Business- Oriented Environmental Applications – Case Studies and ICT Tools

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The EnviroComp Institute www.envirocomp.org

Syrian Computer Society – 20-23 April 2008

Introduction

- Scientific career dedicated to the study of air pollution and environmental modeling + consulting:
  - IBM Scientific Center, Venice, Italy (’70)
  - AeroVironment Inc., Pasadena, CA (’80)
  - Failure Analysis Associates, Menlo Park, CA (’90)
  - EnviroComp Consulting Inc., Fremont, CA (’00)

EnviroComp Consulting, Inc.

- Company specialized in “Environmental Computing”
  - Accidental releases in the atmosphere (acute exposure)
  - Continuous releases (chronic exposure)
  - Use of pesticides in agriculture
  - Many projects involve “litigation support”
  - Some projects involve “regulatory” modeling

The EnviroComp Institute

- Main Activities:
  - R&D – non profit
  - Publication of electronic books on air pollution, groundwater issues, environmentral modeling www.envirocomp.org/pubs
  - Most important electronic book series: www.envirocomp.org/aqm

Today's Presentation Topics

- Business-oriented:
  - Environmental consulting activities
  - Private companies
- Computer Tools
  - Management
  - Data Analysis
  - Modeling
  - Visualization
- Case studies

Environmental Consulting

- Regulatory Compliance
  - Business created by government regulations
  - E.g.: Environmental Impact Assessment (before new plants/activities become operational)
- Special projects - R&D
- Environmental accidents/disasters – evaluation, reconstruction, litigation support

Regulatory Compliance for Air Pollution in the US

- “Permit” studies for new sources or changes to existing sources
- State Implementation plans for improvement of existing conditions
- Emergency preparedness and emergency response
- Etc.
- Large business – predictable – sometimes “routine”

Evaluation, Assessment and Computer Modeling of Accidental Releases in the Atmosphere

Accidents and Litigation

- More and more often, especially in the US, even minor accidental releases are litigated in court
- Even with a good record of regulatory compliance, the industry can be sued
- The cost of litigation (and the potential penalties if the case is lost in court) are very high – and growing…

Cont.

- Litigation requires technical experts and litigation support
- The attorney and the scientist – an interesting interaction!
  - Different culture
  - Different skills
  - Different goals
  - Different language

Post-Accident Investigations

- One of our major consulting activities
- Multi-disciplinary
  - Industrial / chemical / combustion engineering
  - Atmospheric physics and chemistry
  - Computer modeling and GIS
  - Adverse Effects:
    - Toxicology
    - Environmental / Ecological / Material Damages
    - Economic damage

Our Clients

- ExxonMobil, ConocoPhillips, Monsanto, Shell, Honeywell, et al. for chemical accidental releases
- IBM facilities for indoor chronic exposure
- Law firms representing individuals against polluters
- Insurance companies
- Government agencies

Post-Accident Technical Work

The Accident

Technical Tasks

1. Accident Reconstruction
2. Emission Characterization
3. Meteorological Characterization
4. Plume Modeling
5. GIS Visualization
6. Adverse Effects

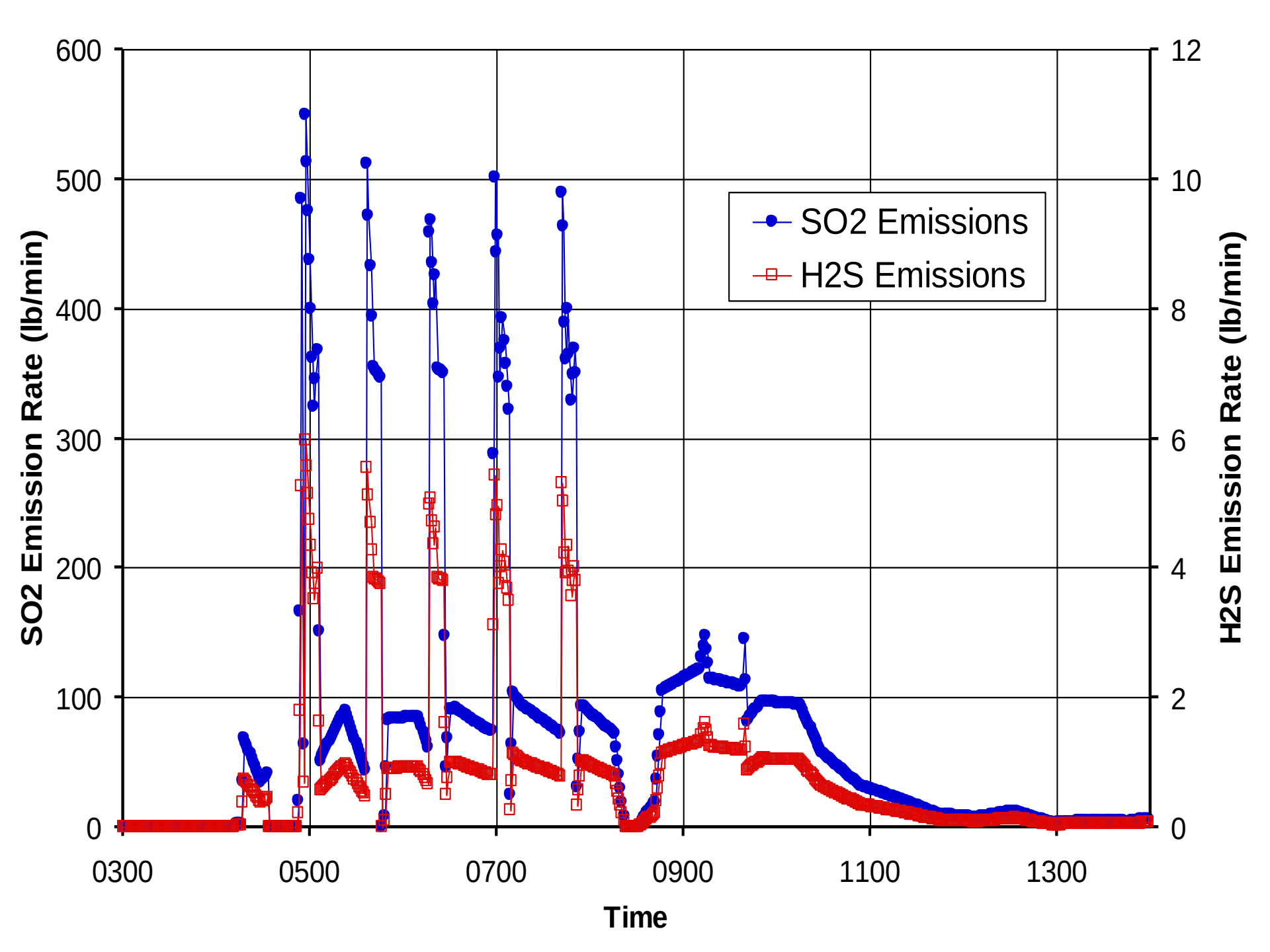
(MULTY-DISCIPLINARY PROJECTS)

1. Accident Reconstruction

- Review of industrial monitors
- Timeline of events
- Mass balance calculations
- Review of testimony, pictures, videos
- Uncertainty analysis

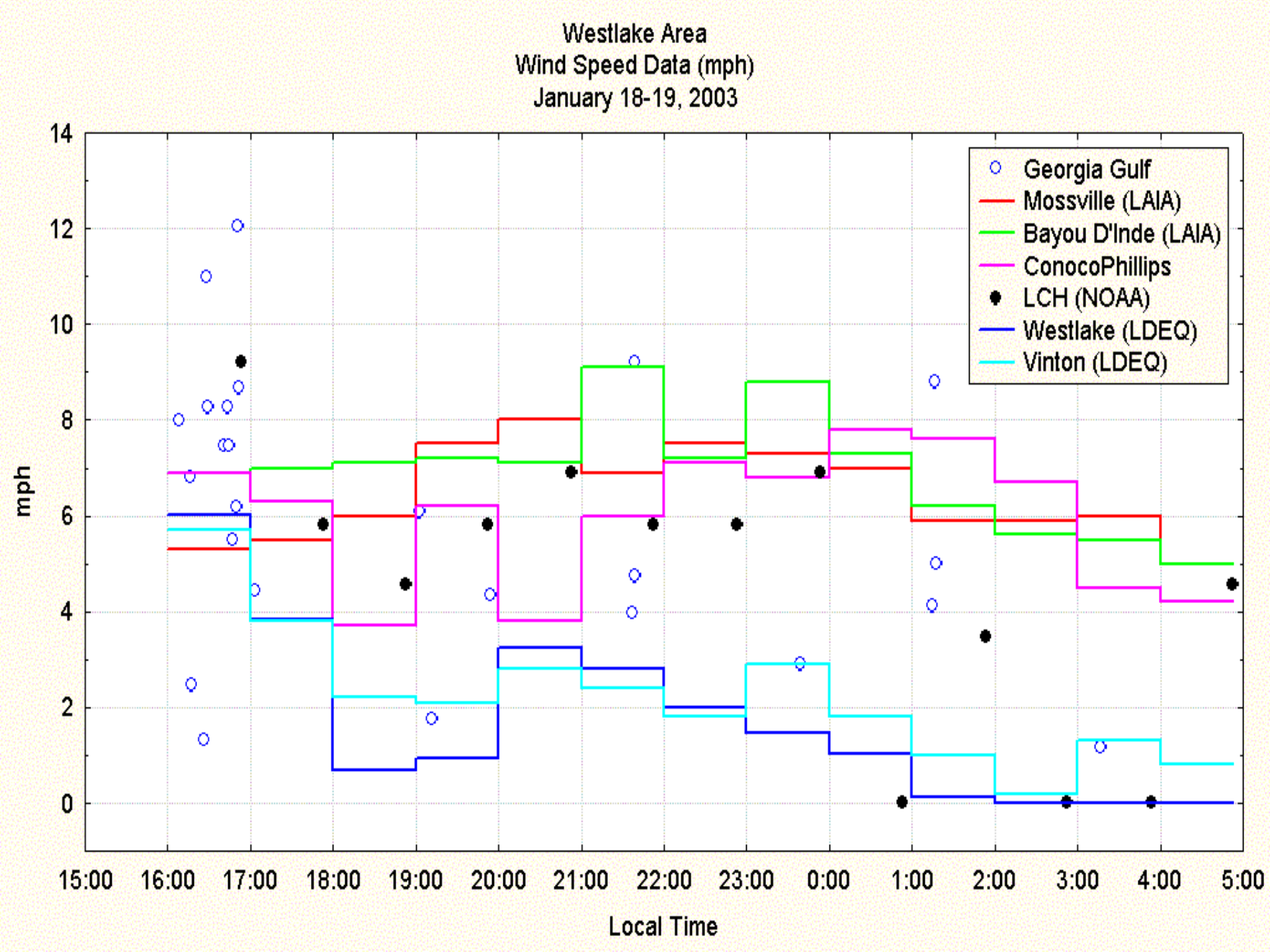
2. Emission Characterization

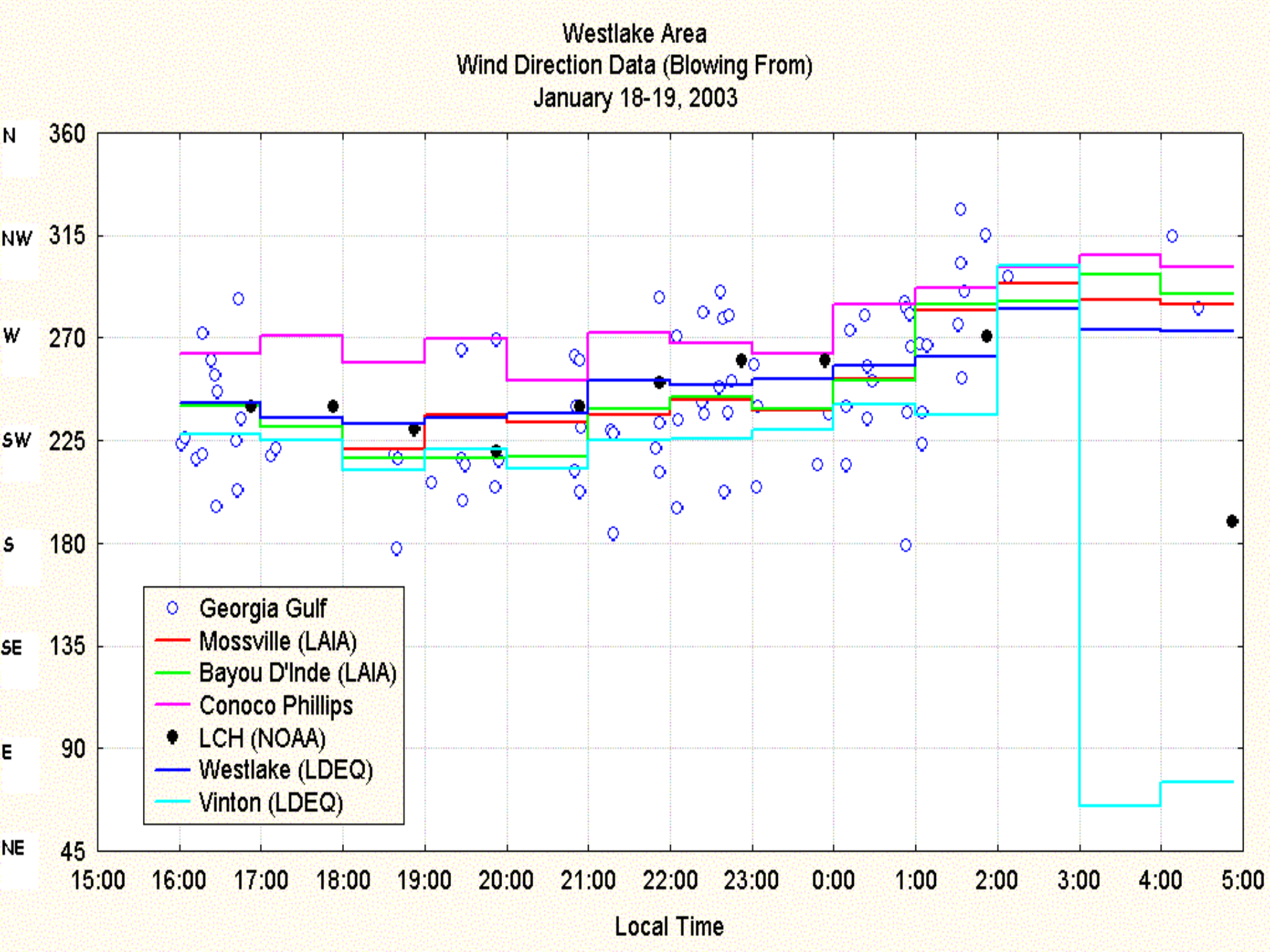
- Average release rate and parameters
- Minute-by-minute estimates


SO2 Emissions
H2S Emissions
SO2 Emission Rate (lb/min)
H2S Emission Rate (lb/min)
Time
600
500
400
300
200
100
0
12
10
8
6
4
2
0
0300
0500
0700
0900
1100
1300

3. Meteorological Characterization

- Collect available meteorological and weather data during the accident
- Review and select relevant information


Westlake Area
Wind Speed Data (mph)
January 18-19, 2003
Georgia Gulf
Mossville (LAIA)
Bayou D'Inde (LAIA)
ConocoPhillips
LCH (NOAA)
Westlake (LDEQ)
Vinton (LDEQ)
mph
14
12
10
8
6
4
2
0
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
Local Time

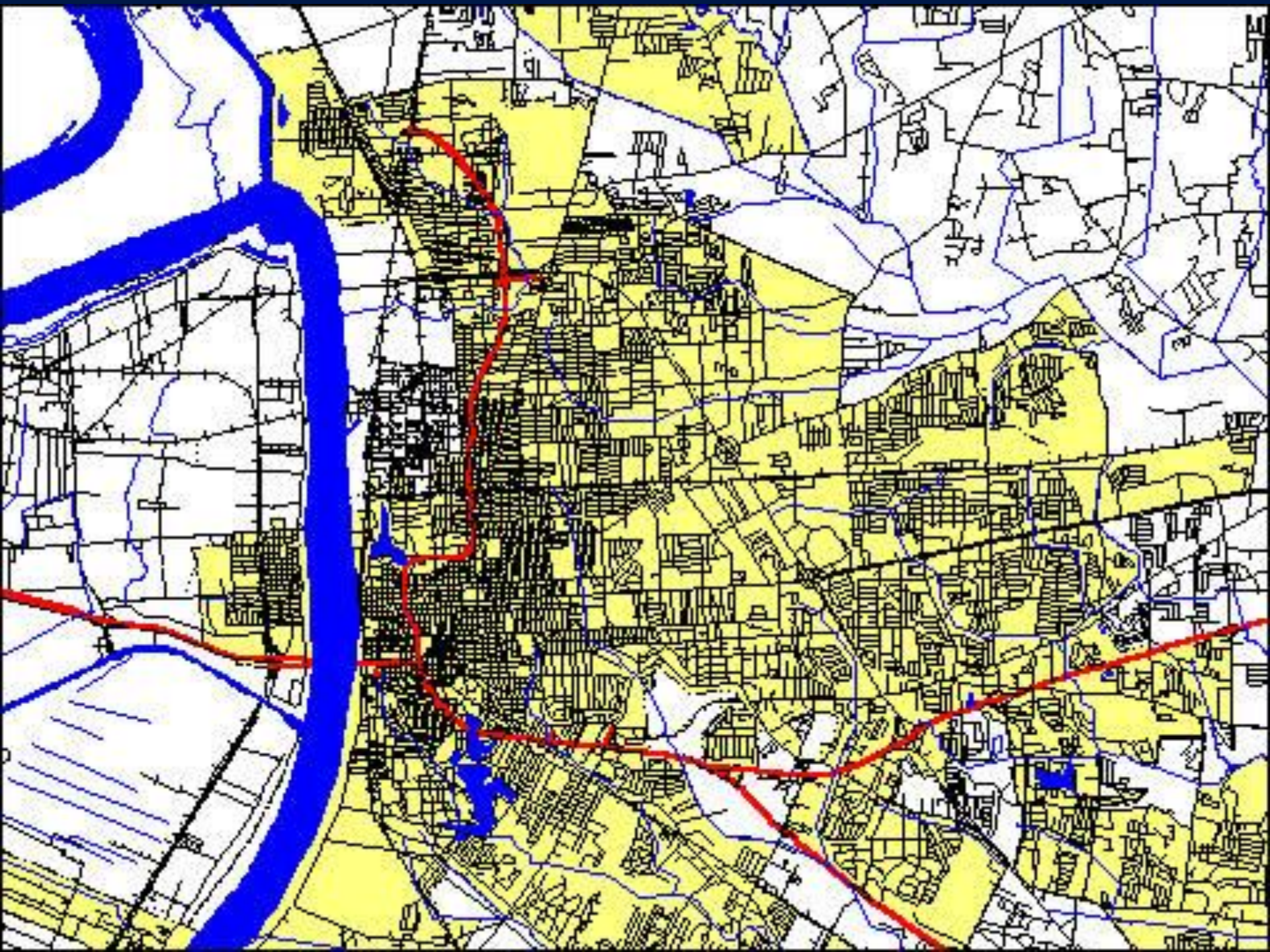

Westlake Area
Wind Direction Data (Blowing From)
January 18-19, 2003
N
NW
W
SW
S
SE
E
NE
360
315
270
225
180
135
90
45
Georgia Gulf
Mossville (LAIA)
Bayou D'Inde (LAIA)
Conoco Phillips
LCH (NOAA)
Westlake (LDEQ)
Vinton (LDEQ)
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
Local Time

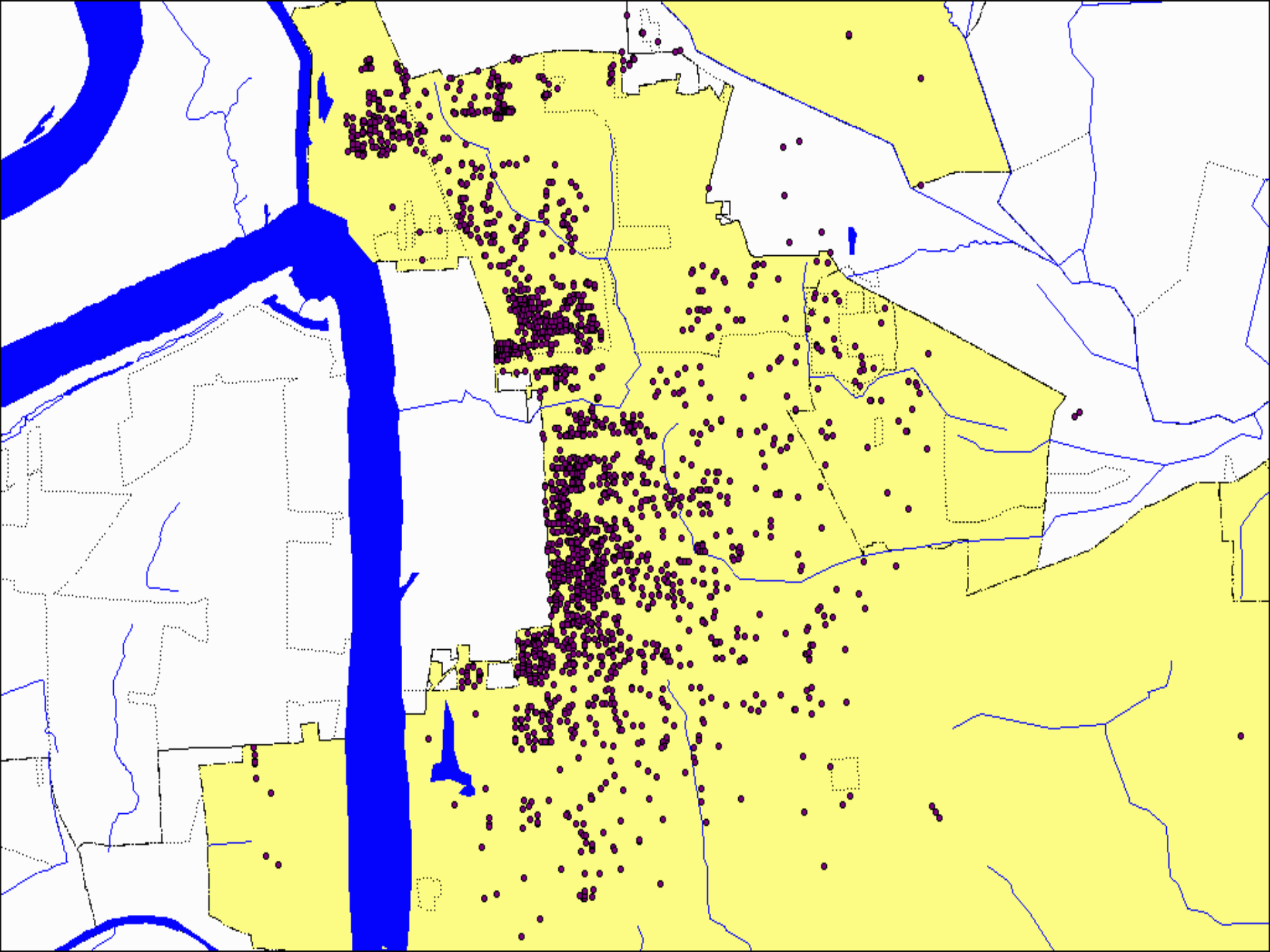
4. Plume Modeling

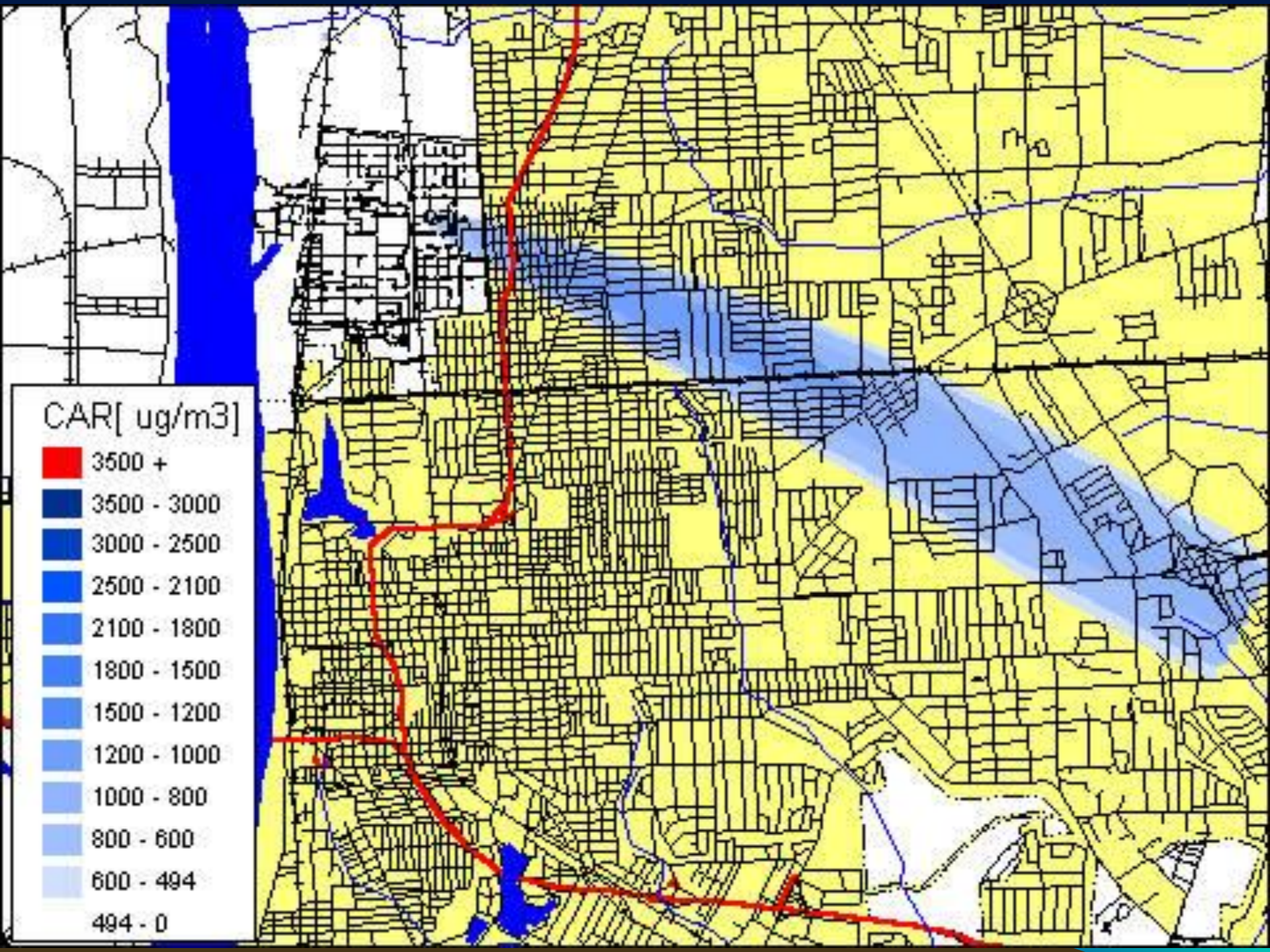
- EPA models vs. other models
- Simple models (e.g., a steady state Gaussian Plume model) vs. complex models (e.g., a dynamic puff model)
- Example of application of simple model for indoor/outdoor dispersion of a chlorine cloud
- Example of application of MONTECARLO

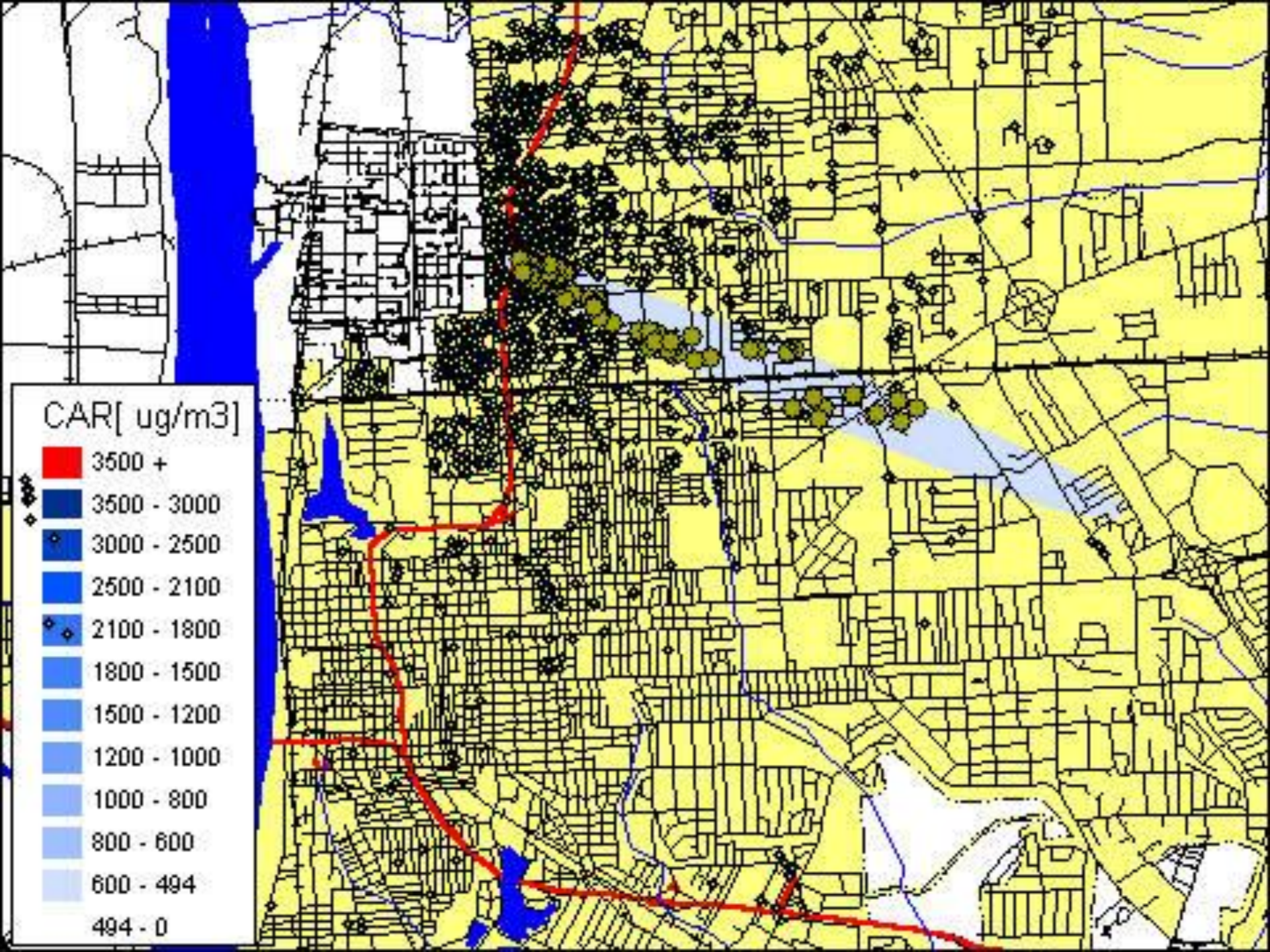
5. GIS Visualization

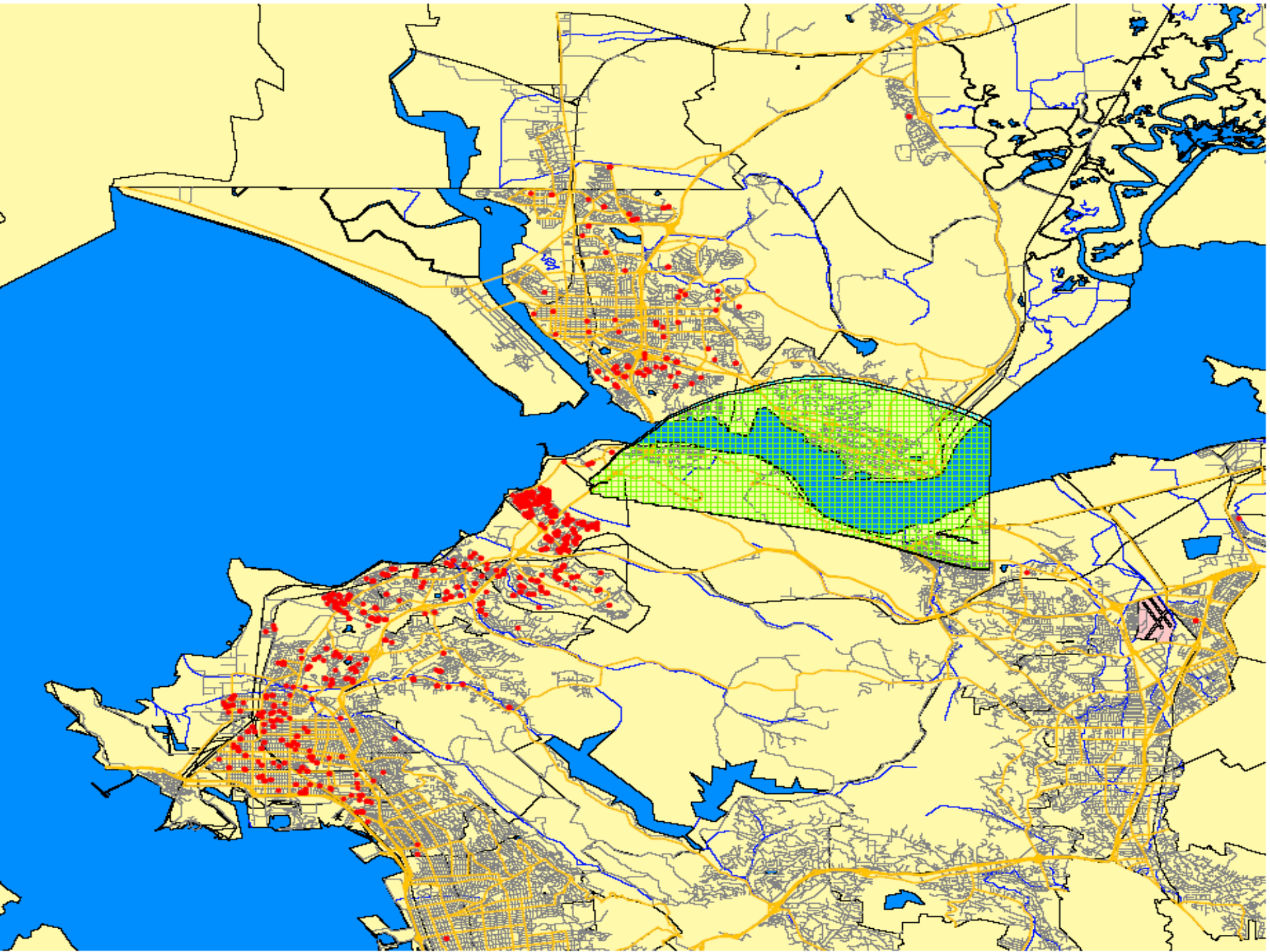
- Visualization of results:
  - Plume
  - Plaintiffs locations
  - Other geographic features
- The use of a GIS is indispensable
  - Different layers of information
  - Easy to change
  - Automatic geocoding of addresses






CAR[ug/m3]
3500 +
3500 - 3000
3000 - 2500
2500 - 2100
2100 - 1800
1800 - 1500
1500 - 1200
1200 - 1000
1000 - 800
800 - 600
600 - 494
494 - 0


CAR[ug/m3]
3500 +
3500 - 3000
3000 - 2500
2500 - 2100
2100 - 1800
1800 - 1500
1500 - 1200
1200 - 1000
1000 - 800
800 - 600
600 - 494
494 - 0



6. Adverse Effects

- Human Health
  - Comparison of simulated concentrations with established Levels of Concern (LOCs) http://www.orau.gov/emi/scapa/index.htm
- Odor Nuisance
  - Comparison of simulated concentrations with odor thresholds
- Damage to materials and surfaces (e.g., paint)
- Reduction in property value

D:\A-EnviroComp Consulting\from Expo 16Mar2001 - MASTER\E disk\WORK\International\Universita Puglie - Politecnico Bari-Taranto\trip Puglia 9-2002\Recent Presentations\Cavalier - Zoomed.avi

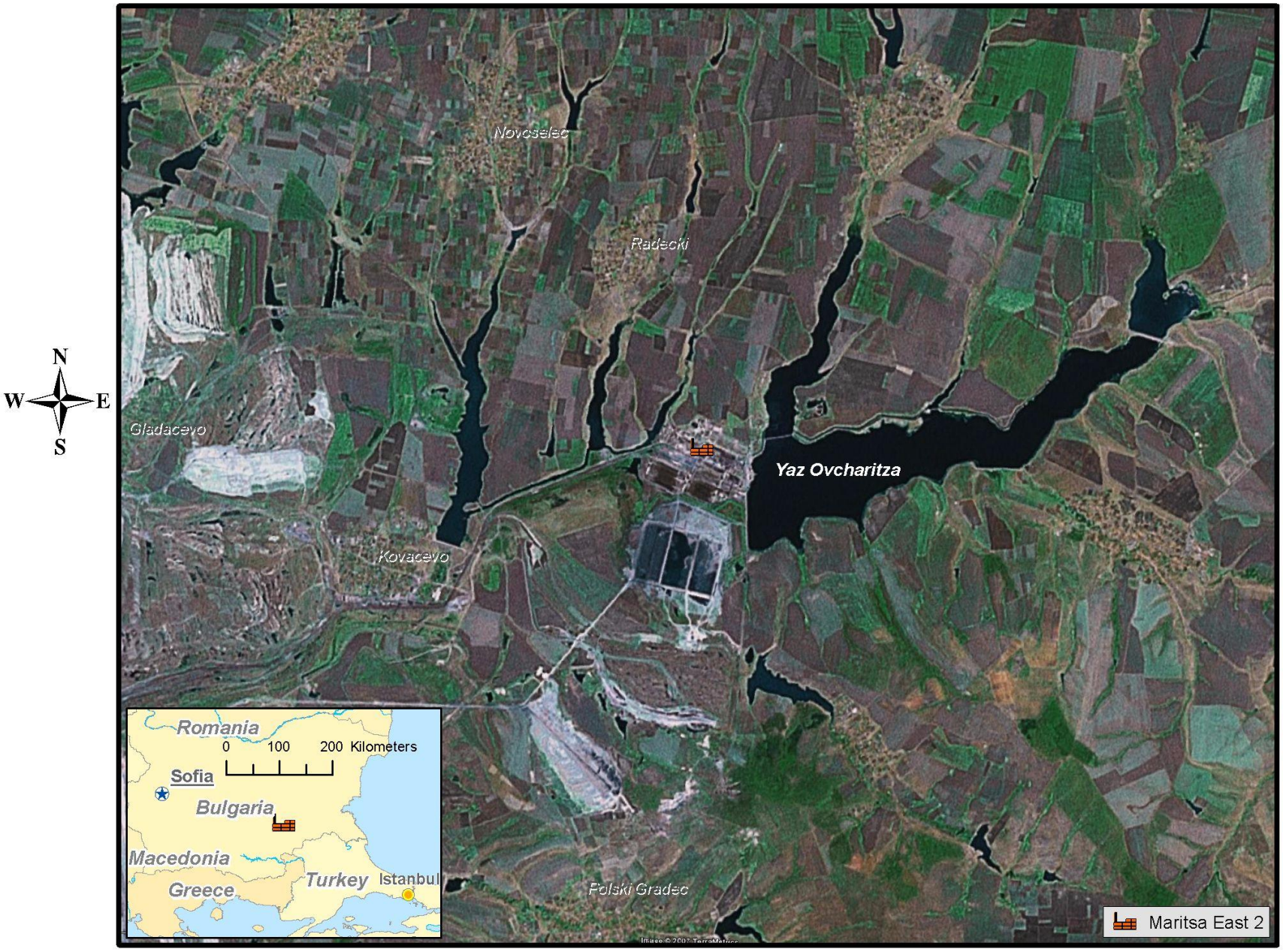
Software Tools

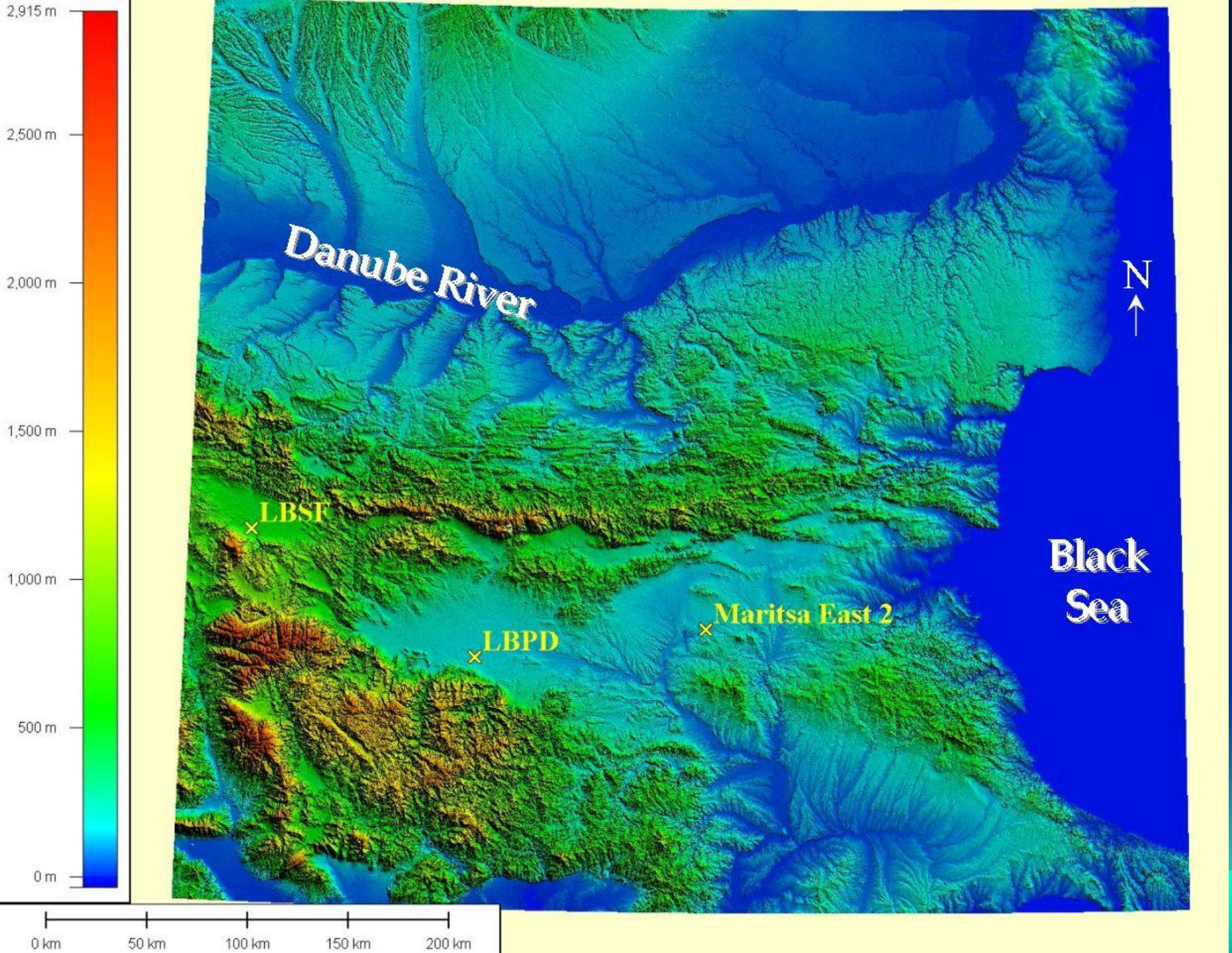
- Visualization of Events
- Accident Reconstruction
  - Short Term Releases
  - Long Term Emissions (unplanned)
- Meteorological Characterization
- Modeling of Transport and Fate of Chemicals (with pre-processing and post-processing: 1; 2)
- Modeling of Adverse Effects

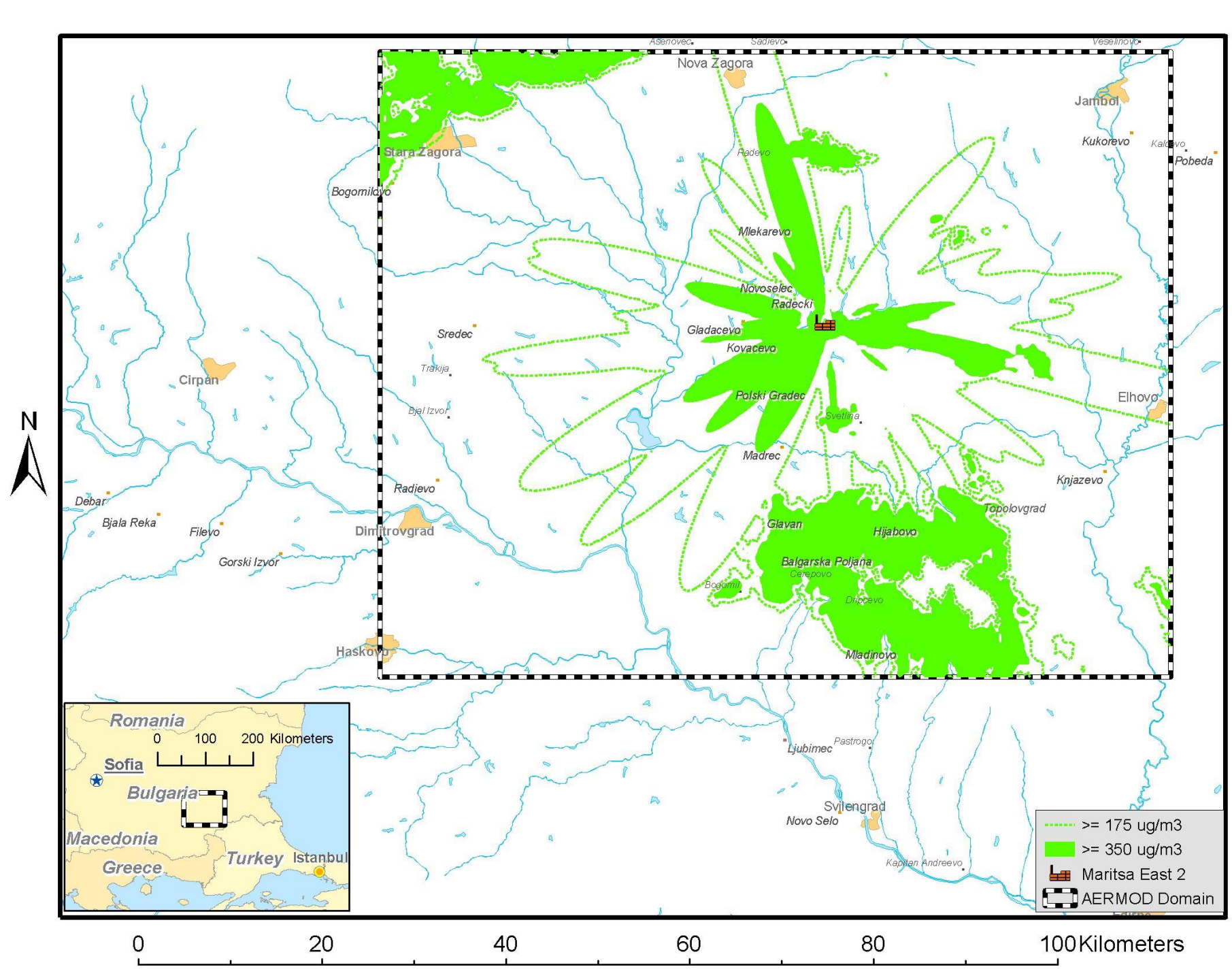
CASE STUDY

Atmospheric Modeling Study of SO2 Emissions from the Maritsa East 2 Thermal Power Plant, Bulgaria

Maritsa East 2 Power Plant and Surrounding Area



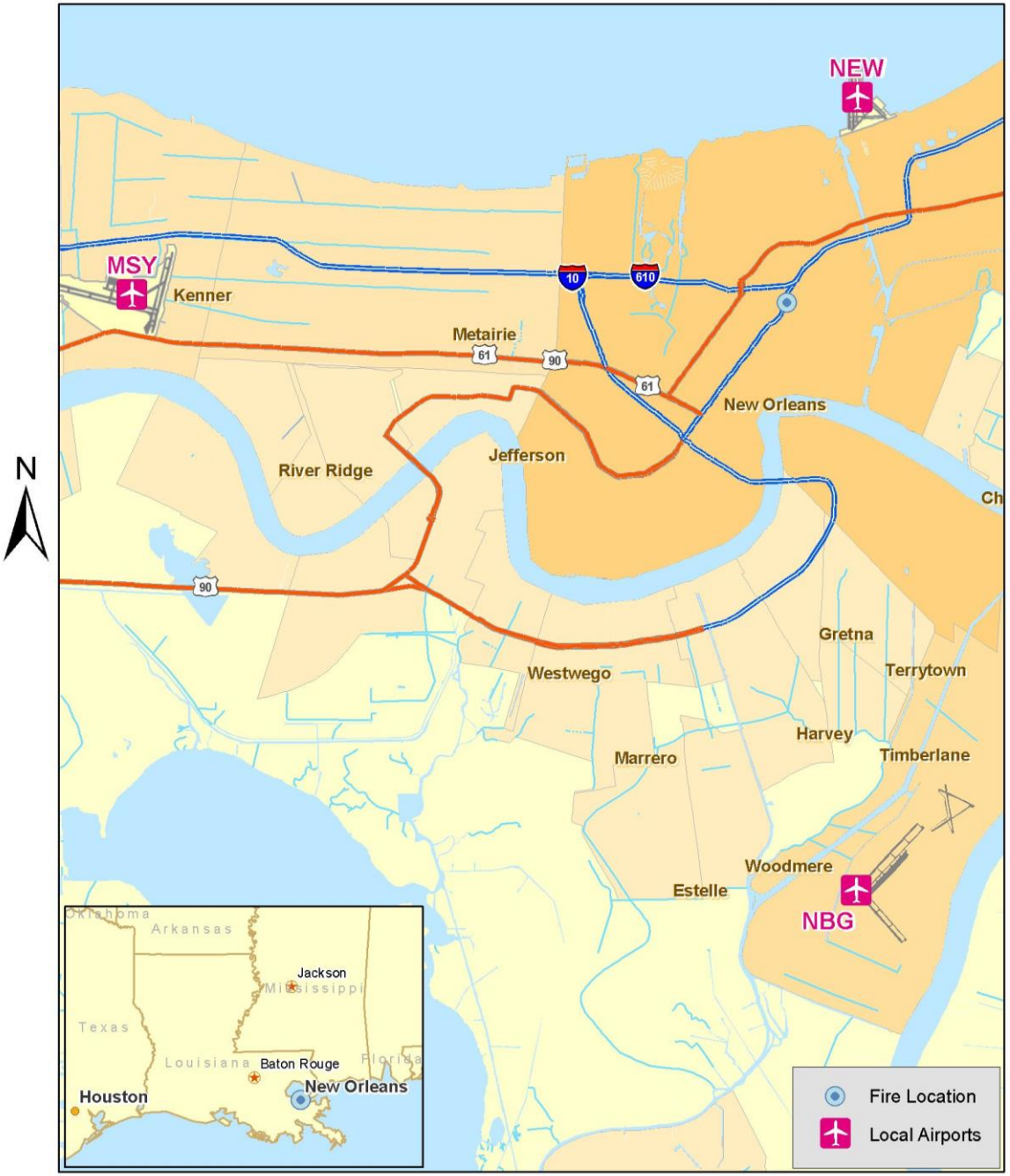

2,915 m
2,500 m
2,000 m
1,500 m
1,000 m
500 m
0 m
Danube River
N
LBSF
LBPD
Maritsa East 2
Black Sea
0 km
50 km
100 km
150 km
200 km


Asenovec
Sadievo
Veselinovo
Nova Zagora
Jambol
Stara Zagora
Kukorevo
Kalchevo
Pobeda
Radevo
Bogomilovo
Mlekarevo
Novoselec
Radecki
Gladacevo
Kovacevo
Sredec
Trakija
Cirpan
Bjal Izvor
Polski Gradec
Svetlina
Elhovo
Madrec
Knjazevo
Radievo
Debar
Topolovgrad
Bjala Reka
Filevo
Dimitrovgrad
Glavan
Hijabovo
Gorski Izvor
Balgarska Poljana
Cerepovo
Bogomil
Dobrevo
Haskovo
Mladinovo
N
Romania
0 100 200 Kilometers
Sofia
Bulgaria
Macedonia
Greece
Turkey
Istanbul
Ljubimec
Pastrogo
Svilengrad
Novo Selo
Kapitan Andreevo
>= 175 ug/m3
>= 350 ug/m3
Maritsa East 2
AERMOD Domain
0 20 40 60 80 100 Kilometers

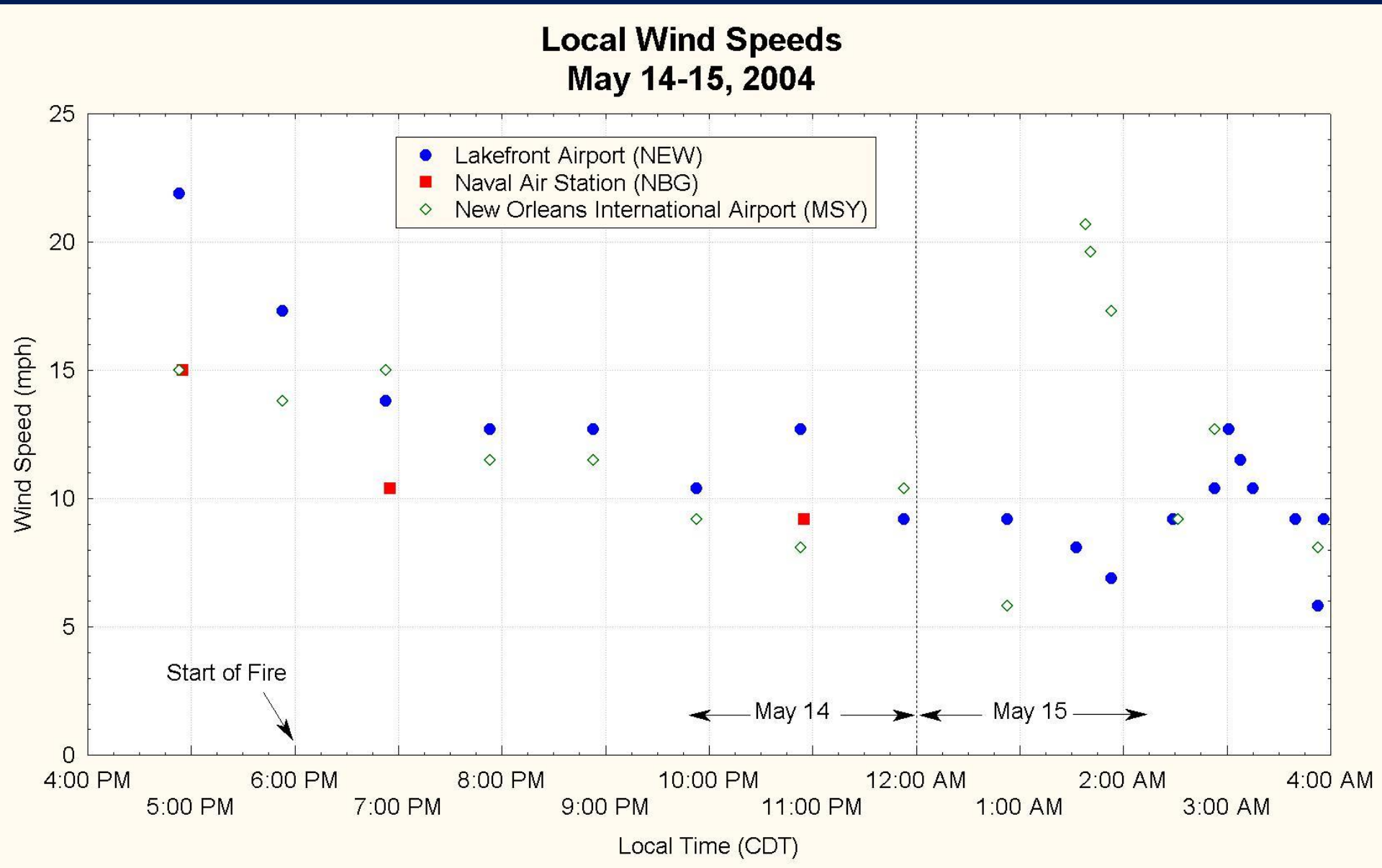
CASE STUDY

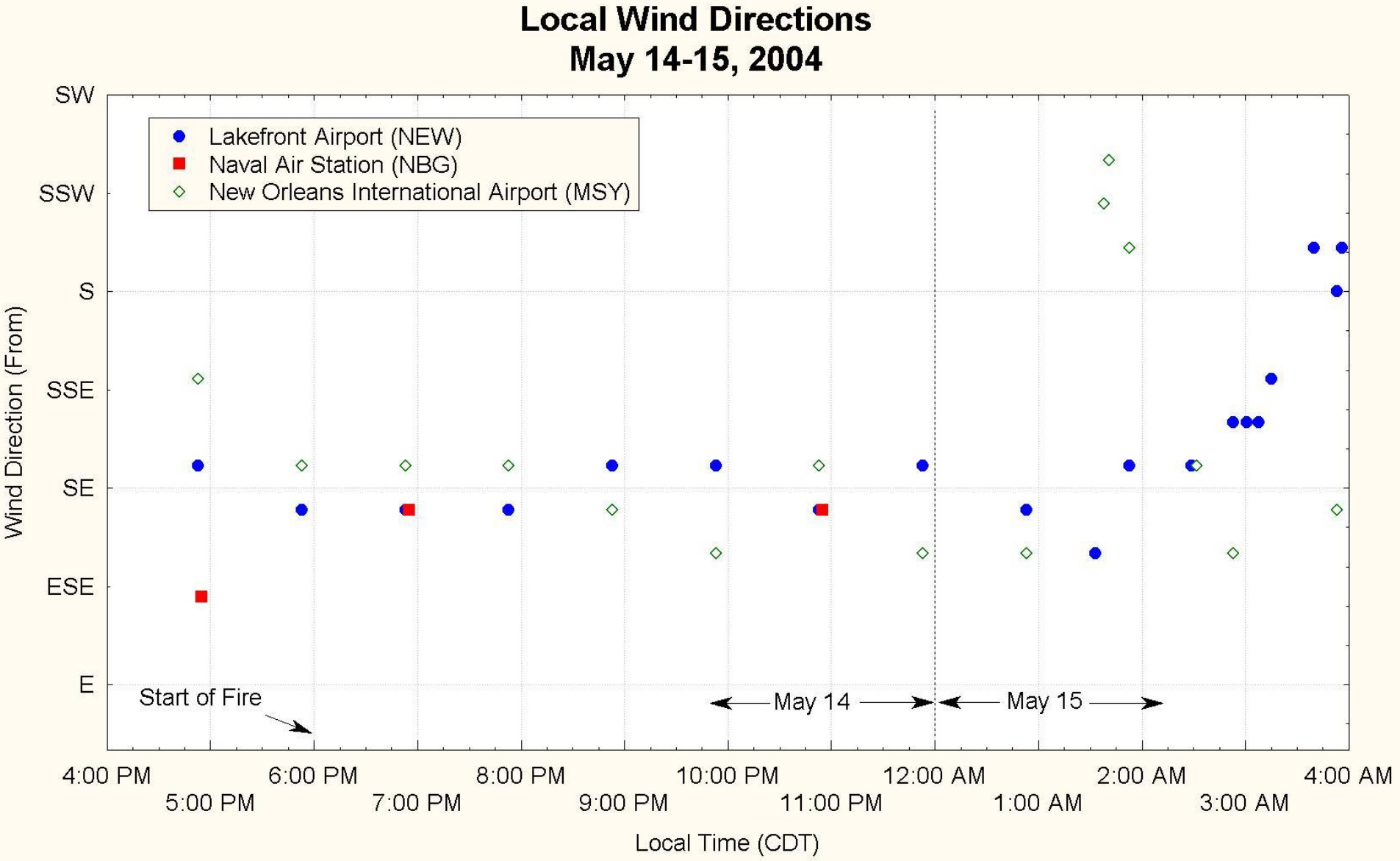
Fire on May 14, 2004 at the facility operated by Advanced Commercial Contracting, Inc. at 2740 Arts Street in New Orleans, Louisiana

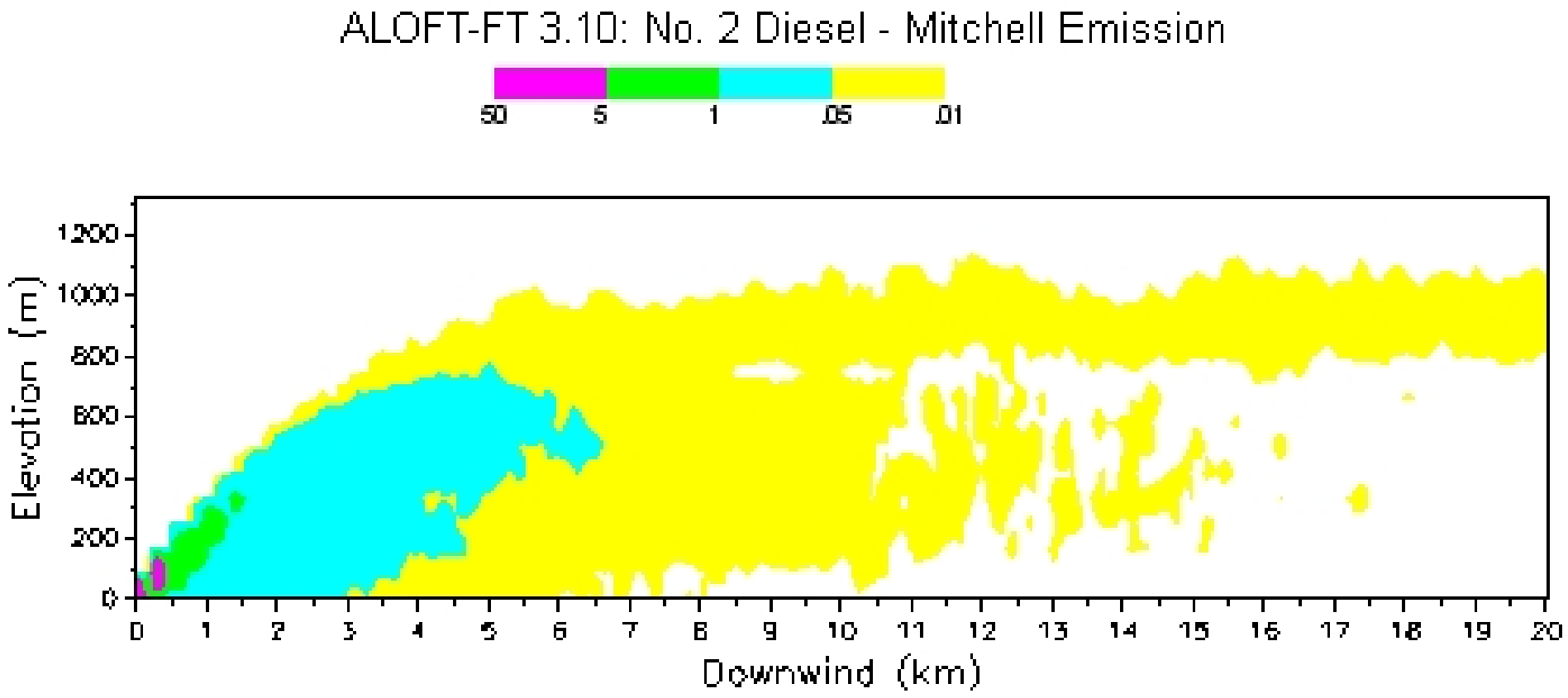
Fire Location and Local Airports



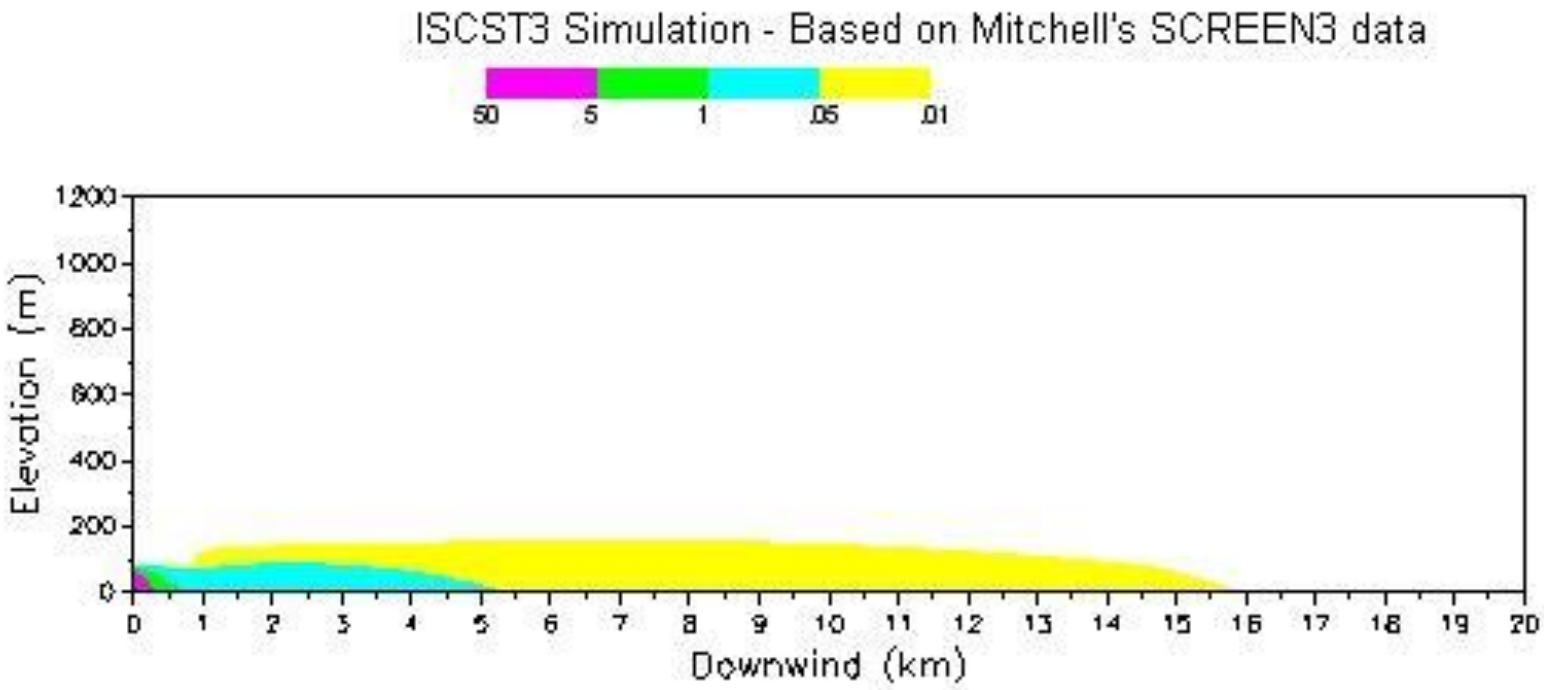
Fire Location


Local Wind Speeds
May 14-15, 2004
Lakefront Airport (NEW)
Naval Air Station (NBG)
New Orleans International Airport (MSY)
Wind Speed (mph)
25
20
15
10
5
0
Start of Fire
May 14
May 15
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
Local Time (CDT)


Local Wind Directions
May 14-15, 2004
Lakefront Airport (NEW)
Naval Air Station (NBG)
New Orleans International Airport (MSY)
Wind Direction (From)
SW
SSW
S
SSE
SE
ESE
E
Start of Fire
May 14
May 15
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
Local Time (CDT)



Ammonia Concentration (ppm - one hr avg) Vertical Plane, 0 m Crosswind



Ammonia Concentration (ppm - one hr avg) Vertical Plane, 0 m Crosswind

ISCST3 Simulated Ammonia Concentrations

ALOFT-FT

- Fire model ALOFT-FT[1] developed by the National Institute of Standards and Technology[2] (NIST), US Department of Commerce.
- ALOFT-FT is capable of simulating the atmospheric dispersion of pollutants released by fires.
- Inputs: the size of the fire, the burning rate, the heat release rate, and the meteorological inputs.
- Emission factors for a chemical of concern[3]
- [1] http://www.fire.nist.gov/aloft/.
- [2] http://www.nist.gov/public_affairs/general2.htm.
- [3] ALOFT-FT uses a computational fluid dynamics algorithm coupled to a Lagrangian particle model to give a realistic picture of downwind hourly average concentrations caused by the fire.

CASE STUDY

TOSCO-CARSON.ppt

CASE STUDY

Chlorine Release of July 20, 2003 at Honeywell International Inc., Baton Rouge, LA

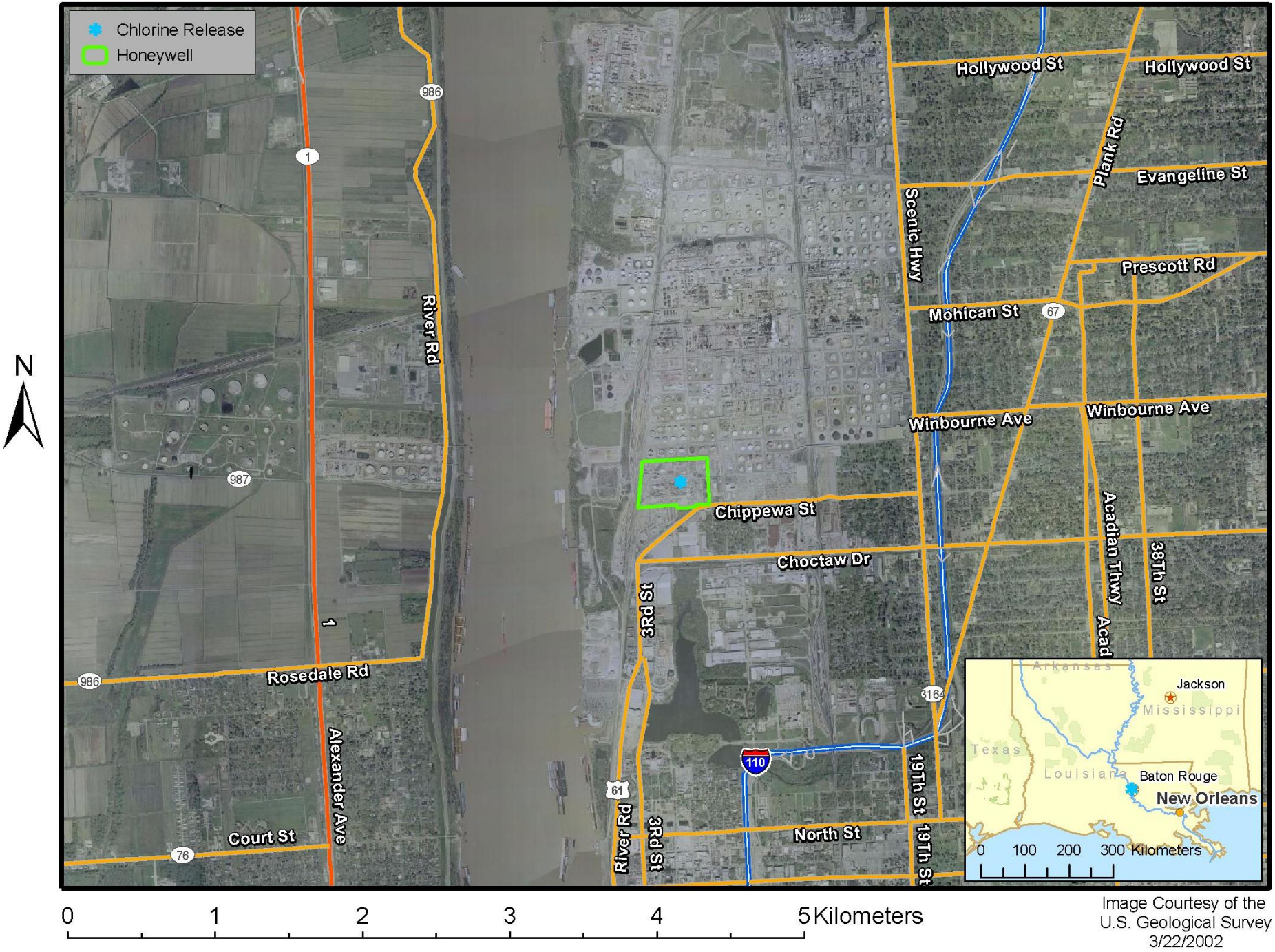
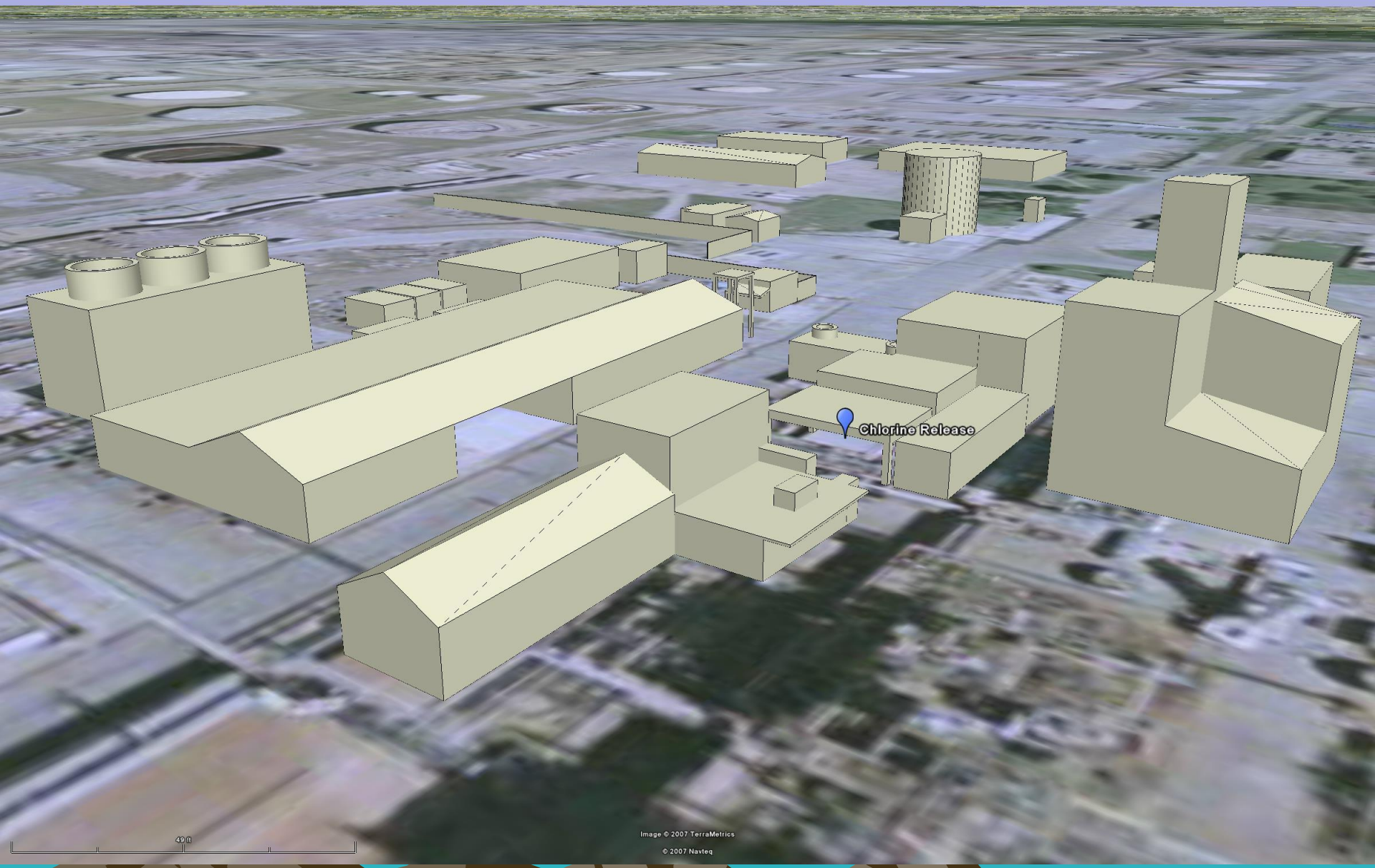
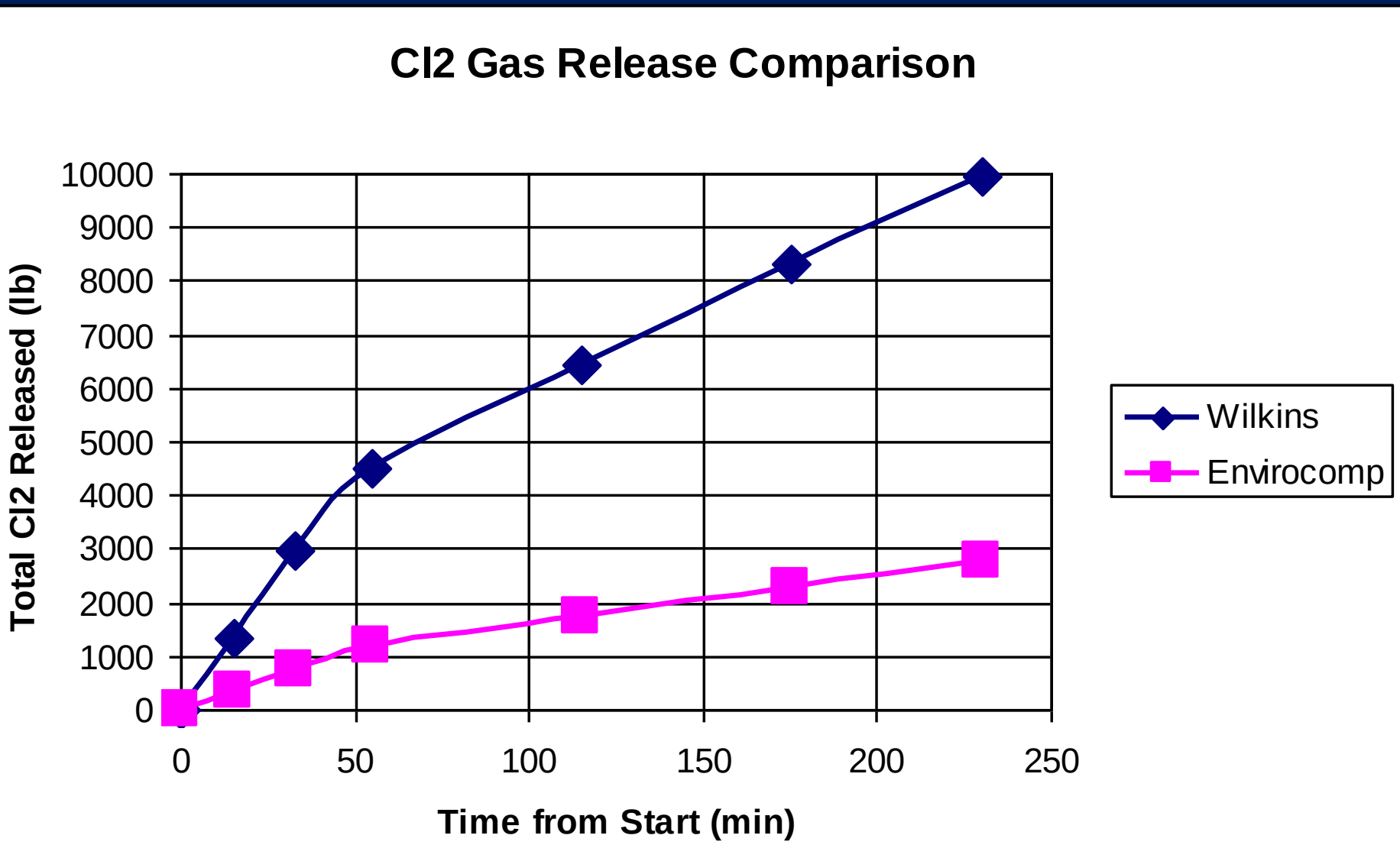


Image Courtesy of the
U.S. Geological Survey
3/22/2002


Chlorine Release
Image © 2007 TerraMetrics
© 2007 Navteq


Cl2 Gas Release Comparison
Total Cl2 Released (lb)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
50
100
150
200
250
Time from Start (min)
Wilkins
Envirocomp

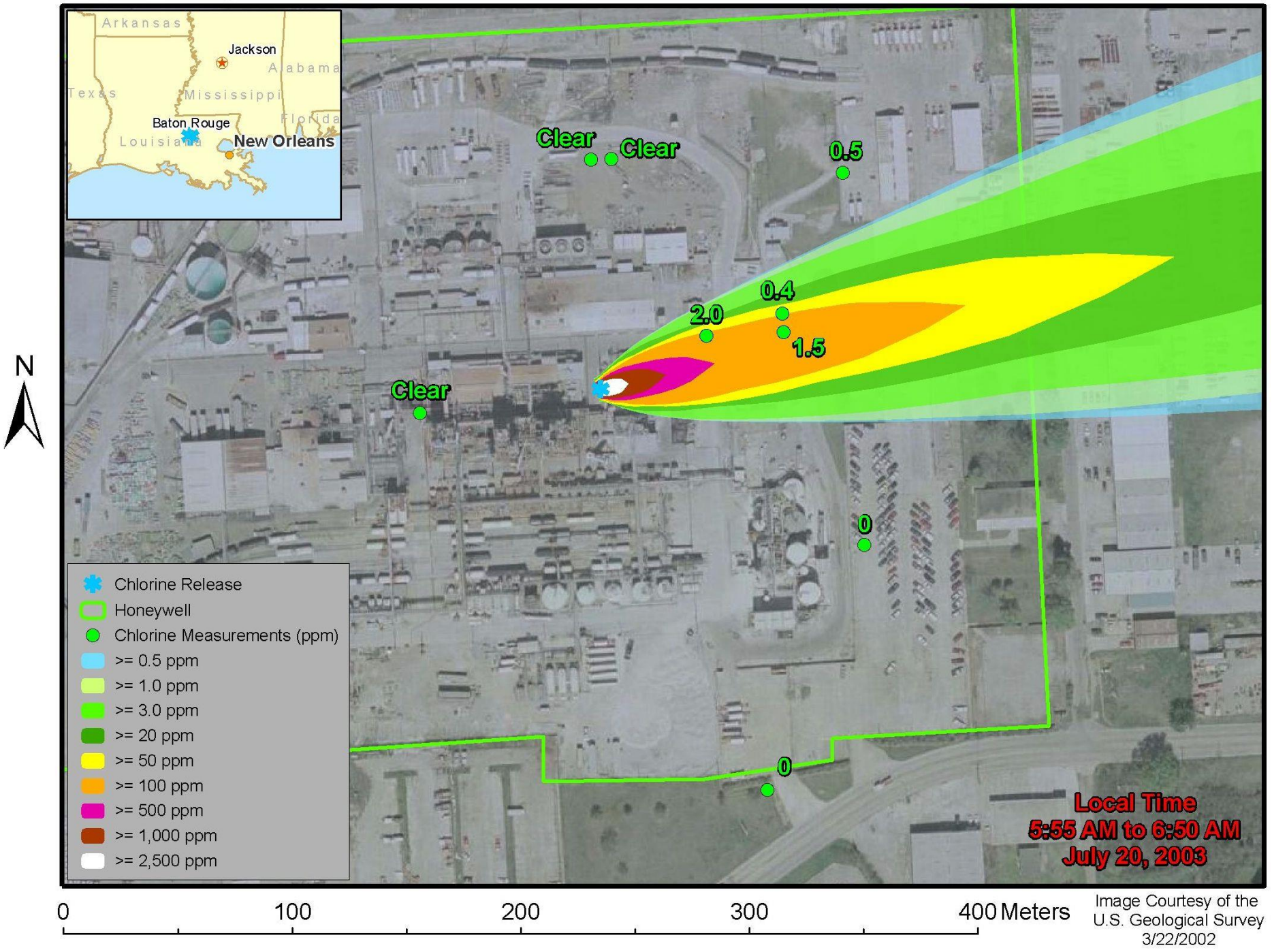
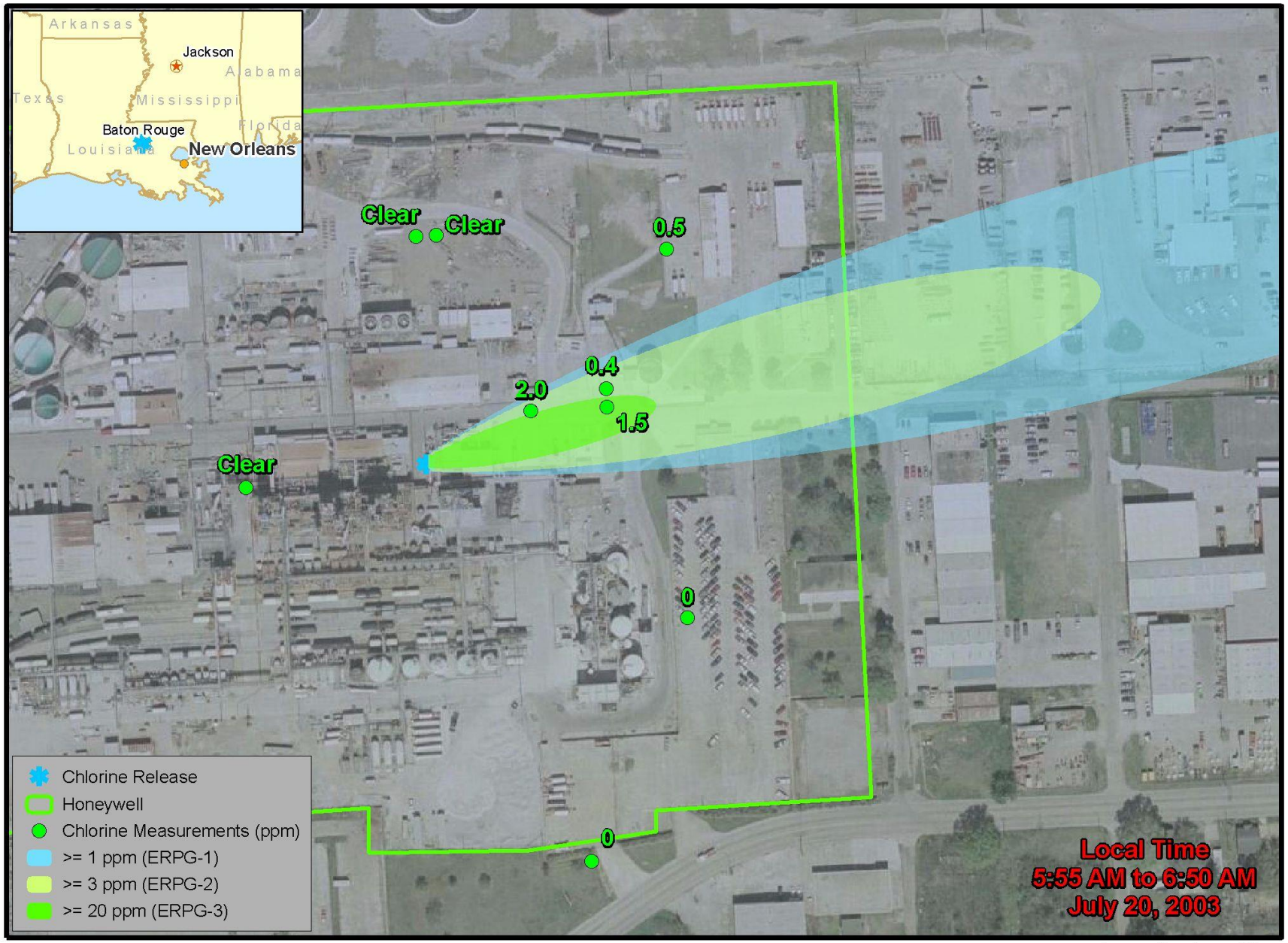


Image Courtesy of the U.S. Geological Survey 3/22/2002

ISCST3 Simulation of Chlorine Release



N

0 100 200 300 400 Meters

Image Courtesy of the U.S. Geological Survey 3/22/2002

Simulations of Release with Chlorine Measurements

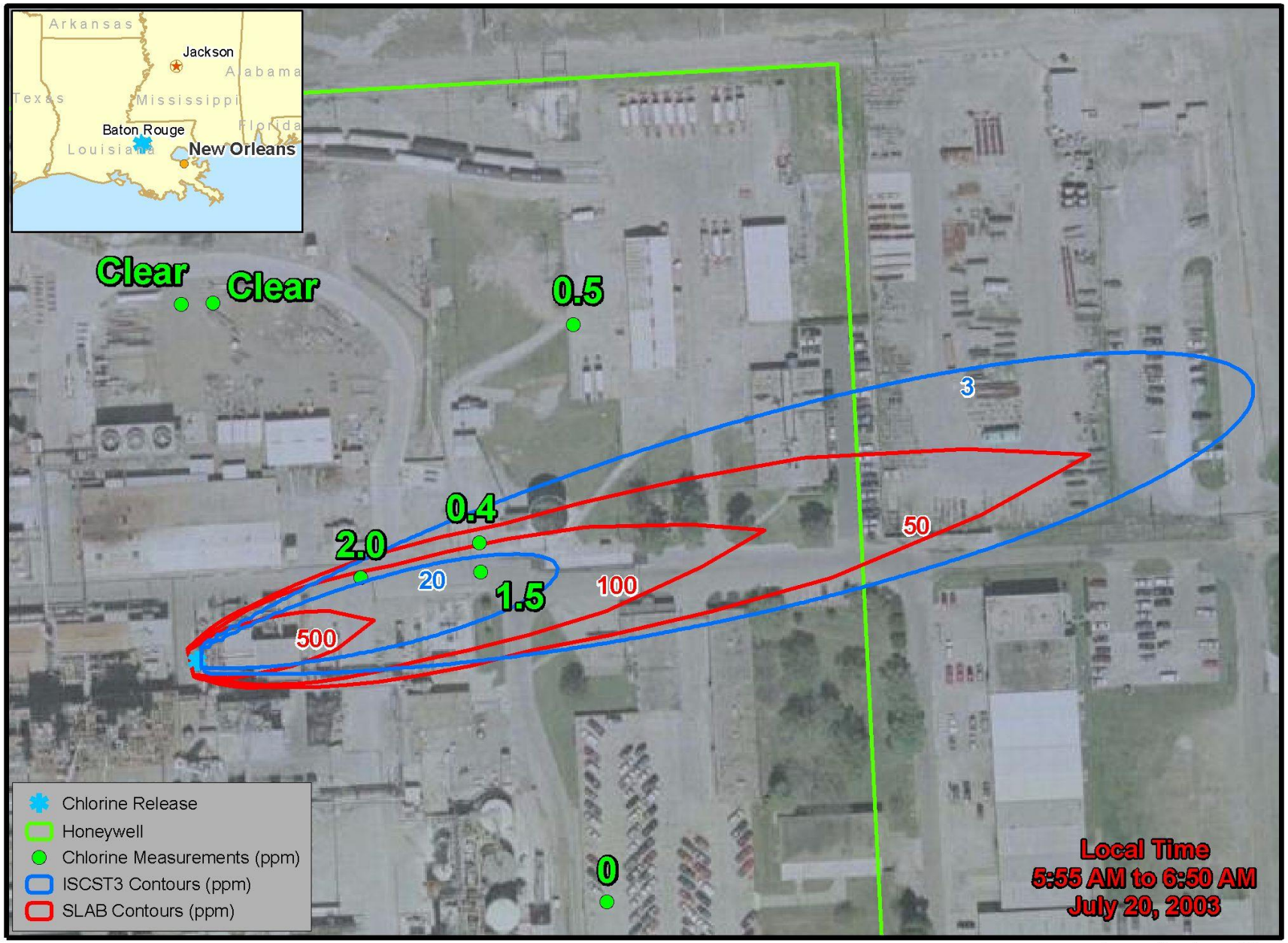


Image Courtesy of the
U.S. Geological Survey
3/22/2002

CASE STUDY

Olivera PZ presentation-EXHIBIT-FINAL.lnk

AgDRIFT UserManual_reg.lnk

CASE STUDY

Biolab summary 11-2006.lnk

Biolab\Biolab_Aug2007_DRAFT.ppt

CASE STUDY

RubioIncident_906.lnk

Discussion

- What is the prospect for similar work in emerging countries like Syria?
- What is the prospect for environmental consulting using state-of-the-art software tools like in the US?
- Will consulting work be “delegated” from the US and Europe throughout the world in the near future?
- If so, what can the developing world do to be ready to take full advantage of the opportunity?

Thank you!

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