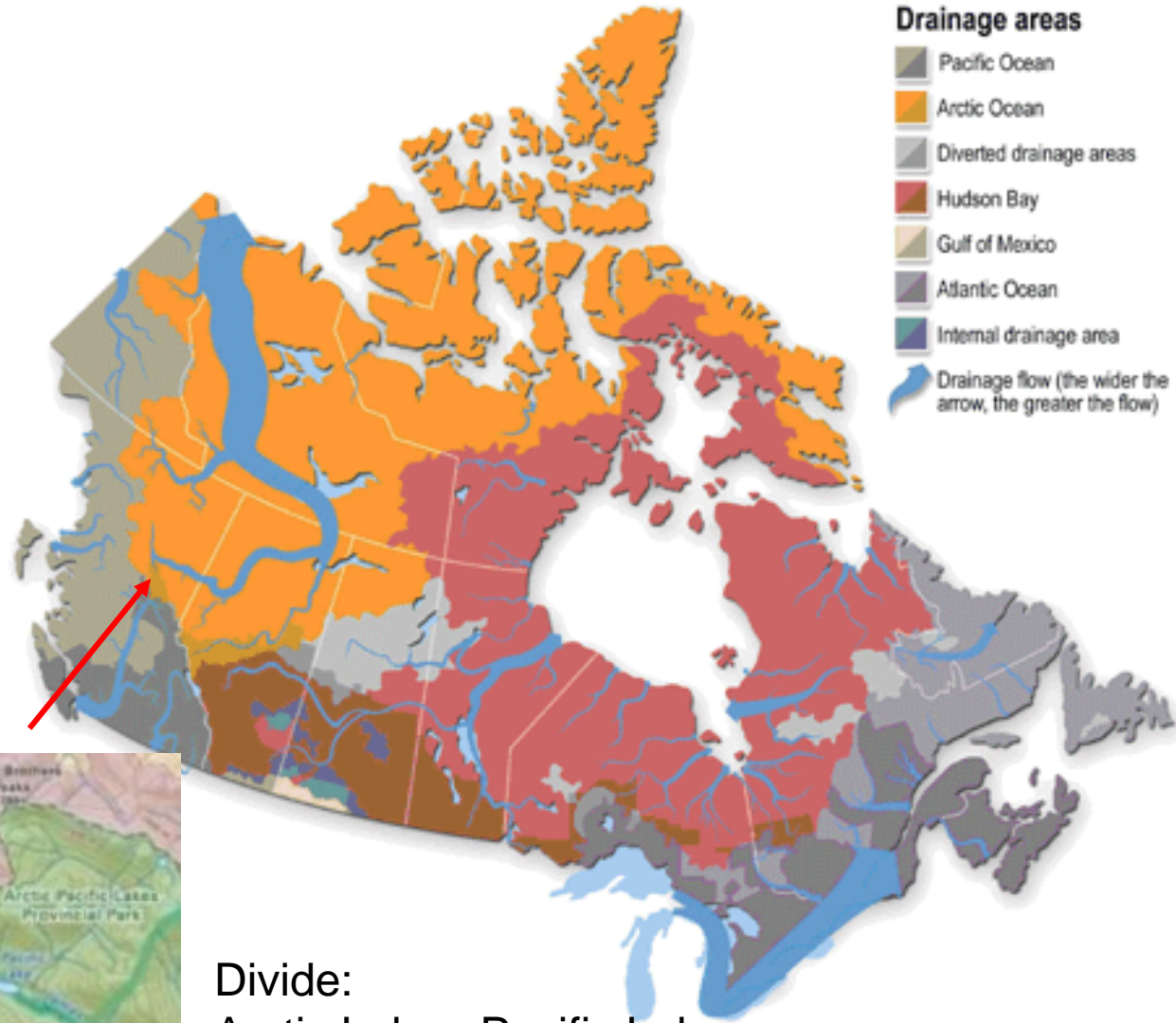# Thematic Line techniques: 1. Graduated line symbols:

(width=volume of water flow)   show **movement**   **(proportional)**


Canada's continental watersheds

Drainage areas
- Pacific Ocean
- Arctic Ocean
- Diverted drainage areas
- Hudson Bay
- Gulf of Mexico
- Atlantic Ocean
- Internal drainage area
- Drainage flow (the wider the arrow, the greater the flow)

Divide:
Arctic Lake - Pacific Lake
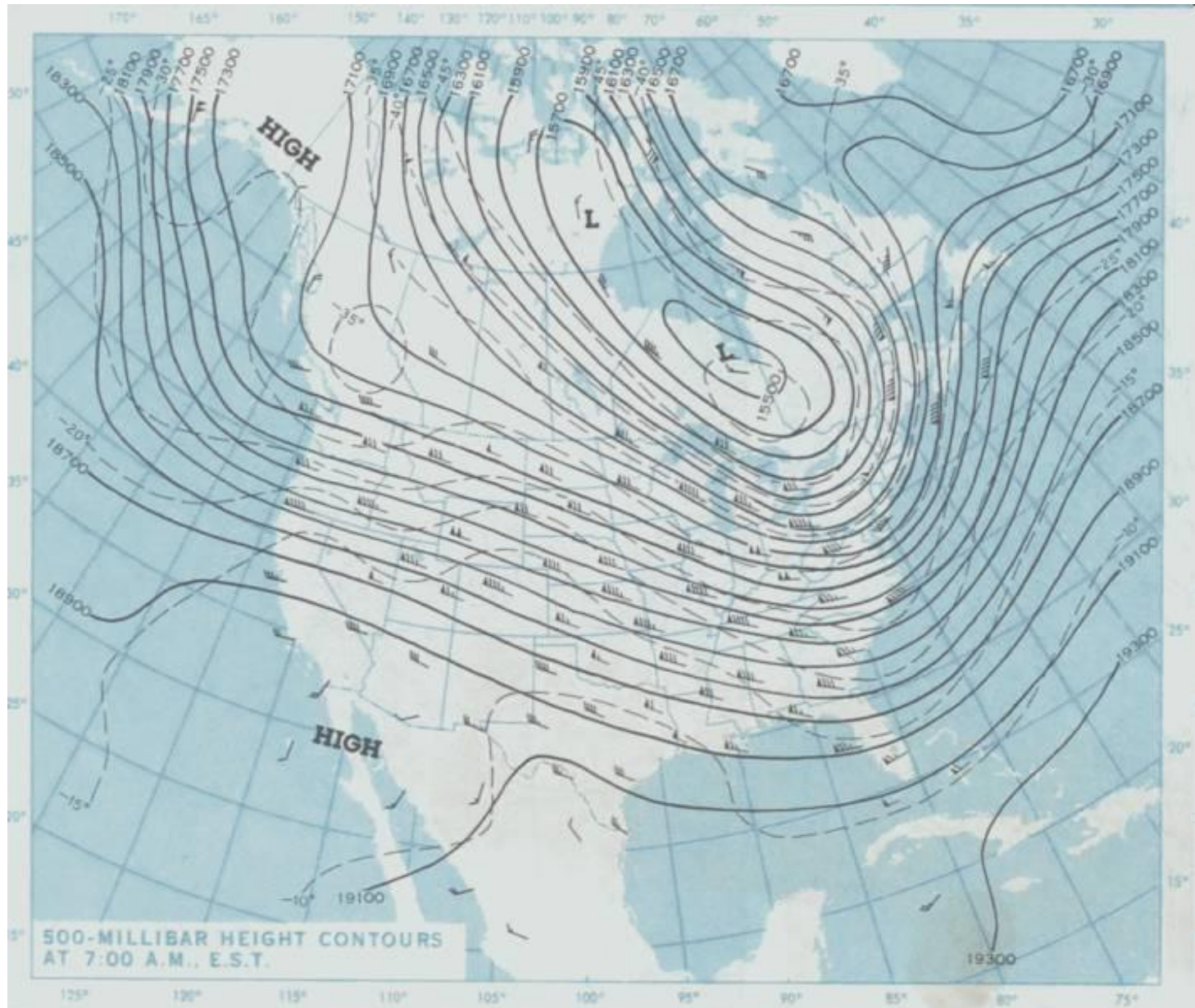
2. **Topological** Cartograms

These are based on shape (geometry) and **connectivity** e.g. route networks; distance is relatively unimportant; the classic examples are city underground and train maps,
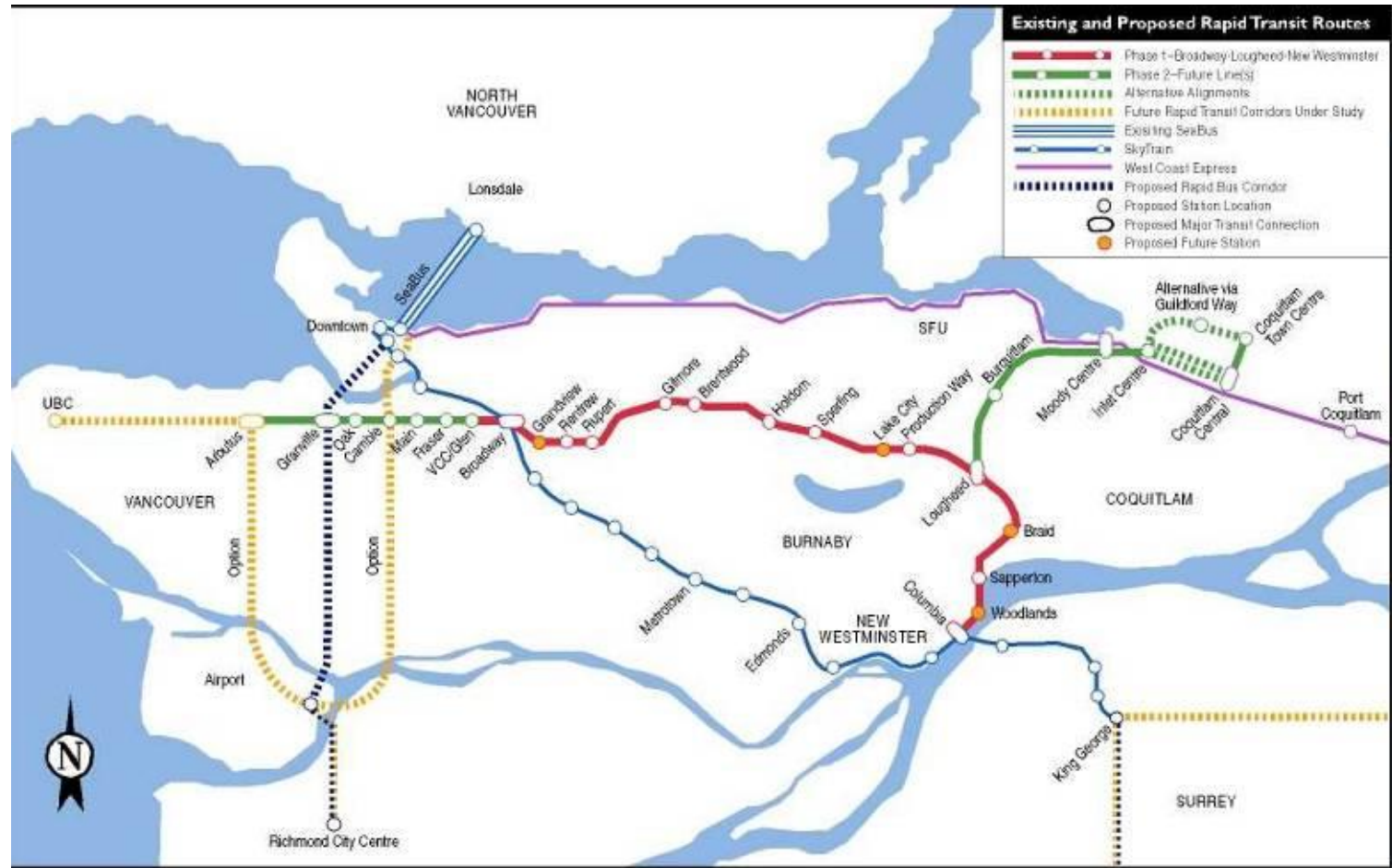
3. Isarithms (Isolines) - lines of equal value e.g. barometric pressure (isobars)

* Often created from point data

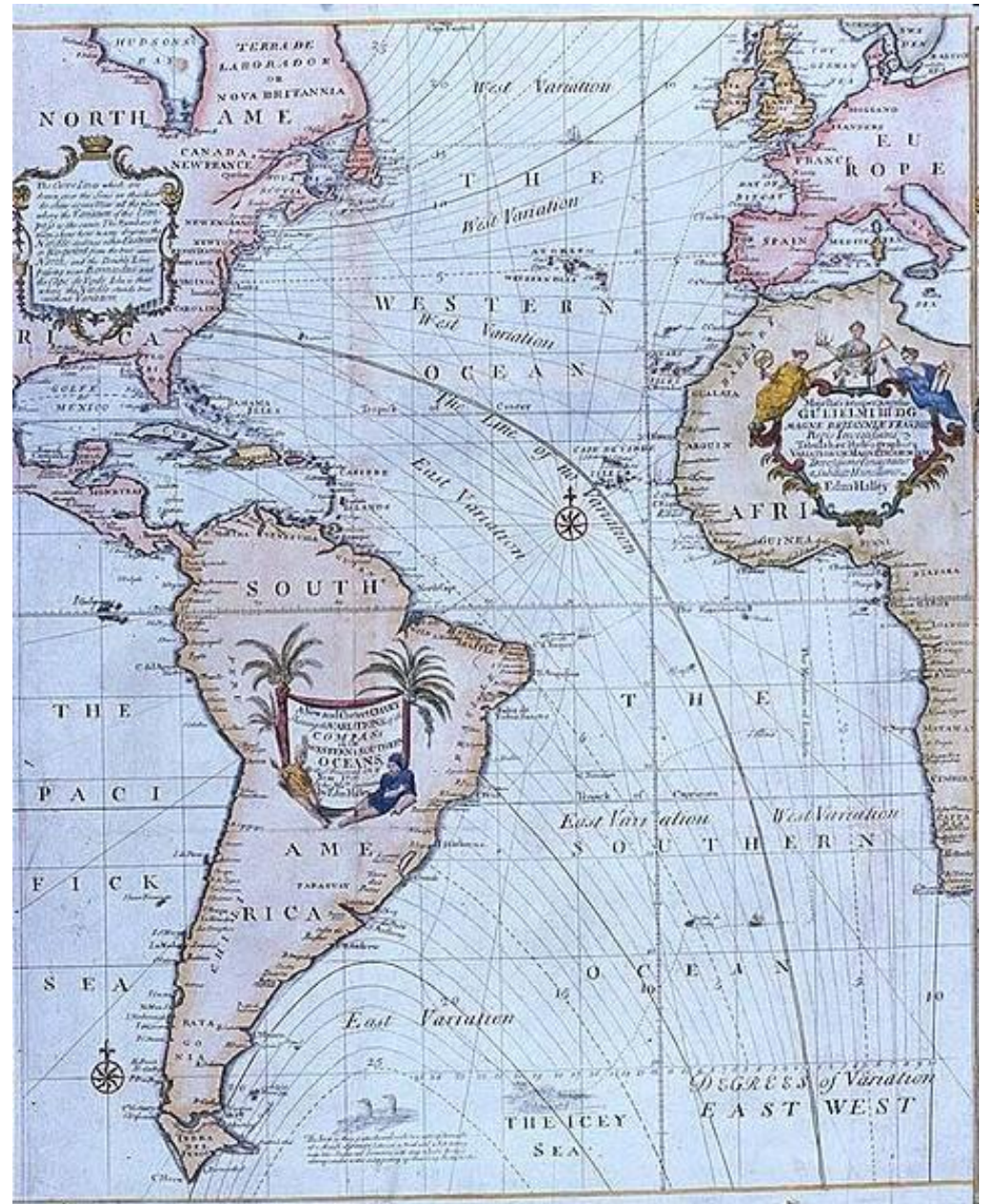500-MILLIBAR HEIGHT CONTOURS
AT 7:00 A.M., E.S.T.

Early thematic map:
Halley, Isogonic map 1701

Isogones:
 Lines of equal magnetic declination
= difference between true north and magnetic north

Some selected types of isarithms – mostly climatic

Isobath	depth below a datum (e.g. mean sea level)
Isogonic line	magnetic declination
Isocline	magnetic dip (inclination) or angle of slope
Isohypse (contour)	elevation above a datum (e.g., mean sea level)
Isodynamic line	value of intensity or a component of the intensity of the magnetic field
Isotherm	temperature (usually average)
Isobar	atmospheric pressure (usually average)
Isohyet	precipitation
Isobront	occurrence of thunderstorms
Isanther	time of flowering of plants
Isopag	duration of ice cover
Isodem	population
Isoamplitude	amplitude of variation (often of annual temperature)
Isoseismal line	number (or intensity) of earthquake tremors
Isochasm	annual frequency of aurorae

Isodynam	equal traffic tension
Isonoet	average degree of intelligence

Canadian wins world Scrabble title: Isogriv

CBC News Posted: Nov 08, 1999 7:50 AM ET Last Updated: Nov 08, 1999

A Montreal (McGill) music professor, Joel Wapnick, has won the World Scrabble Championship

Observers described Wapnick's opening move as "brilliant" ….because he used   all seven tiles to form the word   "**isogriv**"

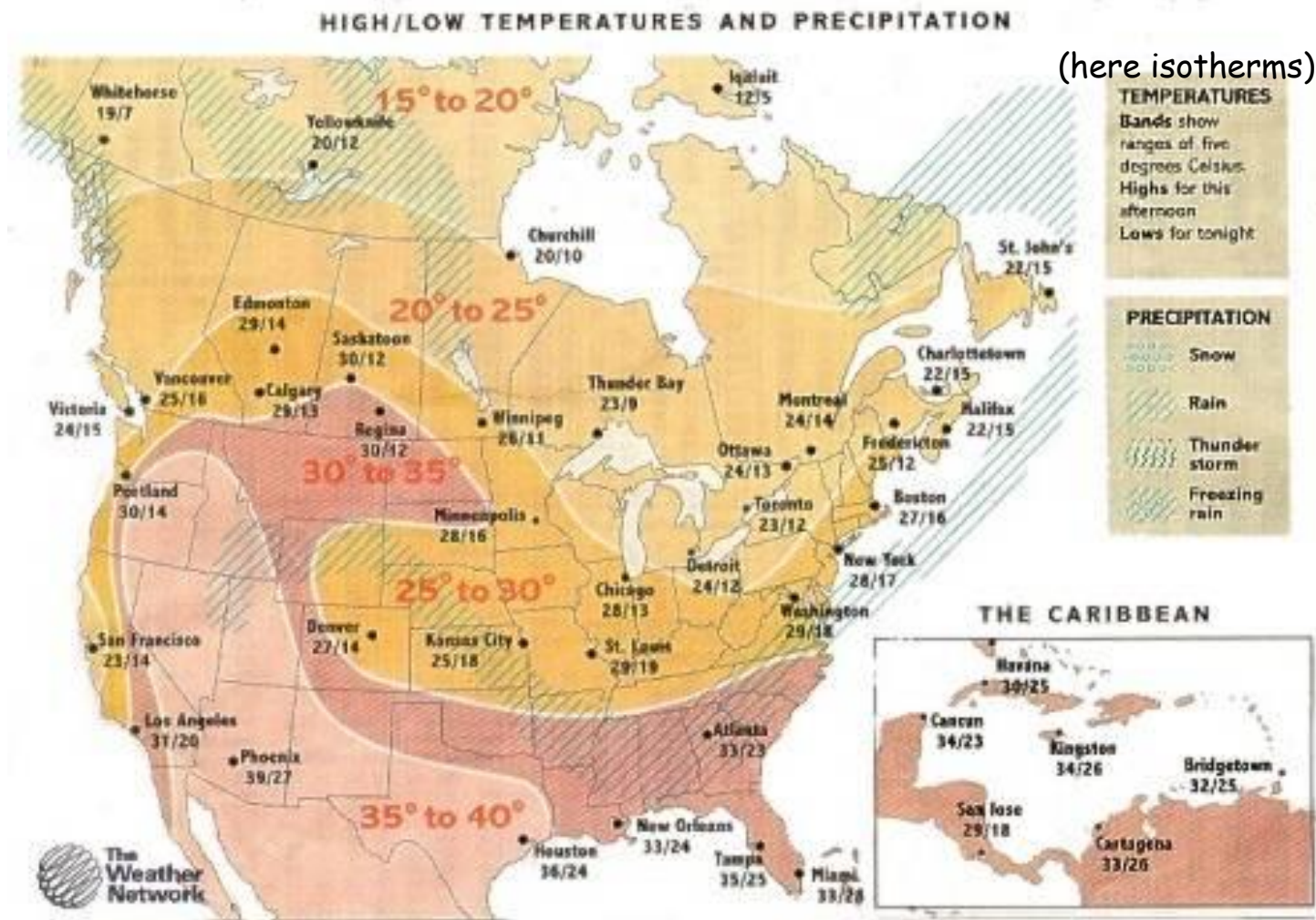 **= a line of equal declination between magnetic and grid north**

More than 100 players from 35 countries took part. Wapnick, won $22,500.

C. Thematic area maps: 1. Isopleths (Isarithms)

HIGH/LOW TEMPERATURES AND PRECIPITATION

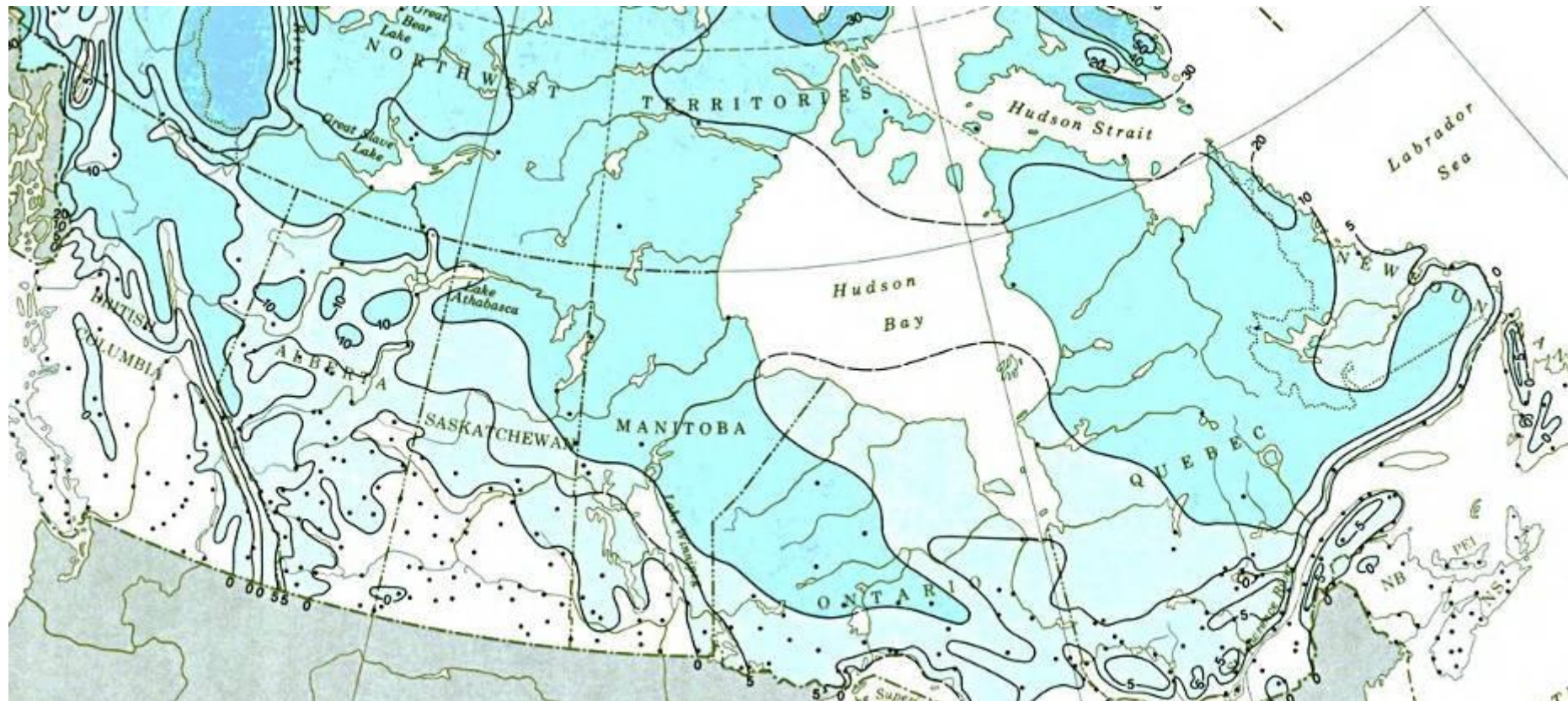(here isotherms)

colours selected according to the feature being mapped, e.g. blue & red for temperature, yellow for sunshine. Increased chroma are used for higher values

Isopleths

➤ Data are gathered by points and interpolated to make lines/areas

➤ This adapts a line technique - with ranges filled with colour tints

Average snow depth, Nov 15 … use of blue to suggest snow/cold

2. Qualitative (categorical) thematic area maps

VEGETATION

1	Cool coniferous forest.
2	Temperate mixed forest.
3	Warm temperate moist forest.
4	Warm temperate drought-resisting woodland.
5	Tropical forest.
6	Equatorial rain forest.
7	Grassland.
8	Savanna.
9	Hot desert.
10	Temperate desert.
11	Tundra.
12	Mountain vegetation.
	Ice Caps.

A great extent of ocean omitted here

Oxford Projection. Equal-Area. Scale 1:100 m. approx.   Copyright Oxford University Press.

The boundaries can be subjective and should not be interpreted as 'hard lines'.

Terrestrial ecozones

- Arctic Cordillera
- Northern Arctic
- Southern Arctic
- Taiga Plains
- Taiga Shield
- Boreal Shield
- Atlantic Maritime
- Mixedwood Plains
- Boreal Plains
- Prairies
- Taiga Cordillera
- Boreal Cordillera
- Pacific Maritime
- Montane Cordillera
- Hudson Plains
- Tundra Cordillera
- Semi-Arid Plateaux
- Atlantic Highlands

Canada

0   250   500   1,000 Kilometers

3. Thematic mapping – choropleth = 'magnitude at place'
One value per 'collection unit' (here each country)   Corruption

VERY CLEAN

	9.0 - 10
	8.0 - 8.9
	7.0 - 7.9
	6.0 - 6.9
	5.0 - 5.9
	4.0 - 4.9
	3.0 - 3.9
	2.0 - 2.9
	1.0 - 1.9
	0 - 0.9
	No Data

HIGHLY CORRUPT
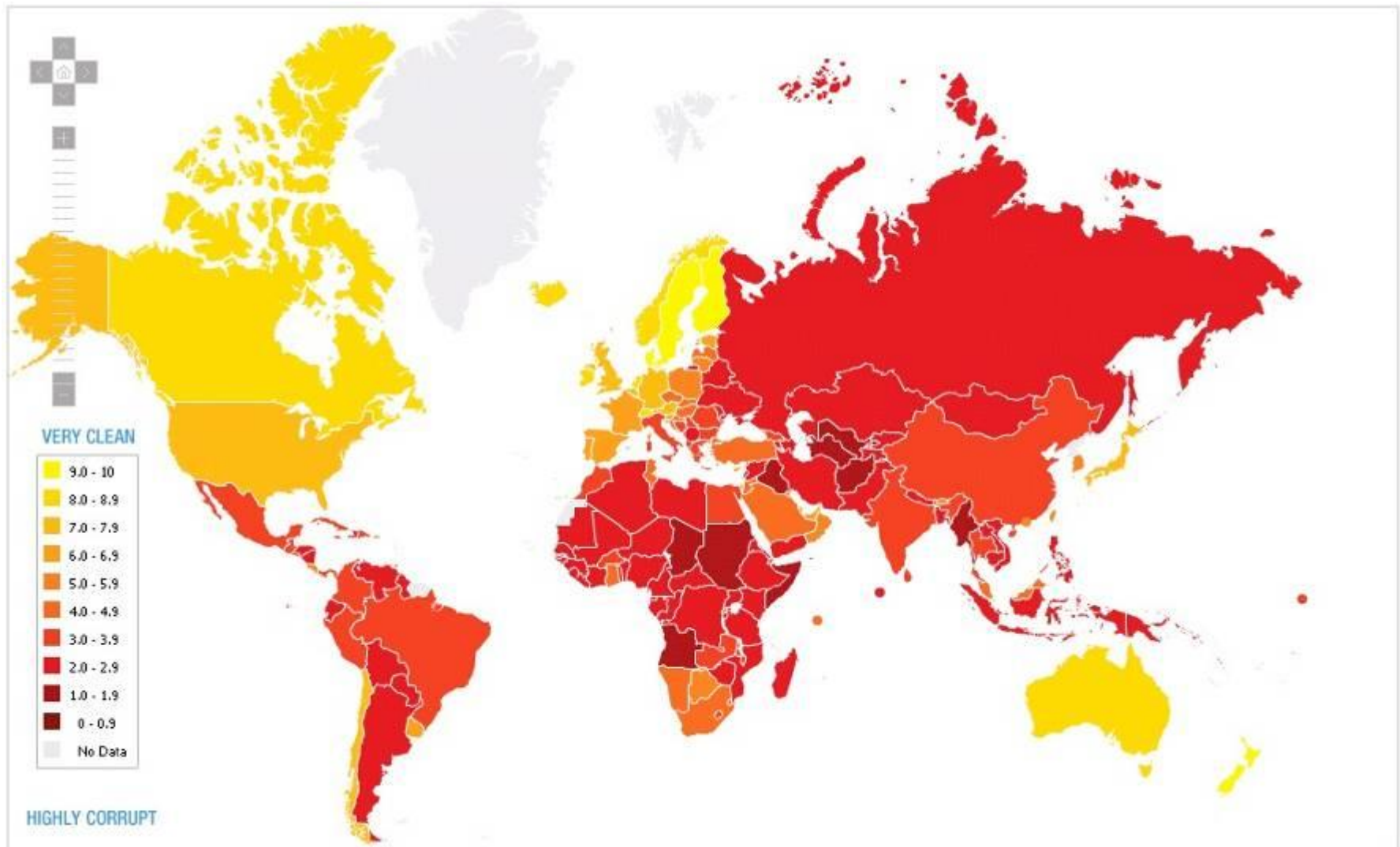
http://transparency.org/policy_research/surveys_indices/cpi/2010/results

Choropleth maps = 'magnitude at place'

Population Density by Census Division (persons / square kilometre)

	Less than 0.1
	0.1 – 0.9
	1.0 – 3.5
	3.6 – 19.9
	20.0 – 49.9
	50.0 – 150.0
	Greater than 150.0

☐ **Selected Populated Place Names**

☑ **Capital Cities**

⊛ National: Ottawa

⊛ Provincial / Territorial

☐ **Roads**

☐ **Railways**

Boundaries

⁄Ν⁄ International

⁄Ν⁄ Provincial / Territorial

With 3.5 persons per square kilometre, Canada is one of the countries with the lowest population densities ...
Read more about this map

close this text box ⊠

Whitehorse

Yellowknife

Edmonton

Victoria

Regina

Winnipeg

PACIFIC OCEAN

Tones or chroma are used to depict values in classes with logical ranges.

Movers
(Number of CTs)

■ 50% +	(23)
■ 25% to < 50%	(83)
■ 10% to < 25%	(88)
■ < 10%	(50)
■ Not available	(143)

VANCOUVER CMA
Change of residence, 1 year ago,
as a proportion of total aboriginal identity population
by 2001 Census Tract*

* Census Tracts have a minimum of 50 persons reporting Aboriginal identity
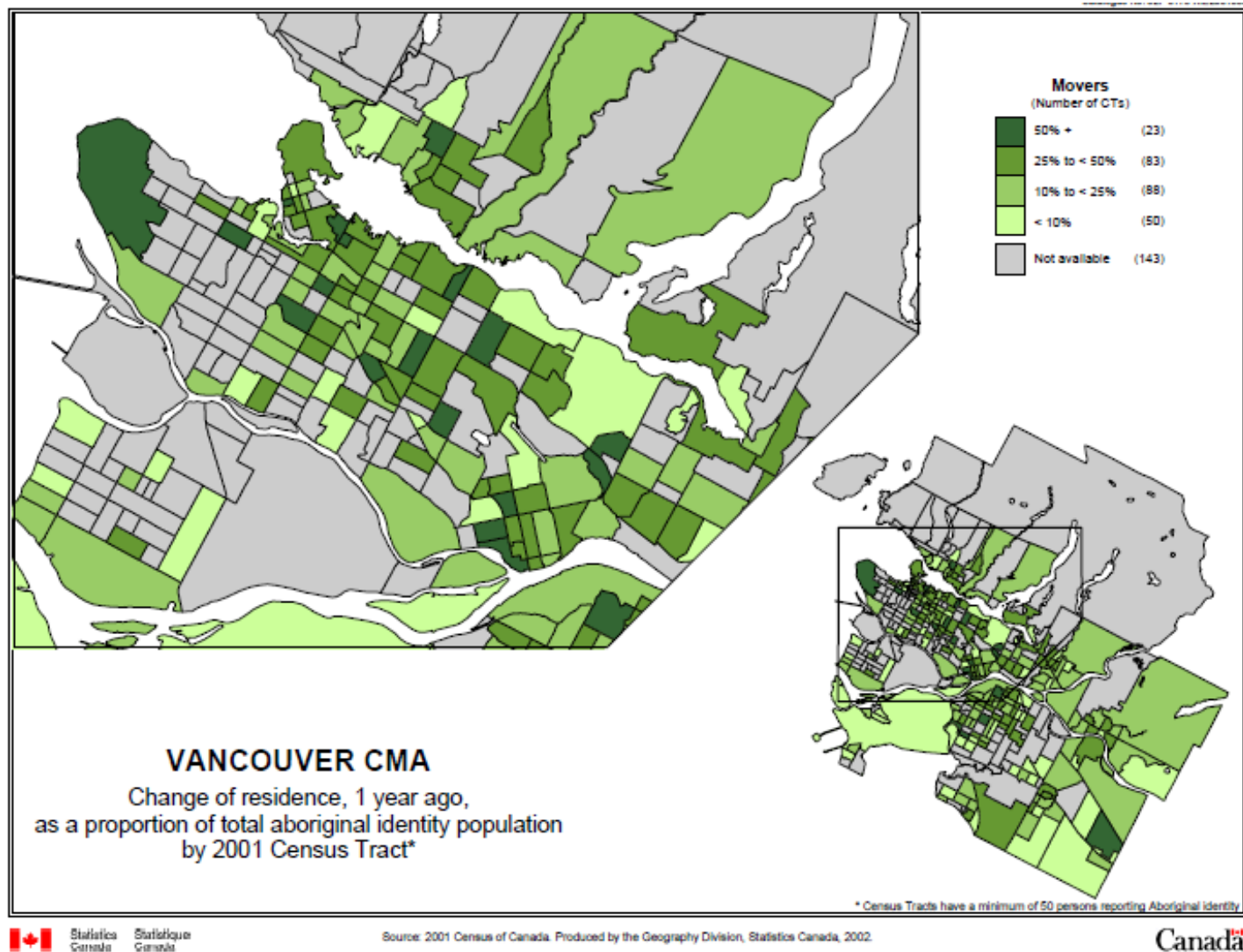
Choropleth maps show data from collection units such as census districts or larger areas. They map intensity, e.g. % more than numbers.
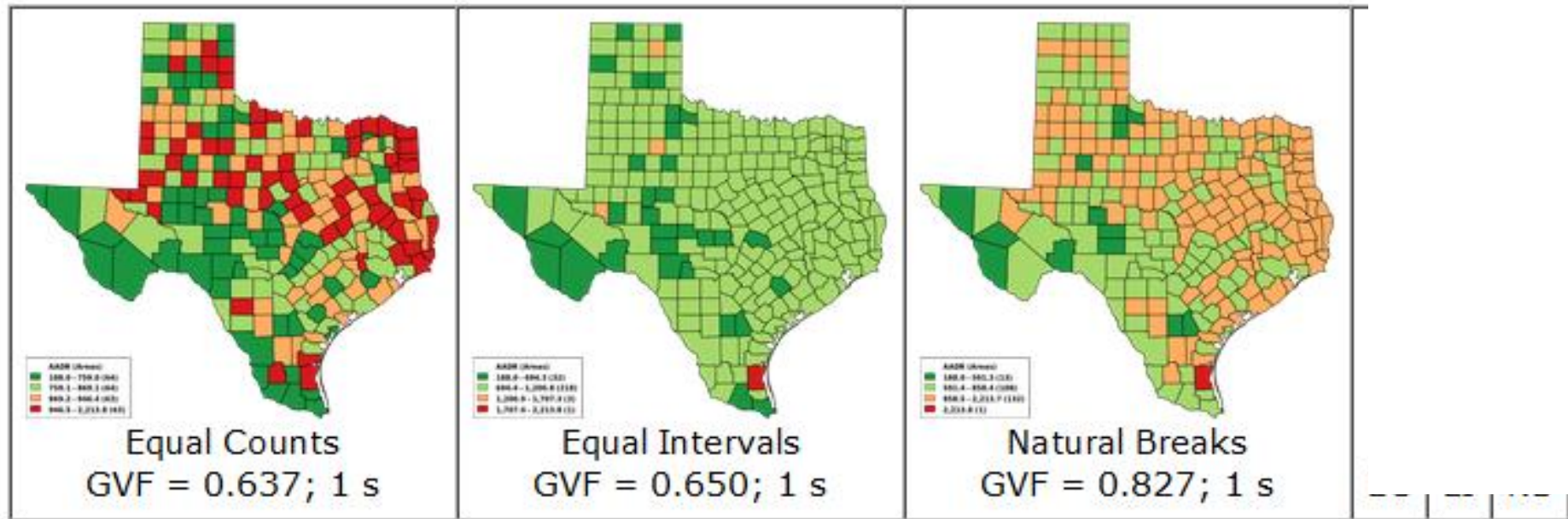
Design of Choropleth Classes

On Isarithmic maps, the intervals are even ('equal-steps');

But for choropleth maps:
the class ranges may be changed to match the data distribution
Often 'equal intervals' give too many values in one class (see below)

TX 2005 Age Adjusted Death Rate, 4 Ranges

| Equal Counts	Equal Intervals	Natural Breaks
GVF = 0.637; 1 s	GVF = 0.650; 1 s	GVF = 0.827; 1 s

General class design goals:

➤ maximize difference between classes and minimize contrast within classes

➤ minimize or eliminate empty classes and avoid too many values in one class

Schemes include these options:
e.g. 5 classes

➤ **Equal steps** 0 –10 –20 –30 -40

➤ **Geometric** 2- 4 –8 –16 –32(64)

➤ **Quantiles** (equal counts)
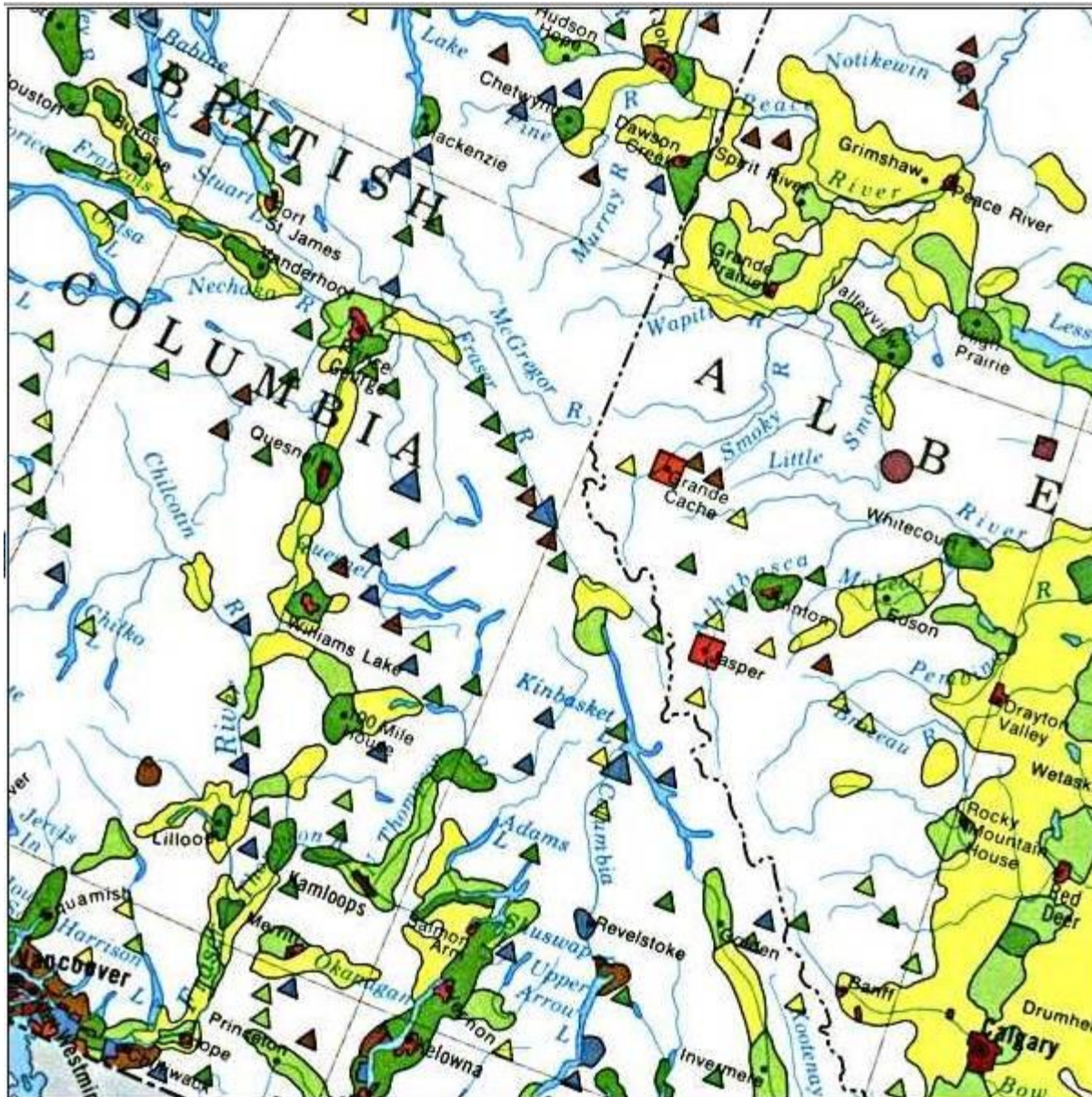 2 - 4 - 7.5 - 10.4 - 40

➤ **Natural breaks**
  2 – 4 – 6 – 15 - 40

2.0	4.4	7.6	10.5
2.7	4.8	7.7	14.1
3.3	4.9	7.9	19.1
3.4	5.3	9.0	22.6
3.5	7.2	10.4	39.8
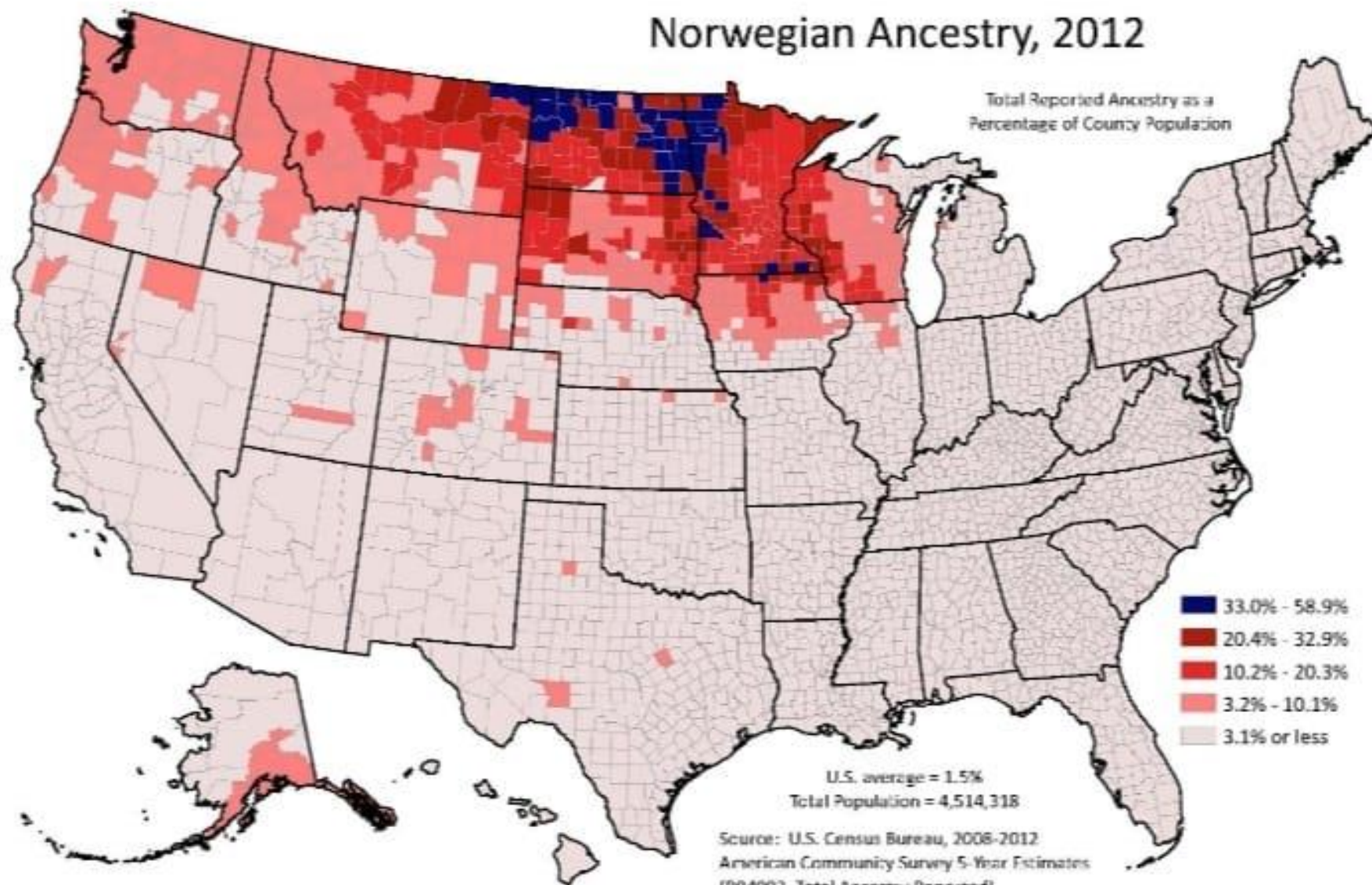
4. Dasymetric = 'measure of density'

Dasymetric maps depict intensities

e.g.%, ratios, densities.

They involve analysis beyond admin.districts;

i.e. they do not assume homogeneity within districts.

Most commonly applied to population density maps;
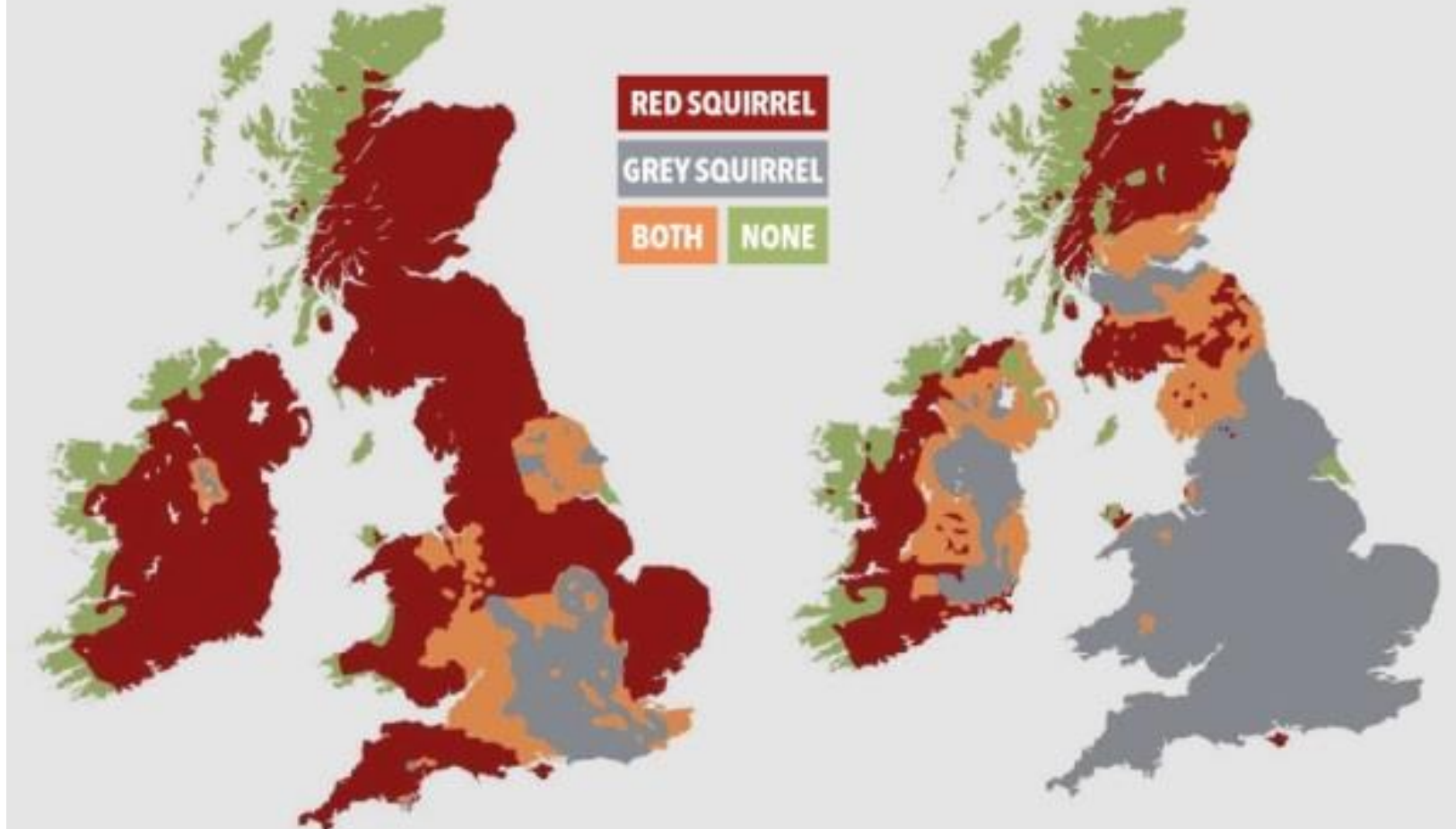
Unlike isopleths, lines do not have exact values

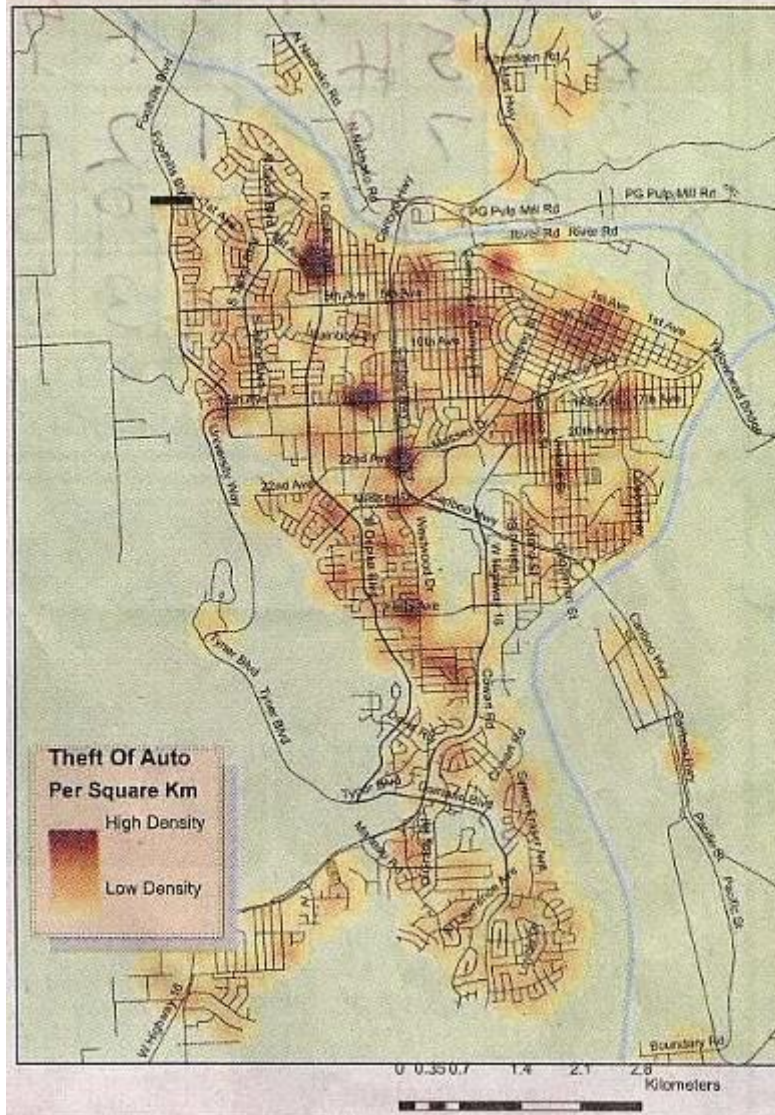# Consequences of importing the larger grey squirrel from North America

1945

RED SQUIRREL
GREY SQUIRREL
BOTH   NONE

2010

Prince George Citizen   'Heat map'   PG week review

Density map showing auto thefts in Prince George
Jan. 1, 2005 to Sept. 30, 2006

Theft Of Auto
Per Square Km
High Density

Low Density

0 0.35 0.7   1.4   2.1   2.8
Kilometers

Density map showing auto thefts
in Prince George
Jan. 1, 2005 to Sept. 30, 2006

Theft Of Auto
Per Square Km
High Density

Low Density

0 0.35 0.7   1.4   2.1   2.8
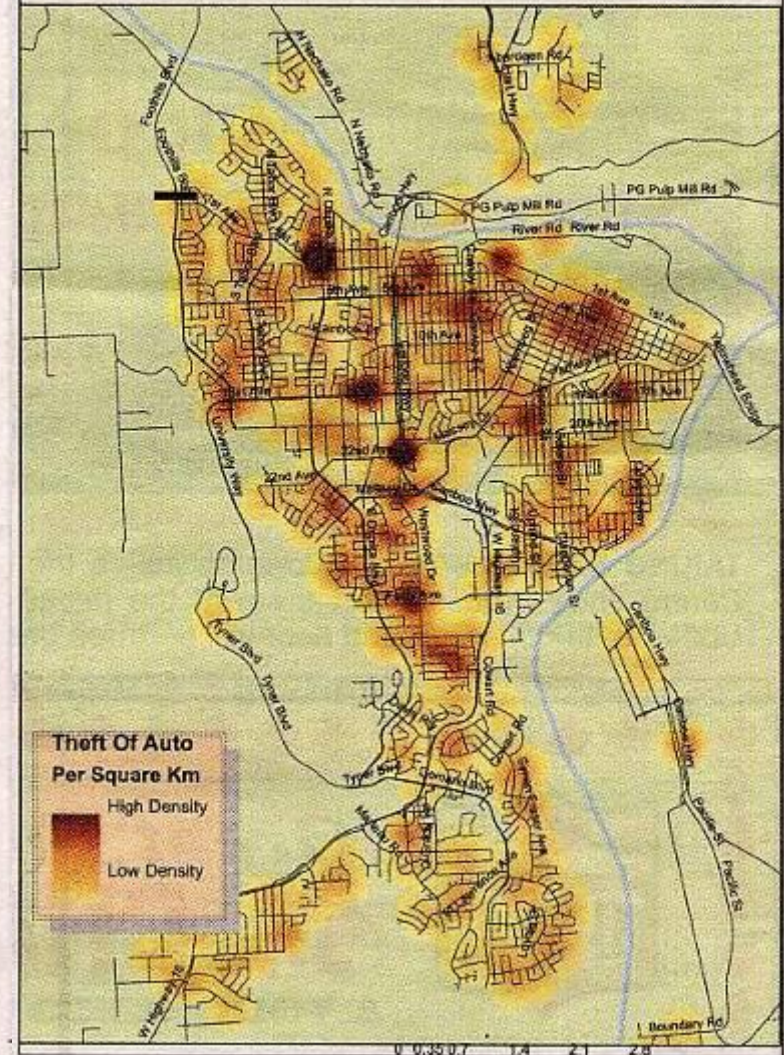
Ordinal
data

5. **Topograms** can avoid the need to create classes, using height

Population density
- 5000 +
- 2500 - 5000
- 1000 - 2500
- 500 - 1000
- 250 - 500
- 100 - 250
- 50 - 100
- 25 - 50
- 0 - 25

2022

Similar data

NEWCASTLE UPON TYNE
LEEDS
SHEFFIELD
NOTTINGHAM
LIVERPOOL
LEICESTER
LONDON
MANCHESTER
BIRMINGHAM
BRISTOL
BRIGHTON
PLYMOUTH
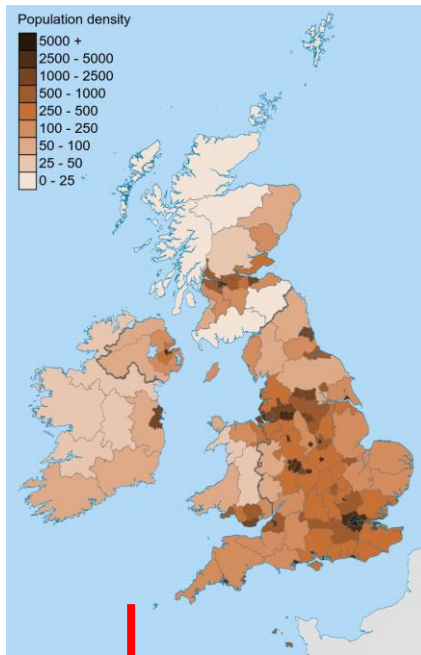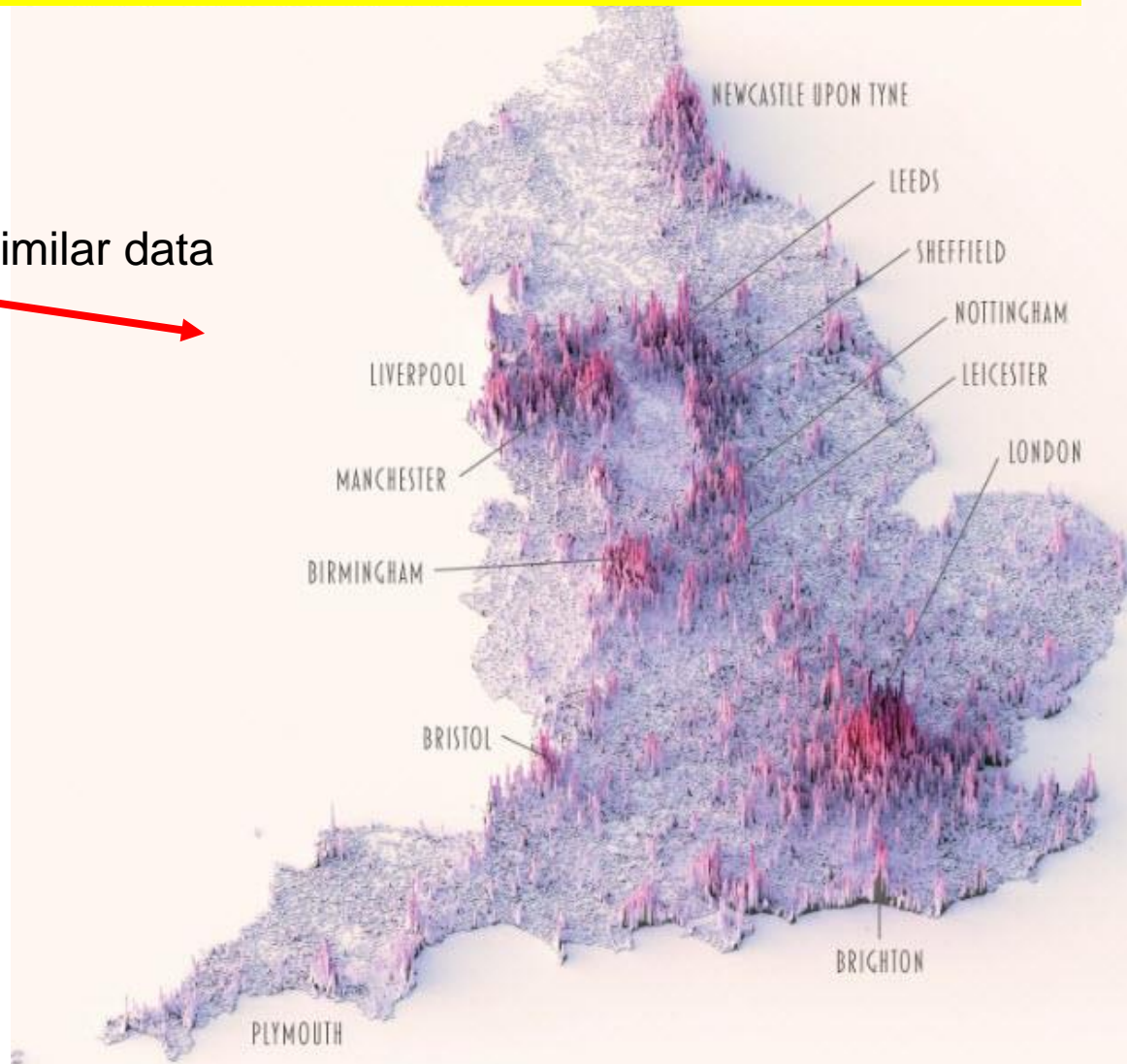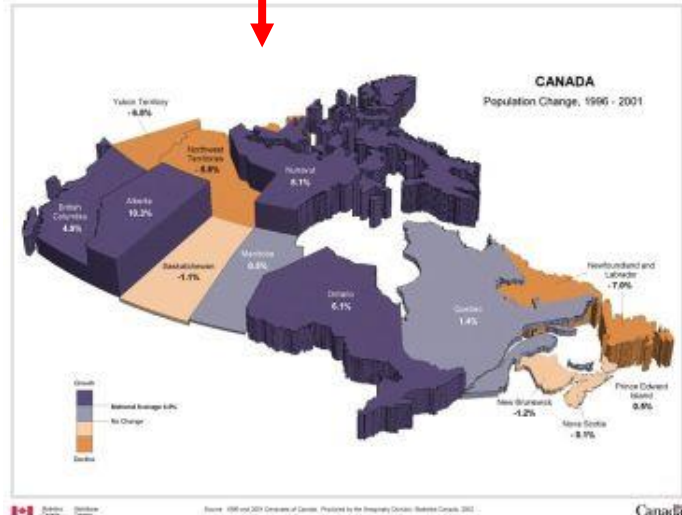
VISUALISED BY @TERENCE@FOSSTODON.ORG IN RSTATS
WITH RAYSHADER (@TYLERMORGANWALL)

KONTUR POPULATION 2022

CANADA
Population Change, 1996 - 2001

Canada

Topogram technique applied to isarithmic data (bivariate – 2 variables)
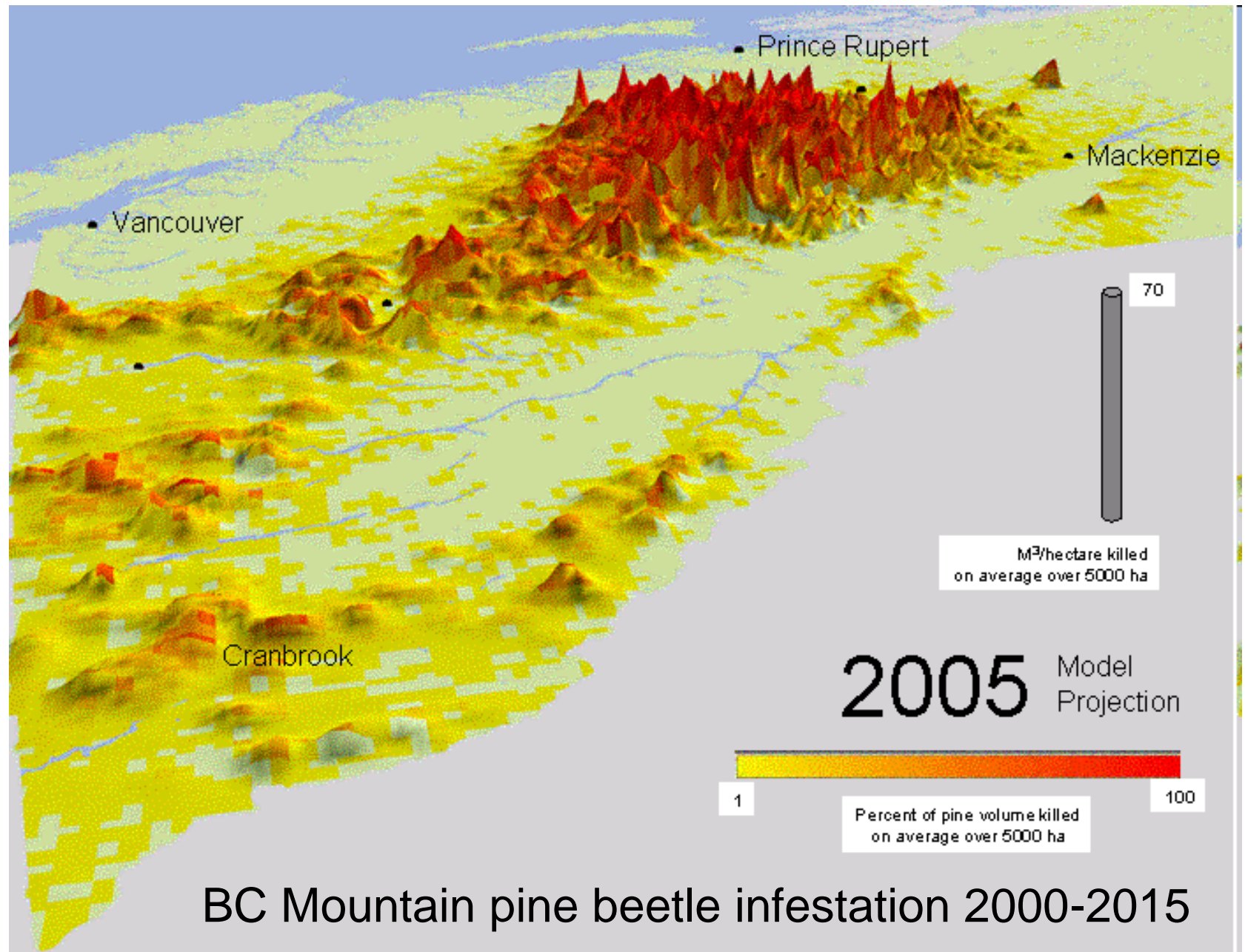
BC Mountain pine beetle infestation 2000-2015

6. Value-by-area cartograms

a cartogram has no 'cartesian' scale - but here, area is based on **another geographic variable**

World population

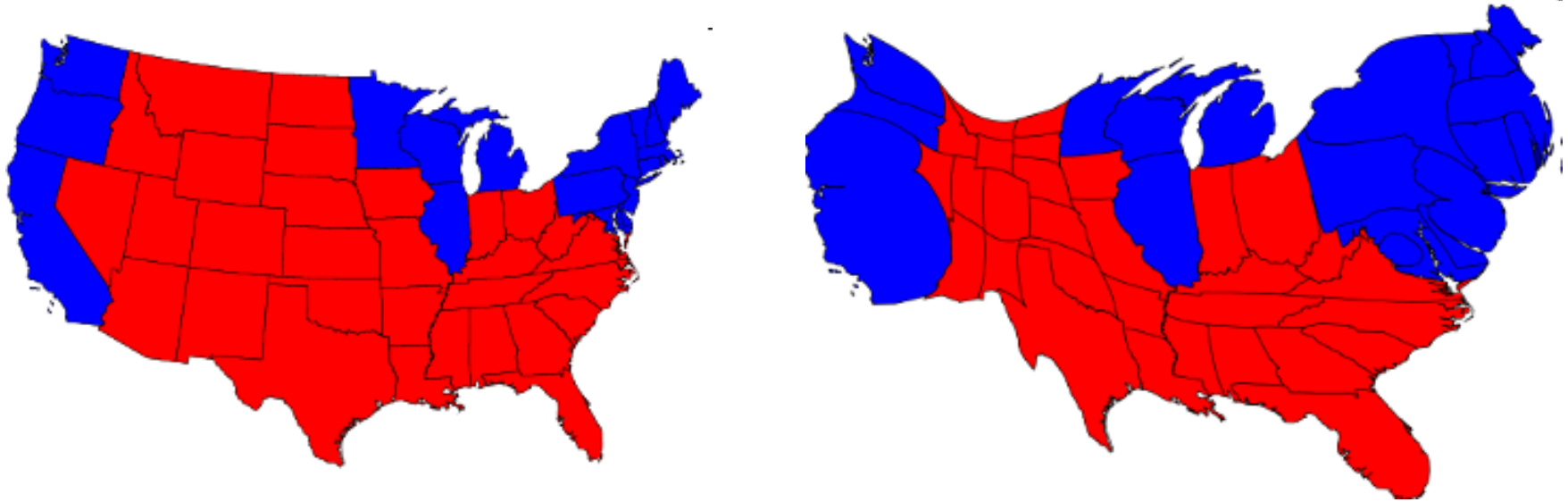**Design principles:**
➢Area scale accurately represents a selected variable
➢Regional Contiguity is maintained
➢Shapes should remain recognisable (if possible)

Value by area cartograms: USA election results

US election results: 2012   **2008**

Cartogram software: http://scapetoad.choros.place

https://www.arcgis.com/home/item.html?id=d348614c97264ae19b0311019a5f2276

US Presidential Election 2020

Results mapped at county level showing the candidate with the largest vote share in each area

Preliminary results*

Biden
78,780,121 votes (50.9%)
306 electoral votes

Trump
73,163,140 votes (47.3%)
232 electoral votes

Vote share of candidate with most votes

0   50   70   90%   Biden

Trump
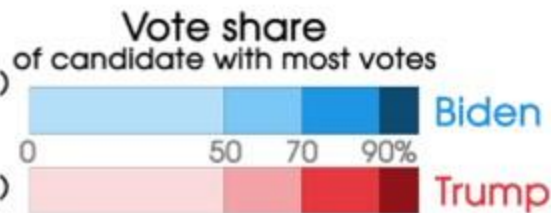
* not confirmed final result, last updated 16. Nov 2020
Source https://github.com/favstats/USElection2020-NYT-Results/

Alaska and Hawaii showing state-level outcomes

Gridded population cartogram:
areas resized according to
the total number of people living there
(Alaska and Hawaii not included)

Seattle, San Francisco, Los Angeles, San Diego, Phoenix, Denver, Dallas, Houston, Chicago, Detroit, Atlanta, Miami, Washington D.C., New York City

Land doesn't vote:
People do ..

WORLD MAPPER
www.worldmapper.org

2016

Question asked: **"Should the UK remain a member of the European Union or leave the European Union?"**

a and vote share

Remain
Leave

70   75   80

Orkney & Shetland
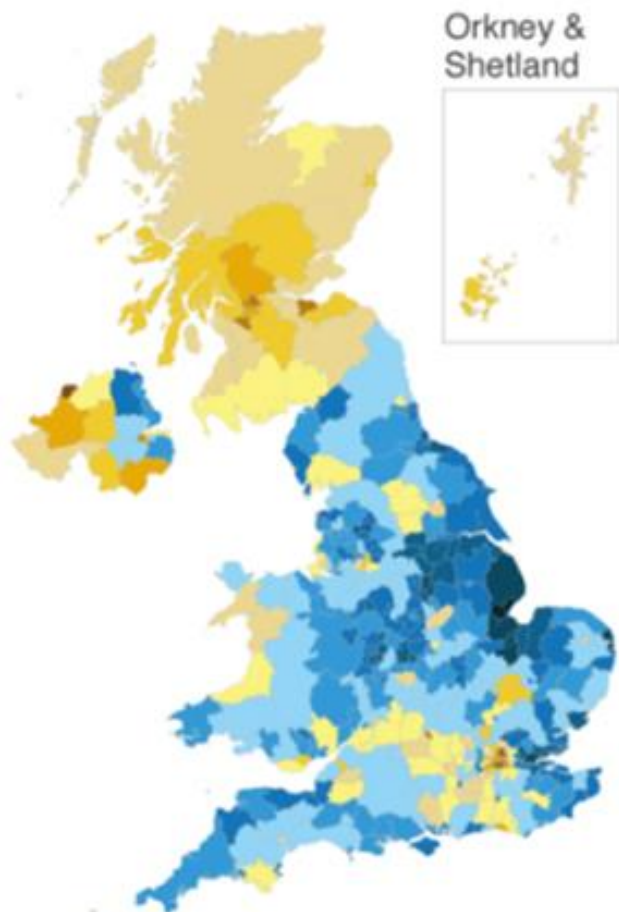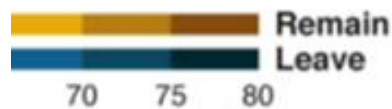
EU Referendum
A Divided Kingdom

Remain vs Leave

70% 60% 50:50 60% 70%

Map showing electoral areas shaded by the share of votes for remaing in / leaving the European Union.
The basemap is a cartogram transformation where each area is resized according to the total electorate in that area.
Some areas are labeled for orientation.

Total electorate:
46,500,001
Total votes:
33,577,342

Turnout: 72.2%

Data Source: UK Electoral Commission (2016)

Not shown in this map: Gibraltar
Remain 95.9%, Leave 4.1%
Turnout: 83.6%
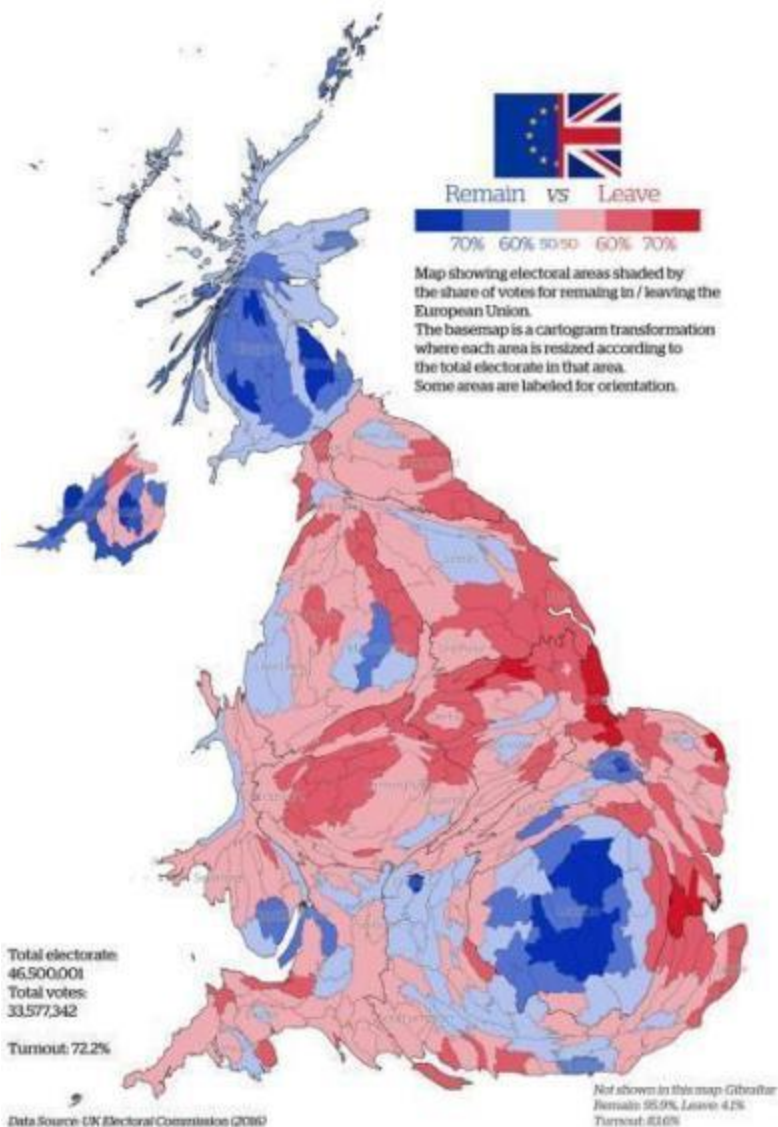
Canada's Federal Election Districts

Sized (approximately) by population
Shaded by population density
Colored by province

DAILY KOS ELECTIONS
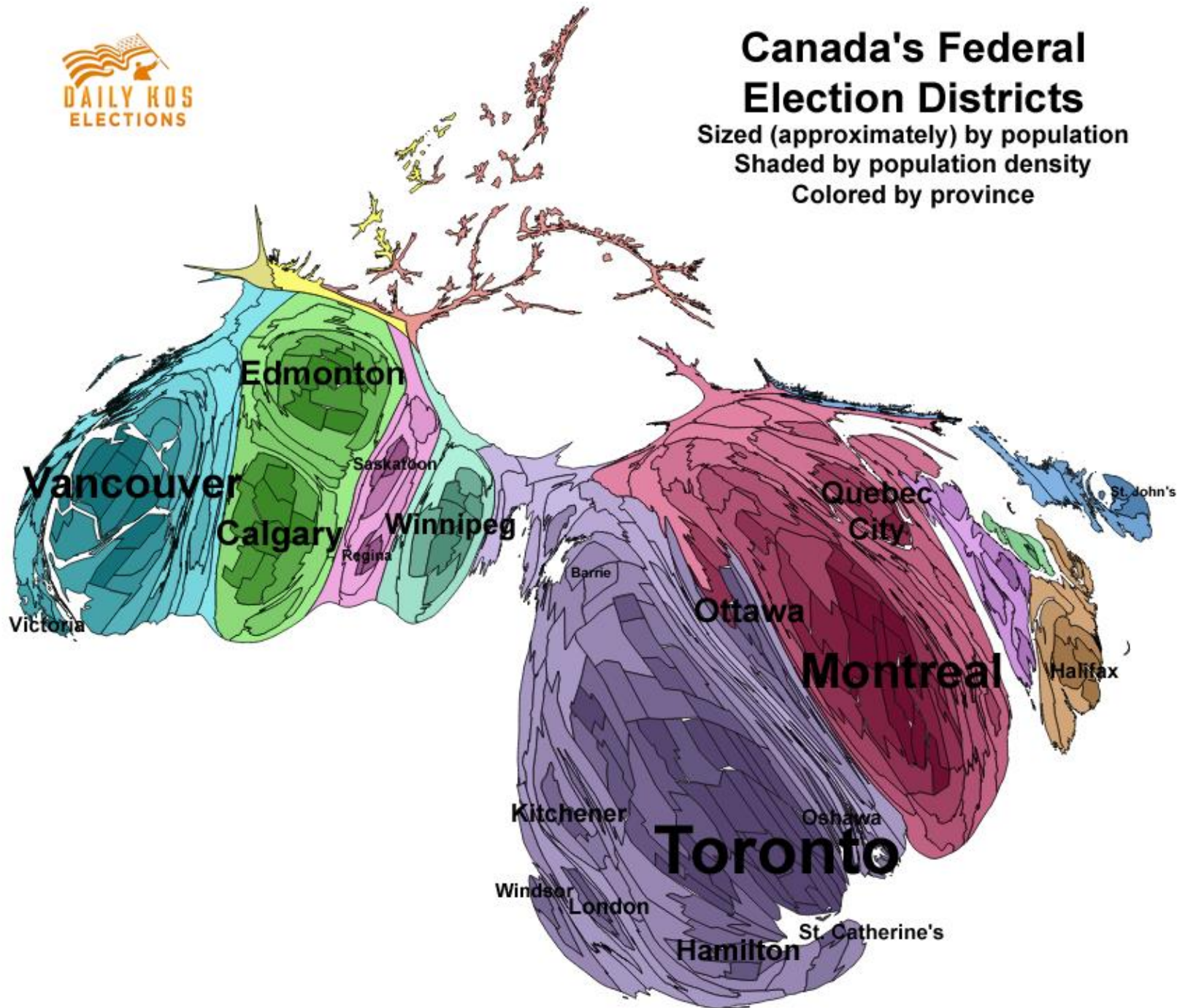
Canada's 2015 Federal Election Results

Districts sized approximately by population
99.8% reporting

DAILY KOS ELECTIONS

	Percent	Seats
Liberal	39.5%	184
Conservative	31.9%	99
NDP	19.7%	44
BLOC Québécois	4.7%	10
green	3.4%	1
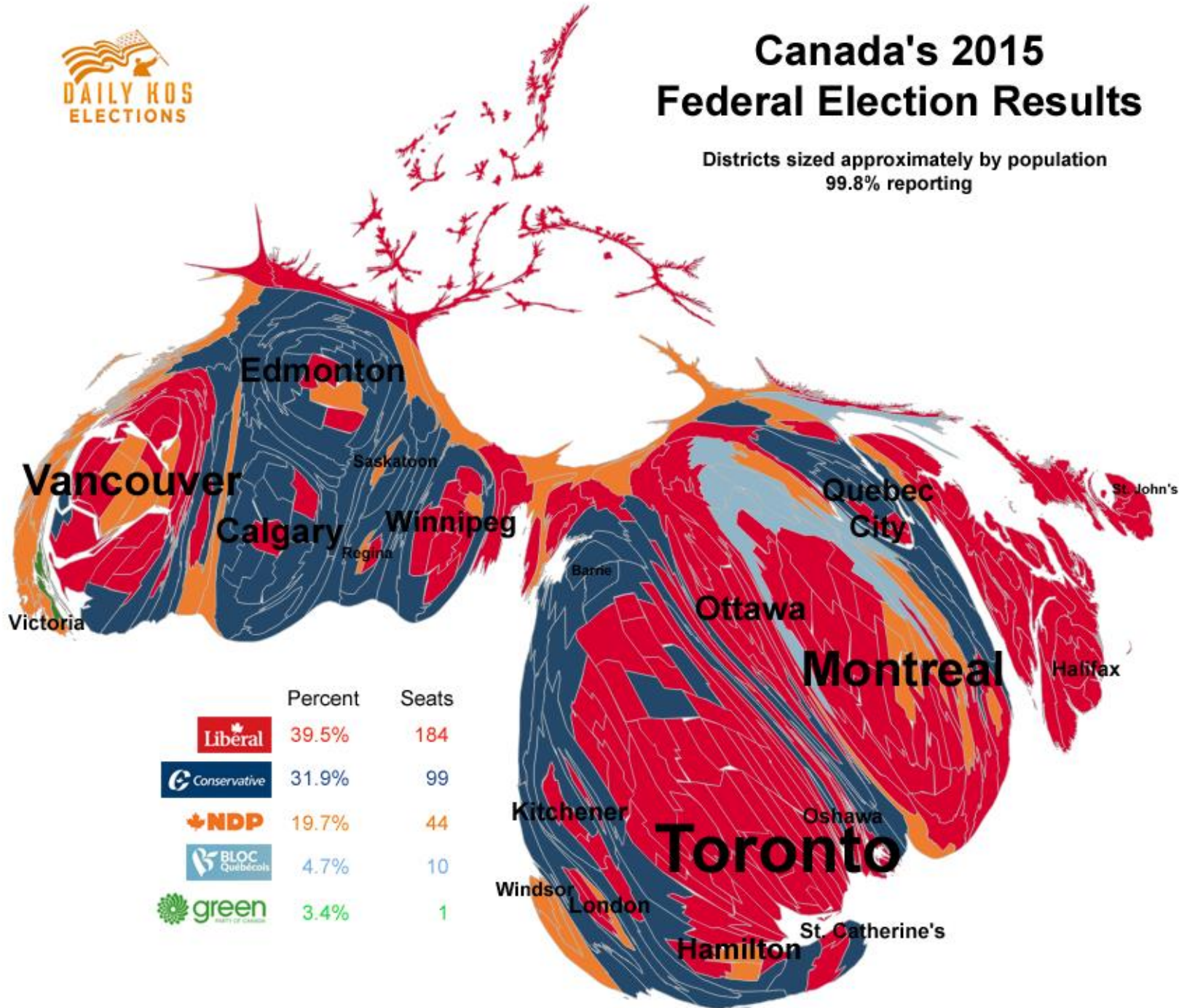
Thematic techniques and data types

Raw values / totals

➢Dot maps

➢Graduated symbols

➢Graduated lines

➢Cartograms (value by area)

Derived densities / % values

➢Choropleth

➢Topograms

➢Isarithms / Isopleths (mostly)

Figure: Alberto Cairo, TKnightcenter ->

Choropleth Map
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis placerat, tellus at vehicula porttitor, neque erat

Percentage of people who have eaten boiled octopus in the last year

0–25%
26–50%
51–75%
76–100%

Dot Map
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis placerat, tellus at vehicula porttitor, neque erat

Every dot represent a restaurant that has served boiled octopus in the last year

Proportional Symbol Map
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis placerat, tellus at vehicula

People that have eaten boiled octopus in the last year

1,000,000
500,000
250,000

7. Cartograms – Mental maps   (based on perceived space)

MY MENTAL MAP OF BRITAIN

John o'Groats

North Sea

SCOTLAND

Ben Nevis

Irish Sea

Edinburgh (uncle Jim)

Glasgow (aunt Eileen)

York

Isle of Man

Warkworth (where Violet lives)

Liverpool (me!)

ENGLAND

WALES

Alton Towers

Cardiff (uncle Amos)

Wembley

queen

London

Brighton

Land's End

English Channel

A tool of psychological research:

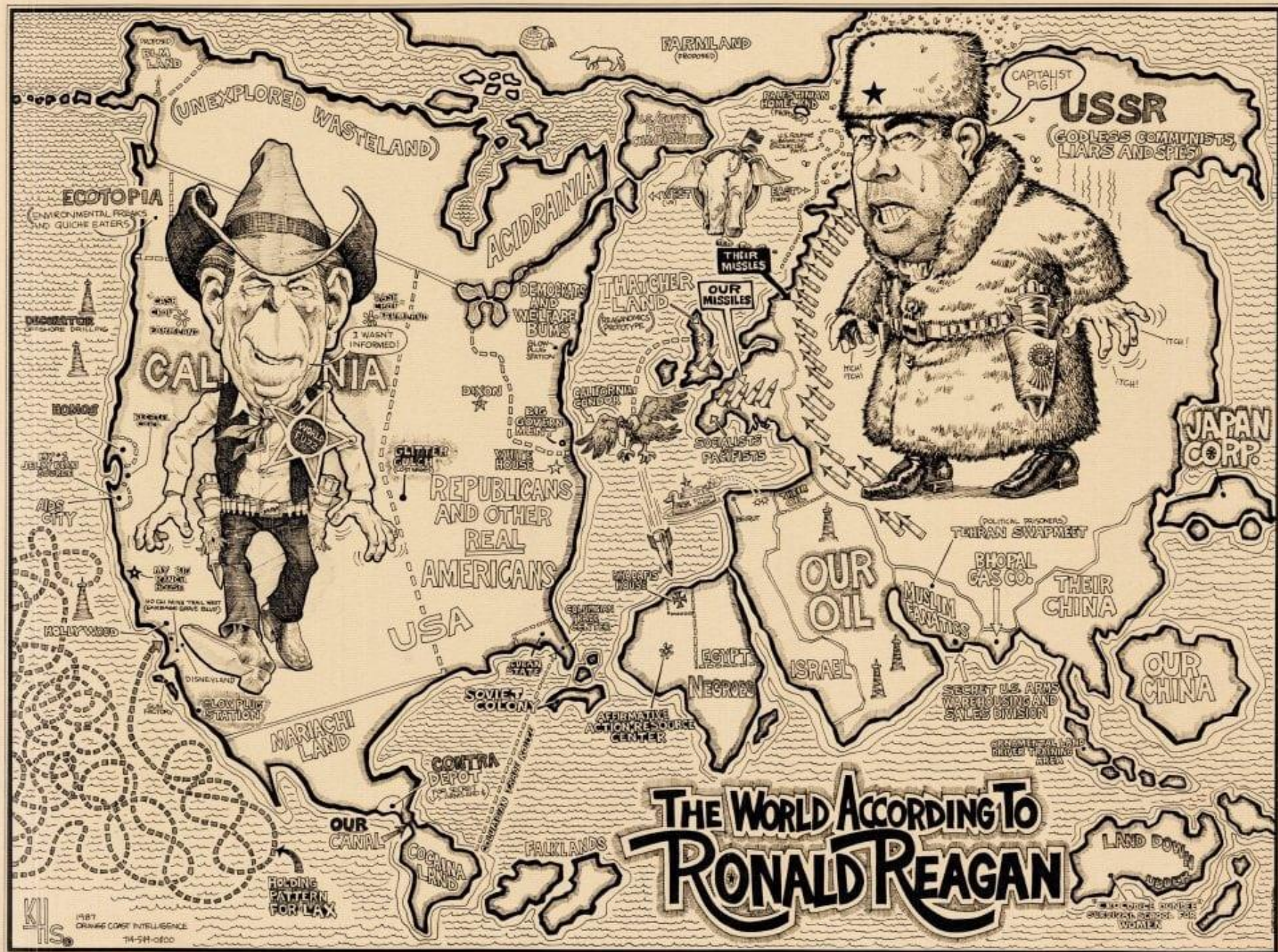People behave according to how they see their 'map'

They tend to:

exaggerate the size and importance of their home area

recall unusual features,

– e.g. the Florida peninsula, 'boot' of Italy, shape of Hudson Bay, etc..

The NORTH
Nottingham
(North)

24 M1

Stoke A50

THE WORLD ACCORDING TO RONALD REAGAN

'Wordclouds'

CANADA
AN INFOGRAPHIC

Quiz 2 on Thematic Mapping   10 questions worth 5% total (mult.choice)
- hope to post later today   Submit via Moodle one week later