**Supplementary Material**

Comparison of simulations with different mesh resolution: 50$ ×$ 50 $× $48; 100$ ×$ 100 $× $96; and 200$ ×$ 200 $× $192 (Fig. S1). Velocity statistics of the mesh study is reported in the Table S1.



Figure S1. Comparison of measurements (circle symbols) and simulation for velocity-dependent *CD,* ***P****,* and *h*, i.e. Case iii for 50$ ×$ 50 $× $48, 100$ ×$ 100 $× $96, and 200$ ×$ 200 $× $192. Vertical coordinate normalized by time-mean canopy height *h0*. (a) streamwise velocity, *u*, normalized by *uh* at the top of the canopy.

*Table. S1. Mesh convergence evaluations for velocity statistics: RMSE Comparison with observations*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Domain grid numbers | *u/u\** | *−u′w′/u\*2* | *σu*/*u\** | *σw*/*u\** | *Sk* (*u*) | *Sk* (*w*) |
| 50$ ×$ 50 $× $48 | 0.18 | 0.26 | 0.38 | 0.23 | 0.40 | 0.32 |
| 100$ ×$ 100 $× $96 | 0.08 | 0.10 | 0.16 | 0.07 | 0.19 | 0.17 |
| 200$ ×$ 200 $× $192 | 0.07 | 0.09 | 0.15 | 0.07 | 0.18 | 0.16 |