Using GIS to Visualize and Analyze Sensor Data

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Making Sense of Sensors

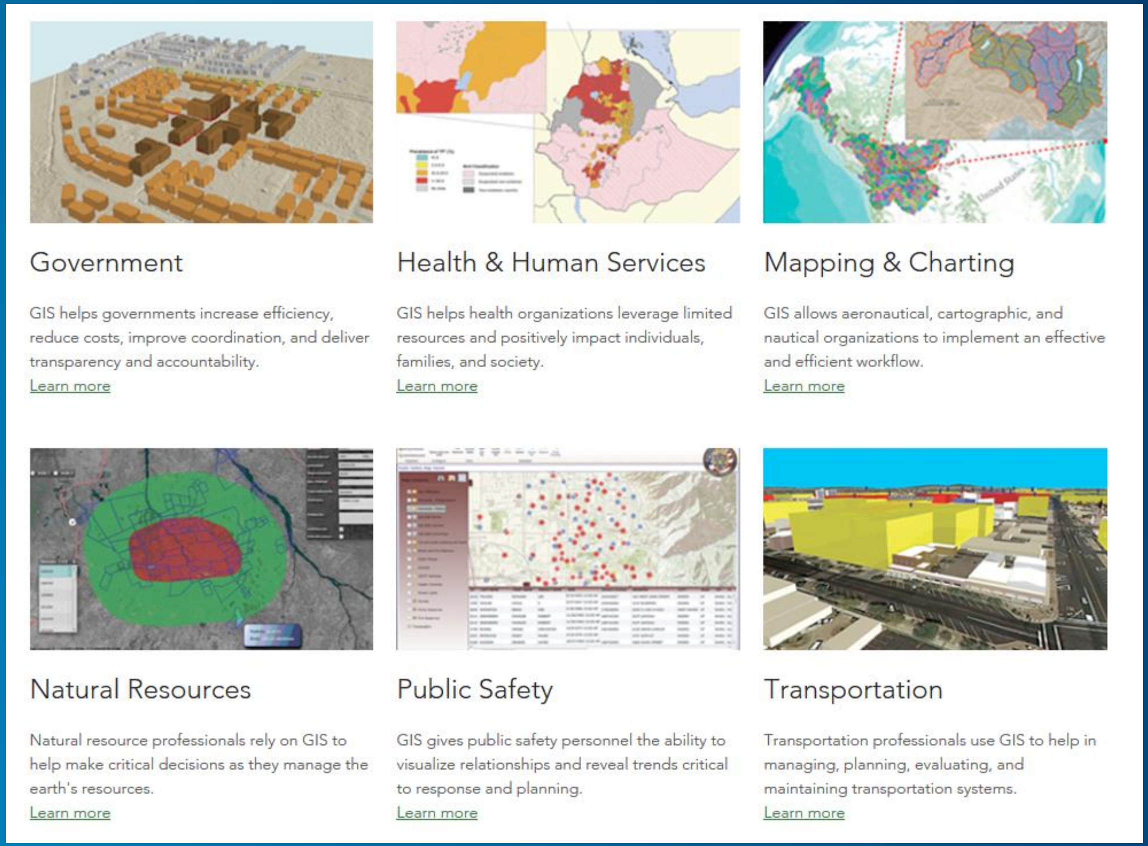
South Coast AQMD

Agenda

- What is GIS
- Example workflow: analyze asthma rates
- Example workflow: near real time sensor analytics

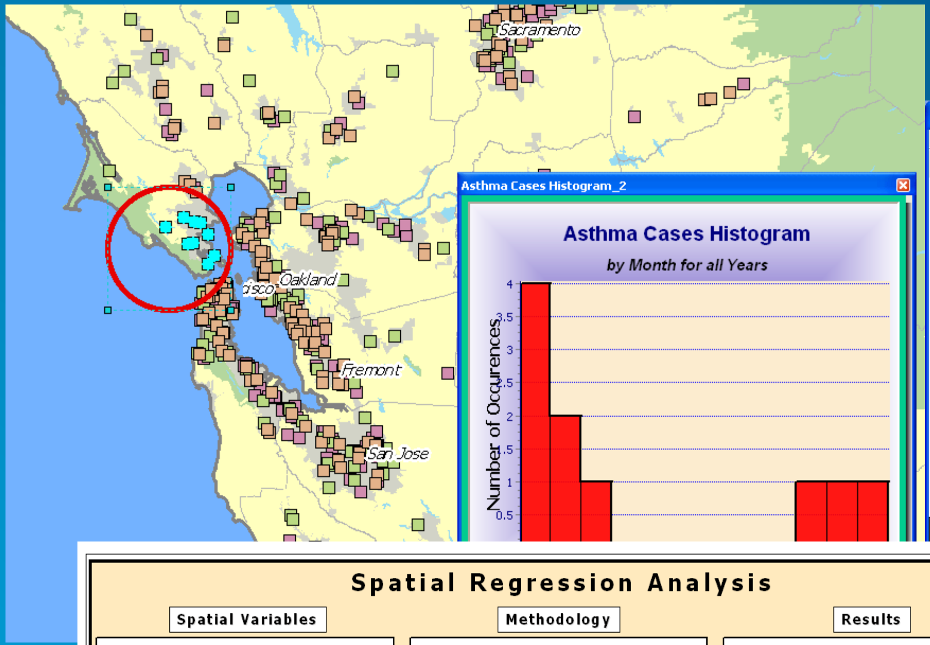
What is GIS

- “In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system.” ~ USGS
- http://www.esri.com/what-is-gis

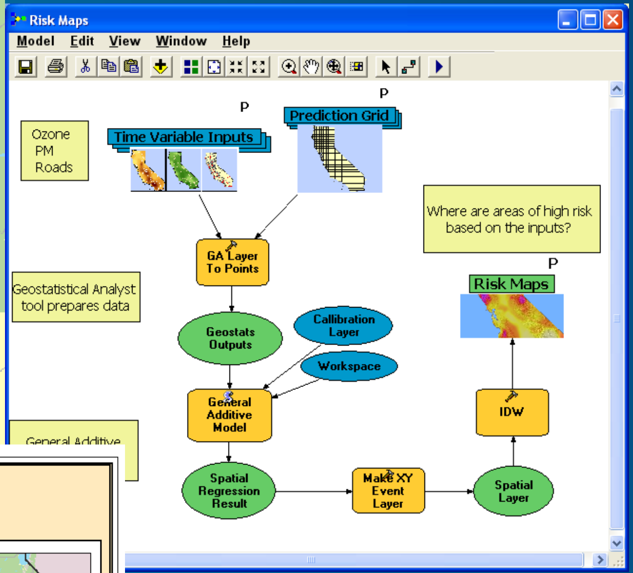


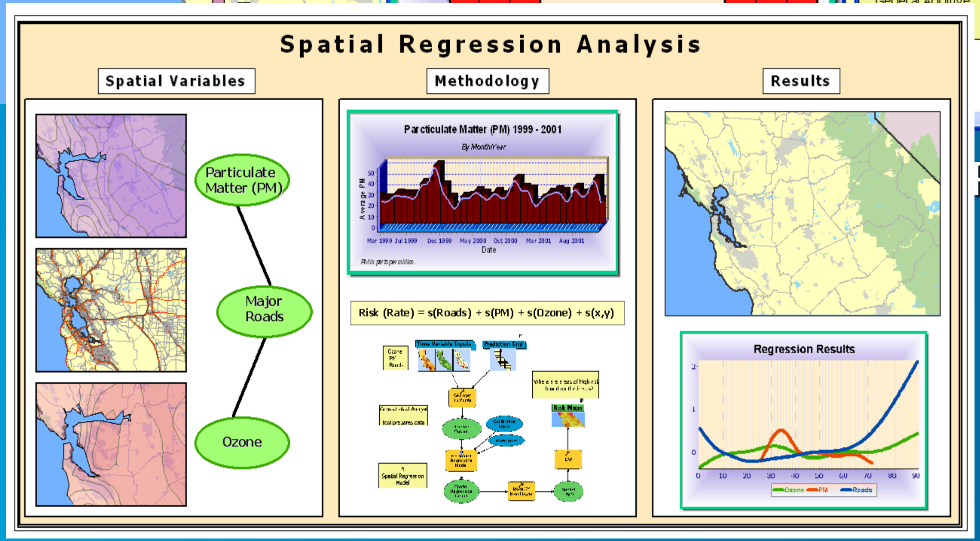
Example workflow: Asthma Analysis

Visualization



Spatial Data Exploration





Risk Analysis

Asthma Study: Methodology

- ESDA of asthma deaths point data (1999-2001)
- Obtain zip code population rates
- Calculate asthma death rate for zip codes
- Assign road density values to California zip codes
- Explore effects of criteria pollutants, age, month of death, proximity to roads, and density of roads on asthma deaths (in R)
- Create ozone and pm surfaces (1995-2004)
- Create spatial regression based on parameters that appear to predict asthma rates the best
  - Distance to roads, ozone, pm, and (x,y)

Asthma Study: Methodology

Roads

{x,y}

Criteria Pollutants

Age

Seasonality

Ozone

x-coord

Major Roads

Particulate Matter

Spatial Statistics

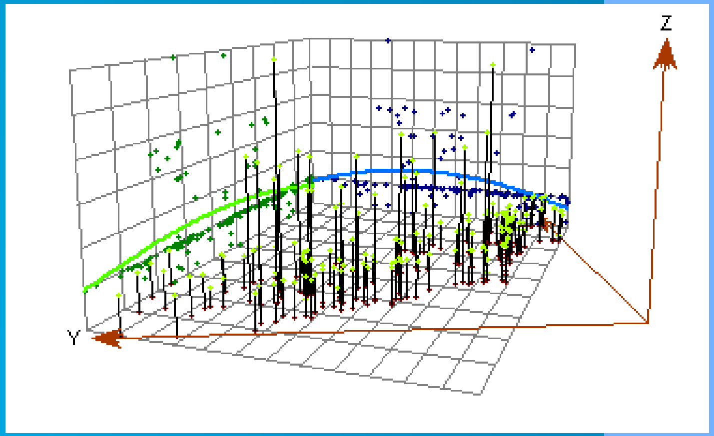
- Geostatistical (continuous)
  - Geostatistical Analyst extension to ArcGIS
- Point pattern (non-continuous)
  - No tools in ArcGIS
  - use external statistical packages
- Lattice data (polygonal)
  - coming in future release of Geostatistical Analyst

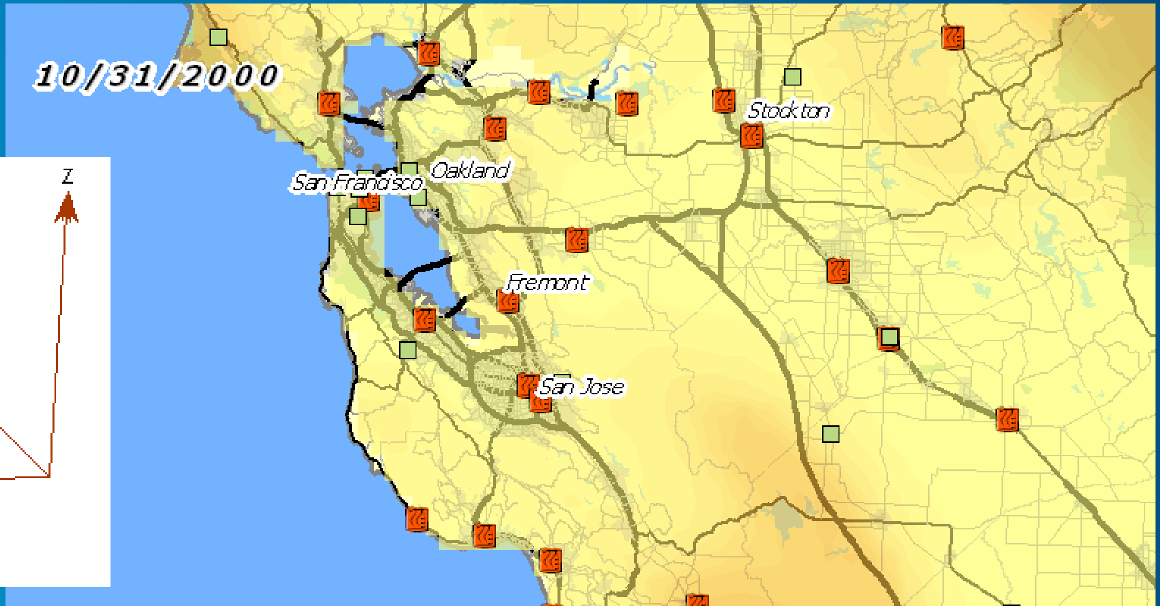
Regression Analysis

- Asthma data are point-pattern data
  - cannot use geostatistics
- Have to use external package
  - ArcGIS integration through geoprocessing framework
- We used R
  - can use other software
- We used GAM (general additive model)
  - use expert opinion to choose appropriate package

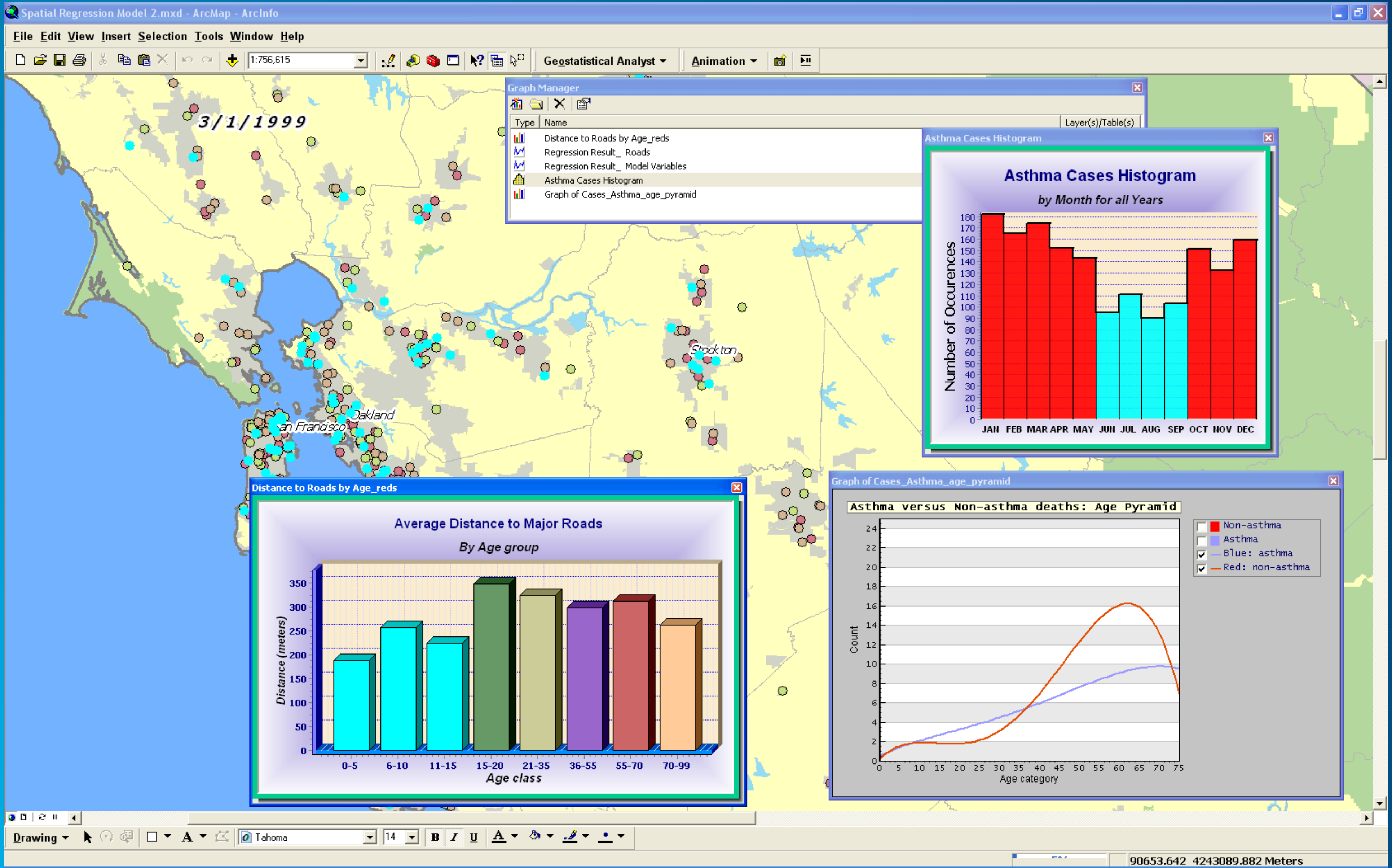
Asthma Study: The Data

- Two asthma datasets used
  - 3-year address data (1999-2001)
  - 10-year zip-level data (1995-2004)
- Ozone and PM data (1995-2004)
- Road density surface created from StreetMap data (2004)

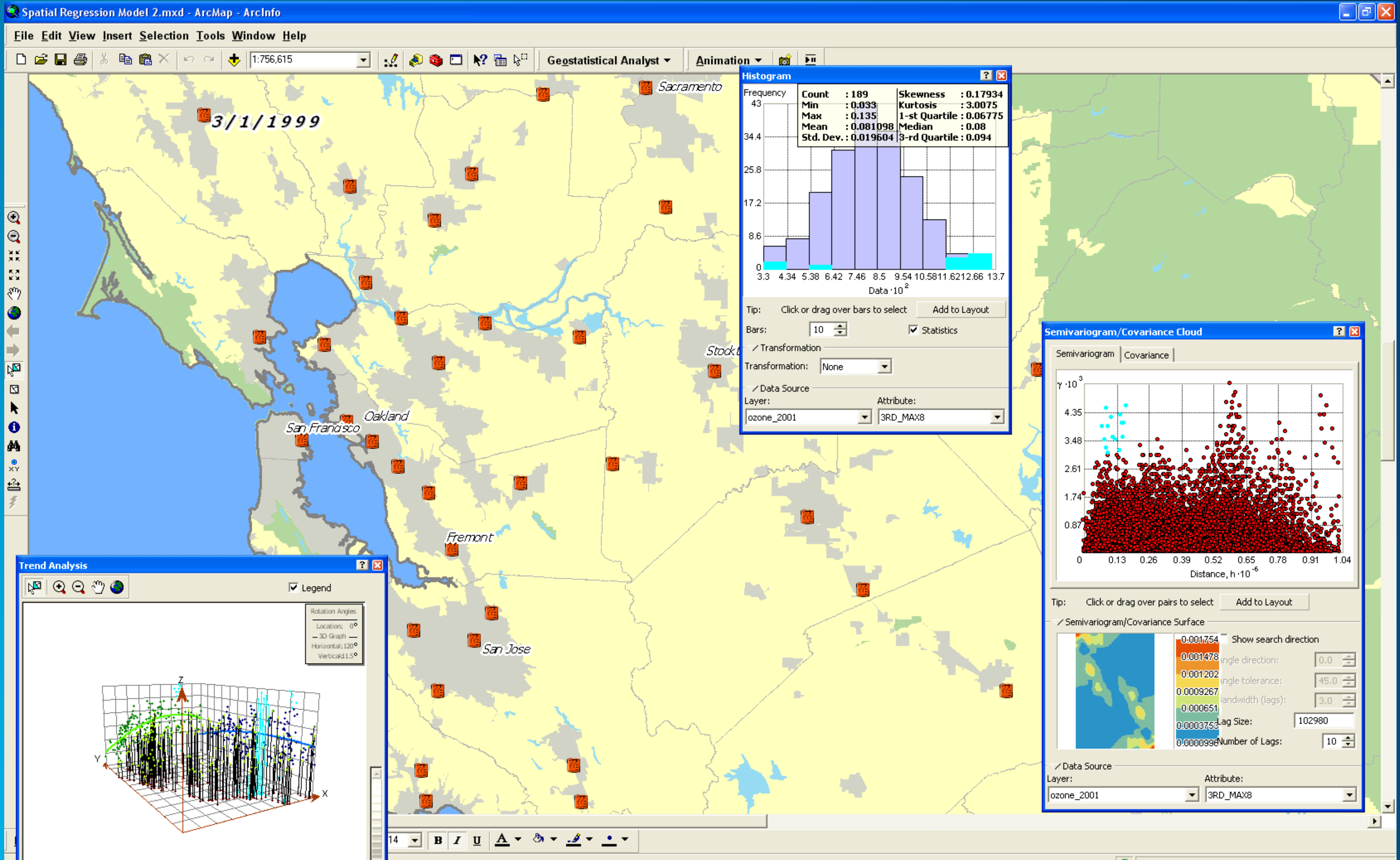




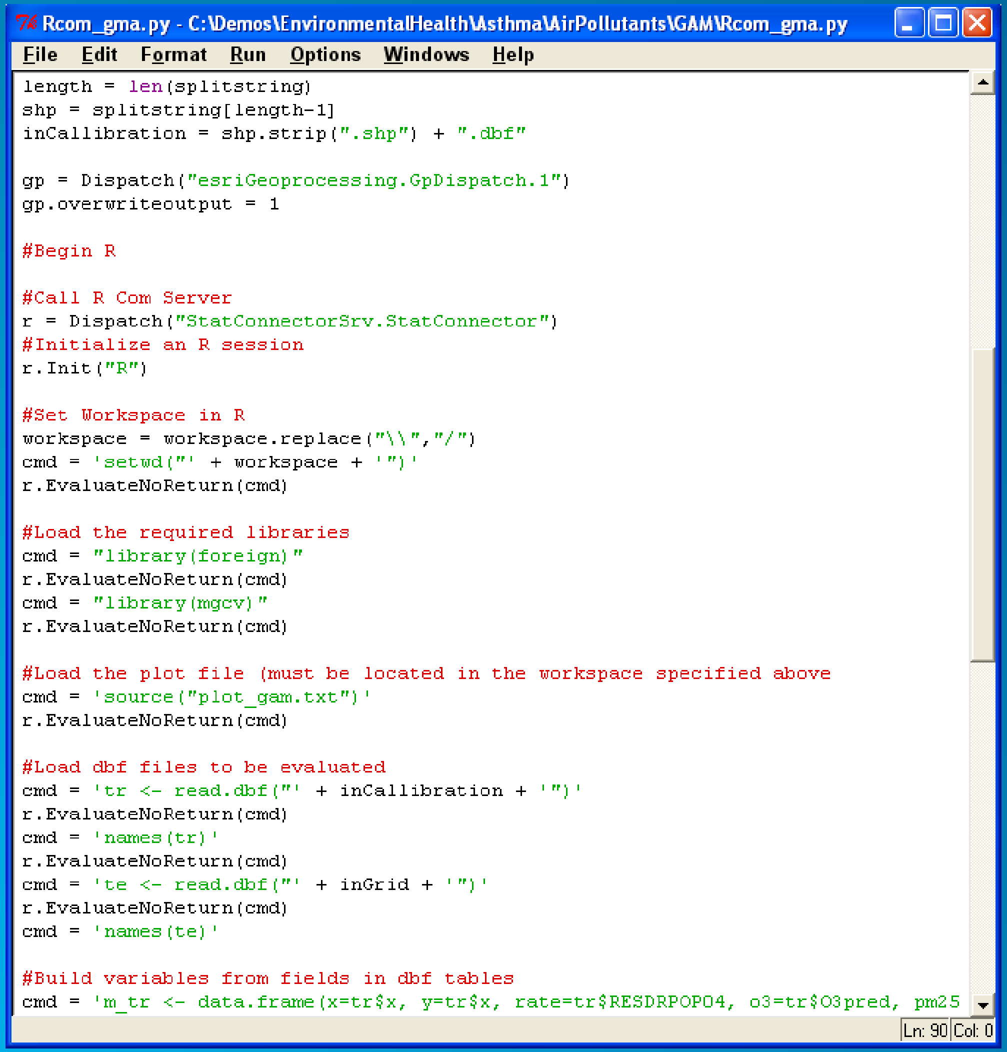
Exploratory Spatial Data Analysis

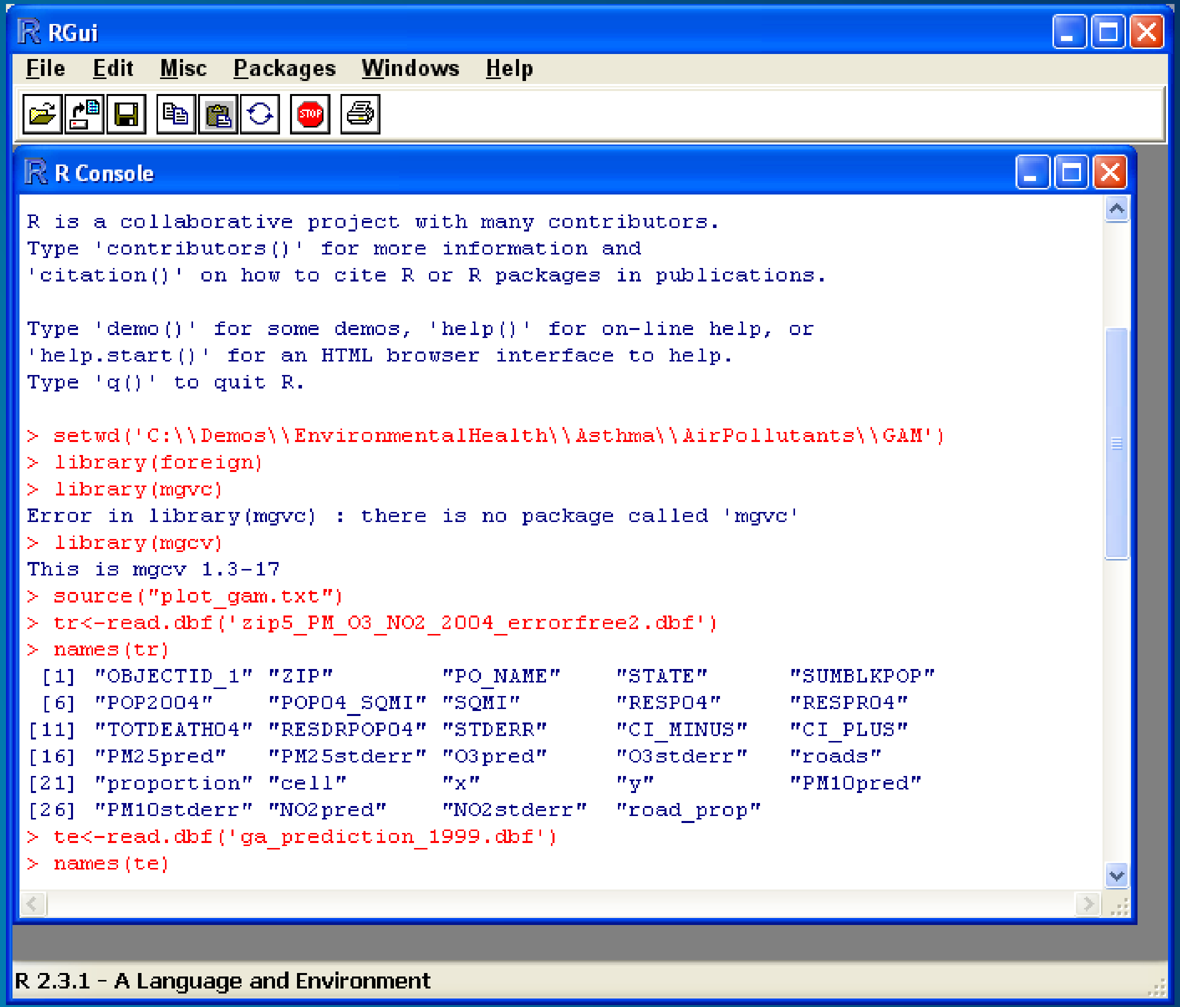


Data over time

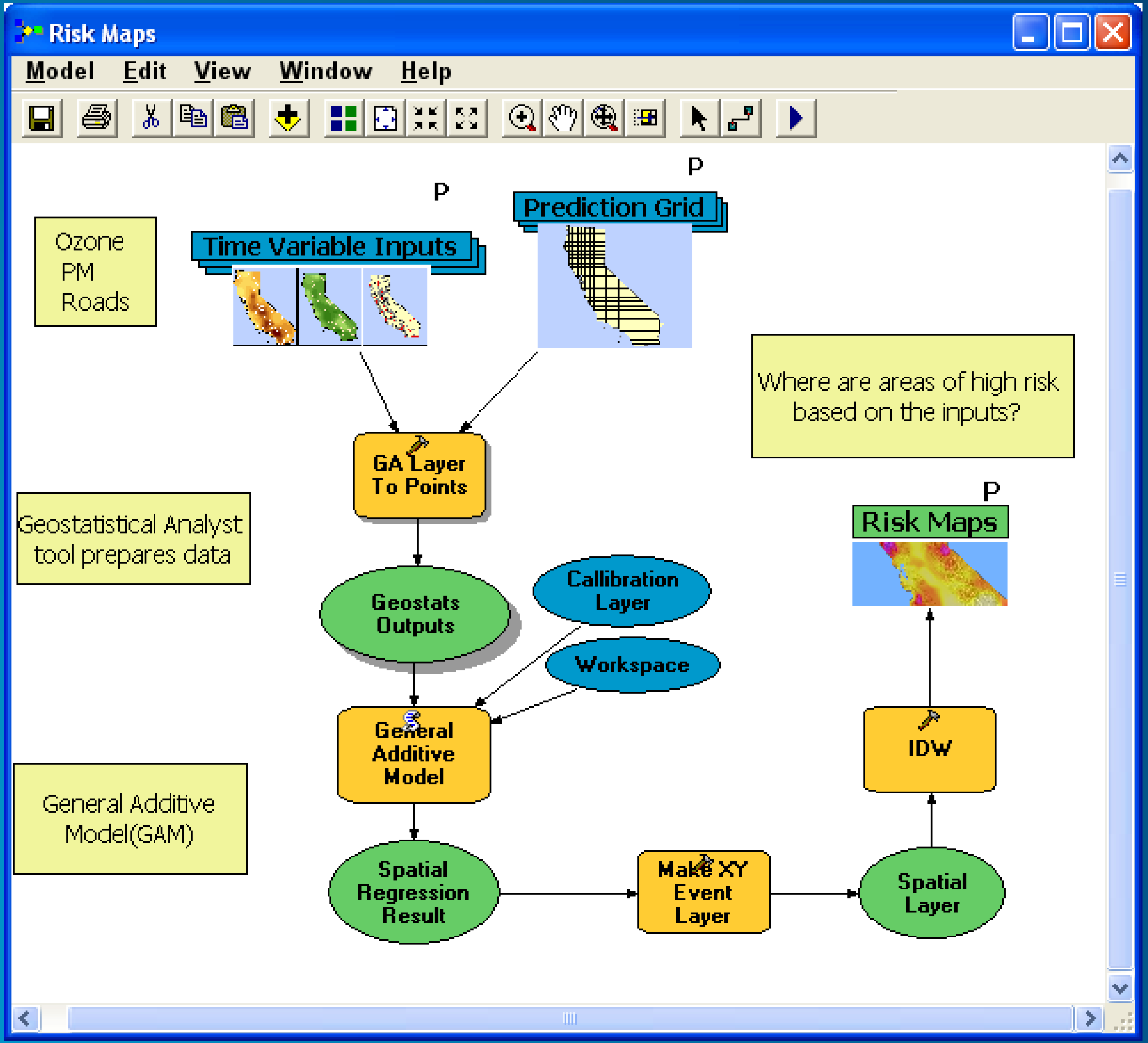


Regression Analysis - R





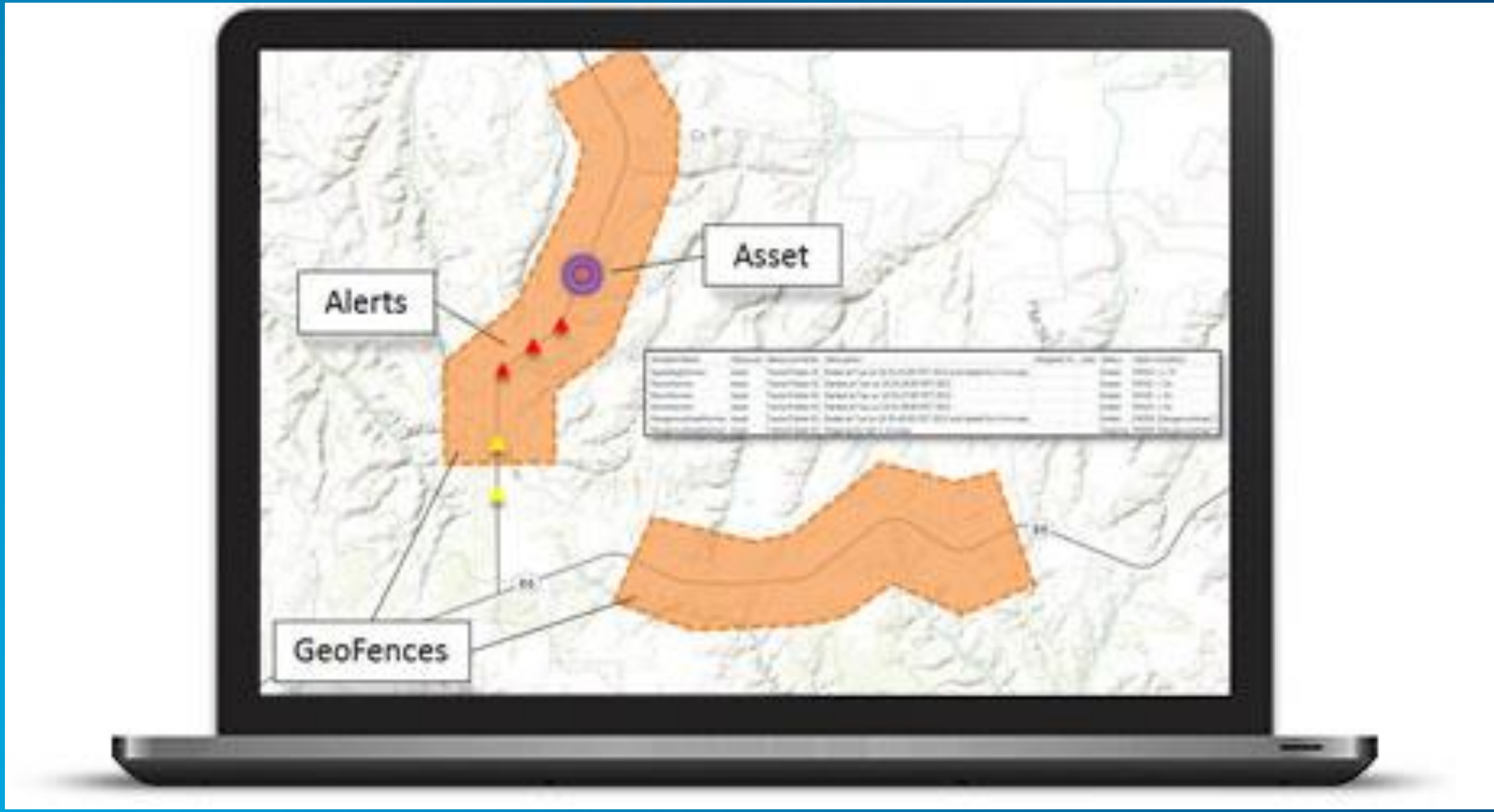
Risk Model



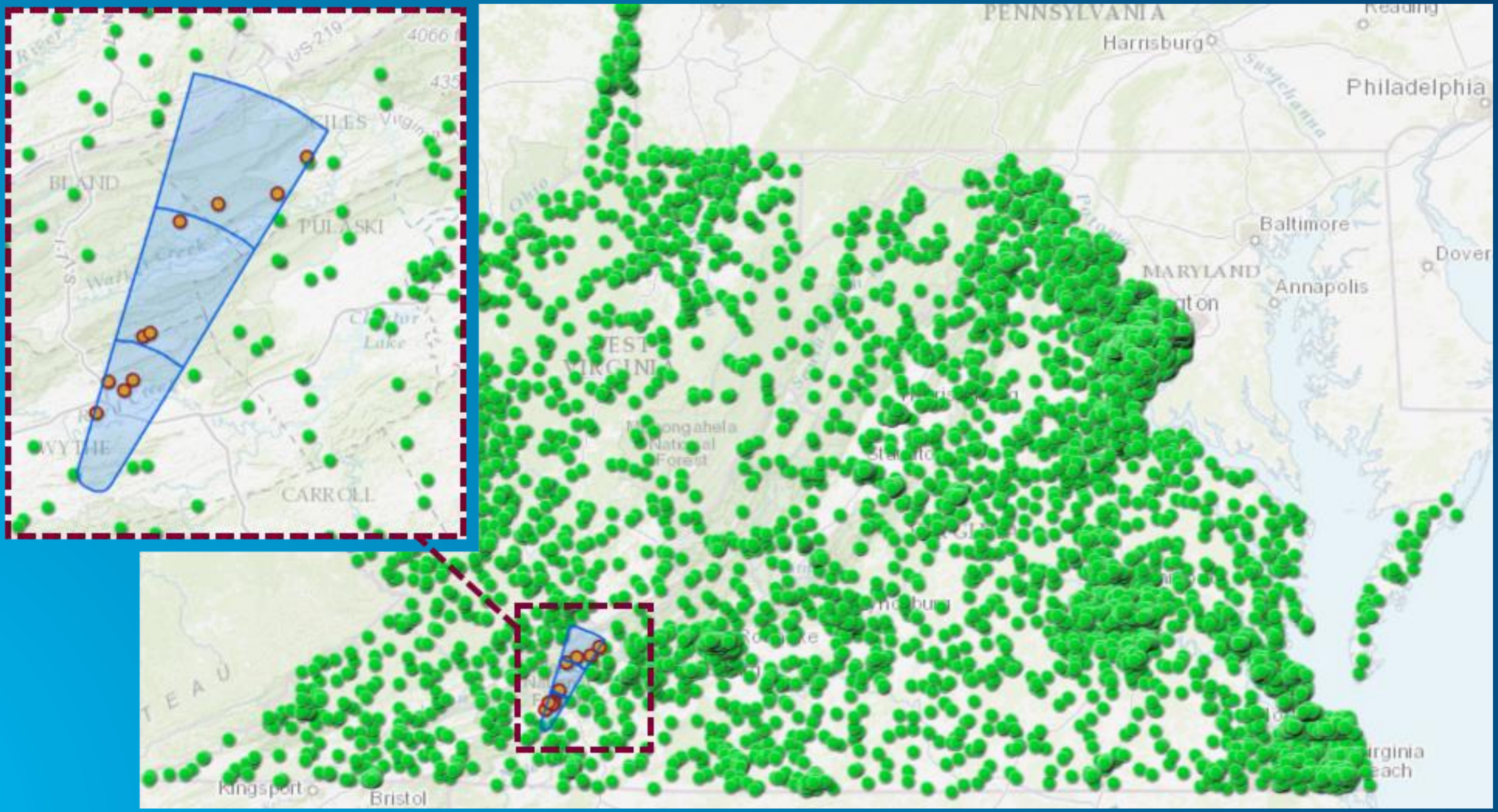
Risk Maps
Model Edit View Window Help
Ozone
PM
Roads
P
Time Variable Inputs
P
Prediction Grid
Where are areas of high risk based on the inputs?
GA Layer To Points
Geostatistical Analyst tool prepares data
P
Risk Maps
Geostats Outputs
Callibration Layer
Workspace
General Additive Model
IDW
General Additive Model(GAM)
Spatial Regression Result
Make XY Event Layer
Spatial Layer

Real time GIS

Alerts when equipment enters or leaves an an area



Example workflow: identify assets in storm's path



Questions?

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