

# Spatial Analysis Tip Sheet – Spatial Joins, Overlays, and Zonal Analysis

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Revised October 2, 2009

**Important!** Prior to beginning any analysis operations, be sure to read the tip sheet for **SettingUp for Spatial Analysis** – on the [Tufts GIS Tip Sheets web site](#) under the *Spatial Analysis Tips* section.

## Spatial Joins, Overlays, and Zonal Analysis

For a good discussion and good graphic illustrations of overlay analysis in GIS, see *The ESRI Guide to GIS Analysis, volume 1: Geographic Patterns and Relationships*, chapter 5 – **Finding What’s Inside**. There is a copy of this book in the Tufts GIS Center.

Spatial joins and overlays are methods for combining information between GIS layers. Most of these tools will result in the attribute information from one layer being combined with the attribute table of another layer. This then makes further analysis possible. For example, you could perform a spatial join between facilities that release pollutants and town boundaries. You could then calculate how many facilities are in each town and the quantity of pollutants released in each town.

All these tools are found in *ArcToolbox – Analysis Tools – Overlay*.

The *Spatial Join function* can also be accessed by right-clicking on the layer to which you want to join the information from another layer – look for Joins and Relates – Join, and make sure to choose the method to *Join data from another layer based on spatial location*.

A major difference between the *Spatial Join* and the other *Overlay* tools is that the *Spatial Join* does not alter the original geography in any way. It simply joins the attribute tables of two layers together based on common spatial locations. In that way it is similar to a table join (based on a common attribute field value). The other *Overlay* tools will result in altered geography – instance if you perform an Intersect between town boundaries and water bodies, the result will be a water bodies layer where water polygons are split at town boundaries instead of crossing them. This would then allow you to calculate the total surface area of water bodies per town.

The *Zonal* tools reside in the Spatial Analyst extension and toolbox. You must have Spatial Analyst enabled (Tools menu – Extensions – checkmark Spatial Analyst) to use these tools. These tools are most useful when your underlying data layer is a raster data set. The overlying layer can be raster or vector, and must represent zones of some sort – e.g., census tracts, areas vulnerable to sea level rise, watersheds.

For help on these tools, go to the online ArcGIS 9.3 Help for Geoprocessing Tools – *An Introduction to the Fundamental Tools* ([http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=An introduction to the fundamental tools](http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=An%20introduction%20to%20the%20fundamental%20tools) – and look at *Overlay Analysis*

Note that a few of the questions below can be achieved by using the *Select by Location* tools.

## Overlay Analysis

Questions to be answered	Example	Data/tool set
How many of these features are inside or near these other features	How many low income housing tax credit properties are within each ward in Boston? What is the total number of low income units by ward?	<i>Spatial Join</i> – works best for points in polygons or points near lines; does <b>NOT</b> work well for polygons in polygons
Tag features in one layer with an important attribute from another layer within which a feature falls	Attach the number of floors from a parcel layer to building footprints to create a 3-D building view; tag each state-regulated facility emitting water pollutants with the watershed name in which it lies.	<i>Spatial Join</i> – works best for points in polygons or points near lines; does <b>NOT</b> work well for polygons in polygons  <i>Intersect</i> overlay works better for polygons in polygons or lines in polygons – the result is a new shape file of the intersection of the two layers, with attributes from both tables
What combination of properties from two or more layers occur in a given area?  Where are certain combinations of properties found?  How much of one layer is found in another layer?	What is the soil type and land cover for any given area?  Where can you find residential zoning on currently forested land?  Summarize the total acres of each soil type by watershed	<i>Union</i> overlay – the result a new shape file with the combined polygons of each layer splitting each other attached to a table combining the attributes of each original layer  If your underlying data layer is a raster data set with code values, e.g., land cover code values, you could also use a Zonal tool.
Exclude areas of one layer based on features in another layer	What is the buildable area of a town, excluding current buildings and floodplains?	<i>Erase</i> tool (needs ArcInfo license, in GIS lab at Tufts). Use one layer (e.g., building footprints and selected “special flood hazard areas” from floodplains) to erase through another layer (e.g., parcels)

## Zonal Analysis

Questions to be answered	Example	Data/tool set
Create basic descriptive statistics of areas based on information in a data layer (especially if the latter layer is already in raster and	What is the annual mean, minimum, and maximum precipitation by watershed in New England.?	<i>Zonal Statistics as Table</i> (under <i>Spatial Analyst</i> - <i>Zonal</i> tool box set)  Note the table of statistics can then be joined back to the

contains continuous values, e.g., elevation, precipitation, density, distance)	What is the mean % canopy cover by census tract in the Boston area?	original overlaying zone layer (e.g., you can join the table canopy cover % stats back to the Census Tract layer to analyze the canopy and demographic data together).
Calculate the area of values for one layer based on zones in another layer	What is the distribution of land cover within zones that are vulnerable to sea level rise?	<i>Tabulate Area</i> (under <i>Spatial Analyst - Zonal</i> tool box set)  Again, the tabular data set can be joined back to the original zone layer
Create basic descriptive statistics regarding the geometry of zones in a raster layer	What is the area, perimeter, and thickness of grassland areas as represented in a landcover raster?	<i>Zonal geometry as Table</i> (under <i>Spatial Analyst - Zonal</i> tool box set)