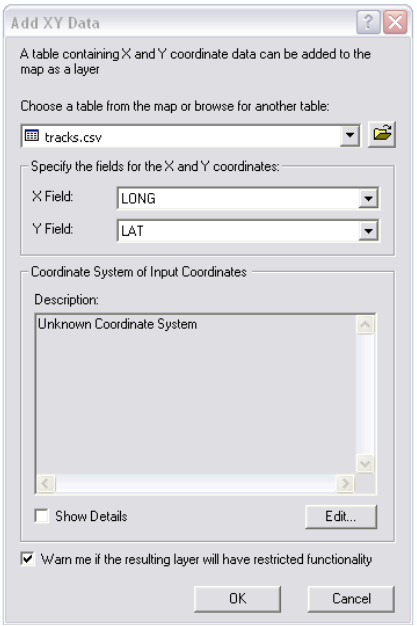
NOAA Ocean Satellite Course
Oregon State University, March 27-29, 2007.
Prepared by LTJG Luke Spence, NOAA CoastWatch

ArcFisheries: Fisheries Applications of Satellite Data and GIS

Yesterday we found out how to import data into ArcMap. Now we will use some of that data to carry out a sample analysis of the track of an animal, as reported by a satellite tag.

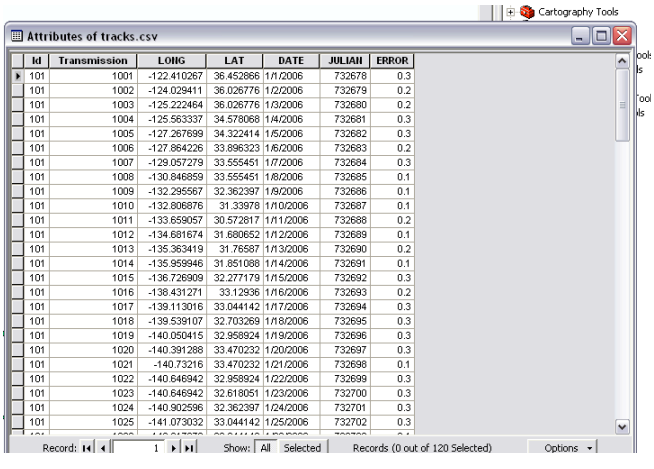
1. First, open ArcCatalog and navigate to your working directory. In your Personal Geodatabase, delete the raster datasets that we imported yesterday. Open ArcMap, and open a new, empty map. Add the file, "tracks.csv" to the map. Click to view the XY data you have just imported. Open the attribute table of the "tracks" table and notice the different fields present in the table and their values. Record the date and spatial range for the animal track.

- **To add tabular data:** In ArcMap, click on "File – Add Data". Navigate to your working folder and select the file that you want to add. Notice that the file is added under the "Layers" frame on the left hand side of the screen.
- **To view the table you just added:** Right click on the name of the table on the left hand side of your screen. Click "Open". A box will appear showing the different rows and columns of data in the table.
- **To add XY points to the map:** Click on "Tools – Add XY Data…" Choose the "tracks.csv" file in the dropdown list. Select the "long" field as the X field and "lat" as the Y Field.



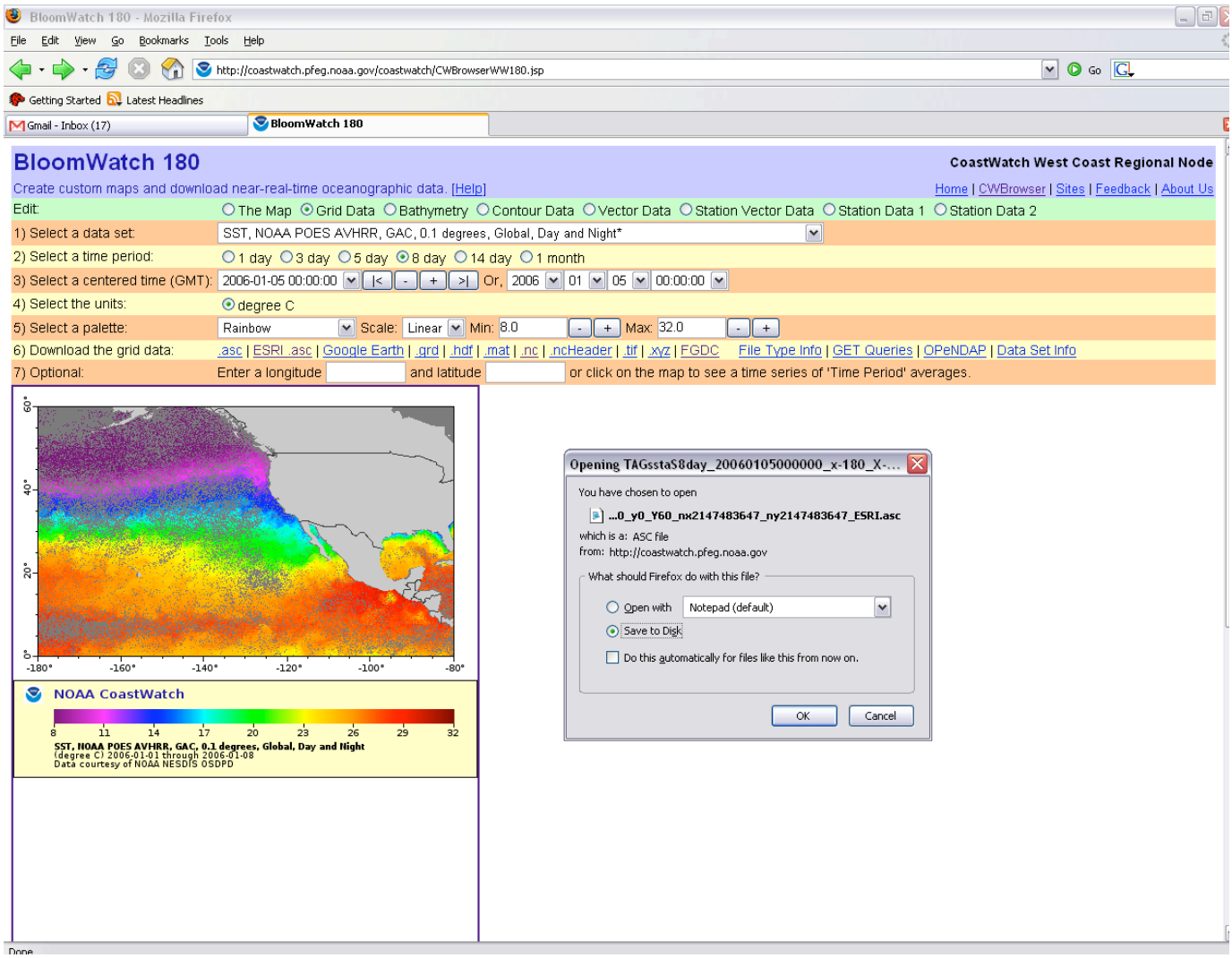
2. Open an internet browser and open the CoastWatch Browser homepage. Download a single sea surface temperature file corresponding to the first 8-days of the animals track. You should find a "SST, NOAA POES AVHRR, GAC, 0.1 degrees, Global, Day and Night", 8-day composite data file. The files from the CoastWatch Browser are identified by the center time for the observation period of the file. Be sure to get a file that covers as much of the animal's track as possible, but still contains data from the first satellite track measurement. Also, download a file that covers the entire spatial extent of the animals track.

- **To find the temporal and spatial extent of the track:** First we need to find the time period of the track that we want to analyze. In ArcMap, right click on the "tracks.csv" layer on the left hand side of the screen. Select "Open" or "Open Attribute Table". Check the field titled "Date" and note that the first location measurement was taken on

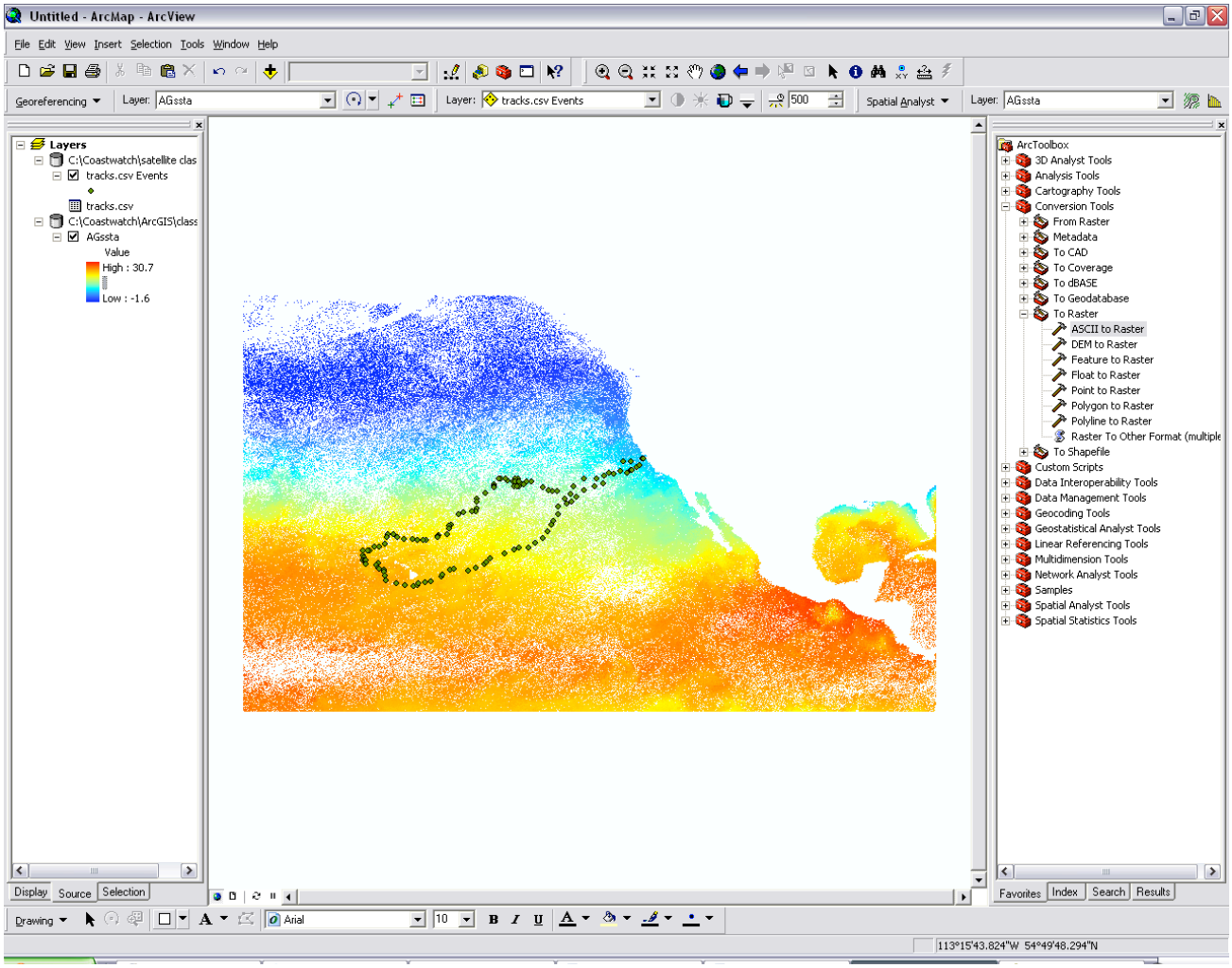


Jan. 1, 2006. Find the minimum and maximum values for the fields Lat and Long to define a rectangular box that contains our animal's entire track. Record these values (Latitude: 18.05N to 36.45N, Longitude: -162.83W to -122.26W)

• **To download SST data corresponding to the time and location of the animal track:** In an internet browser, navigate back to the CoastWatch 180 browser. On the top row, choose to edit "The Map". Choose a spatial extent that covers the animal's entire track by manually entering in latitude and longitude boundary values. Alternatively, you could select the predefined North Pacific region ("N Pacific"), which covers all the required area. Hit Enter once all the values are entered and wait for the Browser's map to update. On the top row, choose to edit "Grid Data". On the dataset dropdown list, choose ""SST, NOAA POES AVHRR, GAC, 0.1 degrees, Global, Day and Night". For Time Period, select "8 day". For centered time, select "2006-01-05 00:00:00". This time is the center of our 8-day window. The data composite begins 4 days prior (Jan 1, 2006) and ends 4 days later (Jan 8, 2006). Download an ESRI ASCII version of this data file by clicking on the "ESRI .asc" link.



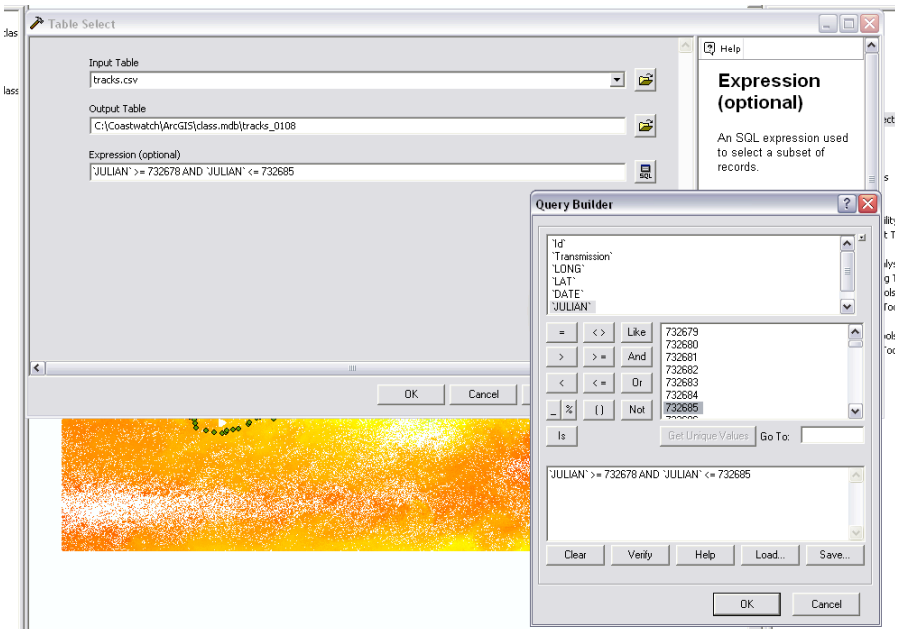
3. Import the ASCII file into ArcMap. For help with this, refer to yesterday's notes, or the instruction file: "arcsatellite instructions".



4. Now we'll extract the points in the animal track that correspond to the dates in the SST file we downloaded. View the dates in the table once more and write down the Julian dates that correspond to the dates of our SST composite. Extract the track points that are within the time period of our SST data. Remove all track points but the ones that correspond to the dates of the SST data.

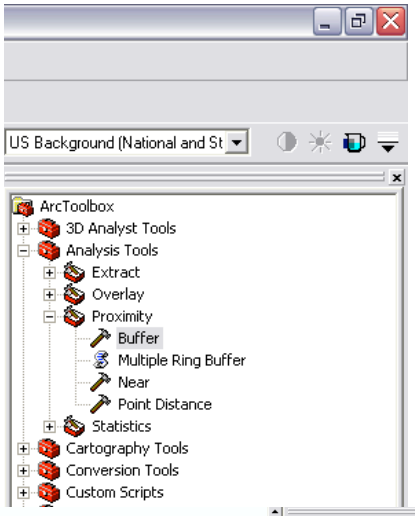
- **To extract points from the animal track table:** Open the Attribute Table once again and record the Julian dates for the time period of our SST data (Julian Dates: 732678 to 732685). In the ArcToolbox, expand "Analysis Tools – Extract " and run the "Table Select" tool. Choose "tracks.csv" for your input table, and choose a name for your output table (path should be your personal geodatabase). Click on the "SQL" button next to the Expression line to define the expression that will extract the desired data from the "tracks.csv" table. Build an SQL Query that will extract the points from the table with dates between Jan. 1 and Jan. 8, 2006. It is easiest to use the "Julian" field in your query. And it also works best to use the mouse to build your query by selecting the fields, operators, and values. This way, Arc builds your query using the correct syntax. It can be picky otherwise. Use the "Get Unique Values" button to select values directly

from the table you are querying. Click the "Verify" button to ensure your expression is valid, and then click OK to insert your expression into the "Table Select" tool. Run the tool.



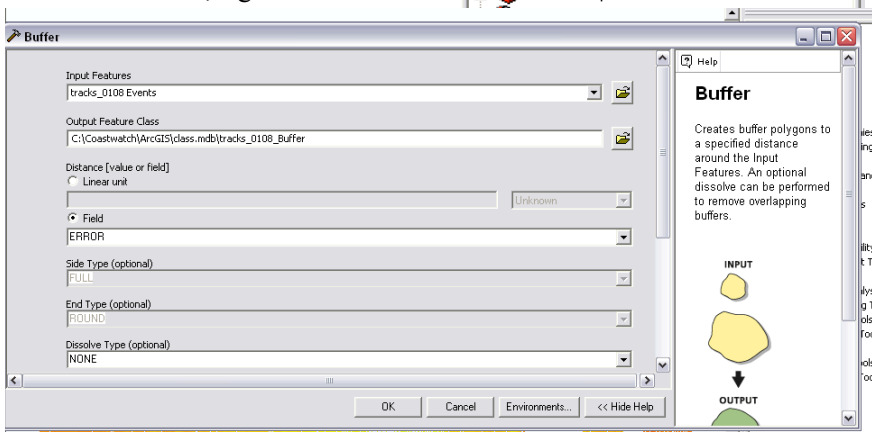
Once the tool has finished, open the new table to be sure that it extracted the correct values. As before, you will have to "Add XY Data…" to view the data that you have extracted in your open map. You will probably not be able to distinguish between the data that you just extracted and displayed, and the original track data that was displayed. Click on the checkbox next to the original track data on the layer frame on the left side of the screen to temporarily disable that display. Now you can clearly see the track of your animal from Jan. 1 to Jan. 8, 2006.

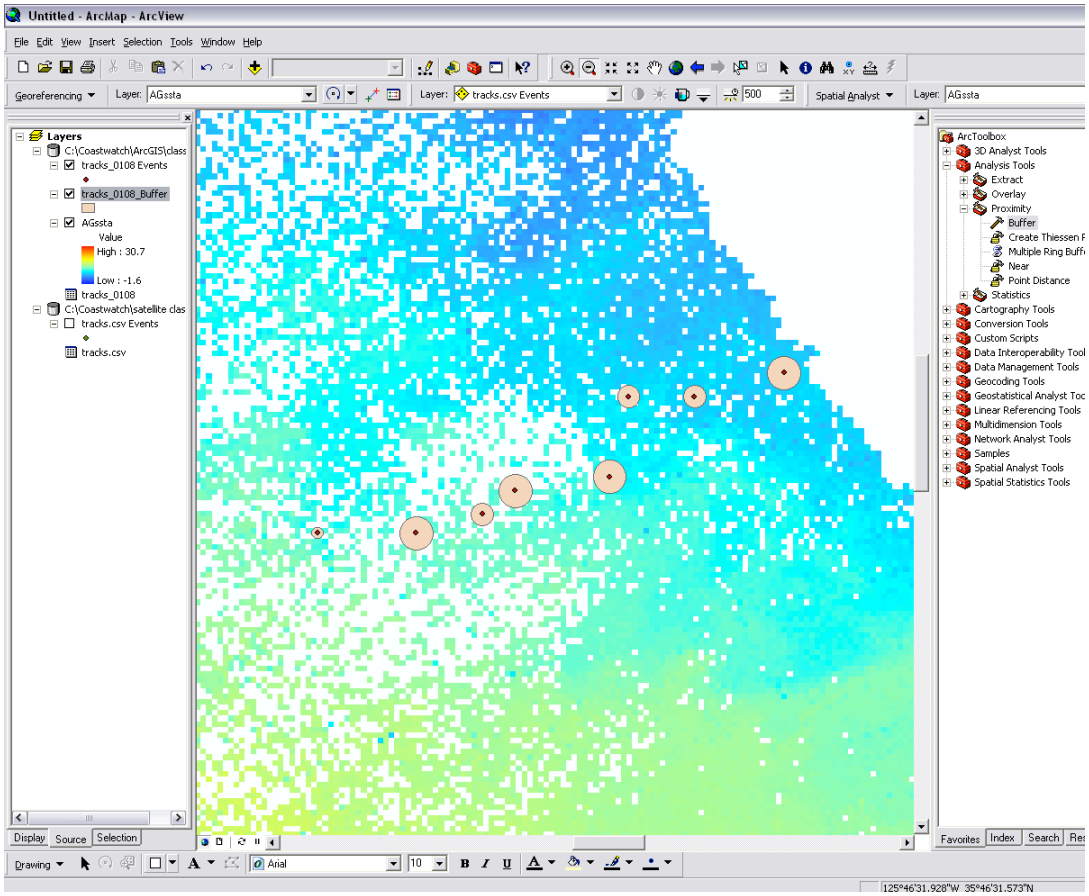
7. Now create a buffer zone around each point using the "Buffer" tool corresponding to the measurement error in the animal's position. You'll notice that the table of values for the animal track data has a field titled "error". This field shows the error (in decimal degrees) of the animal's position at that point. The errors range from 0.1° to 0.3°.



• **To Create a Buffer Around Each Point:** In the ArcToolbox, open "Analysis Tools – Proximity – Buffer". Choose the XY data that you just displayed on the map as the input, and choose a name for your output feature. For the buffer distance, choose the "field" option, and select the "error" field. The tool will look in the "error" field to find out how big to draw the buffer zone. Run the tool.

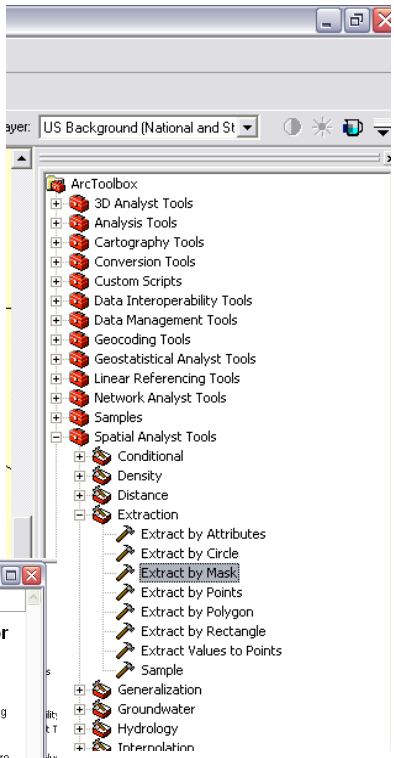
Once the buffer feature has been created, right click on the buffer feature's name and select "Zoom to feature". You can change the style of display of the buffer by clicking on the solid box under the buffer layer's name.

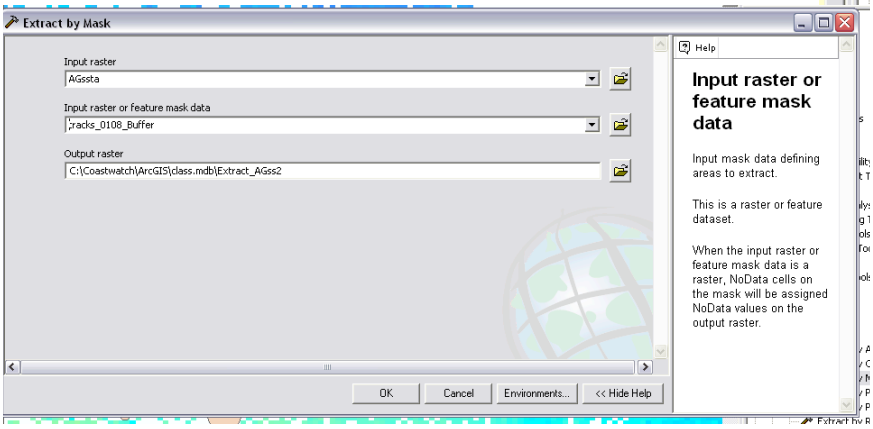




NOTE: Spatial Analyst Extension required for the remaining steps.

8. Extract the SST measurements lying inside each location's buffer zone using the "Extract by Mask" tool. This will create a new raster from the cells of the sea surface temperature that fall within the buffered zones of the animal track.

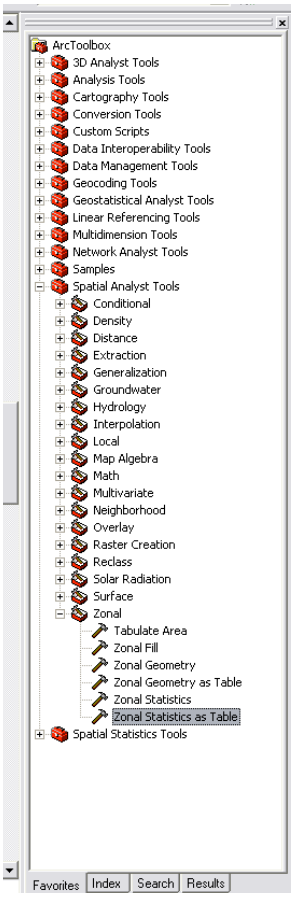




- **To extract the SST from the buffer zones: :** In the ArcToolbox, open "Spatial Analyst Tools – Extraction – Extract by Mask". Choose the SST raster as the input raster. Select the buffer layer just created for the "Input raster or feature mask data". Choose a name for the new raster extraction. Run the tool. A new raster is added that only contains cells that fall within the buffer circles of the animal track.

9. Calculate statistics based on the extracted SST. Use the "Zonal Statistics as Table" tool to calculate the mean, standard deviation and other statistics of the SST pixels within the track buffer zones.

• **To calculate statistics on the extracted SST:** In the ArcToolbox, open "Spatial Analyst Tools – Zonal – Zonal Statistics as Table". For the "Input raster or feature zone data", choose the feature layer that defines the buffer zones around each track location (created with the "Buffer" tool). For the "Zone Field", choose a field in the buffer zones attribute table that will have a unique value for each buffer circle. Either "Transmission" (corresponding to the tags transmission attempt identifier) or "Julian" (corresponding to the Julian date of transmission) will work. For "Input Value Raster", choose the SST raster that we just created with the "Extract by Mask" tool. For the "Output Table", make sure the path is in your personal geodatabase, and choose a name for the output table. Run the tool.



Under the layers panel on the left hand side of the screen, make sure that the "Source" tab is selected (it's near the bottom of the screen). You should see the table that you just added with the "Zonal Statistics as Table" tool. Open it to see the statistics that were calculated for each buffer zone.