

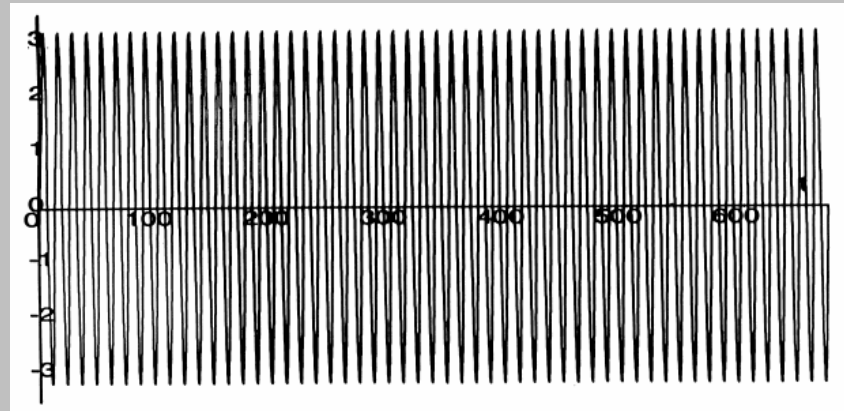
# Tides

Collaborative exercise with computers

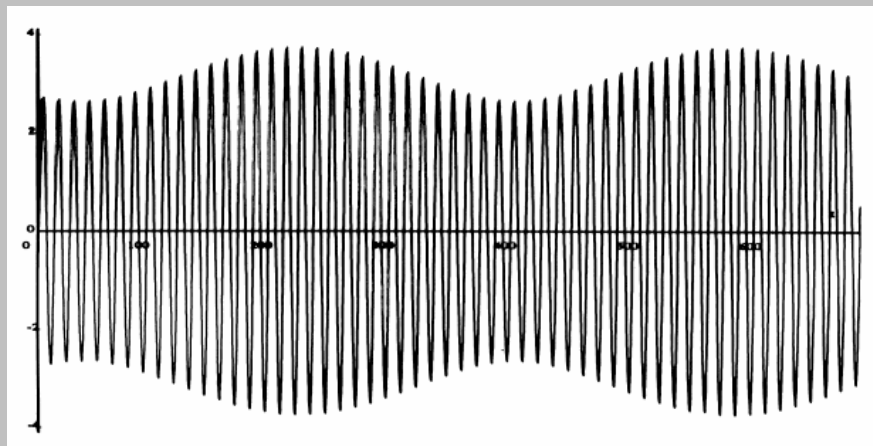
Short Introduction

- Tides are forced waves
  - Gravity and Coriolis
  - Shallow water waves, depth restricts speed
- Earth rotation affects tidal propagation

- **Harmonic analysis** is the branch of mathematics which studies the representation of functions or signals as the superposition of basic waves. It investigates and generalizes the notions of Fourier series and Fourier transforms. The basic waves are called "harmonics", hence the name "harmonic analysis"
- Any periodic signal (i.e. tides) can be broken into a unique combination of sine and cosine functions. Once we've performed analysis on a long enough time series, we will have enough components to make long term predictions.
- Remember:  $A\sin\{2\pi(t/T)\}+B\cos\{2\pi(t/T)\}=C \sin\{2\pi(t/T)+\varphi\}$

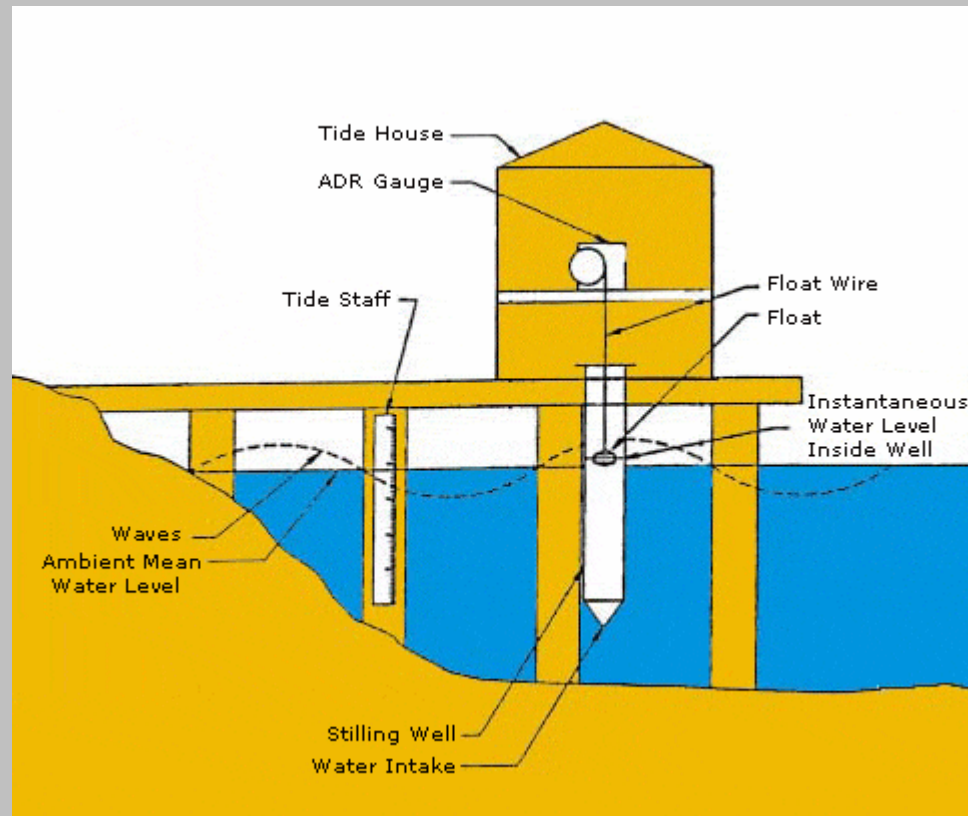


M2 component... This constituent models the tides if the moon was the only gravitational force acting on the earth orbited the earth in a perfect circle around the plane of the earth's equator



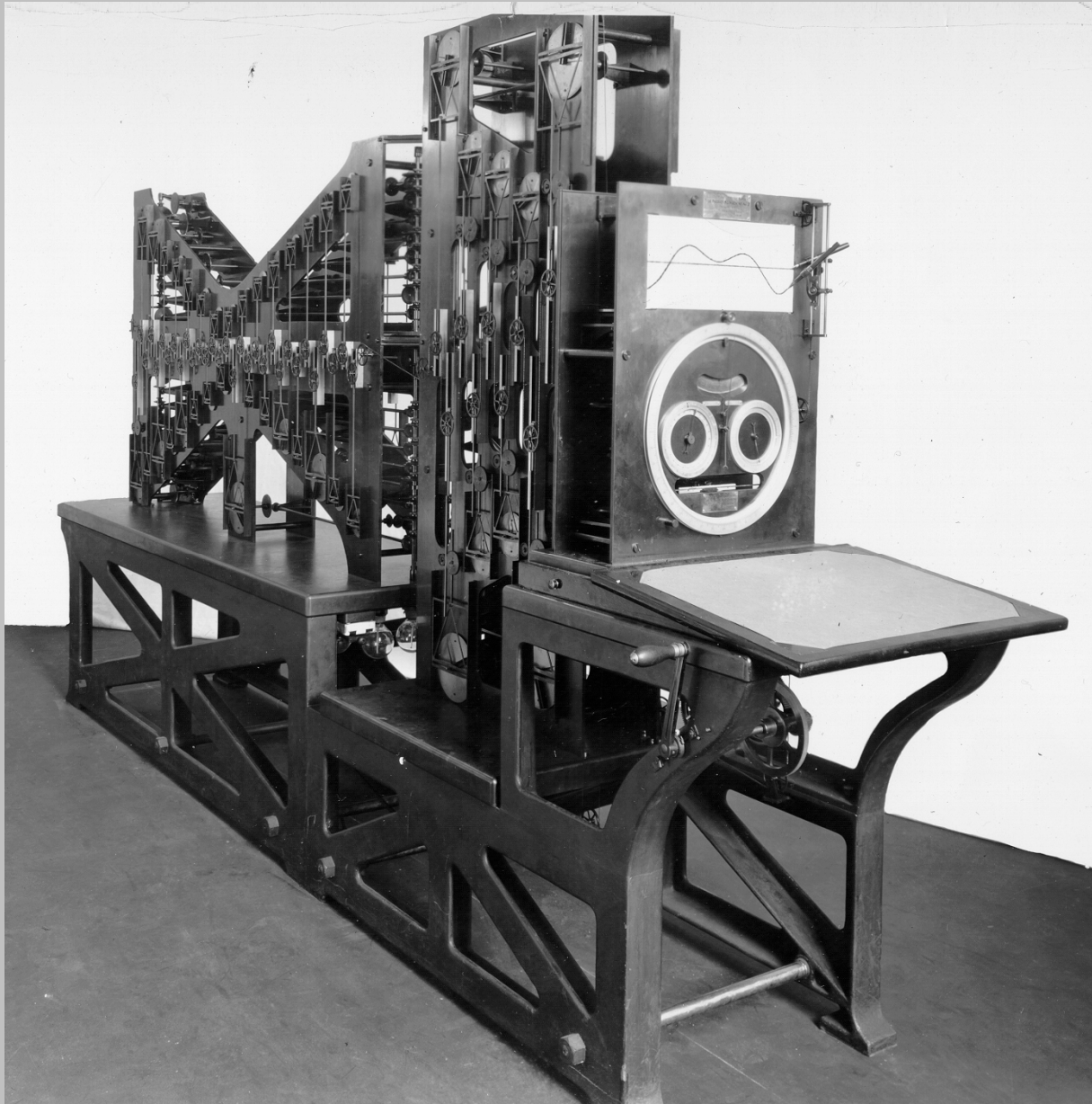
A tidal model using the M2 plus S2 ("ideal" moon + "ideal" sun)

# Measuring Tides



<http://tidesandcurrents.noaa.gov/education.html>

## Tide-Predicting Machine Number 2

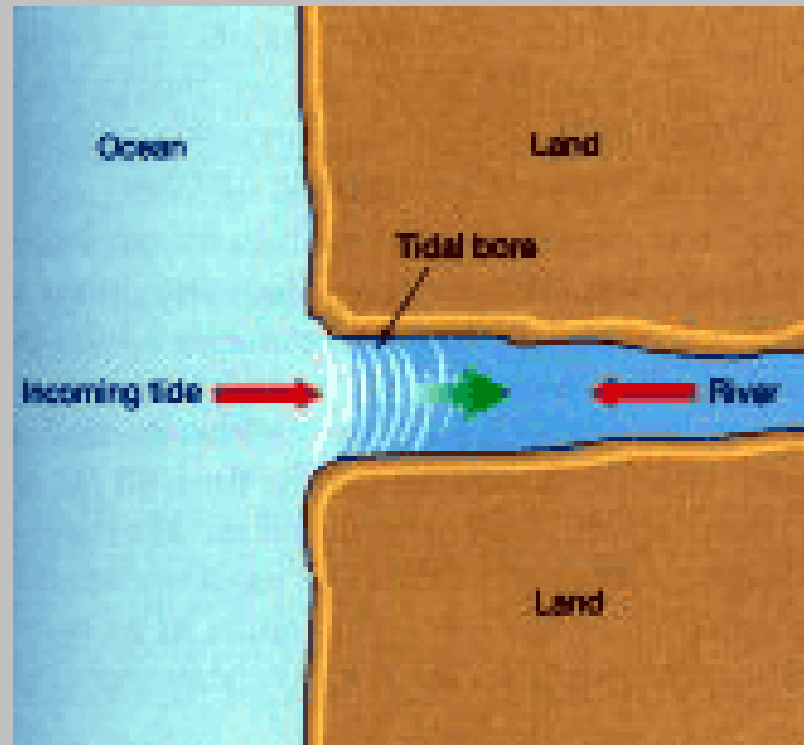


- Built in 1910 by the office of the Coast and Geodetic Survey

- Accounted for 37 tidal constituents

- 11 feet long, 2 feet wide, and 6 feet high, and weighs approximately 2,500 pounds

Tidal Bore: The incoming tide is forced into a shallow, narrowing river forming a wave that travels upriver (usually only occurs in areas where the water level is  $>20$  ft between high and low tide)



# Tidal Bore near Chignecto Bay, New Brunswick





## In-class exercise, Using WebTide software:

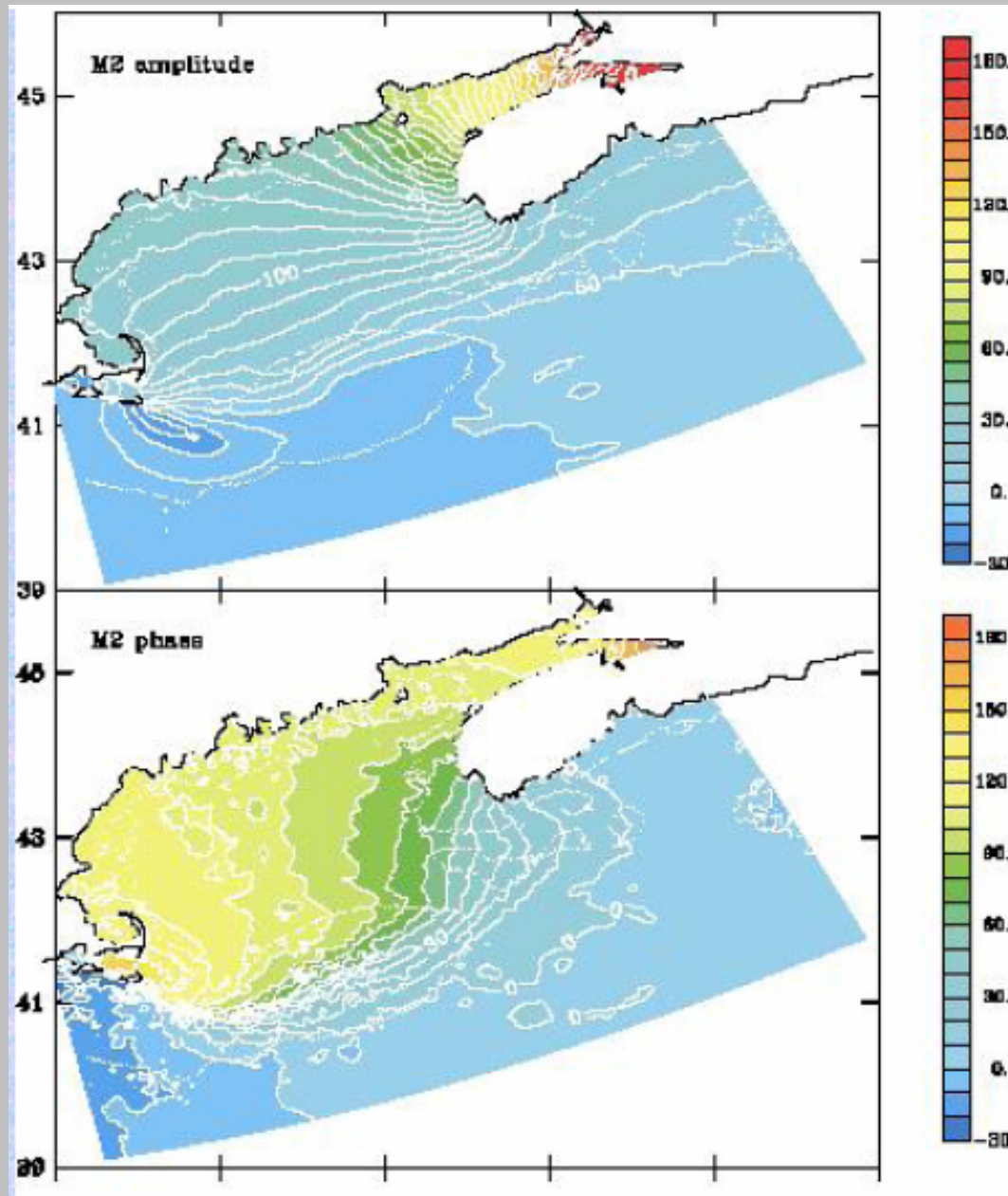
(available freely at: [http://www.mar.dfo.mpg.gc.ca/science/ocean/coastal\\_hydrodynamics/WebTide/webtide.html](http://www.mar.dfo.mpg.gc.ca/science/ocean/coastal_hydrodynamics/WebTide/webtide.html))  
Bedford Institute of Oceanography  
Fisheries and Oceans Canada Science Division

Today we will study the characteristics of the tides in the Gulf of Maine

- 1) Overview of WebTide
- 2) Obtaining amplitudes and currents at given locations
- 3) Analyzing the contribution of different tidal constituents
- 4) Comparing the amplitudes at 2 locations
- 5) Comparing Tidal Phases at 2 locations (which one leads?)

During each part of this lab, a randomly chosen group will be asked to present their results for discussion





Xue *et al.* 2000, JPO

# Compare GoM to Penobscot River

