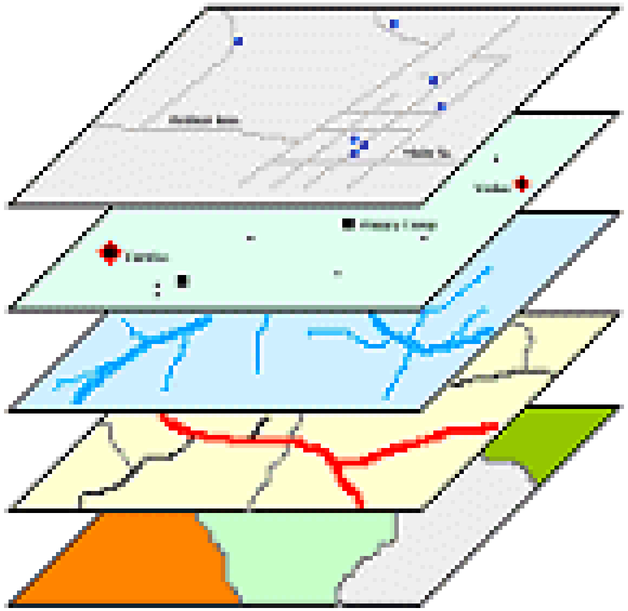
Places in the World whose Climates match with places in RUSSIA

Thematic mapping: which city is most like Moscow ?

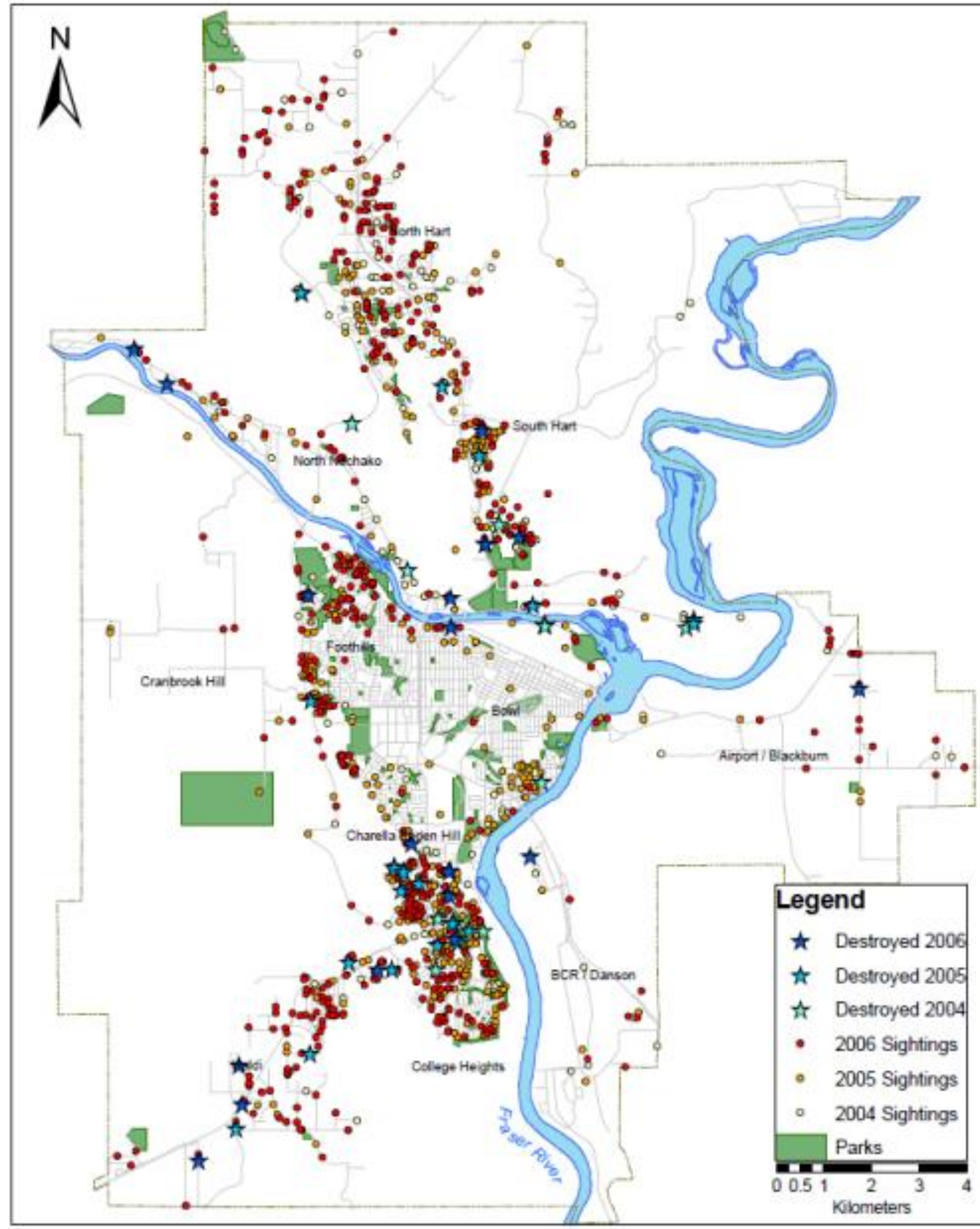
Coordinate map systems and Georeferencing



Registered map layers

digital mapping needs coordinates
- local for local mapping
- global for global datasets

Bear Sightings, Prince George 2004-2006



Registration vs Referencing

Registration:
-lining up the layers together

Georeferencing:
Linking layers to coordinates

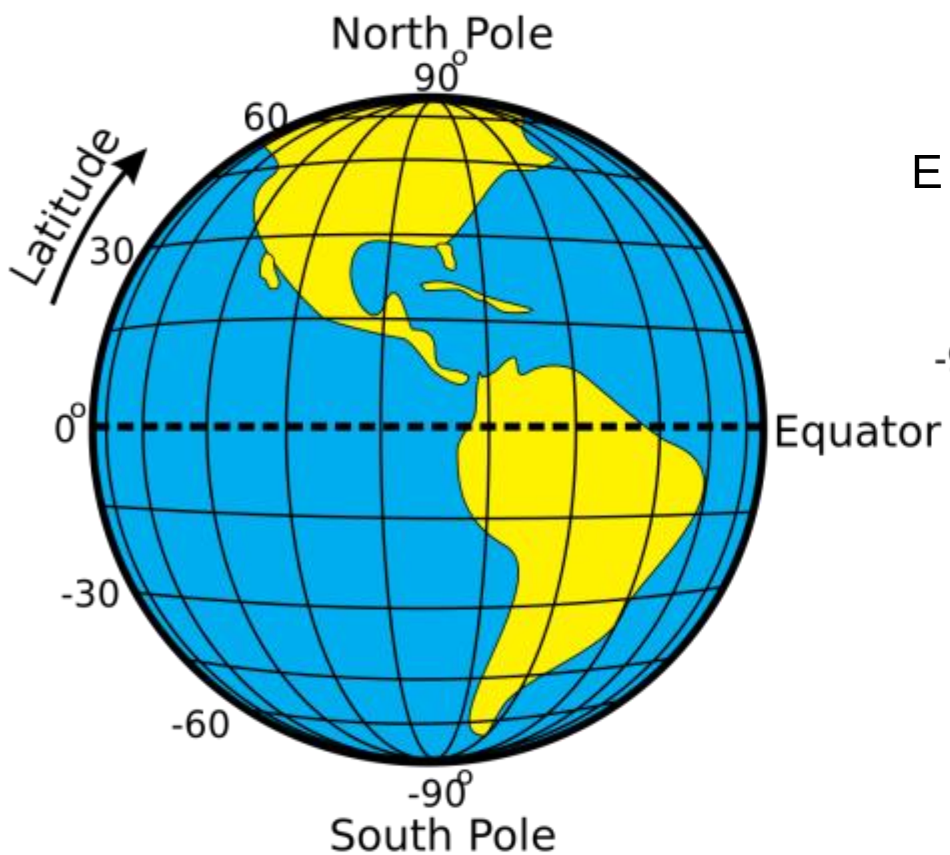
The FLAT EARTH SOCIETY

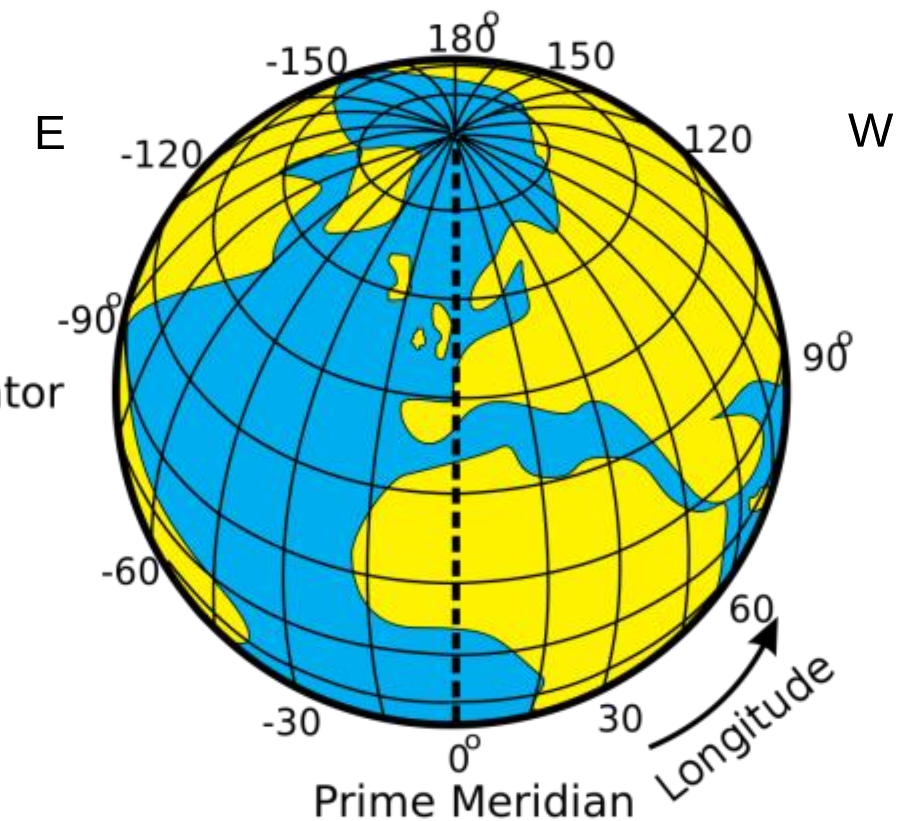
Flat Earth options:– if only it was flat, this would be a very short lecture

We’re pretty sure the Earth is not ‘flat’: the Rockies from Space Station

Coordinate map systems
1.The Earth's Graticule: Latitude - Longitude

- The graticule is the imaginary grid of lines running east-west lines of latitude (parallels) and north-south lines of longitude (meridians)
- The system was first devised by Hipparchus (190-120 BC)





1a. 'Geographic Referencing'

We can identify locations by latitude, longitude

e.g. UNBC campus agora

In decimal degrees: 53.892381, -122.813699 (N, W)

See: http://maps.google.ca (right-click)

In degrees, minutes, seconds:

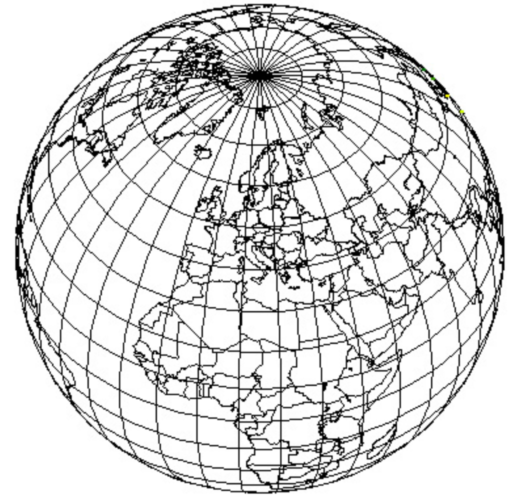
53° **53' 33" (N) 122° 48' 50" (W)**

OR

In degrees and decimal minutes (e.g. GPS)

53° 53.543' N 122° 48.822' W

Latitude



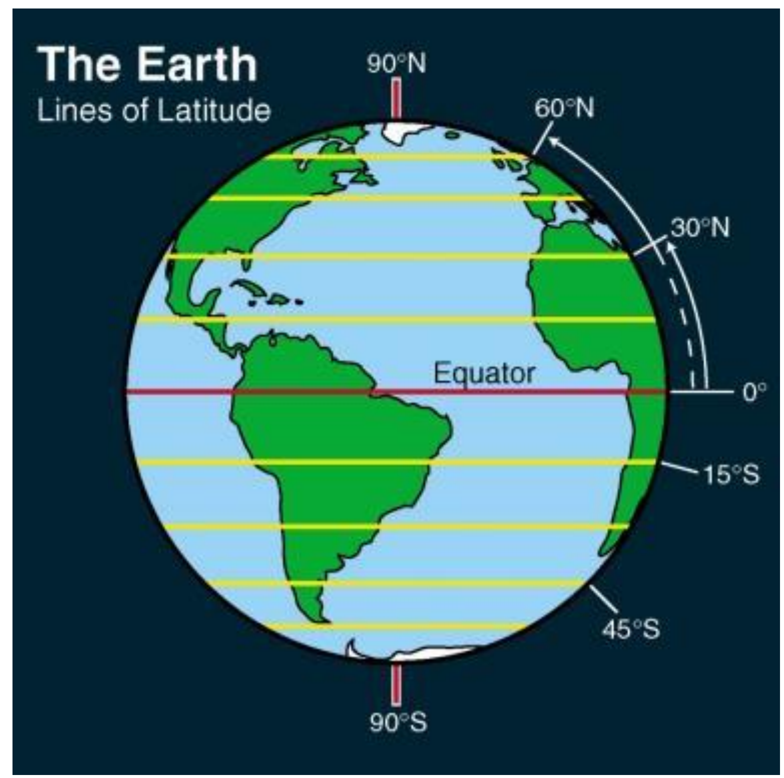
- **Latitude** = the vertical angle from the centre of earth to the location
- e.g. Prince George is at 54°N
- Quesnel is at 53°N
- [1° = ~ 111km]

- Latitude is 0 on the equator

'Sexagesimal system'

- 1 degree = 60′ (minutes)
  [1′ = ~ 2km] (111km /60)

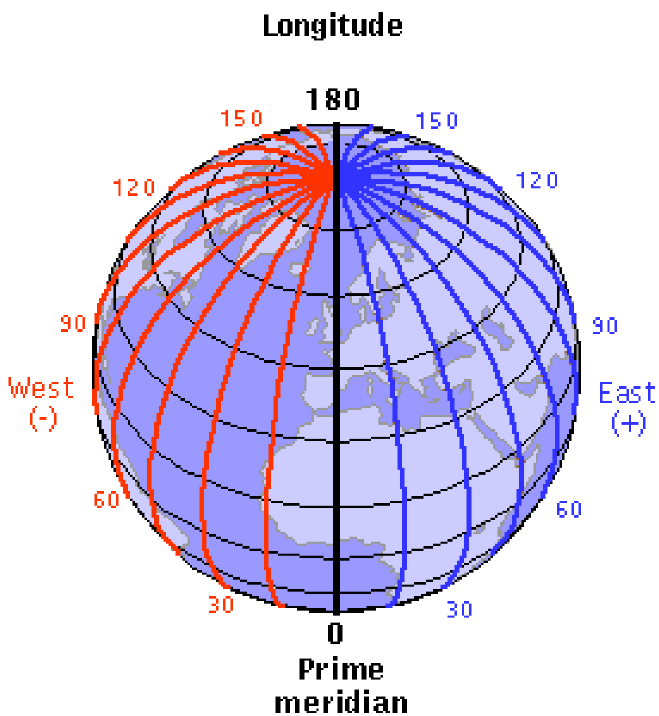
- 1′ = 60″ (seconds)
  [1″=~30m] (2km / 60)



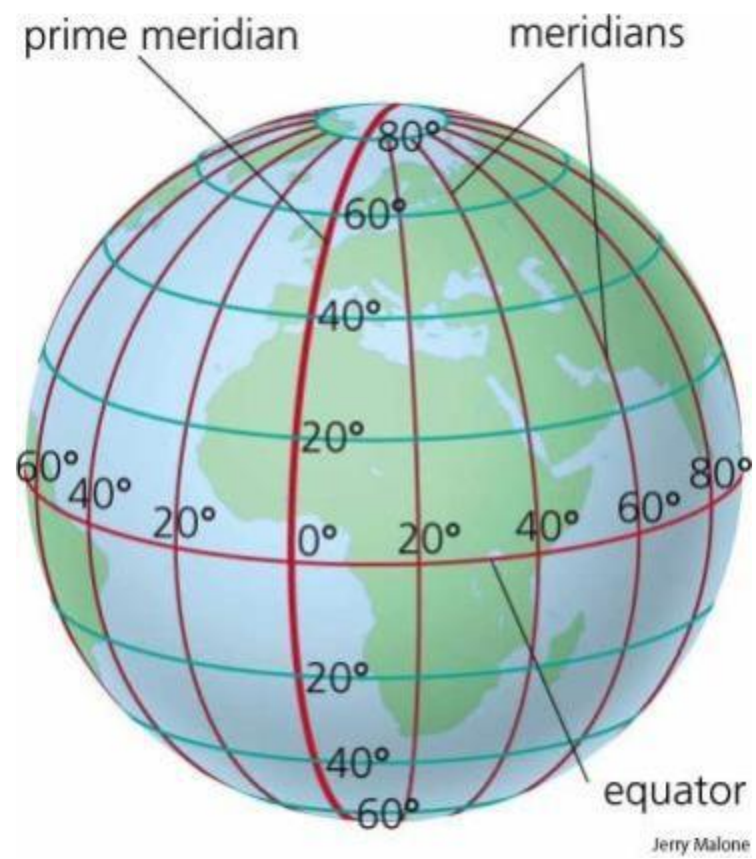
Longitude

Longitude = the angle formed between line from centre of earth to the (arbitrary) 'prime meridian' running through Greenwich, England and the local meridian. The 0 location is arbitrary (1884)

Longitude ranges from
0 to 180 W / 180 E (the same line)
Prince George = 123°W (-123)



W

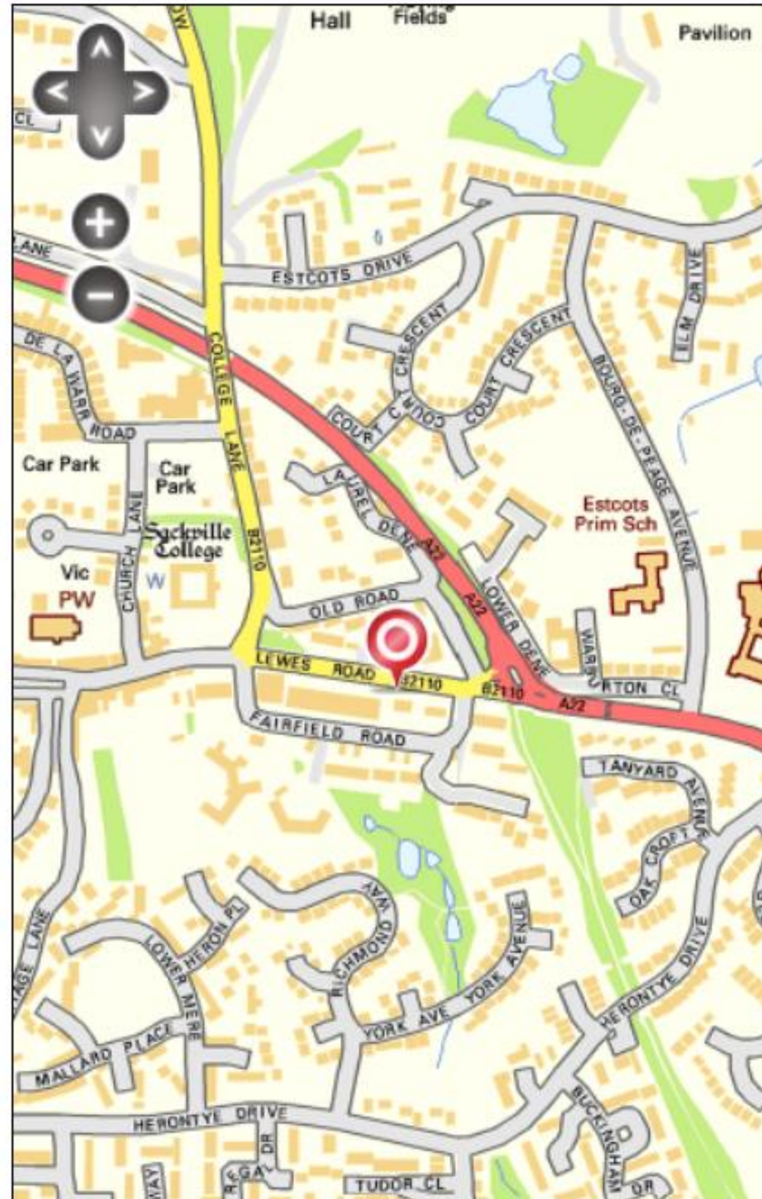


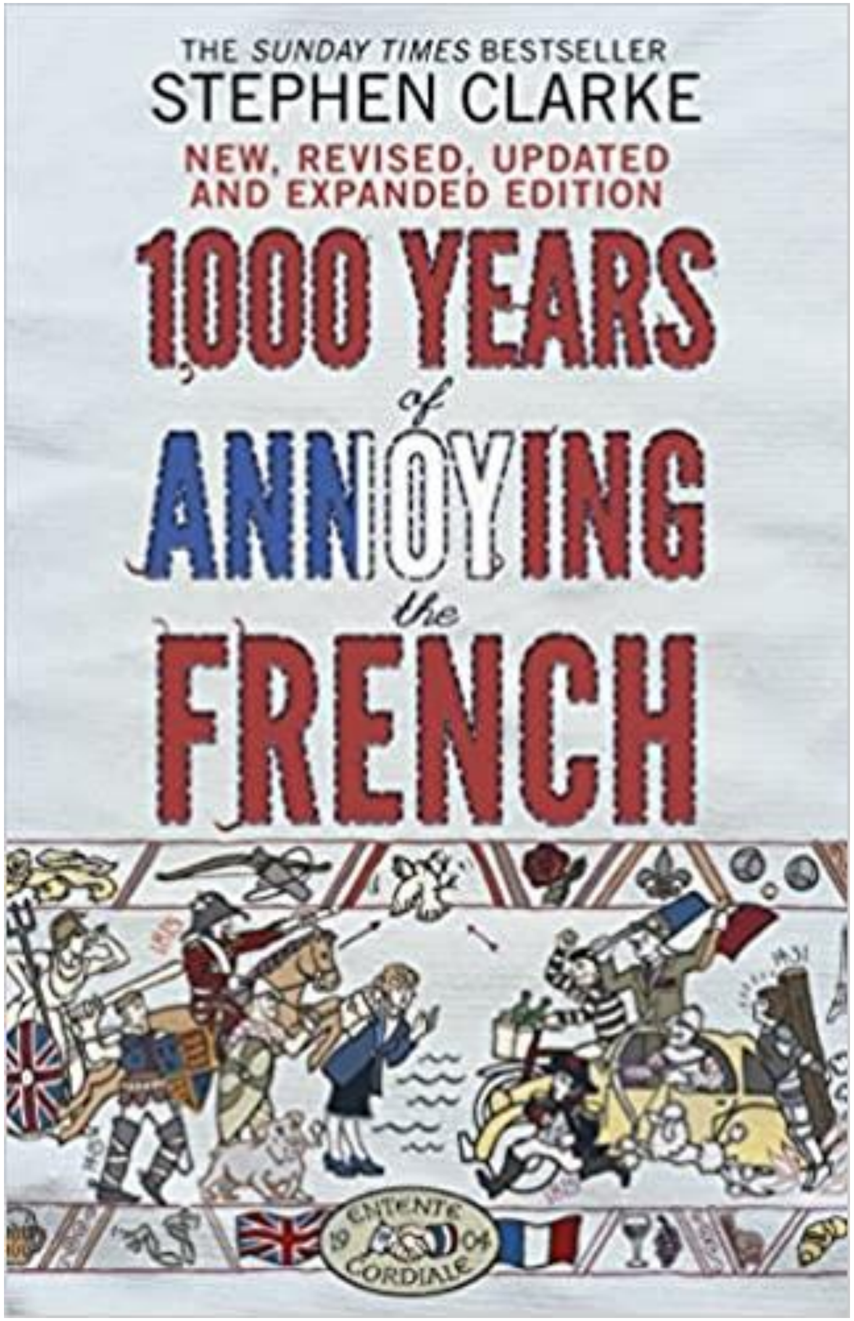
E

The Greenwich Meridian

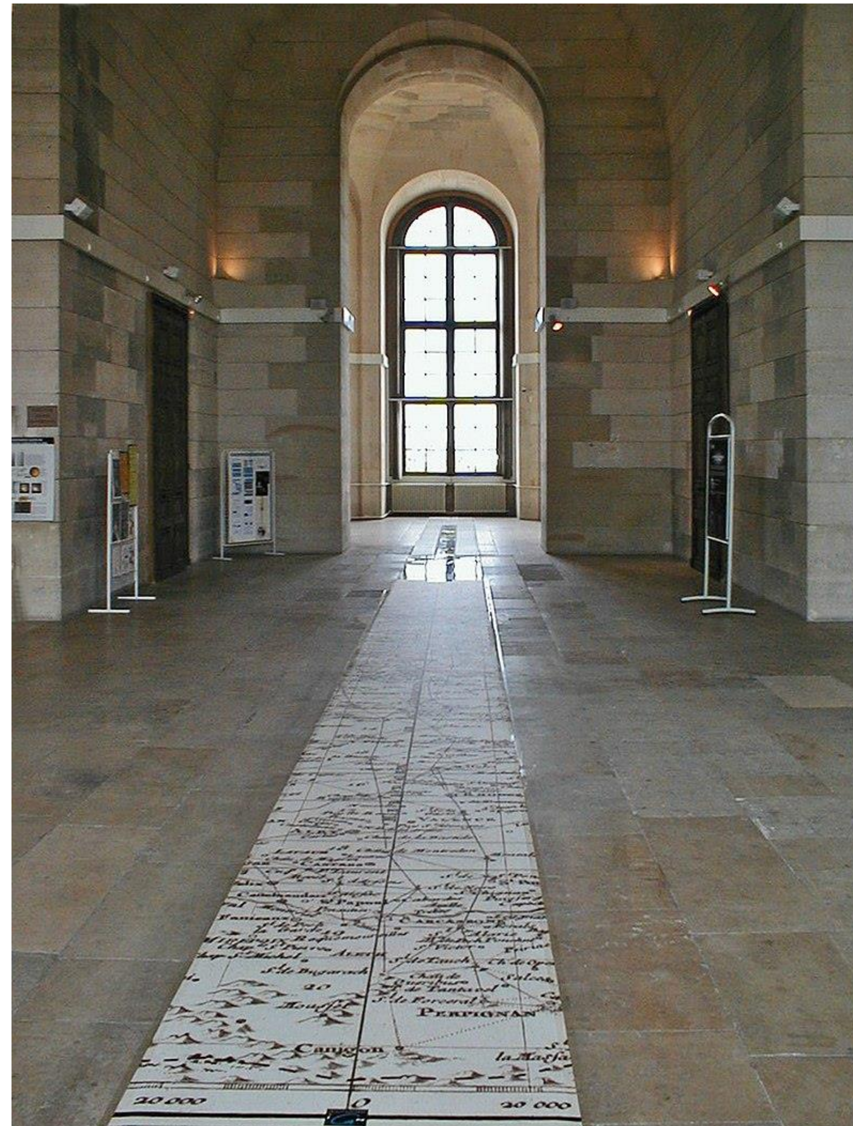
...where east meets west

Location	England West Sussex
	East Grinstead S side of: B2110 (Lewes Road)
Distance (S) from Greenwich	39.39 Km: 24.48 miles
OS map details	OS Explorer: 135
OS grid ref	TQ 39945.37948 (539945,137948)
WGS84 lat/long	51.123729, -0.001647
	Click here for images
Type	Marker 'stone'
Marking date	2000
Access	Unrestricted
	Show satellite view





Meridian Room (or Cassini Room) at the Paris Observatory, The Paris meridian is traced on the floor. Since 1634



‘Geographic’ referencing issues

a. Geographic is <u>not decimal</u>, it is ‘<u>sexagesimal</u>’ (= base 60)

1 degree = 60 minutes
1 minute = 60 seconds

Decimal degrees:	58° 30′	= 58.5	30/60 = 0.5
Decimal degrees:	58° 36′	= 58.6	36/60 = 0.6
Decimal degrees:	58°36′36″	= 58.61	36/(60*60) = 0.01

b. It is suitable for storing global datasets, but …

with <u>negative values</u> south and west of 0, 0

e.g. in a digital system, PG = 54, -123

c. The main issue with mapping with Longitude

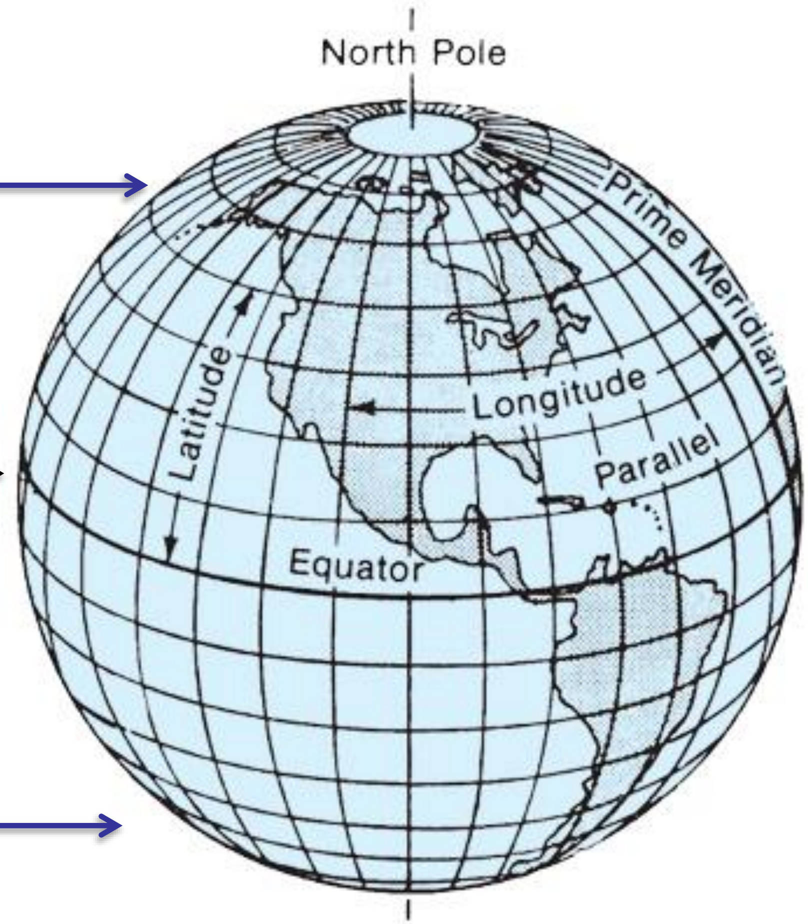
1 degree longitude varies widely from ~111 km at the equator to 0 km at poles

It is not rectangular

half the distance at 60 ° N/S

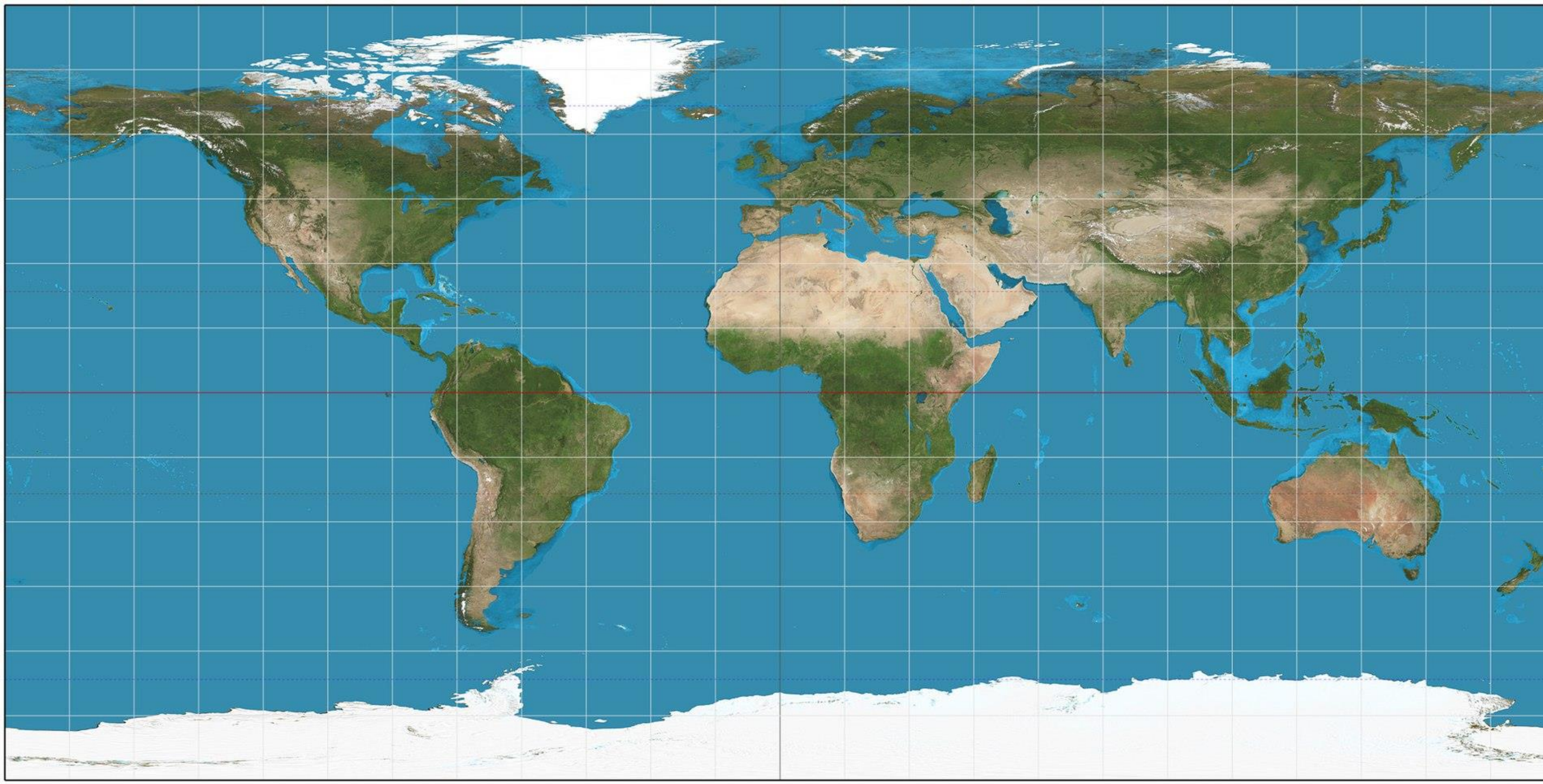
Equator

i.e. 1 degree has no fixed length



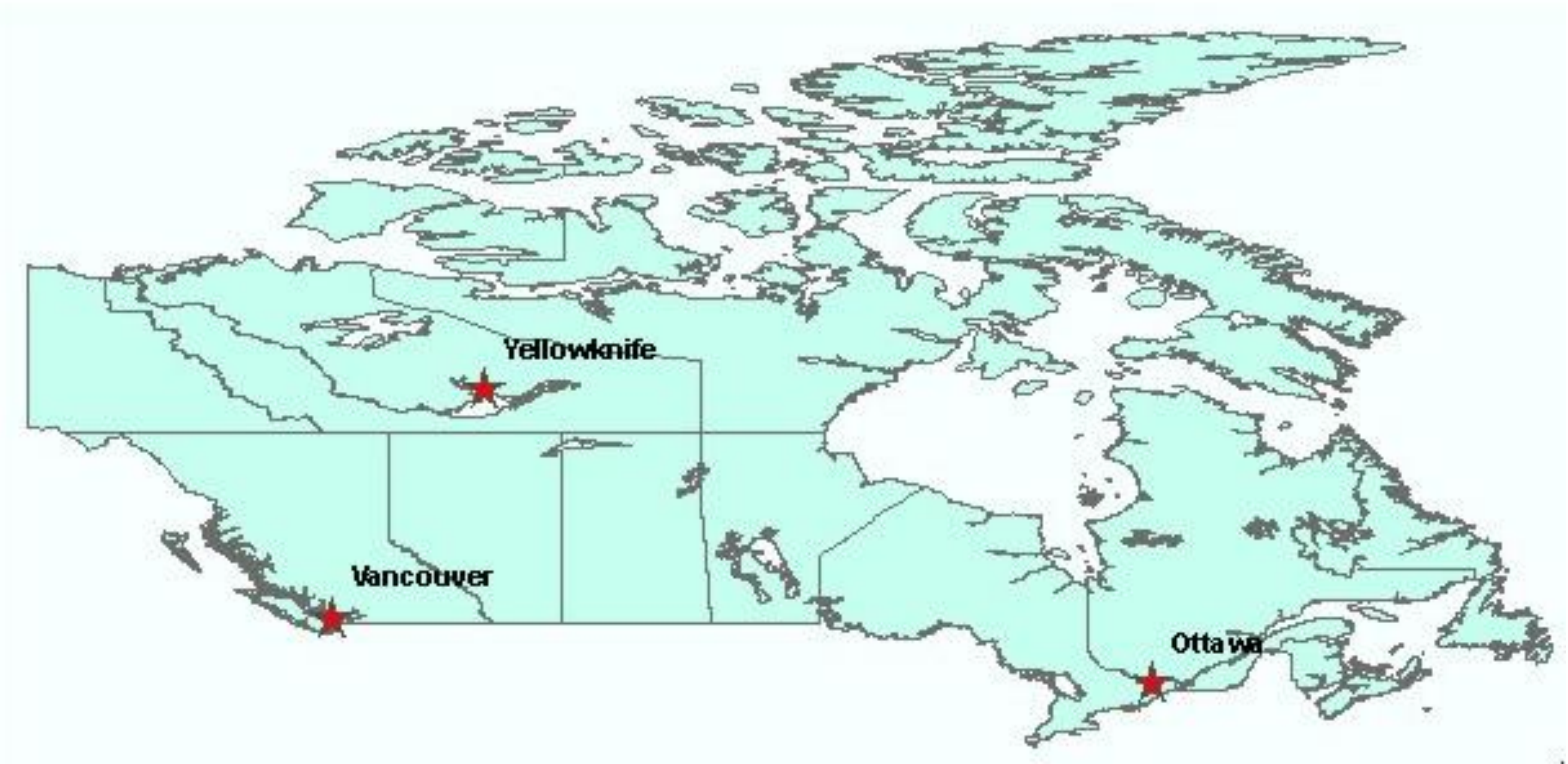
Equirectangular map display

… as if degrees of latitude and longitude were equal
E-W stretching away from the equator: 2x at 60º latitude



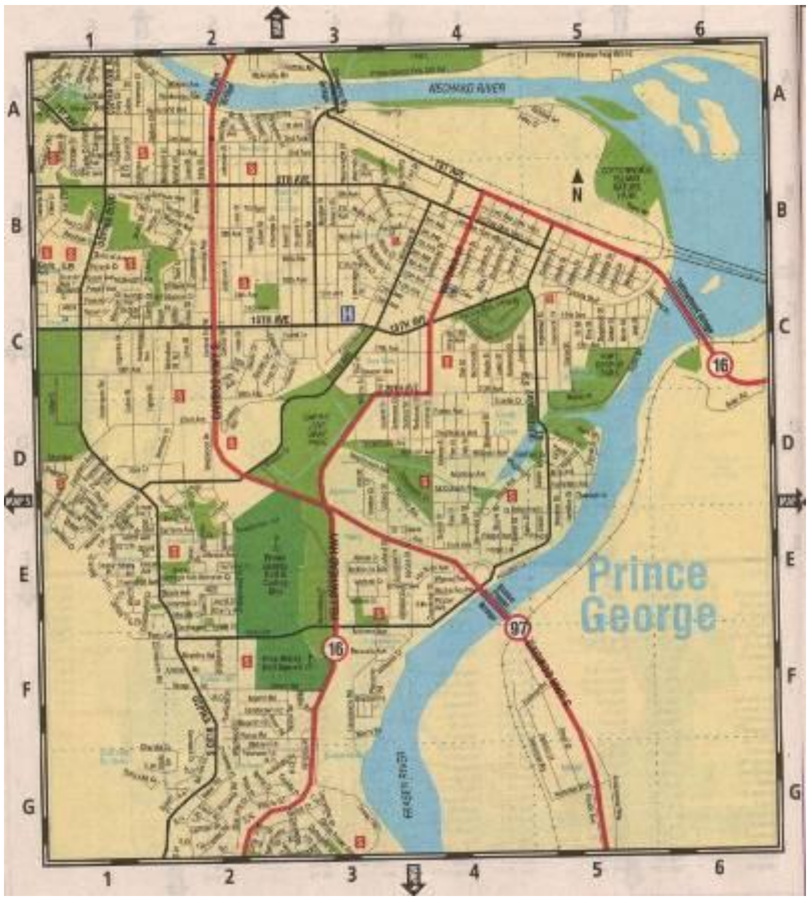
-1 degree longitude varies from 0 -> 111 km
->East-west stretching away from equator
(as a degree is treated uniformly)

<u>'geographic' is OK for data storage, but not for display</u>

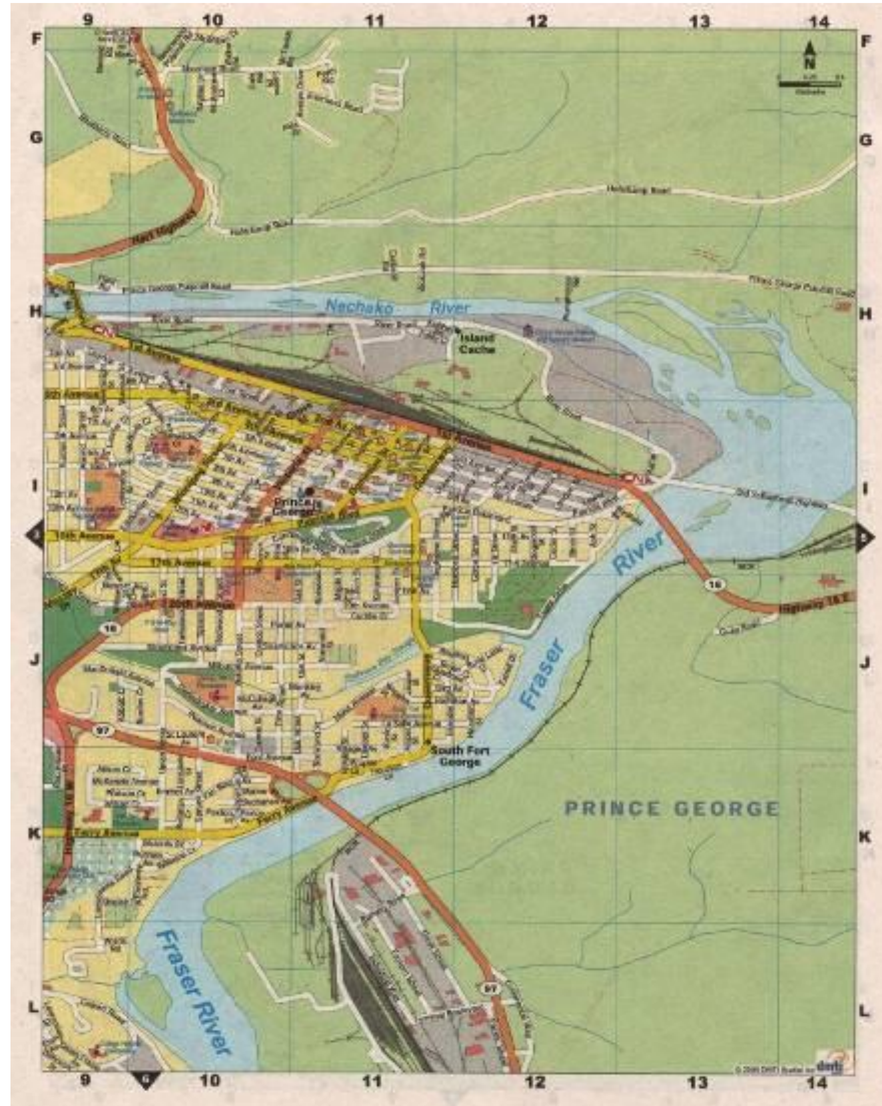


Local example from the phone book

2007: scale is consistent

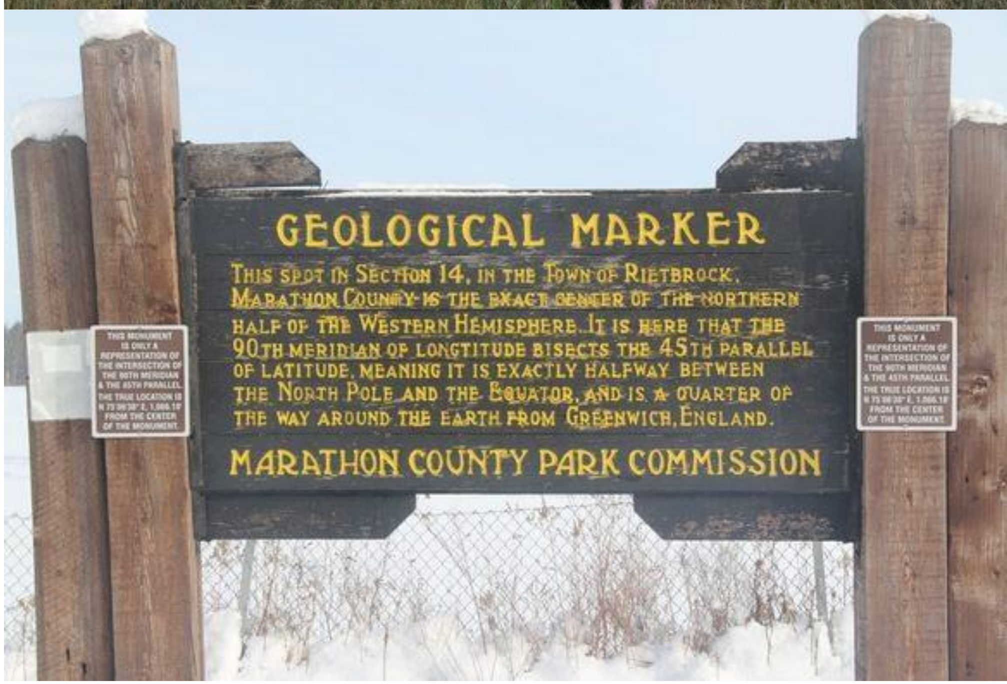


2008: horizontal scale is almost double



Latitude and Longitude

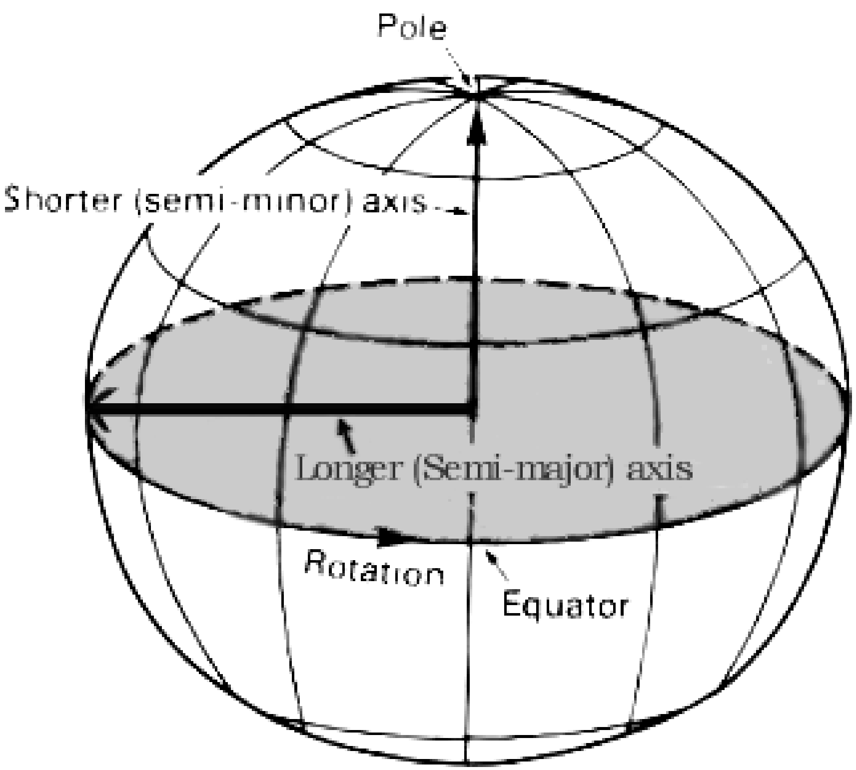
Length of One Degree of Longitude			Length of a Degree of Latitude		
Latitude	**Kilometres**	**Miles**	**Latitude**	**Kilometres**	**Miles**
0º	**111.32**	**69.17**	**0º**	**110.57**	**68.71**
10º	**109.64**	**68.13**	**10º**	**110.61**	**68.73**
20º	**104.65**	**65.03**	**20º**	**110.70**	**68.79**
30º	**96.49**	**59.95**	**30º**	**110.85**	**68.88**
40º	**85.39**	**53.06**	**40º**	**111.04**	**68.99**
50º	**71.70**	**44.55**	**50º**	**111.23**	**69.12**
60º	**55.80**	**34.67**	**60º**	**111.41**	**69.23**
70º	**38.19**	**23.73**	**70º**	**111.56**	**69.32**
80º	**19.39**	**12.05**	**80º**	**111.66**	**69.38**
90º	**0.00**	**0.00**	**90º**	**111.69**	**69.40**



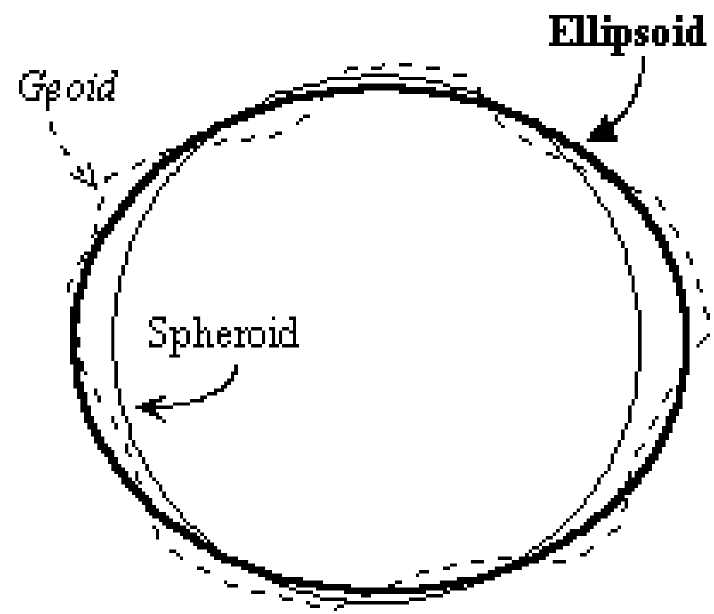
But is 45° North   halfway ?

1b. The Geoid

Earth is not a perfect sphere, it is ellipsoidal ..
The difference between the length of the two axes =
the amount of 'polar flattening' is about 1/300 (0.3%)
and 1º latitude is slightly longer as you move away from the equator



An ellipsoid is formed by rotating an ellipse on its shorter axis

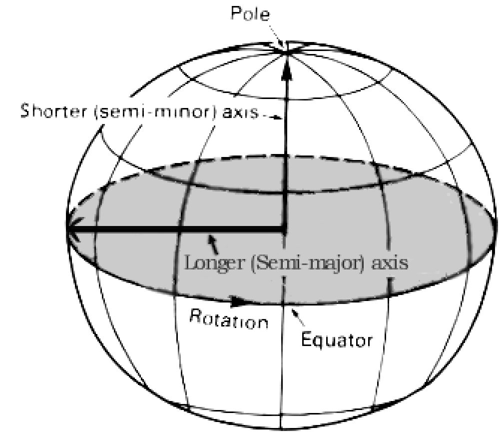


99.7% soccer ball
0.3% 'football'

Official Ellipsoids

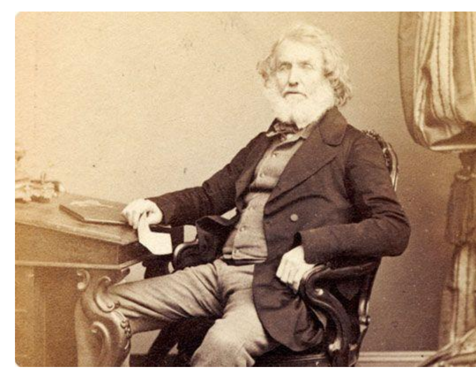
(part of the study of Geodesy)

(from J. Snyder, Map Projections--A Working Manual)



An ellipsoid is formed by rotating an ellipse on its shorter axis

		Equatorial	Polar	
Name	**Date**	**Radius *a* (metres)**	**Radius *b* (metres)**	**Polar Flattening**
WGS 84	***1984***	***6,378,137***	***6,356,752***	***1/298***
GRS 80	1980	6,378,137	6,356,752	1/298
WGS 72	1972	6,378,135	6,356,750	1/298
International	1924	6,378,388	6,356,912	1/297
Clarke	***1866***	***6,378,206***	***6,356,584***	***1/295***
Everest	1830	6,377,276	6,356,075	1/301



Datums (do we need to know this?)

'Datum' = "a set of values that serve as a base for mapping"

a. North American Datum, NAD27 *(1927) based on Clarke 1866*

b. North American Datum, NAD83 *based on GRS80/WGS 1984*

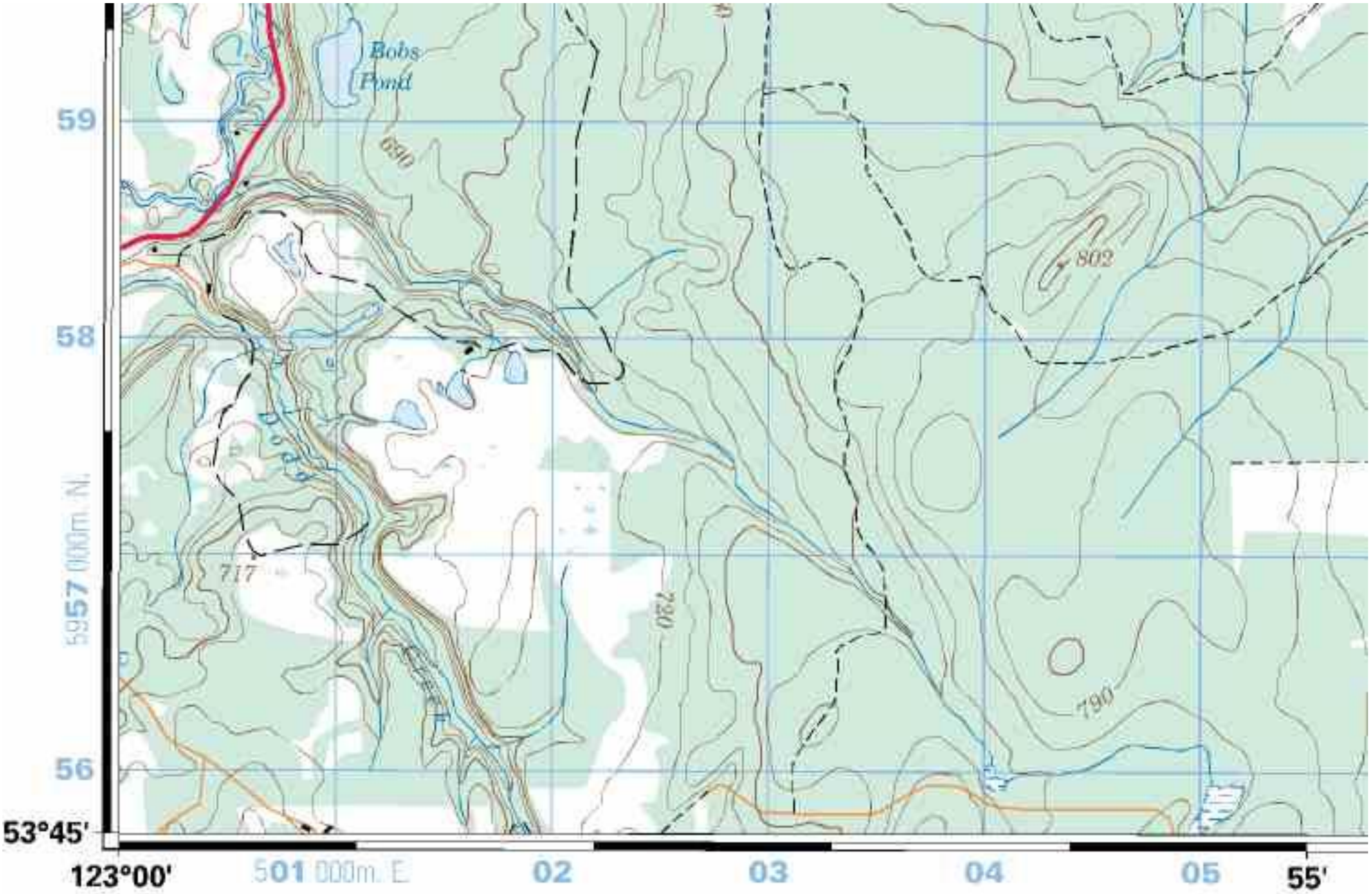
-> NAD27 was the datum for mapping in most of the 20th century

-> NAD83 is the current datum for digital mapping / GIS data

-> The two can differ by ~ **70 metres** (x) and **170 metres** (y)

New millennium: you can 'almost' forget about NAD27 ....
but when UNBC opened in 1994, we still had a lot of NAD27 mapping

Lat/long coordinates given in black in degrees/minutes

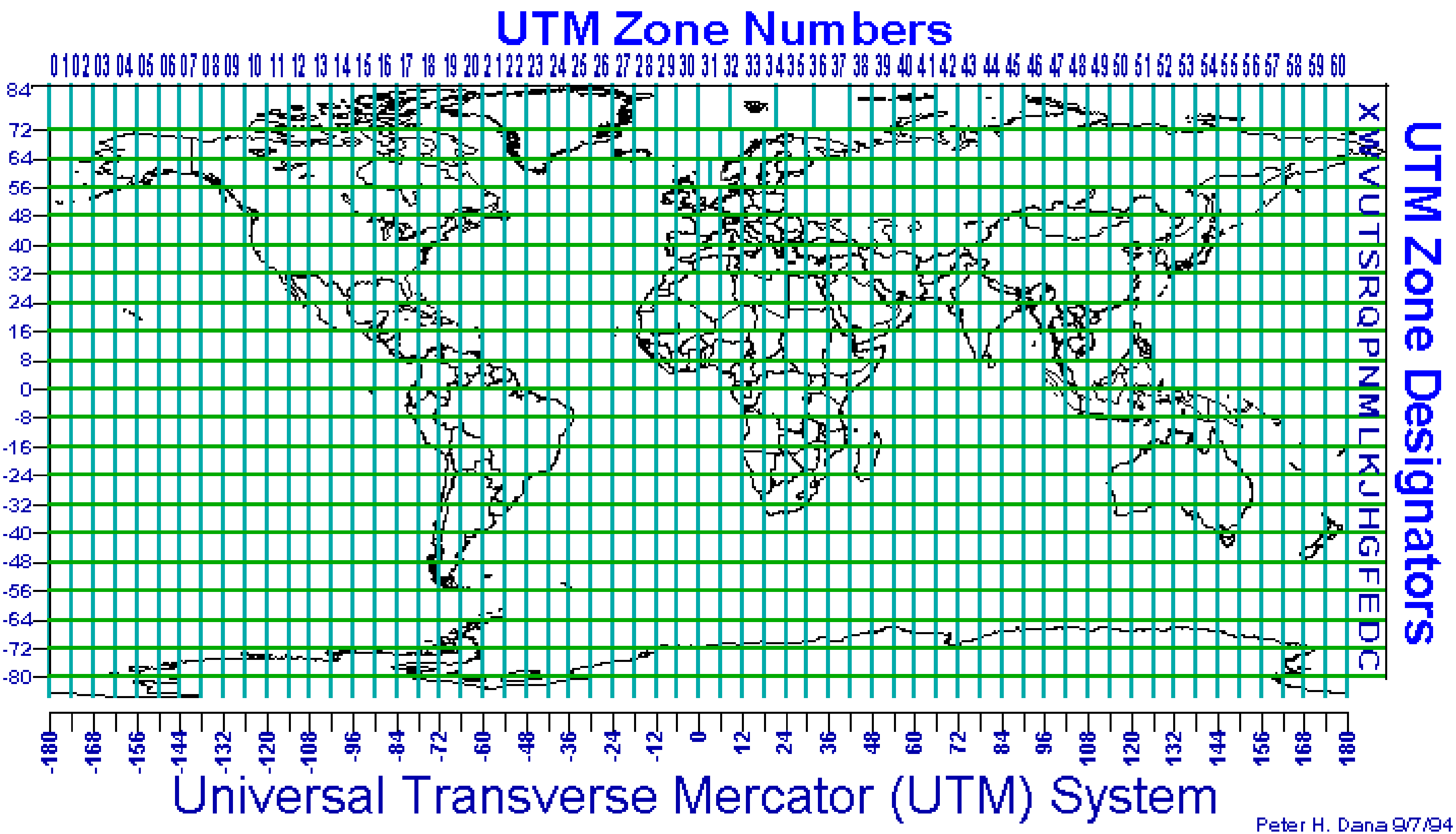


2. UTM map coordinates – a rectangular system

Universal Transverse Mercator (UTM) System

this bit is harder so pay attention ...

The world is divided into 60 x 6 ° longitude (vertical) strips numbered 1 - 60 from 180 degrees West to 180 degrees East



either developed by United States Army Corps of Engineers or German Wehrmacht

Canada: UTM zones – adopted in 1947 for mapping

Zone
Central
Meridians

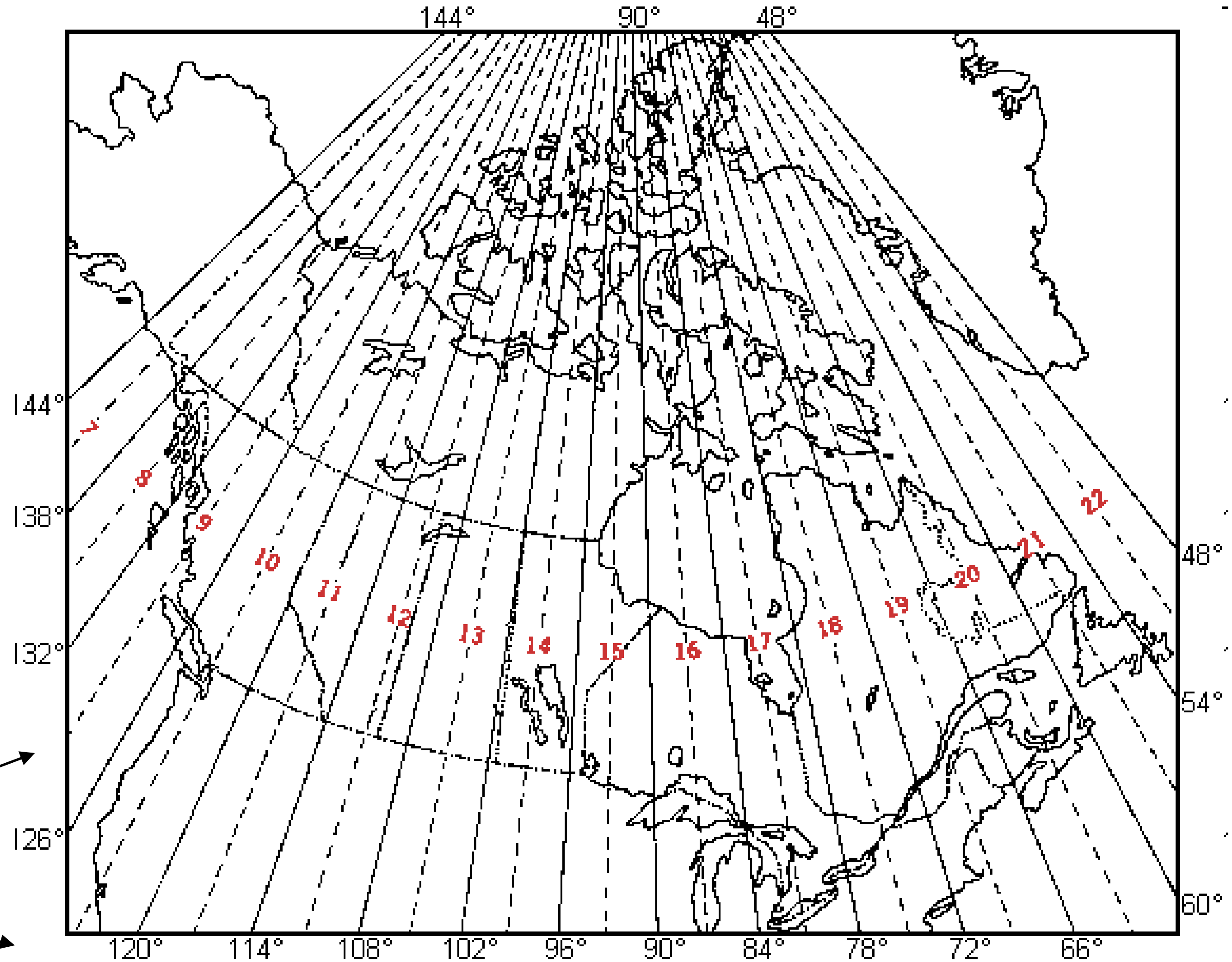


Figure 2 - Zones UTM

– the width of each zone varies from 666 km (6 x 111km) at the equator
…to ~338 km (6 x 55.8 km) at 60 ° N/S, with a 'central meridian' in the middle

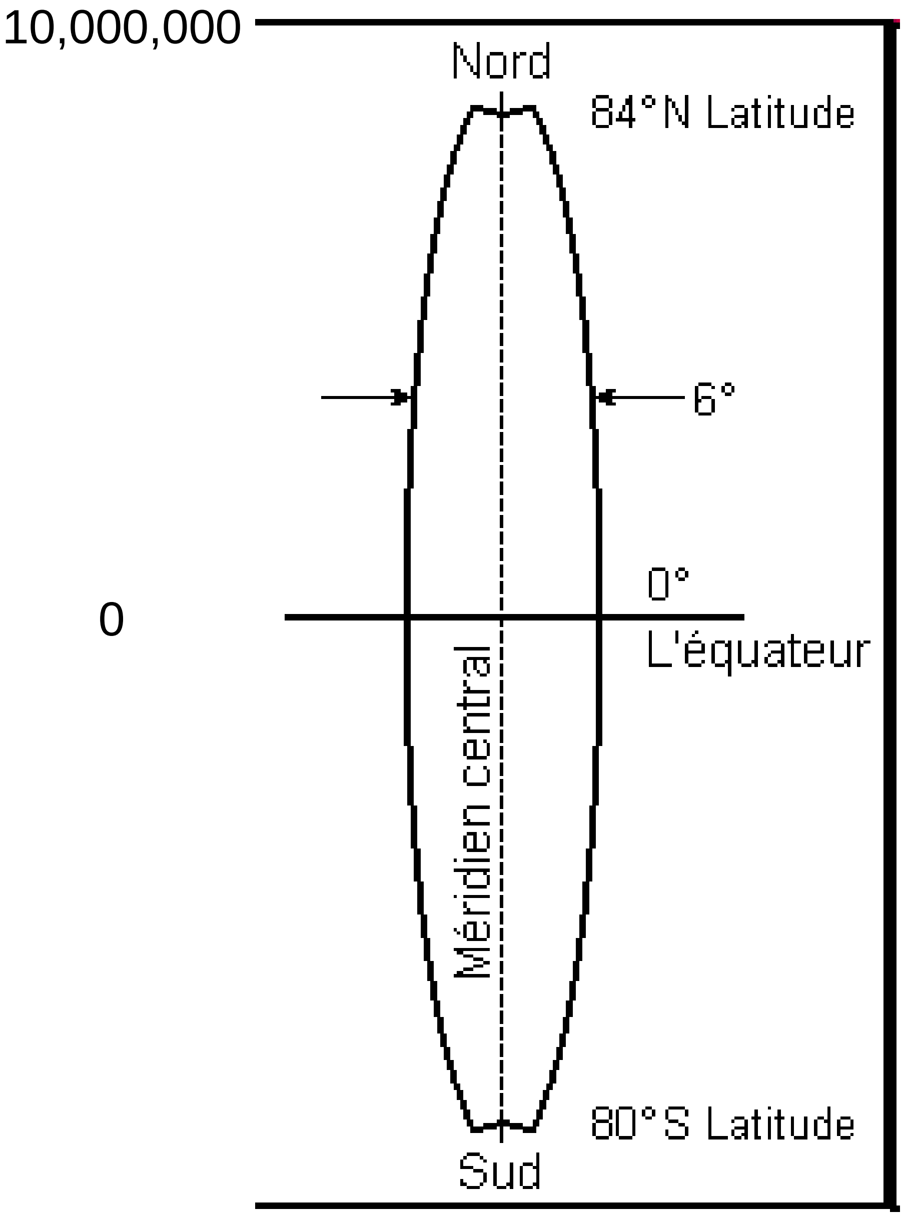


Figure 1 - Zone UTM

UTM coordinates

are in <u>metres</u>

Within each zone …

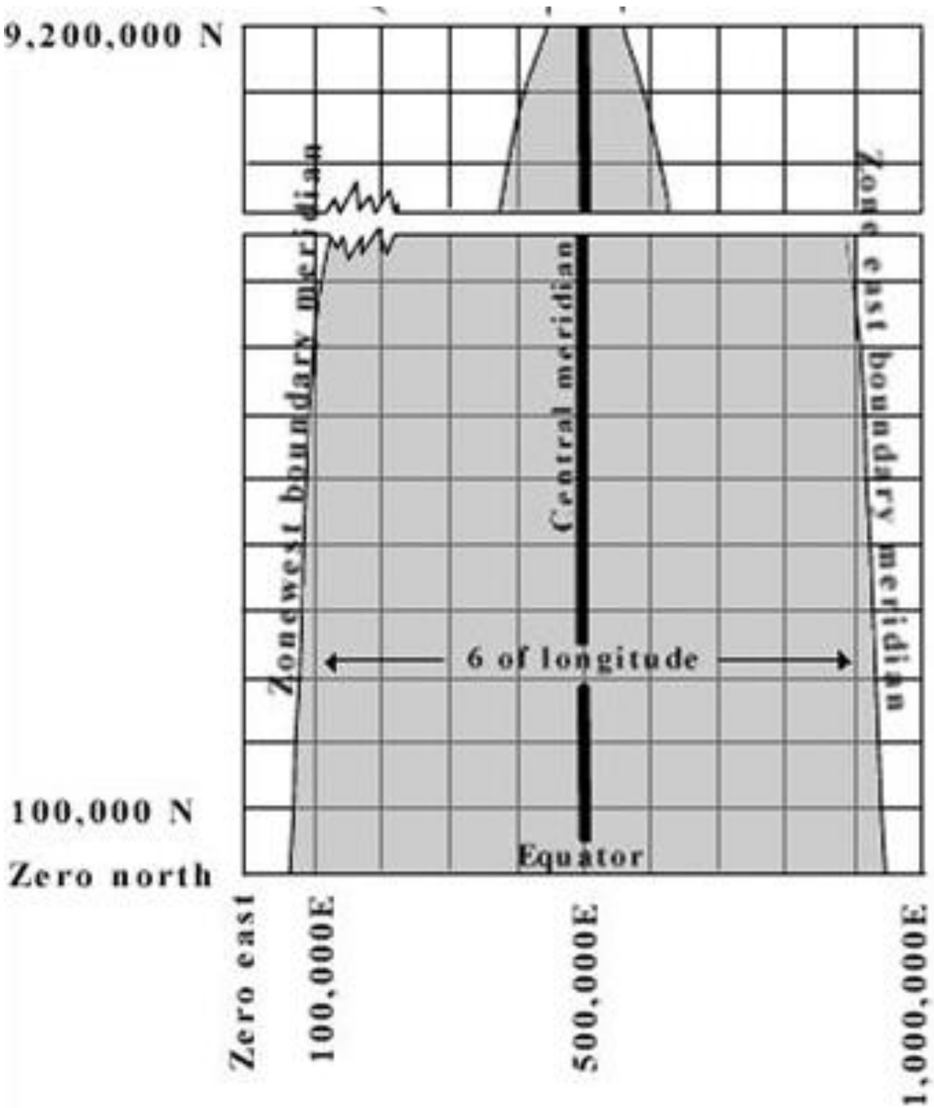
The 'Y' coordinate
Northings (N):

measured from the Equator (0) – to the north pole (10,000,000) … in metres [this is the metric system]

e.g. UNBC ~ 5,972,000

UTM coordinates

The 'x' coordinate



BC range= ~300,000-700,000

- this is the hardest part ...

Eastings (E) for each zone

- based on the zone
Central Meridian at 500,000

the easting value increases to the east, but not > 1,000,000

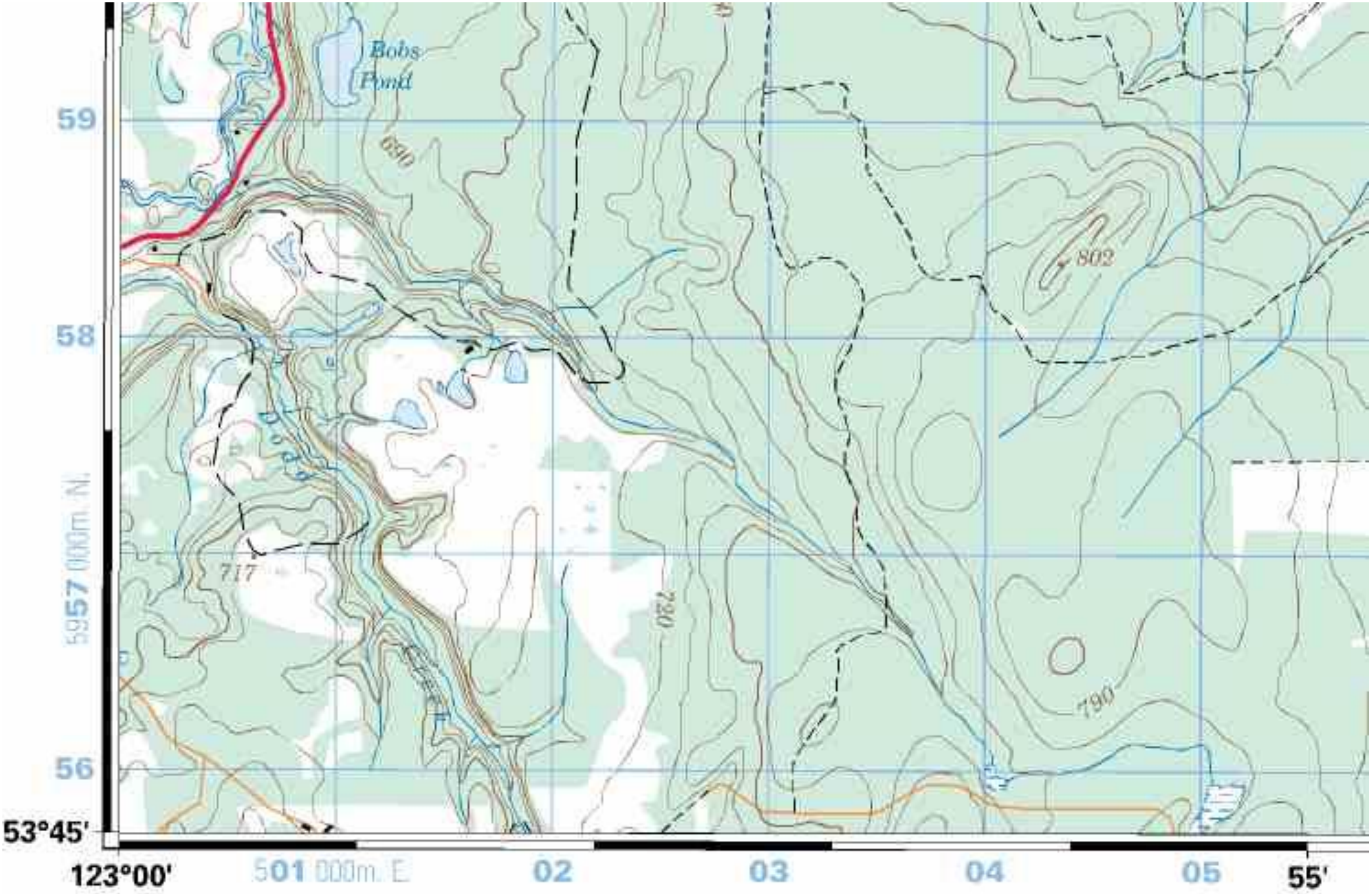
the easting value decreases to the west but not below zero

e.g. UNBC ~ 512,000

Zone must also be given as Coordinates repeat for each zone
Grrrr ... who came up with this crazy scheme !?

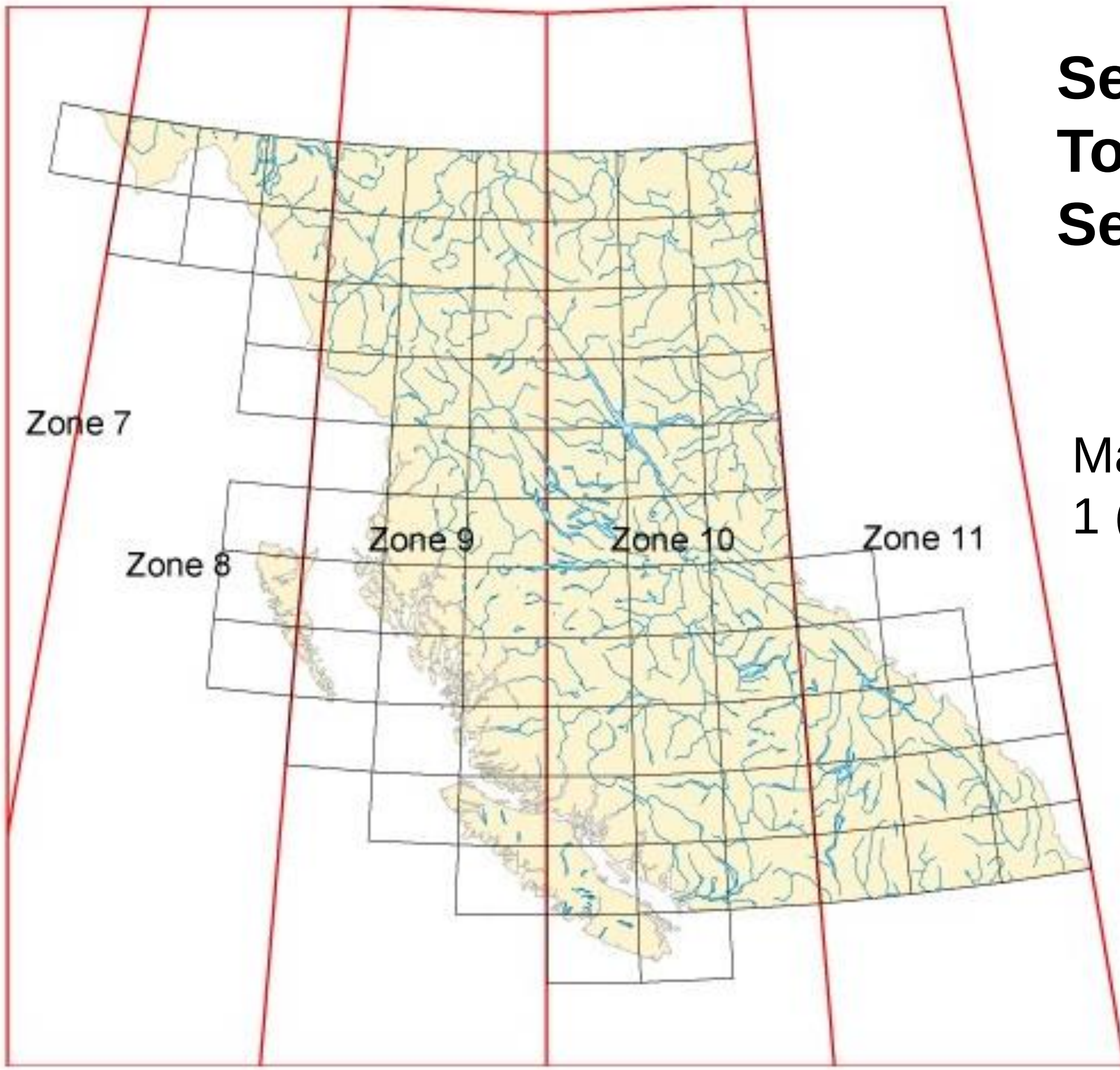
Canadian topographic mapping includes UTM and lat/long coordinates

Blue grid squares in this map are 1000m = 1km



UTM : Eastings are 6-digit, Northings are 7-digit (in Canada)

BC: UTM zones

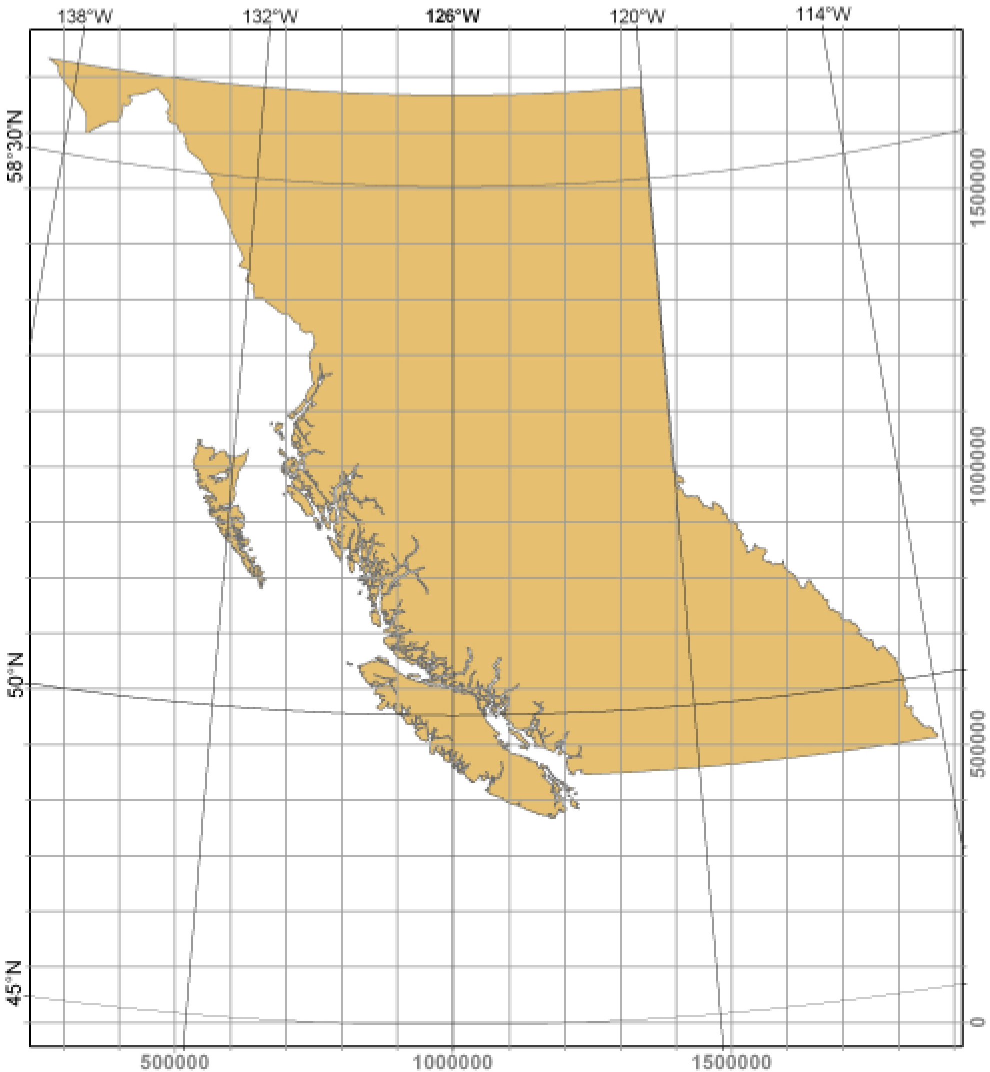


See google earth:
Tools-> options
Select UTM

Many provinces fit into 1 (or 2) UTM zones

How to deal with multiple UTM zones: Eastings switch from ~700,000 at the west edge of one zone to ~300,000 at the east edge of the next zone

BC Albers coordinate system



BC uses UTM for local areas

Albers for the whole province
As with UTM, also in metres

Unlike UTM, eastings and northings are often both 7-digit, Or both 6-digit or one of each.

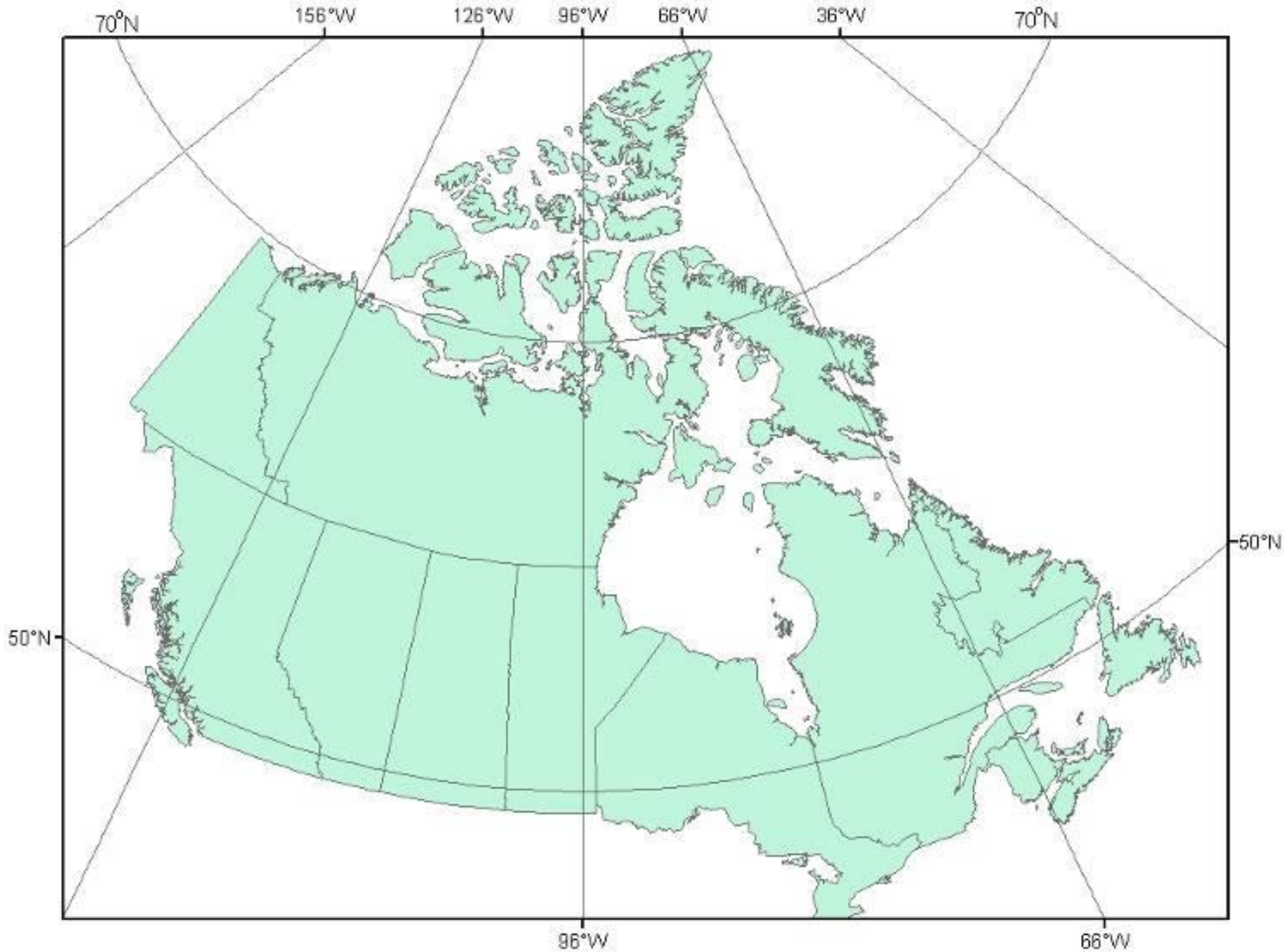
Developed by provincial ministry Forestry/Geomatics in Smithers

British Columbia Albers Equal Area Conic
Central meridian: -126.0 Degrees West longitude
Latitude of projection origin: 45.0 Degrees North latitude

126ºW = 1,000,000 Eastings
45ºN = 0 Northings

Canada Albers Equal Area Conic

Central Meridian: -96   Latitude Of Origin: 40



Download Canada map data using Geographic, Albers, UTM ... or Web Mercator (2019)

Summary: BC mapping coordinates

Could be one of:

1. Geographic – lat. / long. – global reference
2. UTM – zones 7-11 - local /regional mapping
3. BC Albers - BC provincial data
4. Canada Albers - Federal data

Why is it important – because we 'import' data from different sources .. and they need to line up

It makes more sense here : - view these at home or in lab

PGMAP: https://pgmap.princegeorge.ca/Html5Viewer/index.html?viewer=PGMap

UTM coordinates – or lat/long + web Mercator

BC IMAP: http://maps.gov.bc.ca/ess/hm/imap4m/

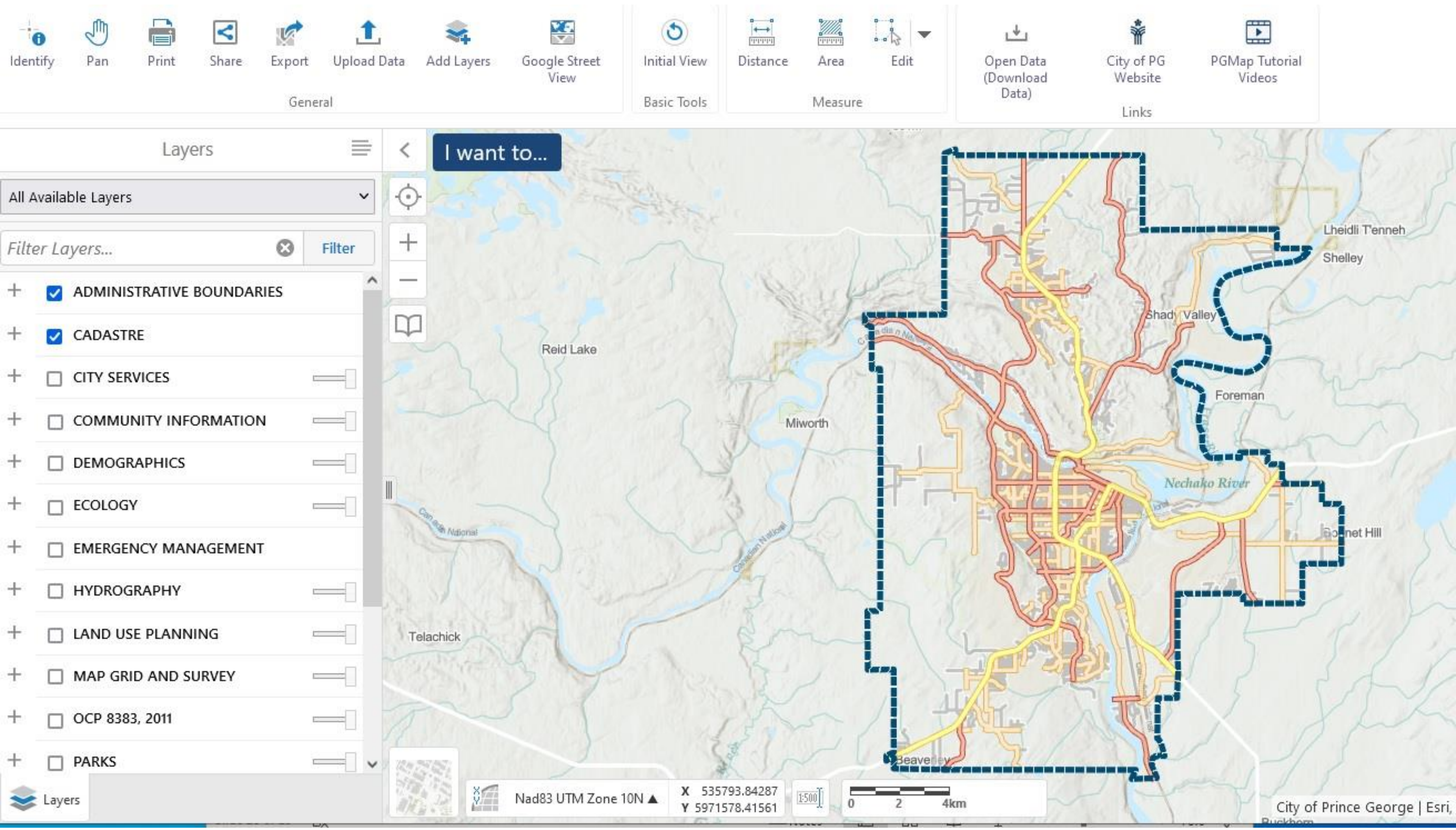
UTM, Lat/long and Albers

Google Earth: Lat/long and UTM

Natural Resources Canada and BC Forestry– UTM grid
https://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9779

UTM coordinates quiz on Moodle – today or Monday, due one week later

PGMap viewer



https://pgmap.princegeorge.ca/Html5Viewer/index.html?viewer=PGMap

The last 3 words on coordinates

https://what3words.com

Earth surface (510m km^2) is divided into (57 trillion) 3x3m squares, each coded by 3 unique word combination

Canadian rescue services:

https://what3words.com/news/emergency/three-words-to-tell-canadian-emergency-services-exactly-where-you-are

Lonely Planet

https://venturebeat.com/mobile/lonely-planet-adopts-what3words-geocoded-navigation-system-to-find-places-using-just-3-words/