

SMS 303: Integrative Marine Sciences III

- Instructor: E. Boss, TA: C. Proctor
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- 5 weeks & topics: ~~Coriolis~~, ~~waves~~, tides, diffusion and mixing.
- Homework:....

- **Tides**

- A collaborative exercise with computers in class.

Short introduction:

- Tides are forced waves (what is the forcing?).
- Both external and internal modes exist.
- Earth rotation affects tidal propagation.
- Tides can predicted well though not always from first principle.

Example: Navy global tide model:

<http://ocean.colorado.edu/~kantha/Tides2D/Global/>

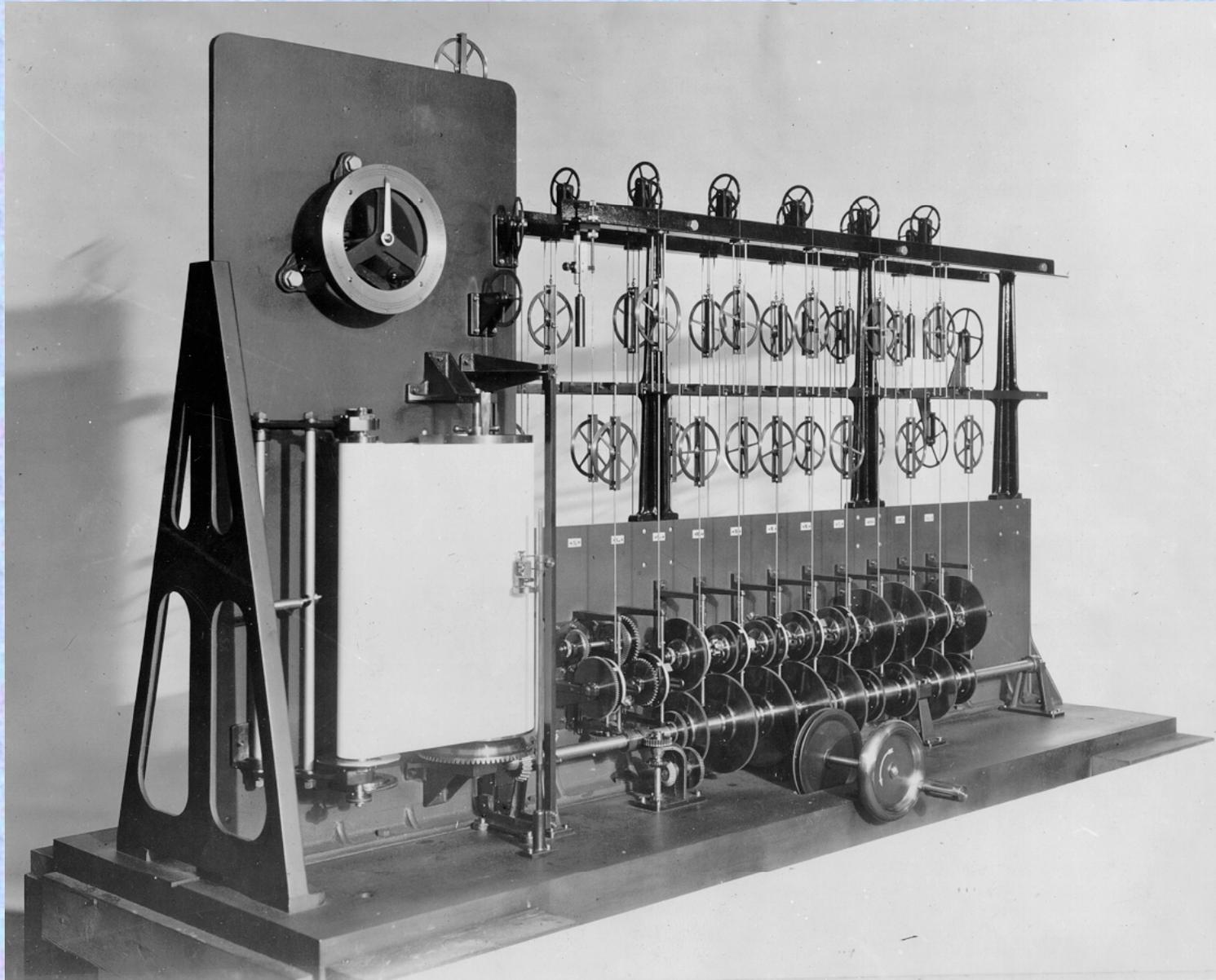
Harmonic analysis:
From Wikipedia:

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 signal (e.g. tide) can be decomposed into a unique combination of sine and cosine functions. Once we have done it to a long enough signal we can use it to *predict* how that signal will evolve in the future.

Remember: $A\sin\{2\pi(t/T)\}+B\cos\{2\pi(t/T)\}=C\sin\{2\pi(t/T)+\phi\}$

Tide predicting machines (<http://co-ops.nos.noaa.gov/predma3.html>):



Tides and marine biology:

Varied forcing

Waves, currents, pressure, wetting

→ High biodiversity, vertical zones.

Tidal currents:

- supply nutrients
- Help get rid of waste products.
- enhance encounter with mates.
- enhance encounter with prey/predators
- Spread progeny.



<http://www.enchantedlearning.com/biomes/intertidal/intertidal.shtml>

In-class exercise, Using WebTide software:

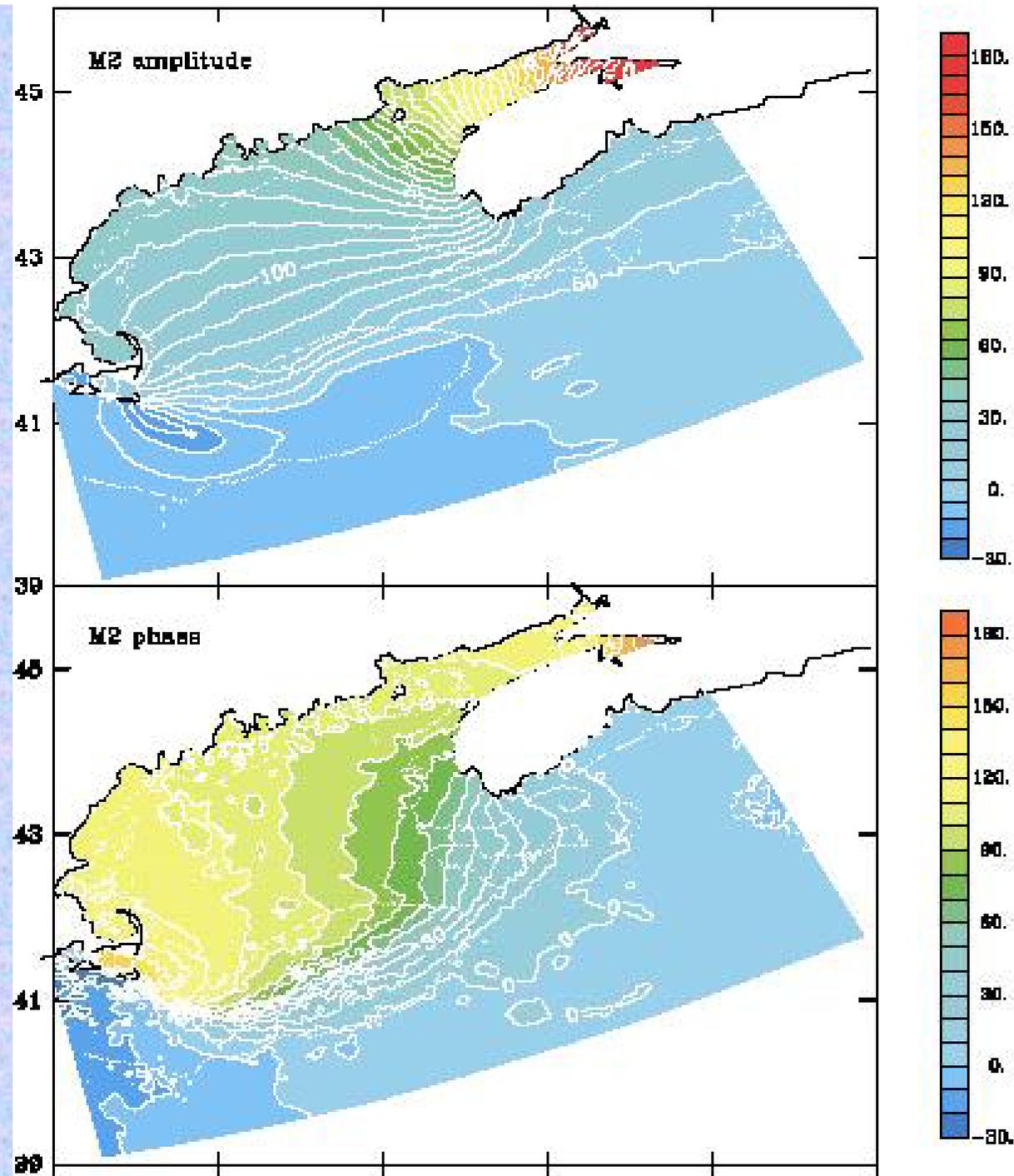
(available freely at: http://www.mar.dfo-mpo.gc.ca/science/ocean/coastal_hydrodynamics/WebTide/webtide.html)

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

1. Overview of software.
2. Obtaining the tidal amplitudes or currents at a given location.
3. Analyzing the contribution of different tidal components.
4. Comparing the tidal amplitudes at two locations (where is the amplitude higher?).
5. Comparing tidal phases at two locations (which one leads?).

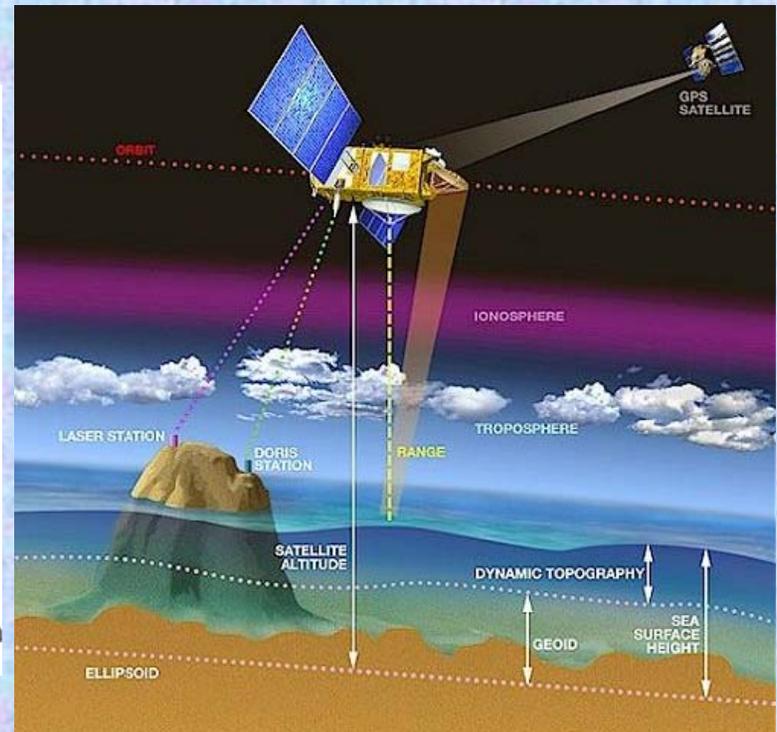
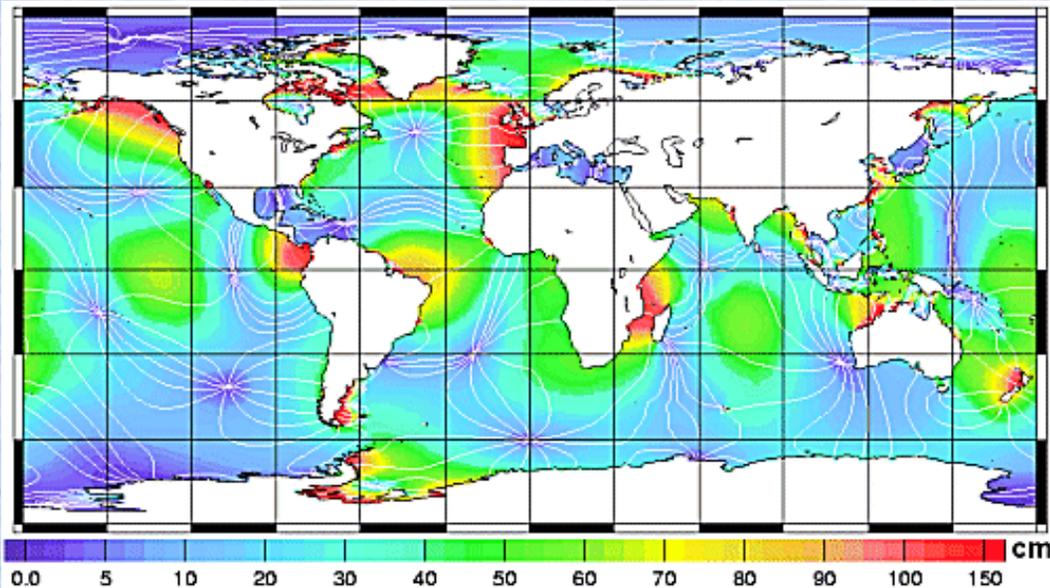
During each part of this lab, one group (chosen randomly) will be asked to present their results for discussion.

Xue et al.,
2000, JPO



Global tides (M2 component) can now be measured directly with altimeters

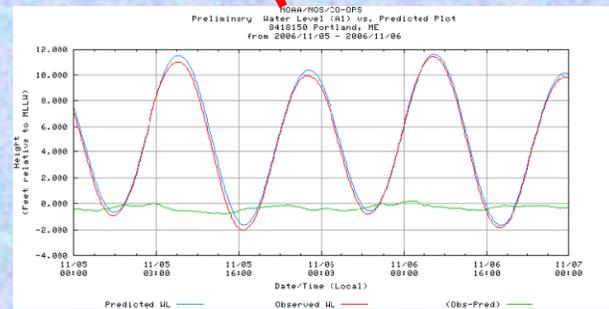
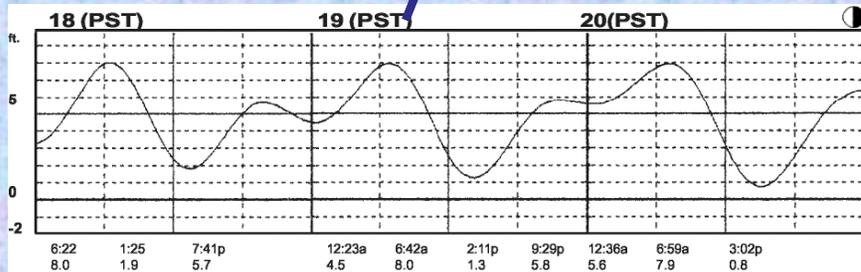
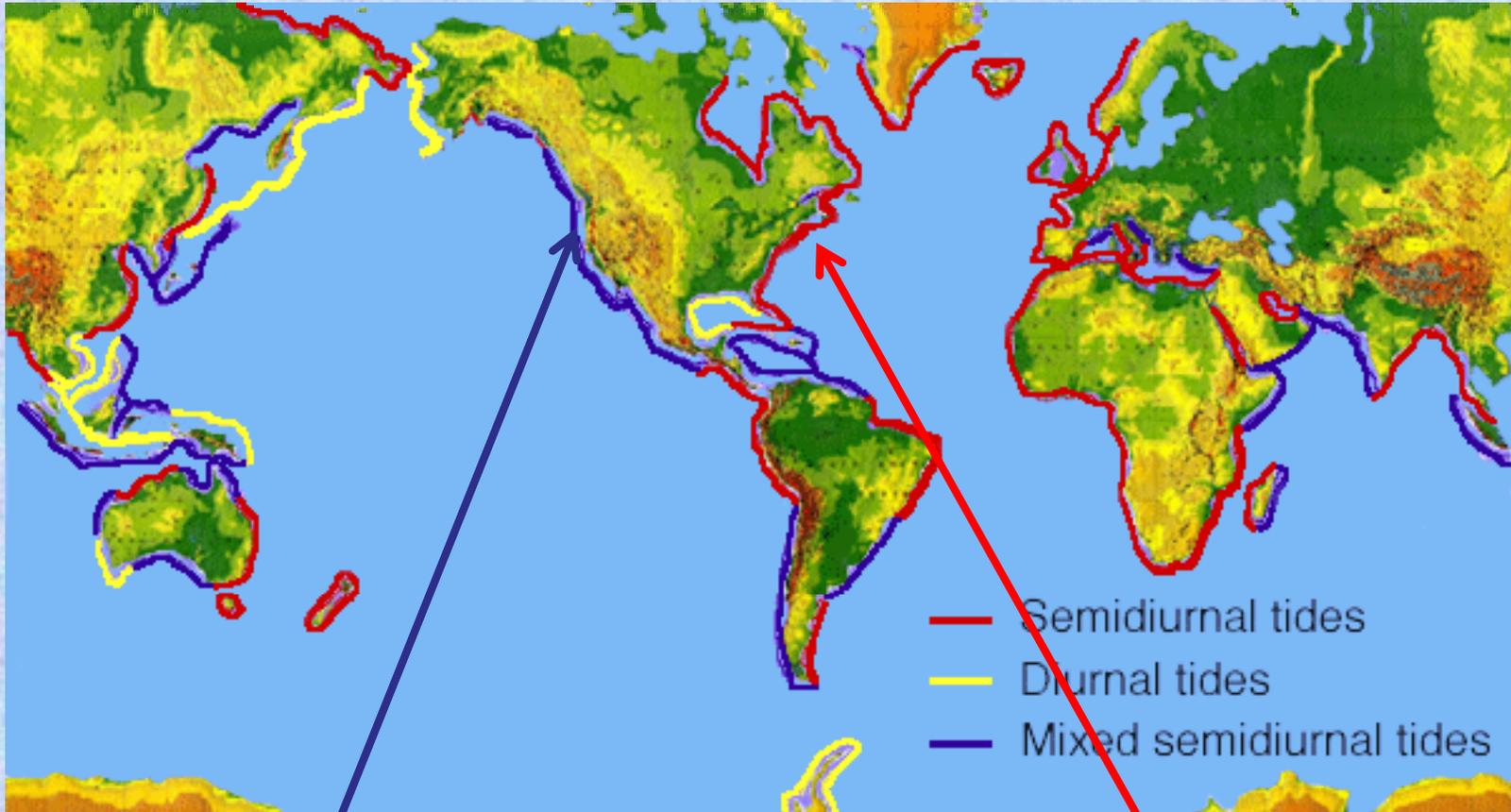
Lines of equal phase:



From tutorial at: http://earth.esa.int/brat/html/general/overview_en.html

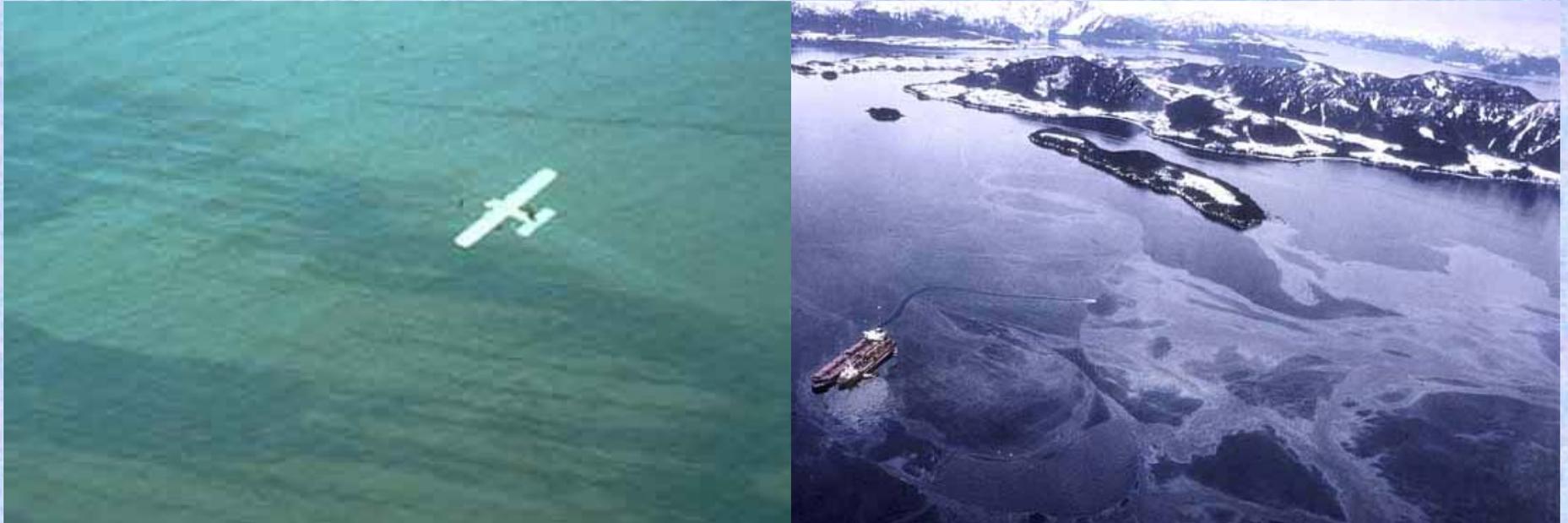
Accuracy within 2cm!

Tides vary between locations. Why?



Example of a real life application:

GNOME- a predictive tool to predict how tides and wind can affect chemical spills.



For code, location files etc' see:

response.restoration.noaa.gov/software/gnome/gnome.html