

# Minnesota Air, Water, and Waste Environmental Conf.

Air Modeling – Training (8am-noon)  
Sheraton Bloomington Hotel, Atrium 7

February 14, 2006  
Chris Nelson & Dennis Becker  
Minnesota Pollution Control Agency

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# Air Modeling (98 Slides)

- AERMOD Status and MPCA “Draft” Data
- AERMOD Urban Modeling Developments
  - Metropolitan Statistical Areas and Micropolitan Statistical Areas
- New MPCA NAAQS/MAAQs Feature: FAR Data
- Break - slide 40
- Rochester and Olmsted County SIP Work
  - RPU-Silver Lake Plant Sensitivity Analyses
- Break - slide 75
- AERA/RASS with supplemental Post-RASS Option
- Fugitive PM<sub>10</sub> emissions: roads, cooling towers, etc.
- VISCREEN (Nearby areas v. Class I areas)
- Future Possibilities

# ROCSIPMA Project

- Rochester and Olmsted County SIPs
- PM10 and SO2 Maintenance Areas
  - Several Rochester Facilities
  - Regional Sources (e.g., mobile sources)
    - US Highways: 14, 52, and 63
    - IBM onsite (public) roads
  - Distant Sources via FAR data
  - Zero Sources (50km radius, county outline)
- ROCSIPMA Summary – Next 32 Slides

# ROCSIPMA Tasks

## ■ Data Collection

- Work Orders for Key Facilities
- Literature values for roads and other sources
  - Paved Roads and Highways; Unpaved Roads
  - Other Sources (e.g., cooling towers)
- “Actual” emissions for distant “FAR” sources

## ■ Computational Challenges

- Many sources and many receptors
- “Key” sources for slow, 5-year runs
- “ALL” sources for fast, event runs


# Rochester Highway Assumptions

- Average Daily Traffic (ADT) Rates
  - US Highway 14 at 25,000
  - US Highway 52 at 65,000
  - US Highway 63 at 25,000
- Fleet-average vehicle weight of 5 Tons
- Paved road silt loading at 0.03 grams/m<sup>2</sup>
- Receptors at 10, 20, 50, 100, 200 meters
- Urban Dispersion
  - “CO URBANOPT 100000 Rochester 0.4”

# Minnesota Traffic Count Data

MnDOT - Transportation Data and Analysis Homepage - Microsoft Internet Explorer


Address: <http://www.dot.state.mn.us/tda/maps/trafficvol.html#>




**Mn/DOT Office of Transportation Data & Analysis**

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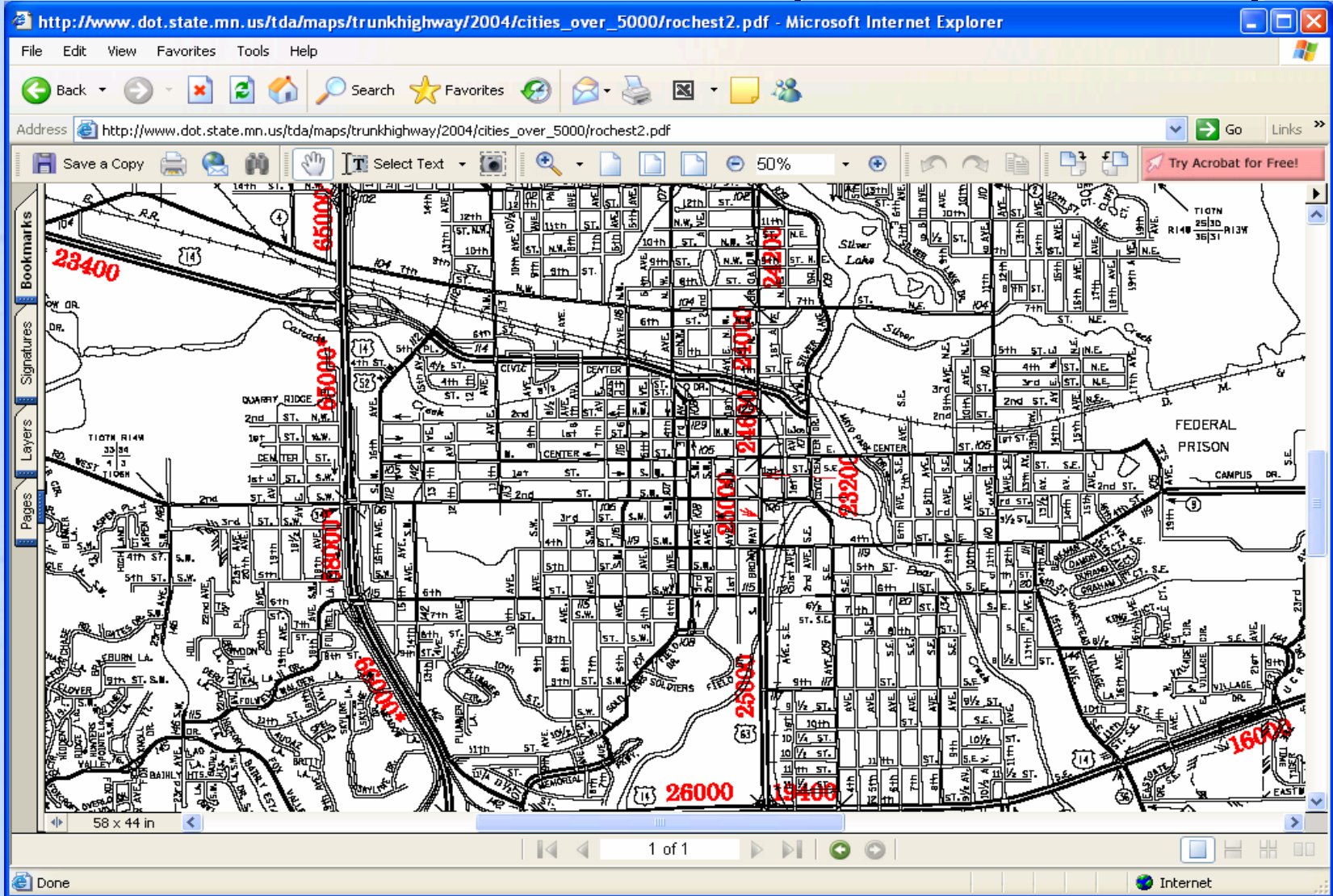
## Traffic Volume Maps

- Traffic volume maps show annual average daily traffic (AADT).
- The trunk highway overview maps also show heavy commercial average daily traffic (HCADT). Trunk Highways are Interstate, U.S. & State Highways.
- Counts are adjusted for day of week and month of year (and for vehicles with more than two axles - TH only).
- Counts are compared to past counts and past official AADT volumes to allow analysts to determine official AADT volumes.
- Heavy commercial average daily traffic (HCADT) volumes are developed by analysts using vehicle classification data collected on the trunk highways. HCADT consists of larger vehicles having six or more tires.

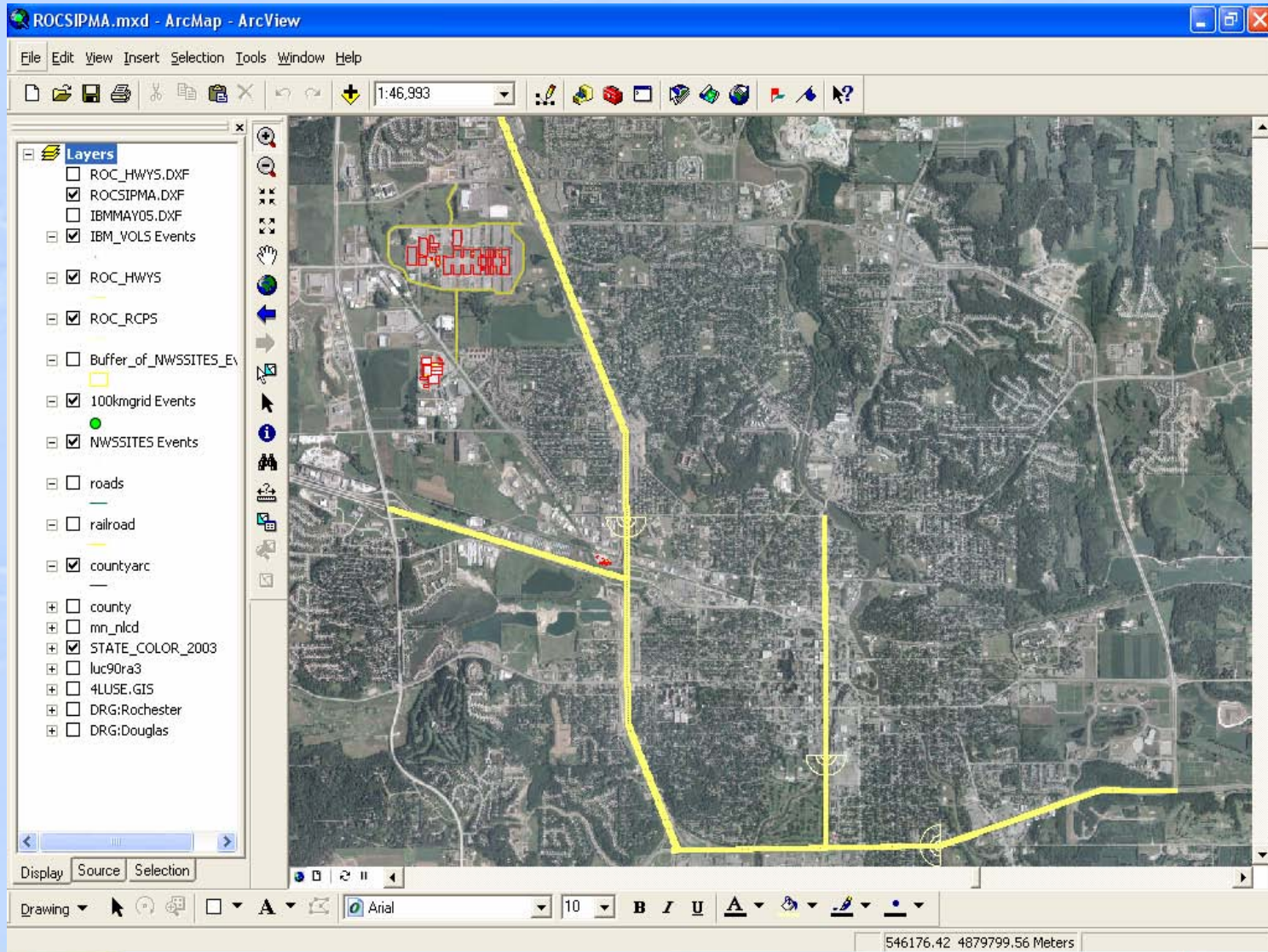
\*\*Note: [Adobe Acrobat Reader](#) is required to view maps. If you get a blank map click reload and the map will display.

Trunk Highway Traffic (PDF format)			
<p style="text-align: center;"><b>Overview (with HCADT)</b></p> <p style="text-align: center;"><input type="radio"/> Statewide <input type="radio"/> Metro</p> <p style="text-align: center;">2004 <span style="font-size: small;">▼</span></p> <p style="text-align: center;"><input type="button" value="View Map"/></p>	<p style="text-align: center;"><b>County and City Maps (without HCADT)</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;"> <p>Select from the Statewide Index Map</p> <p style="text-align: center;">2004 <span style="font-size: small;">▼</span></p> <p style="text-align: center;"><input type="button" value="View Index Map"/></p> </td> <td style="width: 50%; text-align: center;"> <p>Select from Tables</p> <p style="text-align: center;"><a href="#">County Sheet Table</a></p> <p style="text-align: center;"><a href="#">Cities over 5000 Population Table</a></p> </td> </tr> </table>	<p>Select from the Statewide Index Map</p> <p style="text-align: center;">2004 <span style="font-size: small;">▼</span></p> <p style="text-align: center;"><input type="button" value="View Index Map"/></p>	<p>Select from Tables</p> <p style="text-align: center;"><a href="#">County Sheet Table</a></p> <p style="text-align: center;"><a href="#">Cities over 5000 Population Table</a></p>
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<p><b>County and Municipal State Aid Roadway AADT with Trunk Highway AADT</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">Statewide</td> <td style="width: 50%; text-align: center;">Minneapolis / St. Paul Metro Area Street Series</td> </tr> </table>		Statewide	Minneapolis / St. Paul Metro Area Street Series
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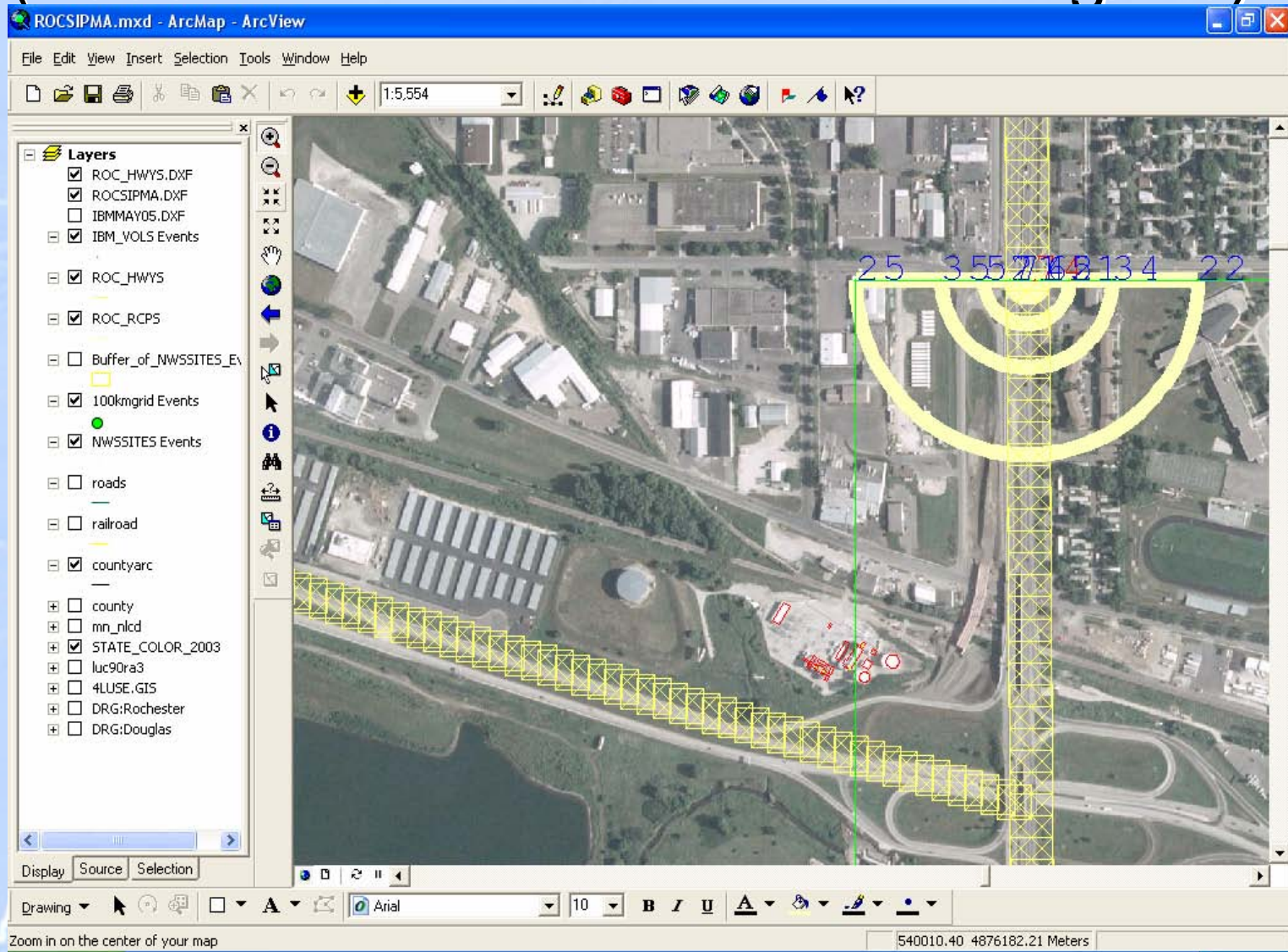
# Rochester ADT (2004 Data)



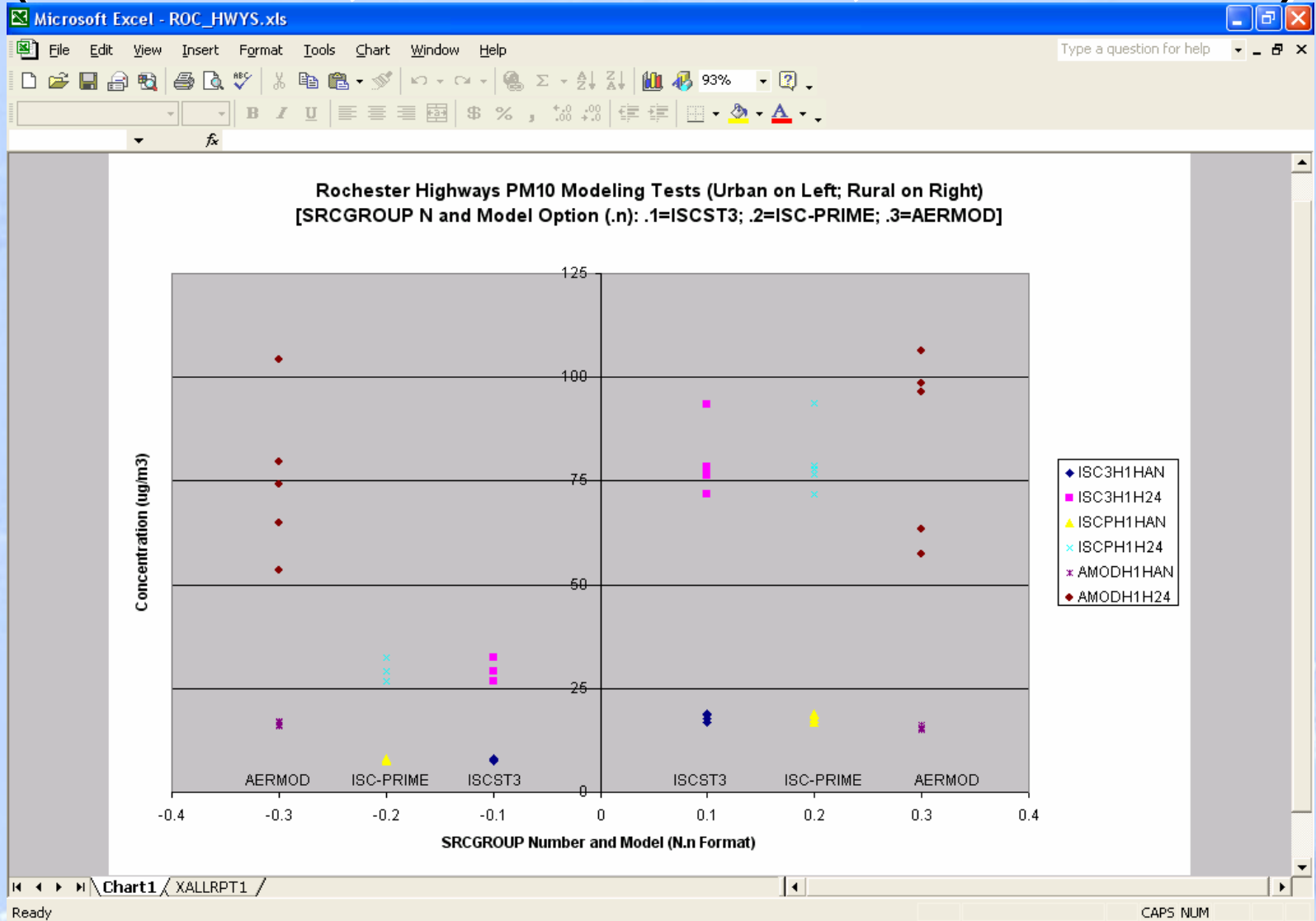
# Rochester Highways (14,52,63)



# Rochester Highway 52 Results (1986 H1H 24-Hour PM10 = 74 ug/m3)



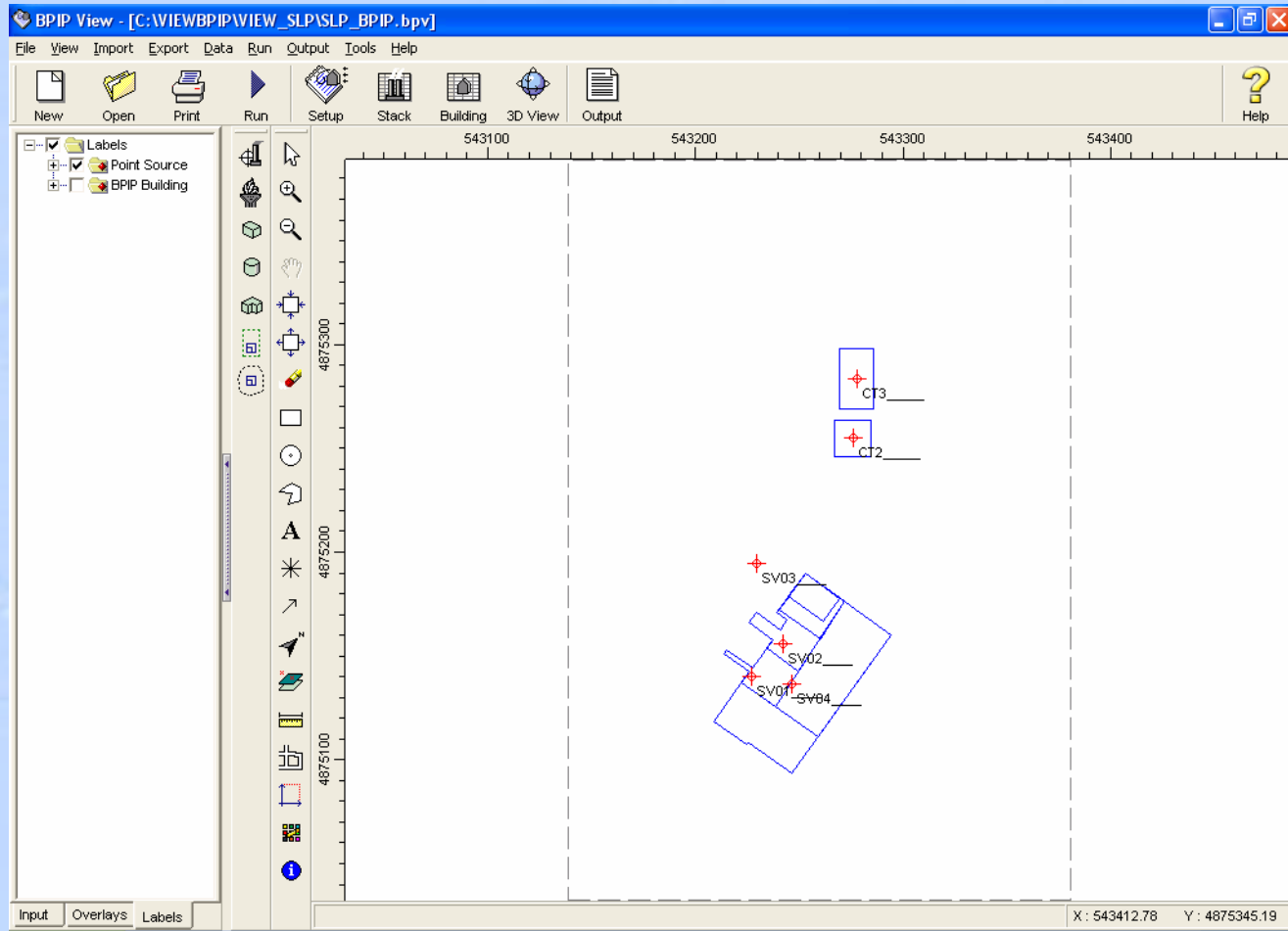
# Rochester Highway PM10 Tests (ISCST3, ISC-PRIME, AERMOD)



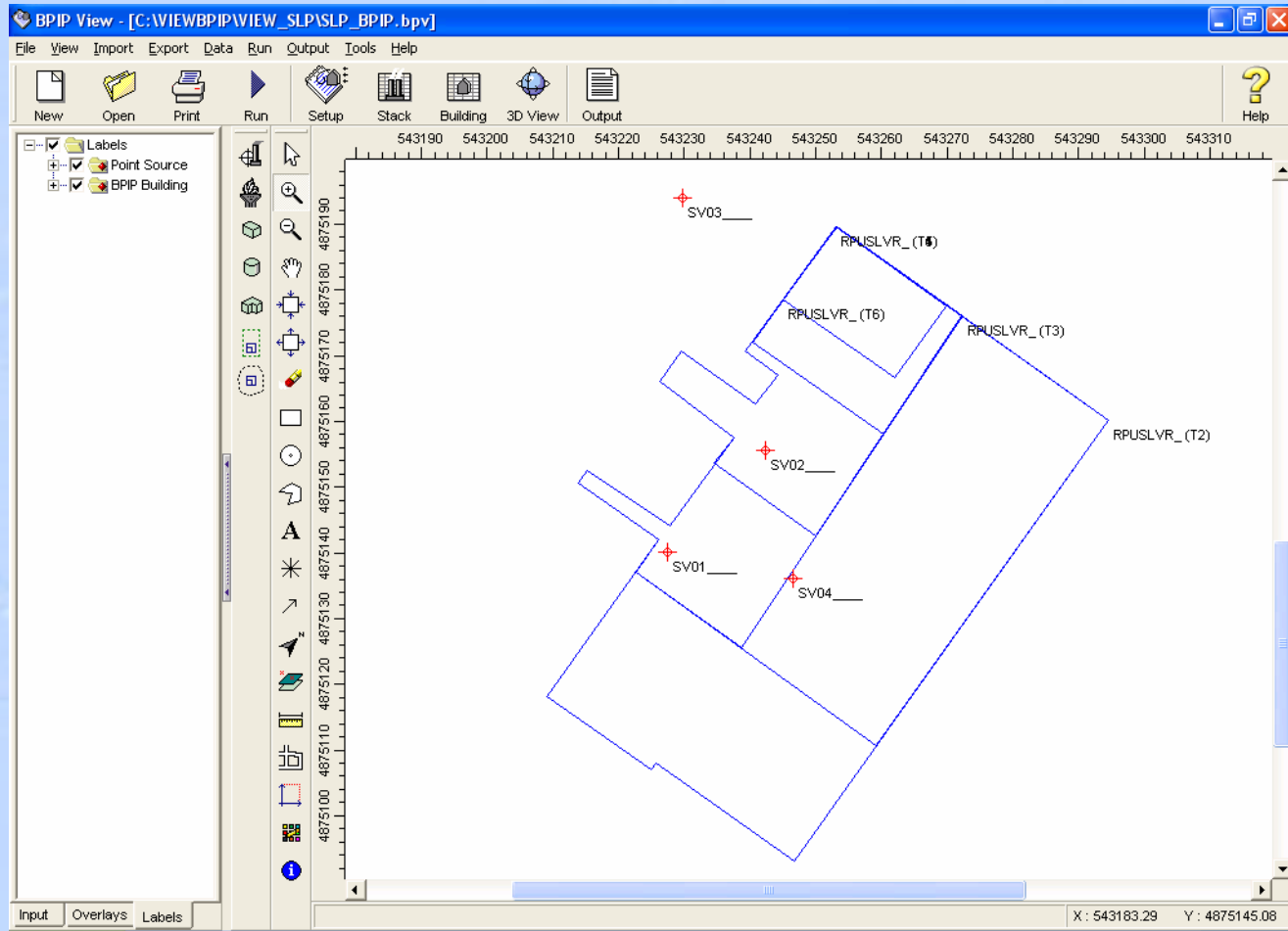
# Rochester Public Utilities – Silver Lake Plant Sensitivity Analyses

- Receptor Grid
  - 360 polar receptors (36 directions and 10 downwind distances)
  - 94 discrete receptors (property line)
- 6 Stacks: 4 Boilers and 2 Cooling Towers
  - Group 1: SV03 (SH~90m) minimal building downwash
  - Group 2: SV01 (SH~61m) moderate building downwash
  - Group 3: SV02 (SH~61m) moderate building downwash
  - Group 4: SV04 (SH~27m) extreme building downwash
  
  - Group 5: CT03 (SH~19m) cooling tower
  - Group 6: CT02 (SH~14m) cooling tower
- 7 Fugitive Sources (groups 7-13, respectively)
- “ALL” Source Group (group 14)

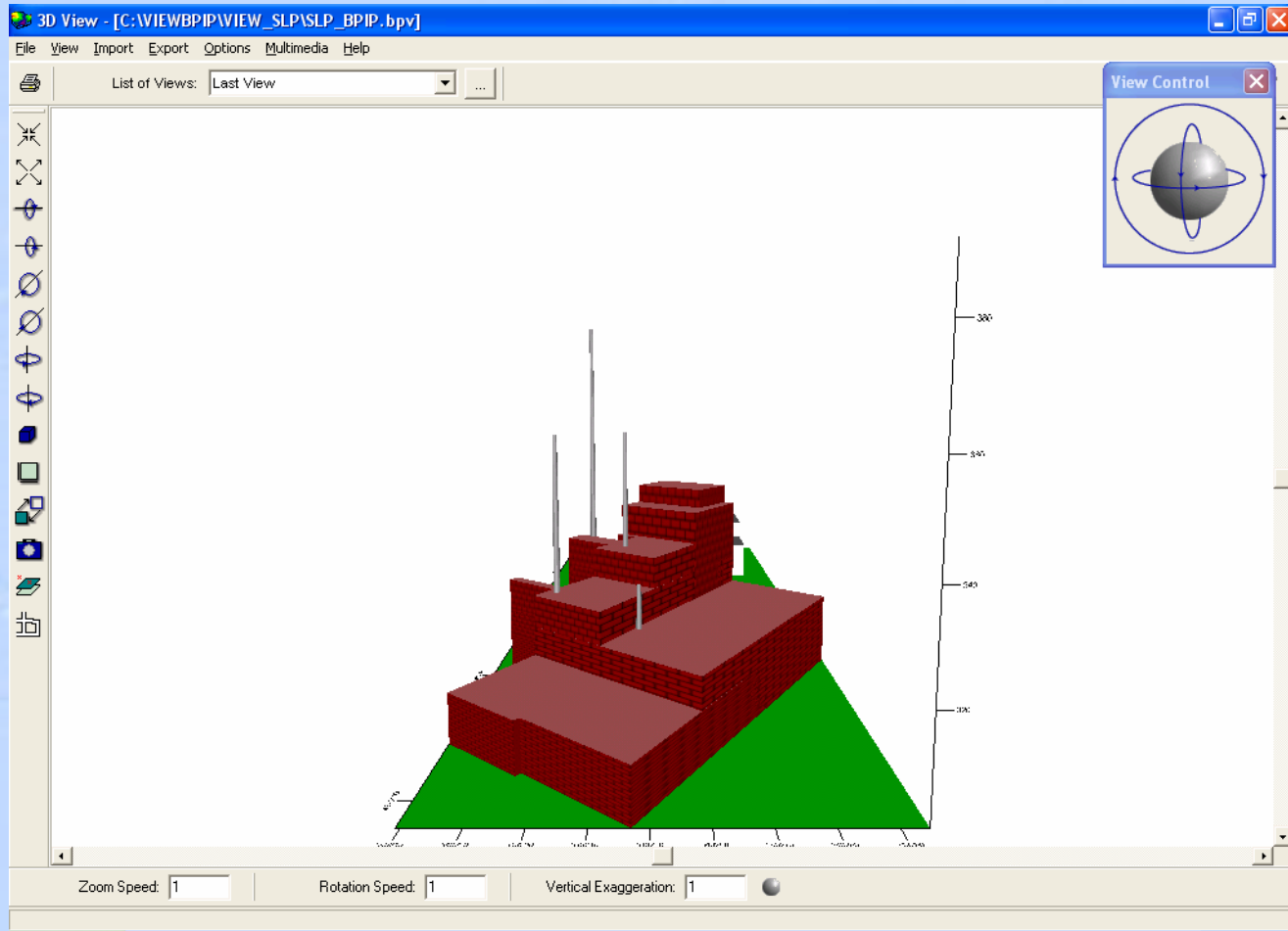
# Site Layout (2D View)



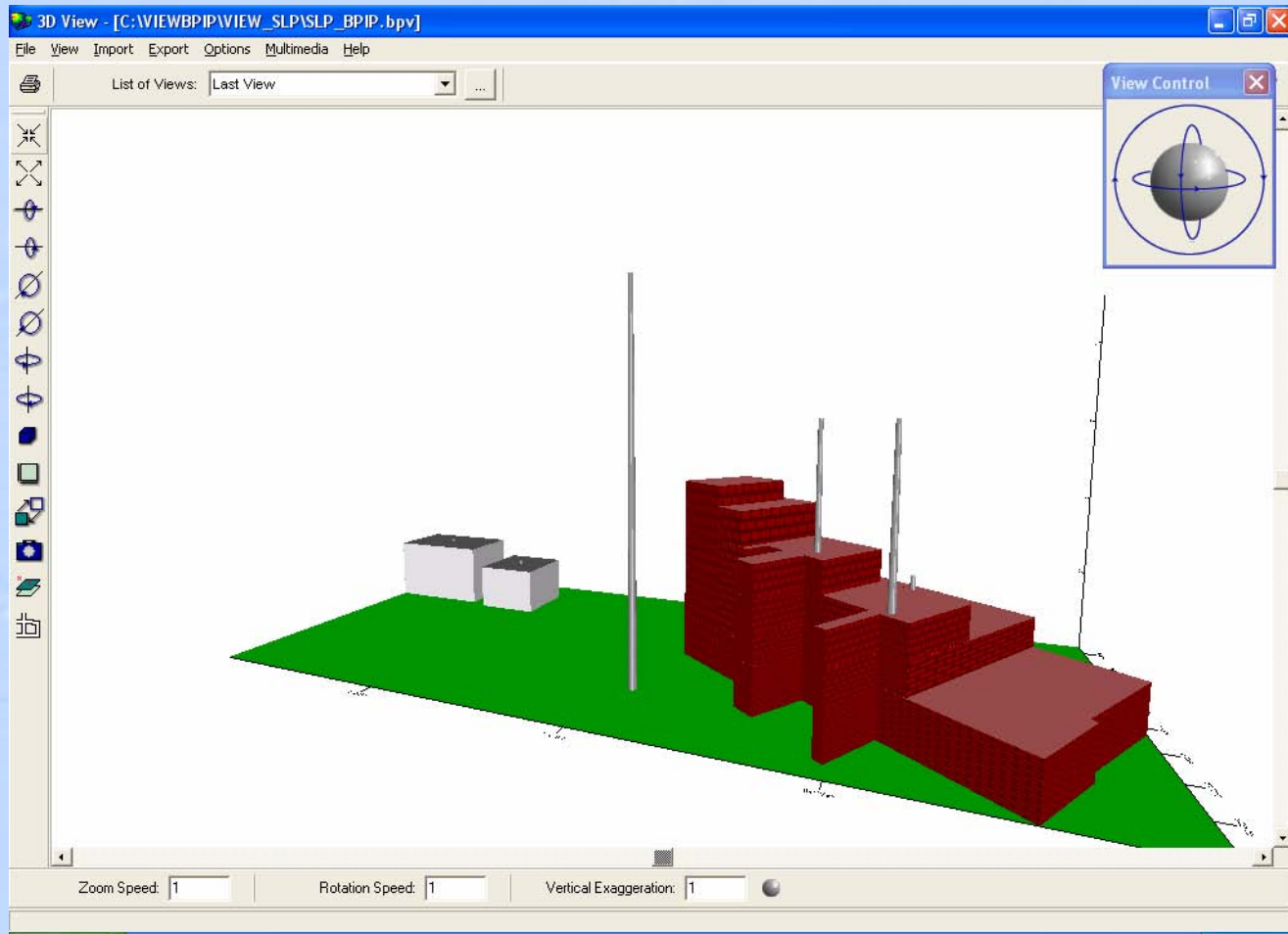
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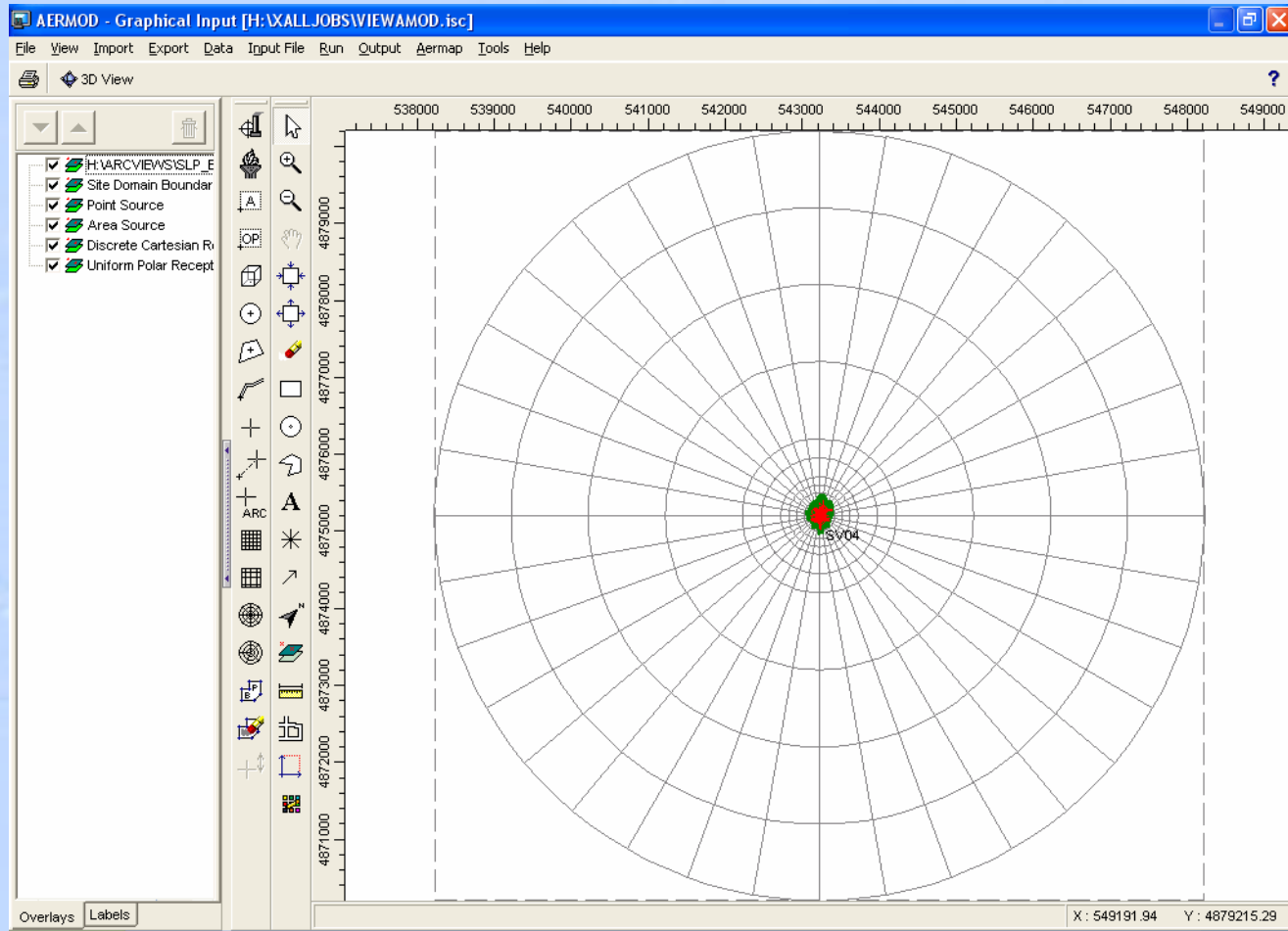
# 3D View – Looking North



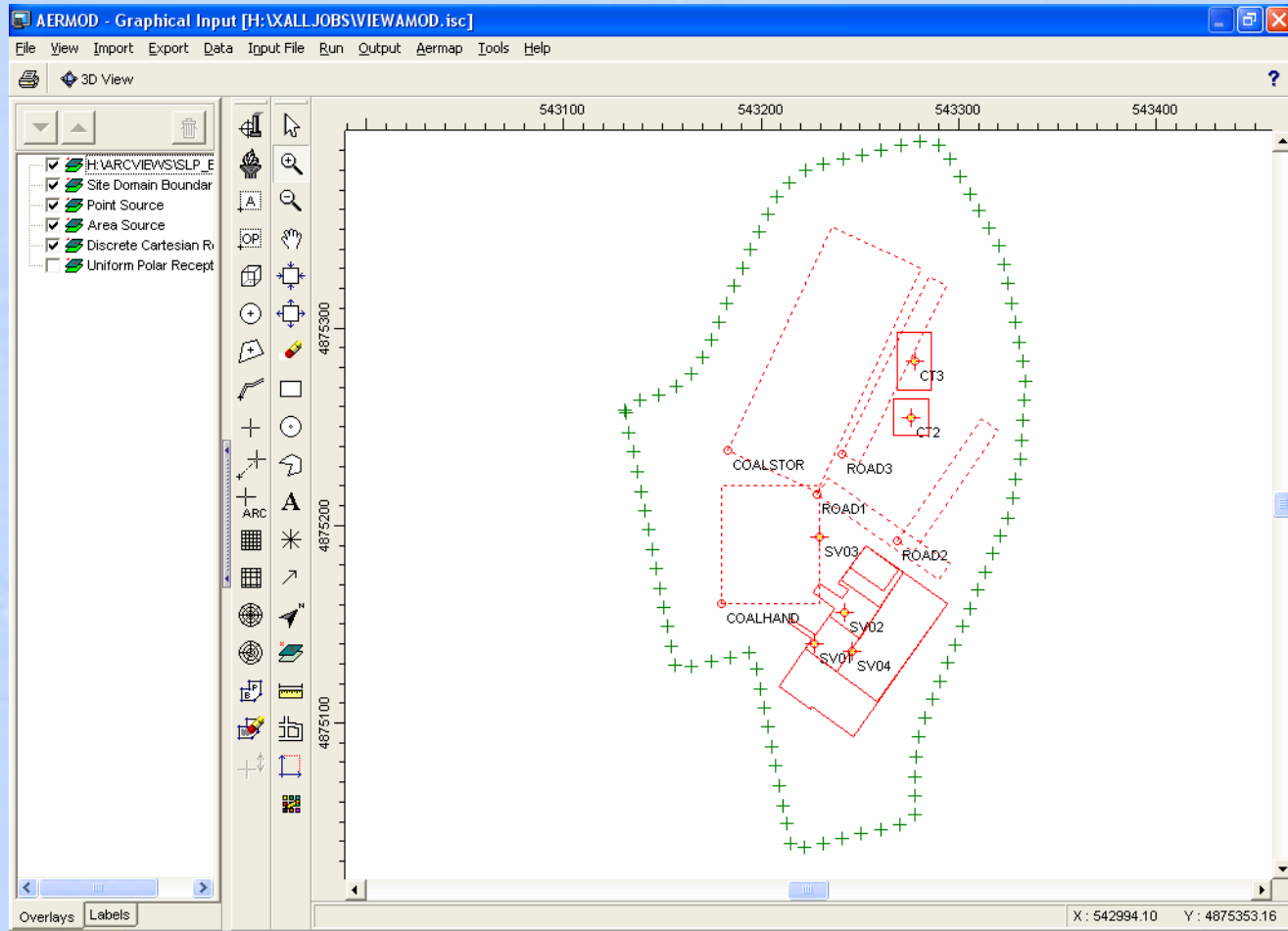
# 3D View – Looking ENE



# Polar Receptors



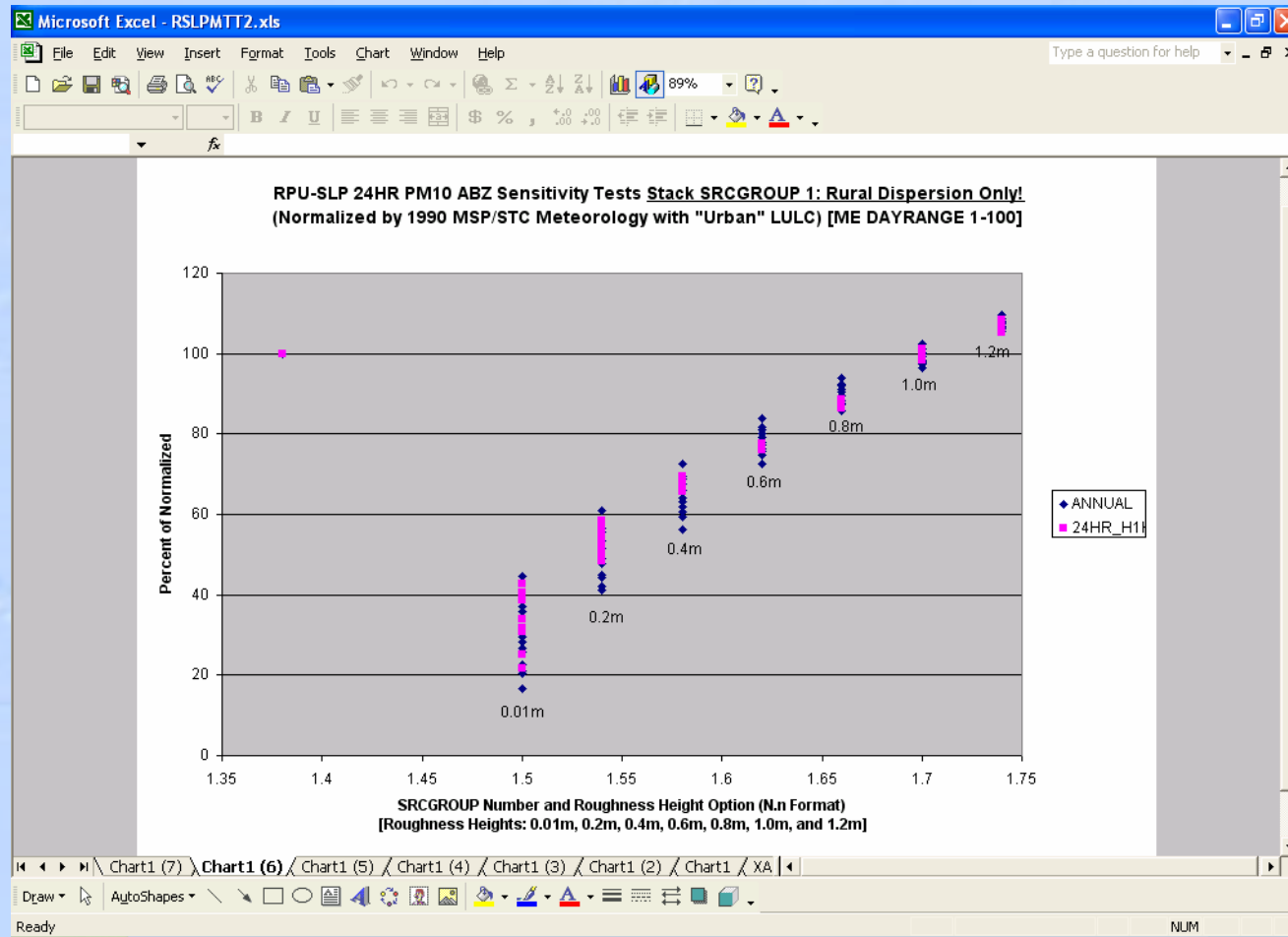
# Discrete Receptors



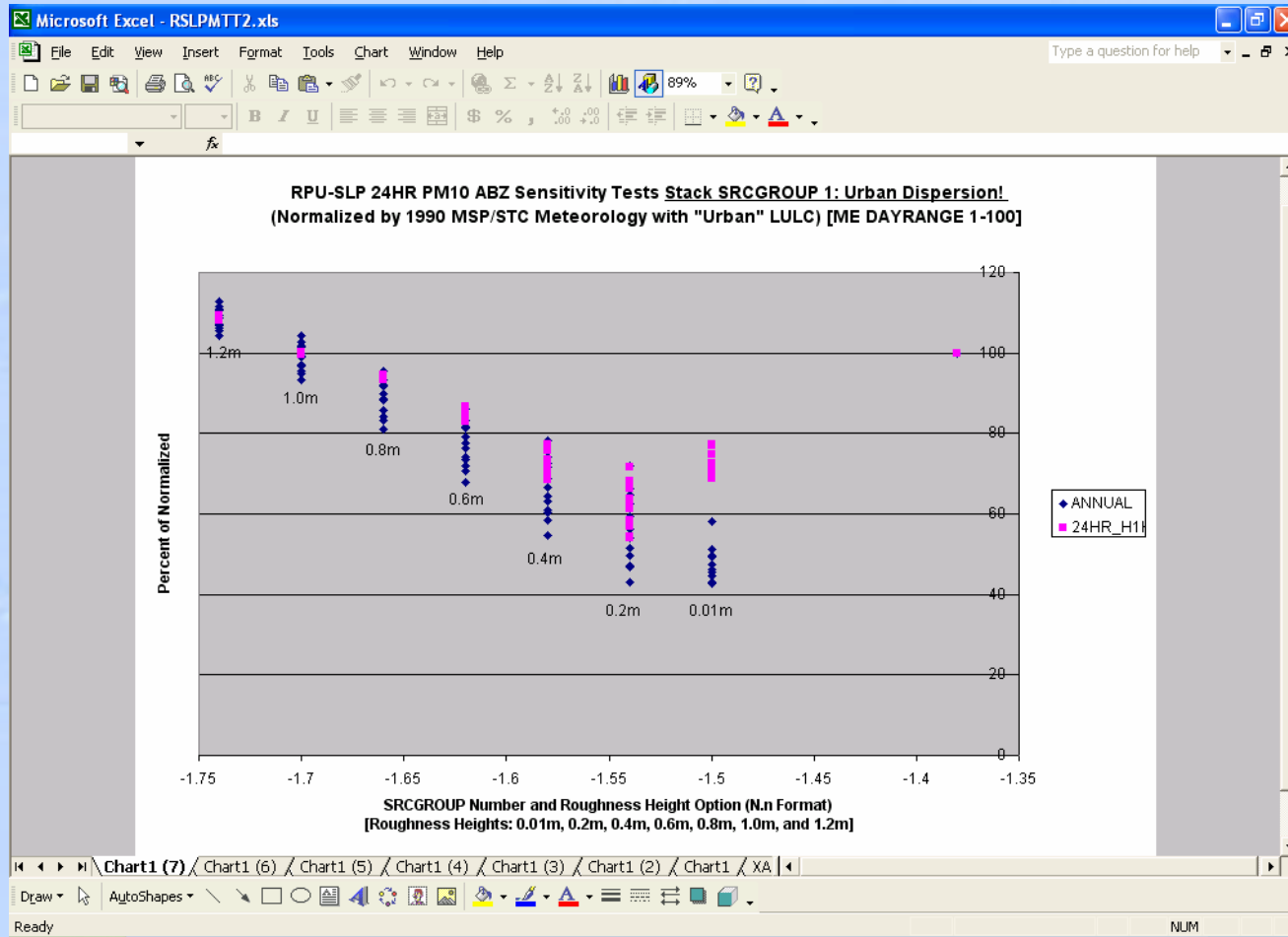
# Base Case vs. 84 “ABZ” Tests

- AERMOD/AERMET/AERMAP (02222)
  - First 100 Days of 1990 (Meteorology)
- Base Case: RPU-SLP 24-Hour PM10 Modeling
  - All “urban” LULC [ $Z_o=1\text{m}$ ]
- 84 “ABZ” Combinations [ $3*4*7=84$ ]
  - 3 Albedos ( $A=0.1, 0.3, \text{ and } 0.5$ ) [dark to light]
  - 4 Bowen Ratios ( $B=0.1, 0.5, 0.9, \text{ and } 4.0$ ) [wet to dry]
  - 7 Roughness Heights ( $Z_o=0.01, 0.2, 0.4, 0.6, 0.8, 1.0, \text{ and } 1.2$  meters) [smooth to rough]
- Results: “Percent of Base Case”

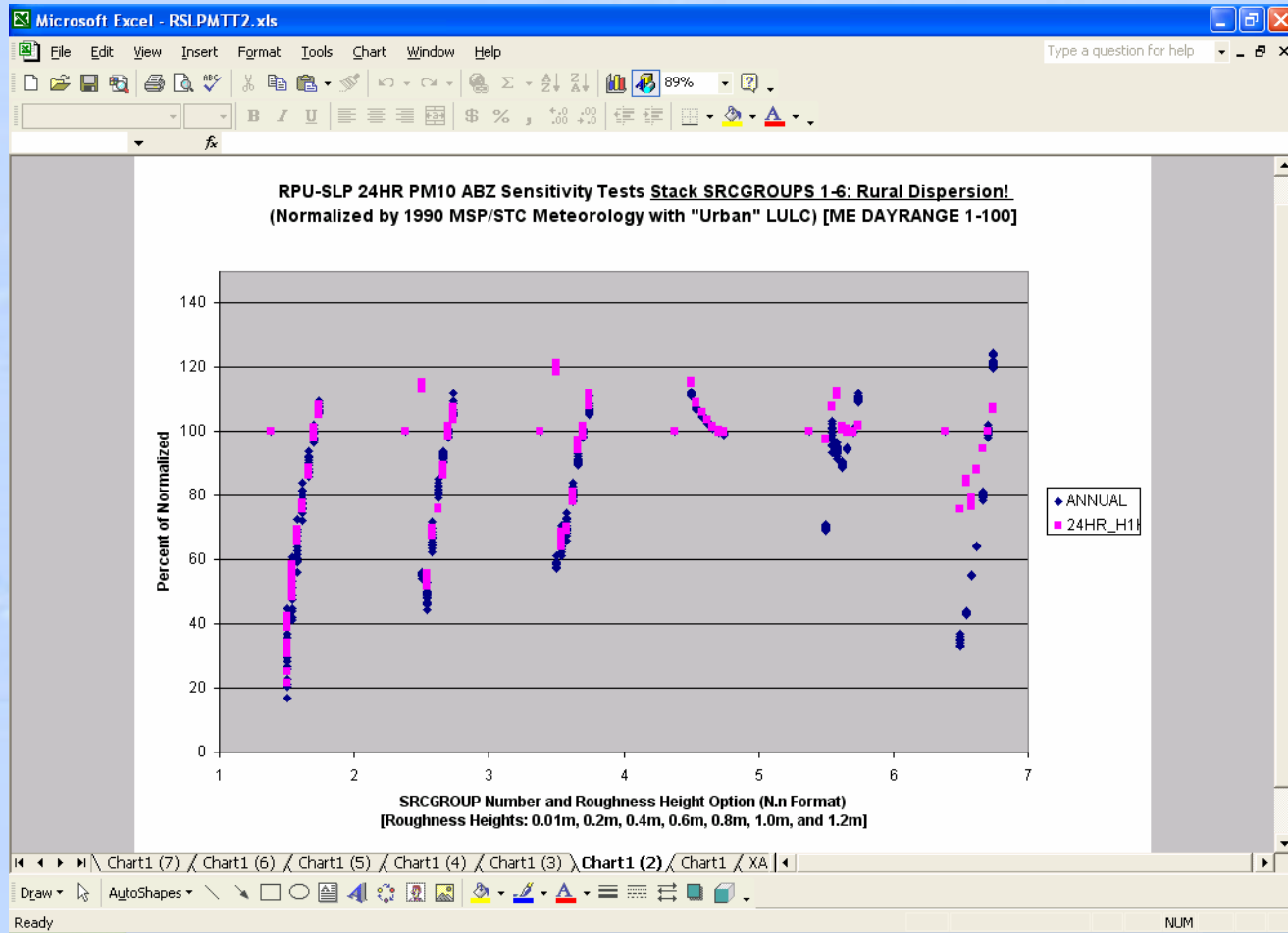
# Group 1 (SV03) Rural Results



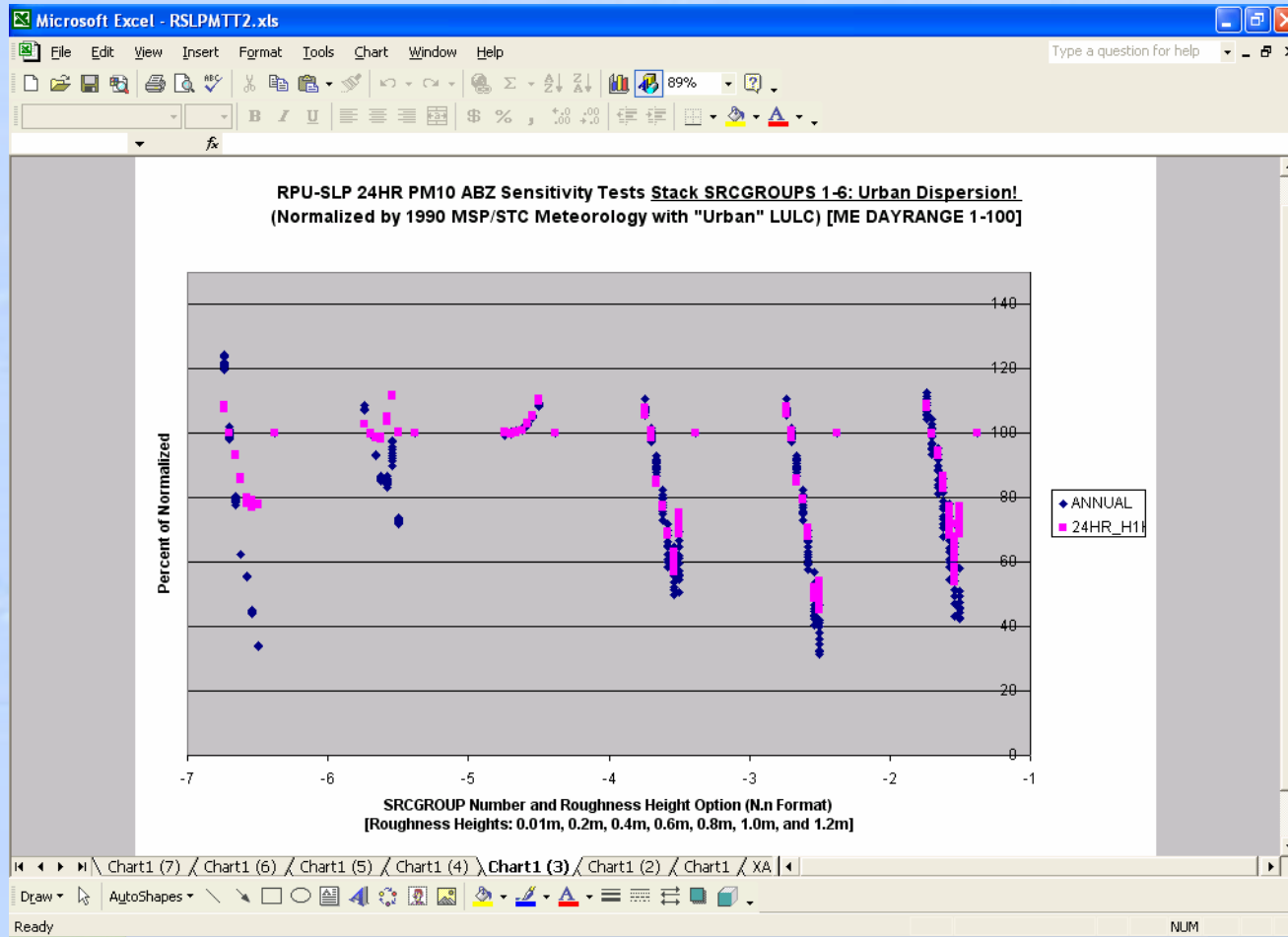
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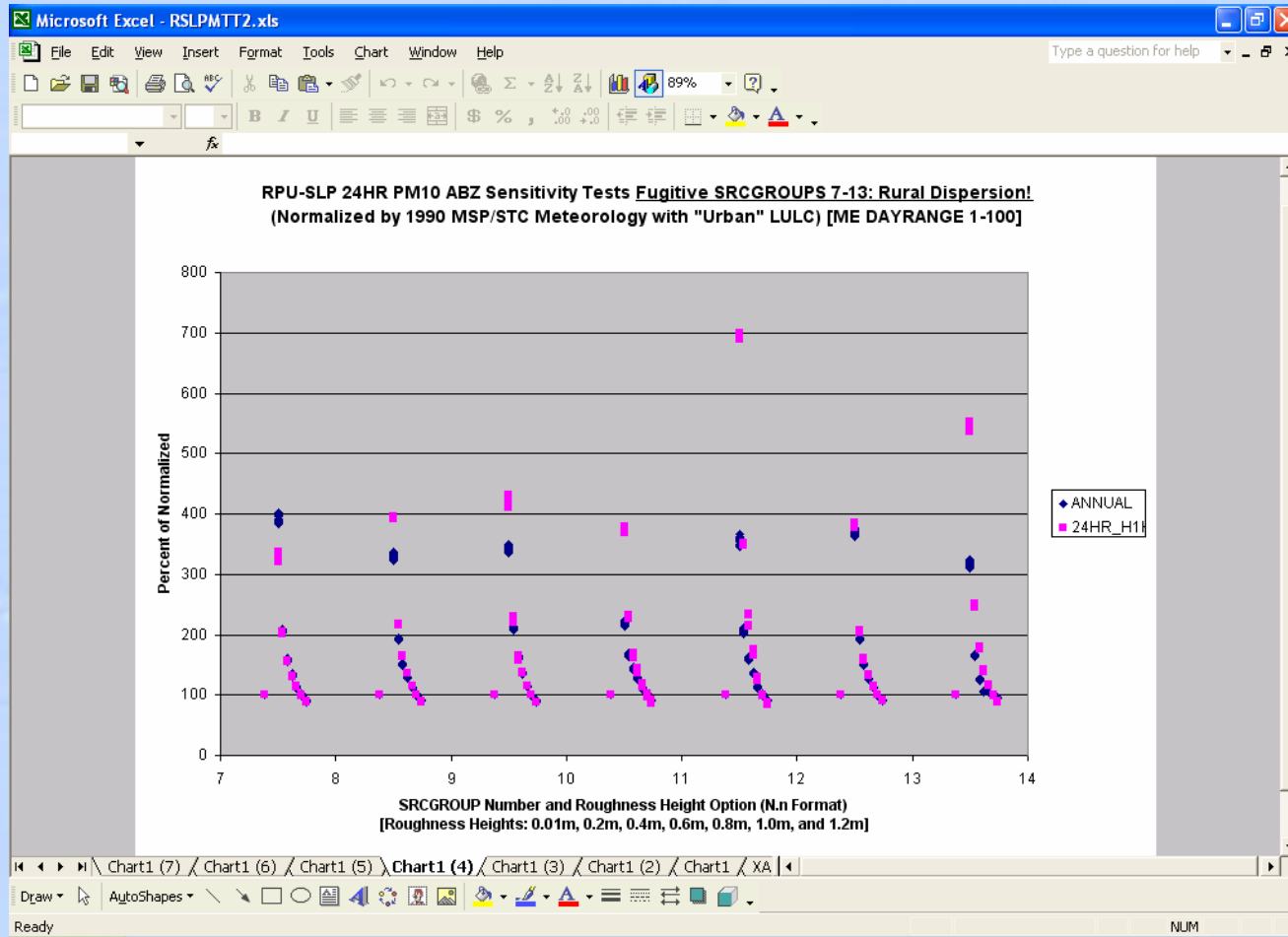
# Groups 1-6 Rural Results (SV03,SV01,SV02,SV04,CT03,CT02)



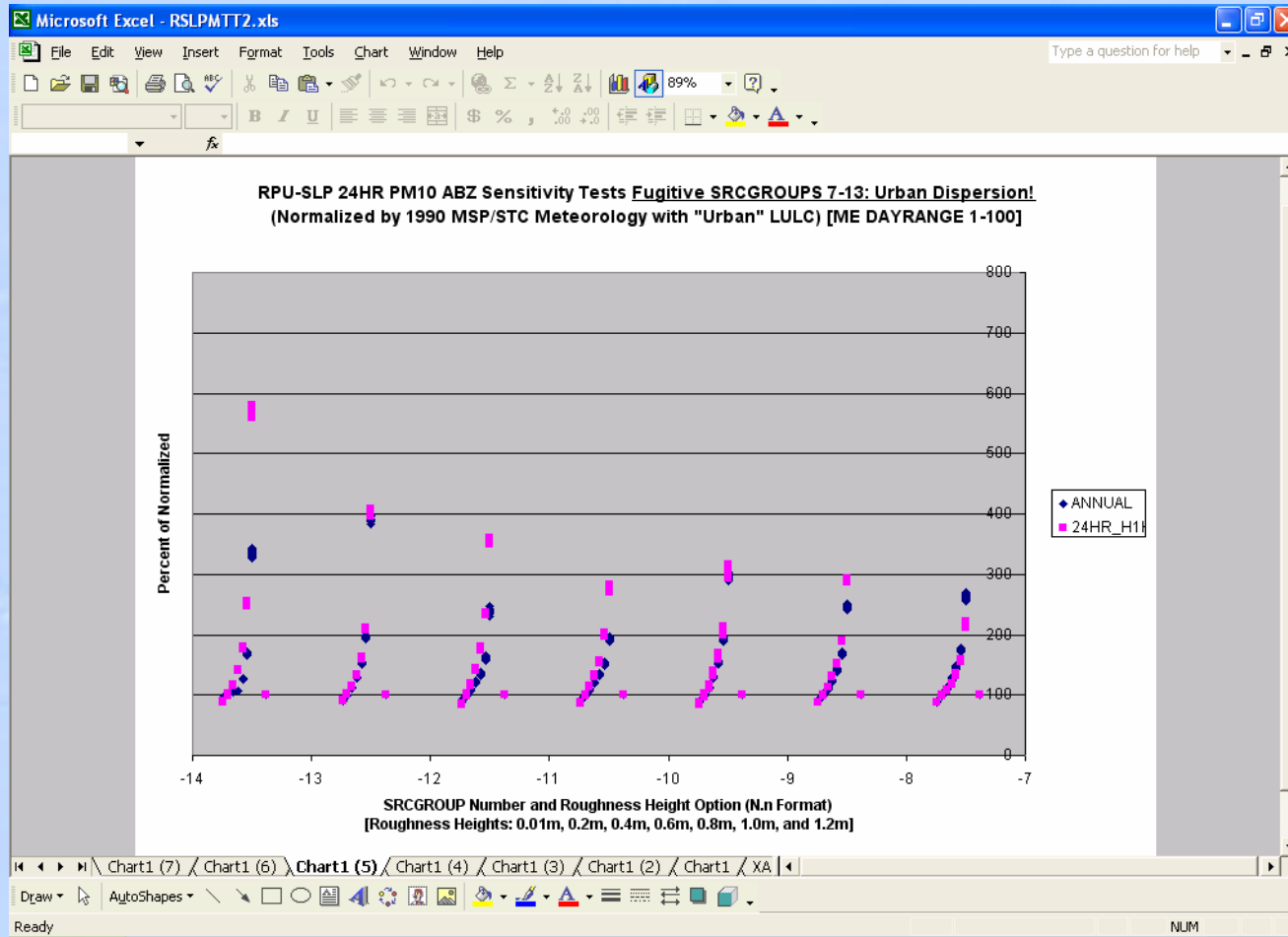
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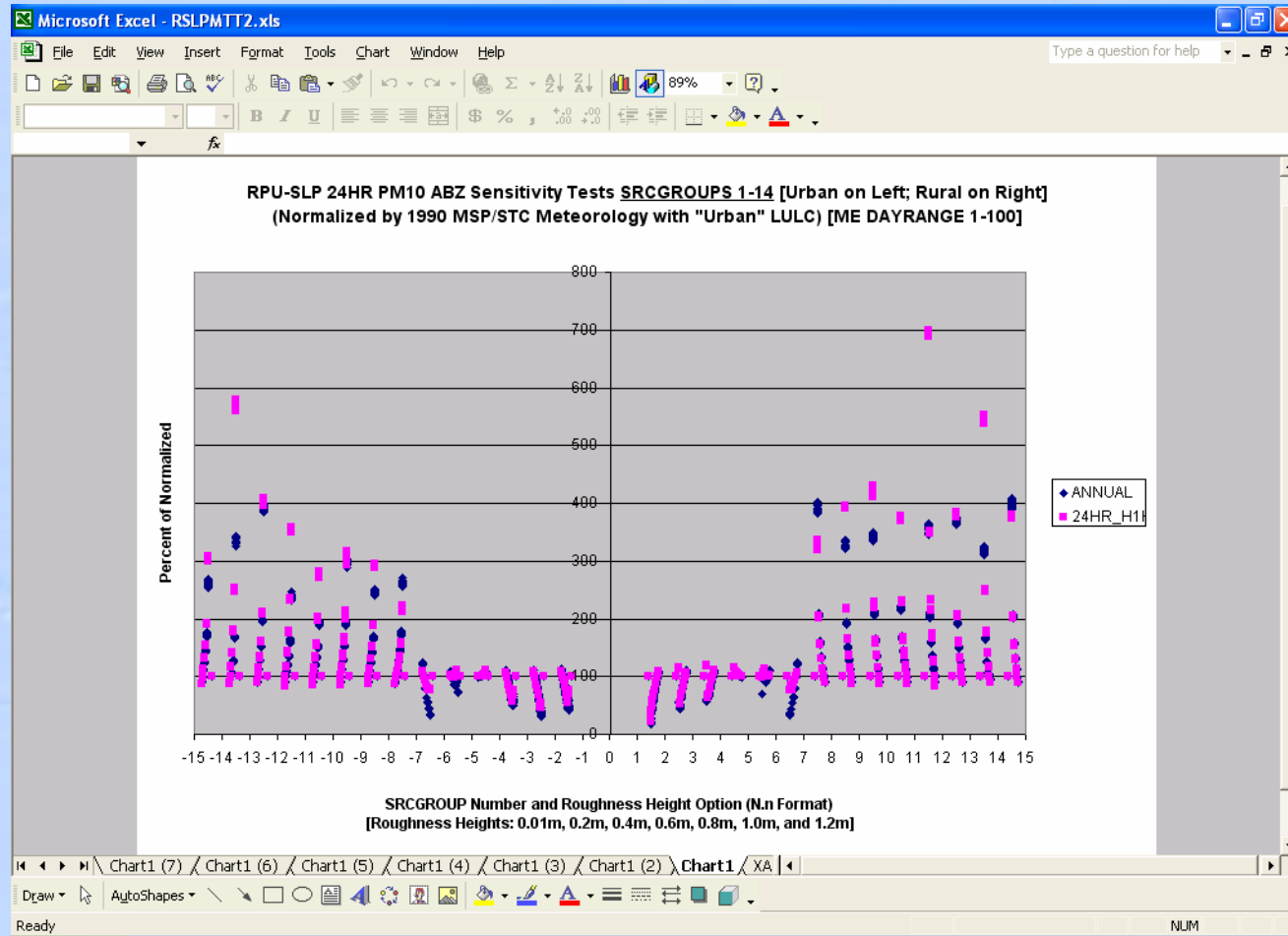
# Groups 7-13 Rural Results (Various Fugitive Sources)



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# All 14 Groups (6 Stacks, 7 Fugitives, ALL) (Urban on Left; Rural on Right)



# “100 Day Test” Summary

- Tall (~GEP) Stacks
  - Roughness Height is most important
  - Albedo & Bowen Ratio are less important
- Intermediate Stacks
  - Roughness Height is still most important
  - Albedo & Bowen Ratio are less important
- Stub Stacks
  - Roughness Height is not very important
  - Albedo & Bowen Ratio are not important
- Fugitive Sources
  - Roughness Height is most important
  - Albedo & Bowen Ratio are less important

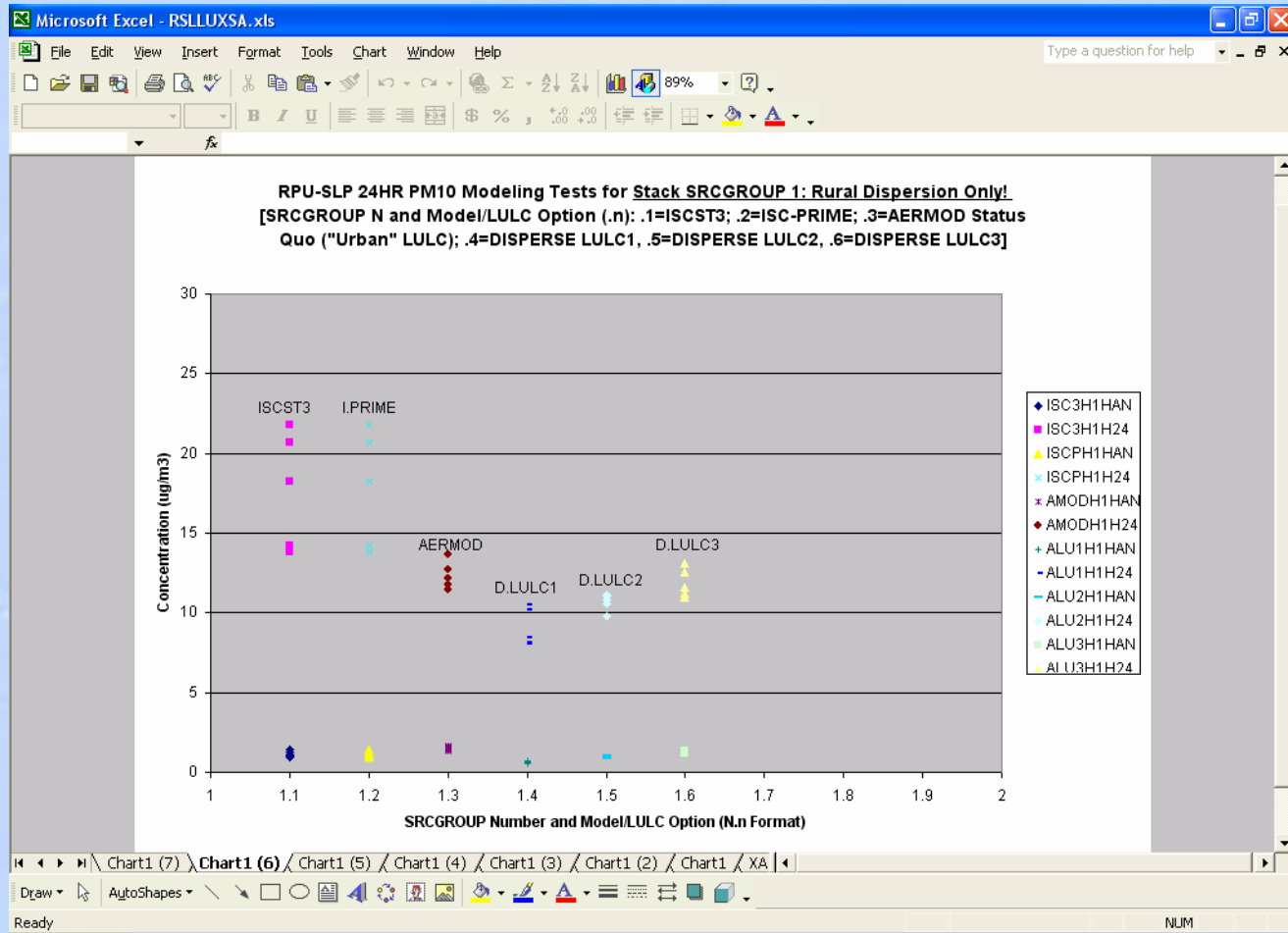
# DISPERSE Tests

- DISPERSE Categories
  - Cultivated land ( $Z_o \sim 0.01\text{m}$  to  $0.2\text{m}$ )
  - 50/50 mix ( $Z_o \sim 0.3\text{m}$  to  $0.8\text{m}$ )
  - Deciduous forest ( $Z_o \sim 0.5\text{m}$  to  $1.3\text{m}$ )
- 1986-1990 MSP/STC Meteorology
- Rural vs. Urban (pop. 100,000;  $Z_o = 1\text{m}$ )
- Results in Micrograms per Cubic Meter

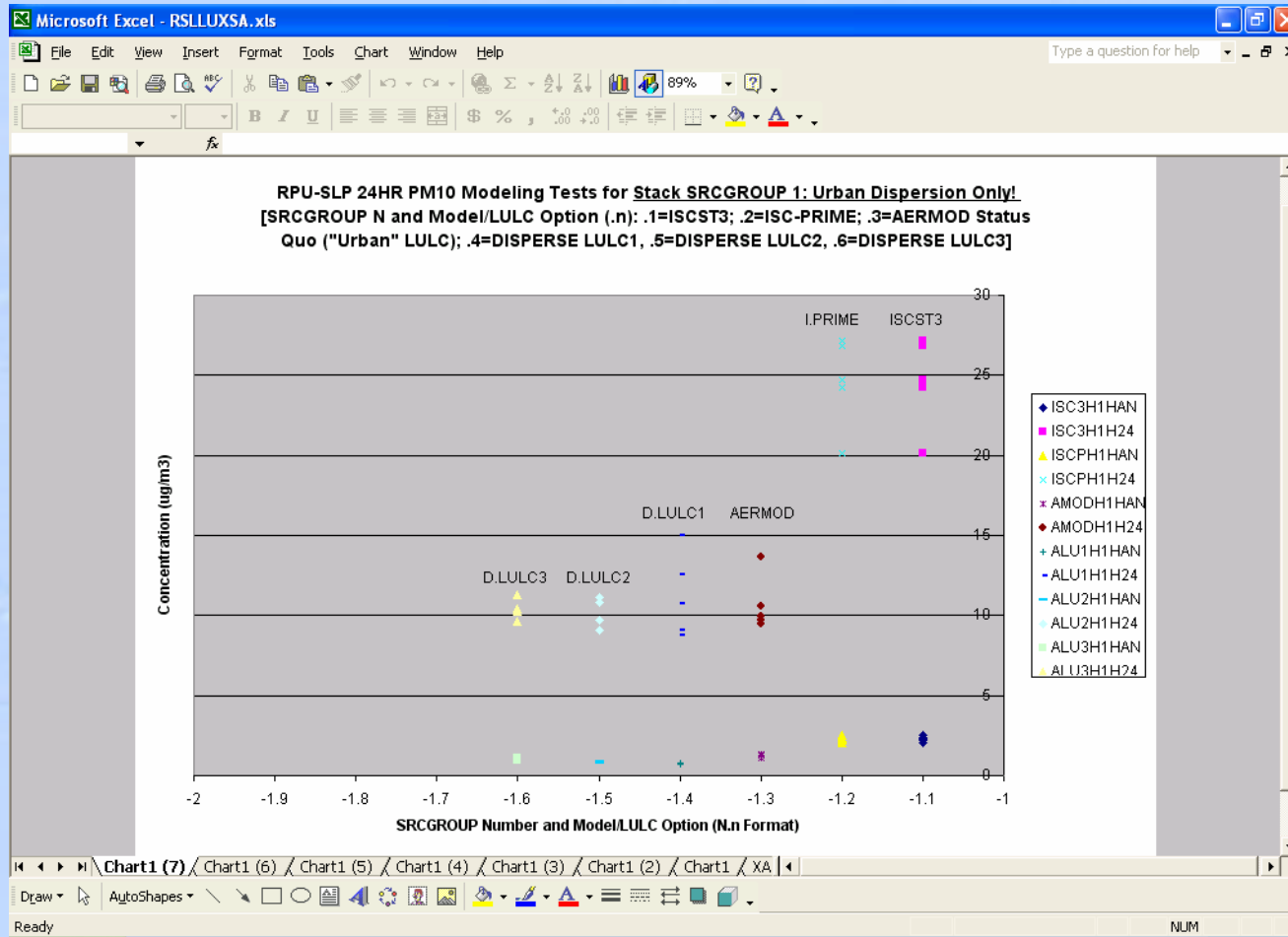
# DISPERSE Comparisons

- Display Format (Group N; Modeling Method M)
  - N.1 denotes ISCST3
  - N.2 denotes ISC-PRIME
  - N.3 denotes AERMOD with 100% “urban” LULC (RPU-Silver Lake [PSD] Project)
  - N.4 denotes AERMOD with DISPERSE LULC1 (cultivated land)
  - N.5 denotes AERMOD with DISPERSE LULC2 (50/50 mix of cultivated land and deciduous forest)
  - N.6 denotes AERMOD with DISPERSE LULC3 (deciduous forest)

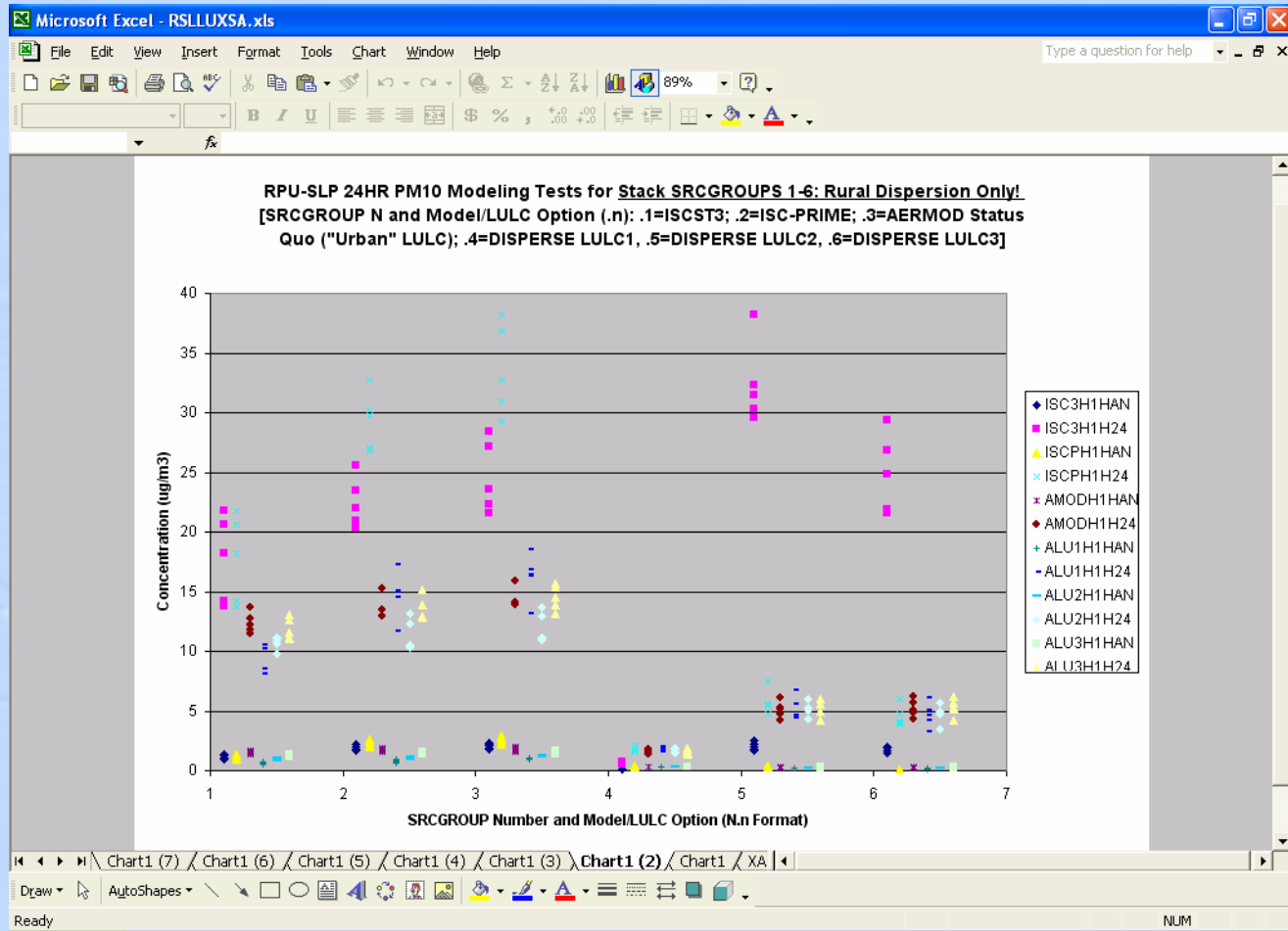
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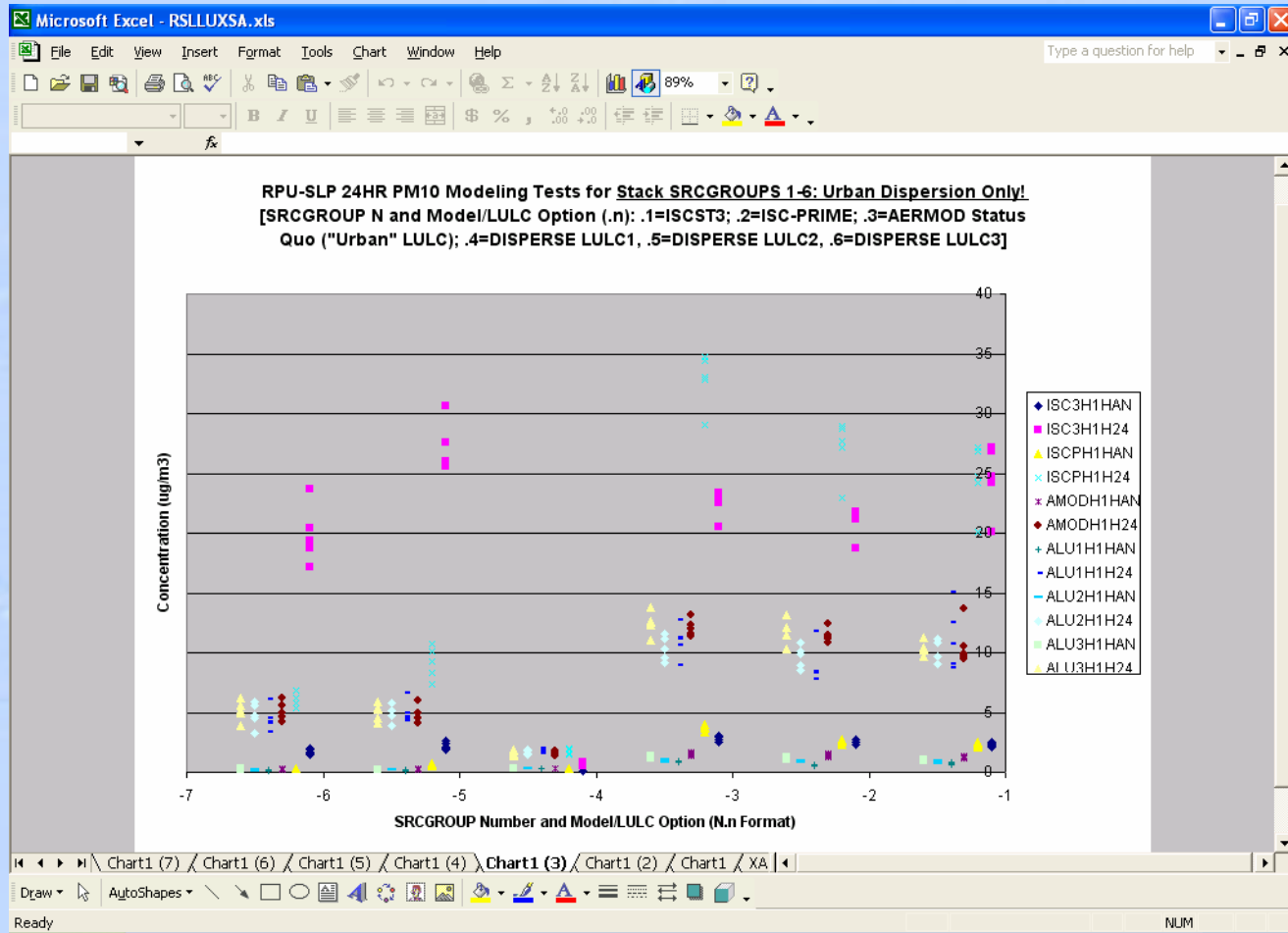
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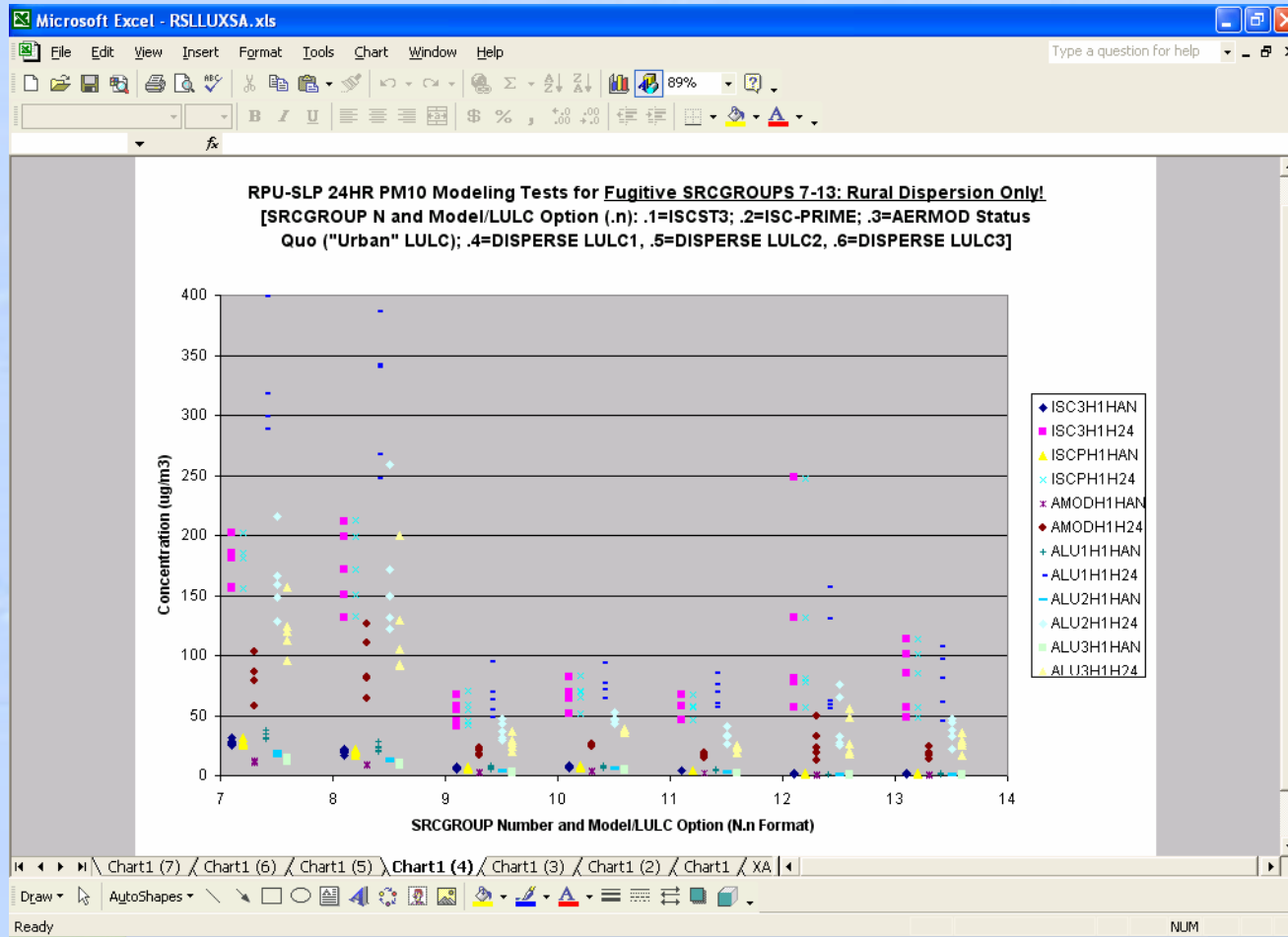
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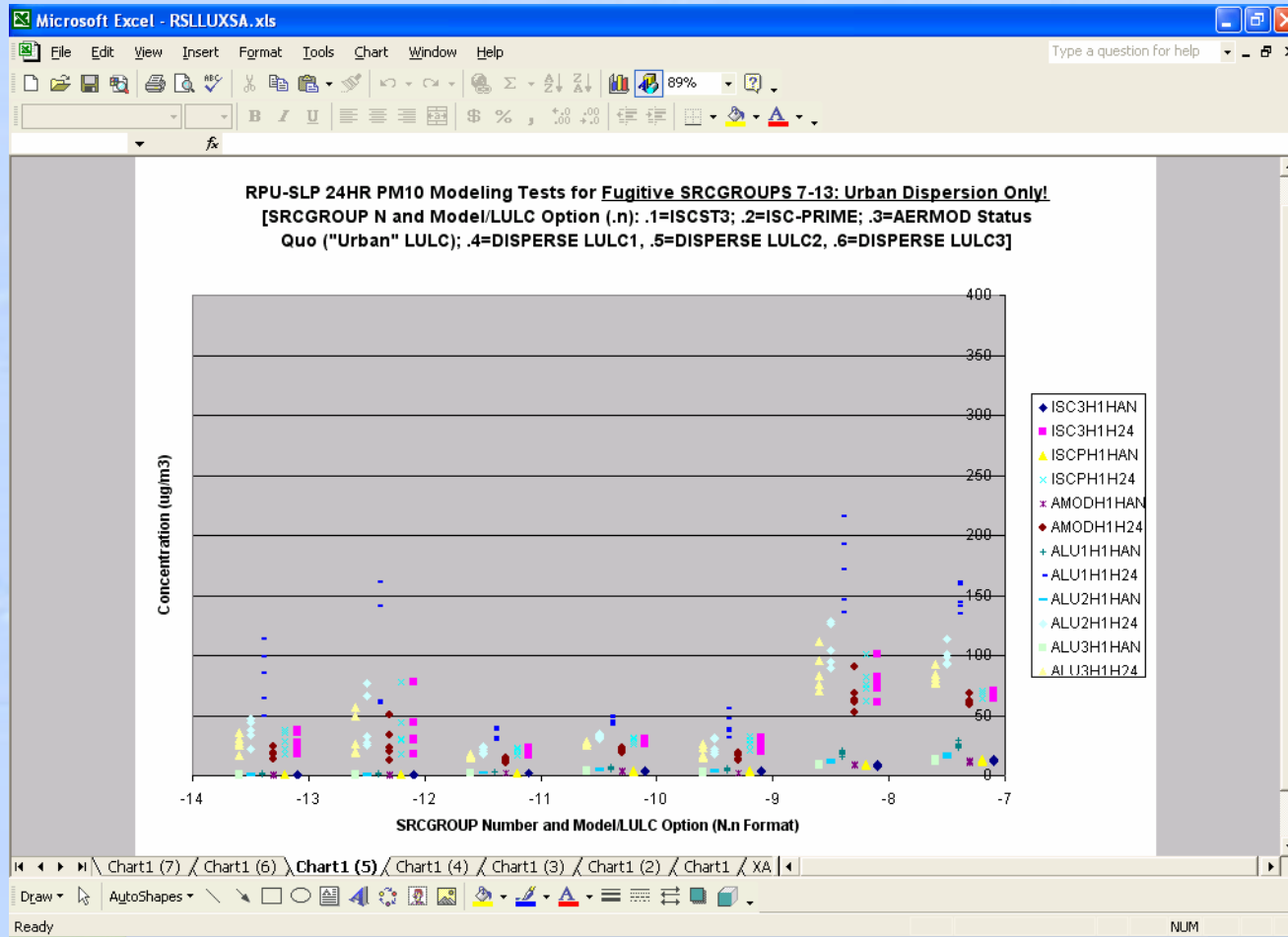
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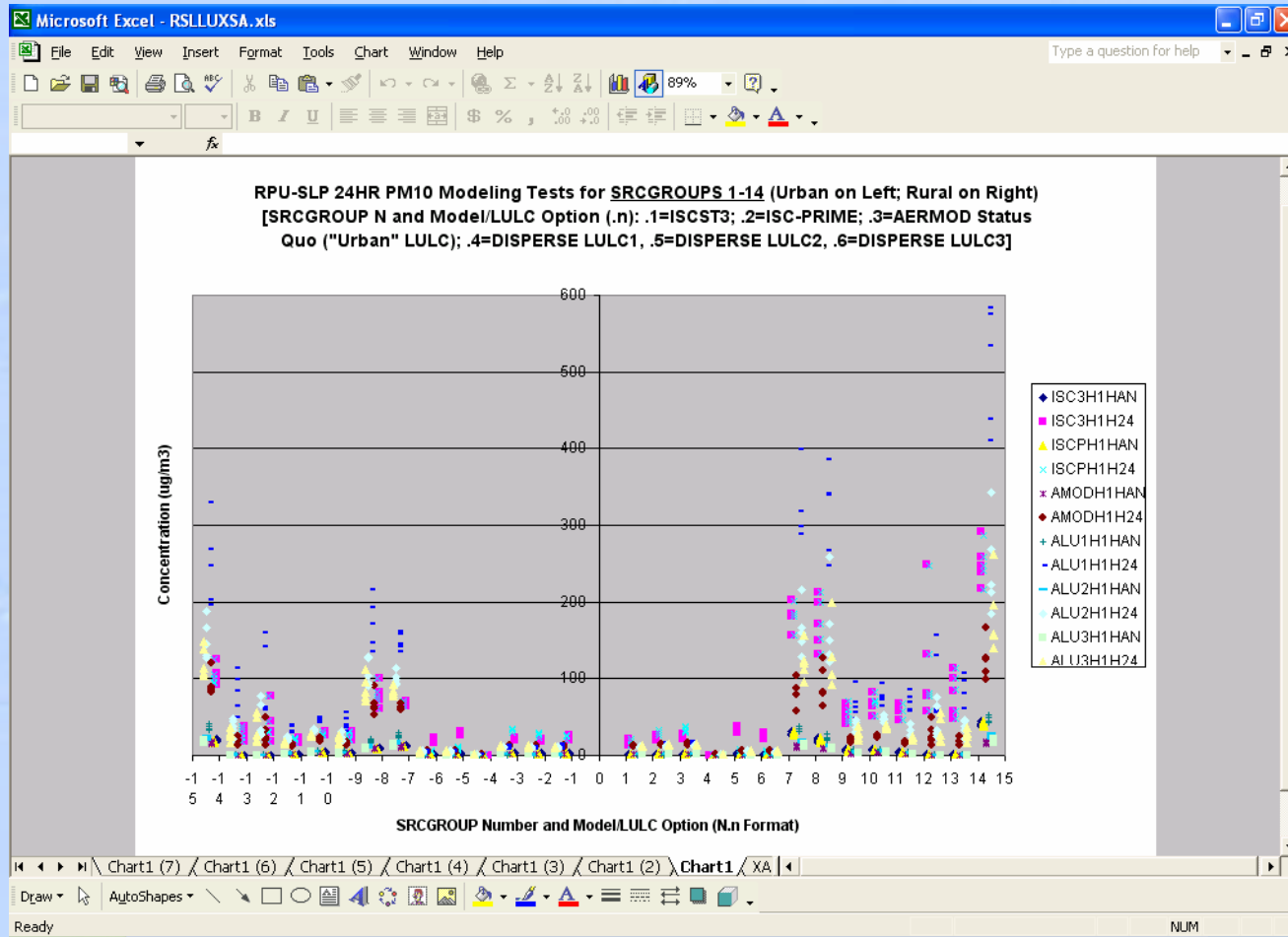
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# DISPERSE Summary

- Significant changes from ISC to AERMOD
- DISPERSE cases are (surprisingly) similar
  - Recall: AERMOD and 3 LULC cases
  - Significant seasonal variability seems to yield the surprisingly similar results