# Potential Cascade Volcanic Ash Fallout Locations

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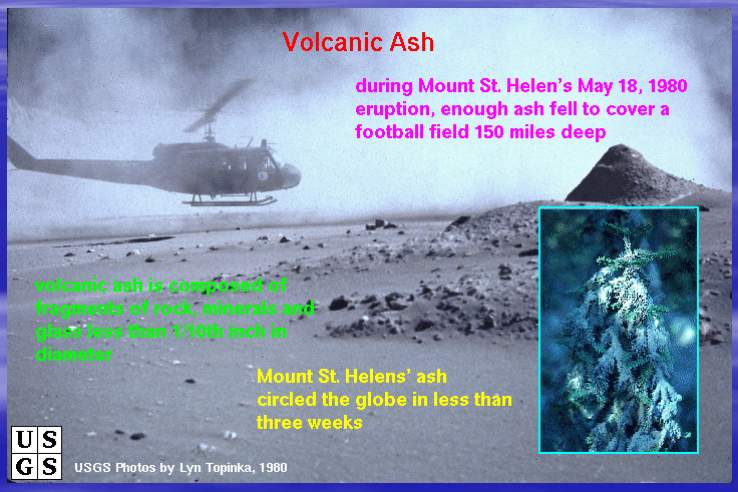
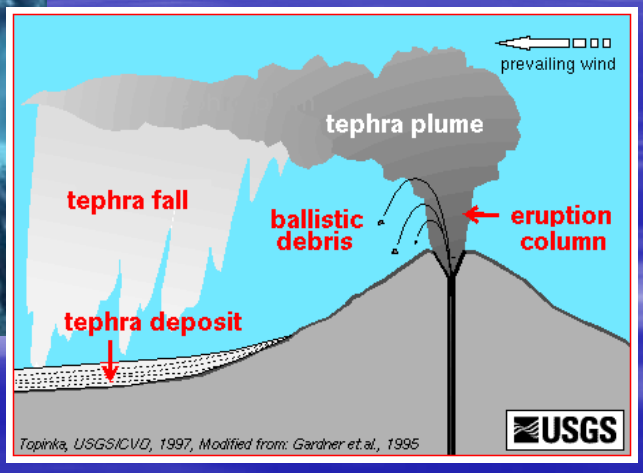
## Introduction

- Background and Weather
- Weather Dynamics
- GIS Analysis
- Combined Weather & GIS
- Results

# Background

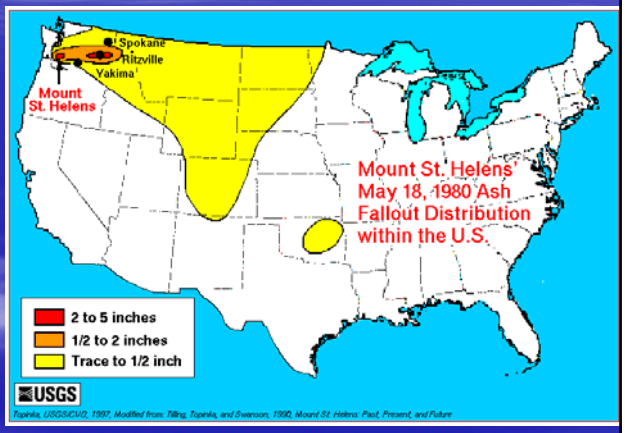



# Background



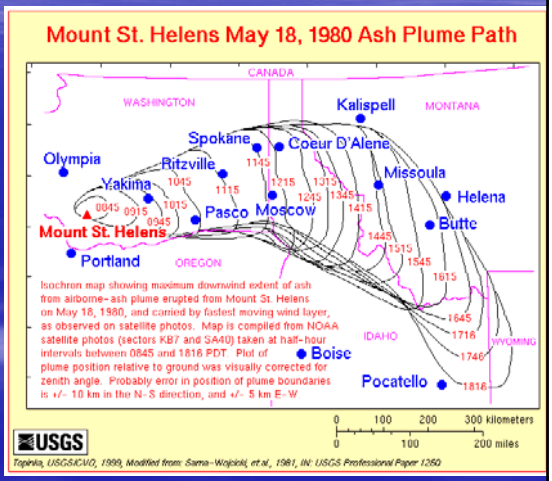
# Background

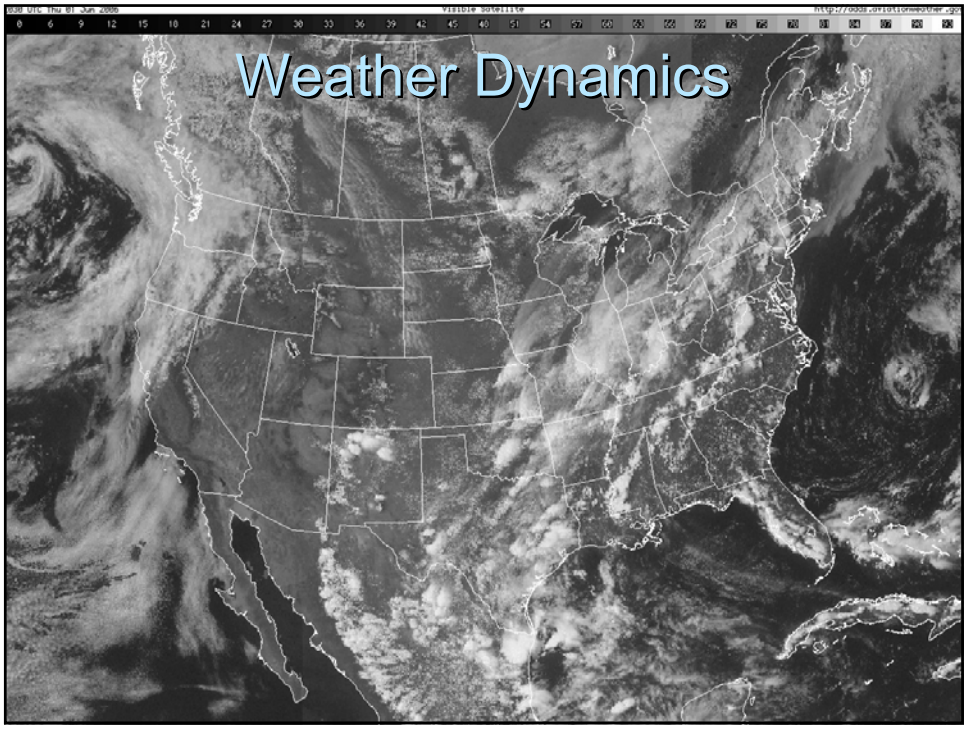
- Where Did Mt. St. Helens Ash go?




# Background

- Where Did Mt. St. Helens Ash go
- Why did it go there?





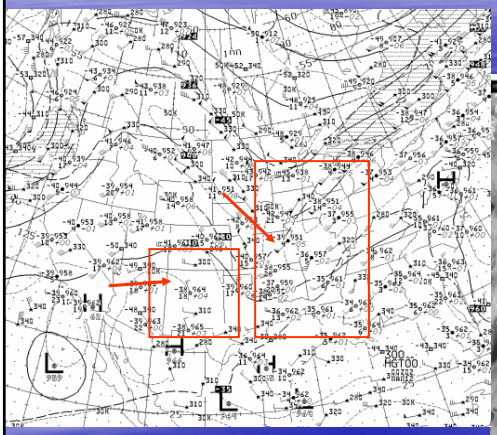

## Weather Dynamics

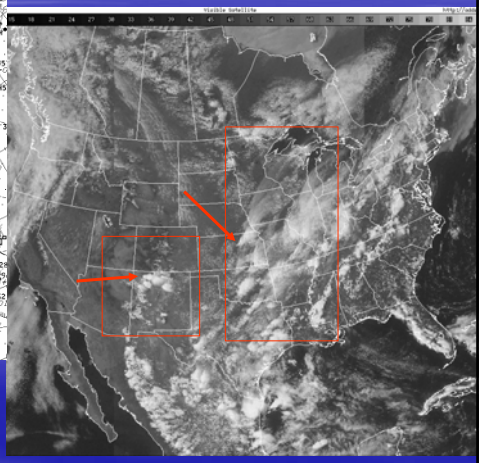
- Comparative analysis of thunderstorm profile vs. volcanic eruptive profile.
- Upper level winds steer volcanic plume and cirrus blow-off
- 300mb winds (winds at 30,000ft)
- Jet Stream winds
- Form continuous band of winds across the world
- Responsible for global distribution of Mt. St. Helens ash and all other volcanoes alike.

# Weather Dynamics

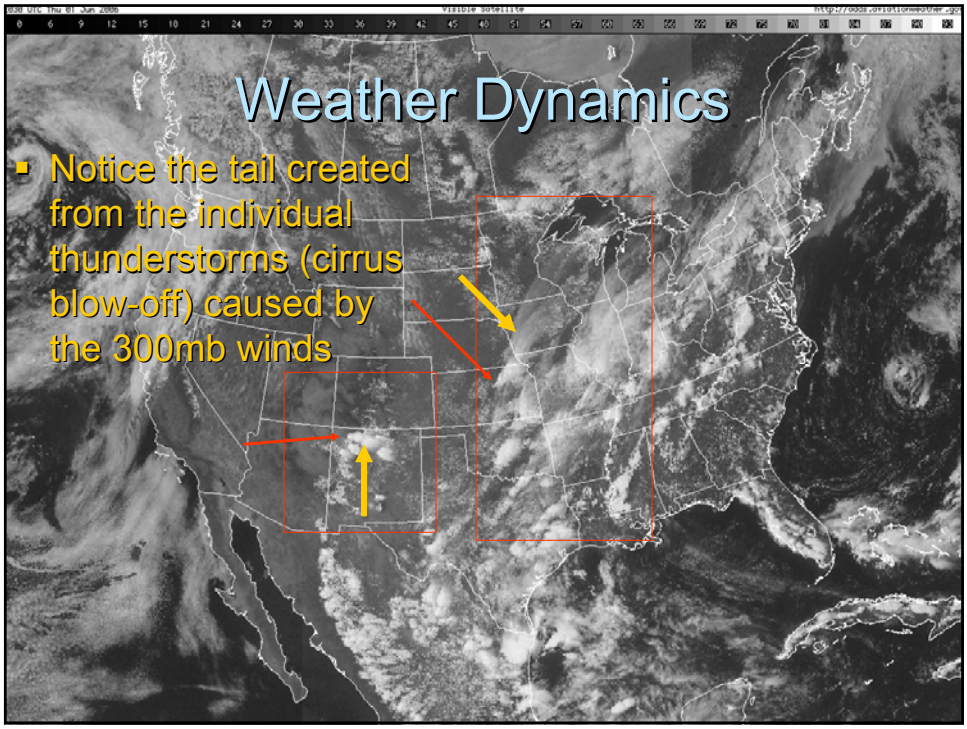
- Volcanic eruption column identical to thunderstorm clouds known as Cumulonimbus clouds (CB's) aka "Mushroom Clouds"

# Weather Dynamics





• Comparative Wind Speeds of Different Thunderstorms




## GIS Analysis

- Purpose of using GIS for this project: Recreate the upper atmosphere winds in a GIS format to analyze for potential ash fallout locations
- Analyze the layer of 300mb winds using kriging to identify locations and the number of cities/people affected by ash fallout

# GIS Analysis

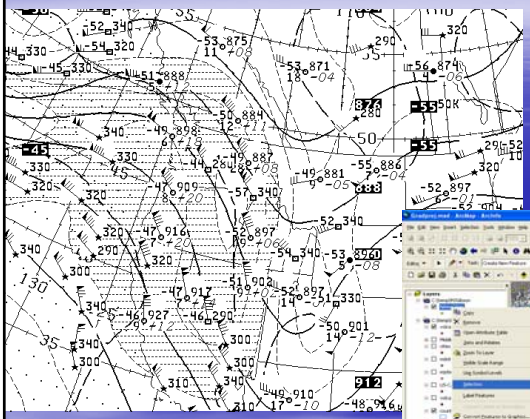
- Steps
- 1: Select background layers, cities, volcanoes
- 2: Select which cities to anaylze and assign wind speed and direction values for
- 3: Build new attribute tables with new fields for wind direction and speed assigned to the selected cities
- 4: Assign wind speeds & directions to selected cities on surface map from 300mb chart to prepare surface for kriging for 4 different seasons
- 5: Perform kriging
- 6: Perform Linear Direction Mean
- 7: Add multiple buffer ring boundary out to 1200 miles from source
- 8: Draw Ash Plume
- 9: Clip city layer to Ash Plume to identify the population affected within the plume

# GIS Analysis

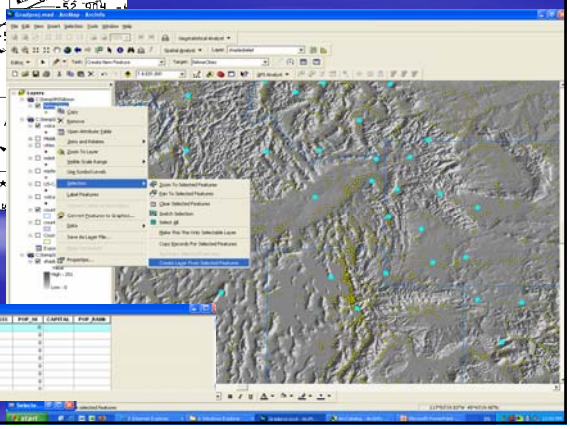
GIS Functions Performed

- Select
- Merge
- Join
- Kriging
- Geowizard
- Project
- Define Projection
- Create Surface from selected features
- Dissolve
- Multiple Ring Buffer
- Create New Attributes
- Edit Surface to create new features
- **Linear Directional Mean function/Analysis**
- Clip
- Generate

# GIS Analysis

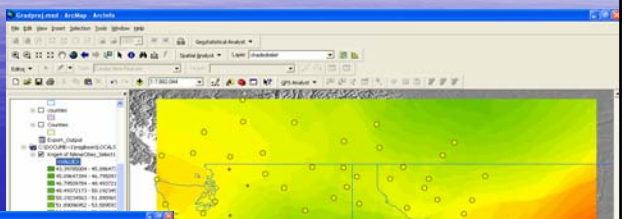


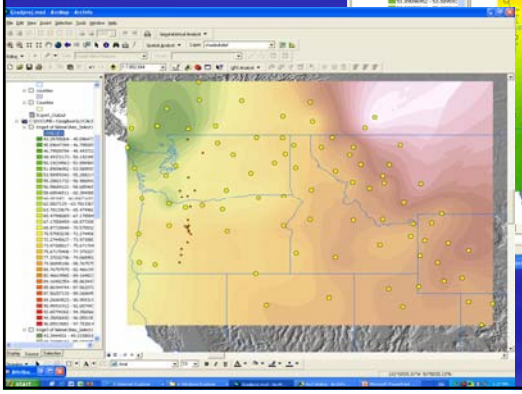
- **Assign wind speed & direction to cities' layer from 300mb chart**

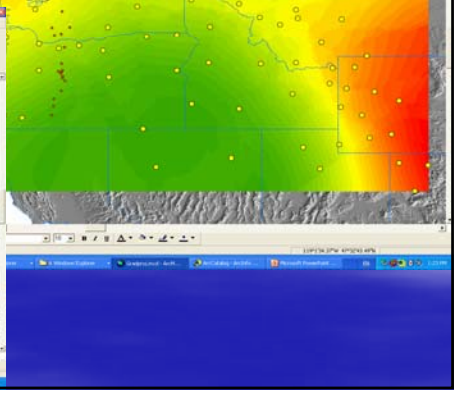


# GIS Analysis

- Something not right with our kriging







# GIS Analysis

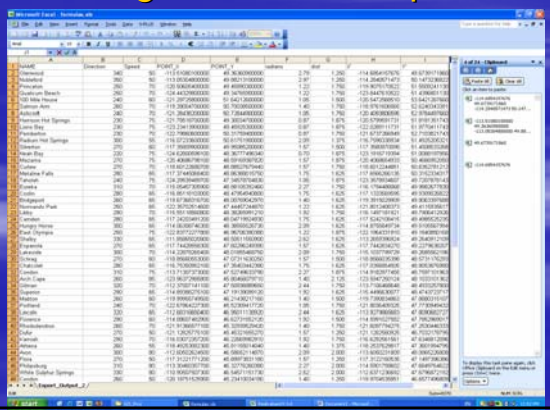
- Creating Directional Wind Arrows
- Generate
  - add XY data to city points, export to Excel
  - calculate endpoints using direction and speed

Calculating (X',Y')

X'=(D*sinΘ)+X

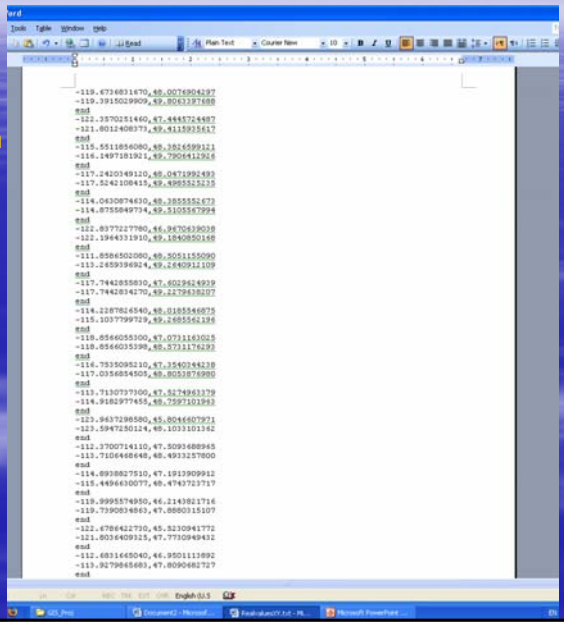
Y'=(D*cosΘ)+Y

Where:
D=wind speed
and
Θ=wind direction



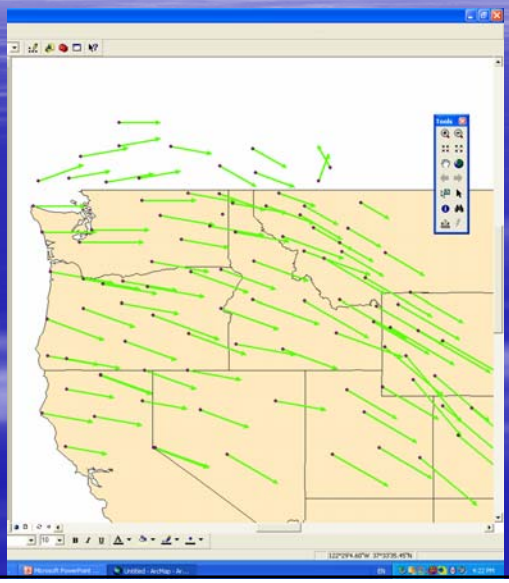
# GIS Analysis

- Create plain text file with start and end points

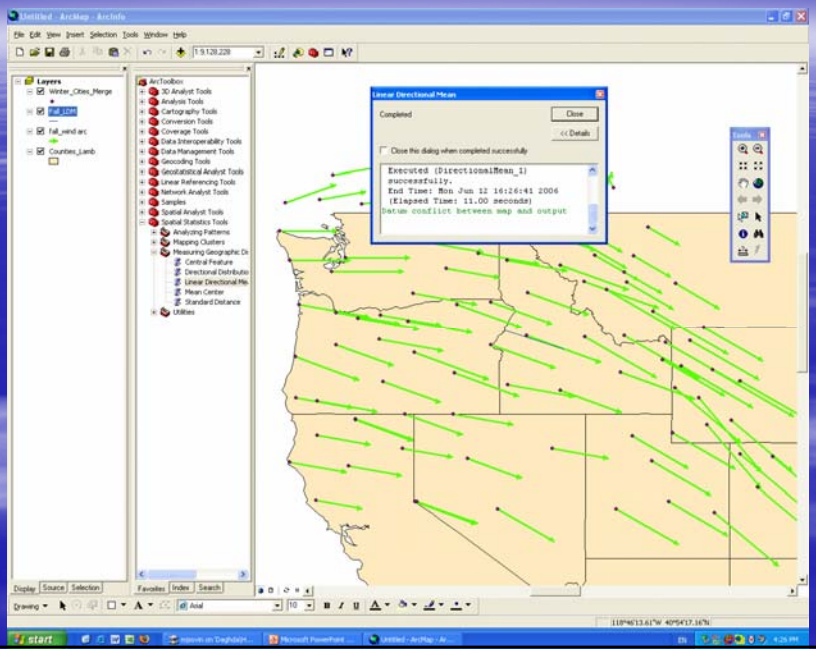


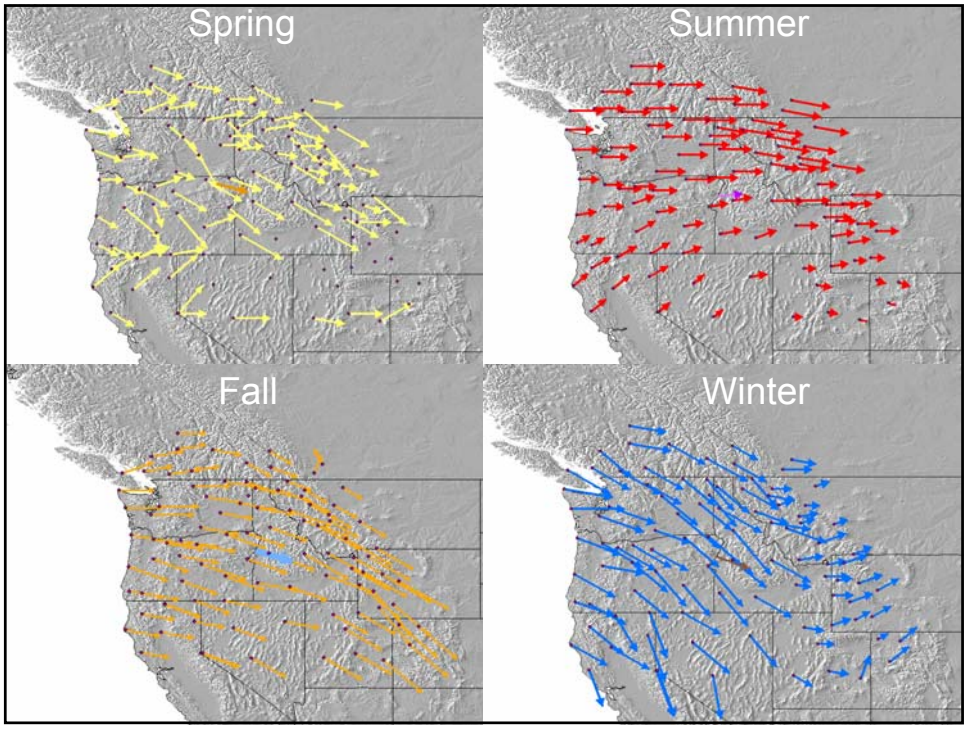
# GIS Analysis

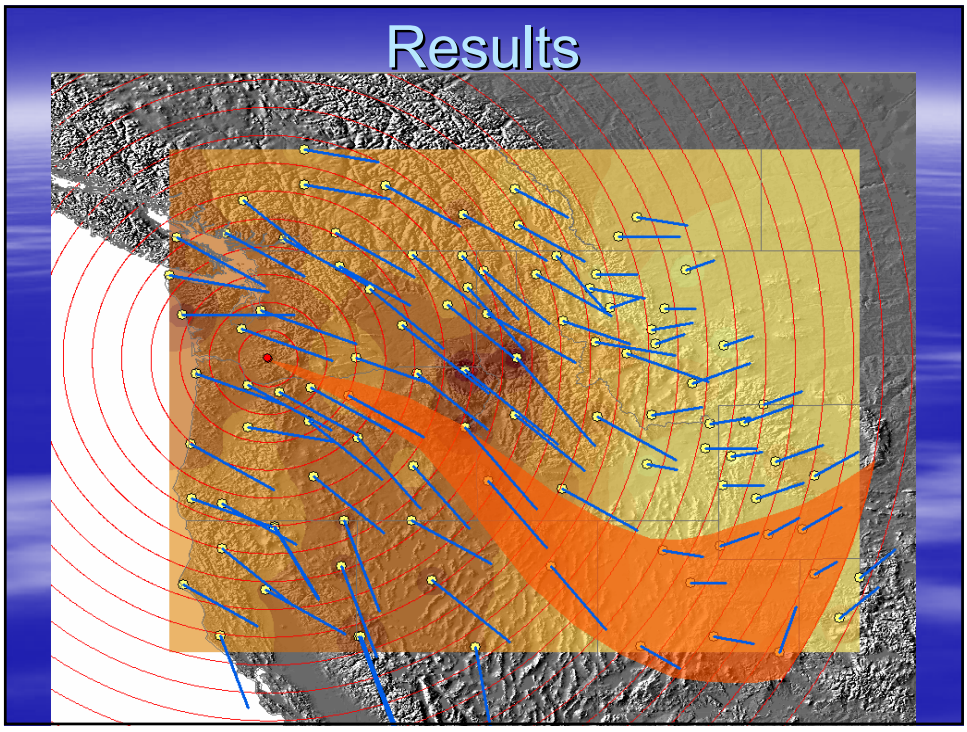
•Generate a coverage of wind direction lines



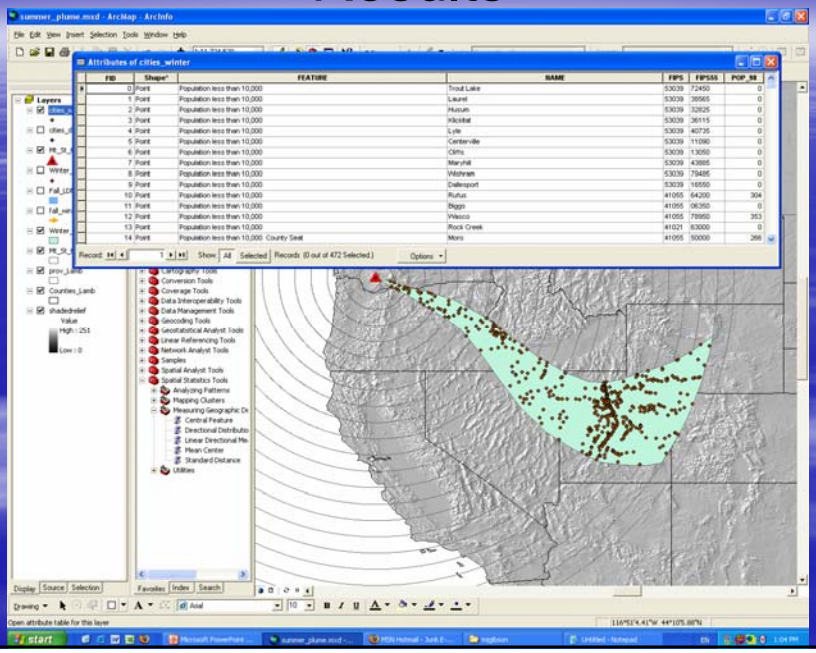
# Linear Directional Mean




Spring
Summer
Fall
Winter

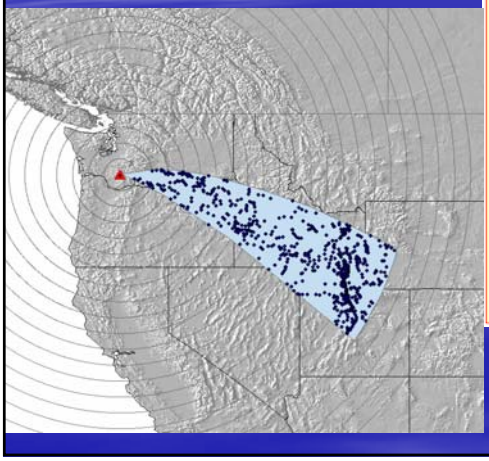

Results

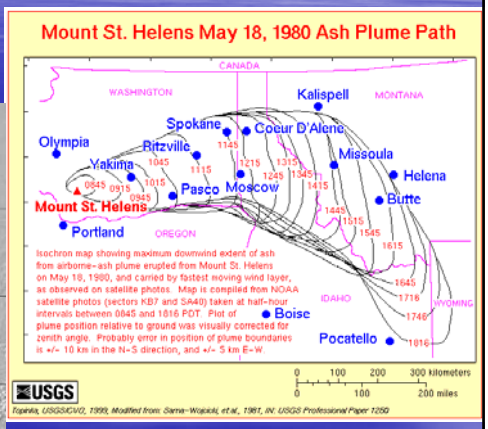
# Results



# Results

- Comparison





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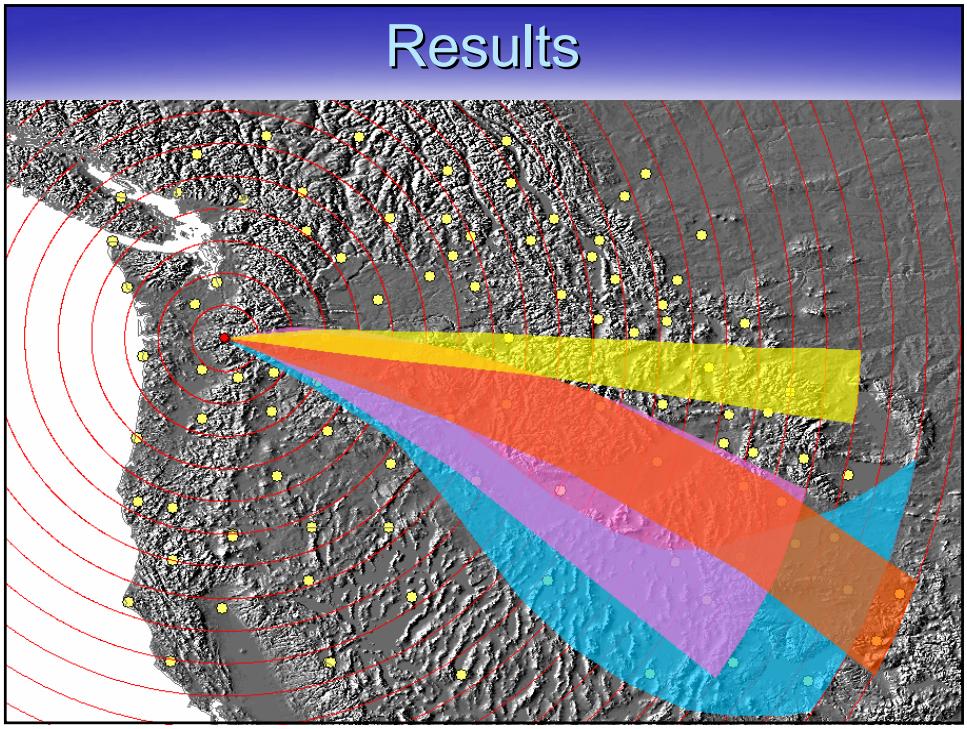

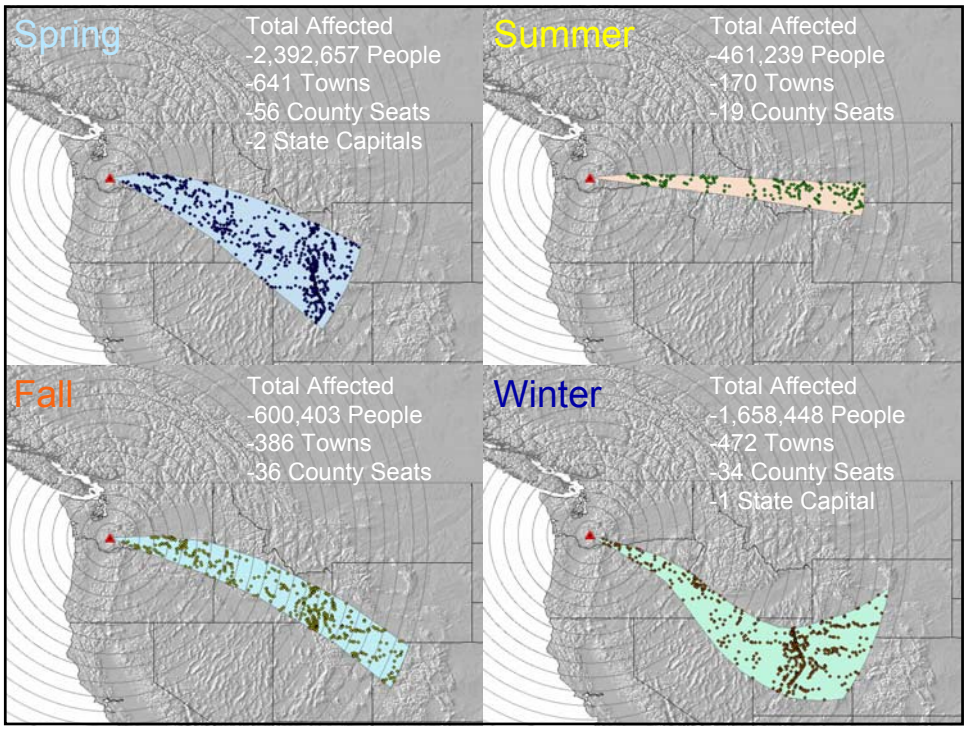
Spring
Total Affected
-2,392,657 People
-641 Towns
-56 County Seats
-2 State Capitals
Summer
Total Affected
-461,239 People
-170 Towns
-19 County Seats
Fall
Total Affected
-600,403 People
-386 Towns
-36 County Seats
Winter
Total Affected
-1,658,448 People
-472 Towns
-34 County Seats
-1 State Capital

# Limitations

- Substitute weather for May 18th 1980 eruption.
- Weather data from 300mb subject to interpretation.
- Atmosphere is dynamic, fluid and multilayered.
- Weather for the 4 individual seasons had to come from a certain day that "fit" a seasonal or average pattern.
- Weather pattern (direction) may be easy to recreate, but wind speeds are most definitely unique to specific days.
- Drawing the plume angle based on relative "best guess" from the source.

# References


- ESRI world data set
  I:\Students\data\GIS\ESRI World Data Set
- NOAA
  http://www.ncdc.noaa.gov/oa/upperair.html
- USGS
  http://vulcan.wr.usgs.gov/Volcanoes/MSH/Maps/may18_ashmap.html
  http://vulcan.wr.usgs.gov/Volcanoes/MSH/Maps/map_may18_ash_path.html
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