Matt Polster – GIS II

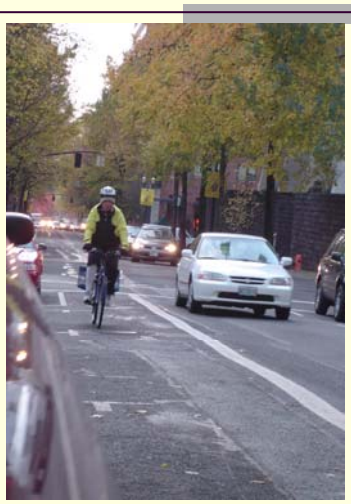
Bicycle Commuter Exposure to Pollution

A Linear Interpolation

6/8/2005

Intro - Background of Study

- Origin: Class project for Research-Based Learning I
- Objective: To design and carry out an experiment to investigate a novel question
- Outcome: A study of bicycle commuter exposure to pollution (PM 2.5) during the morning rush hour



Intro – Health Importance

- Small particles pose health risks because they penetrate the lower regions of the lung and may enter circulation
- Long-term studies show association between air pollution and decline in lung function
- Exposure to traffic correlates with the onset of myocardial infarction in those who are at risk
- Exercising exacerbates health risks due to increased breathing rate

The Data

- ~~Water level data and trail locations from Jackson Bottom Wetland Preserve~~
- ~~10m DEMs of Hillsboro area~~
- PM 2.5 concentrations collected at points along a route
- Portland street map created from RLIS

Two Maxims for Data Acquisition

- If you want to get data from someone else, it will be necessary to pester them for a long time in a variety of ways.
- Sometimes it is better to ask a question for which you have data to answer than it is to try to get data to answer a question you want to ask.

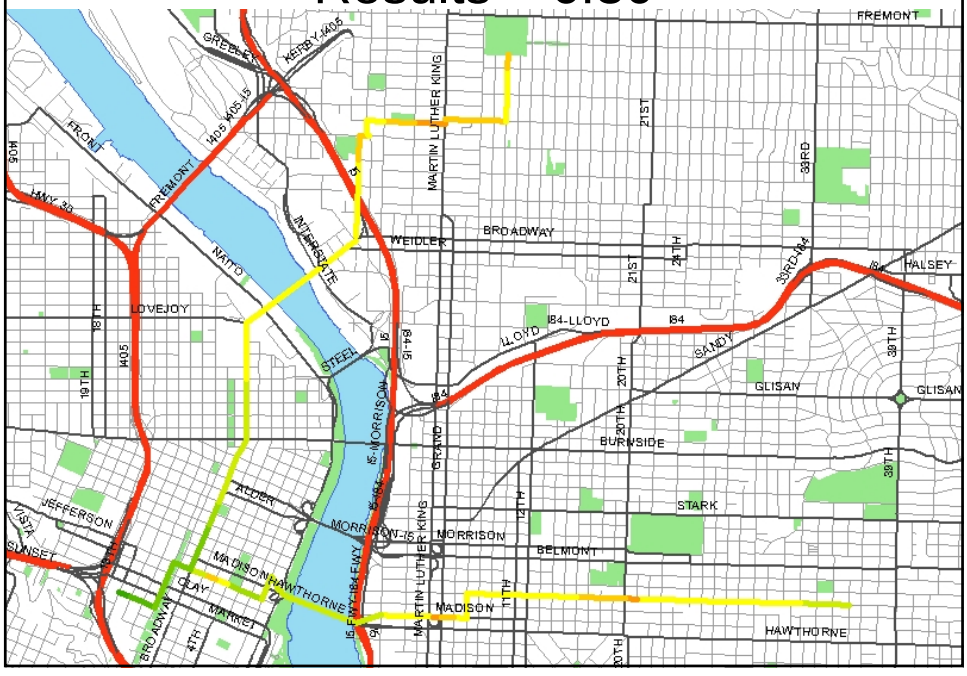
Data collection method

- Point data for PM2.5 concentration recorded every 5 seconds on bicycle traveling down route
- Route measures taken 4 times hourly beginning at 6:30 am
- Performed on an overcast day in November last Fall

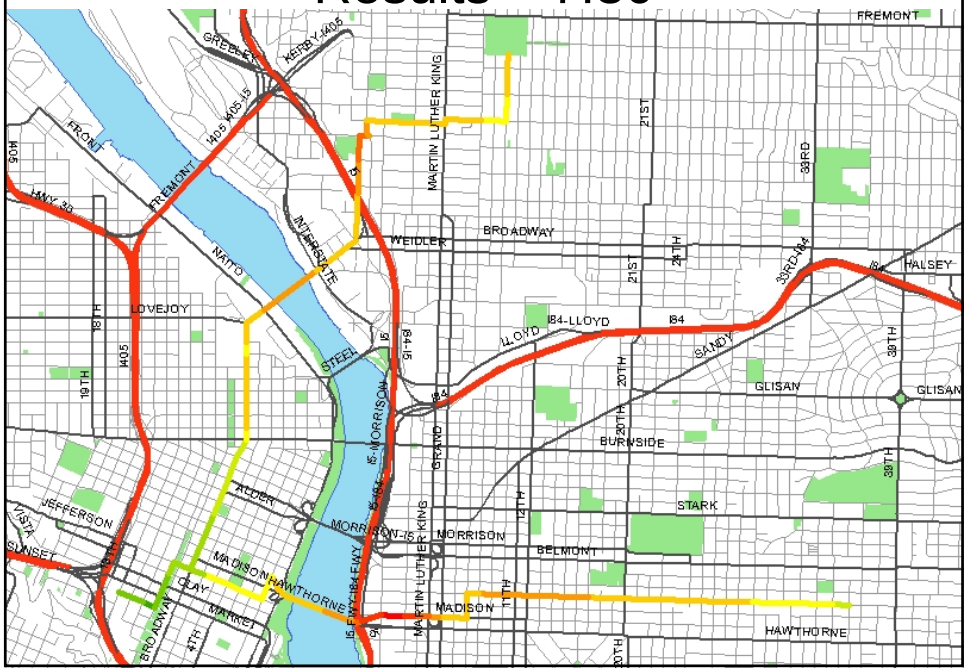
Prior GIS analysis

- PM2.5 concentrations mapped for each run individually
- Values displayed as the average for each street section from intersection to intersection
- Visualized changes throughout the morning commute

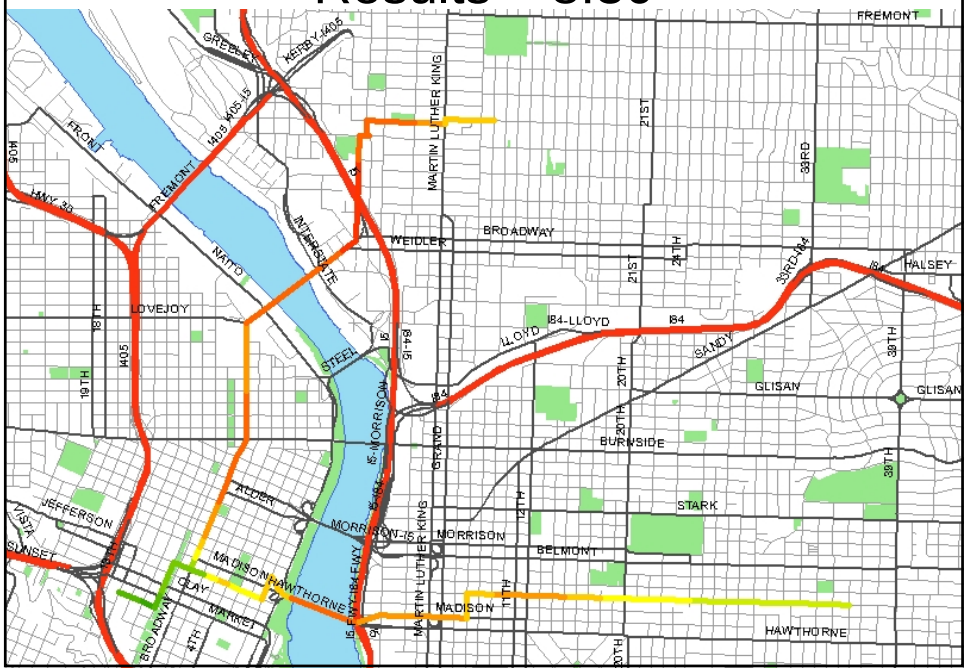
Results – 6:30



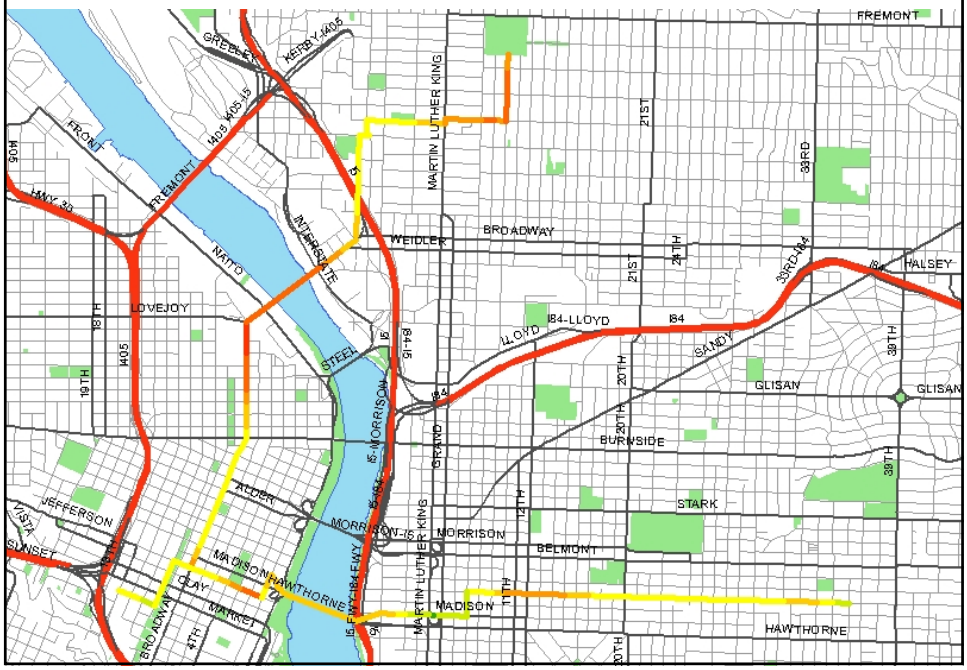
Results – 7:30



Results – 8:30



Results – 9:30



New GIS Question

How can I determine the average exposure for all four trials at any given point along the route?

Challenges Presented by Data

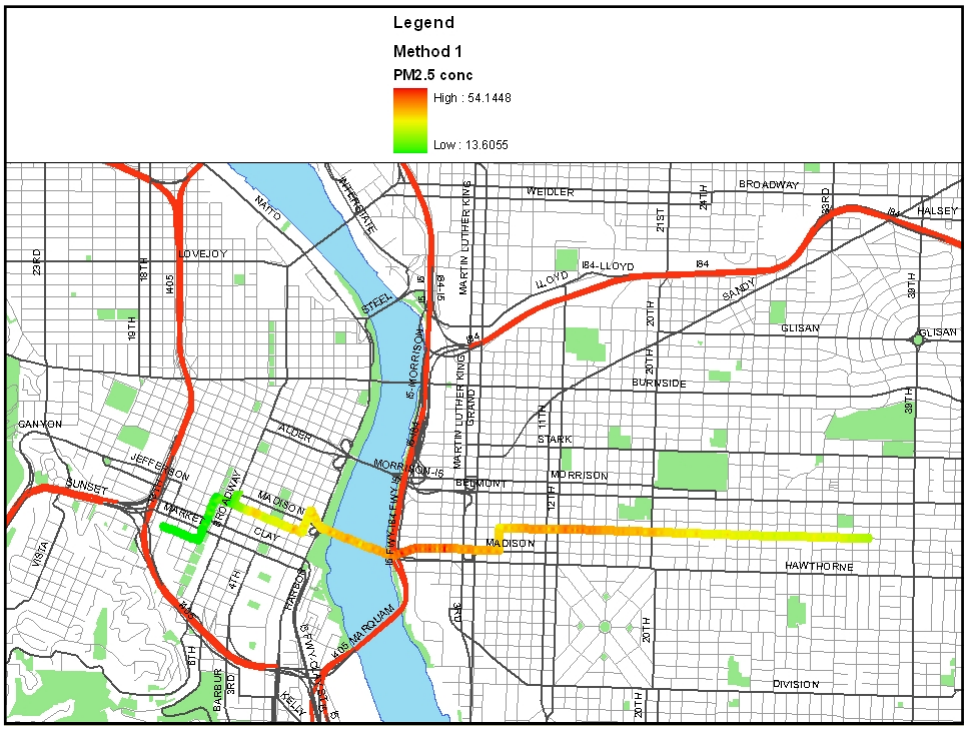
- Spatial autocorrelation is very high within runs but near values may differ widely between runs
- Many data points stack on top of each other
  - Within runs when bicyclist is stopped
  - Between runs when measurements were taken at the same point
- Trying to interpolate to a line instead of a surface

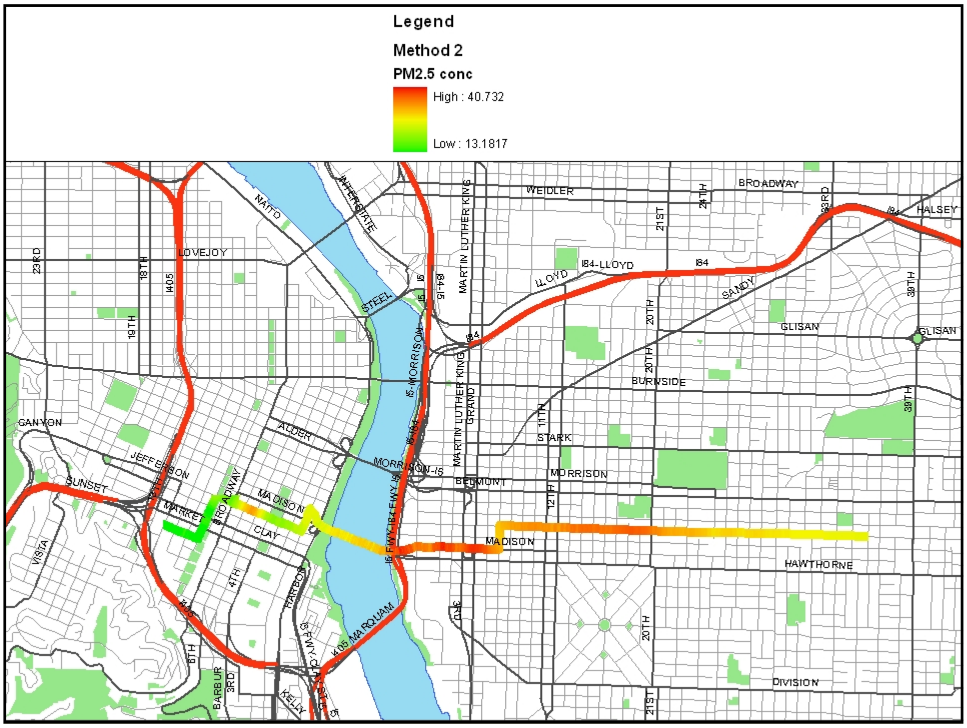
Methods

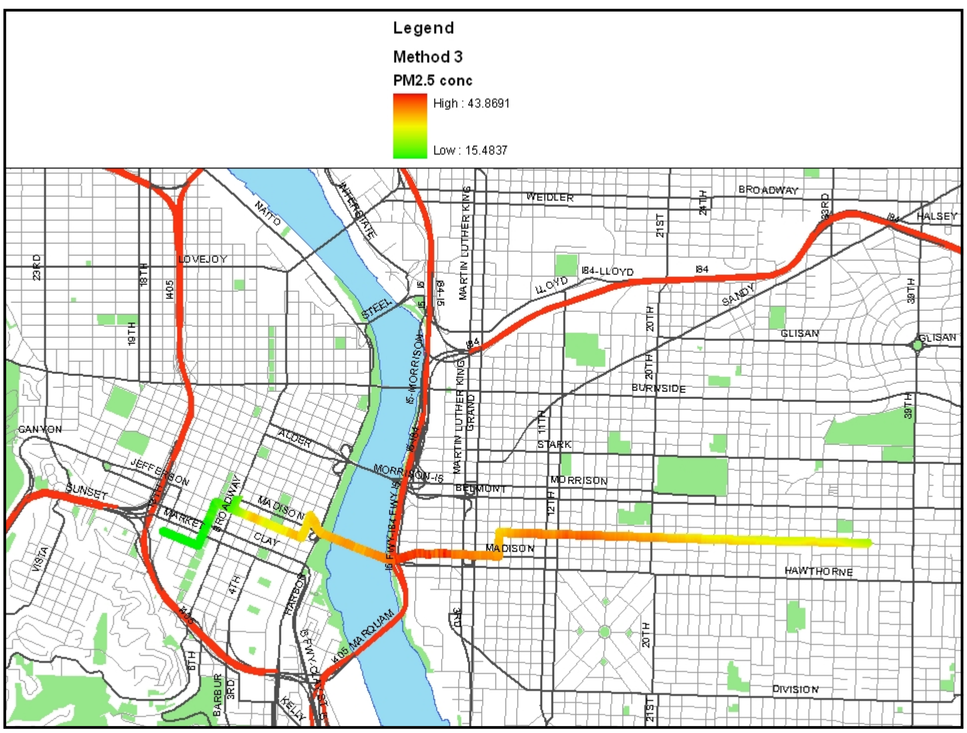
1. Routes created and calibrated in previous work
2. Merge data from all 4 trials into one table
3. Make route event layer from PM2.5 measurements
4. Perform interpolation using Kriging
5. Export kriged surface to raster
6. Create buffer layer around routes
7. Extract by mask using buffered routes

Kriging Methods

	Method 1 GW no trend	Method 2 ArcToolbox	Method 3 GW w/ trend
Interface	**Geostatistical Wizard**	**ArcToolbox**	**Geostatistical Wizard**
Treatment of Coincident Points	**Used mean**	**Not prompted**	**Used mean**
Global Trend	**Not removed**	**Not removed**	**Removed 2nd order trend**
Nugget	**None**	**None**	**Yes**
Lag Size/ Search Radius	**500 ft**	**500 ft**	**500 ft**




Legend
Method 2
PM2.5 conc
High : 40.732
Low : 13.1817
WEIDLER
BROADWAY
HALSEY
LOVEJOY
NAITO
JEFFERSON
SUNSET
MARKET
BROADWAY
MADISON
CLAY
ALDER
STARK
BURNSIDE
GLISAN
SANDY
LLOYD
I84-LLOYD
MORRISON
BELMONT
HAWTHORNE
DIVISION
MARQUAM
BARBUR
KELLY
CANYON
VISTA
MARTIN LUTHER KING
GRAND
23RD
19TH
18TH
I405
11TH
12TH
20TH
21ST
39TH
6TH
4TH
3RD


Legend
Method 3
PM2.5 conc
High : 43.8691
Low : 15.4837
WEIDLER
BROADWAY
HALSEY
LOVEJOY
NAITO
JEFFERSON
SUNSET
MARKET
BROADWAY
MADISON
CLAY
ALDER
STARK
BURNSIDE
GLISAN
SANDY
LLOYD
I84-LLOYD
MORRISON
BELMONT
HAWTHORNE
DIVISION
MARQUAM
BARBUR
KELLY
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23RD
19TH
18TH
I405
11TH
12TH
20TH
21ST
39TH
6TH
4TH
3RD

Comparison of Methods

		Method 1 GW no trend	Method 2 ArcToolbox	Method 3 GW w/ trend
Pared Errors	Mean	-0.01362	No feedback	-0.004943
	RMS	3.857		2.948
	Ave SE	0.976		2.464
	Mean std	-0.006623		-0.001913
	RMS std	3.997		1.198
Range		13.6 - 54.1	13.2 - 40.7	15.5 - 43.9
Visual Inspection		Splotchy	Good	Perpendicular Trend

Observed range is 11.5 - 60.1

Other possible approaches

- Interpolate each run separately, then average the resultant rasters
- Increase number of neighbors to include in the calculation of predicted values to decrease the likelihood of using a majority of points from one run

Conclusions

- Interpolation provides one way of looking at the average PM 2.5 concentration over different runs
- The surface models the natural changes in PM 2.5 concentration changes better than the previous attempt
- There is no clear cut best kriging method

Future Applications

- Examine influence of other factors on PM 2.5 concentration
  - Distance to freeways
  - Distance to intersections
  - Landuse
  - Traffic density