

# GIS and Cervical Cancer Screening: The Contribution of Spatial Analysis.

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GIRAS: Giving some space to health population research...



# Presentation Outline

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- Research Background
- Cervical Cancer Screening in Canada
- Study area
- Geocoding Health Data in Canada
- Cervical Cancer Screening Data
- A Few Descriptive Statistic about Screening
- Geographical Variation of Screening Rate
- Spatial Analysis
- Conclusion

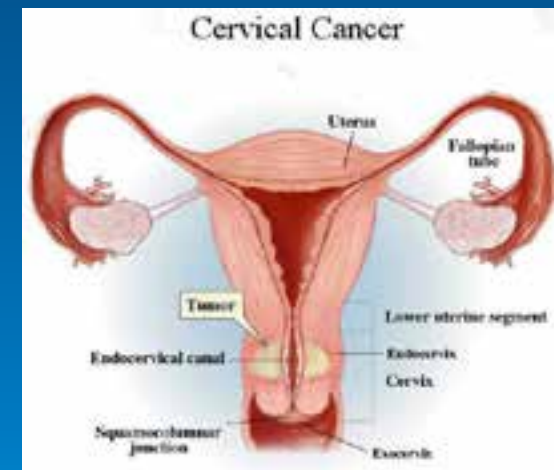
# Research Background

## Why it matters...

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- Statistics widely known

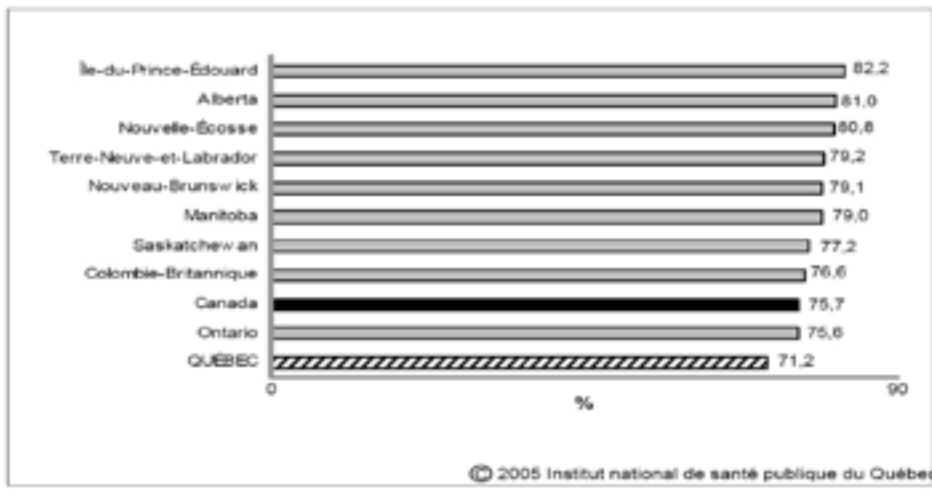
- Cervical cancer is in second rank in the world
  - After breast cancer
  - 1300 cases in Canada yearly
- Best means to control cervical cancer
  - HPV vaccination
  - Cancer screening (PAP test)
  - Screening need to be optimized
  - From opportunistic screening to organized screening
  - Develop means to assess screening efficiency
  - Measure population response to solicitation



# Cervical Cancer Screening in Canada

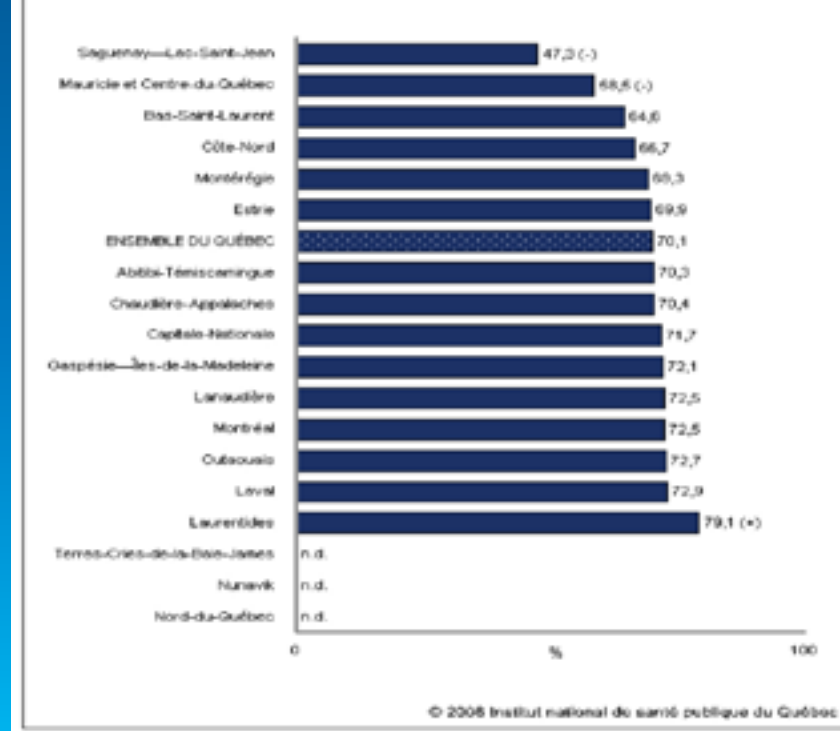
## Screening in Canada\*

Proportion de femmes de 18 à 69 ans ayant passé un test Pap au cours d'une période de moins de trois ans, Québec, provinces canadiennes et Canada, 2003



## Screening in Quebec\*

Proportion de femmes de 18 à 69 ans ayant passé un test de Pap au cours d'une période de moins de trois ans, régions et Québec, 2005



\*Data based on a self-declared survey from Statistics Canada

# Cervical Cancer Screening in Quebec

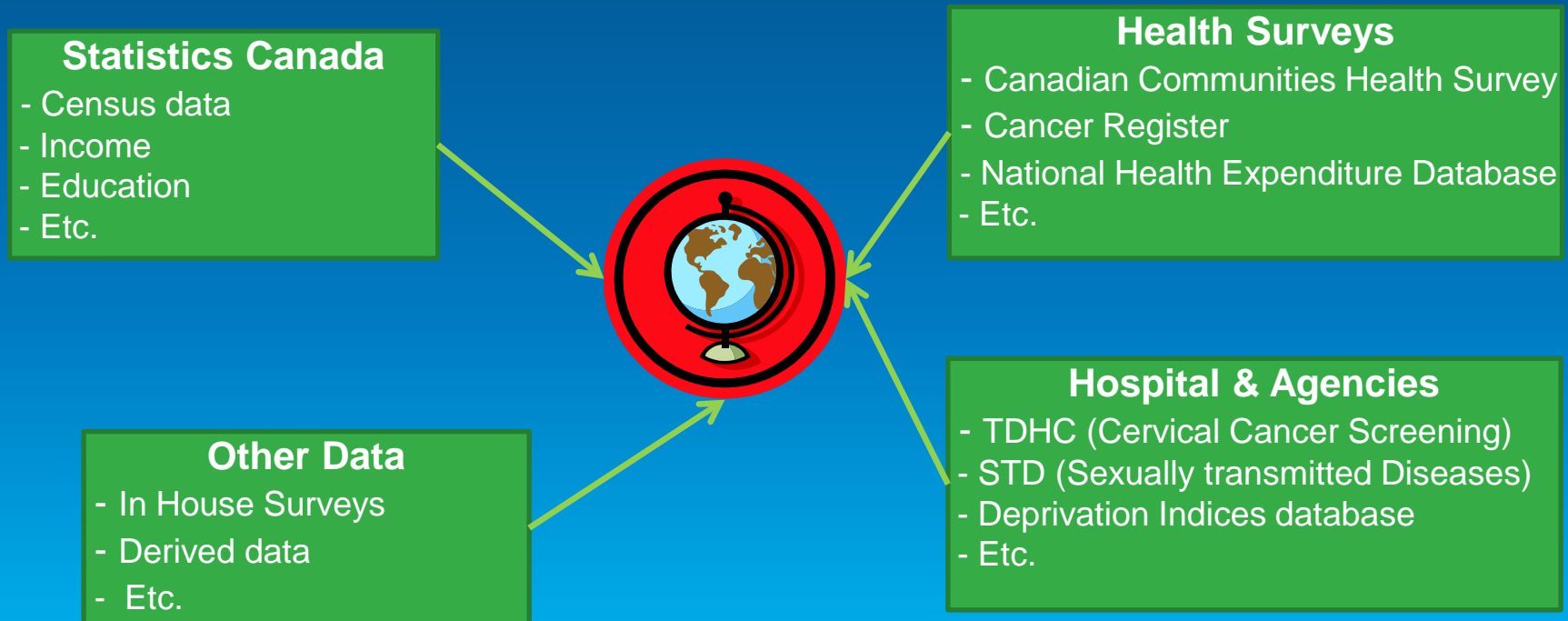
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- Low participation rate of women to screening
  - Facts:
    - No organized screening program in the province
    - Data on screening based on self-declaration
    - Overestimation of participation rates
    - No fine scale data (at geographical scale)
  - Project
    - Assess actual screening rate
    - Map geographical variation of screening rates
    - Focus on a specific region (Mauricie region)

# GIS and Population Health Research

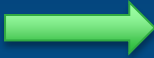
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- GIS can *integrate* and *link* databases from different sources and help study those data on a common base: ***Geographical location***



# Geocoding Health Data in Canada

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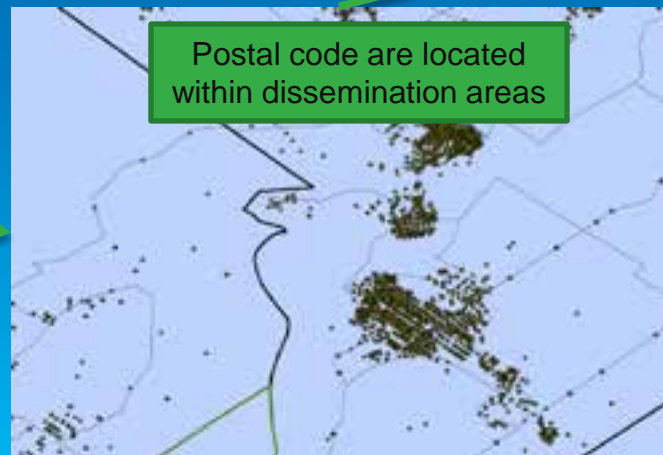
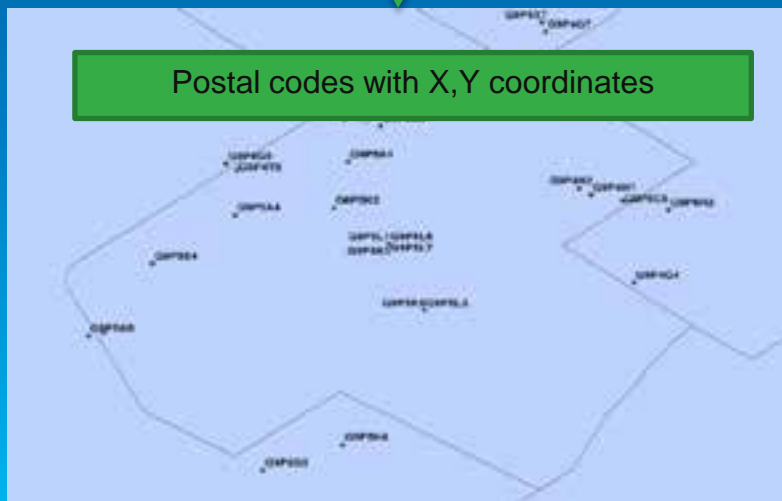
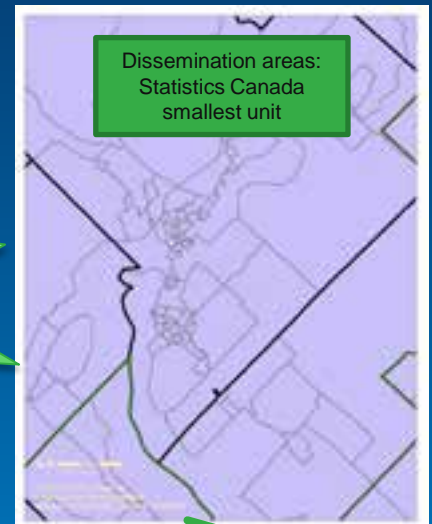
- Spatial Key  Postal Code
  - Advantages
    - Usually coded in all databases (hospital, agencies, patients record)
    - Data remain anonymous
    - No need to obtain patient authorization
    - Easier to get research ethic certificate
    - Good spatial precision in urban areas
  - Disadvantages
    - Design for mail delivery, not health population research!
      - Same postal code repeated along a mail delivery road
    - Low precision in rural areas (1 postal code per municipality)

# Geocoding Health Data in Canada

- Health data geocoding:

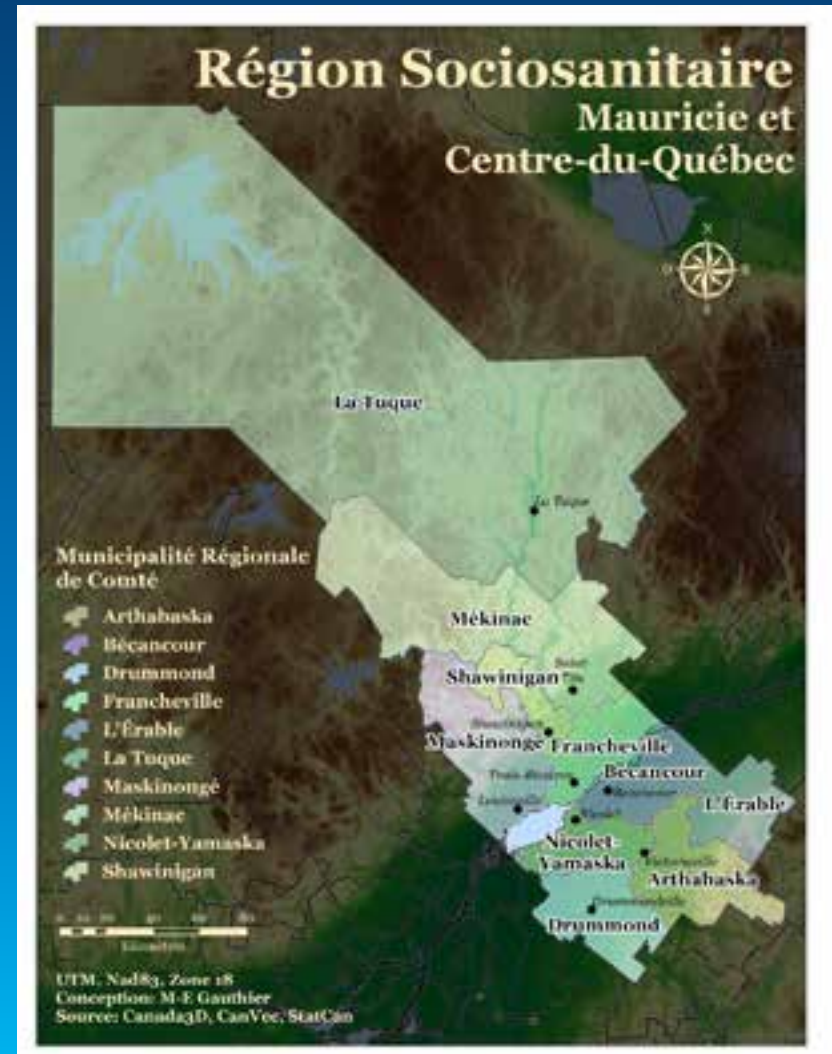
CDE_POST	BIRTH	AN_NAISS	RES_1	DATE_1	RES_2	DATE_2	RES_3	DATE_3	RES_4	
90020	3001981	180	INDG	217000	NULL	NULL	NULL	NULL	NULL	?
987154	3071981	180	NULL	NULL	30CB1	13142005	30CB1	13142005	30CB1	?
989316	3051981	180	30CB1	1250005	NULL	NULL	NULL	NULL	NULL	?
989405	3051981	180	NULL	NULL	30CB1	3180000	30CB1	3090005	NULL	?
987881	3041981	180	145C-U	1080007	1LSL	1080007	00NL1	262007	1MB3	?
100211	3031981	180	NULL	NULL	30CB1	7140000	NULL	NULL	NULL	?
989104	3181981	180	30NL?	480007	1MB3	262006	NULL	NULL	NULL	?
987106	3171981	180	30CB1	1250005	30CB1	4510005	NULL	NULL	30CB1	?

845,990 postal codes in Canada (Jan. 2014)



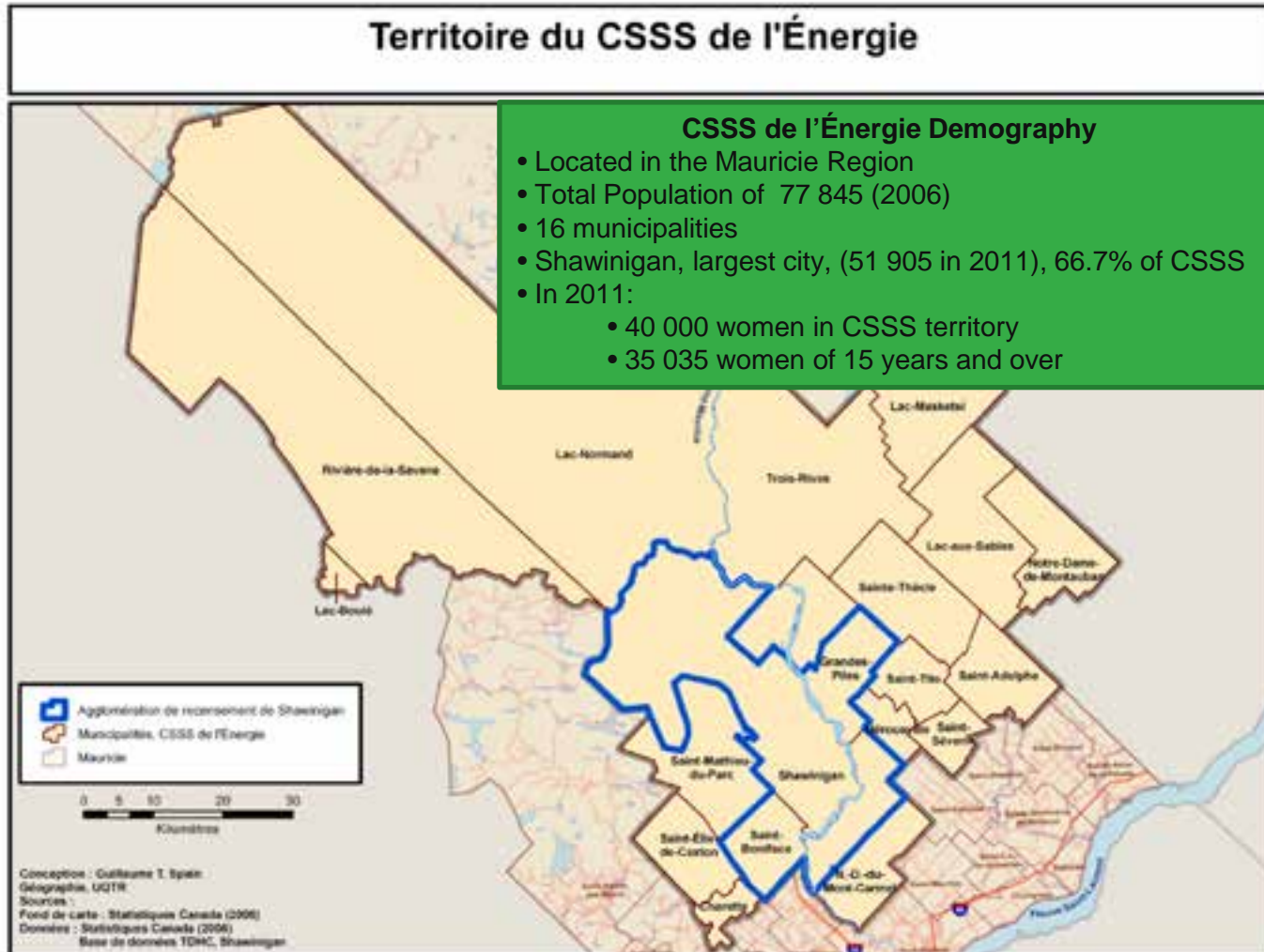


# Study area Mauricie Region



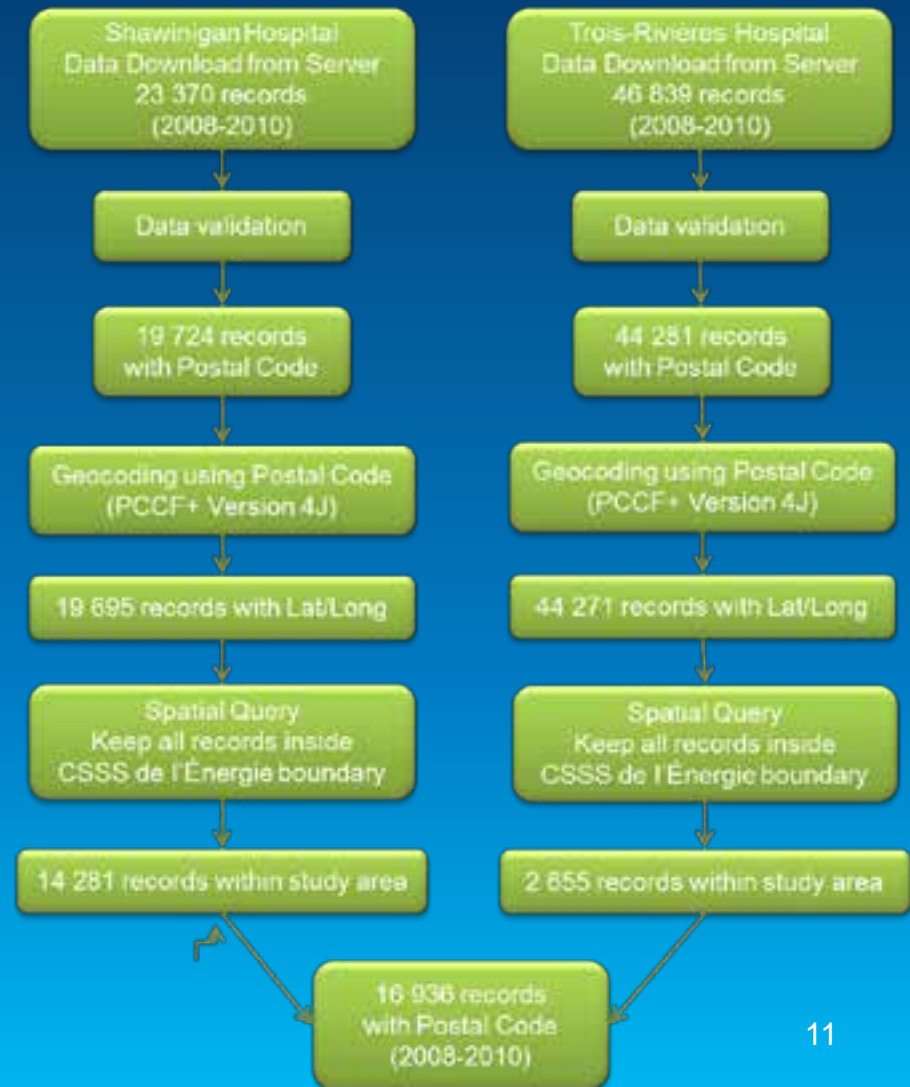
# Study area

## Pilot study (CSSS de l'Énergie)

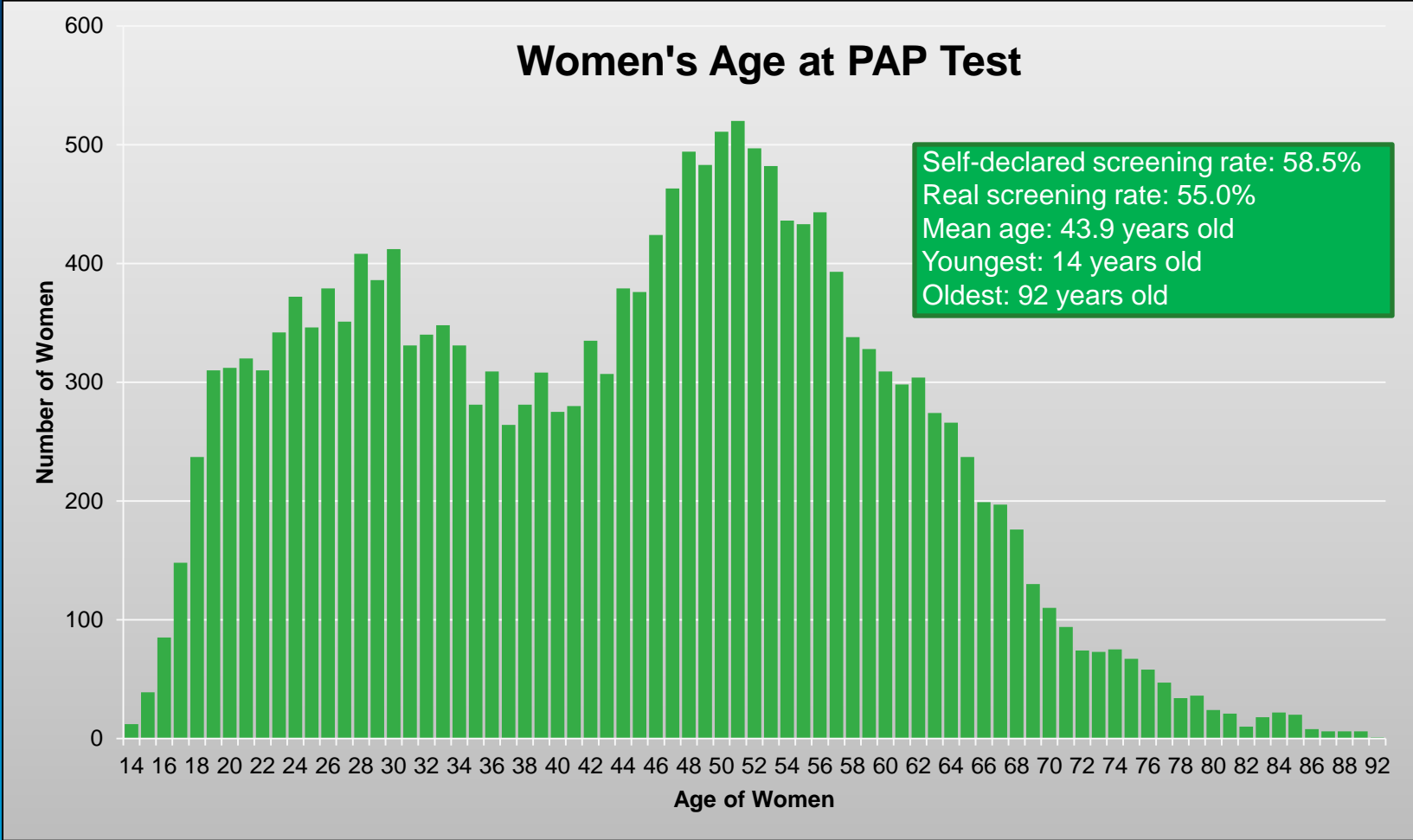


# Cervical Cancer Screening Data

- For each woman who at least one PAP test between 2008-2010:
  - Postal Code
  - City
  - Birthdate
  - Screening dates
  - Screening results
  - Quality of samples
  - Doctor name
- From 1 to 15 test results for each record
  - Guidelines are 1 for each 3 years period.



# A Few Descriptive Statistics



# A Few Descriptive Statistics

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- Age is a good indicator of screening rates:

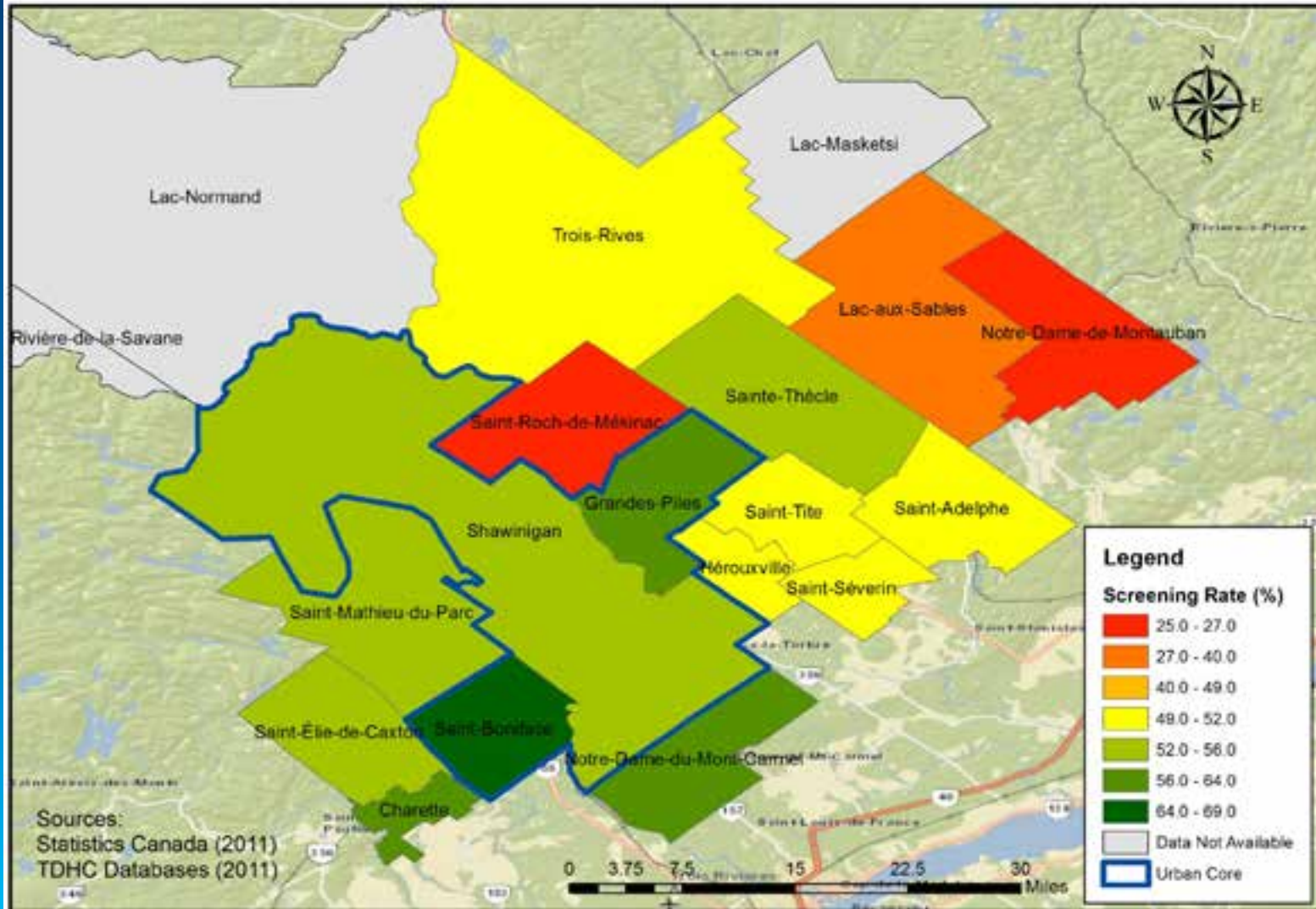
Age Group (years)	Screened Women 2008-2010	Total Number of Women 2010 (ISQ)	Screening Rate 2008-2010
20-24	1656	1770	93.6%
25-34	3632	3675	98.8%
35-44	3019	3840	78.6%
45-54	4686	6910	67.8%
55-64	3386	6590	51.4%
65-74	1365	4430	30.8%
75 & over	384	5190	7.4%
<b>TOTAL</b>	<b>18128</b>	<b>32405</b>	<b>55.0</b>

- But, what about geography ?



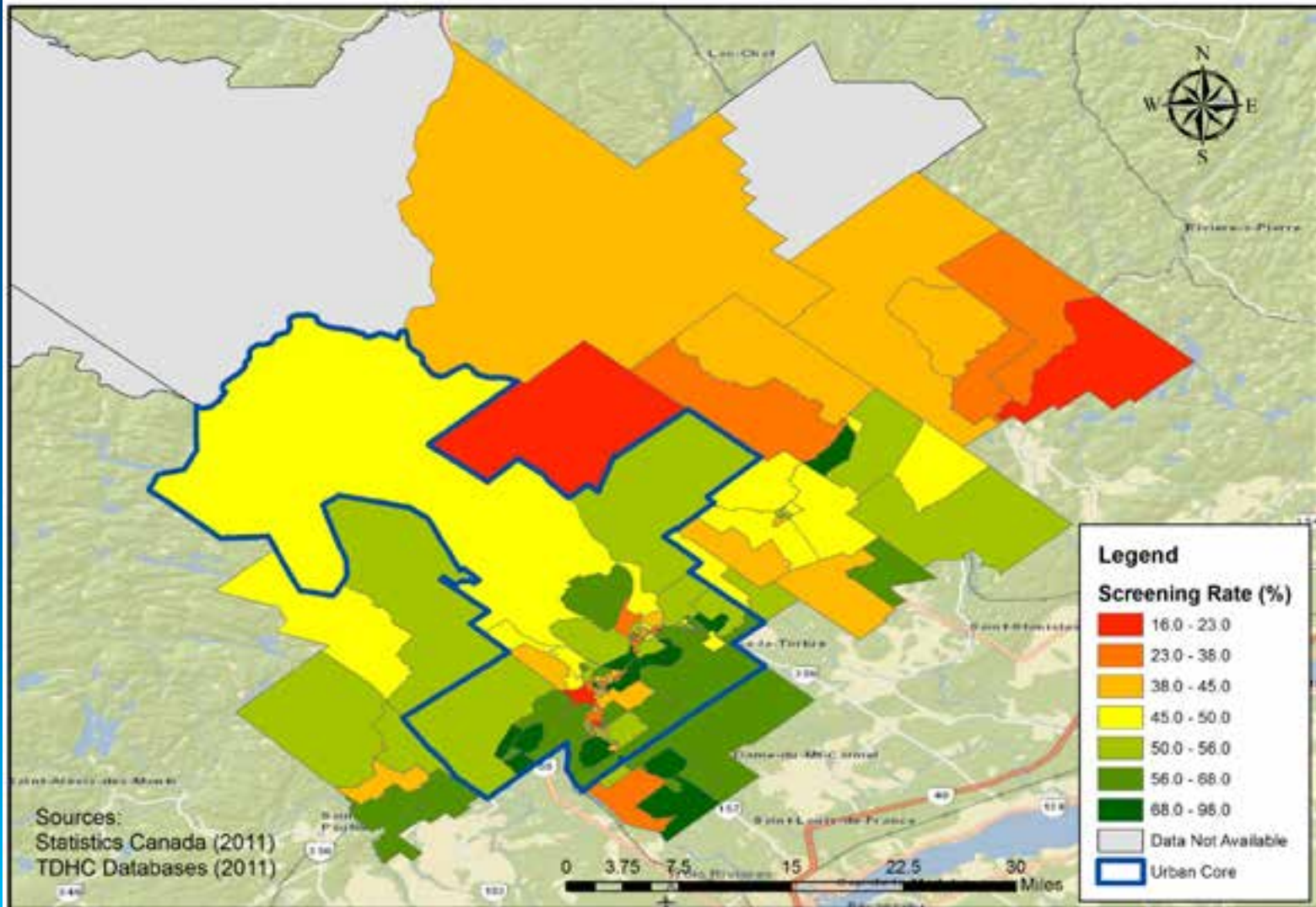
# Mapping cervical cancer screening rate (Municipalities level)

## Cervical Cancer Screening Rate CSSS de l'Énergie (2008-2010)



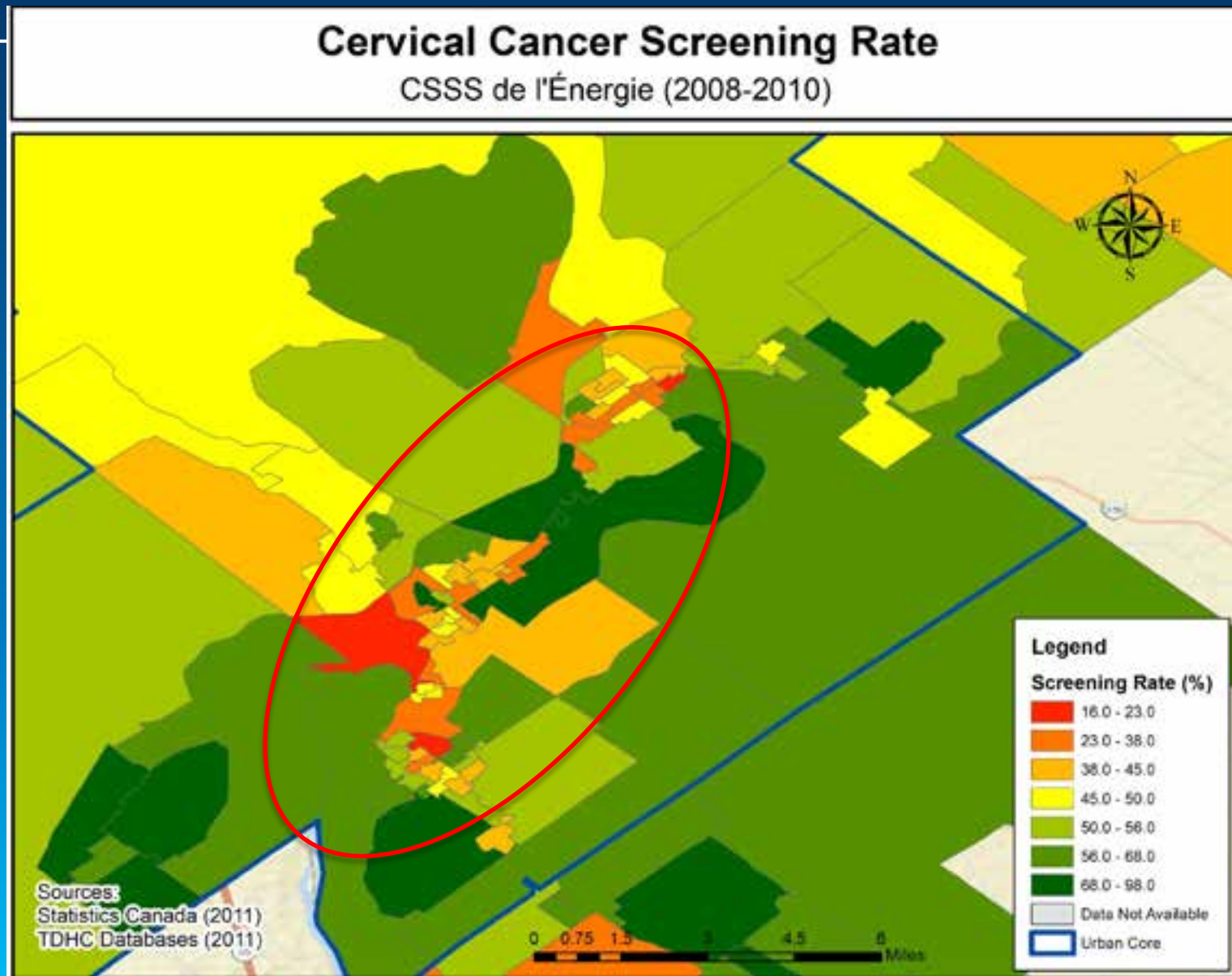
# Mapping cervical cancer screening rate (Dissemination Areas Level)

## Cervical Cancer Screening Rate CSSS de l'Énergie (2008-2010)





# Mapping cervical cancer screening rate (Downtown Shawinigan)



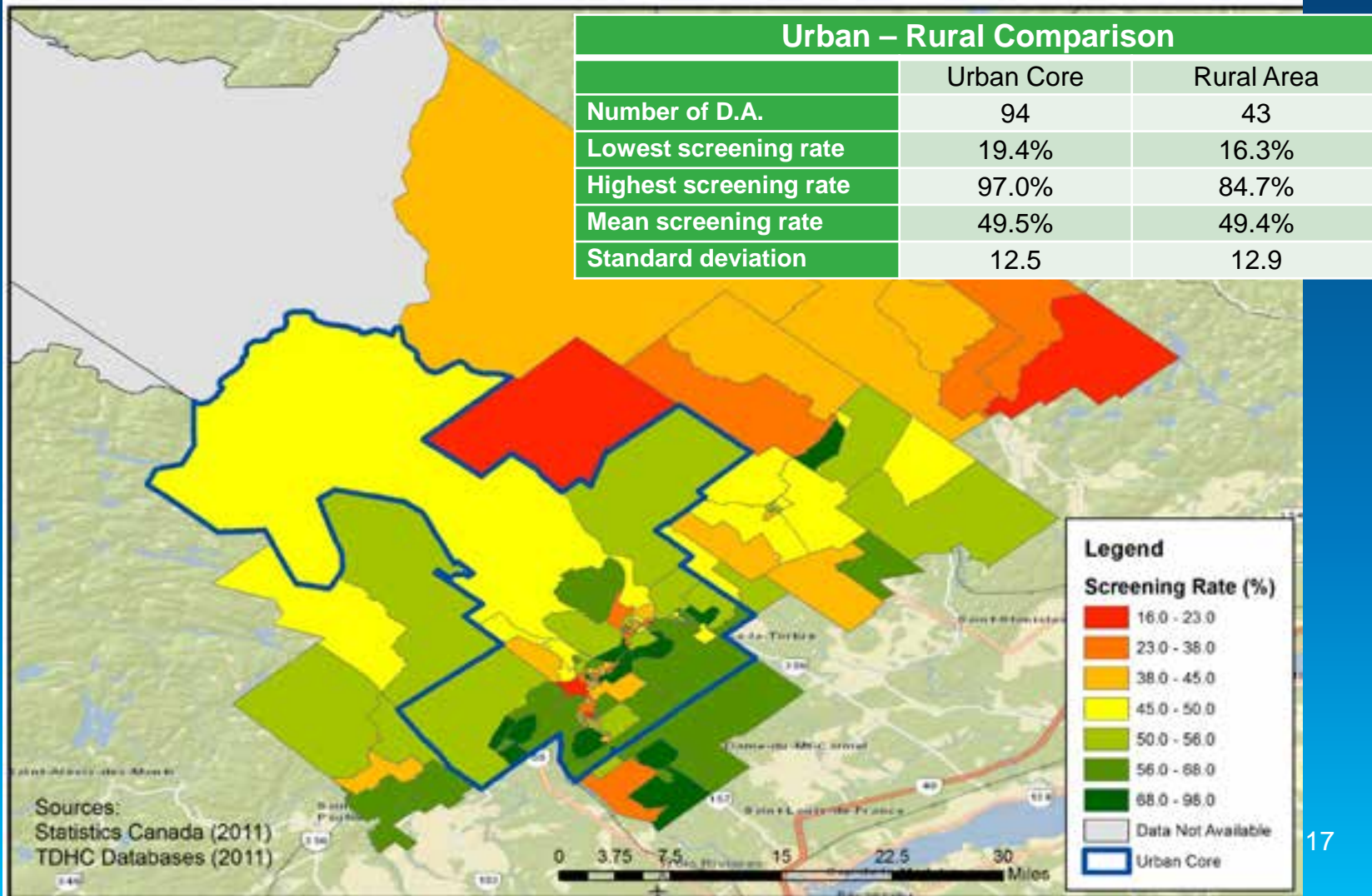


# Mapping cervical cancer screening rate

## Urban Core – Rural Areas Comparison

### Cervical Cancer Screening Rate

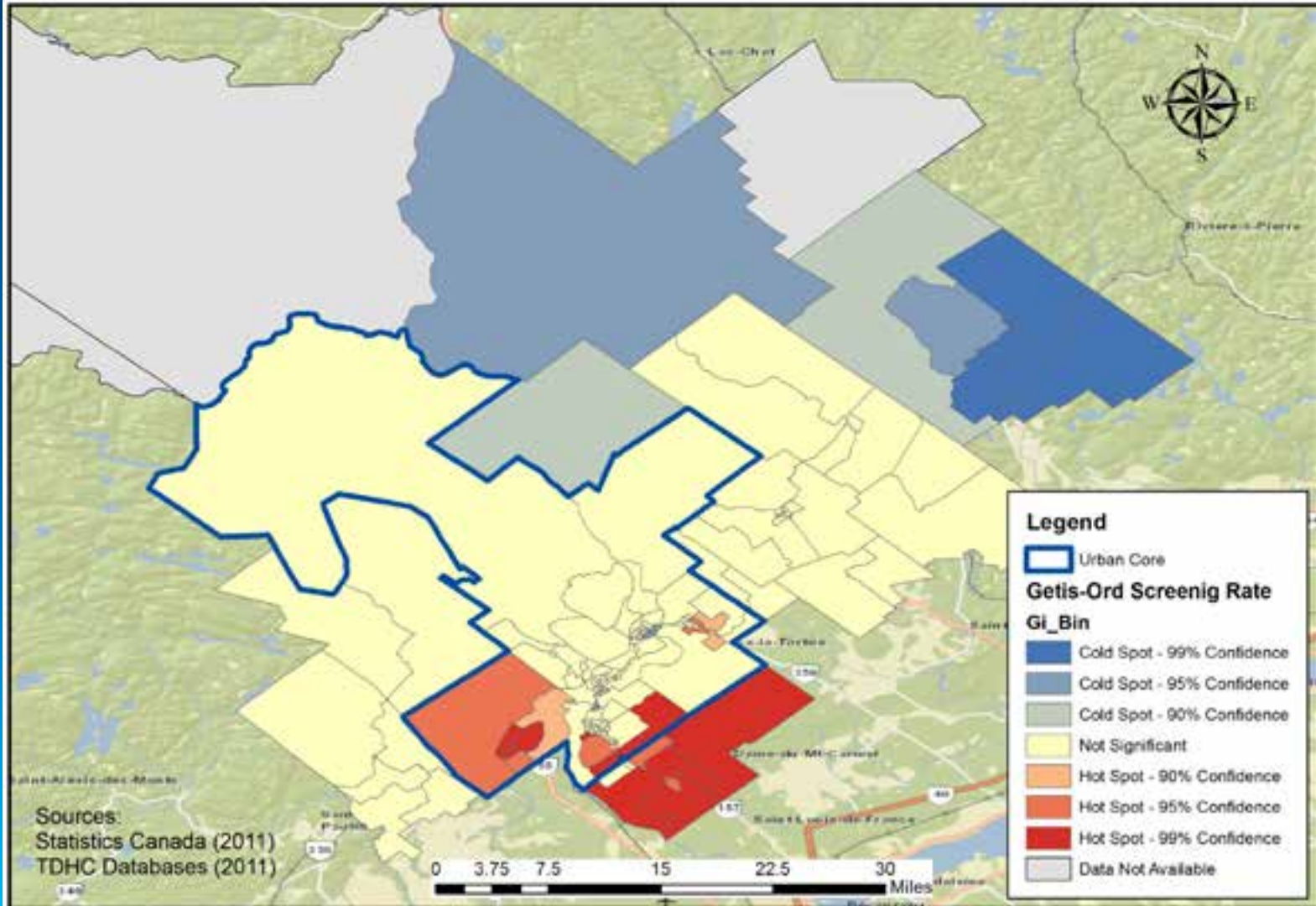
CSSS de l'Énergie (2008-2010)



# Mapping cervical cancer screening rate (Getis-Ord Hot Spot/Cold Spot)

## Getis-Ord Analysis on Screening Rate

CSSS de l'Énergie (2008-2010)



# Can socio-economic factors explain screening rates?

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- We used deprivation indices to assess the impact of socio-economic factors on screening rates;
  - Material deprivation index
    - Principal component analysis of Statistic Canada variables related to income, unemployment, education, etc.
  - Social deprivation index (social network)
    - Principal component analysis of Statistic Canada variables related to single people, single parenthood, divorced, etc.
- Each dissemination area got two scores (one for each index)
  - We studied the spatial relationship between screening rates and deprivation indices using the «Exploratory regression» function

# Can socio-economic factors explain screening rates?

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- Explanatory Regression
  - Dependent variable
    - Screening rate
  - Candidate explanatory variables
    - Material deprivation index score
    - Social deprivation index score
    - Median age of women in D.A.
    - Mean total income in D.A.
    - Median total income in D.A.
    - Unemployment rate in D.A.
    - Percentage of dwelling with less than 20K income
    - Percentage of dwelling with 20k-60K income

# Can socio-economic factors explain screening rates?

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- We got a limited relationship...
- $R^2 = 0.34$ 
  - Significant variables
    - Median age of women in D.A. (make sense!)
    - Material deprivation index
    - Percentage of dwelling with 20k – 60k income
  - Social deprivation index
    - No significant contribution to screening rate explanation
- Need to explore other spatial relationships
  - Multifactorial explanation to undergo a PAP test



# Conclusion

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- Real screening rates are lower than self-declared in the study area
- Women's age is a key factor to undergo a PAP test
- Geographical variations of screening rates are observed at all scales
- There is no significant differences in screening rates between urban and rural areas
- Getis-Ord analysis allowed us to locate hot spots/cold spots in the study region

# Conclusion

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- Exploratory regression confirmed that:
  - Women median age
  - Material deprivation index
  - Percentage of dwelling income between 20k-60kexplain 34% of screening rate in the study area
- ArcGis is a powerful tool for the integration and spatial analysis of data coming from different sources.
- Maps & analysis produced with ArcGis can help locate areas where screening must be increased

# Conclusion

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- What I did not tell you:
- Another team of researchers had meetings with women in some of the low screening rate areas
- It appears that women don't undergo PAP test because:
  - Of there lack of knowledge about cervical cancer
    - Find new means to reach them
  - Cervical cancer is asymptomatic in the first stages
    - Find new means to inform them
  - The clinics opening hours are the same as working hours
    - Extend opening hours of clinics offering screening
  - They forget to take appointments
    - Send a reminder to women after a 3 years period