UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Pediatrics

NPRI Data User Workshop
February 25, 2020

Exploring Co-Location of Adverse Birth Outcomes and Environmental Variables

Charlene Nielsen, Osnat Wine, Carl Amrhein, and Alvaro Osornio-Vargas

Overview

- What are adverse birth outcomes (ABO)?
- How does NPRI data help us in or research?
- What are our challenges in using NPRI data in mapping and spatial analysis?

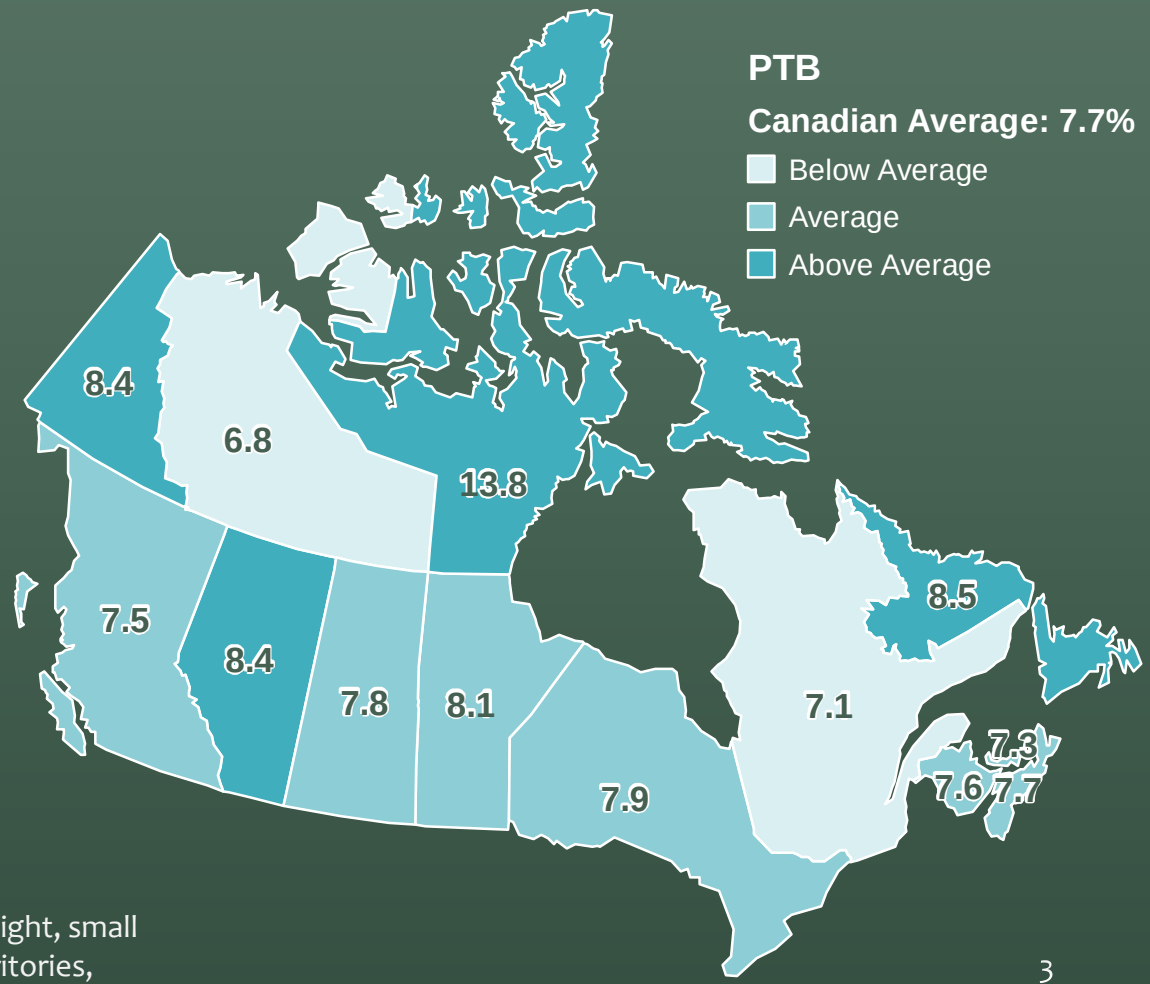
Adverse Birth Outcomes (ABO)

Birth Weight
(grams)

PTB: Preterm Birth

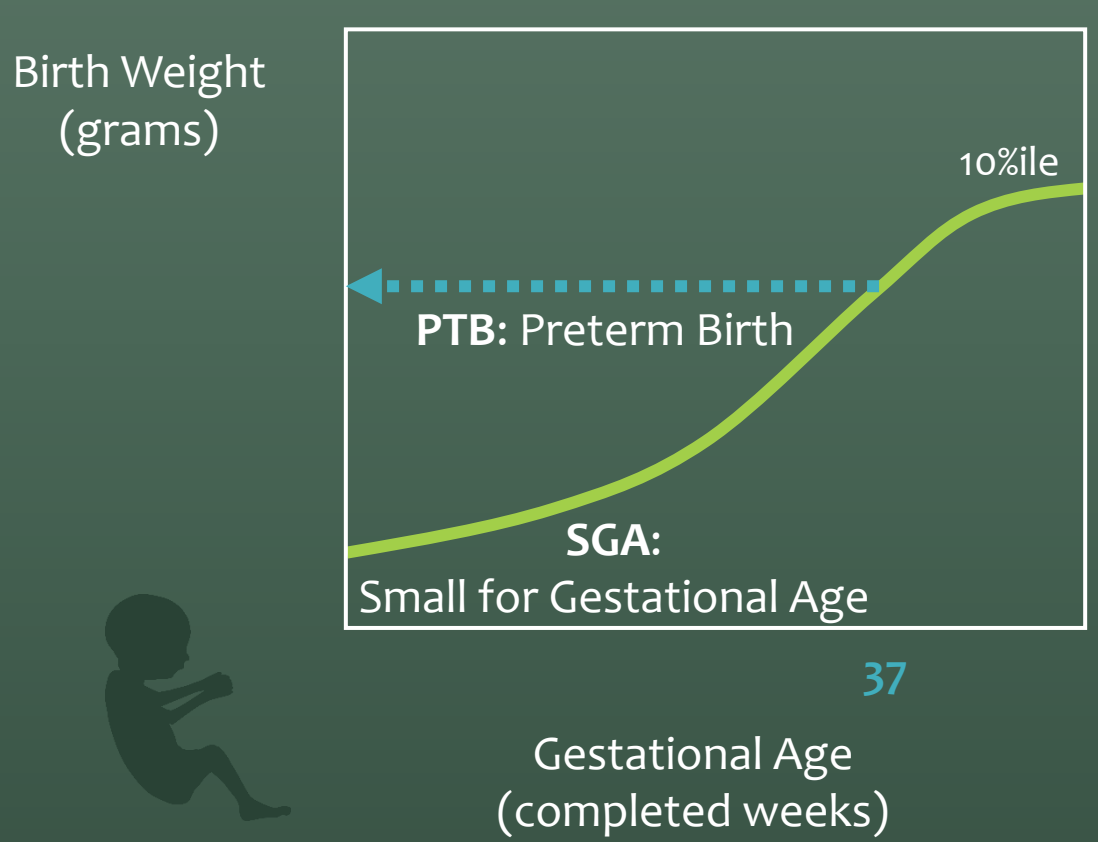
37

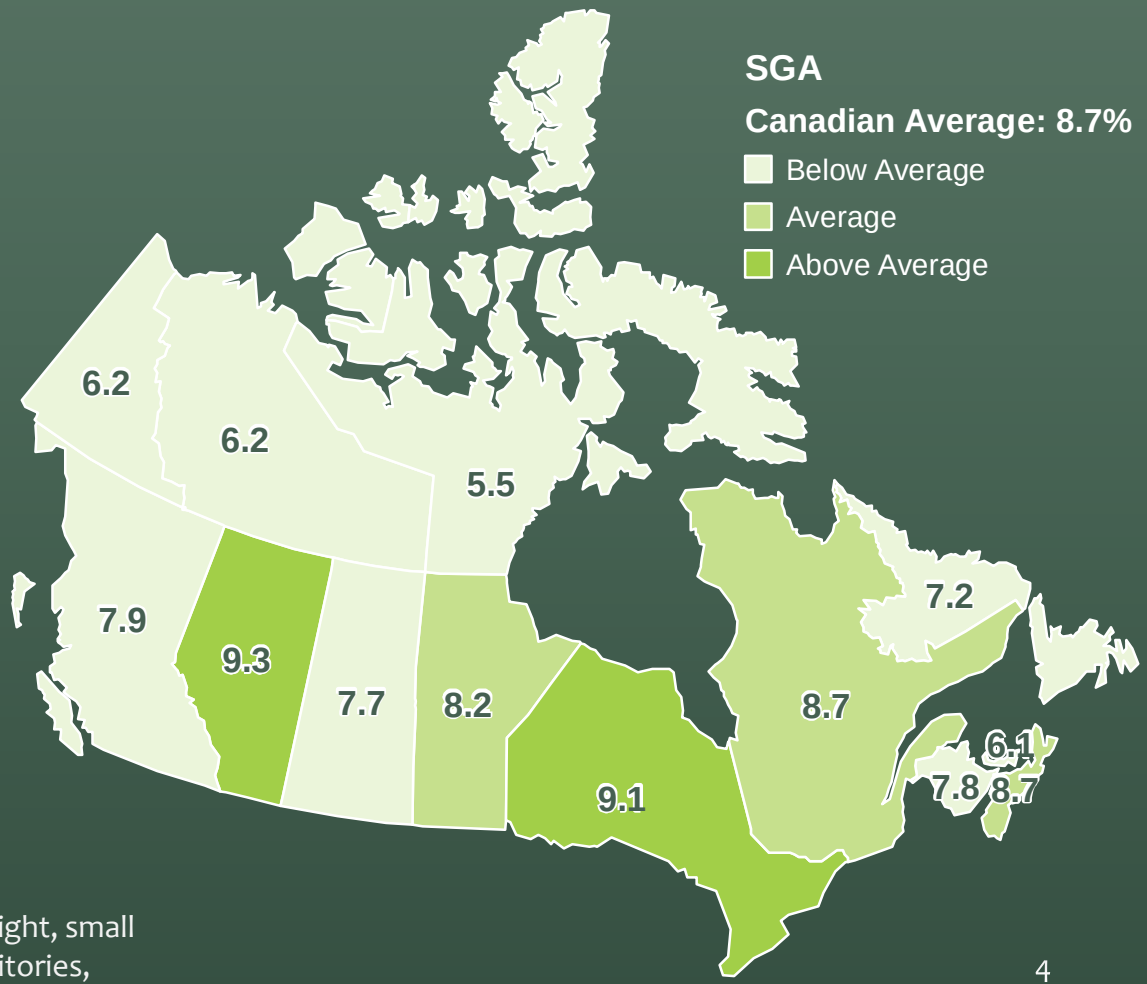
Gestational Age
(completed weeks)



Statistics Canada. Table 13-10-0746-01 , 2010-2012, Birth-related indicators (low and high birth weight, small and large for gestational age, pre-term births), by sex, three-year period, Canada, provinces, territories, census metropolitan areas and metropolitan influence zones. DOI: https://doi.org/10.25318/1310074601-eng.

Adverse Birth Outcomes (ABO)





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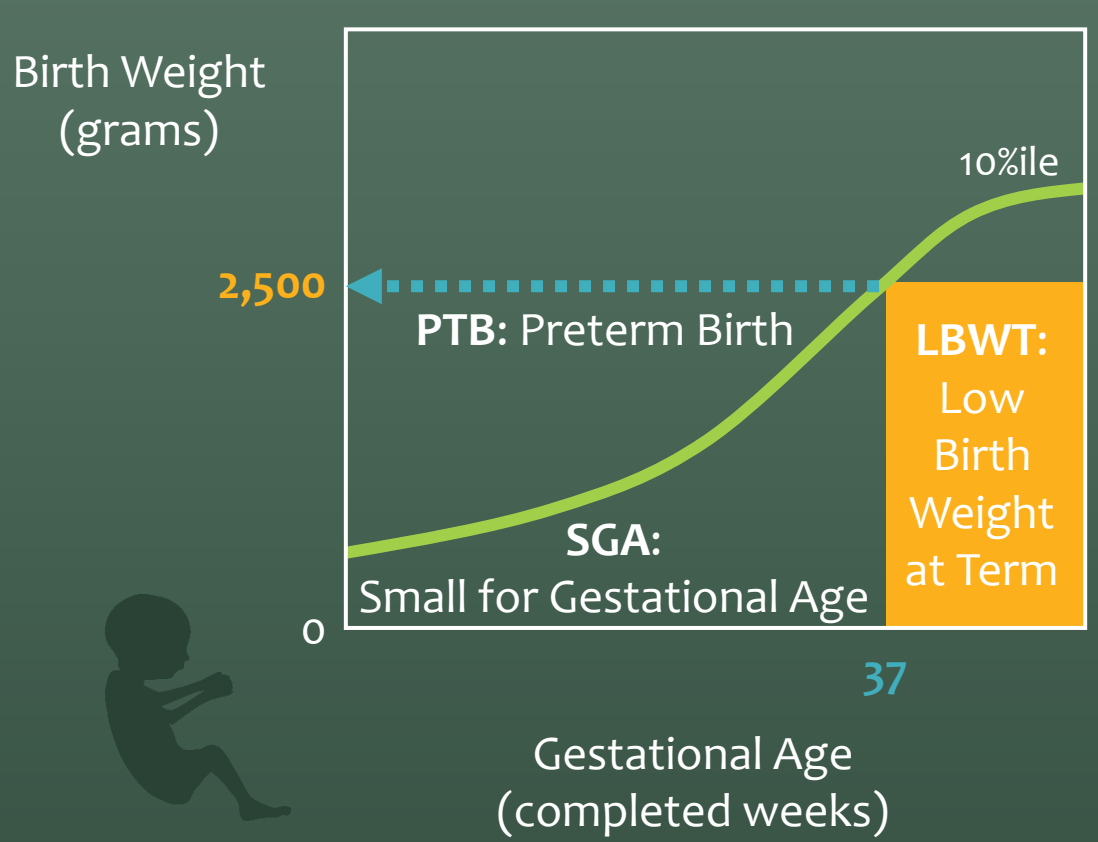
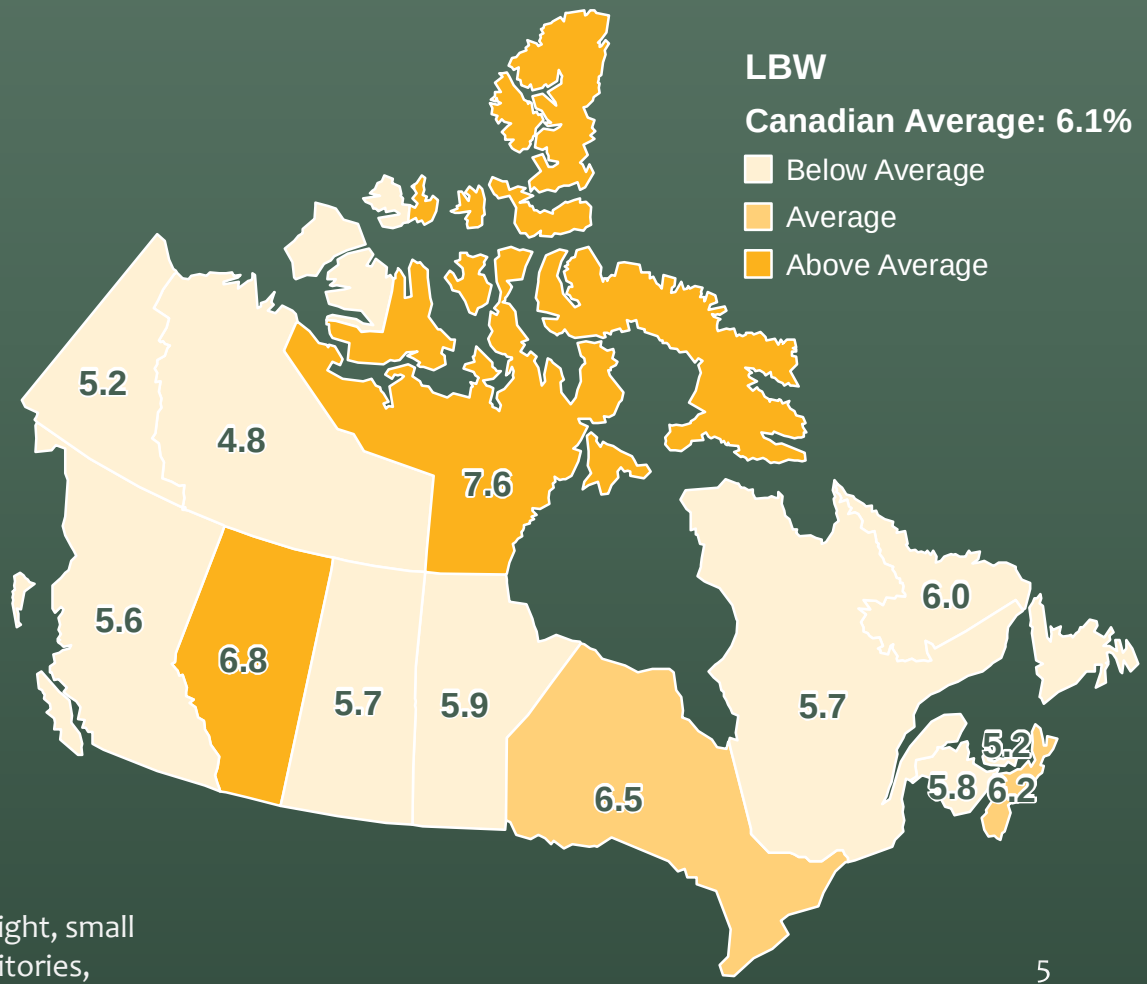
Adverse Birth Outcomes (ABO)





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Individual Characteristics
In Maternal Population

ABO

Behavior

Habitat

Images from wikimedia.org, Microsoft clipart, pixabay.com

There are more newborns having ABO whose mothers have been prenatally exposed to industrial chemicals emitted to air

Health hazards

Prenatal exposure

ABO

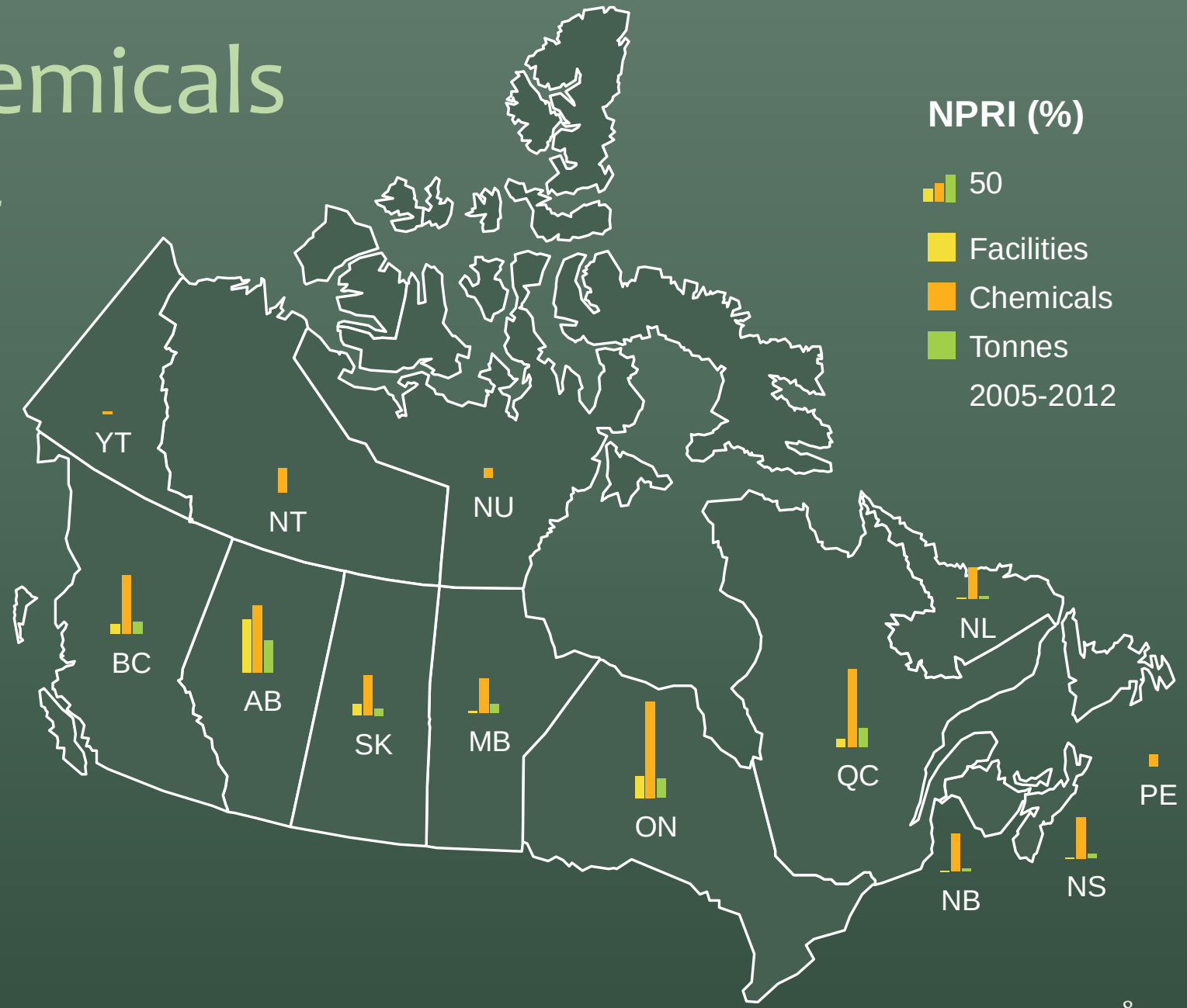
Industrial Chemicals
NPRI, 2005-2012

30,855,608 tonnes

209,456 records

13,558 facilities

228 chemicals



www.ec.gc.ca/inrp-npri/

NPRI Data for ABO Research

1. Identification of industrial chemical emissions co-located with adverse birth outcomes across Canada
2. Development of an ambient health hazard index for Alberta
3. Formulation of hypotheses on the co-location of mixtures of industrial air pollution and adverse birth outcomes
4. Space-time modeling of hot spots

DOI: 10.1016/j.scitotenv.2019.134091

1. Identification of industrial chemical emissions co-located with adverse birth outcomes across Canada

Science of the Total Environment 696 (2019) 134091

Contents lists available at ScienceDirect

Science of the Total Environment

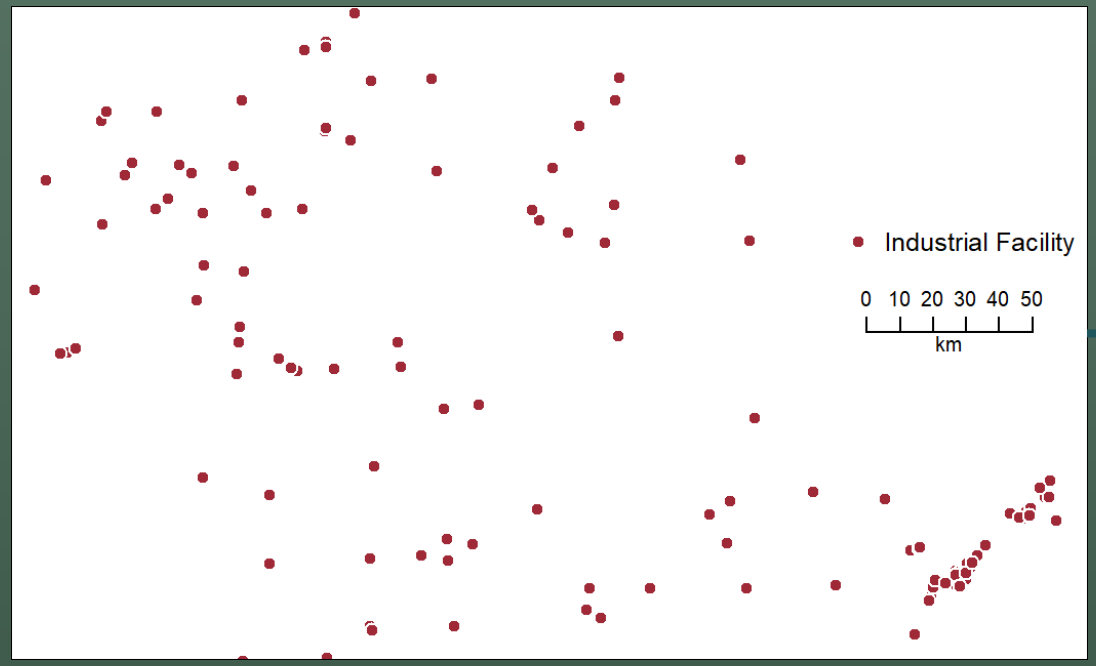
journal homepage: www.elsevier.com/locate/scitotenv

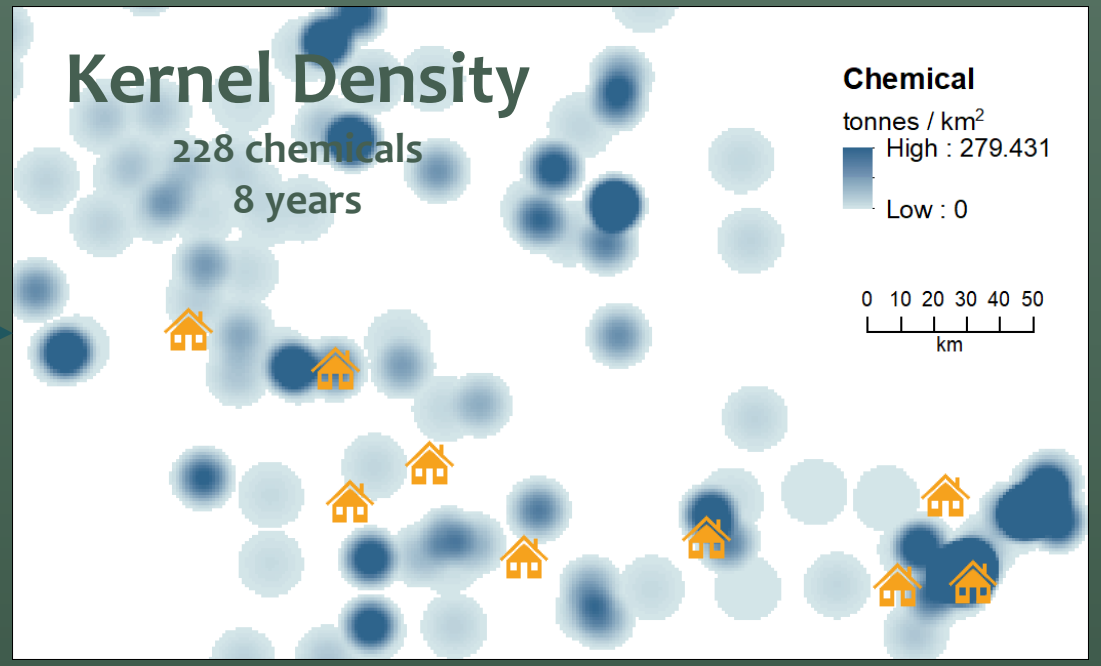
Geographic information assessment of maternal ambient health hazards and adverse birth outcomes in Canada

Charlene C. Nielsen [a,b], Carl G. Amrhein [b,c], Jesus A. Serrano-Lomelin [d], Alvaro R. Osornio-Vargas [a,*], the DoMiNO Team

[a] Department of Pediatrics, University of Alberta, Edmonton, Canada
[b] Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Canada
[c] Faculty of Arts and Sciences, Aga Khan University, Nairobi, Kenya
[d] Department of Obstetrics and Gynecology, University of Alberta, Edmonton, Canada

Annual time-weighted chemical emissions

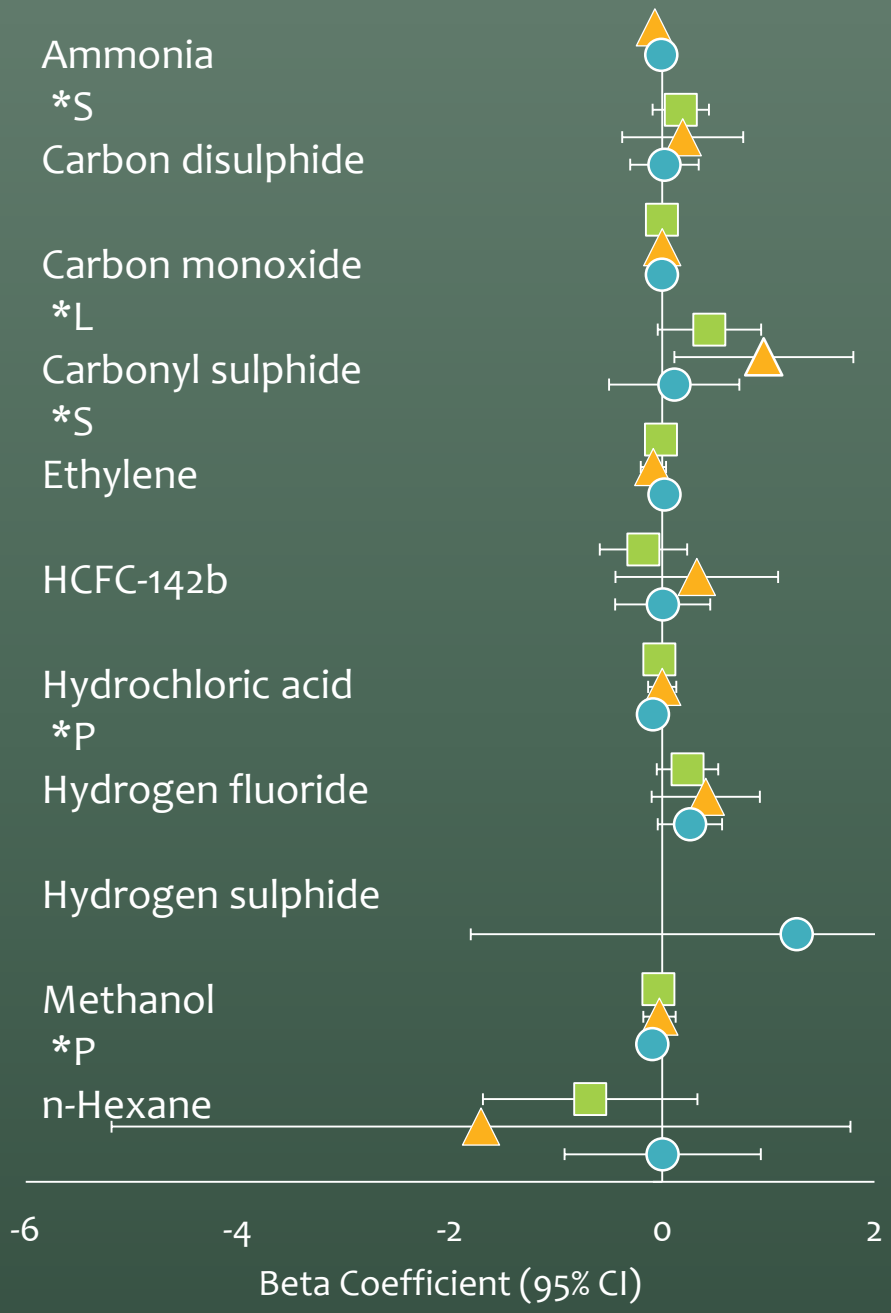


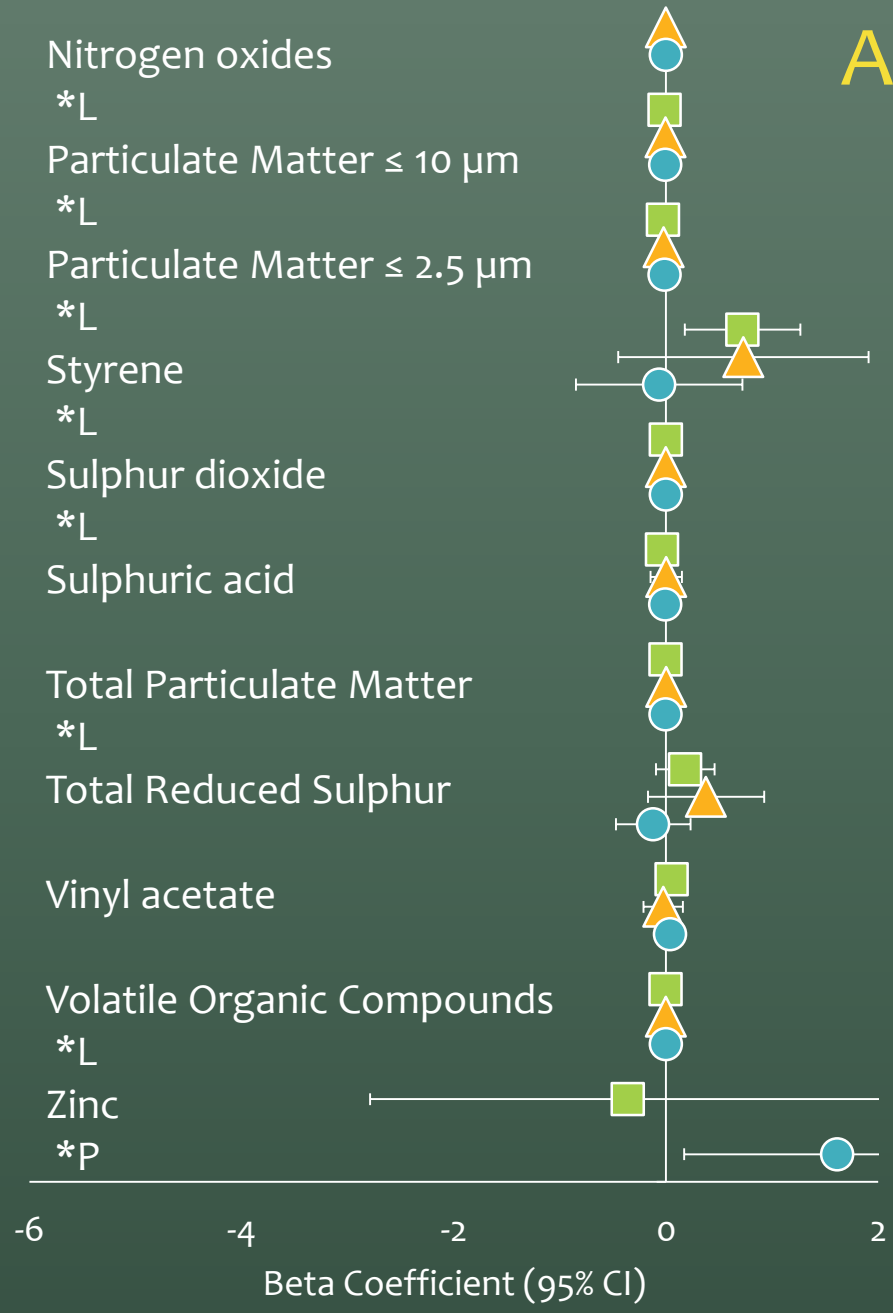


$$\text{Total Tonnes} = P_b \times \text{Tonnes}_b + P_c \times \text{Tonnes}_c$$

where P=proportion of gestation; b=birth year; c=conception year

Alberta





ABO: SGA LBWT PTB

ABO: SGA LBWT PTB

Chemical	Number
Particulate Matter ≤ 2.5 µm	9
Carbon monoxide	7
Particulate Matter ≤ 10 µm	7
Ammonia	6
Nitrogen oxides	6
Volatile Organic Compounds	5
Methanol	4
Total Particulate Matter	4
Carbonyl sulphide	3
Sulphur dioxide	3
HCFC-142b	2
Methyl ethyl ketone	2
Sulphuric acid	2

Chemicals ranked by number of associations for 2 or more ABO-province combinations

DOI: 10.1186/s12942-017-0117-5

2. Development of an ambient health hazard index for Alberta

Nielsen *et al. Int J Health Geogr (2017) 16:43*
DOI 10.1186/s12942-017-0117-5

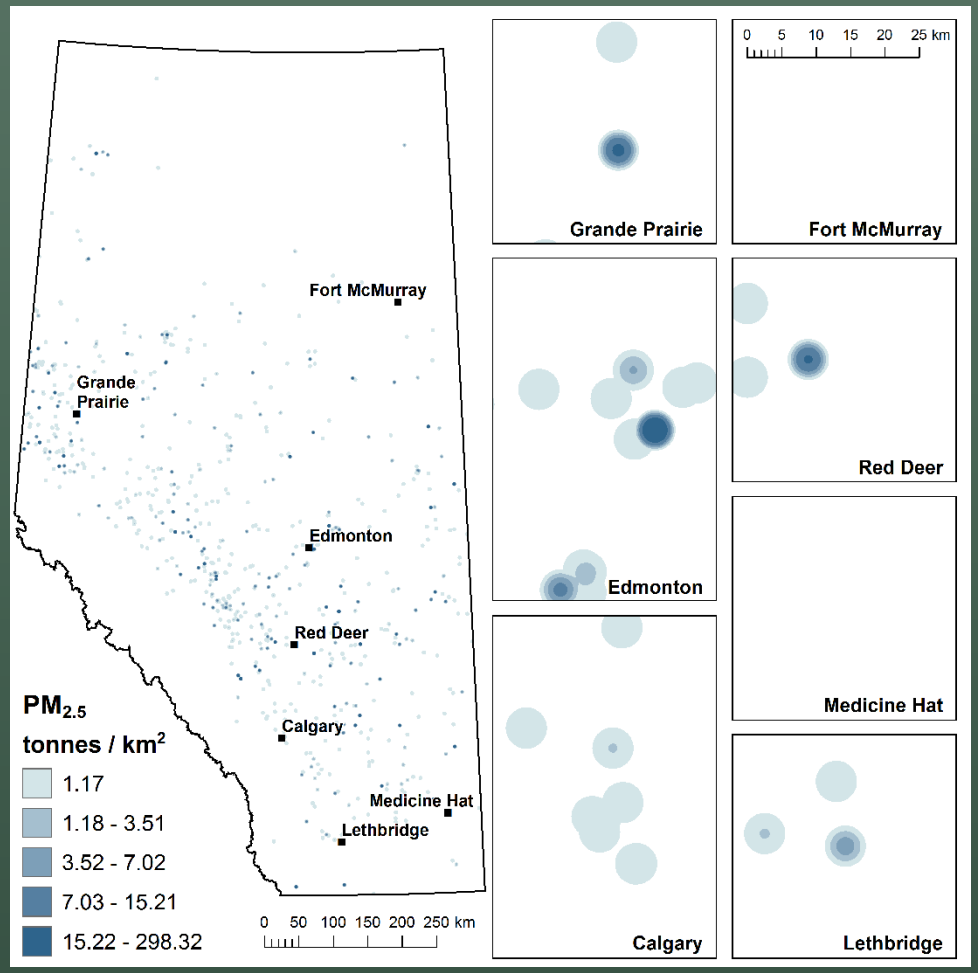
International Journal of Health Geographics

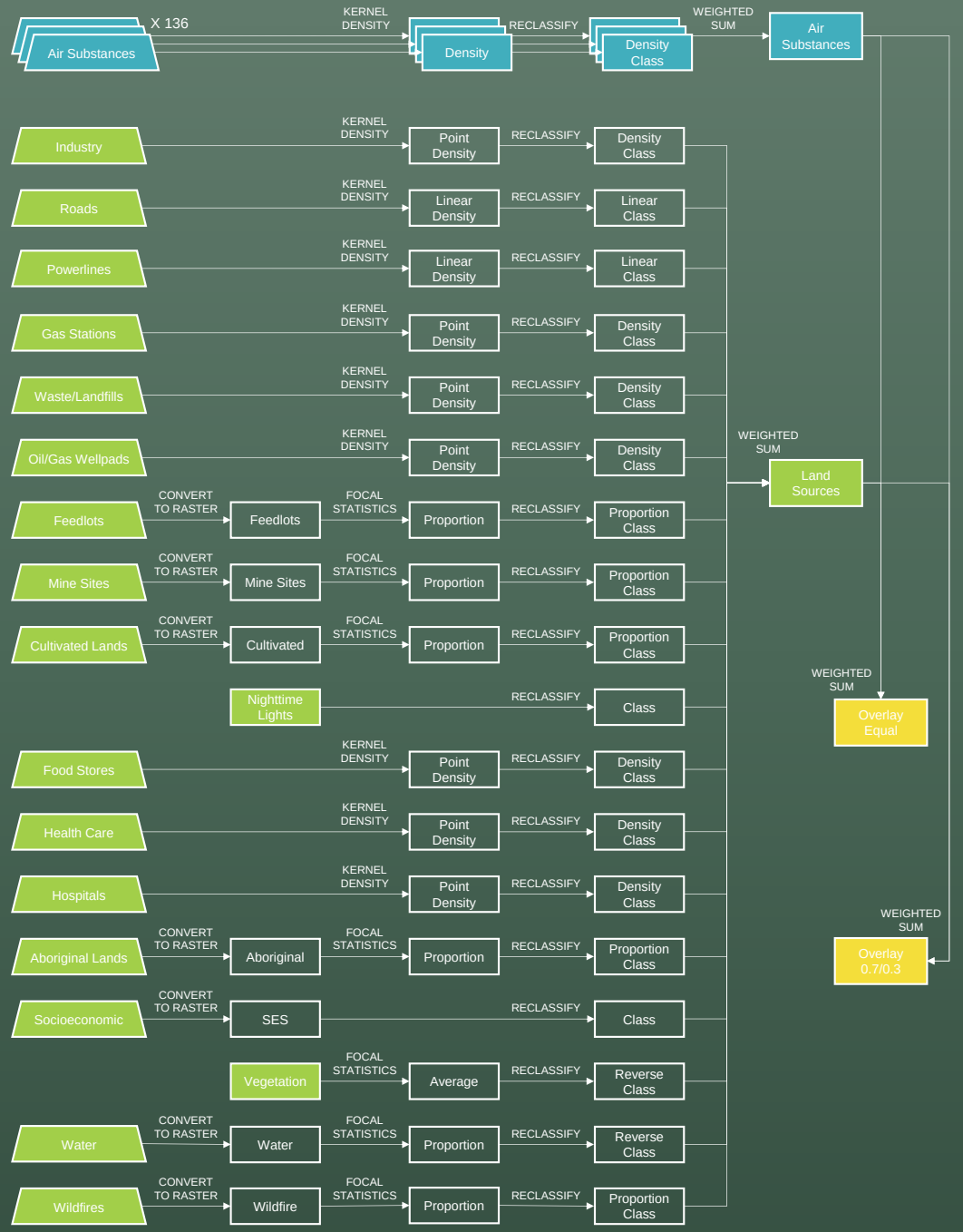
RESEARCH Open Access

Mapping outdoor habitat and abnormally small newborns to develop an ambient health hazard index

Charlene C. Nielsen[1,2], Carl G. Amrhein[1], Alvaro R. Osornio-Vargas[2*] and the DoMiNO Team[1,2]

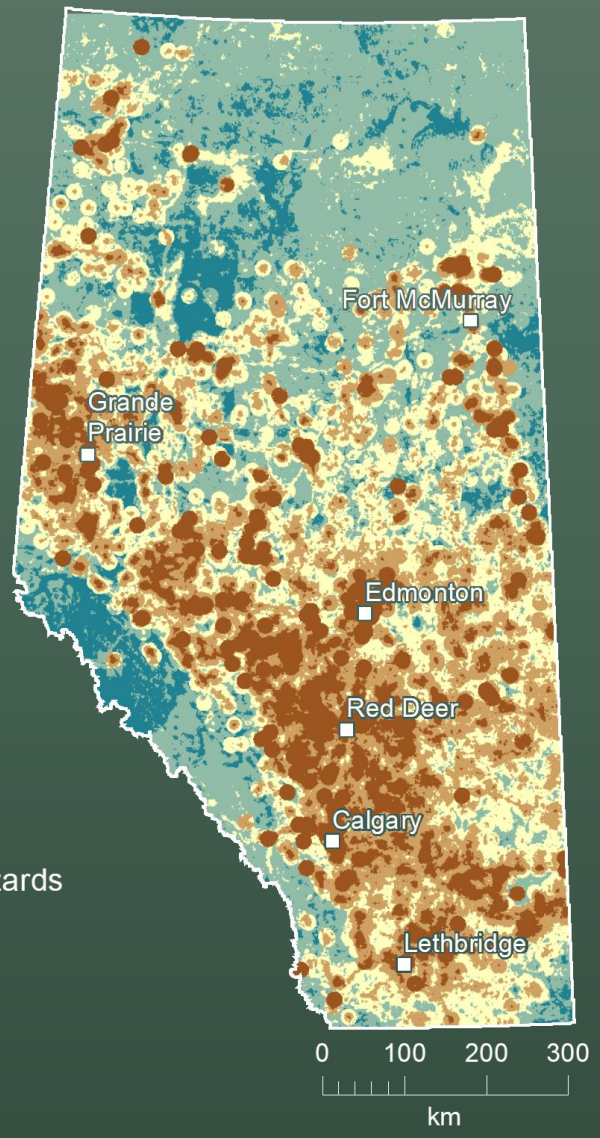
Average chemical emissions in a cumulative hazard overlay



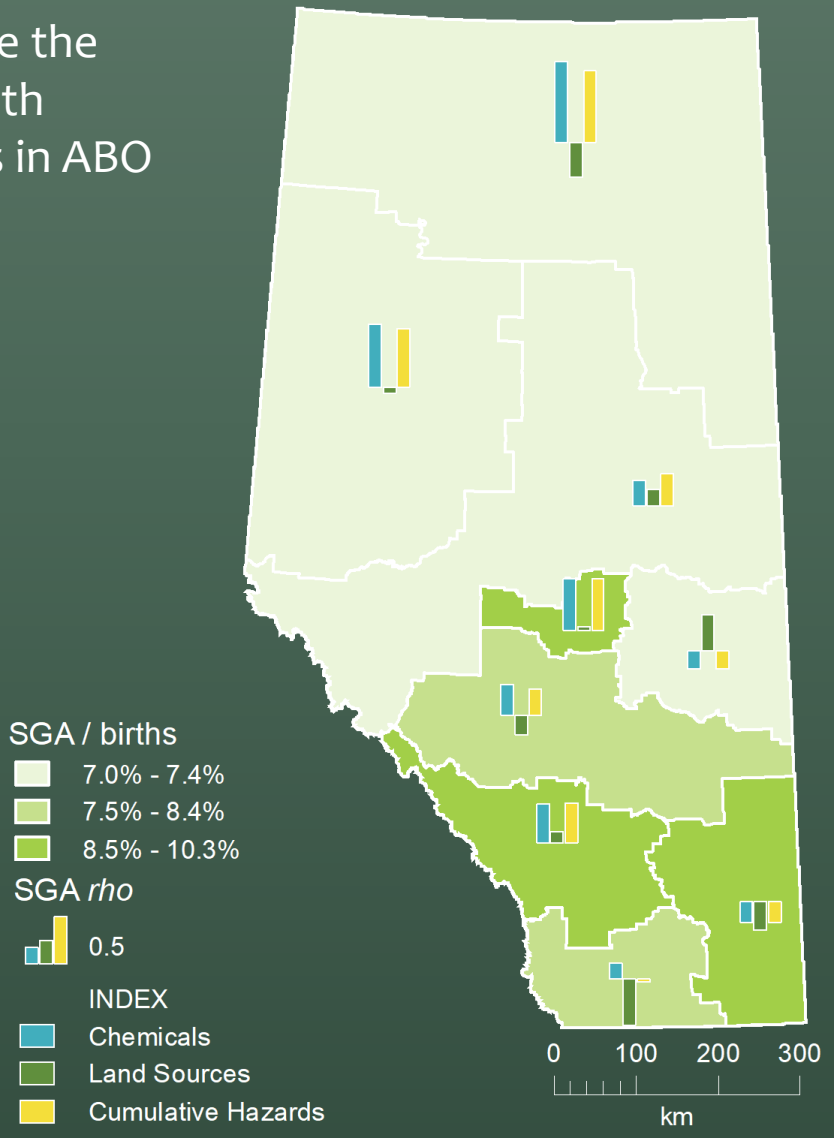


Associations with ABO

Combine the outdoor environmental variables into a single index



Correlate the index with patterns in ABO



Region mattered: There were stronger associations within health regions than for the entire province

DOI: 10.1016/j.envint.2019.104972

3. Formulation of hypotheses on the co-location of mixtures of industrial air pollution and adverse birth outcomes

Environment International 131 (2019) 104972

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Interdisciplinary-driven hypotheses on spatial associations of mixtures of industrial air pollutants with adverse birth outcomes

Jesus Serrano-Lomelin[a,h], Charlene C. Nielsen[b,c], M. Shazan M. Jabbar[d], Osnat Wine[b], Colin Bellinger[d], Paul J. Villeneuve[e], Dave Stieb[f], Nancy Aelicks[g], Khalid Aziz[b], Irena Buka[b], Sue Chandra[h], Susan Crawford[g], Paul Demers[i], Anders C. Erickson[j], Perry Hystad[k], Manoj Kumar[b], Erica Phipps[l], Prakesh S. Shah[m], Yan Yuan[a], Osmar R. Zaiane[d], Alvaro R. Osornio-Vargas[b,*]

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[b] Department of Pediatrics, University of Alberta, Edmonton Clinic Health Academy, 11405 87 Avenue, Edmonton, Alberta T6G 1C9, Canada
[c] Department of Earth and Atmospheric Sciences, University of Alberta, 1-26 Earth Science Building, Edmonton, Alberta T6G 2E3, Canada
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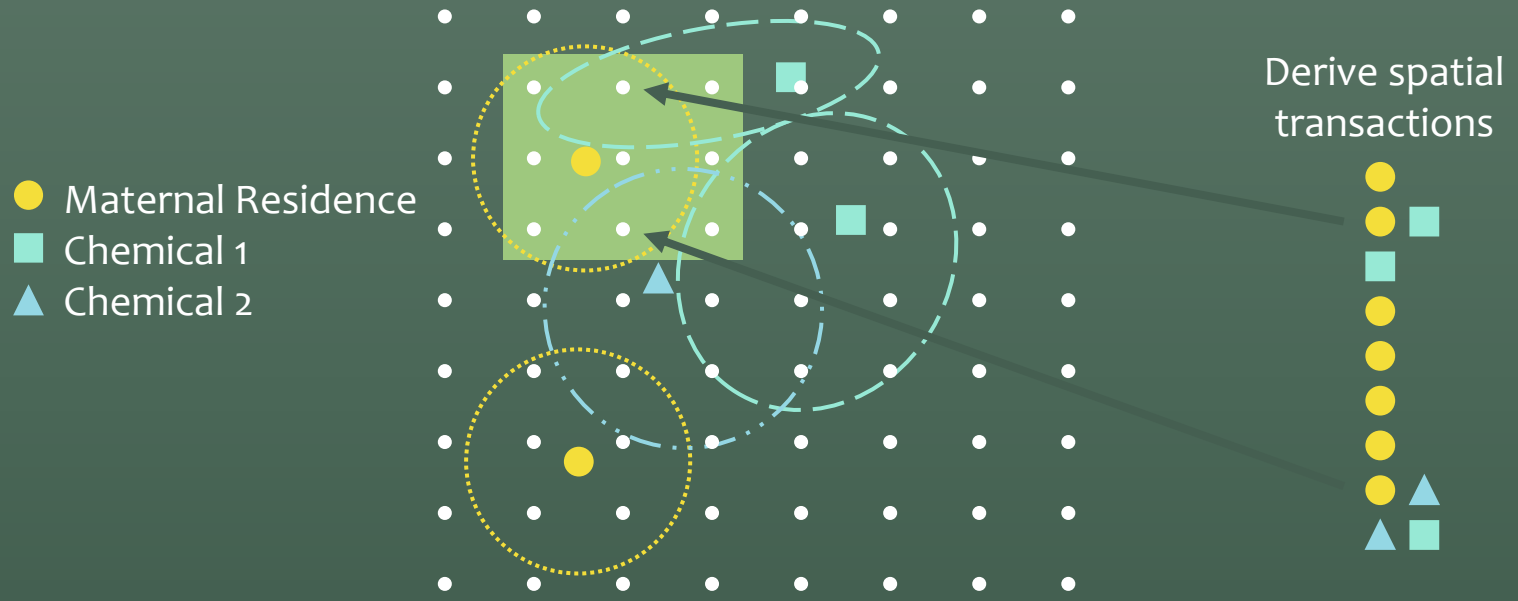
[e] Department of Health Sciences, Carleton University, Herzberg Building, Room 5413, 1125 Colonel By Drive, Ottawa, Ontario K1S 5B6, Canada
[f] Environmental Health Science and Research Bureau, Health Canada, 50 Colombine Driveway, Ottawa, Ontario K1A 0K9, Canada
[g] Alberta Health Services, Alberta Perinatal Health Program, Suite 310, 1403-29 Street NW, Calgary, Alberta T2N 2T9, Canada
[h] Department of Obstetrics & Gynecology, University of Alberta, Royal Alexandra Hospital, 10240 Kingsway Avenue, Edmonton, Alberta T5H 3V9, Canada
[i] CAREX Canada, Faculty of Health Sciences, Simon Fraser University, 105-515 West Hastings St, Vancouver, BC V6B 5K3, Canada
[j] School of Population and Public Health, University of British Columbia, 2206 E Mall, Vancouver, BC V6T 1Z3, Canada
[k] School of Biological and Population Health Sciences, Oregon State University, 101 Milam Hall, Corvallis, OR 97331, USA
[l] Canadian Partnership for Children's Health & Environment, 1500-55 University Avenue, Toronto, Ontario M5J 2H7, Canada
[m] Department of Pediatrics and Institute of Health Policy, Management, and Evaluation, University of Toronto, Mount Sinai Hospital, 600 University Avenue, Room 19-231A, Toronto, Ontario M5G 1X5, Canada

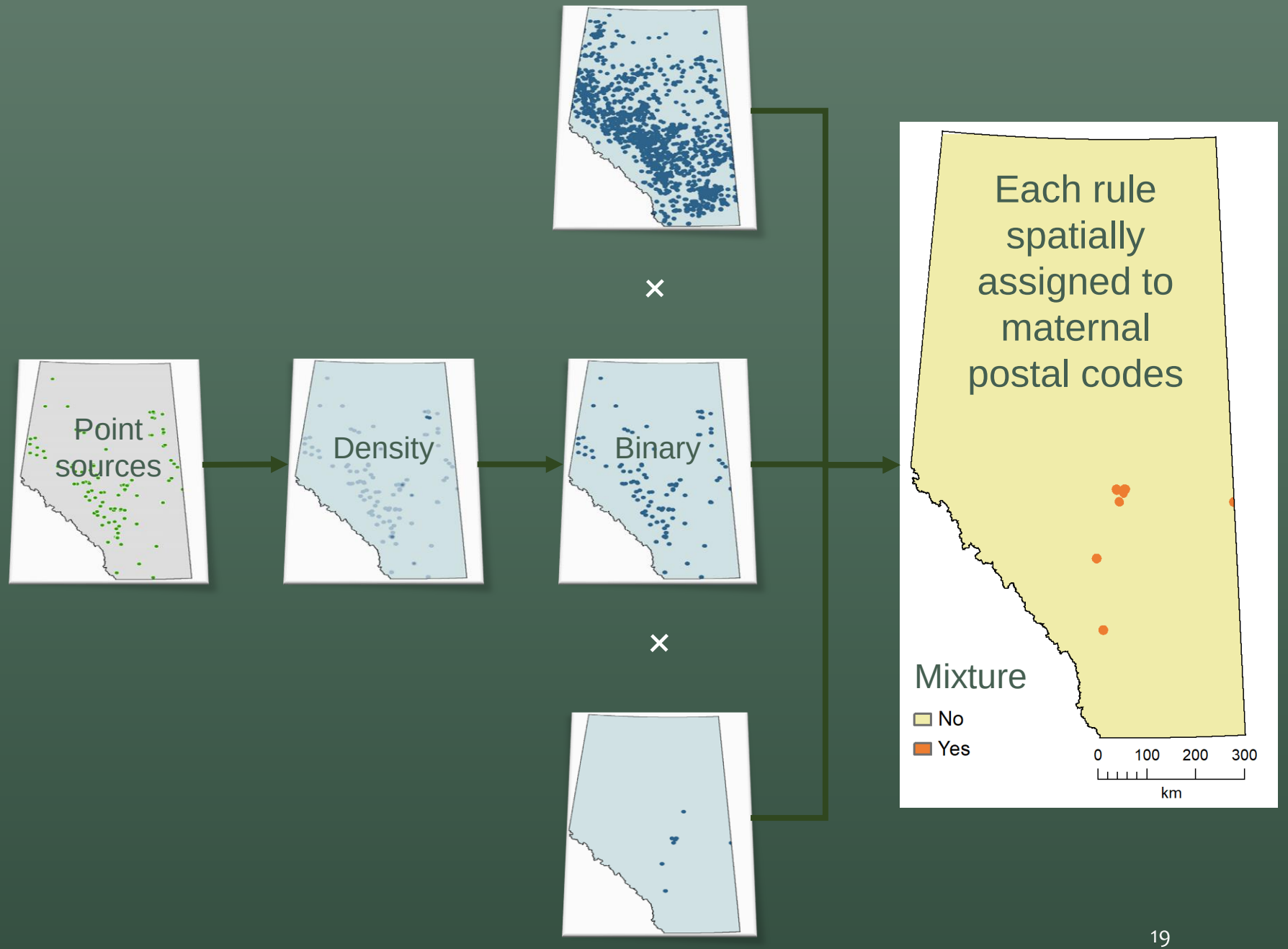
Spatial Data Mining: 3 ABO and 136 Chemicals



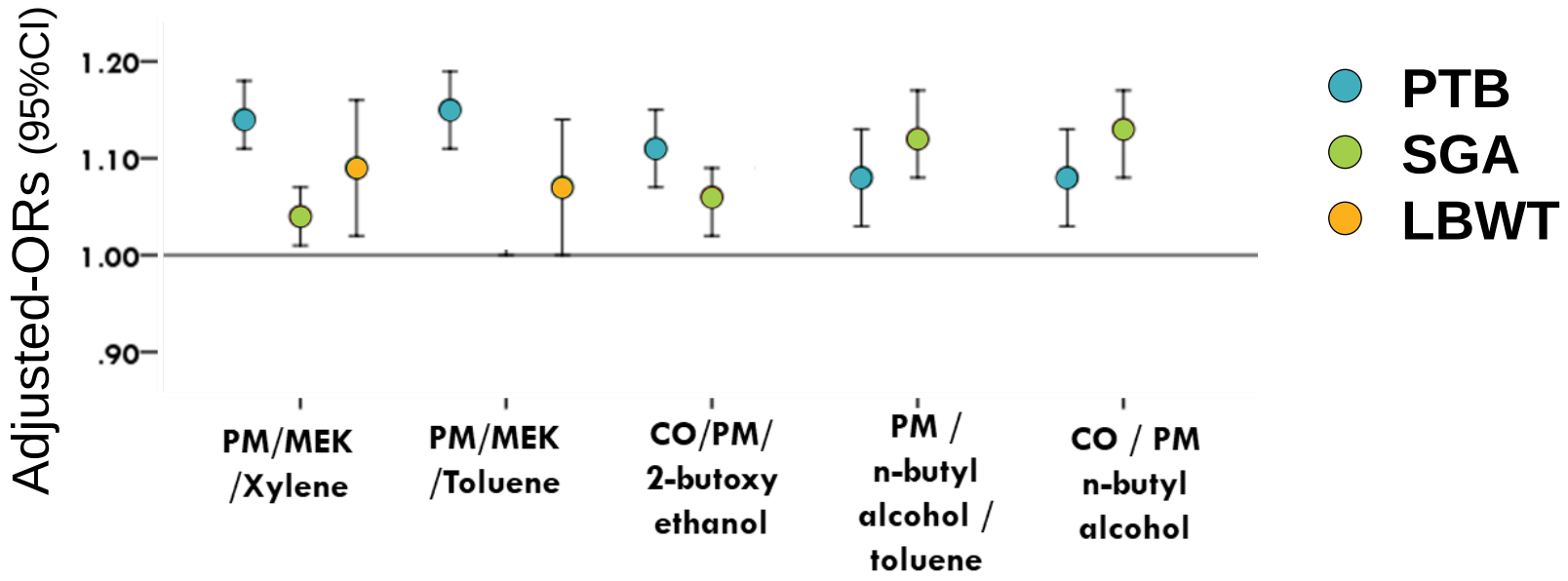
Data mining found patterns ■ → ● that identified the most common chemical mixtures that implied an ABO

~**1,700** rules ($p<0.05$)

Chemical Mixtures		PTB	SGA	LBWT
1	PM / Methyl ethyl ketone / Xylene			
2	PM / Methyl ethyl ketone / Toluene			
3	CO / PM / 2-Butoxyethanol			
4	PM / n-Butyl alcohol / Xylene			
5	CO / PM / n-Butyl alcohol			



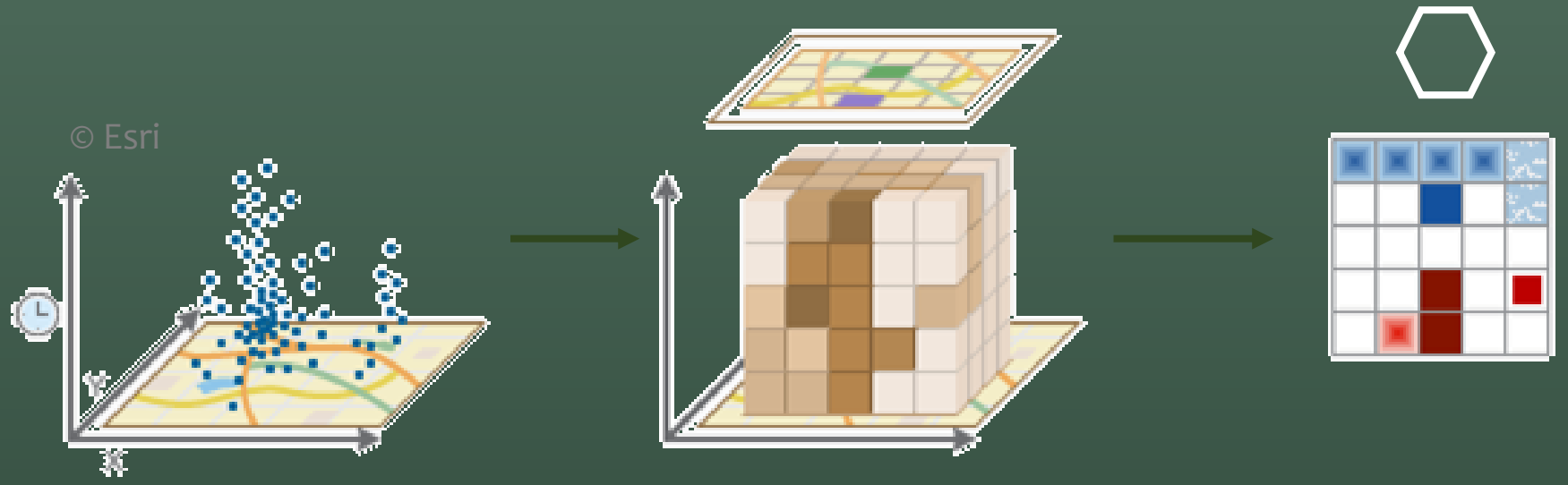
Assess Odds Ratios to Determine Risk



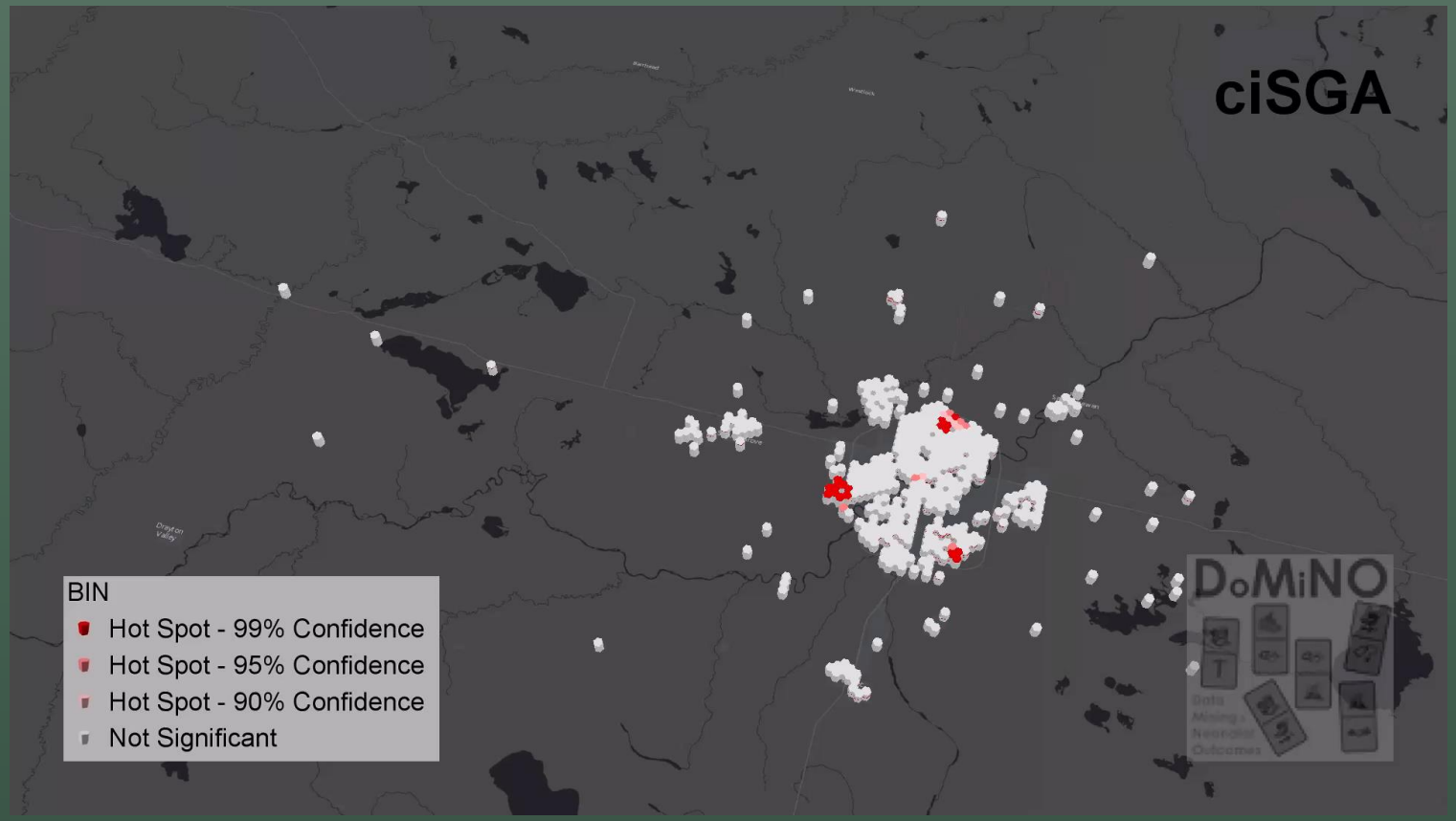
4. Space-time modeling of hot spots

Nielsen CC, Amrhein CG, Shah PS, Stieb DM, Osornio-Vargas AR, Canadian Neonatal Network, and the DoMiNO Team. Space-time hot spots of critically ill small for gestational age newborns and industrial air pollutants in major metropolitan areas of Canada. Environmental Research. In Review.

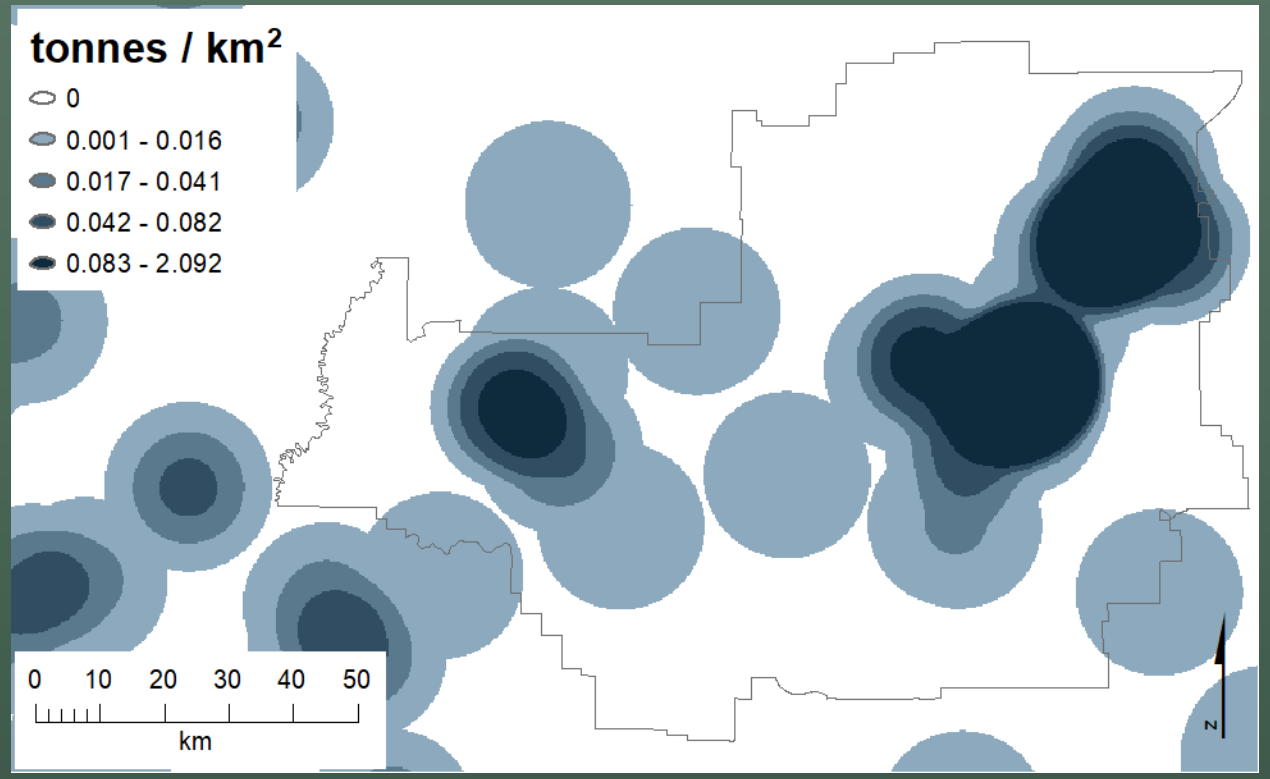
*critically ill small for gestational age = ciSGA



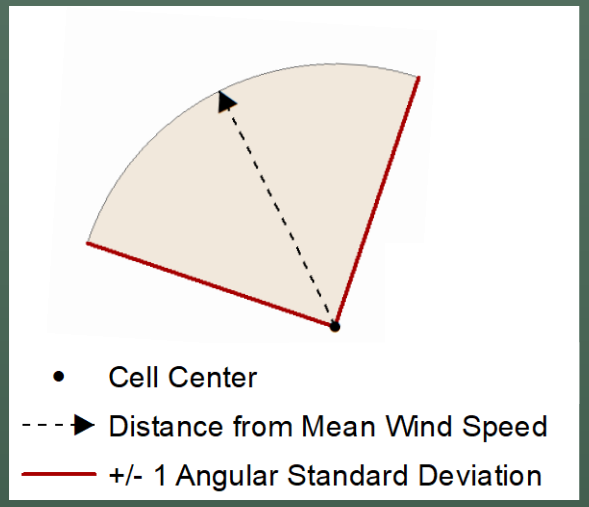
Space-time hot spots of ciSGA in Edmonton

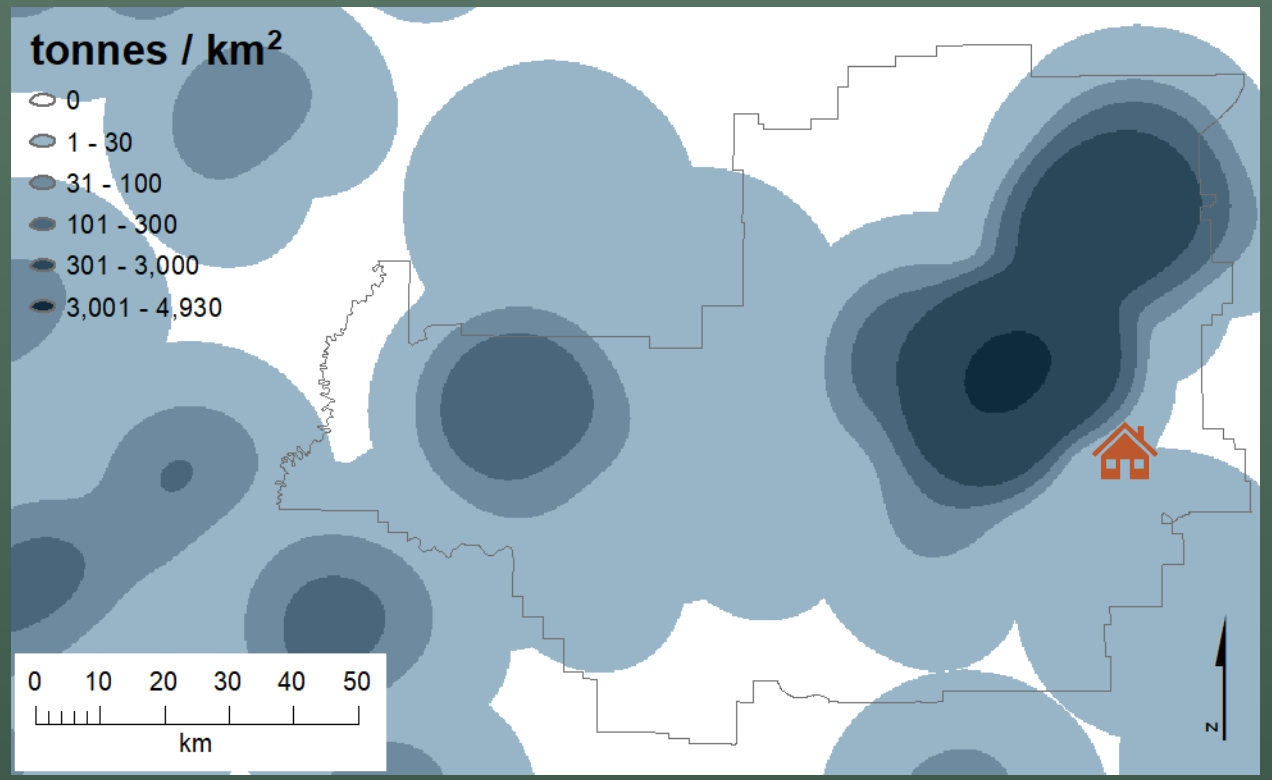


Mean monthly chemical emissions

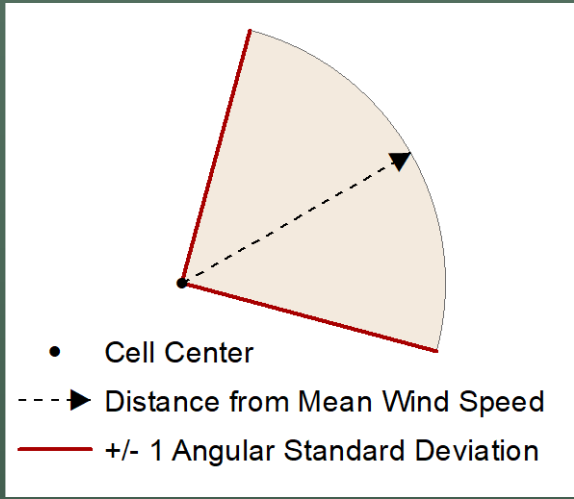


JANUARY


Cell Center
Distance from Mean Wind Speed
+/- 1 Angular Standard Deviation


tonnes / km²
0
1 - 30
31 - 100
101 - 300
301 - 3,000
3,001 - 4,930
0 10 20 30 40 50
km
N

JULY


Cell Center
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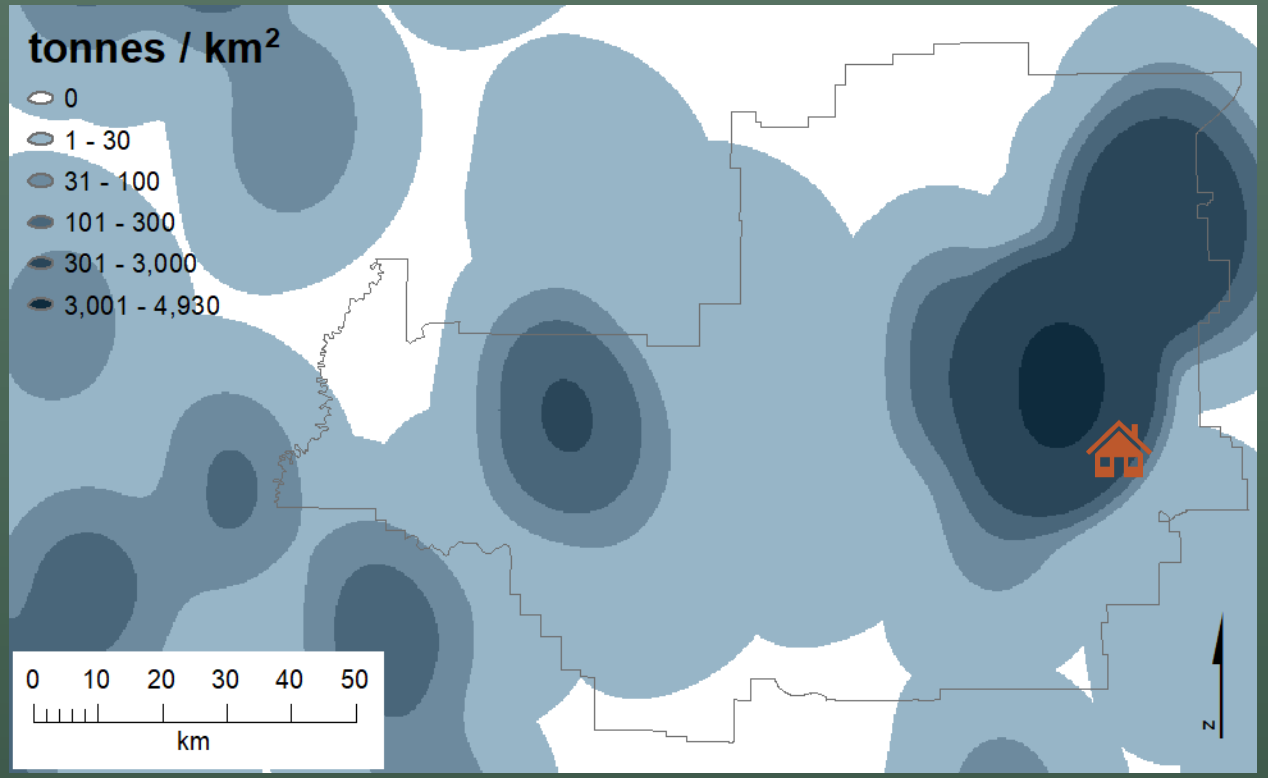
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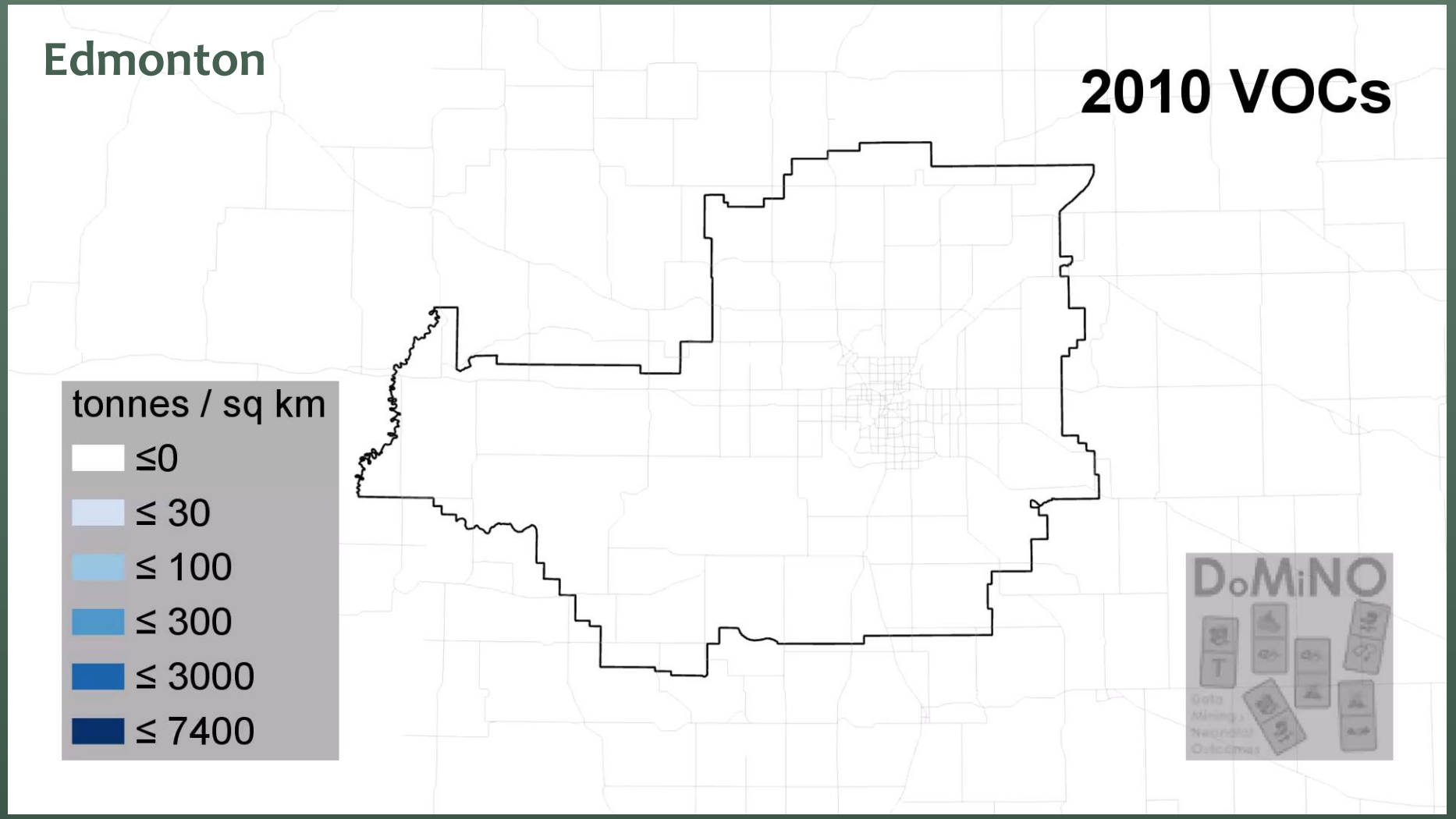
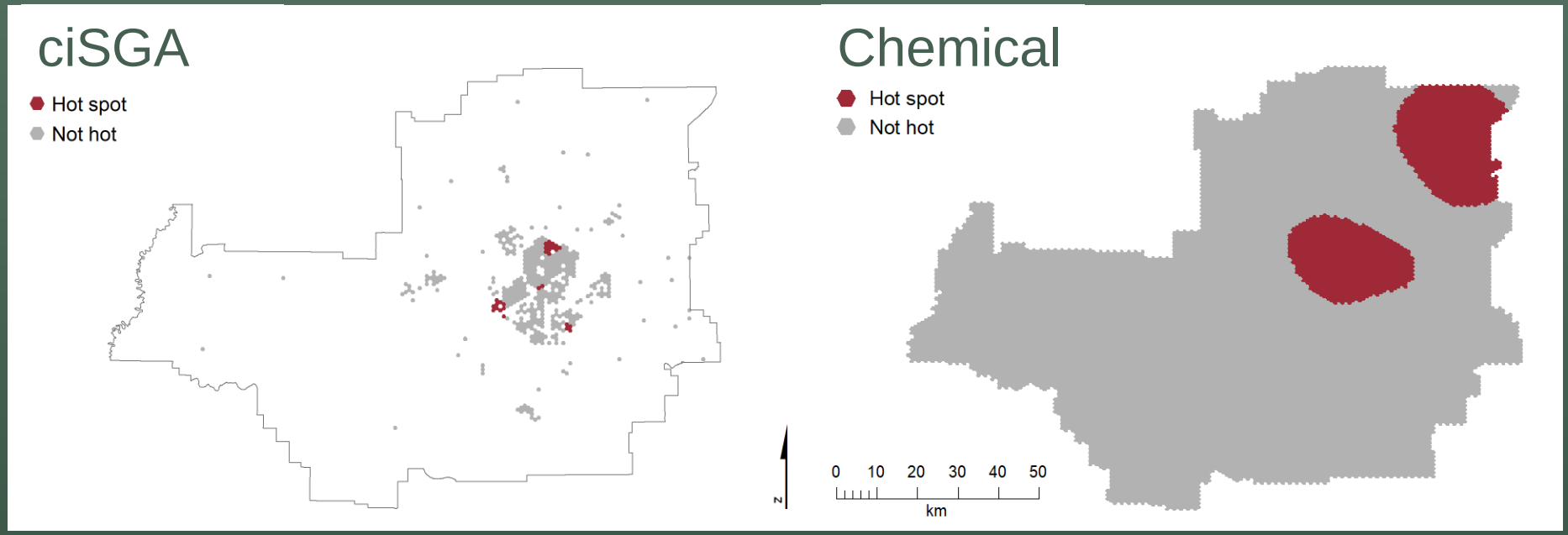
0
1 - 30
31 - 100
101 - 300
301 - 3,000
3,001 - 4,930
0 10 20 30 40 50
km
N


Edmonton
2010 VOCs
tonnes / sq km
≤0
≤ 30
≤ 100
≤ 300
≤ 3000
≤ 7400
DoMiNO

Space-time hot spots of chemical emissions



RED = positive coefficient
BLUE = negative coefficient
SIZE = relative strength or magnitude of coefficient

Online Mapping

ChEHC

Online Map Collection

https://arcg.is/19XyXn0

ChEHC Map Collection

uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da

ChEHC Map Collection

AIR POLLUTION

ChEHC

Introduction

Researchers from the University of Alberta's Department of Pediatrics who are affiliated with the Children's Environmental Health Clinic (ChEHC) have created and curated these environmental health maps as a clinical and public resource. Air pollution from traffic and industry are highlighted here.

Refer to the ChEHC website to learn more about the effects of air pollution on children's health.

Roads

Traffic

Emissions

UNIVERSITY OF ALBERTA
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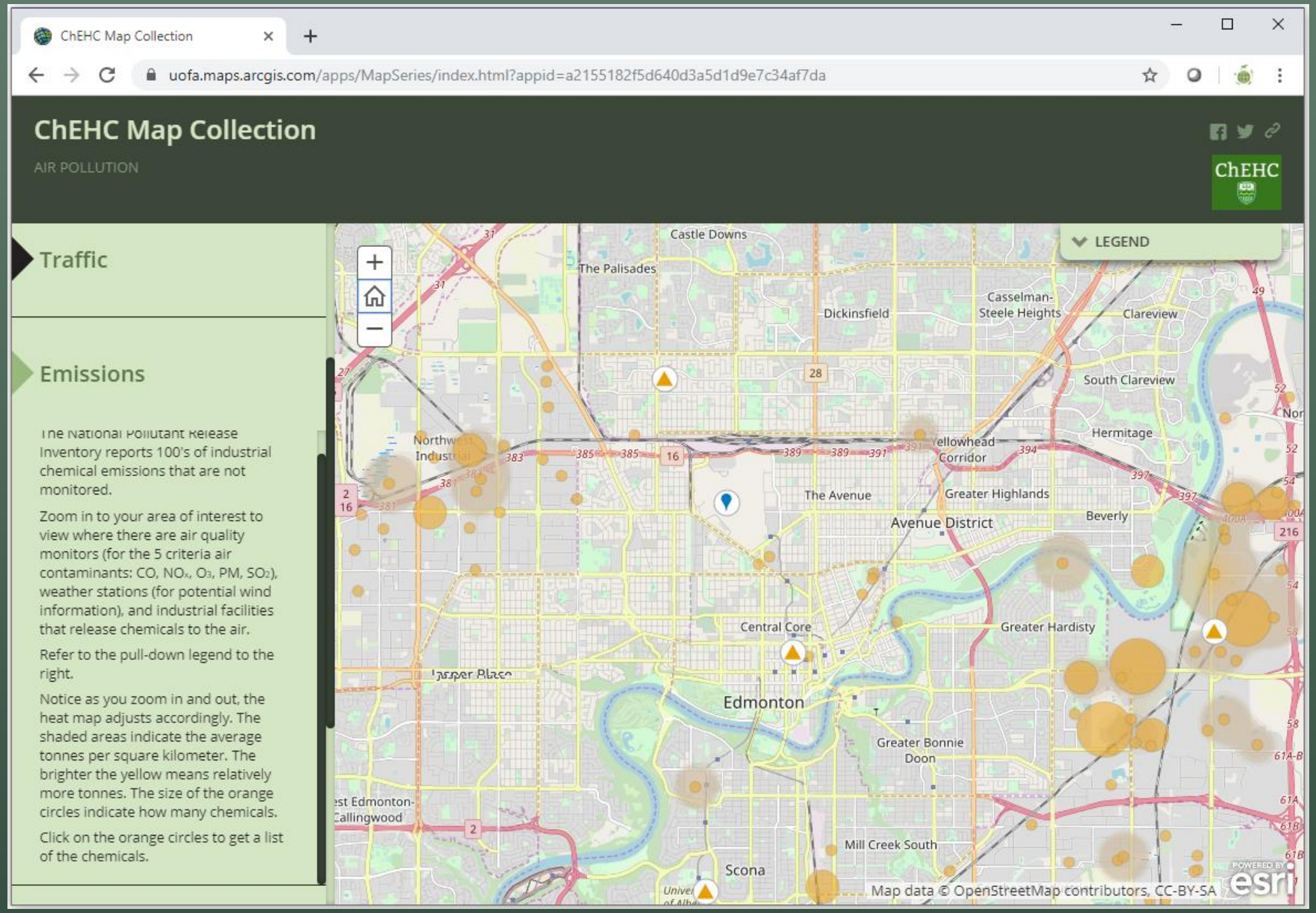
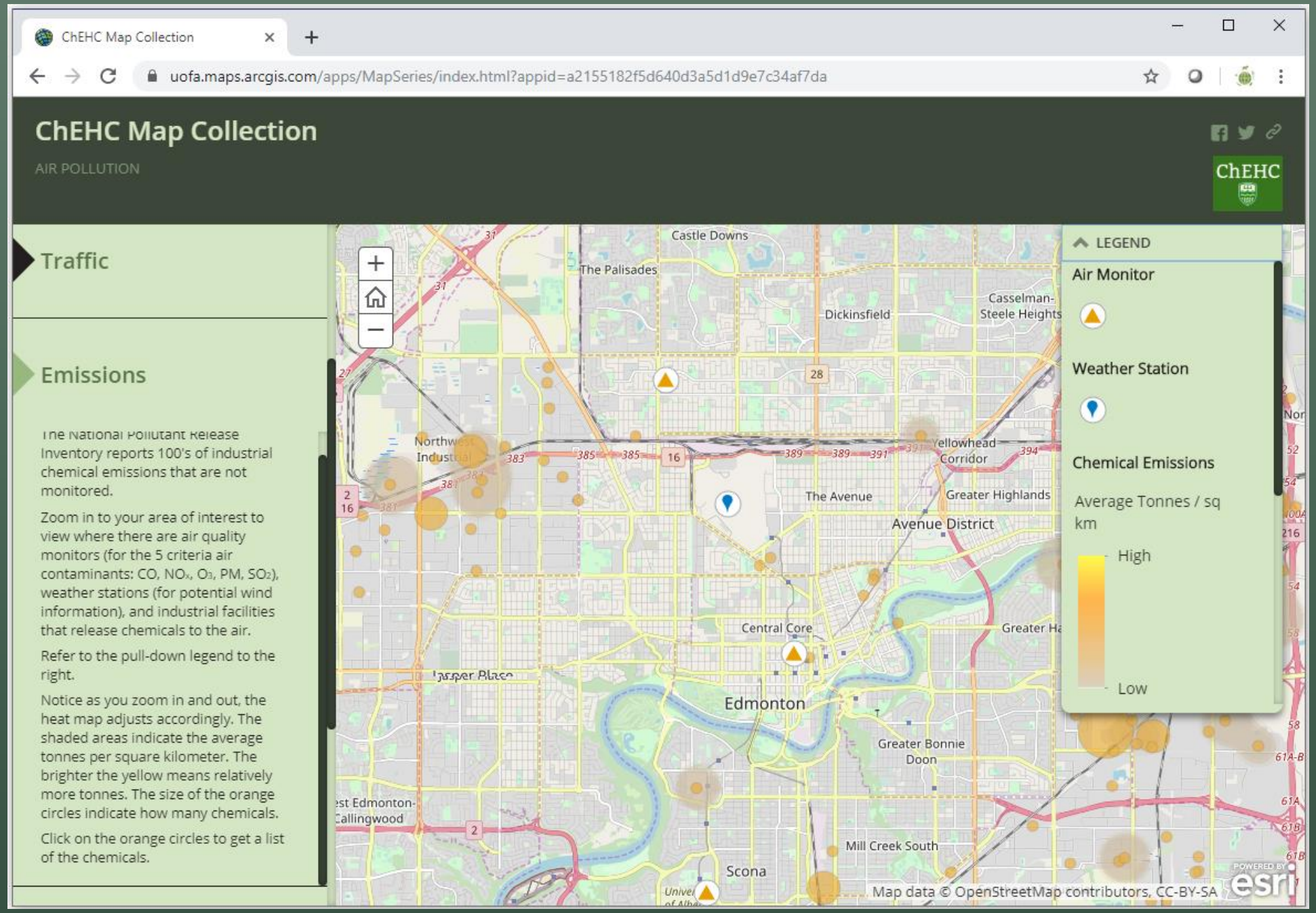
Department of Pediatrics

DoMiNO
Data Mining & Neonatal Outcomes

CIHR IRSC
Canadian Institutes of Health Research / Instituts de recherche en santé du Canada

NSERC CRSNG


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Traffic
Emissions
The National Pollutant Release Inventory reports 100's of industrial chemical emissions that are not monitored.
Zoom in to your area of interest to view where there are air quality monitors (for the 5 criteria air contaminants: CO, NOx, O3, PM, SO2), weather stations (for potential wind information), and industrial facilities that release chemicals to the air.
Refer to the pull-down legend to the right.
Notice as you zoom in and out, the heat map adjusts accordingly. The shaded areas indicate the average tonnes per square kilometer. The brighter the yellow means relatively more tonnes. The size of the orange circles indicate how many chemicals.
Click on the orange circles to get a list of the chemicals.
LEGEND
Castle Downs
The Palisades
Dickinsfield
Casselman-Steele Heights
Clareview
South Clareview
Hermitage
Yellowhead Corridor
The Avenue
Greater Highlands
Avenue District
Beverly
Central Core
Greater Hardisty
Edmonton
Greater Bonnie Doon
Mill Creek South
Scona
Map data © OpenStreetMap contributors, CC-BY-SA
esri


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
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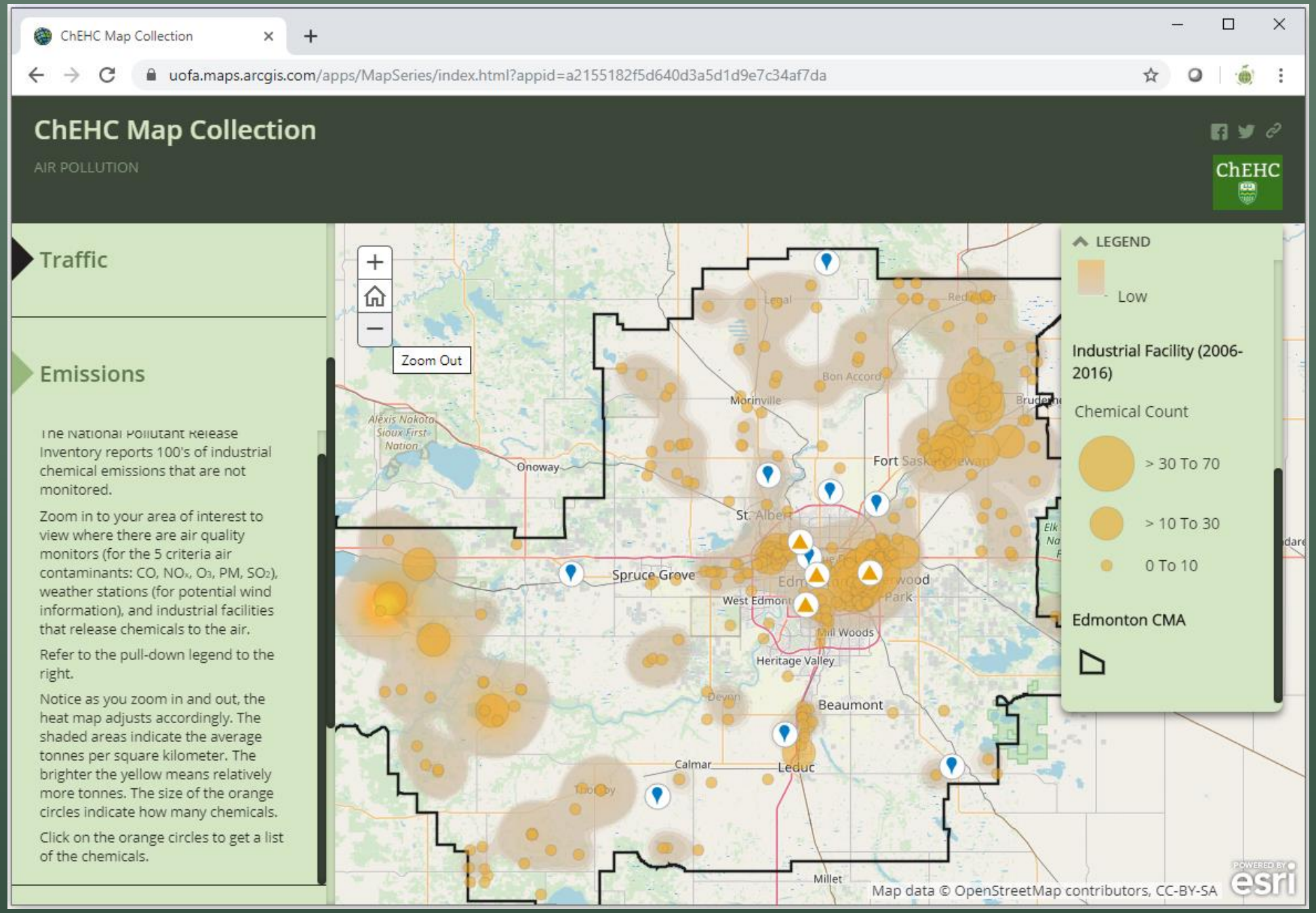
Castle Downs
The Palisades
Dickinsfield
Casselman-Steele Heights
Yellowhead Corridor
The Avenue
Greater Highlands
Avenue District
Central Core
Edmonton
Greater Bonnie Doon
Mill Creek South
Scona
LEGEND
Air Monitor
Weather Station
Chemical Emissions
Average Tonnes / sq km
High
Low
Map data © OpenStreetMap contributors, CC-BY-SA
POWERED BY esri


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
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AIR POLLUTION
ChEHC
Traffic
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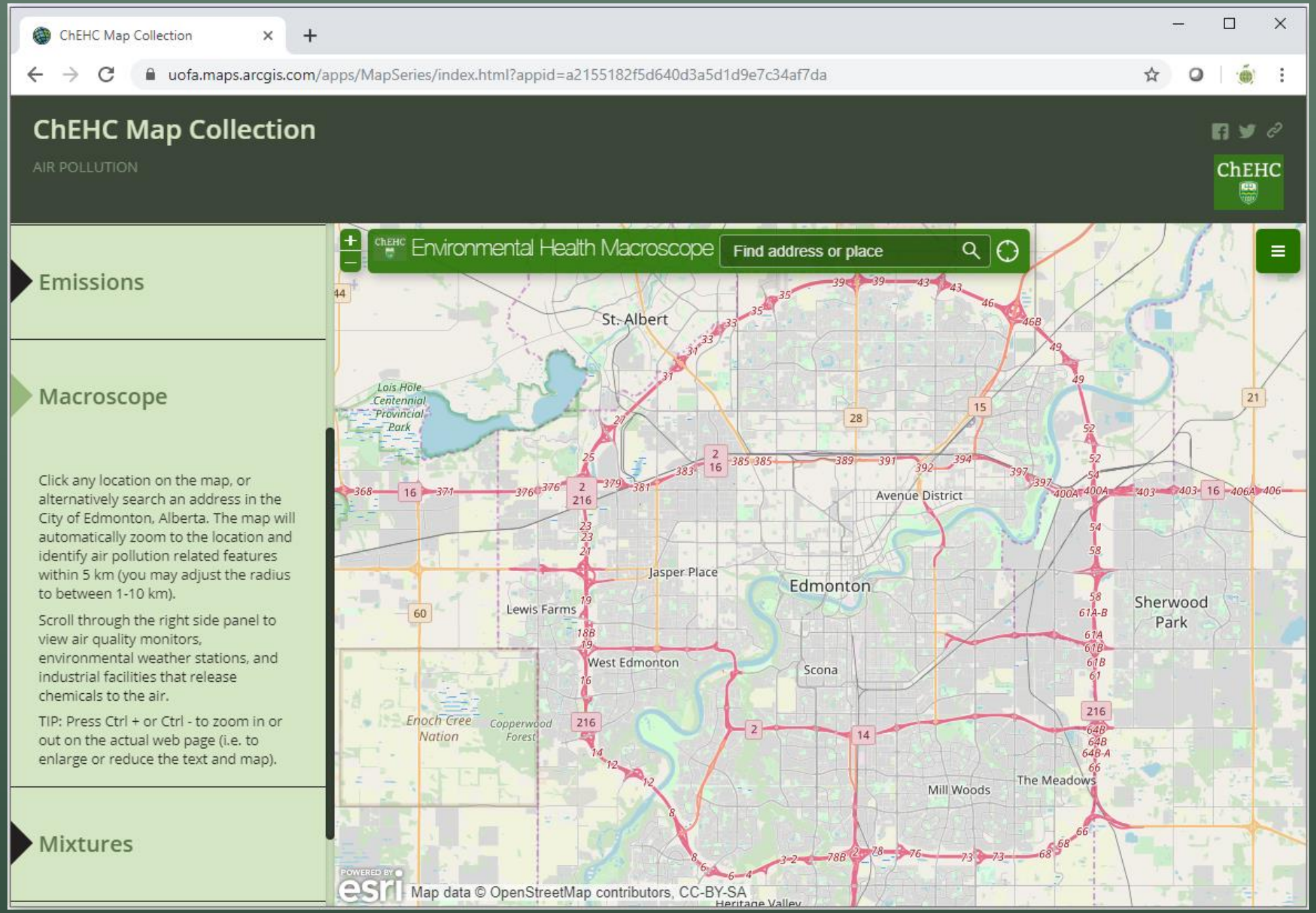
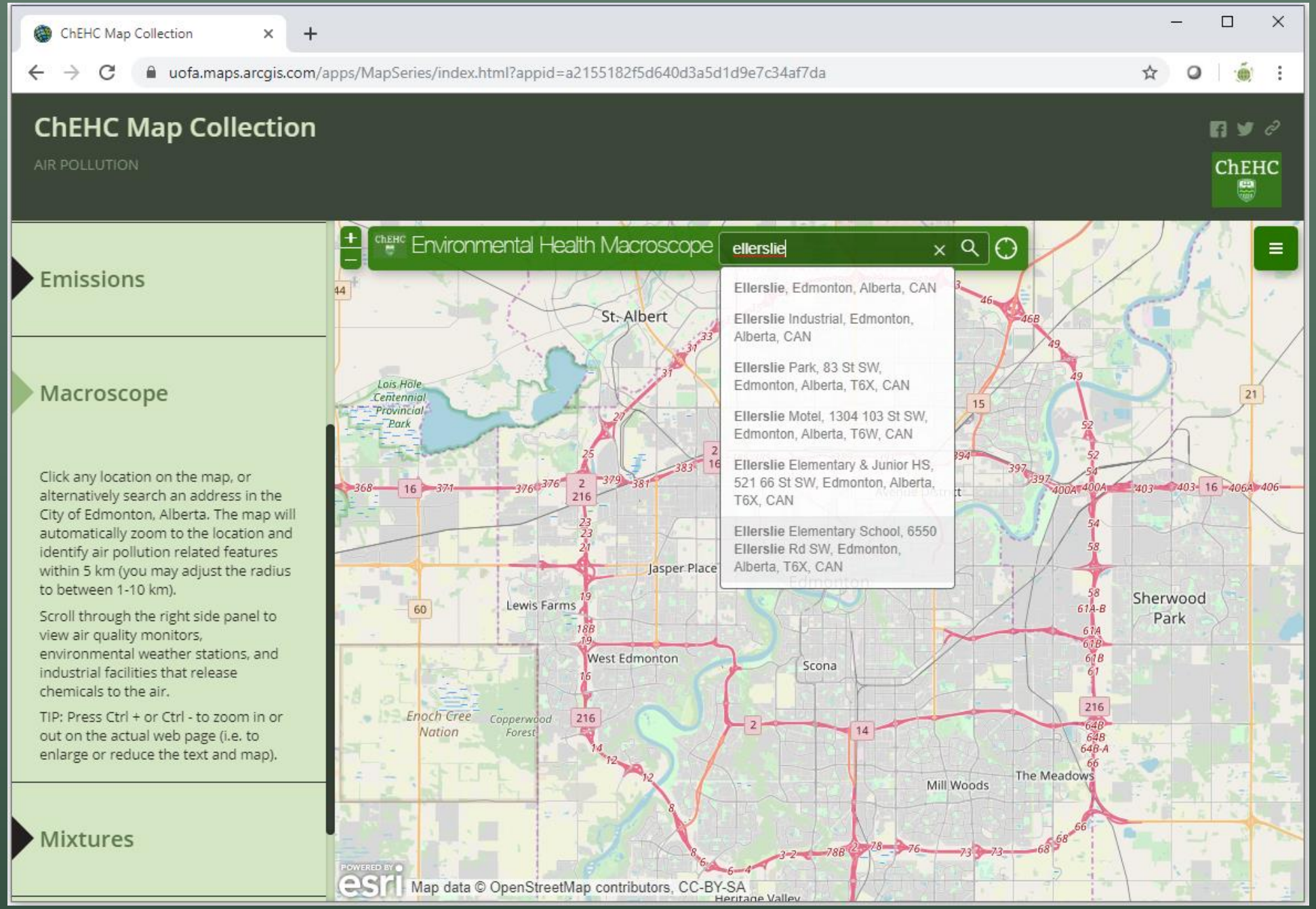
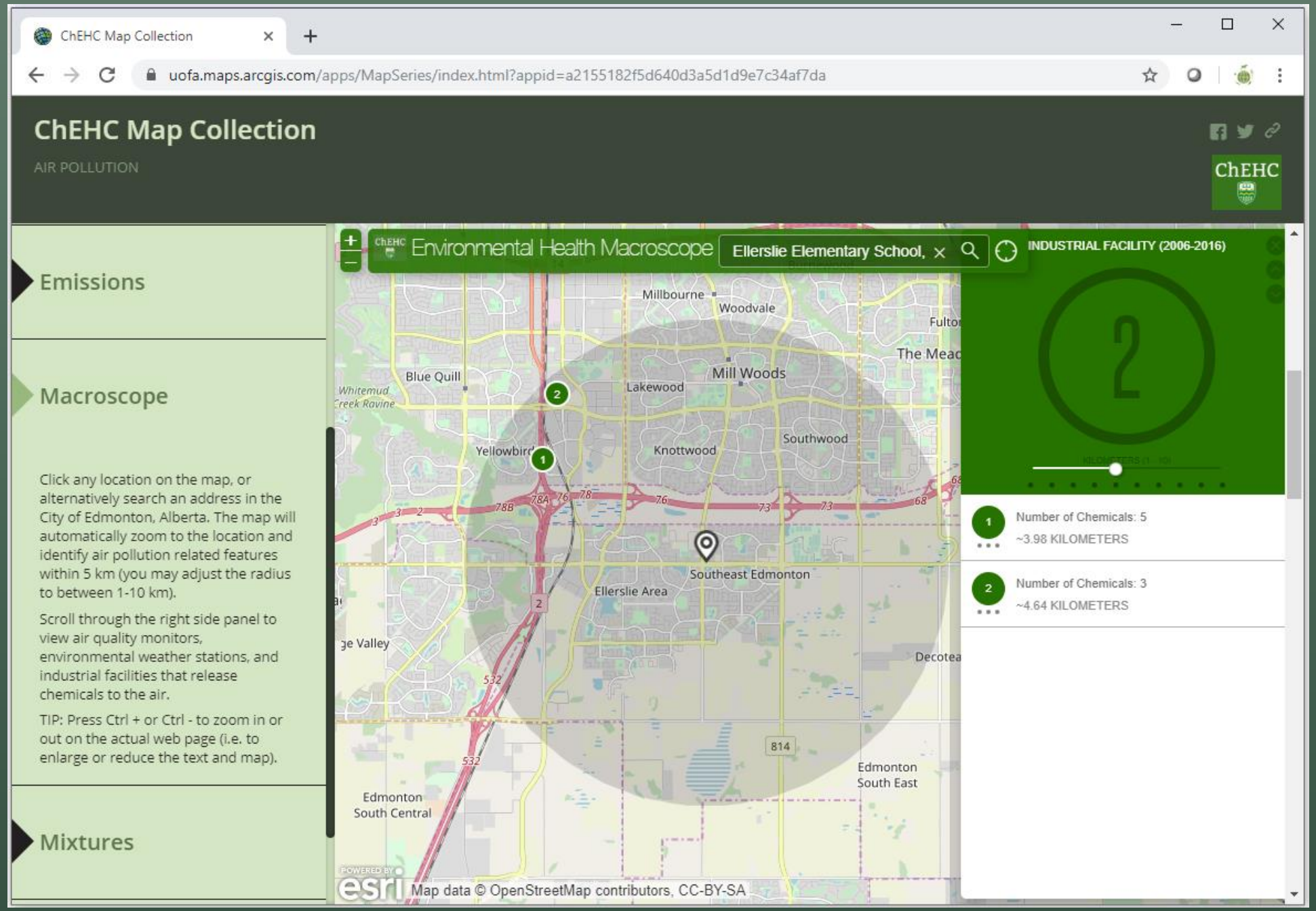
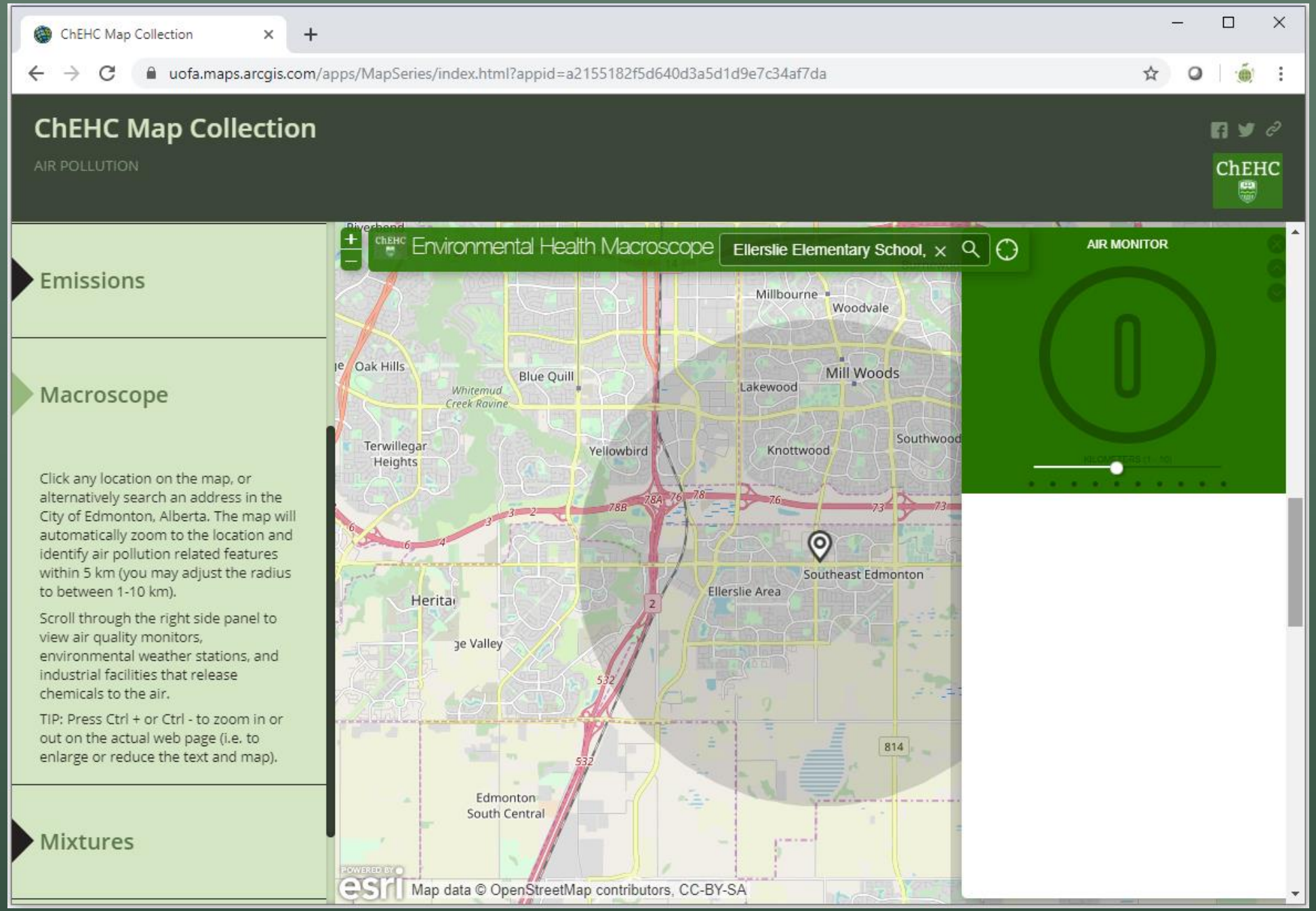
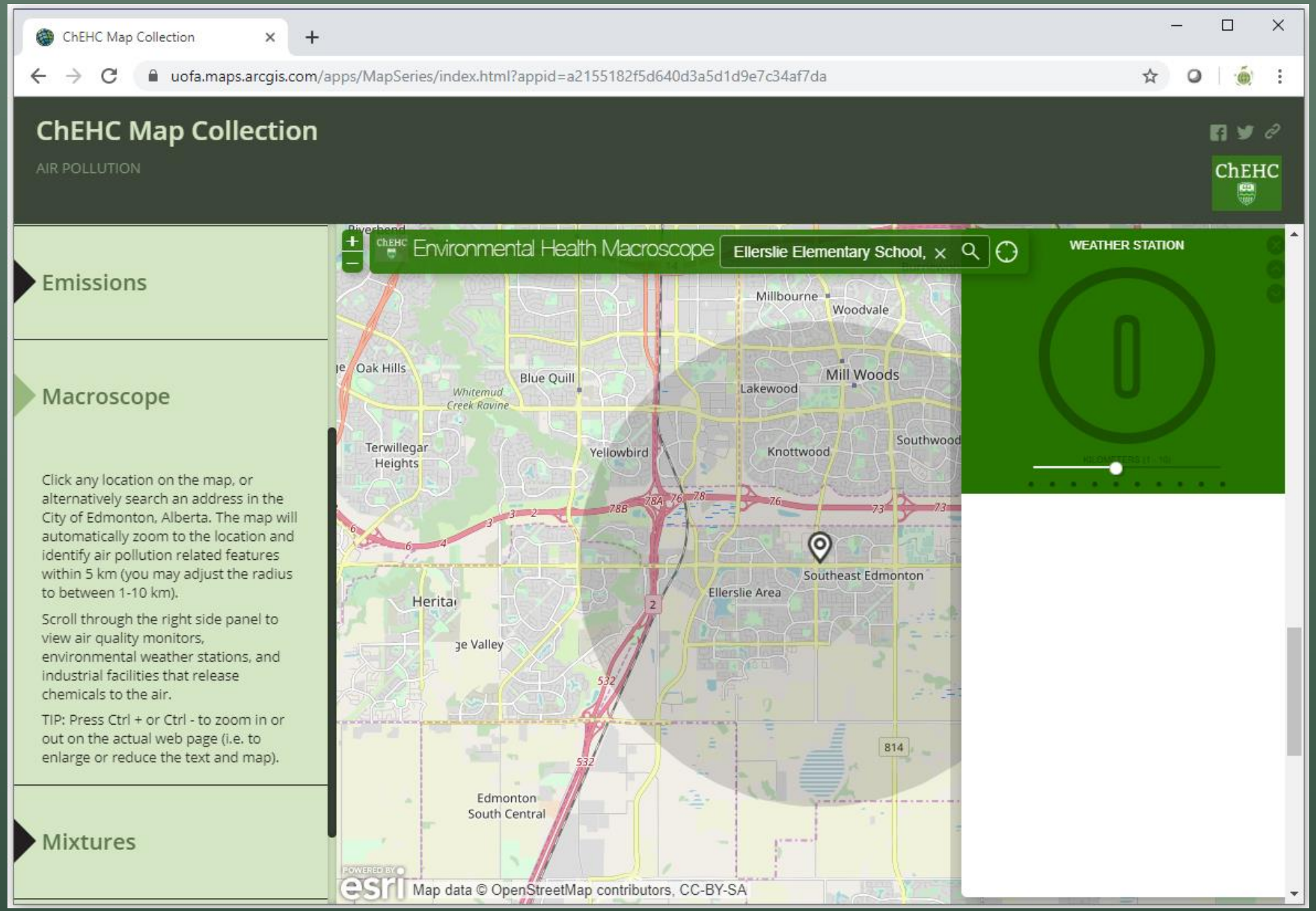
Notice as you zoom in and out, the heat map adjusts accordingly. The shaded areas indicate the average tonnes per square kilometer. The brighter the yellow means relatively more tonnes. The size of the orange circles indicate how many chemicals.
Click on the orange circles to get a list of the chemicals.
Zoom Out
LEGEND
Low
Industrial Facility (2006-2016)
Chemical Count
> 30 To 70
> 10 To 30
0 To 10
Edmonton CMA
Onoway
Morinville
Bon Accord
St. Albert
Spruce Grove
West Edmonton
Mill Woods
Heritage Valley
Beaumont
Calmar
Leduc
Millet
Map data © OpenStreetMap contributors, CC-BY-SA
esri

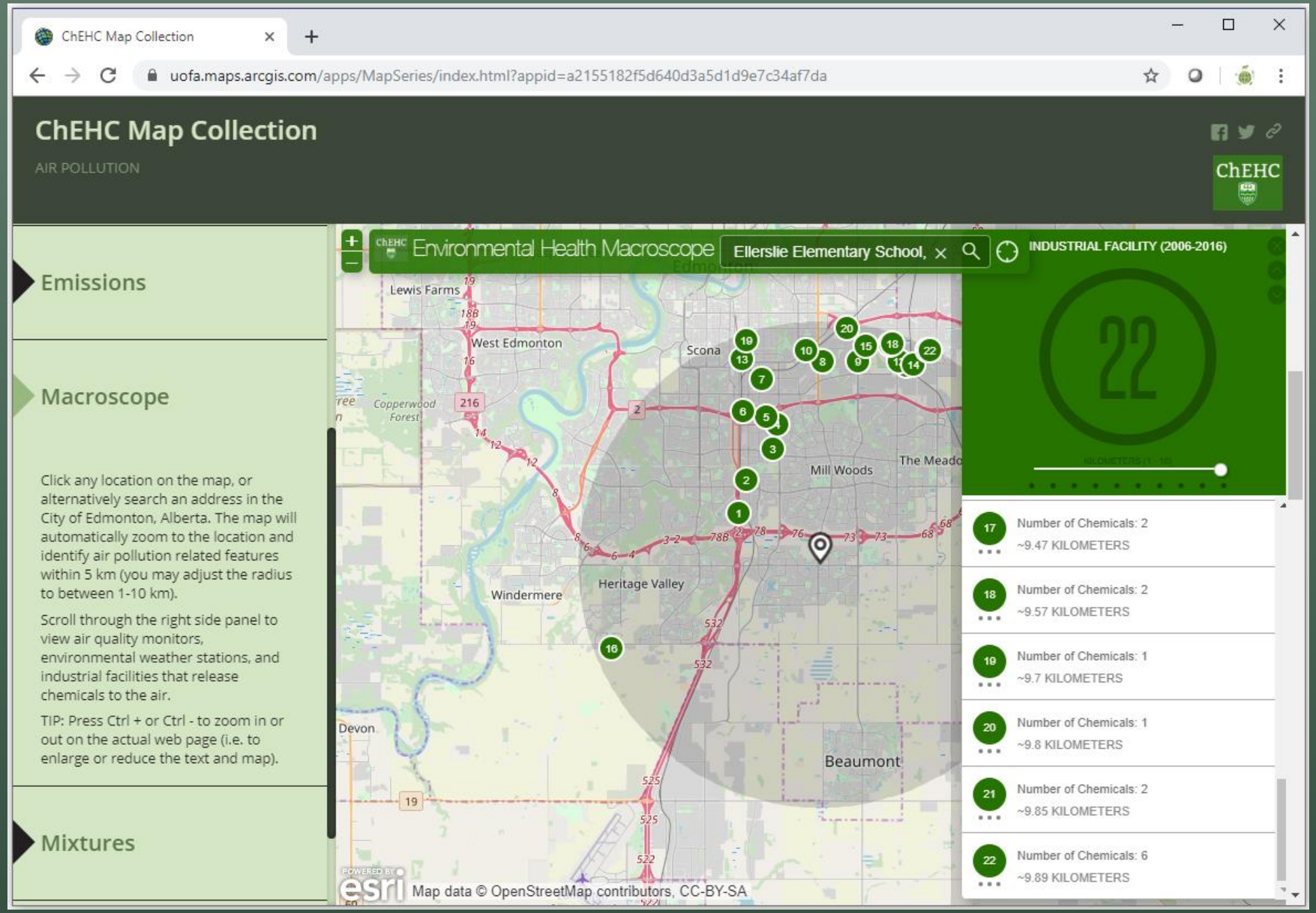

ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
ChEHC Environmental Health Macroscope
Find address or place
St. Albert
Lois Hole Centennial Provincial Park
Avenue District
Jasper Place
Edmonton
Lewis Farms
West Edmonton
Scona
Sherwood Park
Enoch Cree Nation
Copperwood Forest
Mill Woods
The Meadows
Heritage Valley
POWERED BY esri
Map data © OpenStreetMap contributors, CC-BY-SA

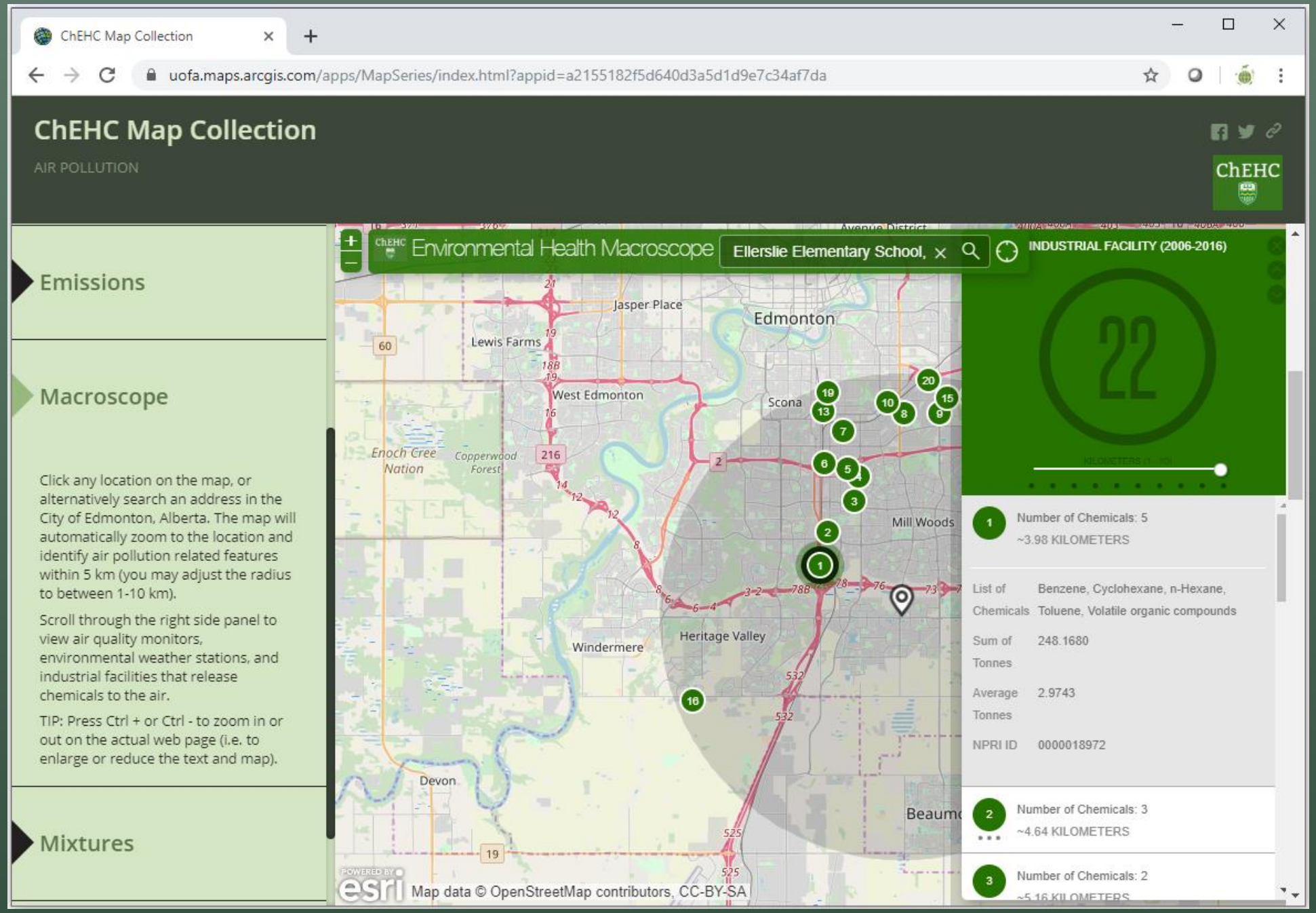

ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
Environmental Health Macroscope
ellerslie
Ellerslie, Edmonton, Alberta, CAN
Ellerslie Industrial, Edmonton, Alberta, CAN
Ellerslie Park, 83 St SW, Edmonton, Alberta, T6X, CAN
Ellerslie Motel, 1304 103 St SW, Edmonton, Alberta, T6W, CAN
Ellerslie Elementary & Junior HS, 521 66 St SW, Edmonton, Alberta, T6X, CAN
Ellerslie Elementary School, 6550 Ellerslie Rd SW, Edmonton, Alberta, T6X, CAN
St. Albert
Lois Hole Centennial Provincial Park
Jasper Place
Lewis Farms
West Edmonton
Enoch Cree Nation
Copperwood Forest
Scona
Sherwood Park
Mill Woods
The Meadows
Heritage Valley
Map data © OpenStreetMap contributors, CC-BY-SA

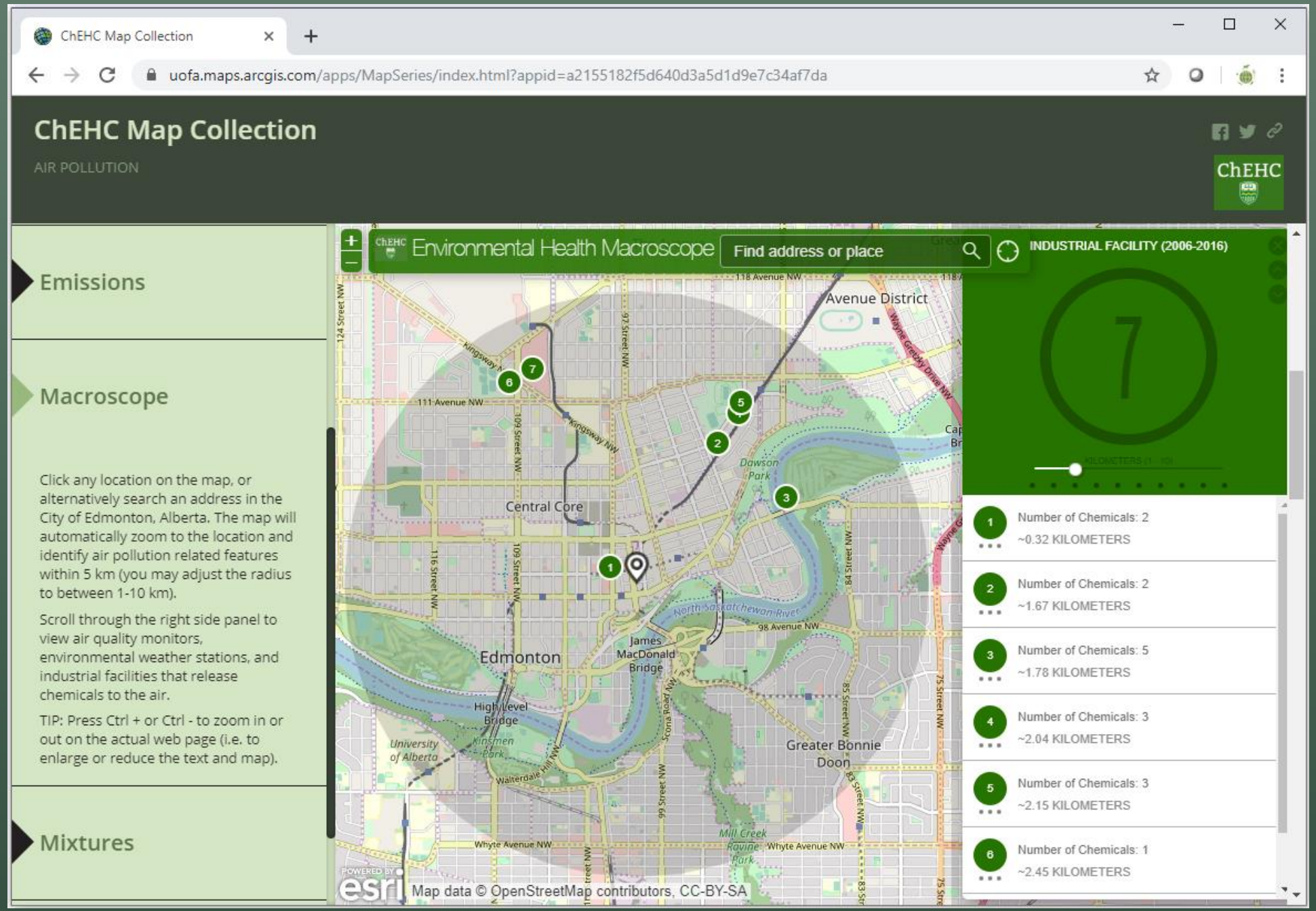

ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
Environmental Health Macroscope
Ellerslie Elementary School,
INDUSTRIAL FACILITY (2006-2016)
Number of Chemicals: 5
~3.98 KILOMETERS
Number of Chemicals: 3
~4.64 KILOMETERS
Millbourne
Woodvale
Blue Quill
Mill Woods
Lakewood
Whitemud Creek Ravine
Yellowbird
Knottwood
Southwood
Southeast Edmonton
Ellerslie Area
Edmonton South Central
Edmonton South East
Map data © OpenStreetMap contributors, CC-BY-SA

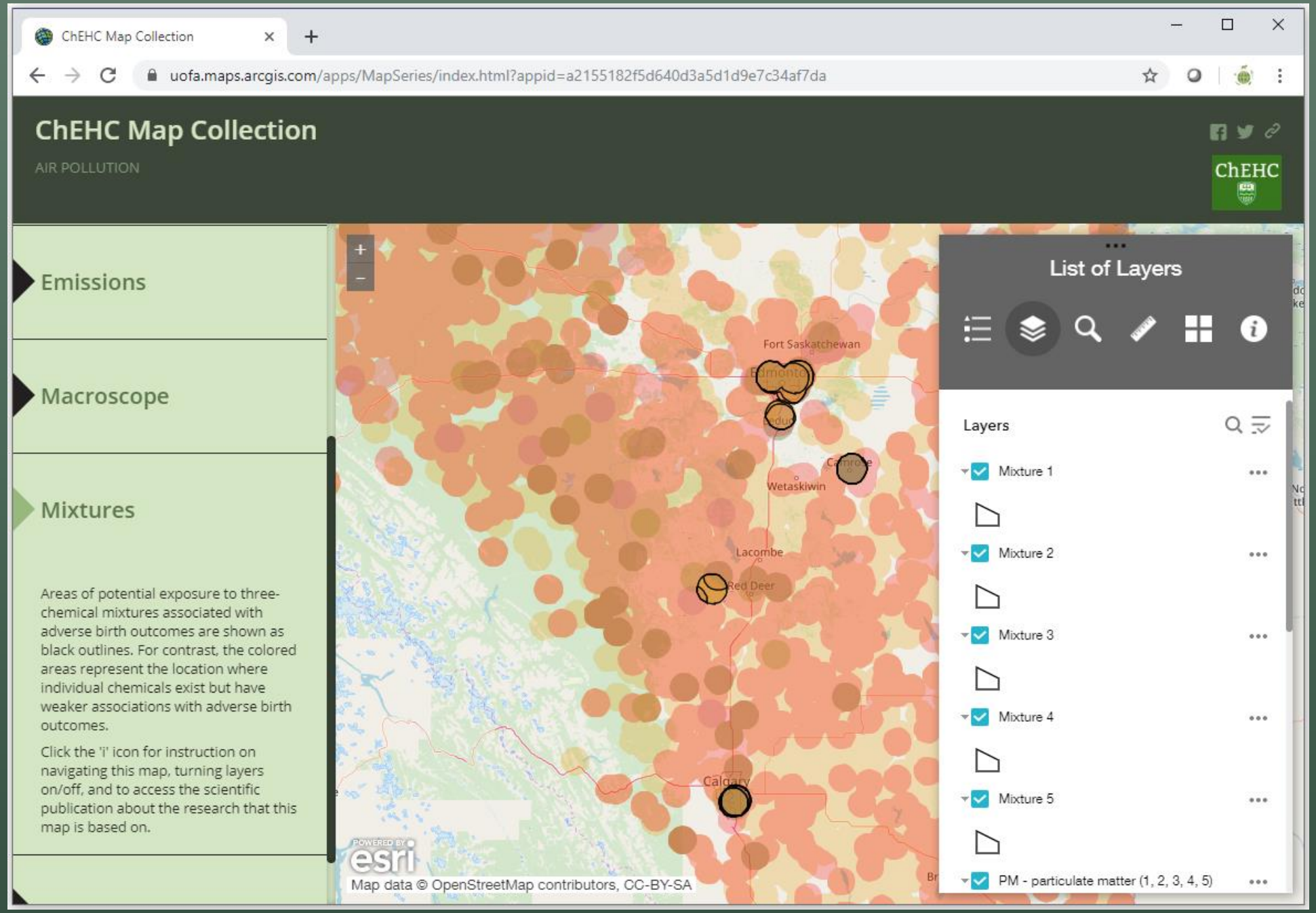

ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
Environmental Health Macroscope
Ellerslie Elementary School,
AIR MONITOR
Millbourne
Woodvale
Oak Hills
Blue Quill
Mill Woods
Lakewood
Whitemud Creek Ravine
Terwillegar Heights
Yellowbird
Knottwood
Southwood
Southeast Edmonton
Ellerslie Area
Edmonton South Central
Map data © OpenStreetMap contributors, CC-BY-SA


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
Environmental Health Macroscope
Ellerslie Elementary School,
WEATHER STATION
Millbourne
Woodvale
Oak Hills
Blue Quill
Mill Woods
Lakewood
Whitemud Creek Ravine
Terwillegar Heights
Yellowbird
Knottwood
Southwood
Southeast Edmonton
Ellerslie Area
Edmonton South Central
Map data © OpenStreetMap contributors, CC-BY-SA


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
ChEHC Environmental Health Macroscope
Ellerslie Elementary School,
INDUSTRIAL FACILITY (2006-2016)
22
Lewis Farms
West Edmonton
Scona
Copperwood Forest
Mill Woods
Heritage Valley
Windermere
Devon
Beaumont
Number of Chemicals: 2
~9.47 KILOMETERS
Number of Chemicals: 2
~9.57 KILOMETERS
Number of Chemicals: 1
~9.7 KILOMETERS
Number of Chemicals: 1
~9.8 KILOMETERS
Number of Chemicals: 2
~9.85 KILOMETERS
Number of Chemicals: 6
~9.89 KILOMETERS
Map data © OpenStreetMap contributors, CC-BY-SA


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
Environmental Health Macroscope
Ellerslie Elementary School,
INDUSTRIAL FACILITY (2006-2016)
22
Jasper Place
Edmonton
Lewis Farms
West Edmonton
Scona
Enoch Cree Nation
Copperwood Forest
Mill Woods
Windermere
Heritage Valley
Devon
Number of Chemicals: 5
~3.98 KILOMETERS
List of Chemicals: Benzene, Cyclohexane, n-Hexane, Toluene, Volatile organic compounds
Sum of Tonnes: 248.1680
Average Tonnes: 2.9743
NPRI ID: 0000018972
Number of Chemicals: 3
~4.64 KILOMETERS
Number of Chemicals: 2
~5.16 KILOMETERS
Map data © OpenStreetMap contributors, CC-BY-SA


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Click any location on the map, or alternatively search an address in the City of Edmonton, Alberta. The map will automatically zoom to the location and identify air pollution related features within 5 km (you may adjust the radius to between 1-10 km).
Scroll through the right side panel to view air quality monitors, environmental weather stations, and industrial facilities that release chemicals to the air.
TIP: Press Ctrl + or Ctrl - to zoom in or out on the actual web page (i.e. to enlarge or reduce the text and map).
Mixtures
ChEHC Environmental Health Macroscope
Find address or place
INDUSTRIAL FACILITY (2006-2016)
7
Number of Chemicals: 2
~0.32 KILOMETERS
Number of Chemicals: 2
~1.67 KILOMETERS
Number of Chemicals: 5
~1.78 KILOMETERS
Number of Chemicals: 3
~2.04 KILOMETERS
Number of Chemicals: 3
~2.15 KILOMETERS
Number of Chemicals: 1
~2.45 KILOMETERS
Avenue District
Central Core
Edmonton
James MacDonald Bridge
High Level Bridge
Greater Bonnie Doon
Dawson Park
Kinsmen Park
Mill Creek Ravine Park
University of Alberta
118 Avenue NW
111 Avenue NW
98 Avenue NW
Whyte Avenue NW
124 Street NW
109 Street NW
116 Street NW
97 Street NW
99 Street NW
84 Street NW
75 Street NW
Kingsway NW
Wayne Gretzky Drive NW
North Saskatchewan River
Scona Road NW
Walterdale Hill NW
Map data © OpenStreetMap contributors, CC-BY-SA


ChEHC Map Collection
uofa.maps.arcgis.com/apps/MapSeries/index.html?appid=a2155182f5d640d3a5d1d9e7c34af7da
ChEHC Map Collection
AIR POLLUTION
ChEHC
Emissions
Macroscope
Mixtures
Areas of potential exposure to three-chemical mixtures associated with adverse birth outcomes are shown as black outlines. For contrast, the colored areas represent the location where individual chemicals exist but have weaker associations with adverse birth outcomes.
Click the 'i' icon for instruction on navigating this map, turning layers on/off, and to access the scientific publication about the research that this map is based on.
Fort Saskatchewan
Wetaskiwin
Lacombe
Red Deer
Calgary
List of Layers
Layers
Mixture 1
Mixture 2
Mixture 3
Mixture 4
Mixture 5
PM - particulate matter (1, 2, 3, 4, 5)
Map data © OpenStreetMap contributors, CC-BY-SA

ABO Take Home Messages

1. We discovered associations with known/suspected developmental toxicants, including ammonia, benzene, carbon monoxide, PMs, VOCs, and sulphuric acid
2. Chemicals were more important than land-based sources or when combined in the ambient health hazard index
3. We identified 5 potentially hazardous mixtures of industrial chemicals
4. Our findings do not support causation, but the associations are still worth paying attention to

NPRI Take Home Messages

- NPRI is very useful, publicly-available, environmental data on many chemical emissions that are not monitored
- Annual estimates for NPRI requires the assumption of uniform emission for calculating monthly averages
- Dispersion can be determined from the average wind speed but incorporating wind direction is more challenging
- We recommend continual and required reporting for all facilities to ensure more complete and consistent coverage
- We are still using coordinates from previously downloaded databases because a minimum of 6 decimal places is required for spatial accuracy in local analysis (current coordinates do not)

ccn@ualberta.ca

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Pediatrics

ALBERTA Perinatal Health PROGRAM

CIHR IRSC

NSERC CRSNG

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