

# The SWiFT Benchmarks

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

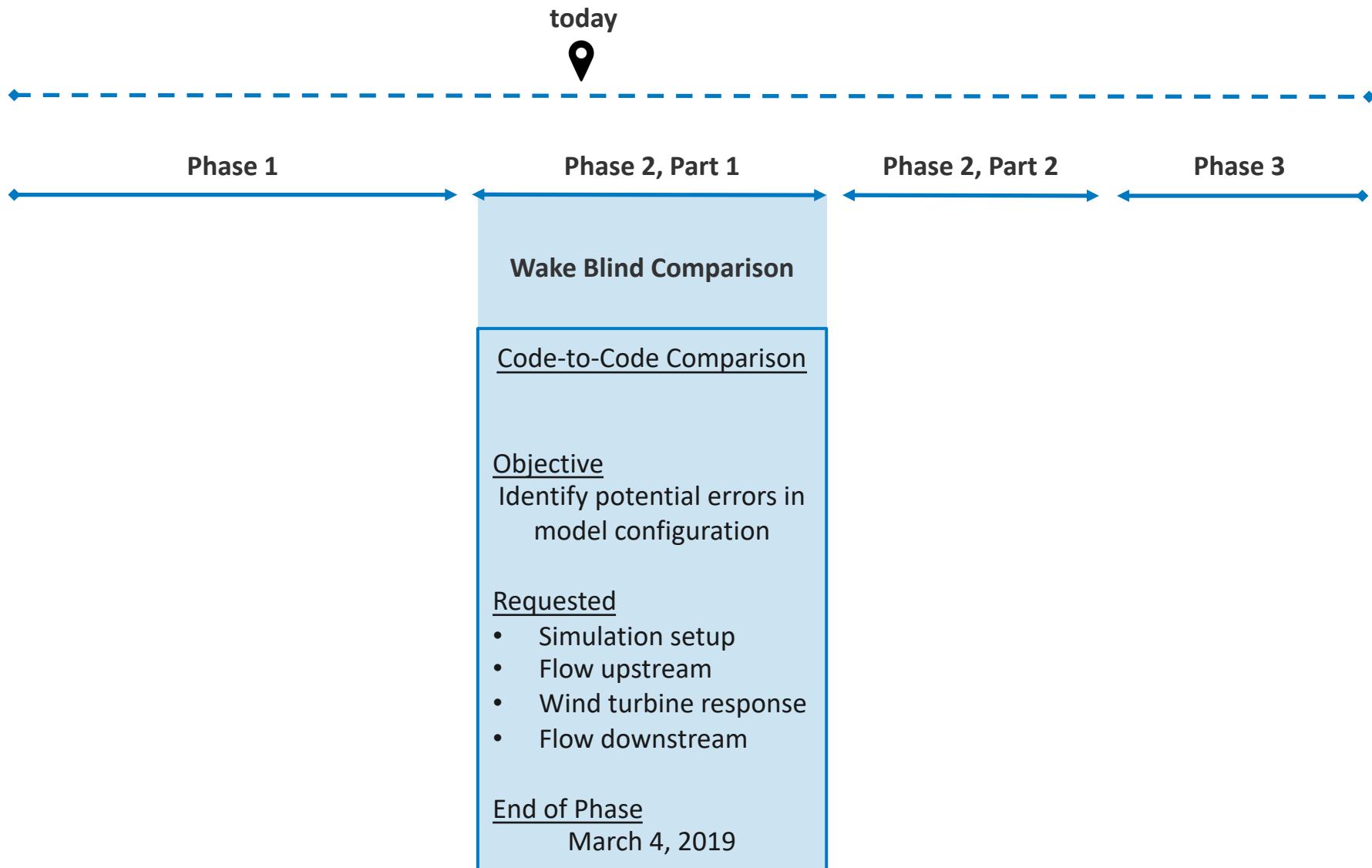
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*National Renewable Energy Laboratory*

**T. Herges, D. Maniaci**

*Sandia National Laboratories*



# Phase 1 – Code Calibration

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Participation and Results

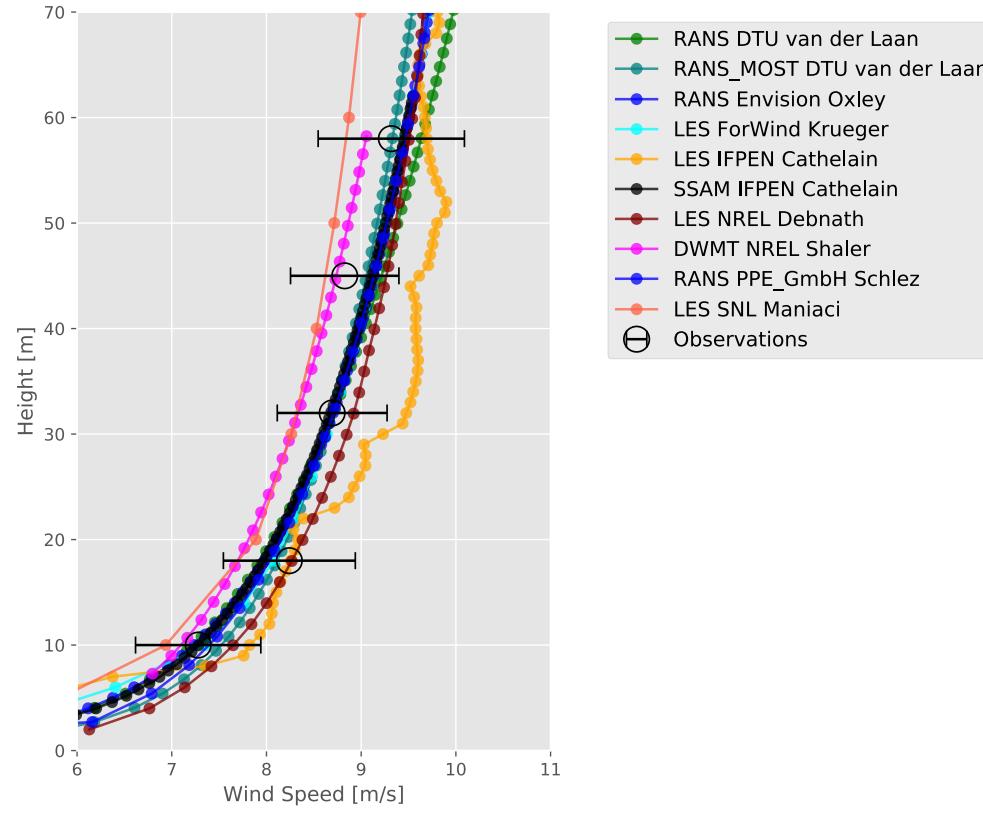
# Participation

- These are the received uploads for Phase 1

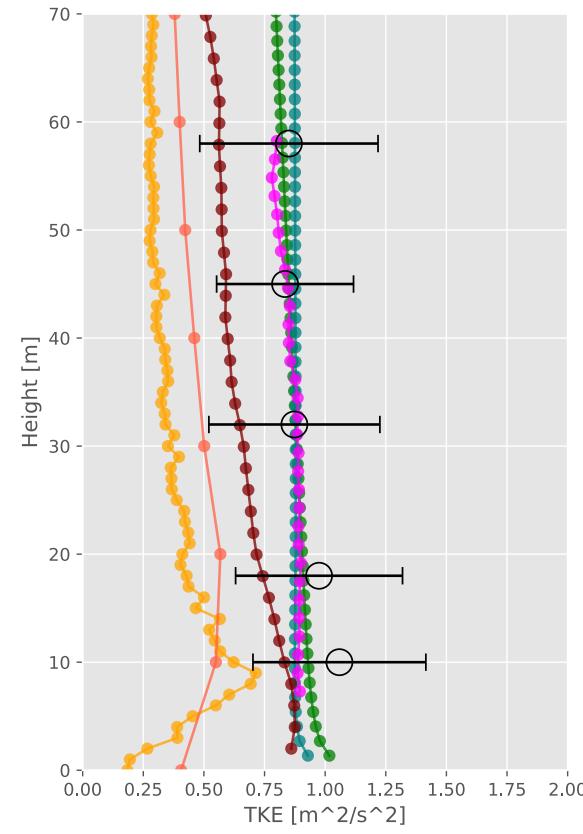
		PHASE 1								
MODEL TYPE	PARTICIPANT ID	SETUP			INFLOW			TURBINE		
		N	U	S	N	U	S	N	U	S
SSAM	IFPEN_CATHELAIN_SSAM	x			x			x		
DWMT	NREL_JONKMAN_DWMT	x	x	x	x	x	x	x	x	x
	NREL_JONKMAN_DWMTLES							x	x	x
RANS	DTU_VANDERLAAN_RANS_MOST	x	x	x	x	x	x	x	x	x
	DTU_VANDERLAAN_RANS	x	x	x	x	x	x	x	x	x
	ENVISION_OXLEY_RANS	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

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

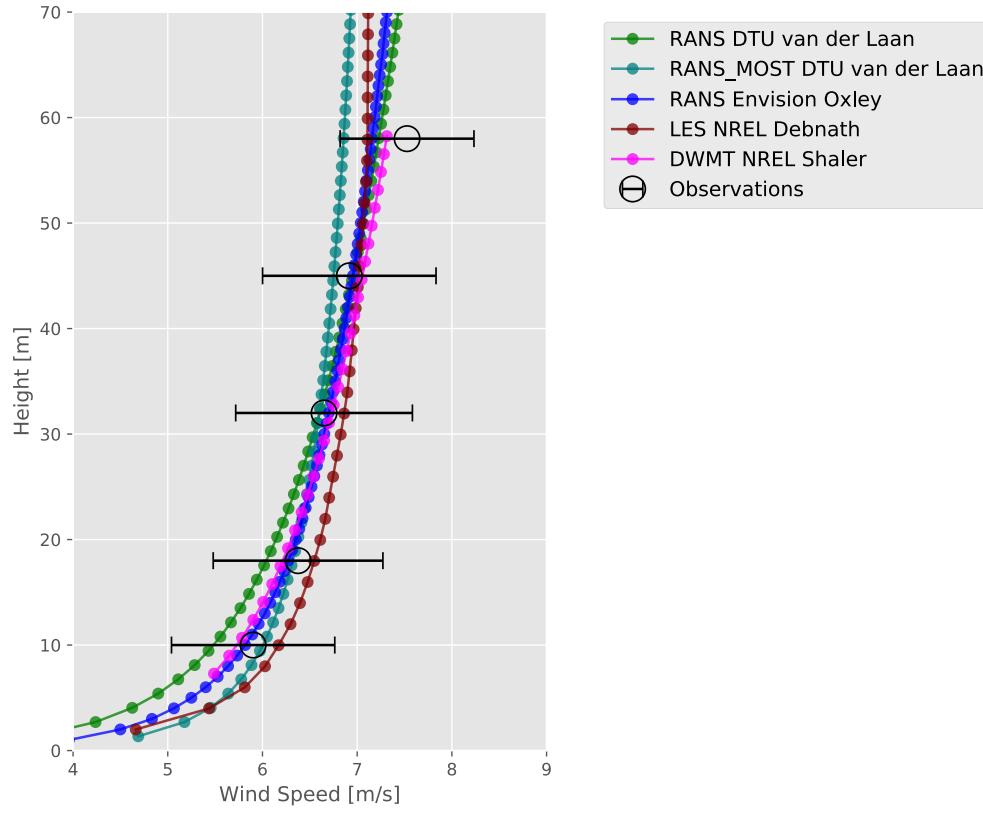


Benchmark: Neutral

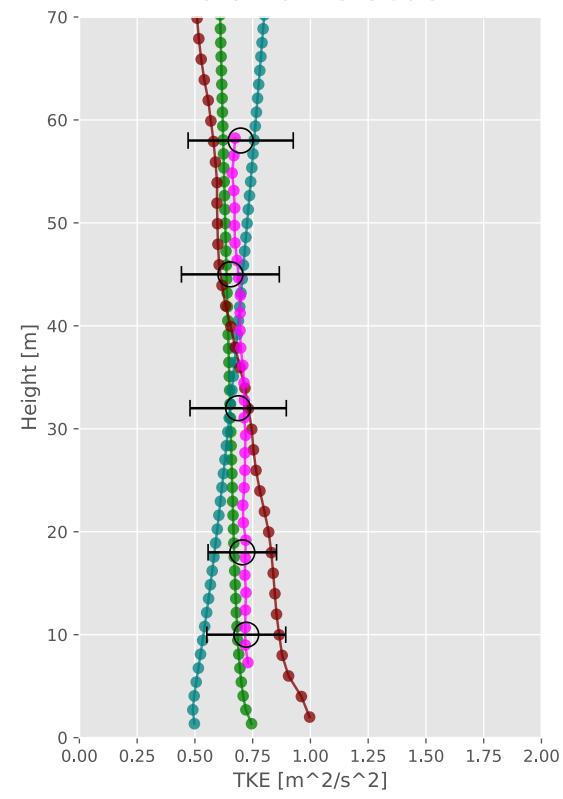


# Simulated vs. Measured Inflow – Unstable Benchmark

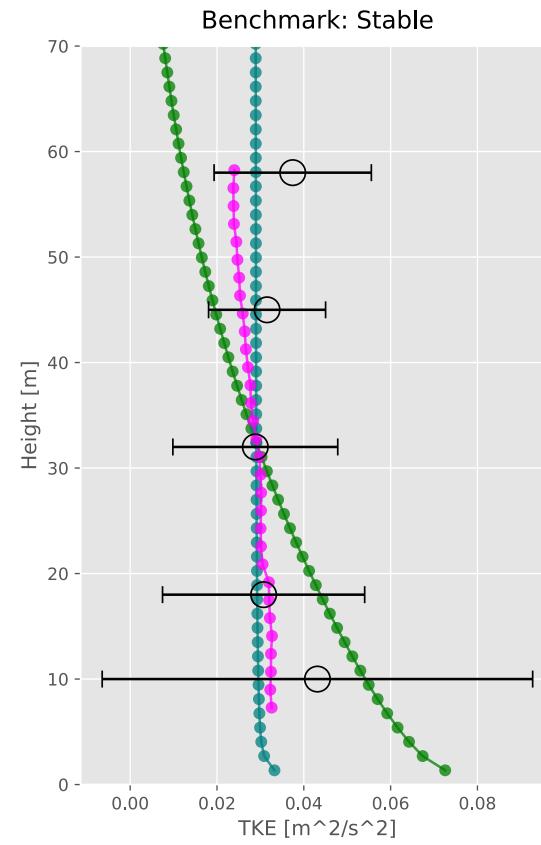
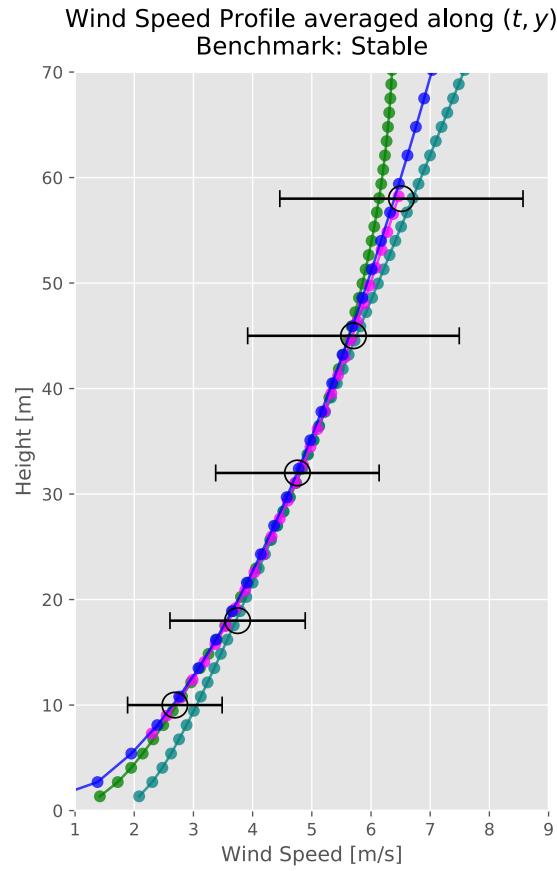
Wind Speed Profile averaged along  $(t, y)$   
Benchmark: Unstable



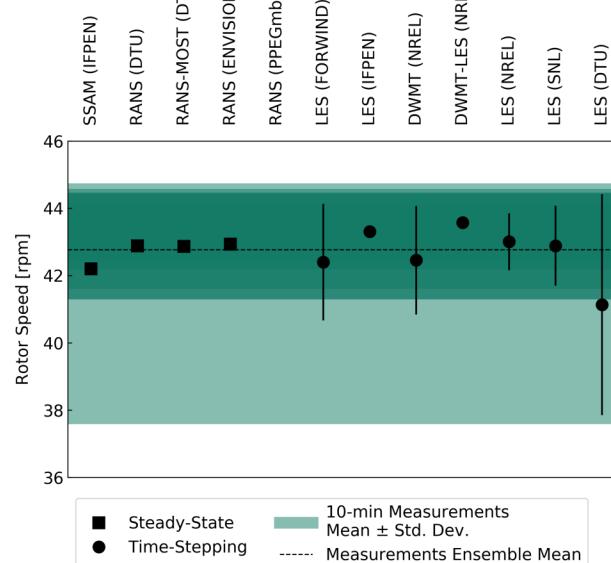
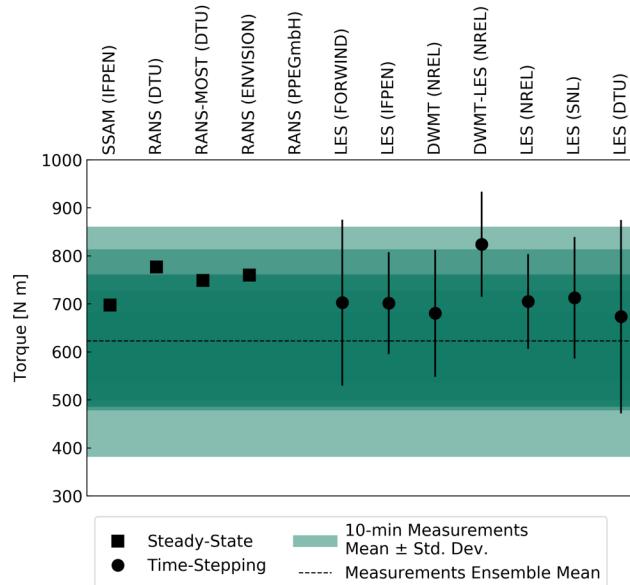
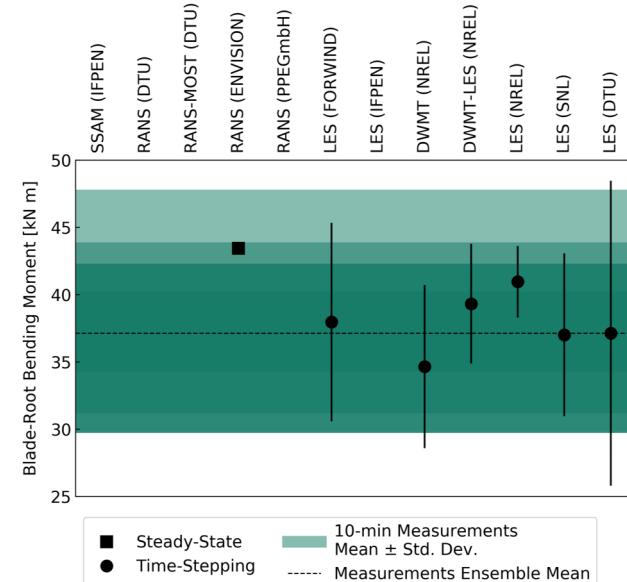
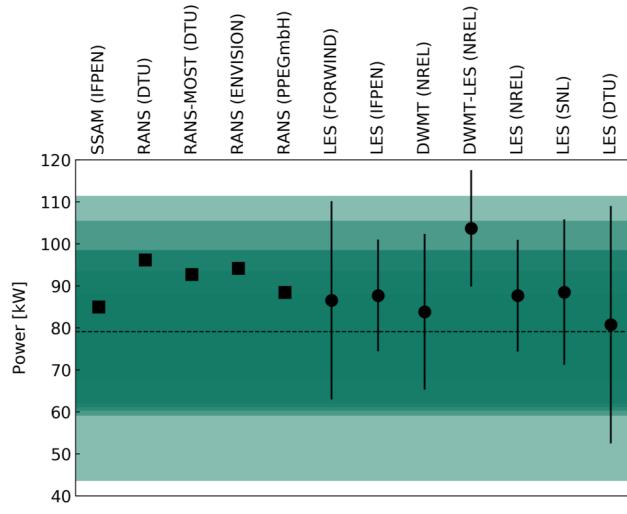
Benchmark: Unstable



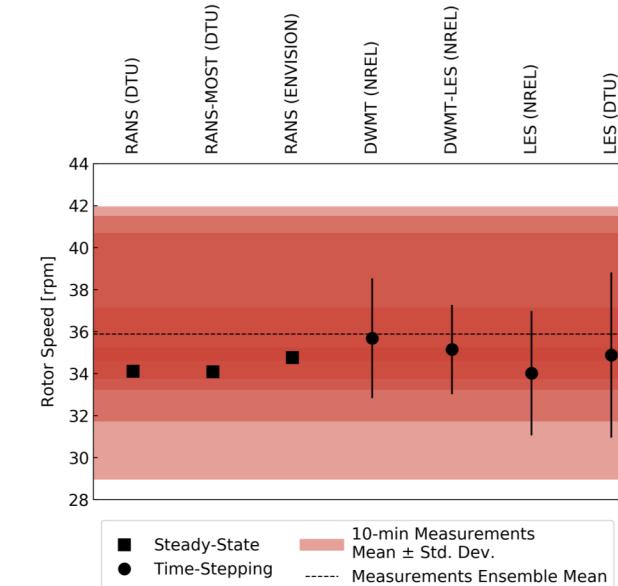
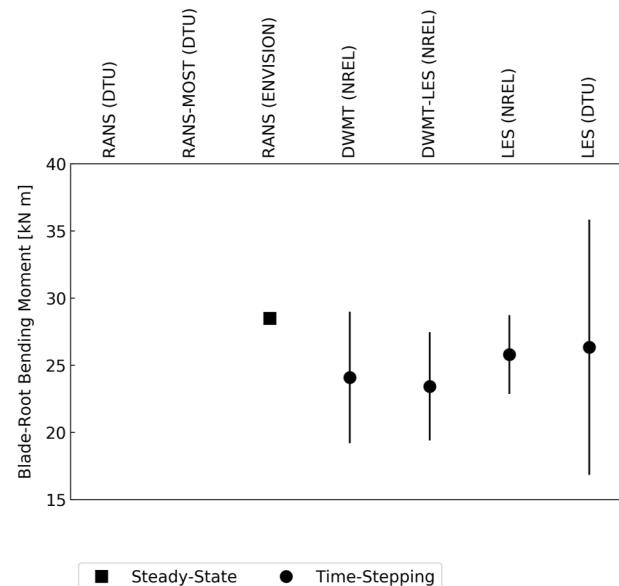
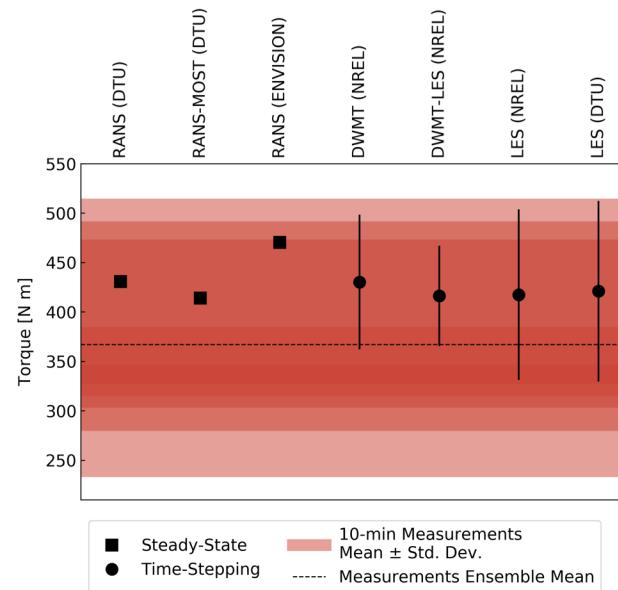
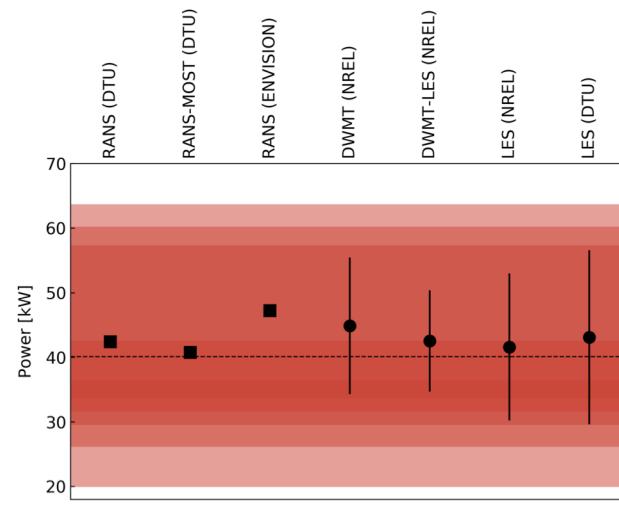
# Simulated vs. Measured Inflow – Stable Benchmark



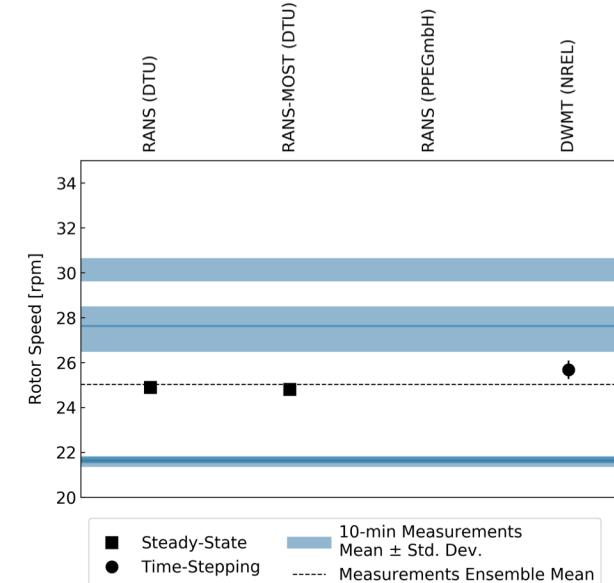
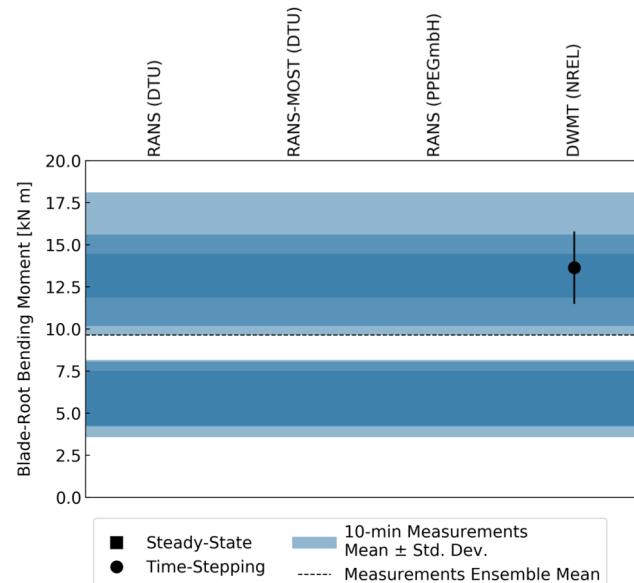
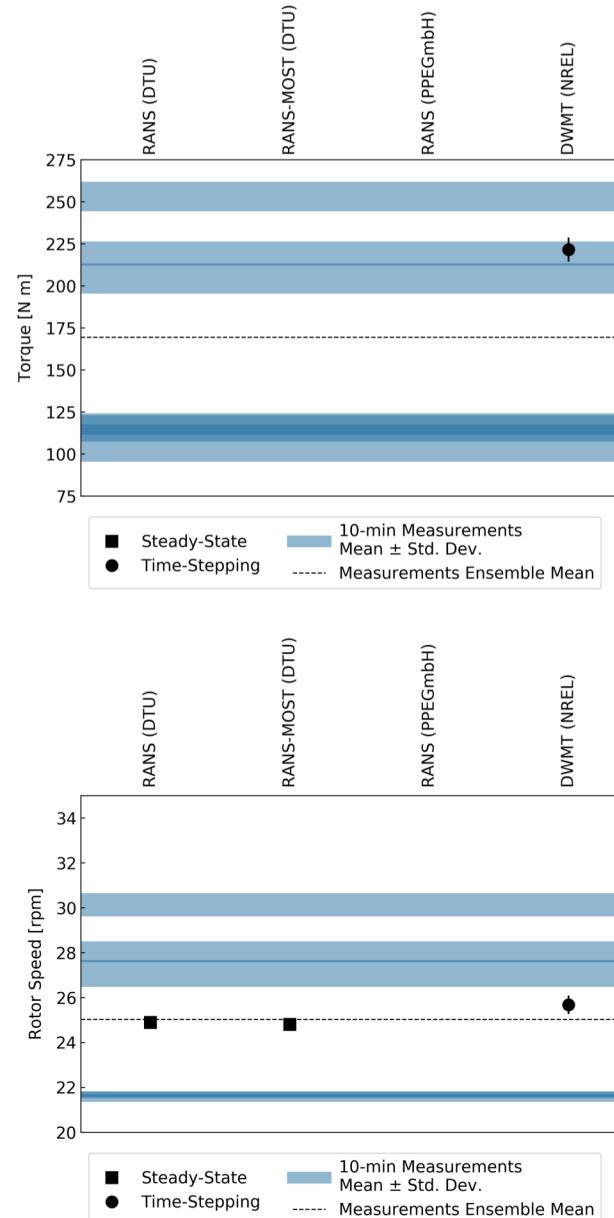
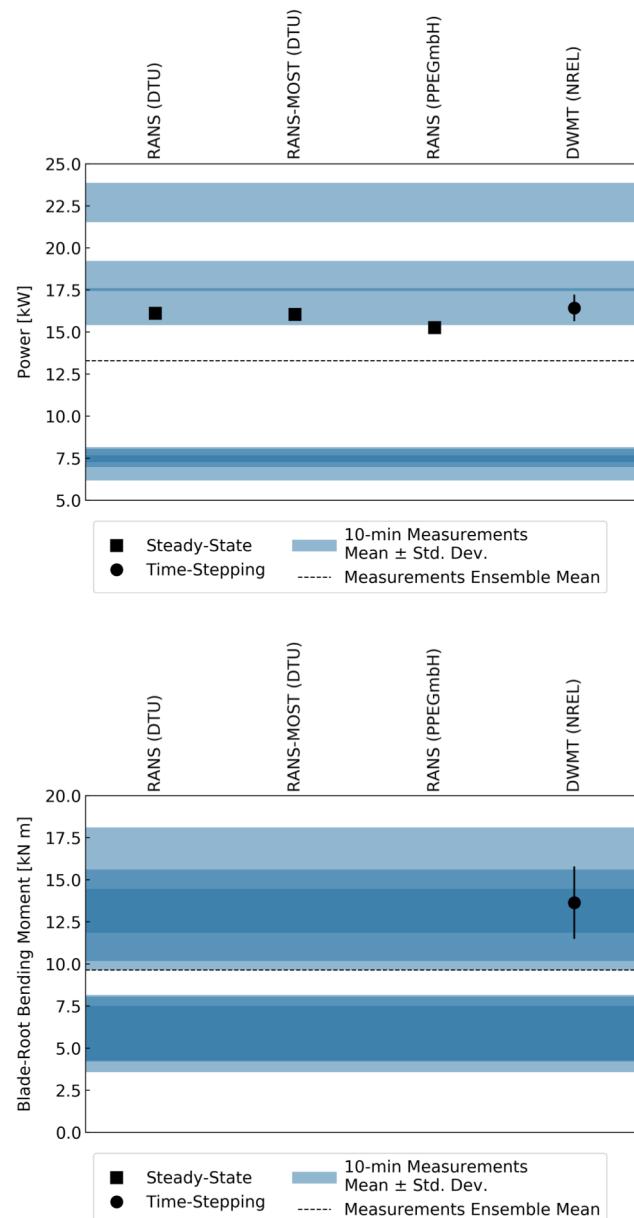
# Simulated vs. Measured WT Response – Neutral Benchmark



# 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.

- **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...

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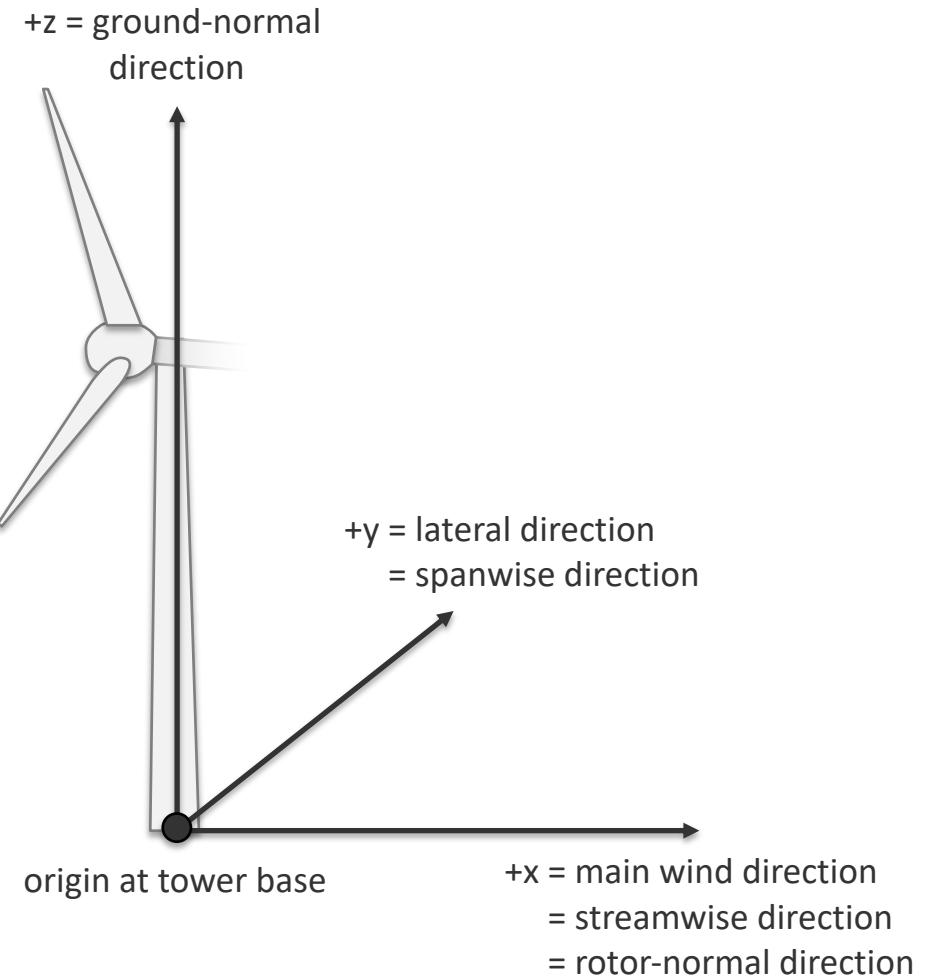
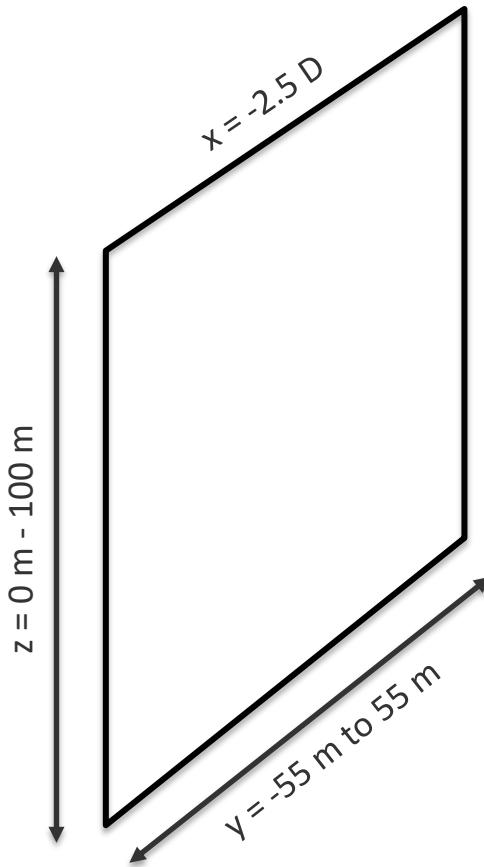
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# Atmospheric Inflow – one .nc file

- 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

This is the upstream ( $x=-2.5 D$ ) wind speed, to ensure the turbine response uploaded in the .txt files is consistent with the upstream flow uploaded in the netcdf files (an issue in Phase 1 where participants uploaded mismatched .txt and .nc files).

Thrust along the shaft (including tilt).

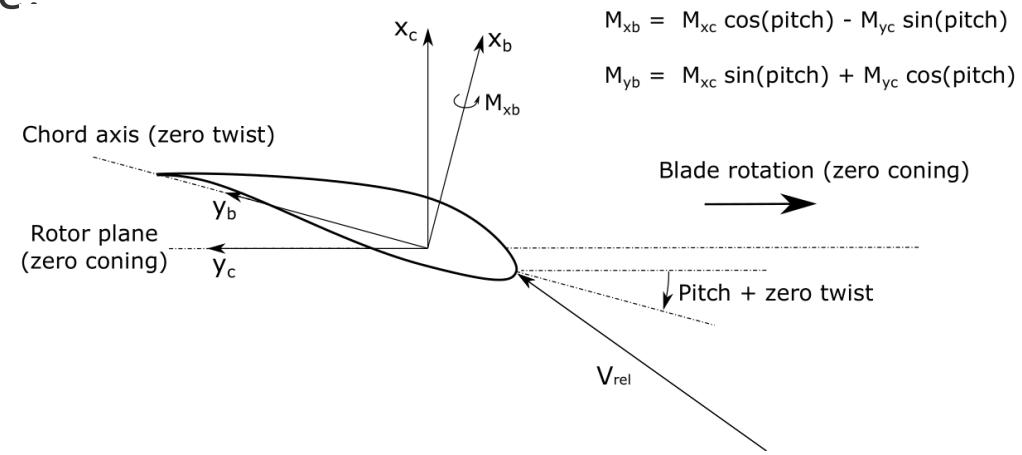
Computed using upstream velocity at  $x=-2.5 D$  and at the hub ( $y_{hub}, z_{hub}$ ).

## 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]
- aero\_thrust\_force\_[N]
- total\_thrust\_force\_[N]
- aero\_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==RootMFIp`

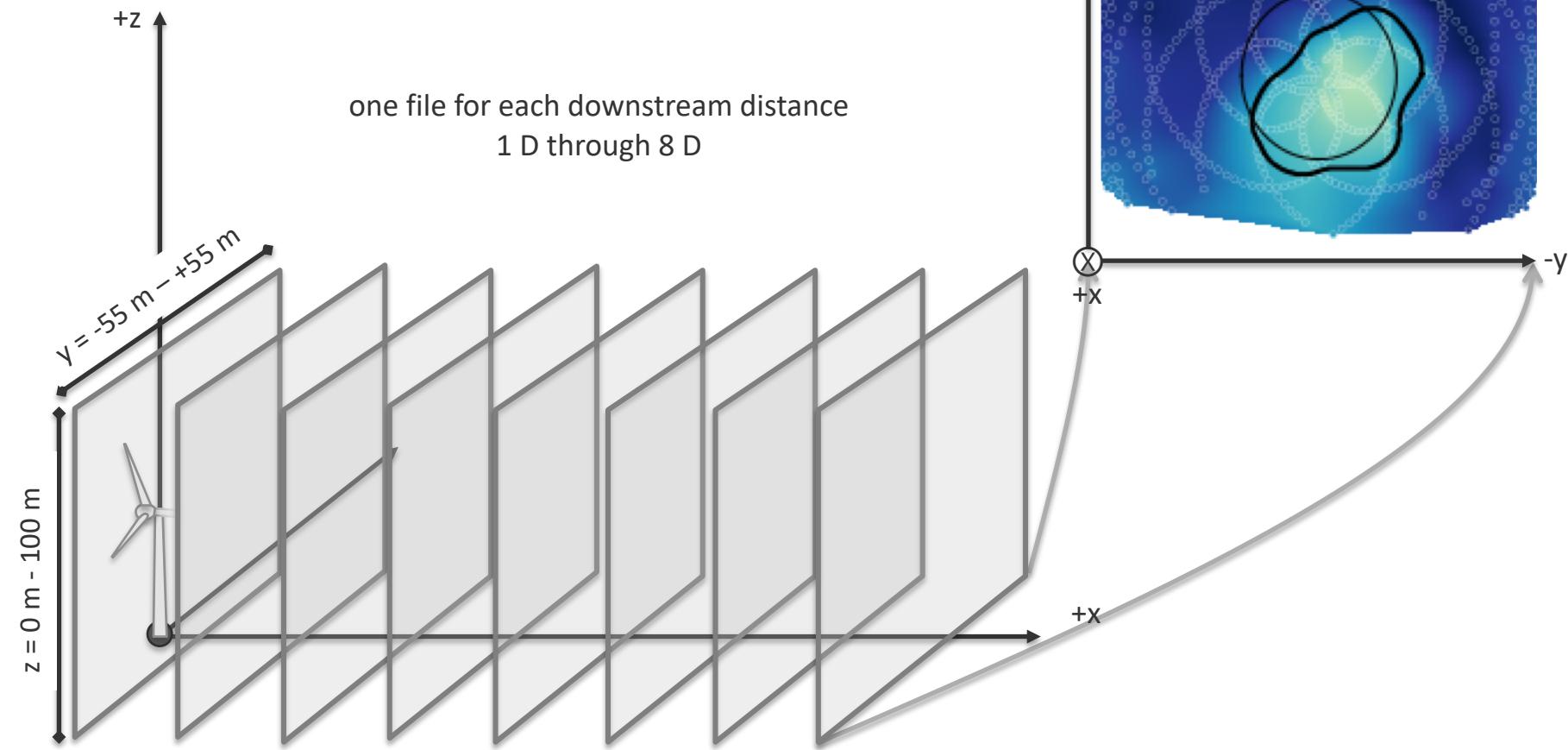


- They are not the in-plane and out-of-plane moments (due to the pitch angle), but very close...

# Wake Flow – eight .nc files

- Be mindful of coordinates

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)
  - fill out the poll  
<https://goo.gl/forms/u9tRi5XRadaPHDc63>



## Phases 1&2 Q&A

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# Thank you for participating!

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