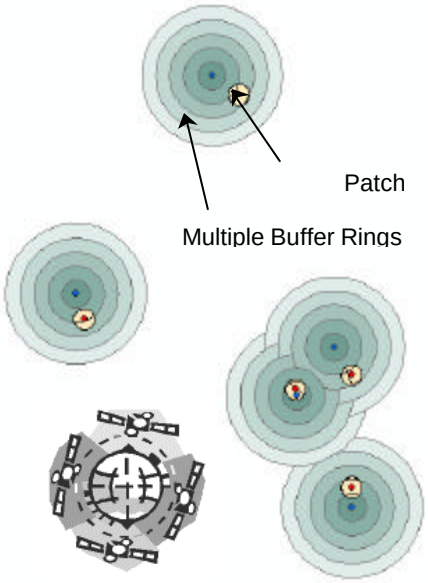
Calculating the Area of Overlap Between Patches and Multiple Buffer Rings



These instructions enable you to calculate how much area of each patch associated with point location data (e.g. GPS, telemetry) is within multiple buffer rings calculated from points of known error. ArcGIS 8.1 software is used to perform the following steps to obtain the required area calculations:

- Add XY data to the map document
- Create buffers and join ID fields
- Union the patch and buffer ring layers
- Manipulate fields and calculate area
- Dissolve and summarize attributes

The patches are zones surrounding point locations (NO error.dbf). The multiple buffer rings indicate zones within specified distances from the center point of known error (1200m err.dbf). By unioning the multiple buffer rings with the patches, manipulating the fields, and obtaining the areas, you can then perform statistical calculations on the tabular output to address the error.

The example file names used here are (note: substitute your file names):

ORIGINAL DATA TABLES

NO error.dbf	randomly generated set of coordinates with X, Y, and PatchID attribute fields (PatchID = BufferID)
1200m err.dbf	error coordinates paired with the above with X, Y, and BufferID attribute fields (BufferID = Patch ID)

CREATED DATA LAYERS

Patch.shp	a polygon shapefile resulting from the buffering of NO error Events
BufferRing.shp	a polygon shapefile resulting from the multiple buffering of 1200m err Events
PatchID.shp	same as Patch.shp but with the NO error table attributes joined by location
BufferRingID.shp	same as BufferRing.shp but with the 1200m err table attributes joined by location
Intersection.shp	A polygon shapefile resulting from the intersection of BufferRingID.shp with PatchID.shp

Setting up the map document

1. Choose START MENU → PROGRAMS → ARCGIS → ARCMAP
2. Start ArcMap with a new empty map but do not add any data yet
3. Save the map document (e.g. **C:\Workspace\BufferArea.mxd**)

Add XY data

Add the tables of points.

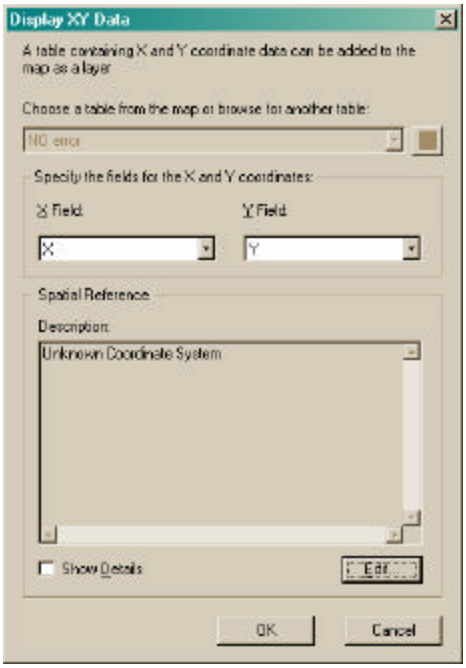
1. Click on ADD DATA
2. Navigate to the directory containing the dBase tables
3. Select the tables (***NO error.dbf*** and ***1200m err.dbf***) and click ADD

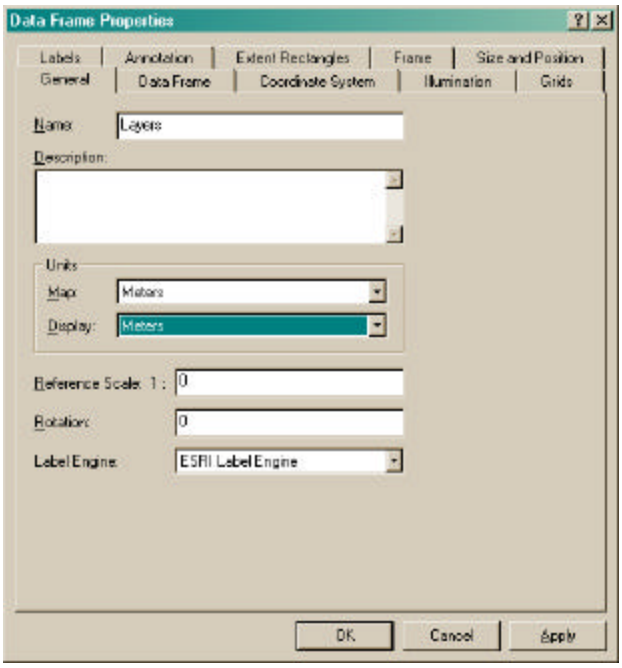
Display the locations as events.

4. In the table of contents (under the SOURCE TAB), right click on each table choose DISPLAY XY DATA…

5. Map the appropriate X and Y fields and click OK
6. If your data has a projection then choose this now by clicking on the Spatial Reference EDIT button
7. Modify the symbology if desired

Define the map and distance units if your data has no projection defined.



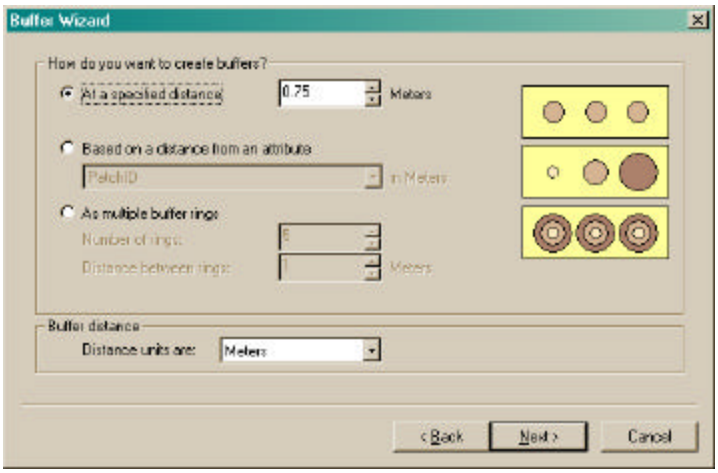


8. In the table of contents, double click on the data frame ("**Layers**")
9. Click on the GENERAL tab
10. Select the appropriate Map and Distance units (e.g. **Meters** and **Meters**)
11. Click OK

Create patch and multiple ring buffers

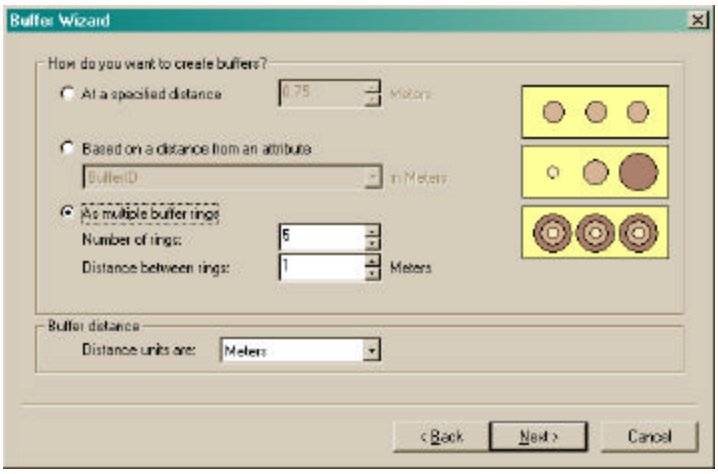
For each layer of points, the process of buffering is the same. First you will buffer the error patches:

1. Choose TOOLS → BUFFER WIZARD…
2. Select the layer: ***NO error Events*** and click NEXT



3. Click to create buffers AT A SPECIFIED DISTANCE
4. Enter the distance (e.g. **0.75**) and the buffer distance units (e.g. **Meters**)
5. Click NEXT
6. Click **NO** for an output that is not dissolved
7. Specify the name and location to save the new layer (e.g. **C:\Workspace\Patch.shp**)
8. Click FINISH

Now you will create the multiple buffer rings:



9. Choose TOOLS → BUFFER WIZARD…
10. Select the layer: ***1200m err Events*** and click NEXT
11. Click to create buffers AS MULTIPLE BUFFER RINGS
12. Enter the number of rings (e.g. **5**), the distance between rings (e.g. **1**), and the distance units (e.g. **Meters**)
13. Click NEXT

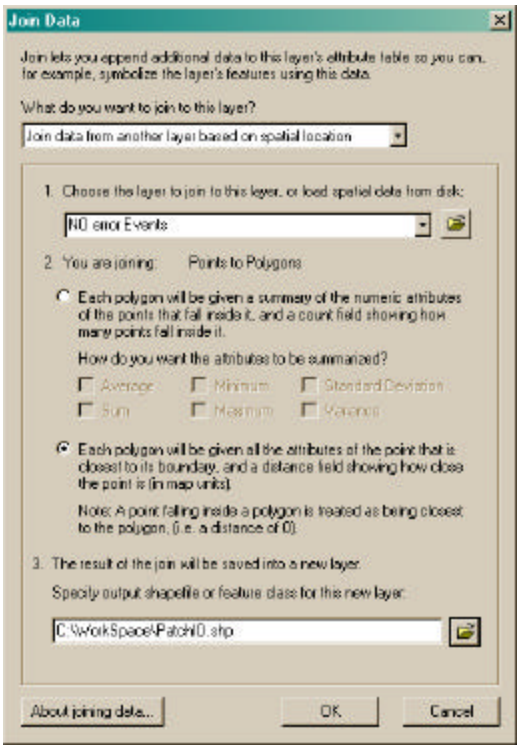
14. Click **NO** for an output that is not dissolved
15. Specify the name and location to save the new output layer (e.g. **C:\Workspace\BufferRings.shp**)
16. Click FINISH
17. IMPORTANT: Create a buffer identification layer by buffering ***1200m err Events*** AT A SPECIFIED DISTANCE using the greatest distance from the multiple buffer ring input (e.g. **5 Meters**)
18. Do NOT dissolve and save the output as **C:\Workspace\RingID.shp**
19. In attribute table, ADD FIELD called **[BufferID]** and calculate it as **`[FID] + 1`**

You may wish to check that the BufferID values in RingID.shp correspond to those in 1200m err Events.

Join attributes by spatial location to assign IDs

To help you keep patch and buffer ring identification straight, you must assign unique identification fields prior to unioning. The buffering process loses the original unique ID fields, but spatial joining reestablishes the link… very important if neighboring buffer rings overlap.

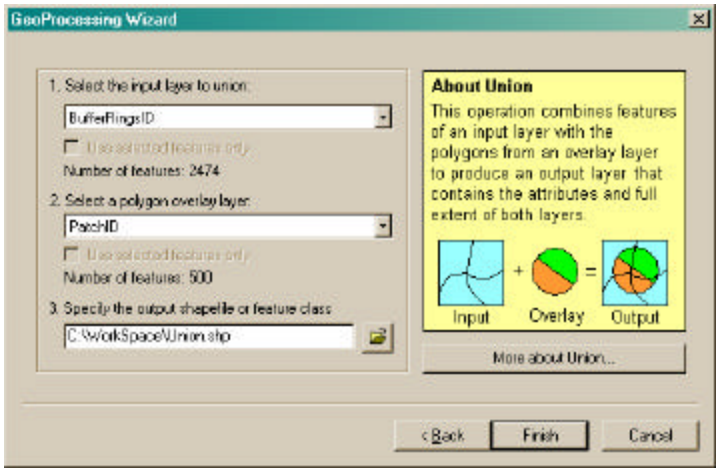
1. In the table of contents, right-click on ***Patch.shp***
2. Choose JOINS AND RELATES → JOIN…
3. Select to "Join data from another layer based on spatial location"
4. Select ***NO error Events*** as the layer to join
5. Click on the *second option* so that each polygon is given the attributes of the point closest to its boundary
6. Specify the name and location to save the new output layer (e.g. **C:\Workspace\PatchID.shp**)
7. Click OK
8. Repeat the above steps 1 through 7 for joining the attributes of ***RingID.shp*** to ***BufferRings.shp*** and save to a new output layer (e.g. **C:\Workspace\BufferRingsID.shp**)



The attributes from RingID.shp are joined because this layer consists of polygons; due to the nature of the spatial join, using the original points would cause misidentification in cases of overlap.

Union layers

1. Choose TOOLS → GEOPROCESSING WIZARD…
2. Click on UNION and click NEXT
3. Select ***BufferRingsID.shp*** as the input layer to union
4. Select ***PatchID.shp*** as the polygon overlay layer
5. Specify the name and location to save the new output layer (e.g. **C:\Workspace\Union.shp**)
6. Click FINISH



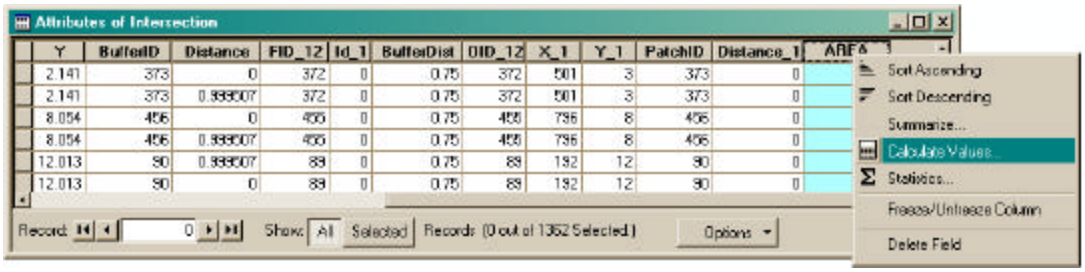
Manipulate fields and calculate area

All polygons outside of the patches and any overlapping neighbors must be deleted.

1. Choose EDITOR → START EDITING
2. Select ***Union.shp*** as the target layer
3. Choose SELECTION → SELECT BY ATTRIBUTES
4. Enter the expression: **`"PatchID" <> "BufferID"`**
5. Click DELETE

The following steps use VBA to perform the area calculations to an AREA field that you must add. (Note: If you have the XTools extension and are familiar with it then use it to quickly calculate the areas for the Intersection.shp layer. Make sure that the default properties are appropriately set.)

6. OPEN ATTRIBUTE TABLE for *Union.shp*
7. Click on the OPTIONS button
8. Choose ADD FIELD…
9. Specify **AREA** as the name, and **FLOAT** as the type; also enter the precision and scale desired (e.g. 8 and 4)
10. Right-click on the AREA column heading



11. Choose to CALCULATE VALUES…
12. In the Field Calculator dialog window, place a check beside ADVANCED

The following VBA script can be found in the ArcGIS Desktop Help file entitled "Making field calculations" (under "How to make field calculations → Updating area for a shapefile"):

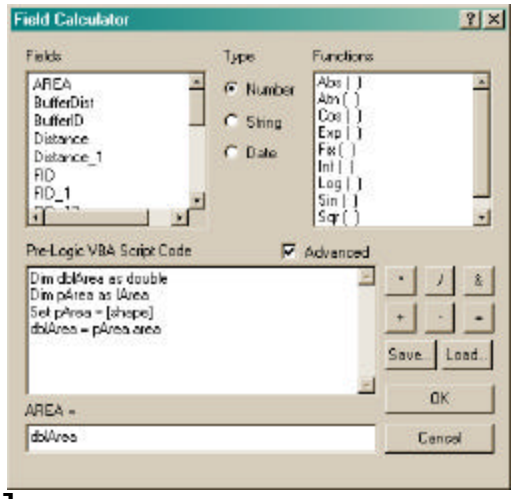
13. Enter the following VBA code in the Pre-Logic VBA Script Code window:

```
Dim dblArea as double
Dim pArea as IArea
Set pArea = [shape]
dblArea = pArea.area
```

14. Enter the following in the AREA = window:

```
dblArea
```

15. Click OK



To identify the patch and the buffer zone:

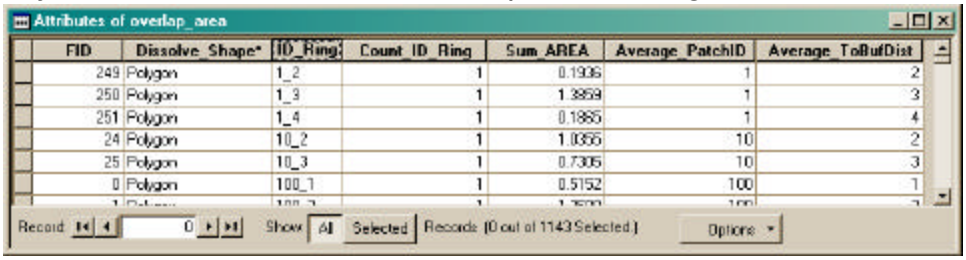
16. ADD FIELD named **[ID_Ring]**, of type **TEXT**, and width **6**
17. CALCULATE VALUES by entering:

```
[PatchID] &"_" & [ToBufDist]
```

Dissolve and summarize attributes

The [ID_Ring] field is used to dissolve Union.shp into a new output layer that also summarizes the area for each patch according to the buffer ring it intersects.

1. Choose TOOLS → GEOPROCESSING WIZARD…
2. Click on DISSOLVE and click NEXT
3. Select **Union** as the input layer to dissolve
4. Select **[ID_Ring]** as the attribute on which to dissolve
5. Specify the output as **C:\Workspace\Overlap_Area.shp**
6. Click NEXT
7. Choose the following fields to be included in the output:
    - AREA – SUM (this will add up all the area in each zone)
    - PATCHID – AVERAGE (this essentially copies the [PatchID])
    - TOBUFDIST – AVERAGE (this copies the [ToBufDist] field)
8. Click FINISH
9. OPEN ATTRIBUTE TABLE for ***Overlap_Area.shp*** to view the attributes that show you how much area of each multiple buffer ring coincides with each patch



10. Choose OPTIONS → EXPORT… if you wish to export the table for analysis in a spreadsheet or statistical software package