



## 7.4 R-Script Development for the Processing of Radar Detected Aerial Tracks (radR .csv)

This process is the final step in accessing the information captured by recording horizontal and vertical radar images in our study. The output from the script has track values of speed and direction available and ready for analysis.

First, to understand how the data was generated:

All radar recordings were viewed using radR 2.5.1 software<sup>1</sup> with periods of interference noted<sup>2</sup>. The tracking of targets captured in the recordings was conducted using radR 2.5.1 with specific blip parameters and tracking restrictions<sup>3</sup>.

The radR 2.5.1 tracking software produces a comma separated values file (.csv). Every track is numbered, and the blips within each track are also numerically identified. Every row of the output file has a tracks' recorded blip values including: time, distance from the radar (range), x and y distances, area, intensity, and perimeter.

The desire to summarize the radR output using passage rate per hour, and the identification of a few time signature irregularities of sequential records in the .csv output caused a data cleaning process to be developed. R code was written to process both the horizontal<sup>4</sup> and vertical<sup>5</sup> .csv files from radR. In both these programs the raw track files are imported, variables are created to identify records by night, hour, and minute of local time. All tracks with periods of interference (usually a result of precipitation events) are removed<sup>6</sup>. Tracks with time signature irregularities are removed through testing the time differences between sequential blips of a track. Passage rates per hour required tracks that span the hour boundary to be assigned to the hour in which they began (in order to

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<sup>1</sup> radR 2.5.1 software release 20110911212451-windows

<sup>2</sup> Refer to: 7.2 Weather Events for Exclusion from Analysis – using radR to view radar recordings (in Protocol folder)

<sup>3</sup> Refer to: 7.3 Radar Recordings Processed Using radR (in Protocol folder)

<sup>4</sup> Refer to: R Script Processing of radR output files\_Horizontal Template READABLE OUTSIDE R in the R script folder.

<sup>5</sup> Refer to: R Script Processing of radR output files\_Vertical Template READABLE OUTSIDE R in the R script folder.

<sup>6</sup> Record numbers to be excluded, the minutes of each hour to be assessed and the area of analysis (km<sup>2</sup>) are entered into the .txt file associated with the .csv file for analysis. The .txt file is very specific for the number of lines for R script input. For further information refer to site\_time6d\_date5\_year\_Vert\_TEXT\_INPUT\_template.txt in the R script/template files folder, the Horizontal template is labeled “Horz” and stored in the same place.



avoid being counted twice). With these factors rectified the tracks remaining are available for analysis.

Wishing to extract more information about the tracks additional R code was written in order to calculate net track: length, time duration, speed, directional quadrant value, and bearing. The horizontal radar track values generate compass bearings<sup>7</sup>, and the vertical radar track values generate vertical bearing of flight elevation gain or loss along the ridge line (North or South).

RStudio GUI [Version 0.95.258 2009-2011 RStudio, Inc.] was used as the graphic user interface for R [Version 2.14.1], as it uses many of the control commands familiar to general computer users. To run the R-scripts, the .csv data file from radR, the .txt input file and the R-script file must all be saved in the same directory. The **.txt file is generated by the user for the specifics of the .csv file being processed**, follow instructions in the template file, watching file name format and line numbers within the .txt file. You will have to have values for the minutes of each hour being assessed, the record numbers to be assessed (starts and stops for interference events) and the area calculated after exclusion zones used in radR were removed by calculating their area as demonstrated in the Tutorial Video Series : Part I, Pre R Script Processing of Radar Images to radR Output (explained at 5:51, diagram at 6:50 into the 11:03 video).

- Open RStudio and on the toolbar under File/ open File/ find the R code in the directory you have set up, and select it. The code will be visible in the top left window in RStudio ready to be manipulated before running.
- The first line of active code (code line 11 in image below) in both R files is the working directory:  

```
setwd("J:\\R runs\\Data to test\\test sets Vert and Horizontal")
```

**Change the directory between the quote marks** to the directory you are running the code from (using double backslashes between directory levels). All files produced will be saved into the same directory as output in .csv format.
- The second and third lines of active code (code lines 12 and 13 above) are:  

```
VNIGHT <- "JR33_224457_May24_2011_Horiz_shortened_dec5_post_run.csv"  
VINPUT <- "JR33_224457_May24_2011_Horiz_dec5_TEXT_INPUT.txt"
```

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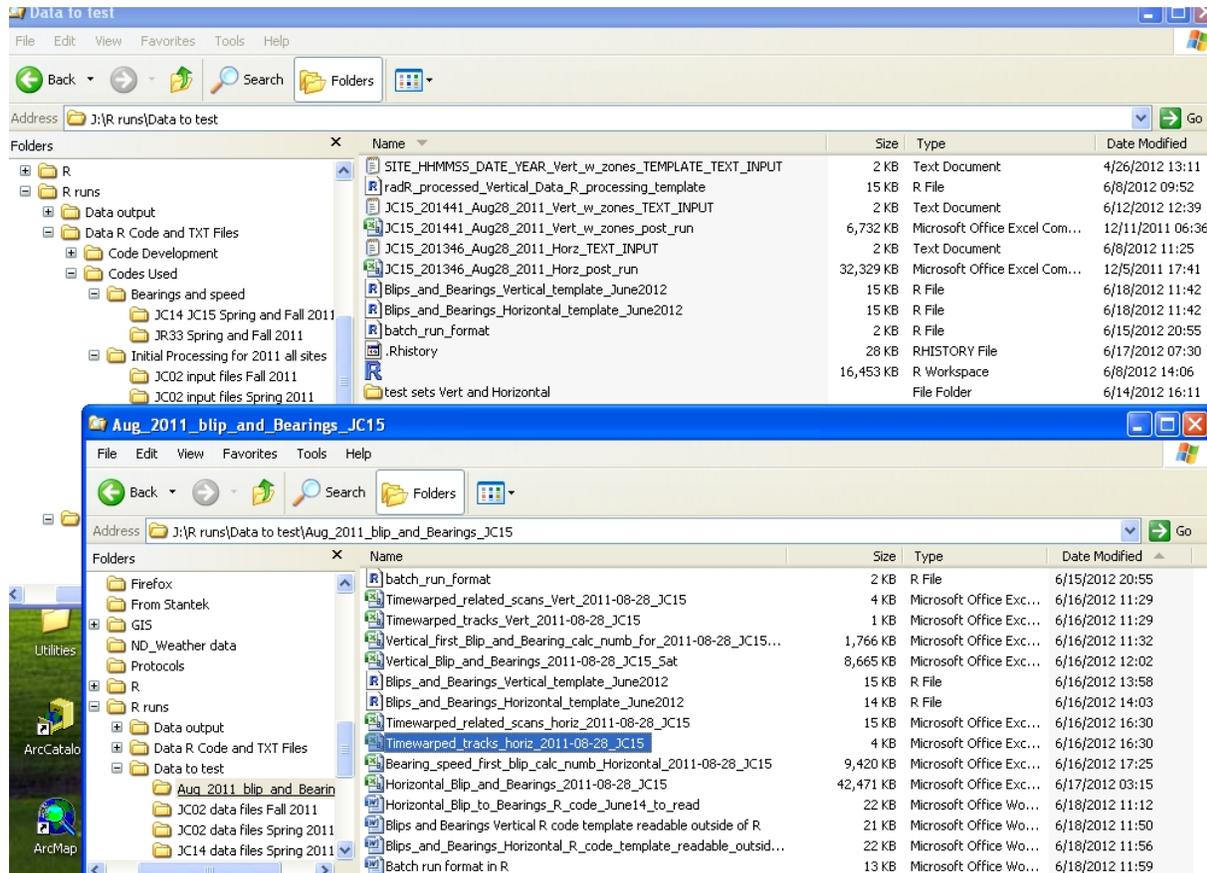
<sup>7</sup> Compass bearings are subject to radR antenna corrections made in radR run of the radar record files. North is calculated assuming a positive y axis, and 0 as the x axis value.



Which need to be **changed to the exact file names you have in the working directory**, **\*\*R is case sensitive.\*\*** If the file name protocol is followed the location, date and time stamp will all be read in from the file name itself. If the .txt file protocol is followed the area of analysis, minutes per hour, and interference periods as noted by record number will be read in from within the .txt file.

```
1 #####
2 ## Horizontal_Blip_and_Bearings_June14_2012
3 ##
4 ##
5 ## 2011 Horizontal radar N.Dokie radR csv output file and .txt
6 ## calculate track bearings, length and speed by quadrants of the sky.
7 ## Paired with Vertical radar, also run in June 2012 to determine bug character
8 ##
9 ## Isobel Hartley June 14, 2012
10 #####
11 setwd("J:\\R runs\\Data to test\\test sets vert and Horizontal")
12 VNIGHT <- "JR33_224457_May24_2011_Horiz_shortened_dec5_post_run.csv"
13 VINPUT <- "JR33_224457_May24_2011_Horiz_dec5_TEXT_INPUT.txt"
14
15 vnight <- read.csv(VNIGHT)
16 vnight$rec.no <- vnight$scan.no
17 vnight$location <- substr(VNIGHT,1,4)
18 vnight$night <- as.Date(substr(VNIGHT,13,22), format="%b%d_%y")
19 vnight$start.time <- substr(VNIGHT,6,11)
20 #####
21 ## local time is defined by pasting the date and time values radR recorded in G
22 ## into one variable, calculating the time difference and formatting for date u
23 vnight$local.time <- as.POSIXct(paste(vnight$date, vnight$time))-7*60*60
24
```

- In the image below you will see examples of these files as displayed by MSWindows Explorer, their sizes and types. [Note that radR .csv files show up as Microsoft Office Excel Comma Separated Values File even though they have never been opened by Excel. If opening a radR .csv file in Excel, be careful to NOT save it while in Excel, as the date formatting is changed by Excel, and will not read into R, even when saved as a .csv format.] I was running JC15 Aug28\_2011 Vertical and Horizontal data from the J:\\R runs\\Data to test folder.



- To run the code while your cursor is in the top left window in R Studio press Ctrl+Shift+R
  - options of how to run single lines of code or sections are given in the toolbar under Edit/Run Code/, it is very useful to run the code from the beginning to where your cursor is so you can identify any errors in the Console window.
- The Horizontal full night of August 28 2011 took 13 hours to run on my home computer, and the Vertical for that same night took 5 hours. The output of these two R runs are available in the “runs” directory associated with this word file, as are all the files needed to create them.
- Good luck, it is amazing, and powerful. I hope you can figure out your error messages using the Help section of the RStudio bottom right window. There will be error messages, but with time it will get more do-able.