# TURBULENCE DEPENDENCE UPON WINDS IN A WEAK-WIND CANOPY SUB-LAYER OVER COMPLEX TERRAIN

Eric S. Russell, Heping Liu, Zhongming Gao, Brian Lamb, Natalie Wagenbrenner

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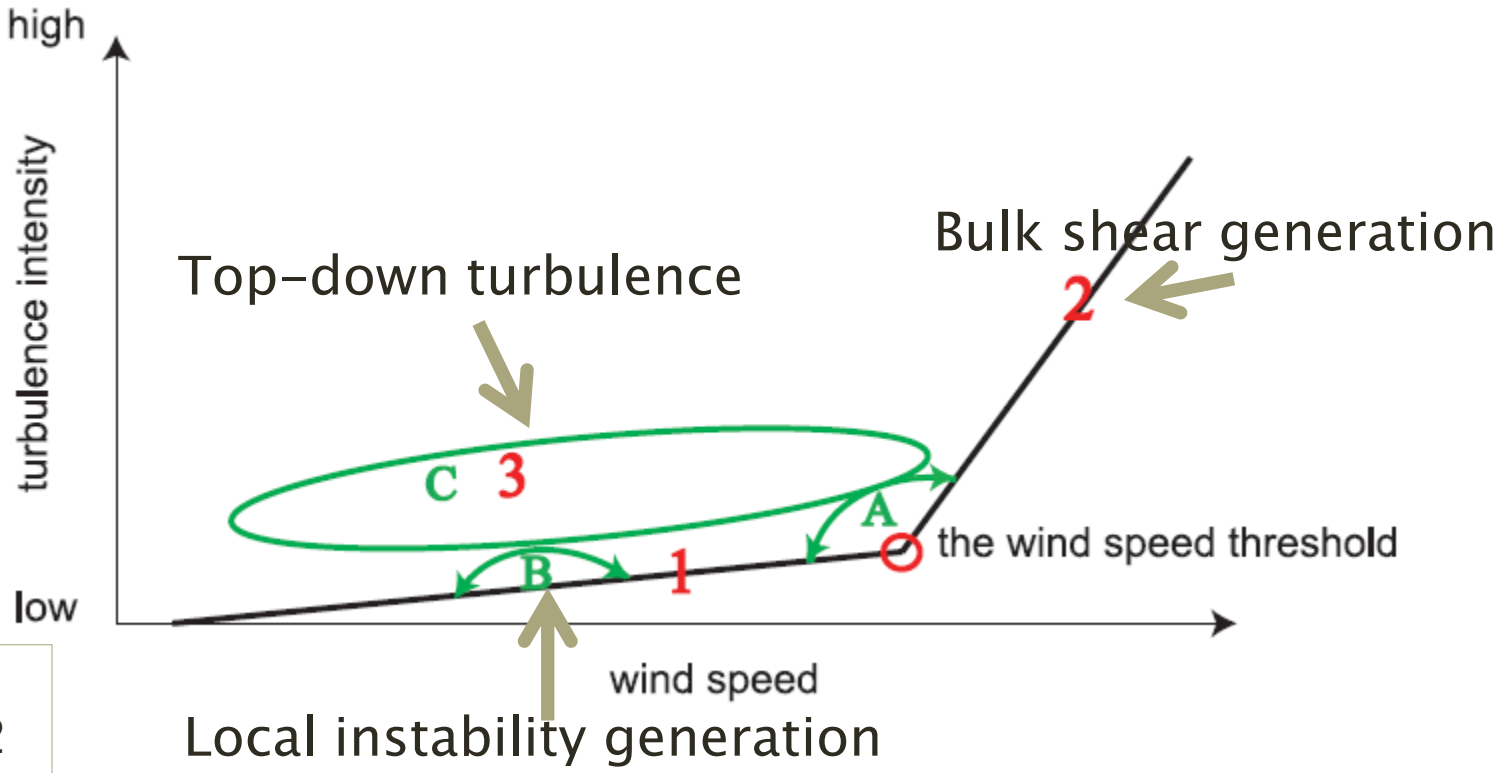
# INITIAL QUESTION

**Is there a wind speed–turbulence threshold in a forest as has been seen over flat terrain?**

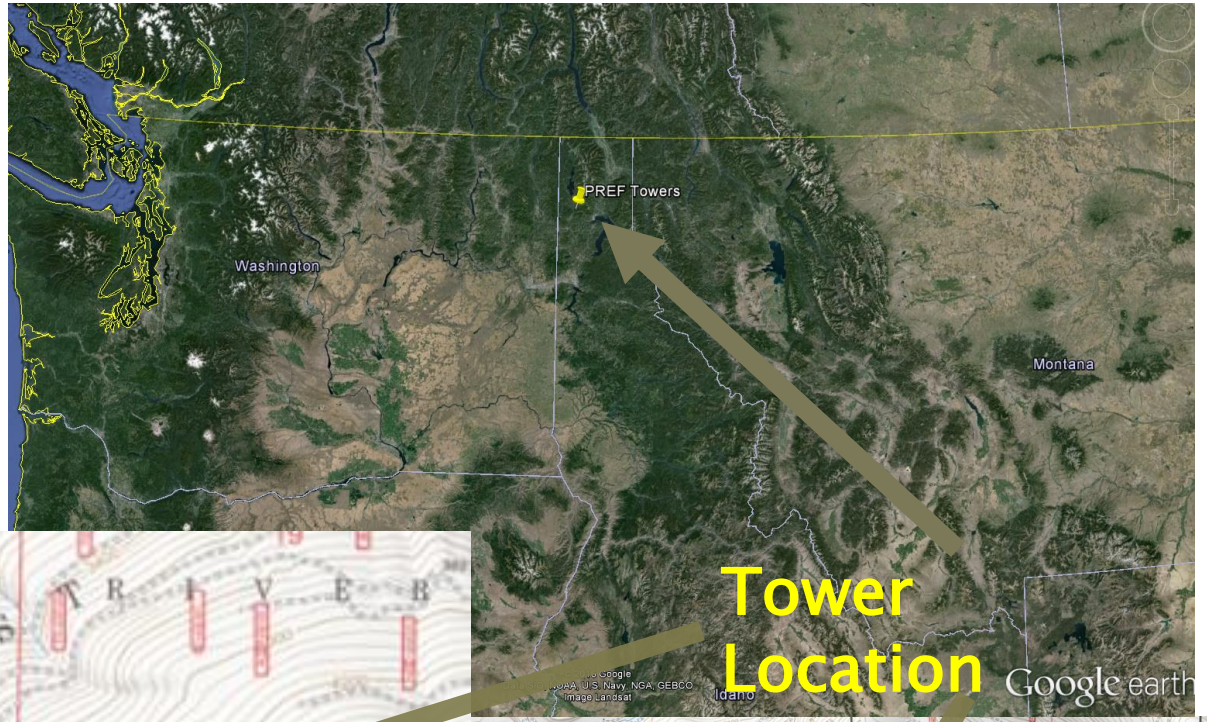



Adapted from
Sun et al., 2012

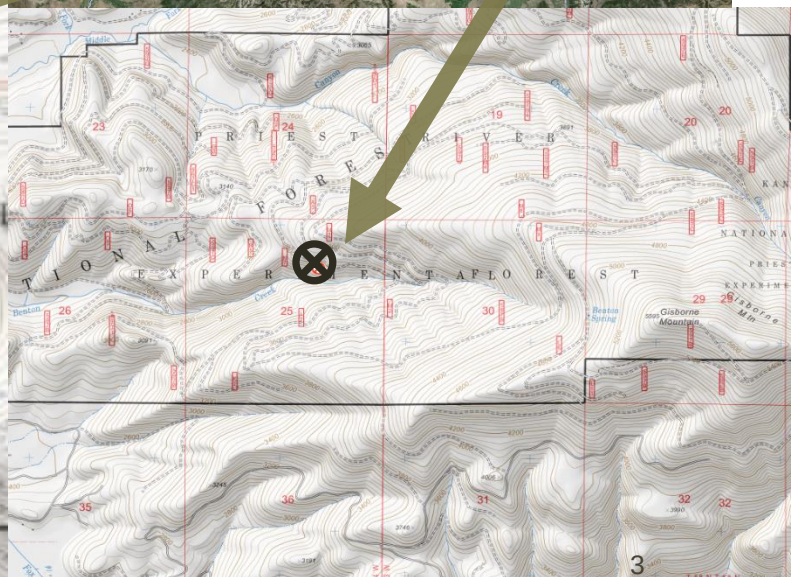
# Priest River Experimental Forest, Idaho

Contours are 30 m on topographic maps

Data period: June 30 to August 15, 2012







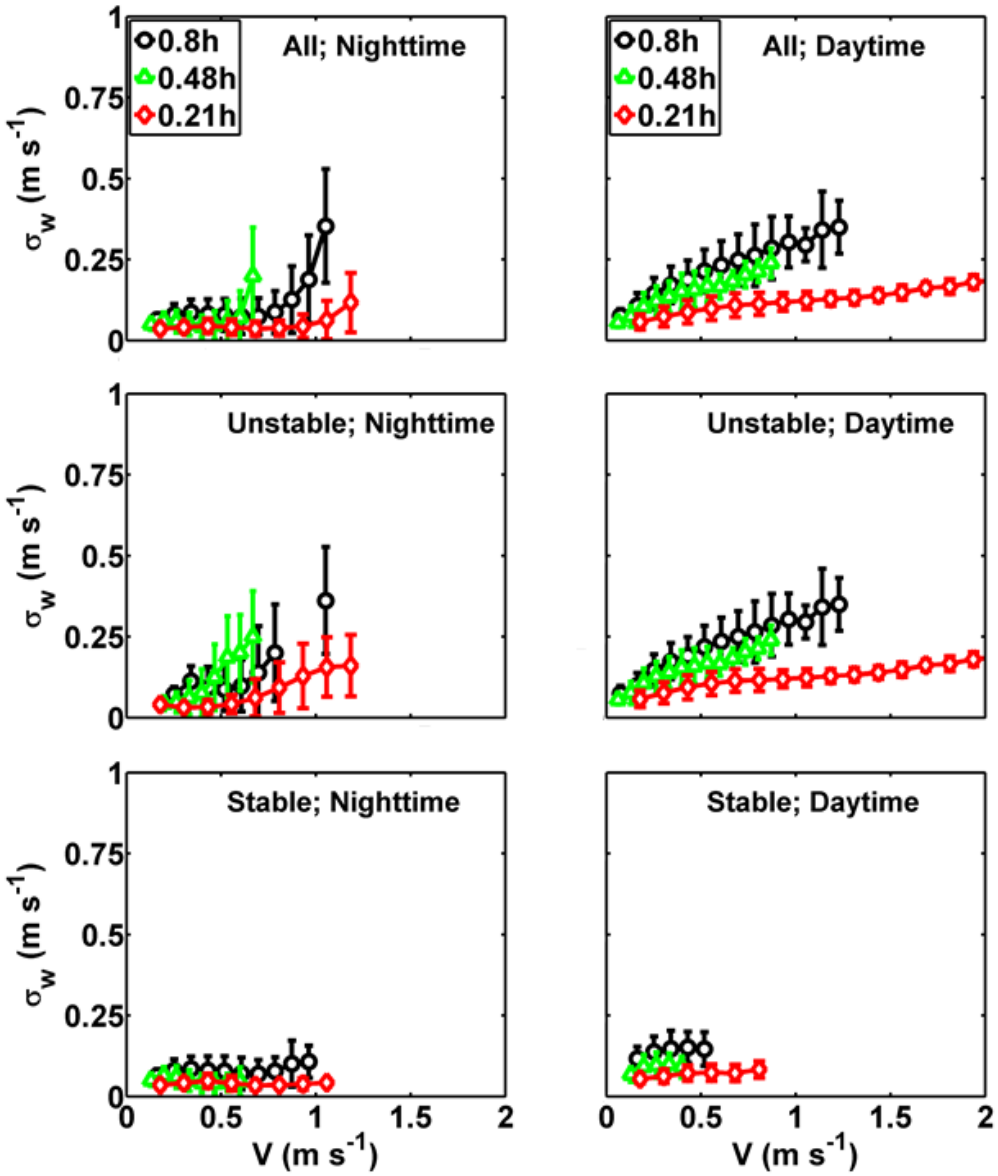
0.8h: Sonic and IRGA

0.48h: Sonic

0.21h: Sonic and IRGA

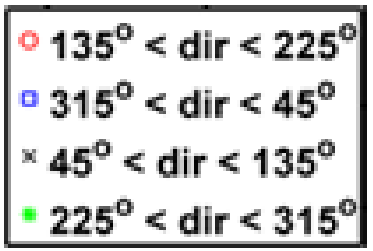
- Data recorded at 10 Hz
- Averaged to 5 minutes
- $\sigma_w$ as a turbulence proxy
- Night: 20:00–04:00
- Day: 08:00–16:00
- Douglas fir dominant
- h = 10 m

# WIND SPEED VS. TURBULENCE



Upslope

Downslope



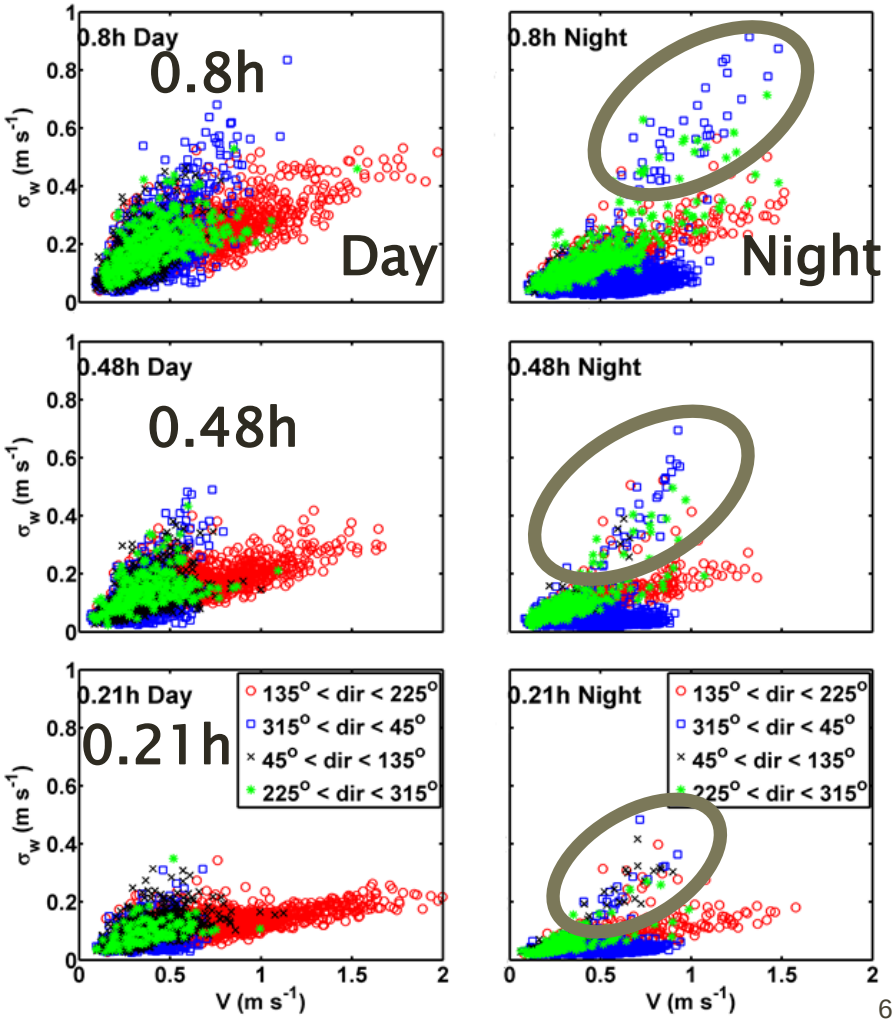

# WIND DIRECTION

Upslope winds tended to be higher and have higher turbulence than downslope winds

No evidence of any threshold-like value

Daytime did not show the same deviation as overnight

**Cause of circled points?**

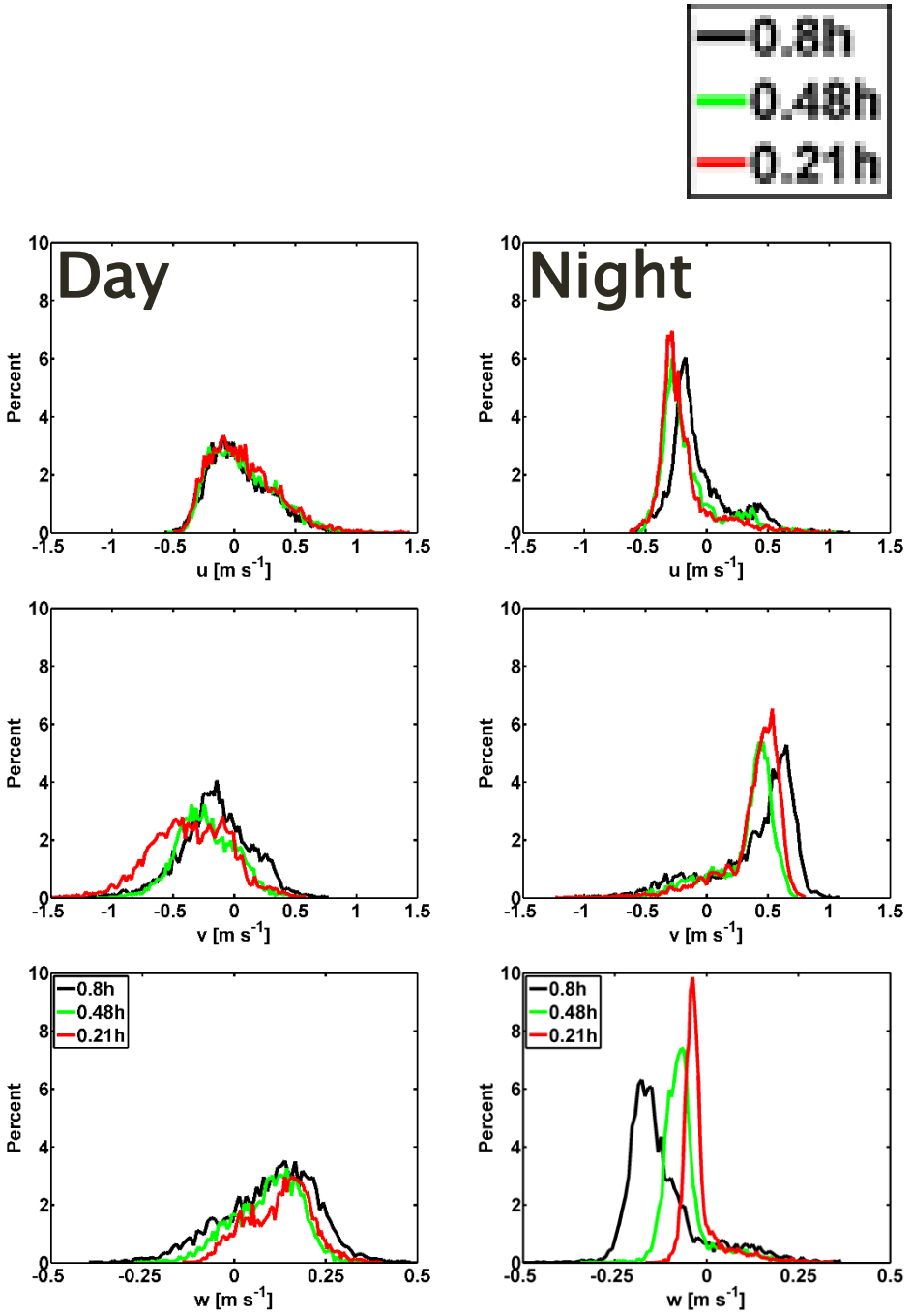


# WIND COMPONENT DISTRIBUTION

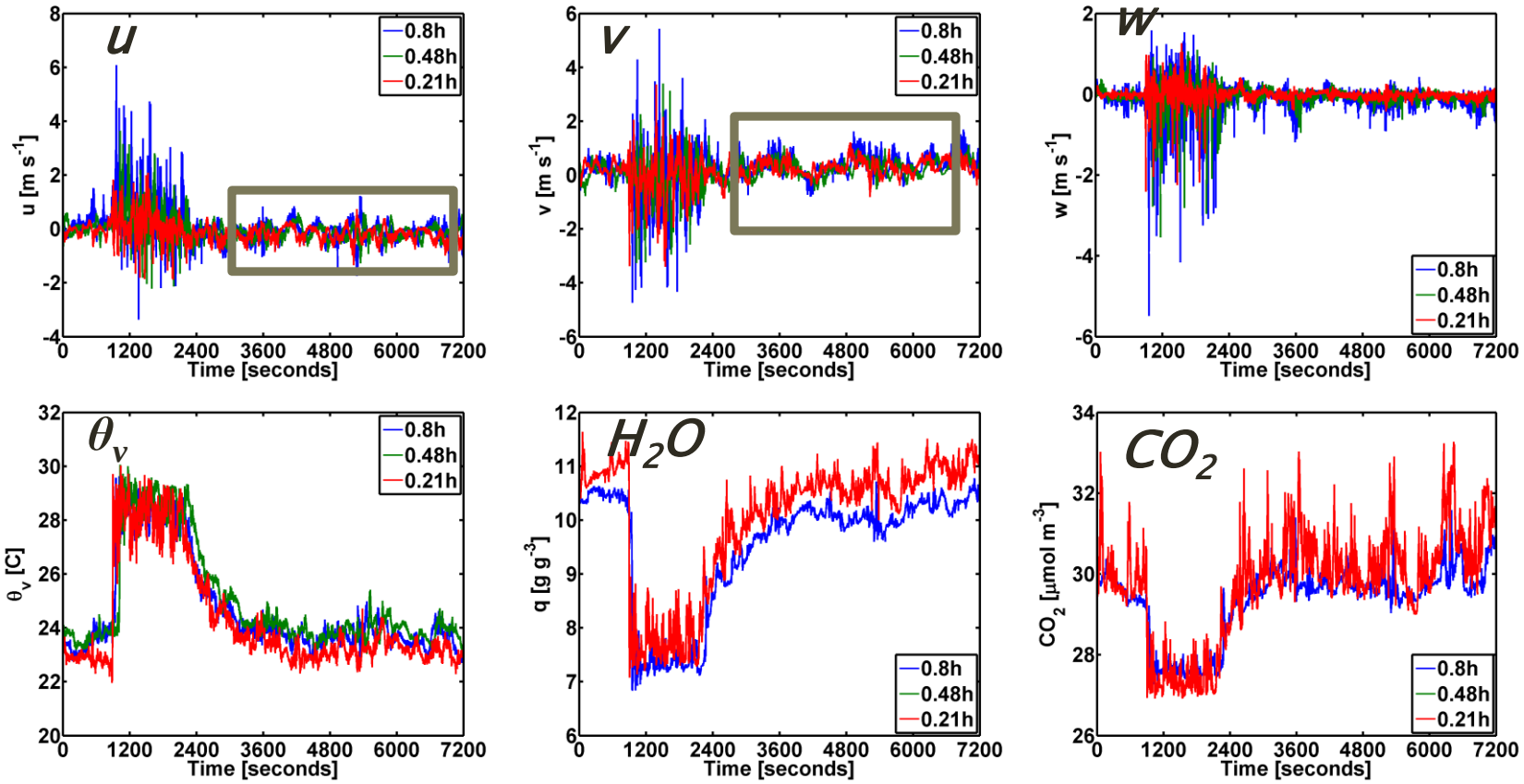
All combinations were significantly different than the normal distribution

Overnight “peakyness” increased with depth into the canopy (w)

Visible skew toward certain values as expected with sloped flow



# OVERNIGHT EVENT EXAMPLE

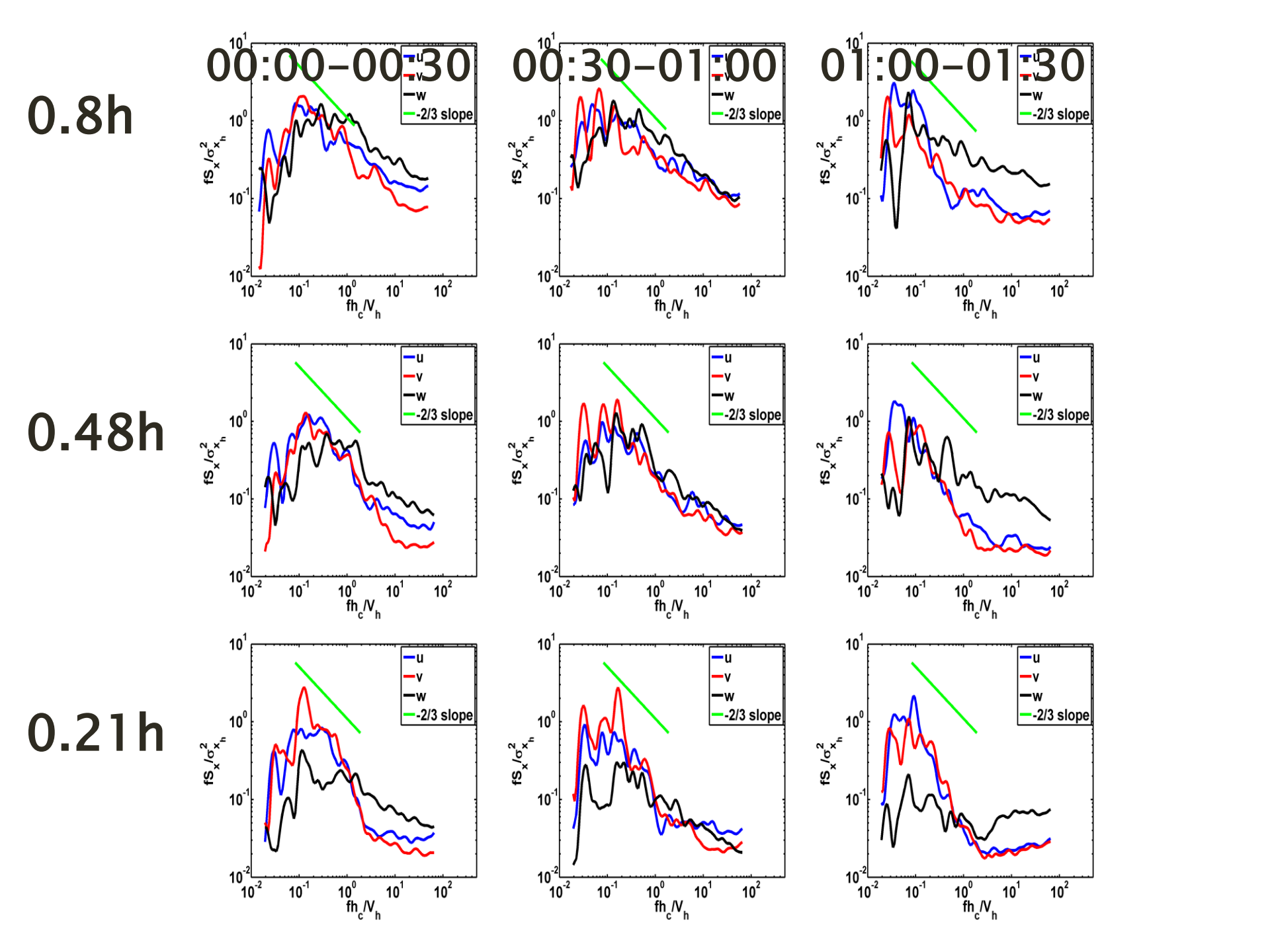



10 Hz data from 00:00 to 2:00 LT July 13, 2012

Warm, dry, low $CO_2$ air-mass injected into canopy

Secondary wave-like disturbance from disruption of the stratified layer

**What do the structure of this event and its effects look like?**


00:00–00:30
00:30–01:00
01:00–01:30
0.8h
0.48h
0.21h
u
v
w
-2/3 slope
$fS_x/\sigma^2_{x_h}$
$fh_c/V_h$

00:00–00:30

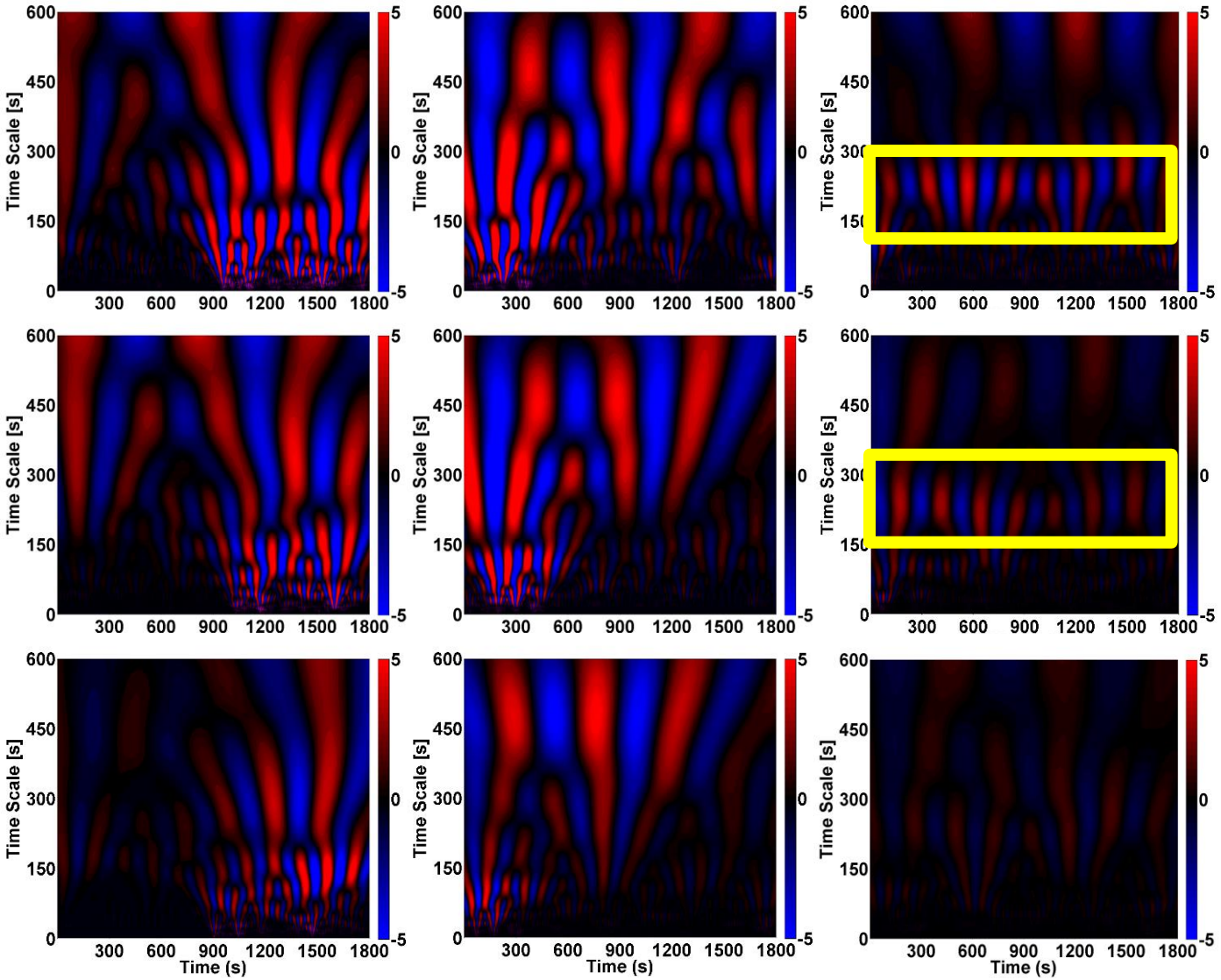
00:30–01:00

01:00–01:30

Vertical velocity for July 13, 2012 for PREF

Local spectral power decreased with depth into canopy

The shorter time scales didn't see the same effects



# CONCLUSIONS

**Is there a wind-speed turbulence threshold in a forest?**

- *Not that was strongly observed as wind speeds were very weak and cause of inflection overnight was due to potential intermittent events*

**Where did the higher overnight turbulence, low wind speed points originate from?**

- *Nocturnal intermittent turbulence that in the case presented likely originated outside the canopy*

**What do the structure of this event and its effects look like?**

- *Event passed through multiple time scales and possibly generated a wave-like disturbance*

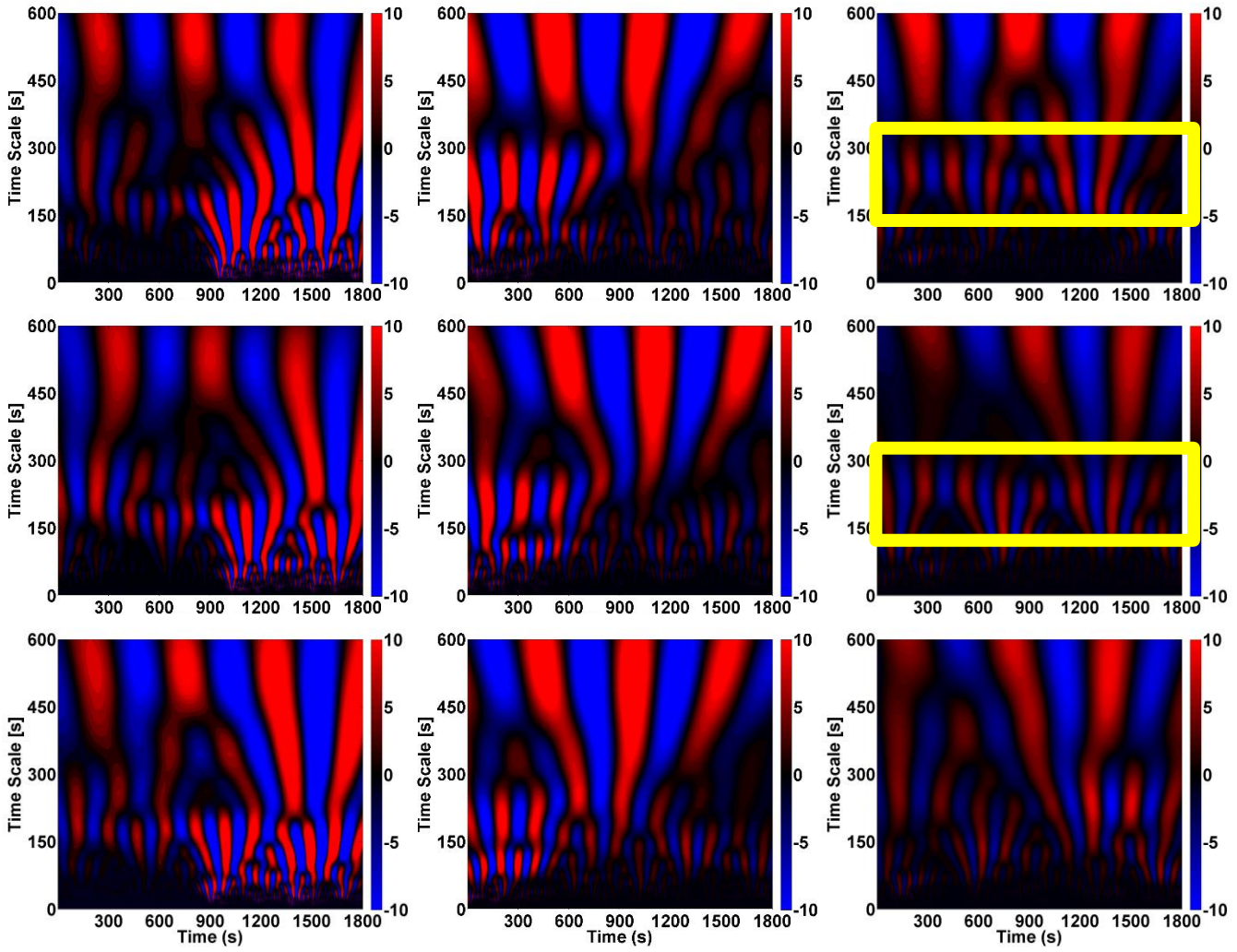
*Future: Affect of event on fluxes and identifying other similar events and their structure*

# Thank you!

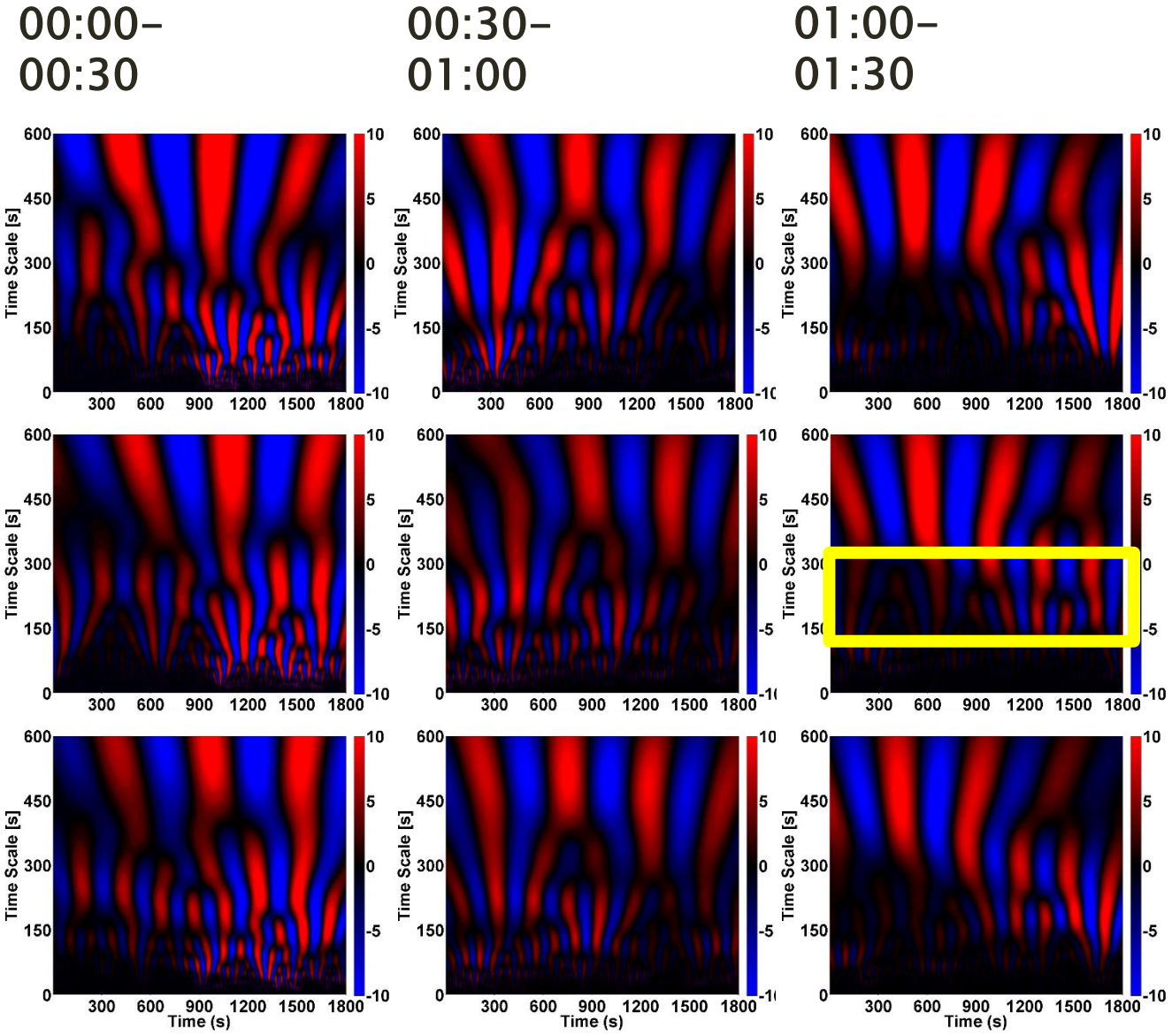
# Questions?

Acknowledgements: Qianyu Zhang, Yulong Ma, Alejandro Pietro, and Bob Denner, NSF #1419614 and #1112938

*v*-component for July 13, 2012 for PREF



*u-component* for July 13, 2012 for PREF



# OVERNIGHT EVENT EXAMPLE

Event overnight at PREF

- Situation previous to even consistent with non-event times

Appears to be top-down

- Exact timings are unknowable
- Structure is complex

Decreases in magnitude with depth into the canopy

Affected total changes in the canopy

- Still seen in the 5 minute averages
- Most events smaller than this, easily isolatable event