

Location Processing (GPE3 & Fastloc®) in the Wildlife Computers Data Portal User Guide

This user guide will give you all the essential information needed for processing location data within the Wildlife Computers Data Portal.

Table of Contents

Location Processing Overview.....	3
Fastloc Solver	3
GPE3	4
Preparing the Dataset.....	4
Reviewing the Dataset.....	5
Setting Start and End Points.....	6
Known Locations Via Double Tagging (Acoustic or SPOT Tags) or Other External Sources	9
Clock Error Corrections.....	10
Navigating the Location Processing View	11
Fastloc or GPE3 Processor?.....	12
Fastloc Processor	13
GPE3 Processor.....	15
Keeping Tabs on Processing Status	16
Viewing and Downloading the Results—Default Runs.....	17
Cleaning Up.....	21
Appendix—Jumpstart NetCDF in R.....	21
Appendix—Troubleshooting GPE3.....	22
Contacting Wildlife Computers	24

Location Processing Overview

The Wildlife Computers Data Portal currently provides two services for post-processing tag location data.

1. A tool for calculating locations from Fastloc® snapshots, satellite ephemerides, and seed locations.
2. A statistical model for estimating animal movements as time-discrete gridded probability surfaces using primarily observations of twilight, sea surface temperature, and bathymetry.

The tag data, reference data, settings, as well as the resulting processing outputs, are all stored in the data portal. These data are available for sharing with collaborators or downloading in a number of file formats.

This guide assumes the reader is familiar with our tags, the data portal, and the portal's many features.

Fastloc Solver

Tags equipped with a Fastloc receiver provide locations approaching the quality of those obtained from traditional GPS receivers, and can do so even when the tag is only at the surface for a very short period of time. The Fastloc receiver achieves this by taking a quick (i.e. fraction of a second) snapshot of the radio signals produced by overhead GPS satellites. These signals are processed onboard the tag and compressed into a snapshot containing just the satellite ID numbers, their respective pseudo ranges, and a timestamp. Compression of the snapshot is optimized for transmission over Argos and can also be stored in the tag's archive if equipped. These snapshots must be post processed by a computer to generate a location. In addition to the time-stamped snapshot itself, the post processing tool requires information about the GPS satellites' positions in the sky (i.e. satellite ephemerides), as well as a rough estimate of location (i.e. seed location). The solver uses all of this information to solve for a location.

To get the most accurate locations, the snapshot's timestamp must be accurate. The data portal provides clock error detection and time stamp correction. Typically tags communicating via Argos send their current time which can be matched to the received time of the message. The data portal keeps tabs on any error and will adjust the timestamp of the snapshots accordingly.

It is important to note that each snapshot is solved in isolation from other snapshots. There is no statistical movement model or location smoothing at play. However, the solution from one snapshot can be used as a seed location of another snapshot. The takeaway message is that a location derived from a given snapshot can change slightly if re-processed with new information about the tag's clock error, or a different seed location is used.



GPE3

Unlike the Fastloc-GPS processor discussed above, GPE3 is a statistical processing tool (i.e. State-space model) that estimates animal movements from tag data. Typically, tags provide observations of twilight, sea surface temperature, and dive depth. GPE3 uses those observations and their corresponding reference data, along with a simple diffusion-based movement model, to generate time-discrete and gridded probability surfaces throughout the deployment. Grids are 0.25 Degrees of Latitude and Longitude. From these surfaces, the most likely animal location for a given time can be derived. One can also estimate residency of an individual or a group from these results. GPE3 allows the inclusion of known locations from independent observations (e.g. visual sightings, moored acoustic arrays, etc.)

Preparing the Dataset

During a deployment on an animal, a tag gathers and reports a set of observations that the location processors will use as inputs. These observations must be available in the data portal, complete with the associated metadata. For archival tags (or recovered pop-up tags), the tag data needs to be uploaded manually into the portal. For datasets transmitted from the tag and received by Argos or Motes, the data portal can be configured to collect and organize the data for you. In either case, your dataset will appear as a row in the data portal viewer. It is essential that the dataset be properly prepared prior to processing.



Note: GPE3 processing should only be performed on the complete data set since it runs a forward-backward algorithm over the entire data set. However, since Fastloc is processed on a snapshot by snapshot basis, these data can be processed in near real-time.

From time-to-time, PTT IDs may be reused and therefore a row in the data portal may contain multiple datasets. The portal has a feature for splitting a row into discrete datasets. This action must be taken before processing begins.

Preparing the dataset involves the following steps:

1. Reviewing the dataset to ensure the tag was associated with the animal for the entire deployment.
2. Setting the Deployment Start and Deployment End points (assuming the deployment is complete).
3. Including any additional known locations.
4. Reviewing and accepting any clock error corrections.

Reviewing the Dataset

Without any user intervention, the portal will simply assume that each and every observation within a deployment (i.e. row) is valid and will include each and every observation in the location processing. However, a tag may report observations that are outside your period of interest and you may not want them included. You can use the metadata editor to set an arbitrary date range without having to manually remove unwanted observations from the dataset. The following describes some of the more common situations where this might occur.

A tag may be set to start recording data prior to being deployed on an animal. This is quite common with implanted archival tags such as the Mk9 or the tagged animal may be held captive for a period of time prior to release. In these situations, there may be several observations of twilight, SST, Fastloc, etc. at the beginning of the dataset that should not be included in the processing.

Further, a predation event could render the later part of a dataset inappropriate for inclusion in the processing. In the following MiniPAT example, the portal shows the Release Date as 12-June-2012 at 23:00. However, upon closer investigation of the data, the temperature trace indicates a rapid rise in temperature and the Dawn_Dusk trace shows absence of light. The evidence suggests that the tag was ingested on 3-June-2012 at 13:35. The tag has therefore reported 9 days of meaningless observations.



Setting Start and End Points

As described in the previous section, it is important to set valid Deployment Start and Deployment End dates, and locations if those are known. This operation is performed in the Metadata editor. Selecting a single deployment (i.e. row) in the Data Portal will enable the Metadata button allowing you to enter or modify the Metadata for that dataset. Selecting multiple deployments (i.e. rows) will disable the Metadata button.

WILDLIFE COMPUTERS | My Tags | My Data | My Motes | My Users

View Data | Download | Labels | Metadata | Advanced | Location Processing | Report | Link Argos Account

Owner: wctagger@gmail.com | Show Deployments: All | Filter: Filter by Prog #, PTT Id

Prog #	PTT	Serial	Decoded As	First Uplink Date	Last Uplink Date
5152	115742	N/A	MiniPAT	09-May-2013 03:46	20-May-2013 11:42
5152	115743	N/A	MiniPAT	21-Jul-2012 22:12	02-Aug-2012 16:36
5152	115744	N/A	MiniPAT	17-Aug-2013 02:31	30-Aug-2013 22:55
5152	115745	N/A	Unknown	02-Sep-2013 14:59	02-Sep-2013 14:59
5152	115745	N/A	MiniPAT	07-Oct-2013 22:27	24-Oct-2013 17:27
5152	115746	N/A	MiniPAT	12-Jun-2012 23:18	24-Jun-2012 20:44
5152	115747	N/A	Unknown	21-Jun-2012 07:19	21-Jun-2012 07:19
5152	115747	N/A	MiniPAT	13-Aug-2013 23:42	26-Aug-2013 11:20
5152	115748	N/A	MiniPAT	25-Jun-2012 22:18	06-Jul-2012 09:37
5152	115749	N/A	MiniPAT	01-Oct-2012 22:42	13-Oct-2012 22:02
5152	115750	N/A	MiniPAT	01-Oct-2012 21:38	13-Oct-2012 16:29

After clicking the Metadata button, the metadata editor window will open for the specific deployment. Selecting the Deployment Dates/Locations tab will take you to the editor where you will enter the Deployment Start and End dates and locations. Initially, the Deployment Date and End fields will be blank (read N/A) until you edit each row by clicking the blue pencil icon.

PTT 115746 - Deployment Metadata

Deploy Id | Clock Corrections | Deployment Dates/Locations | Comments

Type	Date	Lat.	Lon.	
Deployment Start	N/A	N/A	N/A	
Deployment End	N/A	N/A	N/A	

Add Other Location +

Close



Note: Without making these edits, all of the data ranging in time from First Data Date to Last Data Date will be used.

As a convenience, the data portal will use the First Data Date value from your selected row to pre-populate the Deployment Start date for you in the editor. Since the tag in this example is a MiniPAT which started recording using its auto-deploy feature, we will accept the proposed start date. Otherwise, you can manually enter an appropriate Deployment Start date. You can also manually enter a Deployment Start location if you know it.

Edit Start Location ✕

Date:

Latitude (±90): Longitude (±180):

Date prefilled with first data date.

Now that the information for the Deployment Start has been saved, a red “X” appears next to the blue pencil in case you make a mistake and want to enter different data.

PTT 115746 - Deployment Metadata ✕

Deploy Id	Clock Corrections	Deployment Dates/Locations		Comments
Type	Date	Lat.	Lon.	
Deployment Start	16-May-2012 02:00	20.5	-150.5	✎ ✖
Deployment End	N/A	N/A	N/A	✎
Add Other Location				+

This process is repeated for the Deployment End. Depending on the tag type, the data portal may pre-populate values for the Deployment End date and location. Here are the rules:

- Archival Tags (Mk9, SPLASH10, recovered MiniPAT):
 - Deployment End Date—pre-populated with Last Data Date
 - No end location is suggested
- Pop-up Tags (MiniPAT, Mk10)
 - Deployment End Date is pre-populated with Release Date if it is known, Last Data Date otherwise
 - Deployment End Location is pre-populated with the first-best Argos Location if available. The time between this location and the Time will be reported



Note: Release Date is a value transmitted by pop-up tags in status messages and indicates the time when the tag initiated release.

Clicking the blue pencil to edit the Deployment End data presents the window at the right. Since this example is of a MiniPAT, we are given a pre-populated date of 12-June-2012 and location. But since we know this tag was ingested on 3-June 2012, we will make the required changes. Also, since there are about nine days between the predation event and the first Argos location, we will delete the Deployment End location values.

Edit End Location✕

Date:

Latitude (±90): Longitude (±180):

Proposed End Date is the reported Release Date. Location is first reported Argos Location. Class 2, 1h 25m after release.

Save

Close

After the changes are made and the Save button is clicked, we will see the dates and location as expected.

PTT 115746 - Deployment Metadata✕

Deploy Id	Clock Corrections	Deployment Dates/Locations	Comments
Type	Date	Lat. Lon.	
Deployment Start	16-May-2012 02:00	20.5 -150.5	✎ ✕
Deployment End	02-Jun-2012 15:00	N/A N/A	✎ ✕
Add Other Location			+



Note: The Deployment Start and End locations (if applicable) will be displayed in the map view tab in the main data portal view.

Known Locations Via Double Tagging (Acoustic or SPOT Tags) or Other External Sources

There may be times throughout a deployment when an animal's location is known by independent observation. Perhaps, the animal was double tagged with an acoustic pinger and was detected by an acoustic data logger array. Or perhaps the animal was double tagged with a separate SPOT tag that generated occasional Doppler locations via Argos. The portal allows you to enter these known locations and their associated date ranges and will include these in the GPE3 movement model as a set of extremely high probability observations, or in the Fastloc-GPS solver as seed locations. There are two methods available to enter this data; Add Other Location and Add Other Location (Batch).

Type	Date	Lat.	Lon.
Deployment Start	28-Jul-2014 17:20:00	N/A	N/A
Deployment End	21-Nov-2014 11:00:00	10	10
Add Other Location			+
Add Other Locations (Batch)			+

'Add Other Location' will allow you to enter a single location and a date, or date range for that location. Allowing for a date range is handy if the animal was known to be in an area for period of time. 'Add Other Location (Batch)' is handy if you have a list of known and differing locations and associated dates generated from say a SPOT tag. In this case, the locations from the SPOT tag should be downloaded to your computer, filtered so that you are using the best locations (i.e. remove outliers), and then pasted into the text box. The following shows 4 illustrative dates and locations that were copied and pasted directly from Excel.

Clicking the Add button will generate a message indicating that the location(s) were added. The locations will appear as type "Other" in the list.

One location per line, format should match the following.
 dd-MMM-yyyy<delim>hh:mm:ss<delim>latitude.dddd<delim>longitude.dddd
 Where <delim> can be space, comma, or tab.

```
30-Jul-14 11:11:11 10 10
30-Aug-14 11:11:11 11 11
30-Sep-14 11:11:11 12 12
30-Oct-14 11:11:11 13 13
```

PTT 123456 - Deployment Metadata				
Deploy Id	Clock Corrections	Known Dates/Locations		Comments
Type	Date	Lat.	Lon.	
Deployment Start	28-Jul-2014 17:20:00	N/A	N/A	
Other	30-Jul-0014 11:11:11	10	10	
Other	30-Aug-0014 11:11:11	11	11	
Other	30-Sep-0014 11:11:11	12	12	
Other	30-Oct-0014 11:11:11	13	13	
Deployment End	21-Nov-2014 11:00:00	10	10	
Add Other Location				
Add Other Locations (Batch)				



Note: Longitude data in the portal are always in the format -180 (West) to + 180 (East).

This method of adding extra known locations is not needed if the deployment contains the extra data! For example, if you are processing the Fastloc data from a tag that also generated Argos Doppler locations, then those Argos locations will automatically be included as observations (seed locations) for the Fastloc processing.

Clock Error Corrections

Each and every tag uses an internal clock to timestamp all of its reported observations. Error in the clock, and therefore the timestamps, can cause an error in the derived locations. The data portal allows clock errors to be corrected if a measure of the error is known. For satellite tags, the current tag time is transmitted in the satellite uplink and compared with the satellite's clock. For archival tags, any known clock error measurements will need to be entered manually.

The data portal will automatically extrapolate any errors over the entire deployment's dataset. But extrapolation can be dangerous especially if there are few measurements of error, or there is an erroneous error point. It is essential to review the applied clock corrections and determine if the amount of error being corrected is reasonable. You can choose to accept the corrections that the portal proposed or you can add additional corrections.

PTT 115746 - Deployment Metadata
✕

Deploy Id
Clock Corrections
Deployment Dates/Locations
Comments

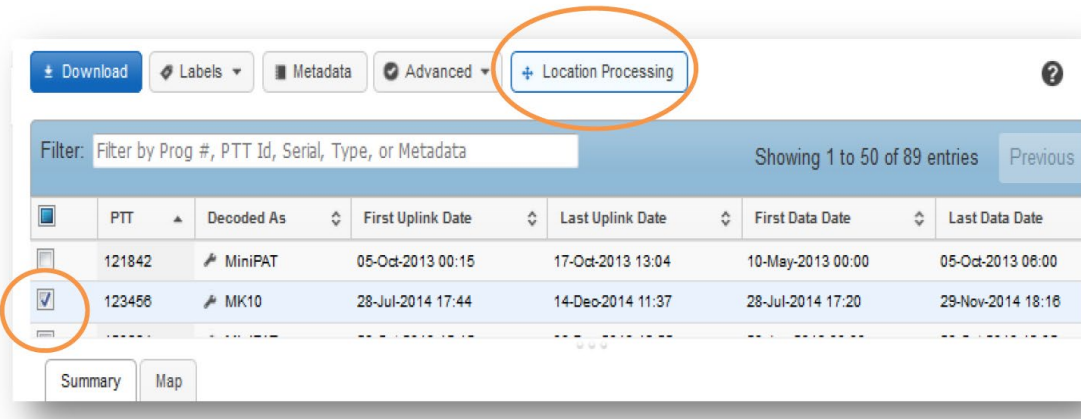
Type	Date	Correction	
Status	16-May-2012 02:00	2s	✓
Status	12-Jun-2012 23:18	5s	✓
Status	23-Jun-2012 22:15	6s	✓
Add Clock Correction			+

Close

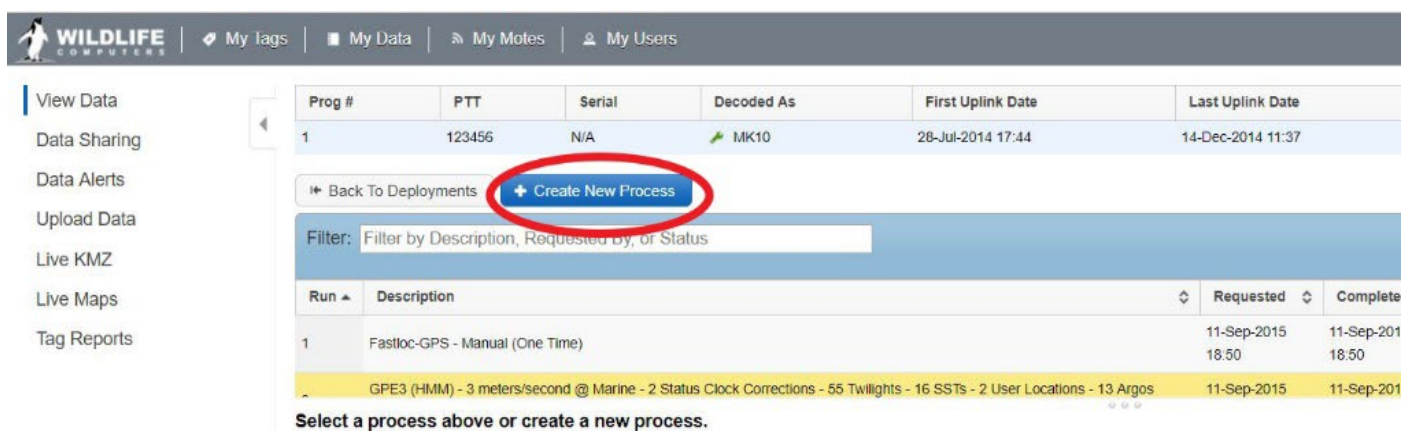
The amount of expected clock error varies by tag type. Tag models such as MiniPAT and SPLASH10 have a high-quality temperature-compensated clock and errors typically range over a few seconds. Anything less than 30 seconds of error will have negligible effect on the output of GPE3. Errors should be corrected to within 10 seconds for Fastloc processing.

Navigating the Location Processing View

Selecting a single row in the data portal will enable the Location Processing button. Location processing will only refer to the deployment that is selected. Therefore, selecting multiple deployments (i.e. rows) will disable the Location Processing button. Also, the portal will only enable the Location Processing button if there are location data to process. You can confirm the presence of location data for a single row by clicking the Summary Tab and reviewing the content of Message Summary.

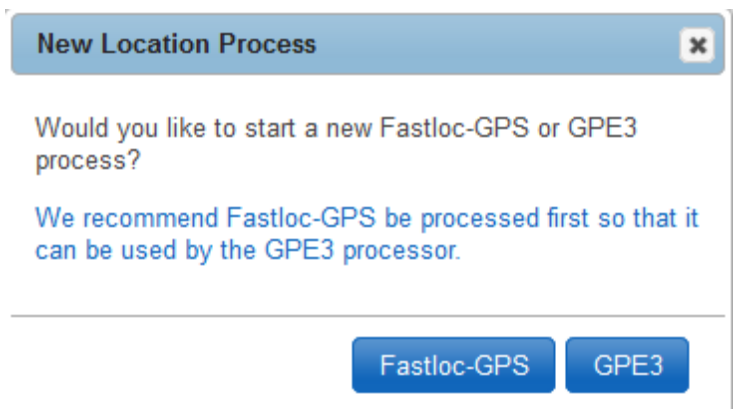


Clicking the Location Processing button will open the processing view for the selected deployment. This view will show the referenced deployment, any past processing jobs, and the Create New Process button. The following graphic highlights the Create New Process button.



Fastloc or GPE3 Processor?

When you ask the portal to create a new process, the portal will check to see if the deployment contains Fastloc data and/or Twilight data. If both are found, the portal will prompt you to choose which type of process to run. Unlike conventional GPS receivers that resolve locations to a latitude and a longitude, Fastloc captures only preliminary



data onboard the tag. That data must be post-processed into locations. Some of our more advanced tags return twilight data as well as Fastloc data. This can be very helpful for tracking animals that spend part of the year at the surface but the other part of the year down deep where GPS signals cannot be detected and GPE3 type processing is required. When the GPE3 processor detects that Fastloc solved locations are available, it can use the locations in the overall GPE3 model and improve the results significantly. We therefore recommend running the Fastloc solver first if those data are present.

Fastloc Processor

In this example, the tag contained both types of data so we will choose to run the Fastloc processor first.

The screenshot displays a web interface for the Fastloc Processor. At the top, a table lists deployment details for a specific tag. Below this, there are navigation buttons for 'Back To Deployments' and 'Create New Process'. The main area is divided into two tabs: 'Model Parameters' and 'Results'. The 'Model Parameters' tab is active, showing a 'Processing Interval' dropdown menu set to 'Manual (One Time)'. To the right, there is a 'Start Fastloc-GPS' button. Below the 'Processing Interval' dropdown, a table titled 'Known Dates/Locations' shows deployment start and end dates with corresponding coordinates.

Prog #	PTT	Serial	Decoded As	First Uplink Date	Last Uplink Date	First Data Date	Last Data Date
1	123456	N/A	MK10	28-Jul-2014 17:44	14-Dec-2014 11:37	28-Jul-2014 17:20	29-Nov-2014 18:16

Processing Interval
Manual (One Time)

Known Dates/Locations				
✓	Date	Type	Latitude	Longitude
✓	28-Jul-2014 17:20	Deployment Start	56.63	-6.46
✓	21-Nov-2014 11:37	Deployment End	55.51	-6.966

Within the Model Parameter tab, you are given the option of when to run the Fastloc processor. This is referred to as the Processing Interval. Currently, you have three choices selectable in the drop-down menu.

- Manual (one time)
 - This is the default selection and will only process the data currently contained within the deployment. Any data that might arrive after a manual process is initiated will not be processed. You should choose manual processing if your tag has finished transmitting and the complete dataset is available, or if the complete dataset has been uploaded to the data portal manually.

- On New Snapshot (automatic)
 - This selection will cause the processor to run each time a new snapshot is added to the deployment. You should choose this option if your tag is actively transmitting snapshot data and you need the most up-to-date location.



Note: This selection adds significant burden to the servers as the processor will re-run all of the data contained within the deployment, not just the newly arrived data.

- Timed (automatic)
 - This selection will cause the processor to run every 12 or 24 hours based on your selection. You should choose this option if your tag is actively transmitting snapshot data and you want to keep track of your animal's location in near real time.

After choosing the appropriate Processing Interval and confirming the Deployment Start and End Dates/Locations, you can click the Start Fastloc-GPS button on the far right. Once the process is complete, the process will show as a run. In this case, we will see below that Run #1 is listed as Fastloc-GPS-Manual and the Status is showing as Completed.

PTT	Decoded As	First Uplink Date	Last Uplink Date	First Data Date	Last Data Date
123456	MK10	28-Jul-2014 17:44	14-Dec-2014 11:37	28-Jul-2014 17:20	29-M

[← Back To Deployments](#)
+ Create New Process

Filter: Showing 1 to 1 of 1 entries

Run	Description	Requested	Completed	Requested By	Status
1	Fastloc-GPS - Manual (One Time)	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed

GPE3 Processor

Click the Create New Process button to setup a new GPE3 process.

The screenshot shows the Wildlife Computers interface. At the top, there are navigation links: My Tags, My Data, My Notes, and My Users. On the left, there is a sidebar with options: View Data, Data Sharing, Data Alerts, Upload Data, Live KMZ, Live Maps, and Tag Reports. The main content area displays a table with columns: Prog #, PTT, Serial, Decoded As, First Uplink Date, and Last Uplink Date. Below this table, there is a button labeled 'Create New Process' which is circled in red. Below the button is a filter input field and another table with columns: Run, Description, Requested, and Complete. The 'Create New Process' button is highlighted with a red circle.

The data portal will prompt you to choose Fastloc-GPS or GPE3 processing if both types of data are available. Our example deployment (PTT 123456) contained both types of data and the Fastloc data were processed. In general, if the Fastloc data have already been processed, GPE3 can use the resulting locations as input along with observations of twilight, SST, and potentially Argos Doppler locations.



Note: If more than one Fastloc process is available, GPE3 will use the “default” results. The default run is highlighted yellow and can be changed to a different run if another one is available.

Choosing GPE3 will create a new GPE3 processing containing a number of tabs which you should become familiar with. See below for more detail on the information and settings available.

The screenshot shows the GPE3 processing configuration screen. At the top, there are navigation links: My Tags, My Data, My Notes, and My Users. Below this, there is a table with columns: PTT, Decoded As, First Uplink Date, Last Uplink Date, First Data Date, and Last Data Date. Below the table, there is a button labeled 'Create New Process'. Below the button is a filter input field and a table with columns: Run, Description, Requested, Completed, Requested By, Status, Score, and Actions. Below the table, there are tabs for Model Parameters, Twilight Observations, SST Observations, Argos Observations, Fastloc GPS Observations, and Scores. Below the tabs, there is a 'Start GPE3' button. Below the 'Start GPE3' button, there are configuration options for Animal Speed (3 meters/second), Model Domain (Marine), and SST Reference Data Set (NOAA OI SST V2 High Resolution). Below the configuration options, there is a 'Known Dates/Locations' table with columns: Date, Type, Latitude, Longitude, and Score. Below the table, there is a 'Start GPE3' button. Below the 'Start GPE3' button, there is a message: 'Fastloc-GPS Run #1 is included in the processing.'



1. Animal Speed is a required field representing the standard deviation of a normal distribution of diffusion rate for the animal.
2. Selecting the Marine Domain will prevent "on land" locations. Currently only the Marine Domain is available.
3. GPE3 uses Sea Surface Temperature (SST) observations made by the tag and compares them with reference SST data products to help make inferences about the animal's location.
4. Known Dates/Locations (entered as Metadata) can be selectively excluded by clicking on the green check marks.
5. The Twilight Observation tab will display a table list view of all of the twilights observed including individual light readings. You can selectively exclude any observation.
6. The SST Observation tab will display a table list view of all of the SST observations. You can selectively exclude any observation.
7. The Argos Observations tab or FastLoc Observations tag will display Locations derived from Argos or FastLoc that can be included as part of the GPE3 modeling process. In this example, GPE3 will include the results of FastLoc Run #1. You can selectively exclude any observation.
8. Clicking the Start GPE3 button will start a GPE3 process!

Keeping Tabs on Processing Status

Once a new process is started, it is assigned a Run number and its current status is displayed as illustrated below. In this example, Run #1 is a Fastloc-GPS process and has been completed while Run #2 is a GPE3 process and has just been started. Run #2 is showing a status of New.

PTT	Decoded As	First Uplink Date	Last Uplink Date	First Data Date	Last Data Date
123456	MK10	28-Jul-2014 17:44	14-Dec-2014 11:37	28-Jul-2014 17:20	29-Nov-2014 18:16

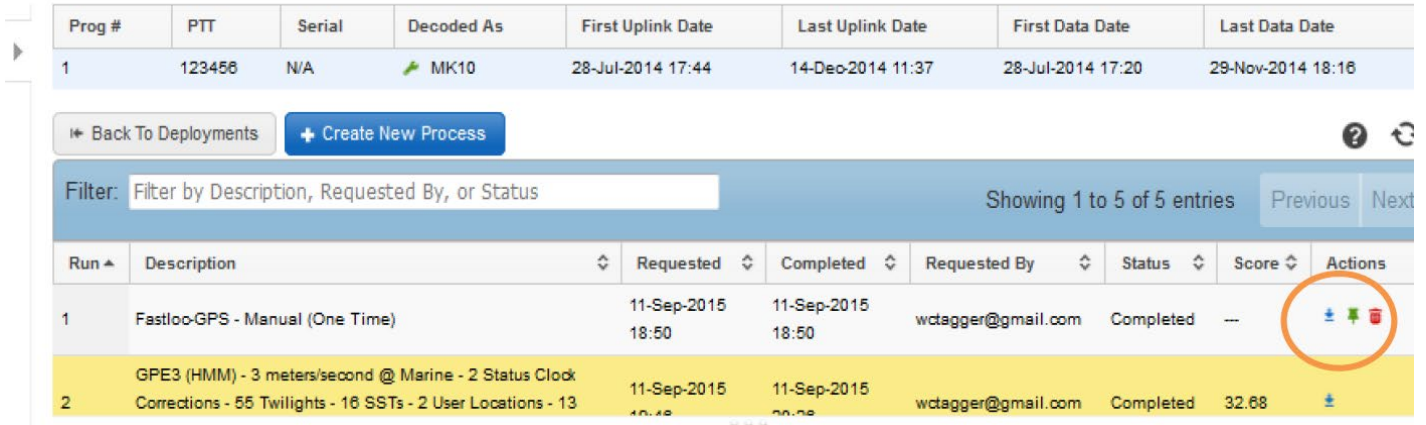
Run	Description	Requested	Completed	Requested By	Status	Score	Actions
1	Fastloc-GPS - Manual (One Time)	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed	--	
2	GPE3 (HMM) - 3 meters/second @ Marine - 2 Status Clock Corrections - 55 Twilights - 16 SSTs - 2 User Locations - 13 Argos Locations - 46 Fastloc Locations (Run #1)	11-Sep-2015 19:46	--	wctagger@gmail.com	New	--	

It is possible to initiate several processes simultaneously for a deployment. If the system gets too busy, your request will be placed in a queue and your position in the queue will be displayed in the status field. When processing is complete, the Data Portal will send you an email.

If you want to work on a different deployment, you can click on the Back To Deployments button and select a different deployment even while the processes are running or pending.

Viewing and Downloading the Results—Default Runs





The results of each processing run are stored in the Data Portal and are available for download over the internet from your web browser or machine to machine using our Web Services. The results are also available for sharing with your colleagues when the deployment itself is shared. There are several ways to view and download the processing results but the results from a single processing run can be downloaded to your computer by clicking the blue download button circled in the illustration below.



Prog #	PTT	Serial	Decoded As	First Uplink Date	Last Uplink Date	First Data Date	Last Data Date
1	123456	N/A	MK10	28-Jul-2014 17:44	14-Dec-2014 11:37	28-Jul-2014 17:20	29-Nov-2014 18:16

← Back To Deployments + Create New Process

Filter: Filter by Description, Requested By, or Status Showing 1 to 5 of 5 entries Previous Next

Run	Description	Requested	Completed	Requested By	Status	Score	Actions
1	Fastloc-GPS - Manual (One Time)	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed	---	  
2	GPE3 (HMM) - 3 meters/second @ Marine - 2 Status Clock Corrections - 55 Twilights - 16 SSTs - 2 User Locations - 13	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed	32.68	

Depending on your web browser, clicking the blue download button will prompt you to open or save a zip file containing just the results of the single processing run. You can also set one GPE3 and one Fastloc-GPS run per deployment as defaults. Setting a run as a default has several knock-on effects.

- If you want to run GPE3 processing on your twilight data and your tag happens to contain processed Fastloc data, GPE3 will automatically include the default Fastloc run locations in its processing
- If you download the deployment data from the deployment view in the data portal, the default processing runs will be included in your download
- If you use web services to fetch data from the data portal, the default processing runs will be included in the fetch
- When you view the map tab in the deployment view, the locations from the default runs will be included

Default runs are colored yellow. You can choose a new default run by clicking the green push pin beside the blue downloaded button circled above.

Fastloc-GPS Output Files

The FastLoc-GPS results are available as a *.CSV and are contained in a zip file. The name of the file is the PTT number (or the serial number), the processing run number, followed by “-FastGPS.CSV”. For example, you might see 12345-6-FastGPS.CSV.

Even when downloading data from the deployment view, the raw unprocessed data are also included. The file containing the unprocessed data does not have a run number. Carrying on with the example from above, the unprocessed data would be in a file named 12345-FastGPS.CSV.

GPE3 Output Files

The results of a GPE3 processing run are contained in a zip file and consist of three file types:

1. *.CSV - this is a comma separated text file that can be opened as a spreadsheet.
2. *.KMZ - this is a compressed Google Earth file.
3. *.NC - this is a NetCDF file.

Each of these three files will have names that contain the PTT number (or the serial number) and the Run number. As an example, you might see 12345-6.CSV where the ‘-6’ refers to Run #6.

The *.CSV File

The *.csv file contains a time series of model output as rows. Each row contains:

- A UTC timestamp for each row of model output.
- The most likely location at that time represented as decimal latitude and longitude.
- The observation type that was made at that time if applicable. The model is capable of producing output for times when there are no observations.
- If the observation type is SST, then the observed SST reading is reported along with the depth at which it was measured. The reference SST reading at the most likely location is also reported.
- If the observation type is light level (i.e. Dawn or Dusk), then the observed Mean Sum of Squares (MSS) is reported for that twilight. The MSS is a measure of how well the observed twilight matches a theoretical twilight. A low MSS represents a high quality observation. The deepest depth experienced during that twilight is also reported.
- The bathymetry depth is reported at the location of maximum likelihood.
- The model score is reported at each observation. A high observation score means that the location suggested by the observation matches closely with the modeled location.

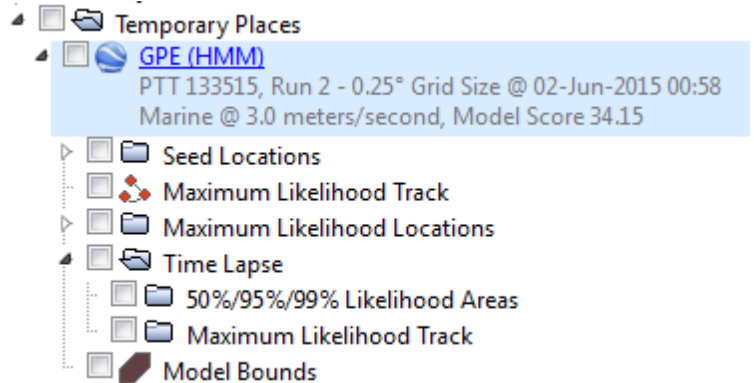
The CSV contains rows representing the model output at the time of each observation. For the ease of post processing though, it also contains rows representing the model output at every noon and midnight during the deployment. This is done for convenience as we cannot control when during the day a twilight event or SST event might occur.

While GPE3 is running a gridded hidden Markov model with 0.25 by 0.25 degree grid spacing, the location output presented in the *.CSV file has been interpolated to a 0.025 by 0.025 grid spacing and smoothed with a cubic spline.

The *.KMZ File

This is a native Google Earth file containing a number of GPE3 outputs. You must have Google Earth installed on your computer in order to view this file. The output is included in Earth's "Temporary Places" and can be saved to "My Places" which is handy for working with the output from multiple runs. The file contains the following:

- Seed Locations are those User Locations (entered via the Metadata editor) that have been used as part of the GPE3 model.
- The Maximum Likelihood Track is an Earth rendered line that connects the Maximum Likelihood Locations.
- The Maximum Likelihood locations represent points centered on a 0.025 by 0.025-degree grid having the highest
- likelihood score for a given time. The Time Lapse folder includes two items that can be played using Earth's animation tool. The Likelihood Areas are a set of transparent colored regions that cover the areas totaling 50, 95 and 99% of the total likelihood score. In other words, there is a 50% likelihood that the animal is somewhere within the 50% region, a 95% likelihood that it is within the 95 AND 50% region and a 99% likelihood that the animal is within all 3 regions combined. Due to memory limitations with Google Earth, and to help with smooth animation playback, we limit the number of likelihood areas to 50. If your model contains thousands of observations, GPE3 will select just a subsample of those outputs to display as likelihood areas.
- The Model Bounds image is useful for showing the area that GPE3 considered in its processing.



The *.NC File

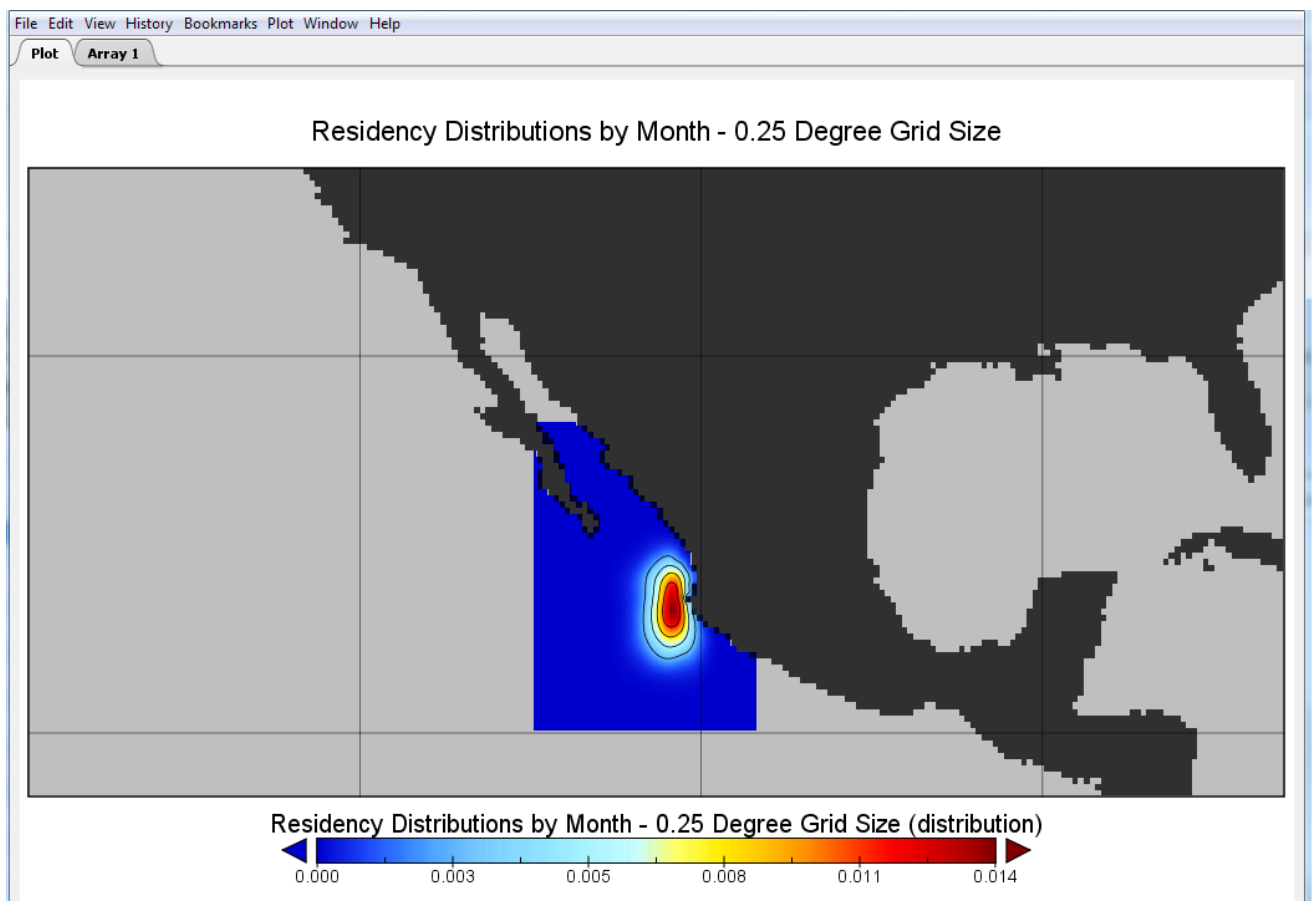
The *.NC is a NetCDF formatted file containing a number of GPE3 model outputs. NetCDF is a convenient method of storing geo-referenced gridded data. There are several tools available for working with NetCDF files including Panoply which is a free package provided by Goddard Institute for Space Studies. GPE3 generates a NetCDF file with three Geo2D arrays along with the 1D arrays required for scaling.

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.

- all_likelihoods. This is a set of surfaces representing each and every observation time as well as surfaces for noon and midnight for each day of the deployment.

- twelve_hour_likelihoods. This is a set of surfaces representing just the noon and midnight times 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.
- The monthly_residency_distribution is an example of how the likelihood surfaces can be manipulated and combined. One could imagine merging the surfaces from multiple animals.

The following is an example of a monthly residency distribution for a single animal as displayed in Panoply. The overall blue area represents the model area considered in the GPE3 processing.



Cleaning Up

From time to time you may find that you have accumulated several processing runs within a deployment that are no longer useful. You can delete these runs by clicking the red garbage can circled below. There is no way to undo a delete. But you can always call or email our Support team and ask to have a run restored.

Prog #	PTT	Serial	Decoded As	First Uplink Date	Last Uplink Date	First Data Date	Last Data Date
1	123456	N/A	MK10	28-Jul-2014 17:44	14-Dec-2014 11:37	28-Jul-2014 17:20	29-Nov-2014 18:16

← Back To Deployments + Create New Process

Filter: Filter by Description, Requested By, or Status Showing 1 to 5 of 5 entries Previous Next

Run	Description	Requested	Completed	Requested By	Status	Score	Actions
1	Fastloc-GPS - Manual (One Time)	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed	---	
2	GPE3 (HMM) - 3 meters/second @ Marine - 2 Status Clock Corrections - 55 Twilights - 16 SSTs - 2 User Locations - 13	11-Sep-2015 18:50	11-Sep-2015 18:50	wctagger@gmail.com	Completed	32.68	

Select a process above or create a new process.

Appendix—Jumpstart NetCDF in R

The following R code is compliments of Josh Stewart from Scripps Institute of Oceanography. The code is included here to help jumpstart R users that might not be familiar with working with NetCDF files (*.NC) and the data they contain. The code is used to:

1. Import and merge NetCDF data from multiple tags processed with GPE3.
2. Interpolate the probability surfaces.
3. Identity regions of probability that sum to 95%, 75% and 50%.

You will need to install both the '**raster**' and the '**ncdf**' packages.

StackedObject<-stack("tagname.nc",varname="all_likelihoods") #creates a raster object that contains the likelihood surfaces for each time point

MergedObject<-overlay(StackedObject,fun=mean) #merges all of the stacked likelihood surfaces using the function of your choice (can do mean, sum, etc, or make your own).

MergedObject[is.na(MergedObject)]<-0 #Remove NA values

Boundaries<-extent(c(-110, -102.5, 17.5, 25)) #creates a bounding box to include all of the different gridded area sizes



ExtendedObject<-extend(MergedObject, Boundaries) #then extends any of your surfaces with the set boundaries

#You can then use **stack()** to stack multiple tags, and **overlay()** to merge them together into a single probability surface.

#To interpolate a surface (resample it at a higher resolution):

Raster.big<-raster(ncol=1200,nrow=900,ext=Boundaries) #creates the higher resolution grid

Raster.HR<-resample(x=MergedObject,y=Raster.big,method="bilinear") #will resample the data object onto the higher resolution grid

Raster.HR@data@values<-Raster.HR@data@values/sum(Raster.HR@data@values) #normalize the grid values so they sum to 1

#To create probability surfaces (95%, 75%, 50%):

RasterVals<-sort(Raster.HR@data@values) #sort the probability values

Raster.breaks <- c(RasterVals[max(which(cumsum(RasterVals)<=0.05))],

RasterVals[max(which(cumsum(RasterVals)<=0.25))],

RasterVals[max(which(cumsum(RasterVals)<=0.5))],1) #sets breaks at the cumulative probabilities (95%, 75%, 50%) with a cap at 1 (higher than necessary, but no value can ever exceed 1)

Raster.cols<-colorRampPalette(c("color1","color2","color3")) #creates a color scale, add as many values as you want or use an existing scale

RasterCols<- c(raster.cols(3)) #create the colors that you will use (there must be 1 fewer colors than breaks, so you could use length(Raster.breaks)-1 instead of the '3' if you're changing the number of quantiles you are plotting)

plot(Raster.HR,col=RasterCols,breaks=Raster.breaks) #plot the polygons

Appendix—Troubleshooting GPE3

The following are the possible errors that can be returned by the GPE3 processor. Please contact us and we will help rectify the problem.

Error: Model bounds too large

This error indicates the area to be considered in the model is too large for the processor.

Error: Could not get '0' dataset

This error indicated there is a problem obtaining the reference satellite SST data.



Error: Model probability ran to 0. Step x of n

This error means that at some step in the model, the probabilities in each grid cell ran to zero. This typically means the animal was over-constrained by the speed parameter and could not possibly travel from the beginning to the end in the duration of the deployment. It could also mean there was an error in the start or end location or time.

Error: Coordinates on land: Latitude: x.xxx Longitude:y.yyyy

This error means that the start or end location entered as metadata for the deployment is on land. When the “model domain” is set to “marine,” all metadata location must not be on land. Check the locations entered in the metadata editor and adjust them slightly to move them off land.

Contacting Wildlife Computers

U.S. and International

Members of the Wildlife Computers technical sales and support team are located in Redmond, WA, USA, and Havelock North, New Zealand, allowing us to cover promptly a wide range of time zones.

Mailing and Shipping

Wildlife Computers

8310 154th Avenue NE, Suite
150 Redmond, WA 98052 USA

E-Mail

Sales, Quotes, and Inquiries:

tags@wildlifecomputers.com Technical Support:

support@wildlifecomputers.com

Phone

+1 (425) 881 3048

Website

WildlifeComputers.com

For Asian Clients

While we welcome your direct correspondence, we recommend that you contact our colleague, Yong Huang, for assistance. Mr. Huang understands the special purchase processes for your countries and will provide you with the best service for the best price. He also is fluent in Japanese, Chinese, and English.

Mailing address—Please ship tags to our main office Yong Huang
Enfotran Corporation
1247 106th Place NE
Bellevue, WA 98004
USA

E-mail

yong.huang@enfo.us

Phone

+1 (425) 456 0101

