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SGDs and Global data: Some examples and recommendations

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Environment Accounts and Statistics Program

Statistics Canada

Delivering insight through data, for a better Canada

About generating national statistics from global databases

1. National Statistical Offices (NSO) are asked to produce or vet SDGs
    1. The national level – for international comparison; and
    2. At the sub-national, disaggregated levels, for policy purposes.

2. To do so, NSO require to access new data streams and computing technologies:
    1. Satellite earth observation can provide internationally comparable data
    2. "In-situ" earth observation and *In-situ knowledge* are also required.
    3. "Advanced" computing environments and skills are required to handle the new data news
    4. Global data may be freely available, but a) is it good enough? and b) can it be ingested?

Test cases : Three Ecosystem Types

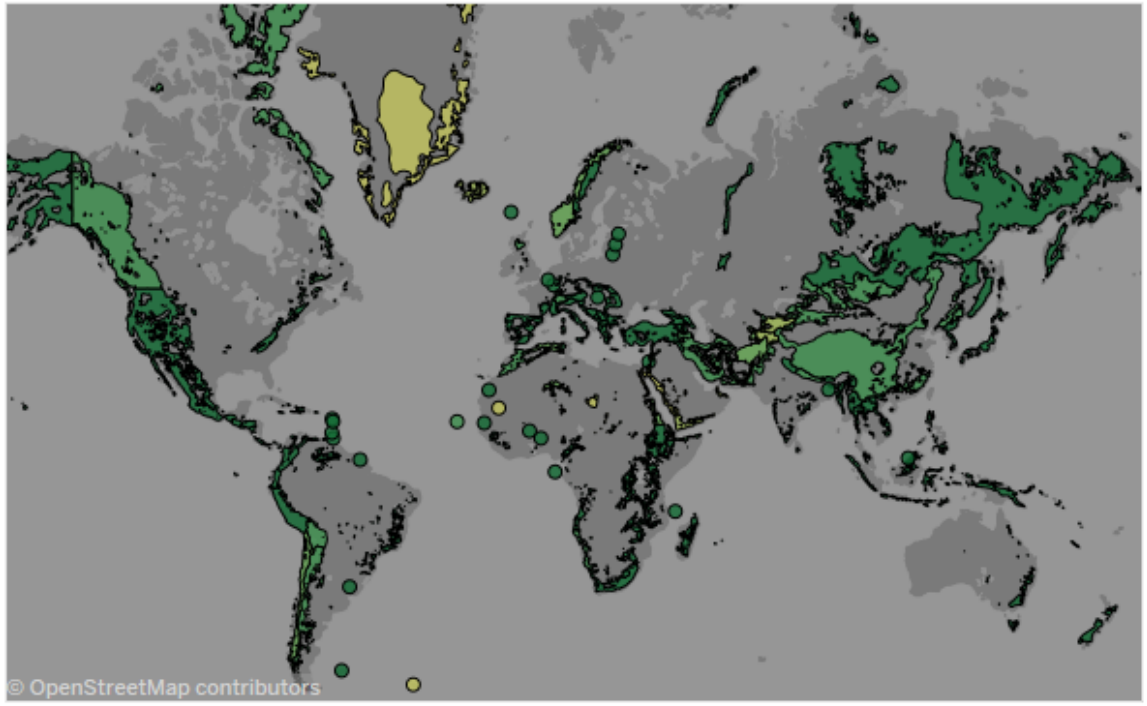
- Forests
- Freshwater
- Urban Areas

Forest

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss *(Review in depth by HLPF in 2018)*	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.1 Forest area as a proportion of total land area	Tier I *(FAO & UNEP)*
		15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	Tier I *(UNEP-WCMC & Ramsar)*
	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	15.3.1 Proportion of land that is degraded over total land area	Tier III *(UNCCD & FAO/ UNEP)*
	15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	15.4.1 Coverage by protected areas of important sites for mountain biodiversity	Tier I *(UNEP-WCMC /UNEP)*
		15.4.2 Mountain Green Cover Index	

Mountain Green Cover Index

Mountain Green Cover Index – baseline map (2017 values for all countries)



The designations employed and the presentation of material in the maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

MGCI Values:

- <20%
- >20% and <=40%
- >40% and <= 60%
- >60% and <=80%
- > 80%

The Mountain Partnership Secretariat at the Food and Agriculture Organization of the United Nations (FAO) is the custodian agency of target 15.4

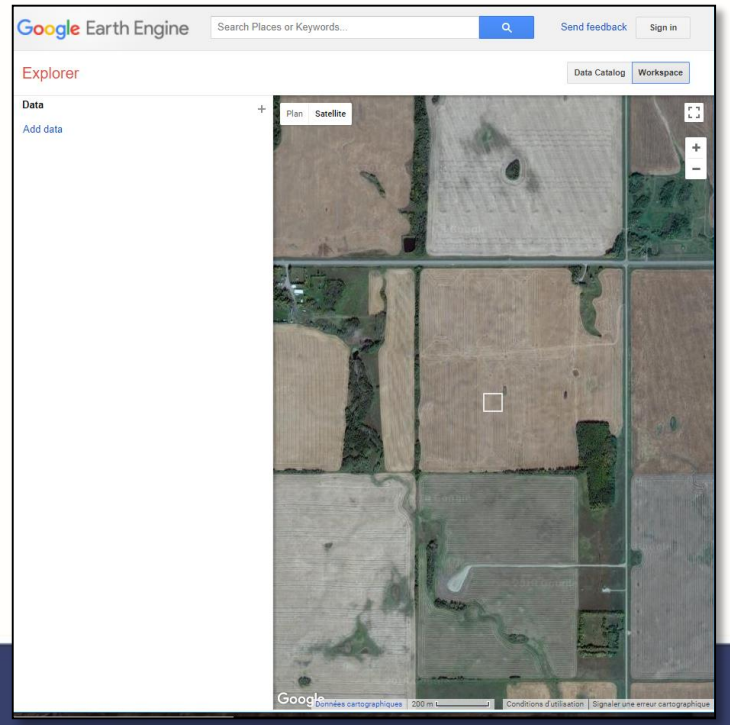
"By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, to enhance their capacity to provide benefits that are essential for sustainable development."

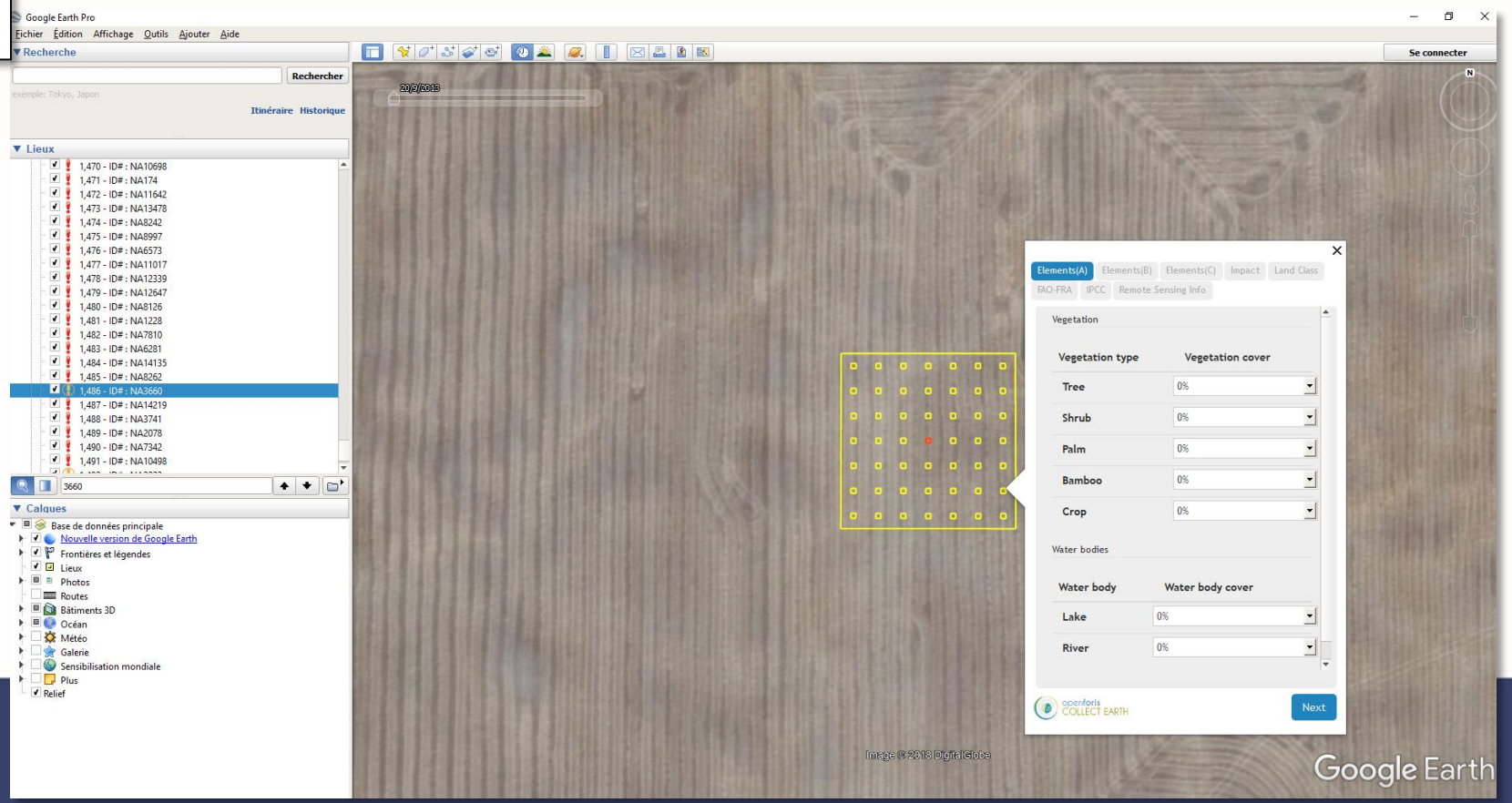
The Green Cover Index is meant to measure the changes of the green vegetation in mountain areas - i.e. forest, shrubs, trees, pasture land, crop land, etc. – in order to monitor progress on the mountain target.

Mountains are defined according to the UNEP-WCMC classification that identifies them according to altitude, slope and local elevation range as described by Kapos et al. 2000:

Class 1: elevation > 4,500 meters
Class 2: elevation 3,500–4,500 meters
Class 3: elevation 2,500–3,500 meters
Class 4: elevation 1,500–2,500 meters and slope > 2
Class 5: elevation 1,000–1,500 meters and slope > 5 or local elevation range (LER 7 kilometer radius) > 300 meters
Class 6: elevation 300–1,000 meters and local elevation range (7 kilometer radius) > 300 meters

The *Mountain Green Cover index* is based on Collect Earth (Open Foris)
Its user friendliness and smooth learning curve make it a perfect tool for performing fast, accurate and cost-effective assessments. It is free, open source and highly customizable for the specific data collection needs and methodologies. It builds upon very high resolution multi-temporal images from Google Earth and Bing Maps and Landsat 7 and 8 datasets from Google Earth Engine. Data and images are stored and globally available for any year from 2000, making possible the monitoring of the change over time.





Statistics Canada
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Mountain Green Cover Index

For Canada 6,352 sample plots are systematically distributed within mountain areas (~25,400 km2)

- Huge amount of work to validate these points
- Very interesting methodology

Reference area code	Reference area name	Plain	Mountain	TotArea	percentage of the mountain area over total area
124	CANADA	7900620.65	1944426.3	9845046.95	19.75

Series Code	Series Name	Indicator I	Reference A	Reference Area Ty	Reference Area Name	Time Peri	Observation Value	Unit of Me	Nature of	Footnotes	Source De	Time Detail
ER_MTN_GRNCVI	Mountain Green Cover Ind	15.4.2	124	3.0-Country	Canada	2017	77.806798	Index	E	Conditional validatio	Food and	2017

Series Code	Series I	Indicat	Refere	Reference Area Typ	Reference Area Name	Time P	Observation Value	Unit of Me	Nature	Footnotes	Source De	Time D
ER_MTN_TOTL	Mountain	15.4.2	21	2.1-Regional (SDG)	Northern America (M49)	2017	5578.4341593750010	square kilom	E	Pending validation	Food and Ag	2017
ER_MTN_TOTL	Mountain	15.4.2	124	3.0-Country	Canada	2017	1970.0570507226564	square kilom	E	Conditional validati	Food and Ag	2017

Mountain Green Cover Index

These results have not been validated, and therefore not on Canada's SDG hub.

1. Validation : access to Collect earth project required
   - Is this of public domain

2. To do the EO interpretation, local expertise is required
   - Was it available and used?

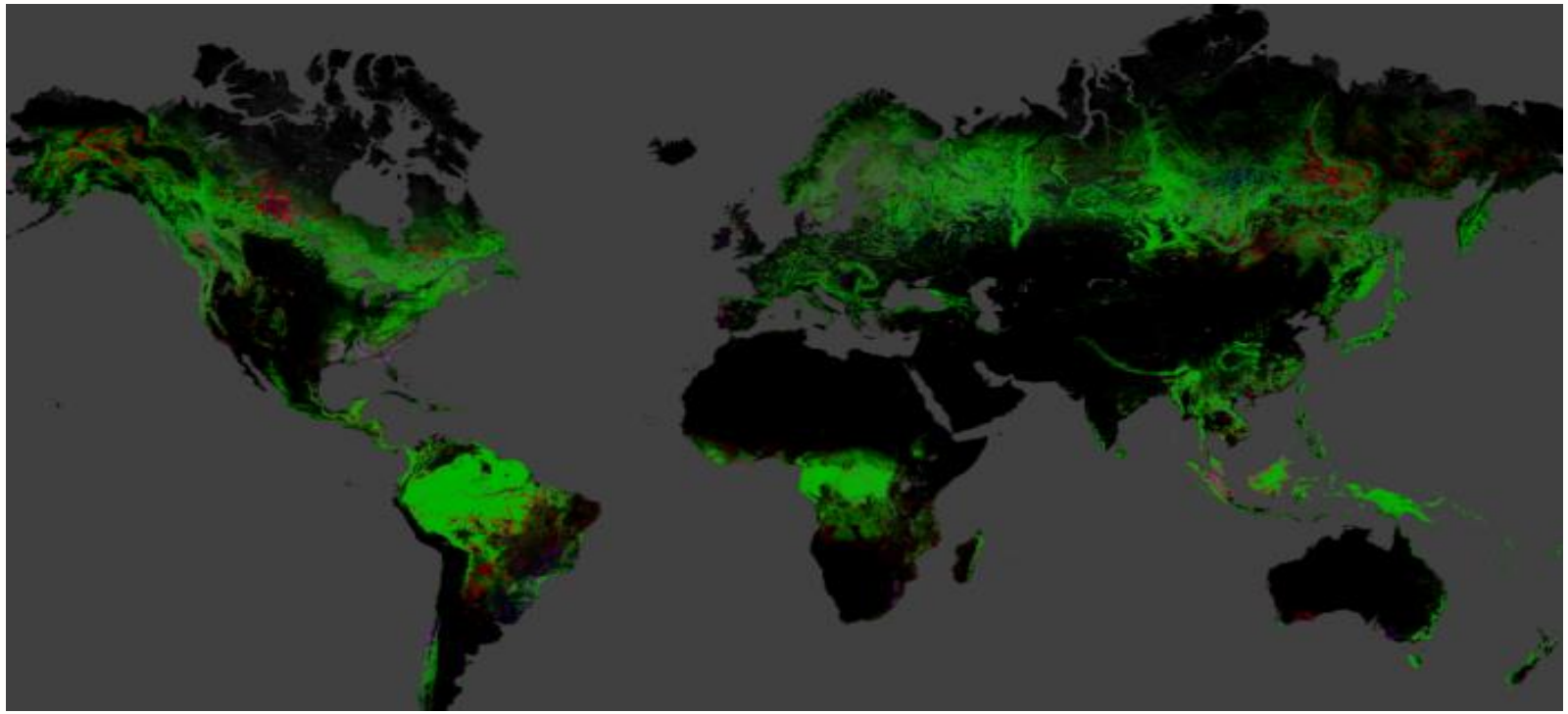
3. If this is be useful as a SDG, it needs to be updated
   - Is such a big task replicable?

4. Spatial integration with other datasets requires processing
   - Data need to be interpolation into a G.I.S. layer to be useful

Mountain Green Cover Index

There are other sources to track these issues:

For example, **Hansen, Potatov, Moore, Hancher et al.,** [Global Forest Change](#).



An overview of Canada's FOREST RESOURCES

HOW MUCH OF CANADA'S AREA IS FOREST?

3,470,690 km² of Canada's total area of **9,979,685 km²** is forest. That's a larger area than Alberta, Ontario and Quebec combined.

FOREST AREA

35% of Canada's area is forest.

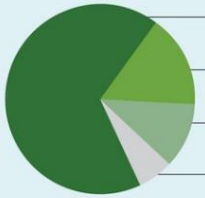
9% of the world's forests are in Canada.

THE BOREAL ZONE

Canada's boreal zone spans 5.5 million km² including all or part of 10 ecozones and accounts for over three-quarters of Canada's forest area.

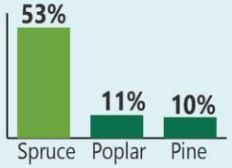
WHAT DO CANADA'S FORESTS LOOK LIKE?

FOREST TYPES



- 68% Coniferous
- 16% Mixedwood
- 11% Broadleaf
- 6% Non-treed

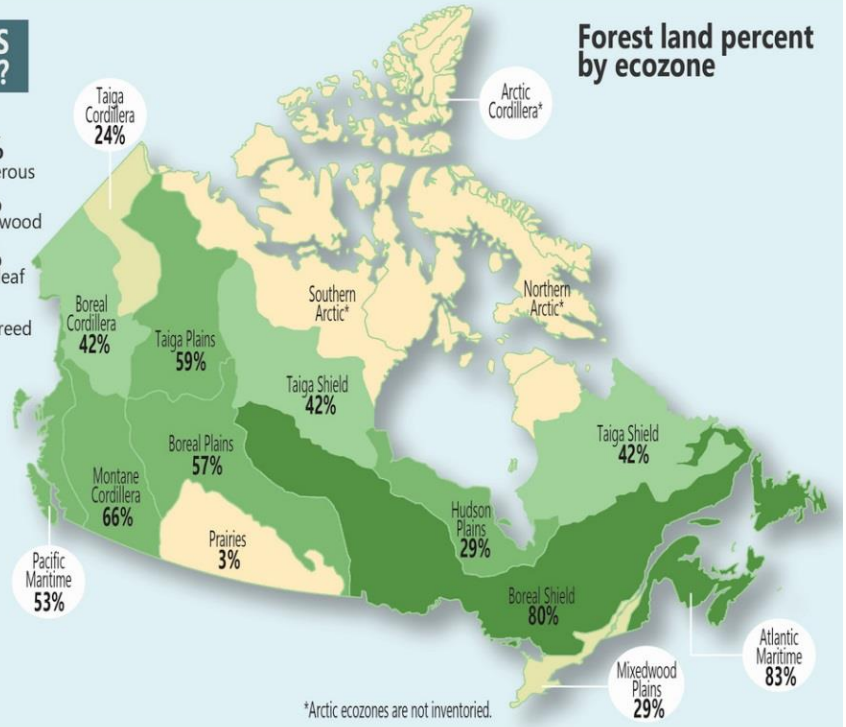
FOREST SPECIES



AGE CLASSES

42% of Canada's forests are between 81 and 120 years old, followed by 26% between 41 and 80 and 12% under 41.

Forest land percent by ecozone



*Arctic ecozones are not inventoried.

WHAT TYPES OF DISTURBANCES AFFECT CANADA'S FORESTS?

INSECTS

In 2015, insects damaged 176,318 km² of forest.

FOREST FIRES

In 2015, 7,140 wildfires burned a total of 38,616 km² of forest.

HARVESTING

In 2015, Canada harvested 7,796 km² of forest.

DEFORESTATION

From 1990 to 2015, forest area decreased 0.3% from 3.48 million km² to 3.47 million km².

An overview of Canada's FOREST SECTOR

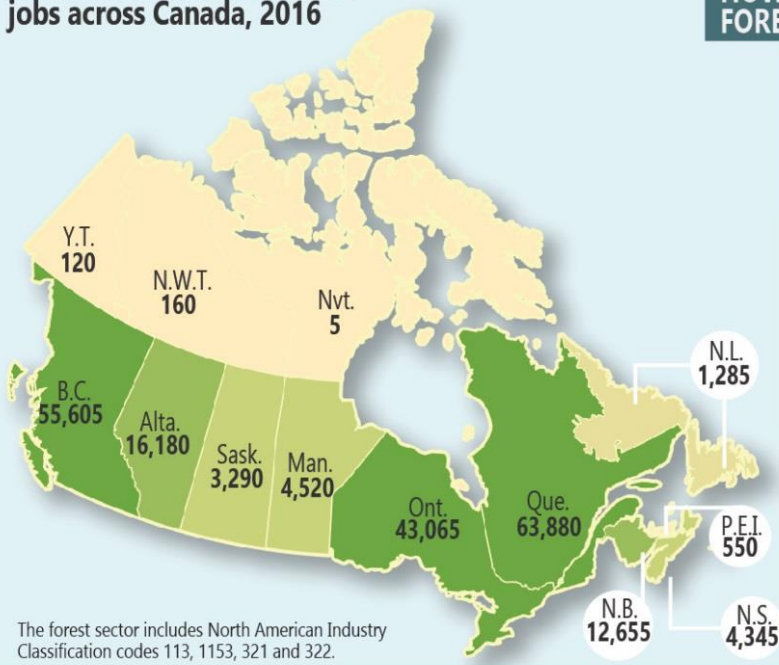
HOW MUCH DOES CANADA'S FOREST SECTOR CONTRIBUTE TO THE ECONOMY?

In 2014, gross domestic product (GDP) for the forest sector in Canada was **$22.1 billion.**

In 2016, forest product exports were valued at **$29.5 billion.**

In 2016, employment in the forest sector was **205,660.**

Distribution of forest sector jobs across Canada, 2016



The forest sector includes North American Industry Classification codes 113, 1153, 321 and 322.

HOW VALUABLE ARE CANADA'S FOREST ASSETS?

Forests provide many products, but also ecosystem services such as water filtration, air purification, carbon sequestration, and recreational and spiritual services.

In 2016, the value of Canada's accessible timber stocks—a component of natural resource wealth—was estimated at **$215.4 billion.**

Volume of roundwood harvested, as a proportion of Canada's total

COMMUNITIES FOR WHICH THE FOREST SECTOR WAS A MAJOR SOURCE OF INCOME

The forest sector continues to be an important provider of jobs and income in communities across the country, particularly in smaller and Indigenous communities. It was a major economic driver for 105 communities in 2016 compared to 463 in 2001.

2001
463 communities

2016
105 communities

Water

Goal 6. Ensure availability and sustainable management of water and sanitation for all *(Review in depth by HLPF in 2018)*	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.2 Proportion of bodies of water with good ambient water quality	Tier III *(UNEP & UN-Water)*
	6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation	Tier II *(UNESCO-UIS/ UNECE & IUCN)*
	6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time	Tier III *(UNEP & UN-Water, IUCN, Ramsar)*

Water ecosystem

1. Tested the Global Surface Water (GSW)
    1. Testing SDG 6.6.1

2. Assessed the indicator for quality
    1. accurately measures change in extent
    2. captures and misses
    3. informing on goal, target and indicator questions/objectives

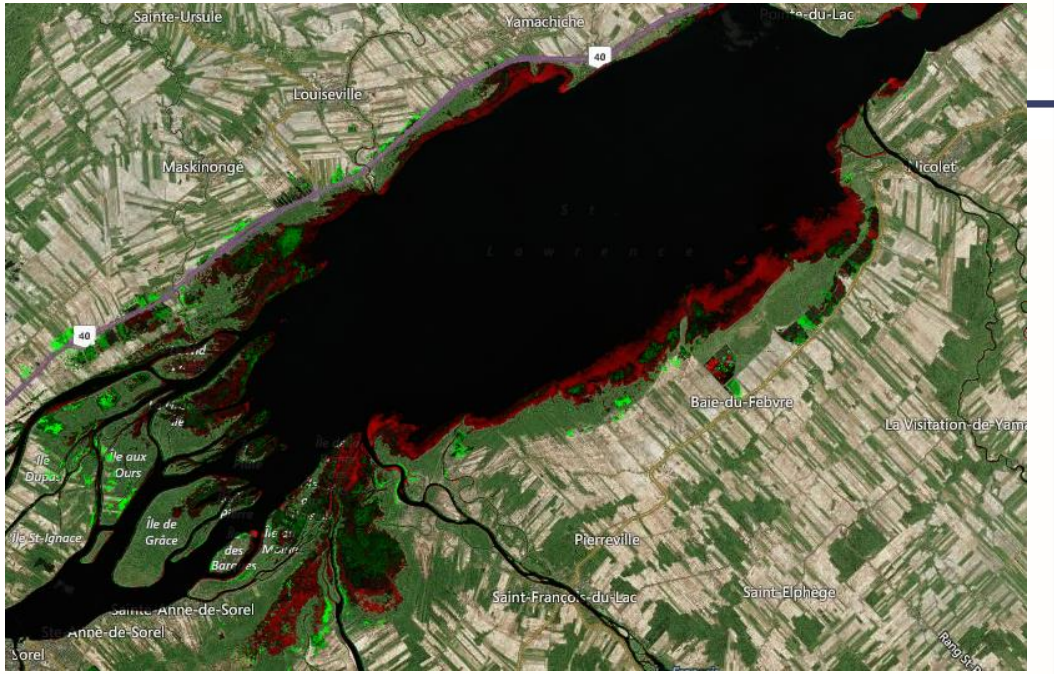
3. Comparisons done with Canadian data sources

Global Surface Water (GSW)

- Produced by European Commission's Joint Research Centre

- Maps the location and temporal distribution of water surfaces at the global scale over the past three decades and provides statistics on the extent and change of those water surfaces (6 layers):
  1. Water Occurrence (1984-2015)
  2. Water Occurrence Change Intensity (1984-1999 to 2000-2015)
  3. Water Seasonality (2014-2015)
  4. Annual Water Recurrence (1984-2015)
  5. Water Transitions (First year to Last Year)

Measuring change in extent



Differences between all homologous pairs of months were averaged to create the surface water occurrence change intensity map

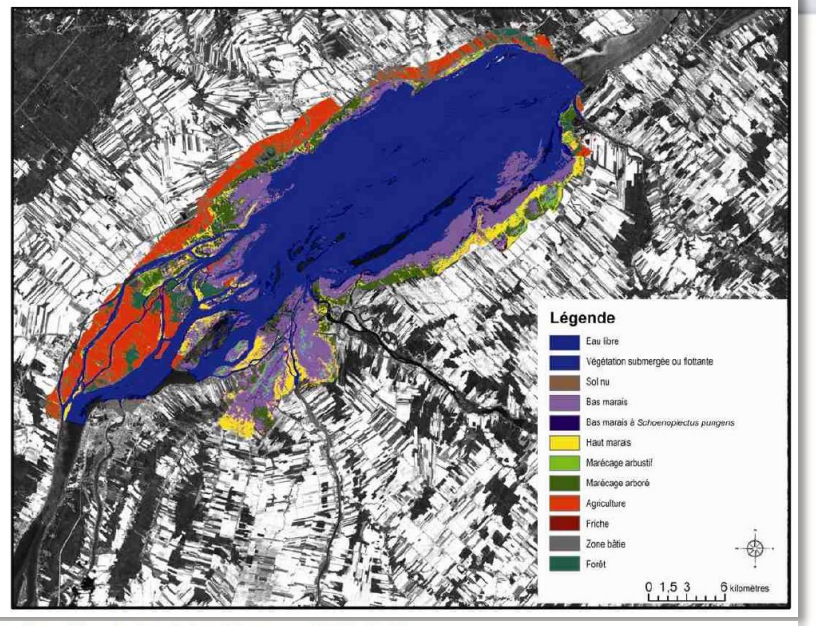
Source: Jean, Martin, et Guy Létourneau. 2011. *Changements dans les milieux humides du fleuve Saint-Laurent de 1970 à 2002*, Environnement
générale des sciences et de la technologie, Monitoring et surveillance de la qualité de l'eau au Québec, Rapport technique numéro 511, 302 page

1. The GSW – decrease area was compared to the Wetland maps produced by Environment and Climate Change Canada for the same time periods.

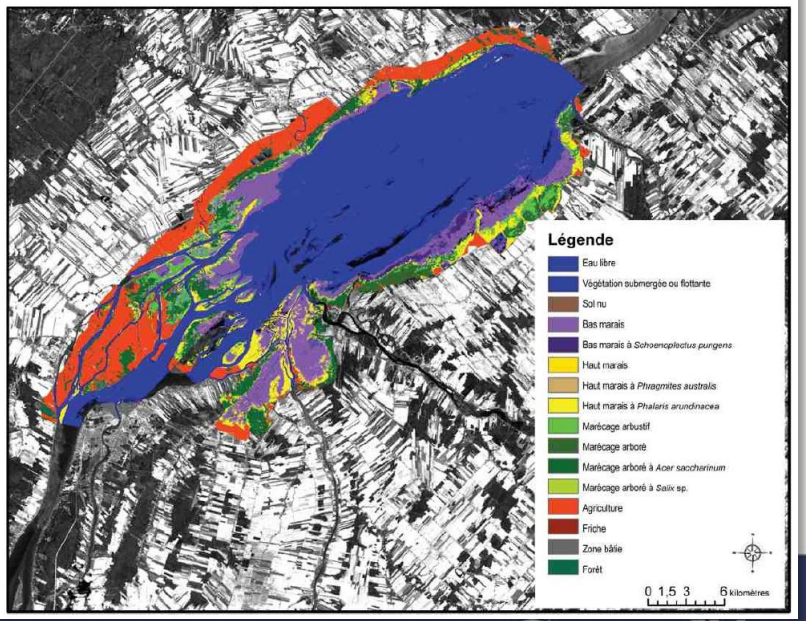
2. The wetland maps show low marshes (purple) where GSW has identified water decrease

3. Marshes are periodically or permanently flooded, there are no or few trees and bushes, and in season vegetation can be seen above water.

Milieux humides du lac Saint-Pierre en 1990-1991

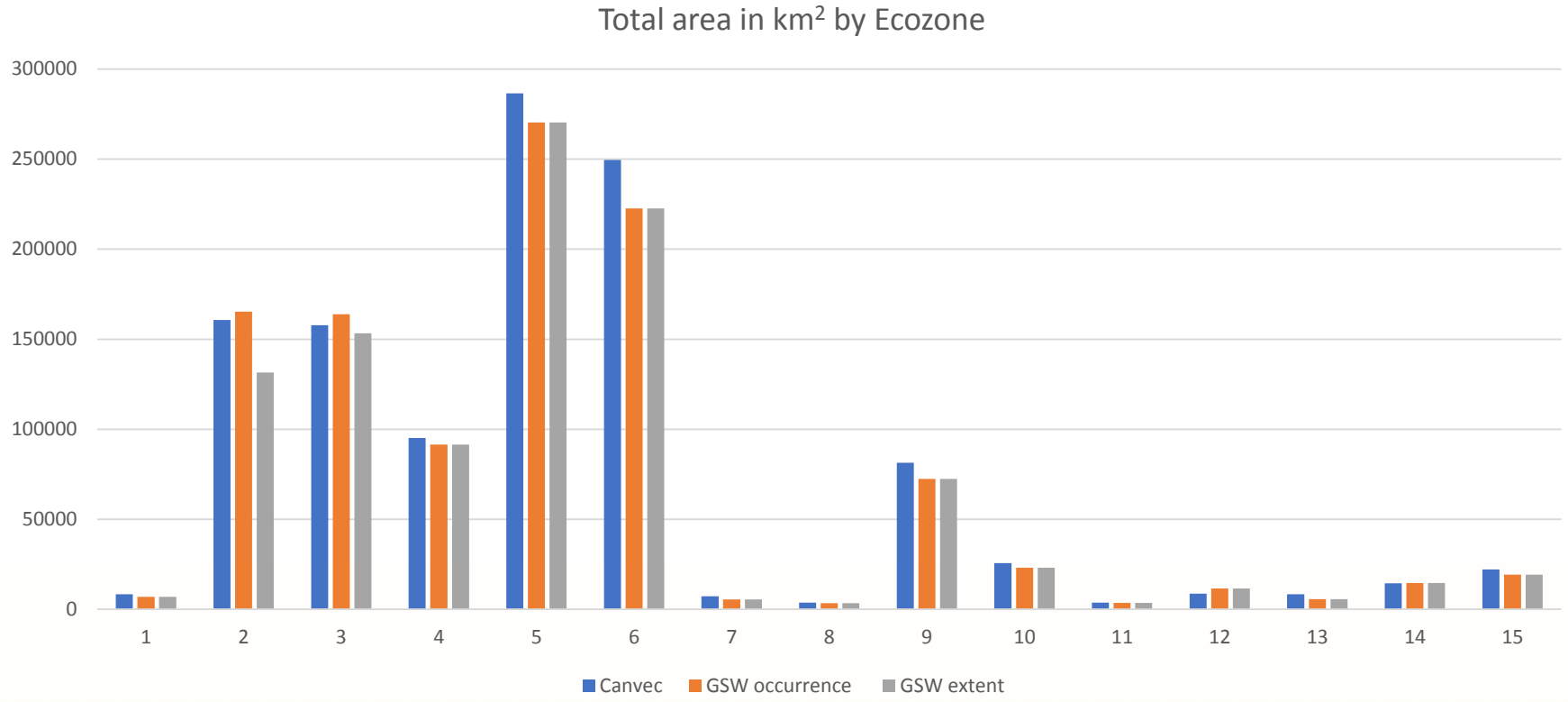


Milieux humides du lac Saint-Pierre en 2000-2002



Measuring change in extent (cont.)

- Comparison between Global Surface Water – Maximum extent and Canadian Hydrographic layer – water body (Canvec – 1:50 000)



Lessons learned about GSW

1. GSW uses satellite Earth observation with a methodology that is transparent, and very detailed.
   - Represents a huge amount of work

2. Free and open source: data sources as well as the scripts are freely available

3. Web mapping application provides:
   1. Fast and easy way to visualize the GSW layers
   2. Useful information on the monthly water recurrence and water history at pixel level
   3. Access to data download
   4. Landsat time series from 1984 to 2015 as base maps

Lessons learned about GSW (cont.)

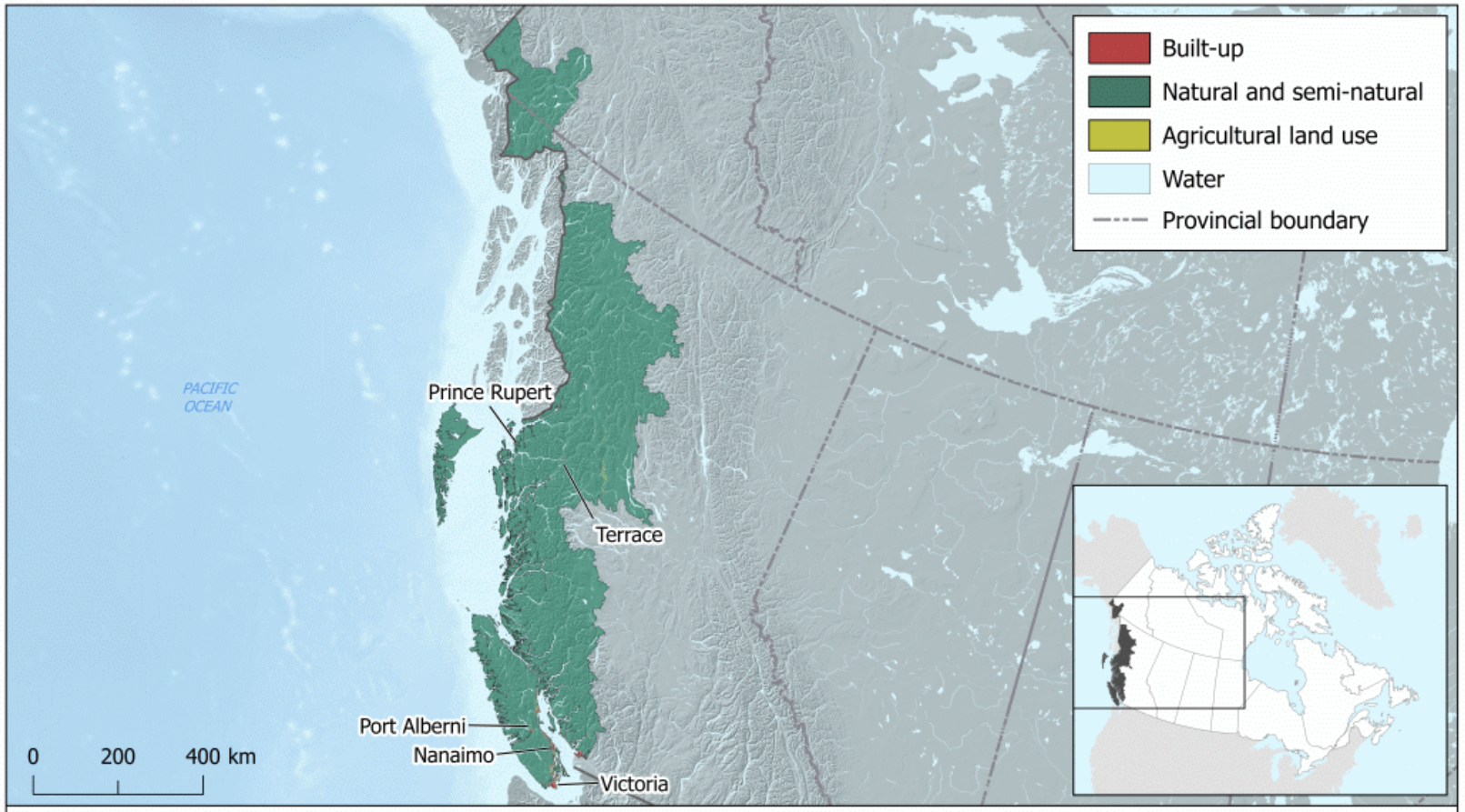
1. There can be limitations with the results – e.g. temporal scale resolution issues

2. The datasets may not measure all relevant information
   - e.g. water do not include most streams, many small rivers, wetlands and ponds, limits on measurement of water surface characteristics.

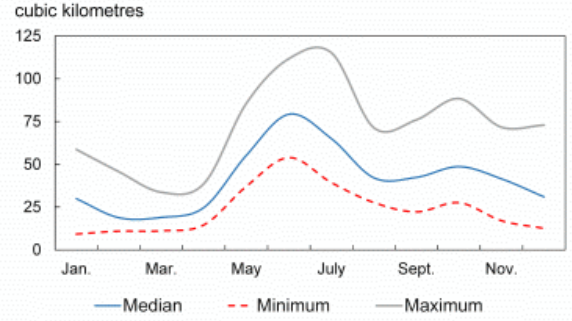
3. Analysis of real change should be done including other important datasets
   - E.g. temperature, precipitation, land cover change

4. Seasonality matters!
   - Floods, droughts, snow cover, glacial mass balance, soil moisture, IDF curves, timing of freshet, etc.

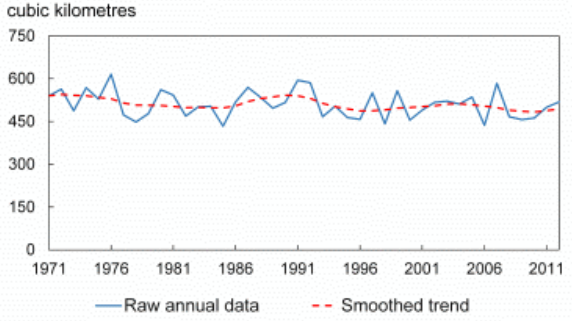
Map 3.3.1
Land use and water yield for the Pacific Coastal drainage region



Monthly water yield, 1971 to 2012



Trends in water yield, 1971 to 2012



A. Comprehensive data tables

Table A.1
Selected land cover and land use statistics by drainage region, 2011

	code	Total area[1]	Water area[1]	Land area[1]	Built-up area, 2011[2]	Arable land, 2011[3]	Natural land for pasture, 2011[3]	Natural and semi-natural area, 2011[4]	Fertilized area, 2011[3]	Irrigated area, 2011[3]	Barriers, 2011[5]	Barrier density, 2011[5]
		km²									m	m/km²
Canada	...	9,978,923	1,169,561	8,809,362	59,351	428,953	146,775	9,343,844	249,056	7,665	1,494,919,813	169.7
Pacific Coastal	1	334,455	14,219	320,236	1,547	493	635	331,781	183	79	45,332,602	141.6
Fraser–Lower Mainland	2	233,104	8,937	224,167	2,481	3,294	7,786	219,544	1,224	725	84,982,300	379.1
Okanagan–Similkameen	3	15,603	585	15,018	432	342	1,062	13,766	150	182	11,080,603	737.8
Columbia	4	87,323	2,348	84,975	666	403	898	85,356	148	117	29,827,848	351.0
Yukon	5	332,906	9									
Peace–Athabasca	6	485,145	16									
Lower Mackenzie	7	1,330,490	177									
Arctic Coast–Islands	8	1,764,280	175									
Missouri	9	27,096										
North Saskatchewan	10	150,151	7									
South Saskatchewan	11	177,623	6									
Assiniboine–Red	12	190,704	8									
Winnipeg	13	107,655	20									

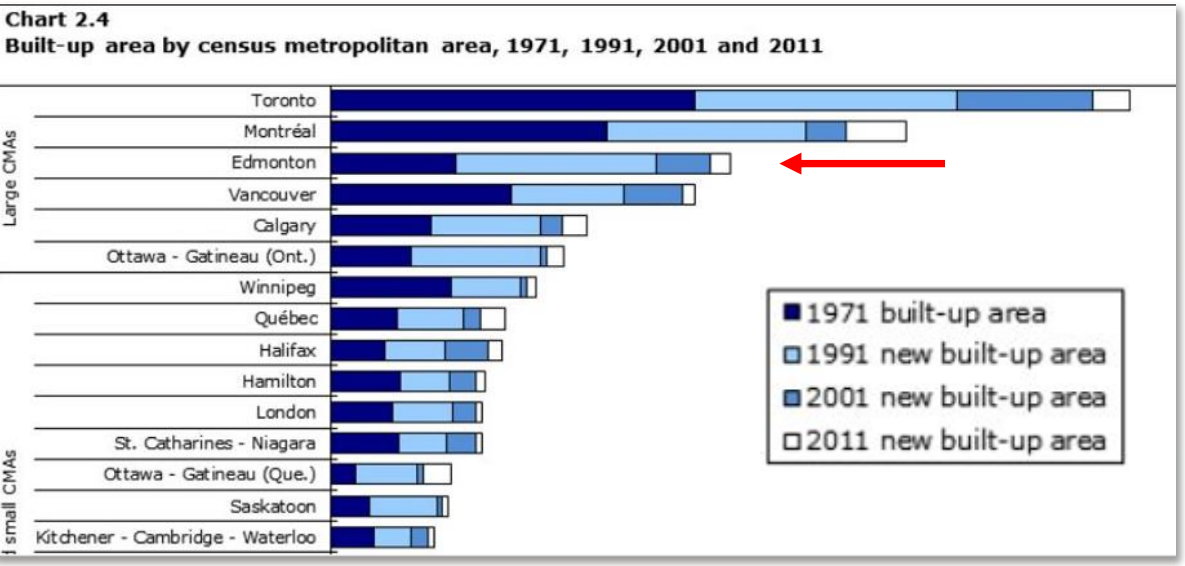
Table A.2
Selected statistics on water supply and demand by drainage region

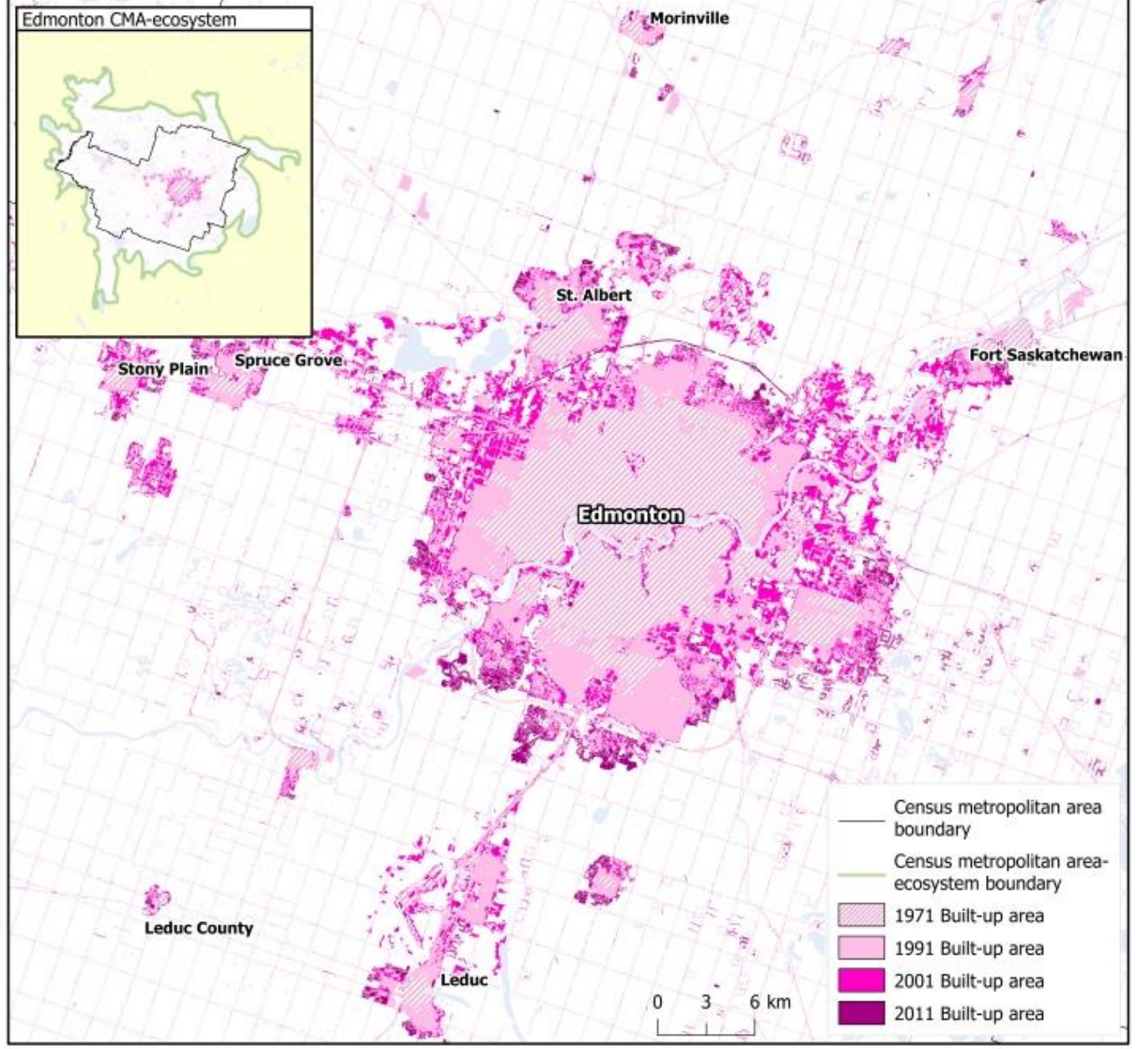
	code	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Water use, 2013[1]	Surface freshwater intake, 2013[1]	Average annual water yield, 1971 to 2013[2]	Water yield per area, 1971 to 2013[2]	Water yield variability index,[3] 1971 to 2013	Average annual evapotrans-piration, 1981 to 2010[4]
		persons		persons/km²		million m³		km³	m³/m²	monthly CV	m³/m²
Canada	...	21,568,311	33,476,688	2.4	3.8	37,892	33,464.7	3,478.2	0.35	1.05	0.23
Pacific Coastal	1	913,522	1,505,007	2.9	4.7	.	617.3	510.2	1.53	0.50	0.26
Fraser–Lower Mainland	2	971,762	2,336,941	4.3	10.4	.	615.3	129.3	0.55	0.83	0.33
Okanagan–Similkameen	3	118,507	327,548	7.9	21.8	.	148.3	4.3	0.27	1.44	0.41
Columbia	4	132,952	160,896	1.6	1.9	.	190.7	67.9	0.78	1.04	0.41
Yukon	5	16,984	32,280	0.1	0.1	.	12.5	106.0	0.32	..	0.14
Peace–Athabasca	6	206,361	406,303	0.4	0.9	.	297.3	99.5	0.21	1.01	0.31
Lower Mackenzie	7	34,283	52,844	0.0	0.0	.	10.7	246.3	0.19	..	0.17
Arctic Coast–Islands	8	7,655	20,133	0.0	0.0	.	1.3	231.3	0.13	..	0.11
Missouri	9	15,328	8,439	0.6	0.3	.	20.2	0.5	0.02	2.14	0.33
North Saskatchewan	10	841,004	1,559,613	5.9	10.9	.	947.4	10.4	0.07	1.04	0.34
South Saskatchewan	11	949,194	2,168,447	5.5	12.7	.	1,942.3	10.3	0.06	1.10	0.34
Assiniboine–Red	12	1,248,357	1,464,936	6.9	8.1	.	1,522.4	8.4	0.04	2.49	0.39

Urban

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable *(Review in depth by HLPF in 2018)*	11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	Tier II *(UN-Habitat & UNEP/ UNECE)*
	11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 Ratio of land consumption rate to population growth rate	Tier II *(UN-Habitat & UNEP)*
	11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	Tier III *(UN-Habitat)*

Mapping land use change around census metropolitan areas: Edmonton

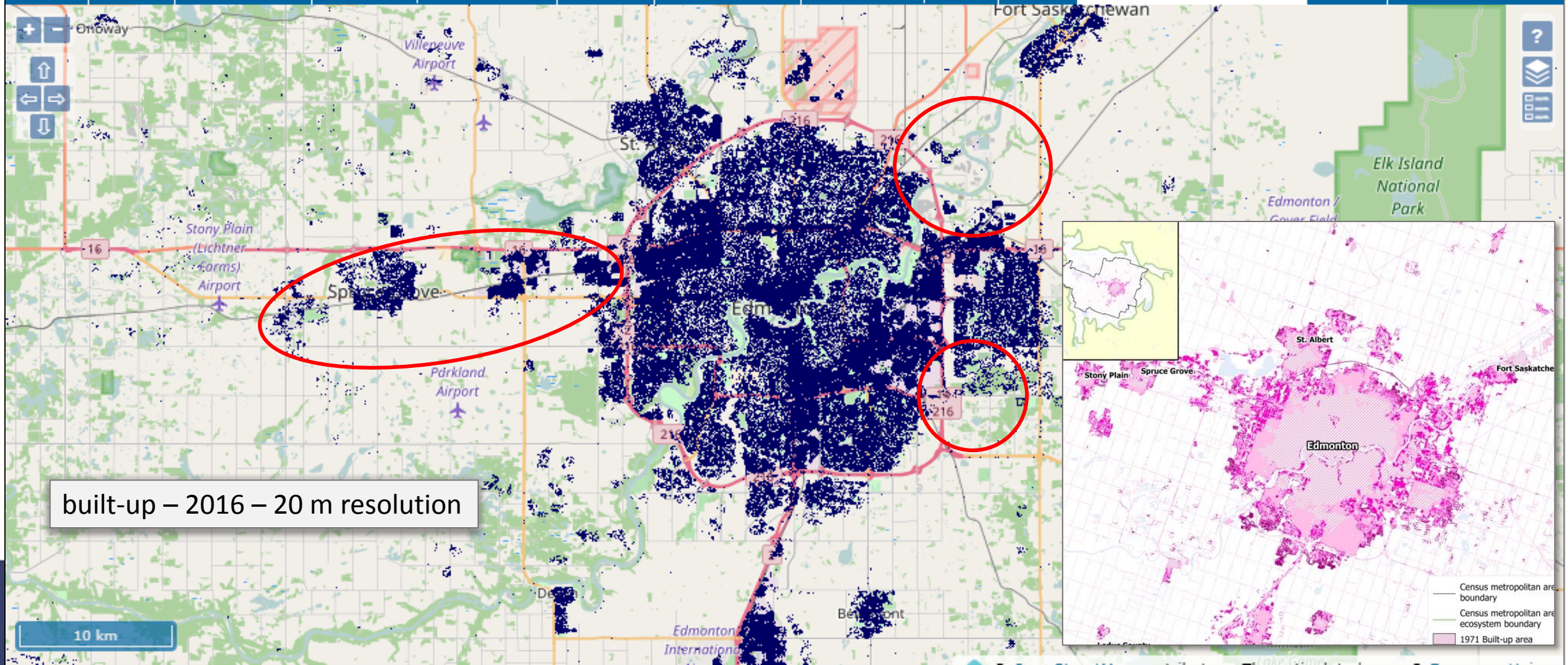




EUROPEAN COMMISSION

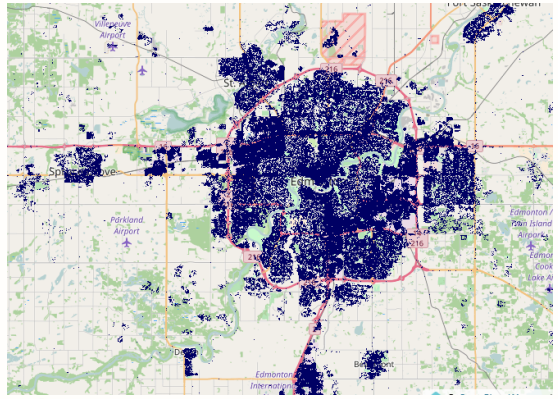
Global Human Settlement

Supported by the Joint Research Centre (JRC) and the DG for Regional Development (DG REGIO) of the European Commission, together with the international partnership GEO Human Planet Initiative (GEO)

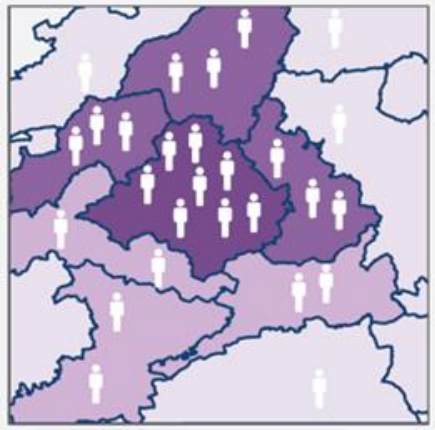


built-up – 2016 – 20 m resolution

GHSL products derived from built-up layer (2016)

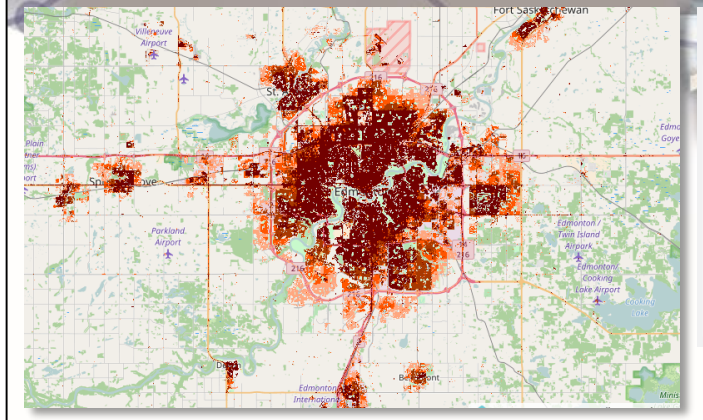


built-up – 2016 – 20 m resolution

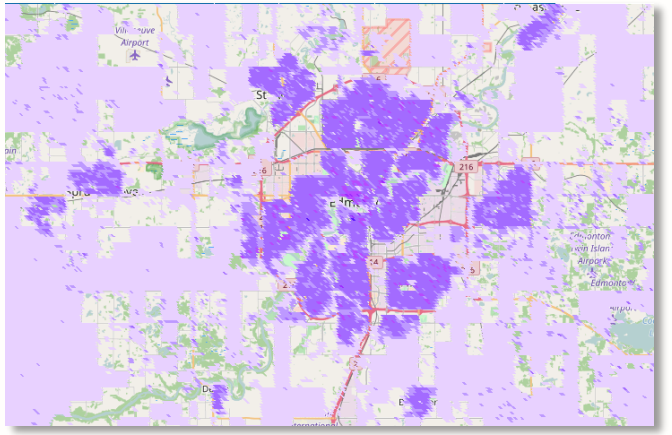


Population censuses

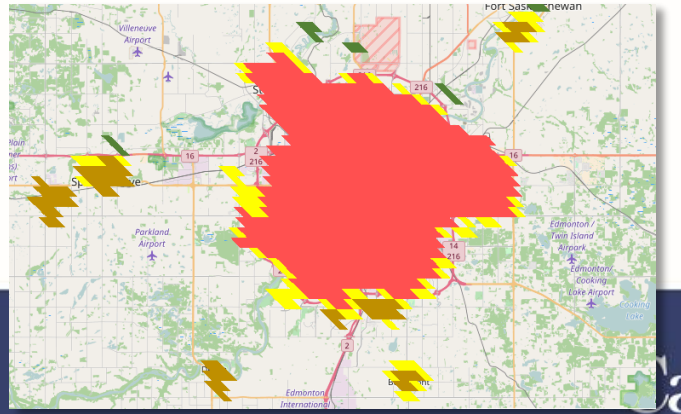
Built-up area is typically expressed with a continuous values representing the proportion of building footprint area within the total size of the cell to measure human settlements regardless of administrative boundaries. Built-up area (38 m resolution) 1975, 1990, 2000, 2015.



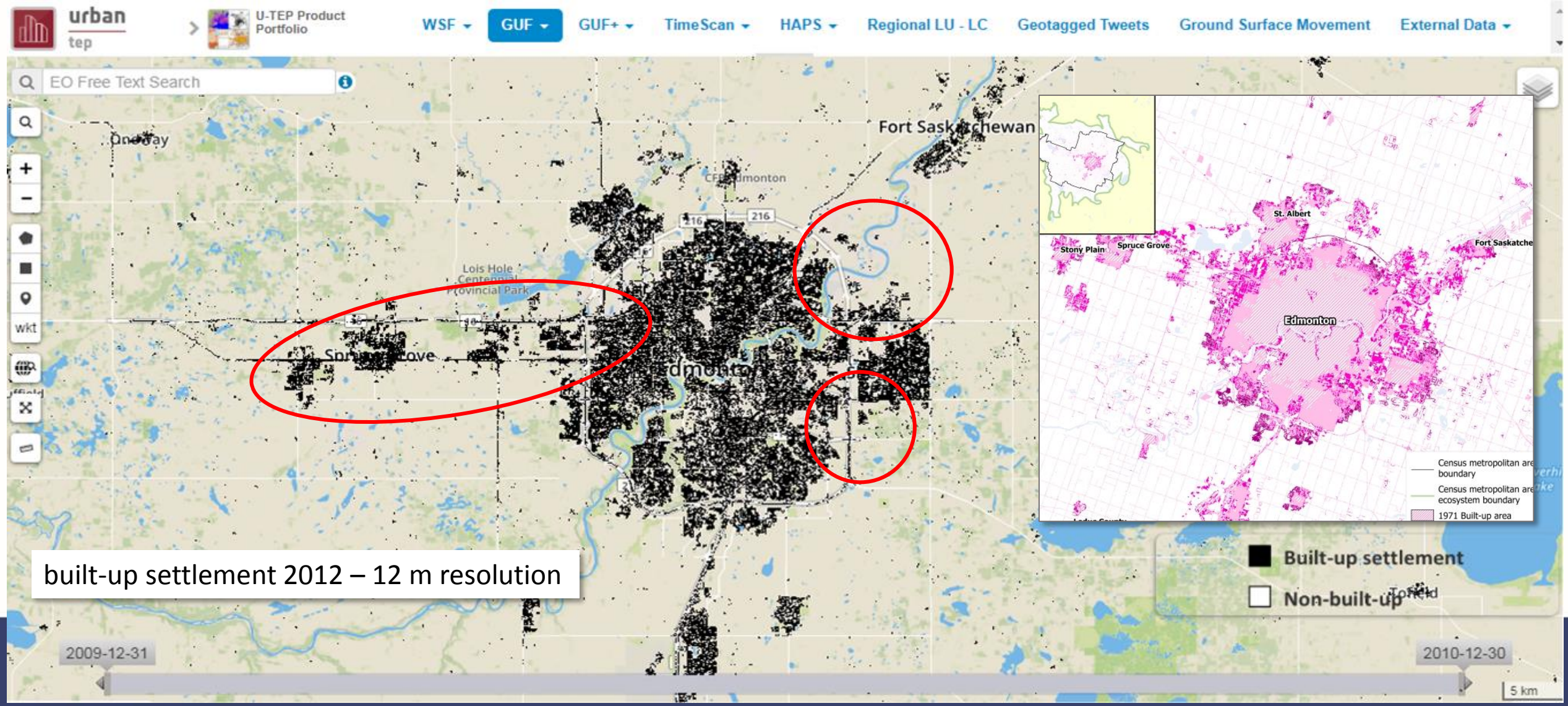
Population grid (250) is the result of the combination of information from population censuses with built-up according to the presence of absence of built-up in the grid cell. The layer represents the presence and density of population



The Settlement Model (1km) aims at classifying human settlements according to certain rules of population and built-up density and contiguity of grid cells



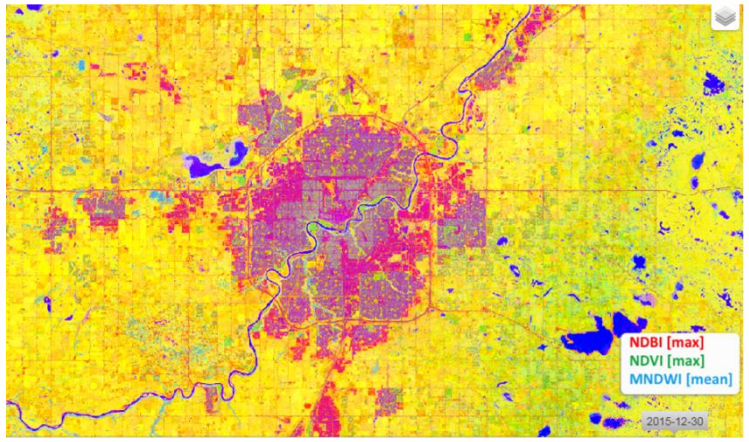
Global Urban Footprint (GUF), German Aerospace Center (DLR)

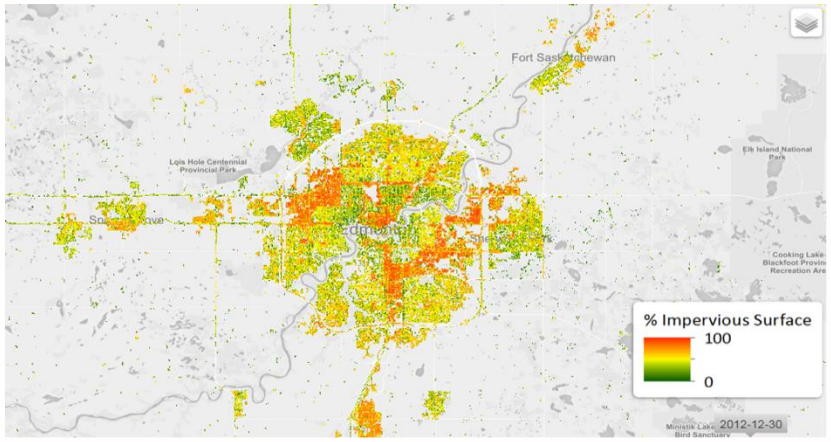


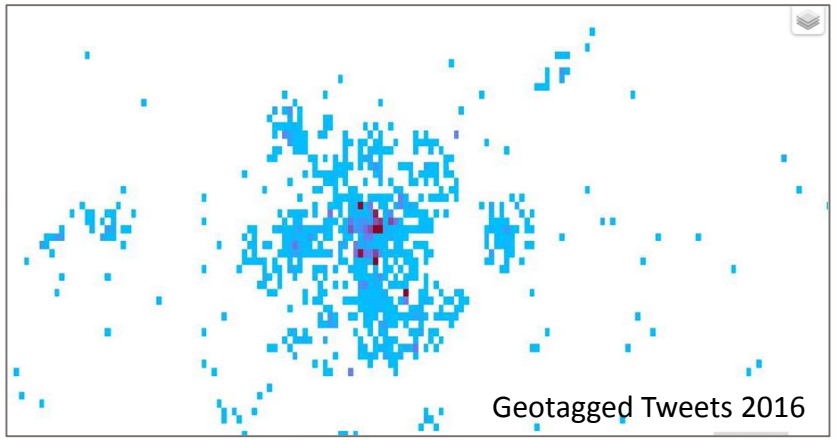
built-up settlement 2012 – 12 m resolution

Global Urban Footprint (Cont.)

- Additional information extracted from imagery or other sources







- However, many layers not available outside Europe

Make cities and human settlements inclusive, safe, resilient and sustainable

Targets	Indicators	Unit of measure	Reference period	Latest data	Previous period	Data for previous period	Data provider	Source
11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 Ratio of land consumption rate to population growth rate	Percentage	2001-2011	0.47		1.36	Statistics Canada [2]	Human Activity and the Environment, The changing landscape of Canadian metropolitan areas
	11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically	Indicator under development						

Discussion: Need to consider a Data Quality Framework

	Dimension	Indicators
1	Institutional environment (authority)	• The producer has the legal authority and responsibility to collect information to produce, update and maintain the dataset • Producers' credentials and affiliations are valid and their research/products are commonly used or cited by other researchers and/or users in their field • The facts, biases, exaggerations, or inaccuracies are identified and documented and can be validated with other methods and/or sources of information
2	Relevance	• Purpose or aim for collecting the information, including identification of the target population, discussion of whom the data represent, who is excluded and whether there are any impacts or biases caused by exclusion of particular people, areas or groups
3	Timeliness	• Data is up-to-date • Data perpetually maintained and available with unique and coherent versioning
4	Accuracy	• The degree to which the data correctly describe the phenomenon they were designed to measure • Should be assessed in terms of the major sources of errors that potentially cause inaccuracy
5	Coherence	• The internal consistency of a statistical collection, product or release, as well as its comparability with other sources of information, within a broad analytical framework and over time
6	Interpretability	• The information regarding the data is available / Complete / Clear with supporting documentation
7	Accessibility	• The ease of access to data by users, including the ease with which the existence of information can be ascertained, as well as the suitability of the form or medium through which information can be accessed

Data Quality Framework: Steps

Data producer	Data	• Earth observation (satellite and airborne) • Geospatial data layers • Field data
	Preprocessing (data preparation)	• Geographical registration, correction of the effect of elevation (orthorectification) • Corrections and calibrations • Mathematical transformation to enhance images to make them more suitable to meet requirements
	Digital image processing for information extraction	• Use of computer's decision-making capability to identify and extract specific pieces of information • Human operators instruct the computer and evaluate the significance of the extracted information
	Quality control	• Accuracy assessment • Document uncertainties and limitations associated with the approach
Data user	Integration	• Horizontal and vertical integration with other data layers • Document data sources and accuracies
	Results	• Baseline • Change detection/ • Documentation • Etc.

Conclusion

Observations:

1. The methodologies that were developed and used to produce the global data presented here (GSW, GUF, GHSL) are very solid technically and scientifically;
2. These products have the advantage to offer a uniform basis for global comparison;
3. However these products may not meet the SDG needs for subnational analysis, in terms of spatial and temporal precision;
4. Main issue for these data sets is related to their objective (fitness for purpose). They were created prior to the definition of the objectives with regards to their use (in the SDG context).

Recommendations:

1. Consideration should be given to regional adjustments (e.g. spatial and temporal (seasonal) characteristics; quantity and quality of the model's training samples; extensiveness of validation);
2. Global data should be compared to national data to understand discrepancies;
3. International comparison should be made in a relative or categorical manner and avoid as much as possible the presentation of numbers that go beyond the precision and accuracy of the data.

Thank you for your attention

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