Name:_____

Ocean Lab 116 Winter 2012

Lab 3: Introduction to Maps & Basic Map Skills

Goals

1. Become familiar with different types of maps used in Oceanography
2. Become familiar with basic map reading skills – latitude, longitude, and scale
3. Understand units of distance and speed and their relation to maps

I. Maps

Maps and **marine charts** represent one way that geologists and oceanographers can record and share spatial and temporal data (i.e., rock types, age of rocks, landforms, ocean depths, ocean floor features). Today, "maps" have a wide variety of forms from simple **topographic**, **bathymetric**, and **geologic** maps to 3-dimensional digital elevation models (DEM) to radar images collected by satellites.

Examples of some maps and charts:

a. **Topographic map**: representation of land surface.
b. **Bathymetric chart**: representation of ocean surface.
c. **Marine chart**: representation of a maritime area and adjacent coastal regions. May show water depth, coastline details, information on tides & currents.
d. **Road map**: representation of roads and highways to aid in navigation

QUESTION 1. If faced with an unfamiliar map, what type of information would you look for in order to quickly understand the type of map it is?

II. Map Projection

Map projection is a method used in **cartography** (mapmaking) to represent the 2-dimensional curved surface of the earth on a flat surface. All charts have distortion because it is not possible to transfer an image from a curved surface to a flat one without some areas being stretched and/or others being compressed.

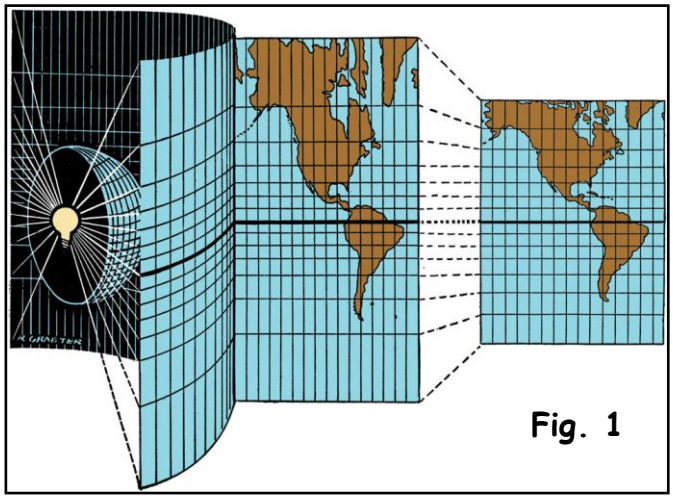

Fig. 1

Most marine charts are **cylindrical projections**. In this method, the sheet is rolled up and placed tangent to the globe at the equator (known as **Mercator Projection**). Points on the globe's surface then are projected onto the sheet in much the same manner as shadows would be cast if the globe was transparent and lit from the center (Fig. 1).

QUESTION 2. Examine the 2-dimensional map below (Mercator Projection) and compare the size of Greenland to South America. Then compare their relative size to each other on the map with their relative size on a globe (2 are available in lab).

a) Is Greenland really as large as South America?

b) What happened to Greenland during the projection process?

c) Have other parts of the world been affected during the projection process?

d) Explain why you think there is a difference between the size of the continents on the paper map vs. their size on the globe (hint: think about how the Mercator Projection is done).

III. Basic Map Skills: Reading Latitude and Longitude

Reading latitude and longitude is essential in navigation.

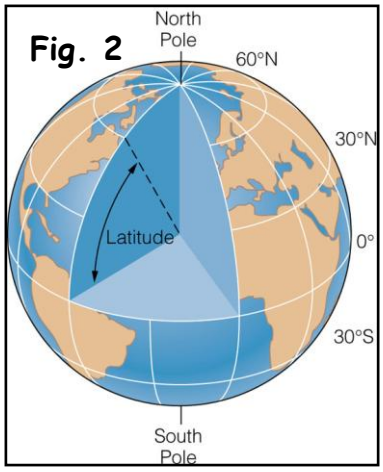

Fig. 2

Latitude (Fig. 2) is a measure in degrees of how far north or south from the Equator you are. Therefore latitude lines run parallel to the Equator, like belts around the Earth.

0°-90°N and 0°-90°S

Longitude lines (also called meridians) run vertically and connect pole to pole (Fig. 3). The prime meridian is 0° E-W and is located in Europe (Greenwich, England).

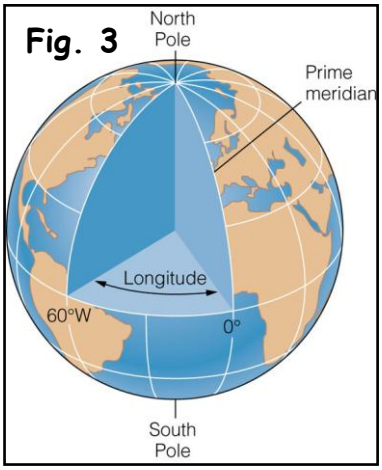

Fig. 3

Points west of the prime meridian: **0°-180° W**
Points east of the prime meridian: **0°-180° E**

Latitude and longitude are usually listed along the borders of a map/chart (along the right and left side for latitude; along the top and bottom for longitude).

Because degrees are large units, smaller divisions are needed for more precise location. Each degree is divided into 60 minutes (1° = 60′) and each minute into 60 seconds (1′ = 60″). Notation: latitude is reported first, followed by longitude.

Example: Seattle is located at 47° 36′ 20″N and 122° 20′ 24′W

QUESTION 3. Using a world atlas (several are available here in lab), determine the approximate latitude and longitude coordinates (in degree only) of each location in the left table.

Location	Latitude	Longitude
Sydney, Australia		
Baghdad, Iraq		
Mouth of Amazon River		
North Pole		
Glendale, CA		
Greenwich, England		
Yerevan, Armenia		

QUESTION 4. Using your answers in the table above, circle the correct answers for the following questions.

a. **Which city is closest to the North Pole - Glendale or Greenwich?**

b. **Which city is closest to the Prime Meridian – Sydney or Glendale?**

c. **True or False? Greenwich and the North Pole lie on the same line of longitude.**

IV. Time Zones

Time can be determined using lines of longitude. The Earth (and any circle) can be divided into 360°. At any time of day, all 24 hours are represented somewhere around the globe. As such, each time zone represents 15° of longitude (360/24). Two cities in adjacent time zones are therefore 15° apart.

For example, the time difference between Boston (42°N, 71°W) and San Francisco (37°N, 122°W) is:

- 122° - 71° = 51° → Boston and San Francisco are 51° apart.
- 51° / 15° = 3.4 hours → Boston and SF are 3 hours or time zones apart.

QUESTION 5. What is the time difference between Glendale and Greenwich? Show all your work.

QUESTION 6. Why does time change with longitude, but not latitude?

V. Units of Distance

Distances on land are expressed in **kilometers** (km) or **statute miles** (mi). At sea, distances are expressed in **nautical miles** (nm). Since one nautical mile is equal to 1′ of latitude, then **1° of latitude is equal to 60 nautical miles**. And since 1 nautical mile is equal to 1.15 statute miles, 1° of latitude is also equal to 69 statute miles (60 x 1.15). *(From Pipkin et al., 2001, Laboratory Exercises in Oceanography, 3rd Edition, Freeman and Company)*

For example, the distance between Los Angeles (34°N, 118°W) and Seattle (47.5°N, 122°W) is:

- 47.5° - 34° = 13.5° → Los Angeles and Seattle are 13.5° apart
- 13.5° X 60 nm = 810 nm → Los Angeles and Seattle are 810 nautical miles apart.

QUESTION 7. How far north is New York (40°30'N 73°58'W) from Miami (25°45'N 80°11'W)?

a) Give the answer in nautical miles. Show all your work.

b) Give the answer in statute miles (1nm = 1.15 mi). Show all your work.

c) Give the answer in kilometers (1 mi = 1.609km). Show all your work.