Impact of tall vegetation on turbulent flow over orography

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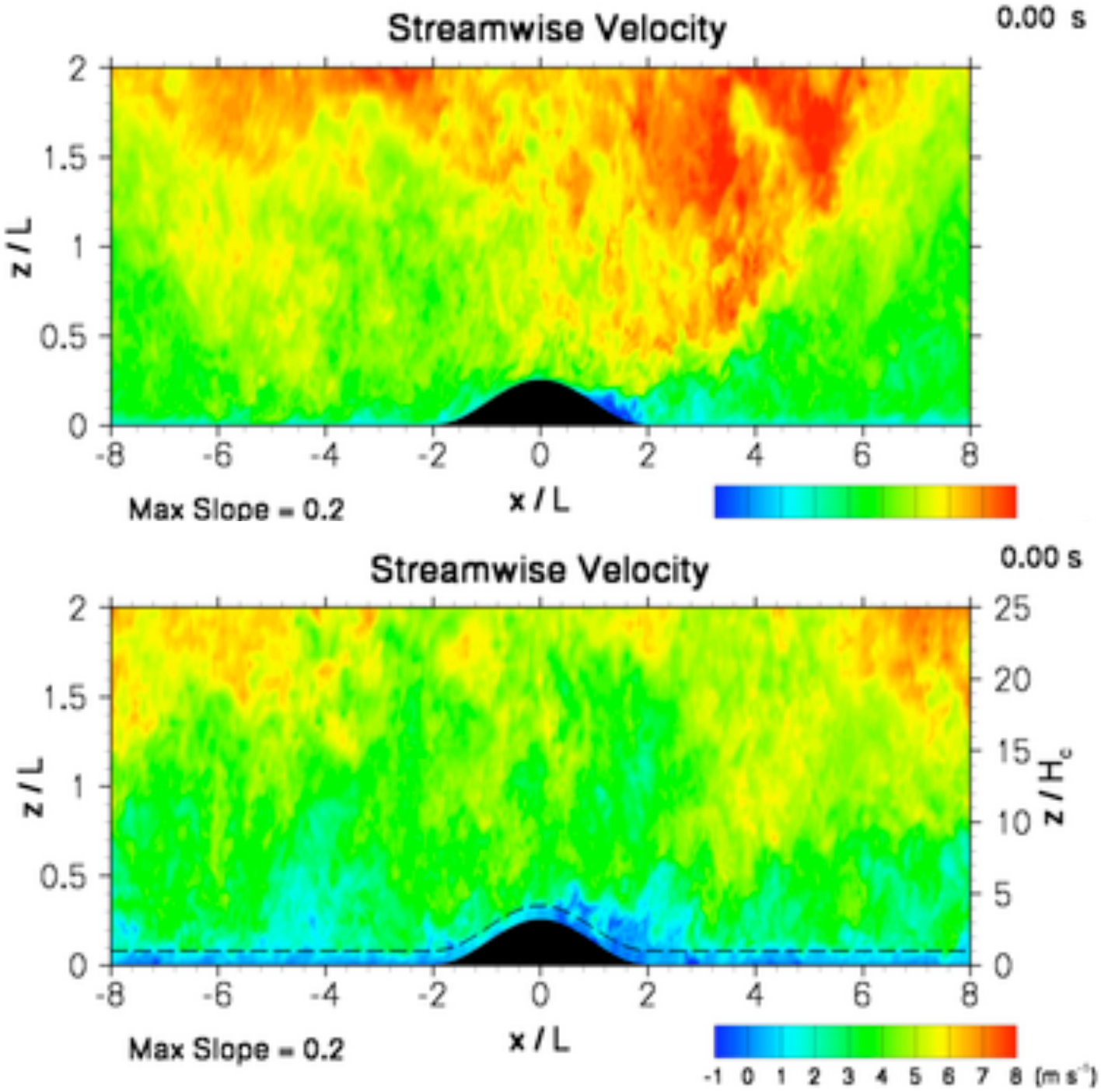

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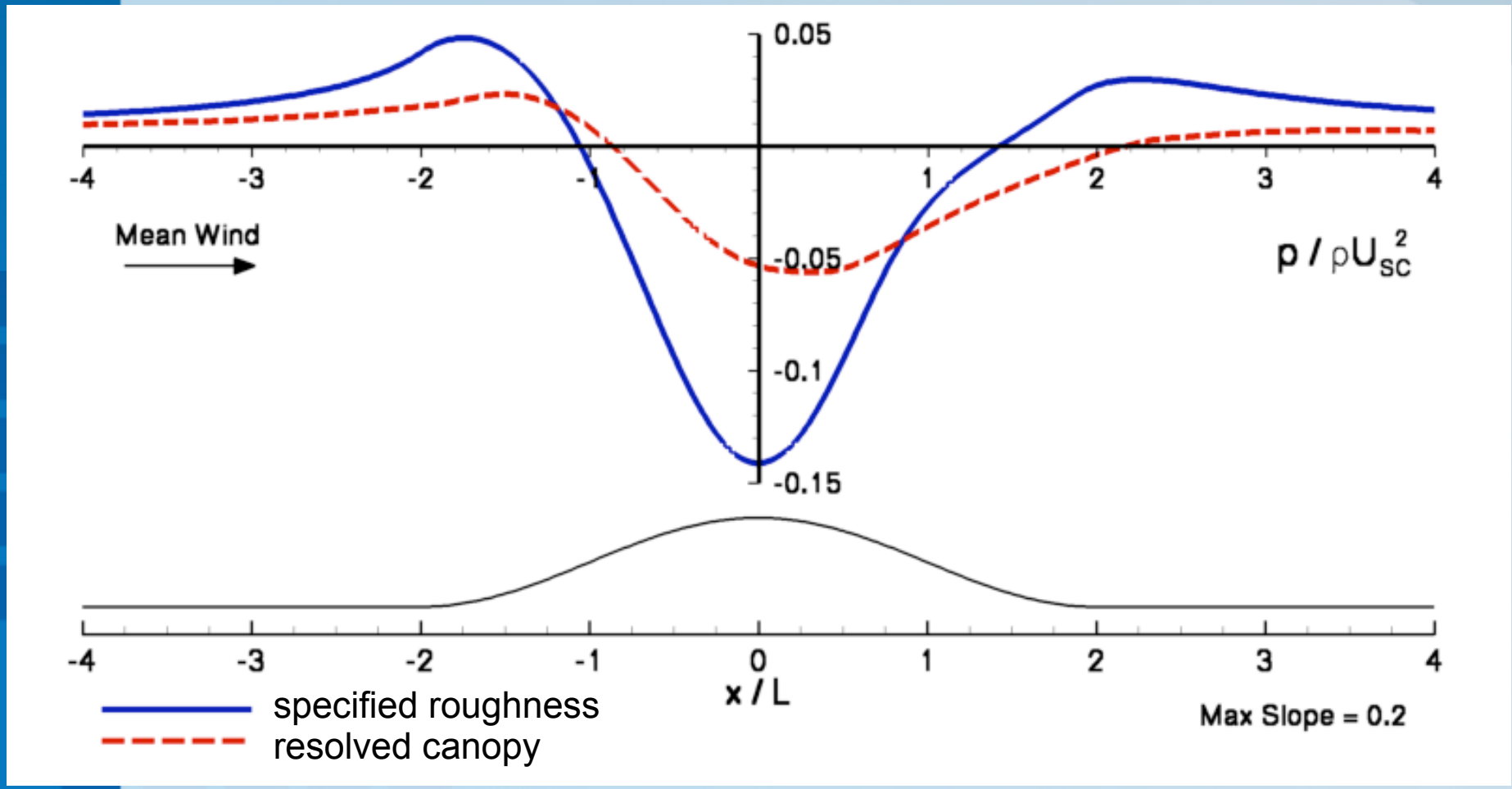
surface roughness

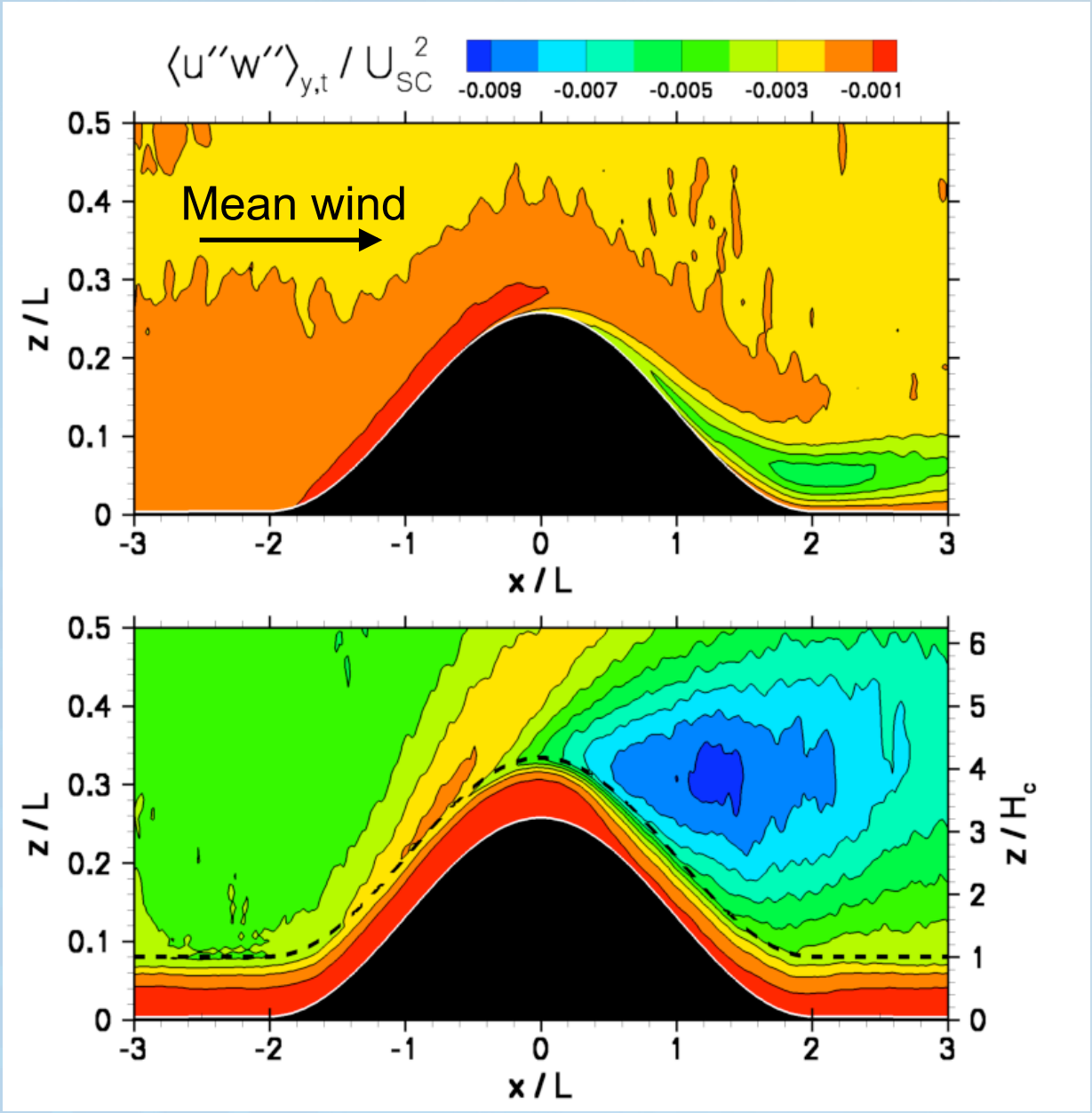
neutral stability

resolved canopy

Normalized surface pressure



Normalized momentum flux



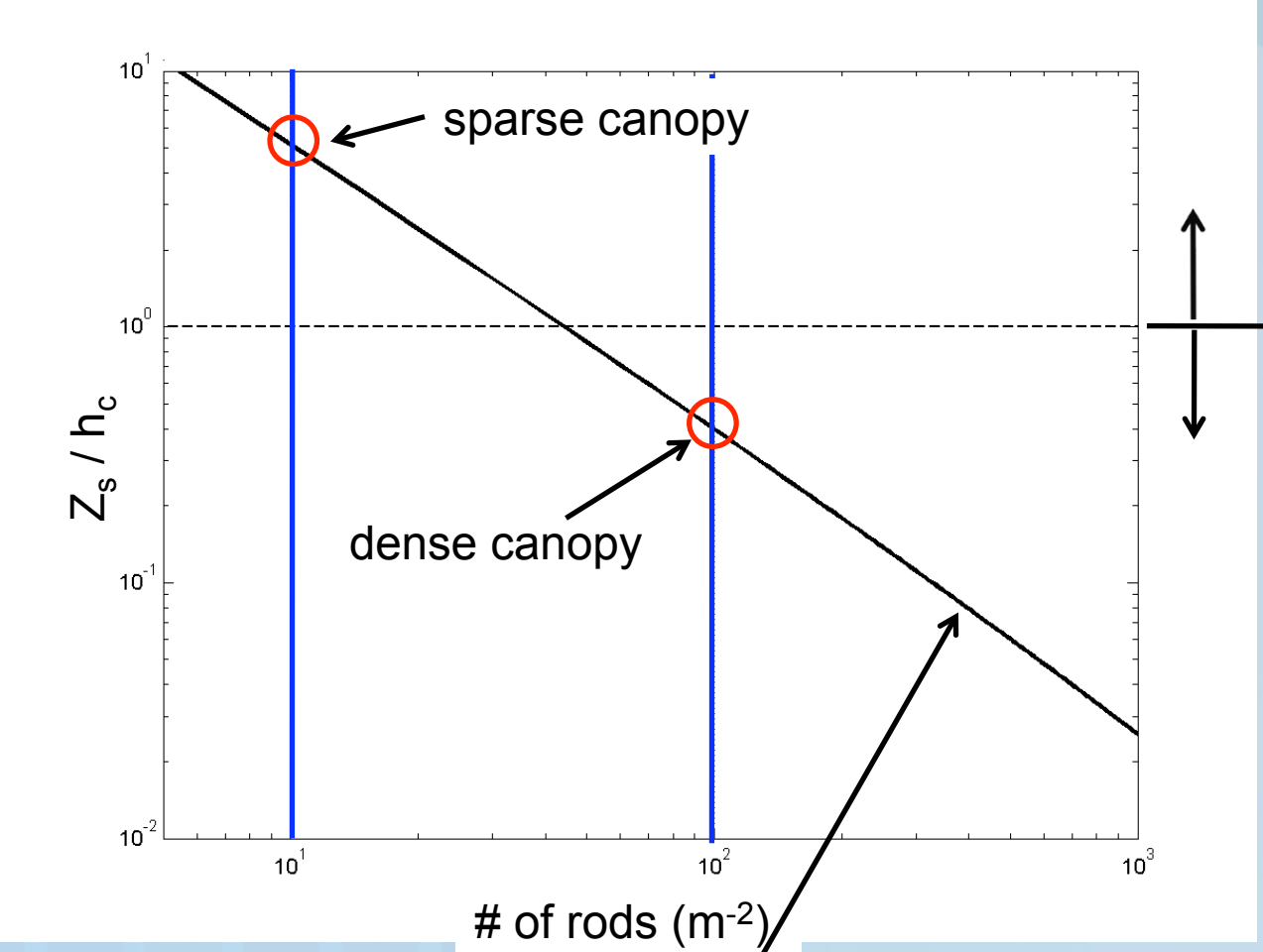
surface roughness

resolved canopy

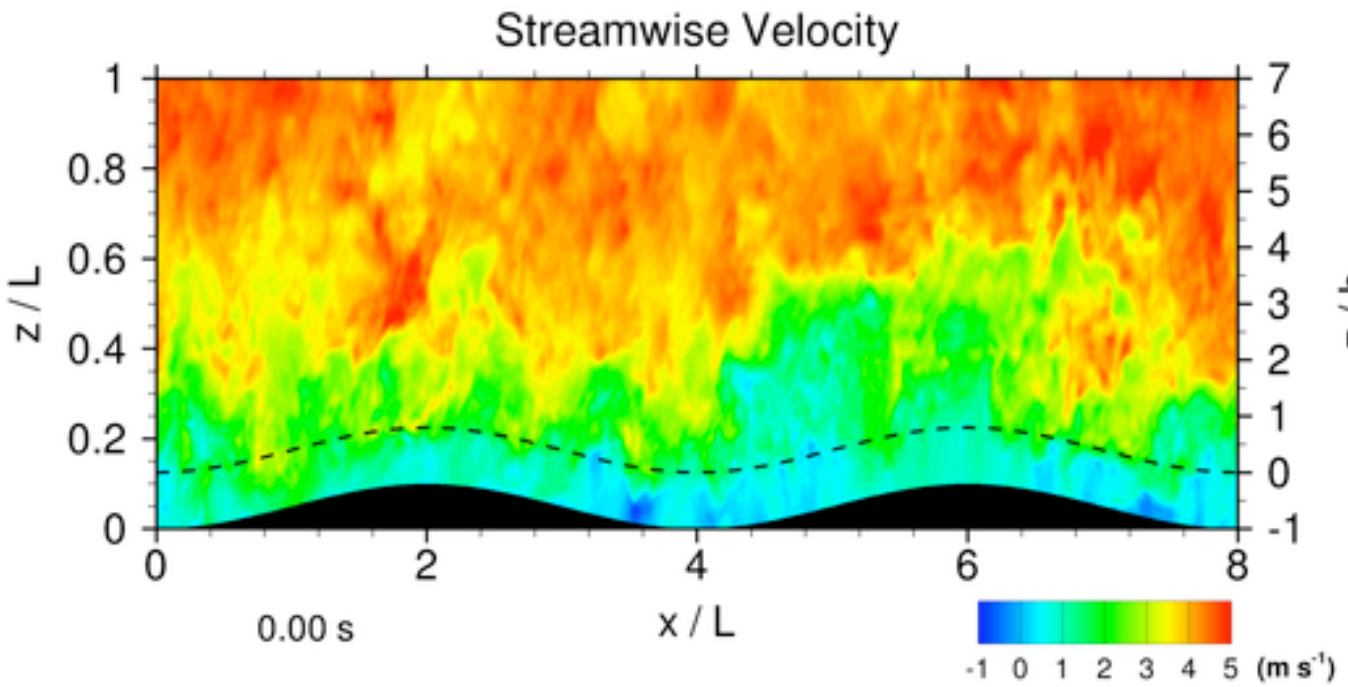
NCAR

Influence of variations in plant area index (PAI)

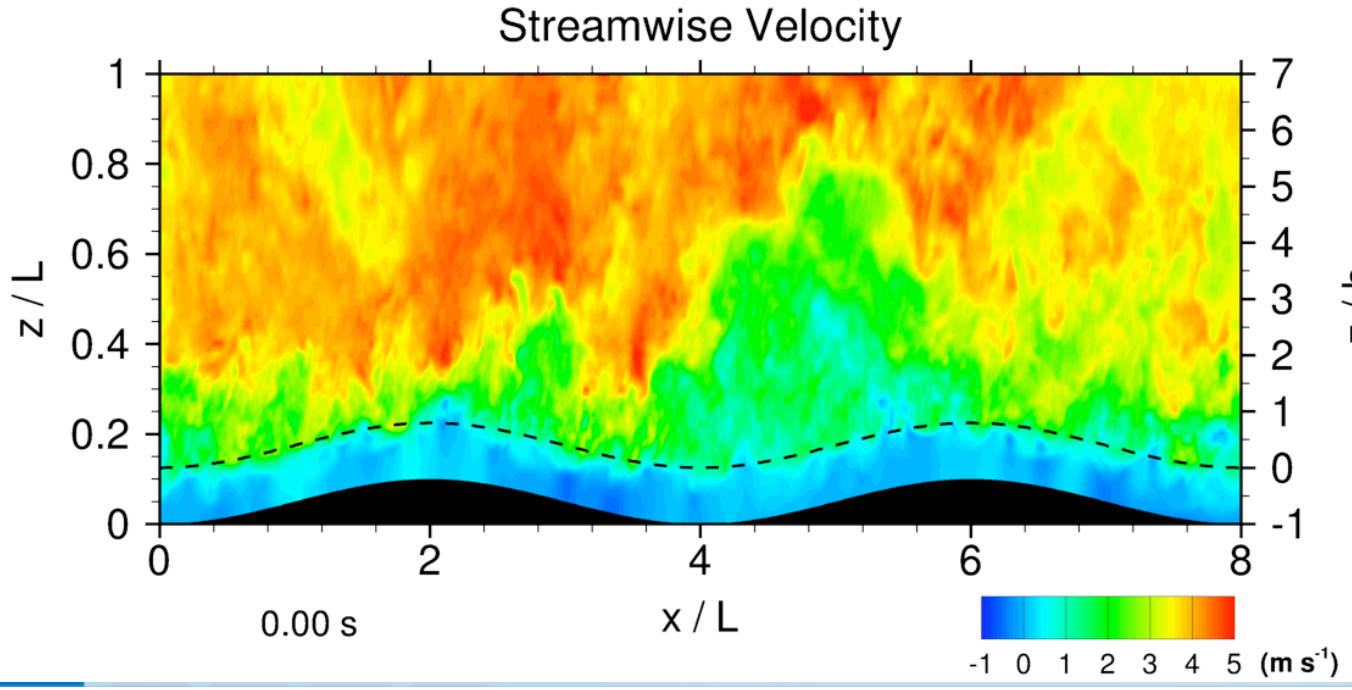
Expected PAI influence on separation



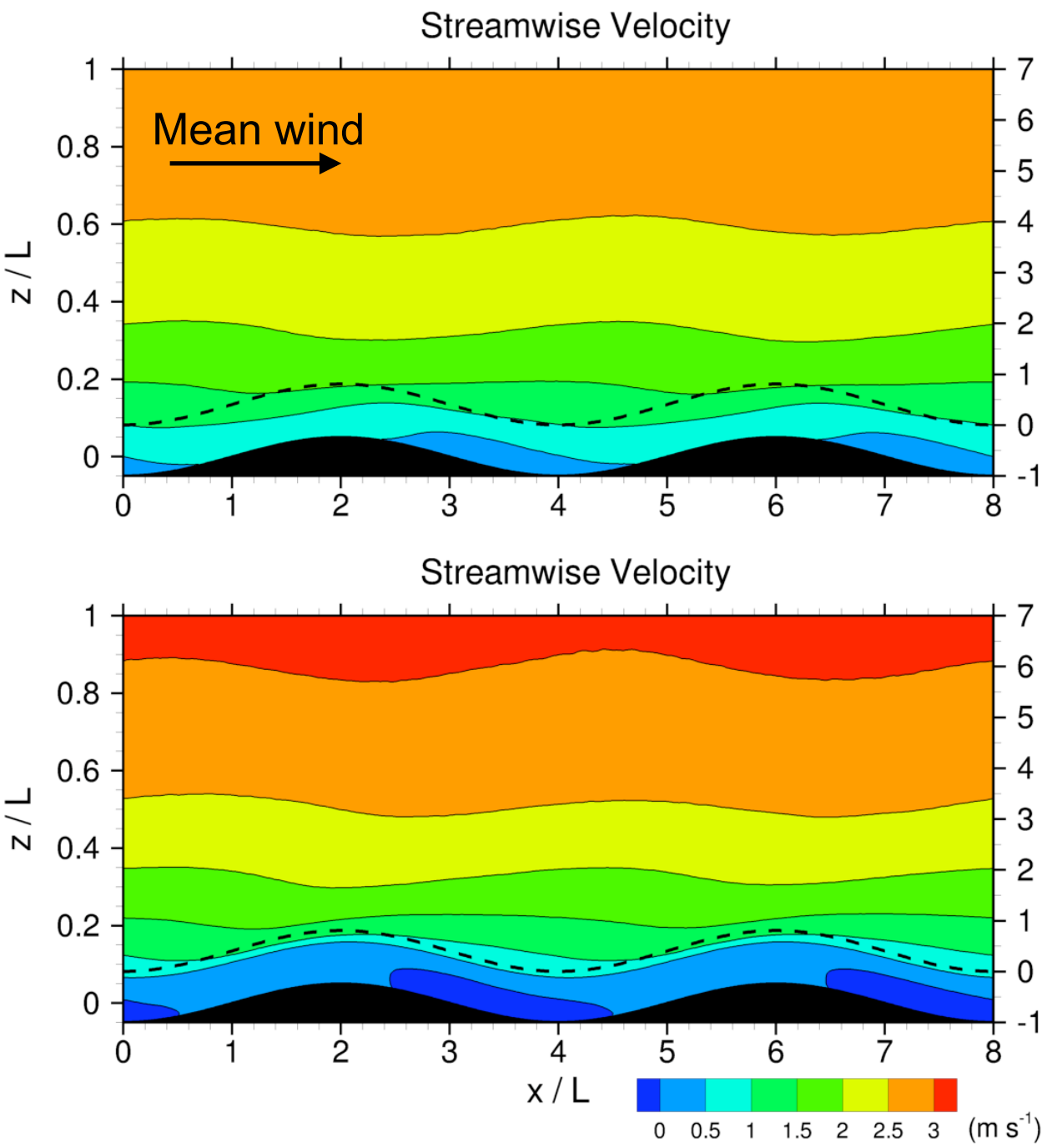
Finnigan and Belcher (2004) : $$\frac{Z_s}{h_c} = \frac{1}{2\beta h_c} \ln\left(\frac{U_o^2}{U_h^2}\frac{H}{2}k^2 L_c\right) < 1$$



sparse canopy



dense canopy



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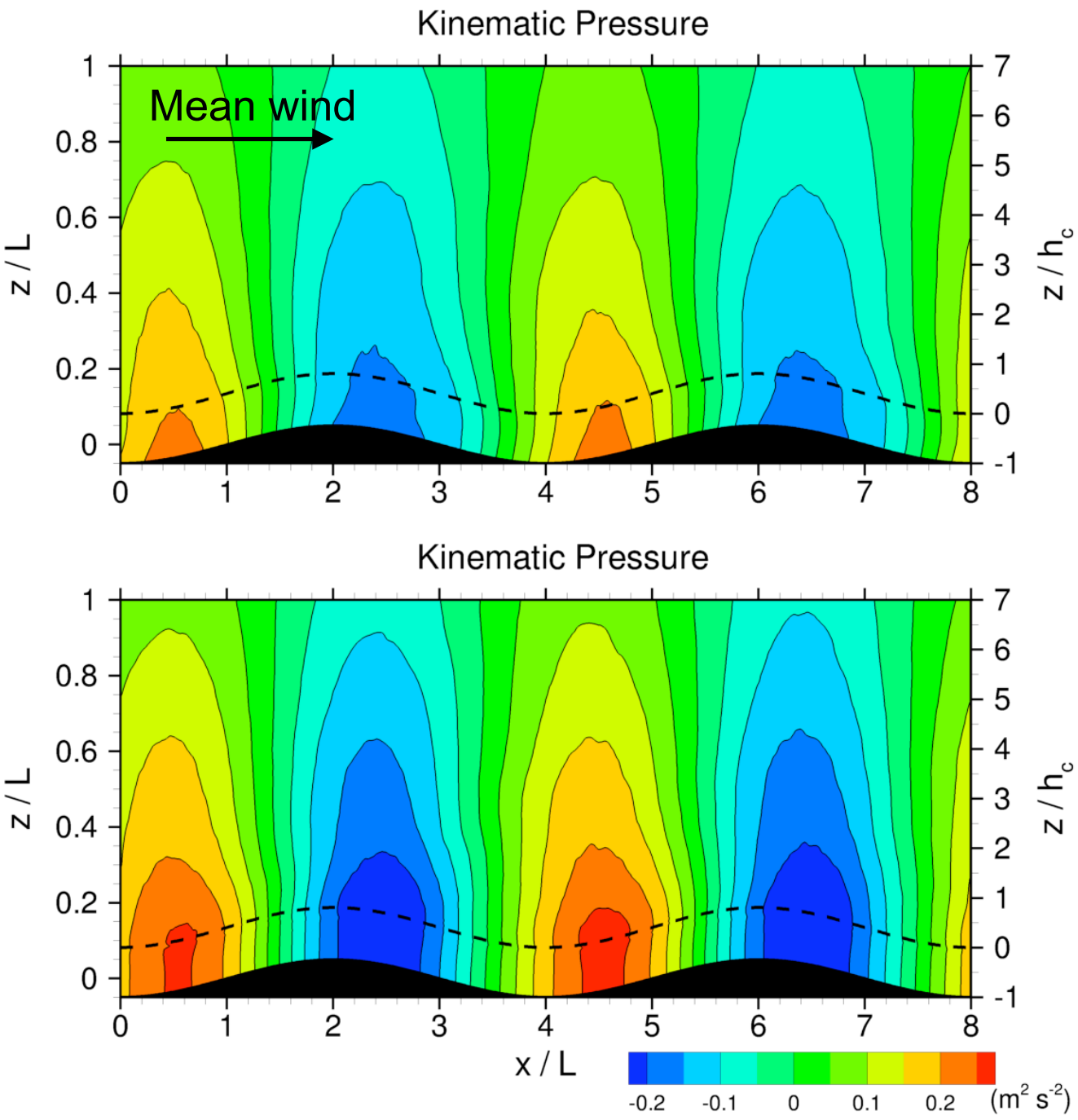
sparse canopy

dense canopy



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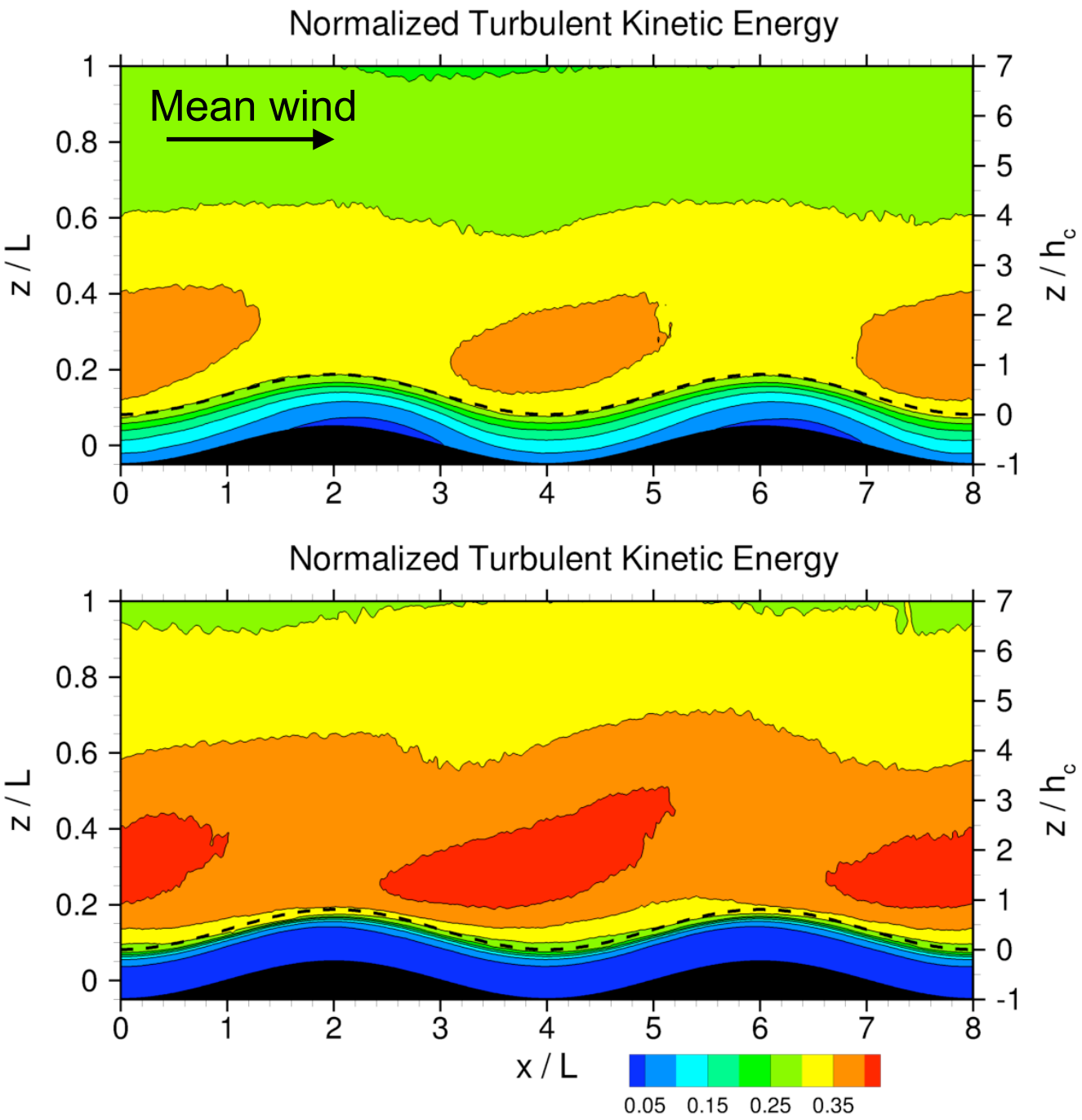
sparse canopy

dense canopy



NCAR

sparse canopy

dense canopy

Summary

- Specified roughness ≠ Resolved canopy
- Finnigan and Belcher (2004) theory accurately predicts separation for canopy density variations
- Increase in PAI mimics the shift from specified roughness to a resolved canopy
- 10-fold increase in PAI increases the orographic pressure drag by about 15%
- Turbulence levels increased up to heights equaling a hill half-length (*L*) and above