Exploring Autocorrelation in Movement Parameters

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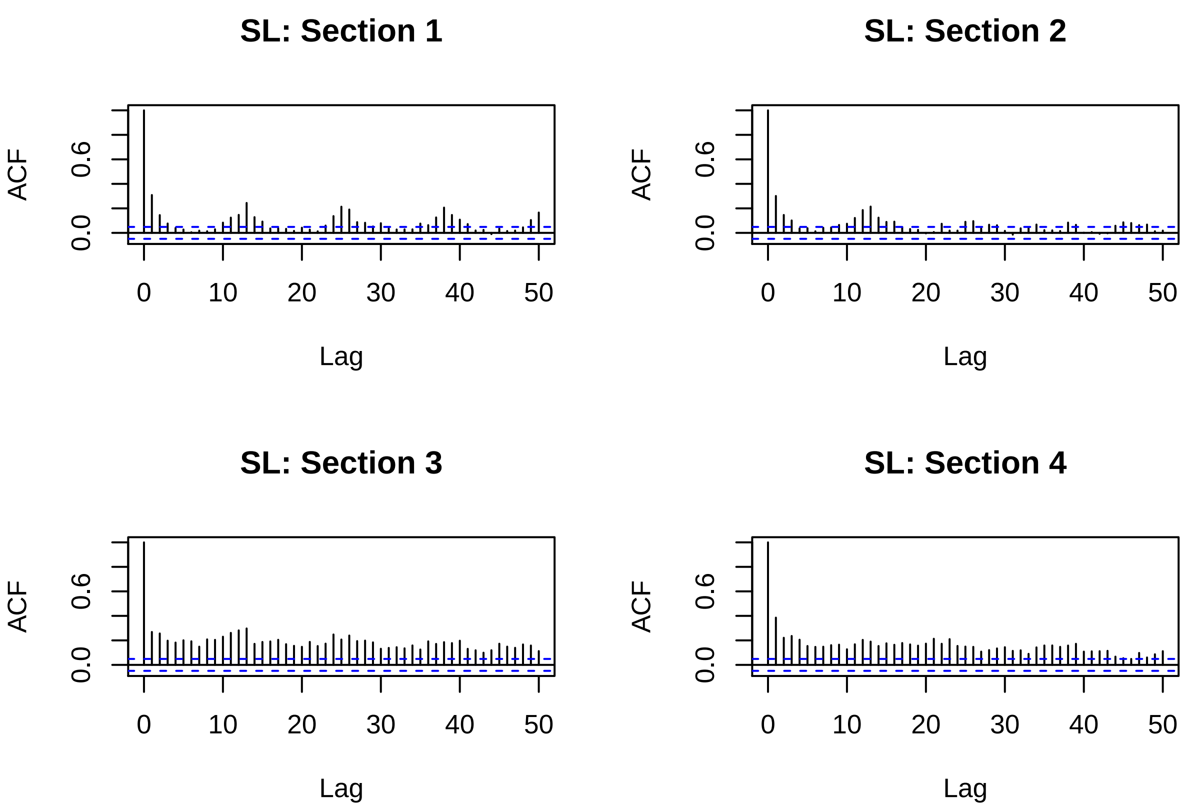
Autocorrelation of SL, TA, and TAA

Autcorrelation is common in the time series of animal trajectories. This document shows trends in autocorrelation of individual movement parameters at different sections of tracks (filtered for only 1 h time steps) for each ID. This is shown at different scales as well (lag.max = 50 or nobs).

ID 1

There are 6500 total observations in this dataset that have 1 h time steps. This will be split into four equal sections.

SL



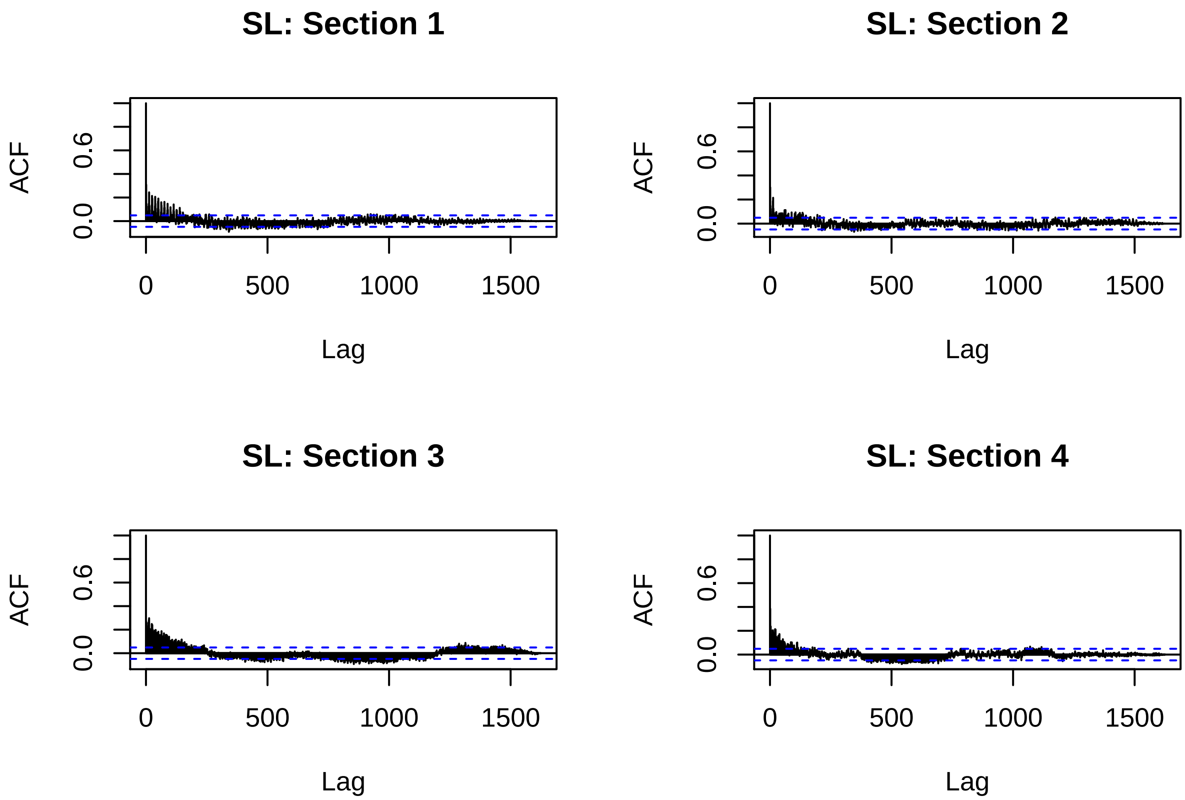
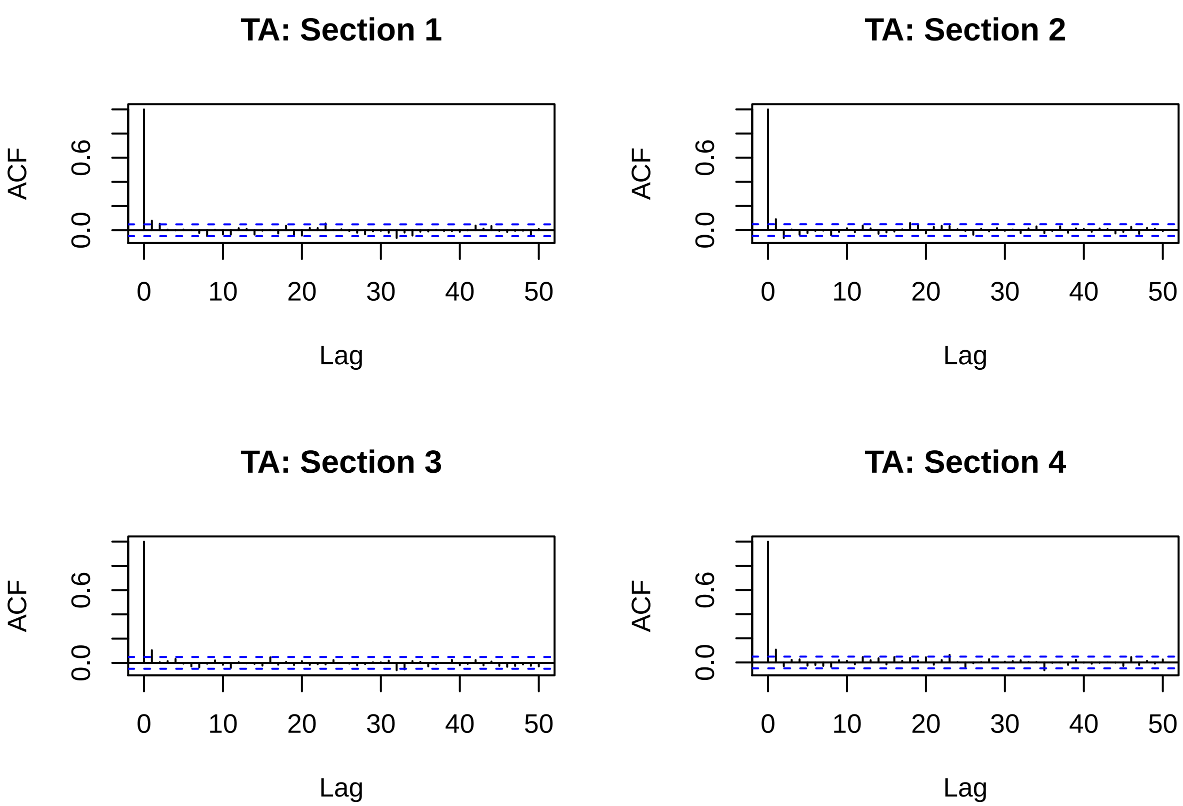


Figure 1: Autocorrelation of SL with a max lag of 50 or 1625 observations.

TA



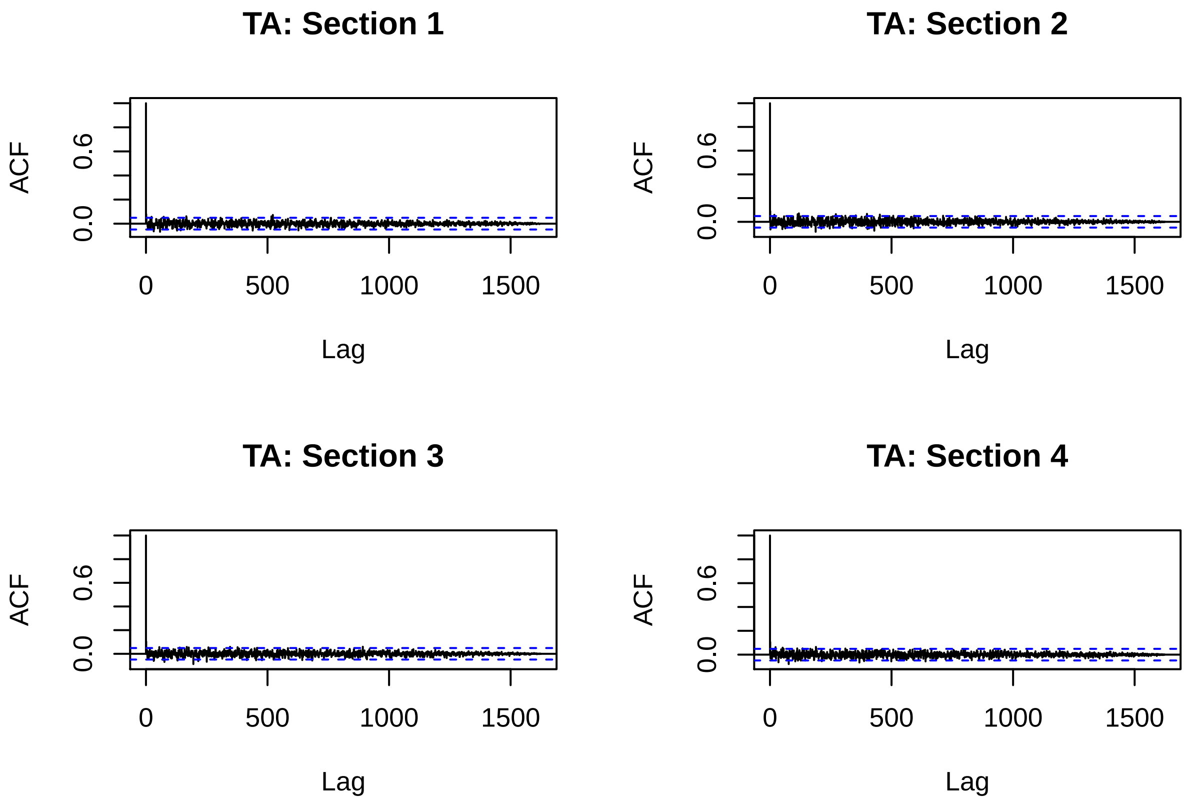


Figure 2: Autocorrelation of TA with a max lag of 50 or 1625 observations.

Trends in autocorrelation differed among the three movement parameters. For SL, it appears that there's a 24 h cycle within the 1st section for at least up to 50 observations, but this cyclical patterns appears to be lost within the last 3 sections that generally have high autocorrelation (**Fig 1**). When visualizing the ACF across all observations within each section, there appears to be a slight sinusoidal pattern that emerges after the decrease in autocorrelation after the first 250 observations. Autocorrelation may be significant at a lag of 1 for TA, but is low for all subsequent observations. When looking at the plot of movement patterns by day, this cyclical autocorrelation is likely a result of only a single observation being recorded each day for 48 days after the first one included in this dataset (w removal of all but 1 h time steps). This may be an artefact of removing all of the 2 h time steps, which were the most common for the beginning of the ID 1 track.

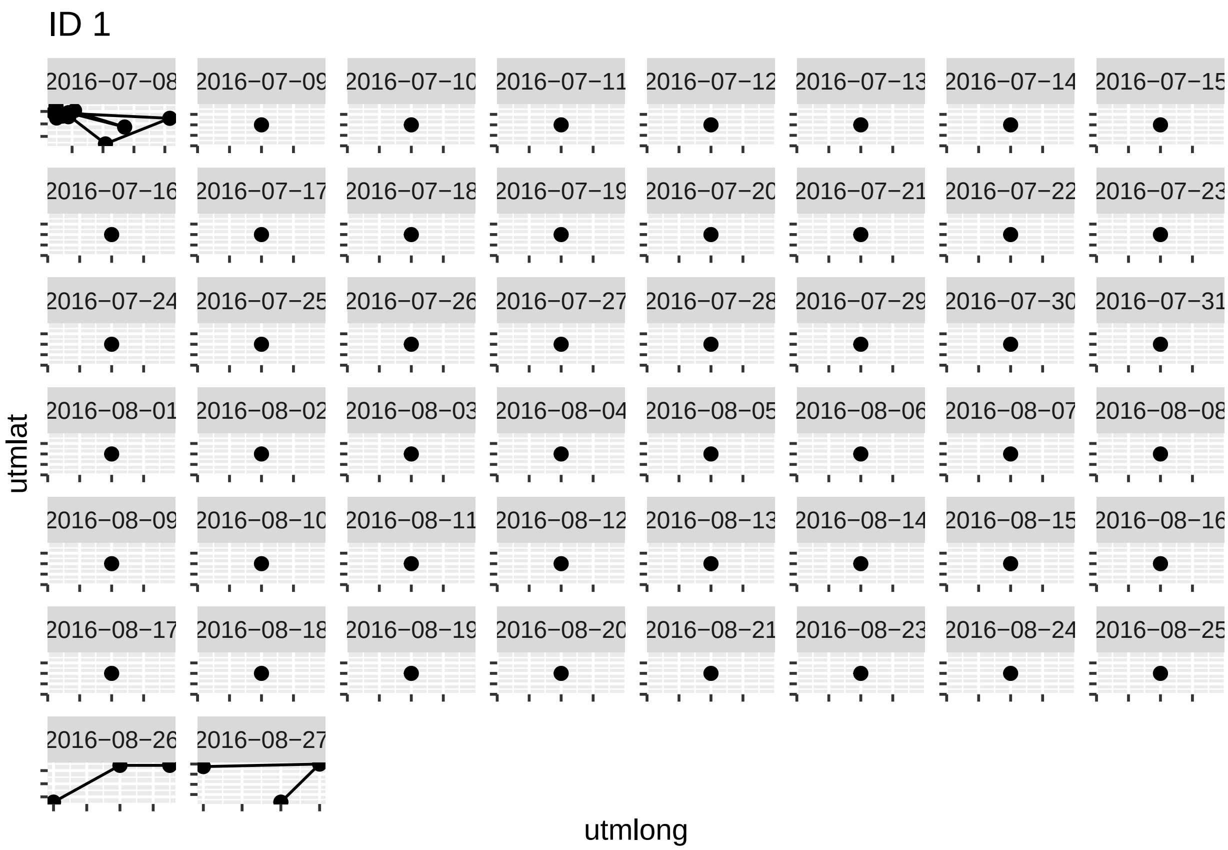
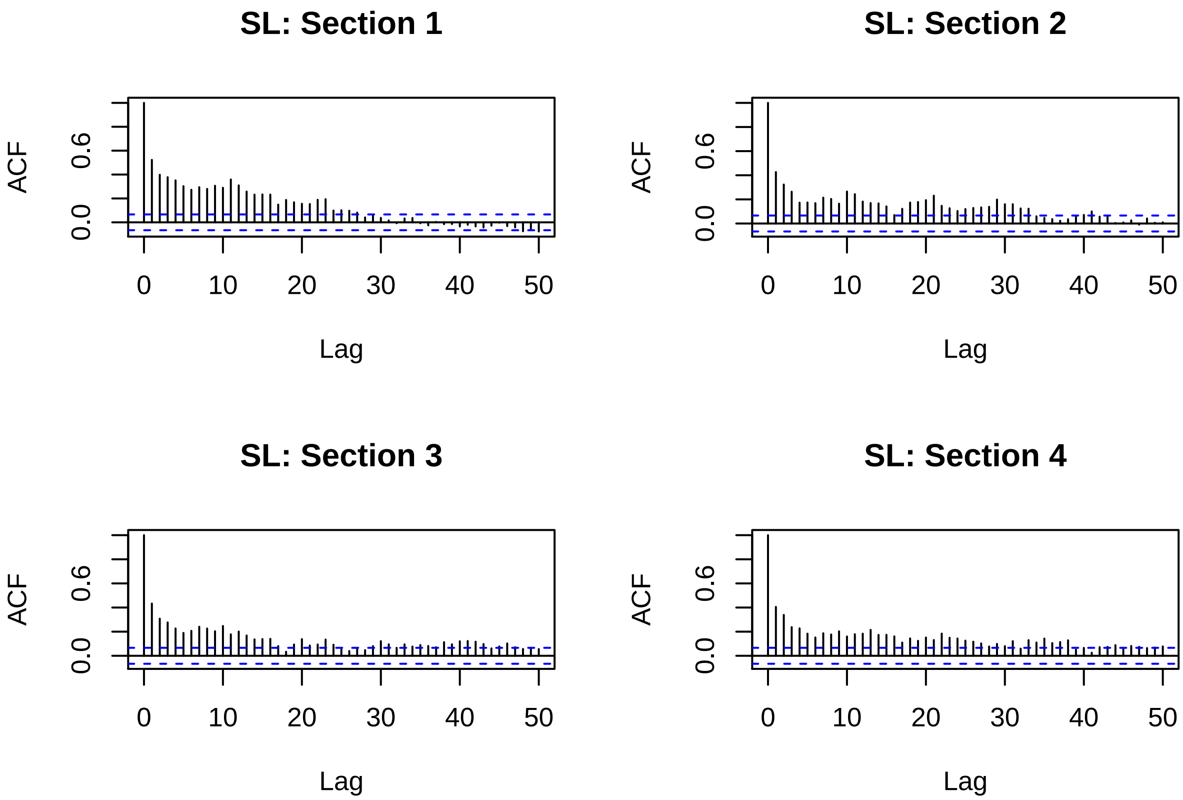


Figure 3: Scales of axes are allowed to be free to show movement patterns. All individual points represent a single observation for a given day for ID 1.

ID 12

There are 3513 total observations in this dataset that have 1 h time steps. This will be split into four (roughly) equal sections.

SL



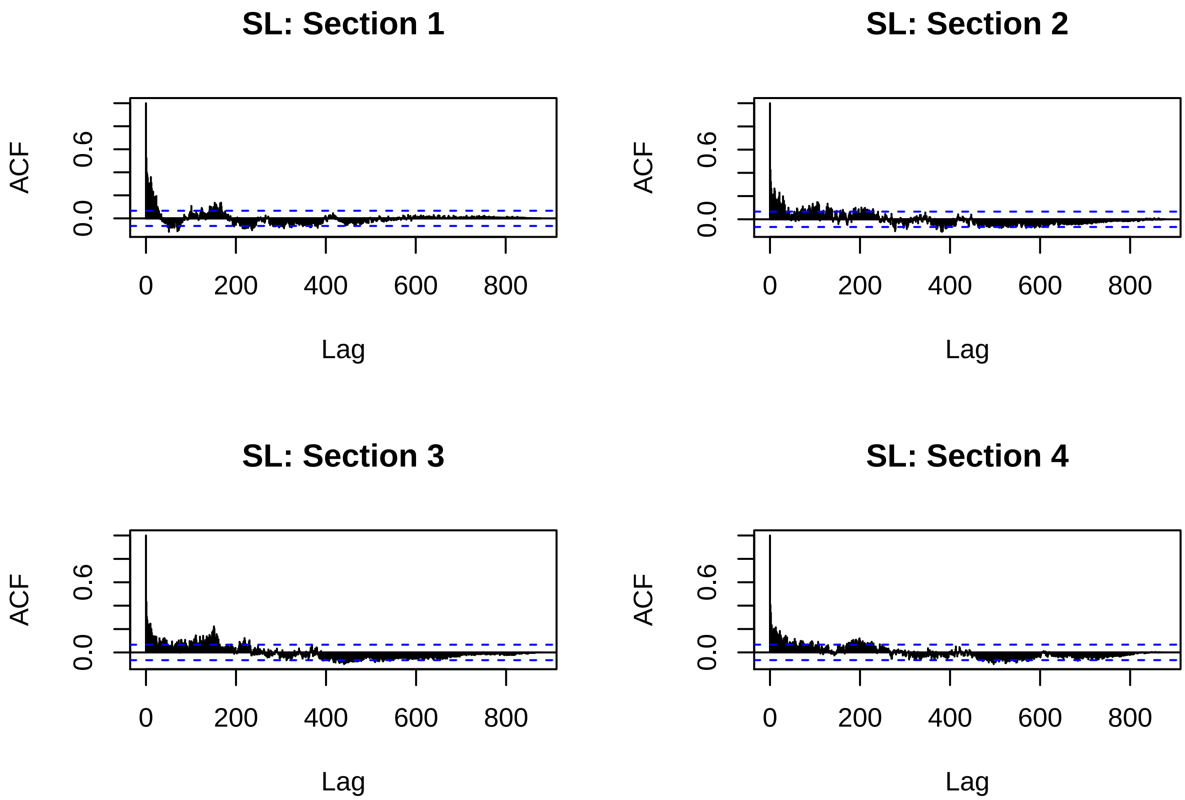
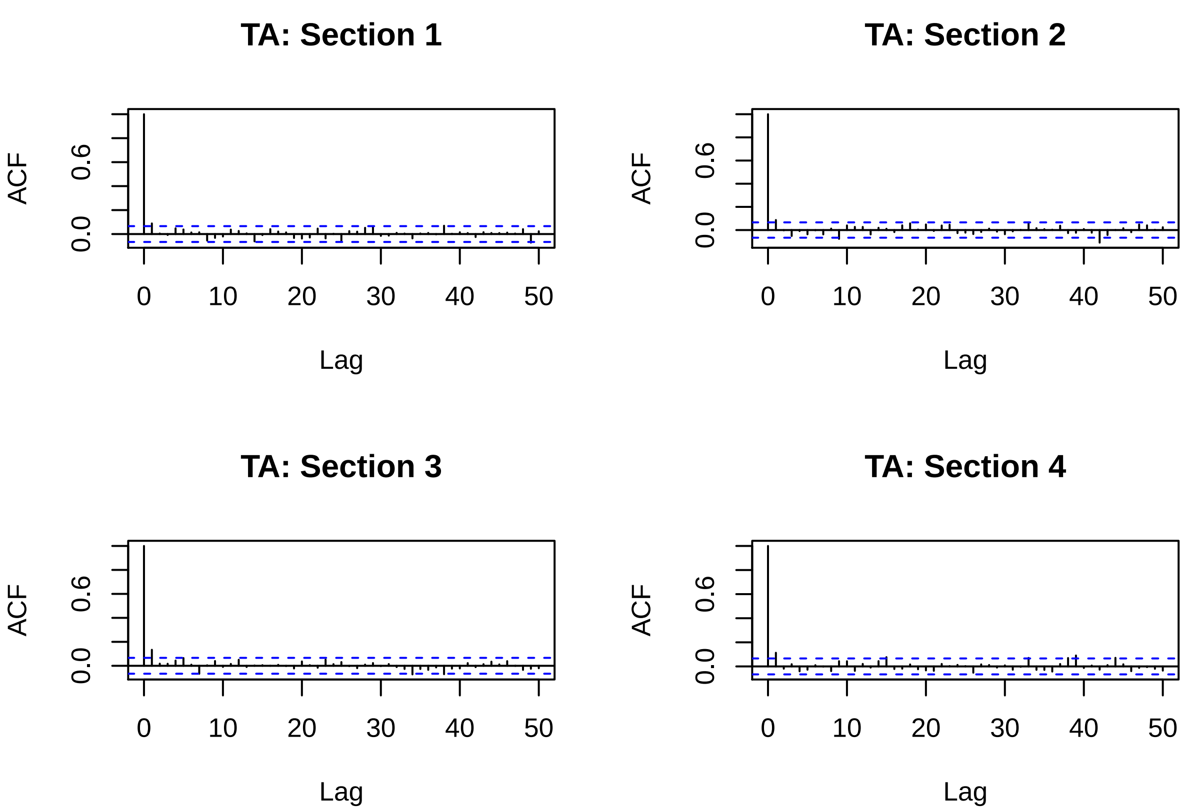


Figure 4: Autocorrelation of SL with a max lag of 50 or 878 observations.

TA



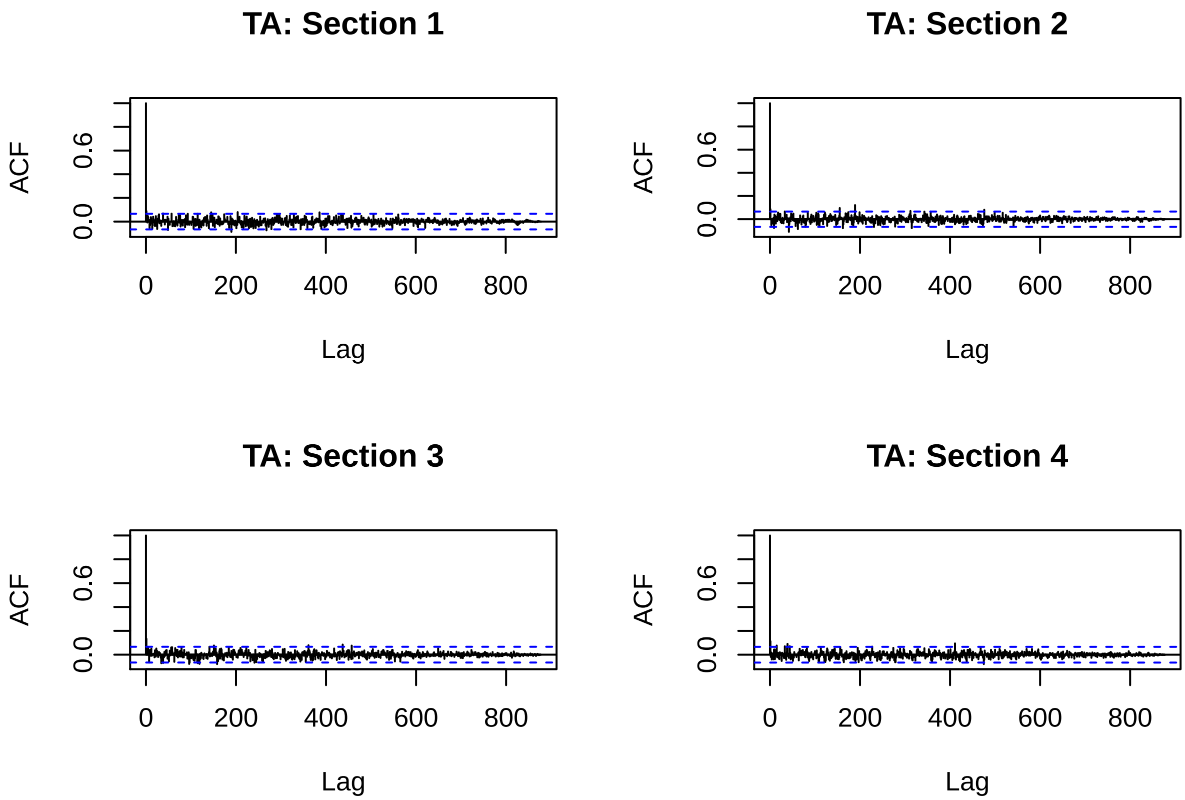


Figure 5: Autocorrelation of TA with a max lag of 50 or 878 observations.

There may be a slight cyclical pattern in the autocorrelation of SL over short lags (~10 obs), but generally decreases until ~20-40 observations. Over the entire time series of each segment, it appears that there are longer-term cyclical patterns emerging, but at different temporal scales by section (**Fig 4**). This pattern appears different in **ID 12** compared to **ID 1**. The autocorrelation in TA is essentially identical to that of **ID 1**, however. Unlike **ID 1**, **ID 12** has multiple observations recorded each day for the first week after tagging that are typically short and recursive in their pattern.

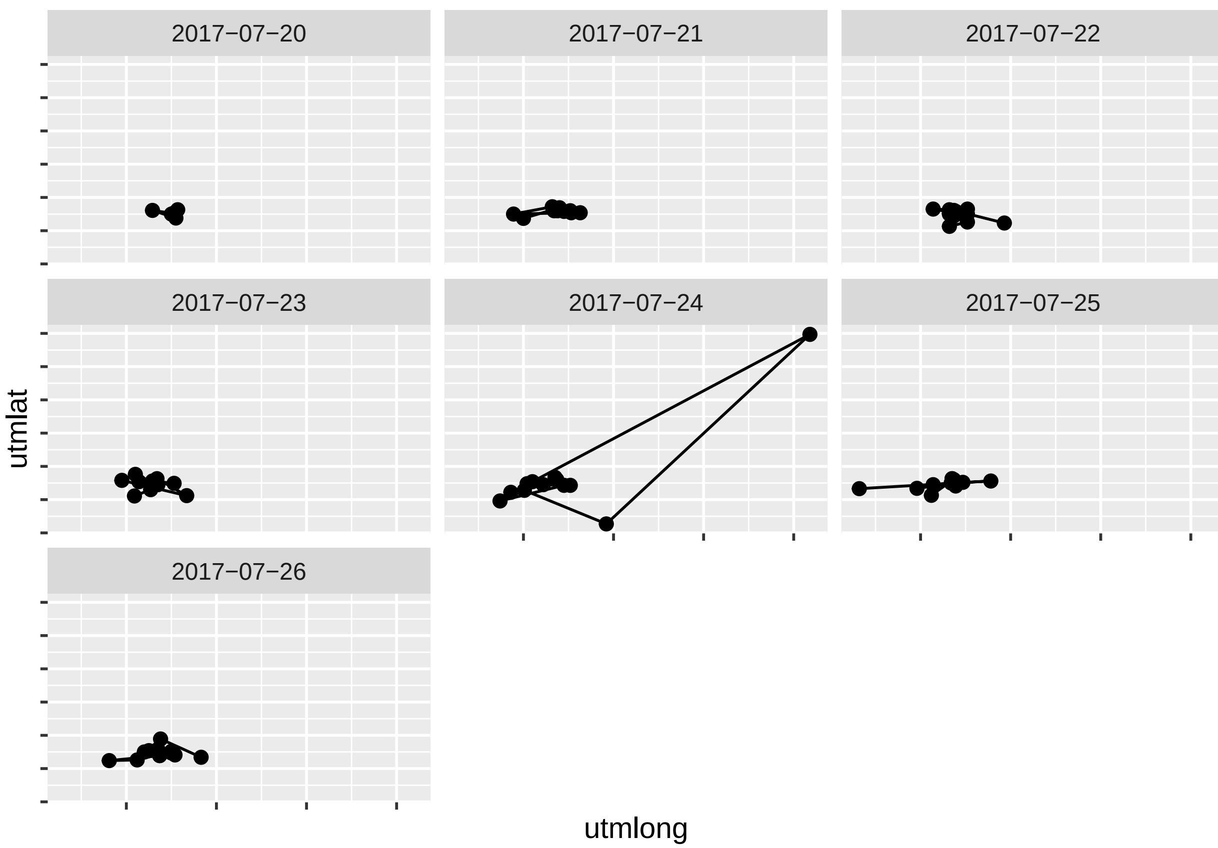
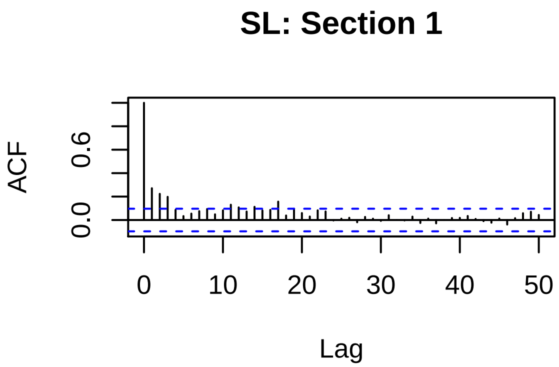


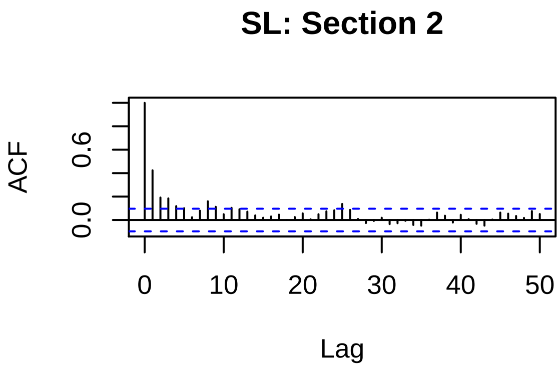
Figure 6: ID 12 generally shows short, recursive movements around the nest site after tagging, with a couple longer step lengths on 7/24/2017.

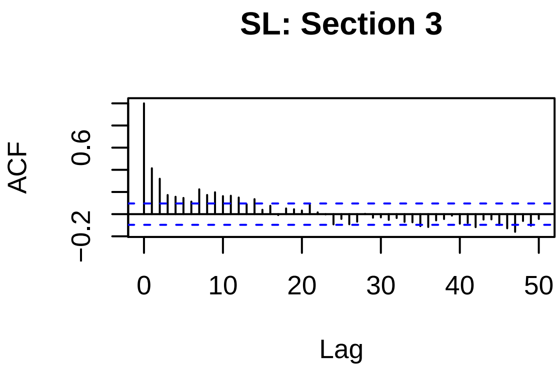
ID 19

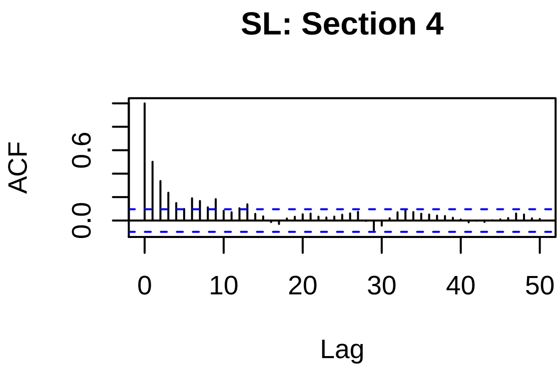
There are 1652 total observations in this dataset that have 1 h time steps. This will be split into four equal sections.

SL









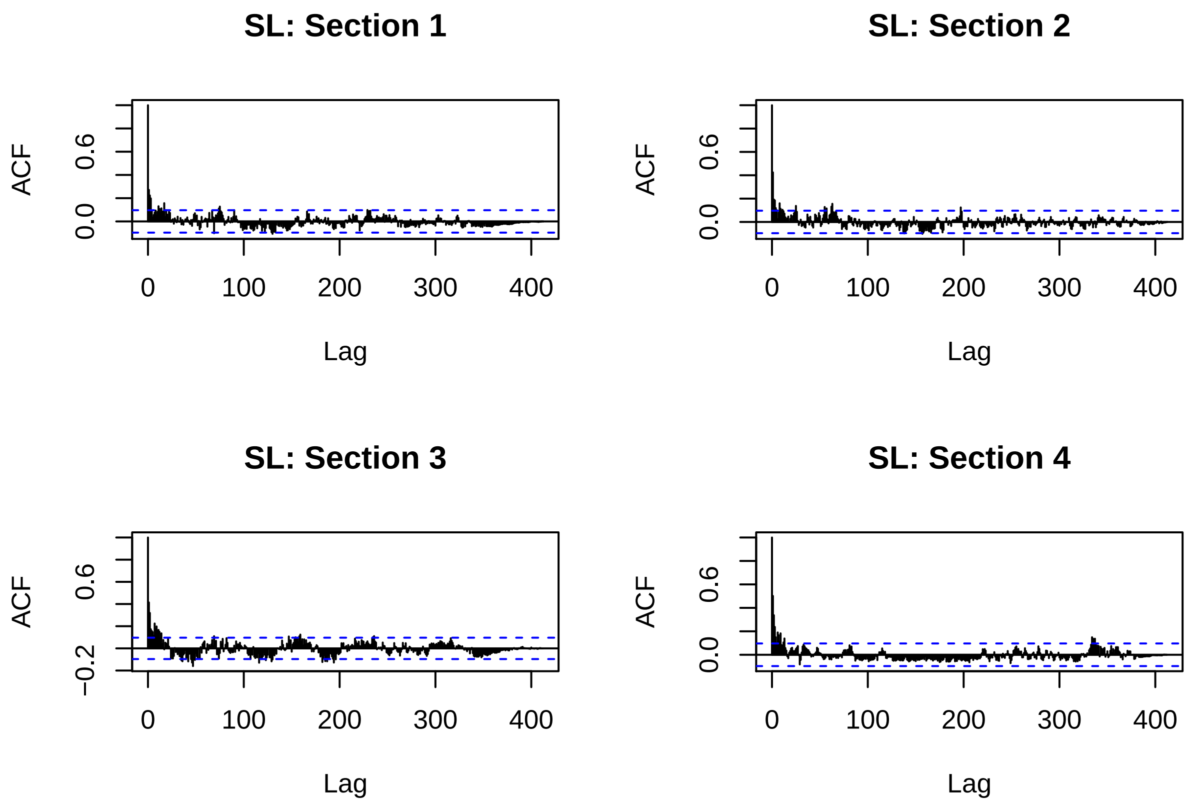
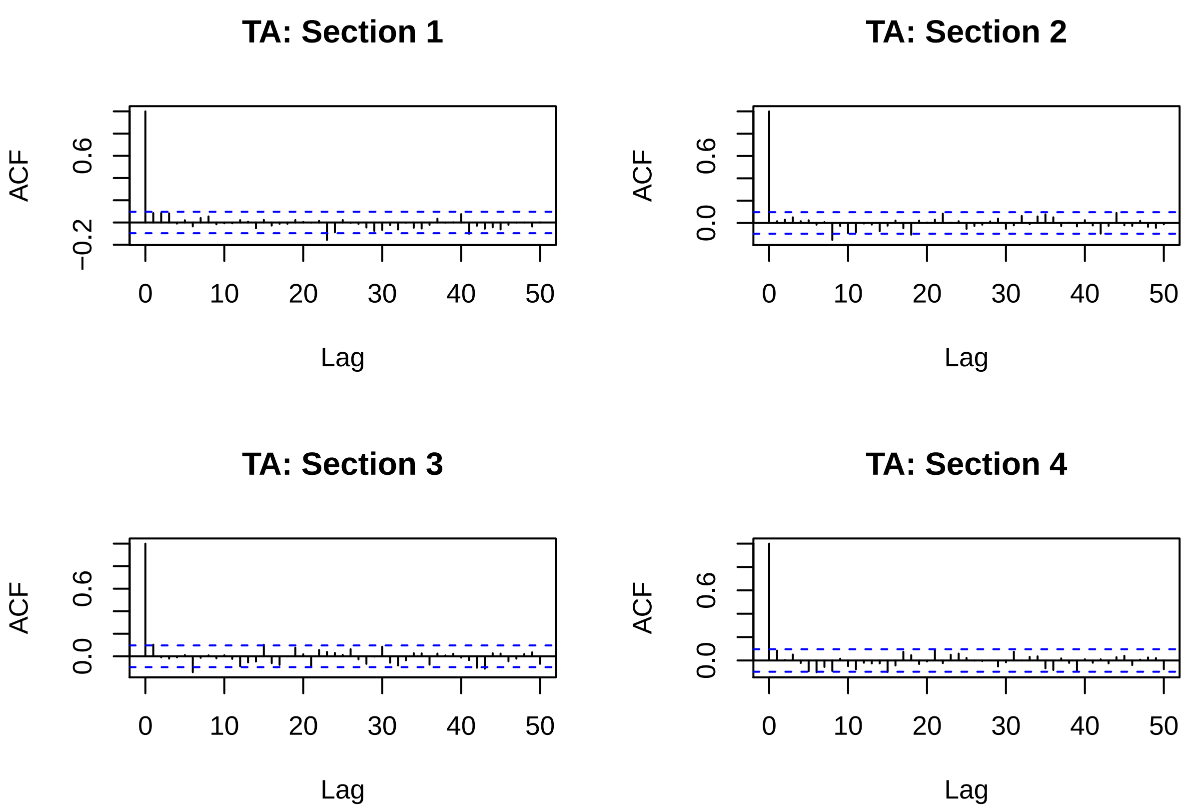


Figure 7: Autocorrelation of SL with a max lag of 50 or 413 observations.

TA



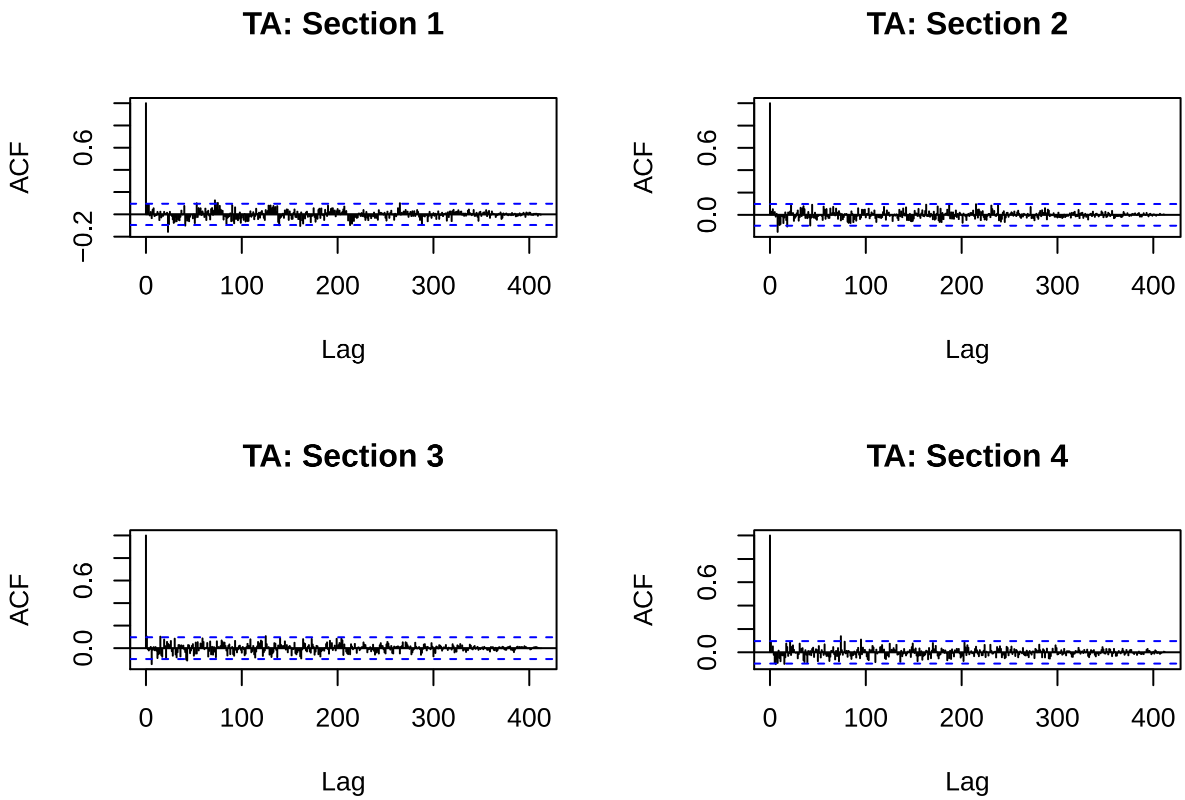


Figure 8: Autocorrelation of TA with a max lag of 50 or 878 observations.

Autocorrelation in SL appears to occur until a lag of 10-20 observations, but also shows long-term cyclical patterns in ACF; these cyclical patterns fall within the confidence interval, however (**Fig 7**). This pattern appears similar to **ID 12**. Again, the autocorrelation in TA is essentially identical to that of **ID 1** and **ID 12** in that it is not significant and shows no patterns over time. The plot of daily movements by **ID 19** is very similar to that of **ID 12**, dominated by short, recursive steps.

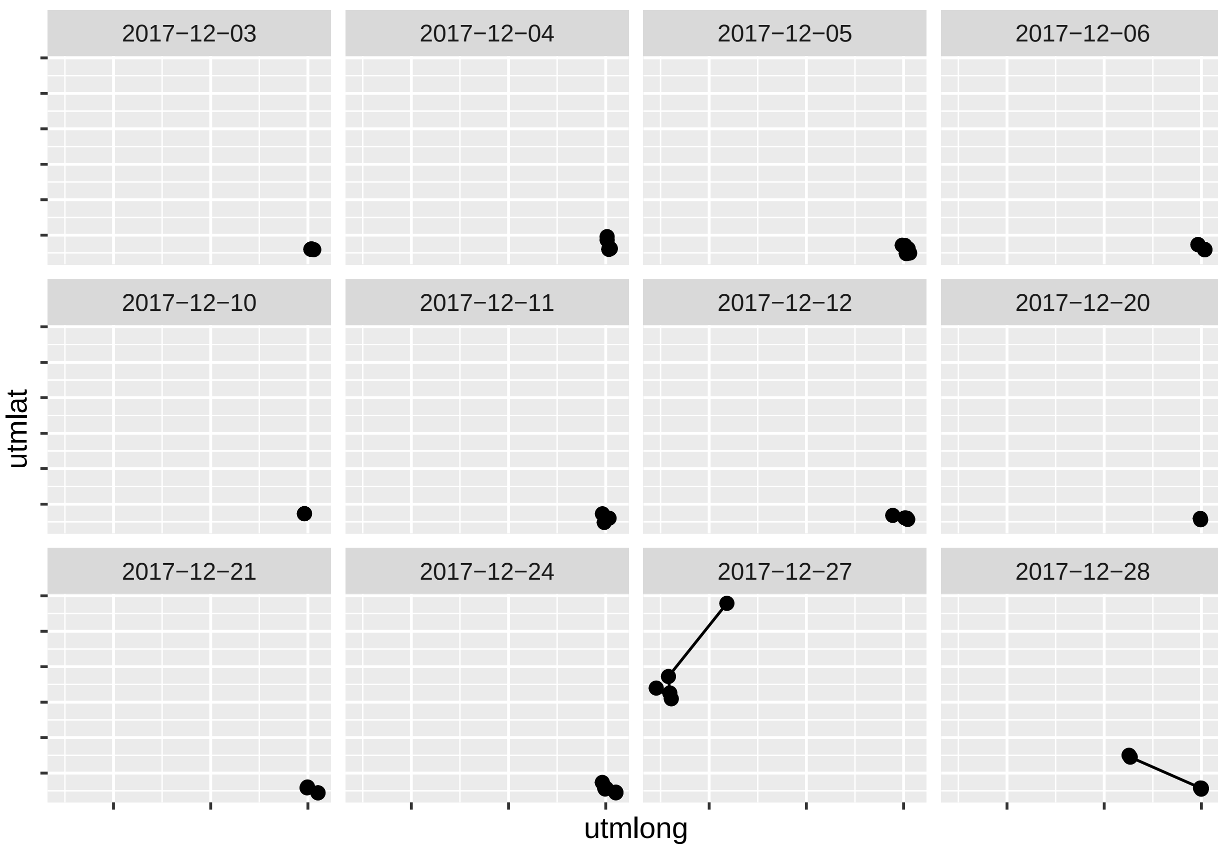
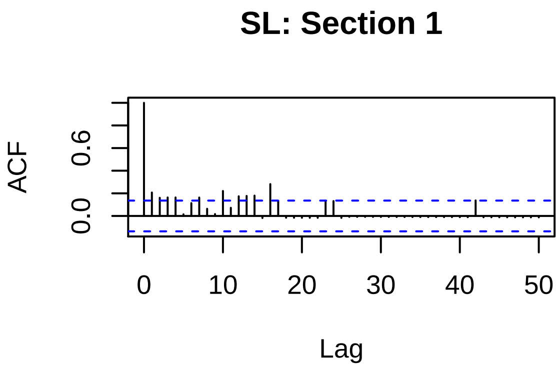


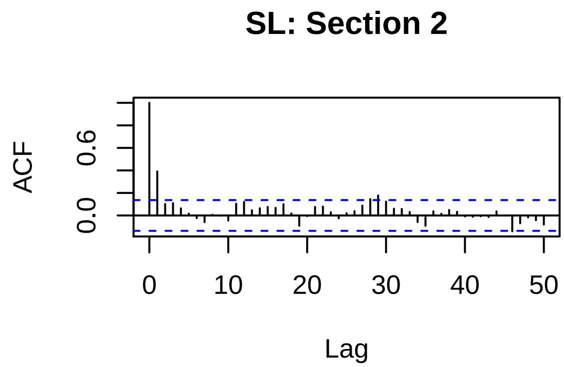
Figure 9: Most movements are short and recursive in ID 19 immediately after tagging, with the exception of a few step lengths on 12/27/2017 and 12/28/2017.

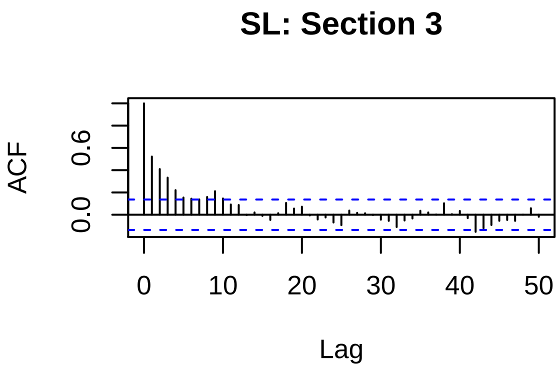
ID 27

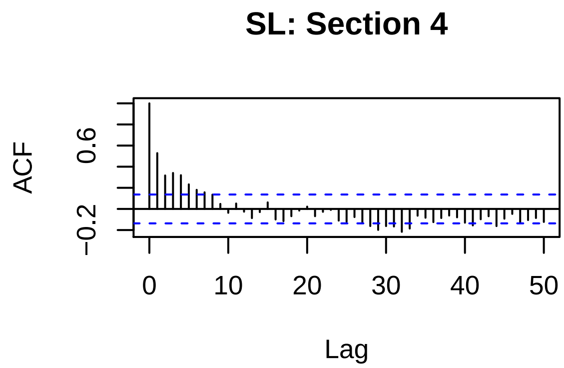
There are 1652 total observations in this dataset that have 1 h time steps. This will be split into four (roughly) equal sections.

SL









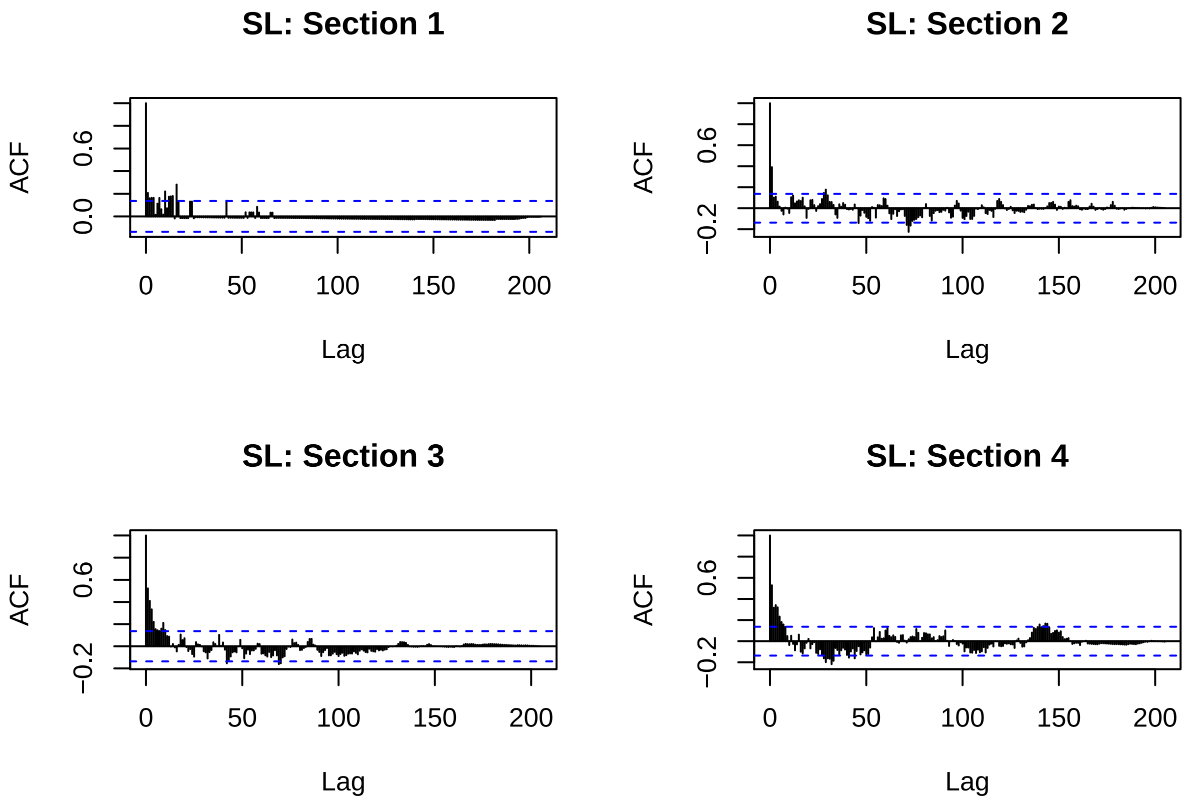
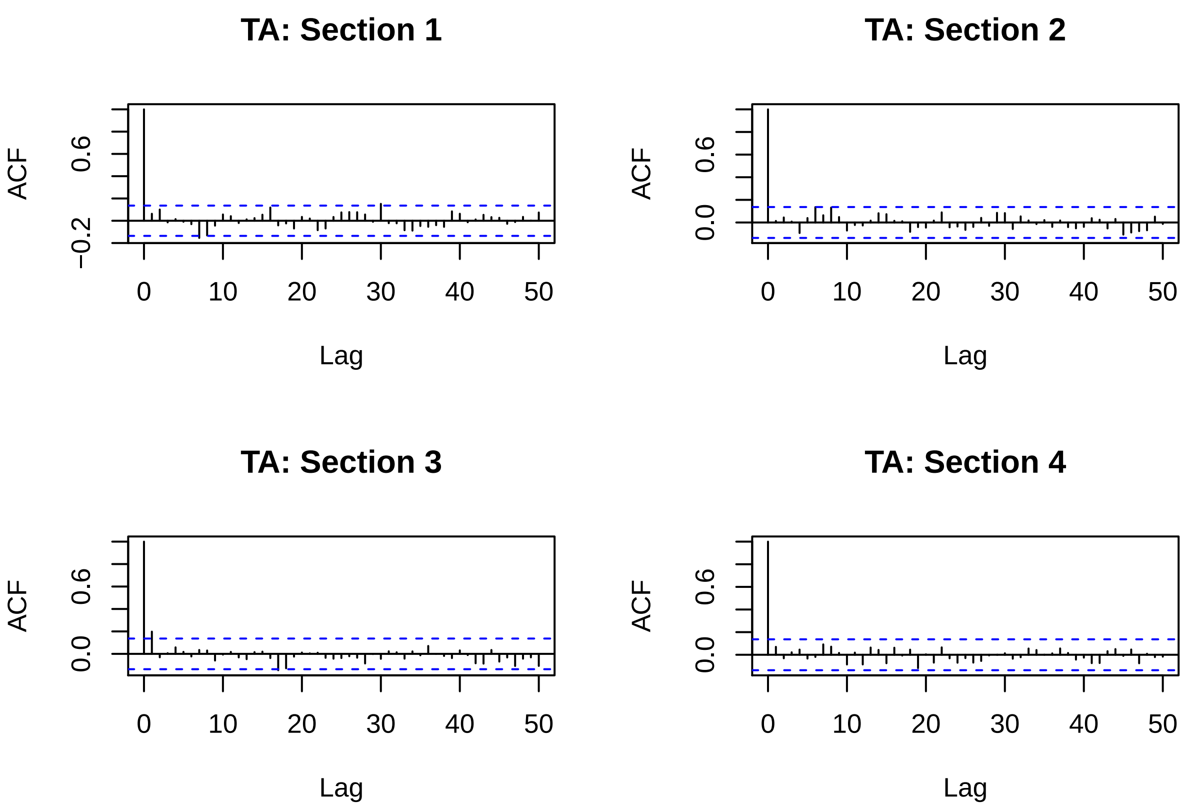


Figure 10: Autocorrelation of SL with a max lag of 50 or 413 observations.

TA



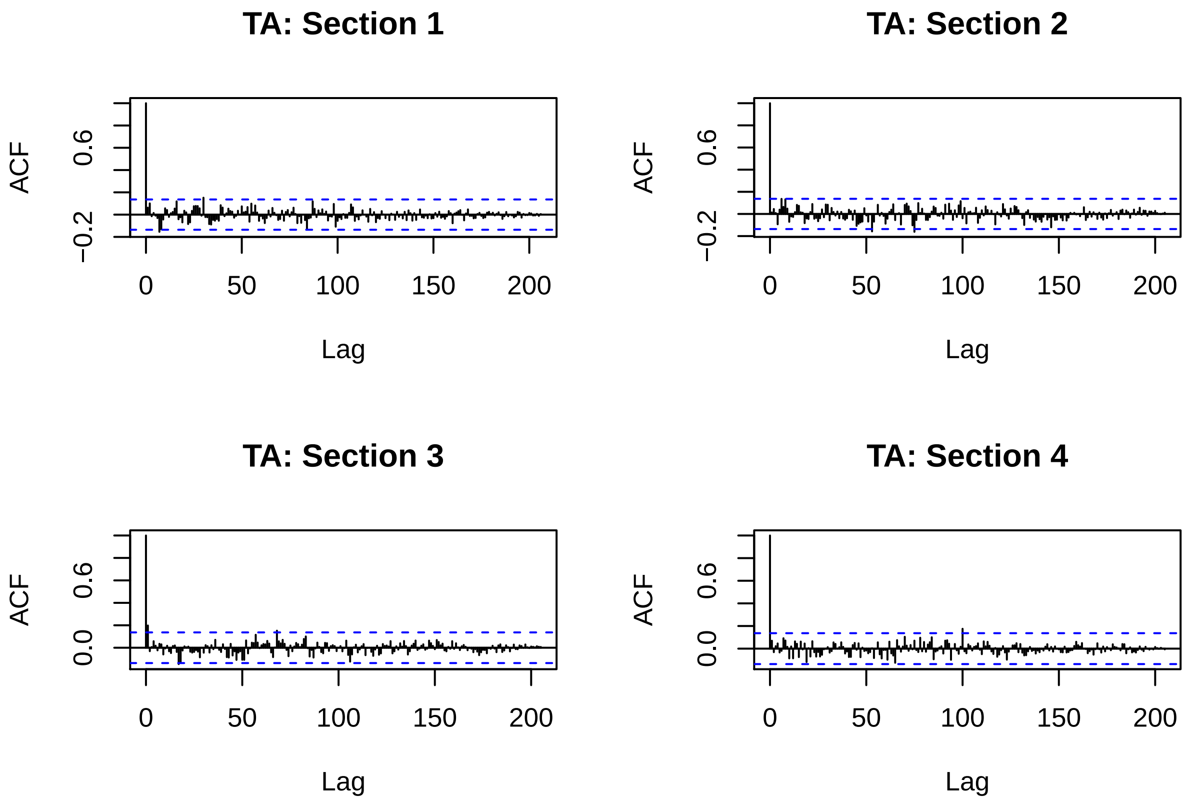


Figure 11: Autocorrelation of TA with a max lag of 50 or 878 observations.

Autocorrelation in SL appears to occur until a lag of 10-20 observations, but shows long-term cyclical patterns in ACF in the second through fourth sections; these cyclical patterns fall mostly within the confidence interval, however (**Fig 10**). This pattern appears similar to **ID 12**. Again, the autocorrelation in TA is essentially identical to that of **ID 1**, **ID 12**, **ID 19** in that it is not significant and shows no patterns over time. The evaluation of the movement patterns in **ID 27** is also nearly identical to that of **IDs 12** and **19**.

Cross-correlation among movement parameters was briefly explored as well, but due to the lack of signficance in the ACF of TA and TAA, there does not appear to be a significant trend when evaluating relationships of time series data.

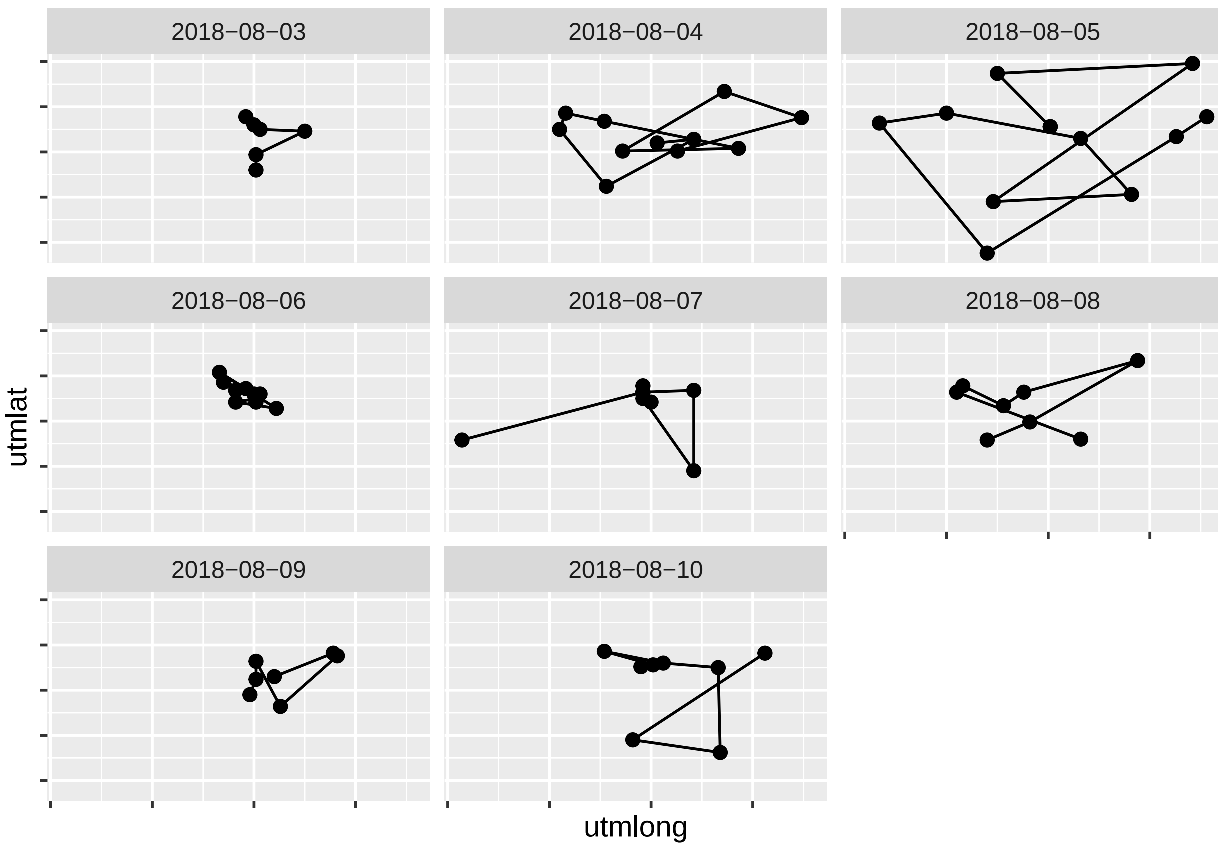


Figure 12: Similar to IDs 12 and 19, ID 27 also exhibits short and recursive movements in the days immediately after tagging.