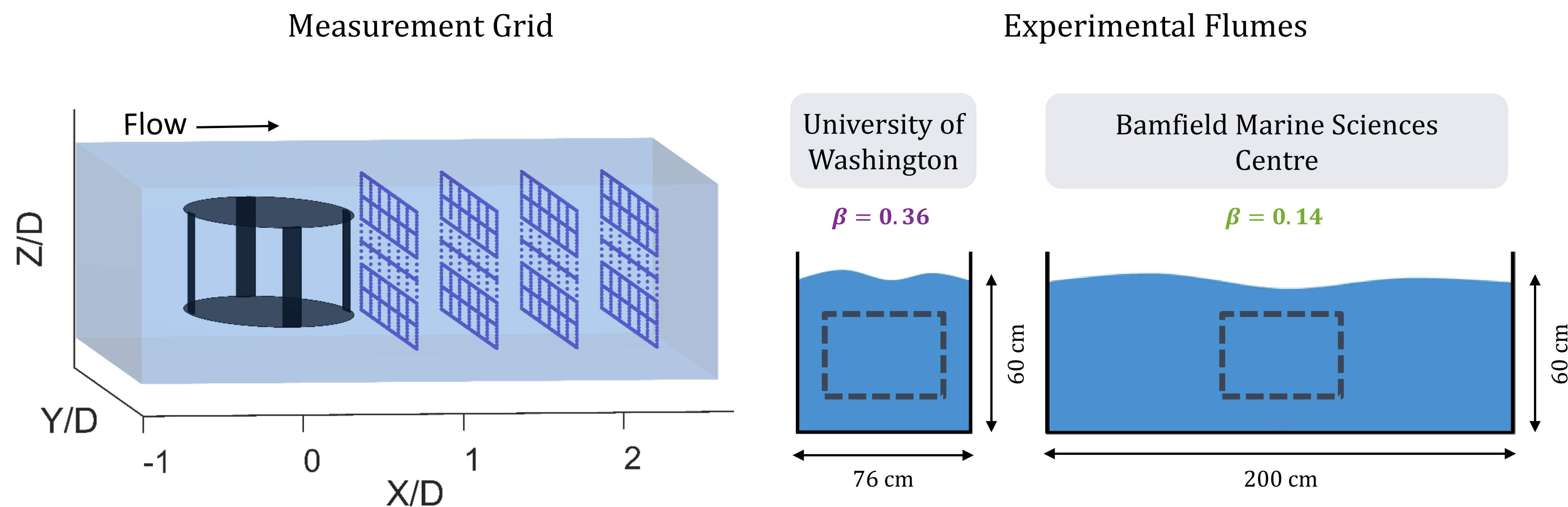


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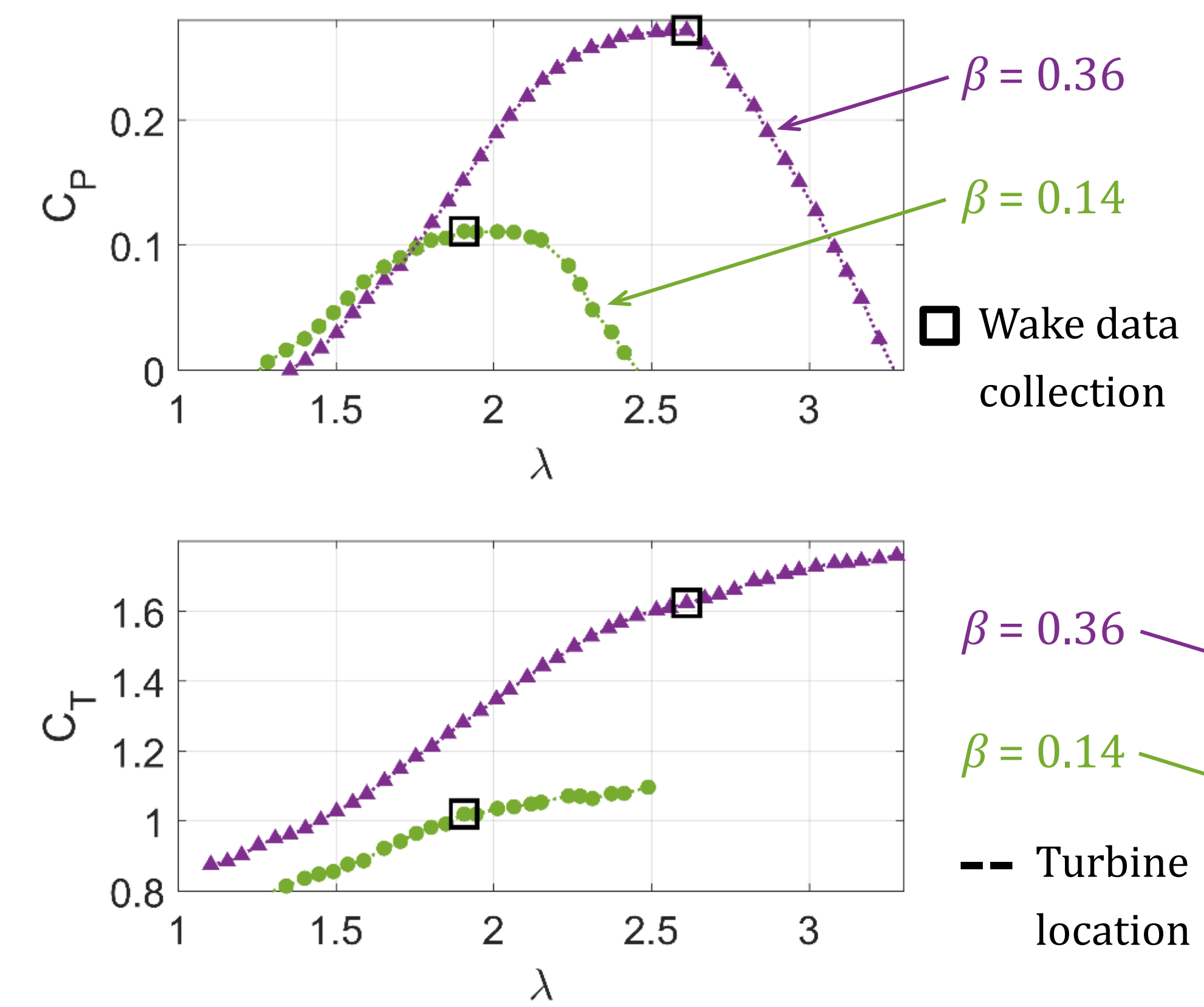
Experimental Wake Characterization



Rendering of the lab-scale turbine ($D=51$ cm, $H=31$ cm) used in experiments. Wake data were collected at the locations marked by purple circles using two acoustic Doppler velocimeters.

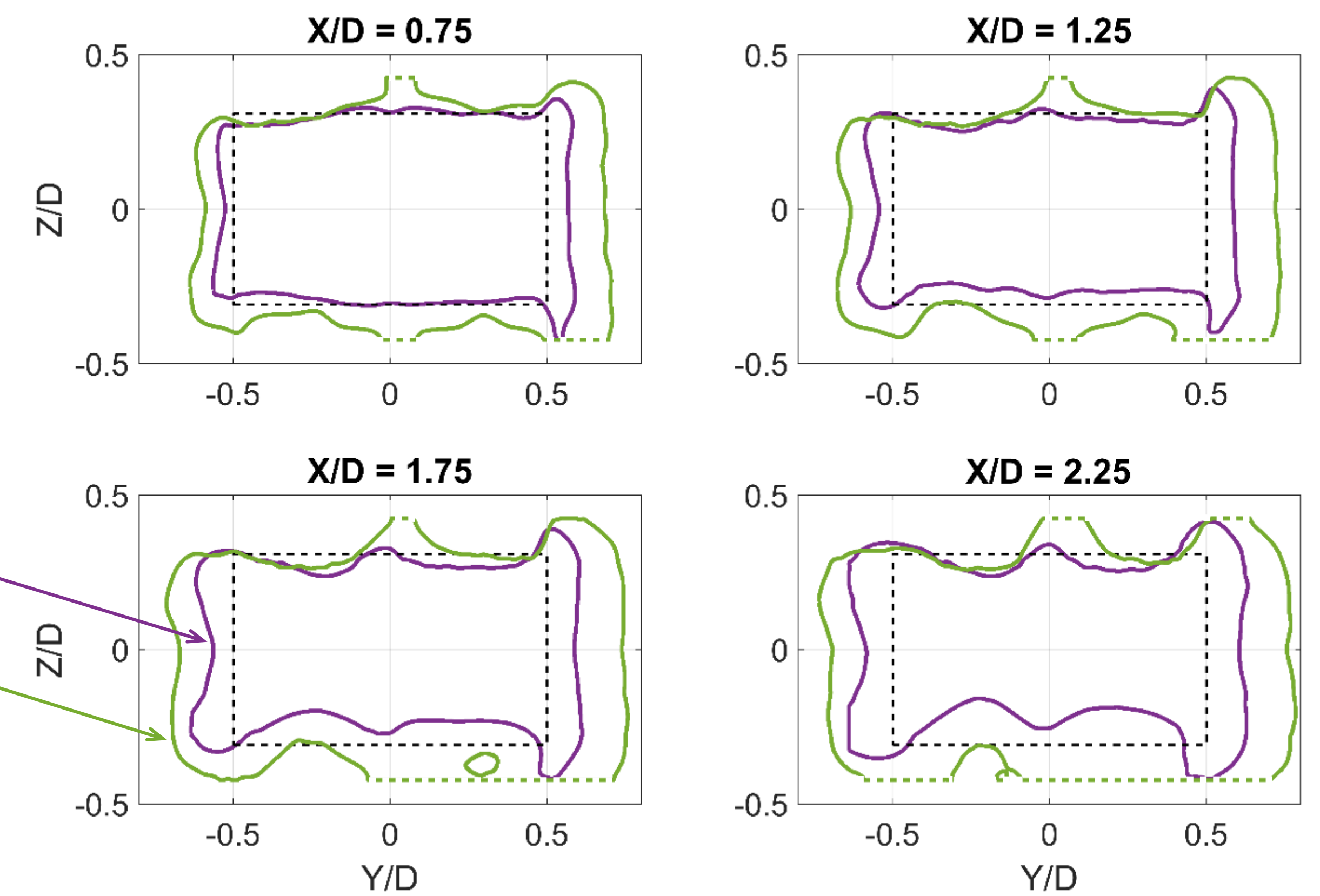
Tests were conducted at varying blockage ratios ($\beta = A_{\text{turbine}}/A_{\text{channel}}$). The water temperature, inflow speed, and channel depth were fixed to achieve constant Reynolds and Froude numbers between tests.

Turbine Performance



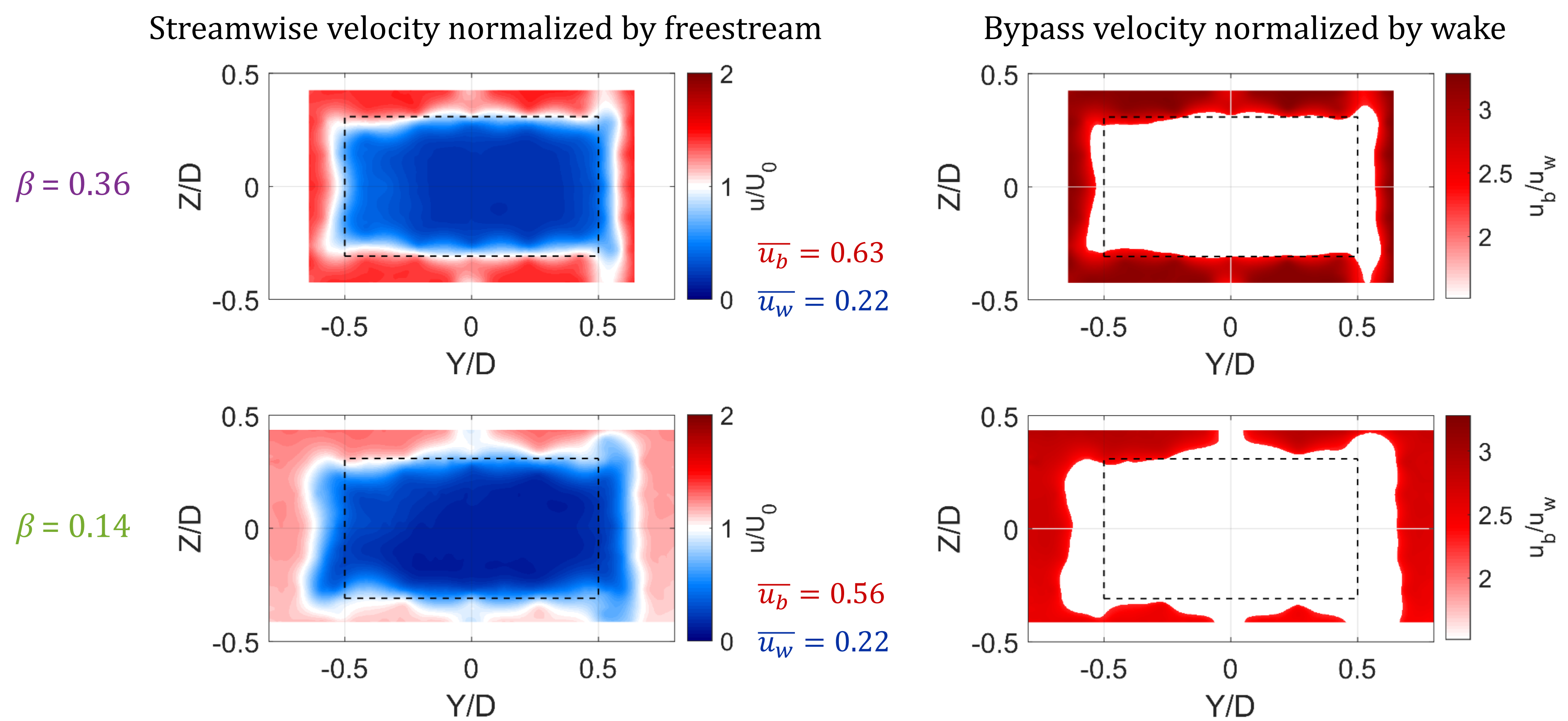
Blockage increases a turbine's power and thrust coefficients. Wake data were collected at the highlighted tip-speed ratios.

Wake Area



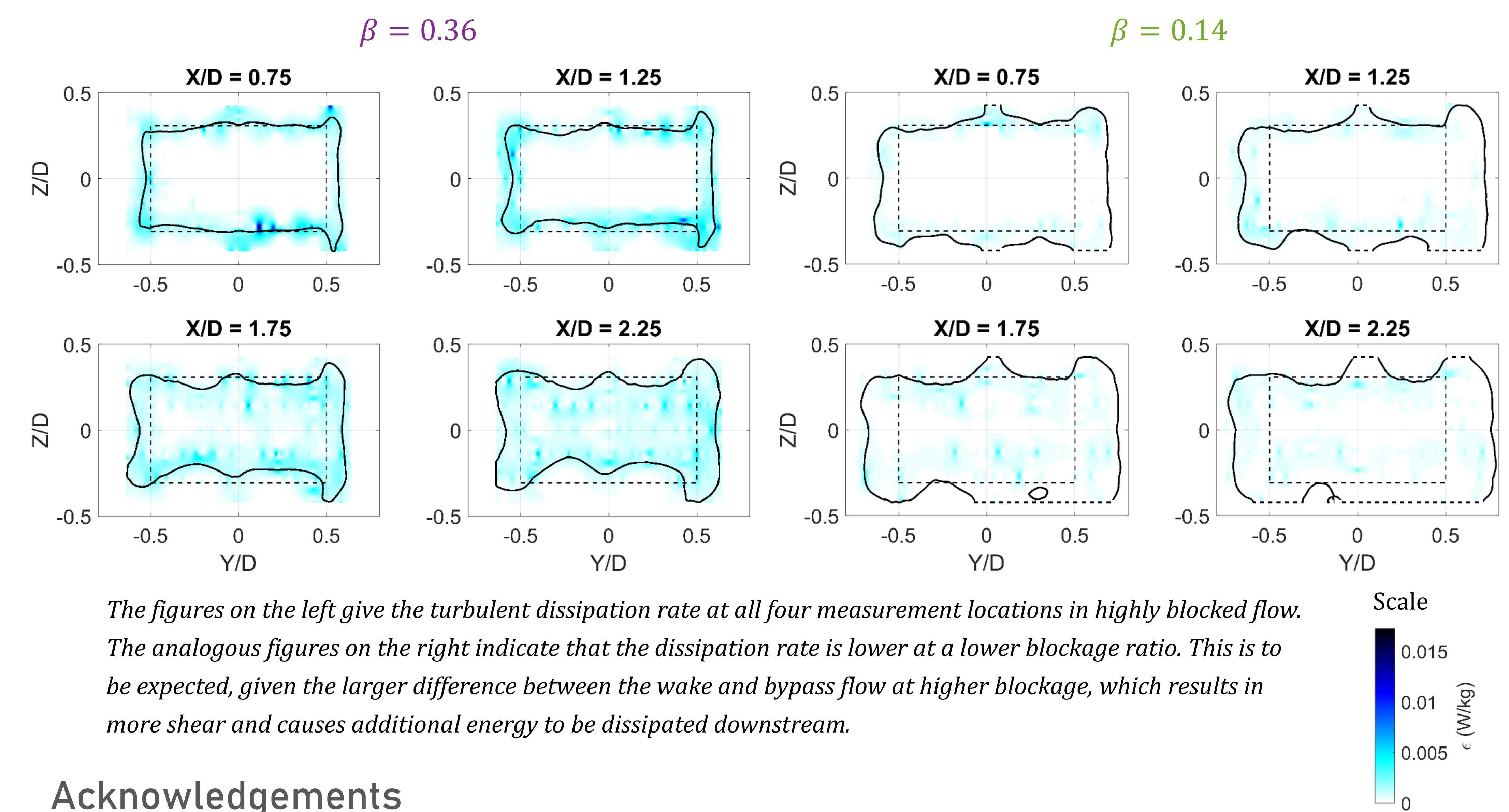
Solid lines denote the boundary between the wake and bypass flow. The wake tends to narrow as blockage increases.

Flow Speeds at First Measurement Plane ($X/D = 0.75$)



The figures on the left indicate that the bypass velocity increases as the blockage ratio increases. However, the wake velocity remains relatively unchanged. This causes a larger difference between the two flows at higher blockage, as shown by the figures on the right.

Turbulent Dissipation



The figures on the left give the turbulent dissipation rate at all four measurement locations in highly blocked flow. The analogous figures on the right indicate that the dissipation rate is lower at a lower blockage ratio. This is to be expected, given the larger difference between the wake and bypass flow at higher blockage, which results in more shear and causes additional energy to be dissipated downstream.

PMEC Member Universities

Acknowledgements