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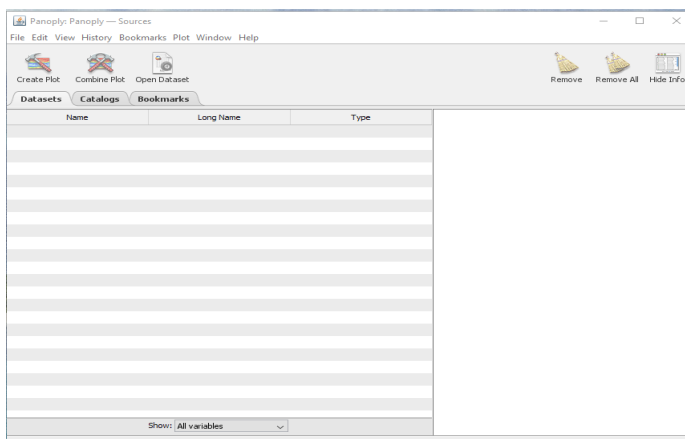8310 154th Ave NE, Suite 150
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HOW TO USE PANOPLY WITH YOUR GPE3 DATA

The output file for GPE3 can be quite large. Wildlife Computers created a georeferenced raster—NetCDF— file, that contains location estimates for each noon and midnight throughout the deployment as well as monthly residence distributions. Panoply is a simple NetCDF visualization tool that was developed by the NASA Goddard Institute for Space Studies that helps visualize your GPE3 data.

1. **Download Panoply**—Panoply can be downloaded for free at https://www.giss.nasa.gov/tools/panoply Panoply requires Java SE 8 (or later version). If you need further help with Java, visit: https://www.bitde-gree.org/learn/verify-java#how-to-verify-java-versions

2. **Open the Panoply Program**— After loading, you will see the user interface. Since you have not imported data, the interface will appear blank.

3. **Load Your Data into Panoply**—You will need to upload a *.nc file (NetCDF). You can obtain your NetCDF file after downloading your data from the Wildlife Computers Data Portal in the GPE3 data file.

After extracting the .zip file from the data portal, import the extracted .nc file into Panoply by either:

- Selecting the .nc file directly from the data folder and dragging the file into the blank Pano-ply interface window.

- Selecting the File menu on the top of the Panoply screen and browsing for the .nc file.

After importing the .nc file, the Panoply window will automatically display several datasets and selectable rows.

4. **Creating a Satellite Plot**—In the example, there are nine viewable datasets on the Panoply screen.

   Open the row "twelve_hour_likelihoods." This row provides a good first look and visualization of the GPE3 model in 12-hour segments.

   Double-click to open a new window called "Create Plot." You will be offered three choices, select "Create a geo-referenced Longitude-Latitude plot."
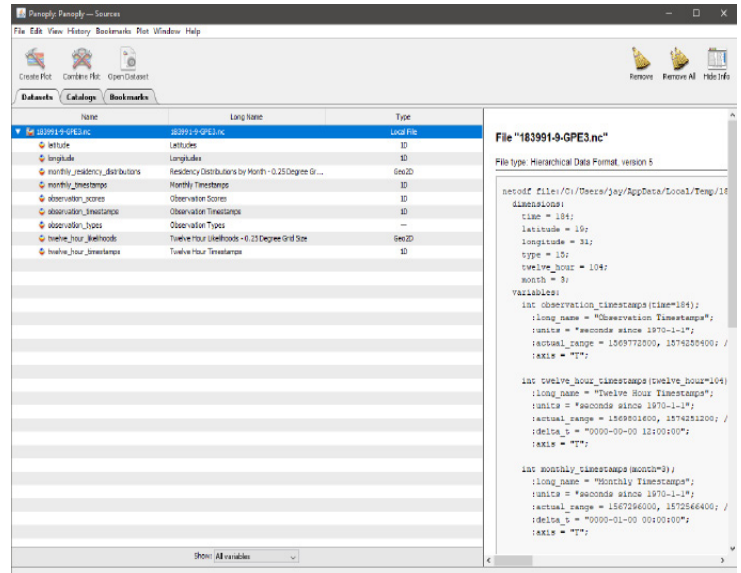

Each Geo2D array is a set of 0.25 by 0.25-degree gridded surfaces containing likelihood scores. Each layer of the set represents a surface for a given point in time.

- twelve_hour_likelihoods—this set of surfaces represents locations at noon and midnight for each day. This array is most useful for merging and averaging surfaces from more than one animal.

- monthly_residency_distributions—for each month, the twelve_hour_likelihood surfaces are averaged together grid by grid. The resulting value in every grid cell is the time, expressed as a percentage of the month, that the animal spent in each grid cell.

5. **Viewing Your Satellite Plot**—Once a plot is created, a geospatial map of the earth's surface will appear with colored squares indicating the output of the GPE3 model. In the figure, the start of the distribution model is indicated by the blue squares seen in the Gulf of Mexico.
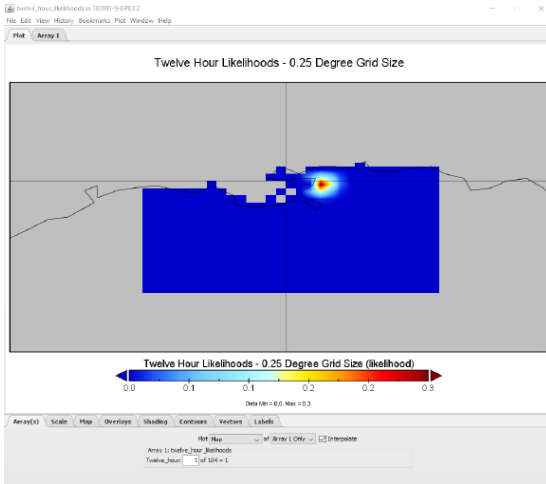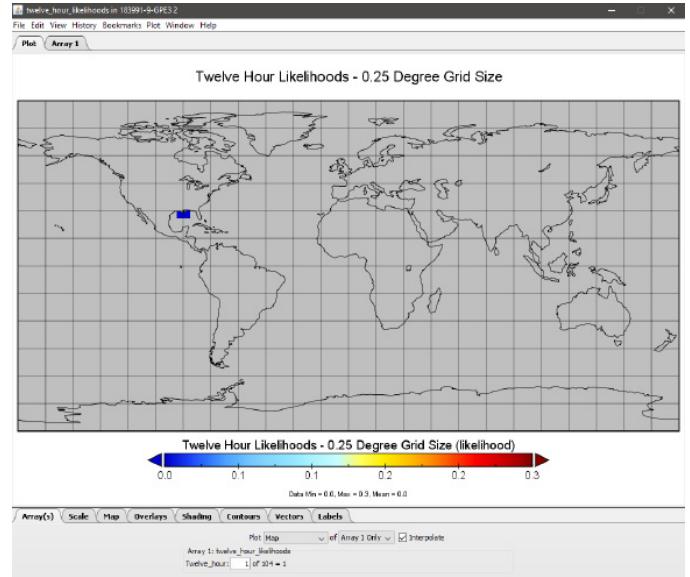
For many users, the initial geospatial map is too broad. To zoom in, hold Ctrl on your keyboard and drag your mouse diagonally across the area you wish to magnify. Magnifying the map lets you view the blue area that represents the model area considered in the GPE3 processing.

6. **Refining the Gridlines on Your Plot**—For ease of reference, we recommend adjusting the grid spacing to that of the GPE3 model=0.25 by 0.25-degree spacing. In Panoply, the grid array does not automatically display the aforementioned gridded surface spacing.

To overlay a grid on the geospatial map, select the "Map" tab at the bottom of the screen. On the right side, select "Grid" and adjust the spacing options to the gridded surface interval of interest.
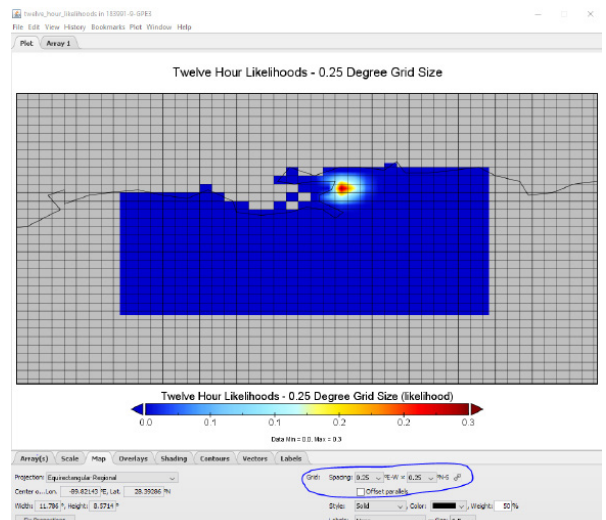

12-hour likelihood plot with 0.25-degree surface spacing. The area circled is the location of the grid spacing controls.

7. **Viewing Movement of Your Tag Over Time—** Select the "Array(s)" tab in the lower window to display each 12-hour segment from the beginning of the deployment to the end. The example shows the selection of array 1 of 104 individual 12-hour time periods. To move through all 104 arrays, place your cursor on the number of the array displayed. On your keyboard, select the UP ↑ or DOWN ↓ arrows to move the map continuously through each 12-hour segment. You can also type in a specific number to view that 12-hour segment.
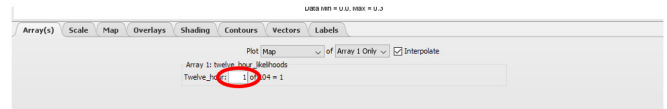
8. **Exporting a Video of Your Tag's Movement Over Time—** Panoply offers you the ability to export the animation of the distribution over time. To export the video animation: Go to File > Export Animation. A prompt will appear. You can then choose your frame rate and video format.

9. **Exporting the Likelihood Data—** You may wish to conduct analyses using the full likelihood surface data. To export all 12-hour likelihood surfaces, select that dataset in the main Panoply window and go to File > Export > Export Data. Panoply offers you the ability to export results in a couple of formats that can be post-processed using your analytical tools of choice.
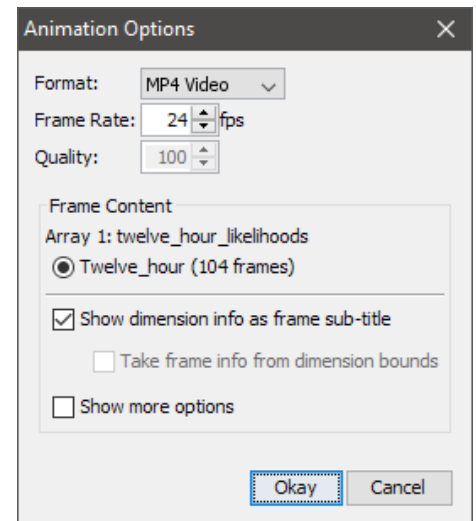
With Panoply as a diagnostics and visual tool for your GPE3 data, you can further understand the area encompassing the likely path taken by your tag and better display and export your data to share with colleagues. For more information on using Panoply's features, visit https://www.giss.nasa.gov/tools/panoply/help

Notes for Analysis of Movement

When viewing the movement of your tag, if the "track" appears to follow an invisible (or visible) grid line and turns 90 degrees either horizontally or vertically, this may indicate that the GPE3 output and dataset imported into Panoply has room for improvement.

Movement that appears to be limited to just a few grids or follows a single grid line for a long period of time may indicate that the speed selected during location processing is too slow, or that the area your tag covered is too small to resolve the movements between time steps in the model. The resolution of the GPE3 model is 0.25 degrees and, in general, errors associated with light-based geolocation can be on the order of a degree or more. If your tag did not move more than two degrees in any direction, GPE3 may not be the best method to resolve movements. If your tag did move over a distance of at least two degrees in any direction, you may be able to improve the model output by returning to the Wildlife Computers Data Portal to increase the location processing speed. It can be informative to try multiple location processes by increasing speed in 0.5 m/s steps, then repeat the Panoply visualization.