

Managing acoustic telemetry data

Eneko Aspíllaga

Mediterranean Institute for Advanced Studies (IMEDEA, CSIC-UIB)
Esporles, Balearic Islands, Spain

aspillaga@imedea.uib-csic.es
<https://github.com/aspillaga>
@enekoasp

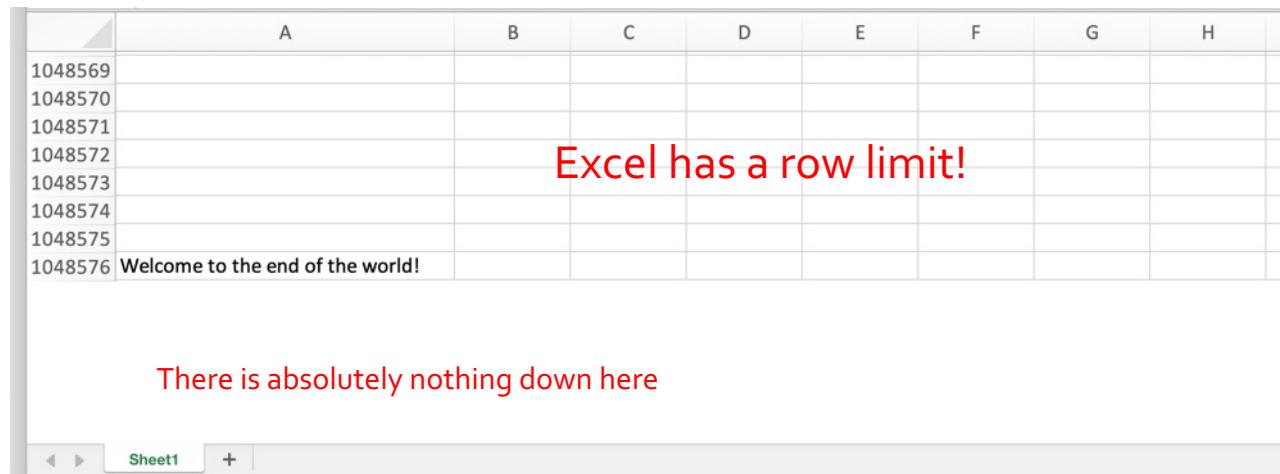


GENERAL INTRODUCTION TO AQUATIC ANIMAL TRACKING
ETN COST Action Training School
Olsztyn (Polska)
29 May - 1 June 2023

1. Issues related to acoustic telemetry data

Main issues related to acoustic telemetry data

- AT produces vast amounts of data (10-100 M detections)
 - Difficult to manage with common office programs (e.g. Excel)



A screenshot of an Excel spreadsheet titled "Sheet1". The data starts at row 1048569 and continues down to 1048576. Row 1048576 contains the text "Welcome to the end of the world!". A red text overlay "Excel has a row limit!" is placed in the center of the sheet. Another red text overlay "There is absolutely nothing down here" is located at the bottom left. The Excel ribbon tabs "Sheet1" and "+" are visible at the bottom.



John Feminella  
@jxxf

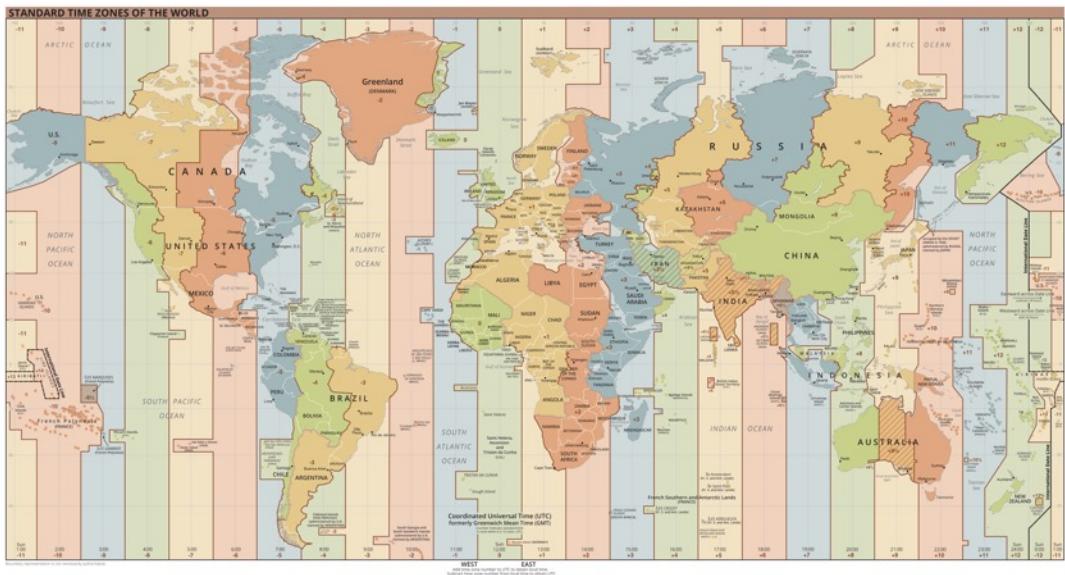
Optimist: The glass is ½ full.
Pessimist: The glass is ½ empty.
Excel: The glass is January 2nd.

- Data is split in several sources that will be regularly updated through the project
 - Receiver log files + metadata files
 - We need to keep track of all the changes
 - We need to automatize the routines to merge and matching all the data sources

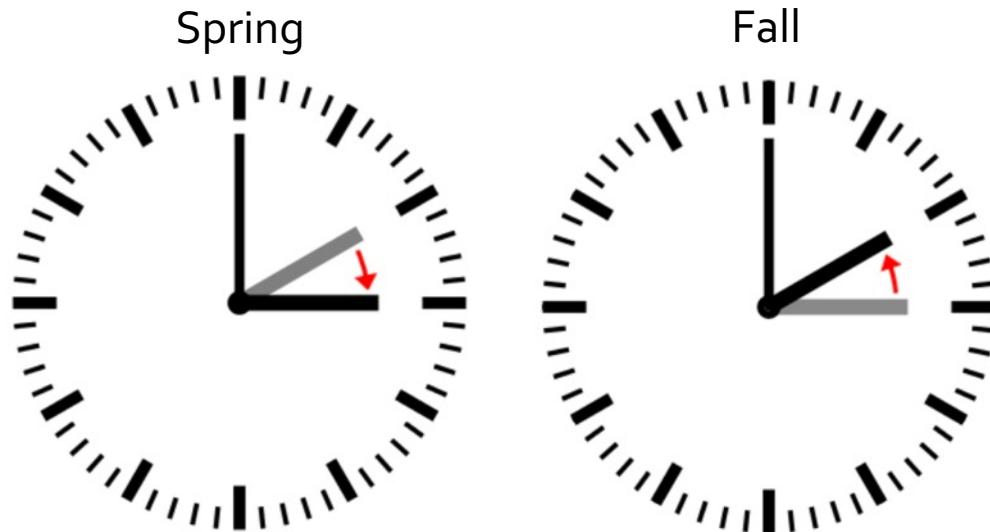
Main issues related to acoustic telemetry data

- Dealing with time

Time zones



Daylight saving time



Always leave a record of the time zone in which **you are working** (e.g., CET = UTC+1 / CEST UTC+2) and in which **the receivers are configured** (usually UTC by default).

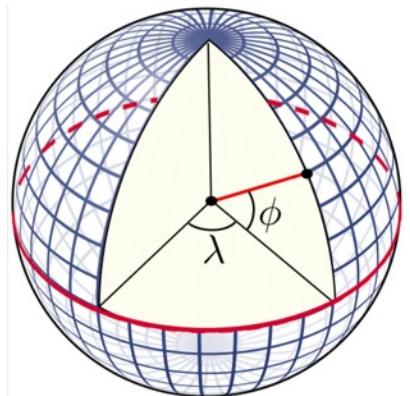
Source: https://en.wikipedia.org/wiki/Time_zone

Source: https://en.wikipedia.org/wiki/Daylight_saving_time

Main issues related to acoustic telemetry data

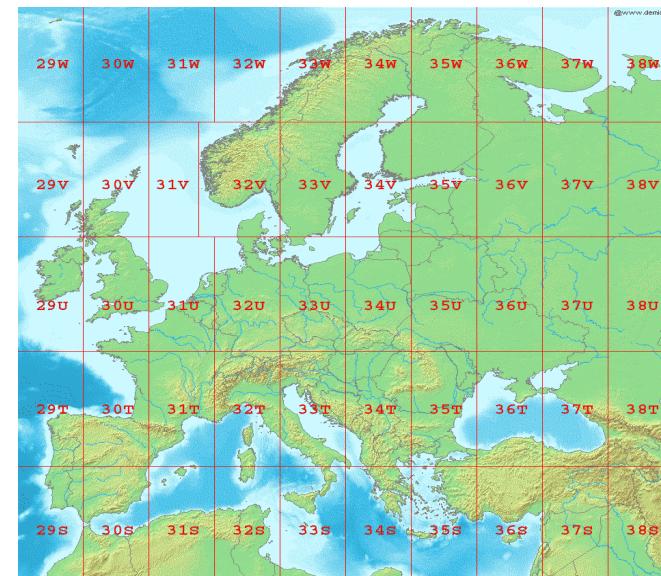
- Dealing with spatial data (spatial reference systems) – Receiver locations

Geographic coordinate systems



Datum	Latitude	Longitude
WGS 84	53.76252° N	20.45875° E
	53° 45.751' N	20° 27,525' E
	53° 45' 45" N	20° 27' 31" E

Projected coordinate systems



Datum	Zone	X	Y
WGS 84	34	464319 m	5957235 m

Source: https://en.wikipedia.org/wiki/Geographic_coordinate_system

Source: https://en.wikipedia.org/wiki/Projected_coordinate_system

2. Structuring acoustic telemetry databases

How to structure an acoustic telemetry database

- Three main data sources:

**Deployment log
(receivers)**



**Fish and metadata
(tagged fish)**



**Receiver log files
(detection data)**



Structure of receiver log files

THELMABIOTEL

ComPort

Project: BTN-IMEDEA_2023 | ComPort v4.0.3

Connect TBR | ?

View 1 Tag Detection Filter

From: YYYY-MM-DD 15

To: YYYY-MM-DD 15

Receiver: 1212 (137484) 1213 (13824) 1214 (14)

ID Min: 1

ID Max: 1048576

ID (list limited to 500 items): 1 (38) 2 (23) 4 (6)

Protocol: OPi-69kHz (172370) OPs-69kHz (2) R01M-69kHz (6)

Order data view by: Time Descending Update View Apply Clear

Tag Detections: Table Plot

Receiver status data: Table Plot

Export Tag Detections: Filtered (172949) All (172949) .csv .tbdb

Date and Time (UTC)	ID	Data	Protocol	SNR	Receiver
2023-02-26 16:59:12.118	54	97	S256-69kHz	18	1638
2023-02-26 16:28:16.602	1281	1	S64K-69kHz	16	1638
2023-02-26 15:34:31.574	3089	-	R64K-69kHz	21	1638
2023-02-26 15:27:16.017	16970	-	R64K-69kHz	18	1638
2023-02-26 15:19:35.003	53002	-	R01M-69kHz	22	1638
2023-02-26 15:14:48.285	38	83	S256-69kHz	18	1638
2023-02-26 15:06:49.313	1	0	S256-69kHz	16	1638
2023-02-26 14:45:11.286	769	-	R64K-69kHz	20	1638
2023-02-26 14:22:55.729	5	0	S256-69kHz	15	1638
2023-02-26 13:44:04.592	50	-	R64K-69kHz	12	1638
2023-02-13 05:26:45.478	12347	-	R64K-69kHz	19	1215
2023-02-13 05:00:42.856	117	185	S256-69kHz	11	1215
2023-02-13 03:58:55.415	2998	-	R64K-69kHz	12	1215
2023-02-13 02:50:34.712	4100	-	R64K-69kHz	12	1215
2023-02-13 01:49:43.704	2098	-	R64K-69kHz	21	1215
2023-02-13 01:43:12.756	10	48	S256-69kHz	17	1215
2023-02-13 01:37:19.553	1793	-	R64K-69kHz	14	1215
2023-02-12 19:37:08.470	4	12	S256-69kHz	16	1213
2023-02-12 19:36:52.547	8	49	S256-69kHz	16	1213
2023-02-12 18:24:01.461	65	139	S256-69kHz	13	1213
2023-02-12 16:57:54.472	35511	-	R64K-69kHz	17	1213
2023-02-12 16:54:19.928	1601	-	R64K-69kHz	13	1213
2023-02-12 16:33:37.383	177	64	S256-69kHz	13	1213
2023-02-12 16:10:50.474	36879	49	S64K-69kHz	13	1213
2023-02-12 15:48:49.020	24661	-	R64K-69kHz	17	1213
2023-02-12 15:13:31.464	166	-	R64K-69kHz	17	1213

Prev. page 1 / 18 Next page (view limited to 10000 items/page)

Structure of receiver log files



Screenshot of the eCATE software interface showing a list of detections from the file "eCATE_2018.vdb".

The interface includes a toolbar with icons for Detections, Files, Filters, Stations, and Transmitters. The main window displays a table of 3495927 detections with the following columns:

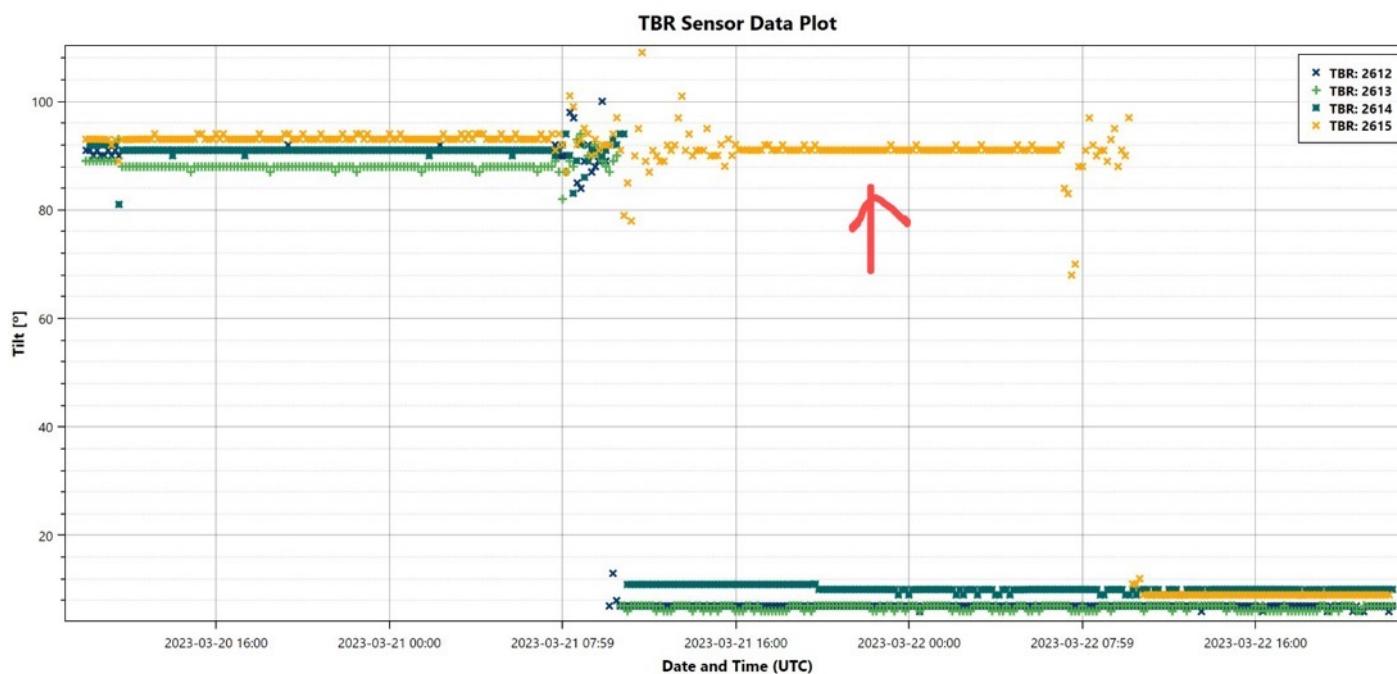
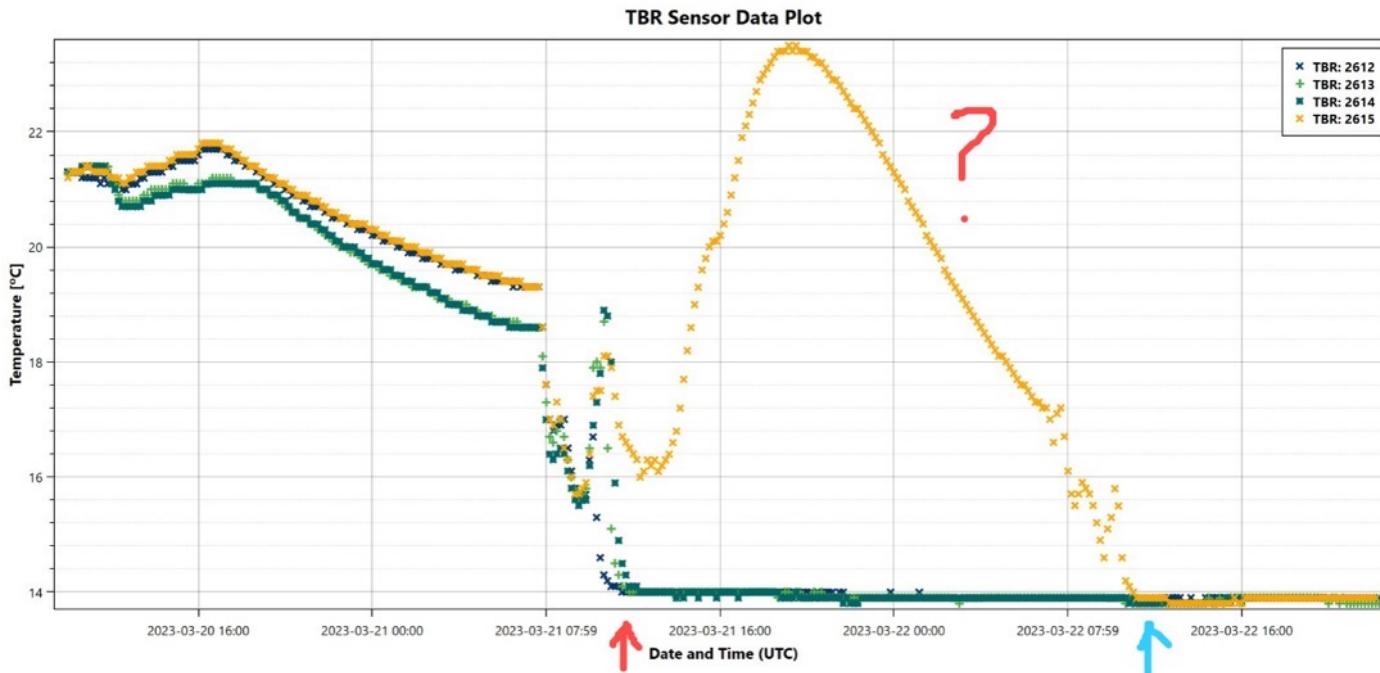
Date	Time	Code Space	ID	Transmitter	Receiver	Station	Data
2014-08-27	07:00:56	A69-9004	396	EPIMAR-396	VR2W-105297	E19	16.1 m
2014-08-27	07:25:58	A69-9004	396	EPIMAR-396	VR2W-105297	E19	17.3 m
2014-08-27	07:26:17	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.3 m
2014-08-27	07:28:11	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.6 m
2014-08-27	07:30:25	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.9 m
2014-08-27	07:33:17	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.3 m
2014-08-27	07:36:07	A69-9004	396	EPIMAR-396	VR2W-125488	E22	19.1 m
2014-08-27	07:38:51	A69-9004	396	EPIMAR-396	VR2W-125488	E22	19.4 m
2014-08-27	07:41:21	A69-9004	396	EPIMAR-396	VR2W-125488	E22	18.8 m
2014-08-27	07:43:26	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.9 m
2014-08-27	07:45:44	A69-9004	396	EPIMAR-396	VR2W-105297	E19	17.6 m
2014-08-27	07:46:02	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.6 m
2014-08-27	07:48:17	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.6 m
2014-08-27	07:49:53	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.3 m
2014-08-27	07:51:30	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.3 m
2014-08-27	07:53:08	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.0 m
2014-08-27	07:54:47	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.6 m
2014-08-27	07:56:29	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.0 m
2014-08-27	07:58:18	A69-9004	396	EPIMAR-396	VR2W-125488	E22	16.7 m
2014-08-27	08:00:18	A69-9004	396	EPIMAR-396	VR2W-125488	E22	16.4 m
2014-08-27	08:02:44	A69-9004	396	EPIMAR-396	VR2W-125488	E22	16.7 m
2014-08-27	08:04:40	A69-9004	396	EPIMAR-396	VR2W-125488	E22	16.4 m
2014-08-27	08:06:57	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.0 m
2014-08-27	08:08:34	A69-9004	396	EPIMAR-396	VR2W-125488	E22	17.9 m

Structure of a receiver deployment sheet

- Receiver ID*
- Deployment date and time*
- Retrieval date and time*
- Latitude and longitude*
- Station ID (unique name to identify each position)
- Mooring type
- Depth
- [any other relevant information]

*** mandatory**

Each deployment should be represented in one row!



Structure of a fish tagging sheet

- Transmitter ID*
- Capture date / tagging date
- Release date (and time)*
- Species name*
- Fish ID (unique ID given to each fish)
- Tagging location
- Length / weight / sex
- Tag type / emission rate / sensor type
- [any other useful information]

*** mandatory**

3. Practical session in R

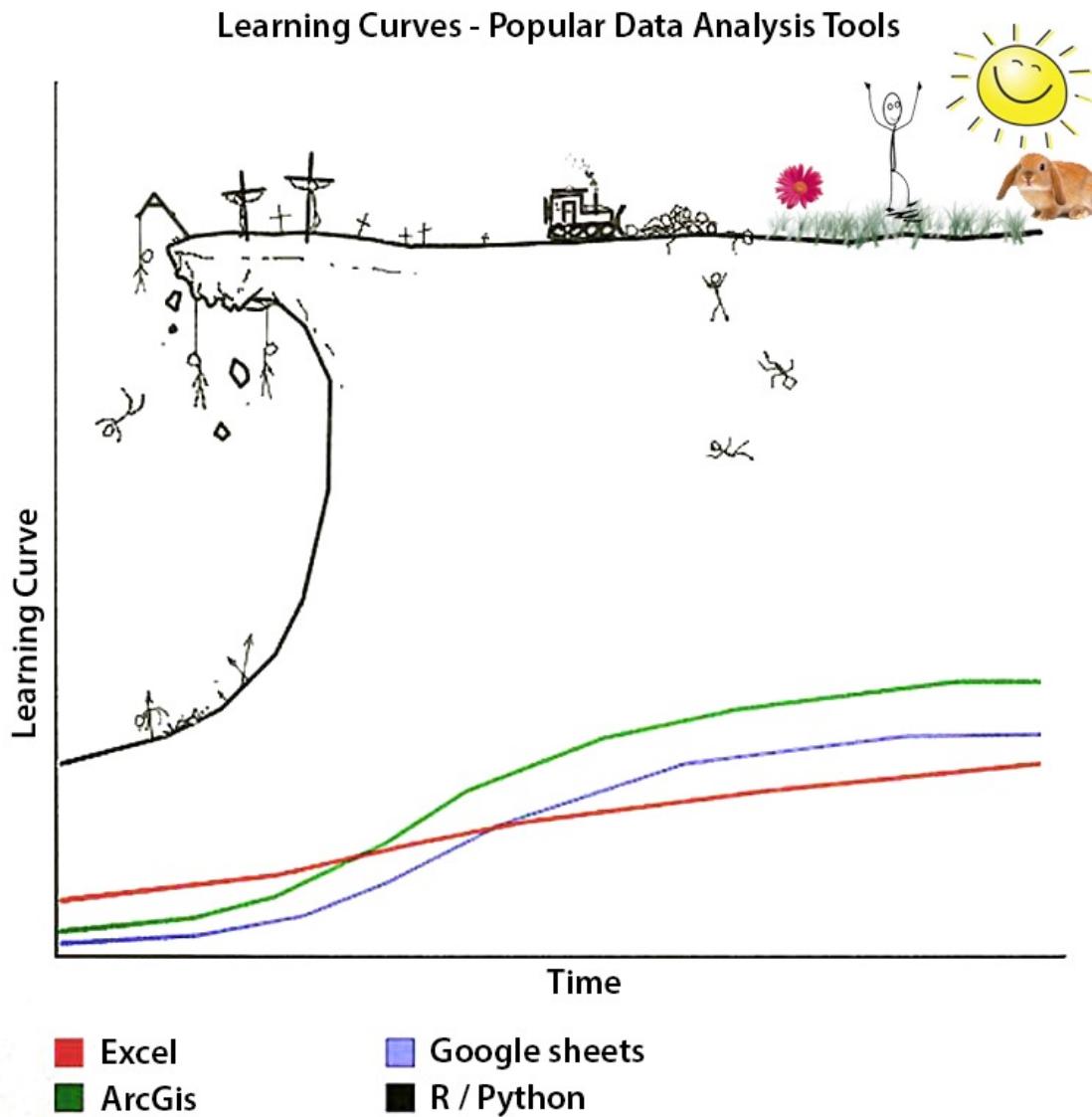
Why to embrace R



- Open-source
- Platform-independent
- Lots of packages and an active developer community
- **Reproducibility and sharing**
- High **performance** and **versatility** in data handling and analysis
 - Statistical analysis, spatial analysis (GIS), data visualizations

But...

- Steep learning curve?



Practical examples

- Example R scripts:

`ETN_TS_01>Loading_and_merging_AT_data.R`

`ETN_TS_02>Handling_AT_data.R`