V-Track

An application programming interface for analysing and visualising data generated from the VEMCO suite of passive and active acoustic receivers

Graphical User Interface

User Manual

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V-Track has been created to enable storage, analysis and visualisation of detection data from the VEMCO suite of receivers and transmitters. It has been written within the R programming language, but has a graphical user interface (GUI) for uploading data and carrying out analysis routines in Microsoft Windows. This manual details operation of the V-Track GUI.

V-Track consists within a sequential modular format, the routine steps for the processing of the acoustic detection data are:

1. Archiving of the detection database
2. Creation of sub-archives based upon study parameters
3. Creation of a distance matrix using direct or circuitous distances between receivers
4. Identification of animal behavioural events within the detection sub-archives
5. Organisation behavioural events by temporal conditions
6. Create animations to visualise animal movement in Google Earth.

V-Track will assimilate acoustic transmissions derived from the VEMCO suite of continuous and coded tags and detected by the VR2, VR2-W and VR100 receivers. This enables the user to process data from both active and passive acoustic telemetry within a central database. Archived acoustic data stored within a third-party database can also be processed and visualised within V-Track.

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0.1 Uploading the V-Track GUI

The V-Track graphical user interface (GUI) runs in both Microsoft Windows and was created so that non-specialists in R programming could still access the analysis tools within V-Track. Although the V-Track GUI operates with a 'point-and-click' interface, the underlying functions are run within the R Programming environment therefore users of the GUI will still require both the R program **and** the V-Track R package to be installed on their machine.

The R software can be downloaded from http://www.r-project.org/ .

The V-track R-package can be downloaded from http://www.uq.edu.au/eco-lab/v-track. Unzip the package and place the folder entitled 'V-Track' into the 'library' folder in the R-program. The directory for the V-track R-package will now be something like…

```
C:/Program Files/R/R-3.0.2/library/V-Track
```

Download the V-Track GUI from http://www.uq.edu.au/eco-lab/v-track. Unzip the folder and click on the V-Track executable (i.e. V-Track.exe). The V-Track Setup Wizard will open, follow the instructions. Once installed the V-Track GUI will automatically locate the V-track R package on your machine**.**

Click on the desktop shortcut and the graphical user interface will open. The **six** steps in the analysis process should be visible as tabs across the top of the V-Track program window. Each step must be run in sequence to create the necessary files for the subsequent analysis.

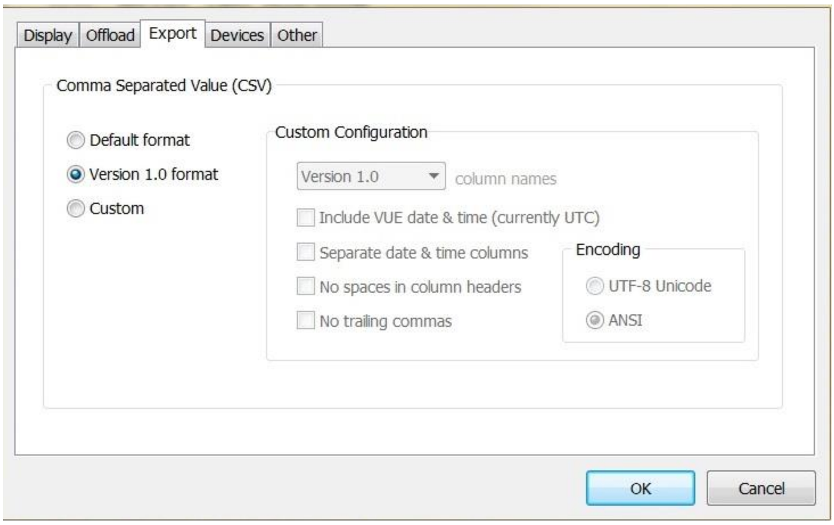
You are now ready to start using V-Track.

0.2 Exporting data from the VEMCO VUE software

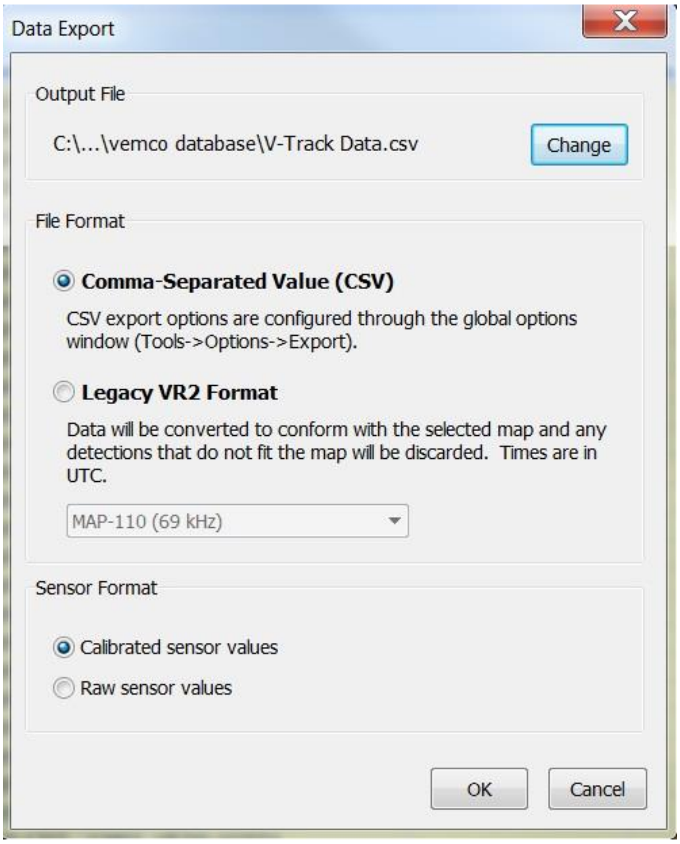
Open the *.vdb* file in VUE

Ensure that the export is Version 1.0 format by selecting …

Tools> Options> Export



Select the transmitters, receivers or entire detection file to export.



`Output File` – `Change` name and location for saved file.

`File Format` – Select `Comma-Separated Values (CSV)`

 # Note: For V-Track versions ≥1.01, it is no longer necessary to change the export format from the 'Default format' to the 'Version 1.0 format' in VUE. The data export format is provided as an option in Step 1. However V-Track still requires the exported File Format to be CSV.

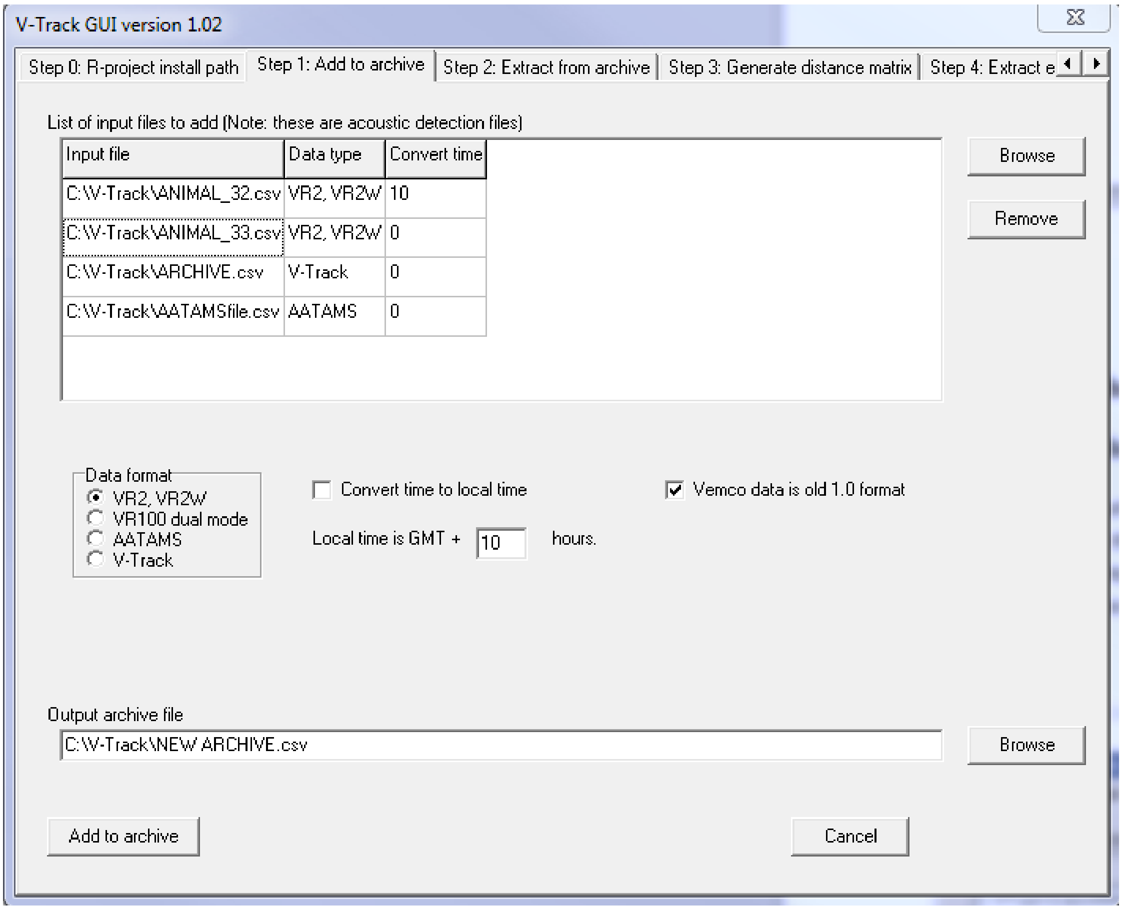
1. Creating the central archive

1.1 The Input files

While all the acoustic detection data processed by V-Track are from the VEMCO suite of receivers and transmitters, there may be differences in how the detection data has been processed and stored. The first step in V-Track is therefore to convert all detection data into a format that can be recognised and processed using the V-Track analysis routines.

To do this:

Click the `Step 1: Add to archive` tab. The following screen will be displayed…



Browse to the location of the acoustic detection data you wish to upload into V-Track. Then select the `Data format`. These files may be either:

1. Exports from the VEMCO VUE software (`VR2, VR2-W`)
2. From a VR100 receiver (`V100 dual mode`),
3. From a third party data repository (Australian Acoustic Tracking and Monitoring System, `AATAMS`)
4. From an archive already produced by `V-Track`.

5. It is also possible to define the VUE export format as 'Default' or the old 'Version 1.0 Format'.

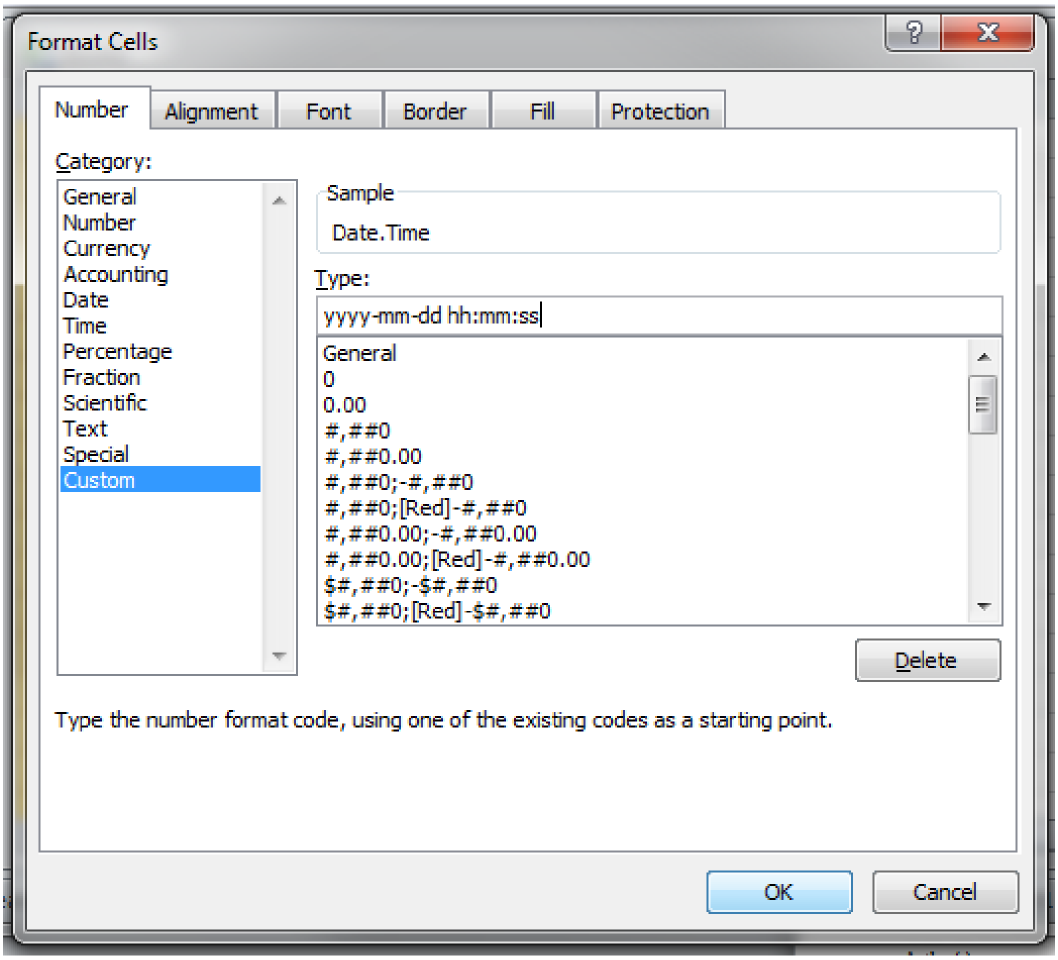
Multiple detection data sets can be combined to create a single archive, including the adding of detection data-sets to existing V-Track archives.

The time stamp for detections collected with VR2 and VR2W receivers is stored as UMT. There is an option within V-Track to convert the detection time stamp within each detection data-file to the local time of the receiver array,

1.2 Important information about the `Datetime` field

The `DateTime` field in the input file **must** be in the format "yyyy-mm-dd hh:mm:ss" for it to be recognised by V-Track. If a detection file has been created or saved as a .csv in Microsoft Excel, then it is likely that the `DateTime` field in the .csv file will no longer be in a format recognisable by V-Track. To ensure the `DateTime` field is in the correct format use the following steps.

1. Open the document in Microsoft Excel
2. Select the entire `Date.Time` column, click the right mouse button and select `Format Cells…`
3. In the `Number tab`, select `Custom` and in the `Type:` field enter `yyyy-mm-dd hh:mm:ss`
4. Click `OK` then `Save` and close the program as a CSV (Comma delimited) (*.csv) file.



Microsoft Excel 2010 window to format time and date into required V-Track format

1.3 The output files

Once the user has completed he table in Step 1 successfully and clicked 'Add to archive', V-Track will generate a new detection archive containing all the files listed in the input file box. This step is required to 1/ ensure all selected items are combined in a format consistent with the V-Track analysis tools, 2/ sort each detection in chronological order and 3/ remove any duplicate detections. The output .csv file will contain the following columns:

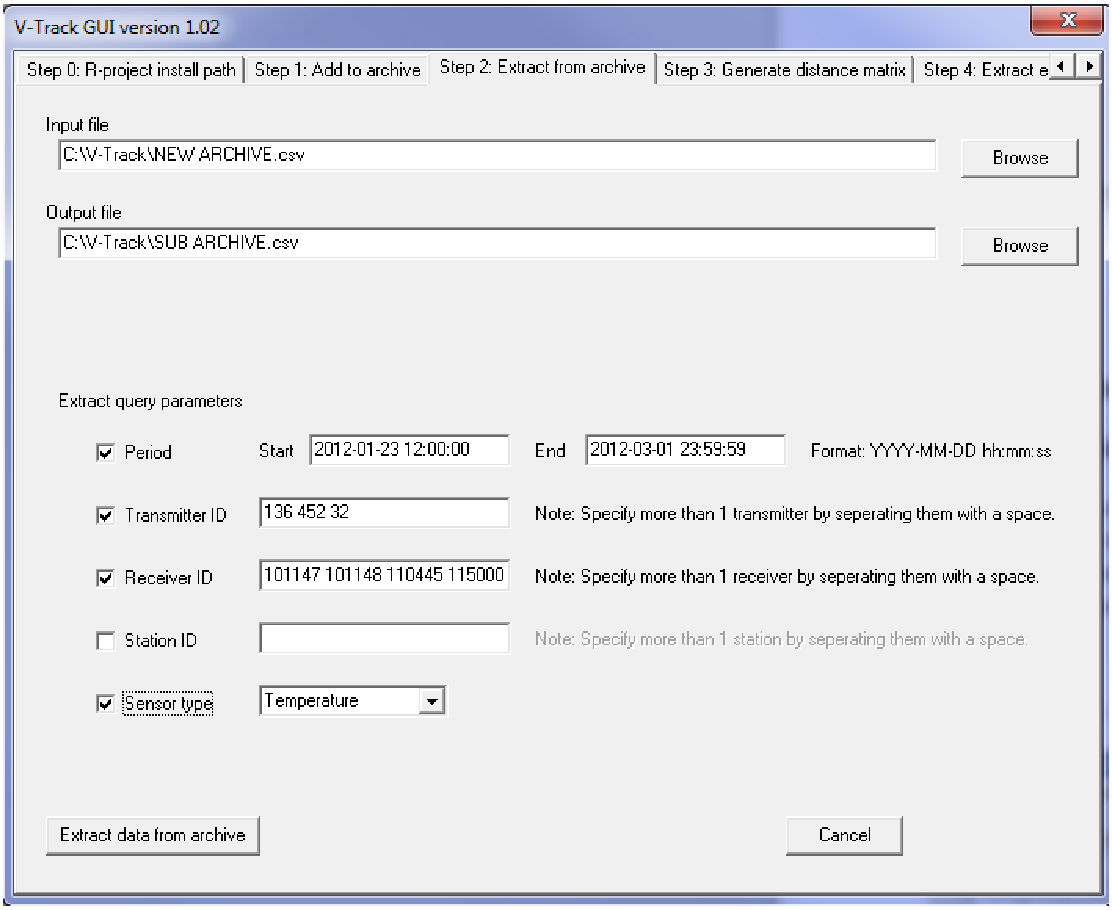
DATETIME	the date and time of the location fix
TRANSMITTERID	the identity of each transmitter (= ID)
SENSOR1	the value of the environmental sensor (i.e. temperature or depth) at the time of detection
UNITS1	the units of each sensor value (m/^{o}C)
RECEIVERID	the factory assigned receiver serial number (= Receiver S/N)
STATIONNAME	the user-defined station name

In addition to the output .csv, step1.R and step1.bat and are also created in this step:

- Step1.R contains the R code used in this step to generate the archive file.
- Step1.bat contains the ….

2. Querying specifics within the data

Once an archive has been successfully generated, V-Track offers the option to sub-set the data by a number of different qualifiers. These can be selected individually or in combination.



A sub-archive is created which contains only the data within the user defined variables.

In the `Input file` field, enter the location of the archive file or alternatively browse to the location of the archive file. The Input file should be in the following format:

DATETIME	ANIMALID	SENSOR1	UNITS1	RECEIVERID	STATIONNAME
2007-07-27 15:15:15	57	31.448	°C	101141	Upper catchment
2007-07-27 15:16:13	58	30.51	°C	101143	Upper catchment
2007-07-27 15:41:56	54	16.212	m	101151	Lower catchment

In the `Output file` field, enter the location and name of the file to be created or alternatively browse to the specified location using the `Browse` tab.

Check each box to define the qualifying parameters from the input file. Data can be selected within a Time `Period`, by `Transmitter ID`(s), `Receiver ID`(s), `Station ID`(s) or `Sensor type`. As with Step 1, time queries should be in the format '`YYYY-MM-DD hh:mm:ss`' If more than one Transmitter, Receiver or Station ID is required, IDs should be separated by a space. Multiple or single parameters can be selected for, and if no selection is desired for a particular parameter then the box should be left unchecked.

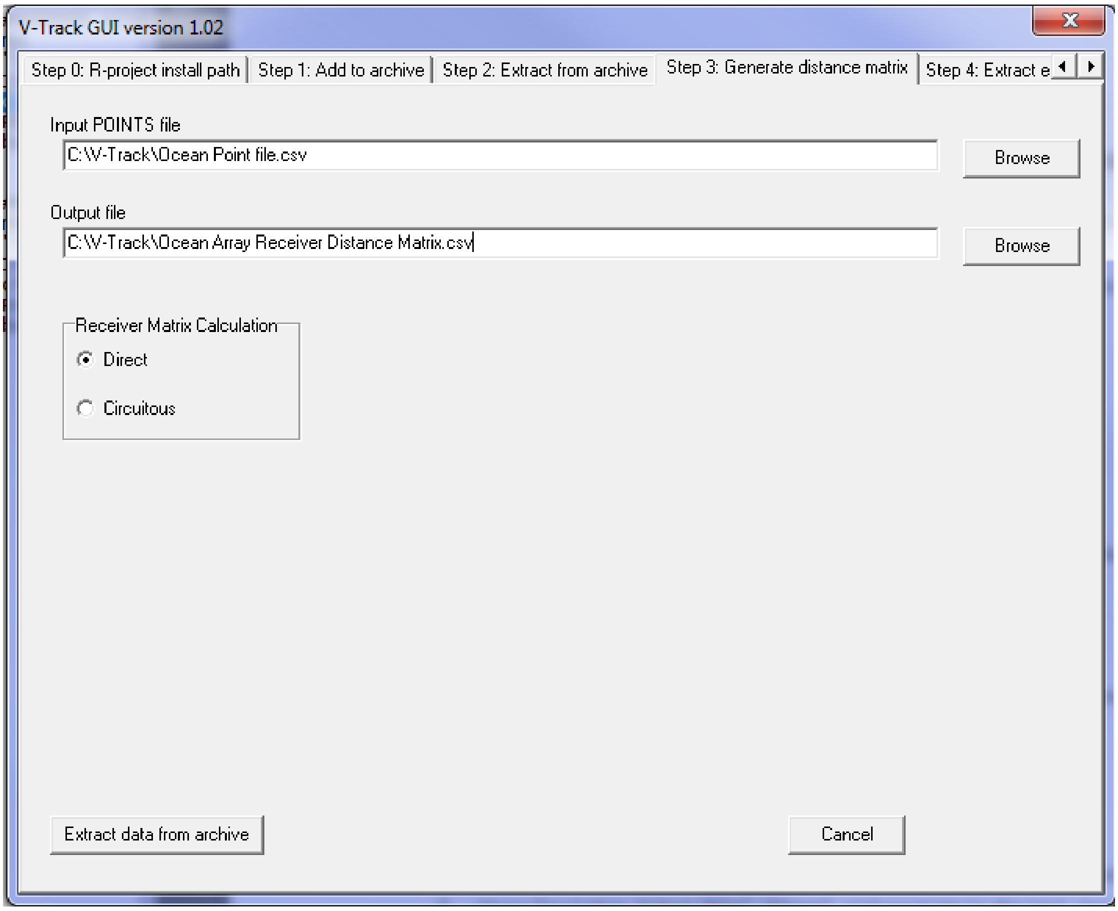
Click 'Extract data from archive' to generate the sub-archive file containing only detections qualifying the user-defined parameters.

As with Step 1, this will generate three output files

- A sub-archive .csv containing the raw data which falls within the selected parameters.
- Step2.R containing the R code used in this step to generate the archive file
- Step2.bat containing the batch or MS DOS information for the processed file

3. Distance matrix generator

Once an archive has been created, click the 'Step 3: Generate distance matrix' tab. The following screen will be displayed:

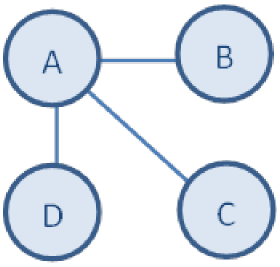


This function calculates the distance between the VR2 or VR2-W receiver detection field within the array (i.e. the Receiver Distance Matrix). V-Track calculates the distance based upon the geographical coordinates of each receiver minus the detection radius (m) of each receiver. The spatial information provided by the Receiver Distance Matrix is used by V-Track in Step 4 to calculate individual movement rates.

V-Track offers two different methods for calculating the Receiver Distance Matrix. The user can select by checking the appropriate box.

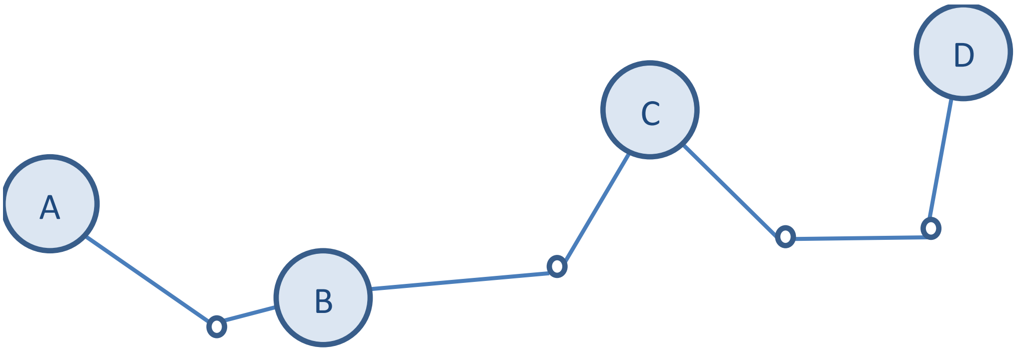
3.1 The direct distance matrix

This is calculated as the shortest/straight line distance between each receiver and all the other receivers within the array. This is the most common method for arrays deployed in a grid formation.



3.2 The circuitous distance matrix

This is calculated with the receivers in series. The user can also add additional waypoints and V-Track will calculate the route distance between adjacent receivers through these waypoints. This method is most common when receivers are deployed in a linear or curtain formation.



3.3 The POINTS file

In the `Input POINTS file` field, enter the location of the points file or alternatively `Browse` to the location of the points file. All receivers used in the archive file must be listed in the distance matrix along with their corresponding detection radii. If the detection radius is unknown, the user may set this field to `0`.

The points file should be in the following format if the user is looking to create a Receiver Distance Matrix using a `Direct` distance calculation.

RECEIVERID	LATITUDE	LONGITUDE	RADIUS
100001	-12.402	142.147	50
100002	-12.371	142.119	50
100003	-12.321	142.109	30

Alternatively, to create a receiver distance matrix using a Circuitous distance calculation then additional waypoints can be created by inserting a 0 in the RECEIVERID field.

RECEIVERID	LATITUDE	LONGITUDE	RADIUS
100001	-12.402	142.147	50
0	-12.402	142.131	
0	-12.388	142.130	
100002	-12.371	142.119	50
0	-12.353	142.112	
100003	-12.321	142.109	30

In the Output file field, enter the location and name of the file to be created or alternatively browse to the specified location using the Browse tab.

3.4 The receiver distance matrix file

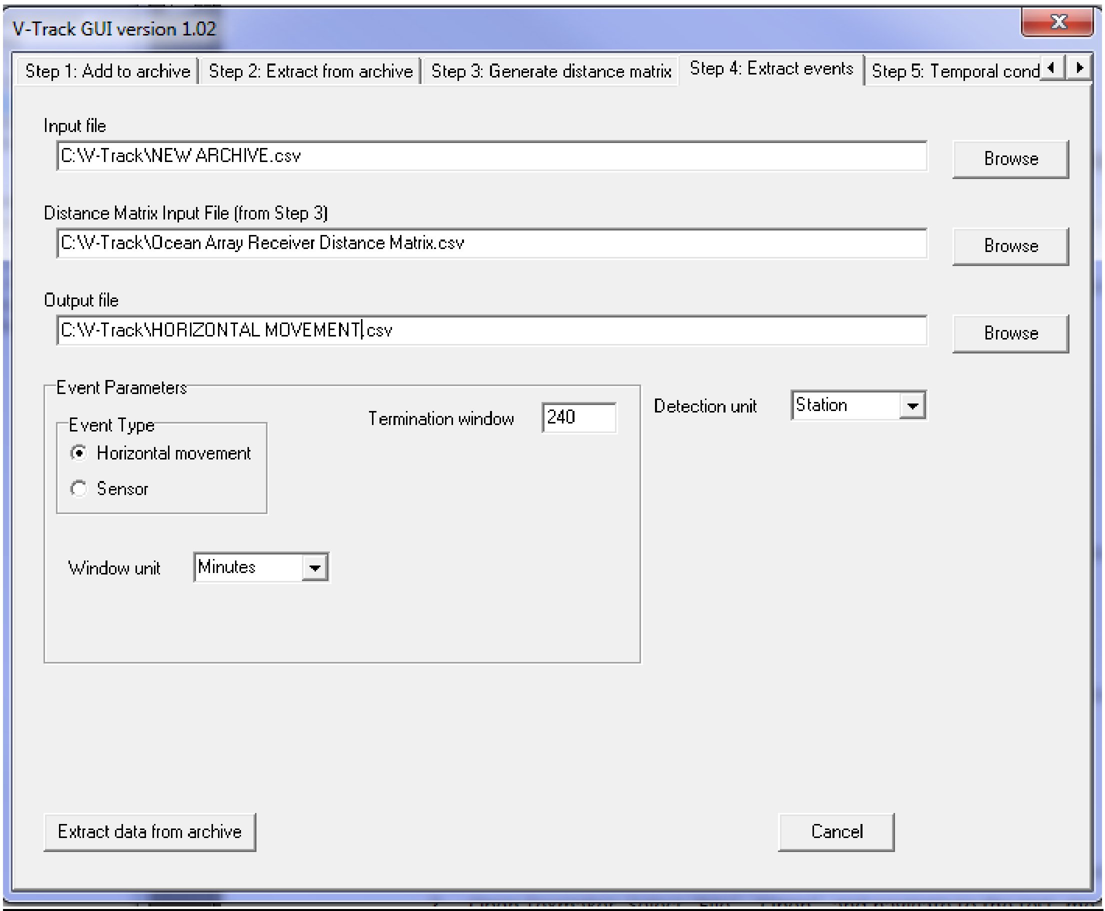
Click 'Extract data from archive' to generate the Receiver Distance Matrix. This will show a list of all the receivers within the array on the first row and column and the relative distance (meters) between each receiver and all the other receivers within the array.

DM	101156	101152	101154	101151	101141	101142	101155
101156	0	13370	15650	17600	19400	21100	22600
101152	13370	0	1580	3530	5330	7030	8530
101154	15650	1580	0	1250	3050	4750	6250
101151	17600	3530	1250	0	1100	2800	4300
101141	19400	5330	3050	1100	0	1000	2500
101142	21100	7030	4750	2800	1000	0	800
101155	22600	8530	6250	4300	2500	800	0

4. The event analyser

This function identifies and quantifies events within the acoustic detection database. These can be horizontal movement events, based upon the presence of tagged animals at adjacent receivers, or sensor events (commonly used as a proxy for vertical movement) based upon depth or temperature sensor information. V-Track defines these events from user defined threshold and timeout parameters. The qualification of an event will need to be tailored to each study and will depend upon the study animal, the environment, the tag transmission rate, receiver arrangement, and the biological questions asked.

Once an archive has been created, click the '`Step 4: Extract events`' tab. The following screen will be displayed…



4.1 Qualifying horizontal movement

Checking the '`Horizontal movement`' box will result in V-Track identifying periods within the detection data when the tagged animals were within or between receiver detection fields. The event is triggered every time a transmitter is detected by a new receiver and terminated when the transmitter is detected at another receiver or if the transmitter is not detected by the same receiver within a user defined `Termination window`. This `Termination window` may be defined as `seconds`, `minutes` or `hours` within the `Window unit` dropdown box. Users may also set the `Detection unit` of interest to `Receiver` or to `Station`. In order to minimise the risk of erroneous pings, a **minimum of two successive transmitter pings** must be detected at receiver for a residence event to occur.

In the Input file field, enter the location of the archive file or alternatively browse to the location of the archive file.

In the Distance Matrix Input file field, enter the Distance Matrix file address or alternatively browse to the location of the file. V-Track has the capacity to create the distance matrix from a point file or alternatively the matrix can be manually created by the user. (Please see Figure 3.4 for an example of a Receiver Distance Matrix Input file)

In the Output file field, enter the location and name of the file to be created or alternatively browse to the specified location using the Browse tab.

Click Extract data from archive. This will generate three horizontal movement files, a residences event file, a residence event logfile, and a nonresidences event file. The details of these are as follows.

4.2 Horizontal movement output files

i) RESIDENCES event file

This file contains the details about all of the residence events.

STARTTIME	ENDTIME	RESIDENCE EVENT	TRANSMITTER ID	RECEIVER ID	DURATION	END REASON	NUM RECS
2007-07-28 15:16	2007-07-28 15:49	16198	45	101158	1955	timeout	38
2007-07-29 13:16	2007-07-29 13:30	16199	45	101158	849	receiver	16
2007-07-29 13:42	2007-07-29 14:12	16200	45	101157	1762	receiver	23

STARTTIME	the date and time of the first detection at the receiver
ENDTIME	the data and time of the last detection within the receiver
RESIDENCEEVENT	the index number of the event, which is referenced within the residence event logfile (see below)
TRANSMITTERID	the transmitter code for the event
RECEIVERID	the receiver which recorded the event
DURATION	the time in seconds from the first to last detection within the event
ENDREASON	this informs that the data was scored as an event due to the animal appearing at another receiver or if the last detection had passed the user defined timeout threshold
NUMRECS	the number of acoustic detections comprising the event

ii) Residence event logfile

In order to explore the raw data that comprises each residence event, a residence event logfile is also created by V-Track. In the example below, the details of all the acoustic detections that comprise RESIDENCE EVENT = 2647 are shown.

DATETIME	RESIDENCEEVENT	RECORD	TRANSMITTERID	RECEIVERID	ELAPSED
2008-04-20 05:04:00	2647	0	45	101152	0
2008-04-20 05:07:00	2647	1	45	101152	161
2008-04-20 05:07:00	2647	2	45	101152	18
2008-04-20 05:08:00	2647	3	45	101152	53
20/04/2008 05:08:00	2647	4	45	101152	17
2008-04-20 05:09:00	2647	5	45	101152	34
2008-04-20 05:10:00	2647	6	45	101152	53
2008-04-20 05:10:00	2647	7	45	101152	17
2008-04-20 05:10:00	2647	8	45	101152	18
2008-04-20 05:11:00	2647	9	45	101152	18

DATETIME	the date and time that the acoustic detection was logged at the receiver
RESIDENCEEVENT	corresponds to the RESIDENCEEVENT index number in the residence event file
RECORD	the number of the acoustic detection within this particular residence event.
TRANSMITTERID	the transmitter ID to which the event belongs.
RECEIVERID	the receiver ID where the event occurred
ELAPSED	the period in seconds between consecutive acoustic detections

iii) NONRESIDENCES event file

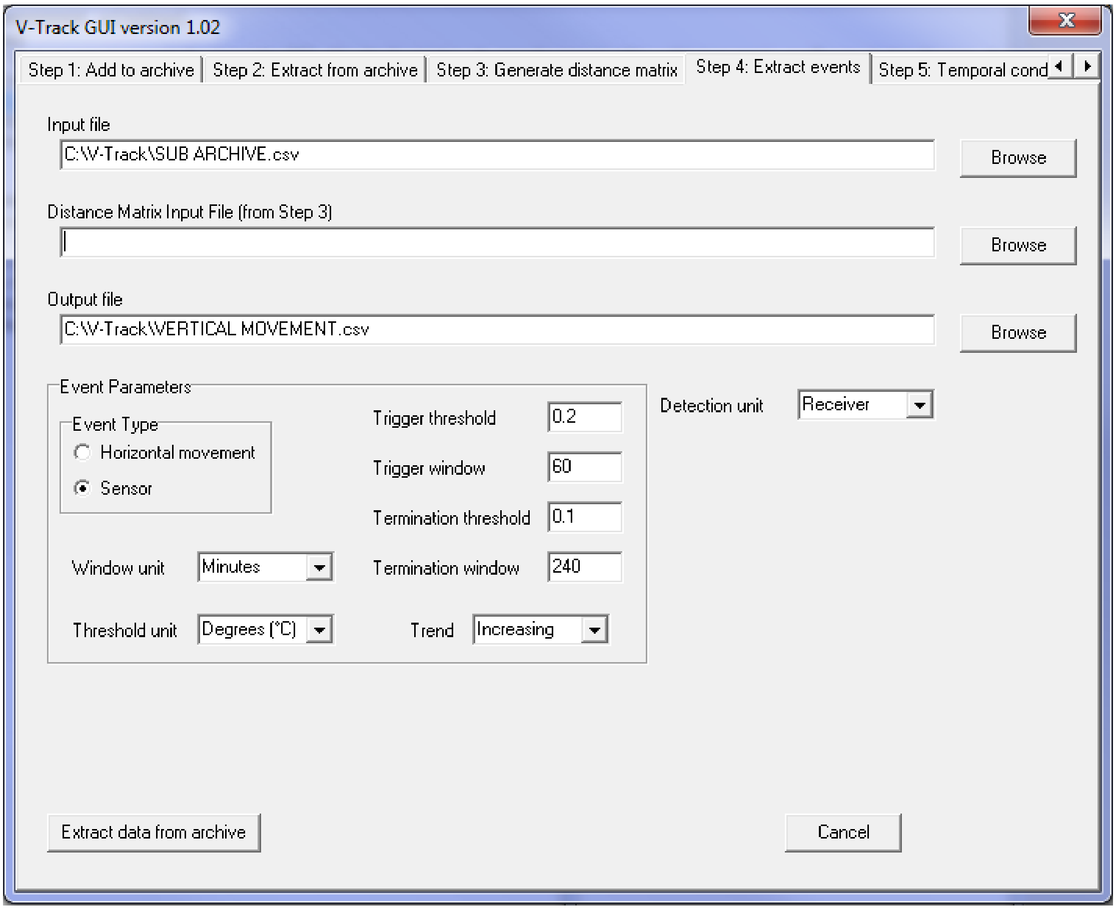
This file contains details of the period when a transmitter leaves the detection field of one receiver and arrives at another.

START TIME	END TIME	NONRESIDENCE EVENT	TRANSMITTER ID	RECEIVER ID1	RECEIVER ID2	DURATION	DISTANCE	ROM
2008-08-22 21:43:00	2008-08-22 21:58:00	23241	35	101155	101142	928	800	0.86
2008-08-22 22:49:00	2008-08-22 23:09:00	24634	33	101157	101140	1257	130	0.10
2008-08-23 00:27:00	2008-08-23 05:09:00	850	34	101143	101158	16896	5290	0.31

STARTTIME	the date and time of the last detection at the receiver the animal has left at RECEIVERID1
ENDTIME	the data and time of the first detection at the receiver the animal has arrived at RECEIVERID2
MOVEMENTEVENT	the unique identifier for the non-residence event
RECEIVERID1	the ID code of the receiver at the STARTTIME of the non-residence event
RECEIVERID2	the ID code of the receiver at the ENDTIME of the non-residence event
DURATION	the period in seconds between the last acoustic detection at RECEIVERID1 and the first detection at RECEIVERID2
DISTANCE	the distance in meters of the movement event between the two receiver detection fields as determined by the Receiver Distance Matrix. If no distance matrix has been loaded into the Distance Matrix Input file field, then DISTANCE = 0 is returned
ROM	the rate of movement in m/s of the movement calculated from the duration of the event divided by the distance between the outer limits of the detection fields of the two receivers. If no distance matrix is loaded in the Distance Matrix Input file field, ROM = 0 is returned

4.3 Qualifying sensor events

If transmitters contain a sensor (i.e. a temperature or depth sensor), checking the `Sensor` box within the `Event Type` field will allow the user to extract sensor-related events according to user-defined sensor and time threshold values. Once the sensor box is checked, the following screen is displayed:



In the `Input file` field, enter the location of the archive file or alternatively browse to the location of the archive file.

Within the `Event parameters` box, the user is provided with four parameters: `Trigger threshold`, `Trigger window`, `Termination threshold` and `Termination window`. The definitions of these variables are listed below

`Trigger threshold` the minimum change in the sensor value for an event to commence

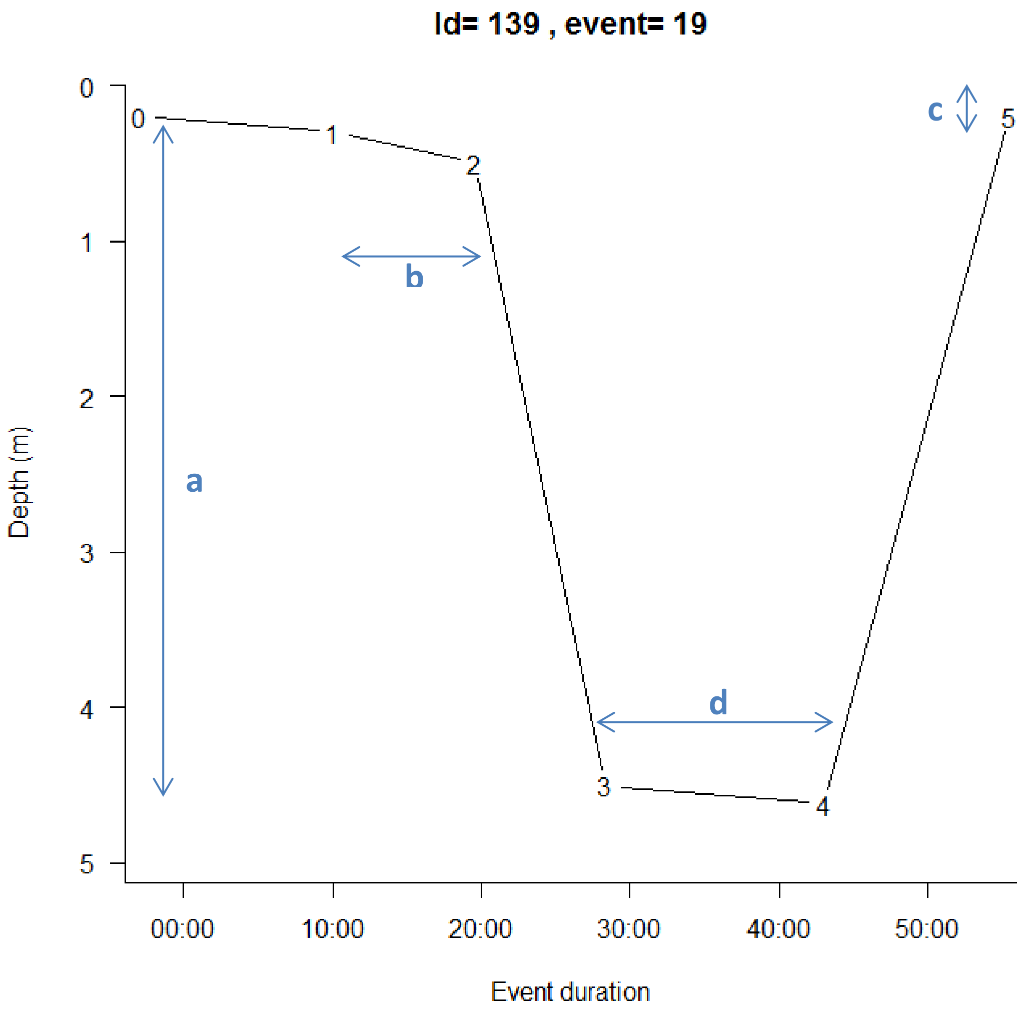
`Trigger window` the maximum time period in which the `Trigger threshold` must be attained for an event to commence

`Termination threshold` how close the sensor value must be to the starting sensor value before a sensor event is completed and the counter is reset

`Termination window` the maximum time period between consecutive detections before the event is terminated and the counter is reset

The units for the trigger and termination window can be set to seconds, minutes or hours using the `Window unit` dropdown menu. Users can extract sensor events that are triggered by either an `Increase` or `Decrease` in the sensor value by selecting either option in the `Value` dropdown menu. The two types of sensor offered by VEMCO in their transmitters is either temperature (`Degrees (°C)`) or depth (`Meters (m)`) and either can be selected in the `Threshold unit` dropdown menu.

The below figure shows the raw sensor data that composes a single depth sensor event for an individual transmitter. The Trend has been selected for decreasing changes in depth. Each number represents a single detection, the number 0 represents the start of an event and the event is composed of 6 detections in total. (a) The trigger threshold was set to >0.5 m, (b) the trigger window was <10 minutes, (c) the sensor termination threshold was <0.5 m from the starting value, and (d) the termination threshold was <60 minutes between detections. If more than 60 minutes passes between successive detections during the event, a 'timeout' will be returned as the `ENDREASON` for a sensor event.



In the Output file field, enter the location and name of the file to be created or alternatively browse to the specified location using the Browse tab.

Click Extract data from archive to generate two sensor files, 1/ a sensor event file, 2/ a sensor event logfile. The details of these are as follows:

4.4 Sensor event output files

i) Sensor event file

This file contains the details about all of the sensor events.

START TIME	END TIME	SENSOR EVENT	TRANSMITTER ID	RECEIVER ID	DURATION	START SENSOR	END SENSOR	MAX SENSOR	END REASON	NUM RECS
2008-08-18 23:22:09	2008-08-19 00:17:34	1	101	103565	3325	0.0	0.0	4.1	timeout	5
2008-08-19 10:18:10	2008-08-19 10:58:51	2	101	103565	10221	0.0	2.5	2.6	timeout	4
2008-11-30 15:41:51	2008-11-30 16:32:18	3	101	103565	3027	0.08	0.2	2.1	timeout	6

STARTTIME the date and time of the first detection of the event (RECORD = 0)

ENDTIME the data and time of the last detection within the event

SENSOREVENT the index number of the event, which is referenced within the **sensor event logfile**

TRANSMITTERID the transmitter id from which sensor events were determined

RECEIVERID the receiver where the sensor event began

DURATION the duration of the event in seconds, from the first to last detection within the event

STARTSENSOR the sensor value when the event was initialised

ENDSENSOR the sensor value when the event was either completed or terminated

MAXSENSOR if the event is an increasing sensor event, this is the maximum sensor value attained during the event. If the event is a decreasing sensor event, MINSENSOR is returned here containing the minimum sensor value attained during the event

ENDREASON: This providing information on why the event was terminated. If the sensor returned to a value within the termination threshold from the STARTSENSOR value and within the time threshold (= return) or exceeded the timeout threshold between successive detections (= timeout)

NUMRECS: The number of records detected within each event.

ii) Sensor event logfile

In order to explore the raw data making up each sensor event, a sensor event logfile is created. Each detection is provided with a SENSOREVENT index code to indicate which event it is associated with in the sensor event file.

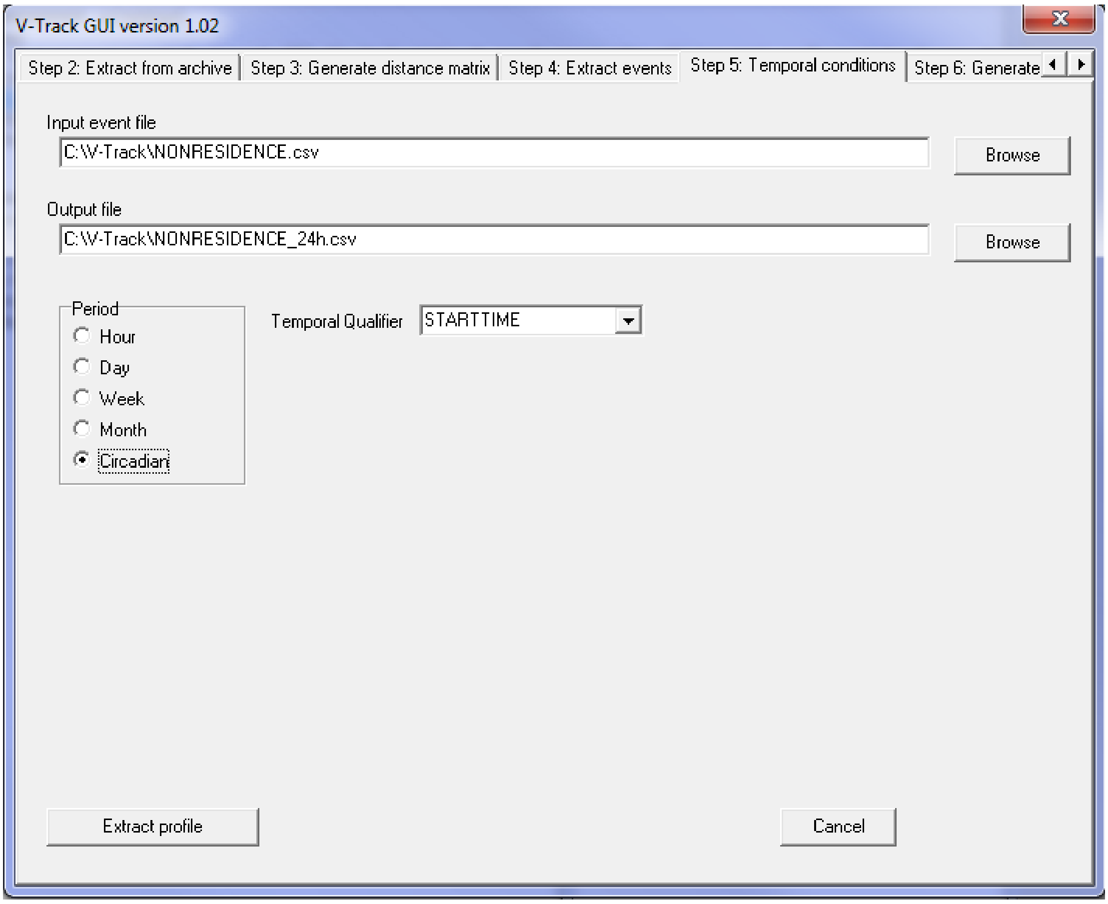
DATETIME	SENSOREVENT	RECORD	TRANSMITTERID	RECEIVERID	SENSOR1	ELAPSED
2008-11-30 15:41:51	3	0	101	103565	0.08	0
2008-11-30 15:49:54	3	1	101	103565	1.30	483
2008-11-30 15:58:57	3	2	101	103565	1.40	1026
2008-11-30 16:08:18	3	3	101	103565	1.80	1587
2008-11-30 16:20:09	3	4	101	103565	2.10	2298
2008-11-30 16:32:18	3	5	101	103565	0.20	3027

DATETIME	the date and time that the information was logged at the receiver
SENSOREVENT	this number corresponds to the SENSOREVENT number in the **sensor event file**
RECORD	the position that this detection is placed within the event, RECORD = 0 represents the beginning of the event
TRANSMITTERID	the transmitter id from which the events were determined
RECEIVERID	the receiver where the event occurred
ELAPSED	the total duration of the event in seconds

5. Generating temporal profiles of events

This step organises the residence, non-residence or sensor events generated from Step 4 into profiles classified by temporal conditions. By specifying the time profile as hour, day, week, or month, the respective time profile is extracted for that particular event. Users can also extract a circadian profile for each event where events are filtered for each hour in the diel cycle (24hr) and summed across days.

Once an event catalogue has been created, click the 'Step 5: Temporal conditions' tab. The following screen will be displayed:



In the Input file field, enter the location of the event file generated in Step 4 or alternatively browse to the location of the event file.

In the Period field, select which profile should be extracted (i.e. Hour, Day, Week, Month, Circadian)

In the Temporal Qualifier field select if you want each event to be categorised by the STARTTIME or ENDTIME of each event.

In the Output file field, enter the location and name of the file to be created or alternatively browse to the specified location using the Browse tab.

Click `Extract profile` to generate the new distance matrix file containing the pairwise distances minus the user-defined detection distances.

5.1 Temporal profile output files

The below table shows an example output file containing a diel profile (midnight to 4am) for residence events.

DATE TIME	TRANSMITTER ID	FREQ	TIMESUM	TIMEMAX	TIMEAV	TIMESTDEV	DETECTIONS
0	13890	24	339434	66089	14143.08	18569.46	522
1	13890	22	151494	19655	6886.091	7089.859	232
2	13890	36	816446	66531	22679.06	19298.77	974
3	13890	24	663190	119395	27632.92	35399.88	1038
4	13890	18	180468	26899	10026	9804.371	206

The output file for residence and non-residence events contains the following items:

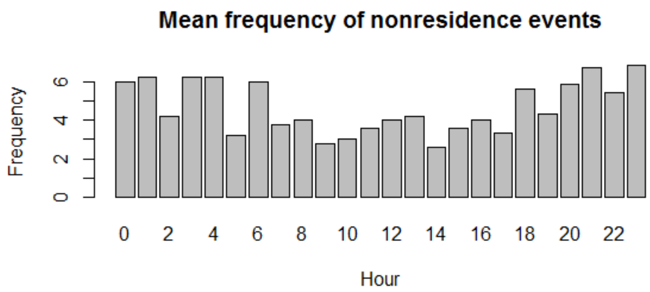
DATETIME	the date and/or time an event was initiated. For example an event at 2012-01-08 12:20:21 will be '2012-01-08 12:00:00' for Hour, '2012-01-08' for Day, '02' for Week, '01' for Month and '12' for Circadian.
TRANSMITTER ID	the ID code of the transmitter
FREQ	the number of events that occurred in that hour/day/week/month
TIMESUM	the total residence or non-residence time for that hour/day/week/month
TIMEMAX	the maximum event duration reading for that hour/day/week/month
TIMEAV	the mean duration of an event in seconds for that hour/day/week/month
TIMESTDDEV	the standard deviation of the event duration by hour/day/week/month (in seconds)

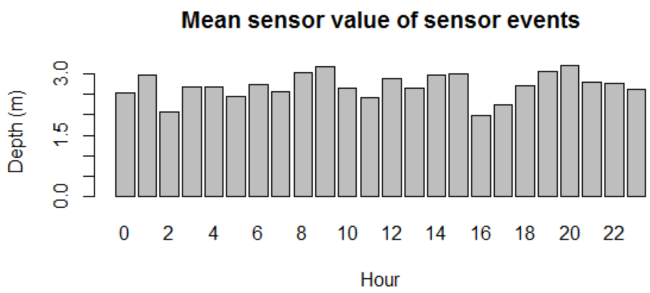
The below table shows an example output file containing a weekly profile for temperature events.

DATETIME	TRANSMITTERID	FREQ	SENSORMAX	SENSORAV	SENSORSTDEV	TIMESUM	TIMEMAX	TIMEAV	TIMESTDEV	DETECTIONS
0	242	1	28.4	28.4	NA	31679	31679	31679	NA	2
1	242	3	28.6	28.43333	0.288675	303192	148205	101064	58676.64	28
2	242	1	28.1	28.1	NA	892	892	892	NA	7
3	242	1	28.4	28.4	NA	199472	199472	199472	NA	2

`DATETIME`	the date and/or time an event was initiated. For example an event at 2012-01-08 12:20:21 will be '2012-01-08 12:00:00' for `Hour`, '2012-01-08' for `Day`, '02' for `Week`, '01' for `Month` and '12' for `Circadian`.
`TRANSMITTER ID`	the ID code of the transmitter
`FREQ`	the number of events that occurred in that hour / day / week / month
`SENSORMAX`	the maximum sensor reading that hour / day / week / month (this is only returned if a sensor event is entered as the `Input file`)
`SENSORAV`	the mean sensor reading that hour / day / week / month (this is only returned if a sensor event is entered as the `Input file`)
`SENSORSTDEV`	the sensor value standard deviation for that hour/day/week/month (this is only returned if a sensor event is entered as the `Input file`)
`TIMESUM`	the total event time for that hour/day/week/month
`TIMEMAX`	the maximum event duration reading for that hour/day/week/month
`TIMEAV`	the mean duration of an event in seconds for that hour/day/week/month
`TIMESTDDEV`	the standard deviation of the event duration by hour/day/week/month (in seconds)

By collating the different events by temporal conditions the acoustic data can answer questions such as what time of year are animals most active? What time of day do animals change depth in the water column, and what time periods are animals not detected?



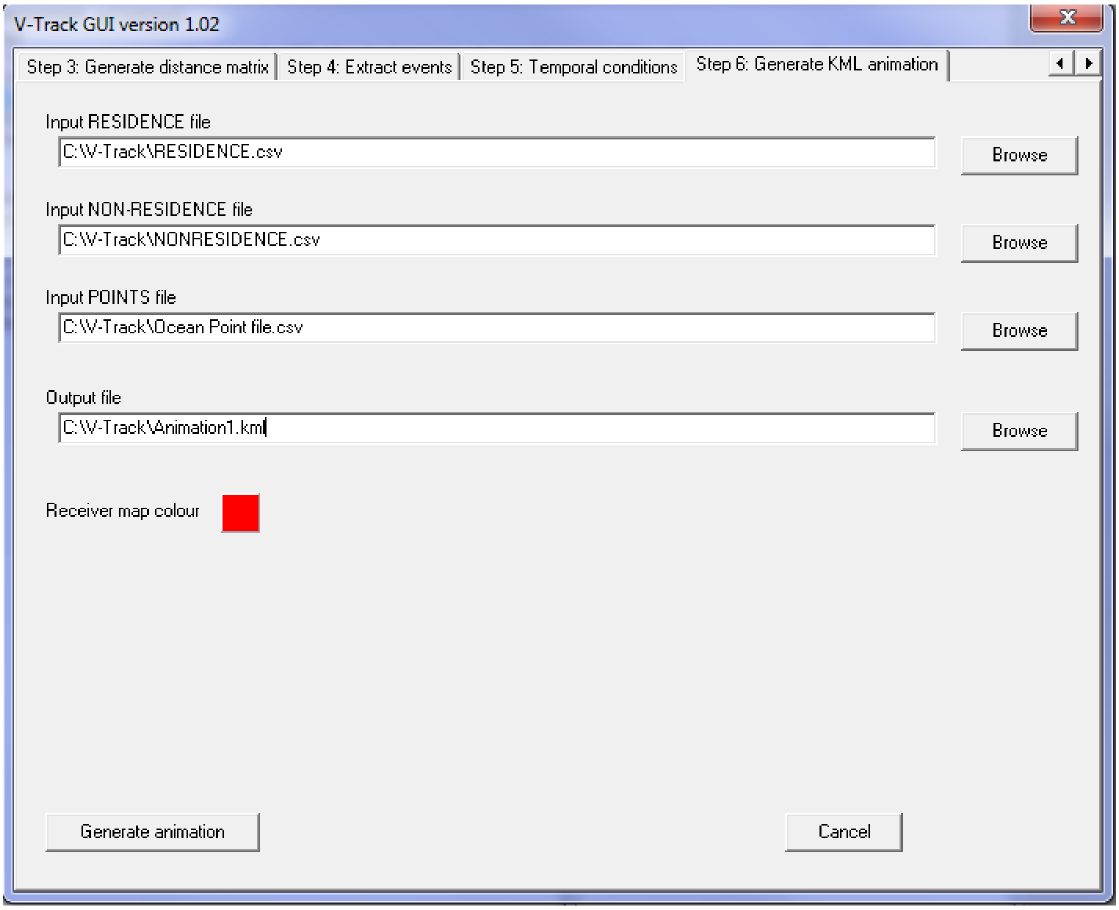


6. Create animation of animal track to view in Google Earth.

6.1 Generating the Google Earth animation

This step creates Google Earth animations to view when animals are within the detection field of various receivers and when they move between receivers. A coloured dot is produced at the location of the receiver to demonstrate when an animal is within the detection field and a white line is produced indicating the period when an animal is between the detection fields of adjacent receivers.

Once an event catalogue has been created, click the 'Step 6: Generate KML Animation' tab. The following screen will be displayed:



In the Input RESIDENCE file field, enter the location of the RESIDENCES event file generated in Step 4 or alternatively browse to the location of the event file.

In the Input NON-RESIDENCE file field, enter the location of the NONRESIDENCES event file generated in Step 4, or alternatively Browse to the location of the event file (optional).

In the Input POINTS file field, enter or Browse to the location of POINTS file, containing the geographical locations of the receivers (this file format is described in Step 3, page 10).

In the `Output file` field, enter the location and name of the file to be created or alternatively browse to the specified location using the `Browse` tab.

The colour of the receivers to be displayed on the Google Earth image can be selected in the drop down window.

6.2 Running the Google Earth animation

Download Google Earth from http://www.google.com/earth/index.html and follow the onscreen instruction to install.

Double click on your .kml file generated by V-Track. The .kml file will be opened in Google Earth and the screen will zoom to the study area location. All the functionality of Google Earth is now available to view your animal track animations.

To run the animation click on the highlighted button on the tool bar

If the animation is running too fast to appropriately view the animal tracks. Click the blue spanner in the left corner of the tool bar. This will open a window where the play speed of the animation can be reduced. The time scale of the animation can also be extended or reduced through the zoom functions with the magnifying glass icons (it should be possible to slow the animation down to a scale of hours and minutes). If the animation does not zoom down then there is too much data within the animation. Unfortunately this is the limitation of Google Earth 5.0, and we recommend reducing the size of your data file using the sub-archive extraction protocols (Step 2) in V-Track. Either reduce the number of transmitters within the animation, and/or the time period of the selected data.

GUI Summary of Steps

Step 1 - V-Track archive

Create database from acoustic detection data, VR2, VR100, or data repository

Amalgamate a collection of different VEMCO acoustic detection files

Add data to an existing V-Track archive

Sort database into chronological order

Remove duplicates records from database

Convert database from UMT to local time

Step 2 - SQL

Sub-archive data by time period, receivers, stations, transmitters, sensor type

Step 3 - Receiver distance matrix calculator

Creates a matrix to define the relative distance between all receivers within the array

Offers two different options for calculating the route distance between receivers within the array

Step 4 - The event analyser

Identifies and catalogues periods when a transmitter is within the detection range of each receiver

Identifies and catalogues periods when transmitter moves between the detection ranges of adjacent receivers

Identifies and catalogues events based upon relative changes in the depth sensor data

Identifies and catalogues events based upon relative changes in the temperature sensor data

Step 5 – The event organiser

Groups events by temporal conditions, these can be hourly, daily, weekly, monthly

Groups events into the hours over the diel cycle

Step 6 – The animation generator

Creates a KML animation file that can be viewed in Google earth

The animation shows periods when a transmitter is within the receiver range of a receiver and when it is moving between receiver detection ranges.