GIS III: **GIS Analysis**
Module 1: Spatial Analyst

*** Files needed for exercise: *MN_ozone_monitors.xls, MN_tracts_2000sf1.shp*

Goals: To learn how to use the Spatial Analyst toolset, specifically interpolation and zonal tools, to perform GIS analyses.

Skills: After completing this exercise, you should be familiar with raster based analyses and the Spatial Analyst toolset.

Mapping point level data:

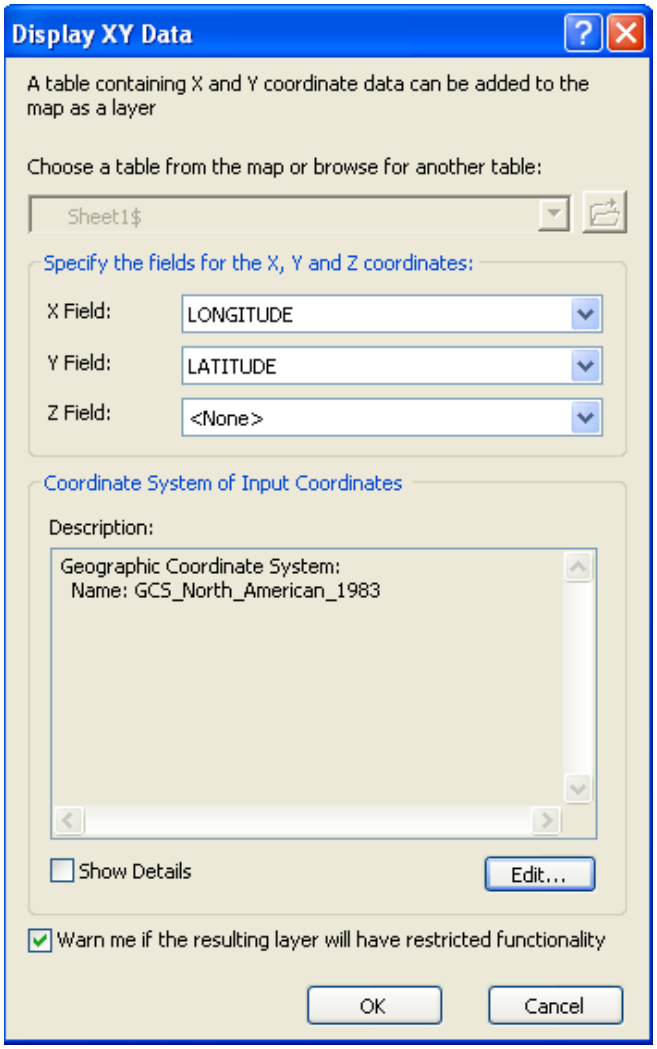
1. Open ArcMap.
2. Add the table *MN_ozone_monitors.xls > sheet 1*.
3. Open the table. These are ozone monitoring stations. We can see that they have latitude and longitude, as well as a mean ozone value.

Table

Sheet1$

STATE_CODE	COUNTY_CODE	SITE_ID	LATITUDE	LONGITUDE	CITY_CODE	MEAN_OZONE
27	3	1001	45.40184	-93.20306	17486	0.0413
27	3	1002	45.13768	-93.20772	6382	0.0413
27	5	2013	46.851811	-95.846272	15832	0.0394
27	17	7416	46.70527	-92.52377	12160	0.0383
27	35	3204	46.39674	-94.1303	7300	0.04
27	49	5302	44.473754	-93.012611	0	0.0431
27	75	5	47.948622	-91.495574	0	0.0369
27	83	4210	44.4438	-95.81789	40688	0.0442
27	95	3051	46.2053	-93.75945	48310	0.0367
27	109	5008	43.996908	-92.450366	54880	0.0414
27	137	34	48.412778	-92.829167	0	0.038
27	137	7550	46.81826	-92.08936	17000	0.0322
27	139	505	44.791437	-93.512534	59350	0.0403
27	145	3052	45.549839	-94.13345	56896	0.0389
27	163	6015	45.11728	-92.85532	0	0.0426
27	171	3201	45.20916	-93.66921	57346	0.0409

4. Map the monitor stations by right clicking on the table on choosing **Display XY Data**. The Latitude and Longitude fields should be filled in for you. For the coordinate system choose **Geographic Coordinate Systems > North America > NAD 1983**. Click **ok** to get a restricted functionality error, and click **ok** to map the data.



5. Now add *MN_tracts_2000sf1.shp*. Change the coordinate system of the data frame to match that of the shapefile.
6. Export the *Sheet1$Events* layer to a permanent shapefile by right clicking and choosing **Data > Export Data** and saving it to your folder. Name the permanent shapefile something logical like *MN_ozone_monitors.shp*.
7. We now have ozone values at 16 points across the state. However, we want a continuous surface of values so that we can get a value for ozone anywhere in the state.

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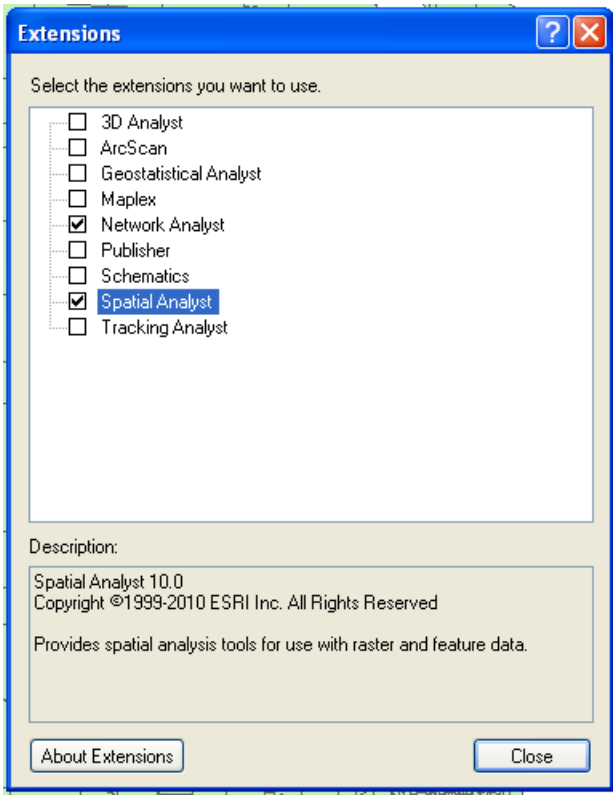
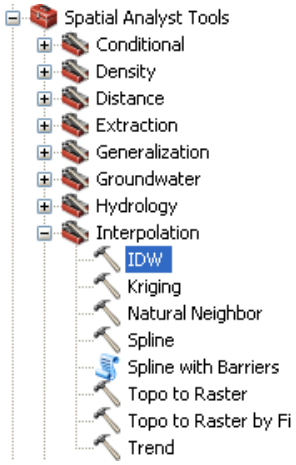
Interpolation:

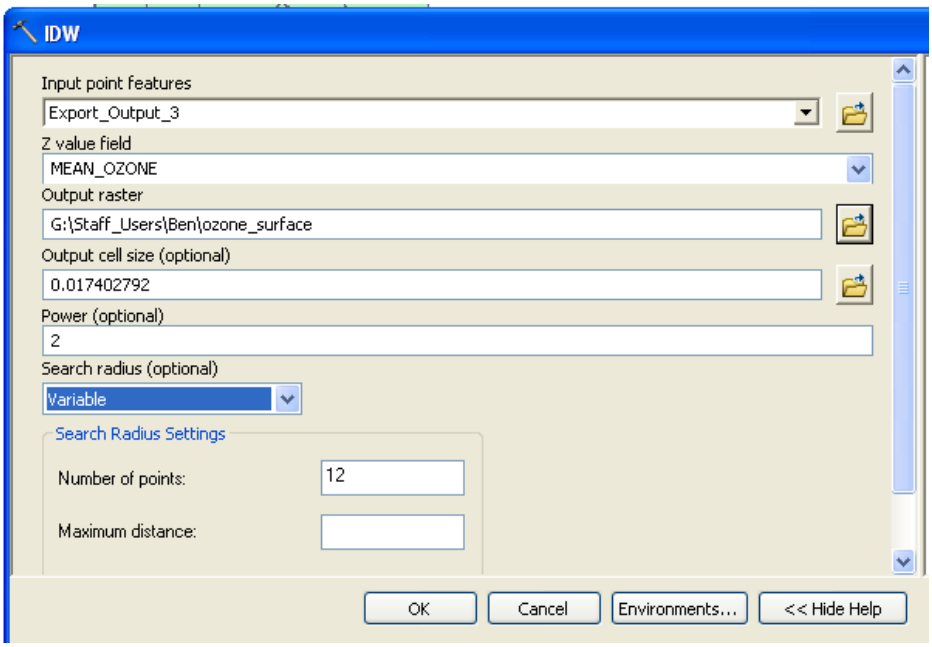
1. First, make sure the Spatial Analyst Extension is turned on by going to **Customize > Extensions** and checking **Spatial Analyst**.



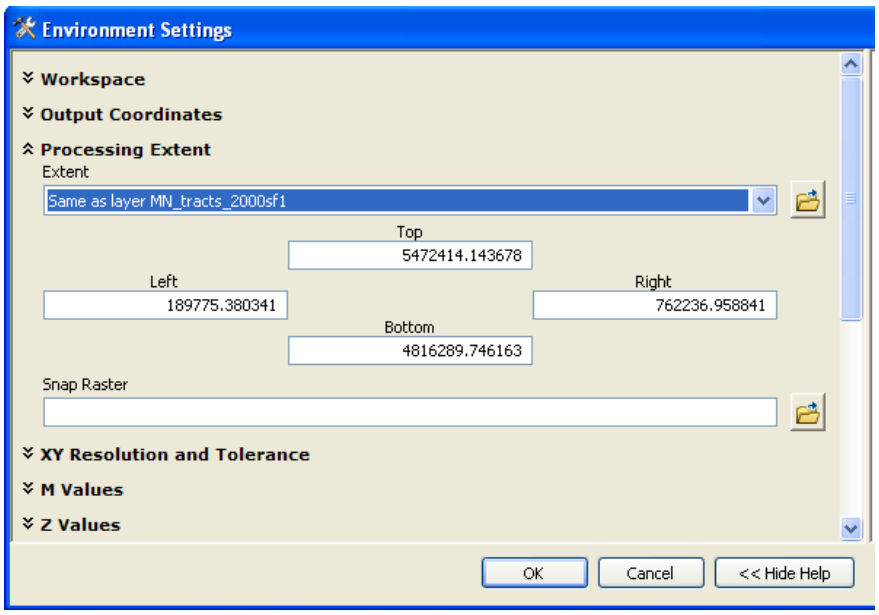
2. In **ArcToolbox**, find the **Spatial Analyst Tools** and click **Interpolation**. We are going to use the **IDW** tool, which stands for Inverse Distance Weighted. This is one of many interpolation techniques.



3. In the IDW dialog box, the Input point features should be our *MN_ozone_monitors*. The Z value field is the field that contains the value that we would like to interpolate. In this case, it is called **MEAN_OZONE**. In the Output raster box, choose a location and name for your raster. Keep in mind that raster names can only be 13 characters long.



4. Leave the other fields alone for now and click the **Environments** button on the bottom of the dialog box. Click on **Processing Extent** and change the Extent to be the same as the *MN_tracts*. This ensures that the whole state will be covered.

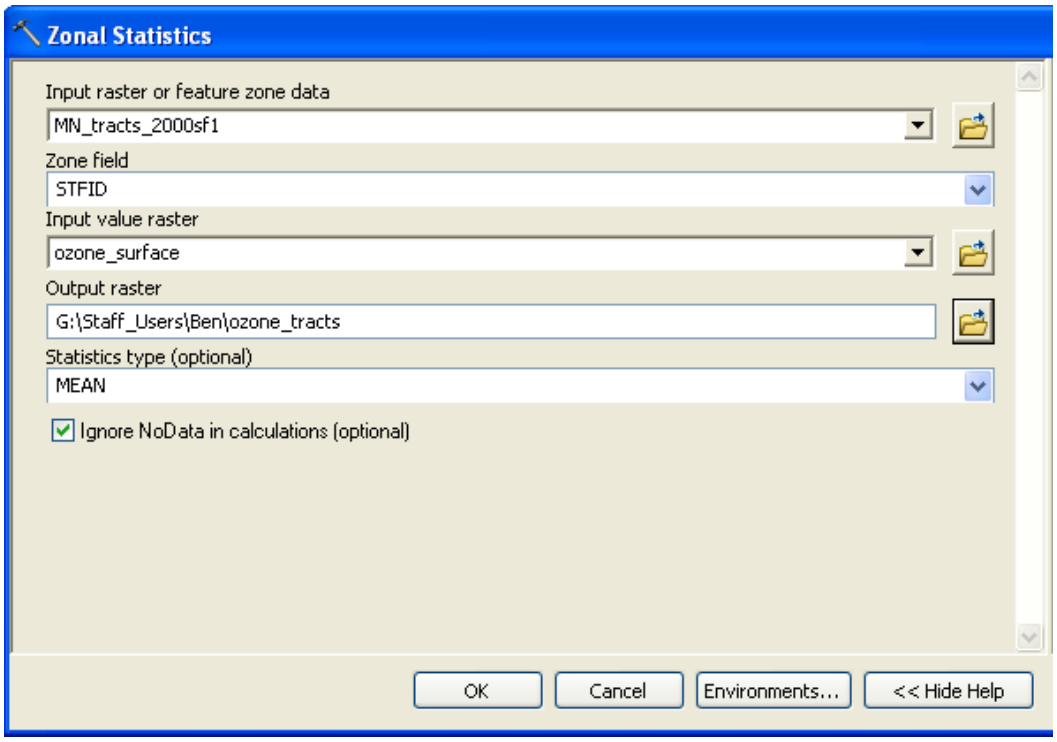


5. Click **OK** twice to run the tool. A surface is produced. You can change the look and color of this surface in the symbology tab of the raster. We now have an estimated ozone value for every location in Minnesota. You can find the value at any point by using the Query tool  and clicking to find the pixel value.

Using Zonal Statistics:

1. Now let's find the mean ozone value for each census tract in Minnesota. In the **Zonal** tab of the **Spatial Analyst** tools, find the **Zonal Statistics** tool.
2. The Input raster or feature zone data is the layer that contains the zones we want to use. In this case, it is our tracts.
3. The Zone field needs to be a unique ID for each zone we want to use. Since we want each tract to be its own zone, use the FID, which is unique for every tract.
4. The Input value raster is our ozone surface. Choose an output path and name.
5. Make sure the Extent is set to the same as *MN_tracts* in the **Environments** window.
6. Finally, choose **MEAN** for the statistics type (or another type if you prefer).

(zone field in below graphic should read **FID**)



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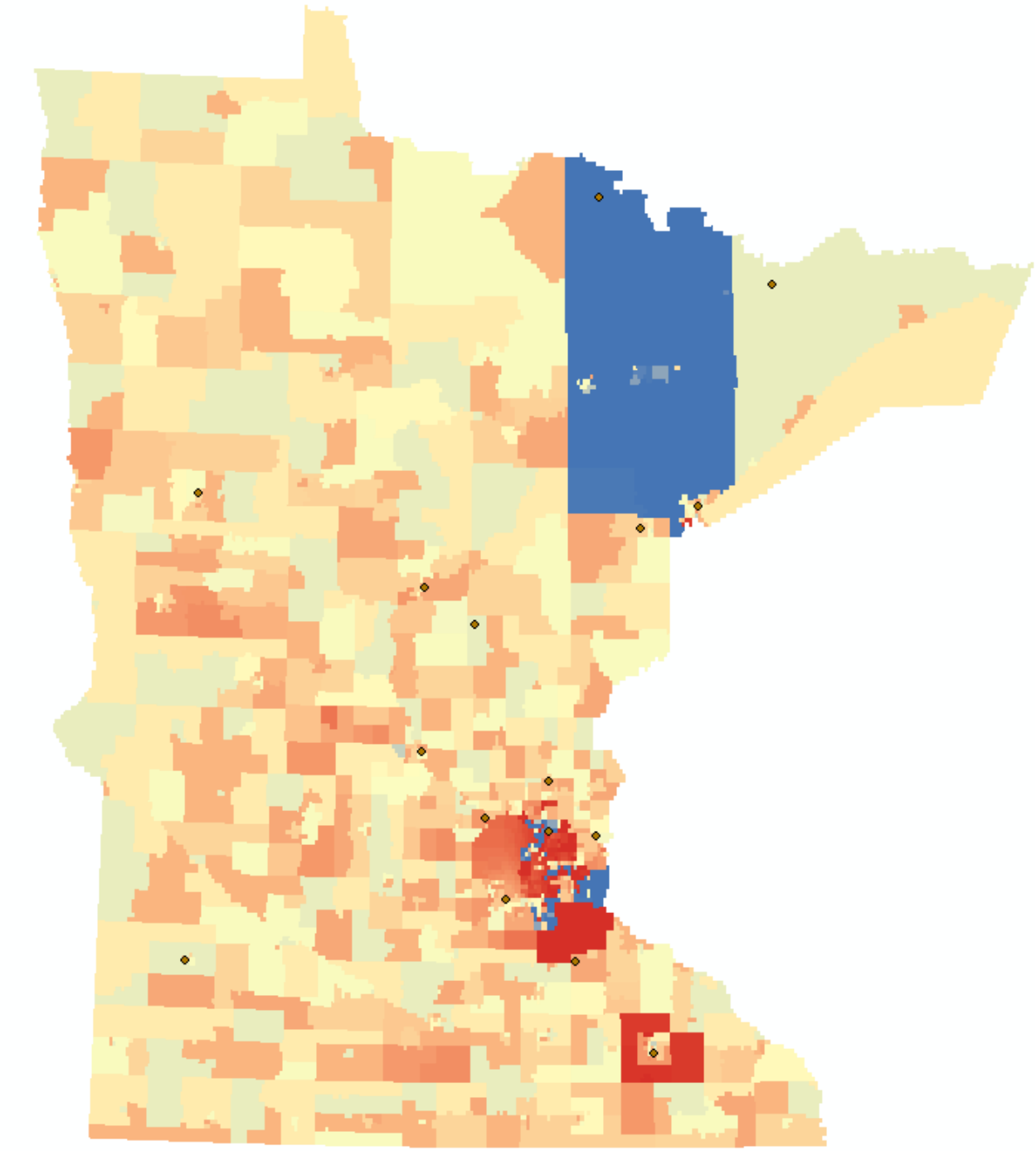

If you have time…
Try out some other interpolation methods like kriging or spline and see how they change the results.