PROBLEM 1

? The ozone concentration in California becomes more and more one of the most important environmental problems. At approximately 200 spots, spread over the whole state, the concentration was measured and is now available to you.

Are there any obvious trends ? Use ArcMap to create a map of California visualizing the regions of extraordinary high values.

The Geostatistical Analyst was not enabled in the default installation. It can be found in the Tools \rightarrow Extensions menu, then the according toolbar has to be added to the program via Views \rightarrow Toolbars \rightarrow Geostatistical Analyst. Once I did it, I do not have to redo it – similar to the Spatial Analyst known from the assignment 2 to 4.

The initial map contains a heightmap (serves as a background image, no further role), California's border, the majority of its medium-sized to big cities and finally the measured ozone concentration.

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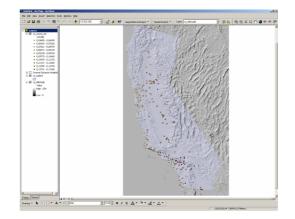


Figure 1 Activating the Geostatistical Analyst

Figure 2 Initial map

A *Trend Analysis* shows changes over space. It draws all observations along the coordinate axes and computes a trend line (it applies an algorithm unknown to me).

In the following images the x-axis stands for West-East (i.e. longitude), the y-axis for South-North (i.e. latitude), and the z-axis represents the ozone concentration.

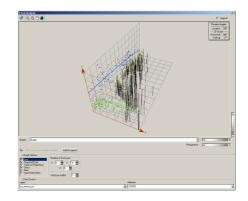


Figure 3 Trend Analysis

The trend becomes even more obvious when rotating the scene by 30° and removing the sticks and input data points:

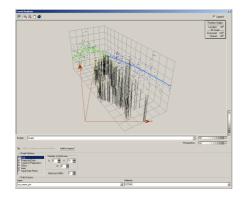


Figure 4 Rotated by 30°

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Figure 5 Removed superfluous items

There is a significant peak in the East-West centre of California and a slight increase towards the southern part.

To be honest, I have some difficulties in reading these ominous trend analyses and prefer a "not-that-abstract" map. The problem is to generate a map covering the whole state of California out of just 192 measured values. Kriging is the tool of choice when it comes to interpolating. It is part of the *Geostatistical Wizard* and very flexible - I merely wish it would contain less functionality ©.

Five dialog guide me through the overwhelming options. Fortunately, the default settings usually perform the desired tasks and only need to be changed in special cases. An important selection of mine is to choose a *Second Order Trend Removal* in step 1 (Figure 7).

ostatistical Wizard: Choose I Dataset 1	nput Data and Method	
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		Tip: Validation creates a model for a subset of data and predicts values for the rest of the locations.
Methods Inverse Distance Weighting Global Polynomial Interpolation Local Polynomial Interpolation Radial Basis Functions Religing Cokriging	the measurement error n spatial autocorrelation. I outputs including predic	puck interpolator that can be exact or smoothed depending on nodel. It is very likesble and allows you to investigate graphs of riging uses statistical models that allow a variety of map bons, prediction standard errors, probability, etc. The flexibility to if decision-making. Kriana assumes the data come from a

Figure 6 Choosing Kriging

Selection
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Figure 7 Step 1 – Second Order Trend Removal

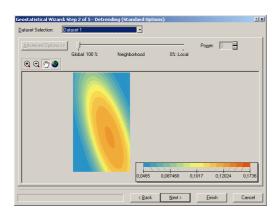


Figure 8 Step 2 – no changes

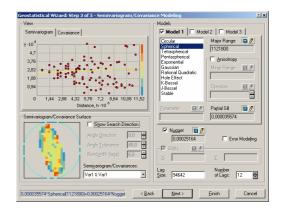


Figure 9 Step 3 – no changes

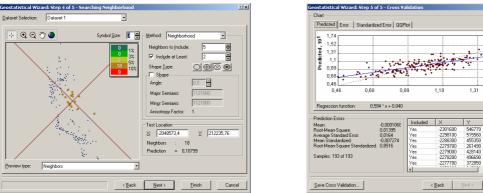


Figure 10 Step 4 – no changes

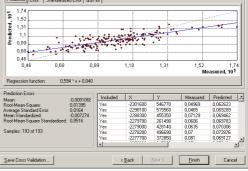


Figure 11 Step 5 – no changes

Output Layer Information	î×
Summary:	
Selected Method: Ordinary Kriging Output: Prediction Map	
Number of datasets currently in use: 1	
Number of Points: 193	
Order of Trend Removal: Second (Estimated by Global Polynomial Interpolation)	
Semivariogram/Covariance: Model: 0.00003574*Spherical(1121800)+0.00025164*Nugget Error modeling: Microstructure: 0.00025164 (100%) Measurement error: 0 (0%)	
Searching Neighborhood: Neighbors to Include: 5 or at least 2 for each angular sector Searching Ellipse: Angle: 0 Major Semiaxis: 1121800 Minor Semiaxis: 1121800 Angular Sectors: 4	
Status: Ready to create layer.	-
Canc	el

Figure 12 Summarized settings

The Geostatistical Analyst outputs a new layer which is added to the current project. I did not like the image and played a bit with the visual appearance. In my eyes, the ozone concentration can be easier obtained from the visualization when just the contours are drawn (not filled !).

Layer Properties		î×
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	Z Unit Conversion Factor: 1 Tip: All Z values in the surface will be multiplied by the conversion factor.	
<u>+</u>		
	OK Cancel App	oly

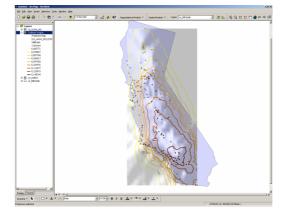


Figure 13 Visual appearance

Figure 14Map with ozone concentration

It is well-known that metropolitan area are the number one source of carbon dioxide and ozone. So I removed the 192 spots from the map and replaced them by the medium-sized to big cities of California (green circles). I was interested in cities with more than 100'000 citizens and emphasized them by black squares (a little bit larger than the circles).

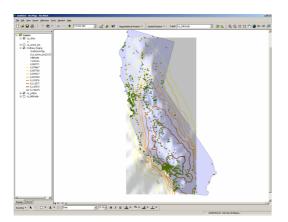


Figure 15 Added cities

Figure 16 Emphasized big cities, enabled heightmap again

It becomes quite clear that the cities are mainly responsible for the high ozone concentrations. However, though their symbols do not exactly match the regions of very high values due to the steady wind coming from the Pacific Ocean.

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