Tools for transboundary wildlife monitoring on Movebank

Sarah C. Davidson
Data Curator
The Ohio State University
Max Planck Institute for Ornithology

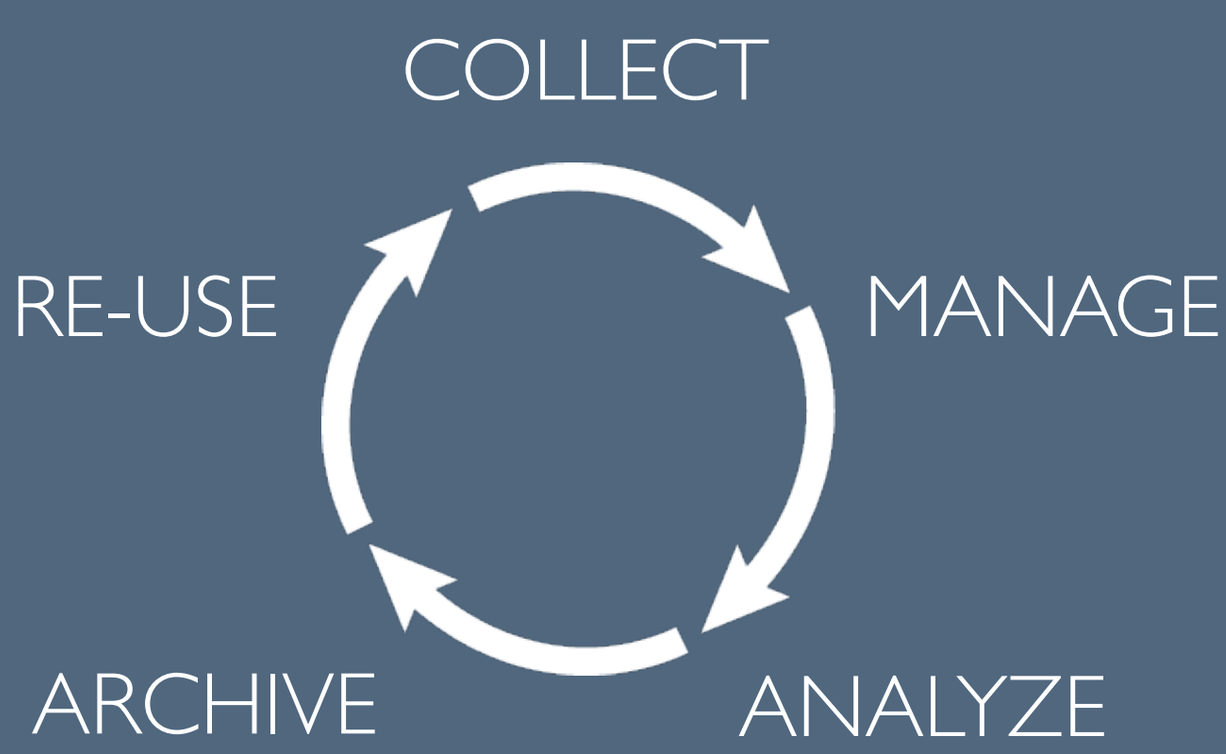
Large Carnivores Workshop
5th Conference of the Forum Carpaticum
Eger, Hungary
15 October, 2018

Movebank is a **global database**

for animal movement data

and a **tool**

for working with data throughout its life cycle.



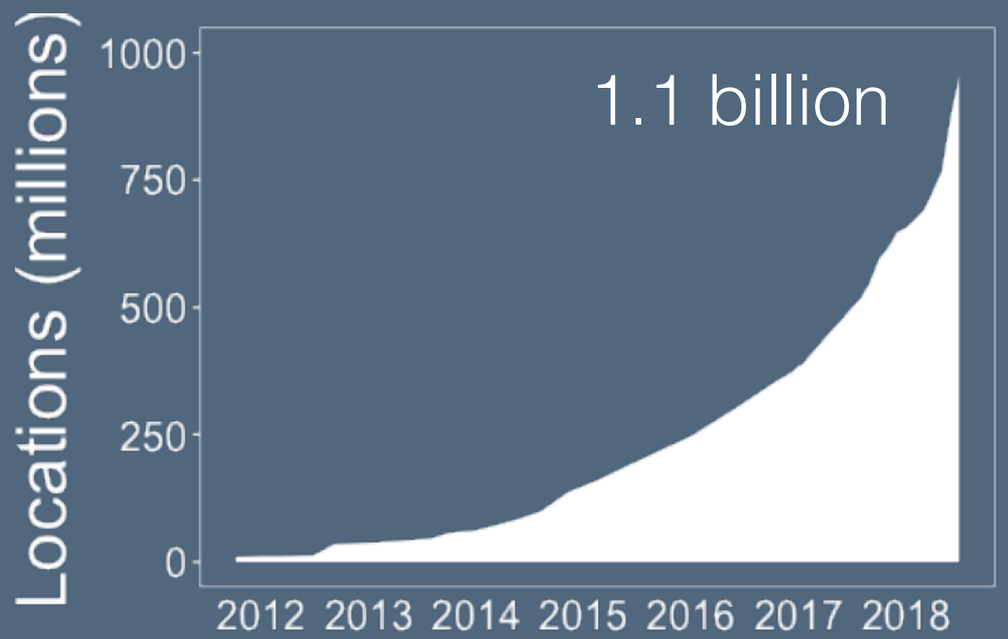
MOVEBANK

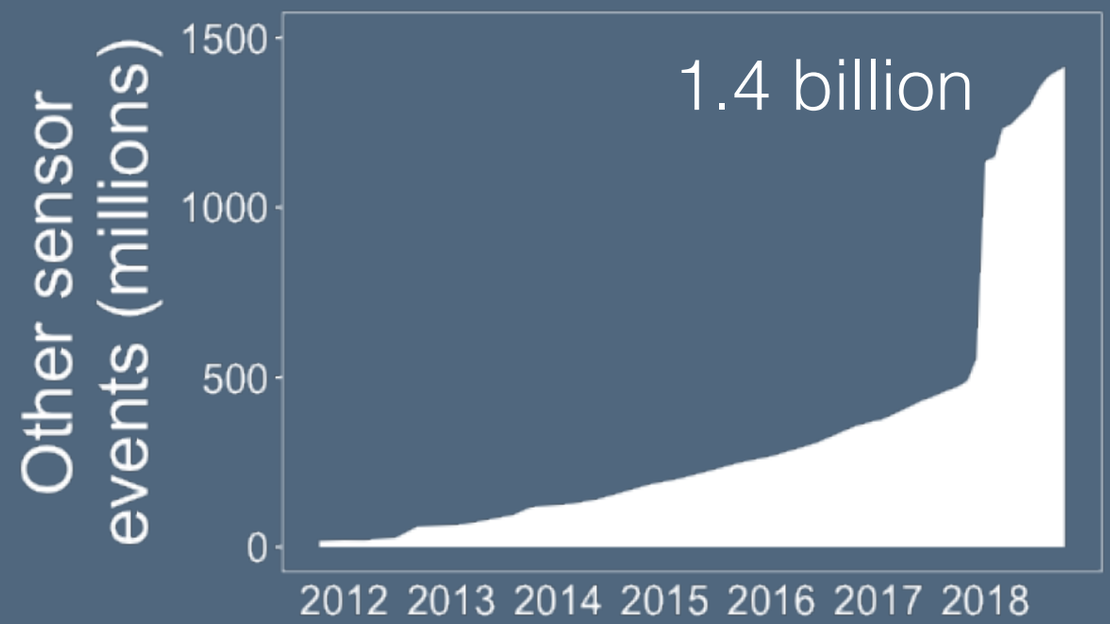
Map | Satellite

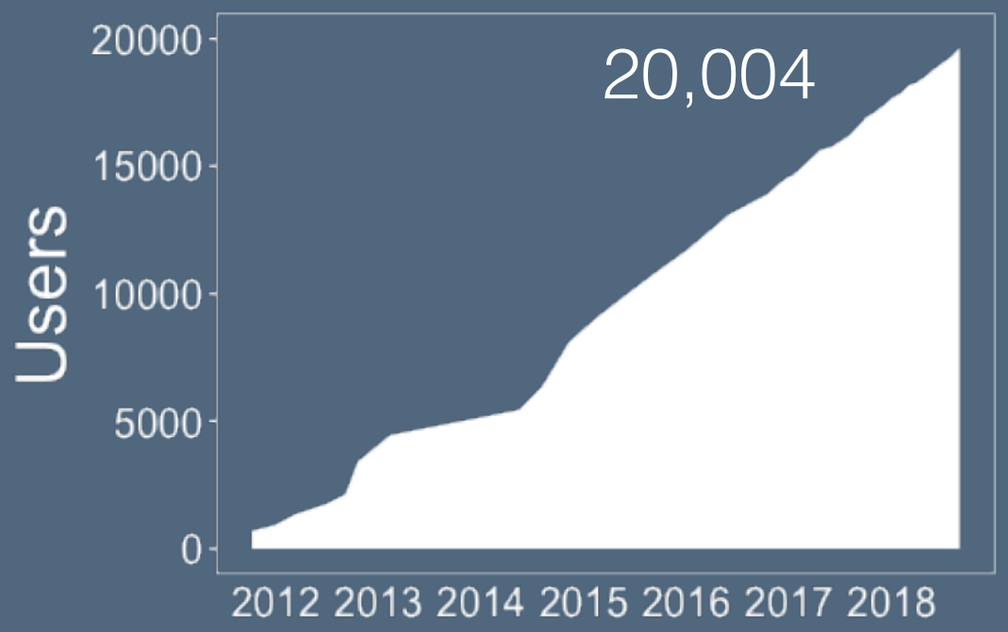
Locations of publicly visible studies at movebank.org (April 2018)

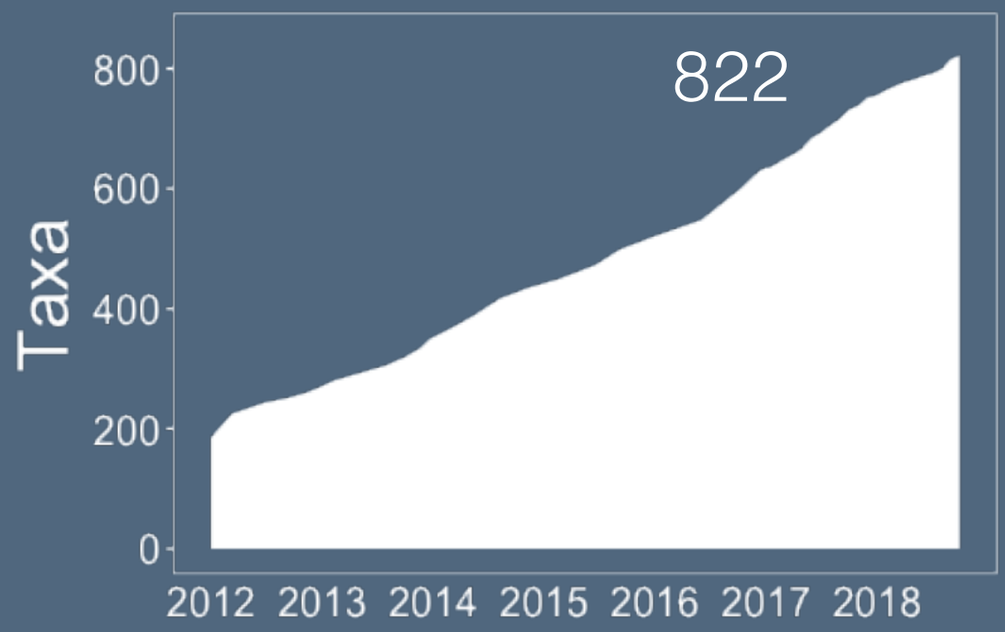
Taxa: 822
Studies: 5,219
Locations: 1.1 bil
Owners: >5,000
Users: 20,004

DATABASE









Content as of October 2018

FUNDING

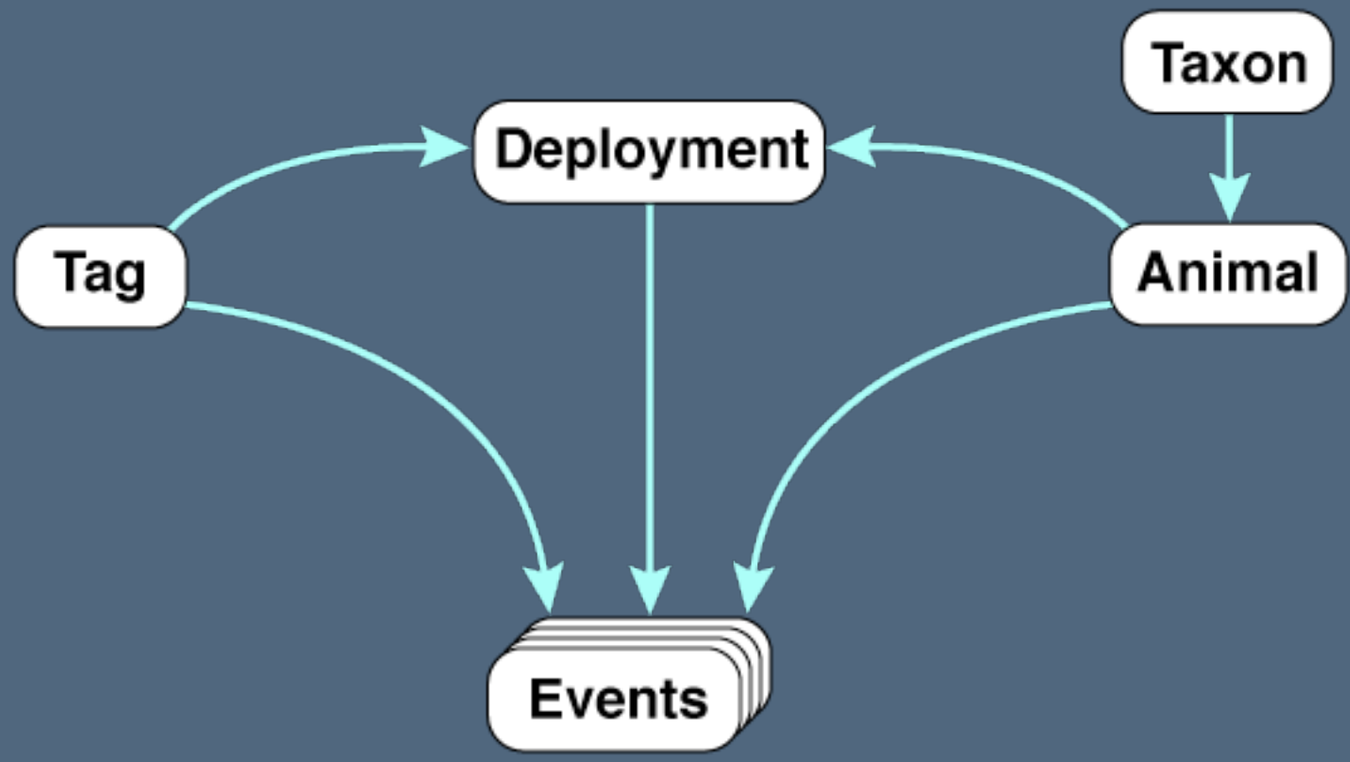
Long term
- Max Planck Society
- University of Konstanz

Current grants
- German Aerospace Center (DLR)
- U.S. National Aeronautics and Space Administration (NASA)
- U.S. National Science Foundation

Previous grants
- German Science Foundation
- NASA
- U.S. National Science Foundation

DATA TYPES

Individual animal tracks and related attributes

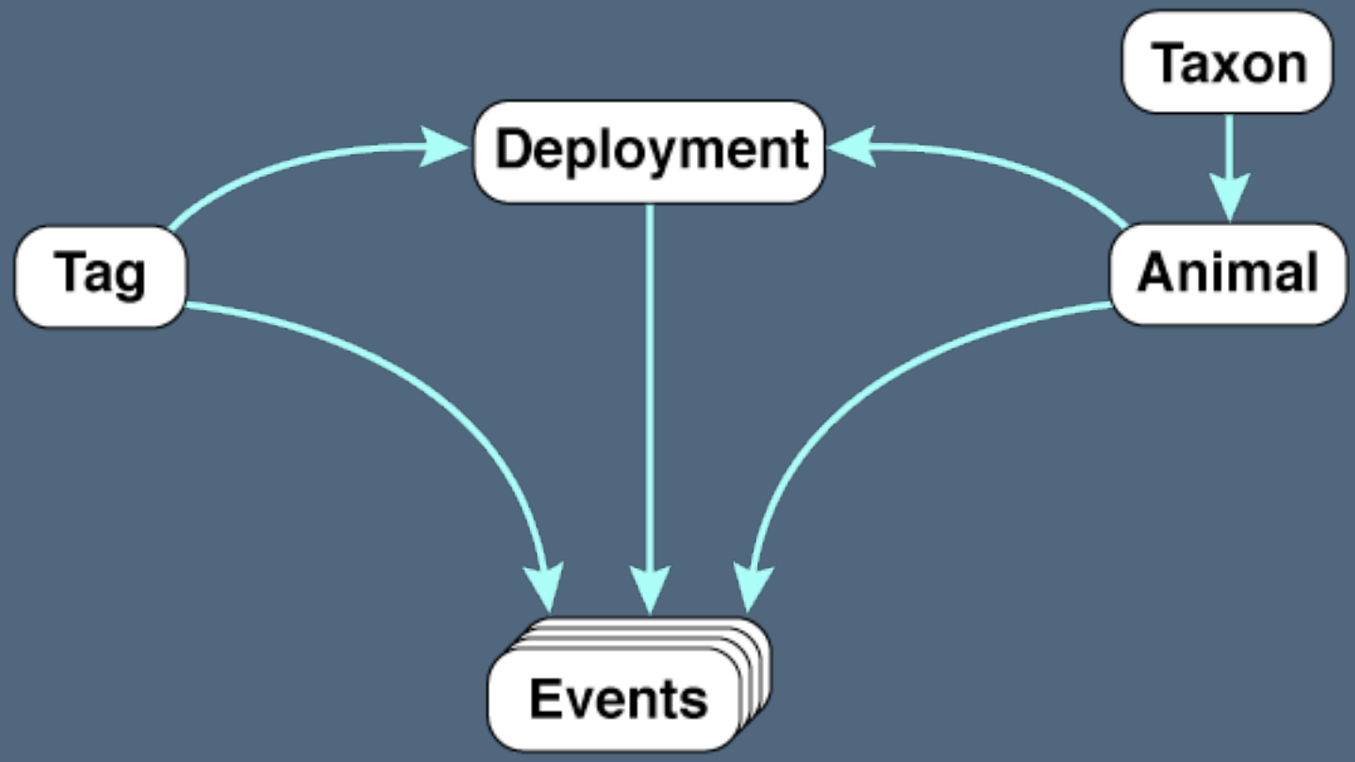


PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software

DATA TYPES

- Individual animal tracks and related attributes
- Tracking methods
  - GPS
  - Argos Doppler Shift
  - Radio transmitter
  - Solar geolocator
  - Bird ring
  - Natural mark



PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software

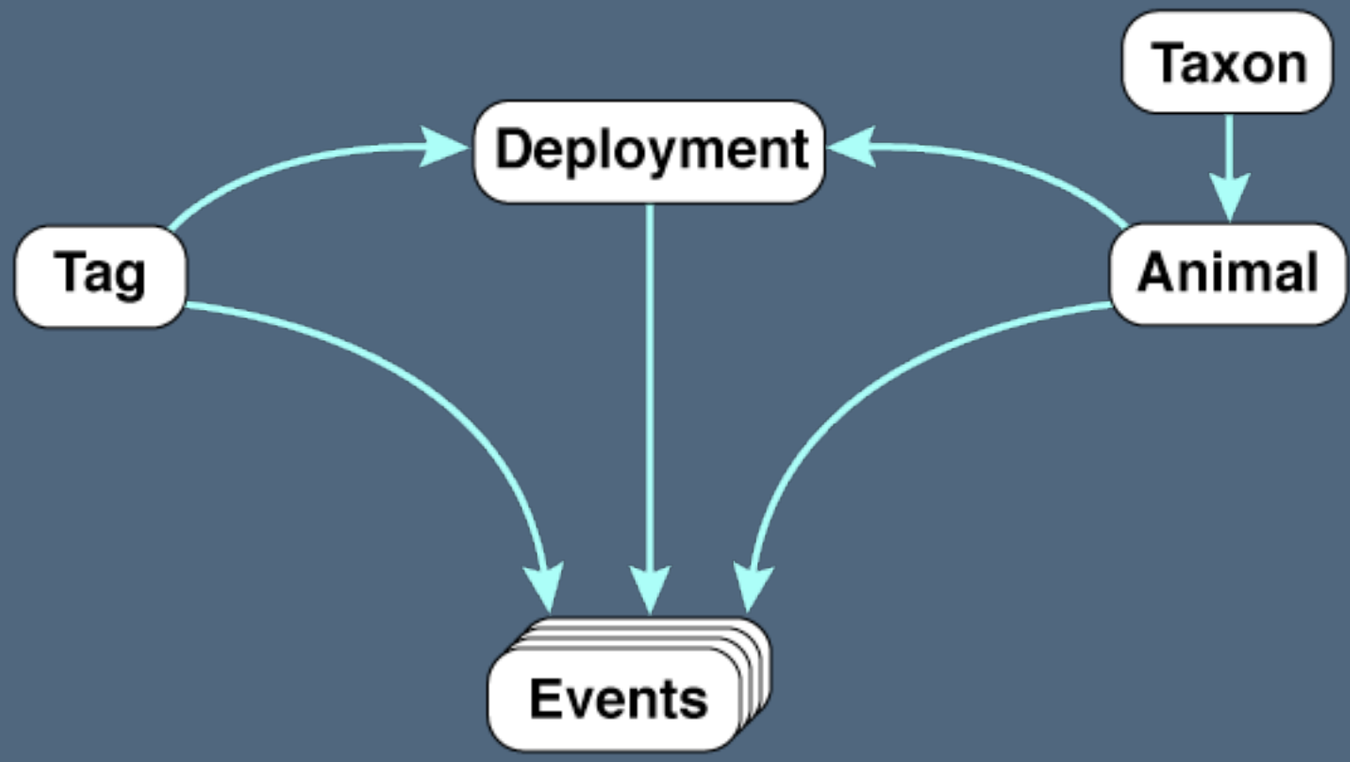
DATA TYPES

Individual animal tracks and related attributes

Tracking methods

Other bio-logging sensors

- Accelerometer
- Barometer
- Light levels
- Magnetometer
- Temperature



PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software

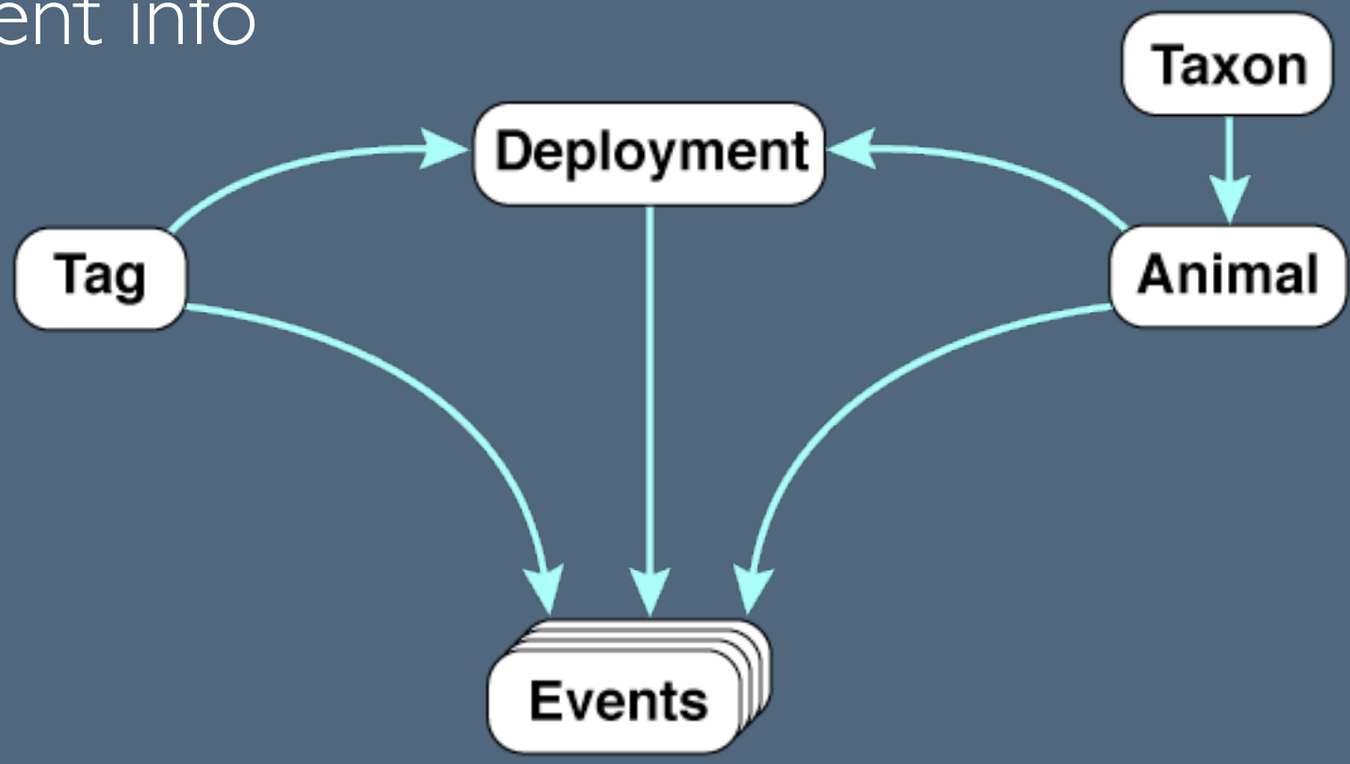
DATA TYPES

Individual animal tracks and related attributes

Tracking methods

Other bio-logging sensors

Animal, tag, and deployment info



PostgreSQL database

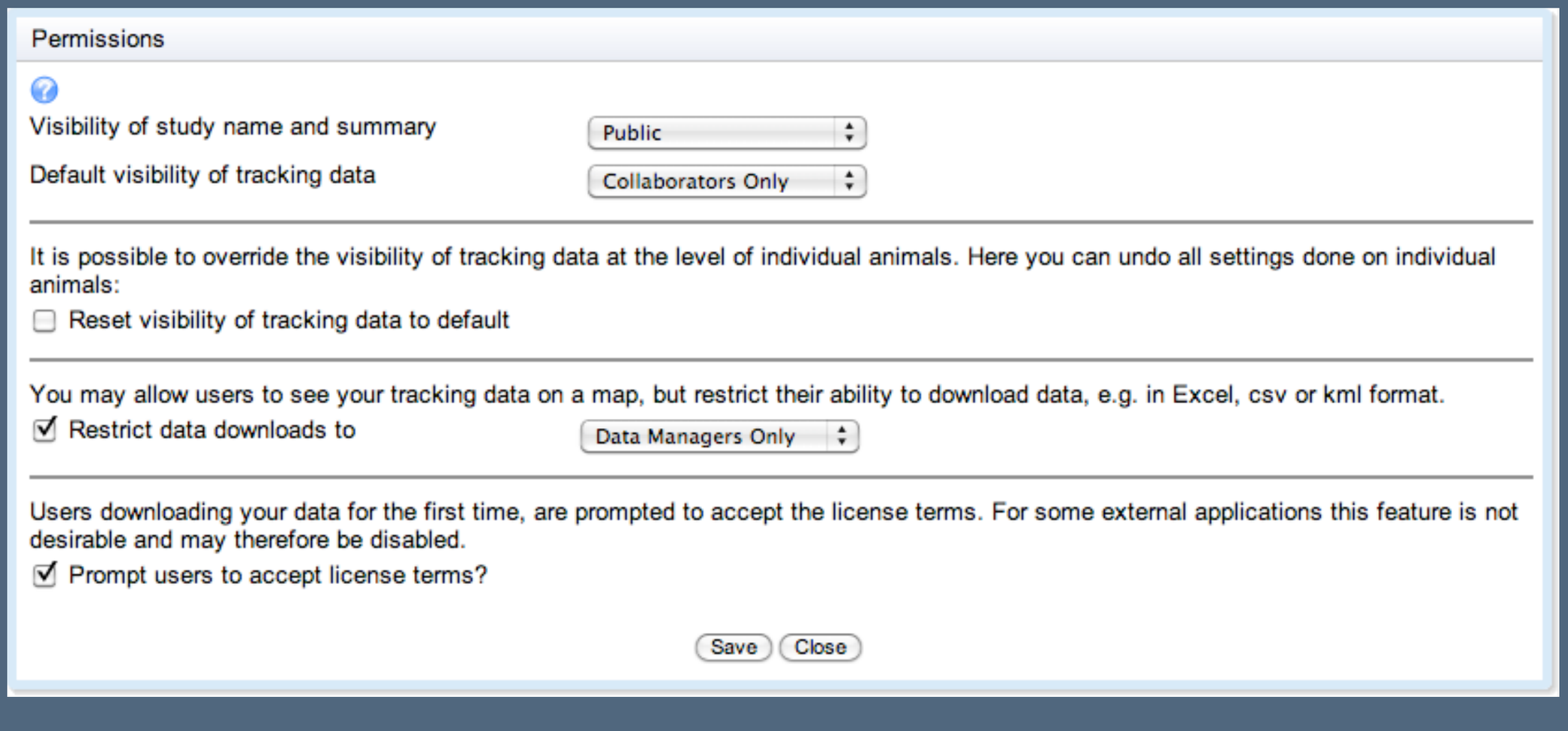
Kranstauber et al. 2011, Environmental Modelling and Software

OWNERSHIP

SHARE

You retain ownership and control access.

- Data Managers (read-write)
- Collaborators (read only)
- Public



IMPORT DATA

COLLECT

Supported or custom CSV

What Movebank sees in your file

date	time	long	lat	species	tag	individual name	speed	heading	height	visible
2008-12-18	12:21:19.001	8.9858828	47.7382944	Aythya ferina	420	Common Pochard F	73	347.34	438.5	TRUE
2008-12-18	12:30:22.999	8.9857864	47.7382972	Aythya ferina	420	Common Pochard F	22	33.42	441	TRUE
2008-12-18	13:01:38.001	8.9859685	47.7378514	Aythya ferina	420	Common Pochard F	97	191.37	441.7	TRUE
2008-12-18	13:30:12.000	8.9855835	47.738281	Aythya ferina	420	Common Pochard F	12	351.93	442.4	TRUE
2008-12-18	14:01:25.998	8.985615	47.7382313	Aythya ferina	420	Common Pochard F	86	348	449.6	TRUE
2008-12-18	14:30:23.999	8.9857624	47.73807	Aythya ferina	420	Common Pochard F	23	336.86	453.1	TRUE

Map other Attributes

How Movebank will save the data

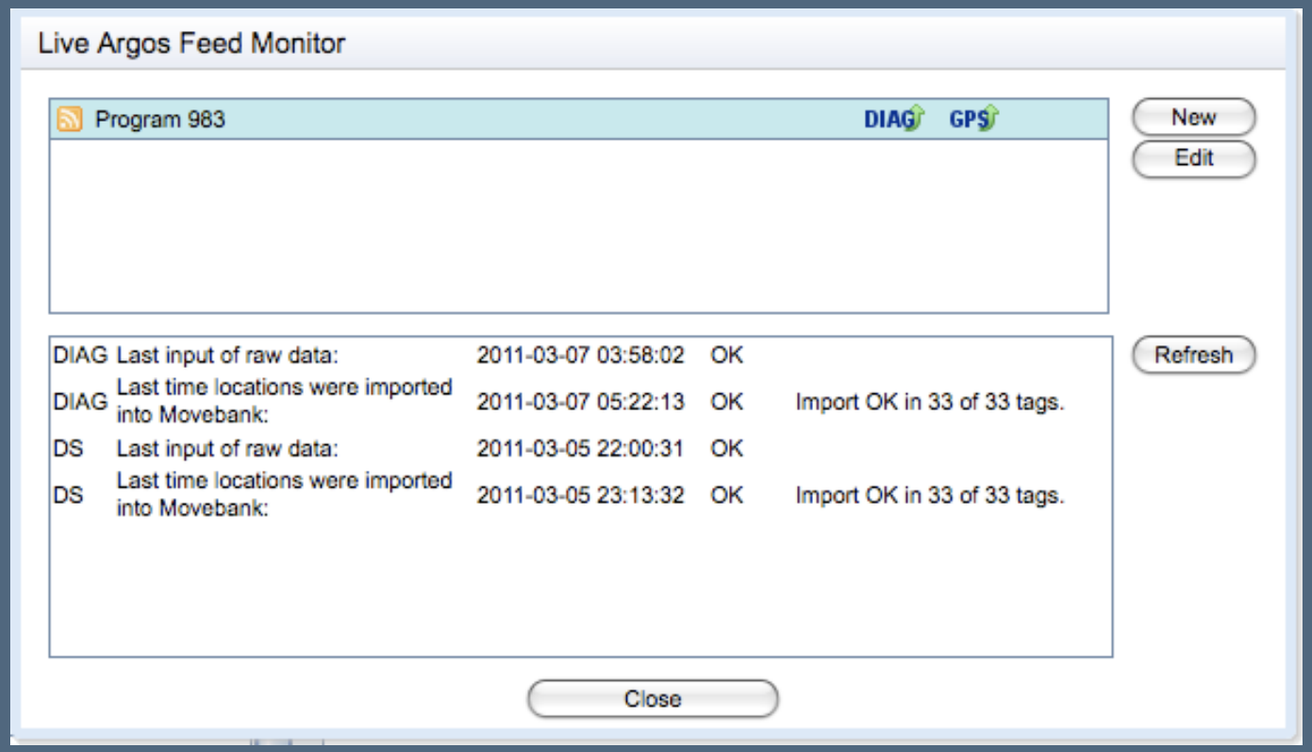
Sensor Type	Timestamp	Location Lat	Location Long	Animal Id	Tag Id
GPS	2008-12-18 12:21:19.001	47.7382944	8.9858828	Common Pochard F	420
GPS	2008-12-18 12:30:22.999	47.7382972	8.9857864	Common Pochard F	420
GPS	2008-12-18 13:01:38.001	47.7378514	8.9859685	Common Pochard F	420
GPS	2008-12-18 13:30:12	47.738281	8.9855835	Common Pochard F	420
GPS	2008-12-18 14:01:25.998	47.7382313	8.985615	Common Pochard F	420
GPS	2008-12-18 14:30:23.999	47.73807	8.9857624	Common Pochard F	420

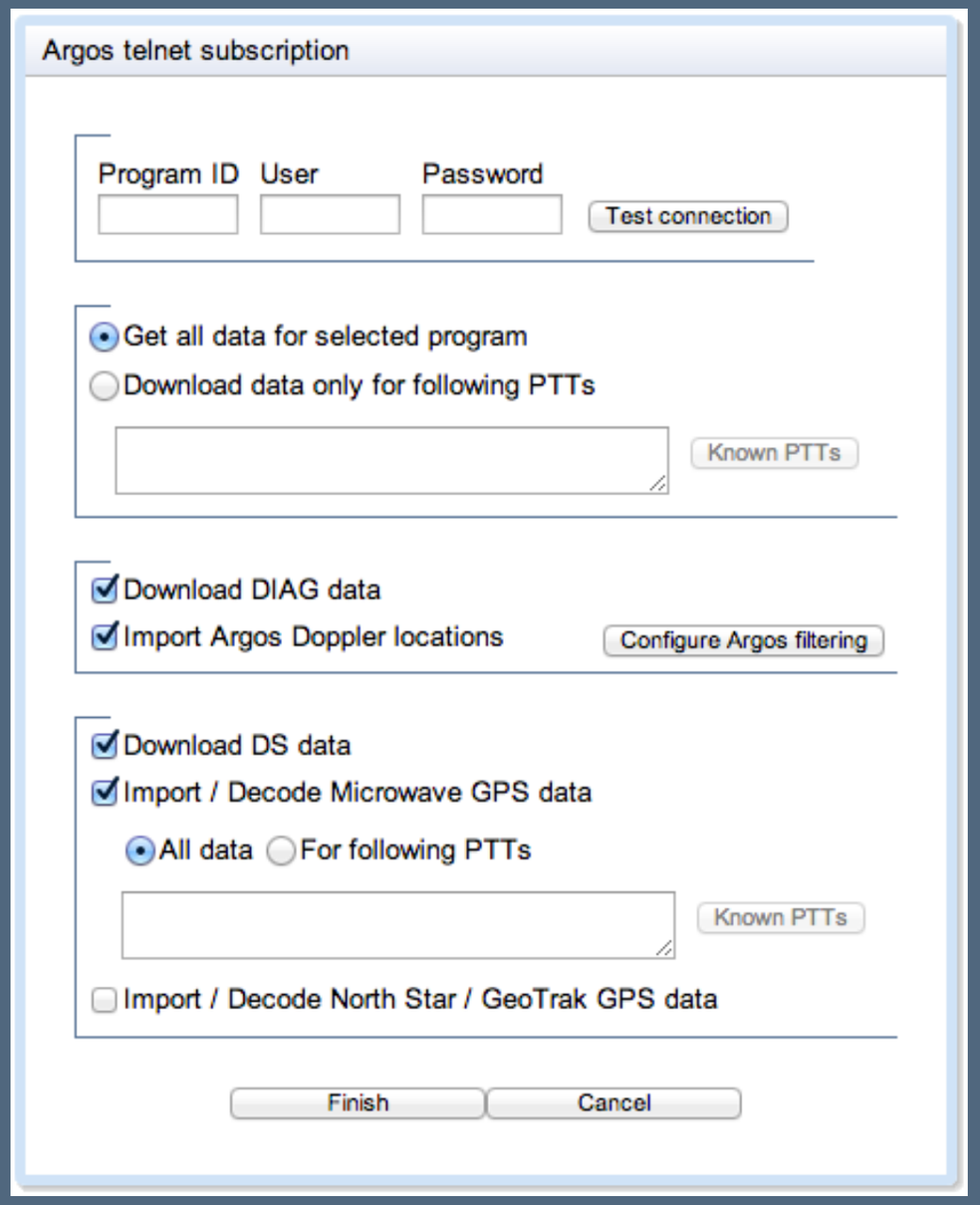
DATA FEEDS

COLLECT

Argos GPS-PTTs: Microwave, GeoTrak (coming next: Lotek)

Argos DIAG: all PTTs





DATA FEEDS

COLLECT

Argos

GSM-GPS: CTT, Ecotone, e-obs, Druid, Fleetronic, FollowIt Wildlife, madebytheo, Microwave, MoveTech, Ornitela

Iridium-GPS: Followit Wildlife

Manage live feed: CTT GSM

Provider CTT GSM
Feed subscriber j.schmoe (Joseph Schmoe)
Feed activity (•) on ( ) off

Feed elements:

Tag ID	Data points	Last import	Status
89014103256540803045	2184	Thu May 15 10:20:34 GMT-400 2014	OK
89014103256540803078	2964	Thu May 15 10:20:30 GMT-400 2014	OK
89014103256345345796	6484	Wed May 21 08:37:45 GMT-400 2014	OK
89014103256345345804	5313	Wed May 21 08:40:03 GMT-400 2014	OK

Add/Remove Tags
Refresh

Close New Delete

DATA FEEDS

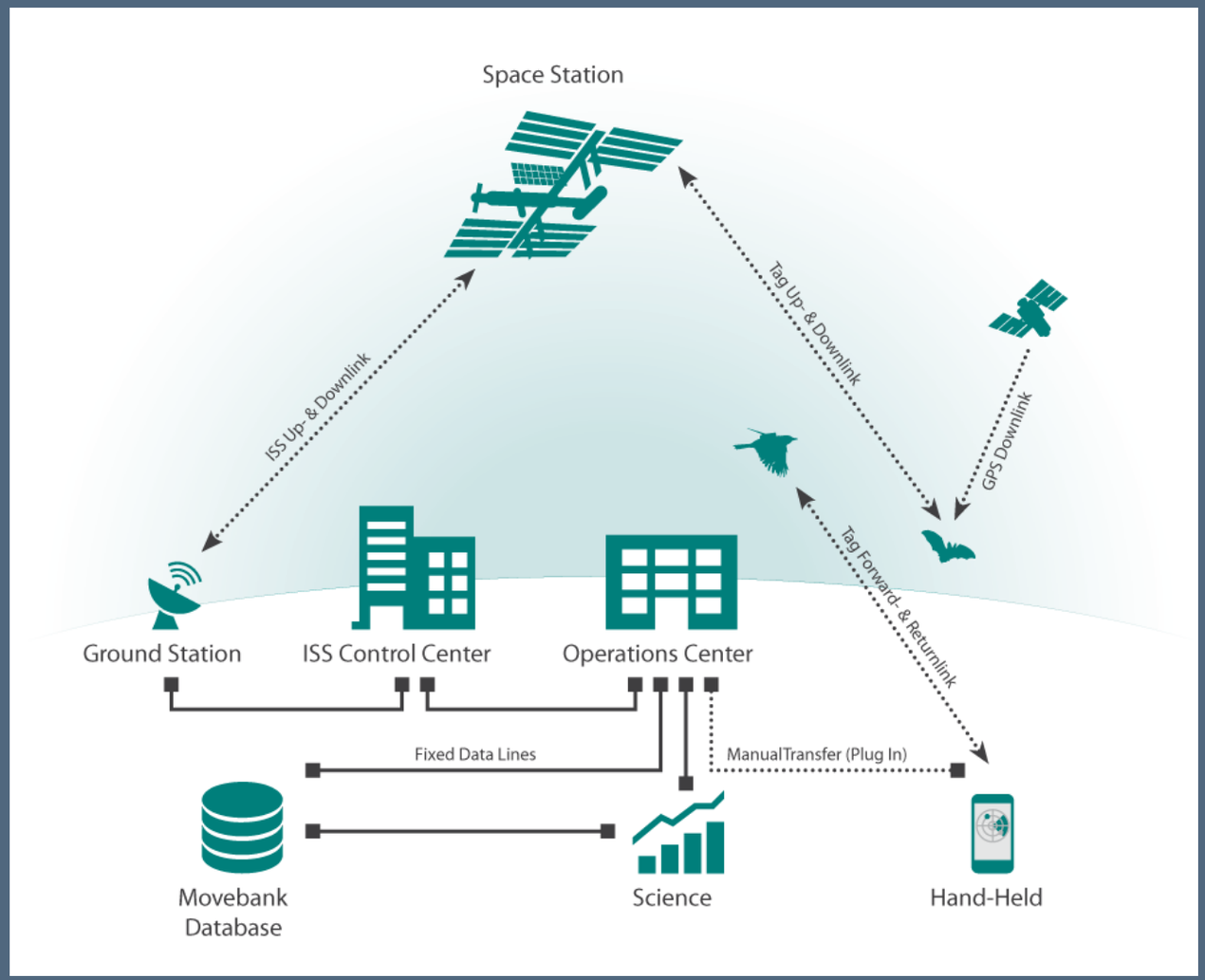
COLLECT

Argos

GSM-GPS

Iridium-GPS

Coming soon: ICARUS



EMAIL NOTIFICATIONS

COLLECT

- Argos
- GSM-GPS
- Iridium-GPS
- ICARUS

Email Configurator

Subscribe here for a daily or weekly email notification containing basic statistics of your recent data. These include information on when data have been last collected and what distances were travelled.

Subscribe for email ☑ (Uncheck to revoke subscription)

Schedule ○ daily ◉ weekly
Day of week: Monday
Time of day (GMT): 9:00
Send to: support@movebank.org
Email format ◉ ASCII ○ HTML

Hide undeployed data ☐
Hide outliers ☑

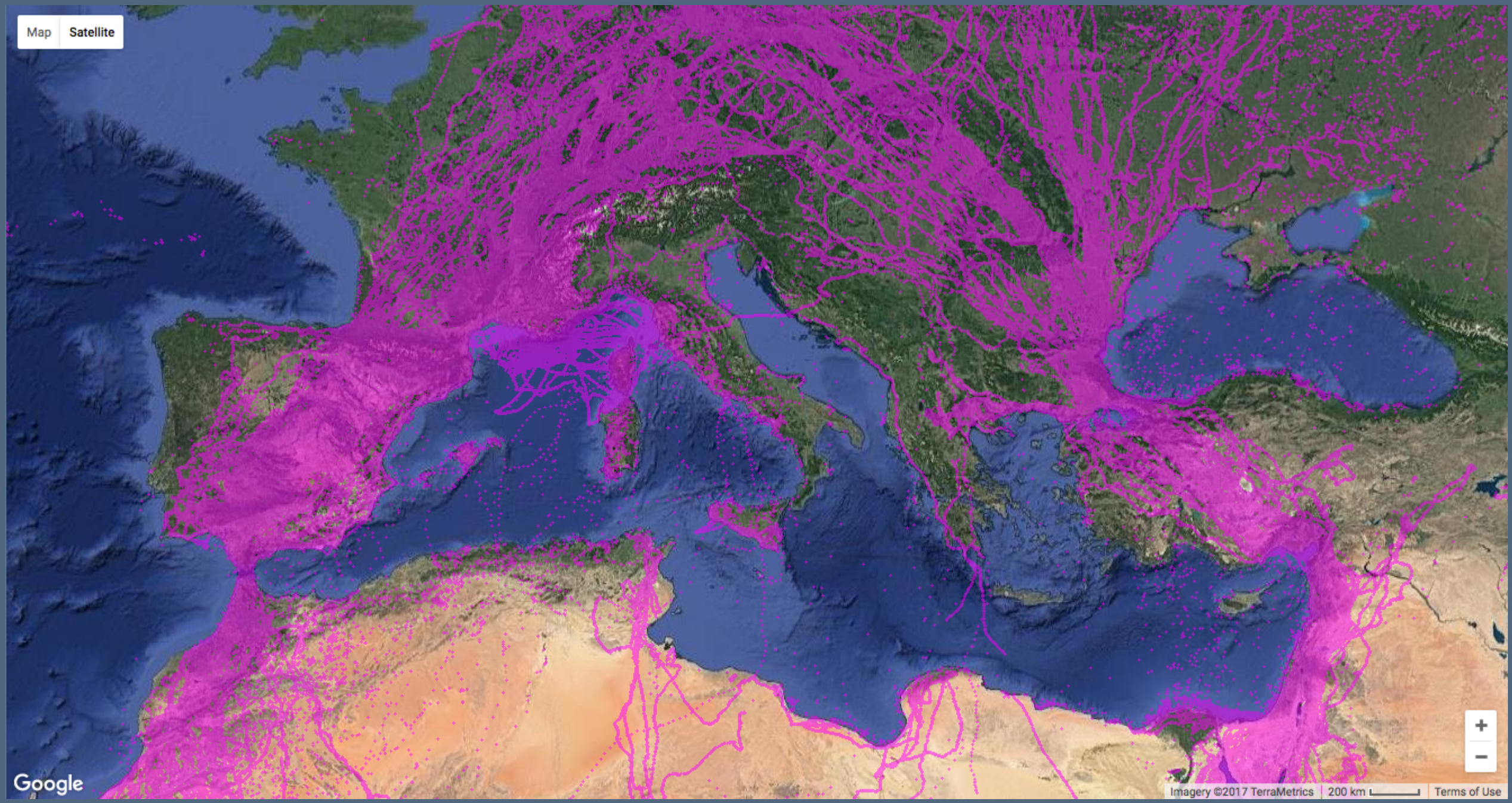
Include Argos Doppler Shift Statistics ☑
Attach KMZ file ☐
KMZ data interval: Unlimited

Include GPS Statistics ☑
Attach KMZ file ☑
KMZ data interval: Two weeks
Detect mortality ☐ Edit criteria

Save | Send mail now | Close

MAPPING

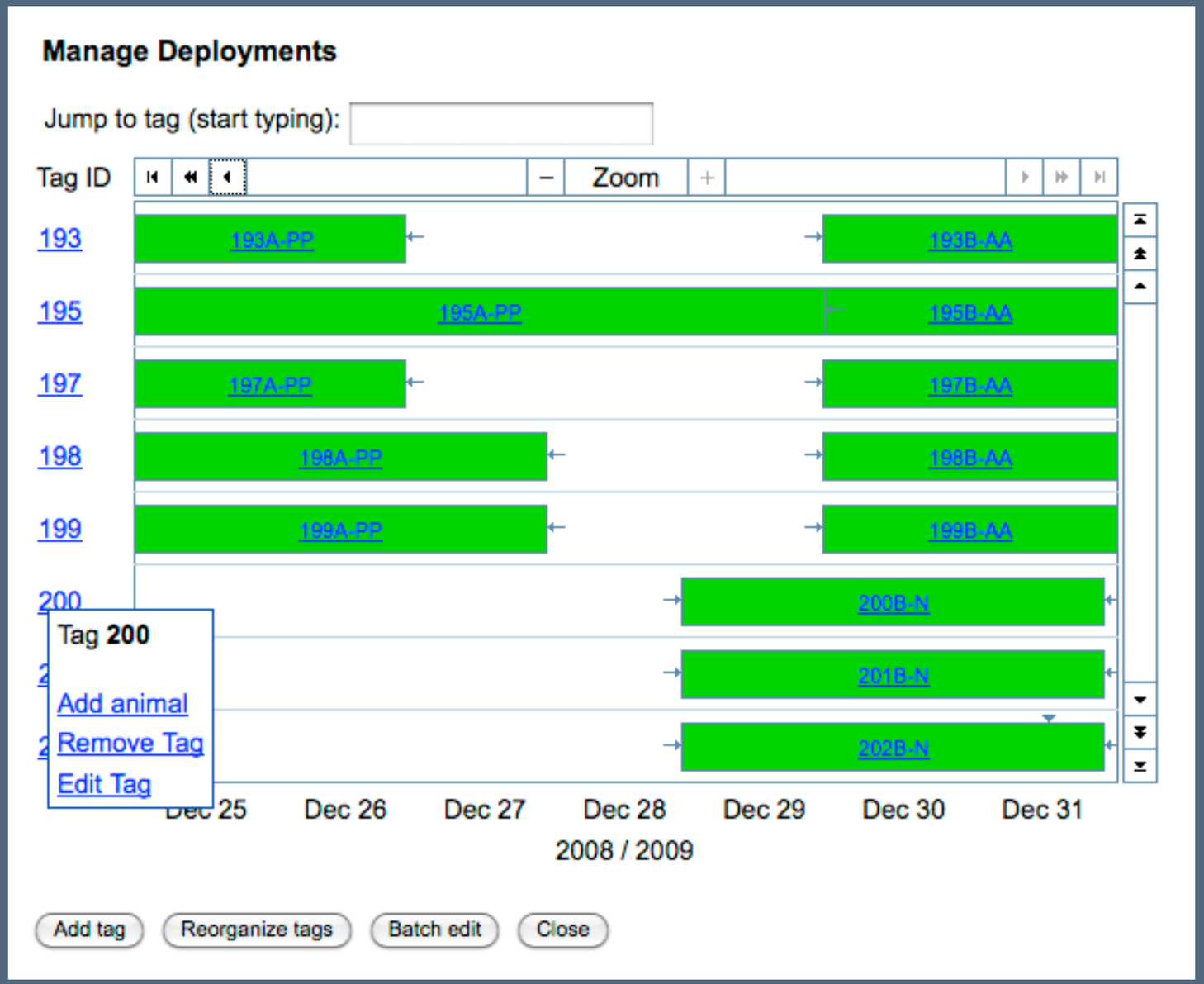
MANAGE



GPS tracks publicly visible in May 2017

DEPLOYMENTS

MANAGE



QC & OUTLIERS

MANAGE

Study Tsavo Lion Study
Sensor Type GPS
Animal Kiboche

▶ Display Options

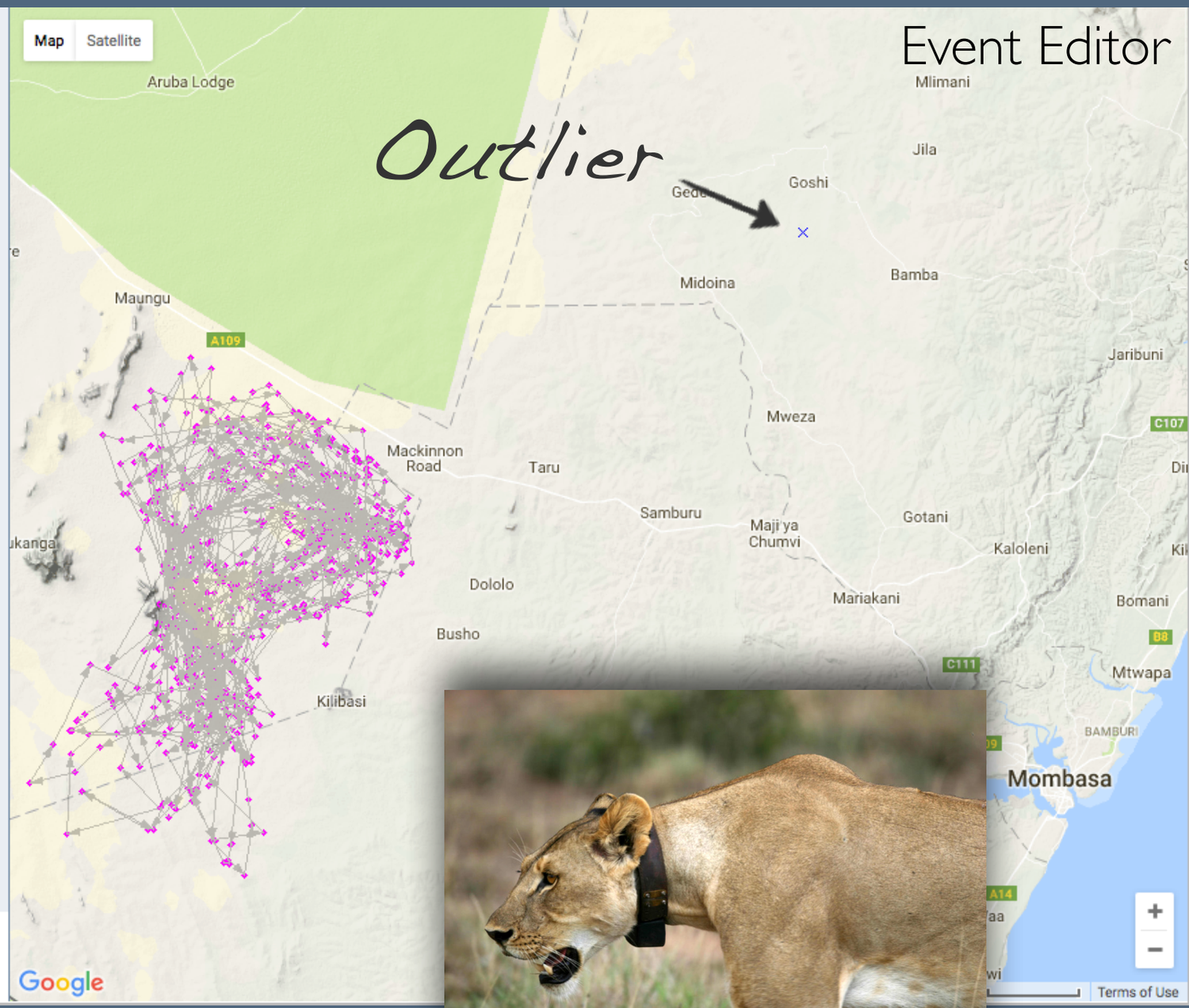
Show/Hide Columns

Timestamp	Location Lat	Location Long	Manually Marked Outlier
2005-10-17 00:00:54	-3.788	38.873	
2005-10-17 04:00:53	-3.810	38.928	
2005-10-17 08:00:48	-3.809	38.928	
2005-10-17 18:00:47	-3.807	38.927	
2005-10-18 00:00:54	-3.793	38.932	
2005-10-18 06:00:54	-3.783	38.941	
2005-10-18 18:01:24	-3.776	38.953	
2005-10-19 00:00:48	-3.780	38.947	
2005-10-19 06:02:23	-3.784	38.933	
2005-10-19 12:02:10	**-3.500**	**39.411**	**true**
2005-10-19 18:00:54	-3.784	38.931	
2005-10-20 00:00:48	-3.807	38.921	
2005-10-20 06:00:41	-3.809	38.922	
2005-10-20 12:01:11	-3.812	38.924	
2005-10-20 18:02:40	-3.808	38.941	
2005-10-21 00:02:59	-3.808	38.940	
2005-10-21 06:02:14	-3.836	38.983	
2005-10-22 00:00:53	-3.840	39.010	
2005-10-22 06:01:35	-3.835	38.956	
2005-10-22 18:01:42	-3.842	38.946	
2005-10-23 00:01:18	-3.843	38.891	
2005-10-23 06:03:04	-3.825	38.897	
2005-10-23 12:01:48	-3.825	38.897	
2005-10-23 18:00:50	-3.802	38.944	
2005-10-24 00:00:53	-3.779	38.970	

Edit Attribute.
- (•) True
- ( ) False
- ( ) Not Set

Hold shift or ctrl key to select multiple events.

Save Cancel

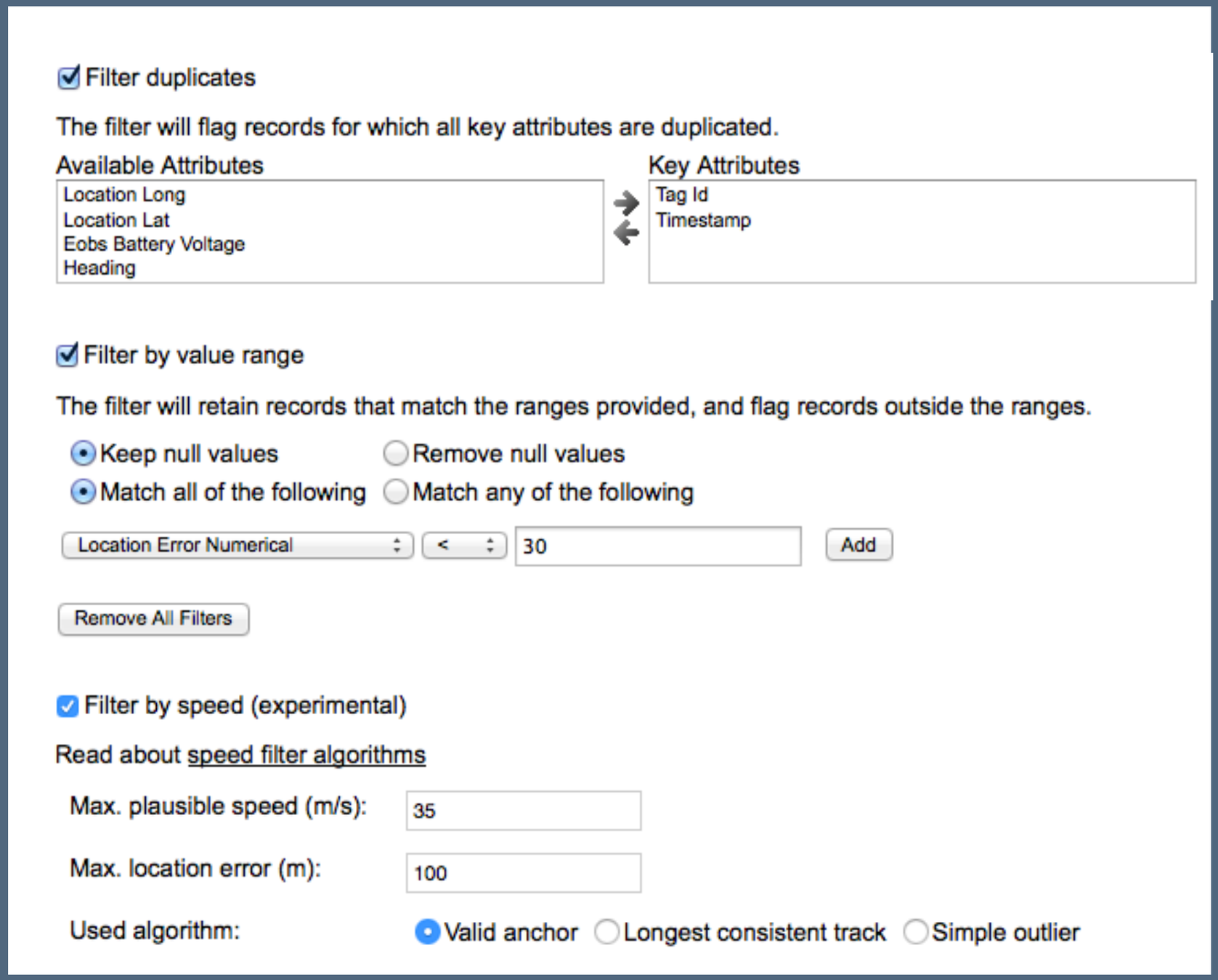


QC & OUTLIERS

MANAGE

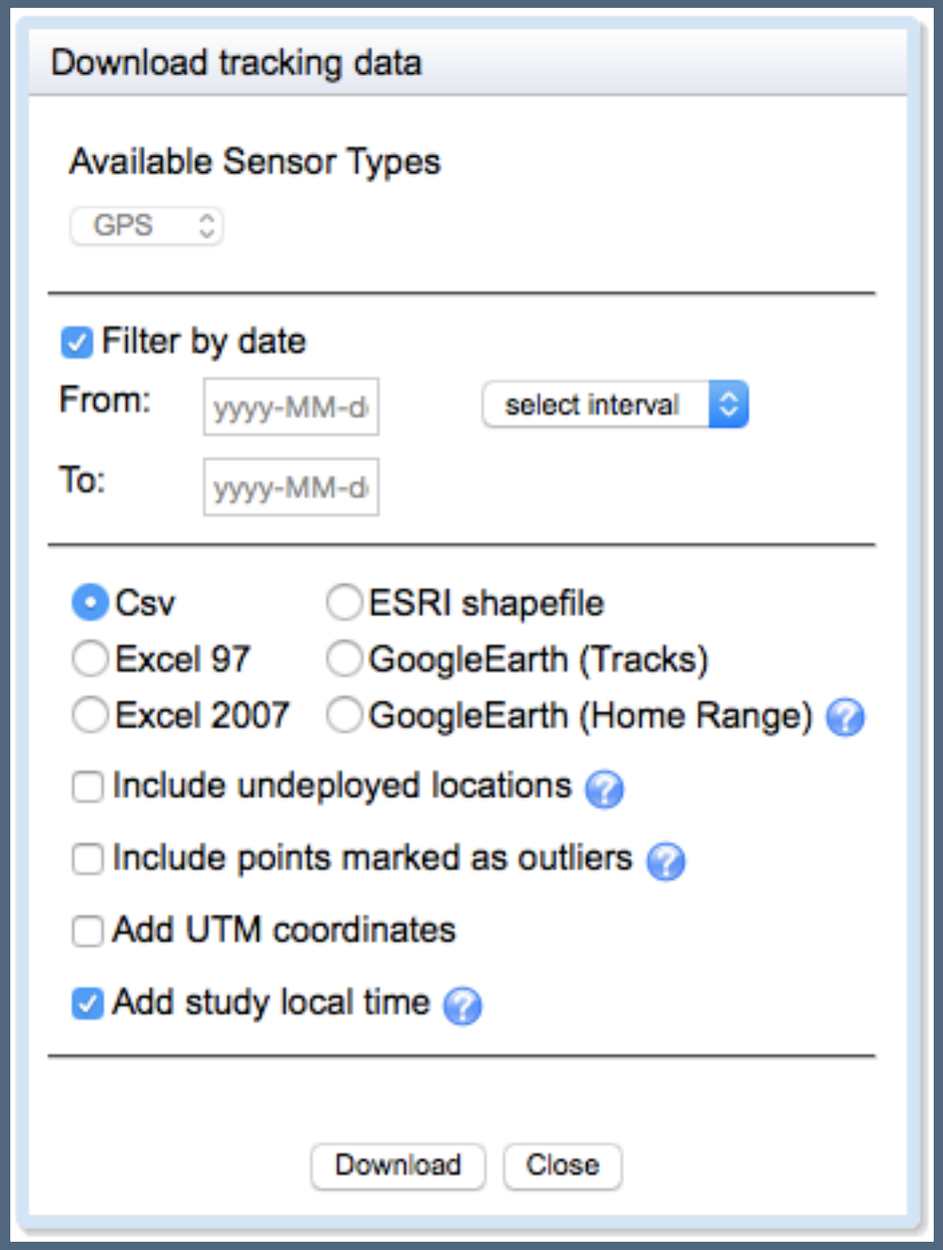
Data filters

- Argos
- Duplicate
- Value Range
- Speed



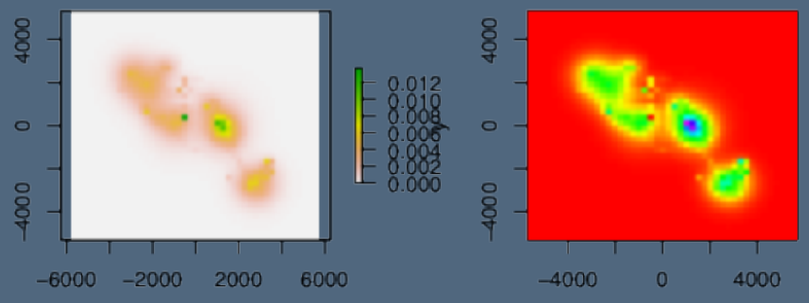
FILE CONVERSION

ANALYZE

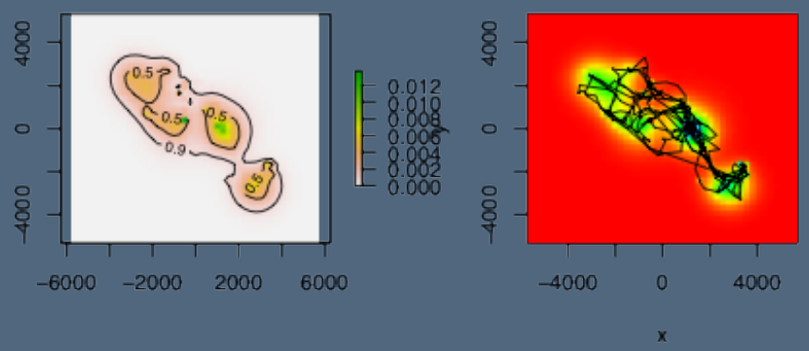


API & SOFTWARE

ANALYZE



R package "move"



R package and Shiny web app "ctmm"

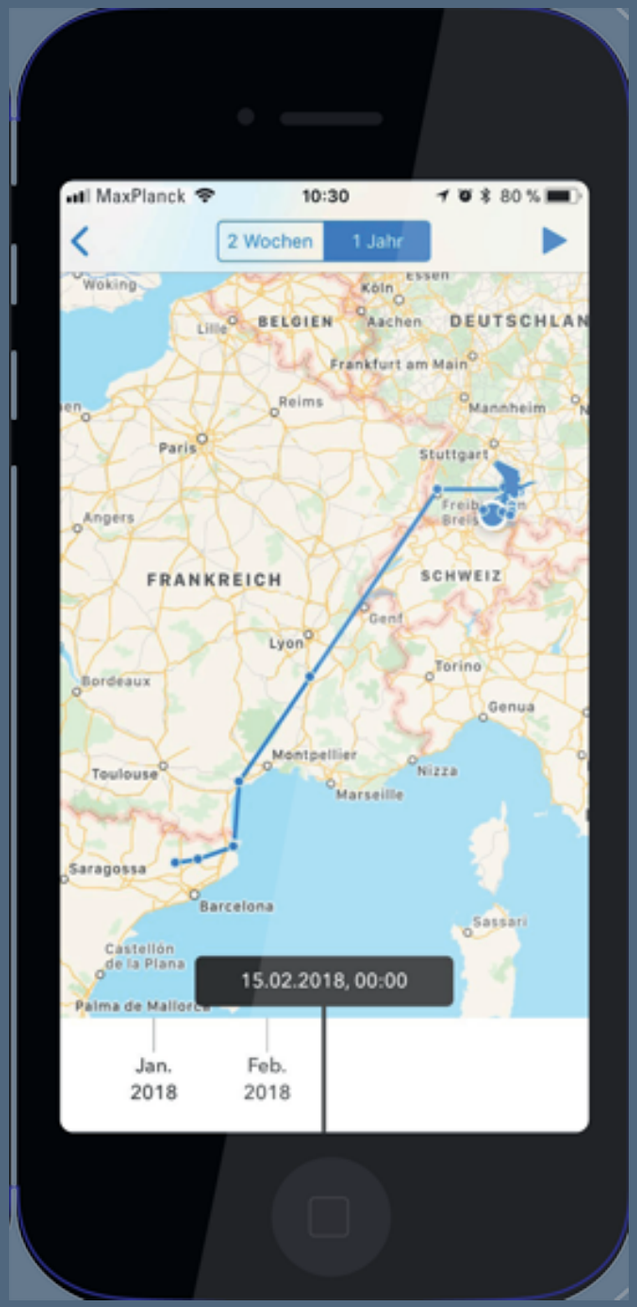
github.com/movebank

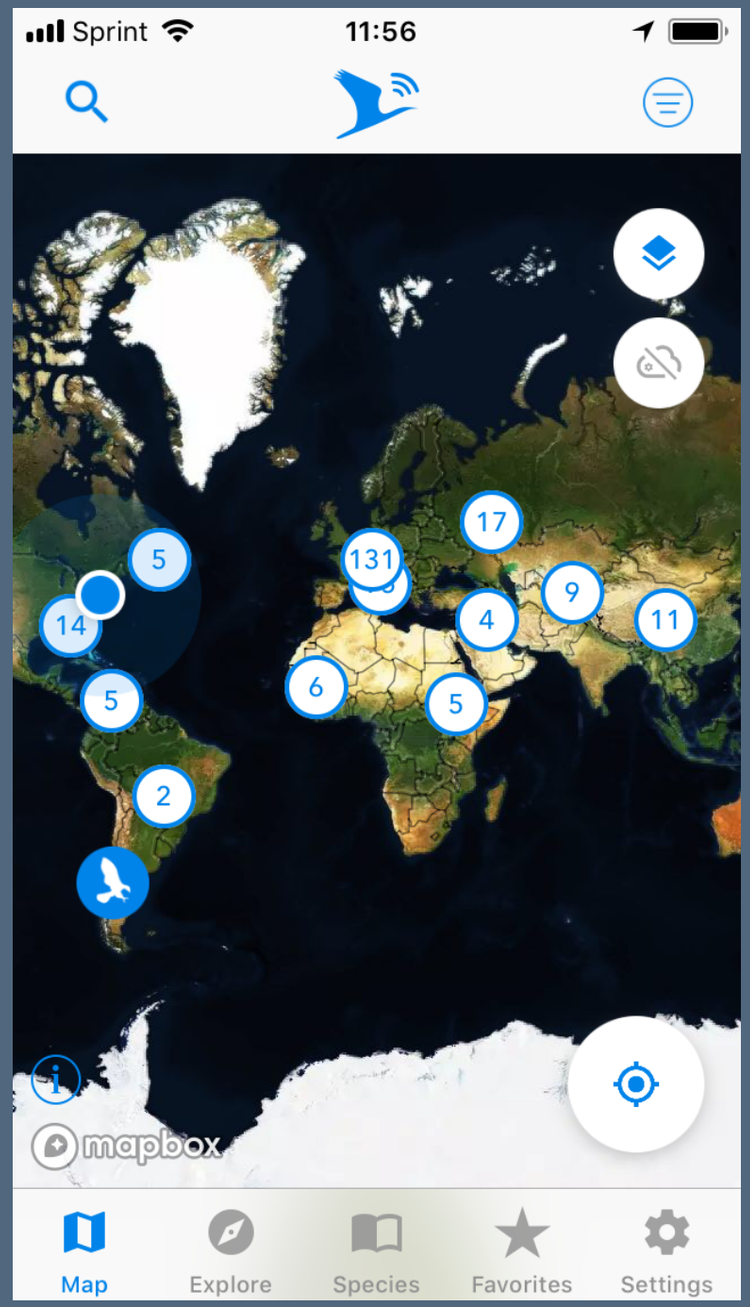
Kranstauber et al. 2012, Journal of Animal Ecology

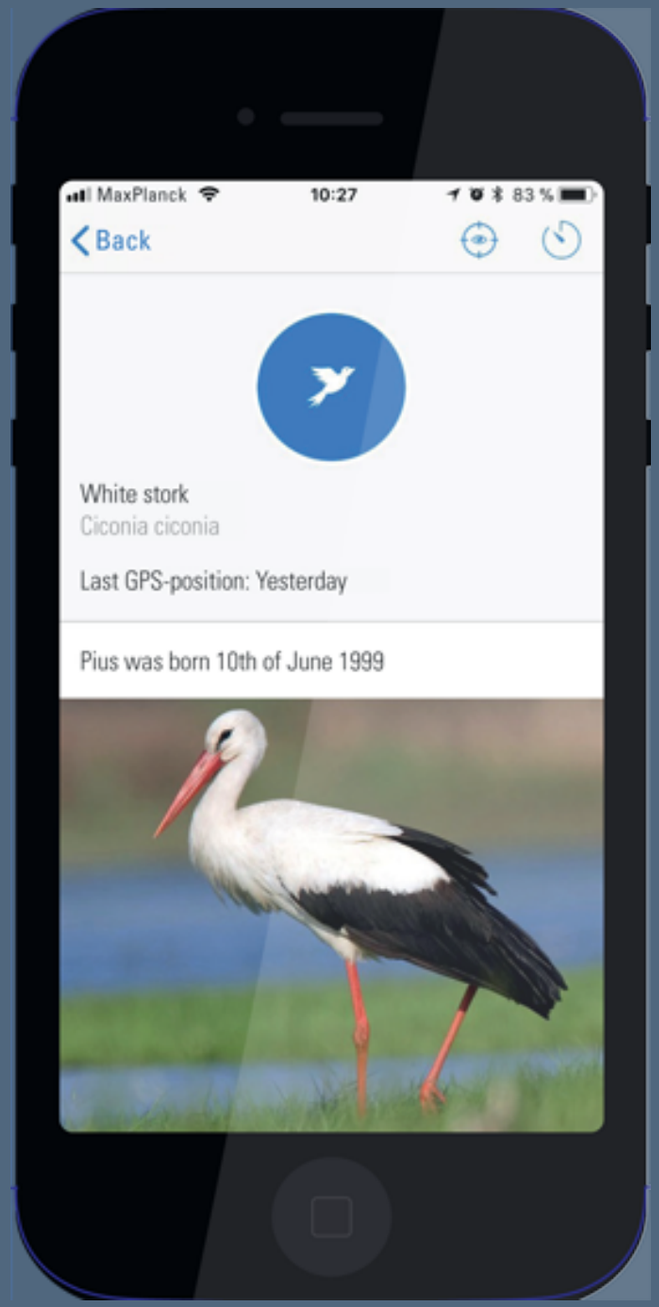
Calabrese and Fleming 2016, Methods in Ecology and Evolution

PUBLIC OUTREACH

SHARE







Animal Tracker App, available on the Apple AppStore and at Google Play

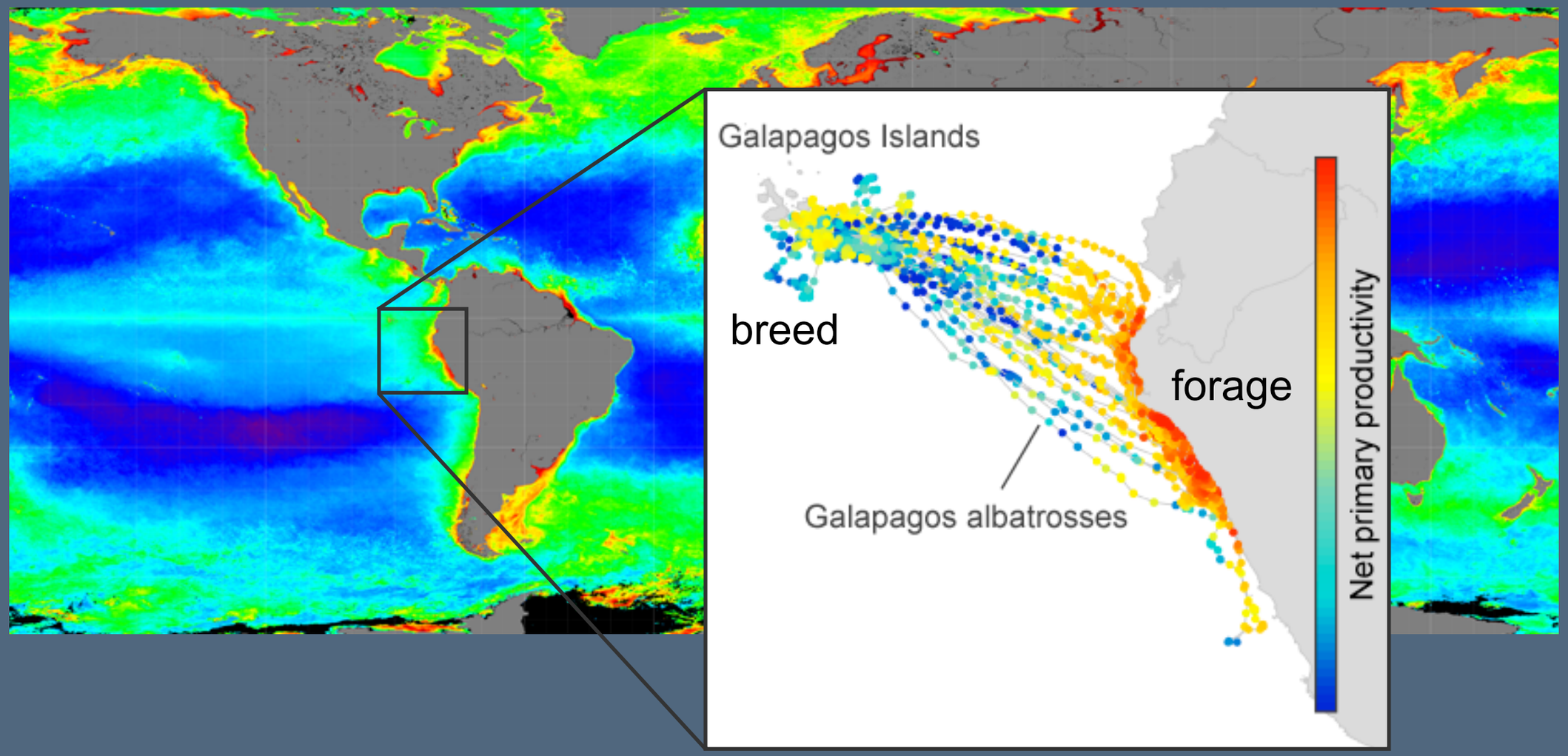
ENV-DATA

ANALYZE

Environmental Data Automated Track Annotation System

Link animal movement data to global environmental datasets

Annotate generic time-location records or areas



funded by the Max Planck Society, NASA and NSF

Dodge et al. 2013, Movement Ecology

ENV-DATA

COLLECT

75 products, 586 variables

- Topography
- Weather and climate
- Surface temperature, vegetation, fire, land cover
- Ocean surface conditions
- Demographics

GlobCover land cover, 2009

movebank.org/node/6607

ENV-DATA

COLLECT

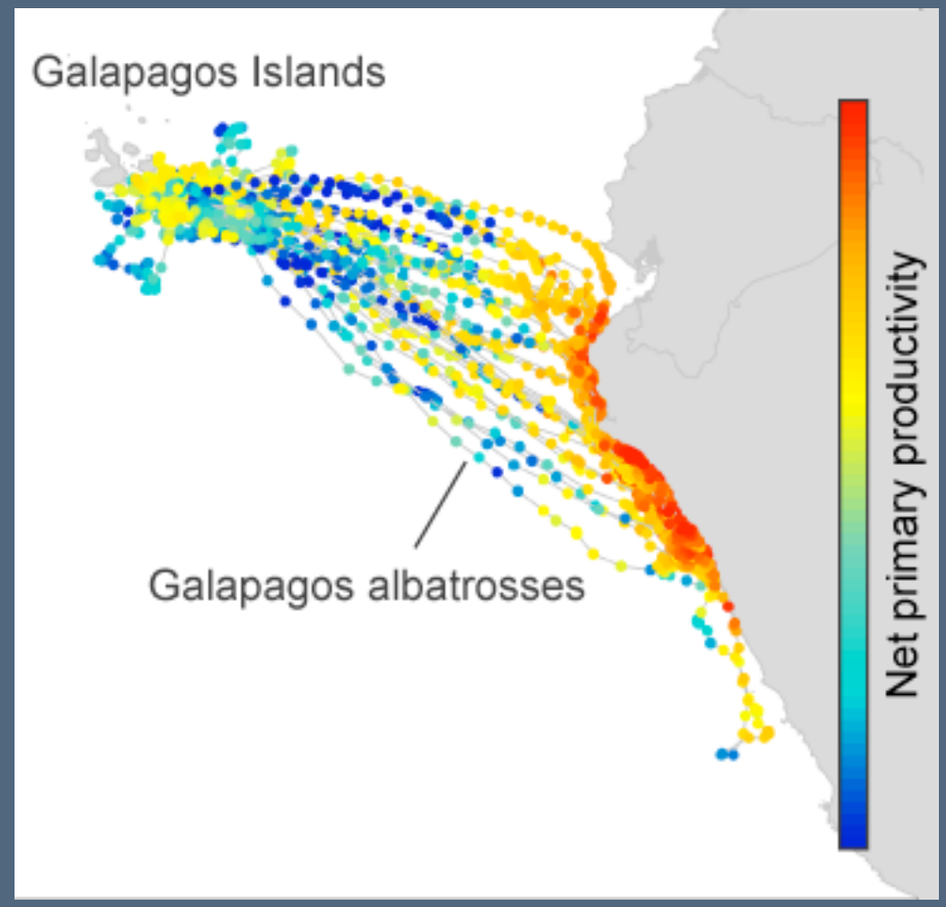
User interface to browse and select variables

Access files from providers

Transform formats/projections

Interpolate values

Provide results and documentation



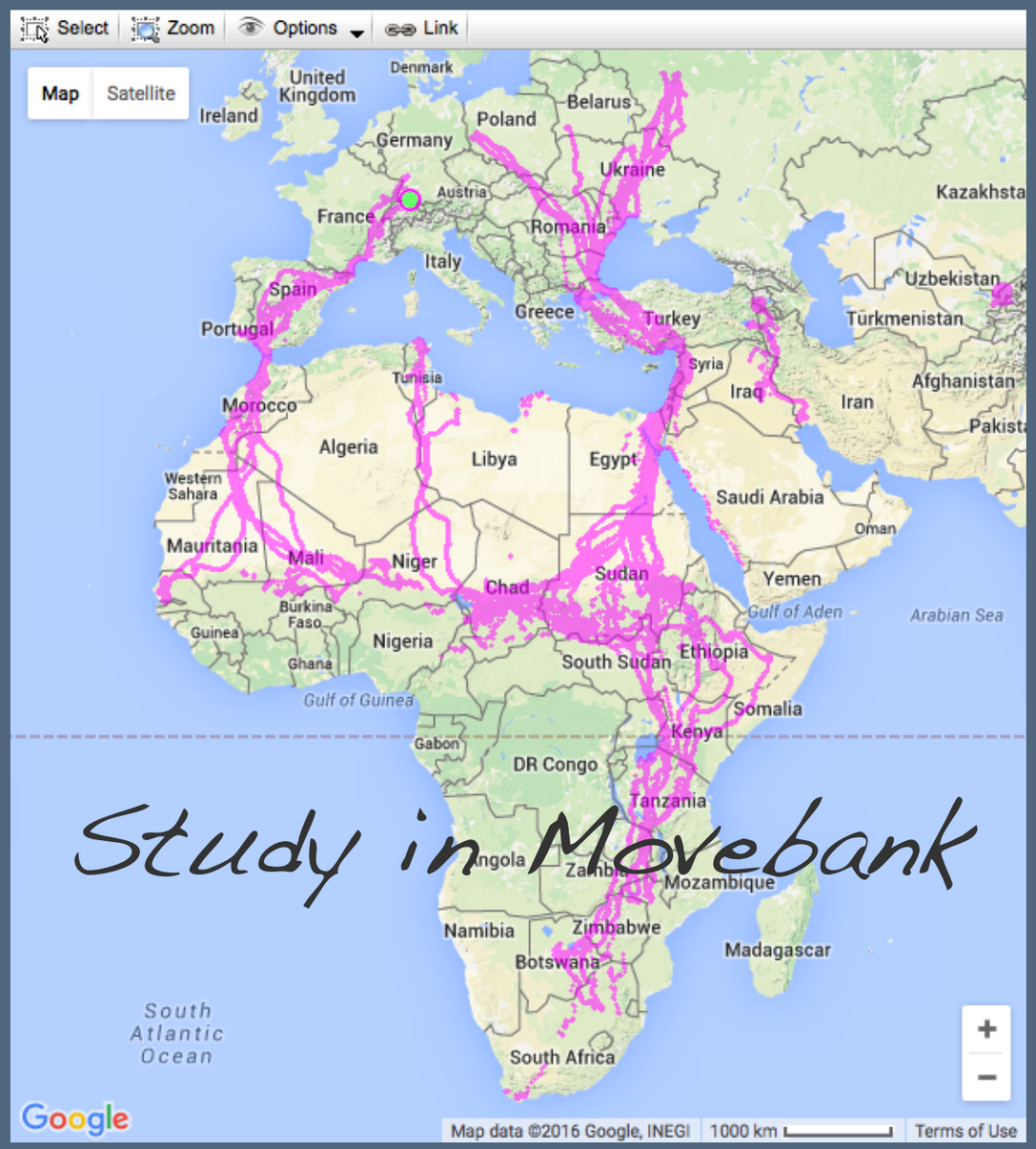
movebank.org/node/6607

Dodge et al. 2013, Movement Ecology

MOVEBANK DATA REPOSITORY

Datasets are reviewed, published and receive a DOI.

Paper

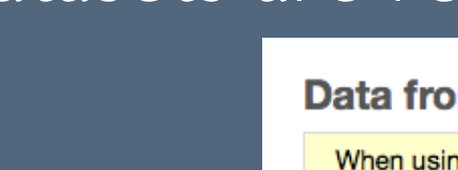


MOVEBANK DATA REPOSITORY

Datasets are reviewed, published and receive a DOI.

Citation

License



Data from: Costs of migratory decisions: a comparison across eight white stork populations

When using this dataset, please cite the original article.

Flack A, Fiedler W, Blas J, Pokrovski I, Kaatz M, Mitropolsky M, Aghababyan K, Fakriadis Y, Makrigianni E, Jerzak L, Shamina Flack A, Fiedler W, Blas J, Pokrovski I, Kaatz M, Mitropolsky M, Aghababyan K, Fakriadis Y, Makrigianni E, Jerzak L, Azafzaf H, Feltrup-Azafzaf C, Rotics S, Mokotjomela TM, Nathan R, Wikelski M, 2016, Costs of migratory decisions: a comparison across eight white stork populations. Science Advances 2(1): e1500931. **doi:10.1126/sciadv.1500931**

Additionally, please cite the Movebank data package:

Flack A, Fiedler W, Blas J, Pokrovski I, Mitropolsky B, Kaatz M, Aghababyan K, Khachatryan A, Fakriadis I, Makrigianni E, Jerzak L, Shamin M, Shamina C, Azafzaf H, Feltrup-Azafzaf C, Mokotjomela TM, Wikelski M (2015) Data from: Costs of migratory decisions: a comparison across eight white stork populations. Movebank Data Repository. **doi:10.5441/001/1.78152p3q**

DOI

Cite | **Share**

Package Identifier doi:10.5441/001/1.78152p3q

CC ZERO

Abstract

Annual migratory movements can range from a few tens to thousands of kilometers, creating unique energetic requirements for each specific species and journey. Even within the same species, migration costs can vary largely because of flexible, opportunistic life history strategies. We uncover the large extent of variation in the lifetime migratory decisions of young white storks originating from eight populations. Not only did juvenile storks differ in their geographically distinct wintering locations, their diverse migration patterns also affected the amount of energy individuals invested for locomotion during the first months of their life. Overwintering in areas with higher human population reduced the stork's overall energy expenditure because of shorter daily foraging trips, closer wintering grounds, or a complete suppression of migration. Because migrants can change ecological processes in several distinct communities simultaneously, understanding their life history decisions helps not only to protect migratory species but also to conserve stable ecosystems.

Keywords animal tracking, avian migration, Ciconia ciconia, Env-DATA, Movebank, movement ecology, white storks,

MPIO white stork lifetime tracking data (2013-2014)-gps.csv View File Details

Download: **README.txt** (14.21Kb)
Download: **MPIO white stork lifetime tracking data (2013-2014)-gps.csv.zip** (24.20Mb)

TRAINING

Resource and step-selection models in Movebank, EnvDATA, R

Lectures & scripts: https://movebankworkshopraleighnc.netlify.com

AniMove

SYMPOSIUM on ANIMAL MOVEMENT and the ENVIRONMENT

Animal movement for conservation: New Tools for Data Management, Visualization and Analysis

ICCB 2017 - Short Course

Cartagena, Colombia

ICCB 2017 · University of Maryland · WCS Colombia · ABoVE Arctic Boreal Vulnerability Experiment

Dr. Eliezer Gurarie
Dr. Silvia Alvarez

amovee.wordpress.com

animove.org

COLLABORATION

NCMNS, 2014

SYMPOSIUM on ANIMAL MOVEMENT and the ENVIRONMENT

Science Home News Journals Topics Careers

Log in | My account | Contact Us

Become a member Renew my subscription | Sign up for newsletters

REPORT

Moving in the Anthropocene: Global reductions in terrestrial mammalian movements

Marlee A. Tucker[1,2,*], Katrin Böhning-Gaese[1,2], William F. Fagan[3,4], John M. Fryxell[5], Bram Van Moorter[6], Susan C. Alberts[7], Abdullahi H. Ali[8], Andrew M. Allen[9,10], Nina Attias[11], Tal Avgar[12], Hattie Bartlam-Brooks[13], Buuveibaatar Bayarbaatar[14], Jerrold L. Belant[15], Alessandra Bertassoni[16], Dean Beyer[17], Laura Bidner[18], Floris M. van Beest[19], Stephen Blake[20,21], Niels Blaum[22], Chloe Bracis[1,2], Danielle Brown[23], P. J. Nico de Bruyn[24], Francesca Cagnacci[25,26], Justin M. Calabrese[3,27], Constança Camilo-Alves[28,29], Simon Chamaillé-Jammes[30], Andre Chiaradia[31,32], Sarah C. Davidson[33,20], Todd Dennis[34], Stephen DeStefano[35], Duane Diefenbach[36], Iain Douglas-Hamilton[37,38], Julian Fennessy[39], Claudia Fichtel[40], Wolfgang Fiedler[20], Christina Fischer[41], Ilya Fischhoff[42], Christen H. Fleming[3,27], Adam T. Ford[43], Susanne A. Fritz[1,2], Benedikt Gehr[44], Jacob R. Goheen[45], Eliezer Gurarie[3,46], Mark Hebblewhite[47], Marco Heurich[48,49], A. J. Mark Hewison[50], Christian Hof[1], Edward Hurme[3], Lynne A. Isbell[18,51], René Janssen[52], Florian Jeltsch[22], Petra Kaczensky[6,53], Adam Kane[54], Peter M. Kappeler[40], Matthew Kauffman[55], Roland Kays[56,57], Duncan Kimuyu[58], Flavia Koch[40,59], Bart Kranstauber[44], Scott LaPoint[20,60], Peter Leimgruber[27], John D. C. Linnell[6], Pascual López-López[61], A. Catherine Markham[62], Jenny Mattisson[6], Emilia Patricia Medici[63,64], Ugo Mellone[65], Evelyn Merrill[12], Guilherme de Miranda Mourão[66], Ronaldo G. Morato[67], Nicolas Morellet[50], Thomas A. Morrison[68], Samuel L. Díaz-Muñoz[69,70], Atle Mysterud[71], Dejid Nandintsetseg[1,2], Ran Nathan[72], Aidin Niamir[1], John Odden[73], Robert B. O'Hara[1,74], Luiz Gustavo R. Oliveira-Santos[75], Kirk A. Olson[14], Bruce D. Patterson[76], Rogerio Cunha de Paula[67], Luca Pedrotti[77], Björn Reineking[78,79], Martin Rimmler[80], Tracey L. Rogers[81], Christer Moe Rolandsen[6], Christopher S. Rosenberry[82], Daniel I. Rubenstein[83], Kamran Safi[20,84], Sonia Saïd[85], Nir Sapir[86], Hall Sawyer[87], Niels Martin Schmidt[19,88], Nuria Selva[89], Agnieszka Sergiel[89], Enkhtuvshin Shiilegdamba[14], João Paulo Silva[90,91,92], Navinder Singh[9], Erling J. Solberg[6], Orr Spiegel[93], Olav Strand[6], Siva Sundaresan[94], Wiebke Ullmann[22], Ulrich Voigt[95], Jake Wall[37], David Wattles[35], Martin Wikelski[20,84], Christopher C. Wilmers[96], John W. Wilson[97], George Wittemyer[37,98], Filip Zięba[99], Tomasz Zwijacz-Kozica[99], Thomas Mueller[1,2,27,*]

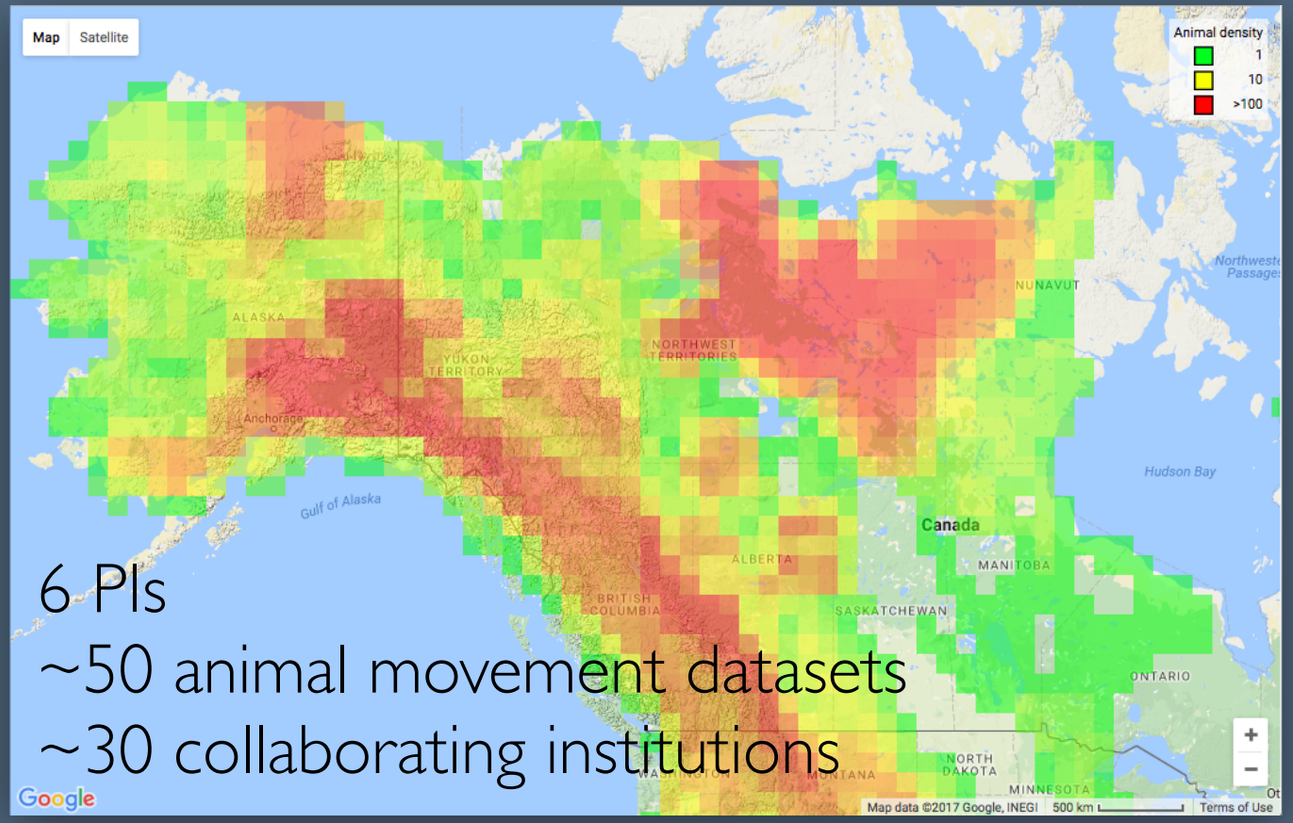
Tucker et al. 2018, Science

January 2018

COLLABORATION

ABoVE
ARCTIC BOREAL VULNERABILITY EXPERIMENT

animals on the move



6 PIs
~50 animal movement datasets
~30 collaborating institutions

above.nasa.gov
github.com/ABoVE-AotM/above

ACKNOWLEDGEMENTS

PIs
Martin Wikelski
Roland Kays
Gil Bohrer

Development and support
Matthias Berger
Sarah Davidson
Friedrich Schaeuffelhut
Martin Storhas

Collaborators
David Douglas
Wolfgang Fiedler
Bart Kranstauber
Kamran Safi
Anne Scharf
many others!

Funding

MAX-PLANCK-GESELLSCHAFT
Universität Konstanz
DFG Deutsche Forschungsgemeinschaft
NSF
DLR
NASA

Partners

USGS science for a changing world
NORTH CAROLINA MUSEUM of NATURAL SCIENCES
ARGOS CLS
EURODEER
SCIENTIFIC TASK FORCE ON WILDLIFE AND ECOSYSTEM HEALTH
THE OHIO STATE UNIVERSITY
FAO FIAT PANIS
EMPRES WILDLIFE HEALTH & ECOLOGY
WRAM
BirdLife INTERNATIONAL

THANK YOU!

Sarah C. Davidson
Data Curator
Max Planck Institute for Ornithology
The Ohio State University
sdavidson@orn.mpg.de

Photo by William C. Campbell