### Coordinates - review: Latitude/Longitude (Geographic - Graticule)



Coordinates – review: Latitude/Longitude (Geographic - Graticule)



# Digital map data

Where do (base) map data and layers come from ? Mostly from aerial photography and surveying ... before 2000



# Traditional surveying: triangulation







Or by Chain and compass



Triangulation station

Geodetic station



The Great trigonometrical survey of India, 1802 – 1870



Since ~1945, our topographic mapping has used aerial photography: Air photos enabled a huge reduction in natural resources fieldwork costs, and increased how quickly and accurately large areas could be mapped



Ground points were still surveyed by field crews

Athabasca Glacier, 1958

### **Photogrammetry:** "the science of obtaining reliable measurements from photos"

Correction of distortions due to :

- airplane tip, tilt and swing
- radial and relief distortion



These are now corrected automatically with modern digital photography

### Aerial Photos -> <u>ORTHO</u>PHOTOS

Once corrected, and **georeferenced**, photos can be used for topographic mapping and also as a base layer, with map data overlain on top.

An orthophoto is a geometrically corrected aerial photograph that displays ground features in their true ground position with a constant scale in the image Ortho = 'straight' (Greek)

e.g. google maps, pgmap or BC- imap



BC provincial photography is redone every 10-30 years City photography: ~3 years (2023 most recently)

UNBC 2003

2006

2010



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

Map data can be traced or digitized from aerial photographs

# Digital (base) map data

- 1975-85 None available (a wee bit from CIA)
- 1985-95 Data generated but not yet available
- 1995-2005 Data there, but not always affordable
- 2005 -> Online map viewers e.g. Google Earth
- 2015 -> More data freely downloadable
- 2020 -> Online 'in the cloud' data portals

How has all this been assembled ...?

# **1. Scanning** maps -> .jpg or .pdf; not editable layers

Raster maps

a. 'print ready' Usually pdf

b.**Georeferenced** (with coordinates) e.g. geotiff

b. may be loaded on your GPS / iPhone



https://open.canada.ca/data/en/dataset/d248b5be-5887-4cfb-942f-d425d82e6ea9

# 2. Digitizing

Tracing lines on maps using a tablet with map taped down (pre 1995), ... or onscreen 'heads-up' 1995 ->





GIS technician jobs 1980s / 90s – all Canada topo maps digitised by 1995

Digitizing from printed maps

Purchase cost \$500 per map sheet free after 2007

### 3. Datasets a. Global data (small scale)

The largest scale for the whole world covered is 1:1,000,000. (1cm = 10km)
The <u>Digital Chart of the World</u> (DCW) was completed in 1993.
Digitised from the printed International Map of the World (IMW) maps
It is <u>not</u> suitable for mapping at larger scales.



**b.** Canada is divided into 1:1,000,000 sheets, numbered 1-117 Each is 8 ° longitude x 4 ° latitude, mapped by **1960** 

### National Topographic Series (NTS)

Digital: National Topographic DataBase (NTDB)

Small-scale



1:1,000,000 maps are divided into (16) 1:250,000 sheets, completed 1970



1:250,000 corresponds to 1 cm = 2.5 km

c. 1:250,000

Medium-scale

Digital: 1990

then into 16 x 1:50,000 (A-P), completed for provinces ~1994

d. 1:50,000 large-scale

BC: 1168 maps

Canada: 13,377

Digital 2005

Canada Completed 2012



BC: UTM zones and 1:250,000 (and 1:50,000) topographic maps



### NTS (National Topographic System) -> National Topographic Database (NTDB)

All Canada 13,377 maps:

- Printed NTS maps (Weller Library)
- Scanned map (pdf) -Raster image - 'printready' or georeferenced e.g. for GPS / background
- Digital layers online for mapping - every point, line, area feature manually digitised (but not all current)

.... e.g. only roads are updated PG: most data from 1982 1:50,000 Prince George: sheet 93G15



# The promise of digital mapping (since 1975)

Data for everyone ..... much are now free since ~2010

... but not always, varies by country / province / scale / data type

- 'Seamless' database ....post-2015: map sheet /Area of Interest (AOI)
- Frequent updating .... municipal, not provincial / federal

Errors of interpretation and change ... always with us

### Errors are possible before or after digital eras

- > Features are misinterpreted (e.g. UNBC Agora, and false trails)
- > Changes will make features out of date e.g. NSC, T+L building



#### Federal: NTS (analogue maps) -> NTDB (digital) - medium to large scale

### 1:50,000 and 1:250,000

Since spring 2007 freely downloadable from <u>geogratis.cgdi.gc.ca</u> August 2017: <u>https://maps.canada.ca/czs/index-en.html</u> by map sheet or Area of Interest (AOI)

Natural Resources Canada > Earth Sciences Sector > GeoGratis

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#### National Topographic Data Base (NTDB), Canada

The National Topographic Data Base (NTDB) comprises digital vector data sets that cover the entire Canadian landmass. Geomatics Canada has digitized and structured thousands of topographic maps, cr... [More details] [Documentation] [Data Discrepancies]

Access the FTP download directory in order to quickly download a large amount of data.

#### Search Datasets by Spatial Extents How to navigate?



#### BC has its own provincial data at 1:20,000 and is 'more recent' 1980s, 90s



### BC digital data - Terrain Resource Information Management (TRIM)

Onscreen from digital (stereo) photogrammetry (not digitized from maps) More 'current' and more detailed : 1:20,000 (from 1980s and 1990s)



#### Each 1:20 000 TRIM sheet is 6' latitude by 12' longitude.

124°W 122°W 54°N 093G.091 093G.099 093G.100 093G.092 093G.093 093G.095 093G.096 093G.098 093G.094 093G.097 093G.081 093G.082 093G.089 093G.090 093G.083 093G.084 093G.085 093G.086 093G.087 093G.088 093G.071 093G.073 093G.079 093G.080 093G.072 093G.074 093G.075 093G.076 093G.077 093G.078 093G.061 093G.062 093G.063 093G.068 093G.069 093G.070 093G.064 093G.065 093G.066 093G.067 093G.051 093G.052 093G.059 093G.060 093G.053 093G.054 093G.055 093G.056 093G.057 093G.058 093G.042 093G.048 093G.050 093G.041 093G.043 093G.044 093G.045 093G.046 093G.047 093G.049 093G.031 093G.032 093G.033 093G.034 093G.037 093G.038 093G.039 093G.040 093G.035 093G.036 093G.021 093G.022 093G.029 093G.030 093G.023 093G.024 093G.025 093G.026 093G.027 093G.028 093G.011 093G.019 093G.020 093G.012 093G.013 093G.014 093G.016 093G.017 093G.018 093G.015 093G.001 093G.002 093G.003 093G.004 093G.005 093G.007 093G.008 093G.009 093G.010 093G.006

53°N

53°N 124°W

54°N

122°W

# BC geographic data viewer 'imapBC'



https://maps.gov.bc.ca/ess/hm/imap4m/

# Spatial digital data: location and attributes

Map layers encode two different types of information:

a. Spatial location (where is it ?)

b. Attributes (what is it ?)

In GIS software, these data are stored in a single 'layer' but in multiple files - this differs from non-GIS software

e.g. Roads as a 'shapefile' (post 2000) roads.shp roads.dbf roads.shx x-y locations types of road index-link file contours.shp contours.dbf contours.shx

x-y locations

points.shp x-y locations contours.dbf heights

contours.shx index- link file

points.dbf p cabins, airport, viewpoint in

points.shx index- link file

#### http://bombsight.org



Locations from address file; bomb type from spreadsheet / database

### Municipal data - not always accessible (1:5,000)

PG data - since 2011: <u>https://data-cityofpg.opendata.arcgis.com/</u>



From digital aerial photography – downloadable from PG city site or UNBC GIS Lab

# Canada summary

Municipal data: sometimes available (check around)

Provincial 1:20,000 mapping (Bold = free download)
BC, AB, MB, ON (south = 50°N ), QC (south), NS, NB, PEI

## NTDB mapping only (1:50,000)

SK, NL, ON (north), QC (north) NT, NU, YT \*

- Yukon Geomatics: <u>http://www.geomaticsyukon.ca/</u>
- Canada: <u>http://canadiangis.com/data.php</u>

**Other countries:** highly variable - free download, high cost, military only

e.g. USA v Canada v UK

#### User generated data (by digitizing, GPS etc..): <u>http://www.openstreetmap.org</u>



# Data layers from ArcGIS onlineVia the Portale.g. living atlas of the worldhttps://livingatlas.arcgis.com



Many thematic layers - see thematic lectures

Canada census data: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

# New millennium map data creation:

- Digital aerial photography
- Satellite imagery (remote sensing)
- Global Positioning Systems (GPS)
- UAVs (drones)
- LiDAR

Online sources e.g. from GIS analysis