CAREX CANADA

www.carexcanada.ca

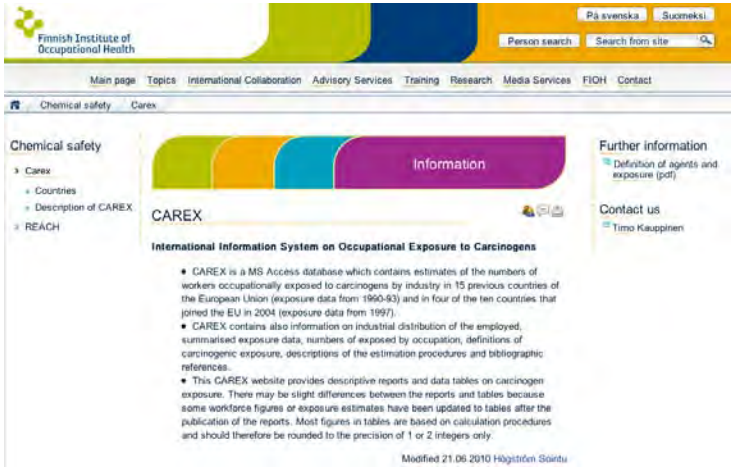
Surveillance of environmental & occupational exposures for cancer prevention

Surveillance de l'exposition aux agents cancérogènes en milieu de travail et dans l'environnement pour la prévention du cancer

Anne-Marie Nicol, PhD
Assistant Professor
School of Population and Public Health

What IS CAREX?

- CARcinogen EXposure
- Based on Finnish initiative for the EU
  - Occupational focus
- Canada- augmented with environmental exposure data
  - Added GIS component
  - Added pesticide focus
- Funded in 2007
  - Canadian Partnership Against Cancer



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Cancer due to Occupational Exposures (using WHO Exposure Models) Steenland- 2003

Lung Cancer	**6-13%**
Larynx Cancer	**1-20%**
Nose/nasopharynx	**33-46%**
Mesothelioma	**85-90%**
Bladder cancer	**7-19%**
Kidney cancer	0-2%
Liver cancer	1%
Skin cancer	1-6%
Leukemia	1-3%

Burden of exposures

The WHO estimates globally, 19% of all cancers are attributable to the environment, including the work setting, resulting in 1.3 million deaths each year.

Sample of **preventable** exposures associated with human cancer[1]

Exposure	Sufficient Human Evidence	Limited Human Evidence
Asbestos	Lung, larynx, mesothelioma, ovary	Colorectal, pharynx, stomach
Arsenic	Lung, skin, urinary bladder	Kidney, Liver, Prostate
Benzene	Leukemia	Multiple Myeloma, NHL
Radon	Lung	Leukemia
Silica Dust	Lung	
Solar Radiation	Skin	Eye

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Cogliano, VJ 2011

CAREX: Objectives

- Which carcinogens are a concern in Canada?
- How many Canadians are exposed to workplace and environmental carcinogens?
- How and where are they exposed
  - What sources/pathways (air, soil, food)
  - What types of workplaces
  - Which communities
- How high are exposures?
  - Where data is available

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Preliminary work: Prioritization

- Based on:
  - carcinogenicity and other toxic properties
  - Presence in Canadian workplaces and communities
  - Can we assess exposure?
- Results of this phase:
  - Priority list of 73 IARC carcinogens
- Created Carcinogen profiles
  - Unique to Canadian context


CARCINOGEN PROFILE

Trichloroethylene

CAREX Canada

CAREX CANADA

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BETA

Surveillance of environmental & occupational exposures for cancer prevention

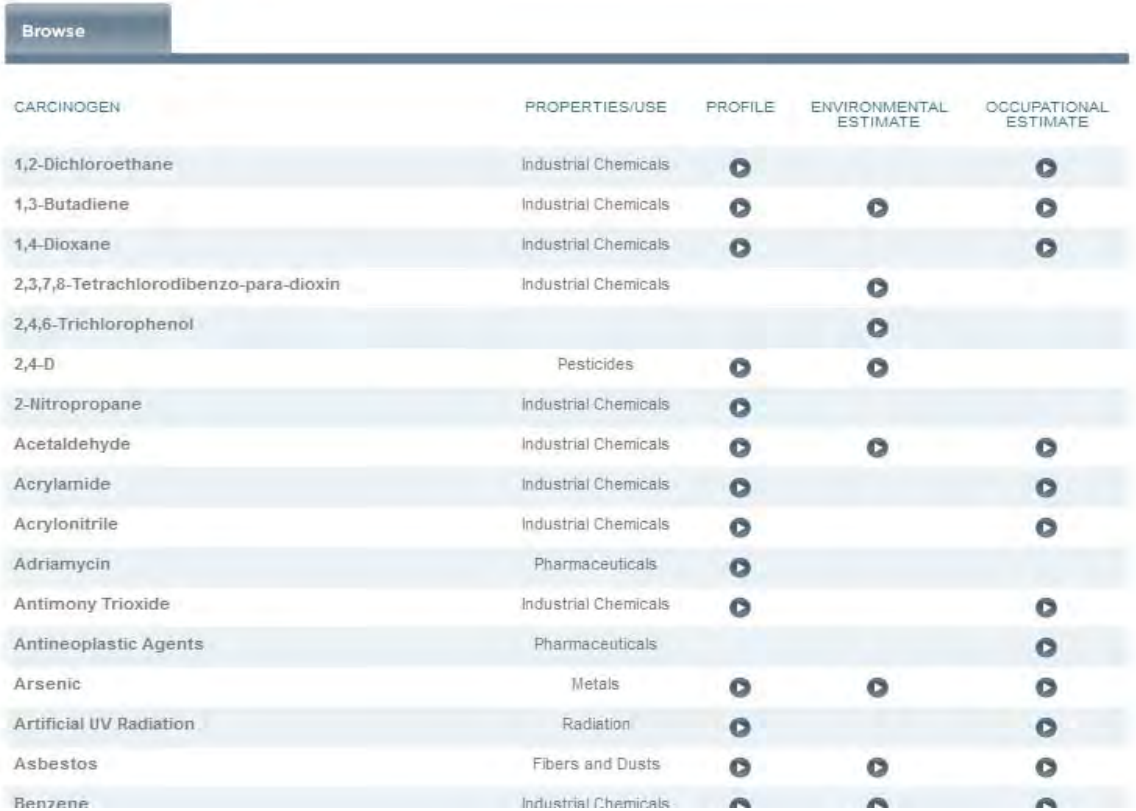
ABOUT US | PROFILES & ESTIMATES | TUTORIALS & TOOLS | COMMUNICATIONS

Français

CAREX Canada is a national surveillance project that estimates the number of Canadians exposed to substances associated with cancer in the workplace and community environments. These estimates provide significant support for targeting exposure reduction strategies and cancer prevention programs.

View Profiles & Estimates ▸

Carcinogen Database



Browse

CARCINOGEN	PROPERTIES/USE	PROFILE	ENVIRONMENTAL ESTIMATE	OCCUPATIONAL ESTIMATE
1,2-Dichloroethane	Industrial Chemicals	●		●
1,3-Butadiene	Industrial Chemicals	●	●	●
1,4-Dioxane	Industrial Chemicals	●		●
2,3,7,8-Tetrachlorodibenzo-para-dioxin	Industrial Chemicals		●	
2,4,6-Trichlorophenol			●	
2,4-D	Pesticides	●	●	
2-Nitropropane	Industrial Chemicals	●		
Acetaldehyde	Industrial Chemicals	●	●	●
Acrylamide	Industrial Chemicals	●		●
Acrylonitrile	Industrial Chemicals	●		●
Adriamycin	Pharmaceuticals	●		
Antimony Trioxide	Industrial Chemicals	●		●
Antineoplastic Agents	Pharmaceuticals			●
Arsenic	Metals	●	●	●
Artificial UV Radiation	Radiation	●		●
Asbestos	Fibers and Dusts	●	●	●
Benzene	Industrial Chemicals	●	●	●

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Carcinogen Profiles

Asbestos

PROFILE

FIBERS AND DUSTS – Known Carcinogen (IARC 1)

CAS No. 1332-21-4

Photo: Wikimedia Commons [1]

- General Information
- Regulations and Guidelines
- Main Uses
- Canadian Production and Trade
- Occupational Exposures
- Environmental Exposures
- Sources

IARC Monograph Vol. 14, Suppl. 7, 1987 (Group 1)

IARC Monograph Vol. 100C, *in prep.* (Group 1)

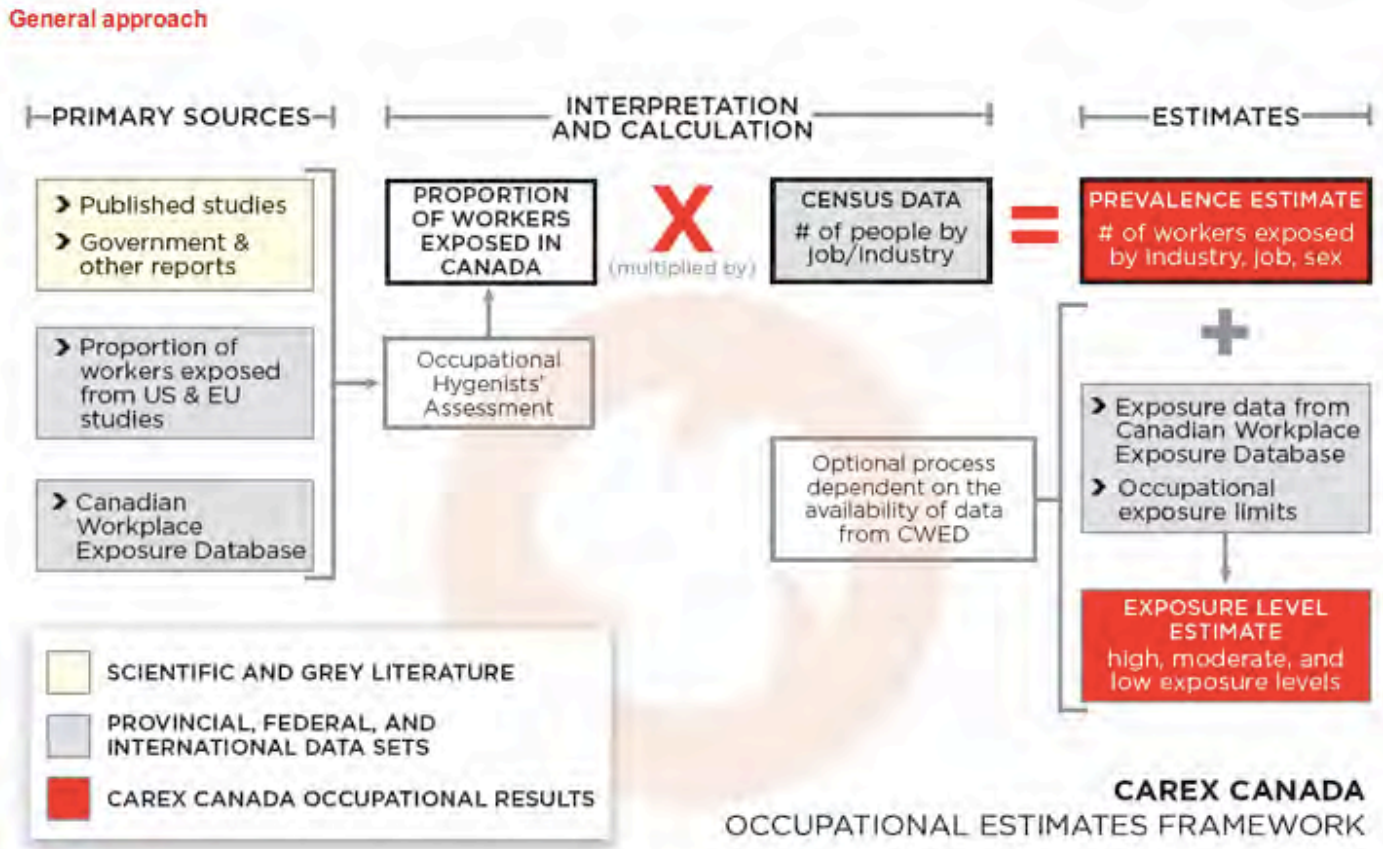
Production and Trade

Activity	Quantity
Canadian Production	175,000 t
Export: Mainly to India, Indonesia	135,459 t of 'asbestos'
Import: Mainly from China	22 t of 'asbestos'
Import: Mainly from the US	57 t of 'articles of asbestos-cement,

Estimating exposure

- General approach
  - existing Canadian exposure data
  - census population estimates
  - the best exposure estimation/modelling procedures available
- Techniques varied considerably
  - Agricultural pesticides
  - Occupational
  - Environmental

Occupational Exposure methods



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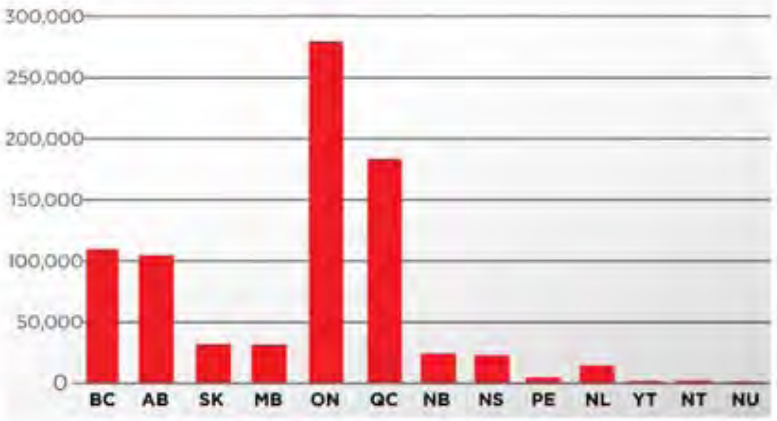
Diesel Exhaust

804,000 WORKERS (EST.) DIESEL ENGINE EXHAUST EXPOSURE **IN CANADA**

eWORK

FIVE LARGEST EXPOSURE GROUPS BY INDUSTRY		PROPORTION OF INDUSTRY EXPOSED
Truck transportation	188,000	68%
Auto repair and maintenance	59,000	35%
Public administration (local)	37,000	13%
School and employee bus transportation	36,000	83%
Taxi and limo service	34,000	79%

WORKERS EXPOSED TO DIESEL ENGINE EXHAUST **BY REGION**

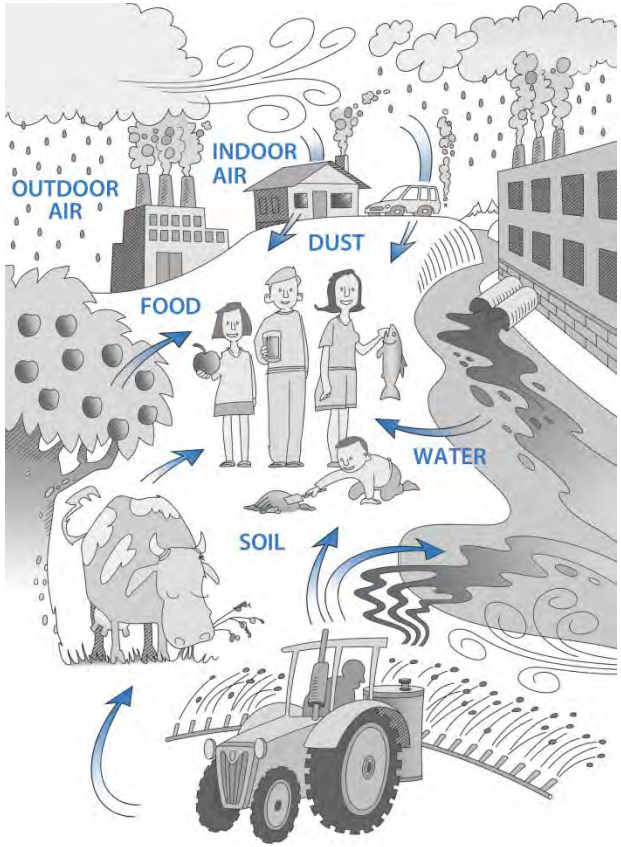


CAREX CANADA

Who is at risk? Number exposed in Canada and cancer sites

Known or suspected carcinogen	# Exposed	Confirmed	Suspected
Shift work with potential for circadian disruption	2,800,000		Breast, prostate?
Solar radiation	1,500,000	Skin	
Diesel engine exhaust	804,000	Lung	
Silica (crystalline)	349,000	Lung	Others?
Polycyclic aromatic hydrocarbons (PAHs)	307,000	Lung, skin, bladder	
Benzene	297,000	Acute non-lymphatic leukemia	ALL, multiple myeloma, NHL
Wood dust	293,000	Sinonasal, nasopharynx	
UV radiation (artificial sources)	207,000	Skin, eye	
Lead	202,000		Lung, stomach
Asbestos	152,000	Lung, mesothelioma, larynx, ovary	Pharynx, colon, rectum, stomach

CAREX – Environmental Estimates



Pathway:	Measured levels:	
Outdoor air	0.86	ug/m3
Indoor air	2.4	ug/m3
Drinking water	0.5	ug/L
Foods:		
• beef	18.0	ug/kg
• bananas	30.0	ug/kg
• cheese	2.5	ug/kg
Beverages:		
• soft drinks	12.0	ug/L

BUT: what is the priority here?

It depends on how much is inhaled and ingested (ie – intake or dose).

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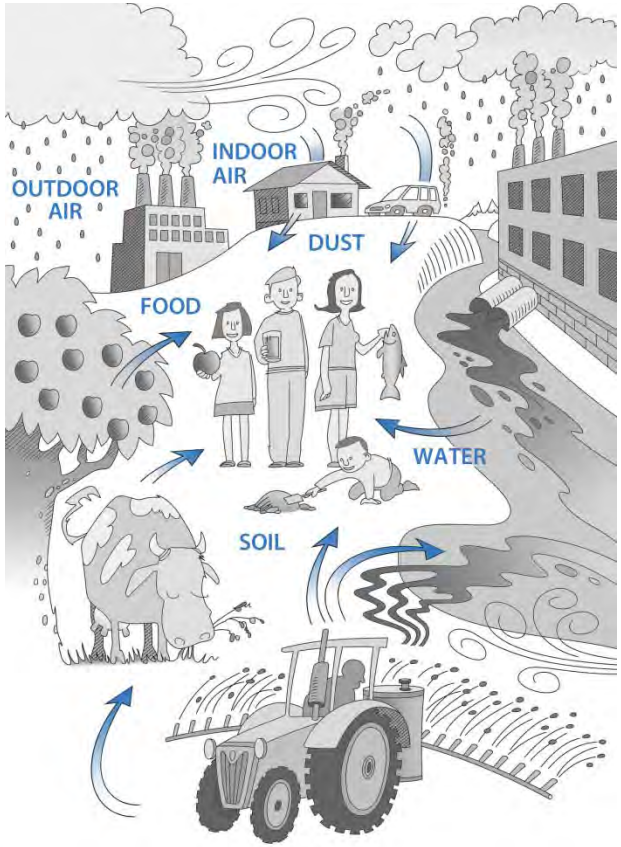
CAREX – Environmental Exposures



INTAKE (DOSE)

Pathway:	Inhaled or ingested per day*:	
Outdoor air	0.005	mg
Indoor air	0.05	mg
Drinking water	0.0001	mg
Foods:		
• beef	0.0004	mg
• bananas	0.00002	mg
• cheese	0.000004	mg
Beverages:		
• soft drinks	0.002	mg

*** Based on standard inhalation and ingestion rates**

GAP: guidelines for recommended daily intake exist for only a few substances in a few exposure pathways, some guidelines do not consider cancer…

CAREX CANADA

2006 Canadian Potential Lifetime Excess Cancer Risk Estimate - ACETALDEHYDE

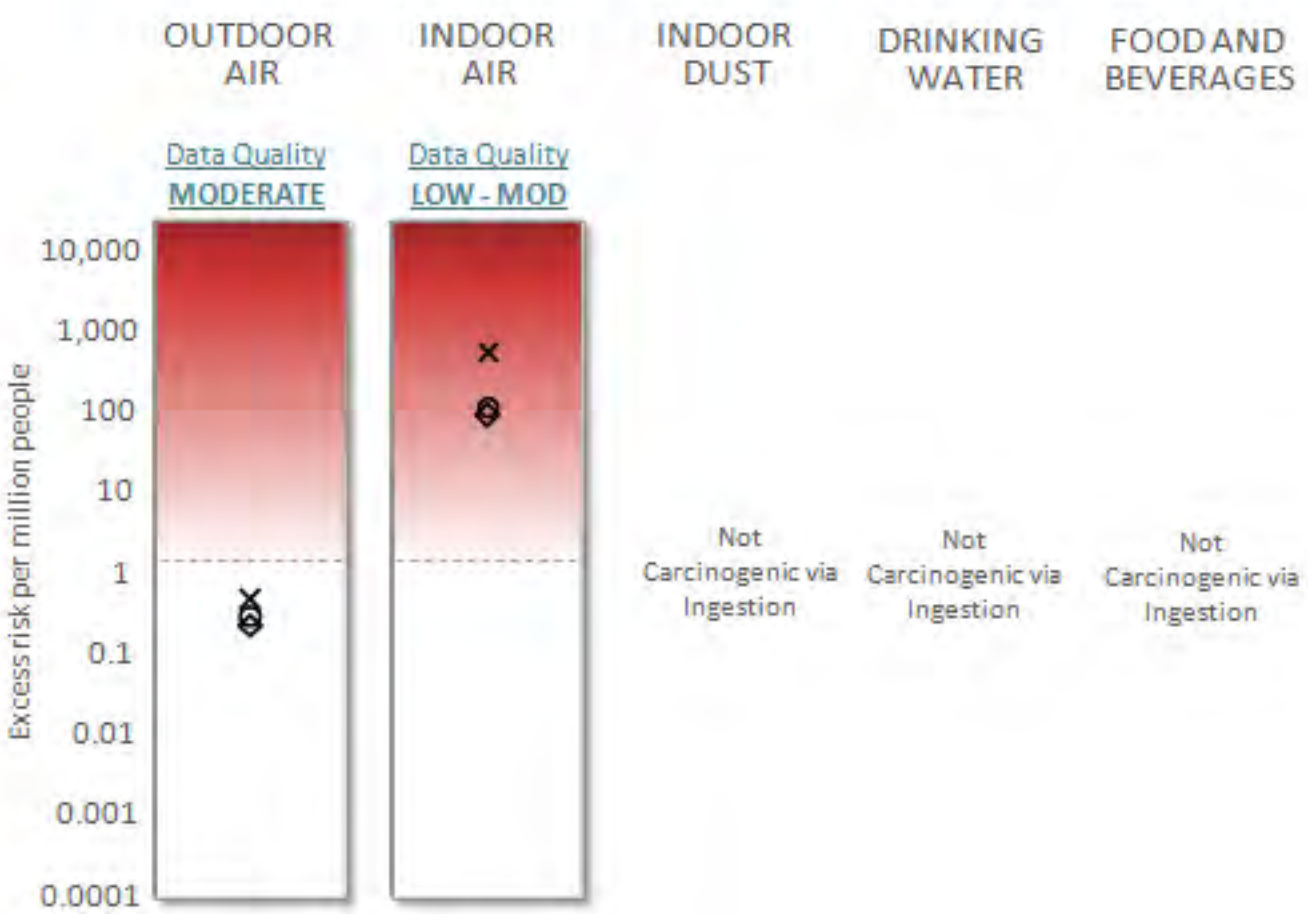
(assuming measured levels and intake remain constant)

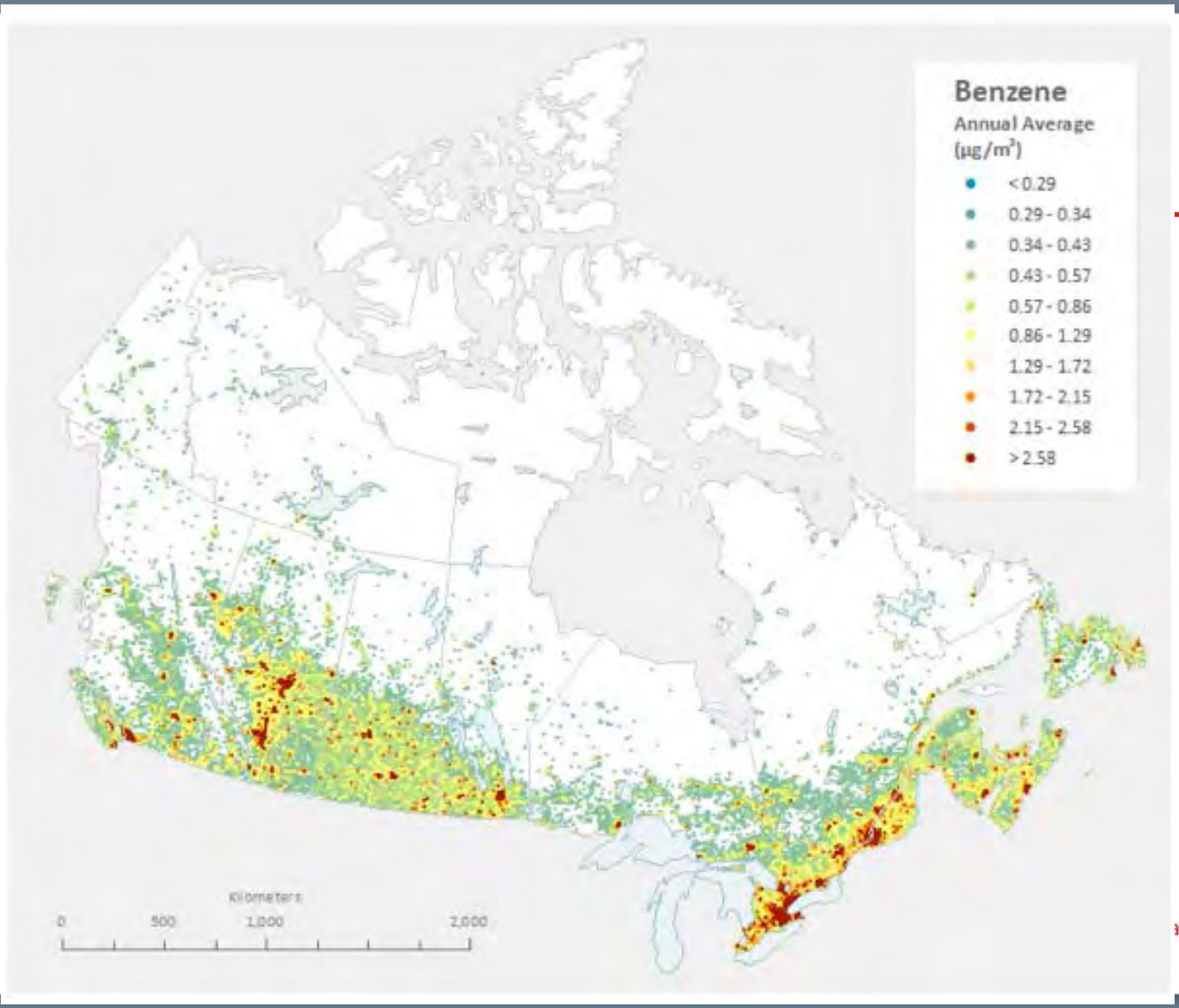
When potential lifetime excess risk is **greater than 1 per million people** in any single pathway, consider identifying ways to reduce the possibility of individual exposure.

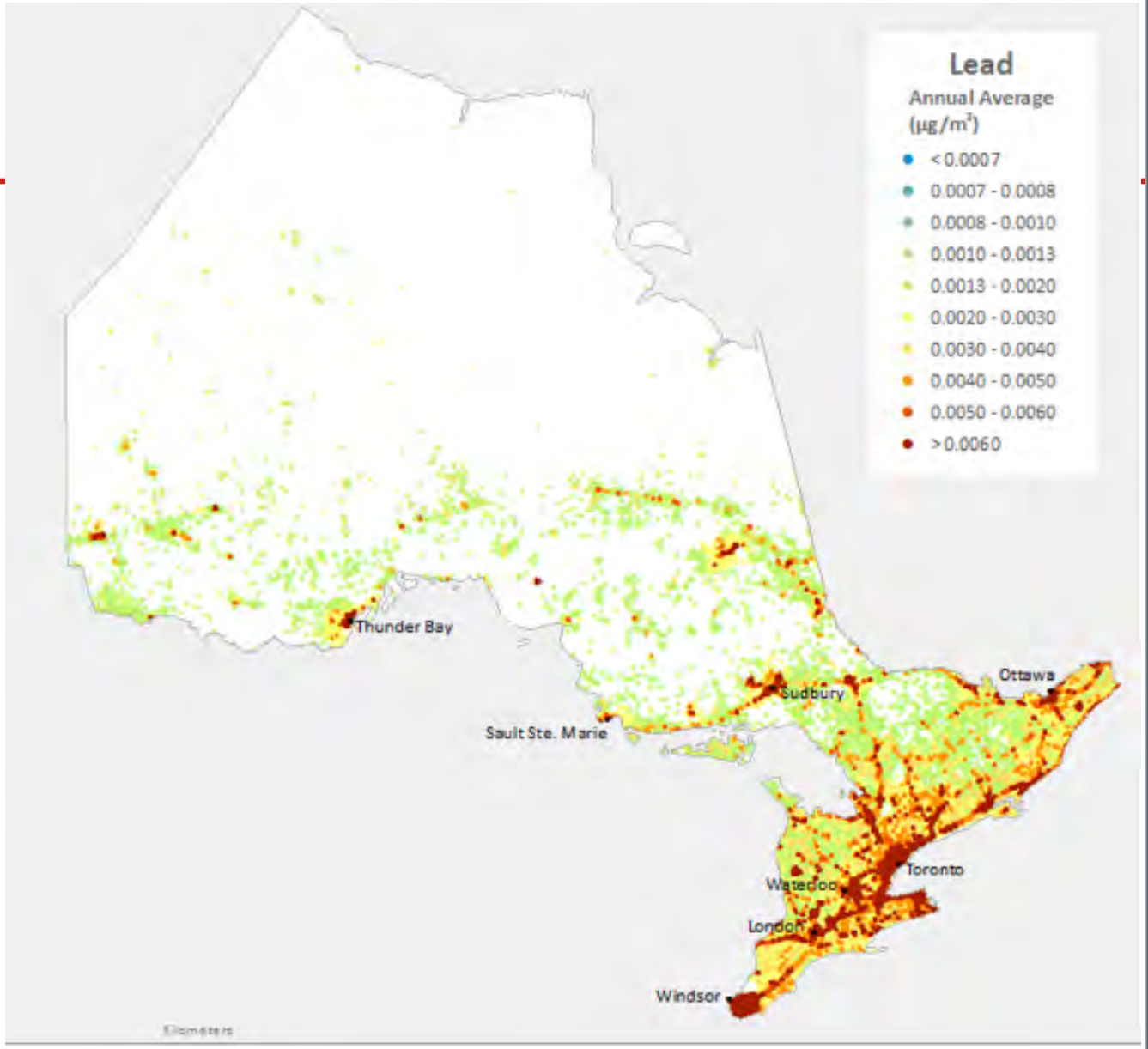
Average Risk:
based on Average Intake X Cancer Potency Factor from:

- Health Canada □
- OEHHA ○
- US EPA ◇

Maximum Risk: ×
based on Maximum Intake X highest Cancer Potency Factor




Benzene
Annual Average
(µg/m³)
< 0.29
0.29 - 0.34
0.34 - 0.43
0.43 - 0.57
0.57 - 0.86
0.86 - 1.29
1.29 - 1.72
1.72 - 2.15
2.15 - 2.58
> 2.58
Kilometers
0
500
1,000
2,000



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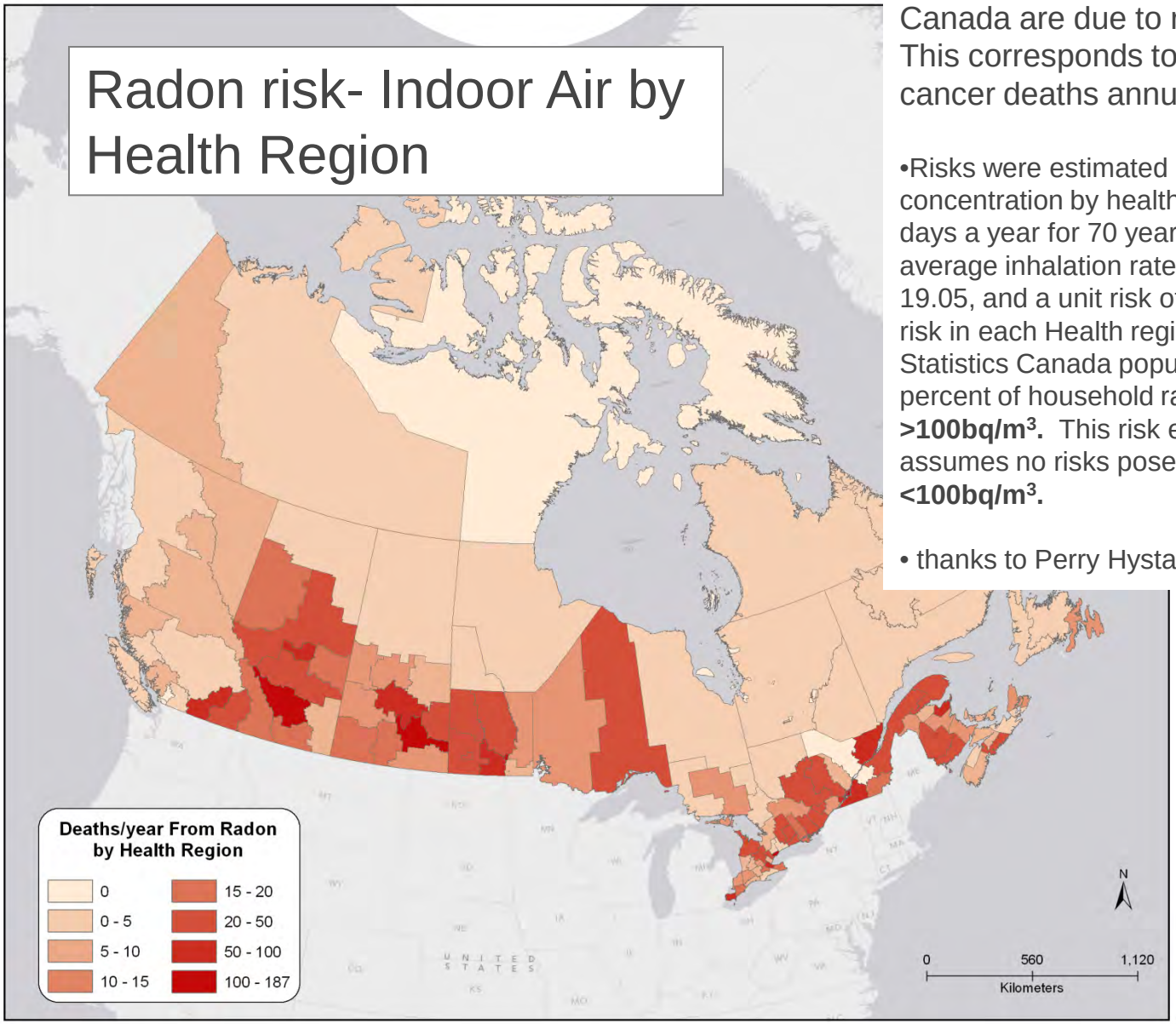
Radon risk- Indoor Air by Health Region



It is estimated that 3,300 deaths/year in Canada are due to radon exposures. This corresponds to ~16% of the lung cancer deaths annually in Canada.

•Risks were estimated using the average radon concentration by health region, exposure 365 days a year for 70 years, a life stage weighted average inhalation rate per day indoors of 19.05, and a unit risk of 1.8e-11. Populations at risk in each Health region were estimated using Statistics Canada population estimates and the percent of household radon measurements **>100bq/m^3.** This risk estimate therefore assumes no risks posed by radon exposures **<100bq/m^3.**

• thanks to Perry Hystad, Alejandro Cervantes

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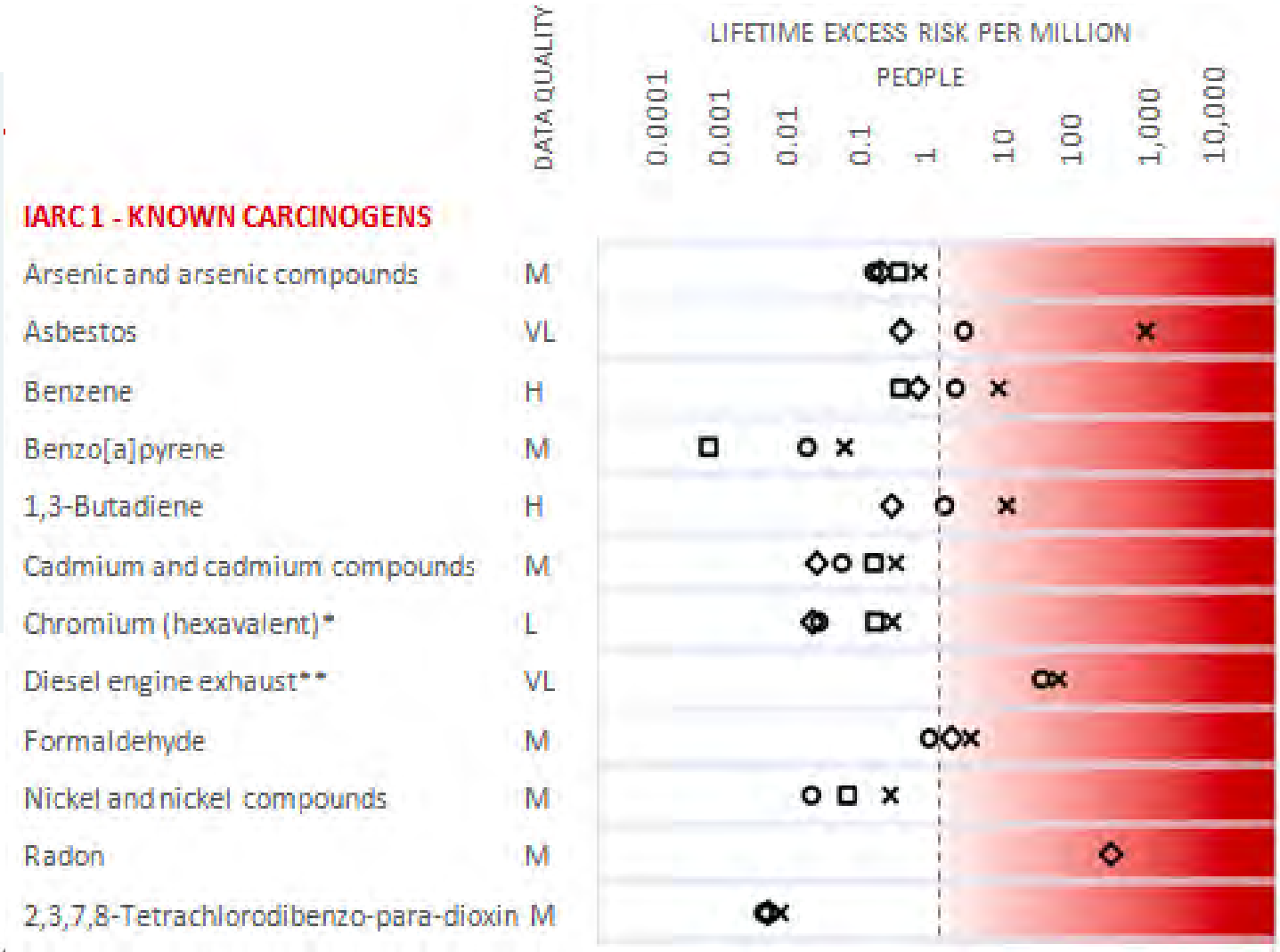
Lifetime Excess Cancer Risk by Substance – Outdoor Air

Average Risk:
based on average intake X cancer potency or unit risk factor from:

- Health Canada □
- CA OEHHA ○
- US EPA ◇

Maximum Risk: ×
based on maximum intake X highest cancer potency factor or unit risk factor



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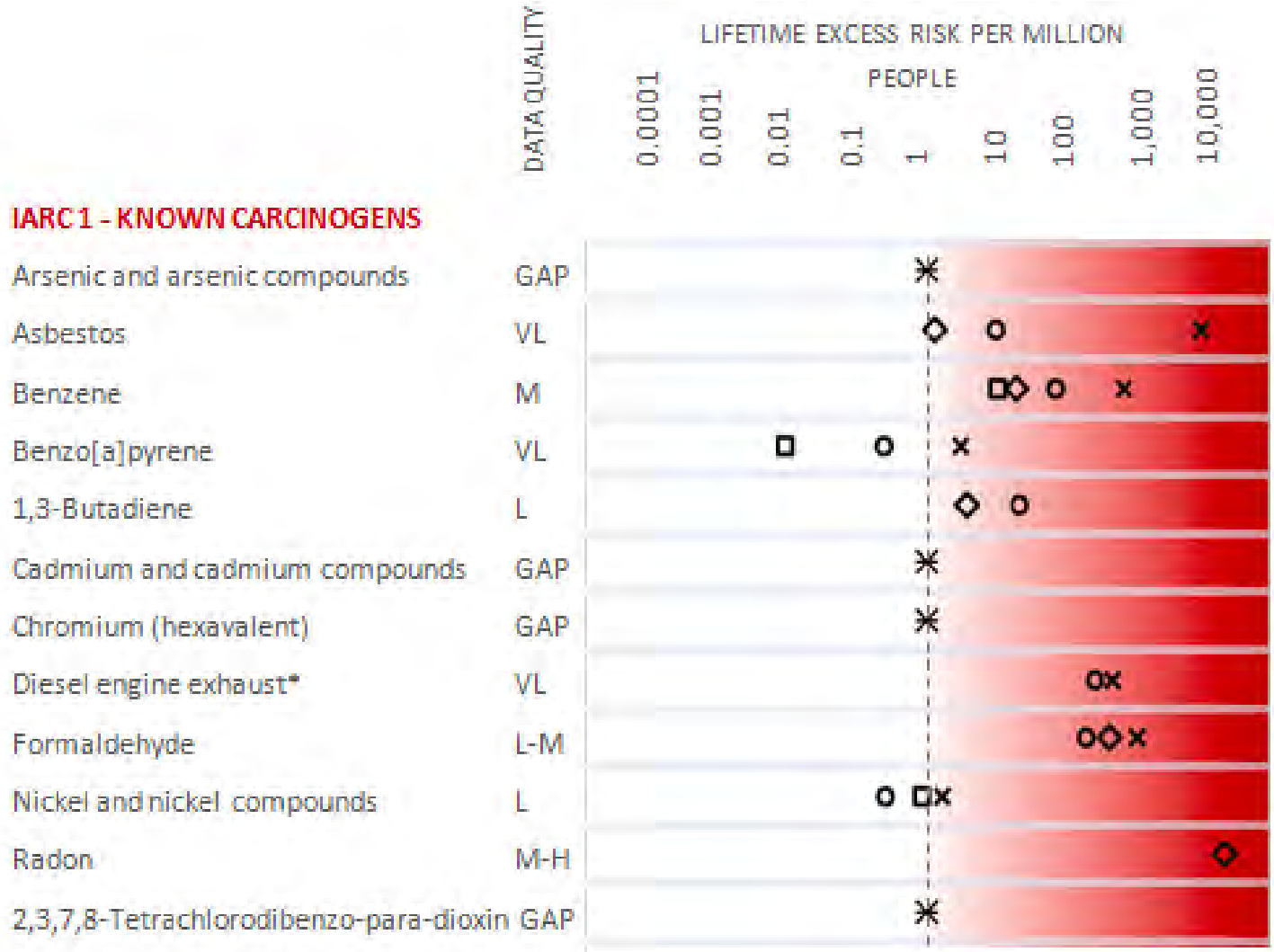

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CAREX EMISSIONS PROJECT

CAREX Emissions Mapping Project

Mapping Sources and Concentrations of Known and Suspected Carcinogens

- Home
- Ranks By Toxicity
- Pesticides
- More Google Earth Files
- Resources and Tutorials
- Am I Exposed?
- About Us

CAREX CANADA Back To

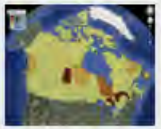
We have ranked different geographic regions in Canada based on total emissions of known and suspected carcinogens to air (in toxic equivalents) for 2006. Use these rankings to compare total emissions across regions, and to explore which sources contribute most in each region in terms of total amount or toxic equivalent amounts.

Ranks are based on emission amounts reported to the National Pollutant Release Inventory by large companies, and our own estimates of emissions from residential oil, gas and wood heating, passenger cars and heavy duty vehicles, trains, airplanes taking off and landing, and hazardous waste incinerators.

A short tutorial on our ranking files.

Download and view CAREX's Ranking Files:

Then click on any ranked feature to see a full list of substances emitted, estimates of emission levels, a link to a printable report, and more...

MAJOR CITIES	PROVINCES	HEALTH REGIONS	WATERSHEDS
			

Ranking Reports available in text form

PLEASE NOTE: A high rank does not necessarily indicate a high health risk. Visit the CAREX environmental estimates for more information on actual measured levels and potential health risk for different substances.

Ranking Method Overview:

1A. Estimate total emissions for each substance: (when data are available)

Emissions reported to the NPRI + (Activity Data x Emission Factors) = Total annual emissions for a substance (kilograms)

Estimates for transportation and residential heating*

1B. Convert to total toxic

CAREX Emissions Mapping Project

Mapping Sources and Concentrations of Known and Suspected Carcinogens

- Home
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MAJOR CITIES | PROVINCES | HEALTH REGIONS | WATERSHEDS

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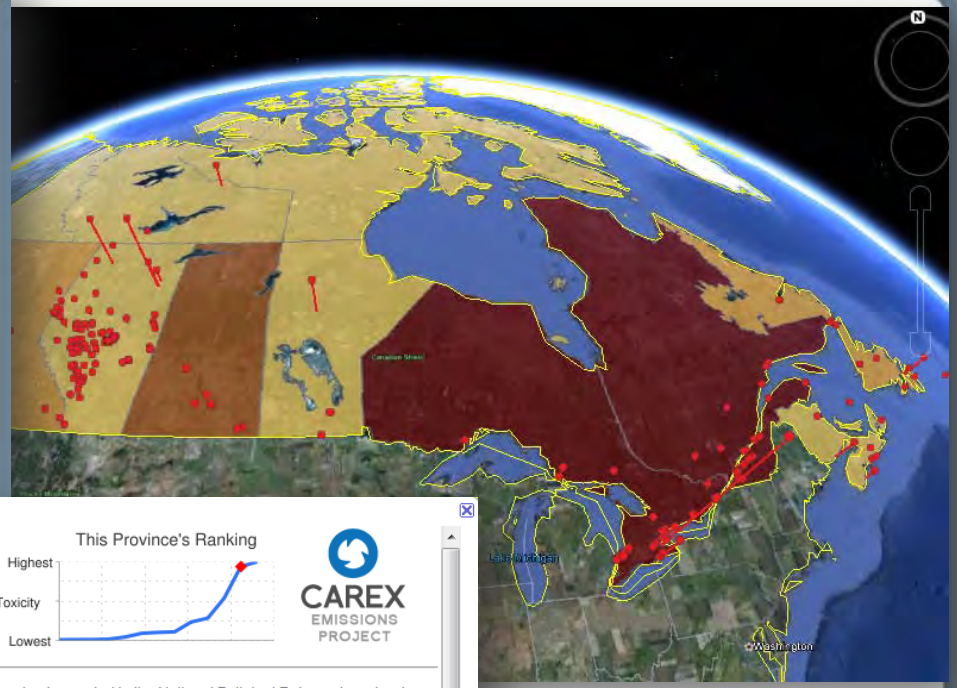
1B. Convert to total toxic



Ontario

PDF Summary Report

This Province's Ranking

CAREX EMISSIONS PROJECT

These rankings are based on emissions to air reported to the National Pollutant Release Inventory in 2006 and our best estimates of emissions from motor vehicles, trains, airplanes taking off and landing, hazardous waste incinerators, and residential heating (oil, gas, and wood). Other sources of these known or suspected carcinogens may exist, and other pollutants not listed here may be emitted from these sources.

NOTE: A high rank does not necessarily indicate a high health risk. Visit the main CAREX environmental estimates for more information on actual measured levels and potential health risk for different substances.

SUBSTANCE	ANNUAL AMOUNT (Kg) *Click for Sources*	TOXICITY FACTOR	TOXIC EQUIVALENT (Kg) *Compared to Benzene*	SUBSTANCE RANK	# PROVINCES WITH SUBSTANCE
Acetaldehyde	3,511,239	0.017	59,691	1st	13
Arsenic	32,030	2600	83,278,776	1st	13
Benzene	12,197,400	1	12,197,400	1st	13
Benzo[a]anthracene	823	54	44,448	3rd	13
Benzo[a]pyrene	1,021	6400	6,531,537	3rd	13
Benzo[b]fluoranthene	2,038	130	264,945	3rd	13
Benzo[k]fluoranthene	387	NO TF	No TQ	3rd	13
Butadiene	1,407,087	0.54	759,827	1st	13
Cadmium	14,077	28	394,152	2nd	13
Chloroform	< 0.5	1.6	< 0.5	4th	5
Chromium	7,546	130	294	1st	13
Chrysene	2,982	5.1	15,206	3rd	13
Dichloromethane	102,141	0.2	20,428	1st	7

SELECT A SUBSTANCE TO DOWNLOAD FILES: Benzene

Benzene

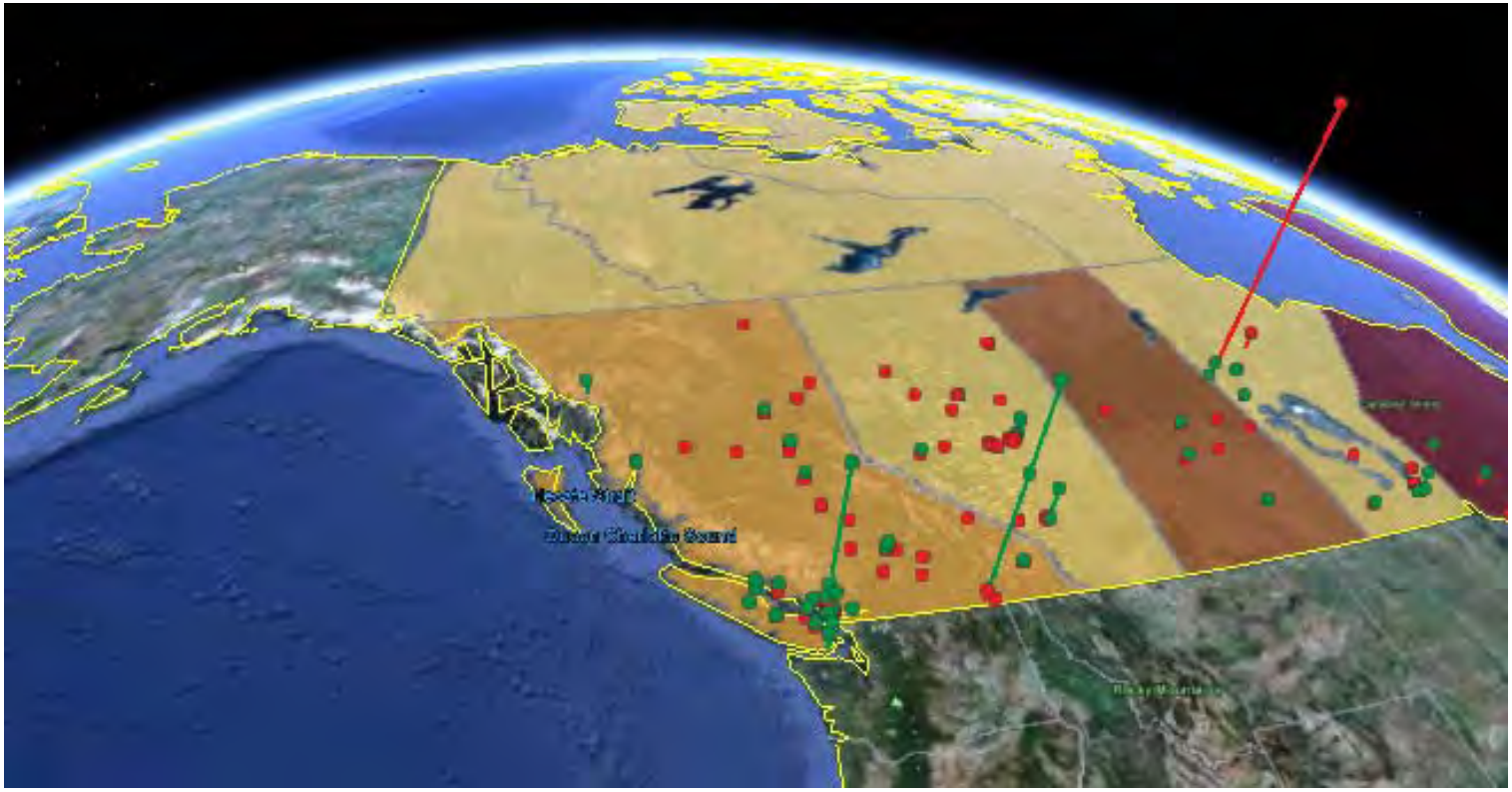
NATIONAL FILES

Measured Values	National Air Pollution Surveillance (NAPS)
Industrial Emissions	To Air
	To Water
	To Land
Other Sources	Airports
	Incinerators
	Tailings
	Wasterock

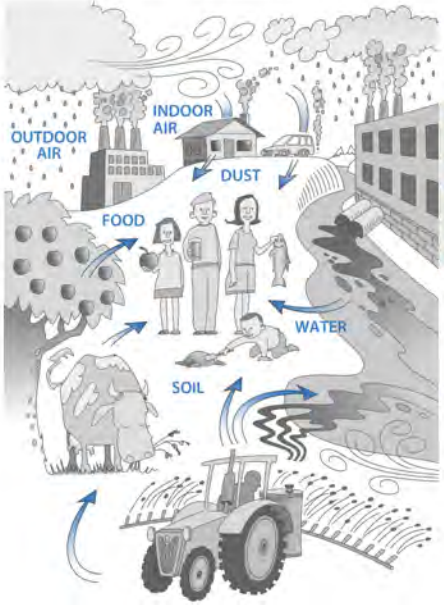
...ene

	Annual Amount (kg)
	11,169,817
	939
...ning	694,194
...as	No Emission Factor
	317,123
	< 0.5
...nd landing	15,328

EMP Example – Lead emissions in soil and air



COMMON EXPOSURE PATHWAYS:



Exposure occurs only when a substance is present in the air you breathe; the food, dust, and soil you eat; and the water and beverages you drink.

Pollutants released to air, land, and water may travel through different pathways before coming into contact with a person.

The physical characteristics of a substance affect how long it stays in the environment, how far it travels, and whether or not it can transfer between air, water, and soil, or be taken up by plants.

Find out which known or suspected carcinogens on the CAREX priority list are present in which exposure pathways:

Substances by exposure pathway

Find out more about some of the factors that affect exposure levels via:

Outdoor air
Indoor air
Indoor dust
Soil
Drinki
Foods
Absor

*Exposure can occur through the skin but this pathway is rarely important in

TUTORIAL VIDEOS:

- How To Read the Ranking Files
- How to Read the Pesticides Files * In Progress
- How to Add More Google Earth Files
- Google Earth Basics: Navigating
- Google Earth Basics: Searching

MANUALS:

- CAREX Manual of Google Earth Basics
  - System Requirements
  - Navigating in Google Earth
  - Searching in Google Earth
  - Adding and Saving files in Google Earth
  - Adding placemarks, polygons, and paths
- CAREX Manual of Geocoding and Creating Google Earth files [for Excel 2007] OR [for Excel 2003]
  - An Overview of Excel Basics
  - Adding your own data directly to Google Earth
  - Converting data in a spreadsheet to a Google Earth file
- Download tools, data, and exercises* to work through Geocoding Manual

*Updated Nov 28/2011 – Download new version now

CAREX EMISSIONS MAPPING PROJECT

IMATING EMISSIONS OF KNOWN AND SUSPECTED CARCINOGENS TO OUTDOOR AIR

METHODS FOR:

Prepared by:
Eleanor Setton, PhD
Anders Erickson, PhD candidate
CAREX Canada - UNIVERSITY OF VICTORIA SITE

November 2011

Emissions and Measured Levels by Substance | Mines and Contaminated Sites | Other Links

Other useful and interesting maps and Google Earth files are available from other websites. Check back regularly as we add to the list.

Canada Lands

The Canada Lands in Google Earth site is maintained by Natural Resources Canada and contains the location, administrative boundaries, and parcel data of the geopolitical Aboriginal Reserve Lands.

Commission for Environmental Cooperation

The CEC's *Taking Stock* Online tools allow you to explore information on pollution America. Create customized queries and download your results in a variety of form Google Earth and Google Maps.

National Pollutant Release Inventory

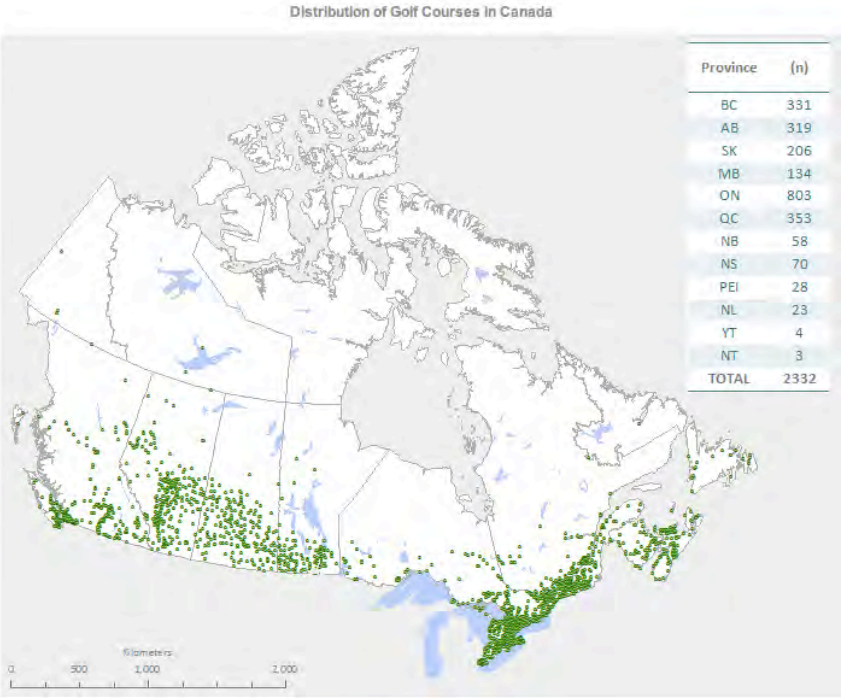
The NPRI is Canada's legislated and publicly accessible inventory of pollutant releases (to air, water, and land), disposals, and transfers for recycling. The website provides resources for accessing, analyzing, and interpreting information on pollutant releases and transfers in Canada.

Canadian Wind Energy Atlas

The Atlas provides wind direction information for any latitude/longitude in Canada.

Contact us to organize a training session:
info@carexcanada.ca

Golf Course Exposure?



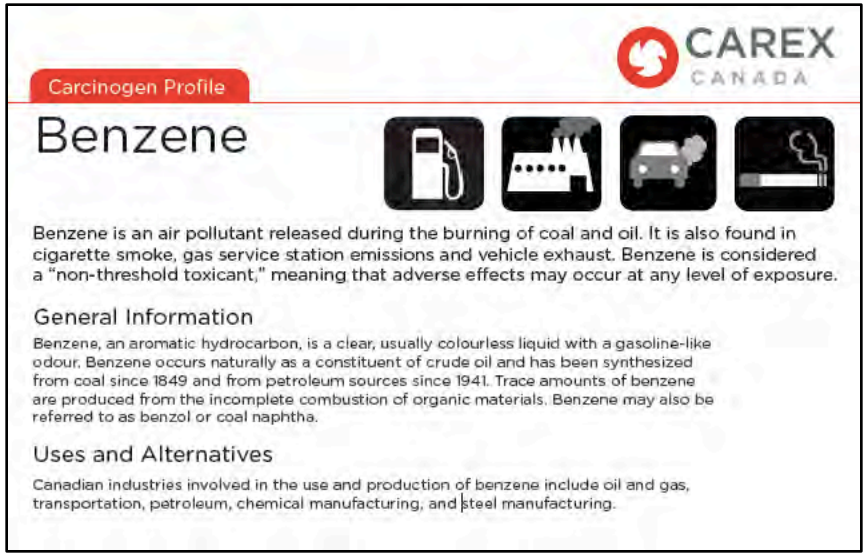
Housing Density Surrounding Golf Courses

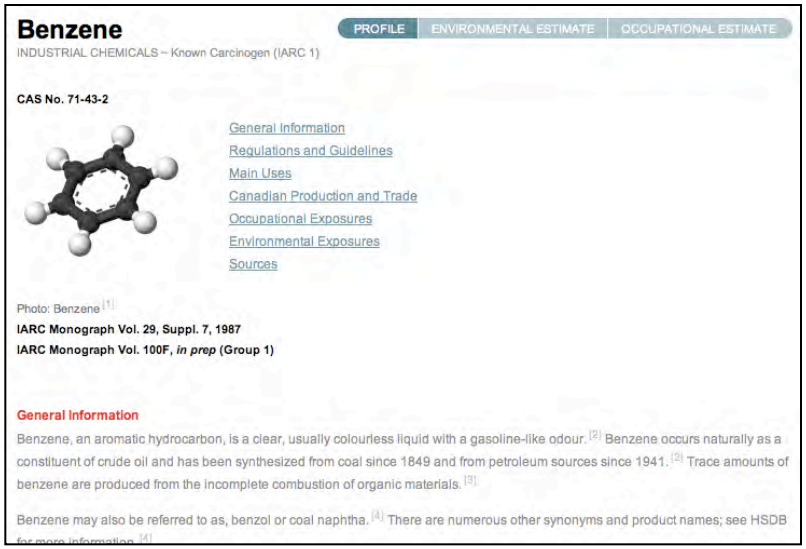
Province	Golf Courses (n)	Low (0-2 houses)	Low-Medium (3-5 houses)	Medium-High (6-20 houses)	High (>20 houses)
BC	331	189 (57%)	63 (19%)	40 (12%)	39 (12%)
AB	319	216 (68%)	51 (16%)	25 (8%)	27 (8%)
SK	206	154 (75%)	44 (21%)	6 (3%)	2 (1%)
MB	134	88 (66%)	28 (21%)	14 (10%)	4 (3%)
ON	803	393 (49%)	257 (32%)	104 (13%)	49 (6%)
QC	353	171 (48%)	97 (27%)	43 (12%)	42 (12%)
NB	58	18 (31%)	34 (59%)	6 (10%)	0
NS	70	35 (50%)	30 (43%)	5 (7%)	0
PE	28	23 (82%)	3 (11%)	2 (7%)	0
NL	23	14 (61%)	5 (22%)	3 (13%)	1 (4%)
NU	0	--	--	--	--
NT	3	3 (100%)	0	0	0
YT	4	4 (100%)	0	0	0
CANADA	2332	1308	612	248	164
%		56	26	10	7

CAREX CANADA

Knowledge Translation: Data Product tailoring

- Dobbins et al: content tailoring most effective for KT (2009)
- Iterative process of data product generation





CAREX CANADA

www.carexcanada.ca

For more detailed information

Visit our website:

- Explore profiles, estimates and tools
- Use online tutorials, download links to presentations

Sign up for our e-Bulletin:

- Find out about upcoming webinars:
- Get the latest updates on data and tools

Discuss ways that CAREX data/tools can be used in your work:

- Email us at info@carexcanada.ca

EXTRA SLIDES

Tools for viewing exposure estimates

Tools

We have developed additional tools to help users explore the data used for our estimates and indicators, and to facilitate access to a wide range of spatial data about known and suspected carcinogens in outdoor environments.

eRISK

eRISK is a Microsoft Access tool that allows you to:

- explore the data used to produce the indicators of potential lifetime excess cancer risk for environmental exposures, and
- use your own local data to see how the risk indicators might differ from the national levels.

Please contact info@carexcanada.ca to request the eRISK application and training manual. You will need MS Access 2007 or 2010 installed on your computer to use the eRISK tool.

EMISSIONS MAPPING PROJECT

The **Emissions Mapping Project** provides a wide range of files that can be easily downloaded and displayed with Google Earth, and allow you to:

- see how watersheds, provinces, health regions and major cities rank according to total toxicity of emissions to air,
- see how different sources contribute to the rankings, and
- see information on sources and levels of known and suspected carcinogens in outdoor environments.

We have also developed tutorials to help you use Google Earth and our files, and a manual showing you how to create your own Google Earth files using simple spreadsheets. Visit the Emissions Mapping Project to get started now:

Launch EMP Tool

The Emissions Mapping Project (EMP) was developed with additional funding from the Canadian Institutes for Health Research.

CAREX CANADA

CAREX – Environmental Estimates

By using standard inhalation and ingestion rates, we can compare different exposure pathways…

BUT, we also want to compare substances:

Benzene:

	MEASURED	INTAKE	CANCER POTENCY	LIFETIME EXCESS RISK
Outdoor air	0.86 ug/m^3	0.005 mg	0.1	6.7 per million
Indoor air	2.40 ug/m^3	0.05 mg	0.1	65.0 per million

Acetaldehyde:

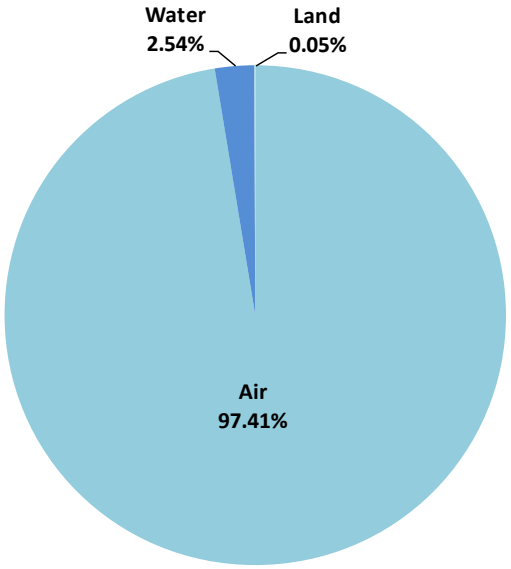
Outdoor air	0.97 ug/m^3	0.005 mg	0.01	0.7 per million
Indoor air	20.00 ug/m^3	0.380 mg	0.01	54.0 per million

It depends on the toxicity/potency of the substance

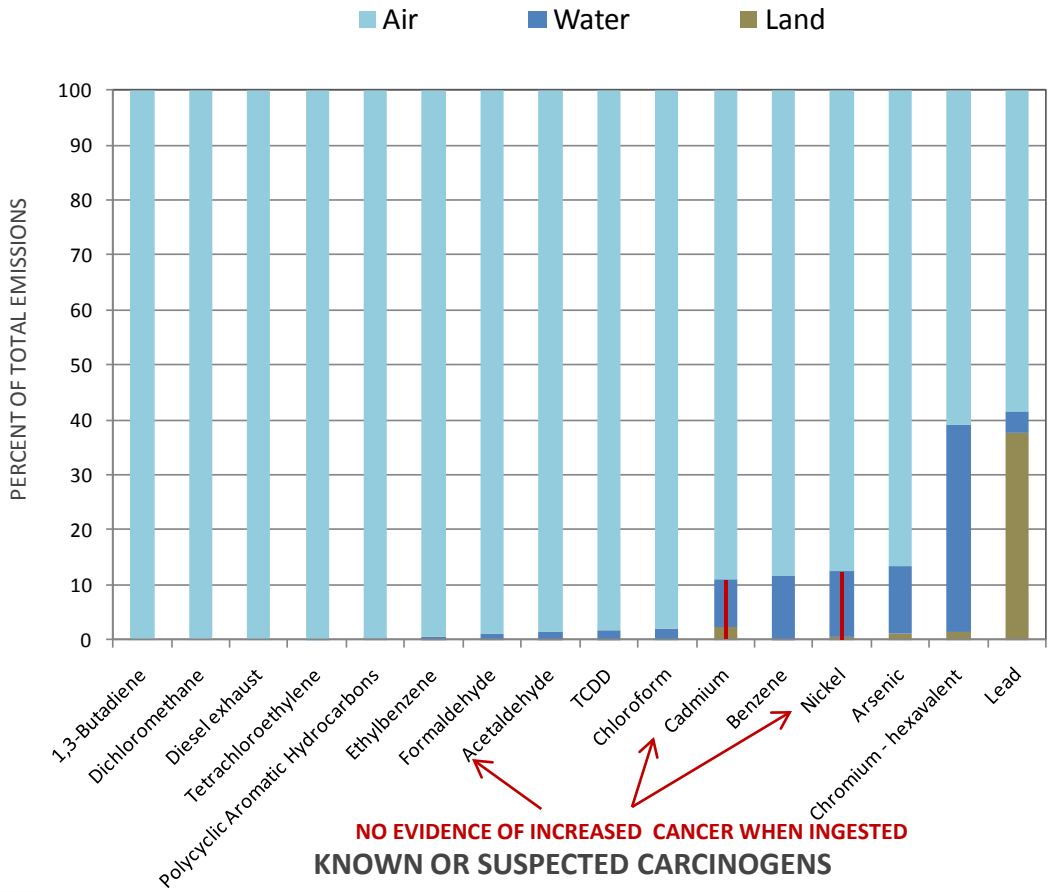
CAREX CANADA

Emissions Mapping Project - Overview

TOTAL EMISSIONS OF ALL SUBSTANCES REPORTED TO THE NPRI IN 2006



TOTAL EMISSIONS OF SELECTED SUBSTANCES REPORTED TO THE NPRI IN 2006



CAREX CANADA

Emissions Mapping Project - Overview

PROVINCES | HEALTH REGIONS | WATERSHEDS | MAJOR CITIES | ABORIGINAL COMMUNITIES

RANKS ARE BASED ON THE TOTAL EMISSIONS REPORTED BY LARGE INDUSTRIES, AND OUR OWN ESTIMATES FOR RESIDENTIAL OIL, GAS AND WOOD HEATING, PASSENGER CARS AND HEAVY DUTY VEHICLES, TRAINS, AIRPLANES TAKING OFF AND LANDING, AND HAZARDOUS WASTE INCINERATORS.

1. EMISSIONS OF A SUBSTANCE AS REPORTED TO THE NATIONAL POLLUTANT RELEASE INVENTORY + ESTIMATES FOR OTHER SOURCES BASED ON → ACTIVITY DATA (TOTAL FUEL CONSUMED) X EMISSION FACTORS FOR EACH SUBSTANCE

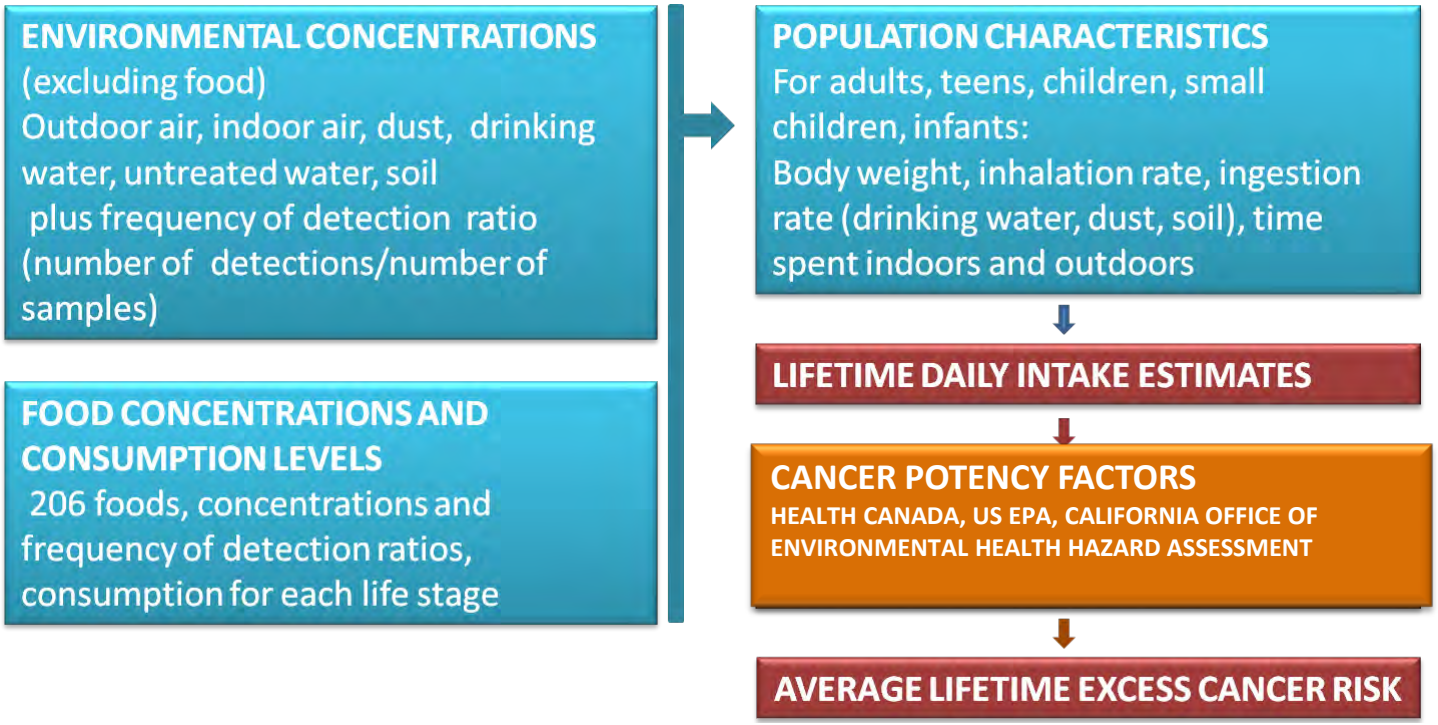
2. TOTAL SUBSTANCE EMISSIONS FROM ALL SOURCES X HUMAN TOXICITY POTENTIAL FACTOR = TOTAL SUBSTANCE EMISSIONS IN TOXIC EQUIVALENT KILOGRAMS

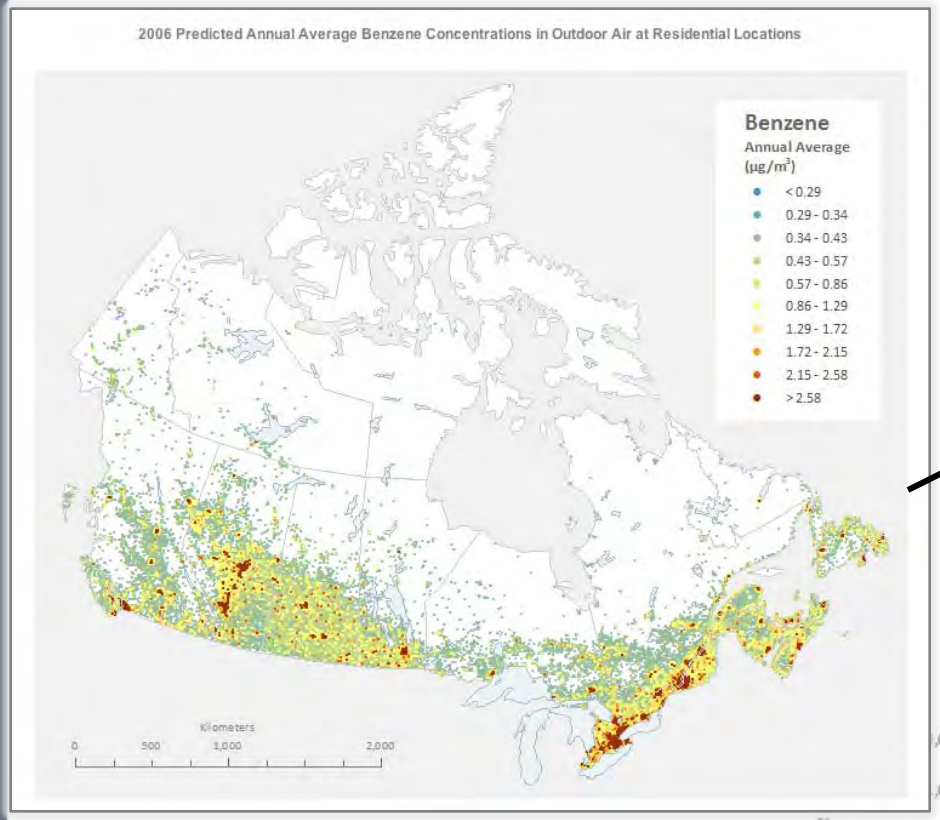
3. TOTAL TOXIC EQUIVALENT EMISSIONS FOR ALL SUBSTANCES → RANK

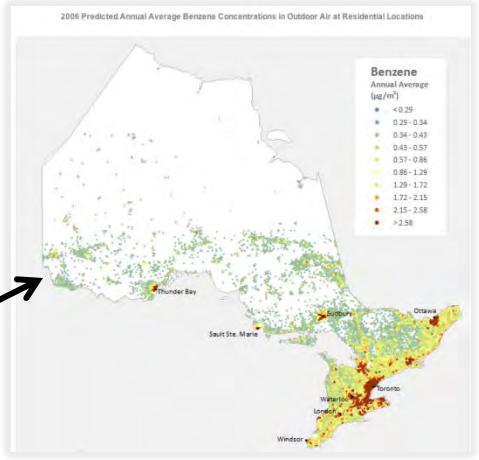
SCROLL DOWN FOR A BRIEF OVERVIEW OF THE RANKING METHODS

DOWNLOAD THE METHODS REPORT FOR FULL DETAILS

CAREX eRisk – Inputs example

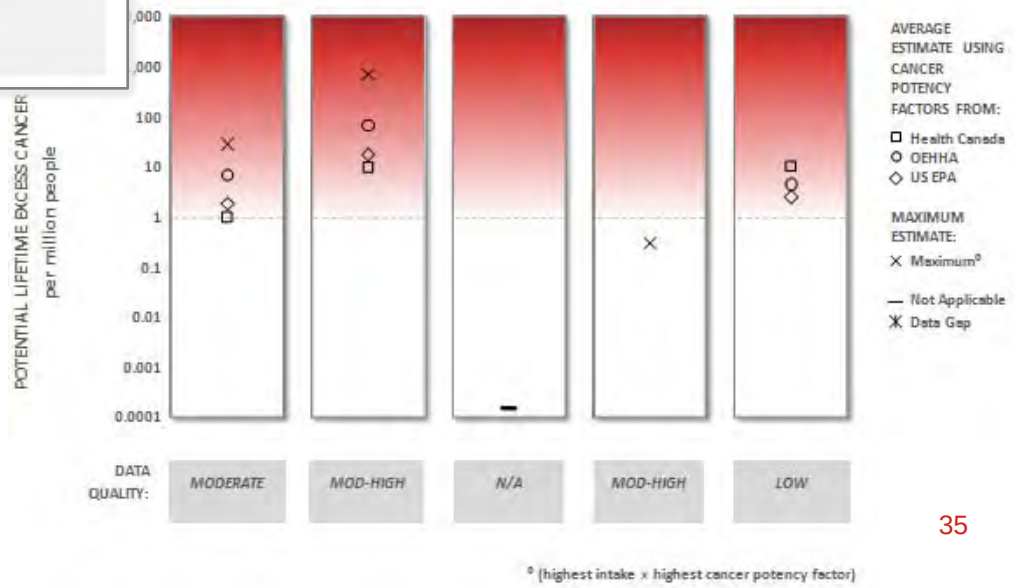






CAREX eRisk – National estimate - benzene

Benzene



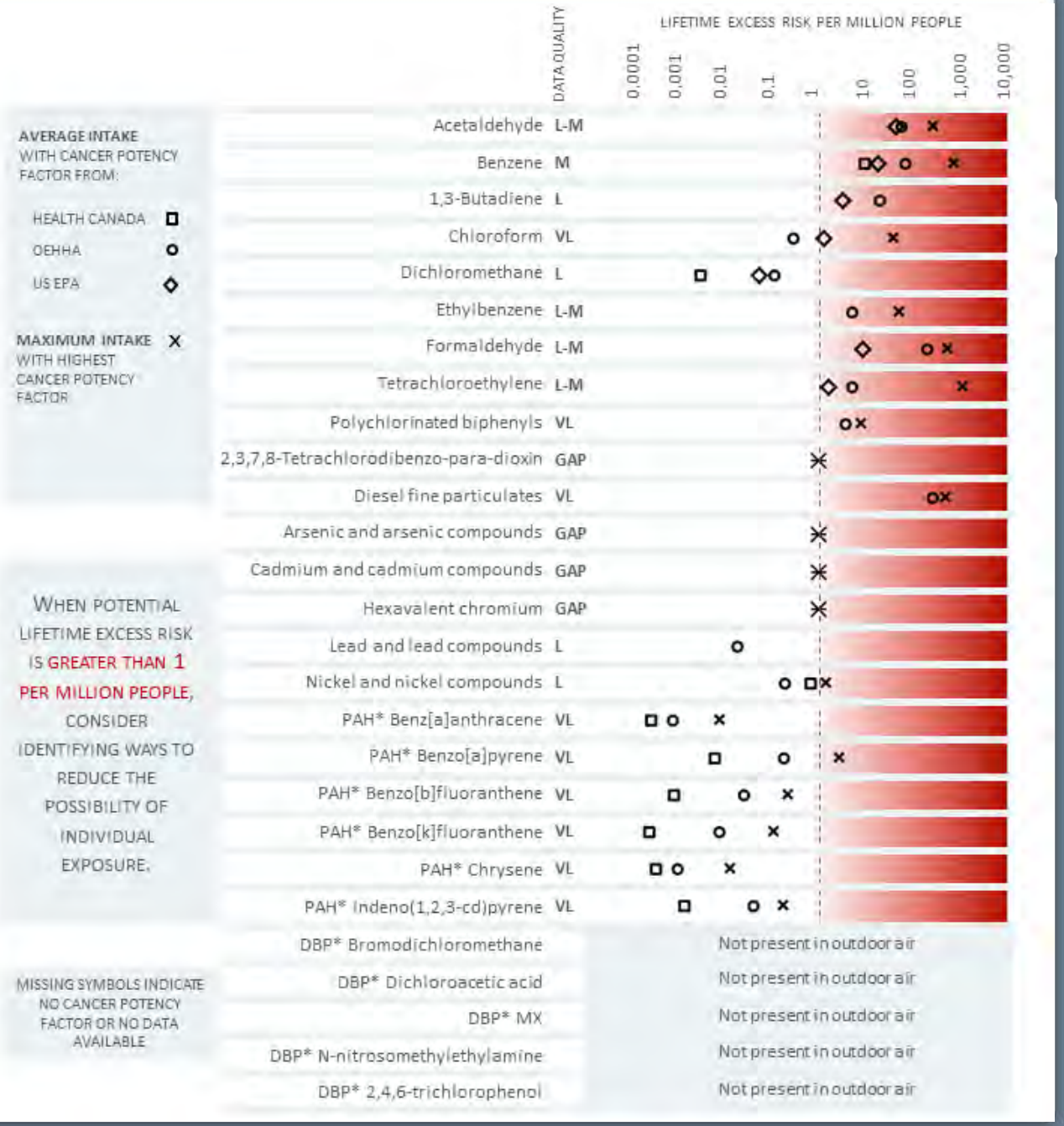
Indoor Air

Data:

Published literature and government reports

Regional Variation:

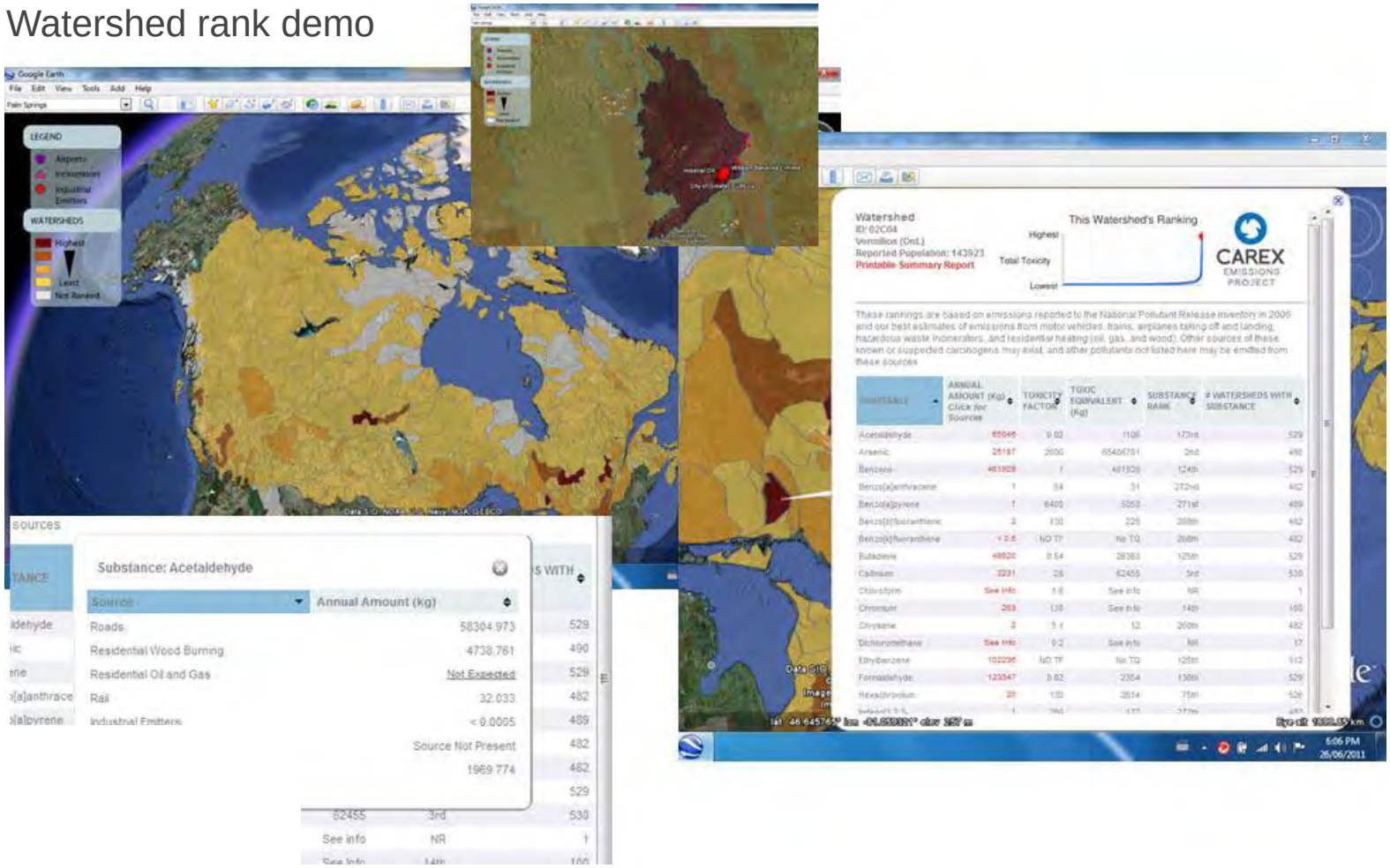
Expect variation among homes, but not regionally



CAREX CANADA

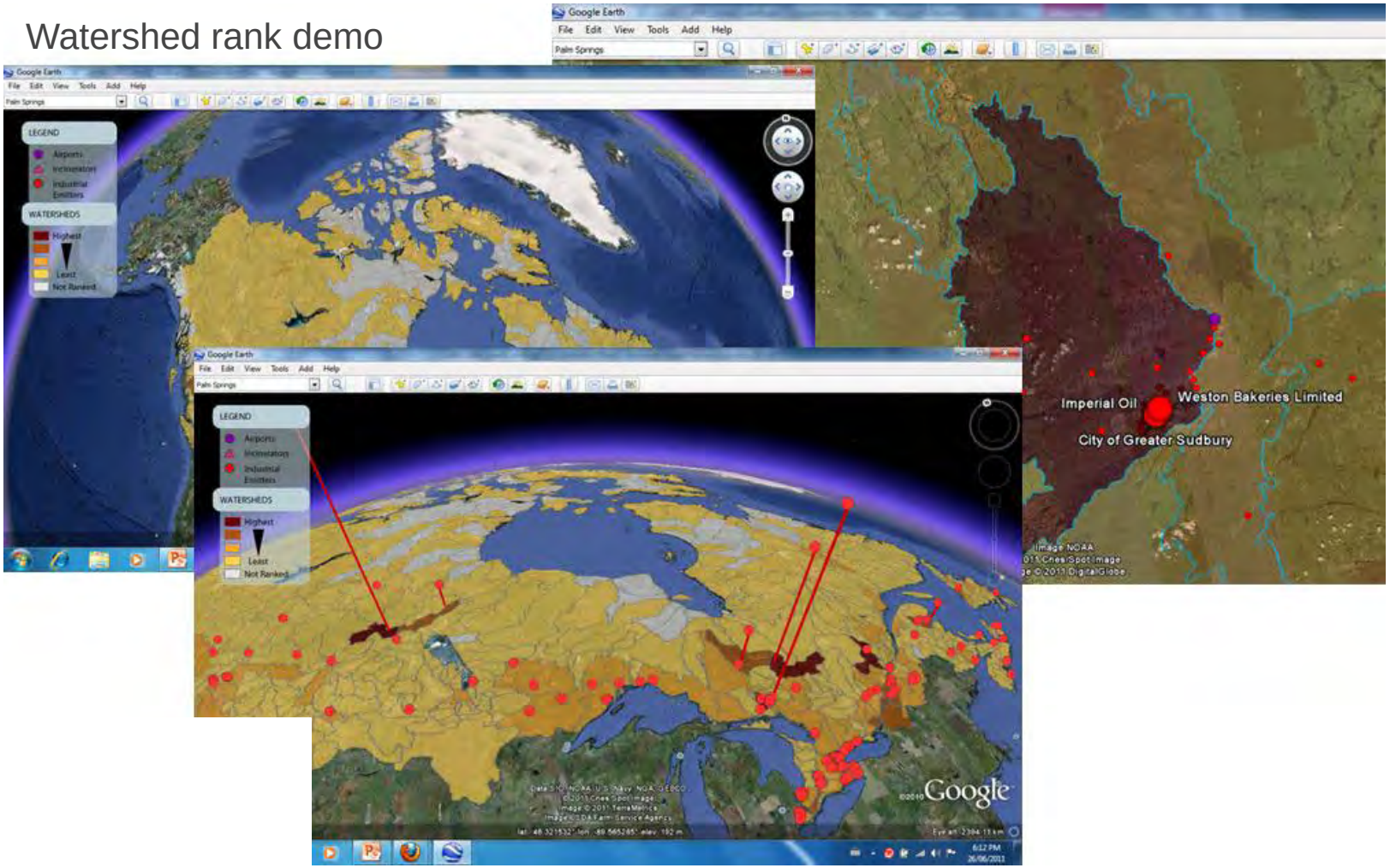
Emissions Mapping Project

Watershed rank demo

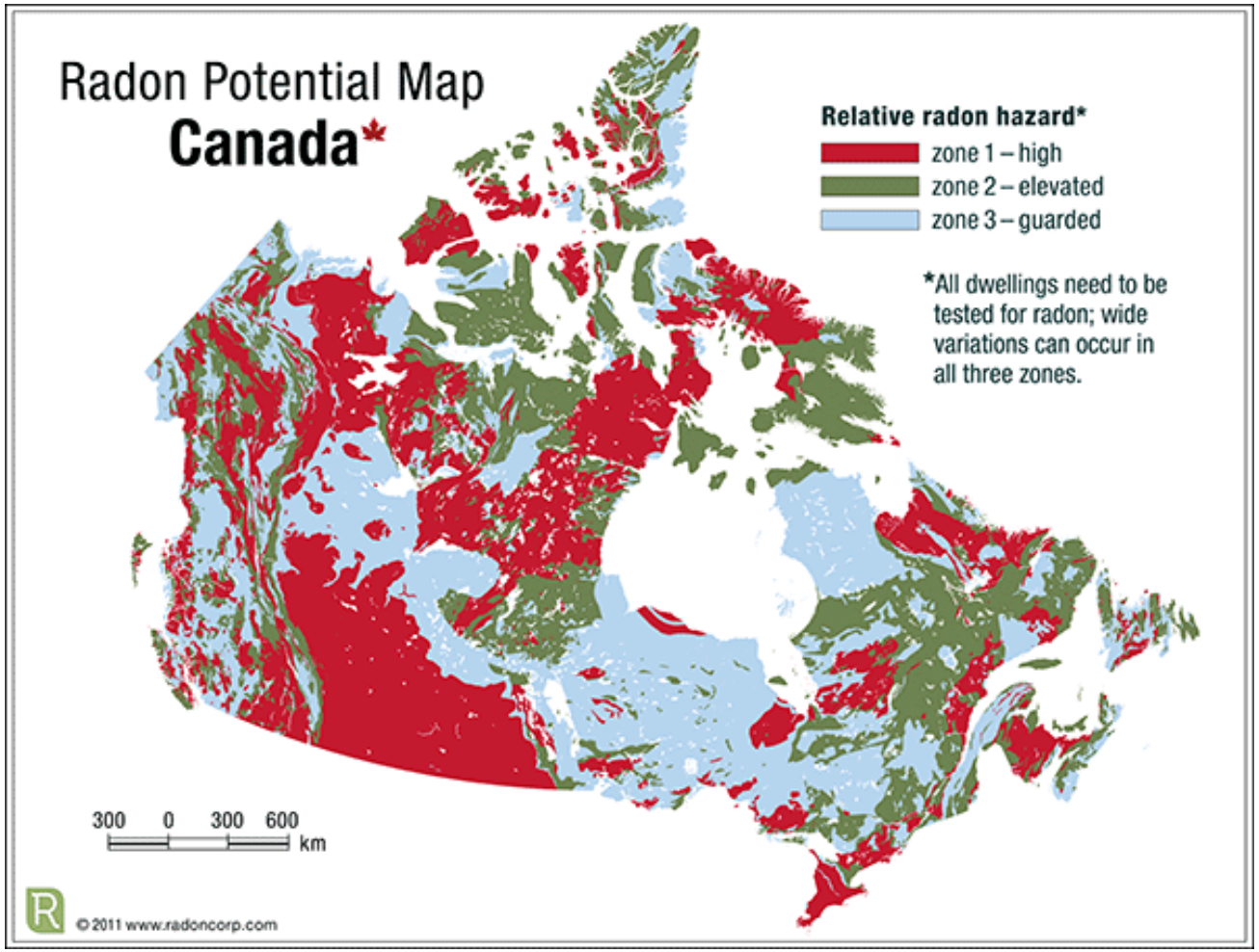


Emissions Mapping Project

Watershed rank demo



Radon: unique approach

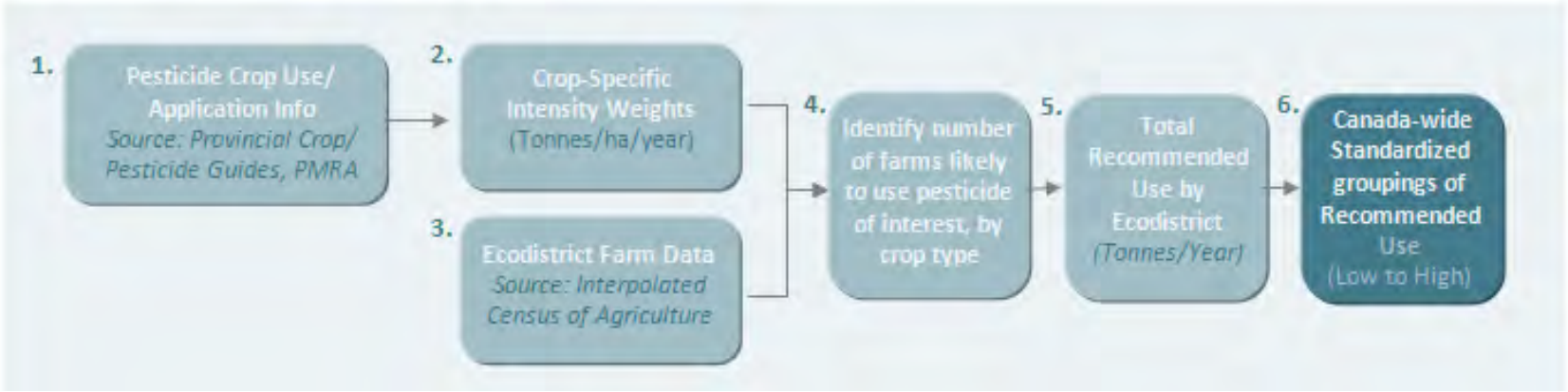


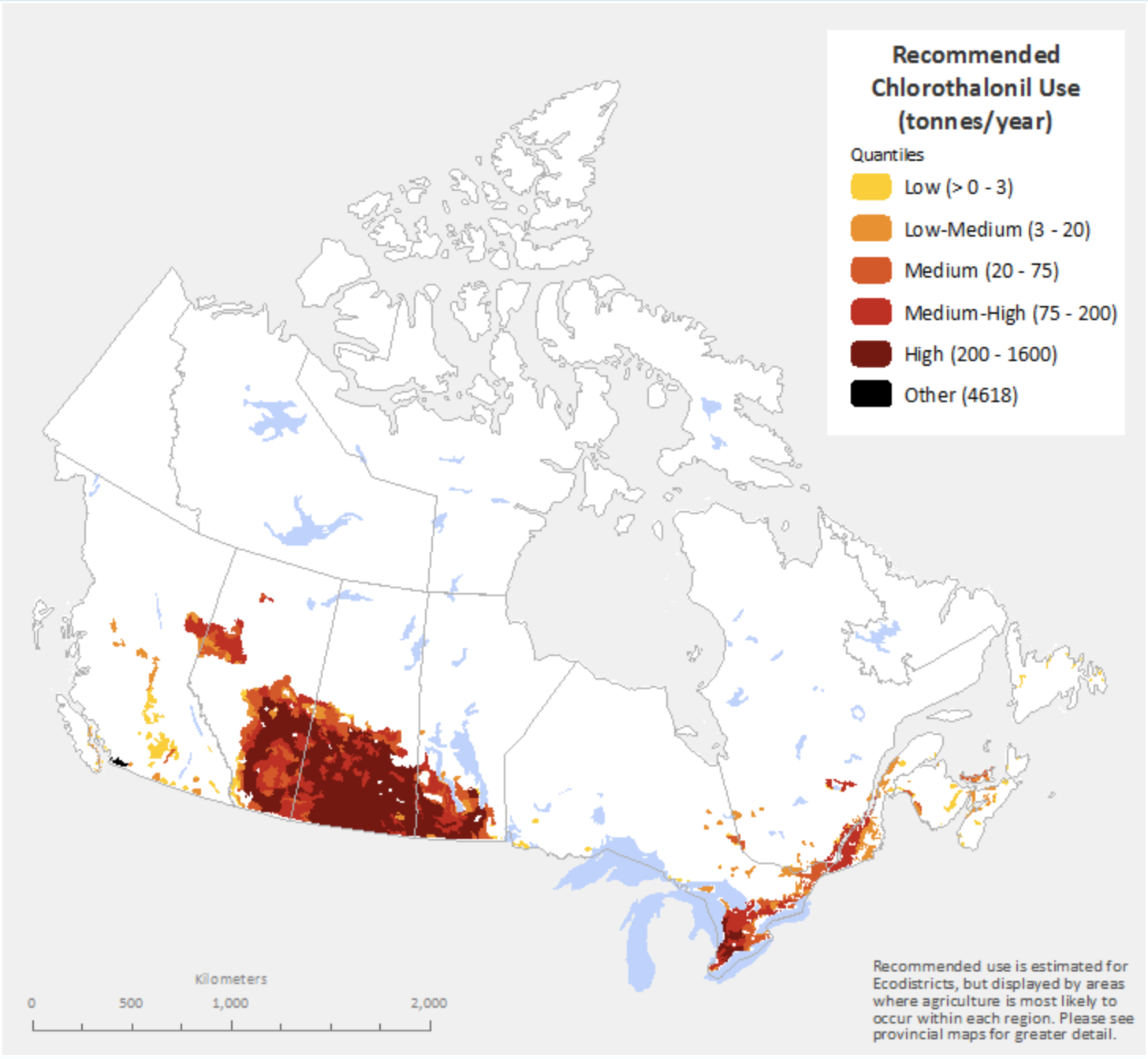
CAREX CANADA

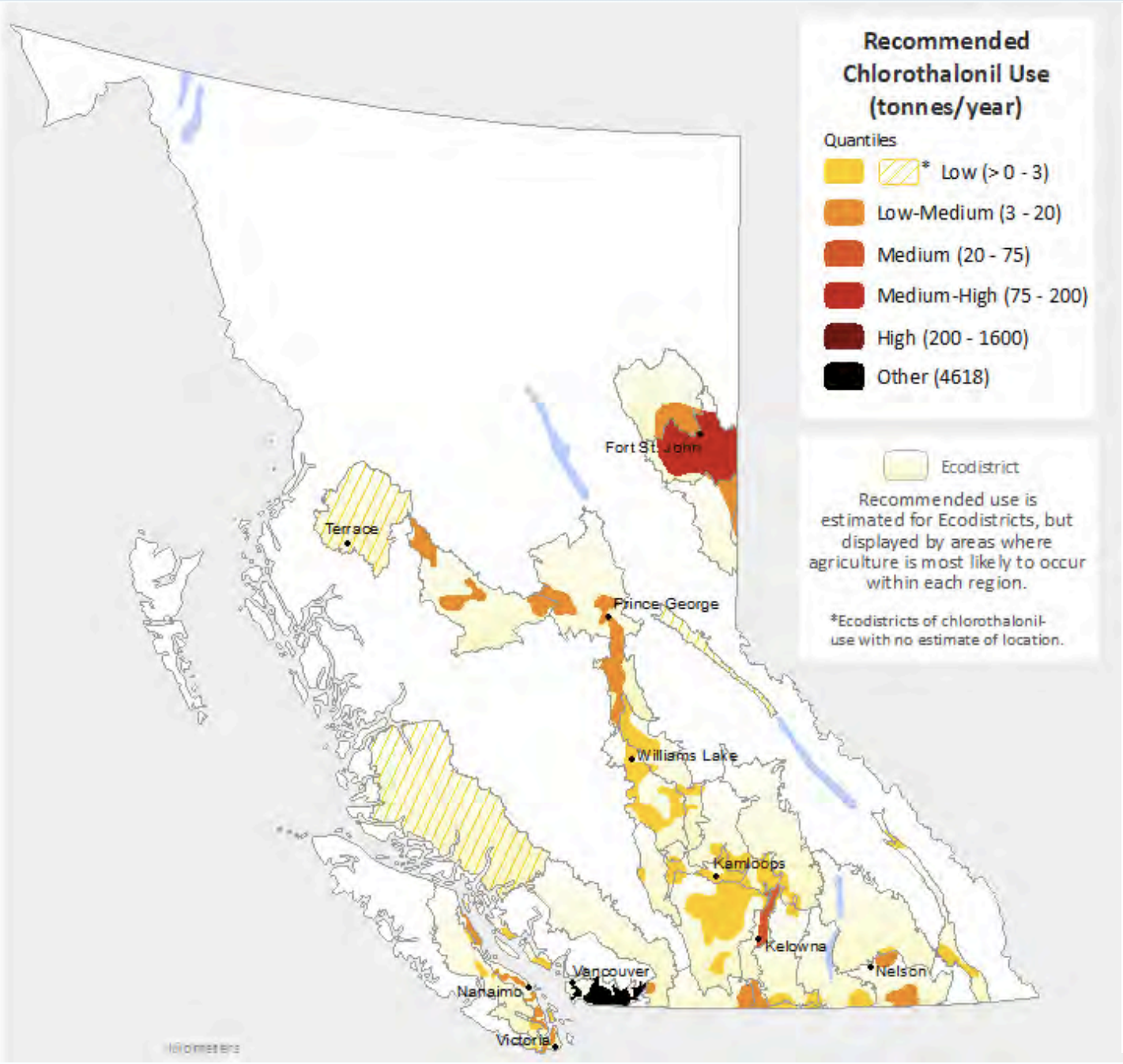
Pesticides

Method

Recommended Annual Agricultural Use Estimates




Recommended Chlorothalonil Use (tonnes/year)
Quantiles
Low (> 0 - 3)
Low-Medium (3 - 20)
Medium (20 - 75)
Medium-High (75 - 200)
High (200 - 1600)
Other (4618)
Kilometers
0
500
1,000
2,000
Recommended use is estimated for Ecodistricts, but displayed by areas where agriculture is most likely to occur within each region. Please see provincial maps for greater detail.


Recommended Chlorothalonil Use (tonnes/year)
Quantiles
* Low (> 0 - 3)
Low-Medium (3 - 20)
Medium (20 - 75)
Medium-High (75 - 200)
High (200 - 1600)
Other (4618)
Ecodistrict
Recommended use is estimated for Ecodistricts, but displayed by areas where agriculture is most likely to occur within each region.
*Ecodistricts of chlorothalonil-use with no estimate of location.
Fort St. John
Terrace
Prince George
Williams Lake
Kamloops
Kelowna
Vancouver
Nelson
Nanaimo
Victoria