



**CENER**

ADItch

NATIONAL RENEWABLE  
ENERGY CENTRE

---

# **An Open Science Approach for Wind Energy V&V: The GABLS3 Case Study**

Javier Sanz Rodrigo, Pawel Gancarski, Roberto Aurelio Chávez Arroyo  
Wind Energy Science Conference, Lyngby, 27 June 2017

---

# Context

The **European Cloud Initiative** will strengthen Europe's position in data-driven innovation, improve competitiveness and cohesion, and help create a **Digital Single Market** in Europe.



Provide EU science, industry and public authorities with:

- a world-class **data infrastructure** to store and manage data;
- **high-speed connectivity** to transport data; and
- ever more powerful **High Performance Computers** to process data

The Cloud Initiative will make it easier for researchers, businesses and public services to fully exploit the benefits of **Big Data** by making it possible to move, share and re-use data seamlessly across global markets and borders, and among institutions and research disciplines

The public and private investment needed to implement the European Cloud Initiative is estimated at **€6.7 billion**. The Commission estimates that, overall, **€2 billion in Horizon 2020** funding will be allocated to the European Cloud initiative

# “Digitizing” Wind Energy

---

- IRPWind – Design of the Wind Energy portal for data discovery and exploitation
- Marine Renewables Infrastructure Network (MaRINET2)
  - Pan-European infrastructure for ocean & marine data management (SeaDataNet.org)
- New European Wind Atlas (NEWA)
- IEA Task 31 Wakebench Phase 2
- A2e DAP
  - Atmosphere to Electrons, Data Archive and Portal

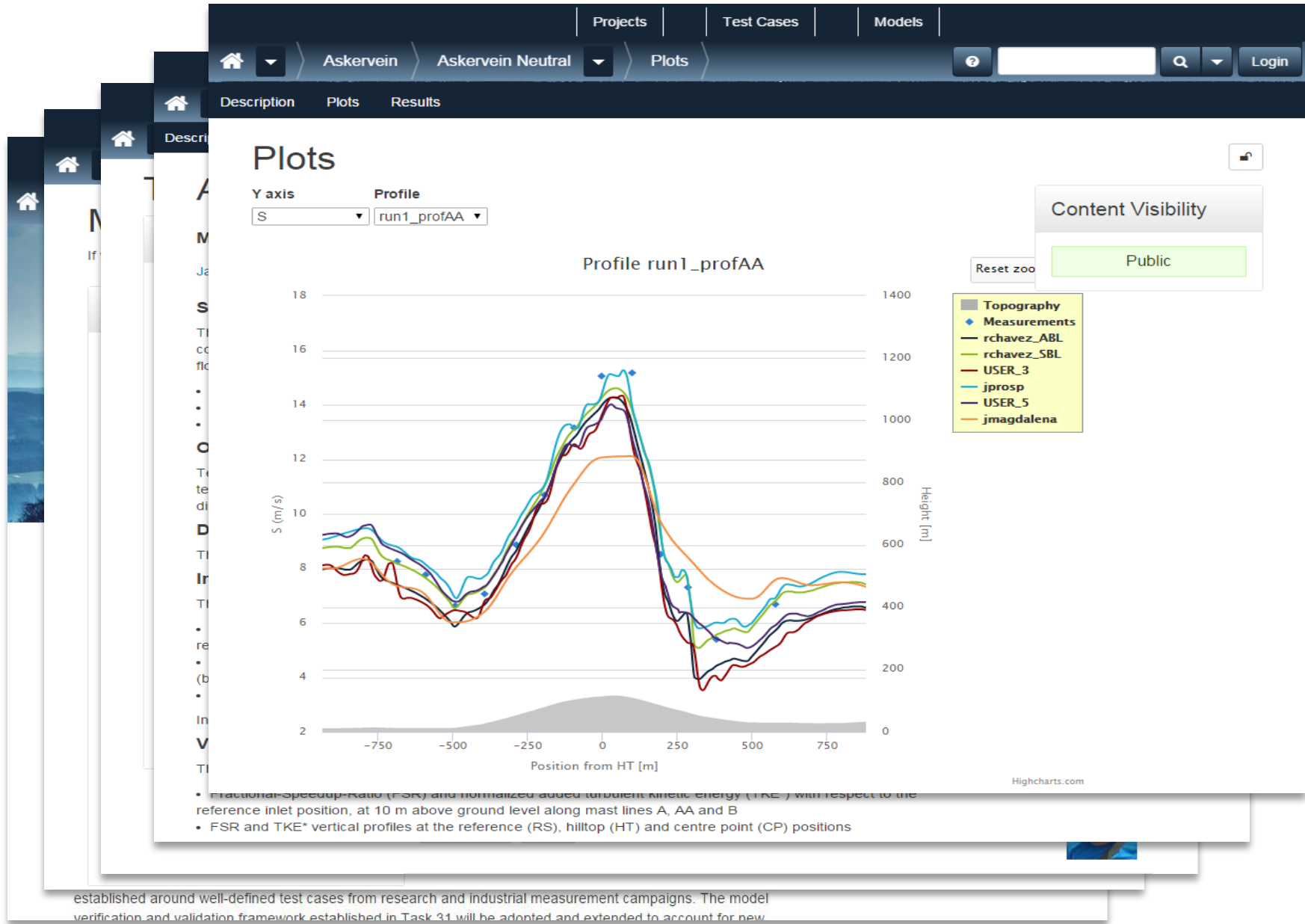
## Background reading

### **Towards an European e-infrastructure for Wind Energy**

Gancarski (2017). EERA IRPWind Mobility report, January 2017

<https://doi.org/10.5281/zenodo.818094>

# Windbench 2.0: V&V Repositories for Wind Energy

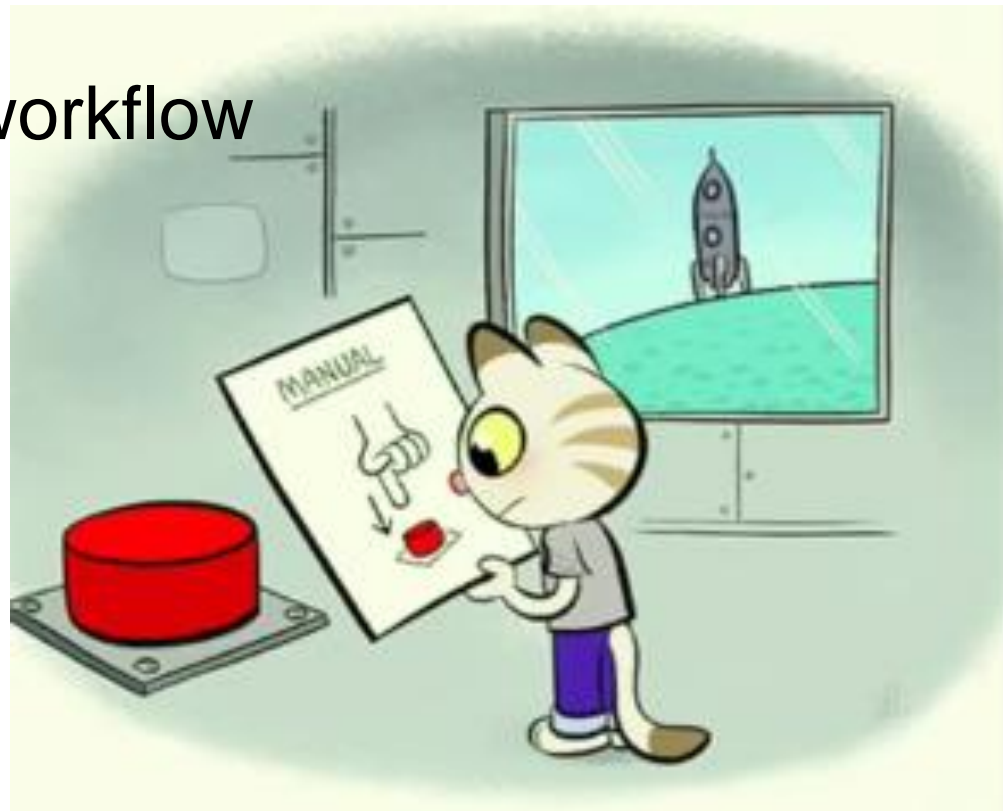


---

# Challenge

# Redesign of Windbench from a data repository to an open-science platform

- Simple and powerful
- Integrated into your workflow



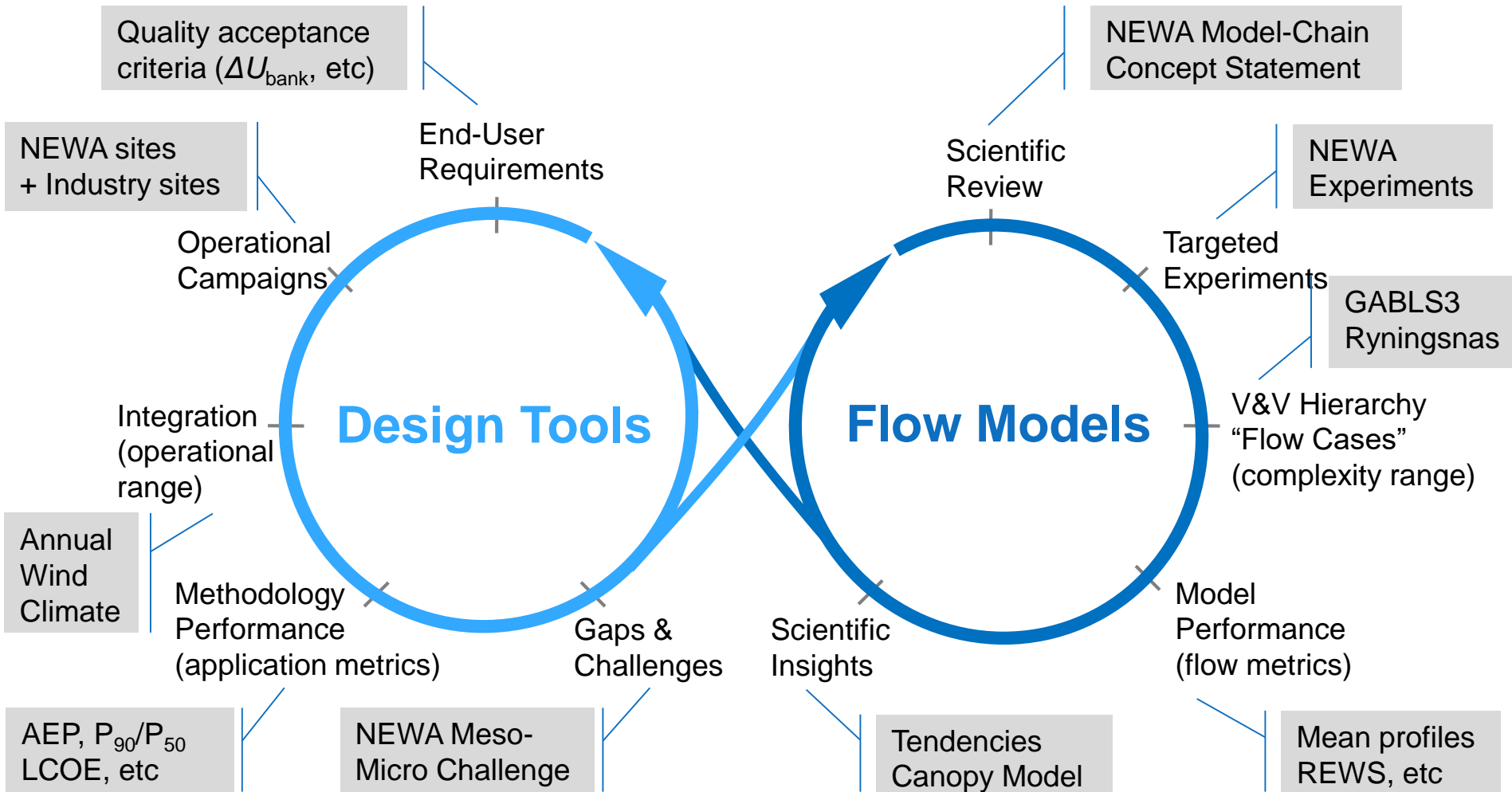
---

# Solution

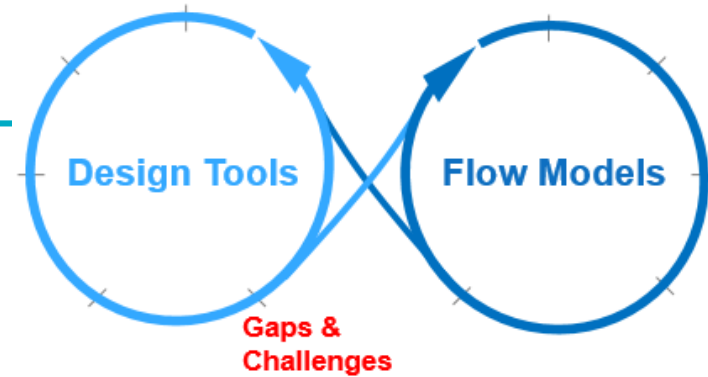
## GABLS3



# Windbench Process: Ambidextrous V&V, the NEWA case



# NEWA Meso-Micro Challenge



Projects | My Test Cases and Benchmarks | My Models

Test Cases | NEWA Meso-Micro Challenge for Wind Resource Assessment

NEWA Meso-Micro Challenge for Wind Resource Assessment

Managed by  
Javier Sanz Rodrigo

## Background

This challenge is organized in the context of the [New European Wind Atlas \(NEWA\)](#) project, whose overarching goal is to produce a seamless high resolution wind atlas for Europe. The wind atlas methodology will be based on a mesoscale to microscale (meso-micro) model-chain, validated with dedicated experiments as well as other observational databases from public and private sources. *Wind resource assessment* is related to the development of wind farms and implies the prediction of long-term wind statistics, notably the annual energy prediction (AEP).

In the development of meso-micro methodologies for wind resource assessment there is a tradeoff to be made between modeling fidelity and its associated cost to yield the required accuracy for the intended use (Figure 1). *Accuracy* is a qualitative concept that is used here to define the closeness of agreement between the predicted quantity of interest and the true value in the real world. Considering wind resource assessment applications, accuracy should gradually improve from the early-stage prospecting phase to the project financing phase, i.e. from *planning* to *bankable* accuracy. This process will hopefully remove the bias and reduce the uncertainty of the assessment to desired financial limits. This typically implies using off-the-shelf wind atlas products during early planning phase to design tools of increasing fidelity as the project matures. The required fidelity will depend on the complexity of the site as indicated in Figure 1 and is capped by the maximum allocated cost in terms of computing time.

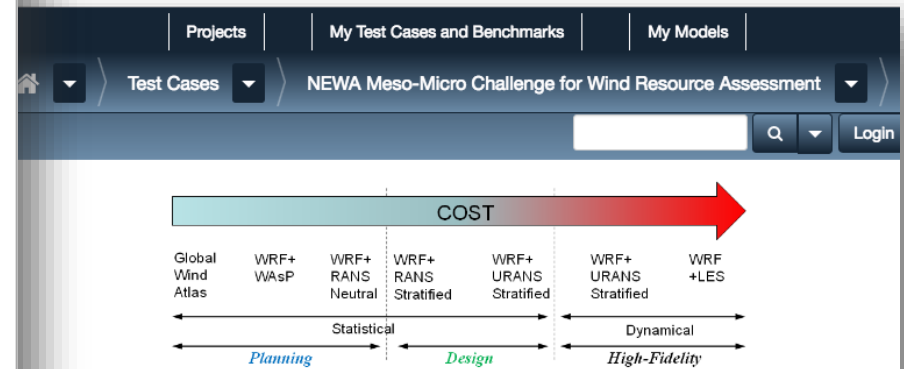


Figure 2: Hierarchy of meso-micro methodologies for wind resource assessment classified in terms of the type of coupling and typical intended use.

## Objectives

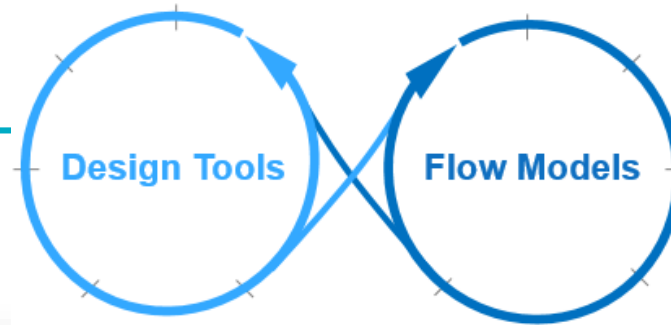
The objectives of this challenge are:

- To determine the applicability range of meso-micro methodologies for wind resource assessment within the NEWA validation domain.
- To establish open-access practices for the assessment of these methodologies to improve the traceability of the state-of-the-art as additional datasets are incorporated in the validation domain.
- To identify knowledge-gaps that will feed plans for future targeted experiments and validation activities.
- To engage with lead users of the NEWA model-chain whose first release will be provided open-access in the fall 2017.

## Data

The ultimate goal is to incorporate as many sites as possible in the challenge, at least during the duration of the NEWA project (until April 2019). This will constitute the "NEWA validation domain" as illustrated in Figure 3, overlapping with the application domain.

# GABLS3: Benchmark Guide



V&V Hierarchy  
“Flow Cases”  
(complexity range)

The screenshot shows the user interface for the GABLS3 benchmark. At the top, there is a navigation bar with 'IEA-Wind Task 31 WAKEBENCH 2 (2015-2018)' and 'GABLS 3'. Below this is a search bar and the user name 'Javier Sanz Rodrigo'. The main heading is 'GABLS 3', followed by 'Managed by Javier Sanz Rodrigo'. The 'Scope' section describes the benchmark's purpose in the NEWA project and lists challenges like mesoscale forcing and turbulence modeling. The 'Data Accessibility' section states that data is open-access for registered participants. The 'Objectives' section lists three goals: demonstrating ABL model capabilities, implementing suitable boundary conditions, and developing calibration strategies.

## GABLS 3

Managed by  
Javier Sanz Rodrigo

### Scope

The GABLS3 case has been selected in the NEWA project as a baseline exercise for the design of mesoscale-to-microscale methodologies for wind resource assessment. The case is suitable for the development of microscale wind farm models that incorporate realistic forcing, derived from a mesoscale model, along a typical diurnal case that leads to the development of a nocturnal low-level jet. Challenges of this case include: incorporating time- and height-dependent mesoscale forcing in microscale models, turbulence modeling at varying atmospheric stability conditions, defining suitable surface boundary conditions for momentum and heat and characterization of the wind profile in (non-logarithmic) LLJ conditions.

### Data Accessibility

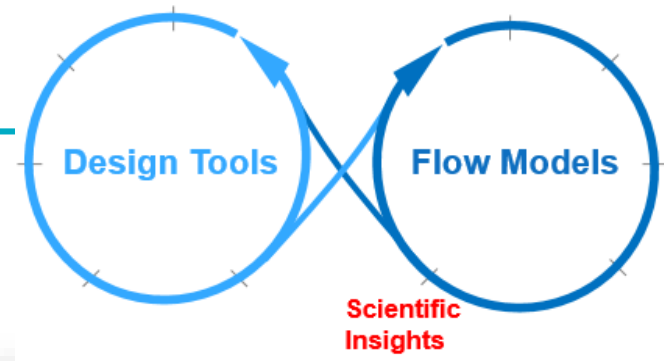
Data is provided open-access for registered participants. For practical reasons, a copy of the GABLS3 observational dataset, made available by KNMI, is provided as well.

### Objectives

Wind-energy specific objectives of the benchmark include:

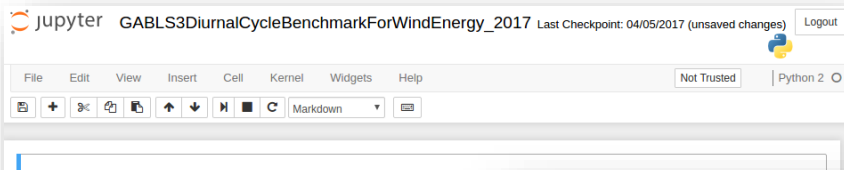
- Demonstrate the capability of wind energy ABL models to incorporate realistic mesoscale forcing
- Implement surface boundary conditions suitable for wind assessment studies using mesoscale simulation data and/or observations (typical of wind energy campaigns)
- Develop suitable model calibration strategies for wind energy applications or, in other words, how to best use

# GABLS3: Benchmark Notebook



GABLS3\_CFDWind1D.ipynb – link available soon

<http://iopscience.iop.org/article/10.1088/1742-6596/854/1/012037/>



## GABLS 3 Diurnal-Cycle Benchmark Applications

Javier Sanz Rodrigo, National Renewable Energy Centre (CENER) May 2017

### Introduction

This benchmark report analyzes the simulations submitted to the NEWA project and the IEA Task 31 Wakebench. The results of the

Sanz Rodrigo J., Allaerts D., Avila M., Barcons J., Cavar D., B., Lundquist J.K., Meyers J., Muñoz Esparza D., Palma J.M. and Veiga Rodrigues C. (2017) Results of the GABLS3 diurnal cycle benchmark. *Journal of Physics: Conference Series*

### Benchmark Set-Up

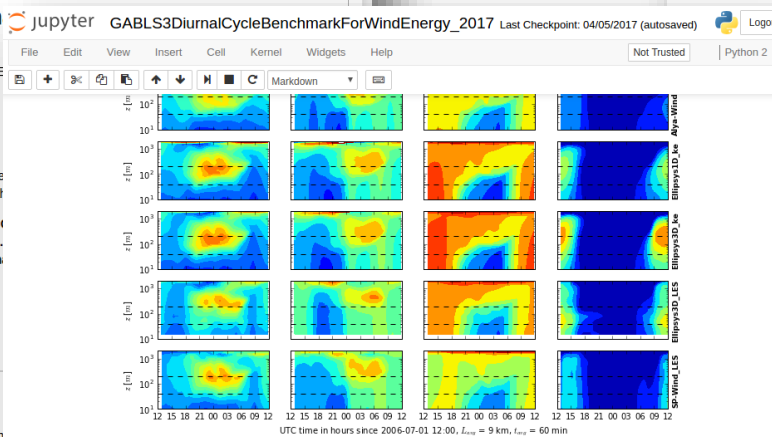
Background information and benchmark set-up can be found in:

### Simulations

The following simulations participate in the benchmark. Notice that the WRF model was used to generate the mesoscale tendencies that are used in the LES simulations. The ensemble mean of these WRF simulations is used as the reference for the LES simulations.

Table 1. Summary of model simulations. Monin Obukhov similarity theory boundary conditions use either heat flux ( $H$ ), 2-m ( $T_2$ ) or skin

Name	Input
WRF-YSU (ref)	ERA-Interim
WRF	ERA-Interim, GFS MJY, MYM
WRF-YSU_LES	ERA-Interim
WRF-VentosM_ke	ERA-Interim



<IPython.core.display.Markdown object>

### Vertical Profiles

```
In [16]: # Specify the datetime at which you want to plot the vertical profiles
t0 = datetime.datetime(2006,7,2,0,0,0)

# Plot settings
linespec = ['k-', 'b-', 'r-', 'c-', 'm-', 'g-', 'y-', 'l-', 'b-', 'r--']
linewidth = np.array([2,1,1,1,1,1,1,2,2])
Nm = 3 # marker every

Z_obs = (S_obs.w.loc[t0].values, WD_obs.w.loc[t0].values,
         Th_obs.w.loc[t0].values)
z_obs = (zf_obs, zf_obs, zT_obs)

Z_sim = []; z_sim = []
for iplot in range(0, len(plotsim)):
    isim = plotsim[iplot]
    Z_sim.append((S[isim].loc[t0].values, WD[isim].loc[t0].values,
```

Wake Conference 2017 IOP Publishing  
IOP Conf. Series: Journal of Physics: Conf. Series 854 (2017) 012037 doi:10.1088/1742-6596/854/1/012037

## Results of the GABLS3 diurnal-cycle benchmark for wind energy applications

J Sanz Rodrigo<sup>1</sup>, D Allaerts<sup>2</sup>, M Avila<sup>3</sup>, J Barcons<sup>4</sup>, D Cavar<sup>5</sup>, RA Chávez Arroyo<sup>6</sup>, M Churchfield<sup>7</sup>, B Kosovic<sup>8</sup>, JK Lundquist<sup>9</sup>, J Meyers<sup>10</sup>, D Muñoz Esparza<sup>11</sup>, JMLM Palma<sup>12</sup>, JM Tomaszewski<sup>13</sup>, N Troldborg<sup>14</sup>, MP van der Laan<sup>15</sup> and C Veiga Rodrigues<sup>16</sup>

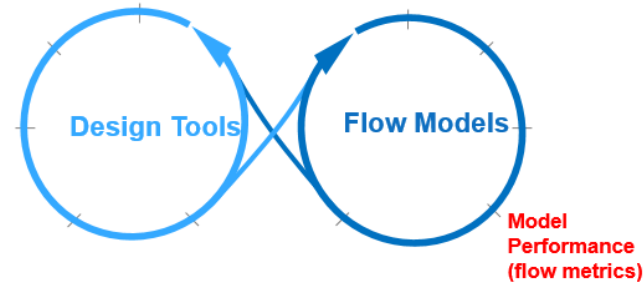
- <sup>1</sup>National Renewable Energy Centre, Sarriguren, Spain
- <sup>2</sup>National Renewable Energy Laboratory, Boulder, CO, U.S.A.
- <sup>3</sup>National Centre for Atmospheric Research, Boulder, CO, U.S.A.
- <sup>4</sup>Barcelona Supercomputing Centre, Barcelona, Spain
- <sup>5</sup>Technical University of Denmark, Roskilde, Denmark
- <sup>6</sup>University of Colorado Boulder, Boulder, CO, U.S.A.
- <sup>7</sup>University of Leuven, Leuven, Belgium
- <sup>8</sup>University of Porto, Porto, Portugal
- E-mail: jsrodrigo@cener.com

**Abstract.** We present results of the GABLS3 model intercomparison benchmark revisited for wind energy applications. The case consists of a diurnal cycle, measured at the 200-m tall Cabauw tower in the Netherlands, including a nocturnal low-level jet. The benchmark includes a sensitivity analysis of WRF simulations using two input meteorological databases and five planetary boundary-layer schemes. A reference set of mesoscale tendencies is used to drive microscale simulations using RANS k-ε and LES turbulence models. The validation is based on rotor-based quantities of interest. Cycle-integrated mean absolute errors are used to quantify model performance. The results of the benchmark are used to discuss input uncertainties from mesoscale modelling, different meso-micro coupling strategies (online vs offline) and consistency between RANS and LES codes when dealing with boundary-layer mean flow quantities. Overall, all the microscale simulations produce a consistent coupling with mesoscale forcings.

**Introduction**  
The increasing growth of wind turbines, with rotor tip heights approaching 200 m, and wind farm extending for tens of kilometers, is pushing the wind farm flow modeling community to effective ways of integrating forcing from large meteorological processes in the simulation of at wind farm scale based on computational fluid dynamic (CFD) models. The dynamics of wings determine the interplay between the wind climatology, relevant for the assessment of resource, and the wind conditions relevant for wind turbine siting. A recent review of state-of-the-art methodologies for mesoscale-to-microscale modeling is given by Sanz Rodrigo et al [1]. Outstanding challenges include: coupling of codes dealing with small differences in terms of physical hypothesis and numerical methods, lack of suitable parameterization in the "terra incognita" [2] that links mesoscale and microscale turbulence processes, and the lack of a systematic evaluation procedure that can identify the source of modeling errors. In addition, for the wind energy community, design conditions are almost entirely based on idealized reference and boundary-layer models rather than recognizing and classifying wind conditions that are relevant for mesoscale forcing in design standards.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Content not for redistribution. Published by IOP Publishing Ltd

# GABLS3: CFDWindSCM Evaluation Notebook



[http://35.187.167.148/notebooks/GABLS3\\_CFDWind1D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae](http://35.187.167.148/notebooks/GABLS3_CFDWind1D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae)

<http://www.wind-energ-sci.net/2/35/2017/>

unidata GABLS3\_CFDWind1D Last Checkpoint: 04/24/2017 (autosaved) Logout

File Edit View Insert Cell Kernel Widgets Help Python 2 O

File Edit View Insert Cell Kernel Widgets Help Python 2 O

Assessment of meso-micro offline coupling methodology based on driving CFDWind single-column-model with WRF tendencies: the GABLS3 diurnal cycle case

Javier Sanz Rodrigo, National Renewable Energy Centre (CENER), Sarriguren, Spain, jsrodrigo@cener.com

April 2017

**Introduction**

This notebook provides the model evaluation of Reynolds-averaged Navier-Stokes (RANS) atmospheric boundary layer models under realistic column-model (SCM) to reproduce the SCM settings as well as profile nudging.

This work has been used to set up a benchmark for wind energy applications. The benchmark was launched at the Torque in [2].

**Benchmark Set-Up**

Background information and benchmarks.

**CFDWind1D Simulation**

The following simulations were conducted:

1. Demonstrate consistency of online
2. Evaluate the choice of turbulent closure
3. Quantify the impact of the choice of turbulence model
4. Quantify the relative importance of different forcing terms
5. Assess bias-correction nudging
6. Assess bias-correction nudging

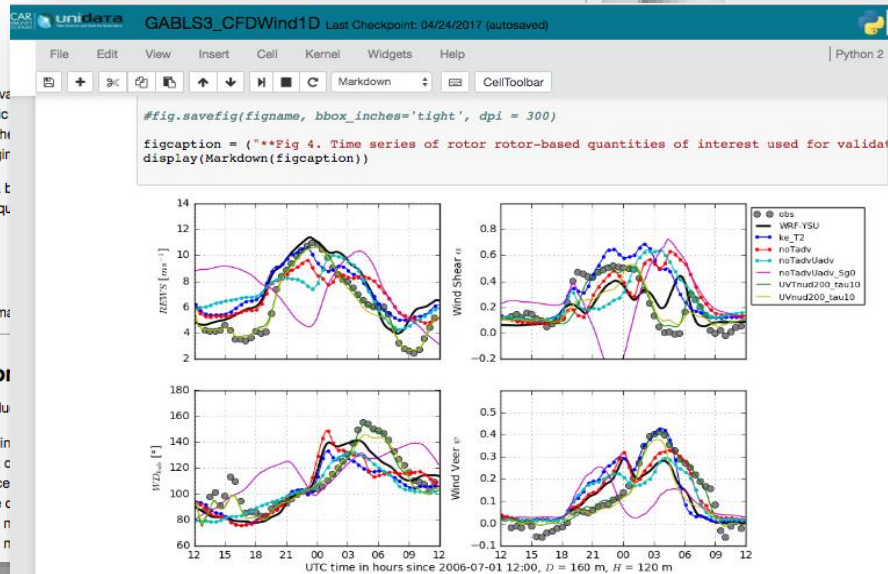


Fig 4. Time series of rotor rotor-based quantities of interest used for validation

```
In [41]: from IPython.display import display
pd.options.display.float_format = '{:,.2f}'.format # format for output data in tables

# Compute error metrics
def mae(xtrue, xpred, norm):
    # Normalized Mean Absolute Error
    # xtrue: series with true values
    # xpred: series with predicted values
```

Wind Energ. Sci., 2, 35–54, 2017  
[www.wind-energ-sci.net/2/35/2017/](http://www.wind-energ-sci.net/2/35/2017/)  
 doi:10.5194/wes-2-35-2017  
 © Author(s) 2017. CC Attribution 3.0 License.



## A methodology for the design and testing of atmospheric boundary layer models for wind energy applications

Javier Sanz Rodrigo<sup>1</sup>, Matthew Churchfield<sup>2</sup>, and Branko Kosovic<sup>3</sup>

<sup>1</sup>Wind Energy department, National Renewable Energy Centre (CENER), Sarriguren, 31621, Spain  
<sup>2</sup>National Wind Technology Center, National Renewable Energy Laboratory (NREL), Golden, 80401 CO, USA  
<sup>3</sup>Atmospheric Sciences Laboratory, National Center for Atmospheric Research (NCAR), Boulder, 80307 CO, USA

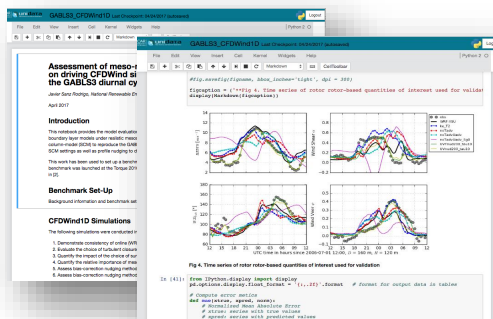
Correspondence to: Javier Sanz Rodrigo (jsrodrigo@cener.com)

Received: 27 July 2016 – Discussion started: 19 August 2016  
 Accepted: 22 December 2016 – Accepted: 6 January 2017 – Published: 9 February 2017

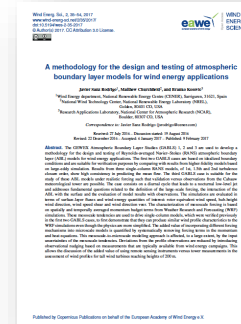
Atmospheric Boundary Layer Studies (GABLS) 1, 2 and 3 are used to develop a design and testing of Reynolds-averaged Navier-Stokes (RANS) atmospheric boundary layer models for wind energy applications. The first two GABLS cases are based on idealized models for verification purposes by comparing with results from higher-fidelity models based on results from three single-column RANS models, of 1st, 1.5th and 2nd turbulence order. The third GABLS case is suitable for the validation of models under realistic forcing such that validation versus observations from the Cabauw site is possible. The case consists on a diurnal cycle that leads to a nocturnal low-level jet. The main questions related to the definition of the large-scale forcing, the interaction of the wind with the terrain, and the evaluation of model results with observations. The simulations are evaluated in terms of fluxes and wind energy quantities of interest: rotor equivalent wind speed, hub-height wind speed and wind direction. The characterization of mesoscale forcing is based on the use of averaged momentum budget terms from Weather Research and Forecasting (WRF) model. The use of mesoscale tendencies are used to drive single-column models, which were verified previously cases, to first demonstrate that they can produce similar wind profile characteristics to the observations, though the physics are more simplified. The added value of incorporating different forcing terms in the mesoscale models is quantified by systematically removing forcing terms in the momentum budget. The mesoscale-to-microscale modeling approach is affected, to a large extent, by the input mesoscale tendencies. Deviations from the profile observations are reduced by introducing mesoscale tendencies that are typically available from wind energy campaigns. This is the added value of using remote sensing instruments versus tower measurements in the field for tall wind turbines reaching heights of 200 m.



# GABLS3: CFDWindSCM Evaluation Notebook



[http://35.187.167.148/notebooks/GABLS3\\_CFDWindSCM.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae](http://35.187.167.148/notebooks/GABLS3_CFDWindSCM.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae)



<http://www.wind-energ-sci.net/2/35/2017/>

Repos Stars



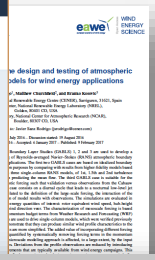
windbench

Joined April 2017

windbench/newa-gabls3  
public | automated build

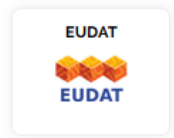
0 STARS 41 PULLS

DETAILS



## Assessment of meso-micro offline coupling methodology based on driving CFDWind single-column-model with WRF tendencies: the GABLS3 diurnal cycle case

by Sanz Rodrigo, Javier;  
Jun 23, 2017



**Abstract:** The dataset was used in the following publication: Sanz Rodrigo J, Churchfield M, Kosović B (2017) A methodology for the design and testing of atmospheric boundary layer models for wind energy applications. Wind Energ. Sci. 2: 1-20, doi:10.5194/wes-2-1-2017 The third GEWEX Atmospheric Boundary-Layer Studie (GABLS3) is used in the design of CFDWind single-column model to run with realistic forcing generated by the Weather Research and Forecasting (WRF) mesoscale model. The case consists on a diurnal cycle that leads to a nocturnal low-level jet and addresses fundamental questions related to the definition of the large-scale forcing, the interaction of the ABL with the surface and the evaluation of model results with observations. A sensitivity analysis of CFDWind is conducted to understand the added value of different elements of the model set-up: input forcing, turbulence model, nudging, etc

**SeriesInformation:** Self-described NetCDF data files are provided using the naming described in the paper.

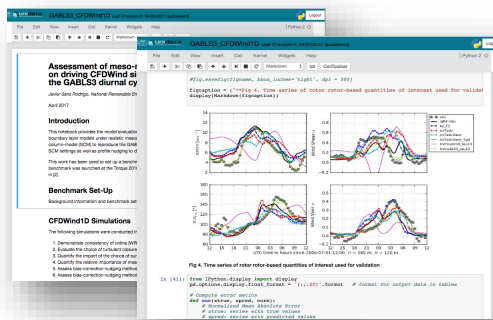
**Disciplines:** 3.3.14 → Earth sciences → Meteorology; 5.6.48 → Engineering → Fluid mechanics;

**Keywords:** wind; atmospheric boundary-layer; mesoscale; WRF; CFDWind; GABLS3; meso-micro; coupling; tendencies;

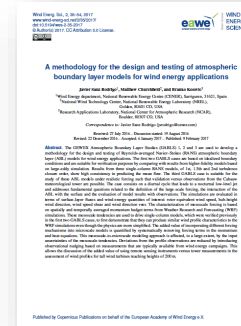
**DOI:** 10.23728/b2share.22e419b663cb4ffa8107391b6716c1b   
**PID:** 11304/183561b5-d3ca-444c-9b5c-1d4aee4a8307

Name	Size
> GABLS3_CFDWindSCM_turbo_T2_g.nc	70.19MB
> GABLS3_CFDWindSCM_turb1_T2_10.nc	81.19MB
> GABLS3_CFDWindSCM_turb5_T2_2.nc	78.20MB

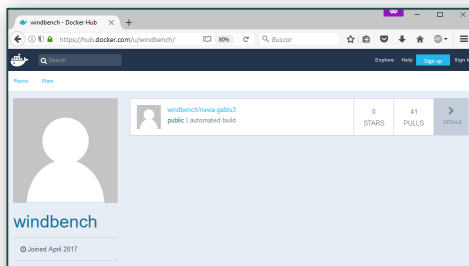
# GABLS3: CFDWindSCM Evaluation Notebook



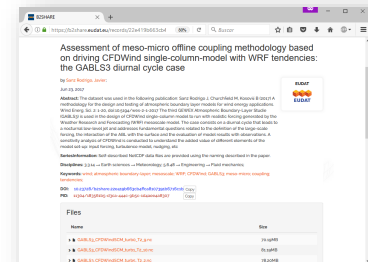
[http://35.187.167.148/notebooks/GABLS3\\_CFDWind1.D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae](http://35.187.167.148/notebooks/GABLS3_CFDWind1.D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae)



<http://www.wind-energ-sci.net/2/35/2017/>



<https://hub.docker.com/r/windbench/newa-gabls3/>



<http://doi.org/10.23728/b2share.22e419b663cb4ffca8107391b6716c1b>



GitHub - windbench/gabls3

Features Business Explore Marketplace Pricing

This repository Search Sign in or Sign up

windbench / gabls3

Code Issues 0 Pull requests 0 Projects 0 Insights

No description, website, or topics provided.

14 commits 1 branch 0 releases 1 contributor

Branch: master New pull request

Find file Clone or download



pgancarski committed on GitHub Update observation file link

- build\_resource Download instead of mount
- Dockerfile Cloning up the code
- README.md Update README.md
- eutat\_start.sh Update observation file link

README.md

windbench

Created April 2017

<https://hub.docker.com/r/windbench/newa-gabls3/>

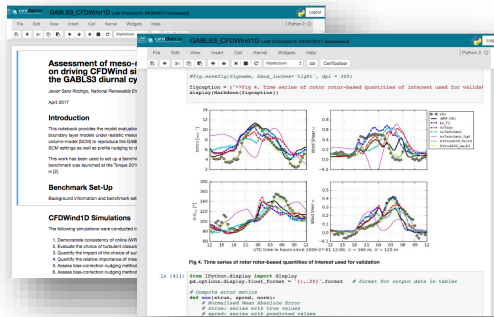
Archivos - b2drop

https://b2drop.eudat.eu/s/gGMxHjRwUGe2A

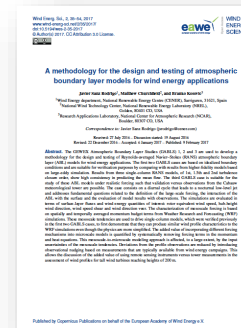
Añadir a tu Nextcloud Descargar

Nombre	Tamaño	Modificado
GABLS3_CFDWindSCM_turb0_T2_9.nc	66.9 MB	hace 2 meses
GABLS3_CFDWindSCM_turb1_T2_10.nc	77.4 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_2.nc	74.6 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_noT...	76.1 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_noT...	76.3 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_noT...	76.6 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_UV...	80 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_UV...	80.2 MB	hace 2 meses
GABLS3_CFDWindSCM_turb5_T2_UV...	80.1 MB	hace 2 meses

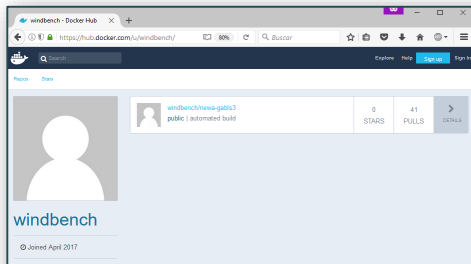
# GABLS3: CFDWindSCM Evaluation Notebook



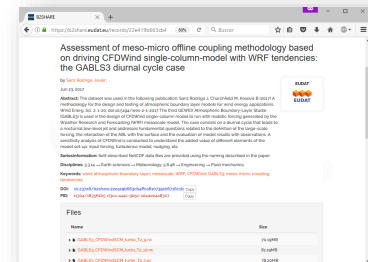
[http://35.187.167.148/notebooks/GABLS3\\_CFDWind1D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae](http://35.187.167.148/notebooks/GABLS3_CFDWind1D.ipynb?token=846e2646cdeec2bd155ddc5ef96fbce35877384a723152ae)



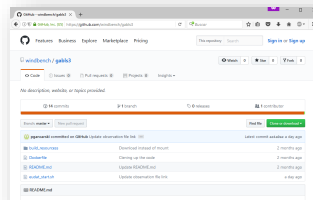
<http://www.wind-energ-sci.net/2/35/2017/>



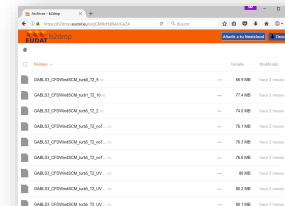
<https://hub.docker.com/r/windbench/newa-gabls3/>



<http://doi.org/10.23728/b2share.22e419b663cb4ffca8107391b6716c1b>

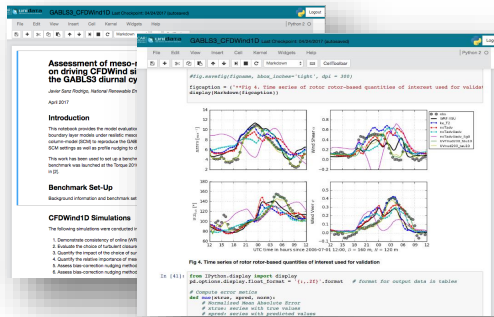


<https://github.com/windbench/gabls3>



<https://b2drop.eudat.eu/s/gGMXxHJjRwUGe2A>

# GABLS3: CFDWindSCM Evaluation Notebook



Wind Energy Sci. Technol. 2017, Vol. 4, No. 1, 014001  
doi:10.1088/1755-1307/4/1/014001  
© 2017 IOP Publishing Ltd

**A methodology for the design and testing of atmospheric boundary layer models for wind energy applications**

Janine von Arnim<sup>1</sup>, Mathias Christen<sup>2</sup> and Markus Basso<sup>3</sup>

<sup>1</sup>Wind Energy Research, National Research Center for Air Quality Research, 7030, Trossen, National Research Center, Trossenstrasse 33, CH-7030 Trossen, Switzerland  
<sup>2</sup>ETH Zurich, Institute for Energy Efficient Buildings and Indoor Climate, 8093, Zurich, Switzerland  
<sup>3</sup>ETH Zurich, Institute for Energy Efficient Buildings and Indoor Climate, 8093, Zurich, Switzerland

Received 15 July 2016, revised 15 February 2017, accepted 15 February 2017

**Abstract.** The design and testing of atmospheric boundary layer models for wind energy applications is a complex task. The design and testing of atmospheric boundary layer models for wind energy applications is a complex task. The design and testing of atmospheric boundary layer models for wind energy applications is a complex task.

windbench - Docker Hub

https://hub.docker.com/u/windbench/

windbench/mesa\_gabls3  
public | latest build

0 STARS 41 PULLS

windbench  
Joined April 2017



Assessment of meso- and micro-coupling methodology based on driving CFDFind as the GABLS3 diurnal cycle case

Janine von Arnim, Mathias Christen, Markus Basso

Files

Name	Size
GABLS3_CFDWindSCM_Data_T1_01	10.1 MB
GABLS3_CFDWindSCM_Data_T1_02	10.1 MB
GABLS3_CFDWindSCM_Data_T1_03	10.1 MB

windbench/mesa\_gabls3

Python, Business, System, Marketplace, Privacy

1 file

- README.md
- LICENSE
- CONTRIBUTING.md

Name	Size	Date
GABLS3_CFDWindSCM_Data_T1_01	10.1 MB	2017-02-15
GABLS3_CFDWindSCM_Data_T1_02	10.1 MB	2017-02-15
GABLS3_CFDWindSCM_Data_T1_03	10.1 MB	2017-02-15

## Conclusions and Outlook

---

- New Windbench design to integrate with European e-infrastructures and promote open science
- Ambidextrous V&V process to combine data from research experiments and operational campaigns
- Pilot for WE portal for data discovery and exploitation (IRPWind/WP2)
- NEWA Meso-Micro Challenge and GABLS3 demo cases

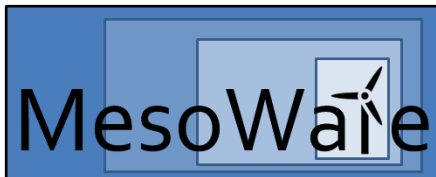
### Outlook

- End-user engagement through existing projects: Wakebench, NEWA and A2e
- Implementation through mid-2018

# Acknowledgements

This work has been produced with support from the following projects:

- **MesoWake**, European Commission FP7-PEOPLE-2013-IOF, 624562, <http://www.windbench.net/mesowake-2014-2017>
- **NEWA**, European Commission FP7-ENERGY-2013.10.1.2, 618122, <http://www.neweuropeanwindatlas.eu/>; MINECO, Spain, PCIN-2014-011-C07-02
- **IRPWind**, European Commission FP7-ENERGY-2013-IRP, 609795, <http://www.irpwind.eu/>
- **IEA Task 31 Wakebench Phase 2**, International Energy Agency
- **PRACE-MesoWake**, PRACE 13th Call, MareNostrum, Barcelona



[www.cener.com](http://www.cener.com)

CENER



**CENER**

NATIONAL RENEWABLE  
ENERGY CENTRE

