

# 5 Geographers' Tools: Location Systems

Prof. Anthony Grande  
Hunter College Geography

Lecture design, content and presentation GAFG 0121  
Individual images and illustrations may be subject to prior copyright.

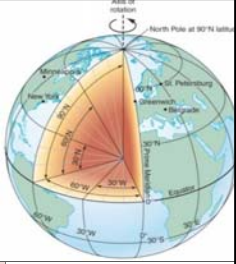
## Location Systems

❖ **Earth's Grid:** system of points on the surface connected by intersecting lines of latitude and longitude.

To portray data spatially, we need a way to accurately locate places on the earth's surface.

❖ This is the **GRID SYSTEM**.

- Composed of **lines of latitude and longitude**.
- ✓ Allows us to **see** locations, patterns, and interrelationships.
- ✓ Allows us to **measure** distance.
- ✓ Allows us to **determine** area.



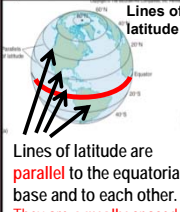
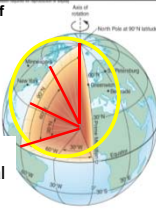
2

## Latitude

❖ **LATITUDE:** Distance measured in degrees **NORTH** and **SOUTH** of the **EQUATOR**.

It is the result of geometric calculations **using the equatorial plane of the earth (equator) as its base.**  
(The equator is at the center point in the movement of the sun's vertical rays on the earth's surface.)

The **measured angle** of the plumb line from the earth's surface to the center of the equatorial plane **equals latitude.**

Lines of latitude are **parallel** to the equatorial base and to each other. They are **equally** spaced. They **never** cross. They **never** converge.

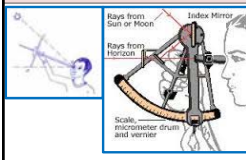
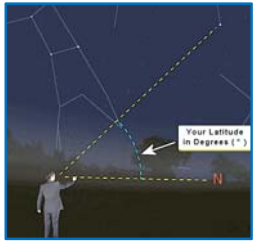
3

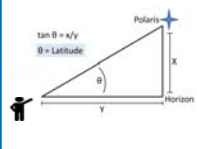
## Latitude

❖ **Latitude is also astronomical.**

You can measure the angle of the sun above the horizon or the height of the North Star at night using a "sextant."

✓ The angle equals latitude.



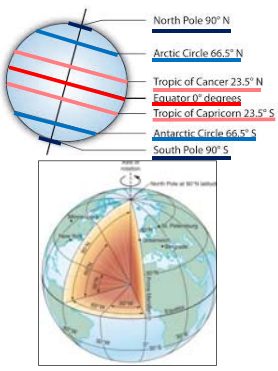
4

## Latitude

**Latitude ranges in value from 0 to 90 degrees.**

❖ There are **seven** lines of latitude we need to know

- 90° N = North Pole**
- 66.5° N = Arctic Circle**
- 23.5° N = Tropic of Cancer**
- 0° = Equator**
- 23.5° S = Tropic of Capricorn**
- 66.5° S = Antarctic Circle**
- 90° S = South Pole**



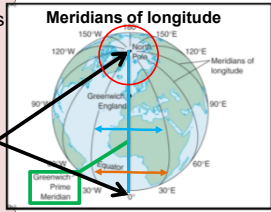
5

## Longitude

Meridians are **man-made** phenomena based on the geometry of circles (360°)

❖ **LONGITUDE:** Distance measured in degrees **east** and **west** of the **0° line** which has been designated the "**Prime Meridian**."

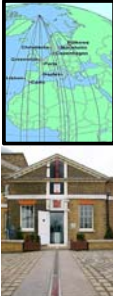
- All other lines of longitude are called **meridians** and each one extends from the **North Pole** to the **South Pole**.
- They all **converge** (touch) at the poles.
- Thus, the **distance between meridians varies with latitude** from the pole to the equator.



The **0° line of longitude** is also known as the "**Greenwich Meridian**."

6

## Why Greenwich Meridian?




Greenwich Meridian

<< At one time, countries defined their prime meridian by the location of the observatory telescope that was used to gather the astronomical data.

**1766** - Britain published the first nautical almanac. Its detailed maps, charts and tables, all based on the 0° meridian at London, became widely used.


**1870s and 1880s** – a series of international conferences was convened to address prime meridian issue.

➢ **The result was a worldwide acceptance of the Greenwich Meridian as the Prime Meridian (0°).**



The American Meridian

George Washington University



0° Prime Meridian

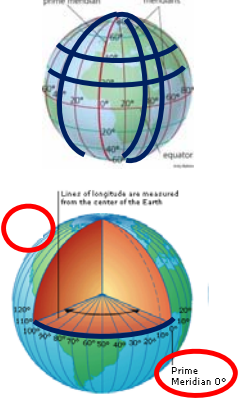
## Drawing Longitude

Meridians of longitude are marked by first dividing the equatorial circle into 360 segments, then dividing every circle of latitude into 360 segments and finally connecting all like-numbered degrees.

- There two meridians we need to know:
  - 0° = Prime Meridian
  - 180° = International Date Line (IDL follows along 180° but not exactly.)

**FYI: 0° and 180° are neither E or W**

**Longitude ranges in value from 0 to 180 degrees.**



prime meridian meridians equator


Lines of longitude are measured from the center of the Earth

Prime Meridian 0°

## Finding Longitude

**To determine your longitude on the earth's surface, you need two accurate clocks (chronometer).**

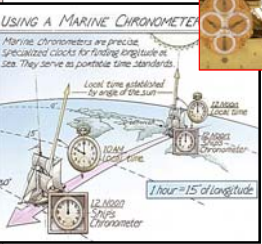
One clock set for the time at 0° (Prime Meridian/GMT), if known, or your departure point and one set locally by the angle of the sun. Each day the second clock is set at noon to local sun time. *The difference in time (hrs/min/sec) between them indicates distance from the Prime Meridian or starting meridian.*



THE MARINE CHRONOMETER

USING A MARINE CHRONOMETER

Marine Chronometers are precise, specialized clocks for finding longitude at sea. They serve as portable time standards.



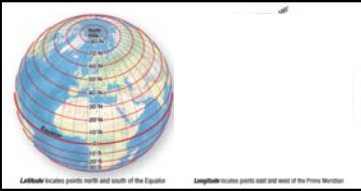
Local time established by angle of the sun

1 hour = 15° of longitude

Each 60 min = 15° of longitude.  
 Each 30 min = 7.5° of longitude.  
 Each 15 min = 3.75° of longitude.  
 Each 4 min = 1° of longitude.

## Latitude and Longitude

L  
A  
T  
I  
T  
U  
D  
E



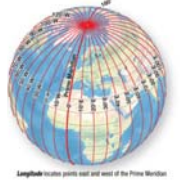
Latitude locates points north and south of the Equator

Longitude locates points east and west of the Prime Meridian

L  
O  
N  
G  
I  
T  
U  
D  
E

## Latitude and Longitude

L  
O  
N  
G  
I  
T  
U  
D  
E



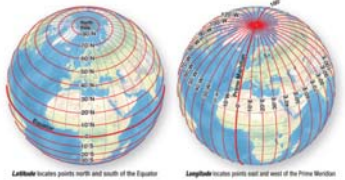
Latitude locates points north and south of the Equator

Longitude locates points east and west of the Prime Meridian

L  
A  
T  
I  
T  
U  
D  
E

## Latitude and Longitude

L  
O  
N  
G  
I  
T  
U  
D  
E



Latitude locates points north and south of the Equator

Longitude locates points east and west of the Prime Meridian

L  
A  
T  
I  
T  
U  
D  
E

## Latitude and Longitude

Latitude + Longitude = Earth's Grid

<https://www.youtube.com/watch?v=swKBiGhHHMA> - 3.5 min summary video

## Latitude and Longitude

We can divide the earth's grid into four quadrants:

north+west	north+east
south+west	south+east

❖ **REMEMBER:**

- Latitude is only designated **NORTH** or **SOUTH**.
- Longitude is only designated **EAST** or **WEST**.

## Reading Latitude and Longitude

When locating places on the earth, we start where the base lines of latitude and longitude cross:

0°, 0°

- First we count lines north or south of the **equator**.
- Then we count lines east or west of the **prime meridian**.

<https://www.youtube.com/watch?v=ALN7qXF1thY>

## TIME

❖ **The longitude of a location is determined by time differential.**

You need to know the difference between "local" or "sun" time and "prime meridian time (GMT)."

NOTE: It is the same time (hour of the day) along any meridian from the North Pole to the South Pole.

## TIME ZONES

❖ **Each 15° of longitude = 1 hour (60 min) of time.**

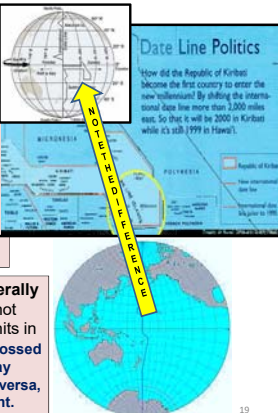
- Each 7.5° of longitude = 30 minutes.
- Each 3.75° of longitude = 15 minutes.
- Each 1° of longitude = 4 minutes.

❖ **Standard Time Zone:** an area of the earth that is **15° of longitude wide** (360° ÷ 24 hrs of one rotation = 15°/hr), where all clocks are set when **solar noon** occurs at the zone's **central meridian**.

- ✓ **Time zones are based on calculating longitude.**
- ✓ Concept created in 1883 by US railroad companies for scheduling purposes.
- ✓ Linked to International Meridian Conference of 1884
- ✓ Officially adopted by countries starting in the 1920s.

## TIME ZONES

- ❖ There are 24 world standard time zones, each 15° wide and equal to one hour.
- Numerous off-standard zones (half hour, multi-hour, sun) created by governments.
- Over 30 irregular-shaped zones due to political borders.

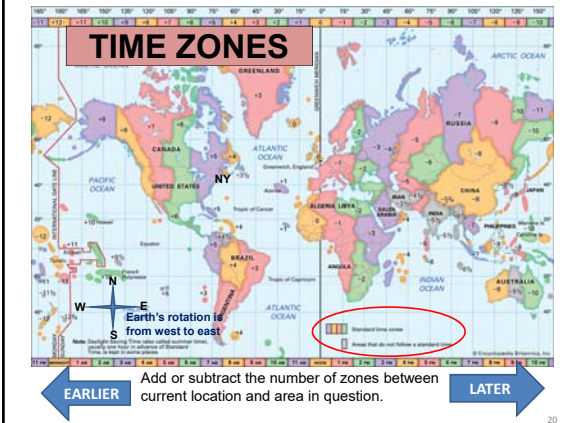


**Date Line Politics**

How did the Republic of Kiribati become the first country to enter the new millennium? By shifting the international date line more than 2,000 miles east for that it will be 2000 in Kiribati while it's still 1999 in Hawaii.

❖ The International Date Line generally follows the 180° meridian – but not exactly in order to keep political units in the same date. When the line is crossed the **date** changes, e.g., 3 PM Tuesday becomes 3 PM Wednesday, or vice versa, depending on direction of movement.

## TIME ZONES

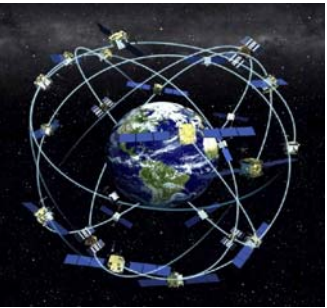


Earth's rotation is from west to east

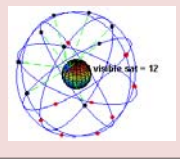
Standard time zones

➔ EARLIER      Add or subtract the number of zones between current location and area in question.      ➔ LATER

## Global Positioning System

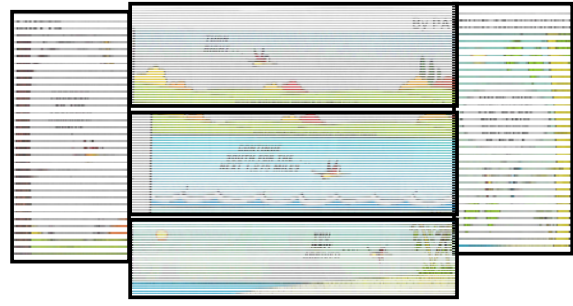


- ❖ An array of 29 (24 active) satellites orbits 12,500 miles above the earth.
- Need to be in contact with 3 to 4 satellites to get a fix on a location: latitude, longitude and elevation.



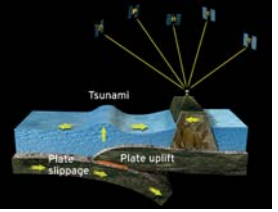
visible sat = 12

## GPS Dependence




## Using GPS

- Location – positioning things in space
- Navigation – getting from point a to point b
- Tracking – monitoring movements
- Mapping – creating maps based on those positions
- Timing – precision global timing




Tsunami

Plate slippage      Plate uplift



Satellite

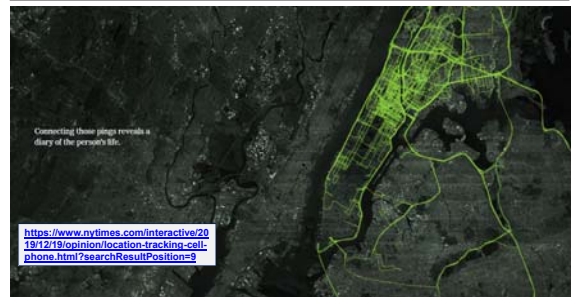
Internet



vs.

<https://www.novatel.com/industries/agriculture/> 2 min GPS ad

## Tracking GPS-enabled Devices: aka, Tracking People




Connecting these paths reveals a diary of the person's life.

<https://www.nytimes.com/interactive/2019/12/19/opinion/location-tracking-cell-phone.html?searchResultPosition=9>



### Using GPS-enabled Apps to Track Your Location

- **Location** - positioning things in space
- **Navigation** - getting from point a to point b
- **Tracking** - monitoring movements
- **Mapping** - creating maps based on those positions
- **Timing** - precision global timing



Data reviewed by the NYTimes shows over 235 million locations captured from more than 1.2 million unique devices during a three-day period in 2017.

<https://www.nytimes.com/interactive/2018/12/10/business/location-data-privacy-apps.html?module=inline>

### Tracking GPS-enabled Devices: aka, Tracking People

In about four months' of data reviewed by The Times, her location was recorded over 8,600 times — on average, once every 21 minutes.



The mayor's staff, New York City

It happened by accident on Wednesday, when the mayor's staff was tracking the location of a group of people on Long Island

The Times obtained data from Verizon, which had received it from 2015 through 2017. The data was then analyzed by The Times' data science team.

## NEXT

# Parts of Maps