

# The SWiFT Benchmarks

Part of IEA Wind Task 31 Phase 3 (2018-2019)  
Meeting #4 – February 26, 2019 08:00 MST

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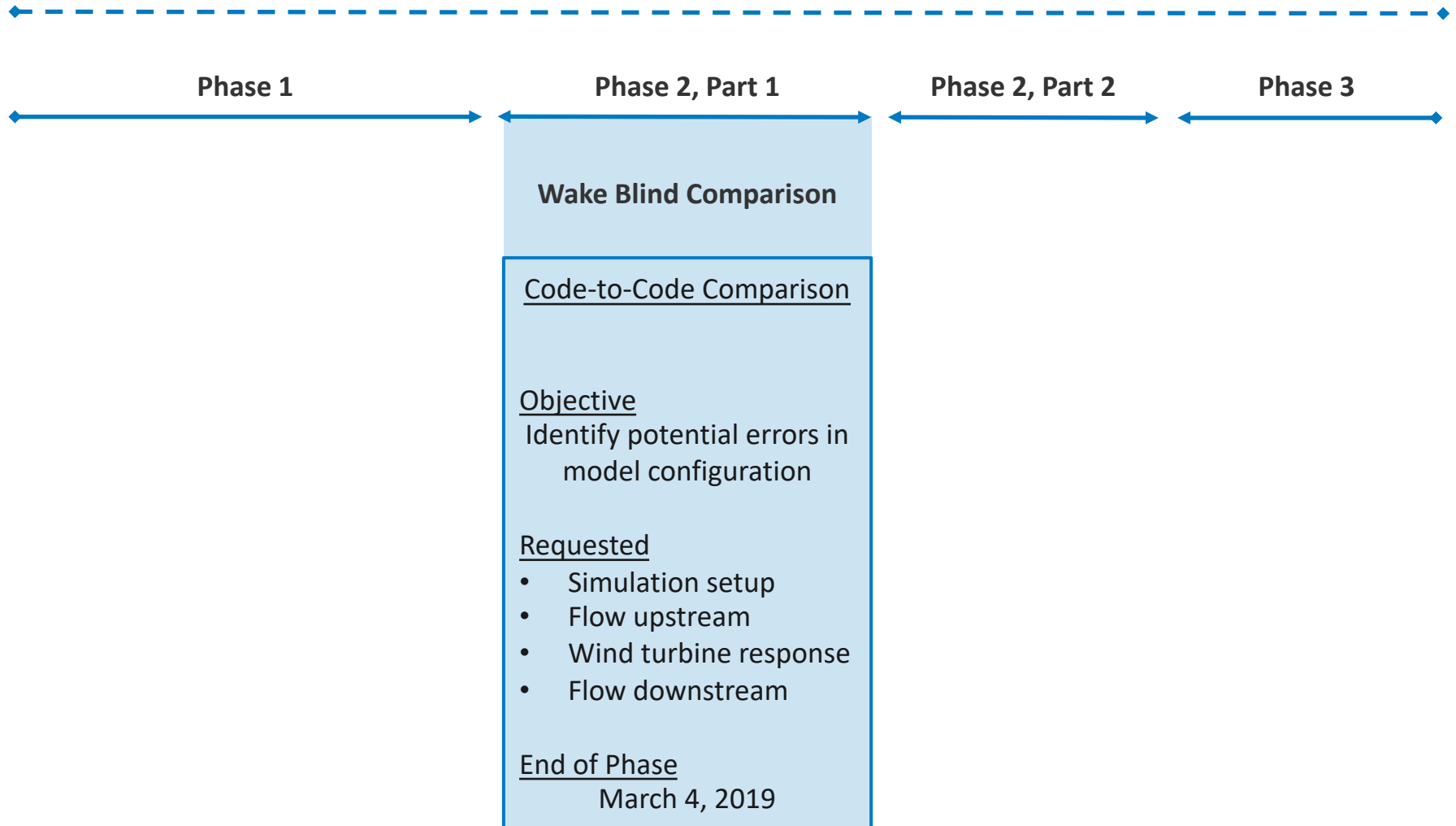
**P. Doubrawa, L. A. Martínez-Tossas, E. Branlard, P. Moriarty**

*National Renewable Energy Laboratory*

**T. Herges, D. Maniaci**

*Sandia National Laboratories*

today



# Phase 1 – Code Calibration

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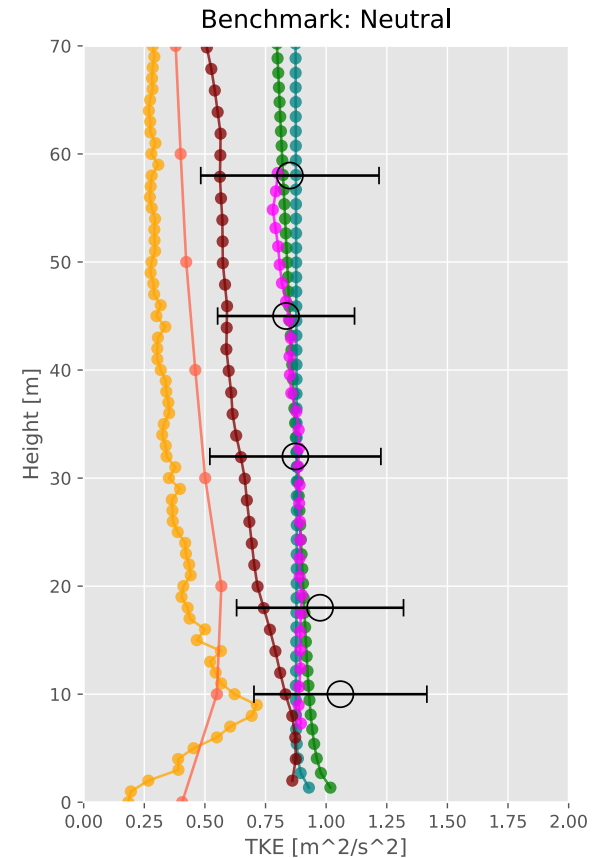
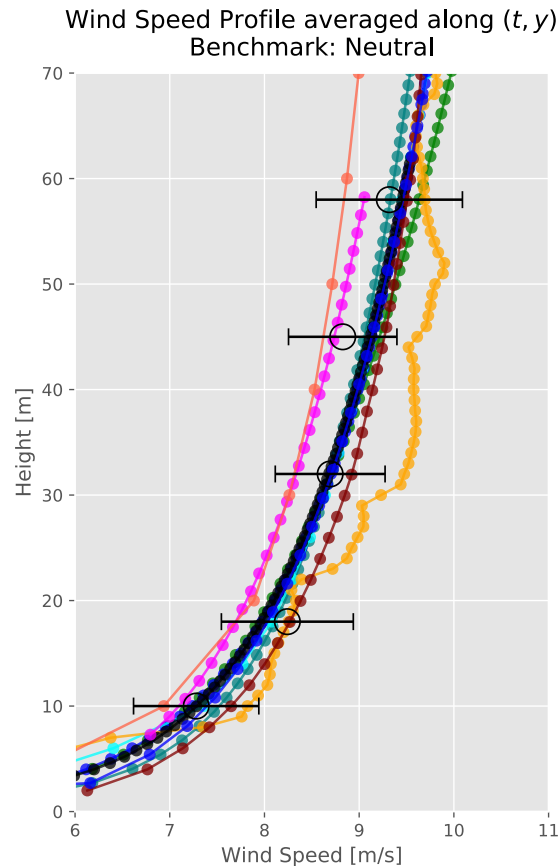
Participation and Results

# Participation

- These are the received uploads for Phase 1

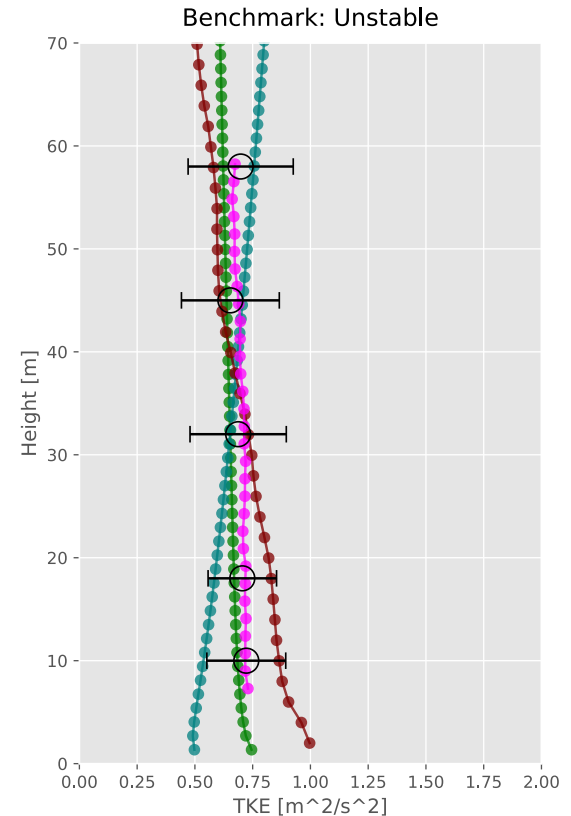
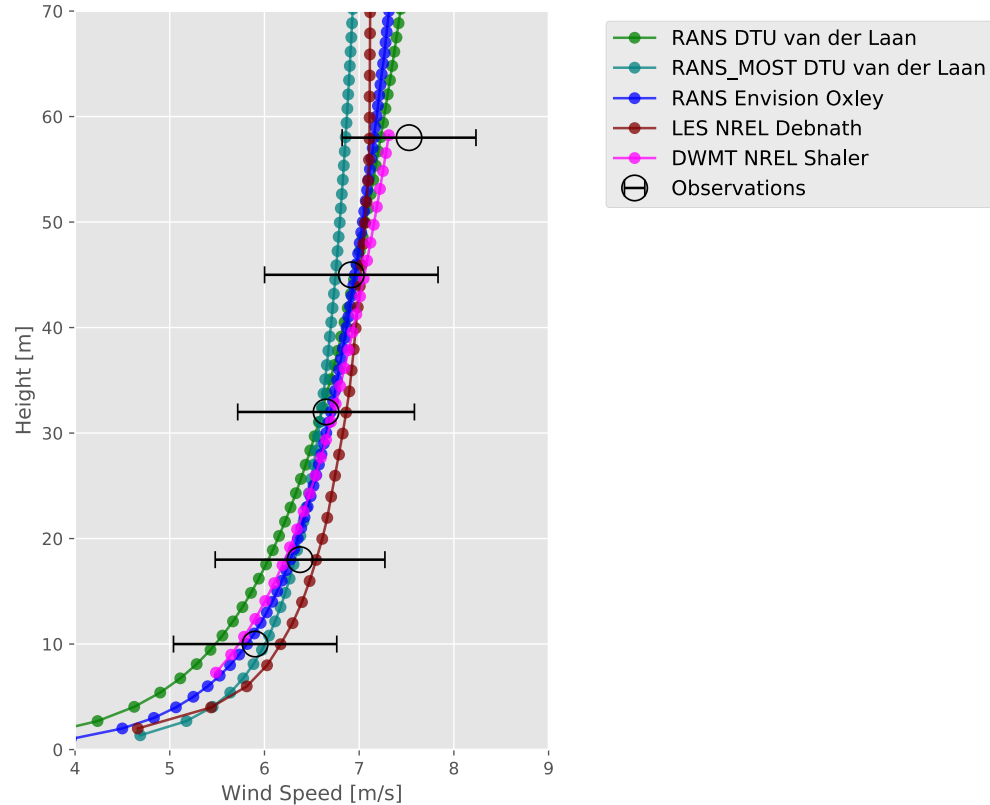
| MODEL TYPE | PARTICIPANT ID           | PHASE 1 |   |   |        |   |   |         |   |   |
|------------|--------------------------|---------|---|---|--------|---|---|---------|---|---|
|            |                          | SETUP   |   |   | INFLOW |   |   | TURBINE |   |   |
|            |                          | N       | U | S | N      | U | S | N       | U | S |
| SSAM       | IFPEN_CATHELAIN_SSAM     | x       |   |   | x      |   |   | x       |   |   |
| DWMT       | NREL_JONKMAN_DWMT        | x       | x | x | x      | x | x | x       | x | x |
|            | NREL_JONKMAN_DWMT_LES    |         |   |   |        |   |   | x       | x |   |
| RANS       | DTU_VANDERLAAN_RANS_MOST | x       | x | x | x      | x | x | x       | x | x |
|            | DTU_VANDERLAAN_RANS      | x       | x | x | x      | x | x | x       | x | x |
|            | ENVISION_OXLEY_RANS      | x       | x |   | x      | x |   | x       | x |   |
|            | PPEGmbH_SCHLEZ_RANS      | x       |   | x | x      |   | x | x       |   | x |
| LES        | NREL_DEBNATH_LES         | x       | x |   | x      | x |   | x       | x |   |
|            | IFPEN_CATHELAIN_LES      | x       |   |   | x      |   |   | x       |   |   |
|            | SNL_MANIACI_LES          | x       |   |   | x      |   |   | x       |   |   |
|            | FORWIND_KRUEGER_LES      | x       |   |   | x      |   |   | x       |   |   |
|            | DTU_ANDERSEN_LES         | x       | x |   |        |   |   | x       | x |   |

# Simulated vs. Measured Inflow – Neutral Benchmark

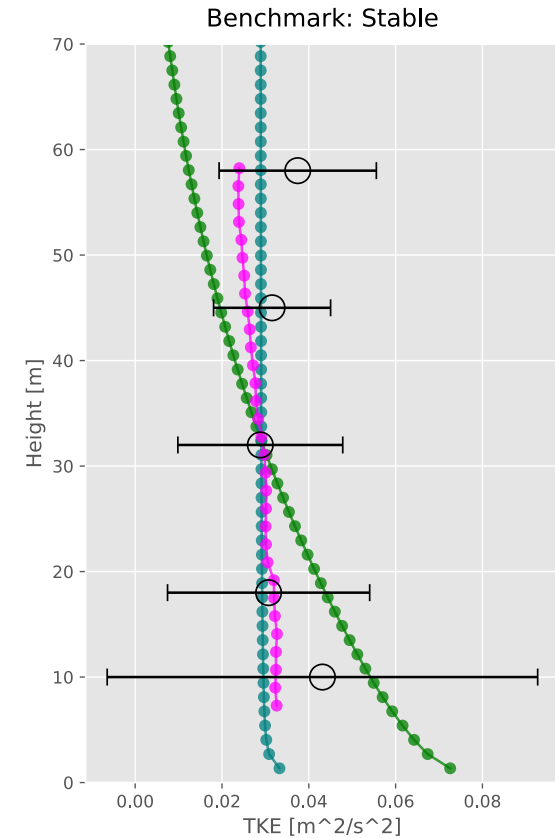
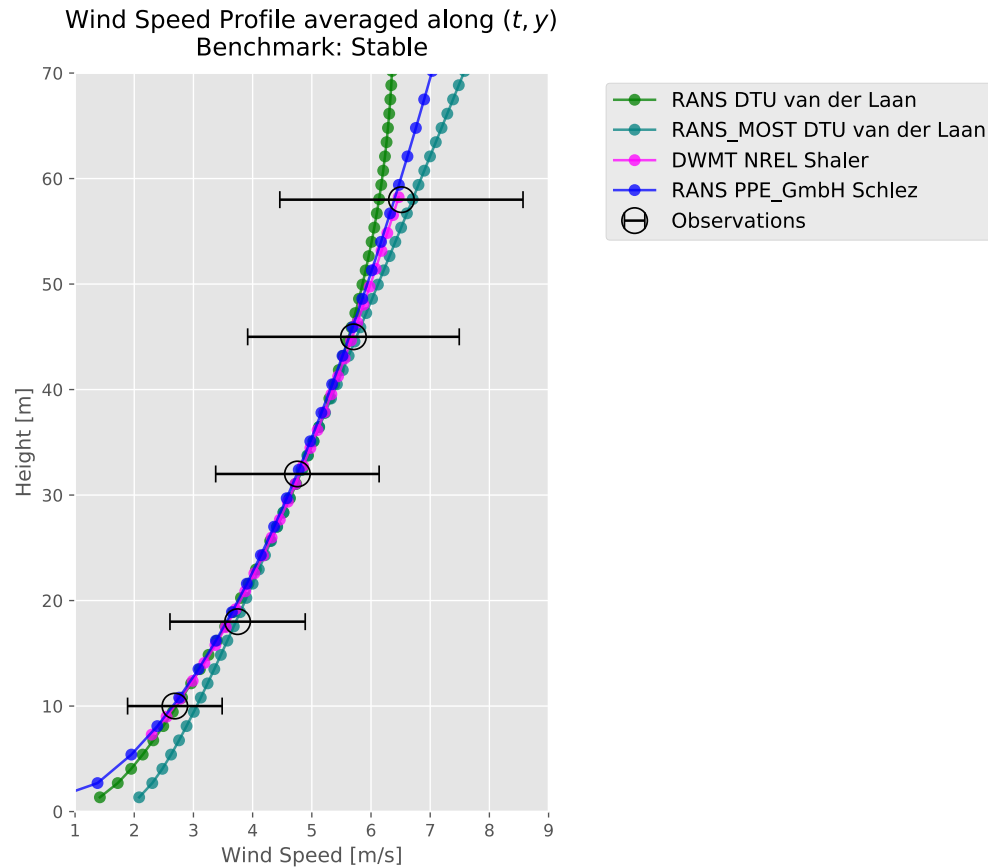


# Simulated vs. Measured Inflow – Unstable Benchmark

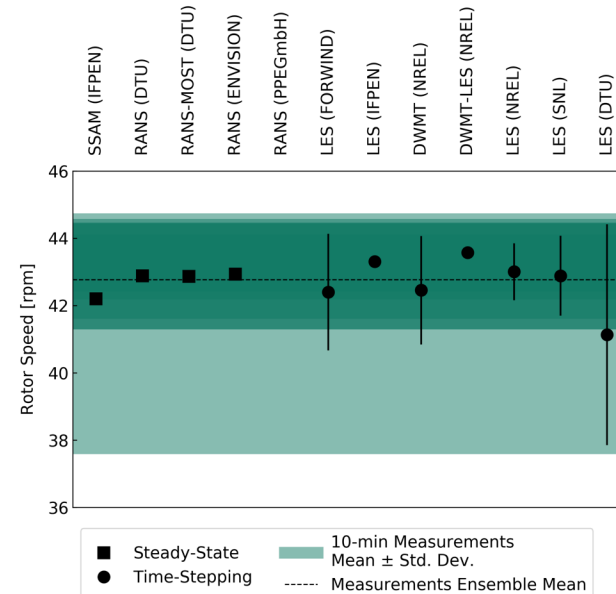
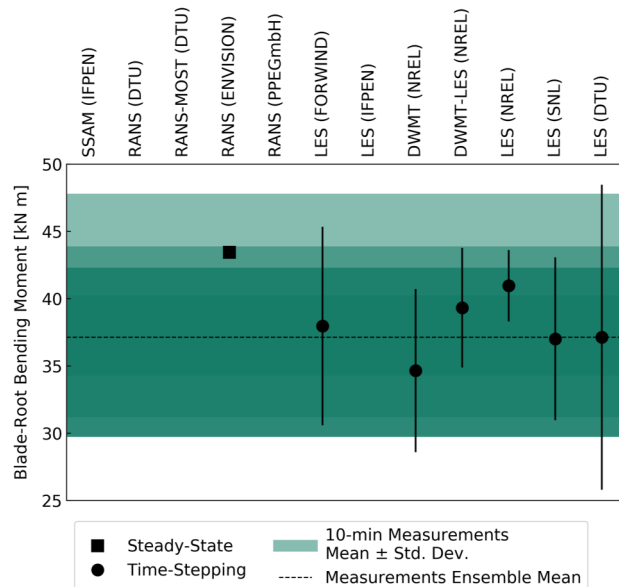
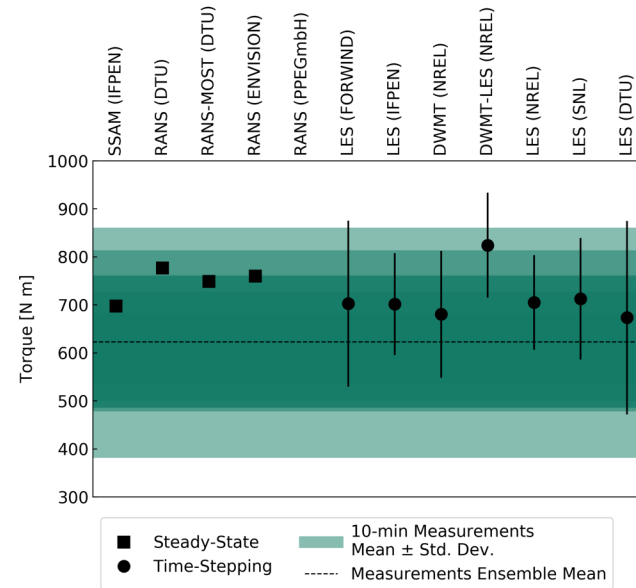
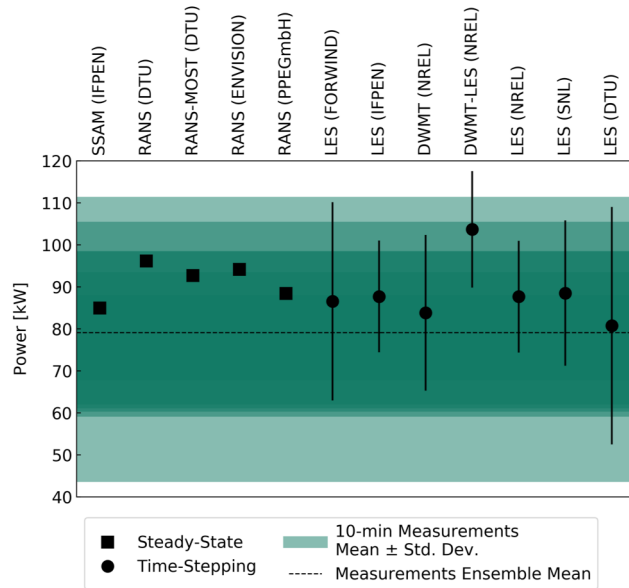
Wind Speed Profile averaged along  $(t, y)$   
Benchmark: Unstable



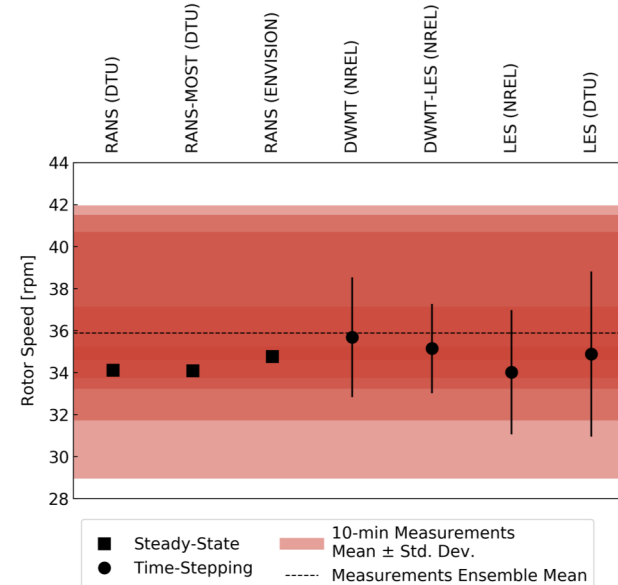
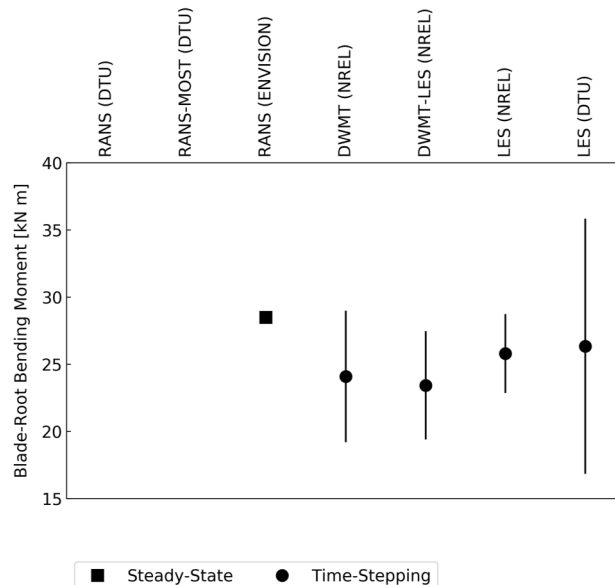
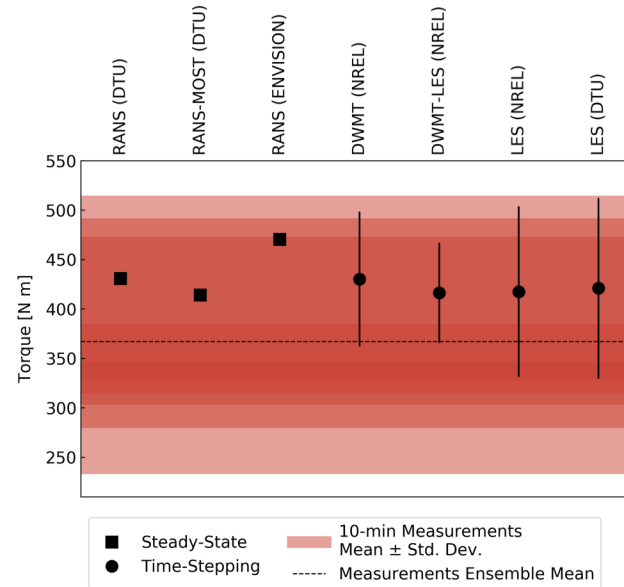
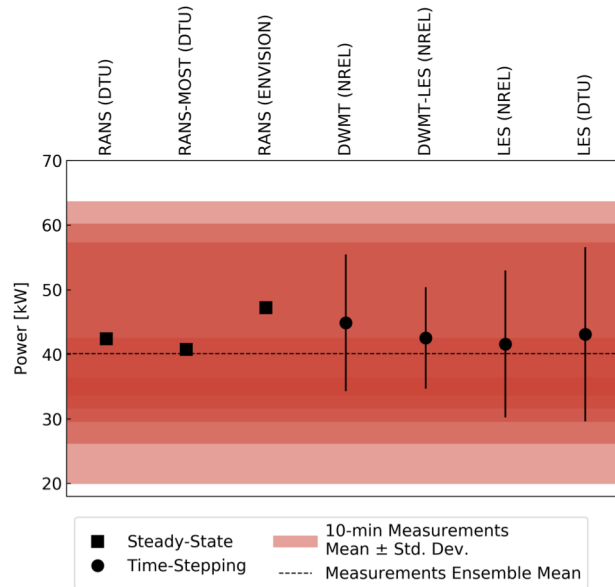
# Simulated vs. Measured Inflow – Stable Benchmark



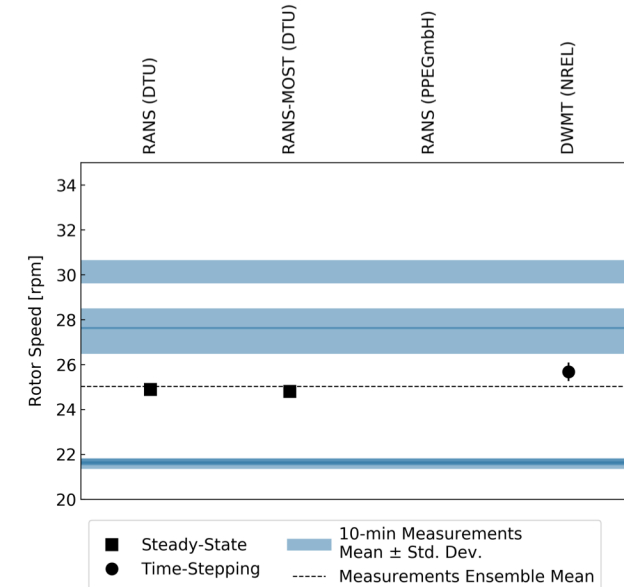
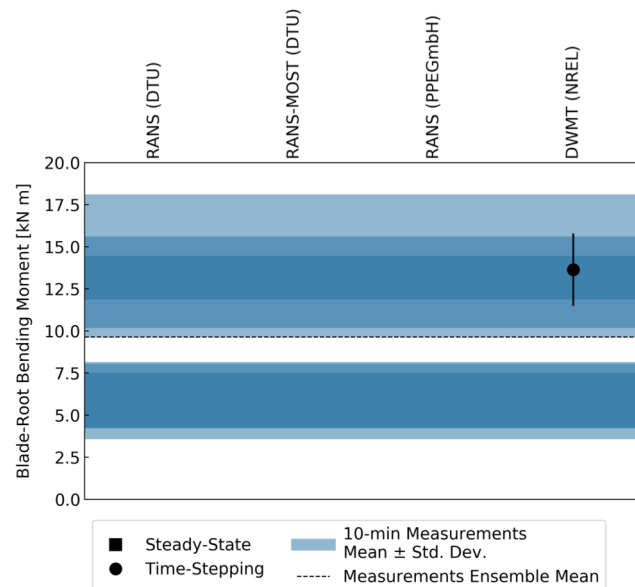
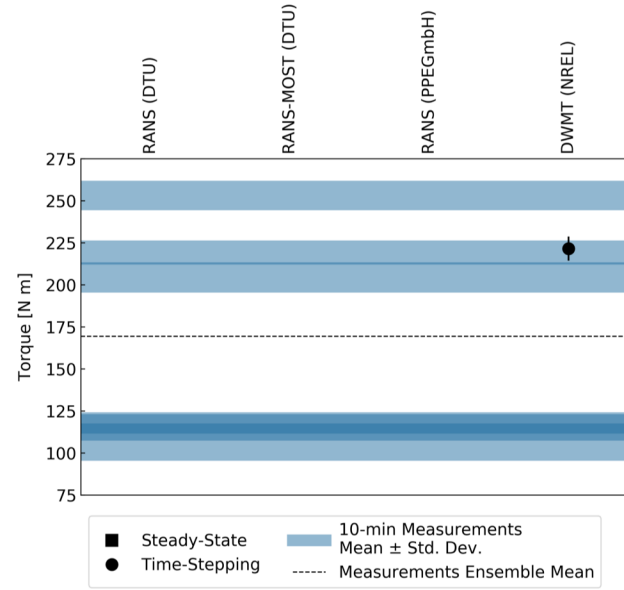
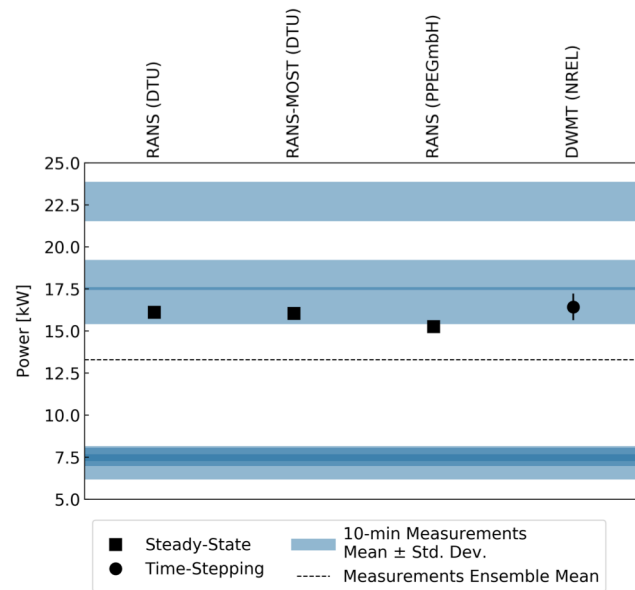
# Simulated vs. Measured WT Response – Neutral Benchmark



# Simulated vs. Measured WT Response – Unstable Benchmark



# Simulated vs. Measured WT Response – Stable Benchmark



# Phase 2 – Blind Comparison

Part 1 – Model-Model Comparison

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Important Information

# Wind Turbine Model

- Stick to the model referred to as “v1”:

`wt_data/v1/`

- The model has received minor updates, but nothing that would change the results

- Preferably, use the model for OpenFAST2 (OF2)

`wt_data/v1/OpenFAST_model/SNLV27_OF2.fst`

- A NALU version (based on OF1) was added:

`wt_data/v1/OpenFAST_model_NALU`

- We will likely release a model “v2” to be used **for the next phases**. Some values will be updated based on recent results from the measurement campaign (losses, controller settings, maybe aero..). Paula will keep everyone updated.

# Time

- **Don't upload the spin up!** All data is used in the analysis.

*“the time is given in units of seconds, since the start of the simulation usable time (i.e., not counting spin-up)”*

- **Upload converged results.** Run for longer...

# Wind Turbine Model

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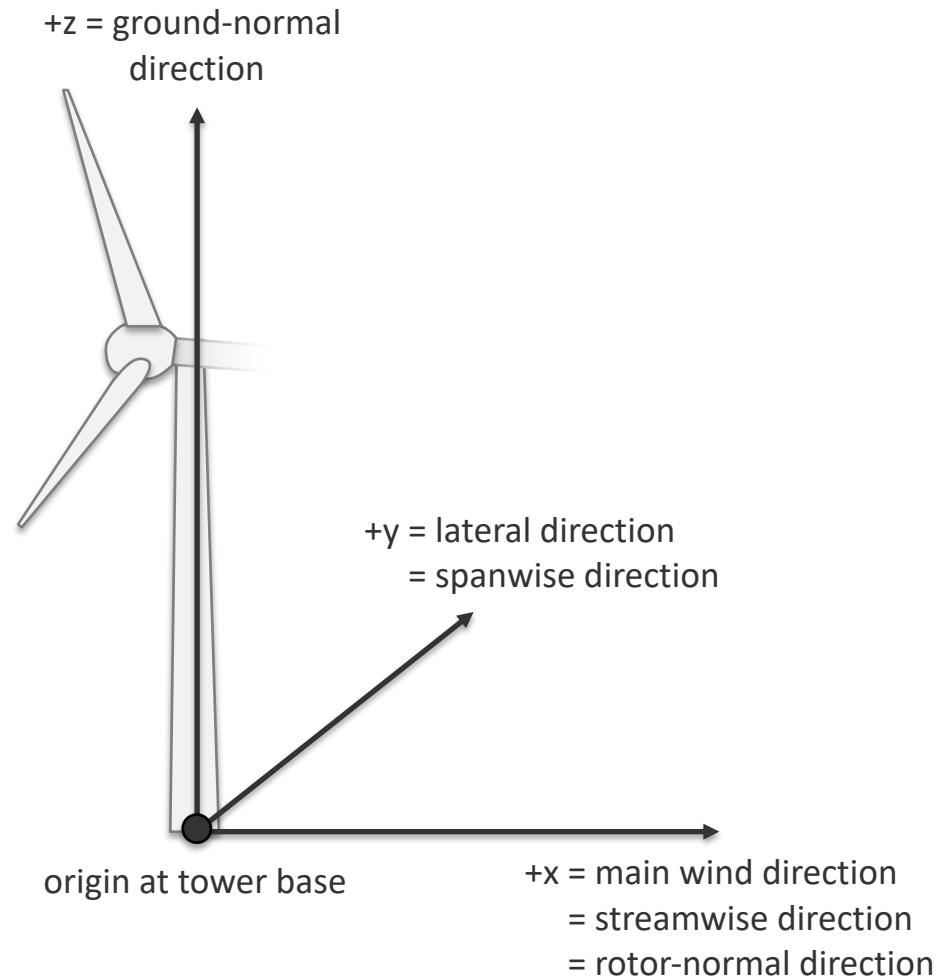
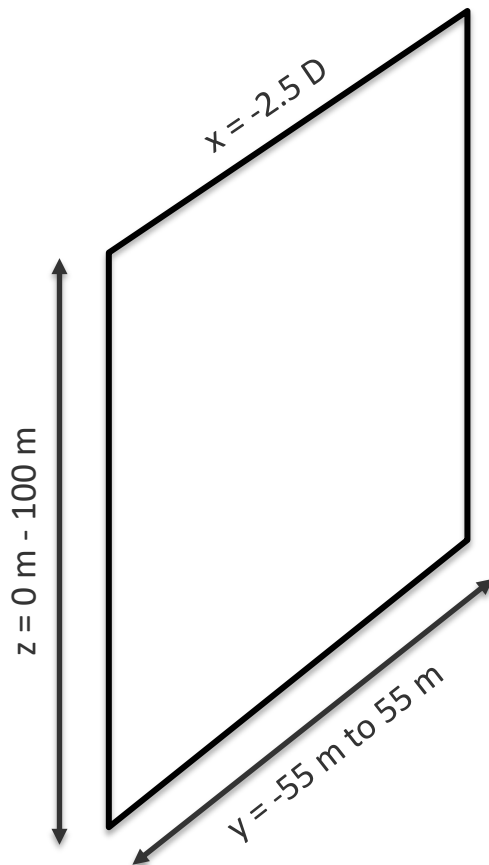
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# Atmospheric Inflow – one .nc file

- Be mindful of coordinates
- Be mindful of file size



# Turbine Response – one .txt file

- More variables requested (updated template in repo)
- Use specified column names
- Check units
- Comma separated
- Missing values: NaN not -999

## Requested Variables

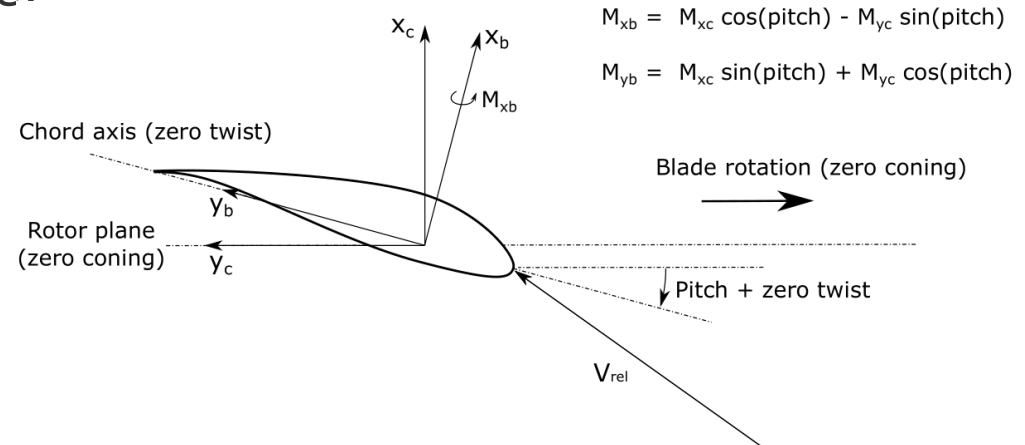
- time\_[s]
- hub\_wind\_speed\_[m\_s-1]
- rotor\_power\_[kW]
- rotor\_torque\_[N\_m]
- rotor\_speed\_[rpm]
- blade\_pitch\_[deg]
- blade\_root\_flap\_moment\_[N\_m]
- blade\_root\_edge\_moment\_[N\_m]
- generator\_power\_[kW]
- generator\_torque\_[N\_m]
- thrust\_force\_[N]
- thrust\_coefficient\_-]

# Blade root moments

- At the blade root (not the rotor center)
- In the blade coordinate system:
  - $y_b$ : points towards the trailing edge, along the chord line at zero twist
  - $z_b$ : points towards the tip, along the pitch axis
- Edgewise moment about  $x_b$  ; Flapwise moment about  $y_b$

- For OpenFAST users, they are:

- `RootMxb==RootMEdg`
- `RootMyb==RootMFlp`

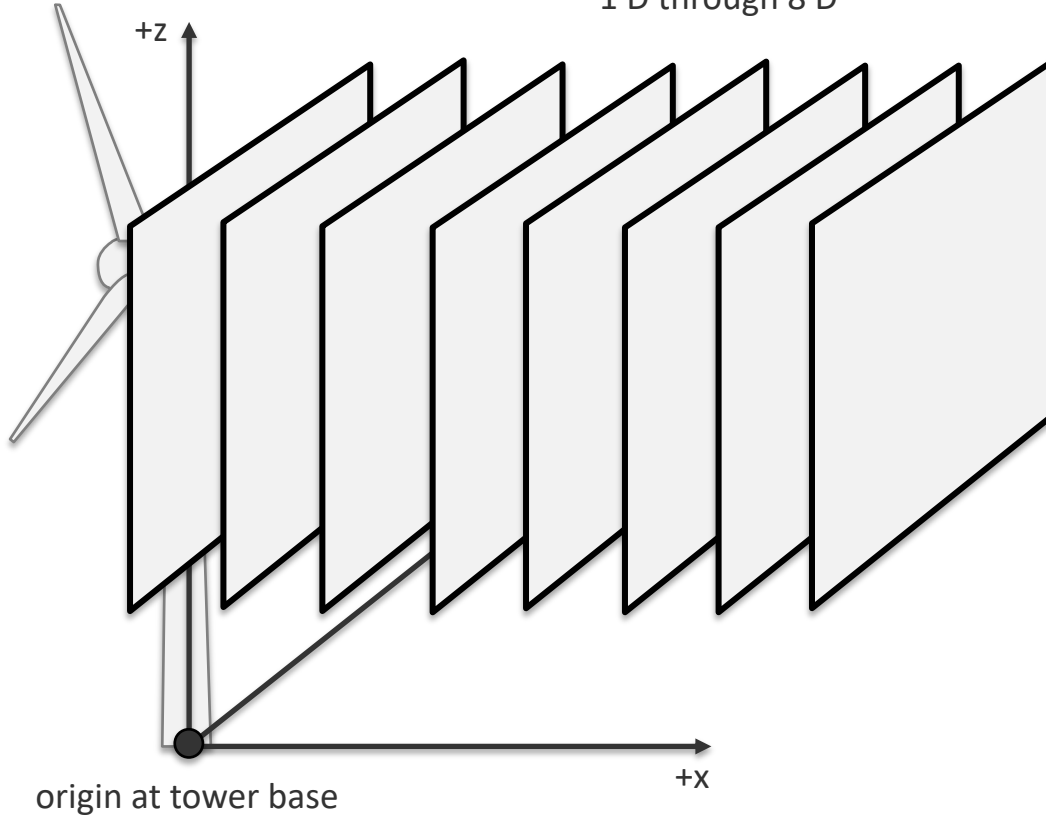


- They are not the in-plane and out-of-plane moments (due to the pitch angle), but very close...

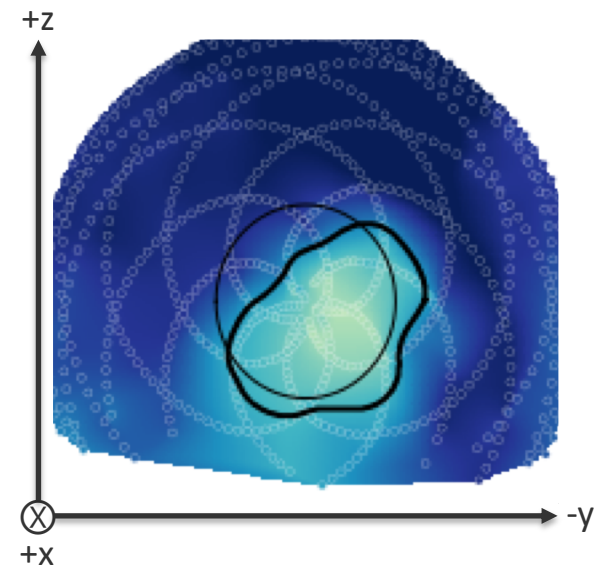
# Wake Flow – eight .nc files

- Be mindful of coordinates

one file for each downstream distance  
1 D through 8 D



Looking at the wind turbine,  
towards the downstream direction ( $+x$ )



# Summary

- Next meeting in Boulder, CO – March 11-12
- Phase 2 Part 1 results due March 4
- Publication of results in journal article (late summer time frame)



# Phases 1&2 Q&A

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# Thank you for participating!

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