

# Visualization of Data in Space and Time: An Interactive Framework

Josh Cullen (*University of Florida*)

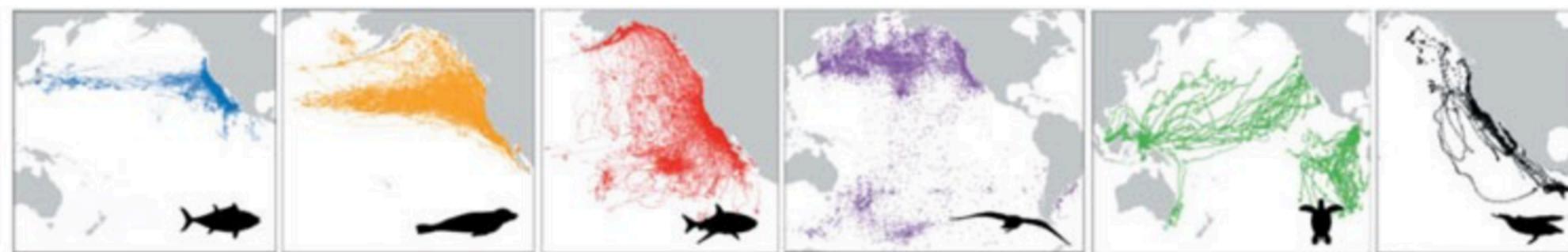
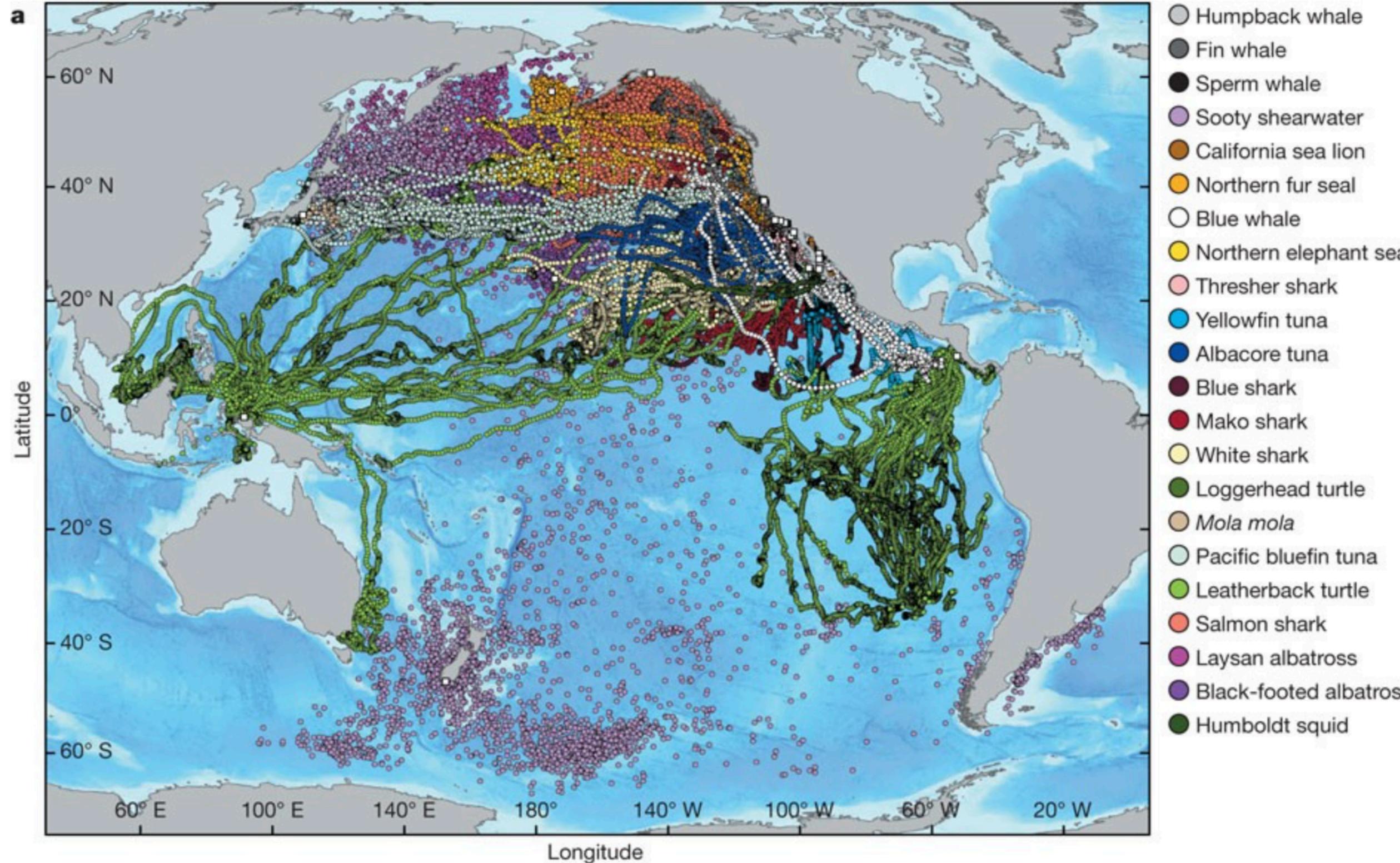
R Shiny Webinar Series

August 10, 2021

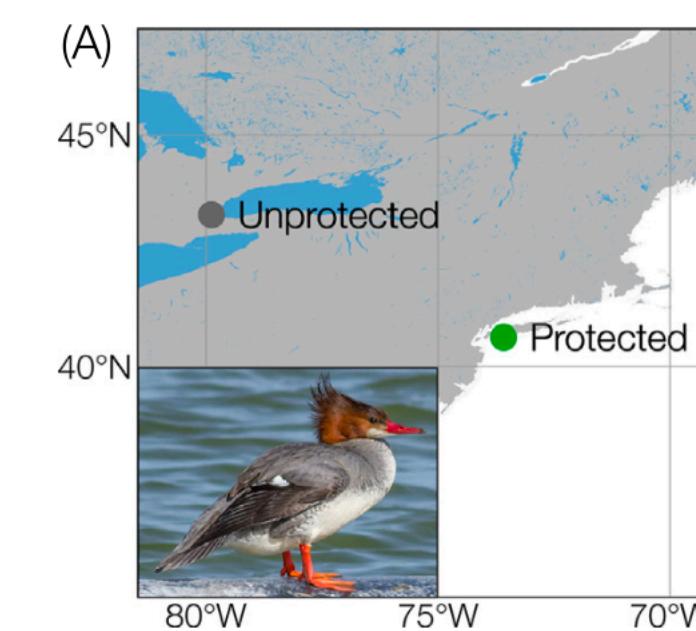
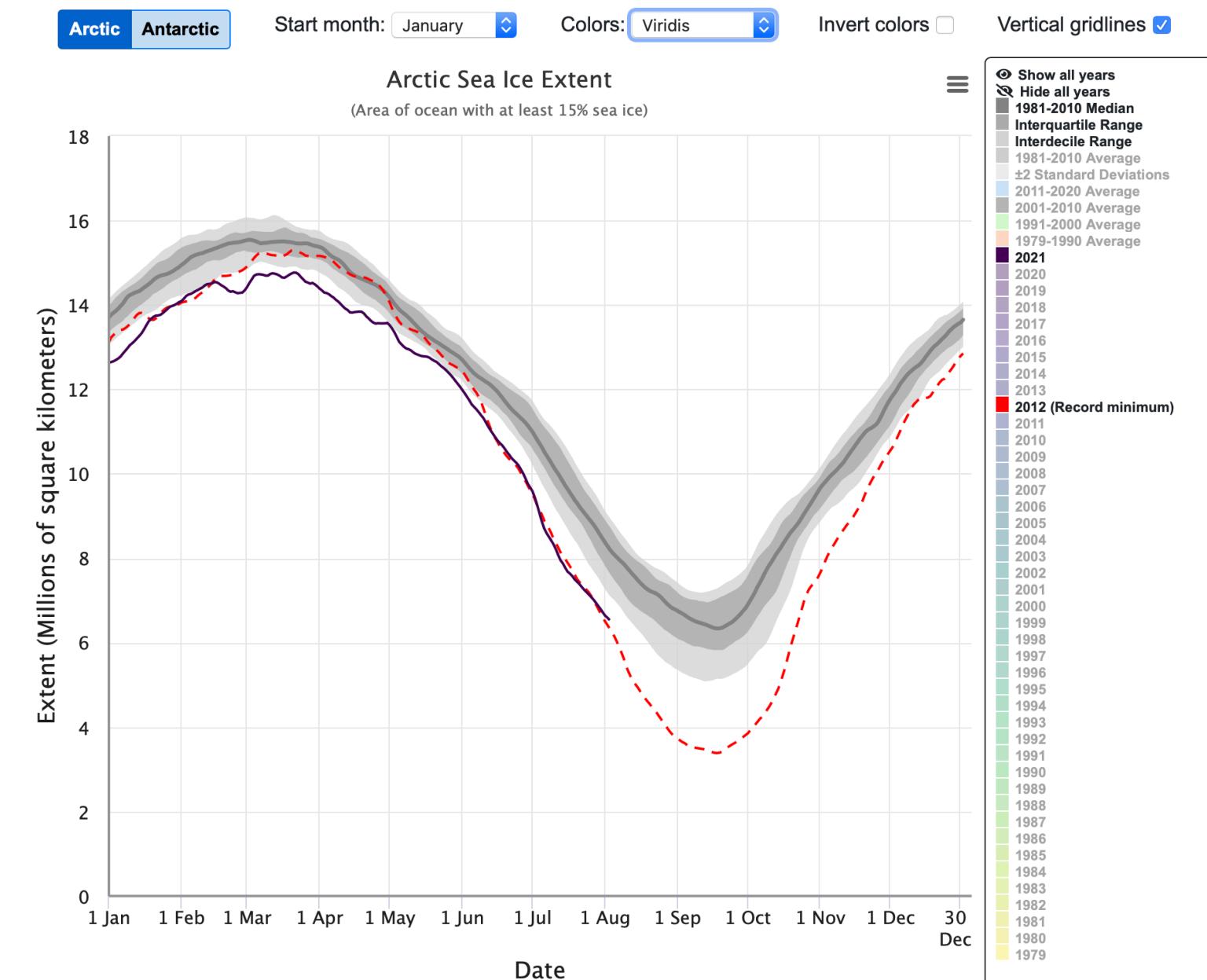


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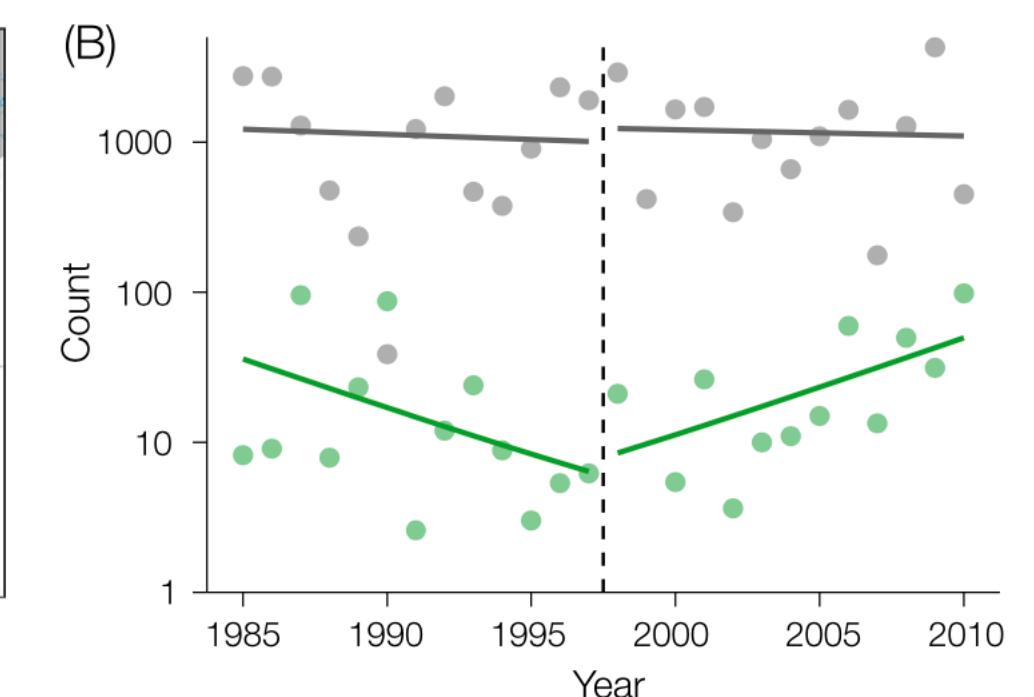
# Spatiotemporal data are ubiquitous



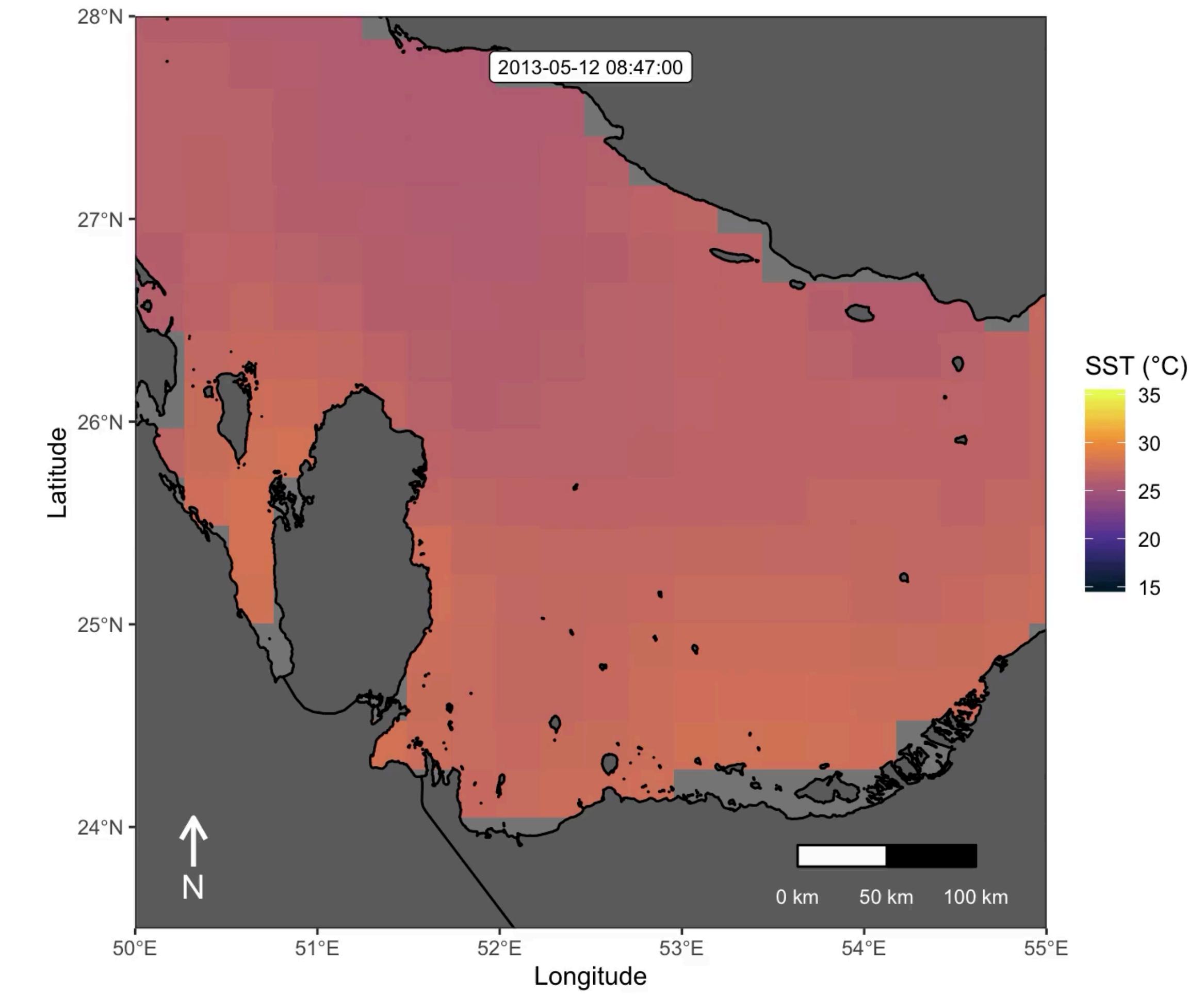
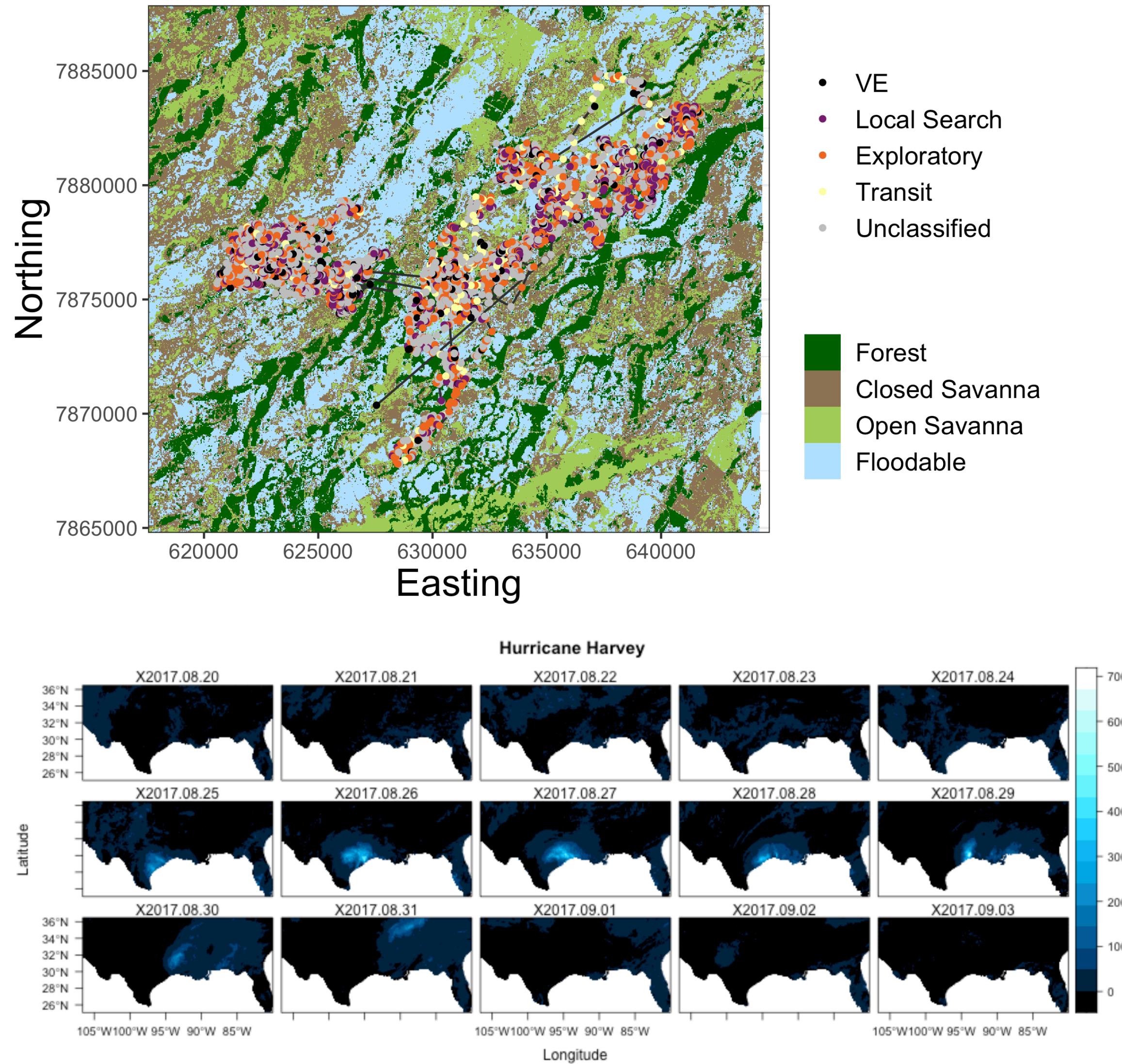
Block et al. 2011



Wauchope et al. 2021



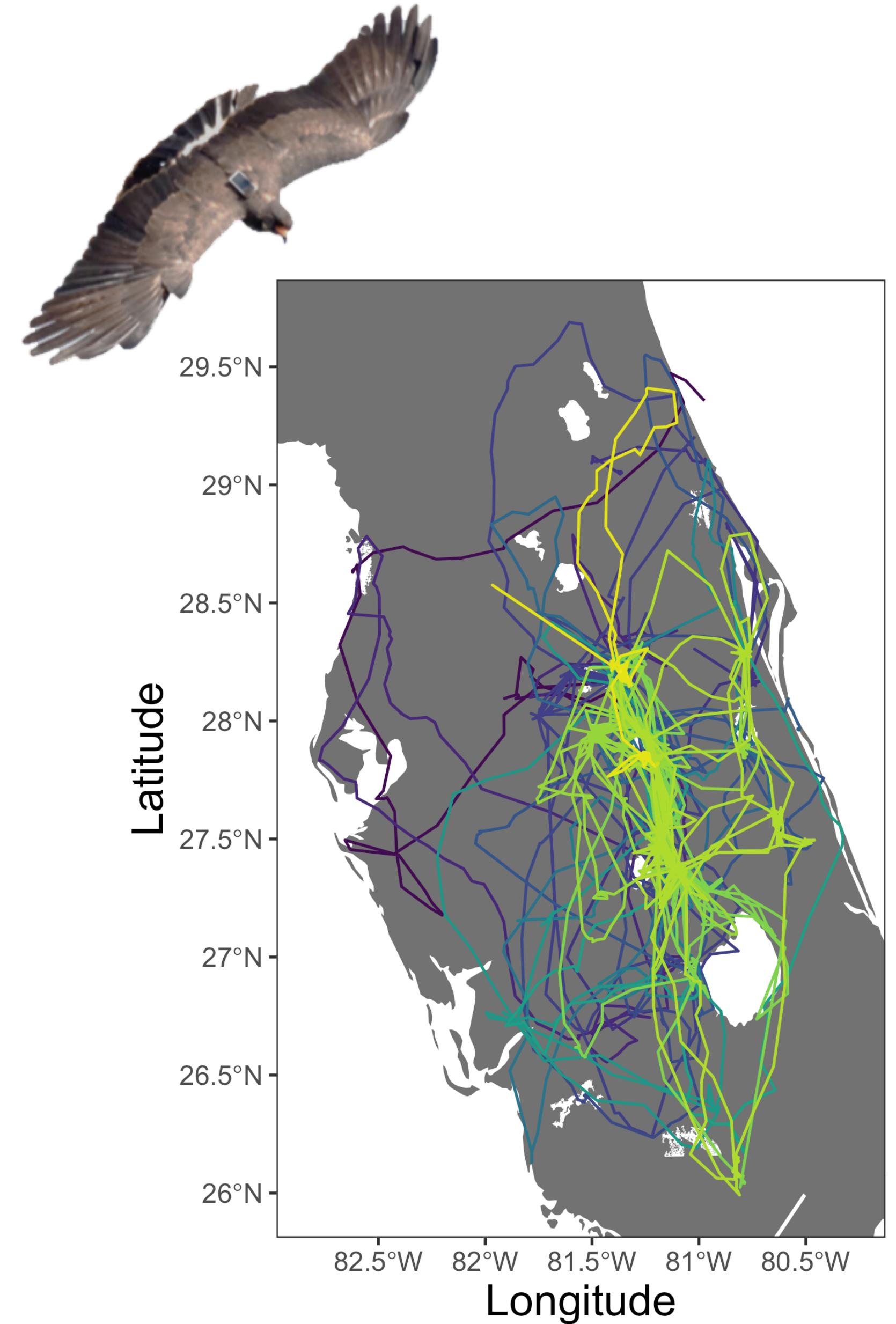
# Visualizing spatiotemporal patterns can be difficult



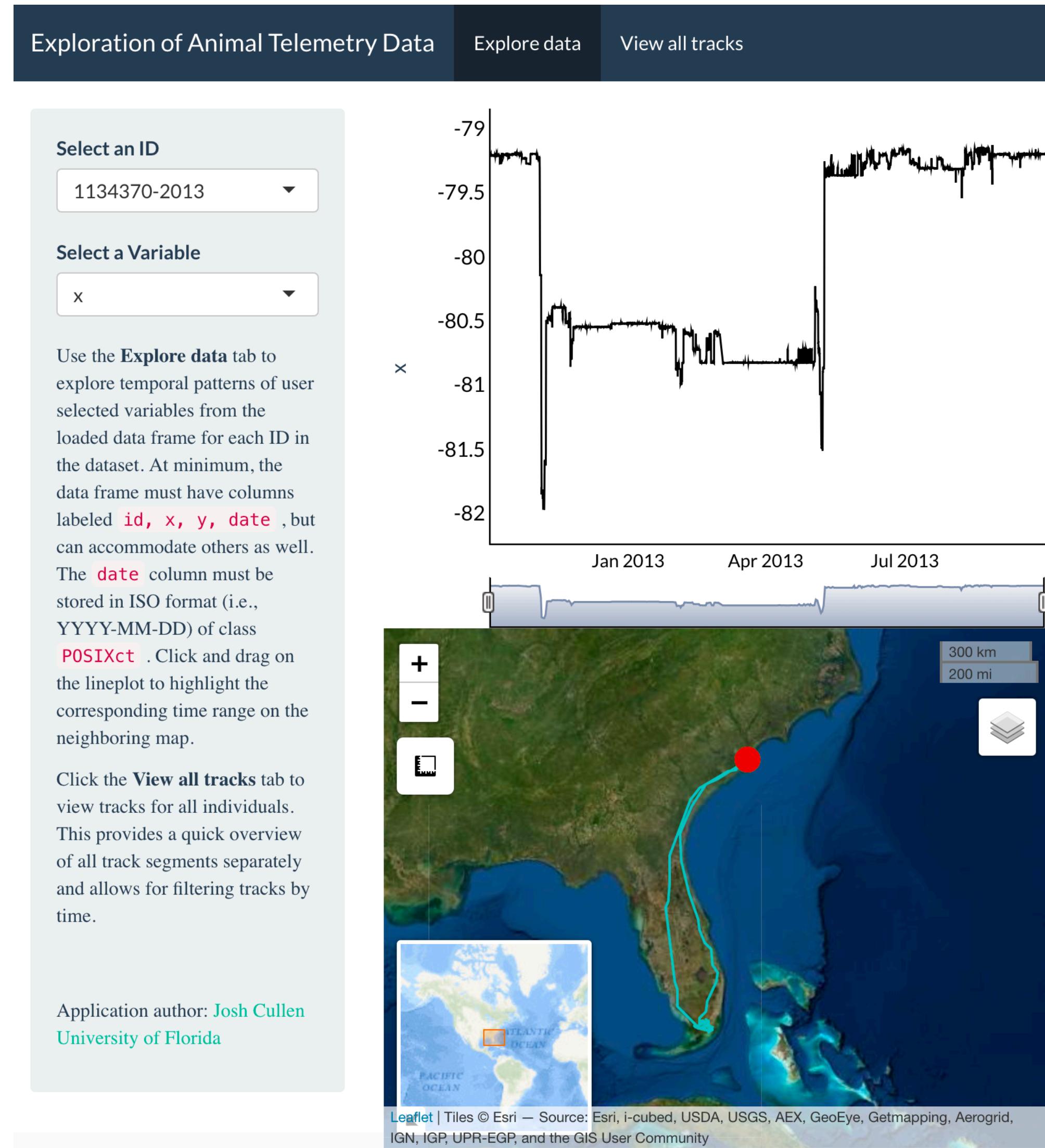
Credit: {climateR} tutorial (Mike Johnson)

# The problem

- Determine patterns of behavior and space-use in endangered raptor
- How to visualize what these movement patterns look like?
  - *Create facet plot at different spatiotemporal scales*
  - *Plot time series of select variables*
  - *Create 3D plot of space and time*



# Our solution



Interactively visualize animal telemetry data over space and time

Available within `bayesmove` and online:  
[https://joshcullen.shinyapps.io/segmentation\\_of\\_NSD](https://joshcullen.shinyapps.io/segmentation_of_NSD)



# Explore time series of variables

For a single ID, visualize one of the variables in your dataset:

## Intrinsic property of track

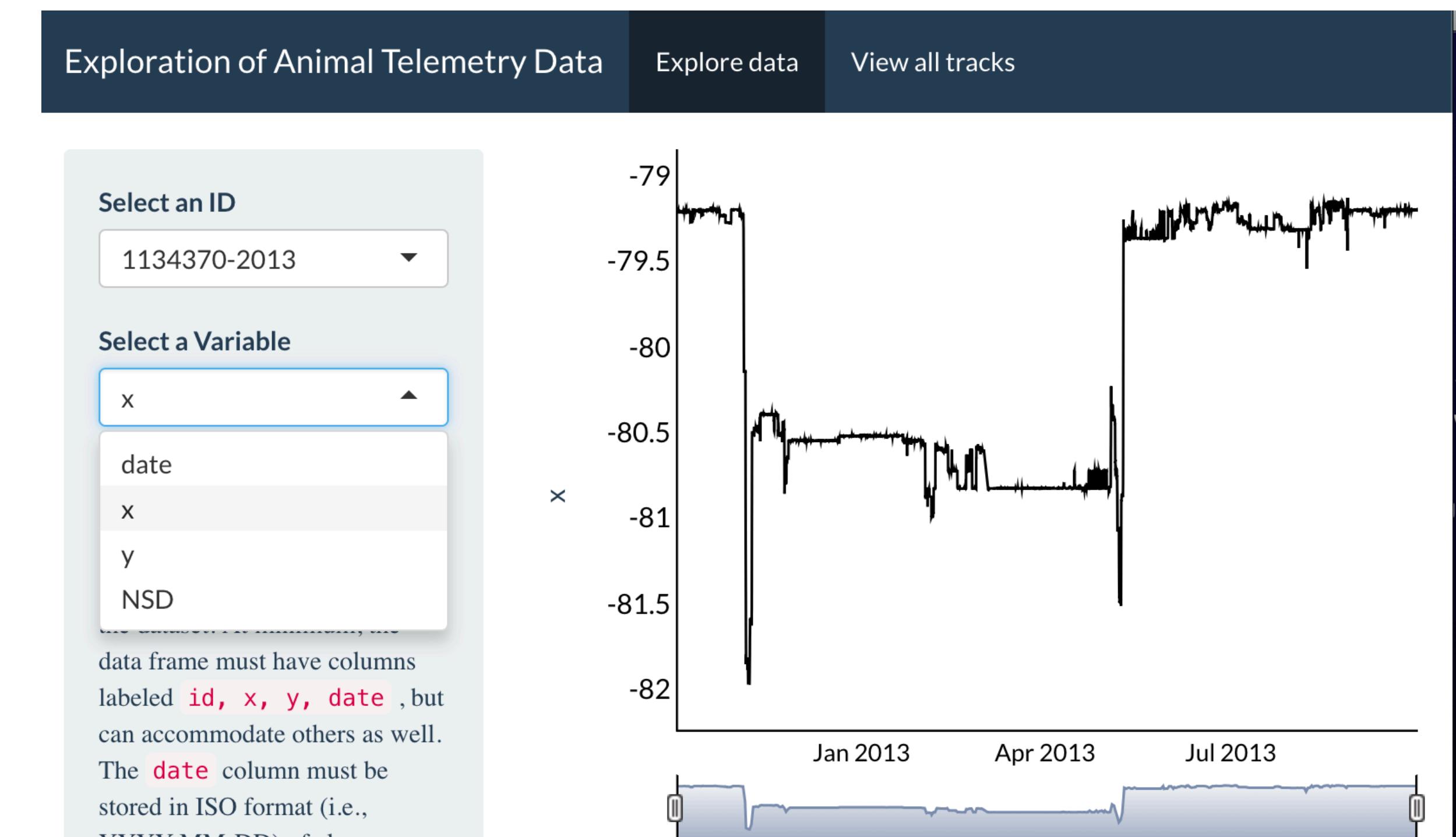
- Speed
- Net-squared displacement

## Remote sensing

- Normalized difference vegetation index
- Sea surface temperature

## Derived variable

- Distance to feature of interest



# Explore spatial patterns of movement

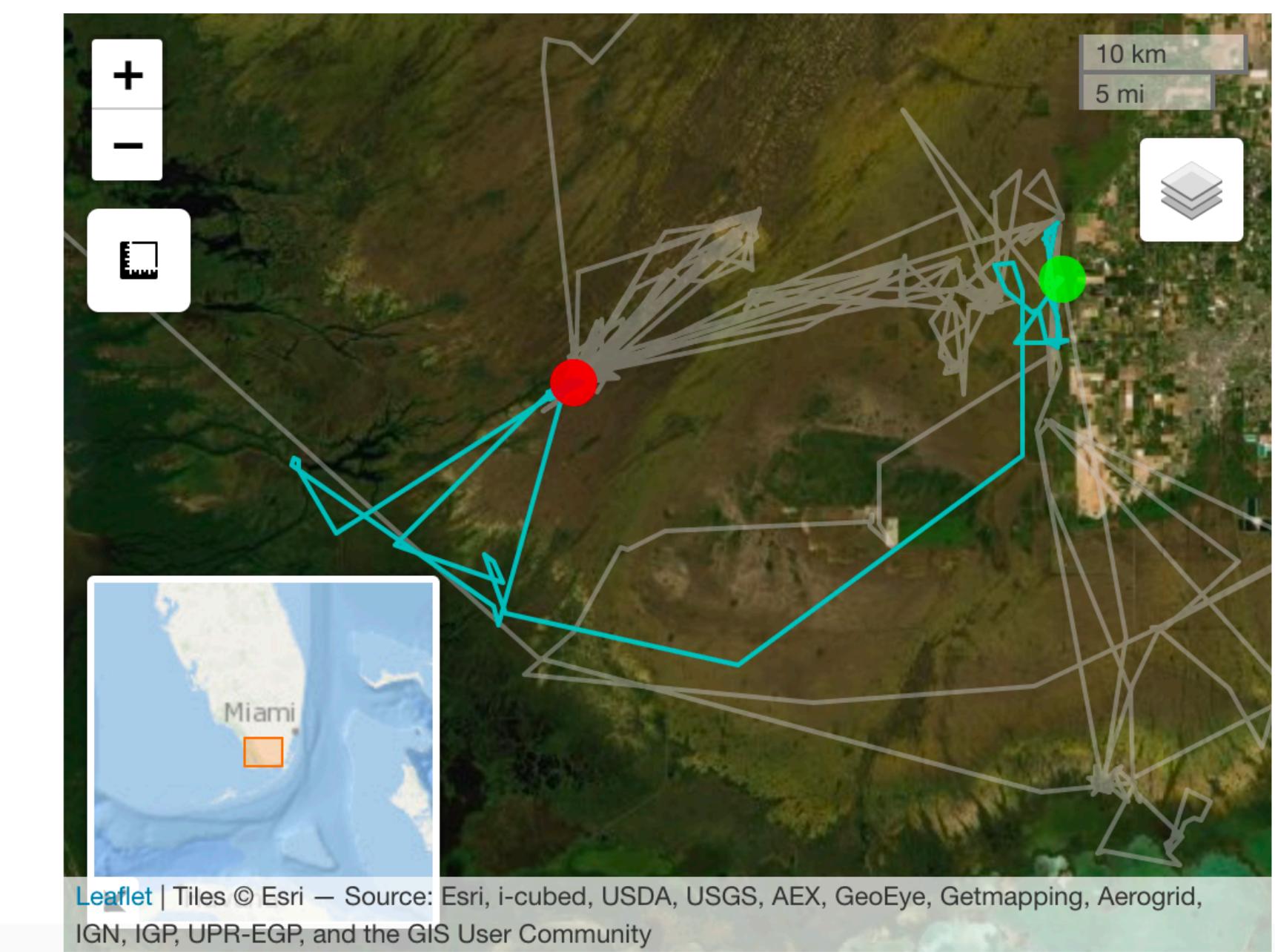
Zoom and pan around area using different basemaps to explore spatial relationships

- What type of land use/land cover?
- How frequently does animal cross roads?
- Near any bathymetric features?
- Is animal occupying unusual habitat?

POSIXct . Click and drag on the lineplot to highlight the corresponding time range on the neighboring map.

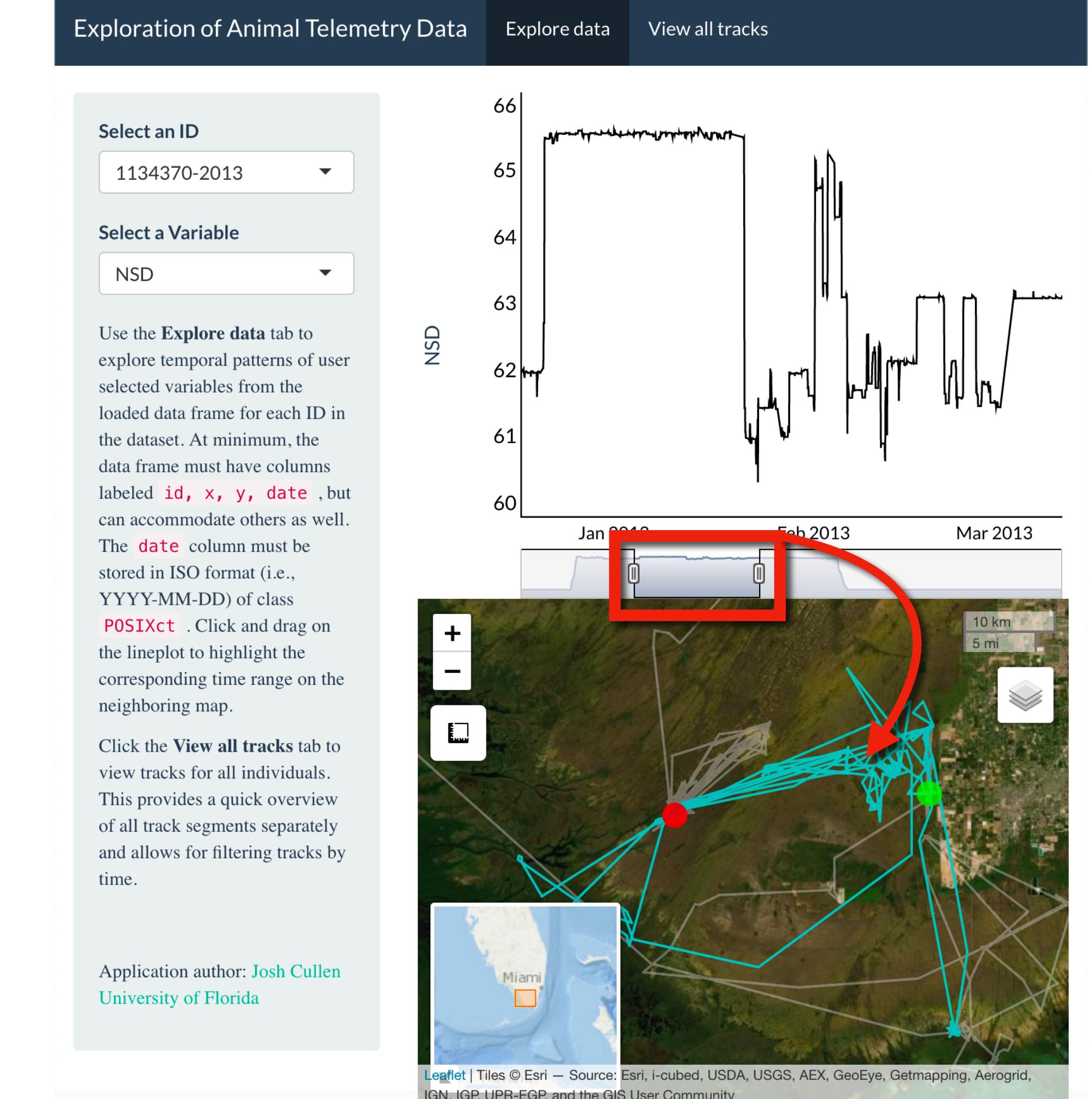
Click the **View all tracks** tab to view tracks for all individuals. This provides a quick overview of all track segments separately and allows for filtering tracks by time.

Application author: [Josh Cullen](#)  
University of Florida



# KEY FEATURE: Link space and time

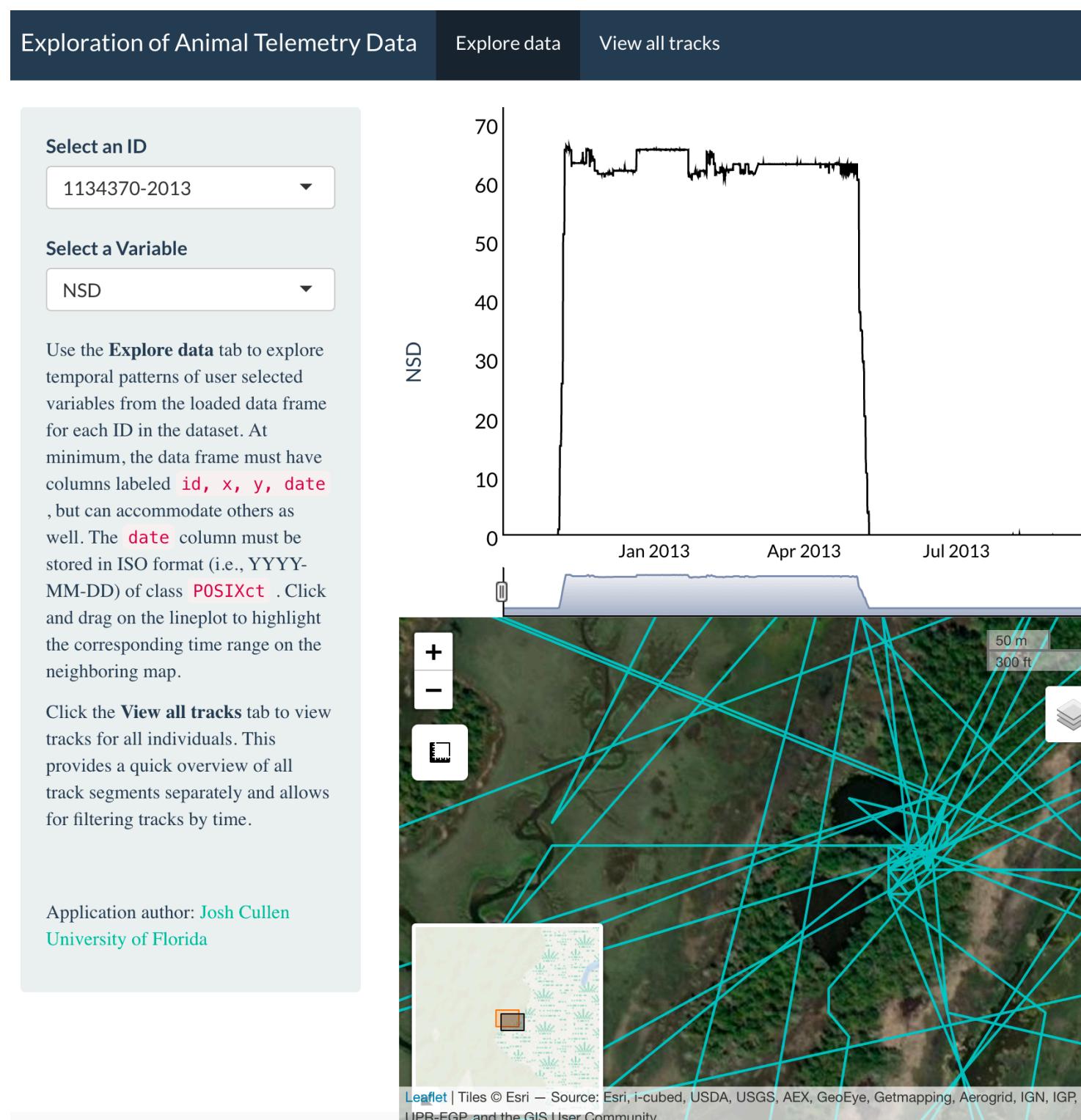
Subset time series by clicking and dragging on plot, which reactively updates the map



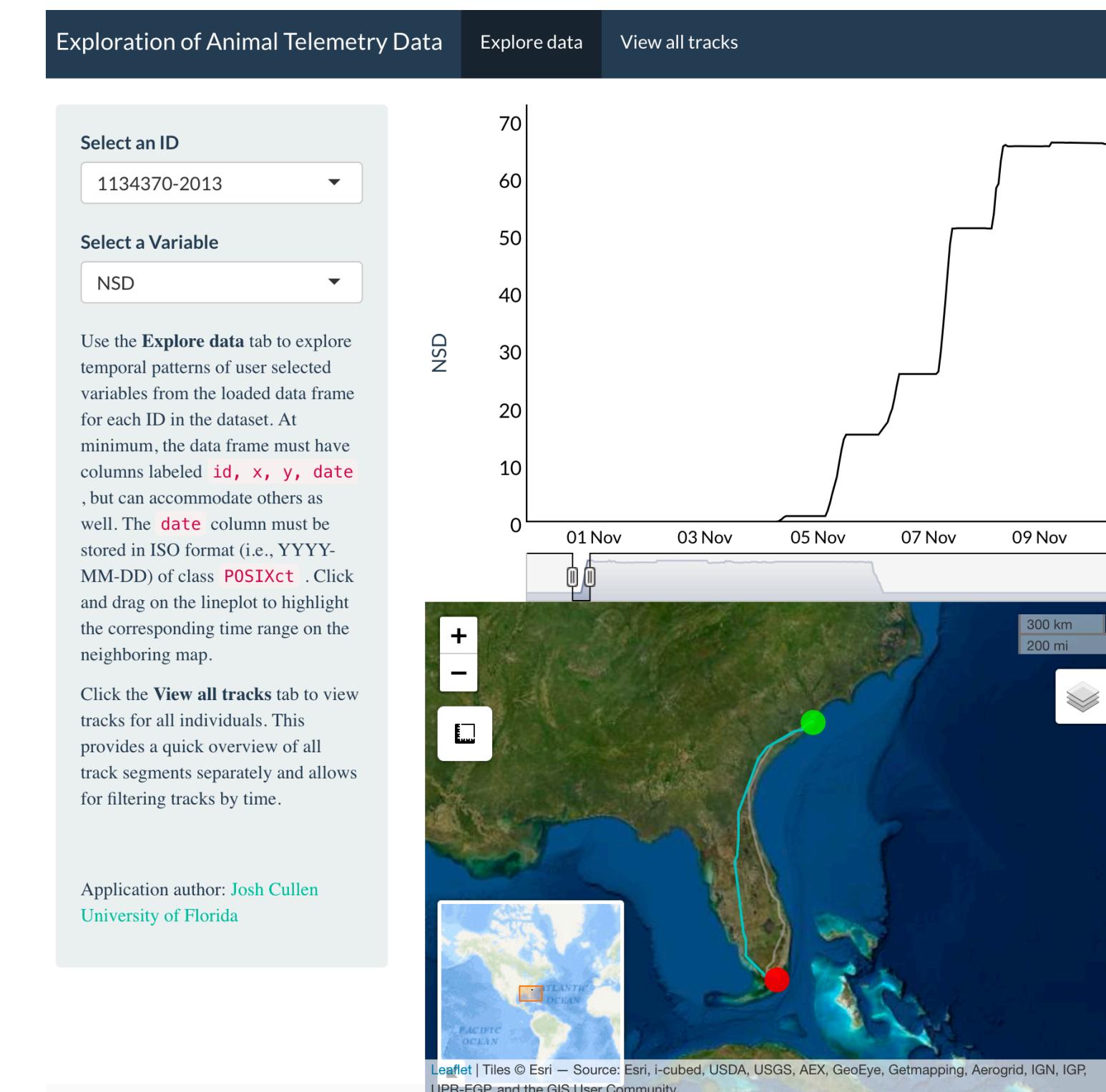
# When could this feature be useful?

If user is interested in determining:

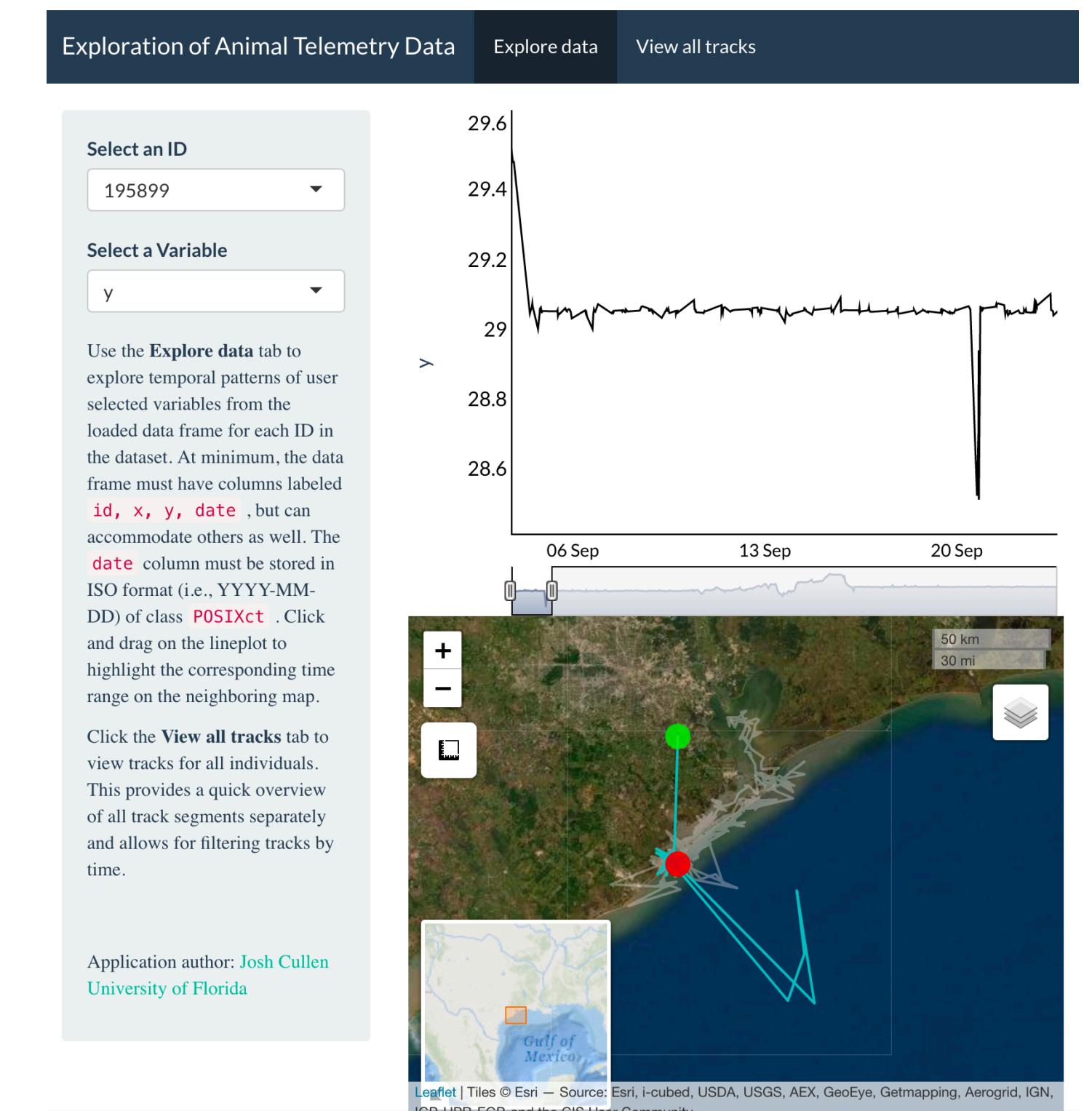
## Land Cover



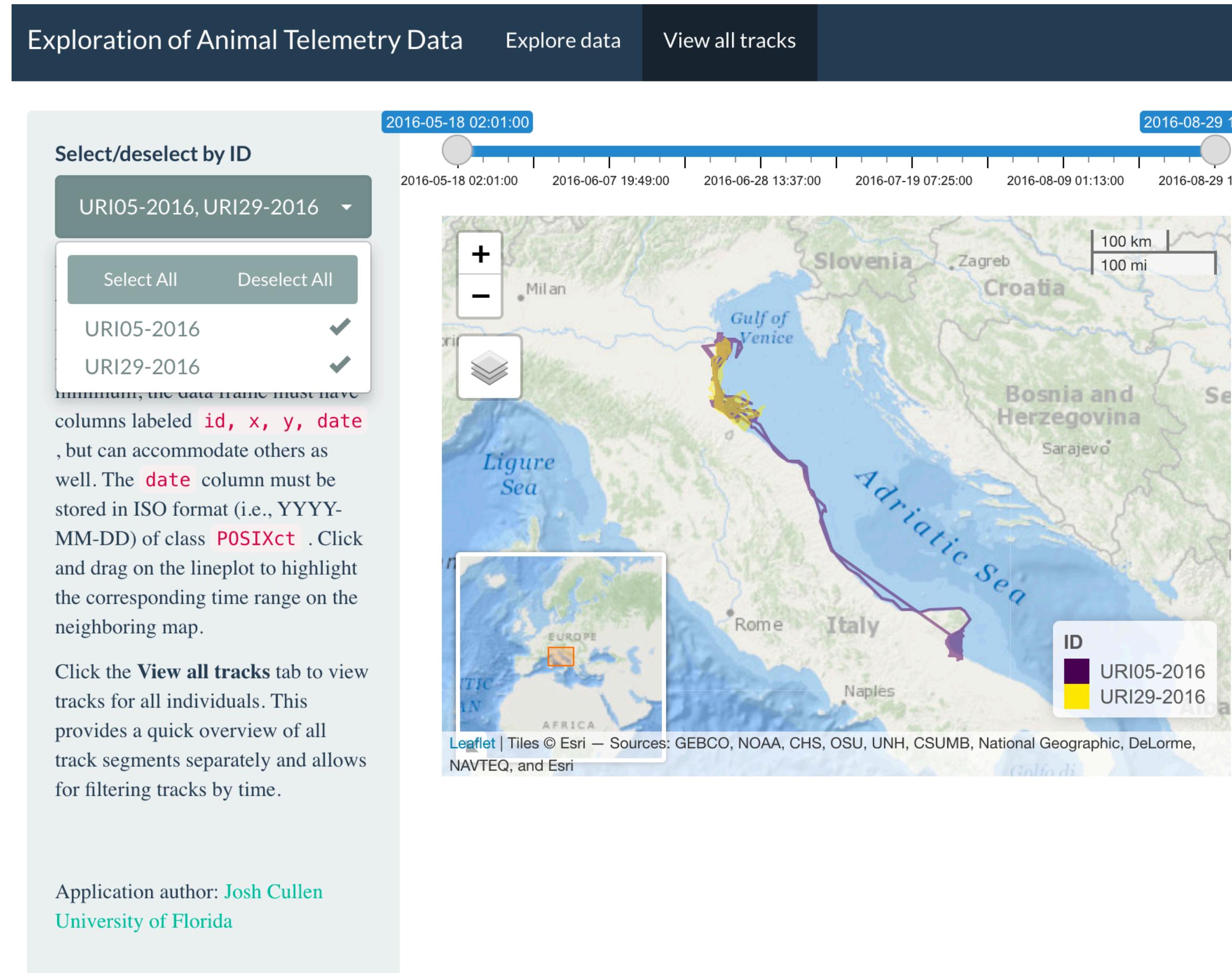
## Time Window



## Data Cleaning



# What if you want to explore patterns of multiple IDs at once?

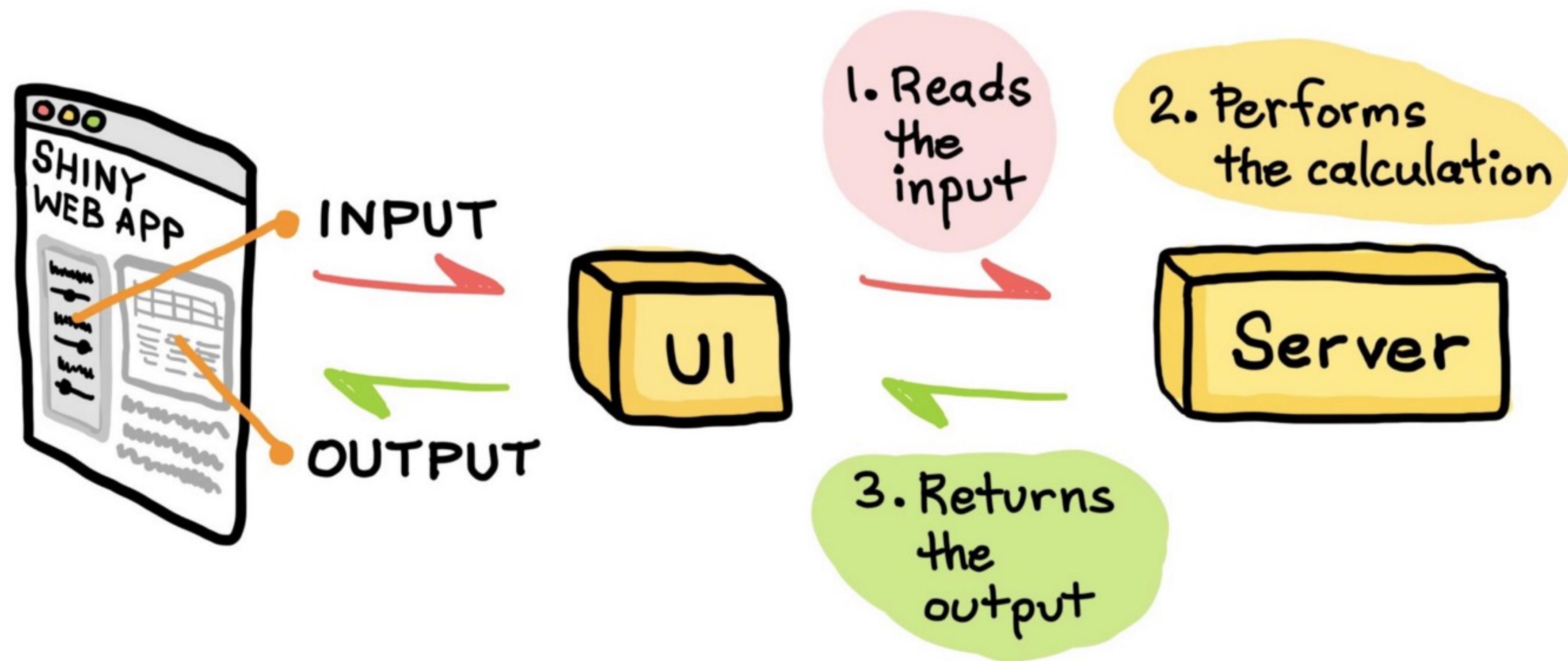


- Filter by ID and time window of interest
  - Useful for exploring spatial patterns of co-occurrence

# Live demo

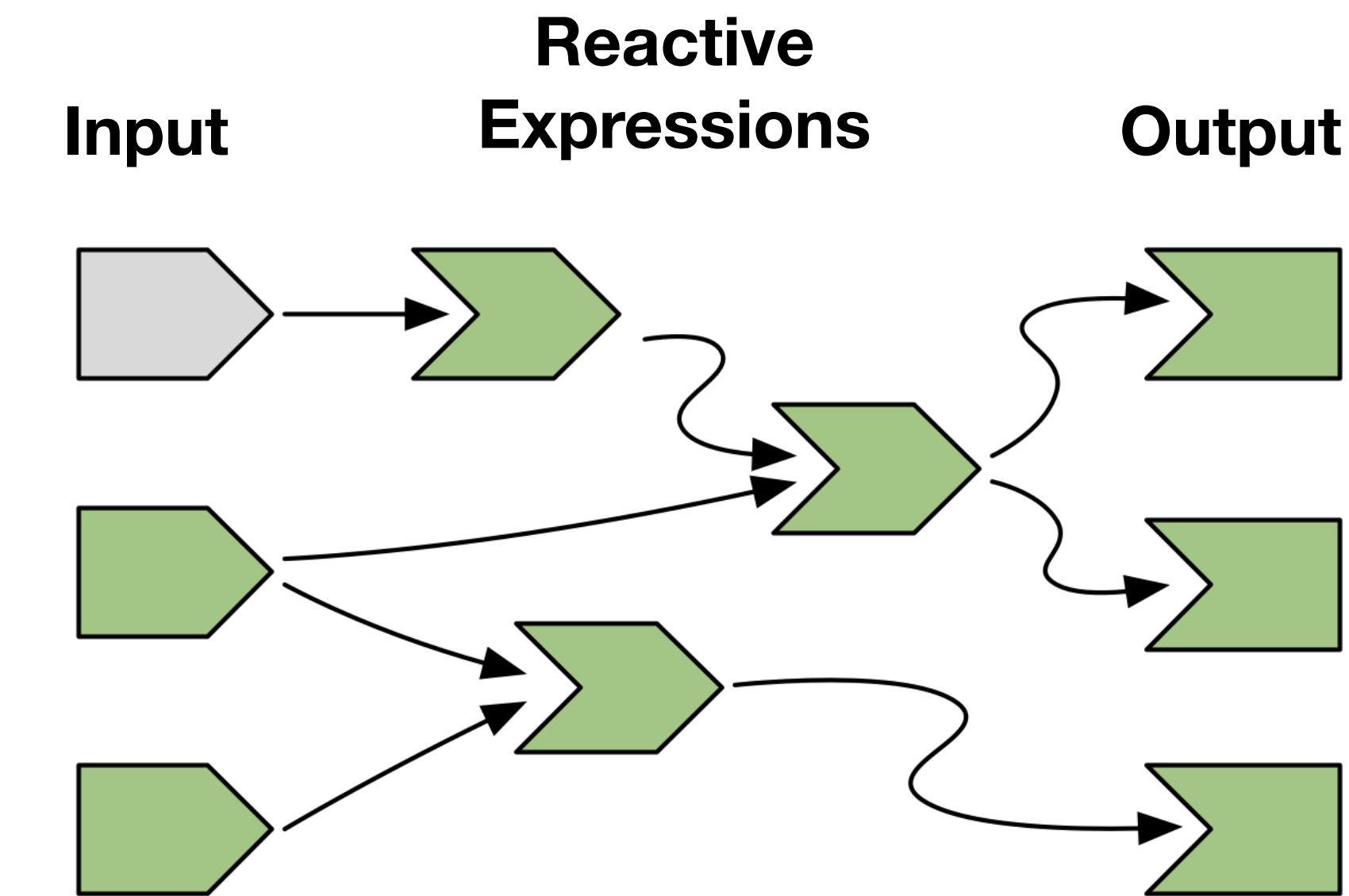
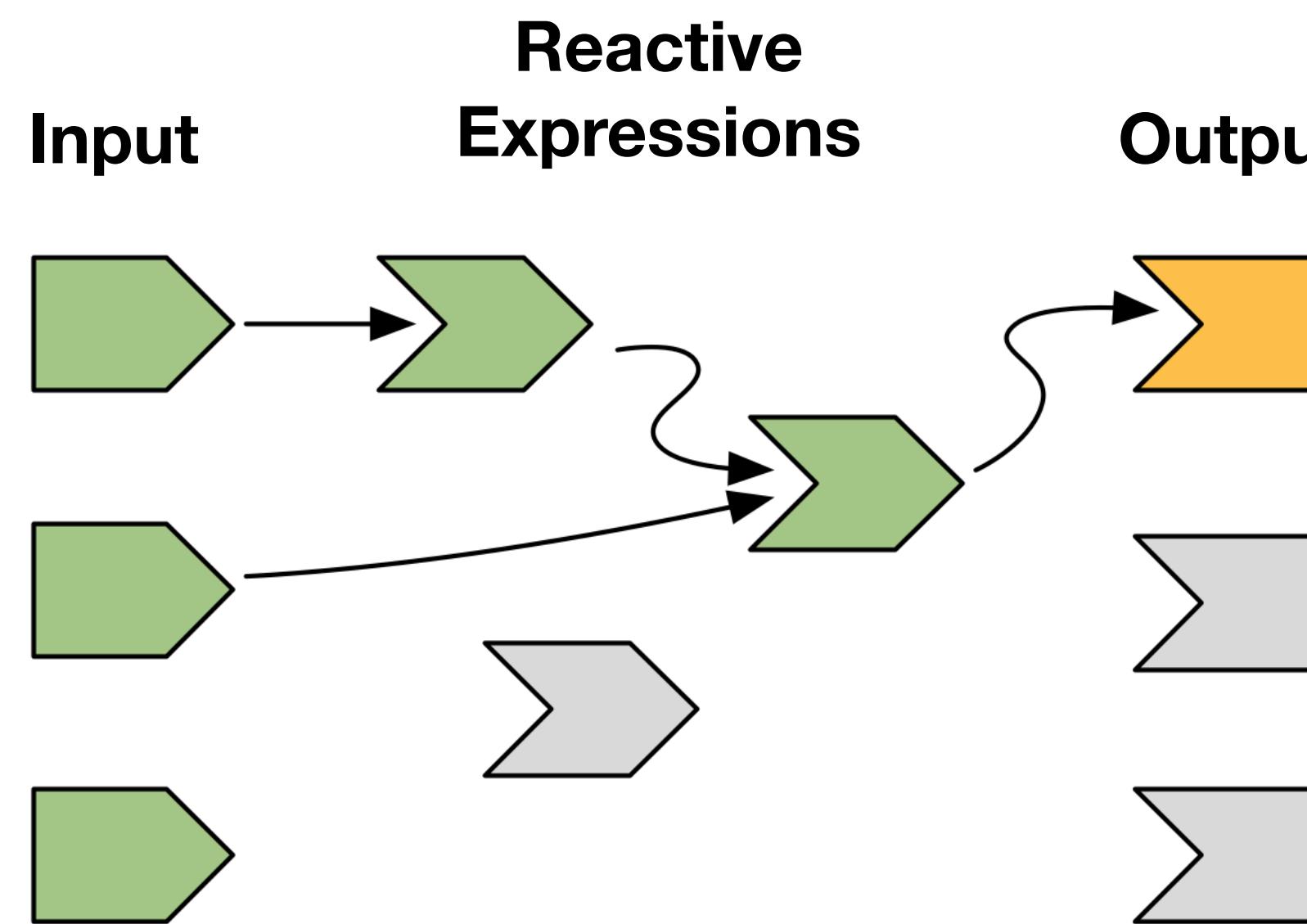


# Brief R Shiny refresher



# Reactivity in Shiny

Reactive expressions cache values and only change when invalidated, helping the Shiny app respond more efficiently



# Let's get started

Go to EFI GitHub repo for R script: <https://github.com/eco4cast/EFI-Rshiny-Seminar-Series>

```
library(shiny)          (v1.6.0)
library(dygraphs)        (v1.1.1.6.)
library(xts)             (v0.12.1)
library(leaflet)         (v2.0.4.1)
library(tidyverse)       (v1.3.0)
library(lubridate)       (v1.7.10)
library(sf)               (v0.9.8)
# remotes::install_github("picardis/nestR")
library(nestR)           (v1.1.0)
```

# Related R packages

## Time series:

- Highcharter
- Plotly



## Mapping:

- Mapview
- Highcharter
- Plotly
- Tmap



# Potential uses in other Shiny apps

- Filtering a table of full dataset
- Filter data in another plot/tab conditional on time window
- Filter spatial data for export (e.g., shapefile, raster)

# Thanks!



## Contact info

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- 💻 <https://joshcullen.github.io>

## Shiny app

- [https://joshcullen.github.io/bayesmove/  
articles/Exploratory-analysis-in-Shiny](https://joshcullen.github.io/bayesmove/articles/Exploratory-analysis-in-Shiny)
- [https://joshcullen.shinyapps.io/  
segmentation\\_of\\_NSD/](https://joshcullen.shinyapps.io/segmentation_of_NSD/)

