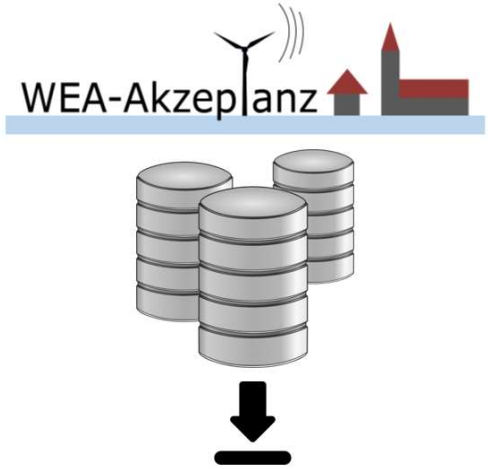
WEA-Acceptance Data
- How to set up and conceptualize a database for wind turbine measurements -



Daphne Schössow, Institute of Communications Technology (IKT)
Susanne Könecke, Institute of Structural Analysis (ISD)
Tanja Grießmann, Institute of Structural Analysis (ISD)

Leibniz Universität Hannover, Germany

What is the idea of the project?

WEA-Acceptance Data promotes for

- sharing experimental data from sound propagation measurements to create a data base to answer relevant questions with respect to wind turbine noise, e.g.:

1. How loud is it, where people live?
2. Is the sound annoying?

   - if yes, why? → What are the physical reasons?

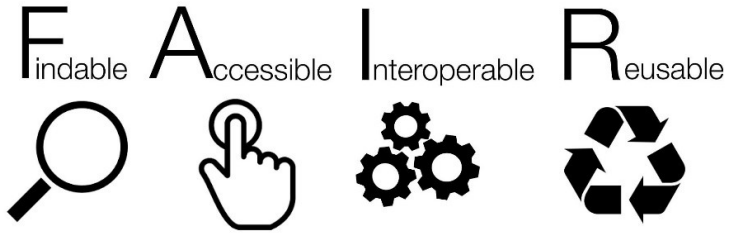
   (spectra, SPLs, amplitude modulations, operational states, etc.)
3. Does infraschall occur?

Quelle: www. rpv-elbtalosterz.de

What is the idea of the project?

WEA-Acceptance Data describes how to

- conceptualise and set up a database for wind turbine measurements,
- select, prepare and structure the data for publication,
- address the wind park owners' and operators' needs for secrecy



The platform offers

- overview of entire data
- selective download

Data:

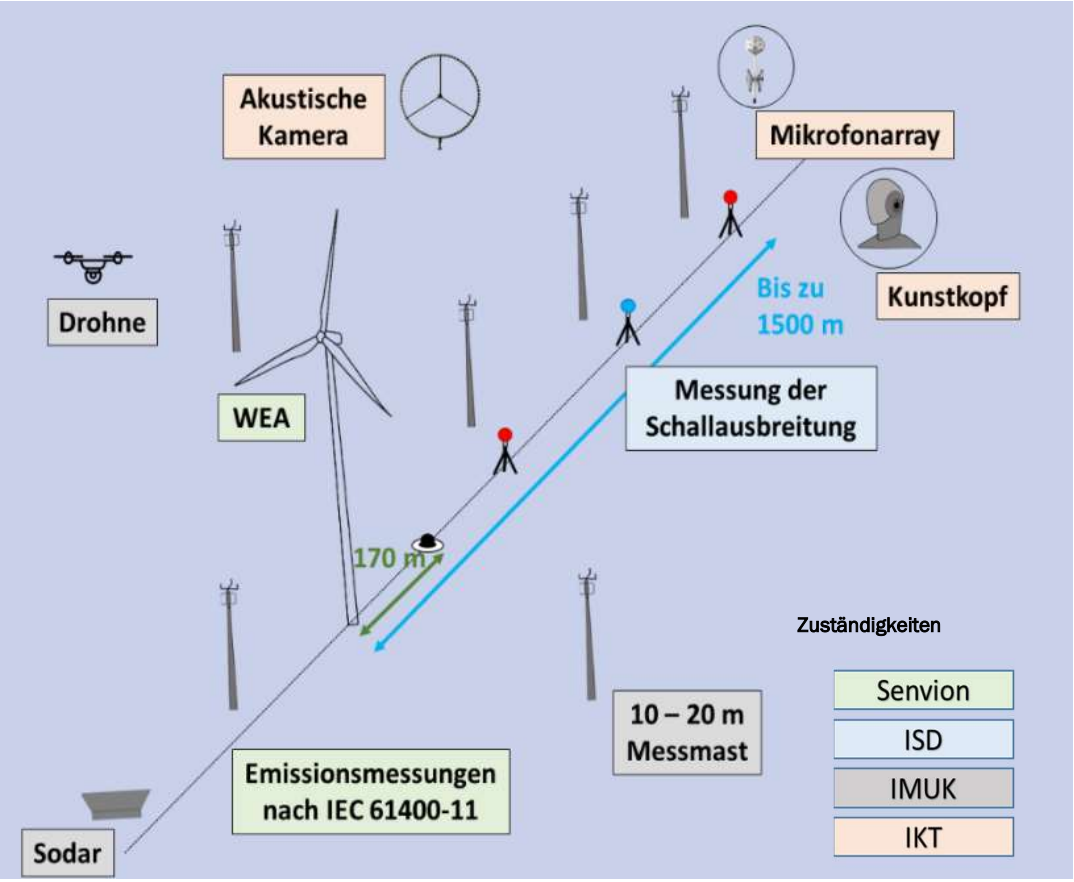
- lossless audio (.flac)
- time series measurements (.parquet)
- descriptive metadata table

Possible uses:

- find stimuli for listening
- find data to validate propagation models
- find data for metadata-driven
- analysis tools

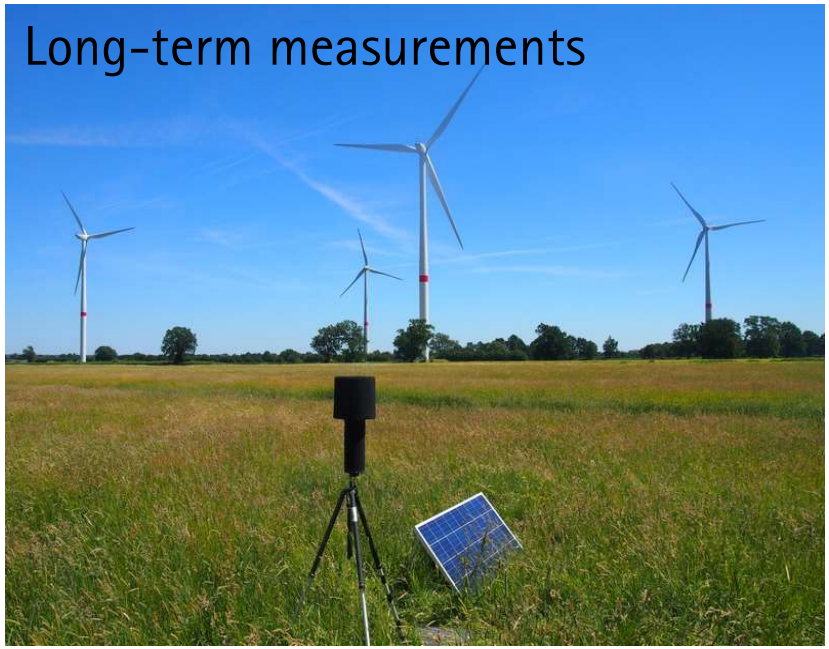
WEA-Acceptance Measurement campaigns

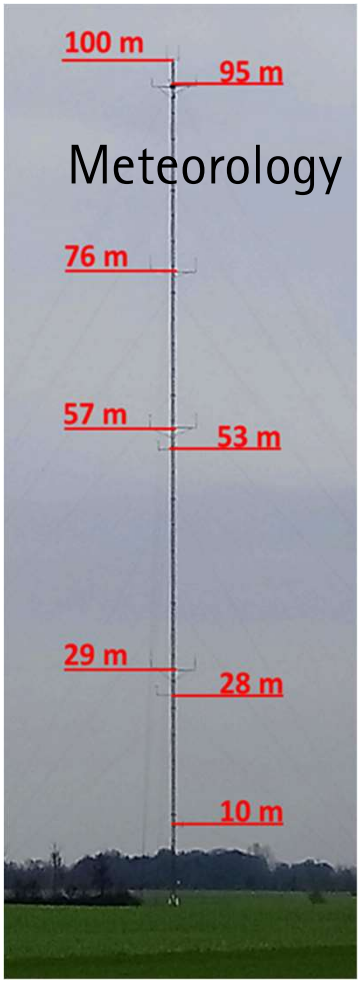
- Extensive field tests for calibration/validation of sound propagation models
- **Five measurement campaigns** under different environmental conditions:
  - different plant types
  - varying meteorological and topographical conditions
  - different soil conditions
- Experimental investigation of wind turbine sound emission and propagation
- Analysis of recorded sound fields for psychoacoustic investigations



Schematic of a measurement campaign

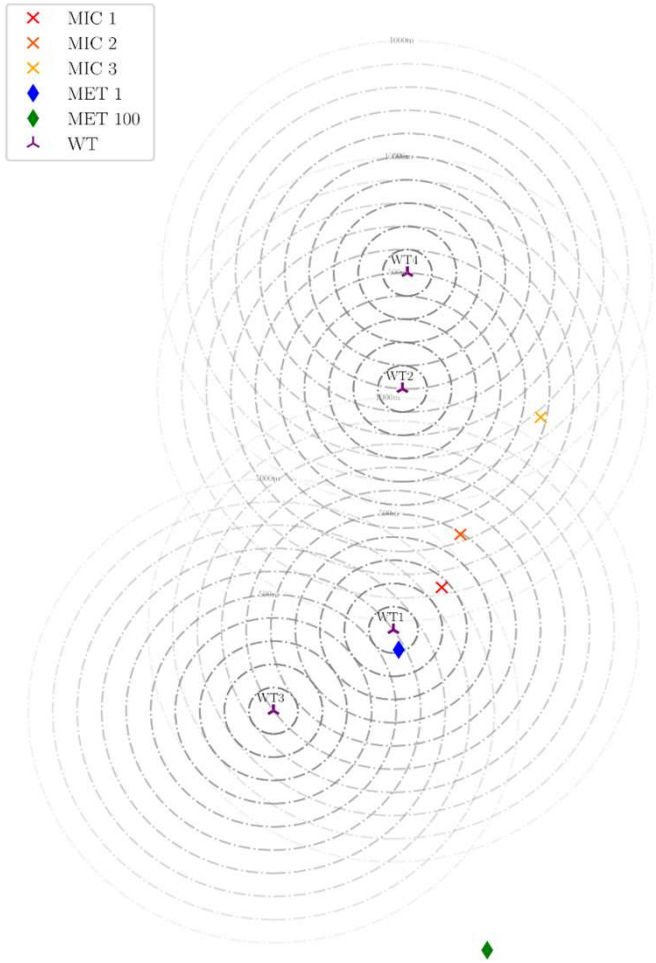
WEA-Acceptance Measurement campaigns





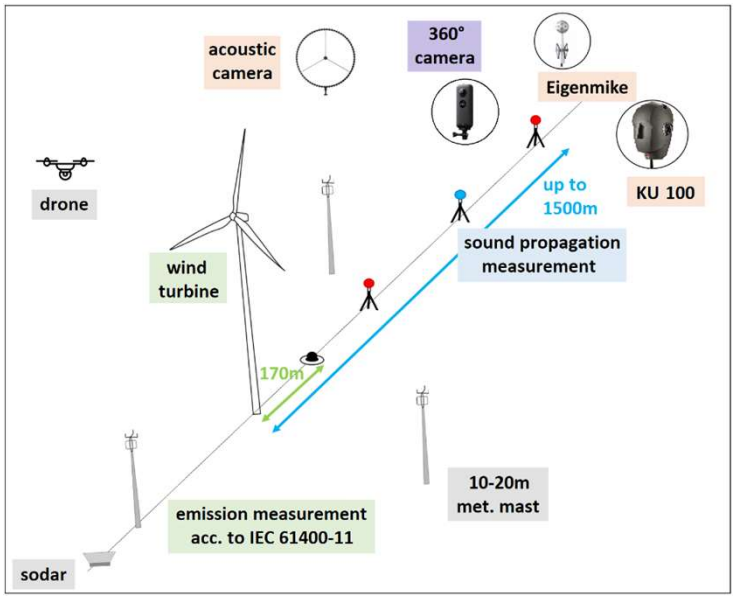
WEA-Acceptance Measurement campaigns

Location	Season	Duration	Completeness	Measurements
1	summer	7 weeks	good	3xMIC, 2xWT
2	spring	11 weeks	good	3xMIC, 4xWT, 1xMET
2	autumn	5 weeks	okay	3xMIC, 4xWT, 1xMET
3	winter	10 weeks	bad	3xMIC, 3xWT, 1xMET
3	spring/summer	22 weeks	very good	3xMIC, 3xWT, 1xMET



Recorded data

Type of data	Distance to focused WT	Duration	Resolution
acoustical (binaural, soundfield)	100-700 m	selected dates only	48 kHz
acoustical (mono)	150-1500 m, 3 in-line positions	continuously	51,2 kHz
SPL, 1/3-octave bands	150-1500 m, 3 in-line positions	continuously	10 min
SCADA	WT in focus + neighbouring WTs	continuously	10 min
meteorological	1000-1300 m	continuously	10 min

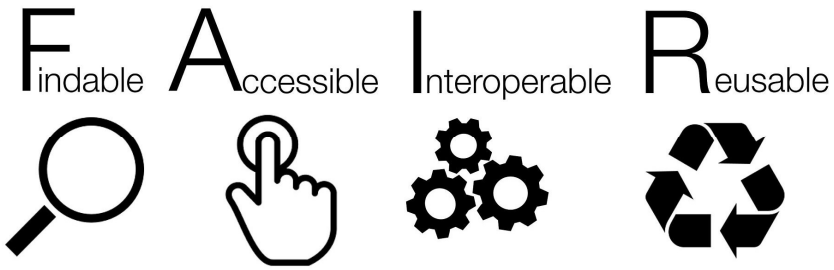


Height	Sensor
28 m	*wind direction*
29 m	*wind speed*
53 m	temperature, humidity
54 m	wind direction
57 m	wind speed
76 m	wind speed
95 m	*temperature, humidity*, pressure
96 m	wind direction
100 m	wind speed

SCADA data fields
wind speed [m/s]
wind direction [°]
true power [kW]
rotor speed [rpm]
gear speed [rpm]
generator speed [rpm]
blade pitch [°]
nacelle position [°]
nacelle temperature [°C]
outside temperature at nacelle [°C]

What is FAIR data?

- Findable (others should be able to find my data)
  - include metadata in searchable public repositories
  - DOI
  - let paper and dataset reference each other

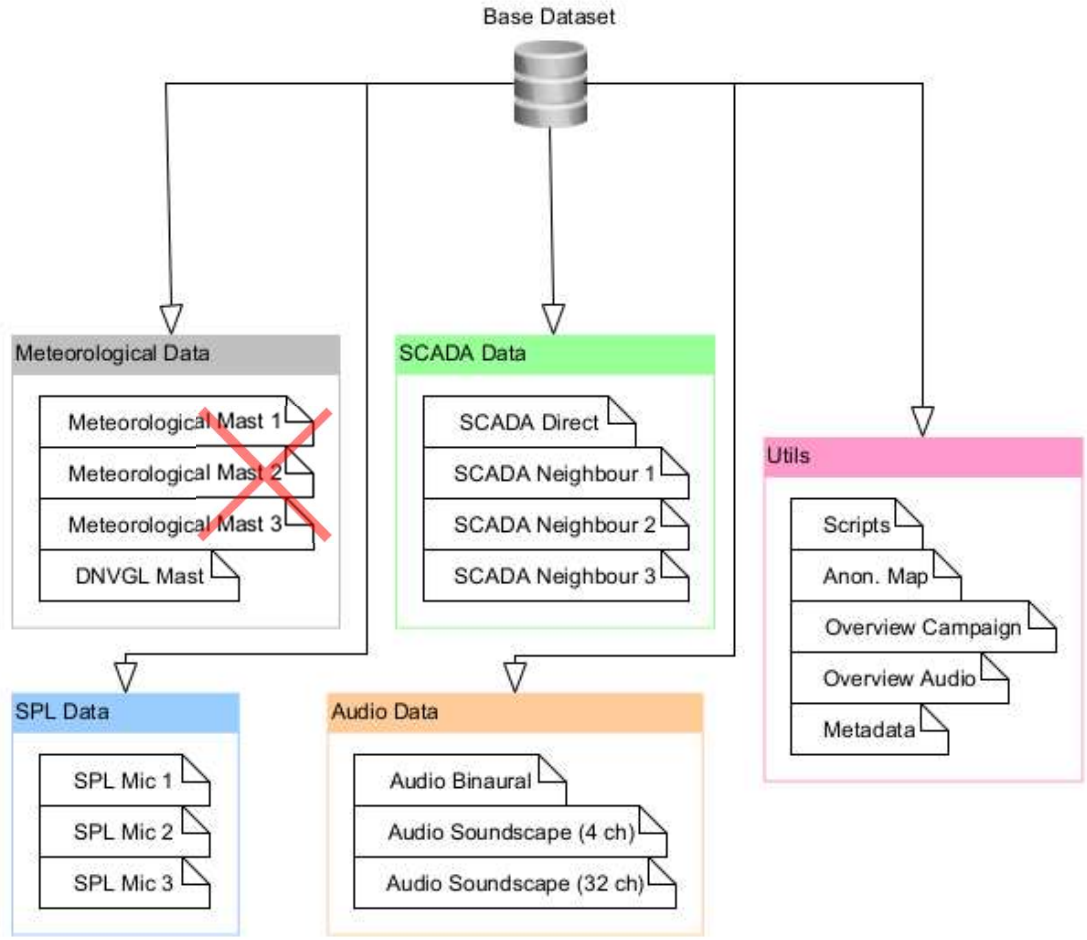


- Accessible (others should be able to access my data)
  - online access using standard protocols etc.
  - transparent conditions for access

- Interoperable (my data should be able to be combined with other data and be processed automatically)
  - use common, if possible open, data formats
  - refer to third party data, if used
  - prepare data according to subject-specific standards

- Reusable (others should be able to use my data)
  - document your data well!
  - definite license

Specification - structure



Selection of data platform

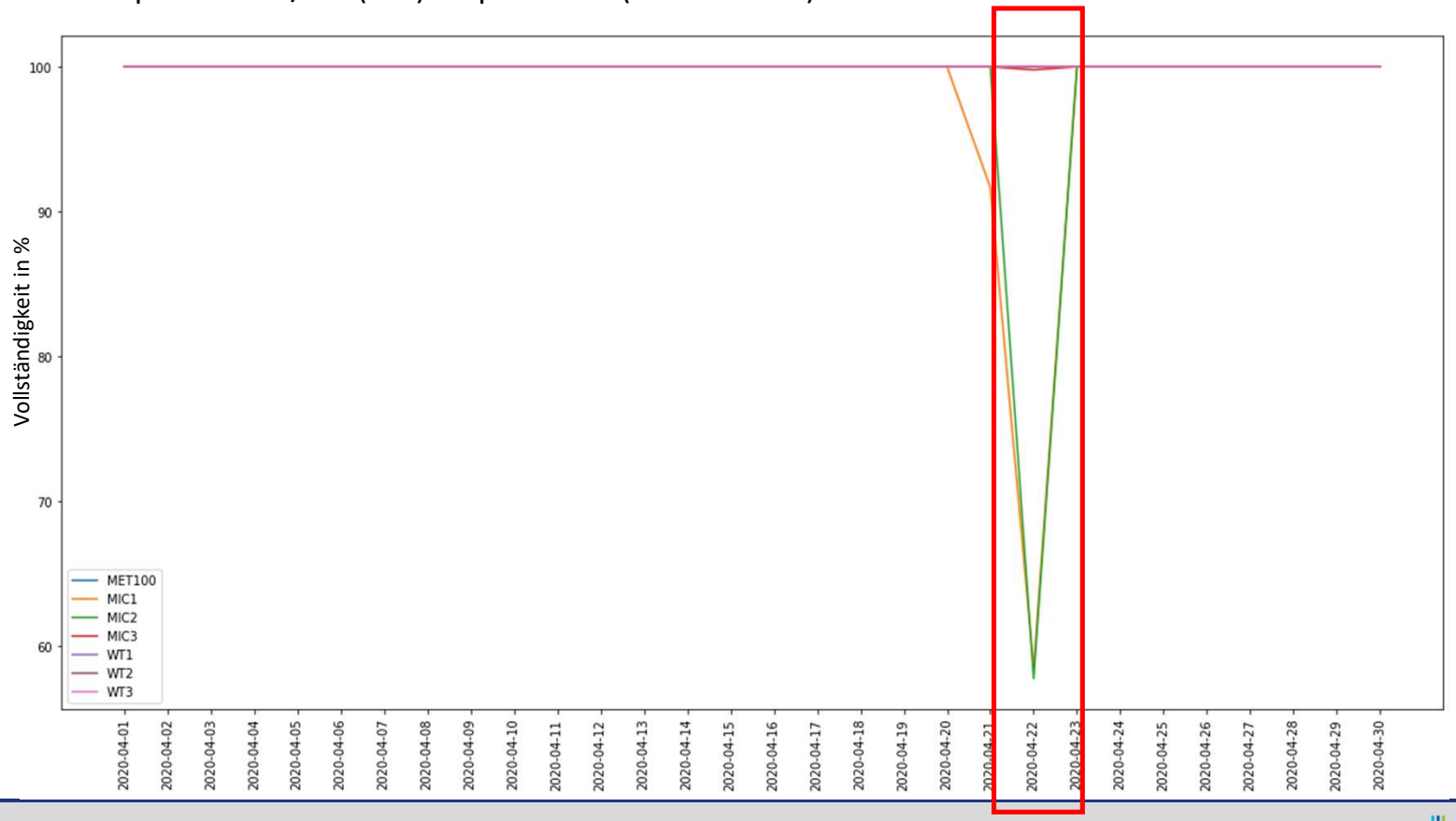
Name	Data set/file sizes limit	Preview	Owner	Download	Metadata
Research data repository (CKAN)	1GB per file, bigger files per request	for csv theoretically possible, muss freigeschaltet werden	LUH	Single file	Author level
Göttingen Reasearch Online (GRO, Dataverse)	??	tab/csv: sortable columns; pdf, txt, R	Uni Göttingen	Single file, selected files, all	Citation level, domain specific, file level
Zenodo	50 GB per file	Yes, but no filter	CERN	Single file	Citation level, domain specific, file level

- Example file (1 month):

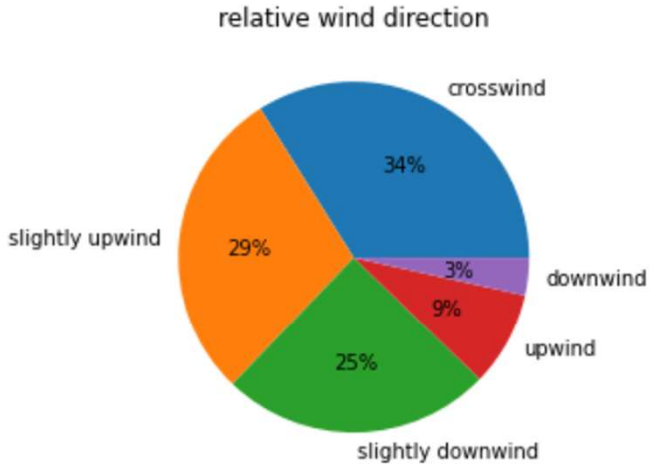
Source	Size
SCADA (x3)	total ca. 400 KB
Meteorology	ca. 1,5 MB
SPL (x3)	total ca. 5,5 MB
Audio, mono (flac)	total ca. 181 GB

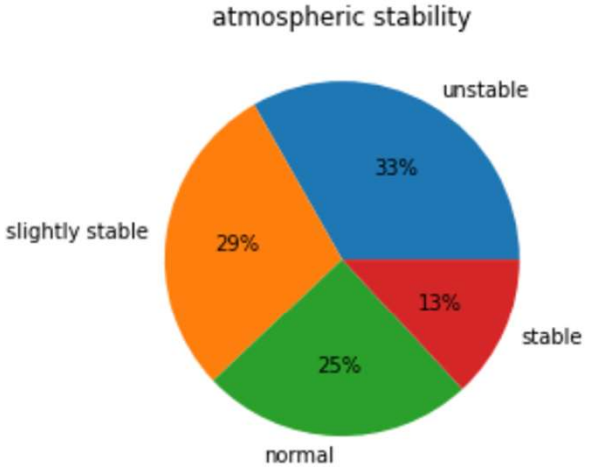
Example data basis

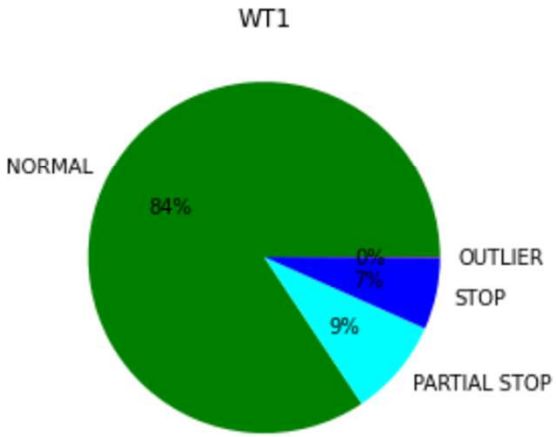
- Selected time period: 1.4.2020 00:00 – 30.4.2020 23:59 (campaign no. 5)
  - No IMUK-data, no IKT data
  - Failures for microphones 21./22. (SPL) resp. 17.-22. (mono Audio)

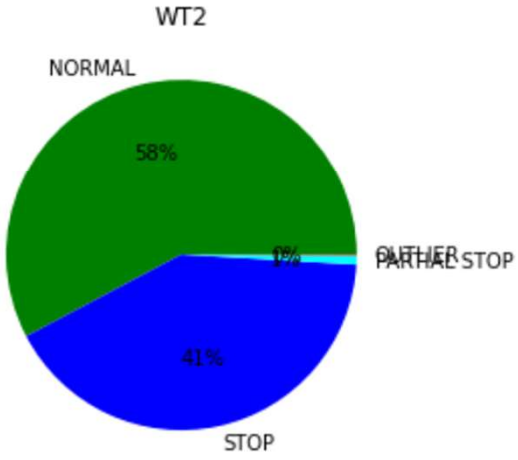


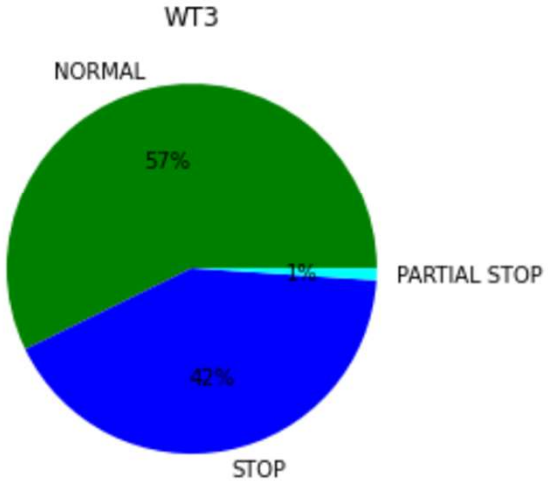
Example data basis - overview











Example of a use case

Use Case No.1	Looking for Stimuli
Actor	a researcher
Use case overview	The researcher wishes to conduct a laboratory study and is looking for binaural recordings of wind turbines at a distance of over 700 m.
Preconditions	The main page of the project database is opened in the browser.
Termination outcome	The researcher has successfully downloaded some recordings.
Condition affecting termination outcome	There are recordings in the database. The recordings are deemed suitable by the researcher.
Use case description	1. The user clicks on `Explore` next to the resource `overview_audio.csv` and then on `Download`. 2. The user opens the just downloaded file `overview_audio.csv` with their preferred method (e.g., Excel or Python+Pandas). 3. The user scrolls through the file and sees that there are 74 stimuli with binaural recordings in total. 4. The user is sorting or filtering the column `distance` and sees that there are 3 recordings with a distance of over 700 m. 5. For each recording: The user copies the link in the column `binaural recording` and pastes it into the address bar of the browser. The resource page of that recording loads and the user can click on `Download` to save the *.flac* file to their hard drive.
Output summary	`overview_audio.csv`, a set of three *.flac* files
Use case notes	This is described for a *CKAN* framework without online preview of tabular files, as it is currently the case with our given installation.

Links

- *Project homepage of WEA-Acceptance:*
  https://www.wea-akzeptanz.uni-hannover.de/en/

- *FAIR principles explained:*
  http://www.go-fair.org/fair-principles/

- S. Martens, T. Bohne, and R. Rolfes. An evaluation method for extensive wind turbine sound measurement data and its application. Proceedings of Meetings on Acoustics, Acoustical Society of America, 41, 2020. https://doi.org/10.1121/2.0001326.

- Iea wind task 43 standard for wea metadata.
  https://github.com/IEA-Task-43/digital_wra_data_stand

Thank you for your attention!

If you are interested in our specification describing the data base, please contact us:

Daphne Schössow

Institut für Kommunikationstechnik
Leibniz Universität Hannover

daphne.schoessow@isd.uni-hannover.de

Susanne Könecke

Institut für Statik und Dynamik
Leibniz Universität Hannover

s.koenecke@isd.uni-hannover.de

Tanja Grießmann

Institut für Statik und Dynamik
Leibniz Universität Hannover

t.griessmann@isd.uni-hannover.de

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