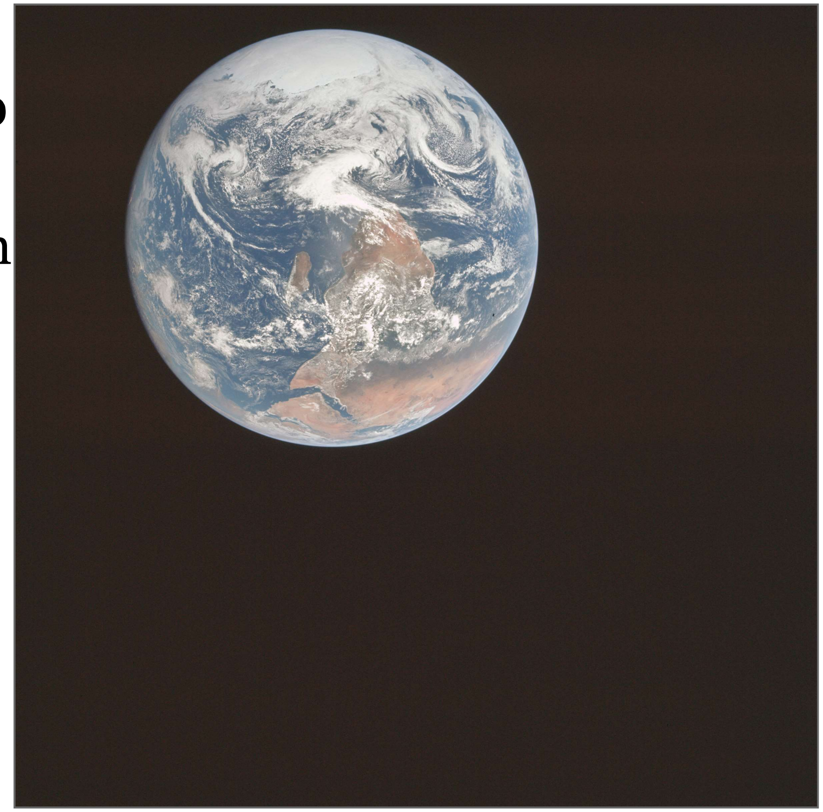
FLATTENING THE BLUE MARBLE

This is what earth looks like when you take a picture of it from 29,000 kilometers away. This is the original **Blue Marble** photo, taken from Apollo 17.



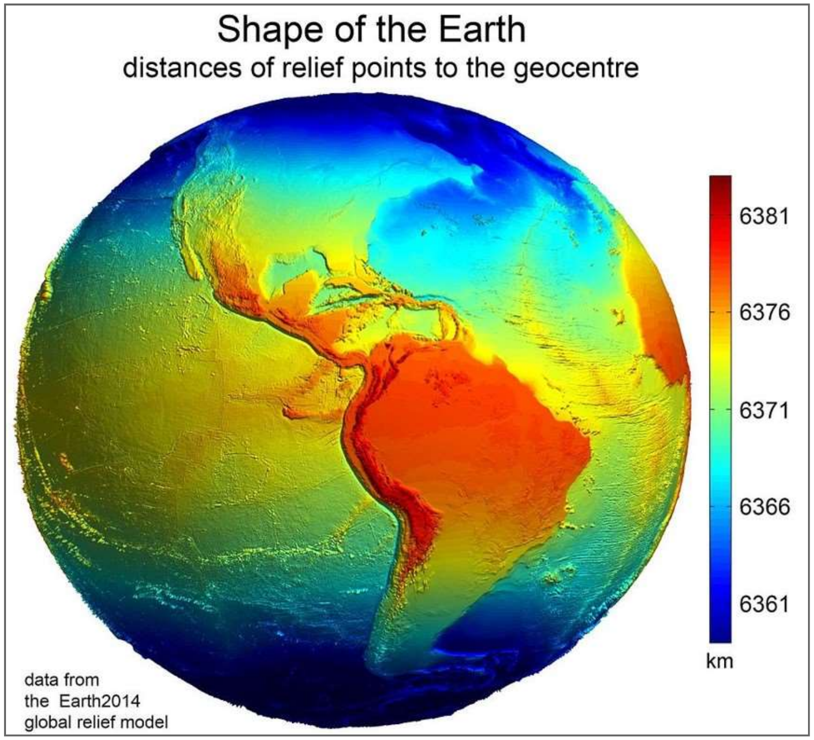
EARTH

Multiple distortions from idealized sphere:

-Topography

-Gravity Differentials

-Centrifugal Force

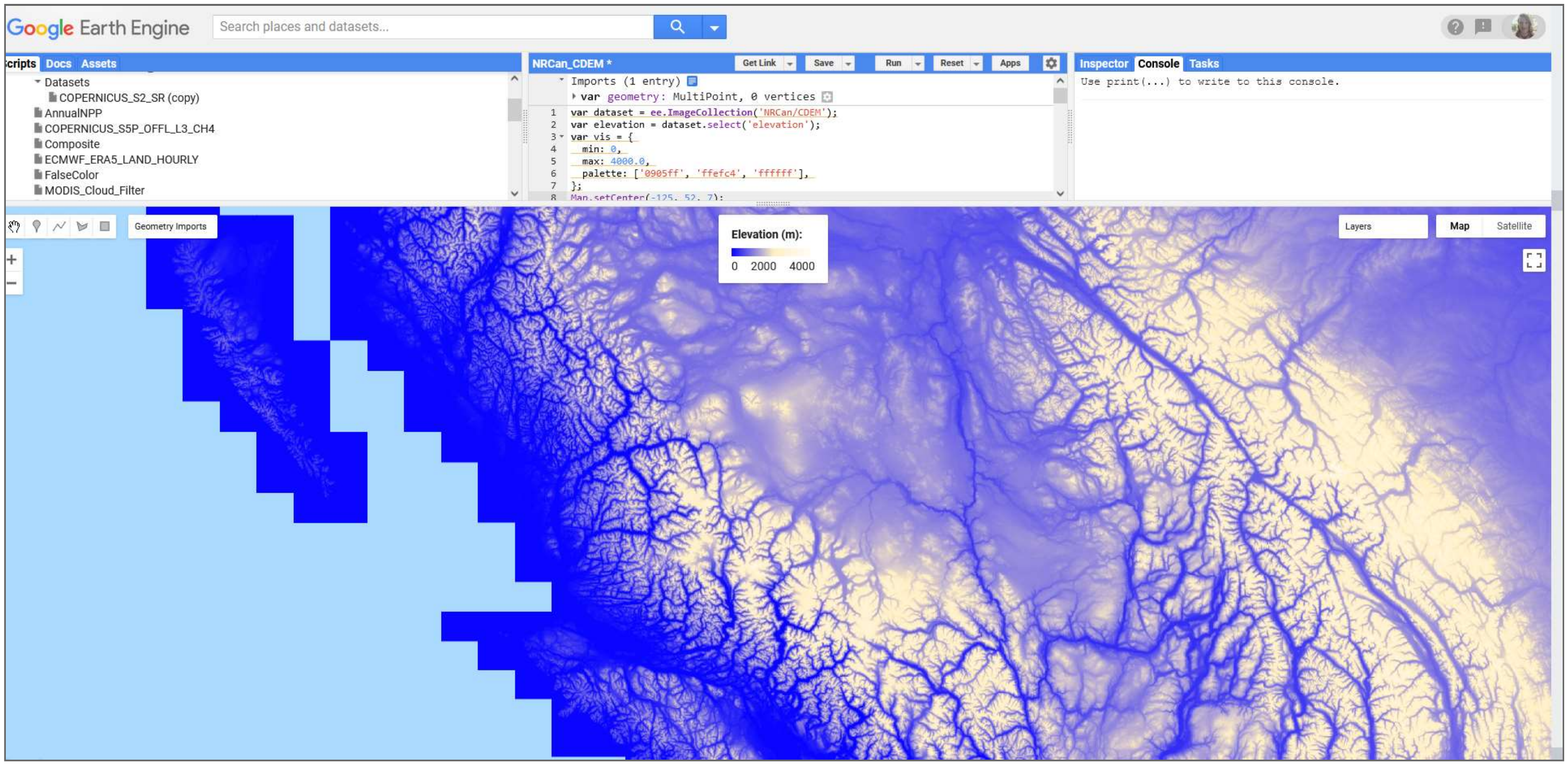


IGNORE TOPOGRAPHY!?

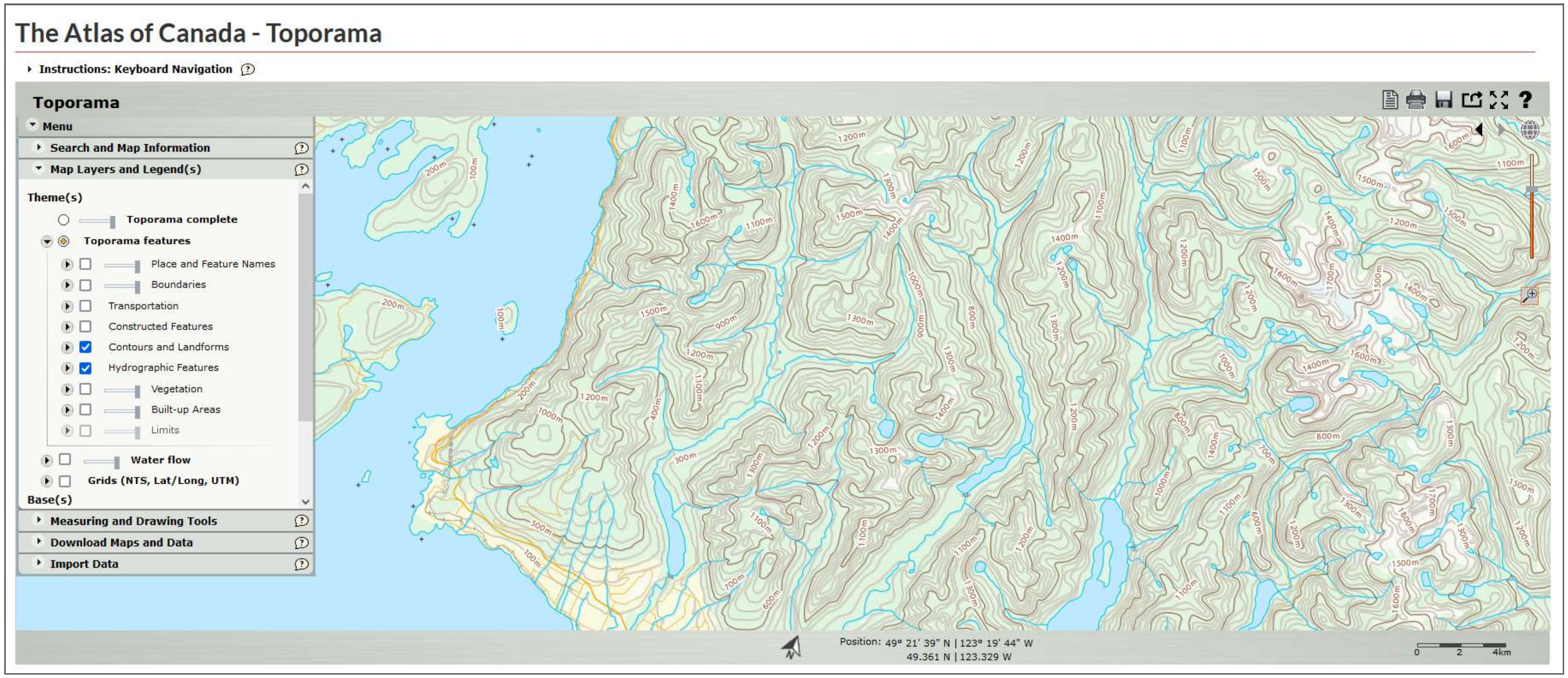
In most applications, topography isn't explicitly needed.

- We can account for it separately if necessary using digital elevation models or contour lines.

DIGITAL ELEVATION MODEL



CONTOUR LINES



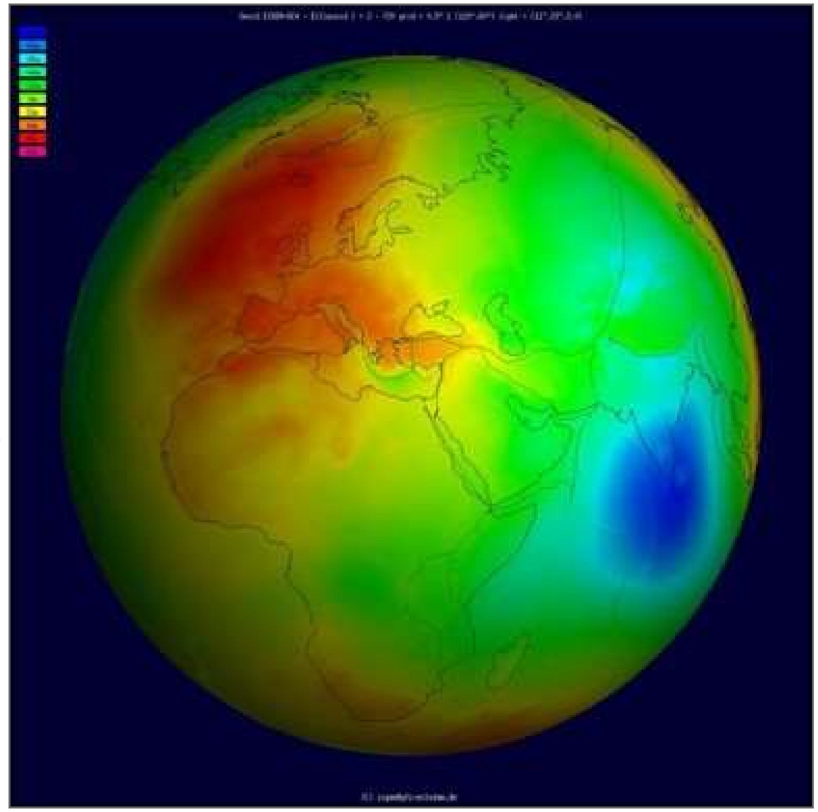
GEOID

Simplification of Earth:

-Smooths topography

-Gravity differences measured by satellites

-Differences in surface heights (180 m)



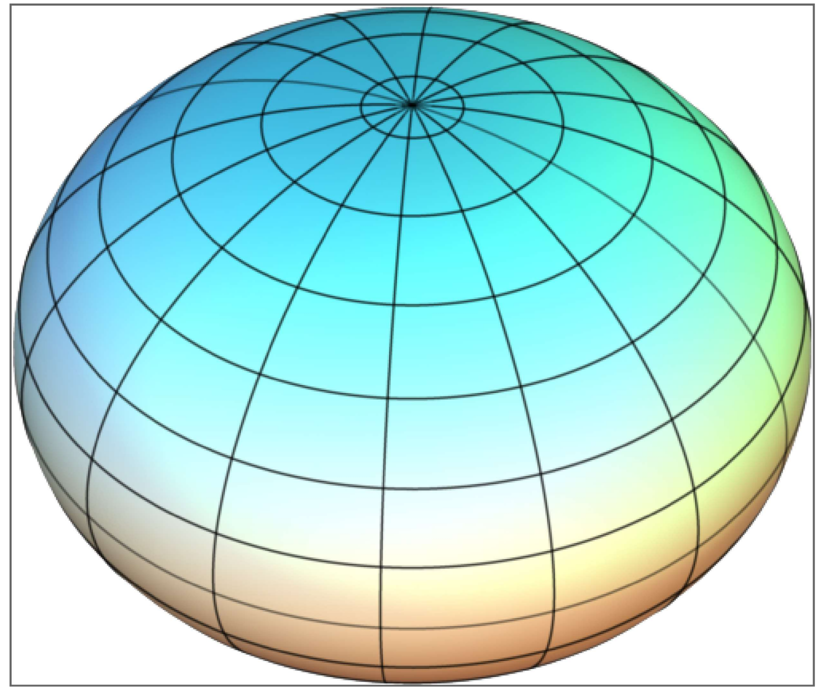
THE OBLATE SPHEROID

A close approximation of Earth's shape

-Topography

-Gravity Differentials

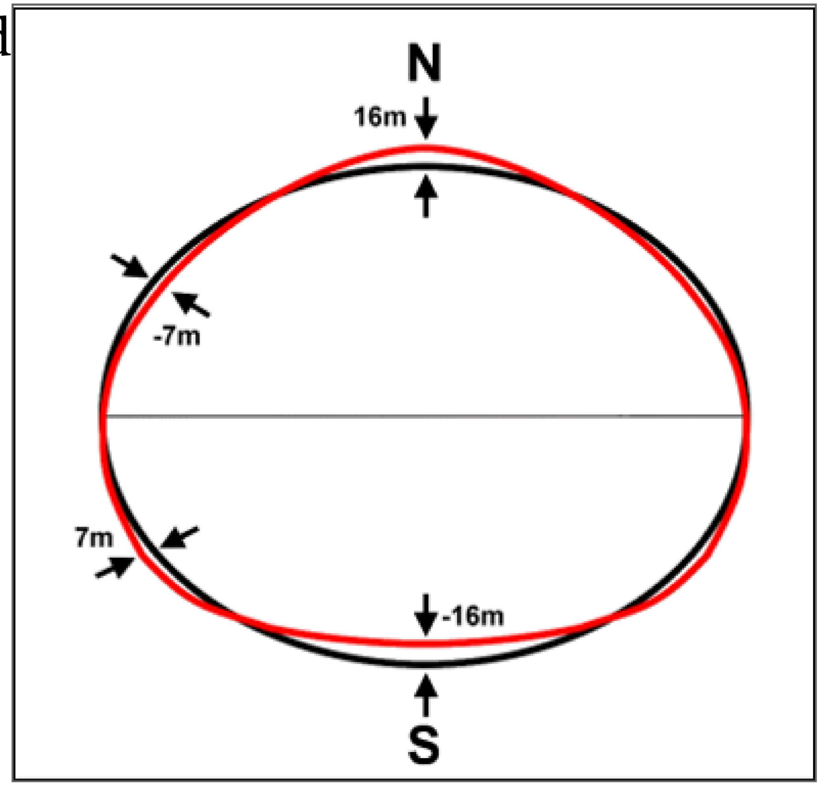
-Centrifugal Force



A DATUM

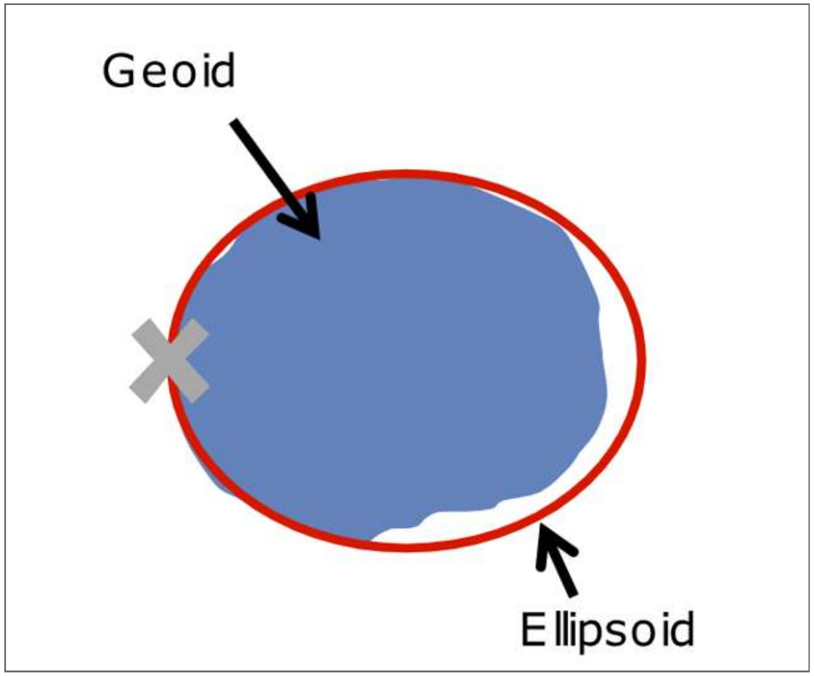
A system to link the oblate spheroid to the geoid

-Connect the coordinates to the earth's surface



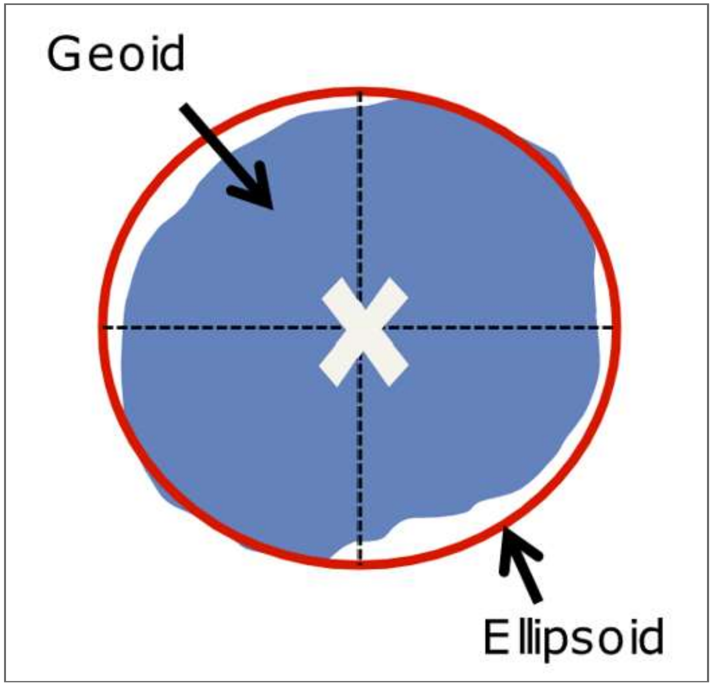
LOCAL DATUM

Fits geoid very well in a particular region



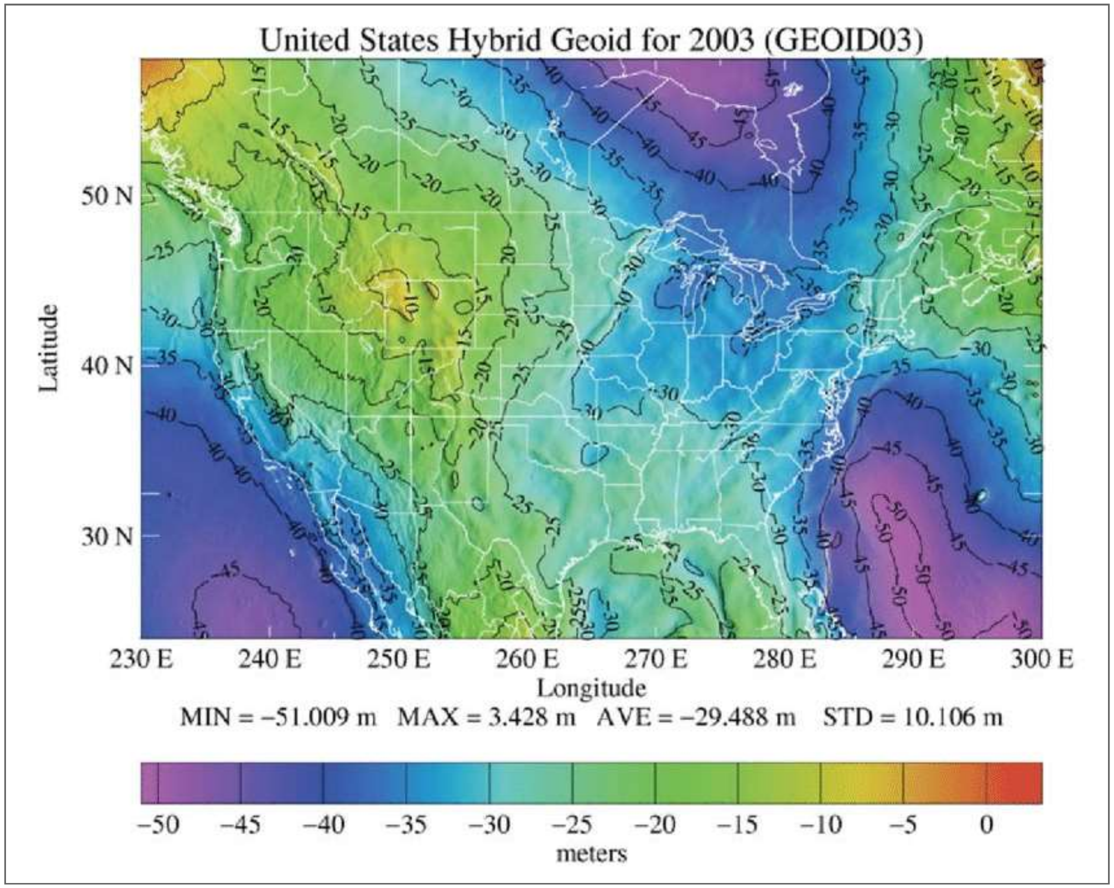
GLOBAL DATUM

Fits the geoid fairly well everywhere



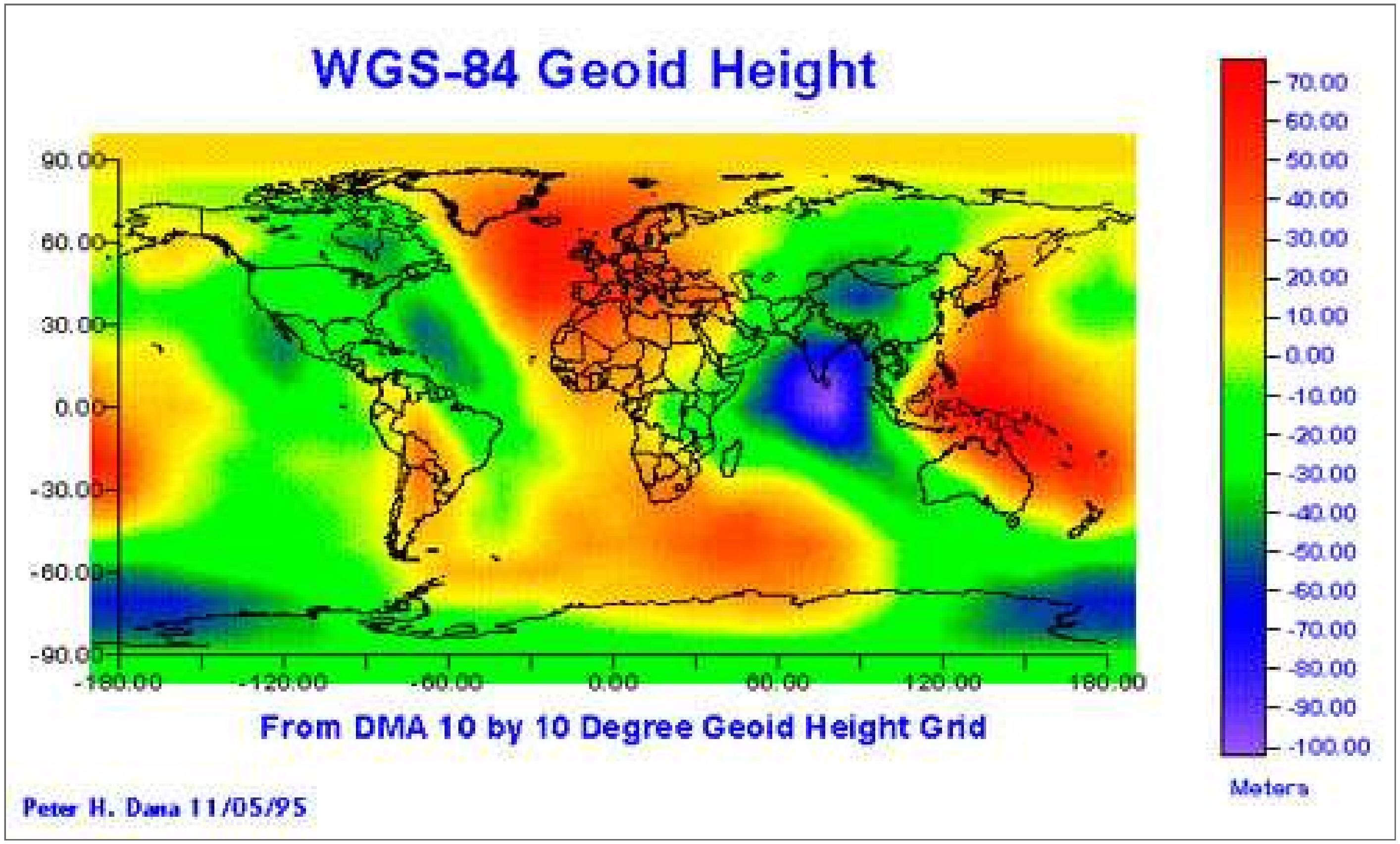
LOCAL DATUM

Fits geoid very well in a particular region



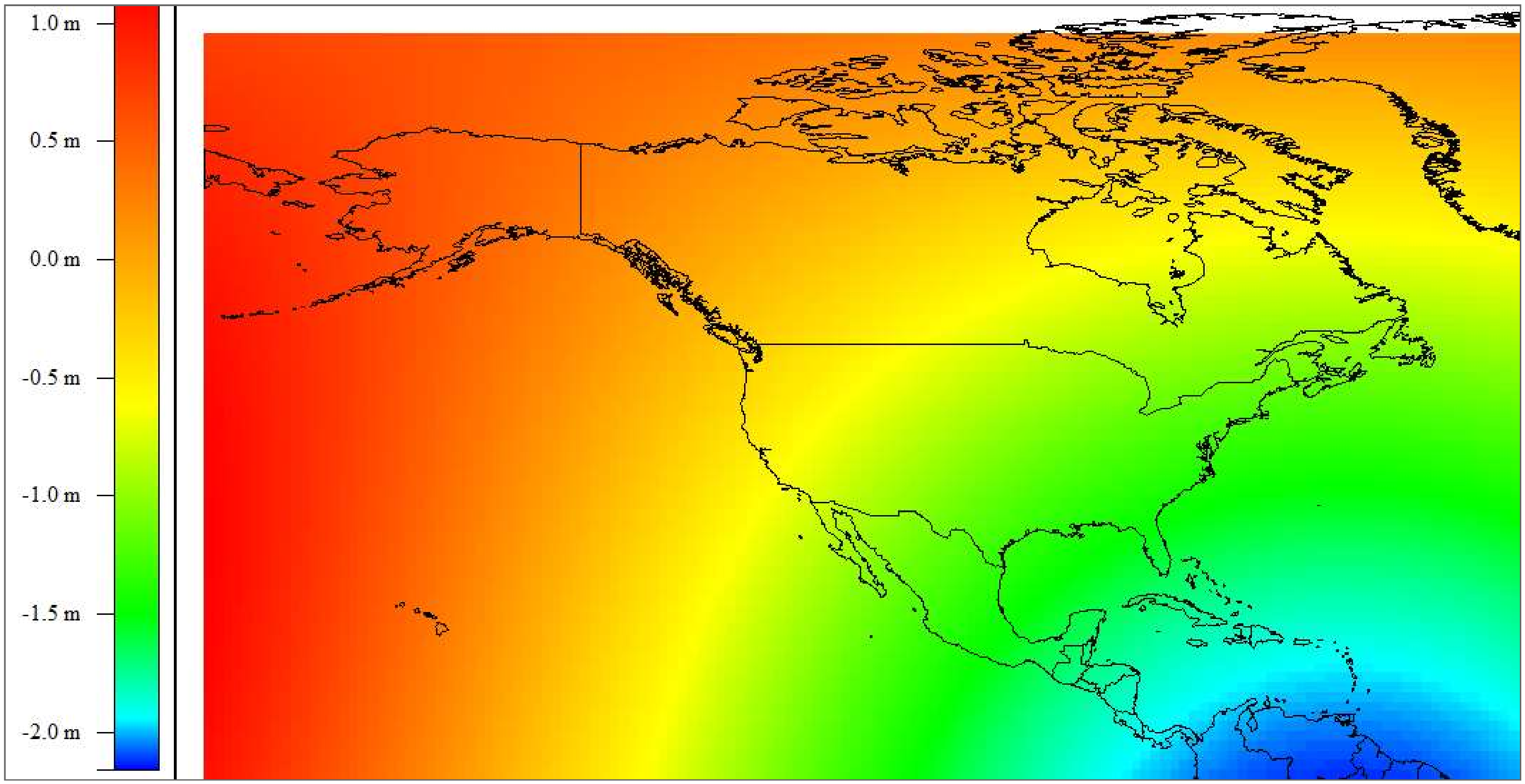
GLOBAL DATUM

Fits the geoid fairly well everywhere



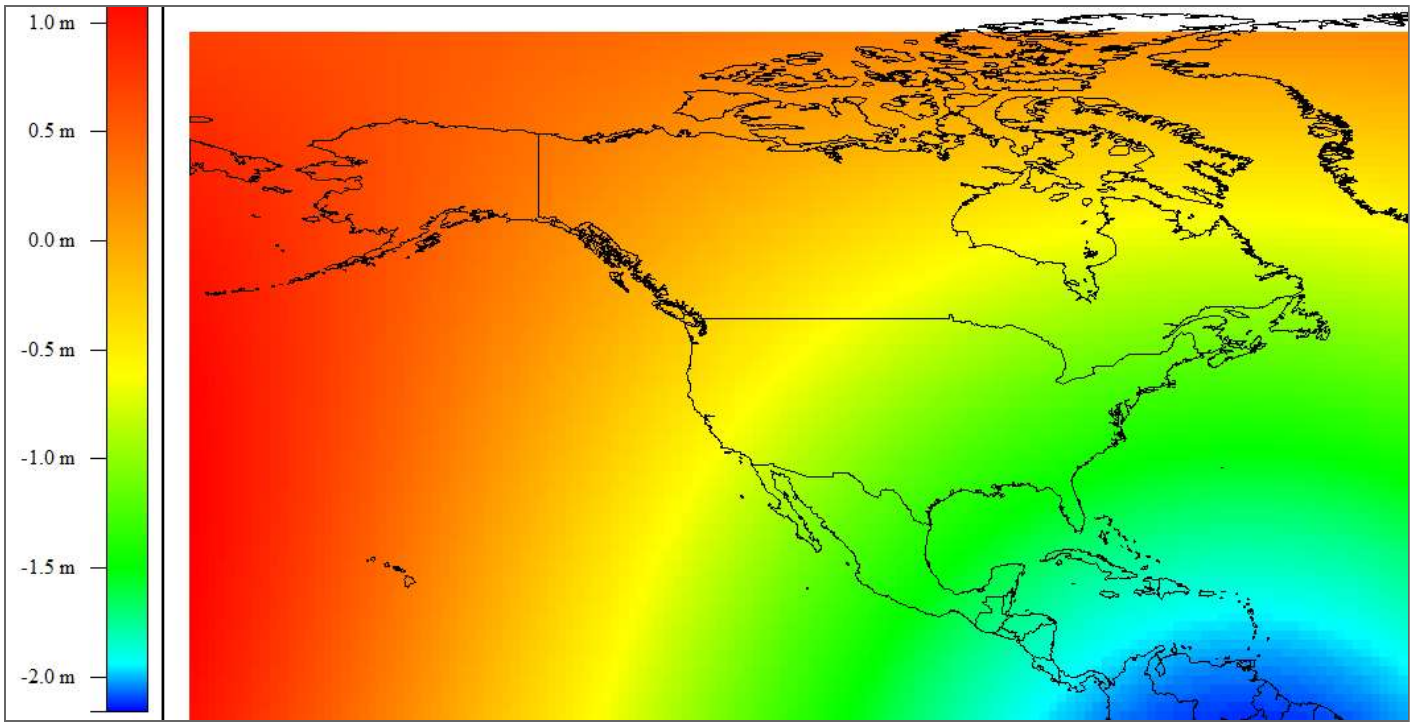
ONLY MINOR DIFFERENCES

For some cases, either datum is suitable.



ONLY MINOR DIFFERENCES

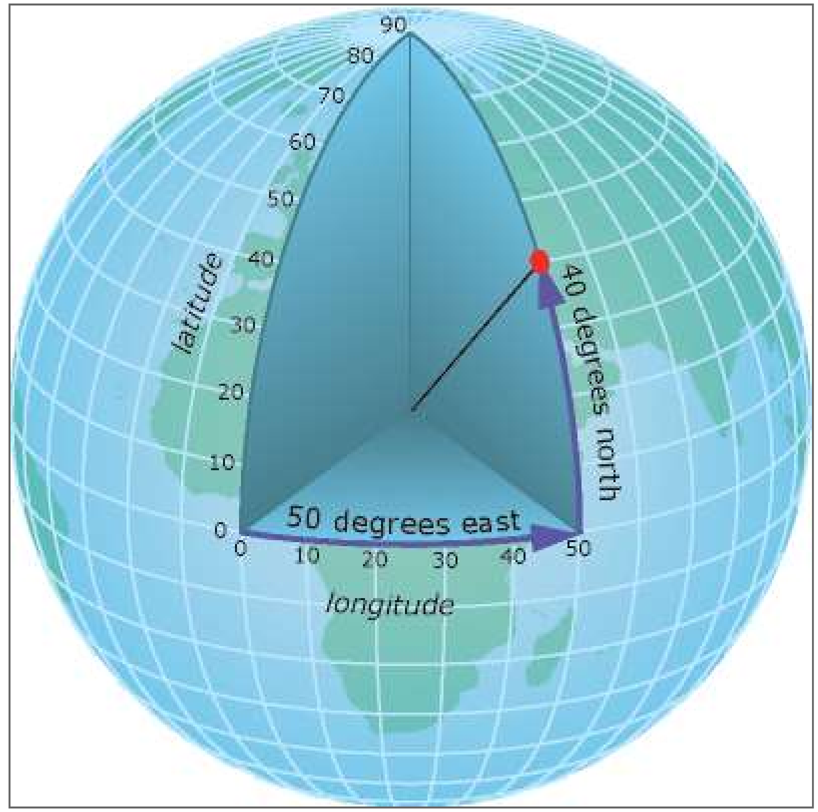
A local datum is better for small areas like a city. For global maps, you **always** need a global datum.



GEOGRAPHIC COORDINATE SYSTEM (GCS)

Spherical Coordinate System for identifying locations on the spheroid.

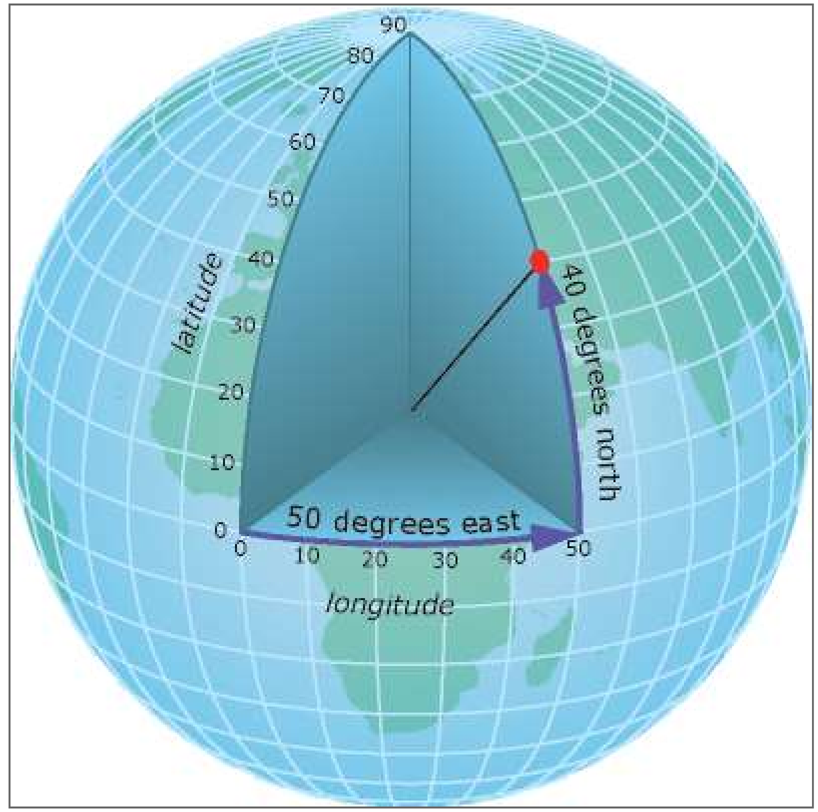
-All GCS are tied to a specific datum.



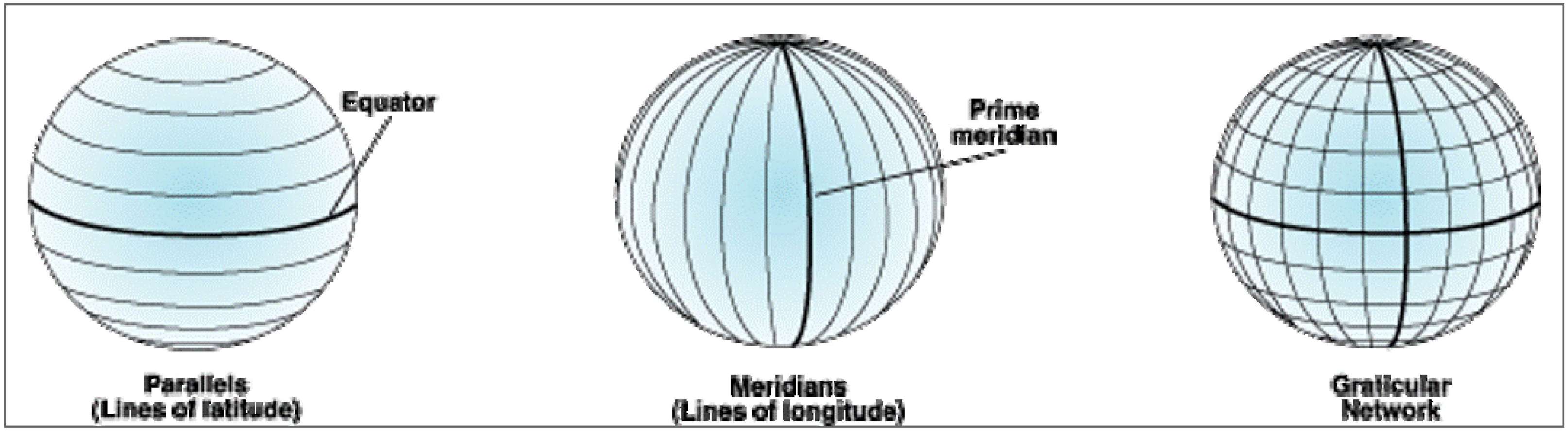
GEOGRAPHIC COORDINATE SYSTEM (GCS)

Latitude/Longitude

- Fixed to the surface of spheroid
- Angular distance from equator and prime meridian
- Location on a 3D object with just 2 numbers

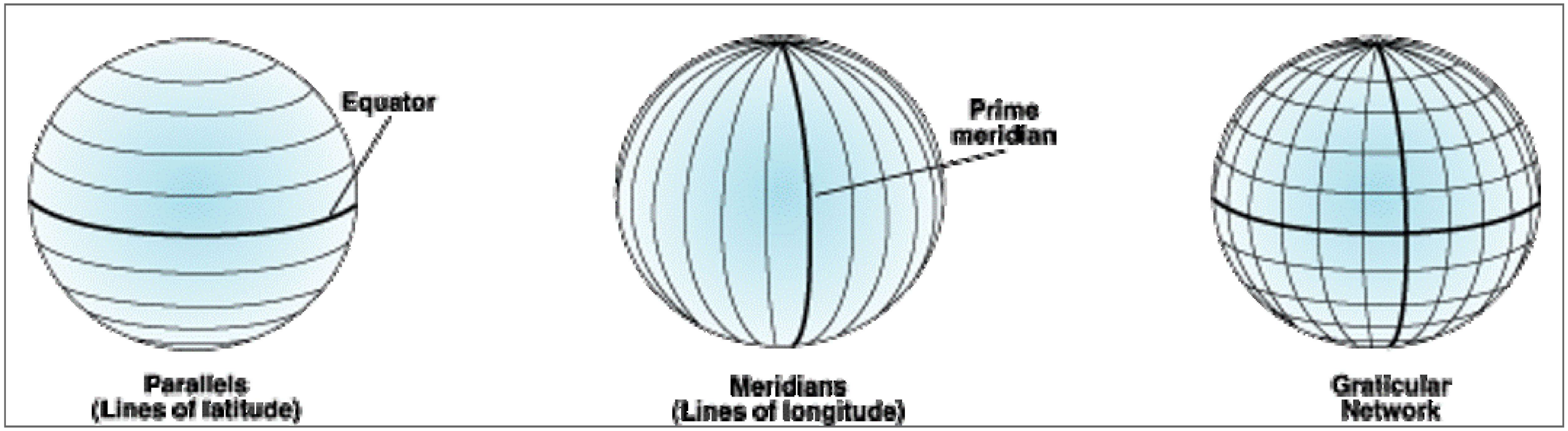


LATITUDE



Distance in degrees form Equator: -90°(South) to +90°(North)

LONGITUDE



Distance in degrees Prime Meridian: -180° (West); to +180° (East)

LATITUDE/LONGITUDE

Decimal Degrees

- Vancouver BC: 49.261111, -123.113889
- Sydney NSW: -33.865, 151.209444

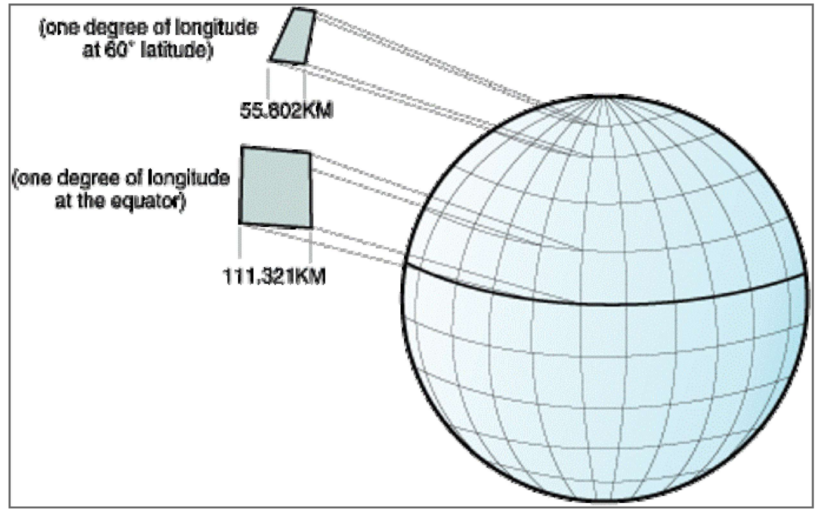
Degrees Minutes Seconds

- Vancouver BC: 49°15′40″N 123°06′50″W
- Sydney NSW: 33°51′54″S 151°12′34″E

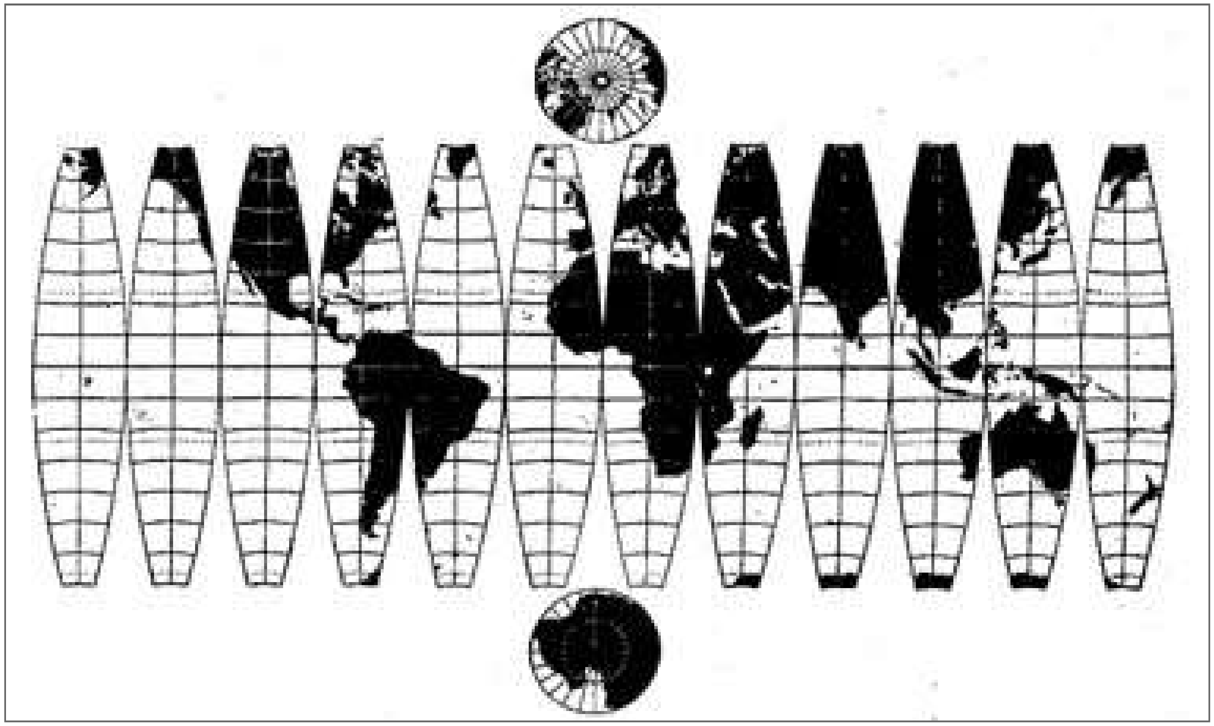
AN IMPORTANT CAVEAT!

Meridians converge!

- Distance between degrees of longitude decreases with increasing latitude



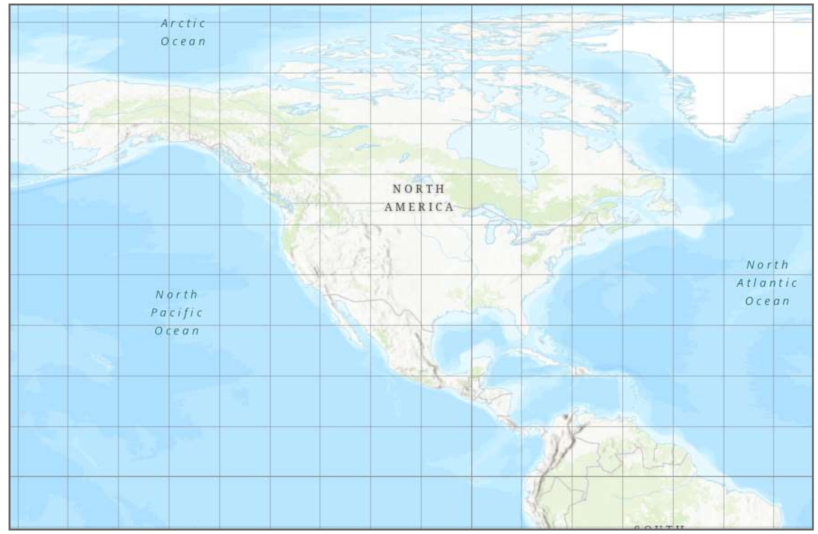
MAKING A FLAT MAP



MAKING A FLAT MAP

Displaying Lat/Lon in 2D doesn't work well

- Causes things to look "scrunched"



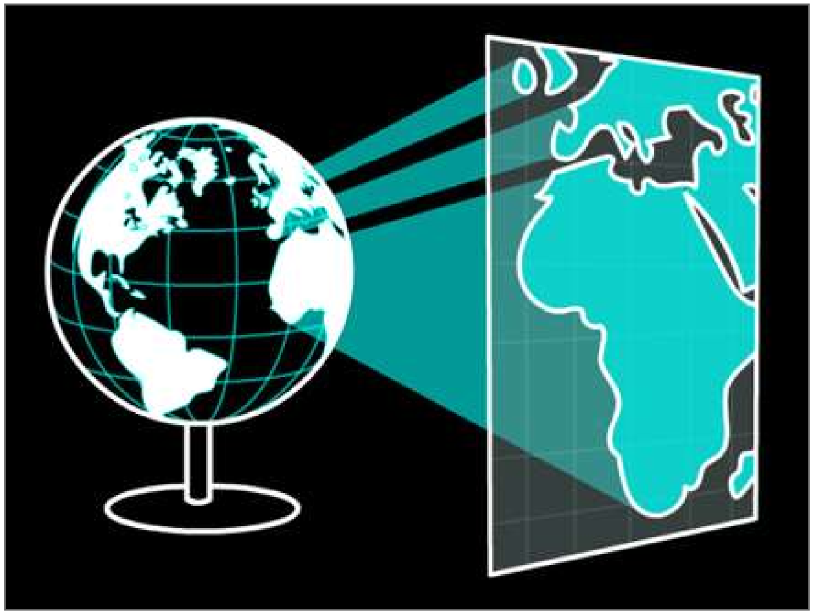
MAKING A FLAT MAP

We have to apply a projection

- Converts to linear units
- Allows distance/area calculations
- Makes things look better

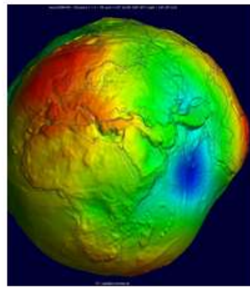
PROJECTED COORDINATE SYSTEMS

A map projection is a flattened GCS. Imagine sending rays of light through the ellipsoid onto a flat surface, the resulting image is a projection.

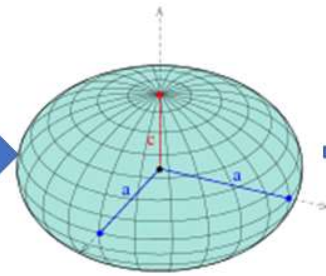


STEPS OF ABSTRACTION

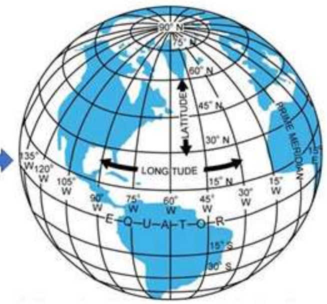
Earth: a very lumpy and irregularly shaped object



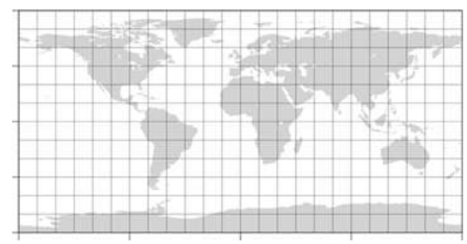
Geoid: a smoother mathematical approximation of the earth



Datum: Fit an oblate spheroid to the geoid



Geographical coordinate system



Map projection: 2D surface

A map projection is a 2D projection of a 3D geographical coordinate system