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Reputation Resources Results

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Application of an Emission Inventory GIS-Based Tool Across the Michigan/Ontario Border

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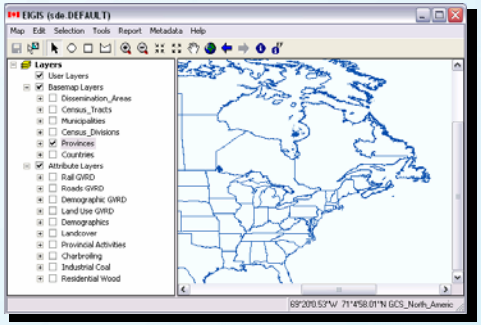
16th Annual International Emission Inventory Conference
Emission Inventories: Integration, Analysis, Communication
GIS Assisted EI Development
Raleigh, North Carolina
May 15–17, 2007

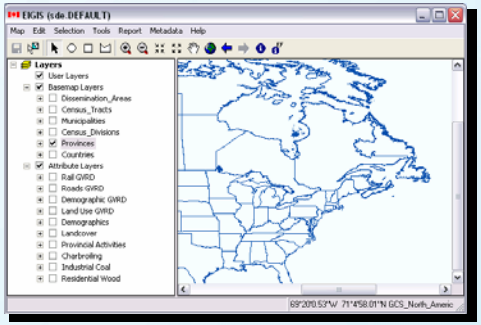
Introduction



- Present the application of an Emission Inventory GIS-based software system (EIGIS) across an area containing Detroit, Michigan and south-western Ontario.

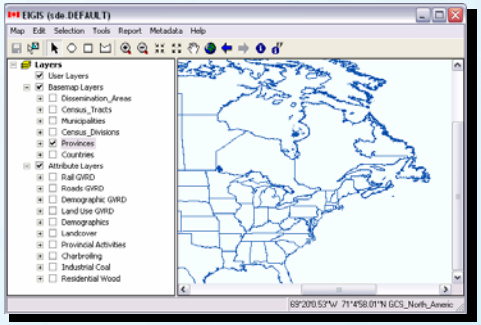
- Goal: Determine how EIGIS could be used to improve the current emission inventories for transboundary modelling applications.

Background



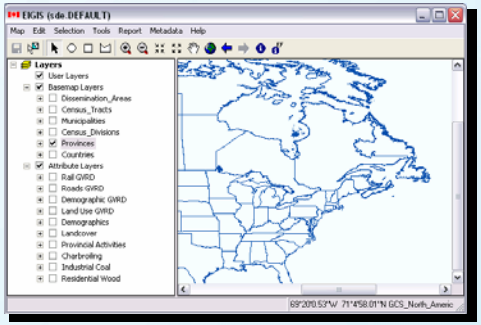
- EIGIS is a software system that computes emission inventories for area and mobile sources using a bottom-up (attribute layer) approach.
- Developed under a multi-phase contract for Environment Canada to aid in the computation of national emission inventories.
- Based upon ESRI ArcGIS technology.

Background
Why?



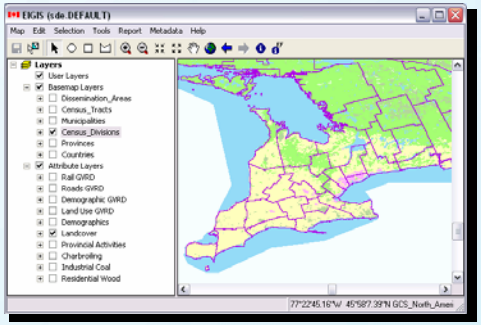
- In modelling, the spatial allocation of emissions can be as important as the emission themselves.
- Emission processors (e.g., SMOKE), convert national EIs into hourly, spatially allocated (gridded) emissions.
- AQ models (e.g., CMAQ) replicate the transport and chemical transformation of pollutants emitted to the atmosphere.
- These models are only as good as their inputs!

Background



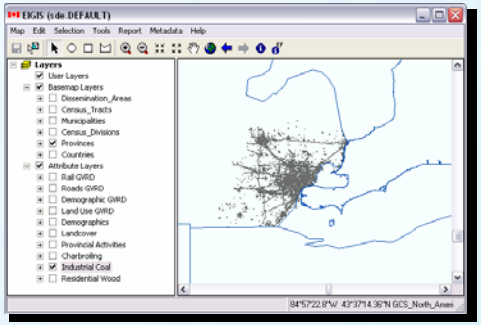
- Work performed under two independent projects that shared a number of common goals.
- US EPA: evaluate different means of computing emissions, with a 2002 NEI benchmark, in three source sectors and 10 counties in Detroit area.
- Environment Canada: assess and improve existing, provincially aggregated 2002 CAC EI for seven sectors and 6 census divisions in SW Ontario.

Current Techniques South-Western Ontario



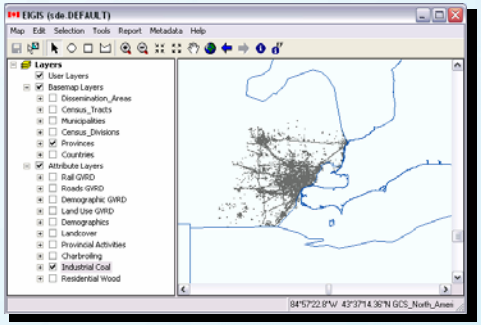
- Asphalt Plants
- Ferrous
- Non-Ferrous Foundries
- Industrial and commercial boilers
- Commercial wood burning
- Agricultural burning
- Residential garbage burning
- Garbage burning at landfills

Current Techniques
Detroit Metropolitan Area



- Residential Wood Combustion
  - Fireplaces and woodstoves
- Industrial Fuel Combustion – Coal
  - Industrial coal burning of anthracite and bituminous/sub-bituminous coals
- Charbroiling
  - Meat cooking at commercial restaurants

EIGIS Methodology (Detroit Specific)



Concentrate on Detroit…

- Step 1: Obtain GIS Data
- Step 2: Obtain Activity Data
- Step 3: Obtain Emission Factors
- Step 4: Input into EIGIS
- Step 5: Have EIGIS Compute the EI
- Step 6: Plot EI in EIGIS for QA
- Step 7: Export to Model-ready Input Files (SMOKE ORL format)

EIGIS Methodology GIS Data

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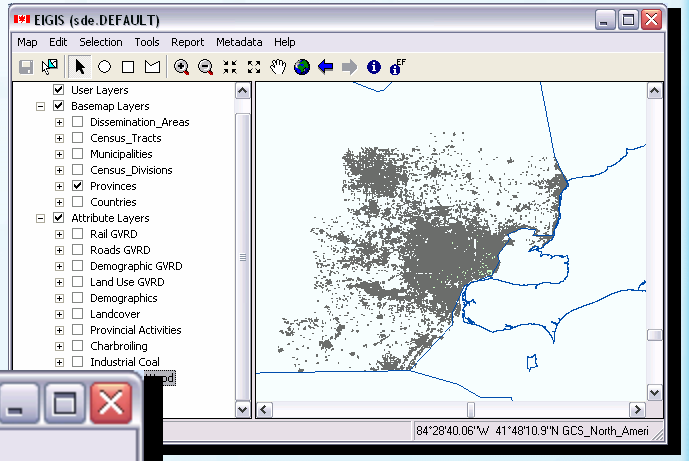


EIGIS (sde.DEFAULT)

Map Edit Selection Tools Report Metadata Help

Attributes of Residential Wood

	COUNTY	NAME	Fireplaces	Non_EPA_Fireplac	Non_Catalytic_Fire	Catalytic_Fireplac	Woodstoves	Catalytic_Woods	Non_Catal
▶	049	GENESEE	3765.967	8703.899	539.2633	217.5975	6222.333	155.5583	385.5141
	087	LAPEER	1520.11	7165.805	443.9684	179.1451	12611.19	315.2798	781.3455
	091	LENAWEE	1846.916	8706.37	539.4164	217.6593	15322.45	383.0613	949.3257
	093	LIVINGSTON	1208.337389	2792.70840995	173.02649931	69.81771024	1996.48	49.912	123.695
	099	MACOMB	6568.364460	15180.79870173	940.54948478	379.51996754	10852.61	271.3151	672.3897
	115	MONROE	1158.132702	2676.67537837	165.83749626	66.91688445	1913.529	47.83823	118.5556
	125	OAKLAND	10090.28064	23320.64858448	1444.86627099	583.01621461	16671.71	416.7926	1032.921
	147	ST. CLAIR	1376.261	3180.812	197.0721	79.52031	2273.932	56.8483	140.8849
	161	WASHTENAW	2688.022085	6212.55449998	384.90826793	155.31386249	4441.295	111.0324	275.1672
	163	WAYNE	16942.95375	39158.54120646	2426.12700953	978.96353016	27994.06	699.8515	1734.415

Show: All Selected (0 of 10 selected) Options

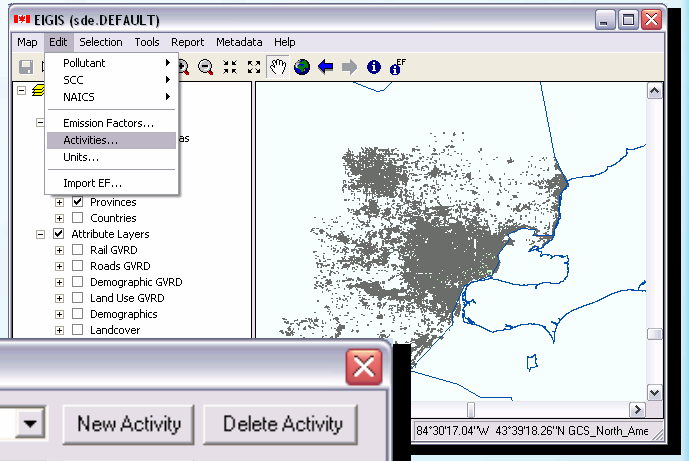
Industrial Coal

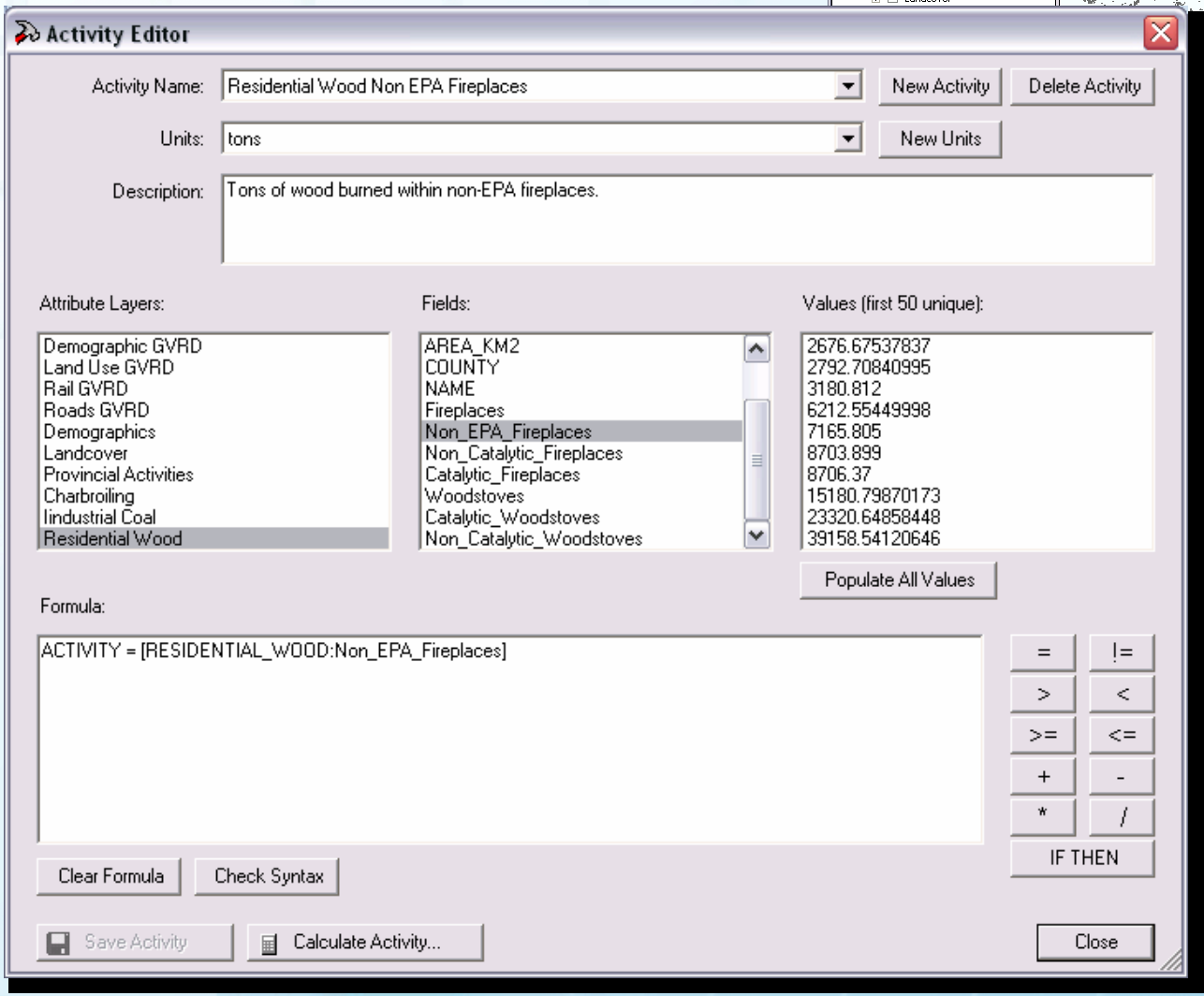
Residential Wood

Zoom To Layer
Selection
Attributes...
Properties...
Plot Emissions...
Add Layer...

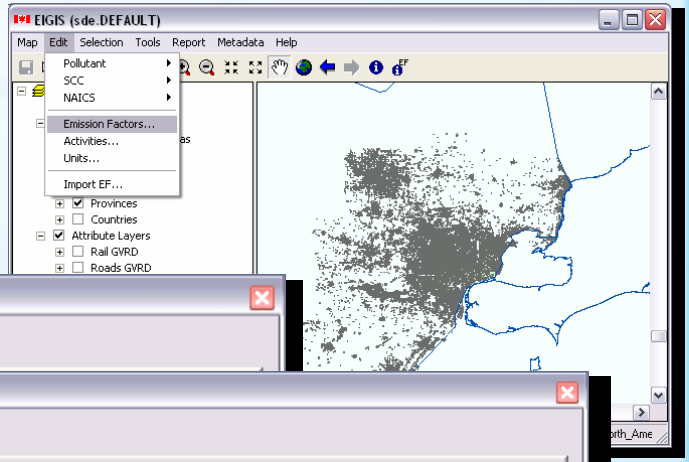
84°28'40.06"W 41°48'10.9"N GCS_North_Ameri

EIGIS Methodology Activity Data





EIGIS Methodology
Emission Factors



Emission Factors

Definition | Editor

Emission Factors

Definition | Editor

Feature Layer: Residential Wood

Selected	NAME	Non_EPA_Firepla	Woodstoves	EF	EF Unit	Activity	Pollutant Shortna	SCC Number
☐	GENESEE	8703.899	6222.333	30.6	lb/tons	Residential Wood N	PM10	2104008002
☐	GENESEE	8703.899	6222.333	30.6	lb/tons	Residential Wood N	PM2.5	2104008002
☐	GENESEE	8703.899	6222.333	0.4	lb/tons	Residential Wood N	SOx	2104008002
☐	GENESEE	8703.899	6222.333	53	lb/tons	Residential Wood N	VOC	2104008002
☐	GENESEE	8703.899	6222.333	2.8	lb/tons	Residential Wood N	NOx	2104008002
☐	GENESEE	8703.899	6222.333	230.8	lb/tons	Residential Wood N	CO	2104008002
☐	LAPEER	7165.805	12611.19	30.6	lb/tons	Residential Wood N	PM10	2104008002
☐	LAPEER	7165.805	12611.19	30.6	lb/tons	Residential Wood N	PM2.5	2104008002
☐	LAPEER	7165.805	12611.19	0.4	lb/tons	Residential Wood N	SOx	2104008002
☐	LAPEER	7165.805	12611.19	53	lb/tons	Residential Wood N	VOC	2104008002
☐	LAPEER	7165.805	12611.19	2.8	lb/tons	Residential Wood N	NOx	2104008002
☐	LAPEER	7165.805	12611.19	230.8	lb/tons	Residential Wood N	CO	2104008002
☐	LENAWEE	8706.37	15322.45	30.6	lb/tons	Residential Wood N	PM10	2104008002
☐	LENAWEE	8706.37	15322.45	30.6	lb/tons	Residential Wood N	PM2.5	2104008002
☐	LENAWEE	8706.37	15322.45	0.4	lb/tons	Residential Wood N	SOx	2104008002
☐	LENAWEE	8706.37	15322.45	53	lb/tons	Residential Wood N	VOC	2104008002
☐	LENAWEE	8706.37	15322.45	2.8	lb/tons	Residential Wood N	NOx	2104008002

Show All Columns | Edit/New Units | Edit/New Activity | Export | Save | Delete

Close | Help

EIGIS Methodology
Input into EIGIS

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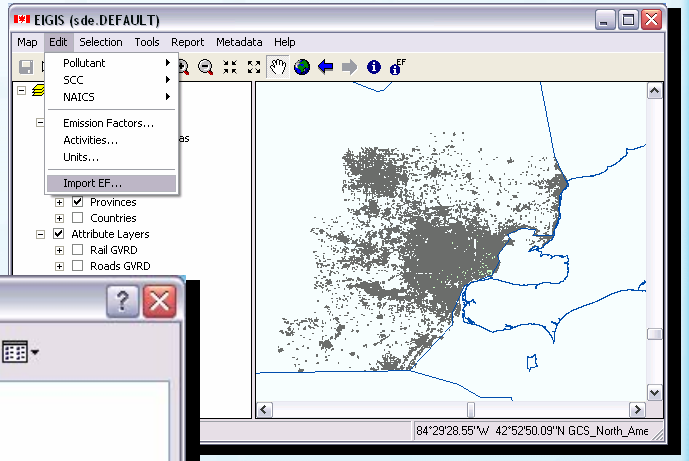

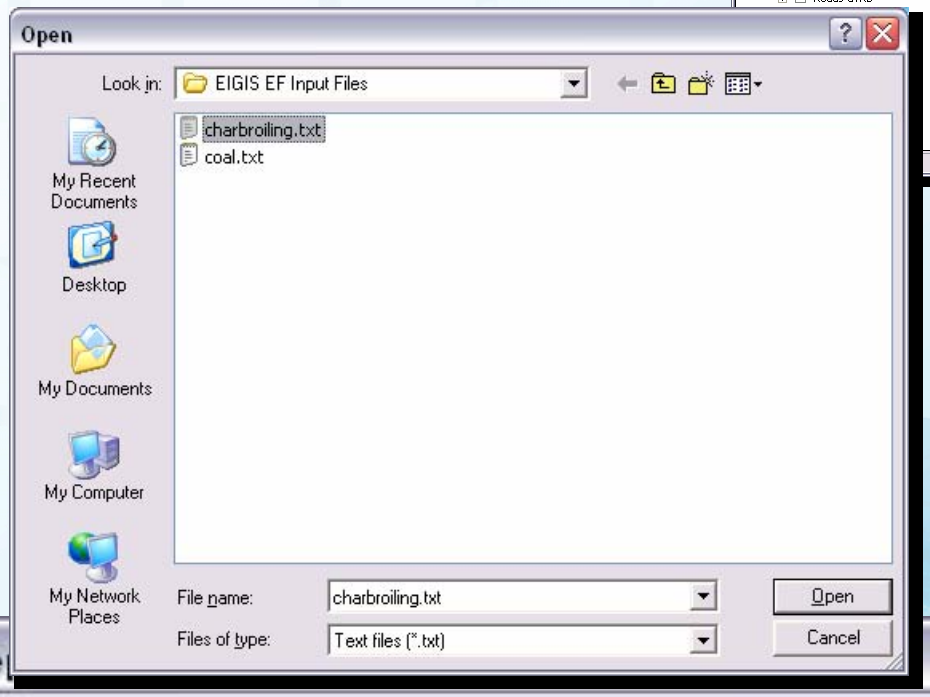

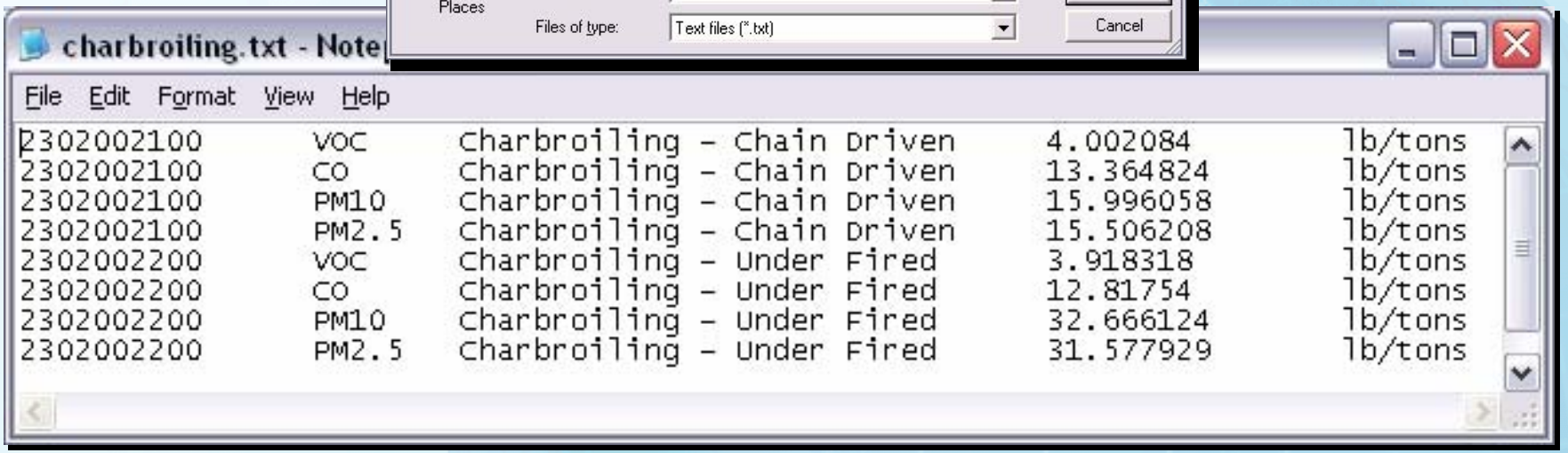

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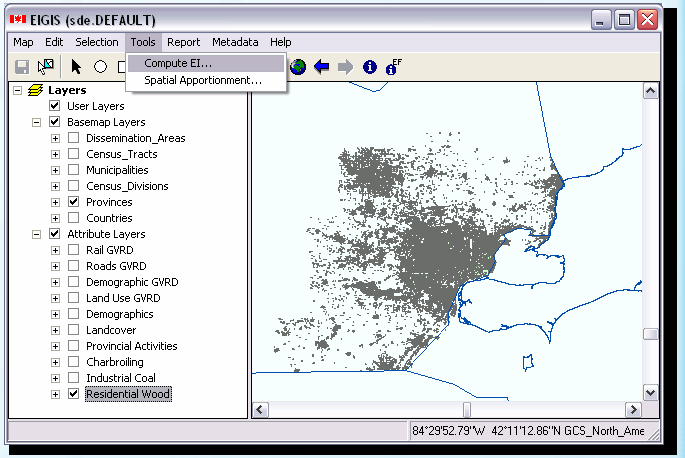
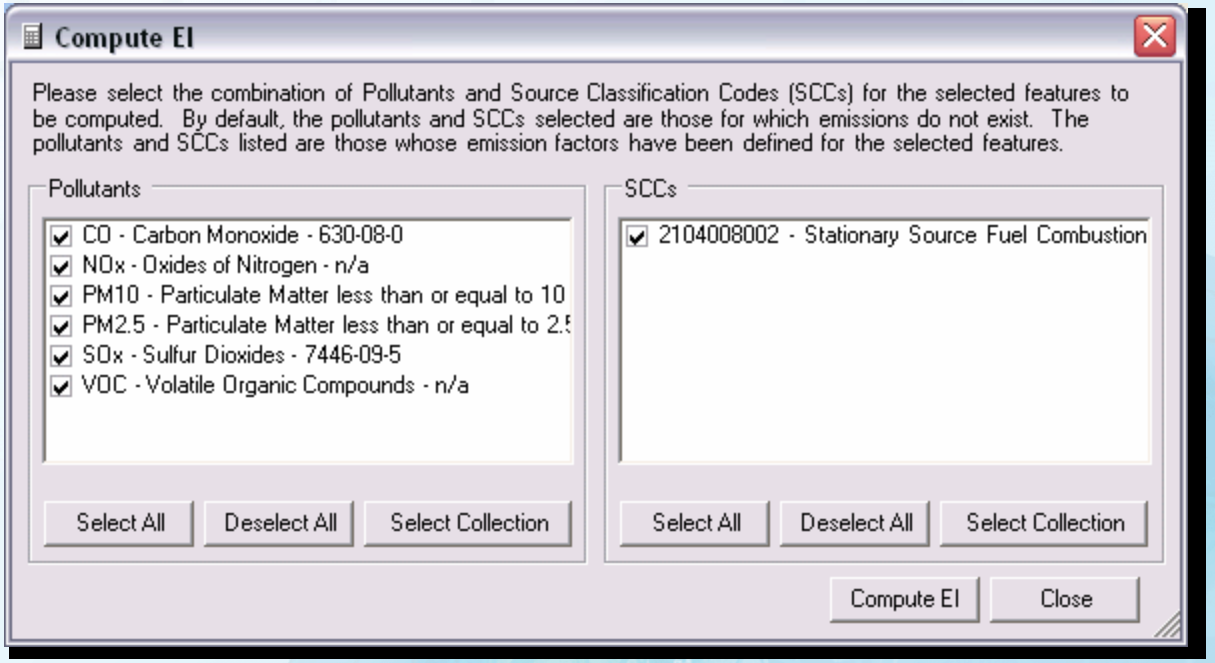
EIGIS Methodology Compute the EI





EIGIS Methodology
Plot EI in EIGIS

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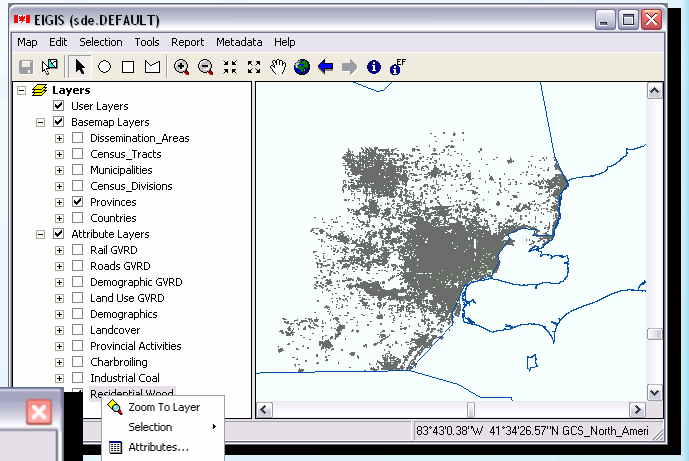

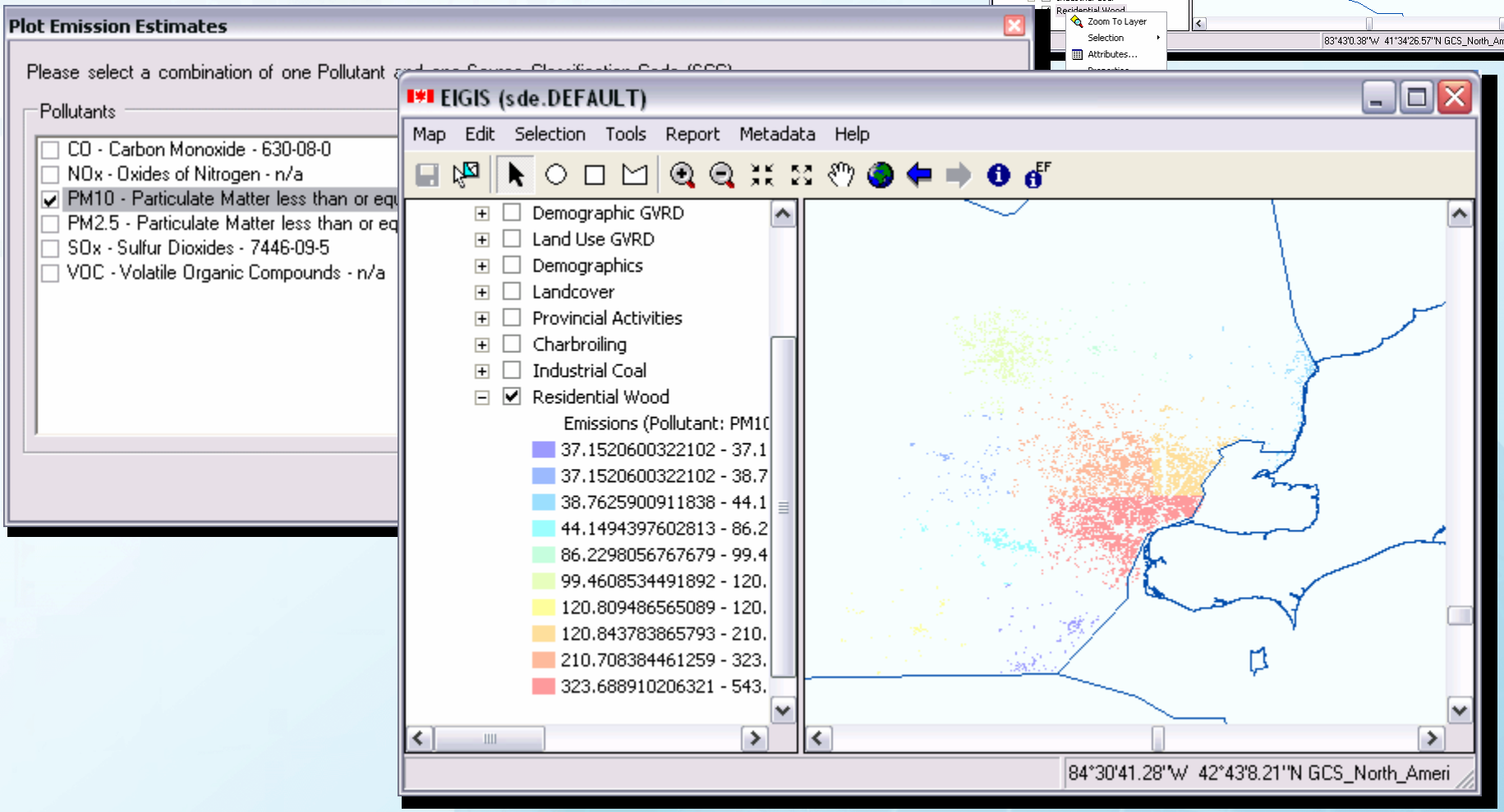

EIGIS Methodology
Export to Model-ready Input Files

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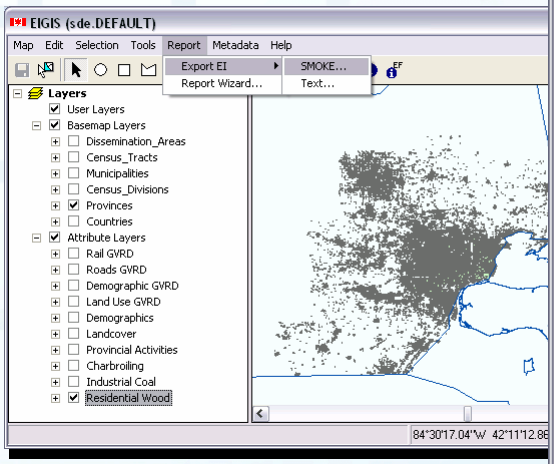

Report - Export EI - SMOKE

Header Information

Year: 2002 Description: Residential Wood

Pollutants

Short Name	Full Name	CAS
☐ PFC	Perfluorocompound	355-42-0
☑ PM10	Particulate Matter less than or equal t...	n/a
☑ PM2.5	Particulate Matter less than or equal t...	n/a
☐ SF6	Sulfur Hexafluoride	2551-62-4
☐ SOx	Sulfur Dioxides	7446-09-5

Source Classification Codes

Type	SCC	Level1	Level2	Level3	Level4
☐ AREA	2104008000	Stationary Source Fu...	Residential	Wood	Total: Woodst
☐ AREA	2104008001	Stationary Source Fu...	Residential	Wood	Fireplaces: Ge
☑ AREA	2104008002	Stationary Source Fu...	Residential	Wood	Fireplaces: Ins
☐ AREA	2104008003	Stationary Source Fu...	Residential	Wood	Fireplaces: Ins
☐ AREA	2104008004	Stationary Source Fu...	Residential	Wood	Fireplaces: Ins

Search

Output File

C:\Data\output_smoke.orl.txt

File Format: ◉ ORL ○ IDA

Export Cancel

EIGIS Methodology
Export to Model-ready Input Files

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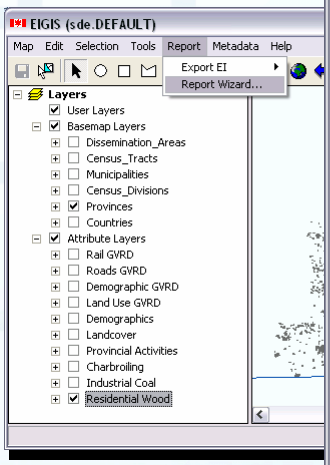
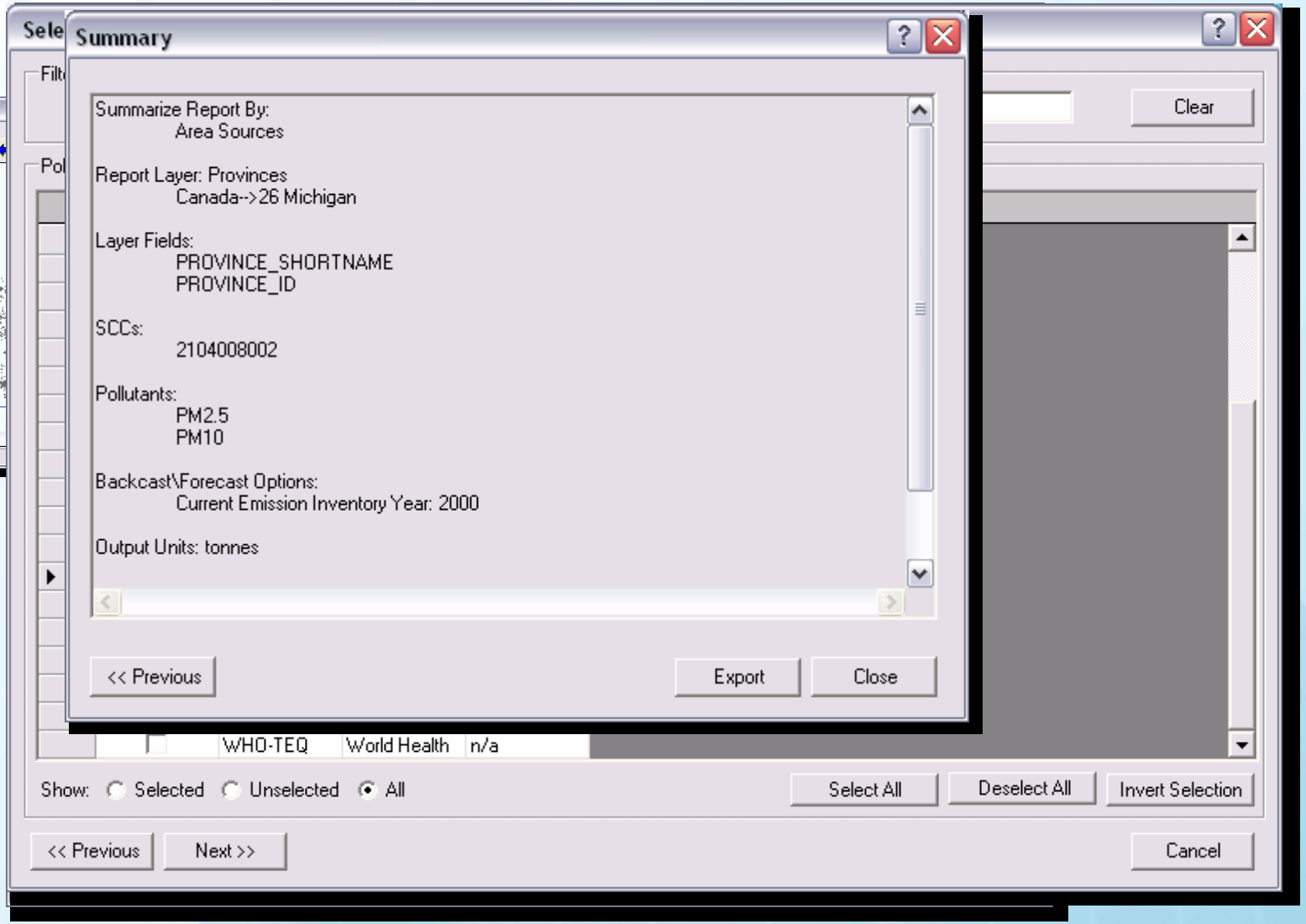
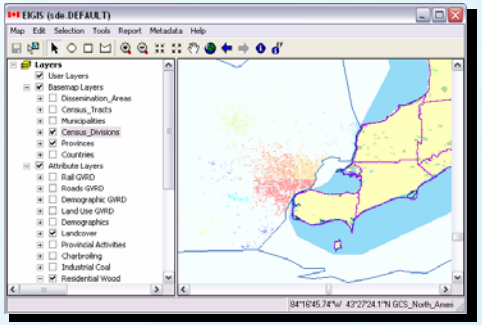


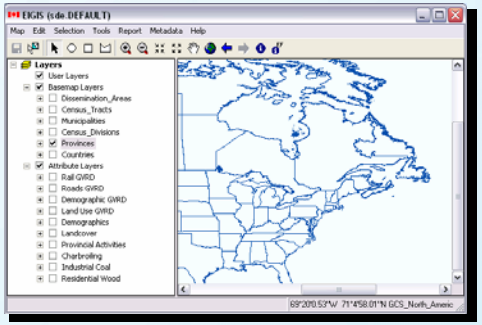


Conclusions



- EIGIS easily adopted in the US - no code changes!
- EIGIS is effective for both high-resolution bottom-up and simple top-down techniques.
- EIGIS is effective for automating the calculation and exporting of emissions into SMOKE model-ready input files (IDA or ORL).
- Mapping feature a useful QA tool within EIGIS.
- Emissions could be further improved by incorporating higher resolution land use information with a larger number of land use types.

Ideas for the Future



- Phase III (ongoing development…)
  - Incorporate pre-computed point sources
  - Test more robust distributed environments
  - More post-processing / analysis tools
  - National EI calculations (pre-populated)
  - Integrated reconciliation functionality
- Additional testing for different geographies
- Test ability to improve emission estimates by incorporating higher resolution land use data with a larger number of land use types

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Acknowledgments

- ESRI Canada
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- Environment Canada, Pollution Data Division
- Environment Canada, Pacific & Yukon Region
- Greater Vancouver Regional District
- BC Ministry of Environment

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