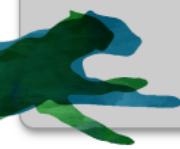




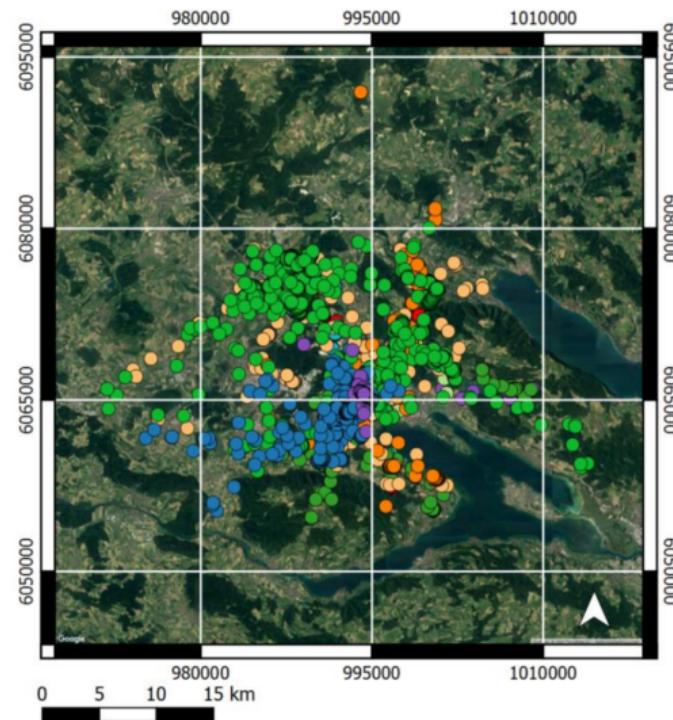
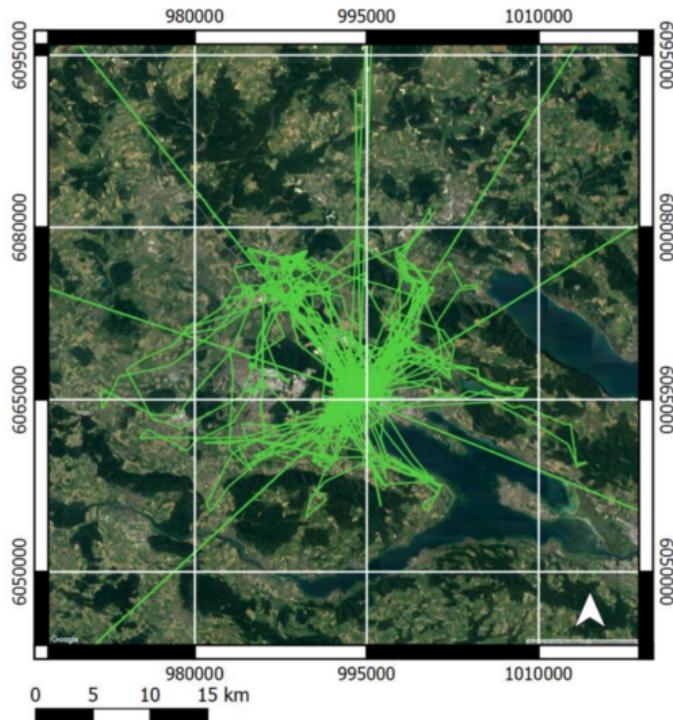
AniMove 2022, Radolfzell

Movement data visualization using moveVis

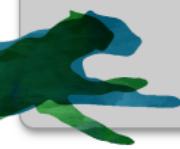
Animating movement trajectories in synchronicity with environmental data



Problem: Visualizing time



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



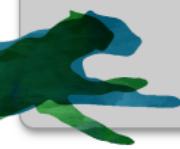
Graphical attributes/features indicating time (map)



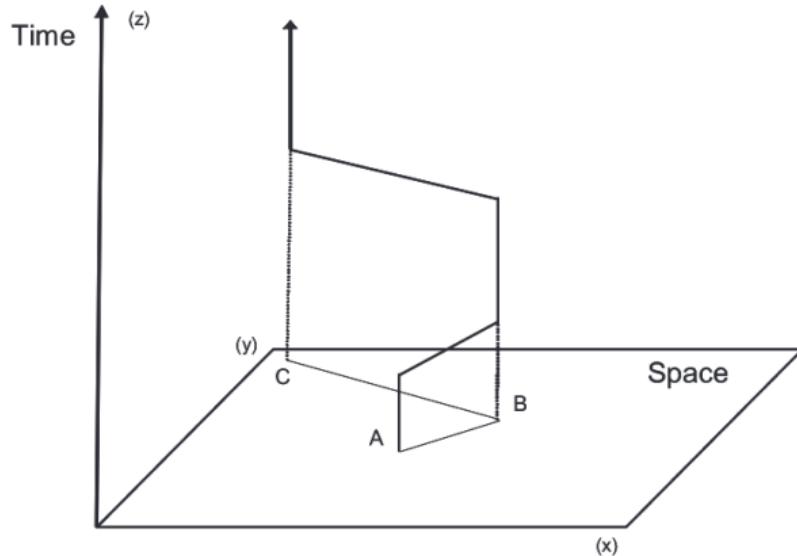
(2) Movements of four storks, with linear marks portraying sequences of time moments and arrows sequences of directions – *Andrienko & Andrienko, 2006*



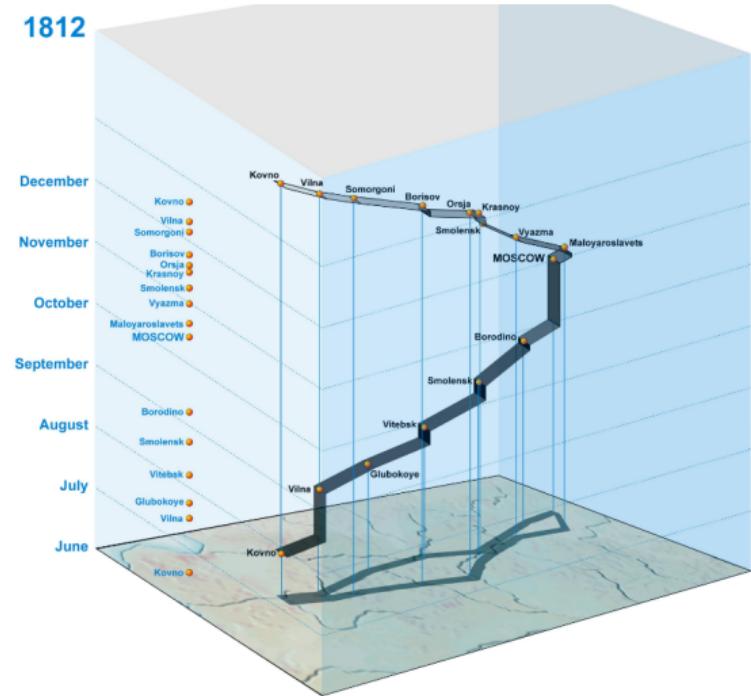
(3) ...whereas here, colour and size are used to show a temporal sequence in the data – *own graphics*



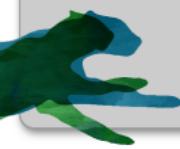
Mapping time onto a spatial axis (cube)



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



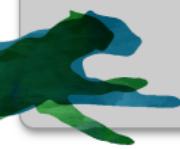
(5) ...like in this example showing Napoleon's march in Russia – Nöllenburg, 2007



Relating temporal dimension to actual time (animation)



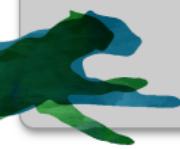
Video
Animation examples



Packages for creating animations in R

Generic R packages to create animations:

- *ggridge*: focus on animations with/from *ggplot2* plots
- *aniation*: focus on statistical animations
- *plotly*: focus on interactive animations



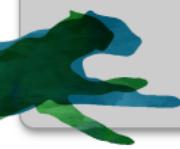
Packages for creating animations in R

Generic R packages to create animations:

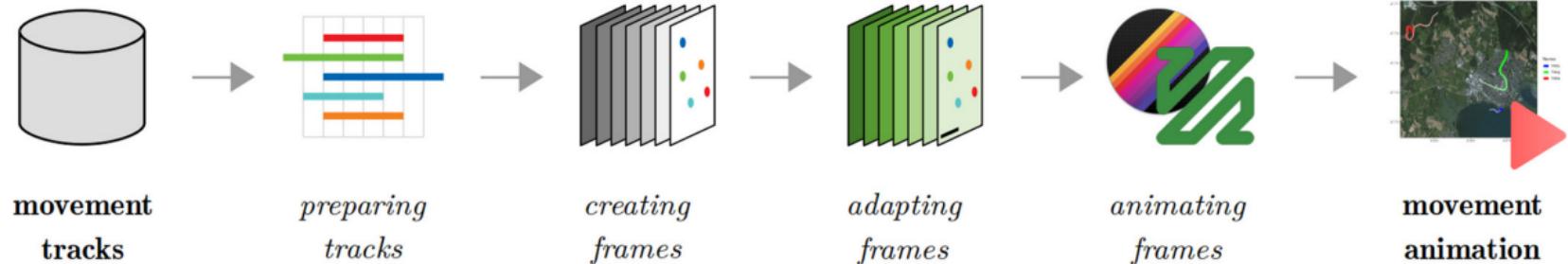
- *ggridge*: focus on animations with/from *ggplot2* plots
- *aniation*: focus on statistical animations
- *plotly*: focus on interactive animations

R packages to create animations from movement data:

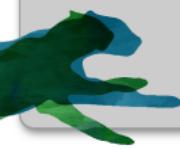
- *anipaths*: focus on spline-based interpolation
- *moveVis*: focus on integrating synchronous environmental data as dynamic base layer



Package workflow

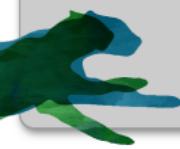


(6) Schematic display of the workflow by which moveVis turns movement data into animations



align_move()

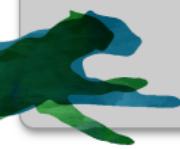
- aligns trajectories to a regular time scale with a consistent temporal resolution, since frame rates (i.e. rate with which frames change) must be discrete and unique throughout a sequence.
- applies *interpolation* along the great-circle path, along a rhumb line or by Euclidean distance, if needed.



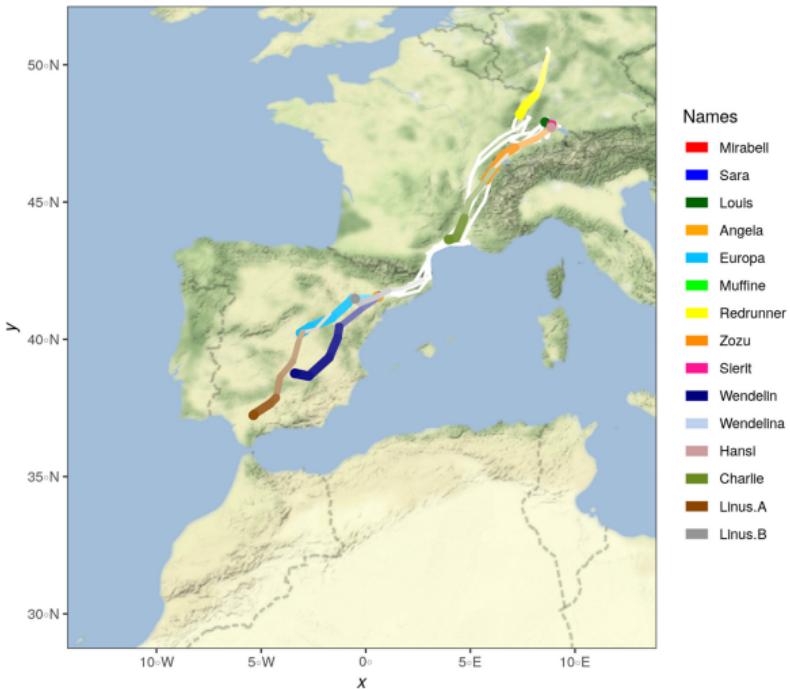
Creating (spatial) frames

frames_spatial()

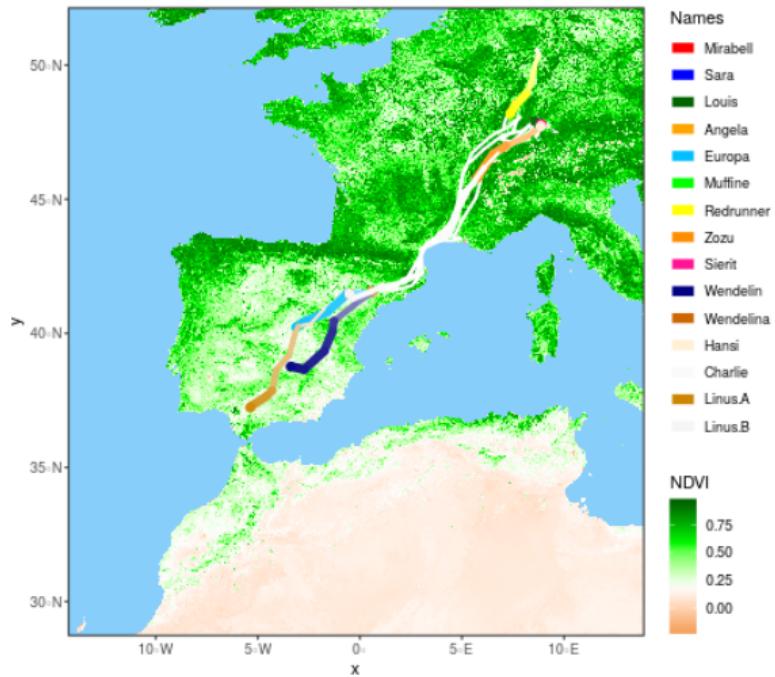
- turns movement trajectories into sequences of frames by assigning sets of trajectory coordinates to individual frames
- frames are *ggplot2* plots
- trajectories can be drawn on *default basemaps* (e.g. OSM, Mapbox etc.) or custom uni- or multi-temporal raster imagery



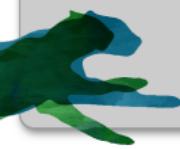
Creating (spatial) frames



(7) A single frame (OSM terrain)



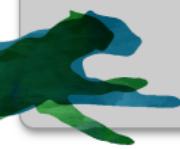
(8) A single frame (MODIS NDVI)



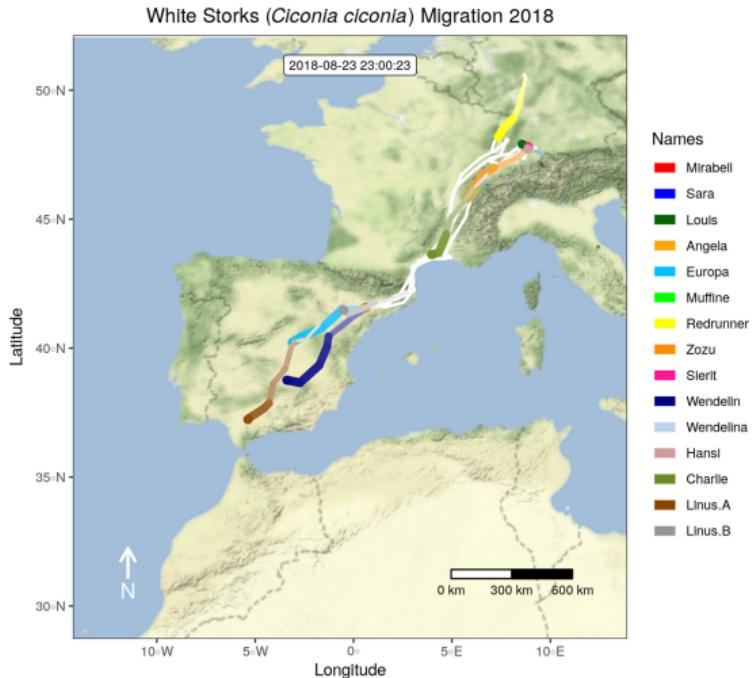
Adapting/customizing frames

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

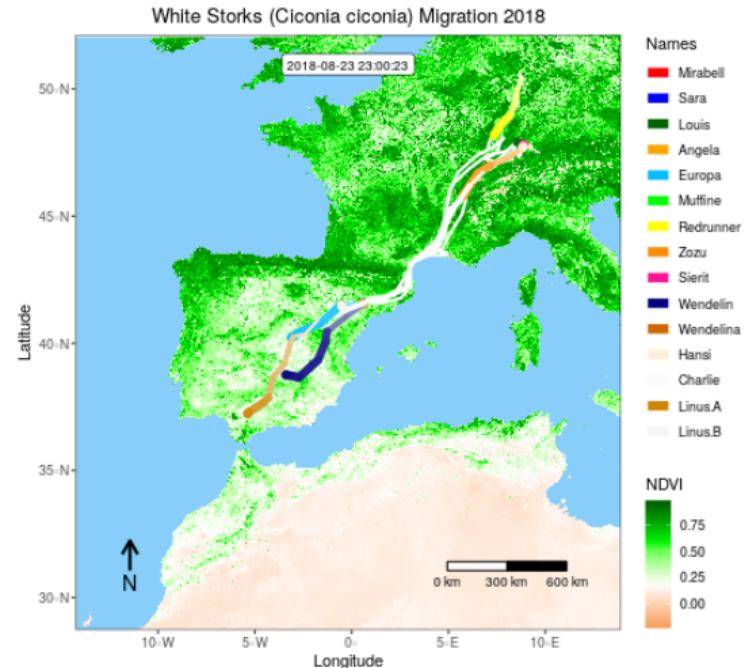
- add temporally static or dynamic elements to a sequence of frames or parts of it, including text annotations, labels, a north arrow, a scalebar, timestamps or point, line and polygon vector features
- adapt colour scales or add custom *ggplot2* objects



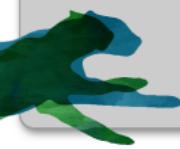
Adapting/customizing frame



(9) A single frame (OSM terrain)



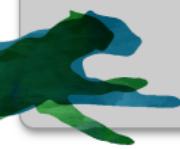
(10) A single frame (MODIS NDVI)



Animating frames

animate_frames()

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



Minimal example

```
1 library(moveVis)
2 library(move)
3
4 data("move_data", package = "moveVis") # move class object, see df2move() for converting data.frames
5
6 # align move_data to a uniform time scale
7 m <- align_move(move_data, res = 4, unit = "mins")
8
9 # create spatial frames with a OpenStreetMap watercolour map
10 frames <- frames_spatial(m, path_colours = c("red", "green", "blue"),
11                           map_service = "osm", map_type = "watercolor", alpha = 0.5) %>%
12   add_labels(x = "Longitude", y = "Latitude") %>% # add some customizations, such as axis labels
13   add_northarrow() %>%
14   add_scalebar() %>%
15   add_timestamps(type = "label") %>%
16   add_progress()
17
18 frames[[100]] # preview one of the frames, e.g. the 100th frame
19
20 # animate frames
21 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

moveVis 0.10.5

Get Started Examples News Functions Other packages ▾ Search... Twitter GitHub

moveVis

Introduction

moveVis provides tools to visualize movement data (e.g. from GPS tracking) and temporal changes of environmental data (e.g. from remote sensing) by creating video animations. It works with move and raster class inputs and turns them into ggplot2 frames that can be further customized. moveVis uses gtrsk1 (wrapping the gtsk cargo crate) and av (binding to FFmpeg) to render frames into animated GIF or video files.

A peer-reviewed open-access paper accompanying moveVis has been published in *Methods in Ecology and Evolution*.



Figure 1: Example movement tracks nearby Lake of Constance on top of a OSM watercolor and a mapbox satellite base map.

Exemplary movement tracks nearby Lake of Constance

Map values per track and time

Links

- Download from CRAN at <https://cloud.r-project.org/package=moveVis>
- Report a bug at <http://github.com/16eagle/moveVis/issues>
- Browse source code at <http://github.com/16eagle/moveVis>
- Read our accompanying MEE paper at <https://doi.org/10.1111/2041-210X.13374>
- Find out more about our work at <http://remote-sensing.org>

License

GPL3

Citation

Citing moveVis

Developers

Jakob Schwalb-Willmann
Author, maintainer

Dev status

CRAN 0.10.5
downloads 64K/recent
CRAN OK
Build status
GitHub 10 stars
codecov 95%
dependencies 14/62

Received: 4 October 2019 | Accepted: 30 January 2020

DOI: 10.1111/2041-210X.13374

Methods in Ecology and Evolution 

APPLICATION

moveVis: Animating movement trajectories in synchronicity with static or temporally dynamic environmental data in R

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Handling Editor: Laura Graham

Abstract

1. Visualizing movement data is challenging: While traditional spatial data can be sufficiently displayed as two-dimensional plots or maps, movement trajectories require the representation of time in a third dimension. To address this, we present moveVis, an R package, which provides tools to animate movement trajectories, overlaying simultaneous uni- or multi-temporal raster imagery or vector data.

2. moveVis automates the processing of movement and environmental data to turn such into an animation. This includes (a) the regularization of movement trajectories enforcing uniform time instances and intervals across all trajectories, (b) the frame-wise mapping of movement trajectories onto temporally static or dynamic environmental layers, (c) the addition of customizations, for example, map elements or colour scales and (d) the rendering of frames into an animation encoded as GIF or video file.

3. moveVis is designed to display interactions and concurrencies of animal movement and environmental data. We present examples and use cases, ranging from data exploration to visualizing scientific findings.

(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



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