WAKES AND FARMS SEMINAR SERIES

2024

Welcome to the TC on Wakes and Farms Seminar

Stefan Ivanell (UU, Sweden), Jens Sörensen (DTU, Denmark), Oğuz Uzol (METU Center, Turkey), Liu Yongqian (NCEPU, China), Philippe Chatelain (UCLouvain, Belgium), Joachim Peinke (Oldenburg University, Germany), Sandrine Aubrun (Centrale Nantes, France), Johan Meyers (KUL), Carlo L. Bottasso (TUM, Germany) , Marinos Manolesos (NTUA, Greece), Majid Bastankhah (DU, Great Britain)

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PROGRAM

2024
SEMINAR SERIES

2024

JANUARY 25
3:30 PM CET

The Helix Approach
Speaker: Henry Korb, University Uppsala University

FEBUARY 29
3:30 PM CET

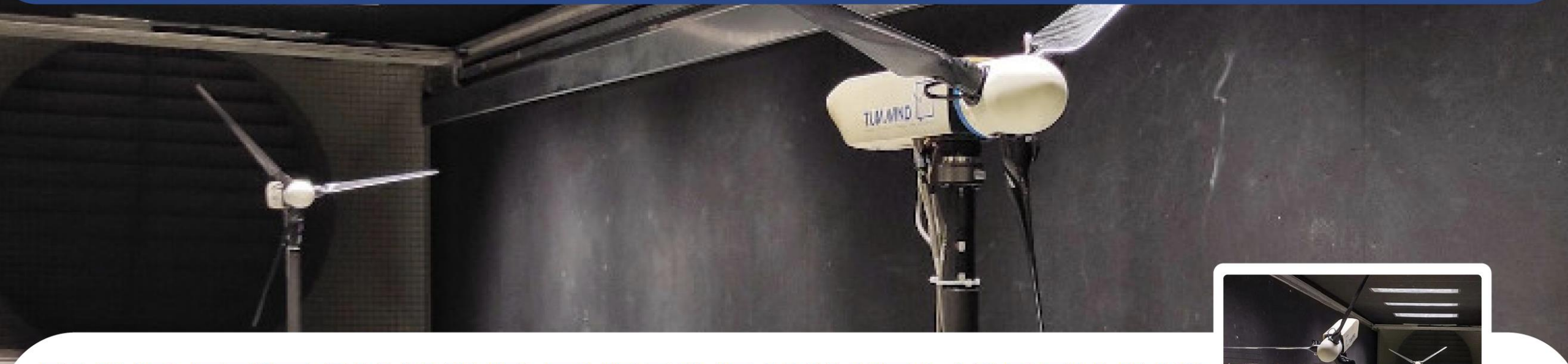
Wind tunnel study of the wake meandering of a floating wind turbines by a porous disk - phase-averaged wake properties
Speaker: Antonin Hubert, EC Nantes

MARCH 27
3:30 PM CET

Wind tunnel experiments on wake aerodynamics and wind farm control with scaled model turbines at TU Munich
Carlo Bottasso, TU Munich

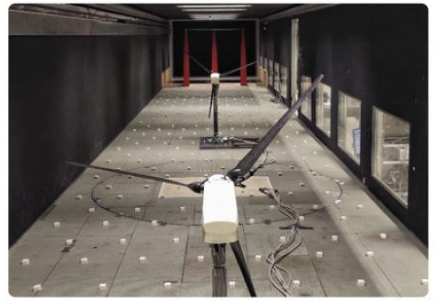
APRIL 25
3:30 PM CET

Wind Energy and LBM
Speaker: Henrik Asmuth, Uppsala University



BLIND TEST ON WIND TURBINE WAKE MODELLING

BASED ON A TWO-TURBINE INTERACTION WIND TUNNEL TEST



Phase I – Open Benchmark

- The baseline, uncontrolled case

Phase II – Blind Test

- Individual Pitch controlled case

Webinar: 20 June 2024

EAWE Wake and Wind farm aerodynamics Committee

TwEET-IE

eawe european academy of wind energy

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TORQUE Paper ID: 510

Blind Test on wind turbine wake modelling

Based on a two-turbine interaction wind tunnel test

Invitation to participate!

Marinos Manolesos, National Technical University of Athens

Wake and Wind farm Aerodynamics Committee Webinar, 20 June 2024

Motivation

To improve wind turbine wake modelling under wake control conditions

How do we do this?

We perform a blind test in two Phases

Phase I

- Open data set
- Without wake control
- Two-turbine interaction

Objective: To eliminate teething issues of modelling the two turbines in a wind tunnel

How do we do this?

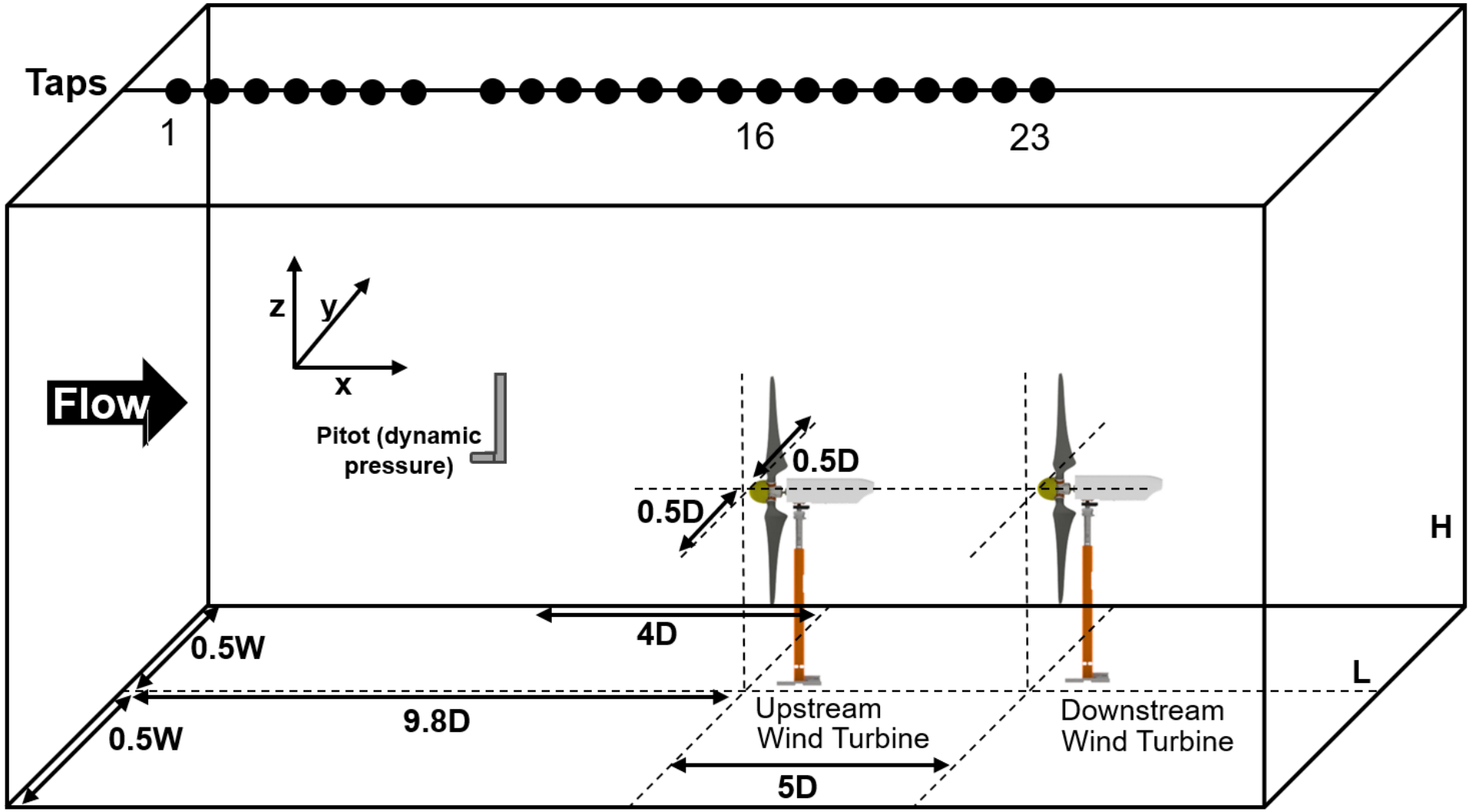
We perform a blind test in two Phases

Phase II

- Blind test
- With wake control (Helix – Individual Pitch Control)
- Two-turbine interaction

Objective: To assess the accuracy and reliability of different computational models

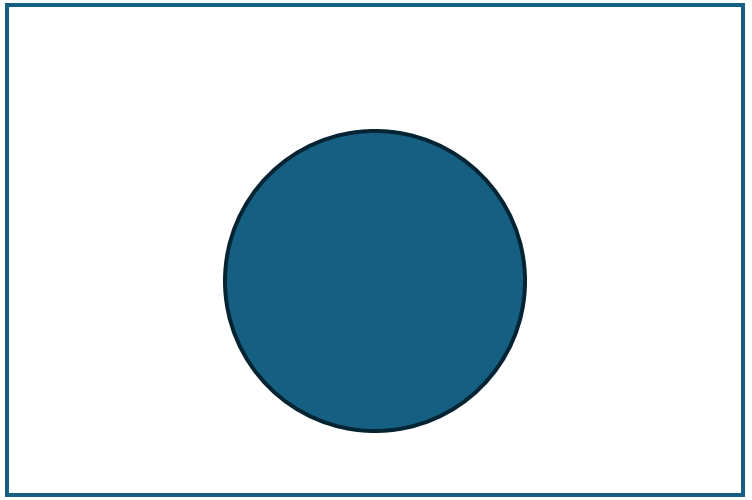
Experimental Set Up



Wind Turbine Models

- $D = 1.1\ m$
- $z_{hub} = 0.82\ m$
- rated rotor speed, $\omega = 850\ rpm$
- Torque meter
- Strain gauges on the shaft and tower base
- Individual Pitch Control
- Developed by TUM

Blockage



- For Phase I, $a_{block} = \frac{A_{turbine}}{A_{tunnel}} = 19.5\%$
- It is **huge**, we know
- We expect participants to **model wind tunnel walls**

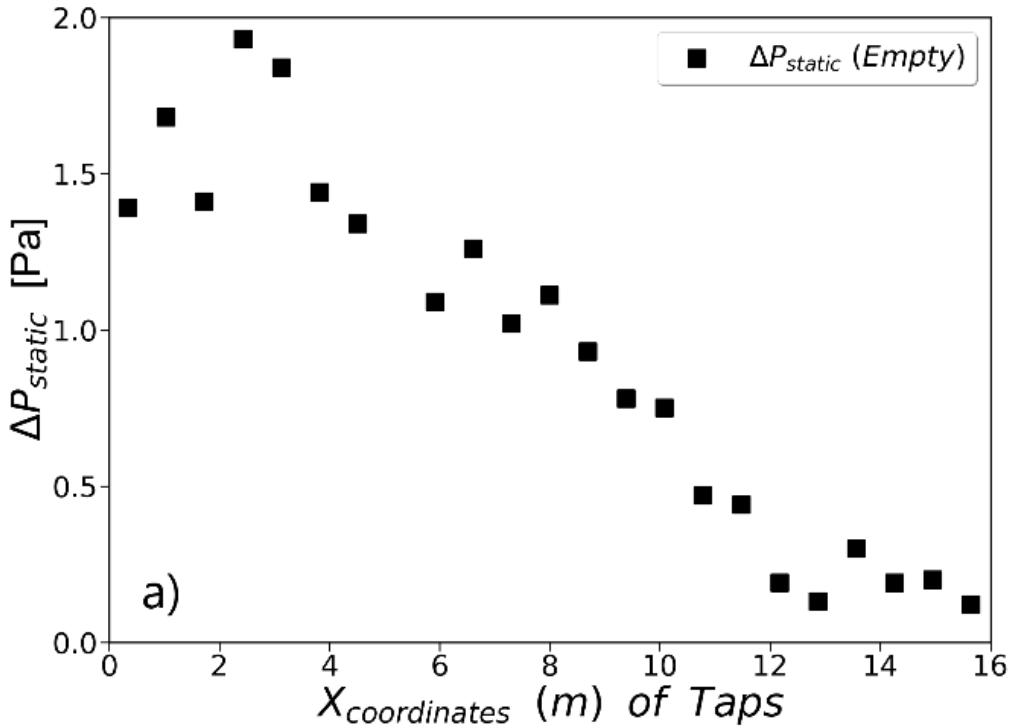
NOTE: We tested the same set up in a different wind tunnel with $a_{block} = \frac{A_{turbine}}{A_{tunnel}} \approx 10\%$ (Phase II)

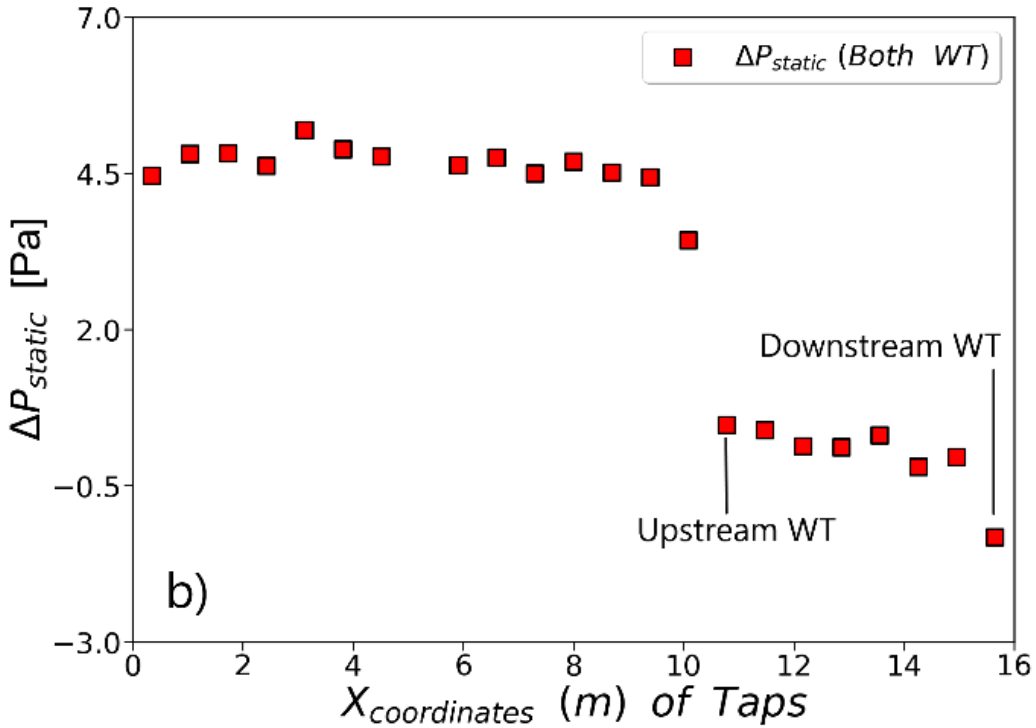
The results were in very good agreement.

More tests planned in an open WT test section (Delft)

Available data

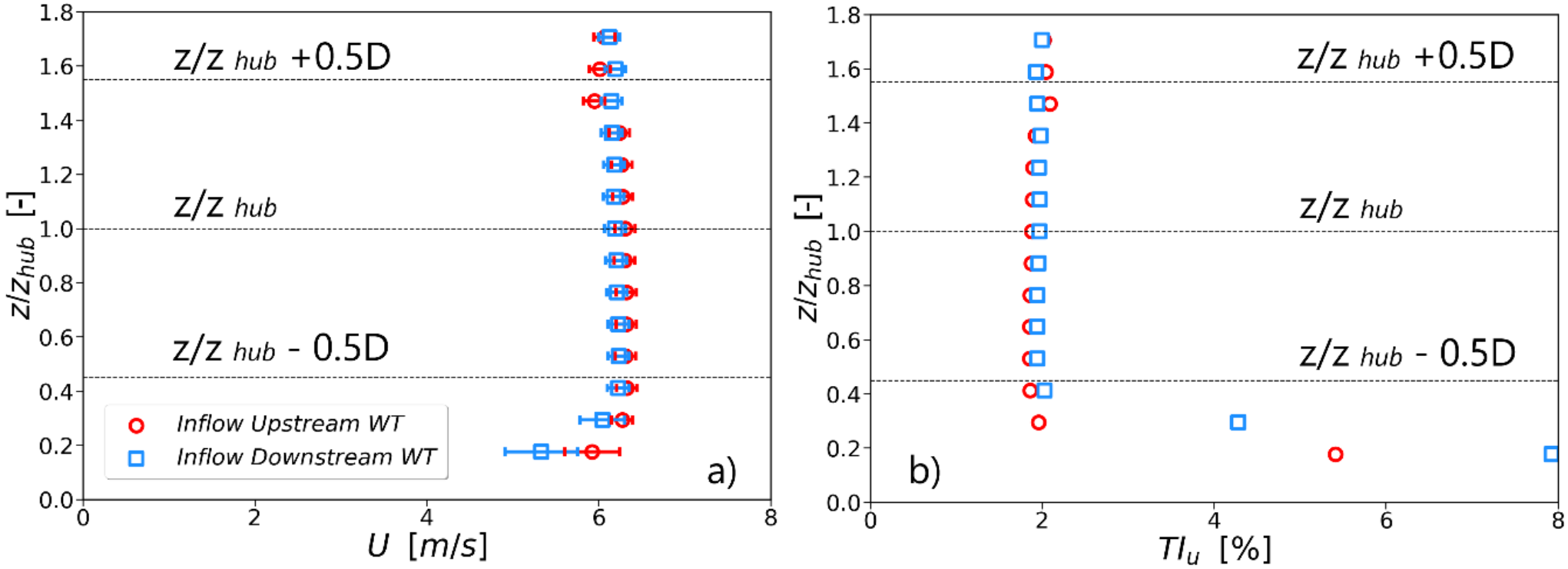
- Pressure variation along the Wind Tunnel wall





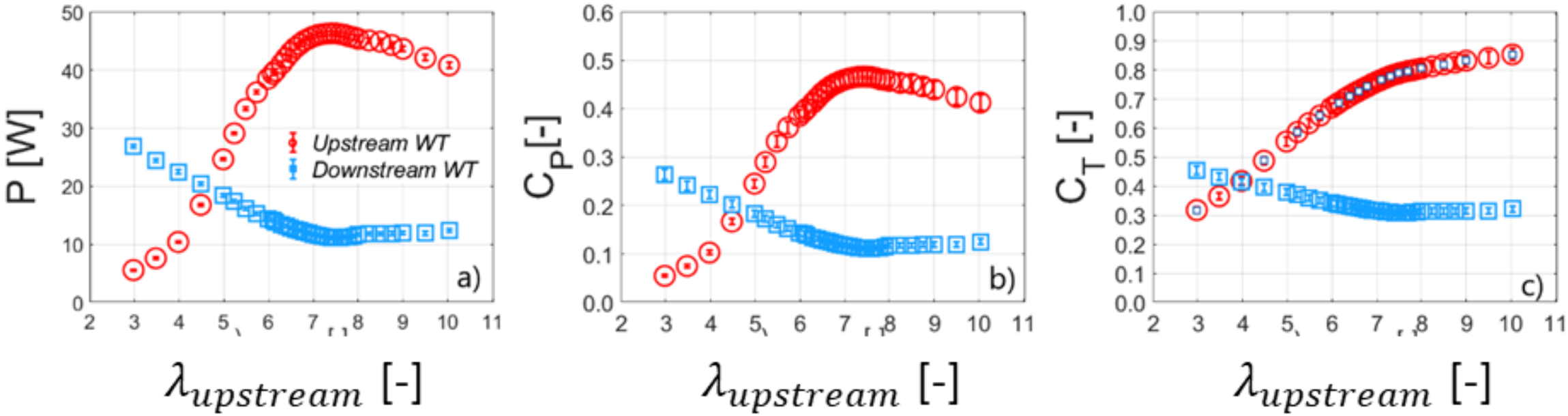
Available data

- Inflow Velocity and Turbulence Intensity profiles



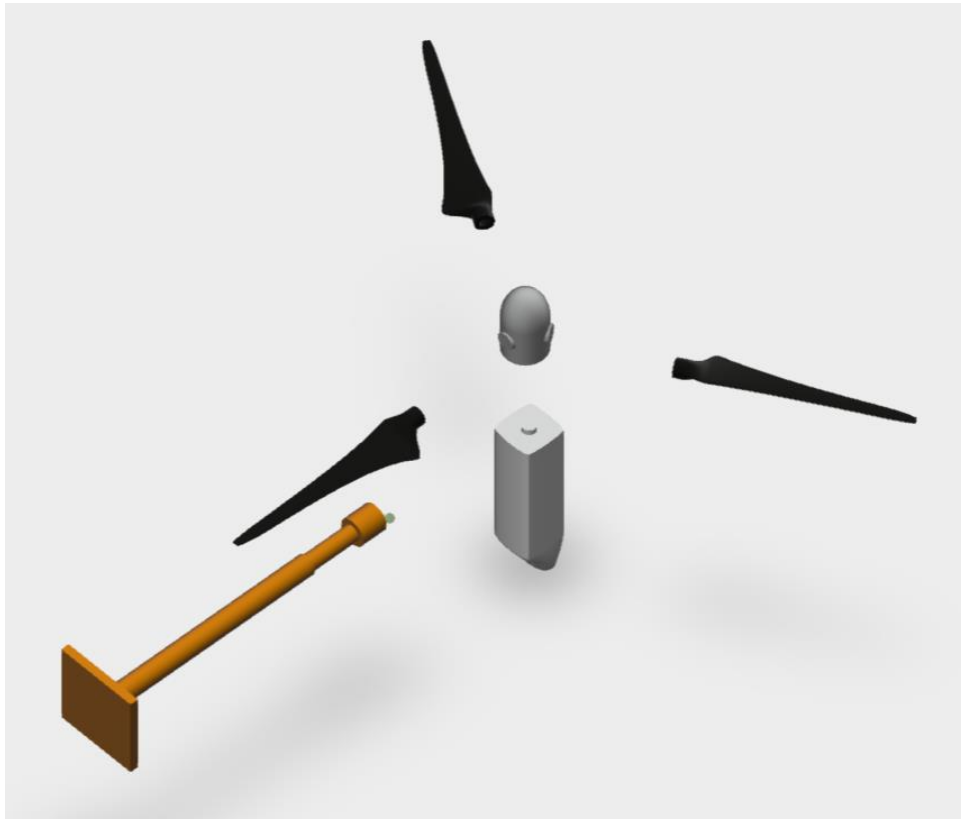
Available data

- Power and thrust under varying TSR



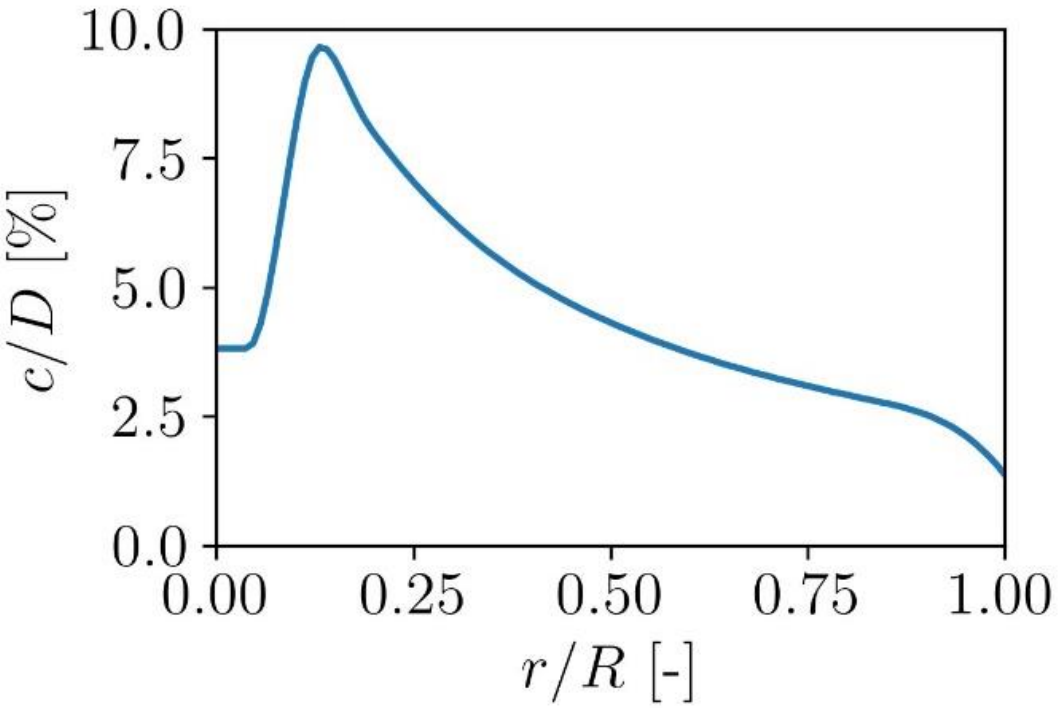
Available data

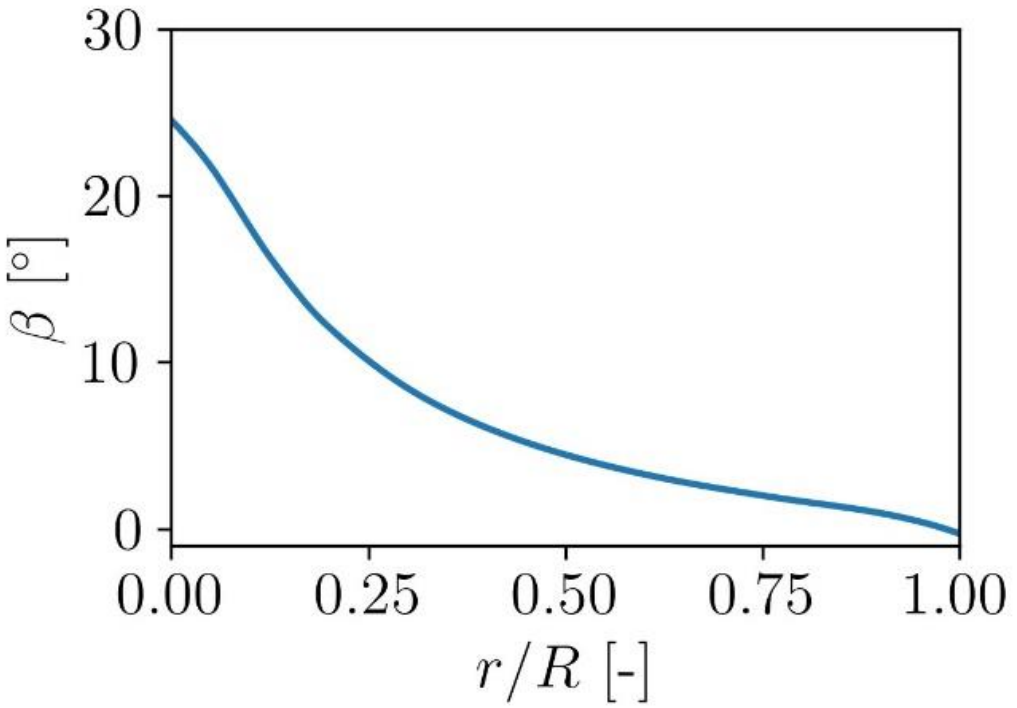
- Turbine CAD model



Available data

- Turbine blade description (including OpenFAST model)

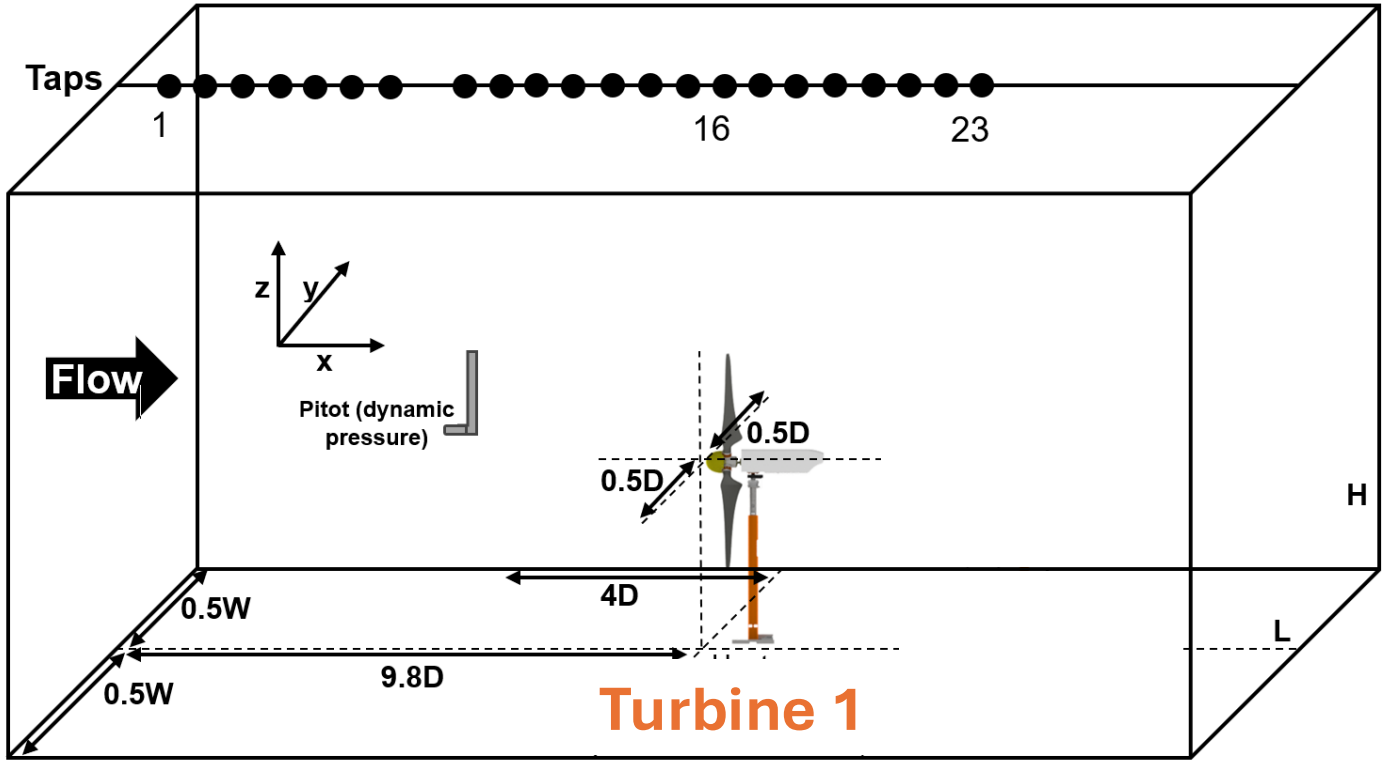




Test Cases

CASE 0 – Individual Wind Turbines

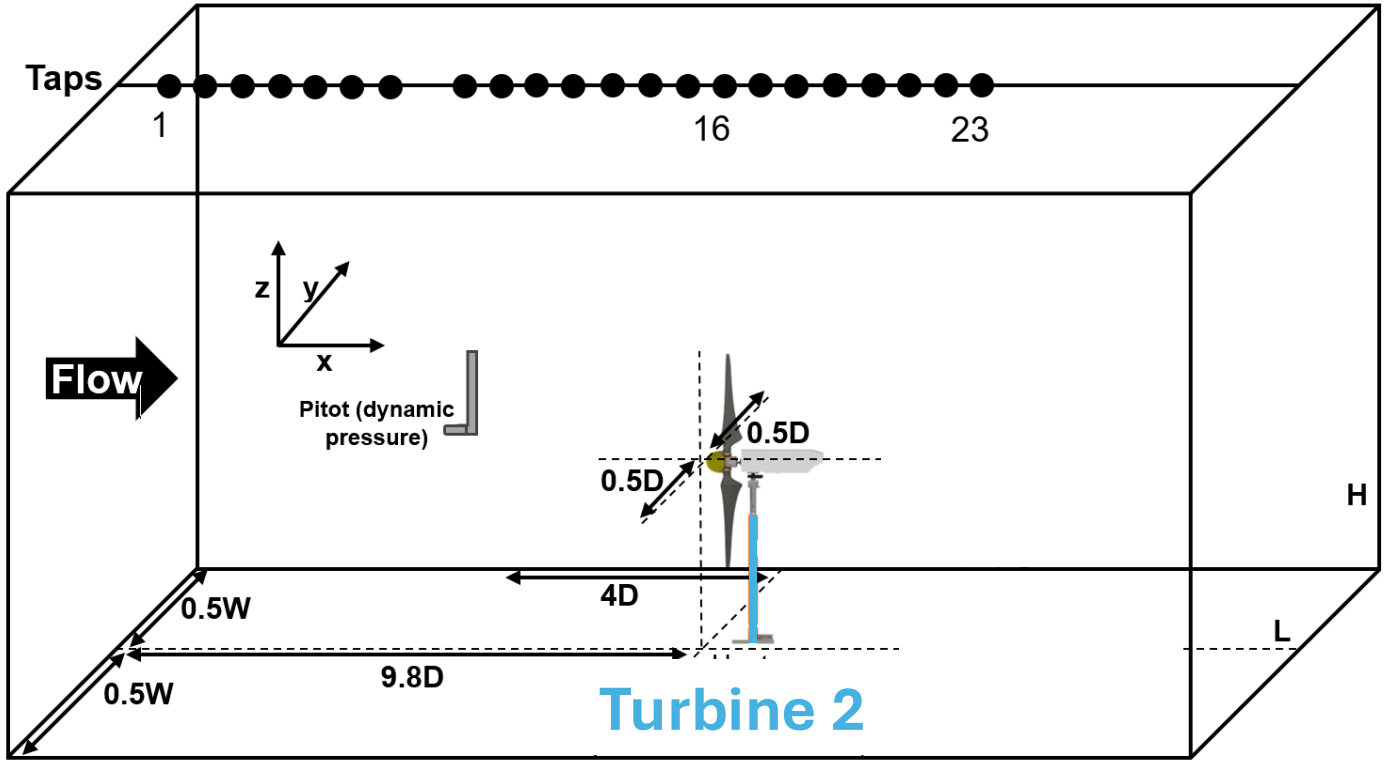
- Turbine 1 at upstream position, on its own



Test Cases

CASE 0 – Individual Wind Turbines

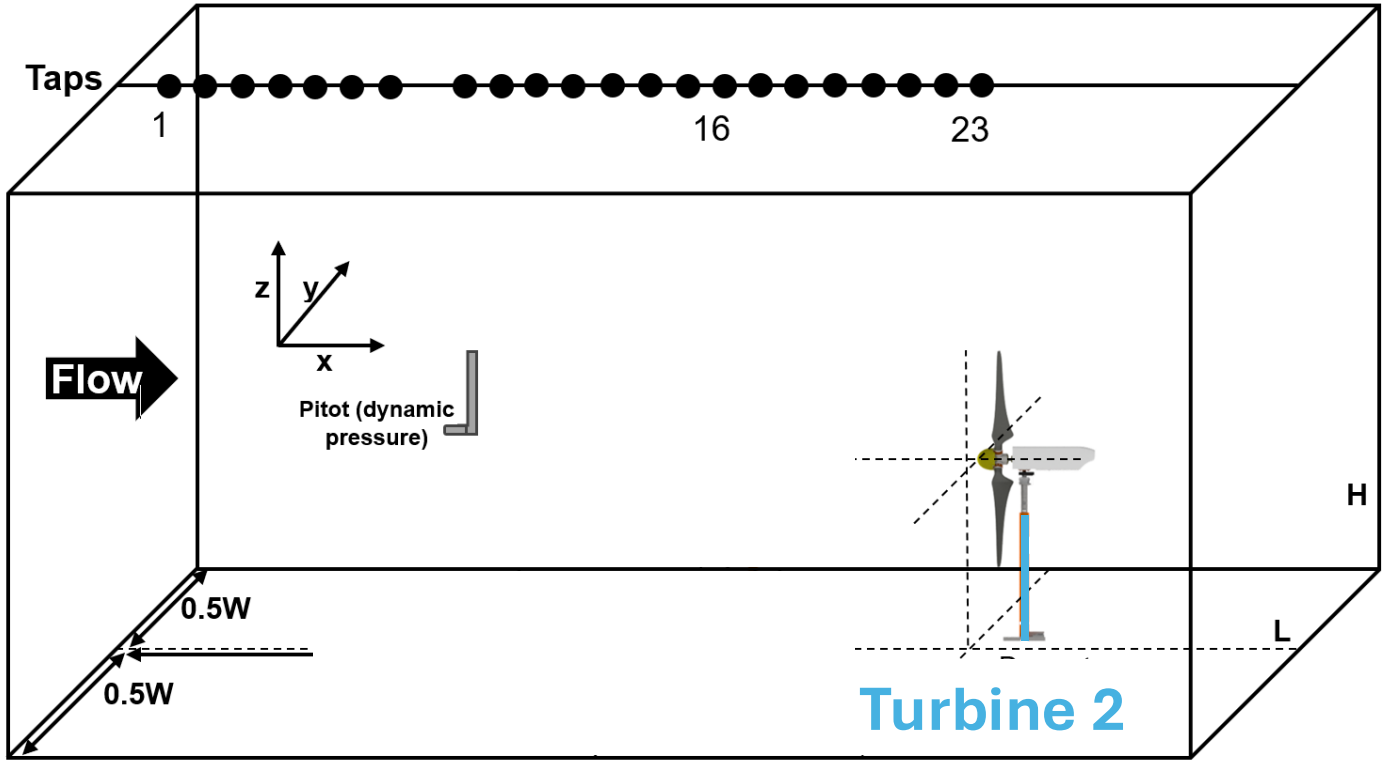
- Turbine 2 at upstream position, on its own



Test Cases

CASE 0 – Individual Wind Turbines

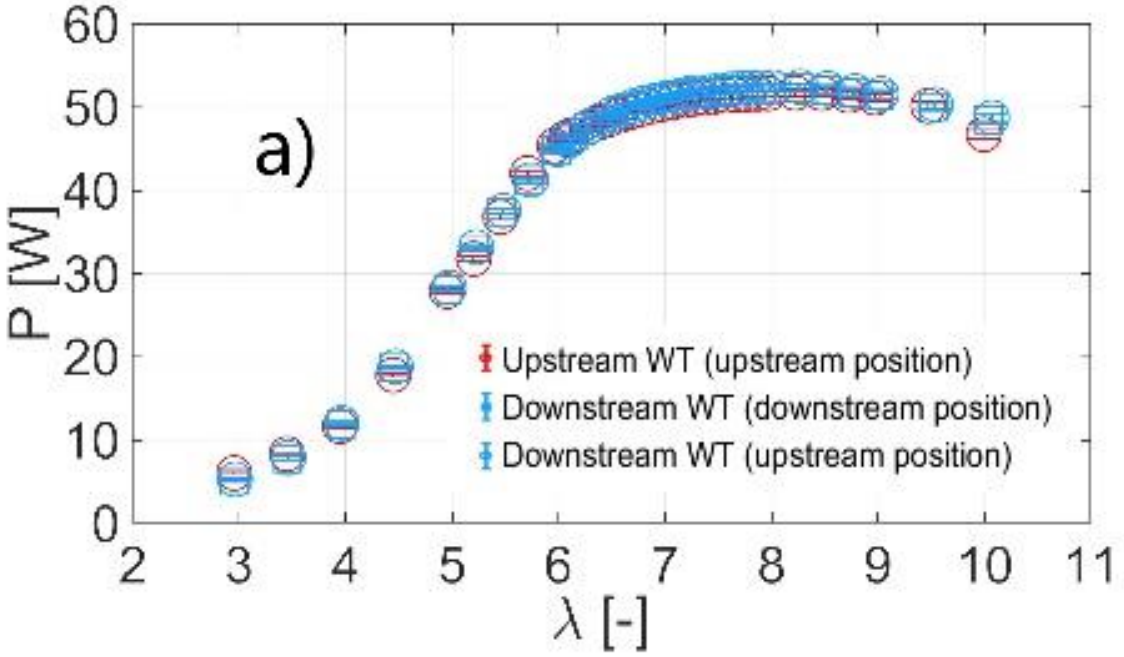
- Turbine 2 at downstream position, on its own

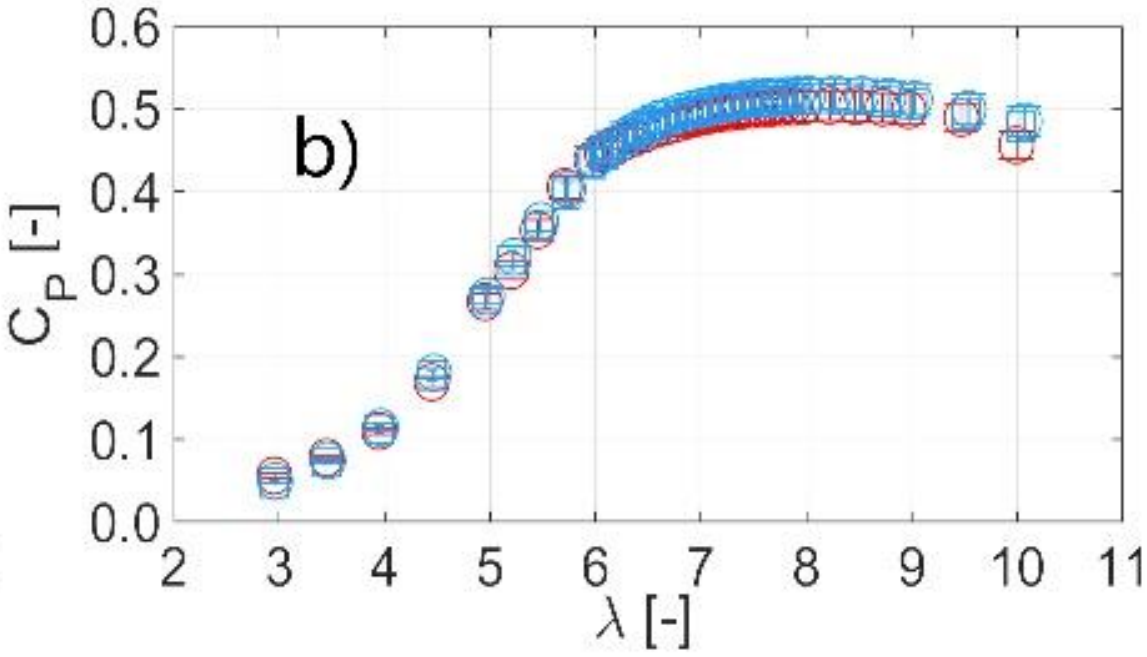


Test Cases

No submission required for CASE 0

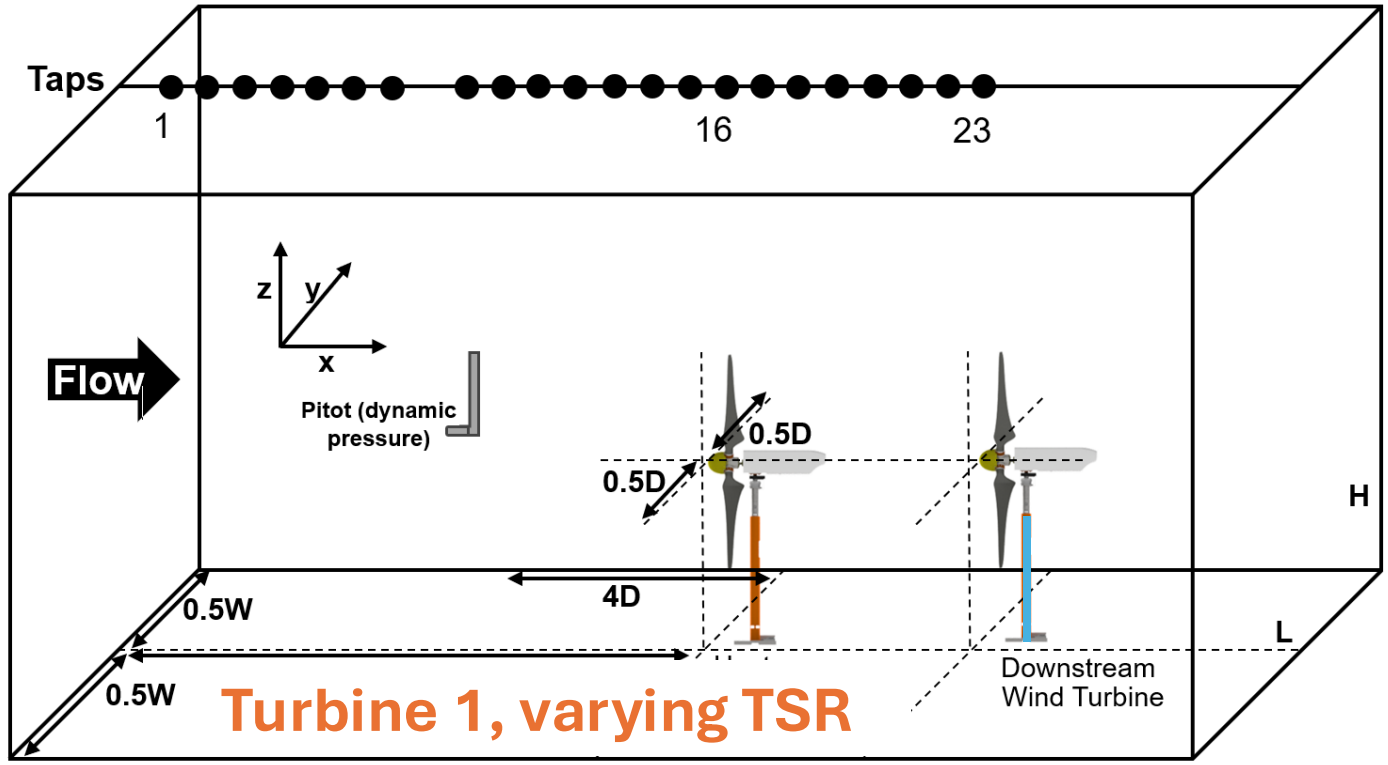
CASE 0 – Individual Wind Turbines





Test Cases

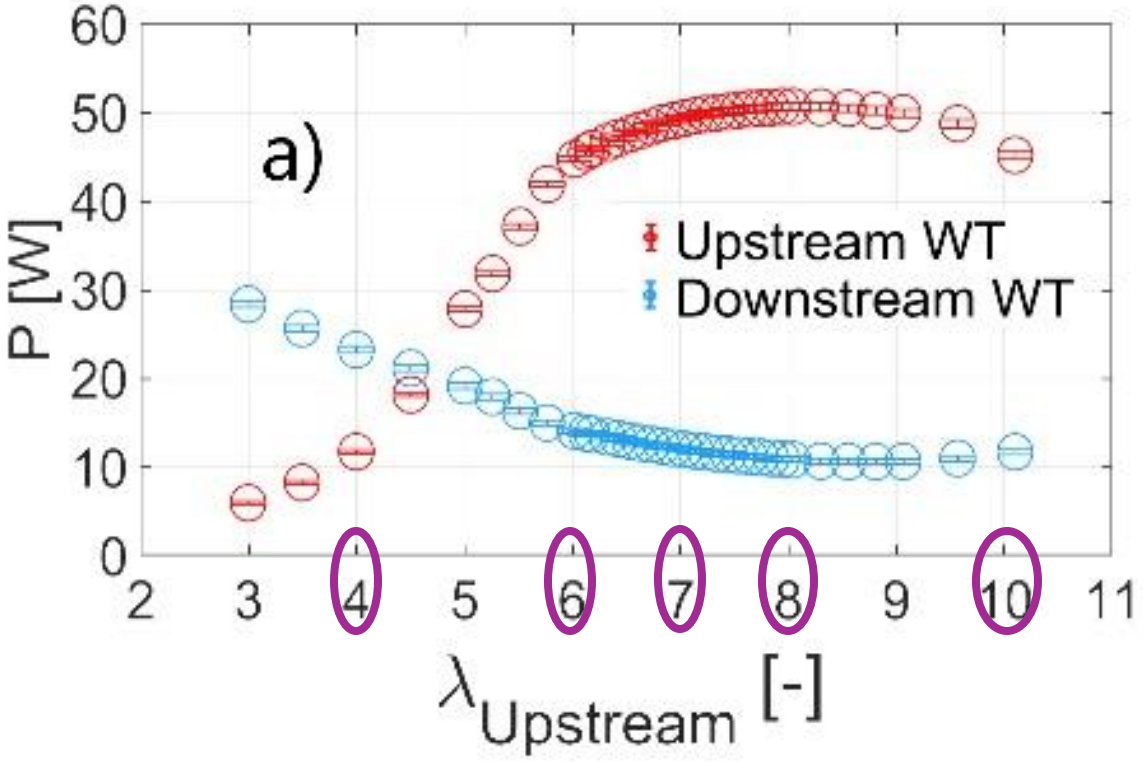
CASE 1 – Both turbines, upstream varying TSR

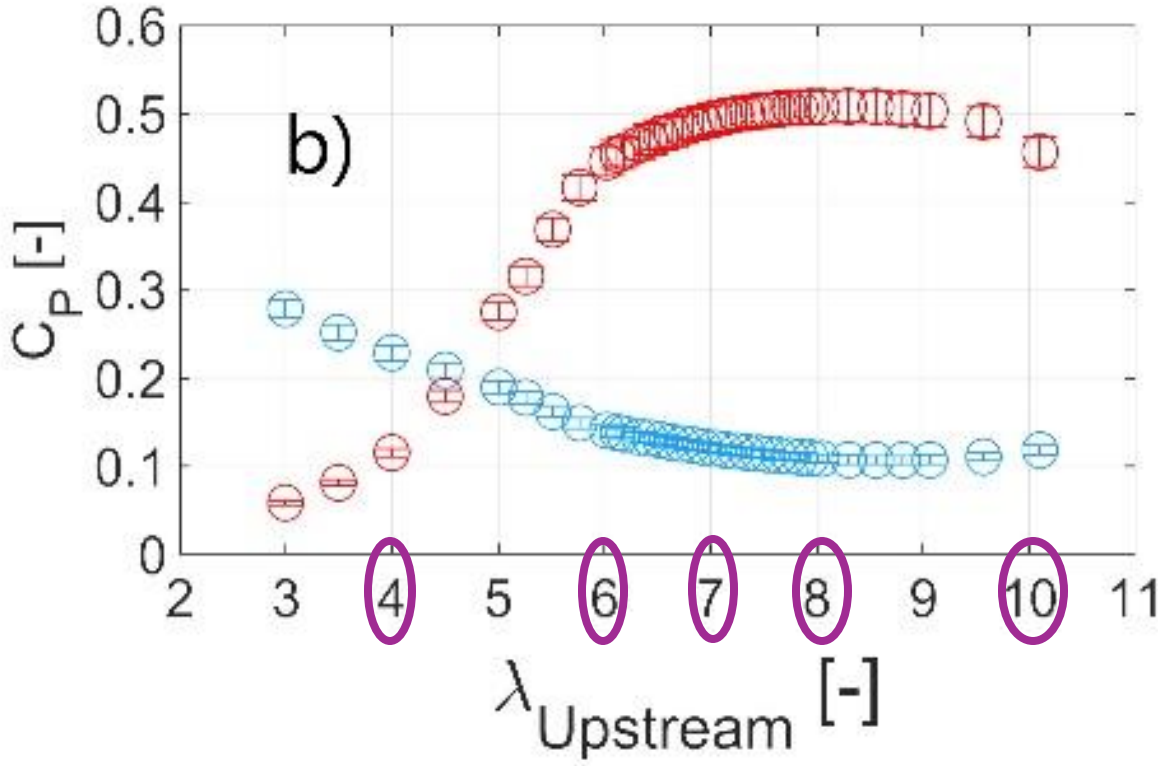


Test Cases

Submission (for 5 TSR) required for CASE 1

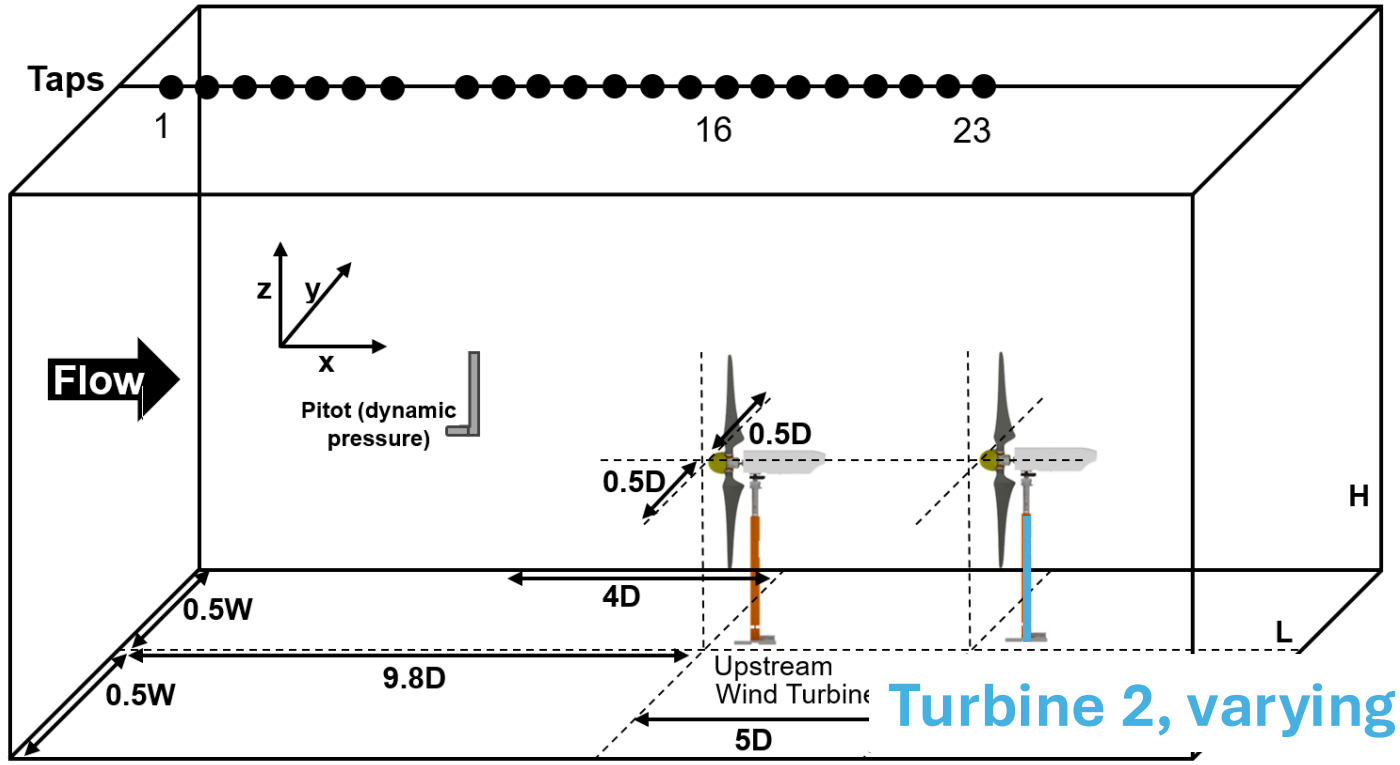
CASE 1 – Both turbines, upstream varying TSR





Test Cases

CASE 2 – Both turbines, downstream varying TSR

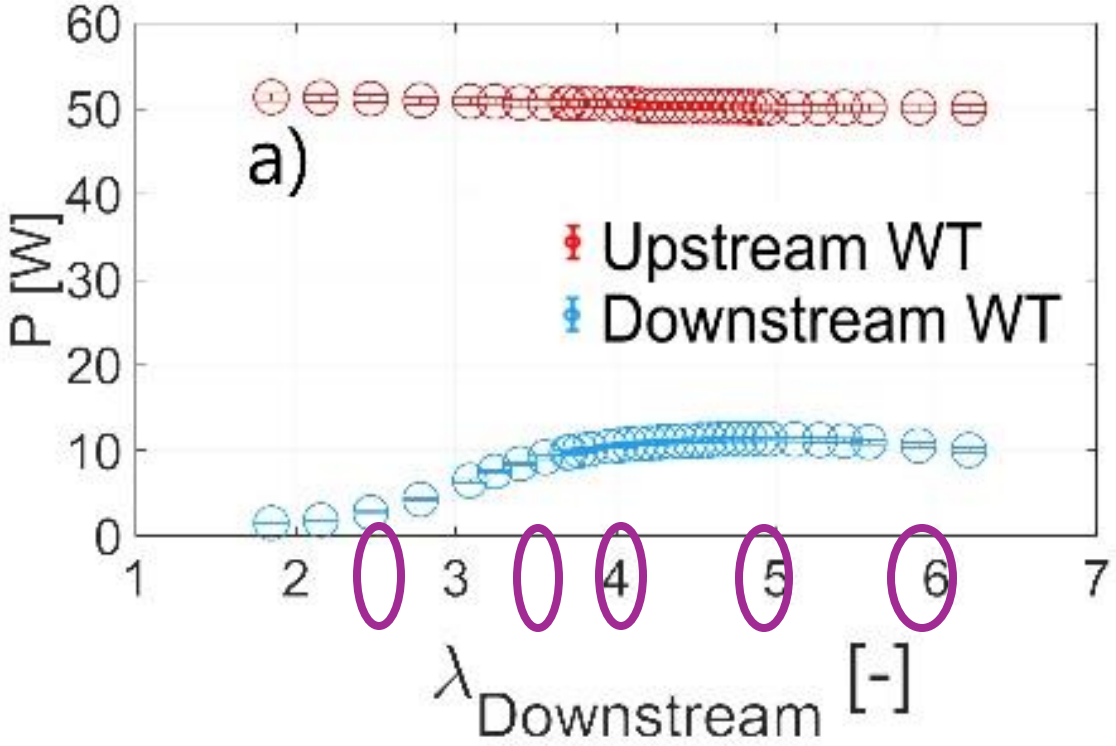


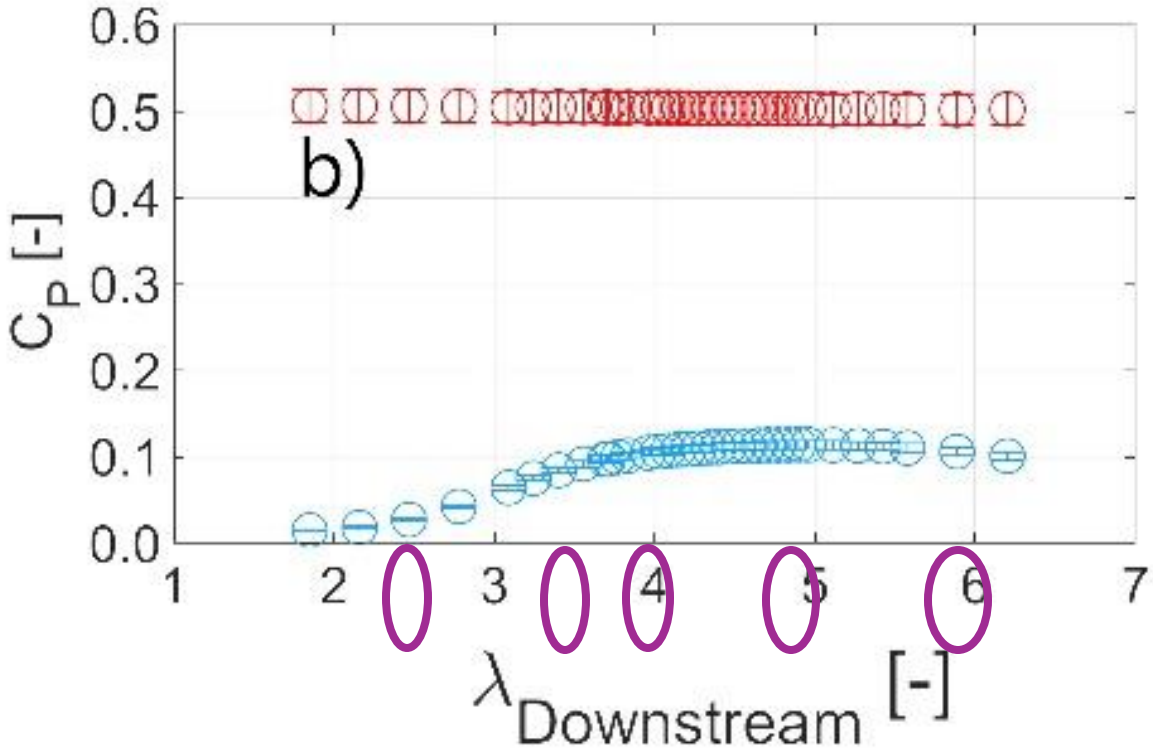
Turbine 2, varying TSR

Test Cases

Submission (for 5 TSR) required for CASE 2

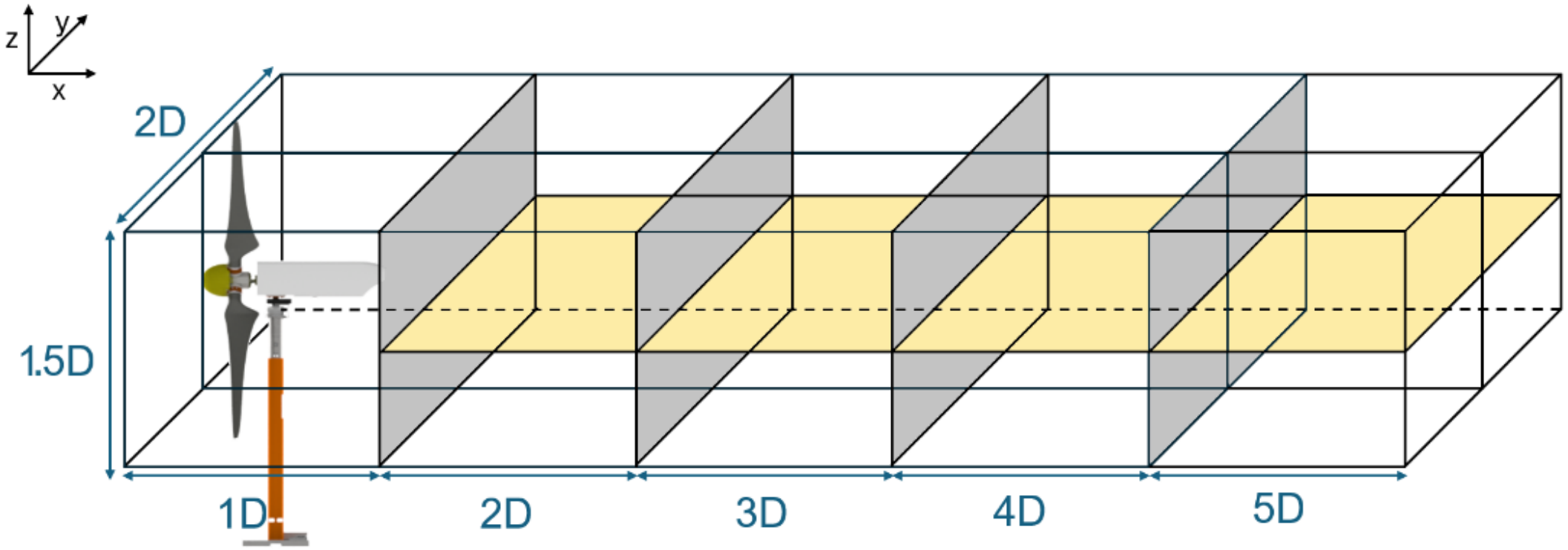
CASE 2 – Both turbines, downstream varying TSR





Optional Submissions

Velocity and pressure data
in the wake of the upstream turbine



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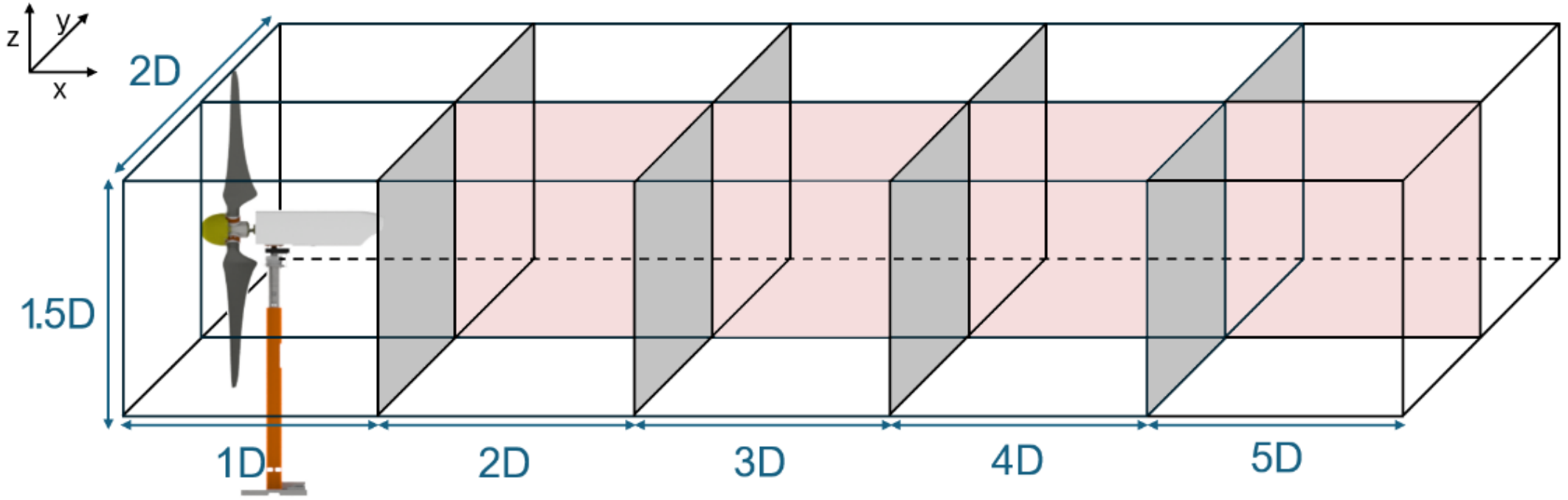
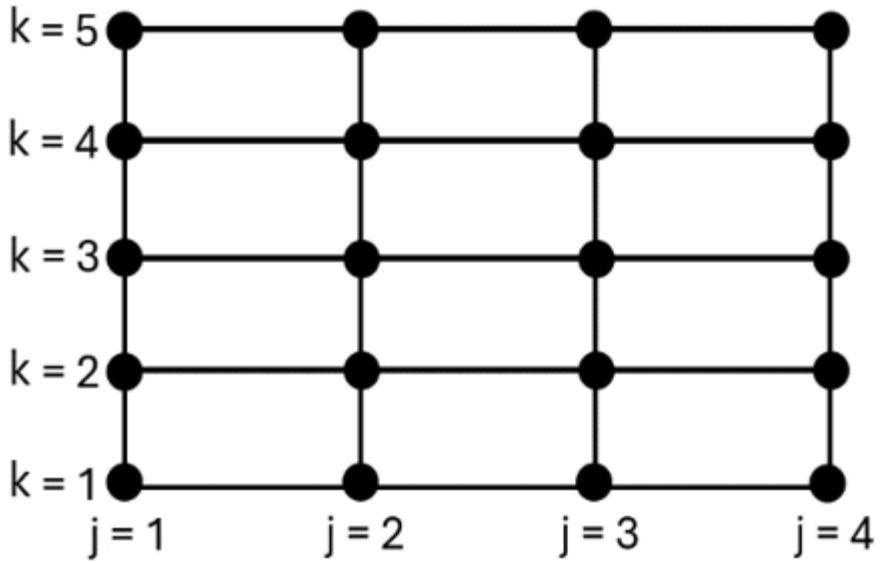


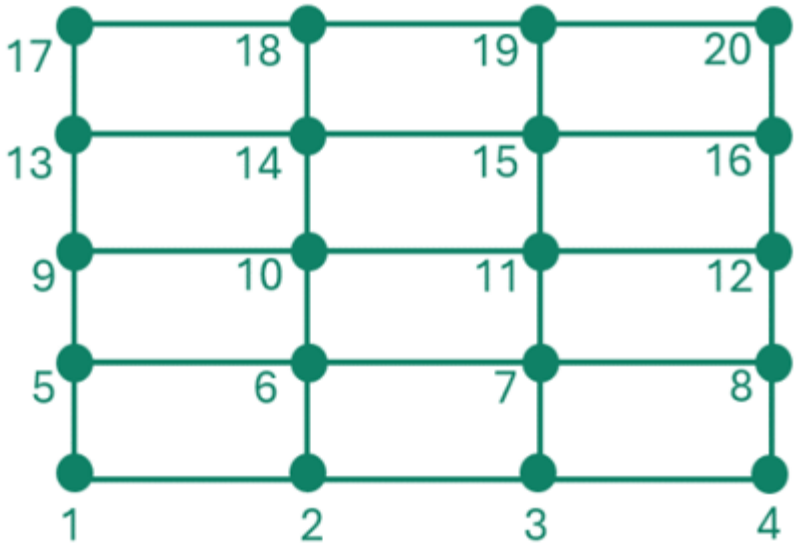
No wake measurements are available for Phase I,
wake data will offer a code-to-code comparison for now

Optional Submissions

Velocity and pressure data
in the wake of the upstream turbine

Example of Wake file 1D node numbering: NTUA_Plane_x1_CASE_1_TSR_xx.dat [yz-plane]





Submission procedure

- We need **at least 3 files**
  - Methodology
  - Data for Case 1
  - Data for Case 2

- Optionally, you can submit **wake data for Case 1**

Where can one find details?

- Data and descriptions can be downloaded from 10.5281/zenodo.10566400
  - Last updated today!

- Sign up to our mailing list! https://docs.google.com/forms/d/e/1FAIpQLSeaPGgJ7DZi_Fcxk0BJ1HsGcUDiPirtaKTkKZhmVj5NT2KhZA/viewform?usp=pp_url

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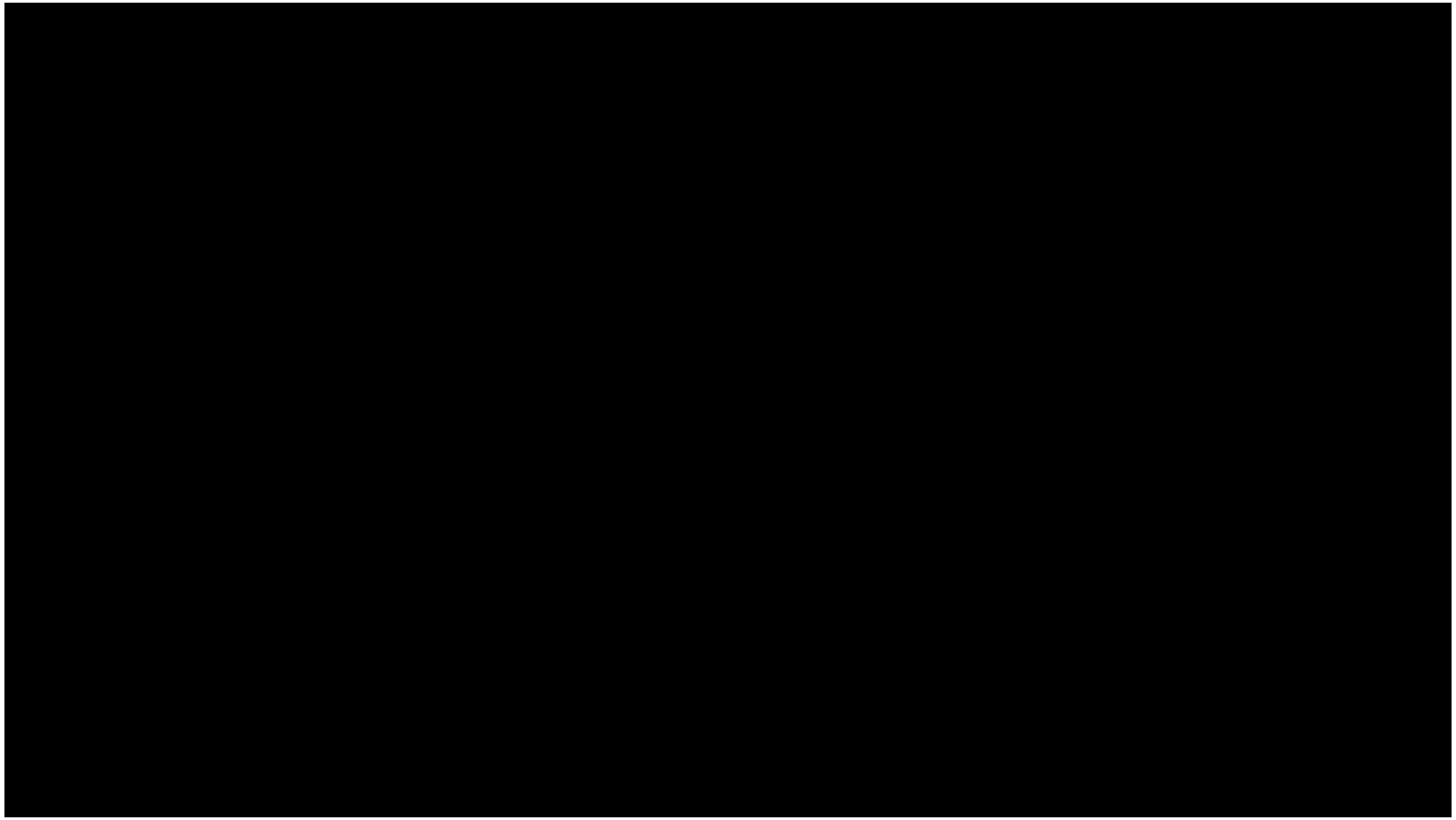
Timeline

Phase I

Timeline

Phase II

Phase 2 Experiments




Thank you for your attention.
Questions?
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