IEA Task 31: Wakebench

IEA Task 31 aims at defining **quality-checked procedures** for the simulation of wind and wakes.

The working methodology will be based on the **benchmarking** different wind and wake modeling techniques in order to identify and quantify **best practices** for using these models under a range of conditions.

These benchmarks will involve model **inter-comparison** versus experimental data.

The best practices will cover the wide range of tools currently used by the industry and attempts to **quantify the uncertainty** bounds for each types of model.

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Wakebench: Objectives

1) To make an inventory of **state-of-the-art models** for the simulation of wind and wakes for site assessment applications: inputs, model equations, outputs, etc
2) To define procedures for the **definition of test cases** for validation purposes of wind and wake models: requirements on measurement data, filtering processes, metrics, etc
3) To identify the most critical aspects of the modeling chain by **quantifying** the associated **uncertainties**: boundary conditions, turbulence model, stability, etc
4) To define the range of **applicability** of the models under investigation: site conditions, wind regimes, wind farm size, etc
5) To reach consensus on **best practice guidelines** for the verification and validation of wind and wake models

Management & coordination: CENER & NREL

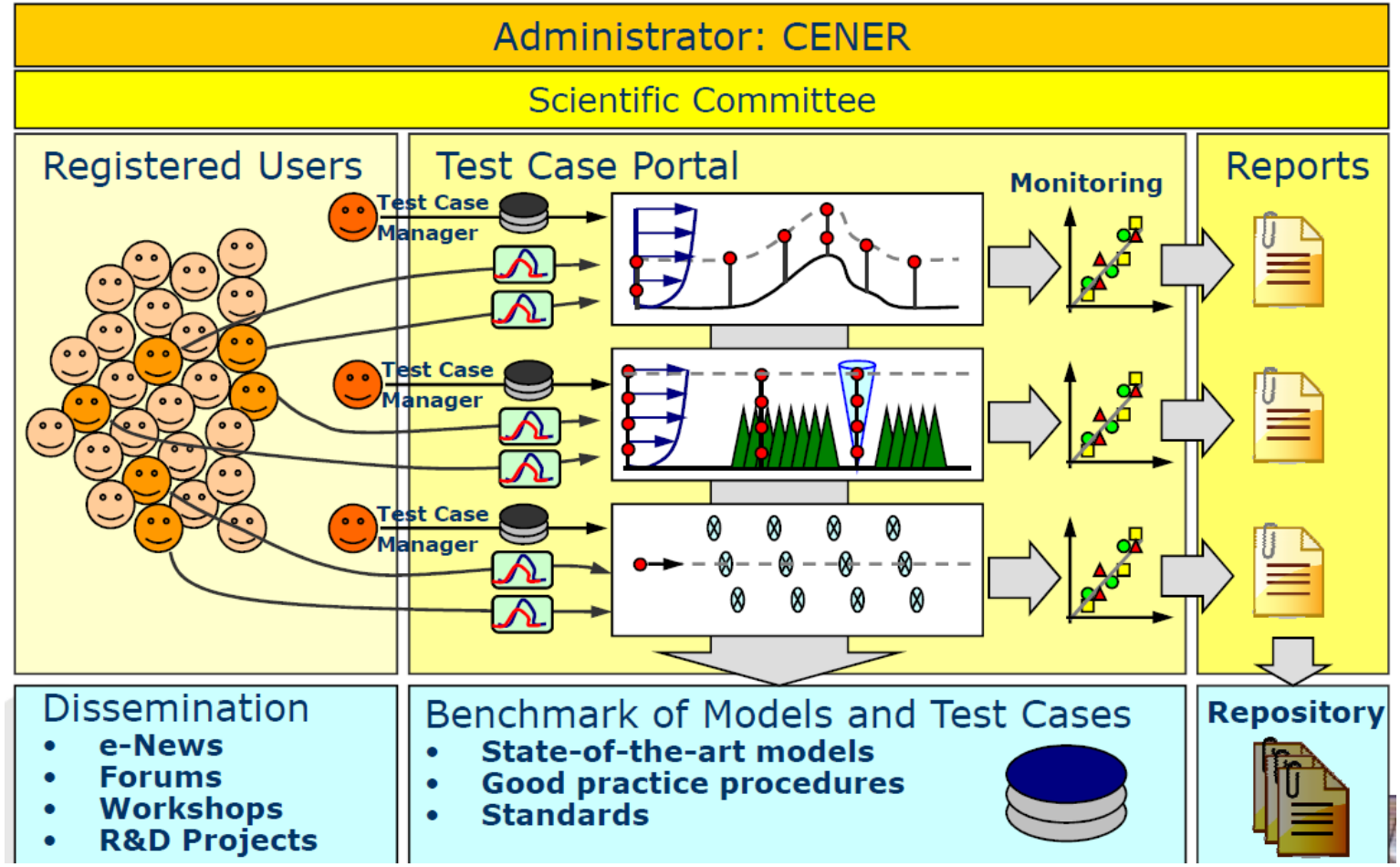
Participants:

- Spain (CENER, Acconia, Gamesa, Iberdrola, UPM,+)
- USA (NREL, Indiana U., E.ON, WERC, PSU, UM,+)
- Denmark (DTU Wind Energy, DONG, Vattenfall)
- Canada (ETS)
- Italy (CNR, U.Genova,+)
- Greece, Switzerland & Japan
- China, Netherlands, Germany, Sweden,UK – has not signed yet!
- Ireland, Finland, Norway – under negotiations!

Working Groups

Wakebench: WG1	**Flow over flat terrain**
Wakebench: WG2	**Flow over hills in wind tunnel**
Wakebench: WG3	**Flow over hills in the field**
Wakebench: WG4	**Flow in and above forest canopies**
Wakebench: WG5	**Flow over Mountains**
Wakebench: WG6	**WT Wakes. Theoretical verification**
Wakebench: WG7	**WT Wakes. Wind tunnel experiments**
Wakebench: WG8	**Small wind farms / Individual WT**
Wakebench: WG9	**Large wind farms**
Walebench:	**Round-Robin on validation on wind tunnel, ressource & SCADA datasets.**

Windbench (Model Evaluation Platform)



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Wakebench quality assessment

WG: Scientific Committee (SC) => Model Evaluation Protocol

Working Group (WG):

- Test case managers;
- Reviewers;
- Benchmark managers;
- Consultants from Advisory Committee;
- **Benchmark participants**;

Wakebench: WG1
Flow over flat terrain

Test Case	Benchmark	Model	Stability	Data ready	Due date
Monin Obukov	MO_neutral	SL	No	Yes	may-12
Monin Obukov	MO_stable	SL	Yes	Yes	sep-12
Leipzig	Leipzig_neutral	ABL	No	Yes	may-12
GABLS	GABLS1_stable	ABL	Yes	Yes	sep-12
GABLS	GABLS2_diurnal	ABL	Yes	Yes	dec-12
Fino1	Fino1_ensemble	ABL/NWP	Yes	No	TBD
Fino1	Fino1_NWP	ABL/NWP	Yes	No	TBD
Hovsore	Hovsore_ensemble	ABL/NWP	Yes	No	TBD
Hovsore	Hovsore_NWP	ABL/NWP	Yes	No	TBD

DTU models: EllipSys/RANS & SCADIS

Wakebench: WG2
Flow over hills in wind tunnel

Test Case	Benchmark	Stability	Data ready	Due date
Isolated 2D hill, two slopes	EnFlo-Hill	No	No	sep-12
Isolated 2D hill, two stable cases	EnFlo-Hill	Yes	No	early-13

DTU models: Fuga-hill & WASP

Wakebench: WG3
Flow over hills in the field

Test Case	Benchmark	Stability	Data ready	Due date
Monin Obukov	MO_neutral	No	Yes	may-12
Monin Obukov	MO_stable	Yes	Yes	sep-12
Askervein	Askervein_210	No	Yes	may-12
Askervein	Askervein_130	No	Yes	sep-12
Askervein	Askervein_90	No	Yes	sep-12
Bolund	Bolund_blind_neutral	No	Yes	may-12
Bolund	Bolund_neutral	No	Yes	sep-12
Cooper's Ridge	CoopersRidge_neutral	No	No	2013
Cooper's Ridge	CoopersRidge_stable	Yes	No	2013
Benakanahalli	Benak_blind_neutral	No	No	2013
Benakanahalli	Benak_blind_stable	Yes	No	2013
Benakanahalli	Benak_blind_diurnal	Yes	No	2013

DTU models: EllipSys-RANS, EllipSys-LES, WASP, SCADIS & Fuga-HILL

DTU Wind Energy
Technical University of Denmark

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Wakebench: WG4
Flow in and above forest canopies

Test Case	Benchmark	Stability	Data ready	Due date
CSIRO-1DCanopy	Fully developed canopy flow	No	Yes	may-12
FurryHill	2D gentle hill with homogeneous canopy	No	Yes	sep-12
Falster_neutral	2D forest edge, two directions, two LAD	No	No	sep-12
Falster_stable	2D forest edge, two directions, two LAD	Yes	No	early-13
VKI-2DClearing_neutral	2D clearing, 3 porosities x 3 fetch	No	No	early-13
VKI-2DShelterbelt	2H-long shelterbelt, 3 porosities	No	No	early-13

DTU models: EllipSys-RANS

DTU Wind Energy
Technical University of Denmark

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Wakebench: WG5
Flow over Mountains

Test Case	Benchmark	Model	Stability	Data ready	Due date
Monin Obukov	MO_neutral	SL	No	Yes	may-12
Monin Obukov	MO_stable	SL	Yes	Yes	sep-12
Leipzig	Leipzig_neutral	ABL	No	Yes	may-12
GABLS	GABLS1_stable	ABL	Yes	Yes	sep-12
Bolund	Bolund_neutral	SL	No	Yes	sep-12
Benakanahalli	Benak_blind_stable	SL	Yes	No	late 2013
Alaiz	Alaiz_sensitivity	SL/ABL	No	Yes	sep-12
Alaiz	Alaiz_blind_neutral	SL/ABL	No	Yes	sep-12
Alaiz	Alaiz_neutral	SL/ABL	No	No	early 2013
Alaiz	Alaiz_blind_stable	SL/ABL	Yes	No	early 2013
Alaiz	Alaiz_stable	SL/ABL	Yes	No	early 2013

DTU models: TBD

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Wakebench: WG6
WT Wakes. Theoretical verification

Test Case	Benchmark	Data Ready	Due Date
Axisymmetric Self Similar Wake	Wake width Wake deficit	Now	May, 2012
Axisymmetric Self Similar Wake with Swirl	Wake width Wake deficit	TDB	TBD
Infinite Wind Farm	7D	Now	July, 2012
Infinite Wind Farm	10D	Now	September, 2012

DTU models: EllipSys:AL/AD/FR, DWM, InfiniPark & Ellipsys-LES

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Wakebench: WG7
WT Wakes. Wind tunnel experiments

Test Case	Benchmark	Data Ready	Due Date
Single Turbine Wake	Low Turbulence Homogeneous	Now	June, 2012
Single Turbine Wake	High Turbulence ABL	Now	August, 2012
Multiple Turbine Wake	Row Aligned	Now	October, 2012
Multiple Turbine Wake	Staggered	Now	TBD

DTU models: FUGA, DWM, EllipSys-AL/AD, InfiniPark

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Wakebench: WG8
Small wind farms / Individual WT

Test Case	Benchmark	Data Ready	Due Date
Sexberium	Varying wind direction Mean Wake Turbulence quantities	Now	July, 2012
EWTW	Multiple wake merging	Now	September, 2012
TWICS	Single turbine wake Mean deficit profiles at different stabibility	Fall, 2012	TBD

DTU models: WASP, InfiniPark, FUGA, DWM, RDWM, EllipSys-AL/AD & SCADIS

Wakebench: WG9
Large wind farms

Test Case	Benchmark	Data Ready	Due Date
Horns Rev	Wind speed direction variation	Now	June, 2012
Horns Rev	Stability	Now	August, 2012
Horns Rev	Turbulence Intensity	Now	October, 2012
Horns Rev	Spacing distance	Now	December, 2012
Lillgrund	Southwest	Now	February, 2013
Lillgrund	Southeast	Now	April, 2013

DTU models: FUGA, WASP,
InfiniPark, DWM, RDWM & EllipSys-AL/AD

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Actions in 2012

- Release of WindBench platform, Ultimo april 2012;
- M8, deadline 12 mar 2012;
- Prepare validation dataset based on SCADA dataset;
- Workshop on the Model Evaluation Protocol; NREL 3-5 October 2012.