Appendix S3: Code for Application 3.2 penguins

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Load required R packages

```
require(tidyverse)
require(ggspatial)
require(patchwork)
require(sf)
require(foieGras)
```

Fit `crw` SSM with 5-min `time.step` to time-regularise little penguin tracks

```
## Load data from .csv file
lipe <- read.csv("../data/lipe_ex32.csv")

## fit `crw` SSM, using: 1) speed filter (vmax) of 5 m/s to exclude any extreme
##   observations; 2) excluding any locations occurring < 5 s apart in time (min.dt);
##   3) a 5-min time.step
fit <- fit_ssm(lipe, vmax=5, min.dt=5, model="crw", time.step=5/60)
```

Fit move persistence model with `fit_mpm` to SSM-predicted locations

```
## use `jmpm` model to fit jointly across the 4 penguin tracks
fmp <- fit_mpm(fit, what = "predicted", model = "jmpm")
```

Plot move persistence time-series for 5-min prediction interval & map along SSM-predicted tracks

```
## plot move persistence time-series for all 4 penguins, drop legend
p1 <- plot(fmp, ncol = 2, pages = 1, pal = "Plasma") &
  theme(legend.position = "none",
        plot.title = element_blank(),
        axis.text = element_text(size = 6),
        panel.grid.minor = element_blank())

## customise mapping aesthetics
my.aes <- aes_lst(conf = F, line = T, mp_pal = hcl.colors(n=100, "Plasma"))
my.aes$df$size[1] <- 1
```

```r
## use foieGras::map to merge SSM & MPM model fits (SSM = fit, MPM = fmp);
##  use map tiles for better coastline resolution (Montague Is not in
##  `rnaturalearthhires` polygon data)
m1 <- map(
  fit,
  fmp,
  what = "p",
  aes = my.aes,
  map_type = "cartolight",
  zoomin = 1,
  ext.rng = c(0.3, 0.1),
  normalise = FALSE,
  silent = TRUE,
  alpha = 0.75
) +
  ggspatial::annotation_scale(height = unit(0.15, "cm"),
                              aes(location = "br")) +
  xlab(element_blank()) +
  ylab(element_blank()) +
  scale_x_continuous(breaks = pretty(seq(150.13, 150.26, l = 4), n = 3)) +
  scale_y_continuous(breaks = pretty(seq(-36.5, -36.24, l = 5), n = 4)) +
  theme(legend.position = c(0.88,0.84),
        legend.key.width = unit(4, "mm"),
        legend.title = element_text(size = 8),
        legend.text = element_text(size = 6),
        axis.text = element_text(size = 6),
        panel.grid = element_line(colour = "black"))

## define bounding box for map annotations
bb <- grab(fit, "p", as_sf = TRUE) %>%
  sf::st_bbox()

## define track labels for map annotations
label.df <- data.frame(tag = c("a","b","c","d"),
                       x = c(0.1, 0.84, 0, 0.86) *
                        (bb["xmax"] - bb["xmin"]) + bb["xmin"],
                       y = c(0.9, 0.225, 0.45, 0.55) *
                        (bb["ymax"] - bb["ymin"]) + bb["ymin"])

m1 <- m1 +
  geom_text(data = label.df, aes(x,y,label=tag), size = 3)

## arrange panels & render Figure 3 with `patchwork` package
(p1 | m1) +
  patchwork::plot_layout(widths = c(3, 2), guides = "keep") +
  patchwork::plot_annotation(tag_levels = "a") &
  theme(plot.tag = element_text(size = 9))
```