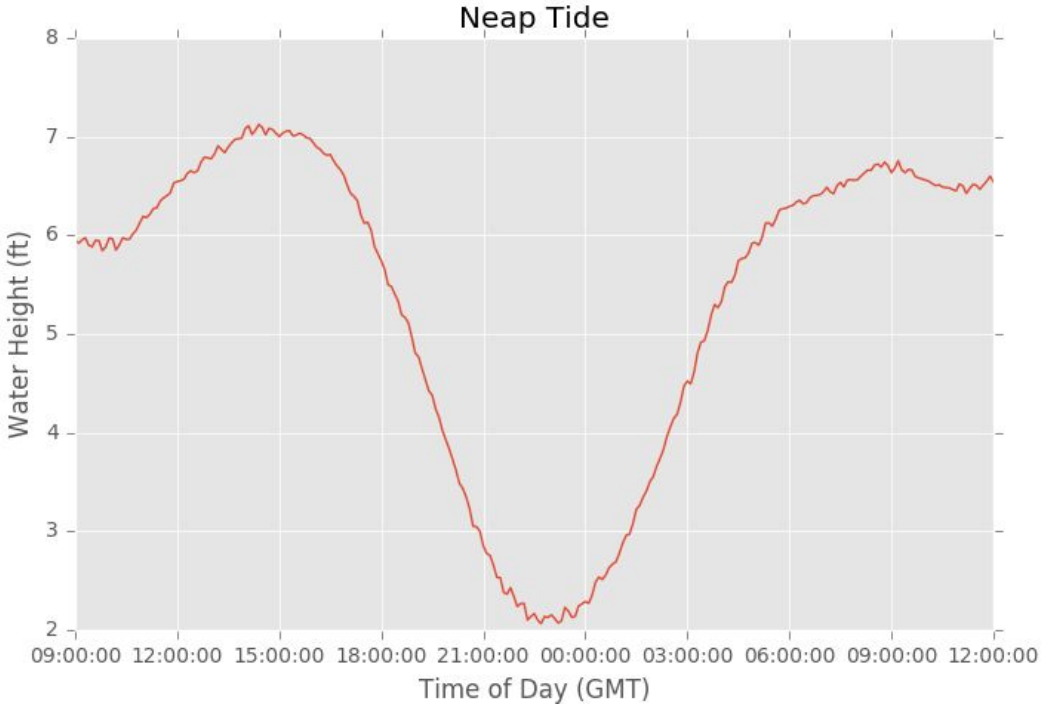
- Neap Tides



Module 1 - Tides

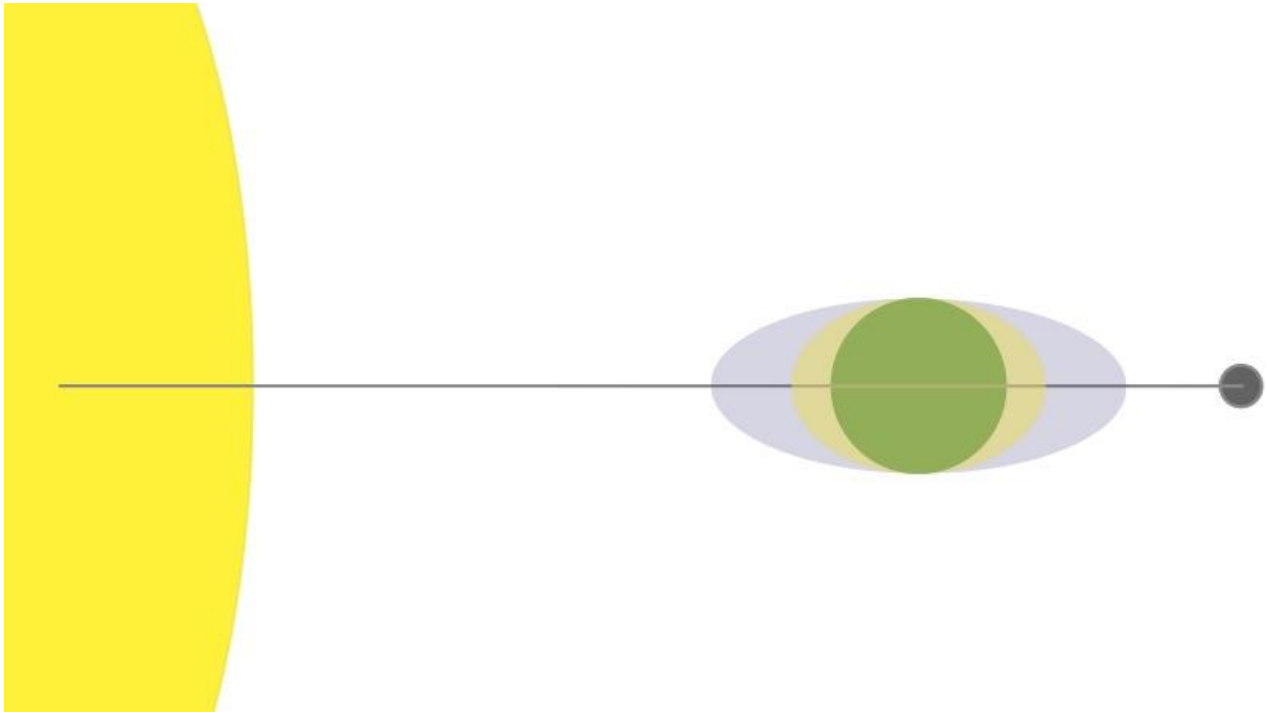
- Neap Tides





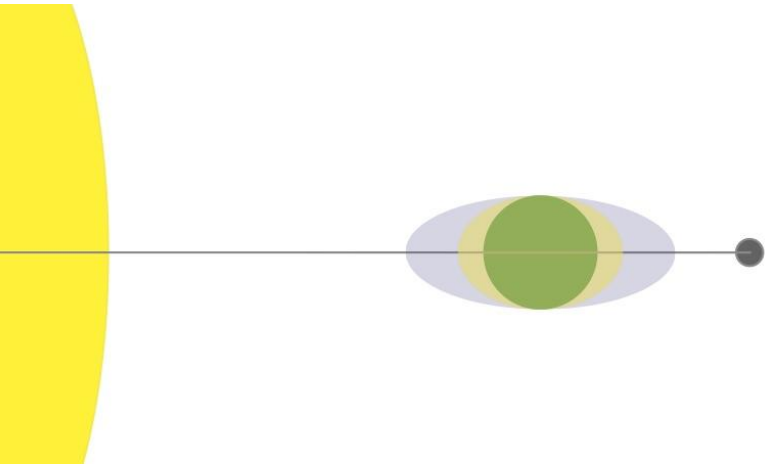
Module 1 - Tides

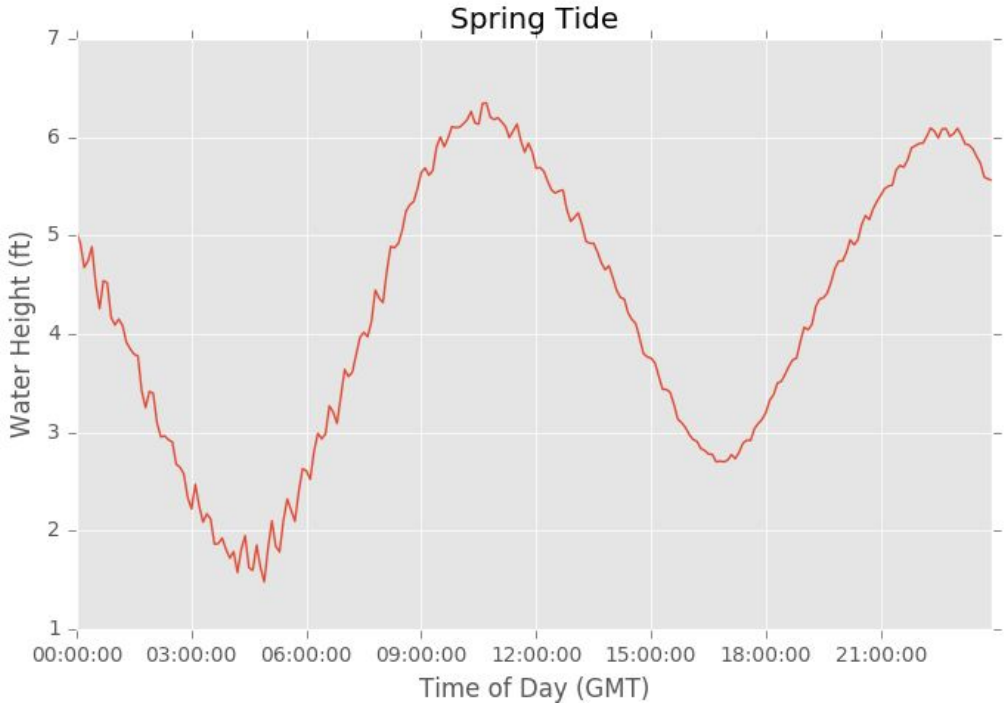
- Spring Tides



Module 1 - Tides

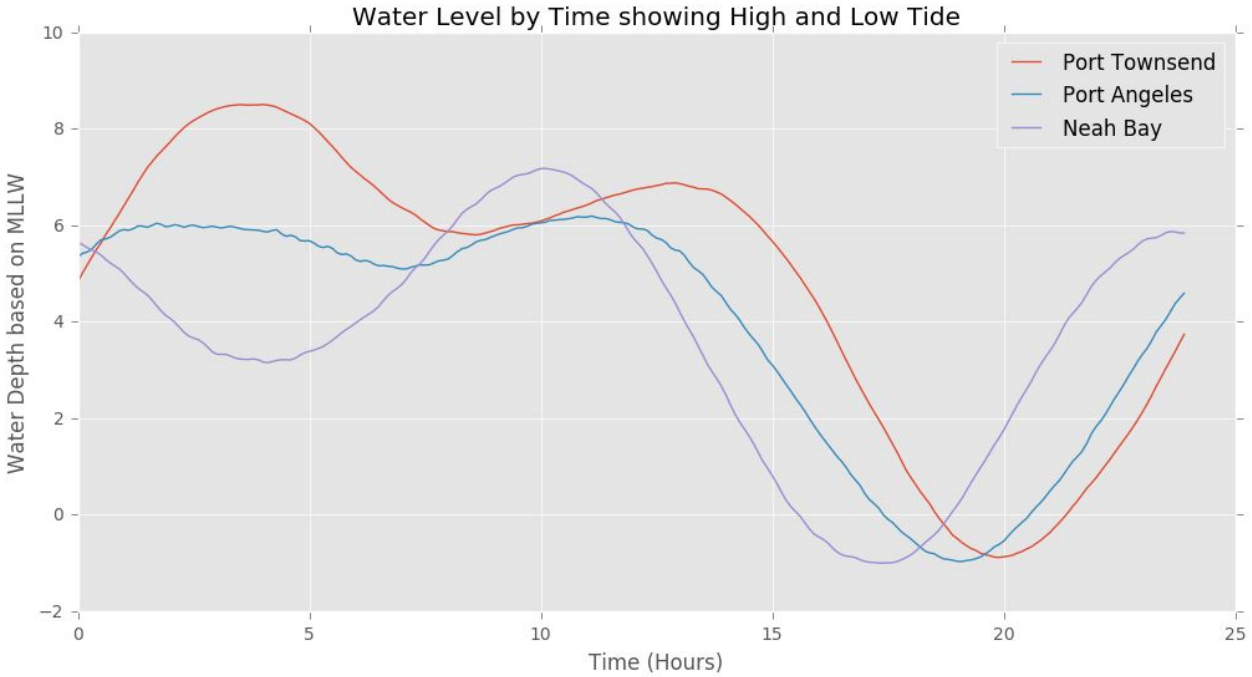
- Spring Tides





Module 1

- Exploration of tidal elevation data from Puget Sound
  - Water level at the three stations through time



Quiz

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In [*]: quiz()
Module 1 Quiz (5 questions)

Question 1: Why is the Earth affected by the Moon?

a. Massive
b. Close/Proximity
c. It isn't
Make your choice: a
Incorrect
Question 2: How many high and low tides are there in a day?

a. 2 high, 1 low
b. 1 high, 1 low
c. 2 high, 2 low
Make your choice: c
Correct!
Question 2: How many high and low tides are there in a day for a semidurinal tideal day?

a. 2 high, 1 low
b. 1 high, 1 low
c. 2 high, 2 low

Make your choice:
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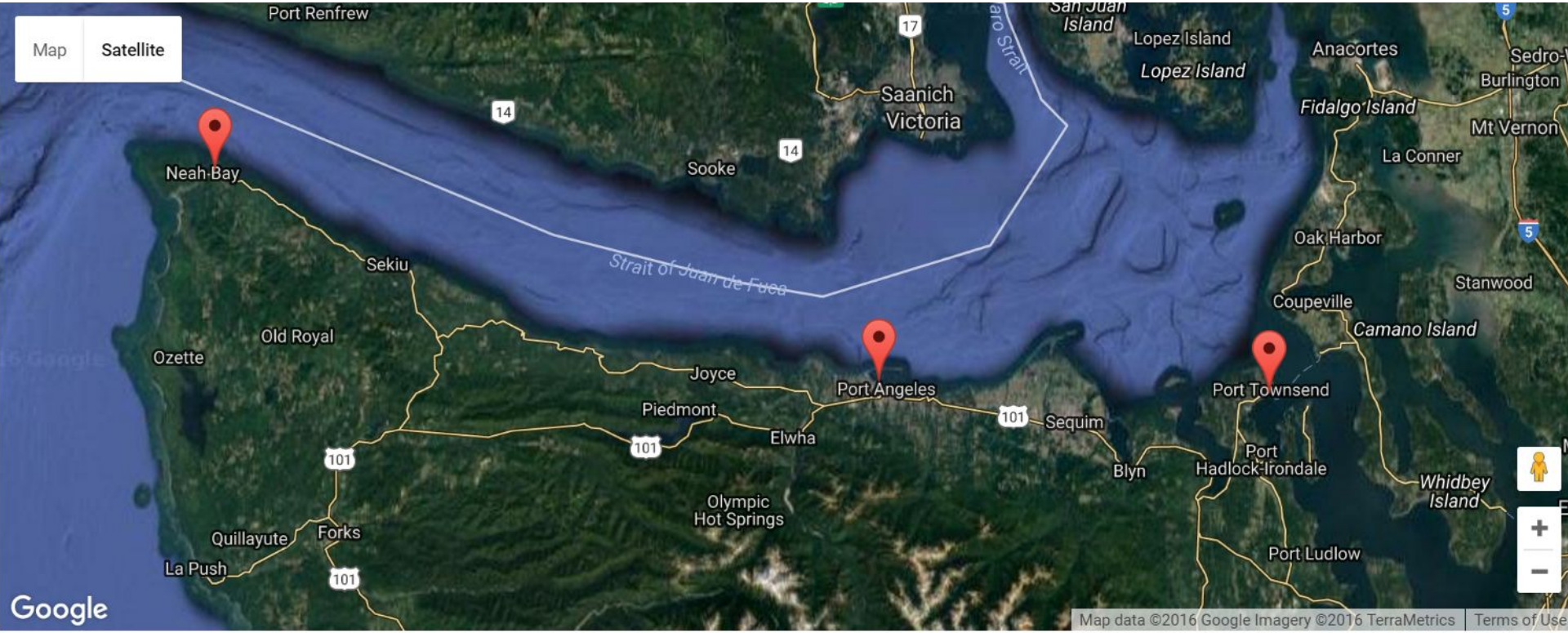
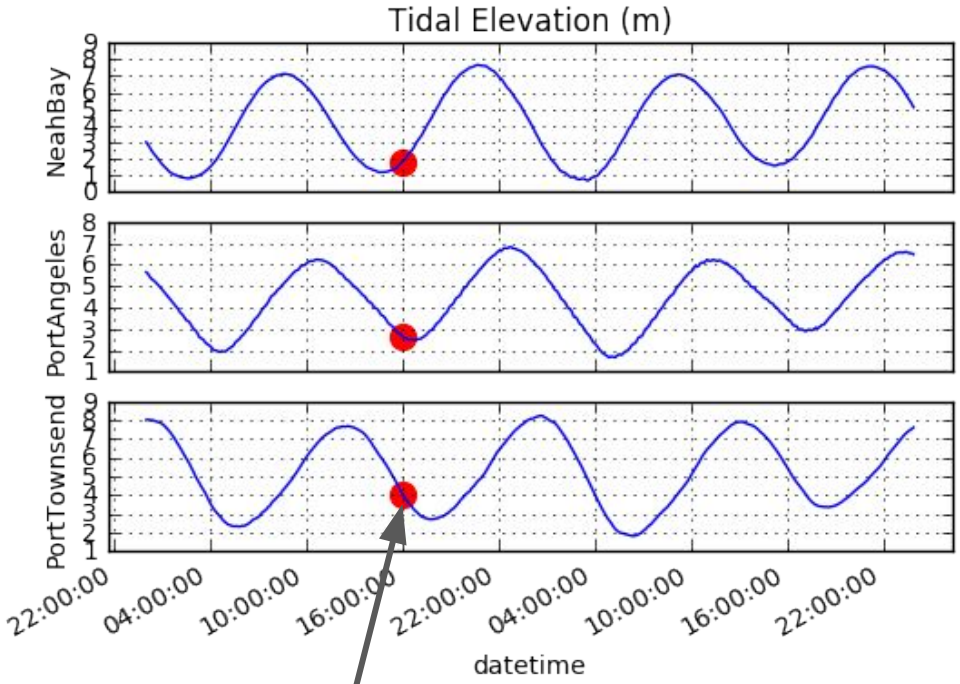
Module 2: Tides in the Puget Sound

- Goal:
  - User learns about the movement of tides with time and connect this to sea surface elevation.
- Uses:
  - Explore the tidal elevation data from three NOAA stations in the Strait of Juan de Fuca: Neah Bay, Port Angeles, Port Townsend
  - Interactive plot of the tide moving past the three stations
  - Demonstrate the connection between the phase of the tide at each station with the sea surface elevation in the Strait.

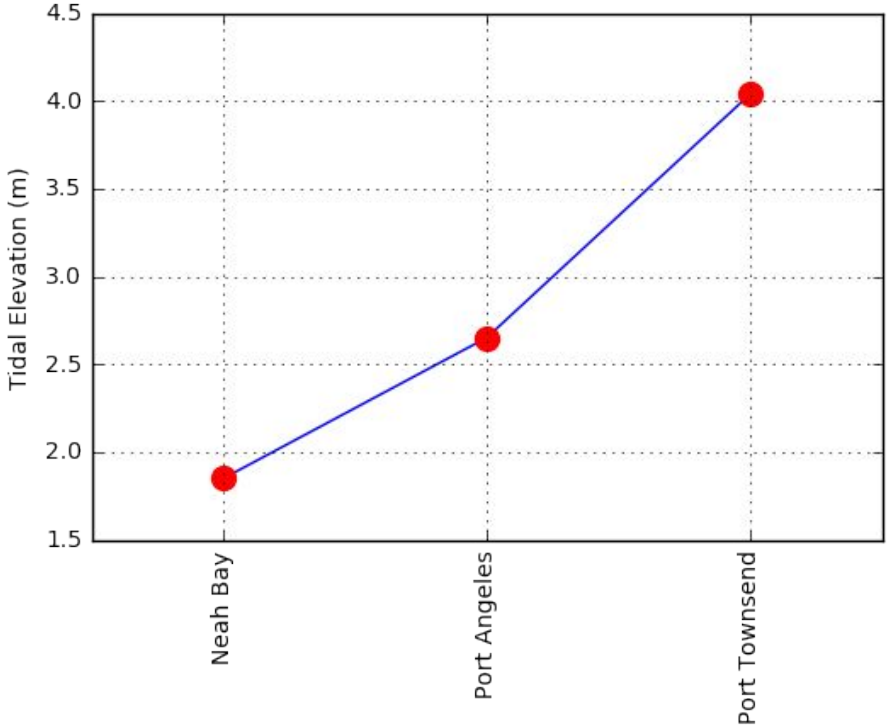
Module 2: Data Locations



Module 2 Example



Slider



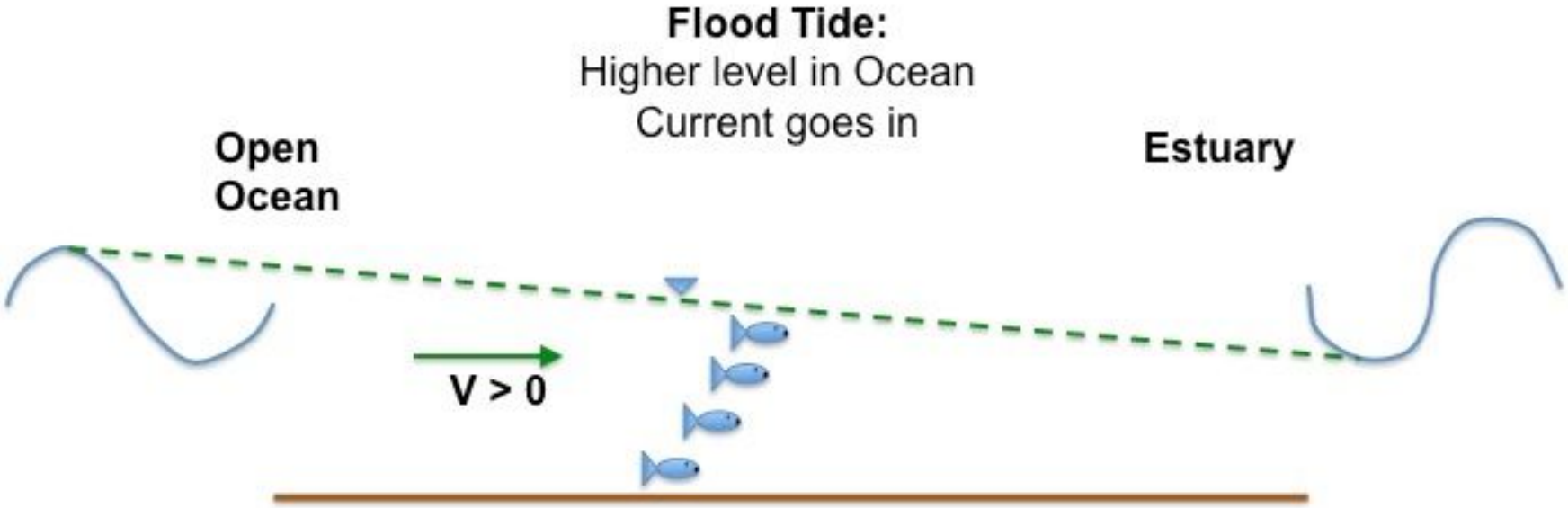
Module 3: Tidal Currents

What happens underwater as the tidal elevation goes up and down?

- Goal:
  - User learns about the connection between tidal elevations and tidal currents
- Uses:
  - Informational images and text to provide context, and further understanding
  - Interactive figure showing tidal current behavior (magnitude and direction) from a mathematical model
  - Interactive figure showing Port Townsend station tidal elevations, and tidal current data from instruments installed on board ferries.

Module 3: Tidal Currents

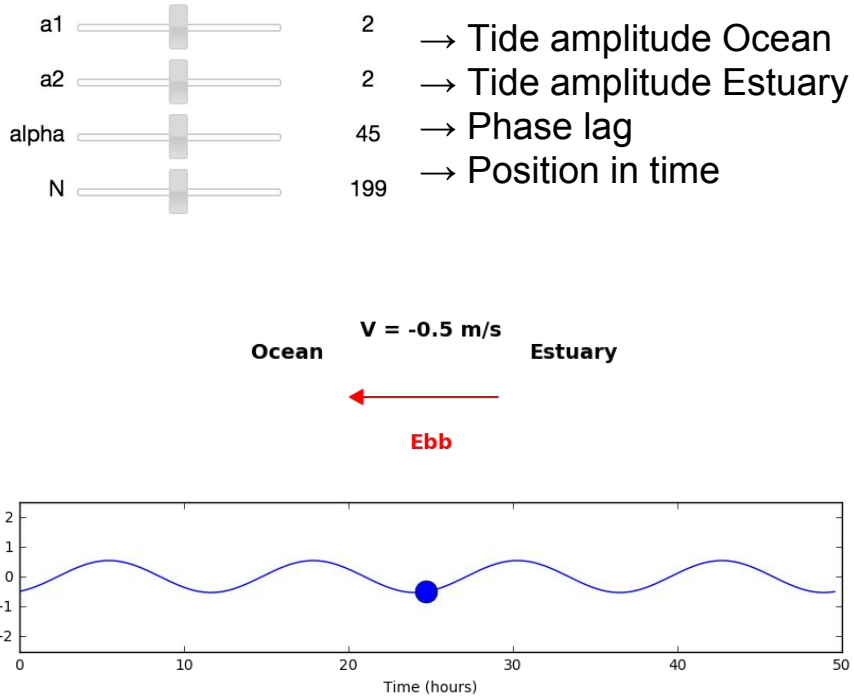
Example Image



Module 3: Tidal Currents

Exploration of tidal currents behavior:

- Estimates velocity between ocean and estuary (uses a PDF solution, assumes sine tides at both ends)
- Shows a time series of velocity
- Shows a single velocity (blue dot)
- Shows an arrow for current direction
- Interactive figure:
  - User selects different boundary conditions.
  - User moves the dot through time
  - The arrow changes size and direction based on the location of the dot.



Module 3: Tidal Currents

Example of interactive figure

- Shows a month of tidal elevation Port Townsend
- User selects time
- Second plot shows a cross-section of Admiralty Inlet colored by horizontal velocity
- User observes spatial and time variability in tidal currents