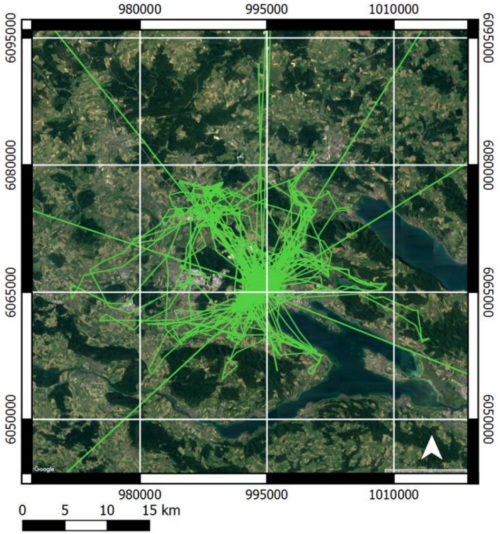
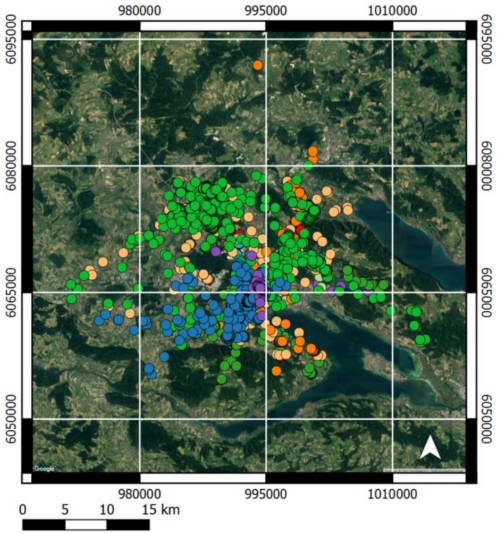
AniMove 2022, Radolfzell

Movement data visualization using moveVis

Animating movement trajectories in synchronicity with environmental data

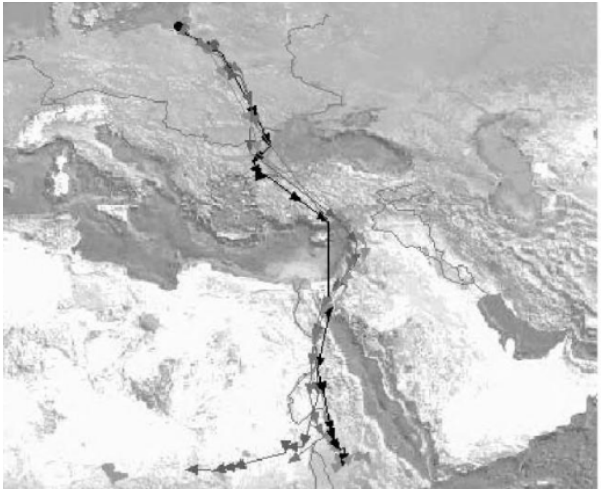
Problem: Visualizig time





(1) Static maps disregard the temporal dimension of spatio-temporal, i.e. tracking data – *own graphics*

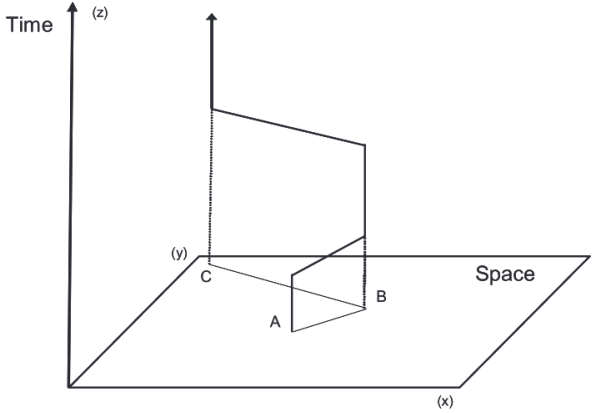
Graphical attributes/features indicating time (map)



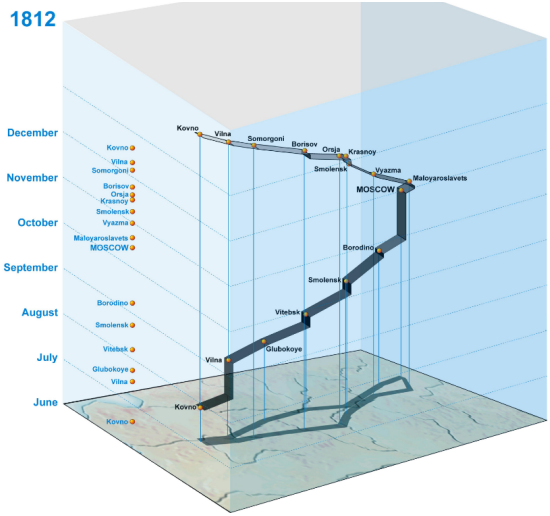
(2) Movements of four storks, with linear marks portraying sequences of time moments and arrows sequences of directions – *Andrienko & Andrienko, 2006*

(3) ...whereas here, colour and size are used to show a temporal sequence in the data – *own graphics*

Mapping time onto a spatial axis (cube)



(4) In a space-time cube, time is visualized orthogonally to the map surface – *Kjellin, Pettersson, Seipel, & Lind, 2008*



(5) ...like in this example showing Napoleon's march in Russia – *Nöllenburg, 2007*

Relating temporal dimension to actual time (animation)

Video

Animation examples

Packages for creating animations in R

Generic R packages to create animations:

- *gganimate*: focus on animations with/from *ggplot2* plots
- *aniamtion*: focus on statistical animations
- *plotly*: focus on interactive animations

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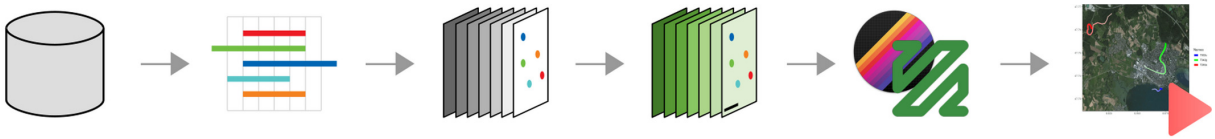
R packages to create animations from movement data:

- *anipaths*: focus on spline-based interpolation
- *moveVis*: focus on integrating synchronous environmental data as dynamic base layer

Package workflow



(6) Schematic display of the workflow by which moveVis turns movement data into animations

align_move()

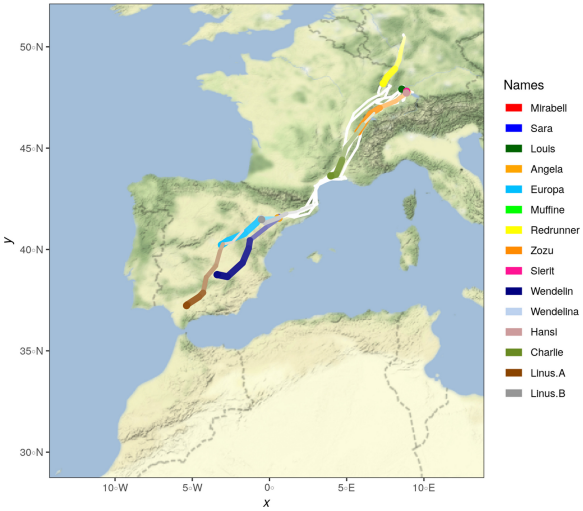
- aligns trajectories to a regular time scale with a consistent temporal resolution, since frame rates (i.e. rate with which frames change) must be discrete and unique throughout a sequence.
- applies *interpolation* along the great-circle path, along a rhumb line or by Euclidean distance, if needed.

Creating (spatial) frames

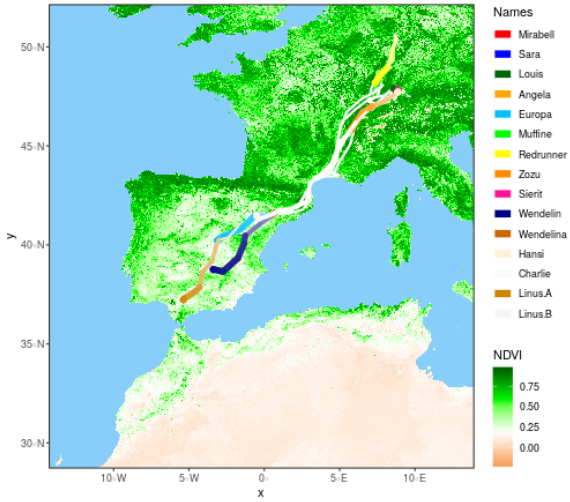
frames_spatial()

- turns movement trajectories into sequences of frames by assigning sets of trajectory coordinates to individual frames
- frames are *ggplot2* plots
- trajectories can be drawn on *default basemaps* (e.g. OSM, Mapbox etc.) or custom uni- or multi-temporal raster imagery

Creating (spatial) frames



(7) A single frame (OSM terrain)



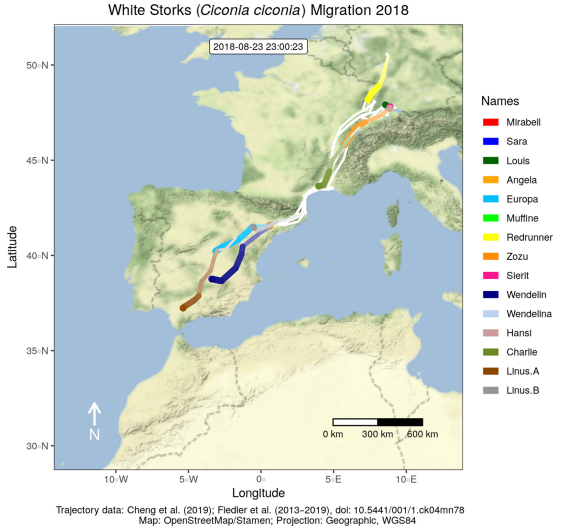
(8) A single frame (MODIS NDVI)

Adapting/customizing frames

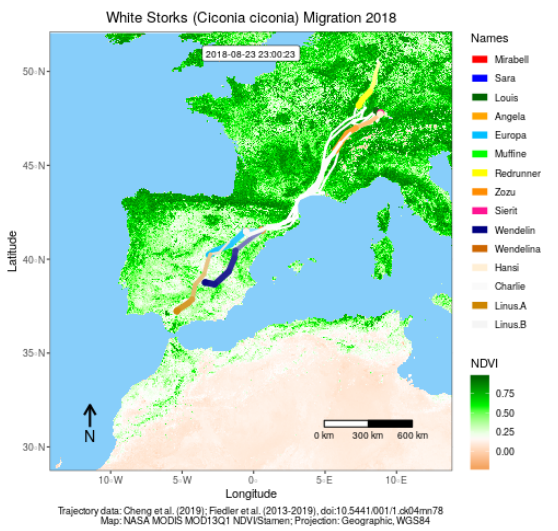
add_labels(), add_northarrow(), add_timestamps(), add_*()

- add temporally static or dynamic elements to a sequence of frames or parts of it, including text annotations, labels, a north arrow, a scalebar, timestamps or point, line and polygon vector features
- adapt colour scales or add custom *ggplot2* objects

Adapting/customizing frame



(9) A single frame (OSM terrain)



(10) A single frame (MODIS NDVI)

Animating frames

animate_frames()

- render frames into an animation
- set resolution, size, output format such as gif/mov etc.

Minimal example

```
library(moveVis)
library(move)

data("move_data", package = "moveVis") # move class object, see df2move() for converting data.frames

# align move_data to a uniform time scale
m <- align_move(move_data, res = 4, unit = "mins")

# create spatial frames with a OpenStreetMap watercolour map
frames <- frames_spatial(m, path_colours = c("red", "green", "blue"),
                         map_service = "osm", map_type = "watercolor", alpha = 0.5) %>%
  add_labels(x = "Longitude", y = "Latitude") %>% # add some customizations, such as axis labels
  add_northarrow() %>%
  add_scalebar() %>%
  add_timestamps(type = "label") %>%
  add_progress()

frames[[100]] # preview one of the frames, e.g. the 100th frame

# animate frames
animate_frames(frames, out_file = "moveVis.gif")
```

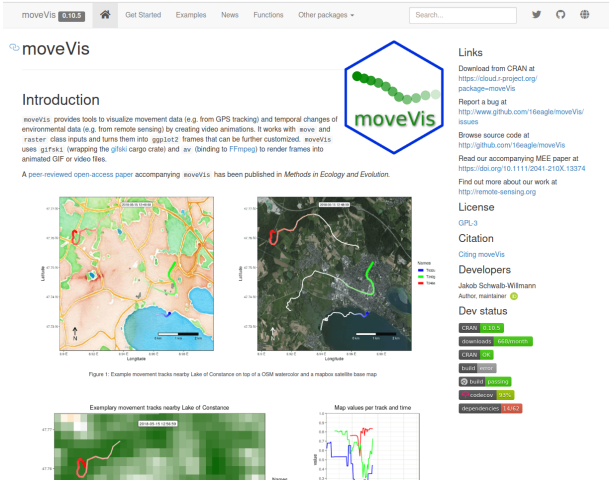
Demo I:

Animating *White Stork* movement trajectories on top of static basemaps

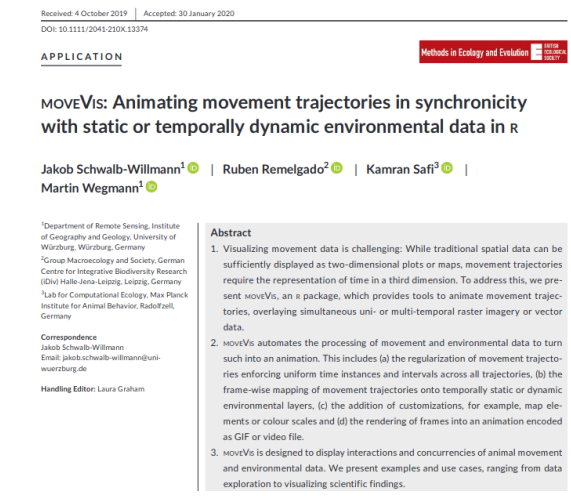
Demo II:

Animating *White Stork* movement trajectories on top of temporally dynamic *MODIS* NDVI data

Resources



(11) For examples and help, go to `https://movevis.org`



(12) ...or have a look as the accompanying MEE paper at `https://doi.org/10.1111/2041-210X.13374`)

Task:

Animate a subset of your own tracking data

https://movevis.org
https://github.movevis.org
https://twitter.com/schwalbwillmann

Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety

MAX PLANCK INSTITUTE
OF ANIMAL BEHAVIOR