Spatial data

Animal tracking 25/26

Giuliano Colosimo

University of Rome Tor Vergata

Table of contents I

Spatial data

Spatial data

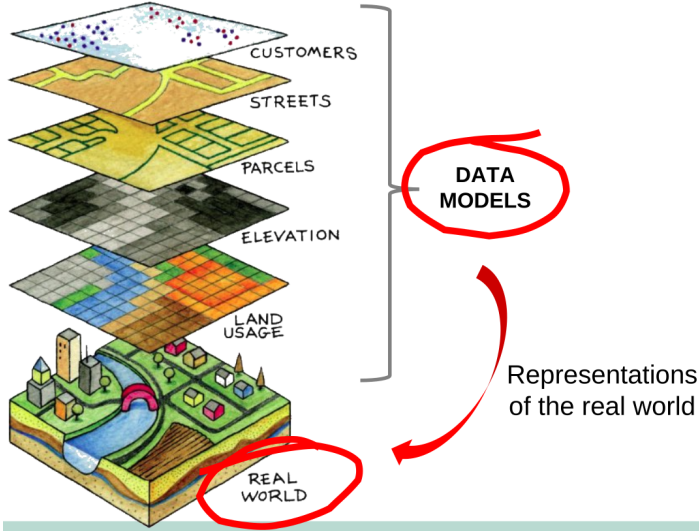

Figure 1: A representation of spatial data. Adapted from AniMove website

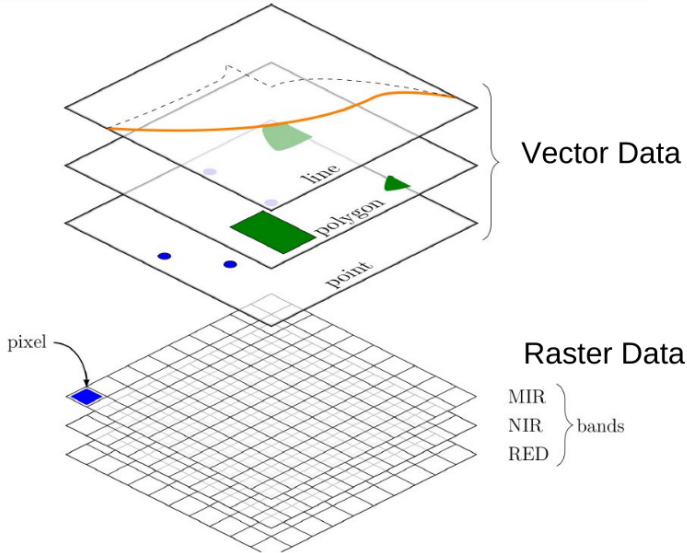

Figure 2: Type of spatial data. Adapted from AniMove website

Vector data

- The geographic vector data model is based on points located within a coordinate reference system (CRS)
- Points can represent self-standing features (e.g., the location of a bus stop) or they can be linked together to form more complex geometries such as lines and polygons
- Most point geometries contain only two dimensions (much less prominent three-dimensional geometries contain an additional z value, typically representing height above sea level)

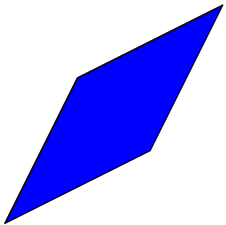

Figure 3: Polygons. Ordered set of connected lines

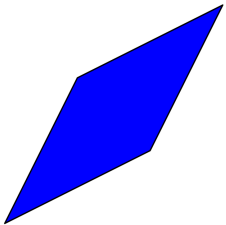

Figure 3: Polygons. Ordered set of connected lines

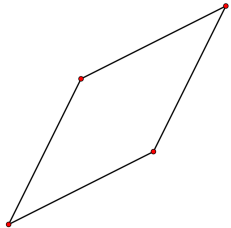

Figure 4: Lines. Ordered set of coordinate pairs

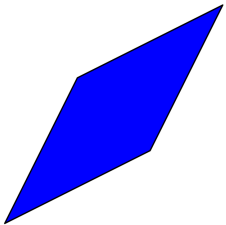

Figure 3: Polygons. Ordered set of connected lines

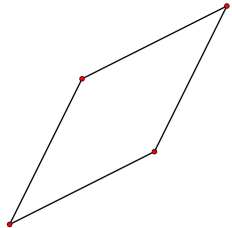

Figure 4: Lines. Ordered set of coordinate pairs

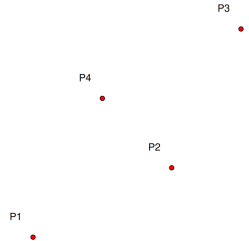

Figure 5: Points. A set of coordinates

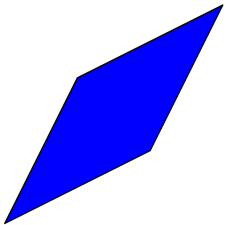

Figure 3: Polygons. Ordered set of connected lines

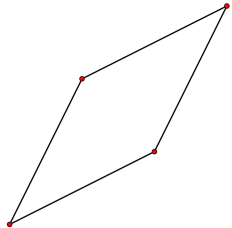

Figure 4: Lines. Ordered set of coordinate pairs

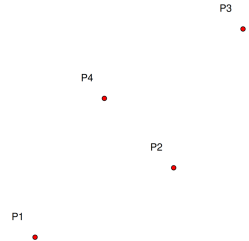

Figure 5: Points. A set of coordinates

- Existing vector formats: *.shp, *.GeoPackage, *.gpx, *.kml

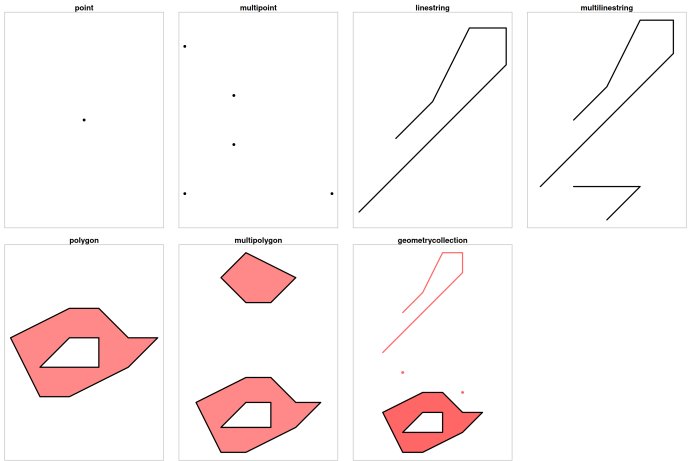

Figure 6: Main geometry types. Code reproduced from here

Raster data

- Raster data represent the world with a continuous grid of cells (often called pixel)
- The raster data model usually consists of a raster header and a matrix (with rows and columns) representing equally spaced cells
- The raster header defines the CRS, the extent and the origin
- The header defines the extent via the number of columns, the number of rows and the cell size resolution
- Existing raster formats: *.tiff, *.raw, *.dat, *.bsq

A. Cell IDs

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

B. Cell values

92	55	48	21
58	70	NA	37
NA	12	94	11
36	83	4	88

C. Colored values

Figure 7: How a raster looks like behind the scenes. After Lovelace, Nowosad, & Muenchow (2025)

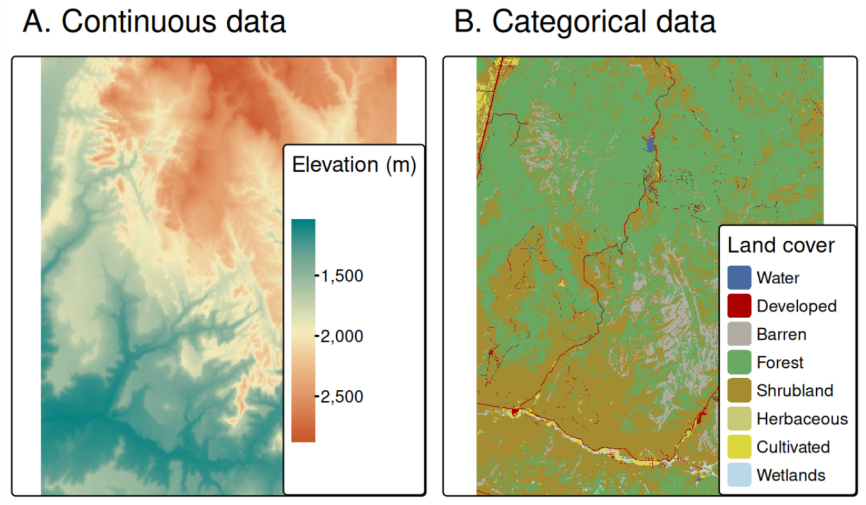

Figure 8: Types of raster. After Lovelace et al. (2025)

Movebank

Movebank

movebank.org

- As of February 2024, Movebank stores 6.1 billion animal locations
- Billions bio-logged sensor measurements managed by thousands of researchers and wildlife managers
- Data represent the movements and behavior of over 200,000 animals and 1,383 species
- Approximately over 11 million new data records per day

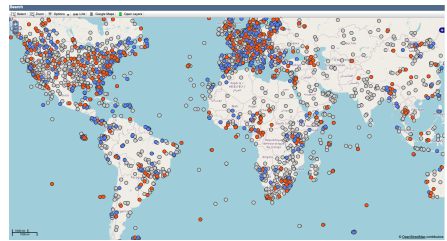

Figure 9: The movebank.org homepage

Download Movebank data

Download Movebank data

- These are the libraries that we will use. In particular, *move2* (Kranstauber, Kamran, & Scharf, 2025) is a library that allows to access MoveBank data directly and import them in R
- If you do not have them already, install them using the following lines of code

```
install.packages("move2")
install.packages("readr")
```

- We can now load all the libraries that are going to be needed to run the excercise

```
library(move2)
library(dplyr)
library(sf)
library(readr)
```

Access movebank

```
### 1. Directly downloading data from Movebank ####
# For the actual download we will look at 3 functions:
# movebank_download_study_info()
# movebank_download_deployment()
# movebank_download_study()

### store the movebank credentials
# you will be prompted to set a keyring password
# by default this will be stored in the key list as
# service="movebank"
movebank_store_credentials("RBook", "Obstberg1")

### Browse the Movebank database
# get the metadata of the studies from this account
allStudies <- movebank_download_study_info()
```

```
nrow(allStudies)
```

```
[1] 8068
```

```
length(names(allStudies))
```

```
[1] 31
```

```
allStudies[4:6, "name"]
```

```
# A tibble: 3 x 1
  name
  <fct>
1 Natal dispersal of Golden Eagles in Chihuahua, Mexico
2 Movement Ecology of RTHA in WA State
3 Oiseaux marins Océan Indien [ID_PROG616]
```

```r
# list studies for which we have download access
allStudies[4:6, "i_have_download_access"]
```

```
# A tibble: 3 x 1
  i_have_download_access
  <lgl>
1 FALSE
2 FALSE
3 FALSE
```

```r
# list studies for which we have download access
movebank_download_study_info(i_have_download_access=T)
```

Sensor types

```
# retrieve all sensor ids recognized by Movebank
senstype <- movebank_retrieve(entity_type = "tag_type",
  attributes = c("external_id", "id"))
head(senstype)
```

```
# A tibble: 6 x 2
  external_id              id
  <chr>                 <int64>
1 bird-ring               397
2 gps                     653
3 radio-transmitter       673
4 argos-doppler-shift   82798
5 natural-mark        2365682
6 acceleration        2365683
```

A study about bats

```
# select columns of interest and studies about bats
movebank_download_study_info() %>%
  select(id, name) %>%
  filter(grepl("Parti-colored bat", name))
```

```
# A tibble: 1 x 2
       id name
  <int64> <fct>
1 1918503 Parti-colored bat Safi Switzerland
```

```
### Download information about a specific Movebank study
# get the metadata of the study
movebank_download_study_info(study_id = 1918503) %>%
  print(width = Inf) #all cols
```

Get data directly from the study

```
### Download LOCATION data as a move2 object ----
### download all data (all sensors, all animals)
bat_1918503 <- movebank_download_study(study_id =
                                         1918503)
bat_1918503_names <- names(bat_1918503)
bat_1918503_names[c(1,7,8)]
```

```
[1] "sensor_type_id" "event_id"       "geometry"
```

Get data from a CSV file

- We will now assume we downloaded a dataset from Movebank and we will import it in to R
- Use this link to download a .csv file with with the dataset we will be using
- Place the dataset in a directory where you will be working

```
# We read in this dataset downloaded
# from Movebank directly as a move2 object
bat_1918503 <- mt_read("/PATH TO YOUR DIRECTORY FILE")
bat_1918503_class <- class(bat_1918503)
bat_1918503_class[c(1,2,3)]
```

```
[1] "move2"  "sf"     "tbl_df"
```

References

References I

Kranstauber, B., Kamran, S., & Scharf, A. K. (2025). *move2*. Retrieved from https://cran.r-project.org/web/packages/move2/index.html

Lovelace, R., Nowosad, J., & Muenchow, J. (2025). *Geocomputation with r*. CRC Press. Retrieved from https://r.geocompx.org/