# ZEPHYR

## Towards a more efficient exploitation of on-shore and urban wind energy resources

Research and Innovation Action
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# D5.6: Complex terrain wind farm (T5.2): documented public databases archived on ZENODO (WP6)

**Executive summary**
This report presents a description of the public database published on ZENODO, containing some of the scripts and datasets used for the zEPHYR Complex terrain benchmark. Useful scripts and datasets are provided for case setup/comparison with simulation models.

Partner in charge: VKI

| Project co-funded by the European Commission within Horizon 2020 Dissemination Level | | |
|---|---|---|
| PU | Public | PU |
| PP | Restricted to other programme participants (including the Commission Services) | – |
| RE | Restricted to a group specified by the Consortium (including the Commission Services) | – |
| CO | Confidential, only for members of the Consortium (including the Commission Services) | – |

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The ZEPHYR Consortium partner responsible for this deliverable has addressed all comments received. Changes to this document are detailed in the change log table below.

## Change log

| Date | Version number | Author/Editor | Summary of changes made |
|---|---|---|---|
| 31/08/2023 | v1.0 | A. Bresciani, B. Kale, M. Elagamy, U. Boatto | Final Report |
| 09/10/2023 | v1.0 | J. Christophe | Final Review |

# 1 Database structure

This repository contains some of the scripts and datasets used for the zEPHYR Complex terrain benchmark:

- bemt_aerodynamics : simulation results for Tower 20 (tse04) https://perdigao.fe.up.pt/, corresponding to cases representing neutral and unstable atmospheric stability conditions.
- microscale : setup files for a case in OpenFOAM v2012 to simulate a forest canopy/buoyancy as a source term.
- turbine : contains blade geometry for the approximated Vestas V80 turbine.
- weather : comprises name list files to setup WRF-LES simulation cases, and data for processing field measurements.
- wind_field_statistical_analysis: MATLAB scripts for statistical analysis of wind fields.

# bemt_aerodynamics

- unstable_tow20_0-3600s_TA : BEMT data for Tower 20 (tse04) for Unstable Stability condition case.
- neutral_tow20_0-3600s_TA : BEMT data for Tower 20 (tse04) for Neutral stability condition case

# microscale

- fvOptions_buoyantBoussinesqSimpleFoam : source terms included in the non-neutral flow solver model.
- fvOptions_forestcanopy : source terms included in the forest canopy model (modelled as a porous medium).
- topoSetDict_forestcanopy : dictionary to select the forest canopy layer.

Further details about the case setup can be found in:

Venkatraman, K., Hagbo, T.-O., Buckingham, S., and Teigen Giljarhus, K. E. (2023). Effect of different source terms and inflow direction in atmospheric boundary modeling over the complex terrain site of Perdigao. Wind Energy Science, 8(1):85-108. DOI: https://doi.org/10.5194/wes-8-85-2023

# turbine

Data in turbine folder includes geometrical information to reconstruct a v80 wind turbine blade from the following files:

- v80_blade_geometry_spanwise_distribution.json: spanwise distribution of chord, twist angle and used profile.
- XXX_profile_coordinates.json: non-dimensional profile coordinates where XXX is the profile name.
- v80_operating_curves.json: wind turbine operating curves, rotation speed and blade pitch angle vs. wind speed.
- V80_blade_v0.prt: Simcenter 3D (NX) part file with the blade CAD.

- V80_blade_v0.stp: step file generated from V80_blade_v0.prt.

# weather

- input_wrflesgal : comprises namelist files for WRF-LES Simulations around Perdigão - simulation cases for different atmospheric stability conditions.
- met_mast_data_processing: comprises set of Python scripts for post-processing sonic anemometer/temperature data from NCAAR

INPUT DATA:

Datasets for Perdigão can be downloaded from:
NCAR/EOL Quality Controlled High-rate ISFS surface flux data, geographic coordinate, tilt corrected https://data.eol.ucar.edu/dataset/536.015

SCRIPTS:

To be used with datasets from NCAAR (netCDF4 files)

- complete_writer_sonic: calls and writes specific date/time for post processing sonic anemometer data.
- FunctionsISFS_Sonic : sampling Data from sonic anemometer datasets and compute thermal fluxes/stability parameters.
- complete_writer_TRH : calls and writes specific date/time for post processing from Temperature & Relative Humidity (TRH) sensor.
- FunctionsISFS_TRH : Sampling Data from Temperature & Relative Humidity (TRH) sensor.
- HighRateDataSetWriter : Unwrap 20 Hz sonic anemometer datasets from field measurements.

# wind_field_statistical_analysis

- raw_data: this directory contains the raw data obtained from the LES simulations and measurements. The data files should be stored in this directory before running the script.
- preprocessed_data: the pre-processed data in the format required for calculating the wind characteristics will be generated in this directory. The script will save the processed data files here for further analysis.
- scripts: this directory contains the MATLAB scripts for calculating the statistical characteristics of the wind field. These scripts utilize the preprocessed data and generate statistical results such as mean, standard deviation, turbulence intensity, and other relevant parameters.

For any questions, suggestions, or feedback, please contact the author via email:
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# 2 Availability of the database

The database is part of the zEPHYR ZENODO community (https://zenodo.org/communities/zephyr/) and is directly accessible from https://zenodo.org/record/8306015.

The database should be cited as: *Venkatraman Kartik, Andrea Bresciani, Baris Kale, Mohanad Elagamy, & Umberto Boatto. (2023). zEPHYR - Complex Terrain Benchmark (1.0) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.8306015*